SUPPLEMENTAL MATERIAL to:

Assessment of Non-Occupational Exposure to DDT in the Tropics and the North – Relevance of Uptake via Inhalation from Indoor Residual Spraying

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Table of Contents

1 Measurements in Exposure Media 3

2 Comparison of Measurements with Fitted Log-Normal Distributions 10

3 Exposure Factors and Model Parameters 11

4 Pharmacokinetic Model and Dose-Weighted Elimination Half-Life for ∑DDT 14

5 Measurements in Humans 17

6 Generic Indoor Air Model 21

References 24

List of Tables

Table 1. Measurements in exposure media used in the geographically integrated exposure assessment

Table 2. Food consumption rates of different food groups (g/person/day)

Table 3. Average lipid fractions of food groups and human tissues

Table 4. Exposure factors and model parameters used in Eq. 1–3 (main text) and the pharmacokinetic model

Table 5. Comparison of empirical and modeled ratios of $U_{\text{total DDE}}/U_{\text{total DDT}}$

Table 6. Dose-weighted, intrinsic human elimination half-lives of ∑DDT

Table 7. Human biomonitoring data from Tropical and Northern Regions (ng/g lipid)

Table 8. Comparison of measured and modeled concentrations of DDT in indoor air

Table 9. Description and values of parameters for the generic indoor air mass balance model

List of Figures

Figure 1. Comparison of original measured data sets with fitted log-normal distributions that are used in the Monte-Carlo sampling that is employed to construct the distribution of total uptake.

1 Measurements in Exposure Media

In Tables 1 and 7 of this Supplemental Material, concentration data derived from measurements in food products and human tissue are all given on a lipid-normalized basis. If not reported in this form by the authors of the original studies, we used given lipid fractions to calculate lipid-normalized concentrations. In a few cases, no lipid fractions were provided by the authors. In these cases we used the average lipid fractions from Table 3 below.

Studies used as data sources report results mainly as arithmetic means and medians; in a few cases geometric means are reported. In cases where we summarized data of a single study in order not to assign too much weight to the data from that study (e.g. in cases where a study presented large tables of detailed data for every sample), we calculated median values.

The definition of reported ∑DDT concentrations differs between studies but often includes both p,p'- and o,p'-isomers of DDT, and also DDE and DDD. Whereas the majority of human biomonitoring studies reported metabolites and isomers individually, an important fraction of studies on concentrations in exposure media reported only ∑DDT.

All measurements in exposure media used in our work, i.e. various food groups, air, soil and dust, are given in Table 1; all human biomonitoring data used are given in Table 7 below (p. 18).

Table 1. Measurements in exposure media used in the integrated exposure assessment

Exposure Medium	Region	Country	*n* [a]	Sampling year	∑DDT	units	References
Indoor Soil	Tropics	Mexico	10	2006	21	[ng/mg]	Herrera-Portugal et al. 2005
Indoor Dust	Tropics	Mexico	10	2006	31	[ng/mg]	Herrera-Portugal et al. 2005
Indoor Air Partic. Phase	Tropics	India	1	1990	7400	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	6000	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	3400	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	1700	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	4200	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	1600	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	1400	[ng/m3]	Singh et al. 1992
Indoor Air Partic. Phase	Tropics	India	1	1990	1000	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	4900	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	8600	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	6600	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	2900	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	2800	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	2200	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	400	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	800	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	1000	[ng/m3]	Singh et al. 1992
Indoor Air Gas Phase	Tropics	India	1	1990	5900	[ng/m3]	Singh et al. 1992
Grain	Tropics	India	30	na	920	[ng/ g lip]	Babu et al. 2003
Grain	Tropics	India	150	na	9720	[ng/ g lip]	Bakore et al. 2004
Grain	Tropics	India	170	2002	400	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	120	2002	400	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	120	2002	800	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	240	2002	80	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	240	2002	1200	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	119	2002	80	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	123	2002	80	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	240	2002	1280	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	120	2002	160	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	120	2002	80	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	130	2002	440	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	123	2002	80	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	India	135	2002	80	[ng/ g lip]	Toteja et al. 2003
Grain	Tropics	Mexico	50	2003	3080	[ng/ g lip]	Waliszewski et al. 2004
Grain	Tropics	India	na	2004	50	[ng/ g lip]	Subramanian et al. 2007
Grain	Tropics	India	na	2004	26	[ng/ g lip]	Subramanian et al. 2007
Grain	Tropics	India	na	2004	0	[ng/ g lip]	Subramanian et al. 2007
Marine Fish	Tropics	Chile	22	na	390	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	36	na	992	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	24	na	1003	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	38	na	763	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	28	na	926	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	10	na	940	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	18	na	1650	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Chile	26	na	984	[ng/ g lip]	Focardi et al. 1996
Marine Fish	Tropics	Thailand	10	1997	71	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	2111	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	957	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	283	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	313	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	286	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	88	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	125	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	11	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	193	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	188	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	882	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	152	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	289	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	300	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	25	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	455	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	424	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	81	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	103	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	263	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	56	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	34	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Cambodia	1-4	1997-1998	48	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	India	na	1998	156	[ng/ g lip]	Senthilkumar et al. 2001
Marine Fish	Tropics	India	na	1998	1706	[ng/ g lip]	Senthilkumar et al. 2001
Marine Fish	Tropics	India	na	1998	146	[ng/ g lip]	Senthilkumar et al. 2001
Marine Fish	Tropics	India	na	1998	182	[ng/ g lip]	Senthilkumar et al. 2001
Marine Fish	Tropics	Tanzania	na	1998-99	663	[ng/ g lip]	Mwevura et al. 2002
Marine Fish	Tropics	Tanzania	na	1998-99	94	[ng/ g lip]	Mwevura et al. 2002

[a] *n* = number of measurements

Table 1: continued …

Marine Fish	Tropics	Tanzania	na	1998-99	165	[ng/ g lip]	Mwevura et al. 2002
Marine Fish	Tropics	Tanzania	na	1998-99	83	[ng/ g lip]	Mwevura et al. 2002
Marine Fish	Tropics	Tanzania	na	1998-99	385	[ng/ g lip]	Mwevura et al. 2002
Marine Fish	Tropics	India	na		427	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		7	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		407	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		426	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		10	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		5	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		31	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	na		8	[ng/ g lip]	Pandit et al. 2006
Marine Fish	Tropics	India	4		27	[ng/ g lip]	Sankar et al. 2006
Marine Fish	Tropics	India	8		11	[ng/ g lip]	Sankar et al. 2006
Marine Fish	Tropics	India	3		386	[ng/ g lip]	Sankar et al. 2006
Marine Fish	Tropics	India	50		7	[ng/ g lip]	Sankar et al. 2006
Marine Fish	Tropics	India	200		17	[ng/ g lip]	Sankar et al. 2006
Marine Fish	Tropics	India	6		19	[ng/ g lip]	Sankar et al. 2006
Freshwater Fish	Tropics	Thailand	10	1997	35	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	9	1997	170	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	10	1997	36	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	8	1997	35	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	8	1997	61	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	9	1997	33	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	10	1997	45	[ng/ g lip]	Kumblad et al. 2001
Freshwater Fish	Tropics	Thailand	10	1997	87	[ng/ g lip]	Kumblad et al. 2001
Marine Fish	Tropics	Cambodia	1-3	1997-1998	81	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	138	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	15	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	16	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	146	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	55	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	23	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	9	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	52	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	34	[ng/ g lip]	Monirith et al. 2000
Marine Fish	Tropics	Cambodia	1-3	1997-1998	235	[ng/ g lip]	Monirith et al. 2000
Freshwater Fish	Tropics	Kenya	6	1998	140	[ng/ g lip]	Lalah et al. 2003
Freshwater Fish	Tropics	Kenya	6	1998	2	[ng/ g lip]	Lalah et al. 2003
Freshwater Fish	Tropics	Uganda	70	1998	72	[ng/ g lip]	Kasozi et al. 2006
Freshwater Fish	Tropics	Uganda	78	1998	80	[ng/ g lip]	Kasozi et al. 2006
Freshwater Fish	Tropics	Tanzania	na	1998-99	255	[ng/ g lip]	Mwevura et al. 2002
Freshwater Fish	Tropics	Tanzania	na	1998-99	158	[ng/ g lip]	Mwevura et al. 2002
Freshwater Fish	Tropics	Tanzania	na	1998-99	459	[ng/ g lip]	Mwevura et al. 2002
Freshwater Fish	Tropics	India	2		3	[ng/ g lip]	Sankar et al. 2006
Freshwater Fish	Tropics	India	3		16	[ng/ g lip]	Sankar et al. 2006
Freshwater Fish	Tropics	SouthAfrica	13	?	9834	[ng/ g lip]	Barnhoorn et al. 2009
Dairy & Meat Products	Tropics	India	75	1993-98	5300	[ng/ g lip]	John et al. 2001
Dairy & Meat Products	Tropics	India	75	1993-101	6400	[ng/ g lip]	John et al. 2001
Dairy & Meat Products	Tropics	India	75	1993-104	6800	[ng/ g lip]	John et al. 2001
Dairy & Meat Products	Tropics	India	120	na	1200	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	263	na	1200	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	120	na	440	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	240	na	120	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	240	na	400	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	299	na	1660	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	120	na	40	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	120	na	400	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	120	na	1260	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	240	na	40	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	203	na	600	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	India	120	na	600	[ng/ g lip]	Kalra et al. 1999
Dairy & Meat Products	Tropics	Brazil	4	1998-99	4	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	Tropics	Brazil	4	1998-99	41	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	Tropics	India	1	1998-99	249	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	Tropics	India	22	1999	117	[ng/ g lip]	Pandit et al. 2002
Dairy & Meat Products	Tropics	India	18	1999	69	[ng/ g lip]	Pandit et al. 2002
Dairy & Meat Products	Tropics	India	8	1999	21	[ng/ g lip]	Pandit et al. 2002
Dairy & Meat Products	Tropics	India	6	1999	71	[ng/ g lip]	Pandit et al. 2002
Dairy & Meat Products	Tropics	Mexico	3	1998-99	101	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	Tropics	Philippines	2	1998-99	71	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	Tropics	Thailand	1	1998-99	4	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	Tropics	Brazil	1	2001-01	25	[ng/ g lip]	Weiss et al. 2005
Dairy & Meat Products	Tropics	India	12	2001	1600	[ng/ g lip]	Aulakh et al., 2006
Dairy & Meat Products	Tropics	Thailand	1	2001-01	4	[ng/ g lip]	Weiss et al. 2005

