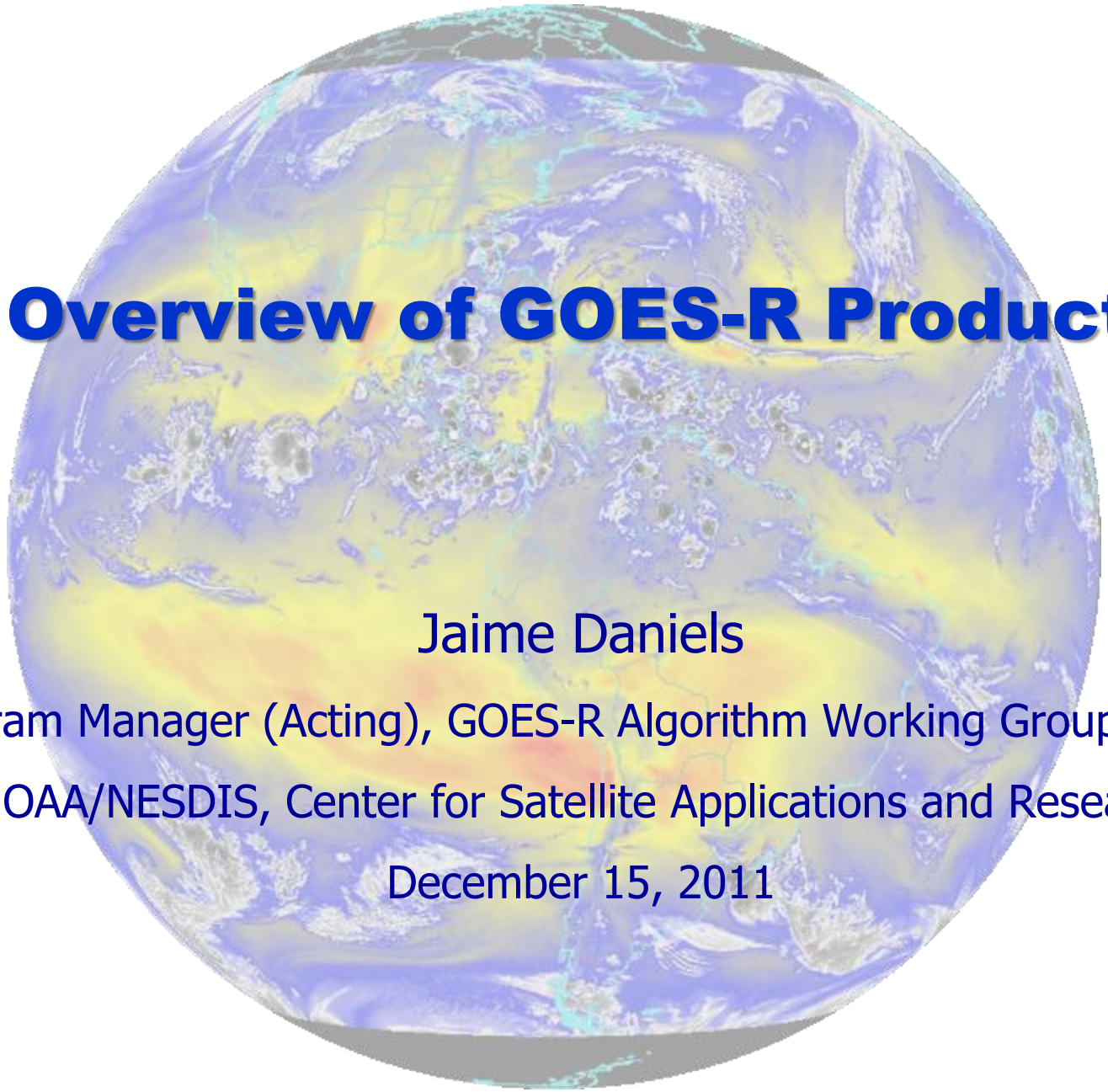


Overview of GOES-R Products

Jaime Daniels

Program Manager (Acting), GOES-R Algorithm Working Group (AWG)

NOAA/NESDIS, Center for Satellite Applications and Research

December 15, 2011

Thanks to: GOES-R AWG product teams, Proving Ground Participants

OUTLINE

- **Introduction**

- **Product Overview (Baseline)**
  - Cloud and Moisture Imagery Product from the Advanced Baseline Imager (ABI)
  - GOES-R Level-2 Products (ABI and GLM)
  - Product Examples, Algorithm Highlights, Operational Applications

