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Report from the Survey of Exposure Assessment Models Used in a Regulatory Context

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NO. 389

Report from the Survey of Exposure Assessment Models Used in a Regulatory Context

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Paris 2023

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Foreword

This document summarises descriptions of existing exposure assessment models used in a regulatory context collected from the responses to a 2021 survey – conducted by the OECD Working Party on Exposure Assessment (WPEA). This survey was conducted as an update to a previous survey conducted in 2012 (ENV/JM/MONO(2012)37). The aim was to compile a list of the available models, classify them by type, clarify accessibility and limitations, and collate key references related to model peer review, validation, and verification.

This document has been drafted by Japan and the US and overseen by the WPEA.

The first draft report was prepared and submitted to the WPEA for review in August 2022. It was also circulated to the Working Party on Pesticides (WPP) and the Working Party on Biocides (WPB) in August 2022. The revised report reflecting the comments provided was circulated to the WPEA in February and then finalised. This report is published under the responsibility of the Chemical and Biotechnology Committee of the OECD.

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Executive Summary

A survey was conducted to gather up-to-date information on the range of human and environmental exposure assessment models available to the OECD member countries as well as the industry and international organisations. This survey was conducted as an update to a previous survey conducted in 2012 (ENV/JM/MONO(2012)37). The aim was to compile a list of the available models, classify them by type, clarify accessibility and limitations, and collate key references related to model peer review, validation, and verification. The survey was also designed to provide information on the use of the models in a regulatory context, including which regulatory bodies use the models to conduct risk assessments of chemicals, how these regulatory bodies incorporate the models into their regulatory schemes, and how they use the model estimation results for decision-making and risk communication.

A total of 126 responses were collected from the survey. In addition, information on a further 28 models obtained after the end of the survey period. These models included computational models that fully or partially simulate chemical fates, environmental behaviours, and exposures in humans or organisms. The reported models also included (multi)media models (e.g., environmental fate and transport models), consumer exposure models, and worker exposure models.

The majority of the models target organic substances, irrespective of the target environmental medium, including when the target is a non-environmental medium such as in the case of direct exposure. Many of the models were specific to pesticides, biocides, and industrial chemicals. The other target substances targeted by the models include mixtures, organometallics, ionising substances, gases, and microorganisms, and there are also models that are not substance-specific.

This document also analysed model distribution in terms of target exposure receptor and medium, exposure source and medium, target exposure route and medium, target environmental compartment and medium, target environmental fate and behaviour and target medium, and target indirect exposure route in humans and target medium. Cross-tabulation between the categories were also analyzed.

The vast majority of the 112 surveyed models are free to use and easily accessible. Only six of the models require access to a license and another six (two of which were reported as both available and unavailable) are unavailable to the general public. The free-to-use models are accessed primarily by downloading from a website, although 27 can be accessed by sending a request to the relevant agency. Nine models have other access needs or issues, such as the model being internal for regulators or requiring training before obtaining access. For most of the reported models (92), model description information is published in documents accompanying the models. Some descriptions are included within the model source code or in spreadsheets, though the source code is only disclosed for four models.

Of the 112 total surveyed models, key references are available for 88 models. In some cases, respondents referred to a document or weblink where key references could be obtained. Eighty-three of the surveyed models provide information on peer review, validation, or verification. Most responses either provided specific references associated with model peer review or statements of the models being peer-reviewed or having undergone a quality control and review process. Only four responses specifically noted there having been no or only limited validation of the respective models. In addition, the survey responses

included information on default values for 98 of the 112 total models—either sources of the information or the actual values used in the models.

Regarding the model uses for regulatory purposes, the largest proportion of models are used for the regulation of pesticides, followed by industrial chemicals, pollutant emissions, consumer products, biocides, and pharmaceuticals. Over 80 models are found incorporated into a regulatory screening assessment framework, 60 into higher tier assessment, and 50 into assessment for substance registration by manufacturer/importer. Also, the vast majority of models support decision-making at the national government level, followed by the industry and local government levels. In terms of risk communication, the majority of the models are used by national governments, followed by industry, and the target audience is national citizens, followed by downstream users, consumers, and workers.

The information collected in this survey, specifically the descriptions of the models and the reported uses of the models, will be made available online as an OECD database. The responses to the initial survey will also be added to the database. The intention is that this database will allow users to search for models by country/organisation, target substances/media/exposure receptors, and regulatory field. The database is expected to be updated periodically with new data provided by the members of the WPEA and other working parties.

1 What is the "Survey of Exposure Assessment Models Used in a Regulatory Context"?

1.1. Survey scope and objectives

A survey was conducted to gather up-to-date information on the range of human and environmental exposure assessment models available to the member countries of the Chemical and Biotechnology Committee of the Organisation for Economic Co-operation and Development (OECD). This survey was conducted as an update to a previous survey conducted in 2012 (ENV/JM/MONO(2012)37). The aim was to compile a list of the available models, classify them by type, clarify accessibility and limitations, and collate key references related to model peer review, validation, and verification.

The survey was also designed to provide information on the use of the models in a regulatory context, including which regulatory bodies use the models to conduct risk assessments of chemicals, how these regulatory bodies incorporate the models into their regulatory schemes, and how they use the model estimation results for decision-making and risk communication.

A total of 126 responses were collected from the survey. These models included computational models that fully or partially simulate chemical fates, environmental behaviours, and exposures in humans or organisms. The reported models also included (multi)media models (e.g., environmental fate and transport models), consumer exposure models, and worker exposure models. Models estimating physicochemical properties, models estimating internal exposures such as skin absorption, physiologically based pharmacokinetic (PBPK) models, and databases and scenario documents were beyond the scope of the survey.

Models targeting nanomaterials were also excluded because the OECD Working Party on Manufactured Nanomaterials has recently conducted a thorough study of exposure models developed specifically for the assessment of nanomaterials (ENV/CBC/MONO(2021)23, ENV/CBC/MONO(2021)27/REV, ENV/CBC/MONO(2021)28, ENV/CBC/MONO(2021)29/REV).

This document summarises the survey results, which will later be published as an OECD report. In addition, an online database containing the survey results and responses will also be constructed to accompany the publication.

1.2. Survey procedure

A draft questionnaire was prepared and reviewed by the Working Party on Exposure Assessment (WPEA) at the WPEA mid-year teleconference in February 2021. The questionnaire was revised to reflect the comments from the WPEA and then conducted from June to September 2021. The questionnaire was

circulated not only to the members of the WPEA but also to the members of the Working Party on Pesticides and the Working Party on Biocides. All of the responses received are included in this summary report.

2 Overview of the survey results

2.1. Responses obtained from the survey

A total of 126 responses were reported by 22 countries or organisations. Details of the individual models are presented in Annexes B–E. In addition, information on a further 28 models obtained after the end of the survey period is summarised in Annex F, which are not included following results and analysis. Note that the models are associated only with the country or organisation that reported them, even if they were developed by third parties or other organizations. In addition, some of the models may be used by multiple countries/organizations, which is also not captured in the annexes. There were duplicate responses for the following models: AERMOD (2), AgDRIFT (2), BeeRex (2), CEM (2), ConsExpo (5), EFSA PRIMo (4), EPI Suite (2), OECD's RexTox (2), and Stoffenmanager (2). These 23 responses were consolidated into 9 models, then 112 models were provided for the analysis. In the consolidation of responses, each question were interpreted as filled if that question was filled in one or more responses. In the analysis, items checked in any of the responses for the same models were considered checked. Many of the models (97 of 112) are publicly available and free to use. There were 12 web-based models, 71 computer-based models (downloadable via websites), and 27 models that are available upon request. Figure 2.1 and Tables 2.1–2.3 summarise the responses to the questionnaire. Nearly all responses (112 of 126) contained a website URL to information about the exposure model. A total of 120 responses contained contact e-mail addresses and/or website URLs for contact information.

The reported models target a wide variety of substances: 42 models target both organic and inorganic substances, of which 15 also target other substances (e.g., mixtures; and substances of unknown or variable composition, complex reaction products, or biological materials). Fifty-six models target only organic substances, 3 target only inorganic substances, 4 target only other substances, and 6 target both organic substances and other substances. Ninety-nine models target one or more of the following exposure receptors: consumers, workers, general population, children, aquatic organisms, terrestrial organisms, and benthic organisms; the remaining models target residents, operators, or livestock. Some models target substance behaviours in soils, soil–plant systems, or wastewater treatment systems. Other models target long-range transport potential and overall persistence in the environment.

Sixty-six models target pesticides (Table 2.3), which could be expected given that the questionnaire was circulated to the Working Parties on Pesticides and Biocides. In the following analysis, the target substances are categorised as either "Pesticides" or "General substances".

Figure 2.1. Substances targeted by the reported models

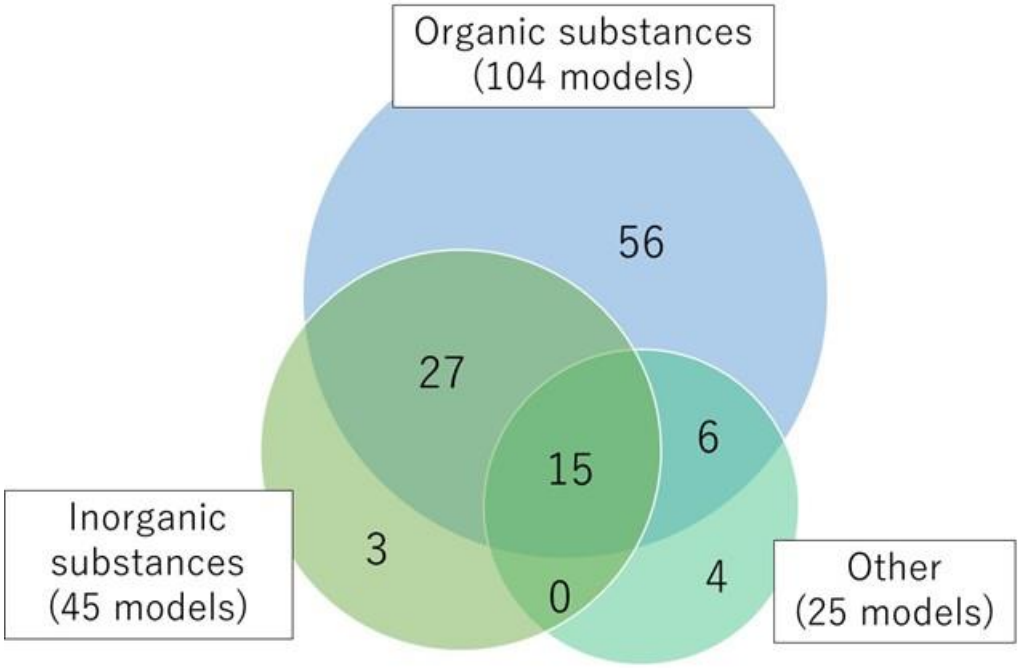


Table 2.1. Questionnaire responses related to exposure sources and routes targeted by the reported models

Question about exposure sources and routes	Response	Number of models
Target exposure source	Sources within the workplace	13
	Direct emission of industrial chemicals to the environment from an industrial facility	27
	Use of industrial chemicals (professional workers and consumers)	27
	Use of consumer products	32
	Land contamination	9
	Waste	5
	Use of pesticides	55
	Use of biocides	27
	Use of pharmaceuticals	14
	Use of food additives	7
	Use of feed additives	7
	Other	12
Target exposure receptor	Consumers	21
	Workers	22
	General population	46

		Children	29
		Aquatic organisms	44
		Terrestrial organisms	34
		Benthic organisms	17
		Other	20
Target is direct exposure	Exposure to	Consumers	17
		Workers	21
		General public	24
	Duration	Short-term exposure	73
		Long-term exposure	69
	Route	Inhalation	45
		Dermal	36
		Oral	33
		Other	10
Target is exposure to the environment and indirect exposure of humans via the environment	Compartment	Air	35
		Soil	36
		Surface water	56
		Groundwater	17
		Sediment	24
		Dust	7
	Environmental fate and behavior	Environmental degradation	44
		Environmental mobility	42
		Environmental bioavailability	17
		Aquatic food web bioaccumulation	9
		Terrestrial food web bioaccumulation	11
		Other	16
	Route for indirect exposure to humans	Inhalation	26
		Dermal	17
		Ingestion	23
		Other	4

Footnote: Multiple choices were allowed for each question.

Table 2.2. Questionnaire responses related to additional functions and availability of the reported models

Question about additional functions and availability		Response	Number of models
Additional model functions		Spatial distribution (mapping)	14
		Simulation of time-dependent exposure	38
		Sensitivity and uncertainty analysis	12
		Other	13
Availability	Availability to general public	Free to use	97
		License needed	6
		Unavailable	6
		Other	8
	Access to the model	Web-based	12

		Download via website	71
		Distributed by request	27
		Other	9
	Disclosure of model specifics	Document published	84
		Confidential	2
		Disclosure of source code	4
		Described in a spreadsheet	30
		Other	15
Does the information inputted into the model remain confidential to the inputting user?		Yes	69
		No	45

Footnote: Multiple choices were allowed for each question.

Table 2.3. Questionnaire responses related to use of the reported models for regulatory purposes

Question about use of the model for regulatory purposes	Response	Number of models
Regulatory field (exposure source)	Industrial chemicals	48
	Pesticides	59
	Pollutant emission	31
	Land contamination	8
	Waste management	4
	Consumer products	27
	Occupational health	10
	Biocides	20
	Pharmaceuticals	16
	Contaminants in food	3
	Other	7
Incorporated into a regulatory framework for	Screening assessment	81
	Higher tier assessment	64
	Assessment for substance registration by manufacturer/importer	50
	Other	12
Supports decision-making for	National government	97
	Local government	16
	Industry	40
	Other	14
Used for risk communication by	National government	89
	Local government	14
	Industry	30
	NGOs/NPOs	8
	Other	9
Used for risk communication with	National citizens	51
	Local residents	12

	Workers	23
	Consumers	24
	Downstream users	29
	Other	13

Footnote: Multiple choices were allowed for each question.

3 Observations from the survey results

This chapter presents detailed descriptions of the survey results, including descriptions of the distributions of the substances, exposure receptors, and exposure sources targeted by the models. This chapter also provides additional information from the survey that is relevant to exposure assessment such as routes of exposure and use of models in regulatory context.

3.1. Categorisation of the models by target substances, media, and exposure receptors

The reported models were categorised based on their target substances, media, and exposure receptors, which are key factors related to the source, route, and final destination of substances, respectively. Each model was categorised into the most suitable subcategory for each main category without duplication. Table 3.1 shows the parts of the questionnaire (Annex A) that were used to gather the information for this categorisation. Definitions of the subcategories are provided in Table 3.2. The subcategories assigned to each of the reported models are shown in Annex B.

Table 3.1. Information from the questionnaire used for model categorisation

CATEGORY	LOCATION IN QUESTIONNAIRE	
	QUESTION	SUB-QUESTION
Target substances	Use for regulatory purposes	Regulatory field (exposure source)
Target medium	Target exposure compartments/sources/routes	Exposure compartment
Target exposure receptors	Target exposure receptors	-

The number of models in each subcategory is shown in Table 3.2. Because many of the models were developed to specifically target pesticides, the “Target substances” category was split into two subcategories: “Pesticides” and “General substances”. The models developed to specifically target pesticides were placed in the “Pesticides” subcategory. The models in this sub-category include some that target both pesticides and general substances. The number of models in the “Pesticide” subcategory is higher than that in the “General substances” subcategory, partly because models that can be used for both pesticide and non-pesticidal substances were placed in the “Pesticide” subcategory.

The “Target medium” category was spilt into 6 subcategories. A similar number of models were placed in the “Multiple environmental media” and “Water”, subcategories; fewer models were placed in the “Soil” subcategory. The greatest number of models was placed in the “Other (non-environmental media)” subcategory. The models in the “Other” subcategory included those that target exposure and/or fate in specific environments, exposure routes, and related chemical properties. For example, they simulate

indoor exposures, direct exposures by humans or animals, and exposures via food consumption in humans or animals, and they estimate physical/chemical properties related to degradation or environmental fates.

The “Target exposure receptors” category was spilt into 5 subcategories. The largest number of models was placed in the “Ecological organisms” subcategory.

Table 3.2. Category and subcategory definitions and the number of models in each subcategory

Category	Subcategory	Definition	Number of models
Target substances	Pesticides	Models targeting pesticides and/or biocides for the regulatory field (exposure source). Models targeting both pesticides and general substances are also included in the “Pesticide” subcategory. They may target organic and/or inorganic substances.	66
	General substances	Remaining models	46
Target medium	Multiple environmental media	Models targeting all three compartments: air, water (surface water and/or sediment), and soil (soil and/or ground water)	20
	Soil & water	Models targeting both soil and water; excluding models classified into the “Multiple environmental media” subcategory	13
	Air	Models targeting air (partly also soil or water); excluding models classified into the “Multiple environmental media” subcategory	15
	Soil	Models targeting soil; excluding models classified into the “Multiple environmental media” and “Soil & water” subcategories	8
	Water	Models targeting water; excluding models classified into the “Multiple environmental media” and “Soil & water” subcategories	21
	Other (non-environmental media)	Models targeting non-environmental media (e.g., indoor exposure, direct exposure by human or animals, or exposure via food consumption; estimating physical/chemical properties)	35
Target exposure receptors	General population & ecological organisms	Models targeting both population (consumers or general population) and ecological organisms (aquatic, terrestrial, or benthic organisms)	20
	Workers	Models targeting workers; excluding models classified into the “General population & ecological organisms” subcategory	20
	General population	Models targeting population (consumers or general population); excluding models classified into the “General population & ecological organisms” and “Workers” subcategories	21
	Ecological organisms	Models targeting ecological organisms; excluding models classified into the “General population & ecological organisms” subcategory	38
	Other	Remaining models with other assessment or calculation targets (e.g., persistence and potential for long-range transport, mass balances among media, chemical behavior in the environment, physical/chemical properties)	13

The results of cross-tabulation analyses between the subcategories in pairs of categories are shown in Tables 3.3–3.5. Table 3.3 shows the cross-tabulation results for the "Target substances" and "Target medium" categories. Models in the "Pesticide" subcategory tend to target the "Soil & water", "Water", and "Other" media. In contrast, models in the "General substances" subcategory tend to target " Multiple environmental media", "Air", and "Other" media. When comparing the models in the "Pesticides" and "General substances" subcategories, the former focuses more on "Soil & water" and "Water" whereas the latter focuses more on "Air". Models in the combination "Pesticides" and "Other (non-environmental media)" subcategories include ones for calculating exposure to operators during mixing and loading activities, workers (dermal exposure), swimmers in indoor pools, and organisms (e.g., bees, arthropods, birds, mammals, plants), and for assessing the risk of residents living near to greenhouses or the dietary risks of pesticide residues. Models in the combination "General substances" and "Other (non-environmental media)" subcategories include ones for estimating persistence, bioaccumulation, and toxicity profiles; biodegradation profiles; the final composition of petroleum mixtures after wastewater treatment; physical/chemical properties; exposure from consumer products; dietary intake of chemicals, exposure to fragrance materials; inhalation exposure at a workplace; and indoor air concentrations of chemicals released from products.

Table 3.4 shows the cross-tabulation results for the "Target substances" and "Exposure receptors" categories. Overall, there is good model coverage for both human and ecological receptors for both the "Pesticides" and "General substances" categories. Models targeting pesticides tend to be more focused on the "General population & ecological organisms" and "Ecological organisms" exposure receptors than are those targeting "General substances".

Table 3.5 shows the cross-tabulation results for the "Exposure receptors" and "Target medium" categories, with further categorisation into the models targeting pesticides and general substances. The "Multiple environmental media" and "Air" subcategories have a well-balanced distribution of models for exposure receptors in the models targeting general substances. In the models targeting pesticides, the greatest number of models are in the combination "Ecological organisms" and "Water" group.

Table 3.3. Cross-tabulation between the "Target substances" and "Target medium" categories

	Multiple environmental media	Soil & water	Air	Soil	Water	Other (non-environmental media)
Pesticides	9	12	4	4	14	23
General substances	11	1	11	4	7	12

Table 3.4. Cross-tabulation between the "Target substances" and "Exposure receptors" categories

	General population & ecological organisms	Workers	General population	Ecological organisms	Other
Pesticides	12	10	11	25	8
General	8	10	10	13	5

Table 3.5. Cross-tabulation between the "Exposure receptors" and "Target medium" categories

		Multiple environmental media	Soil & water	Air	Soil	Water	Other (non-environmental media)	**Subtotal**
Pesticides	General population & ecological organisms	5	3	1	0	3	0	**12**
	Workers	0	0	2	0	0	8	**10**
	General population	1	1	1	1	1	6	**11**
	Ecological organisms	3	5	0	2	10	5	**25**
	Other	0	3	0	1	0	4	**8**
	Subtotal	**9**	**12**	**4**	**4**	**14**	**27**	**66**
General substances	General population & ecological organisms	5	0	2	0	1	0	**8**
	Workers	1	0	3	1	0	5	**10**
	General population n	2	0	4	0	0	4	**10**
	Ecological organisms	2	1	1	3	5	1	**13**
	Other	1	0	1	0	1	2	**5**
	Subtotal	**11**	**1**	**11**	**4**	**7**	**12**	**46**

3.2. Model descriptions

Table 3.6 shows the distribution of the reported models when stratified by their target environmental media and whether their target substances are organic, inorganic, or other. The majority of the models target organic substances, irrespective of the target environmental medium, including when the target is a non-environmental medium such as in the case of human exposure assessment. Many of the models were specific to pesticides, biocides, and industrial chemicals. The target substances targeted by the models in the "Other" subcategory include mixtures, organometallics, ionizing substances, gases, and microorganisms, and this subcategory also includes models that are not substance-specific.

Table 3.6. Distribution of models by target substances and medium

	Multiple environmental media	Soil & water	Air	Soil	Water	Non-environmental media
Organic substances	18	13	12	8	20	33
Inorganic substances	8	6	8	2	5	16
Other	6	4	5	2	4	4

Figure 3.1 shows the distribution of the models with respect to target substance and medium. The largest proportion of models target organic substances in non-environmental media (e.g., use of consumer products, application of pesticides). Water is the target medium of most media-specific models, especially for organic substances. For models targeting inorganic substances, the largest proportions of models

target air or multiple environmental media. Soil is the least-targeted medium, irrespective of the target substances.

Figure 3.1. Distribution of models by target substance and medium

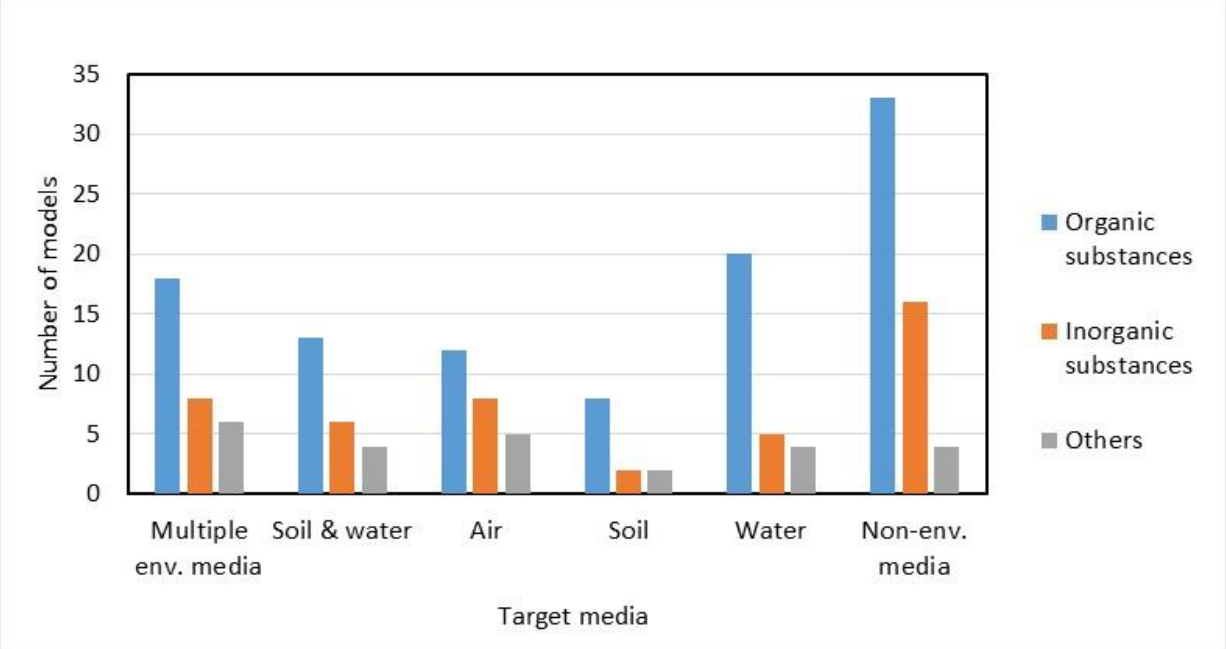


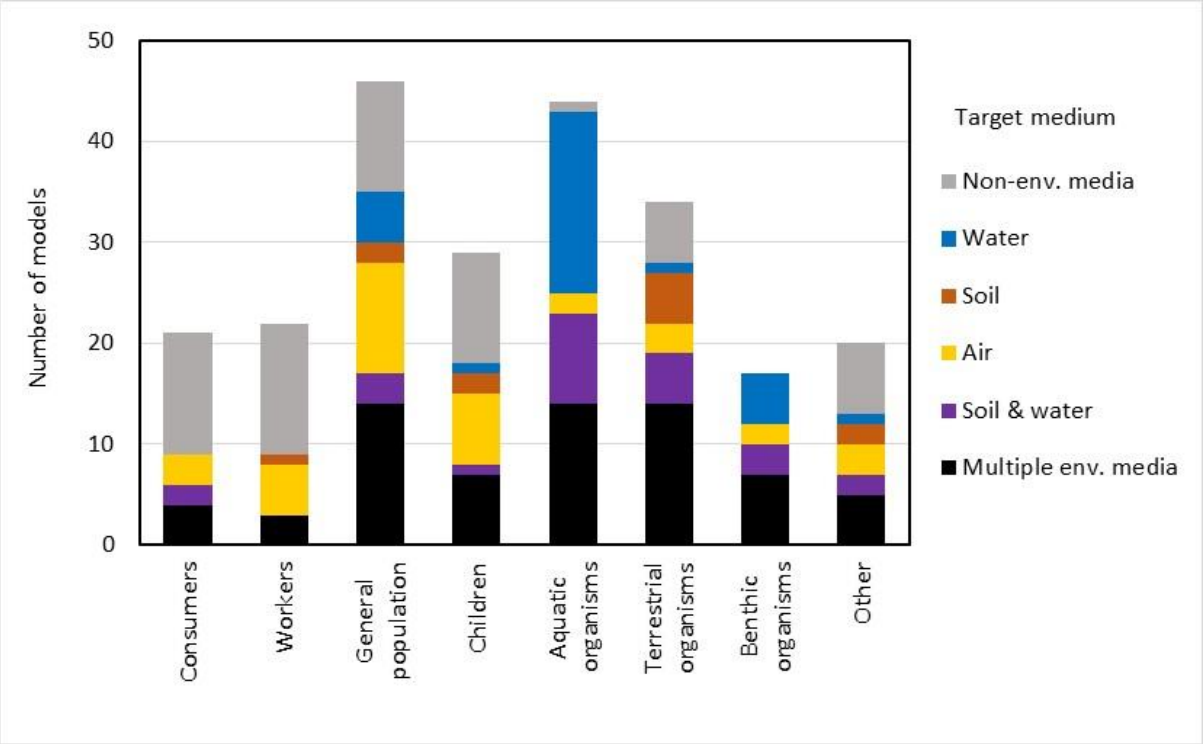
Table 3.7 shows the distribution of the models by target exposure receptor and medium. Some models can be used to estimate both environmental media impacts and human/animal exposure from substances, whereas others can be used to estimate human/animal exposure only. Models in the "non-environmental media" group include models that estimate exposure to consumer products, models that estimate exposure to animals from pesticides, models that estimate human exposure from dietary intake, and models that estimate worker exposure from industrial/commercial sources.

Table 3.7. Distribution of models by target exposure receptor and medium

	Multiple environmental media	Soil & water	Air	Soil	Water	Non-environmental media
Consumers	4	2	3	0	0	12
Workers	3	0	5	1	0	13
General population	14	3	11	2	5	11
Children	7	1	7	2	1	11
Aquatic organisms	14	9	2	0	18	1
Terrestrial organisms	14	5	3	5	1	6
Benthic organisms	7	3	2	0	5	0
Other	5	2	3	2	1	7

Figure 3.2 shows the distribution of models by target exposure receptor and medium. Collectively, the models cover a wide variety of exposure receptors, including aquatic organisms, terrestrial organisms, and children, with the general population being the most common target receptor. The next most common target is aquatic organisms, which is consistent with the large number of models whose target medium is water. Few models target benthic organisms. Models in the "Other" subcategory include those that do not target a specific exposure receptor.

Figure 3.2. Distribution of models by target exposure receptor and medium



Footnote: "Other" includes 20 models targeting other exposure receptors (e.g., facility operators, residents, livestock, and soil-dwelling organisms, as well as models that simulate/estimate long-range transport, overall persistence, and fate).

Table 3.8 shows the distribution of models by target exposure source and medium. The highest number of models target the use of pesticides, followed by the use of industrial chemicals and biocides, use of consumer products, and sources within the workplace. A few models target "Other" sources, which include construction products, veterinary medicinal products, pathogens, nanoparticles, and biosolids.

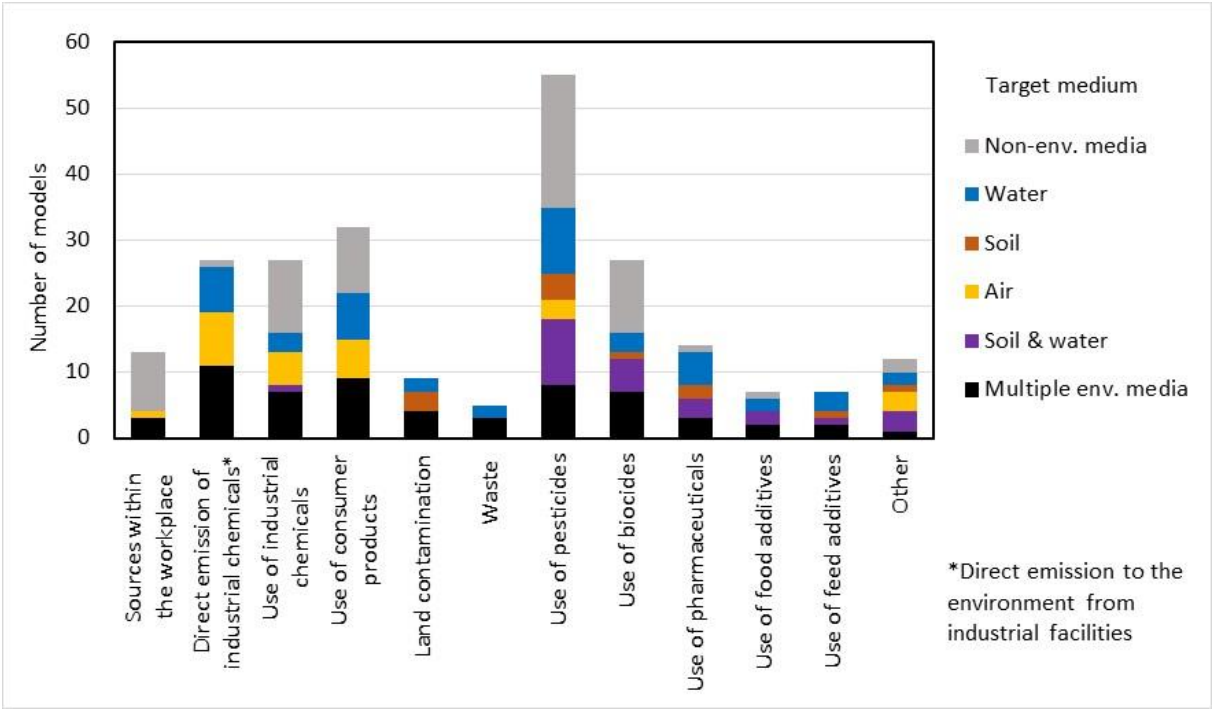
Table 3.8. Distribution of models by target exposure source and medium

	Multiple environmental media	Soil & water	Air	Soil	Water	Non-environmental media
Sources within the workplace	3	0	1	0	0	9
Direct emission of industrial chemicals	11	0	8	0	7	1
Use of industrial chemicals	7	1	5	0	3	11

Use of consumer products	9	0	6	0	7	10
Land contamination	4	0	0	3	2	0
Waste	3	0	0	0	2	0
Use of pesticides	8	10	3	4	10	20
Use of biocides	7	5	0	1	3	11
Use of pharmaceuticals	3	3	0	2	5	1
Use of food additives	2	2	0	0	2	1
Use of feed additives	2	1	0	1	3	0
Other	1	3	3	1	2	2

Figure 3.3 shows the distribution of models by target exposure source and medium. The largest proportion of models target exposure from the use of pesticides. Many models also target exposure from direct emission and use of industrial chemicals and use of consumer products. Very few models target exposure from waste.

Figure 3.3. Distribution of models by exposure source and medium

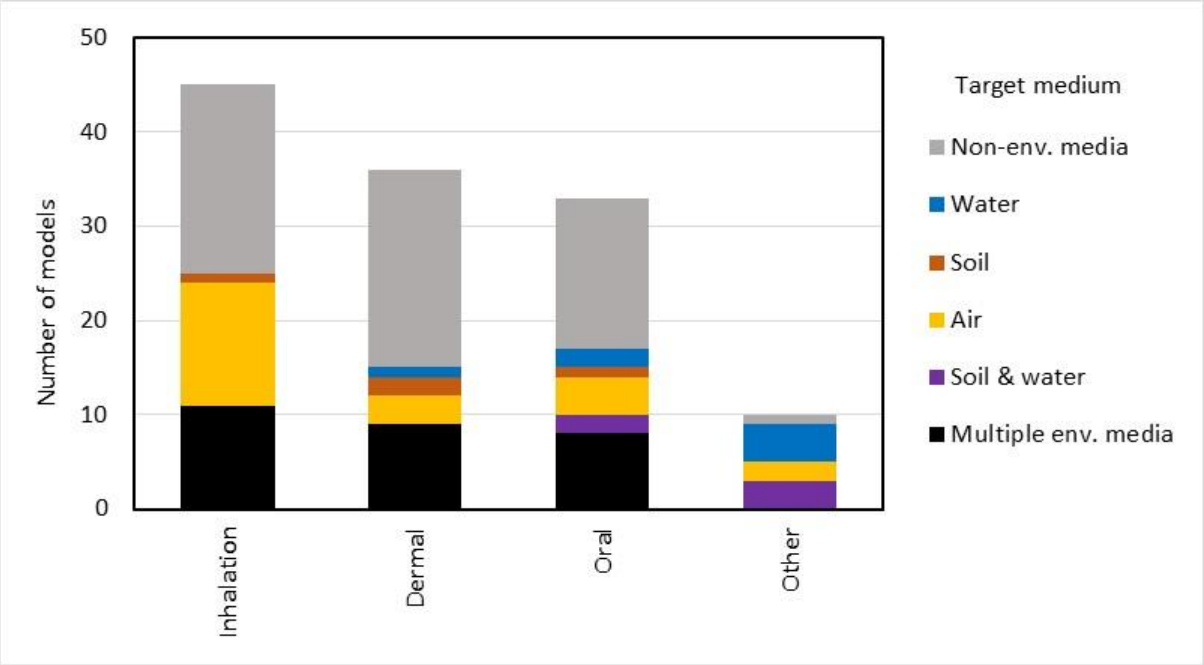


Footnote: "Other" includes 12 models targeting other exposure sources (e.g., secondary formation in the atmosphere, construction products, veterinary medicinal products, indirect releases from industrial and consumer activities via application of biosolids, biodegradation, and wildlife consumers).

