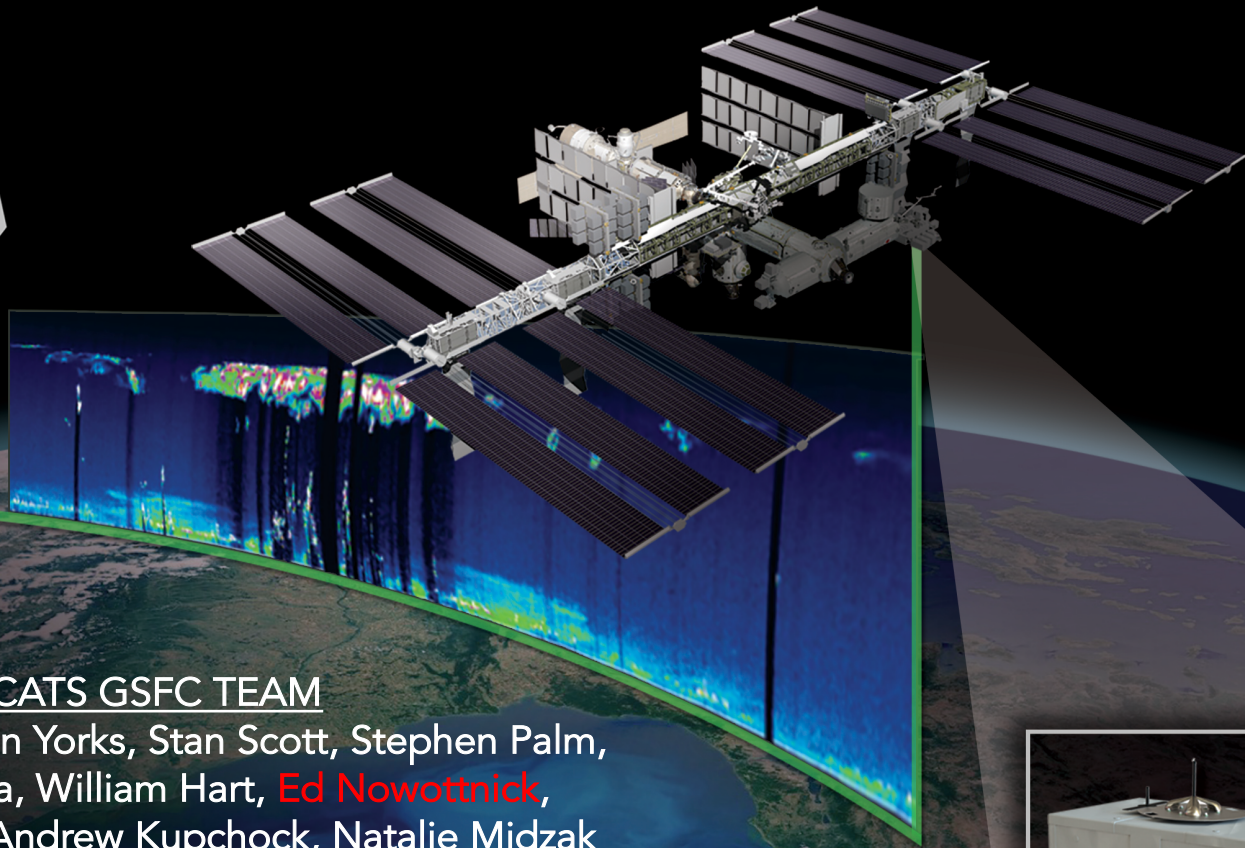


CATS Aerosol Typing and Future Directions



CATS GSFC TEAM

Matt McGill, John Yorks, Stan Scott, Stephen Palm,
Dennis Hlavka, William Hart, **Ed Nowottnick**,
Patrick Selmer, Andrew Kupchock, Natalie Midzak

CATS LaRC Team

Chip Trepte, Mark Vaughan, Sharon Rodier, Tim Murray, Mike Jensen

NASA GEOS-5 Collaborators

Peter Colarco, Arlindo da Silva, Virginie Buchard-Marchant



Overview

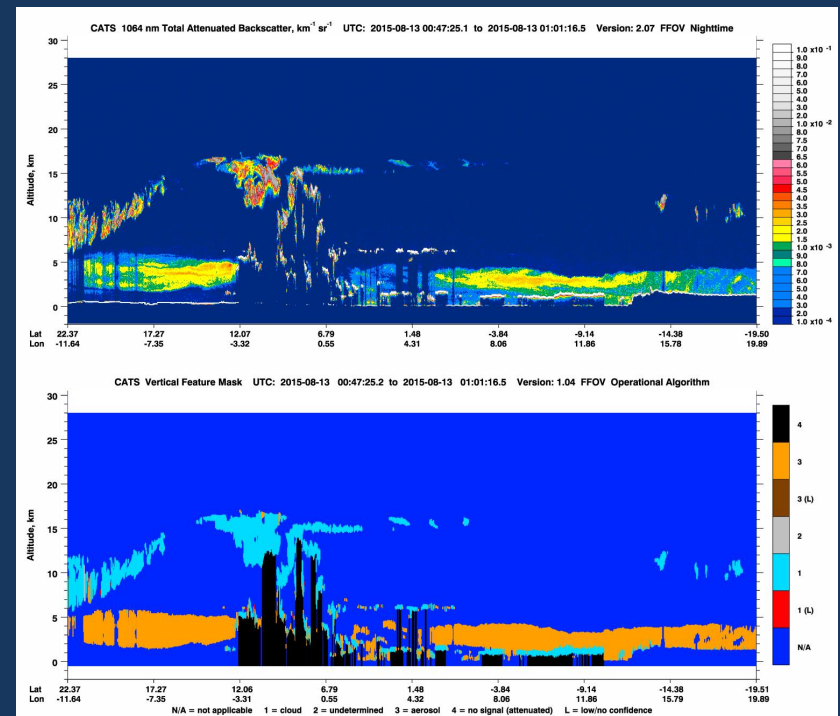
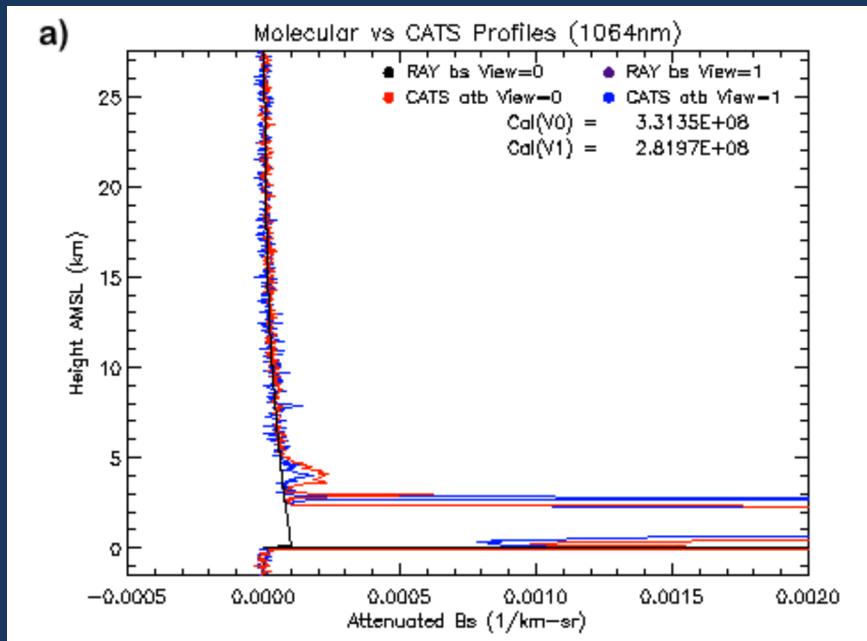
- CATS Mode 2 Aerosol Typing Algorithm
- Case Studies
- Known Issues, Challenges and Current Efforts
- CATS Mode 1 Aerosol Typing Algorithm
- Future Plans
- Getting CATS Data

Why do we need aerosol type?

- An extinction to backscatter ratio (lidar ratio) is needed to derive extinction products from observed backscatter.
- For standard backscatter lidars like CATS, lidar ratios are assigned for aerosol types.

1. The CATS feature detection algorithm first looks for regions of enhanced attenuated scattering ratios (observed to molecular) within a 5 km averaged profile.

2. Aerosol features are discriminated from cloud features using layer integrated total attenuated backscatter, integrated depolarization ratio, temperature, thickness, and color ratio (Mode 1 only).



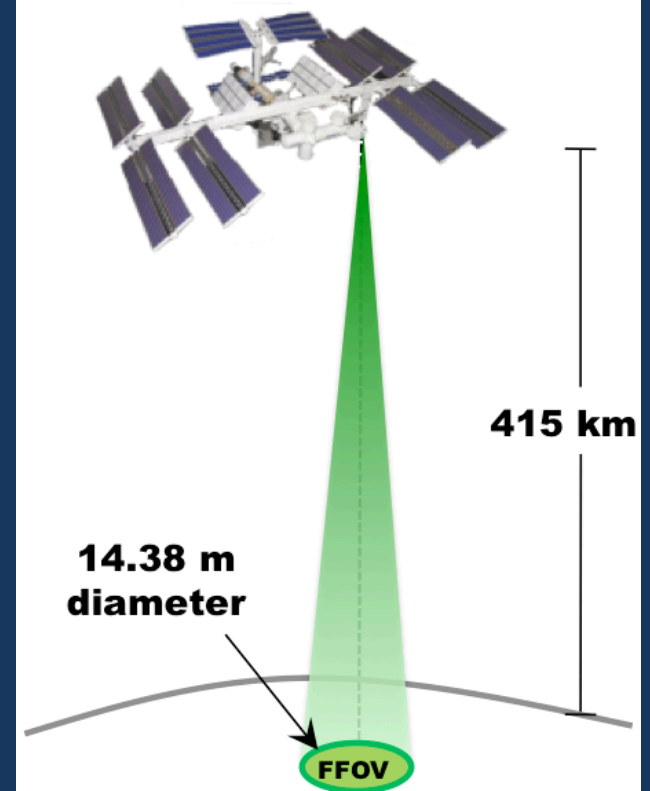
CATS Mode 2 Aerosol Typing Overview

- Backscatter and Depolarization Ratio at 1064 nm
- Backscatter at 532 nm is very noisy and is not used in the algorithm
- For our version 1 Mode 2 aerosol typing, we rely on heritage from CALIOP

Aerosol Type	1064 nm Lidar Ratio
Marine	45
Dust	55
Dust Mixture	45
Clean/Background	35
Polluted Continental	35
Smoke	40
Volcanic Sulfate	35

Mode 2: Laser 2

Backscatter: 532, 1064 nm
Depolarization: 1064 nm
L2 Products: 1064 nm



Semi-continuous operation:
25 Mar. 2015 – Present

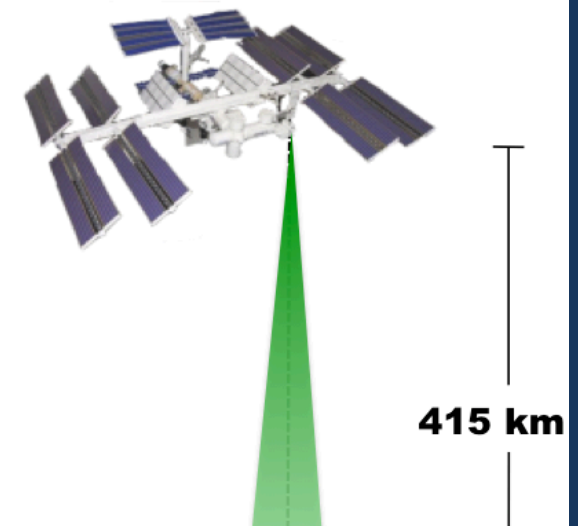
CATS Mode 2 Aerosol Typing Overview

- Backscatter and Depolarization Ratio at 1064 nm
- Backscatter at 532 nm is very noisy and is not used in the algorithm
- For our version 1 Mode 2 aerosol typing, we rely on heritage from CALIOP

Aerosol Type	1064 nm Lidar Ratio
Marine	45
Dust	55
Dust Mixture	45
Clean/Background	35
Polluted Continental	35
Smoke	40
Volcanic Sulfate	35

