

Model application	Model Title/Name	References
Multi-media	BETR	Exploring the fate, transport and risk of Perfluorooctane Sulfonate (PFOS) in a coastal region of China using a multimedia model. By Liu, Shijie; Lu, Yonglong; Xie, Shuangwei; Wang, Tieyu; Jones, Kevin C.; Sweetman, Andrew J. From <i>Environment International</i> (2015), 85, 15-26.
	SF-tool	Simulating the uncertain effect of active carbon capping of a dioxin- polluted Norwegian fjord. By Starrfelt, Jostein; Saloranta, Tuomo M. From <i>Integrated Environmental Assessment and Management</i> (2015), 11(3), 481-489.
	BETR	Using gridded multimedia model to simulate spatial fate of Benzo[ $\alpha$ ] pyrene on regional scale.  By Liu, Shijie; Lu, Yonglong; Wang, Tieyu; Xie, Shuangwei; Jones, Kevin C.; Sweetman, Andrew J. From <i>Environment International</i> (2014), 63, 53-63.
	Level III	Multimedia modeling of the fate of triclosan and triclocarban in the Dongjiang River Basin, South China and comparison with field data. By Zhang, Qian-Qian; Zhao, Jian-Liang; Liu, You-Sheng; Li, Ben-Gang; Ying, Guang-Guo. From <i>Environmental Science: Processes &amp; Impacts</i> (2013), 15(11), 2142-2152.
	EQC model, RAIDAR model,  ChemCAN, the OECD Tool, BETR Models, the EQC-Spreadsheet Level III model	Uncertainty analysis using a fugacity- based multimedia mass- balance model: Application of the updated EQC model to decamethylcyclopentasiloxane (D5). By Kim, Jaeshin; Powell, David E.; Hughes, Lauren; Mackay, Don. From <i>Chemosphere</i> (2013), 93(5), 819-829.
	Extensions on the fugacity-based models of Paterson et al. (1994) and Hung and MacKay (1997)	Modeling the difference among Cucurbita in uptake and translocation of p, p'- dichlorophenyl-1, 1- dichloroethylene. By Gent, Martin P. N.; White, Jason C.; Eitzer, Brian D.; Mattina, MaryJane Incorvia. From <i>Environmental Toxicology and Chemistry</i> (2007), 26(12), 2476-2485.
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	BETR-World model	BETR- World: a geographically explicit model of chemical fate: application to transport of $\alpha$ -HCH to the Arctic. By Toose, L.; Woodfine, D. G.; MacLeod, M.; Mackay, D.; Gouin, J. From Environmental Pollution (Amsterdam, Netherlands) (2004), 128(1-2), 223-240
	SoilFug model, Level I	Pesticide risk assessment in a lagoon ecosystem. Part I: Exposure assessment. By Villa, Sara; Finizio, Antonio; Vighi, Marco From Environmental Toxicology and Chemistry (2003), 22(4), 928-935.
	BETR-North America	BETR North America: A regionally segmented multimedia contaminant fate model for North America By MacLeod, Matthew; Woodfine, David G.; Mackay, Donald; McKone, Tom; Bennett, Deborah; Maddalena, Randy. From Environmental Science and Pollution Research International (2001), 8(3), 156-163.
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	Level IV, CoZMo-POP model	Estimating the Influence of Forests on the Overall Fate of Semivolatile Organic Compounds Using a Multimedia Fate Model. By Wania, Frank; McLachlan, Michael S. From Environmental Science and Technology (2001), 35(3), 582-590.
	Level IV	Simulation of long- term environmental dynamics of polychlorinated dibenzo- p- dioxins and polychlorinated dibenzofurans using the dynamic multimedia environmental fate model and its implication to the time trend analysis of dioxins. By Suzuki, Noriyuki; Yasuda, Masashi; Sakurai, Takeo; Nakanishi, Junko. From Chemosphere (2000), 40(9-11), 969-976.
	CHEMFRANCE, a regional fugacity level III model	Modeling the environmental fate of atrazine. By Devillers, J.; Bintein, S.; Domine, D. From Book of Abstracts, 211th ACS National Meeting, New Orleans, LA, March 24-28 (1996), AGRO-072.