Figure 3.4 shows the distribution of models by target exposure route (i.e., how the target chemical is expected to enter the human body) and medium. The largest proportion of models target the inhalation exposure route, and of those models, the largest proportion target direct exposure from non-environmental

sources or from air. Many of the models also target the dermal and oral exposure routes. Again, most of these models target direct exposure from non-environmental sources, but many also cover indirect exposure from multiple environmental media.

Figure 3.4. Distribution of models by target exposure route and medium



Footnote: "Other" includes 10 models targeting other exposure routes (e.g., runoff, organisms in terrestrial and aquatic environments, fish gills, and surface water).

Figure 3.5 shows the distribution of models by environmental compartment and medium. The largest proportion of models target the surface water environmental compartment. Of these models, the majority target water or water & soil. The environmental compartments with the second- and third-largest proportions of models are soil and air. The majority of these models target multiple environmental media.

Figure 3.5. Distribution of models by target environmental compartment and medium

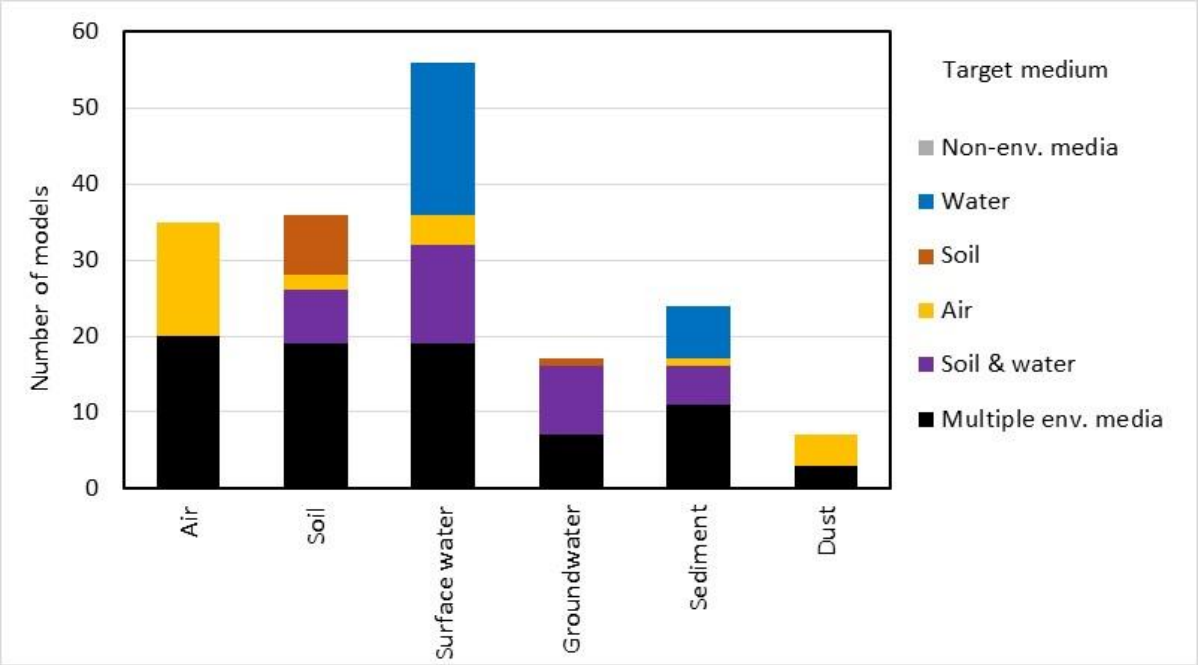
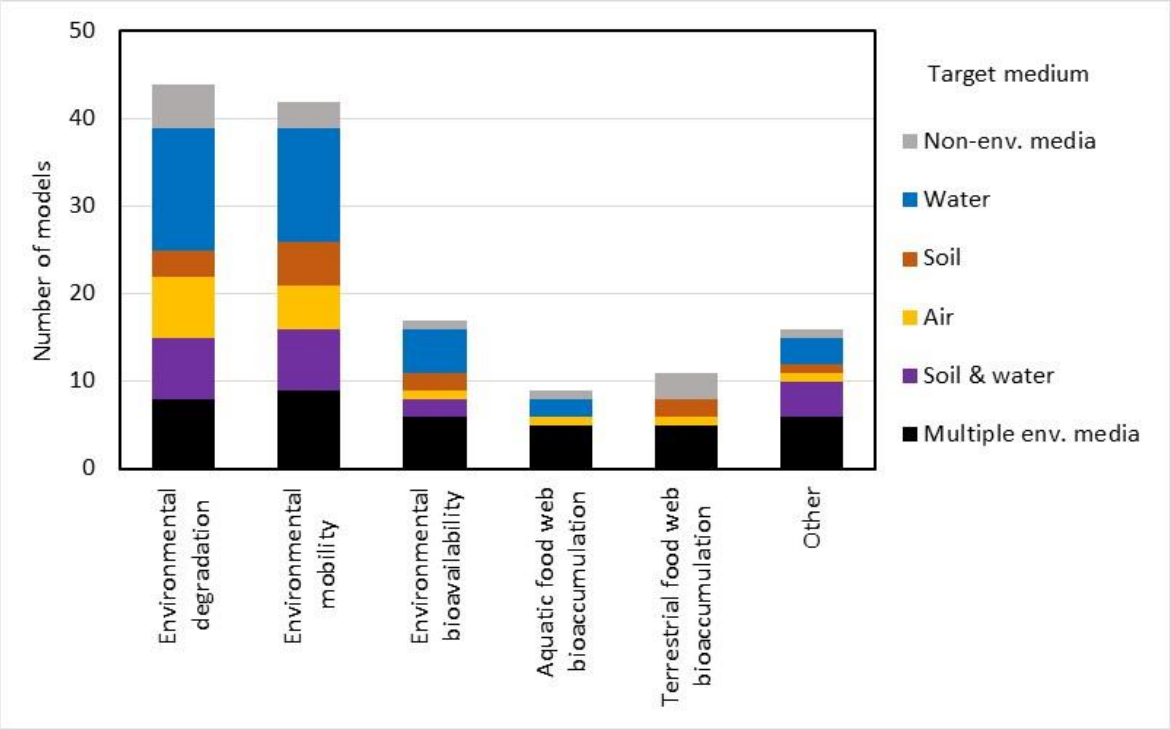


Figure 3.6 shows the distribution of models by environmental fate and behaviour (i.e., how a chemical of interest exits an system of interest) and target medium. The largest proportions of models target environmental degradation and environmental mobility. Both of these groups contain many models that target the water medium, but also models that target soil, air, and multiple environmental media.

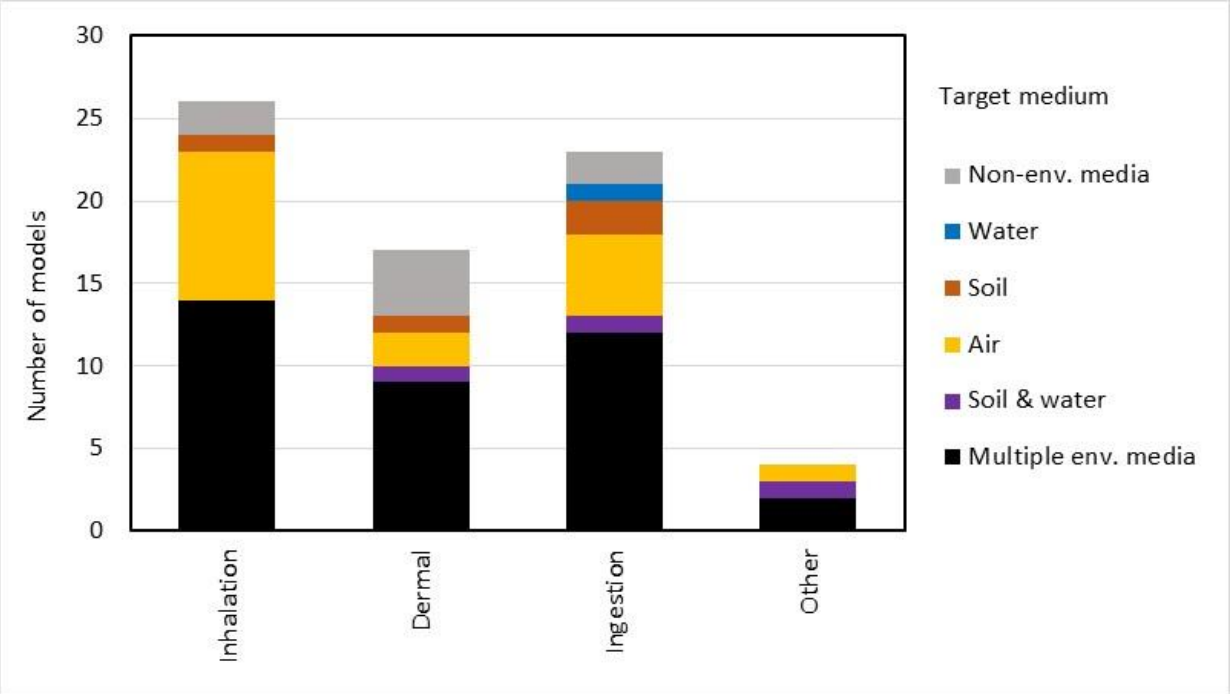
Figure 3.6. Distribution of models by target environmental fate and behaviour and target medium



Footnote: "Other" includes 16 models with other target environmental fate and behaviours (e.g., multiple environmental media partitioning, stormwater runoff, spray drift, environmental chemical mass balance, single organism bioaccumulation, food commodities of animal origin, and sewage treatment plant).

Figure 3.7 shows the distribution of models by target exposure route for indirect exposure to humans and target medium. Consistent with the data for direct exposure to humans, the largest proportion of models target the inhalation indirect exposure route. Of these models, the largest proportions target air or multiple environmental media. The exposure routes with the next largest proportions of models are ingestion and then dermal. Irrespective of the indirect exposure route, the majority of models target multiple environmental media.

Figure 3.7. Distribution of models by target indirect exposure route in humans and target medium



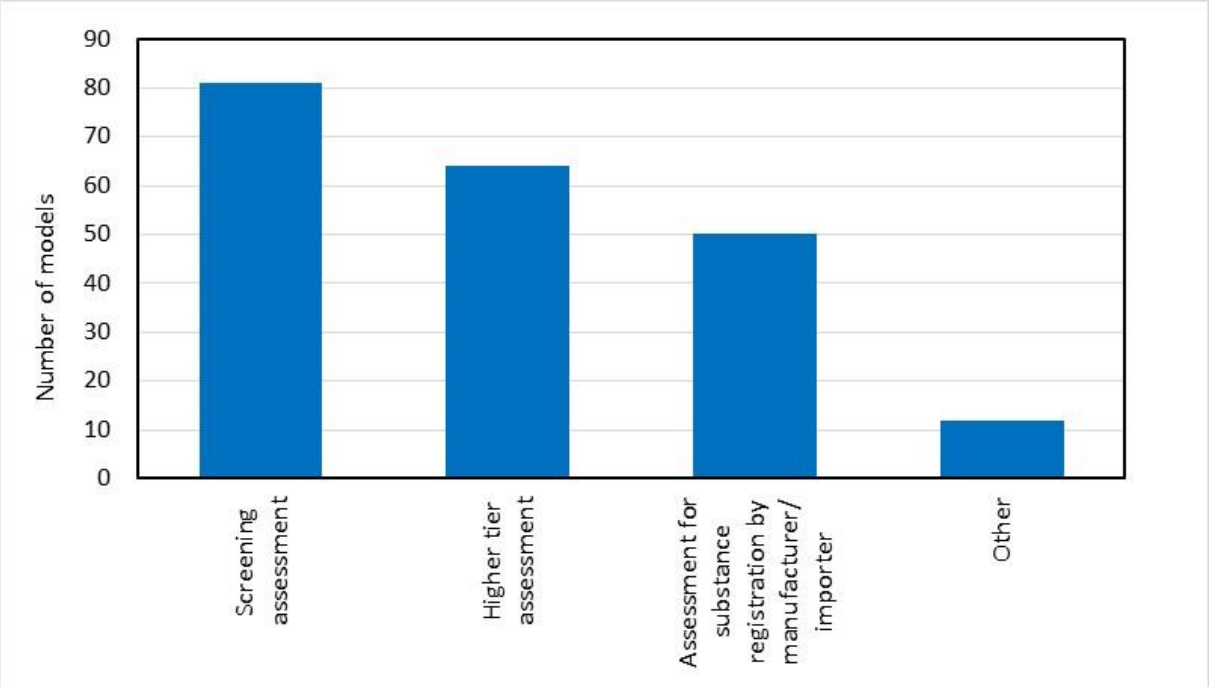
Footnote: "Other" includes 4 models with other target indirect exposure routes (e.g., multiple environmental media partitioning, deposition, and children crawling in exposed areas).

3.3. Use for regulatory purposes

3.3.1. Incorporation into a regulatory framework

Figure 3.8 shows the distribution of models by regulatory use. The largest proportion of models are used in screening assessments, followed by higher tier assessments, and assessments for substance registration.

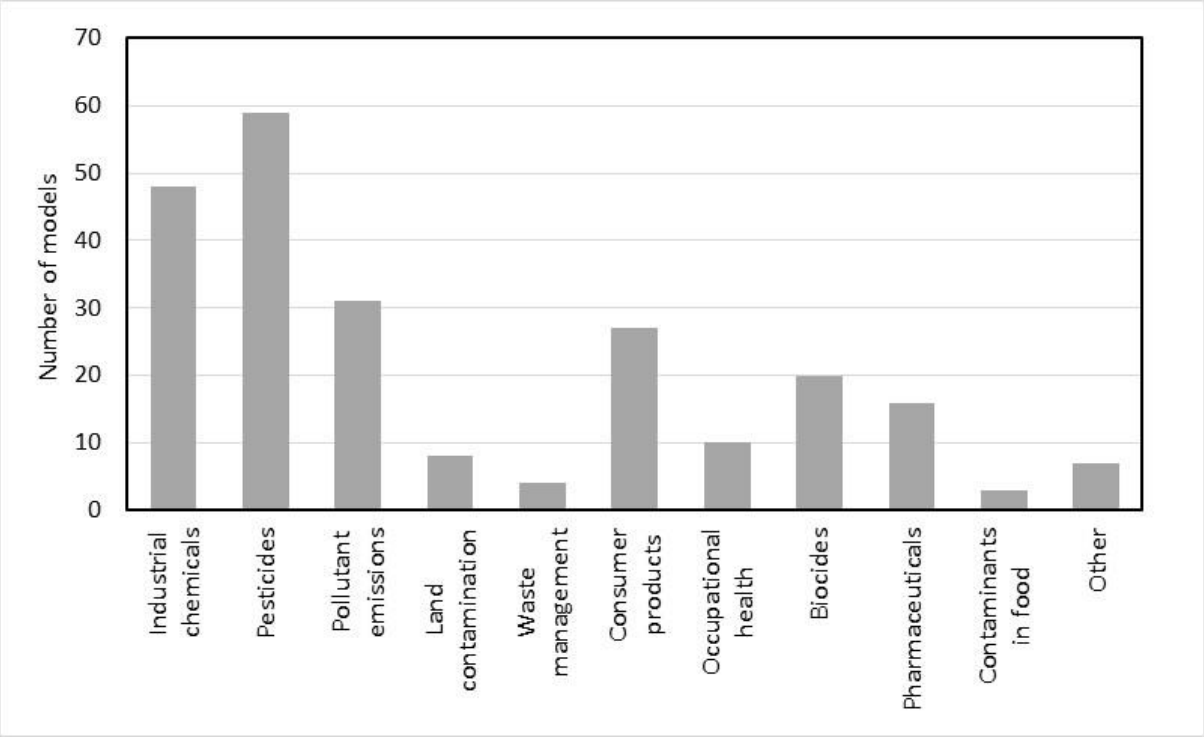
Figure 3.8. Distribution of models by regulatory use



Footnote: "Other" includes 12 models with other regulatory uses (e.g., scientific opinion, product development, approval of active substances, setting of legal limits for pesticide residues in food, assessment and classification of drift-reducing application techniques and drift-reducing nozzles, and prioritization and trend analysis).

Figure 3.9 shows the distribution of models by regulatory purpose. The largest proportion of models are used for the regulation of pesticides, followed by industrial chemicals, pollutant emissions, consumer products, biocides, and pharmaceuticals.

Figure 3.9. Distribution of models by regulatory purpose

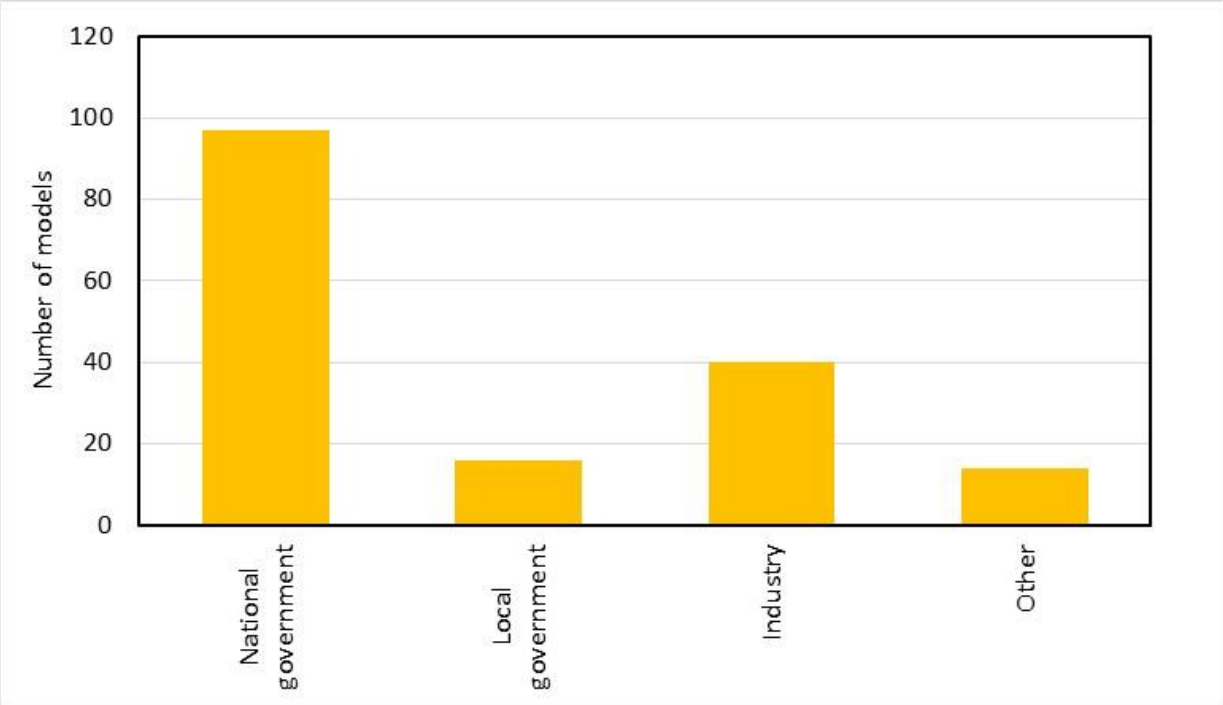


Footnote: "Other" included 7 models targeting other regulatory purposes (e.g., personal care products, veterinary drugs, stormwater management of building products, and spraying on arable crops/fruit orchards/avenue tree nurseries).

3.3.2. Support decision-making

Figure 3.10 shows the distribution of models by the sector in which they support decision-making. The vast majority of models support decision-making at the national government level, followed by the industry and local government levels. Many models in the "Other" category are models that specifically support decision-making for the European Union.

Figure 3.10. Distribution of models by the sector in which they support decision-making

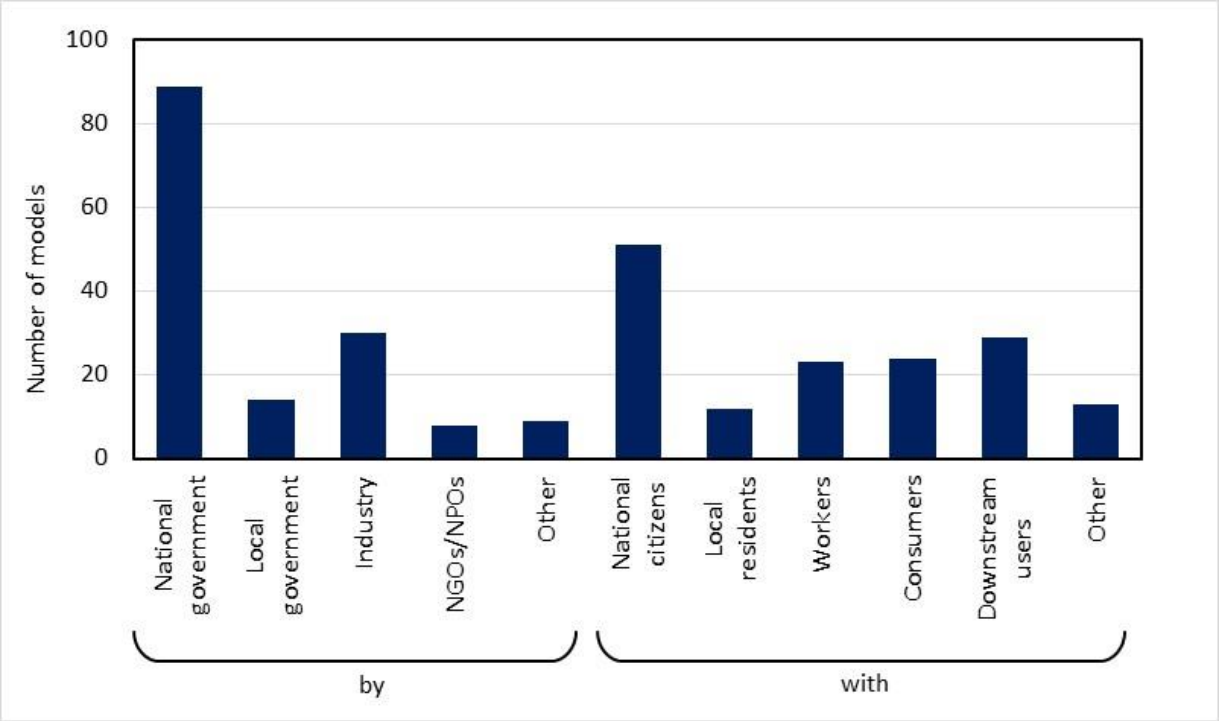


Footnote: "Other" includes 14 models that support other sections (e.g., academia, European Commission, and European Union risk assessment).

3.3.3. Use of estimation results for risk communication

Figure 3.11 shows the distribution of models by the groups who use them for risk communication. The majority of the models are used by national governments, followed by industry. The target audience for this risk communication is national citizens, followed by downstream users, consumers, and workers.

Figure 3.11. Distribution of models by the groups who use them for risk communication



Footnote: "by Other" includes 9 models that are used by other sectors (e.g., inter-governmental bodies, environmental agencies, European Food Safety Authority, governmental research institutes, European Union, and European Chemicals Agency/Commission). "with Other" includes 14 models that are used to communicate with other sectors (e.g., veterinary drug companies, stakeholders and the general public, farmers, and submitters of pre-manufacture notices).

4 Toward better model applications in the regulatory sphere

This chapter discusses the limitations, applicability, and accessibility of the models; the disclosure of model specifics; the peer review and evaluation of the models; and whether confidential business information entered into the models is held confidential only to the user; recommendations are provided for issues elucidated by survey results Potential future studies and follow-up activities are also discussed.

4.1. Limitations and accessibility of the models

The vast majority of the 112 reported models are free to use and easily accessible. Only six of the models require access to a license and another six (two of which were reported as both available and unavailable) are unavailable to the general public. The free-to-use models are accessed primarily by downloading from a website, although 27 can be accessed by sending a request to the relevant agency. Nine models have other access needs or issues such as the model is internal for regulators or requires training before obtaining access. Detailed information is presented in Annex E.

4.2. Disclosure of model specifics

Disclosure of model specifics is important for the proper use of the model in its intended application. It is important to include within the model description information on the intended application of the model (e.g., the model domain), assumptions and default values included within the model, and the limitations of the model. For most of the reported models (92), these descriptions are published in documents accompanying the models. Some descriptions are included within the model source code or in spreadsheets, though the source code is only disclosed for four models.

4.3. Peer review, model validation, and verification

Model validation[1], verification, and peer review are important contextual information for users and are topics included in the survey. Of the 112 total surveyed models, key references are available for 88 models. In some cases, respondents referred to a document or weblink where key references could be obtained.

Eighty-three of the surveyed models provide information on peer review, validation, or verification. Most responses either provided specific references associated with model peer review or statements of the

[1] The survey did not define the term ‘validation’ – this term can be interpreted differently by individual survey respondent, such as whether the formulas are correctly implemented, or whether the models correctly predict actual exposure. This document only summarises the responses from the survey.

models being peer-reviewed or having undergone a quality control and review process. Only four responses specifically noted there having been no or only limited validation of the respective models. In addition, the survey responses included information on default values for 98 of the 112 total models—either sources of the information or the actual values used in the models. The key references and references related to peer review, validation, or verification for each of the models are provided in Annex D.

4.3.1. Protection of confidential business information (entered by the user)

This category was fairly evenly split with slightly more models confirming that the information inputted remains confidential to the user (i.e., the data is protected and not made available to others). See Annex E for additional information.

4.4. Recommendations related to availability and accessibility; disclosure of model descriptions and peer reviews and evaluations; and protection of confidential business information

Most of the reported models (97) are free to use and available online. However, there is variability as to model accessibility; that is, whether the model is web-based, downloaded via a website, or distributed by request. The majority of models ensure that confidential business information remains confidential to the user.

Access to a variety of models that represent estimates of chemical exposures from a variety of media and routes of exposure are important considerations for the exposure community. It is recommended that accessibility would be further encouraged by regulators and/or model developers. A summary of models and their applicability is also recommended (see the following section). Lastly, it is recommended that peer review of models would be prioritised for those models that have not yet been reviewed. Peer review would increase user confidence in the model's reliability and relevance as well as assure scientific quality, validity and trust.

4.5. Possible follow-ups based on the survey results

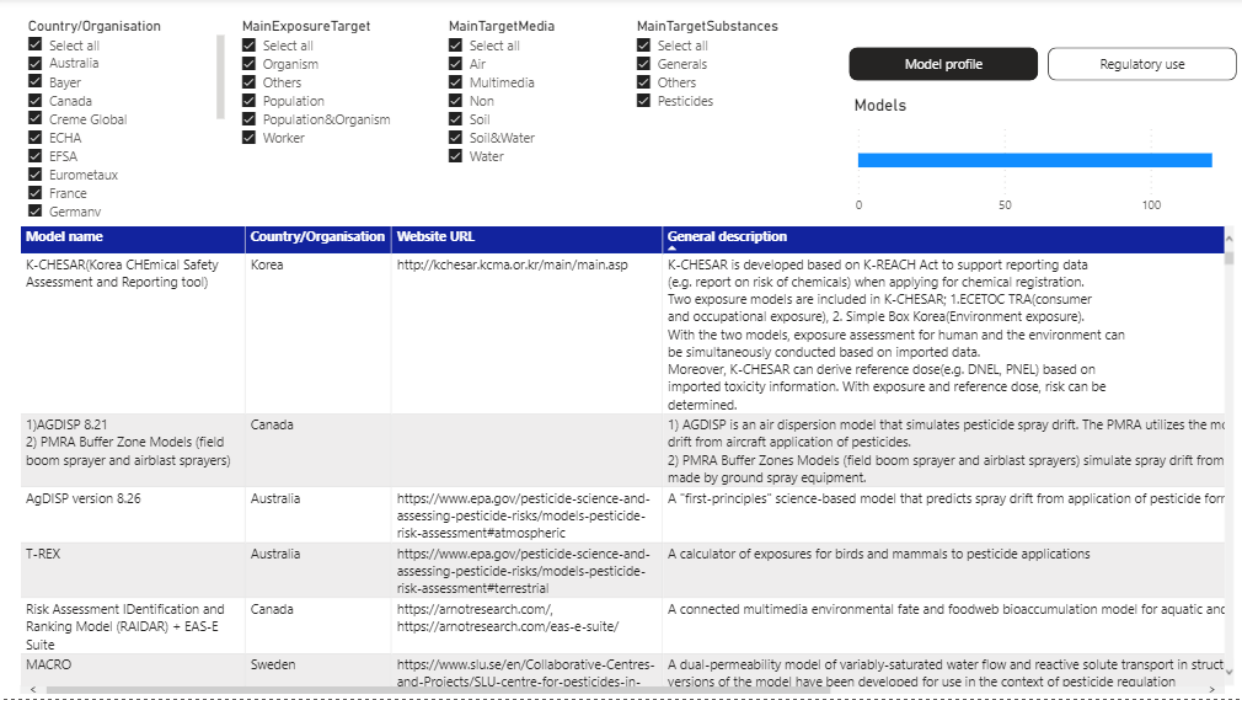
The following additional studies and follow-up activities could be conducted based on the survey results and present analysis:

- The information collected in this study could be further broken down by sorting out the models by regulatory field (exposure scenarios) with the number of respondents reporting to use that model so that the reader could get a sense of how commonly used a particular model is.
- Good practices for model application in the regulatory context could be identified by using the models collected in this survey. Ways to increase applicability could also be explored.
- National/regional/local regulatory authorities could review this report to explore the potential applicability of the reported exposure models for their chemical regulation activities.
- Comparisons of performance among models used for similar regulatory purposes could be performed. The WPEA currently conducts such a comparison for wastewater treatment plant models.
- Further discussion could be done on how models should be validated to be used for regulatory purposes.

- Few models can be used to estimate exposure to dust and exposure during waste handling activities; additional model development in this area could be considered.

The information collected in this survey, specifically the descriptions of the models (Annex B) and the reported uses of the models (Annex C), will be made available online as an OECD database. The responses to the initial survey will also be added to the database. The intention is that this database will allow users to search for models by country/organisation, main target exposure/media/substance, and regulatory field. A mock-up of the database is shown in Figure 4.1. The database is expected to be updated periodically with new data provided by the members of the WPEA and other working parties.

Figure 4.1. Mock-up of the proposed model database



Model name	Country/Organisation	Website URL	General description
K-CHESAR(Korea CHEmical Safety Assessment and Reporting tool)	Korea	http://kchesar.kcma.or.kr/main/main.asp	K-CHESAR is developed based on K-REACH Act to support reporting data (e.g. report on risk of chemicals) when applying for chemical registration. Two exposure models are included in K-CHESAR; 1.ECETOC TRA(consumer and occupational exposure), 2. Simple Box Korea(Environment exposure). With the two models, exposure assessment for human and the environment can be simultaneously conducted based on imported data. Moreover, K-CHESAR can derive reference dose(e.g. DNEL, PNEL) based on imported toxicity information. With exposure and reference dose, risk can be determined.
1)AGDISP 8.21 2) PMRA Buffer Zone Models (field boom sprayer and airblast sprayers)	Canada		1) AGDISP is an air dispersion model that simulates pesticide spray drift. The PMRA utilizes the m drift from aircraft application of pesticides. 2) PMRA Buffer Zones Models (field boom sprayer and airblast sprayers) simulate spray drift from made by ground spray equipment.
AgDISP version 8.26	Australia	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#atmospheric	A "first-principles" science-based model that predicts spray drift from application of pesticide forr
T-REX	Australia	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#terrestrial	A calculator of exposures for birds and mammals to pesticide applications
Risk Assessment IDentification and Ranking Model (RAIDAR) + EAS-E Suite	Canada	https://arnotresearch.com/, https://arnotresearch.com/eas-e-suite/	A connected multimedia environmental fate and foodweb bioaccumulation model for aquatic and
MACRO	Sweden	https://www.slu.se/en/Collaborative-Centres-and-Projects/SLU-centre-for-pesticides-in-	A dual-permeability model of variably-saturated water flow and reactive solute transport in struct versions of the model have been developed for use in the context of pesticide regulation

Annex A. Survey on Exposure Assessment Models used in a Regulatory Context

Scope and Objective

This survey is aimed at gathering information from your chemical regulation program on the application and use of Exposure models as an update of the previous survey (ENV/JM/MONO(2012)37) conducted a decade ago. It intends to list and classify exposure assessment models as well as the example of the application and use of those models in regulatory contexts. The survey is also aimed at identifying the applicability and limitation of the model to be used in a regulatory context. After the analysis of the survey result, an OECD report will be prepared to be published.

The scope of the application and use example in regulatory context includes that regulatory bodies use the exposure models to conduct a risk assessment of chemicals, incorporate the use of exposure models into their regulatory schemes, and use the estimation results of exposure models for decision making. Also, this scope can be expanded to the use in risk communication, i.e., the estimation results are used as communication tools between local government and residents and so on.

The scope of exposure models in this survey is about computational models which simulate (whether fully or partially) chemical fate and behaviours in the environment and exposures from sources to targets (human or organisms) including (multi)media models (e.g., environmental fate and transport models), consumer exposure models, and worker exposure models. Models estimating physicochemical property, estimating internal exposure such as skin absorption and PBPK models, and databases and scenario documents are thus beyond the focus of this survey.

In terms of the target substances, both organic and inorganic substances are included (see the questionnaire in detail), while nanomaterials are excluded in this study as the OECD WPMN is currently conducting a thorough study on the exposure models developed specifically for the assessment of nanomaterials.

By the outcome of the present survey, we hope to facilitate the appropriate use and application of exposure models.

