Supporting Information

for E.G. Hertwich and T.E. McKone, "The Pollutant-specific Scale of Multimedia Models and its Implications for the Potential Dose", ES9911061

A. Derivation of the characteristic atmospheric height

1. Gravitational effect

The scale height of inert gases takes into account the variation of pressure p with elevation z due to the atmosphere's own weight and the ideal gas law (*1*). Eq. 1.1 describes the variation of pressure with elevation.

$$\frac{dp(z)}{dz} = -\frac{MW\, g\, p(z)}{RT(z)} \tag{1.1}$$

g is the gravitational acceleration (9.8 m/s^2), MW the molecular weight of the gas, R the ideal gas law constant, and T the absolute temperature. If we neglect the variation of temperature and gravity with elevation, we get eq. 1.2. The scale height h is defined by eq. 1.3. For air at 273 K, h = 8 km.

$$p(z)/p_0 = \exp(-z/h) \tag{1.2}$$

$$h = \frac{RT}{MW\, g} \tag{1.3}$$

2. Diffusion

In the atmosphere, dispersion (also called eddy diffusion or macro-diffusion) dominates over molecular diffusion. In atmospheric modeling, the description of eddy-diffusion takes into account the layering of the atmosphere and hence the variation of the diffusion coefficient (eddy velocity)

with both height and atmospheric stability (*1*). We are looking for a simpler expression that will give a generic description of the vertical dispersion of gases. We hence use the regular diffusion equation with a vertical diffusion coefficient D=0.5 m^2/s. Taking into account both diffusion and gravitational effects, we get following steady state conditions:

$$\frac{\partial p}{\partial t} = D\frac{\partial^2 p}{\partial z^2} + D\frac{\partial}{\partial z}\frac{MW\, g\, p}{RT} = 0 \qquad (1.4)$$

The first term is the regular diffusion term, and the second term subtracts the derivative of eq 1.1 to ensure that a pressure profile of as described by eq 1.2 results in the absence of degradation and advection. The equation is expressed in terms of partial pressure. It can be expressed in terms of concentration through a multiplication with MW/RT.

3. Advection

We would like into account both wet and dry deposition of particles as well as wet deposition of gases (partitioning from the gas phase to water). In the CalTOX model, these processes are described in terms of the deposition rates and the equilibrium partitioning between the moving phase (particles, water) and the gas phase. Assuming equilibrium partitioning, the removal rate of pollutants from a layer of atmosphere is hence described by

$$\frac{\partial C_a}{\partial t} = \left(\left(v_{dry} + v_{wet}\right)\frac{Z_{ap}\rho_a}{Z_a\rho_{ap}} + v_{rain}\frac{H}{RT} \right)\frac{\partial C_a}{\partial z} \qquad (1.5)$$

Here, v_{dry} and v_{wet} are the dry and wet deposition velocities of particles, Z_{ap} and Z_a are the fugacity capacities of particles and air, respectively, and ρ_a, ρ_{ap} are the respective mass densities of gas and particles in a volume of air. v_{rain} is the rain rate, H the Henry's law constant in Pa.m3/mol. C_a is the

air concentration. In the following, we will represent the term in parenthesis with vK, symbolizing the product of deposition rate and partitioning constant.

4. Degradation

The pollutant loss through chemical transformation (degradation) is described by the degradation rate k.

$$\frac{\partial C_a}{\partial t} = -kC_a \tag{1.6}$$

5. Governing equation including degradation and advection

If we combine the different terms of pollutant removal (eqs 1.4,1.5,1.6) expressed in terms of pressure, we obtain eq 1.7.

$$\frac{\partial p}{\partial t} = D\frac{\partial^2 p}{\partial z^2} + D\frac{MW\,g}{RT}\frac{\partial p}{\partial z} + vK\frac{\partial p}{\partial z} - kp \tag{1.7}$$

This equation governs the vertical distribution of a degrading pollutant that is also removed through advection in a uniform air compartment with a vertical dispersion coefficient D. A number of significant simplification assumptions have been taken (no variation of D, K, k, v, T, g with z). In steady state, we obtain a solution of the form of eq 1.2 with following scale height.

$$\frac{1}{h} = \frac{1}{2}\left(\frac{vK}{D} + \frac{MW\,g}{RT} + \sqrt{\left(\frac{vK}{D} + \frac{MW\,g}{RT}\right)^2 + \frac{4k}{D}}\right) \tag{1.8}$$

Eq 1.8 allows us to identify the distinct contribution of advection (first term), gravitation (second term) and degradation (last term under the square root).

B. Results

This appendix presents further detailed results of the spatial scale calculations. Fig. A shows the scale height of different chemicals as a function of their Henry's law constant (H). The figure indicates that for chemicals with H <= 1 Pa-m3/mol, there is little difference in the scale height between the rain and no rain scenarios. At lower H values, the scale height under rain conditions decreases in proportion to H. This strong influence of rain on the residence time of hydrophilic chemicals was first noted in investigations of the spatial range using Hertwich's iterative approach (*2*), as explained in section C. Fig. B displays the spatial range of various release scenarios plotted against the spatial range of air emissions under the no rain scenario. It indicates that a large group of pollutants, especially the more mobile ones, have the a similar spatial range under all scenarios. These are probably pollutants that travel predominantly in air and pollutants that partition close to equilibrium.

The detailed results of the spatial range and scale height calculations are listed in Table B1. The table also indicates the limiting factor for the scale height. For the no rain situation, only the gravitational effect (which is the one that determines the scale height of inert atmospheric constituents) and the degradation of the pollutant (last term under the square root in eq. 1.8) are important. When it rains, the scale height can also be limited by the washout of the gaseous pollutant from the atmosphere (95 pollutants) or the wet deposition of particles (7 pollutants). Note that the dry deposition of particles is not limiting for any of the organic compounds listed here, but it would be limiting for metals.

Table B1:

Fig. A:

Fig. B:

C. A further exploration of advection-based spatial range expressions

This appendix explores the relationship of the spatial range as defined in this paper with previous advection-based formulations, that of Bennett et al. (*3*) as extended by Beyer et al. (*4*), and that of Hertwich (*2*) and the Fairmont group (*5*).

Using steady state conditions, the model of a Lagrangian air cell, and emissions to air, Bennett et al. derive following analytical equation for what they call the critical travel distance (L):

$$L = \frac{u_a N_a}{\sum_i k_i N_i} \qquad (3.1)$$

u_a is the advection speed of the Lagrangian air cell, N_a the inventory of the air compartment, and k the degradation or transformation rate in compartment i. The steady state inventories N_i assume no loss through advection and are the same as those determined in a regular multimedia model with closed system boundaries. Beyer et al. (*4*) have extended this approach to address situations in which the pollutant moves in surface water, which is symmetric to the case when the pollutant moves only in air.

We have previously proposed to identify the spatial scale by determining the model size at which the transformation of pollutant within the model equals the advection of pollutant out of the model (*2*). This proposal was presented the first time at the SETAC workshop in Fairmont Hot Springs, Canada in 1998 (*5*). The spatial range is simply the square-root of the spatial scale. This

formulation has the advantage that it is defined also for emissions to and transport in all compartments. Hertwich has implemented this approach in an iterative scheme using the CalTOX model and has developed an analytical expression that can be used in place of the iteration (*2*). The iterative scheme searches for the model area at which the pollutant degradation inside the model area equals the transfer of pollutant out of the model area. Hertwich found that for emissions to soil, such a solution could often not be found. This occurs when more than half of the pollutant remains in the soil and u_s=0. In this case, the amount of pollutant advected can never equal the amount degraded in the soil.

The analytic formulation was derived in the following way. Degradation and advection are described by eqs 3.2 and 3.3.

$$Advection = \sum_{i=1}^{n} u_i R f_i h_i C_i \tag{3.2}$$

$$Degradation = \sum_{i=1}^{n} k_i C_i R^2 h_i f_i \tag{3.3}$$

f_i is the fraction of the surface area occupied by compartment i, C_i is the concentration, h_i is the compartment height, and k_i is the compartment-specific reaction rate. The volume of the model is R^2*h, and R*h*u gives the rate at which the medium (air, surface water) passes through the system boundaries. If advection and degradation are set equal, two solutions are possible. One is R=0. The other is:

$$R = \frac{\sum_{i=1}^{n} u_i f_i h_i C_i}{\sum_{i=1}^{n} k_i f_i h_i C_i} \tag{3.4}$$

If we expand both the denominator and the numerator by R^2, we can summarize terms in terms of the pollutant inventory, $N_i = f_i h_i C_i R^2$. The resulting equation looks similar to that obtained by Bennett et al.

$$R = \frac{\sum_i u_i N_i^o}{\sum_i k_i N_i^o} \tag{3.5}$$

only that the compartment inventories $N^o{}_i$ are determined using open system boundaries. Contrary to the iterative solution, this equation is defined at all times. In the case where more than half of the pollutant remains in soil or another immobile compartment, however, it does not represent the area at which advection equals degradation. This is because, going from eq. 3.2 and eq 3.3 to eq 3.4, the possibility of R=0 was eliminated.

Note that for a steady state system with open systems boundaries, the total emission equal the degradation inside the system plus the removal from the system (eq 3.6). For closed boundaries, the second term on the right hand of eq. 3.6 is zero. If closed system boundaries are used in eq. 3.5 instead of open system boundaries, the quantity degraded inside the system equals the emissions rate, which was 1 in the main text. With closed systems boundaries, eq. 3.5 equals eq 9 in the main text.

$$\sum_i S_i = \sum_i k_i N_i^o + \sum_i T_{io} N_i^o \tag{3.6}$$

The analytic formulation for the spatial range derived in the main text (eq 9) is hence similar to previous formulations derived from a Lagrangian air cell (eq 3.1) and the Fairmont definition (eq 3.5). It does not have the restricted assumptions embedded in the Lagrangian air cell and is also defined for pollutants that predominantly remain in a non-moving compartment when emitted there. Moreover, we have shown that the results are valid not only for steady state conditions, but also for dynamic conditions. The definition is derived from the assumption that the pollutant will move with the advection speed of the medium it resides in. This is the average wind speed for air and the average stream flow speed for surface water. This assumption is as intuitive as the Fairmont definition.

