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Interactive Comment

Interactive comment on "CCN predictions using simplified assumptions of organic aerosol composition and mixing state: a synthesis from six different locations" *by* B. Ervens et al.

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We thank U. Pöschl for his suggestion to extend our paper by a comprehensive discussion of previous CCN studies. In the attached additional table (Table 3 in the revised manuscript), we have summarized the results of prior CCN studies at different locations, together with the assumptions that have been made about the hygroscopicity of organics and their mixing state. This table will be described in an additional Section 5, entitled 'Comparison to previous CCN studies'. In agreement with our study, the table shows that other investigators have also pointed out the presence of an externally mixed, hydrophobic (CCN inactive) organic mode around the critical activation diame-

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ter of CCN (∼ 50-200 nm) (Broekhuizen et al., 2005; Cubison et al., 2008; Quinn et al., 2008; Lance et al., 2009). We also refer to studies that did not include a CCN closure study but reported size resolved measurements with the same findings (Kuwata and Kondo, 2008; Shinozuka et al., 2009). Other previous studies show that with increasing distance from sources an assumed internal mixture of insoluble organics leads to reasonable CCN closure results (i.e., within a factor of 2). At very remote locations, where air masses did not have any influence of major pollution sources for several days, aerosol is sufficiently aged that organics appear to be hygroscopic. The range of kappa(org) that has been assumed in such studies is 0.1 – 0.5. In summary, this additional overview of previous CCN studies corroborates our findings of the transition of externally mixed insoluble organics over internally mixed insoluble organics to internally mixed soluble organics. It also gives more confidence in our suggested values for kappa(org) and organic mixing states in different scenarios.

Broekhuizen, K., R. Y.-W. Chang, W. R. Leaitch, S.-M. Li, and Abbatt, J. P. D.: Closure between measured and modeled cloud condensation nuclei (CCN) using size-resolved aerosol compositions in downtown Toronto, Atmos. Chem. Phys. Discuss., 5, 6263-6293, 2005.

Cubison, M., Ervens, B., Feingold, G., Docherty, K., Ulbrich, I., Denkenberger, K. A., Shields, L., Prather, K., Snyder, D., Schauer, J. J., Hering, S., and Jimenez, J. L.: The influence of chemical composition and mixing state of Los Angeles urban aerosol on CCN number and cloud properties, Atmos. Chem. Phys., 8, 5649-5667, 2008.

Kuwata, M., and Kondo, Y.: Dependence of size-resolved CCN spectra on the mixing state of nonvolatile cores observed in Tokyo, J. Geophys. Res., 113, doi: 10.1029/2007JD009761, 2008.

Lance, S., Nenes, A., Mazzoleni, C., Dubey, M., Gates, H., Varutbangkul, V., Rissman, T. A., Murphy, S. M., Sorooshian, A., Flagan, R. C., and Seinfeld, J. H.: Cloud condensation nuclei activity, closure, and droplet growth kinetics of Houston aerosol during the

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Gulf of Mexico Atmospheric Composition and Climate Study (GoMACCS), J. Geophys. Res., 114, doi:10.1029/2008JD011699, 2009.

Quinn, P. K., Bates, T. S., Coffman, D. J., and Covert, D. S.: Influence of particle size and chemistry on the cloud nucleating properties of aerosols, Atmos. Chem. Phys., 8, 1029-1042, 2008.

Shinozuka, Y., Clarke, A. D., DeCarlo, P. F., Jimenez, J. L., Dunlea, E. J., Roberts, G. C., Tomlinson, J. M., Collins, D. R., Howell, S. G., Kapustin, V. N., McNaughton, C. S., and Zhou, J.: Aerosol optical properties relevant to regional remote sensing of CCN activity and links to their organic mass fraction: airborne observations over Central Mexico and the US West Coast during MILAGRO/INTEX-B, Atmos. Chem. Phys., 9, 6727-6742, 2009.

