

# Overview of SSEC/CIMSS Remote Sensing Expertise

**Allen Huang**

Cooperative Institute for Meteorological Satellite Studies  
Space Science & Engineering Center  
University of Wisconsin-Madison, USA



**GEOSS Americas/Caribbean Remote Sensing Workshop**

**– Transforming Data into Products**

**26-30 November 2007**

**CPTEC/INPE Cachoeira Paulista - São Paulo**



# SSEC Overview

Hank Revercomb, Director

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**University of Wisconsin - Madison  
Space Science and Engineering  
Center (SSEC)**



# Space Science and Engineering Center

## Graduate School, UW-Madison

- ◆ **Mission: To conduct atmospheric, oceanic, environmental, and astronomical research using space or space-age techniques to discover and apply the physical properties of our universe for the benefit of humanity**

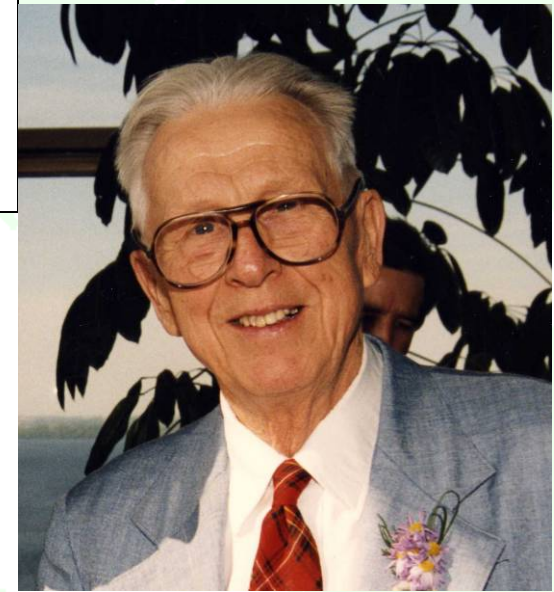
**From Idea, to Concept, to Implementation, to Information about the world**

- ◆ Symbiotic relationship with Department of Atmospheric & Oceanic Sciences symbolized by shared building provided by NSF, NASA, & the State



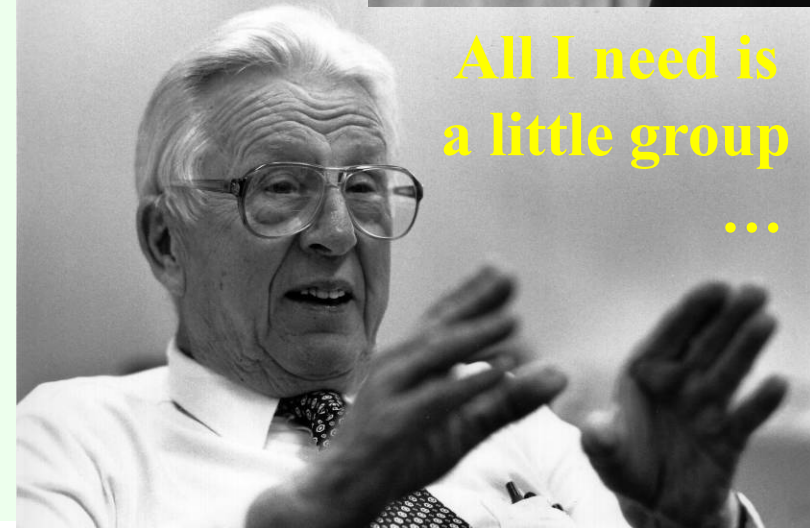
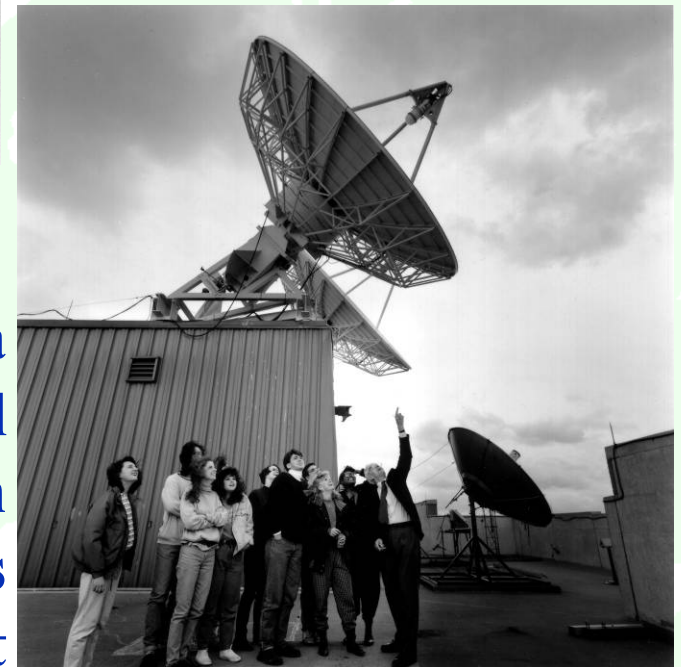
# SSEC Co-Founder Verner E. Suomi (1915-1995)

**Keep it  
simple**

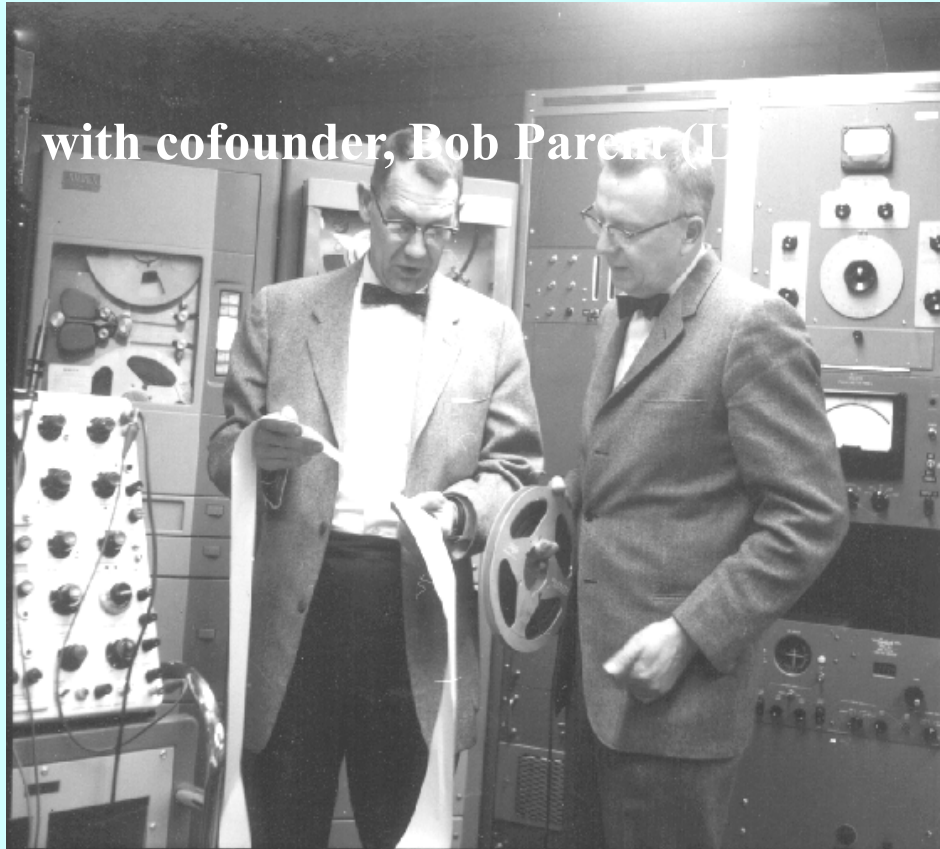


**All I need is  
a little group  
...**

**We'll keep a  
critical  
eye on  
earth & its  
environment**



# SSEC works to maintain the spirit of exploration of its founder, **Verner E. Suomi (1915-1995)**



**1959: 1st Meteorological  
Satellite Experiment**

**Earth Radiation Balance  
Observations on Explorer VII**

**1966: 1st Earth Imaging  
from GEO**

**Spin-scan Camera on 1st  
Advanced Technology Satellite  
(ATS 1)**

**Verner Suomi**

**“Father of Satellite Meteorology”**

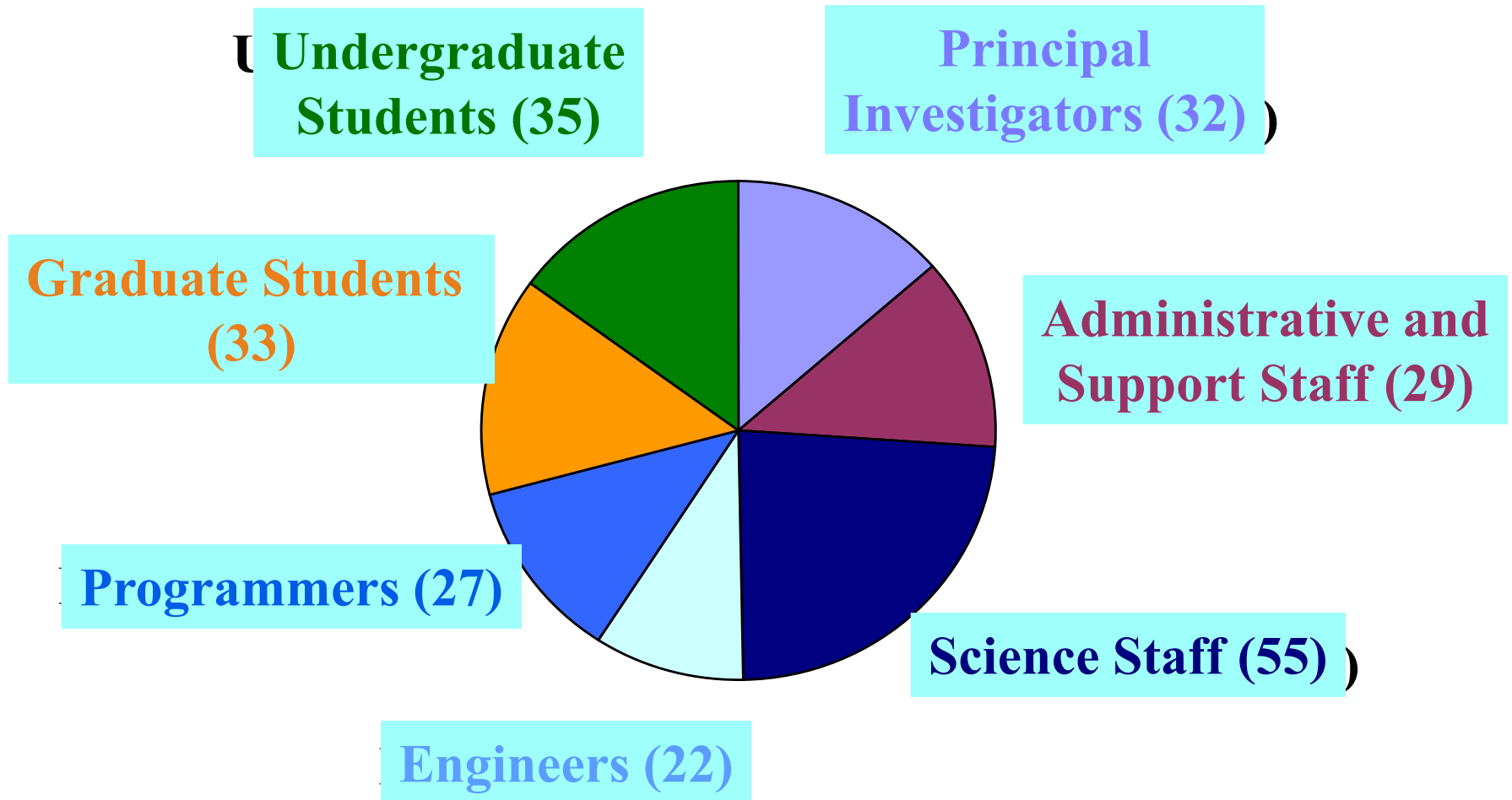
## Nature of the Organization

# Space Science & Engineering Center

- ◆ Matrix Organization: PIs are the Cornerstone
- ◆ Staff: About 250
- ◆ Annual Budget: ~\$18 M
- ◆ A diverse Center: support distributed among agencies, including NASA, NOAA, NSF, DoD, DoE, IPO
- ◆ SSEC includes a major institute and “Macro Projects”
  - **Cooperative Institute for Meteorological Satellite Studies (CIMSS)**: SSEC includes a cooperative institute with NOAA and NASA established 1980, Professor Steve Ackerman, Director
  - **Antarctic Meteorological Research Center (AMRC)**: Providing Automated Weather Stations since 1980, Professor Charles Stearns, founder
  - **Ice Coring and Drilling Services (ICDS)**: Providing NSF-sponsored researchers with ice coring & drilling capabilities in polar and high- altitude sites; Professor Charles Bentley, PI
  - **Office of Space Science Education (OSSE)**: K-12 programs, public outreach, internships; Rosalyn Pertzborn, Director, Dr. Sanjay Limaye, founder

# SSEC Staff

233 members



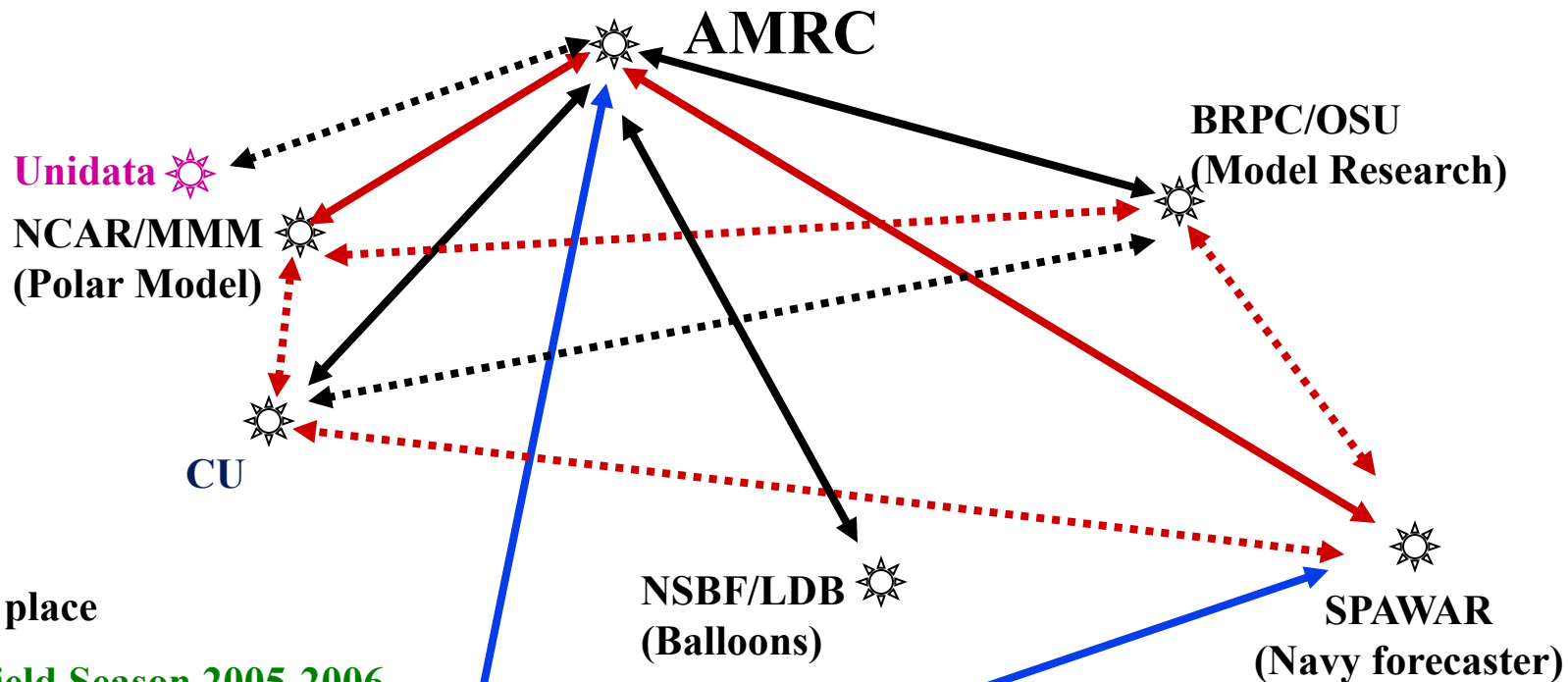
# SSEC areas of technical expertise

- ◆ **Observational Science** (spacecraft system/mission design, instrumentation, field programs, spaceflight instrument fabrication)
- ◆ **Computational & Visualization Science** (hardware and software systems for information generation, data management, and communication)
- ◆ **Analytical Science** (satellite & conventional data analysis, technical development & analysis)
- ◆ **Campus Science Support** (Physics, Astronomy, Botany, Geology)
- ◆ **Education and Public Outreach** (UW undergraduate and graduate programs, K-12 collaborations, science education of the general public)



# Antarctic Meteorological Research Center (AMRC)

## Antarctic-Internet Data Distribution System



### Phases:

Phase I - In place

Phase II – Field Season 2005-2006

Phase III - Future

### Key:

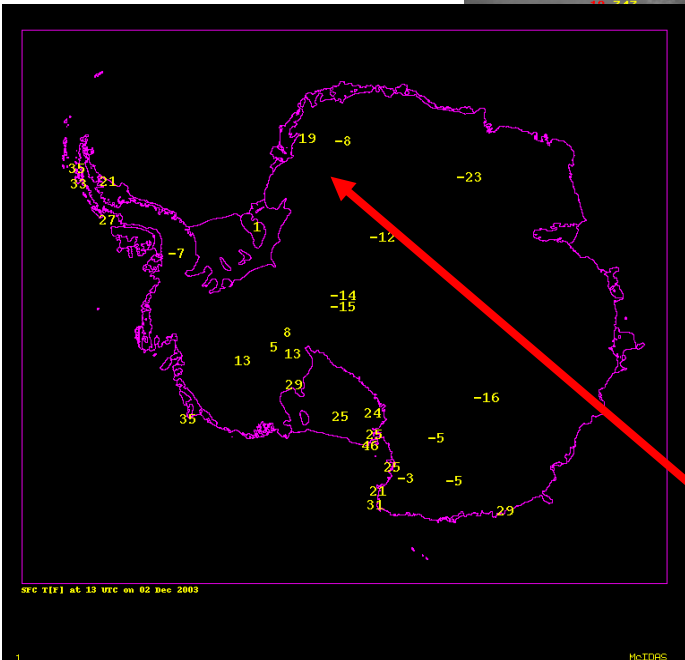
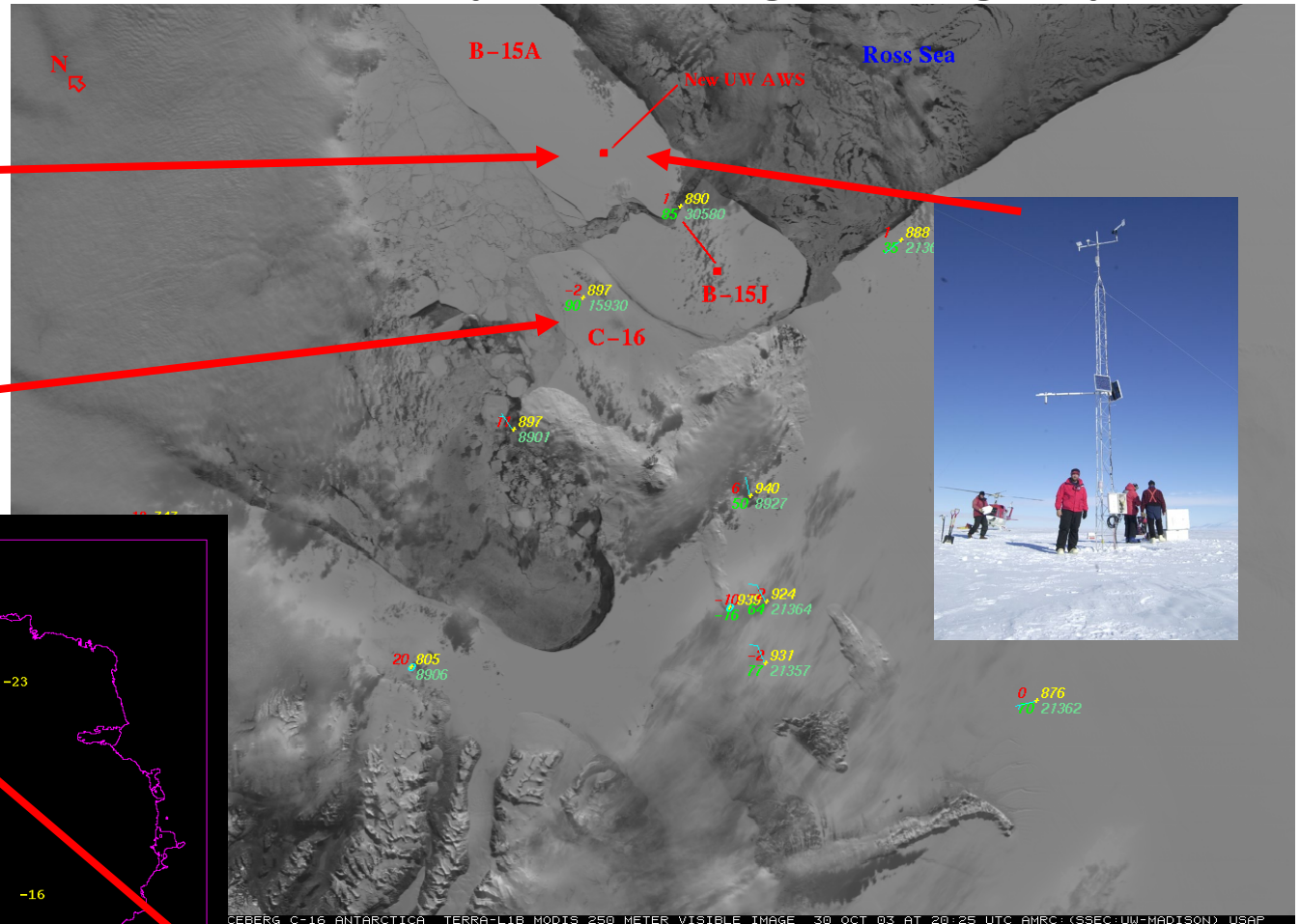
- ↔ Two-way, full data stream
- One-way, full data stream & Firewall limited data insert return
- ↔ Limited two-way data stream
- ⋯ Future/Planned – dates TBD

