CloudSat: Mission Status

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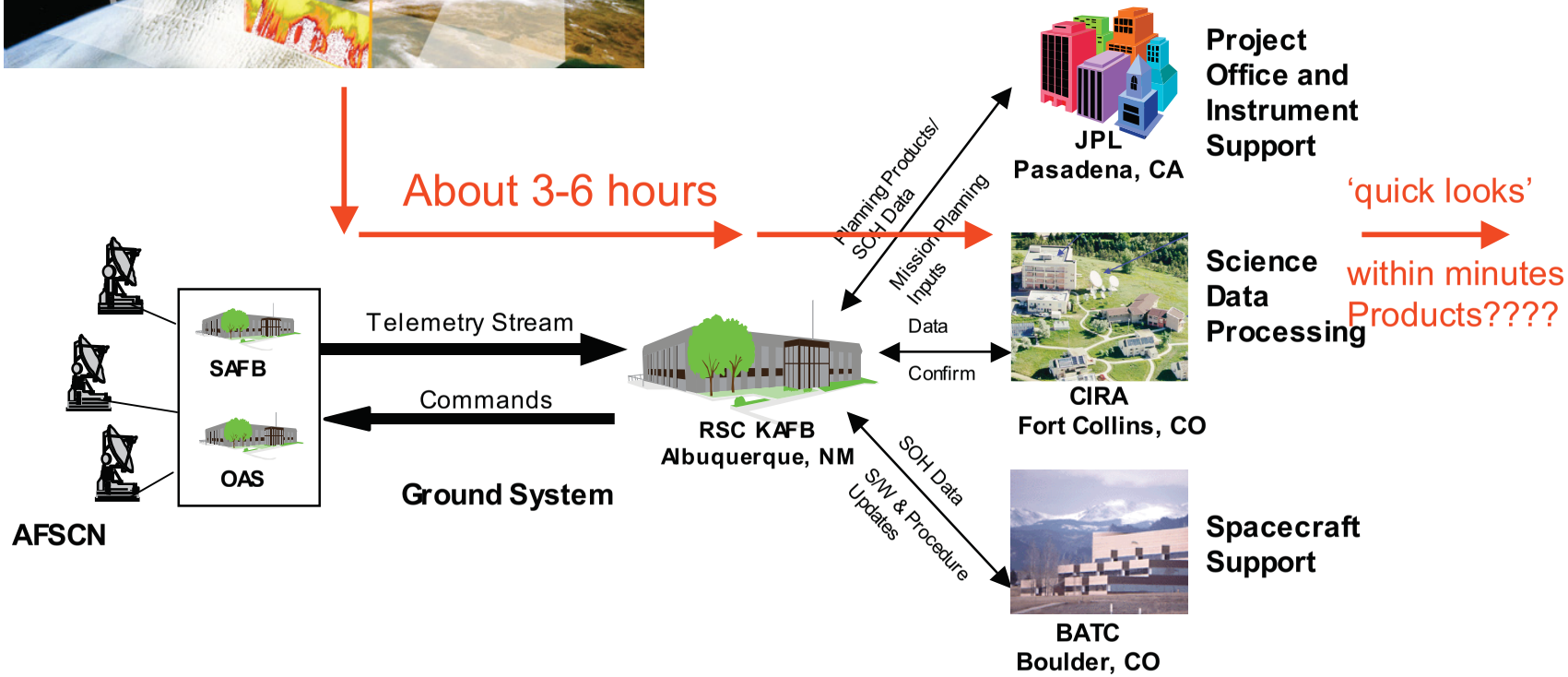
CloudSat Project Manager and Deputy PI

