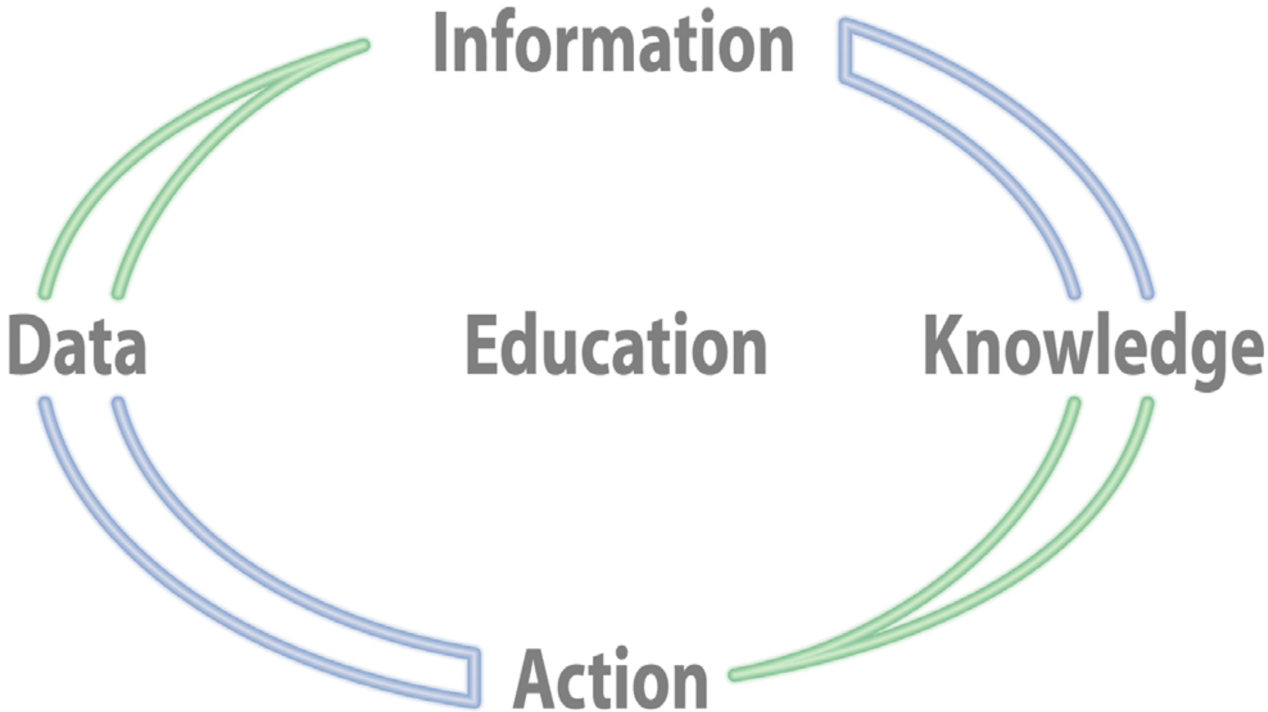
CIMSS Science Review



Presented by Steve Ackerman

CIMSS Mission

- Foster collaborative research among NOAA, NASA, and the University in those aspects of atmospheric and earth system science which exploit the use of satellite technology.

- Serve as a center at which scientists and engineers working on problems of mutual interest may focus on satellite related research in atmospheric studies and earth system science.

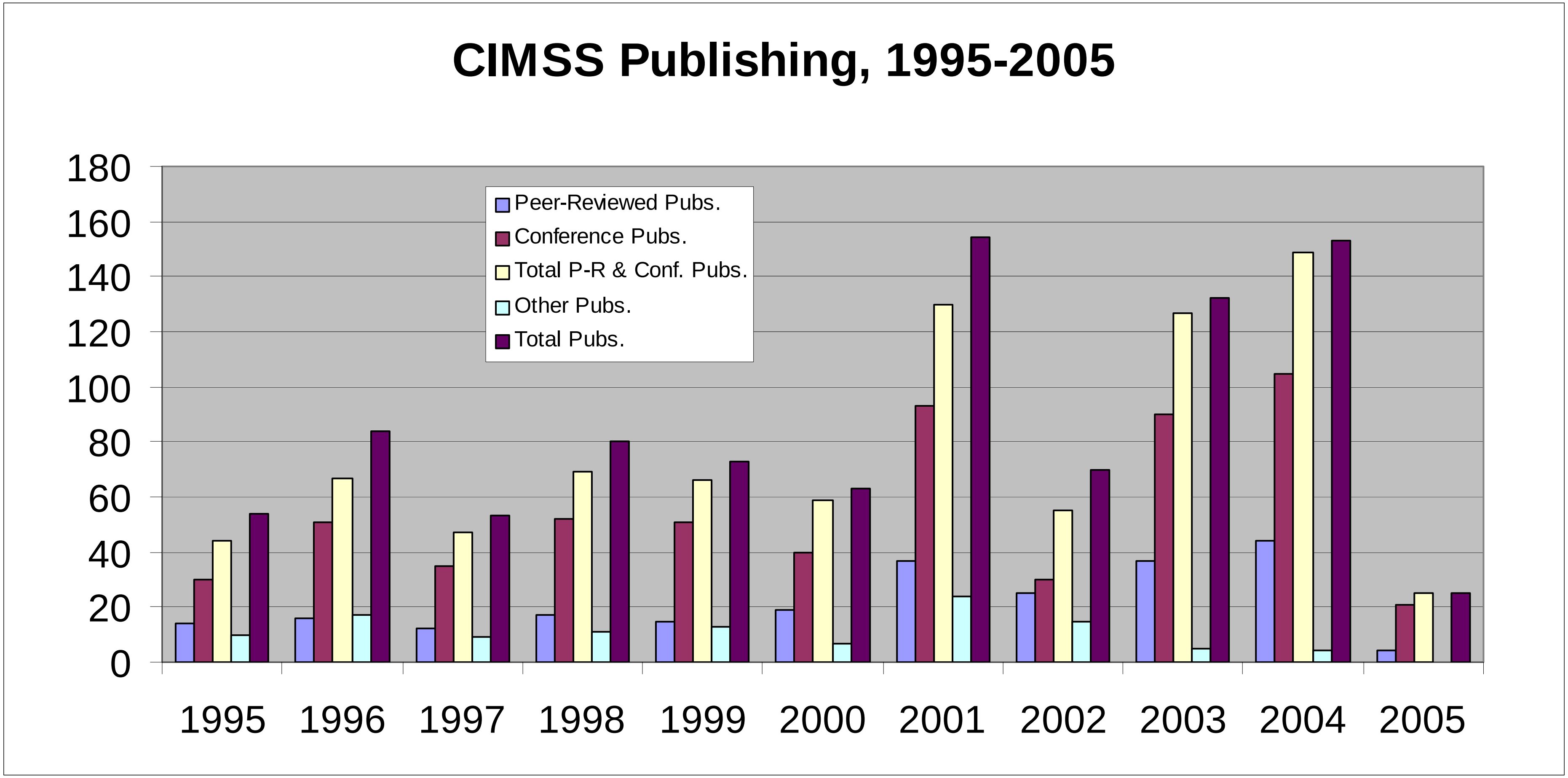
- Stimulate the training of scientists and engineers in the disciplines involved in the atmospheric and earth sciences.

Measures of Success

- MODIS Algorithms
- ITOVS, IMAPP algorithms
- AODT to TPC
- Community RT Model

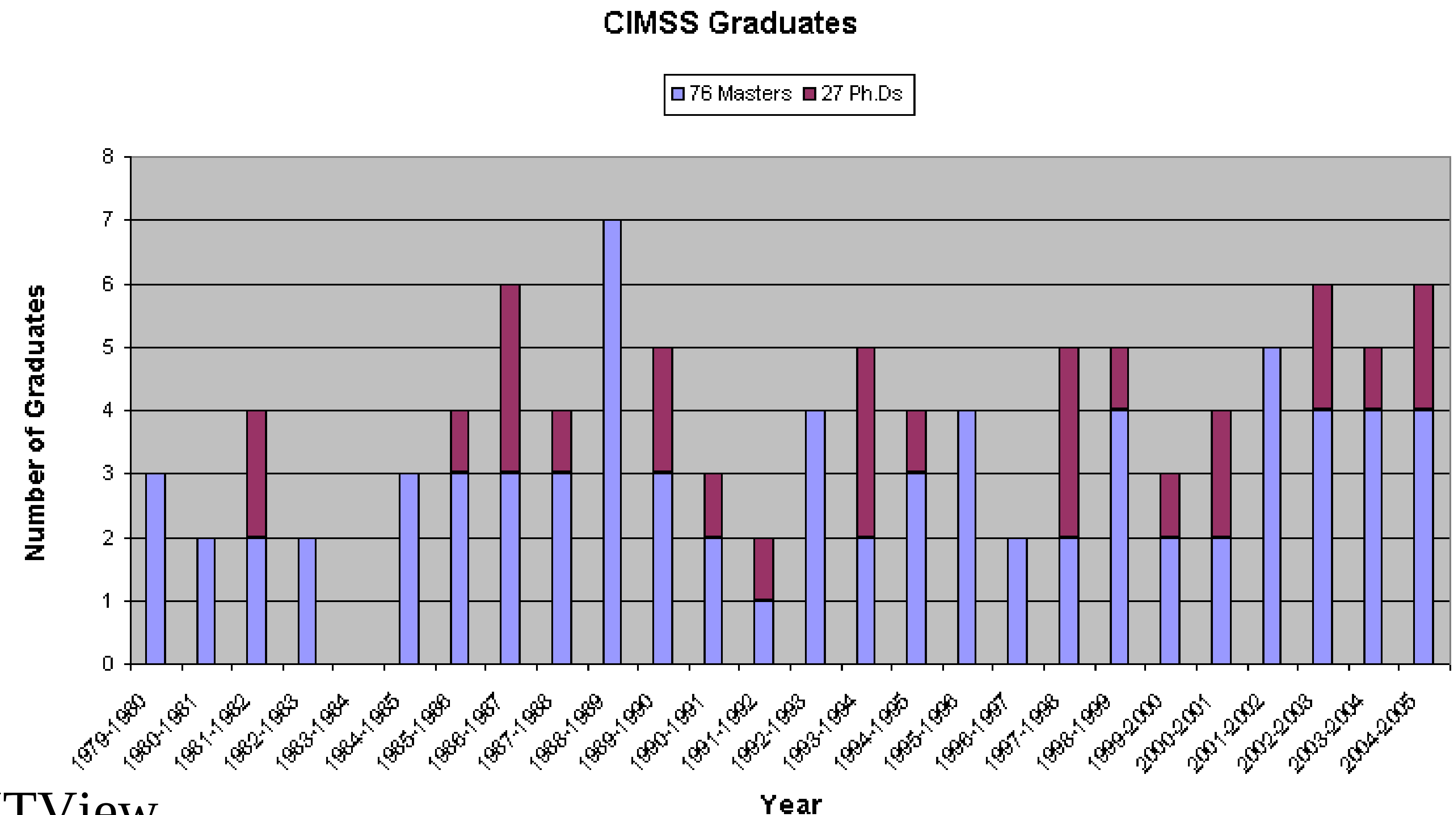
Imager	Sounder
Derived Product Images	Derived Product Images
Water vapor	Water vapor
Lifted Index	Lifted Index
Skin Temperature	Skin Temperature
Winds from multiple satellites	Winds
High density infrared	7.0 micrometers
High density water vapor	7.5 micrometers
High density visible	
High density 3.9 um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

Measures of Success



- Workshops
- International visitors

Measures of Success



- VISITView
- Undergraduates
- Education workshops

Winds Program

CIMSS Satellite-Derived Winds Algorithm: An Historical Perspective

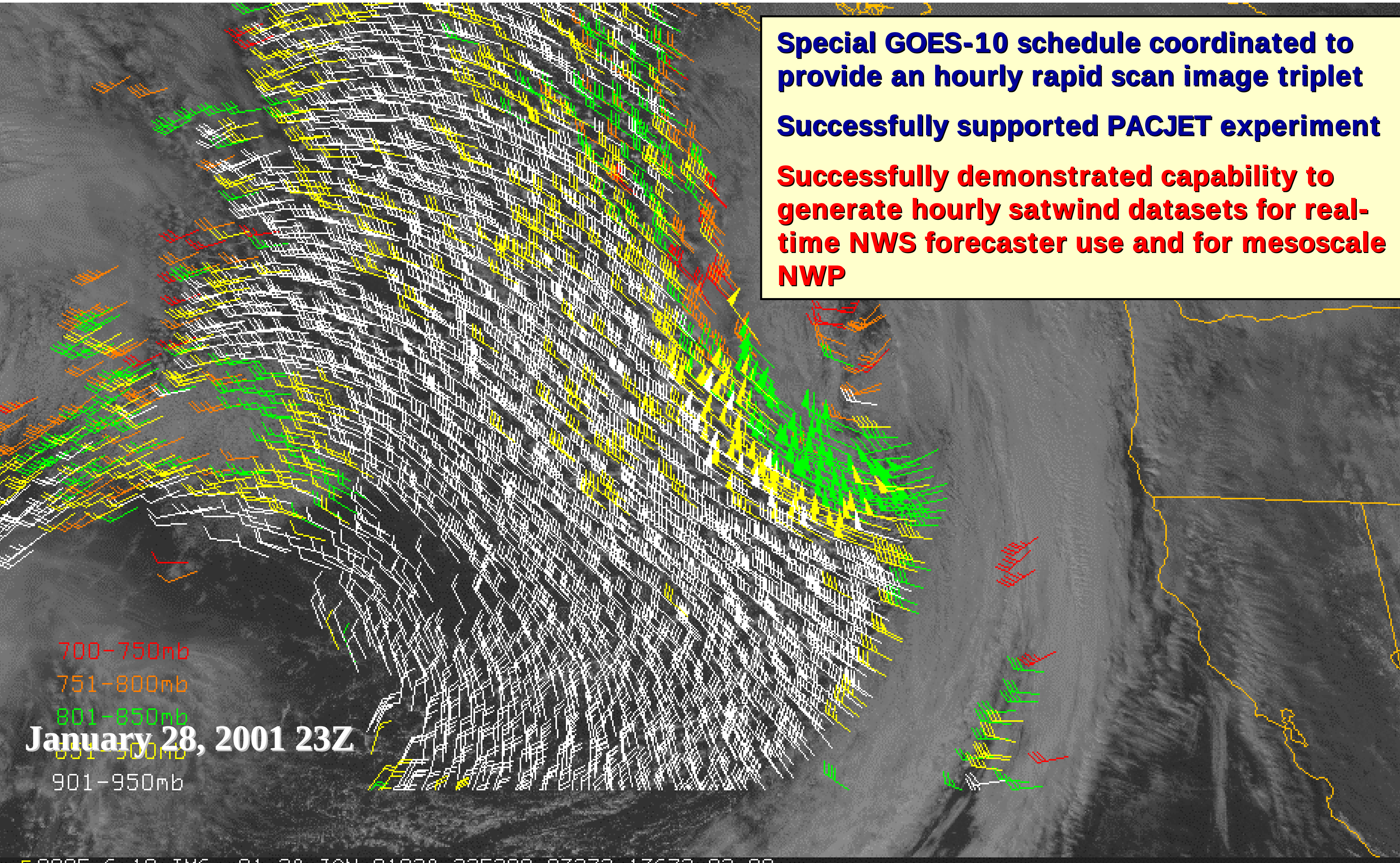
- **1970**
- **1972** — Concept and initial development of McIDAS, designed to animate satellite imagery and demonstrate cloud tracking
- **1979** — FGGE - Global demonstration of cloud tracked winds, produced on McIDAS by an SSEC analyst operating a cursor to select and track targets
- **1985** — "Water vapor winds" demonstrated as a potential operational dataset

  Stewart et al. BAMS
- **1989** — Completion of first version of automated algorithm
- **1991** — Automated algorithm delivered to NOAA/NESDIS for experimental winds production

  Merrill et al. BAMS
- **1992- 96** — Vigorous testing and algorithm fine-tuning produces full-disk "high-density winds" from multispectral GOES imagery in less than an hour
- **1997** — "High-density winds" derived operationally at NESDIS using CIMSS automated algorithms

  Nieman et al. BAMS
- **1999** — C. Velden recognized by AMS with Special Achievement Award
- **2000- 2003** — Demonstration of the value of winds derived from rapid-scan operations
- **2002>** — Winds from MODIS successfully developed, tested, and produced in real time for NWP with positive impacts
- **2003** — First demonstration of "altitude-resolved" winds derived from hyperspectral moisture soundings
- **2004** — Publication of "Recent Innovations in Satellite-Derived Winds" in BAMS (Velden et al.)

GOES-10 Rapid Scan Visible Cloud-Drift Winds During PACJET 2001

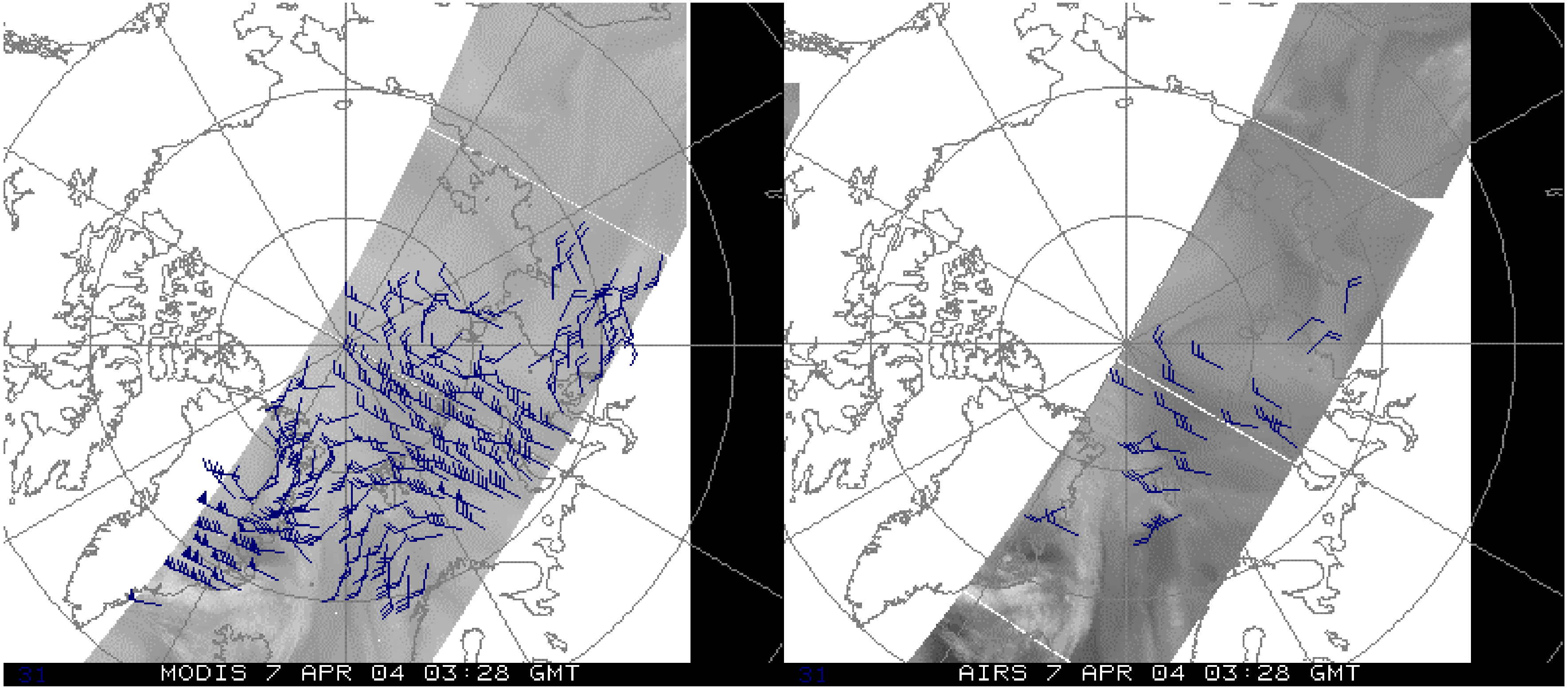


Special GOES-10 schedule coordinated to provide an hourly rapid scan image triplet

Successfully supported PACJET experiment

Successfully demonstrated capability to generate hourly satwind datasets for real-time NWS forecaster use and for mesoscale NWP

MODIS (left) vs. AIRS (right) Radiance-tracked Winds

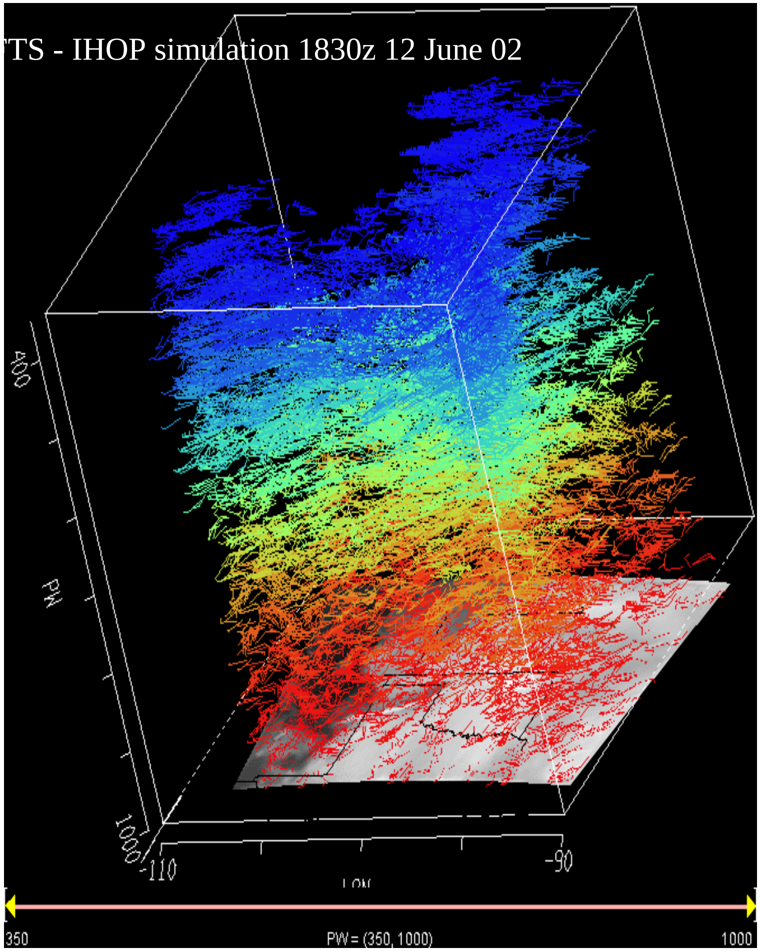


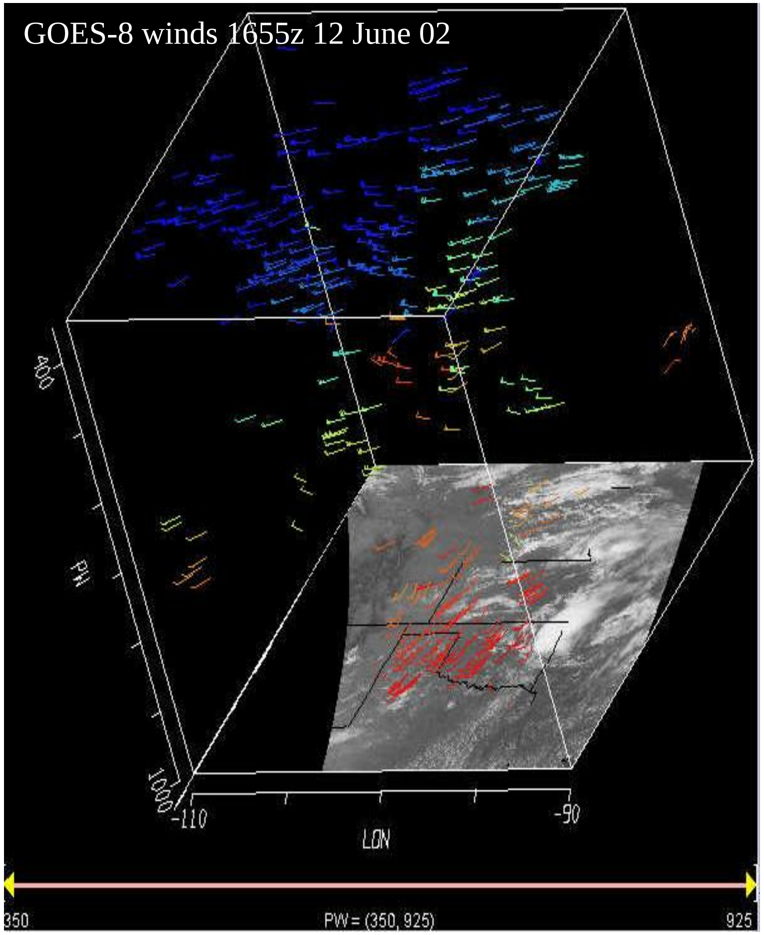
A test was performed to track AIRS radiance features from a WV channels for one case on 7 April 2004. The AIRS channel chosen was close to the 6.7 μm MODIS band used for real-time polar winds processing. The reduction in the number of vectors is similar to the spatial resolution factor between MODIS and AIRS.

NWP Sites where MODIS winds are used in the operational model.

