Analysis of In-situ Observations Made During the POLCAST Field Projects

David Delene[1], Nicholas Gapp[1], Kurt Hibert[1] and Darin Langerud[2]

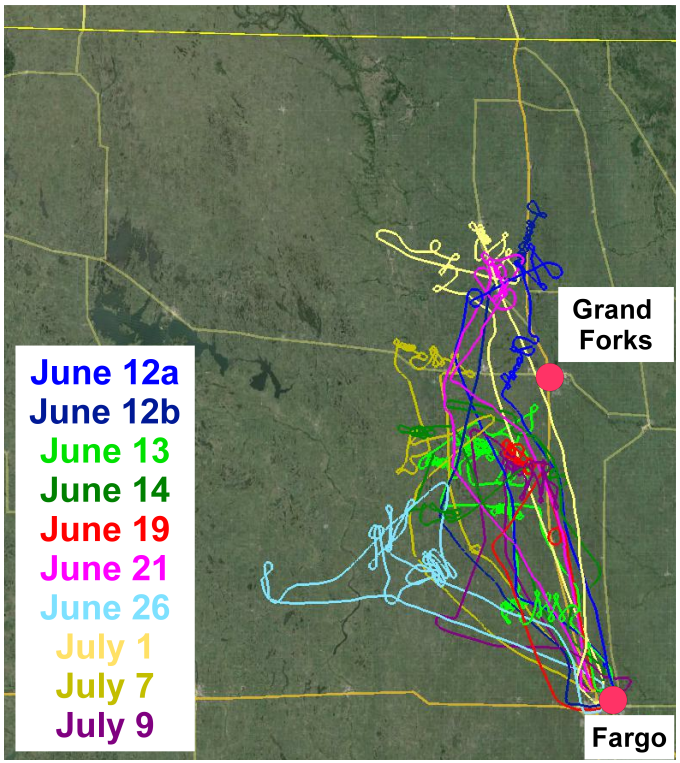
[1]Atmospheric Sciences Department, University of North Dakota
[2]North Dakota Atmospheric Resource Board

Collaborators

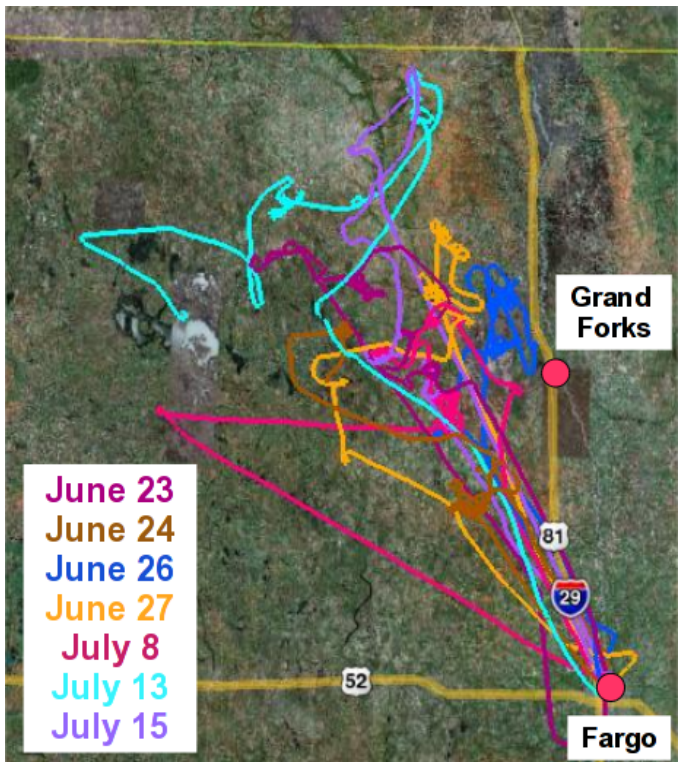
University of North Dakota
Gretchen Mullendore, Mariusz Starzec,
Richard Cochran, Alena Kubatova, Frank Bowman
National Center for Atmospheric Research - RAL
Paul Kucera and Duncan Axisa
Weather Modification Inc.

POLCAST Objectives

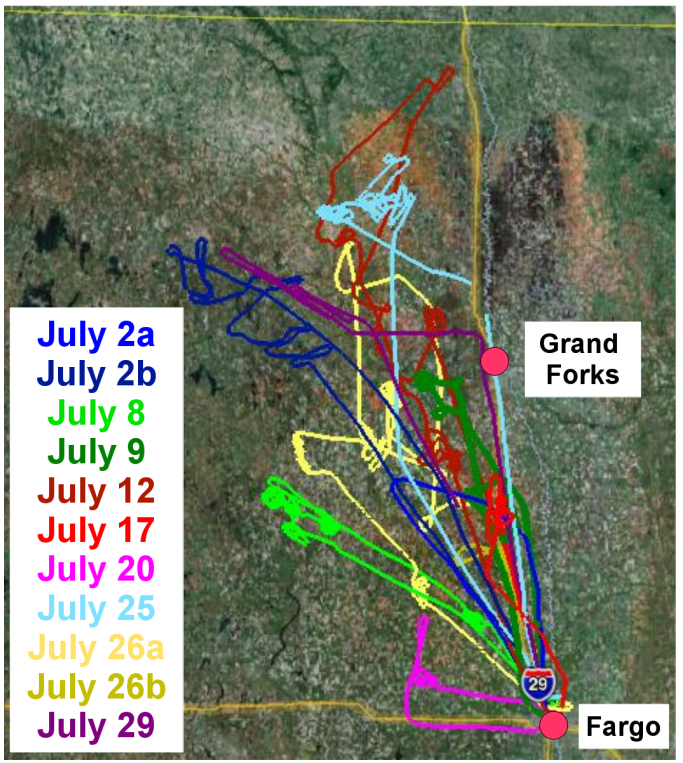
- Evaluate effectiveness of hygroscopic seeding in North Dakota using randomized seeding study.
- Determine atmospheric conditions in which hygroscopically seedable clouds are found in North Dakota.



Flight paths during 2008.

