Cooperative Institute for Research in the Atmosphere
CIRA
Colorado State University

2005-2006 Highlights

NESDIS Cooperative Institute Directors Meeting

Corvallis, Oregon

June 20-21, 2006

Professor Thomas H. Vonder Haar, Director

www.cira.colostate.edu **vonderhaar@cira.colostate.edu**

CIRA HIGHLIGHTS, 2005-06

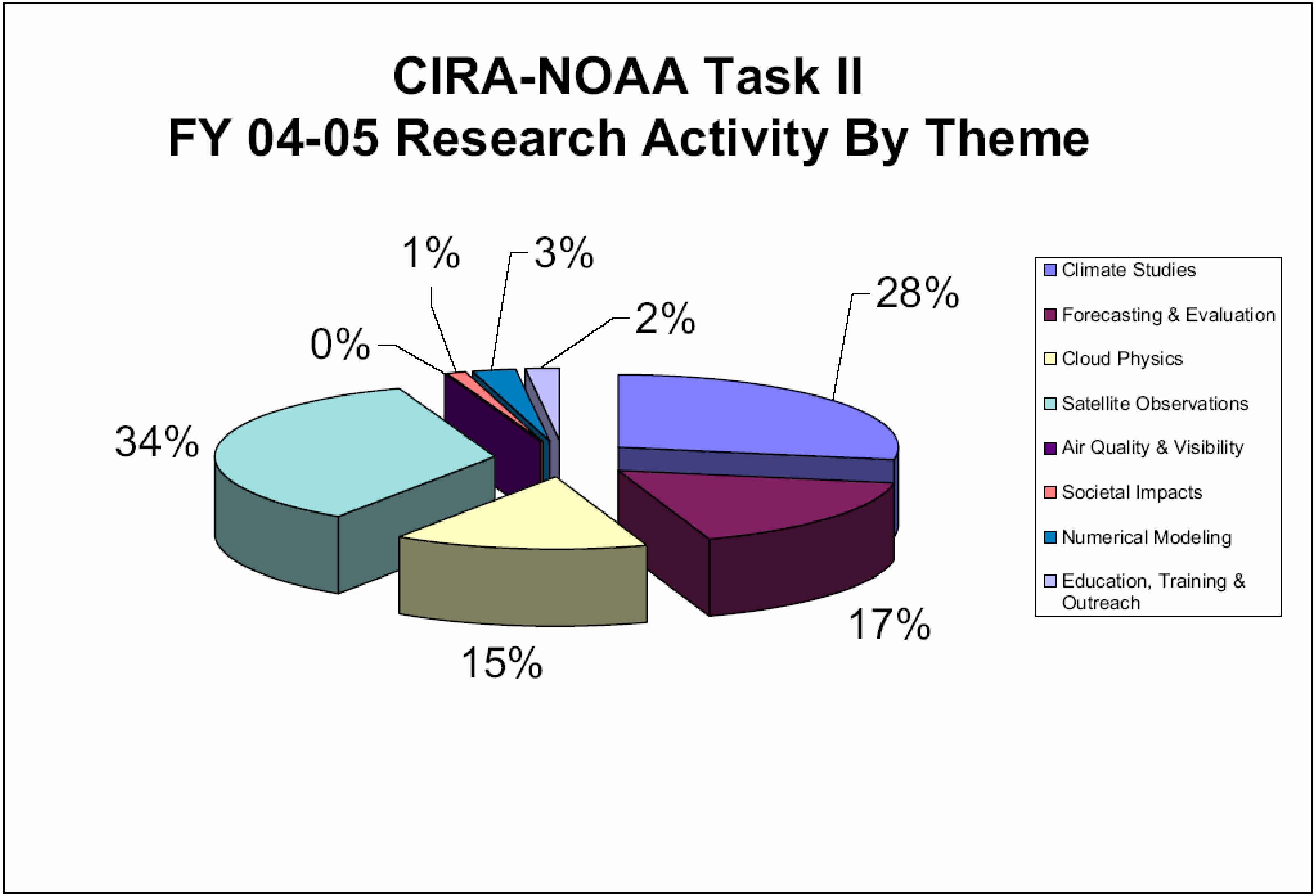
- CIRA Today
- New Research Results and Applications
- Some Future Plans
- Human Resources for Research

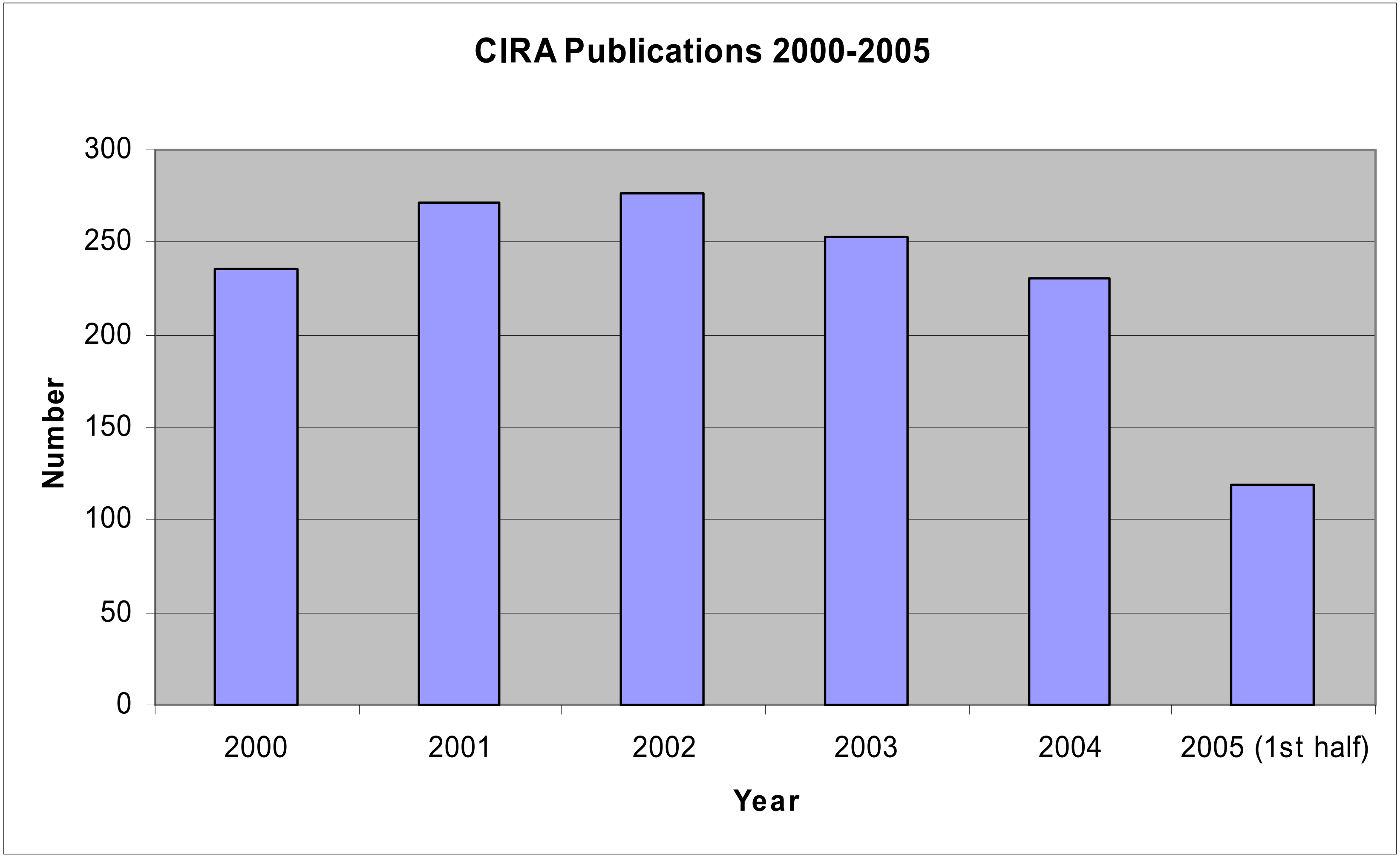
CIRA in 05/06 – the 26th Year

- Operates under a 5-year, renewable Cooperative Agreement (CA) with NOAA
- NOAA CI co-sponsored by NESDIS and OAR with good NWS interaction
- Complementary CAs with DOI/NPS and DoD/ARL
- 180 scientists, staff and students (144 FTE)
- Including 6 NESDIS, RAMM Team scientists on site
- Including 12 postdocs, 25 graduate students, 16 undergraduates supported by NOAA
- Including 15 academic faculty (part time)

- $12M/year in research and outreach funding
- $8M/year from NOAA

Colorado State University CIRA


CIRA-NOAA Task II
FY 04-05 Research Activity By Theme
1%
3%
2%
28%
0%
34%
17%
15%
Climate Studies
Forecasting & Evaluation
Cloud Physics
Satellite Observations
Air Quality & Visibility
Societal Impacts
Numerical Modeling
Education, Training & Outreach


CIRA Publications 2000-2005
300
250
200
150
100
50
0
Number
2000
2001
2002
2003
2004
2005 (1st half)
Year

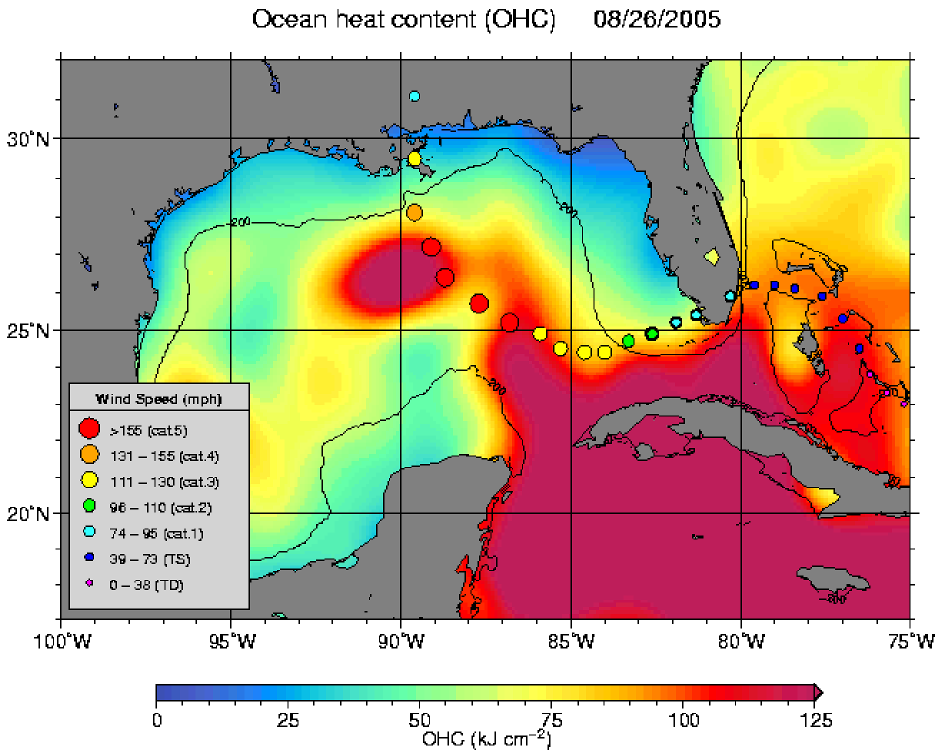
What’s New and Exciting at CIRA

- DOC Silver Medal Award to Dr. Mark DeMaria and Ms. Michelle Mainelli
- NASA CloudSat Launch on 28 April 2006 (Prof. G. Stephens et al.)
  - First Cloud Radar in Space for Climate Study and Cloud Modeling
    - CIRA hosts the CloudSat Science Data Processing Center
- NSF Science Center on Multi-scale Modeling of Atmospheric Processes (proposal pending at highest levels of NSF/NSB) (Prof. D. Randall et al.)
- The FAA has certified a cloud top height product after a quality assessment was completed. This is the first time remote sensing data was used in such an assessment. CIRA/GSD, ESRL
- New Project with North American Carbon Program CIRA/GMD, ESRL


UNITED STATES
DEPARTMENT of COMMERCE
SILVER MEDAL AWARD
Presented to
MARK DeMARIA MICHELLE MAINELLI
for Meritorious Federal Service
CITATION:
For the improvement of operational hurricane intensity forecasts through better utilization of satellite observations.
Secretary of Commerce

Operational Hurricane Intensity Forecast Improvements (by DeMaria et al.)

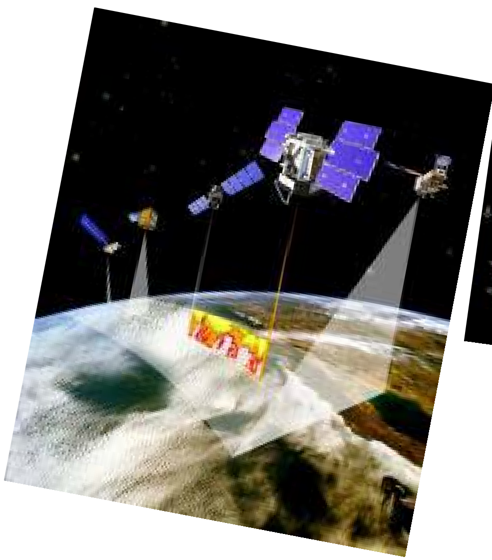
- Satellite altimetry algorithm developed for oceanic heat content (OHC) estimation
- OHC added to the National Hurricane Center operational SHIPS intensity forecast model
- OHC input significantly improved intensity forecasts for the all four of the 2005 category 5 storms

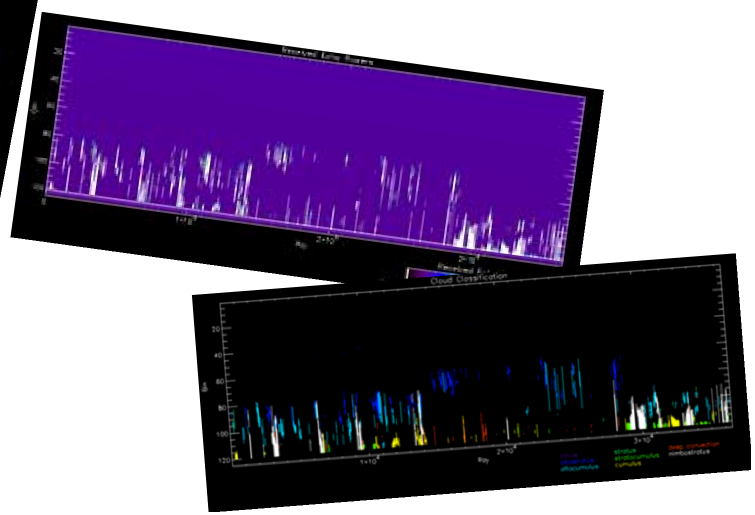


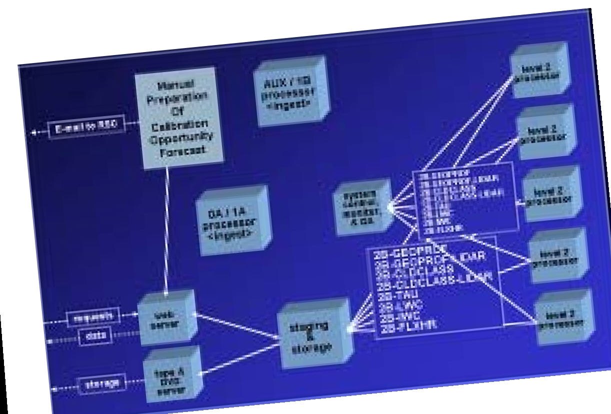
Example of the OHC product and the track/intensity of Hurricane Katrina 2005

