

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 $\kappa(\text{org})$ 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 $\kappa(\text{org})$ and organic mixing states in different scenarios.

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Location	Dist [km]	κ	Mixing stat	'slope'	S [%]	Comment	Reference
Riverside	close	$\kappa_{\text{org}} = 0$	int	2.8-7.1	0.1-0.9		(Cubison et al., 2008)
		$\kappa_{\text{org}} = 0$	ext	0.79-4.1	0.1-0.9	hydrophobic org at ~100 nm (ext. mixed)	
		$\kappa_{\text{org}} = 0$	int/ext	1-3.7	0.1-0.9	size-resolved composition	
Houston (ship)	close	$\kappa_{\text{org}} = 0$	ext	0.85 - 1.2	0.22-1	CCN prediction of particles ~ 200 nm	(Quinn et al., 2008)
Houston (aircraft)	close	$\kappa_{\text{org}} = 0.6$	int	1.36	0.3-1.1		(Lance et al., 2009)
Toronto	close	$\kappa_{\text{org}} = 0$	int	1.03		Hydrophobic org at ~100 nm	
		$\kappa_{\text{org}} = 0$	ext	1.12	0.56-0.6		(Broekhuizen et al., 2005)
New Hampshire (Thompson Farm)	close	$\kappa_{\text{org}} = 0$	int	1.03	0.56-0.6		
		$\kappa_{\text{org}} = 0.096$	int	1.16	0.56-0.6	assumption: 10% of org fraction soluble	
		$\kappa_{\text{org}} = 0$	int	1.22	0.3		(Medina et al., 2007)
Vancouver	45	$\kappa_{\text{org}} = 0$	int	1.052	0.3	size-resolved composition	
Vancouver	45	$0.001 < \kappa_{\text{org}} < 0.11$	int	-0.8-1	0.19-0.5	$\kappa_{\text{org}} = 0.16$, size-resolved	(Shantz et al., 2008)
Guangzhou (China)	60	$\kappa_{\text{org}} = 0.32 \pm 0.1$	int	1.0 ± 0.07	0.27	κ derived based on HTDMA	(Rose et al., 2008)
Toronto (rural)	70	$\kappa_{\text{org}} = 0$	int	0.89 - 1.14	0.42		(Chang et al., 2009)
Duke Forest (polluted)	10s	$\kappa_{\text{org}} = 0$	int	1.23	0.42		
		$\kappa_{\text{org}} = 0.13$	int	1.7 - 2.1	0.2		(Stroud et al., 2007)
Monterey		$\kappa_{\text{org}} = 0$	int	1.4 - 1.65			
		$\kappa_{\text{org}} = 0$	int	0.94-0.95	0.2	boundary layer and free troposphere	(Wang et al., 2008)
		$\kappa_{\text{org}} = 0.25$	int	1.1-1.15	0.2		
Californian Coast		$\kappa_{\text{org}} = 0.1$	int	1.17	0.2	above clouds	
		$\kappa_{\text{org}} = 0.1$	int	0.89	0.2	above clouds	
		$\kappa_{\text{org}} = 0.1$	ext	0.89	0.2		
Jeju Island	100s	$\kappa_{\text{org}} = 0.13$	int	~ 1	0.6	κ derived based on $D_{\text{ext,median}}$ (66.7 nm)	(Furutani et al., 2008)
North Sweden	100s	$\kappa_{\text{org}} = 0.17$	int	0.73	0.1-1		(Kuwata et al., 2007)
N American Coast	80-	$\kappa_{\text{org}} = 0.6$	int	1.16			
Free troposphere	1000s	$\kappa_{\text{org}} = 0.09$	int	1.12	0.6	size-dependent κ derived based on HTDMA	(Kammermann et al., 2010)
Central Valley		$\kappa_{\text{org}} = 0.6$	int	-1-1.5	0.3	CCN closure results reported for whole data set (aircraft data)	(Roberts et al., 2010)
Northeast Atlantic		$\kappa_{\text{org}} = 0$	int	0.34	0.1	Assumption: pure $(\text{NH}_4)_2\text{SO}_4$	(Chuang et al., 2000)
Tasmania		$\kappa_{\text{org}} = 0$	int	1.26 (0.99)	0.5	Better agreement in air masses with low aerosol loading and Rn	(Covert et al., 1998)
North Pacific		$0 < \kappa_{\text{org}} < 0.5$	int	0.6 - 1.15	0.34	size-resolved	(Shantz et al., 2008)
Remote, marine		$\kappa_{\text{org}} = 0$	int	0.92	0.38		(Bougiatioti et al., 2009)
		$\kappa_{\text{org}} = 1.58$	int	0.98			
Eastern Pacific		$\kappa_{\text{org}} = 0.6$	int	1.78	0.3		(Roberts et al., 2006)
Amazon		$\kappa_{\text{org}} = 0$	int	0.2-0.3	0.2 - 1		(Mircea et al., 2002)
		$\kappa_{\text{org}} = 0.1$	int	0.5-1			
Amazon		$\kappa_{\text{org}} = 0.1$	int	1.17	0.1-0.82	size-resolved composition	(Gunthe et al., 2009)
Amazon		$\kappa_{\text{org}} = 0.03$	int	1.11	0.3-1	2 internally modes of different sizes	(Rissler et al., 2005)
		$\kappa_{\text{org}} = 0.1$	ext	1.06			

Fig. 1.

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