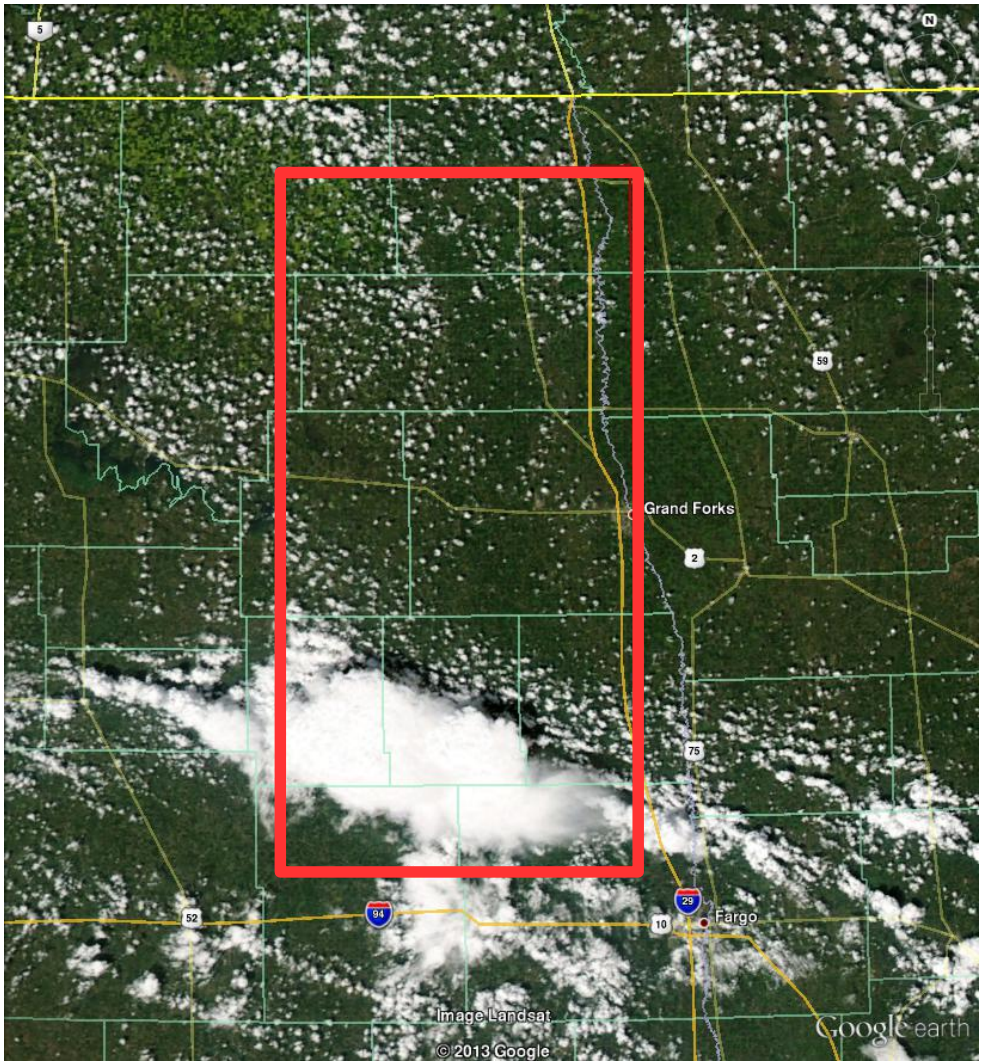


Flight paths during 2010.

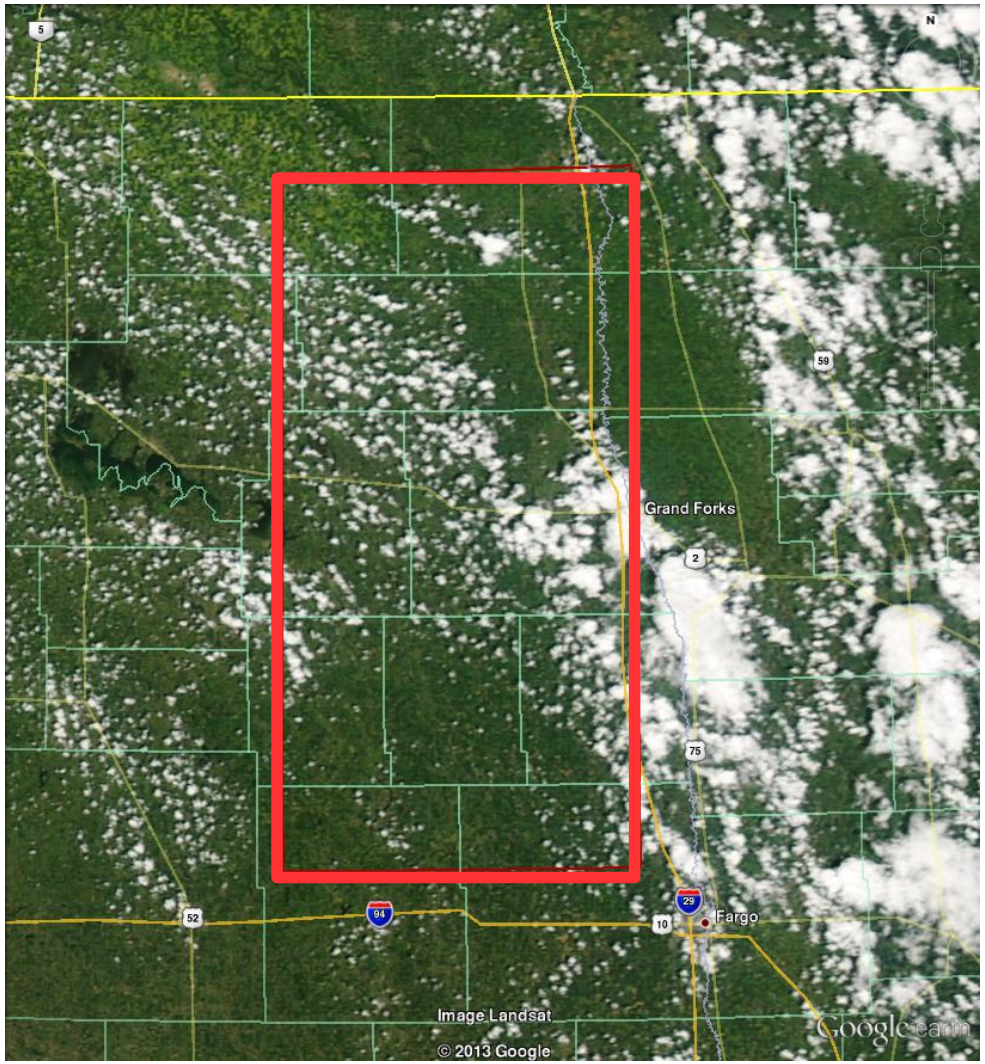


Flight paths during 2012.