NWP Site	Operational Begin Date
ECMWF European Centre for Medium-Range Weather Forecasts	January 2003
GMAO Global Modeling and Assimilation Office	2003
JMA Japan Meteorological Agency	May 2004
CMC Canadian Meteorological Centre	September 2004
FNMOC US Navy, Fleet Numerical Meteorology and Oceanography Center	October 2004
Met Office United Kingdom	January 2005
NCEP	Planned Summer 2005

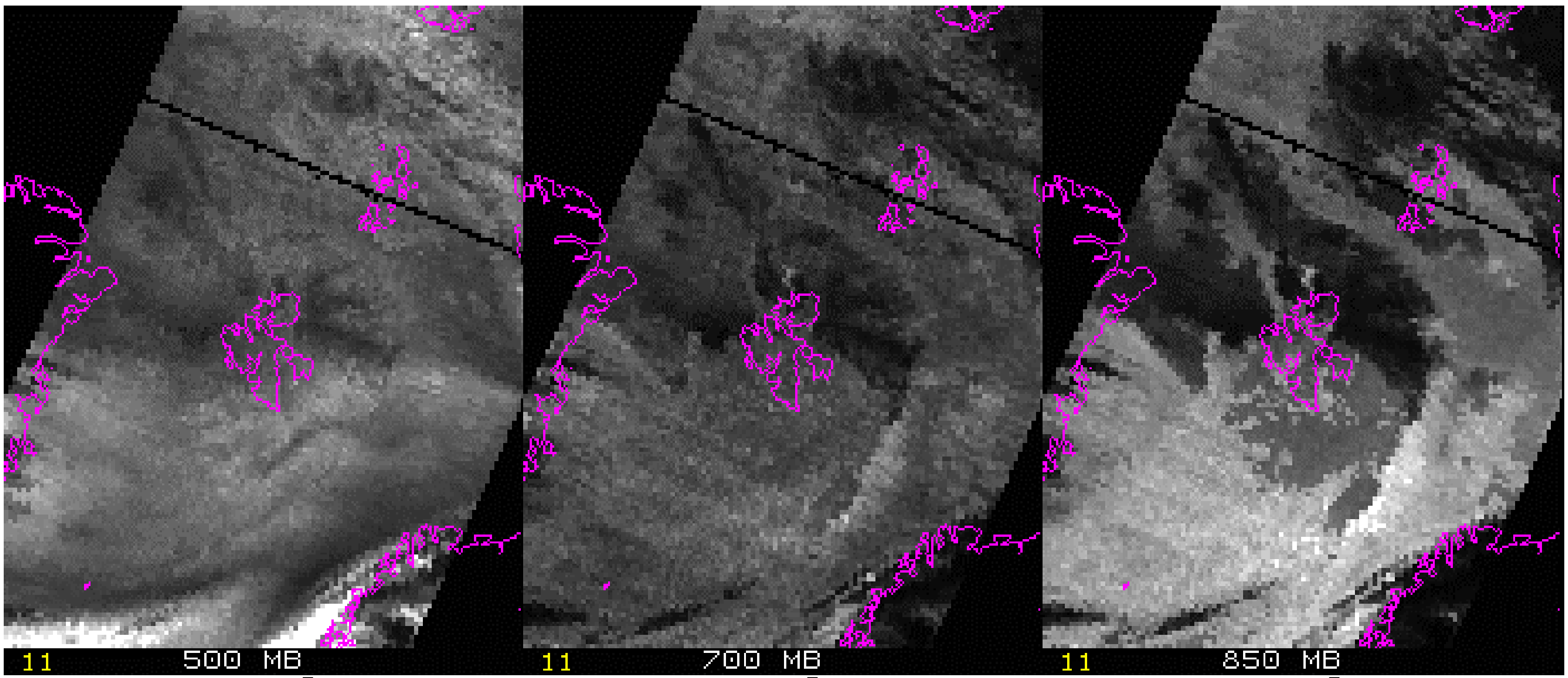
Hyperspectral Altitude Resolved Water Vapor Wind Retrieval and Validation





Simulated GIFTS winds (left) versus GOES operational winds (right)

AIRS Retrieval Moisture Fields

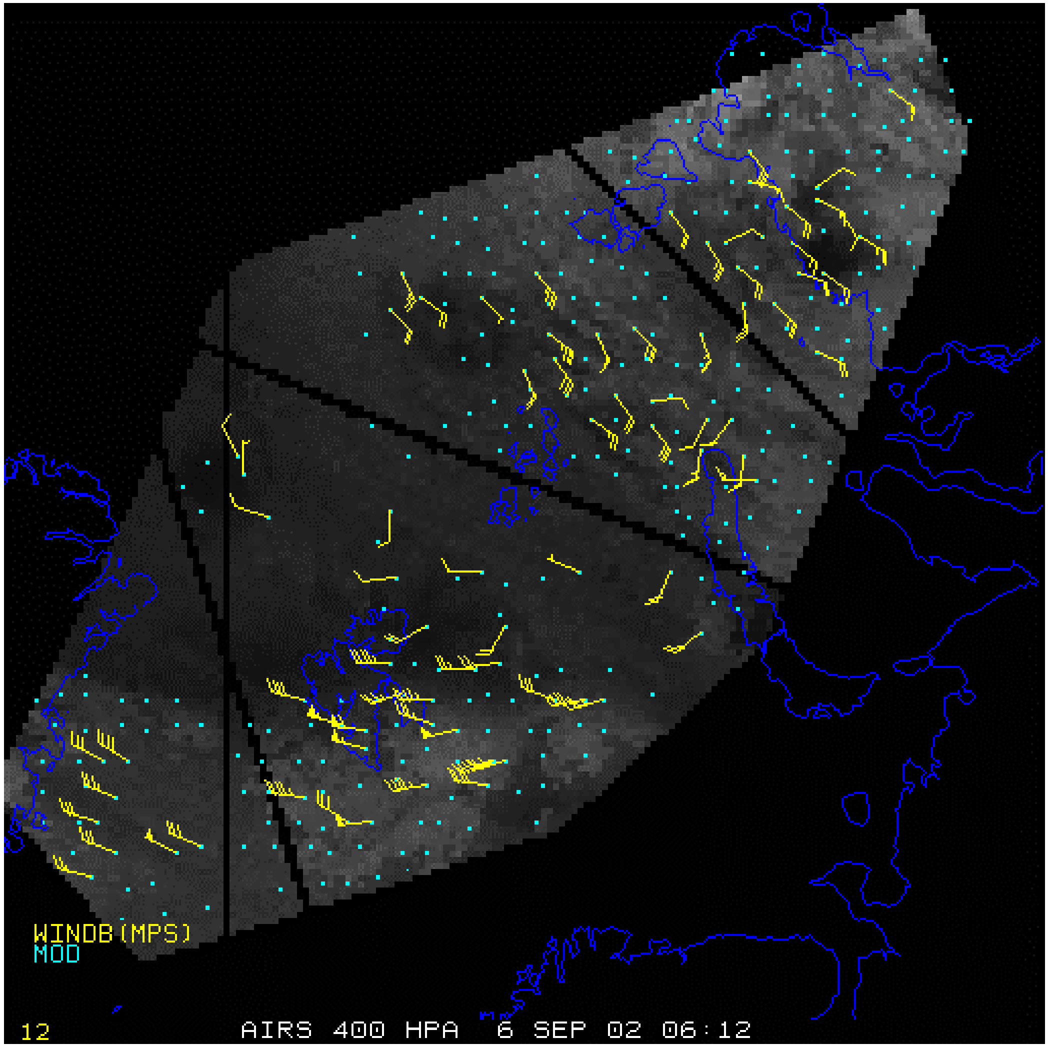


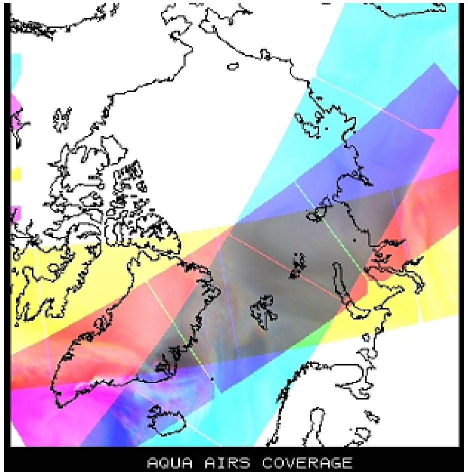
500mb 700mb 850mb

Specific humidity fields from SFOV AIRS retrievals

AIRS Moisture Retrieval Targets and winds (unedited) at 400 hPa

The moisture features are tracked in an area that is inscribed by 3 successive, overlapping passes in the polar region. See below.





CIMSS/SSEC road to the Hyperspectral Sounders

CIMSS/SSEC has played a significant roles in the past, current, and future Hyperspectral Sounders (labeled in green)

HES **(~1600; GEO; O)**

GIFTS **(~1600; GEO; E)**

CrIS (~2215; LEO; O)

IASI (~8000; LEO; O)

AIRS (~2200; LEO; E)

NAST-I (8220; Airborne)

IMG (18400; LEO; E)

S-HIS (4840; Airborne)

GOES Sounder **(18; GEO; O)**

HIS (4492; Airborne)

VAS (12; GEO; O)

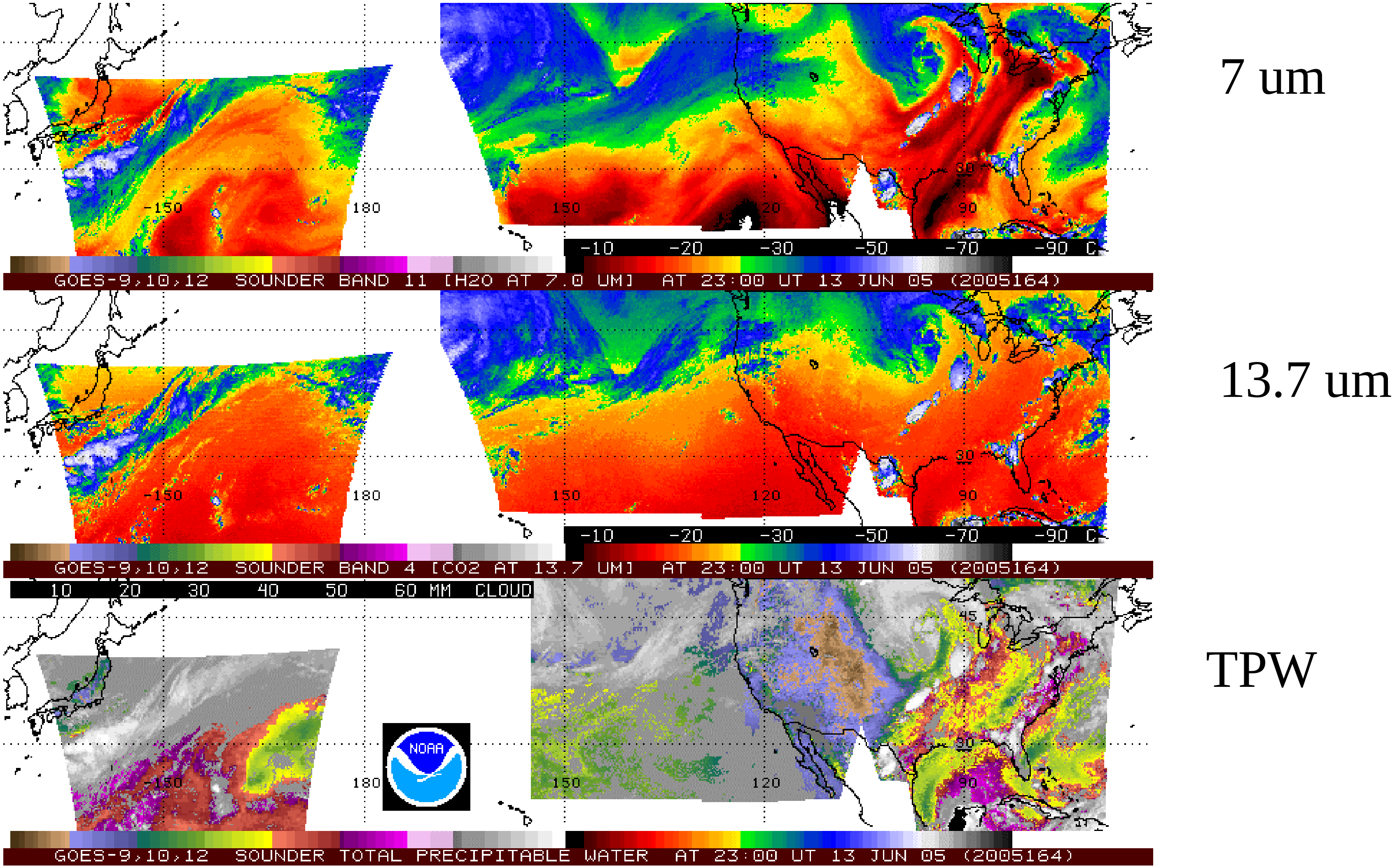
VTPR, HIRS (18; LEO; O)

IRIS (862; LEO; E)

1978 **Time** **2012**

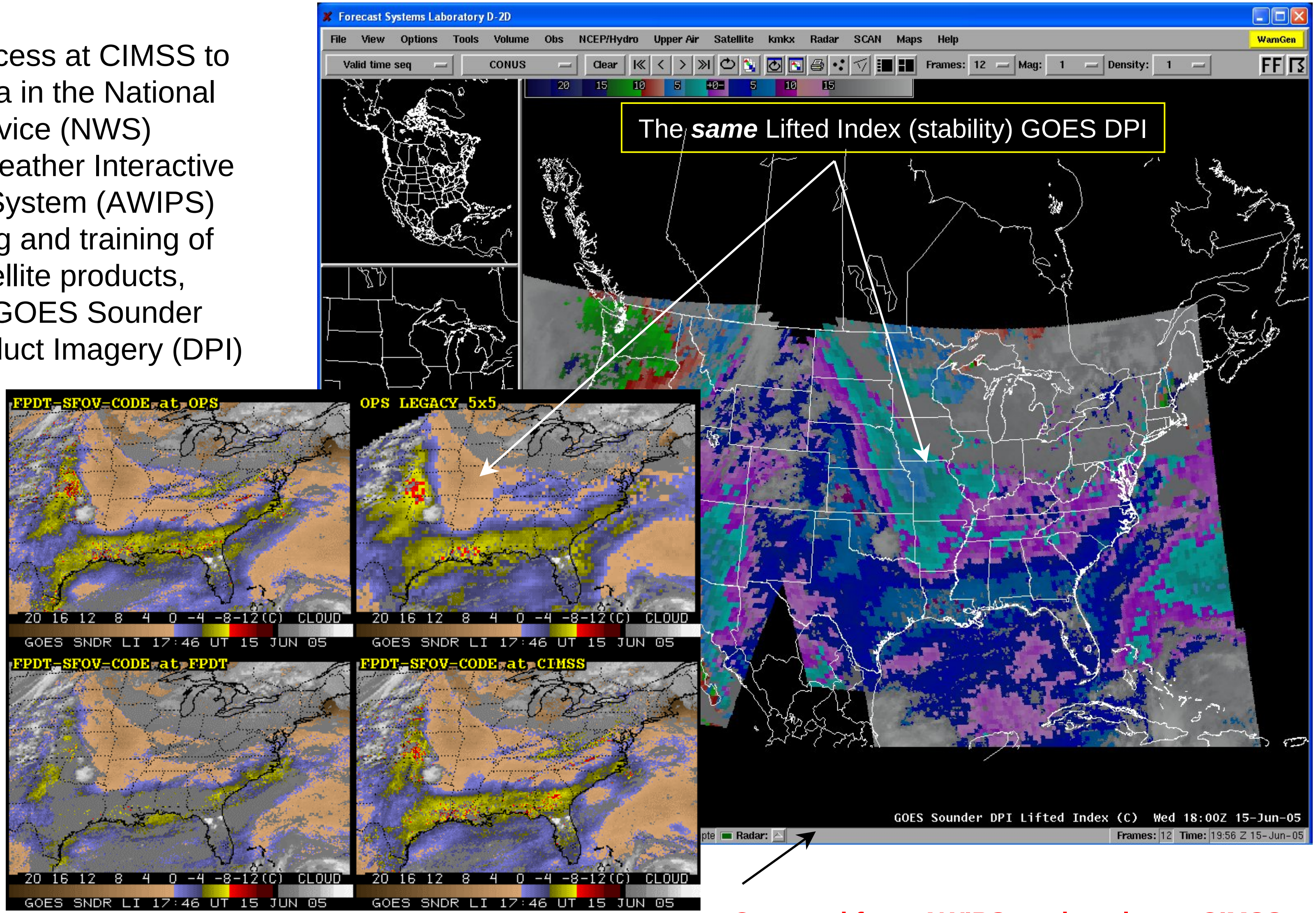
(# of spectral bands)
O: Operational
E: Experimental

Montage of GOES-9, -10 and -12 Sounder data, showing 7.0μm imagery (top panel), 13.7μm imagery (middle), and Total Precipitable Water (TPW) Derived Product Imagery (DPI, bottom), from 23UTC on 13 June 2005.



Distributing Products

Providing access at CIMSS to real-time data in the National Weather Service (NWS) Advanced Weather Interactive Processing System (AWIPS) for monitoring and training of NESDIS satellite products, such as the GOES Sounder Derived Product Imagery (DPI)

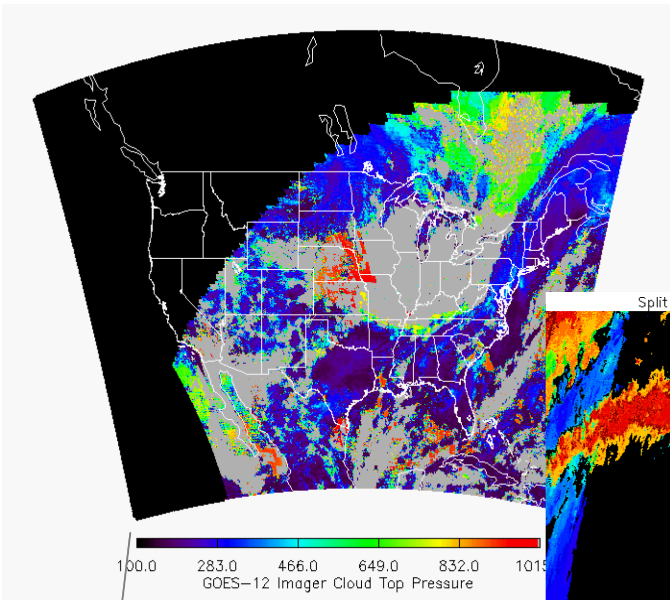


Four sources of DPI:
Current 5x5 @ Ops
Exp SFOV @ CIMSS
Exp SFOV @ FPDT
Exp SFOV @ Ops

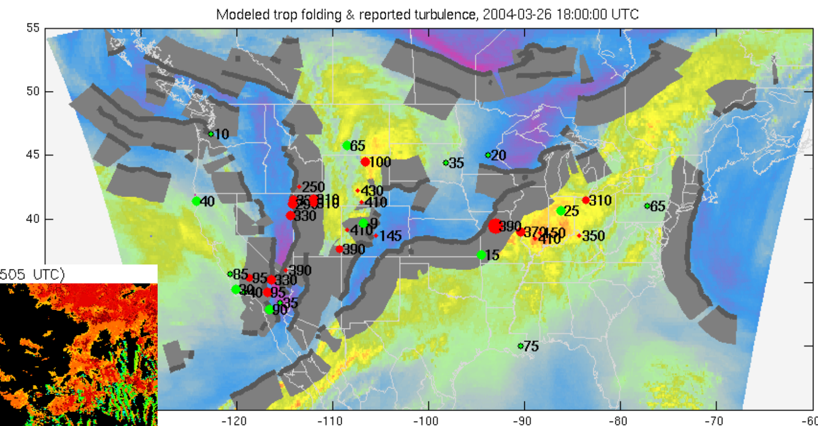
Captured from AWIPS workstation at CIMSS

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

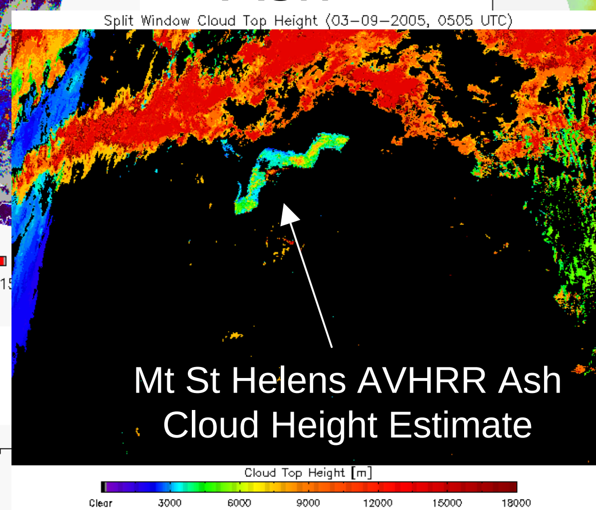
Cloud Top Altitude/Mask



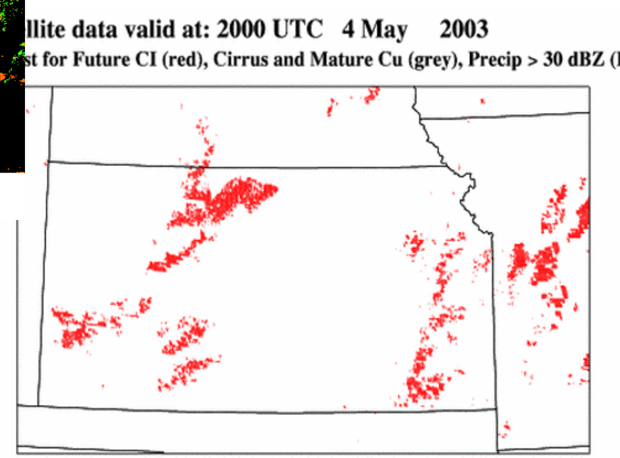
Turbulence



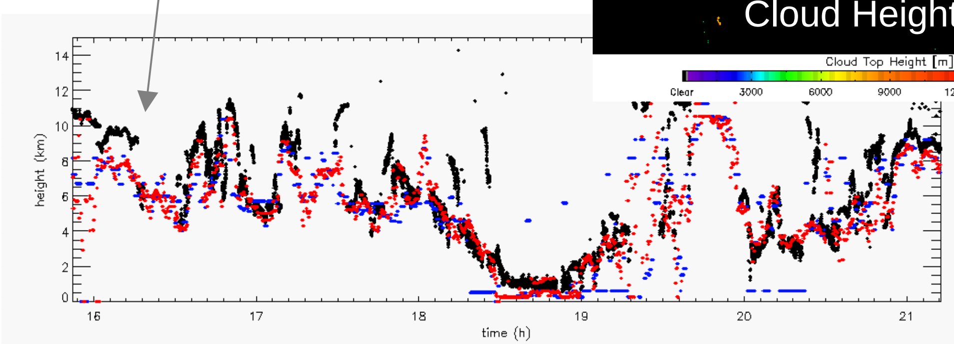
Volcanic Ash



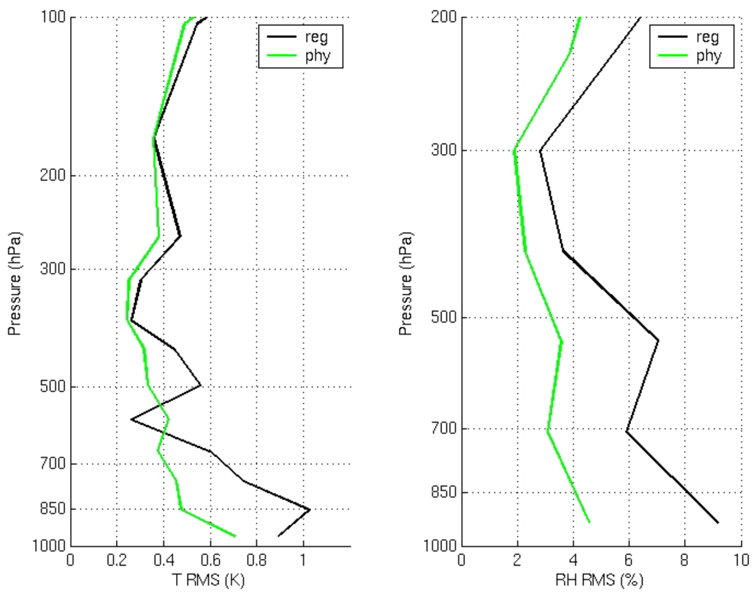
Convection



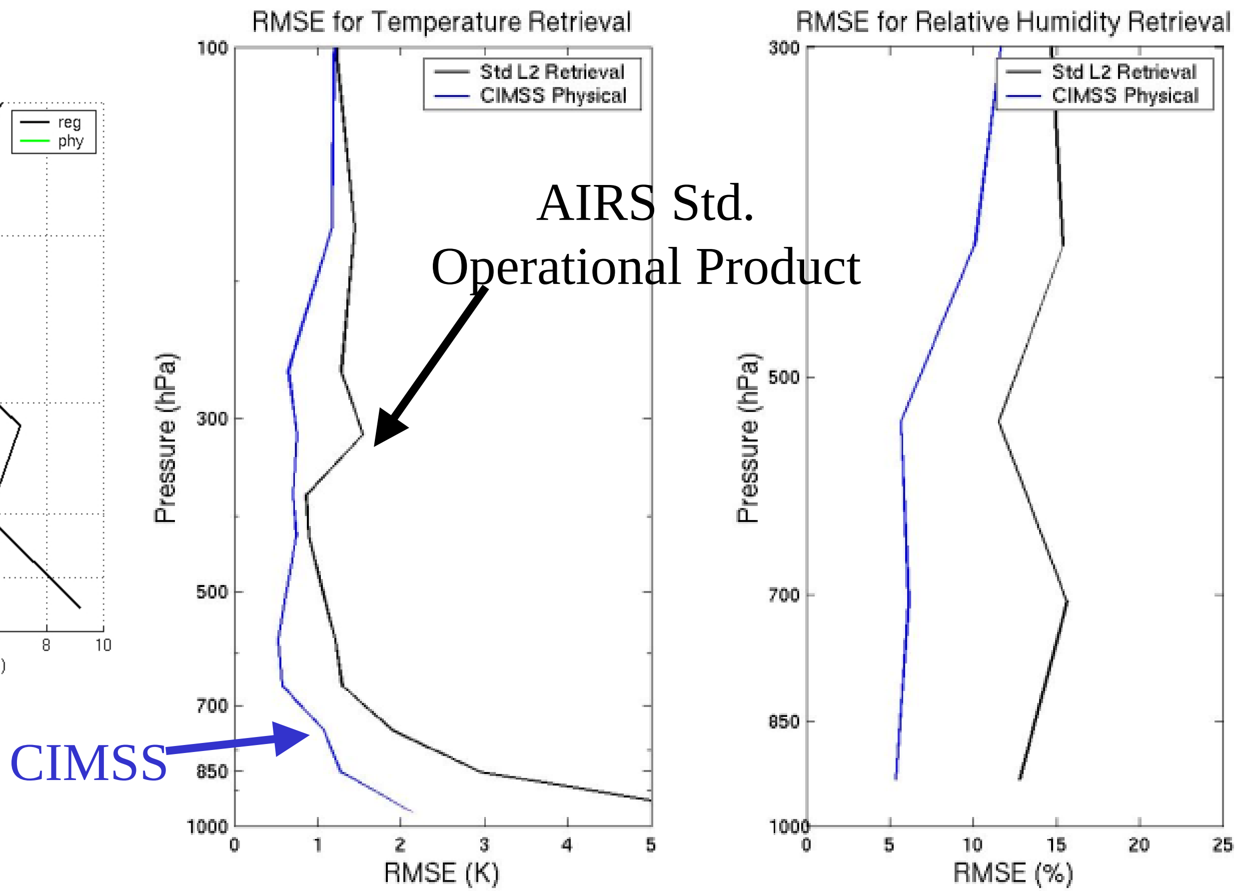
Validation



Hyperspectral Atmospheric Sounding Profile Retrieval and Validation



Simulation



25 clear AIRS retrievals over ARM Cart Site

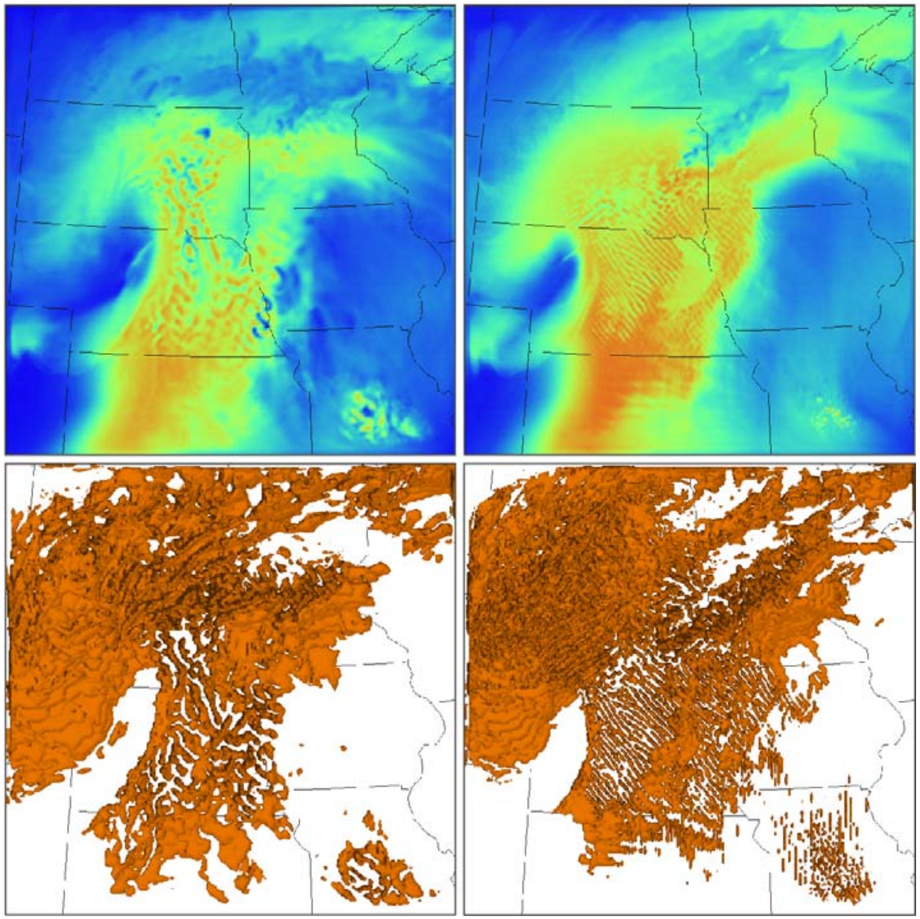
Validation

MURI Provided Opportunity to Produce Realistic NWP simulations for Hyperspectral Research