Launch

28 April 2006

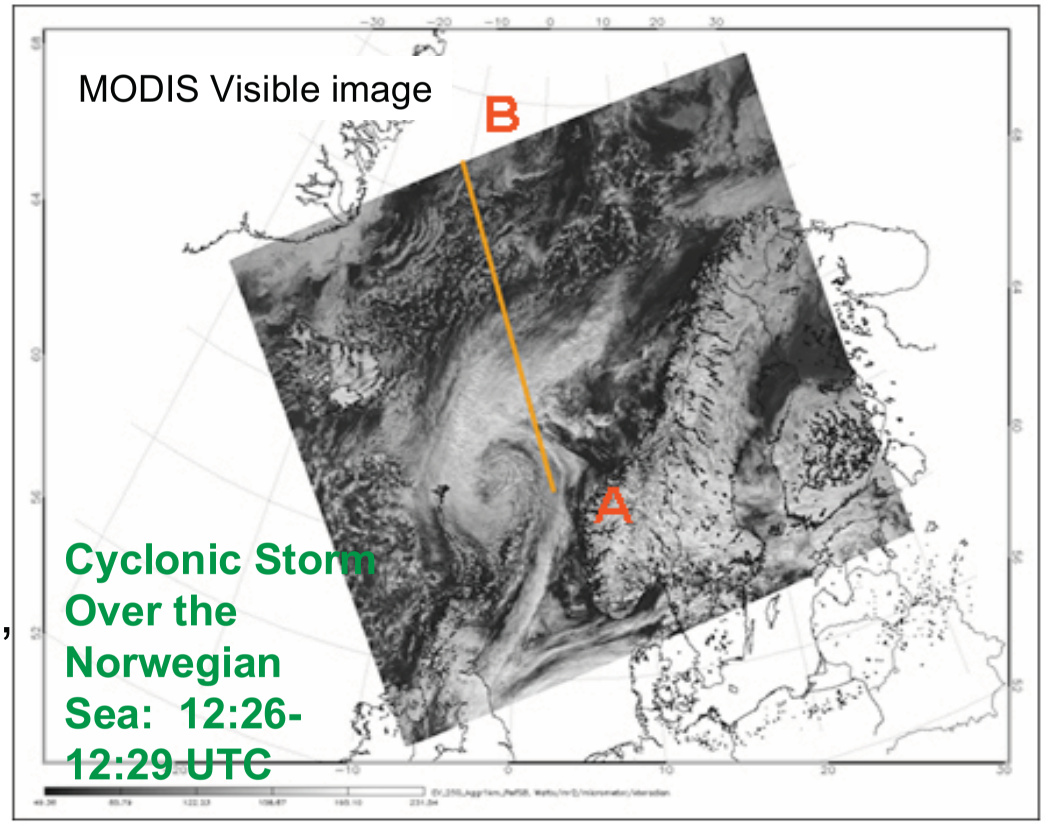
Overview : Ground Operations System



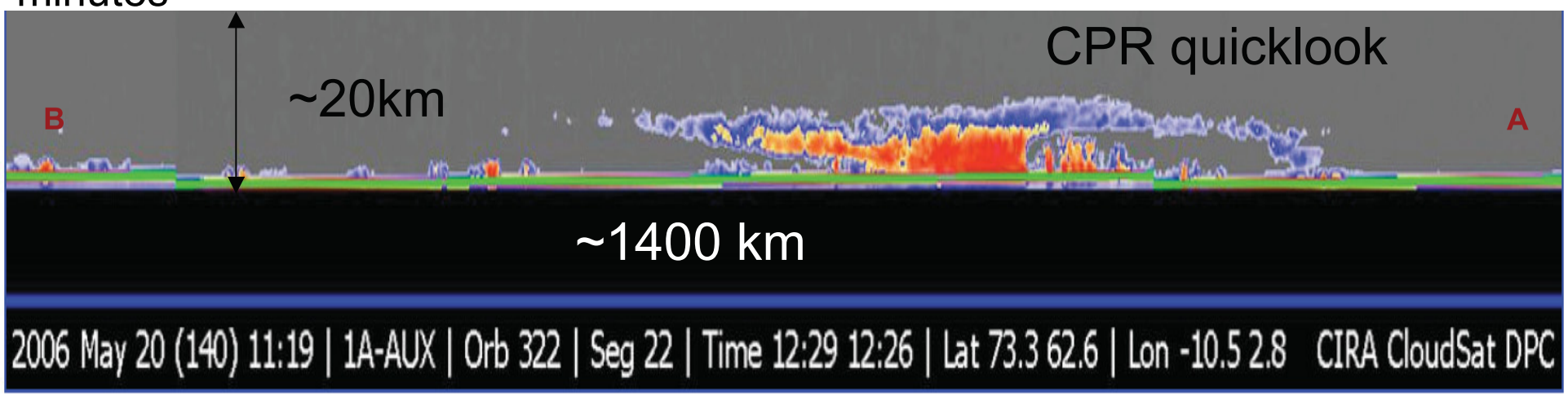
CLOUDSAT

A NASA EARTH SYSTEM SCIENCE PATHFINDER MISSION

