Agenda

- **Brief Overview of SAB**
- **Key SAB positions relevant to the Testbed**
- **Value of SAB as a Testbed Organization**
- **Summary of SAB Testbed Activities**
- **Lessons Learned**
- **Summary**
- **Backup (everything you wanted to know about SAB products)**
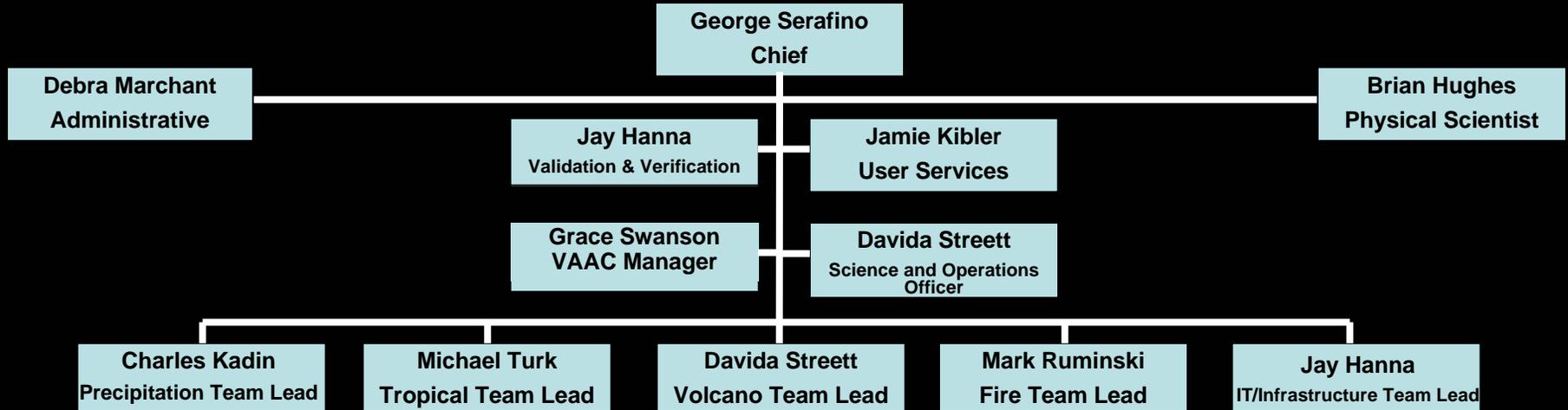
Satellite Analysis Branch

- **Serves as NOAA/NESDIS focal point for providing high quality, real time global satellite-derived products, interpretive analyses, and other information.**

- **These services, provided by professional meteorologists, support domestic and international meteorological warnings and forecasts, numerical weather models, climate analyses, and other initiatives within the Federal government.**

Satellite Analysis Branch

George Serafino
Chief

Debra Marchant
Administrative

Brian Hughes
Physical Scientist

Jay Hanna
Validation & Verification

Jamie Kibler
User Services

Grace Swanson
VAAC Manager

Davida Streett
Science and Operations Officer

Charles Kadin	Michael Turk	Davida Streett	Mark Ruminski	Jay Hanna
Precipitation Team Lead	**Tropical Team Lead**	**Volcano Team Lead**	**Fire Team Lead**	**IT/Infrastructure Team Lead**
Sheldon Kusselson	Gregg Gallina	Jamie Kibler	John Simko	Gregg Gallina
John Simko	Alan Schwartz	Michael Turk	Jamie Kibler	Nancy Merckle
Tom Baldwin	Michelle Spampata (RTi)	Tony Salemi (RTi)	Robert Evans (RTi)	Mark Ruminski
Jay Hanna	Tony Salemi (RTi)			Dustin Sheffler
Dustin Sheffler				Keith Liddick (RTi)
Keith Liddick (RTi)				Michelle Spampata (RTi)
Chris Warren (RTi)				

Product and Service Focal Points/Backups:

Snow & Ice: T. Baldwin / NIC
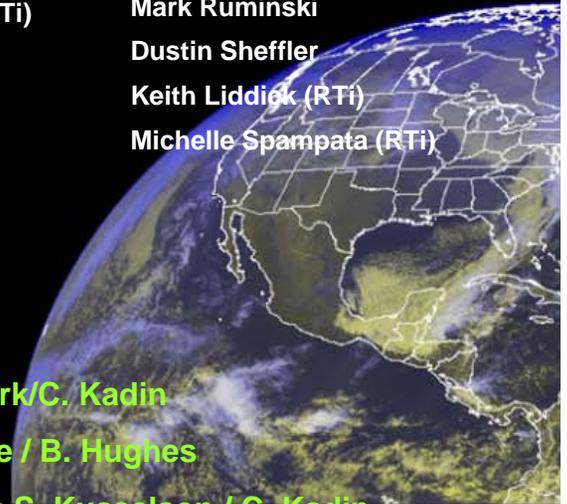
Air Quality: J. Simko / M. Ruminski

Scheduling: J. Hanna / J. Simko

OSEI: M. Shih (PSGS) / C. Holland

Training: M. Turk/C. Kadin

Web: N. Merckle / B. Hughes

DPI/Microwave: S. Kusselson / C. Kadin

SAB Mission Statement 2003

Satellite Analysis Branch serves as the operational focal point for real-time imagery products and multi-disciplinary environmental analyses within NOAA's National Environmental Satellite, Data, and Information Service (NESDIS). The Branch's primary mission is to support disaster mitigation and warning services for U.S. Federal agencies and the international community. Routine environmental analyses are provided to forecasters and the numerical models of the National Weather Service, and to oceanographic and other environmental users. The Branch schedules and distributes real-time satellite imagery products from global geostationary and polar orbiting satellites to environmental customers.
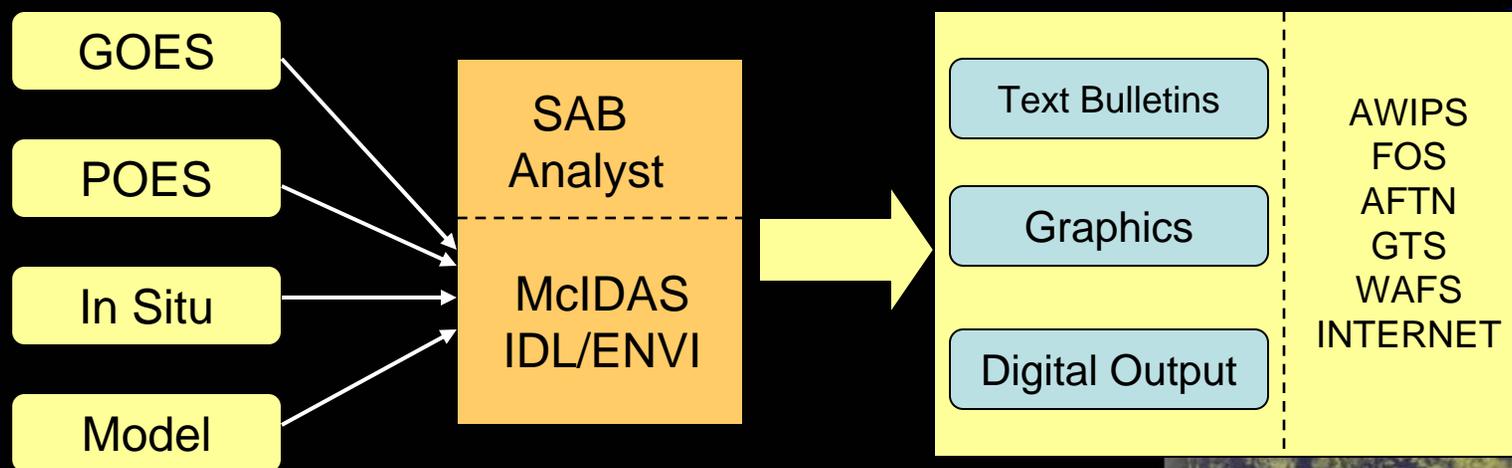
SAB Mission Statement 2008

