

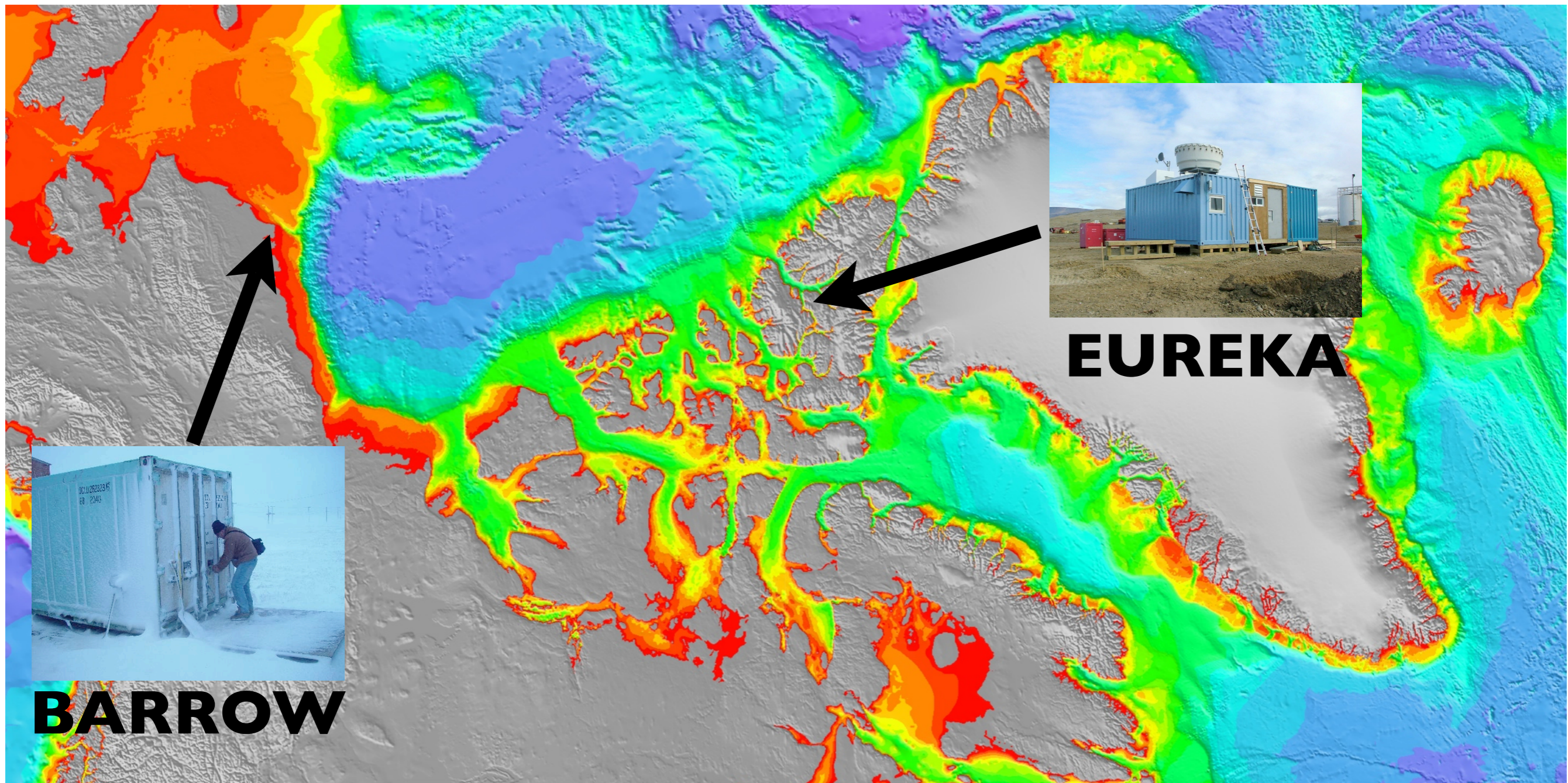
# A multi-platform study towards the understanding of mixed-phase cloud processes in the Arctic

**Gijs de Boer**

Edwin W. Eloranta, Gregory J. Tripoli

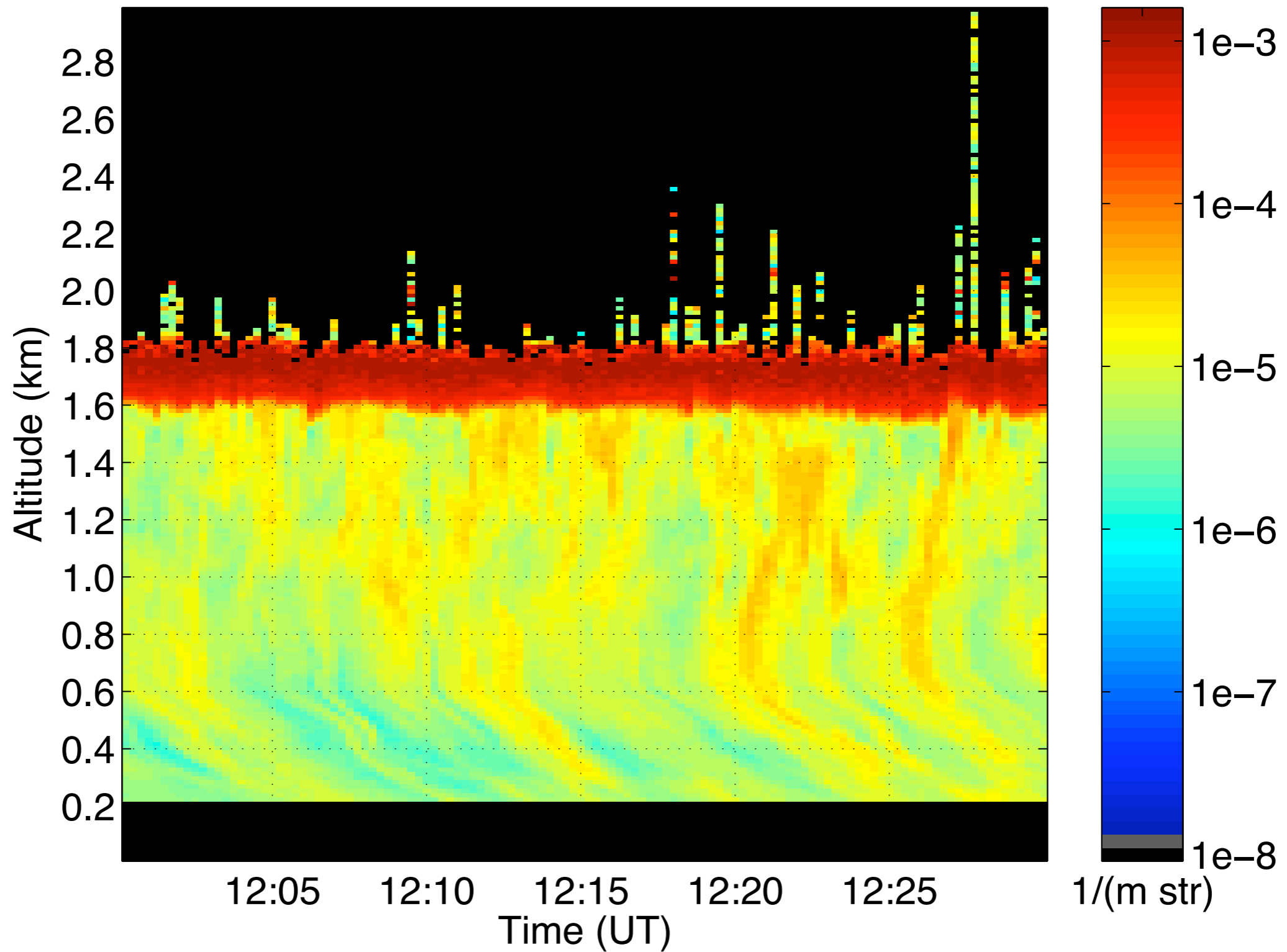


# Arctic Stratus

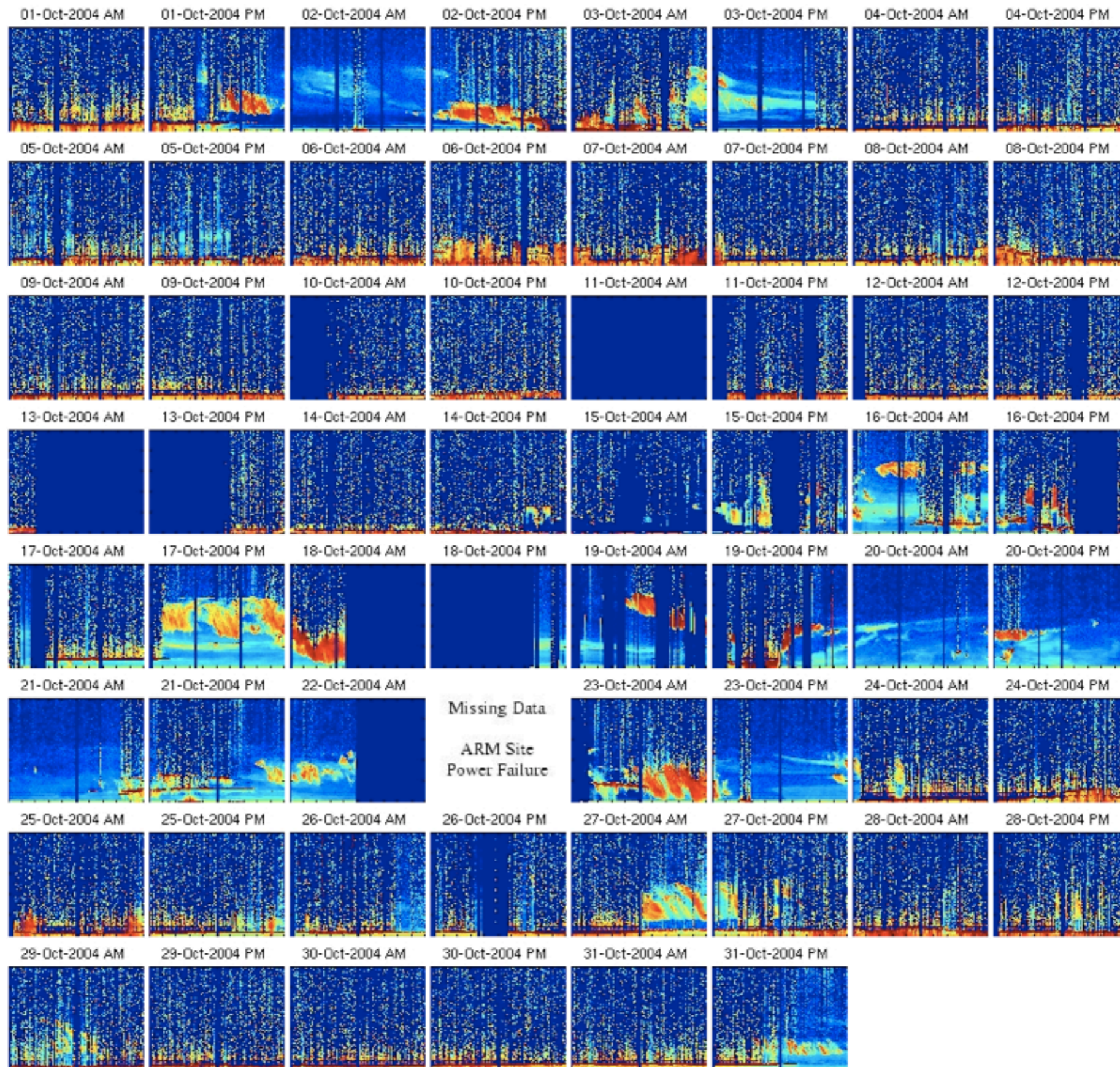


# Arctic Stratus

Lidar backscatter cross section (Masked values shown in black and white)