CloudSat Launch!

http://cloudsat.cira.colostate.edu/

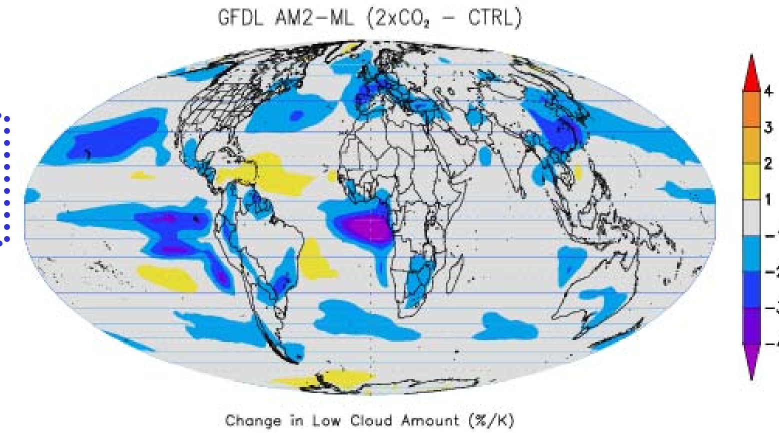




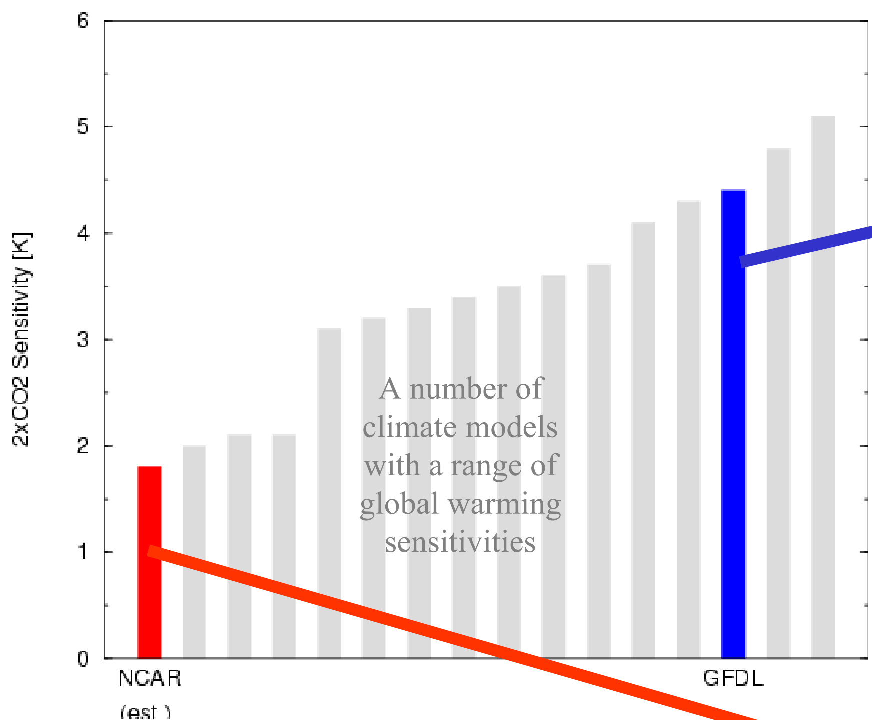


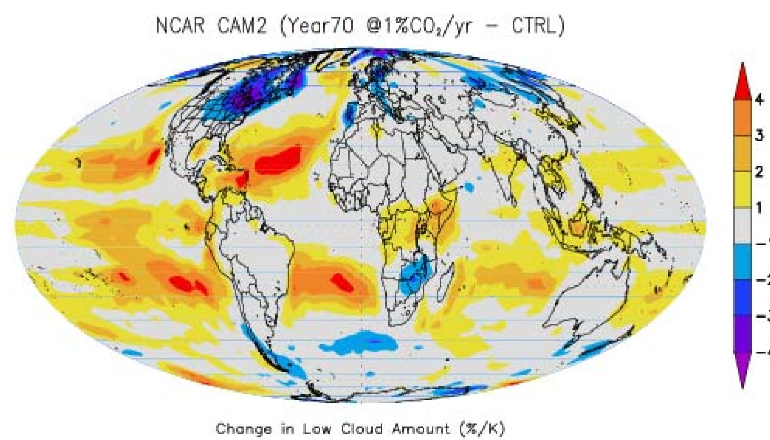
CloudSat will improve our understanding of cloud processes, leading to **improved climate predictions**

The large differences in these two climate model predictions is connected to the amount of low cloud



Fewer low clouds =more warming

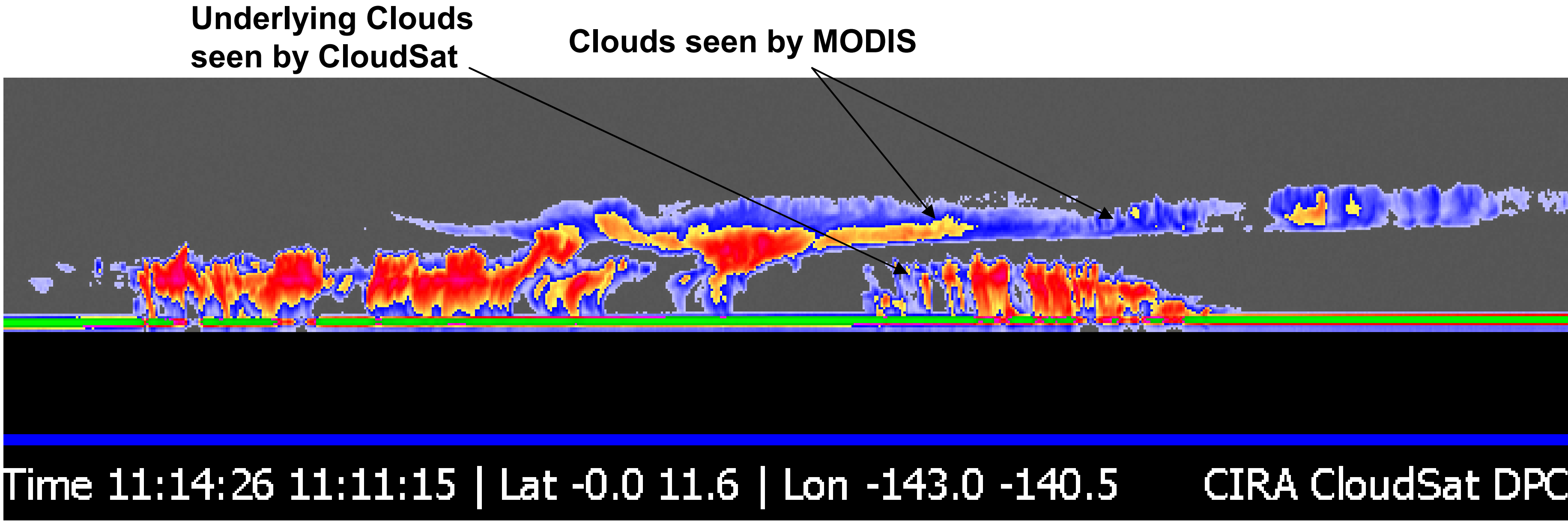




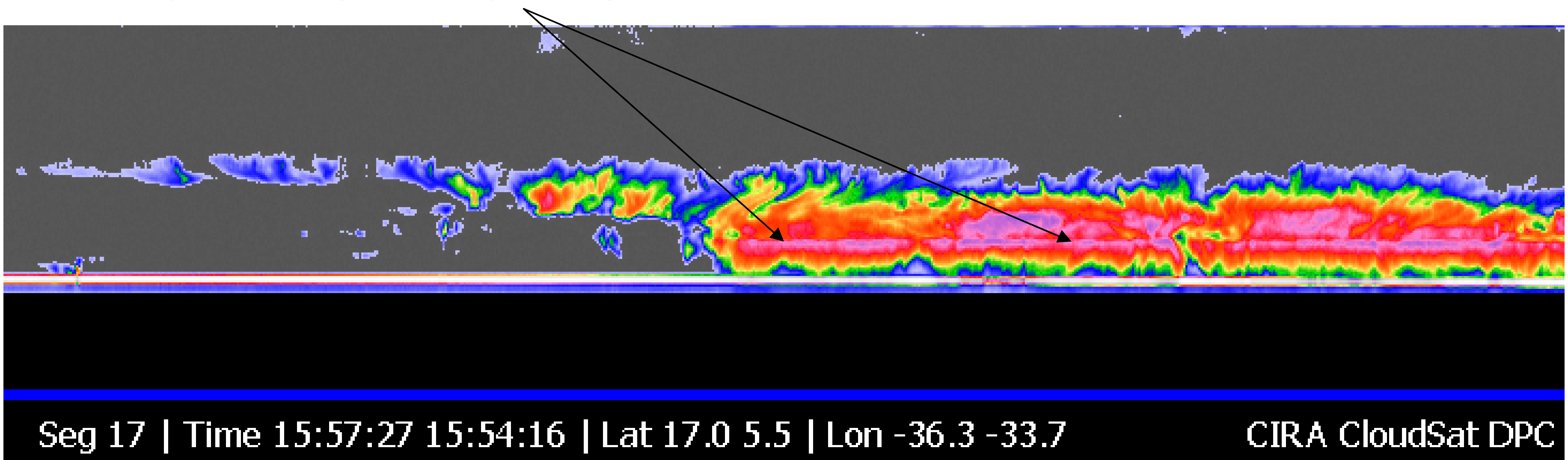
More low clouds =less warming

“Hidden” Precipitation / Clouds

(below a cloud shield that prevents detection by a passive system)

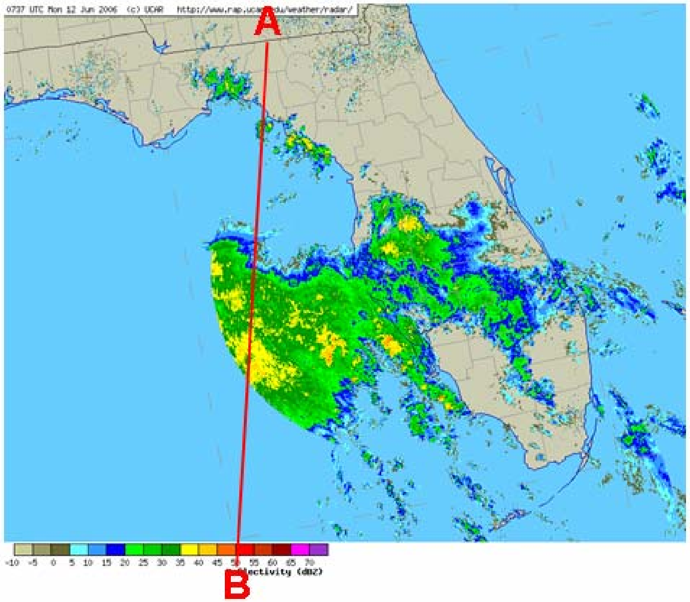


“Melting Level” (freezing level) …

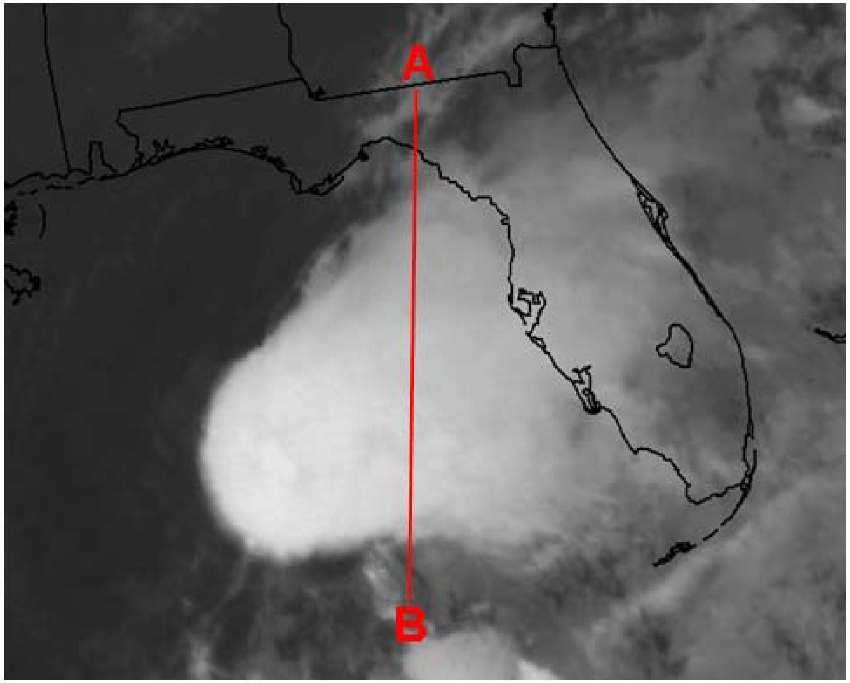


CloudSat Sees Alberto …

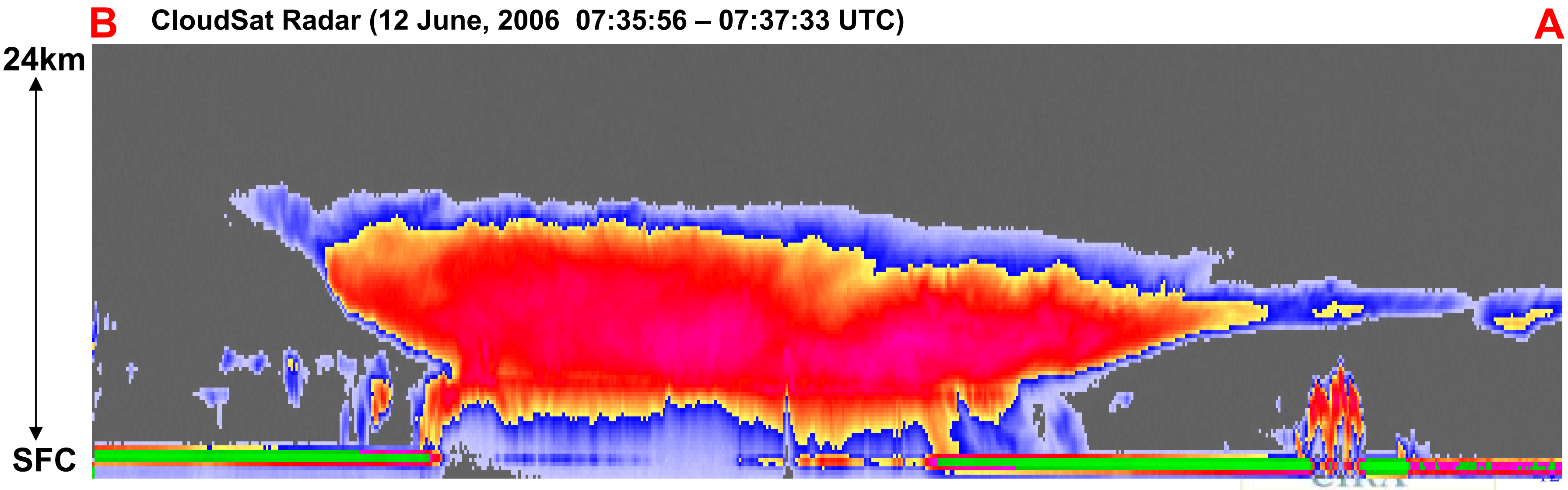
NEXRAD Radar (12 June, 2006 07:37 UTC)