The Satellite Analysis Branch serves as the operational focal point for real-time imagery products and multi-disciplinary environmental analyses within NESDIS. The Branch's primary mission is to support hazards mitigation and warning services for U.S. Federal agencies, the international community and other users by providing around-the-clock, quality-controlled environmental analyses for decision support applications. The Branch schedules and continuously monitors real-time satellite imagery products from global geostationary and polar orbiting environmental satellites for dissemination to customers. The Branch collaborates closely with its research partners to test, evaluate and validate the results of new interpretive satellite analysis techniques and satellite-derived products, and to assess their suitability for operational implementation and utility to existing and potentially new user communities. The Branch coordinates with internal and external partners to infuse new technology into science operations to better meet customer needs for products and services. Branch personnel are heavily engaged in outreach activities designed to increase customer awareness and use of environmental satellite data products

SAB Operations

- **24 x 7 Operations**
- **Interactive (man-machine mix) products**
- **Near realtime hazards-related product generation**
- **Quality assurance procedures utilized**
- **Validation / verification studies performed**
- **Testing and Evaluation of new satellite analysis methods**

SAB Product Summary

Discipline	Data Sources	Output Products	Frequency	Regions	Customers
Precipitation	GOES imagery; GOES DPI; AMSU, SSMI, TRMM RR/TPW	Text messages; Rainfall Graphics; Regular Briefings	Event-driven (as needed)	Lower 48 , Hawaii and Puerto Rico	NWS WFOs ; NWS RFCs ; NCEP HPC
Tropical	GOES, MTSAT, Meteosat imagery; SSMI BT/RR/TPW; TRMM, AMSU BT/RR; QuikSCAT winds	Text bulletins of tropical disturbance position & intensity; Rainfall Potential; Telephone coordination with Hurricane Centers	4 times per day (W. Hemisphere); 4 times per day (E. Hemisphere); 2 times per day (Indian Ocean)	Global Tropics	NCEP TPC ; NCEP CPHC ; JTWC ; WMO gov't agencies
Volcano	GOES and MTSAT imagery and sounder products; Meteosat and AVHRR imagery; planned OMI, AIRS SO2 signatures	Text advisories; Ash Cloud Graphics	Event-driven (at least every 6 hours if ash is discernible in imagery)	Lower 48, C. America, S. America to 10S, Central Pacific	MWOs, AWC, FAA, AFWA, FEMA, Airlines, other VAACs, NWS WFOs
Fire / Air Quality	GOES, AVHRR, MODIS imagery ; MODIS Rapid Response Fire Product	JPEG images and Web GIS maps of automated and manually detected hotspots / smoke /aerosols	Initial analysis at 1600 ELT; Final analysis at 2300 ELT	Lower 48. Canada and Alaska ; Mexican sector done by Mexican Weather Service	NWS SPC; NOAA ARL; EPA; USGS; BLM

Key Positions for SAT

- **Science Operations Officer (SOO)**
  - Leads efforts to infuse new science & technology into local operations
  - Seeks new applications for NOAA and non-NOAA observations
  - Works with V & V and Team Leads to develop quality management procedures for product generation

- **Validation and Verification (V & V) Lead**
  - Assesses the utility of a product for possible operational implementation
  - Leads, coordinates and engages in branch-wide validation studies
  - Develops strategy and procedures for testing functional & performance capabilities of candidate methodologies

- **Team Leads & Product Focal Points**
  - Directs efforts in the test and evaluation of candidate satellite products or satellite analysis methodologies
  - Provides direct interface to researchers and customer to solidify user requirements and ensure user satisfaction with product

- **Outreach Lead**
  - Plays crucial role in engaging and training current and potentially new users on utilization of satellite remote sensing products

Testbed Activities – Why SAB?

- Highly skilled multi-disciplinary meteorologists and physical scientists with many years experience in operational satellite analysis for various applications

- Established, long-term working relationship with research partners (STAR, CIRA, CIMSS, OAR, NWS/EMC, etc)

- Provides crucial link between operational customers engaged in decision support and the algorithm developers

- Serves as a "beta test" site for new and enhanced products and their applicability to customer needs

Testbed Activities – Why SAB?

- Frequently included in PSDI and NASA ROSES proposals as a test and evaluation site for new automated and interpretive products

- Through continuous customer contact SAB Outreach and Team Leads obtain first hand feedback from users and is used to advocate for customer needs

- Provides important feedback to developers on improvements needed (functional and performance) to be of use in an operational setting

- Experience with GOES and POES will be a valuable asset in upcoming NPOESS/ NDE and GOES-R algorithm evaluation

Testbed Efforts - Precipitation

|		
Convective Initiation	CIMSS, Univ of Alabama/ Huntsville	Algorithm tracks cloud elements on visible imagery and predicts potential for convective development up to 45 minutes in advance
Dendritic Snow Growth	NSSL	Algorithm uses GOES imager cloud top data and NWP data to determine where best lift is occurring through dendritic snow growth layer, a situation favorable for heavy snow.
Mesoscale Convective System (MCS) Index	CIRA	Index calculated from GOES sounder and NWP data to determine the likelihood that convection will undergo upscale growth into an MCS.
Precipitation Estimates	ORA	Automated techniques using GOES but also looking at blended GOES/POES methods currently under development
Microwave-derived snowfall	STAR	Uses N-15, 16, 18 and METOP AMSU/MHS observations to determine global snowfall rates over land
Blended TPW and TPW Anomaly	CIRA	Multi-instrument (SSMI-AMSU-GPS) merged precipitable water over land & water using MW satellite over ocean and ground-based GPS

Testbed Efforts - Tropical

Advanced Dvorak Technique	CIMSS	Objective tropical cyclone position and intensity estimates derived from geostationary IR data. SAB played a role in the precursors to the ADT: CIRA's DVORSE and CIMSS' Objective Dvorak Technique (ODT) in mid 90s followed by CIMSS' Advanced Objective Dvorak Technique (AODT). ADT represents more than 10 years of collaboration!
MW-based storm intensities	CIRA, CIMSS	Objective tropical cyclone intensity estimates derived from AMSU data. The CIRA algorithm also provides wind radii.
Satellite Consensus (SATCON)	CIRA, CIMSS	Objective tropical cyclone intensity estimates derived from a consensus of CIMSS ADT and AMSU intensity estimates and CIRA AMSU estimates.
Tropical Rainfall Potential (TRaP) & ensemble TRaP	STAR, BoM	Estimates of 24-hr rainfall associated from landfalling tropical cyclones derived from official RSMC and/or JTWC forecasts and MW (AMSU, TRMM, SSMI, AMSR-E) rain rates
Probability of Formation Parameter	CIRA	In 1994 SAB tested the Genesis Parameter (GP) which proved to be riddled with false alarms. Some 10 years later, SAB is now testing the Probability of Formation Parameter for the Atlantic, East and Central Pacific Oceans. Product has most recently been expanded to include the NW Pacific Ocean.