Model descriptions	Information to be filled in
Model name	
General description	
Owner	
Website URL	
Released/last updated	*(ex. released in 2015, last updated in 2020)*
Compatibility	*(ex. compatible with Windows 10)*
Target substances	☐ Organic substances *(e.g. PAH, mixtures… if specified)*

Model descriptions	Information to be filled in
	☐ Inorganic substances (*Please specify (ex. Lead, Mercury)*) ☐ Others (*Please specify (ex. Organometallic substances, UVCBs)*)
Estimates exposure to:	☐ Consumers ☐ Workers ☐ General population ☐ Children ☐ Aquatic organisms ☐ Terrestrial organisms ☐ Benthic organisms ☐ Others (*Please specify*)
Target Exposure compartments/source/routes/s	- *Exposure Source* ☐ Sources within the workplace ☐ Direct emission of Industrial chemicals to the environment from an industrial facility ☐ Use of industrial chemicals (professional workers and consumers) ☐ Use of consumer product ☐ Land contamination ☐ Waste ☐ Use of Pesticides ☐ Use of Biocides ☐ Use of Pharmaceuticals ☐ Use of Food additives ☐ Use of Feed additives ☐ Others (*Please specify*) **[Direct exposure to ☐ Consumers ☐ Workers ☐ General Public]** - *Exposure duration* ☐ Short Term exposure ☐ Long term exposure - *Exposure route* ☐ Inhalation ☐ Dermal ☐ Oral ☐ Others (*Please specify*) **[Exposure to the environment and indirect exposure to humans via the environment]** - *Exposure compartment* ☐ Air ☐ Soil ☐ Surface water ☐ Groundwater ☐ Sediment ☐ Dust - *Environmental Fate and behaviour* ☐ Environmental degradation ☐ Environmental mobility ☐ Environmental bioavailability ☐ Aquatic food web bioaccumulation ☐ Terrestrial food web bioaccumulation ☐ Others (*Please specify*) - *Exposure route for indirect exposure to humans* ☐ Inhalation ☐ Dermal ☐ Ingestion ☐ Others (*Please specify*)
Other model functions	☐ Spatial distribution (Mapping) ☐ Simulate time-dependent exposure ☐ Sensitivity and Uncertainty analysis ☐ Others (*Please specify*)
Limitation and applicability	(*ex. for polar/non-polar substances, regional/local scale estimation*)

<table>
<tr><th>Model descriptions</th><th>Information to be filled in</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Availability</td><td>- Availability to general public
☐ Available (free) ☐ Licence needed ☐ Unavailable ☐ Others (Please specify)
- Accessibility to the model
☐ Web-based ☐ Download via website ☐ Distributed by request
☐ Others (Please specify)
- Disclosure of the model description (equation/formula, parameter values, etc.)
☐ Document published ☐ Confidential
☐ Disclosure of source code ☐ Described in a spreadsheet (ex. Excel-based)
☐ Others (Please specify)
<table><tr><td>Relevant links</td><td></td></tr></table></td></tr>
<tr><td>Data input and Confidential Business Information (CBI)</td><td>Does the information inputted into the model remain confidential to the user (i.e. stays protected and is not made available to others)? ☐ Yes ☐ No</td></tr>
<tr><td>Key references</td><td></td></tr>
<tr><td>Peer review, validation or verification reference</td><td>(ex. peer review of the model)</td></tr>
<tr><td>Default values</td><td>(What is the origin of the default data to populate the model?)</td></tr>
<tr><td>Application and use for regulatory purpose</td><td>[Regulatory field (Exposure source)]
☐ Industrial chemicals ☐ Pesticides ☐ Pollutant emission (to air, water, etc.)
☐ Land contamination ☐ Waste management ☐ Consumer product
☐ Occupational health ☐ Biocides ☐ Pharmaceuticals
☐ Contaminants in food ☐ Others (Please specify)

[Regulatory use]
- Incorporated in regulatory framework
☐ Screening assessment ☐ Higher tier assessment
☐ Assessment for substance registration by manufacturer/importer
☐ Others (Please specify)
<table><tr><td>Application examples</td><td>Indicate relevant chapters of legislations and/c documents with links and brief descriptions</td></tr></table></td></tr>
</table>

<table>
<tr><th>Model descriptions</th><th colspan="2">Information to be filled in</th></tr>
<tr><td></td><td colspan="2">- Supports decision making for
☐ National government ☐ Local government ☐ Industry
☐ Others (Please specify)
<table><tr><td>Application examples</td><td>Indicate relevant reports or website with links descriptions</td></tr></table>
- Used the estimation result for risk communication by
☐ National government ☐ Local government ☐ Industry
☐ NGOs/NPOs ☐ Others (Please specify)
with
☐ National citizens ☐ Local residents ☐ Workers ☐ Consumers
☐ Downstream users ☐ Others (Please specify)
<table><tr><td>Application examples</td><td>Indicate relevant reports or website with links descriptions</td></tr></table></td></tr>
<tr><td>Contact information</td><td>Organisation :

Name :

Email address :

Website :</td><td></td></tr>
<tr><td>Any other information</td><td colspan="2"></td></tr>
</table>

If you want to lead drafting the report which summarizes the results of the survey, please tick this box ☐

If you want to participate in the discussion and review of the draft report, please tick this box ☐

Annex B. Summary table of available models and tools

A total of 126 responses were received from 22 countries/organisations. More specific information on individual models is presented in Annex B – E. Note that models are associated with country/organization that reported using them, but may have been developed by third parties or other organizations. Additionally, some of these models may be used by multiple countries/organizations, which may not be captured in Annex B - E. There were duplicate responses for the following models: AERMOD (2), AgDRIFT (2), BeeRex (2), CEM (2), ConsExpo (5), EFSA PRIMo (4), EPI Suite (2), OECD's RexTox (2), and Stoffenmanager (2)[2]. Definitions of terms in the columns Target substances, Target medium, and Target exposure receptors are described in Table 3.2.

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Australia	Environmental Emission Scenarios for Product Type 14: Biocides used as rodenticides	A model that calculates concentrations of rodenticides and biocides in 5 scenarios: sewer systems, in and around buildings, open areas, waste dumps and bank slopes. The first version of the model (v1.0) included also a calculation of primary and secondary poisoning for various types of animals via dietary ingestion of baits, but this calculations have been removed in the current version (v2.0)	Pesticides (including general substances)	Multiple environmental media	Ecological organisms	http://echa.europa.eu/en/guidance-documents/guidance-on-biocides-legislation/emission-scenario-documents
Australia	AgDRIFT version 2.1.1	A modified version of AgDISP, a "first-principles" science-based model that predicts spray drift from application sites.	Pesticides	Multiple environmental media	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#atmospheric

[2] The numbers in parentheses indicate the number of duplicates.

[3] "General population" refers to human receptors, and "ecological organisms" refers to ecological receptors.

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Australia	T-REX	A calculator of exposures for birds and mammals to pesticide applications	Pesticides	Other (non-environmental media)	Ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#terrestrial
Australia	EPISUITE v4.11	Collection of various models used to predict persistence, bioaccumulation and fugacity	General substances	Multiple environmental media	Ecological organisms	https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface
Australia	AgDISP version 8.26	A "first-principles" science-based model that predicts spray drift from application of pesticide formulations on sites.	Pesticides	Multiple environmental media	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#atmospheric
Australia	Beerex	A simple calculator of honey bee exposure to pesticides	Pesticides	Other (non-environmental media)	Ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#terrestrial
Australia	ConsExpo	Estimation of exposure from consumer products	General substances	Other (non-environmental media)	General population	https://www.rivm.nl/en/consexpo
Australia	SimpleTreat v3.0	A model to predict the distribution and elimination of chemicals by Sewage Treatment Plants. Used to produce estimates of STP removal efficiencies and predicted concentrations of chemicals in surface waters and agricultural land	General substances	Soil & water	Ecological organisms	https://rivm.openrepository.com/handle/10029/257231
Bayer	Bayer Safety Standard for Operator Safety	Operator exposure model for handheld application of plant protection product particular for exposure scenarios that are relevant in low- and middle-income countries	Pesticides	Other (non-environmental media)	Workers	https://www.cropscience.bayer.com/who-we-are/transparency/information-about-operator-safety-standards
Canada	Consexpo	Consexpo is a computer program which allows the estimation of exposure to consumer products	General substances	Other (non-environmental media)	General population	https://www.rivm.nl/en/consexpo
Canada	Consumer/Industrial Drinking water/PECaqua Models	Model which estimates the PECaqua and potential drinking water intake for children and adults following consumer use or industrial formulation or manufacture in Canada	General substances	Water	General population & ecological organisms	NA

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Canada	SCREEN3	US EPA air dispersion screen assessment too. Run as a Microsoft Windows	General substances	Air	General population	https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models#screen3
Canada	ChemCAN	The CEMC Level 1 Fugacity model estimates the distribution of a chemical in a multi-media evaluative environment with the following compartments: air, aerosol, soil, water, sediment, suspended sediment, and fish. The model's estimations provide a general impression on which compartment the chemical will likely partition to, along with relative concentrations and mass distributions. The model's Level 1 category suggests that the model operates under the assumption of steady-state, instantaneous equilibrium (equal fugacity between media) with no advective processes, no chemical reactions, and no degradation. A level III fugacity model of 24 regions of Canada that simulates the release of substances into the environment. It estimates average concentrations in air, fresh surface water, fish, sediments, soils, vegetation, and marine near-shore waters. Other regions of at least a 300 km radius can be defined by the user and added to the database.	General substances	Multiple environmental media	General population	https://www.trentu.ca/cemc/resources-and-models/chemcan-model
Canada	Canadian Veterinary Drug PECsoil Model	The model used to calculate a realistic worst case (screening level) Predicted Environmental Concentration in soil (PECsoil) for veterinary drugs following the application of animal waste from treated livestock to agricultural fields	General substances	Soil	Ecological organisms	https://setac.onlinelibrary.wiley.com/doi/full/10.1002/ieam.1833
Canada	U.S. Environmental Protection Agency's Consumer Exposure Model (CEM)	Microsoft Access tool that assesses exposure to consumer products and articles across a range of exposure scenarios and pathways.	General substances	Other (non-environmental media)	General population	https://www.epa.gov/tsca-screening-tools/cem-consumer-exposure-model-download-and-install-instructions
Canada	Swimmer Exposure Assessment Model (SWIMODEL)	The Swimmer Exposure Assessment Model was developed by the USEPA as a screening tool to conduct exposure assessments of pesticides found in indoor swimming pools and spas (these include the 200+ pesticides registered for swimming pool uses, as well as those that exist in water and run-off water). The SWIMODEL uses well-accepted screening exposure assessment equations to calculate the total worst-case exposure for swimmers expressed as a mass-based intake value (mg/event). The assessor has the option of using the default values available within the model or entering other available values. The model focuses on potential chemical intakes only and does not take into account metabolism or excretion of the chemical of concern. The SWIMODEL is being used for swimmer exposure assessments by Health	Pesticides (including general substances)	Other (non-environmental media)	General population	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/swimmer-exposure-assessment-model-swimodel

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		Canada's Pest Management Regulatory Agency (PMRA), the USEPA, registrants, and in academic circles.				
Canada	Dietary Exposure Evaluation Model - Food Commodity Intake Database (DEEM-FCID)	DEEM-FCID/Calendex software incorporates food consumption data from the National Health and Nutrition Examination Survey/"What We Eat in America" (NHANES/WWEIA) dietary survey. The DEEM-FCID component of DEEM-FCID/Calendex can be used to estimate dietary intake of any component of food or water including toxicants, pesticides, and natural constituents to perform acute and chronic dietary exposure assessments. Health Canada's Pest Management Regulatory Agency (PMRA) uses the DEEM-FCID component to conduct dietary risk assessments to support the establishment of maximum residue limits (MRLs) for residues of pesticides in/on raw agricultural and processed commodities. It also allows PMRA to look at exposures at each eating occasion rather than grouping the entire day's food and drink intake at once. PMRA can thus conduct more refined risk assessments that will help inform regulatory decisions for pesticides.	Pesticides	Other (non-environmental media)	General population	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#deem
Canada	Generic Exposure Data	Chemical generic exposure data	Pesticides (including general substances)	Other (non-environmental media)	Workers	
Canada	The Standard Operating Procedures for Residential Pesticide Exposure Assessment	The Standard Operating Procedures for Residential Pesticide Exposure Assessment (Residential SOPs) are instructions for estimating exposure resulting from the most common non-occupational pesticide uses including lawn and garden care, foggers, and pet treatments. They are an important tool for the Pesticide Program because they provide: - guidance for exposure assessors who are responsible for the residential non-dietary component of the risk assessment process; - a description of the methods used to evaluate pesticide chemicals in a straightforward and user-friendly fashion; and - a framework for future research directed at improvements in the residential assessment process for pesticides. This is an SOP along with Excel-based templates. The Health Canada templates have been modified to reflect Canadian specific policies.	Pesticides (including general substances)	Other (non-environmental media)	General population	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Canada	PWC – the Pesticide in Water Calculator	Simulates pesticide applications to land surfaces and the pesticide's subsequent transport to and fate in water bodies, including surface water bodies and simple ground water aquifers	Pesticides	Soil & water	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#PWC
Canada	1)AGDISP 8.21 2) PMRA Buffer Zone Models (field boom sprayer and airblast sprayers)	1) AGDISP is a mechanistic air dispersion model that simulates pesticide spray drift. The PMRA utilizes the model to evaluate spray drift from aircraft application of pesticides. 2) PMRA Empirical Buffer Zone Models (field boom sprayer and airblast sprayers) simulate spray drift from pesticide applications made by ground spray equipment.	Pesticides	Soil & water	Ecological organisms	
Canada	Risk Assessment IDentification and Ranking Model (RAIDAR) + EAS-E Suite	A connected multimedia environmental fate and foodweb bioaccumulation model for aquatic and terrestrial environments	Pesticides (including general substances)	Multiple environmental media	General population & ecological organisms	https://arnotresearch.com/, https://arnotresearch.com/eas-e-suite/
Canada	AERMOD	AERMOD is a modelling system that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using USGS Digital Elevation Data.	General substances	Air	General population & ecological organisms	https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod
Canada	Artifical Intelligence Expert Predictive System (AIEPS) v3.0	This model is a Probabilistic Neural Network. PNNs are neural network implementations of various mapping or classification algorithms based on the well known Bayesian Maximum Likelihood Estimation methodology. The model implemented in the AIEPS targeting computation of the Percentage Biodegradation 28-d (BOD) endpoint for organic chemicals and is based on the Bayesian Maximum Likelihood Estimation methodology. The relationship between the biodegradation effect and the selected atoms, bonds and molecular fragment indicators is implemented through a basic Probabilistic Neural Network (PNN) with Gaussian kernel (statistical corrections included). Fragment information is generated directly from molecular structure (SMILES) using fragment chemistry data mining. The	General substances	Other (non-environmental media)	Other	N/A

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		model is trained on data from Japan's Chemical Substances Control Law Database.				
Canada	Biosolids-Amended Soil: Level IV (BASL4)	The Biosolids-Amended Soil: Level IV (BASL4) model calculates the fate of chemicals in soil. Chemical may be introduced to the soil by direct application or in association with contaminated biosolids. Application can be to the surface of the soil or injected into a deeper layer. Processes of chemical degradation, volatilization, leaching, erosion, diffusion and sorbed phase transport due to bioturbation are quantified. The degradation of the organic matter (OM) present in the soil and biosolids is also calculated. Applications of biosolids or neat chemical can occur at user-specified times during the simulation, as can ploughing events which result in the mixing of chemical and OM between the layers of soil. BASL4 also contains six biota sub-models: two carrot models (equilibrium, simple dynamic), two soil invertebrate models (steady-state, dynamic) and two invertebrate-eating mammal models (steady-state, dynamic). These calculate concentrations in biota as a result of soil concentrations. This model is useful for assessing the long-term, year-to-year fate and possible build-up of chemicals in biosolids-amended soils as well as for estimating risk of biotic uptake and bioaccumulation in soil-dwelling organisms.	General substances	Soil	Ecological organisms	https://www.trentu.ca/cemc/resources-and-models/BASL4-model
Canada	CATALOGIC biodeg.	Biodegradation models estimating biodegradation rates and percent degradants composition under aerobic conditions in water or soil for organic substances.	Pesticides (including general substances)	Soil & water	Other	https://oasis-lmc.org
Canada	Canadian POPs	Predicts the PBT profile of degradation products.	General substances	Other (non-environmental media)	Ecological organisms	
Canada	Consumer Release Aquatic Model (CRAM)	The Consumer Release Aquatic Model (CRAM) is an Excel spreadsheet tool to quantify the level of aquatic exposure to a substance resulting from products being released down the drain to wastewater treatment systems (WWTS), and associated risk quotients. The tool estimates predicted environmental concentrations (PEC) resulting from consumer product releases and compares these to a concentration of concern (CC). The result is to identify whether environments receiving WWTS effluents could potentially be at risk	General substances	Water	Ecological organisms	n/a

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		from the release of the substance. CRAM is a mechanistic model that estimates the level of aquatic exposure using distribution information derived from receiving water body flows (dilution factor), wastewater system treatment levels and per person water discharge, to determine variation in results. Other parameters such as per person consumption of consumer products are considered deterministically within the model.				
Canada	New Equilibrium Criterion model (EQC)	The EQC, or EQuilibrium Criterion, model uses chemical-physical properties to quantify a chemical's behaviour in an evaluative environment. The environment is fixed to facilitate chemical-to-chemical comparison. Three degrees of complexity are treated in the EQC, or EQuilibrium Criterion, Model. Levels I and II assume thermodynamic equilibrium is achieved; Level II includes advective and reaction processes. Level III is a non-equilibrium, steady-state assessment of chemical fate in the environment. Three types of chemicals are treated: chemicals that partition into all media (Type 1), involatile chemicals (Type 2), and chemicals with zero or near-zero solubility (Type 3). This model is useful for establishing the general features of a new or existing chemical's behaviour, ie. the media into which the chemical will tend to partition, the primary loss mechanisms, and its tendency for intermedia transport. The result of various emission scenarios can be explored.	General substances	Multiple environmental media	Other	https://www.trentu.ca/cemc/resources-and-models/eqc-equilibrium-criterion-model
Canada	Soil exposure from air deposition spreadsheet program	This tool converts deposition rates (from air dispersion models) to soil concentrations, after a determined period of time. The deposition rates are converted to soil concentrations after year(s) of deposition by the spreadsheet program which is based on the work of Baes and Sharp (1983), U.S. EPA (1999) and ECHA (2012). This calculation consideres losses from both biodegradation and physical processes, such as soil leaching, runoff and volatilization.	General substances	Soil	Ecological organisms	n/a
Canada	STP-EX	This is a fugacity-based model that estimates removal in wastewater treatment systems, including in lagoons system. It is in Excel format.	General substances	Water	Other	n/a
Canada	TaPL3	The TaPL3 model is intended as an evaluative tool to be used in the detailed assessment of chemicals for persistence and potential for long-range transport in a mobile medium, either air, or water, in a Level III (steady state environment). It is expected that chemicals will be compared. (Absolute values may be misleading due to the absence of advection.) Mass balances are calculated for the four bulk media of air (gas + aerosol),	General substances	Air (target of this model is not only air. See definition of	Other	https://www.trentu.ca/cemc/resources-and-models/tapl3-model

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		water (solution + suspended sediment + biota), soil, (solids + air + water), and sediment (solids + pore water). Equilibrium exists within, but not between media. Physical-chemical properties are used to quantify a chemical's behaviour in an evaluative environment. Three types of chemicals are treated in this model: chemicals that partition into all media (Type 1), involatile chemicals (Type 2), and chemicals with zero, or near-zero, solubility (Type 3). The TaPL3 model assumes a simple, evaluative environment with user-defined volumes and densities for the following homogeneous environmental compartments: air, water, soil, sediment, suspended sediment, fish and aerosols. Chemical is set to enter each of the mobile media (air and water) separately and at a fixed rate. Overall environmental persistence and potential for long-range transport in the mobile medium are calculated. There is no advective removal from the environment.		categories and original responses)		
Canada	UVCB Modifier	This tool estimates the final composition of petroleum mixtures after wastewater treatment systems (to account for differential removal of different components). Although it was developed initially for dealing with petroleum substances and their removal in wastewater treatment systems, it was designed in a flexible way as to allow other mixtures and other types of transformations to be considered (if the information is added in the library). The tools contains a librairy with relevant substance information from different sources. The calculated post transformation composition is determined by using the mapping scheme of the hydrocarbon block method described in PETROTOX User's Guide – PETROTOX_v3.06.xlsm (updated October 17, 2011). Low or high resolution composition can be used as an input. This tool can be used in association with the PetroTox model to determine toxicity of the post transformation composition.The initial composition (in low or high resolution) of the substance is entered in the post transformation composition tool. The tool is run to determine total removal and to determine the new composition based resulting from the differential removal of the original "blocks" used.	General substances	Other (non-environmental media)	Other	n/a
Canada	Wildlife spreadsheet models	Estimate wildlife exposure (total daily intake TDI) and effects (toxicity reference values TRV) in the absence of tissue residue data for focal wildlife species.	General substances	Water	Ecological organisms	n/a

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Canada	Bioconcentration for Ionizable Organics (BIONIC)	Mass-balance bioaccumulation model specifically able to account for charged substances, but not permanently charged compounds	Pesticides (including general substances)	Water	Ecological organisms	https://arnotresearch.com/bionic/
Canada	OECD POV and LRTP Screening Tool v2.2	Excel based model that calculates overall persistence (Pov) and long-range transport potential (LRTP)	Pesticides (including general substances)	Multiple environmental media	Ecological organisms	https://www.oecd.org/chemicalsafety/risk-assessment/oecdpovandlrtpscreeningtool.htm
Canada	CATALOGIC BCFMax	Bioaccumulation model estimating bioconcentration factors taking into account mitigating factors metabolism rate, molecular size ionization and water solubility	Pesticides (including general substances)	Water	Ecological organisms	https://oasis-lmc.org/
Concawe	PetroRisk	PetroRisk implements the ECHA Guidance on environmental exposure estimation and risk characterization with refinements to improve its applicability to complex hydrocarbon substances. The tool extrapolates the user-provided substance analytical information to individual hydrocarbon concentrations via the Hydrocarbon Block Method (HBM), and subsequently calculates the Predicted Environmental Concentrations (PECs) of the representative hydrocarbons in soil, air, water, sediment, sewage treatment plant (STP) effluent, and drinking water and foodstuff. Compared to the REACH Guidance approach (as implemented in for example EUSES), PetroRisk uses tailored methods to estimate organic carbon-water partitioning coefficients (Koc) and Biomagnification Factors (BMF), and implements version 4 of SimpleBox and SimpleTreat, including an adapted version of the latter for a better representation of industrial wastewater treatment.	General substances	Multiple environmental media	General population & ecological organisms	https://www.concawe.eu/reach/petrorisk/
Costa Rica	Surface water tool for exposure prediction-STEP 1-2	STEPS1-2 in FOCUS is a stand-alone Surface water Tool for Exposure Predictions -Steps 1 & 2 for the derivation of PEC values in water and sediment based upon the chosen scenario. The tool requires a minimum of input values (molecular weight, water solubility, DT50soil, Koc, DT50sediment/water, number of applications, application interval and application rate) and is designed to evaluate both active substances and metabolites.	Pesticides	Water	Ecological organisms	https://esdac.jrc.ec.europa.eu/projects/stepsonetwo

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Creme Global	Creme Food Safety/Creme Food Data Science Model	Creme Food Safety is a scientific cloud based software service used for estimating dietary intakes of foods, chemicals and nutrients in populations of consumers. This is achieved by linking food consumption studies to the appropriate food composition and chemical occurrence data using a number of validated and published models. The system supports both deterministic and probabilistic input data. Probabilistic data can be represented by parametric or empirical distributions, and these data sets are then combined in the Creme Food Safety model using Monte Carlo simulations. Output calculation types include daily average intakes, acute exposures, as well any required population statistics, standard errors and confidence intervals.	General substances	Other (non-environmental media)	General population	https://www.cremefood.com/food/ and https://app.expertmodels.com/
Creme Global	Creme/RIFM Aggregate Exposure Model	The model estimates exposure to fragrance materials, aggregated over 70 product sources, in European and American populations. The products include cosmetics, personal care products, air care products, and household cleaning products. The model uses habits and practices data drawn from population surveys and aggregated industry-provided concentration data to produce probabilistic estimates of exposure.	General substances	Other (non-environmental media)	General population	cremerifm.expertmodels.com
Creme Global	CARES NG	The Cumulative and Aggregate Risk Evaluation System – Next Generation (CARES NG®) is a web-based platform designed to conduct complex dietary and residential exposure assessments for pesticides, such as the assessments required under the 1996 Food Quality Protection Act (FQPA) and the 1988 Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). The FQPA mandates that the US Environmental Protection Agency evaluate both the aggregate and cumulative risks associated with pesticide use. Aggregate risk assessments take into account multiple sources and routes of exposure for a single chemical while cumulative risk assessments combine exposures to two or more chemicals that share a common mechanism of toxicity. The CARES NG® software was developed by Creme Global.	Pesticides	Multiple environmental media	General population	https://caresng.org/
ECHA	Chesar - CHemical Safety Assessment and Reporting tool	Chesar is an application developed by the European Chemicals Agency (ECHA) to help companies to carry out their chemical safety assessments (CSAs) and to prepare their chemical safety reports (CSRs) and exposure scenarios (ESs) for communication in the supply chain. Chesar enables registrants to carry out their safety assessments in a structured, harmonised, transparent and efficient way. This includes the importing of substance-related data directly from IUCLID, describing the uses of the substance, carrying out exposure assessment including identifying conditions of safe use, related exposure estimates and demonstrating control of risks. Based on this, Chesar automatically generates the CSR and exposure scenarios for communication	General substances	Multiple environmental media	General population & ecological organisms	https://chesar.echa.europa.eu/

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		as a text document, and export information on use and exposure to IUCLID. Chesar also facilitates the re-use (or update) of assessment elements generated in a single Chesar instance or imported from external sources. Several exposure estimation tools are embedded in Chesar: a) EUSESv2.1 combined with a release module as described in R16 to estimate environmental exposure concentrations; b) ECETOC TRA workers 3.0 to estimate worker exposures and c) ECETOC TRA consumers 3.1 to estimate consumer exposure. It is also possible to import in Chesar assessments made via Consexpo (consumers) and report measure exposure concentrations.				
ECHA	EUSES 2.2.0	The European Union System for the Evaluation of Substances (EUSES) is a software that supports chemical companies, authorities and research institutes to carry out quantitative assessments of the risks posed by chemical substances to the environment. It implements the technical guidance for the EU legislation for industrial chemicals and biocides. It dates back to 1994. As alone standing tool (EUSES 2.2.0) it is currently used for the exposure and risk assessment for biocides. EUSES is in addition integrated in the CHESAR tool for the assessment of chemicals under REACH. In the latest EUSES version 2.2.0, the software was updated with new biocides emission scenarios and the newest SimpleTreat version, as an intermediate step to provide a software solution until the Chesar platform developments, merging EUSES and CHESAR into one tool (planned to take place between 2020 and 2023), are finalised.	Pesticides (including general substances)	Multiple environmental media	Ecological organisms	https://echa.europa.eu/de/support/dossier-submission-tools/euses?utm_source=echa.europa.eu&utm_medium=display&utm_campaign=customer-insight&utm_content=homepage-it-tools
EFSA	Exposure calculation spreadsheet of the EFSA Guidance on the assessment of exposure of operators, workers, residents and bystanders in risk assessment for plant protection product	This exposure tool (Excel spreadsheet) represents current application techniques and practices in the EU for which data are available. Exposure studies conducted between 1994 and 2009, and provided for authorisation of PPPs, were evaluated regarding quality criteria, e.g. conformance with Good Laboratory Practice (GLP) and compliance with OECD guidance. Exposure data and supplementary information from these 34 studies were used for a statistical analysis of exposure factors. The statistical analyses resulted in six validated models for typical outdoor scenarios of pesticide mixing/loading and application (for operators). The models include application techniques and scenarios for outdoor treatment of low and high crops, by vehicle-mounted/trailed or self-propelled sprayers or by hand-held spray guns and knapsack sprayers. Further models are also included, covering partly additional scenarios (e.g. granular application). The underlying studies for the worker exposure part show a high level of uncertainties in terms of quality and reliability of data.	Pesticides	Air (target of this model is not only air. See definition of categories and original responses)	Workers	https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2014.3874 (see Supporting Information) https://www.efsa.europa.eu/en/efsajournal/pub/7032 (New version)

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		The dataset available for assessing resident and bystander exposure is rather limited, being based on only a few studies, some of which performed in the 1980s. Furthermore, some of the US EPA values used to conclude on these assessments are not completely reported (raw data missing).				
EFSA	EFSA PRIMo rev. 3.1	The EFSA PRIMo (Pesticide Residue Intake Model), an Excel-based calculation spreadsheet, is the standard tool used at EU level to perform the dietary risk assessment for pesticide residues in the framework of setting and reviewing of maximum residue levels for pesticides under Regulation (EC) No 396/2005 and in the peer review of pesticides under Regulation (EU) No 1107/2009. The model is based on food consumption data derived from national dietary food surveys. It is used to support risk assessors in performing the risk assessments in a transparent way reflecting the currently agreed risk assessment approach at European Union (EU) level and to provide risk managers with the relevant details needed to take risk management decisions on setting or amending legal limits and risk management decisions to be taken in the framework of maximum residue level (MRL) enforcement. It is easy to handle, based on standard Information Technology (IT) tools (Excel) which do not require specific IT expertise of the user; It allows to perform risk assessments in a standardised way required for regulatory questions at EU level and also allow the flexibility to calculate not standard risk assessment scenarios.	Pesticides	Other (non-environmental media)	General population	https://www.efsa.europa.eu/de/applications/pesticides/tools https://www.efsa.europa.eu/en/efsajournal/pub/5147 https://www.efsa.europa.eu/en/supporting/pub/en-1605
Eurometaux	Metal EUSES DU scaling tool	Under REACH, the Downstream User (DU) is obliged to check compliance with the Exposure Scenario (ES) forwarded by the Registrant. The information on Operational Conditions (OCs) and Risk Management Measures (RMMs) given in the ES should be compared with the actual OCs and RMMs of the DU. OCs/RMMs may not always be completely identical with the OCs/RMMs specified in the ES, and may actually deviate from them. When one or more of the actual OC and RMM differ from those of the ES, it is not immediately apparent whether the use is still in compliance with the ES. In all cases, the DU should still be able to ascertain that he is in compliance with the ES. For this situation, the registrant can provide scaling rules as part of the ES to help DUs to check compliance with the ES and to increase the flexibility of ESs for a wider range of downstream users. EUROMETAUX and ARCHE have developed a DU scaling tool for compliance checking with the environmental ES of metals. The DU scaling tool is based on the spreadsheet version of EUSES.	General substances (only Metals)	Multiple environmental media	Ecological organisms	https://www.arche-consulting.be/tools/du-scaling-tool/

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Eurometaux	Eurometaux SPERCs	The Specific Environmental Release Factors (SPERCS) for metals and metal compounds provide a more realistic approach to characterize the environmental releases from manufacture, processing and downstream uses of the metal (compounds) in the EU.	General substances (only Metals)	Air (target of this model is not only air. See definition of categories and original responses)	Ecological organisms	https://www.reach-metals.eu/reach/em-guidance-documents-and-tools/spercs-tool-for-metals
France	MODUL'ERS	A multimedia software estimating media concentrations, exposure and risk levels links to chemicals in contaminated soils or emitted by facilities – It has been designed to give flexibility (for example, there is no predefined exposure scheme but the user has to built its model in links with the diagram source-media-exposure route of the case study) and transparency	General substances	Multiple environmental media	General population & ecological organisms	Delivered in the framework of a 2-days training period to learn how to use the software
Germany	Stoffenmanager (version 8.3)	Stoffenmanager (Dutch for "substance manager") is a web-tool that is free to use following registration. Besides the free version, it also has a commercial Premium version. Stoffenmanager includes a quantitative model for estimating inhalation exposure to vapours, aerosols of low volatility liquids and inhalable dusts. Stoffenmanager is a continuous development platform.	General substances	Other (non-environmental media)	Workers	https://stoffenmanager.com/
Germany	EMKG-Expo-Tool 2.0	The EMKG-Expo-Tool 2.0 is a first tier IT-tool to estimate the inhalation exposure at the workplace to fulfil the obligations arising from REACH. The tool uses a control banding approach, based on the "Easy-to-use workplace control scheme for hazardous substances (EMKG)". Requiring only three input parameters, the tool's simple structure enables the user to distinguish quickly between critical and non-critical workplace situations. The tool offers a simplified approach to evaluate worker exposure and identify RMMs requiring a small number of input parameters. Thus the tool is easy to use and still allows quantitative exposure estimations.	General substances	Other (non-environmental media)	Workers	https://www.baua.de/media/BAuAInternet/download/EMKG-Expo-Tool-Windows.zip
Germany	The Advanced Reach Tool (ART) (version 1.5)	The Advanced REACH Tool, ART (version 1.5) makes use of mechanistically modelled estimates of exposure and any relevant measurements of exposure. The tool provides estimates of the whole distribution of exposure variability and uncertainty, allowing the user to produce a variety of reasonably foreseeable realistic and worst-case exposure estimates, dependent upon the requirements of the particular risk assessment.	Pesticides (including general substances)	Other (non-environmental media)	Workers	https://www.advancedreachtool.com/

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Germany	RISKOFDERM	RISKOFDERM is a MS Excel based tool which can be easly used for estimations of dermal exposure. This tool was developed within the RISKOFDERM-project (EU fifth Framework Program, project QLK4CT-1999-01107) and based on a variety of data from exposure measurements. It is addressed to expert use of mid and small companies. The tool provides different exposure scenarios and asks the user for relevant parameters (e.g ventilation rate and/or frequency of skin contact).	Pesticides (only Biocides)	Other (non-environmental media)	Workers	www.tno.nl
Germany	ConsExpo	With the mathematical model ConsExpo the users has the opportunity to calculate the exposure to hazardous compounds. Therefore the users have to chose the suitable scenario and fill in the exposure prarameters (e.g. application duration and/or body weight) in the ConsExpo Web tool. The model can calculate the inhalation, oral and dermal exposure. Beside a higher tier model for exposure estimation the programm can be also used for screening assesments.	Pesticides (only Biocides)	Other (non-environmental media)	Workers	www.consexpoweb.nl
Germany	Professional-Users Generic Simple Database Models (TNsG 2002 & 2007) – Recommended Models for Primary (direct) Exposure	These database models are included in Chapter 10 of the "Biocides Human Health Exposure Methodology" Document and provide information on exposure levels used for the assessment of biocidal products under the European Biocidal Products Regulation. For different exposure scenarios, datasets based on measured exposure levels are provided. These datasests usually consist of various percentiles derived from exposure levels measured for hand, body, or inhalation exposure and are in most cases related to a single input parameter such as application duration or number of application cycles. This information is summarised in individual tables for each model.	Pesticides (only Biocides)	Other (non-environmental media)	Workers	www.echa.europa.eu
Germany	ECETOC-TRA (ECETOC's Targeted Risk Assessment tool), version 3.1 (ONLY the tool for workers / occupational exposure tool is considered here!)	The tool integrates three models for calculating exposures and risks from chemicals to workers, consumers and the environment. In the context of exposure assessments for regulatory purposes under REACH only the worker model is used by the German Federal Institute for Occupational Safety and Health. The ECETOC's TRA worker tool is considered a tier 1 model under REACH, i.e. the tools aims to be simple and easy to use by a range of assessors and to provide conservative estimates of exposure.	General substances	Other (non-environmental media)	Workers	https://www.ecetoc.org/tools/targeted-risk-assessment-tra
Germany	MEASE (The Metals' EASE)	The MEASE tool is a first Tier exposure assessment tool developed for the derivation of inhalation and dermal occupational exposure estimates to metals and their inorganic compounds under REACH. MEASE combines the approaches from the ECETOC TRA tool, the EASE expert system and the health risk assessment guidance for metals (HERAG project).	General substances (only Metals and inorganic	Other (non-environmental media)	Workers	EASE version 1.02.01: https://www.ebrc.de/industrial-chemicals-reach/projects-and-references/mease.php

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		MEASE version 1.02.01 is an Excel-based tool contained in a single worksheet in which all necessary information can be entered and the results are presented, whereas MEASE version 2.00.00 is a java based application, consisting of an improved and extended model and a sophisticated user interface.	substances)			MEASE version 2.00.00: https://www.ebrc.de/tools/downloads.php
Germany	VFSMOD	VFSMOD is a computer simulation model created to study hydrology, sediment and pollutant transport through vegetative filter strips (VFS) used as a runoff pollution mitigation practise. The model can be used as a stand alone for environmental management to design and evaluate existing VFS, or within pesticide higher-tier regulatory environmental exposure assessment framworks.	Pesticides	Soil & water	Ecological organisms	https://abe.ufl.edu/faculty/carpena/vfsmod/
Germany	AppDate	AppDate calculates consistent application dates which can be used in further FOCUS modelling as input parameters Currently, a couple of FOCUS models (e.g., PEARL, PELMO, MACRO, PRZM, and TOXSWA) are used in European pesticide registration to assess predicted environmental concentrations (PEC) in ground and surface water. AppDate is officially used to support the input of these models.	Pesticides (including general substances)	Soil & water	General population & ecological organisms	https://www.ime.fraunhofer.de/en/Research_Divisions/business_fields_AE_BR/Businessareas_AE/Software_E/Appdate.html
Germany	STEPS1-2 in FOCUS	STEPS1-2 in FOCUS is a stand-alone Surface water Tool for Exposure Predictions -Steps 1 & 2 for the derivation of PEC values in water and sediment based upon the chosen scenario. The tool requires a minimum of input values (molecular weight, water solubility, DT50soil, Koc, DT50sediment/water, number of applications, application interval and application rate) and is designed to evaluate both active substances and metabolites.	Pesticides	Water	Ecological organisms	https://www.ime.fraunhofer.de/en/Media_Center/Calculation_models.html
Germany	German scenario for inland water marinas - Development of a realistic worst-case scenario for antifouling biocides in German inland water marinas	An environmental exposure scenario for antifouling products in German inland water marinas is provided. The scenario development and iits data base is described in a report available under the below mentioned website. An Excel tool is also provided on the website, which can be used to apply the scenario for all antifouling active substances approved in the EU. The underlying substance distribution modeling is based on the software MAMPEC (Marine Antifoulant Model to Predict Environmental Concentration (see below).	Pesticides (only Biocides)	Water	Ecological organisms	https://www.umweltbundesamt.de/themen/chemikalien/biozide/biozidprodukte/antifouling-mittel/umweltrisikobewertung-von-antifouling-produkten-in
Germany	BfR calculator for estimating the external exposure of livestock to biocidal active substances	The calculator is provided as an Excel file and as a web application and is a tool to facilitate the estimation of external livestock exposure to biocidal active substances (a.s.) as described in the ECHA Guidance on the Biocidal Products Regulation (Version 4.0, 2017). In addition, it allows estimation of the worst-case consumer exposure (WCCE) resulting from the calculated	Pesticides (only Biocides)	Other (non-environmental media)	General population	https://www.bfr.bund.de/en/exposure_estimation_for_biocides-239939.html

