

Air Pollution Workshop



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Airborne Atmospheric Measurements

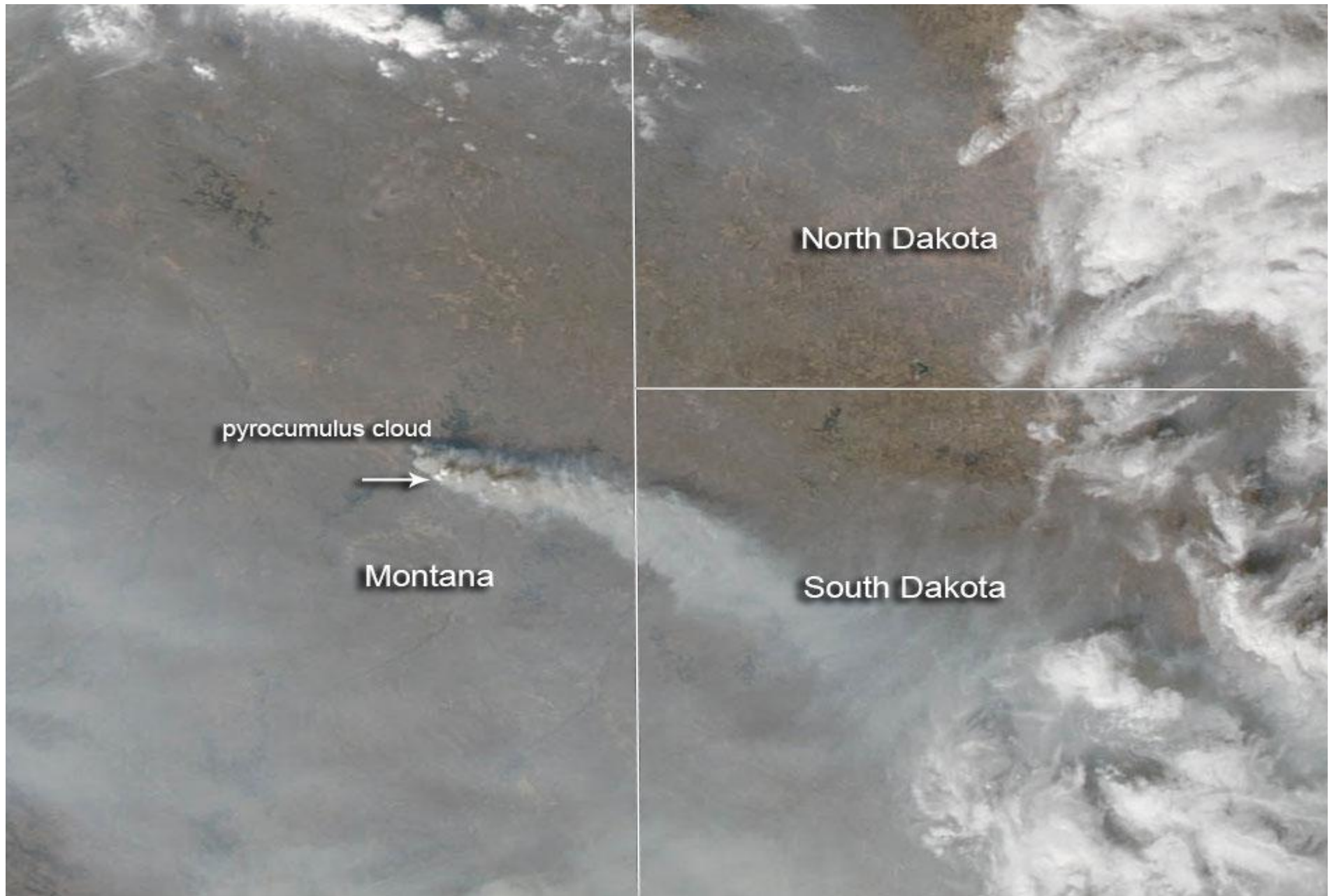


View from the front of the Citation Research Aircraft on July 14, 2011 flight.



Citation's right wing taken over Lake Superior, with Isle Royale in the background, on March 3, 2012

Sources of Aerosols



The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite captured this image on September 15, 2012.