It should be emphasized that the definition of the spatial range is based on the expected travel distance of a pollutant molecule emitted to a specific compartment, where the term 'expected' is

used as in statistics. The case of emissions to soil makes clear that not every molecule will travel. For example, a molecule emitted to soil may degrade being bound to organic carbon in the soil and therefore not travel at all. Or it may be transferred to air and travel very far. Since the transfer rates specified in the multimedia models give probabilities of intermedia transfer, the multimedia model calculates probabilities for the fate of the pollutant. This probabilistic interpretation of multimedia results (*6*) also explains the correspondence of the solutions in eqs 8 and 9. This interpretation, which sees steady state results as representing the time-averaged probabilities of the pollutant fate of a single molecule, should be explored further.

D. The Uncertainty in Spatial Range and Scale Height

We present an exploratory uncertainty analysis of the spatial range and scale height of dioxin. We only investigate the uncertainty and variability in chemical-specific and landscape parameters. In previous work, we have extensively analyzed the uncertainty in the potential dose calculations and, in the process, the uncertainties in air and surface water concentrations (*7, 8*). This experience has led us to conclude that at the current point the model uncertainties are probably as important for the spatial range than the more easily quantified uncertainties in the input parameters. Model uncertainties are especially important for pollutants that partition predominantly into soil or plants. The air-plant partitioning, gas-particle dynamics in the air (*9*), and the role of intermittent conditions with respect to rainfall and photodegradation (*6*) need to be investigated in more detail.

We present Monte Carlo simulations of the spatial range and scale height of 2,3,7,8 Tetrachlorodibenzo(p)dioxin using Crystal Ball. The use of Crystal Ball with CalTOX has been described previously (*8*). The chemical-specific data is available on the California Environmental Protection Agency web site for CalTOX (*10, 11*). The landscape-specific data describes the contiguous United States and comes from McKone et al. (*12*). The current analysis includes uncertainty in both chemical and landscape data. It does not assume degradation in the plant compartment, however, which may be important, as Bennett et al. (*3*) have demonstrated.

The results show a large uncertainty for the spatial range, especially when transport in surface water is important (all conditions except for air emissions under the no rain scenario). In Table D1, we use the ratio of the 95th percentile to the 5th percentile to express the variance, because, for log-normally distributed parameters, the standard deviation is too sensitive to outliers (*8*). Fig C indicates a highly skewed distribution for the spatial rang, with small but non-negligible

probabilities that dioxin will travel more than 1000 km. The distribution of the scale height Fig D, on the other hand, is normally distributed. The close proximity of median and mean scale height in Table D1 also reflects this normal distribution.

The point-estimate presented in Table 1 in the main paper does not show a clear tendency to reflect either mean or median, but it can be substantially removed from both. This divergence and the high uncertainties in the spatial range, which are higher than the uncertainties in persistence or potential dose, indicate that the uncertainty in the spatial range needs to be investigated in more detail.

Table D1

Fig C

Fig D

Table B1: The spatial range and the scale height of 288 organic pollutants. The spatial range for air emissions and the atmospheric scale height are presented for both no rain and rain conditions. The spatial range for emissions to surface water and surface soil are presented only for the no rain scenario.

		Spatial range [km]				Scale height [m]*	
Chemical	CAS No	air	air rain	surface water	soil	no rain	rain
1,1,1,2-Tetrachlorroethane	630-20-6	8.7 e+4	8.7 e+4	7.2 e+3	8.6 e+4	1.2 e+3 g	1.2 e+3 g
1,1,1-Trichloroethane	71-55-6	5.0 e+5	5.0 e+5	4.7 e+5	5.0 e+5	1.7 e+3 g	1.7 e+3 g
1,1,2,2-Tetrachloroethane	79-34-5	2.6 e+4	2.6 e+4	1.5 e+4	2.5 e+4	9.8 e+2 g	9.8 e+2 g
1,1,2-Trichloroethane	79-00-5	2.4 e+4	2.4 e+4	2.3 e+4	2.4 e+4	1.1 e+3 t	1.1 e+3 t
1,1-Dichloroethane	75-34-3	3.0 e+4	3.0 e+4	2.6 e+4	3.0 e+4	1.3 e+3 t	1.3 e+3 t
1,1-Dichloroethylene	75-35-4	5.4 e+2	5.4 e+2	5.7 e+2	5.4 e+2	2.4 e+2 t	2.4 e+2 t
1,1-Difluoro-1-Chloroethane	75-68-3	8.8 e+5	8.8 e+5	7.5 e+3	8.5 e+5	2.3 e+3 g	2.3 e+3 g
1,1-Dimethylhydrazine	57-14-7	2.8 e+1	2.4 e+1	3.4 e+1	2.4 e+1	6.1 e+1 t	2.0 e+0 r
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	1.6 e+2	3.4 e+1	1.9 e+2	7.5 e+0	3.6 e+2 g	8.8 e+1 w
1,2,4,5-Tetrachlorobenzene	95-94-3	9.0 e+4	9.0 e+4	7.2 e+4	8.4 e+4	1.0 e+3 g	1.0 e+3 g
1,2,4-Trichlorobenzene	120-82-1	1.6 e+4	1.6 e+4	1.4 e+4	1.5 e+4	8.3 e+2 g	8.3 e+2 g
1,2,4-Trimethylbenzene	95-63-6	6.6 e+1	6.6 e+1	4.7 e+1	6.4 e+1	8.5 e+1 t	8.5 e+1 t
1,2-Dibromoethane	106-93-4	1.1 e+4	1.1 e+4	8.1 e+3	1.0 e+4	7.2 e+2 t	7.2 e+2 t
1,2-Dichlorobenzene (O)	95-50-1	1.9 e+4	1.9 e+4	1.7 e+4	1.9 e+4	9.5 e+2 t	9.5 e+2 t
1,2-Dichloroethane	107-06-2	2.4 e+4	2.4 e+4	2.4 e+4	2.4 e+4	1.2 e+3 t	1.2 e+3 t
1,2-Dichloroethylene	540-59-0	1.1 e+3	1.1 e+3	8.4 e+2	1.1 e+3	3.2 e+2 t	3.2 e+2 t
1,2-Dichloropropane	78-87-5	8.1 e+3	8.1 e+3	7.9 e+3	8.1 e+3	1.6 e+3 t	1.6 e+3 t
1,2-Dinitrobenzene	528-29-0	4.7 e+3	9.4 e+1	1.6 e+2	6.2 e+2	1.3 e+3 g	6.5 e+1 r
1,3-Butadiene	106-99-0	3.2 e+1	3.2 e+1	3.2 e+1	3.2 e+1	6.0 e+1 t	6.0 e+1 t
1,3-Dichlorobenzene	541-73-1	1.2 e+4	1.2 e+4	1.0 e+4	1.2 e+4	8.3 e+2 t	8.3 e+2 t
1,3-Dichloropropene	542-75-6	9.8 e+2	9.8 e+2	3.8 e+2	9.7 e+2	3.1 e+2 t	3.1 e+2 t
1,3-Phenylenediamine	108-45-2	5.5 e+1	6.3 e+1	8.0 e+1	6.2 e+1	6.2 e+1 t	1.1 e-1 r
1,4-Dichlorobenzene (P)	106-46-7	2.1 e+4	2.1 e+4	9.2 e+3	2.1 e+4	9.8 e+2 t	9.8 e+2 t
1,4-Dinitrobenzene	100-25-4	9.0 e+4	8.8 e+4	6.0 e+4	8.2 e+4	1.3 e+3 g	1.2 e+3 g
1,4-Dioxane	123-91-1	3.2 e+2	3.1 e+2	1.3 e+2	2.3 e+2	1.9 e+2 t	1.8 e+2 t
11,12-Benzofluoranthene	207-08-9	1.2 e+2	1.3 e+2	1.6 e+3	1.1 e+2	1.1 e+2 t	1.3 e-1 r
1-Chloro-2,3-Epoxypropane	106-89-8	5.5 e+3	5.4 e+3	1.6 e+3	4.7 e+3	7.1 e+2 t	7.0 e+2 t
1-Chloro-4-Nitrobenzene	100-00-5	1.2 e+5	1.2 e+5	1.1 e+5	1.2 e+5	1.4 e+3 g	1.3 e+3 g
1-Chlorobutane	109-69-3	2.0 e+6	2.0 e+6	2.0 e+6	2.0 e+6	2.5 e+3 g	2.5 e+3 g
1-Naphtyl N-Methylcarbamate	63-25-2	3.4 e+0	3.4 e+0	2.2 e+1	3.4 e+0	1.9 e+1 t	1.9 e+1 t
2,2-(4,4'-Dihydroxydiphenyl)Propane	80-05-7	1.3 e+1	2.0 e+0	5.7 e+0	1.9 e+0	5.6 e+1 t	7.4 e-3 r
2,3,4,6-Tetrachlorophenol	58-90-2	1.6 e+2	4.2 e+1	1.9 e+2	3.6 e+1	4.5 e+2 g	6.6 e-2 r
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	1.6 e+2	3.5 e+1	6.6 e+1	7.9 e+0	4.3 e+2 g	1.1 e+2 w
2,3,7,8-TCDD	1746-01-6	2.7 e+2	1.3 e+2	7.6 e+2	8.6 e+1	5.2 e+2 g	1.9 e+2 w
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	1.7 e+2	9.8 e+1	7.1 e+1	2.7 e+1	4.2 e+2 t	2.5 e+2 t
2,4,5-T	93-76-5	7.4 e+1	7.5 e+0	2.0 e+1	8.7 e+0	2.9 e+2 t	6.8 e+0 r
2,4,5-Trichlorophenol	95-95-4	2.1 e+3	1.9 e+3	2.5 e+2	9.9 e+2	5.1 e+2 t	4.7 e+2 t
2,4,6-Trichlorophenol	88-06-2	3.3 e+3	3.1 e+3	1.3 e+1	2.1 e+3	5.6 e+2 t	5.3 e+2 t
2,4,6-Trinitrophenol	88-89-1	2.9 e+2	5.0 e+1	6.0 e+1	5.0 e+1	6.7 e+2 g	8.9 e-2 r
2,4,6-Trinitrotoluene	118-96-7	4.6 e+1	1.8 e+0	2.0 e+0	3.4 e+0	1.1 e+2 t	3.9 e+0 r
2,4-D [Acetic Acid (2,4-Dichlorophenoxy)-]	94-75-7	2.3 e+1	5.7 e+0	7.7 e+0	5.8 e+0	8.5 e+1 t	1.6 e-1 r
2,4-Diaminotoluene	95-80-7	8.6 e+0	6.0 e+0	7.3 e+0	5.9 e+0	3.5 e+1 t	6.0 e-1 r
2,4-Dichlorophenol	120-83-2	7.2 e+2	6.7 e+2	6.4 e-1	3.5 e+2	2.8 e+2 t	2.7 e+2 t
2,4-Dimethylphenol	105-67-9	4.7 e+1	4.6 e+1	5.8 e+0	1.7 e+1	7.4 e+1 t	7.2 e+1 t
2,4-Dinitrophenol	51-28-5	2.8 e+3	7.0 e+2	5.0 e+1	7.7 e+2	5.5 e+2 t	2.5 e+2 r