Table 1: continued …

Dairy & Meat Products	Tropics	Brazil	18	na	30	[ng/ g lip]	Heck et al. 2007
Dairy & Meat Products	Tropics	Brazil	13	na	11	[ng/ g lip]	Heck et al. 2007
Dairy & Meat Products	Tropics	Brazil	10	na	14	[ng/ g lip]	Heck et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	57	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	12	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	4	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	227	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	95	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	19	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	19	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	209	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	58	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	India	na	2004	23	[ng/ g lip]	Subramanian et al. 2007
Dairy & Meat Products	Tropics	SouthAfrica	10	2005	73	[ng/ g lip]	Serada et al. 2009
Continental Air	Tropics	Belize	na	1995-96	0.4080	[ng/m3]	Alegria et al. 2006
Continental Air	Tropics	Belize	na	1995-97	0.8500	[ng/m3]	Alegria et al. 2006
Continental Air	Tropics	Belize	na	2000-01	0.4400	[ng/m3]	Alegria et al. 2006
Continental Air	Tropics	Costa Rica	na	na	0.0140	[ng/m3]	Alegria et al. 2006
Continental Air	Tropics	Mexico	na	2000-01	0.3500	[ng/m3]	Alegria et al. 2006
Continental Air	Tropics	Mexico	18	2000-01	0.9970	[ng/m3]	Alegria et al. 2006
Continental Air	Tropics	Mexico	na	2002-04	2.3000	[ng/m3]	Alegria et al. 2008
Continental Air	Tropics	Mexico	na	2002-04	0.2390	[ng/m3]	Alegria et al. 2008
Continental Air	Tropics	Mexico	na	2002-04	1.2000	[ng/m3]	Alegria et al. 2008
Continental Air	Tropics	Mexico	na	2002-04	0.5470	[ng/m3]	Alegria et al. 2008
Continental Air	Tropics	India	na	2006	0.6490	[ng/m3]	Zhang et al. 2008
Continental Air	Tropics	India	na	2006	0.1050	[ng/m3]	Zhang et al. 2008
Continental Air	Tropics	India	na	2006	0.1210	[ng/m3]	Zhang et al. 2008
Marine Mammals	North	Barents Sea	8	1990	1584	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Barents Sea	5	1990	1109	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	10	1990	720	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	10	1990	890	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Hudson Bay	24	1992	922	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Hudson Bay	30	1992	1797	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Barents Sea	11	1993	883	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	33	1993	3712	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	17	1993	2414	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Lancaster Sound	10	1993	360	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Lancaster Sound	10	1993	393	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Ellesmere Isl.	7	1993	736	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Ellesmere Isl.	9	1993	1134	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Baffin Island	10	1994	376	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Baffin Island	10	1994	738	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	25	1994	1549	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	25	1994	488	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	25	1994	832	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	25	1994	620	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	25	1994	823	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	25	1994	453	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	25	1994	590	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	25	1994	1538	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Beaufort Sea	9	1993-1994	3662	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Beaufort Sea	26	1993-1994	3826	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Kara Sea	29	1995	4045	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Kara Sea	9	1995	2527	[ng/ g lip]	AMAP 1998
Marine Mammals	North	Greenland	13	1998	1076	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	14	1998	455	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	34	1998	903	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	8	1998	999	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	4	1998	330	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Alaska	5	1997-1999	450	[ng/ g lip]	Hoekstra et al. 2005
Marine Mammals	North	Alaska	5	1997-1999	102	[ng/ g lip]	Hoekstra et al. 2005
Marine Mammals	North	Alaska	20	1997-1999	2334	[ng/ g lip]	Hoekstra et al. 2005
Marine Mammals	North	Alaska	5	1997-1999	733	[ng/ g lip]	Hoekstra et al. 2005
Marine Mammals	North	Alaska	20	1997-1999	327	[ng/ g lip]	Hoekstra et al. 2005
Marine Mammals	North	Alaska	7	1997-1999	196	[ng/ g lip]	Hoekstra et al. 2005
Marine Mammals	North	Greenland	6	1999	573	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	4	1999	330	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	10	1999	332	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	9	1999	178	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	2	1999	186	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	3	1999	126	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	2	1999	58	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	3	1999	56	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	11	1999	660	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	8	1999	594	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	2	1999	712	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	3	1999	238	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	11	1999	360	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	9	1999	779	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	14	2000	327	[ng/ g lip]	Riget et al. 2004

Table 1: continued …

Marine Mammals	North	Greenland	6	2000	325	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	8	2000	1191	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	11	2000	991	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	3	2000	2433	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	20	2000	1270	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	5	2000	354	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	5	2000	800	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	10	2000	1772	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	19	1999-2000	463	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	13	1999-2000	531	[ng/ g lip]	Riget et al. 2004
Marine Mammals	North	Greenland	60	1999-2000	453	[ng/ g lip]	Riget et al. 2004
Marine Fish	North	Barents Sea	3	1995	17	[ng/ g lip]	AMAP 2002
Marine Fish	North	Barents Sea	3	1995	42	[ng/ g lip]	AMAP 2002
Marine Fish	North	North Sea	75	1995	11	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	50	1995	209	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	2	1995	470	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	Jan Mayen	2	1995-96	56	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	pool	1995-96	165	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	3	1995-96	170	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	pool	1995-96	122	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	5	1995-96	47	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	pool	1995-96	276	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	pool	1995-96	177	[ng/ g lip]	AMAP 2002
Marine Fish	North	Jan Mayen	1	1995-96	107	[ng/ g lip]	AMAP 2002
Marine Fish	North	North Sea	50	1997	91	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	25	1997	10	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	25	1997	58	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	25	1997	7	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	Faroe Islands	45	1997	70	[ng/ g lip]	AMAP 2002
Marine Fish	North	Alaska	7	1998	26	[ng/ g lip]	AMAP 2002
Marine Fish	North	Alaska	pool	1998	13	[ng/ g lip]	AMAP 2002
Marine Fish	North	Alaska	2	1998	19	[ng/ g lip]	AMAP 2002
Marine Fish	North	Alaska	7	1998	200	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	8	1998	216	[ng/ g lip]	AMAP 2002
Marine Fish	North	Canada	9	1998	19	[ng/ g lip]	AMAP 2002
Marine Fish	North	Canada	2	1998	53	[ng/ g lip]	AMAP 2002
Marine Fish	North	Canada	7	1998	49	[ng/ g lip]	AMAP 2002
Marine Fish	North	Canada	7	1998	19	[ng/ g lip]	AMAP 2002
Marine Fish	North	Canada	7	1998	32	[ng/ g lip]	AMAP 2002
Marine Fish	North	North Sea	50	1999	459	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	25	1999	143	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	Beaufort Sea	10	1999	27	[ng/ g lip]	AMAP 2002
Marine Fish	North	Faroe Islands	13	1999	984	[ng/ g lip]	AMAP 2002
Marine Fish	North	Finland	5	1999	13	[ng/ g lip]	AMAP 2002
Marine Fish	North	Finland	5	1999	22	[ng/ g lip]	AMAP 2002
Marine Fish	North	Finland	pool	1999	96	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	5	1999	31	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	15	1999	41	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	20	1999	230	[ng/ g lip]	AMAP 2002
Marine Fish	North	Iceland	23	1999	194	[ng/ g lip]	AMAP 2002
Marine Fish	North	na	4	1999	81	[ng/ g lip]	AMAP 2002
Marine Fish	North	na	4	1999	81	[ng/ g lip]	AMAP 2002
Marine Fish	North	Alaska	9	2000	80	[ng/ g lip]	AMAP 2002
Marine Fish	North	Alaska	2	2000	47	[ng/ g lip]	AMAP 2002
Marine Fish	North	North Sea	50	2000	5	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	1	2000	60	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	50	2000	88	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	50	2000	7	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	1	2000	21	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	Faroe Islands	15	2000	1576	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	4	2000	76	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	11	2000	40	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	6	2000	163	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	13	2000	185	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	pool	2000	180	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	pool	2000	236	[ng/ g lip]	AMAP 2002
Marine Fish	North	Iceland	21	2000	178	[ng/ g lip]	AMAP 2002
Marine Fish	North	Iceland	1	2000	229	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	pool	2000	194	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	9	2000	90	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	3	2000	144	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	pool	2000	447	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	pool	2000	232	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	pool	2000	186	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	6	2000	271	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	5	2000	192	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	6	2000	271	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	5	2000	192	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	10	2000	316	[ng/ g lip]	AMAP 2002
Marine Fish	North	White Sea	8	1999-2000	505	[ng/ g lip]	AMAP 2002