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	SHED-MM, SHED-HT	SHEDS- HT: an integrated probabilistic exposure model for prioritizing exposures to chemicals with near- field and dietary sources. By Isaacs Kristin K; Glen W Graham; Egeghy Peter; Goldsmith Michael-Rock; Smith Luther; Vallero Daniel; Brooks Raina; Grulke Christopher M; Ozkaynak Haluk. From Environmental science & technology (2014), 48(21), 12750-9.
	Generic regional models	A critical assessment of the environmental fate of linear and cyclic volatile methylsiloxanes using multimedia fugacity models.  By Panagopoulos, Dimitri; MacLeod, Matthew  From Environmental Science: Processes & Impacts (2018), 20(1), 183-194.
	Level III and IV multimedia fugacity models	Quantitative assessment of human health risks induced by vehicle exhaust polycyclic aromatic hydrocarbons at Zhengzhou via multimedia fugacity models with cancer risk assessment.  By Li, Qian; Kim, Minjeong; Liu, Ying; Yoo, ChangKyoo. From Science of the Total Environment (2018), 618, 430-438.
	CeStoc in steady state	The environmental fate of polybrominated diphenyl ethers in the center of Stockholm - assessment using a multimedia fugacity model. By Palm, Anna  From IVL Report (2001), (B 1400), i-ii, 1-64.
	level IV fugacity model	Intermittent Rainfall in Dynamic Multimedia Fate Modeling. By Hertwich, Edgar G. From Environmental Science and Technology (2001), 35(5), 936-940.
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	Level III	Multimedia Model for Polycyclic Aromatic Hydrocarbons (PAHs) and Nitro- PAHs in Lake Michigan. By Huang, Lei; Batterman, Stuart A. From Environmental Science & Technology (2014), 48(23), 13817-13825
	Level III and IV	Persistence of Parent Compounds and Transformation Products in a Level IV Multimedia Model  -Kathrin Fenner, Martin Scheringer, and Konrad Hungerbuhler  -2000
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	Level II Mackay model	A regional Chemical Fate and Exposure model suitable for Denmark and its Coastal Sea  -M. Severinsen, M. B. Andersen, F. Chen, N. Nyholm  -1996

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	Level III, steady state	Developing a multimedia model of chemical dynamics in an urban area. By Diamond, M. L.; Priemer, D. A.; Law, N. L. From Chemosphere (2001), 44(7), 1655-1667.
	Level III, Multimedia Urban Model (MUM)	Application of the Multimedia Urban Model To Compare the Fate of SOCs in an Urban and Forested Watershed. By Priemer, David A.; Diamond, Miriam L. From Environmental Science and Technology (2002), 36(5), 1004-1013.
	Level IV	Assessment of Industry- Induced Urban Human Health Risks Related to Benzo[a] pyrenebased on a Multimedia Fugacity Model: Case Study of Nanjing, China.  By Xu Linyu; Song Huimin; Wang Yan; Yin Hao; Song Huimin From International journal of environmental research and public health (2015), 12(6), 6162-78.