# Arctic Stratus



# Arctic Stratus

## Frequency of cloud presence:

### - From AHSRL/MMCR:

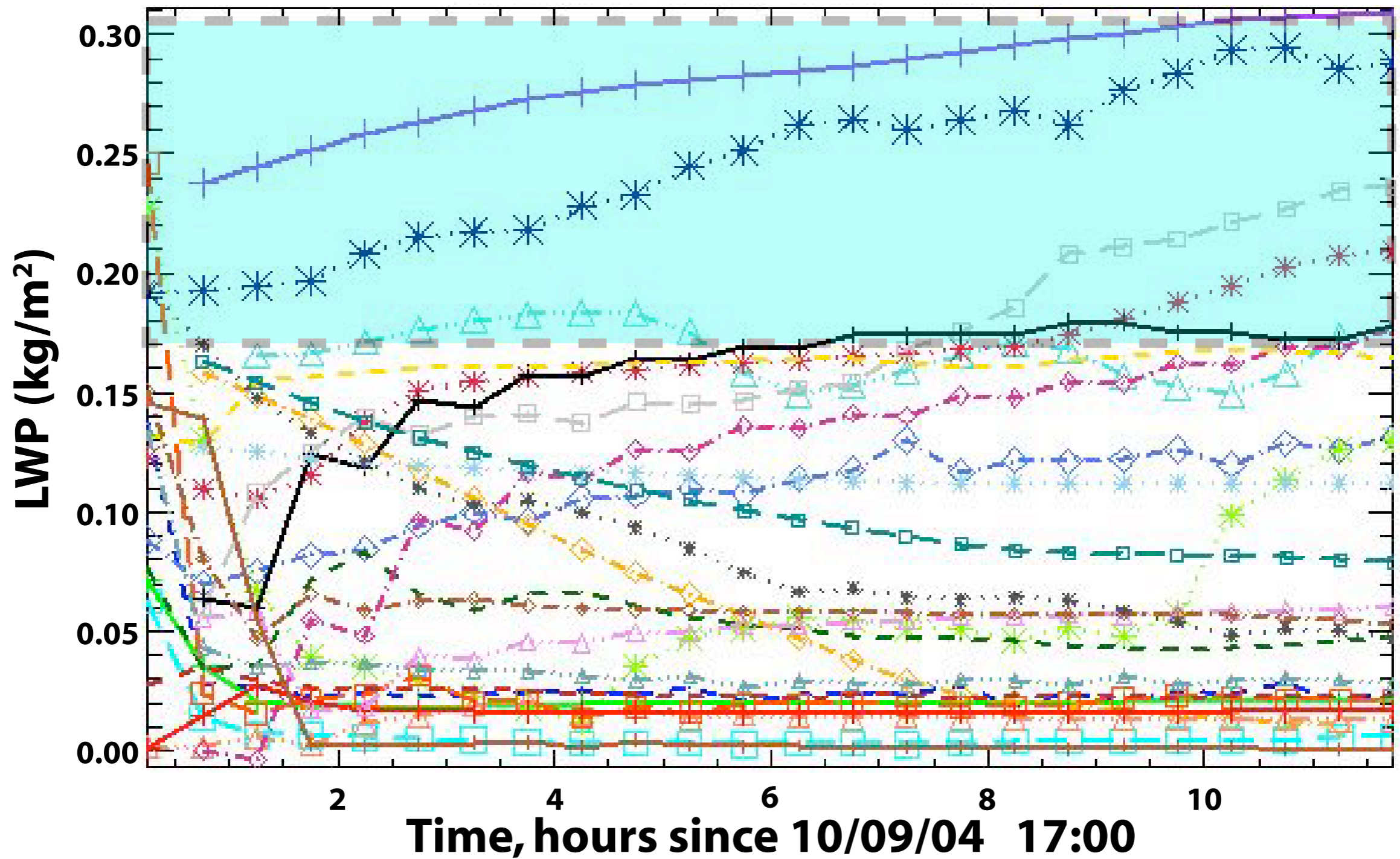
- Eureka: over 1700 30 minute cases for September 2005-December 2006.
- M-PACE: over 500 30 minute cases for mid September-mid November, 2004.

### - From Others:

- SHEBA: 48% occurrence in May (Rogers et al., 2001)
- Low altitude stratus frequency of up to 70% during transitional seasons (Curry et al., 1996; Herman and Goody, 1976)

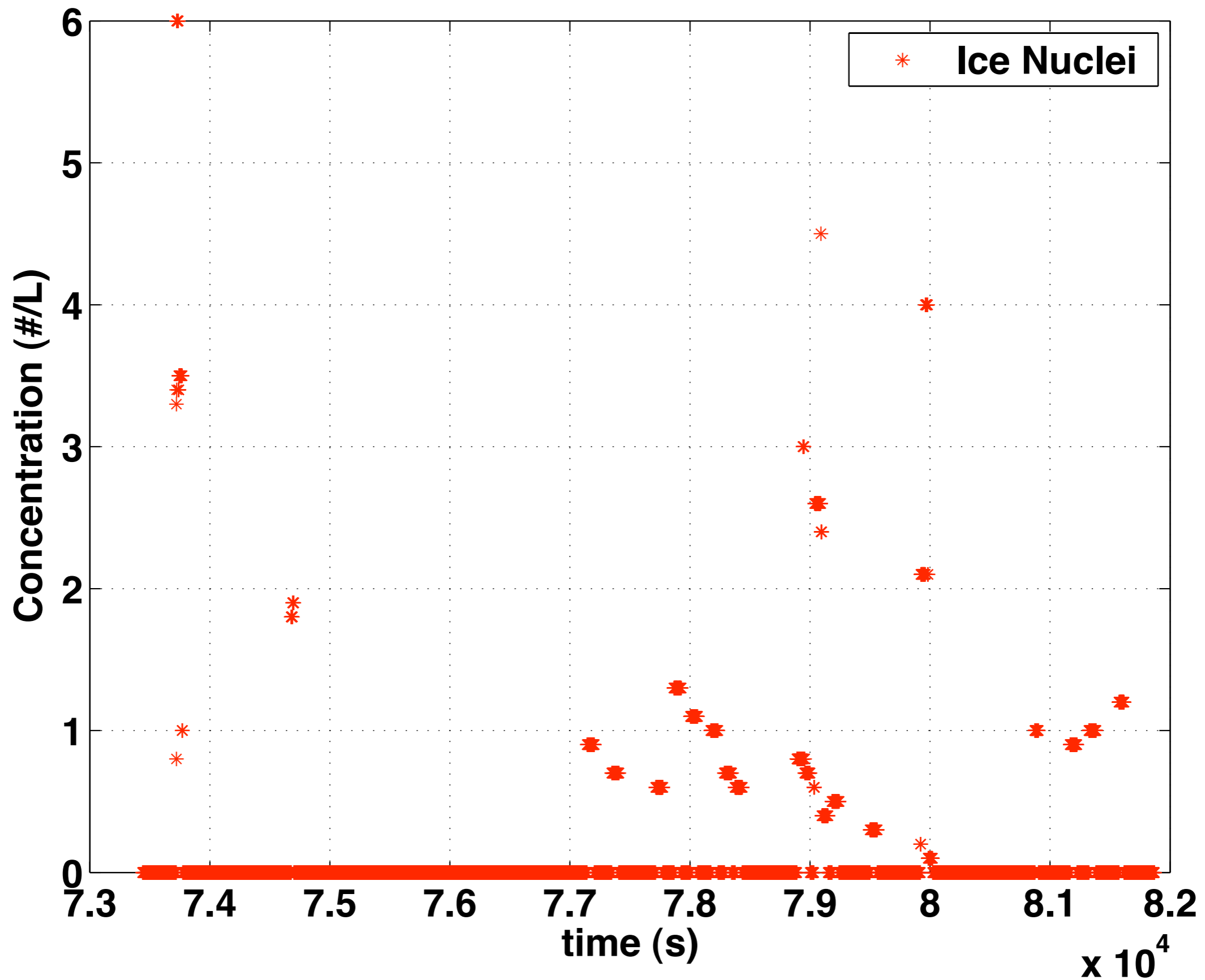
# Arctic Stratus

## Cloud liquid water path, Case: b1

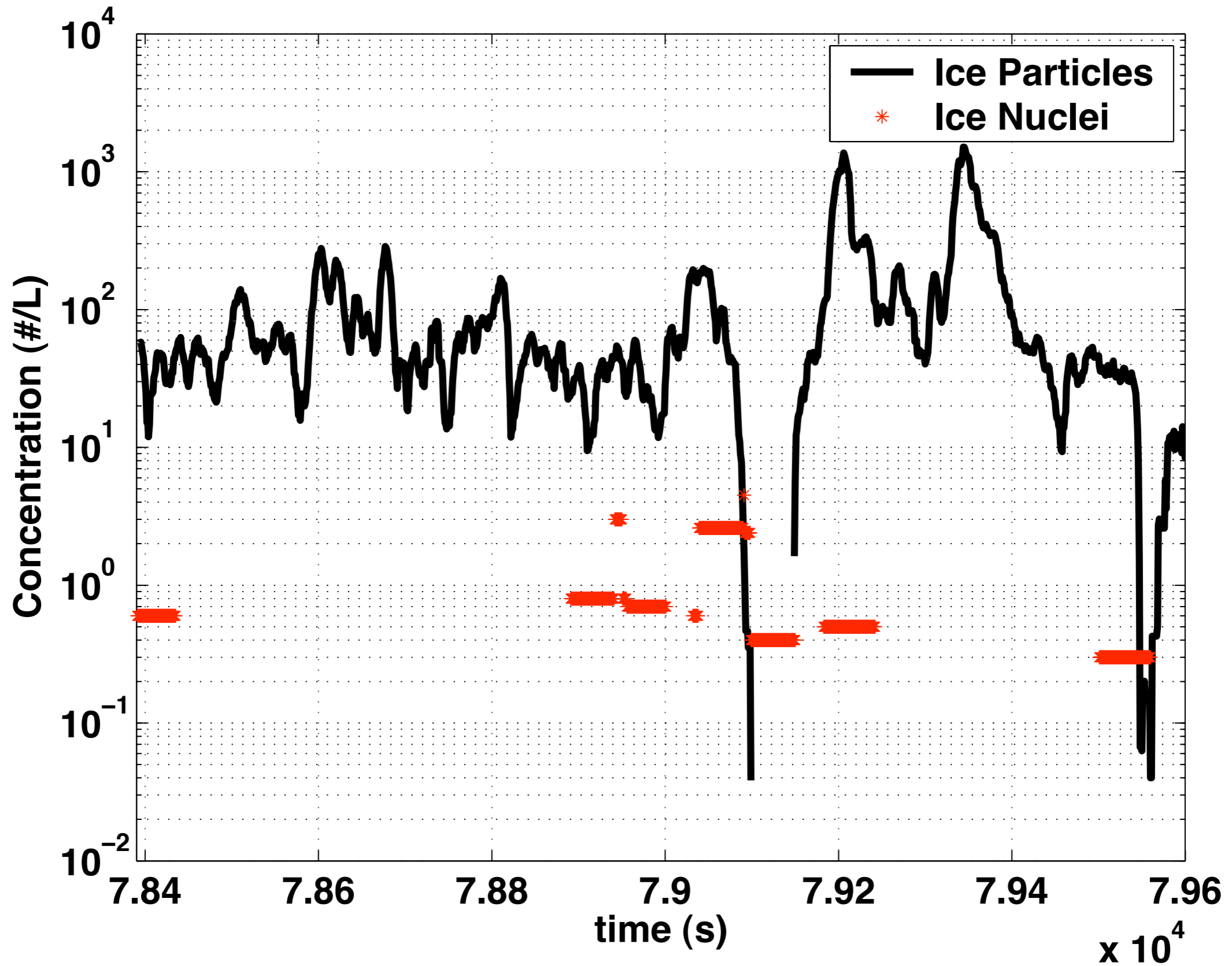


(From ARM Model Intercomparison, Klein et al., 2008)

