	the contribution of sea salt and DMS derived aerosol to marine CCN" *ACP*	DMS flux, sea salt emission, and aerosols entrained from free troposphere. H_2SO_4 could either nucleate new aerosol or condense onto sea salt particles, or the newly formed aerosol.	linear due to mass transfer of H_2SO_4 onto SS CCN and FT CCN. SS CCN and FT CCN affected MBL CCN directly by supplying CCN and indirectly by providing a condensation sink for H_2SO_4. SS CCN and FT CCN are more important sources of CCN in MBL than DMS CCN (only important in pristine regions with very low wind speeds).
05/10/12	Russell et al., 1999	Field- MAST Experiment: June 1994, Monterey CA. Model- cloud parcel to identify source CCN in/near ship tracks	Cloud parcel model was used in conjunction with field observations from two case studies: clean and continentally influenced background conditions. Polluted background conditions resulted in smaller change in R_{eff}, CDNC, and LWC than clean conditions. Primary particles (BC) alone are too small and too hydrophobic to serve as CCN. Instead, condensation of H_2SO_4 on primary particles adds water-soluble mass and allows them to serve as CCN.
Russell, et al. 1999	Langley et al., 2010: "Contributions from DMS and ship emissions to CCN observed over the summertime North Pacific" *ACP*	Field- Aerosol measurements onboard *El Puma* in the North Pacific, July 2002	Correlations of CCN to MSA, DMS, organics, show that CCN in the North Pacific is controlled by sulphate. Case study: increase in regional shipping emissions (increased CN, ultrafine particles, and m/z 43 and 57). Organics were correlated to CCN, and sulphate species condensed onto smaller organic particles during the case study. Aerosol particles grew >90nm and CCN increased. Ship emissions can have strong impact on CCN concentrations over Northeast Pacific.
Russell, et al. 1999	Kim et al., 2009: "Investigation of ship-plume chemistry using	Field- airborne measurements from ITCT-2K2 Model- UBoM 2K8 (photochemical box	Ship-plume chemistry box model was used to better understand atmospheric impact of ship emissions. Model could accurately predict NOx, NOy, O_3, HNO_3, and H_2SO_4 in plume. Probability of HNO_3 reacting with sea salt particles

	a newly-developed photochemical/dynamic ship-plume model" *ACP*	model)	was found to be .05-0.1. (HNO_3 +NaCl → $NaNO_3$ + HCl). NO_x lifetimes in plume were shortened by ~2 hrs due to increased atmospheric oxidants.
Russell, et al. 1999	Corbett and Koehler, 2003: "Updated emissions from ocean shipping" *JGR*	Model – global shipping emission inventory (ship registry data → engine size → apply vessel activity data → fuel consumption)	Bottom up analysis of global shipping emissions show fuel consumption to be ~290 million metric tons/yr. Updated shipping emissions almost doubles global NO_x emissions to ~6.9 TgN/yr. Regional near-shore emissions may be much larger than predicted by global inventories, suggesting need for geographically resolved global inventories.
Russell, et al. 1999	Shao and Liu, 2009: "A critical examination of the observed first aerosol indirect effect" *J. of the Atmospheric Sciences*	Review- of the first aerosol indirect effect (AIE): field measurements and theory	Critical examination of AIE: discrepancies between albedo of a single cloud (0.60-0.90) and direct measurements from polluted and clean clouds (0.25-0.85), result in uncertain cooling effects. Variability in adiabaticity among clouds and the "activation effect" is responsible for CDNC between clean and polluted clouds. Activation effect is suppression of CCN activation in presence of continental/anthropogenic aerosols, and could reduce Twomey's suggested cooling effect.
05/10/12	Feingold et al., 1998	Model – Lagrangian parcel model coupled to a large-eddy simulation model to follow aqueous-phase processing of gases & CCN	Large-eddy simulation (LES) model used to describe boundary layer dynamics and derive parcel trajectories for use in trajectory ensemble model (TEM) (coupled microphysical/chemical model). However, the dynamics are not coupled to the microphysics/chemistry. Cloud processing of aerosol may or may not enhance drizzle, ultimately depends on CCN concentration and extent of processing.
Feingold	Stevens and	Review, global model	After decades of research, relationships among aerosols,

et al., 1998	Feingold, 2009: "Untangling aerosol effects on clouds and precipitation in a buffered system" *Nature*		clouds, and precipitation remains unknown. Problems with models and inadequate tools have left these relationships unknown. "Correlation-causation conundrum" of satellite data: a) aerosol-cloud correlations are prone to measurement artifacts. b) correlation does not imply causation. Deepening Effect- local inhibition of precipitation in a cloud with more CCN active aerosol helps provide deeper convection, later causing more precipitation.
Feingold et al., 1998	Chen et al., 2011: "Nucleation spikes in the planetary boundary layer" *ACP*	Model – aerosol parcel model	Photochemically driven nucleation bursts occur after sunrise and generate large CN. Proposed to be from the turbulence eddy effect – specifically in updrafts when adiabatic cooling results in sharp increase in water saturation ratio.