Testbed Efforts - Volcano

Infrasound	Natural Resources (Canada), Univ of HI, Univ of MS	Use of infrasonics to infer new eruption or change in volcanic activity in near-real time
Ash Cloud Detection using POES & GOES	UMBC, CIMSS, STAR, CIRA	Variety of ash detection algorithms, including CIMSS' IMAPP proposal
Ash Height Determinations	CIMSS	Development of CLAVR-x and GSIP-fd ash height products
Automated hotspot detection	CIMSS	Application of Wildfire Automated Biomass Burning Algorithm (ABBA) to eruption detection.
SO_2 detection	UMBC, NASA, ESA, STAR	Algorithms for OMI and GOME-2 SO2 and aerosol index to enhance volcanic alert system
Dispersion Models	STAR, INPE, Univ of AK	Forecasting location and extent of ash and SO2 in 6-18 hours
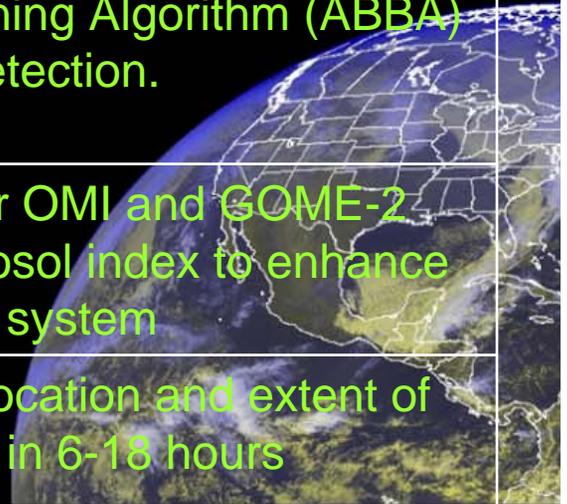
Testbed Efforts - Fire / AQ

Air Quality Forecast Initialization	NWS, EMC, ARL	Use of HYSPLIT model to improve representation of smoke emissions in air quality models
GOES Aerosol & Smoke Product (GASP)	STAR	Aerosol Optical Depth for determining smoke density using GOES visible data
Operational Linescan System (OLS)	NGDC	Use of DMSP/OLS data for fire detection and fire false alarm screening
IDEA (Future) 3D-AQS (Future)	CIMMS, STAR, UMBC	Infusion of satellite Data for Environmental Applications and 3D Air Quality System may be part of future testbed activities in SAB

Testbed Efforts - Other

- ## Synthetic Satellite Radiances
  - Simulated GOES observations using model output in a CRTM
  - useful for verifying consistency and fidelity of model data
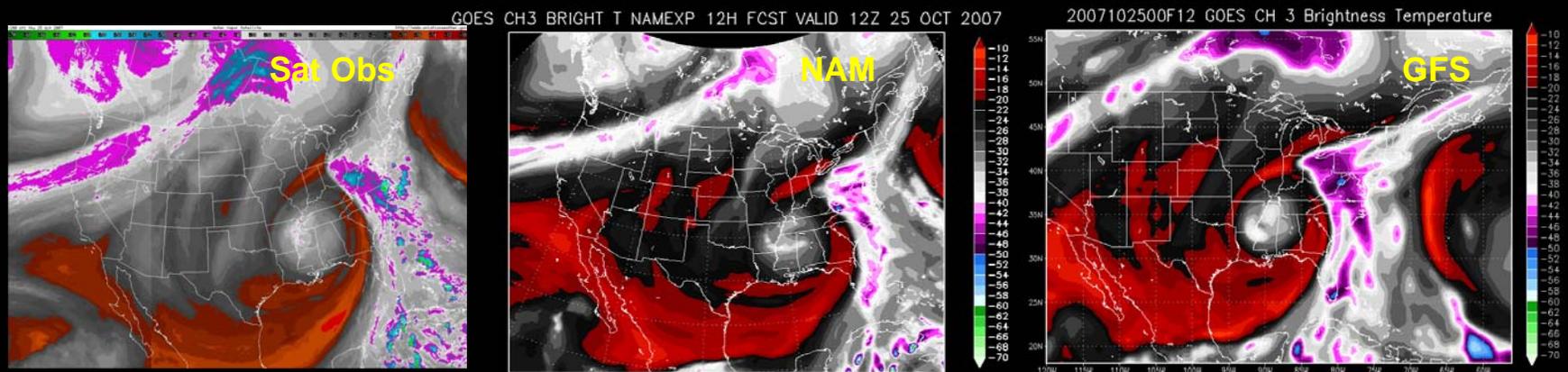
- ## Sensor Web
  - Engaged GSFC / JPL personnel on possible use of SAB as a testbed for autonomous EO-1 tasking for volcanic / fire events

- ## Neural Network Approaches
  - Participated with NASA/GSFC on efforts to utilize an NN approach to fire detection from multiple sensors
  - Near real-time Precipitation studies and nowcasting ?
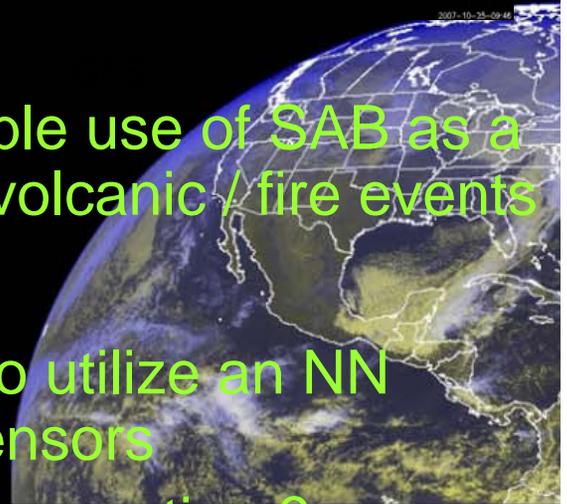
Testbed Lessons Learned

- Ground truth is critical! SAB's tropical testbed has benefited tremendously from Atlantic reconnaissance missions which provide ground truth from which to derive homogeneous comparisons between experimental products and SAB's subjective TC classifications

- Awareness of current research efforts is a vital component. Over the last decade the tropical testbed has attended professional conferences to increase such awareness and to establish initial collaboration which successfully builds upon itself

- The researcher needs assurances that their algorithm will get an independent and unbiased hearing if the testbed is to thrive and expand. Experienced analysts become critical as is ongoing open and honest communication between the researcher and the testbed.

- The end-user must be able to trust the testbed. The V&V methodology must be acceptable to the end-user, requiring an understanding of the their operation and communication with them throughout the validation process.

Testbed Lessons Learned

- Metrics matter! The formulation of sound metrics depends upon an accurate understanding of the end-user's operations. What is important to them?