MM5 | WRF

2.5 km Water Vapor Mixing Ratio

Liquid Cloud Water

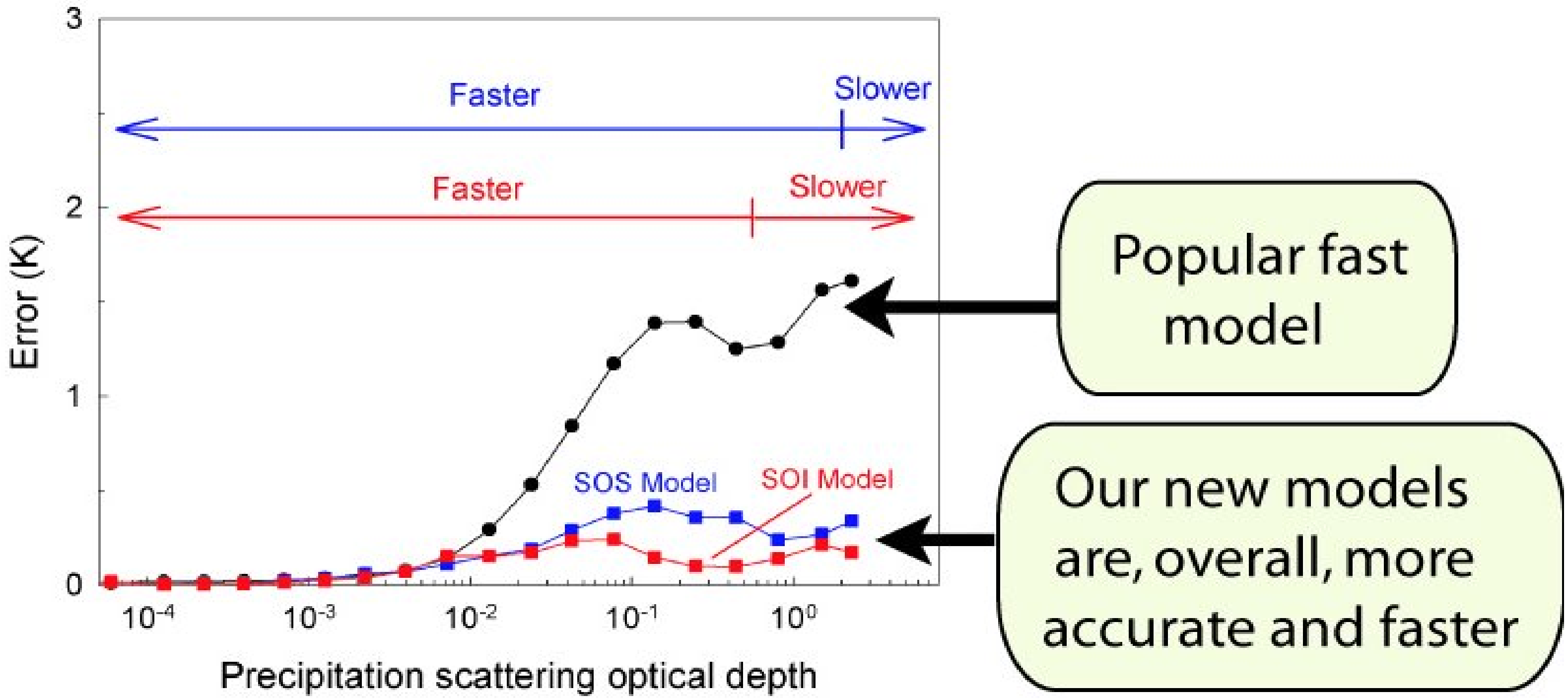


- WRF has much finer horizontal resolution than the MM5
- WRF effective resolution is ~7*Δx
- MM5 effective resolution is ~10*Δx

New computer has provided resource to produce high resolution NWP simulation datasets for future look at GIFTS/HES capabilities

Toward Passive Microwave Radiance Assimilation of Clouds and Precipitation

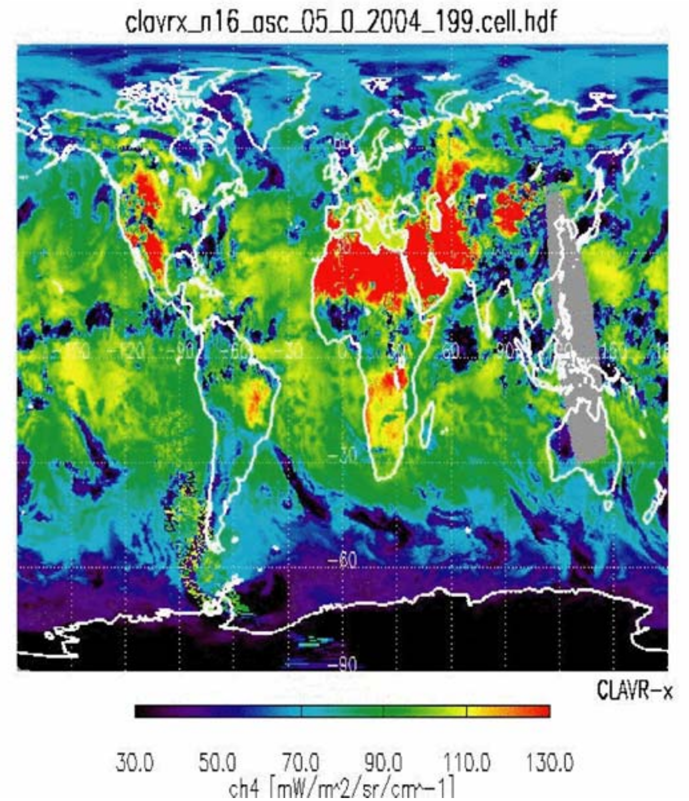
Global Analysis of Fast Model Performance



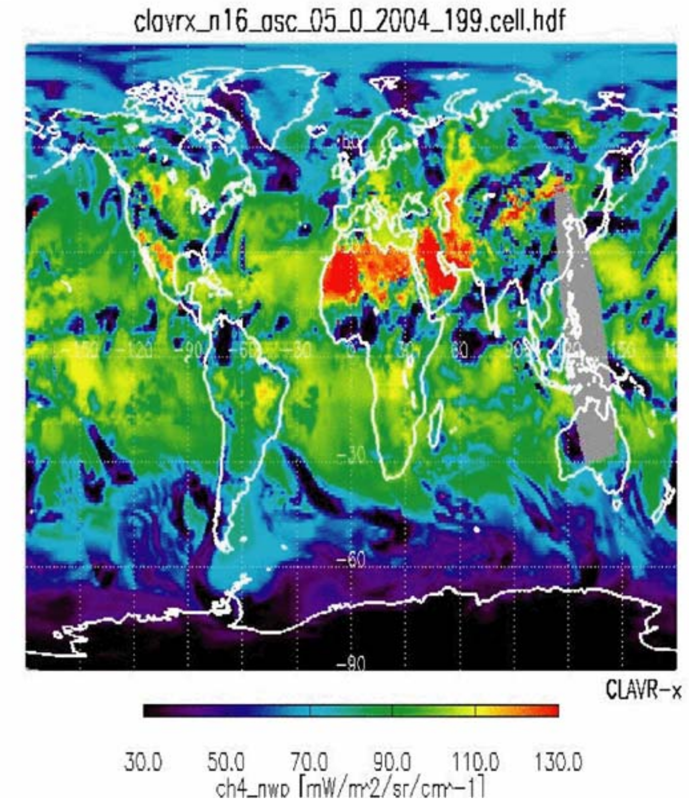
Toward Model Validation

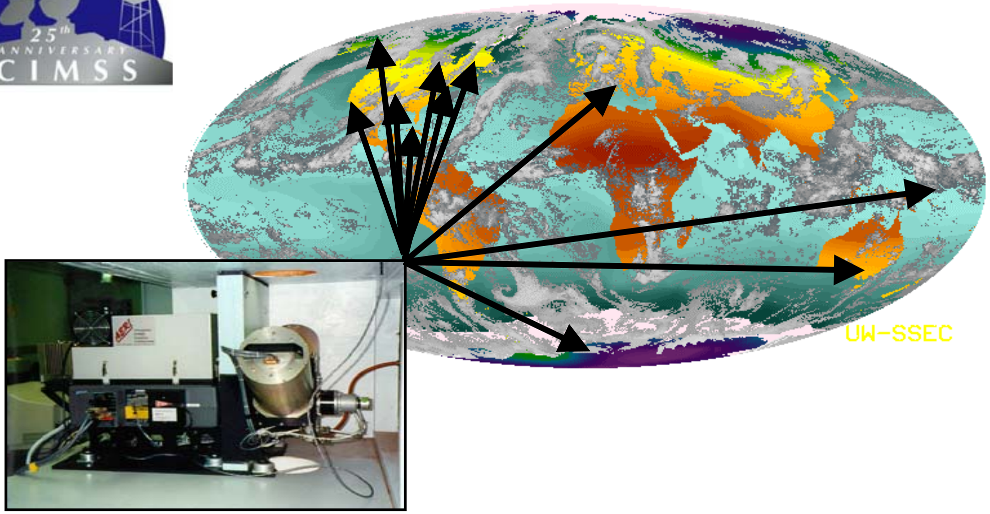
Extending model validation to the infrared: Comparisons between NCEP global simulations and AVHRR 11 μm radiances

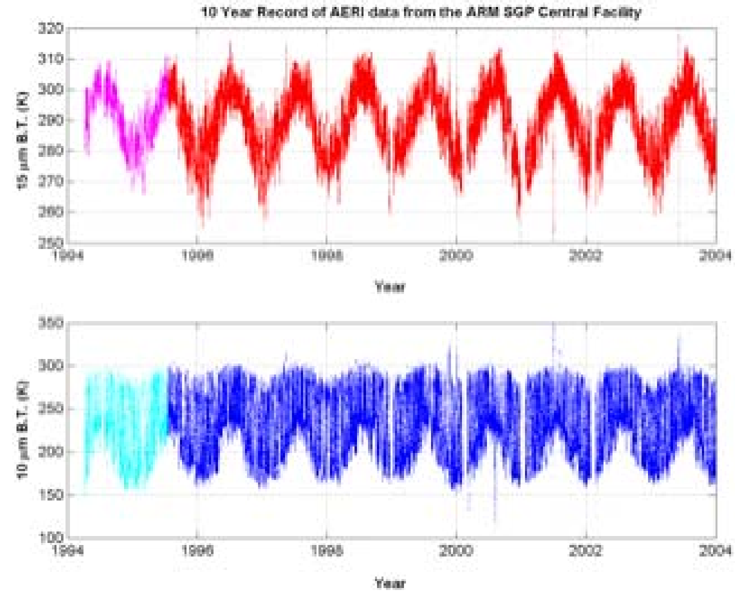
AVHRR NOAA-16

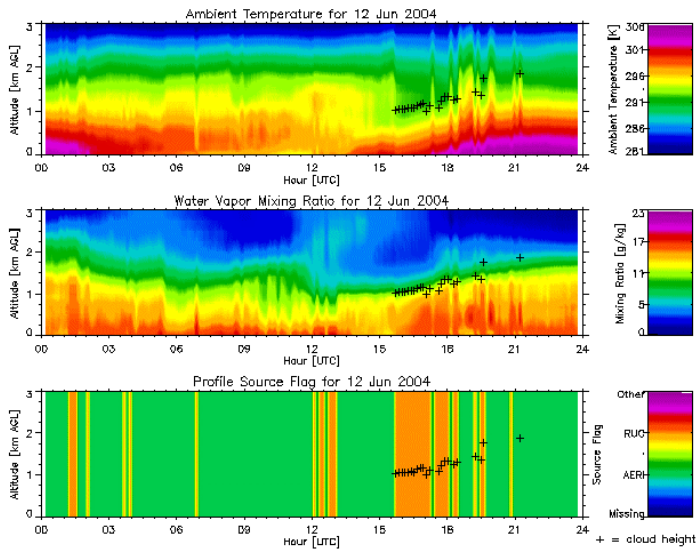


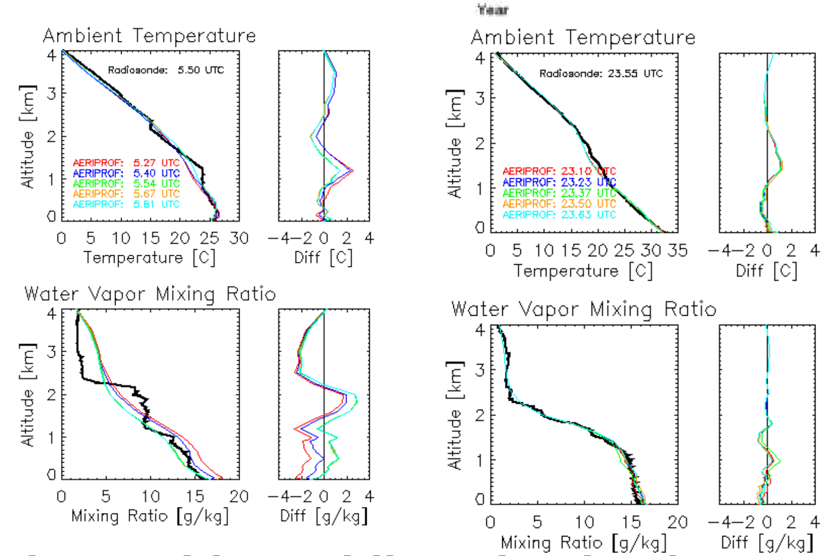
Global Forecast System







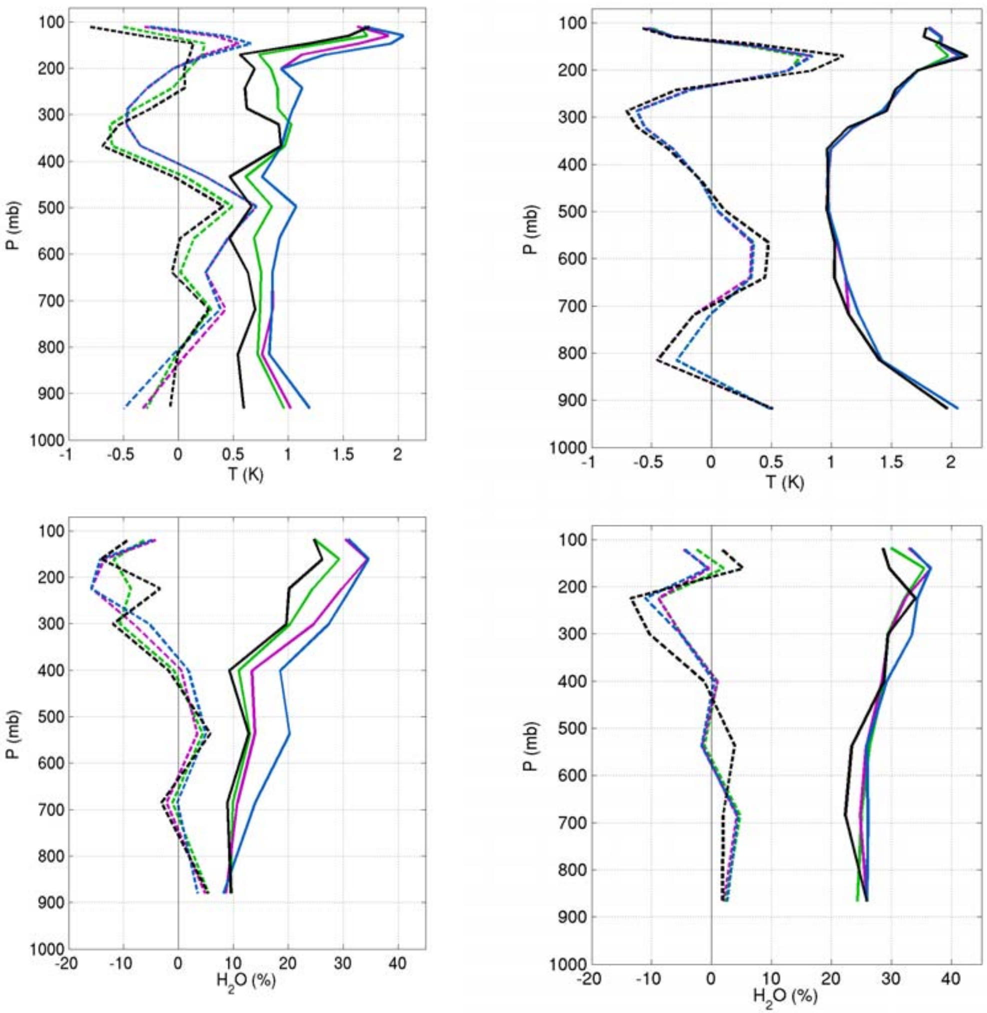




Several AERI systems deployed around the world providing absolutely calibrated downwelling radiance and thermodynamic retrievals for several years (>10-years at Lamont Oklahoma

AIRS v4 Retrieval Performance Assessment

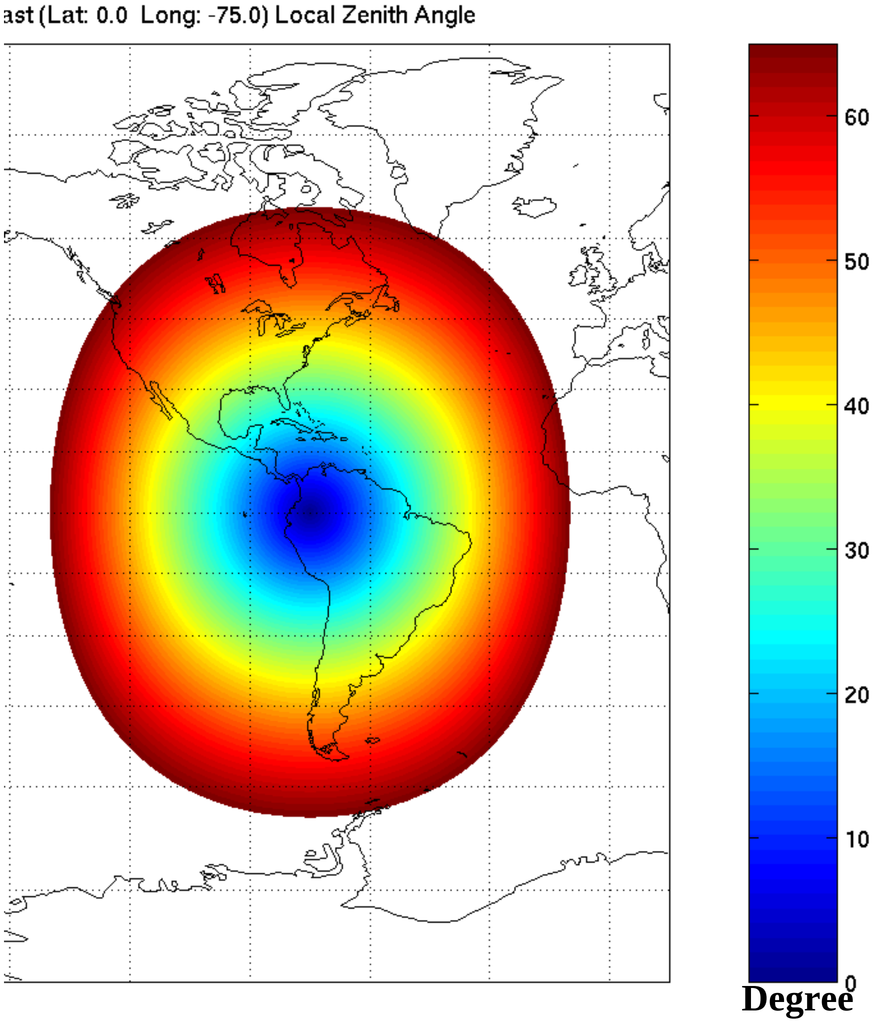
TWP SGP

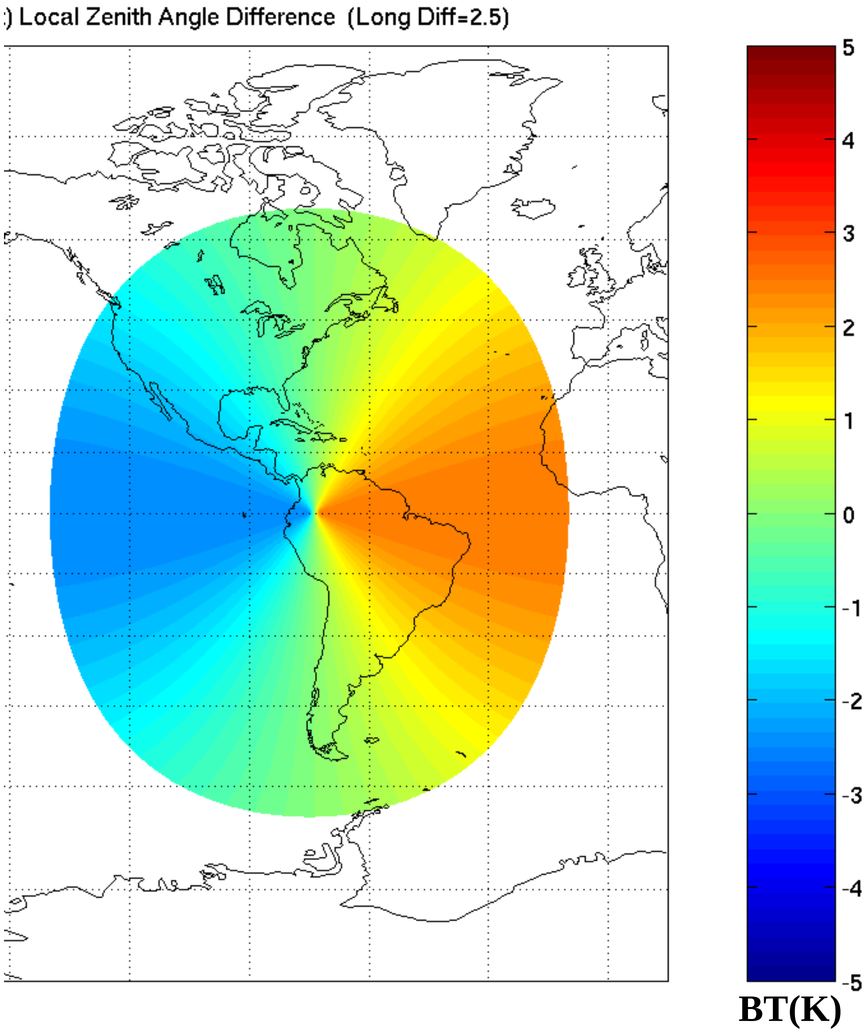


Validation of AIRS retrieval against ARM site best estimates of temperature and moisture profiles.

(Dashed=bias, Solid= RMS)

GOES-R East local zenith angle (left). There are two possible GOES-R designs: ABI and HES are on the same GOES-R satellite, or ABI and HES are separately on the two GOES-R satellites. The two-satellite design for ABI and HES has impact on ABI/HES synergy. Right panel show the ABI 11 μm BT difference under clear skies between the two designs when the two GOES-R East satellites for ABI and HES are apart away with distance of 2.5 degree longitude.



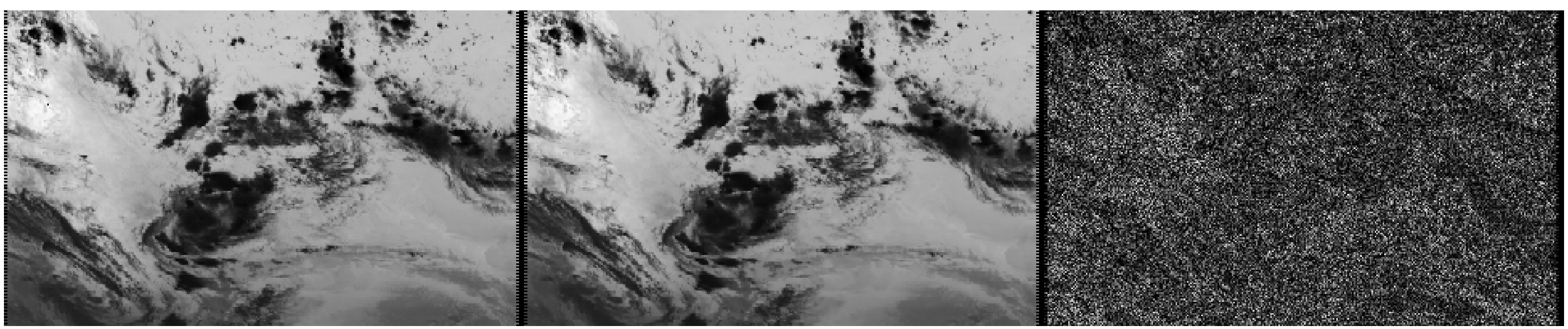


The GOES-12 Sounder band 1 (14.7 μm) and band 9 (9.7 μm) images before spatial filtering (left panels), images after spatial filtering (middle panels), and the difference images (right panel).