2,4-Dinitrotoluene	121-14-2	6.3 e+2	1.0 e+2	2.3 e+0	1.9 e+2	3.1 e+2	t	1.0 e+2 r
2,6-Dimethylpnenol	576-26-1	1.8 e+6	1.6 e+6	1.8 e+6	1.8 e+6	1.9 e+3	g	1.2 e+3 g
2,6-Dinitrotoluene	606-20-2	2.8 e+2	2.1 e+1	1.2 e+0	4.0 e+1	2.1 e+2	t	4.6 e+1 r
2-Aminonaphthalene	91-59-8	1.1 e+2	1.1 e+2	3.4 e+1	5.3 e+1	1.1 e+2	t	1.1 e+2 t
2-Butenal	123-73-9	1.1 e+2	1.1 e+2	2.1 e+1	1.1 e+2	1.1 e+2	t	1.1 e+2 t
2-Chlor-1,3-Butadiene	126-99-8	1.2 e+2	1.2 e+2	1.2 e+2	1.2 e+2	1.1 e+2	t	1.1 e+2 t
2-Chlorophenol	95-57-8	9.7 e+2	9.3 e+2	4.6 e+2	3.4 e+2	3.2 e+2	t	3.1 e+2 t
2-Chloropropane	75-29-6	2.0 e+6	2.0 e+6	2.0 e+6	2.0 e+6	3.0 e+3	g	3.0 e+3 g
2-Methoxyethanol	109-86-4	2.4 e+2	2.4 e+2	1.2 e+2	2.3 e+2	1.6 e+2	t	1.6 e+2 t
2-Nitroaniline	88-74-4	2.0 e+2	1.6 e+2	3.0 e+1	5.6 e+1	1.5 e+2	t	1.3 e+2 t
2-Nitropropane	79-46-9	2.0 e+2	2.0 e+2	1.9 e+2	2.0 e+2	1.5 e+2	t	1.5 e+2 t
2-Nitrotoluene	88-72-2	3.8 e+2	3.8 e+2	4.6 e+1	3.3 e+2	2.0 e+2	t	2.0 e+2 t
2-Phenylphenol	90-43-7	4.5 e+0	4.5 e+0	5.0 e+0	3.5 e+0	2.3 e+1	t	2.3 e+1 t
3,3-Dichlorobenzidine	91-94-1	9.4 e-1	6.1 e-1	6.0 e-3	2.2 e-2	1.1 e+1	t	8.4 e+0 t
3-Nitrotoluene	99-08-1	2.0 e+6	2.0 e+6	2.0 e+6	2.0 e+6	1.7 e+3	g	1.7 e+3 g
4,4-Diamino Ditan	101-77-9	6.7 e+0	1.2 e+0	5.0 e+0	1.0 e+0	3.5 e+1	t	4.8 e-2 r
4,6-Dinitro-O-Cresol	534-52-1	4.5 e+3	7.1 e+2	5.8 e+1	1.2 e+3	7.5 e+2	t	2.6 e+2 r
4-Aminobiphenyl	92-67-1	9.4 e+0	8.5 e-1	5.0 e+0	6.8 e-1	5.1 e+1	t	3.1 e-1 r
4-Nitrophenol	100-02-7	1.4 e+2	1.4 e+2	1.6 e+1	1.4 e+2	1.2 e+2	t	1.2 e+2 t
Acenaphthene	83-32-9	1.1 e+2	1.1 e+2	4.4 e+1	9.4 e+1	1.1 e+2	t	1.1 e+2 t
Acephate	30560-19-1	1.2 e+2	6.8 e+1	1.5 e+2	6.4 e+1	2.6 e+2	t	4.0 e-7 r
Acetaldehyde	75-07-0	1.1 e+2	1.1 e+2	2.0 e+1	1.0 e+2	1.1 e+2	t	1.1 e+2 t
Acetamide	60-35-5	7.7 e+1	3.9 e+0	5.1 e+0	6.2 e+0	1.2 e+2	t	8.8 e+0 r
Acetone	67-64-1	2.7 e+4	2.6 e+4	5.0 e+3	2.3 e+4	1.6 e+3	t	1.5 e+3 t
Acetonitrile	75-05-8	4.1 e+4	4.0 e+4	1.6 e+4	3.7 e+4	2.0 e+3	t	1.9 e+3 t
Acetophenone	98-86-2	9.0 e+3	8.3 e+3	1.7 e+3	5.5 e+3	8.9 e+2	t	8.3 e+2 t
Acrolein	107-02-8	1.4 e+2	1.4 e+2	7.8 e+1	1.4 e+2	1.2 e+2	t	1.2 e+2 t
Acrylamide	79-06-1	3.0 e+1	4.7 e-1	3.8 e+0	3.4 e-1	1.3 e+2	t	8.1 e-1 r
Acrylic Acid	79-10-7	8.9 e+1	3.7 e+1	5.2 e+0	1.6 e+1	1.1 e+2	t	6.2 e+1 t
Acrylonitrile	107-13-1	5.6 e+2	5.6 e+2	8.0 e+1	5.3 e+2	2.5 e+2	t	2.5 e+2 t
Aldicarb	116-06-3	3.5 e+2	4.6 e+2	5.2 e+2	4.5 e+2	1.1 e+2	t	1.2 e+0 r
Aldrin	309-00-2	7.5 e+1	7.1 e+1	1.5 e+2	5.3 e+1	1.0 e+2	t	9.5 e+1 t
Allyl Alcohol	107-18-6	8.9 e+1	8.8 e+1	8.7 e+0	4.2 e+1	1.0 e+2	t	1.0 e+2 t
Allyl Chloride	107-05-1	1.2 e+2	1.2 e+2	1.9 e+1	1.2 e+2	1.2 e+2	t	1.2 e+2 t
Allyl Trichloride	96-18-4	7.6 e+3	7.6 e+3	7.3 e+3	7.6 e+3	7.0 e+2	t	7.0 e+2 t
Alpha-HCH (Alpha-BHC)	319-84-6	7.7 e+2	7.1 e+2	4.9 e+2	2.0 e+2	2.9 e+2	t	2.8 e+2 t
Ammonia	7664-41-7	9.8 e+2	9.7 e+2	8.9 e+0	7.4 e+2	3.5 e+2	t	3.4 e+2 t
Anilazine	101-05-3	3.3 e+1	1.2 e-1	2.9 e+0	5.2 e-2	1.5 e+2	t	2.3 e-4 r
Aniline	62-53-3	1.1 e+2	1.0 e+2	2.6 e+1	4.6 e+1	1.1 e+2	t	1.1 e+2 t
Anthracene	120-12-7	2.5 e+1	2.5 e+1	1.8 e-1	1.8 e+1	5.3 e+1	t	5.3 e+1 t
Aroclor 1016	12674-11-2	2.2 e+3	2.2 e+3	9.8 e+2	6.9 e+1	4.0 e+2	t	4.0 e+2 t
Atrazine	1912-24-9	5.3 e+1	2.4 e-1	3.0 e-1	2.3 e+0	2.2 e+2	t	2.4 e+0 r
Azinphos-Methyl	86-50-0	1.2 e+1	2.8 e+0	8.7 e+0	2.6 e+0	5.4 e+1	t	2.5 e-3 r
Aziridine	151-56-4	4.3 e+2	4.2 e+2	4.3 e+2	3.6 e+2	2.2 e+2	t	2.0 e+2 t
Baygon	114-26-1	2.2 e+1	1.8 e+1	4.6 e+1	1.7 e+1	5.6 e+1	t	3.6 e-1 r
Benomyl	17804-35-2	1.5 e+1	4.8 e+0	2.0 e+1	4.1 e+0	6.0 e+1	t	1.5 e-5 r
Bentazone	25057-89-0	4.8 e+4	4.9 e+4	6.4 e+4	4.8 e+4	5.0 e+2	g	2.0 e-5 r
Benzene	71-43-2	3.2 e+3	3.2 e+3	1.4 e+3	3.2 e+3	5.5 e+2	t	5.5 e+2 t
Benzene, M-Dimethyl	108-38-3	1.1 e+2	1.1 e+2	6.5 e+1	1.1 e+2	1.1 e+2	t	1.1 e+2 t
Benzene, O-Dimethyl	95-47-6	1.8 e+2	1.8 e+2	9.7 e+1	1.8 e+2	1.0 e+3	t	1.0 e+3 t
Benzene, P-Dimethyl	106-42-3	1.7 e+2	1.7 e+2	9.4 e+1	1.7 e+2	1.4 e+2	t	1.4 e+2 t
Benzenethiol	108-98-5	2.0 e+6	2.0 e+6	2.0 e+6	2.0 e+6	2.1 e+3	g	2.1 e+3 g
Benzidine	92-87-5	4.0 e+1	1.0 e+1	2.0 e+1	9.9 e+0	1.0 e+2	t	3.7 e-3 r
Benzo(A)Anthracene	56-55-3	1.8 e+1	1.7 e+1	2.4 e-1	2.8 e+0	6.9 e+1	t	6.5 e+1 t