Smoke From Russian Fires Approaches North America

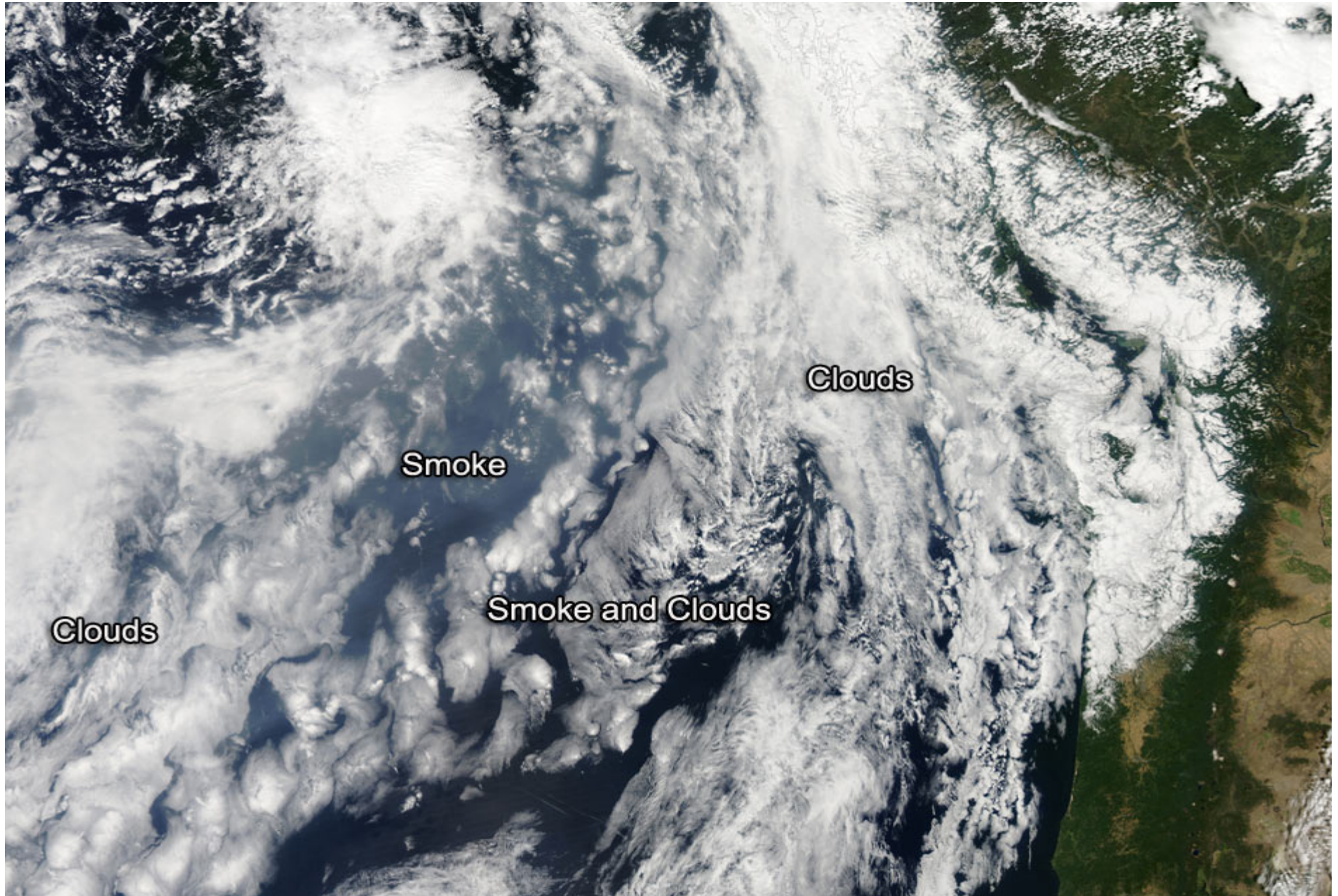
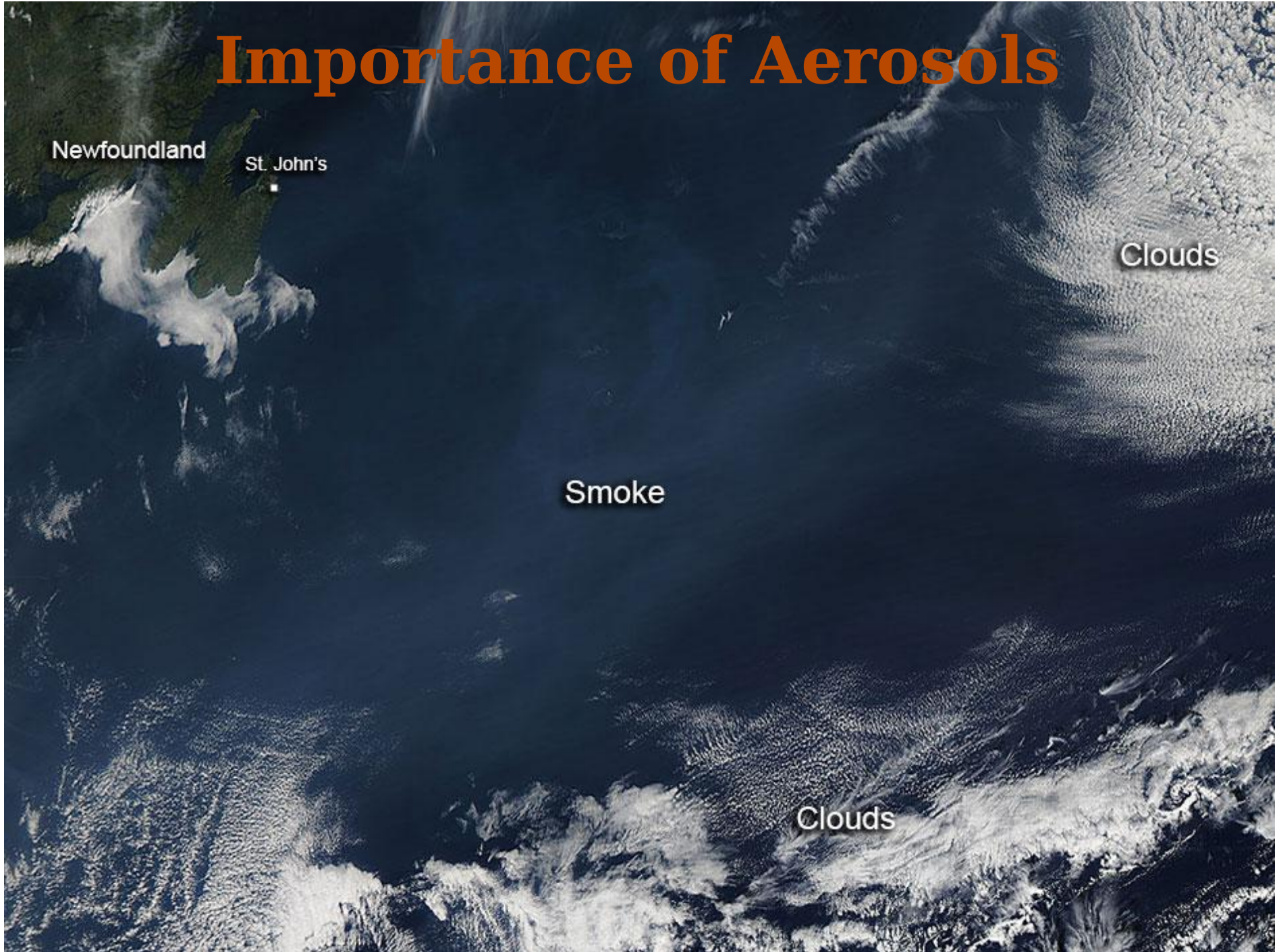


Image captured on August 09, 2012 at 21:50 UTC (8:50 am EDT).

Importance of Aerosols



Natural-color satellite image that was collected by the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua satellite on September 19, 2012.

