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Global distribution of the effective aerosol hygroscopicity parameter for CCN activation

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1 Introduction

This supplement contains an alternative data-set of simulated κ values in which κ is calculated considering the hydrophillic particles only. This is equivalent to the κ_a parameter as presented and discussed by Rose et al. (2008) and Gunthe et al. (2009). This is different from the values in the main text, which show the κ calculated considering both CCN active and inactive particles.

Alternative (κ_a) versions of Tables 1 to 4, and Figures 1 and 2 are shown.

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Table 1. Simulated global and regional mean κ_a values (and standard deviation (St Dev)) at the surface and at the simulated PBL height under present day conditions. Standard deviation is calculated for the year from 5-hourly average data. Difference columns show the absolute difference between κ_t and κ_a for the region.

Region	Area (10^{13} m^2)	Mean κ_a Surface	St Dev Surface	Mean κ_a PBL height	St Dev PBL height	Surface difference ($\kappa_a - \kappa_t$)	PBL difference ($\kappa_a - \kappa_t$)
Global (Continental)	14.4	0.34	0.21	0.34	0.20	0.07	0.07
Global (Marine)	37.0	0.75	0.23	0.64	0.23	0.04	0.04
N. America	1.61	0.37	0.16	0.36	0.15	0.07	0.07
S. America	1.90	0.24	0.18	0.26	0.16	0.07	0.07
Africa	3.48	0.25	0.15	0.26	0.13	0.10	0.09
Europe	1.14	0.45	0.17	0.42	0.16	0.10	0.10
Asia	3.64	0.28	0.16	0.28	0.14	0.07	0.07
Australia	0.87	0.29	0.19	0.31	0.17	0.09	0.08
N. Atlantic	1.25	0.64	0.16	0.52	0.17	0.05	0.04
Southern Ocean	1.56	0.93	0.09	0.83	0.15	0.01	0.02

Table 2. Comparison between observed and modelled κ_a values. ^{A} κ calculated from reported aerosol soluble fraction, following Gunthe et al. (2009). Most measurement sites were surface campaigns, with the exception of Shinozuka et al. (2009) and Hudson (2007), which are flight data. For flight data an average altitude of approx. 1500 (m) was assumed.

Site	Region	Reference	κ observed	κ model
1	Amazon	Gunthe et al. (2009)	0.16±0.06	0.16
2	China	Rose et al. (2008)	0.3	0.46
3	Mexico	Shinozuka et al. (2009)	0.2 - 0.3	0.38
4	US West Coast	Shinozuka et al. (2009)	0.176 - 0.47	0.25
5	Puerto Rico	Allan et al. (2008)	0.6±0.2	0.72
6	Antigua	Hudson (2007)	0.87±0.24	0.75
8	Amazon	Vestin et al. (2007)^A	0.148	0.11
9	Amazon	Zhou et al. (2002)^A	0.115	0.15
10	Tenerife	Guibert et al. (2003)^A	0.43	0.67
11	Germany (Feldberg)	Dusek et al. (2006)	0.15 - 0.3	0.41
12	Germany (Munich)	Kandler and Shütz (2007)^A	0.36	0.37
13	Eastern Mediterranean	Bougiatioti et al. (2009)	0.24	0.49
14	Toronto	Broekhuizen et al. (2006)^A	0.15 - 0.3	0.38
15	Ontario	Chang et al. (2009)	0.3	0.33

Table 3. Standard deviation (St Dev) of κ values calculated considering variation in i) all dimensions (x, y, t_5 = area and time (t_5 = 5 hourly time intervals), ii) area only (x, y), iii) time only (t_5 = 5 hourly time intervals) and iv) time only (t_m = monthly mean values used). For each standard deviation value the adjacent column (to the right) shows the number of data points used in the calculation (n).

