

# **Aircraft Atmospheric Research and Planetary Exploration**

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**Centre for Research in Earth and Space Science  
York University, Toronto**

## York University Aircraft Projects

2009: Twin Otter, Forest Fire Smoke Transport

2009: DC-3, Arctic Surface Air Chemistry

2007: Dimona, Australian Desert Dust

2007: Twin Otter, Forest Fire Smoke Transport

2006: Egrett and Twin Otter

Tropical Convection, Clouds, Water Vapour

2002: Egrett and King Air

Tropical Convection, Clouds, Water Vapour

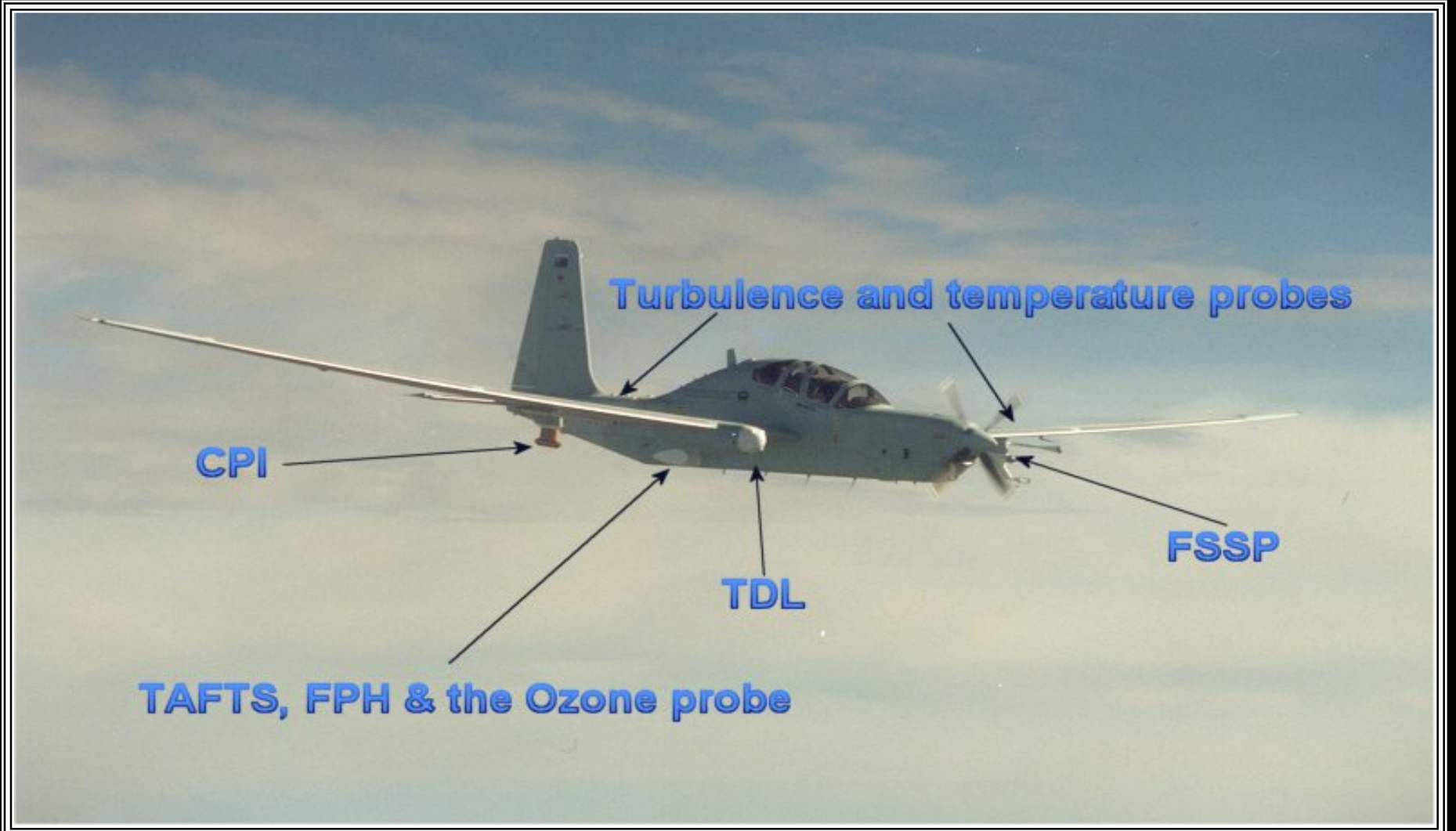
2001: Egrett and King Air, Cirrus Clouds

2000: Egrett, Gravity Wave Breaking

# The Egrett

Airborne Research Australia

15 km; 70-100 m/sec; 750 Kg



# Twin Otter

- Twin Otter Airborne Research, Colorado (2006, 2007)
- Kenn Borek Air, Calgary (2009)



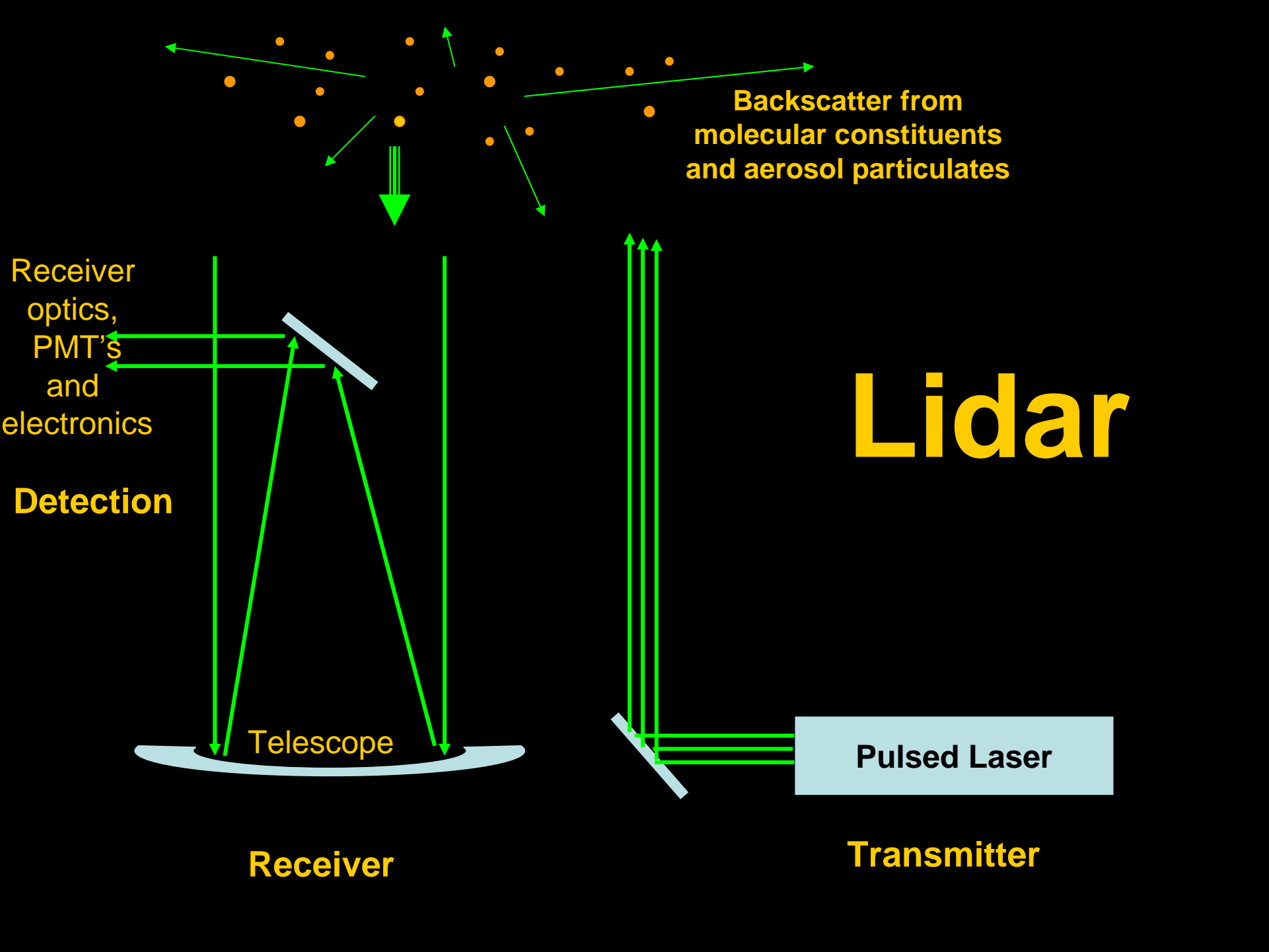
**Figure 3.** Photograph of the Twin Otter aircraft (left) and the new Phoenix Field Lidar (right) during installation on the Twin Otter at Grand Junction Colorado (base of Twin Otter Airborne Research).

