INVESTIGATING DIURNAL CYCLES IN A SPECTRUM OF CLOUD CONDENSATION NUCLEI

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OBJECTIVES

- Determine the presence of diurnal cycles in cloud condensation nuclei and test for correlation with other atmospheric measurements.
- Calibrate and setup various particulate matter instruments in preparation for data collection.
- Analyze data collected and automate the data collection and analysis using the ADPAA software used by UND.
- Challenge the results found by CCN modeling experiments using real time atmospheric data.

BACKGROUND

- Cloud condensation nuclei (CCN) are particles that form water droplets in a supersaturated environment.
- Aerosols that become CCN are dependent on many factors, explained by Kappa-Kohler theory [1].
- High intensity of UV light from the sun during the day typically results in large concentrations of small sized aerosols and ozone.

METHODOLOGY

- Determine the CCN counter's average time to adjust temperature gradient, using a constant flow of ammonium sulfate aerosol.
- Calibrate the CCN counter using a constant flow of ammonium sulfate aerosol, an electrostatic classifier, and an x-ray neutralizer.
- Data collected over a period of 6 days using instruments in the Clifford Hall 423 lab at the University of North Dakota in Grand Forks, North Dakota (see setup figure to the right).

RESULTS

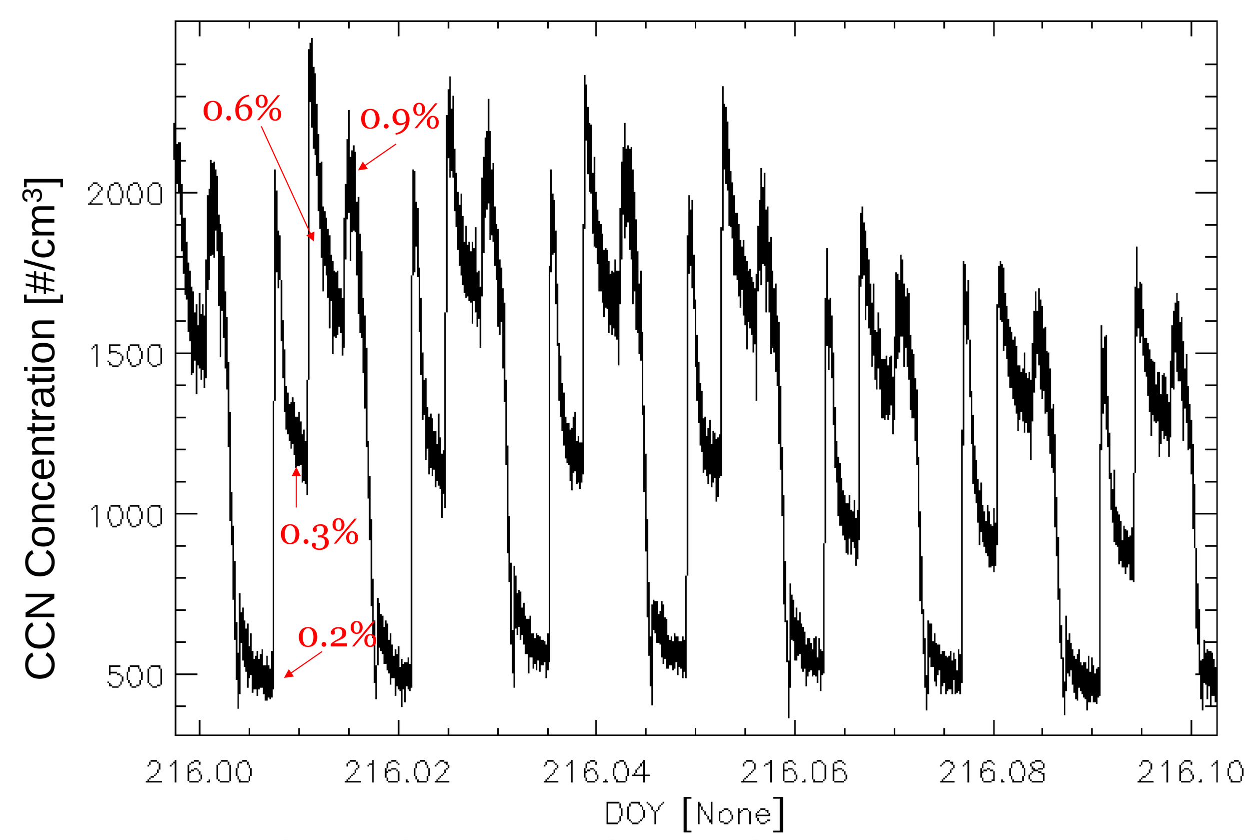


Figure 1. Plow showing the ambient CCN concentration over 2 hours. The CCN concentration is at 4 supersaturations (red text), corresponding to different particle size ranges. Assuming ammonium sulfate, supersaturations of 0.2, 0.3, 06, and 0.9 correspond to 80, 60, 40, 20 nm, respectively. The day of year (DOY) is using UTC time.