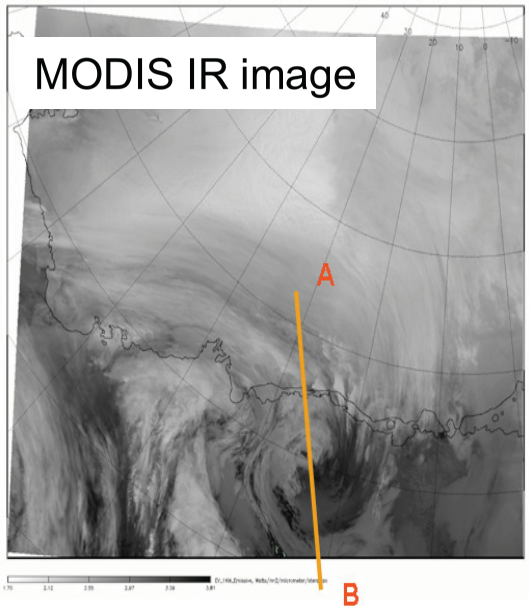
First (3 minute) Image of CPR on May 20, 2006



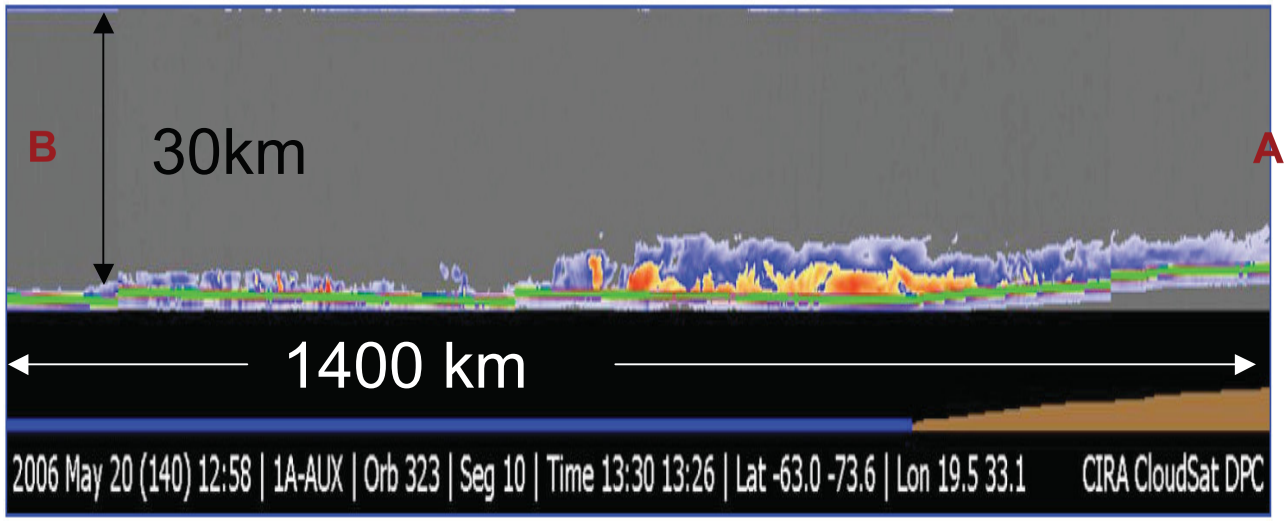
Time of turn on, downlink to RSC, transmission of data to CIRA, returned image to RSC ~15 minutes



