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Predicting global scale exposure of humans to PCB 153 from historical emissions

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Supporting Information

Contents

Text S1. Description of changes to the BETR-Global model*

BETR-Global was validated with measured air concentrations of PCBs, and good agreement with model predictions was found when using the highest emissions estimates of the Breivik et al. emissions inventory (Lamon et al., 2009). However, after running preliminary calculations it was found that the model underestimated dissolved surface water concentrations of PCB-153 in the Baltic Sea. Furthermore, the fugacity ratios of surface media to air were always much less than one, indicating that the equilibrium was still shifted far towards the air phase even after 80 years of emissions, which is counter to prevailing knowledge about PCB long-term and seasonal time trends in the environment. This may be partially due to the structure of the model: BETR-Global has no marine sediment compartments and treats particle settling and down-welling in the marine compartments as a loss process.

Minor modifications to BETR-Global were made to address the low surface media fugacities: three environmental parameters and one process description were re-parameterized. First, the atmospheric particle scavenging ratio was changed from 20000 to 68000 to match the parameterization of CoZMo-POP2 (Wania et al., 2006). This caused a minor (average factor 1.2) increase in the marine water/air fugacitiy ratio. It was determined that the major parameters in the BETR-Global marine compartment affecting fugacities of PCB-153 in marine water are the volume fraction of particulate organic carbon (POC) and the particle sinking mass transfer coefficient (MTC). In the default process description of particle sinking BETR-Global multiplies the chemical concentration in POC by the particle sinking MTC to obtain a flux of chemical amount per m^2 per hour. The particle settling MTC was replaced with a particle settling velocity, and the process description was altered by replacing the MTC with the product of the volume fraction of POC and the settling velocity.

In the default parameterization of BETR-Global the volume fraction of POC is $1 \cdot 10^{-6}$ m^3_{POC}/m^3_{water} in all marine compartments and the MTC varies by latitude within the range $7.6 \cdot 10^{-8}$ to $1.6 \cdot 10^{-7}$ m/h. Average volume fractions of POC were defined for each 15° latitudinal zone by taking the latitudinal average chlorophyll A concentrations from Dachs et al. (2002) and inputting these into a regression model from Marinho and Rodrigues (2003) that relates chlorophyll A concentrations to total biomass. Chlorophyll A measurements for the region of 75°-90° were not provided by Dachs et al. and it was assumed that the concentration for this region was the same as the 60°-75° region. This resulted in volume fractions of POC in the range of $6.2 \cdot 10^{-9}$ to $1.6 \cdot 10^{-7}$ m^3_{POC}/m^3_{water}, lower than the default value by a factor of approximately 20 on average. The volume fraction of POC in marine water was divided into three size classes of plankton using a model from Brotas et al. (2013) and then the size dependent settling velocities of each class was estimated with data from Stemmann et al. (2004) using an assumed average size in each class. A weighted average of these settling velocities was taken as the settling velocity of each latitudinal zone. The velocities range from 0.009 to 0.033 m/h. Multiplying the settling velocities by the volume fraction of POC gives settling MTCs in the range $5.4 \cdot 10^{-11}$ to $5.3 \cdot 10^{-9}$ m/h, lower than the default MTCs by a factor of approximately 45 on average.

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** These modifications were proposed by Trevor Brown based on his work applying BETR-Global to study the global multimedia fate of PCBs. We have adopted his proposals. The above is a text that he wrote describing and motivating the changes he made.*

Text S2. Parameterization of dietary intake for the ACC-HUMAN model

The dietary intake of different food items was taken from the WHO Global Environment Modeling System (GEMS) cluster diets. GEMS has defined 17 cluster diets for the globe and specified for each country which cluster diet best represents food consumption in that country. The wet weight consumption rates of each food item in the cluster diets was converted to a lipid consumption rate using lipid contents derived from the FAO's food balance sheets (Table S2). This conversion was made by comparing the average reported parameter "food supply" and average reported "fat supply" for each food item for all years (1961-2013) for all countries in the human milk sampling campaign. The FAO food items were then matched to GEMS food groups as shown in Table S3; average fat content was used when several food items were allocated to a food group. The resulting ACC-HUMAN diets for each food group are shown in Table S4.