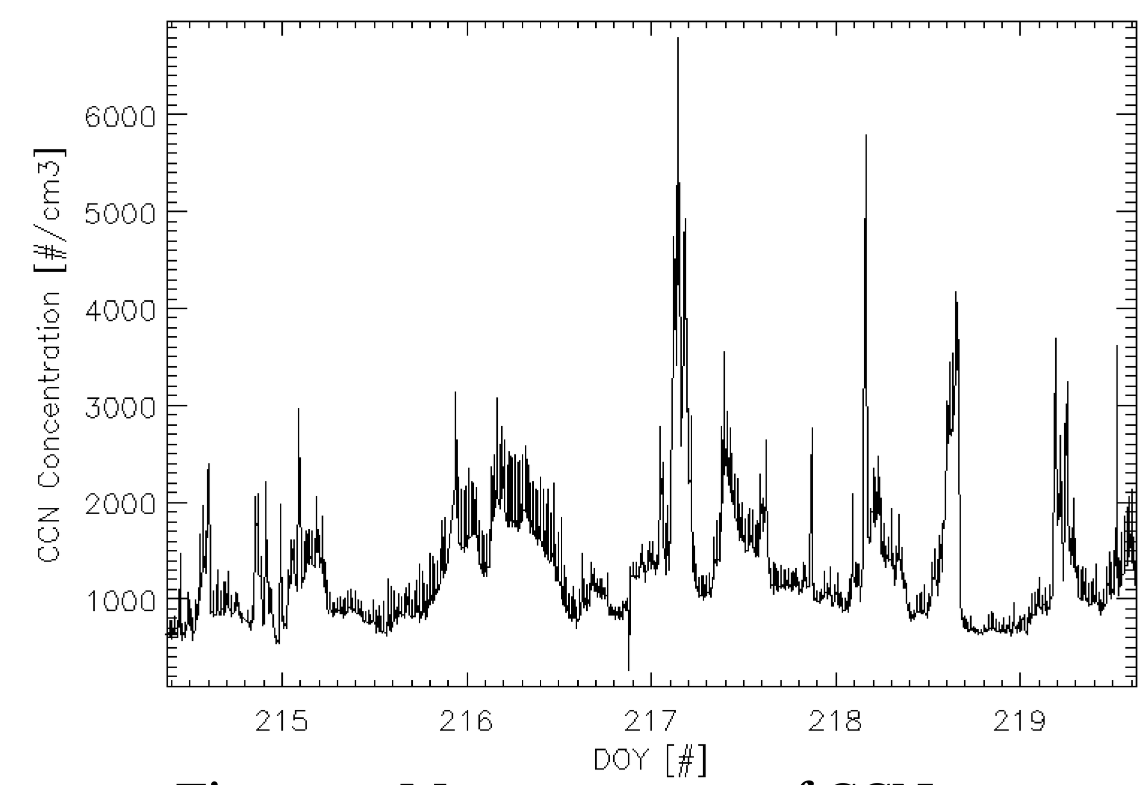