One of the first Images on May 20, 2006

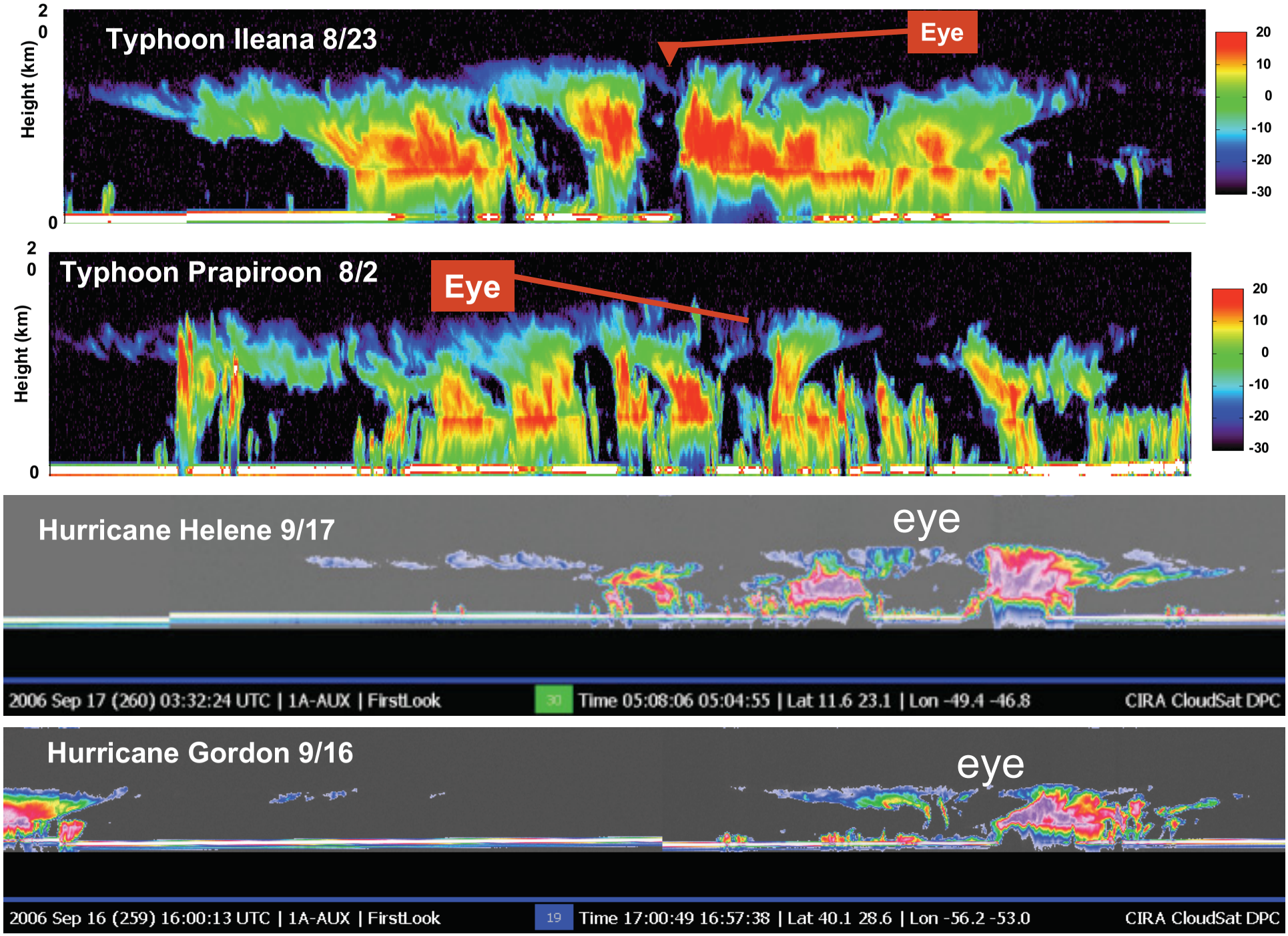


Polar Night Storm Near Antarctica: 13:26-13:30 UTC



CloudSat image of a horizontal cross-section of a polar night snow storm near Antarctica. Until now, clouds have been hard to observe in polar regions using remote sensing, particularly during the polar winter or night season and it has not be possible to quantify the mass of water that falls as snow.

