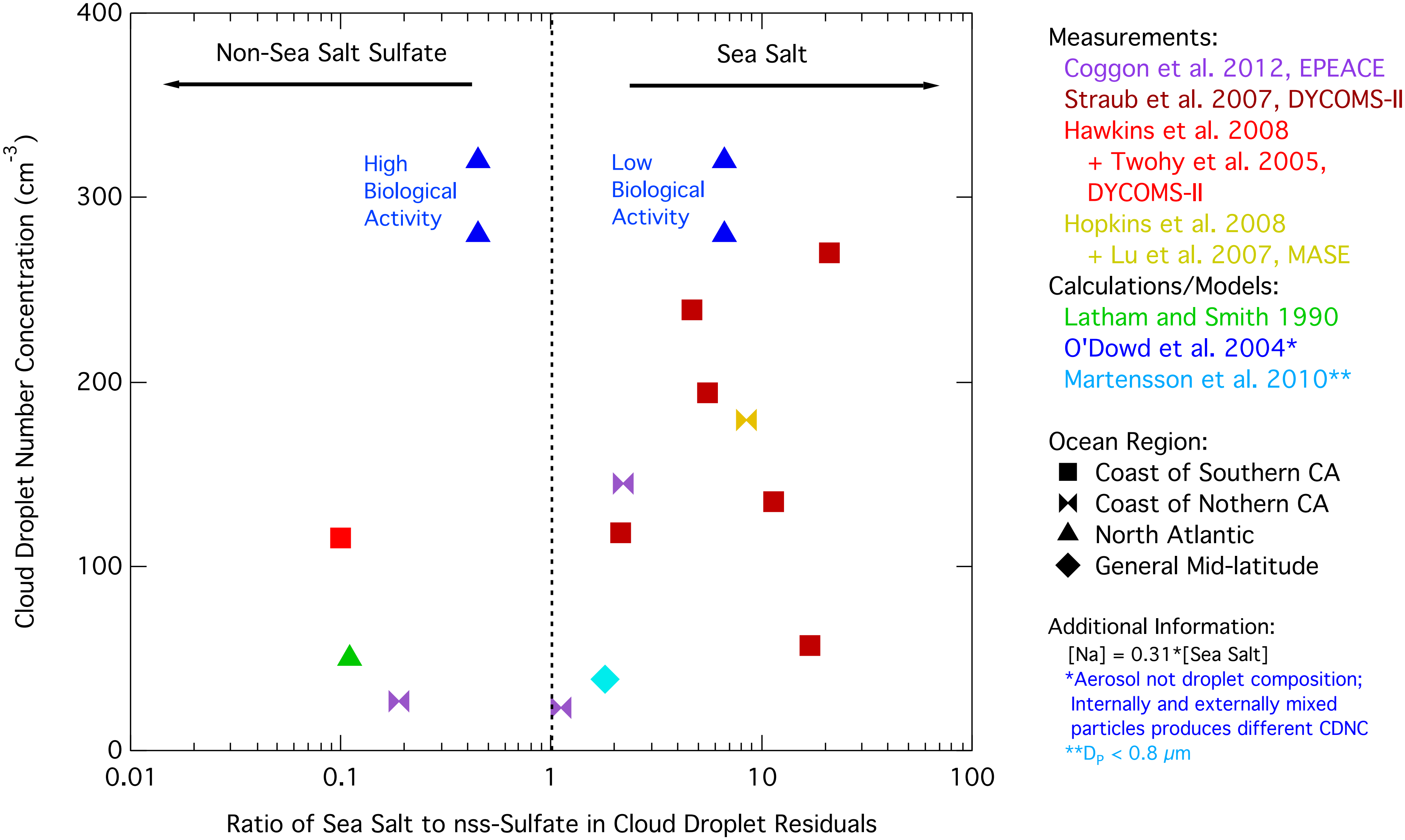
Comparison of CDNC and the Ratio of Sea Salt to Sulfate In Clean Marine Stratocumulus Clouds



Paper	Methods	Project	Key Findings
Twohy et al. 2005	Aircraft meas.; CDNC with optical scattering probe	DYCOMS-II, off coast of San Diego, July 2001	Found that aerosol number conc. (ANC) below cloud correlates with CDNC. Effective drop radius decreases with an increase in ANC. Cloud drizzle decreases with increase in ANC. No correlation between LWC and ANC.
Hawkins et al. 2008	Aircraft meas.; Comp.- FTIR, XRF, SEM behind CVI	DYCOMS-II, off coast of San Diego, July, 2001	Filter samples of droplet residuals were dominated by sea salt, ammonium, sulfate, and organic compounds. 90% of single particles measured contained sea salt components.
Straub et al. 2007	Aircraft meas.; cloud water collector	DYCOMS-II, off coast of San Diego, July, 2001	Found that both anthropogenic and biogenic aerosol impact marine stratocumulus. Na and Cl were the most abundant ions in cloud water. Found enriched levels of sulfate, magnesium, and calcium in the cloud water.
Lu et al. 2007	Aircraft meas.; CDNC from FSSP	MASE, off coast of Monterey, July 2005	Found that drizzle was suppressed at elevated ANC. Ship-track impacted clouds had larger liquid water path. Clouds with smaller effective radius of droplets showed a reduce in drizzle.
Hopkins et al. 2008	Single CD residual from CVI; STXM-NEXAFS, SEM-EDX	MASE, off coast of Pt. Reyes, July 2005	Found two distinct classes of S-containing particles: aged sea salt and secondary sulfate. particles contained methanesulfonate and sulfate from DMS conversion. Particles were classified as sea salt in > 80% of those collected.
Coggon et al. 2012	Aircraft; HR-ToF-AMS with CVI; cloud water collector; MS	EPEACE, off coast of Monterey, July 2011	Used measurements of cloud droplets from a CVI and cloud water collector to observe a change in cloud-processed ship emissions. These droplets had an enhancement of m/z 42 and 99 compared to clean cloud droplets. Found that 72% of marine aerosol off the coast of CA is influenced by shipping emissions.
Latham and Smith 1990	Calculated CDNC; given wind speed and sea salt flux	North Atlantic	Calculated that an increase in wind speed in a warmer climate will increase the contribution of sea salt to CDNC. Current concentrations of sea salt are too low, compared with DMS-derived sulfate, to contribute much to CDNC.
O'Dowd et al. 2004	Modeled CDNC; measured aerosol composition	Northeastern Atlantic, 2002	Using a cloud droplet model, for an internal mixture of sea salt and sulfate, adding water soluble organics (WSOC) increases CDNC by 15-20%. CDNC increases 29-100% for an external mixture with WSOC. During high biological activity (HBA), sulfate > sea salt fraction and vice versa during low BA.
Martensson et al. 2010	Microphysics box model to calculate CDNC	Typical mid-lat ocean	Used DMS emissions and a sea spray source function for inputs in the model and found that ultrafine sea salt contributes to CNDC. Found that sulfate is 20-80% of CCN, DMS emissions increase size of sea salt aerosol, and CDNC increases with increasing ocean temperature.
Korhonen et al. 2010	Microphysics box model; imposed flux of sea spray	N., S. Pacific, S. Atlantic, Indian Ocean	Used a global aerosol transport model and found changes in CDNC vary due to wind speed, deposition, and sources in different regions. Additional particles can suppress in-cloud supersaturation.