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River/Bodies of water	fugacity/aquivalence-based model (Level III QWASI model), TRANSPEC	Contaminant fate and transport in the Venice Lagoon: Results from a multi- segment multimedia model By Sommerfreund, J. K.; Gandhi, N.; Diamond, M. L.; Mugnai, C.; Frignani, M.; Capodaglio, G.; Gerino, M.; Bellucci, L. G.; Giuliani, S. From Ecotoxicology and Environmental Safety (2010), 73(3), 222-230.
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	QWASI	Modeling the multimedia fate dynamics of $\gamma$ - hexachlorocyclohexane in a large Chinese lake. By Kong, Xiangzhen; He, Wei; Qin, Ning; He, Qishuang; Yang, Bin; Ouyang, Huiling; Wang, Qingmei; Yang, Chen; Jiang, Yujiao; Xu, Fuli. From Ecological Indicators (2014), 41, 65-74.
	EQC model	The environmental fate of polybrominated diphenyl ethers (PBDEs) in western Taiwan and coastal waters: evaluation with a fugacity- based model. By O'Driscoll, Kieran; Robinson, Jill; Chiang, Wen-Son; Chen, Yang-Yih; Kao, Ruey-Chy; Doherty, Rory. From Environmental Science and Pollution Research (2016), 23(13), 13222-13234.
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		Jun; Zeng, Eddy Y. From Environmental Pollution (Oxford, United Kingdom) (2016), 212, 598-604.
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	Multi-compartment fugacity model	Modeling the impact of biota on polychlorinated biphenyls (PCBs) fate and transport in Lake Ontario using a population-based multi-compartment fugacity approach By Sun, Xiangfei; Ng, Carla A.; Small, Mitchell J. From Environmental Pollution (Oxford, United Kingdom) (2018), 241, 720-72
	STREAM-EU (Spatially and Temporally Resolved Exposure Assessment Model for European Basins)	Estimating emissions of PFOS and PFOA to the Danube River catchment and evaluating them using a catchment- scale chemical transport and fate model. By Lindim, C.; Cousins, I. T.; van Gils, J. From Environmental Pollution (Oxford, United Kingdom) (2015), 207, 97-106.
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	CoZMo-POP2 model	Modeling toxaphene behavior in the Great Lakes.  By Xia, Xiaoyan; Hopke, Philip K.; Holsen, Thomas M.; Crimmins, Bernard S.  From Science of the Total Environment (2011), 409(4), 792-799.
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	QWASI, Level V model, Level IV, III, II, I	
	MacLeod et al (2005) fugacity-based mass balance model	Mercury cycling and species mass balances in four North American lakes. By Qureshi, Asif; MacLeod, Matthew; Scheringer, Martin; Hungerbuehler, Konrad. From Environmental Pollution (Oxford, United Kingdom) (2008), Volume Date2009, 157(2), 452-462.
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	QWASI	Reconstruction of historical trends of PCDD /Fs and PCBs in the Venice Lagoon, Italy. By Dalla Valle, Matteo; Marcomini, Antonio; Jones, Kevin C.; Sweetman, Andrew J. From Environment International (2005), 31(7), 1047-1052.
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	Level III	Fate and risk evaluation of persistent organic contaminants and related compounds in Victoria Harbor, Hong Kong. By Connell, D. W.; Wu, R. S. S.; Richardson, B. J.; Leung, K.; Lam, P. S. K.; Connell, P. A. From Chemosphere (1998), 36(9), 2019-2030.
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	QWASI fugacity /equivalence approach	Development of a mass balance model of the fate of 17 chemicals in the Bay of Quinte.  By Diamond, Miriam L.; Poulton, Donald J.; Mackay, Donald; Stride, F. A. From Journal of Great Lakes Research (1994), 20(4), 643-66.
	QWASI	Modeling the long- term behavior of an organic contaminant in a large lake: application to PCBs in Lake Ontario. By Mackay, Donald. From Journal of Great Lakes Research (1989), 15(2), 283-97.
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	Level II, III-W and III-S	Fate factors and emission flux estimates for emerging contaminants in surface waters.

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	<p>“coupling the “multiplier method” to the Quantitative Water Air Sediment Interaction (QWASI) model”, Harvard GEOS-CHEM model, Acid Deposition and Oxidants Model (ADOM), Community Multi-Scale Air Quality (CMAQ), Global/Regional Atmospheric Heavy Metals Model (GRAHM), fugacity/aquivalence QWASI model (FA-QWASI), RIVMOD (hydrodynamic and sediment transport model), WASP 5 (water quality model), and</p>	<p>The development and application of a mass balance model for mercury (total, elemental and methyl) using data from a remote lake (Big Dam West, Nova Scotia, Canada) and the multi-species multiplier method</p> <p>-A.L.M. Ethier, D. Mackay, L.K. Toose-Reid, N.J. O’Driscoll, A.M. Scheuhammer, D.R.S. Lean</p> <p>-Applied Geochemistry 23 (2008) 467–481</p>

