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Title: Suitability of Atmospheric Conditions in North Dakota for Conducting Effective Hygroscopic Cloud Seeding

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Abstract: Atmospheric conditions vary widely between locations where operational weather modification programs may be conducted. Changes in cloud condensation nuclei (CCN) concentration, cloud base temperature, cloud base height, and cloud microphysical properties can have a significant influence on the effectiveness of hygroscopic cloud seeding. The North Dakota Atmospheric Resource Board has conducted a series of field programs, called the Polarimetric Cloud Analysis and Seeding Test (POLCAST), to evaluate the effectiveness of hygroscopic flares in increasing precipitation in North Dakota. During 2008, 2010, and 2012, the POLCAST field campaigns conducted airborne measurements within 600 m below the cloud base of developing cumulus clouds during the months of June and July. Airborne measurements with a Passive Cavity Aerosol Spectrometer Probe (PCASP) and a CCN counter show that concentrations at cloud base are higher in North Dakota than in other regions (Mali and Saudi Arabia) where operational hygroscopic cloud seeding programs have recently been conducted. A large daily variation (approximately 500-2000 #/cm^3) in CCN concentration is seen during the POLCAST field campaigns. Day-to-day variations in CCN concentration are larger than changes in concentration across North Dakota on a single day. Furthermore, daily variations are larger than the uncertainty in the CCN measurements.

During the 2012 field campaign, both Droplet Measurements Technologies (DMT) and University of Wyoming (UWyo) CCN counters were used for airborne measurements. The DMT CCN counter conducted measurements at three different ambient supersaturations of 0.2%, 0.3%, and 0.6%, while the UWyo CCN counter measured CCN concentrations at a constant supersaturation of 0.6%. Both the DMT and UWyo CCN counters were evaluated in the lab to ensure accurate measurements of concentration and supersaturation. Based on our current conceptual understanding of hygroscopic seeding and the POLCAST CCN, cloud base temperature, cloud base height and cloud microphysical measurements, North Dakota has suitable atmospheric conditions for conducting effective hygroscopic cloud seeding.