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Impact of mixing state and hygroscopicity on CCN activity of biomass burning aerosol in Amazonia

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Table S1. 3 log-normal fits for Amazonian biomass burning number size distributions: CLAIRE, SMOCC and SAMBBA experiments. N_m, d_{g_m} **and** σ_m **refer to the mode number concentration, geometric mean diameter and geometric standard deviation, respectively.**

Experiment/mode	N_m (cm^{-3})	d_{g_m} (nm)	σ_m	***Notes and references***
CLAIRE				Balbina, Brazil, LBA-CLAIRE
Recent smoke				2001,wet-to-dry transition period
Nucleation	302	14.0	1.31	2001 (Rissler et al., 2004).
Aitken	280	69.0	1.35	Recent smoke refers to an hours-old
Accumulation	529	148.0	1.43	biomass burning plume (dry crops
Aged smoke				residues), duration 3 days.
Nucleation	276	15.0	1.29	The aged smoke period (duration 4
Aitken	304	68.0	1.32	days) was considered to be
Accumulation	736	139.0	1.45	representative of 2.5-5 days aged
				smoke.
SMOCC				Rondônia, Brazil, LBA-SMOCC
Dry season[(a)]				2002 (Rissler et al., 2006).
Nucleation	1090	12.0	1.82	Data can be considered
Aitken	5213	92.0	1.63	representative of regional haze in
Accumulation	5214	190.0	1.53	the region and includes both fresh
Dry to wet period[(a)]				and aged BB aerosols.
Nucleation	841	12.0	1.89	Diurnal averages fits for the dry
Aitken	984	66.0	1.39	season and dry to wet transition
Accumulation	3708	131.0	1.69	periods are presented.
SAMBBA				Porto Velho, Brazil, SAMBBA
Nucleation	948	14.2	2.50	2012 (Brito et al., 2014).
Aitken	4071	98.1	1.78	Averages for the campaign,
Accumulation	1063	179.1	1.48	includes both fresh and aged BB
				aerosols.

Table S2. Effective hygroscopicity parameter $\kappa_{p,group}$ and aerosol fraction f (number fraction times frequency of occurrence) for hygroscopic groups with very low hygroscopicity (VLH, $\kappa_p < 0.1$) and low hygroscopicity (LH, $0.1 \le \kappa_p < 0.2$), and mode- and population effective $\kappa_{p_{eff}} = \sum \kappa_{p,group} AF_{group}$. Values are given for particles in the Aitken mode ($30\ \text{nm} < d_{dry} < 100\ \text{nm}$), accumulation mode ($100\ \text{nm} \le d_{dry} < 300\ \text{nm}$), and Aitken mode plus accumulation mode ($30\ \text{nm} \le d_{dry} < 300\ \text{nm}$) dry sizes ranges.

Period	$\kappa_{p,VLH}$ / f	$\kappa_{p,LH}$ / f	$\kappa_{p_{eff}}$	*Notes and references*
CLAIRE				
Recent smoke				Balbina, Brazil, LBA-CLAIRE wet-to-dry transition period 2001. κ values calculated from ε values reported by Rissler et al. (2004), where ammonium hydrogen sulfate was used to represent the soluble fraction.
Aitken	0.026 / 0.24	0.128 / 0.76	0.103	
Accumulation	0.052 / 0.15	0.182 / 0.85	0.163	
Aitken+Accumulation	0.039 / 0.19	0.155 / 0.81	0.133	
Aged smoke				
Aitken	0.017 / 0.33	0.139 / 0.67	0.096	
Accumulation	0.059 / 0.11	0.173 / 0.89	0.160	
Aitken+Accumulation	0.038 / 0.22	0.156 / 0.78	0.128	
SMOCC				
<u>*Afternoon Averages*</u>				Rondônia, Brazil, LBA-SMOCC 2002, during the dry season and dry to wet transition periods. Afternoon averages (1200-1600 local time) were calculated from κ_R (Vestin et al., 2007) and daily averages were calculated from H-TDMA G_f data (Rissler et al., 2006).
Dry period				
Aitken	0.051 / 0.90	0.146 / 0.10	0.061	
Accumulation	0.068 / 0.81	0.154 / 0.19	0.084	
Aitken+Accumulation	0.059 / 0.85	0.150 / 0.15	0.072	
Dry to wet period				
Aitken	0.061 / 0.72	0.154 / 0.28	0.087	
Accumulation	0.064 / 0.5	0.172 / 0.5	0.119	
Aitken+Accumulation	0.062 / 0.61	0.163 / 0.39	0.103	
<u>*Diurnal averages*</u>				
Dry period				
Aitken	0.032 / 0.93	0.120 / 0.07	0.038	
Accumulation	0.041 / 0.80	0.119 / 0.20	0.056	
Aitken+Accumulation	0.037 / 0.86	0.119 / 0.14	0.048	
Dry to wet period				
Aitken	0.038 / 0.87	0.131 / 0.13	0.050	
Accumulation	0.042 / 0.59	0.127 / 0.41	0.077	
Aitken+Accumulation	0.040 / 0.73	0.129 / 0.27	0.064	