Table 1: continued …

Marine Fish	North	North Sea	50	2001	153	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	North Sea	2	2001	2	[ng/ g lip]	Julshamn et al. 2004
Marine Fish	North	Canada	4	1999	81	[ng/ g lip]	AMAP 2002
Marine Fish	North	Faroe Islands	pool	2001	623	[ng/ g lip]	AMAP 2002
Marine Fish	North	Greenland	1	na	186	[ng/ g lip]	AMAP 2002
Marine Fish	North	Iceland	1	na	229	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	5	2000	192	[ng/ g lip]	AMAP 2002
Marine Fish	North	SW Greenland	6	2000	271	[ng/ g lip]	AMAP 2002
Marine Fish	North	na	na	na	1287	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	na	1995	236	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1995	50	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1995	145	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1995	34	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1995	50	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1995	19	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	na	1996	64	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	1	1996	127	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Jan Mayen	pool	1995/96	2828	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1996	47	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1996	21	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1996	123	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	5	1996	1264	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	1	1997	2972	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	7	1997	309	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Cornwallis IsL,	10	1997	179	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	1	1997	29	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	1	1997	513	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	1	1997	46	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	2	1997	215	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Alaska	9	1998	120	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Alaska	3	1998	13	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Bjørnøya	3	1998	177	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	9	1998	142	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	2	1997	207	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	GreatLakes	79	1991-1998	4687	[ng/ g lip]	Hickey et al. 2006
Freshwater Fish	North	GreatLakes	92	1991-1998	7581	[ng/ g lip]	Hickey et al. 2006
Freshwater Fish	North	GreatLakes	78	1991-1998	4093	[ng/ g lip]	Hickey et al. 2006
Freshwater Fish	North	GreatLakes	69	1991-1998	894	[ng/ g lip]	Hickey et al. 2006
Freshwater Fish	North	Yukon	5	1998	1770	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	12	1998	382	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	11	1998	249	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	2	1998	136	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	7	1998	587	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Bjørnøya	pool	1999	1997	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	21	1999	54	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	11	1999	5297	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	11	1999	236	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	9	1999	180	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	9	1997-99	343	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Cornwallis IsL,	4	1999	1129	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	5	1999	13	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	5	1999	22	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NE Greenland	2	1999	68	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NE Greenland	11	1999	68	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NE Greenland	8	1999	260	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Nunavut	10	1999	174	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1999	53	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1999	131	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1999	256	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NWT	na	1999	118	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	SW Greenland	9	1999	145	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	SW Greenland	9	1999	150	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Sweden	4	1999	96	[ng/ g lip]	Darnerud et al. 2006
Freshwater Fish	North	Yukon	3	1999	4679	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	14	1999	3015	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	1	1999	568	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	8	1999	68	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	12	1999	300	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	10	1999	22	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Alaska	11	2000	44	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Alaska	2	2000	30	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Canada	20	2000	59	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NE Greenland	6	2000	183	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	NE Greenland	14	2000	158	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Nunavut	8	2000	161	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Nunavut	3	2000	536	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Yukon	2	2000	186	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	5	2001	96	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	4	1997-2001	43	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	3	2001	36	[ng/ g lip]	AMAP 2002

Table 1: continued

Freshwater Fish	North	Finland	2	2001	260	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	2	2001	37	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	3	2001	52	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	1	2001	1471	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	4	2001	682	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	1	2001	45	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	4	2001	53	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	5	2001	8	[ng/ g lip]	AMAP 2002
Freshwater Fish	North	Finland	5	2001	6	[ng/ g lip]	AMAP 2002
Dairy & Meat Products	North	Sweden	80	1991-1997	6	[ng/ g lip]	Glynn et al. 2000
Dairy & Meat Products	North	Sweden	80	1991-1997	3	[ng/ g lip]	Glynn et al. 2000
Dairy & Meat Products	North	Danmark	na	1995-1996	4	[ng/ g lip]	Juhler et al. 1999
Dairy & Meat Products	North	Danmark	na	1995-1996	36	[ng/ g lip]	Juhler et al. 1999
Dairy & Meat Products	North	Sweden	4	1999	3	[ng/ g lip]	Darnerud et al. 2006
Dairy & Meat Products	North	Sweden	4	1999	4	[ng/ g lip]	Darnerud et al. 2006
Dairy & Meat Products	North	Sweden	3	1998-99	4	[ng/ g lip]	Kalantzi et al. 2001
Dairy & Meat Products	North	Canada	1	2001-01	5	[ng/ g lip]	Weiss et al. 2005
Dairy & Meat Products	North	Finland	1	2001-01	1	[ng/ g lip]	Weiss et al. 2005
Dairy & Meat Products	North	Norway	1	2001-01	2	[ng/ g lip]	Weiss et al. 2005
Dairy & Meat Products	North	Sweden	1	2001-01	3	[ng/ g lip]	Weiss et al. 2005
Continental Air	North	Canada	na	1993-97	0.0005	[ng/m3]	Alegria et al. 2006
Continental Air	North	Canada	na	1994-1995	0.0110	[ng/m3]	Aulagnier and Poissant 2005
Continental Air	North	Canada	na	1994-1995	0.0120	[ng/m3]	Aulagnier and Poissant 2005
Continental Air	North	Canada	na	1994-1995	0.0050	[ng/m3]	Aulagnier and Poissant 2005
Continental Air	North	Canada	52	1995	0.0013	[ng/m3]	Hung et al. 2005
Continental Air	North	Canada	52	1994	0.0018	[ng/m3]	Hung et al. 2005
Continental Air	North	Canada	52	1994	0.0012	[ng/m3]	Hung et al. 2005
Continental Air	North	Canada	na	1996-98	0.0310	[ng/m3]	Buehler et al. 2001
Continental Air	North	Great Lakes	na	1996-98	0.0110	[ng/m3]	Buehler et al. 2001
Continental Air	North	Great Lakes	na	1996-98	0.0029	[ng/m3]	Buehler et al. 2001
Continental Air	North	Great Lakes	na	1996-98	0.0044	[ng/m3]	Buehler et al. 2001
Continental Air	North	Canada	na	2000-01	0.0240	[ng/m3]	Alegria et al. 2006
Continental Air	North	Great Lakes	an	2000-01	0.0033	[ng/m3]	Alegria et al. 2006
Continental Air	North	Great Lakes	an	2000-01	0.0025	[ng/m3]	Alegria et al. 2006
Continental Air	North	Greenland	103	2000-03	0.0005	[ng/m3]	Su et al. 2008
Continental Air	North	Norway	174	2000-03	0.0009	[ng/m3]	Su et al. 2008

2 Comparison of Measurements with Fitted Log-normal Distributions

Figure 1 compares data sets of original measurements in exposure media (from Table 1) and corresponding fitted log-normal distributions (N = 2000) that were used in the Monte-Carlo sampling. Log-normal distributions were used here, because they are observed for many environmental variables including concentrations of chemicals in humans and food (Limpert et al. 2001).