Definitions

Aerosols

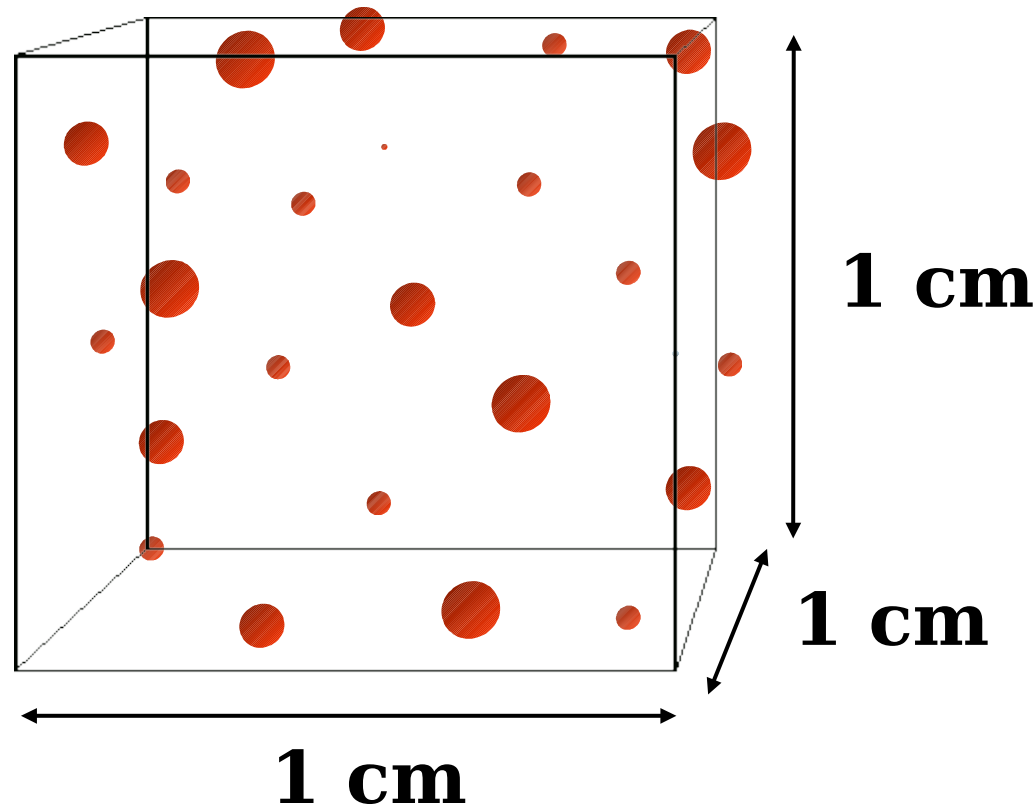
- Suspended solid or liquid matter
- Small settling velocity

Atmospheric Aerosols

- Suspended material in the Earth's atmosphere that have residence times of days, to a few weeks.
- Atmospheric Aerosols are sometimes referred to as “particles”

Aerosol Number Concentration

Number of Aerosols per unit Volume



$$24 \text{ particles} / 1 \text{ cm}^3 = 24 \text{ cm}^{-3}$$

Airborne Instrument Size Range

10^{-9}m to 10^{-3} m

(.001 μm to 1,000 μm or 1 nm to 1,000,000 nm)

Wavelength of Visible Light?

Size of cloud droplet?

Size of a rain drop?

Size of a human hair?