GOES-12 Geostationary Satellite –
Infrared Image (12 June, 2006 07:32 UTC)



CloudSat Radar (12 June, 2006 07:35:56 – 07:37:33 UTC)



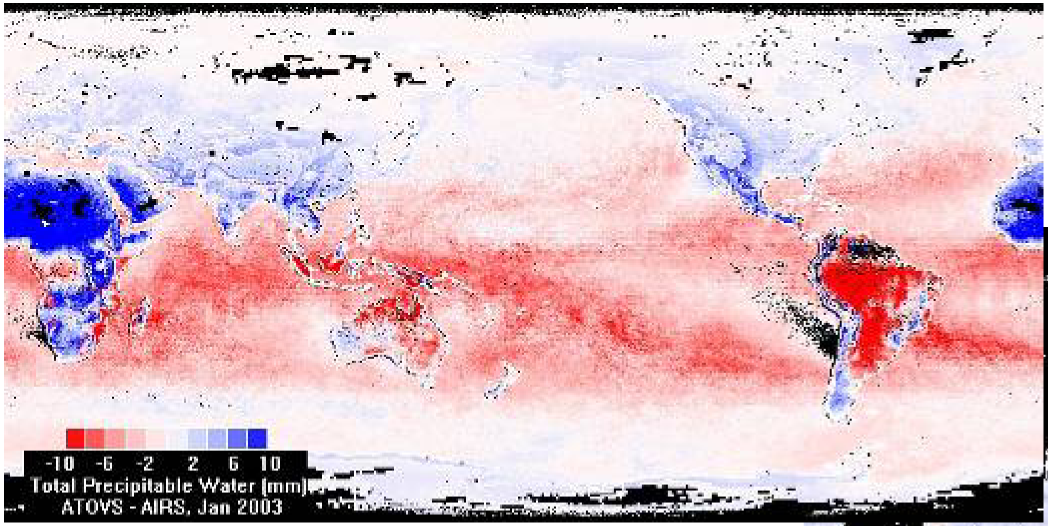
The Future

- Science Stewardship of Climate Data Records
- Co-op Initiatives with STAR and CI's
- R 2 O
- Human Resources for NOAA's Research Mission

"Science Stewardship of Thematic Climate Data Records: A Pilot Study with Global Water Vapor"

Completed at CIRA in 2005

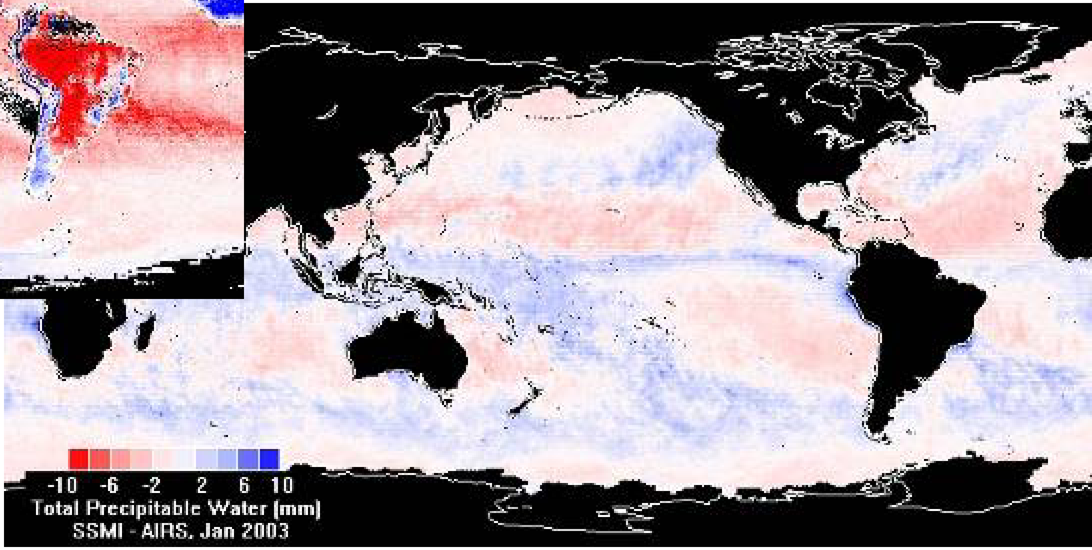
Goal: Examine the critical water vapor CDR in light of new results from the NASA Aqua satellite and provide knowledge for interpretation and reanalysis.
Method: Extend the NVAP dataset to 2003-2004 to match Aqua.



ATOVS minus AIRS Total Precipitable Water (Jan 2003)

RED = AIRS MOISTER

ATOVS minus SSM/I Total Precipitable Water (Jan 2003)

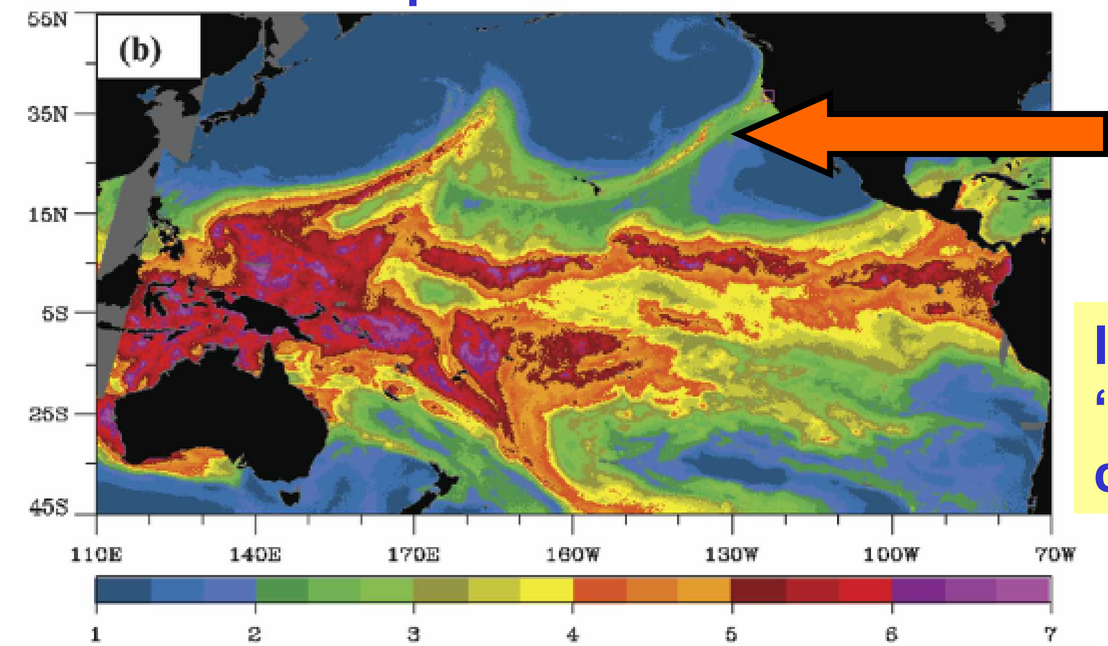


Conclusion: Aqua and NVAP agree well over oceans. NOAA ATOVS soundings and AIRS have large differences.

1987-1992 SSM/I data at CIRA also rescued in this effort and provided to NOAA.

"Atmospheric Rivers" Cause High Impact Weather

Total Precipitable Water from SSM/I



Bao et al 2006

Feb. 2004 moisture plume, 10" of rain produced flooding in California

In some cases these "rivers" are a direct connection to the Tropics

- What is their vertical structure?
- How well do satellite moisture retrievals capture these rivers?
- Do forecast models represent these features?
- Crosscutting effects across atmosphere, surface, ocean (flooding, erosion, sediment and pollution transport…)

Brant Dodson (CSU M.S. student) investigating this topic.

Established New Center for Accelerating Research Results into Operations (CARRO)

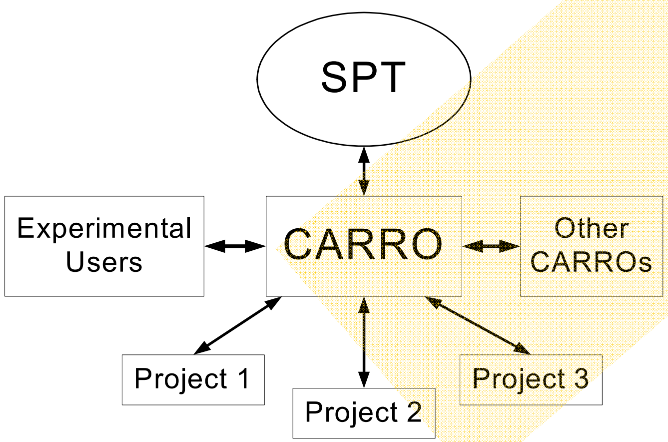
•WWith ORA and other CI's (other CARRO's?)

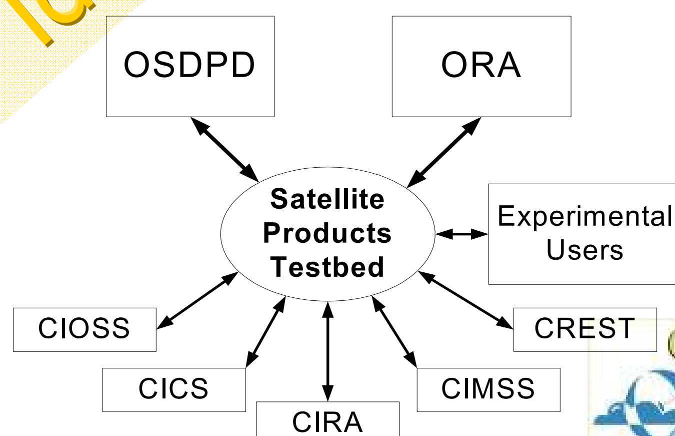
•LLessons learned; best practices; new mechanisms

•CCARRO Algorithm Incubator Program (CAIP) for local CI and joint CI research activities interface to Satellite Products Testbed (SPT) at NESDIS

Progress?

Ideas?





(Contacts: Andy Jones and Stan Kidder)

All NOAA's Cooperative Institutes help build Human Resources In NOAA's Mission Areas

At CIRA …

CIRA POSTDOCS

- Dr. Isidora Jankov
  - The Role of Physical Scheme Interactions on Warm Season Rainfall Forecasts
    - Iowa State (at GSD)
- Dr. Yoo-Jeong Noh
  - Observational Analysis and Retrieval of Snowfall of Microwave Frequencies
    - Florida State
- Dr. Sarah Tessendorf
  - Wind and Solar Power in Colorado: Public Opinion and Climatological Viability *AND* Satellite Observations of the Relationship Between Aerosol Optical Depth and Lightning
    - Colorado State University
- Dr. Tarendra Lakhankar
  - Estimation of Soil Moisture Using Active Microwave Remote Sensing Data
    - New York University (CREST)

Sample of CIRA Graduate Student Research

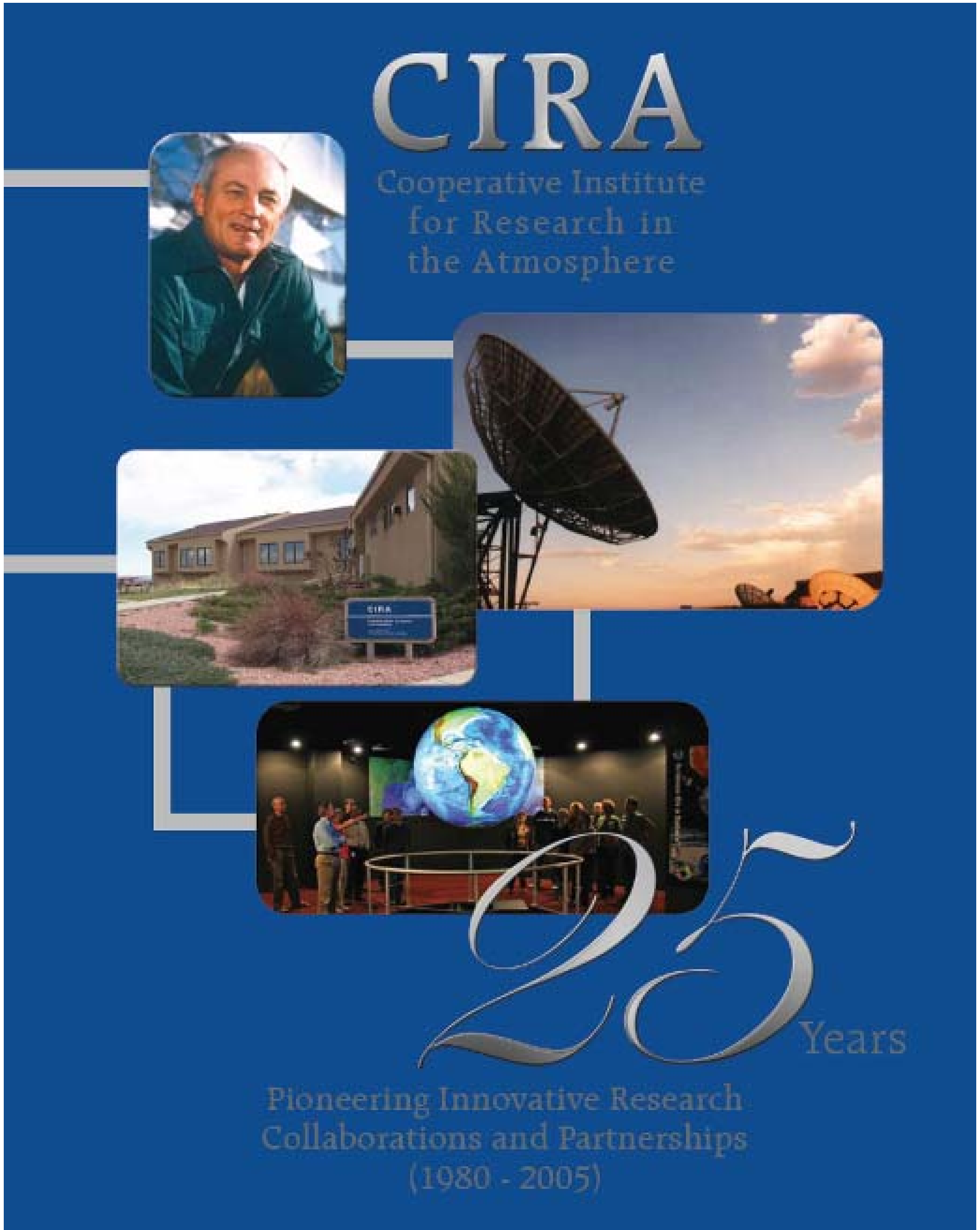
Student Name	Proposed Thesis Title	Area of Interest
Gordon Wichern	Adaptive Methods for Rapid Acoustic Transmission Loss Prediction in the Atmosphere	Acoustics, Neural Networks
Guenter Engling	Characterizing Biomass Combustion Emission Contributions to Ambient Aerosol Concentrations	Aerosol Chemistry
Taeyoung Lee	Aerosol Chemical Characterization	Aerosol Chemistry
Richard Cullin	TBD	Biomass Combustion Aerosol
Courtney Gorin	TBD	Nitrogen Deposition
Xinhua Shen	TBD	Aerosol Chemistry
Mike Smith	TBD	Cloud microphysics/dust effects
David Stokowski	The Addition of the Direct Radiative Effect of Atmospheric Aerosols into the Regional Atmospheric Modeling System (RAMS)	Mesoscale Modeling, Aerosol Modeling
James Halgren	Long Term, Fully-Distributed Hydrologic Model with Chemical Transport	Computer Modeling, Channel Hydraulics
Gavin McMeeking	Optical Properties of Carbonaceous Particles	Carbonaceous Particles