- **Future Capabilities Products**
  - GOES-R ABI Level-2 products
  - Product Examples, Algorithm Highlights, Operational Applications
  - Prioritizing
  - Opportunity to address evolving user needs

Introduction

- **GOES-R Algorithm Working Group (AWG)**
  - Developed and delivered the Level-2 product algorithms to the GOES-R Program (includes ATBDs and test product datasets)
    - Extensive use of available proxy data (GOES,SEVIRI,MODIS, etc) and reference/"ground truth" observations to validate performance
  - Algorithm Teams are currently:
    - Developing product validation tools
    - Pursuing more complete product validation using additional proxy data
    - Performing more case studies – difficult cases, in particular
    - Supporting Harris/AER implementation efforts
- **Harris/AER**
  - Implementing the Level-2 product algorithms into the GOES-R Ground Segment
  - Technical interactions with the AWG are ongoing
- **Increasing Focus on User Readiness/Training and Evolving User Needs**
  - GOES-R Proving Ground (PG), GOES-R Risk Reduction (GOES-R3), AWG
  - Joint Center for Satellite Data Assimilation (JCSDA)
  - NDE/JPSS (Proving Ground & Risk Reduction)

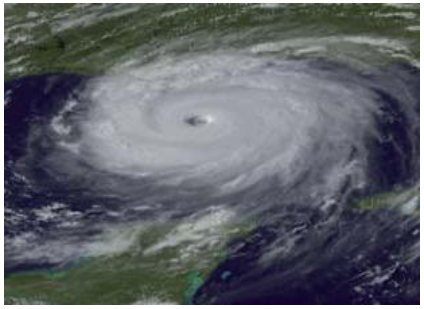
GOES-R Instrument Overview

GOES-R is the next generation of GOES satellites that will provide a major improvement in quality, quantity, and timeliness of data collected.

Earth Pointing

ITT

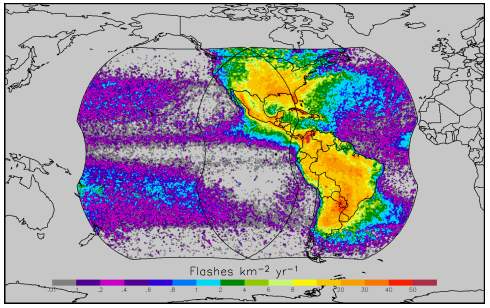
Visual & IR Imagery



- ***Advanced Baseline Imager (ABI)***

LOCKHEED MARTIN

Lightning Mapping

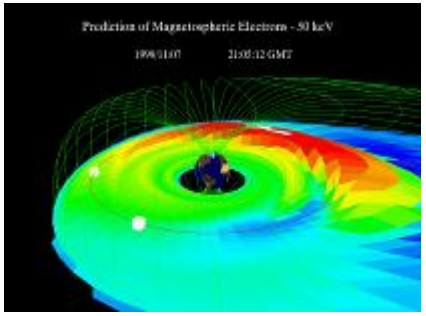


- ***Geostationary Lightning Mapper (GLM)***

In-Situ

Assurance Technology Corporation

Space Weather Monitoring



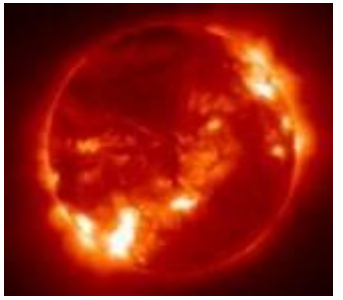
- ***Space Environment in-Situ Sensor Suite (SEISS)***
- ***Magnetometer***

Sun Pointing

LOCKHEED MARTIN

LASP

Solar Imaging



- ***Solar Ultra-Violet Imager (SUVI)***
- ***Extreme UV/X-Ray Irradiance Sensors (EXIS)***

New and improved capabilities for:

- Increased lead times for severe weather warnings
- Better storm tracking capabilities
- Solar, space weather, and climate analyses
- Advanced products for aviation, transportation, commerce

GOES-R ABI vs. GOES Imager

	ABI	GOES Imager
Spectral Coverage		
	16 bands	5 bands
Spatial resolution		
0.64 μm Visible	0.5 km	Approx. 1 km
Other Visible/near-IR	1.0 km	n/a
Bands (>2 μm)	2 km	Approx. 4 km
Spatial/Temporal coverage		
Full disk	4 per hour	Scheduled (3 hrly)
CONUS	12 per hour	~4 per hour
Mesoscale	Every 30 sec	n/a
Visible (reflective bands)		
On-orbit calibration	Yes	No

ABI Level-2 product algorithms will take advantage of the ABI's improved spectral coverage, higher spatial resolution, and improved temporal coverage.