Text S3. Extraction of data for concentrations of PCB 153 in air

All data for PCB concentrations in air available in the data warehouse for the Global Monitoring Plan (GMP) for Persistent Organic Pollutants (POPs) under the Stockholm Convention (http://www.pops-gmp.org/visualization-2014) were downloaded. The data were formatted, filtered to obtain all data for PCB 153 that had been obtained using passive samplers, and sorted according to sampling site. Sampling sites for which data were available for two or fewer years were discarded. Data points for which a large number of the individual data had been <LOQ were discarded. Samplings sites for which several data points were discarded for this reason were also discarded. The first order time constant for the change in concentration of PCB 153 in air with time was calculated for each site as the slope of the linear regression of ln concentration versus sampling year. Sites for which the regression coefficient (r2) was <0.5 were discard. This left first order time constants for 40 sites, 36 of which were within Europe.

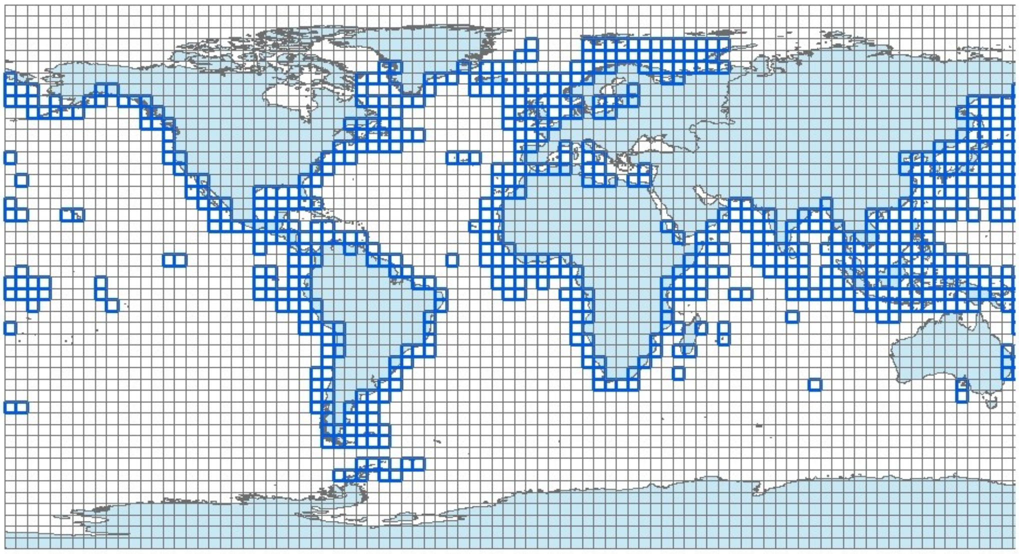

Figure S1. BETR Global grid cells included (marked in dark blue) in the marine average fugacity and temperature used to calculate concentration of PCB153 in marine fish. Grid cells were selected based on total fish catch reported by Seas Around Us http://www.seaaroundus.org/data/#/spatial-catch