**The Dimona**  
**Airborne Research Australia**  
**Muloorina 2007**



**Polar-5 (DC-3) Alfred Wegener Institute  
Arctic Flights  
April 2009, 2011**





Backscatter from  
molecular constituents  
and aerosol particulates

# Lidar

Receiver  
optics,  
PMT's  
and  
electronics

Detection

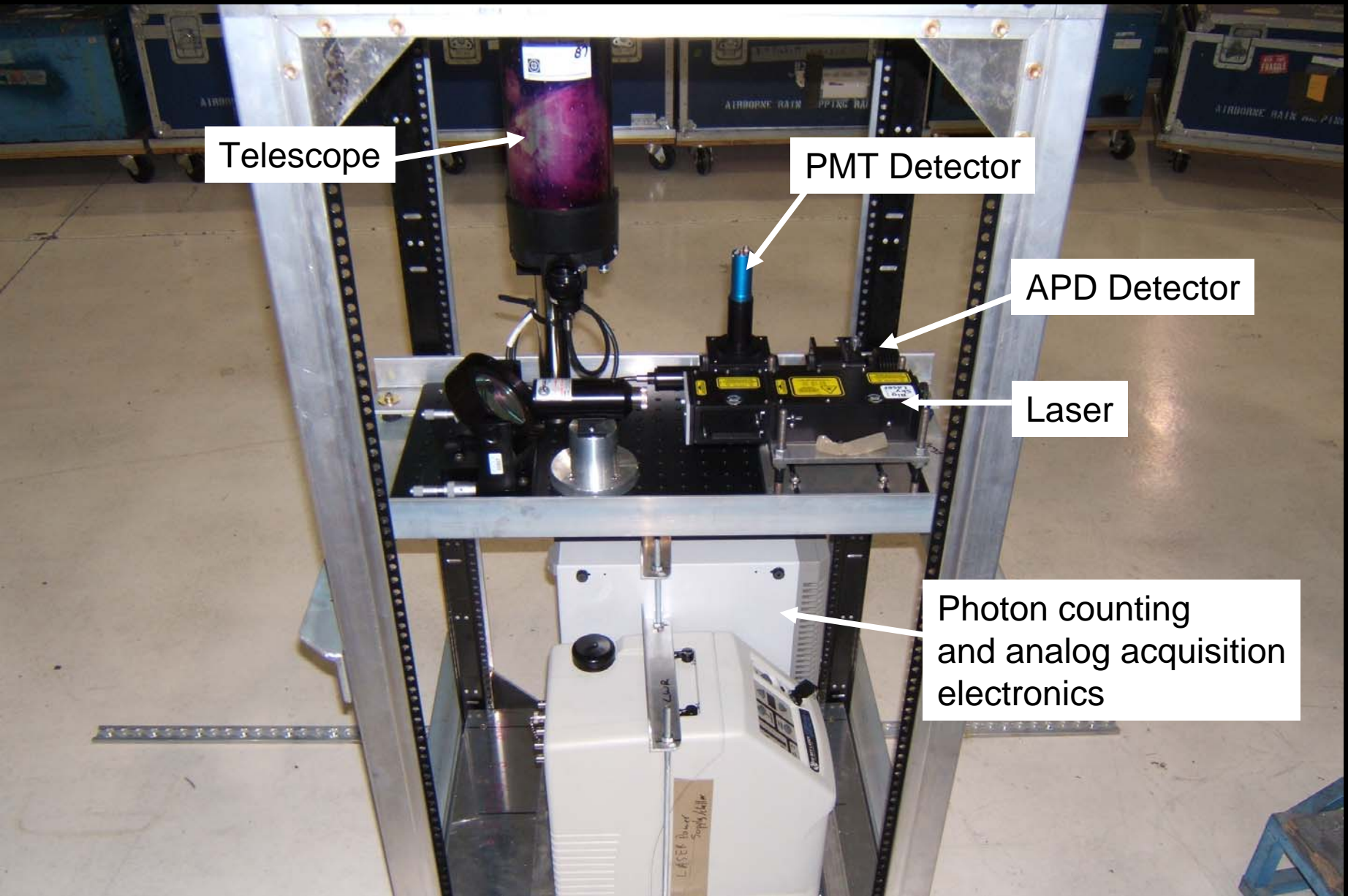
Telescope

Receiver

Pulsed Laser

Transmitter

# Phoenix Lidar for Aircraft



Telescope

PMT Detector

APD Detector

Laser

Photon counting  
and analog acquisition  
electronics



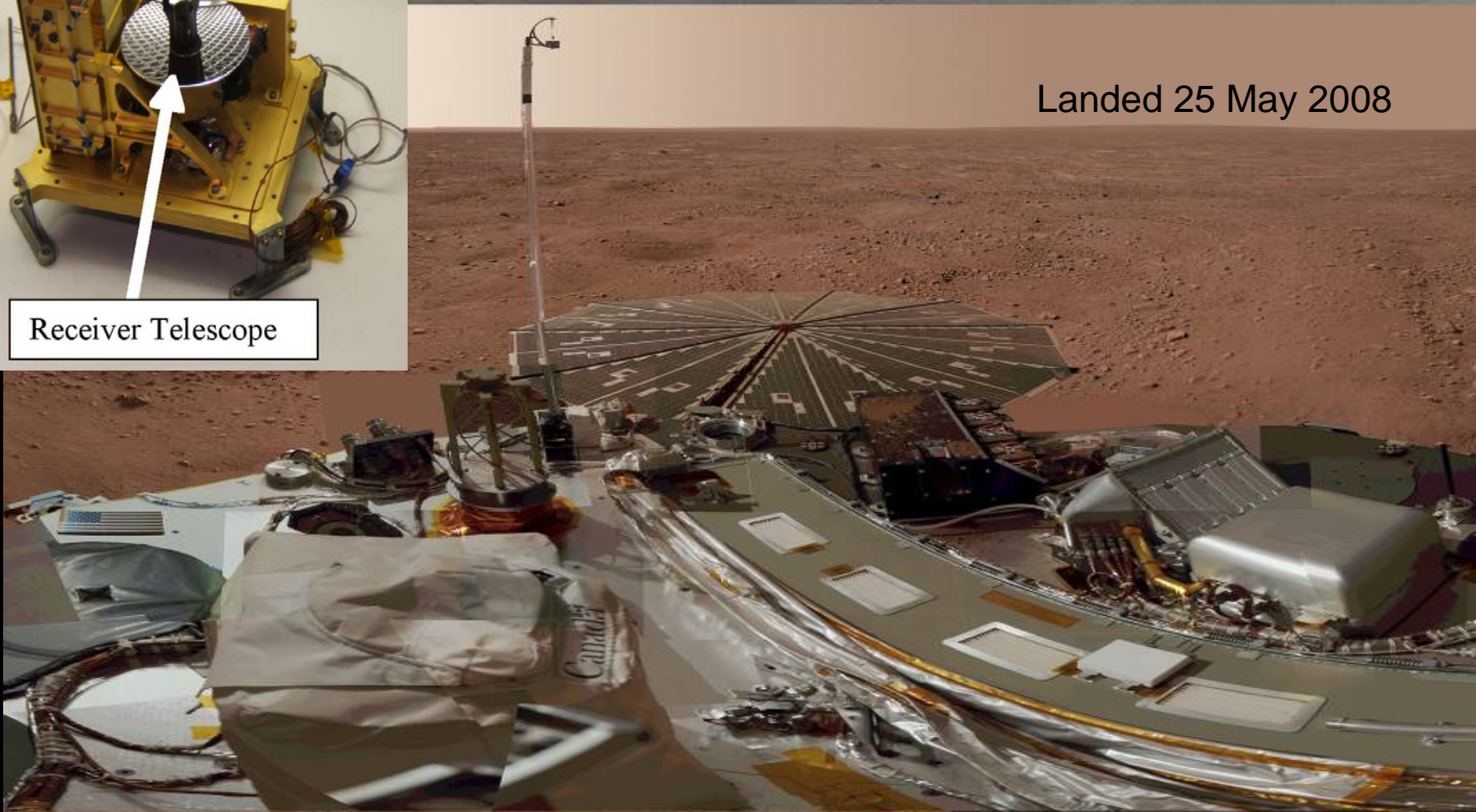
# LIDAR on Phoenix Mars Mission

Transmitter



Receiver Telescope

Landed 25 May 2008



# Phoenix Lidar Testing January 2007

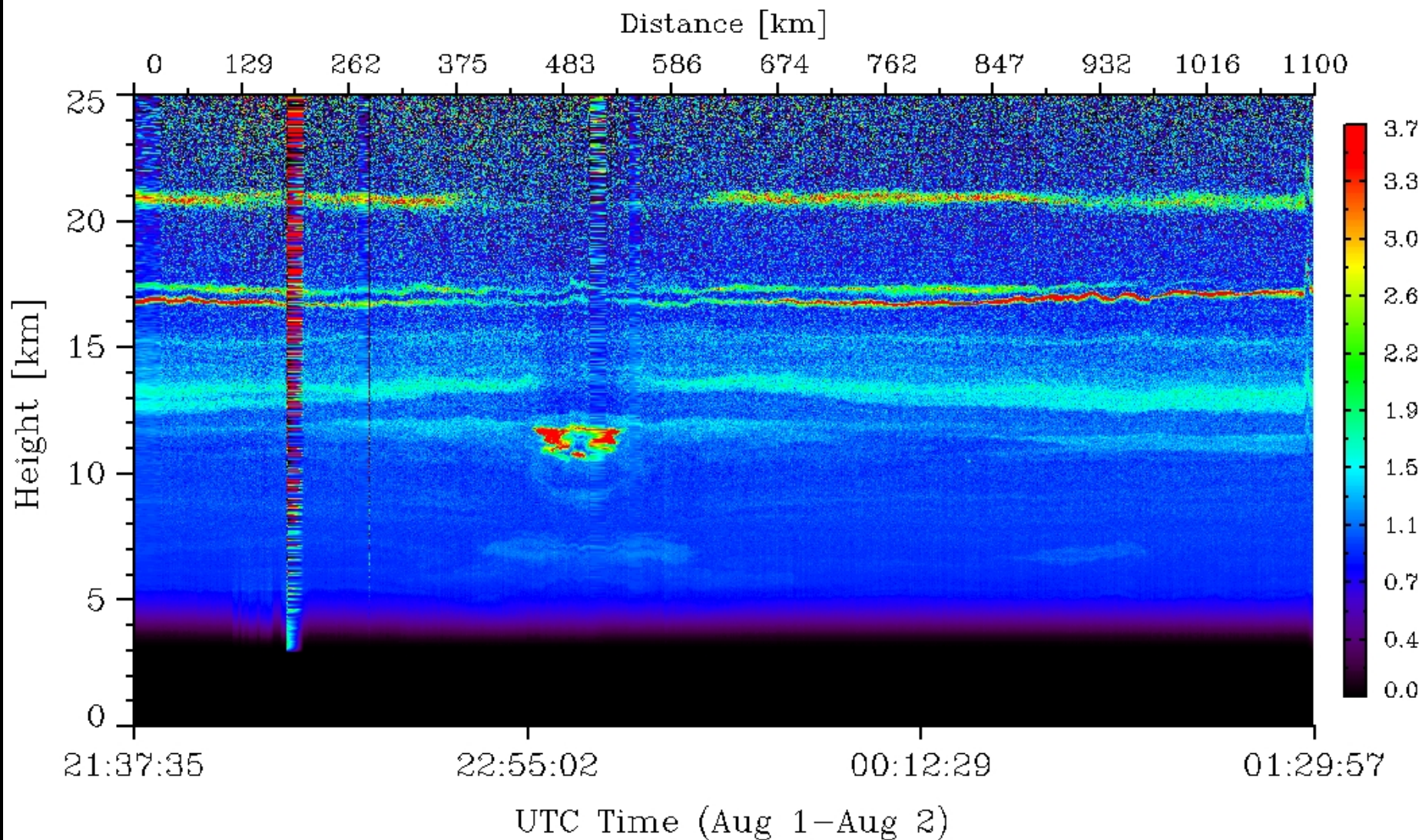


# Twin Otter, Forest Fire Smoke July 2009



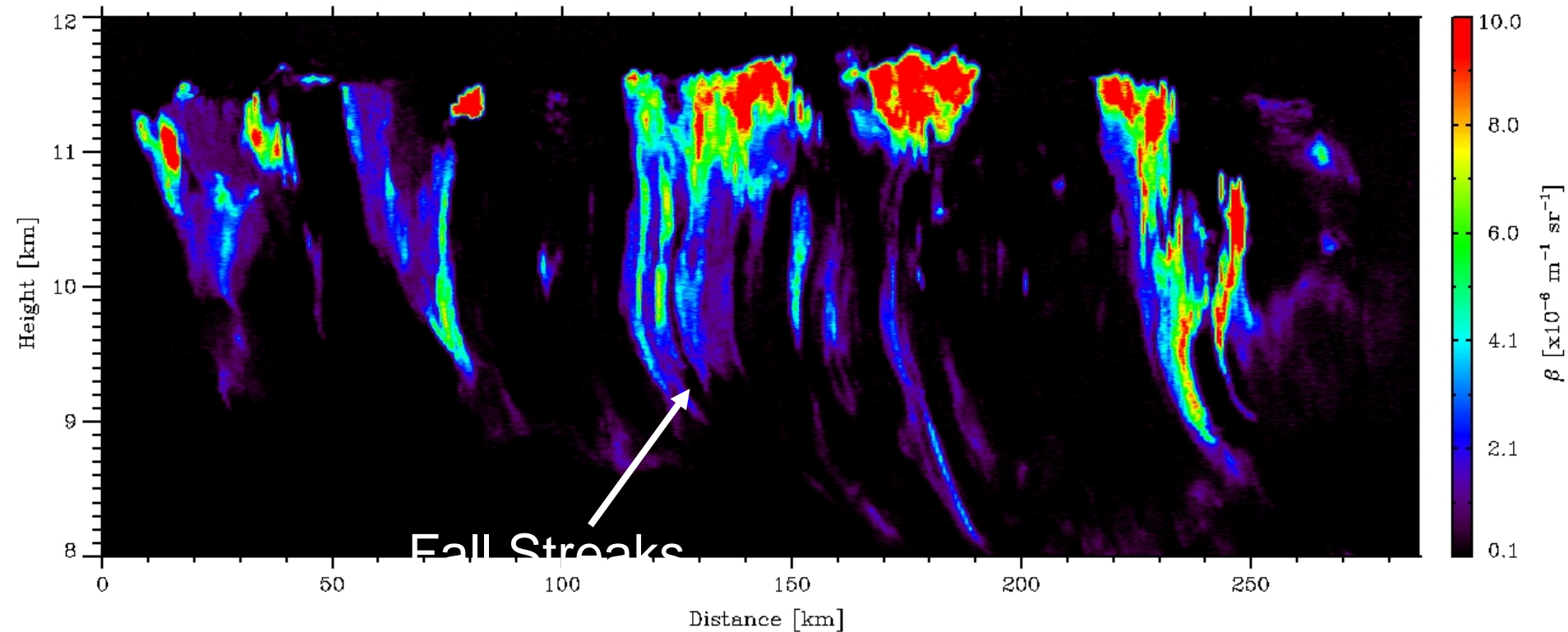
# Forest Fire Smoke and Volcanic Aerosol over NWT

