Papers: Cloud modification by anthropogenic aerosol emissions

Paper	**Method/Time/Location**	**Key Finding**
Conover 1966	TIROS satellite images; 1962-1966; northern Pacific ocean	Observations of long lived bright cloud lines in the clean marine boundary layer produced from exhaust of ocean vessels that add additional cloud nuclei and can be referred to as "ship contrails".
Ferek et al. 1998	NOAA AVHRR satellites and aircraft measurements; August 1992; off the coast of Washington, northeastern Pacific	Used satellite images to detect ship tracks and used aircraft measurements to determine that effluents from ship tracks were increasing the concentration and decreasing the size of cloud droplets.
Durkee et al. 2000	Four aircraft, one research ship, satellite observations, plume model simulation; June 1994; Off the coast of California, northeastern Pacific Ocean	The MAST (Monterey Area Ship Track) experiment used aircraft measurements of created ship tracks to determine that ship tracks are due to particle emissions from the ships, stronger ship tracks are made from more polluting ships, and sea salt from ship wakes does not produce ship tracks.
Noone et al. 2000	Aircraft measurements; same MAST experiment	Compared measurements of ship emissions in the same cloud to determine that combustion-derived particles (0.03-0.3μm) contribute the most to the changes in the clouds that create ship tracks.
Broekhuizen et al. 2006	ground based measurements of particle size and composition and CCN; August and September 2003; downtown Toronto	Used mass size distributions and CCN measurements to determine that small amounts of soluble inorganic material can drive the CCN activity of organic rich particles and that both an internal mixture and a bimodal external mixture represented the CCN activity.
Novakov and Penner 1993	ground based measurements; March and April 1992; Puerto Rico	Measurements of mass size distributions and calculated number size distributions show that the overall number concentration of organic particles is greater than sulfate and that organic particles may contribute significantly to CCN.
Lohmann et al. 2000	ECHAM4 global climate model; "present day"; global	Used global climate models and internally and externally mixed sulfate and carbon particles to determine that the addition of carbonaceous aerosol can enhance the cloud albedo effect and that the assumption of sulfate-only particles does not represent atmospheric conditions.

Roberts et al. 2002	ground based measurements of size and mass, CCN three component model; Spring 1998; Amazon Basin	Rurual, ambient CCN observations and comparison to CCN models show that the sulfate mass fraction could account for most of the CCN activity and predicts that soluble organic components could have a similar contribution.
Chang et al. 2007	Ground based measurements of aerosol size distribution and composition; Fall 2005; Semi-rural location 80km north of Toronto, Canada	Ambient measurements of CCN compared with Kohler model of predicted CCN show that the hygroscopicity of the carbonaceous component is more important as the soluble inorganic (ex: sulfate) fraction decreases.
Leaitch et al. 2010	Aircraft measurements and cloud parcel model; October 2003; northwest Atlantic	Continentally influenced air has more particles thus more cloud droplets due to the relative increase in organic carbon to sulfate fraction compared to clean marine air which increases the cloud reflectivity.