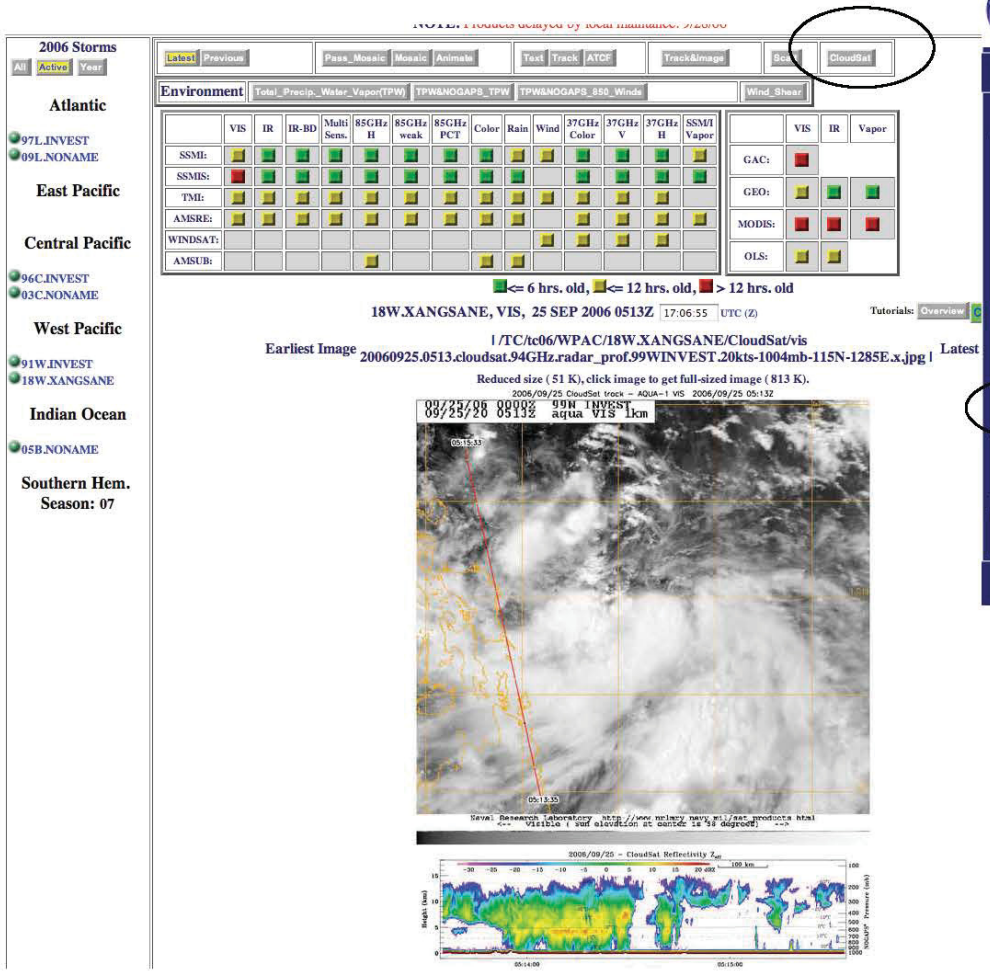
Routine radar operations commenced 2 June 2006