ECHO 2009: Scattering Ratio Contour Plot



# Twin Otter Lidar Measurements (July 2009) Cirrus Clouds Above Northern Alberta

ECHO 2009: BackScatter Coefficient Contour Plot for July 30, 2009

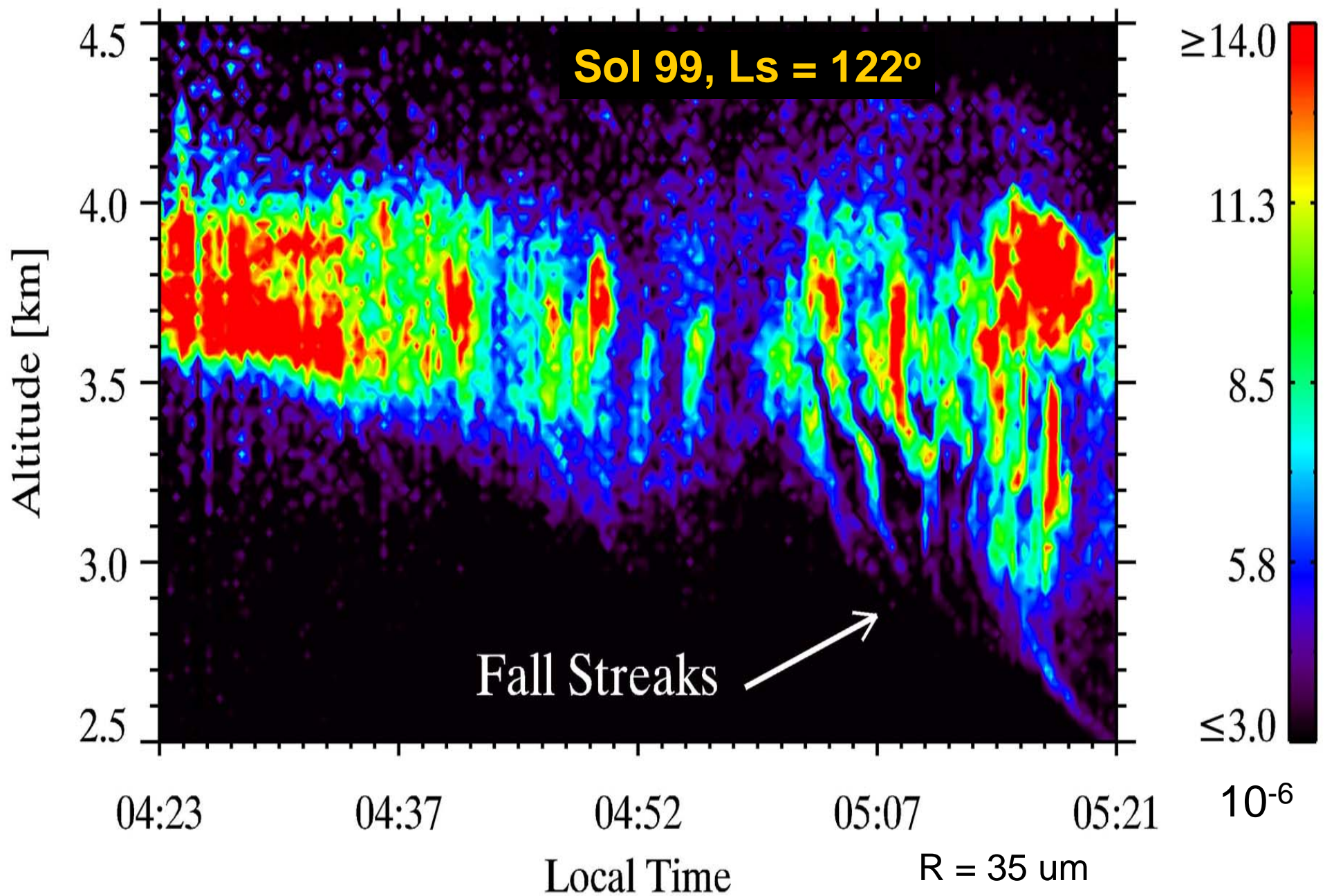


# Cirrus Clouds on Earth



**Fall Streaks**

# Lidar Backscatter Coefficient ( $\text{m}^{-1}\text{sr}^{-1}$ )



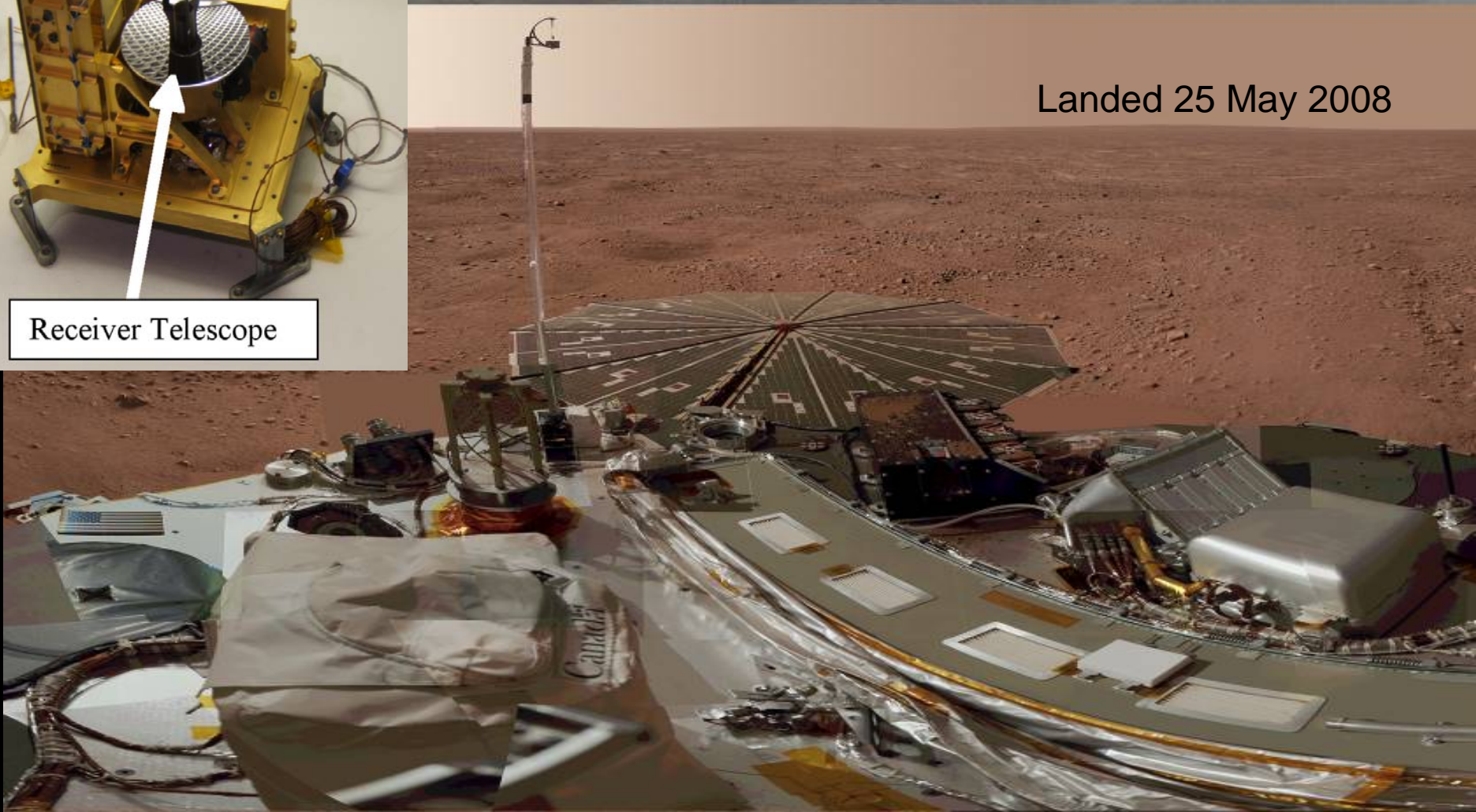
# LIDAR on Phoenix Mars Mission

Transmitter



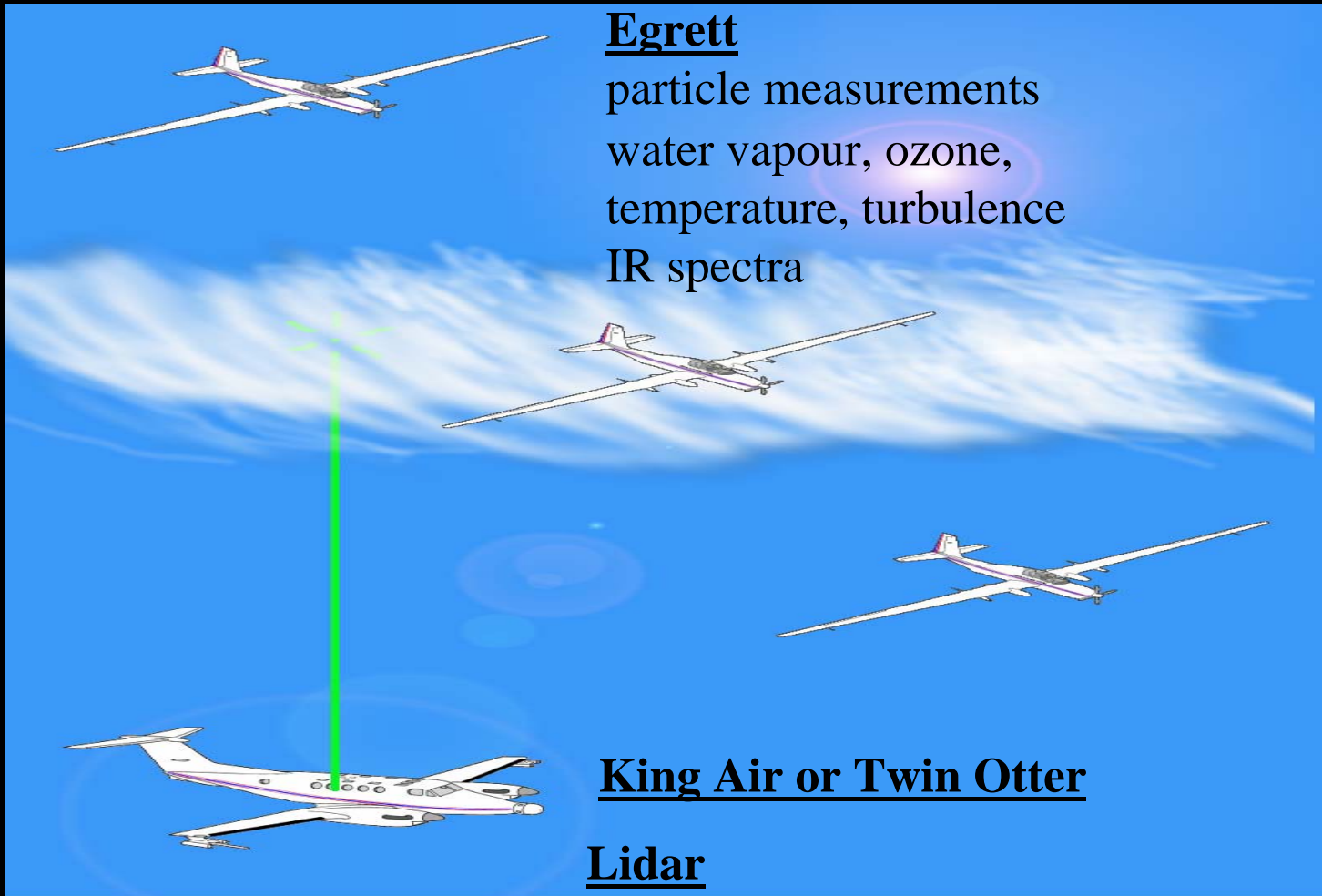