NSBF/LDB  
(Balloon launches)

# Antarctic Meteorological Research Center

## Automatic Weather Station (AWS) Project & Iceberg Tracking Project

Deployment of  
AWS/GPS  
On B-15A  
&  
Seismic Array  
On C-16



Decoding Dutch AWS in Real-time

# Ice Coring and Drilling Services Deep Ice Sheet Coring (DISC) Drill System

- Capable of penetrating 2.5 miles of ice
- Assembled and tested in SSEC warehouse
- Successfully tested in Greenland this year
- Production drilling – Antarctica, 2006-2012





**\*\*In 2003  
OSSE Reached  
over 2400  
K-12 students/teachers  
through 37 events!!**

### UW PEOPLE Workshop



### GLOBE- Space Science Teacher Workshops



Margaret helped develop the Satellite Meteorology Course for high schools

“Physics of Star Trek” lecture featuring Lawrence Krauss draws the largest audience ever at Space Place

Hosted 3 SHARP students (Larry Sromovsky, Jim Kossin and Sanjay Limaye) and a local High School student (Schnettler)

Sanjay manned the Ask-A-Scientist booth at the National Science Teachers Association Meeting in Philadelphia



Sanjay became the third generation scientist in his family to present a paper at the Indian Science Congress (90<sup>th</sup>)

Neptune Mosaic Displayed at the Association of Science Technology Centers Annual meeting in St. Paul, MN

Sanjay and Margaret participated in Speakers Bureau and WAA UW-On-the-Road Visits

**OSSE Director,  
Rosalyn  
Pertzborn**

# MOA with Hampton University

- ◆ **Collaborative agreement** signed between UW/SSEC & HU Center for Atmospheric Sciences (CAS). Establishes connections between CIMSS and the HU part of the NOAA cooperative institute CREST and also between the UW AOS and HU Physics Departments
- ◆ **Joint research, teaching, and student connections/exchanges are envisioned**
- ◆ **New joint proposal won:** Cooperative effort to support Science on a Sphere in the NOAA portion of the Nauticus Museum
- ◆ **Nauticus** is a spectacular maritime-themed science center featuring hands-on exhibits, interactive theaters, aquaria, digital high-definition films, and an extensive variety of educational programs.



Nauticus Museum, Norfolk, VA



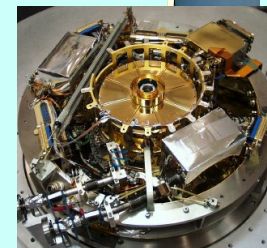
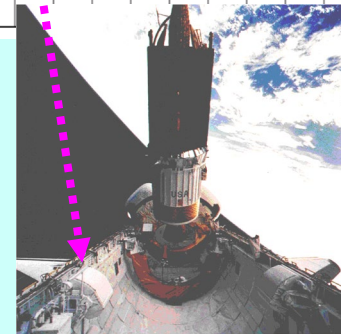
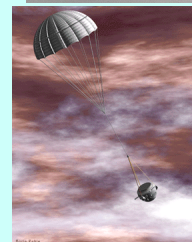
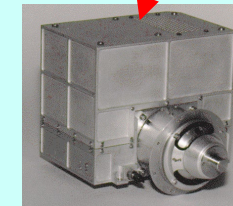
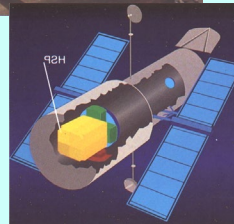
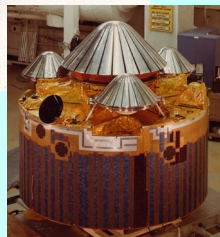
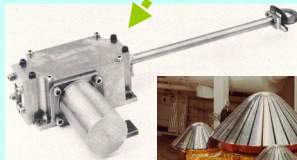
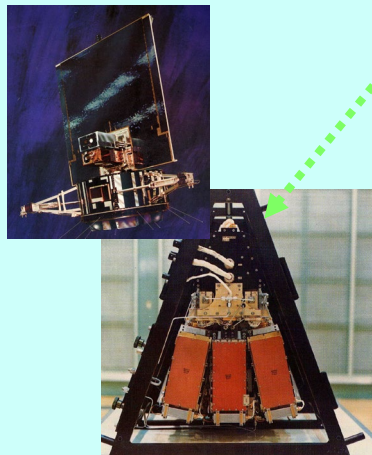
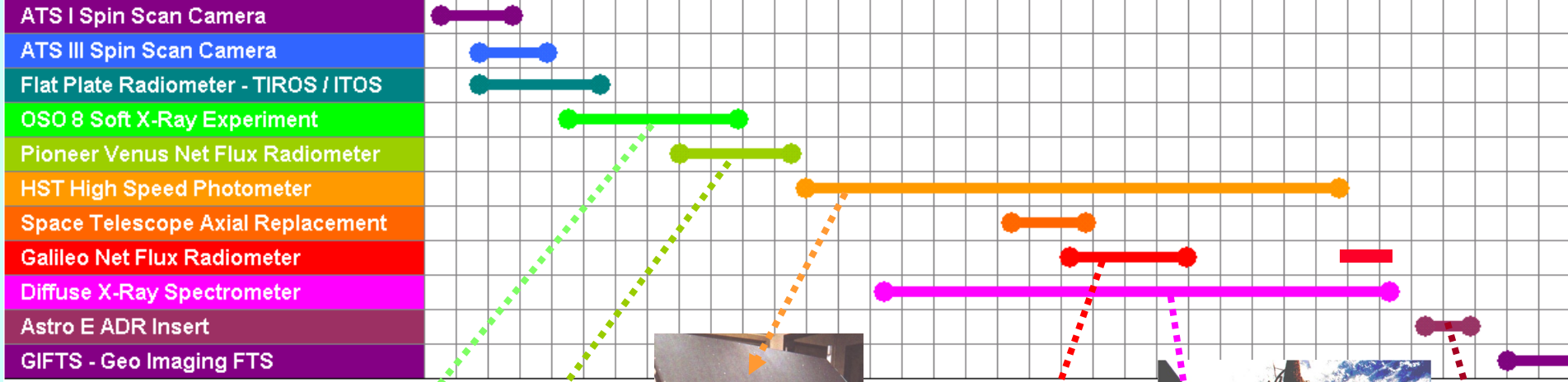
Science on a Sphere

# SSEC Space Flight Programs



YEAR: 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01

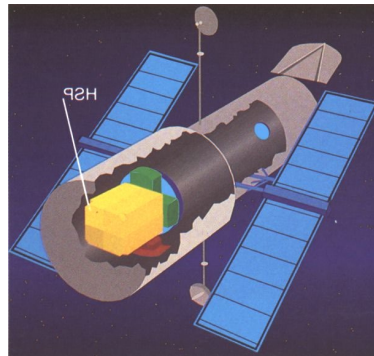
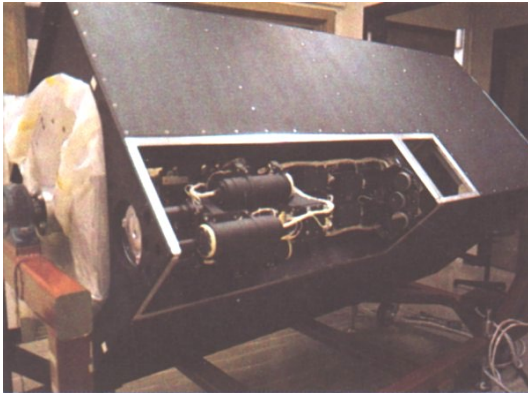
## Space Flight Instruments



# SSEC, University of Wisconsin-Madison Space Flight Hardware

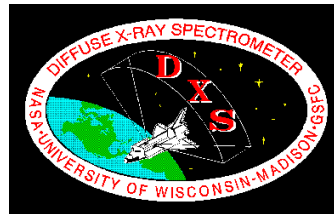
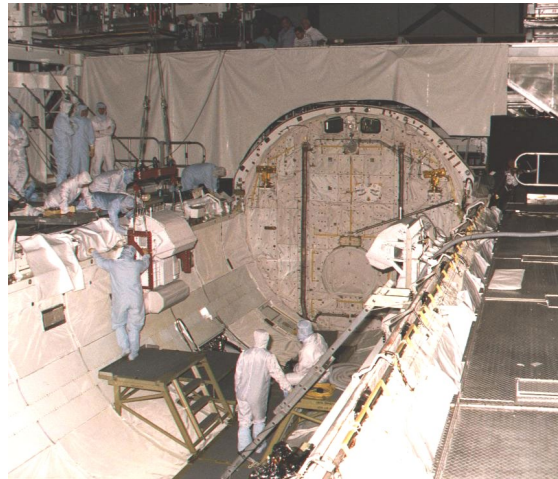


## High Speed Photometer



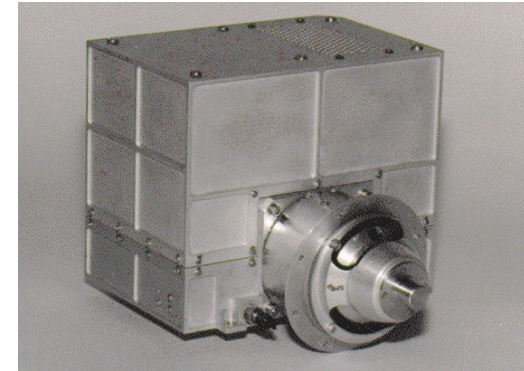
Space Telescope  
1990-93

## Diffuse X-ray Spectrometer



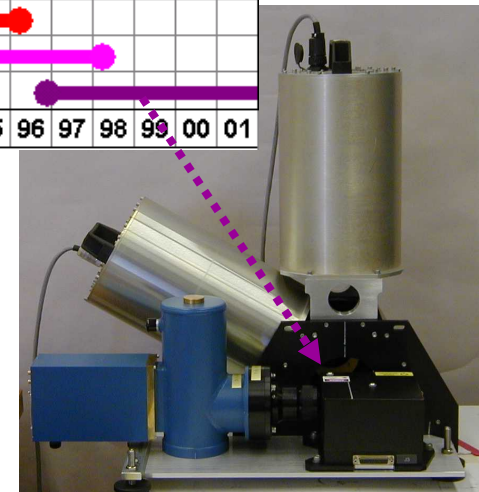
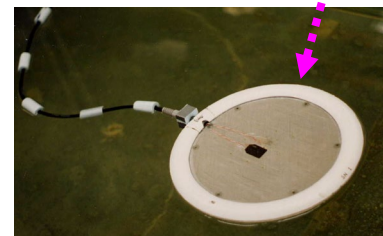
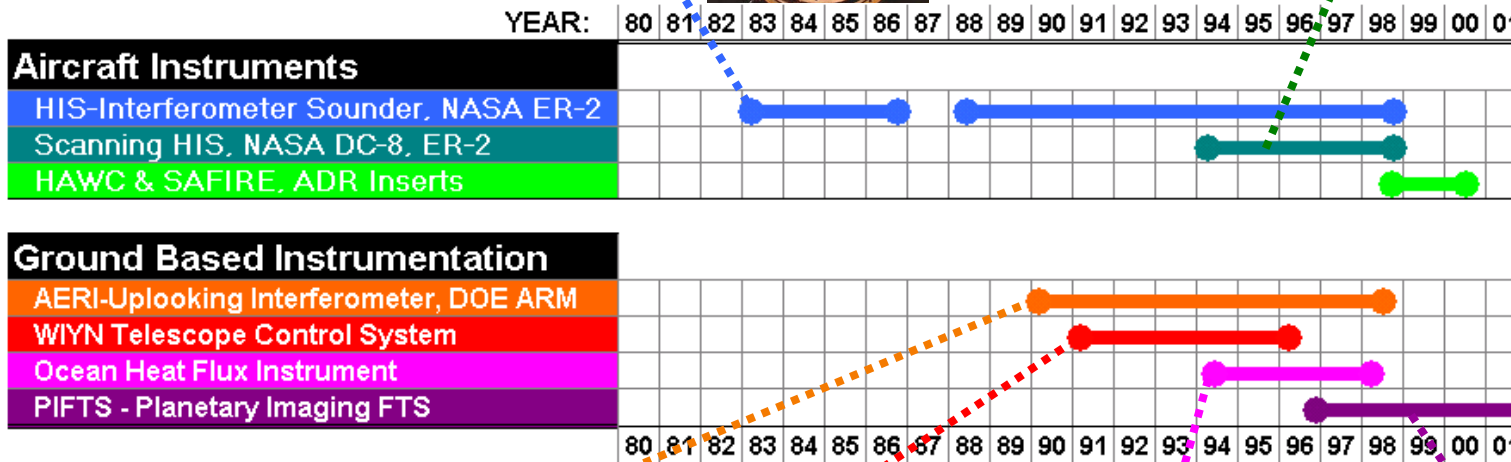
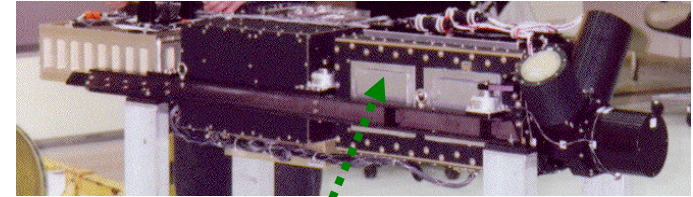
STS-54  
1993

