Analysis of Cloud Condensation Nuclei Measurements Conducted during the Polarimetric Cloud Analysis and Seeding Test (POLCAST) Projects

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Objective

- Determine under what conditions surface based CCN measurements can be used to infer cloud base CCN concentrations.
- Determine the magnitude of day-to-day and regional scale changes in CCN concentrations in North Dakota.



View from Seeding Aircraft on July 8, 2012



View of Cumulus Cloud on July 12, 2012

Aerosol Importance

- Scatter and Absorb Radiation
- Media for Chemical Reactions
- Serve as Cloud

Condensation Nuclei CCN)





Grow Aerosols to Detectable Size



POLCAST4 CESSNA340 N98585 INSTRUMENT CONFIGURATION



POLCAST4 Surface Measurements: Clifford Hall 601



CCN Counter Lab Calibration Setup



Cessna 340 Flight Tracks



Aircraft flight paths during the 2010 POLCAST3 (left) and 2012 POLCAST 4 (right) field project.

Cloud Base: 2012



Statistical distributions near cloud base of 30 s 1 % supersaturation (counter's theoretical value) Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure during the 2010 POLCAST3 field project. The solid circle is the mean value, the horizontal line is the 50th percentile, the top of the box is the 75th percentile, the bottom is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.

Cloud Base: 2010



Statistical distributions near cloud base of 30 s 1 % supersaturation (counter's theoretical value) Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure during the 2010 POLCAST3 field project. The solid circle is the mean value, the horizontal line is the 50th percentile, the top of the box is the 75th percentile, the bottom is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.



12-Jun 13-Jun 14-Jun 19-Jun 26-Jun 1-Jul 7-Jul 9-Jul 11-Jul

Statistical distributions near cloud base of 30 s 1 % supersaturation (counter's theoretical value) Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure during the 2008 POLCAST2 field project. The solid circle is the mean value, the horizontal line is the 50th percentile, the top of the box is the 75th percentile, the bottom is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.



For individual profiles see, Bart, N. and D. J. Delene, North Dakota Aircraft and Surface CCN Measurements during the Summers of 2010 and 2012, Poster presented at the 93rd Annual Conference of the American Meteorological Society, January 6, 2013 in Austin, Texas.

Cloud Base: 2012



Statistical distributions near cloud base of 30 s 1 % supersaturation (counter's theoretical value) Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure during the 2010 POLCAST3 field project. The solid circle is the mean value, the horizontal line is the 50th percentile, the top of the box is the 75th percentile, the bottom is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.

July 8, 2012 (190 DOY)



University of Wyoming cloud condensation nuclei (CCN) counter measurements (0.6 % ambient supersaturation) adjusted to standard pressure and temperature (STP) on aircraft ascent (red, 17:40:00-17:45:00 UTC), during cloud base sampling (black stars, 18:04:00-19:36:10) and during descent (blue, 19:36:20-19:56:40).

POLCAST-2012



POLCAST-2012



July 8, 2012 (190 DOY) Case 1 Case 5



July 9, 2012 (191 DOY) Case 1 Case 2



DMT CCN Surface Measurements 10 min Samples in 2012





MODIS Terra Visible Image July 8, 2012 with Flight Track and Hysplit Backtrajectory



MODIS Aqua Visible Image July 9, 2012 with Flight Track and Hysplit Backtrajectory



Conclusions

- Day-to-day variations in CCN concentrations are larger than regional scale changes.
- On Cloud seeding days, the below cloud base atmosphere is well-mixed so surface CCN measurements can be used to determine cloud base measurements
- Not clear the what is the cause of the observed day-to-day CCN changes.

Future Work

- Finish software development work for the DMT CCN, including CCN spectrum parameters.
- Determine statistics for all parameters on all flight days.
- Analyze season long surface measurement statistics.
- Compare changes in CCN concentration to changes in aerosol chemistry.
- Investigate how changes in CCN concentration affect model predictions of precipitation.

If your in the Fog

Ask Questions

Hopefully things are a little clearer.

Thanks for listing.