Receiver Telescope

Landed 25 May 2008

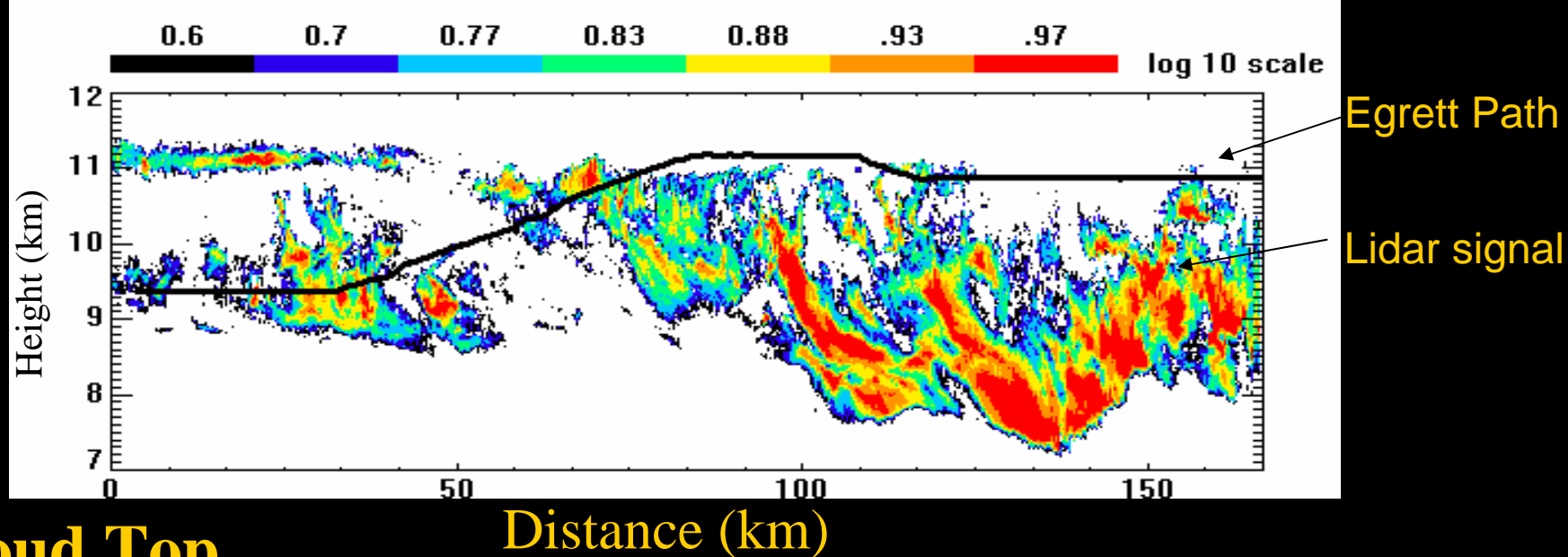


# Egrett and Twin Otter

## Remote Sensing and In Situ Measurements

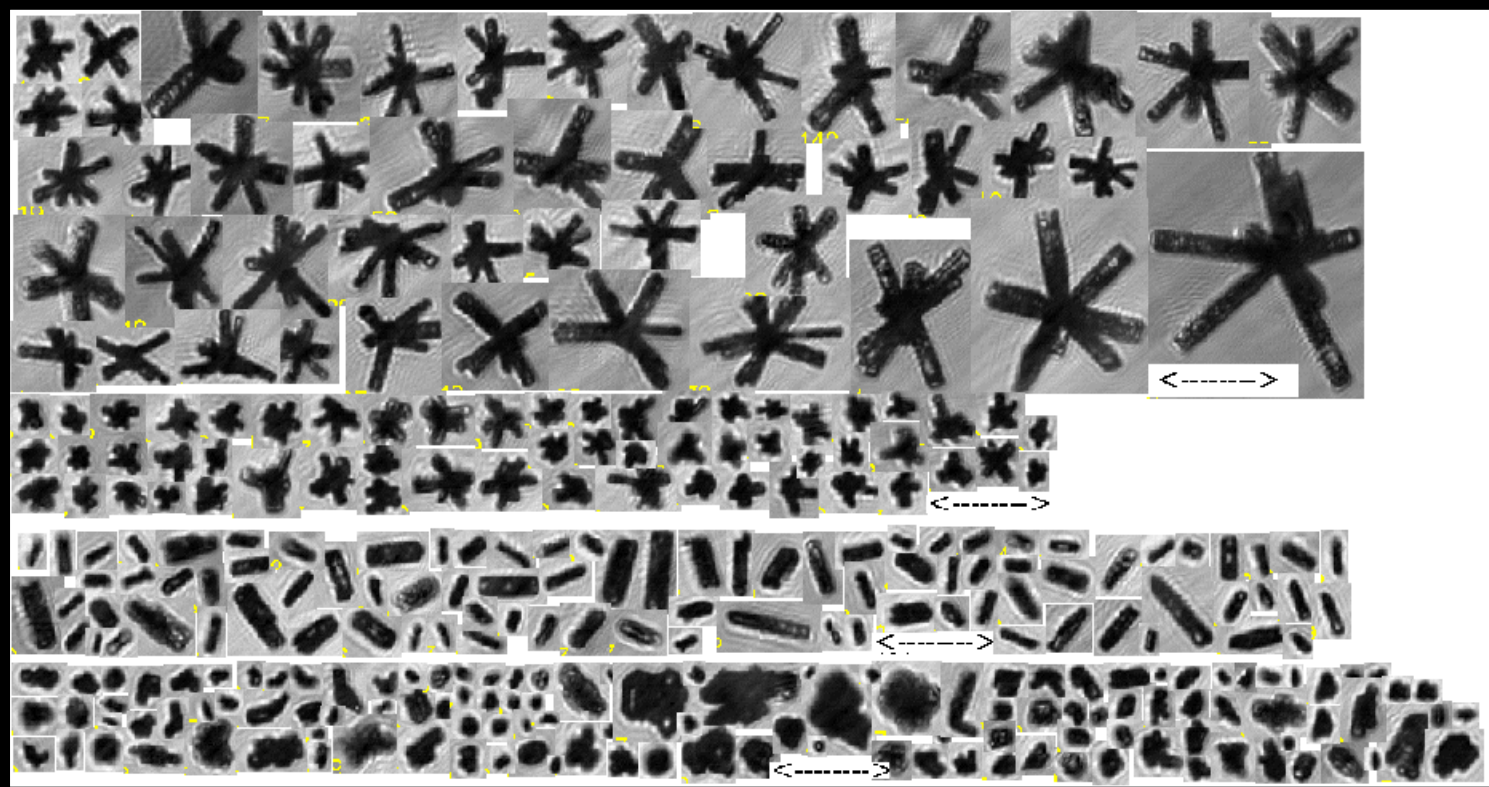






**Cloud Top**

**Distance (km)**

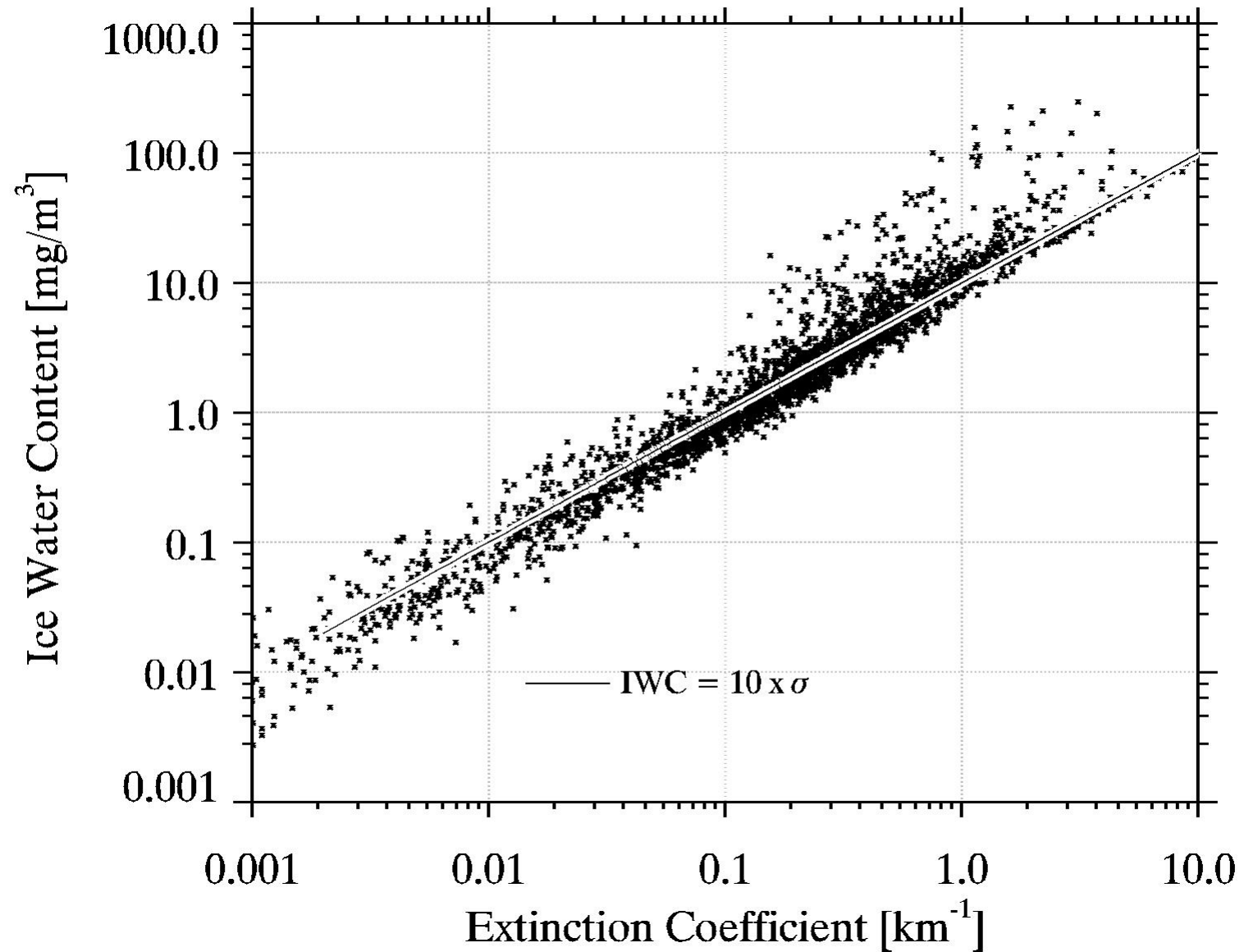


**In situ  
Cloud crystal  
Sampling**

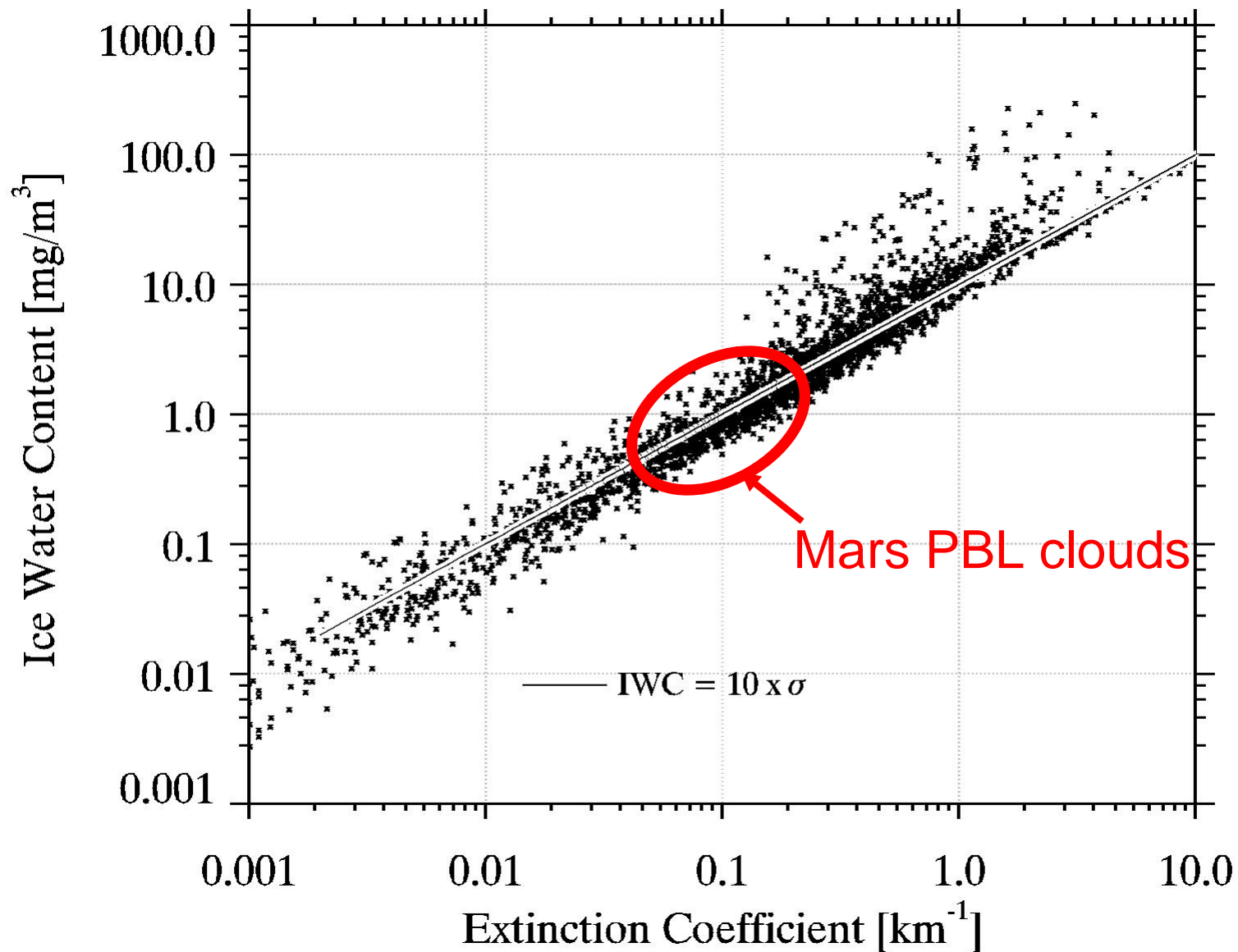
**200  $\mu\text{m}$**



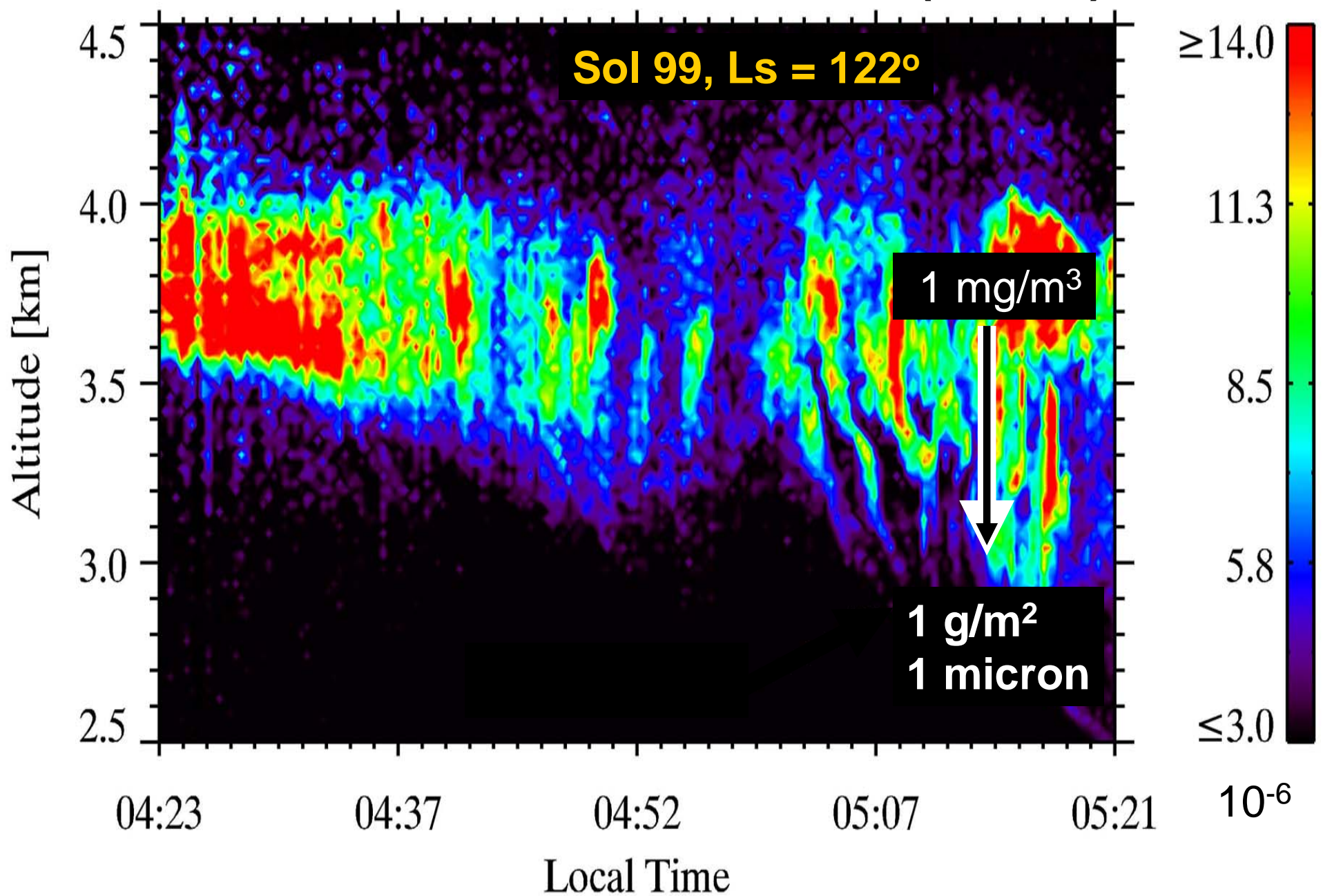
# Ice Water Content: Lidar and in situ measurements