- Infrastructure support is vitally important to the testbed, especially in the case of SAB where operational products are being generated according to short-fuse deadlines. The testbed needs to be able to gather the data with as minimal an impact as possible on the analysts while they generate their operational products.

- The testbed needs to conduct outreach efforts to ensure that the research community realizes that the testbed exists. The existence of a funding mechanism (e.g. PSDI) is very helpful.

- The testbed can serve as a conduit for useful feedback to the development organization for product or system improvements; there are many cases that can be cited in support of this in SAB

Testbed Lessons Learned

- Continuous dialog with the development organization and early embedding of the testbed personnel in the development process will help to reduce the number of iterations and ensure adherence to operational needs, thus serving to accelerate the research-to-operations transition.

- Testbed should continuously engage users especially as an algorithm approaches maturity

  - development of training material using expertise from operational satellite analysts provides real world experience. Example: inclusion of operational perspective at NPOESS Curriculum Workshops

  - Regular information exchange and updates on testbed efforts with customers. Example: bi-monthly SSD-NWS Center telecons including working level representatives from all NCEP centers, NCO, CPHC, and SSD staff serves to engender true team work between customer and provider.

Summary

- SAB has many years of *experience in operational satellite analysis* in the meteorological, hydrometeorological and physical science realms

- SAB serves as a *trusted agent* between the research community and the operational decision support organizations

- SAB has significant *experience in testbed activities* extending over many years and in various disciplines

- SAB is *available for further testbed studies* as NOAA enters a new era of advanced environmental remote sensing capabilities

BACKUP SLIDES

SAB Hazards Products

SAB Tropical Program

Tropical Storm Positioning and Intensity

- **Global analysis of Geostationary and Polar Orbiting data**

- **Satellite fixes on storm centers every six hours**

- **Western Hemisphere – data sent to NHC, CPHC**

- **Eastern Hemisphere – data sent to NOAA Family of Services as text bulletin**

GOES-EAST RGB IMAGE [CH1,CH1,CH4] - AUG 28 05 12:15 UTC   McIDAS
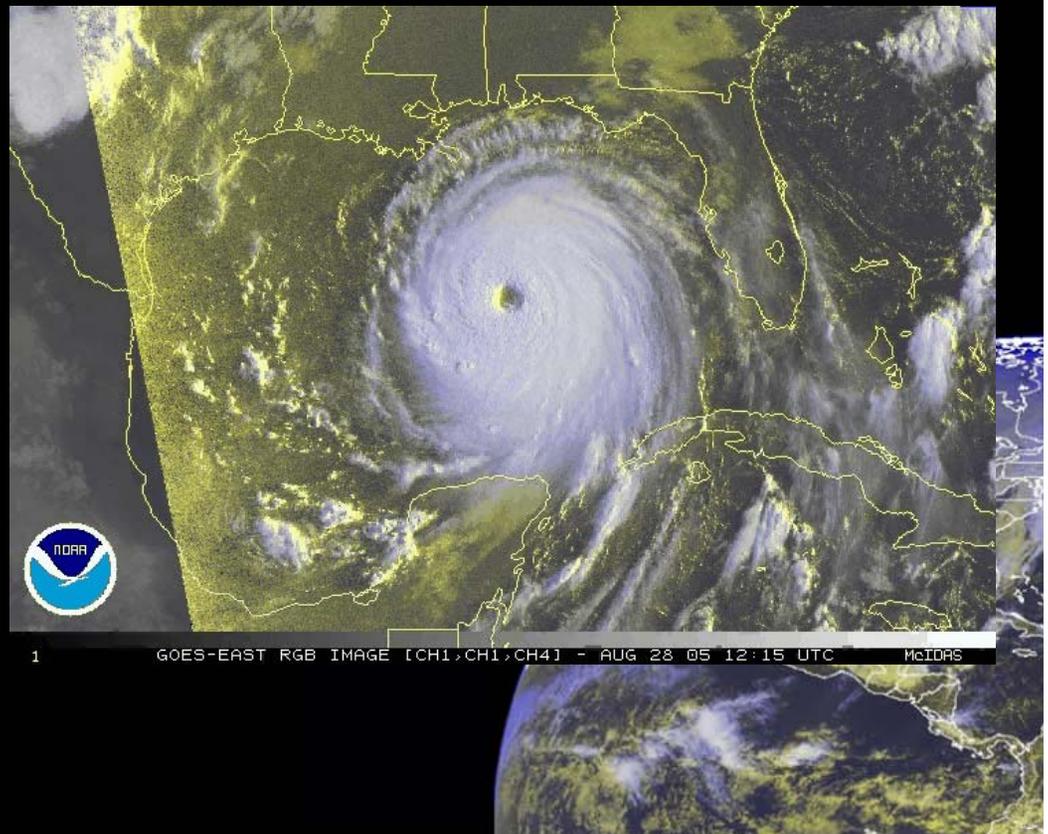
SAB Tropical Program

Tropical Rainfall Potential (TRaP)
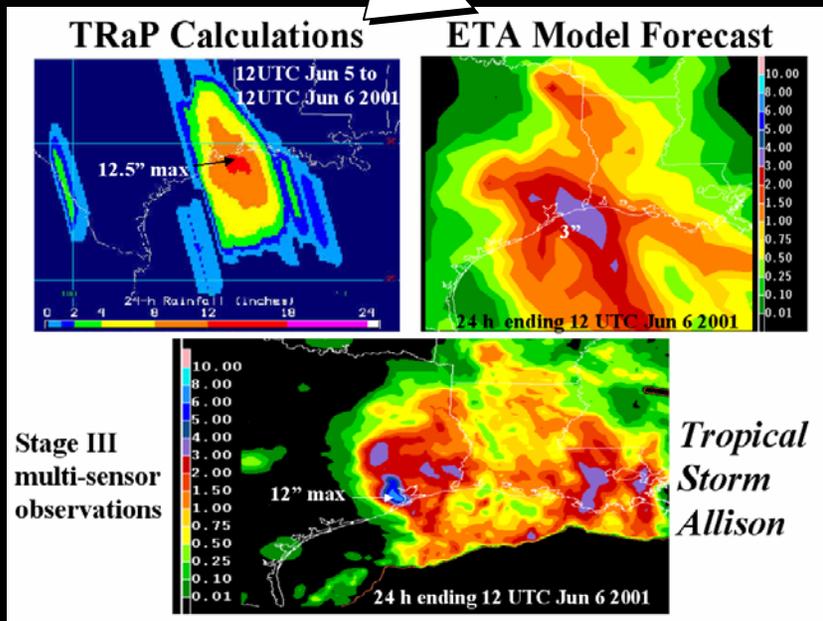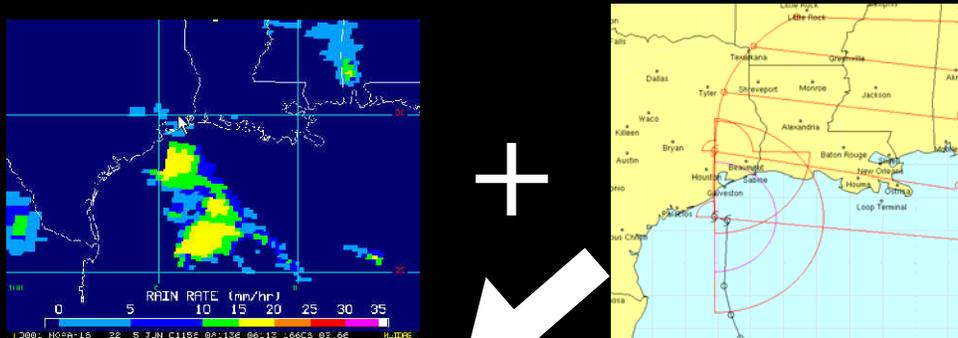
- **Calculates an objective rainfall potential map from the latest Rain Rates**