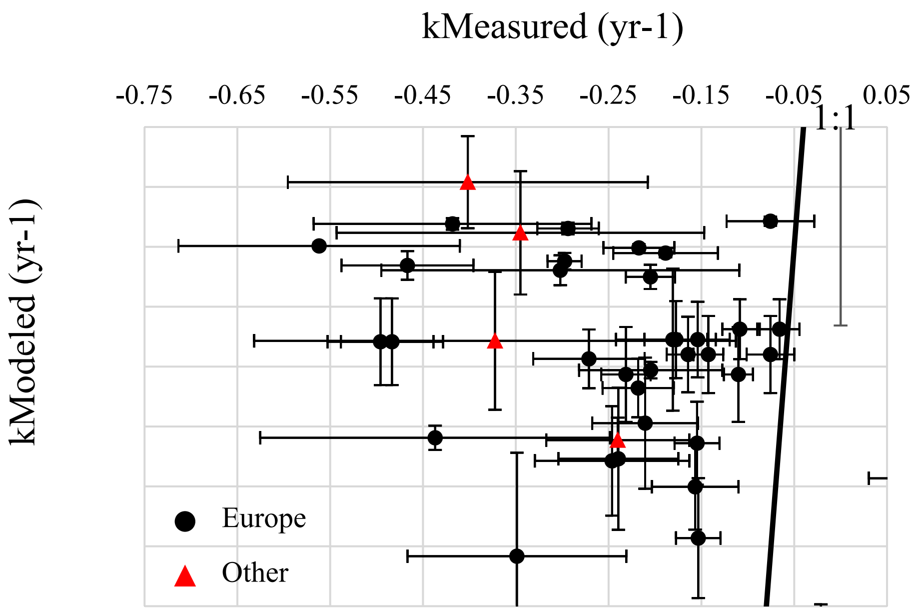

Figure S2. Modeled versus measured time constant for the change in the concentration of PCB 153 in air. The measured data were derived from passive samplers deployed at 40 sites around the world (36 of them in Europe) during the period 2005-2014. The modeled time constants were derived from modeled average annual concentrations in air for the same site and for the same time interval as the measured data. The mean and standard error of the time constant are shown. The thick line shows the line of perfect agreement between the modeled and measured values. Expanded image of the data in Figure 1.

Table S1. Physical chemical properties of PCB 153 used in the simulations

Property	Value	Unit	Reference
log K_{AW}	-2.13	m^3 m^{-3}	Schenker et al. 2005
log K_{OW}	6.86	m^3 m^{-3}	Schenker et al. 2005
log K_{OA}	9.45	m^3 m^{-3}	Schenker et al. 2005
log ΔU_{AW}	68200	J/mol	Schenker et al. 2005
log ΔU_{OW}	-26600	J/mol	Schenker et al. 2005
log ΔU_{OA}	-94800	J/mol	Schenker et al. 2005
Average half-life in Air[a]	737	h	Anderson and Hites 1996
Half-life in Water	55000	h	Wania and Daly 2002
Half-life in Vegetation	55000	h	Wania and Daly 2002
Half-life in Soil	550000	h	Wania and Daly 2002
Half-life in Sediment	170000	h	Wania and Daly 2002
Metabolism rate constant in Human	5.25E-6	h^{-1}	Brown 1994
Metabolism rate constant in all other organisms	0	h^{-1}	Czub and McLachlan 2004
Feces/blood partitioning coefficients	2E-8	m^3 blood lipid g^{-1} dry feces	Czub and McLachlan 2004

[a] Half-life in air is adjusted for OH radical concentrations that vary with season and location. All half-lives are adjusted for temperature, using an E_A of 10000 J/mol for air and 20000 J/mol for all other media.

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Table S2. Lipid content of the cluster diet item groups estimated from FAO Food Balance Sheet based on the elements "Fat Supply Quantity" and "Food Supply Quantity" (including all sampled countries and all years) http://www.fao.org/faostat/en/#data/FBS. The italic text in brackets indicates which of the food groups (marine or freshwater) the fish cluster diet items were allocated to.

Cluster diet item groups (Lev2NAME)	Lipid content
Dairy products (incl. whey, excl. milk fats)	18%
Milk fats	81%
Milks (no other ingredients)	3%
Egg products and processed eggs	9%
Eggs	9%
Crustaceans, unprocessed (incl. home-cooked) *(marine)*	0.3%
Freshwater fish, unprocessed (incl. home-cooked) *(freshwater)*	3%
Marine animal fat	88%
Marine fish, unprocessed (incl. home-cooked) *(marine)*	3%
Molluscs and cephalopods, unprocessed (incl. home-cooked) *(marine)*	0%
Other fishes and aquatic animals, unprocessed (incl. home-cooked) *(50% marine, 50% freshwater)*	3%
Processed aquatic animals *(50% freshwater, 50% marine)*	0.2%
Animal or vegetable fat, nes	82%
Mammalian (not marine) meat, unprocessed (incl. home-cooked)	17%
Mammalian fats (no milk fat)	82%
Mammalian offals, unprocessed (incl. home-cooked)	3%
Meat and offals, nes (incl. reptiles and amphibians), unprocessed (incl. home-cooked)	4%
Meat and offals, processed (excl. marine)	4%
Poultry (incl. pigeon) meat, unprocessed (incl. home-cooked)	8%
Poultry fats	8%
Poultry offals, unprocessed (incl. home-cooked)	6%

Table S3. Allocation of food items in FAO food balance sheets to GEMS food groups and ACC-HUMAN food groups.