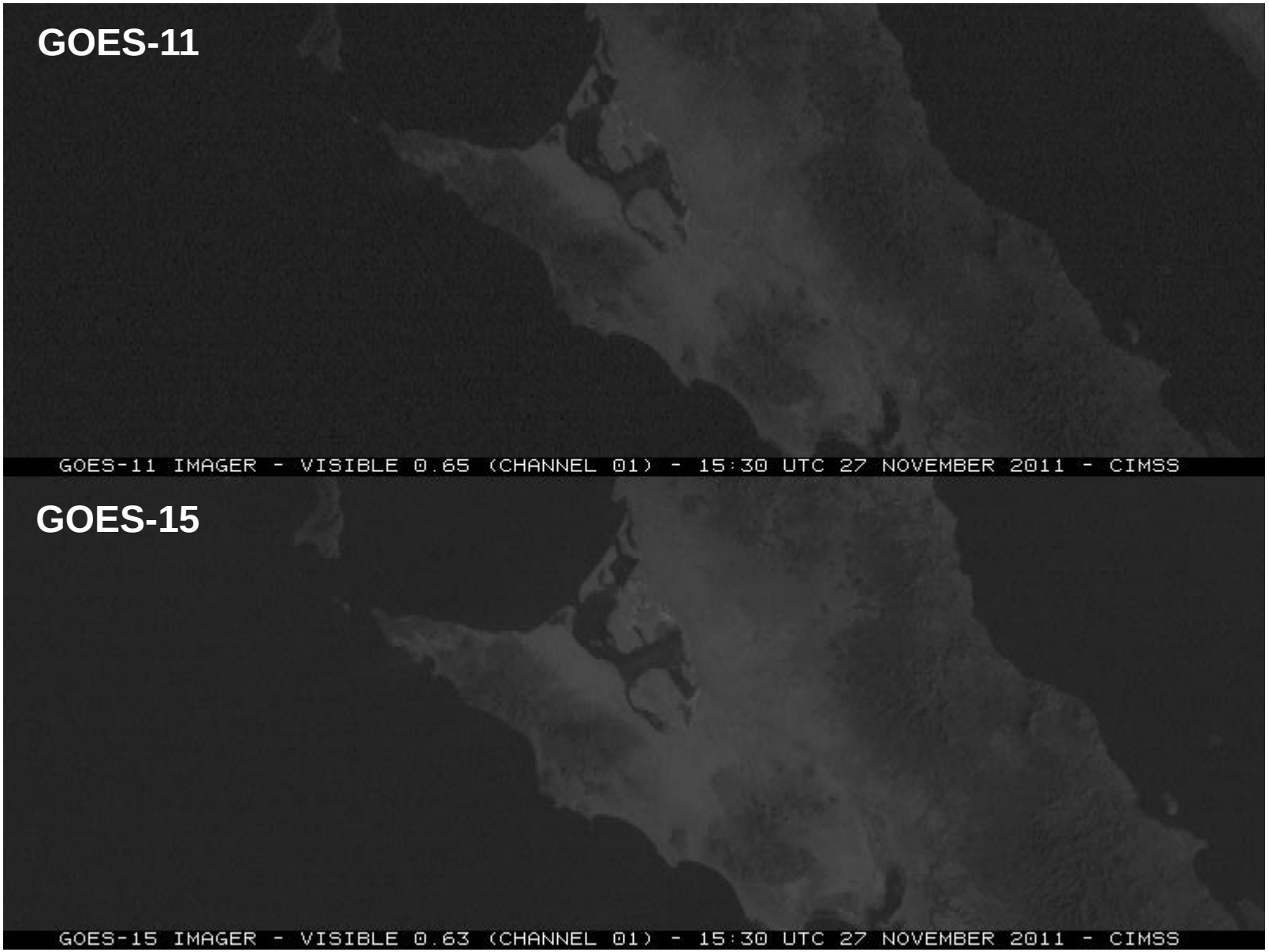
Channel Noise Comparison

GOES-R ABI			GOES Imager			GOES-12	GOES-15
Channel	Freq.(um)	Spec	Channel	Freq. (um)	Spec	Measured (PLT)	Measured (PLT)
7	3.9	0.1	2	3.9	1.4	0.130	0.063
8	6.185	0.1					
9	6.95	0.1	3	6.x	1.0	0.15	0.17
10	7.34	0.1					
11	8.5	0.1					
12	9.61	0.1					
13	10.35	0.1					
14	11.2	0.1	4	10.7	0.35	0.11	0.06
15	12.3	0.1	5	12.0	0.35	-	-
16	13.3	0.3	6	13.3	0.32	0.19	0.13

GOES-R ABI: Instrument noise will be similar to that measured for current GOES even with the much finer spatial resolutions!