# Ice Formation



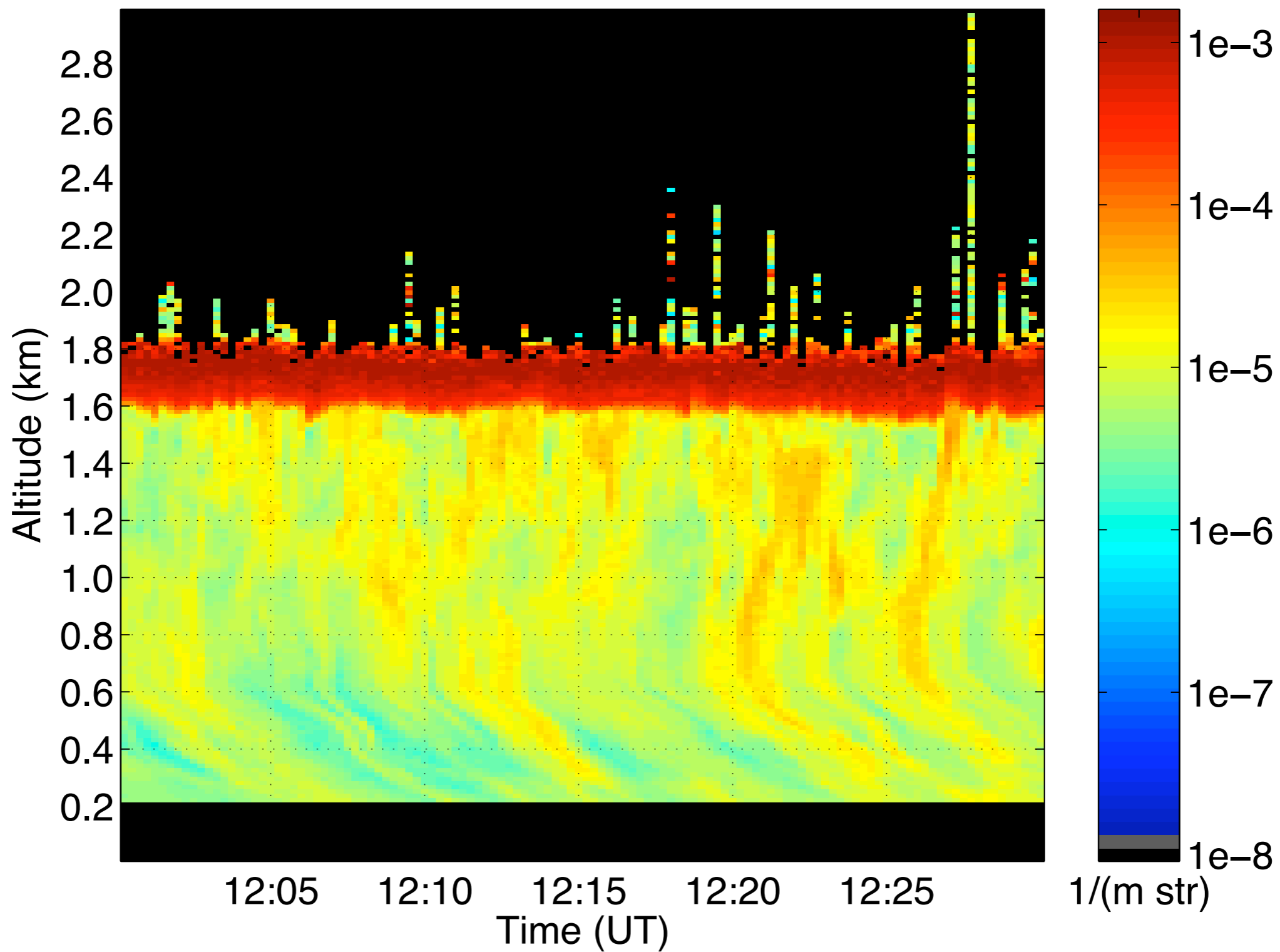
# Ice Formation



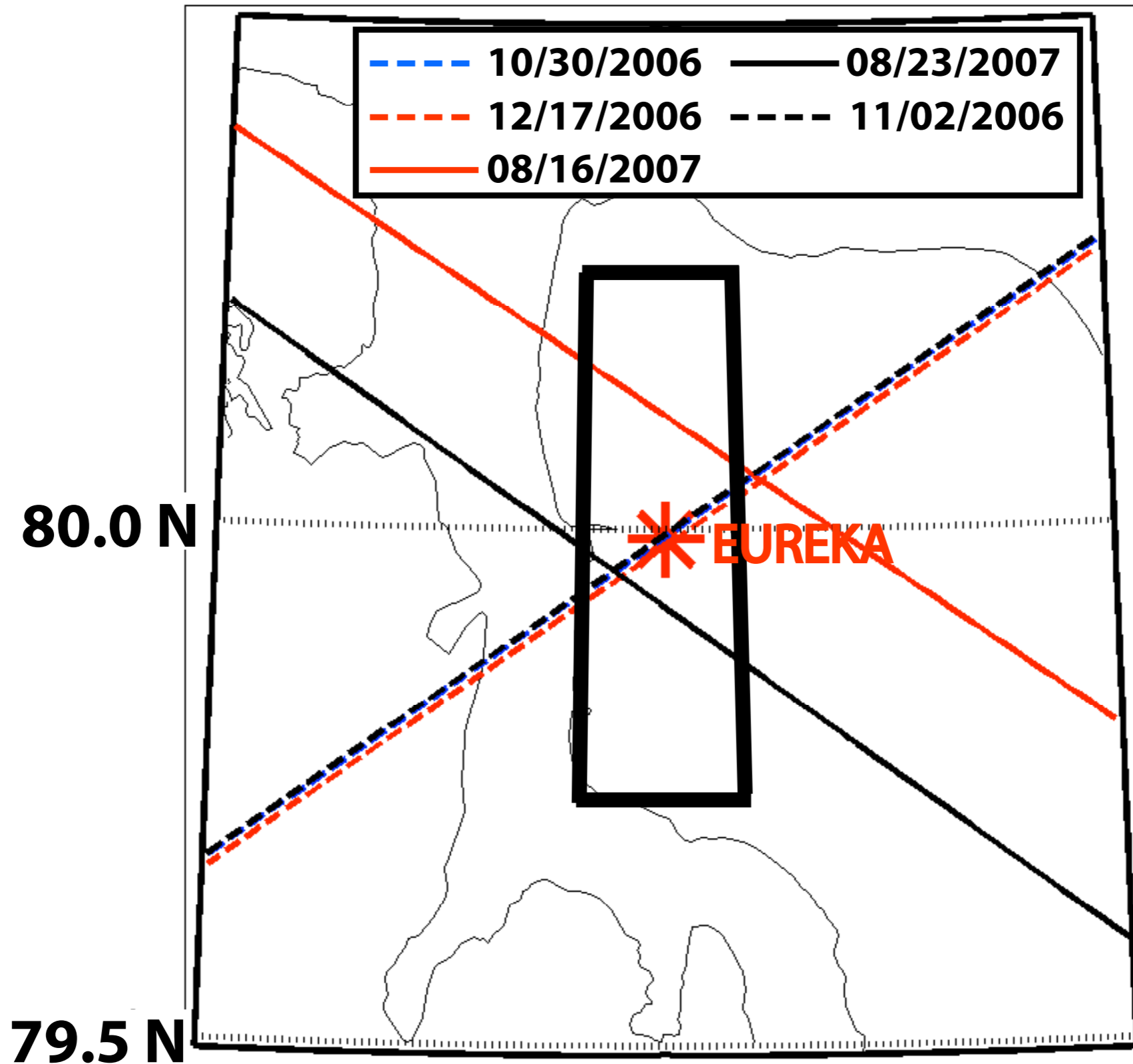


# Ice Formation

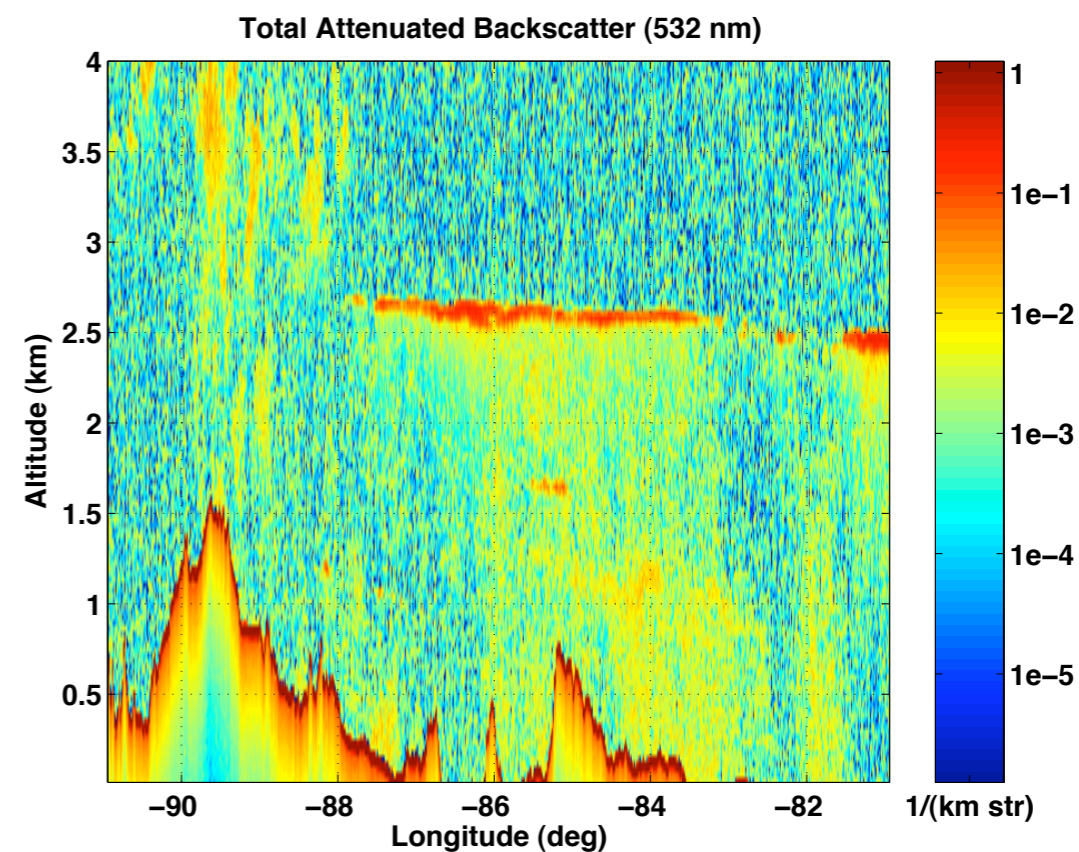
