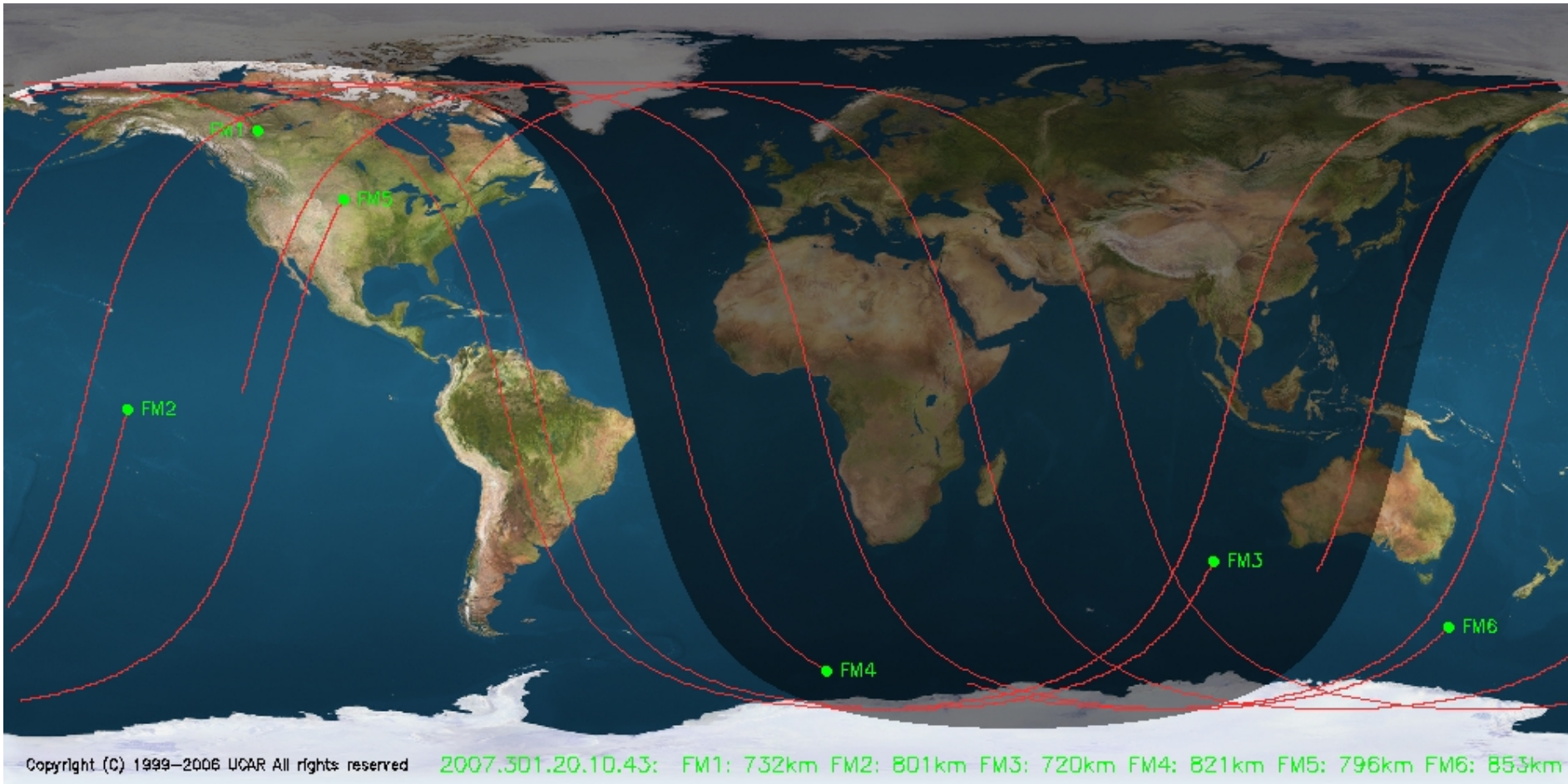
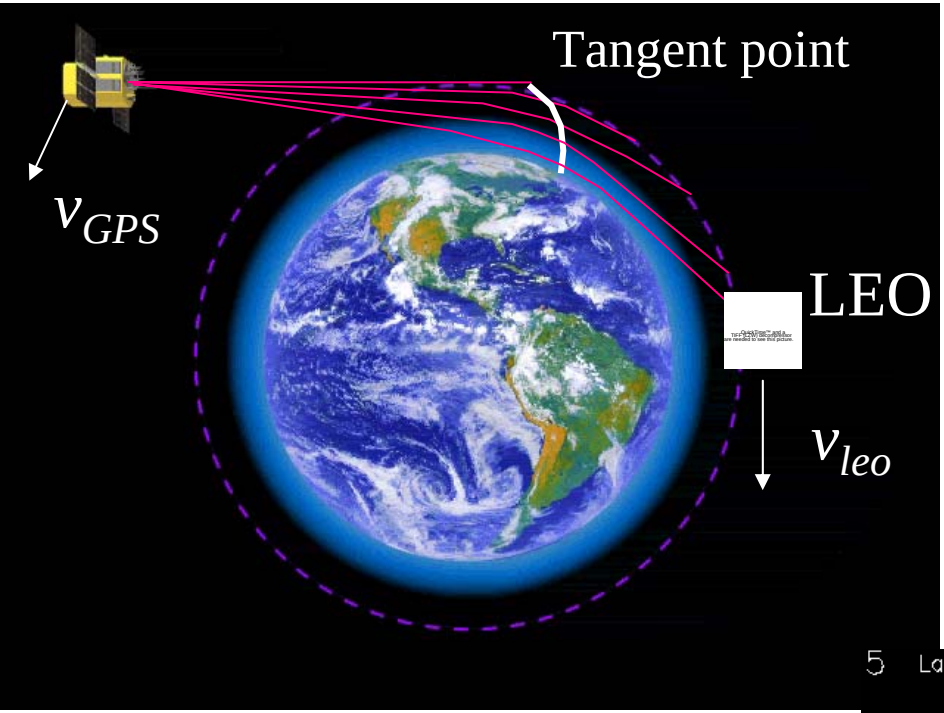
Formosat3 / COSMIC: Constellation Observing System for Meteorology, Ionosphere and Climate