Benzo(A)Pyrene	50-32-8	1.3 e+1	8.3 e+0	6.7 e+0	1.1 e-1	5.9 e+1	t	4.3 e+1 t
Benzo(B)Fluoranthene	205-99-2	5.3 e+1	4.3 e+1	4.3 e+1	1.2 e+1	1.3 e+2	t	1.1 e+2 t
Benzo(B)Pyridine	91-22-5	3.7 e+2	3.5 e+2	3.2 e+1	1.7 e+2	2.0 e+2	t	1.9 e+2 t
Benzoic Acid	65-85-0	1.1 e+3	1.0 e+3	5.2 e+1	4.9 e+2	3.4 e+2	t	3.3 e+2 t
Benzoic Trichloride (Benzotrichloride)	98-07-7	6.6 e+3	6.6 e+3	1.9 e-1	2.0 e+1	6.3 e+2	t	6.3 e+2 t
Benzyl Chloride	100-44-7	9.1 e+2	9.1 e+2	3.8 e+1	8.6 e+2	3.0 e+2	t	3.0 e+2 t
Beta-HCH (Beta-BHC)	319-85-7	1.8 e+2	7.1 e+1	1.9 e+2	5.1 e+1	2.9 e+2	t	7.1 e+1 r
Bifenthrin	82657-04-3	9.6 e+1	4.8 e-1	7.2 e+0	3.8 e+0	3.4 e+2	g	8.0 e-1 r
Biphenyl	92-52-4	3.3 e+2	3.3 e+2	5.2 e+1	2.8 e+2	1.8 e+2	t	1.8 e+2 t
Bis(2-Chloro-1-Methylethyl) Ether	108-60-1	1.9 e+2	1.9 e+2	1.6 e+2	1.8 e+2	1.4 e+2	t	1.4 e+2 t
Bis(2-Chloroethyl)Ether	111-44-4	1.2 e+3	1.2 e+3	1.0 e+3	1.1 e+3	3.3 e+2	t	3.3 e+2 t
Bis(2-Ethylhexyl)Phthalate	117-81-7	9.1 e+1	8.4 e+1	4.5 e+1	7.8 e-1	1.7 e+2	t	1.6 e+2 t
Bis(Tributyltin) Oxide	56-35-9	1.6 e+2	4.1 e+1	3.5 e+2	3.0 e+1	2.9 e+2	g	9.3 e-2 r
Bromodichloromethane	75-27-4	2.9 e+5	2.9 e+5	2.2 e+5	2.9 e+5	1.4 e+3	g	1.4 e+3 g
Bromoform	75-25-2	1.5 e+5	1.5 e+5	1.5 e+5	1.5 e+5	9.1 e+2	g	9.1 e+2 g
Bromoxynil	1689-84-5	1.3 e+2	2.0 e+1	1.1 e+2	1.7 e+1	4.5 e+2	g	5.9 e-1 r
Butanol	71-36-3	9.7 e+2	9.4 e+2	1.1 e+2	5.2 e+2	3.4 e+2	t	3.2 e+2 t
Butyl Benzyl Phthalate	85-68-7	1.4 e+2	1.1 e+2	1.3 e+1	1.5 e-1	2.4 e+2	t	2.0 e+2 t
Butyric Acid, 4-(2,4-Dichlorophenoxy)	94-82-6	5.6 e+1	2.3 e+0	1.2 e+1	4.2 e-1	2.4 e+2	t	1.6 e+1 r
Captafol	6/1/25	1.2 e+1	6.6 e+0	1.1 e+2	2.8 e+0	5.7 e+1	t	1.9 e-7 r
Captan	133-06-2	1.3 e+2	1.3 e+2	6.6 e-1	7.4 e+1	1.1 e+2	t	1.1 e+2 t
Carbazole	86-74-8	2.2 e+1	2.2 e+1	2.4 e+1	3.5 e-1	5.0 e+1	t	5.0 e+1 t
Carbendazim	10605-21-7	3.2 e+2	1.1 e+2	1.7 e+2	1.1 e+2	5.4 e+2	g	1.2 e-5 r
Carbofuran	1563-66-2	3.4 e+4	3.3 e+4	8.3 e+3	3.1 e+4	9.0 e+2	g	8.9 e+2 g
Carbon Disulfide	75-15-0	1.1 e+4	1.1 e+4	1.0 e+4	1.1 e+4	9.3 e+2	t	9.3 e+2 t
Carbon Tetrachloride	56-23-5	9.8 e+5	9.8 e+5	9.3 e+5	9.8 e+5	1.5 e+3	g	1.5 e+3 g
Carbonyl Chloride	75-44-5	1.2 e+6	1.2 e+6	3.3 e+2	9.1 e+5	2.4 e+3	g	2.4 e+3 g
Catechol	120-80-9	4.2 e+1	1.6 e+0	5.0 e+0	1.6 e+0	1.1 e+2	t	2.5 e+0 r
Cellosolve	110-80-5	1.8 e+2	7.0 e+1	3.4 e+1	5.2 e+1	1.5 e+2	t	7.5 e+1 t
Cfc-11	75-69-4	1.4 e+6	1.4 e+6	1.3 e+6	1.4 e+6	1.7 e+3	g	1.7 e+3 g
Cfc-12	75-71-8	8.4 e+4	8.4 e+4	6.4 e+4	8.4 e+4	1.5 e+3	g	1.5 e+3 g
Chlordane	57-74-9	5.8 e+2	5.8 e+2	6.4 e+2	5.5 e+2	2.2 e+2	t	2.1 e+2 t
Chlorfenvinphos	470-90-6	1.3 e+2	2.3 e+1	5.9 e+1	2.6 e+1	4.0 e+2	g	2.3 e-3 r
Chlorinated Fluorocarbon (Freon 113)	76-13-1	1.7 e+6	1.7 e+6	1.6 e+6	1.7 e+6	1.3 e+3	g	1.3 e+3 g
Chloroacetic Acid	79-11-8	3.0 e+2	3.9 e+0	5.1 e+0	6.1 e+0	8.1 e+2	t	1.0 e+0 r
Chlorobenzene	108-90-7	9.0 e+3	9.0 e+3	7.9 e+3	8.9 e+3	8.0 e+2	t	8.0 e+2 t
Chlorodibromomethane	124-48-1	1.2 e+5	1.2 e+5	1.1 e+5	1.2 e+5	1.1 e+3	g	1.1 e+3 g
Chlorodifluoromethane (Freon-22)	75-45-6	1.1 e+6	1.1 e+6	8.9 e+3	1.1 e+6	2.6 e+3	g	2.6 e+3 g
Chloroethane	75-00-3	6.6 e+3	6.6 e+3	4.8 e+3	6.6 e+3	7.7 e+2	t	7.7 e+2 t
Chloroform	67-66-3	7.5 e+4	7.5 e+4	6.6 e+4	7.5 e+4	1.5 e+3	g	1.5 e+3 g
Chloromethyl Methyl Ether	107-30-2	9.3 e+2	9.3 e+2	8.2 e-2	9.0 e+2	3.1 e+2	t	3.1 e+2 t
Chlorothalonil	1897-45-6	6.6 e+2	3.5 e+2	8.5 e+0	5.9 e+1	2.9 e+2	t	2.0 e+2 t
Chlorpropham	101-21-3	1.4 e+2	1.5 e+1	4.8 e+1	1.6 e+1	4.7 e+2	g	1.9 e-2 r
Chlorpyriphos	2921-88-2	3.2 e+1	8.2 e+0	1.5 e+2	4.5 e+0	1.1 e+2	t	7.8 e+0 r
Chrysene	218-01-9	3.1 e+1	2.1 e+1	1.1 e+0	9.8 e-1	9.9 e+1	t	7.3 e+1 t
Cis-1,2-Dichloroethylene	156-59-2	3.6 e+3	3.6 e+3	3.2 e+3	3.6 e+3	5.6 e+2	t	5.6 e+2 t
Cis-1,3-Dichloropropene	10061-01-5	1.1 e+3	1.1 e+3	4.2 e+2	1.1 e+3	3.3 e+2	t	3.3 e+2 t
Coumaphos	56-72-4	9.8 e+0	1.5 e+0	2.5 e+1	8.4 e-1	5.3 e+1	t	3.3 e-2 r
Cumene	98-82-8	4.0 e+2	4.0 e+2	8.0 e+1	4.0 e+2	2.0 e+2	t	2.0 e+2 t
Cyanazine	21725-46-2	1.8 e+2	8.3 e+1	1.2 e+2	8.2 e+1	3.8 e+2	t	8.1 e-2 r
Cyclohexane	110-82-7	3.6 e+2	3.6 e+2	3.1 e+2	3.6 e+2	2.0 e+2	t	2.0 e+2 t
Cyclohexanone	108-94-1	1.2 e+3	1.2 e+3	3.2 e+2	9.6 e+2	3.5 e+2	t	3.5 e+2 t
Cygon	60-51-5	9.2 e+1	1.1 e+2	1.5 e+2	1.0 e+2	7.8 e+1	t	5.0 e-2 r
Cypermethrin	52315-07-8	1.8 e+2	6.6 e+0	1.4 e+1	2.6 e+1	3.4 e+2	g	1.5 e-1 r