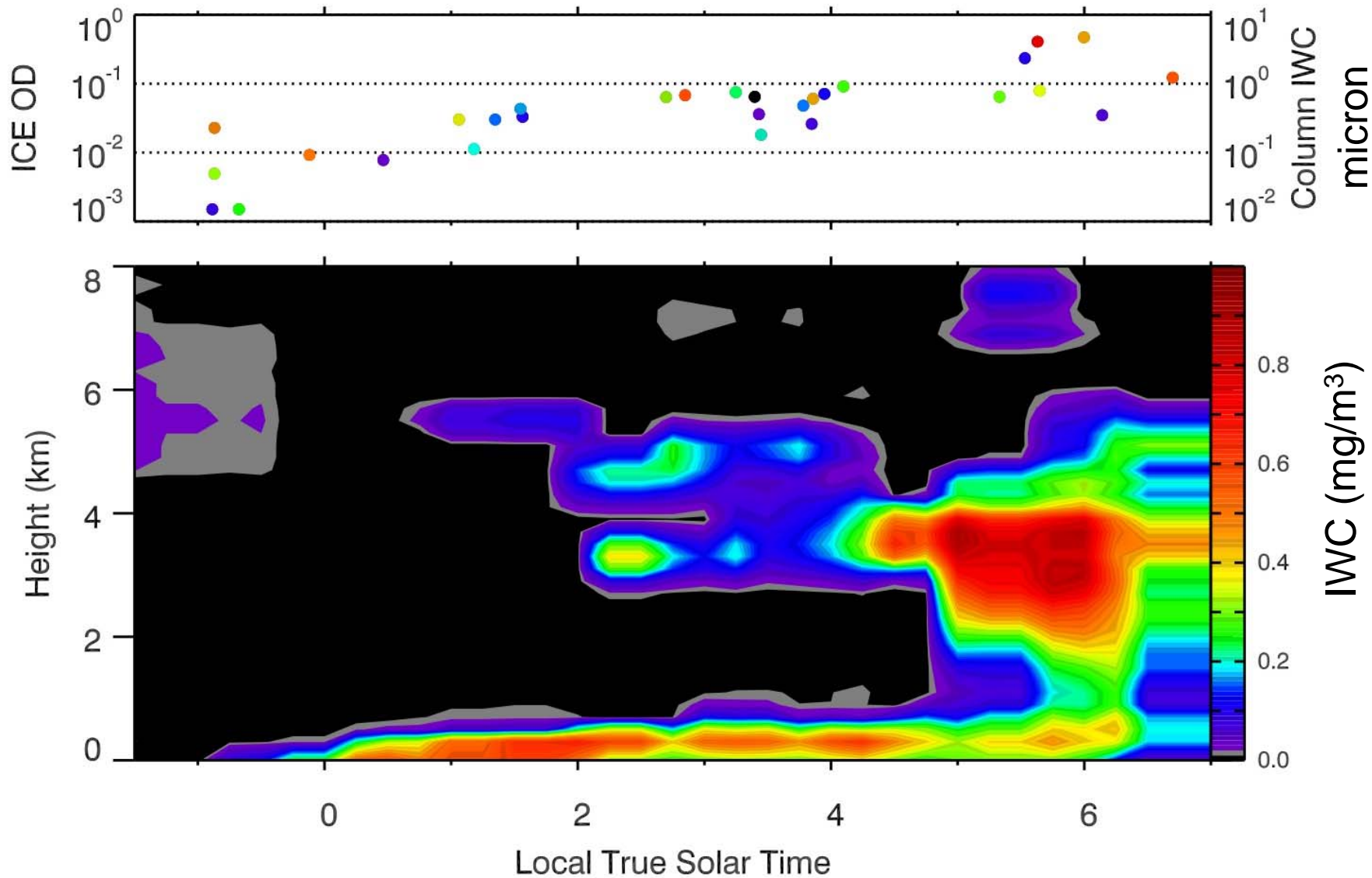
# Ice Water Content: Lidar and in situ measurements