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		external livestock exposure and consumption of animal commodities as explained in the EMA-CVMP Guideline on risk characterisation and assessment of maximum residue limits (MRL) for biocides (EMA/CVMP/90250/2010).				
Italy	PERSAM (Persistence in soil analytical model)	The PERSAM software tool was developed for predicting environmental concentrations of pesticides and their transformation products in top soil.	Pesticides	Soil	Other	JRC/ESDAC website. https://esdac.jrc.ec.europa.eu/content/european-food-safety-authority-efsa-data-persam-software-tool
Italy	Guidance on the Assessment of Exposure for Operators, Workers, Residents and Bystanders in Risk Assessment for Plant Protection Products	Pesticide exposure assessement for operator,workers, bystanders,residents	Pesticides	Air (target of this model is not only air. See definition of categories and original responses)	Workers	www.efsa.europa.eu/efsajournal
Japan	AIST-ADMER (Atmospheric Dispersion Model for Exposure and Risk Assessment)	Estimate the atmospheric concentration distribution of directly emitted substances in Japan	General substances	Air	General population	https://admer.aist-riss.jp/
Japan	ADMER-PRO (Atmospheric Dispersion Model for Exposure and Risk Assessment-PRO)	Estimate the atmospheric concentration distribution of chemical substances including secondary products over Japan	General substances	Air	General population	https://admer-pro.aist-riss.jp/
Japan	AIST-CBAM (Chemical Bioaccumulation Model)	Model for estimating the concentration and accumulation of chemical substances and heavy metals that fish take into their bodies through the food chain in Tokyo Bay.	General substances	Water	Ecological organisms	https://cbam.aist-riss.jp/
Japan	G-CIEMS	G-CIEMS is the multimedia model of detailed geographical resolution for multimedia approach based on gridded air and catchment-river segment structure on surface soil and river/lake and sediment media. The model can be used to estimated exposure distribution in combination of some data manipulation tools on the website.	General substances	Multiple environmental media	General population & ecological organisms	https://www.nies.go.jp/rcer_expoass/gciems/gciems.html (Japanese only)

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Japan	AIST-ICET (Indoor Consumer Exposure Assessment Tool)	ICET is a tool for assessing human inhalation, dermal and oral exposure of chemicals contained in indoor products.	General substances	Air	General population	https://icet.aist-riss.jp/
Japan	METI-LIS(Ministry of Economy, Trade and Industry-Low rise Industrial Source dispersion Model)	This model was developed for a better simulation of downdraft effect accompanying low emission sources. The model puts special importance to expressing the effect of downdraft when building data around the sources are given, while it gives solutions of simple Gaussian plume and puff formula for elevated sources. Basic concept of formulation follows that of the ISC model(US-EPA), with improved parameterization after new experiments.	General substances	Air	Workers	https://www.jemai.or.jp/tech/meti-lis/download.html https://www.jemai.or.jp/tech/meti-lis/analysis.html https://en.aist-riss.jp/softwares/2671/
Japan	PACSs Risk Assessment System (We call PRAS-NITE) (PACSs : Priority Assessment Chemical Substances)	PRAS-NITE has been developed in accordance with the technical guidance for risk assessment of priority assessment chemical substances under Chemical substances control law (We call CSCL) to conduct detailed risk assessments on chemicals in the stage of tier-Ⅰ and Ⅱ of phase-1. The model estimates the environmental emission of the substance, the environmental concentration of that, the amount of exposure by each environmental compartment, and the risk to human health and ecology. Working PRAS-NITE requires the information under CSCL, such as the quantities of manufacture and/or import, as well as shipment by each usage and prefectures. The information of emission factors as well as physicochemical properties and hazard assessment values of PACSs(long-term toxicity) has already been entered in the model. By using these information as described above, we can get the number of emission sources which might have unreasonable risk out of the total number of nationwide emission sources based on information on CSCL and PRTR. This model can also be used for voluntary management of chemical substances by businesses, risk communication with government and citizens, and information dissemination to public.	General substances	Air (target of this model is not only air. See definition of categories and original responses)	General population & ecological organisms	https://www.nite.go.jp/chem/risk/pras-nite.html
Japan	AIST-RAMTB (Ecological Risk Assessment Model for Tokyo Bay)	Model for esimating the concentration of chemical substances to evaluate the ecological risk in Tokyo Bay.	General substances	Water	Ecological organisms	https://ramtb.aist-riss.jp/
Japan	AIST-SHANEL (Standardized Hydrology-based AssessmeNt tool for	Model for estimating the spatial distribution and temporal changes of chemical concentrations in river water and sediment in Japan.	General substances	Water	Ecological organisms	https://shanel.aist-riss.jp/

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
	chemical Exposure Load)					
Korea	K-CHESAR(Korea CHEmical Safety Assessment and Reporting tool)	K-CHESAR is developed based on K-REACH Act to support reporting data (e.g. report on risk of chemicals) when applying for chemical registration. Two exposure models are included in K-CHESAR; 1.ECETOC TRA(consumer and occupational exposure), 2. Simple Box Korea(Environment exposure). With the two models, exposure assessment for human and the environment can be simultaneously conducted based on imported data. Moreover, K-CHESAR can derive reference dose(e.g. DNEL, PNEL) based on imported toxicity information. With exposure and reference dose, risk can be determined.	General substances	Multiple environmental media	General population & ecological organisms	http://kchesar.kcma.or.kr/main/main.asp
Netherlands	ConsExpo Web	Consumer exposure model	General substances	Other (non-environmental media)	Workers	www.consexpoweb.nl
Netherlands	Stoffenmanager®	Stoffenmanager® helps organisations to comply with the regulatory and broader ethical and sustainability requirements. Stoffenmanager® is an online system to identify the chemical hazards, control the exposure at workplaces and communicate in an understandable, transparent manner to managers, employees and external stakeholders.	General substances	Other (non-environmental media)	Workers	www.stoffenmanager.com
Netherlands	Lee side turbulence model	Model to assess the risk of residents living nearby greenhouses due to the emission of pesticides out of the greenhouse	Pesticides	Other (non-environmental media)	Other	https://www.ctgb.nl/documenten/rekenmodellen/2016/10/28/resident-lee-side-turbulence-model
Netherlands	NL model mixing & loading	Model to predict the exposure of an operator during mixing & loading activities.	Pesticides	Other (non-environmental media)	Other	https://www.ctgb.nl/documenten/rekenmodellen/2016/10/28/operator-nl-model-mixing--loading
Netherlands	Animal model 2017	Animal dietary burden calculator Calculations of Dietary burden of pesticide resitues for livestock and calculation of MRLs and risk assessment values for animal commodities listed in Annex I of Regulation (EC) No 396/2005.	Pesticides	Other (non-environmental media)	Other	https://ec.europa.eu/food/plants/pesticides/maximum-residue-levels/guidelines-maximum-residue-levels_en
Netherlands	PRIMo ver. 2.0	Pesticide Residue Intake Model- EFSA PRIMo revision 2.0. The EFSA PRIMo (Pesticide Residue Intake Model) is an Excel-based calculation spreadsheet. The calculation model was initially developed by EFSA for the risk assessment of temporary MRLs. It was the standard tool used at EU level for applications before 1 February 2018 to perform the dietary	Pesticides	Other (non-environmental media)	General population	https://www.efsa.europa.eu/en/applications/pesticides/tools

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		risk assessment for pesticide residues in the framework of setting and reviewing of maximum residue levels for pesticides under Regulation (EC) No 396/2005 and in the peer review of pesticides under Regulation (EU) No 1107/2009. PRIMo ver. 2.0 is replaced by PRIMo ver. 3.1, however in certain exceptional situations PRIMo ver. 2.0 may still be used at national level to perform consumer risk assessments in the framework of authorisation op plant protection products.				
Netherlands	PRIMo rev. 3.1	Pesticide Residue Intake Model- EFSA PRIMo revision 3. The EFSA PRIMo (Pesticide Residue Intake Model) is an Excel-based calculation spreadsheet, is the standard tool used at EU level to perform the dietary risk assessment for pesticide residues in the framework of setting and reviewing of maximum residue levels for pesticides under Regulation (EC) No 396/2005 and in the peer review of pesticides under Regulation (EU) No 1107/2009. It is also used at national level to perform consumer risk assessments in the framework of authorisation op plant protection products.	Pesticides	Other (non-environmental media)	General population	https://www.efsa.europa.eu/de/applications/pesticides/tools https://www.efsa.europa.eu/en/efsajournal/pub/5147 https://www.efsa.europa.eu/en/supporting/pub/en-1605
Netherlands	WUR Drift Calculator	Software tool to compute ground deposits of spray drift downwind from a treated arable field, fruit orchard or avenue tree nursery. Deposits onto adjacent surface water is covered as well.	Pesticides (including general substances)	Soil & water	Ecological organisms	https://www.wur.nl/en/Research-Results/Research-Institutes/plant-research/show-wpr/WUR-Drift-Calculator.htm
Netherlands	xSPEXUS Drift Model	Software tool to compute deposits of spray drift onto surface waters downwind from a treated fruit orchard or avenue tree nursery. It includes spray drift from herbicide treatments underneath fruit and avenue trees. The model offers a probabilistic approach and takes into account environmental conditions (e.g. wind speed, wind direction), the spray application dates, and mitigation techniques. 1 through 15 spray applications per year are taken account of; temporal aspects (many consecutive years) are considered as well. xSPEXUS is closely linked to the TOXSWA fate model in the DRAINBOW shell software	Pesticides (including general substances)	Water	Ecological organisms	
Netherlands	IDEFICS Spray Drift Model	The model computes deposits of spray drift onto downwind ground area as a function of distance from the field edge; for arable crops. It also computes emission of sprays into the air. The model is deterministic and based on physics of transport of droplets and particles through air. It takes into account different spray nozzles, sprayer boom height and driving speed, crop height, meteorological conditions (including stochastic turbulence of air)	Pesticides (including general substances)	Multiple environmental media	General population & ecological organisms	

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Netherlands	GeoPEARL	GeoPEARL is a spatially-distributed model, calculating the leaching potential of a substance for the area of potential use. The basis of the GeoPEARL model is the PEARL model, which is a one-dimensional, dynamic, multilayer model of the fate of a pesticide and relevant transformation products in the soil-plant system. The model is linked with the Soil Water Atmosphere Plant (SWAP) model. The spatial schematisation for GeoPEARL is based an a combination of map layers of the geometry of the subsoil ('hydrotypes'), drainage characteristics, seepage fluxes, groundwater depth classes, land use type, climate district, soil physical types and soil profiles.	Pesticides	Other (non-environmental media)	Other	https://www.pesticidemodels.eu/pearl/home
Netherlands	PEARL	PEARL is an acronym of Pesticide Emission Assessment at Regional and Local scales. PEARL is a one-dimensional, dynamic, multi-layer model, which describes the fate of a pesticide and relevant transformation products in the soil-plant system. The most important processes included in PEARL are pesticide application and deposition, convective and dispersive transport in the liquid phase, diffusion through the gas and liquid phase, equilibrium sorption, non-equilibrium sorption, first-order transformation, uptake of pesticides by plant roots, lateral discharge of pesticide with drainage water, and volatilization of pesticide from soil and plant surfaces.	Pesticides	Soil	Ecological organisms	https://www.pesticidemodels.eu/pearl/home
Netherlands	DROPLET (acronym for 'DRinkwater uit OPpervlaktewater-Landbouwkundig gebruik Evaluatie Tool')	The DROPLET model is a one-dimensional model that calculates the concentrations in the 9 abstraction points for drinking water production from surface water in the Netherlands, based upon the peak concentration in the EU-FOCUS D3 ditch scenario (with spray drift deposition according to Dutch numbers) calculated by the Dutch TOXSWA model. It takes difference in application timing in the intake area, dissipation during travel time and dilution into account as well as the cropped area in the intake area onto which the pesticide may be applied.	Pesticides	Water	General population	https://www.pesticidemodels.eu/droplet
Netherlands	TOXSWA	TOXSWA is a pseudo-2-dimensional model, describing pesticide behaviour in a water layer and its underlying sediment at the edge-of-field scale. TOXSWA calculates Predicted Environmental Concentrations in surface water. TOXSWA can predict concentrations of pesticides that may enter the water by spray drift, atmospheric deposition, surface runoff, drainage or leaching through the soil. The model considers the processes of transport, transformation, sorption and volatilisation of pesticides. The water layer contains suspended solids and aquatic macrophytes. The sediment layer is characterised by porosity, organic matter content and bulk density, that vary with depth.	Pesticides	Water	Ecological organisms	https://www.pesticidemodels.eu/toxswa

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
Netherlands	GEM	GEM is the acronym for Glasshouse Emission Model. GEM calculates exposure concentrations of Plant Protection Products (PPP) in surface water and leaching to groundwater as part of the environmental risk assessment. The PPP is applied in greenhouses on soil bound and soilless cultivated crops	Pesticides	Soil & water	Other	https://www.pesticidemodels.eu/gem/home
New Zealand	Risk Assessment for Birds and Mammals (EFSA 2009)	Dose exposure model, the dose that a bird receives is referred to as the Daily Dietary Dose, or DDD, and is calculated from the application rate and a so-called 'shortcut value' for the residue per unit dose (RUD), reflecting the concentration of the active ingredient on the bird's food and the quantity of food consumed. Quantities consumed are based on a bird's energy requirements, its energy assimilation and the energy content of its food (by dry weight). Birds' energy requirements are based on an algorithm based on body weight and bird type (for example, passerine or non-passerine). European species are used as a surrogate for NZ species.	Pesticides	Other (non-environmental media)	Ecological organisms	EFSA guidance document: https://www.efsa.europa.eu/en/efsajournal/pub/1438 NZ Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx
New Zealand	An amended version of the bystander elements of the EFSA operator, worker, resident and bystander exposure model (EFSA, 2014a) is used, incorporating exposure the US EPA approach to soil ingestion (US EPA, 1997) to supplement the dermal exposure and hand- and object-to-mouth activity of the EFSA approach	Model to determine exposure level of bystanders near agricultural fields where pesticides are sprayed	Pesticides	Soil	General population	https://www.efsa.europa.eu/en/efsajournal/pub/1438 NZ Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
New Zealand	The ConsExpo 4.1 (National Institute for Public Health and the Environment, 2016a, 2016b) model is used for assessing products intended for use within the home. It can be used for bystanders as well as users with minor parameter value modifications	Model to determine exposure level of users/bystanders for application of non-agricultural pesticides	Pesticides	Other (non-environmental media)	Workers	https://www.efsa.europa.eu/en/efsajournal/pub/1438 https://www.rivm.nl/en/consexpo NZ Risk assessment document: Request for feedback on our risk assessment guide | EPA https://www.epa.govt.nz/public-consultations/decided/request-for-feedback-on-our-risk-assessment-guide/
New Zealand	GENEEC2	See link below GENEEC2 Description | Pesticide Science and Assessing Pesticide Risks | US EPA https://archive.epa.gov/epa/pesticide-science-and-assessing-pesticide-risks/geneec2-description.html	Pesticides	Water	Ecological organisms	GENEEC2 Description | Pesticide Science and Assessing Pesticide Risks | US EPA https://archive.epa.gov/epa/pesticide-science-and-assessing-pesticide-risks/geneec2-description.html
New Zealand	OECD's RexTox model (adapted model)	The US EPA Screening Concentration in Ground Water (Sci-Grow) model is used to estimate pesticide concentrations in groundwater.	Pesticides	Soil	Other	Model Description: https://archive.epa.gov/epa/pesticide-science-and-assessing-pesticide-risks/sci-grow-description.html Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
New Zealand	ESCORT 2	The ESCORT 2 methodology is used to calculate in-field and off-field exposure of non-target arthropods. Calculations are relatively simple incorporating , application rate, multiplication factor, drift factor (BBA curves (Ganzelmeier et al., 1995, Rautmann et al., 2001), vegetation distribution factor and correction factor.	Pesticides	Other (non-environmental media)	Ecological organisms	Not available
New Zealand	UK Chemicals Regulation Directorate (CRD) version of the German Federal Biological Research Centre for Agriculture and Forestry's (Biologische Bundesanstalt für Land- und Forstwirtschaft, BBA) operator assessment model is used. This is often referred to as the 'BBA CRD version'	Model to determine exposure level of operators for commercial agricultural pesticides with different levels of Personal Protective Equipment (PPE)	Pesticides	Other (non-environmental media)	Workers	https://www.efsa.europa.eu/en/efsajournal/pub/1438 NZ Risk assessment document: Request for feedback on our risk assessment guide | EPA https://www.epa.govt.nz/public-consultations/decided/request-for-feedback-on-our-risk-assessment-guide/
New Zealand	Plant exposure spreadsheet	Simple model to calculate short term exposure of plants from spraydrift, generally using the most sensitive plants. The spray curve data from the BBA (Ganzelmeier et al., 1995, Rautmann et al., 2001) are used in this model to predict off field spray-drift and calculate recommended downwind buffer zones. Ganzelmeier H. D., Rautmann R., Spangenberg M., Streloke M., Herrmann H.-J., Wenzelburger and H.-F. Walter, 1995, Studies on the spray drift of plant protection products. Heft 305, Blackwell Wissenschafts-Verlag GmbH, Berlin: 111 pp Rautmann D., Streloke M. and R. Winkler, 2001, New basic drift values in the authorization procedure for plant protection products. Mitt. Biol. Bundesanst. Land- Forstwirtsch. 383:133-141	Pesticides	Other (non-environmental media)	Ecological organisms	NZ Risk assessment document: Request for feedback on our risk assessment guide | EPA https://www.epa.govt.nz/public-consultations/decided/request-for-feedback-on-our-risk-assessment-guide/
New Zealand	BeeRex (v1 2015)	The US EPA bee risk assessment is a tiered risk assessment to evaluate the potential effects of pesticides on bees, in particular honey bees. At Tier 1, there are a number of different equations taking into account the different exposure routes above and the different classes and ages of bees within the hive. This tier is a screening step and so is conservative. The US EPA bee	Pesticides	Other (non-environmental media)	Ecological organisms	US EPA: https://www.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		approach starts with the worst-case scenario of products being sprayed directly on to flowers and the risk assessment is refined if needed				
New Zealand	OECD's RexTox model (adapted model)	The adapted sub-model of the OECD's RexTox model, proposed and validated by Probst et al. (2005), is used to calculate the buffer zone that would reduce exposure through runoff to such a concentration that the resulting risk quotient is acceptable. Some calculations have been slightly modified. Model can be refined using crop and region specific slopes.	Pesticides	Water	Ecological organisms	Equations: Risk assessment methodology: risk assessment methodology https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx
New Zealand	ECHA sediment	The concentration in freshly deposited sediment is taken as the PEC for sediment, therefore, the properties of suspended matter are used. The concentration in bulk sediment can be derived from the corresponding water body concentration, assuming a thermodynamic partitioning equilibrium between water and suspended matter. PEClocal for sediment can be compared to the PNEC for sediment dwelling organisms. (ECHA 2016) Note: this is a discharge model and actually not designed for the purpose of pesticide evaluation	Pesticides	Water	Ecological organisms	ECHA (2016): https://echa.europa.eu/documents/10162/13632/information_requirements_r16_en.pdf/b9f0f406-ff5f-4315-908e-e5f83115d6af Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx
New Zealand	PEC soil (Focus 1997 based)	Simple model to calculate short and long term exposure of soil organisms, generally using earthworms as a proxy for all soil organisms. The spray curve data from the BBA (Ganzelmeier et al., 1995, Rautmann et al., 2001) are used in this model to predict off field spray-drift. Ganzelmeier H. D., Rautmann R., Spangenberg M., Streloke M., Herrmann H.-J., Wenzelburger and H.-F. Walter, 1995, Studies on the spray drift of plant	Pesticides	Soil	Ecological organisms	Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		protection products. Heft 305, Blackwell Wissenschafts-Verlag GmbH, Berlin: 111 pp Rautmann D., Streloke M. and R. Winkler, 2001, New basic drift values in the authorization procedure for plant protection products. Mitt. Biol. Bundesanst. Land- Forstwirtsch. 383:133-141				Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx FOCUS 1997: https://ec.europa.eu/food/system/files/2016-10/pesticides_ppp_app-proc_guide_fate_soil-persistance-1997.pdf
New Zealand	AgDRIFT and AgDisp (NZ Modification)	Model to calculate exposure concentrations in surface waters via spraydrift exposure using spraydrift curves and environmental fate (degradation, partitioning to suspended solids and sediment). The APVMA modified the AgDRIFT curves (APVMA 2010) to create different use scenarios that were more applicable to Australian environment, these were considered appropriate for the NZ environment as well. For determination of aerial curves the AgDISP model is used.	Pesticides	Water	Ecological organisms	APVMA curves: most curves superseded by BBA curves` AGDISP: Models for Pesticide Risk Assessment | US EPA https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDisp Risk assessment methodology: risk assessment methodology https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx
New Zealand	The European Predictive Operator Exposure Model database (EUROPOEM) approach developed by	Model to determine exposure level of workers performing standard tasks in agricultural fields	Pesticides	Other (non-environmental media)	Workers	https://www.efsa.europa.eu/en/efsajournal/pub/1438 NZ Risk assessment document: Request for feedback on our risk assessment guide | EPA

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
	other international regulators (EUROPOEM, 2002; Chemicals Regulation Directorate, 2016b) is used					https://www.epa.govt.nz/public-consultations/decided/request-for-feedback-on-our-risk-assessment-guide/
Slovak Republic	EFSA Pesticide Residue Intake Model (EFSA PRIMo revision 3.1)	The model was developed to calculate simultaneously the short-term and long-term dietary exposure to pesticide residues in food according to internationally agreed methodologies. The exposure is compared to the toxicological reference values (i.e. the ADI and the ARfD). If the exposure is below the toxicological reference values, it is concluded that the consumer exposure is not leading to an unacceptable risk. If the exposure exceeds the toxicological reference values, the risk assessor should check if the exposure calculations can be refined. If this is not the case, the conclusion of the risk assessment is that for the residue levels in food assessed in the risk assessment scenario a potential consumer health concern cannot be excluded.	Pesticides	Other (non-environmental media)	General population	https://www.efsa.europa.eu/de/applications/pesticides/tools https://www.efsa.europa.eu/en/efsajournal/pub/5147 https://www.efsa.europa.eu/en/supporting/pub/en-1605
Slovak Republic	Aminal model 2017 (Livestock dietary burden calculation)	Animal model calculates the maximum and median intake (dietary burden) (in milligrams per kilogram bodyweight per day and milligrams per kilogram dry matter) for the following production species; beef cattle, dairy cattle, breeding sheep, meat producing sheep, breeding pigs, finishing pigs, broiler chickens, laying chickens and turkeys. Based on this calculation and considering the results of the livestock feeding studies, the calculator also derives the highest residue levels (in milligrams per kilogram) in the relevant tissues and products (muscle, fat, liver, kidney, milk and eggs). These values are estimated using three approaches transfer factors, interpolation and linear regression as described in OECD, 2013 and allow the user to derive the maximum residue level (MRL) for each commodity of animal origin.	Pesticides	Other (non-environmental media)	General population	https://ec.europa.eu/food/plants/pesticides/maximum-residue-levels/guidelines-maximum-residue-levels_en#technical-guidance
Sweden	MACRO	A dual-permeability model of variably-saturated water flow and reactive solute transport in structured soils. Bespoke versions of the model have been developed for use in the context of pesticide regulation	Pesticides	Soil & water	Other	https://www.slu.se/en/Collaborative-Centres-and-Projects/SLU-centre-for-pesticides-in-the-environment/
Switzerland	COMLEAM (Construction Materials Leaching Model)	The leaching behaviour of substances from construction products and buildings influence their occurrence in soil, groundwater and surface waters. The physical and chemical processes underlying mass transfer to the material surface are dynamic and multidimensional. In order to assess the leaching of substances and the associated environmental risk, the simulation model	Pesticides (including general substances)	Soil & water	Ecological organisms	https://www.comleam.com/en

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		COMLEAM can be used. COMLEAM is a software that calculates the transport path from the building to the environment.				
UK	Contaminated Land Exposure Assessment (CLEA) model	A model used to estimate human exposure to chemical soil contamination that takes into account ten direct and indirect exposure pathways via oral, dermal, and inhalation routes. Exposure is estimated using default assumptions according to a number of generic land-use scenarios including residential, allotments, public open space, and commercial. Exposure is compared with health criteria values such as tolerable daily intakes to provide a conservative screening level assessment of risk. The model is often used in backwards mode (that is, working from an exposure level equal to the health criteria value back to a soil concentration) to derive soil guidelines that are used to identify and screen-out low risk sites. The model and its outputs are also used to inform more detailed tiers of risk assessment, for example, identifying the key pathways of concern for further investigation.	General substances	Soil	Workers	Model and handbook https://www.gov.uk/government/publications/contaminated-land-exposure-assessment-clea-tool Technical basis https://www.gov.uk/government/publications/updated-technical-background-to-the-clea-model
US	Agricultural Drift (AgDRIFT)	AgDRIFT (version 2.1.1), a modified version of the AGricultural DISPersal (AGDISP) model developed by the US Forest Service, was created under a Cooperative Research and Development Agreement between the EPA, the US Department of Agriculture's Forest Service, and the Spray Drift Task Force. The AgDRIFT model has the capability to assess a variety of spray drift conditions from agricultural applications and off-site deposition of liquid formulation of pesticides. This model can be used in estimating downwind deposition of spray drift from aerial, ground boom and orchard/vineyard airblast applications.	Pesticides	Soil & water	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDrift
US	Agricultural Dispersal (AGDISP)	AGDISP (version 8.26) is a "first-principles" science-based model that predicts spray drift from application sites. The model was developed by the USDA Forest Service. AGDISP was designed to optimize agricultural spraying operations and has detailed algorithms for characterizing the release, dispersion, and deposition over and downwind of the application area. This model can be used in estimating downwind deposition of spray drift from aerial and ground boom applications. In addition, it can be used in estimating downwind deposition of spray drift from forestry and adulticide/mosquitocide applications. While more recent versions of the model are available, U.S. EPA currently has evaluated and uses version 8.26.	Pesticides	Multiple environmental media	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDisp
US	Pesticide in Flooded Applications Model	Calculates aquatic concentrations for pesticide application to rice and other aquatic agriculture uses.	Pesticides	Water	General population &	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
					ecological organisms	
US	Pesticide Water Calculator	Calculates pesticide concentrations in surface water and groundwater after application to an agricultural field	Pesticides	Soil & water	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment
US	Tier 1 Rice Model	Calculates aquatic concentrations for pesticide application to rice and other aquatic agriculture uses.	Pesticides	Water	General population & ecological organisms	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment
US	Probabilistic Exposure and Risk Model of Fumigants (PERFUM)	The Probabilistic Exposure and Risk Model for FUMigants (PERFUM) was developed at Exponent to address the issue of bystander exposures to fumigants following agricultural applications. Following application of fumigants, some of the applied material may volatilize from the field and be carried downwind, causing potential exposure to persons in the vicinity of the application. The model was developed to address the regulatory need to establish buffer zones for some fumigants. The purpose of a buffer zone is to define a distance from the edge of the field where the concentration of the fumigant is at or below a level assumed to be safe. Over time, the model has been used to estimate bystander and terrestrial animal and plant exposure for building fumigations and for agricultural applications of semi-volatile pesticides. The model uses the established algorithms in the Industrial Source Complex, Short Term (ISCST3), the American Meteorological Society/EPA Regulatory Model (AERMOD), and CALPUFF models to estimate air concentrations surrounding a treated facility or field.	Pesticides	Air	General population & ecological organisms	https://www.exponent.com/
US	DEEM	DEEM is a dietary (food + water) exposure model.	Pesticides (including general substances)	Soil & water	General population	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/deem-fcidcalendex-software-installer
US EPA	American Meteorological Society/Environmental Protection Agency	AERMOD is a steady-state Gaussian plume dispersion model that incorporates air dispersion based on plantary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources and both simple and complex terrain. The AERMOD	General substances	Air	General population	https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
	Regulatory Model (AERMOD)	modeling system is comprised of several modeling routines that work together to estimate time-average air concentrations and deposition rates around emission sources. AERMOD can incorporate a variety of emission source characteristics, chemical deposition properties, complex terrain, and site-specific hourly meteorology to estimate air concentrations and deposition amounts at user-specified receptor distances and at a variety of averaging times. AERMOD is EPA's regulatory air dispersion model for near-field (<50 km) modeling applications.				
US EPA	Consumer Exposure Model (CEM)	The Consumer Exposure Model (CEM) estimates indoor air and dust concentrations, dermal exposure, and mouthing exposure for a variety of consumer products and materials. Inhalation, ingestion, and dermal exposures are calculated as single day doses and chronic average daily doses.	General substances	Other (non-environmental media)	General population	https://www.epa.gov/tsca-screening-tools/approaches-estimate-consumer-exposure-under-tsca
US EPA	Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER)	The Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER) is a computer-based software program that can be used to estimate workplace exposures and environmental releases for chemicals manufactured, processed, and used in industrial/commercial settings.	General substances	Other (non-environmental media)	Workers	https://www.epa.gov/tsca-screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases
US EPA	Exposure and Fate Assessment Screening Tool (E-FAST)	This tool estimates general population, consumer, and ecological exposures from environmental releases for chemicals manufactured and used in industrial/commercial settings.	General substances	Multiple environmental media	Workers	https://www.epa.gov/tsca-screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014
US EPA	Indoor Environment Concentration in Buildings with Conditioned and Unconditioned Zones (IECCU)	IECCU is a simulation program which can be used as (1) a general-purpose indoor exposure model in buildings with multiple zones, multiple chemicals and multiple sources and sinks or (2) as a special purpose concentration model for simulating the effects of sources in unconditioned zones on the indoor environmental concentrations in conditioned zones.	General substances	Air	Workers	https://www.epa.gov/tsca-screening-tools/approaches-estimate-consumer-exposure-under-tsca
US EPA	Integrated Indoor-Outdoor Air Calculator (IIOAC)	IIOAC is a user-friendly Excel-tool based on EPA's AERMOD for use in assessing releases to air and exposure potential for new and existing chemicals.	General substances	Multiple environmental media	General population	https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator
US EPA	Multi- Chamber Concentration and Exposure Model (MCCEM) version 1.2 (via Internet	MCCEM estimates average and peak indoor air concentrations of chemicals released from products or materials in houses, apartments, townhouses, or other residences.	General substances	Other (non-environmental media)	General population	https://www.epa.gov/tsca-screening-tools/igemscsm-internet-geographical-exposure-modeling-systemchemical-safety-mapper

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
	Geographical Exposure Modeling System (IGEMS))					
US EPA	Point Source Calculator (PSC) v1.05	The Point Source Calculator (PSC) is a tool designed to estimate acute and chronic concentrations of chemicals directly applied to water bodies. Waterbodies may include flowing waters like streams and river segments and more static waters like lakes and ponds. Direct applications of chemical may be simulated in a flexible manner from simple to complex repetitive events or as completely unique daily events defined on a daily scale. The PSC is a graphical user interface which gathers the user's inputs and runs USEPA's Variable Volume Water Model (VVWM). Required inputs are the same as those for the VVWM, but the PSC graphical interface facilitates user interaction for the direct-application problem. Post processing of the PSC is also relevant to the direct-application problem and includes the ability to analyze concentrations in comparison to target concentrations of concern (CoC), including number of days above the CoC and number of consecutive days above the CoC.	Pesticides (including general substances)	Water	General population & ecological organisms	https://www.epa.gov/tsca-screening-tools/point-source-calculator-version-105-psc-v105
US EPA	EPA's Risk-Screening Environmental Indicators (RSEI) Model	EPA's Risk-Screening Environmental Indicators (RSEI) is a geographically-based, multi-media model that helps policy makers, researchers, and communities quickly analyze large amounts of data on toxic chemicals from Toxics Release Inventory (TRI) reporting facilties. RSEI incorporates information from EPA's TRI database, which tracks certain toxic chemical releases and waste management activities at federal facilities and larger industrial facilities across the United States. RSEI incorporates over 30 years of TRI chemical release data, three U.S. censuses, toxicity and physicochemical properties for more than 400 chemicals, and geographical information for more than 50,000 facilities and thousands of streams and other waterbodies. All of this information is used to model and map the environmental fate and transport of each toxic chemical release through the environment and the potential human exposure that may result. The RSEI model then calculates numeric results that are designed to be compared to other RSEI model generated results. These RSEI results are designed to help users contextualize, understand, and better communicate the relative hazard and potential for risks posed by certain waste management activities of TRI chemicals (e.g., from releases to the environment). RSEI results and custom analyses can be used for screening level activities such as trend analyses that compare potential	Pesticides (including general substances)	Air (target of this model is not only air. See definition of categories and original responses)	General population	https://www.epa.gov/rsei

Country/Organisation	Model name	General description	Target substances	Target medium	Target exposure receptors[3]	Website URL
		relative risks from year to year, or for prioritizing toxic chemicals, industry sectors, or geographic regions for strategic planning. RSEI can also be used in conjunction with other data sources and environmental information, to help policy makers, researchers, and communities establish priorities for further investigation and to look at changes in potential human health impacts over time.				
US EPA	Wall Paint Exposure Model (via Internet Geographical Exposure Modeling System (IGEMS))	The Wall Paints Exposure Assessment Model (WPEM) estimates the potential exposure of consumers and workers to the chemicals emitted from wall paint which is applied using a roller or a brush.	General substances	Air	Workers	https://www.epa.gov/tsca-screening-tools/wall-paint-exposure-assessment-model-wpem
US EPA	EPI Suite	The EPI (Estimation Programs Interface) Suite™ is a Windows®-based suite of physical/chemical property and environmental fate estimation programs developed by EPA's and Syracuse Research Corp. (SRC). EPI Suite™ uses a single input to run the following estimation programs: KOWWIN™, AOPWIN™, HENRYWIN™, MPBPWIN™, BIOWIN™, BioHCwin, KOCWIN™, WSKOWWIN™, WATERNT™, BCFBAF™, HYDROWIN™, KOAWIN and AEROWIN™, and the fate models WVOLWIN™, STPWIN™ and LEV3EPI™. ECOSAR™, which estimates ecotoxicity, is also included in EPI Suite™.	General substances	Other (non-environmental media)	Other	https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface

Annex C. Summary table of the model application examples in regulatory context

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Australia	Environmental Emission Scenarios for Product Type 14: Biocides used as rodenticides	Pesticides/ Pollutant emission/Land contamination/ Waste management/ Biocides/	Screening assessment/		National government/ Industry/			
Australia	AgDRIFT version 2.1.1	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/		National government/	
Australia	T-REX	Pesticides/	Screening assessment/		National government/		National government/	
Australia	EPISUITE v4.11	Industrial chemicals/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Accepted in silico method in the Industrial Chemicals categorisation Guidelines (link: https://www.industrialchemicals.gov.au/sites/default/files/2020-	National government/		National government/ WITH National citizens/	Regularly informs the publicly available chemical risk evaluations performed by AICIS

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				06/Industrial%20Chemicals%20Categorisation%20Guidelines%20%5BWord%20169%20KB%5D.DOCX)				
Australia	AgDISP version 8.26	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/		National government/	
Australia	Beerex	Pesticides/	Screening assessment/		National government/		National government/	
Australia	ConsExpo	Industrial chemicals/ Consumer product/	Higher tier assessment/ Assessment for substance registration by manu/impo/	Estimating exposure of chemicals to consumers	National government/	The model can be used to estimate exposure of chemicals in cosmetic to consumers such as the example in the link below. https://www.industrialchemicals.gov.au/sites/default/files/2-Pyrrolidinone%2C%201-methyl-_%20Human%20health%20tier%20III%20assessment.pdf	National government/ WITH National citizens/ Consumers/	
Australia	SimpleTreat v3.0	Industrial chemicals/	Screening assessment/ Higher tier assessment/ Assessment for substance		National government/		National government/ WITH National citizens/	Regularly informs the publicly available chemical risk evaluations performed by AICIS

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
			registration by manu/impo/					
Bayer	Bayer Safety Standard for Operator Safety	Pesticides/		Used for Bayer-internal risk assessments	Industry/	Internal decision on safety of plant protection product for countries with no or limited regulatory environment		Only internal, no communication of decision outside Bayer.
Canada	Consexpo	Consumer product/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/	Many screening assessments conducted under the Canadian Chemical Management Plan which contain an estimation of consumer product exposure are based on results from Consexpo	National government/	Although the detailed results are considered to be CBI, assessment summaries with masked results are available at the following website: https://www.canada.ca/en/environment-climate-change/services/managing-pollution/evaluating-new-substances/chemicals-polymers/risk-assessment-summaries.html
Canada	Consumer/Industrial Drinking water/PECaqua Models	Industrial chemicals/ Pharmaceuticals/ Personal Care Products/	Screening assessment/	New Substances Notification Regulations (Chemicals and Polymers. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-247/index.html	National government/	New Substances Notification Regulations (Chemicals and Polymers. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-247/index.html	National government/	Risk assessment summaries are published here https://www.canada.ca/en/environment-climate-change/services/managing-pollution/evaluating-new-

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
								substances/chemicals-polymers/risk-assessment-summaries.html
Canada	SCREEN3	Industrial chemicals/ Pollutant emission/	Screening assessment/		National government/ Industry/	Screening Assessment Natural Gas Condensates: https://www.ec.gc.ca/ese-ees/default.asp?lang=En&n=7933A3C7-1	National government/ WITH National citizens/	
Canada	ChemCAN	Industrial chemicals/ Pollutant emission/	Screening assessment/	Screening assessment - hexanoic acid, 2-ethyl-,calcium salt There were no Canadian environmental data for calcium 2-ethylhexanoate. Distribution of this substance to the environment (through air, water, soil) was estimated using ChemCAN based on quantities reported in Canadian commerce. The estimated environmental concentrations were used to calculate upper-bounding intake estimates for	National government/	Screening assessment - hexanoic acid, 2-ethyl-,calcium salt The estimated environmental concentrations were used to calculate upper-bounding intake estimates for the general population (all age groups). Intake estimates for all age groups were below 1 ng/kg/day, therefore, exposure to this substance from environmental media was considered negligible. No concern from environmental releases.	National government/	Screening Assessment – Phosphoric Acid Derivatives Group ChemCAN was used to estimate potential air and soil concentrations of trixylyl phosphate in Canada. The estimated concentrations were used to calculate daily intake estimates. After combining the environmental media estimates and comparing it to a critical effect level, the margin of exposure for environemtnal media was considered

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				the general population (for all age groups). [https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-hexanoic-acid-2-ethyl-calcium-salt.html]		[https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-hexanoic-acid-2-ethyl-calcium-salt.html]		adequate to address any uncertainties and the substance was concluded not to meet the criteria under 64(c) as it is not entering the environment in a quantity or concentration or under conditions that constitute or may consititute a danger in Canada to human life or health. [https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-phosphoric-acid-derivatives-group.html#toc16]
Canada	Canadian Veterinary Drug PECsoil Model	Land contamination/ Pharmaceuticals/ veterinary drugs/	Screening assessment/	New Substances Notification Regulations (Chemicals and Polymers. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-247/index.html	National government/	New Substances Notification Regulations (Chemicals and Polymers. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-247/index.html	National government/ Industry/ WITH National citizens/ Downstream users/ veterinary drug companies	Risk assessment summaries are published here https://www.canada.ca/en/environment-climate-change/services/managing-pollution/evaluating-new-substances/chemic

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
								als-polymers/risk-assessment-summaries.html
Canada	U.S. Environmental Protection Agency's Consumer Exposure Model (CEM)	Consumer product/	Screening assessment/		National government/	Draft Screening Assessment Furan Compounds (exposure estimates) - https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/draft-screening-assessment-furan-compounds-group.html Draft Screening Assessment Ethers Group (default value) - https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/draft-screening-assessment-ethers-group.html		
Canada	Swimmer Exposure Assessment Model (SWIMODEL)	Pesticides/ Consumer product/ Biocides/	Screening assessment/ Higher tier assessment/ Assessment for substance	Pest Control Products Act https://www.canada.ca/en/health-canada/services/co	National government/	Public consultation and decisions on regulatory risk assessments of pesticides	National government/ WITH National citizens/	Public consultation and decisions on regulatory risk assessments of pesticides

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
			registration by manu/impo/	nsumer-product-safety/pesticides-pest-management/public/protecting-your-health-environment/pest-control-products-acts-and-regulations-en.html				
Canada	Dietary Exposure Evaluation Model - Food Commodity Intake Database (DEEM-FCID)	Pesticides/ Biocides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Pest Control Products Act https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public/protecting-your-health-environment/pest-control-products-acts-and-regulations-en.html	National government/	Public consultation and decisions on regulatory risk assessments of pesticides	National government/ WITH National citizens/	Public consultation and decisions on regulatory risk assessments of pesticides
Canada	Generic Exposure Data	Pesticides/ Consumer product/ Biocides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Pest Control Products Act https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public/protecting-your-health-environment/pest-	National government/	Public consultation and decisions on regulatory risk assessments of pesticides	National government/ WITH National citizens/	Public consultation and decisions on regulatory risk assessments of pesticides

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				control-products-acts-and-regulations-en.html				
Canada	The Standard Operating Procedures for Residential Pesticide Exposure Assessment	Pesticides/ Consumer product/ Biocides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Pest Control Products Act https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public/protecting-your-health-environment/pest-control-products-acts-and-regulations-en.html	National government/	Public consultation and decisions on regulatory risk assessments of pesticides	National government/ WITH National citizens/	Public consultation and decisions on regulatory risk assessments of pesticides
Canada	PWC – the Pesticide in Water Calculator	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Pest Control Products Act - S.C. 2002, c. 28 (Section 7), Pest Control Products Act - S.C. 2002, c. 28 (Section 11), Pest Control Products Act - S.C. 2002, c. 28 (Section 19), direct the inclusion of human exposure via drinking water in the regulation of pesticide use in Canada. Pest Control Products Act - S.C. 2002, c. 28 (Section 4)	National government/	https://www.canada.ca/en/health-canada/services/consumer-product-safety/reports-publications/pesticides-pest-management/decisions-updates.html gives links to all published decisions and proposed decisions by Health Canada's Pest Management Regulatory Agency, which is responsible for pesticide	National government/ WITH Consumers/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				directs the protection of the environment from unacceptable risk from pesticides in Canada.		regulation in Canada.		
Canada	1)AGDISP 8.21 2) PMRA Buffer Zone Models (field boom sprayer and airblast sprayers)	Pesticides/	Screening assessment/ Higher tier assessment/	Pest Control Products Act – S.C. 2002. C. 28 (Section 4) directs the protection of the environment from unacceptable risk from pesticides in Canada.	National government/	Pest control product labels with spray buffer zone requirements	National government/	
Canada	Risk Assessment IDentification and Ranking Model (RAIDAR) + EAS-E Suite	Industrial chemicals/ Pesticides/ Pollutant emission/Biocides/ Pharmaceuticals/ Contaminants in food/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Technical approach for rapid screening of substances of lower ecological concern: approach - Canada.ca Environment and Climate Change Canada - Science Approach Document: Ecological Risk Classification of Organic Substances Bonnell, M. 2021. Identifying Chemicals of Global Concern in 2021 and Beyond: A Canadian	National government/	Same as above	National government/	Same as above

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				Perspective. Society of Environmental Toxicology and Chemistry 31th Annual Meeting. Seville, Spain. May. Bonnell, M., O'Brien, J., Bemis, J.C. and Hall, N. 2020. Assessing eco-genotoxicity for prioritizing chemicals using version 2.0 of the Ecological Risk Classification approach. Society of Environmental Toxicology and Chemistry 30th Annual Meeting. Dublin, Ireland. May.				
Canada	AERMOD	Industrial chemicals/ Pollutant emission/	Screening assessment/		National government/ Industry/	This model is used in some regulatory screening risk assessment conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity, for example Screening Assessment Coal	National government/ WITH Stakeholders (industry, NGO) and general public	This model is used in some regulatory screening risk assessment conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity, for example Screening Assessment Coal

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
						Tar and their distillates https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-coal-tars-distillates.html		Tar and their distillates https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-coal-tars-distillates.html
Canada	Artifical Intelligence Expert Predictive System (AIEPS) v3.0	Industrial chemicals/	Screening assessment/		National government/			
Canada	Biosolids-Amended Soil: Level IV (BASL4)	Industrial chemicals/ Consumer product/ Pharmaceuticals/	Screening assessment/		National government/	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessments.	National government/ WITH stakeholders (industry, NGO) and general public	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessment.
Canada	CATALOGIC biodeg.	Industrial chemicals/ Pesticides/ Pollutant emission/Land contamination/ Waste management/ Consumer product/ Biocides/ Pharmaceuticals/	Screening assessment/ Higher tier assessment/		National government/ Industry/		National government/ Industry/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Canada	Canadian POPs	Industrial chemicals/	Screening assessment/		National government/		National government/	
Canada	Consumer Release Aquatic Model (CRAM)	Consumer product/ Pharmaceuticals/	Screening assessment/ Assessment for substance registration by manu/impo/		National government/	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessment.	National government/ WITH National citizens/ stakeholders (industry, NGO) and general public	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help infor the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessment.
Canada	New Equilibrium Criterion model (EQC)	Industrial chemicals/ Pollutant emission/Consumer product/ Pharmaceuticals/	Screening assessment/		National government/	This model is used in most regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to provide insight on the behaviour and fate of the substance in the environment.	National government/	
Canada	Soil exposure from air deposition spreadsheet program	Industrial chemicals/ Pollutant emission/	Screening assessment/	This model has been used in regulatory screening risk assessments conducted under the Canadian Environmental	National government/	This model has been used in regulatory screening risk assessments conducted under the Canadian Environmental	National government/ WITH National citizens/ stakeholders (industry, NGO) and general public	This model has been used in regulatory screening risk assessments conducted under the Canadian Environmental

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				Protection Act, CEPA to help inform the decision on toxicity under CEPA, for instance https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-coal-tars-distillates.html#toc23		Protection Act, CEPA to help inform the decision on toxicity under CEPA, for instance https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-coal-tars-distillates.html#toc23		Protection Act, CEPA as part of the analysis to determine whether a substance is toxic under CEPA.
Canada	STP-EX	Industrial chemicals/ Consumer product/ Pharmaceuticals/	Screening assessment/		National government/	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessment.	National government/ WITH National citizens/ stakeholders (industry, NGO) and general public	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA as part of the analysis to determine whether a substance is toxic under CEPA.
Canada	TaPL3	Industrial chemicals/ Consumer product/ Pharmaceuticals/	Screening assessment/		National government/	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental	National government/ WITH stakeholders (industry, NGO) and general public	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
						Protection Act, CEPA to provide insight on the fate and behaviour in the environment. It has been used and cited in a variety of screening assessments.		Protection Act, CEPA to provide insight on the fate and behaviour in the environment. It has been used and cited in a variety of screening assessment.
Canada	UVCB Modifier	Industrial chemicals/ Consumer product/	Screening assessment/	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used in differet petroleum screening assessment, for instance https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/draft-screening-assessment-base-oils.html#toc23.	National government/	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used in differet petroleum screening assessment, for instance https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/draft-screening-assessment-base-oils.html#toc23.	National government/ WITH National citizens/ stakeholders (industry, NGO) and general public	This model is used in regulatory screening risk assessments conducted under the Canadian Environmental Protection Act, CEPA as part of the analysis to determine whether a substance is toxic under CEPA.
Canada	Wildlife spreadsheet models	Industrial chemicals/	Screening assessment/	This model is used in regulatory screening risk	National government/		National government/ WITH National citizens/	This model is used in regulatory screening risk

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessment.				assessments conducted under the Canadian Environmental Protection Act, CEPA to help inform the decision on toxicity under CEPA. It has been used and cited in a variety of screening assessment.
Canada	Bioconcentration for Ionizable Organics (BIONIC)	Industrial chemicals/ Pesticides/ Pollutant emission/Pharmaceuticals/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	CMP Third Phase risk assessment of aliphatic amines https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/chemicals-glance/aliphatic-amines-group.html	National government/ Industry/		National government/ Industry/	
Canada	OECD POV and LRTP Screening Tool v2.2	Industrial chemicals/ Pesticides/ Pollutant emission/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/ Local government/ Industry/		National government/	
Canada	CATALOGIC BCFMax	Industrial chemicals/ Pesticides/ Pollutant emission/Pharmaceuticals/	Screening assessment/ Higher tier assessment/ Assessment for substance		National government/ Industry/		National government/ Industry/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
			registration by manu/impo/					
Concawe	PetroRisk	Industrial chemicals	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		Industry/		Industry/	
Costa Rica	Surface water tool for exposure prediction-STEP 1-2	Pesticides	Assessment for substance registration by manu/impo/		National government/		National government/ WITH National citizens/	
Creme Global	Creme Food Safety/Creme Food Data Science Model	Consumer product/ Contaminants in food/	Higher tier assessment/ Assessment for substance registration by manu/impo/ Scientific opinion, refined probabilistic assessment	GRAS notification https://www.cfsanappsexternal.fda.gov/scripts/fdcc/?set=GRASNotices&id=894&sort=GRN_No&order=DESC&startrow=1&type=basic&search=894 GRAS notification https://www.cfsanappsexternal.fda.gov/scripts/fdcc/?set=GRASNotices&id=894&sort=GRN_No&order=DESC&startrow=1&type=basic&search=894	National government/ Local government/ Industry/	FSAI (Food Safety Authority of Ireland). Report on a Total Diet Study carried out during the period 2012−2014	National government/ Local government/ Industry/ WITH National citizens/ Consumers/ (EU member states)	https://www.fsai.ie/publications_metals_irish_diet/ Irish Reformulation Project https://www.fooddrinkireland.ie/Sectors/FDI/FDI.nsf/vPages/Publications~fdi-creme-global-reformulation-report-27-01-2016/$file/The+FDI+Creme+Global+Reformulation+Project.pdf
Creme Global	Creme/RIFM Aggregate Exposure Model	Consumer product/	Scientific opinion		National government/ Industry/ published safety assessment on fragrance ingredients	http://fragrancematerialsafetyresource.elsevier.com/	Inter-governmental body	SCCS (Scientific Committee on Consumer Safety), Opinion on Propylparaben (CAS No 94-13-3,

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
								EC No 202-307-7), preliminary version of 27-28 October 2020, final version of 30-31 March 2021, SCCS/1623/20 SCCS (Scientific Committee on Consumer Safety), Opinion on Propylparaben (CAS No 94-13-3, EC No 202-307-7), preliminary version of 27-28 October 2020, final version of 30-31 March 2021, SCCS/1623/20
Creme Global	CARES NG	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/ Industry/ academics		National government/ Industry/	
ECHA	Chesar - CHemical Safety Assessment and Reporting tool	Industrial chemicals/ Consumer product/ Occupational health/ Biocides (environmental assessment) will be covered by Chesar Platform under development (see below), as well as	Screening assessment/ Assessment for substance registration by manu/impo/	Chesar is used to support registrant of substances under REACH to perform their Chemical Safety Assessment (CSA). Chesar Platform under development is also meant to support the environmental	Decision making at the level of EU	In principle, Chesar can also be used by authorities e.g. under restriction or to review the Application for Authorisation of SVHC received by applicants	Downstream users/	Chesar is able to generate set of conditions of safe use directly from Chemical Safety Assessment to be conveyed to Downstream User via the extended Safety Data Sheets.

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
		coformulants in pesticides. /		assessment for applications under Biocides regulation.				
ECHA	EUSES 2.2.0	Industrial chemicals/ Biocides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/ Preparation of competent authority reports for biocidal active substances (CAR) or biocidal products (PAR)	Please refer to the requirements for environmental exposure and risk assessment in Annex VI of the BPR	National government/ Industry/ ECHA/Commission		National government/ Industry/ ECHA/Commission	
EFSA	Exposure calculation spreadsheet of the EFSA Guidance on the assessment of exposure of operators, workers, residents and bystanders in risk assessment for plant protection product	Pesticides/	Approval (and renewal of approval) of active substances at EU level	Regulation 1107/2009, Article 3, paragraph 23 Regulation 1107/2009, Annex II, paragraph 3.6 Commission Regulation (EU) No 546/2011 implementing Regulation (EC) No 1107/2009 as regards uniform principles for evaluation and authorisation of plant protection products.	European Commission (ec.europa.eu)	Review reports produced for the approval of active substances can be found in the EU Pesticides database: https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/active-substances/?event=search.as (where applicable, the EFSA guidance and annexed calculator were used to provide exposure estimates and risk assessment results for the	National government/ NGOs/NPOs/ WITH Local residents/	At national level, for authorisation of plant protection products, the EFSA guidance and annexed calculator are also used in cases where they are applicable.

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
						operators, workers, residents and bystanders)		
EFSA	EFSA PRIMo rev. 3.1	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/ Setting of legal limits for pesticide residues in food at EU level	Regulation (EC) No 396/2005 Regulation (EC) No 1107/2009	National government/ European Commission	Commission Communication in the framework of the implementation of Commission Regulation (EU) No 283/2013 of 1 March 2013 setting out the data requirements for active substances, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market; (2013/C 95/01) RASFF WI 2.2: Guidelines for the calculation of consumer intake and evaluation of the risk for pesticide residues (https://ec.europa.eu/food/system/files/2017-02/rasff_reg-guid_sops_wi-2-2_en.pdf)	National government/ Local government/ NGOs/NPOs/ EFSA WITH National citizens/ Consumers/	Numerous reasoned opinions of EFSA on MRL setting, MRL review and EFSA conclusions on approval or renewal of approval of a.s. RASFF notifications

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
						Reference to previous version of PRIMo.		
Eurometaux	Metal EUSES DU scaling tool	Industrial chemicals/	Screening assessment/		Industry/		Industry/ WITH Downstream users/	
Eurometaux	Eurometaux SPERCs	Industrial chemicals/ Pollutant emission/	Higher tier assessment/		National government/ Industry/		National government/ WITH Downstream users/	
France	MODUL'ERS	Pollutant emission/Land contamination/	Higher tier assessment/	No compulsary use but the software is refered by several guidances (Haut Conseil de la Santé Publique, 2020, Guide pour l'élaboration d'une liste de mesures de prévention individuelles et collectives visant à limiter l'exposition des populations riveraines des sites et sols pollués ; Ineris, 2021, Evaluation de l'état des milieux et des risques sanitaires, Démarche intégrée pour la gestion des émissions des substances chimiques par les intallations classées, version 2)	Local government/	Most studies for contaminated soils and registrated industries are conducted by private consultants for industrial companies. Examples of other studies performed by Ineris : Ineris, Interreg, projet Valse, Prioritisation de scénarios de valorisation de sites de gestion à terre des sédiments, Approche par évaluation d'indicateurs sanitaires et socio-économiques , 2021 , Ineris-21-156135-2098479-v1 Ineris, Evaluation des risques sanitaires attribuables à		

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
						l'épandage des boues et composts de boues et liés aux substances réglementées dans ces matrices, 202608-2704964-v2 Ineris, Tierce-expertise de l'Evaluation Quantitative des risques sanitaires associée à l'incendie Lubrizol/NL Logistiques du 26 septembre 2019		
Germany	Stoffenmanager (version 8.3)	Industrial chemicals/ Occupational health/	Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/ Industry/		National government/ Industry/ WITH Downstream users/	
Germany	EMKG-Expo-Tool 2.0	Industrial chemicals/ Occupational health/	Screening assessment/ Assessment for substance registration by manu/impo/		National government/ Industry/		National government/ Industry/ WITH Workers/	
Germany	The Advanced Reach Tool (ART) (version 1.5)	Industrial chemicals/ Occupational health/ Biocides/	Higher tier assessment/ Assessment for substance registration by manu/impo/	ECHA Guidance on Information Requirements and Chemical Safety AssessmentChapter R.14: Occupational exposure assessment.	National government/ Industry/		National government/ Industry/ WITH Downstream users/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				https://echa.europa.eu/documents/10162/13632/information_requirements_r14_en.pdf/bb14b581-f7ef-4587-a171-17bf4b332378				
Germany	RISKOFDERM	Biocides/	Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/ Industry/		National government/ Industry/ WITH Workers/	
Germany	ConsExpo	Biocides/	Higher tier assessment/		National government/ Industry/		National government/ Industry/ WITH Workers/	
Germany	Professional-Users Generic Simple Database Models (TNsG 2002 & 2007) – Recommended Models for Primary (direct) Exposure	Biocides/	Higher tier assessment/				National government/ Industry/ WITH Workers/	
Germany	ECETOC-TRA (ECETOC's Targeted Risk Assessment tool), version 3.1 (ONLY the tool for workers / occupational exposure tool is considered here!)	Industrial chemicals/ Occupational health/	Assessment for substance registration by manu/impo/	https://echa.europa.eu/documents/10162/13632/information_requirements_r14_en.pdf	Industry/		Industry/ WITH Downstream users/	
Germany	MEASE (The Metals' EASE)	Industrial chemicals/ Occupational health/	Assessment for substance registration by manu/impo/	https://echa.europa.eu/documents/10162/13632/information_requirements_r14	Industry/		Industry/ WITH Downstream users/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				_en.pdf/bb14b581-f7ef-4587-a171-17bf4b332378				
Germany	VFSMOD	Pesticides/	Higher tier assessment/	https://abe.ufl.edu/faculty/carpena/vfsmod/citations.shtml	National government/ Local government/ Industry/	https://abe.ufl.edu/faculty/carpena/vfsmod/citations.shtml	National government/ Local government/ Industry/ Governmental Research Institutes WITH National citizens/	www.envsys.co.kr/~vfsmod/ BUVARD online (irstea.fr) http://buvard.irstea.fr/ SynopsWebGui (julius-kuehn.de) http://synops.julius-kuehn.de/#/dashboard
Germany	AppDate	Pesticides/ Biocides/ Pharmaceuticals/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	EFSA (2020): Scientific report of EFSA on the 'repair action' of the FOCUS surface water scenarios. EFSA Journal 2020;18(6):6119	National government/ EU risk assessment for active substances	EFSA (2020): Scientific report of EFSA on the 'repair action' of the FOCUS surface water scenarios. EFSA Journal 2020;18(6):6119	National government/ EU risk assessment for active substances	EFSA (2020): Scientific report of EFSA on the 'repair action' of the FOCUS surface water scenarios. EFSA Journal 2020;18(6):6119
Germany	STEPS1-2 in FOCUS	Pesticides/	Screening assessment/	FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.1. 221 pp	Industry/ EU Risk assessment	FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.1. 221 pp	Industry/ EU Risk assessment	FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.1. 221 pp

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Germany	German scenario for inland water marinas - Development of a realistic worst-case scenario for antifouling biocides in German inland water marinas	Biocides/		Is still pending	National government/	Is still pending		
Germany	BfR calculator for estimating the external exposure of livestock to biocidal active substances	Biocides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/ Exposure and consumer risk assessment	Biocidal Products Regulation (BPR, Regulation (EU) 528/2012)	National government/ Industry/ EU		National government/ EU/ WITH Consumer/ Stakeholder in regulatory framework/	
Italy	PERSAM (Persistence in soil analytical model)	Pesticides/		PERSAM was developed for the regulatory zones and Member States in EU for assessment of pesticides and their transformation products according to EU regulation 1107/2009. The PERSAM tool is expected to be used in the regulatory framework in the near future when the EU commission and the Memberstates endorse the EFSA guidance document	see below	PERSAM was developed for the regulatory zones and member states in the EU for assessment of pesticides and their transformation products according to EU regulation 1107/2009. The PERSAM tool is expected to be used in the regulatory framework in the near future when the EU commission and the member states endorse the EFSA guidance document	see below WITH When the EFSA guidance on PECs in soil and the supporting software tools including PERSAM have been endorsed by the European Commission and the EU member states it will be used as part of the decision making in the EU for pesticide approvals according to EU regulation 1107/2009	https://www.efsa.europa.eu/en/efsajournal/pub/4982 and https://esdac.jrc.ec.europa.eu/content/european-food-safety-authority-efsa-data-persam-software-tool

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				on PECs in soil and the supporting software tools.		on PECs in soil and the supporting software tools.		
Italy	Guidance on the Assessment of Exposure for Operators, Workers, Residents and Bystanders in Risk Assessment for Plant Protection Products	Pesticides/	Screening assessment/ Assessment for substance registration by manu/impo/	Regulation (EC) No 1107/2009	National government/	https://www.salute.gov.it/	National government/ Industry/ WITH National citizens/ Local residents/ Workers/	https://www.salute.gov.it/
Japan	AIST-ADMER (Atmospheric Dispersion Model for Exposure and Risk Assessment)	Industrial chemicals/ Pollutant emission/Consumer product/	Higher tier assessment/		National government/ Local government/ Industry/		National government/ Local government/ NGOs/NPOs/ WITH National citizens/ Local residents/ Workers/ Consumers/	
Japan	ADMER-PRO (Atmospheric Dispersion Model for Exposure and Risk Assessment-PRO)	Industrial chemicals/ Pollutant emission/Consumer product/	Higher tier assessment/		National government/ Local government/ Industry/		National government/ Local government/ NGOs/NPOs/ WITH National citizens/ Local residents/ Workers/ Consumers/	
Japan	AIST-CBAM (Chemical Bioaccumulation Model)	Industrial chemicals/ Pollutant emission/Consumer product/ Pharmaceuticals/	Screening assessment/ Higher tier assessment/		National government/ Local government/ Industry/		National government/ Local government/ Industry/ NGOs/NPOs/ WITH National citizens/ Local residents/ Workers/ Consumers/ Downstream users/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Japan	G-CIEMS	Industrial chemicals/ Pollutant emission/Land contamination/ Consumer product/	Higher tier assessment/	VII. Exposure Assessment in Technical Guidance Documents for risk assessment of Priority Assessment Chemical Substances under the Chemical Substances Control Law, Japan. https://www.meti.go.jp/policy/chemical_management/kasinhou/files/information/ra/07_tech_guidance_vii_samazamana_v_1_0_140626.pdf (in Japanese)	National government/			
Japan	AIST-ICET (Indoor Consumer Exposure Assessment Tool)	Consumer product/	Screening assessment/ Higher tier assessment/		National government/ Industry/		National government/ Industry/ WITH National citizens/ Consumers/ Downstream users/	
Japan	METI-LIS(Ministry of Economy, Trade and Industry-Low rise Industrial Source dispersion Model)	Industrial chemicals/ Pollutant emission/	Screening assessment/		National government/ Local government/ Industry/		Industry/ WITH Local residents/	
Japan	PACSs Risk Assessment System (We call PRAS-NITE) (PACSs : Priority Assessment Chemical Substances)	Industrial chemicals/	Screening assessment/ Higher tier assessment/	https://www.meti.go.jp/policy/chemical_management/kasinhou/information/ra_index.html	National government/		National government/ Local government/ Industry/ WITH National citizens/ Local residents/ Downstream users/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Japan	AIST-RAMTB (Ecological Risk Assessment Model for Tokyo Bay)	Industrial chemicals/ Pollutant emission/Consumer product/ Pharmaceuticals/	Screening assessment/ Higher tier assessment/		National government/ Local government/ Industry/		National government/ Local government/ Industry/ NGOs/NPOs/ WITH National citizens/ Local residents/ Workers/ Consumers/ Downstream users/	
Japan	AIST-SHANEL (Standardized Hydrology-based AssessmeNt tool for chemical Exposure Load)	Industrial chemicals/ Pollutant emission/Consumer product/ Pharmaceuticals/	Screening assessment/ Higher tier assessment/		National government/ Local government/ Industry/		National government/ Local government/ Industry/ NGOs/NPOs/ WITH National citizens/ Local residents/ Workers/ Consumers/ Downstream users/	
Korea	K-CHESAR(Korea CHEmical Safety Assessment and Reporting tool)	Land contamination/ Consumer product/ Occupational health/	Assessment for substance registration by manu/impo/	According to article 14 (Data be submitted when applying for registration of chemical substance) of K-REACH Act, report on risk of chemicals must be submitted to the Ministry of Environment. K-CHEAR supports writing report on risk of chemicals.	National government/		National government/ Industry/	According to article 14 (Data be submitted when applying for registration of chemical substance) of K-REACH Act, report on risk of chemicals must be submitted to the Ministry of Environment. K-CHEAR supports writing report on risk of chemicals.

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Netherlands	ConsExpo Web	Industrial chemicals/ Pesticides/ Consumer product/ Occupational health/ Biocides/	Screening assessment/ Higher tier assessment/	Both REACH guidance R15 and the Biocides exposure methodology document recommend the use of ConsExpo Web for consumer exposure.	National government/ Industry/	ConsExpo Web is used in registration dossiers, authorisation requests, restriction proposals (REACH) and in Chemical assessment reports (Biocides). Also used in Cosmetics Regulation in EU and Canada		
Netherlands	Stoffenmanager®	Industrial chemicals/ Pesticides/ Occupational health/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Stoffenmanager® can be used under both the REACH Regulation and Occupational Safety and Health legislation like the Chemical Agents Directive. More specific information can be found here: https://stoffenmanager.com/what-is-stoffenmanager/#h-legislation	National government/ Local government/ Industry/	https://stoffenmanager.com/what-is-stoffenmanager/#h-legislation. It can e.g. be used by national governments in the REACH substance evaluation process (e.g. authorisation, restriction) or for feasibility testing for newly proposed occupational exposure limits.	National government/ Local government/ Industry/ WITH Workers/ Downstream users/	Stoffenmanager® generates reports and workplace instruction cards based on quantitative exposure estimates that can be used to instruct workers on the necessary risk management measures and operational conditions required to safely perform their activities.
Netherlands	Lee side turbulence model	Pesticides/	Assessment for substance registration by manu/impo/		National government/		National government/ WITH National citizens/	
Netherlands	NL model mixing & loading	Pesticides/	Assessment for substance registration by manu/impo/		National government/		National government/ WITH National citizens/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Netherlands	Animal model 2017	Pesticides/	Screening assessment/ Higher tier assessment/	https://english.ctgb.nl/binaries/ctgb-en/documents/assessment-framework-ppp/2021/07/05/5-residues-residue-dossier-eu-part-em2.8/G+5+Residue+Dossier+EU+EM2-8.pdf	National government/			
Netherlands	PRIMo ver. 2.0	Pesticides/	Screening assessment/ Higher tier assessment/	https://english.ctgb.nl/binaries/ctgb-en/documents/assessment-framework-ppp/2021/07/05/5-residues-risk-to-consumers-eu-part-em2.5/G+5+Risk+Consumer+EU+EM2-5.pdf	National government/			
Netherlands	PRIMo rev. 3.1	Pesticides/	Screening assessment/ Higher tier assessment/	https://english.ctgb.nl/binaries/ctgb-en/documents/assessment-framework-ppp/2021/07/05/5-residues-risk-to-consumers-eu-part-em2.5/G+5+Risk+Consumer+EU+EM2-5.pdf	National government/			
Netherlands	WUR Drift Calculator	Pesticides/ Pollutant emission/Biocides/ any substance that is applied by spraying to arable crops, fruit orchards or avenue tree nurseries/	Assessment for substance registration by manu/impo/	Dutch CTGB will allow manufacturers to use the software for authorization of plant protection products;	National government/	Dutch CTGB will use the software for authorization of plant protection products; https://english.ctgb.nl/plant-	National government/	see above

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
						protection/assessment-framework/evaluation-manuals		
Netherlands	xSPEXUS Drift Model	Pesticides/ Pollutant emission/Biocides/ : any substance that is applied by spraying in fruit orchards or avenue tree nurseries/	Higher tier assessment/ Assessment for substance registration by manu/impo/	Dutch CTGB will allow manufacturers to use the DRAINBOW software for authorization of plant protection products;	National government/	Dutch CTGB will use the DRAINBOW software for authorization of plant protection products; https://english.ctgb.nl/plant-protection/assessment-framework/evaluation-manuals	National government/	See above
Netherlands	IDEFICS Spray Drift Model	Pesticides/ Pollutant emission/Biocides/ : any substance that is applied by spraying in arable crops /	used in assessment and classification of drift-reducing application techniques (DRT) and drift-reducing nozzles (DRN)	Dutch TCT (technical committee for authorization of DRTs and DRNs) requires that manufacturers can show drift-reducing potential of their equipment, e.g. from results carried out with the IDEFICS model	National government/ Industry/	See above; (1) classification of drift-reducing techniques; (2) drift-reducing nozzle types	National government/	Dutch CTGB uses results from IDEFICS model for establishing drift boundary levels for arable crops; https://english.ctgb.nl/plant-protection/assessment-framework/evaluation-manuals
Netherlands	GeoPEARL	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	https://www.rivm.nl/bibliotheek/rapporten/601450019.pdf https://www.rivm.nl/bibliotheek/rapporten/716601007.pdf https://acsess.onlinelibrary.wiley.com/d	National government/			

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				oi/abs/10.2134/jeq2011.0167				
Netherlands	PEARL	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	EU: https://eur-lex.europa.eu/eli/reg/2009/1107/oj NL: https://wetten.overheid.nl/BWBR0022545/2021-04-01	National government/ EU	This model is described in the EFSA FEEDAP Panel guidance on the assessment of feed additives for the environment to refine the predicted environmental concentration in groundwater.		
Netherlands	DROPLET (acronym for 'DRinkwater uit OPpervlaktewater-Landbouwkundig gebruik Evaluatie Tool')	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	NL: https://wetten.overheid.nl/BWBR0022545/2021-04-01 Use for evaluation of pesticide concentrations in Dutch surface water abstracted for drinking water	National government/		National government/	See the website of the Dutch Board for the Authorisation of Plant Protection Products and Biocides. They apply DROPLET to evaluate the risks for drinking water from surface water as a Dutch specific element of their registration procedure. See https://english.ctgb.nl/plant-protection/documents/assessment-framework-ppp/2020/09/01/6.-fate-behaviour-in-water-nl-part-em2.5, see page 11 for DROPLET