Satellite Images of North Dakota Project Area

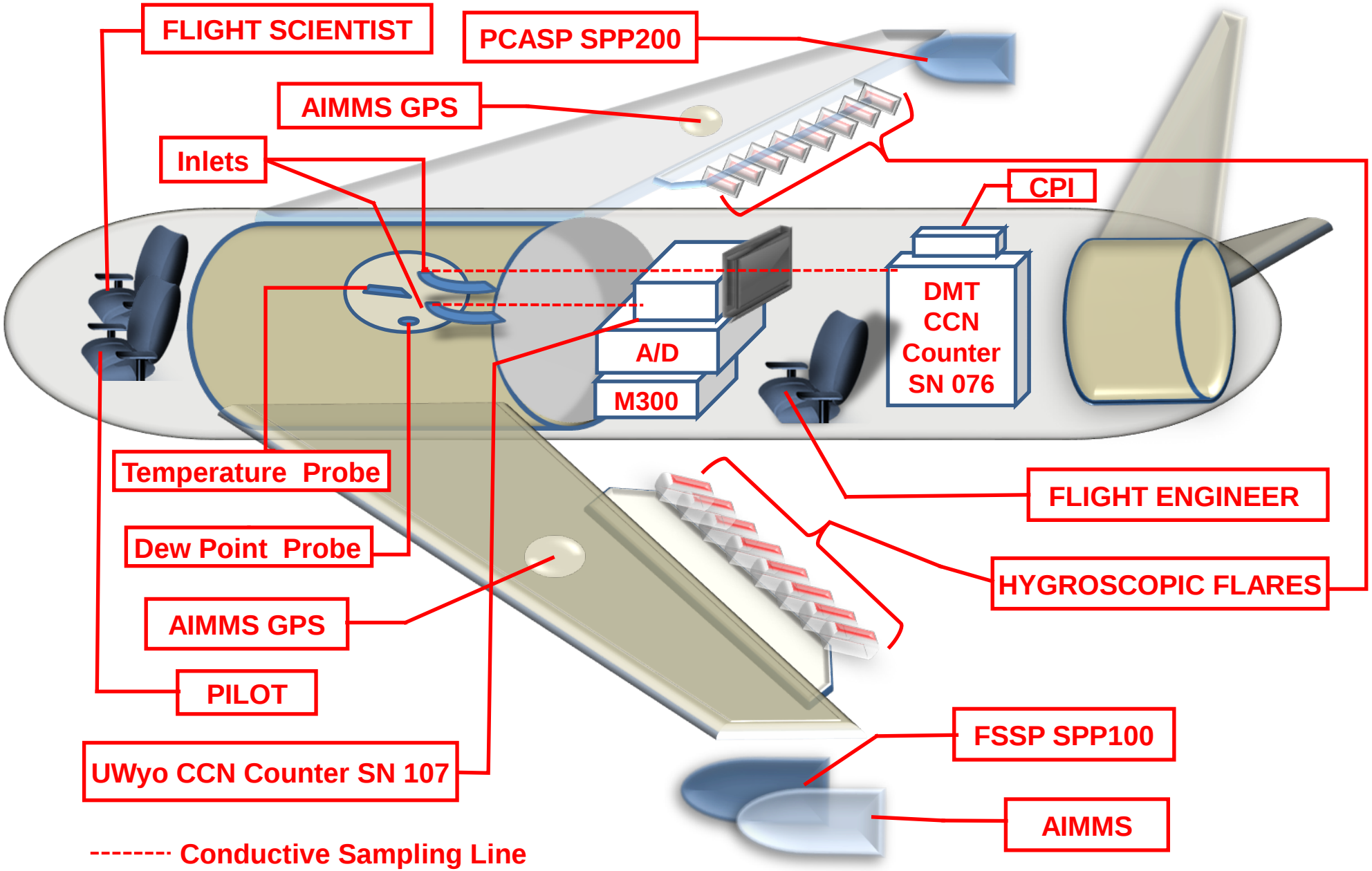


MODIS Image
July 8, 2012



MODIS Image
July 9, 2012

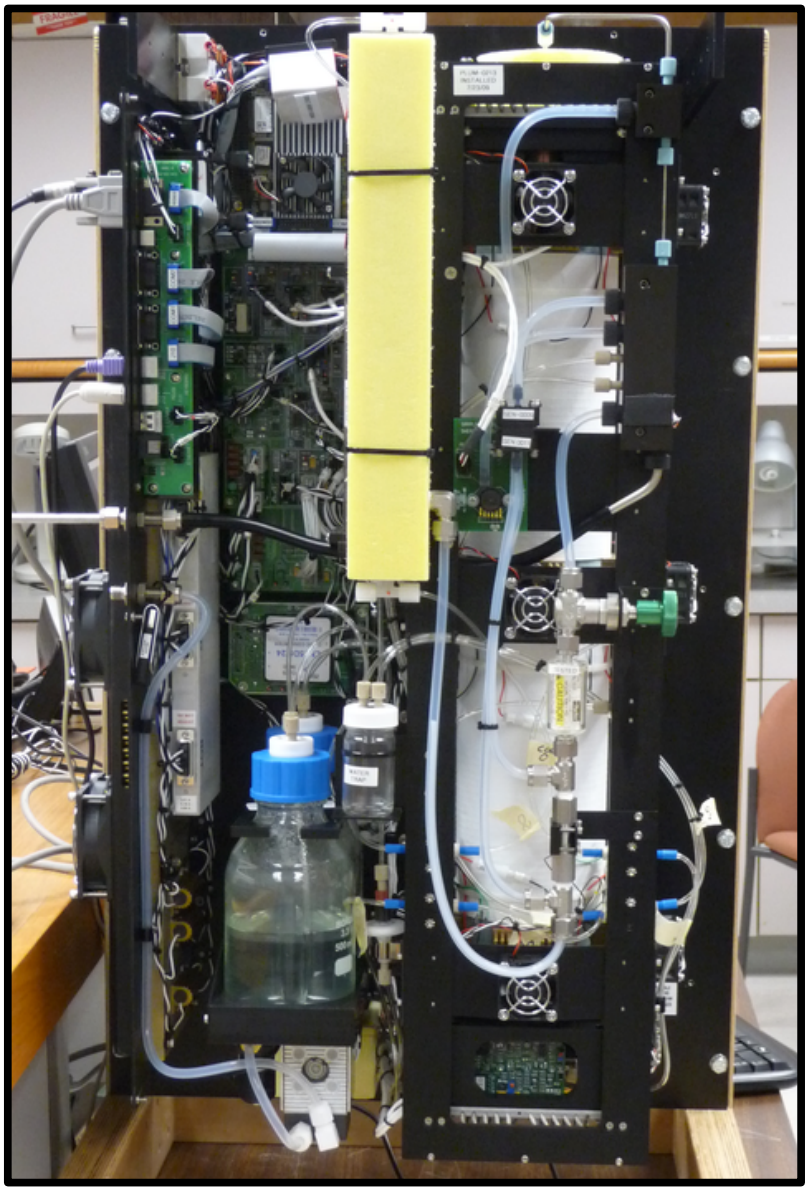
Seeding and Atmospheric Sampling



2012 Cessna 340 Configuration

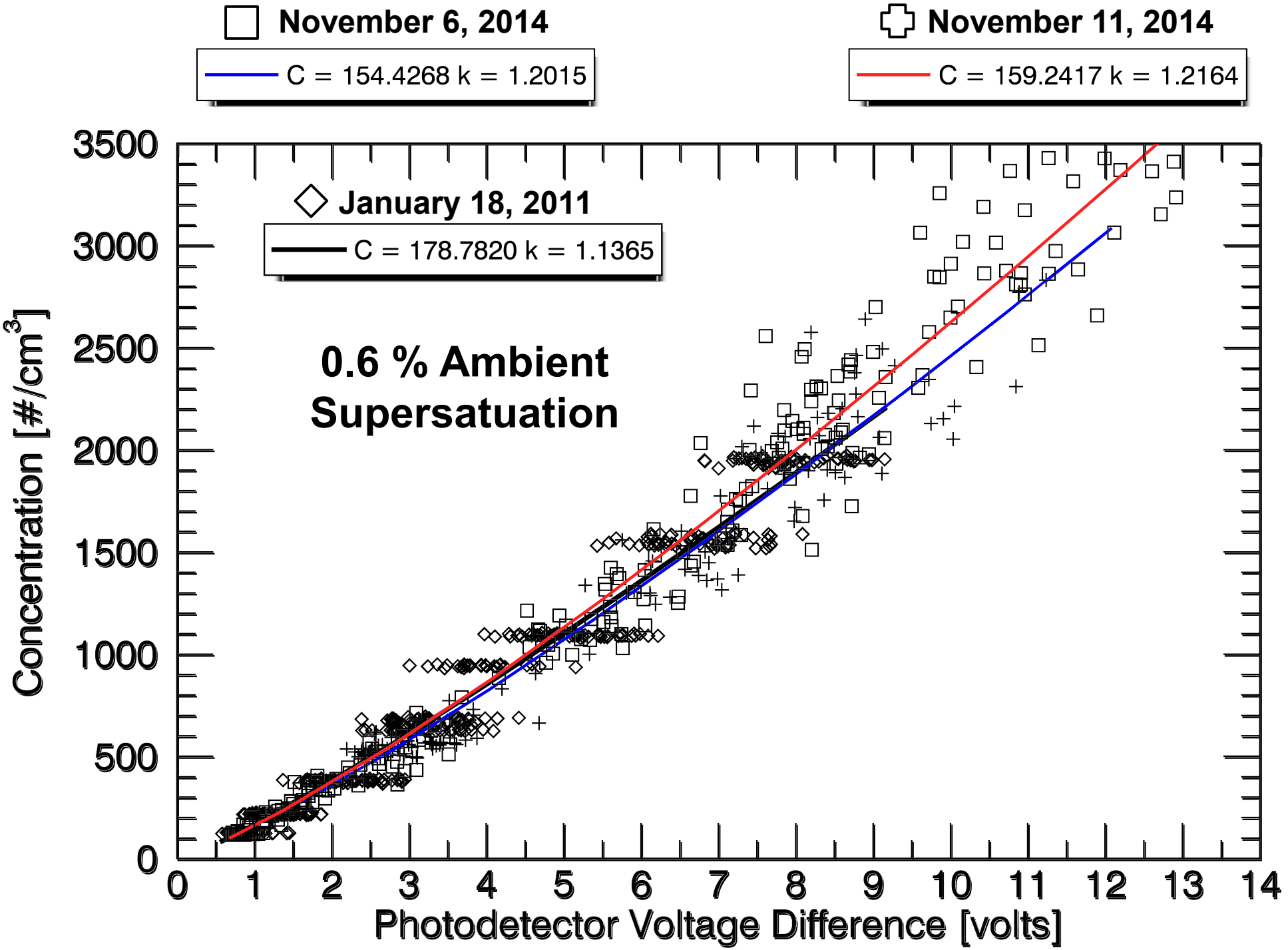
What is cloud base cloud condensation Nuclei (CCN) Concentrations