Mode 2: Laser 2

Backscatter: 532, 1064 nm
Depolarization: 1064 nm
L2 Products: 1064 nm



Opportunity for models to help

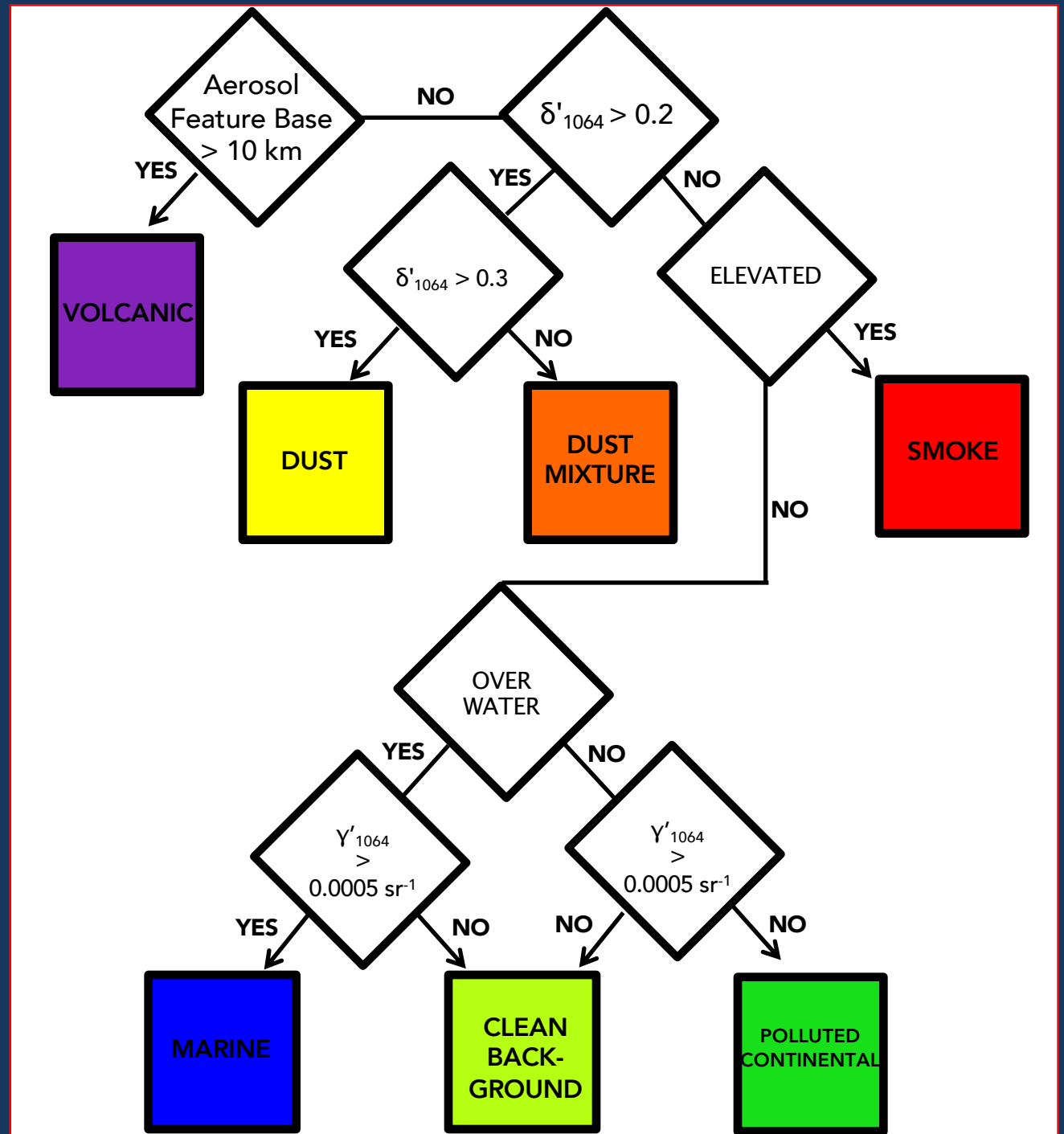
ion:
ent

CATS Mode 2 Aerosol Typing Algorithm

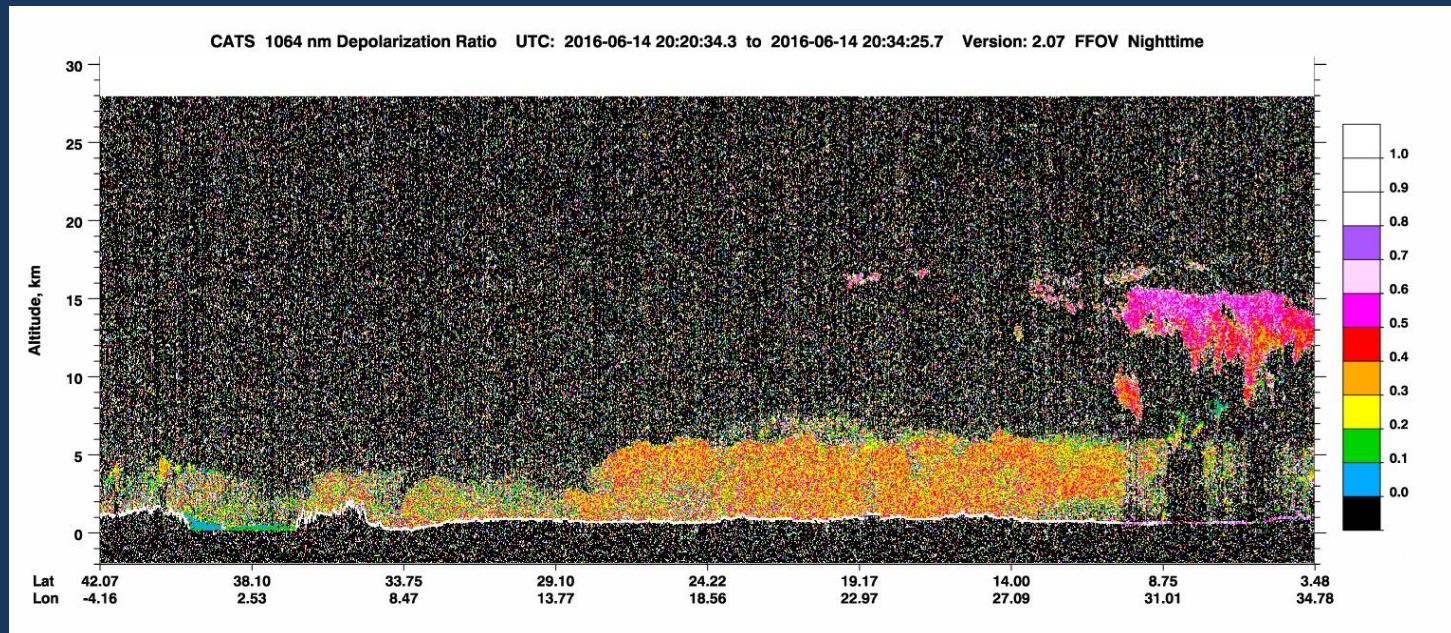
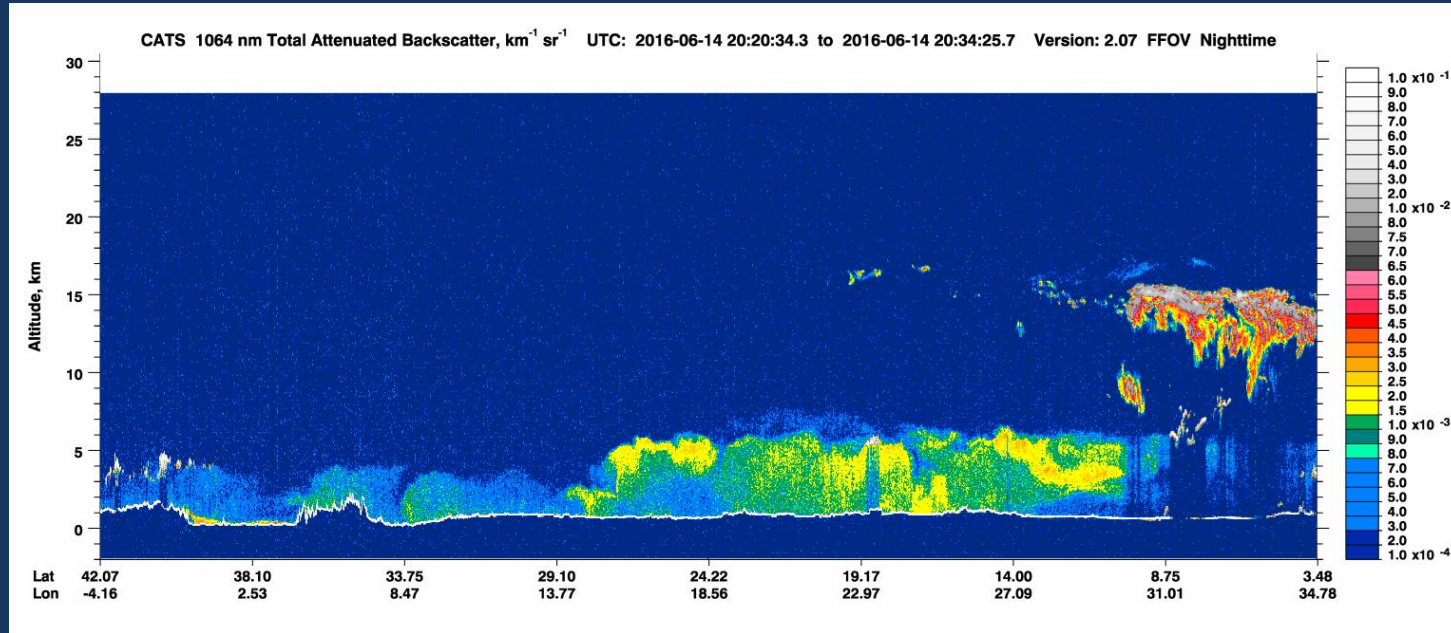
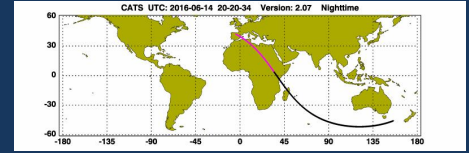
Inputs:

- Feature Integrated Depolarization Ratio at 1064 nm (δ'_{1064}) averaged to 5 km horizontally
- Feature Integrated Total Attenuated Backscatter at 1064 nm (γ'_{1064}) averaged to 5 km horizontally
- Surface Type (for maritime)
- Feature Altitude

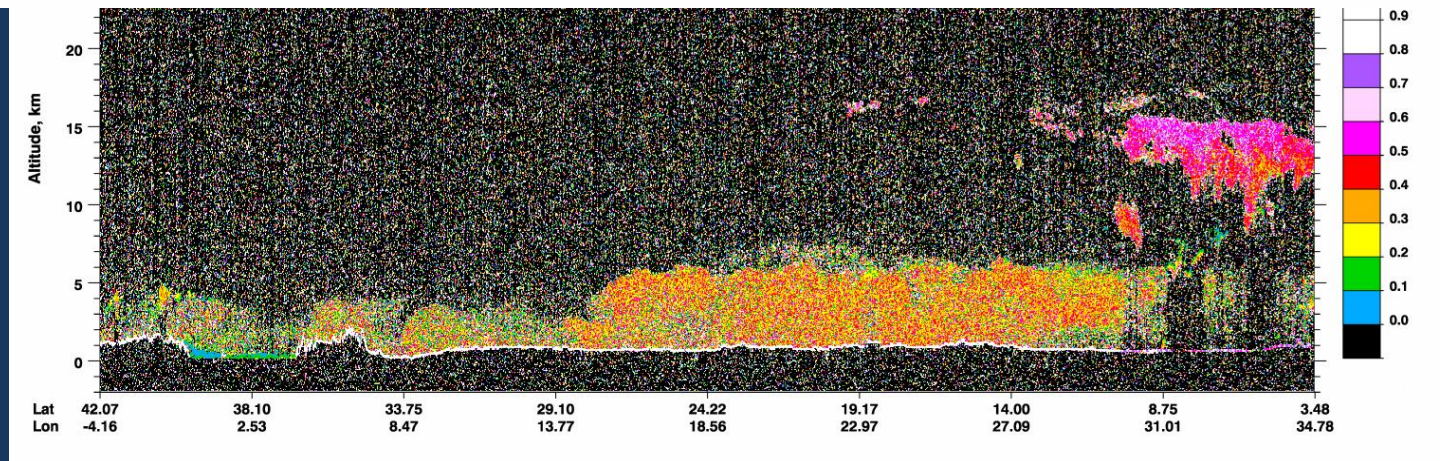
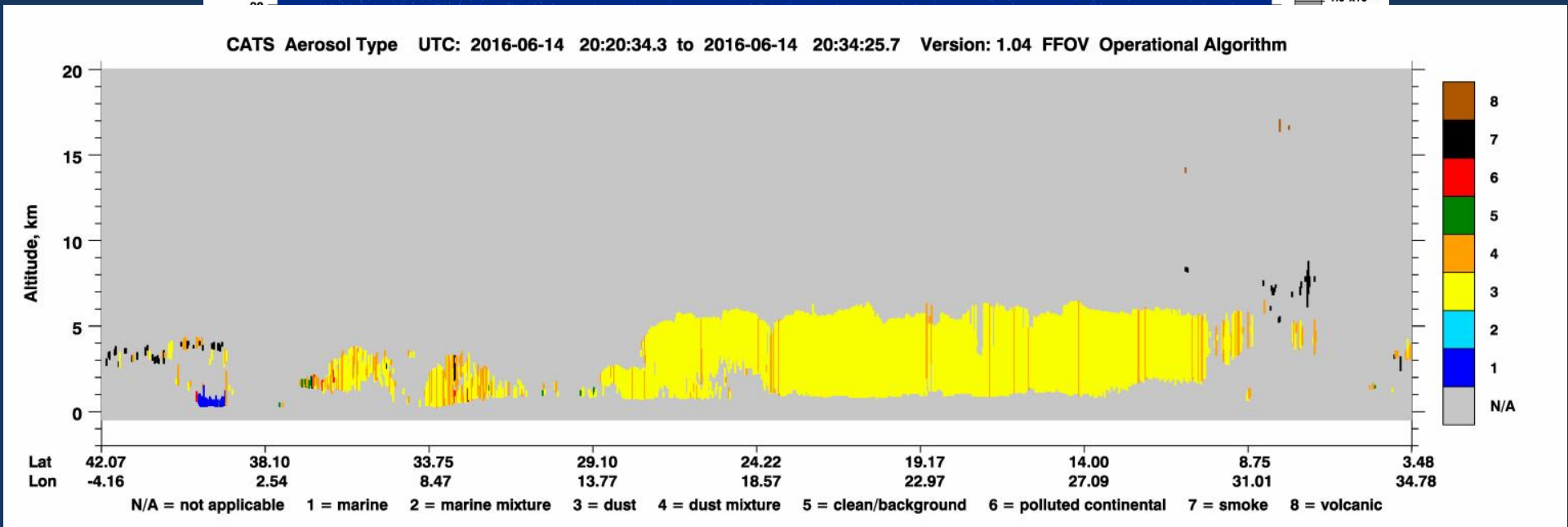
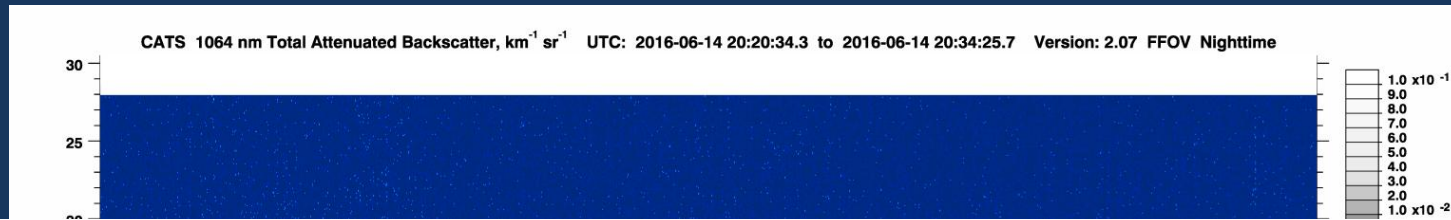
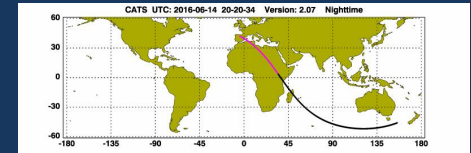
* Heritage from CALIOP aerosol typing algorithm