.001

.01

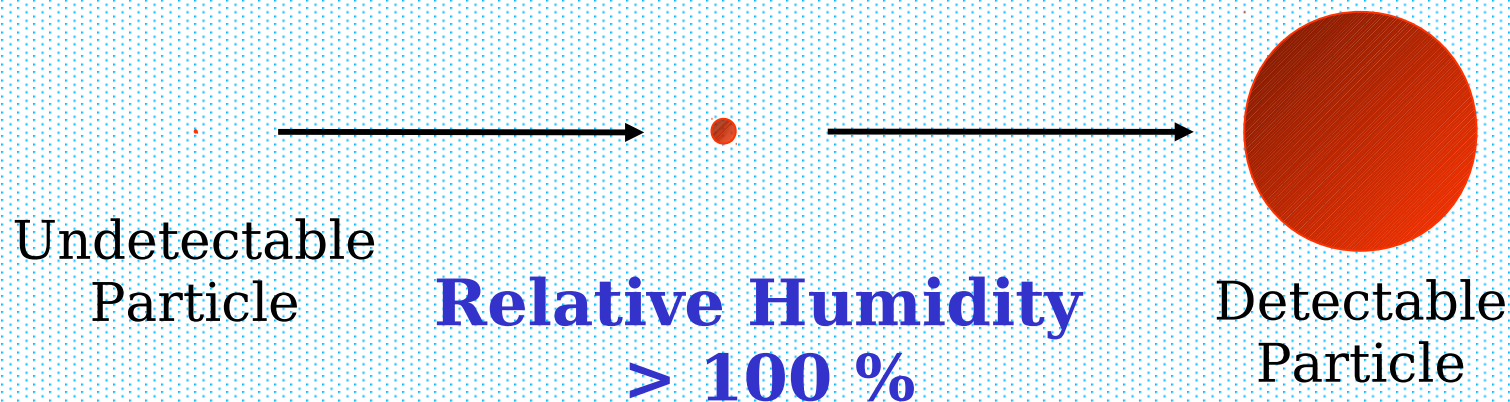
.1

1



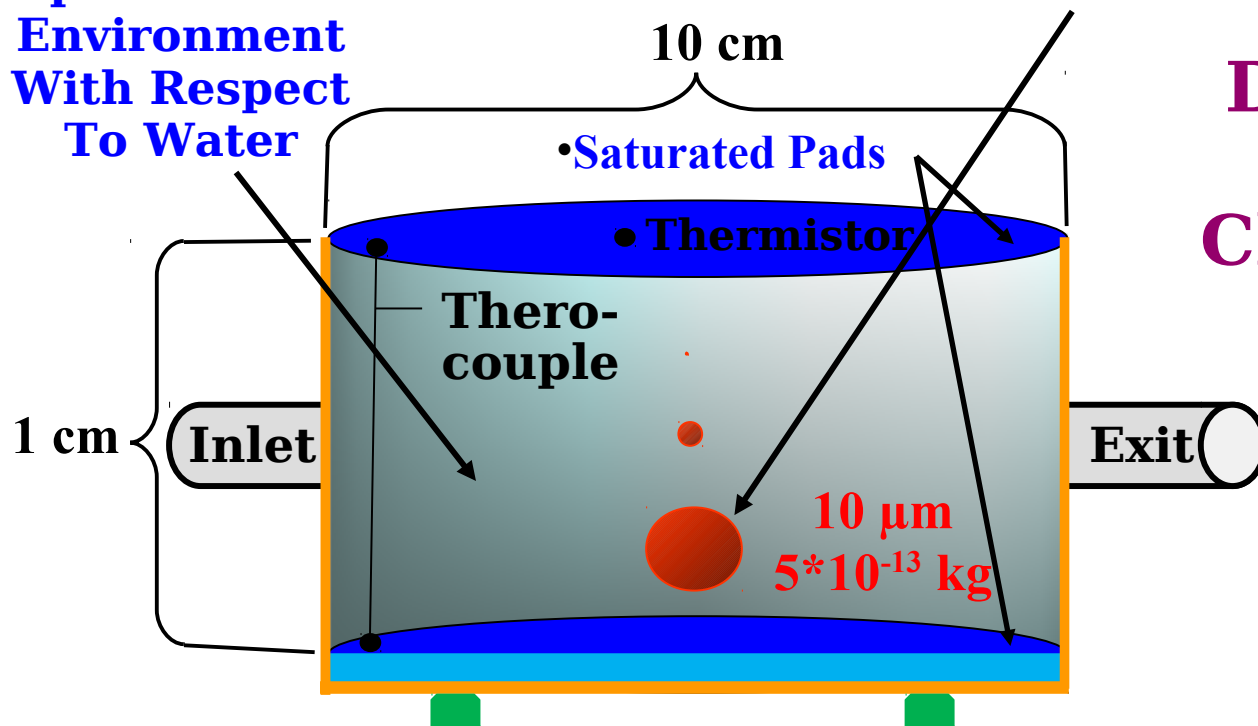
Grow Aerosols to Detectable Size

Supersaturated Water Vapor Environment



Supersaturated Environment With Respect To Water

Grow to Form Droplet

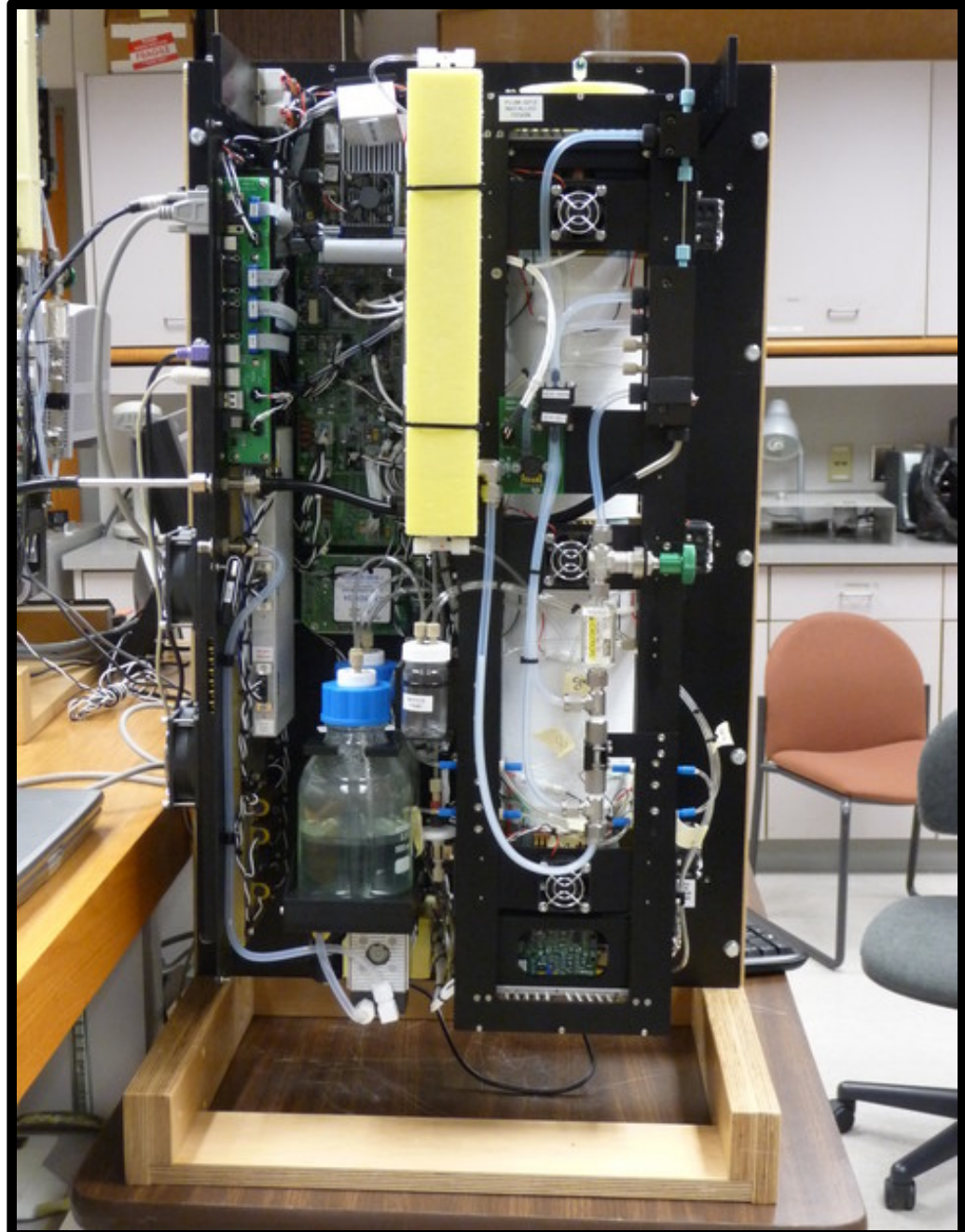


Diffusion Chamber for Cloud Condensation Nuclei Counter

Determines the number of particles in air the cloud droplets form on.



