Supporting Information of

Relative importance of gas uptake on aerosol and ground surfaces characterized by equivalent uptake coefficients

Meng Li[1], Hang Su[2,1], Guo Li[1], Nan Ma[2], Ulrich Pöschl[1], and Yafang Cheng[1]

[1] Max Planck Institute for Chemistry, Mainz, 55118, Germany

[2] Center for Air Pollution and Climate Change Research (APCC), Institute for Environmental and Climate Research (ECI), Jinan University, Guangzhou, 511443, China

Correspondence to: Hang Su (h.su@mpic.de) and Yafang Cheng (yafang.cheng@mpic.de)

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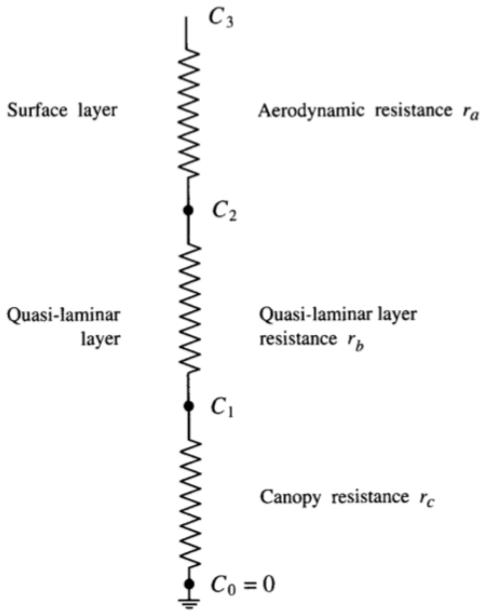

Figure S1. Resistance model for dry deposition, derived from the Figure 19.1 in Seinfeld and Pandis (2006).

$$V_d = \frac{1}{R_a + R_b + R_c}$$

Following Wesely (1989) and Zhang et al. (2003), we calculated R_a (aerodynamic resistance), R_b (quasi-laminar layer resistance) and R_c (canopy resistance) as below.

1.1 calculation of R_a

Under neutral atmospheric condition:

$$R_a = \int_{Z_0}^{Z} \frac{1}{\kappa u_* z} dz = \frac{1}{\kappa u_*} \ln(\frac{Z}{Z_0})$$

where κ is the von Karman constant (about 0.41); u_* means the friction velocity (in unit of m s^{-1}); Z_0 is the roughness length (in unit of m); Z is the PBL mixing height (in unit of m), we use a typical value of Z as 300 m.

For different land use type, we assign different u_* following the parameterization scheme of Zhang et al. (2003), and Z_0 based on Seinfeld and Pandis (2006):

Table S1. Friction velocity and canopy roughness length by land use type.

land use index	land use type	u_*_day (m s^{-1})	u_*_night (m s^{-1})	Z_0 (m)
1	urban land	0.6	0.3	1
2	agricultural land	0.4	0.2	0.1
3	range land	0.4	0.2	0.1
4	deciduous forest	0.6	0.3	1
5	coniferous forest	0.6	0.3	0.9
6	mixed forest including wetland	0.6	0.3	0.9
7	water	0.3	0.25	0.1
8	barren land, desert	0.25	0.15	0.04
9	non-forested wetland	0.25	0.2	0.1
10	mixed agricultural and range land	0.4	0.2	0.1
11	rocky open areas with low-growing shrubs	0.4	0.2	0.1
12	amazon forest	0.6	0.3	1

1.2 calculation of *R*b

$$R_b = \frac{5Sc^{2/3}}{u_*} \quad Sc = \frac{v}{D}$$

where Sc is the Schmidt number (unitless), v means the kinematic viscosity of air, D is the molecular diffusivity for gases. We use $D=10^{-5}$ m^2 s^{-1}, and a temperature-dependent v in the calculation.

1.3 calculation of *R*c

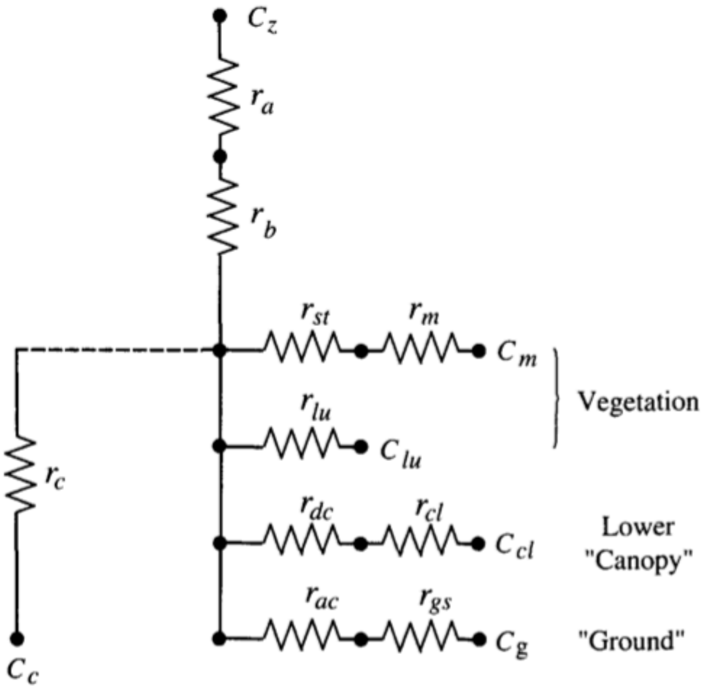

Figure S2. Schematic model for canopy resistance, derived from Wesely (1989).