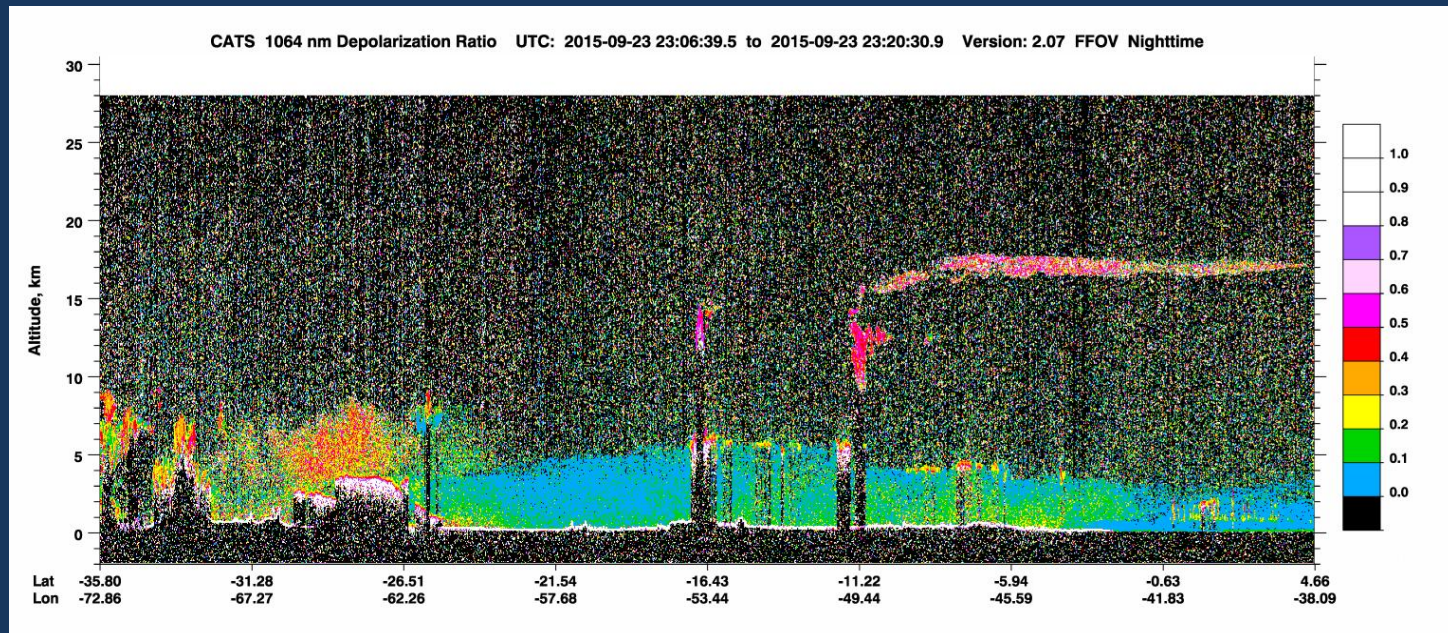
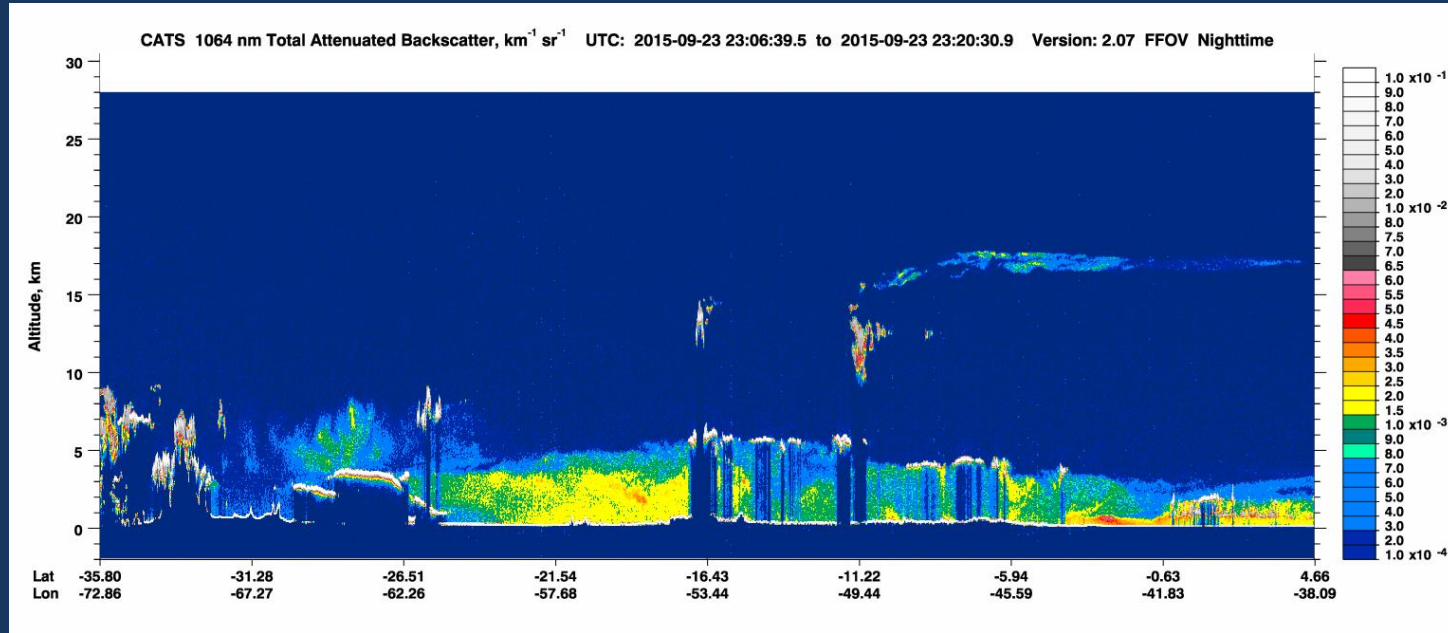
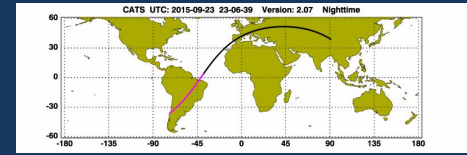
Case Study: Saharan Dust



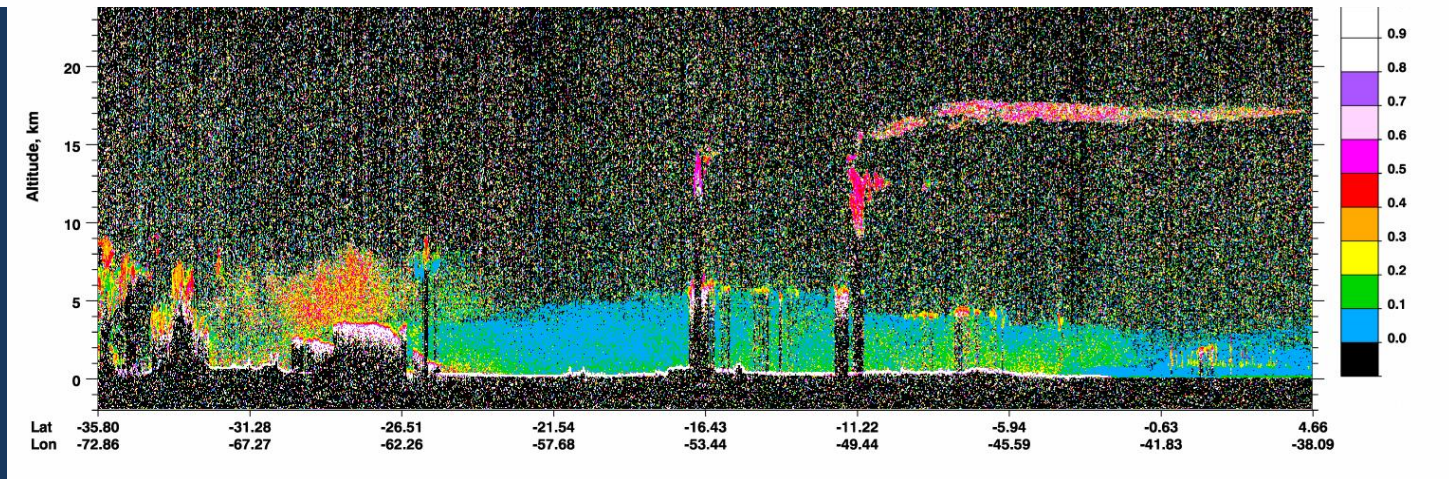
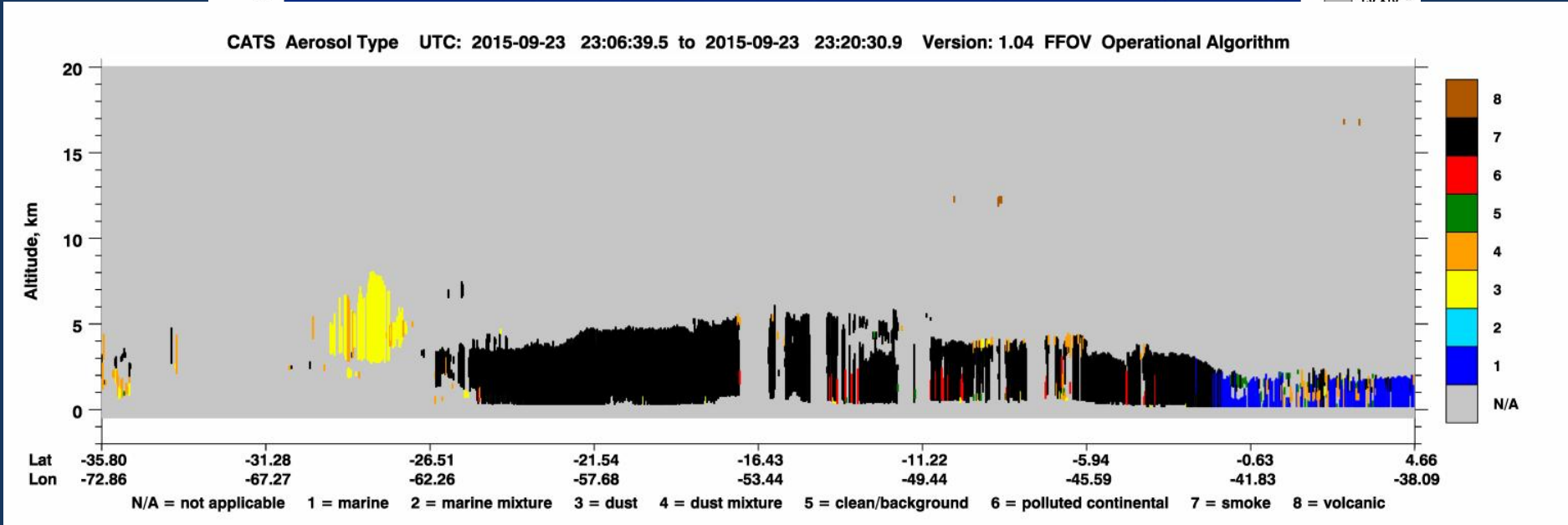
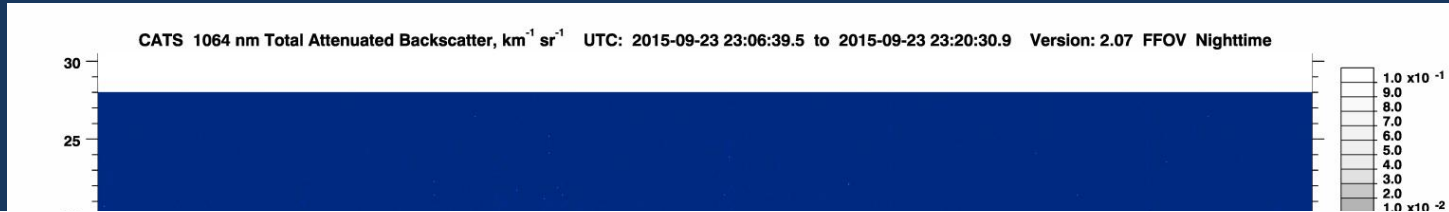
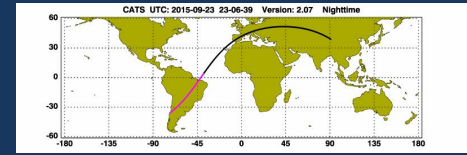
Case Study: Saharan Dust