Region	Area (10^{13} m^2)	Mean κ Surface	x, y, t_5 St Dev	n	x, y St Dev	n	t_5 St Dev	n	t_m St Dev	n
Global (Cont.)	14.4	0.34	0.21	4761936	0.17	2718	0.02	1752	0.02	12
Global (Marine)	37.0	0.75	0.22	9702576	0.18	5538	0.02	1752	0.02	12
N. America	1.61	0.38	0.16	420480	0.05	240	0.09	1752	0.09	12
S. America	1.90	0.24	0.18	367920	0.15	210	0.02	1752	0.01	12
Africa	3.48	0.25	0.15	672768	0.11	384	0.03	1752	0.03	12
Europe	1.14	0.46	0.17	350400	0.09	200	0.06	1752	0.05	12
Asia	3.64	0.28	0.16	1038936	0.08	593	0.03	1752	0.03	12
Australia	0.87	0.30	0.19	173448	0.14	99	0.04	1752	0.02	12
N. Atlantic	1.25	0.63	0.16	264552	0.07	151	0.10	1752	0.09	12
Southern Ocean	1.56	0.93	0.09	346896	0.05	198	0.04	1752	0.04	12

Table 4. Simulated global and regional mean κ_a values (and standard deviation) at the surface and at the simulated PBL height under preindustrial conditions. Difference columns show the absolute difference between κ_t and κ_a for the region.

Region	Area (10^{13} m^2)	Mean κ_a Surface	St. Dev Surface	Mean κ_a PBL height	St. Dev PBL height	Surface difference ($\kappa_a - s\kappa_t$)	PBL difference ($\kappa_a - \kappa_t$)
Global (Continental)	14.4	0.30	0.25	0.30	0.24	0.06	0.06
Global (Marine)	37.0	0.79	0.22	0.68	0.25	0.03	0.05
N. America	1.61	0.32	0.20	0.32	0.19	0.06	0.06
S. America	1.90	0.23	0.18	0.24	0.17	0.06	0.06
Africa	3.48	0.17	0.14	0.18	0.13	0.08	0.07
Europe	1.14	0.41	0.24	0.39	0.23	0.11	0.12
Asia	3.64	0.21	0.18	0.21	0.16	0.06	0.06
Australia	0.87	0.32	0.21	0.33	0.19	0.09	0.08
N. Atlantic	1.25	0.76	0.17	0.62	0.21	0.05	0.05
Southern Ocean	1.56	0.95	0.06	0.87	0.12	0.00	0.02