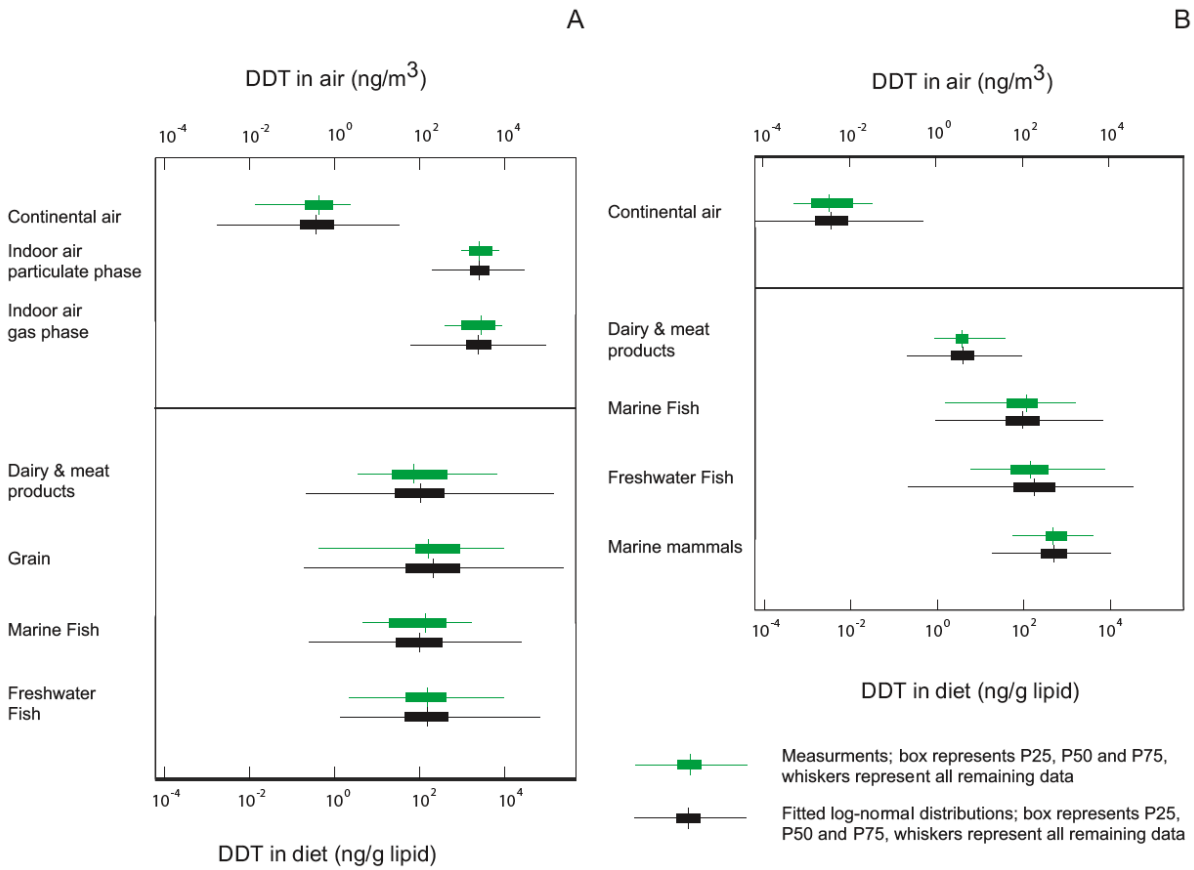

Figure 1. Comparison of original measurement data sets with fitted log-normal distributions used in the Monte-Carlo sampling. Box plots in green (upper part of each pair) represent original measurements (Table 1). Black box plots (lower part of each pair) represent fitted log-normal distributions. (*A*) Tropics, (*B*) North.

3 Exposure Factors and Model Parameters

We use food consumption rates based on data from the Global Environment Monitoring System (GEMS)/Food Consumption Cluster Diets (WHO 2010). Each cluster represents consumption rates that represent population averages from a group of countries and are based on FAO food balance sheets. Their use is in accordance with WHO guidelines for predicting long-term dietary intakes of pesticide residues on the international level (WHO 1997). For the Tropical General Population (TGP) and the Tropical Highly Exposed Population (THEP), an average consumption rate was calculated from the 42 Tropical countries from clusters G, H and I. Cluster F, representing seven northern countries, was used for the Northern General Population (NGP). Food consumption data for the Northern Highly Exposed Population (NHEP) are based on different studies specific to Greenland (Blanchet et al. 2000; Johansen 2004; AMAP 2002). Table 2 provides a summary of all food consumption rates used.

Table 2. Consumption rates of different food groups, m_i (g/person/day). See eq. 1 in the main text.

	TGP[a]	THEP[a]	NGP[a]	NHEP[b]
dairy & meat products	197	197	440	260
marine fish	9	9	35	50
freshwater fish	4	4	9	29
grains	539	539	405	194
marine mammal products	0	0	0	95

a: GEMS Food Consumption Cluster Diets (WHO 2010)

b: Blanchet et al. (2000); Johansen (2004); AMAP (2002)

DDT contamination of grains in Tropical regions has been reported frequently in the literature (Babu et al. (2003), Bakore et al. (2004), Subramanian et al. (2007), Toteja et al. (2006), Walizewski et al. (2004)), see values listed in Table 1. DDT present in grains may originate from recent DDT applications for malaria combat and/or from residuals from earlier applications in agriculture (Toteja et al. 2003). It has been reported in the literature that DDT can be found in soils in temperate regions several decades after its applications (Bidleman et al. 2006). Also in tropical countries, rice contamination with DDTs can be detected many years after the ban in agriculture, caused by the high persistence of DDT (Toteja et al. 2003, p. 935)

DDTs in grains from the North are often below detection limits (NFA 2006) and therefore usually neglected in exposure assessments for the North (Darnerud et al. 2006). This was also done in this study. Hence, consumption rates of grain products in the North are shown for information only in Table 2.

Average lipid fractions in food groups and human tissues are presented in Table 3.

Table 3. Average lipid fractions of food groups and human tissues [a]

Medium	Lipid content, f_{lipid} (%)	References
Food groups		
dairy & meat products [b]	10	Darnerud et al. (2006); FSA (2003)
fish products	8	Darnerud et al. (2006); FSA (2003)
grain	2.5	DTU (2009); FAO (2010)
marine mammal products	16	Blanchet et al. (2000)
Human tissues		
human milk	2.5	Rogan et al. (1987)
human blood/plasma	0.5	Haddad et al. (2000)
whole human body	30	Ginsberg et al. (2005)

a: for the purpose of lipid normalization of data given inTables 1 and 7; these average lipid fractions were only employed if no sample-specific measured fractions were reported by the authors

b: averages for specific products: milk 5 % (DTU 2009), meat 15 % (FSA 2003, DTU 2009), butter 80 % (Kalantzi et al. 2001)

All parameters used in Equations 1, 2 and 3 of the main text and in the PK model (equation 1 below) are given in Table 4.