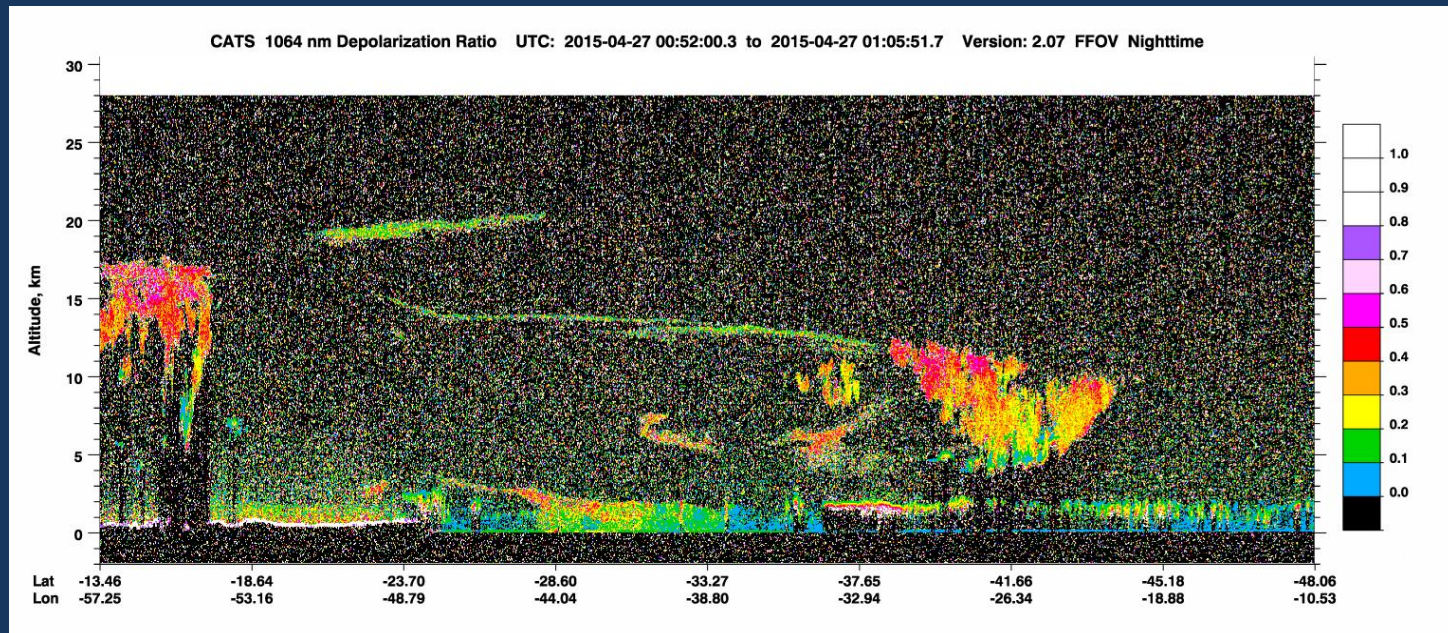
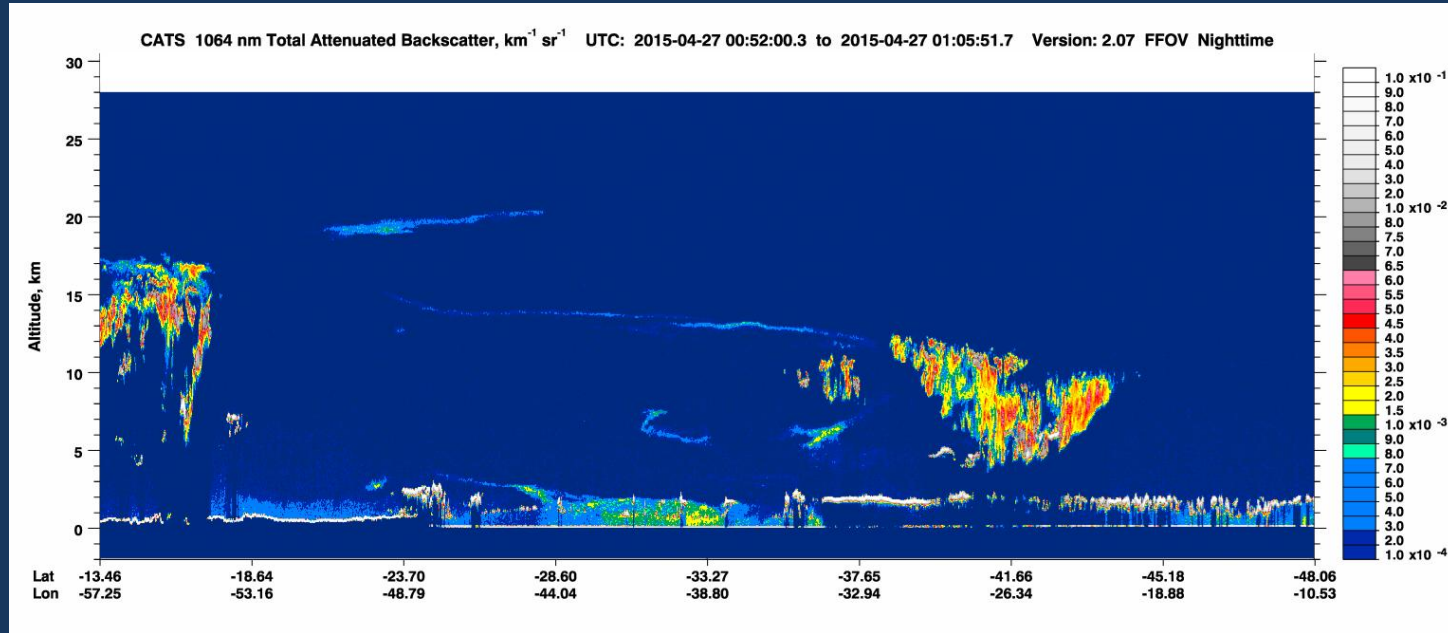
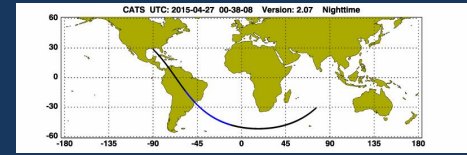
Case Study: Smoke over South America



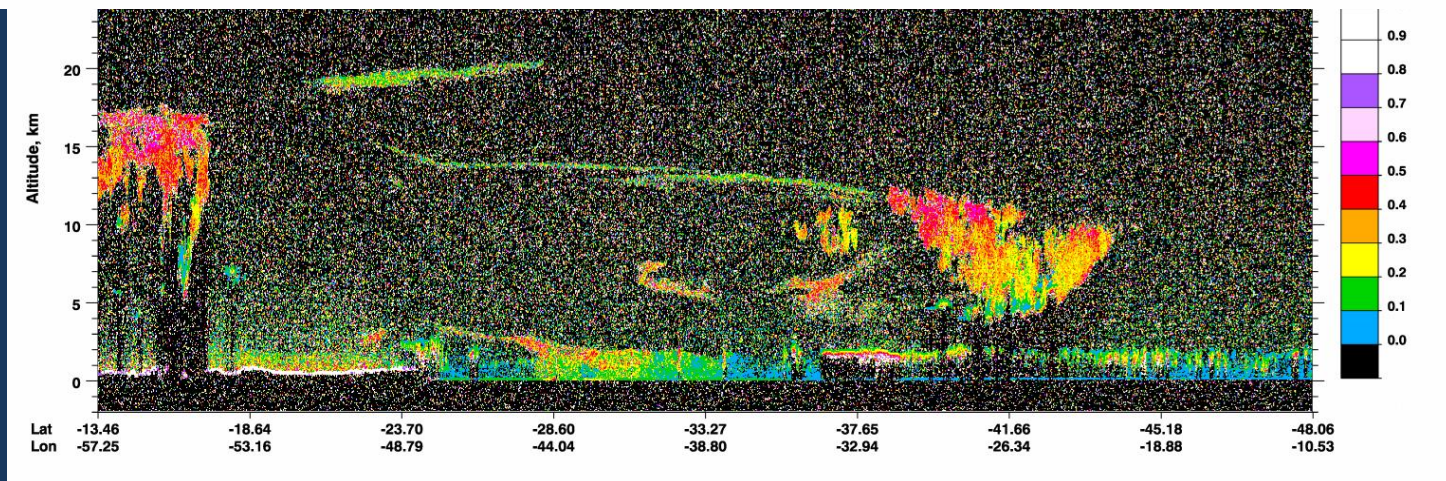
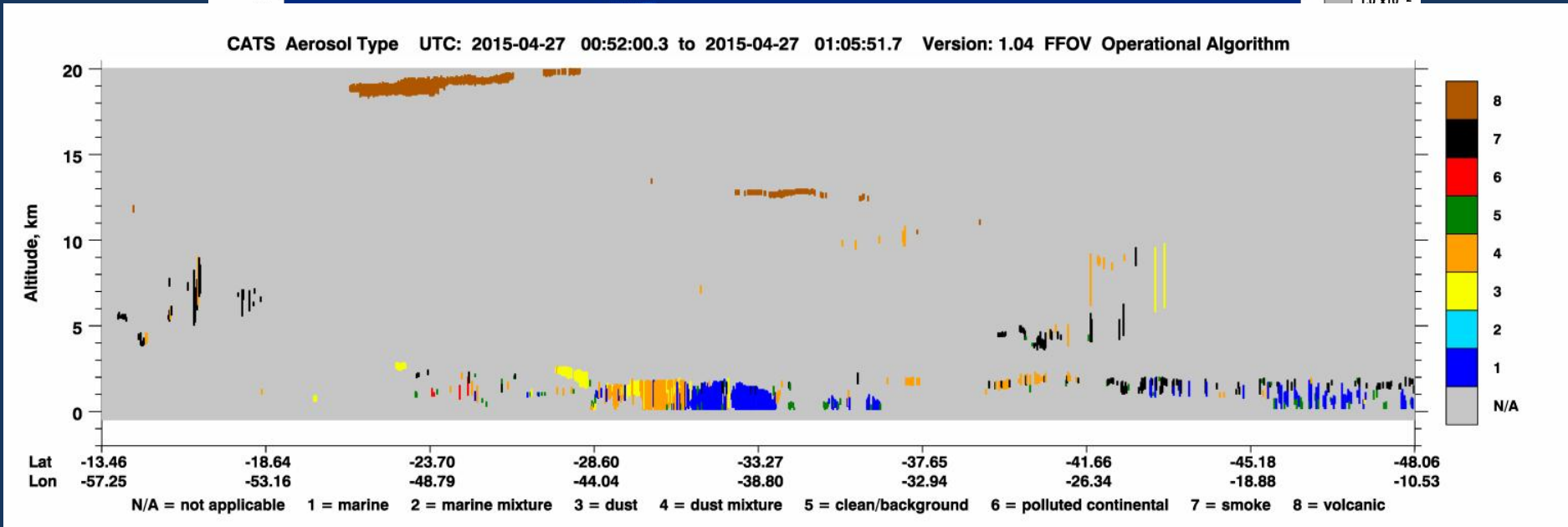
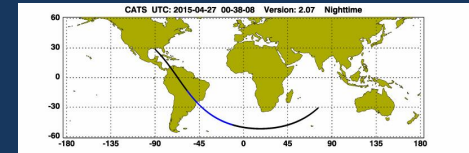
Case Study: Smoke over South America