University of Wyoming (UWyo) CCN Counter

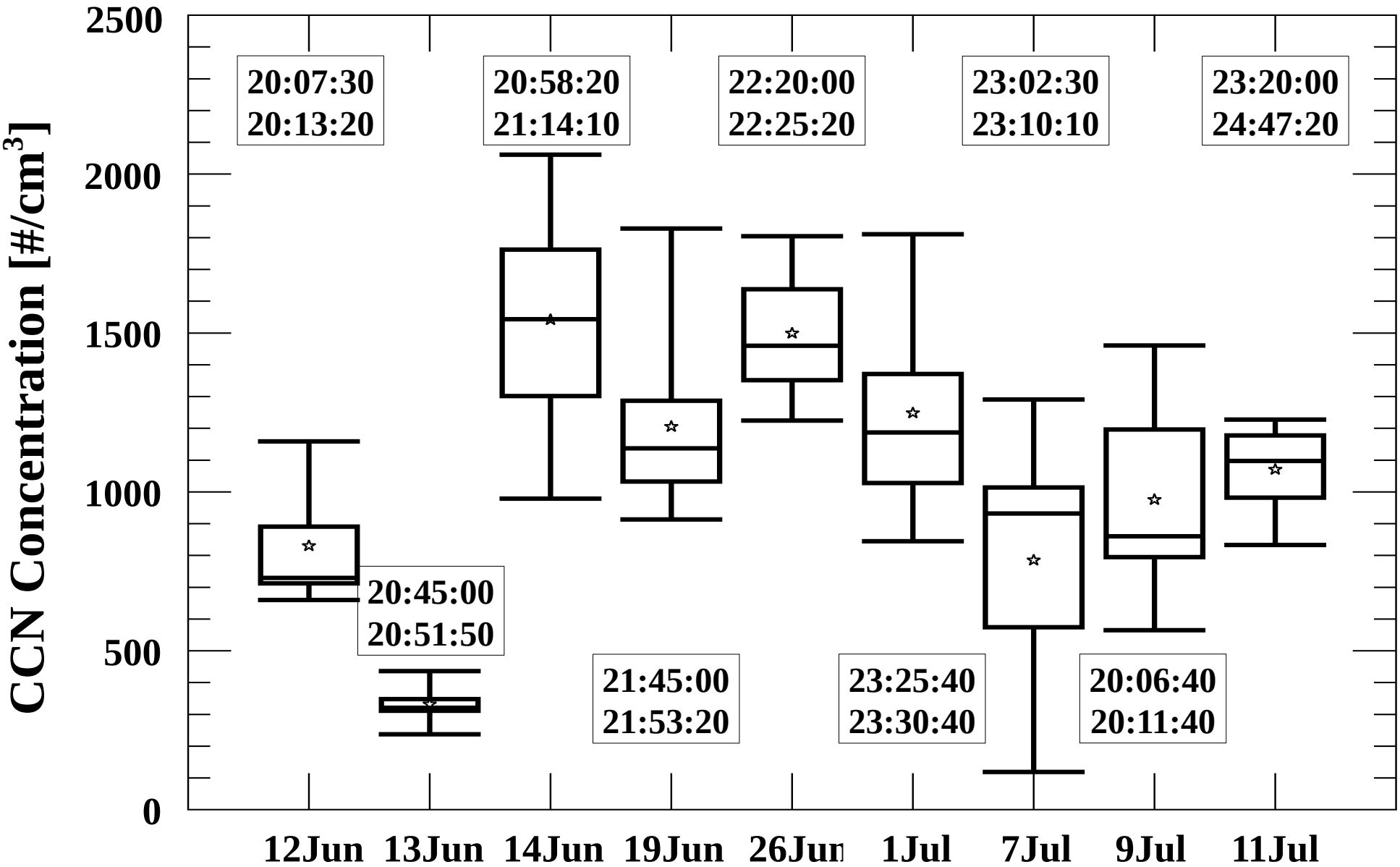


Droplet Measurement Technologies (DMT) CCN Counter

Uwyo CCN Counter (SN 107) Calibration

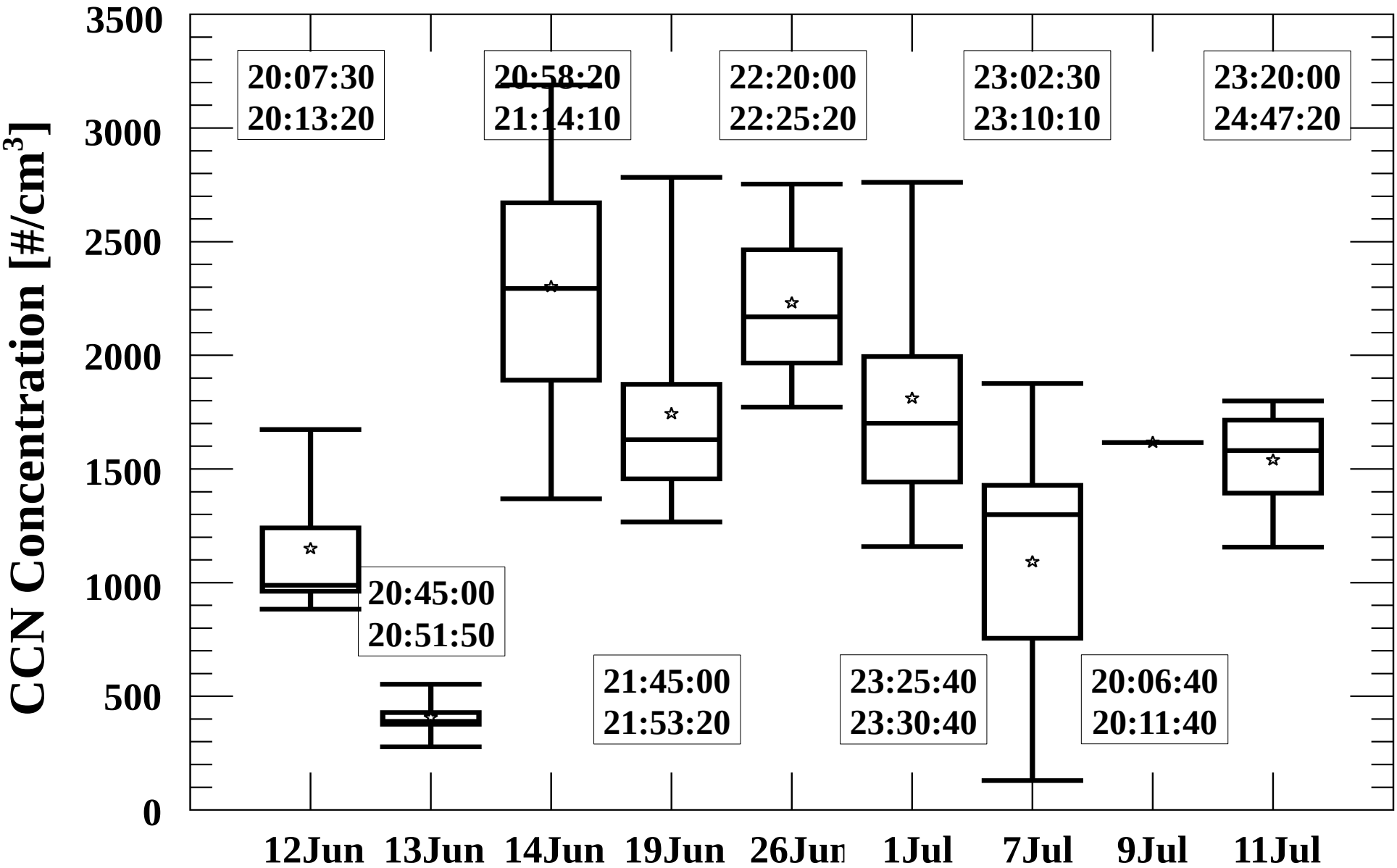


UWyo Cloud Base – North Dakota 2008 (2008 Calibration)



Statistical distributions near cloud base of 30 s, 0.6 % ambient supersaturation Cloud Condensation Nuclei (CCN) adjusted to standard temperature and pressure. Measurements are using the University of Wyoming (Uwyo) CCN counter. Star symbols are means, horizontal line is the 50th percentile, top of the box is the 75th percentile, bottom of the box is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.