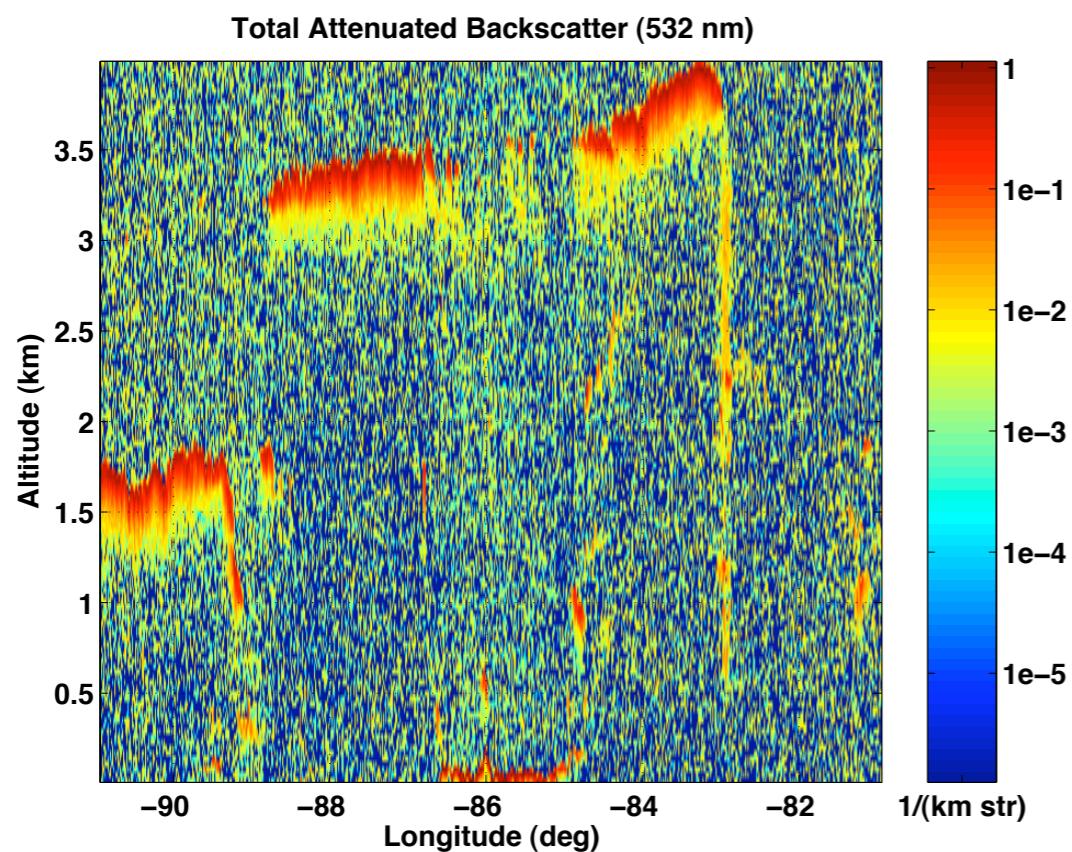
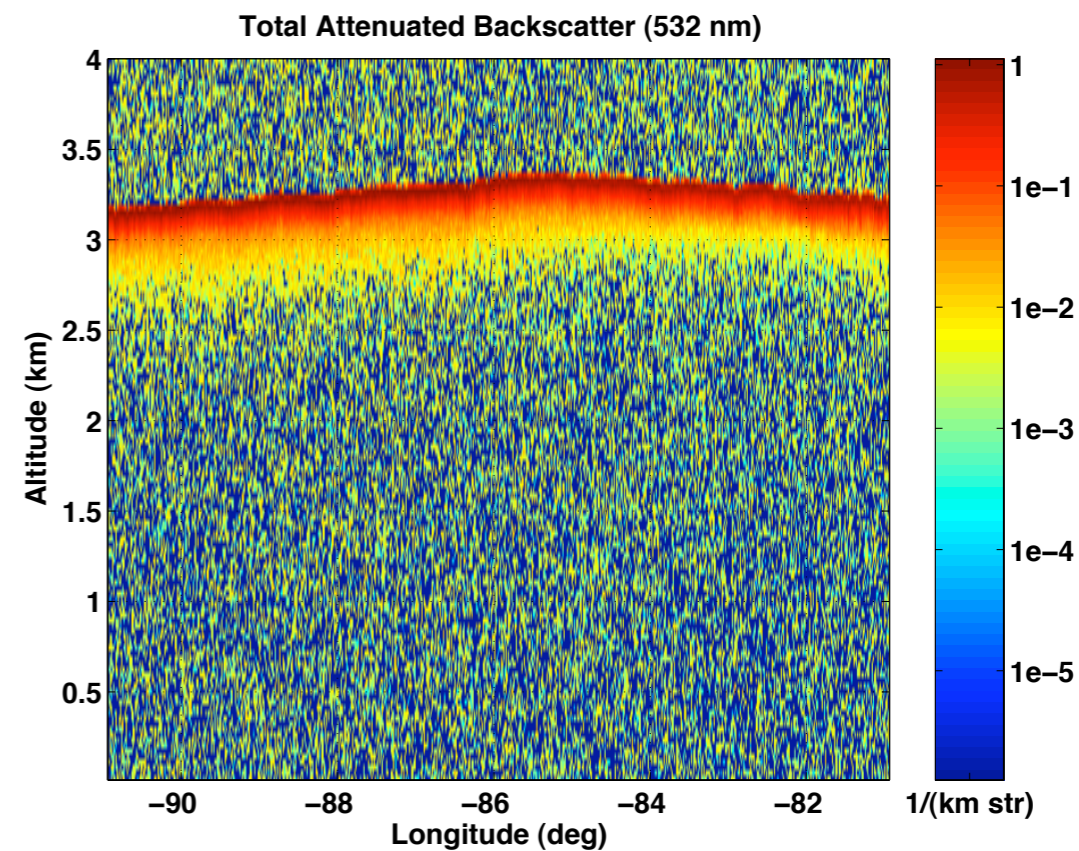
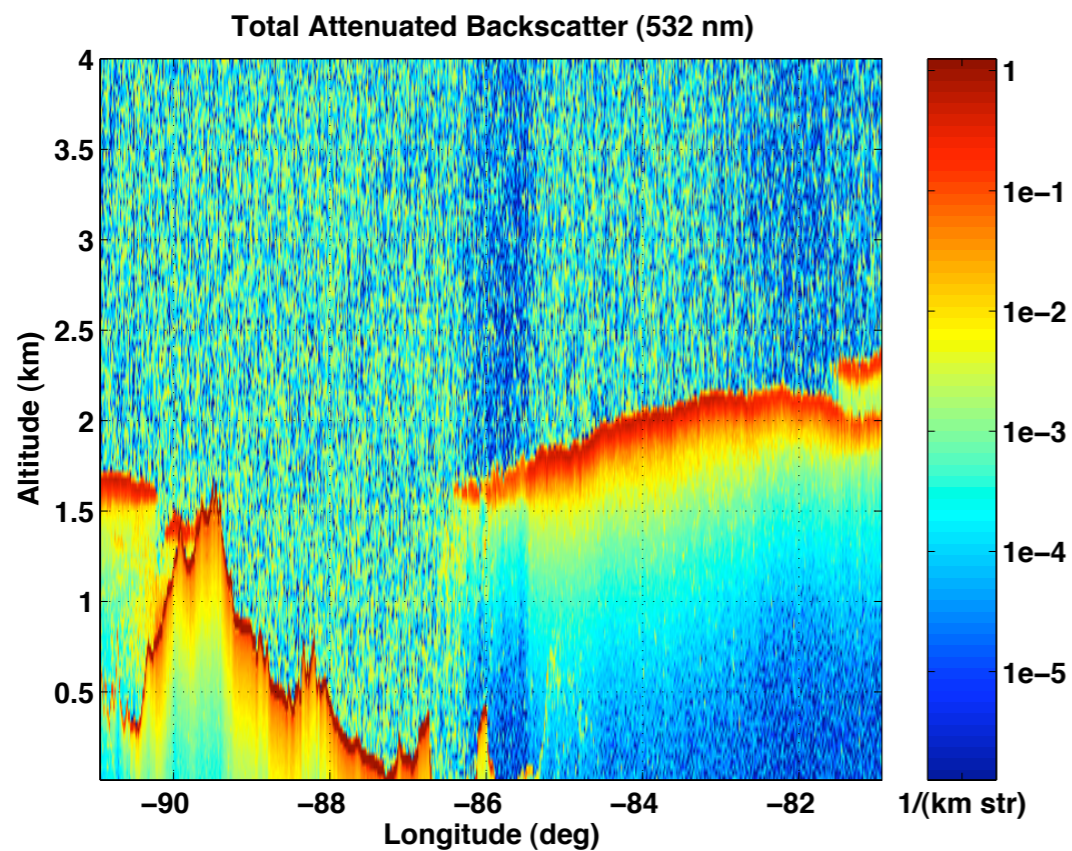
Lidar backscatter cross section (Masked values shown in black and white)