## Net Flux Radiometer



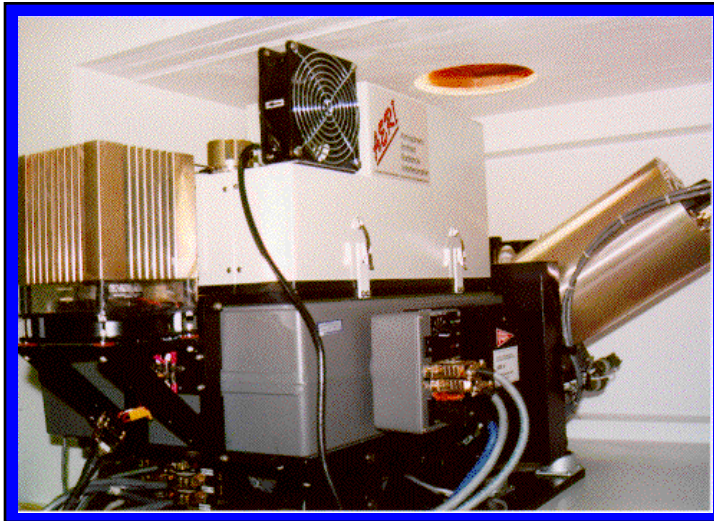
Galileo Entry Probe  
7 December 1995

# SSEC A/C and Ground-based Instrumentation



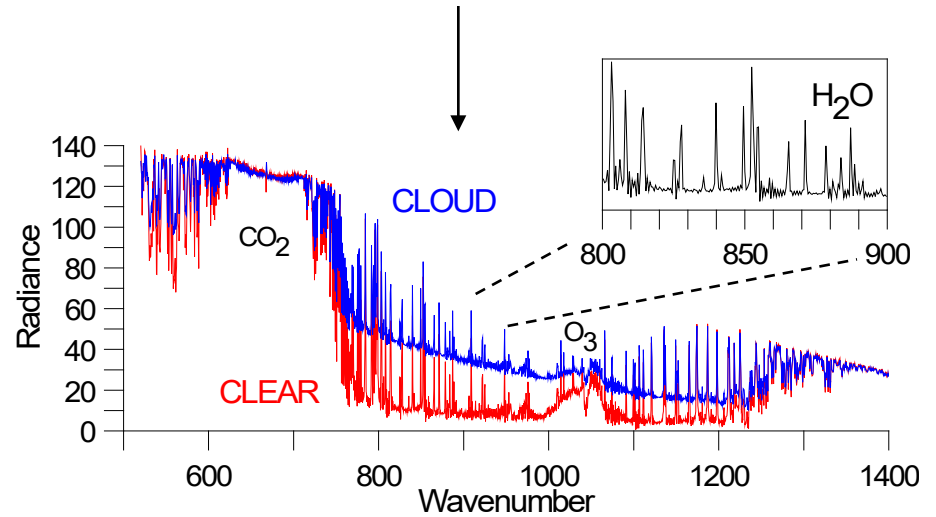


# ATMOSPHERIC EMITTED RADIANCE INTERFEROMETER (AERI)

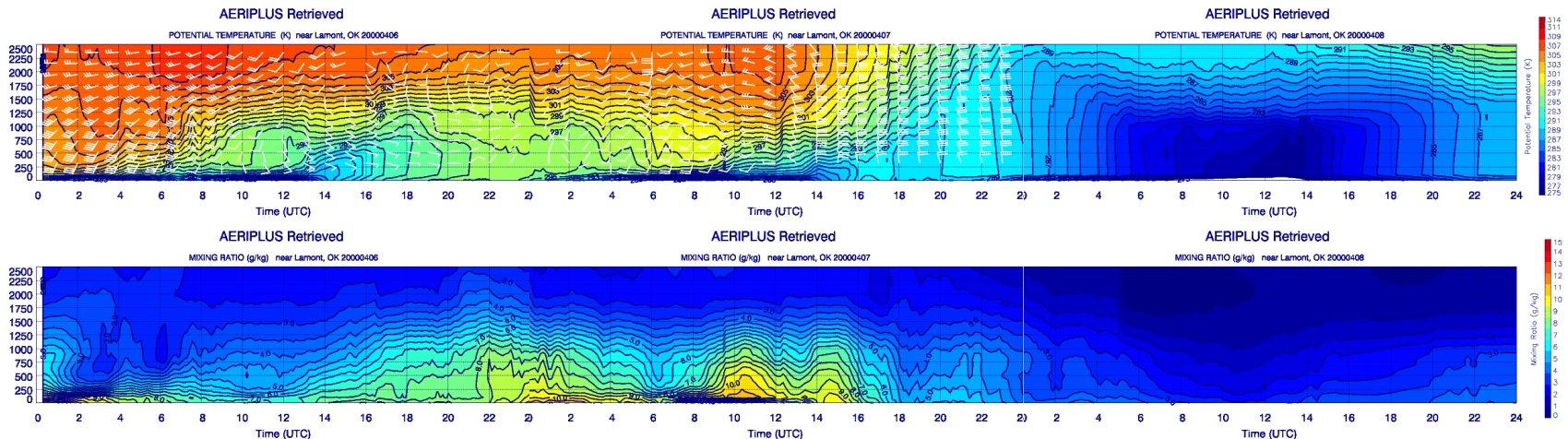


Operational at DOE ARM

Clear Sky and Cloud Downwelling Emission



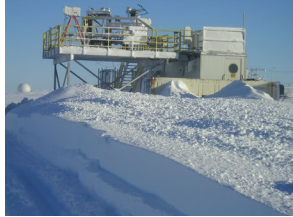
Accurate High Resolution Radiometry



Continuous Atmospheric Profiling - Temperature and Water Vapor

# AERI Systems Around The World

December, 2005



Barrow, AK



SGP - Lamont, OK



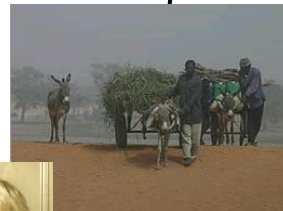
AERIBago



Explorer of the Seas



U of Miami



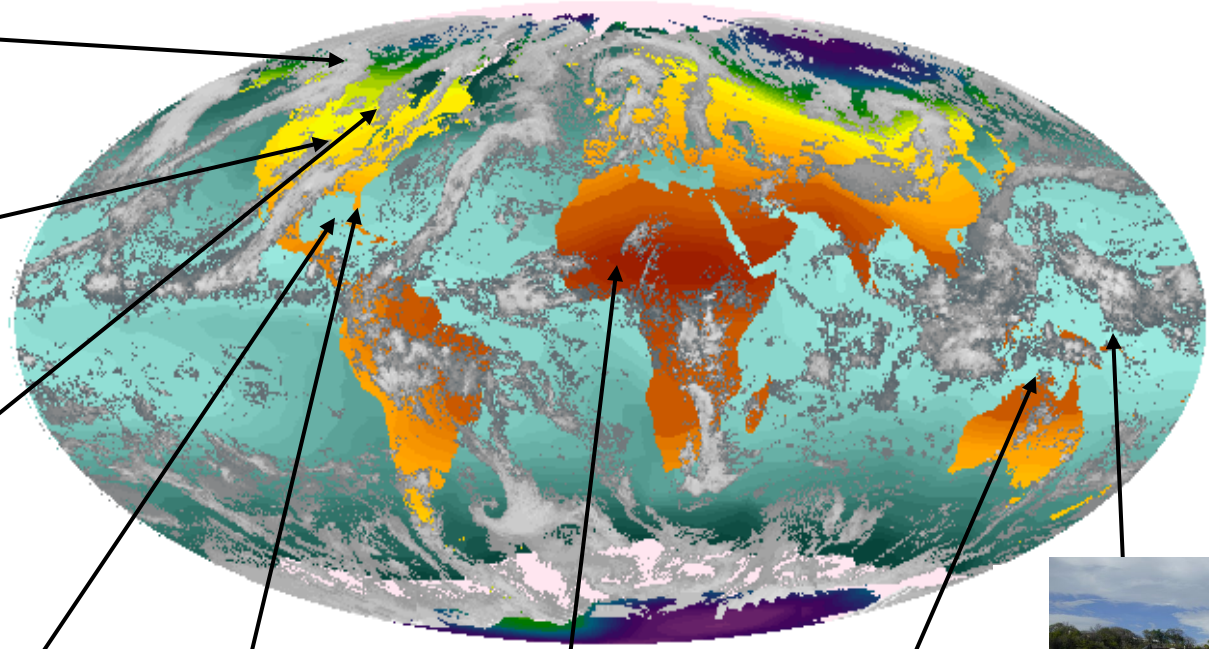
Niger, Africa



Darwin, Australia



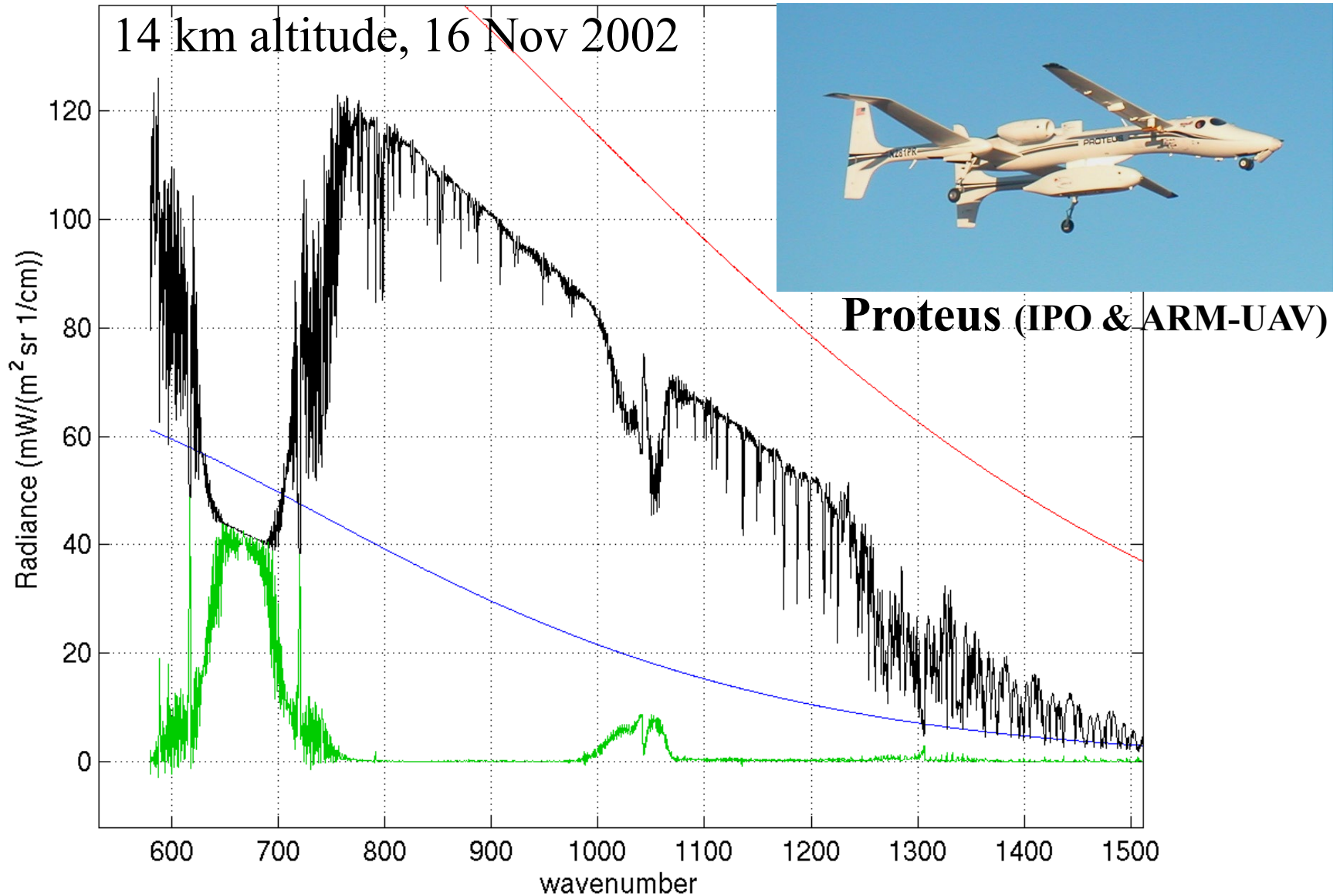
Nauru



- UW AERI - 2 (AERIBAGO, SSEC)
- DOE AERI - 7 (Barrow Oklahoma, Africa, Australia, S. Pacific)
- U-Miami M-AERI - 3 (Florida, Explorer of the Seas)

- Bomem AERI - 5 (Australia, Italy, California, Maryland, Canada)
- U Idaho P-AERI - 1
- New pending AERI systems - 2 (Canada, UK)

# S-HIS: Our tool for Research & Satellite Validation



**UW aircraft Sounders helped set the course for AIRS, CrIS & GOES-R HES**

# S-HIS in Costa Rica

## January 2006



NASA WB57



**S-HIS**  
scans cross-  
track downward  
&  
looks upward

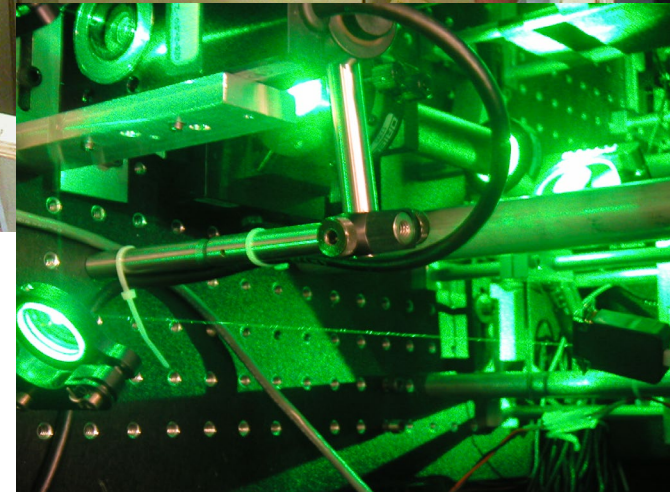
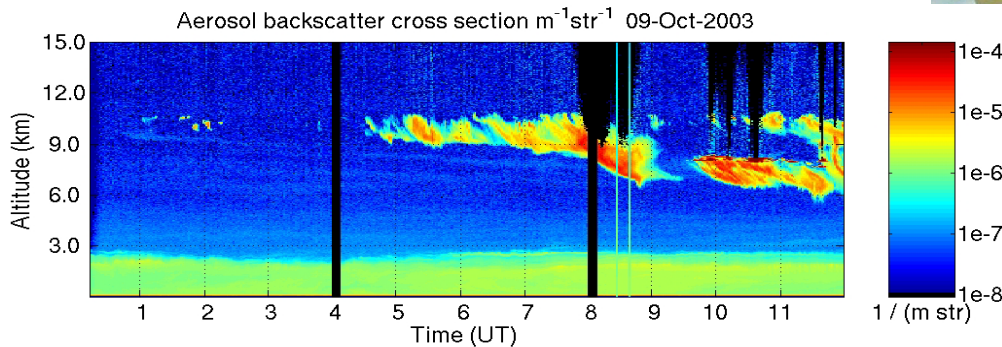
Left Wing Pod

# Arctic HSRL (High Spectral Resolution Lidar)

## Very successful 2004 deployment in Barrow Alaska

**New Instrument  
has provided more  
HSRL data than  
collected in the last  
20 Years!**

(Web site with data  
[lidar.ssec.wisc.edu](http://lidar.ssec.wisc.edu))



**New aircraft instrument  
version under development**

# Arctic HSRL at NOAA/SEARCH site in Eureka Canada

HSRL/Radar C-tainer



HSRL with NOAA Radar

*Eureka, August 2005 by Igor-Razenkov*

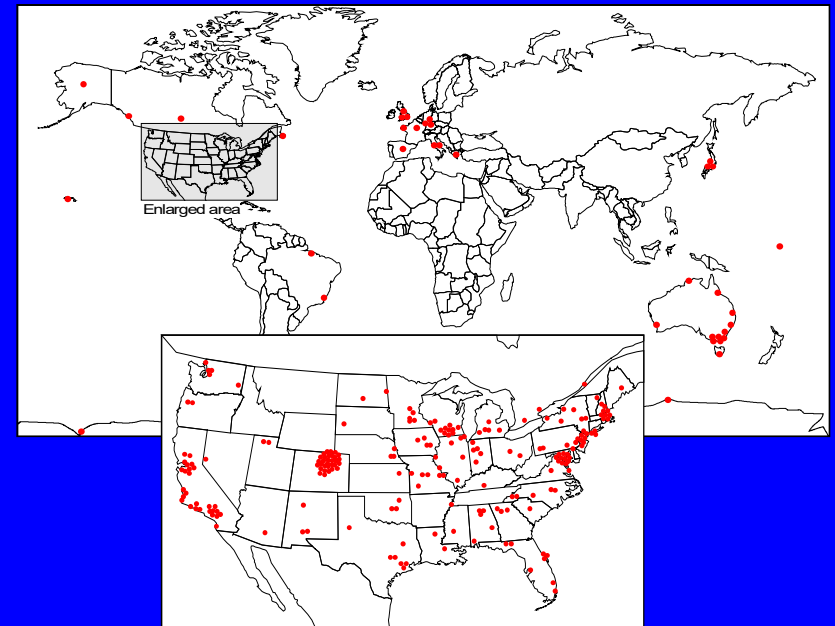
## SSEC Data Center



# SSEC

Satellite / Meteorological  
Data Access

McIDAS Sites



National GOES Archive  
1978-2003



Now have **50 TB** of raid storage for "online archive" of GOES data – Headed toward having the full GOES archive (**~400 TB**) online, giving rapid access to **~30 years** of satellite data!

# McIDAS

## (Man-computer Interactive Data Access System & Data Center



- ◆ McIDAS going strong at 30+  
100s of National and International users,  
including international weather services,  
aviation weather providers, researchers, NASA Shuttle  
support..., NOAA Storm Prediction Center...
- ◆ Data Center support for wide range of NOAA  
activities to continues
- ◆ Engaging in new processing efforts for
  - Pipeline Processing for GIFTS/GOES-R  
high resolution IR data
  - Smart Data Access System for GOES-R
  - Future McIDAS under development



# SSEC Data Center – Satellite Data

## ◆ Online Real-Time

– GOES-12	75 W	18 Sep. 2005 - present
– GOES-10	135 W	18 Sep. 2005 - present
– METEOSAT-7	0 E	3.5 days
– METEOSAT-5	63 E	9.0 days
– MET-8 (msg-1)	3 E	3.0 days
– MTSAT-1R	140 E	3.0 days
– FY2C*	105 E	3.5 days
– KALPANA*	74 E	25 days
– NOAA-15 – NOAA-18 (relay)		3.0 days
– NOAA-15 – NOAA-18 (flyover)		3.5 days
– FY-1D (flyover)		3.5 days
– TERRA (MODIS)		7.0 days
– AQUA (MODIS)		7.0 days
– AQUA (AIRS)		7.0 days

\* data received in near real-time from another site

# SSEC Data Center – Satellite Data

## ◆ Archived

- GOES 26 Jan 1979 - present
- GMS-5 9 Nov 1998 - 21 May 2003
- MET-7 9 Mar 1999 - present
- MET-5 (Indoex) 9 Mar 1999 - present
- MET-3 1 Jan 1993 - 1 Jan 1995
- MET-8 15 Mar 2004 - present
- MTSAT-1R 5 July 2006 - present
- FY2C 25 June 2005 - present

## ◆ Archived global products from web

- Montage April 1997 - present
- IR composites April 1997 - present
- WV composites June 2002 – present
- Numerous other products generated for SSEC webpage

# SSEC Data Center – Weather Data

## ◆ Real-Time Online (conventional data)

- Point 3.0 days + current
- Grids 3.0 days + current
- Text 3.0 days + current
- Radar (all stations) 3.0 days + current

## ◆ Archived

- Point data Mar 1976 - present
- Grid data Sep 1996 - present
- Text data Sep 1996 - present

# New Numerical Modeling Hardware for high speed computing at SSEC



- ◆ **SGI Altix linux cluster**
- ◆ **32 processors (64-bit) with high speed interconnects**  
(6.4 GB / second transfer speeds between memory and processors)
- ◆ **192 GB shared memory**
- ◆ **2.5x increase in model run speed**
- ◆ **12x increase in model domain size capability**

# Retrieval and Development Hardware for Parallel Processing at SSEC



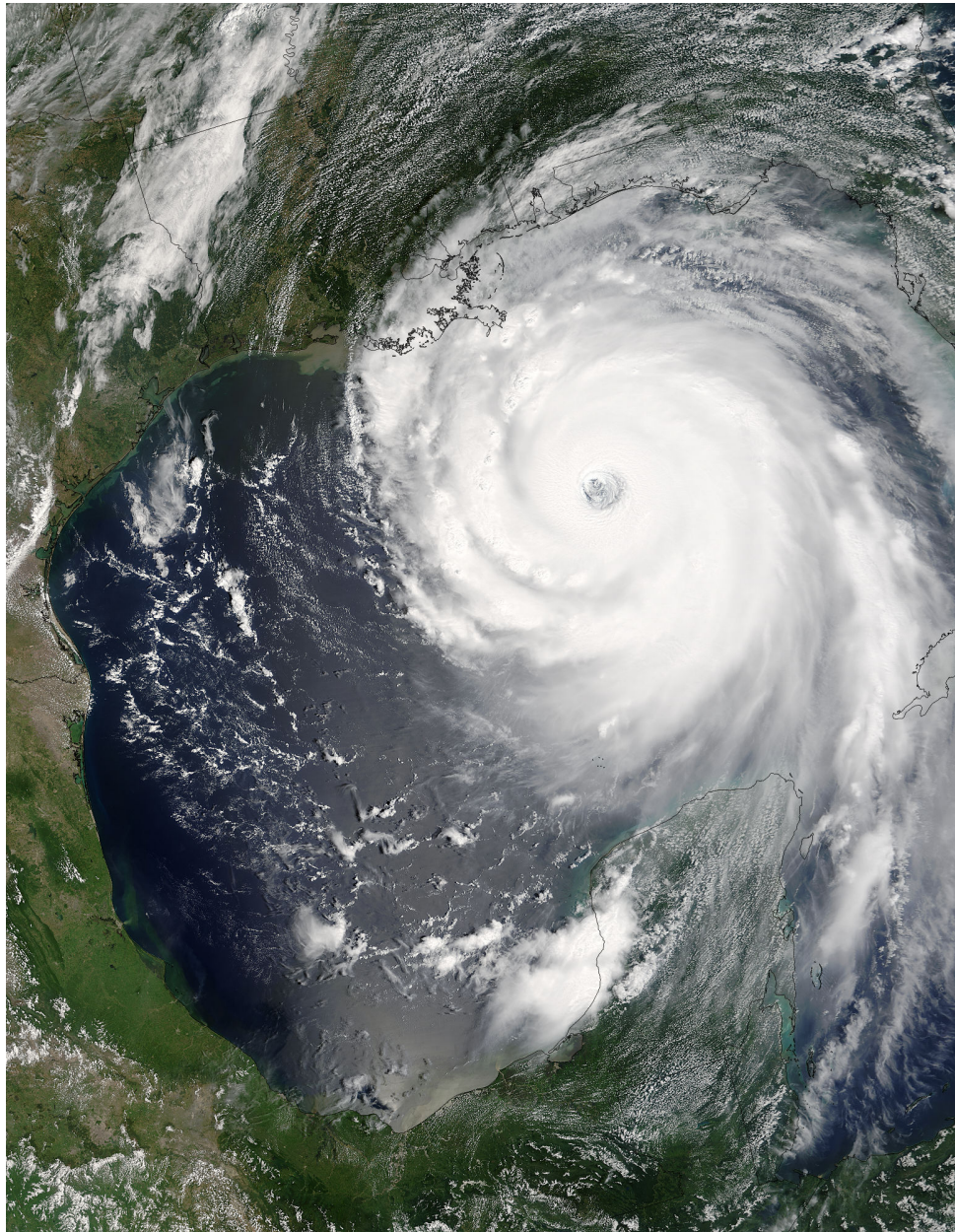
- ◆ **Combined NASA research cluster: 24 PIII and 22 P4 processors with gigabit interconnect.**
- ◆ **NOAA development cluster: 14 P4 processors with gigabit interconnect and tape archive system.**
- ◆ **Expandable asset**