GEMS food group	ACC-HUMAN food group	FAO food balance sheet Food items
Dairy products (incl. whey, excl. milk fats)	Dairy	Cream
Milk fats	Dairy	Butter, Ghee
Milks (no other ingredients)	Dairy	Milk - Excluding Butter
Egg products and processed eggs	Dairy	Eggs
Eggs	Dairy	Eggs
Crustaceans, unprocessed (incl. home-cooked)	Fish	Crustaceans
Freshwater fish, unprocessed (incl. home-cooked)	Fish	Freshwater Fish
Marine animal fat	Fish	Fish, Body Oil and Fish, Liver Oil
Marine fish, unprocessed (incl. home-cooked)	Fish	Pelagic Fish, Marine Fish, Other, Demersal Fish
Molluscs and cephalopods, unprocessed (incl. home-cooked)	Fish	Molluscs, Other, Cephalopods
Other fishes and aquatic animals, unprocessed (incl. home-cooked)	Fish	Aquatic Animals, Others, Meat, Aquatic Mammals
Processed aquatic animals	Fish	Aquatic Animals, Others
Animal or vegetable fat	Meat	Fats, Animals, Raw
Mammalian (not marine) meat, unprocessed (incl. home-cooked)	Meat	Bovine Meat, Pigmeat, Mutton & Goat Meat
Mammalian fats (no milk fat)	Meat	Fats, Animals, Raw
Mammalian offals, unprocessed (incl. home-cooked)	Meat	Offals, Edible
Meat and offals (incl. reptiles and amphibians), unprocessed (incl. home-cooked)	Meat	Meat, Other, Offals, Edible
Meat and offals, processed (excl. marine)	Meat	Meat, Other, Offals, Edible
Poultry (incl. pigeon) meat, unprocessed (incl. home-cooked)	Meat	Poultry Meat
Poultry fats	Meat	Poultry Meat
Poultry offals, unprocessed (incl. home-cooked)	Meat	Poultry Meat, Offals, Edible

Table S4. Country specific parameters used in ACC-HUMAN simulations. Age of mothers at birth of first child, daily consumption of lipid from various food categories, fraction of total fish intake consisting of freshwater fish, and organic carbon content in soil.

Country	Age of mother	Lipid ingestion (g d^{-1})			fraction freshwater fish	Soil OC content (g g^{-1})	Cluster diet #
		Dairy	Meat	Fish			
Australia	29	36.5	35.6	0.32	0.66	0.040	7
Belgium	29	41.3	42.6	0.44	0.53	0.065	11
Brazil	22	10.6	9.4	0.34	0.69	0.010	5
Bulgaria	27	23.8	31.8	0.41	0.59	0.053	10
Chile	24	10.6	9.4	0.34	0.69	0.008	5
Cote d'Ivoire	20	1.1	4.4	0.39	0.62	0.030	3
Croatia	28	23.8	31.8	0.41	0.59	0.039	10
Cuba	23	13.7	9.8	0.53	0.69	0.004	6
Cyprus	29	23.8	31.8	0.41	0.59	0.037	10
CzechRepublic	28	31.3	38.1	0.21	0.61	0.048	3
Democratic Republic of Congo	20	1.1	4.4	0.39	0.62	0.007	3
Djibouti	20	10.6	9.4	0.34	0.69	0.012	5
Egypt	23	13.7	9.8	0.53	0.69	0.011	6
Ethiopia	20	4.1	6.2	0.20	0.70	0.007	13
Finland	29	36.5	35.6	0.32	0.66	0.070	7
Georgia	25	22.0	19.7	0.24	0.53	0.012	2
Germany	29	40.3	40.7	0.23	0.64	0.076	8
Ghana	23	1.1	4.4	0.39	0.62	0.033	3
Haiti	23	4.1	6.2	0.20	0.70	0.012	13
Hungary	28	31.3	38.1	0.21	0.61	0.025	15
India	20	10.6	9.4	0.34	0.69	0.027	5
Indonesia	23	4.6	18.9	1.03	0.81	0.034	9
Ireland	31	31.3	38.1	0.21	0.61	0.042	15
Israel	28	12.3	20.6	0.51	0.52	0.033	4
Italy	31	23.8	31.8	0.41	0.59	0.041	10
Kenya	20	4.1	6.2	0.20	0.70	0.008	13
Lithuania	27	31.3	38.1	0.21	0.61	0.061	15
Luxembourg	30	36.5	35.6	0.32	0.66	0.065	7
Mali	19	4.1	6.2	0.20	0.70	0.021	13
Mexico	21	10.6	9.4	0.34	0.69	0.012	5
Netherlands	30	41.3	42.6	0.44	0.53	0.065	11
NewZealand	28	23.8	31.8	0.41	0.59	0.017	10
Niger	18	4.1	6.2	0.20	0.70	0.023	13
Nigeria	20	4.1	6.2	0.20	0.70	0.057	13
Norway	29	36.5	35.6	0.32	0.66	0.164	7
Peoples Republic of Hong Kong	30	4.6	18.9	1.03	0.81	0.055	9
Peru	22	10.6	9.4	0.34	0.69	0.015	5

Table S4 continued.