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
Netherlands	TOXSWA	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	EU: https://eur-lex.europa.eu/eli/reg/2009/1107/oj NL: https://wetten.overheid.nl/BWBR0022545/2021-04-01	National government/ EU	This model is described in the EFSA FEEDAP Panel guidance on the assessment of the safety of feed additives for the environment to refine the predicted environmental concentration of feed additives in surface water and sediment.		
Netherlands	GEM	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Wipfler et al. 2015: Manual GEM 1.1.1 http://edepot.wur.nl/348735	National government/ EU			
New Zealand	Risk Assessment for Birds and Mammals (EFSA 2009)	Pesticides/	Screening assessment/ Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	An amended version of the bystander elements of the EFSA operator, worker, resident and bystander exposure model (EFSA, 2014a) is used, incorporating exposure the US EPA approach to soil ingestion (US EPA,	Pesticides/	Screening assessment/ Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
	1997) to supplement the dermal exposure and hand- and object-to-mouth activity of the EFSA approach							
New Zealand	The ConsExpo 4.1 (National Institute for Public Health and the Environment, 2016a, 2016b) model is used for assessing products intended for use within the home. It can be used for bystanders as well as users with minor parameter value modifications	Pesticides/	Screening assessment/ Higher tier assessment/		National government/		National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	
New Zealand	GENEEC2	Pesticides/	Screening assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	OECD's RexTox model (adapted model)	Pesticides/	Screening assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	ESCORT 2	Pesticides/	Screening assessment/ Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
New Zealand	UK Chemicals Regulation Directorate (CRD) version of the German Federal Biological Research Centre for Agriculture and Forestry's (Biologische Bundesanstalt für Land- und Forstwirtschaft, BBA) operator assessment model is used. This is often referred to as the 'BBA CRD version'	Pesticides/	Screening assessment/ Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	Plant exposure spreadsheet	Pesticides/	Screening assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	BeeRex (v1 2015)	Pesticides/	Screening assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	OECD's RexTox model (adapted model)	Pesticides/	Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	ECHA sediment	Pesticides/	Screening assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP	National government/ WITH National citizens/ Workers/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				203605_Science_Memo.pdf		203605_Science_Memo.pdf	Consumers/ Downstream users/	203605_Science_Memo.pdf
New Zealand	PEC soil (Focus 1997 based)	Pesticides/	Screening assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	AgDRIFT and AgDisp (NZ Modification)	Pesticides/	Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
New Zealand	The European Predictive Operator Exposure Model database (EUROPOEM) approach developed by other international regulators (EUROPOEM, 2002; Chemicals Regulation Directorate, 2016b) is used	Pesticides/	Screening assessment/ Higher tier assessment/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf	National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203605/APP203605_Science_Memo.pdf
Slovak Republic	EFSA Pesticide Residue Intake Model (EFSA PRIMo revision 3.1)	Pesticides/						
Slovak Republic	Aminal model 2017 (Livestock dietary burden calculation)	Pesticides/						
Sweden	MACRO	Pesticides/	Screening assessment/ Higher tier assessment/	Adriaanse, P., Allen, R., Gouy, V., Hollis, J., Hosang, J.,	National government/ Local government/	For national-(Sweden) and local-scale tools based on	National government/ WITH farmers, advisors	https://www.slu.se/en/Collaborative-Centres-and-

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				Jarvis, N., Jarvis, T., Klein, M., Layton, R., Linders, J., Schäfer, H., Smeets, L. & Yon, D. 1997. Surface water models and EU registration of plant protection products. Report 6476-VI-96 (EU Commission), Regulatory Modelling Group, FOCUS, 218 pp. FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.2. 245 pp. Adriaanse, P., Boivin, A., Klein, M., Jarvis, N., Stemmer, M., Fait, G., Egsmose, M. 2020. Scientific report of EFSA on the 'repair		the MACRO model, see: https://www.slu.se/en/Collaborative-Centres-and-Projects/SLU-centre-for-pesticides-in-the-environment/ This model is also considered in the EFSA FEEDAP guidance on the safety of feed additives for the environment to refine the predicted environmental concentration in groundwater.		Projects/SLU-centre-for-pesticides-in-the-environment/

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				action' of the FOCUS surface water scenarios. EFSA Journal, 18 (6), Article 6119. DOI: 10.2903/j.efsa.2020 .6119.				
Switzerland	COMLEAM (Construction Materials Leaching Model)	Industrial chemicals/ Pollutant emission/Biocides/ Building products, stormwater management/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/ product development				Local government/ environmental agencies WITH National citizens/ Downstream users/	To derive mitigation measures, to assess surface water exposure
UK	Contaminated Land Exposure Assessment (CLEA) model	Land contamination/	Screening assessment/	Regulations do not specify or require use of the CLEA model or any other tool. However, it is used widely in the UK to derive soil guideline values for screening out low risk contaminated sites and can inform higher tiers of assessment (for example, identifying key pathways of concern). Parameters can be altered with additional site knowledge to enable higher tiers	Local government/ Industry/	See above	Local government/ Industry/ WITH Local residents/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				of assessment. It is used for this purpose under the planning regime (new land developments) and also in the early stages of assessment of sites being considered under the contaminated land regime (existing land developments).				
US	Agricultural Drift (AgDRIFT)	Pesticides/	Screening assessment/ Higher tier assessment/	Decision documents are publicly available on regulations.gov	National government/ Industry/	Decision documents are publicly available on regulations.gov	National government/ WITH National citizens/	Decision documents are publicly available on regulations.gov
US	Agricultural Dispersal (AGDISP)	Pesticides/	Screening assessment/ Higher tier assessment/	Decision documents are publicly available on regulations.gov	National government/ Industry/	Decision documents are publicly available on regulations.gov	National government/ WITH National citizens/	Decision documents are publicly available on regulations.gov
US	Pesticide in Flooded Applications Model	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/		National government/	
US	Pesticide Water Calculator	Pesticides/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/		National government/		National government/	

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
US	Tier 1 Rice Model	Pesticides/	Screening assessment/ Assessment for substance registration by manu/impo/		National government/		National government/	
US	Probabilistic Exposure and Risk Model of Fumigants (PERFUM)	Pesticides/	Higher tier assessment/	Decision documents are publicly available on regulations.gov	National government/ Local government/ Industry/	Decision documents are publicly available on regulations.gov	National government/ Local government/ WITH National citizens/	Decision documents are publicly available on regulations.gov
US	DEEM	Pesticides/ Contaminants in food/	Screening assessment/ Higher tier assessment/ Assessment for substance registration by manu/impo/	Decision documents are publicly available on https://www.regulations.gov/	National government/ Local government/ Industry/	Decision documents are publicly available on https://www.regulations.gov/	National government/ Local government/ WITH National citizens/	Decision documents are publicly available on regulations.gov
US EPA	American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD)	Pollutant emission/	Screening assessment/ Higher tier assessment/	AERMOD was developed for use in implementing the National Ambient Air Quality Standards, and is also used in other EPA programs. It is used in the Toxic Substances Control Act (TSCA) to model exposure concentrations at user defined distances to inform exposure to general population receptors for risk evaluations where measured data are not	National government/ Local government/	AERMOD was developed for use in implementing the National Ambient Air Quality Standards, and is also used in other EPA programs. It is used in the Toxic Substances Control Act (TSCA) to model exposure concentrations at user defined distances to inform exposure to general population receptors for risk evaluations where measured data are not	National government/ WITH National citizens/ Local residents/	AERMOD was developed for use in implementing the National Ambient Air Quality Standards, and is also used in other EPA programs. It is used in the Toxic Substances Control Act (TSCA) to model exposure concentrations at user defined distances to inform exposure to general population receptors for risk evaluations where measured data are not

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				available or needs to be supplemented https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca		available or needs to be supplemented https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca		available or needs to be supplemented https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca
US EPA	Consumer Exposure Model (CEM)	Industrial chemicals/ Consumer product/	Screening assessment/ Assessment for substance registration by manu/impo/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act (TSCA) through existing chemical risk evaluations of high priority chemicals https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca and Section 5 of TSCA for new chemical risk evaluations https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act (TSCA) through existing chemical risk evaluations of high priority chemicals https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca and Section 5 of TSCA for new chemical risk evaluations https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/ WITH National citizens/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act (TSCA) through existing chemical risk evaluations of high priority chemicals https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca and Section 5 of TSCA for new chemical risk evaluations https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
US EPA	Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER)	Industrial chemicals/ Pollutant emission/Occupational health/	Screening assessment/ Assessment for substance registration by manu/impo/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/ WITH e.g., Submitters of Premanufacture Notices (PMNs)	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca
US EPA	Exposure and Fate Assessment Screening Tool (E-FAST)	Industrial chemicals/ Pollutant emission/Land contamination/ Consumer product/	Screening assessment/ Assessment for substance registration by manu/impo/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/ WITH National citizens/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca
US EPA	Indoor Environment Concentration in Buildings with Conditioned and Unconditioned Zones (IECCU)	Consumer product/	Higher tier assessment/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act (TSCA) through existing chemical risk evaluations of high priority chemicals https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca and Section 5 of TSCA for new chemical risk evaluations https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-		Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act (TSCA) through existing chemical risk evaluations of high priority chemicals https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca and Section 5 of TSCA for new chemical risk evaluations https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-	National government/ WITH National citizens/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act (TSCA) through existing chemical risk evaluations of high priority chemicals https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca and Section 5 of TSCA for new chemical risk evaluations https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
				control-act-tsca, as appropriate.		control-act-tsca, as appropriate.		control-act-tsca, as appropriate.
US EPA	Integrated Indoor-Outdoor Air Calculator (IIOAC)	Industrial chemicals/ Pollutant emission/	Screening assessment/ Higher tier assessment/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca	National government/	https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca
US EPA	Multi- Chamber Concentration and Exposure Model (MCCEM) version 1.2 (via Internet Geographical Exposure Modeling System (IGEMS))	Industrial chemicals/ Pollutant emission/Consumer product/	Higher tier assessment/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act through existing chemical risk evaluations of high priority chemicals.	National government/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act through existing chemical risk evaluations of high priority chemicals. https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca	National government/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act through existing chemical risk evaluations of high priority chemicals. https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluations-existing-chemicals-under-tsca
US EPA	Point Source Calculator (PSC) v1.05	Industrial chemicals/ Pesticides/ Pollutant emission/	Higher tier assessment/		National government/		National government/ WITH National citizens/	
US EPA	EPA's Risk-Screening Environmental Indicators (RSEI) Model	Industrial chemicals/ Pesticides/ Pollutant emission/Waste management/ Biocides/ Pharmaceuticals/	Screening assessment/ Prioritization and trend analysis tool for EPA programs and program offices		National government/ Local government/ Industry/ Community members and other organizations		National government/ Local government/ Industry/ NGOs/NPOs/ WITH National citizens/ Local residents/ Downstream users/	Common uses for RSEI include: • Identifying facilities and industry sectors for further investigation and pollution prevention opportunities. • Examining trends over time for

Country/ Organisation	Model name	Regulatory field (Exposure source)	Incorporated in regulatory framework	Application examples	Supports decision making for	Application examples	Used the estimation result for risk communication by	Application examples
								facilities, industry sectors, or geographic areas. • Helping to prioritize issues for communities relating to toxics management. • Looking at environmental justice issues. Combining RSEI data with demographic and income data can help communities and policymakers identify areas of potential concern.
US EPA	Wall Paint Exposure Model (via Internet Geographical Exposure Modeling System (IGEMS))	Industrial chemicals/ Pollutant emission/Consumer product/ Occupational health/	Screening assessment/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act through existing chemical risk evaluations of high priority chemicals.	National government/ Industry/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act through existing chemical risk evaluations of high priority chemicals.	National government/ Industry/	Regulation of Chemicals under Section 6(a) of the Toxic Substances Control Act through existing chemical risk evaluations of high priority chemicals.
US EPA	EPI Suite	Industrial chemicals/ Waste management/ Occupational health/	Screening assessment/		National government/		National government/ WITH National citizens/ Workers/ Consumers/ Downstream users/	

Annex D. Peer Review, Validation or Verification References

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
Australia	Environmental Emission Scenarios for Product Type 14: Biocides used as rodenticides	Revised Emission Scenario Document for Product Type 14 – Rodenticides, August 2018. https://echa.europa.eu/documents/10162/16908203/esd_pt14_en.pdf/d27d3b7e-9aa6-8146-9228-f464901b526e	unknown
Australia	AgDRIFT version 2.1.1		EPA quality control and review process.
Australia	T-REX	USEPA. 1993. Wildlife Exposure Factors Handbook. Volume I of II. EPA/600/R-93/187a. Office of Research and Development, Washington, DC 20460	EPA quality control and review process.
Australia	EPISUITE v4.11	Model references are available in the program	Model references are available in the program https://yosemite.epa.gov/sab/sabproduct.nsf/02ad90b136fc21ef85256eba00436459/CCF982BA9F9CFCFA8525735200739805/$File/sab-07-011.pdf
Australia	AgDISP version 8.26		EPA quality control and review process.
Australia	Beerex	Manual at http://www2.epa.gov/sites/production/files/2014-06/documents/pollinator_risk_assessment_guidance_06_19_14.pdf	EPA quality control and review process.
Australia	ConsExpo	Model references are available in the program	Model references are available in the program
Australia	SimpleTreat v3.0	J, Struijs. (1996). SimpleTreat 3.0: a model to predict the distribution and elimination of Chemicals by Sewage Treatment Plants.	J, Struijs. (1996). SimpleTreat 3.0: a model to predict the distribution and elimination of Chemicals by Sewage Treatment Plants.
Bayer	Bayer Safety Standard for	TECHNICAL DOCUMENTATION Bayer Safety Standard	No

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	Operator Safety	for Operator Safety March 2021	
Canada	Consexpo	ConsExpo Web. Consumer exposure models - model documentation: Update for ConsExpo Web 1.0.2 (doi: 10.21945/RIVM-2017-0197 Delmaar, J., M. Park and J. Engelen (2005), ConsExpo 4.0-Consumer Exposure and Uptake Models: Program Manual, RIVM. Delmaar, C., Meesters, J. Modeling consumer exposure to spray products: an evaluation of the ConsExpo Web and ConsExpo nano models with experimental data. J Expo Sci Environ Epidemiol 30, 878–887 (2020).	The default parameters of the Consexpo web are described in the Consexpo factsheets; The Consexpo facstsheets are being updated over time by RIVM and other partners such as ANSES, Health Canada and BfR; the updated factsheets are reviewed by RIVM and partners and stakeholders before the final version is published. https://www.nature.com/articles/s41370-020-0239-x
Canada	Consumer/Industrial Drinking water/PECaqua Models	NA	NA
Canada	SCREEN3		The SCREEN3 model is incorporated in EFAST which was peer reviewed in 2014
Canada	ChemCAN	Webster, E., Mackay, D., Di Guardo, A., Kane, D., Woodfine, D. 2004. Regional Differences in Chemical Fate Model Outcome. Chemosphere. 55: 1361-1376. Mackay, D. 2001. "Multimedia Environmental Models: The Fugacity Approach - Second Edition", Lewis Publishers, Boca Raton, pp. 1-261. Mackay, D., Paterson, S., Tam, D.D. 1991. Assessments of Chemical Fate in Canada: Continued Development of a Fugacity Model. A report prepared for Health and Welfare Canada.	Studies that have assessed the functionality, efficacy, accuracy of the ChemCAN model: Kawamoto, Katsuya & MacLeod, Matthew & Mackay, Don. (2001). Evaluation and comparison of multimedia mass balance models of chemical fate: Application of EUSES and ChemCAN to 68 chemicals in Japan. Chemosphere. 44. 599-612. 10.1016/S0045-6535(00)00348-9. Webster, Eva & Mackay, Don & Di Guardo, Antonio & Kane, David & Woodfine, David. (2004). Regional differences in chemical fate model outcome. Chemosphere. 55. 1361-76. 10.1016/j.chemosphere.2003.10.061. Woodfine, David & MacLeod, Matthew & Mackay, Don. (2002). A regionally segmented national scale multimedia contaminant fate model for Canada with GIS data input and display. Environmental pollution (Barking, Essex : 1987). 119. 341-55. 10.1016/S0269-7491(01)00344-X. Tell, Joan & Parkerton, Tom. (1997). A Comparison of Multi-media Models Used in

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
			Regulatory Decision-making. SAR and QSAR in Environmental Research. 6. 29-45. 10.1080/10629369708031723. Mackay, D., Paterson, S., Kicsi, G., Di Guardo, A., Cowan, C.E. 1996. Assessing the Fate of New and Existing Chemicals: A Five Stage Process. Environ. Toxicol. Chem. 15: 1618-1626. Mackay, D., Paterson, S., Di Guardo, A., Cowan, E.C. 1996. Evaluating the Environmental Fate of a Variety of Types of Chemicals Using the EQC Model. Environ. Toxicol. Chem. 15: 1627-1637. Mackay, D., Paterson, S., Kicsi, G., Cowan, E.C., Di Guardo, A., Kane, D.M. 1996. Assessment of Chemical Fate in the Environment Using Evaluative, Regional and Local-Scale Models: Illustrative Application to Chlorobenzene and Linear Alkylbenzene Sulfonates. Environ. Toxicol. Chem. 15: 1638-1648.
Canada	Canadian Veterinary Drug PECsoil Model	[EMA] European Medicines Agency. 2008. Revised guideline on environmental impact assessment for veterinary medicinal products in support of the VICH guidelines GL6 and GL38, EMEA/EMEA/ERA/418282/2005-Rev.1. London (UK): EMA. [cited 2013 August 12]. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004386.pdf Kullik, S.A. and AM Belknap. 2017. Flexing the PECS: Predicting environmental concentrations of veterinary drugs in Canadian agricultural soils. Integrated Environmental Science and Management, 13(2): 331-341. http://setac.onlinelibrary.wiley.com/doi/epdf/10.1002/ieam.1833	The Kullik and Belknap 2017 is a peer-reviewed journal article. No validation has been published yet.
Canada	U.S. Environmental Protection Agency's Consumer Exposure Model (CEM)		Model was peer reviewed in 2019
Canada	Swimmer Exposure Assessment Model (SWIMODEL)	References are defaults noted in the user's manual: https://www.epa.gov/sites/default/files/2015-09/documents/swimodel-users-guide.pdf	

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
Canada	Dietary Exposure Evaluation Model - Food Commodity Intake Database (DEEM-FCID)		Via the FIFRA Scientific Advisory Panel https://archive.epa.gov/scipoly/sap/meetings/web/html/022900_mtg.html https://www.regulations.gov/docket/EPA-HQ-OPP-2004-0071
Canada	Generic Exposure Data		
Canada	The Standard Operating Procedures for Residential Pesticide Exposure Assessment		Via the FIFRA Scientific Advisory Panel https://www.regulations.gov/docket/EPA-HQ-OPP-2009-0516
Canada	PWC – the Pesticide in Water Calculator	https://www.epa.gov/sites/default/files/2020-09/documents/framework-conducting-pesticide-dw-sw.pdf	A timeline of the peer-review, by Scientific Advisory Panels, of the entire drinking water framework into which PWC fits, as well as links to the resulting documents, can be found in https://www.epa.gov/sites/default/files/2020-09/documents/framework-conducting-pesticide-dw-sw.pdf
Canada	1)AGDISP 8.21 2) PMRA Buffer Zone Models (field boom sprayer and airblast sprayers)		
Canada	Risk Assessment IDentification	Arnot JA, Mackay D, Webster E, Southwood JM. Screening level risk assessment model for chemical fate and effects in the environment. Environ Sci Technol. 2006 Apr 1;40(7):2316-23. doi: 10.1021/es0514085. PMID: 16646468.	Multimedia models impossible to validate given the nature of these mass-balance models instead use:

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	and Ranking Model (RAIDAR) + EAS-E Suite		Buser AM, MacLeod M, Scheringer M, Mackay D, Bonnell M, Russell MH, DePinto JV, Hungerbühler K. 2012. Good modeling practice guidelines for applying multimedia models in chemical assessments. Integr. Environ Assess. Manage. 8(4): 703-8.
Canada	AERMOD		AERMOD is the recommended air dispersion model by the USEPA
Canada	Artifical Intelligence Expert Predictive System (AIEPS) v3.0	[1] Niculescu, S.P. (2010). Artificial Intelligence Expert Predictive System R&D version 1.0. [2] Niculescu, S.P. (2011). Artificial Intelligence Expert Predictive System version 2.50. Environment Canada, Gatineau. [3] Bishop, C.M. (1995). Neural Networks for Pattern Recognition. Oxford University Press, Oxford. [4] Ripley, B.D. (1996). Pattern Recognition and Neural Networks. Cambridge University Press, Cambridge. [5] Niculescu, S.P. (2003). Artificial neural networks and genetic algorithms in QSAR. Journal of Molecular Structure (Theochem) 622:71-83	
Canada	Biosolids-Amended Soil: Level IV (BASL4)	Hughes, L., Mackay, D. 2011. Model of the Fate of Chemicals in Sludge-Amended Soils with Uptake in Vegetation and Soil-Dwelling Organisms. Soil and Sediment Contamination 20, 938-961. Hughes, L., Webster, E., Mackay, D. 2008. An Evaluative Screening Level Model of the Fate of Organic Chemicals in Sludge-Amended Soils Including Organic Matter Degradation. Soil and Sediment Contamination 17, 564-585. Armitage, J., Gobas, F.A.P.C. 2007. A Terrestrial Food-Chain Bioaccumulation Model for POPs. Environmental Science and Technology 41, 4019-4025. Hughes, L., Mackay, D., Webster, E., Armitage, J., Gobas, F. 2005. Development and Application of Models of Chemical Fate in Canada: Modelling the Fate of Substances in Sludge-Amended Soils. Report to Environment Canada. CEMN Report No. 200502. Trent University, Peterborough, Ontario. Mackay, D. 2001. Multimedia Environmental Models: The Fugacity Approach, Second Edition, Lewis Publishers, Boca Raton, 194-199. Hughes, L., Mackay, D. 2011. Assessing the Exposure and Risk of Organic Contaminants in Soils: Using The Biosolids-Amended Soil Level 4 Model (BASL4). Report to Environment Canada.	
Canada	CATALOGIC biodeg.	1. Chemicals Inspection and Testing Institute, Biodegradation and Bioaccumulation data of existing chemicals based on the CSCL Japan, Chemical Industry Ecology-Toxicology & Information Center, Japan, 1992, ISBN 4-98074-101-1.	Model validation according to QSAR principles. See references above.

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		2. NITE, Biodegradation and Bioconcentration of the Existing Chemical Substances under the Chemical Substances Control Law, http://www.safe.nite.go.jp/english/db.html 3. S Dimitrov, T Pavlov, G Veith, O Mekenyan. SAR and QSAR in Environ Res, 22, 2011, 699-718. 4. S Dimitrov, T Pavlov, N Dimitrova, D Georgieva, D Nedelcheva, A Kesova, R Vasilev, O Mekenyan. SAR and QSAR in Environ Res, 22, 2011, 719-755. 5. S Dimitrov, G Dimitrova, T Pavlov, N Dimitrova, G Patlevisz, J Niemela and O Mekenyan, J Chem Inf Model, 45, 2005, 839-849.	
Canada	Canadian POPs	Developed with Environment and Climate Change Canada	CPOPs] Canadian Persistent Organic Pollutants Profiler Model. 2008. Ver. 1.2.3. Gatineau (QC): Environment Canada; Bourgas (BG): University "Prof. Dr. Assen Zlatarov", Laboratory of Mathematical Chemistry. [Model developed based on Mekenyan G, Dimitrov SD, Pavlov TS, Veith GD. 2005. POPs: a QSAR system for creating PBT profiles of chemicals and their metabolites. SAR QSAR Environ Res. 16(1-2):103-133.]
Canada	Consumer Release Aquatic Model (CRAM)		This model went through a series of reviews from different stakeholders and contractors, however this did not lead to publication of material (internal reports are available).
Canada	New Equilibrium Criterion model (EQC)	Mackay D, Paterson, S., Kicsi, G., Di Guardo, A., Cowan, C.E. "Assessing the Fate of New and Existing Chemicals: A Five Stage Process". Environ. Toxicol. Chem. 15 No.9 , 1618-1626, 1996. Mackay D, Paterson, S., Di Guardo, A., Cowan, C.E. "Evaluating the Environmental Fate of a Variety of Types of Chemicals Using the EQC Model", Environ. Toxicol. Chem. 15 No.9, 1627- 1637, 1996. Mackay D, Paterson, S., Kicsi, G., Cowan, C.E., Di Guardo, A., Kane, D.M. "Assessment of Chemical Fate in the Environment Using Evaluative, Regional and Local-Scale Models: Illustrative Application to Chlorobenzene and Linear Alkylbenzene Sulfonates" Environ. Toxicol. Chem. 15 No.9, 1638-1648, 1996.	
Canada	Soil exposure from air deposition spreadsheet program	Baes CF, Sharp RD. 1983. A proposal for estimation of soil leaching and leaching constants for use in assessment models. J Environ Qual. 12(1):17-28. United States Environmental Protection Agency. 1999. Screening level ecological risk assessment protocol for hazardous waste combustion facilities. Volume 1, Chapter 3: Air dispersion and air deposition modelling. U.S. EPA, Office of Solid Waste. Peer Review	

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
		Draft. Aug. 1999. EPA530-D-99-001A. European Chemicals Agency. 2012. Guidance on information requirements and chemical safety assessment. Chapter R.16: Environmental exposure estimation. Version 2.1, Oct. 2012. Helsinki, Finland.	
Canada	STP-EX	Seth R, Webster E, Mackay D. Continued development of a mass balance model of chemical fate in a sewage treatment plant. Water Res. 2008 Feb;42(3):595-604	
Canada	TaPL3	Beyer, A., Mackay, D., Matthies, M., Wania, F., Webster, E. 2000. Assessing Long-range Transport Potential of Persistent Organic Pollutants. Environ. Sci. Tech. 34: 699-703	
Canada	UVCB Modifier	PETROTOX User's Guide – PETROTOX_v3.06.xlsm (updated October 17, 2011).	
Canada	Wildlife spreadsheet models	Bonnell. 2005. Guidance for conducting the wildlife risk assessment of substances under CEPA Draft 1. Environment Canada.	Internal document. The basis for the this approach has been used for the US Superfund Risk Assessment and has undergone reviews by wildlife risk assessments from industry and government.
Canada	Bioconcentration for Ionizable Organics (BIONIC)	Armitage, J.M., Arnot, J.A., Wania, F. and Mackay, D. (2013), Development and evaluation of a mechanistic bioconcentration model for ionogenic organic chemicals in fish. Environmental Toxicology and Chemistry, 32: 115-128. https://doi.org/10.1002/etc.2020 A workpackage in CEFIC LRI ECO37 Project: Mechanistic bioaccumulation model(s) for ionogenic organic substances in fish http://cefic-lri.org/wp-content/uploads/2013/01/6.ECO21.pdf http://cefic-lri.org/projects/eco37-d-bass-developing-a-bioaccumulation-assessment-strategy-for-surfactants/	http://cefic-lri.org/projects/eco37-d-bass-developing-a-bioaccumulation-assessment-strategy-for-surfactants/
Canada	OECD POV and LRTP Screening Tool v2.2	F. Wegmann et al(2009), Environmental Modeling & Software 24, 228-237.	OECD Multimedia Modeling Expert group + model developers for verification of model functions and comparisons with other models Multimedia models impossible to validate given the nature of these mass-balance models instead use: Buser AM, MacLeod M, Scheringer M, Mackay D, Bonnell M, Russell MH, DePinto JV, Hungerbühler K. 2012. Good modeling practice guidelines for applying multimedia models in chemical assessments. Integr. Environ Assess. Manage. 8(4): 703-8.

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			1. Comparing Estimates of Persistence and Long-Range Transport Potential among Multimedia Models Kathrin Fenner, Martin Scheringer, Matthew MacLeod, Michael Matthies, Thomas McKone, Maximilian Stroebe, Andreas Beyer, Mark Bonnell, Anne Christine Le Gall, Jörg Klasmeier, Donald Mackay, Dik van de Meent, David Pennington, Bernd Scharenberg, Noriyuki Suzuki, and Frank Wania Environmental Science & Technology 2005 39 (7), 1932-1942 DOI: 10.1021/es048917b
Canada	CATALOGIC BCFMax	http://storage.oasis-lmc.org/_ALL_/web/CATALOGIC/Annex1-CATALOGICModelsAndModelingResults.pdf S. Dimitrov, N. Dimitrova, T. Parkerton, M. Comber, M. Bonnell & O. Mekenyan (2005) Base-line model for identifying the bioaccumulation potential of chemicals, SAR and QSAR in Environmental Research, 16:6, 531-554, DOI: 10.1080/10659360500474623	Model validation according to QSAR principles. See references above.
Concawe	PetroRisk		No peer review of last model verrsion (yet). Previous version has been peer reviewed: https://echa.europa.eu/documents/10162/17221/review_environmental_physicochemical_methodol_en.pdf
Costa Rica	Surface water tool for exposure prediction-STEP 1-2	FOCUS. (2015). Generic guidance for FOCUS surface water scenarios.	
Creme Global	Creme Food Safety/Creme Food Data Science Model	https://www.cremeglobal.com/publication/	McNamara C, Naddy, Rohan D, Sexton J. Design, development and validation of software for modelling dietary exposure to food chemicals and nutrients. Food Addit Contam. 2003; Part A, 20:8-26.
Creme Global	Creme/RIFM Aggregate		Comiskey, D., Api, A. M., Barratt, C., Daly, E. J., Ellis, G., McNamara, C., O'Mahony, C., Robison, S.H., Safford, B., Smith, B., Tozer, S. (2015). Novel database for exposure to fragrance ingredients in cosmetics and personal care products. Regulatory

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	Exposure Model		Toxicology and Pharmacology : RTP, 72(3), 660–672. https://doi.org/10.1016/j.yrtph.2015.05.012 Comiskey, D., Api, A. M., Barrett, C., Ellis, G., McNamara, C., O'Mahony, C., Robison, S.H., Rose, J., Safford, B., Smith, B., Tozer, S. (2017). Integrating habits and practices data for soaps, cosmetics and air care products into an existing aggregate exposure model. Regulatory Toxicology and Pharmacology, 88, 144–156. https://doi.org/10.1016/j.yrtph.2017.05.017 Safford, B., Api, A. M., Barratt, C., Comiskey, D., Daly, E. J., Ellis, G., McNamara, C., O'Mahony, C., Robison, S., Smith, B., Thomas, R., Tozer, S. (2015). Use of an aggregate exposure model to estimate consumer exposure to fragrance ingredients in personal care and cosmetic products. Regulatory Toxicology and Pharmacology : RTP, 72(3), 673–682. https://doi.org/10.1016/j.yrtph.2015.05.017 Safford, B., Api, A. M., Barratt, C., Comiskey, D., Ellis, G., McNamara, C., O'Mahony, C., Robison, S., Rose, J., Smith, B., Tozer, S. (2017). Application of the expanded Creme RIFM consumer exposure model to fragrance ingredients in cosmetic, personal care and air care products. Regulatory Toxicology and Pharmacology, 86, 148–156. https://doi.org/10.1016/j.yrtph.2017.02.021
Creme Global	CARES NG		In order to verify the integrity and accuracy of the CARES NG dietary model available on this platform, extensive testing was carried out in a collaborative effort between Creme Global and the CARES NG consortium. US EPA are currently reviewing the dietary exposure assessment module. To promote transpar ency it was decided that these documents should be made available to users of the model. This document can be viewed at the following g URL: https://caresng.expertmodels.com/support/articles/159/dietary-model-validation-documents
ECHA	Chesar - CHemical Safety Assessment and Reporting tool	https://chesar.echa.europa.eu/fi/support (key support elements to understand and use Chesar)	Peer review and validation of the exposure models embedded in Chesar is done outside ECHA responsibility. Owners of the tools need to be contacted, namely ECETOC for TRA workers and consumers. For EUSES, some limited information on validation an analysis of (sub) models in EUSES is reported here: https://echa.europa.eu/documents/10162/17228/echa_2014_253_euses_report_en.pdf/35a43ff6-4186-4c82-b1fd-8a7742cbfcdf?t=1442400546592

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ECHA	EUSES 2.2.0	R16, BPC guidance Volume IV Part B+C	
EFSA	Exposure calculation spreadsheet of the EFSA Guidance on the assessment of exposure of operators, workers, residents and bystanders in risk assessment for plant protection product	EFSA (European Food Safety Authority), 2014. Guidance on the assessment of exposure of operators, workers, residents and bystanders in risk assessment for plant protection products. EFSA Journal 2014;12(10):3874, 55p., doi: 10.2903/j.efsa.2014.3874	Website of European Commission (ec.europa.eu) > Food Safety < Plants < Pesticides < Approval of active substances < Guidelines on Active Substances and Plant Protection Products (section Toxicity) : Assessment of exposure of operators, workers, residents and bystanders https://ec.europa.eu/food/system/files/2017-01/pesticides_ppp_app-proc_guide_tox_accpt-exp-levs-2015.pdf
EFSA	EFSA PRIMo rev. 3.1	EFSA, 2018. EFSA Guidance document on the use of EFSA Pesticide Residue Intake Model (EFSA PRIMo revision 3) First published: 15 January 2018 https://doi.org/10.2903/j.efsa.2018.5147 EFSA, 2019. Technical report on Pesticide Residue Intake Model – EFSA PRIMo revision 3.1 (update of EFSA PRIMo revision 3, EFSA supporting publication 2019:EN-1605. 15 pp. doi:10.2903/sp.efsa.2019.EN-1605	Validation f the model against some national models which are based on the same consumption data and which use the same calculation algorithm
Eurometaux	Metal EUSES DU scaling tool		
Eurometaux	Eurometaux SPERCs	Verdonck FAM, Van Assche F, Hicks K, Mertens J, Voigt A, Verougstraete V. 2014. Development of realistic environmental release factors based on measured data: approach and lessons from the EU metal industry. Integrated Environmental Assessment and Management, 10(4), 529-538.	The first version of the metal SPERCs was published in 2010 for the purpose of the 2010 REACH registration deadline and underwent a review process conducted by Lüskow et al. (2011) on behalf of the Federal Environment Agency of Germany (UBA). The second version of the metal SPERCs were improved based on the recommendations by Lüskow et al. (2011) and Sättler et al. (2012) and were further

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
			updated with new data for the purpose of the 2013 REACH registration deadline. A third review was conducted in 2020 using SPERC quality criteria.
France	MODUL'ERS	Many regulatory studies for contaminated sites and emissions of registrated facilities performed in France with MODUL'ERS. Currently, the software has been delivered to more than 120 organizations	The report gathering the models (equations) used in the software was peer-reviewed. The comments of reviewers and responses given by Ineris are available at the website given above. The software was produced according the requirements of internal processes 1) for designing and developing software products and for the validation of scientific softwares. The implementation of all the data and equations was controlled by a second person. Many tests were performed (details are provided in a quality document and referenced in Ineris'quality system management according to the ISO 9001 norm).
Germany	Stoffenmanager (version 8.3)	https://stoffenmanager.com/what-is-stoffenmanager/#h-background	Arnone M, Koppisch D, Smola T, Gabriel S, Verbist K, Visser R (2015) Hazard banding in compliance with the new Globally Harmonised System (GHS) for use in control banding tools. Regul Toxicol Pharmacol. 2015 Oct;73(1):287-95. Cherrie J, Schneider T. (1999) Validation of a new method for structured subjective assessment of past concentrations. Ann Occup Hyg; 43(4) 235. Cherrie JW, Fransman W, Heussen GAH, Koppisch D, Jensen KA (2020) Exposure Models for REACH and Occupational Safety and Health Regulations. Int. J. Environ. Res. Public Health; 17(2), 383. Duuren-Stuurman B, Vink SR, Verbist KJM, Heussen HG, Brouwer DH, Kroese DE, Van Niftrik MF, Tielemans E, Fransman W. (2012): Stoffenmanager Nano version 1.0: a web-based tool for risk prioritization of airborne manufactured nano objects. Ann Occup Hyg: 56(5): 525-41. EN 529: 2005 Respiratory protective devices – Recommendations for selection, use, care and maintenance – Guidance document. Goede H, Tijssen S, Schipper H, Warren N, Oppl R, Kalberlah F, van Hemmen J. (2003) Classification of dermal exposure modifiers and assignment of values for a risk assessment toolkit. Ann Occup Hyg; 47(8):609-18. Heussen H, Verbist K, Hollander A (2020) Stoffenmanager® preventie platform – Op

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			weg naar een persoonlijk blootstellingsdossier gevaarlijke stoffen. Tijdschrift voor Toegepaste Arbowetenschap 33(3): 104-112. Huang S-Z, Wu K-Y (2019) Health Risk Assessment of Photoresists Used in an Optoelectronic Semiconductor Factory. Huang S-Z et al (2020) Incorporating Exposure Measurement Data from Similar Exposure Scenarios to Inform Exposure Modeling Estimates: A Demonstration Using Cluster Analysis and Bayesian Modeling. Jankowska A et al (2015) Application of predictive models for estimation of health care workers exposure to sevoflurane. Jung et al (2016) Further stratification of the Eteam study results. BAuA report F2303. Koppisch D, Schinkel J, Gabriel S, Fransman W, Tielemans E. (2012). Use of the MEGA exposure database for the validation of the Stoffenmanager model. Ann Occup Hyg: 56(4): 426-39. Lamb J, S. Hesse, B. G. Miller, L. MacCalman, K. Schroeder, J. Cherrie, M. van Tongeren (2015) Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project. Lamb J et al (2017) Between-User Reliability of Tier 1 Exposure Assessment Tools Used Under REACH. Landberg HE et al (2015): Comparison and Evaluation of Multiple Users' Usage of the Exposure and Risk Tool: Stoffenmanager 5.1. Landberg HE et al (2017) A Study of the Validity of Two Exposure Assessment Tools: Stoffenmanager and the Advanced REACH Tool Landberg H (2018) The use of exposure models in assessing occupational exposure to chemicals Landberg HE et al (2018) Evaluation of risk assessment approaches of occupational chemical exposures based on models in comparison with measurements.