Mission Status and Data Distribution

Unidata Policy Committee Meeting 29 Oct. 2007

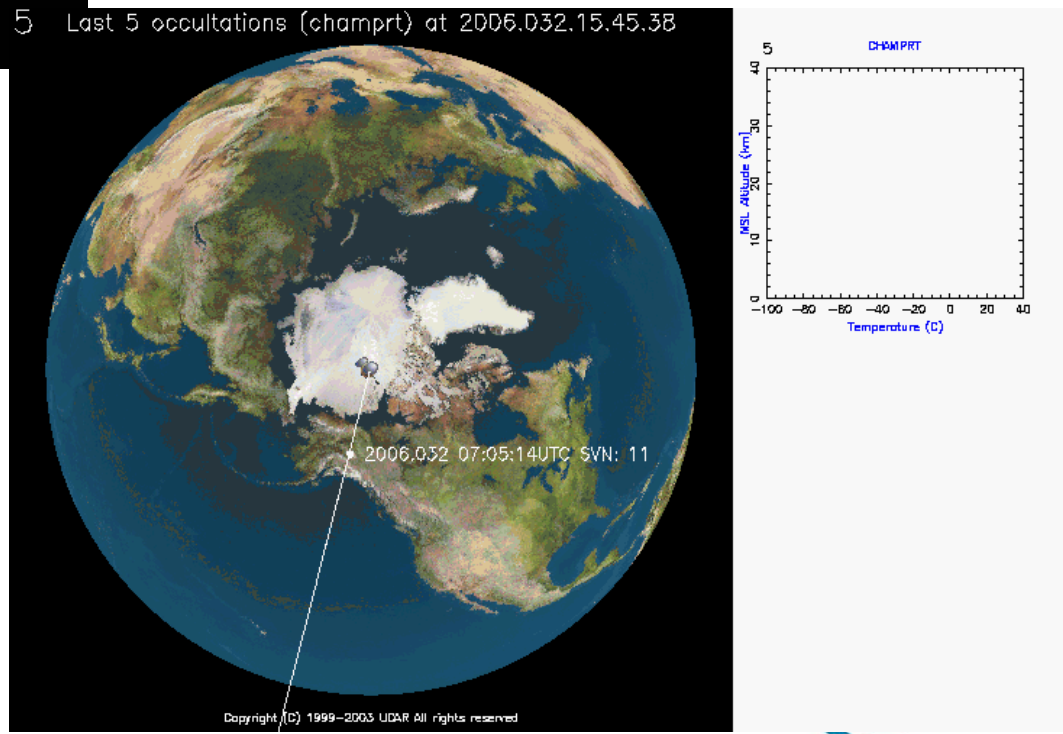
Current Constellation Oct. 28, 2007





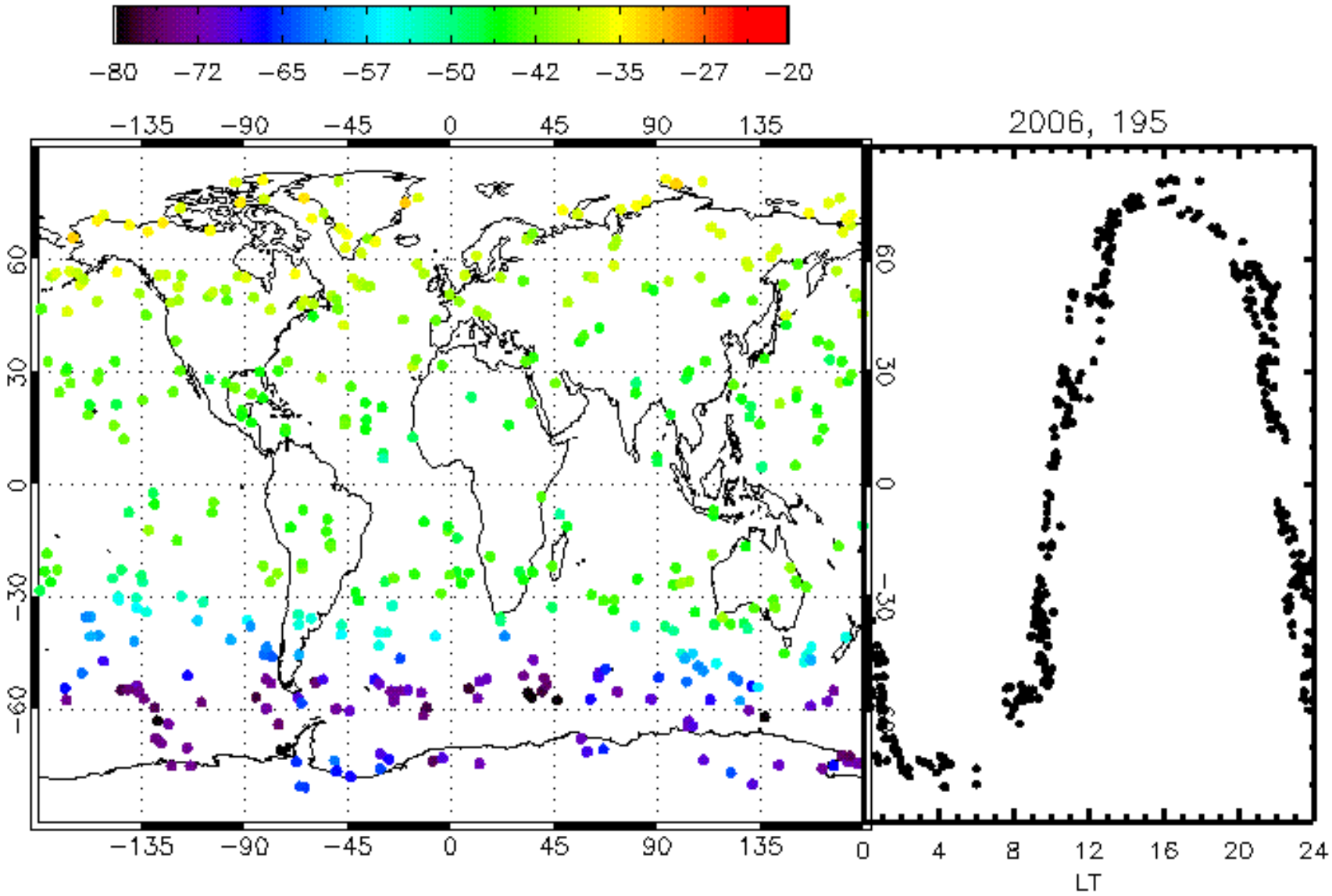
The LEO tracks the GPS phase while the signal is occulted to determine the Doppler

The velocity of GPS relative to LEO must be estimated to **~0.2 mm/sec** (20 ppb) to determine precise temperature profiles