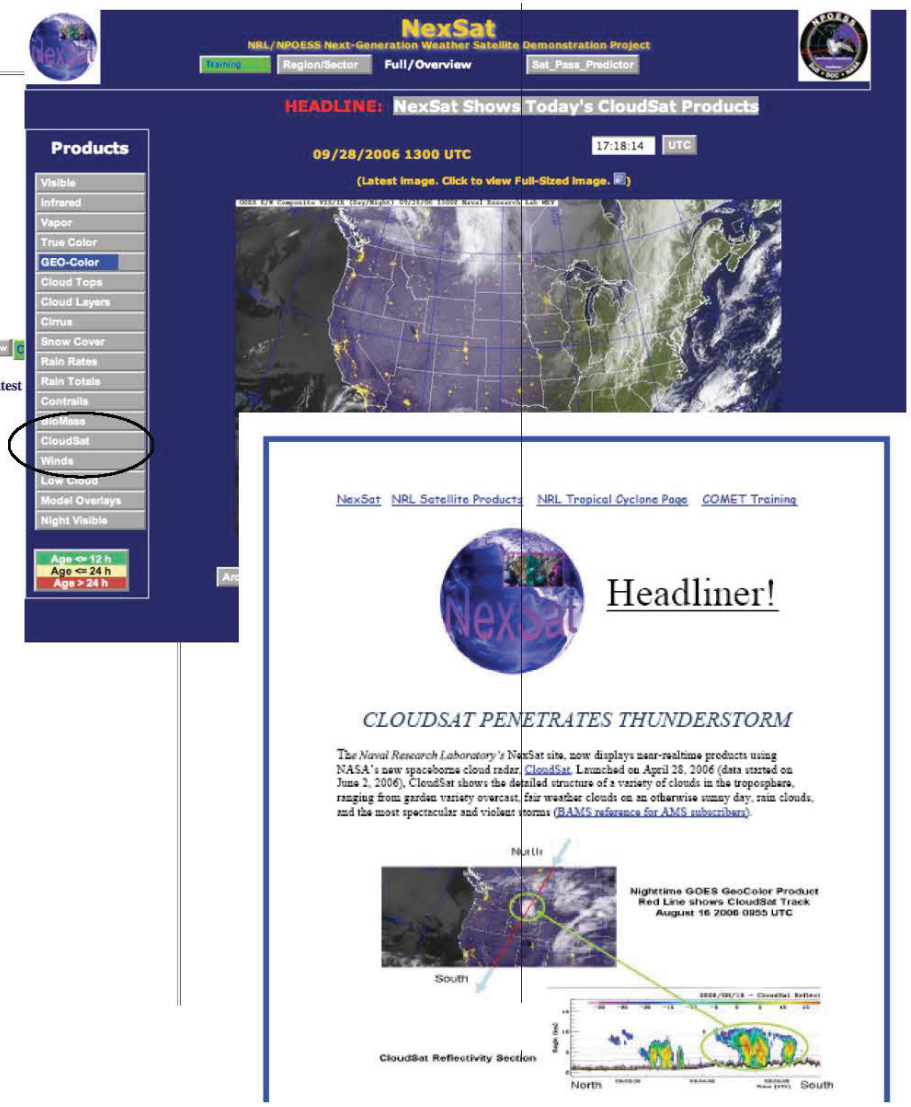

Typhoon Ileana 8/23
Eye
Height (km)
2
0
0
20
10
0
-10
-20
-30
Typhoon Prapiroon 8/2
Eye
Height (km)
2
0
0
20
10
0
-10
-20
-30
Hurricane Helene 9/17
eye
2006 Sep 17 (260) 03:32:24 UTC | 1A-AUX | FirstLook
30
Time 05:08:06 05:04:55 | Lat 11.6 23.1 | Lon -49.4 -46.8
CIRA CloudSat DPC
Hurricane Gordon 9/16
eye
2006 Sep 16 (259) 16:00:13 UTC | 1A-AUX | FirstLook
19
Time 17:00:49 16:57:38 | Lat 40.1 28.6 | Lon -56.2 -53.0
CIRA CloudSat DPC

CloudSat and operational applications - near real time CloudSat data are being used

NRL NexSat site serves a broad constituency

NRL tropical cyclone site used by civilian and military





http://www.nrlmry.navy.mil/tc_pages/tc_home.html

http://www.nrlmry.navy.mil/nexsat_pages/nexsat_home.html

Early assessment of the CPR suggests nominal or above-nominal performance

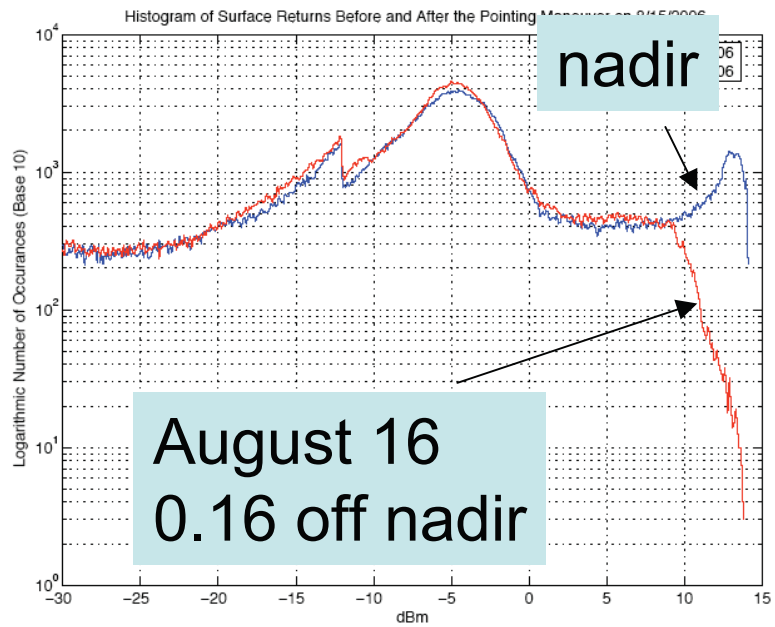
- Minimum Detection Sensitivity Requirement:
  - < -26 dBZ at EOL (i.e., at the end of 22-month primary mission)
  - Pre-launch estimates: BOL -29.6 dBZ; EOL -28.4 dBZ and preliminary post launch evaluations are consistent with pre-launch estimates
  - Early validation of radar suggests that we are meeting or exceeding performance requirements .
- Evaluations continue using systematic comparison with surface radars and aircraft measurements (e.g CCVEX)