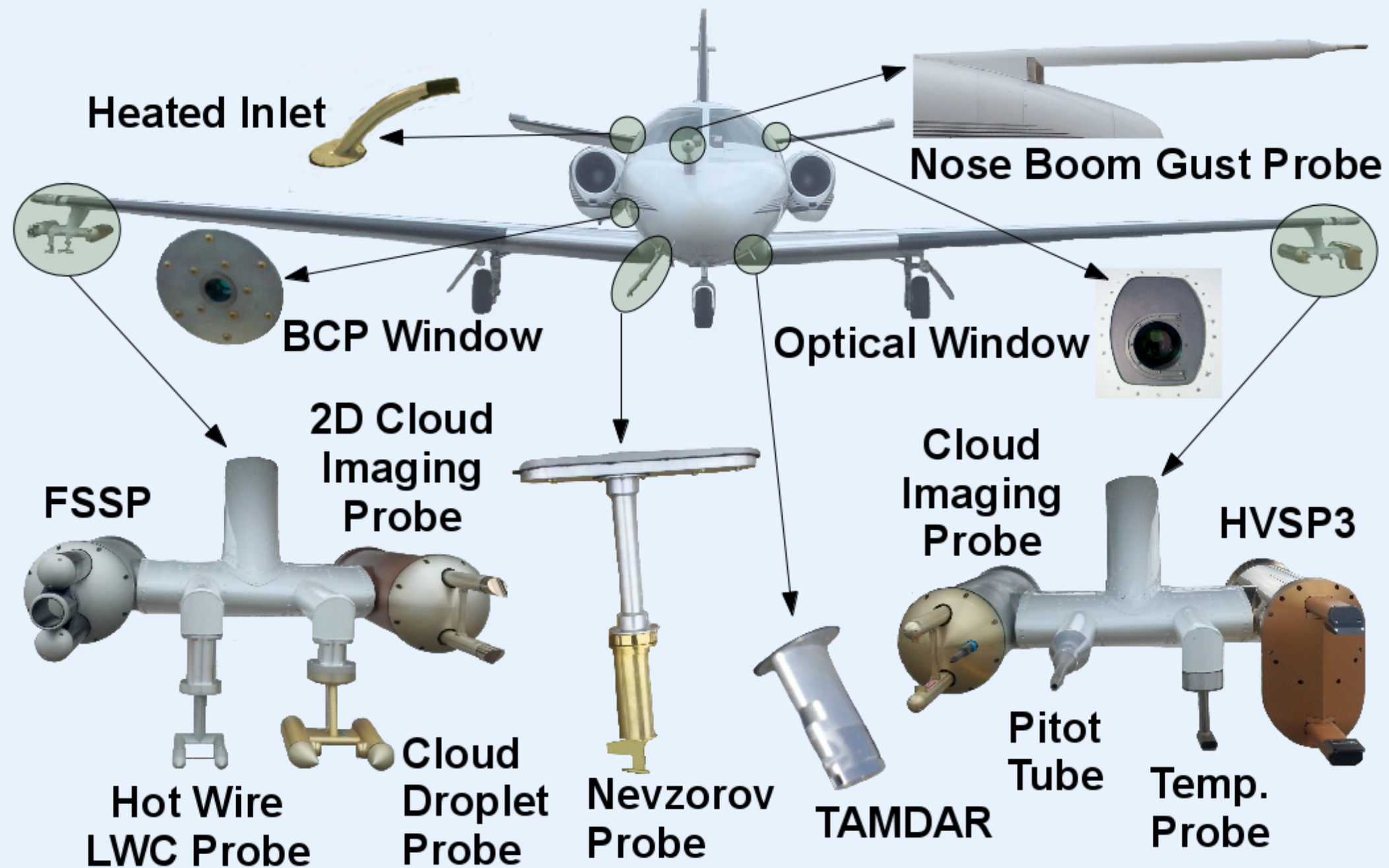
University of Wyoming's Cloud
Condensation Nuclei Counter



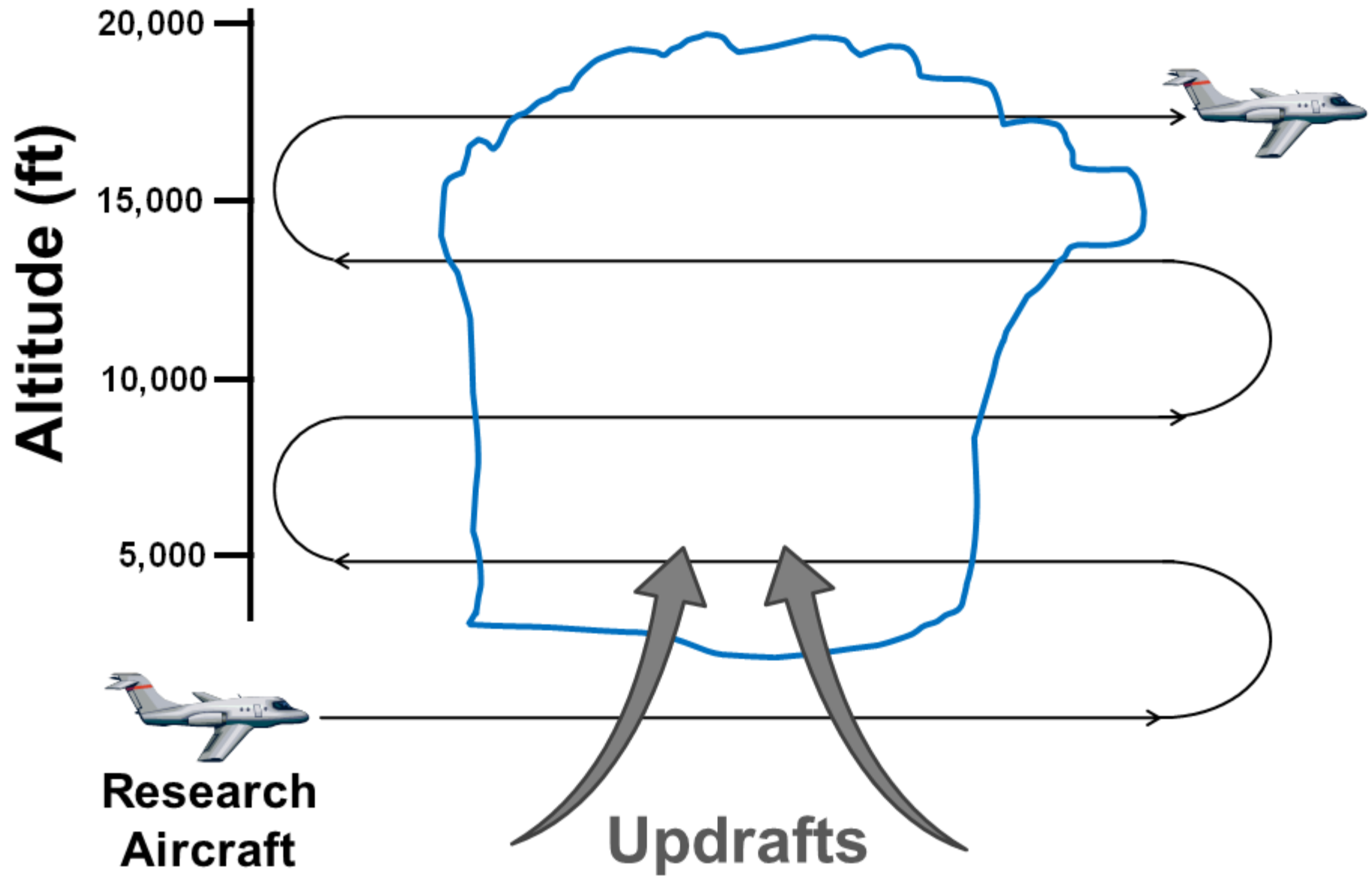
Droplet Measurement Technologies
Cloud Condensation Nuclei Counter