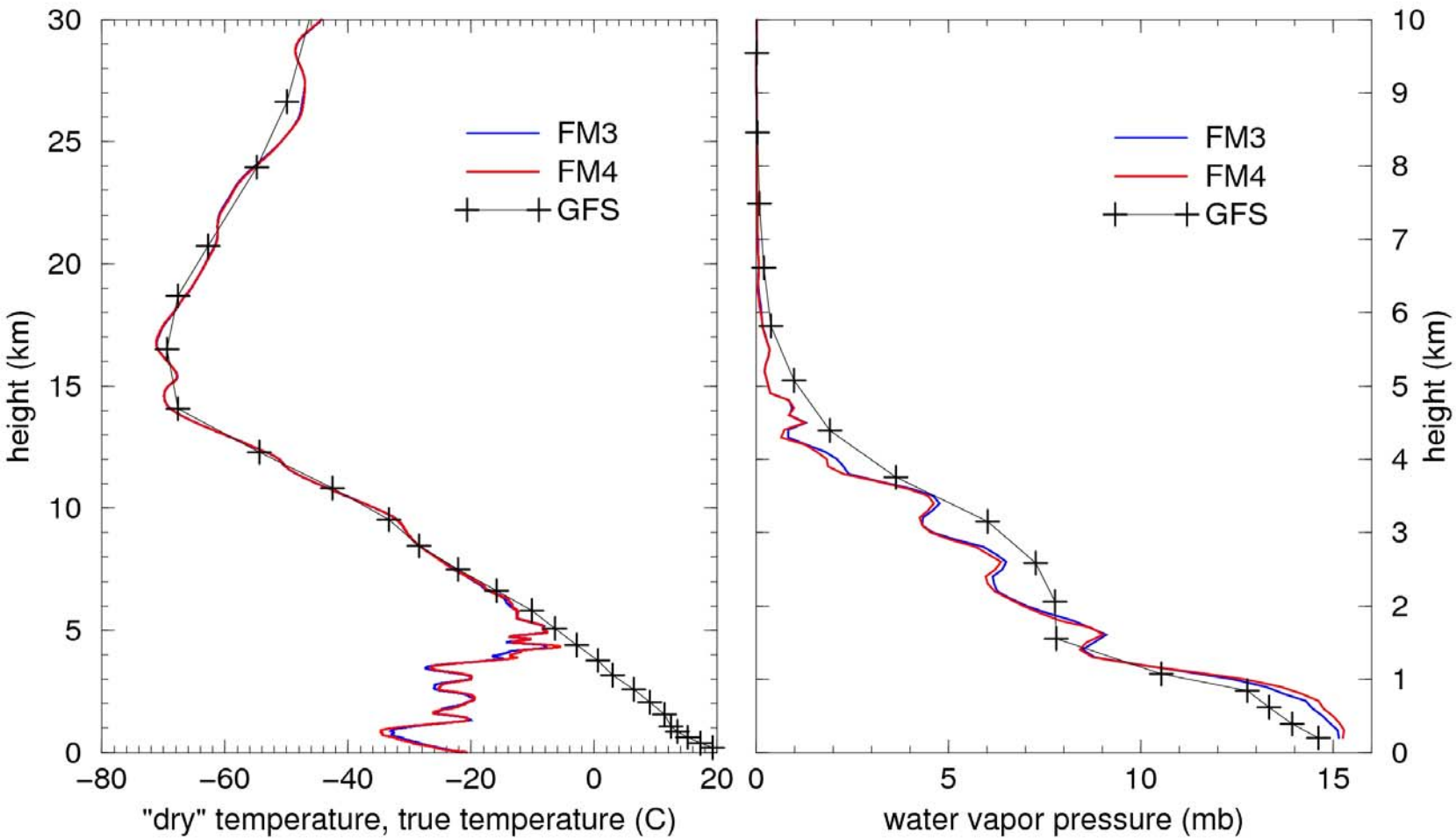


Evolving COSMIC Constellation

Temperature [C] at 100 mb (16km)

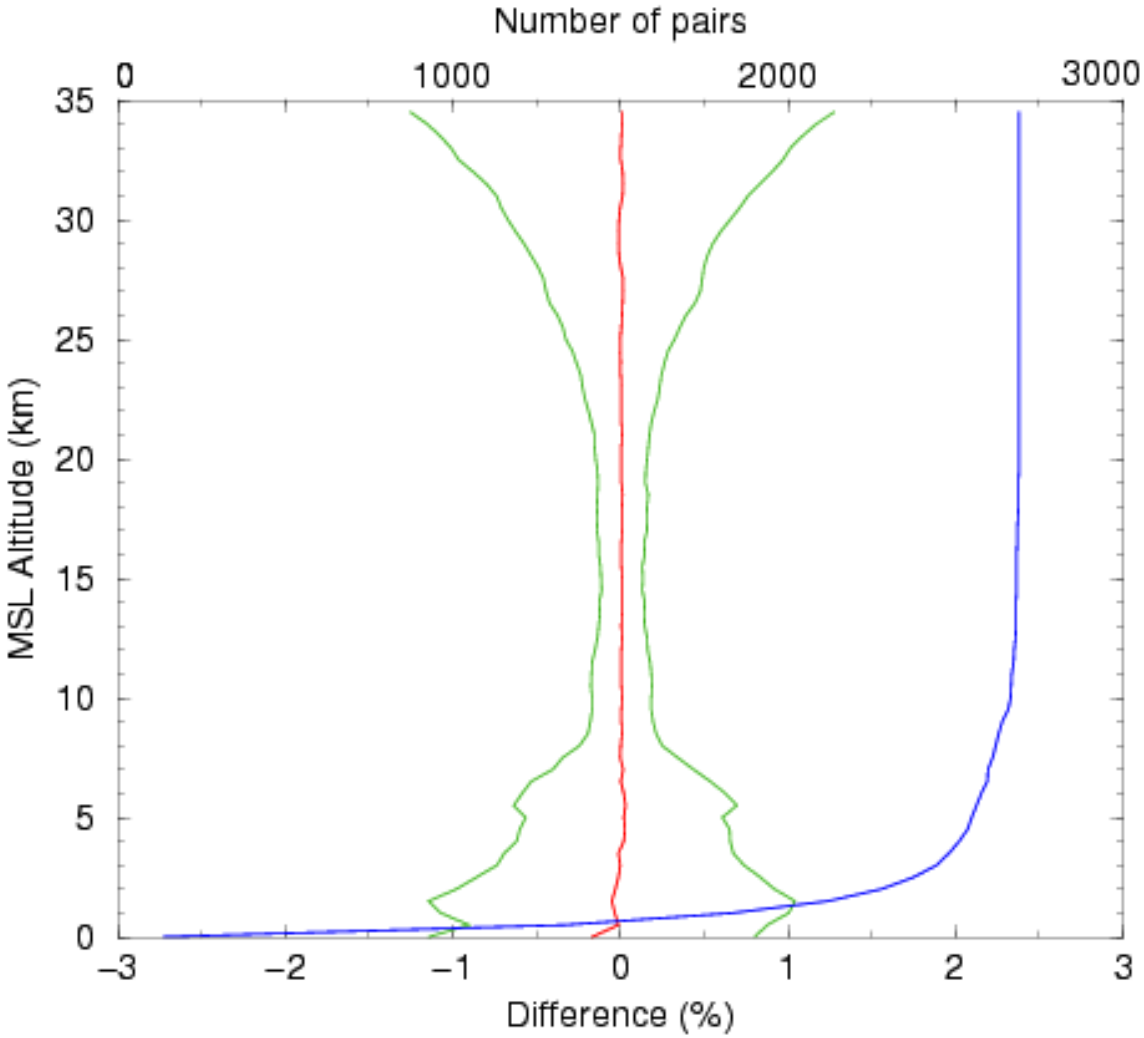


Comparison of collocated Profiles



QuickTime™ and a
Video decompressor
are needed to see this picture.

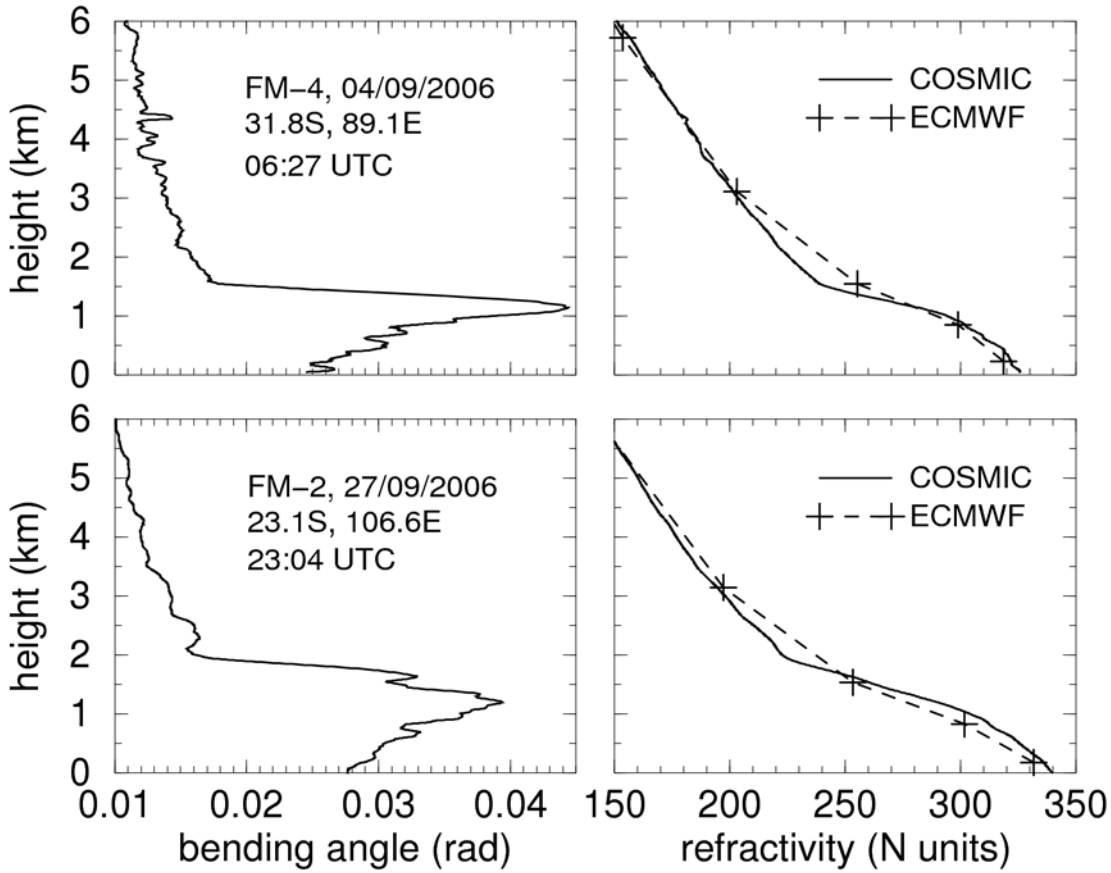
Statistical comparison of FM3-FM4 Soundings separation < 10 km