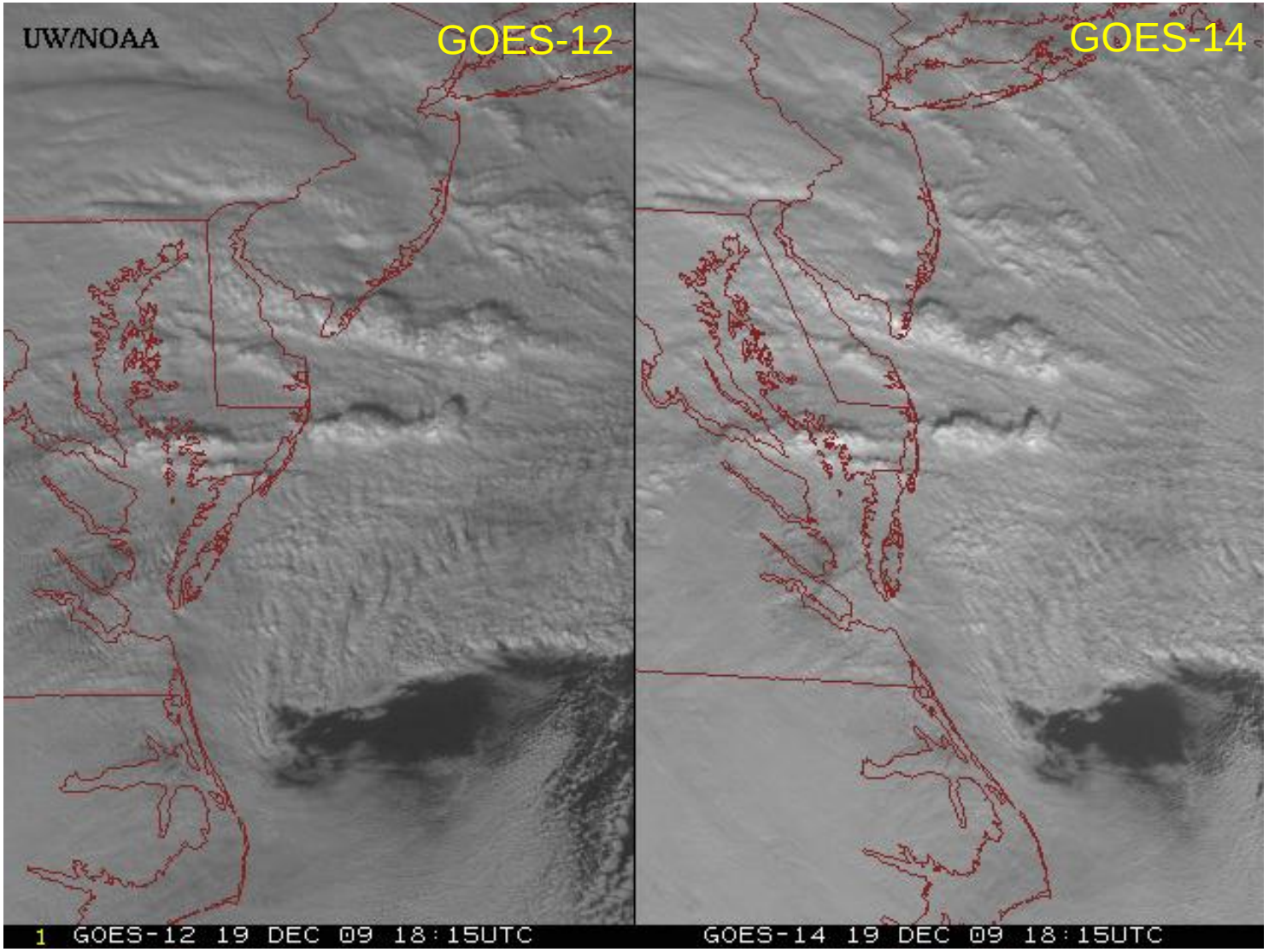
Improved Navigation & Registration

GOES-15 provides a hint of ABI's INR quality…



GOES-14: Sample “1-min” imagery

A hint of what GOES-R will routinely provide…



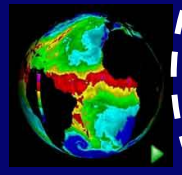
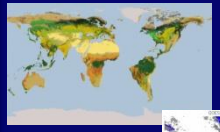
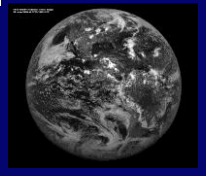
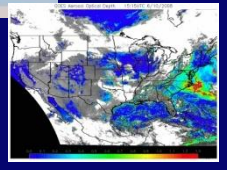
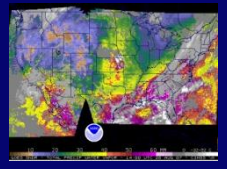
Visible data from the GOES-14 NOAA Science Test, lead by Hillger and Schmit

Pre-Launch Characterization of Level-2 Algorithm Performance

Proxy Data (GOES, SEVIRI, MODIS, etc)





Seasonal conditions represented

Wide variety of atmospheric and surface conditions are represented

Algorithm Iterations

Level 2 Product Generation

Validate with Ground Truth

As algorithms mature…

- ✓ Better estimates of product performance
- ✓ Increased confidence that on-orbit product performance will meet specs
- ✓ Increased confidence that user needs are met

AWG is responsible for Level-2 product accuracy and precision specifications, and therefore, established and used robust pre-launch algorithm testing strategies for each product.