Country	Age of mother	Lipid ingestion (g d^{-1})			fraction freshwater fish	Soil OC content (g g^{-1})	Cluster diet #
		Dairy	Meat	Fish			
Philippines	23	4.6	18.9	1.03	0.81	0.059	9
Republic of Korea	31	23.8	31.8	0.41	0.59	0.020	10
Republic of Moldova	24	22.0	19.7	0.24	0.53	0.020	2
Romania	27	31.3	38.1	0.21	0.61	0.023	15
Russia	25	23.8	31.8	0.41	0.59	0.021	10
Senegal	22	4.1	6.2	0.20	0.70	0.020	13
Slovakia	28	31.3	38.1	0.21	0.61	0.025	15
Spain	31	40.3	40.7	0.23	0.64	0.039	8
Sudan	20	4.1	6.2	0.20	0.70	0.009	13
Suriname	21	10.6	9.4	0.34	0.69	0.007	5
Sweden	29	31.3	38.1	0.21	0.61	0.022	15
Switzerland	31	36.5	35.6	0.32	0.66	0.038	7
Syria	23	13.3	8.6	0.21	0.58	0.027	1
Tajikistan	23	10.6	9.4	0.34	0.69	0.006	5
Togo	21	1.1	4.4	0.39	0.62	0.056	3
Uganda	19	2.0	5.1	0.52	0.96	0.006	16
Ukraine	25	22.0	19.7	0.24	0.53	0.018	2
Uruguay	24	36.5	35.6	0.32	0.66	0.007	7
USA	26	23.8	31.8	0.41	0.59	0.040	10

Data for the average age of women giving birth to their first child are from the CIA World Fact Book (https://www.cia.gov/library/publications/the-world-factbook/fields/2256.html#af) and the United Nations (http://www.un.org/en/development/desa/population/publications/dataset/fertility/wfr2012/Data/Data_Sources/TABLE%20A.6.%20Mean%20age%20at%20first%20birth.xlsx).
For some countries data were not found; they were substituted with data from another country (in brackets): Cuba (Haiti), Djibouti (Kenya), Sudan (Ethiopia), Suriname (Guyana), Syria (Egypt), Uruguay (Chile).

Table S5. Concentrations of PCB 153 in human milk: modeled, measured, and modeled/measured. The modeled concentrations are based on the default emissions scenario and the local food sourcing assumption for the food categories dairy, meat, and freshwater fish.

Country	Sampling year	Concentration (ng g^{-1} lipid)		
		Modeled	Measured	Modeled/Measured
Hungary	2006	140	8.0	17.5
Hungary	2001	213	16.1	13.2
Netherlands	2014	189	18.6	10.2
Switzerland	2009	290	37	7.9
Belgium	2010	235	33	7.2
Netherlands	2001	516	78	6.6
Bulgaria	2014	41	6.39	6.5
Belgium	2006	225	38	5.9
Luxembourg	2006	290	53	5.5
Bulgaria	2001	84	16.4	5.2
Luxembourg	2002	405	90	4.5
Belgium	2002	322	75	4.3
Spain	2002	285	70	4.1
Germany	2002	351	88	4.0
Italy	2001	407	104	3.9
Croatia	2001	207	55	3.8
Lithuania	2009	76	22	3.5
Republic of Korea	2008	26	7.8	3.3
Romania	2001	154	62	2.5
Spain	2001	304	141	2.2
Romania	2014	74	37	2.0
Ireland	2002	42	22	1.94
Mexico	2011	2.9	1.50	1.94
Ireland	2001	39	21	1.84
Cyprus	2006	21	11.7	1.78
Georgia	2009	19.2	11.5	1.67
Republic of Moldova	2009	49	29	1.65
Ireland	2010	19.8	14.3	1.38
Czech Republic	2006	207	156	1.33
USA	2003	26	20	1.31
Slovakia	2006	140	107	1.31
Czech Republic	2001	332	260	1.27
Slovakia	2001	213	170	1.25
Syria	2009	5.4	4.8	1.13
Israel	2012	10.8	9.8	1.10
Ukraine	2001	58	54	1.07
Finland	2007	18.4	18.3	1.01
Sweden	2001	57	59	0.96
Sweden	2007	33	39	0.85