Band 1: 14.7 μm

Before filter After filter Difference

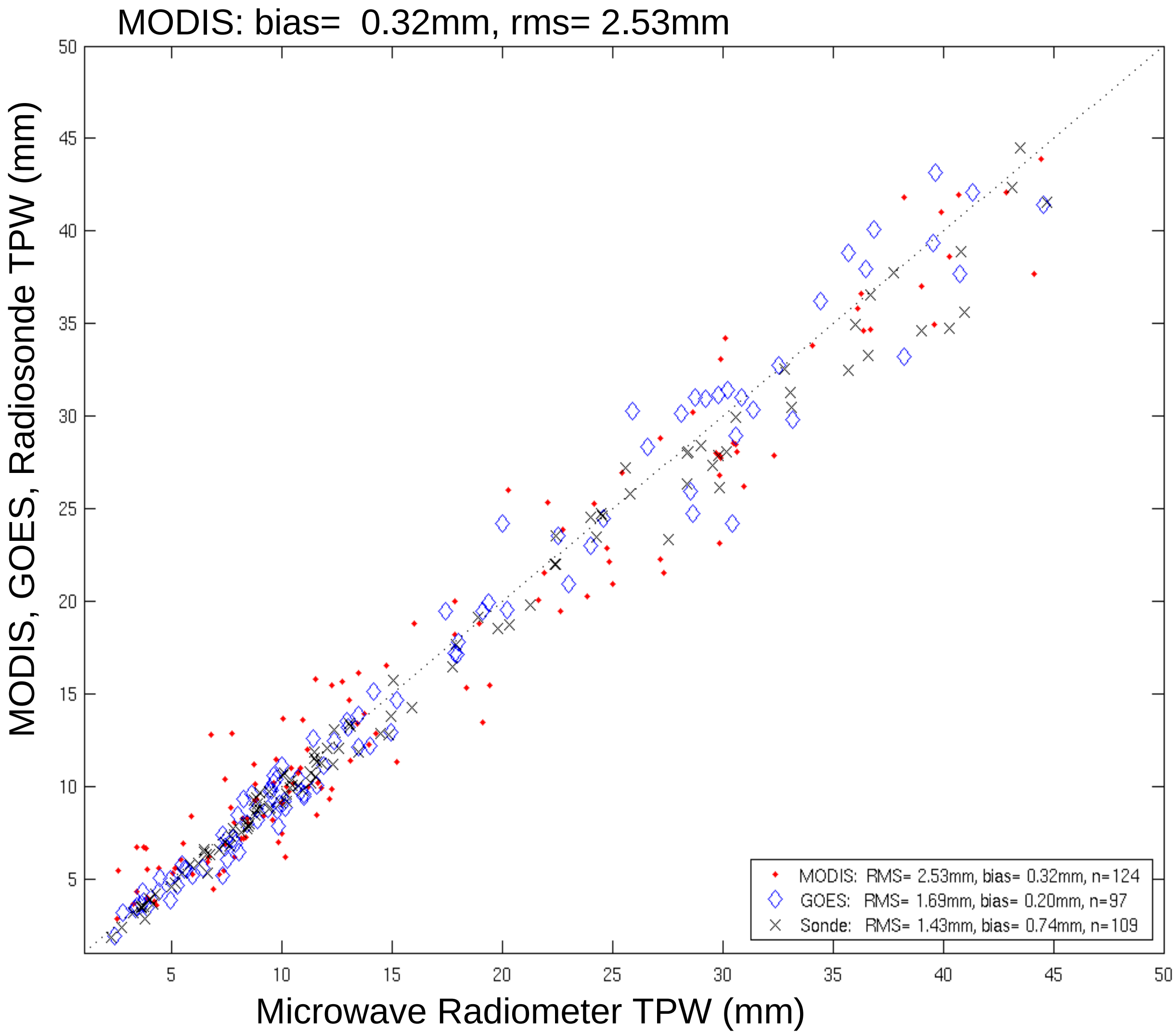
Band 9: 9.7 μm



Before filter After filter Difference

Comparison of Total Precipitable Water:

Terra MOD07 (red dots), GOES-8 and -12 (blue diamonds), and radiosonde (black X) TPW is compared to the ground-based ARM SGP microwave water radiometer for 124 clear sky cases April 2001 to September 2003.

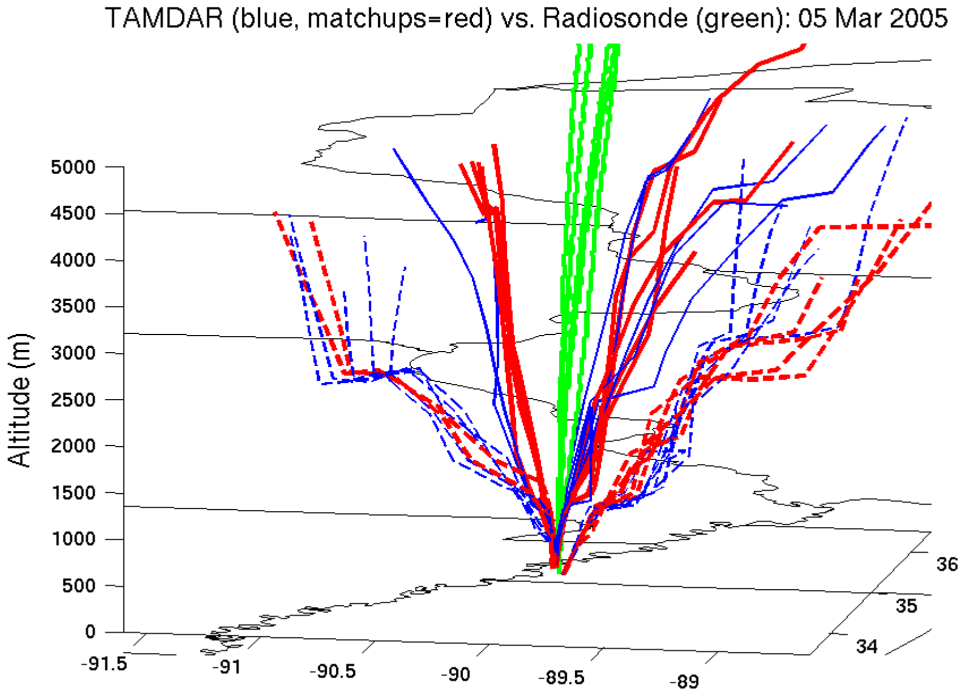


Field Programs

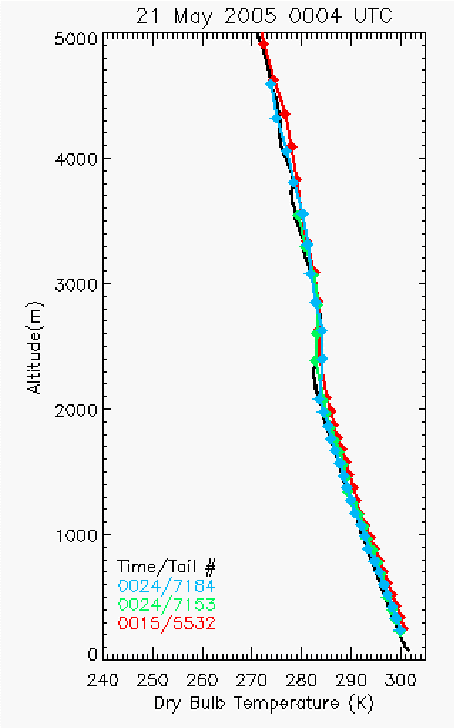
	Field Programs
1985	
'86	Kitt Peak; COHMEX, SE US; FIRE 1, Wisconsin - HIS
'87	
'88	GAPEX, Denver – Uplooking HIS
'89	
1990	
'91	CaPE/SERON, SE US; FIRE 2 Kansas - HIS, SPECTRE, Kansas - AERI
'92	STORMFEST, SGP - HIS, AERI
'93	CAMEX 1, Atlantic Coast - HIS, AERI
'94	ASHOE, New Zealand - HIS
1995	Gulf of Mexico - HIS, AERI; CAMEX 2 - HIS
'96	SUCCESS, SGP – HIS; CSP, TWP – AERI
'97	WINCE, Wisconsin – HIS, AERI; FIRE 3, Alaska – HIS; SHEBA - AERI
'98	Wallops '98 – NAST, HIS; CAMEX 3, Atlantic/Gulf – NAST (ER2) SHIS (DC8); NOAA K, Dryden – SHIS (ER2); AERI
'99	WINTEX, Wisc (ER2) – NAST, SHIS, AERI;KWAJEX, Kwajalein - SHIS (DC8); Wallops '99 – NAST, Intessa
2000	SAFARI, S Africa – SHIS (ER2); AFWEX, SGP – NAST (Proteus); SHIS (DC8); WISC-T2000, Wisconsin – SHIS (ER2)
'01	Texas-2001 – SHIS (ER2); Trace-P, Pacific Rim – NAST (Proteus) CLAMS, Wallops – SHIS (ER2), NAST (Proteus)
'02	IHOP – SHIS (ER2); NAST (Proteus); CRYSTAL, NAST (Proteus)
'03	THORPEX – SHIS and NAST (ER2); MAINE, – SHIS and NAST (ER2)
'04	MPACE – SHIS and NAST; TAMDAR – AERIBago;
'05	TAMDAR – AERIBago; WVSS-II, – AERIBago AVE – SHIS

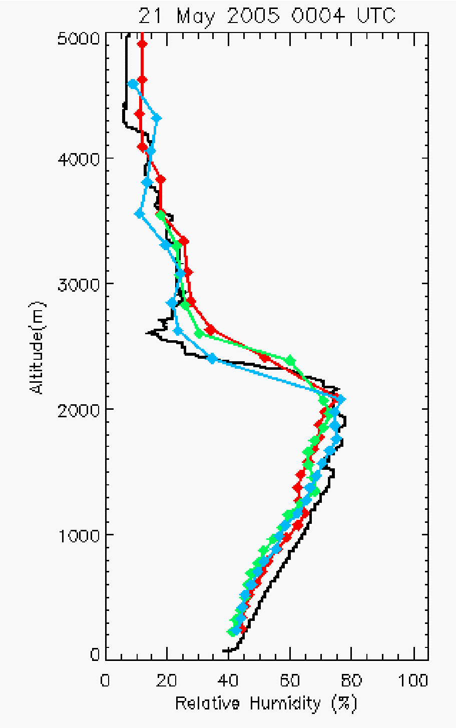
TAMDAR AERIBAGO Validation Experiment

22 February - 08 March 2005, 16 May – 27 May 2005, Memphis, TN



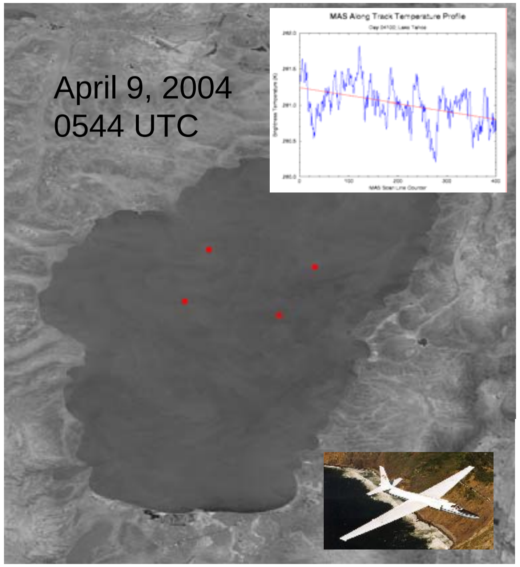
Dashed=descending, solid=ascending

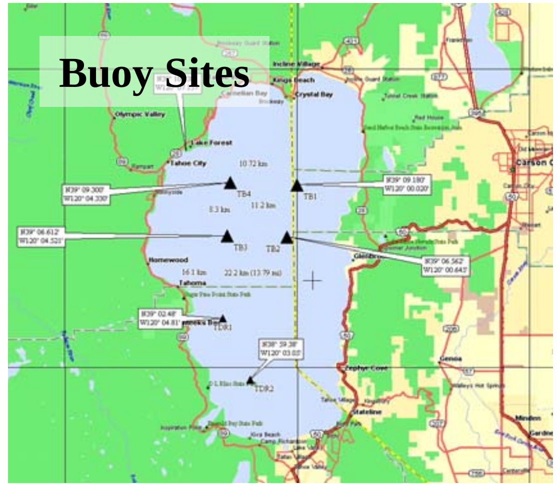


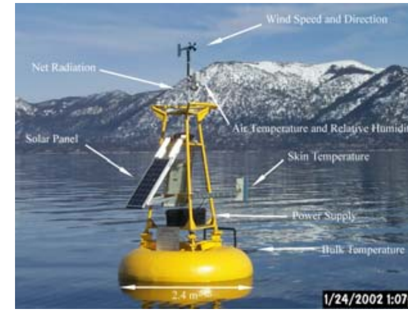


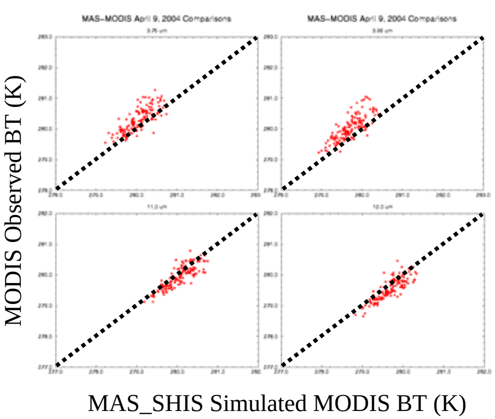
TAMDAR temperature, moisture, and wind sensors are mounted on 64 MESABA Saab 340 aircraft. Comparisons are being made with radiosondes to validate these data.

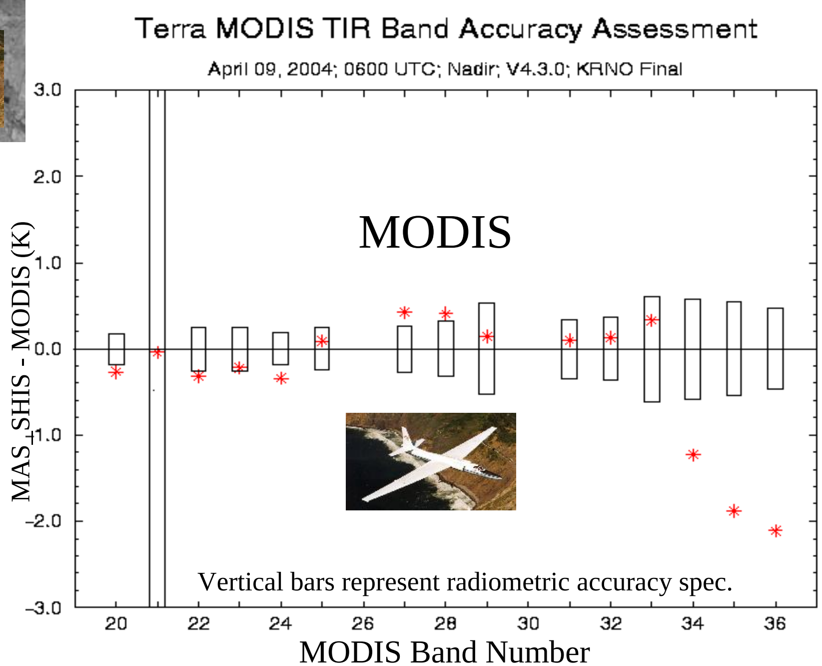
The Lake Tahoe 2004 field activity evaluated Terra MODIS radiometric performance.

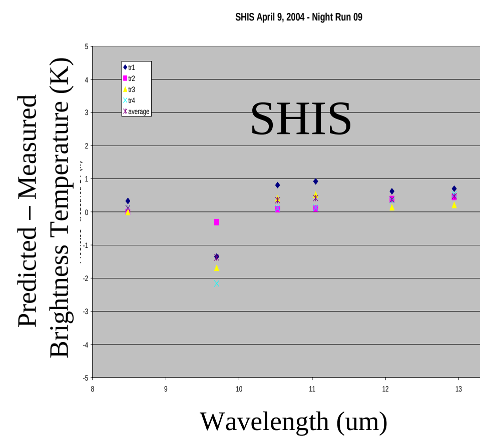












Intercalibrating GEOs with High Spectral Resolution AIRS

Geo:	GOES-9	GOES-10	GOES-12	MET-7	MET-5
N	14	16	15	14	16
ΔTbb (K)	-0.63	-0.10	-0.13	-0.87	-1.93
STD (K)	1.04	0.35	0.55	0.38	.55

Table 1. 11μm band results. ΔTbb (GEO minus AIRS) is the mean of N cases.

Geo:	GOES-9	GOES-10	GOES-12	MET-7	MET-5
N	14	16	15	6	16
ΔTbb (K)	-1.31	-1.35	-9.94	-7.24	-9.26
STD (K)	0.39	0.18	0.49	0.54	2.42

Table 2. 6 μm band results. ΔTbb (GEO minus AIRS) is the mean of N cases.

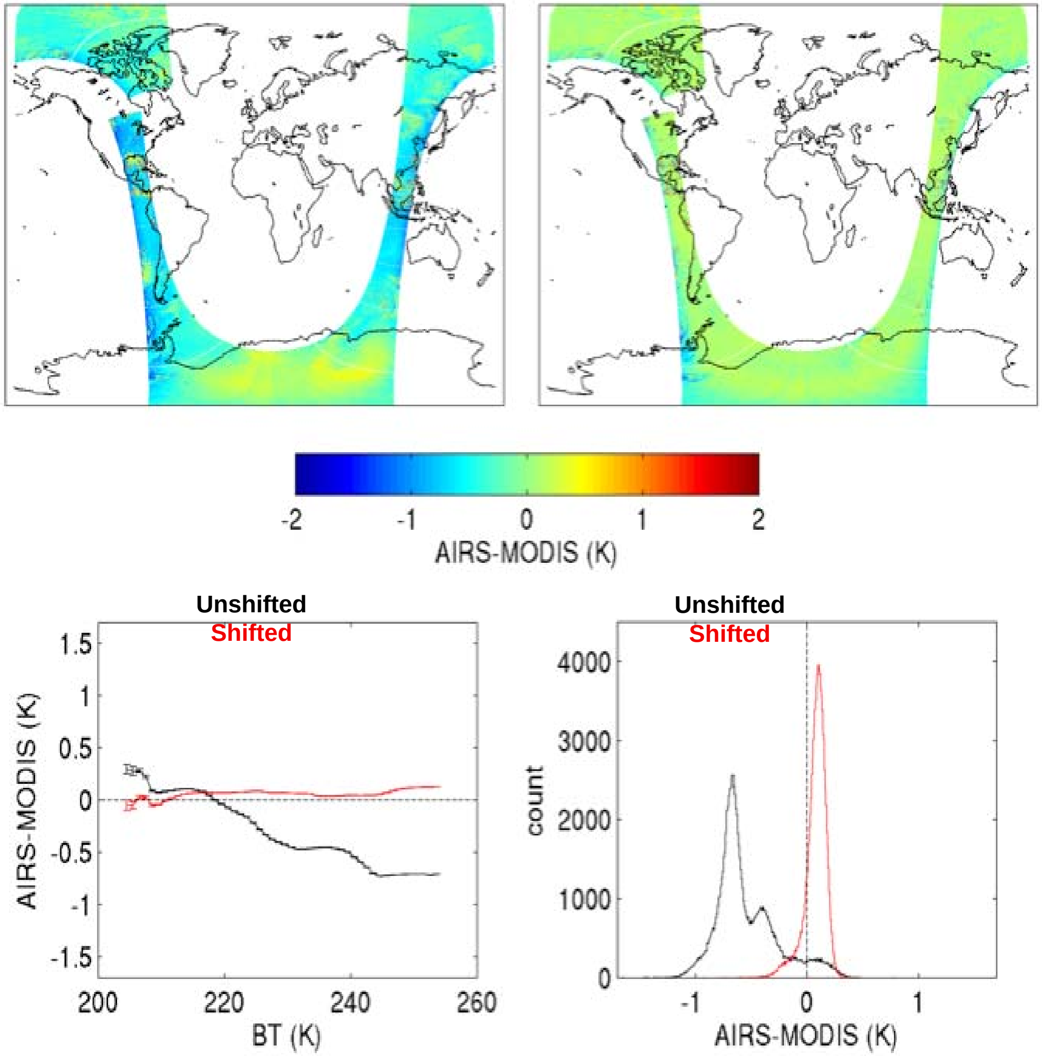
Geo:	GOES-9	GOES-10
N	14	16
ΔTbb (K)	-0.50	0.32
STD(K)	1.03	0.32

Table 3. 12 μm band results. ΔTbb (GEO minus AIRS) is the mean of N cases.

Geo:	GOES-9	GOES-10	GOES-12
N	8	16	14
N (Day)	7	11	8
N (Night)	1	5	6
ΔTbb (K)	-0.97	-0.06	-0.62
ΔTbb (K) (Day)	-1.16	-0.25	-1.13
ΔTbb (K) (Night)	0.35	0.37	0.07
STD (K)	0.95	0.42	0.74
STD (K) (Day)	0.85	0.35	0.51
STD (K) (Night)	NA	0.17	0.29

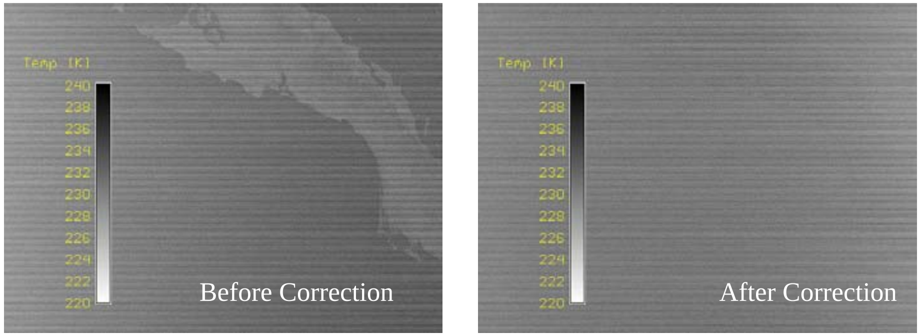
Table 4. 3.9 μm band results. ΔTbb (GEO minus AIRS) is the mean of N cases.
Day and night are determined by local sunrise and sunset times.

AIRS-MODIS for Band 35 (13.9 μm) with nominal MODIS SRF and shifted SRF

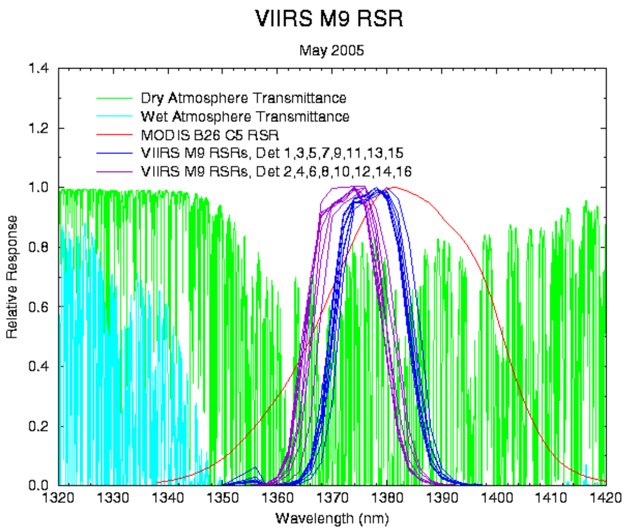


Evaluations

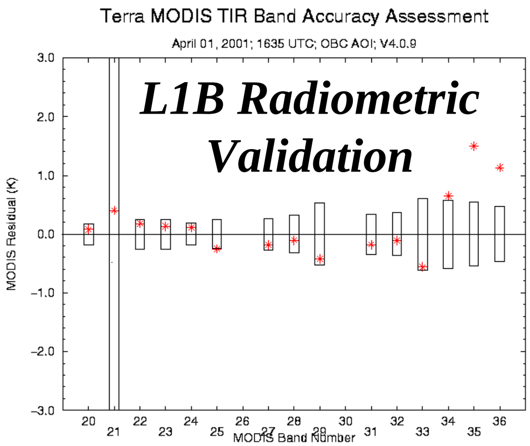
Crosstalk Assessment



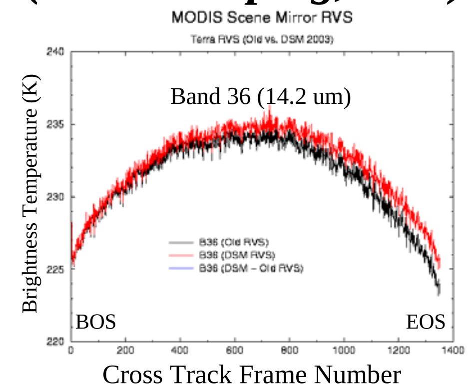
Spectral Calibration

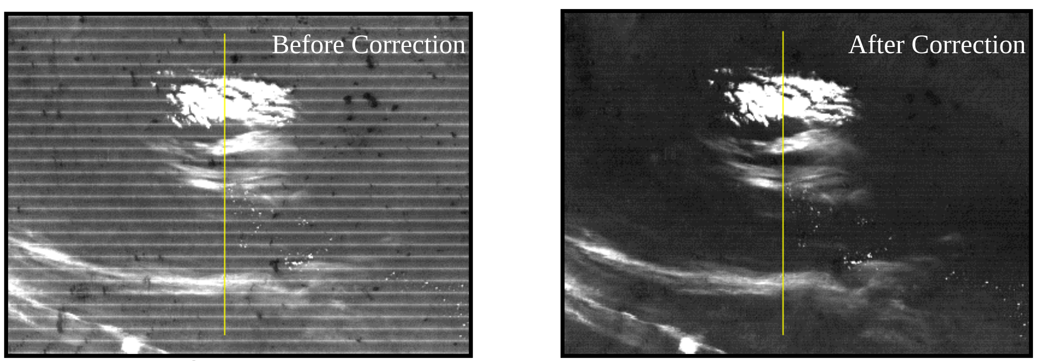


L1B Radiometric Validation



Optics Performance (mirror striping, RVS)



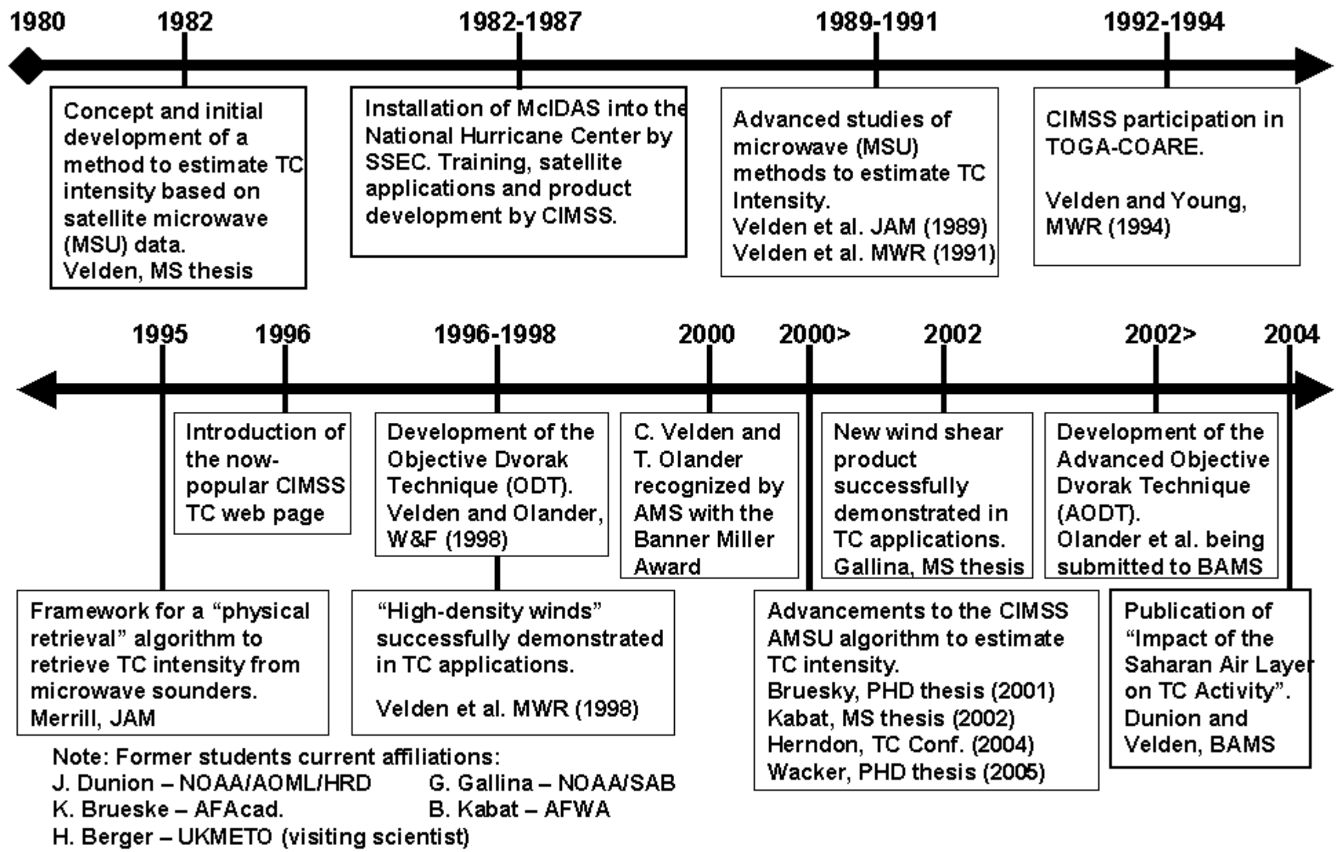


Detector Performance (Linearity, NEDT, Stability, Striping)

Tropical Cyclone

The TC program at CIMSS is a good example of how a successful research program can evolve, maintaining a vigorous research program. A chronology of CIMSS research on tropical cyclone, including student involvement.