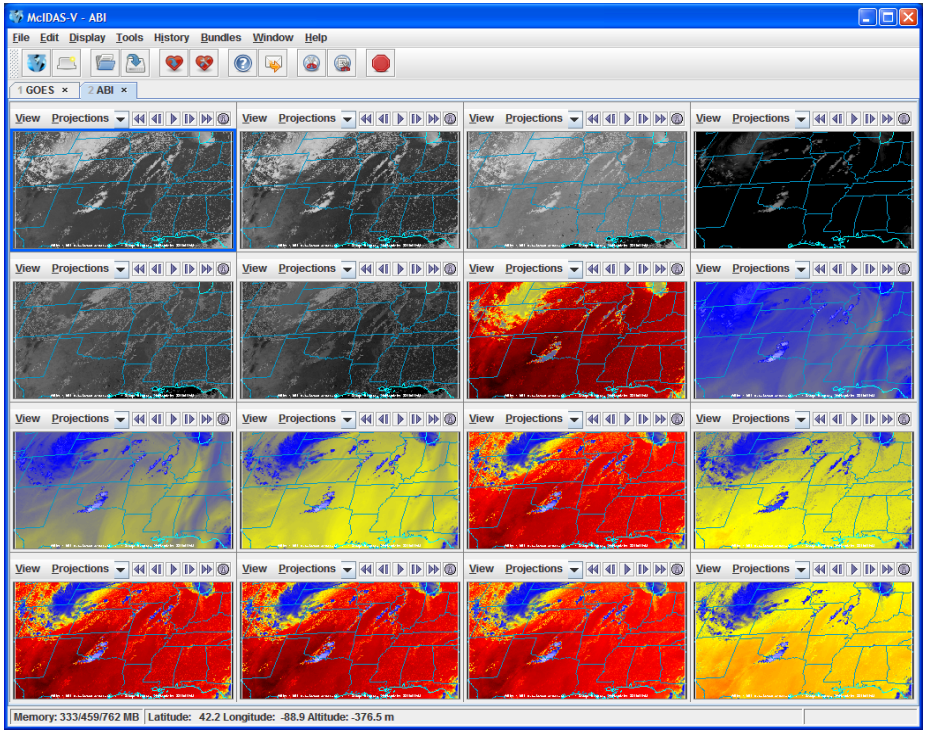
ABI Cloud and Moisture Imagery

ABI Cloud and Moisture Imagery

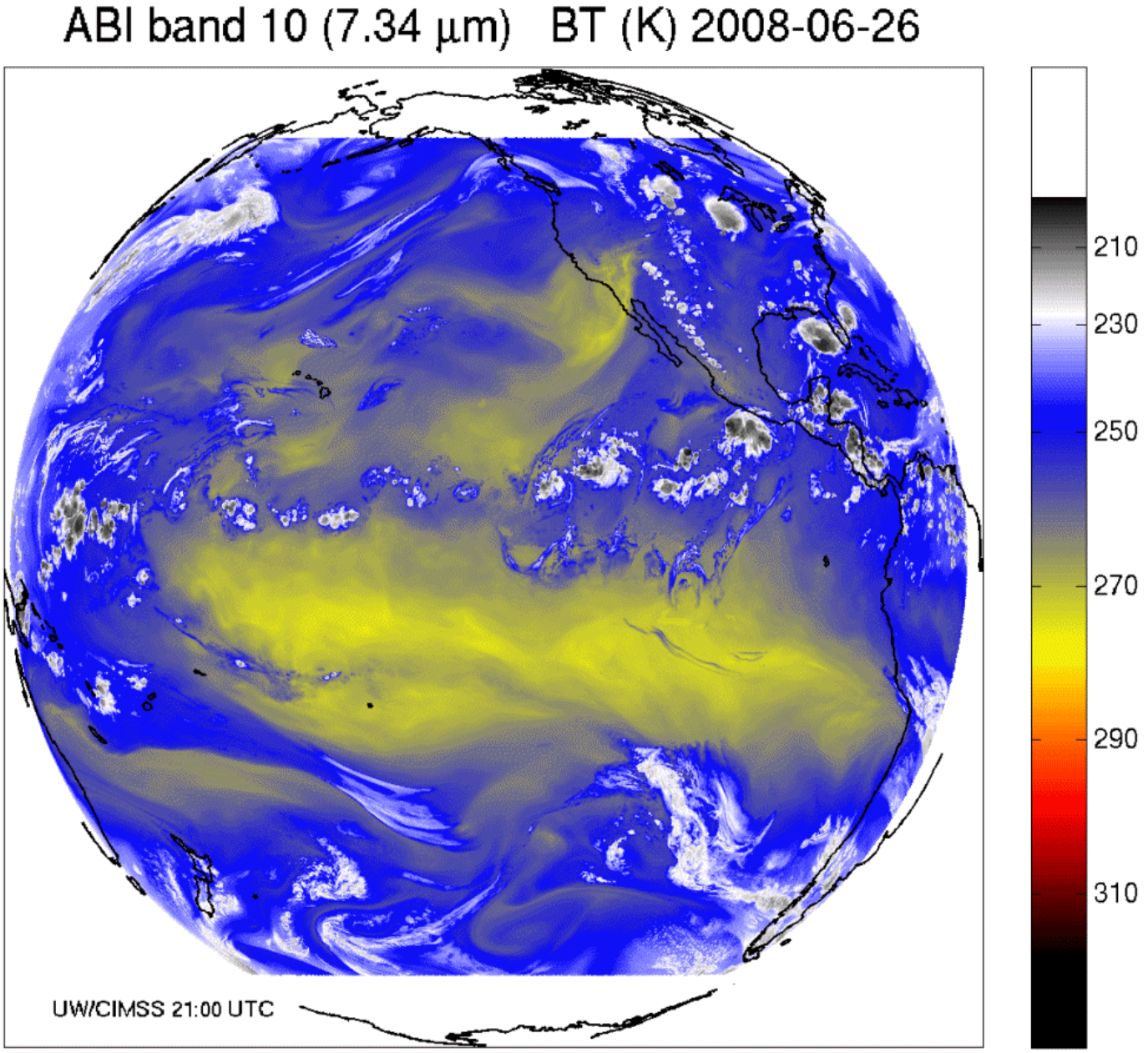
Key Performance Parameter (KPP)…

- **Product Highlights**
  - Cloud and Moisture Imagery is the satellite imagery that forecasters and the public are accustomed to viewing in weather forecast offices, on the web, and in the news.
  - It includes digital maps of the observed land, water, and clouds.
  - Reflectance and radiance measurements for visible/near-infrared (IR) and IR bands, respectively, are converted into digital information which can be displayed by a visualization system.
  - Imagery is used as input to the various Level-2 product algorithms
- **Operational Applications**
  - Viewed/analyzed/used by weather forecast offices, private industry, emergency managers, etc
  - NWP radiance assimilation