Table 4. Exposure factors and model parameters used in Equations 1-3 of the main text and in the PK model (equation 1 below)

abbreviation	parameter name	value	units	reference
AE_{max}	maximal body surface exposed	9550	cm^2	assumed [a]
AE_{min}	minimal body surface exposed	1120	cm^2	assumed [b]
bw	standard body weight	70	kg	EC 1996
E_a	dietary uptake efficiency of DDTs [c]	0.9	dimensionless	Moser and McLachlan 2001
$E_{inh,g}$	respiratory uptake efficiency of p,p'-DDT from gas phase [d]	1	dimensionless	Volckens and Leith 2003
$E_{inh,p}$	respiratory uptake efficiency of p,p'-DDT from particulate phase	0.44	dimensionless	Volckens and Leith 2003
f_{indoor}	fraction of the day spent in IRS treated dwellings	0.3	dimensionless	Bouwman et al. 2009
f_{lipid}	fraction of body fat in humans (adults/average)	0.3	dimensionless	Ginsberg et al. 2005
$f_{lipid,i}$	fraction of lipid in food groups (average)	see Table 3	dimensionless	Table 3
SDA	soil & dust adherence	1	mg/cm^2	EPA 2009
$t_{1/2\ DDE}$	intrinsic human elimination half-life of p,p-DDE	6.2	years	Ritter et al. 2009
$t_{1/2\ DDT}$	intrinsic human elimination half-life of p,p-DDT	2.2	years	Ritter et al. 2009
u_1	unit conversion factor	0.365	$days \cdot year^{-1} \cdot kg \cdot g^{-1}$	Ritter et al. 2009
UR_{derm}	dermal uptake rate DDT (per day exposure)	0.01	1/day	Spalt et al. 2009
V_{inh}	volume of air inhaled by one adult person per day	16	m^3/day	EPA 2009

a: all upper and lower extremities (Vermeire et al. 1993)

b: feet (Vermeire et al. 1993)

c: i.e. maximum net absorption in the gastro intestinal tract (Moser and McLachlan 2001)

d: given by $1/(1+1/K_{la})$ where K_{la} is the lung-air partition coefficient for p,p-DDT of 3.34E7 (Volckens and Leith 2003)

4 Pharmacokinetic Model and Dose-Weighted Elimination Half-life for ∑DDT

We use a one-compartment pharmacokinetic (PK) model with first order elimination kinetics to translate the estimated distributions of total uptake, U_{total} (Figure 2B, main text), into corresponding distributions of body concentration (Figure 2C, modeled, main text). At steady state the lipid-normalized body concentration, C (ng/g lipid), corresponding to a given U_{total} is:

$$C = \frac{U_{total} \cdot t_{1/2} \cdot u_1}{bw \cdot f_{lipid} \cdot \ln 2} \qquad \text{eq. 1}$$

where $U_{total} = \sum_i U_{diet,i} + U_{inh} + U_{derm}$ (ng/person/day), i indicates different food groups, see Tables 2 and 3 above, and the other parameters and units are given in Table 4. Distributions of U_{total} were derived by Monte-Carlo sampling from distributions of route-specific uptake (see main text, *Methods* section, subsection on *Construction of total DDT uptake distribution*).

To parameterize elimination of ∑DDT, we use the approach of a dose-weighted half-life (Lorber 2002). We base the weighting on estimates of intrinsic elimination half-lives of 6.2 years for p,p'-DDE and 2.2 years for p,p'-DDT recently provided (Ritter et al. 2009). No quantitative estimates for DDD are available. However, DDD is often negligible in human biomonitoring data (Bouwman et al. 2006), because it is probably eliminated even faster than DDT (ATSDR 2002).

Using equation 1 once for DDT and once for DDE, we can formulate the DDE/DDT concentration ratio in the human body as:

$$\frac{C_{DDE}}{C_{DDT}} = \frac{U_{total,DDE}}{U_{total,DDT}} \cdot \frac{t_{1/2,DDE}}{t_{1/2,DDT}} \qquad \text{eq. 2}$$

where $U_{total,DDE}$ and $U_{total,DDT}$ is the total uptake of DDE and DDT, respectively, and C_{DDE} and C_{DDT} is the body concentration of DDE and DDT, respectively; all other parameters are given in Table 4 above. Rearranging leads to:

$$\frac{U_{total\ DDE}}{U_{total\ DDT}} = \frac{\frac{C_{DDE}}{C_{DDT}}}{\frac{t_{1/2\ DDE}}{t_{1/2\ DDT}}} \qquad \text{eq. 3}$$

where $\frac{U_{total\ DDE}}{U_{total\ DDT}}$ represents the ratio of total uptake of DDE and DDT.

Hence, under steady state conditions the ratio of daily uptake of DDE to DDT is given by the ratio of body concentrations and the ratio of intrinsic elimination half-lives. To verify the suitability of this approach, we tested it by using empirical data from biomonitoring and food

monitoring programs. We compared measured DDE/DDT uptake ratios with DDE/DDT uptake ratios derived from measured DDE/DDT concentration ratios by equation 3 from similar time periods and the same country (Table 5).

The measured DDE/DDT uptake ratios shown in Table 5 were derived from total diet studies. Dietary uptake is given as the product of the intake multiplied by the dietary uptake efficiency factor, i.e. $U_{diet} = I_{diet} \cdot E_{diet}$, with I_{diet} being the dietary intake from the total diet study and E_{diet} being the dietary uptake efficiency. In the uptake ratio, the uptake efficiency E_{diet}, which can be assumed to be the same for DDT and DDE due to their similar physical chemical properties (Moser and McLachlan 2001), cancels out. Hence, under the condition that the dietary route dominates total uptake, as it is the case for the general population data used in Table 5, equation 3 can directly be applied to results derived from total diet studies in order to obtain uptake ratios of DDE and DDT.

Table 5. Comparison of empirical and modeled ratios of $U_{total\ DDE}/U_{total\ DDT}$

country/region	measured C_{DDE}/C_{DDT}	year	reference	measured $U_{total\ DDE}/U_{total\ DDT}$	year	reference	predicted $U_{total\ DDE}/U_{total\ DDT}$ [a]
Vietnam	1.43	1989	Minh et al. 2004	0.75 [b]	1990-1991	Kannan et al. 1992	0.51
Canada	3.00	1968	Jensen and Slorach 1991	1.00	1970	Smith et al. 1973	1.06
UK	2.35	1965	Abbott et al. 1981	1.16	1966-1967	Abbott et al. 1969	0.83
South Africa (no IRS activity) [c]	10.2	2005	Serada et al. 2009	4 [d]	2005	Serada et al. 2009	3.62

a: calculated from Equation S7 with measured C_{DDE}/C_{DDT} from this table and intrinsic human elimination half-lives of 6.2 years and 2.2 years for p,p'-DDE and p,p'-DDT respectively (Ritter et al. 2009).

b: combining total diet measurements by Kannan et al. (1992) with food consumption data from Table 2 of this SM

c: Gwaliweni

d: based on bovine milk samples

The dose-weighted half-life for ∑DDT can be expressed as (Lorber 2002):

$$t_{1/2\Sigma DDT} = \frac{1}{U_{total,DDE} + U_{total,DDT}} \cdot \left(U_{total,DDE} \cdot t_{1/2,DDE} + U_{total,DDT} \cdot t_{1/2,DDT}\right) \qquad \text{eq. 4}$$

Rearrangement of eq. 4 yields:

$$t_{1/2\Sigma DDT} = \frac{1}{\frac{U_{total,DDE}}{U_{total,DDT}} + 1} \cdot \left(\frac{U_{total,DDE}}{U_{total,DDT}} \cdot t_{1/2,DDE} + t_{1/2,DDT}\right) \qquad \text{eq. 5}$$

where the value of $\frac{U_{total\ DDE}}{U_{total\ DDT}}$ can be determined according to equation 3.

Hence, the dose-weighted intrinsic elimination half-life for ∑DDT can directly be calculated from the human p,p'-DDE/p,p'-DDT concentration ratios in the biomonitoring data in combination with knowledge of the ratio of intrinsic elimination half-lives of p,p'-DDE and p,p'-DDT. The dose-weighted elimination half-lives applied in this study are given in Table 6.

Table 6: Dose-weighted, intrinsic human elimination half-lives of ∑DDT.

population	C_{DDE}/C_{DDT}	$t_{1/2\Sigma DDT}$ (years) [a]
TGP	9.7	5.3
THEP	2.6	4.1
NGP	17.7	5.7
NHEP	48.4	6

a: by applying equation 5 to median C_{DDE}/C_{DDT} derived from Table 7.

5 Measurements in Humans

Concentration data derived from measurements in humans are all given on a lipid-normalized basis. If not reported in this form by the authors of the original studies, we used given lipid fractions to calculate lipid-normalized concentrations. In a few cases, no lipid fractions were provided by the authors. In these cases we used the average lipid fractions from Table 3.

Studies used as data sources report results mainly as arithmetic means and medians; in a few cases geometric means are reported. In cases where we summarized data of a single study in order not to assign too much weight to the data from that study (e.g. in cases where a study presented large tables of detailed data for every sample), we calculated median values.

The definition of reported ∑DDT concentrations differs between studies but often includes both p,p'- and o,p'-isomers of DDT, and also DDE and DDD. Whereas the majority of human biomonitoring studies reported metabolites and isomers individually, an important fraction of studies on concentrations in exposure media (Table 1 above) reported only ∑DDT.

All human biomonitoring data used are given in Table 7 (all measurements in exposure media used, i.e. food groups, air, soil and dust, are given in Table 1 above).