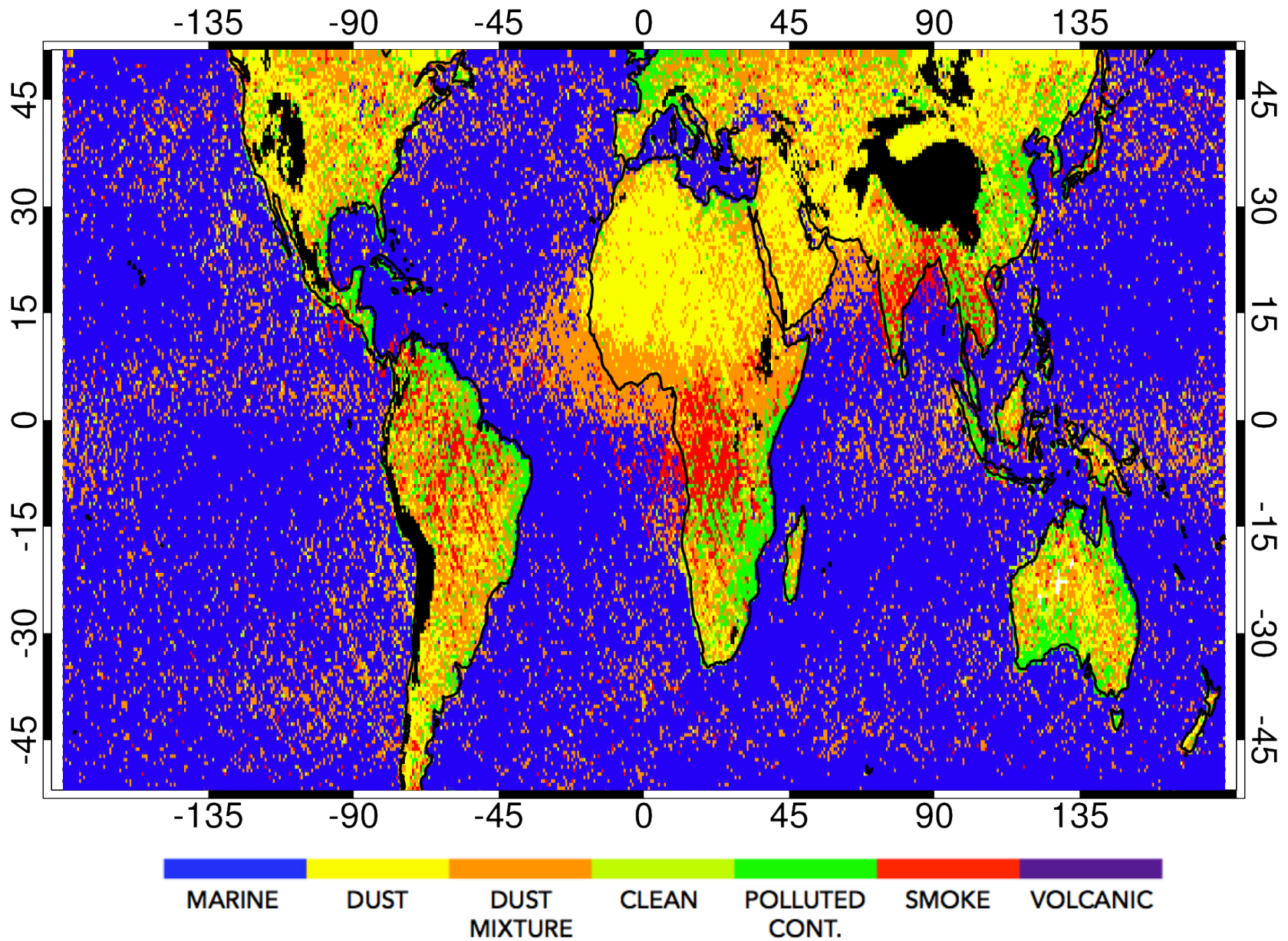
Case Study: Calbuco Eruption



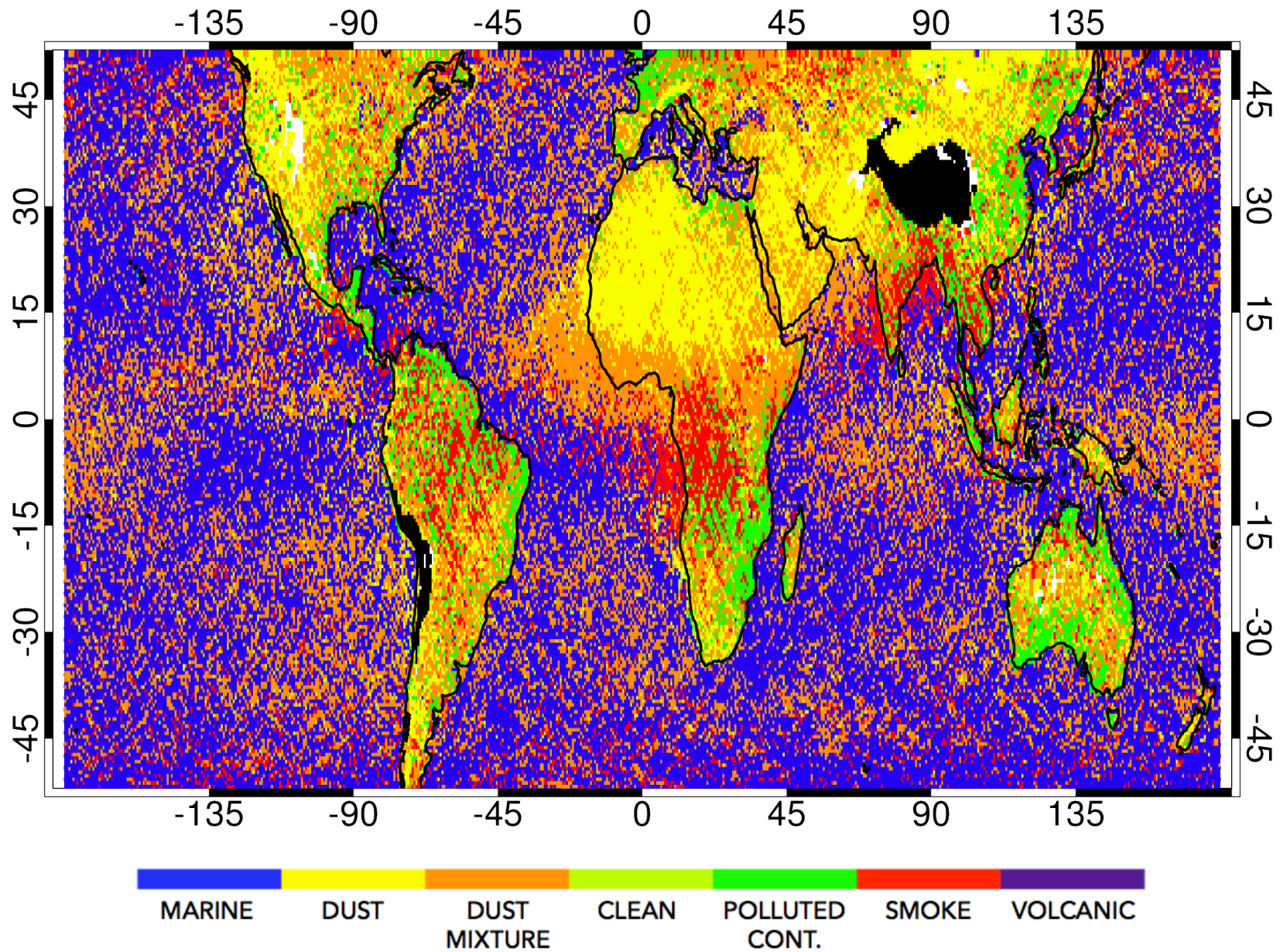
Case Study: Calbuco Eruption



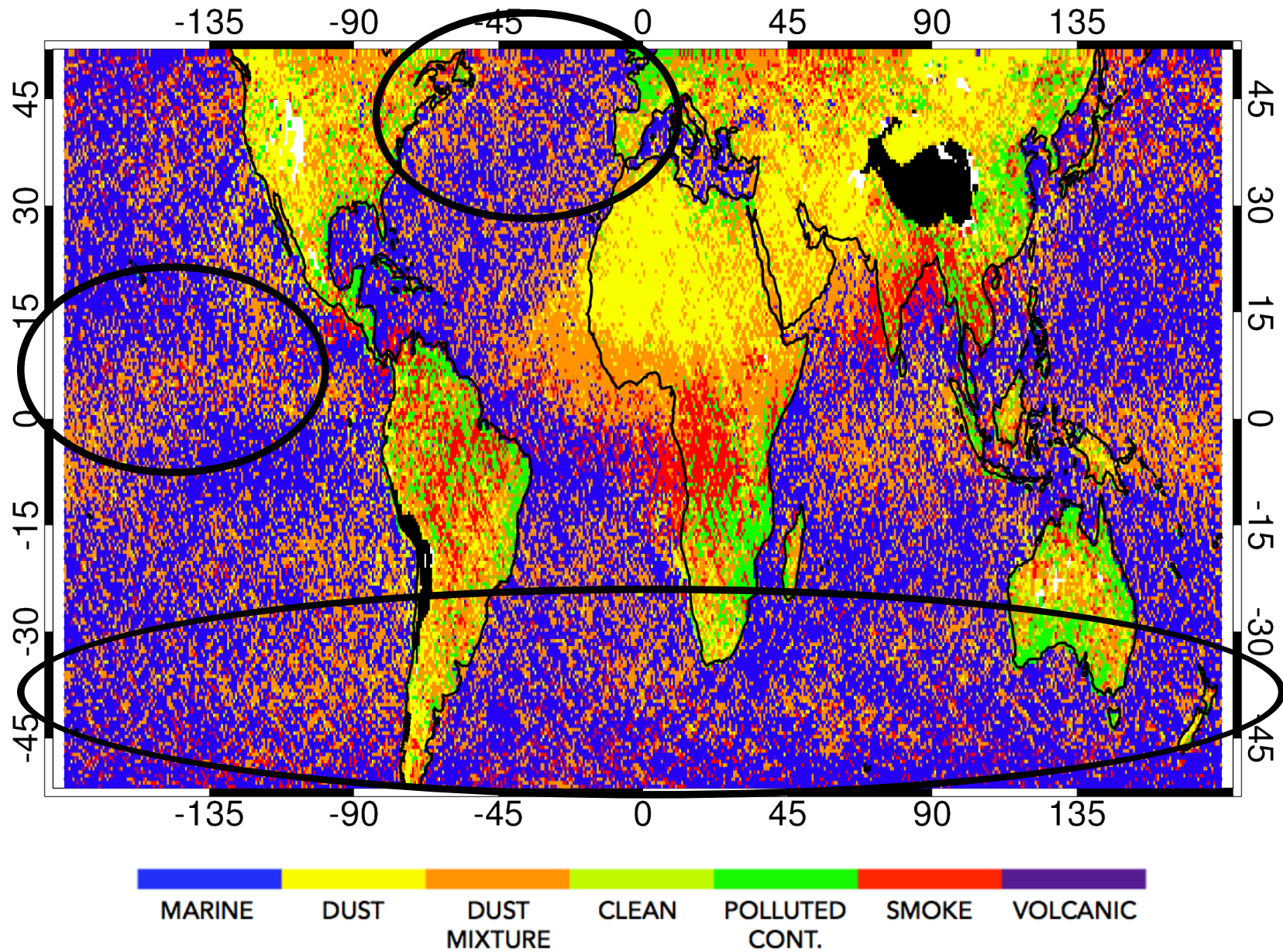
March 2015 – Present Aerosol Typing [0 – 2 km]



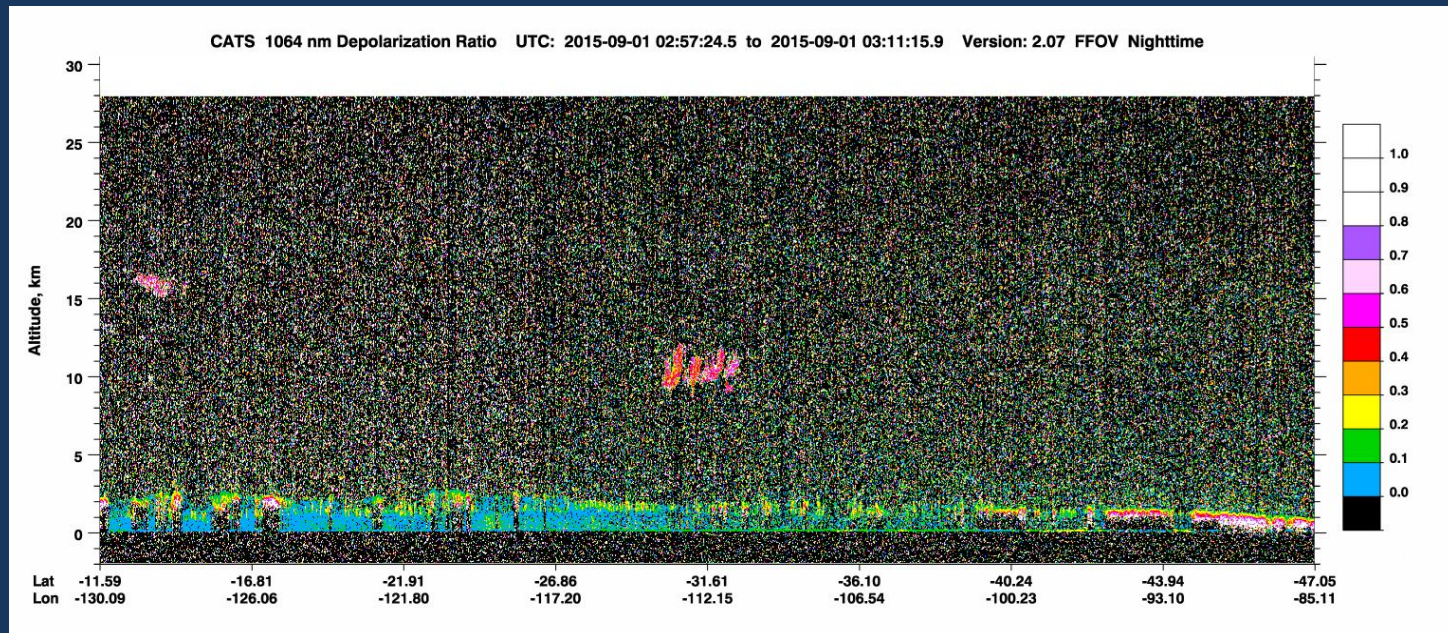
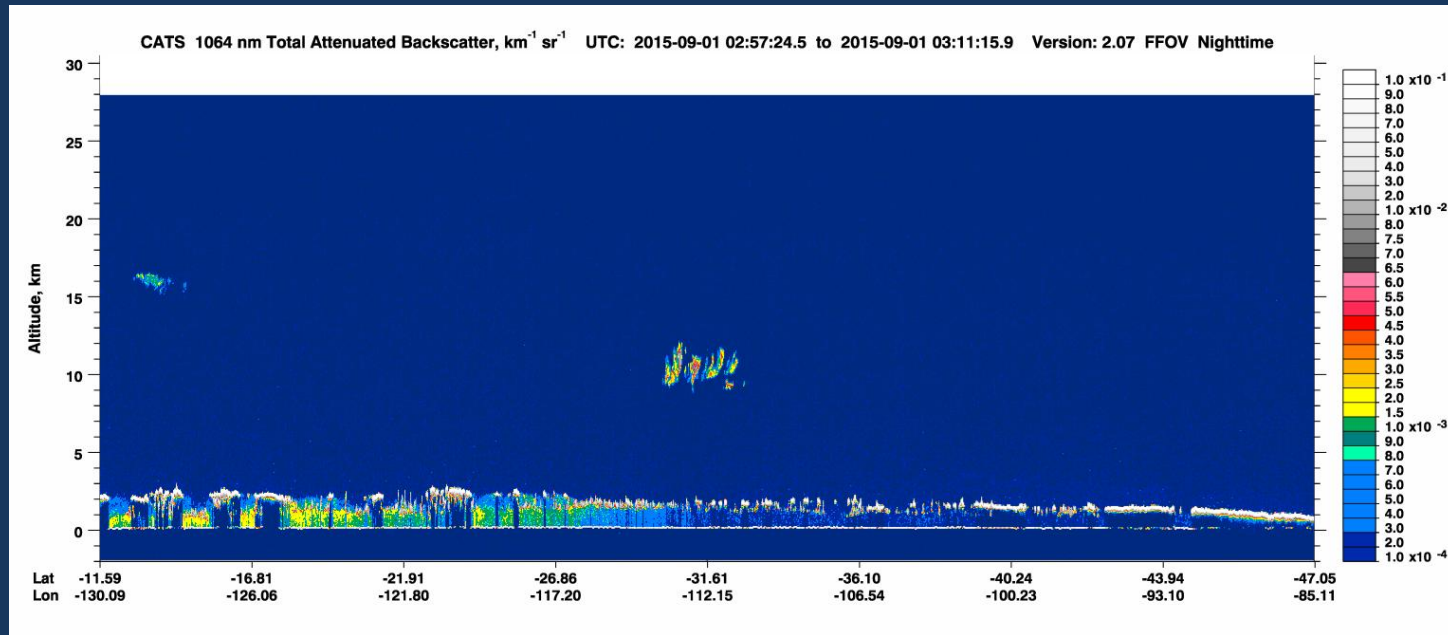
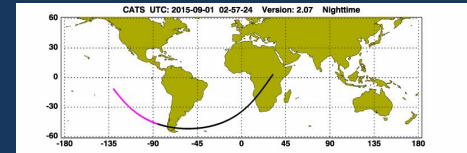
March 2015 – Present Aerosol Typing [1 – 2 km]