Cyromazine	66215-27-8	5.2 e+2	3.5 e+2	4.3 e+2	3.5 e+2	5.5 e+2	g	4.6 e-8 r
Ddd	72-54-8	3.7 e+2	2.5 e+2	1.3 e+3	2.0 e+2	3.3 e+2	t	1.4 e+2 w
Dde	72-55-9	5.7 e+2	3.9 e+2	4.6 e+1	4.3 e+2	3.5 e+2	t	2.4 e+2 t
Ddt	50-29-3	4.6 e+2	3.2 e+2	4.5 e+2	3.1 e+2	3.3 e+2	t	2.1 e+2 t
Ddvp (Dichlorvos)	62-73-7	4.1 e+2	4.1 e+2	1.1 e+2	3.6 e+2	2.0 e+2	t	2.0 e+2 t
Deltamethrin	52918-63-5	1.4 e+2	3.9 e+0	8.6 e+0	3.8 e-2	3.5 e+2	g	1.6 e+1 r
Demeton	8065-48-3	2.8 e+2	2.3 e+1	4.3 e+1	2.3 e+1	5.8 e+2	g	1.2 e+0 r
Diazinon	333-41-5	3.5 e+2	1.6 e+2	2.4 e+2	1.6 e+2	3.8 e+2	t	7.7 e+1 r
Dibenz(A,H)Anthracene	53-70-3	3.0 e+1	9.6 e+0	4.6 e+1	2.0 e+0	7.2 e+1	t	1.9 e+1 r
Dibromomethane	74-95-3	3.5 e+4	3.5 e+4	3.3 e+4	3.4 e+4	1.0 e+3	g	1.0 e+3 g
Dicamba	1918-00-9	4.5 e+2	5.7 e+1	1.3 e+2	6.4 e+1	9.4 e+2	g	6.3 e+0 r
Dichlorobenzene (Mixed Isomers)	25321-22-6	1.7 e+2	5.1 e+1	2.0 e+2	4.7 e+1	5.1 e+2	t	1.6 e-1 r
Dichlorprop	120-36-5	1.0 e+2	4.0 e+0	3.1 e+1	2.7 e+0	3.9 e+2	t	3.8 e-7 r
Dieldrin	60-57-1	2.2 e+2	1.9 e+2	3.8 e+2	1.4 e+2	2.0 e+2	t	1.5 e+2 t
Diethanolamine	111-42-2	8.2 e+0	2.0 e+0	3.2 e+0	2.0 e+0	5.8 e+1	t	3.2 e-2 r
Diethyl Phthalate	84-66-2	1.7 e+3	6.6 e+2	1.8 e+2	3.8 e+2	4.3 e+2	t	2.5 e+2 t
Diethyl Sulfate	64-67-5	6.3 e+1	6.3 e+1	3.5 e-1	2.7 e+1	8.4 e+1	t	8.3 e+1 t
Dimethyl Phthalate	131-11-3	6.9 e+3	3.3 e+3	1.9 e+2	1.2 e+3	7.8 e+2	g	5.4 e+2 g
Dimethyl Sulfate	77-78-1	1.2 e+3	1.1 e+3	1.2 e+0	2.2 e+2	3.7 e+2	t	3.5 e+2 t
Dimethylamine	124-40-3	1.1 e+2	1.1 e+2	1.7 e+1	8.8 e+1	1.1 e+2	t	1.1 e+2 t
Dimethylphylamine	121-69-7	1.1 e+2	1.1 e+2	1.4 e+1	1.0 e+2	1.1 e+2	t	1.1 e+2 t
Di-N-Butyl Phthalate	84-74-2	2.0 e+2	1.6 e+2	2.9 e+1	7.5 e+1	2.7 e+2	t	2.2 e+2 t
Dinitrobutyl Phenol	88-85-7	8.3 e+2	5.5 e+2	4.3 e+2	4.6 e+2	3.4 e+2	t	2.0 e+2 t
Di-N-Octyl Phthalate	117-84-0	1.5 e+2	3.0 e+1	4.9 e+1	3.6 e-2	1.8 e+2	t	6.5 e+1 w
Diphenylamine	122-39-4	7.2 e+1	6.0 e+1	7.9 e+1	1.5 e+1	1.1 e+2	t	9.4 e+1 t
Disulfothon	298-04-4	1.8 e+1	1.7 e+0	2.3 e+1	9.9 e-1	7.9 e+1	t	1.7 e+0 r
Diuron	330-54-1	2.5 e+2	7.1 e+1	1.2 e+2	7.2 e+1	6.7 e+2	g	1.2 e+0 r
Endosulfan	115-29-7	3.0 e+2	2.9 e+2	4.8 e+1	1.6 e+2	1.6 e+2	t	1.6 e+2 t
Endrin	72-20-8	2.6 e+2	2.6 e+2	5.6 e+2	2.4 e+2	1.6 e+2	t	1.4 e+2 t
Ethoprop	13194-48-4	2.5 e+2	1.7 e+2	2.6 e+2	1.7 e+2	3.1 e+2	t	1.3 e-1 r
Ethyl Acetate	141-78-6	1.2 e+3	1.2 e+3	1.6 e+2	1.1 e+3	3.5 e+2	t	3.5 e+2 t
Ethyl Acrylate	140-88-5	9.8 e+1	9.8 e+1	1.5 e+1	9.2 e+1	1.0 e+2	t	1.0 e+2 t
Ethyl Dipropylthiocarbamate	759-94-4	2.2 e+5	2.1 e+5	5.8 e+4	1.9 e+5	1.3 e+3	g	1.2 e+3 g
Ethyl Ether (Diethyl Ether)	60-29-7	3.9 e+2	3.9 e+2	2.6 e+2	3.8 e+2	2.0 e+2	t	2.0 e+2 t
Ethyl Methacrylate	97-63-2	2.0 e+6	2.0 e+6	2.0 e+6	2.0 e+6	2.1 e+3	g	2.1 e+3 g
Ethylbenzene	100-41-4	1.1 e+3	1.1 e+3	3.4 e+2	1.1 e+3	3.2 e+2	t	3.2 e+2 t
Ethylene Glycol	107-21-1	2.4 e+2	2.2 e+1	1.0 e+1	2.2 e+1	1.9 e+2	t	4.5 e+1 r
Ethylene Oxide	75-21-8	3.5 e+4	3.5 e+4	1.5 e+4	3.3 e+4	1.7 e+3	t	1.7 e+3 t
Ethylenethiourea	96-45-7	2.1 e+1	2.1 e+1	3.2 e+1	2.1 e+1	4.8 e+1	t	2.5 e-1 r
Fenitrothion	122-14-5	1.1 e+2	5.4 e+0	3.6 e+1	4.7 e+0	4.0 e+2	g	9.6 e-3 r
Fenthion	55-38-9	2.0 e+2	9.1 e+1	5.4 e+2	8.0 e+1	4.3 e+2	g	1.8 e-1 r
Fentin Acetate	900-95-8	8.7 e+1	1.8 e+0	2.0 e+1	1.2 e+0	3.4 e+2	g	7.8 e-2 r
Fluoranthene	206-44-0	1.2 e+2	1.2 e+2	8.1 e+0	5.3 e+1	1.6 e+2	t	1.5 e+2 t
Fluorene	86-73-7	8.1 e+2	8.1 e+2	6.1 e+2	4.0 e+2	2.8 e+2	t	2.8 e+2 t
Folpet	133-07-3	2.2 e+1	2.9 e-1	5.7 e-1	3.2 e-1	1.1 e+2	t	3.0 e+0 r
Formaldehyde	50-00-0	4.3 e+1	3.5 e+1	5.3 e+0	1.3 e+1	7.3 e+1	t	6.4 e+1 t
Formic Acid	64-18-6	2.3 e+3	1.5 e+2	1.1 e+1	5.4 e+2	7.3 e+2	t	1.3 e+2 r
Furan	110-00-9	3.9 e+2	3.9 e+2	1.4 e+2	3.9 e+2	2.0 e+2	t	2.0 e+2 t
Gamma-HCH (Lindane)	58-89-9	8.3 e+2	7.6 e+2	6.2 e+2	4.1 e+2	2.9 e+2	t	2.7 e+2 t
Glyphosate	1071-83-6	1.4 e+2	2.5 e+1	1.7 e+2	1.9 e+1	5.2 e+2	g	4.2 e-7 r
Heptachlor	76-44-8	1.2 e+2	1.2 e+2	2.6 e+1	1.0 e+2	1.1 e+2	t	1.1 e+2 t
Heptachlor Epoxide	1024-57-3	7.4 e+2	7.4 e+2	7.4 e+2	6.1 e+2	2.3 e+2	t	2.3 e+2 t
Hexachlorinated Dibenzofuran, 1,2,3,4,7,8-	70648-26-9	3.5 e+3	3.1 e+3	3.2 e+3	3.4 e+3	4.6 e+2	g	1.1 e+2 w
Hexachloro-1,3-Butadiene	87-68-3	3.0 e+5	3.0 e+5	2.5 e+5	3.0 e+5	9.0 e+2	g	9.0 e+2 g