# Lidar Backscatter Coefficient ( $\text{m}^{-1}\text{sr}^{-1}$ )



# Cloud Ice Water Content



# Lidar and Aircraft In Situ Desert Campaign

Australia, November 2007



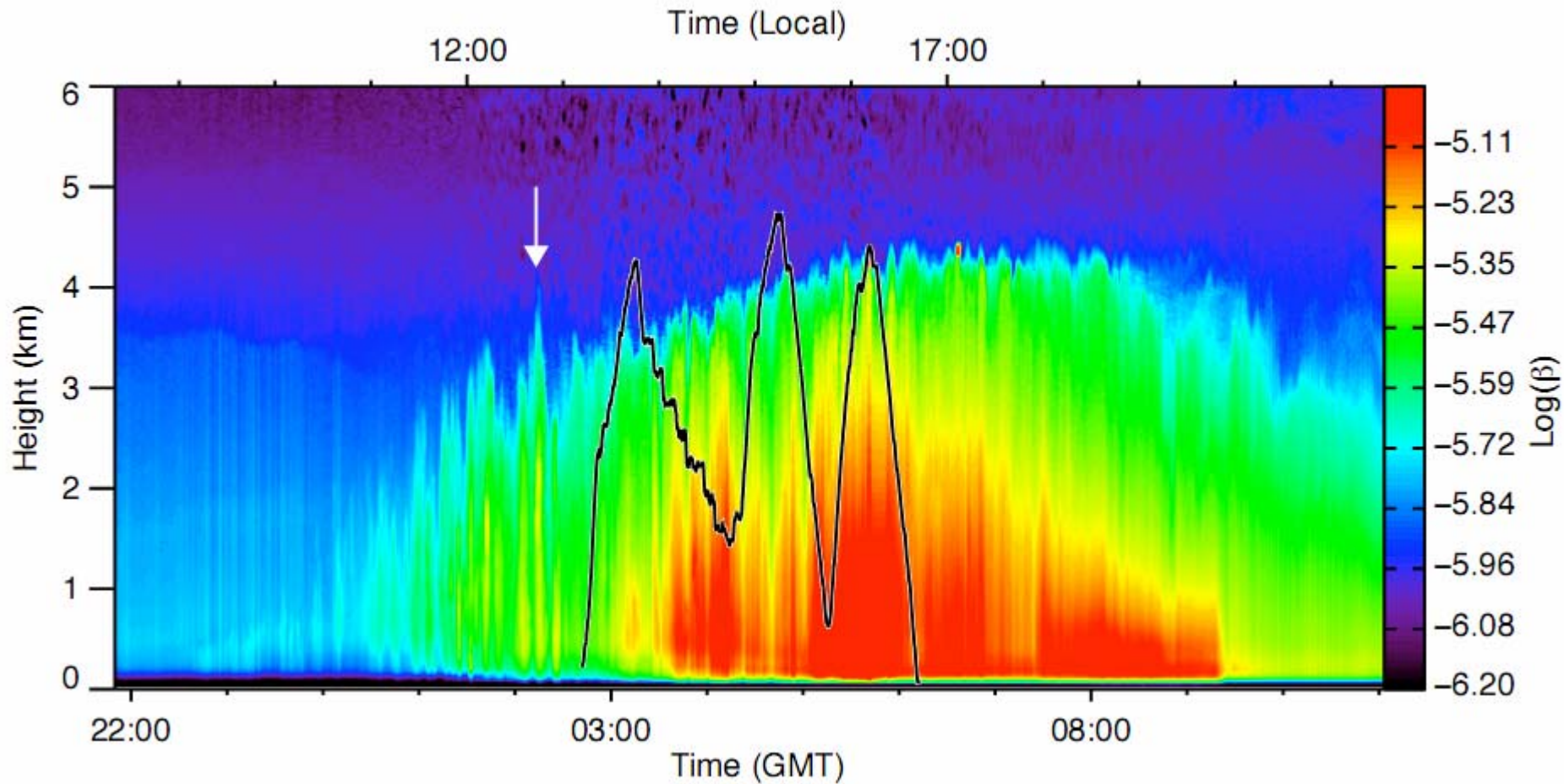




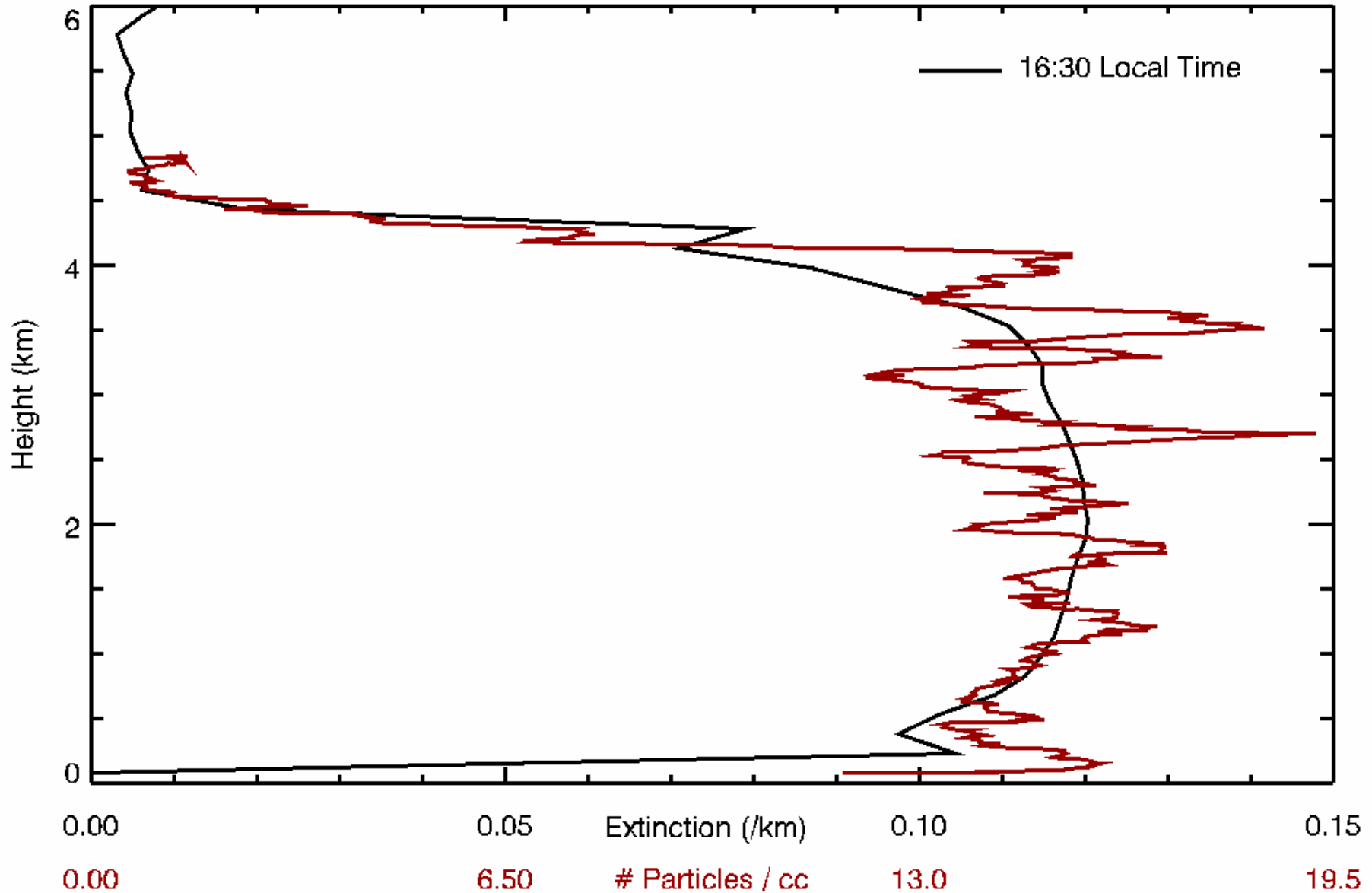
3531896



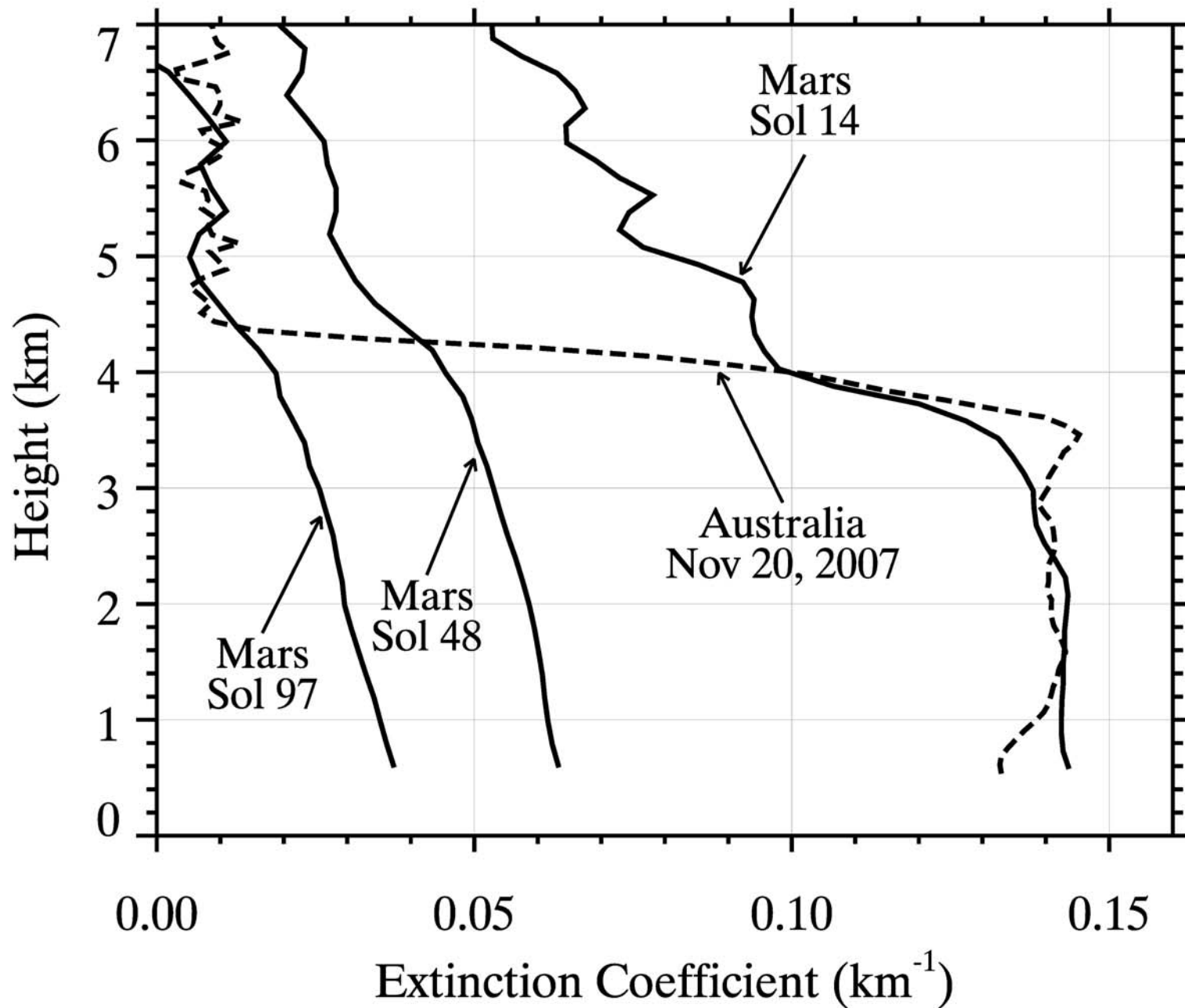
# Lidar Measurements of Dust Above Mulloorina



# Lidar and Aircraft In Situ Comparison



# Mars and Australia



**Aircraft ...**

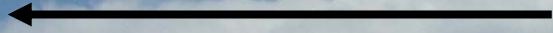
**Vital for Results of the Phoenix Mars Mission**

# Climate Processes

## Humidity in the Tropical Upper Troposphere

### Outflow from Tropical Convection

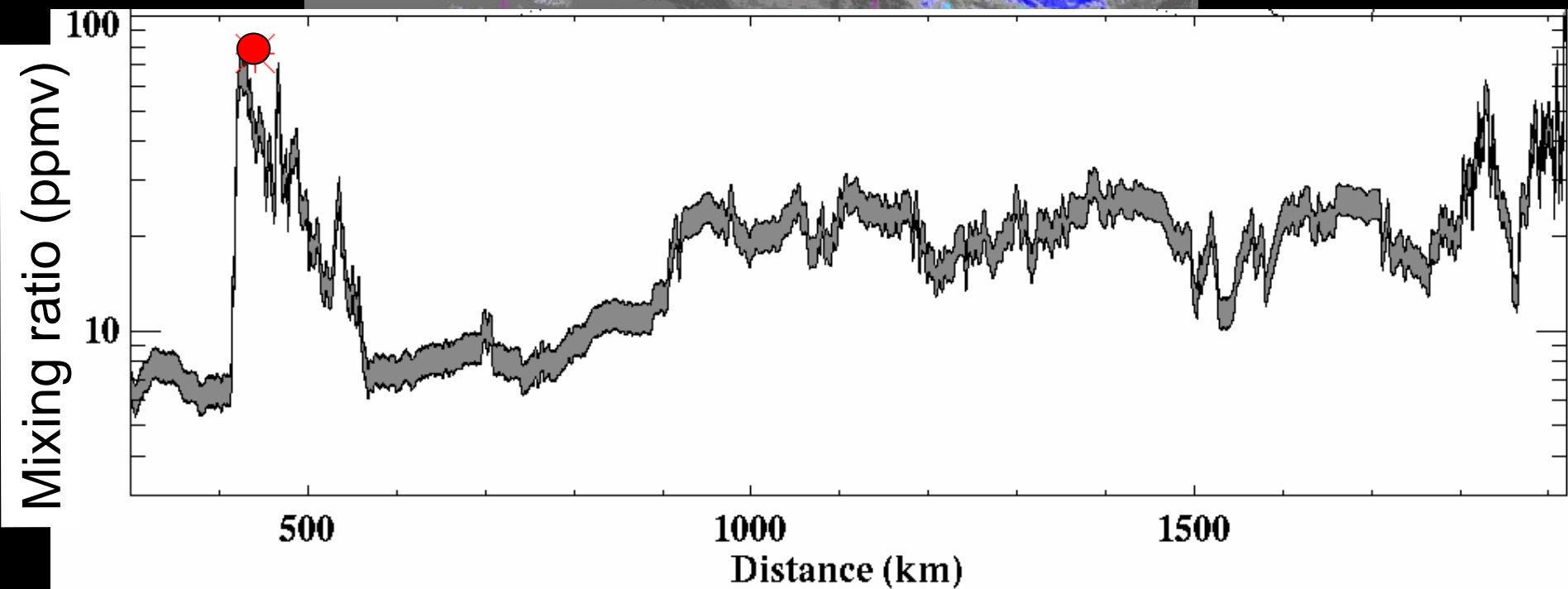
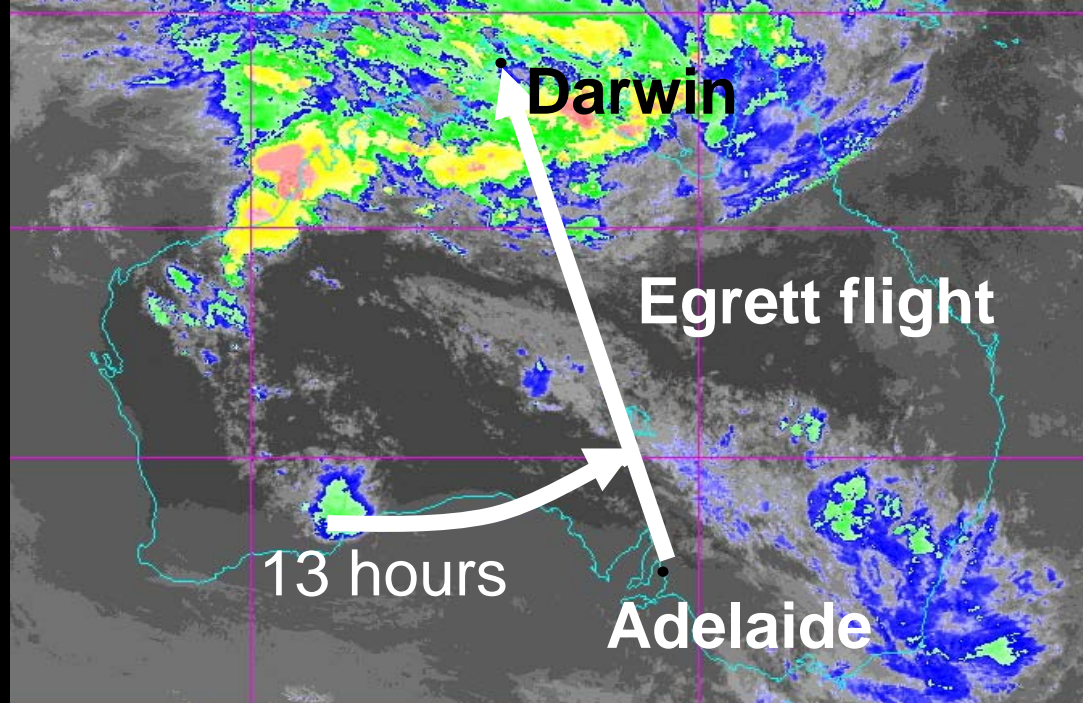
(Hector)



15 km: **Outflow cirrus**

10-15 km: **Moisture**





# Moving Forward with the Egrett

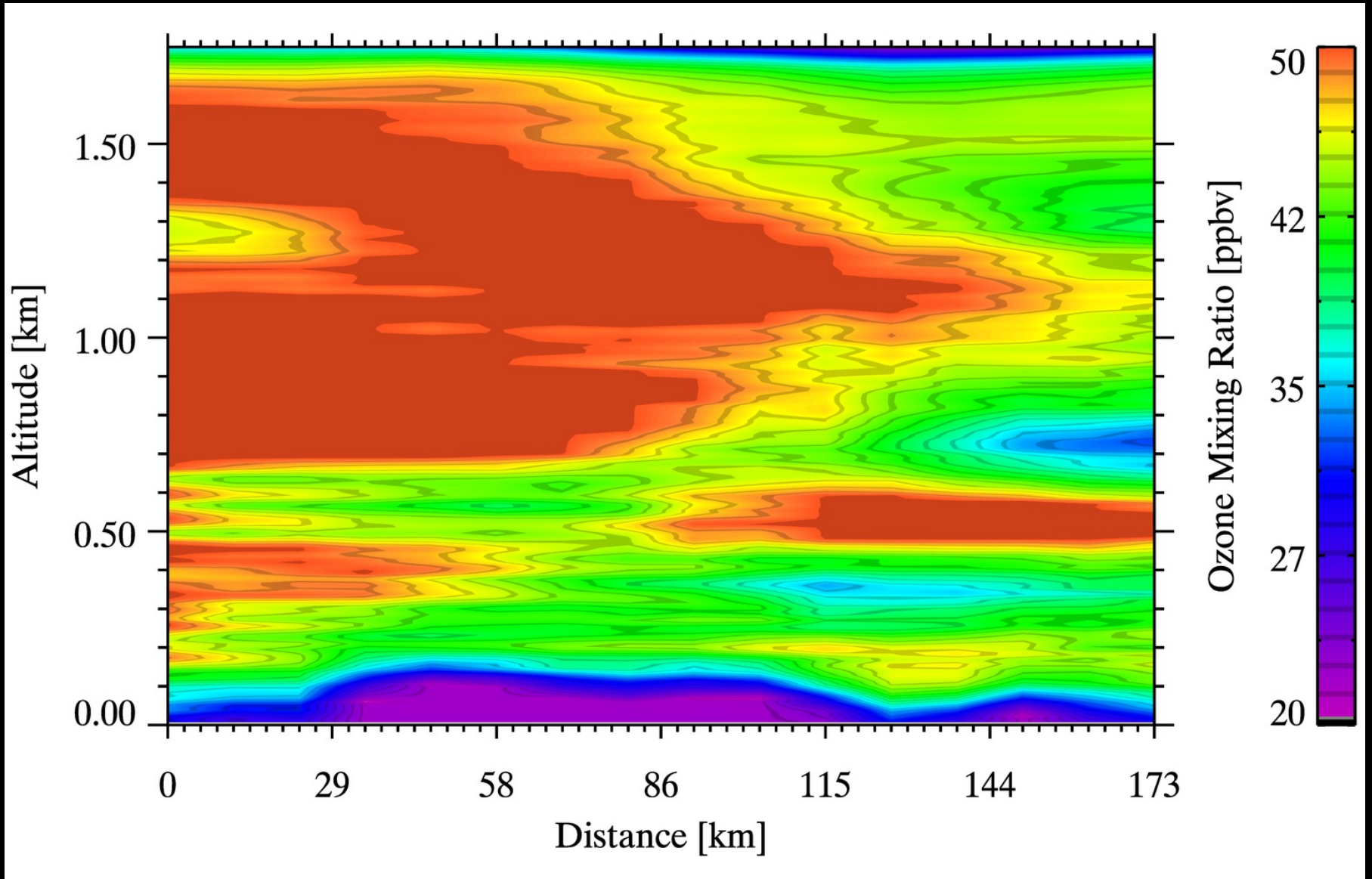
- Water in the upper troposphere, lower stratosphere
- Testing and characterization of instruments for space missions