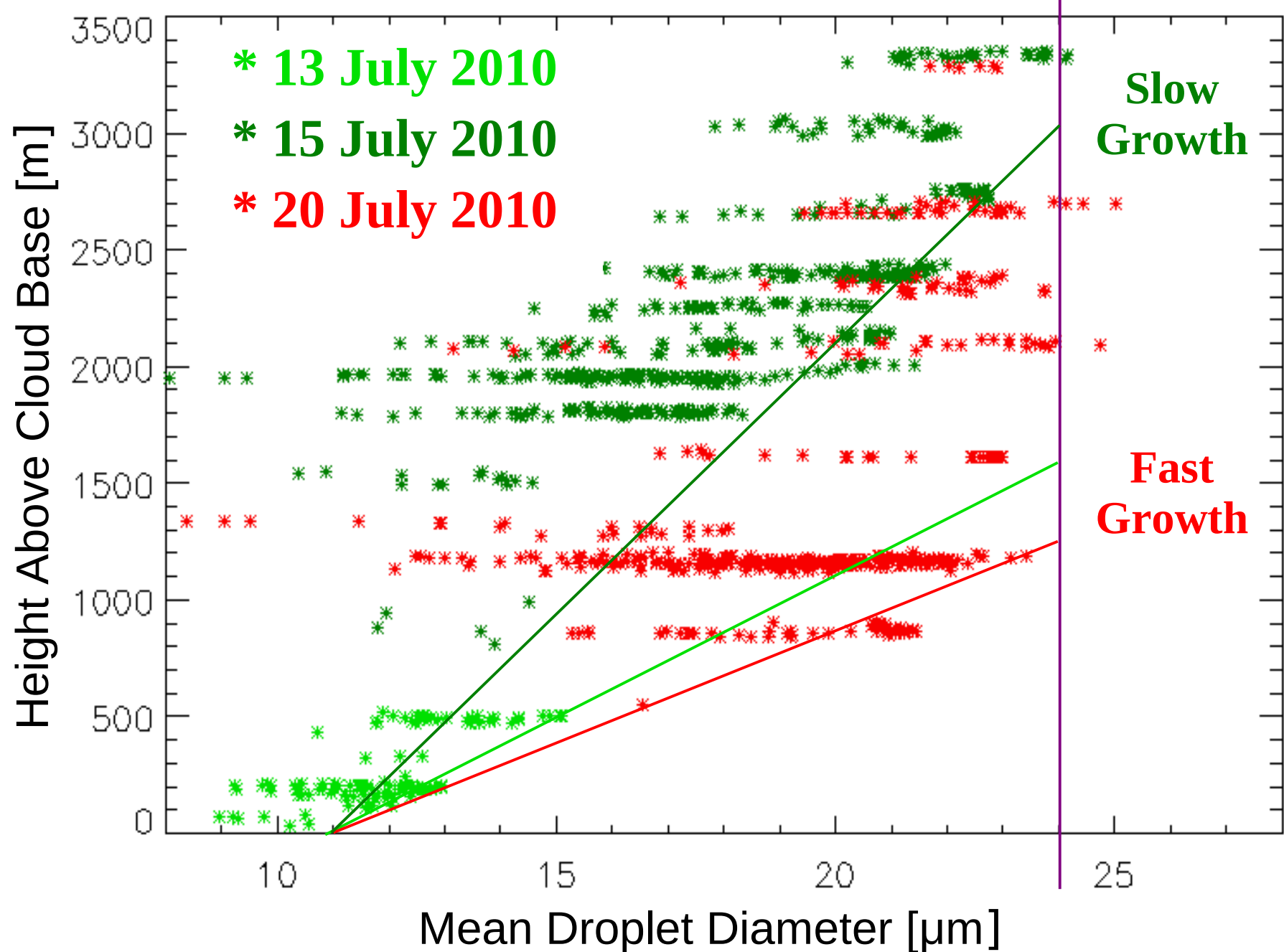
University of North Dakota

Cessna Citation II Research Aircraft



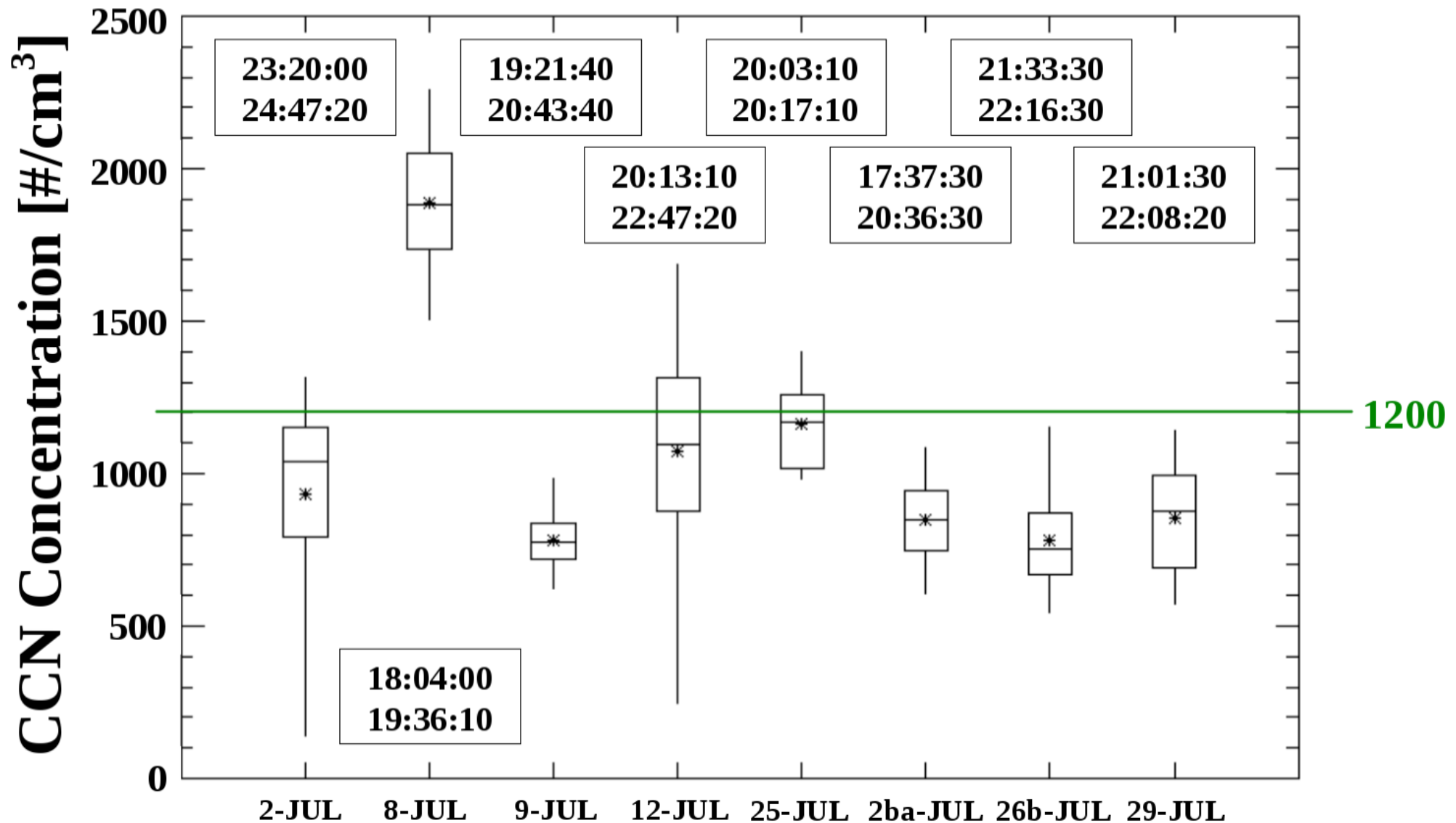
Convective Cloud





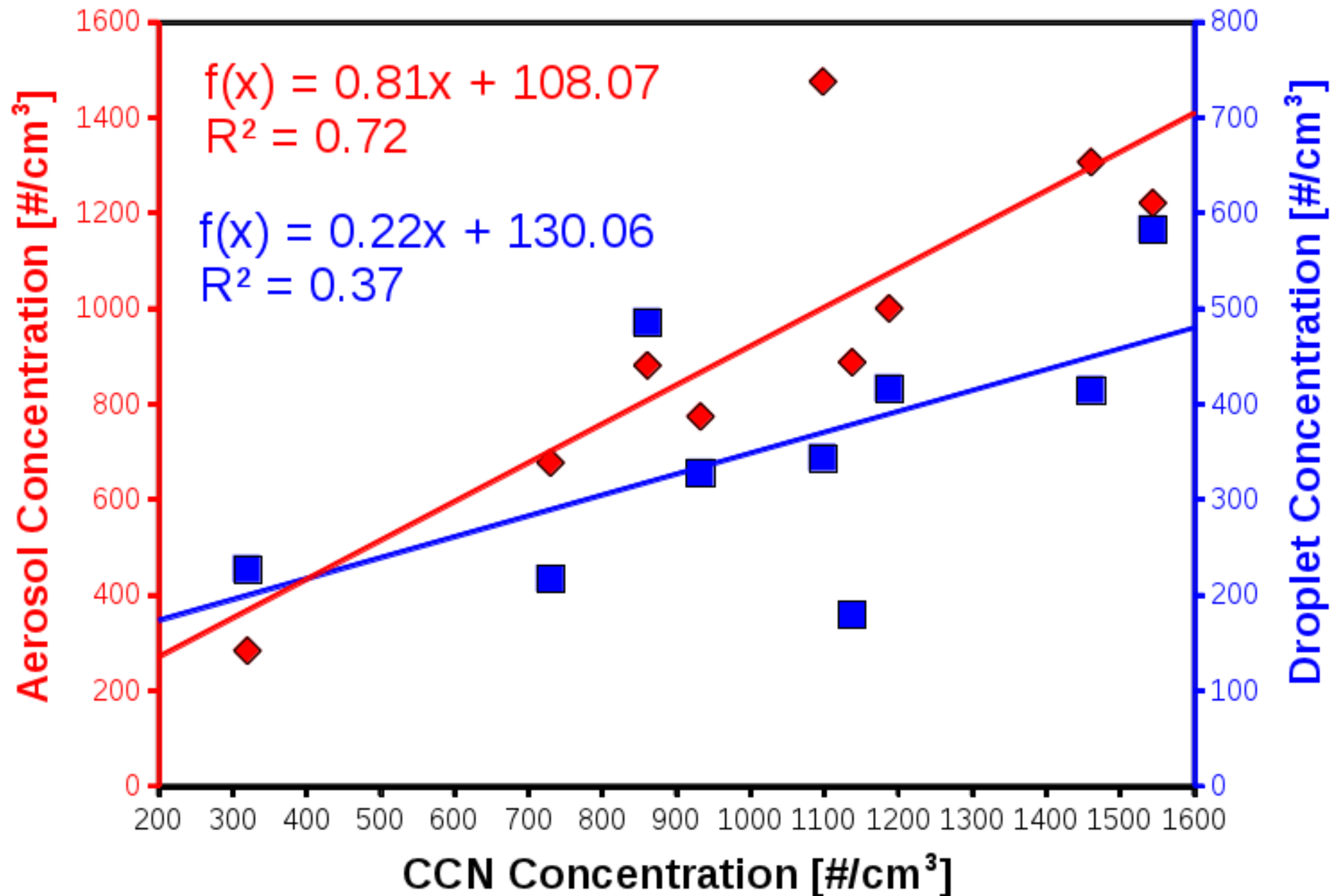
The Cloud Droplet Probe (CDP) mean droplet diameter versus the height above cloud base for aircraft flights during POLCAST3 near Grand Forks, North Dakota. Only measurements with CDP concentrations about 140 cm^{-3} are presented.