- **Extrapolates using McIDAS to 24 hours by every 6 hours using the latest NHC, CPHC, or JTWC forecast track**

- **Now fully automated – will run for every forecast and every latest rain rate produced**

- **Can be used with SSM/I, AMSU, TRMM, or GOES Multispectral Rain Rates**

SAB Tropical Program

Positioning: Finding the Surface Cyclone Center

Geostationary: Visible, IR2, IR4. (Goes and Meteosat)

Polar/Microwave: ("see through" clouds to surface)

NOAA AMSU – 89 GHz
DMSP SSMI – 37, 85 GHz
NASA TRMM – 37, 85 GHz (H and V polarizations)
NASA Quikscat – Surface winds
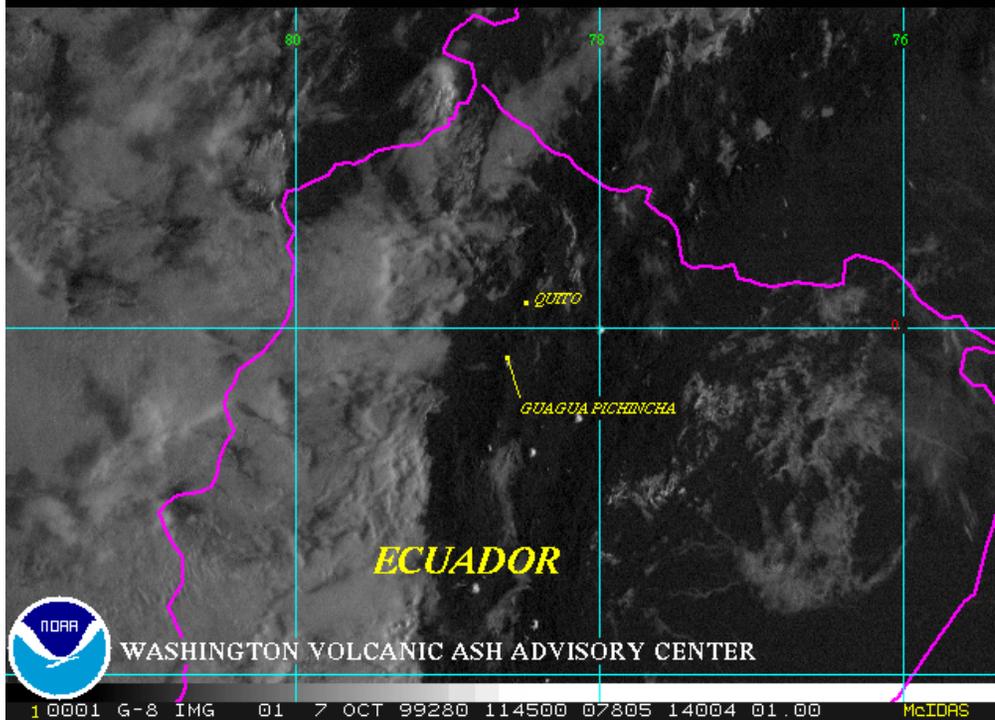NASA Aqua – 89 GHz (in office soon, only via web now)

AMSU
3/3/04 1404Z

SSM/I
3/3/04 1719Z

AQUA
3/3/04 2137Z

TRMM 37V
3/4/04 0815Z
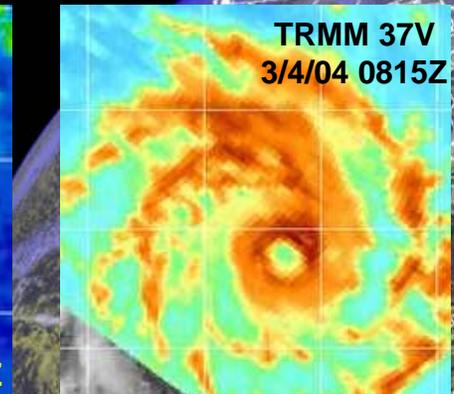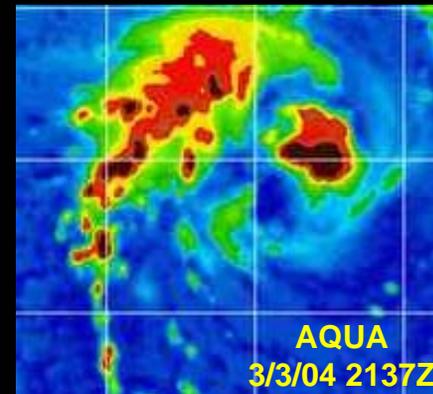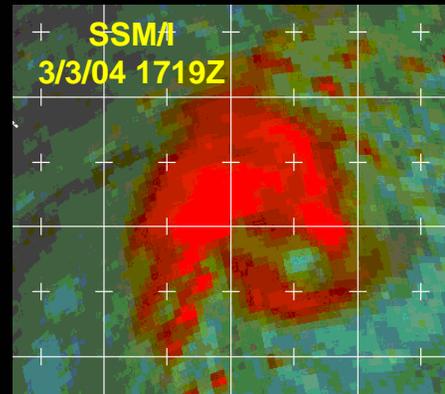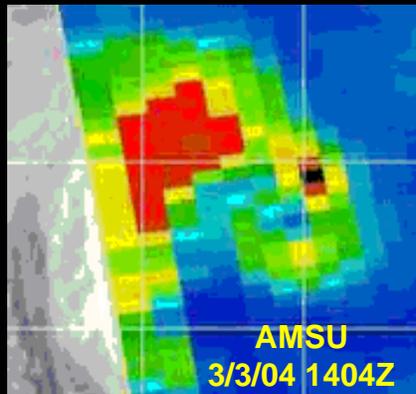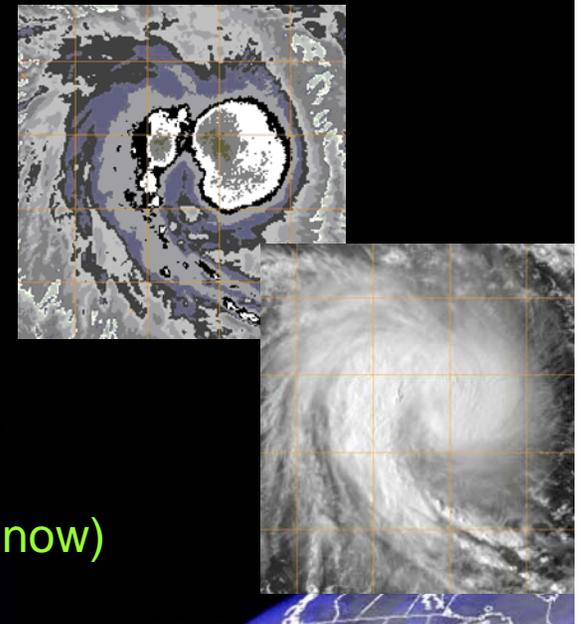
Imagery Courtesy of NRL

SAB Volcano Program

- **Volcanic Ash Analysis**
- **Washington Volcanic Ash Advisory Center (VAAC)**

- **Uses McIDAS to display and draw outline of ash visible in multichannel GOES imagery.**

- **Text product detailing the time, location, volcano, height and speed of the ash cloud is created and sent to customers vis the Global Telecommunications System (GTS) and NOAAPORT.**

# SAB Volcano Program

Example: Tungurahua in Ecuador September 23, 2001

• Ash can be difficult to discern using IR alone but using multiple channels around maximum silicate reflectivity bands (~12.7mm) can add more information to determining ash content.