Table 7. Human biomonitoring data from Tropical and Northern Regions (ng/g lipid)

Pop-ulation	Region	Country	*n* [a]	Sampling year	∑DDT	p,p'-DDT	p,p'-DDE	References
TGP	Tropics	Mexico	80	2008	2006	114	1829	Waliszewski et al. 2010
TGP	Tropics	Mexico	80	2008	452	56	352	Waliszewski et al. 2010
TGP	Tropics	Vietnam	20	2008	1200	56	1200	Haraguchi et al. 2009
TGP	Tropics	South Africa	9	2006	100	2	64	Röllin et al. 2009
TGP	Tropics	South Africa	11	2006	583	63	488	Röllin et al. 2009
TGP	Tropics	South Africa	16	2006	166	2	109	Röllin et al. 2009
TGP	Tropics	South Africa	12	2006	74	2	41	Röllin et al. 2009
TGP	Tropics	SouthAfrica	41	2005	1766	50	510	Serada et al. 2009
TGP	Tropics	Thailand	97	na	5209	629	4058	Asawasinsopon et al. 2006
TGP	Tropics	Vietnam	94	2005	1596	134	1438	Hansen et al. 2009
TGP	Tropics	Vietnam	95	2005	1728	157	1547	Hansen et al. 2009
TGP	Tropics	South Africa	48	2003-2005	129500	30000	99500	Aneck-Hahn et al. 2007
TGP	Tropics	India	7	2000-2003	1200	94	1100	Subramanian et al. 2007
TGP	Tropics	India	9	2000-2003	620	95	520	Subramanian et al. 2007
TGP	Tropics	India	4	2000-2003	410	120	280	Subramanian et al. 2007
TGP	Tropics	India	7	2000-2003	270	51	210	Subramanian et al. 2007
TGP	Tropics	Indonesia	15	2001-2003	1100	32	1100	Sudaryanto et al. 2006
TGP	Tropics	Indonesia	6	2001-2003	1000	75	920	Sudaryanto et al. 2006
TGP	Tropics	Mexico	30	2003	2220	380	1840	Herrera-Portugal et al. 2005
TGP	Tropics	Brasil	63	2001-2002	440	35.1	296.5	Azeredo et al. 2008
TGP	Tropics	Indonesia	16	2001-2003	640	33	600	Sudaryanto et al 2006
TGP	Tropics	Indonesia	15	2001-2003	1100	32	1100	Sudaryanto et al 2006
TGP	Tropics	Indonesia	18	2001-2003	1300	180	1100	Sudaryanto et al 2006
TGP	Tropics	Indonesia	6	2001-2003	1000	75	920	Sudaryanto et al 2006
TGP	Tropics	Indonesia	18	2001-2003	1300	180	1100	Sudaryanto et al. 2006
TGP	Tropics	South Africa	16	2002	728	272	411	Bouwman et al. 2006
TGP	Tropics	South Africa	25	2002	871	247	568	Bouwman et al. 2006
TGP	Tropics	Thailand	30	2002	6900	800	6000	Zimmermann et al. 2005
TGP	Tropics	Indonesia	16	2001-2003	640	33	600	Sudaryanto et al. 2006
TGP	Tropics	Vietnam	42	2000-2001	2100	170	1900	Minh et al. 2004
TGP	Tropics	Vietnam	44	2000-2001	2300	265	2000	Minh et al. 2004
TGP	Tropics	Cambodia	10	2000	1500			Sudaryanto et al 2006
TGP	Tropics	Philipines	49	2000	190			Sudaryanto et al 2006
TGP	Tropics	Thailand	25	1998	15000	3600	11500	Zimmermann et al. 2005
TGP	Tropics	Mexico	na	1995	594			Smith 1999
TGP	Tropics	Mexico	50	1994-1996	760	160	590	Wong et al. 2005
TGP	Tropics	Uganda	60	na	3620			Ejobi et al. 1998
TGP	Tropics	Uganda	83	na	2480			Ejobi et al. 1998
TGP	Tropics	Kenya	na	1994	6990	3730	2950	Chikuni et al. 1997
TGP	Tropics	Zimbabwe	na	1994	6500	1330	4490	Chikuni et al. 1997
TGP	Tropics	Zimbabwe	39	1994	25260	9070	13600	Chikuni et al. 1997
TGP	Tropics	Brazil	40	1992	1700	180	1520	Wong et al. 2005
TGP	Tropics	Kenya	216	1991	473	152	306	Kinyamu et al. 1998
TGP	Tropics	Zimbabwe	40	1991	4920	2390	2530	Wong et al. 2005
TGP	Tropics	Papua New Guinea	41	1990	890			Smith 1999
TGP	Tropics	India	20	1989	3030	880	710	Nair and Pillai 1992
TGP	Tropics	Indonesia	4	1989	7150	1700	3800	Noegrohati etal. 1992
TGP	Tropics	Indonesia	na	1989	460			Sudaryanto et al 2006
TGP	Tropics	Mexico	229	1989	6250			Smith 1999
TGP	Tropics	Vietnam	12	1989	11400			Smith 1999
TGP	Tropics	India	25	1988	1200			Smith 1999
TGP	Tropics	Thailand	3	1988	4340	731	3610	Schecter et al. 1989
TGP	Tropics	South Africa	88	1987	712	37	676	Bouwman et al. 1990
TGP	Tropics	Kenya	8	1986	4800			Smith 1999
TGP	Tropics	Mexico	22	1986	1740	230	1470	Jensen and Slorach 1991
TGP	Tropics	Nigeria	na	1986	3830	2370	1330	Chikuni et al. 1997
TGP	Tropics	South Africa	77	1986	1208	15	1190	Bouwman et al. 1991
TGP	Tropics	Kenya	48	1985	9760	3630	5230	Kanja et al. 1986
TGP	Tropics	Kenya	12	1985	7940	4080	3480	Kanja et al. 1986
TGP	Tropics	Kenya	42	1985	4320	2470	1520	Kanja et al. 1986
TGP	Tropics	Kenya	44	1985	2200	650	1410	Kanja et al. 1986
TGP	Tropics	Brazil	30	1984	1000			Smith 1999
TGP	Tropics	India	6	1984	7900			Smith 1999
TGP	Tropics	India	6	1984	1890			Smith 1999
TGP	Tropics	India	6	1984	4750			Smith 1999
TGP	Tropics	India	6	1984	8000			Smith 1999
TGP	Tropics	Kenya	68	1984	7020	5150	1730	Kanja et al. 1986
TGP	Tropics	Kenya	13	1984	1690	470	430	Kanja et al. 1986
TGP	Tropics	India	6	1983	7600	2760	4200	Jensen and Slorach 1991
TGP	Tropics	India	6	1983	2120	760	1160	Jensen and Slorach 1991
TGP	Tropics	India	6	1983	4560	1920	2240	Jensen and Slorach 1991
TGP	Tropics	India	6	1983	8960	5720	2640	Jensen and Slorach 1991
TGP	Tropics	India	25	1983	5520	1760	2840	Jensen and Slorach 1991
TGP	Tropics	Kenya	50	1983	3510	1590	1720	Kanja et al. 1986
TGP	Tropics	India	50	1982	6070	1100	4780	Jani et al. 1988
TGP	Tropics	Mexico	48	1981	4400	710	3700	Jensen and Slorach 1991