# Polar-5 (DC-3) Arctic Flights April 2009, 2011

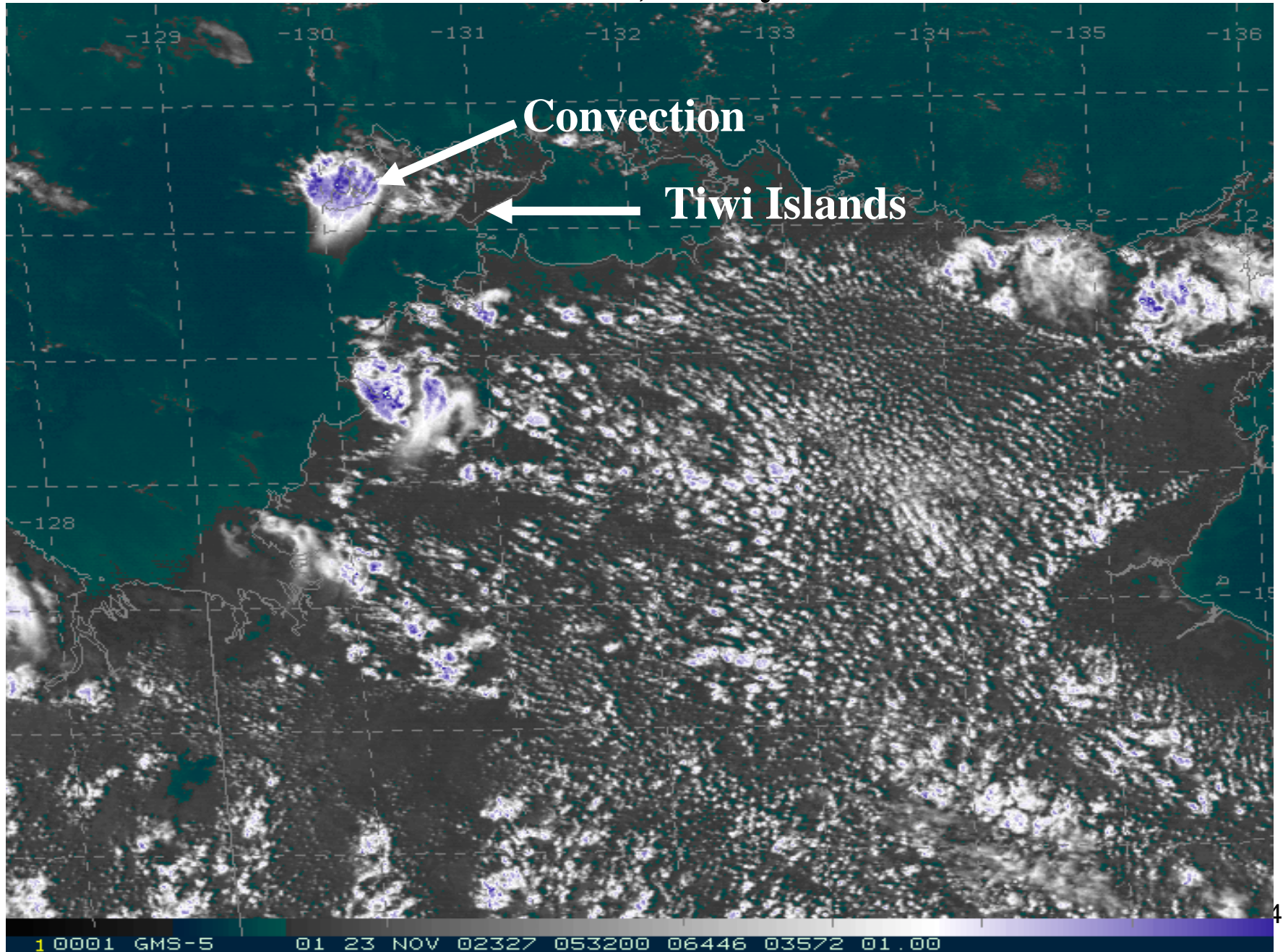




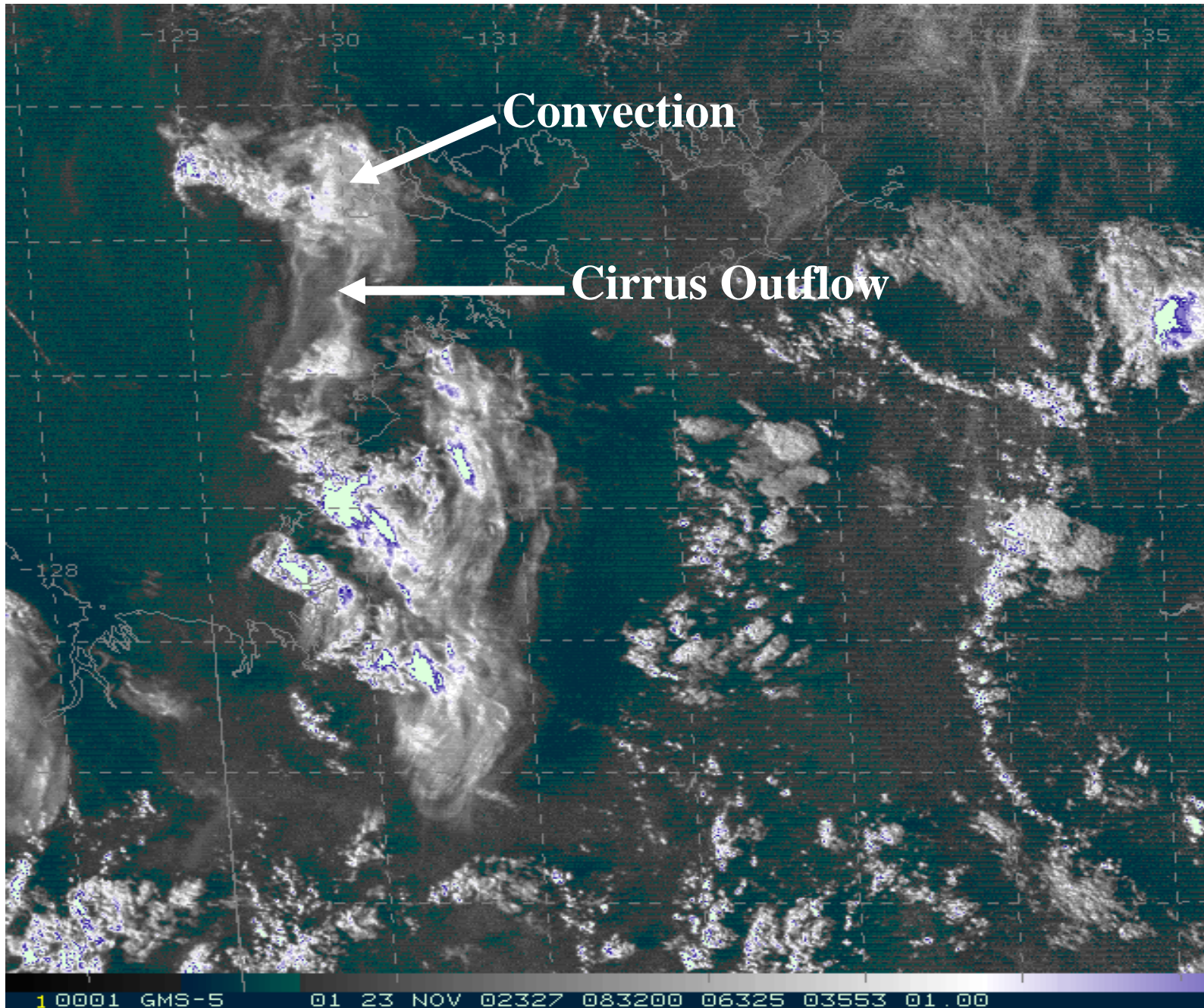
# Polar-5 Lidar Ozone Measurements Over Sea Ice