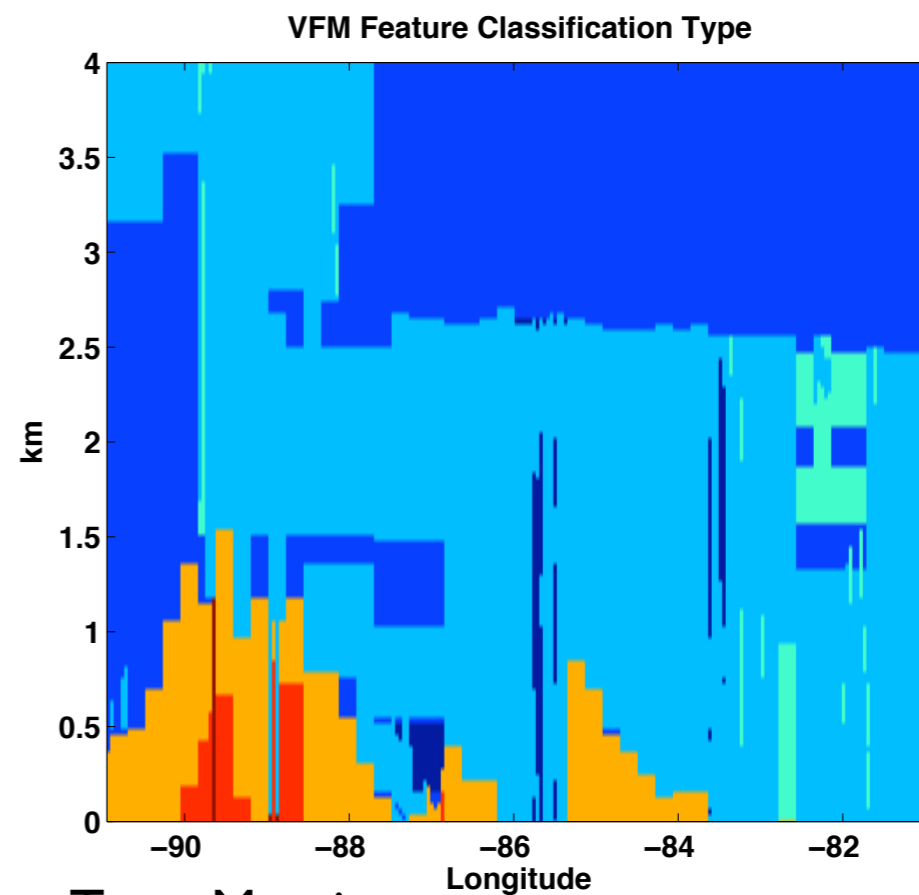
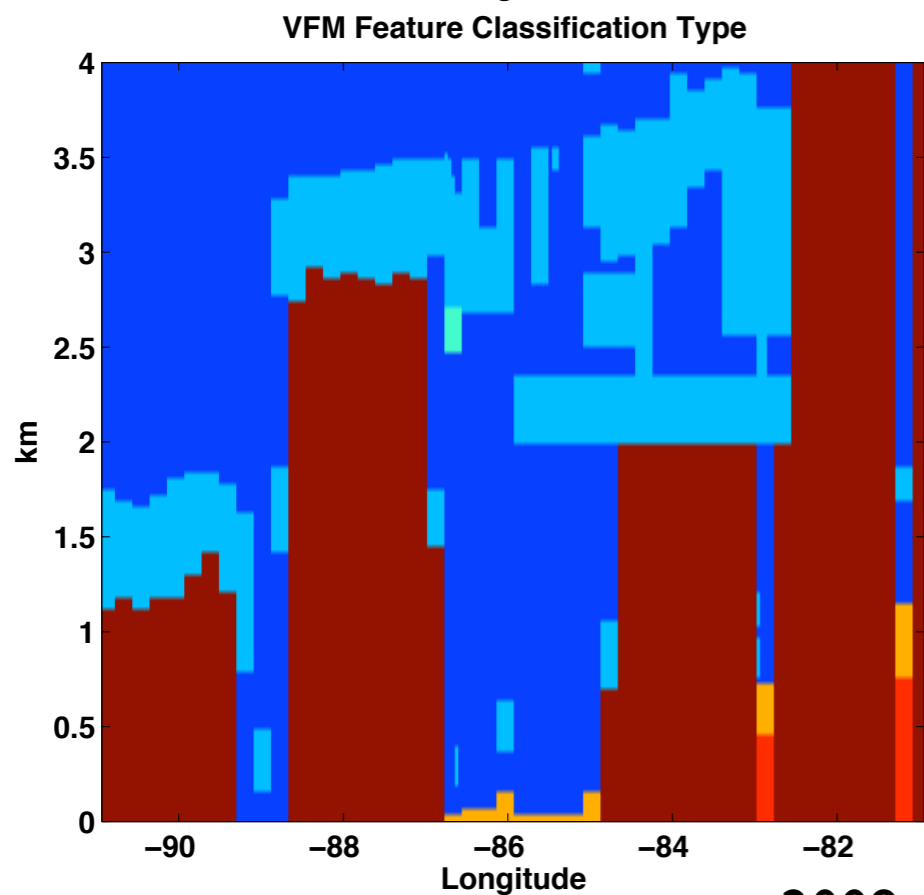
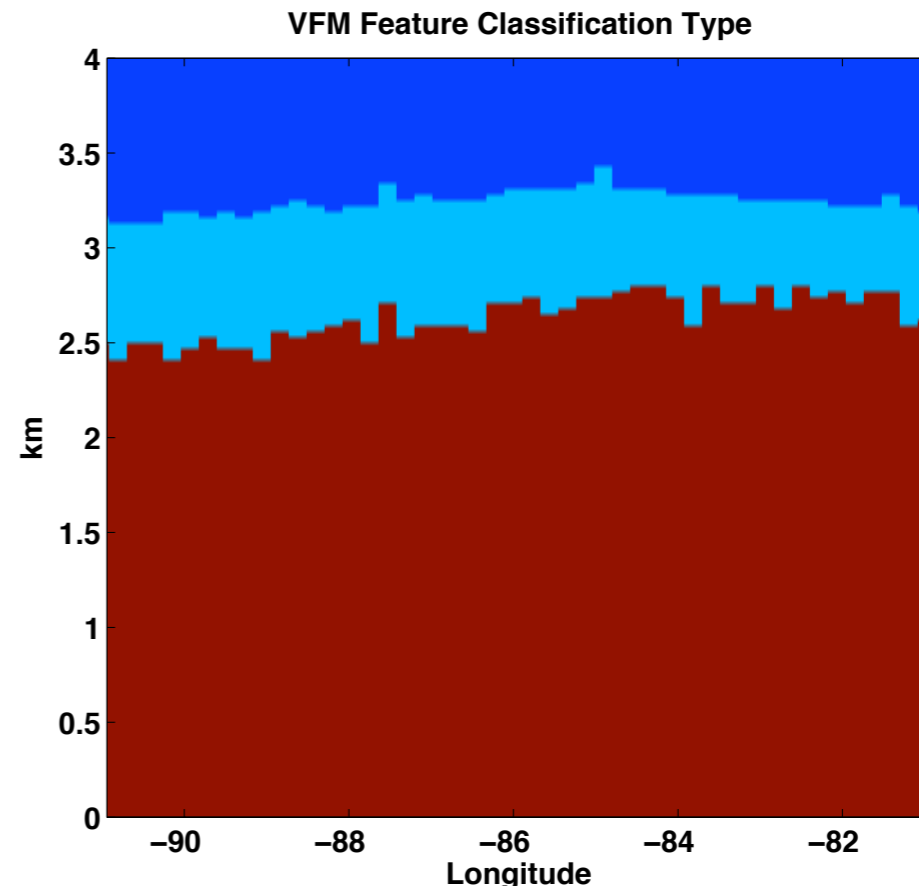
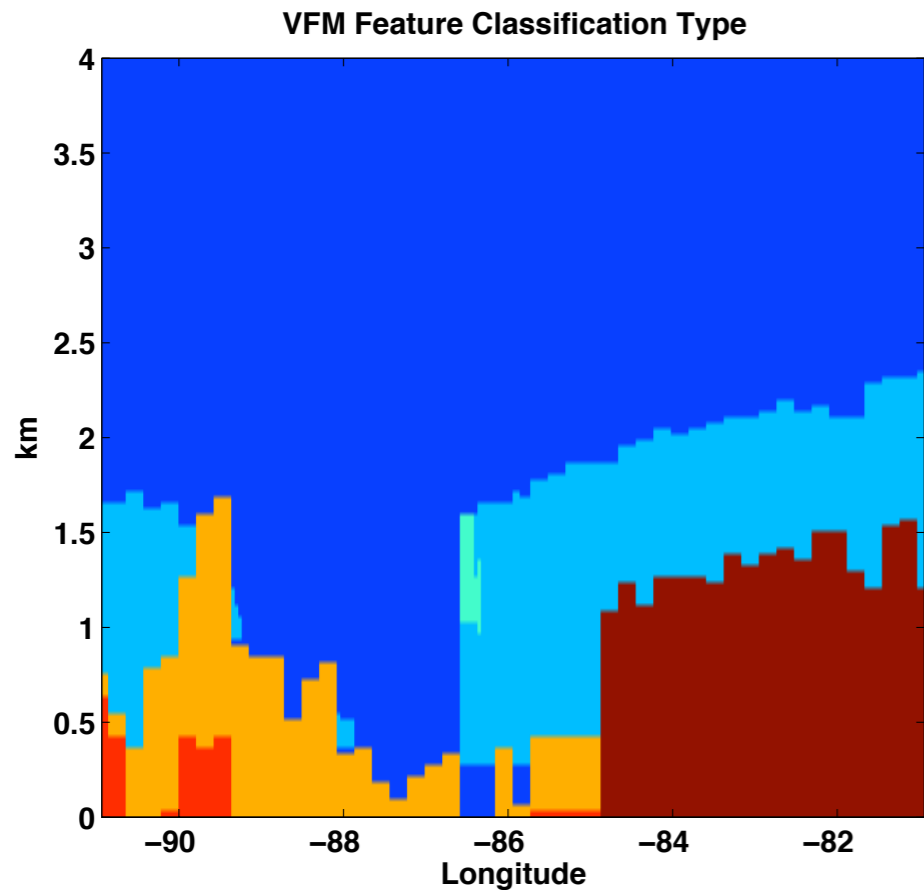
# Ice Formation Calipso Tracks