Notes:

The aerosol soluble fraction, ε, and the hygroscopicity parameter by Rissler et al (2006), κ_R, for the biomass burning episode averages for CLAIRE (Rissler et al., 2004) and the afternoon averages for SMOCC (Vestin et al., 2007), respectively, were converted to the specific hygroscopicity parameter κ_p using the relations $\kappa_p \approx \kappa_{p_{salt}} \varepsilon \approx \kappa_{P_{salt}} \kappa_R \frac{M_{salt}}{\upsilon_{salt}\, \rho_{salt}}$, suggested by Gunthe et al. (2009), where the subscript *salt* refers to the reference salt used, $\kappa_{p_{salt}}$ is the hygroscopicity parameter determined for the salt and M, ρ and υ are the molar mass, density and dissociation factor of the salt, respectively. Diurnal values of the effective hygroscopicity parameter were also calculated for the dry season and the dry-to-wet transition period of SMOCC from the diurnal averaged H-TDMA particle growth factor (G_f) data reported in Table 3 of Rissler et al. (2006) using the relation $\kappa_p = \left(G_f^3 - 1\right)\left(a_w^{-1} - 1\right)$.

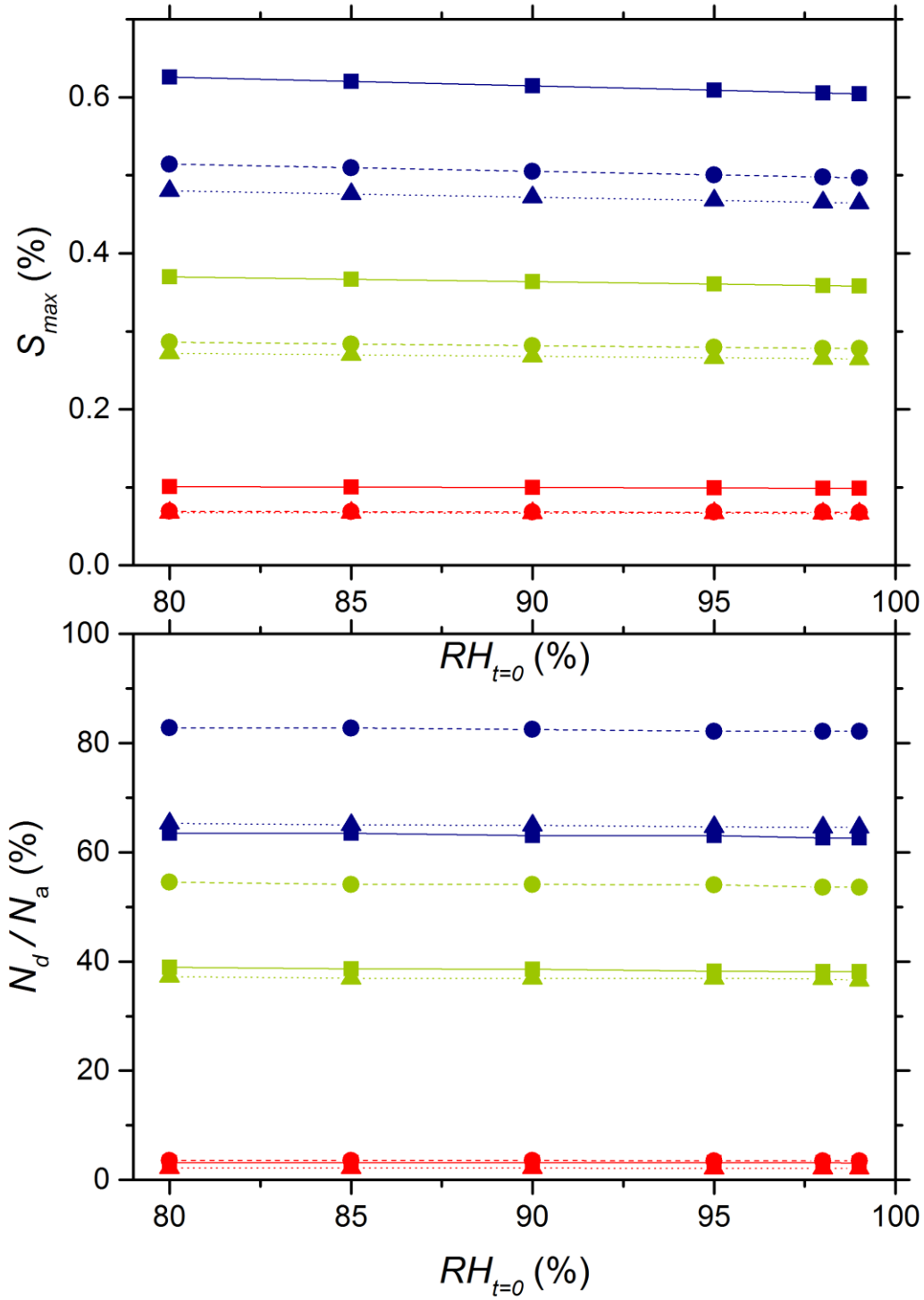

Figure S1. Maximum supersaturation (top) and activated particle fraction N_d / N_a (bottom), as function of the initial relative humidity, for the $MP_{5,1}$ (solid line, squares), $MP_{1,5}$ (dashed line, circles), and $HP_{5,5}$ (dotted line, triangles) size distributions and external mixing case *Ext2* with a population average κ_p =0.10. Values refer to updraft velocities W=0.1 m s^{-1} (red), W=3 m s^{-1} (green) and W=10 m s^{-1} (blue).