Table S5 continued

Country	Sampling year	Concentration (ng g^{-1} lipid)		
		Modeled	Measured	Modeled/Measured
Finland	2001	31	37	0.83
Ethiopia	2012	0.61	0.76	0.79
Uruguay	2009	8.8	11.2	0.78
Russia	2001	43	60	0.72
Russia	2002	47	69	0.67
Norway	2001	31	47	0.66
Egypt	2001	7.8	11.8	0.66
Norway	2006	20	31	0.65
Tajikistan	2009	3.3	5.7	0.58
New Zealand	2011	2.6	5.0	0.53
Australia	2010	3.6	7.2	0.50
Chile	2008	2.4	5.2	0.46
Australia	2002	4.9	11.0	0.44
Chile	2011	1.83	4.5	0.41
Brazil	2012	1.60	4.2	0.38
Hong Kong	2009	4.1	10.7	0.38
Hong Kong	2002	6.7	17.7	0.38
Indonesia	2011	1.55	4.1	0.38
Philippines	2002	3.3	9.2	0.36
Kenya	2009	0.44	1.29	0.34
Brazil	2001	2.8	9.1	0.31
New Zealand	2000	4.1	13.4	0.31
India	2009	1.54	5.1	0.30
Haiti	2004	2.4	10.0	0.24
Djibouti	2011	1.36	5.9	0.23
Haiti	2011	1.29	5.8	0.22
Suriname	2012	1.27	7.9	0.160
Peru	2011	1.06	8.5	0.124
Cuba	2011	2.7	22	0.124
Uganda	2009	0.23	2.5	0.092
Ghana	2009	1.11	14.0	0.079
Mali	2009	0.79	11.0	0.072
Niger	2011	0.82	13.0	0.063
Nigeria	2008	1.35	21	0.063
Togo	2010	0.99	16.4	0.060
Democratic Republic of Congo	2009	0.75	13.1	0.057
Senegal	2009	1.44	30	0.048
Côte d'Ivoire	2010	1.07	23	0.046
Sudan	2006	0.75	21	0.035

Table S6. Fraction of meadows and pastures located in each EU member state in year 2000. Data from FAOSTAT Land use, http://www.fao.org/faostat/en/#data/RL

Country	Fraction of permanent + temporary meadows and pastures in the EU
Austria	1.9%
Belgium	0.7%
Bosnia and Herzegovina	1.3%
Bulgaria	2.4%
Croatia	0.4%
Czech Republic	1.2%
Denmark	1.0%
Estonia	0.6%
Finland	0.8%
France	15.9%
Germany	8.2%
Greece	5.6%
Hungary	1.3%
Ireland	4.8%
Italy	5.4%
Latvia	0.8%
Lithuania	1.6%
Luxembourg	0.1%
Netherlands	1.2%
Poland	4.1%
Portugal	2.2%
Romania	6.7%
Slovakia	0.7%
Slovenia	0.4%
Spain	15.1%
Sweden	0.6%
United Kingdom	15.1%

Table S7. Concentrations of PCB 153 in human milk in European Union countries: modeled, measured, and modeled/measured. The modeled concentrations are based on the default emissions scenario and the revised food sourcing scenario with all of the meat, dairy products and freshwater fish being sourced from a European Union average food source (for countries in the European Union only).

Country	Sampling year	Modeled/Measured
Hungary	2006	14.7
Ireland	2002	13.0
Ireland	2001	12.3
Hungary	2001	10.9
Bulgaria	2014	10.5
Ireland	2010	9.4
Bulgaria	2001	8.7
Netherlands	2014	6.3
Finland	2007	6.0
Lithuania	2009	5.9
Finland	2001	4.9
Belgium	2010	4.5
Spain	2002	4.2
Netherlands	2001	4.1
Belgium	2006	3.7
Luxembourg	2006	3.5
Sweden	2001	3.0
Sweden	2007	2.8
Romania	2001	2.8
Luxembourg	2002	2.8
Belgium	2002	2.7
Croatia	2001	2.7
Italy	2001	2.3
Spain	2001	2.2
Romania	2014	2.2
Germany	2002	2.1
Cyprus	2006	1.78
Slovakia	2006	1.09
Slovakia	2001	1.04
Czech Republic	2006	0.75

Table S8. Concentrations of PCB 153 in human milk: modeled, measured, and modeled/measured. The modeled concentrations are based on the worst case emissions scenario and the local food sourcing assumption for the food categories dairy, meat, and freshwater fish.