UWyo Cloud Base – North Dakota 2008 (2011 Calibration)



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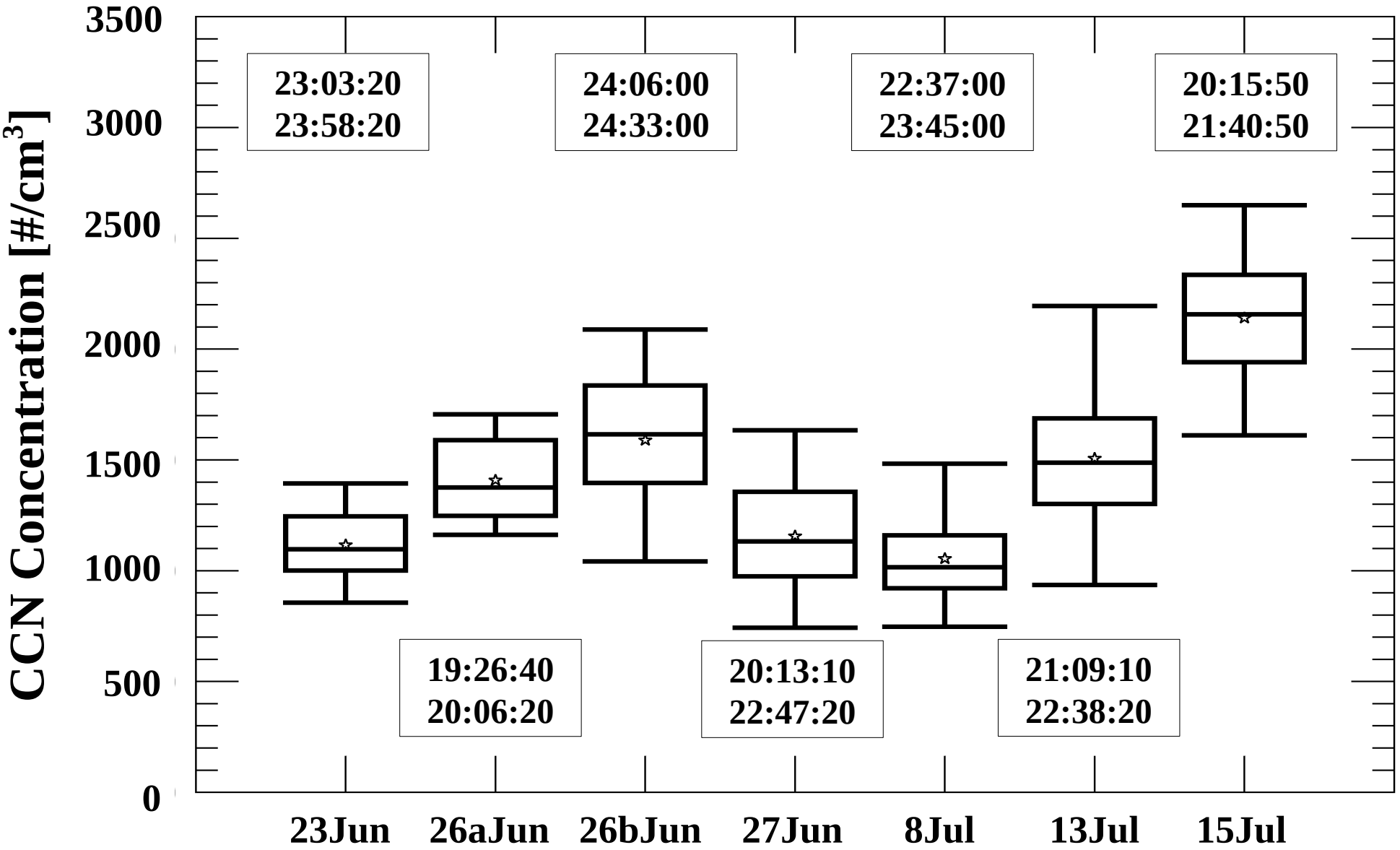
UWyo Cloud Base – North Dakota 2010 (2011 Calibration)



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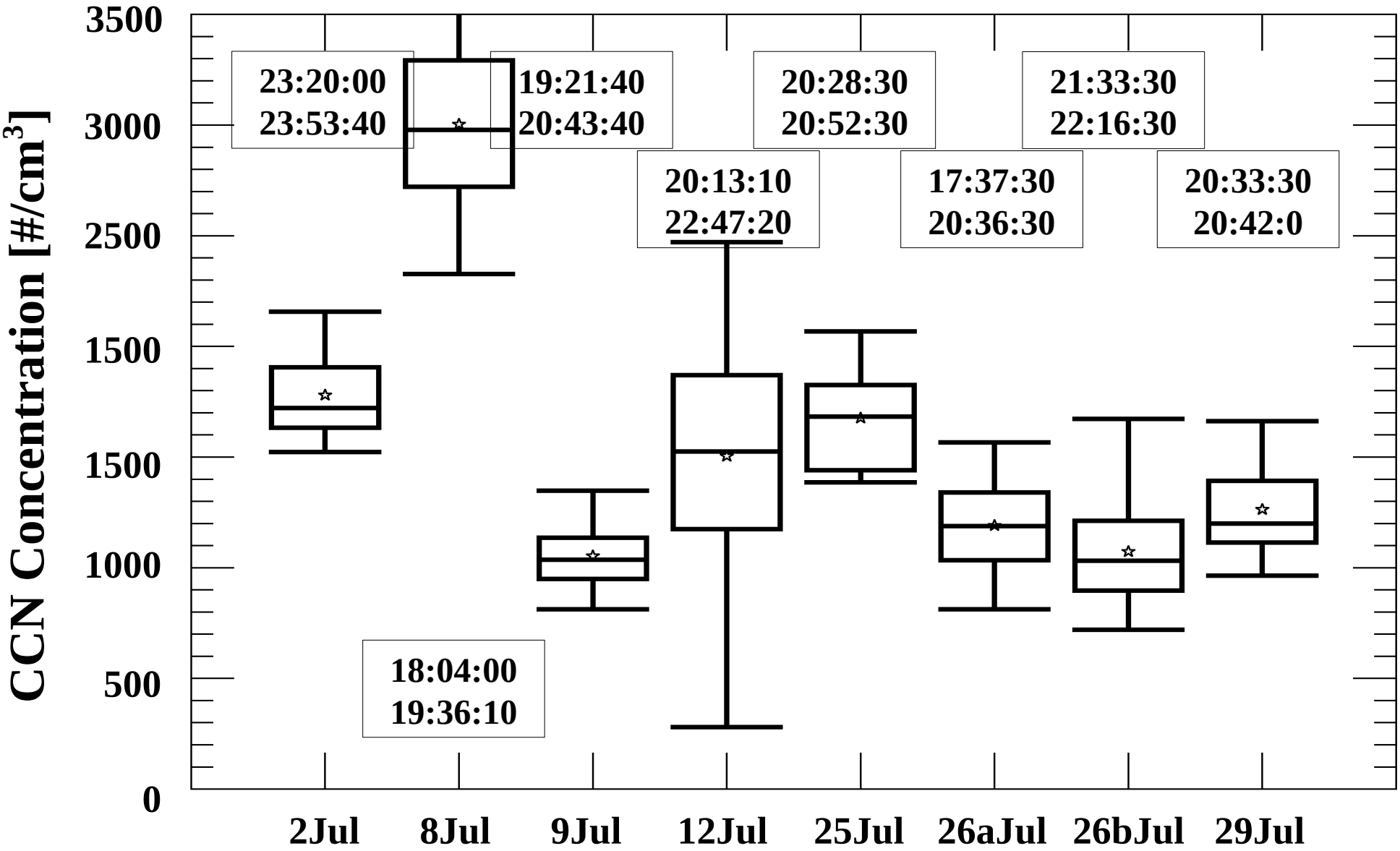