# Key Applications

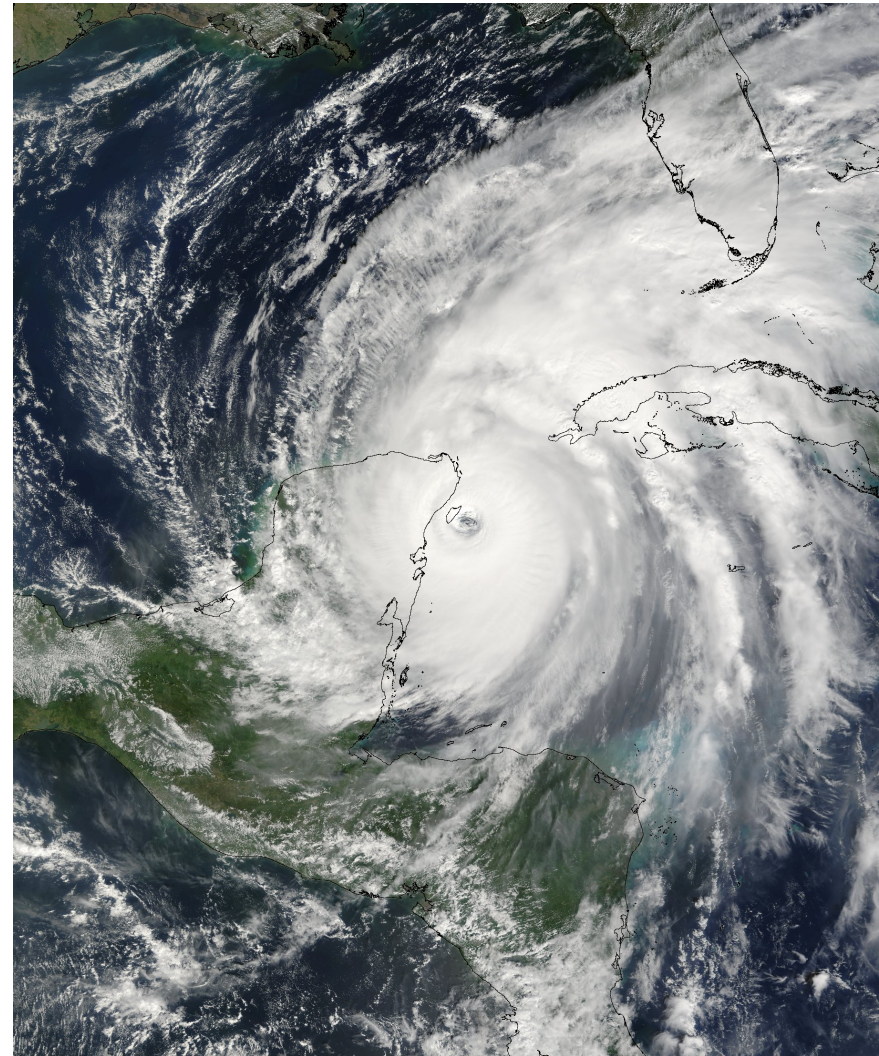


- ◆ Tropical Cyclones
- ◆ ASAP: Satellite data for Aviation Safety
- ◆ IDEA: Satellite data for Air Quality with EPA
- ◆ Broad array of Satellite Products
- ◆ Atmospheric Modelling
- ◆ Planetary Sciences
- ◆ New Satellite Capabilities

# Tropical Cyclones



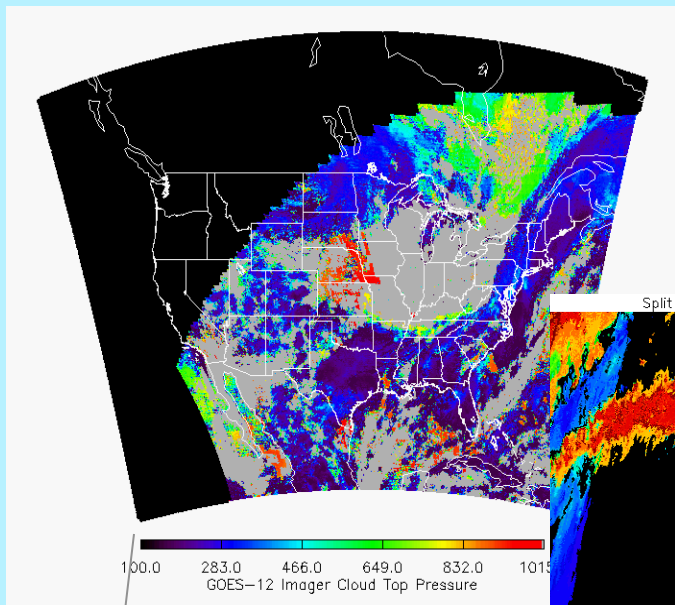
Katrina, 28 August 2005



Wilma, 21 October 2005

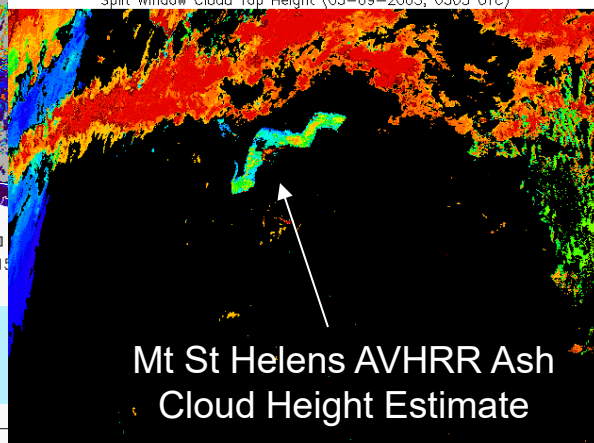
# Advanced Satellite Aviation-weather Products (ASAP) Satellite Derived Fields

## Cloud Top Altitude/Mask

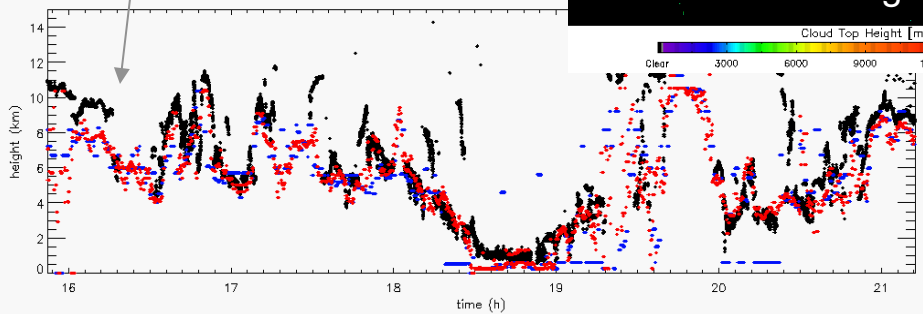


Volcanic  
Ash

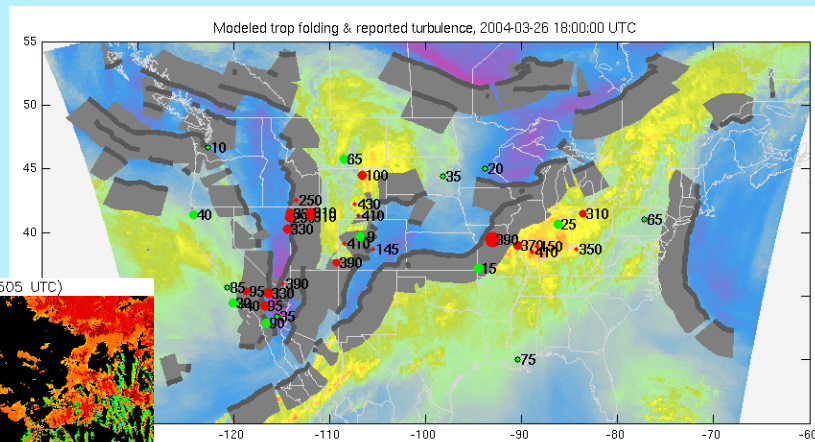
Split Window Cloud Top Height (03-09-2005, 0505 UTC)



Validation

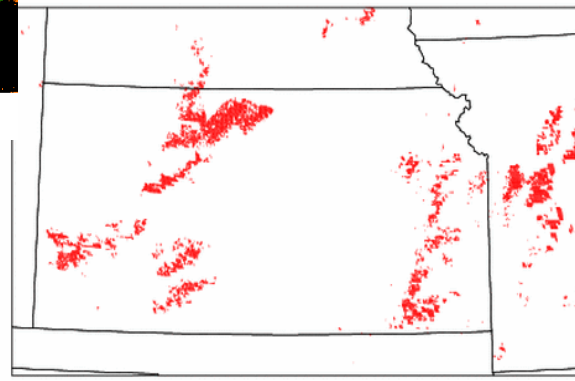


## Turbulence



Convection

Satellite data valid at: 2000 UTC 4 May 2003  
Legend for Future CI (red), Cirrus and Mature Cu (grey), Precip > 30 dBZ (B)







**IDEA** Infusing satellite  
Data into  
Environmental  
Applications

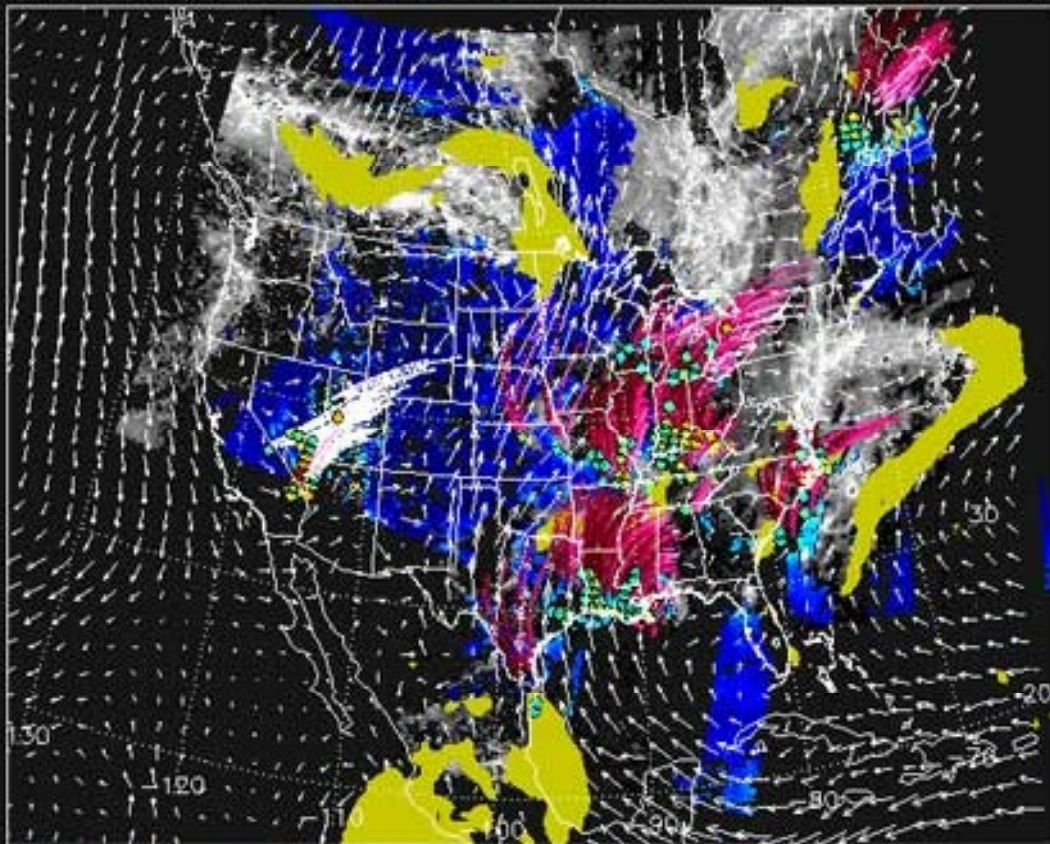
Steve Ackerman, Tom Achtor, Scott Bachmeier, Bill Bellon, Cheiko Kittaka, Nikhil Kumar, Scott Lindstrom, Jerry Robaidek, Kathy Strabala, Tony Wimmers

<http://idea.ssec.wisc.edu>

## Highlights

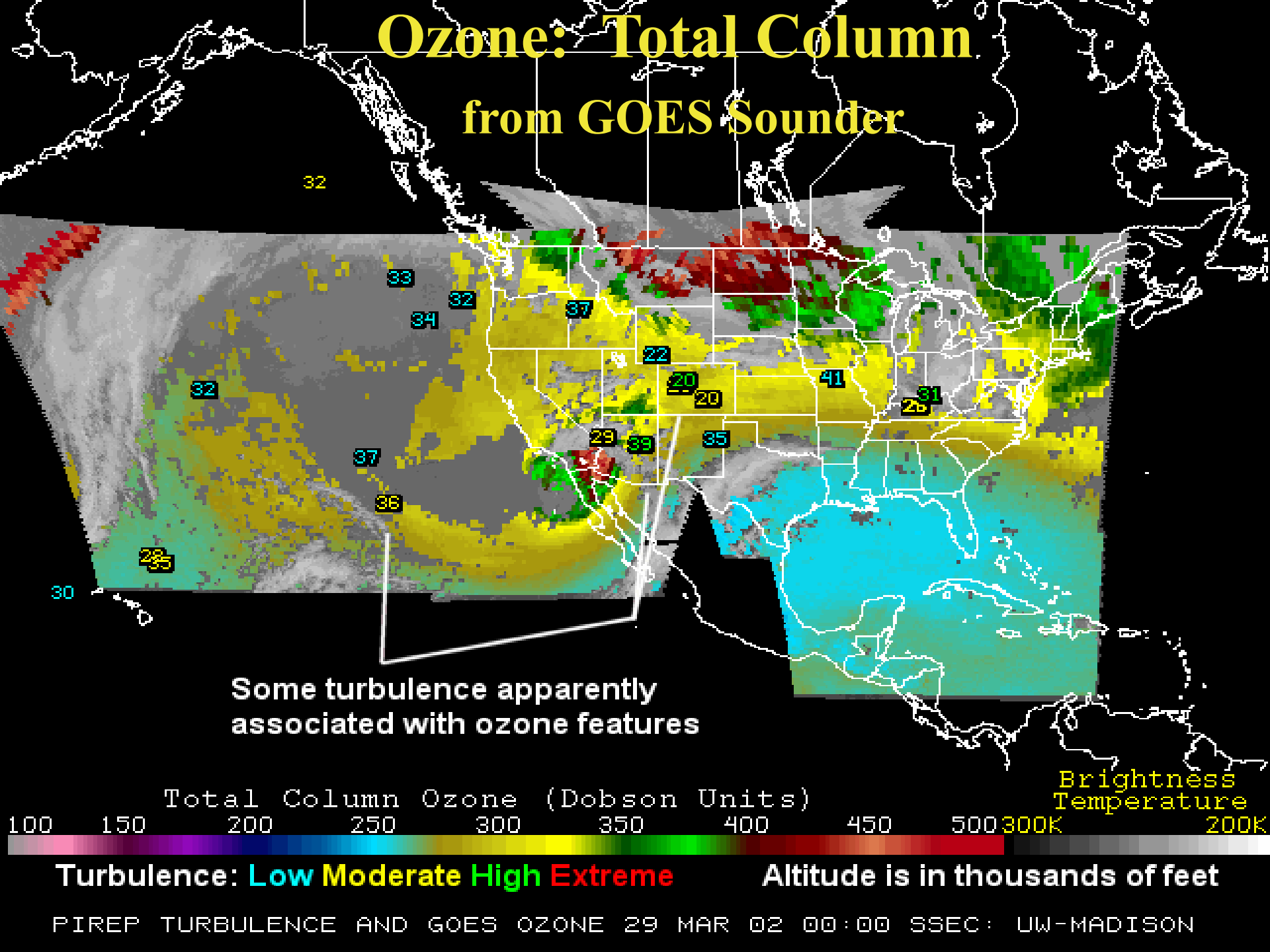
- ◆ **Up-to-the-hour MODIS air quality display**
- ◆ **Pioneered** the process of forecasting air quality daily with MODIS data
- ◆ Currently working with NOAA to use MODIS in a **new national air quality forecasting system**

MODIS 2004/06/06 AOD/COT & AOD Trajectories on 2004/06/07 10Z



0.0 0.2 0.4 0.6 0.8 1.0 1000 800 600 400 200 0 0 10 20 30 40 50 60 70  
AOD Trajectory Pressure (mb) COT

# Ozone: Total Column from GOES Sounder

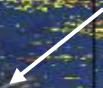


# Saharan Aerosol from GOES (yellow/orange)

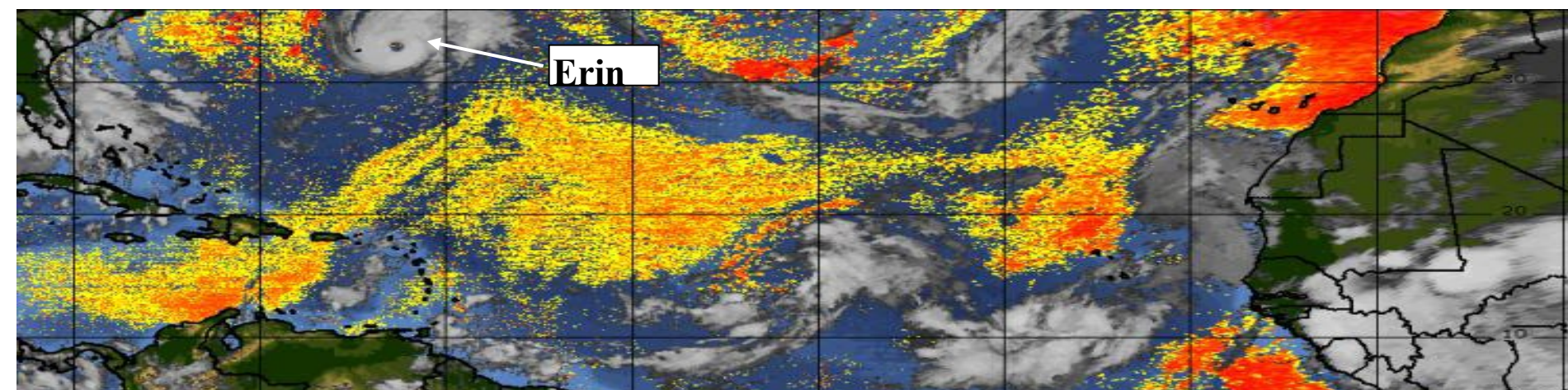
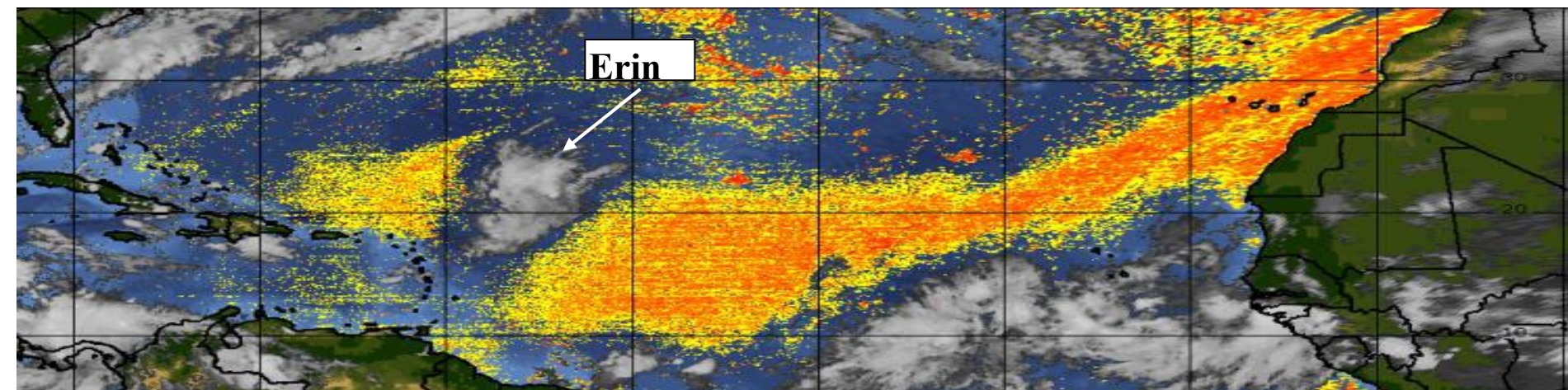
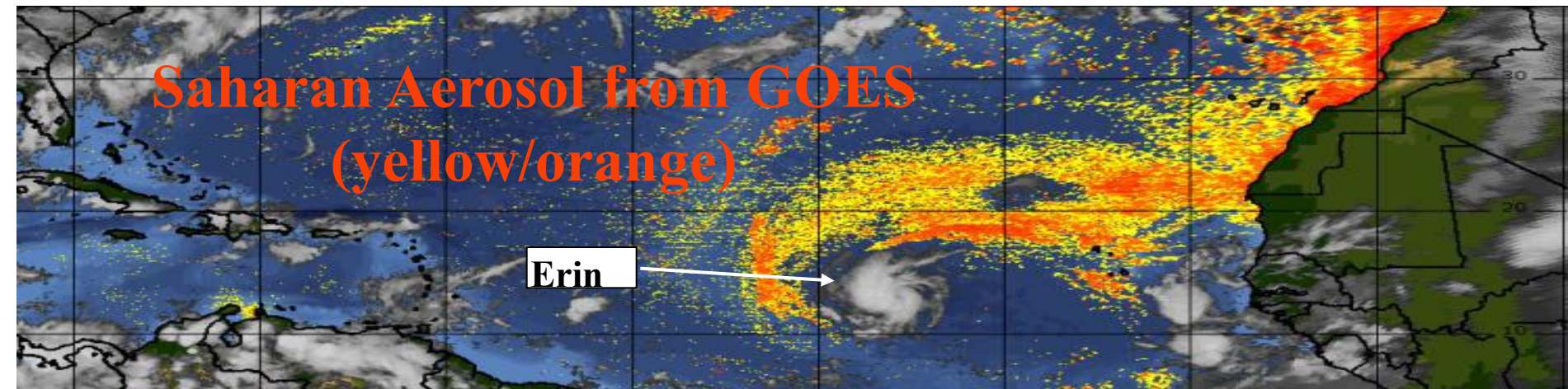
Erin