Country	Sampling year	Concentration (ng g^{-1} lipid)		
		Modeled	Measured	Modeled/Measured
Hungary	2006	140	8.0	17.5
Hungary	2001	214	16.1	13.3
Netherlands	2014	190	18.6	10.2
Switzerland	2009	291	37	7.9
Belgium	2010	236	33	7.2
Netherlands	2001	517	78	6.7
Bulgaria	2014	42	6.4	6.5
Belgium	2006	225	38	5.9
Luxembourg	2006	291	53	5.5
Bulgaria	2001	85	16.4	5.2
Luxembourg	2002	406	90	4.5
Belgium	2002	322	75	4.3
Republic of Korea	2008	32	7.8	4.1
Spain	2002	285	70	4.1
Germany	2002	351	88	4.0
Italy	2001	408	104	3.9
Croatia	2001	208	55	3.8
Lithuania	2009	77	22	3.5
Romania	2001	154	62	2.5
Spain	2001	305	141	2.2
Mexico	2011	3.0	1.50	2.0
Romania	2014	75	37	2.0
Ireland	2002	43	22	1.97
Ireland	2001	40	21	1.87
Cyprus	2006	21	11.7	1.82
Georgia	2009	19.6	11.5	1.70
Republic of Moldova	2009	49	29	1.66
Ireland	2010	21	14.3	1.43
Czech Republic	2006	208	156	1.34
USA	2003	27	20	1.33
Slovakia	2006	140	107	1.31
Czech Republic	2001	332	260	1.27
Slovakia	2001	214	170	1.26
Syria	2009	5.5	4.8	1.16
Israel	2012	11.2	9.8	1.14
Ukraine	2001	58	54	1.07
Finland	2007	18.8	18.3	1.03
Sweden	2001	58	59	0.97
Ethiopia	2012	1	1	0.87

Table S8 continued

Country	Sampling year	Concentration (ng g^{-1} lipid)		
		Modeled	Measured	Modeled/Measured
Sweden	2007	34	39	0.87
Finland	2001	31	37	0.84
Uruguay	2009	8.9	11.2	0.79
Russia	2001	44	60	0.73
Egypt	2001	8.0	11.8	0.67
Russia	2002	47	69	0.67
Norway	2006	21	31	0.67
Norway	2001	32	47	0.67
Tajikistan	2009	3.7	5.7	0.64
New Zealand	2011	2.7	5.0	0.55
Australia	2010	3.7	7.2	0.52
Hong Kong	2009	5.4	10.7	0.51
Chile	2008	2.5	5.2	0.47
Australia	2002	5.0	11.0	0.45
Hong Kong	2002	7.8	17.7	0.44
Chile	2011	1.90	4.5	0.42
Indonesia	2011	1.67	4.1	0.41
Brazil	2012	1.68	4.2	0.40
India	2009	1.99	5.1	0.39
Kenya	2009	0.49	1.29	0.38
Philippines	2002	3.5	9.2	0.38
Brazil	2001	2.9	9.1	0.32
New Zealand	2000	4.2	13.4	0.32
Haiti	2004	2.5	10.0	0.25
Djibouti	2011	1.47	5.9	0.25
Haiti	2011	1.40	5.8	0.24
Suriname	2012	1.44	7.9	0.181
Cuba	2011	3.0	22	0.134
Peru	2011	1.14	8.5	0.133
Niger	2011	1.32	13.0	0.102
Uganda	2009	0.25	2.5	0.102
Nigeria	2008	2.1	21	0.099
Ghana	2009	1.37	14.0	0.098
Mali	2009	0.91	11.0	0.083
Togo	2010	1.30	16.4	0.079
Democratic Republic of Congo	2009	0.84	13.1	0.064
Côte d'Ivoire	2010	1.27	23	0.054
Senegal	2009	1.56	30	0.052
Sudan	2006	0.81	21	0.038