Cloud Base 2012



Statistical distributions near cloud base of 30 s 1 % supersaturation Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure during the 2012 POLCAST4 field project conducted near Grand Forks, North Dakota. 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.

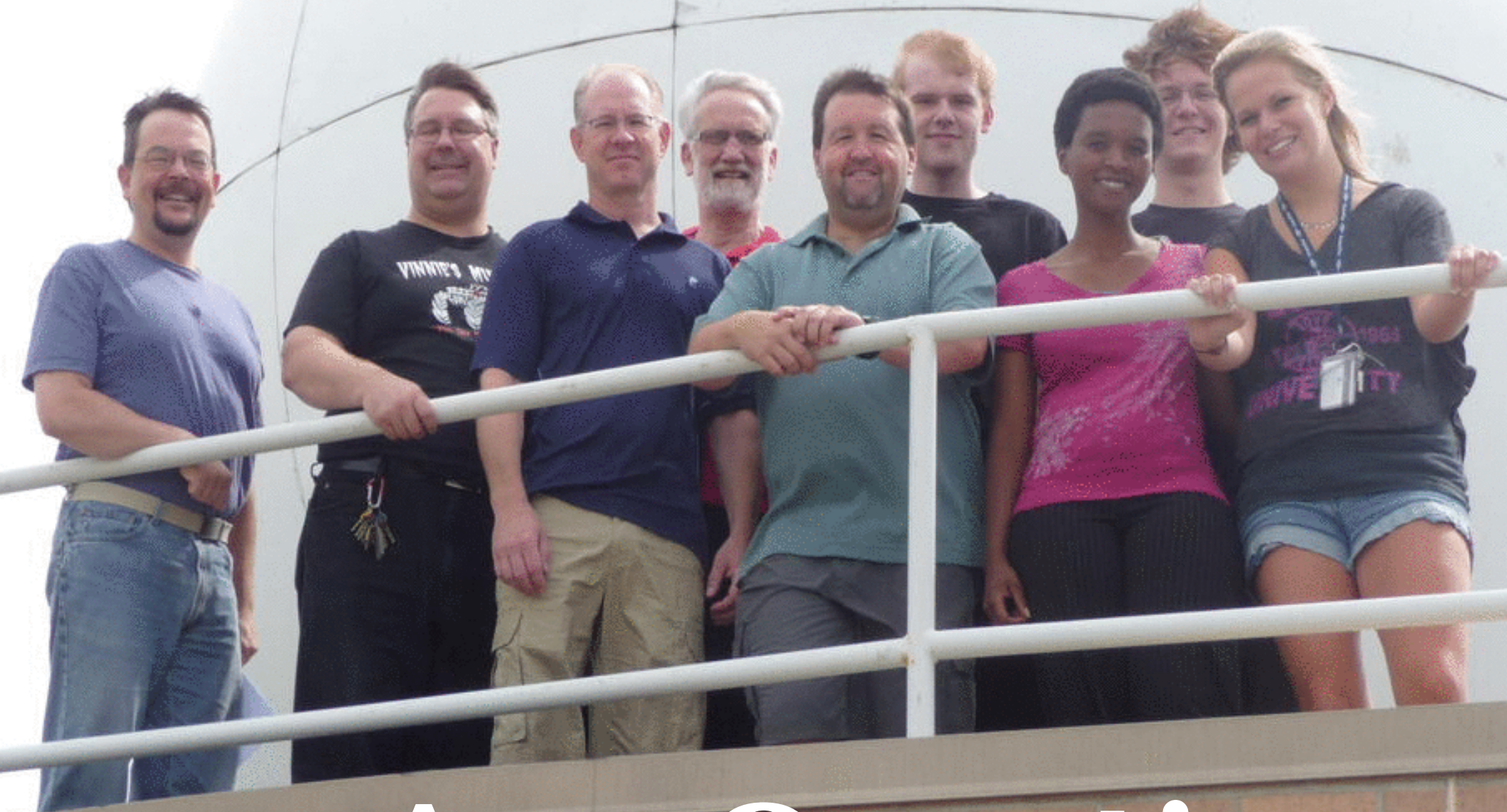
North Dakota 2008



Summary

- Aerosols are suspended particles in the atmosphere that affect the scattering and absorption of sunlight and affect cloud and participation process.
- To understand precipitation formation require airborne measurements with many instruments.
- Conducting measurements to learn about the atmosphere can be a lot of fun; however, it takes a lot of planning and work to achieve new understanding such as the type of precipitation formation in a region.

Thanks for Listening



Any Questions