[a] *n* = number of measurements

Table 7. continued …

TGP	Tropics	Costa Rica	29	1980	50800	35680	8240	Jensen and Slorach 1991
TGP	Tropics	Costa Rica	22	1980	4400	3600	1600	Jensen and Slorach 1991
TGP	Tropics	India	na	1979	5080	1760	1080	Jensen and Slorach 1991
TGP	Tropics	India	50	1979	20920	4960	12560	Jensen and Slorach 1991
TGP	Tropics	India	75	1979	20400	10400	9600	Jensen and Slorach 1991
TGP	Tropics	Chile	24	1978	10000	3680	6000	Albert et al. 1981
TGP	Tropics	Rwanda	35	1977-1979	6273	2061	4061	Jensen and Slorach 1991
TGP	Tropics	Rwanda	40	1977-1979	2379	1241	1034	Jensen and Slorach 1991
TGP	Tropics	Mexico	620	1976	13180	1980	10350	Albert et al. 1981
TGP	Tropics	Mexico	620	1976	3240	890	2350	Jensen and Slorach 1991
TGP	Tropics	Mexico	15	1976	13200	1980	10400	Jensen and Slorach 1991
TGP	Tropics	El Salvador	40	1974	27191	7459	18842	de Campos and Olzyna-Marzys 1979
TGP	Tropics	Guatemala	290	1974	15120			Smith 1999
TGP	Tropics	Guatemala	30	1973-1974	34560			Winter et al. 1976
TGP	Tropics	Guatemala	31	1973-1974	23480			Winter et al. 1976
TGP	Tropics	Guatemala	31	1973-1974	19600			Winter et al. 1976
TGP	Tropics	Guatemala	31	1973-1974	18640			Winter et al. 1976
TGP	Tropics	Guatemala	31	1973-1974	11040			Winter et al. 1976
TGP	Tropics	Guatemala	30	1973-1974	10920			Winter et al. 1976
TGP	Tropics	Guatemala	78	1973-1974	9320			Winter et al. 1976
TGP	Tropics	Guatemala	28	1973-1974	1400			Winter et al. 1976
TGP	Tropics	Guatemala	15	1971	19200			Smith 1999
TGP	Tropics	Guatemala	46	1971	76800			Smith 1999
THEP	Tropics	South Africa	12	2006	2761	726	1966	Röllin et al. 2009
THEP	Tropics	South Africa	11	2006	7092	1797	5178	Röllin et al. 2009
THEP	Tropics	SouthAfrica	14	2005	9661	4500	4600	Serada et al. 2009
THEP	Tropics	South Africa	249	2003-2005	340900	101900	239000	Aneck-Hahn et al. 2007
THEP	Tropics	Mexico	30	2003	14820	3180	11640	Herrera-Portugal et al. 2005
THEP	Tropics	South Africa	33	2002	6238	1990	4170	Bouwman et al. 2006
THEP	Tropics	South Africa	52	2002	3358	1396	1866	Bouwman et al. 2006
THEP	Tropics	South Africa	4	2002	2965	1641	2116	Bouwman et al. 2006
THEP	Tropics	South Africa	22	2002	1149	307	833	Bouwman et al. 2006
THEP	Tropics	Mexico	60	1997-1998	4700	650	4000	Waliszewski et al. 2001
THEP	Tropics	Mexico	60	1998	5920	1001	4820	Waliszewski et al. 2001
THEP	Tropics	Mexico	~100	1996-1998	10461	3006	6941	Parido et al. 1998
THEP	Tropics	Mexico	~100	1996-1998	2578	500	1979	Parido et al. 1998
THEP	Tropics	Mexico	~100	1996-1998	7914	1957	5597	Parido et al. 1998
THEP	Tropics	Mexico	na	1997	5006	680	4300	Waliszewski et al. 2001
THEP	Tropics	Mexico	na	1995	13660	3880	9430	Waliszewski et al. 2001
THEP	Tropics	Mexico	na	1994-1995	5720	1560	3890	Waliszewski et al. 2001
THEP	Tropics	Mexico	na	1994	9410	4530	4470	Waliszewski et al. 2001
THEP	Tropics	Indonesia	4	1989	46850	14350	35500	Noegrohati etal. 1992
THEP	Tropics	Indonesia	4	1989	30250	12400	17600	Noegrohati etal. 1992
THEP	Tropics	Mexico	11	1988	19840	5420	14160	Yanez et al. 2002
THEP	Tropics	South Africa	132	1987	15948	6815	8699	Bouwman et al. 1990
THEP	Tropics	South Africa	71	1986	28180	7460	20680	Bouwman et al. 1991
THEP	Tropics	Kenya	25	1985	18730	9600	7610	Kanja et al. 1986
THEP	Tropics	Kenya	na	1983-1985	6990	3700	2950	Kinyamu et al. 1998
NGP	North	Canada	62	1959-1960	4900			Hayes et al. 1975
NGP	North	Canada	47	1966	4390			Hayes et al. 1975
NGP	North	Canada	na	1967	7280			Mes 1994
NGP	North	Sweden	210	1967	3300	1300	2000	Norén and Meironyté 2000
NGP	North	Canada	51	1967-1968	5860			Hayes et al. 1975
NGP	North	Canada	147	1967-1968	5460	1250	3840	Jensen and Slorach 1991
NGP	North	Canada	59	1966-1970	3520	1140	2230	Jensen and Slorach 1991
NGP	North	Canada	147	1968	5500			Smith 1999
NGP	North	Canada	na	1969	4440			Mes 1994
NGP	North	Sweden	75	1968-1969	2720	1020	1700	Norén and Meironyté 2000
NGP	North	Norway	42	1970	3270			Smith 1999
NGP	North	Canada	na	1971	4480			Mes 1994
NGP	North	Canada	9	1972	3570	960	2610	Jensen and Slorach 1991
NGP	North	Canada	9	1972	2410	610	1800	Jensen and Slorach 1991
NGP	North	Canada	na	1972	3570	960	2610	Musial et al. 1974
NGP	North	Canada	na	1972	2410	610	1800	Musial et al. 1974
NGP	North	Sweden	227	1972	3130	710	2420	Norén and Meironyté 2000
NGP	North	Canada	na	1971	1760			Mes 1994
NGP	North	Finland	49	1974	1570			Smith 1999
NGP	North	Finland	na	1974	2320			Smith 1999
NGP	North	Sweden	250	1974	2270	470	1800	Norén and Meironyté 2000
NGP	North	Canada	na	1975	1840			Mes 1994
NGP	North	Norway	50	1975	3270			Smith 1999
NGP	North	Norway	83	1973-1975	2115	225	1890	Ward et al. 2000
NGP	North	Norway	44	1976	1758			Smith 1999
NGP	North	Norway	70	1976	1796	164	1632	Ward et al. 2000
NGP	North	Sweden	1500	1976	1840	340	1500	Norén and Meironyté 2000
NGP	North	Canada	na	1977	1160			Mes 1994
NGP	North	Canada	33	1977-1978	1580	440	1090	Jensen and Slorach 1991
NGP	North	Sweden	745	1978	1540	270	1270	Norén and Meironyté 2000
NGP	North	Norway	133	1979	1404			Smith 1999
NGP	North	Sweden	805	1979	1340	210	1130	Norén and Meironyté 2000

Table 7. continued …

NGP	North	Sweden	41	1979	1500			Smith 1999
NGP	North	Norway	60	1977-1982	1134	103	1031	Ward et al. 2000
NGP	North	Sweden	973	1980	1240	185	1055	Norén and Meironyté 2000
NGP	North	Sweden	46	1981	1060			Smith 1999
NGP	North	Canada	na	1982	1720			Mes 1994
NGP	North	Finland	50	1982	890			Smith 1999
NGP	North	Norway	14	1982	1000			Smith 1999
NGP	North	Norway	34	1982	910			Smith 1999
NGP	North	Finland	165	1985	570			Smith 1999
NGP	North	Sweden	102	1984-1985	561	61	500	Norén and Meironyté 2000
NGP	North	Canada	na	1986	400			Mes 1994
NGP	North	Norway	85	1985-1990	464	20	444	Ward et al. 2000
NGP	North	Sweden	140	1988-1989	527	47	480	Norén and Meironyté 2000
NGP	North	Sweden	40	1990	411	42	369	Norén and Meironyté 2000
NGP	North	Sweden	13	1990	320			Smith 1999
NGP	North	Norway	28	1991	338			Smith 1999
NGP	North	Sweden	40	1991	291	36	255	Norén and Meironyté 2000
NGP	North	Canada	497	1992	240			Wong et al. 2005
NGP	North	Sweden	20	1992	249	22	227	Norén and Meironyté 2000
NGP	North	Sweden	20	1994	211	12	199	Norén and Meironyté 2000
NGP	North	Sweden	20	1996	170	11	159	Glynn et al. 2007
NGP	North	Sweden	20	1996	178	14	164	Norén and Meironyté 2000
NGP	North	Sweden	67	1997	151	14	137	Glynn et al. 2007
NGP	North	Sweden	40	1997	143	14	129	Norén and Meironyté 2000
NGP	North	Sweden	90	1998	127	8	119	Glynn et al. 2007
NGP	North	Sweden	26	1999	114	6	108	Glynn et al. 2007
NGP	North	Sweden	29	2001	96	6	90	Glynn et al. 2007
NGP	North	Sweden	31	2002	73	5	69	Glynn et al. 2007
NGP	North	Sweden	32	2004	75	5	70	Glynn et al. 2007
NGP	North	Sweden	30	2006	86	4	82	Glynn et al. 2007
NGP	North	Sweden	31	2008	53	2	51	Lignell et al. 2009
NHEP	North	Greenland	33	1974	4100	900	3100	Jensen and Clausen 1979
NHEP	North	Greenland	10	1997		50	1089	AMAP 2002
NHEP	North	Greenland	95	1997-1998		12	390	AMAP 2002
NHEP	North	Greenland	32	1999		6	244	AMAP 2002
NHEP	North	Greenland	94	1999	2040			Deutch et al. 2006
NHEP	North	Greenland	48	1999	2440			Deutch et al. 2006
NHEP	North	Greenland	~50	1999	1627			Deutch et al. 2007
NHEP	North	Greenland	~50	1999	2215			Deutch et al. 2007
NHEP	North	Greenland	29	1999-2000		6	292	AMAP 2002
NHEP	North	Greenland	8	1999-2000		36	739	AMAP 2002
NHEP	North	Greenland	~50	2000	1298			Deutch et al. 2007
NHEP	North	Greenland	~50	2000	1423			Deutch et al. 2007
NHEP	North	Greenland	92	2000-2001	1500			Deutch et al. 2006
NHEP	North	Greenland	94	2002	440			Deutch et al. 2006
NHEP	North	Greenland	42	2002 -2003		4	250	AMAP 2009
NHEP	North	Greenland	34	2003		21	581	AMAP 2009
NHEP	North	Greenland	51	2002 -2003		5	404	AMAP 2009
NHEP	North	Greenland	41	2003		34	970	AMAP 2009
NHEP	North	Greenland	79	2003	1060			Deutch et al. 2006
NHEP	North	Greenland	~50	2003	1897			Deutch et al. 2007
NHEP	North	Greenland	~50	2003	416			Deutch et al. 2007
NHEP	North	Greenland	15	2004	2060			Deutch et al. 2006
NHEP	North	Greenland	19	2005		17	898	AMAP 2009
NHEP	North	Greenland	45	2005		4	283	AMAP 2009
NHEP	North	Greenland	~50	1999-2005	542			Deutch et al. 2007
NHEP	North	Greenland	~50	1999-2005	345			Deutch et al. 2007
NHEP	North	Greenland	~50	1999-2005	2160			Deutch et al. 2007
NHEP	North	Greenland	~50	1999-2005	1357			Deutch et al. 2007
NHEP	North	Greenland	~50	1999-2005	869			Deutch et al. 2007
NHEP	North	Greenland	35	2006		12	720	AMAP 2009
NHEP	North	Greenland	28	2006		11	774	AMAP 2009
NHEP	North	Greenland	44	2006		7	364	AMAP 2009
NHEP	North	Greenland	42	2006		12	596	AMAP 2009