0.2% precision between 10-20 km

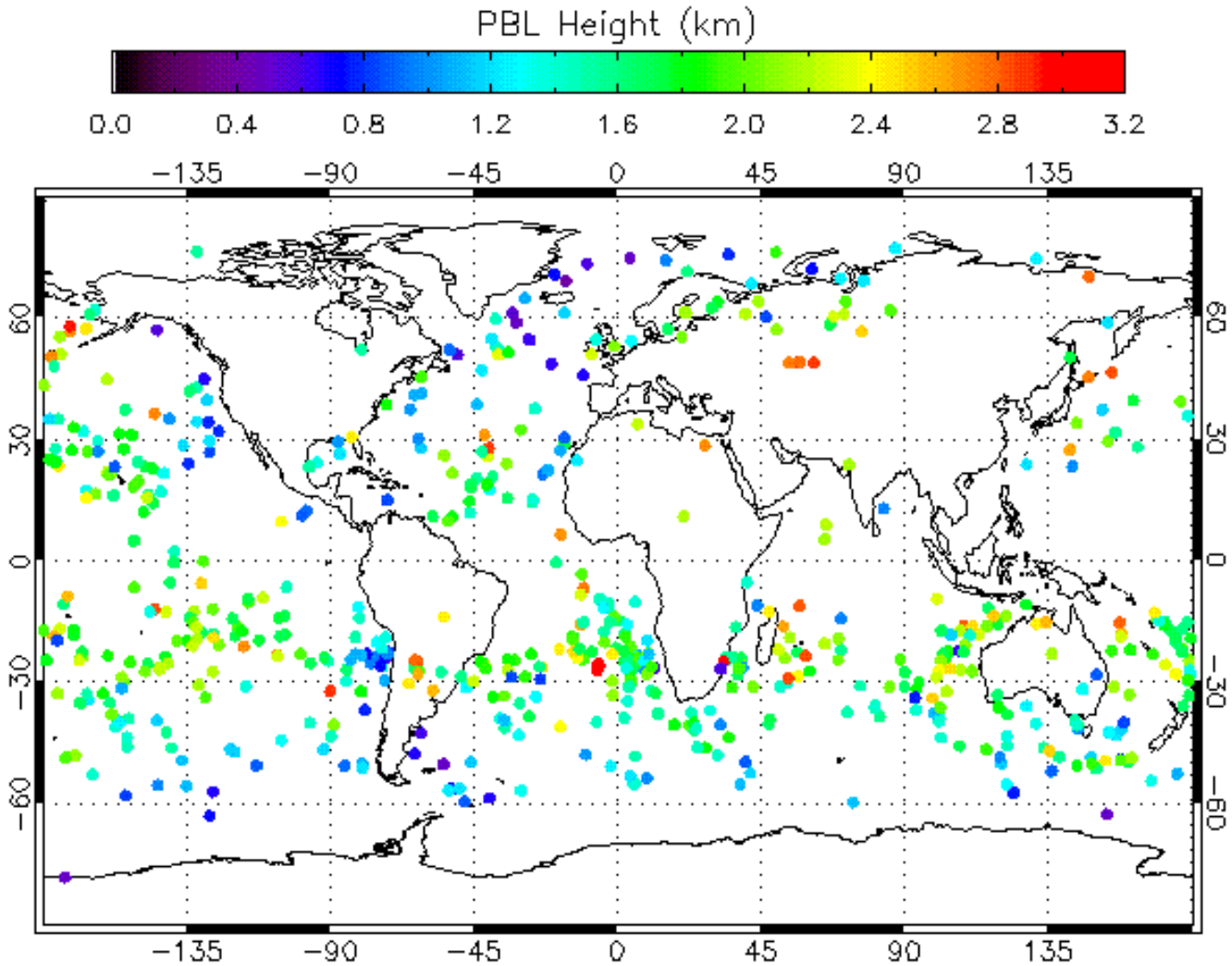
Schreiner et al. 2007

Detection Of Boundary Layer With RO



ABL Height Observations During COSMIC Year 1

(bending angle gradient > 1e-2 rad/dH, height < 3 km)



Leading Weather Center Newsletters

JCSDA Quarterly

No. 18, March 2007

Joint Center for Satellite Data Assimilation • 5200 Auth Road • Camp Springs • MD • 20746 Editor: George Ohring
NOAA……NASA……US Navy……US Air Force Web-site: www.jcsda.noaa.gov

News in This Quarter

Science Update

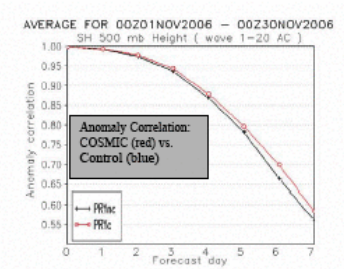
Cosmic Data to be Assimilated Operationally at NOAA

After successful testing at the JCSDA, Global Positioning System (GPS) radio occultation (RO) soundings from the COSMIC mission will go into operational use with the implementation of the Gridpoint Statistical Interpolation (GSI)/Global Forecast System (GFS) system at NOAA/NCEP on May 1st 2007.

In preparation for the assimilation of COSMIC data, the JCSDA developed, tested and incorporated the necessary components to assimilate GPS RO profiles. These components include forward operators and associated tangent linear and adjoint models, quality control algorithms, error characterization models, data handling, decoding procedures, and verification and impact evaluation techniques.

Impact tests indicate that the assimilation of GPS RO observations improves the fit to rawinsonde observations by reducing the mean and root-mean-square differences in the upper troposphere and stratosphere. The anomaly correlation (AC) scores for both the Northern and Southern Hemispheres also improved with the use of COSMIC data for the test period, November 2006. In general, the improvement in AC scores will be more or less significant depending on the meteorological situation and the model performance for the period under study. The accompanying figure shows the 500 hPa geopotential height AC as a function of the forecast range in the Southern Hemisphere for November 1st to 30th 2006. The assimilation of COSMIC data (PRYc, in red) improves the AC scores when compared to the control run (PRYnc, in black). Both PRYnc and PRYc experiments assimilate all the observations currently being used in operations. Therefore the difference between the runs is due to the impact of assimilating COSMIC data.