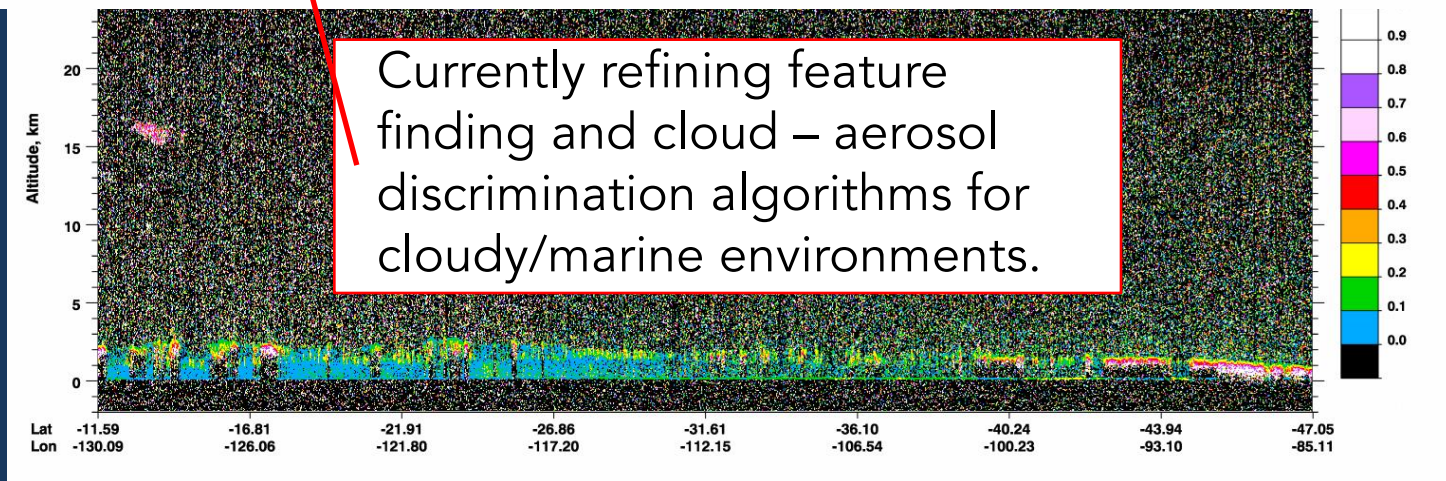
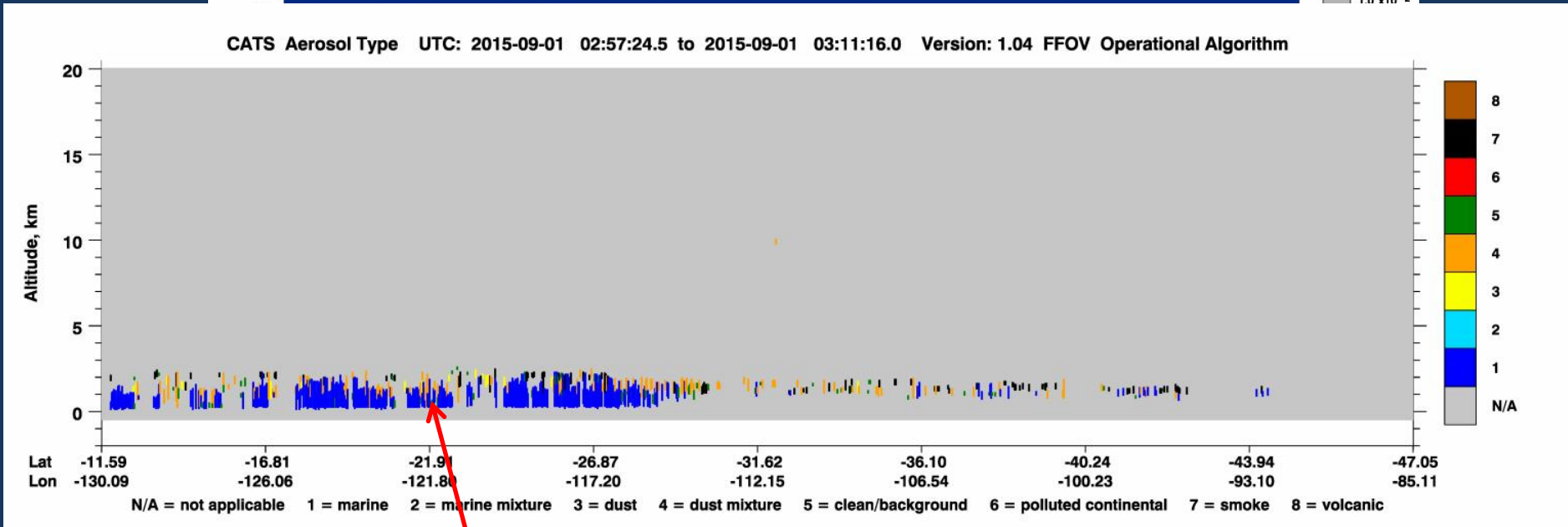
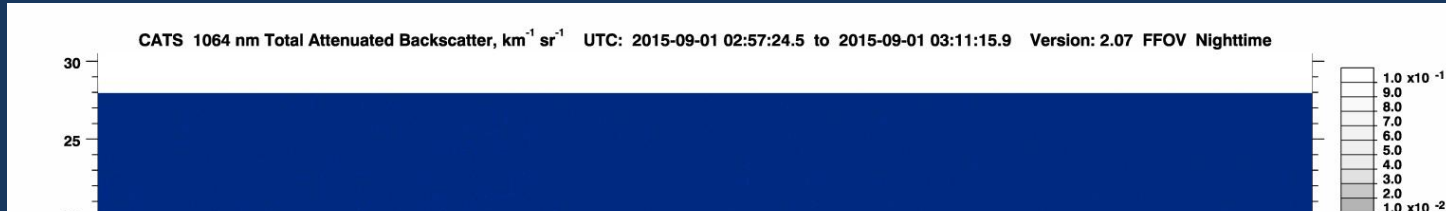
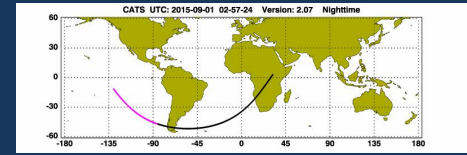
March 2015 – Present Aerosol Typing [1 – 2 km]



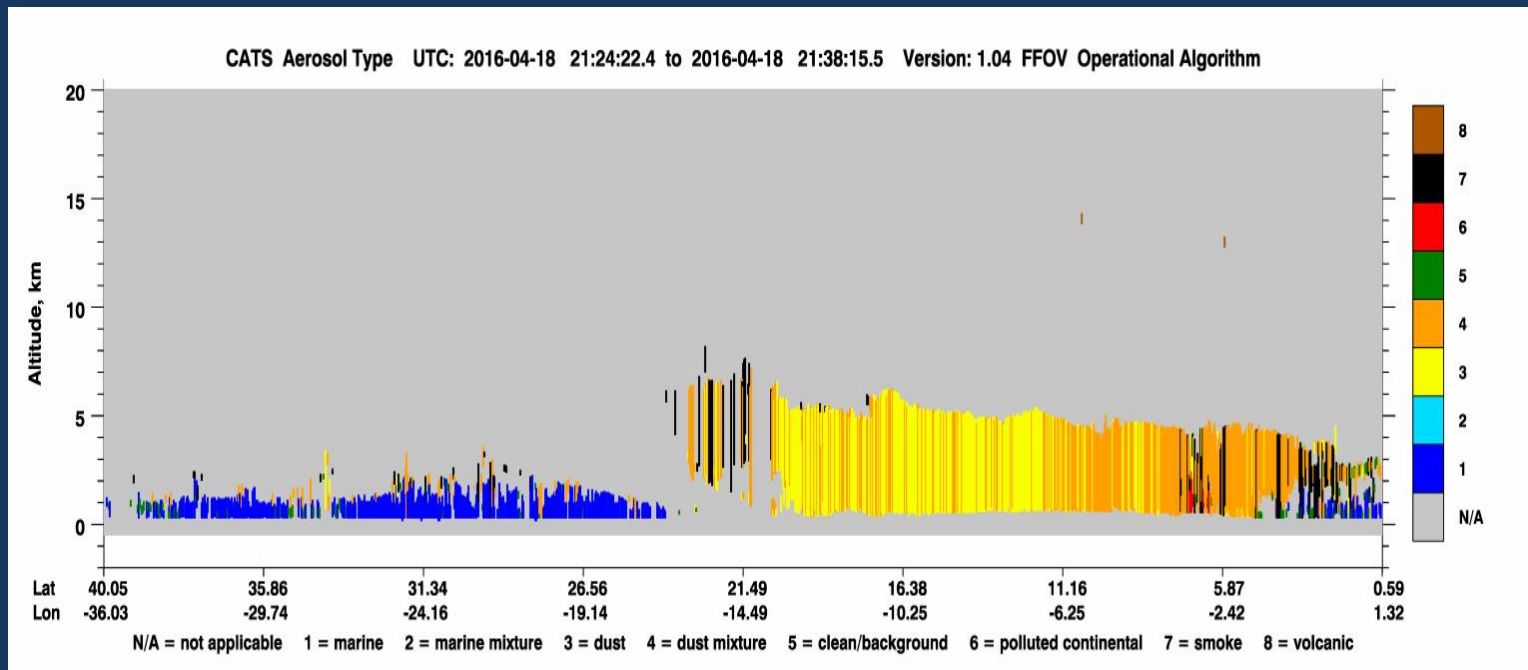
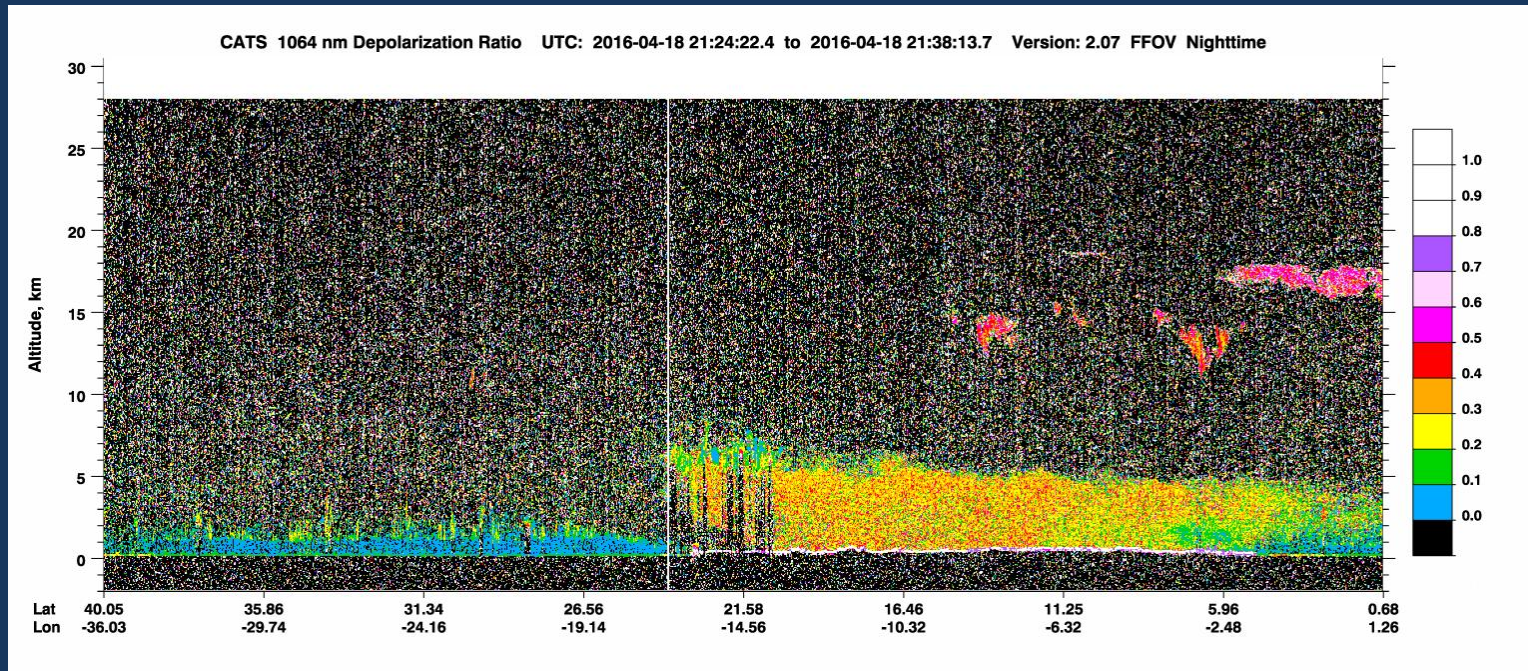
Known Issues: High Frequency of Dust Layers