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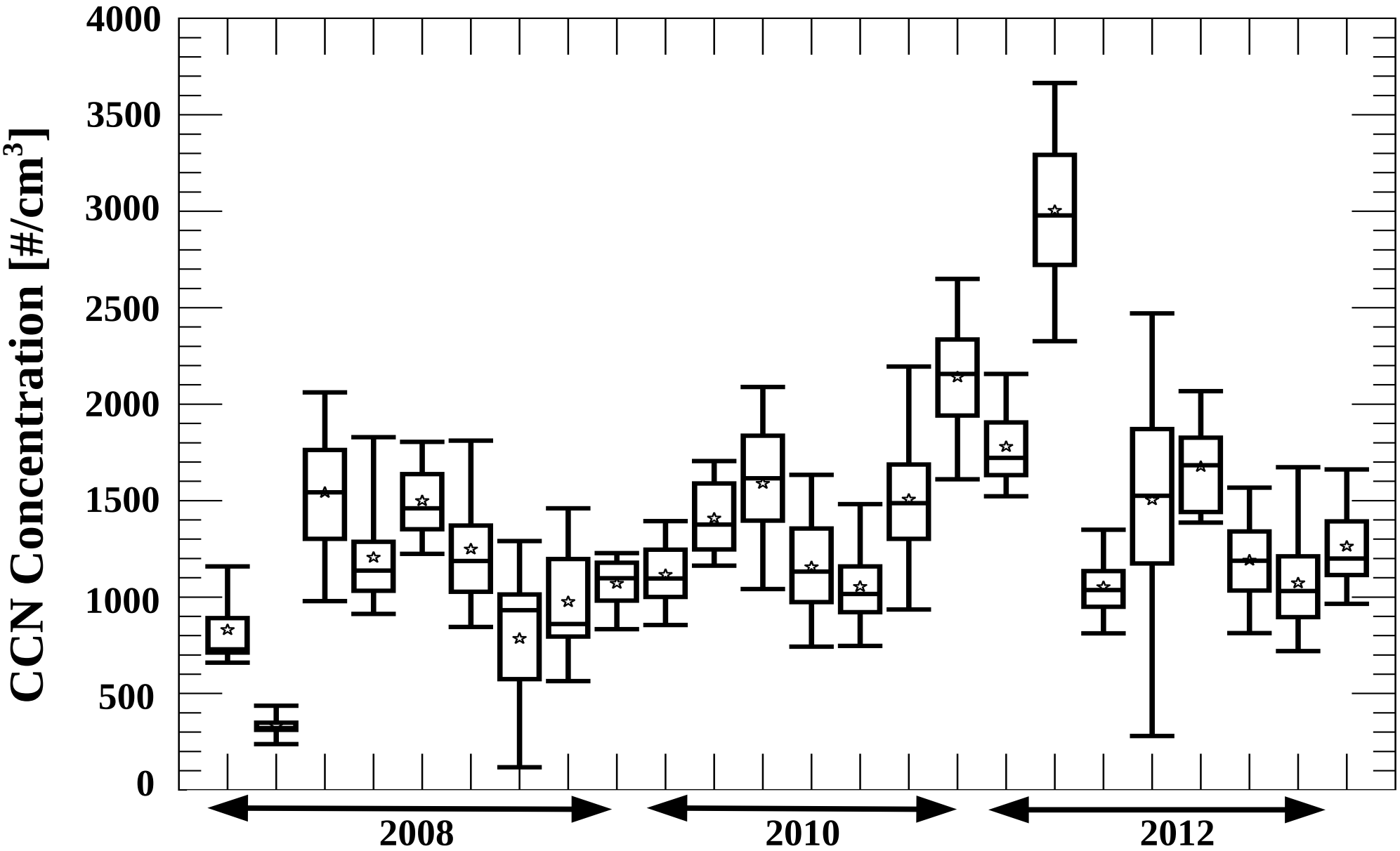
CCN Concentration – North Dakota (2011 Calibration)



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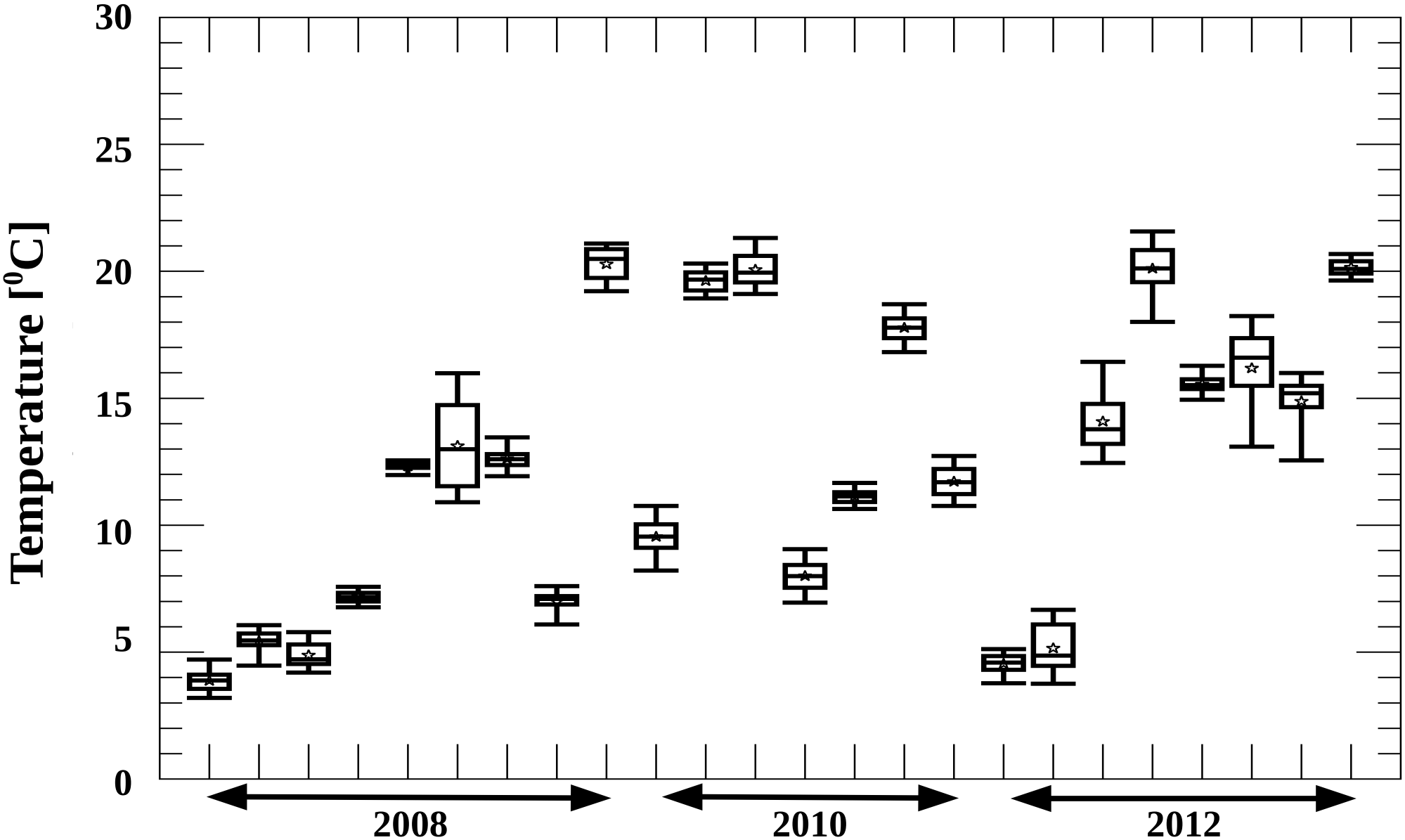
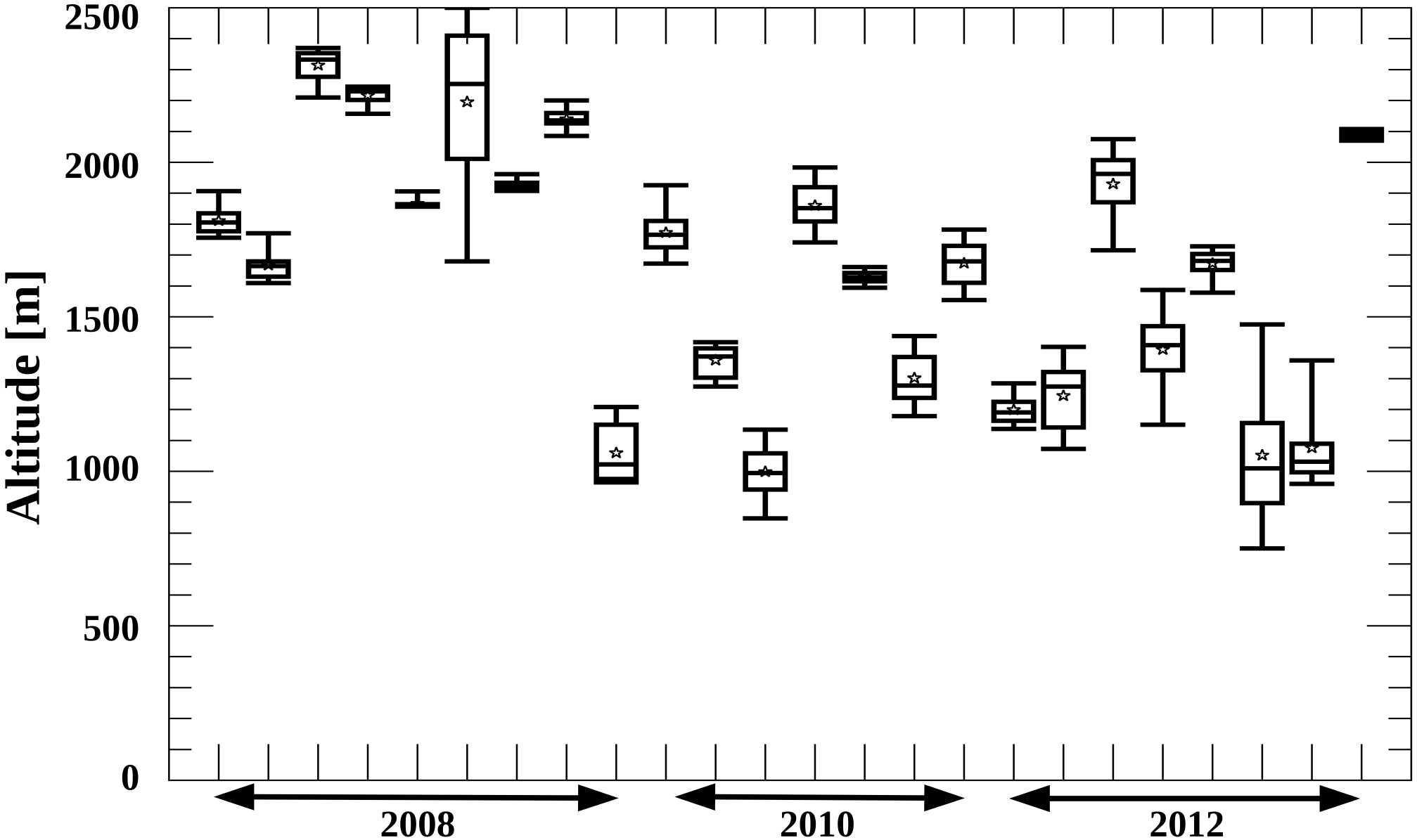
Cloud Base Temperature – North Dakota 2008, 2010, 2012