COSMIC, the Constellation Observing System for Meteorology, Ionosphere and Climate, a joint Taiwan-U.S. project, was launched in April 2006. The scientific foundation for COSMIC is the radio occultation (limb sounding) technique. The six-satellite constellation provides high vertical resolution information on atmospheric temperature/humidity at about a thousand locations each day.
(Lidia Cucurull, JCSDA/NCEP)



Anomaly correlation scores (Red: With COSMIC; Blue: without COSMIC) for the 500 mb height field in the Southern Hemisphere as a function of the forecast length.

Assimilation of MLS Ozone Observations Improves Antarctic Ozone Hole Depiction

NASA's EOS Aura satellite provides comprehensive atmospheric chemical composition measurements. For example, the Aura Microwave Limb Sounder (MLS) instrument captures ozone profiles with the vertical resolution of about 3 km in the stratosphere. These data can be used to constrain stratospheric ozone in atmospheric models, potentially improve assimilation of infrared radiances, and provide a better field for radiative computations. In combination with Aura's Ozone Monitoring Instrument (OMI) total column ozone measurements, the MLS ozone data can also be used to estimate tropospheric ozone, which is an important component of the air quality.

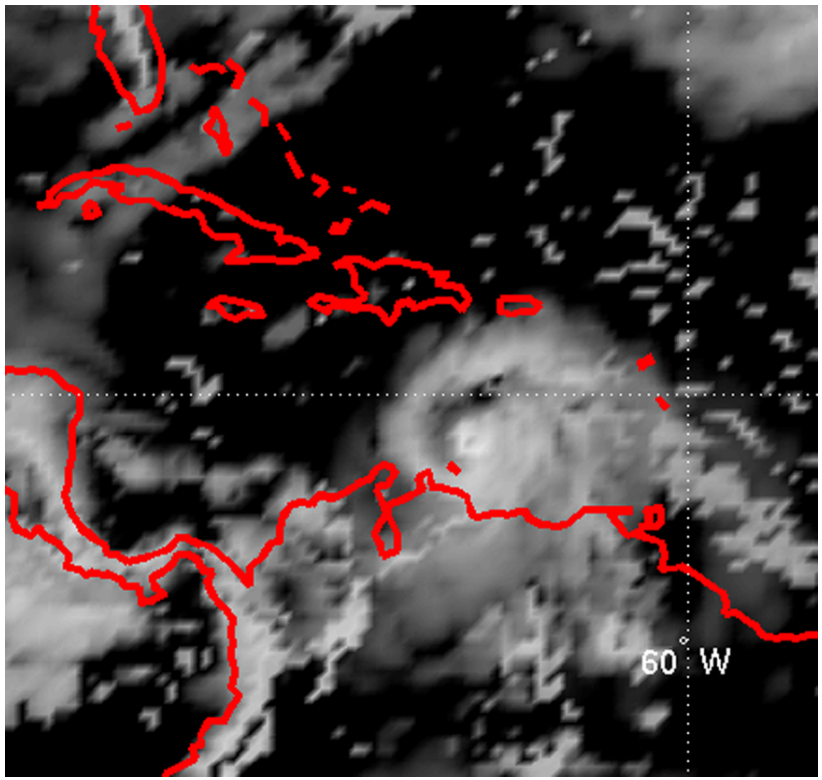
The Goddard Earth Observing System-5 (GEOS-5) Data Assimilation System at NASA Goddard's Global Modeling and Assimilation Office (GMAO) uses the Gridpoint Statistical Interpolation (GSI) as its analysis component. Recently, scientists at the GMAO modified the GSI code to add assimilation of ozone profiles, such as those produced by ozone retrievals from the Aura MLS.

The results from a recent one-month assimilation of MLS ozone data are very encouraging. The figure below compares zonal mean ozone partial pressure (mPa) at the end of the one-

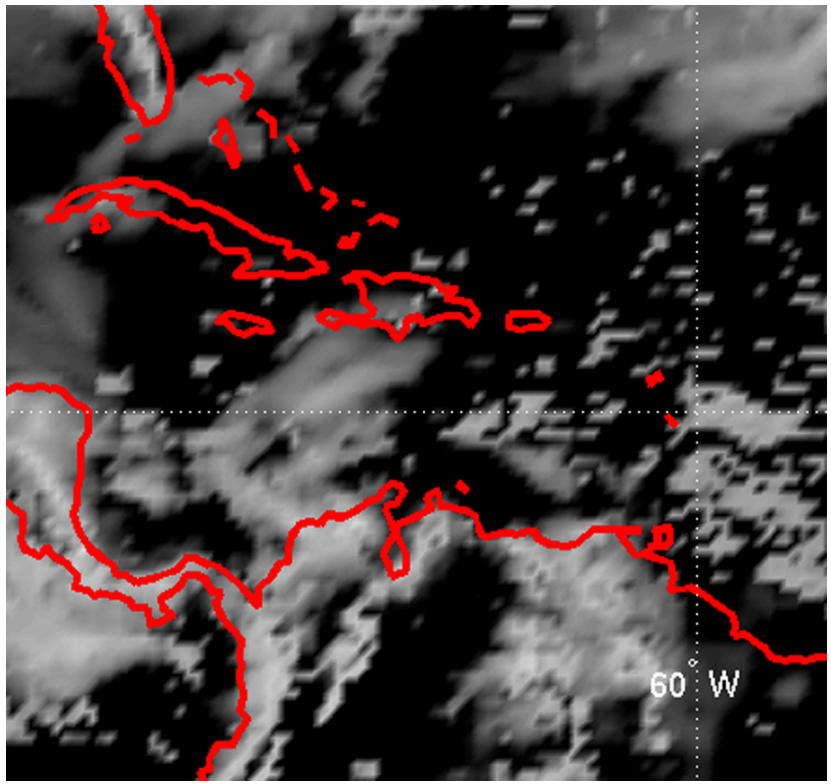
QuickTime™ and a
Video decompressor
are needed to see this picture.