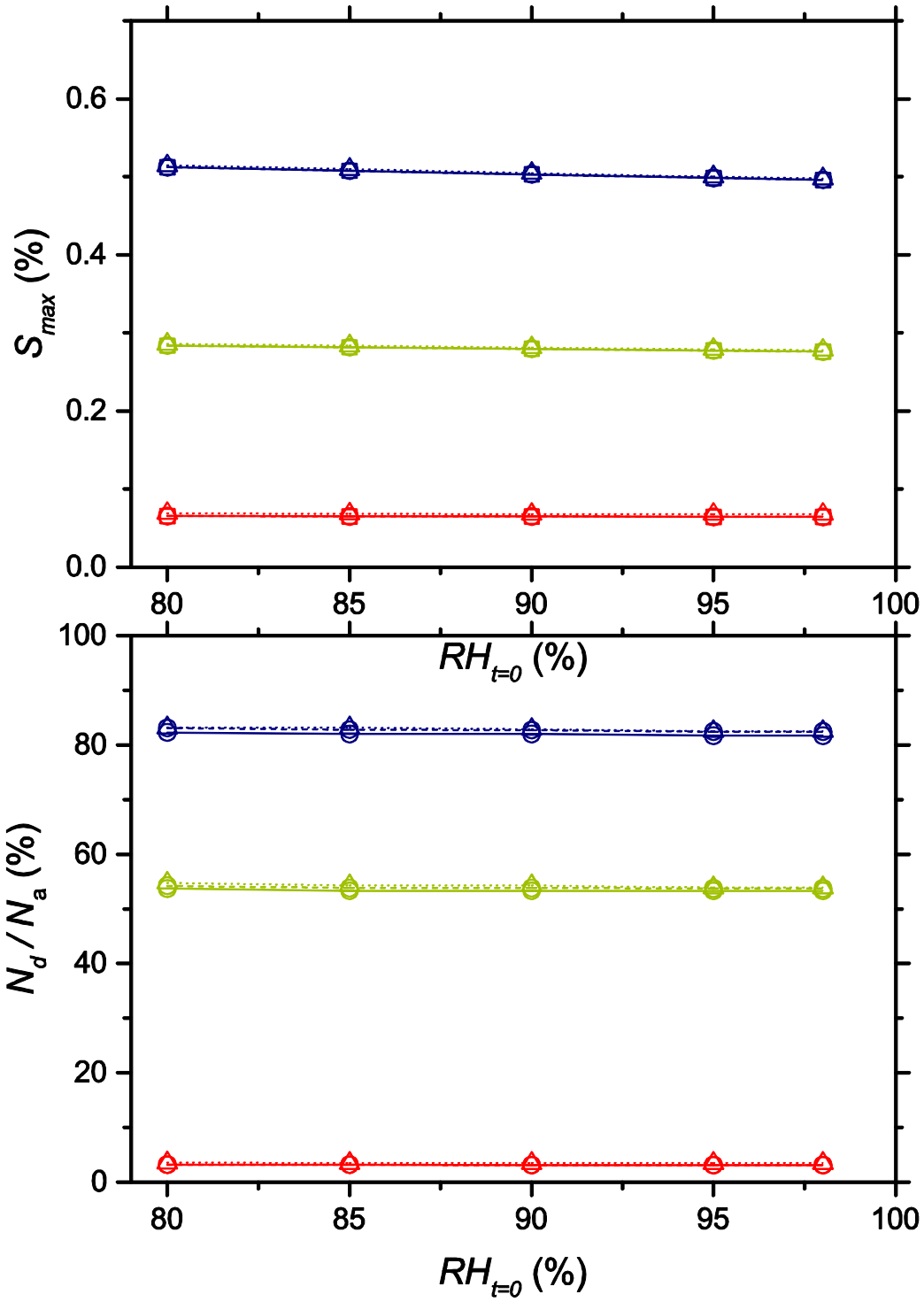

Figure S2. Maximum supersaturation (top) and activated particle fraction N_d / N_a (bottom), as function of the initial relative humidity for the $MP_{1,5}$ case study, external mixing case *Ext2* and population average κ_p =0.10 with an additional coarse mode with size distribution parameters d_{g_m} = 1.5 µm, σ_m =1,5 and N_m =0.6 (cm^{-3}) (dotted line, triangles), N_m = 6 (cm^{-3}) (dashed line, circles) and N_m = 60 (cm^{-3}) (solid line, squares). Values refer to updraft velocities W=0.1 m s^{-1} (red), W=3 m s^{-1} (green) and W=10 m s^{-1} (blue).