Hexachlorobenzene	118-74-1	2.1 e+5	2.0 e+5	2.0 e+5	2.0 e+5	8.3 e+2	g	8.3 e+2 g
Hexachlorocyclopentadiene	77-47-4	1.1 e+2	1.1 e+2	2.2 e+1	8.3 e+1	1.1 e+2	t	1.1 e+2 t
Hexachloroethane	67-72-1	1.4 e+6	1.4 e+6	1.2 e+6	1.3 e+6	1.0 e+3	g	1.0 e+3 g
Hexane	110-54-3	3.9 e+2	3.9 e+2	2.6 e+2	3.9 e+2	2.0 e+2	t	2.0 e+2 t
Hexone	108-10-1	1.9 e+2	1.9 e+2	2.4 e+1	1.7 e+2	1.4 e+2	t	1.4 e+2 t
Hydrazine	302-01-2	6.6 e+1	5.8 e+1	1.3 e+1	1.8 e+1	9.0 e+1	t	8.2 e+1 t
Hydrocyanic Acid	74-90-8	2.3 e+5	2.3 e+5	2.0 e+5	2.2 e+5	3.9 e+3	t	3.8 e+3 t
Hydroquinone	123-31-9	2.1 e+1	4.7 e-2	9.2 e-2	4.8 e-2	1.1 e+2	t	3.1 e-2 r
Indeno(1,2,3-C,D)Pyrene	193-39-5	4.5 e+1	3.0 e+1	4.4 e+2	1.1 e+1	8.6 e+1	t	3.0 e+1 t
Iprodione	36734-19-7	8.7 e+1	4.9 e+0	1.3 e+1	5.2 e+0	3.2 e+2	t	9.5 e-5 r
Isobutanol	78-83-1	1.1 e+3	1.1 e+3	1.0 e+2	6.9 e+2	3.6 e+2	t	3.5 e+2 t
Isophorone	78-59-1	4.0 e+1	4.0 e+1	4.7 e+1	3.6 e+1	6.7 e+1	t	6.6 e+1 t
Isopropyl Alcohol	67-63-0	2.4 e+2	2.4 e+2	1.8 e+1	1.1 e+2	1.7 e+2	t	1.7 e+2 t
Linuron	330-55-2	7.5 e+1	8.3 e+1	2.0 e+2	7.8 e+1	8.1 e+1	t	6.1 e-1 r
Malathion	121-75-5	2.7 e+1	5.7 e+0	8.0 e+1	2.6 e+0	1.1 e+2	t	3.9 e+0 r
Maleic Anhydride	108-31-6	1.2 e+2	2.3 e-5	5.2 e-4	6.6 e-7	4.2 e+2	t	6.0 e-5 r
M-Cresol	108-39-4	4.4 e+1	4.1 e+1	1.1 e+1	1.9 e+1	7.1 e+1	t	6.7 e+1 t
M-Dinitrobenzene	99-65-0	1.4 e+3	1.1 e+2	1.1 e+2	1.5 e+1	1.2 e+3	g	1.6 e+2 r
Mecoprop	7085-19-0	1.6 e+2	1.2 e+1	2.0 e+1	1.2 e+1	4.5 e+2	g	3.8 e-7 r
Methanol	67-56-1	2.7 e+3	2.5 e+3	1.8 e+2	1.4 e+3	6.4 e+2	t	5.8 e+2 t
Methomyl	16752-77-5	6.2 e+2	5.2 e+2	7.0 e+2	5.1 e+2	3.6 e+2	t	1.5 e-4 r
Methoxone	94-74-6	5.4 e+1	4.8 e+0	1.5 e+1	4.3 e+0	2.2 e+2	t	2.5 e-8 r
Methoxychlor	72-43-5	7.3 e+1	6.9 e+1	5.2 e-1	2.4 e+0	1.2 e+2	t	1.1 e+2 t
Methyl Acetate	79-20-9	1.2 e+3	1.2 e+3	1.6 e+2	1.1 e+3	3.6 e+2	t	3.6 e+2 t
Methyl Acrylate	96-33-3	1.1 e+2	1.1 e+2	1.6 e+1	1.0 e+2	1.1 e+2	t	1.1 e+2 t
Methyl Bromide	74-83-9	1.8 e+5	1.8 e+5	1.0 e+5	1.8 e+5	2.0 e+3	g	2.0 e+3 g
Methyl Chloride	74-87-3	1.7 e+5	1.7 e+5	9.2 e+4	1.7 e+5	2.8 e+3	t	2.8 e+3 t
Methyl Ethyl Ketone	78-93-3	3.5 e+3	3.5 e+3	4.0 e+2	2.7 e+3	6.0 e+2	t	5.9 e+2 t
Methyl Hydrzine	60-34-4	8.3 e+1	8.2 e+1	5.7 e+1	5.7 e+1	9.7 e+1	t	9.5 e+1 t
Methyl Iodide	74-88-4	2.2 e+4	2.2 e+4	9.5 e+3	2.2 e+4	1.4 e+2	t	1.4 e+2 t
Methyl Methacrylate	80-62-6	4.5 e+1	4.5 e+1	3.8 e+1	4.4 e+1	7.1 e+1	t	7.1 e+1 t
Methyl Parathion	298-00-0	1.2 e+2	1.1 e+2	1.9 e+2	1.0 e+2	1.1 e+2	t	5.7 e+1 t
Methyl Tert-Butyl Ether	1634-04-4	8.7 e+2	8.7 e+2	7.0 e+2	8.6 e+2	3.0 e+2	t	3.0 e+2 t
Methylacrylonitrile	126-98-7	1.4 e+6	1.3 e+6	9.5 e+5	1.3 e+6	3.4 e+3	g	3.4 e+3 g
Methylene Chloride	75-09-2	5.6 e+4	5.6 e+4	3.0 e+4	5.5 e+4	7.7 e+2	t	7.7 e+2 t
Methyl-Mercury	22967-92-6	2.9 e+3	2.4 e+3	2.4 e+3	2.8 e+3	7.1 e+2	g	1.2 e+2 w
Metolachlor	51218-45-2	2.5 e+2	1.0 e+2	1.7 e+2	1.0 e+2	4.3 e+2	g	2.2 e-2 r
Metribuzin	21087-64-9	4.5 e+3	4.5 e+3	3.7 e+3	4.5 e+3	5.2 e+2	t	5.2 e+2 t
Mevinphos	7786-34-7	2.4 e+1	1.7 e+0	1.4 e+1	1.1 e+0	8.8 e+1	t	5.1 e-5 r
N,N-Bianiline	122-66-7	2.1 e+1	4.6 e-1	6.6 e+0	5.5 e-2	1.0 e+2	t	2.7 e+0 r
Naphthalene	91-20-3	3.7 e+2	3.7 e+2	1.7 e+2	3.6 e+2	1.9 e+2	t	1.9 e+2 t
Nitrobenzene	98-95-3	1.6 e+3	1.6 e+3	1.4 e+3	1.4 e+3	3.9 e+2	t	3.8 e+2 t
Nitroglycerin	55-63-0	5.3 e+1	8.2 e+0	9.0 e+0	1.4 e+0	8.7 e+1	t	3.0 e+1 r
N-Nitrosodiphenylamine	86-30-6	2.9 e+1	2.9 e+1	4.1 e+1	1.4 e+1	5.6 e+1	t	5.6 e+1 t
O-Anisidine	90-04-0	2.2 e+1	2.1 e+1	1.5 e+1	1.6 e+1	4.9 e+1	t	4.8 e+1 t
O-Cresol(2)	95-48-7	6.3 e+1	5.8 e+1	5.7 e+0	1.4 e+1	8.5 e+1	t	8.2 e+1 t
O-Toluidine	95-53-4	1.6 e+1	1.6 e+1	5.4 e+0	1.6 e+1	4.3 e+1	t	4.3 e+1 t
Oxamyl	23135-22-0	1.0 e+2	1.4 e+1	2.3 e+1	1.4 e+1	3.7 e+2	t	1.9 e-4 r
Oxydemeton Methyl	301-12-2	7.7 e+1	2.8 e+1	1.3 e+2	2.4 e+1	2.5 e+2	t	4.2 e-4 r
Parathion	56-38-2	9.7 e+1	2.9 e+0	6.0 e+1	1.2 e+0	3.8 e+2	g	1.1 e-1 r
Pcb-1254	11097-69-1	9.5 e+2	7.6 e+2	7.4 e+2	4.8 e+2	6.2 e+2	g	5.1 e+2 g
P-Chloroaniline	106-47-8	1.0 e+2	7.1 e+1	2.1 e+1	1.4 e+1	1.1 e+2	t	9.0 e+1 t
P-Cresol	106-44-5	5.8 e+1	5.1 e+1	2.5 e-1	2.5 e+0	8.3 e+1	t	7.7 e+1 t
Pentachlorobenzene	608-93-5	1.3 e+5	1.3 e+5	1.2 e+5	1.2 e+5	9.1 e+2	g	9.1 e+2 g