Using COSMIC for Hurricane Ernesto Prediction

With COSMIC



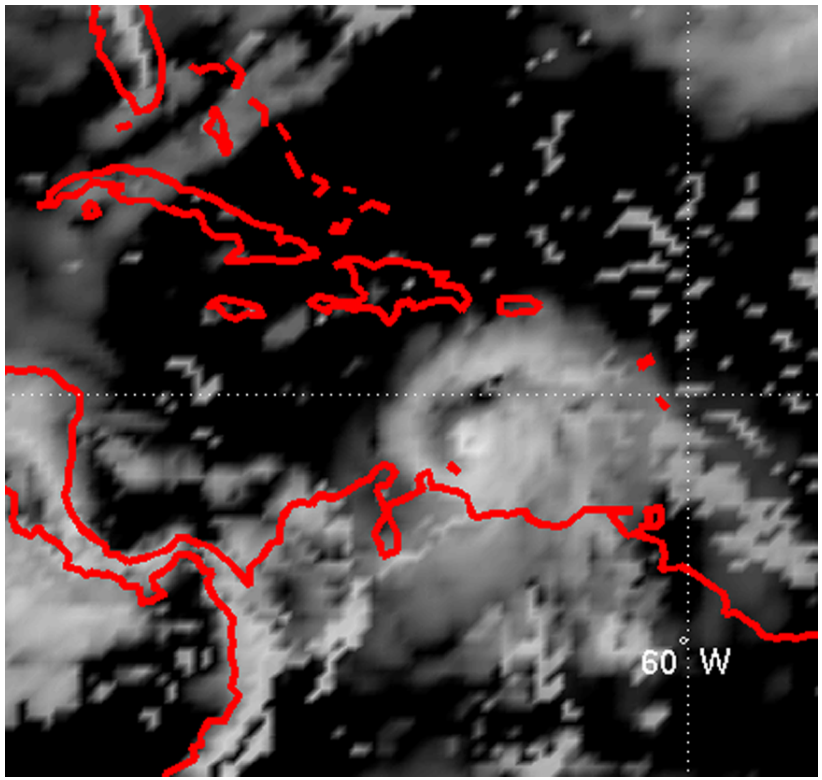
Without COSMIC



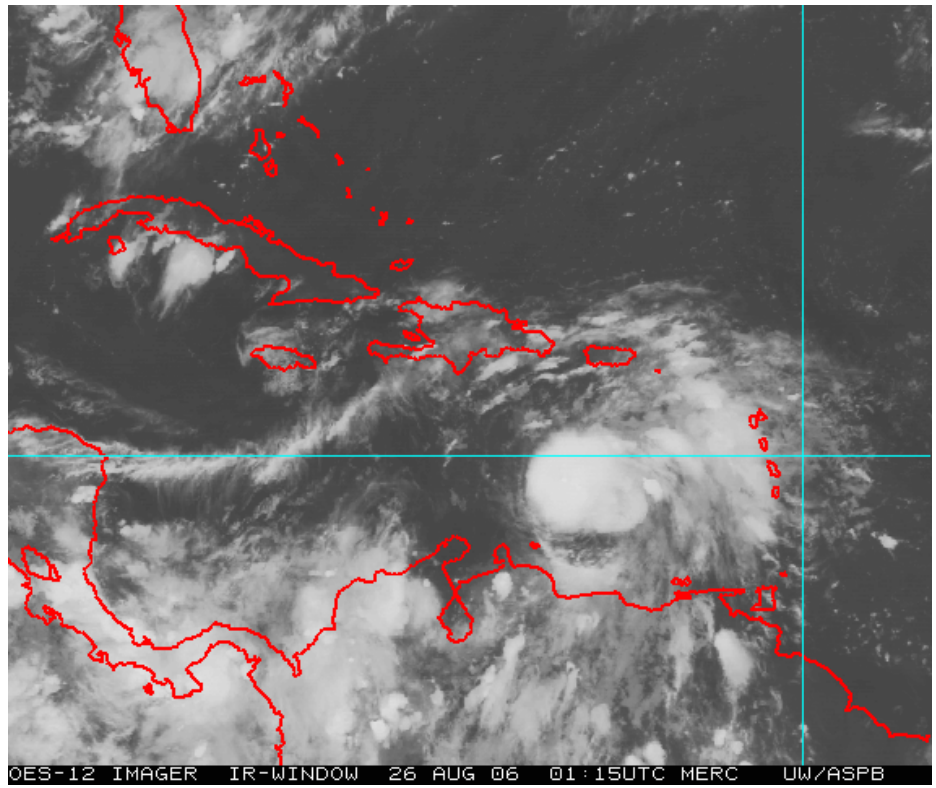
Results from Hui Liu, NCAR

Using COSMIC for Hurricane Ernesto Prediction

With COSMIC

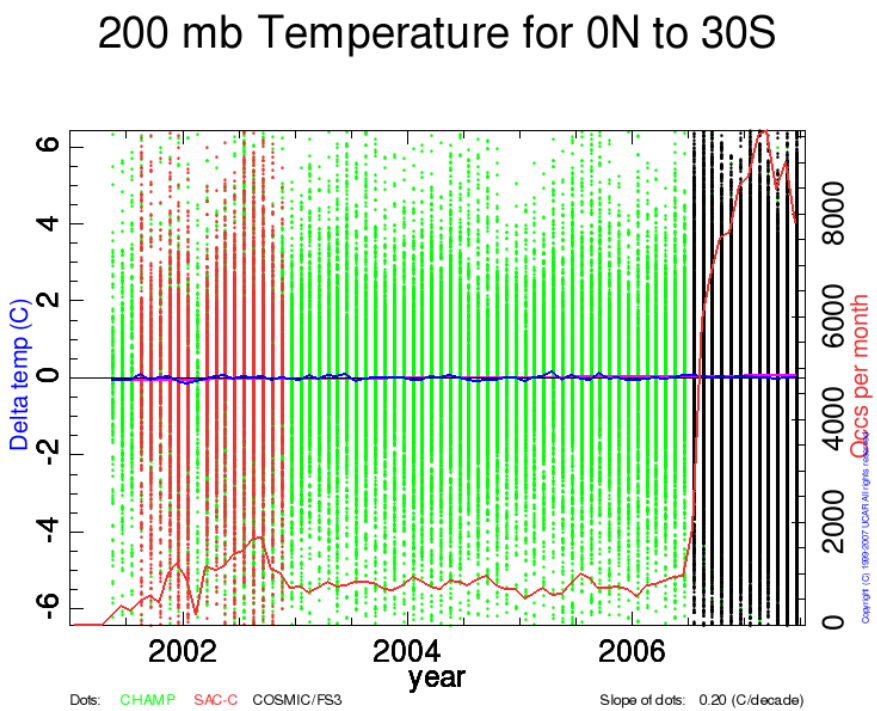


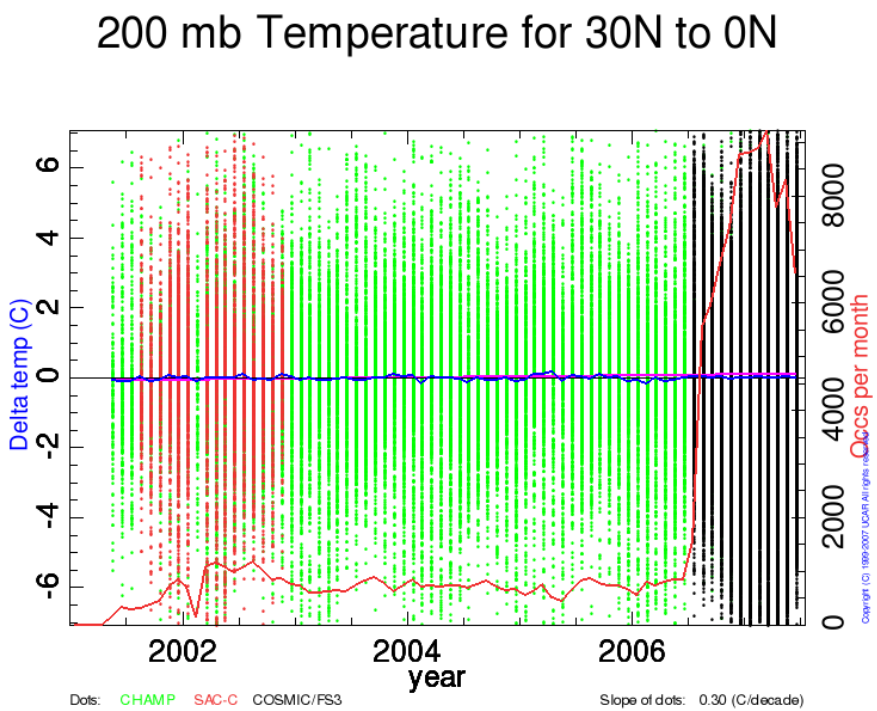
GOES Image



GOES Image from Tim Schmitt, SSEC