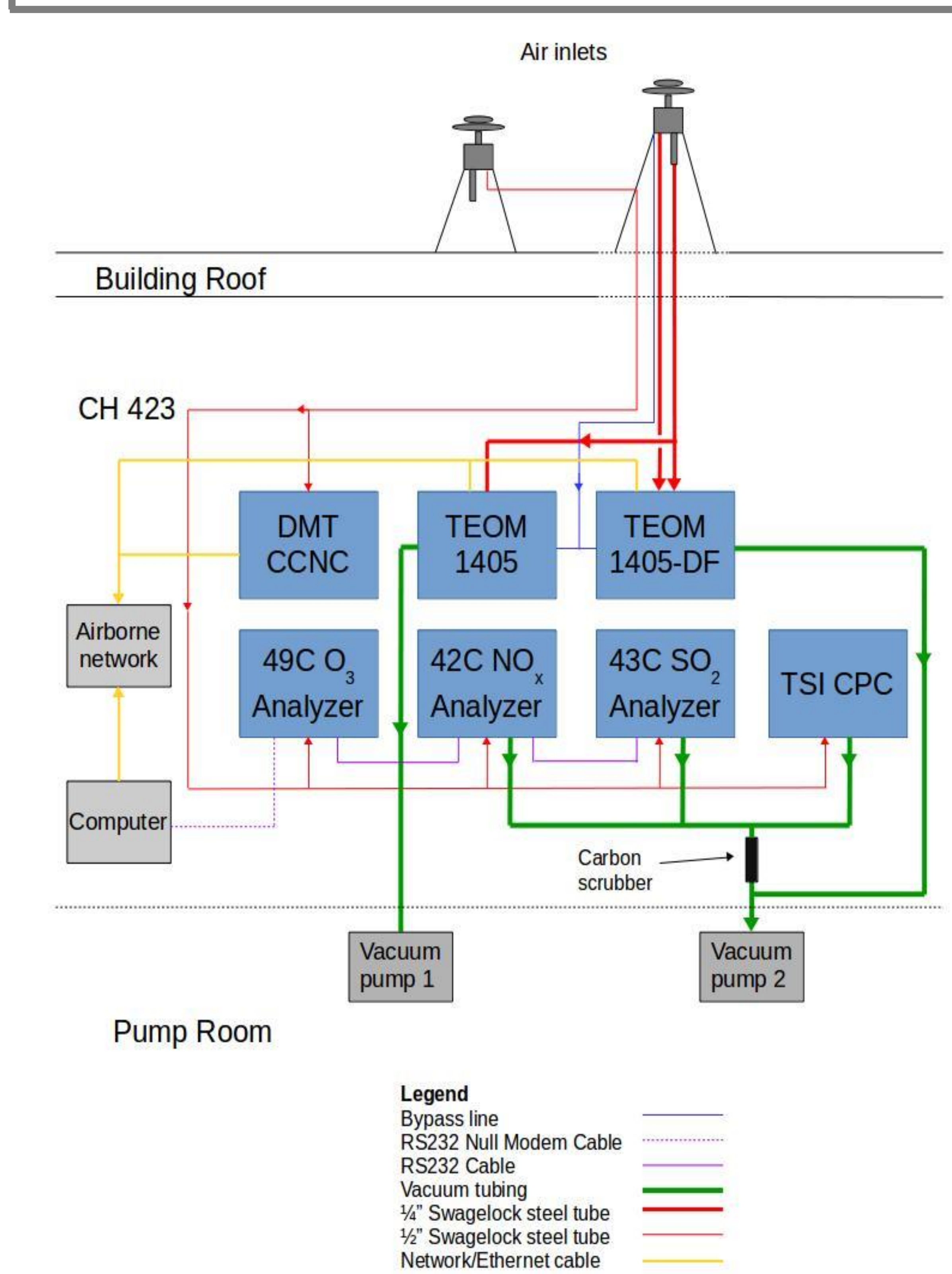