CIMSS Tropical Cyclone (TC) Research Group: An Historical Perspective



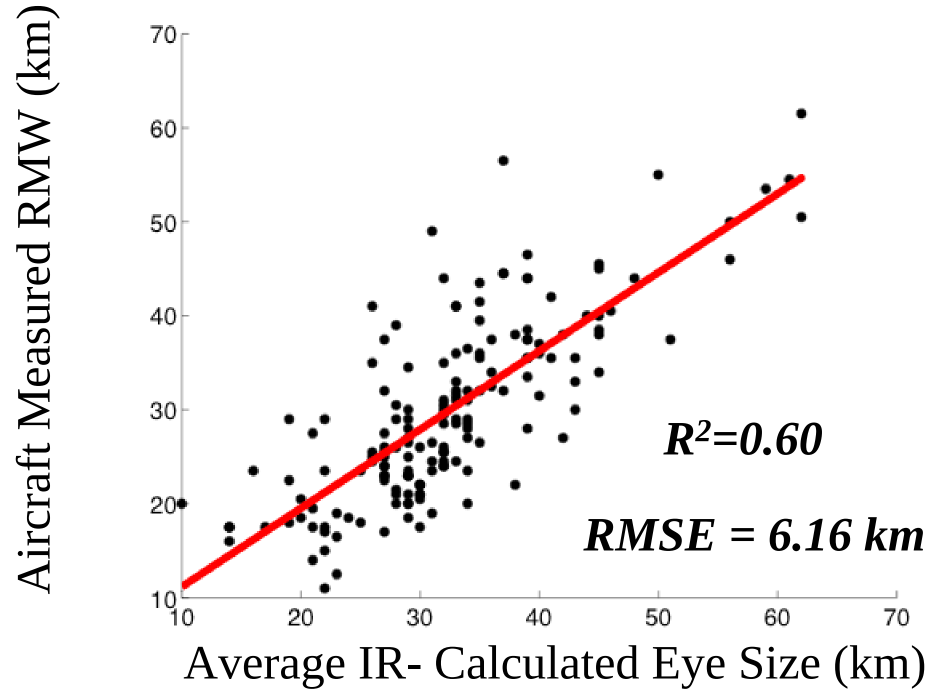
Validation of UW-CIMSS ADT (fully-automated) and Operational Center Dvorak Technique vs. Aircraft Reconnaissance MSLP (hPa)

Development sample: 1995–2003 Atlantic Seasons – 56 Total Storms

	Bias	RMSE	Abs Error	Sample
AODT-v6.4	-0.38	9.63	7.54	3434
Op Center	0.73	9.78	7.726	3434

Op Center = Ave. of 3 Agency DT values

RMW versus Eye-size as determined by Infrared Imagery

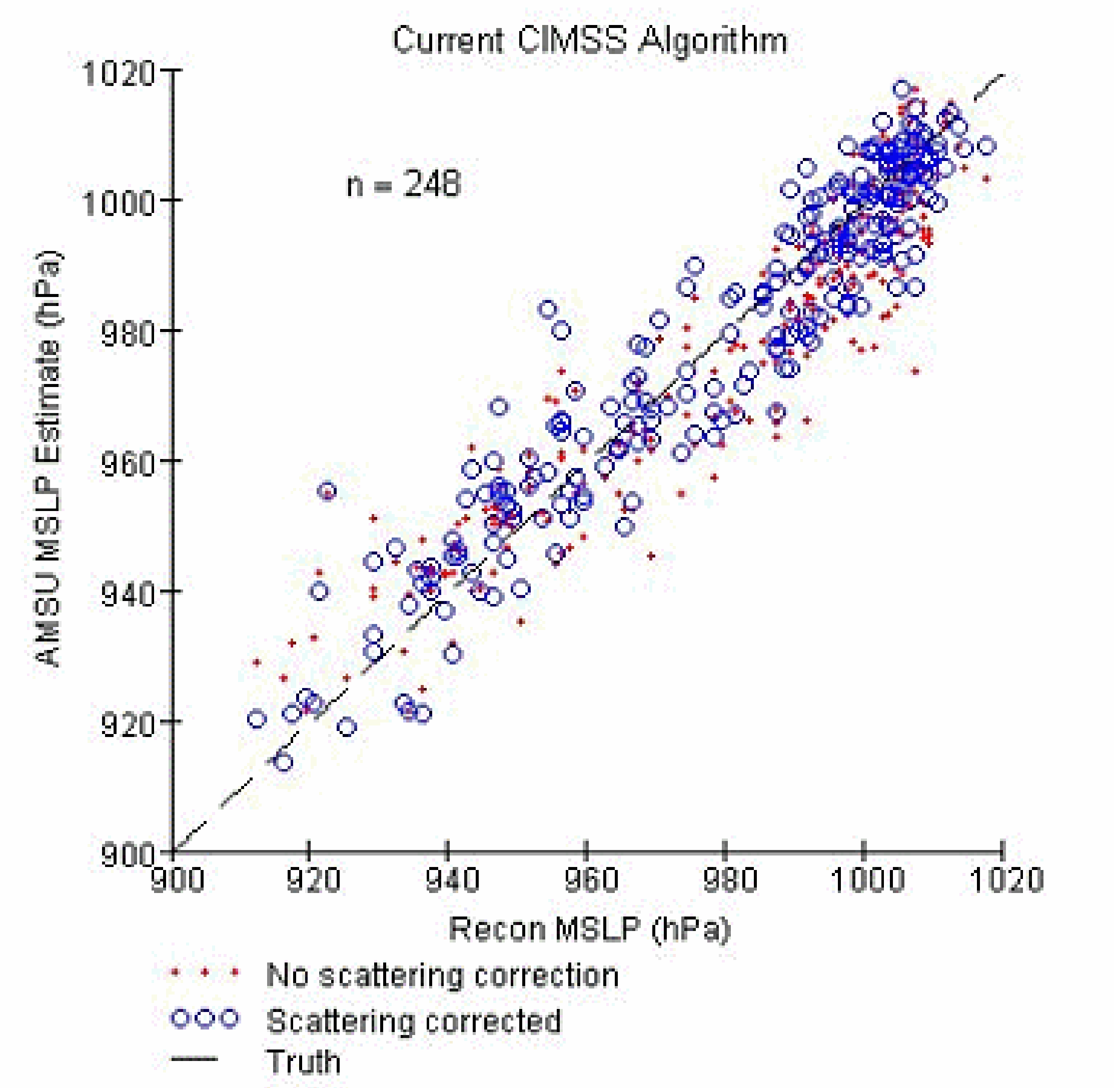


UW/CIMSS-AMSU Tropical Cyclone Intensity estimates using IR-derived RMWs perform better than previous estimates that use standard operational RMWs on independent cases verified against Atlantic recon.

MSLP (hPa)	Using new IR-derived RMW	Using standard operational RMW
Bias	**-0.5**	5.1
Absolute Error	**6.8**	8.3
RMSE	**8.7**	10.6
N	**50**	50

Accounting for scattering

Comparison of CIMSS TC intensity algorithm performance before and after precipitation correction.

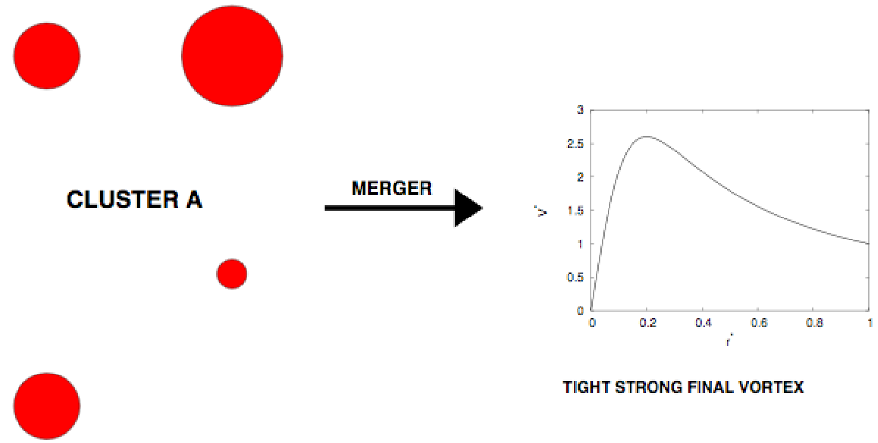


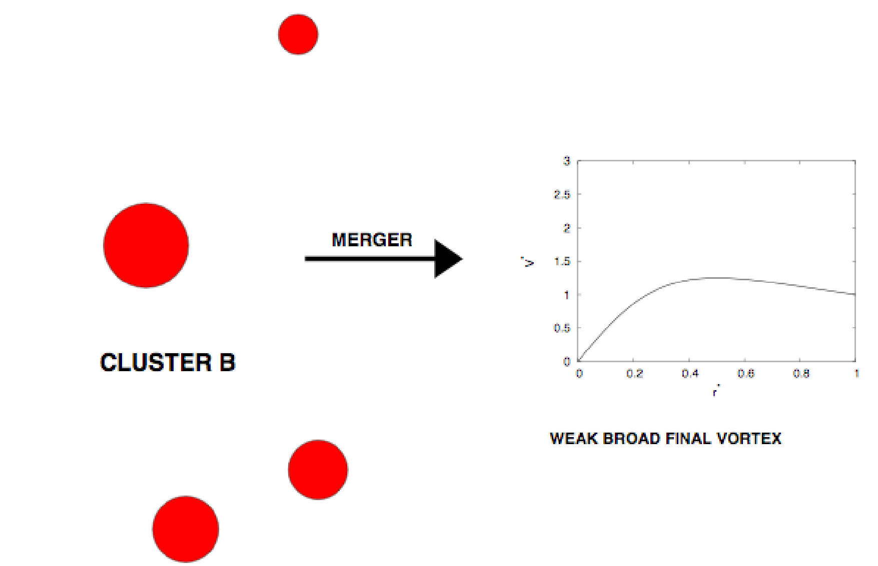
Self-Organization of Mesovortices as a Mechanism for Tropical Cyclogenesis

A statistical mechanics approach is taken to predict the structure of a nascent tropical cyclone from knowledge of large-scale flow invariants. The upshot to this is that we can better predict whether an incipient vortex has a good chance of intensifying to become a tropical storm.

Two very different outcomes of vortex merger from two very similar Cu-clusters. The MCVs in the cumuli have the same circulation but different energies because they are configured differently.

Cluster A (top panel) has a better chance of intensifying into a tropical storm.





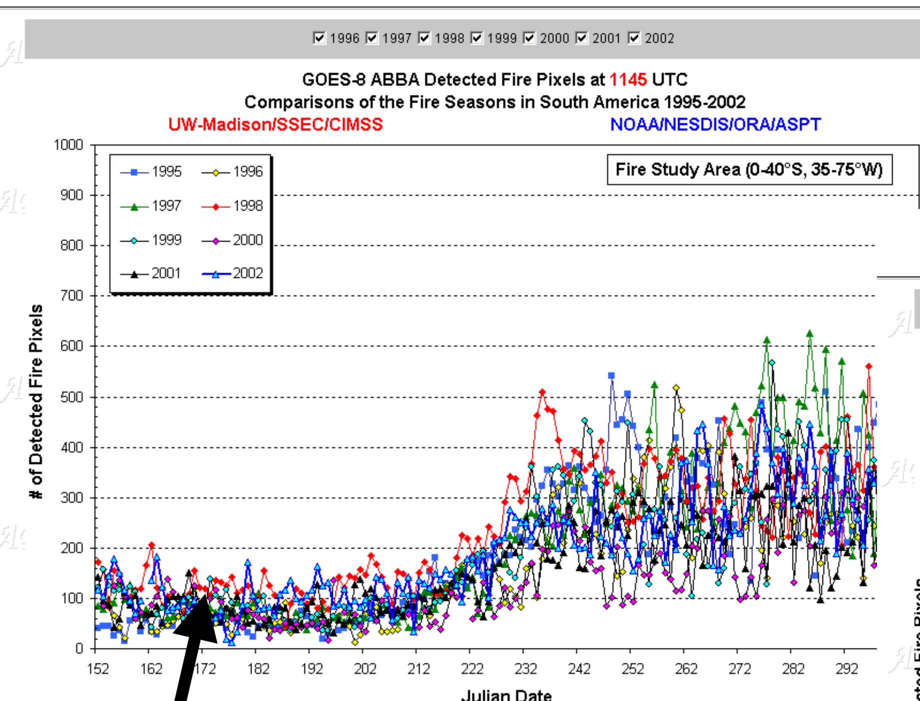
Biomass Burning

ABBA Results

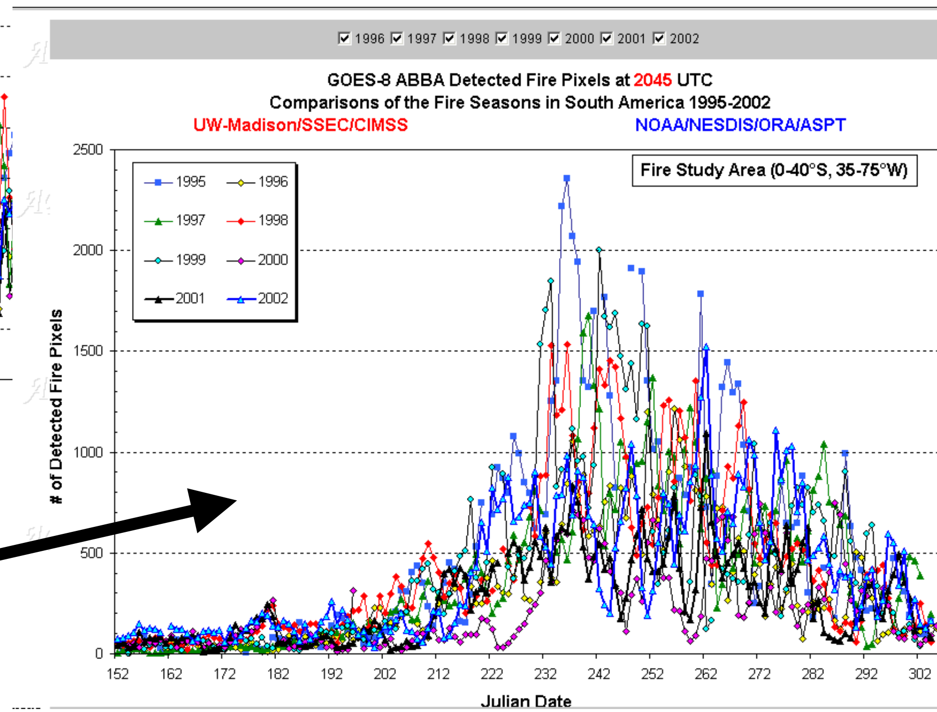
GOES-8 1995-2002:

Fires pixels vs. Julian Day

Time Series of Detected Fire Pixels at 1145 UTC



Time Series of Detected Fire Pixels at 2045 UTC

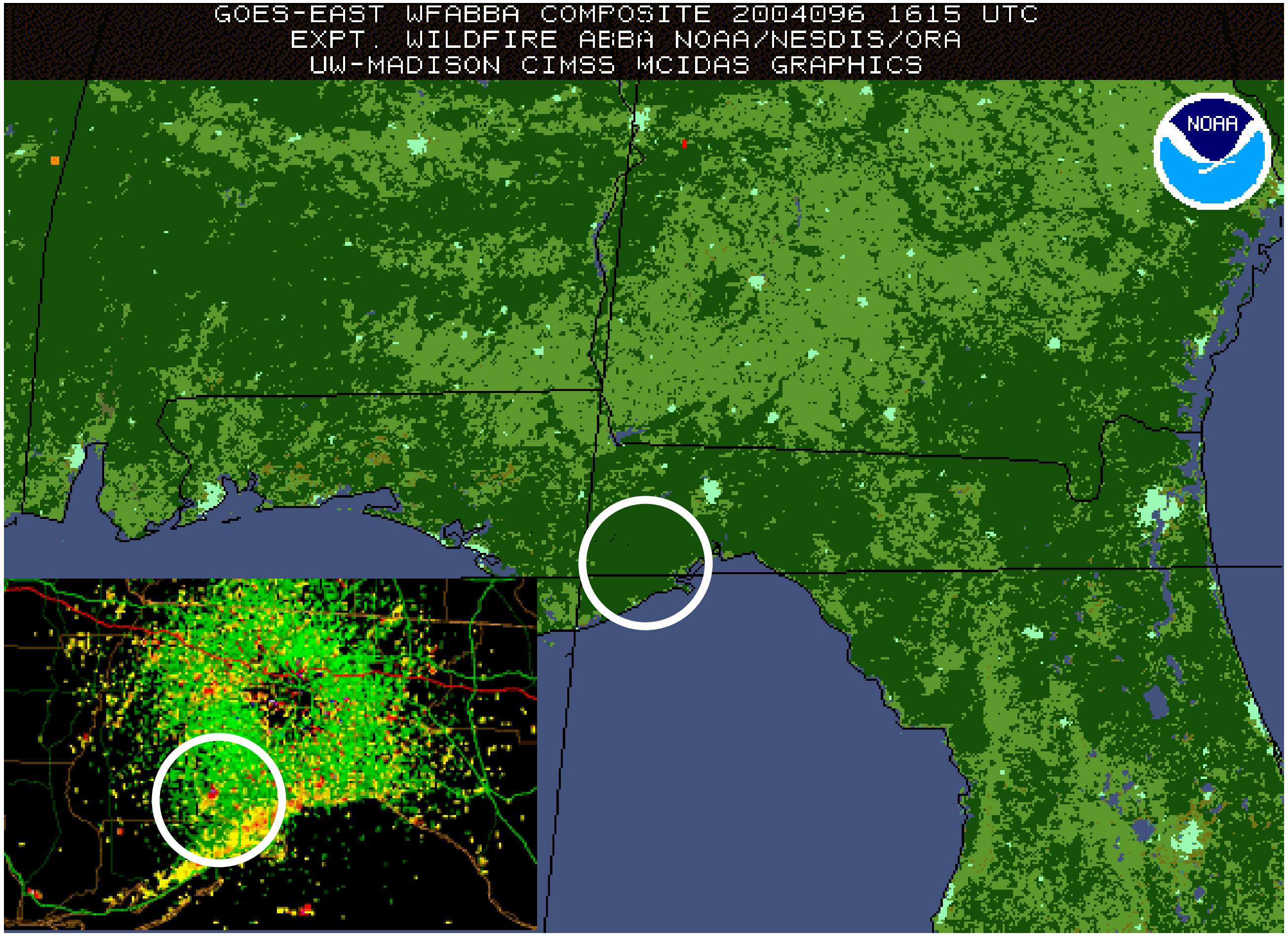


1145UTC

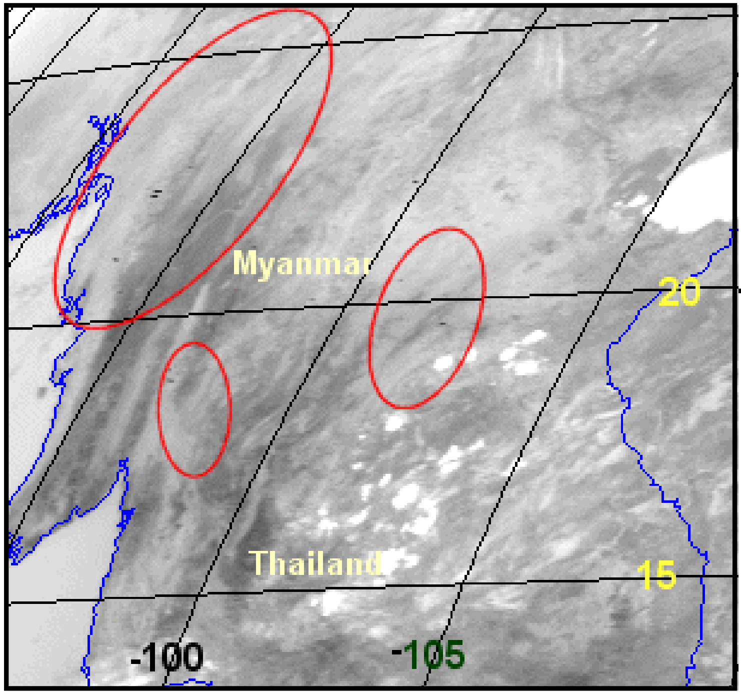
2045 UTC

An example of a possible future WFABBA realtime application: Seabreeze enhanced fire in Florida:

On 5 April 2004 a wildfire south of Tallahassee, FL suddenly flared in response to a seabreeze front. The fire appeared on GOES WF_ABBA imagery approximately 30 minutes prior to the plume enhancement as seen by the Tallahassee NWS radar. The seabreeze is also visible on the radar loop. Imagery of this type could be generated for regions of interest on a realtime basis.