Sample of CIRA Graduate Student Research

Student Name	Proposed Thesis Title	Area of Interest
Kelley Johnson	A Comparison of the Navy Aerosol Analysis and Prediction System (NAAPS) to In-situ Aerosol Measurements in the Continental U.S.: Transport vs. Local Production of Soil Dust Aerosol	Transport and Radiative Effects of Soil Dust Aerosol
Timothy Nobis	The Impact of an Urban Parameterization Scheme on Simulations of Washington DC	Urban Boundary Layers
Giovanni Leoncini	Improving Numerical Weather Prediction: Specialized Models and Look Up Table Approach	Mesoscale Dynamics
Rahul Peroor	Upscaling of Hydrologic Fluxes with a Physical Mechanistic and Fully Coupled Watershed Model	Hydrometeorology
Matt Masarik	Analytical Solutions to a Primitive Equation Model and Balanced Model for the MJO	Tropical dynamics, specifically looking at theoretical modeling of the Madden-Julian Oscillation (MJO)
Brant Dodson	TBD	Global Water Vapor Variability
Kevin Donofrio	Remote Sensing of Cloud Liquid Water over Land and Ocean using the Advanced Microwave Sounding Unit	Microwave Remote Sensing of Cloud Liquid Water

Sample of CIRA Graduate Student Research

Student Name	Proposed Thesis Title	Area of Interest
Kate Maclay	Tropical Cyclone Inner Core Energetics and it's Relation to Storm Structural Change	Hurricane Energetics
Becca Mazur	Observations of Inflow Feeder Clouds and Their Relation to Thunderstorms	Observe the relationship between clouds that form in the inflow region of thunderstorms (called feeder clouds) and severe weather
Dustin Rapp	The Use of Windsat Passive Microwave data in Soil Moisture Monitoring	Analyzing Windsat data with regard to a large rain event which occurred over the Midwest in September 2003
Curtis Seaman	Assimilation of Satellite Humidity Information to Improve Forecasting of Mid-level, Mixed-phase Clouds	Cloud dynamics, cloud microphysics, radiative transfer, and assimilation of satellite data



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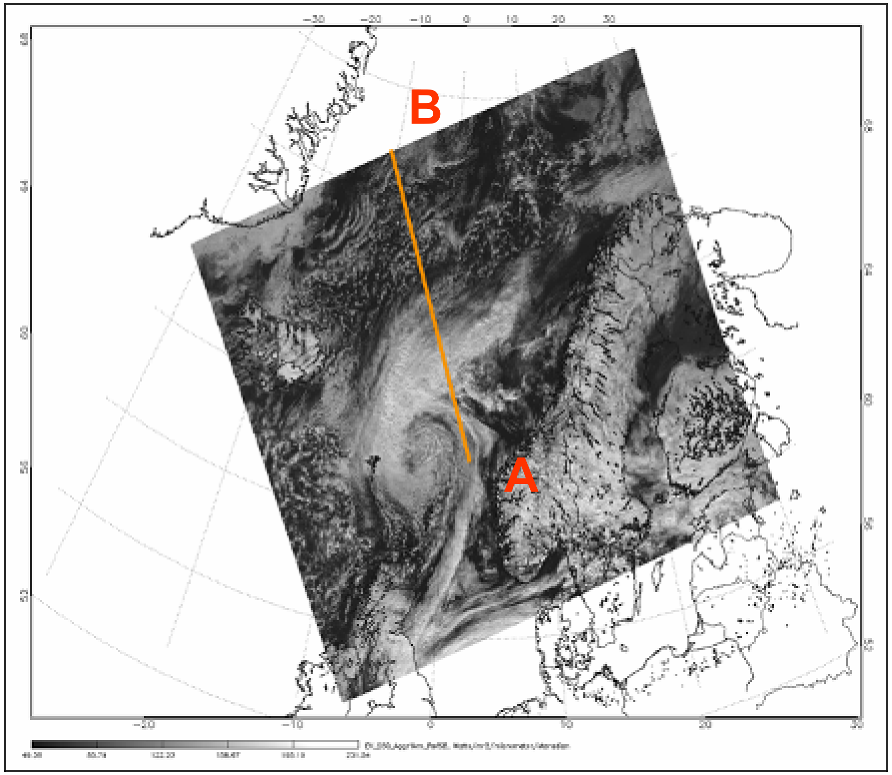
Back-up

First Two Weeks of CloudSat Imagery …

- Comparison with MODIS instrument (flying on-board AQUA)
- Cloud Overlap / Melting Level
- Topography mapping
- Alberto
- Level 2 products
- Unusual clouds …

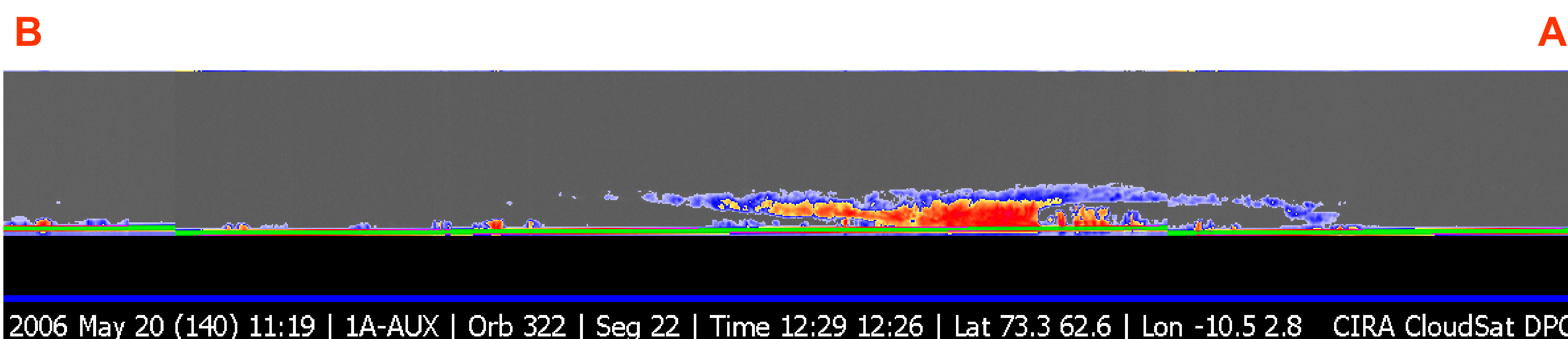
"FIRST IMAGE"

This segment was the first dump of CloudSat data - 20 May 2006 12:26-12:29 UTC



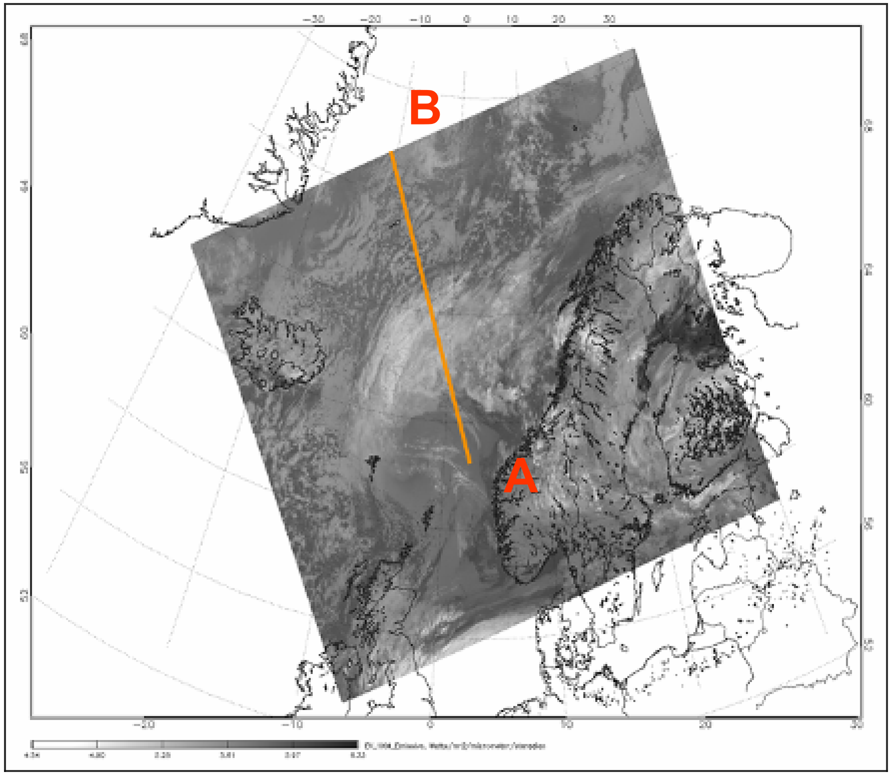
Location of CloudSat data segment on a 5-minute MODIS visible data swath (approx. 25 minutes prior to CloudSat overpass)

(MODIS image downloaded from Goddard DAAC)



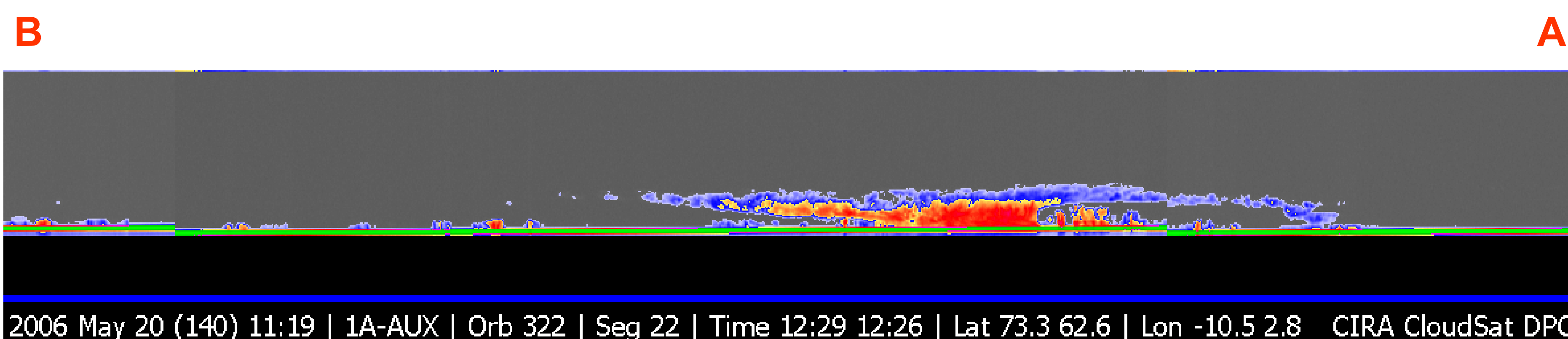
"FIRST IMAGE"

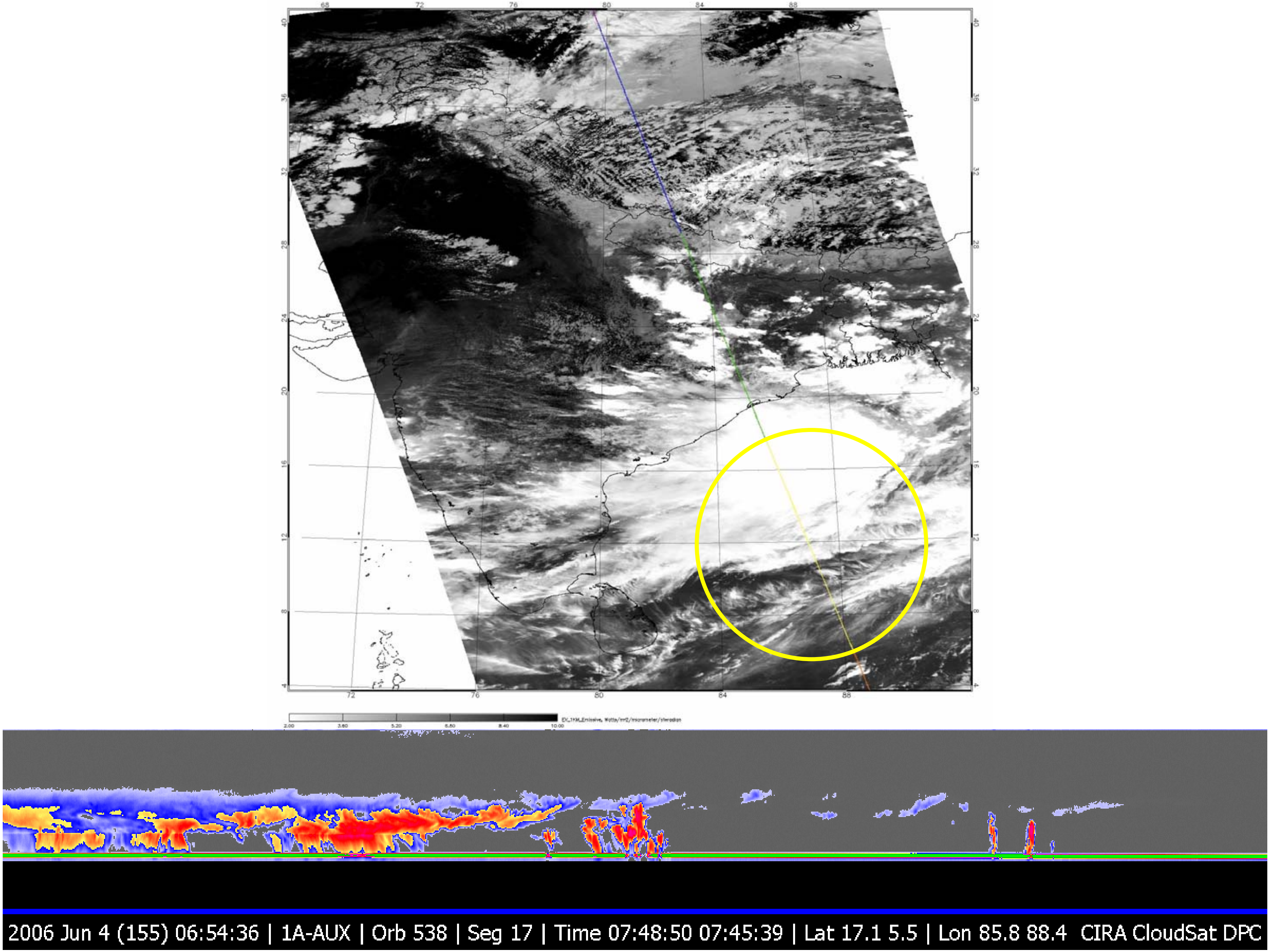
This segment was the first dump of CloudSat data - 20 May 2006 12:26-12:29 UTC