Figure 2. Measurements of CCN counter concentration at 0.9% supersaturation over 5 days, averaged every 30 seconds



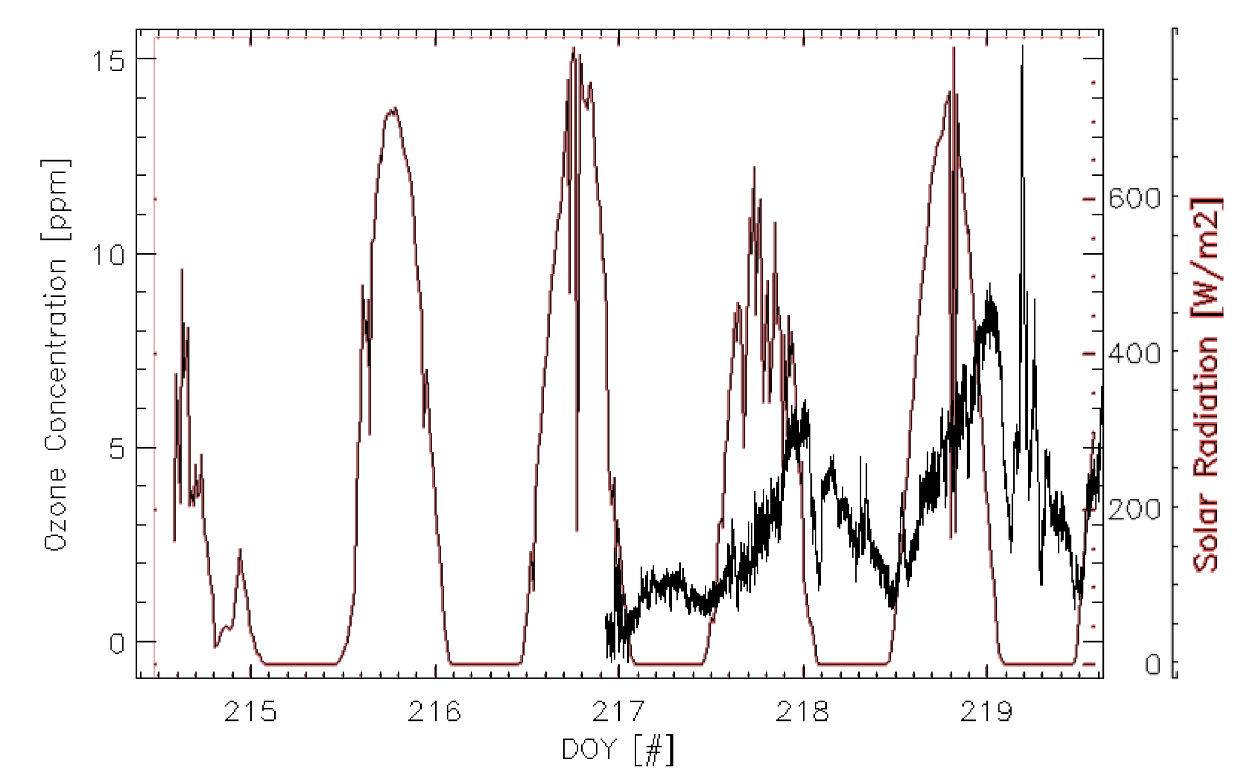


Figure 3. Time series plot of Ozone concentration and Solar Radiation[2] over 5 days.