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Location	Dist [km]	κ	Mixing state	'slope'	S [%]	Comment	Reference
Riverside	close	$\kappa_{org} = 0$	int	2.8-7.1	0.1-0.9		(Cubison et al., 2008)
		$\kappa_{org} = 0$	ext	0.79-4.1	0.1-0.9		
		$\kappa_{org} = 0$	int/ext	1-3.7	0.1-0.9	hydrophobic org at ~100 nm (ext. mixed) size-resolved composition	
Houston (ship)	close	$\kappa_{org} = 0$	ext	0.85 – 1.2	0.22-1	CCN prediction of particles ~ 200 nm	(Quinn et al., 2008)
Houston (aircraft)	close	$\kappa_{all} = 0.6$	int	1.36	0.3-1.1		(Lance et al., 2009)
		$\kappa_{org} = 0$	int	1.03		Hydrophobic org at ~100 nm	
Toronto	close	$\kappa_{org} = 0$	int	1.12	0.56-0.6		(Broekhuizen et al., 2005)
		$\kappa_{org} = 0$	ext	1.03	0.56-0.6		
		$\kappa_{org} = 0.096$	int	1.16	0.56-0.6	assumption: 10% of org fraction soluble	
New Hampshire		$\kappa_{org} = 0$	int	1.22	0.3		(Medina et al., 2007)
(Thompson Farm)		$\kappa_{org} = 0$	int	1.052	0.3	size-resolved composition	
Vancouver	45	$0.001 < \kappa_{org} < 0.11$	int	~0.8-1	0.19-0.5	$\kappa_{all} = 0.16$, size-resovled	(Shantz et al., 2008)
Guangzhou (China)	60	$\kappa_{all} = 0.32 \pm 0.1$	int	1.0 ± 0.07	0.27	κ derived based on HTDMA	(Rose et al., 2008)
Toronto (rural)	70	$\kappa_{org} = 0$	int	0.89 –1.14	0.42		(Chang et al., 2009)
		$\kappa_{ox} = 0.2$; $\kappa_{non\text{-}ox} = 0$	int	1.23	0.42		
Duke Forest (polluted)	10s	$\kappa_{org} = 0.13$	int	1.7 - 2.1	0.2		(Stroud et al., 2007)
		$\kappa_{org} = 0$		1.4 - 1.65			
Monterey		$\kappa_{org} = 0$	int	0.94-0.95	0.2	boundary layer and free troposphere	(Wang et al., 2008)
		$\kappa_{org} = 0.25$	int	1.1-1.15	0.2		
		$\kappa_{org} = 0.1$	int	1.17	0.2	above clouds	
		$\kappa_{org} = 0.1$	ext	0.89	0.2	above clouds	
Californian Coast		$\kappa_{all} = 0.13$	int	~ 1	0.6	κ derived based on $D_{crit,mean}$ (66.7 nm)	(Furutani et al., 2008)
Jeju Island	100s	$\kappa_{all} = 0.17$	int	0.73	0.1-1		(Kuwata et al., 2007)
		$\kappa_{all} = 0.6$	int	1.16			
North Sweden	100s	$\kappa_{org} = 0.09$	int	1.12	0.6	size-dependent κ derived based on HTDMA	(Kammermann et al., 2010)
N American Coast Free troposphere Central Valley	80- 1000s	$\kappa_{all} = 0.6$	int	~1-1.5	0.3	CCN closure results reported for whole data set (aircraft data) Assumption: pure $(NH_4)_2SO_4$	(Roberts et al., 2010)
Northeast Atlantic		$\kappa_{org} = 0$	int	0.34	0.1	instrumental errors (?)	(Chuang et al., 2000)
Tasmania		$\kappa_{org} = 0$	int	1.26 (0.99)	0.5	Better agreement in air masses with low aerosol loading and Rn	(Covert et al., 1998)
North Pacific		$0 < \kappa_{org} < 0.5$	int	0.6 – 1.15	0.34	size-resolved	(Shantz et al., 2008)
Remote, marine		$\kappa_{org} = 0$	int	0.92	0.38		(Bougiatoti et al., 2009)
		$\kappa_{org} = 0.158$	int	0.98			
Eastern Pacific		$\kappa_{all} = 0.6$	int	1.78	0.3		(Roberts et al., 2006)
Amazon		$\kappa_{org} = 0$	int	0.2-0.3	0.2 - 1		(Mircea et al., 2002)
		$\kappa_{org} \sim 0.1$	int	0.5-1			
Amazon		$\kappa_{org} = 0.1$	int	1.17	0.1–0.82	size-resolved composition	(Gunthe et al., 2009)
Amazon		$\kappa_{org1} = 0.03$;	int	1.11	0.3-1	2 internally modes of different sizes	(Rissler et al., 2005)
		$\kappa_{org2} = 0.1$	ext	1.06			

Fig. 1.

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