CPR Pointing and Surface Reflection

Three measurement ‘epochs’

- Prior to July 7, radar viewed 1.7 degrees off-nadir along-track
- July 7 - August 15: nadir-viewing
  - Significant increase in surface reflection, with leakage into bottom two bins.
- August 15 - present: 0.16° off-nadir along-track (reduced reflection from surface)

PDF of surface reflection



Spacecraft Computer Reset

- Description
  - On 25 September, the CloudSat spacecraft experienced a reset of the spacecraft control computer.
- Current Status
  - Fault protection worked as expected, safing the CPR, restarting the computer, and placing the spacecraft in the “Acquire-Sun” ACS mode.
  - The spacecraft was successfully transitioned from Acquire-Sun mode to Point mode.
  - The CPR resumed taking data on Tuesday, 3 Oct.
- Causes:
  - An exhaustive analysis was conducted to determine the exact cause of the SCC reset. Two possible causes:
    - An SEU in the reset circuit induced a false SCC reset. If a SCC reset does not reoccur, or does not reoccur for several months (with the exact same telemetry indications), then an SEU would be the likely cause and switching to the redundant SCC would not resolve the problem or be recommended.
    - A weak or degraded electronic component in the SCC reset circuit created a “glitch” which triggered the reset. If a SCC reset reoccurs multiple times (with the exact same telemetry indications), the problem is most likely due to a weak or degraded electronic part and switching to the redundant SCC would be recommended.
- Impact
  - A little over 1 week of CPR data was lost due to this anomaly.

EIK “Trips”

- Description:
  - After working nominally in Operate Mode for 4 hours on 5/20/06, CPR HPA-102 was switched back to Receive Mode (pulse grid off but EIK and HVPS were still powered). 50 hours into the Receive Mode, HPA-102 experienced a body-current trip.
  - After the trip and the 7-minute internal timeout, HPA-102 returned to Receive Mode. Cathode Voltage telemetry came back at 4.5V (from 4.7V normal), and it abruptly dropped to 2.5V about 10 seconds later, and to 2V about 50 minutes later. HPA-102 was turned off after an additional 10-hours in Receive Mode.
  - Two other trip-offs occurred on 16 June and 17 July.
- Cause:
  - Leaving EIK in Receive Mode for an extended period causes excessive barium vapor build-up near EIK cathode causing high voltage discharge (trip-off). [Note: In Operate Mode when EIK is pulsing, the electron beam ionization removes excess barium vapor].
  - The trip-current spike causes the diodes in HVPS telemetry circuit to leak, resulting in erroneous Cathode Voltage telemetry
- Resolution:
  - Implemented a new flight rule that limits the Receive Mode duration to less than 2 hours (per EIK manufacturer (CPI) recommendation).
  - HVPS is designed to reset itself to operate mode (if tripped in operate mode), so receive mode cannot be accidentally engaged
  - Cathode Voltage telemetry is routinely monitored during passes as an indication of a ‘trip’. SSOH data is examined daily for changes.
- Impacts:
  - The CPR is healthy. Minimal loss of science data.
  - Subsequent trip-off events should not pose threat to the health of HPA and DSS
  - Interval between events appears to be increasing.