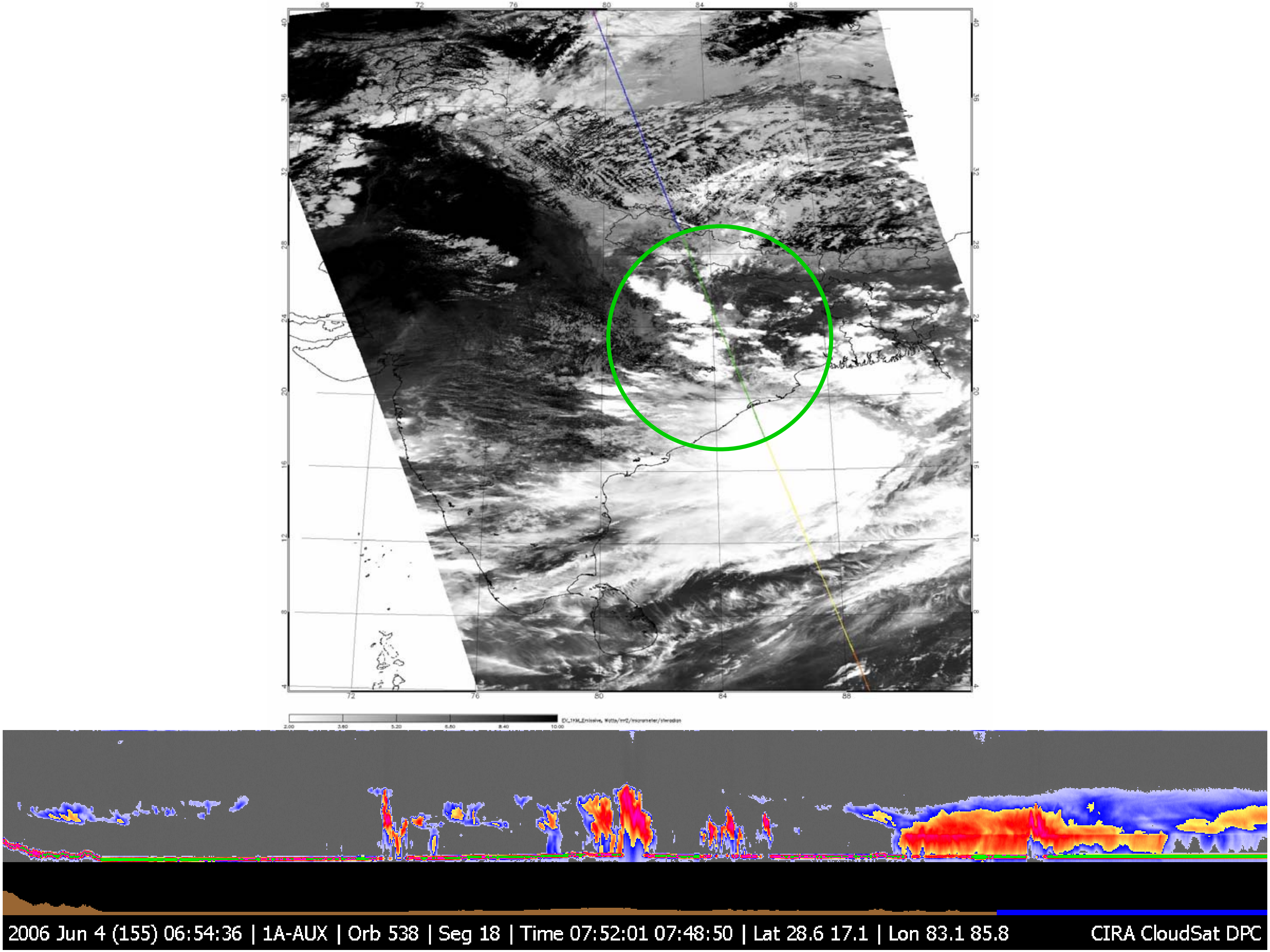


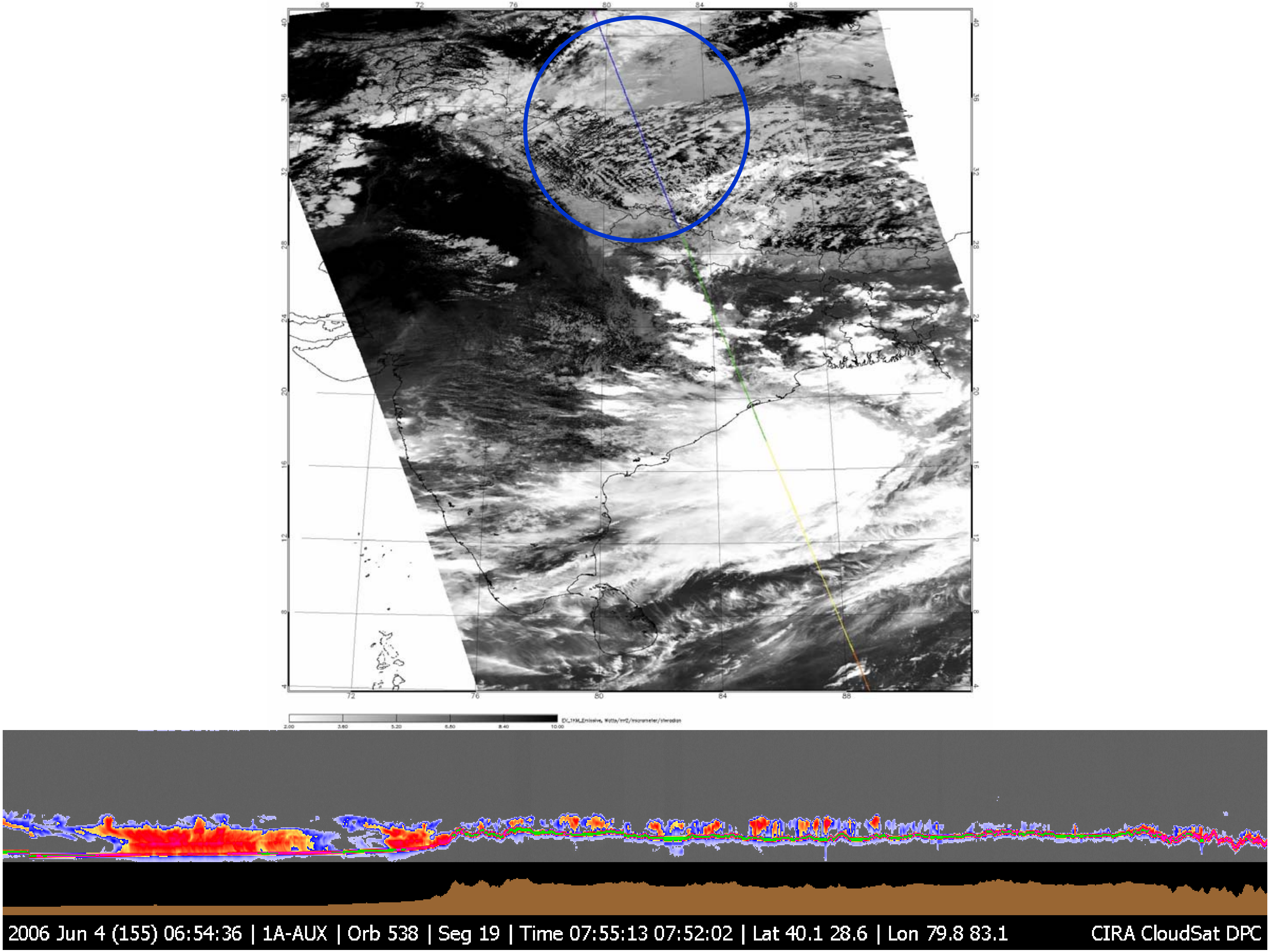
Location of CloudSat data segment on a 5-minute MODIS infrared (10.8μ) data swath
(<u>approx. 25 minutes prior to CloudSat overpass</u>)

(MODIS image downloaded from Goddard DAAC)




2006 Jun 4 (155) 06:54:36 | 1A-AUX | Orb 538 | Seg 17 | Time 07:48:50 07:45:39 | Lat 17.1 5.5 | Lon 85.8 88.4 CIRA CloudSat DPC


72
76
80
84
88
2006 Jun 4 (155) 06:54:36 | 1A-AUX | Orb 538 | Seg 18 | Time 07:52:01 07:48:50 | Lat 28.6 17.1 | Lon 83.1 85.8
CIRA CloudSat DPC


68
72
76
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84
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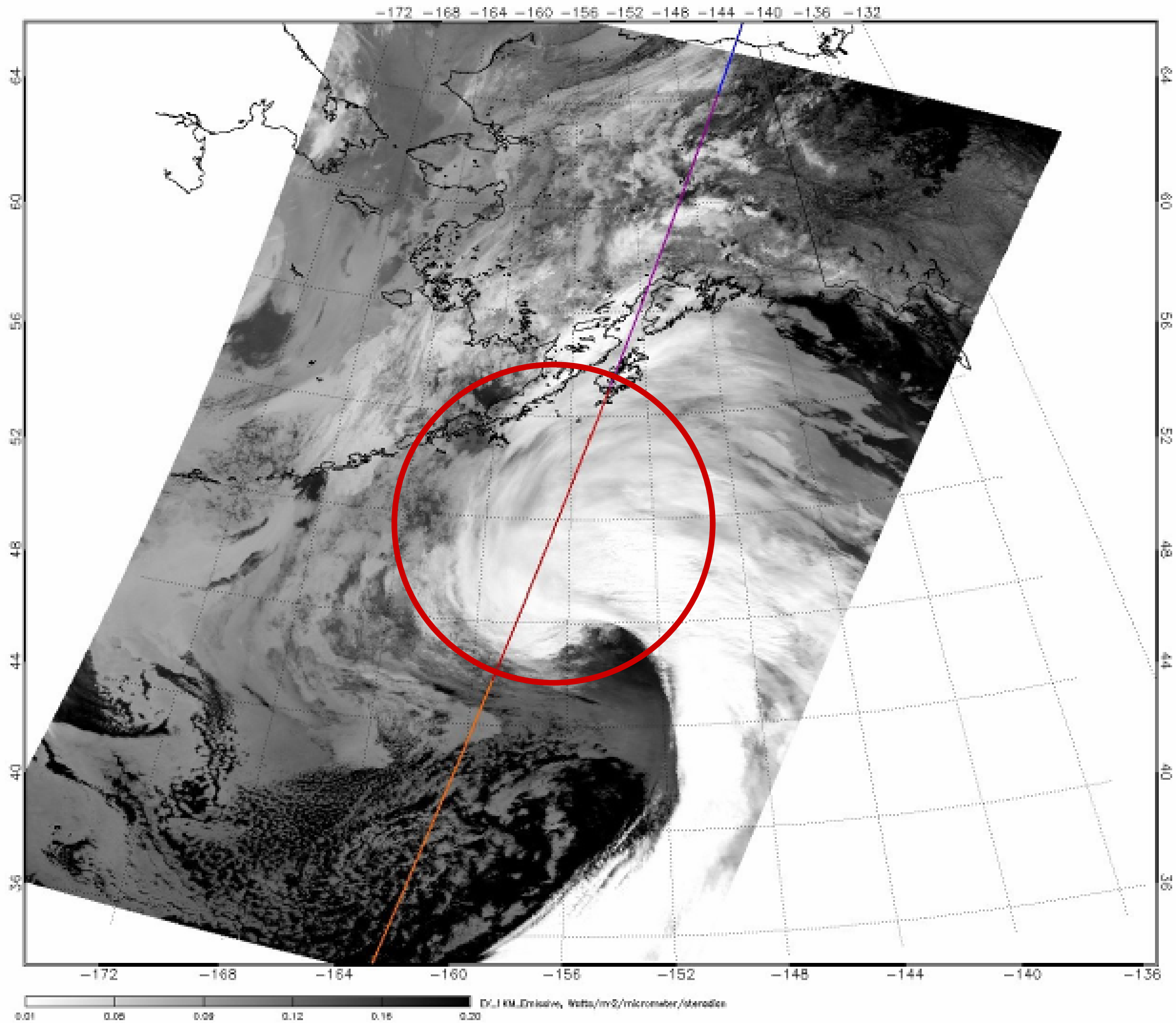
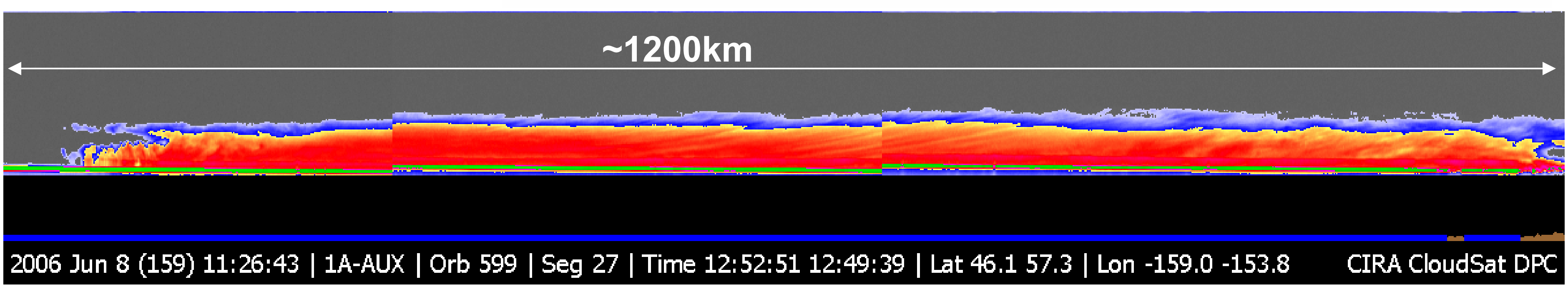
72
76
80
84
88
2006 Jun 4 (155) 06:54:36 | 1A-AUX | Orb 538 | Seg 19 | Time 07:55:13 07:52:02 | Lat 40.1 28.6 | Lon 79.8 83.1
CIRA CloudSat DPC

Horizontal extent of precipitation …

This example extends over 1100km (683 miles)