• GOES 12 does not have channel 5 but can substitute channel 6

GOES-8 VISIBLE

Channel 1

GOES-8 SPLIT WINDOW

Ch 4- Ch 5

GOES-8 THREE CHANNEL IR

Channels 2,4 & 5
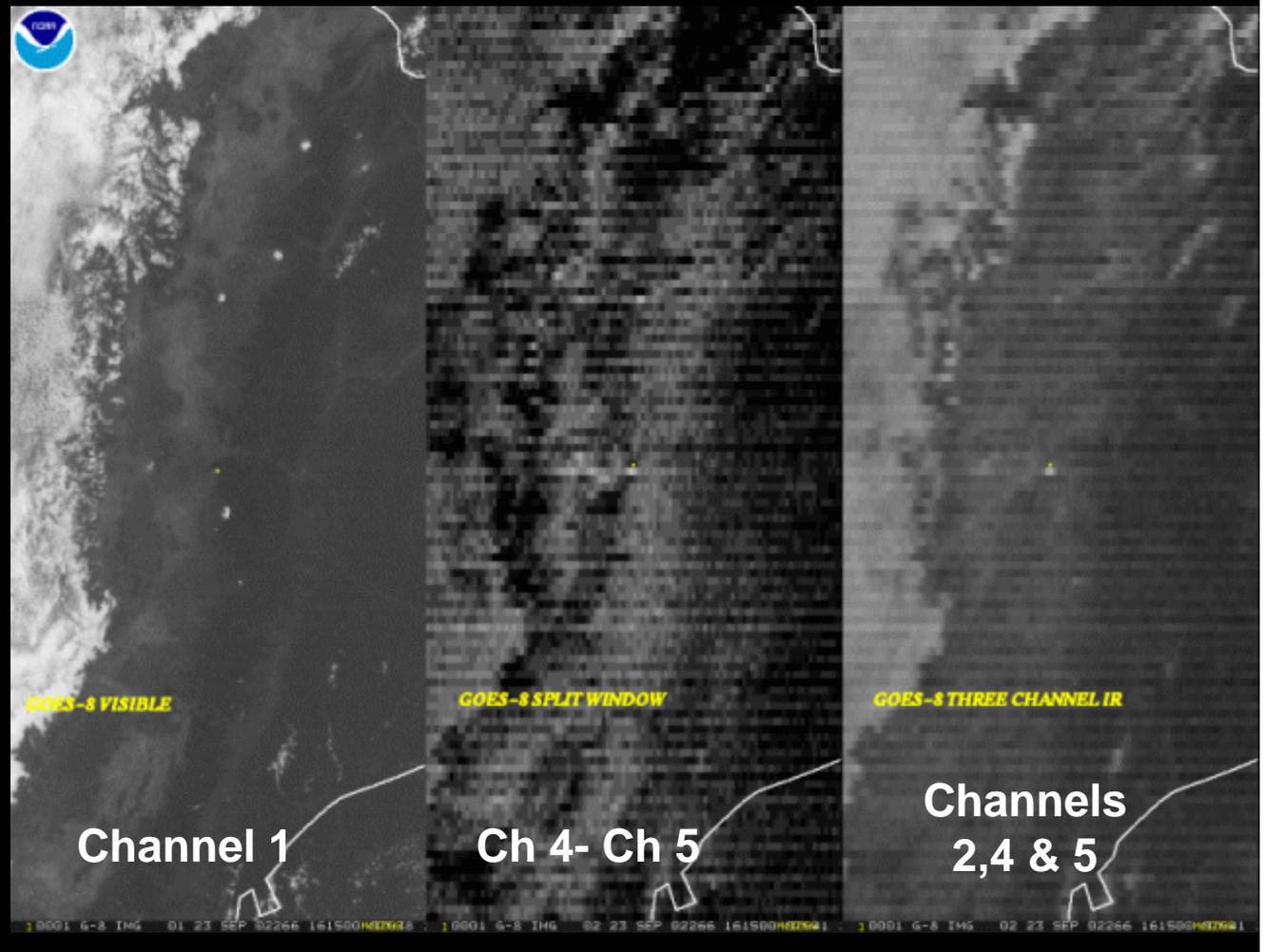
SAB Fire / Smoke Program