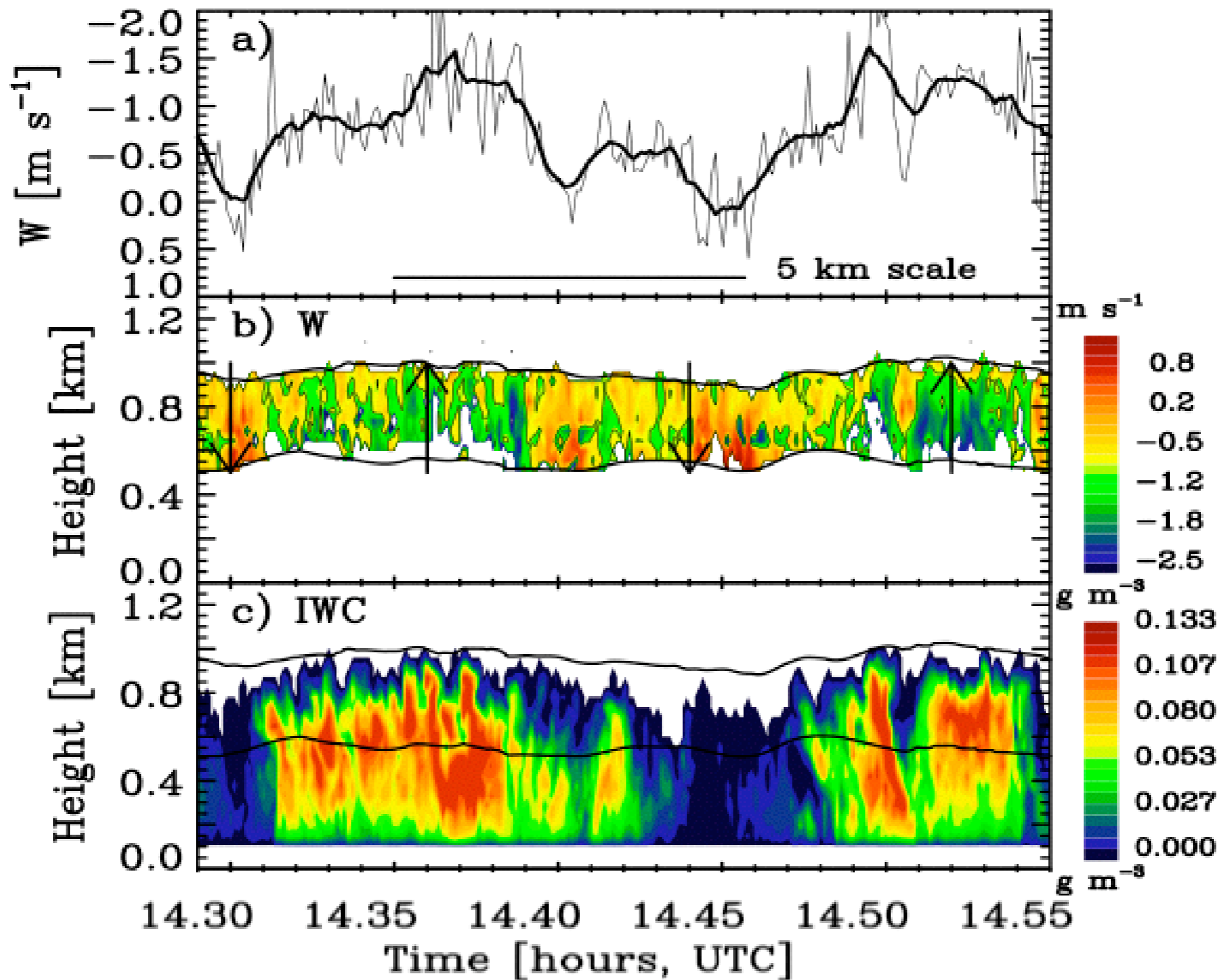
# Ice Formation



# Ice Formation



# Ice Formation



Courtesy of Matt Shupe (NOAA)

2008 CALIPSO Science Team Meeting

# Ice Formation

- Ice crystal concentrations strongly proportional to concentration of drops larger than  $20 \mu\text{m}$ . (Rangno & Hobbs, 2001)

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- Sulphuric acid coating on insoluble particles inhibits ice formation (Girard, Blanchet and Dubois, 2005; Möhler et al., 2005) and increases immersion freezing.

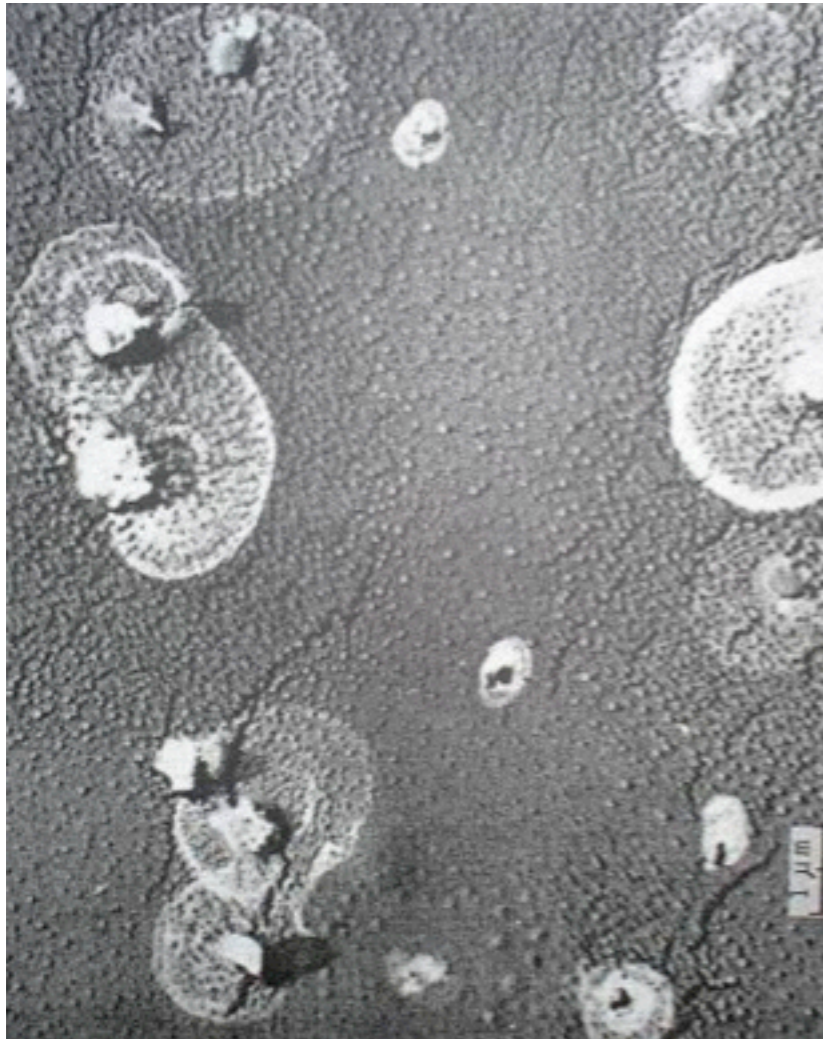


Image from Blanchet (2007)

# Ice Formation

- Ice crystal concentrations strongly proportional to concentration of drops larger than  $20 \mu\text{m}$ . (Rangno & Hobbs, 2001)
- Sulphuric acid coating on insoluble particles inhibits ice formation (Girard, Blanchet and Dubois, 2005; Möhler et al., 2005) and increases immersion freezing.
- IN immersed in liquid drops will not be counted by the CFDC (too big), and it is not certain that the coated nuclei will either.

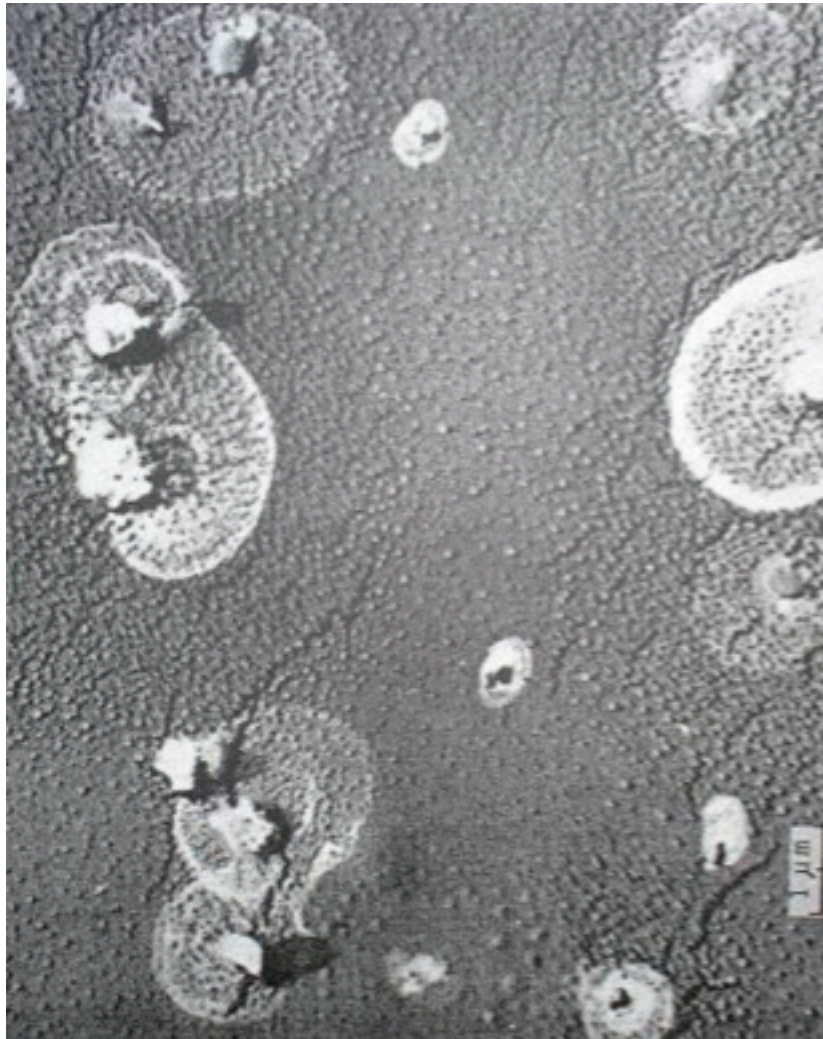


Image from Blanchet (2007)



# Science Summary

- Ice formation mechanisms appear to hold the secret to maintaining these mixed-phase layers.
- Aerosol source does not appear to lie above the cloud layer.
- Ice formation is likely linked to aerosol composition.

## **Future work**

- Track aerosol structures advected over the Arctic to see how sources influence formation of mixed-phase layers.
- Implement new immersion freezing parameterization in our cloud-resolving model to test theories on immersion freezing.

# Validation/Comparison Opportunities

<http://lidar.ssec.wisc.edu>

## Welcome to the University of Wisconsin Lidar Group



[About this image...](#)

### Index of Topics

- [Arctic HSRL](#): A new lidar designed for long term observations in the Arctic
- [Data: HSRL, MMCR, PAERI, MWR](#) Web access to data acquired after 01-May-2004
- [Volume Imaging Lidar](#): System description
- [High Spectral Resolution Lidar](#): System description (van mounted system used prior to May 2004)
- [Lidar Images](#): Thousand's of Lidar images acquired before 2004
- [Movies](#): MPEG animations generated from VIL data
- [HSRL with MODIS](#): Data at Satellite Overpasses, for MODIS Instrument
- [Vis5D Images](#): 3-D scattering volumes produced from VIL data
- [Project Results](#): Data products and science results from selected projects
- [Publications](#): List of Lidar Group publications
- [Operation Times and Statistics](#): Some HSRL and VIL experiments prior to 1998
- [Staff](#): UW Lidar Group staff and contact information
- [Results from Lake-ICE](#): Lake-Induced Convection Experiment
- [Large-eddy simulation](#): UW Nonhydrostatic Modeling System LES Results
- [Lidar Multiple Scattering](#): Models
- [Acknowledgements](#)
- [Server Statistics](#)



# Validation/Comparison Opportunities

A High Spectral Resolution Lidar for Long Term Arctic Observations

http://lidar.ssec.wisc.edu/syst/ahsrl/ahsrl\_data.htm

Return to the [Index](#).