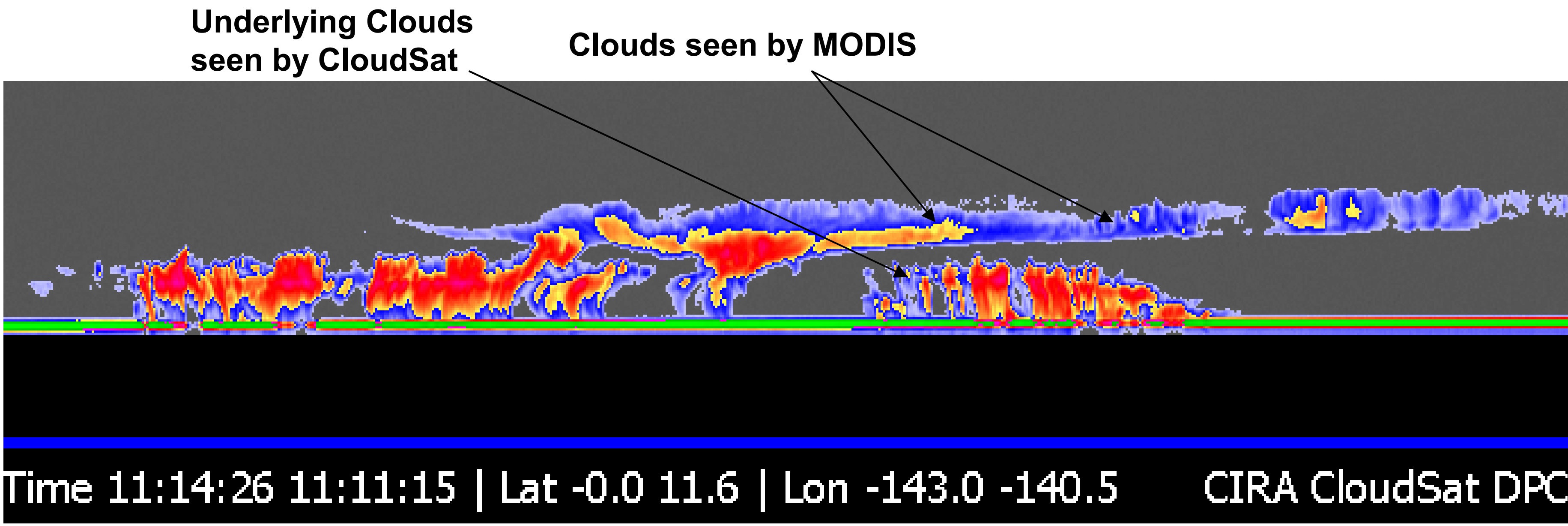


MODIS 3.7 μm (Channel 20)

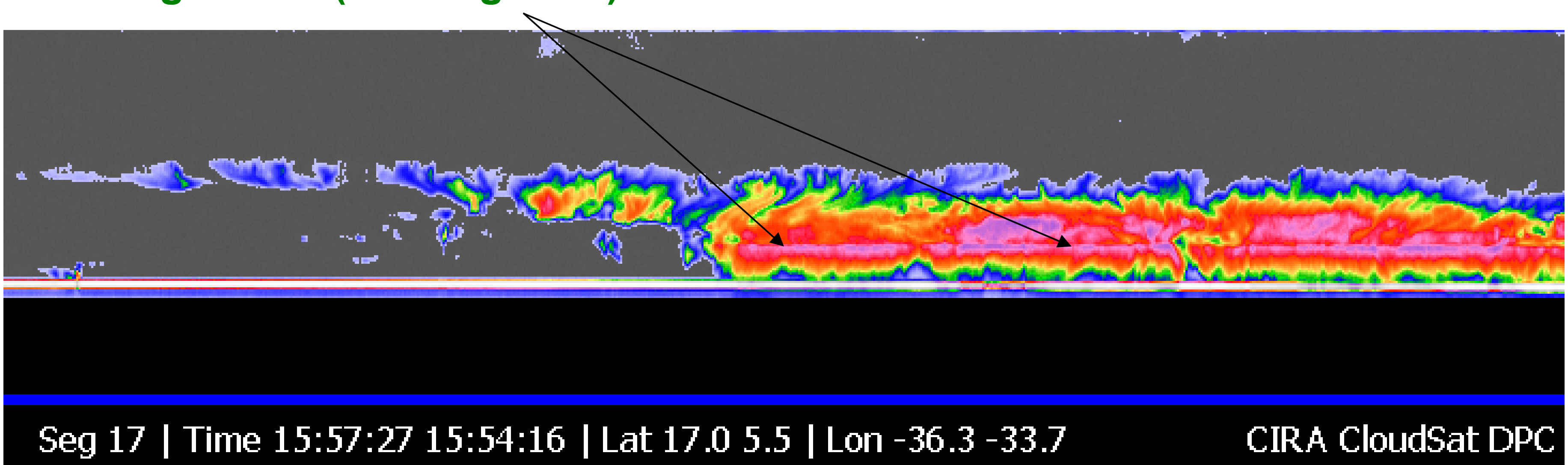


“Hidden” Precipitation / Clouds

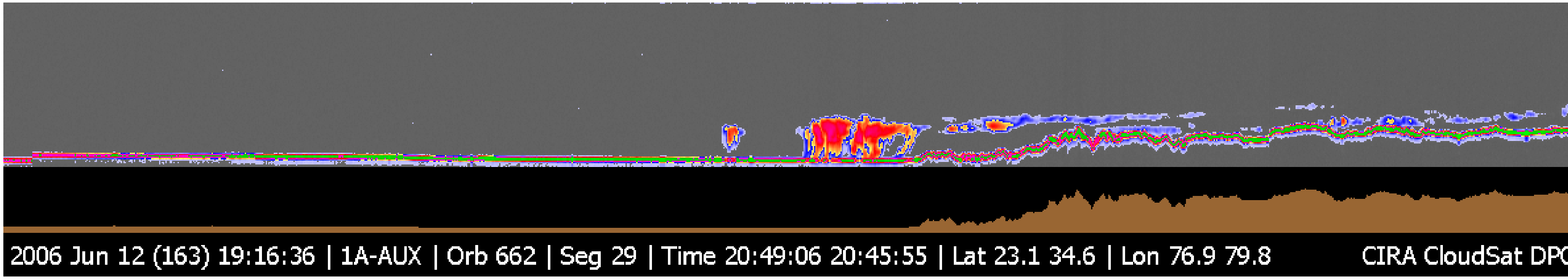
(below a cloud shield that prevents detection by a passive system)

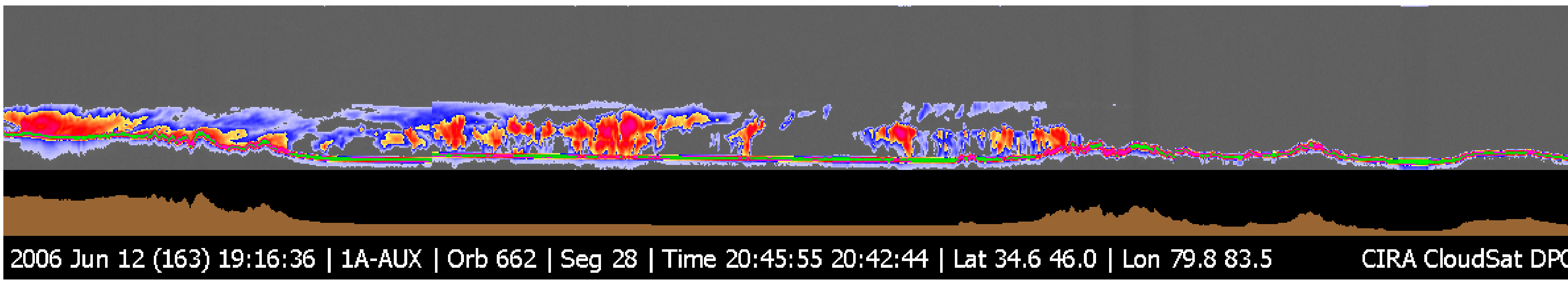


“Melting Level” (freezing level) …

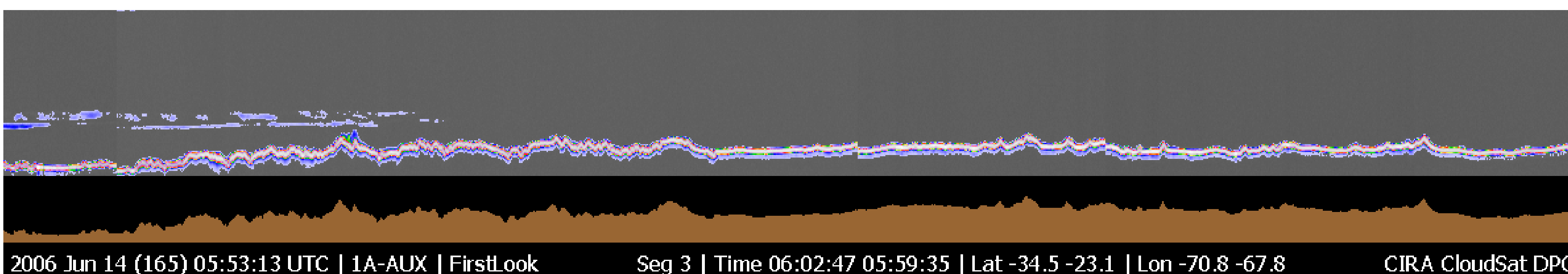


CloudSat – Topography Match-up … 12 June … orbit 662



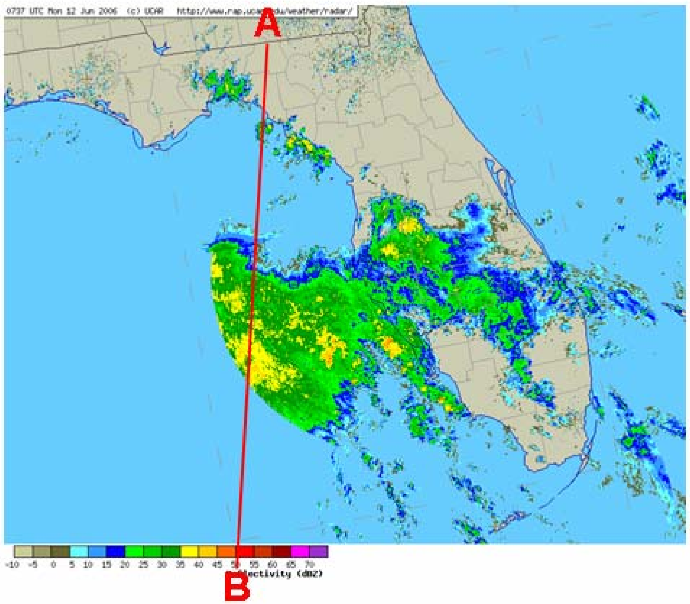


CloudSat – Topography Match-up … 14 June … orbit 683 (FirstLook)

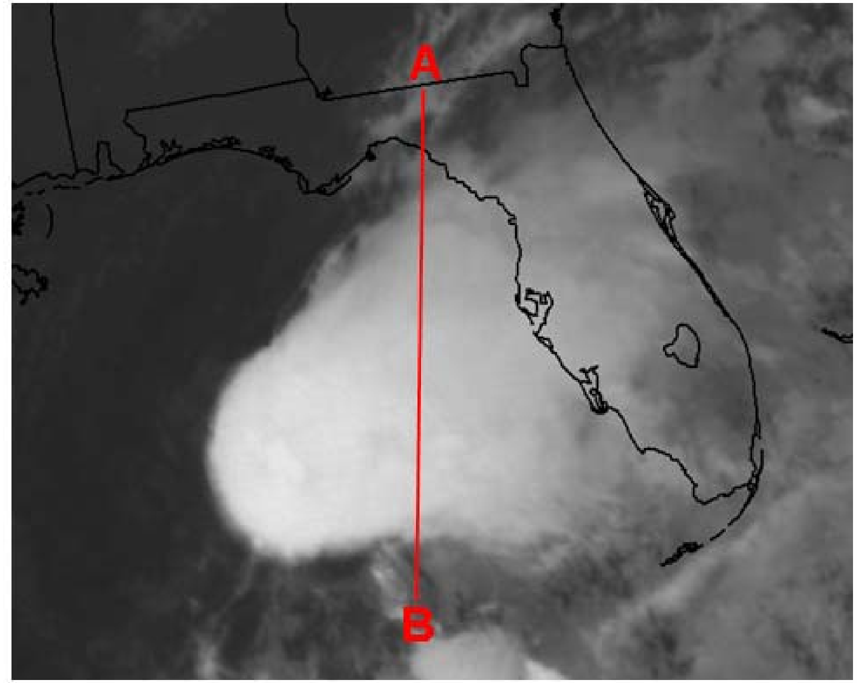


CloudSat Sees Alberto …

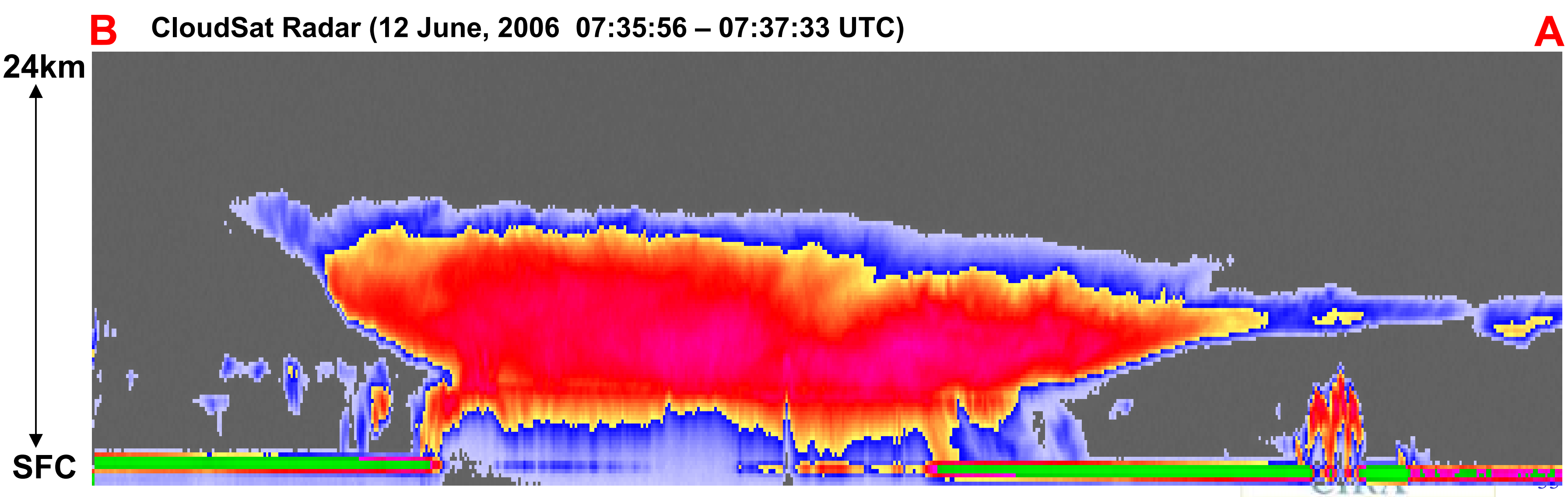
NEXRAD Radar (12 June, 2006 07:37 UTC)