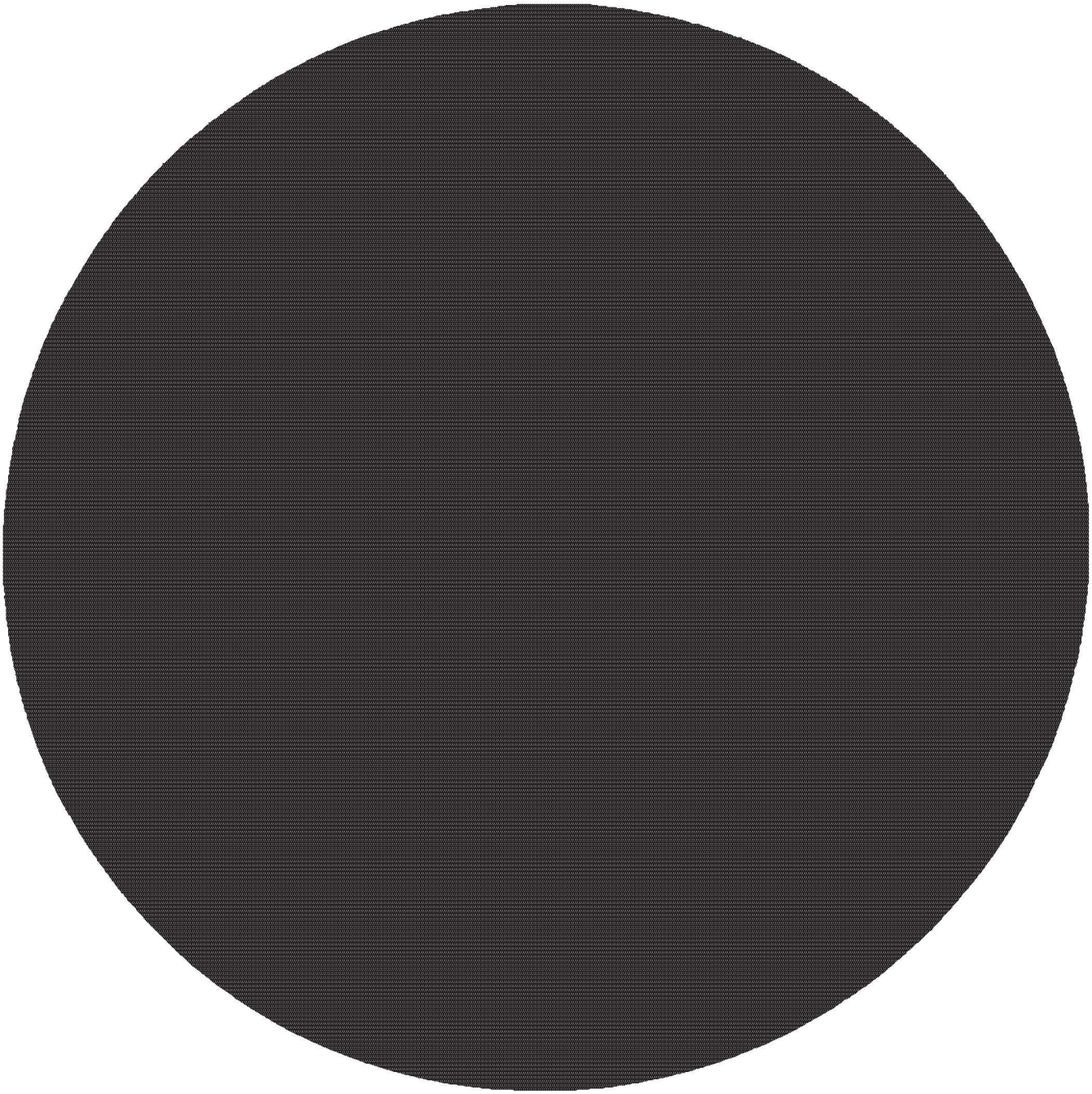
Other significant events

- The A-Train inclination maneuver campaign
  - Aqua conducted four of its planned six inclination maneuvers. CloudSat and CALIPSO executed maneuvers to match Aqua adjustments. The campaign will resume in Spring 2007.

- Level 1B and two Level 2 products, Geometrical Profile and Cloud Classification, were released to the science team.

Manager's Assessment

- The flight system is performing very well.
- The ground system has captured and processed >99% of all CPR data taken (exception: outages due to anomalies)
- Level 1B and two Level 2 products (GEOPROF and CLDCLASS) have been released to the Science Team.
- CloudSat data are already being used by research and applications groups (4 months after CPR ops began). Experimental products are under development.

CloudSat is giving us a new view of the atmosphere and is opening new areas of research!

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