Known Issues: High Frequency of Dust Layers

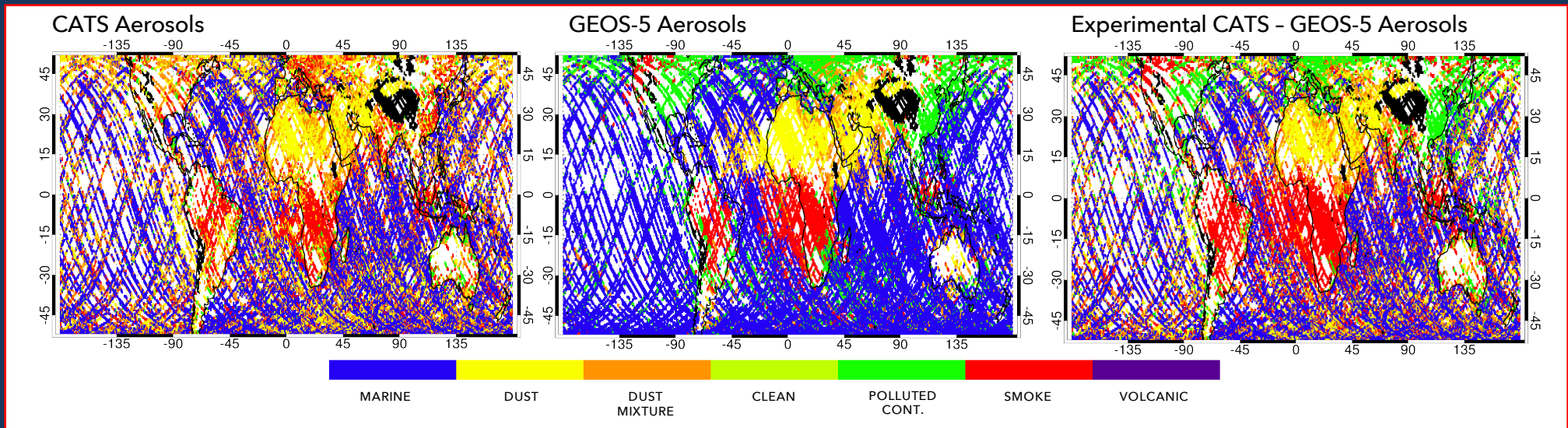


Known Issues: "Striping" within Aerosol Layers



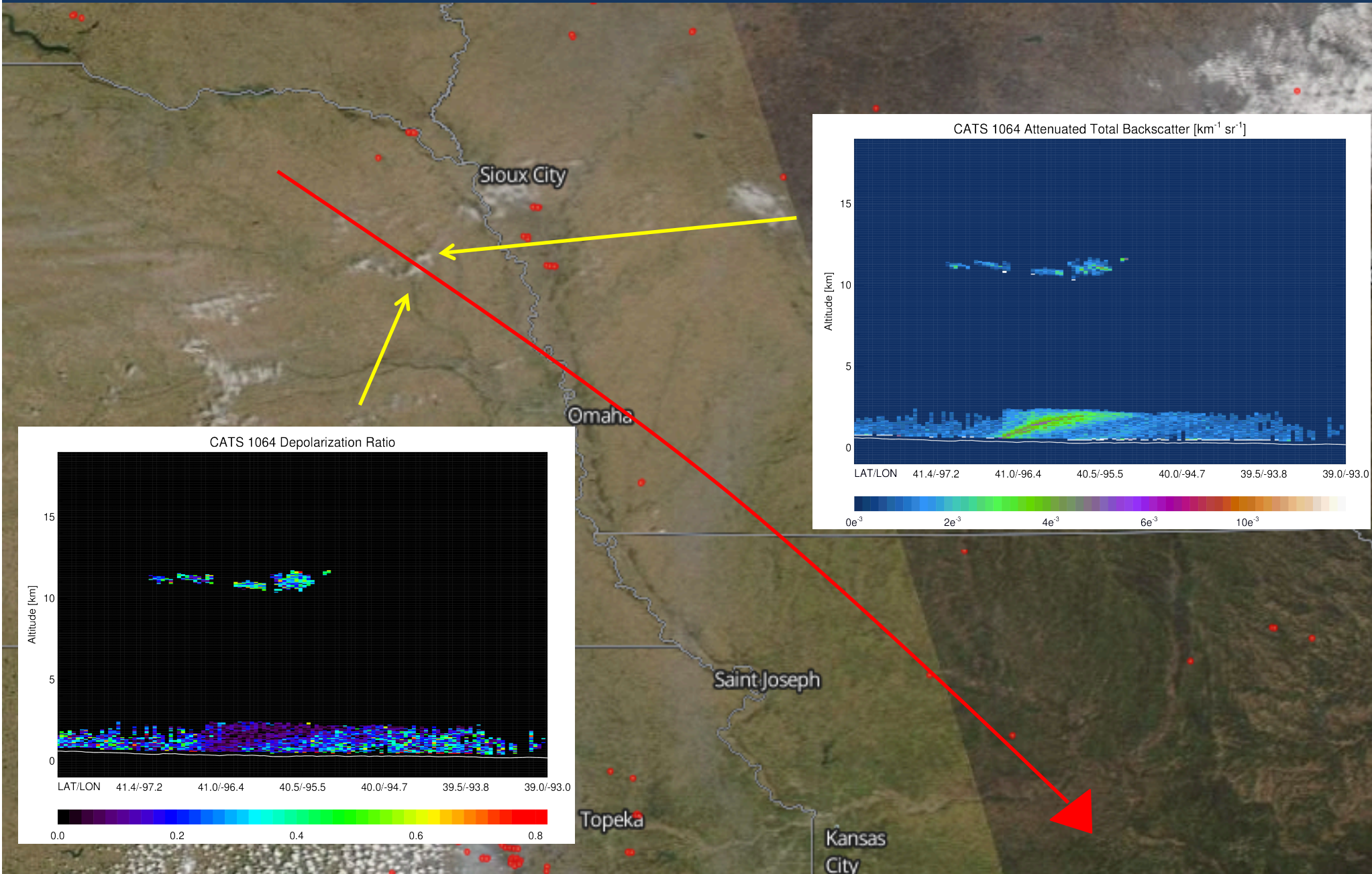
Known Issues: Polluted Continental vs. Smoke Typing

- Differentiation between polluted continental and smoke type depends only on layer thickness and layer base altitude
- Can also lead to “striping” due to set thresholds in algorithm
- Plan to utilize simulated aerosols from the NASA GEOS – 5 AGCM to help classify non – depolarizing aerosol types
 - Aerosol Climatology (ex. MERRA2)
 - 1-D Var Assimilation (in development)



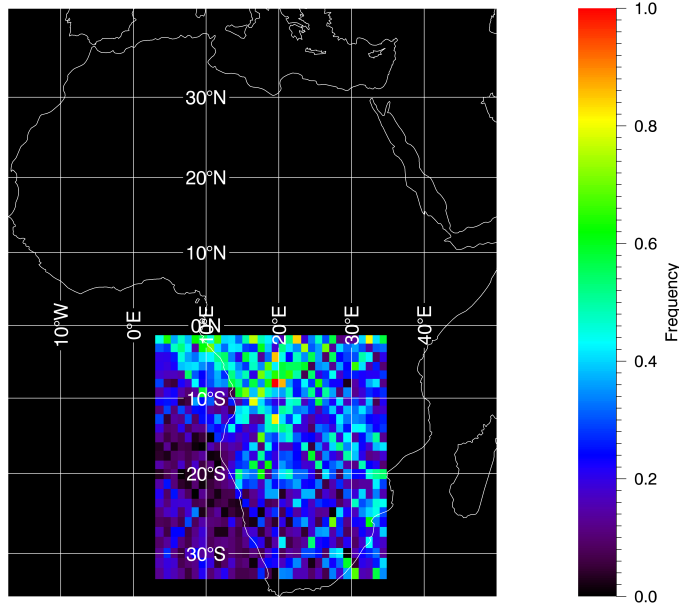
Challenges: Depolarizing Smoke

- Active Fires over Nebraska on 4/14/16

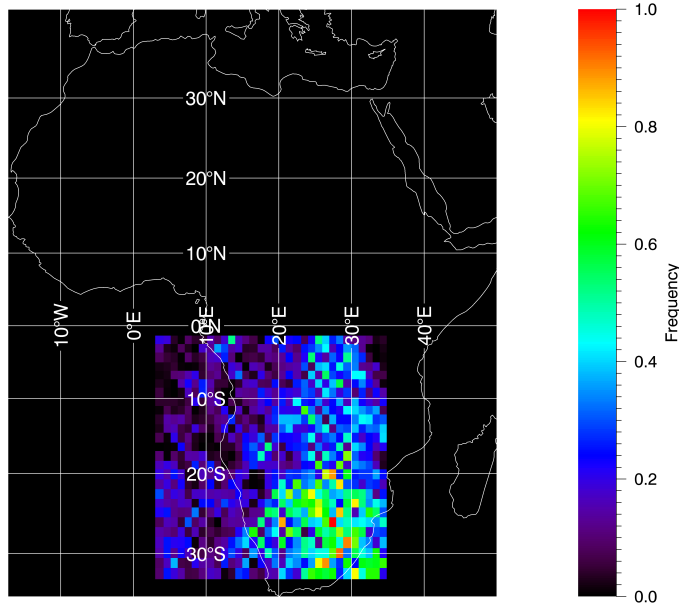


Challenges: Depolarizing Smoke

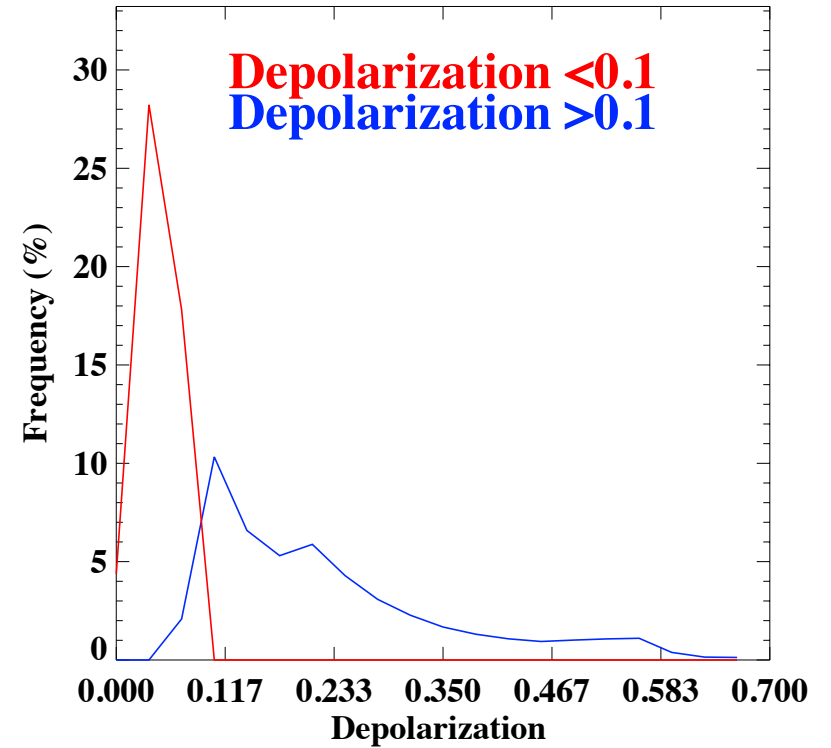
CATS Non-Spherical Smoke Detection Frequency: May-October 2015



CATS Spherical Smoke Detection Frequency: May-October 2015



CATS Depolarization Ratio Frequency



Courtesy of N. Midzak

CATS Mode 1 Overview

- Backscatter and Depolarization Ratio at 532 nm and 1064 nm
- 2 different fields of view (left + right)
- Utilize spectral depolarization ratio for aerosol typing

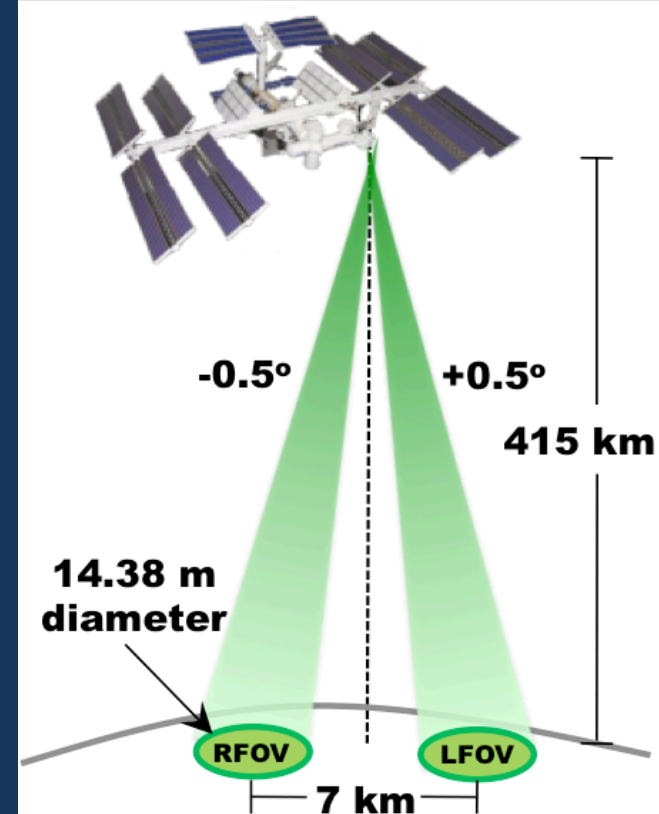
Aerosol Type	532 nm Lidar Ratio	1064 nm Lidar Ratio
Marine	25	45
Polluted Marine	45	40
Dust	45	55
Dust Mixture	35	45
Clean/Background	55	35
Polluted Continental	65	35
Smoke	70	40
Volcanic	45	35

Mode 1: Multi-Beam

Backscatter: 532, 1064 nm

Depolarization: 532, 1064 nm

L2 Products: 532, 1064 nm

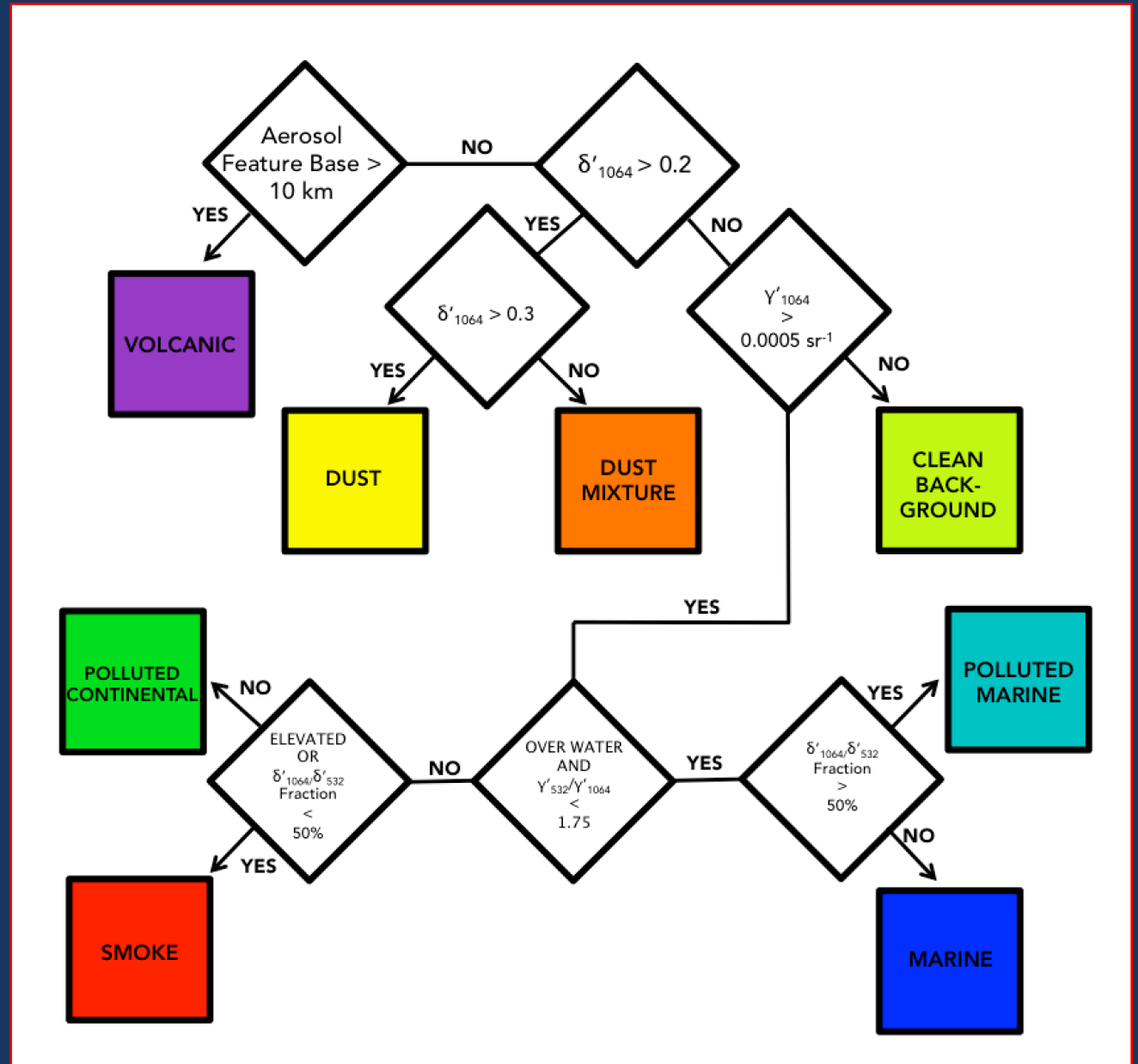


**Semi-continuous operation:
Feb. 10 – Mar. 21 (2015)**

CATS Mode 1 Aerosol Typing Algorithm

Inputs:

- Feature Integrated Depolarization Ratio at 1064 nm (δ'_{1064}) averaged to 5 km horizontally
- Feature Integrated Total Attenuated Backscatter at 1064 nm (γ'_{1064}) averaged to 5 km horizontally
- Surface Type (for maritime)
- Feature Altitude
- Feature Integrated Spectral Depolarization Ratio



Status of CATS Level 2 and Plans for the Future:

Version 1 Aerosol Typing (ongoing):

- Mode 1:
 - L1B data released later this summer
 - L2 data released shortly after
 - Identify algorithm biases (ex. striping, FOV biases)
- Mode 2:
 - Processed & Released
 - Currently working on correcting algorithm issues

Version 2 Aerosol Typing (Fall, 2016):

- Implementation of version 1 modifications
- Integrate GEOS-5 aerosols for typing guidance for non – spherical aerosols

Version 3 Aerosol Typing (2017):

- Implementation of 1-D Var Assimilation into GEOS-5
 - “Dynamic” lidar ratio that will evolve in conjunction with simulated aerosol mixtures

Field Campaign Support:

April – May, 2016



June 2016 - Present



Starting Fall 2016

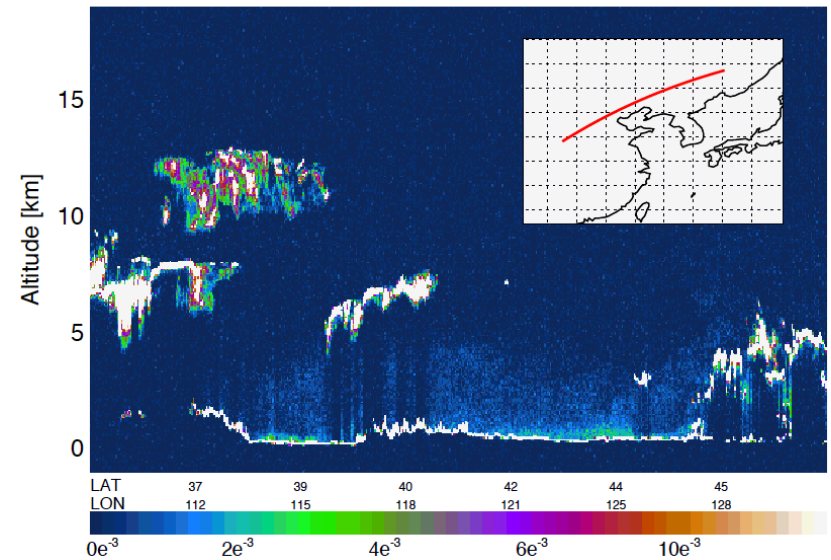


Contacts:

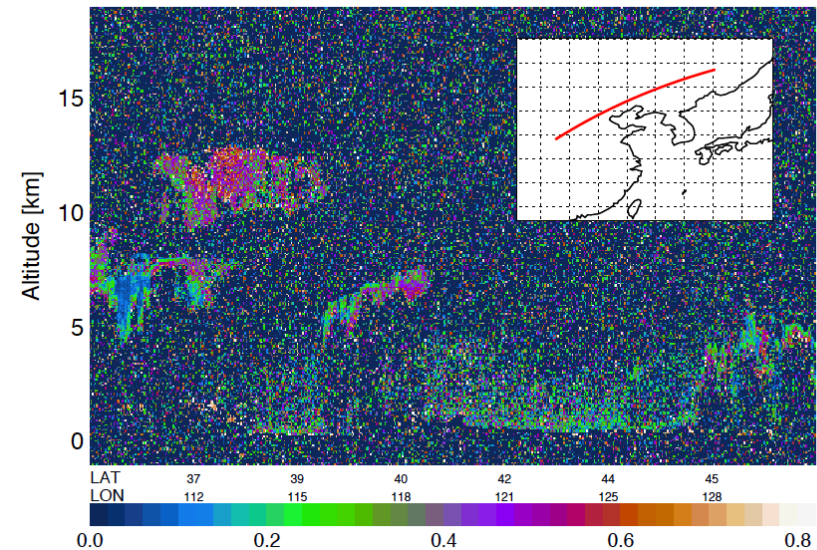
John Yorks – john.e.yorks@nasa.gov

Ed Nowotnick – edward.p.nowotnick@nasa.gov

CATS 1064nm ATB 2016-05-25T13-41-06T14-25-33UTC



CATS 1064nm DEPOL 2016-05-25T13-41-06T14-25-33UTC

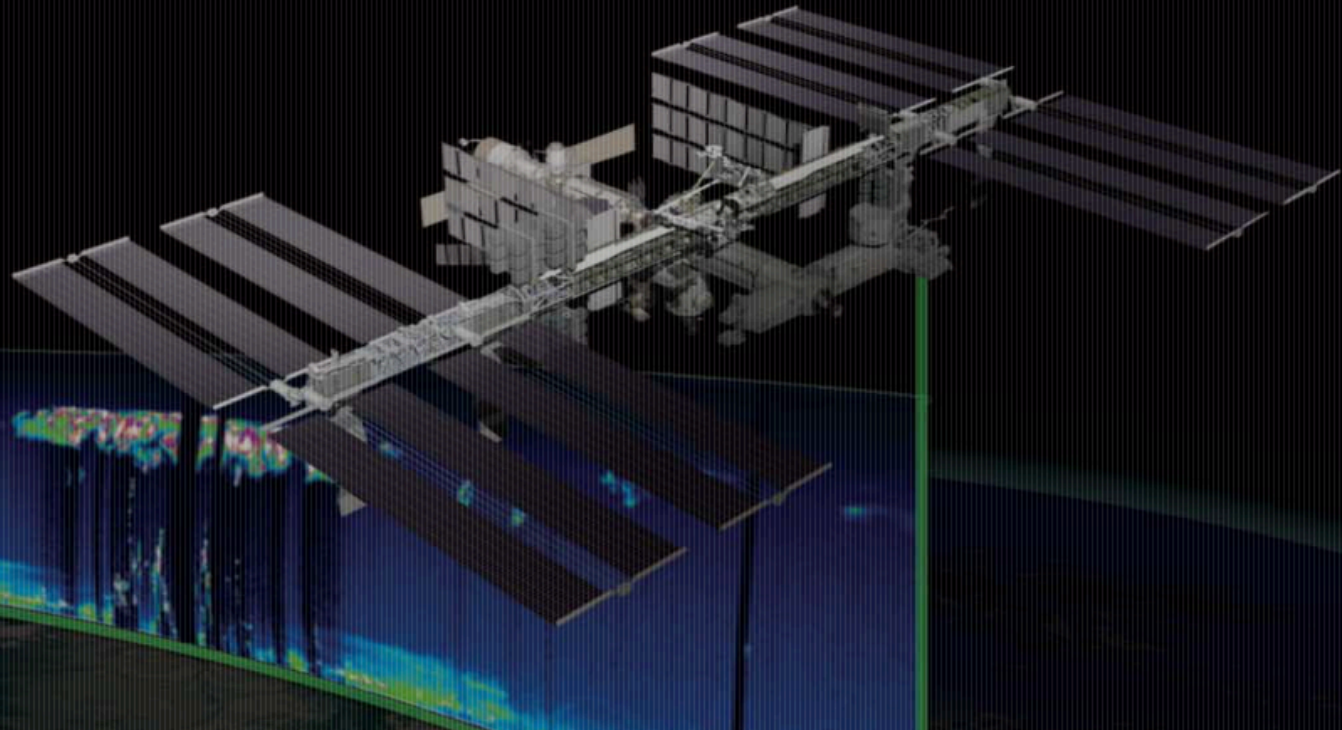
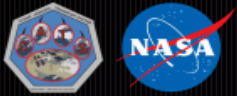


Getting CATS Data:

<https://cats.gsfc.nasa.gov>

Cloud-Aerosol Transport System (CATS)

[Home](#) [Project](#) [Science](#) [Contact](#)



CATS

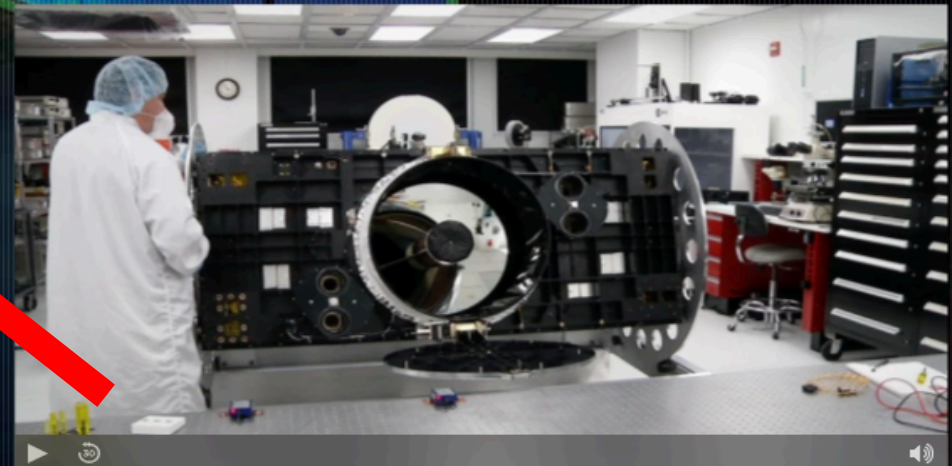
The Cloud-Aerosol Transport System (CATS), launched in January of 2015, is a lidar remote sensing instrument that will provide range-resolved profile measurements of atmospheric aerosols and clouds from the International Space Station (ISS). CATS is intended to operate on-orbit for at least six months, and up to three years.

[Operation Status](#)

[Data & Browse Images](#)

[Image of the Week](#)

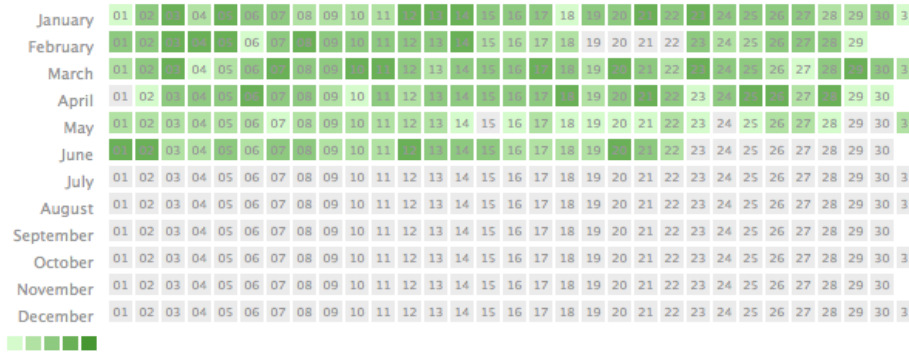
[CATS Brochure \[PDF\]](#)



Getting CATS Data:

<https://cats.gsfc.nasa.gov>

Granule
Availability
2016



CATS data users, please note the instrument modes and data versions below:

- *Mode 7.1:* data from 10 Feb. through 21 March 2015, version 2-04 (V2.06 will be released shortly)
- *Mode 7.2:* data from 25 Mar. 2015 through present, version 2-06

NRT HDF5 Files

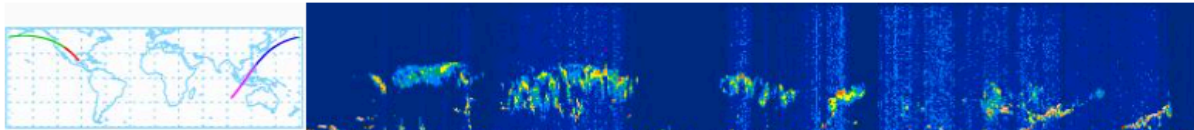


HDF5 ▾

- Lidar Level 2 Operation Layer DP
- Lidar Level 2 Operation Profile DP
- Lidar Level 1B

2016-06-22

00:28 UTC



01:15 UTC



Quick Look
Images

Getting CATS Data:

<https://eosweb.larc.nasa.gov/project/cats/>



Atmospheric
Science
Data Center

Processing, archiving and distributing Earth science data
at the NASA Langley Research Center

Search

[Home](#) [Data Descriptions](#) [Order Data](#) [Citing ASDC Data](#) [Help & Resources](#)

[Home](#) » CATS Data and Information Page

Cloud-Aerosol Transport System (CATS) Data and Information



The Cloud-Aerosol Transport System ([CATS](#)), is a lidar remote sensing instrument that will provide range-resolved profile measurements of atmospheric aerosols and clouds from the International Space Station (ISS).

CATS will provide vertical profiles at three wavelengths, orbiting between ~230 and ~270 miles above the Earth's surface at a 51-degree inclination with nearly a three-day repeat cycle. For the first time, it will allow scientist to study diurnal (day-to-night) changes in cloud and aerosol effects from space by observing the same spot on Earth at different times each day.

[Products](#)

[Parameters](#)

Product Level	Description
Level 2	L1B files that are run through the new operational CATS L2 algorithm, which will include new capabilities. Includes geophysical parameters, such as the vertical feature mask, profiles of cloud and aerosol properties and layer-integrated parameters.
Level 1B	L1A data that have been calibrated, annotated with ancillary meteorological data, and processed to sensor units.