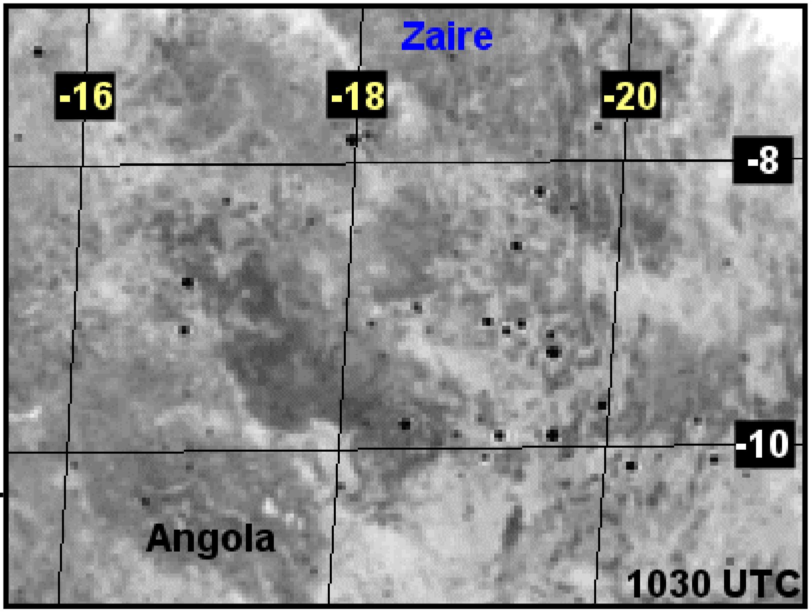


Fire Monitoring in Southeast Asia (GOES-9) and Africa (MSG)



Satellite view angle: 70º

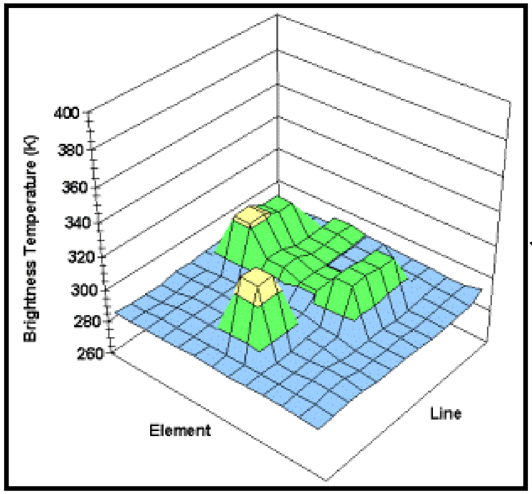
Animation of GOES-9 3.9 micron imagery
Date: 19- Mar-2004
Times: 0325 - 0725 UTC

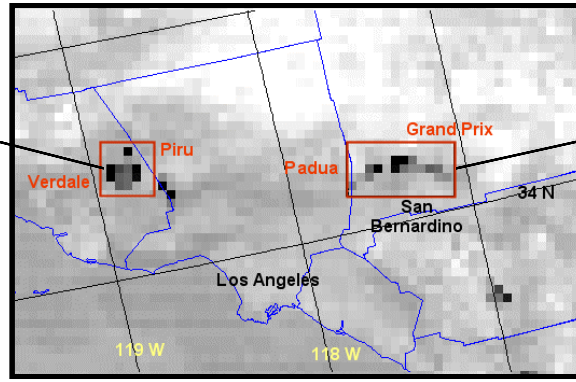


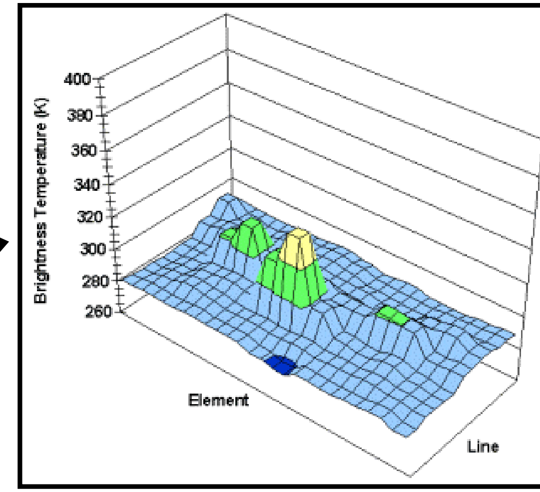
Animation of MSG 3.9 micron imagery
Date: 30- Jul-2004
Times: 1030 - 1215 UTC

GOES-R and GOES I/M Simulations of Southern California Fires

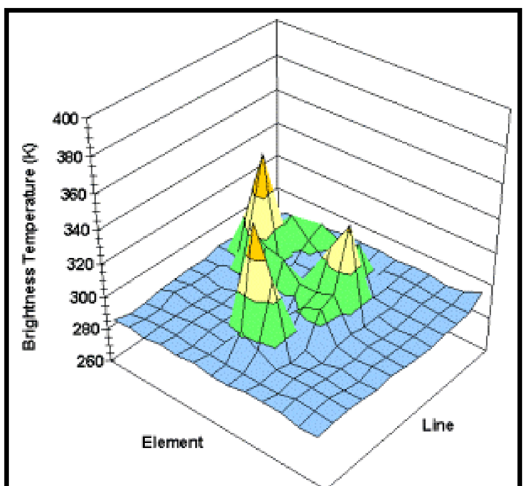
GOES-12 Simulated 3.9 micron Data
Padua/Grand Prix Fires
Date: 27-Oct-03   Time: 09:50 UTC

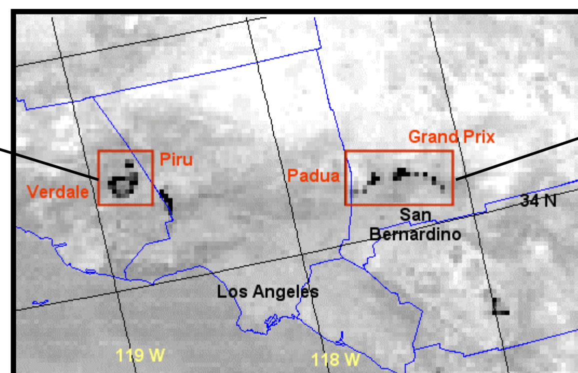


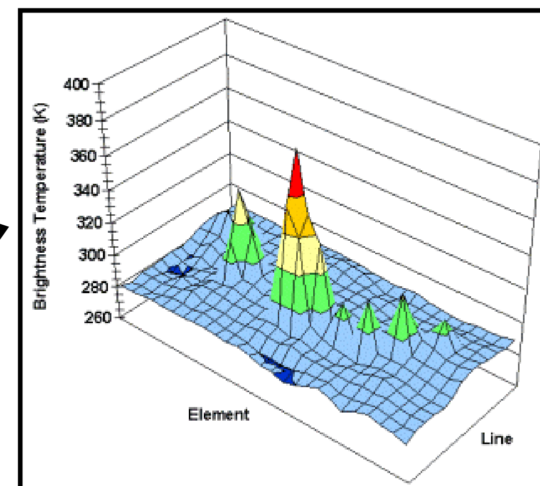




GOES-R Simulated 3.9 micron Data
Padua/Grand Prix Fires
Date: 27-Oct-03   Time: 09:50 UTC



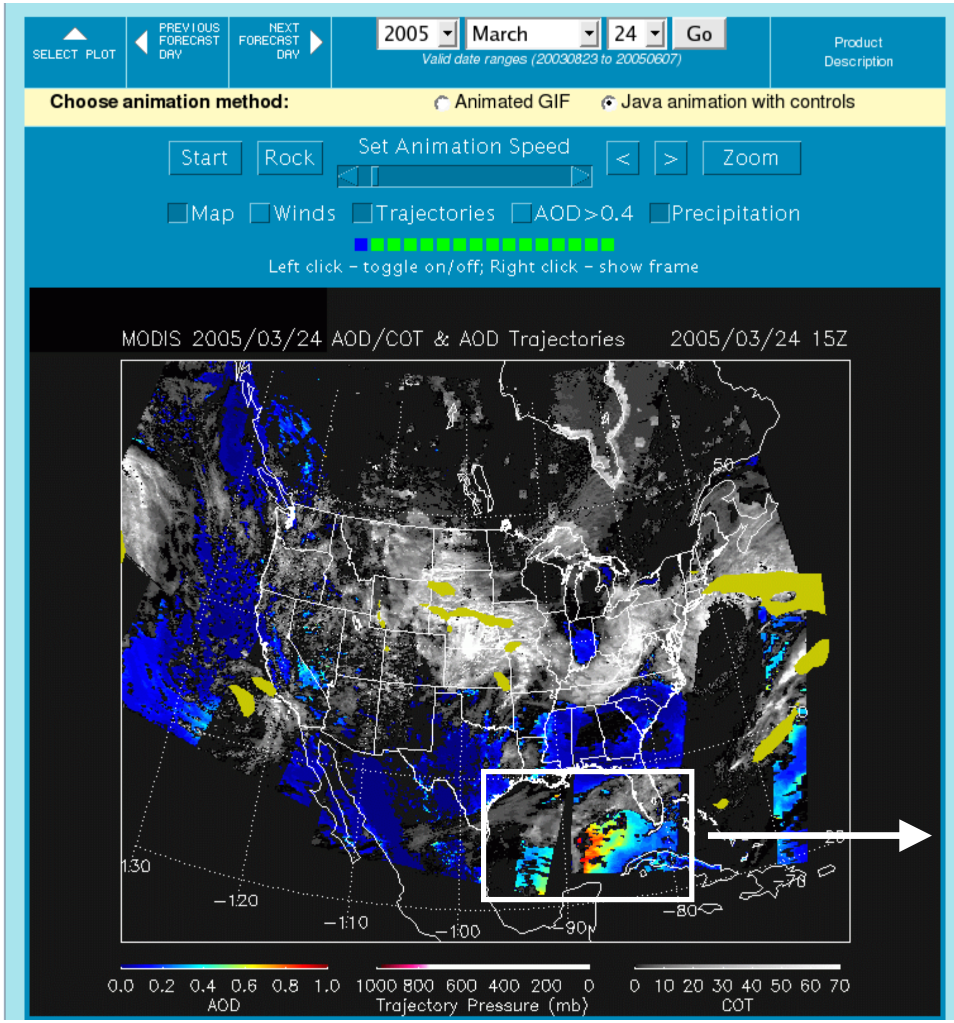




Brightness Temperature (K)

260-280 | 280-300 | 300-320 | 320-340 | 340-360 | 360-380 | 380-400

IDEA aerosol trajectory model example

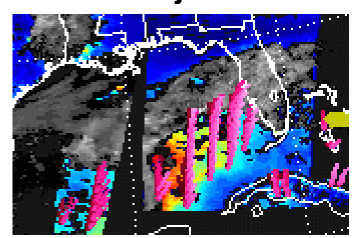


Initial image: 2005/03/24 15Z

IDEA (Infusing Data into Environmental Applications)

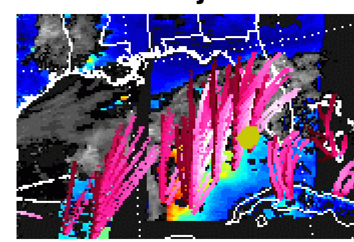
MODIS is the best instrument for retrieving quantified aerosol content over the U.S. and surrounding areas. Here, smoke plumes over the Gulf of Mexico (from biomass burning in the Yucatan) are projected to advect to Florida in 15 hours.

+6 hr trajectories



2005/03/24 21Z

+15 hr trajectories



2005/03/25 06Z

Aerosols from AVHRR

Example analysis of AVHRR climate records

PATMOS-x provides more data than cloud products. Below is an analysis of a 20 year record of Saharan Dust from AVHRR. CIMSS developed the algorithm and performed the analysis (Amato Evan).

Mean Dust Fraction from PATMOS-x

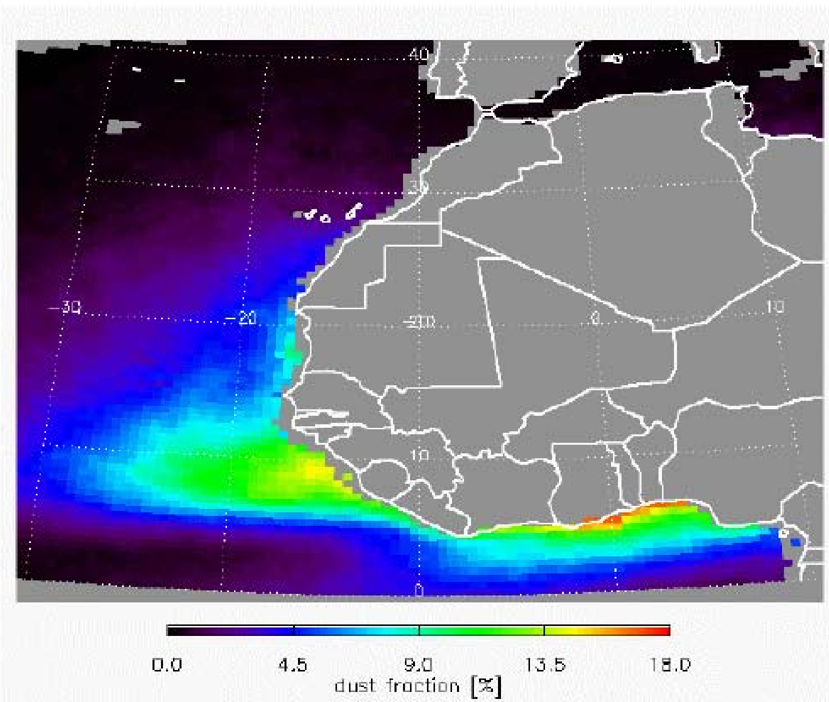


Figure 1. Image of the mean wintertime (JFM averaged) grid cell dust fraction for 1982 through 2004. The interpretation of the values, consistent with the data set, is the percent of time that a grid cell was completely obscured by dust.

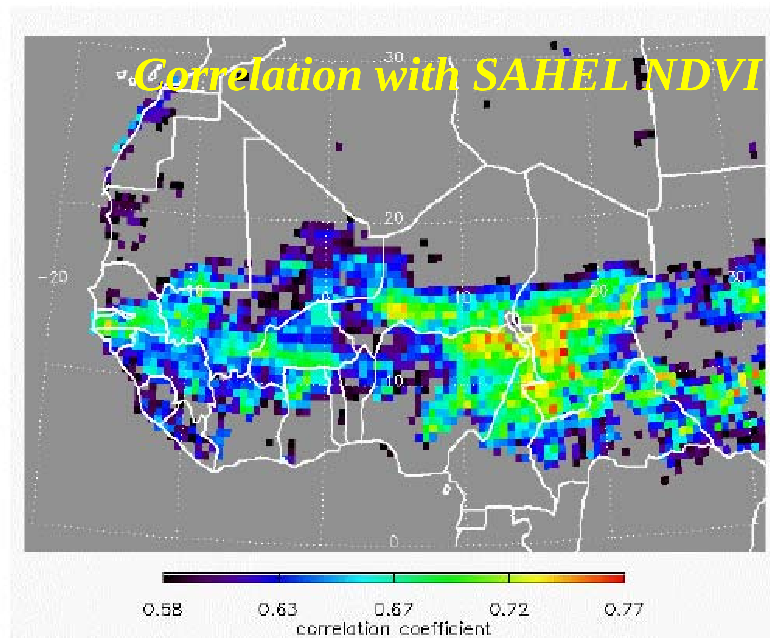
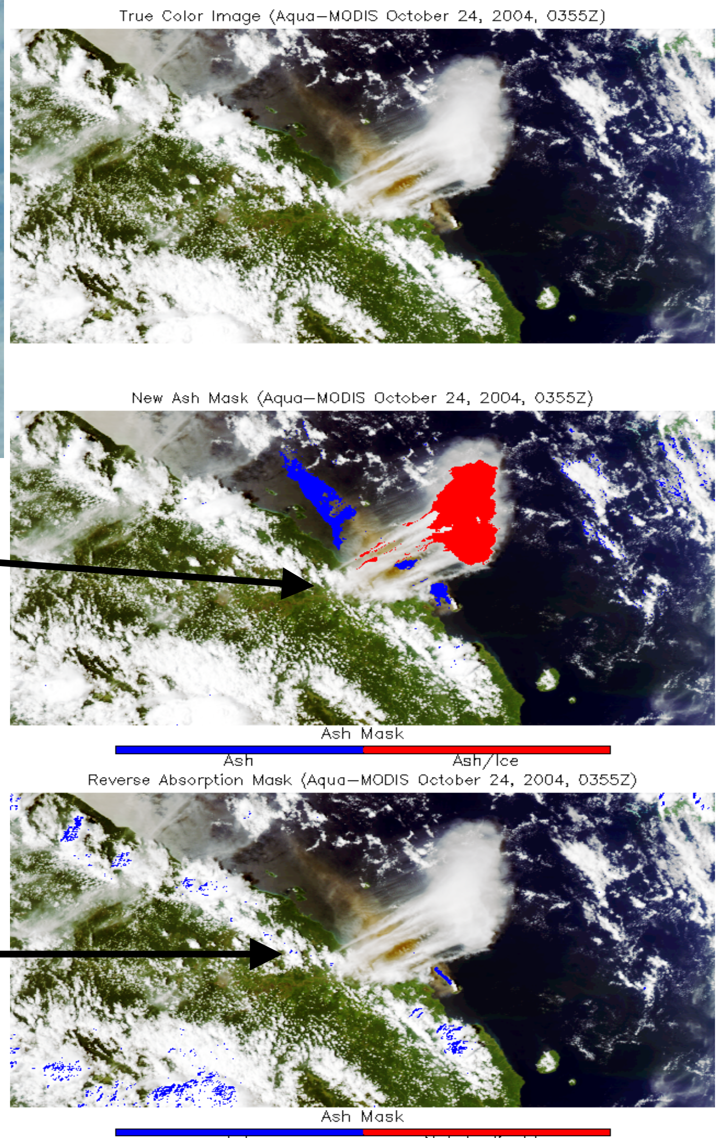


Figure 10. Correlations of mean JFM NDVI to mean JJASO Sahel rainfall index of the previous year for 1982 through 2004, all correlation coefficients are statistically significant at 99.5%.

Volcanic Aerosols

New algorithm

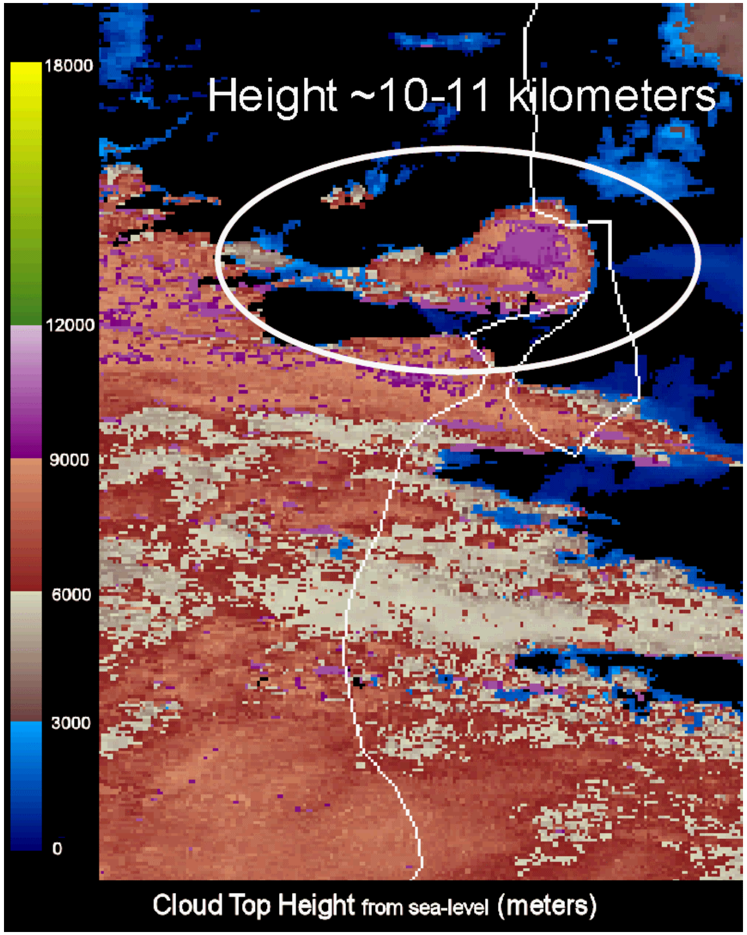
Standard reverse absorption technique

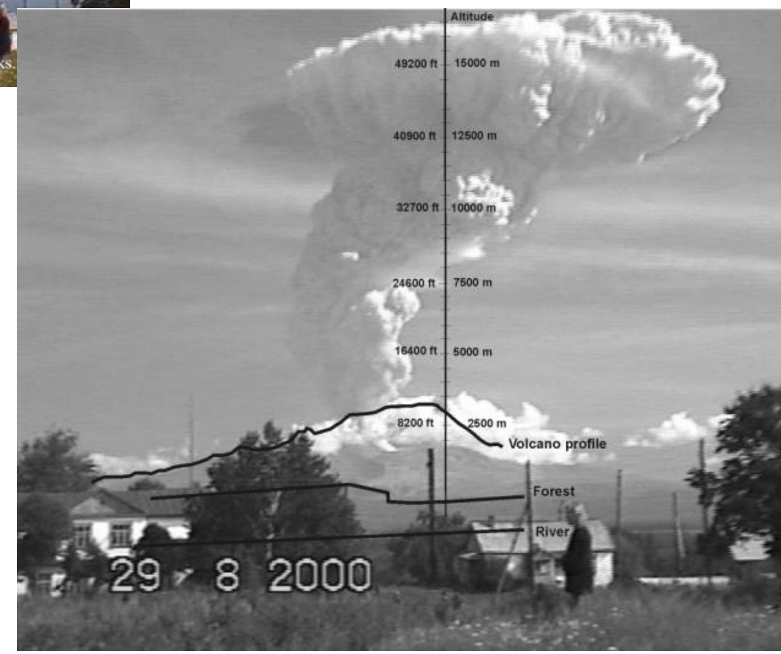


- New multi-spectral algorithm is much more effective than the standard reverse absorption technique at identifying ash plume.
- The new technique also provides information on the location of ice clouds that are contaminated with volcanic aerosols.

True color Aqua-MODIS images capturing an eruption of Manam, PNG on October 24, 2004, 0355 UTC.

Sheveluch, Russia – August 28, 2000 – Terra/MODIS 2355Z





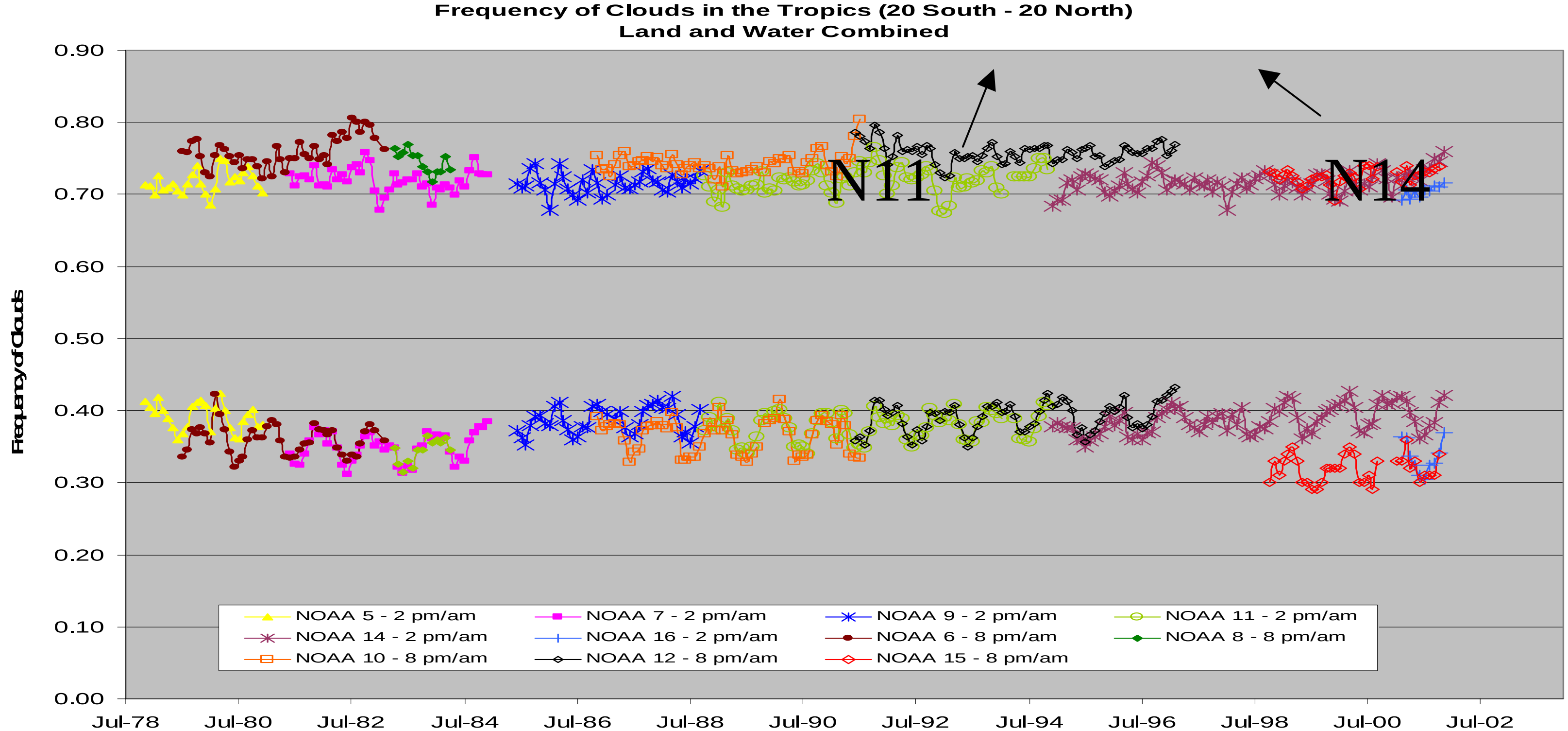
•CO_2-slicing yields heights at approximately 10-11 km, video estimate is 14 to 16 km, MODIS is 80 minutes after eruption.

Clouds at CIMSS

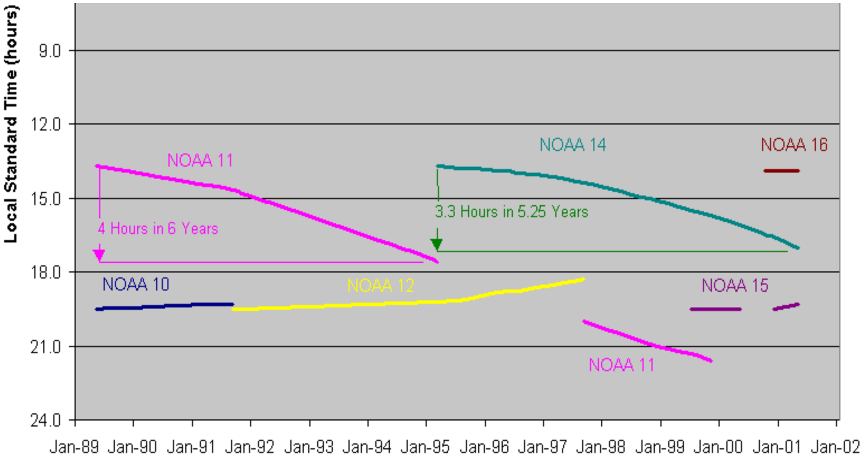
CO_2 Slicing Technique at CIMSS
A Historical Perspective

- **1970**
- **1974** – Description of the technique and first demonstration using NIMBUS-5 data (Chahine & Smith et al.)
- **1978** – Comparison of cloud heights from NIMBUS-5 with radiosondes and ground-based lidar systems & using McIDAS and HIRS data to specify cloud heights (Smith and Platt & Menzel et al.)
- **1988** – Cloud height determination using HIS radiances (Smith and Frey)
- **1989** – Cloud cover statistics based on CO_2 derived determinations from VAS (Wylie and Menzel)
- **1992** – Seasonal and diurnal studies using CO_2 heights and four years of VAS radiances (Menzel et al.)
- **1993** – First CO_2 derived heights from MODIS data & a demonstration of CO_2 derived heights from GOES to compliment the ASOS (Menzel et al. & Schreiner et al.)
- **1994** – Long term global cirrus statistics from HIRS (Wylie et al.)
- **1999** – Comparison of CO_2 cloud heights based on LIDAR and MAS(Frey et al.)
- **2001** – Diurnal trends from clouds based on GOES data (Schreiner et al.)
- **2004** – CO_2 sorting under development to combine with slicing algorithm (Holz et al. 2004))

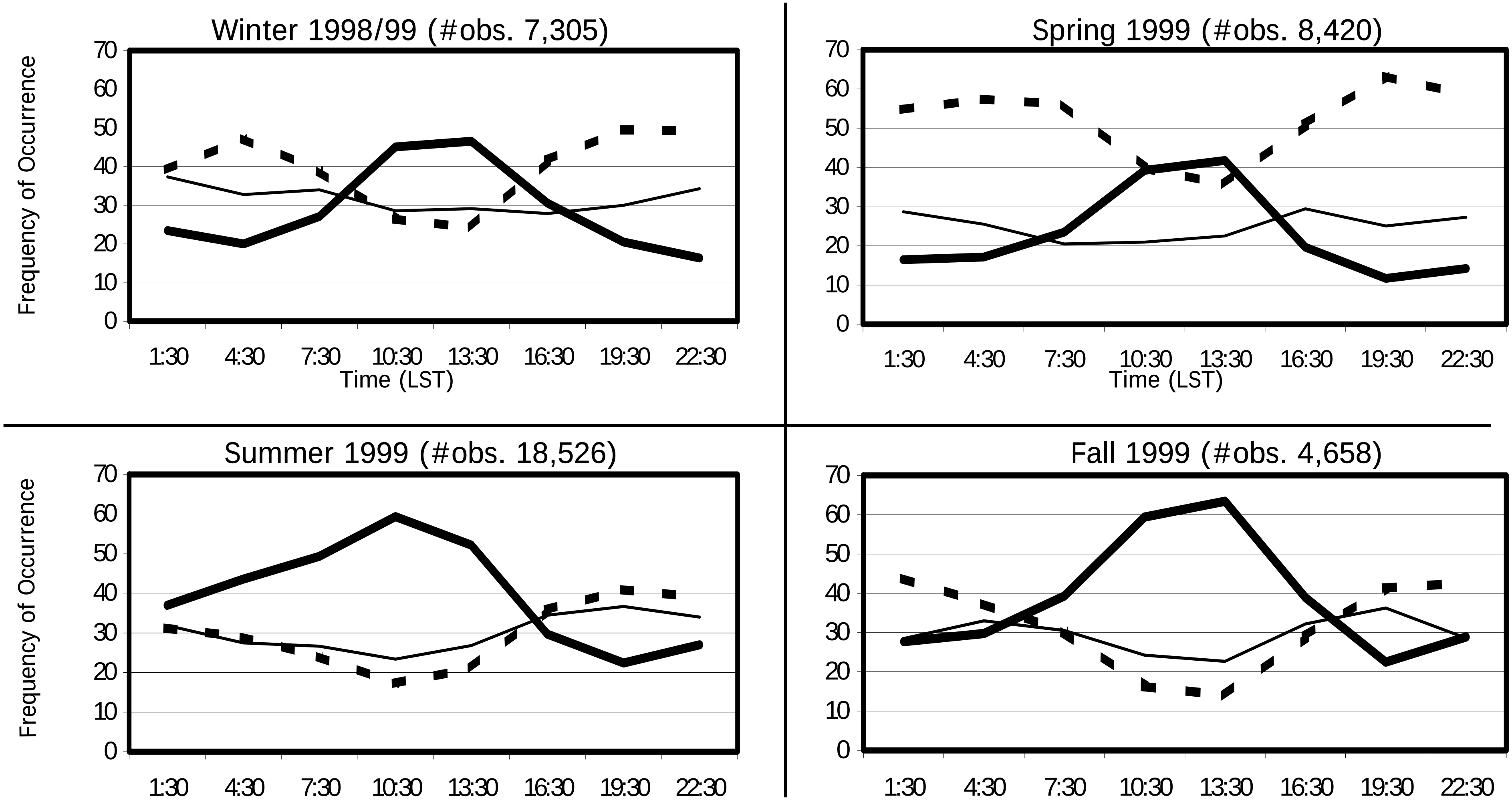
Clouds from HIRS



N11 and N14 show gradual increase of cloud detection in tropics in part due to orbit drift from 14 to 18 LST