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			Landberg HE et al (2018) Evaluating the Risk Assessment Approach of the REACH Legislation: A Case Study. Lee EG et al (2018) Evaluation of Exposure Assessment Tools under REACH: Part II—Higher Tier Tools. Lee S et al (2018) Comparison of Quantitative Exposure Models for Occupational Exposure to Organic Solvents in Korea. Marquart H, Heussen H, Le Feber M, Noy D, Tielemans E, Schinkel J, West J, Van der Schaar, D (2008) 'Stoffenmanager', a web-based control banding tool using an exposure process model. Ann. Occup. Hyg.; 52 (6), 429. REACH Guidance on Information Requirements and CSA, Chapter R.14 Occupational Exposure Estimation, August 2016. Ribalta C et al (2019) Health risk assessment from exposure to particles during packing in working environments. Ribalta C et al (2019) Testing the performance of one and two box models as tools for risk assessment of particle exposure during packing of inorganic fertilizer. Riedmann RA et al (2015): Sensitivity Analysis, Dominant Factors, and Robustness of the ECETOC TRA v3, Stoffenmanager 4.5, and ART 1.5 Occupational Exposure Models. Risk Anal. 2015 Feb;35(2):211-25. Schinkel J, Fransman W, Heussen H, Kromhout H, Marquart H, and Tielemans E. (2010) Cross-validation and refinement of the Stoffenmanager as a first tier exposure assessment tool for REACH. Occup. Environ. Med. 2010 (67), 125. Spinazzè A et al (2017) Accuracy Evaluation of Three Modelling Tools for Occupational Exposure Assessment. Spinazzè A et al (2019) How to Obtain a Reliable Estimate of Occupational Exposure? Review and Discussion of Models' Reliability.

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
			Terwoert, J., Verbist, K., & Heussen, H. (2016). An Intervention Study on the Implementation of Control Banding in Controlling Exposure to Hazardous Chemicals in Small and Medium-sized Enterprises. Safety and Health at Work, 7(3), 185-193. Tielemans E, Noy D, Schinkel J, Heussen H, van der Schaaf D, West J, Fransman W (2008) Stoffenmanager exposure model: development of a quantitative algorithm. Ann. Occup. Hyg., 52(6) 443. Tielemans E, Schneider T, Goede H, Tischer M, Warren N, Kromhout H, van Tongeren M, van Hemmen J and Cherrie JW (2008) Conceptual Model for Assessment of Inhalation, Exposure: Defining Modifying Factors. Ann. Occup. Hyg., 52(7), 577. Tongeren van M, Lamb J, Cherrie JW, MacCalman L, Basinas I, Hesse S (2017) Validation of Lower Exposure Tools Used for REACH: Comparison of Tools Estimates With Available Exposure Measurements. Annals of Work Exposures and Health., 1-18. Ustailieva E, Hollander A, Heussen H (2016) Stoffenmanager® for smart chemicals management and business continuity. OSH WIKI. Verbist KJM, Marquart H, Heussen HG, Schinkel J, West J, Fransman W, Van Niftrik MF, Tielemans E. (2011): Stoffenmanager: een web-based control banding tool. Vink SR et al (2010) Use of read across and tiered exposure assessment in risk assessment under REACH - A case study on a phase-in substance. Zalk DM, Nelson DI (2008) History and Evolution of Control Banding: A Review. J. Occup. Environm. Hyg. 5(5): 330-346. Zalk DM, Heussen GAH (2011) Banding the World Together; The Global Growth of Control Banding and Qualitative Occupational Risk Management.
Germany	EMKG-Expo-Tool 2.0	EMKG-Expo-Tool 2.0 User Guide: https://www.baua.de/EN/Topics/Work-design/Hazardous-substances/REACH-assessment-unit/pdf/User-Guide-EMKG-Expo-Tool.pdf?__blob=publicationFile&v=2	S. Hesse, St. Hahn, K. Schroeder, I. Mangelsdorf, J. Lamb, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Uncertainty of Tier 1 Models. Teilbericht zu Unsicherheiten bei Tier 1-Modellen. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin.

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			S. Hesse, K. Schroeder, I. Mangelsdorf, J. Lamb, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Gathering of Background Information and Conceptual Evaluation. Teilbericht zur Sammlung von Hintergrundinformation und der konzeptionellen Evaluierung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. J. Lamb, B. G. Miller, L. MacCalman, S. Rashid, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on External Validation Exercise. Teilbericht zur externen Validierung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. J. Lamb, K. S. Galea, B. G. Miller, S. Spankie, M. van Tongeren, G. Hazelwood: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Between-User Reliability Exercise (BURE) and Workshop. Teilbericht über die Zuverlässigkeit und Variabilität zwischen Anwendern mittels Übungsaufgaben und Workshop. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. J. Crawford, H. Cowie, J. Lamb, M. van Tongeren, K. S. Galea: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on User-Friendliness of Tier 1 Exposure Assessment Tools under REACH. Bericht zur Benutzerfreundlichkeit von Tier 1-Expositionsabschätzungswerkzeugen unter REACH. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. J. Lamb, S. Hesse, B. G. Miller, L. MacCalman, K. Schroeder, J. Cherrie, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Final Overall Project Summary Report. Endbericht zur Evaluierung von Tier 1-Modellen. 1. Auflage. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. Jung, C., Tischer, M., & Schlüter, U. (2016). Further stratification of the ETEAM study results. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. Van Tongeren, M., Lamb, J., Cherrie, J. W., MacCalman, L., Basinas, I., & Hesse, S. (2017). Validation of lower tier exposure tools used for REACH: comparison of tools estimates with available exposure measurements. Annals of work exposures and

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			health, 61(8), 921-938. Fransman, W. (2017). How accurate and reliable are exposure models?. Schlueter, U., & Tischer, M. (2020). Validity of tier 1 modelling tools and impacts on exposure assessments within reach registrations—eteam project, validation studies and consequences. International Journal of Environmental Research and Public Health, 17(12), 4589. Spinazzè, A., Borghi, F., Campagnolo, D., Rovelli, S., Keller, M., Fanti, G., ... & Cavallo, D. M. (2019). How to obtain a reliable estimate of occupational exposure? Review and discussion of models' reliability. International journal of environmental research and public health, 16(15), 2764. Tischer, M., Lamb, J., Hesse, S., & Van Tongeren, M. (2017). ETEAM Project: An overview of the project background and methodology. Annals of Work Exposures and health. Schlueter, U., & Tischer, M. (2020). Validity of tier 1 modelling tools and impacts on exposure assessments within reach registrations—eteam project, validation studies and consequences. International Journal of Environmental Research and Public Health, 17(12), 4589.
Germany	The Advanced Reach Tool (ART) (version 1.5)	https://www.advancedreachtool.com/assets-1.5.12110.3/doc/ART%20Mechanistic%20model%20report_v1_5_20130118.pdf	McNally K., Warren N., Fransman W., Entink R.K., Schinkel J., van Tongeren M., Cherrie J.W., Kromhout H. Schneider T., Tielemans E. (2014). Advanced Reach Tool: A Bayesian model of Occupational Exposure Assessment. Ann Occup Hyg 58(5): 551-565. Schinkel J., Fransman W., McDonnell P., Entink R.K., Tielemans E., Kromhout H. (2014). Reliability of the Advanced REACH Tool (ART). Ann Occup Hyg 58(4): 450-468. Schinkel J., Ritchie P., Goede H., Fransman W. , van Tongeren M., Cherrie J.W., Tielemans E., Kromhout H., Warren N. (2013). The Advanced Reach Tool (ART): Incorporation of an Exposure Measurement Database. Ann Occup Hyg 57(6): 717-727. Schinkel J., Warren N., Fransman W., van Tongeren M., McDonnell P., Voogd E.,

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			Cherrie J.W., Tischer M., Kromhout H., Tielemans E. (2011). Advanced REACH Tool (ART): Calibration of the mechanistic model. J. Environ. Monit. (13): 1374-1382. Marquart H., Schneider T., Goede H., Tischer M., Schinkel J., Warren N., Fransman W., Spaan S., Van Tongeren M., Kromhout H., Tielemans E., Cherrie J.W. (2011). Classification of Occupational Activities for Assessment of Inhalation Exposure. Ann Occup Hyg 55(9): 989-1005. Fransman W., Cherrie J., van Tongeren M., Schneider T., Tischer M., Schinkel J., Marquart H., Warren, N.D., Spankie S., Kromhout H., Tielemans E. Development of a mechanistic model for the Advanced REACH Tool (ART). (PDF) Fransman W., Schinkel J., Meijster T., van Hemmen J., Tielemans E., Goede H. (2008). Development and Evaluation of an Exposure Control Efficacy Library (ECEL). Ann Occup Hyg 52(7): 567-575. Tielemans E., Schneider T., Goede H., Tischer M., Warren, N.D., Ritchie P., Kromhout H., van Tongeren M., van Hemmen J.J., Cherrie J. (2008). Conceptual model for assessment of inhalation exposure: Defining modifying factors. Ann Occup Hyg 52(7): 577-586. Tielemans E., Warren, N.D. Schneider T., Tischer M., Ritchie P., Goede H., Kromhout H., van Hemmen J.J., Cherrie J. (2007). Tools for regulatory assessment of occupational exposure – development and challenges. J Expos Sci Environ Epidemiol (17): 72-80. Cherrie J., Schneider T. (1999). Validation of a New Method for Structured Subjective Assessment of Past Concentrations. Ann Occup Hyg 43(4): 235-245. Lee, E. G., et al. (2019). "Evaluation of Exposure Assessment Tools under REACH: Part II-Higher Tier Tools." Ann Work Expo Health 63(2): 230-241. Savic, N., et al. (2017). "Comparing the Advanced REACH Tool's (ART) Estimates With Switzerland's Occupational Exposure Data." Annals of Work Exposures and Health 61(8): 954-964.

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			Savic, N., et al. (2018). "ART, Stoffenmanager, and TRA: A Systematic Comparison of Exposure Estimates Using the TREXMO Translation System." Annals of Work Exposures and Health 62(1): 72-87. Landberg, H. E., et al. (2017). "A Study of the Validity of Two Exposure Assessment Tools: Stoffenmanager and the Advanced REACH Tool." Annals of Work Exposures and Health 61(5): 575-588. Spinazze, A., et al. (2017). "Accuracy Evaluation of Three Modelling Tools for Occupational Exposure Assessment." Ann Work Expo Health 61(3): 284-298.
Germany	RISKOFDERM	J. Auffarth, J. van Hemmen, R. Hebisch, E. Lechtenberg-Auffarth, J. Marquart, K. Oppl, B. Rajan, H. Wriedt; RISKOFDERM - Europas Beschäftigte sollen nicht länger ihre Haut zu Markte tragen; Gefahrstoffe - Reinhaltung der Luft, volume 63, issue 10 (2003), 399-405 Kromhout, H. et al.; Variability of task-based dermal exposure measurements from a variety of workplace; Ann Occup Hyg.; (2004), 48(3), 187-196. Rajan-Sithamparanadarajah, R. et al.; Patterns of dermal exposure to hazardous substances in European union workplaces; Ann Occup Hyg., (2004), 48(3), 285-297 Warren, N. D. et al., Task-based dermal exposure models for regulatory risk assessment; Ann Occup Hyg. (2006), 50(5), 491-503.	Vink, S. R. et al.; Use of read-across and tiered exposure assessment in risk assessment under REACH-a case study on a phase-in substance; Regul Toxicol Pharmacol. (2010), 58(1), 64-71. Lesmes Fabian C, Teubl S and Binder CR. Evaluation of models for dermal exposure assessment in farming systems in developing countries. J Environ Eng Ecol Sci. 2014; 3:1.
Germany	ConsExpo	te Biesebeek JD, Nijkamp MM, Bokkers BGH and Wijnhoven SWP, 2014. General Fact Sheet General default parameters for estimating consumer exposure – Updated version 2014, RIVM Report 090013003/2014. Delmaar JE, Schurr AG; ConsExpo Web, Consumer exposure models Model documentation Update for ConsExpo Web 1.0.2, RIVM Report 2017-0197	C. Delmaar, J. Meesters; Journal of Exposure Science & Environmental Epidemiology (2020) 30:878–887 Overview of existing methodologies for the estimation of non-dietary exposure to chemicals from the use of consumer products and via the environment, European Food Safety Authority (EFSA) (2016), volume 14, issue 7 Young et al.; Journal of Exposure Science and Environmental Epidemiology (2012) 22, 522 -532
Germany	Professional-Users Generic Simple	Technical Notes for Guidance (2002) https://echa.europa.eu/documents/10162/16960215/bpd_guid_tnsg+human+exposure+2002_en.pdf Technical Guidance Document on Risk Assessment (2003)	

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	Database Models (TNsG 2002 & 2007) – Recommended Models for Primary (direct) Exposure	https://echa.europa.eu/documents/10162/16960216/tgdpart1_2ed_en.pdf Recommendations of the Ad hoc Working Group on Human Exposure https://echa.europa.eu/de/view-article/-/journal_content/title/recommendations-of-the-ad-hoc-working-group-on-human-exposure	
Germany	ECETOC-TRA (ECETOC's Targeted Risk Assessment tool), version 3.1 (ONLY the tool for workers / occupational exposure tool is considered here!)		S. Hesse, St. Hahn, K. Schroeder, I. Mangelsdorf, J. Lamb, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Uncertainty of Tier 1 Models. Teilbericht zu Unsicherheiten bei Tier 1-Modellen. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. S. Hesse, K. Schroeder, I. Mangelsdorf, J. Lamb, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Gathering of Background Information and Conceptual Evaluation. Teilbericht zur Sammlung von Hintergrundinformation und der konzeptionellen Evaluierung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. J. Lamb, B. G. Miller, L. MacCalman, S. Rashid, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on External Validation Exercise. Teilbericht zur externen Validierung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. J. Lamb, K. S. Galea, B. G. Miller, S. Spankie, M. van Tongeren, G. Hazelwood: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Between-User Reliability Exercise (BURE) and Workshop. Teilbericht über die Zuverlässigkeit und Variabilität zwischen Anwendern mittels Übungsaufgaben und Workshop. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. J. Crawford, H. Cowie, J. Lamb, M. van Tongeren, K. S. Galea: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on User-Friendliness of Tier 1 Exposure Assessment Tools under REACH. Bericht zur Benutzerfreundlichkeit von Tier 1-Expositionsabschätzungswerkzeugen unter REACH.

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			Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. J. Lamb, S. Hesse, B. G. Miller, L. MacCalman, K. Schroeder, J. Cherrie, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Final Overall Project Summary Report. Endbericht zur Evaluierung von Tier 1-Modellen. 1. Auflage. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. Jung, C., Tischer, M., & Schlüter, U. (2016). Further stratification of the ETEAM study results. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. Marquart, H., Franken, R., Goede, H., Fransman, W., & Schinkel, J. (2017). Validation of the dermal exposure model in ECETOC TRA. Annals of work exposures and health, 61(7), 854-871. Van Tongeren, M., Lamb, J., Cherrie, J. W., MacCalman, L., Basinas, I., & Hesse, S. (2017). Validation of lower tier exposure tools used for REACH: comparison of tools estimates with available exposure measurements. Annals of work exposures and health, 61(8), 921-938. Franken, R., Kasiotis, K. M., Tsakirakis, A. N., Chartzala, I., Anastasiadou, P., Machera, K., ... & Spaan, S. (2020). Experimental Assessment of Inhalation and Dermal Exposure to Chemicals During Industrial or Professional Activities in Relation to the Performance of ECETOC TRA. Annals of Work Exposures and Health, 64(9), 944-958. Fransman, W. (2017). How accurate and reliable are exposure models?. Schlueter, U., & Tischer, M. (2020). Validity of tier 1 modelling tools and impacts on exposure assessments within reach registrations—eteam project, validation studies and consequences. International Journal of Environmental Research and Public Health, 17(12), 4589. Spinazzè, A., Borghi, F., Campagnolo, D., Rovelli, S., Keller, M., Fanti, G., ... & Cavallo, D. M. (2019). How to obtain a reliable estimate of occupational exposure? Review and discussion of models' reliability. International journal of environmental research and public health, 16(15), 2764.

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			Urbanus, J., Henschel, O., Li, Q., Marsh, D., Money, C., Noij, D., ... & Wormuth, M. (2020). The ECETOC-Targeted Risk Assessment Tool for Worker Exposure Estimation in REACH Registration Dossiers of Chemical Substances—Current Developments. International Journal of Environmental Research and Public Health, 17(22), 8443. Tischer, M., Lamb, J., Hesse, S., & Van Tongeren, M. (2017). ETEAM Project: An overview of the project background and methodology. Annals of Work Exposures and health. Ishii, S., Katagiri, R., Kitamura, K., Shimojima, M., & Wada, T. (2017). Evaluation of the ECETOC TRA model for workplace inhalation exposure to ethylbenzene in Japan. Journal of Chemical Health & Safety, 24(1), 8-20. Kim, K. E., Kim, J., Jeon, H., Kim, S., & Cheong, Y. (2019). Enhancement of Occupational Exposure Assessment in Korea through the Evaluation of ECETOC TRA according to PROCs. Journal of Environmental Health Sciences, 45(2), 173-185.
Germany	MEASE (The Metals' EASE)		S. Hesse, St. Hahn, K. Schroeder, I. Mangelsdorf, J. Lamb, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Uncertainty of Tier 1 Models. Teilbericht zu Unsicherheiten bei Tier 1-Modellen. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. S. Hesse, K. Schroeder, I. Mangelsdorf, J. Lamb, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Gathering of Background Information and Conceptual Evaluation. Teilbericht zur Sammlung von Hintergrundinformation und der konzeptionellen Evaluierung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. J. Lamb, B. G. Miller, L. MacCalman, S. Rashid, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on External Validation Exercise. Teilbericht zur externen Validierung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. J. Lamb, K. S. Galea, B. G. Miller, S. Spankie, M. van Tongeren, G. Hazelwood: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on Between-User Reliability Exercise (BURE) and Workshop.

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			Teilbericht über die Zuverlässigkeit und Variabilität zwischen Anwendern mittels Übungsaufgaben und Workshop. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. J. Crawford, H. Cowie, J. Lamb, M. van Tongeren, K. S. Galea: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Substudy Report on User-Friendliness of Tier 1 Exposure Assessment Tools under REACH. Bericht zur Benutzerfreundlichkeit von Tier 1-Expositionsabschätzungswerkzeugen unter REACH. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. J. Lamb, S. Hesse, B. G. Miller, L. MacCalman, K. Schroeder, J. Cherrie, M. van Tongeren: Evaluation of Tier 1 Exposure Assessment Models under REACH (eteam) Project - Final Overall Project Summary Report. Endbericht zur Evaluierung von Tier 1-Modellen. 1. Auflage. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015. Jung, C., Tischer, M., & Schlüter, U. (2016). Further stratification of the ETEAM study results. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. Van Tongeren, M., Lamb, J., Cherrie, J. W., MacCalman, L., Basinas, I., & Hesse, S. (2017). Validation of lower tier exposure tools used for REACH: comparison of tools estimates with available exposure measurements. Annals of work exposures and health, 61(8), 921-938.
Germany	VFSMOD	1. Muñoz-Carpena, R., J.E. Parsons, and J.W. Gilliam. 1999. Modeling hydrology and sediment transport in vegetative filter strips. Journal of Hydrology 214(1-4):111-129. doi: 10.1016/S0022-1694(98)00272-8 2. Sabbagh, G., G. Fox, G., R. Muñoz-Carpena and M. Lenz. 2010. A revised framework for pesticide aquatic environmental exposure assessment that accounts for vegetative filter strips. Environmental Science & Technology 44:3839–3845 . doi: 10.1021/es100506s. 3. Muñoz-Carpena, R., G.A. Fox and G.J. Sabbagh. 2010. Parameter Importance and Uncertainty in Predicting Runoff Pesticide Reduction with Filter Strips. J. Environ. Qual. 39(1):630-641. doi:10.2134/jeq2009.0300. 4. Wu, L., B. Gao, R. Muñoz-Carpena and Y. Pachepsky. 2012. Single collector attachment efficiency of colloid capture by a cylindrical collector in laminar overland flow. Environ. Sci. Technol. 46 (16):8878–8886. doi:10.1021/es301365f	Several products including model intercomparison (“cold-testing”) (https://abe.ufl.edu/faculty/carpena/files/pdf/software/vfsmod/WinchellJonesEstes2011.pdf) and over 100 peer-review publications (https://abe.ufl.edu/faculty/carpena/vfsmod/citations.shtml)

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		5. Yu, C., B. Gao, and R. Muñoz-Carpena. 2012. Effect of dense vegetation on colloid transport and removal in surface runoff. J. of Hydrology 434–435:1–6. doi:10.1016/j.jhydrol.2012.02.042 6. Sabbagh, G.J., R. Muñoz-Carpena, G.A. Fox. 2013. Distinct influence of filter strips on acute and chronic pesticide aquatic environmental exposure assessments across U.S. EPA scenarios. Chemosphere 90(2):195-202. doi:10.1016/j.chemosphere.2012.06.034 7. Wu, L., R. Muñoz-Carpena, B. Gao, W. Yang, Y. Pachepsky. 2014 .Colloid filtration in surface dense vegetation: Experimental results and theoretical predictions. Environ. Sci. and Technol. 8(7):3883–3890. doi:10.1021/es404603g 8. Muñoz-Carpena, R. A. Ritter, G.A. Fox and O. Perez-Ovilla. 2015. Does mechanistic modeling of filter strip pesticide mass balance and degradation affect environmental exposure assessments? Chemosphere 139:410-421. doi:10.1016/j.chemosphere.2015.07.010 9. Muñoz-Carpena, R., G. Fox, A. Ritter, I. Rodea-Palomares. 2018 .Effect of vegetative filter strip pesticide residue degradation assumptions for environmental exposure assessments. Science of the Total Environment 619–620:977–987, doi:10.1016/j.scitotenv.2017.11.093 10. Muñoz-Carpena, R., A. Ritter, G. Fox. 2019. Comparison of empirical and mechanistic equations for vegetative filter strip pesticide mitigation in long-term environmental exposure assessments. Water Research 165:1149833. doi:10.1016/j.watres.2019.114983	
Germany	AppDate	EFSA (2020): Scientific report of EFSA on the 'repair action' of the FOCUS surface water scenarios. EFSA Journal 2020;18(6):6119 Klein M (2018): AppDate 3.0. Estimation of consistent application dates dependent on BBCH crop development stages for FOCUS models. Fraunhofer IME, Schmallenberg Klein M (2006): Estimation of reasonable application dates dependent on BBCH crop development stages for PELMO. Report Umweltbundesamt, FKZ: 360 06 034. Fraunhofer IME, Schmallenberg.	EFSA (2020): Scientific report of EFSA on the 'repair action' of the FOCUS surface water scenarios. EFSA Journal 2020;18(6):6119
Germany	STEPS1-2 in FOCUS	FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.1. 221 pp	FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.1. 221 pp
Germany	German scenario for inland water marinas -		

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	Development of a realistic worst-case scenario for antifouling biocides in German inland water marinas		
Germany	BfR calculator for estimating the external exposure of livestock to biocidal active substances	- Guidance on the Biocidal Products Regulation, Vol III Parts B+C, Section 6: Guidance on estimating livestock exposure (Version 4.0, 2017) https://echa.europa.eu/de/guidance-documents/guidance-on-biocides-legislation - Guideline on Risk Characterisation and Assessment of Maximum Residue Limits (MRL) for Biocides (EMA/CVMP/90250/2010) https://www.ema.europa.eu/en/risk-characterisation-assessment-maximum-residue-limits-mrl-biocides	Peer reviewed on EU level by Member States (ECHA ad hoc working group – ARTFood)
Italy	PERSAM (Persistence in soil analytical model)	The PERSAM tool supports the EFSA guidance document for predicting environmental concentrations of active substances of plant protection products and transformation products of these active substances in soil: https://www.efsa.europa.eu/en/efsajournal/pub/4982	The PERSAM software was checked and verified by the EFSA PECs in soil working group. The PECs calculated by PERSAM where compared with the numerical models PEARL and PELMO to ensure the tiered approach presented in the EFSA guidance where respected.
Italy	Guidance on the Assessment of Exposure for Operators, Workers, Residents and Bystanders in Risk Assessment for Plant		

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	Protection Products		
Japan	AIST-ADMER (Atmospheric Dispersion Model for Exposure and Risk Assessment)	H. Higahsino, et al.(2003) Development of the Atmospheric Dispersion Model for Exposure and Risk Assessment (ADMER), J.Jpn.Soc.Atmos.Environ., 38(2) pp.100-115, (in Japanese).	H. Higahsino, et al.(2003) Development of the Atmospheric Dispersion Model for Exposure and Risk Assessment (ADMER), J.Jpn.Soc.Atmos.Environ., 38(2) pp.100-115, (in Japanese)
Japan	ADMER-PRO (Atmospheric Dispersion Model for Exposure and Risk Assessment-PRO)	K. Inoue and H. Higashino (2015) Development and Verification of the Atmospheric Model ADMER-PRO Applicable for Secondary Formation, J.Jpn.Soc.Atmos.Environ., 50(6) pp.278-291 (in Japanese).	K. Inoue and H. Higashino (2015) Development and Verification of the Atmospheric Model ADMER-PRO Applicable for Secondary Formation, J.Jpn.Soc.Atmos.Environ., 50(6) pp.278-291 (in Japanese).
Japan	AIST-CBAM (Chemical Bioaccumulation Model)	Eriguchi, T. et al. (2009) Development of a Bioaccumulation Model for Chemicals in Marine Organisms ―Prototype Model―. Journal of Advanced Marine Science and Technology Society 15 (1), pp.15-21. (in Japanese)	Eriguchi, T. et al. (2009) Bioaccumulation Model for Predicting Chemicals in an Estuary -Tokyo Bay Model for Conger myriaster -. Journal of Advanced Marine Science and Technology Society 15 (2), pp.189-195. (in Japanese)
Japan	G-CIEMS	Suzuki, N., Murasawa, K., Sakurai, T., Nansai, K., Matsuhashi, K., Moriguchi, Y., Tanabe, K., Nakasugi, O. and Morita, M., Environ. Sci. Technol. 38, 5682-5693 (2004)	Suzuki, N., Murasawa, K., Sakurai, T., Nansai, K., Matsuhashi, K., Moriguchi, Y., Tanabe, K., Nakasugi, O. and Morita, M., Environ. Sci. Technol. 38, 5682-5693 (2004) Imaizumi, Y., Suzuki, N., Shiraishi, F., Nakajima, D., Serizawa, S., Sakurai, T., Shiraishi, H. Development and validation of a simulation method, PeCHREM, for evaluating spatio-temporal concentration changes of paddy herbicides in rivers. Environ. Sci.: Process. Impacts, 20, 120-132 (2018) Sakurai, T., Imaizumi, Y., Kuroda, K., Hayashi, T., Suzuki, N. Georeferenced multimedia environmental fate of volatile methylsiloxanes modeled in the populous Tokyo Bay catchment basin. Sci. Total Environ., 689, 843-853 (2019)
Japan	AIST-ICET (Indoor Consumer Exposure	H. Higashino and H. Kajihara (2017) Development of an Indoor Consumer Exposure Tool (ICET), Japanese Journal of Risk Analysis, 26(4), pp.209-216 (in Japanese)	H. Higashino and H. Kajihara (2017) Development of an Indoor Consumer Exposure Tool (ICET), Japanese Journal of Risk Analysis, 26(4), pp.209-216 (in Japanese)

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	Assessment Tool)		
Japan	METI-LIS(Ministry of Economy, Trade and Industry-Low rise Industrial Source dispersion Model)	METI-LIS Model Technical Manual Ver.3.02 (in Japanese) : Available from the JEMAI website. METI-LIS Model Ver.2.0 Technical Manual (with Appendices on validation studies using data from a wind tunnel experiment and multiple field experiments) : The English version will be provided from the JEMAI at official requests.	METI-LIS Model Ver.2.0 Technical Manual (with Appendices on validation studies using data from a wind tunnel experiment and multiple field experiments) : The English version will be provided from the JEMAI at official requests. Kouchi A., Okabayashi K., Okamoto S., Yoshikado H., Yamamoto S., Kobayashi K., Ono N. and Koizumi M.: Development of a low-rise industrial source dispersion model (METI-LIS model), International J. of Environ. and Pollution, 21, 325-338 (2004).
Japan	PACSs Risk Assessment System (We call PRAS-NITE) (PACSs : Priority Assessment Chemical Substances)	https://www.meti.go.jp/policy/chemical_management/kasinhou/files/information/ra/05_tech_guidance_v_haisyutsugengoto_v_1_0_140626.pdf (Only in Japanese)	https://www.nite.go.jp/data/000010058.pdf (Only in Japanese)
Japan	AIST-RAMTB (Ecological Risk Assessment Model for Tokyo Bay)	Horiguchi, F. et al. (2003) Model Study of Environmental Concentrations of TBT in Tokyo Bay - Development of a Windows Version Prototype -. Journal of Advanced Marine Science and Technology Society 8 (2), pp.99-107 (in Japanese)	Horiguchi, F. et al. (2006) Model study of environmental concentrations of TBT in Tokyo Bay – development of a Windows® version prototype. Environmental Modelling & Software 21, pp.229–233.
Japan	AIST-SHANEL (Standardized Hydrology-based AssessmeNt tool for chemical	Y. ISHIKAWA and A. TOKAI (2006) Development of Watershed Model for Chemical Risk Assessment in Aquatic System, Journal of Japan Society on Water Environment, 29(12), pp.797-807 (in Japanese)	Y. ISHIKAWA and A. TOKAI (2006) Development of Watershed Model for Chemical Risk Assessment in Aquatic System, Journal of Japan Society on Water Environment, 29(12), pp.797-807 (in Japanese)

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	Exposure Load)		
Korea	K-CHESAR(Korea CHEmical Safety Assessment and Reporting tool)		SimpleBox Korea has reviewed and validated by related research projects (e.g. Development of technology for chemical risk assessment and predictive chemical risk assessment modeling of chemical exposure in the environment based on K-REACH). * The project reports were written in Korean.
Netherlands	ConsExpo Web	Consumer, exposure, products, emission, spray, evaporation, substances	See reports on the spray exposure model on www.rivm.nl/en/consexpo
Netherlands	Stoffenmanager®	For key reference see: https://stoffenmanager.com/what-is-stoffenmanager/#referenties	For validation studies see: https://stoffenmanager.com/what-is-stoffenmanager/#h-tool-description-333-validation-studies Stoffenmanager® is included REACH Guidance document R.14 on Occupational Exposure Assessment: https://echa.europa.eu/documents/10162/13632/information_requirements_r14_en.pdf/bb14b581-f7ef-4587-a171-17bf4b332378
Netherlands	Lee side turbulence model	Duyzer et al., 2004. De blootstelling van omwonenden van kassen aan gewasbeschermingsmiddelen via de lucht. TNO-rapport R 2004/517.	Generic model with many limitations and a limited validation
Netherlands	NL model mixing & loading		
Netherlands	Animal model 2017		
Netherlands	PRIMo ver. 2.0		
Netherlands	PRIMo rev. 3.1	EFSA (European Food Safety Authority), Anastassiadou M, Brancato A, Carrasco Cabrera L, Ferreira L, Greco L, Jarrah S, Kazocina A, Leuschner R, Magrans JO, Miron I, Pedersen R, Raczyk M, Reich H, Ruocco S, Sacchi A, Santos M, Stanek A, Tarazona J, Theobald A, Verani A, 2019. Pesticide Residue Intake Model- EFSA PRIMo revision 3.1 (update of EFSA PRIMo revision 3). EFSA	

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
		supporting publication 2019:EN-1605. 15 pp. doi:10.2903/sp.efsa.2019.EN-1605 EFSA (European Food Safety Authority), Anastassiadou M, Brancato A, Carrasco Cabrera L, Ferreira L, Greco L, Jarrah S, Kazocina A, Leuschner R, Magrans JO, Miron I, Pedersen R, Raczyk M, Reich H, Ruocco S, Sacchi A, Santos M, Stanek A, Tarazona J, Theobald A, Verani A, 2019. Pesticide Residue Intake Model- EFSA PRIMo revision 3.1 (update of EFSA PRIMo revision 3). EFSA supporting publication 2019:EN-1605. 15 pp. doi:10.2903/sp.efsa.2019.EN-1605 EFSA (European Food Safety Authority), Anastassiadou M, Brancato A, Carrasco Cabrera L, Ferreira L, Greco L, Jarrah S, Kazocina A, Leuschner R, Magrans JO, Miron I, Pedersen R, Raczyk M, Reich H, Ruocco S, Sacchi A, Santos M, Stanek A, Tarazona J, Theobald A, Verani A, 2019. Pesticide Residue Intake Model- EFSA PRIMo revision 3.1 (update of EFSA PRIMo revision 3). EFSA supporting publication 2019:EN-1605. 15 pp. doi:10.2903/sp.efsa.2019.EN-1605	
Netherlands	WUR Drift Calculator	[1] WUR Drift Calculator user manual: Belonging to software version 2.6 Holterman, H. J. & van de Zande, J., Feb 2021, Wageningen: Stichting Wageningen Research, Wageningen Plant Research, Business Unit Agrosystems Research. 43 p. (Report Wageningen Plant Research; no. WPR-877)	No (but the model is fully empirical and directly based on experimental drift data)
Netherlands	xSPEXUS Drift Model	[1] An empirical model based on phenological growth stage for predicting pesticide spray drift in pome fruit orchards. Holterman, H. J., van de Zande, J. C., Huijsmans, J. F. M. & Wenneker, M., 2017, In: Biosystems Engineering. 154, p. 46-61 [2] Development of a spray drift model for spray applications in fruit orchards. Holterman, H. J., van der Zande, J. C., Huijsmans, J. F. M. & Wenneker, M., 2018, Wageningen: Stichting Wageningen Research, Wageningen Plant Research, Business Unit Agrosystems Research. 71 p. (Wageningen Plant Research rapport; no. WPR-566) [3] Scenarios for exposure of aquatic organisms to plant protection products in the Netherlands: Part 2: Sideways and upward spraying in Dutch fruit crops (interim report). Boesten, J. J. T. I., Holterman, H. J., Wipfler, L., ter Horst, M. M. S., van de Zande, J. C. & Adriaanse, P. I., Jan 2018, Wageningen: Wageningen Environmental Research. 55 p. (Wageningen Environmental Research report; no. 2861)	Key reference [1] is peer reviewed
Netherlands	IDEFICS Spray Drift Model	[1] Modelling spray drift from boom sprayers. Holterman, H. J., Van De Zande, J. C., Porskamp, H. A. J. & Huijsmans, J. F. M., Dec 1997, In: Computers and Electronics in Agriculture. 19, 1, p. 1-22 22 p. [2] Spray drift in crop protection: validation and usage of a drift model. Holterman, H.J.,	Key reference [1] is peer reviewed; it includes model validation Key references [2],[3] deal with additional validation experiments