Erin



Erin

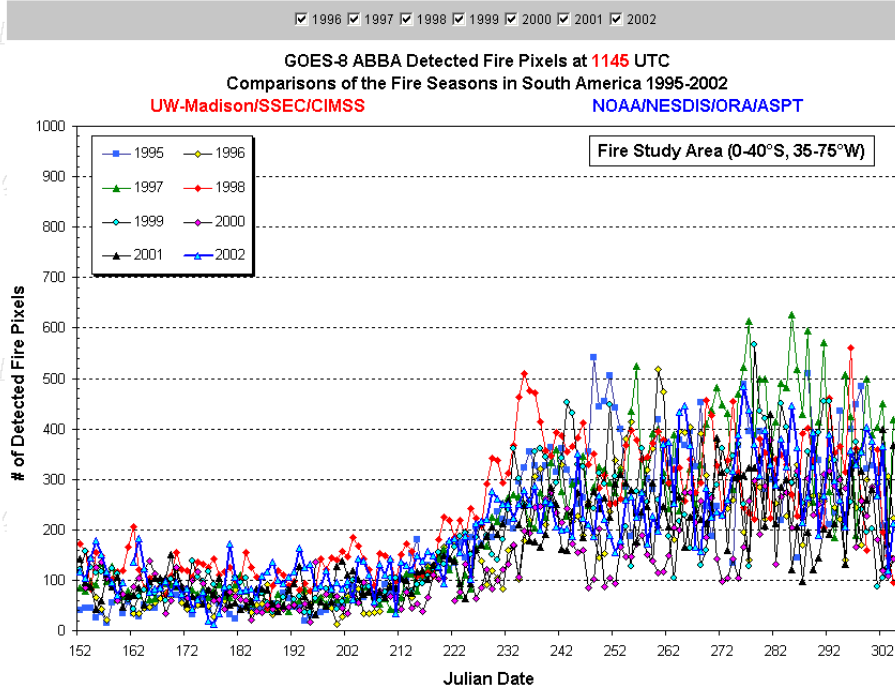


# Biomass Burning 8-year Climatology

## ABBA Results

### GOES-8 1995-2002: Fires pixels vs. Julian Day

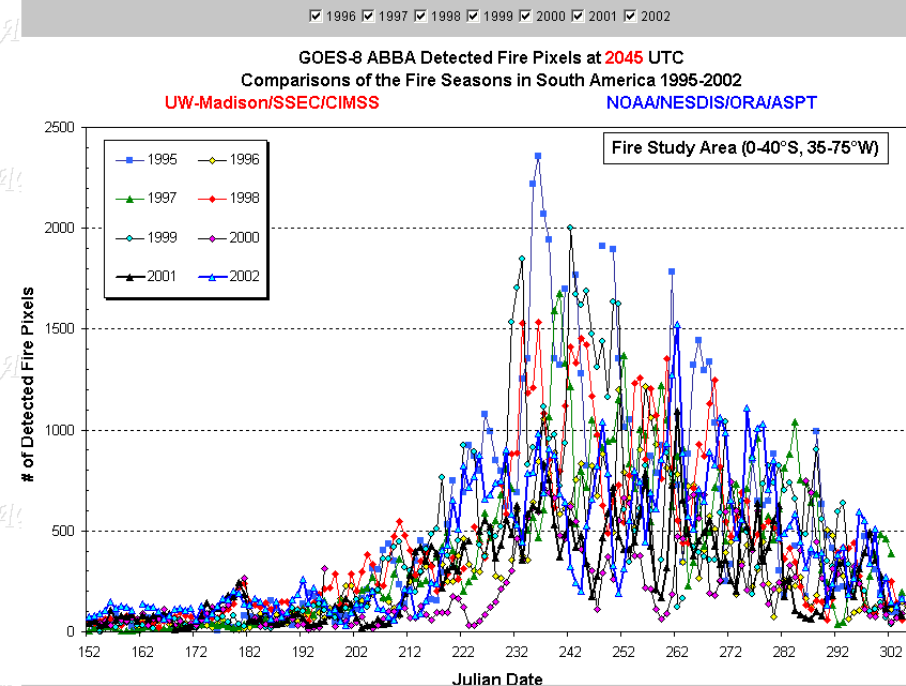
Time Series of Detected Fire Pixels at 1145 UTC



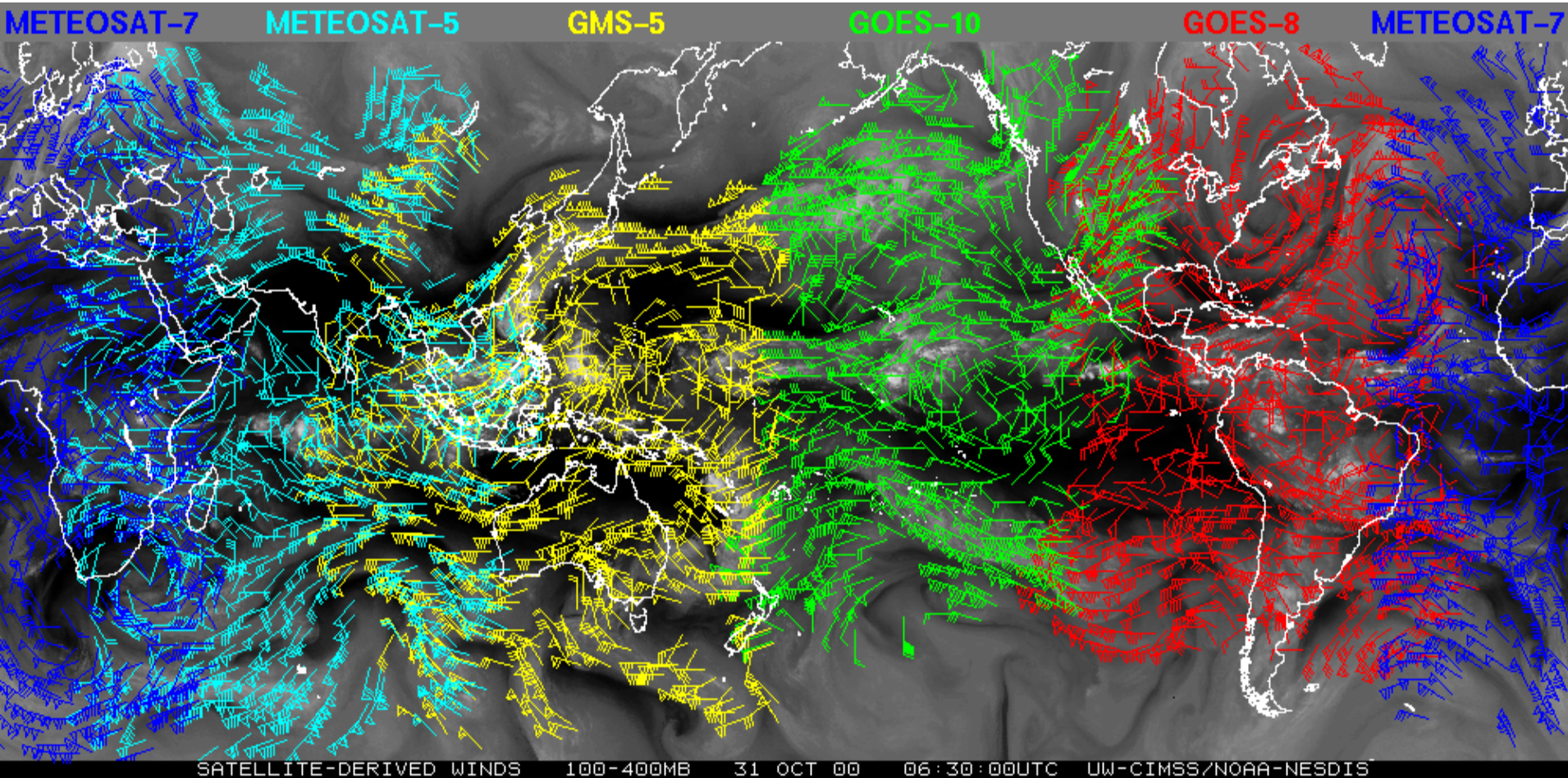
1145UTC

2045 UTC

Time Series of Detected Fire Pixels at 2045 UTC

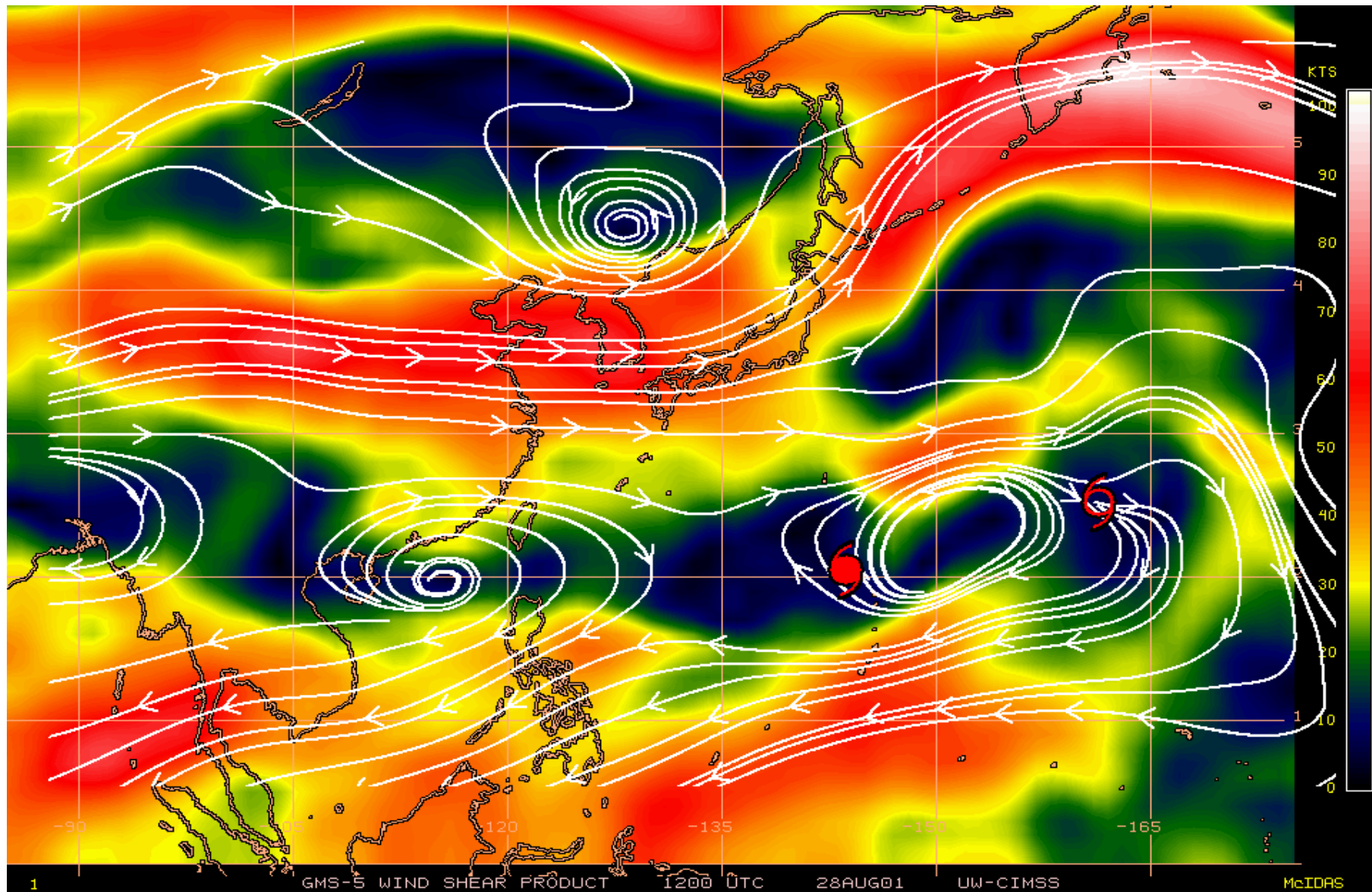


# Multiple Geostationary Satellite Wind Data Automatically Produced



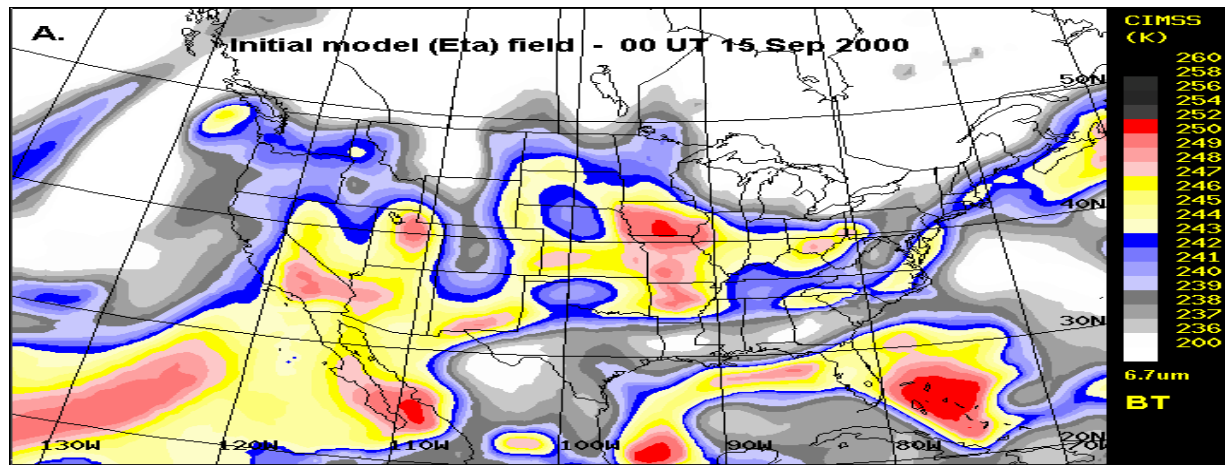
# Wind Shear Product

(150-300 mb minus 700-925 mb)

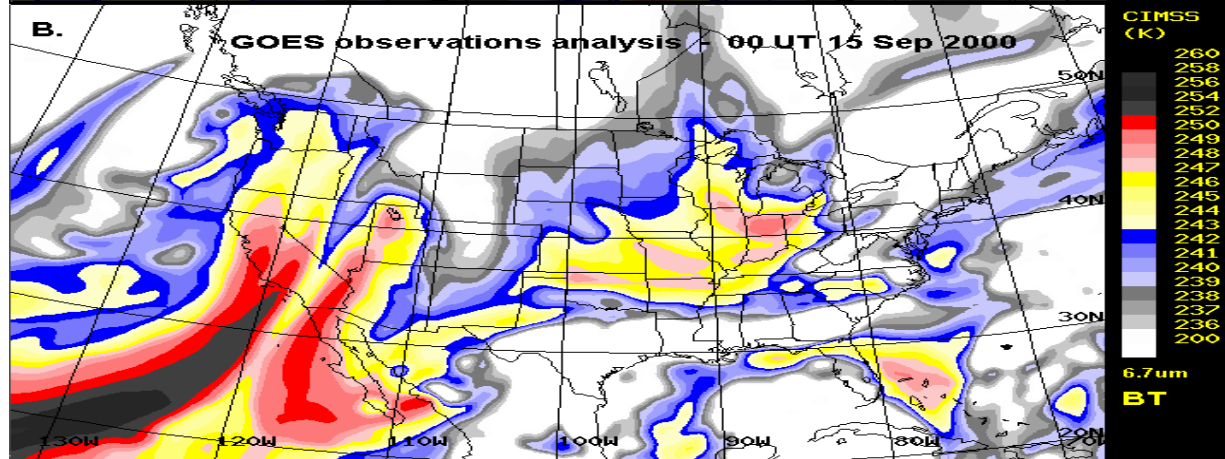


# Assimilating Cloudy GOES Imager Obs into CRAS

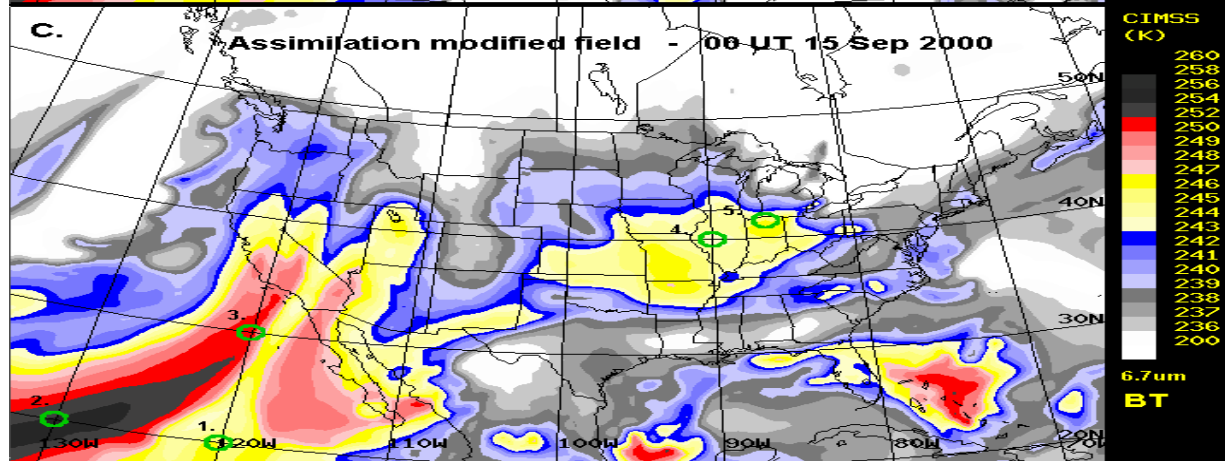
**A. Eta Model  
First Guess**



**B. GOES  $T_b$   
observations for  
Assimilation--  
“Truth”**



**C. CRAS Accepts  
the information &  
Maintains improved  
GOES Correlation  
for > 48 hours**

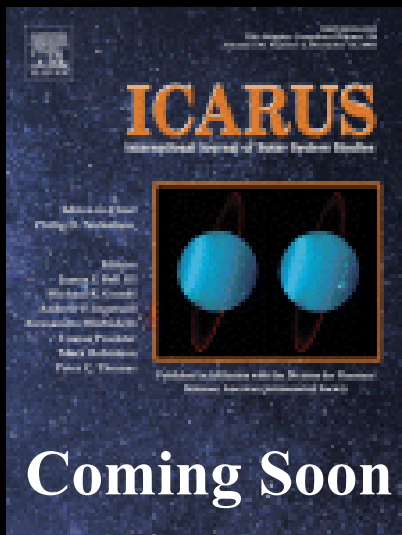
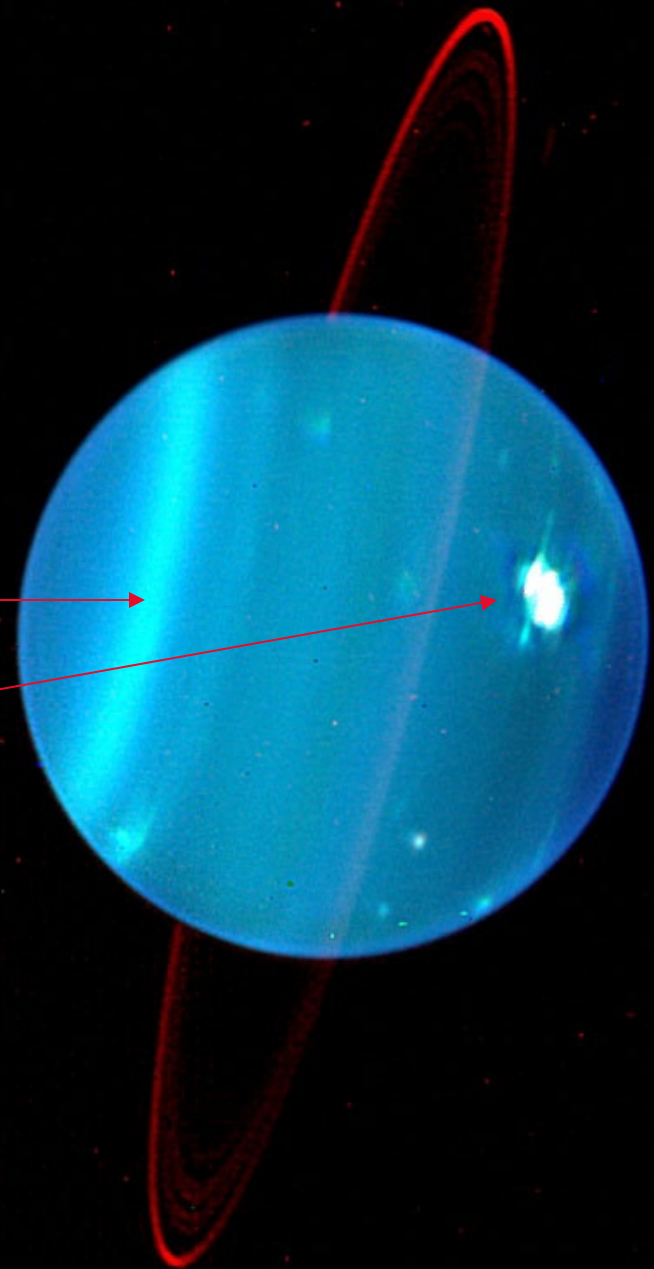


New low-T methane absorption models, described in two 2005 Icarus submissions, will be applied to Keck AO imaging observations of Uranus and Neptune, and Cassini observations of Titan.