Statistical distributions near cloud base of ambient temperature [0C]. Star symbols are means, horizontal line is the 50th percentile, top of the box is the 75th percentile, bottom of the box is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.

Cloud Base Altitude – North Dakota 2008, 2010, 2012



Statistical distributions of cloud base height m]. Star symbols are means, horizontal line is the 50th percentile, top of the box is the 75th percentile, bottom of the box is the 25th percentile, and the top and bottom of the whiskers are the 95th and 5th percentiles, respectively.

Conclusions

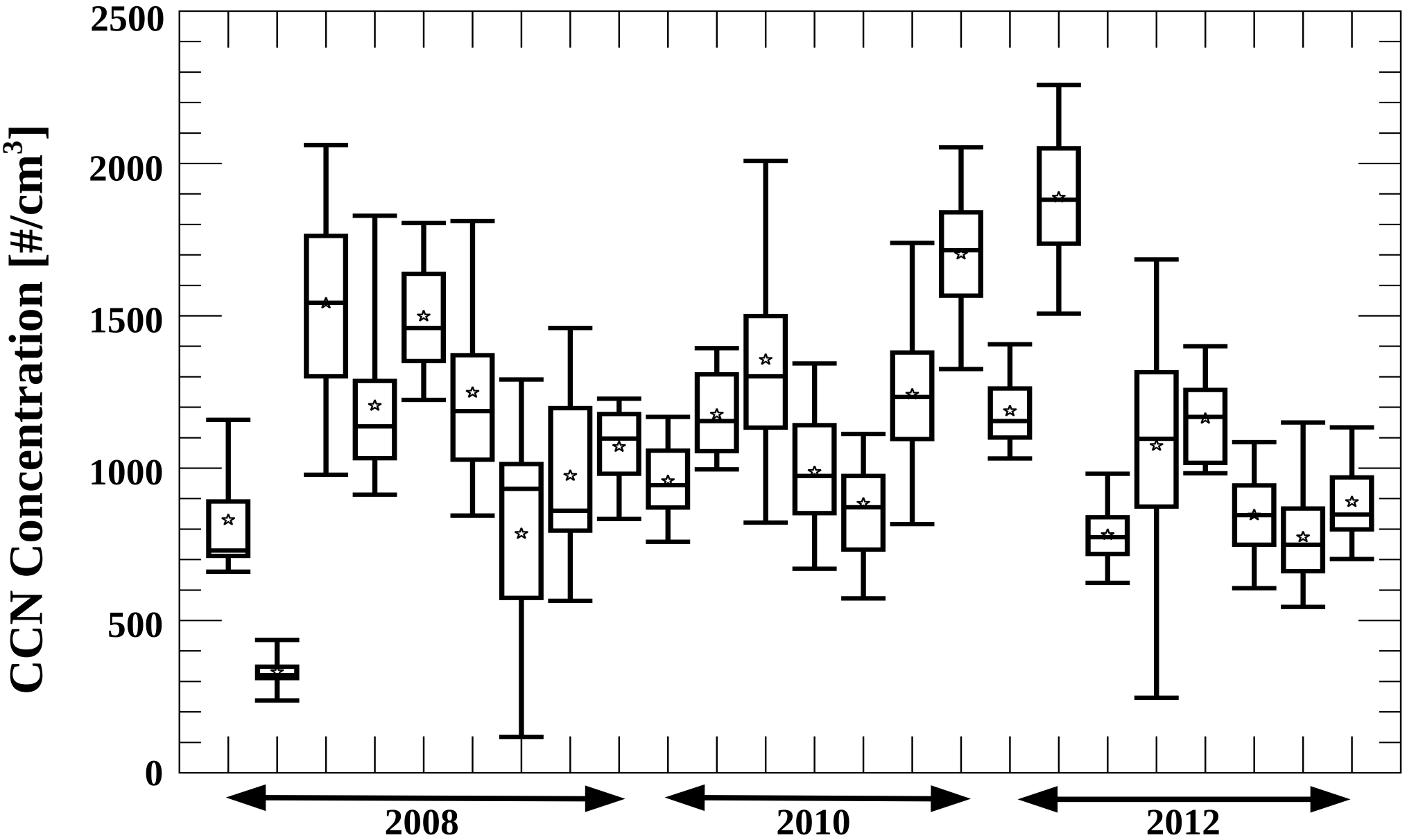
- Lots of care must be taken when processing airborne measurements.
- Statistical distribution on several days and during several seasons are important to understanding atmospheric conditions.
- Summer North Dakota Hygroscopic Seeding Conditions
  - 300 – 3,000 #/cm^{-3} cloud condensation nuclei
  - 4 – 20 ^{0}C cloud base temperature
  - 1,000 – 2,500 m cloud base altitude

Future Work

- Complete CCN calibration work.
- Article on the suitability of North Dakota for hygroscophic cloud seeding.