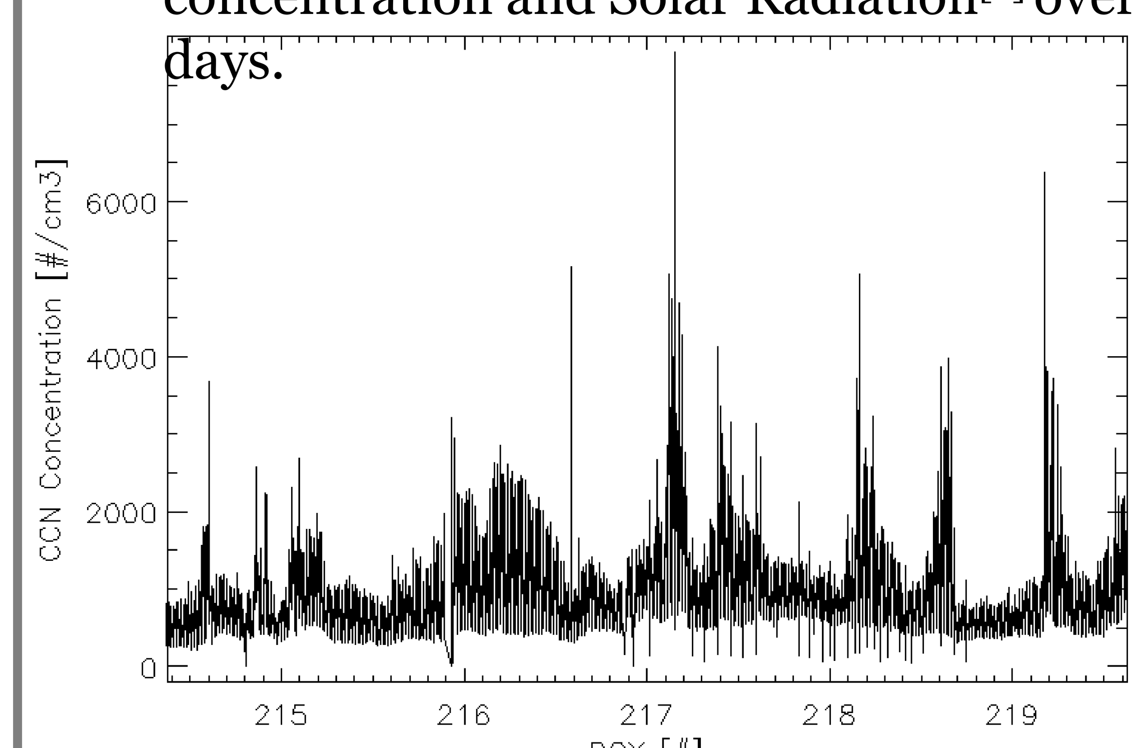
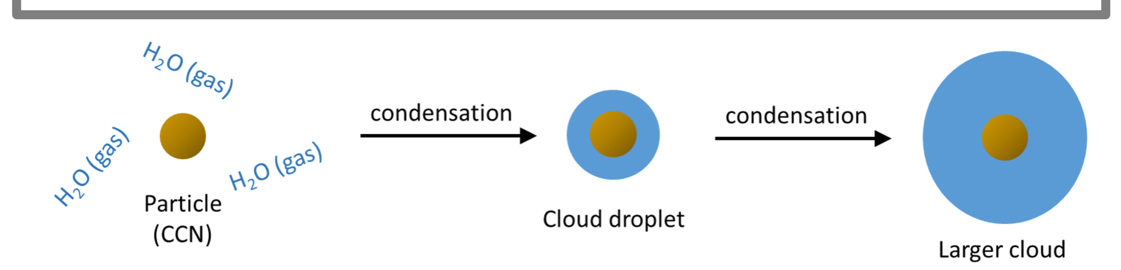


Figure 4. Measurement of CCN counter concentration at 0.2% supersaturation over 5 days

CONCLUSIONS

- Overall there is a noticeable change in CCN throughout the day and night cycle
- There is a strong correlation between ozone and solar radiation.
- There are various other unaccounted factors that show a strong presence in the CCN count data, such as passing automobiles and trains, and cloud coverage.
- A large sample of data is needed to create a proper model of the current atmosphere in Grand Forks.
- Further work would entail an automated process allowing for various months of continuous data.



http://www.physics.uu.se/research/molcond/ongoingresearch/molecules-and-liquids/aerosols/

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REFERENCES

1. Petters, M. D.; Kreidenweis, S. M. *Atmospheric Chemistry and Physics* 2007, *7* (8), 1961–1971.
2. Emerado ND010: Grand Forks August 7, 2017.