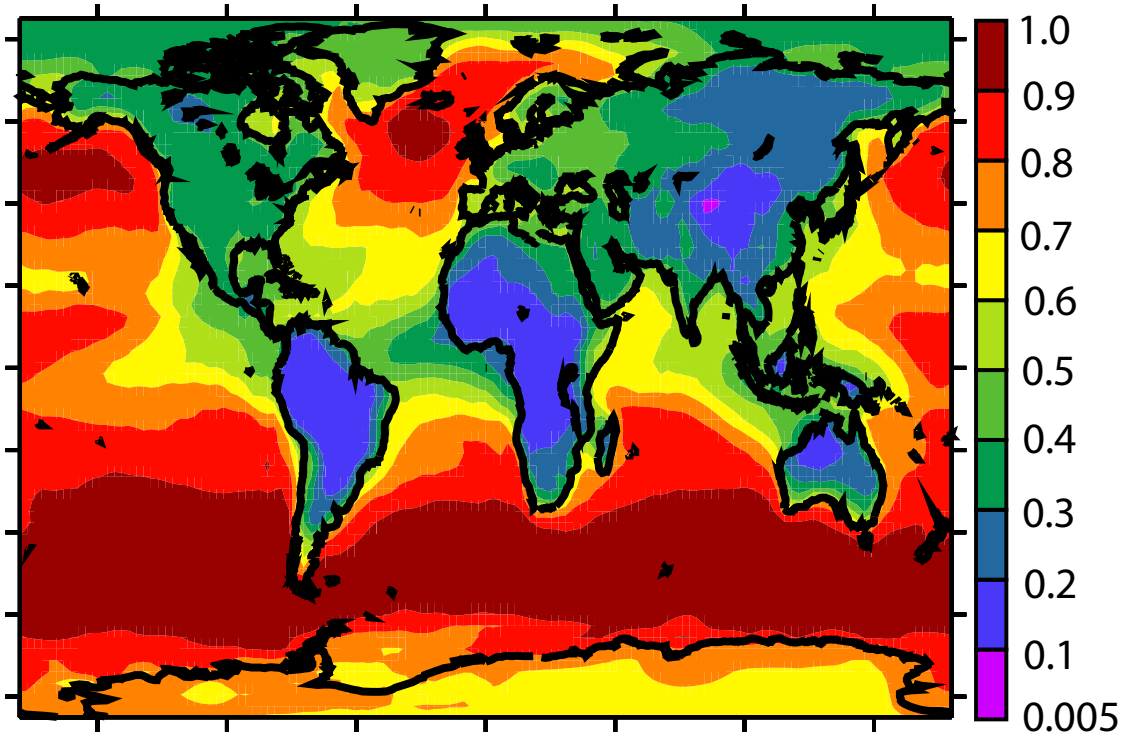

Figure 1. Annual mean distribution of κ_a at the surface simulated by EMAC.

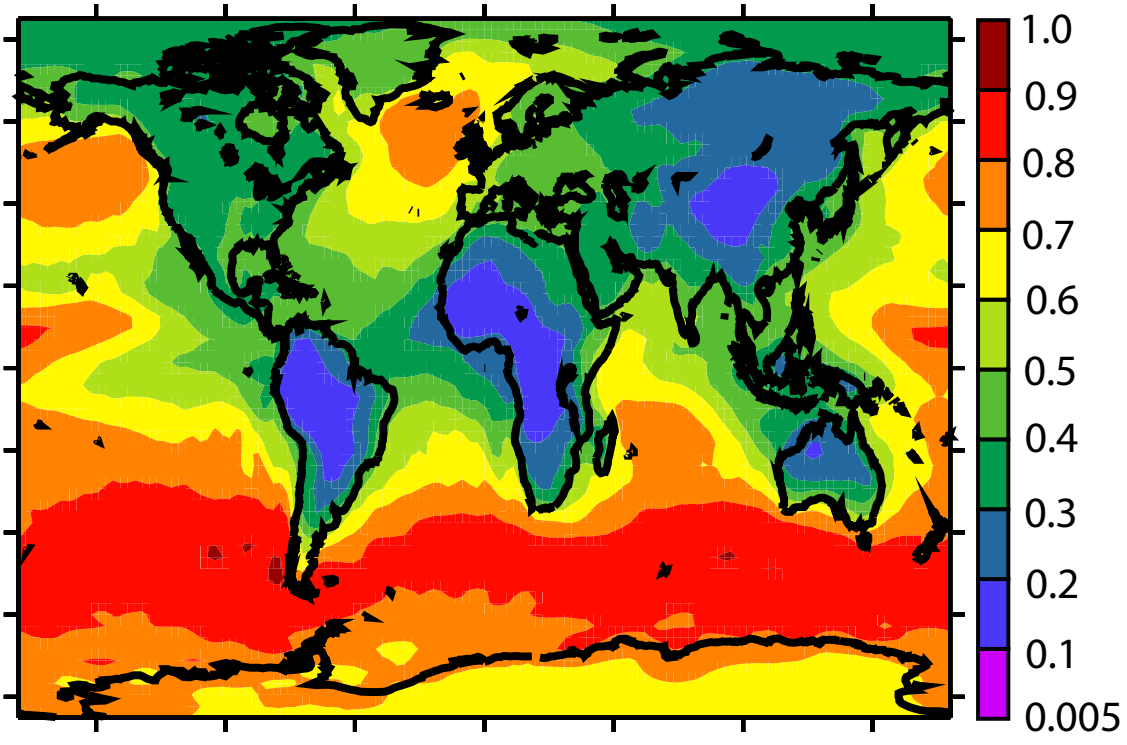

Figure 2. Annual mean distribution of κ_a at the altitude of the planetary boundary layer.