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## Data from the Arctic HSRL, MMCR, PAERI, MWR, Radiosonde, and the CRAS forecast for Eureka

### [Access Tools](#)

- [Generate RTI Images and Data Plots](#)
- [View Archived Quicklook Images: HSRL MMCR AERI MWR \(By Month\) \[MULTI-VIEW\]](#)
- [Generate HSRL System Housekeeping Data Plots](#)
- [View System Online LogBook](#)
- [Process and Export Data as a NetCDF \(under construction\)](#)
- [Download Archived Instrument Data as Received \(under construction\)](#)
- [View weather forecasts for Eureka produced by the CRAS model](#)
- [Matlab routines for use with NetCDF files downloaded from this site.](#)

### Data Provided By:

 <b>Earth System Research Laboratory</b>	<a href="#">National Oceanic and Atmospheric Administration : Earth System Research Laboratory</a>
 <b>CANDAC</b> Canadian Network for the Detection of Atmospheric Change	<a href="#">CANDAC : Polar Environment Atmospheric Research Laboratory (PEARL)</a>
 <b>University of Idaho</b>	<a href="#">University of Idaho</a>
 <b>ARM</b>	U.S. DOE <a href="#">Atmospheric Radiation and Measurement (ARM)</a>

# Validation/Comparison Opportunities

AHSRL Processed Data Retrieval

http://lidar.ssec.wisc.edu/cgi-bin/processeddata/retrievedata.cgi

**To generate a Downloadable NetCDF Dataset,  
select UTC time and averaging intervals for data**

**From:**  
year  month  day  hour  minute

**To:**  
year  month  day  hour  minute

Min altitude: <input type="text" value="0"/> km	Time Resolution: <input type="text" value="30"/> seconds/record	File Mode: <input type="text" value="single"/>
Max altitude: <input type="text" value="15"/> km	Altitude Resolution: <input type="text" value="30"/> meters/point	

[Data Quality Masking](#) (Leave blank to disable)

Minimum Radar Backscatter <input type="text" value="1e-15"/> 1/(m str)	Minimum Radar Reflectivity <input type="text" value="-66.1"/> dBz
Minimum Lidar Backscatter <input type="text"/> 1/(m str)	Lidar Backscatter Signal-to-Noise Ratio <input type="text" value="1"/>
Minimum Molecular Count <input type="text" value="1"/> counts	Molecular Count Signal-to-Noise Ratio <input type="text"/>
Lock Quality <input type="text" value="0.6"/>	

under construction

[Documentation](#)

Select your desired datasets:

<a href="#">Derived Quantities</a>	<a href="#">Raw Data</a>	<a href="#">Radar Quantities (MMCR)</a>
<input checked="" type="checkbox"/> Particulate Backscatter Cross Section	<input checked="" type="checkbox"/> Combined Channel Counts	<input type="checkbox"/> Reflectivity
<input checked="" type="checkbox"/> Particulate Optical Depth	<input checked="" type="checkbox"/> Molecular Channel Counts	<input type="checkbox"/> Backscatter Cross Section ?
<input checked="" type="checkbox"/> Particulate Depolarization	<input checked="" type="checkbox"/> Cross Polarized Channel Counts	<input type="checkbox"/> Spectral Width
<input checked="" type="checkbox"/> Particulate Extinction Cross Section	<input checked="" type="checkbox"/> Radiosonde Profile(s)	<input type="checkbox"/> Doppler Velocity
<input checked="" type="checkbox"/> Attenuated Molecular Backscatter	<input checked="" type="checkbox"/> Molecular Scattering Cross Section	
<input checked="" type="checkbox"/> Error Estimates	<input checked="" type="checkbox"/> Calibration/System Measurements	

[AERI Quantities](#)      [Micro-wave Radiometer Quantities](#)      [HSRL/MMCR Cooperative Quantities](#)

# Validation/Comparison Opportunities

AHSRL Processed Data Retrieval

http://lidar.ssec.wisc.edu/cgi-bin/processeddata/retrievedata.cgi

To generate a Downloadable NetCDF Dataset,  
select UTC time and averaging intervals for data

From:

year 2006 month September day 30 hour 00 minute 00

To:

year 2006 month November day 30 hour 00 minute 00

Min altitude: 0 km	Time Resolution: 30 seconds/record	File Mode: satellite
Max altitude: 15 km	Altitude Resolution: 30 meters/point	Username: gdeboer (4 or more characters)
		Minutes Per File: 60
		Max Distance From Site: 10 km
		Satellite: CALIPSO
		Counted 8 intervals.
		<a href="#">Preview Data Intervals (Incomplete)</a>

[Data Quality Masking](#) (Leave blank to disable)

Minimum Radar Backscatter 1e-15 1/(m str)	Minimum Radar Reflectivity -66.1 dBz
Minimum Lidar Backscatter 1/(m str)	Lidar Backscatter Signal-to-Noise Ratio 1
Minimum Molecular Count 1 counts	Molecular Count Signal-to-Noise Ratio
Lock Quality 0.6	

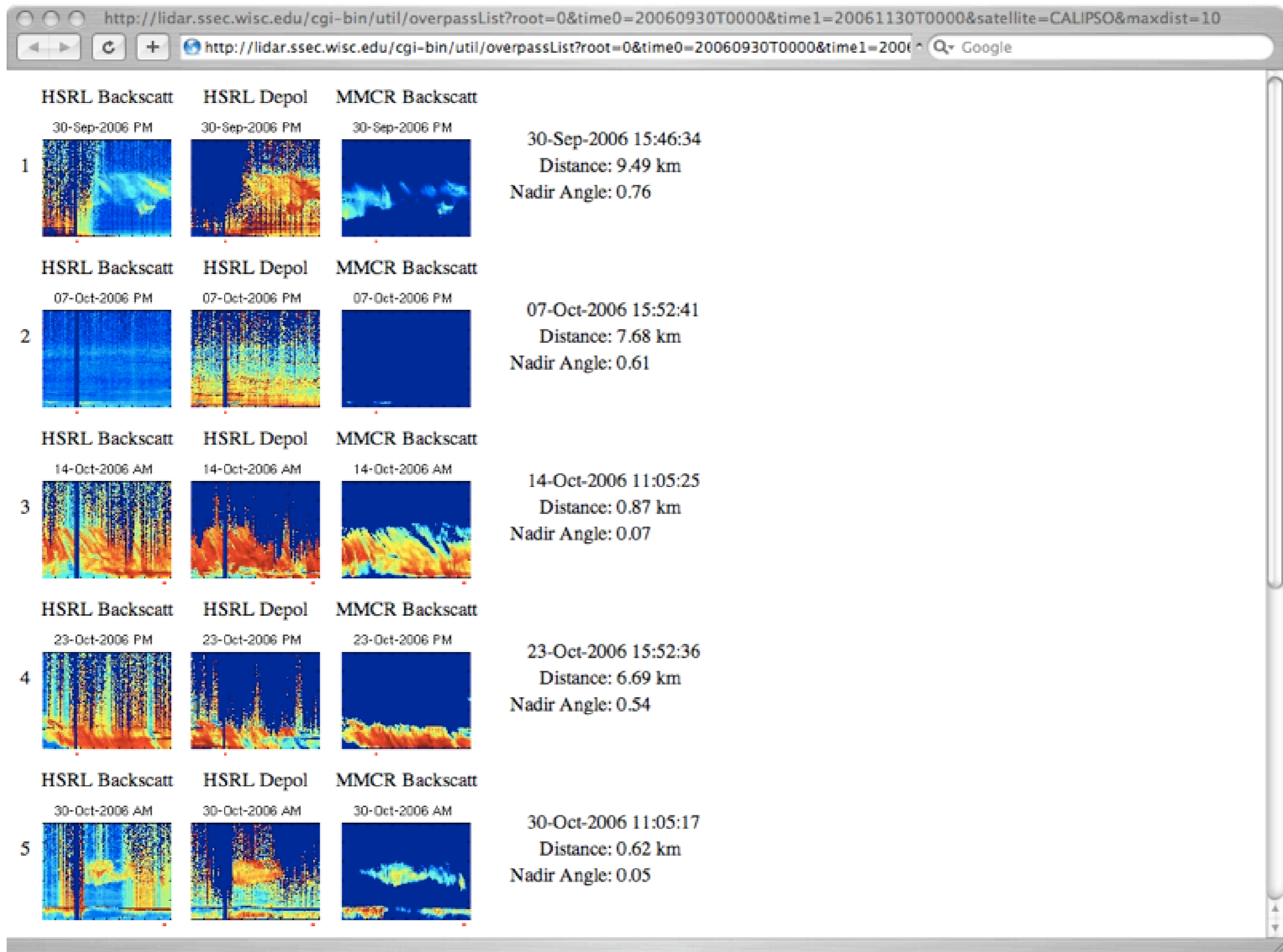
under construction

[Documentation](#)