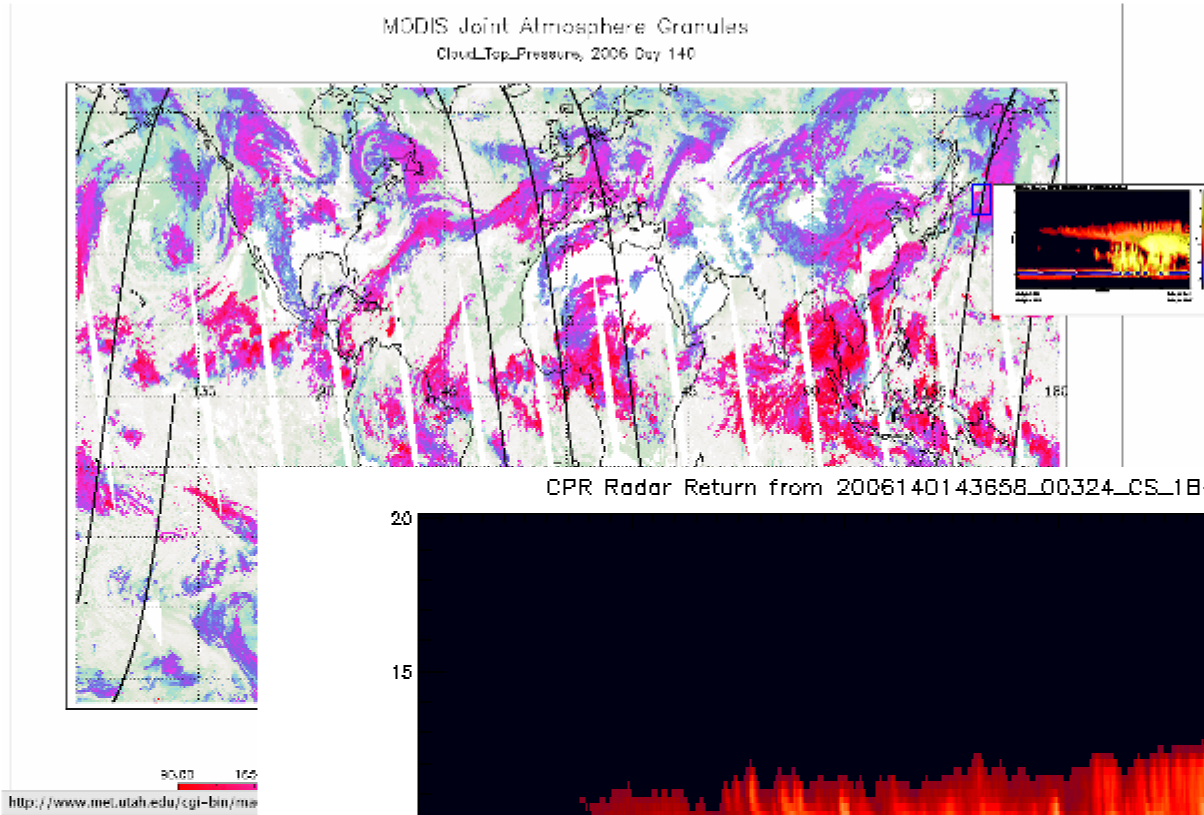
GOES-12 Geostationary Satellite – Infrared Image (12 June, 2006 07:32 UTC)

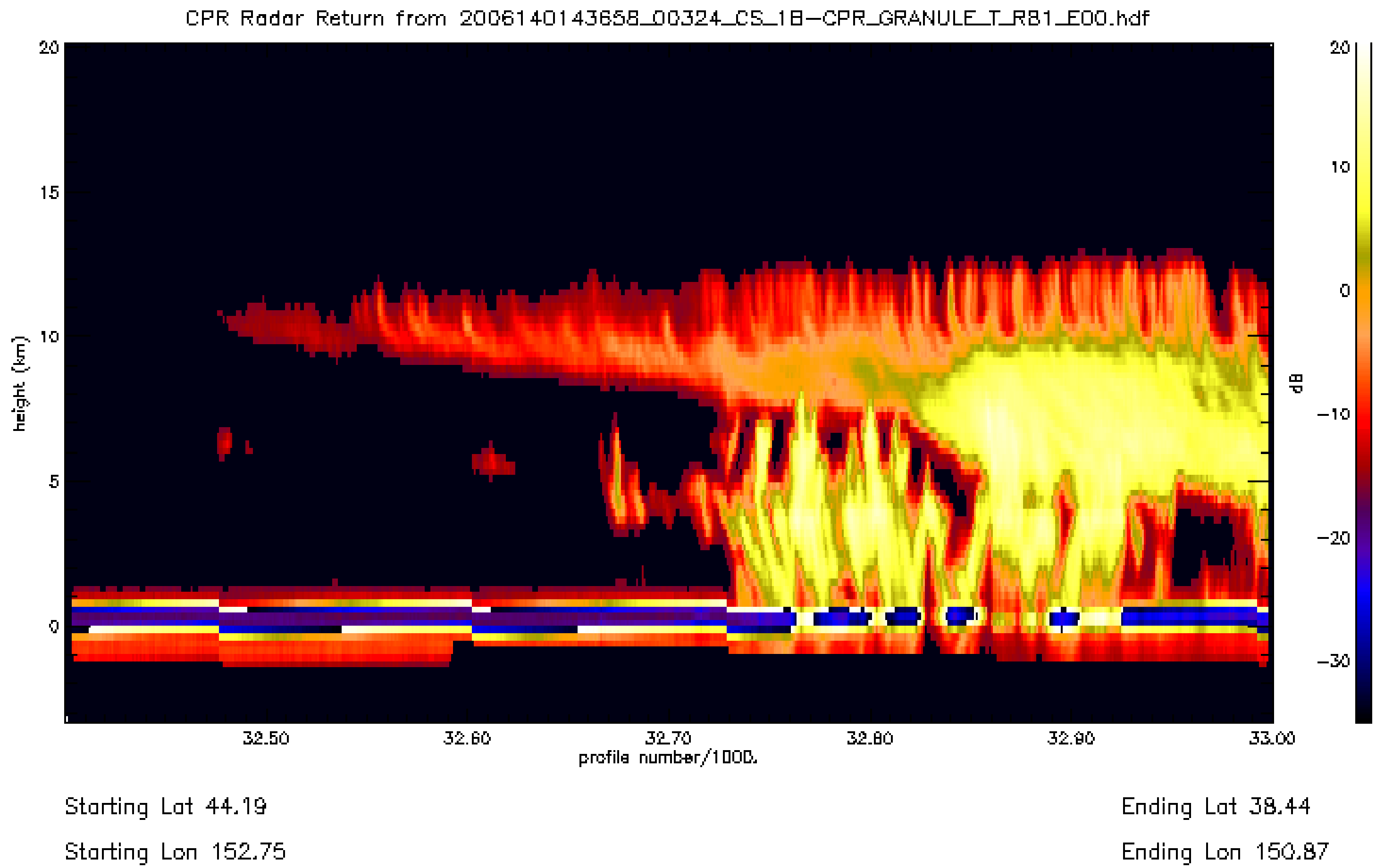


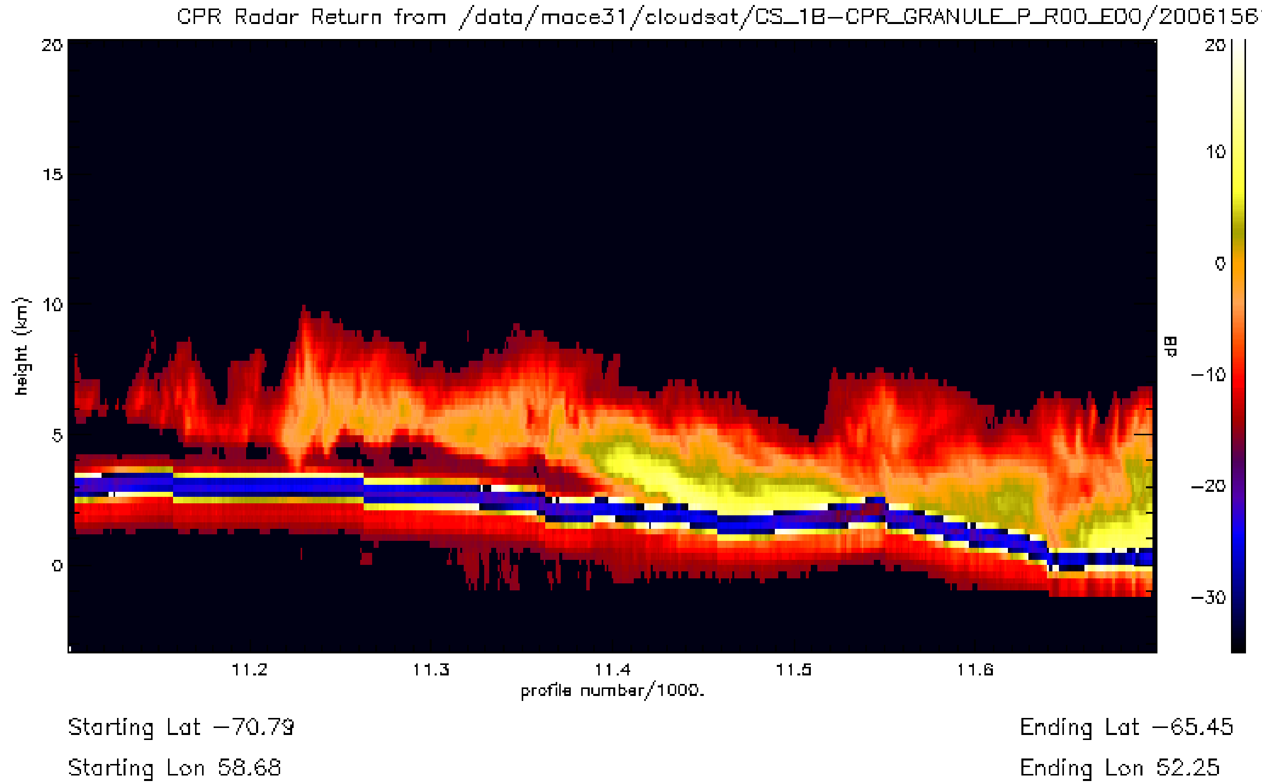
CloudSat Radar (12 June, 2006 07:35:56 – 07:37:33 UTC)

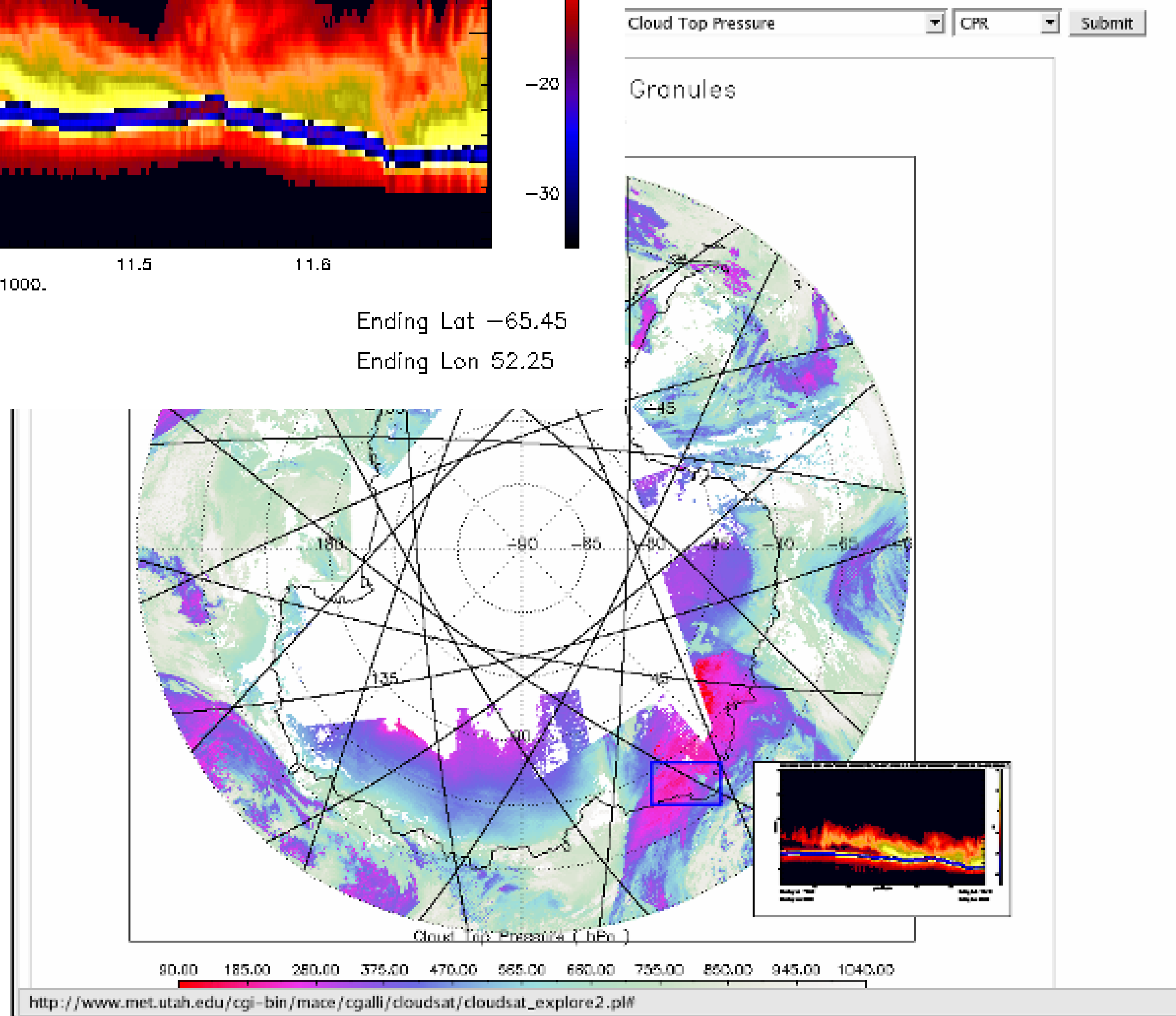


Cloud top structure of an intense frontal system east of Hokkaido Japan on 20 May.