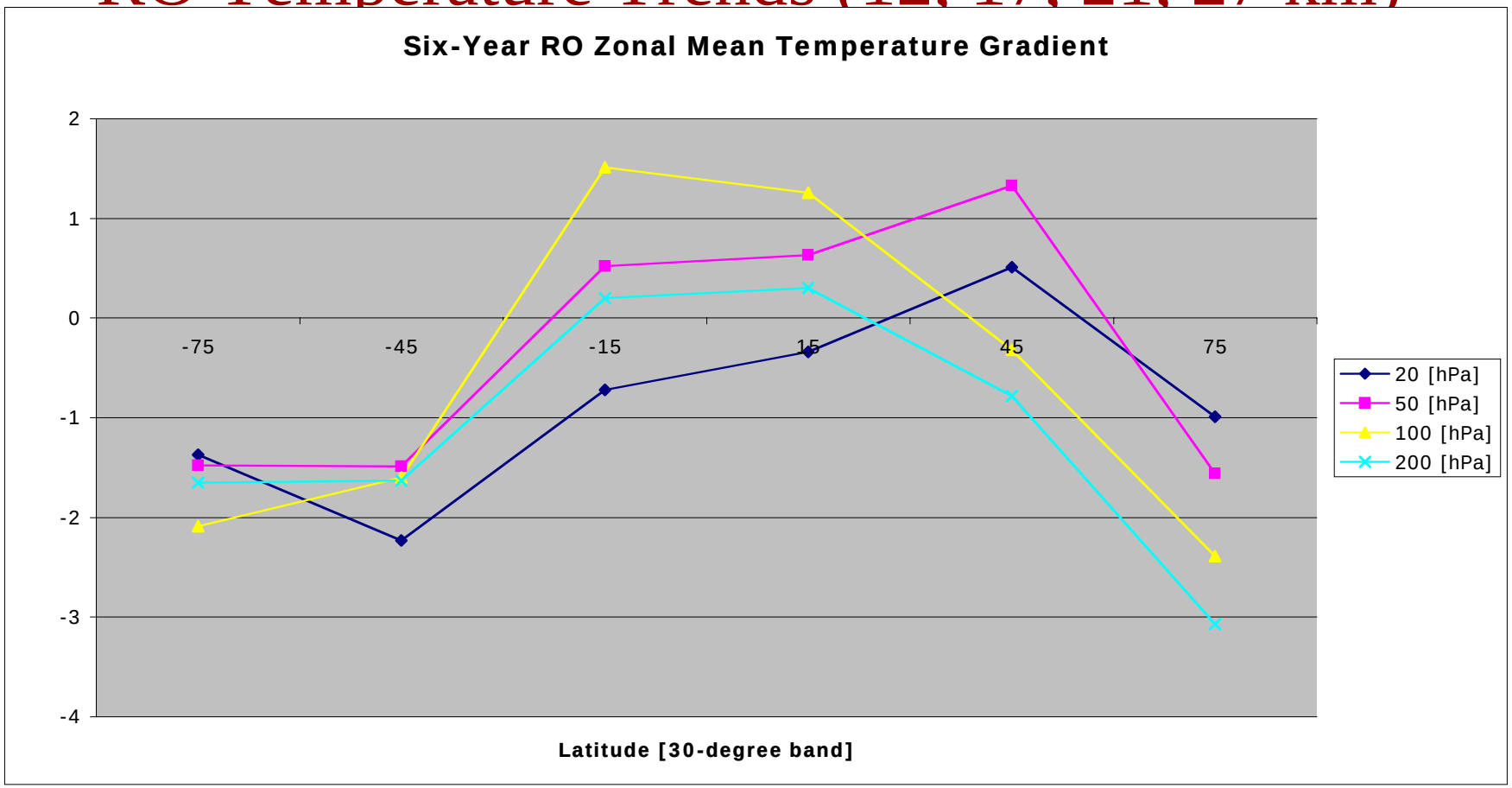
6-Year RO Temperature Anomaly Trend
Tropics, 200 mb (~12 km)





Preliminary 2002 - 2007

RO Temperature Trends (12, 17, 21, 27 km)



Chanin et al., 2001: 0.75 C/decade cooling in 20-35 km NH

QBO not removed (significant for 6 years)

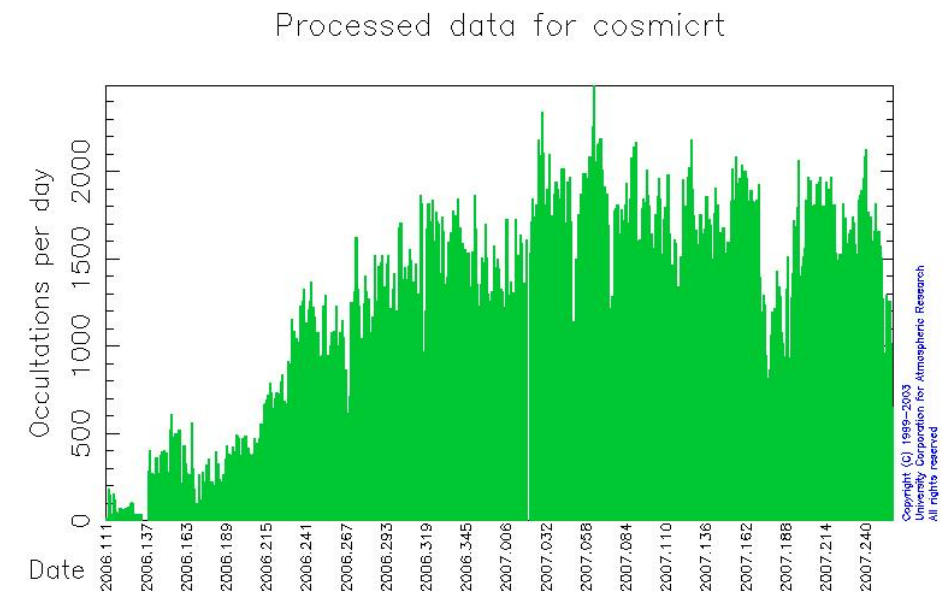
Need to add slope uncertainties

Number of Profiles (Oct. 28, 2007)