Diurnal Change of Effective Cloud Amount over Central Plains for High Clouds Only

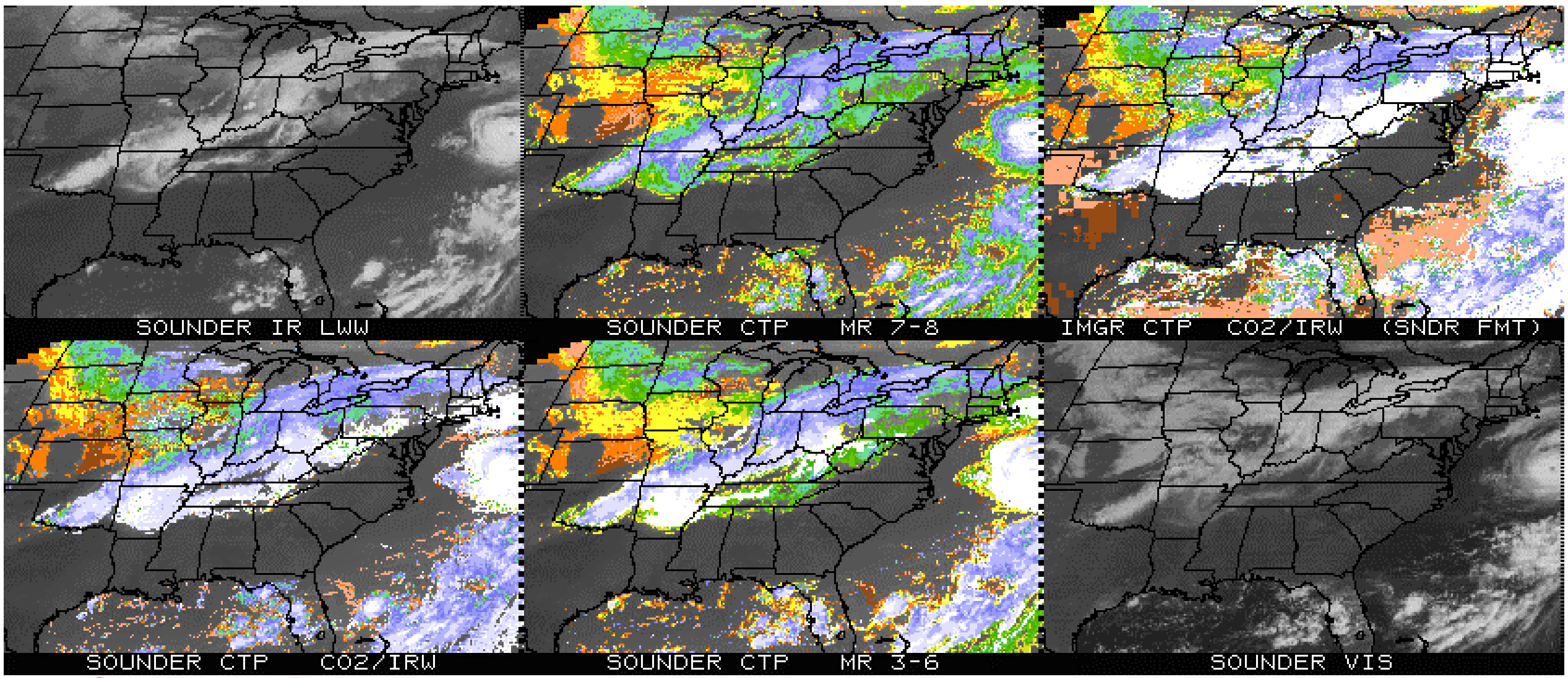


Thin (0<ECA<50)
Thick (50<ECA≤95)
Opaque (95<ECA≤100)

- Central Plains includes 31N to 45N and 92W to 107W.
- High Cloud is defined as layer from 300 to 100 hPa

Improved Cloud Heights from GOES

IR LW window BT | CTP from MR (ch. 7-8) | CTP from CO2 – slicing (Imager)



CTP from CO2-slicing (Sounder)

CTP from MR (ch. 3-6) (Sounder)

Sounder VIS image

(combination)

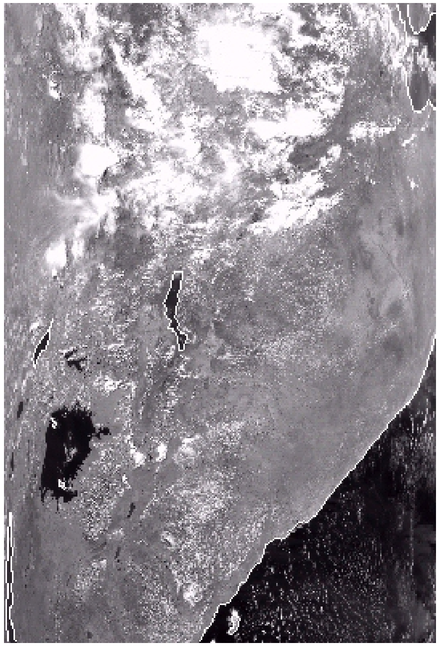
GOES-12 Sounder 4 August 2004 1446UTC

The IR LW window BT and CTP from GOES-12 Sounder with CO_2-slicing (left panel), CTP from minimum residual (MR, Li et al. 2004, JAM) (middle panels), CTP from Imager and the visible image (right panels) at 14:46 UTC on 4 August 2004. Combination of CO2-slicing (for middle and high level clouds) and MR (for low clouds) will improve the cloud-top pressure product. Currently, single band IR window technique is applied for low clouds.

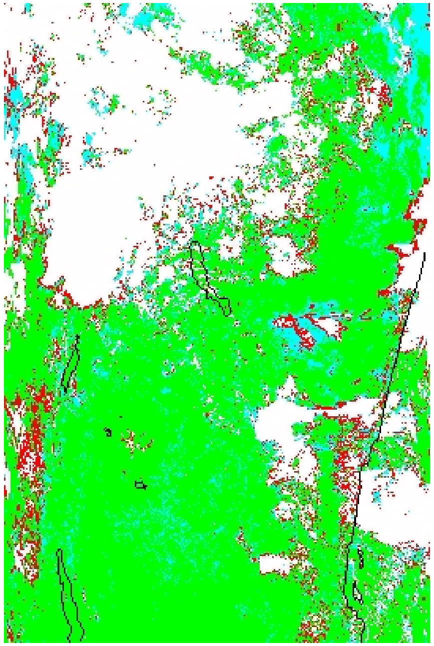
Cloud Detection

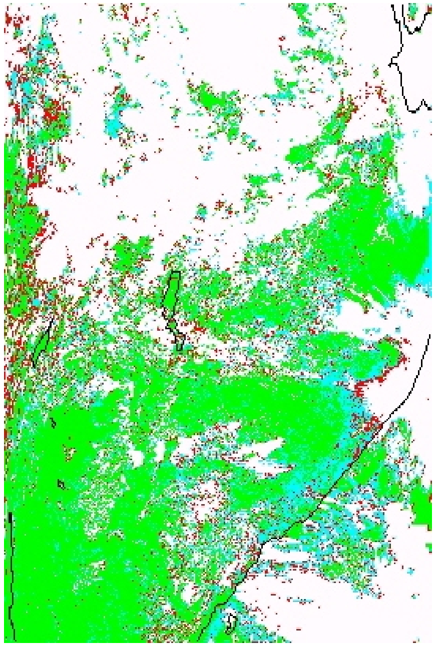
Terra and Aqua

East African Scene from July 11, 2002
Terra at 08:05 UTC, Aqua from 11:00 UTC



MODIS Band 2
Terra (left) and Aqua (right)





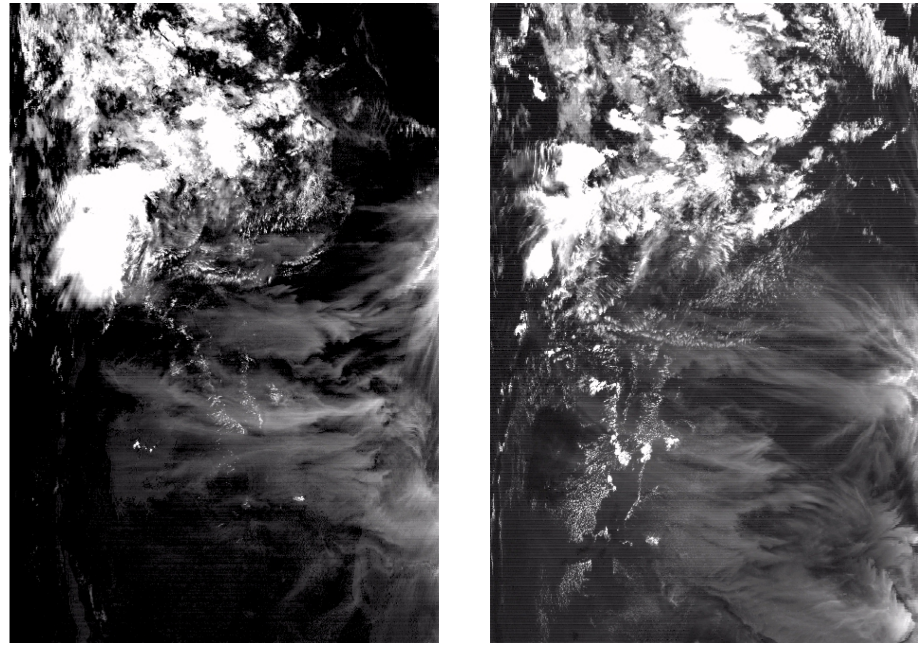
MODIS Cloud Mask
Terra (left) and Aqua (right)

Colors: green is confident clear
cyan is probably clear
red is uncertain
white is cloudy

Terra and Aqua

East African Scene from July 11, 2002
Terra at 08:05 UTC, Aqua from 11:00 UTC

MODIS Band 26
Terra (left) and Aqua (right)

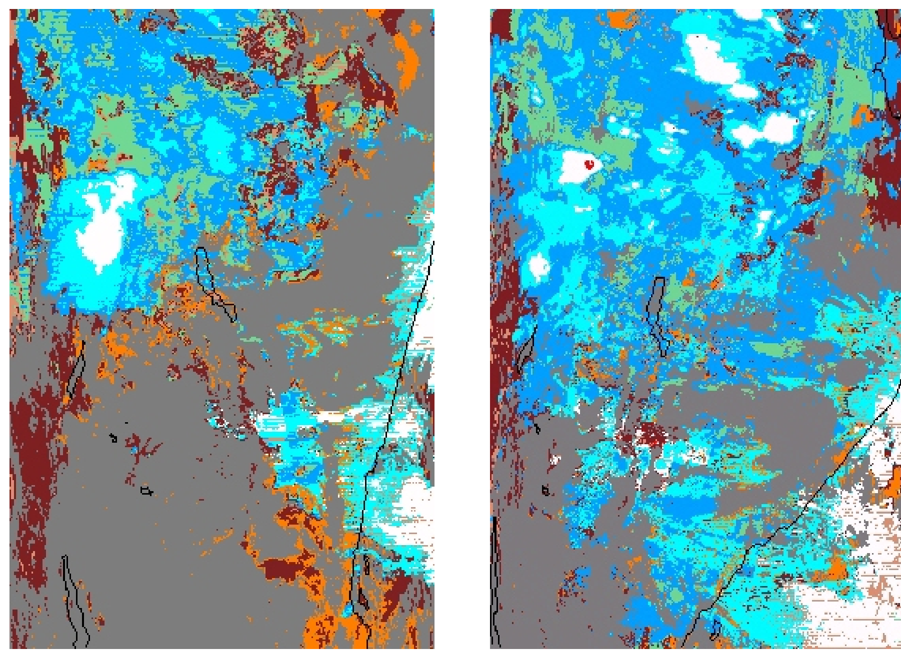


MODIS Cloud Top Pressure (mb)
Terra (left) and Aqua (right)

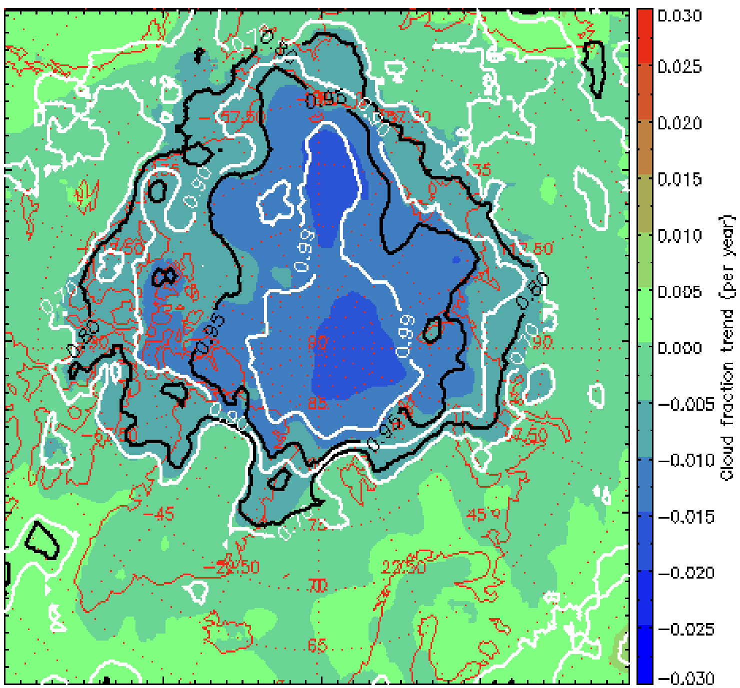
Colors:

red	≤ 100	aqua	400-500
white	100-200	tan	500-700
cyan	200-300	brown	700-850
blue	300-400	orange	850-1000

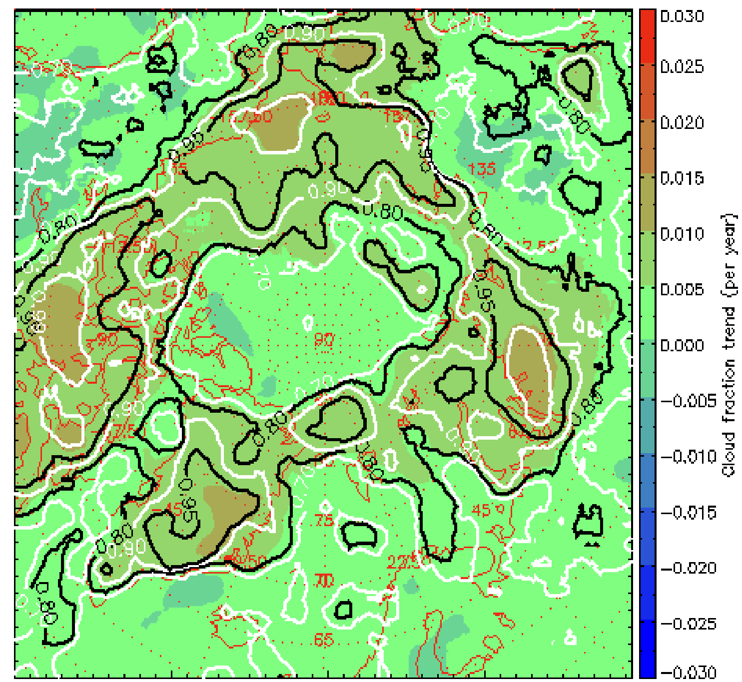
gray is clear



Recent Trends in the Arctic



Winter



Spring

Results show that the Arctic has warmed and become more cloudy in spring and summer, but has cooled and become less cloudy in winter.

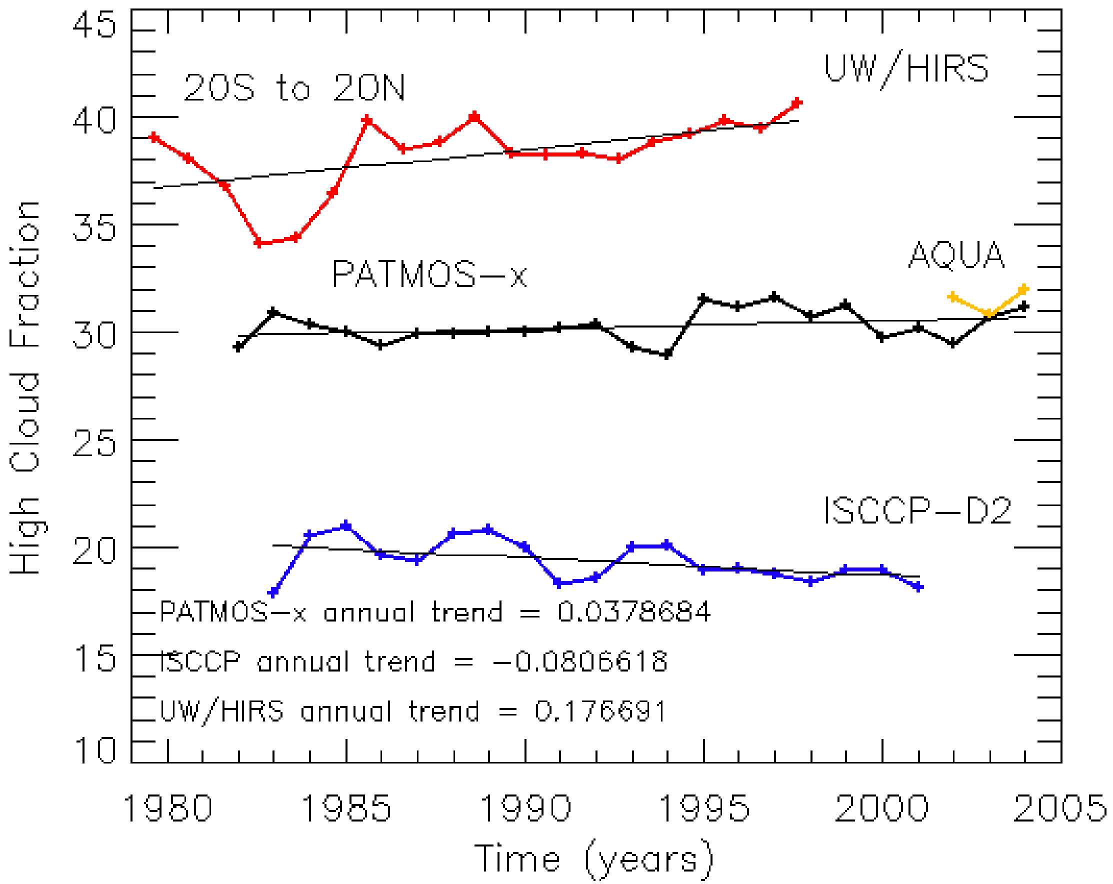
Towards Understanding Difference in Cloud Climatologies.

This comparison shows the yearly variation in the mean July High Cloud Amount in the Tropics.

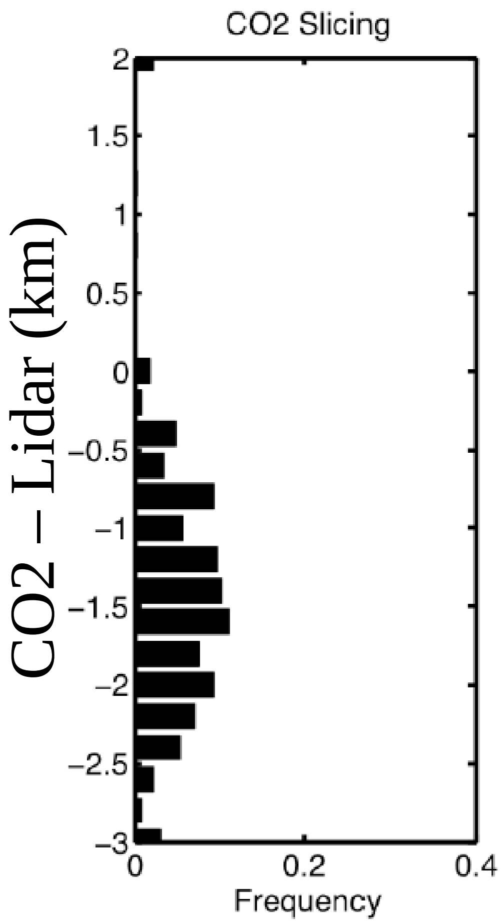
• AQUA and PATMOS-x agree in magnitude.

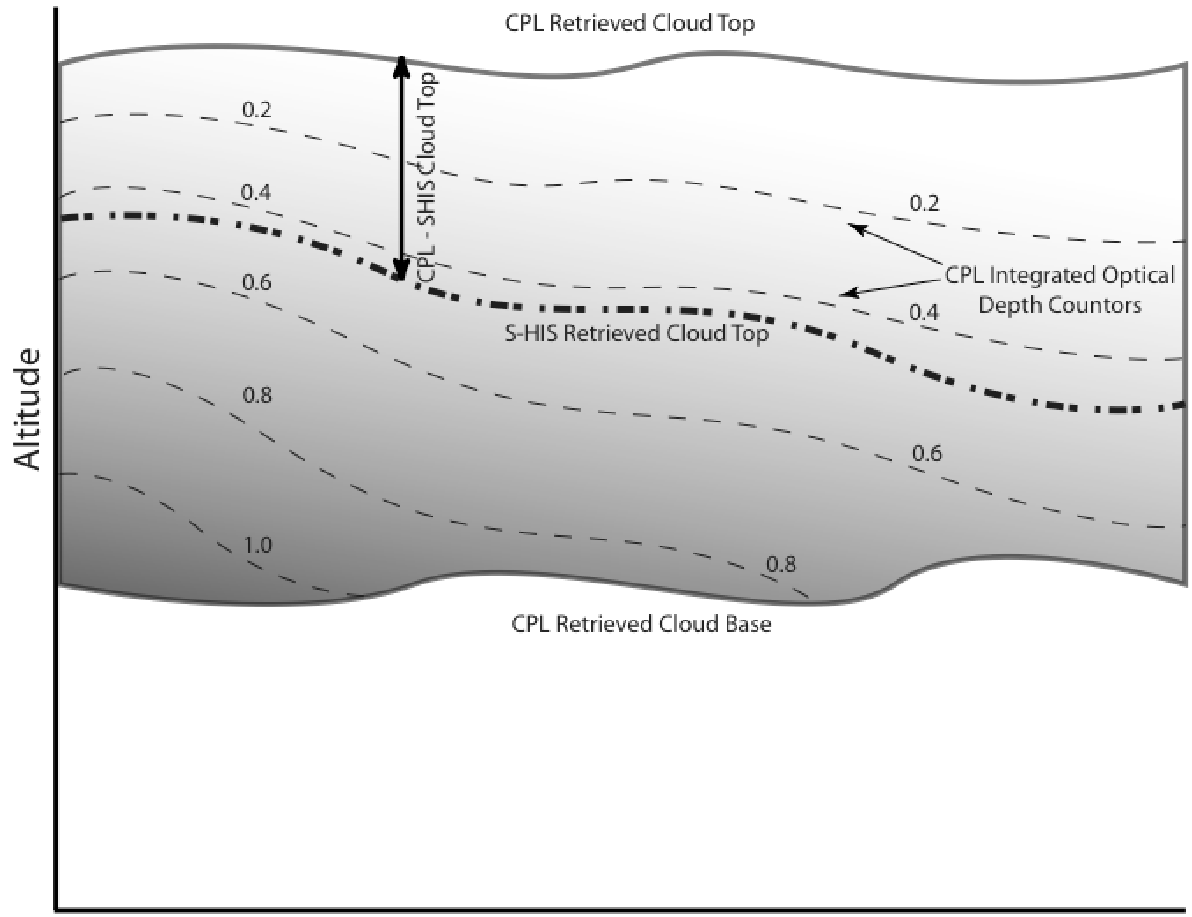
•ISCCP-D2 daily value suffers from poor night-time performance.

•HIRS shows a slight positive trend while PATMOS-x shows no trend and ISCCP-D2 shows a very small negative trend.



What is a cloud?