$$R_c = \left(\frac{1}{R_{st} + R_m} + \frac{1}{R_{lu}} + \frac{1}{R_{dc} + R_{cl}} + \frac{1}{R_{ac} + R_{gs}}\right)^{-1}$$

As illustrated by Seinfeld and Pandis (2006), R_{st} represents the resistance of the leaf stomatal, R_m for mesophyll resistance, R_{lu} is the surface resistance in the upper canopy, R_{dc} means the resistance by buoyant convection, R_{cl} is the uptake resistance by leaves, twigs and etc., R_{ac} means the transfer resistance for processes at the ground, and R_{gs} is the uptake resistance by soil, leaf litter and others on the ground surface.

The equations to calculate each item of R_c are illustrated in Wesely (1989). The important input parameters for Rc calculation include: the input resistance by land use and season, the physical and chemical reactivity scales by gas species, and the meteorological parameters. We adopted the the parameterization scheme of Wesely (1989) for the former two items of input, and a set of typical hourly temperature and radiation values for each season derived from the standard meteorological database for construction in China (Zhang, 2004).

The calculated dry deposition velocities by gas and land use type for each season are presented in Table S2. Furthermore, we show the seasonal equivalent uptake coefficients (γ_{eq}) at typical conditions based on the dry deposition velocities in Table S3.

Table S2. Seasonal mean dry deposition velocities by gas species, unit: cm s^{-1}.

Gases	Winter	Spring	Summer	Autumn with unharvested cropland	Late autumn after frost
Urban					
O_3	0.15	0.24	0.24	0.24	0.24
NO_2	0.02	0.04	0.04	0.04	0.04
SO_2	0.41	0.17	0.20	0.20	0.20
N_2O_5	2.10	2.26	2.31	2.14	2.14
HNO_3	2.10	2.26	2.31	2.14	2.14
H_2O_2	0.44	0.32	0.34	0.33	0.33
Agricultural land					
O_3	0.07	0.45	0.44	0.29	0.41
NO_2	0.02	0.20	0.29	0.07	0.07
SO_2	0.49	0.43	0.42	0.24	0.40
N_2O_5	1.10	1.18	1.21	1.12	1.12
HNO_3	1.10	1.18	1.21	1.12	1.12
H_2O_2	0.51	0.57	0.51	0.34	0.57
Amazon forest					
O_3	0.15	0.27	0.37	0.14	0.14
NO_2	0.04	0.17	0.28	0.04	0.04
SO_2	0.14	0.25	0.34	0.14	0.14
N_2O_5	2.10	2.26	2.31	2.14	2.14
HNO_3	2.10	2.26	2.31	2.14	2.14
H_2O_2	0.23	0.37	0.48	0.23	0.23
Water					
O_3	0.07	0.07	0.07	0.06	0.06
NO_2	0.01	0.01	0.01	0.01	0.01
SO_2	0.03	0.03	0.03	0.03	0.03
N_2O_5	1.05	1.06	1.07	1.05	1.05
HNO_3	1.05	1.06	1.07	1.05	1.05
H_2O_2	0.08	0.08	0.08	0.08	0.08

Table S3. Seasonal γ_{eqv} by gas species at typical condition (typical aerosol area density of *A* as described in the main text, and mixing height of 300m), $\times 10^{-4}$.

Gases	Winter	Spring	Summer	Autumn with unharvested cropland	Late autumn after frost
Urban					
O_3	0.64	1.01	1.01	1.00	1.00
NO_2	0.10	0.15	0.15	0.15	0.15
SO_2	1.73	0.72	0.84	0.83	0.83
N_2O_5	8.91	9.59	9.78	9.07	9.07
HNO_3	8.91	9.59	9.78	9.07	9.07
H_2O_2	1.87	1.37	1.44	1.41	1.41
Agricultural land					
O_3	1.31	8.76	8.55	5.63	7.93
NO_2	0.30	3.88	5.57	1.38	1.36
SO_2	9.45	8.39	8.12	4.55	7.69
N_2O_5	21.21	22.88	23.37	21.65	21.65
HNO_3	21.21	22.88	23.37	21.65	21.65
H_2O_2	9.80	10.97	9.94	6.61	11.06
Amazon forest					
O_3	14.01	25.72	35.56	13.78	13.78
NO_2	3.88	16.54	27.18	3.56	3.56
SO_2	13.96	24.22	33.03	13.76	13.76
N_2O_5	203.33	218.79	223.13	207.08	207.08
HNO_3	203.33	218.79	223.13	207.08	207.08
H_2O_2	22.43	35.42	45.95	22.25	22.25
Water					
O_3	3.92	3.81	3.82	3.76	3.76
NO_2	0.70	0.53	0.53	0.49	0.49
SO_2	1.76	1.66	1.67	1.61	1.61
N_2O_5	61.37	62.24	62.36	61.33	61.33
HNO_3	61.37	62.24	62.36	61.33	61.33
H_2O_2	4.68	4.61	4.63	4.51	4.51

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