Last year's dynamical results on Uranus will appear as the cover article in the December 2005 issue of Icarus.

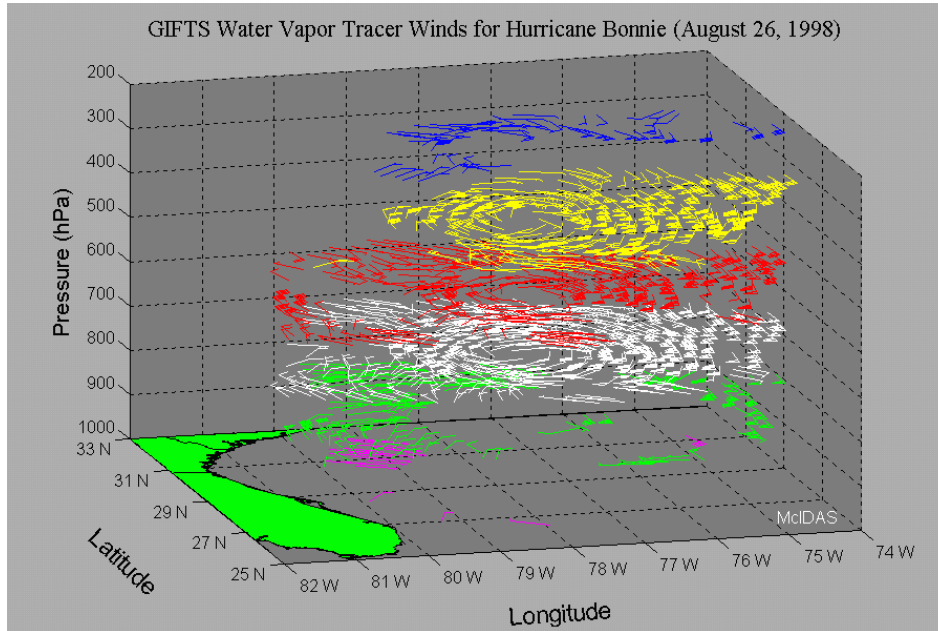
Bright band formed at 6 bars →

Brightest cloud feature ever seen on **Uranus** reaches 500-mb level. →





# GIFTS: The Next Major Advance in Observing from Geostationary Orbit



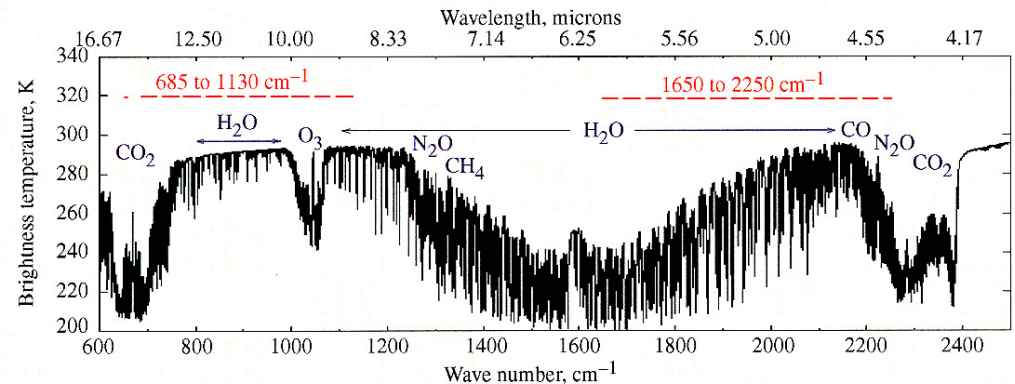
## GOES-R HES Risk Reduction

16,000 Temperature, Humidity & Trace Gas Profiles in 10 sec-

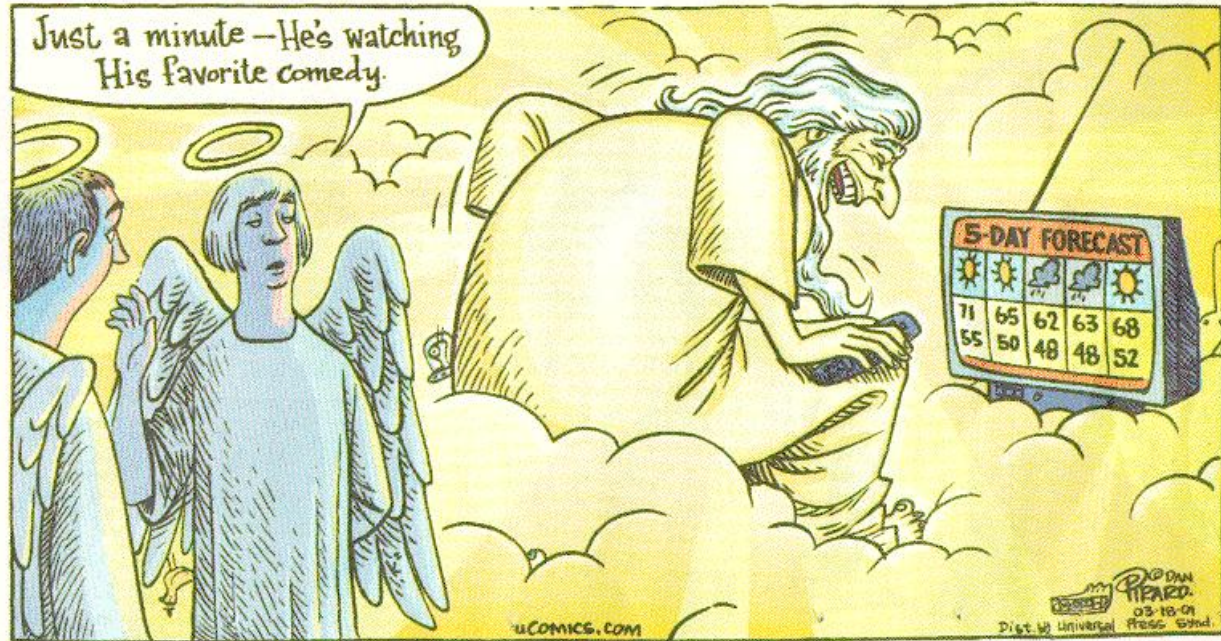
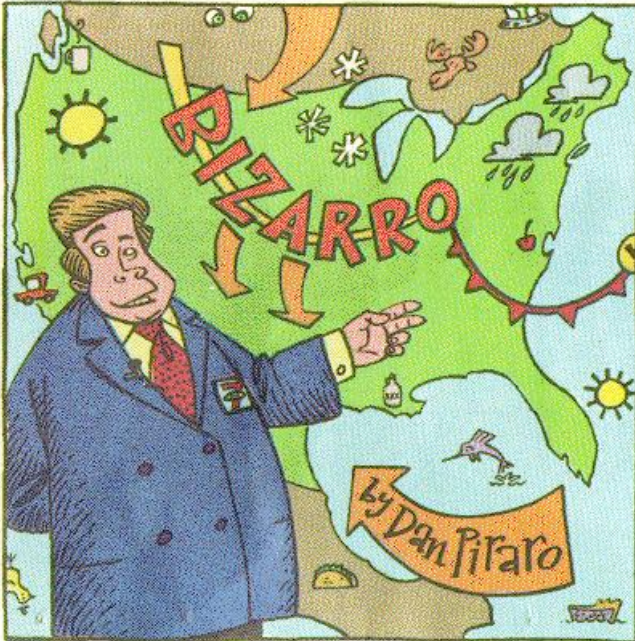
Dense Wind Observations, tracked from Water Vapor Sdgs

Global Sounding in  $< 10$  min

High resolution Sounding of 6000 x 6000 km in  $< 30$  min



# Atmospheric and Oceanic Science Goal:



**Improve weather and climate forecasts**



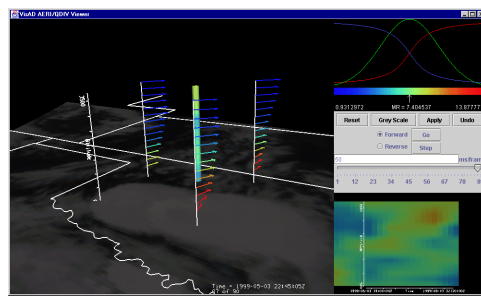
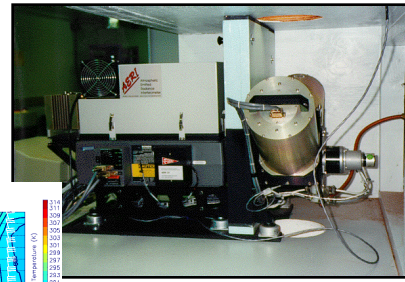
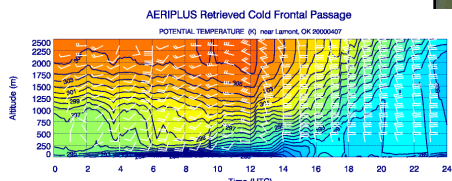
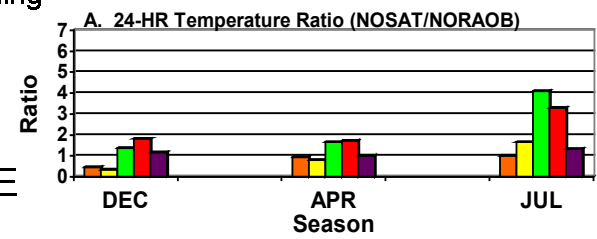
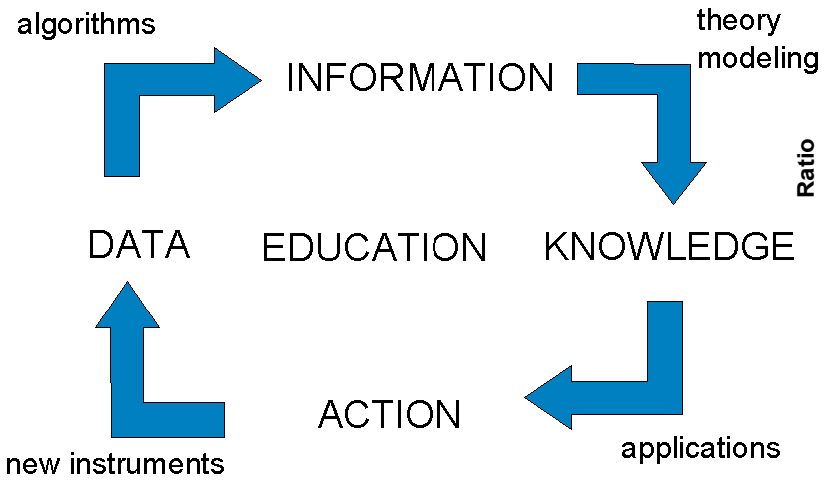
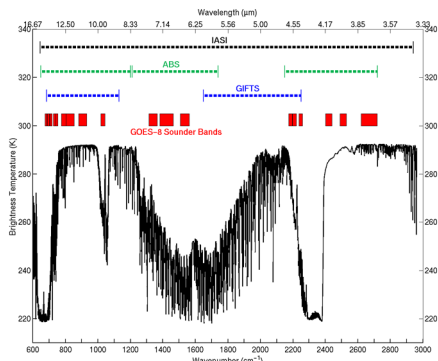
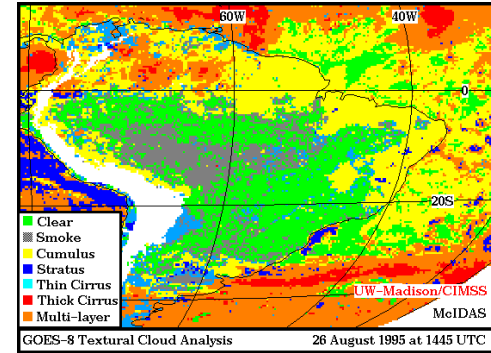
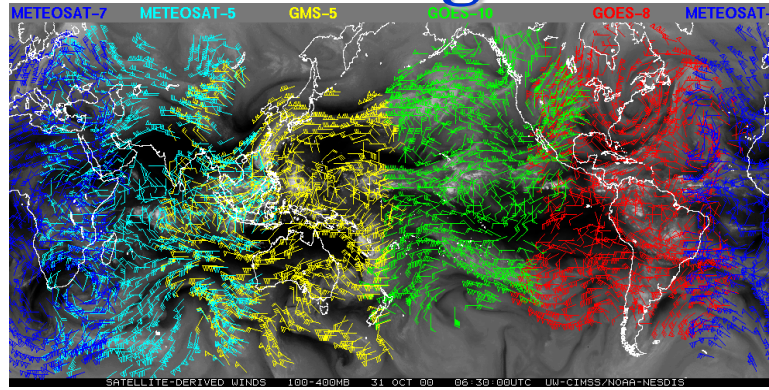
# CIMSS Overview

Steve Ackerman, Director

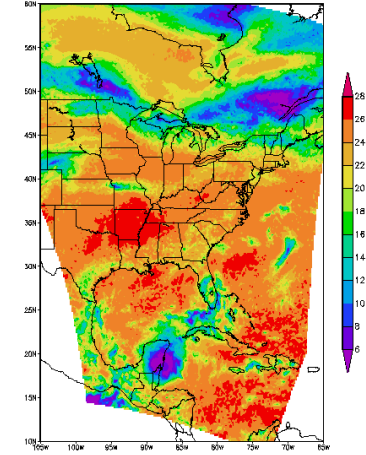
University of Wisconsin - Madison  
Cooperative Institute for Meteorological  
Satellite Study (CIMSS)



# The CIMSS Research Program



Daily Insol (MJ day<sup>-1</sup> m<sup>-2</sup>) for 17 August 99



# CIMSS Research Activities

## ◆ Remote Sensing Research and Development

- develop techniques and algorithms for inferring Earth surface and atmospheric state parameters from remote sensing observations

## ◆ Data Processing Techniques

- develop new data processing approaches and visualization techniques to apply emerging technologies

## ◆ New Remote Sensing Instruments and Applications

- investigate new instrument approaches to improve environmental remote sensing measurements

## ◆ Data Assimilation Studies

- examine the impact of remote sensing data on numerical analysis and prediction models

## ◆ Data Collection and Archive

- collect remote sensing data for long term trend analyses as needed for climate and other retrospective studies

# Products in NESDIS Operations from CIMSS

<b>Imager</b>	<b>Sounder</b>
<a href="#">Derived Product Images</a>	<a href="#">Derived Product Images</a>
Water vapor	Water vapor
Lifted Index	Lifted Index
Skin Temperature	Skin Temperature
<a href="#">Winds from multiple satellites</a>	<a href="#">Winds</a>
High density infrared	7.0 micrometers
High density water vapor	7.5 micrometers
High density visible	
High density 3.9 um (in transition)	
Derived wind fields (shear, divergence, etc)	
<a href="#">Hurricanes</a>	
Objective Dvorak technique (SAB)	
Intensity estimates (from <i>AMSU-A</i> )	
<a href="#">Sea Surface Temperature</a>	<a href="#">Clouds</a>
	Site-specific Cloud Product
<a href="#">Biomass Burning</a>	Single FOV product DPI
(produced 24x7)	
<a href="#">Rainfall</a>	<a href="#">Retrievals</a>
(auto-estimator via G. Vicente)	Temperature/moisture
	Layer PW
	Clear-sky Brightness Temperature
<a href="#">Clear-sky Brightness Temperature</a>	

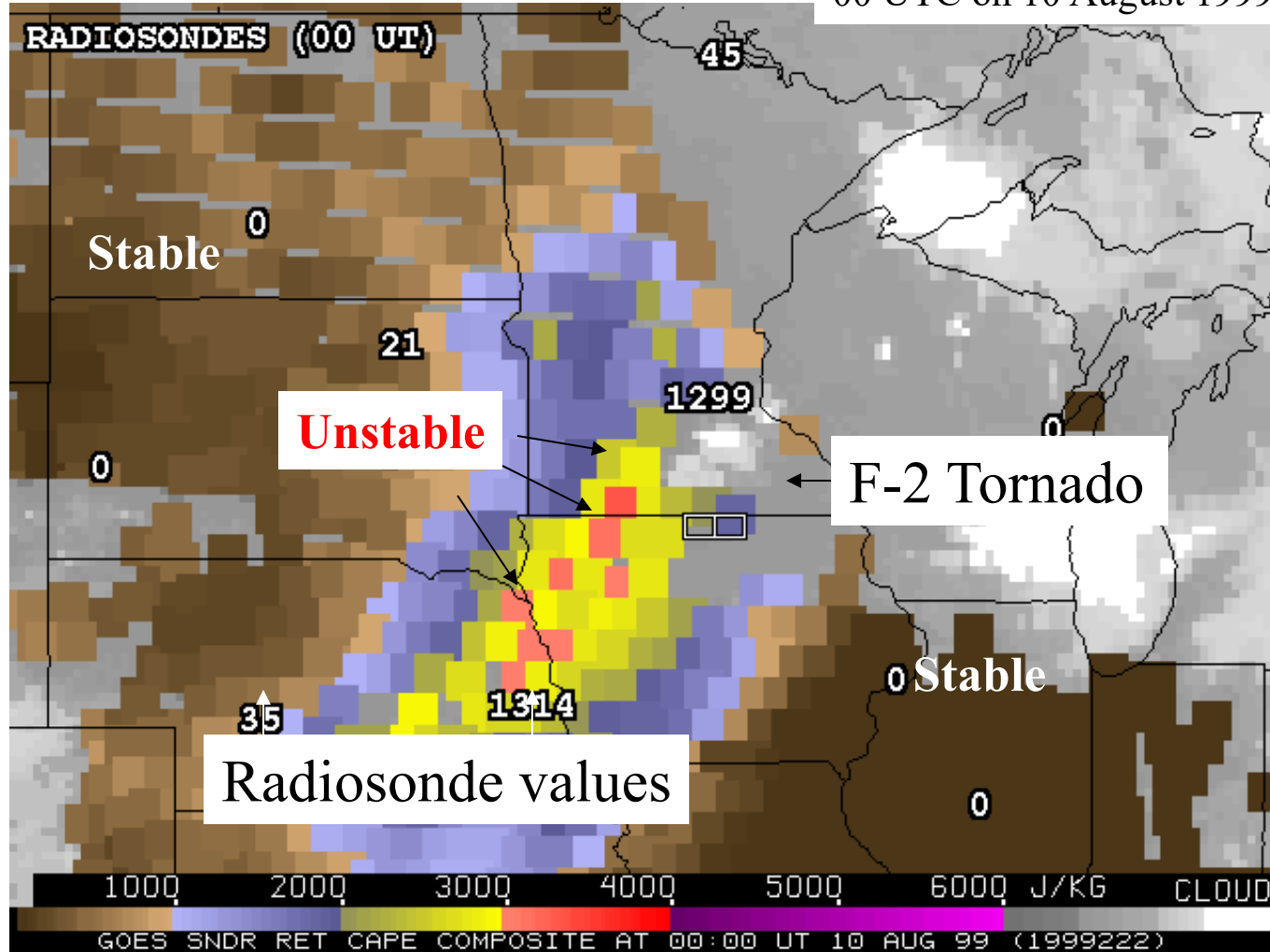
# GOES Products from CIMSS in NWP; **routine** and **experimental**

<u>Model</u>	<u>GOES Data</u>
NCEP Global (GFS)	Sounder Radiance, Imager Winds, <b>Imager Radiances</b>
NCEP Eta (NAM)	Sounder Radiance, Sounder PW, Imager Winds, <b>Sounder Clouds</b>
FSL RUC	Sounder TPW, Sounder Clouds
UW CIMSS CRAS	Sounder PW, Sounder Clouds
Australia (LAPS)	Imager Winds
ECMWF	Imager Winds, <b>Imager Radiances</b>
GFDL (experimental)	Imager Winds, <b>GWINDEX rapid-scan winds</b>
Navy NOGAPS	Imager Winds, Sounder Winds
NAAPS	Biomass Fire Product
CSU RAMS	Biomass Fire Product
UW ALEXI	Sounder Skin Temperature time-change

Data Assimilation -- CIMSS has a role in every listed GOES product

# Derived Product Image of CAPE from the GOES-8 Sounder

00 UTC on 10 August 1999



The axis of CAPE values greater than 2500 J/kg extended from eastern Nebraska into southern Minnesota. CAPE values calculated from the 00 UTC radiosondes were too sparse to capture this feature. A NWS forecaster used Sounder data to help correctly forecast this event.