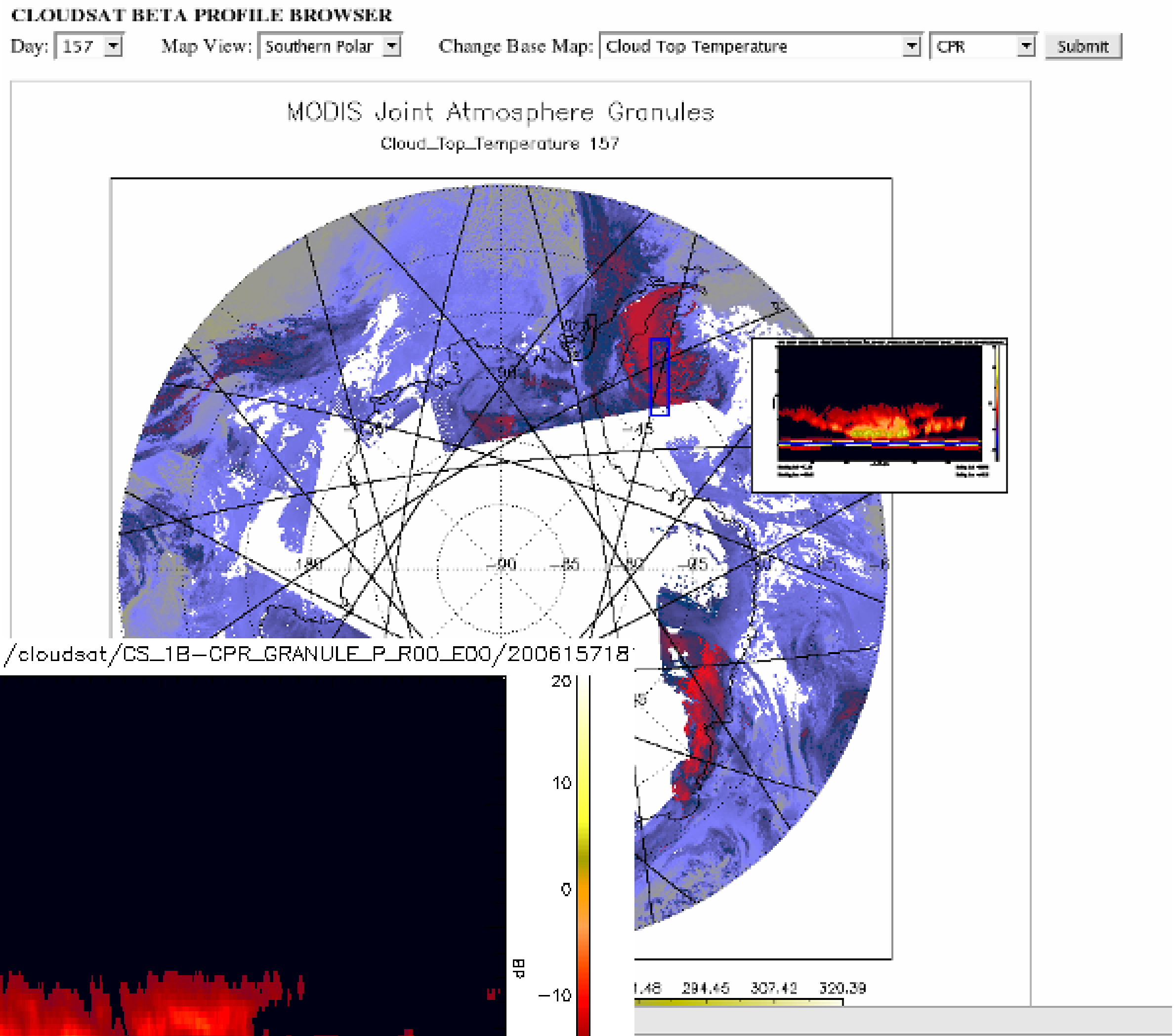


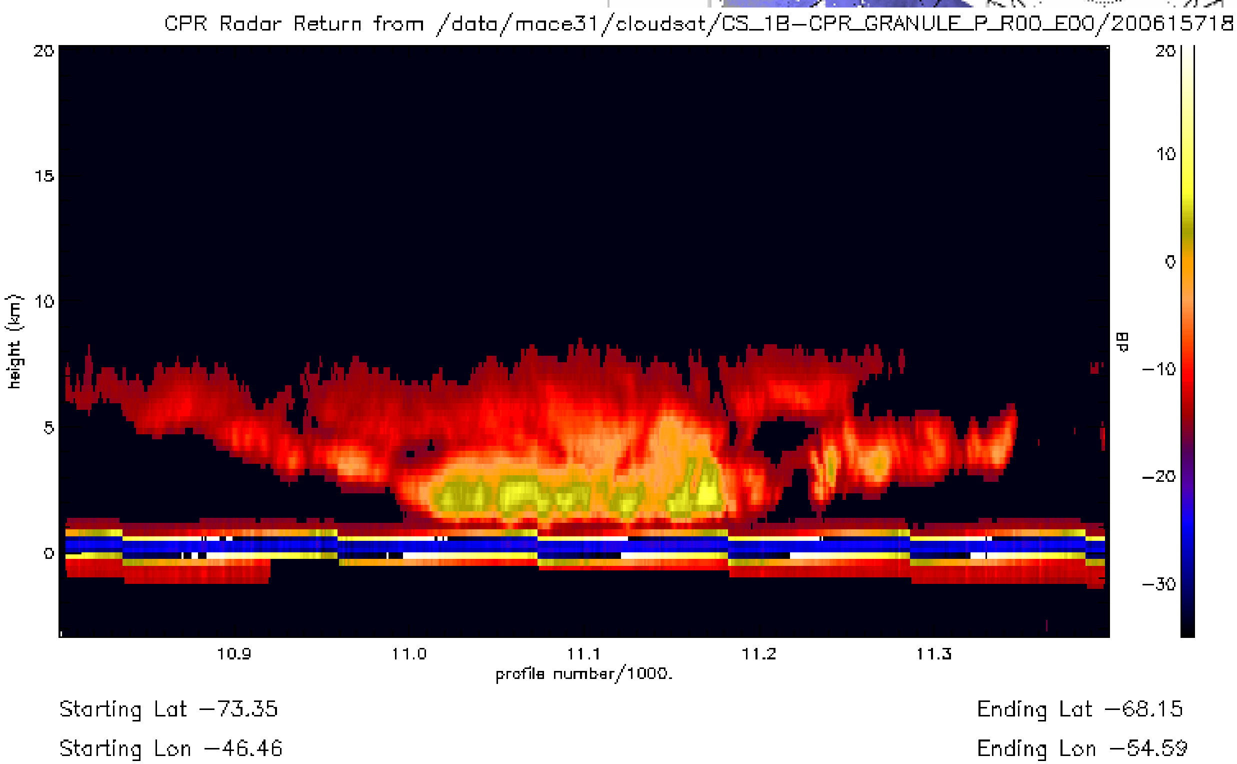


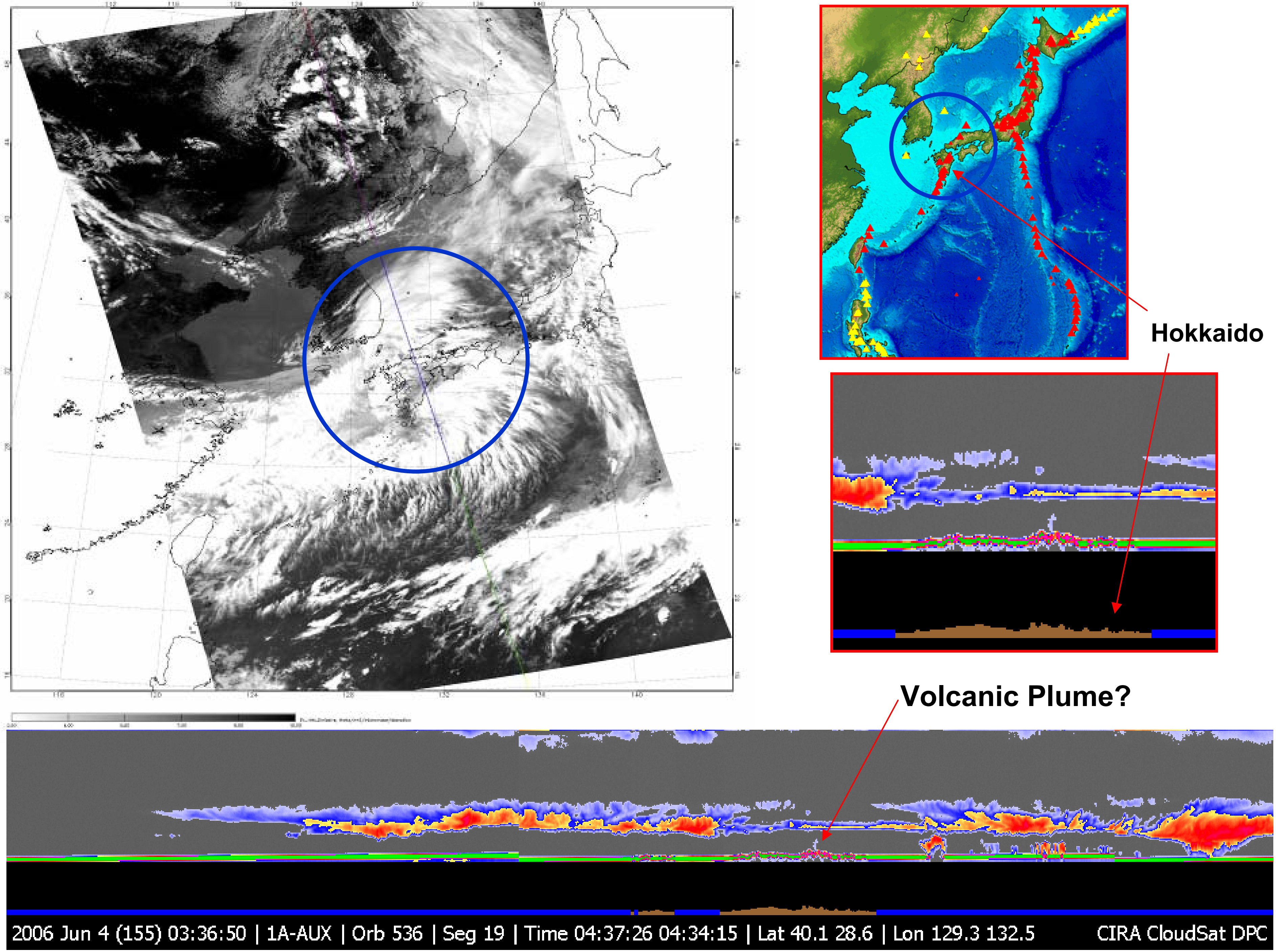


Vertical Structure of Clouds and Precipitation In the Polar Night have never before been observed!

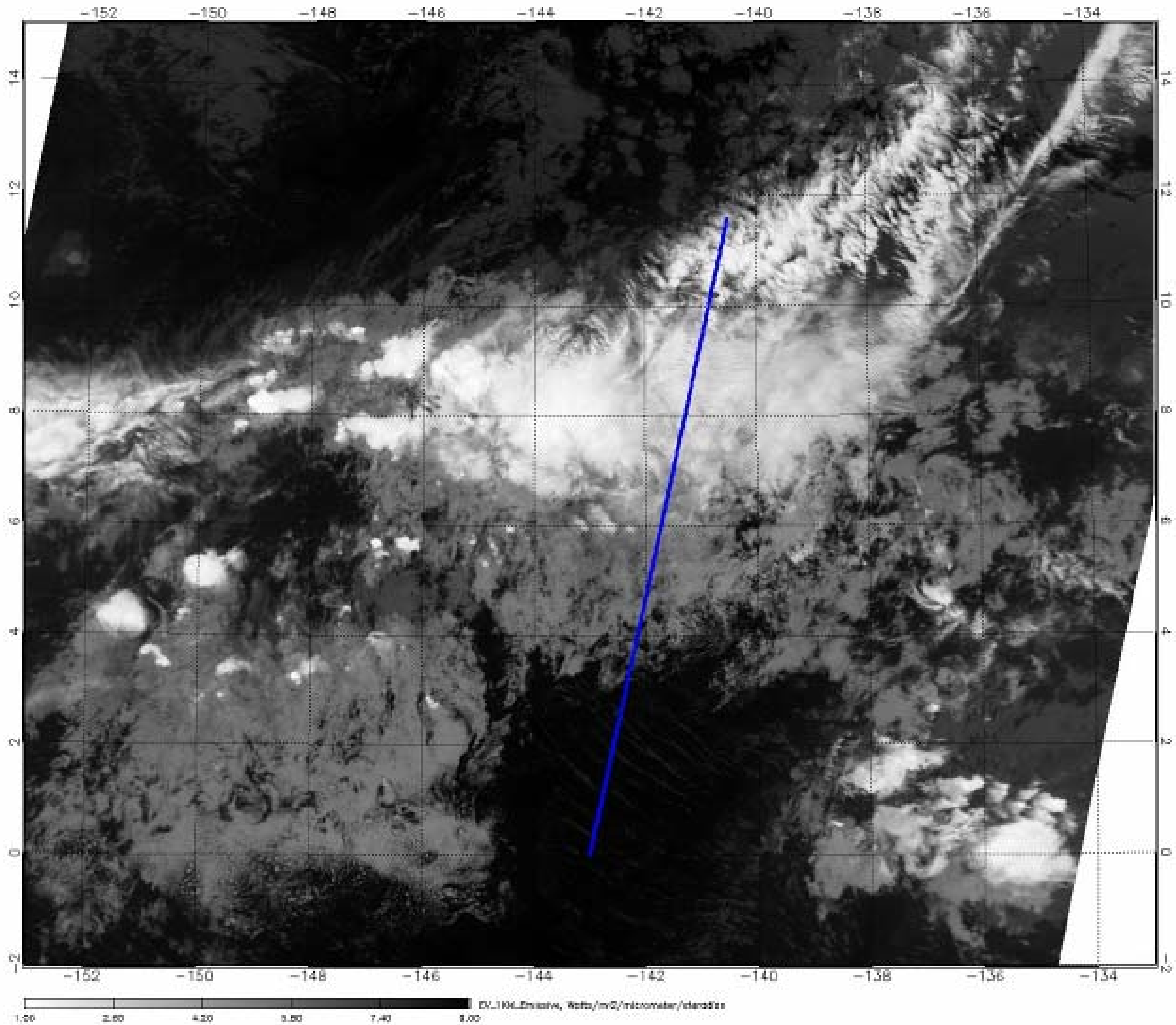
The vertical structure of an intense storm system during the south polar night is documented as it buffets the Antarctic Peninsula and the Weddell Sea

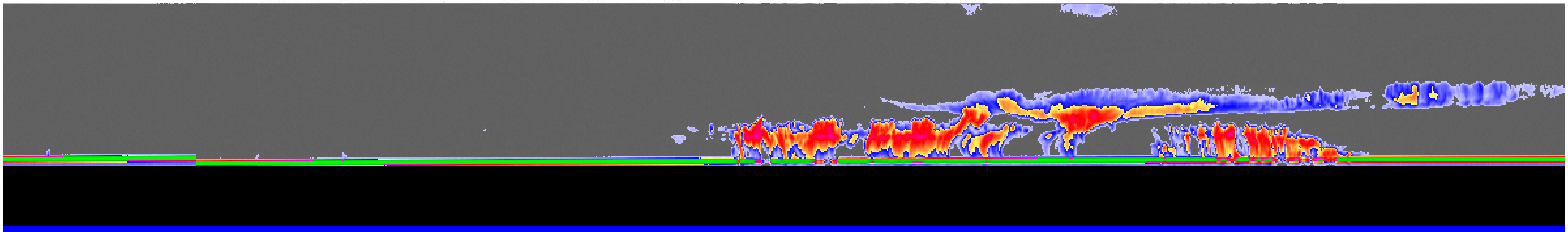





Hokkaido
Volcanic Plume?
2006 Jun 4 (155) 03:36:50 | 1A-AUX | Orb 536 | Seg 19 | Time 04:37:26 04:34:15 | Lat 40.1 28.6 | Lon 129.3 132.5
CIRA CloudSat DPC

MODIS 11 μm
(Channel 31)





2006 Jun 10 (161) 09:35:33 | 1A-AUX | Orb 627 | Seg 31 | Time 11:14:26 11:11:15 | Lat -0.0 11.6 | Lon -143.0 -140.5 CIRA CloudSat DPC

MODIS 3.7 μm (Channel 20)