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
		Michielsen, J.M.G.P., Van de Zande, J.C. (1998). Paper presented at the International Conference on Agricultural Engineering (AgEng), Oslo (Norway), August 24-27, 1998, Paper no. 98-A-012, 9 pp. [3] Validatiemetingen ten behoeve van de luchtemissiemodule van IDEFICS : metingen 2004-2005. Stallinga, H., Holterman, H. J., Michielsen, J. G. P. & van Velde, P., 2009, Wageningen: Plant Research International. 34 p. (Nota / Plant Research International; no. 638); in Dutch with English abstract	
Netherlands	GeoPEARL	https://www.pesticidemodels.eu/pearl/references	The model kernels SWAP and PEARL have been tested succesfully against data from field experiments. e.g. Boesten, J.J.T.I. and B. Gottesbüren (2000). Testing PESTLA using two modellers for bentazone and ethoprophos in a sandy soil. Agric. Water Management 44: 283-305.
Netherlands	PEARL	https://www.pesticidemodels.eu/pearl/references	Boesten, J.J.T.I. and B. Gottesbüren (2000). Testing PESTLA using two modellers for bentazone and ethoprophos in a sandy soil. Agric. Water Management 44: 283-305. Scorza, jr., R.P. & J.J.T.I. Boesten, 2005. Simulation of pesticide leaching in a cracking clay soil with the PEARL model. Pest Manag. Sci. 61, 432-448. Tiktak, A., Hendriks, R.F.A. and Boesten, J.J.T.I., 2011. Simulation of movement of pesticides towards drains with a preferential flow version of PEARL. Pest Management Science, 68, 290-302
Netherlands	DROPLET (acronym for 'DRinkwater uit OPpervlakte water-Landbouwkundig gebruik Evaluatie Tool')	Adriaanse, P.I., J.B.H.J. Linders, G.A. van den Berg, J.J.T.I. Boesten, M.W.P. van der Bruggen, K. Jilderda, R. Luttik, W.S.W. Merkens, Y.J. Stienstra and R.J.M. Teunissen, 2008. Development of an assessment methodology to evaluate the use of plant protection products for drinking water production from surface waters. A proposal for the registration procedure in the Netherlands.Wageningen, Alterra-rapport 1635. Leerdam R.C. van, P.I. Adriaanse, M.M.S. ter Horst and J.A. te Roller, 2010. DROPLET to calculate concentrations at drinking water abstraction points; User manual for evaluation of agricultural use of plant protection products for drinking water production from surface waters in the Netherlands; Wageningen, Alterra, Alterra-Rapport 2020. Adriaanse, P.I. and W.H.J. Beltman, Comparison of pesticide concentrations at drinking water abstractions points in The Netherlands simulated by DROPLET version 1.2 and 1.3.2 model suites. Wageningen, the Statutory Research Tasks Unit for Nature & the	DROPLET 1.3.2 is in the process of obtaining compliance with the Status A level for models and databases of Wageningen UR, i.e. conform to requirements for software robustness, software and model performance tests, documentation of the concepts and user documentation. https://www.wur.nl/nl/Onderzoek-Resultaten/Wettelijke-Onderzoekstaken/WOT-Natuur-en-Milieu/Kwaliteit-modellen-en-data-WOT-Natuur-Milieu.htm (in Dutch)

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
		Environment (WOT Natuur en Milieu). Wot-technical report 100, 52 p. Wageningen, The Netherlands.	
Netherlands	TOXSWA	https://www.pesticidemodels.eu/toxswa/references	TOXSWA (FOCUS_TOXSWA version 4.4.3) is in compliance with the Status A level for models and databases of Wageningen UR, i.e. conform to requirements for software robustness, software and model performance tests, documentation of the concepts and user documentation. https://www.wur.nl/nl/Onderzoek-Resultaten/Wettelijke-Onderzoekstaken/WOT-Natuur-en-Milieu/Kwaliteit-modellen-en-data-WOT-Natuur-Milieu.htm (in Dutch) http://dx.doi.org/10.1002/ps.3435
Netherlands	GEM	Wipfler et al. 2015: Manual GEM 1.1.1 http://edepot.wur.nl/348735 Van der Linden et al. 2015. Scenarios for exposure of aquatic organisms to plant protection products in the Netherlands. https://www.rivm.nl/bibliotheek/rapporten/2015-0128.pdf Wipfler et al. 2014. Scenarios for exposure of aquatic organisms to plant protection products in the Netherlands. Soil-bound crops in greenhouses. http://edepot.wur.nl/348731	Publication to be submitted
New Zealand	Risk Assessment for Birds and Mammals (EFSA 2009)	EFSA guidance document: https://www.efsa.europa.eu/en/efsajournal/pub/1438 Risk assessment methodology: risk assessment methodology (see the link above)	
New Zealand	An amended version of the bystander elements of the EFSA operator, worker, resident and bystander exposure model (EFSA, 2014a) is	https://www.efsa.europa.eu/en/efsajournal/pub/1438 Risk assessment methodology: see the link above	

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	used, incorporating exposure the US EPA approach to soil ingestion (US EPA, 1997) to supplement the dermal exposure and hand- and object-to-mouth activity of the EFSA approach		
New Zealand	The ConsExpo 4.1 (National Institute for Public Health and the Environment, 2016a, 2016b) model is used for assessing products intended for use within the home. It can be used for bystanders as well as users with minor parameter	https://www.efsa.europa.eu/en/efsajournal/pub/1438 https://www.rivm.nl/en/consexpo NZ Risk assessment document: Request for feedback on our risk assessment guide | EPA https://www.epa.govt.nz/public-consultations/decided/request-for-feedback-on-our-risk-assessment-guide/	

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	value modifications		
New Zealand	GENEEC2	Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx	See US EPA website
New Zealand	OECD's RexTox model (adapted model)	Barrett, M. 1997. Initial Tier Screening of Pesticides for Groundwater Concentration Using the SCI-GROW Model. U.S. Environmental Protection Agency. Washington, D.C. US EPA, 2003, Sci-Grow Users Manual v2.3, https://archive.epa.gov/oppefed1/web/html/scigrow_users_manual.html US EPA, 2016d, SCI-GROW Description, https://archive.epa.gov/epa/pesticide-science-and-assessing-pesticide-risks/sci-grow-description.html	From US EPA archives: A. Model Evaluation and Validation Some of the efforts in progress include the following: 1. A systematic comparison of SCI-GROW estimates to various ground-water monitoring data sets (for example, to answer the question can SCI-GROW be adopted to predict impacts of pesticides in vulnerable ground water/ drinking water in proportion to their use?) 2. A systematic comparison of SCI-GROW estimates to PRZM predictions of pesticide concentrations in leachate at a site with sandy soils and shallow ground water (SCI-GROW and PRZM estimates are comparable for weakly adsorbed compounds and SCI-GROW estimates are increasingly large relative to PRZM estimates for more strongly adsorbed compounds). 3. Addition of new data from recently completed small-scale prospective ground-water monitoring studies to the SCI-GROW regression data set. (These data are being incorporated into a database which will also be used for Tier 2 ground-water model development and validation). Also, an effort is being made to evaluate results from studies without detections in ground water, comparing SCI-GROW estimates for vulnerable sites with the detection limits in these studies.
New Zealand	ESCORT 2	Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx	ESCORT workinggroup
New Zealand	UK Chemicals Regulation Directorate (CRD)	https://www.efsa.europa.eu/en/efsajournal/pub/1438 Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-	

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	version of the German Federal Biological Research Centre for Agriculture and Forestry's (Biologische Bundesanstalt für Land- und Forstwirtschaft, BBA) operator assessment model is used. This is often referred to as the 'BBA CRD version'	How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx	
New Zealand	Plant exposure spreadsheet	Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx	Validated spraydrift curves
New Zealand	BeeRex (v1 2015)	US EPA: https://www.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance	US EPA validation
New Zealand	OECD's RexTox model (adapted model)	Probst et al., 2005 Probst M. Berenzen N. Lentzen-Godding A. and Schulz R., 2005, Scenario-based simulation of runoff-related pesticide entries into small streams on a landscape level, Ecotoxicological and Environmental Safety 62, 145-159	Peer reviewed in Probs et al 2005

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
New Zealand	ECHA sediment	ECHA guidance (2016): b9f0f406-ff5f-4315-908e-e5f83115d6af.pdf	ECHA processes
New Zealand	PEC soil (Focus 1997 based)	FOCUS Soil Modelling Working Group (1997): https://ec.europa.eu/food/system/files/2016-10/pesticides_ppp_app-proc_guide_fate_soil-persistance-1997.pdf	Validated by overseas authority
New Zealand	AgDRIFT and AgDisp (NZ Modification)	Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx	External subcontractor (2011)
New Zealand	The European Predictive Operator Exposure Model database (EUROPOEM) approach developed by other international regulators (EUROPOEM, 2002; Chemicals Regulation Directorate, 2016b) is used	https://www.efsa.europa.eu/en/efsajournal/pub/1438 Risk assessment methodology: https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Risk-Assessment-methodology/Risk-Assessment-Methodology-for-Hazardous-Substances-How-to-assess-the-risk-cost-and-benefit-of-new-hazardous-substances-for-use-in-New-Zealand-v2.docx	
Slovak Republic	EFSA Pesticide Residue Intake Model (EFSA		

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	PRIMo revision 3.1)		
Slovak Republic	Aminal model 2017 (Livestock dietary burden calculation)		
Sweden	MACRO	Larsbo, M., et al., 2005. An improved dual-permeability model of water flow and solute transport in the vadose zone. Vadose Zone Journal, 4, 398-406. Jarvis, N.J., Larsbo, M. 2012. MACRO (V5.2): Model use, calibration and validation. Trans. ASABE, 55, 1413-1423.	https://esdac.jrc.ec.europa.eu/projects/macro Adriaanse, P., Allen, R., Gouy, V., Hollis, J., Hosang, J., Jarvis, N., Jarvis, T., Klein, M., Layton, R., Linders, J., Schäfer, H., Smeets, L. & Yon, D. 1997. Surface water models and EU registration of plant protection products. Report 6476-VI-96 (EU Commission), Regulatory Modelling Group, FOCUS, 218 pp.
Switzerland	COMLEAM (Construction Materials Leaching Model)	Tietje, O. et al. (2018): Emissions- und Übertragungsfunktionen für die Modellierung der Auslaugung von Bauprodukten. UBA-Texte 28, Umweltbundesamt, Dessau-Rosslau, Germany (https://www.umweltbundesamt.de/publikationen/emissions-uebertragungsfunktionen-fuer-die). Wicke et al. (2021): Bauen und Sanieren als Schadstoffquelle in der urbanen Umwelt. Umweltbundesamt, Dessau-Rosslau, Germany.	Wicke, D. et al. (submitted): Emissions of building materials – a thread for the environment? Journal Water.
UK	Contaminated Land Exposure Assessment (CLEA) model	ENVIRONMENT AGENCY, 2008. Human health toxicological assessment of contaminants in soil, Science Report SC050021/SR2. Bristol: Environment Agency. ENVIRONMENT AGENCY, 2008. Updated technical background to the CLEA model. Science Report SC050021/SR3. Bristol: Environment Agency. ENVIRONMENT AGENCY, 2008. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values, Science Report SC050021/SR7. Bristol: Environment Agency	Model verification was undertaken, but it has not been published. Peer review of the approach has been undertaken by Government with the support of industry on at least two occasions including: (a) as part of the Way Forward review in 2006 (published at the time, but difficult to find), and (b) as part of the development of Category Four Screening Levels. The latter documentation is available here: http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=18341
US	Agricultural Drift (AgDRIFT)	Users should consult the AgDRIFT user guide for discussion of key references.	Peer review of the updated model was conducted by EPA's Office of Pesticide Programs
US	Agricultural Dispersal (AGDISP)	Users should consult the AGDISP user guide for of key references.	Peer review of the updated model was conducted by EPA's Office of Pesticide Programs
US	Pesticide in Flooded		

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	Applications Model		
US	Pesticide Water Calculator		
US	Tier 1 Rice Model		
US	Probabilistic Exposure and Risk Model of Fumigants (PERFUM)	Users should consult the PERFUM user guide for key reference. https://www.exponent.com/~/media/experience/probablistic-exposure-and-risk-model-for-fumigants/perfum3-users-guide.pdf?la=en	Peer review of the updated model was conducted internally by EPA's Office of Pesticide Programs. The PERFUM model was also previously peer reviewed as part of the Scientific Advisory Panel (SAP) in 2004 (https://archive.epa.gov/scipoly/sap/meetings/web/html/082404_mtg.html)
US	DEEM	https://www.epa.gov/sites/production/files/2015-09/documents/deem-user-guide-sep30-14.pdf	https://archive.epa.gov/scipoly/sap/meetings/web/pdf/final_sap_document_feb_1_2000.pdf
US EPA	American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD)	See references provided at: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models	See information at: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models
US EPA	Consumer Exposure Model (CEM)	USEPA (2011). Exposure Factors Handbook: 2011 Edition (EPA/600/R-09/052F). Washington, DC: U.S. Environmental Protection Agency USEPA (2007). Exposure and fate assessment screening tool (E-FAST): Version 2.0, documentation manual CEM User Guide: https://www.epa.gov/tsca-screening-tools/consumer-exposure-model-cem-version-21-users-guide	CEM version 2.1 was peer reviewed in 2019 by external experts.
US EPA	Chemical Screening Tool for Exposures	Please refer to the ChemSTEER User Guide for references: https://www.epa.gov/tsca-screening-tools/chemsteer-quick-start-guide-and-user-guide-tsca-predictive-screening-tool	The methods and models in ChemSTEER have undergone internal EPA review and most have been used extensively in EPA assessments for over 10 years. Some models have been peer reviewed.

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	and Environmental Releases (ChemSTEER)		
US EPA	Exposure and Fate Assessment Screening Tool (E-FAST)	See information at https://www.epa.gov/tsca-screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014	The consumer portions of E-FAST have been peer reviewed by experts outside EPA, and EPA has developed E-FAST 2014 based on the external peer review for the general population, down-the-drain, environmental exposure and risk aspects of E-FAST.
US EPA	Indoor Environment Concentration in Buildings with Conditioned and Unconditioned Zones (IECCU)	See documentation at https://www.epa.gov/sites/default/files/2017-06/documents/ieccu_questions_and_answers.pdf	An external (i.e., by scientists outside of EPA) peer review of IECCU was conducted in 2016. Beta-testing was also conducted in 2016 and 2017. Revisions to the model in response to the peer reviewers' comments were completed in 2017.
US EPA	Integrated Indoor-Outdoor Air Calculator (IIOAC)		IIOAC is a tool based on EPA's AERMOD. AERMOD is EPA's recommended air dispersion model and has been subject to peer review and model evaluation See information at: https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator#review
US EPA	Multi-Chamber Concentration and Exposure Model (MCCEM) version 1.2 (via Internet	Koontz, MD, and Nagda, NL, 1991, "A Multichamber Model for Assessing Consumer Inhalation Exposure," Indoor Air, Vol. 4, pp 593-605.	Described in the peer-reviewed literature (Koontz and Nagda, 1991)

Country/Organisation	Model name	Key references	Peer review, validation or verification reference
	Geographical Exposure Modeling System (IGEMS))		
US EPA	Point Source Calculator (PSC) v1.05	Young, D.F. 2014. The Variable Volume Water Model, EPA-734-F-14-003, United States EPA Washington DC.	An external peer review was completed in 2004 for the Variable Volume Water Model that serves as foundation of the PSC model.
US EPA	EPA's Risk-Screening Environmental Indicators (RSEI) Model	https://www.epa.gov/rsei	EPA's RSEI model has been peer reviewed by the Science Advisory Board (EPA-SAB-EEC-98-007)
US EPA	Wall Paint Exposure Model (via Internet Geographical Exposure Modeling System (IGEMS))	-WESTAT, 1987. Household Solvent Products: A National Usage Survey. Final report prepared for USEPA Office of Pollution Prevention and Toxics under EPA Contract No. 68-02-4243. -USEPA, 1992. Guidelines for Exposure Assessment. EPA/600/Z-92/001, U.S. Environmental Protection Agency, Office of Research and Development, Office of Health and Environmental Assessment. -USEPA, 1997. Exposure Factors Handbook, Volumes I-III. EPA/600/P-95/002Fa, b, c, U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment.	The model has been peer reviewed by experts outside EPA.
US EPA	EPI Suite	https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface	

Annex E. Availability, Accessibility, Disclosure and CBI

Country/Organisation	Model name	Availability				Accessibility to the model				Disclosure of the model description (equation/formula, parameter values, etc.)					CBI confidential to the user?	
		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
Australia	Environmental Emission Scenarios for Product Type 14: Biocides used as rodenticides	X					X			X			X			X
Australia	AgDRIFT version 2.1.1	X													X	
Australia	T-REX	X					X			X					X	
Australia	EPISUITE v4.11	X					X			X					X	
Australia	AgDISP version 8.26	X													X	
Australia	Beerex	X					X			X					X	
Australia	ConsExpo	X				X				X					X	
Australia	SimpleTreat v3.0			X					X	X			X		X	
Bayer	Bayer Safety Standard for Operator Safety	X					X			X						X
Canada	Consexpo	X				X				X				X	X	
Canada	Consumer/Industrial Drinking water/PECaqua Models	X					X						X		X	

Country/Organisation	Model name	Availability				Accessibility to the model				Disclosure of the model description (equation/formula, parameter values, etc.)					CBI confidential to the user?	
		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
Canada	SCREEN3	X					X			X						X
Canada	ChemCAN	X					X							X	X	
Canada	Canadian Veterinary Drug PECsoil Model	X					X			X			X		X	
Canada	U.S. Environmental Protection Agency's Consumer Exposure Model (CEM)	X					X			X					X	
Canada	Swimmer Exposure Assessment Model (SWIMODEL)	X					X									X
Canada	Dietary Exposure Evaluation Model - Food Commodity Intake Database (DEEM-FCID)	X					X									X
Canada	Generic Exposure Data										X			X	X	
Canada	The Standard Operating Procedures for Residential Pesticide Exposure Assessment	X					X	X							X	
Canada	PWC – the Pesticide in Water Calculator	X					X			X		X			X	
Canada	1)AGDISP 8.21 2) PMRA Buffer Zone Models (field boom sprayer and airblast sprayers)	X						X		X			X		X	
Canada	Risk Assessment IDentification and	X				X	X	X		X			X			X

Country/Organisation	Model name	Availability				Accessibility to the model				Disclosure of the model description (equation/formula, parameter values, etc.)					CBI confidential to the user?	
		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
	Ranking Model (RAIDAR) + EAS-E Suite															
Canada	AERMOD	X					X								X	
Canada	Artifical Intelligence Expert Predictive System (AIEPS) v3.0	X						X						X	X	
Canada	Biosolids-Amended Soil: Level IV (BASL4)	X					X			X				X	X	
Canada	CATALOGIC biodeg.		X				X			X						X
Canada	Canadian POPs	X	X				X							X		X
Canada	Consumer Release Aquatic Model (CRAM)	X		X				X					X		X	
Canada	New Equilibrium Criterion model (EQC)	X					X			X				X	X	
Canada	Soil exposure from air deposition spreadsheet program			X					X	X					X	
Canada	STP-EX	X		X				X		X					X	
Canada	TaPL3	X					X			X				X	X	
Canada	UVCB Modifier			X					X	X					X	
Canada	Wildlife spreadsheet models				X				X				X			X
Canada	Bioconcentration for Ionizable Organics (BIONIC)	X					X	X		X						X
Canada	OECD POV and LRTP Screening Tool v2.2	X					X									X
Canada	CATALOGIC BCFMax		X				X			X						X

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Concawe	PetroRisk	X					X			X					X	
Costa Rica	Surface water tool for exposure prediction-STEP 1-2	X					X			X					X	
Creme Global	Creme Food Safety/Creme Food Data Science Model		X		X	X				X					X	
Creme Global	Creme/RIFM Aggregate Exposure Model		X		X	X				X					X	
Creme Global	CARES NG	X				X		X		X					X	
ECHA	Chesar - CHemical Safety Assessment and Reporting tool	X					X			X				X	X	
ECHA	EUSES 2.2.0	X					X			X			X		X	
EFSA	Exposure calculation spreadsheet of the EFSA Guidance on the assessment of exposure of operators, workers, residents and bystanders in risk assessment for plant protection product	X					X			X			X		X	
EFSA	EFSA PRIMo rev. 3.1	X					X			X			X			X
Eurometaux	Metal EUSES DU scaling tool	X					X					X	X			X
Eurometaux	Eurometaux SPERCs	X					X			X	X				X	
France	MODUL'ERS	X	X						X	X				X		X
Germany	Stoffenmanager	X			X	X									X	

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	(version 8.3)															
Germany	EMKG-Expo-Tool 2.0	X					X								X	
Germany	The Advanced Reach Tool (ART) (version 1.5)	X				X				X					X	
Germany	RISKOFDERM	X					X			X			X		X	
Germany	ConsExpo	X				X				X					X	
Germany	Professional-Users Generic Simple Database Models (TNsG 2002 & 2007) – Recommended Models for Primary (direct) Exposure	X					X			X					X	
Germany	ECETOC-TRA (ECETOC's Targeted Risk Assessment tool), version 3.1 (ONLY the tool for workers / occupational exposure tool is considered here!)	X					X	X		X			X		X	
Germany	MEASE (The Metals' EASE)	X					X	X		X(only version 1.02.01)					X	
Germany	VFSMOD	X					X			X		X			X	
Germany	AppDate	X								X						X
Germany	STEPS1-2 in FOCUS	X								X						X
Germany	German scenario for inland water marinas - Development of a realistic worst-case	X					X			X					X	

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		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
	scenario for antifouling biocides in German inland water marinas															
Germany	BfR calculator for estimating the external exposure of livestock to biocidal active substances	X				X	X			X					X	
Italy	PERSAM (Persistence in soil analytical model)	X					X			X					X	
Italy	Guidance on the Assessment of Exposure for Operators, Workers, Residents and Bystanders in Risk Assessment for Plant Protection Products	X					X			X			X		X	
Japan	AIST-ADMER (Atmospheric Dispersion Model for Exposure and Risk Assessment)	X					X			X						X
Japan	ADMER-PRO (Atmospheric Dispersion Model for Exposure and Risk Assessment-PRO)	X						X		X						X
Japan	AIST-CBAM (Chemical Bioaccumulation	X						X		X					X	

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	Model)															
Japan	G-CIEMS	X					X			X						X
Japan	AIST-ICET (Indoor Consumer Exposure Assessment Tool)	X					X			X						X
Japan	METI-LIS(Ministry of Economy, Trade and Industry-Low rise Industrial Source dispersion Model)	X					X			X					X	
Japan	PACSs Risk Assessment System (We call PRAS-NITE) (PACSs:Priority Assessment Chemical Substances)	X					X			X			X			X
Japan	AIST-RAMTB (Ecological Risk Assessment Model for Tokyo Bay)	X						X		X					X	
Japan	AIST-SHANEL (Standardized Hydrology-based AssessmeNt tool for chemical Exposure Load)	X						X		X					X	
Korea	K-CHESAR(Korea CHEmical Safety Assessment and Reporting tool)	X					X							X	X	
Netherlands	ConsExpo Web	X					X									
Netherlands	Stoffenmanager®	X	X			X										

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Netherlands	Lee side turbulence model	X					X			X						X
Netherlands	NL model mixing & loading	X					X						X			X
Netherlands	Animal model 2017	X					X								X	
Netherlands	PRIMo ver. 2.0	X					X			X					X	
Netherlands	PRIMo rev. 3.1	X					X			X					X	
Netherlands	WUR Drift Calculator	X					X			X					X	
Netherlands	xSPEXUS Drift Model				X				X	X					X	
Netherlands	IDEFICS Spray Drift Model			X					X	X					X	
Netherlands	GeoPEARL	X								X					X	
Netherlands	PEARL	X					X			X					X	
Netherlands	DROPLET (acronym for 'DRinkwater uit OPpervlaktewater-Landbouwkundig gebruik Evaluatie Tool')	X					X			X					X	
Netherlands	TOXSWA	X					X			X					X	
Netherlands	GEM	X								X					X	
New Zealand	Risk Assessment for Birds and Mammals (EFSA 2009)	X						X		X						X
New Zealand	An amended version of the bystander elements of the EFSA operator, worker, resident and bystander exposure model (EFSA, 2014a)							X					X			X

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	is used, incorporating exposure the US EPA approach to soil ingestion (US EPA, 1997) to supplement the dermal exposure and hand- and object-to-mouth activity of the EFSA approach															
New Zealand	The ConsExpo 4.1 (National Institute for Public Health and the Environment, 2016a, 2016b) model is used for assessing products intended for use within the home. It can be used for bystanders as well as users with minor parameter value modifications					X		X					X			X
New Zealand	GENEEC2				X				X	X				X		X
New Zealand	OECD's RexTox model (adapted model)				X								X			X
New Zealand	ESCORT 2	X						X		X			X			X
New Zealand	UK Chemicals Regulation Directorate (CRD) version of the German Federal Biological Research Centre for Agriculture							X					X			X

Country/Organisation	Model name	Availability				Accessibility to the model				Disclosure of the model description (equation/formula, parameter values, etc.)					CBI confidential to the user?	
		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
	and Forestry's (Biologische Bundesanstalt für Land- und Forstwirtschaft, BBA) operator assessment model is used. This is often referred to as the 'BBA CRD version'															
New Zealand	Plant exposure spreadsheet	X						X		X			X			X
New Zealand	BeeRex (v1 2015)	X					X			X			X			X
New Zealand	OECD's RexTox model (adapted model)	X						X		X			X			X
New Zealand	ECHA sediment	X						X		X			X			X
New Zealand	PEC soil (Focus 1997 based)	X						X		X			X			X
New Zealand	AgDRIFT and AgDisp (NZ Modification)	X						X		X			X			X
New Zealand	The European Predictive Operator Exposure Model database (EUROPOEM) approach developed by other international regulators (EUROPOEM, 2002; Chemicals Regulation Directorate, 2016b) is							X					X			X

Country/Organisation	Model name	Availability				Accessibility to the model				Disclosure of the model description (equation/formula, parameter values, etc.)					CBI confidential to the user?	
		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
	used															
Slovak Republic	EFSA Pesticide Residue Intake Model (EFSA PRIMo revision 3.1)	X					X			X			X			X
Slovak Republic	Aminal model 2017 (Livestock dietary burden calculation)	X					X			X			X			X
Sweden	MACRO	X					X			X						X
Switzerland	COMLEAM (Construction Materials Leaching Model)	X				X	X			X					X	
UK	Contaminated Land Exposure Assessment (CLEA) model	X					X			X			X			X
US	Agricultural Drift (AgDRIFT)	X					X			X					X	
US	Agricultural Dispersal (AGDISP)	X					X			X					X	
US	Pesticide in Flooded Applications Model	X					X									X
US	Pesticide Water Calculator	X					X									X
US	Tier 1 Rice Model	X												X		X
US	Probabilistic Exposure and Risk Model of Fumigants (PERFUM)	X					X			X					X	
US	DEEM	X					X			X					X	
US EPA	American Meteorological	X					X			X		X			X	

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	Society/Environmental Protection Agency Regulatory Model (AERMOD)															
US EPA	Consumer Exposure Model (CEM)	X					X			X					X	
US EPA	Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER)	X						X		X						X
US EPA	Exposure and Fate Assessment Screening Tool (E-FAST)	X					X			X					X	
US EPA	Indoor Environment Concentration in Buildings with Conditioned and Unconditioned Zones (IECCU)	X					X			X					X	
US EPA	Integrated Indoor-Outdoor Air Calculator (IIOAC)	X					X								X	
US EPA	Multi- Chamber Concentration and Exposure Model (MCCEM) version 1.2 (via Internet Geographical Exposure Modeling System (IGEMS))	X				X									X	

Country/Organisation	Model name	Availability				Accessibility to the model				Disclosure of the model description (equation/formula, parameter values, etc.)					CBI confidential to the user?	
		Available(free)	Licence needed	Unavailable	Others	Web-based	Download via website	Distributed by request	Others	Document published	Confidential	Disclosure of source code	Described in a spreadsheet	Others	Yes	No
US EPA	Point Source Calculator (PSC) v1.05	X					X			X					X	
US EPA	EPA's Risk-Screening Environmental Indicators (RSEI) Model	X			X	X	X	X	X	X			X	X		
US EPA	Wall Paint Exposure Model (via Internet Geographical Exposure Modeling System (IGEMS))	X				X	X			X					X	
US EPA	EPI Suite	X					X								X	

Annex F. Additional model information provided

Country/Organisation	Model name	General description	Website URL
Australia	Refinement of Aquatic Exposure Estimates in Australian Pesticide Environmental Assessments	Tiered approach that begins with realistic worst-case scenario followed by refinements that consider real world spatial (soil & site characteristics) and temporal (seasonal rainfall) characteristics of Australia's growing regions	https://apvma.gov.au/node/46426
Australia	PEC soil calculators	This spreadsheet will calculate soil PECs (including accumulation) for active substances resulting from multiple applications and allows for different application rates and application intervals.	https://www.hse.gov.uk/pesticides/pesticides-registration/data-requirements-handbook/fate/pec-tools-2015/PEC%20Soil.xlsx
Australia	SDRAM	spray drift model & tools	https://apvma.gov.au/node/51826
Australia	SDRAT	spray drift model & tools	https://apvma.gov.au/node/39701
Australia	SDMT	spray drift model & tools	https://apvma.gov.au/node/39706
Canada	Dietary burden and anticipated residues in animal matrices calculator	A linear and non-linear Langmuir model in MS Excel for the analysis of residue data from livestock feeding studies in conjunction with livestock dietary burden estimates.	n/a
Canada	ENASGIP	Europe-North America Soil Geographic Information for Pesticide Studies	n/a
Canada	BCF SEQcalcR	R package for estimating bioconcentration factors	n/a
Canada	PestDF	Kinetic analysis: Calculating representative half lives developed by the U.S. EPA	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-calculate-representative-half-life-values
Canada	EPISuiteV4.11	The Estimations Programs Interface for Windows (EPI Suite) includes an interface program that transfers a single SMILES Notation to thirteen separate structure estimation programs that require SMILES notations. The thirteen stand-alone programs that are part of the EPI Suite of Programs, are: AOPWIN - estimates atmospheric oxidation rates BCFBAF - estimates bioconcentration factor (BCF) and biotransformation rate (kM) HENRYWIN - estimates Henry's law constant HYDROWIN - estimates aqueous hydrolysis rates (acid-, base-catalyzed) KOAWIN - estimates octanol-air partition coefficient	https://www.epa.gov/tsca-screening-tools/download-epi-suitetm-estimation-program-interface-v411

Country/Organisation	Model name	General description	Website URL
		KOWWIN - estimates octanol-water partition coefficient MPBPVP - estimates melting pt, boiling pt, and vapor pressure (also referred to as MPBPWIN) WSKOWWIN - estimates water solubility (from log octanol-water partition coefficient) WATERNT - estimates water solubility (using atom-fragment methodology)	
EFSA	Feed Additives Conumer Exposure (FACE)	used for the regulatory risk assessment of feed additives	https://www.efsa.europa.eu/en/science/tools-and-resources
EFSA	Food Additives Intake Model (FAIM)	used for the regulatory risk assessment of food additives	https://www.efsa.europa.eu/en/science/tools-and-resources
EFSA	Rapid Assessment of Contaminant Exposure (RACE)	used for the assessment of notifications circulated through the Rapid Alert System for Food and Feed (RASFF)	https://www.efsa.europa.eu/en/science/tools-and-resources
EFSA	Dietery Exposure (DietEx) tool	used as a more generic tool for estimation of dietary exposure in other domains such as contaminants, proteins, novel foods, etc.	https://www.efsa.europa.eu/en/science/tools-and-resources
EFSA	Feed additives environmental risk assessment (FERA) calculation tool		https://www.efsa.europa.eu/en/applications/feedadditives/tools
EFSA	DietaryBurdenCalculator	Model to calculate dietary burden of fish to pesticide residues:	https://www.ime.fraunhofer.de/en/Research_Divisions/Division_AE/Software_E/DBC.html
EFSA	WHO IEDI model	for chronic exposure to pesticides	
EFSA	WHO IESTI model	for acute exposure to pesticides	
EFSA	EFSA bee guidance, 2013		https://www.efsa.europa.eu/en/efsajournal/pub/3295
EFSA	PRZM	surface runoff model	https://www.epa.gov/ceam/przm-version-index https://esdac.jrc.ec.europa.eu/projects/przmsw
EFSA	PELMO model	for estimating concentrations in soil and groundwater	
EFSA	EVA3	EXCEL based short range aerial transport and deposition 'model' used in Germany and other EU member states for estimating this deposition route to surface water	https://www.bvl.bund.de/EN/Tasks/04_Plant_protection_products/03_Applicants/04_AuthorisationProcedure/08_Environment/ppp_environment_node.html
European Solvents Industry Group (ESIG)	EGRET	Consumer exposure estimation for solvents from formulated products in commerce.	https://www.esig.org/reach-ges/consumers/
EU	TRA consumers 3.0		
EU	FEE tool		
EU	ECPA LET tool		
EU	CHARM		https://eosca.eu/wp-content/uploads/2018/08/CHARM-User-Guide-Version-1-5.pdf
Germany	EVA3	Estimation of deposition caused by drift and volatilisation of active substances contained in plant protection products in non-target areas (Exposure Via Air).	https://www.bvl.bund.de/EN/Tasks/04_Plant_protection_products/03_Applicants/04_AuthorisationProcedure/08_Environment/ppp_environment_node.html

Country/Organisation	Model name	General description	Website URL
		The program EVA3 calculates PEC and TER values for adjacent surface waters (water bodies, sediment) and terrestrial ecotones on the basis of current basic drift values and empirical models for deposition after volatilisation. Volatilisation is examined for treated crops outdoors and in greenhouses. To support FOCUS step 4 calculations, time-resolved values for deposition after volatilisation on a 1-h time scale from 0-24 h are provided on a separate worksheet.	
Germany	EXPOSIT 3.02	Calculation of the entry of plant protection products into surface and groundwater, particularly taking into consideration surface run-off and drainage	https://www.bvl.bund.de/EN/Tasks/04_Plant_protection_products/03_Applicants/04_AuthorisationProcedure/08_Environment/ppp_environment_node.html

Annex G. Original responses provided

Access the original survey responses at: https://www.oecd.org/chemicalsafety/risk-assessment/survey-report-exposure-assessment-models-annex-G-original-responses.zip