# Monitoring and comparing real-time GOES Sounder Single Field-of-View (SFOV) Derived Product Imagery (DPI) for ultimate use by the National Weather Service (NWS)

Compare versions of GOES Sounder DPI - Netscape

File Edit View Go Bookmarks Tools Window Help

http://cimss.ssec.wisc.edu/goes/realtime/compare/

Start Rock Set Animation Speed < > Zoom Show Refresh

GOES Sndr PW DPI or  CTP or  LI or  GOES Sndr Radiance Imagery

Left click - toggle on/off, Right click - show frame

FPDT-SFOV-CODE at OPS

GOES Sndr TPW 18:46 UT 14 JUN 05

OPS LEGACY 5x5

GOES Sndr TPW 18:46 UT 14 JUN 05

FPDT-SFOV-CODE at FPDT

GOES Sndr TPW 18:46 UT 14 JUN 05

0.7um VISIBLE

GOES Sndr VIS 18:46 UT 14 JUN 05

6.5 um WATER VAPOR

GOES Sndr LI 18:46 UT 14 JUN 05

FPDT-SFOV-CODE at OPS

GOES Sndr LI 18:46 UT 14 JUN 05

OPS LEGACY 5x5

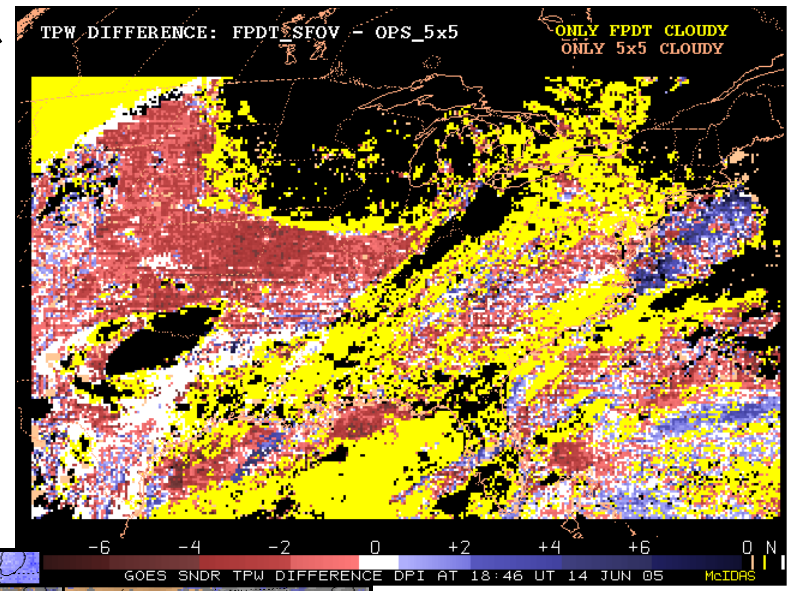
GOES Sndr LI 18:46 UT 14 JUN 05

FPDT-SFOV-CODE at FPDT

GOES Sndr LI 18:46 UT 14 JUN 05

FPDT-SFOV-CODE at CIMSS

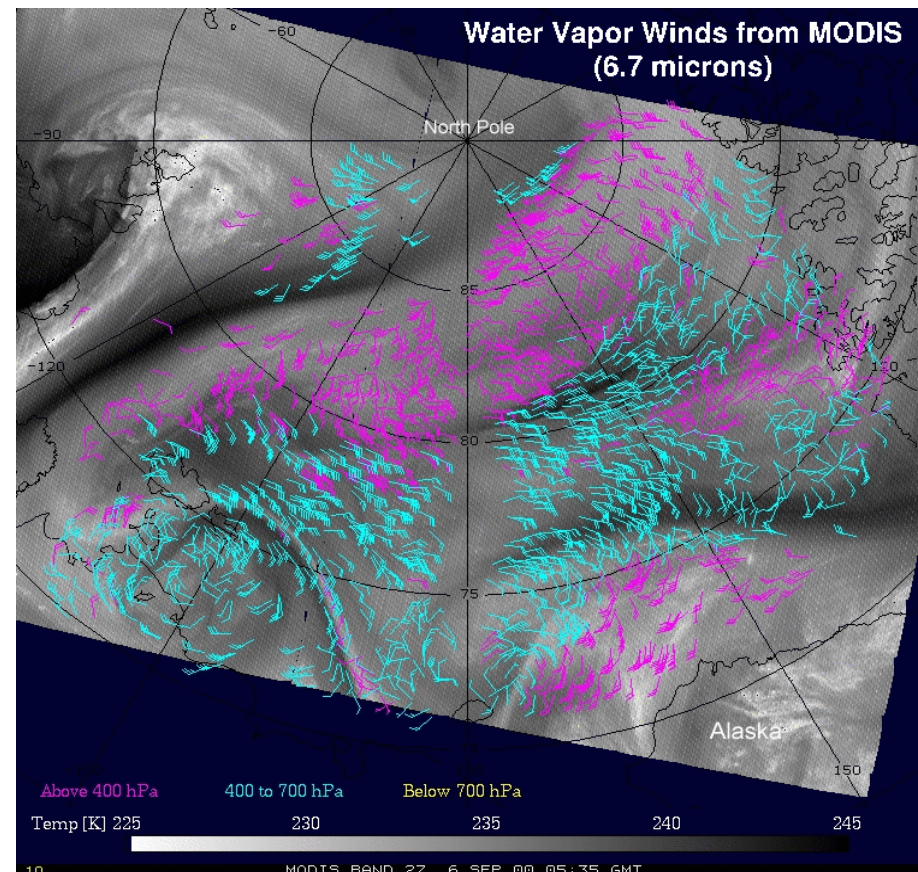
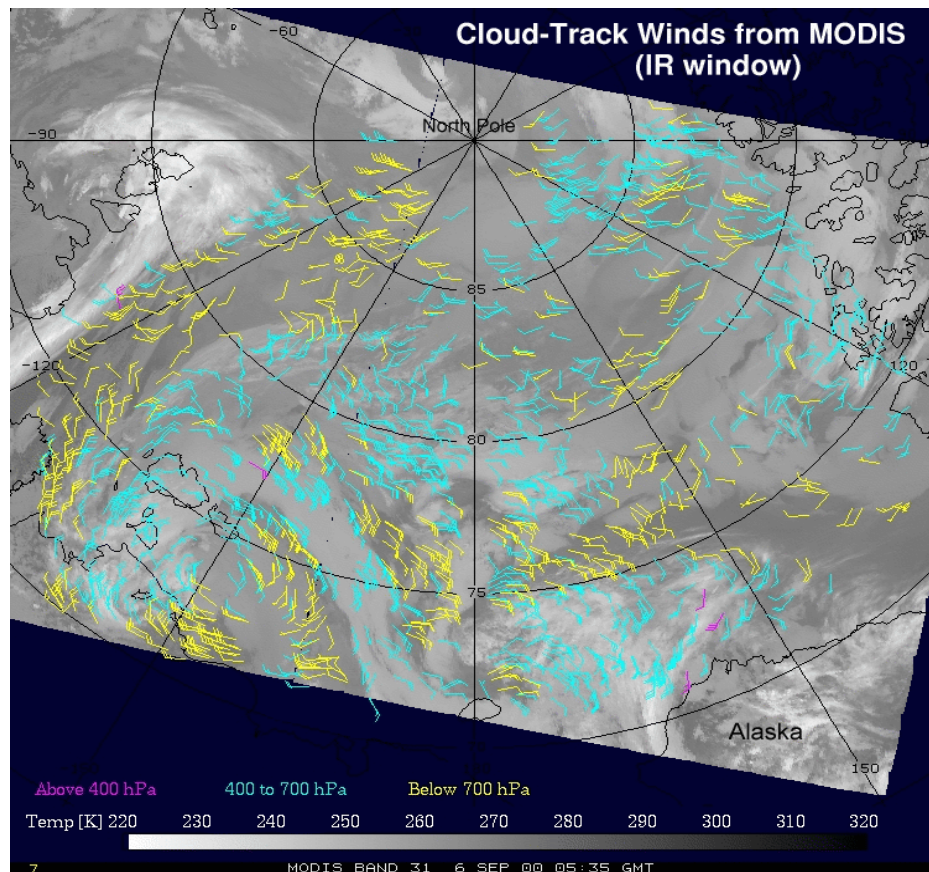
GOES Sndr LI 18:46 UT 14 JUN 05



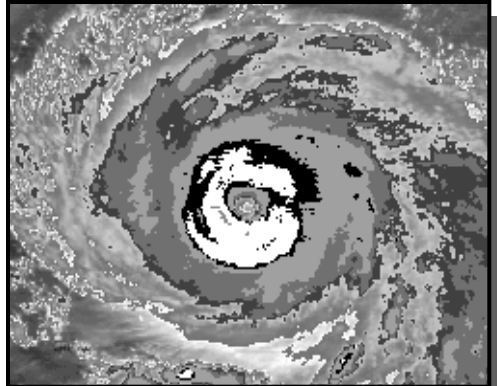
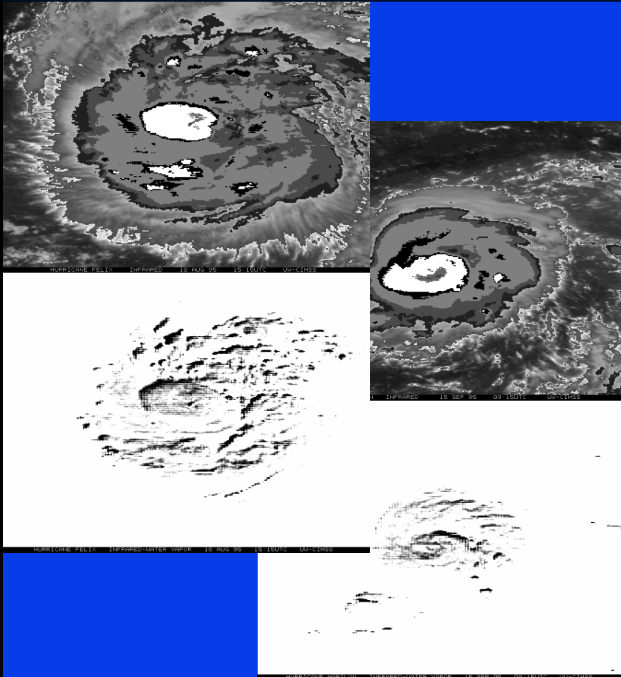
Four sources of DPI:  
 Current 5x5 @ Ops  
 Exp SFOV @ CIMSS  
 Exp SFOV @ FPDT  
 Exp SFOV @ Ops

# Polar Winds from MODIS

Cloud-track winds (left) and water vapor winds (right) from MODIS for a case in the western Arctic. The wind vectors were derived from a sequence of three images, each separated by 100 minutes. They are plotted on the first 11  $\mu\text{m}$  (left) and 6.7  $\mu\text{m}$  (right) images in the sequence.



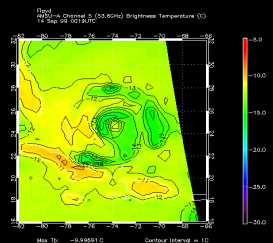
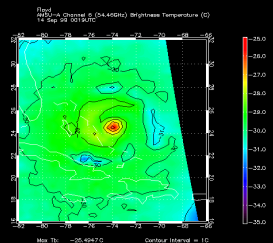
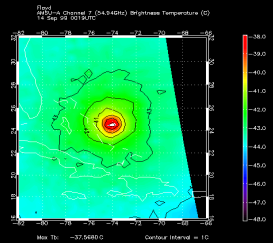
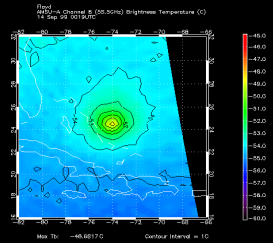
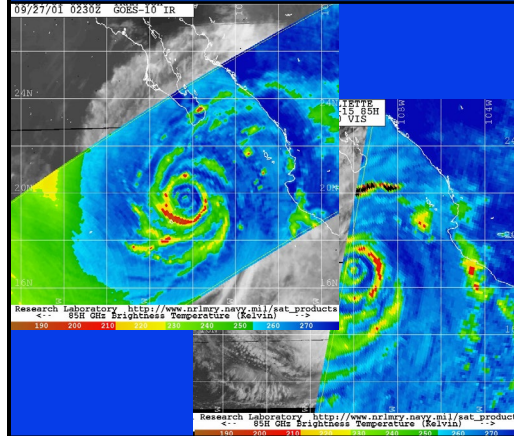
## IRW-WV channel difference



## Current AODT

# Integrated Satellite-Based TC Intensity Estimation System

## Microwave imagery










## AMSU

# Professional Training

Satellite Meteorology: Remote Sensing Using the New GOES Imager

Satellite Meteorology: Remote Sensing Using the New GOES Imager  
Main Menu

Concept Map

- ✓  **Chapter 1:** Introduction
- ✓  **Chapter 2:** Definition of Radiance
- ✓  **Chapter 3:** Sun-Earth-Atmosphere Energy System
- ✓  **Chapter 4:** Radiative Transfer Equation
- ✓  **Chapter 5:** Selective Absorption
-  **Chapter 6:** Channel Selection
-  **Chapter 7:** Case Studies and Exercises

Chapters are listed in the suggested learning order.

Click on the chapter icon to go to that section.

Pass the mouse over a button to see a short description.



# Outreach and Education



2004 High School Student Workshop on Atmospheric, Earth & Space Science



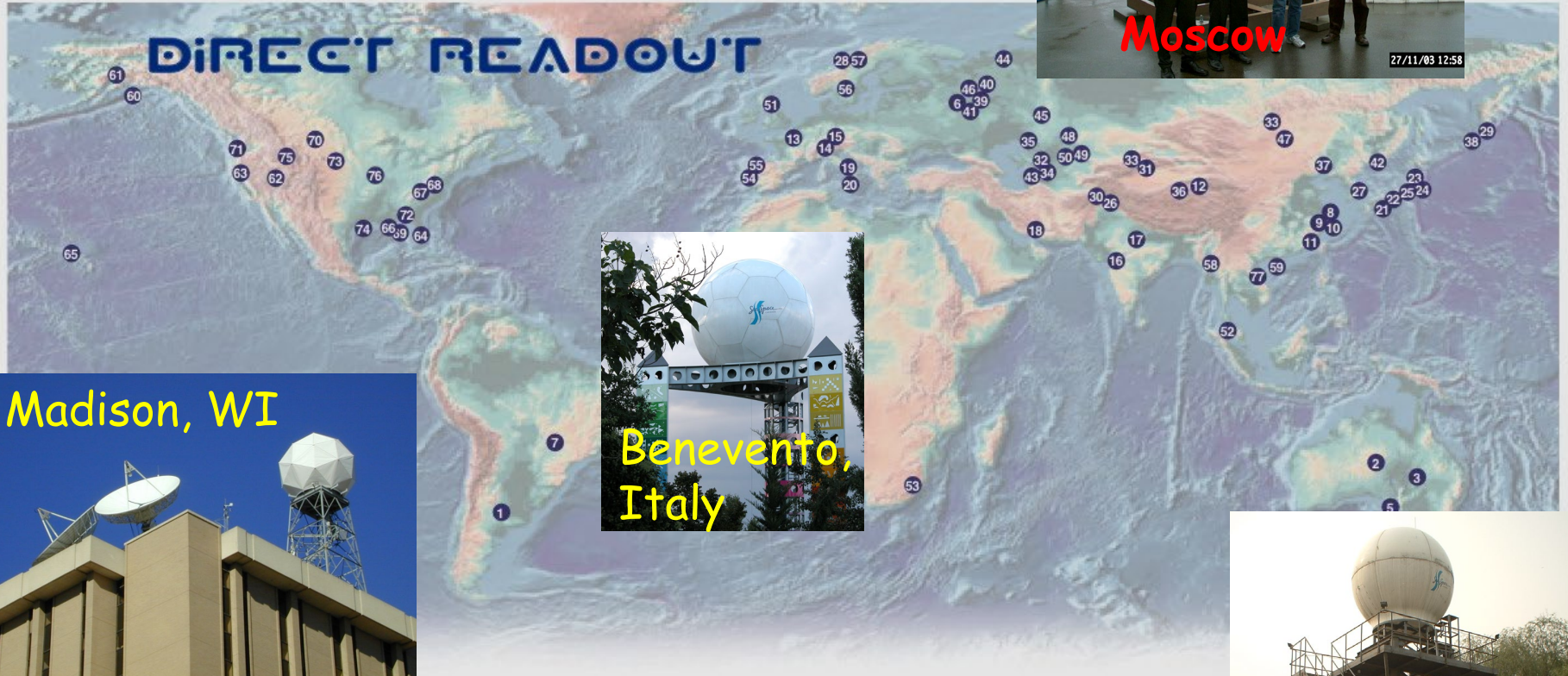
2004 Teacher Workshop in Satellite Meteorology



Satellite Meteorology CD  
<http://cimss.ssec.wisc.edu/satmet>  
Linked to the NESDIS and  
NPOESS Web pages!

**28 teachers** have registered for  
for the 2005 Teacher Workshop  
scheduled for June 28<sup>th</sup> & 29<sup>th</sup>

# EOS Direct Broadcast Sites



More than 150 sites around the world

# NASA Earth Observing System (EOS)

## Direct Broadcast Groundstation

4.4 m antenna: First data acquired 18 August 2000



# International MODIS/AIRS Processing Package (IMAPP)

Builds upon our previous experience with

- ITPP (International TOVS Processing Package) since 1985
- IAPP (International ATOVS Processing Package) since 1998

## *Purpose:*

- The intention in developing IMAPP for processing direct broadcast MODIS and AIRS data is to help foster the rapid improvement of retrieval algorithms and other applications of EOS data in a variety of global weather, process studies, and climate applications, just as the ITPP and IAPP have done for TOVS and ATOVS data.