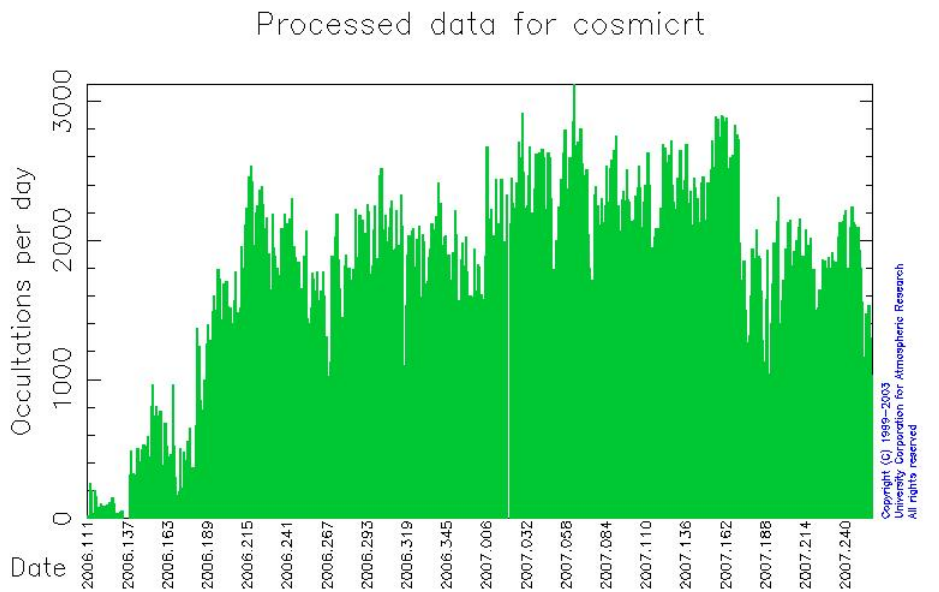
752,000 Neutral Atmosphere

1,006,000 Ionosphere

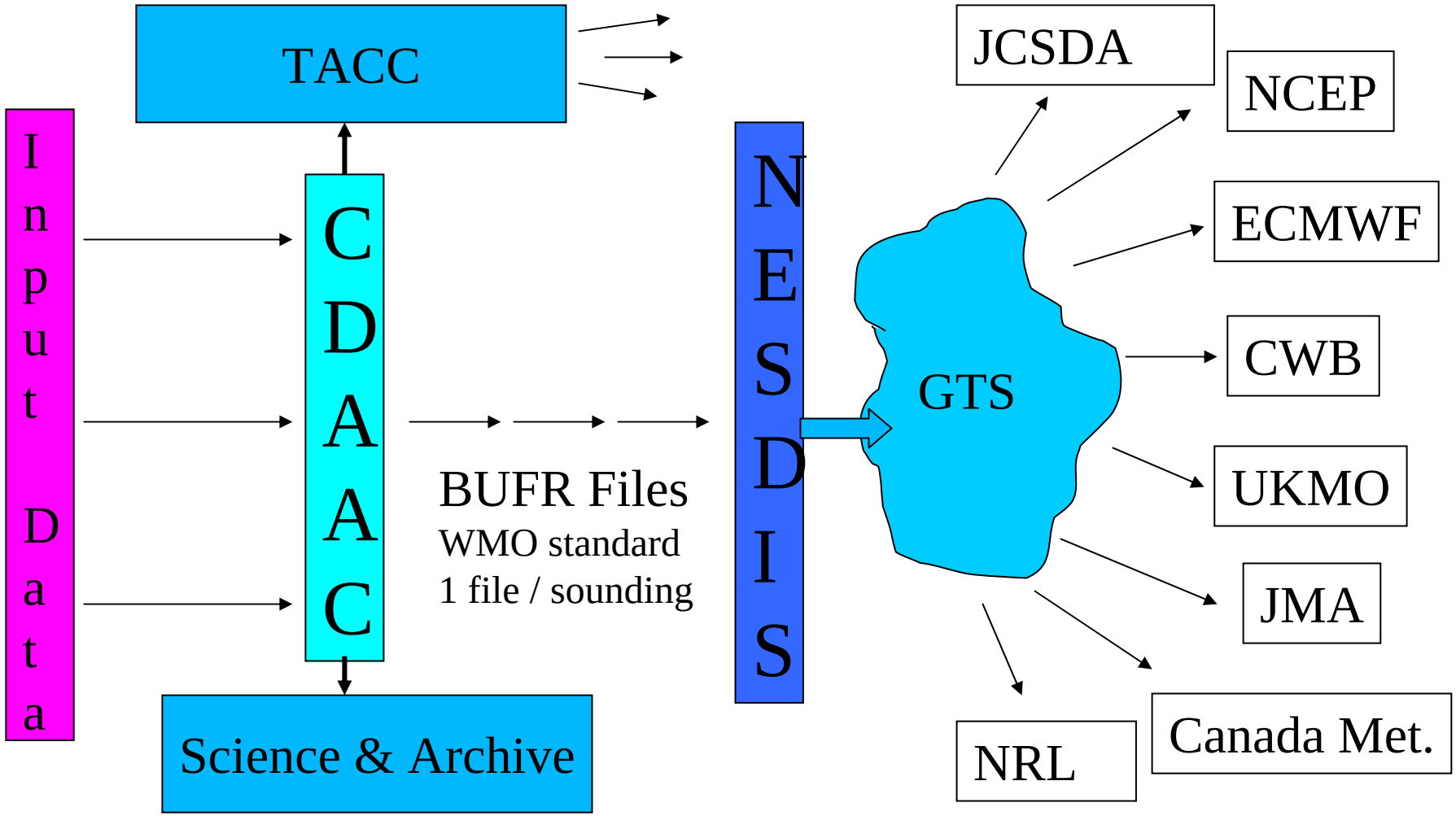
Return home Total: 642984 atmPrf files on 505 days with 1 or more profiles



Return home Total: 904133 ionprf files on 505 days with 1 or more profiles

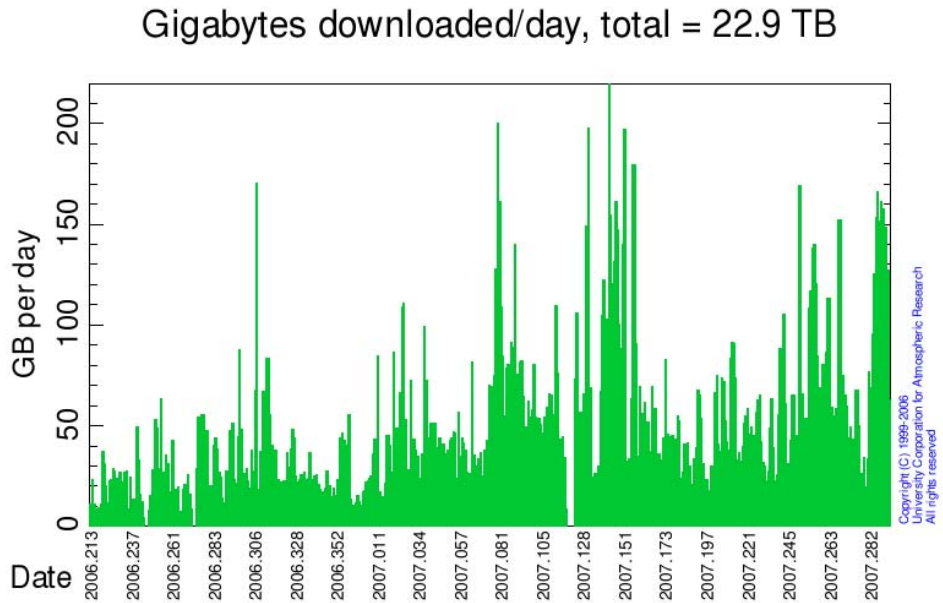


Operational Processing



Data available to weather centers within < 180 minutes of on-orbit collection

Processing Center Status



- 30 TB downloaded (100-150 Gbytes/day)
- 80% of soundings delivered in < 3 hours
- All data post-processed with CDAAC 2.0 software (until June 2007)
- New firmware currently tested at JPL

619 data users from 42 countries are registered

http://www.cosmic.ucar.edu

* Select the 'Sign Up ' link under COSMIC

•Accept data use agreement

* Enter information:
Name, Address, email, user_id, Password, planned use of data

• An email will be sent within 2-3 business days to indicate access has been granted.

COSMIC Data Availability

- Data opened up to public in July 2006
- All Data (including raw data) available at the end of each day
- Real-time products (profiles of bending, refractivity, …) in WMO standard format available via the GTS
- Post-processed data for climate research will be updated every few months
- Data use agreement with NSPO required for use of all data and data products (via TACC or CDAAC website)

COSMIC Data Policy

- Real-time data (raw data, excess phase data, etc.) available upon approval of letter request to NSPO director and UCAR president
- All requests have been approved

- Data policy must be revised for distribution of near-real-time data products to Unidata community
  - Users should still register

Summary

- Deployment to final constellation almost complete (raising FM1)
- Large amount of high quality data resulted in:
  - 600+ registered data users
  - ~80% of soundings penetrate to lowest km of atmosphere
  - Operational use by world's leading weather centers
  - Demonstration of 0.2% precision of RO observation in 10-20 km height range
  - Extened climate record
  - Remote sensing of global ABL / Convection
  - Improvements to ionospheric models
  - Global scintillation observations
- COSMIC presently faces several difficulties
  - Frequent unexplained drops in SNRs from GPS antennas
  - Lost 1 solar panel on FM2
  - Stuck solar array drive on FM3
  - No communications presently with FM6
- Chances for a Follow - on mission would benefit from wider user community