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	Multispecies QWASI Model	Diamond, M.; Ganapathy, M.; Peterson, S.; Mach, C. Mercury dynamics in the Lahontan Reservoir, Nevada: Application of the QWASI fugacity/aquivalence multispecies model. Water Air Soil Pollut. 2000, 117, 133-156.
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	Riederer (1990) "A simple fugacity model"	Estimating Partitioning and Transport of Organic Chemicals in the Foliage/ Atmosphere System: Discussion of a Fugacity-Based Model  -Markus Riederer  -1990
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Waste Water	Level III	Linking the environmental loads to the fate of PPCPs in Beijing: Considering both the treated and untreated wastewater sources. By Wang, Bin; Dai, Guohua; Deng, Shubo; Huang, Jun; Wang, Yujue; Yu, Gang. From Environmental Pollution (Oxford, United Kingdom) (2015), 202, 153-159.
	STP-EX	Fate of anthropogenic cyclic volatile methylsiloxanes in a wastewater treatment plant.

		By Wang, De-Gao; Aggarwal, Monica; Tait, Tara; Brimble, Samantha; Pacepavicius, Grazina; Kinsman, Laura; Theocharides, Mike; Smyth, Shirley Anne; Alaei, Mehran. From Water Research (2015), 72, 209-217
	STP	Input characterization of perfluoroalkyl substances in wastewater treatment plants: Source discrimination by exploratory data analysis. By Xiao, Feng; Halbach, Thomas R.; Simcik, Matt F.; Gulliver, John S. From Water Research (2012), 46(9), 3101-3109.
	STP-Level II	Use of fugacity model to analyze temperature- dependent removal of micro- contaminants in sewage treatment plants. By Thompson, Kelly; Zhang, Jianying; Zhang, Chunlong. From Chemosphere (2011), 84(8), 1066-1071.
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	Model by Clarke et al., 1995  (Clark, B., Henry, J. G. and Mackay, D. (1995) Environ. Sci. Technol., 29, 1488-1494.)	Estimation of pharmaceutical residues in primary and secondary sewage sludge based on quantities of use and fugacity modelling. By Khan, S. J.; Ongerth, J. E. From Water Science and Technology (2002), 46(3, 2nd World Water Congress: Environmental Monitoring, Contaminants and Pathogens, 2001), 105-112.

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	STP, STP-EX, SimpleTreat, ASTREAT	Continued development of a mass balance model of chemical fate in a sewage treatment plant  -Rajesj Seth, Eva Webster, Donald Mackay  -2008

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Arctic Applications/ High Altitude Lakes	QWASI version 2.8 with steady state and with dynamic version that allowed for temporal changes	Understanding of Cyclic Volatile Methyl Siloxane Fate in a High Latitude Lake Is Constrained by Uncertainty in Organic Carbon- Water Partitioning. By Krogseth, Ingjerd Sunde; Whelan, Michael John; Christensen, Guttorm Normann; Breivik, Knut; Evenset, Anita; Warner, Nicholas Alexander. From Environmental Science & Technology (2017), 51(1), 401-409.
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	BETR-World	BETR- World: a geographically explicit model of chemical fate: application to transport of alpha- HCH to the Arctic. By Toose L; Woodfine D G; MacLeod M; Mackay D; Gouin J. From Environmental pollution (Barking, Essex : 1987) (2004), 128(1-2), 223-40.
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Aquatic Food Chains	Thomann (1989) chemical distribution in ecosystem model	Bioaccumulation Model of Organic Chemical Distribution in Aquatic Food Chains -Robert V. Thomann -1989

Fish	QWASI version 3.00 along with Level III calculations	Bioconcentration of polycyclic musks in fathead minnows caged in a wastewater effluent plume Lefebvre, Claudine; Kimpe, Linda E.; Metcalfe, Chris D.; Trudeau, Vance L.; Blais, Jules M. From Environmental Pollution (Oxford, United Kingdom) (2017), 231(Part_2), 1593-1600
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Model application	Model Title/Name	References
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	CARPET-MOM	Matoba, Y.; Ohnishi, J.; Matsuo, M. Chemosphere 1995, 30, 345-365. Indoor simulation of insecticides in broadcast spraying

