CCN activation sensitivity to hygroscopicity

SIO 209 Final Project
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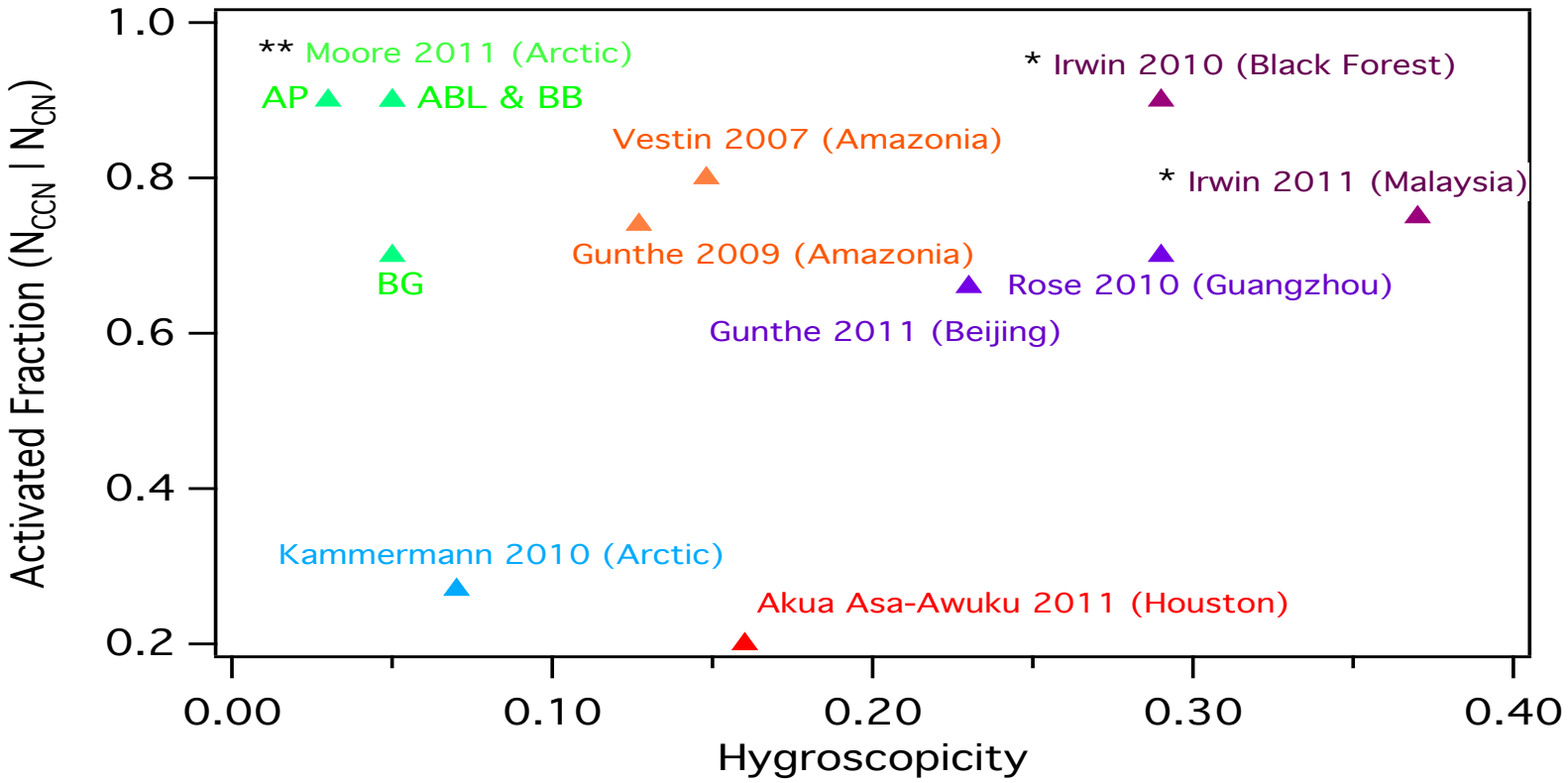

Three set of studies, with similar particle size distributions, suggest consistency respecting CCN activation sensitivity to hygroscopicity. Orange: high biogenic environ., Purple: strong anthropogenic environ., and Dark purple: medium biogenic environ.

* Reported effective hygroscopicity κ_t. As possible, κ_a (from CCNc measurements) is preferred as it represents hygroscopicity of CCN-active particles in the size range around de activation diameter, Da. Each pair of N_{CCN}/N_{CN} and kappa values lie within S=0.7-0.8% among studies.

** Moore et al. 2011, separate four different air masses: anthropogenic influenced (AP), arctic boundary layer (ABL), biomass burning (BB), and background (BG).

Author	Closure study focused on	Field campaign	* κ=0.3 suitable as a prescribed value in GCM?
1 Akua Asa-Awuku et al. 2011	Best schemes for predicting CCN from CN are INORG and BK-INT-SOL. WSOC matters on particle activation	TexAQS/GoMACCS: Houston	yes
2 Gunthe et al. 2009	Hygroscopicity prediction based on AMS-based organic and inorganic mass fraction. The CCN measurement results are consistent with AMS data.	AMAZE-08: central Amazonia	yes
3 Irwin et al. 2011	The HTDMA sees a more hygroscopic aerosol than the CCNc, resulting in a higher predicted number of CCN. Similar κ value tan for Amazonian rainforest.	OP3: Southeast Asian Forest	yes
4 Rose et al. 2010	Hygroscopicity prediction based on AMS-based organic and inorganic mass fraction. Efficient prediction using κ derived value. Data of aerosol chemical composition improve CCN predictions.	PRIDE_PRD2007: Guangzhou China	yes
5 Moore et al. 2011	Aerosol chemistry and mixing state are size dependent. CCN predictions tended toward overprediction, even when assuming the aerosol to be externally-mixed with soluble organics.	ARCPAC: Alaskan Arctic	no
6 Gunthe et al. 2011	Hygroscopicity prediction based on AMS-based organic and inorganic mass fraction. Fractions of externally mixed weakly CCN-active particles are explained by the presence of freshly emitted soot particles.	CAREBeijing-2006: Beijing, China	yes
7 Vestin et al. 2007	The predicted and measured CCN concentrations were highly correlated. No chemical data was used.	LBA_SMOCC: Southwest Amazonia	no**
8 Kammermann et al. 2010	***Ignoring particle mixing state did not affect CCN predictions.	Arctic Circle: Northern Sweden	no
9 Irwin et al. 2010	Comparison of critical supersaturation derived by the CCNc and HTDMA κ-model. Variability in the measurements of hygroscopic growth factor and critical supersaturation for particles of similar sizes indicates significant compositional impact on particle water affinity.	COPS: Black Forest, Germany	yes**

* Based on mean kappa values derived from HTDMA and CCNc measurements during the field observations.
** The authors do not state a position respecting the suitability of κ=0.3 used in GCM.
*** Kammermann et al. stand out for finding particle mixing state irrelevant to CCN formation (contrary to 1, 3, 4, and 5). Suggesting that the omission of aerosol mixing state information bias calculated CCN concentration in areas with several types of emission source.