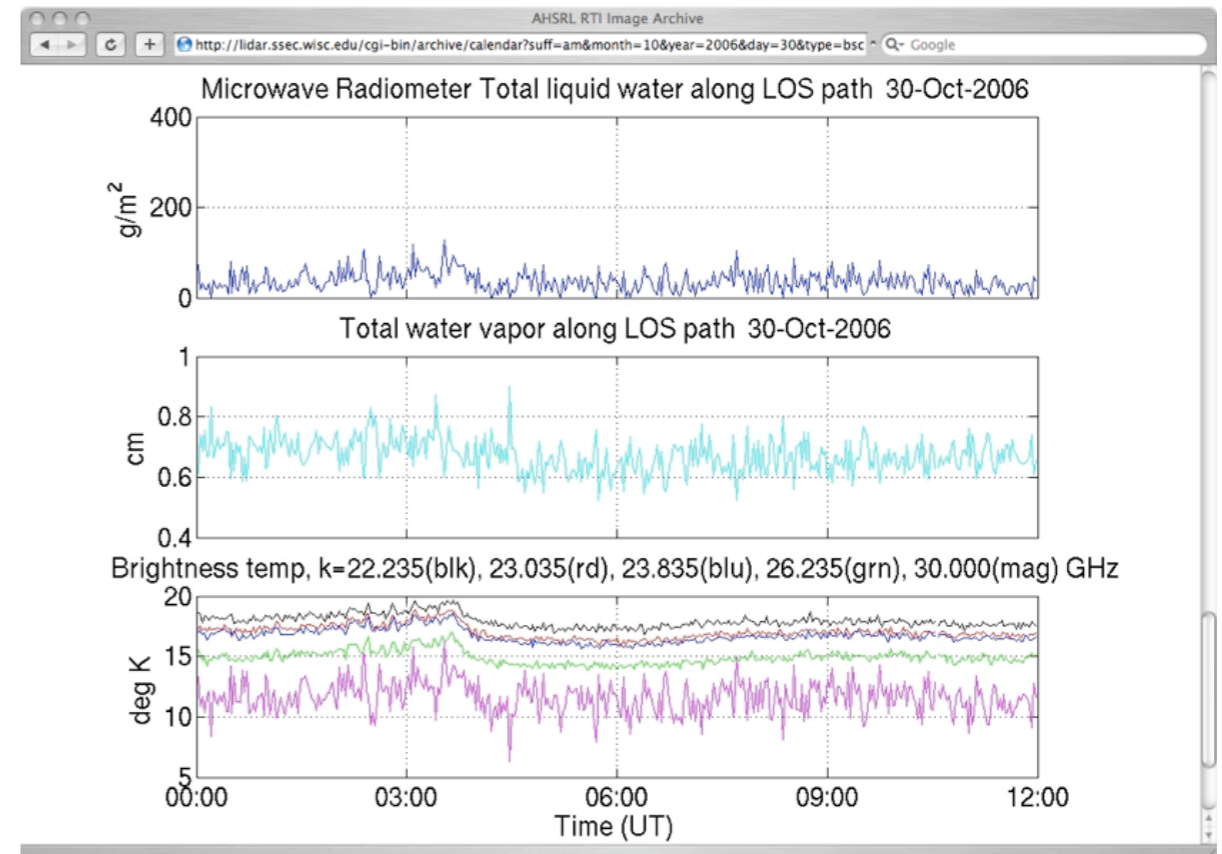
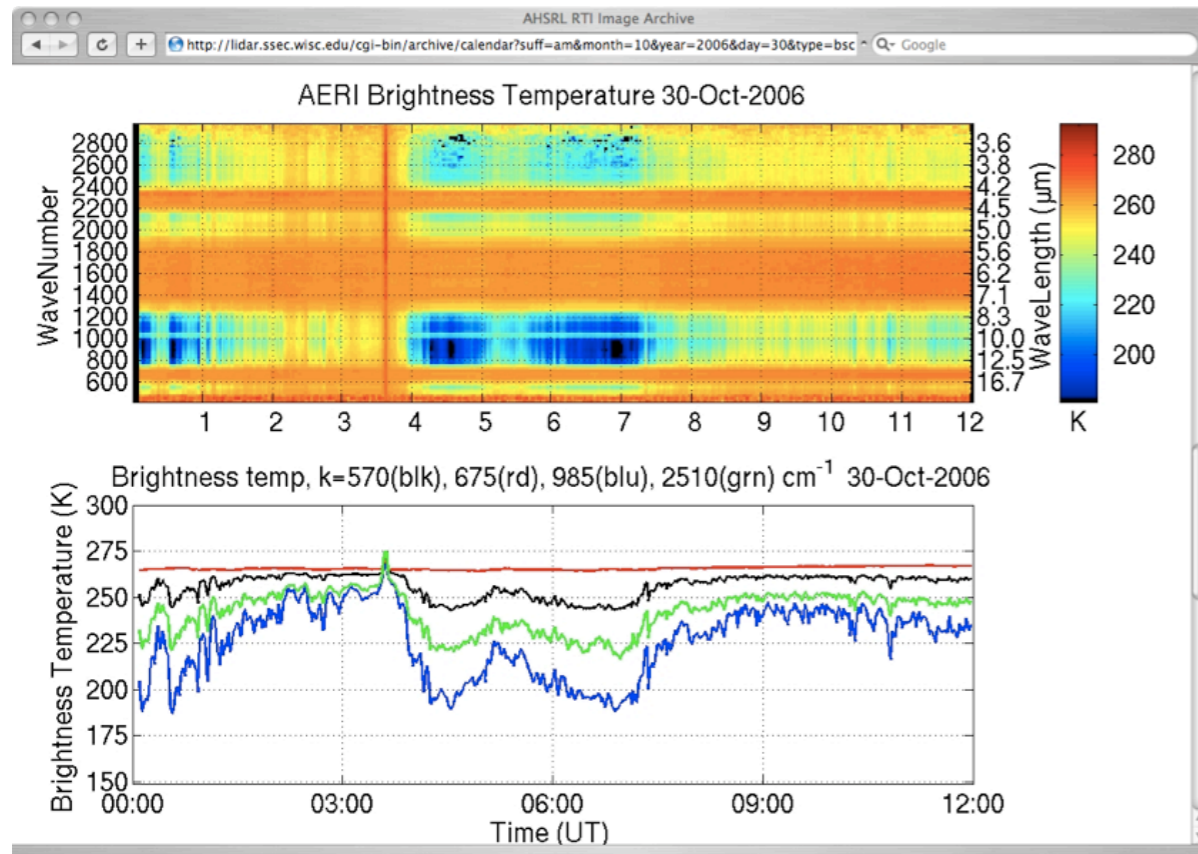
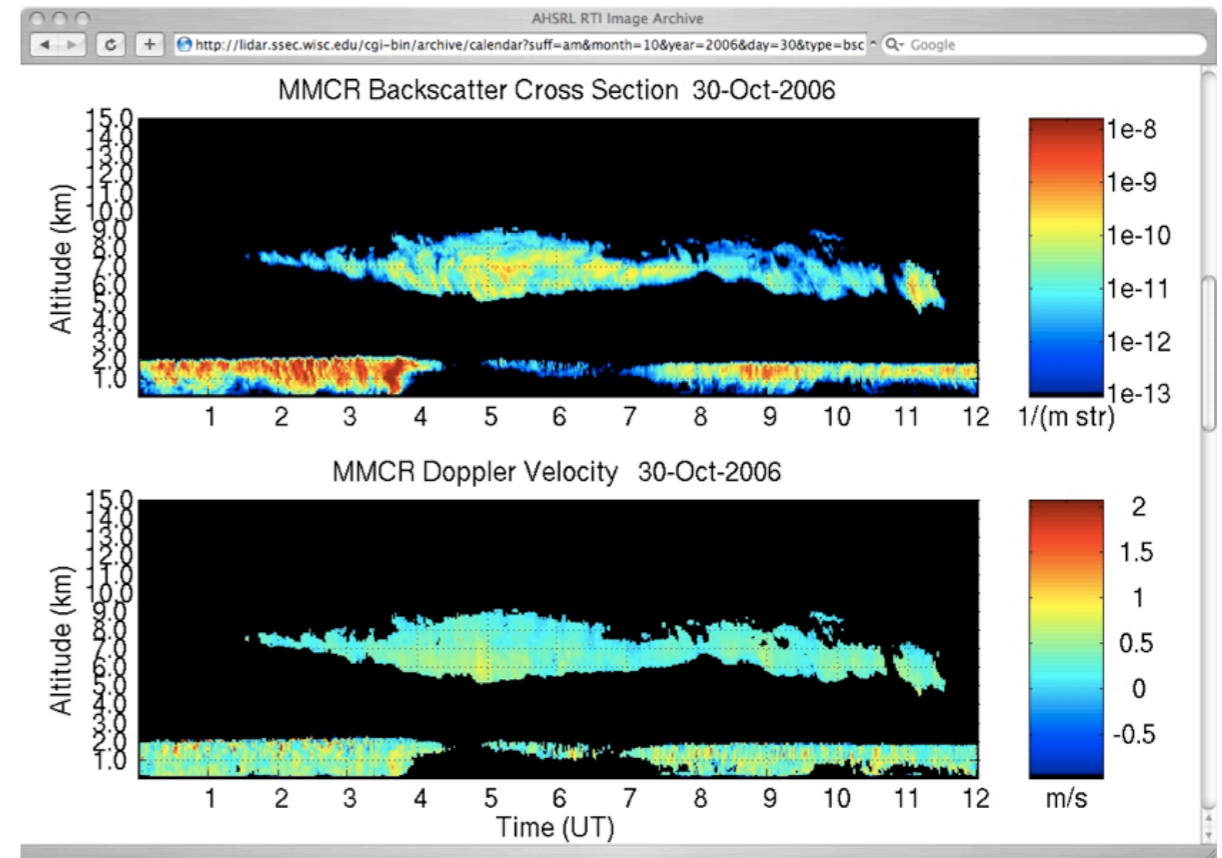
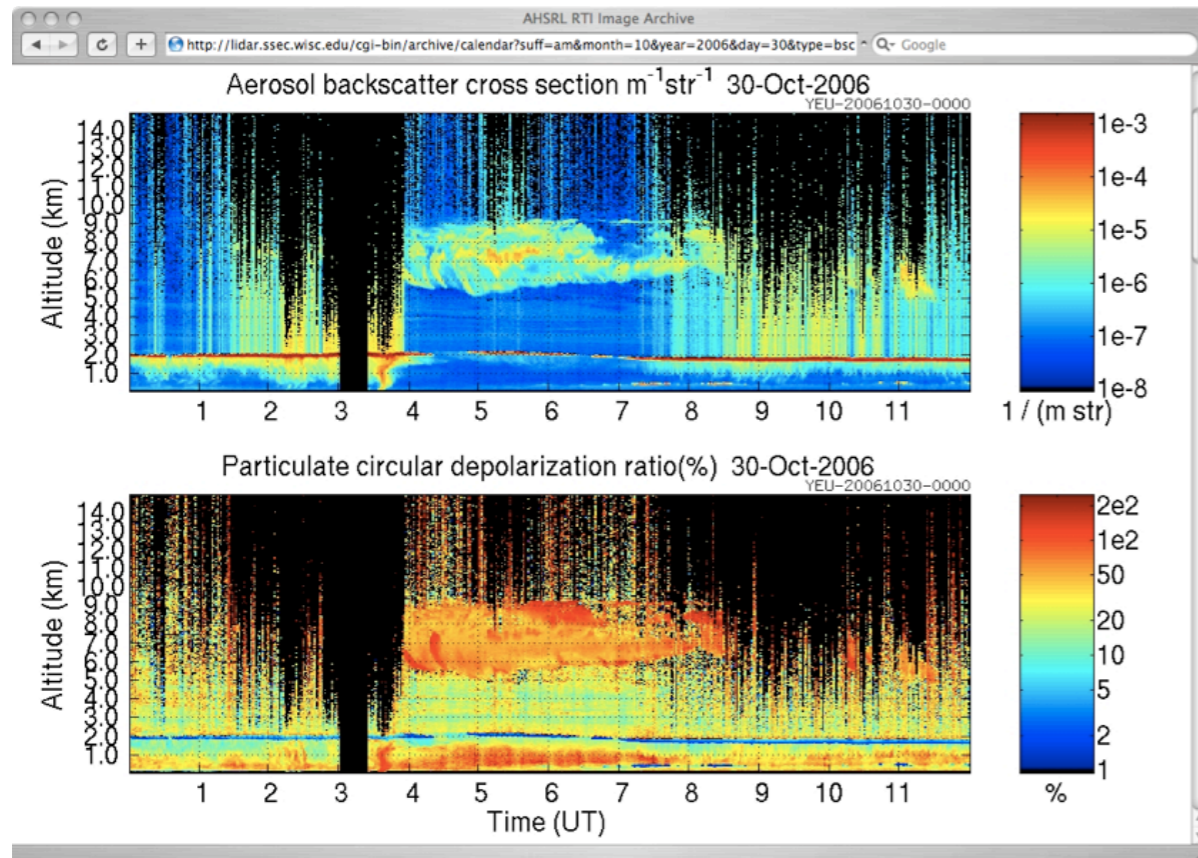
Select your desired datasets:

<a href="#">Derived Quantities</a>	<a href="#">Raw Data</a>	<a href="#">Radar Quantities (MMCR)</a>
<input checked="" type="checkbox"/> Particulate Backscatter Cross Section	<input checked="" type="checkbox"/> Combined Channel Counts	<input type="checkbox"/> Reflectivity
<input checked="" type="checkbox"/> Particulate Optical Depth	<input checked="" type="checkbox"/> Molecular Channel Counts	<input type="checkbox"/> Backscatter Cross Section ?

# Validation/Comparison Opportunities



# Validation/Comparison Opportunities



# Validation/Comparison Opportunities

Other retrieved quantities:

- Optical Depth
- Particle effective size
- Particle number density
- Water Content

Contacts:

Gijs de Boer ([gdeboer@wisc.edu](mailto:gdeboer@wisc.edu))

Ed Eloranta ([eloranta@lidar.ssec.wisc.edu](mailto:eloranta@lidar.ssec.wisc.edu))