Fires and Smoke: Using infrared imaging technology from GOES, POES and non-NOAA polar orbiting satellites (MODIS), SAB analysts can pinpoint wildfires in all US states, S. Canada and N. Mexico with up to an accuracy of 1 km. Visible sensors can show large smoke plumes from those fires. Users such as the National Interagency Fire Center in Boise, Idaho and the Storm Prediction Center use analyses to aid in the detection and mitigation of devastating wildfires while local Environmental Protection Agencies (EPA) monitor smoke areas for health and pollution issues.
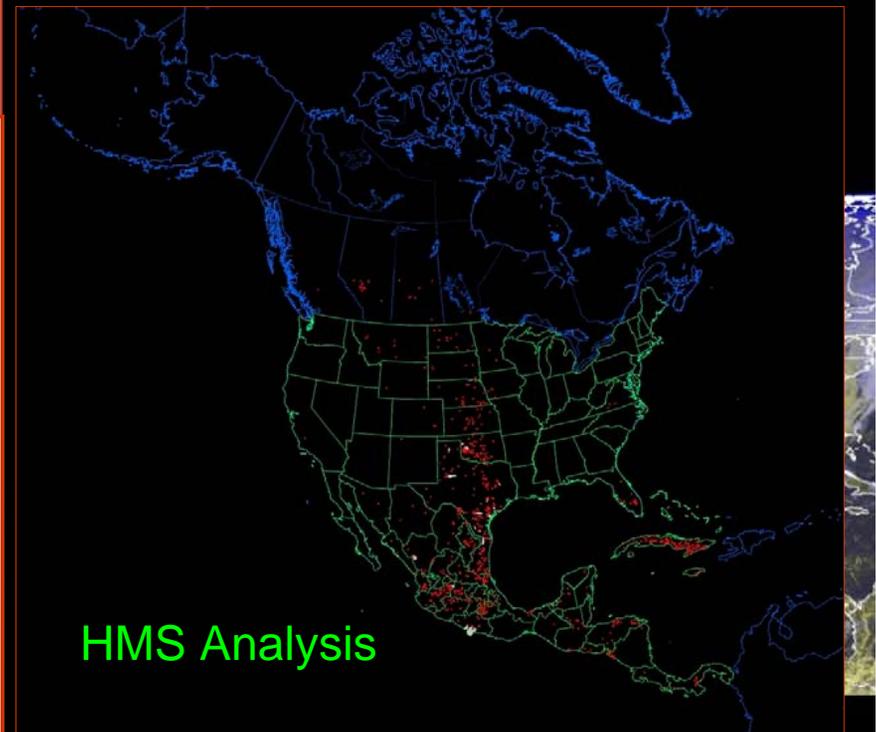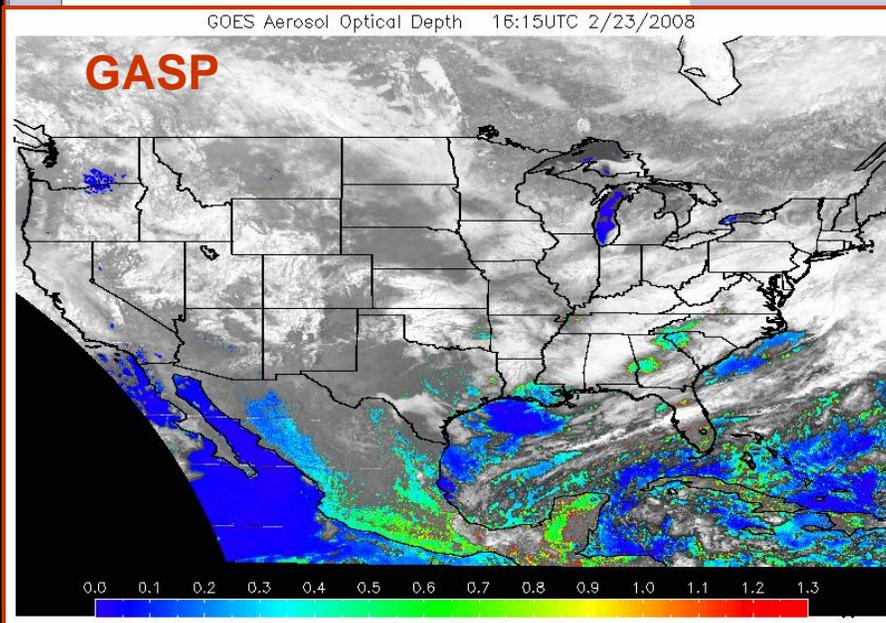
SAB Fire / Smoke Program

NGDC Archive
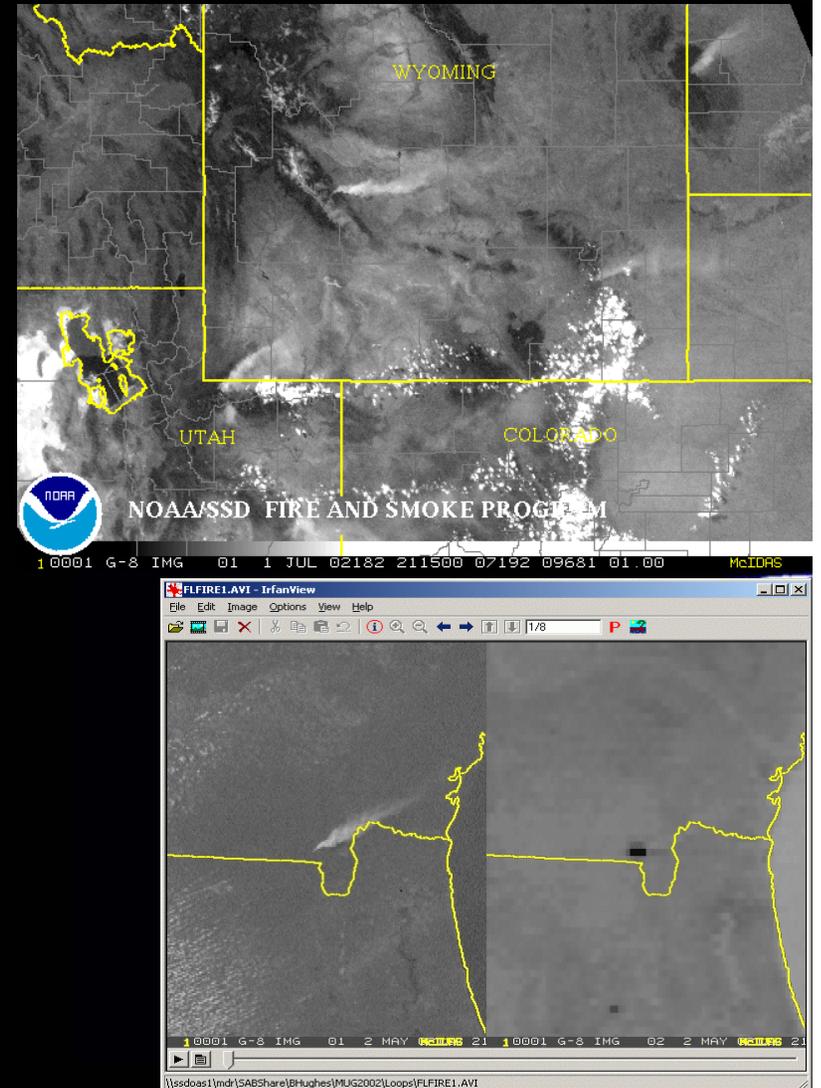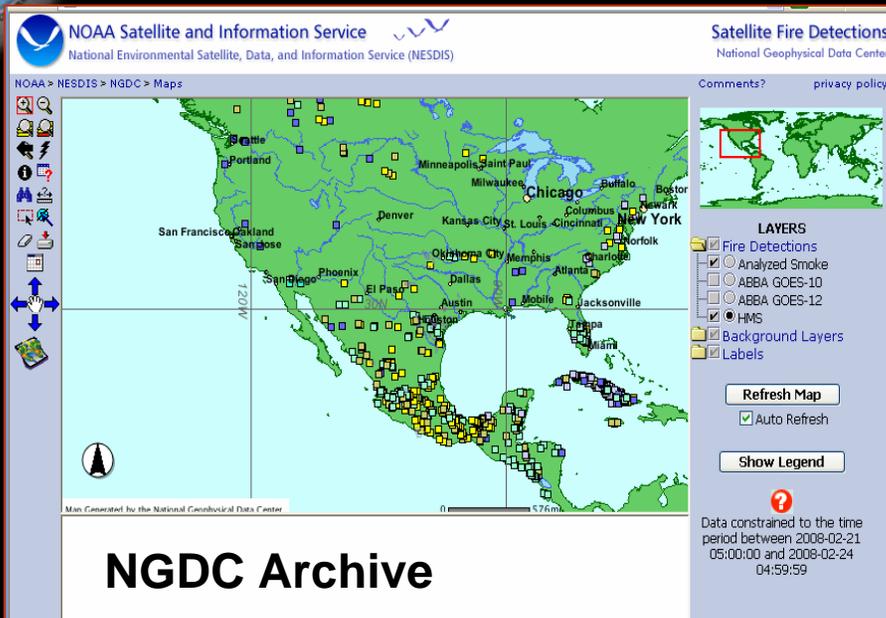
GASP

SAB Fire / Smoke program uses GOES, AVHRR and MODIS fire detects to create a QC'ed analyzed product using the Hazard Mapping System (HMS). Information from the GOES Aerosol & Smoke Product (GASP) is also used with visible imagery to create smoke extent graphics. Fire point data is archived at NGDC.