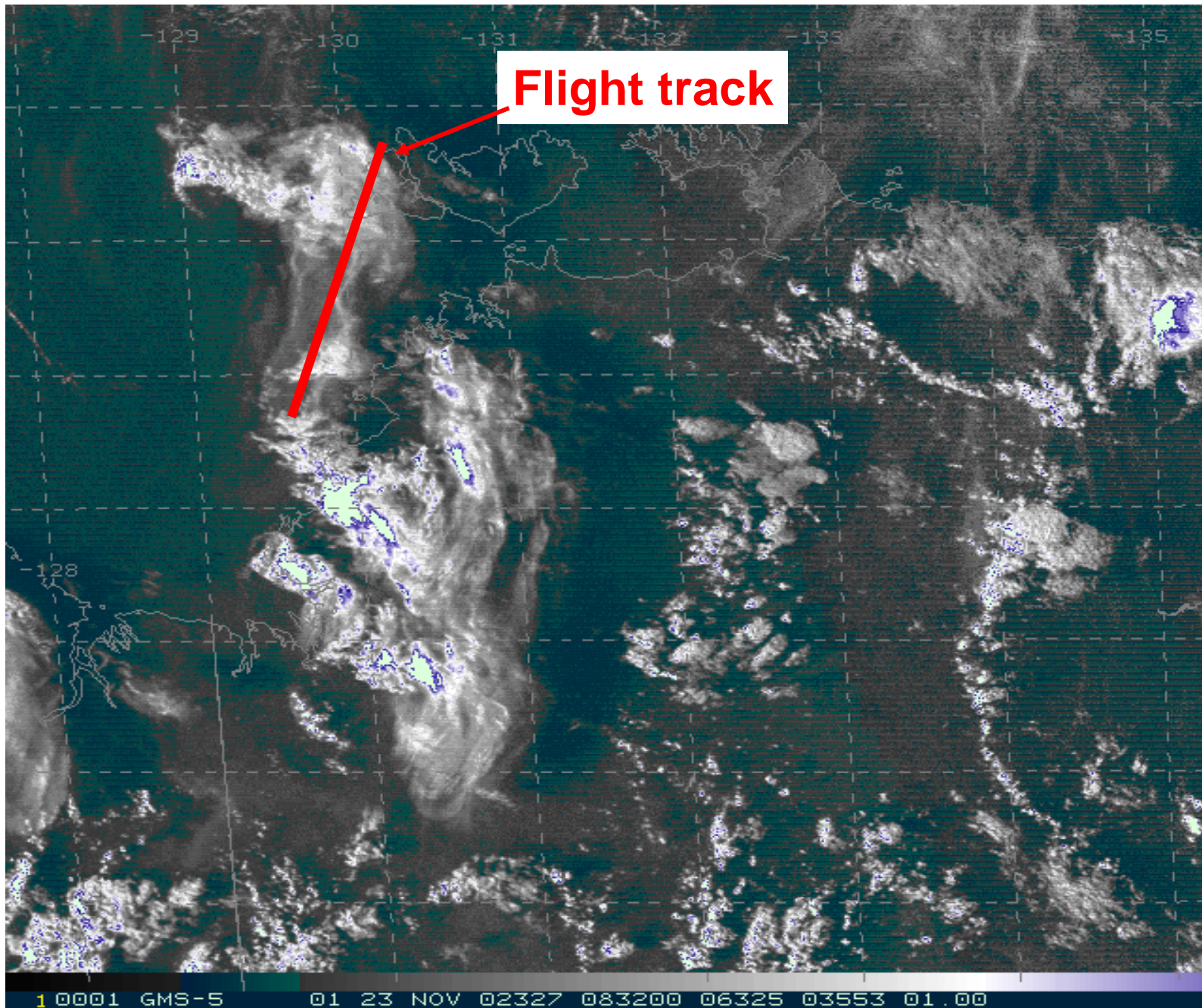
# 23 November 2002, Early afternoon

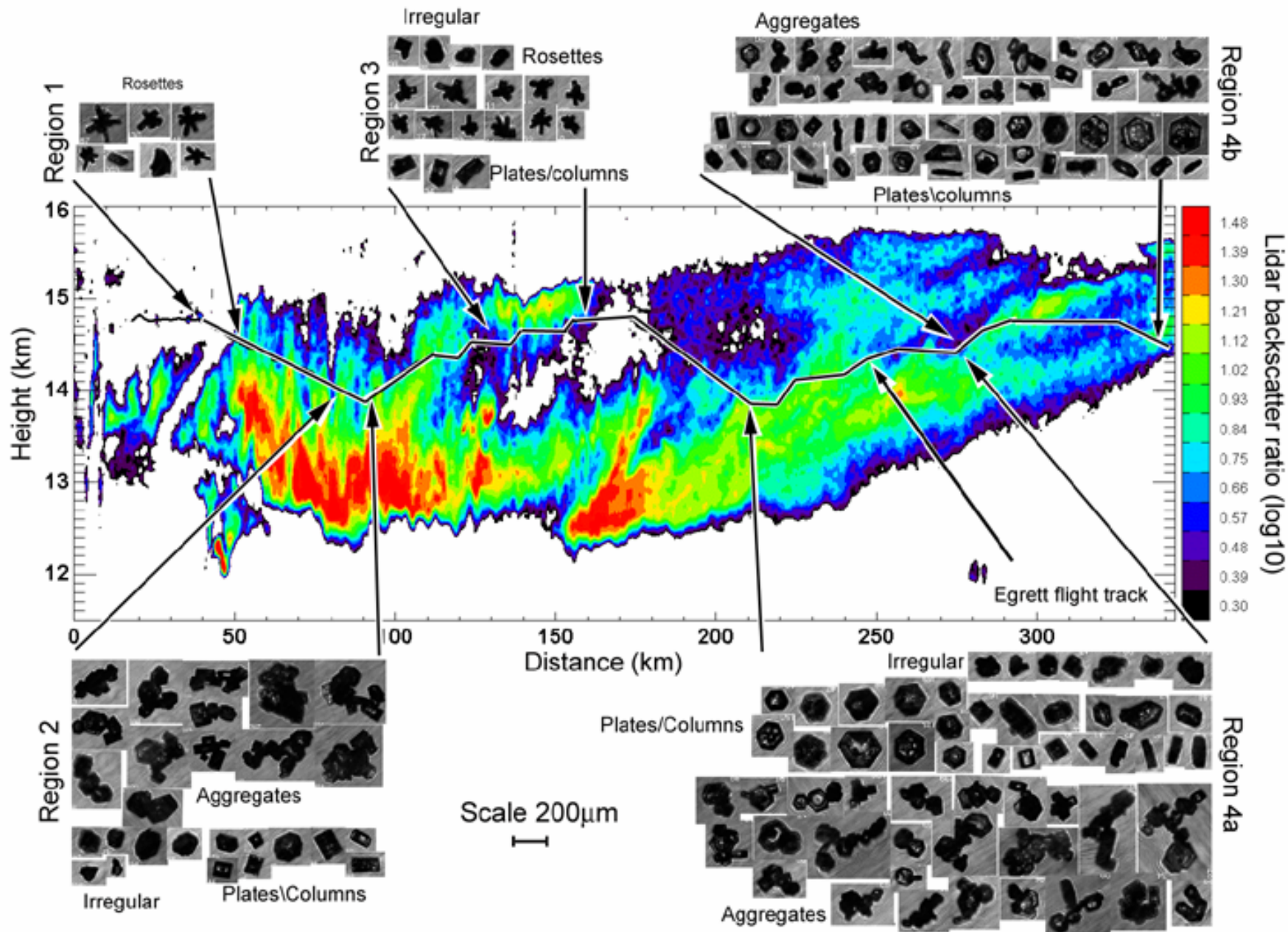


**23 November 2002, Late afternoon**

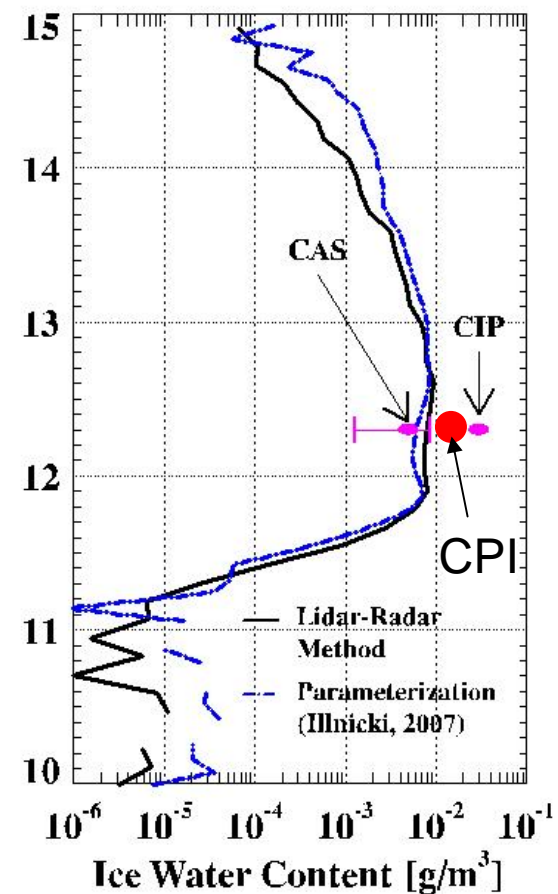
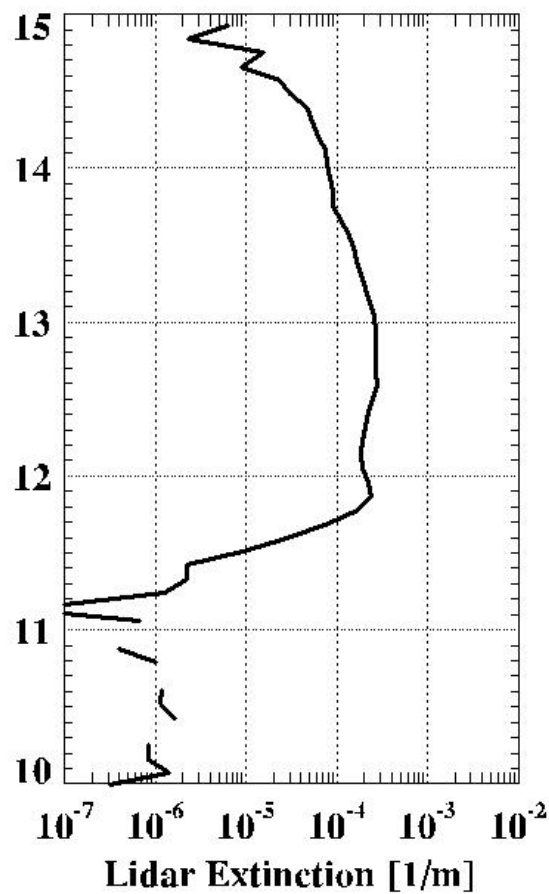
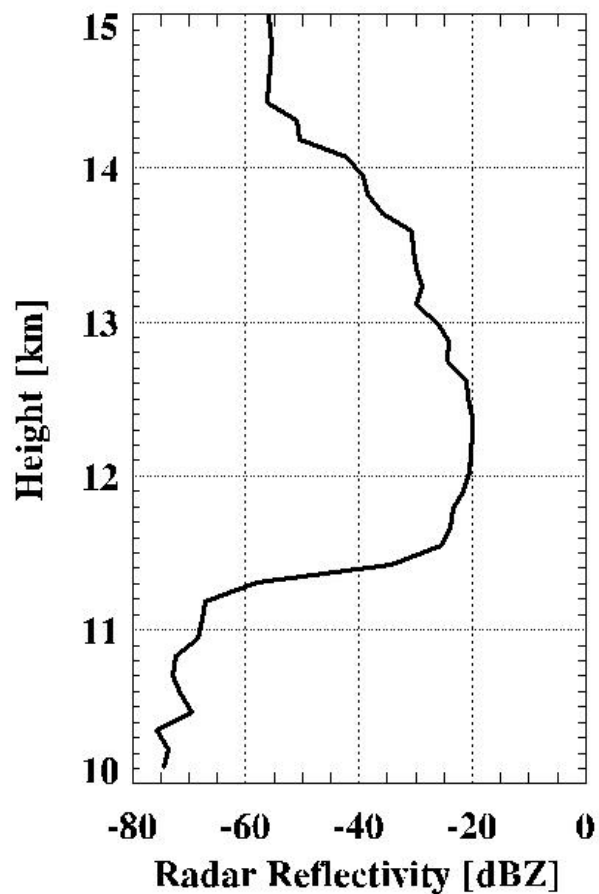


# Flight leg along the outflow



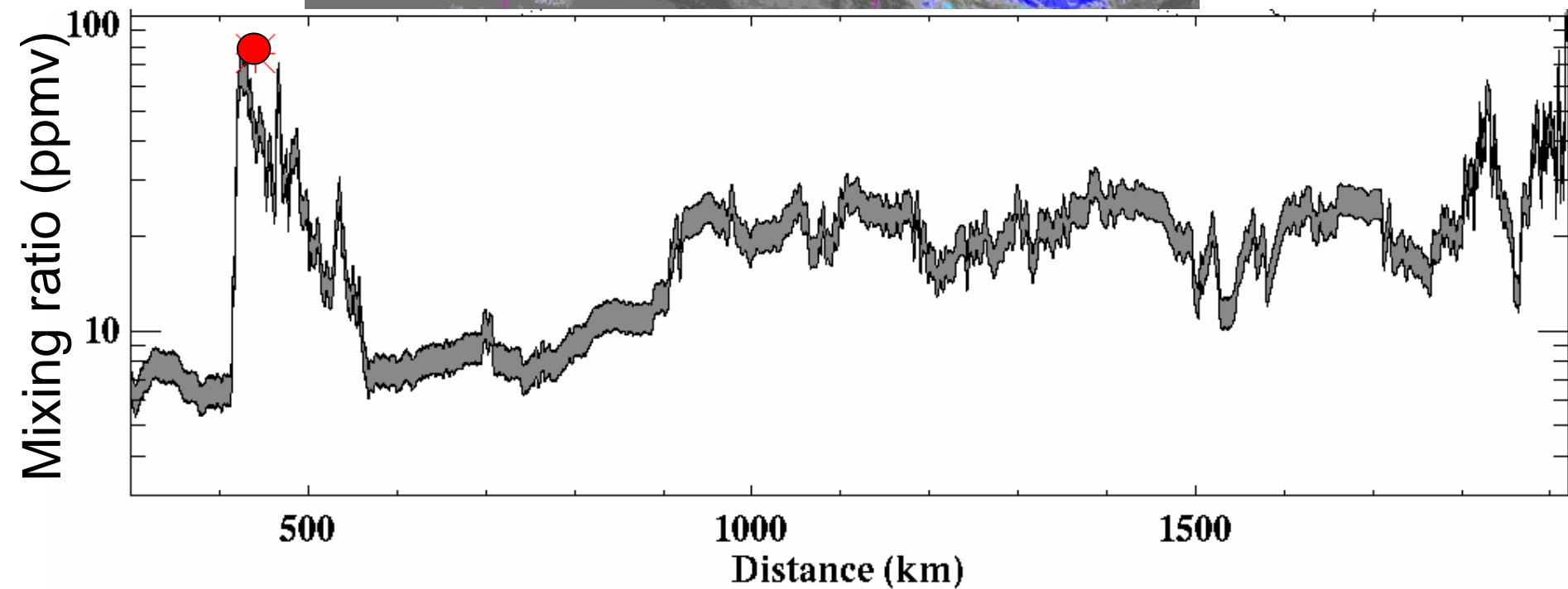
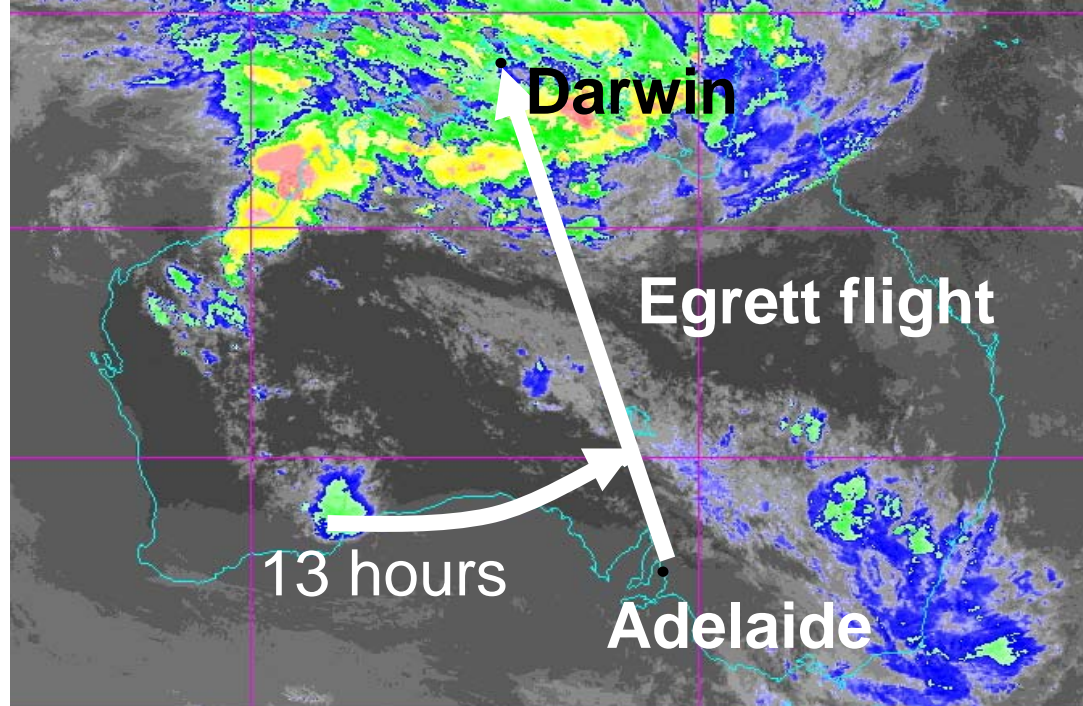


# Lidar-Radar Analysis / Jan 27, 2006 / 7:08 - 7:12 UTC



# Egrett Open Path Tunable Diode Laser







# York University Ozone Lidar on Polar-5

J. Seabrook, L. Gray, L. Komguem, J. Whiteway



# Phoenix Lidar

## Testing at CSA David Florida Laboratory, Ottawa



# Alberta, NWT, Forest Fire Smoke, July 2009



# Aircraft Atmospheric Science at York

**Mars**

**Clouds**

**Desert Dust**

**Forest Fire Smoke**

**Atmospheric Dynamics**

**Arctic Surface Ozone Chemistry**