Pentachloronitrobenzene	82-68-8	9.1 e+4	8.9 e+4	8.6 e+4	6.8 e+4	8.0 e+2	g	8.0 e+2 g
Pentachlorophenol	87-86-5	1.5 e+2	4.4 e+0	2.4 e-1	2.2 e+1	3.8 e+2	t	1.6 e+1 r
Permethrin	52645-53-1	7.9 e+1	1.1 e+0	5.7 e+1	5.2 e-1	2.9 e+2	t	8.7 e-1 r
Phenol	108-95-2	8.6 e+1	6.6 e+1	1.2 e+0	1.8 e+1	1.0 e+2	t	8.7 e+1 t
Phoxim	14816-18-3	1.7 e+4	1.2 e+4	1.6 e+3	1.1 e+4	8.1 e+2	g	6.8 e+2 g
Phthalic Anhydride	85-44-9	1.1 e+3	1.3 e+0	5.5 e-2	1.2 e-1	9.6 e+2	t	1.3 e+1 r
Pirimicarb	23103-98-2	1.4 e+2	1.7 e+0	2.9 e+0	1.8 e+0	3.8 e+2	t	5.7 e-4 r
P-Phenylenediamine	106-50-3	8.1 e+0	5.1 e+0	7.1 e+0	5.0 e+0	3.6 e+1	t	5.4 e-1 r
Pronamide	23950-58-5	7.3 e+3	5.5 e+3	2.9 e+3	2.6 e+3	7.8 e+2	g	6.7 e+2 g
Propachlor	1918-16-7	1.4 e+2	7.6 e+0	2.2 e+1	7.1 e+0	4.2 e+2	t	8.4 e-2 r
Propylene (Propene)	115-07-1	6.9 e+1	6.9 e+1	4.8 e+1	6.9 e+1	8.8 e+1	t	8.8 e+1 t
Propylene Oxide	75-56-9	1.0 e+4	1.0 e+4	4.8 e+3	9.4 e+3	9.6 e+2	t	9.5 e+2 t
P-Toluidine	106-49-0	1.9 e+6	1.8 e+6	1.9 e+6	1.9 e+6	2.2 e+3	g	1.6 e+3 g
Pyrazophos	13457-18-6	1.0 e+2	3.4 e+0	2.9 e+1	3.6 e+0	3.9 e+2	g	3.3 e-2 r
Pyrene	129-00-0	2.5 e+1	2.5 e+1	1.9 e-1	1.1 e+1	5.8 e+1	t	5.7 e+1 t
Pyridine	110-86-1	4.1 e+3	3.9 e+3	2.3 e+2	2.6 e+3	6.8 e+2	t	6.5 e+2 t
S,S,S-Tributyltrithiophosphate	78-48-8	1.5 e+4	1.5 e+4	1.5 e+4	1.2 e+4	6.1 e+2	g	6.1 e+2 g
Safrole	94-59-7	2.5 e+1	2.5 e+1	3.0 e+1	1.8 e+1	5.2 e+1	t	5.2 e+1 t
Sec-Butyl Alcohol	78-92-2	6.3 e+2	6.1 e+2	8.5 e+1	2.5 e+2	2.7 e+2	t	2.6 e+2 t
Simazine	122-34-9	1.8 e+2	4.1 e+1	6.0 e+1	4.1 e+1	4.7 e+2	g	2.7 e-3 r
Styrene	100-42-5	9.3 e+1	9.3 e+1	8.0 e+1	9.2 e+1	1.0 e+2	t	1.0 e+2 t
Styrene Oxide	96-09-3	4.8 e+2	4.7 e+2	3.8 e+1	1.1 e+2	2.3 e+2	t	2.2 e+2 t
Tert-Butyl Alcohol	75-65-0	6.9 e+3	6.7 e+3	5.5 e+3	5.5 e+3	8.0 e+2	t	7.6 e+2 t
Tetrachloroethylene	127-18-4	2.8 e+4	2.8 e+4	1.7 e+4	2.8 e+4	1.0 e+3	g	1.0 e+3 g
Thiourea	62-56-6	1.4 e+1	3.1 e+0	5.0 e+0	3.1 e+0	8.6 e+1	t	1.0 e-1 r
Thiram	137-26-8	1.8 e+3	3.2 e+1	7.7 e+0	1.1 e+2	6.6 e+2	g	6.0 e+1 r
Tolclophos-Methyl	57018-04-9	2.4 e+2	8.5 e+1	9.6 e+1	5.5 e+1	5.9 e+2	g	1.9 e+2 g
Toluene	108-88-3	1.3 e+3	1.3 e+3	6.3 e+2	1.3 e+3	3.6 e+2	t	3.6 e+2 t
Toxaphene	8001-35-2	1.2 e+4	1.2 e+4	1.2 e+4	1.2 e+4	4.8 e+2	g	4.8 e+2 g
Trans-1,2-Dichloroethylene	156-60-5	3.6 e+3	3.6 e+3	3.2 e+3	3.6 e+3	5.6 e+2	t	5.6 e+2 t
Trans-1,3-Dichloropropene	10061-02-6	6.6 e+2	6.6 e+2	2.6 e+2	6.5 e+2	2.6 e+2	t	2.6 e+2 t
Triallate	2303-17-5	3.1 e+2	1.6 e+2	5.4 e+2	1.6 e+2	4.6 e+2	g	8.3 e+0 r
Triazophos	24017-47-8	1.6 e+2	5.2 e+1	1.0 e+2	5.3 e+1	4.4 e+2	g	1.9 e-2 r
Trichlorfon	52-68-6	1.0 e+2	1.1 e+1	1.9 e+1	1.0 e+1	2.7 e+2	t	1.3 e-5 r
Trichloroethylene	79-01-6	1.9 e+3	1.9 e+3	1.7 e+3	1.9 e+3	4.1 e+2	t	4.1 e+2 t
Triethylamine	121-44-8	1.0 e+2	1.0 e+2	3.6 e+0	4.4 e+1	1.1 e+2	t	1.1 e+2 t
Trifluralin	1582-09-8	1.7 e+2	1.7 e+2	3.1 e+0	1.1 e+2	1.6 e+2	t	1.5 e+2 t
Triphenyltin Chloride	639-58-7	4.4 e+1	6.6 e+0	2.0 e+1	2.0 e+0	1.9 e+2	t	3.2 e+1 r
Vinyl Acetate	108-05-4	1.2 e+3	1.2 e+3	4.3 e+2	1.2 e+3	3.5 e+2	t	3.5 e+2 t
Vinyl Bromide	593-60-2	3.9 e+2	3.9 e+2	3.3 e+2	3.9 e+2	2.0 e+2	t	2.0 e+2 t
Vinyl Chloride	75-01-4	1.8 e+3	1.8 e+3	1.8 e+3	1.8 e+3	4.2 e+2	t	4.2 e+2 t
Xylenes (Total)	1330-20-7	5.3 e+2	5.3 e+2	3.1 e+2	5.3 e+2	2.3 e+2	t	2.3 e+2 t
Zineb	12122-67-7	1.9 e+2	3.6 e+1	1.0 e+2	3.3 e+1	4.2 e+2	g	2.9 e-3 r

* The letter after the scale height indicates the limiting factor: g for gravity, r for advection of dissolved pollutant in rain, w for wet deposition of particle-bound pollutant, and t for transformation (decay).

Table D1: Some statistics of the Monte Carlo analysis of the spatial range (R) and scale height (h) of 2,3,7,8-TCDD under rain and no rain (nr) conditions and for emissions to air, surface soil, and surface water (sw).

	Rair nr	*R air rain*	*Rsw*	*Rsoil*	*h nr*	*h rain*
Mean	474	293	682	224	464	263
Median	321	177	424	77	458	258
95%/5%	15	27	26	131	1.7	9.3

Figure Captions:

Fig A: The atmospheric scale height of pollutants as a function of the Henry's law constant for scenarios with and without rainfall.

Fig B: A comparison of the spatial range for air emissions in situations with and without rain, and for emissions to surface water and surface soil (no rain).

Fig C: Cumulative distribution of a Monte Carlo analysis of the spatial range of 2,3,7,8-TCDD with 10,000 simulations. The analysis was conducted for emissions to air, surface water, and surface soil under conditions of no rainfall and emissions to air with rainfall.

Fig D: Cumulative distribution of a Monte Carlo analysis of the atmospheric scale height of 2,3,7,8-TCDD with 10,000 simulations under rain and no rain conditions.