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	Shehata (1985) multi-compartment mathematical model	Shehata, A. T. Toxicol. Ind. Health 1985, 4, 277-298. A MULTI-ROUTE EXPOSURE ASSESSMENT OF CHEMICALLY CONTAMINATED DRINKING WATER
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	Extension of Bennett et al work (below)	Multimedia Modeling of Polybrominated Diphenyl Ether Emissions and Fate Indoors  -Xianming Zhang, <a href="#">Miriam L. Diamond</a> , <a href="#">Catalina Ibarra</a> and <a href="#">Stuart Harrad</a>  -Environ. Sci. Technol., 2009, 43 (8), pp 2845–2850
	Bennett and Furtaw (2004) indoor pesticide model	Bennett, D. H.; Furtaw, E. J. Fugacity-based indoor residential pesticide fate model. Environ. Sci. Technol. 2004, 38, 2142– 2152.
	ConsExpo, Multi-Chamber Concentration and Exposure Model, Consumer Exposure Module (CEM), PROMISE, LifeLine™ Software Version 4.3 is a tool to characterize population-based aggregate and cumulative exposures and risks from pesticide	RIVM report 320104006/2006 Comparison of consumer exposure modelling tools Inventory of possible improvements of ConsExpo -M.V.D.Z. Park, J.E. Delmaar and J.G.M. van Engelen

	residues, Central Risk and Exposure Modelling e-solution (CREMe), Pesticide Inert Risk Assessment Tool (PIRAT), Residential Exposure Assessment Model (REx), Wall Paints Exposure Assessment Model (WPEM), SprayExpo, Skin Permeation (SKINPERM)	
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Aquatic Systems	QWASI model 1. Equilibrium QWASI 2. Standard QWASI 3. Multi-QWASI 4. Dynamic QWASI 5. Dynamic Multi-QWASI 6. Pseudo-dynamic QWASI	A suite of multi-segment fugacity models describing the fate of organic contaminants in aquatic systems: application to the Rihand Reservoir, India. By Warren, Christopher S.; Mackay, Donald; Bahadur, Nisheeth P.; Boocock, David G. B. From Water Research (2002), 36(17), 4341-4355.
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	Level IV	A hierarchical Bayesian approach to modelling fate and transport of oil released from subsea pipelines. By Arzaghi, Ehsan; Abaei, Mohammad Mahdi; Abbassi, Rouzbeh; Garaniya, Vikram; Binns, Jonathan; Chin, Christopher; Khan, Faisal

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Food web bioaccumulation	fugacity-based food web bioaccumulation model	Risk assessment of butyltins based on a fugacity- based food web bioaccumulation model in the Jincheng Bay mariculture area: I. model development.  By Hu, Yanbing; Gong, Xianghong; Xu, Yingjiang; Song, Xiukai; Liu, Huihui; Deng, Xuxiu; Ru, Shaoguo. From Environmental Science: Processes & Impacts (2014), 16(8), 1994-2001.
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	<p>equilibrium partitioning theory (EPT) model, Terrestrial Vertebrate Bioaccumulation Model, Soil-Invertebrate Bioaccumulation Model</p>	<p>A Terrestrial Food-Chain Bioaccumulation Model for POPs</p> <p>-James M. Armitage and Frank A. P. C. Gobas</p> <p>-2007</p>
	<p>food web model (a modified version of the 1993 Gobas food web model)</p>	<p>A food web bioaccumulation model for organic chemicals in aquatic ecosystems</p> <p>-Jon A. Arnot, Frank A. P. C. Gobas</p> <p>-2004</p>
	<p>Lake Ontario Food Web model</p>	<p>A model for predicting the bioaccumulation of hydrophobic organic chemicals in aquatic food-webs: application to Lake Ontario</p> <p>-Frank A. P. C. Gobas</p> <p>-1993</p>
	<p>mechanistic bioconcentration model</p>	<p>Development and Evaluation of a Mechanistic Bioconcentration model for Ionogenic Organic Chemicals in Fish</p> <p>-James M. Armitage, Jon A. Arnot, Frank Wania, Don Mackay</p> <p>-2013</p>
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