6 Generic Indoor Air Model

Measurements in IRS-treated dwellings show that indoor air gas phase concentrations of DDT remain at constant levels in the low $\mu g/m^3$ range (Table 8) for many months after a spraying event. These levels are about one million times higher than typical DDT concentrations measured in outdoor air in the North (Table 1). In fact, long-lasting residual concentrations are the basis of the IRS strategy. DDT as a persistent insecticide has the longest (> 6 months) IRS residual effectiveness of all IRS-approved insecticides (Bouwman and Kylin 2009).

In the main text (*Methods* section, subsection on *Calculation of route-specific uptake*), we describe that we based our estimate of inhalation exposure to DDT in the Tropical Highly Exposed Population (THEP) on DDT concentrations measured by Singh et al. (1992), see Table 8 and also Table 1. Singh et al. (1992) report DDT concentrations in the gas phase and in the particulate phase (sorbed to aerosol particles) separately. We use these concentrations as input to eq. 2 in the main text and apply eq. 2 two times, once for the gas-phase concentrations and one for the particle-bound concentrations, see also main text, subsection on *Calculation of route-specific uptake*.

Table 8. Measured and modeled concentrations of DDT in indoor air.

Study type	Measurement period (days)	Parameters/conditions	Concentration ($\mu g/m^3$)	References
measurements	240	gas phase	0.4–8.6	Singh et al. (1992)
measurements [a]	240	particulate phase	n.d. to 7.4	Singh et al. (1992)
measurements [b]	84		3.4–9.6	Bouwman et al. (2009)
indoor air model	steady state	MTC = 3; *ACH* = 0.45	19	this study
indoor air model	steady state	MTC = 3; *ACH* = 15	0.57	this study
indoor air model	steady state	MTC = 30; *ACH* = 0.45	191	this study
indoor air model	steady state	MTC = 30; *ACH* = 15	5.7	this study

a: n.d.: not detected

b: gas and particulate phase not separately reported, values are interpreted as sum of both phases

Here, we employ a generic indoor air mass balance model to back up the values reported by Singh et al. (1992). Results from this model are also shown in Table 8; they are not used in our estimation of inhalation uptake of DDT, but just as a confirmation of the data reported by Singh et al. (1992). Using the model, we derive DDT concentrations in indoor air from the physicochemical properties of p,p'-DDT, which is the major component of technical DDT used for spraying (Bouwman et al. 2006).

For all parameters of the model, numerical values, descriptions and units are given in Table 9.

Table 9. Symbols and values of parameters for the generic indoor air mass balance model.

Parameter symbol	Parameter name	Units	Values used	References
A	sprayed surface	m^2	32	Bouwman et al. (2006)
ACH	air exchange rate of the room	1/h	0.45–15	EPA (2009)/assumption
$C_{outdoor,\,g}$	air concentration outdoors	$\mu g/m^3$	0.00044	Table 1 (median)[a]
E	emission rate	µg/h	from equation 9	
MTC	mass transfer coefficient	m/h	3–30	Mackay and Paterson (1983)
MW	molecular weight	g/mol	354.5	
P_V	vapor pressure (298 K)	Pa	2.00E-05	Mackay et al. (1997)
R	gas constant	$Pa \cdot m^3 / mol \cdot K$	8.314	
T	temperature	K	298	
u_2	unit conversion factor	µg/g	1.00E+06	
V	volume of sprayed room	m^3	32	Bouwman et al. (2006)

a: in many publications of outdoor air measurements, particulate and gas phase concentrations have not been reported separately; they therefore represent both, the particulate and the gas phase. We assume these concentrations to represent the outdoor gas phase concentration in the generic indoor mass balance model; despite of this, the influence of outdoor air on indoor air concentrations remains negligible in IRS-treated dwellings.

The basic mass balance of a single room that exchanges air with the outdoor environment can be formulated as:

$$\frac{1}{V} \cdot \frac{dm}{dt} = \frac{dC_{\text{indoor,g}}}{dt} = -ACH \cdot C_{\text{indoor,g}} + ACH \cdot C_{\text{outdoor,g}} + \frac{E}{V} \qquad \text{eq. 6}$$

where $C_{\text{indoor,g}}$ is the gas phase concentration of DDT indoors and $C_{\text{outdoor,g}}$ is the gas phase concentration of DDT outdoors; all other parameters are given in Table 9. Assuming steady-state in order to describe long-term concentration levels of DDT in the room yields:

$$ACH \cdot \left(C_{\text{outdoor,g}} - C_{\text{indoor,g}}\right) + \frac{E}{V} = 0 \qquad \text{eq. 7}$$

Solving for the indoor air gas phase concentration of DDT leads to

$$C_{\text{indoor,g}} = C_{\text{outdoor,g}} + \frac{E}{V \cdot ACH} \qquad \text{eq. 8}$$

where E is the emission rate (Mackay and Paterson 1983) of p,p'-DDT from the IRS-treated surfaces in the room (µg/h) and is given by

$$E = \frac{MTC \cdot A \cdot P_V \cdot MW \cdot u_2}{R \cdot T} \qquad \text{eq. 9}$$

Since the model is solved at steady-state, E is assumed to be constant.

We use standard values for physical chemical properties of p,p'-DDT (Mackay et al. 1997) and assume the dimension of the dwellings and sprayed surface according to typical IRS settings in South Africa (Bouwman et al. 2006). No IRS-specific descriptions of indoor air movements, i.e. parameters *MTC* and *ACH* (Table 9), have been identified in the literature. Consequently, we use plausible ranges of these parameters. For the *MTC*, which depends on the air turbulences at the wall surface, we use typical values ranging from 3–30 m/h (Mackay

and Paterson 1983). For the air exchange rate, *ACH* (1/h), we assume the minimum value to be represented by the average for buildings in the US (EPA 2009) and the maximum value to be 30 times larger than this average. Model results are presented in Table 8 above.

Modeled concentrations range between 0.57 and 191 μg/m^3, which is in good agreement with the range of concentrations observed during the two long-term measurement series (Bouwman et al. 2009; Singh et al. 1992) except for the combination of a high *MTC* with a low *ACH,* which results in higher concentration compared to the measurements. However, this combination of a high *MTC* and a low *ACH* is not likely to occur under real conditions because both, *MTC* and *ACH,* reflect air movement in the room. Hence, despite the low vapor pressure of DDT and the assumption of high room ventilation rates, the sustained indoor air concentrations in the μg/m^3 range are plausible.

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