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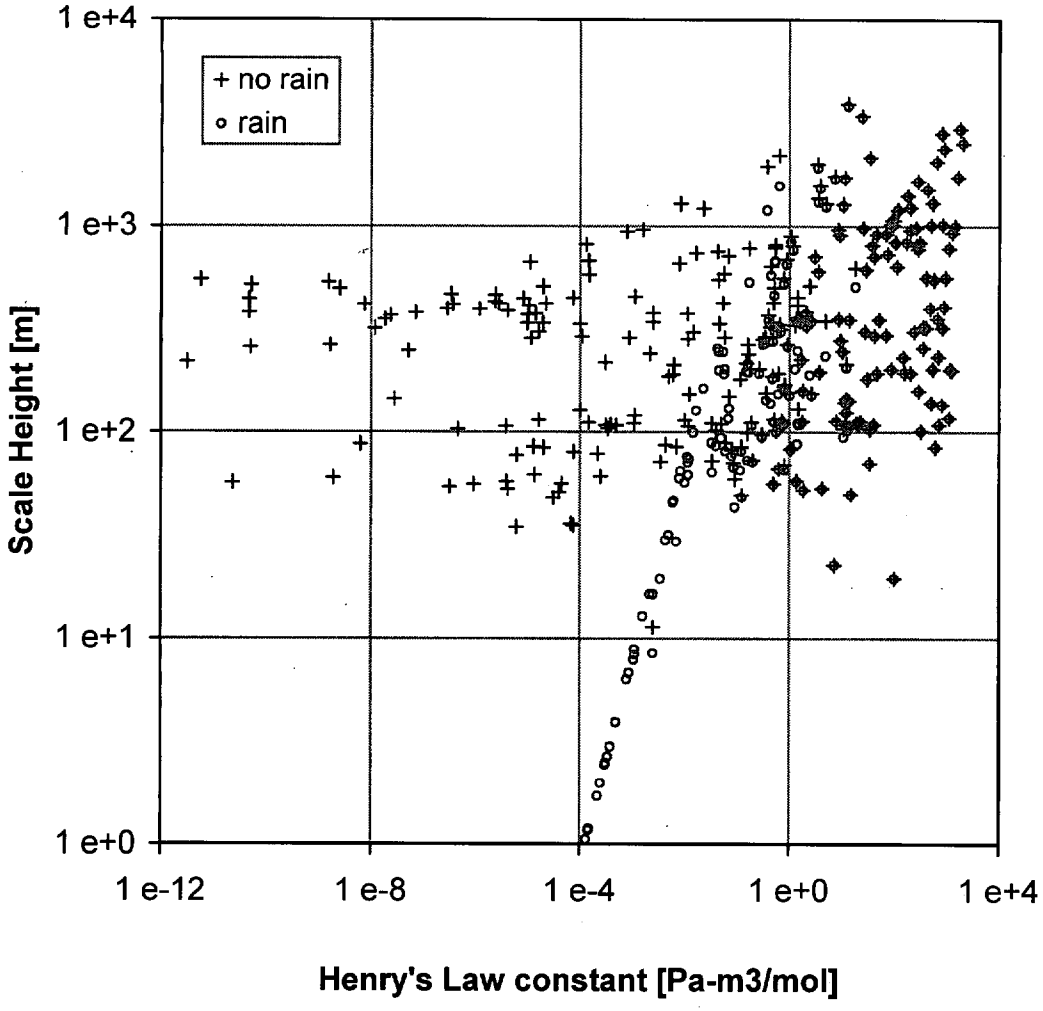
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1 e+2
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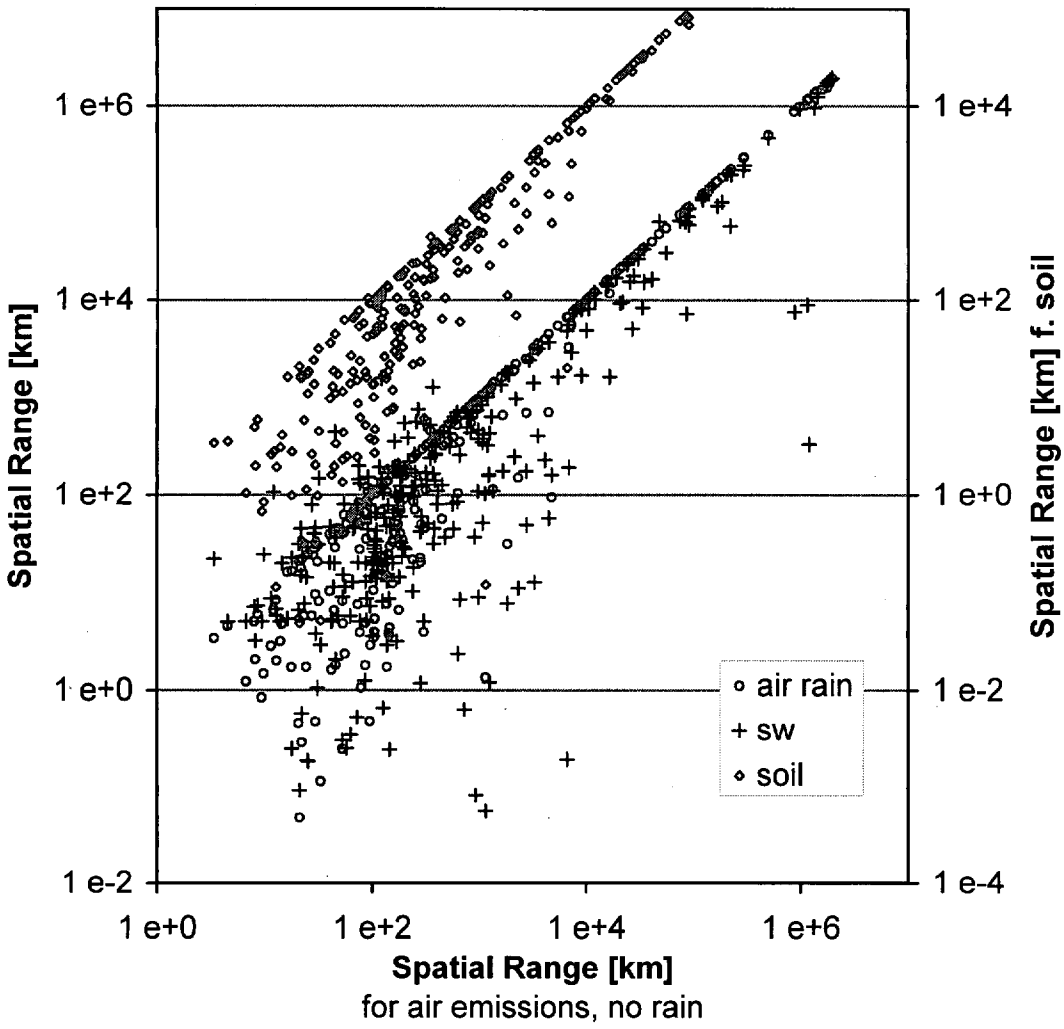
o rain
1 e-12
1 e-8
1 e-4
1 e+0
1 e+4
Henry's Law constant [Pa-m3/mol]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Spatial Range [km]
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1 e+2
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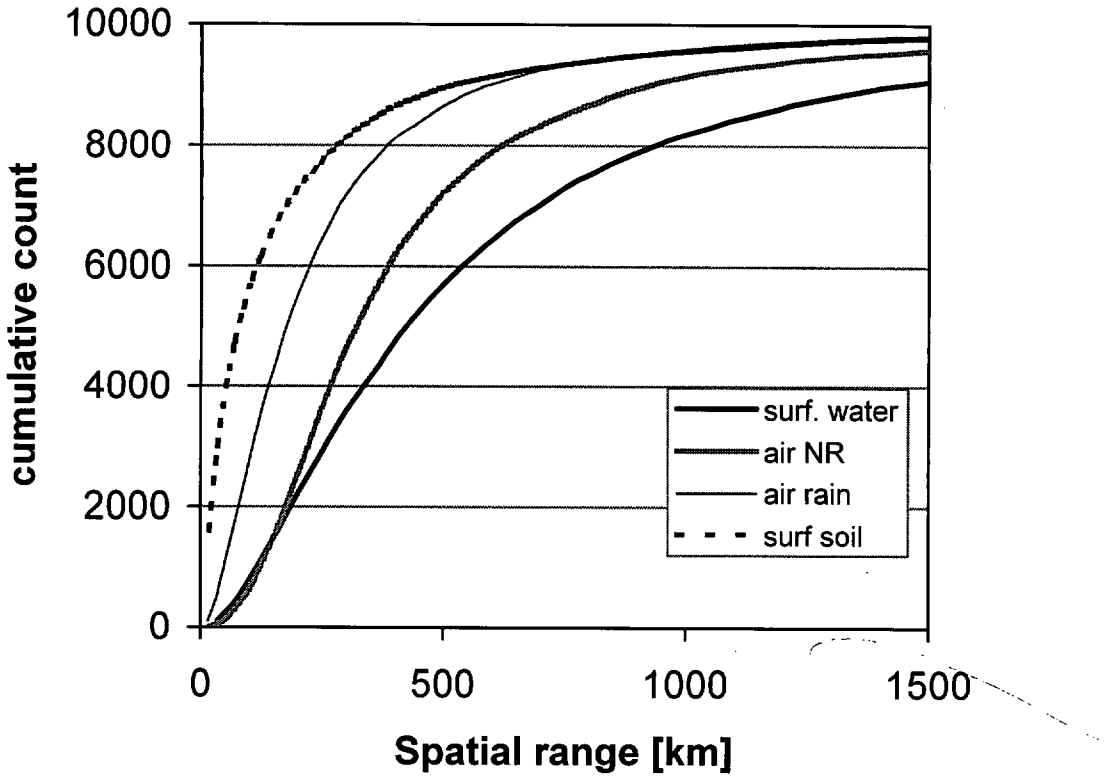
1 e-4
Spatial Range [km] f. soil
air rain
sw
soil
1 e+0
1 e+2
1 e+4
1 e+6
Spatial Range [km]
for air emissions, no rain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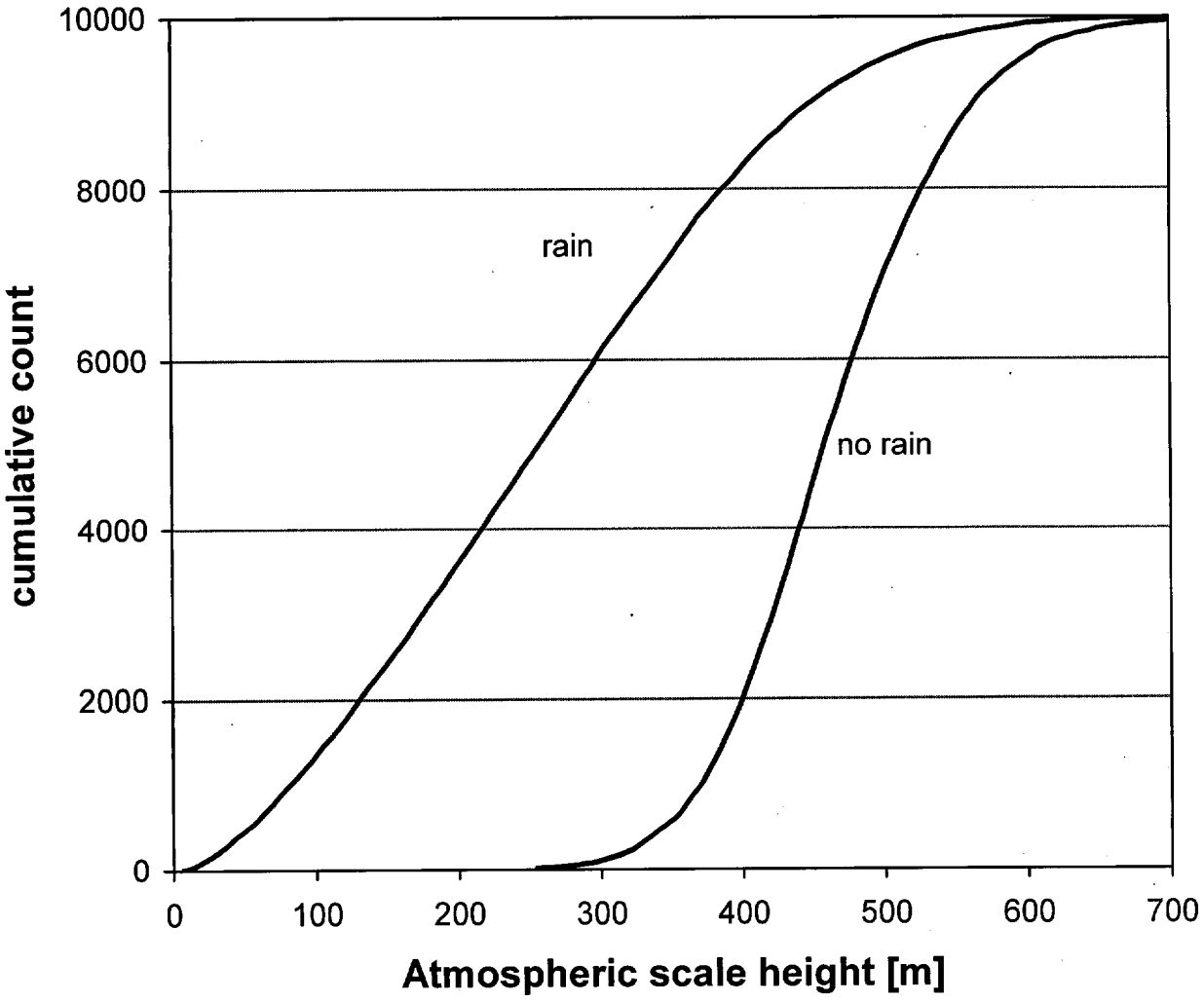
6000
4000
2000
0
cumulative count
0
500
1000
1500
Spatial range [km]
surf. water
air NR
air rain
surf soil

Fig C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6000
4000
2000
0
cumulative count
rain
no rain
0
100
200
300
400
500
600
700
Atmospheric scale height [m]