HMS Analysis

Satellite Precipitation Program

Heavy Rain/Snow Analysis and NOWCasting

- Animated imagery used to identify movements and trends in specific meteorological parameters such as Precipitable Water, Rain Rate, Cloud Liquid Water, Jet Streams, waves, Vorticity centers, etc.

- Analysis of data given to NWS HPC as part of Precip forecasts and to NWS offices in Satellite Precip. Estimate Messages
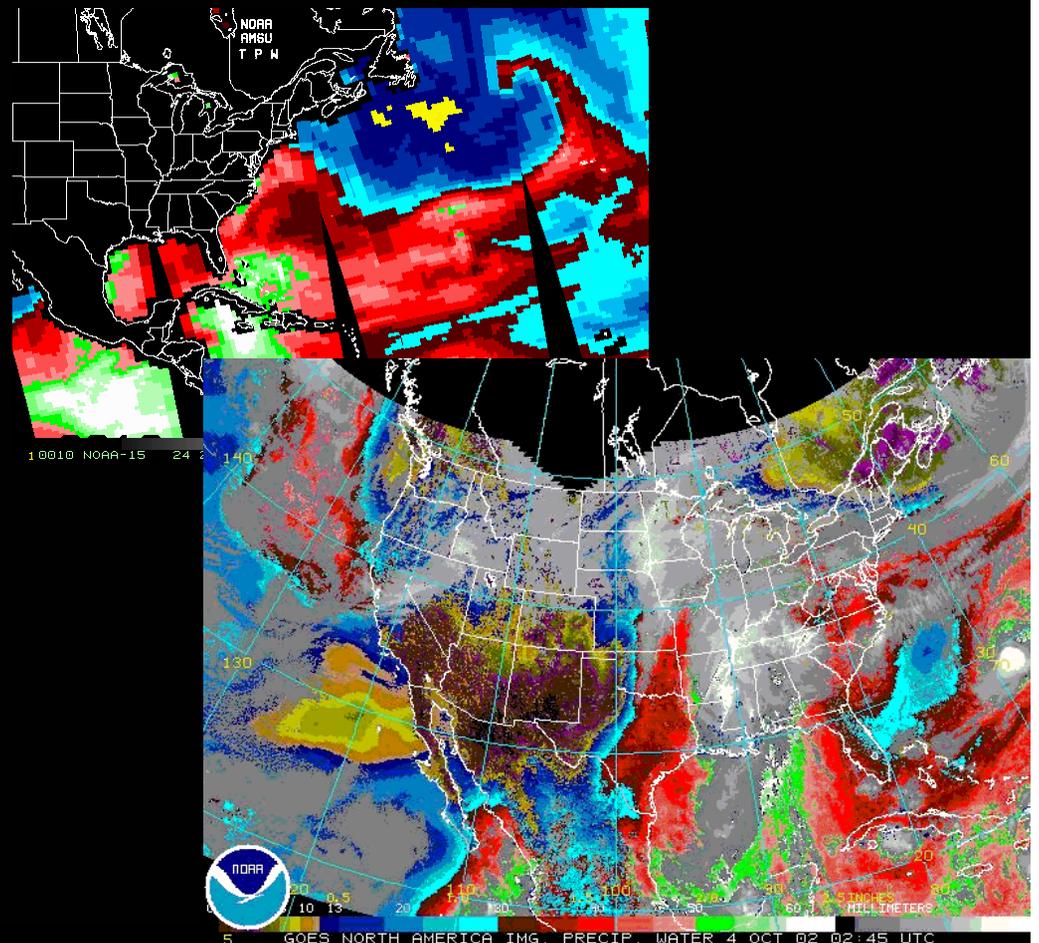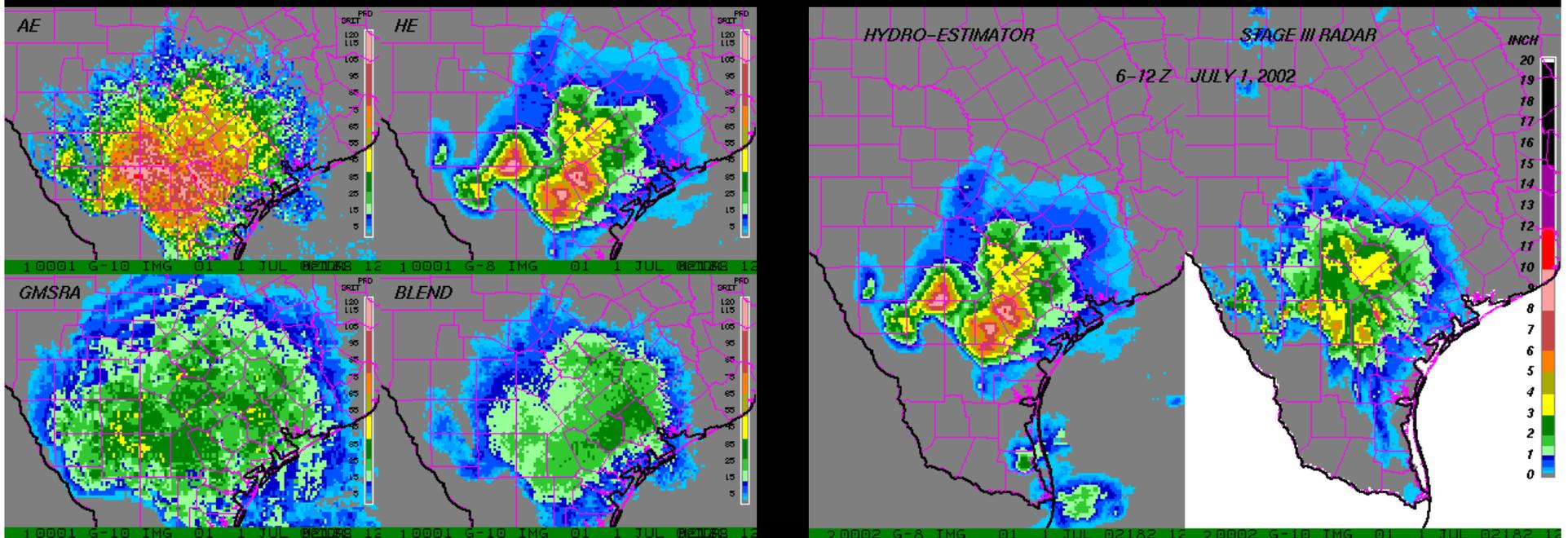
Satellite Precipitation Program

The AutoEstimator and Hydro-Estimator

Computer algorithm that blends GOES, POES, Model, and Radar data into one product that will analyze precipitation amounts every 15 minutes and produce quantitative precipitation totals.

Snow and Ice Product

Daily N.H. Snow and Ice Analysis

Satellite Analysis Branch meteorologists produce a daily snow and ice cover map using various satellite data as input, especially fast looping GOES and POES Visible imagery. Analysis is input into operational models.