## *Available from:*

**<http://cimss.ssec.wisc.edu/~gumley/IMAPP/>**

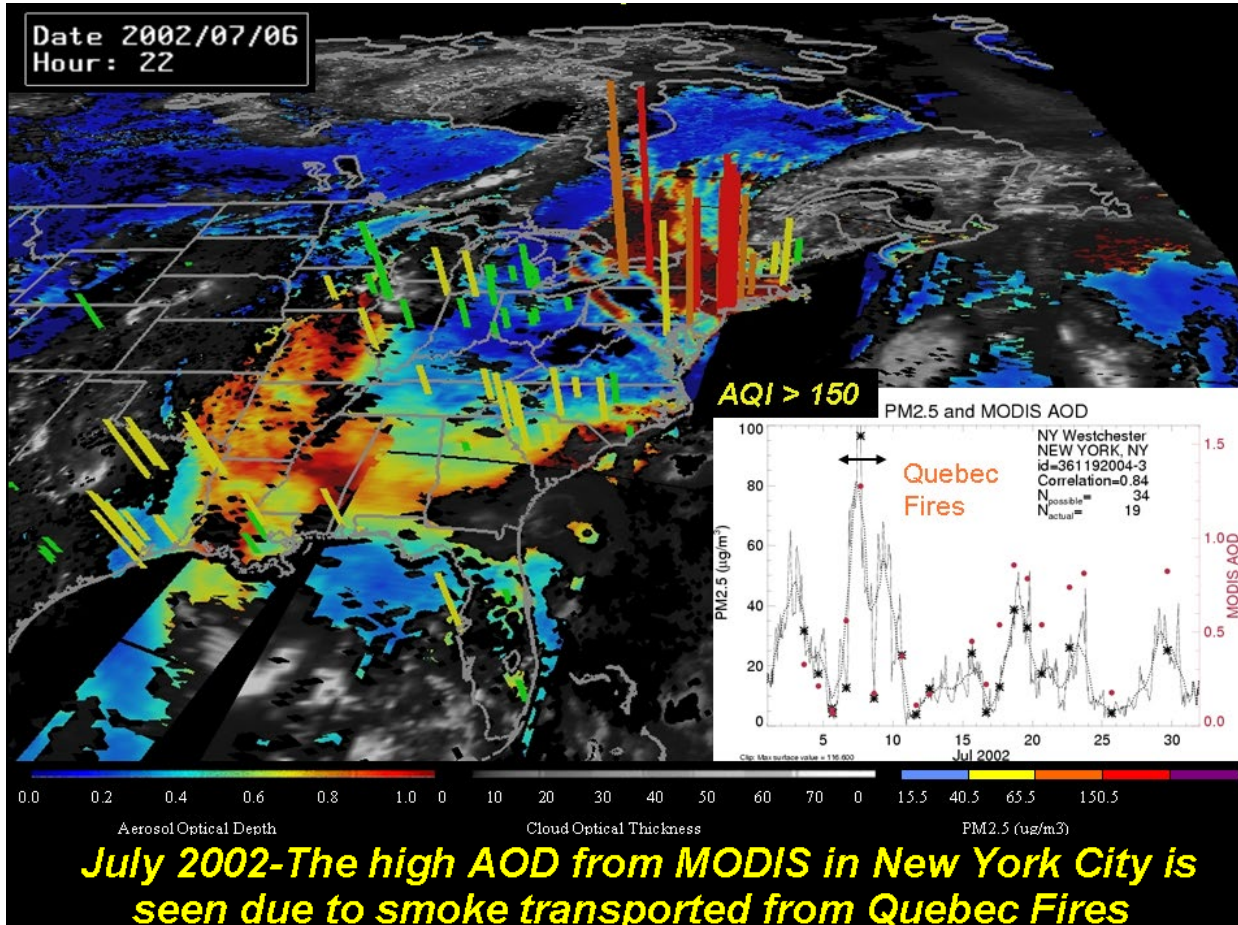


# Infusing Satellite Data into Environmental Applications (IDEA)

Tony Wimmers, Brad Pierce, Chieko Kittaka, Liam Gumley,  
Scott Bachmeir, Scott Lindstrom, Jerry Robaidek, Bill Bellon

- ◆ Direct Broadcast MODIS data used to initialize aerosols for trajectory forecasts to improve air quality assessment, management and prediction
- ◆ Moved processing to CIMSS due to real-time availability of MODIS data and central location of antenna providing CONUS coverage
- ◆ <http://idea.ssec.wisc.edu/>

# IDEA (Infusing satellite Data into Environmental Applications)



Regional air quality monitoring and forecasting using MODIS aerosol retrievals, satellite-observed fire, ground-station reports and ancillary model fields

Development of An Advanced Integrated Real Time Operational System  
for the  
Improvement of Air Quality Forecast during 2008 Olympic Event  
and for the

Long Term Strategic Observations in Support of Feng Yun (FY) Calibration, Validation, Research, and Applications

# MODIS into Advanced Weather Interactive Processing System (AWIPS)

Steve Wanzong, Jordan Gerth, Russ Dengel, Gary Wade,  
Scott Bachmeier, Scott Lindstrom, Jerry Robaidek, TomWhittaker

- ◆ *Support of SPORT (Short-term Prediction Research and Transition) Center at NASA MSFC*
  - Aim is to improve short term (0-24hr) weather forecasts
  - SSEC DB MODIS and AMSR-E Products distributed to 6 NWS sites in the Southern Region
- ◆ *CIMSS began routine insertion into AWIPS central region data feed on 30 June 2006*
  - Current feed consists of
    - » MODIS L1B Bands 1 (.86 micron), 7 (2.1 micron), 26 (1.38 micron), 20 (4.0 micron), 27 (6.7 micron) and 31 (11 micron)
    - » Products – Cloud Phase, TPW, Cloud Top Temperatures, Fog, SST
  - Keys to success
    - » Provide something better or new to forecasters (ie, higher spatial resolution)
    - » Must be placed in format that can be accepted by AWIPS
    - » Must have a person at the forecast offices to champion the data (SOO – Dan Baumgardt – ARX Jordan Gerth – MKX)

# GOES-R Observational Requirements: Alternative 1 (no sounder)

Aerosol Detection	Dust/Aerosol *	Surface Albedo
Aerosol Particle Size	Probability of Rainfall	Surface Emissivity *
Suspended Matter	Rainfall Potential	Vegetation Fraction
Volcanic Ash *	Rainfall Rate	Vegetation Index
Aircraft Icing Threat	Derived Stability Indices *	Currents
Cloud Imagery	Total Precipitable Water *	Sea & Lake Ice / Displacement & Direction
Cloud & Moisture Imagery	Total Water Content *	Sea & Lake Ice / Age
Cloud Layers / Heights & Thickness *	Clear Sky Masks	Sea & Lake Ice / Concentration
Cloud Ice Water Path *	Radiances *	Sea & Lake Ice / Extent & Characterization
Cloud Liquid Water	Absorbed Shortwave Radiation	Sea & Lake Ice / Extent & Edge
Cloud Optical Depth	Downward Longwave Radiation	Sea & Lake Ice / Surface Temp
Cloud Particle Size Distribution	Downward Solar Insolation	Sea & Lake Ice / Motion
Cloud Top Phase	Reflected Solar Insolation	Sea & Lake Ice / Thickness
Cloud Top Height *	Upward Longwave Radiation *	Ice Cover / Landlocked
Cloud Top Pressure *	Ozone Total *	Snow Cover
Cloud Top Temperature *	SO <sub>2</sub> Detection *	Snow Depth
Cloud Type	Derived Motion Winds *	Sea Surface Temps
Convection Initiation	Fire / Hot Spot Imagery	Energetic Heavy Ions
Enhanced "V"/Overshooting Top Detection	Flood / Standing Water	Mag Electrons & Protons: Low Energy
Hurricane Intensity	Land Surface (Skin) Temperature	Mag Electrons & Protons: Med & High Energy
Imagery: All-Weather / Day - Night		Solar & Galactic Protons
Lightning Detection		Solar Flux: EUV
Low Cloud & Fog		Solar Flux: X-Ray
Turbulence *		Solar Imagery: X-Ray
Visibility		
Geomagnetic Field		

\*D1 = Degraded from original GOES-R requirements in Alternative 1 (no HES, nor Sounder)

ABI – Advanced  
Baseline Imager

SEISS – Space Env.  
In-Situ Suite

SIS – Solar  
Instrument Suite

GLM – Geostationary  
Lightning Mapper

Magnetometer

## CIMSS GOES-R AWG Tasks (17) (1/2)

**Task 1. GOES-R Proxy Data Sets and Models to Support a Broad Range of Algorithm Working Group (AWG) Activities** 🔒

**Task 2. GOES-R Analysis Facility Instrument for Impacts on Requirements (GRAFIIR)** 🔒

**Task 3. Development of Generalized Radiative Transfer Model for Multilayer Clouds**

**Task 4. Algorithm Integration Team (AIT) Technical Support**

**Task 5. Total Ozone retrieval from ABI** 🔒

**Task 6. Cloud Products**

**Task 7. Development of Static Libraries for Retrieval of Cloud Optical and Microphysical Properties**

**Task 8. GEOCAT Enhancements and Documentation**

## CIMSS GOES-R AWG Tasks (17) (2/2)

**Task 9. GOES-R ABI Fire** Detection and Characterization Algorithm Development and Evaluation 🔒

**Task 10. GOES-R Legacy Profile Algorithm** Evaluation and Selection 🔒

**Task 11. Sounding** Product Evaluation and Validation

**Task 12. Winds** from GOES-R ABI 🔒

**Task 13. Hurricane** Intensity Estimation from GOES-R ABI

**Task 14. Aviation** Weather Products

A. Turbulence

B. Volcanic Ash/SO<sub>2</sub> Detection

C. Low Cloud and Fog

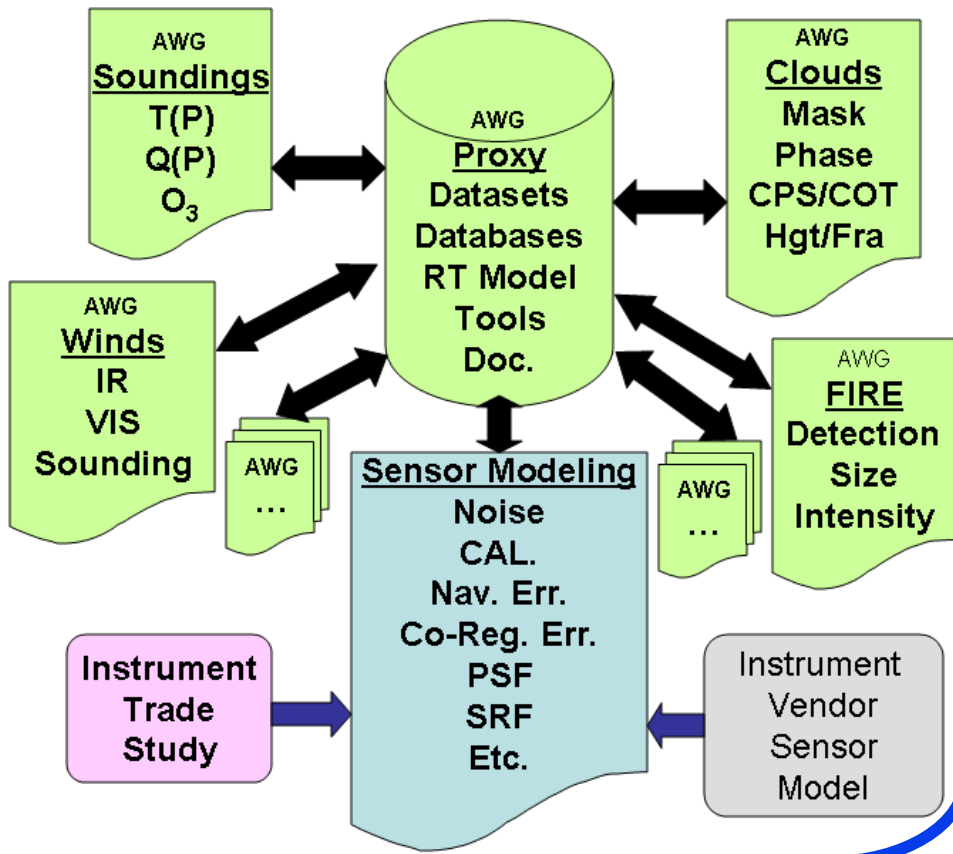
**Task 15. Snow and Ice** Products

**Task 16. Aerosol** imagery from GOES-R ABI

**Task 17. Data Analysis and Visualization** for GOES-R

# GRAFIIR Error Budget

## GRAFIIR Connecting the Dots



### GRAFIIR Error Budget

Sensor Effects

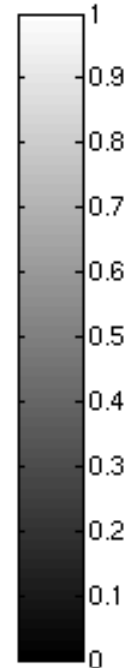
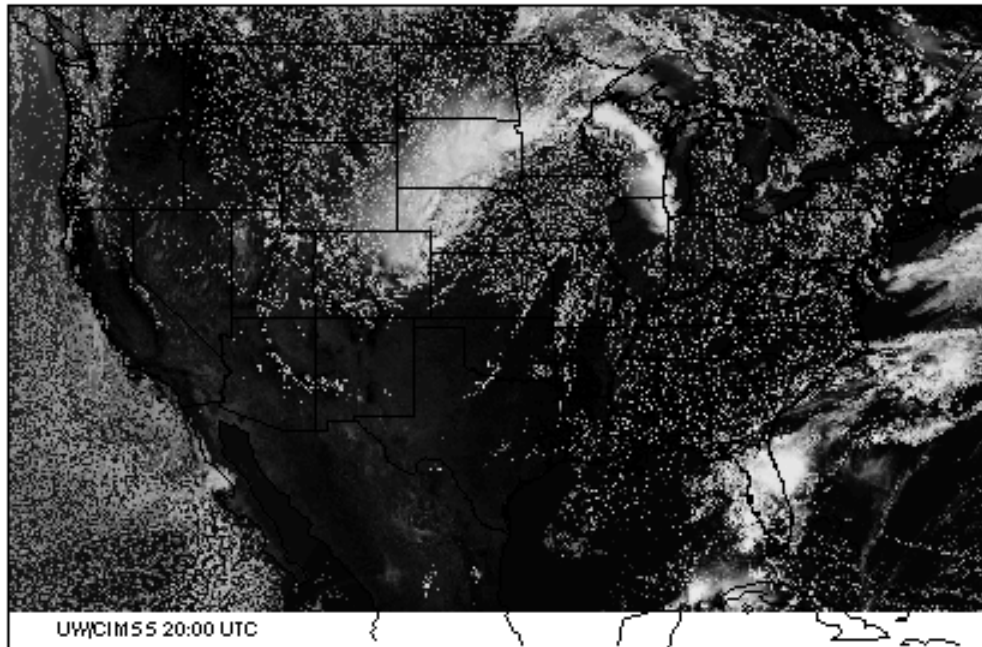
	NEdT	Cal	Nav.	Co-R	PSF	SRF	Strip	Others	Requirements
NEdT	●	●	●	●	●	●	●	●	S ●
Cal	●	●							C ●
Nav Err	●		●						W ●
Co-Reg Err				●					F ●
PSF	●				●				O ●
SRF						●			
Stripping	●						●		
Others									
COMBO	●	●	●	●	●	●	●	●	
	NEdT	Cal	Nav.	Co-R	PSF	SRF	Strip	Others	Requirements

# All Bands 20:00 UTC

## June 4, 2005

<u>Band</u>	<u><math>\mu\text{m}</math></u>
1	0.47
2	0.64
3	0.86
4	1.38
5	1.61
6	2.26
7	3.90
8	6.19
9	6.95
10	7.34
11	8.50
12	9.61
13	10.4
14	11.2
15	12.3
16	13.3

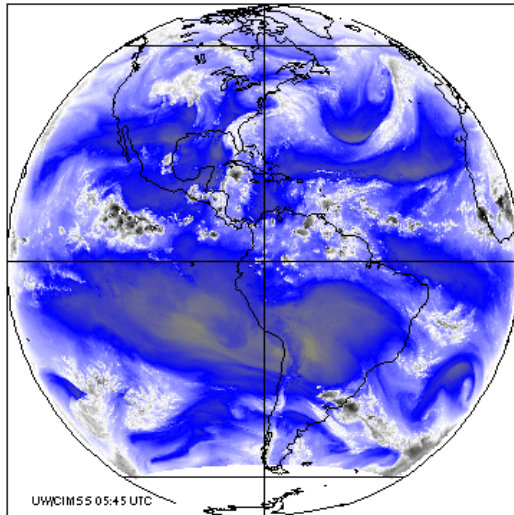
ABI band 1 (0.47  $\mu\text{m}$ ) reflectance 2005-06-04



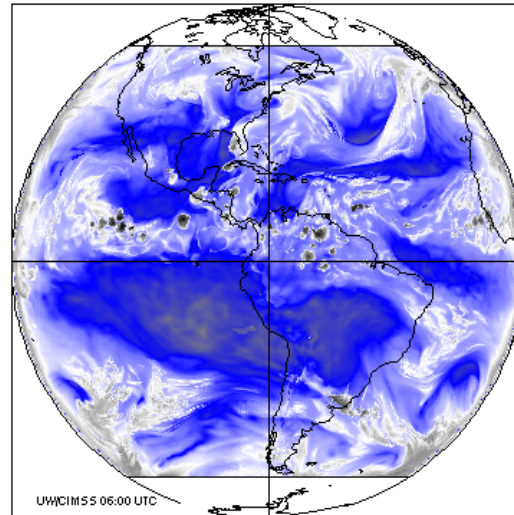


# ABI Full-disk Animations

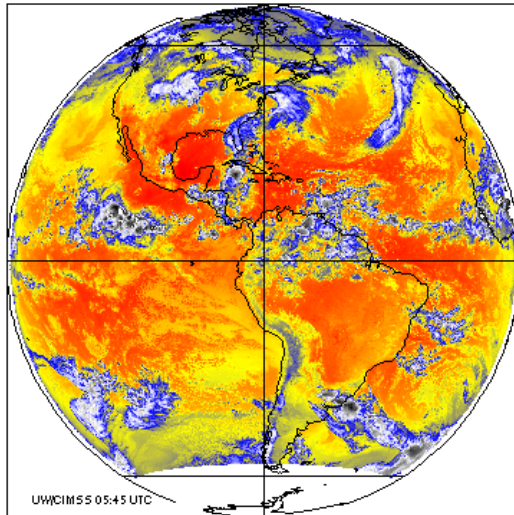
GOES-12 band 3 (6.5  $\mu\text{m}$ ) BT (K) 2005-06-04



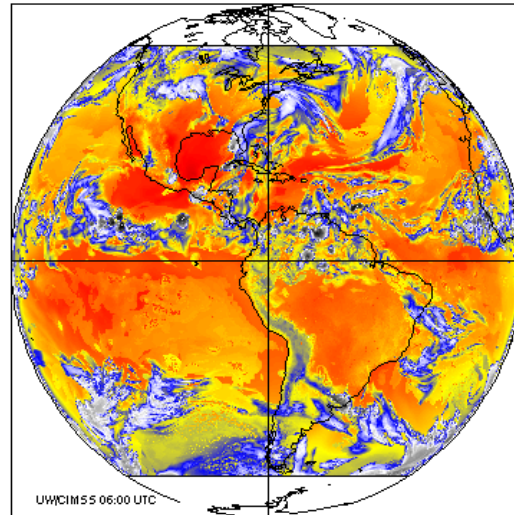
GOES-12 Simulated band 3 (6.5  $\mu\text{m}$ ) BT (K) 2005-06-04



GOES-12 band 4 (10.7  $\mu\text{m}$ ) BT (K) 2005-06-04



GOES-12 Simulated band 4 (10.7  $\mu\text{m}$ ) BT (K) 2005-06-04



**Observed  
Left**

**Simulated  
Right**