Questions

CCN Concentration – North Dakota (2008 Calibration)



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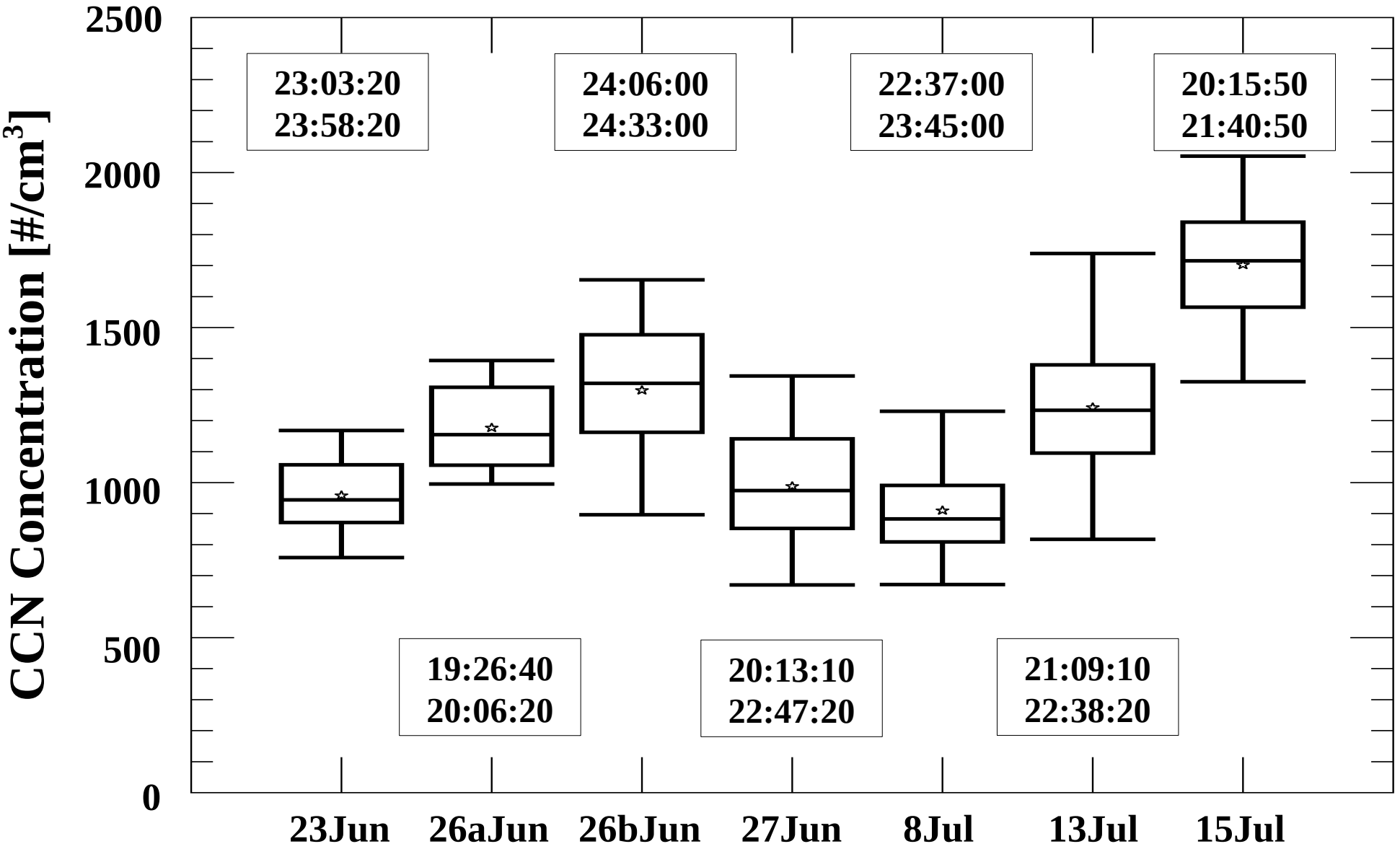

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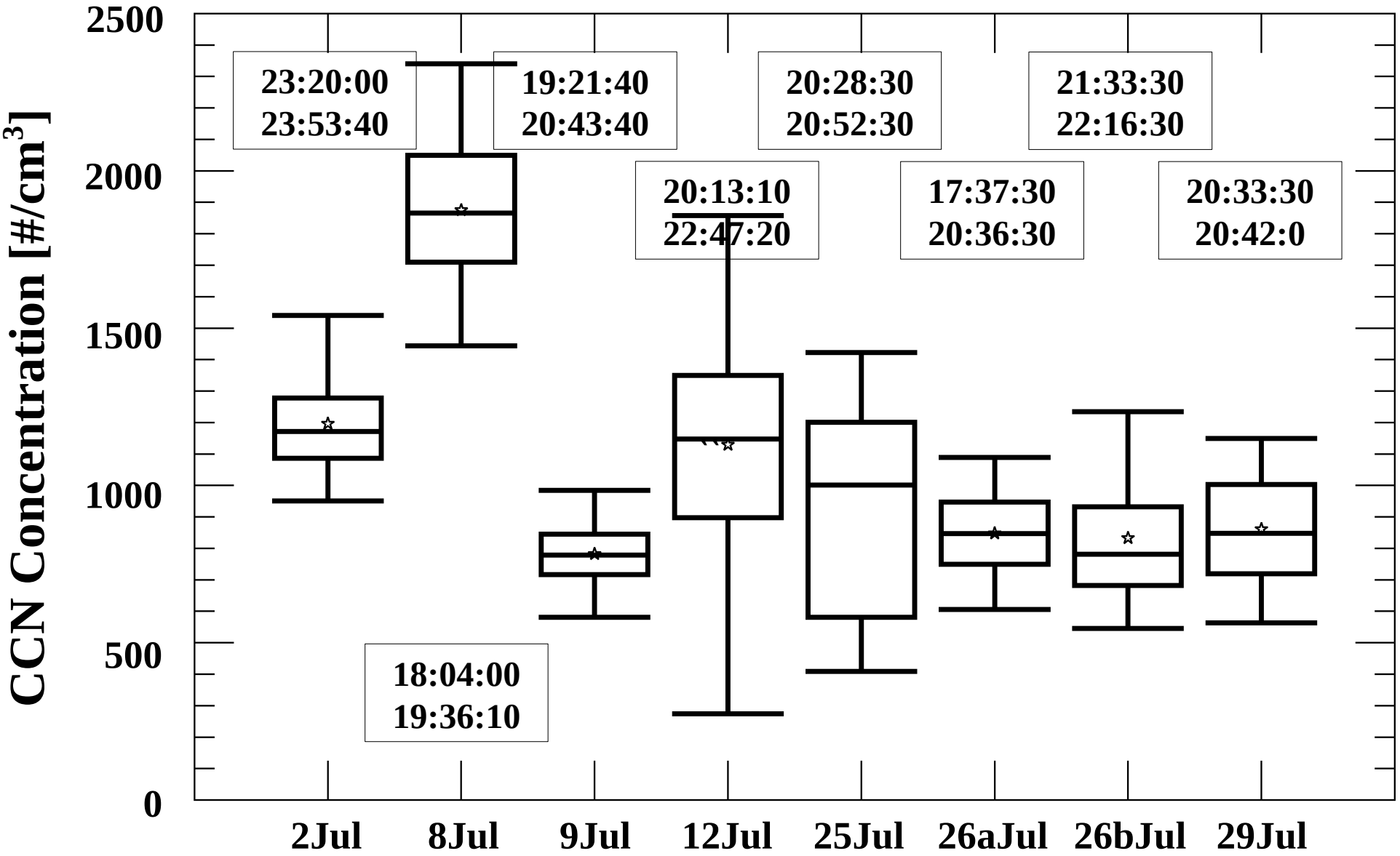
UWyo Cloud Base – North Dakota 2012 (2008 Calibration)



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