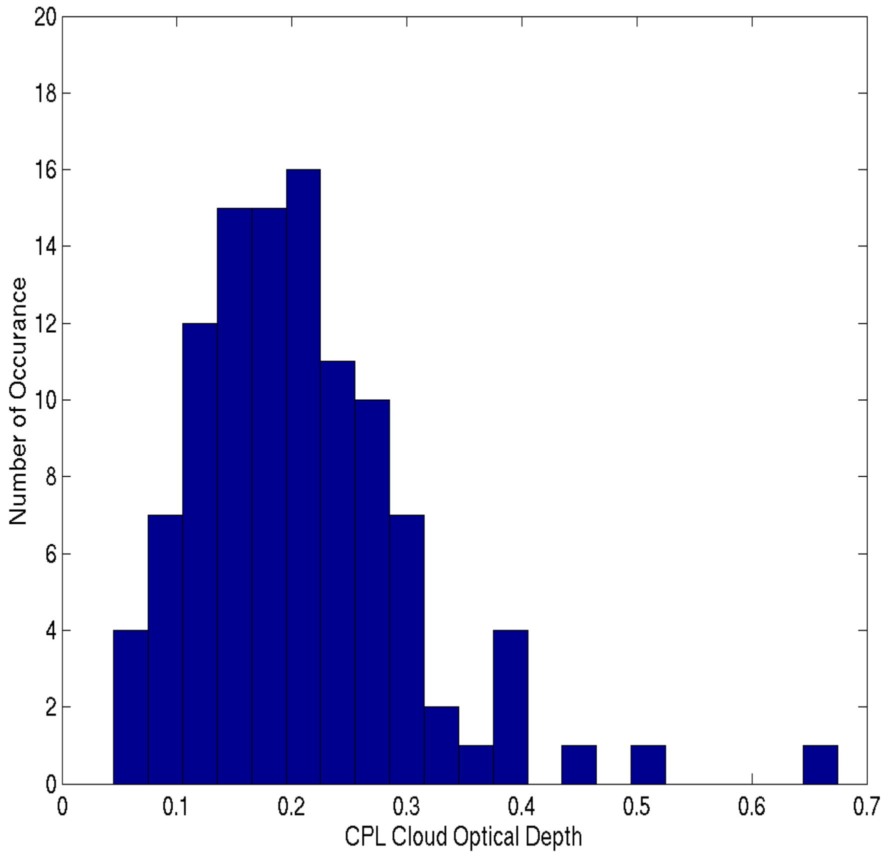




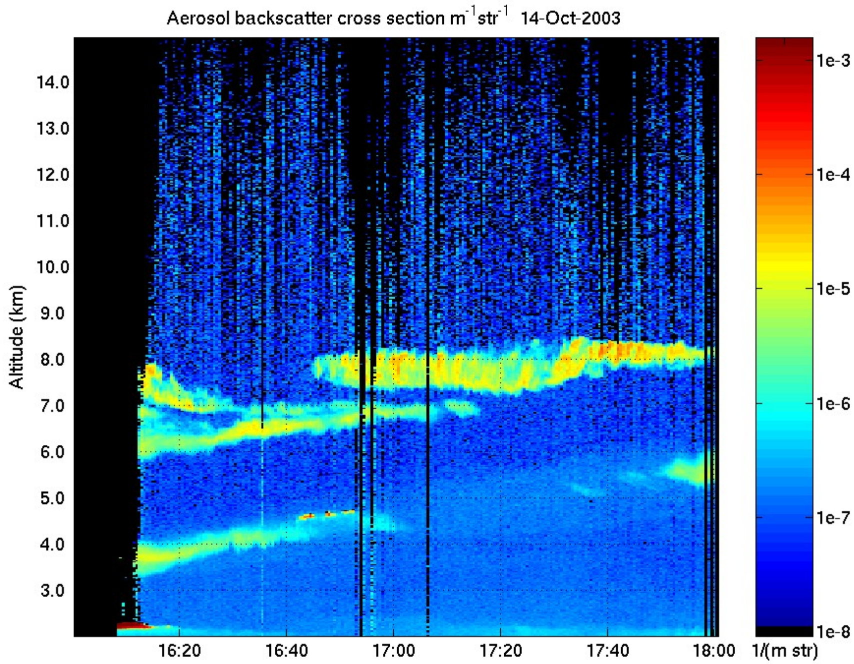
Optical Depth Thresholds for Detection of GLI/MODIS (MAS)

To estimate cloud optical detection limits cloud mask results from the MODIS and GLI were compared to ground based observations from the High-Spectral Resolution Lidar (HSRL), which measures visible optical depth. Comparisons were also made using the ER-2 borne cloud physics lidar and collocated observations of the MODIS Airborne Simulator (MAS).

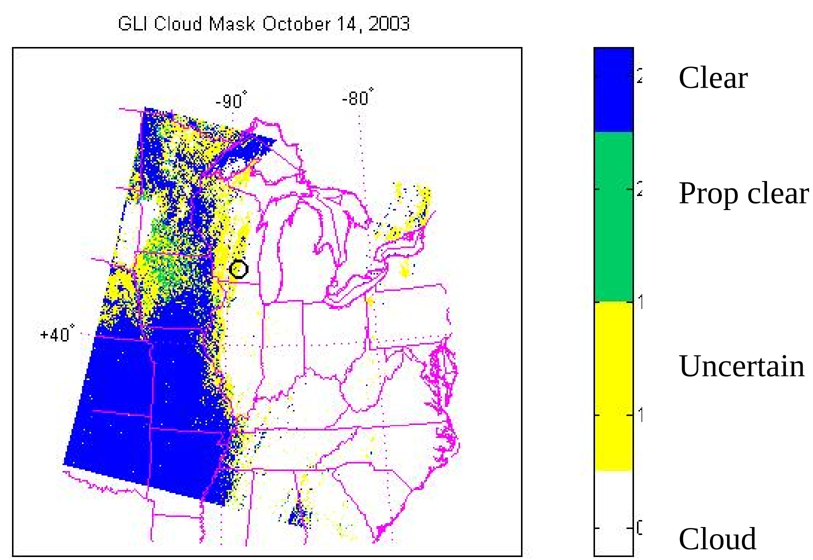
The number of occurrences that MAS scene was identified as clear and the cloud physics lidar detected a cloud optical depths (visible wavelengths). This figure suggests that the cloud limit is less then approximately 0.3, consistent with comparison with HSRL



Optical Depth Thresholds for Detection of GLI/MODIS (MAS)

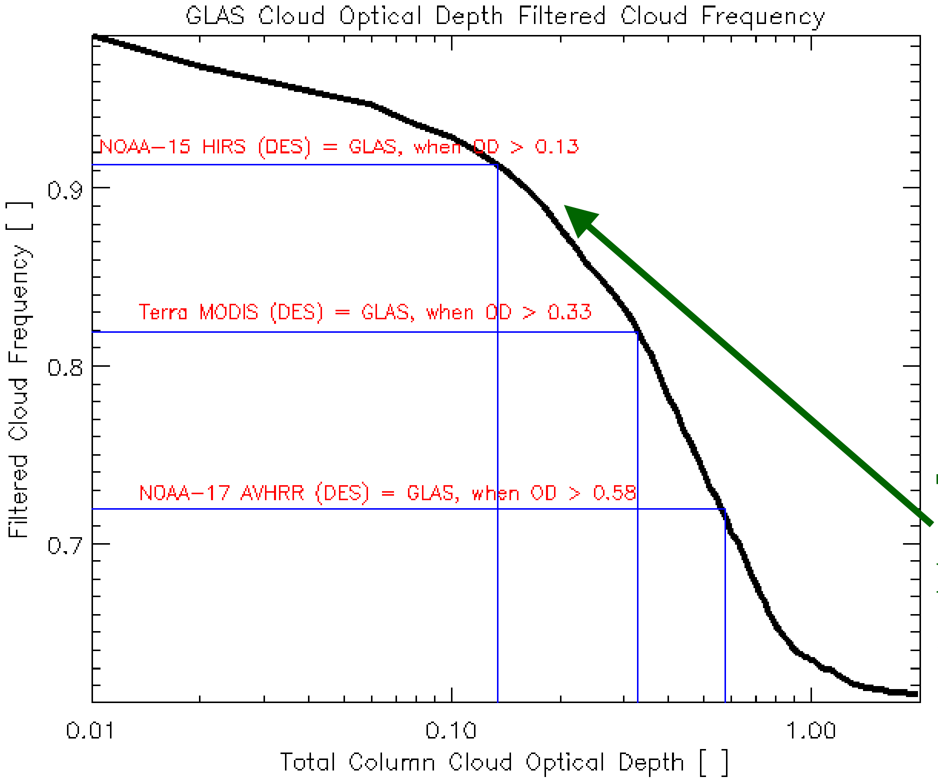


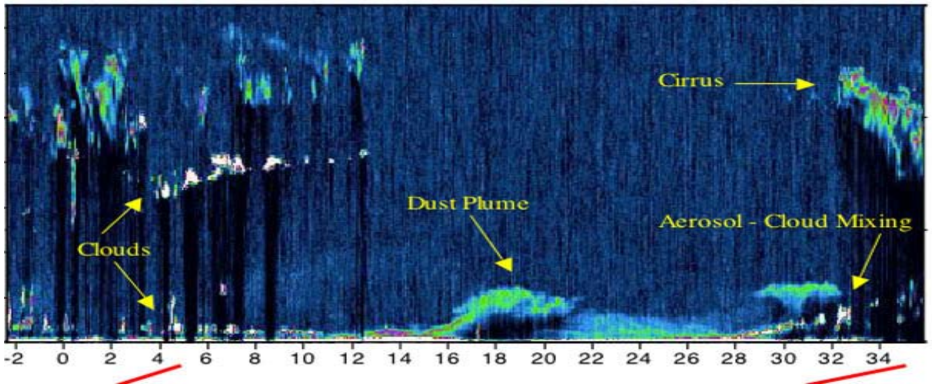
GLI and MODIS observations were compared to the HSRL site over the University of Wisconsin-Madison. The HSRL directly measures cloud optical depth at visible wavelengths.Initial results indicate that when the MODIS or GLI flag a cloudy region as Uncertain Clear, the optical depth is less then approximately 0.3.



More Passive and Active Sensing

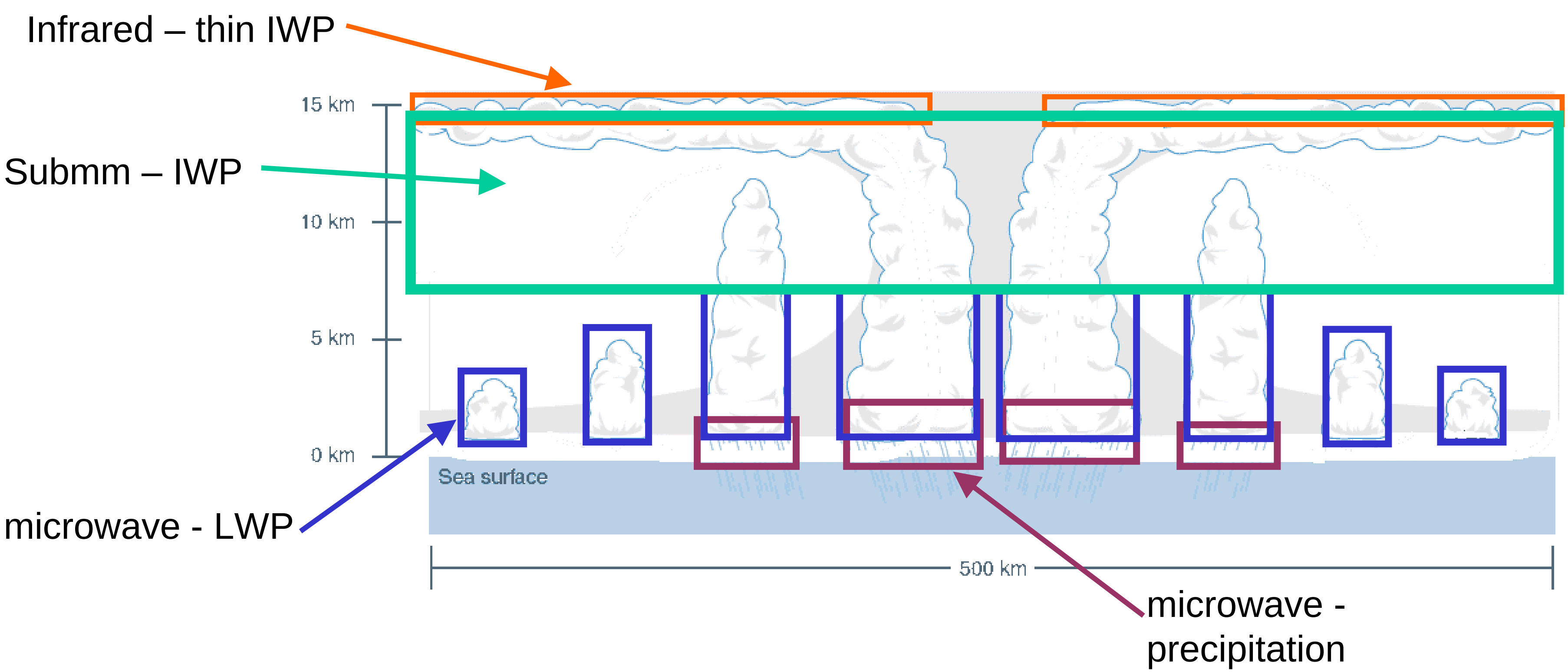
The GLAS cloud amount (for regions dominated by high cloud) is shown below as a function of optical depth filtering, in that the GLAS cloud amount at a given point on the curve was calculated using only observations with a total column optical depth greater than or equal to the value given on the x-axis. The AVHRR (CLAVR-x), the “VIIRS-like” MODIS (MOD35), and HIRS (Wylie and Menzel) intersects are shown on the plot and "OD" stands for optical depth. A month of data were used.





The greater the spectral resolution, the greater the sensitivity to thin clouds.

What cloud properties need to be measured?



Submm IR Ice Cloud Experiment

Provide global measurements of ice water path (IWP-defined as the vertically integrated mass of ice particles per unit area) and median mass particle diameter (D_{me}).

> **These measurements will have the temporal and spatial sampling required to resolve ice processes in cloud systems and yield accurate regional averages of needed cloud properties.**

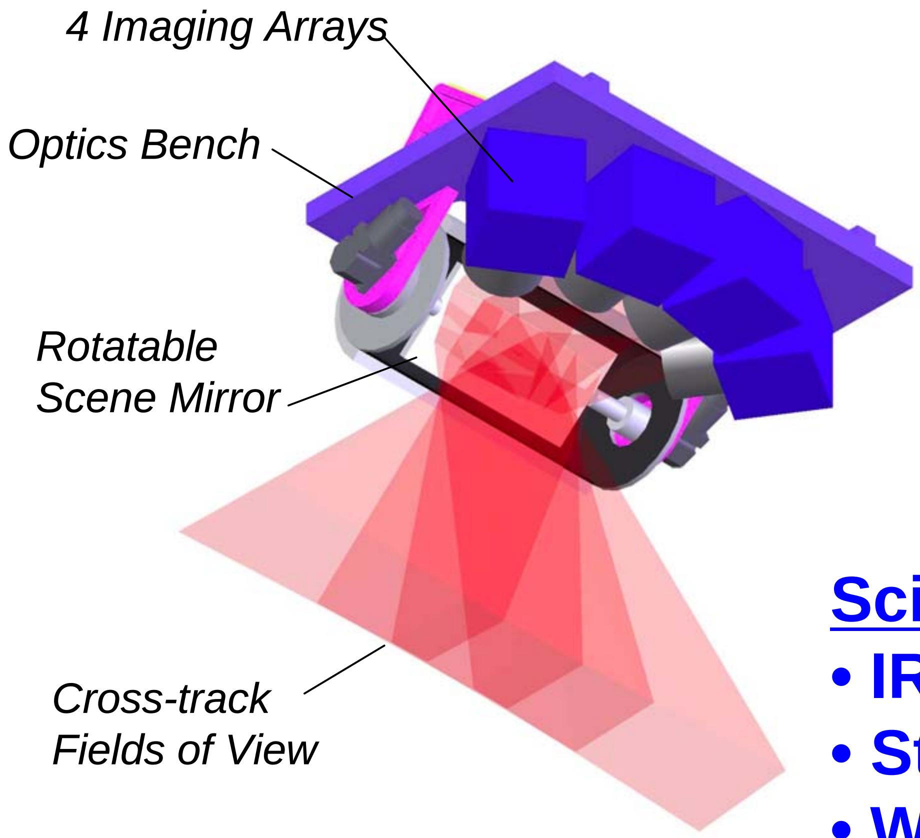
Characterize IWP and D_{me} distributions as a function of meteorological process, thus quantifying the contribution of upper tropospheric ice production by convection and synoptic lifting.

> **Application of measurements to cloud system modeling research will improve our understanding of ice cloud processes needed for improved climate predictions.**

Demonstrate new measurement capability by providing a unique data set of sub-mm wave radiances.

> **Earth scanning observations over this wavelength range and directly tied to ice cloud water mass and particle size are not available from any satellite platform.**

InfraRed Cloud Ice Radiometer (IRCIR)
(for a proposed SIRICE ESSP Mission)



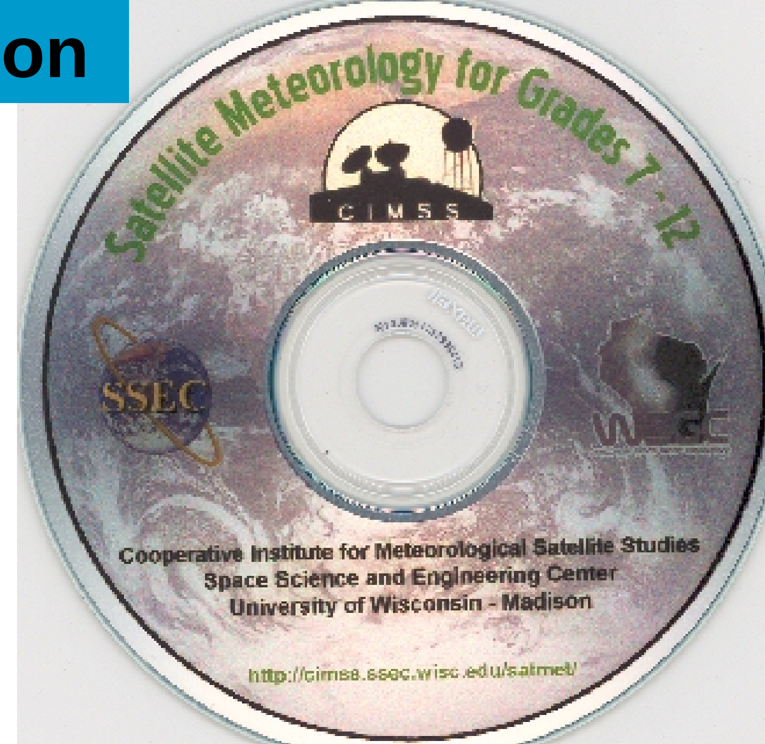
Science

- IR Cloud Height
- Stereo Cloud Height
- Winds (flying in orbit with NPP)

IRCIR Provides Full Cross-track Coverage using Four 640 x 480 pixel Uncooled Silicon Micro-bolometer Arrays

Outreach and Education

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



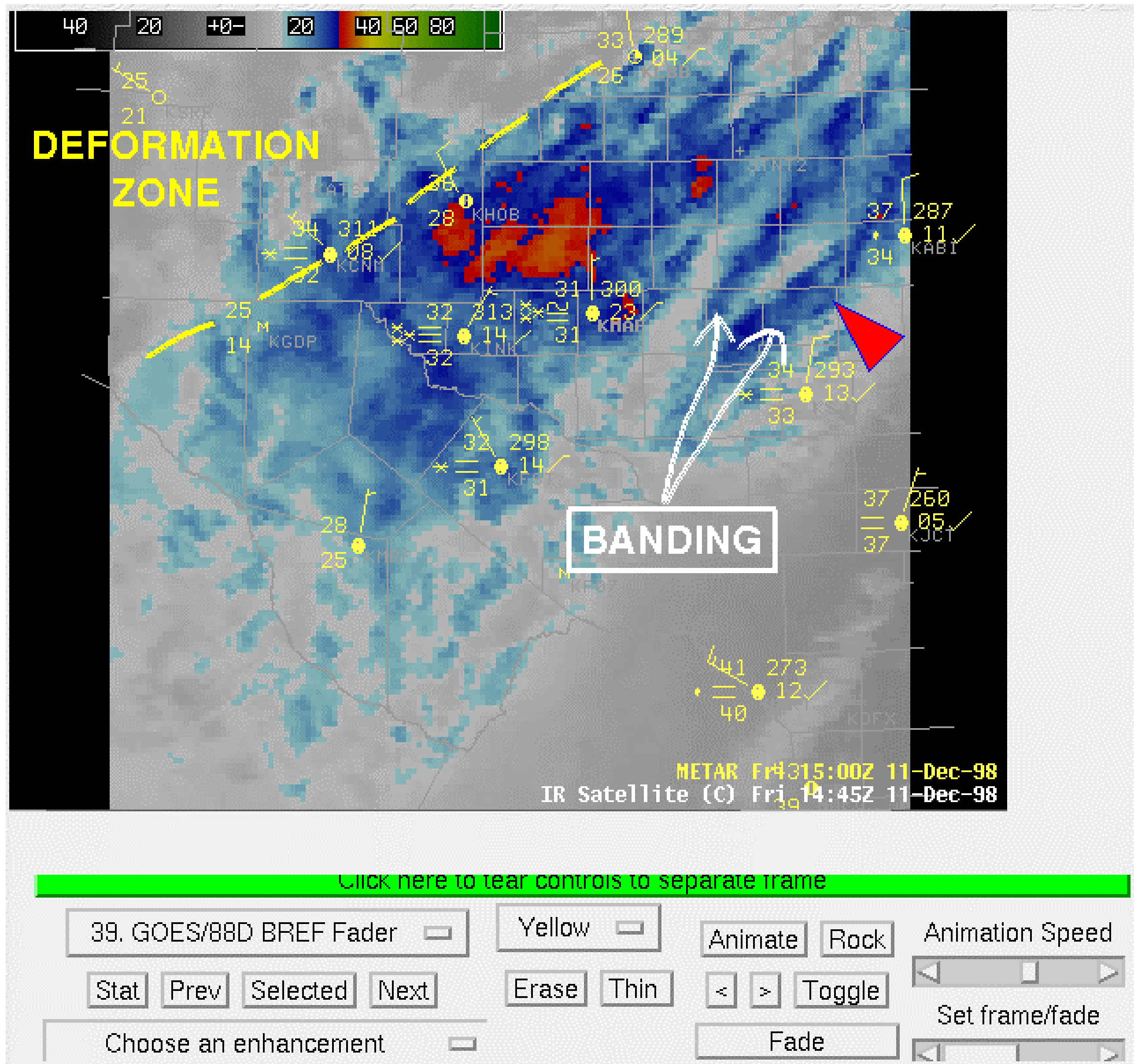
Satellite Meteorology CD
http://cimss.ssec.wisc.edu/satmet
Linked to the NESDIS and NPOESS Web pages!

2004 Teacher Workshop in Satellite Meteorology

28 teachers participated in the 2005 Teacher Workshop scheduled for June 28th & 29th

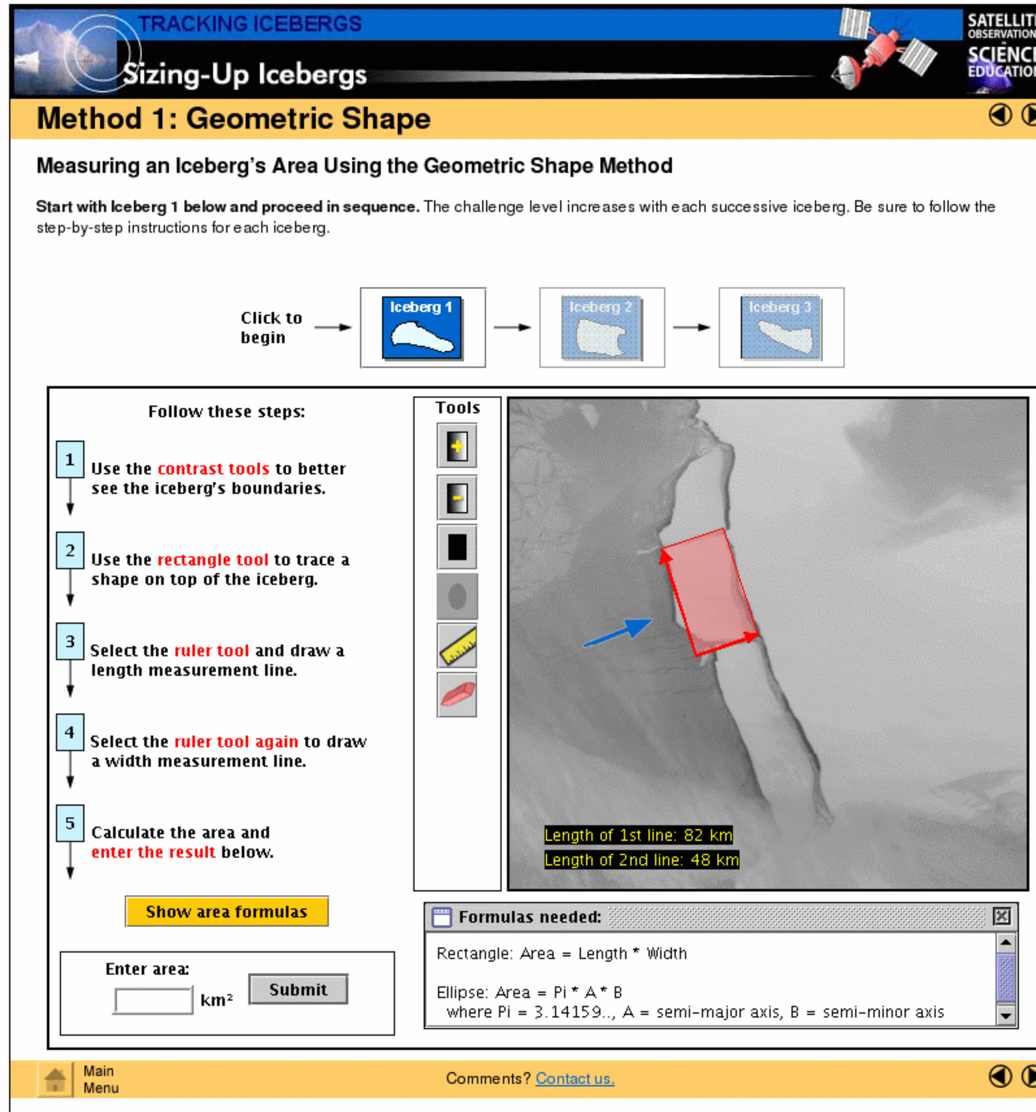
Distance Education: VISITView

Sample page from "Midland TX Heavy Snow Event" VISITview lesson, showing AWIPS GOES IR imagery with instructor annotation



Interactive Teaching

Screenshot of “Feature Sizer” RCO used in Sizing Icebergs lesson



CIMSS Research Community

Research communities bring people together for shared learning, discovery, and the generation of knowledge. Within a research community, all participants take responsibility for achieving the goals.

Importantly, research communities are the process by which individuals come together to achieve goals. These goals can be specific to individual projects or can be those that guide the entire institute.

Four core ideas define the research community process:

Research Community

1. Shared discovery and learning: Collaborative research activities where participants share responsibility for the learning and research that takes place are important to development of a research community.

Research Community

2. Functional connections among researchers: Research communities develop when the interactions among researchers are meaningful, when they are functional and necessary for the accomplishment of the "work“. Moreover, meaningful connections must extend throughout the research community—among students, postdocs, faculty, and staff—rather than simply among cohort- or role-related peers.

Research Community

3. Connections to other related research, applications and life experiences: Research communities flourish when implicit and explicit connections are made to experiences and activities beyond the program in which one participates at any given moment. These connections help situate one's research in a larger context by solidifying one's place in the broader community, decreasing one's sense of personal isolation.

Research Community

4. Inclusive environment: Research communities succeed when the diverse backgrounds and experiences of participants are welcomed in such a way that they help inform the group's collective research. Whenever possible, activities should be sought that help participants reach out and connect with others from backgrounds different from their own.

Thank you!

…and…

CIMSS the next 25 years