Simulated images of the 16 ABI bands over the Continental United States

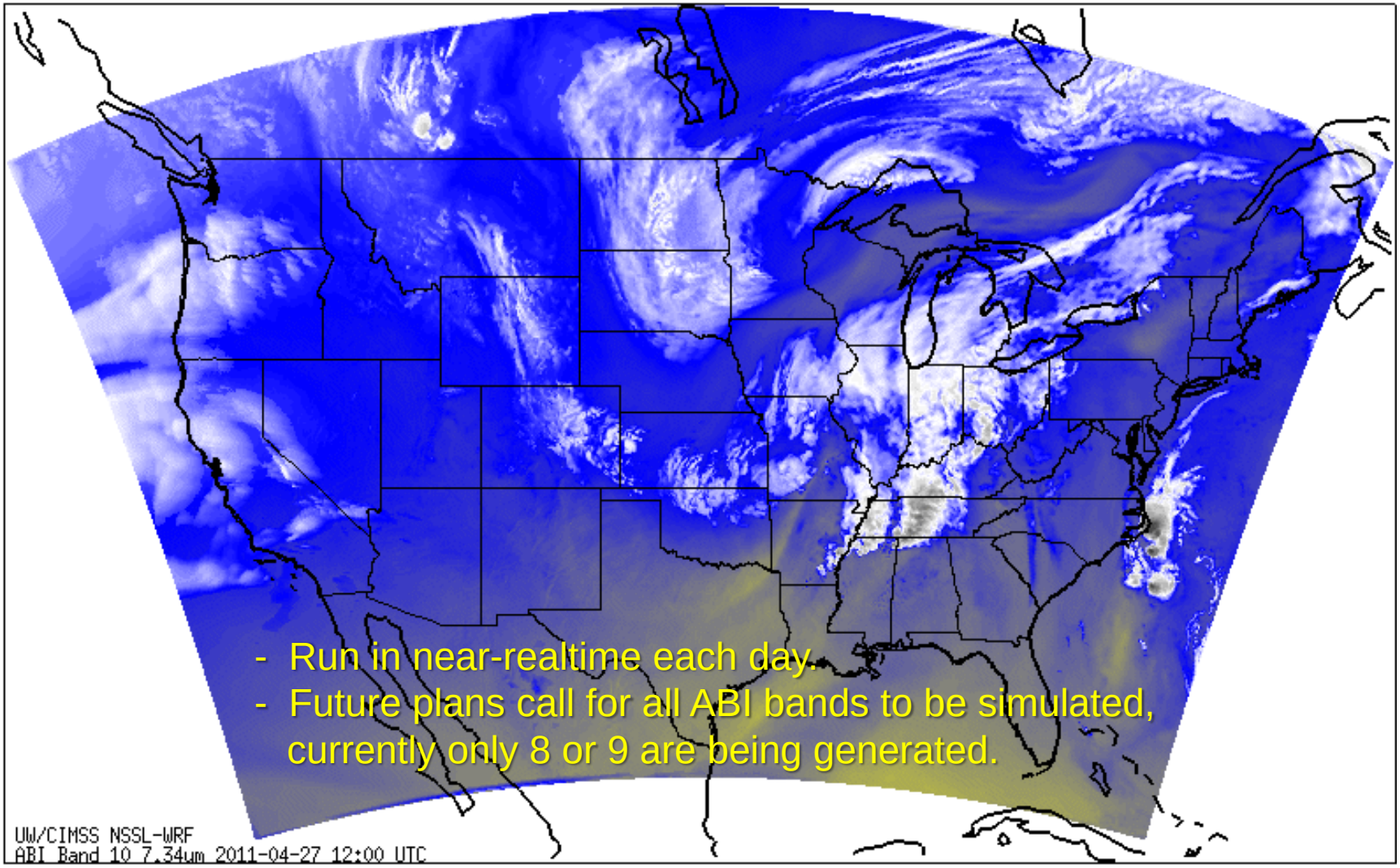


These images were simulated via a combination of high spatial resolution numerical model runs and advanced 'forward' radiative transfer models



Band 10: Lower mid-level tropospheric water vapor band– moisture, flow, winds

Simulated ABI band – NSSL WRF

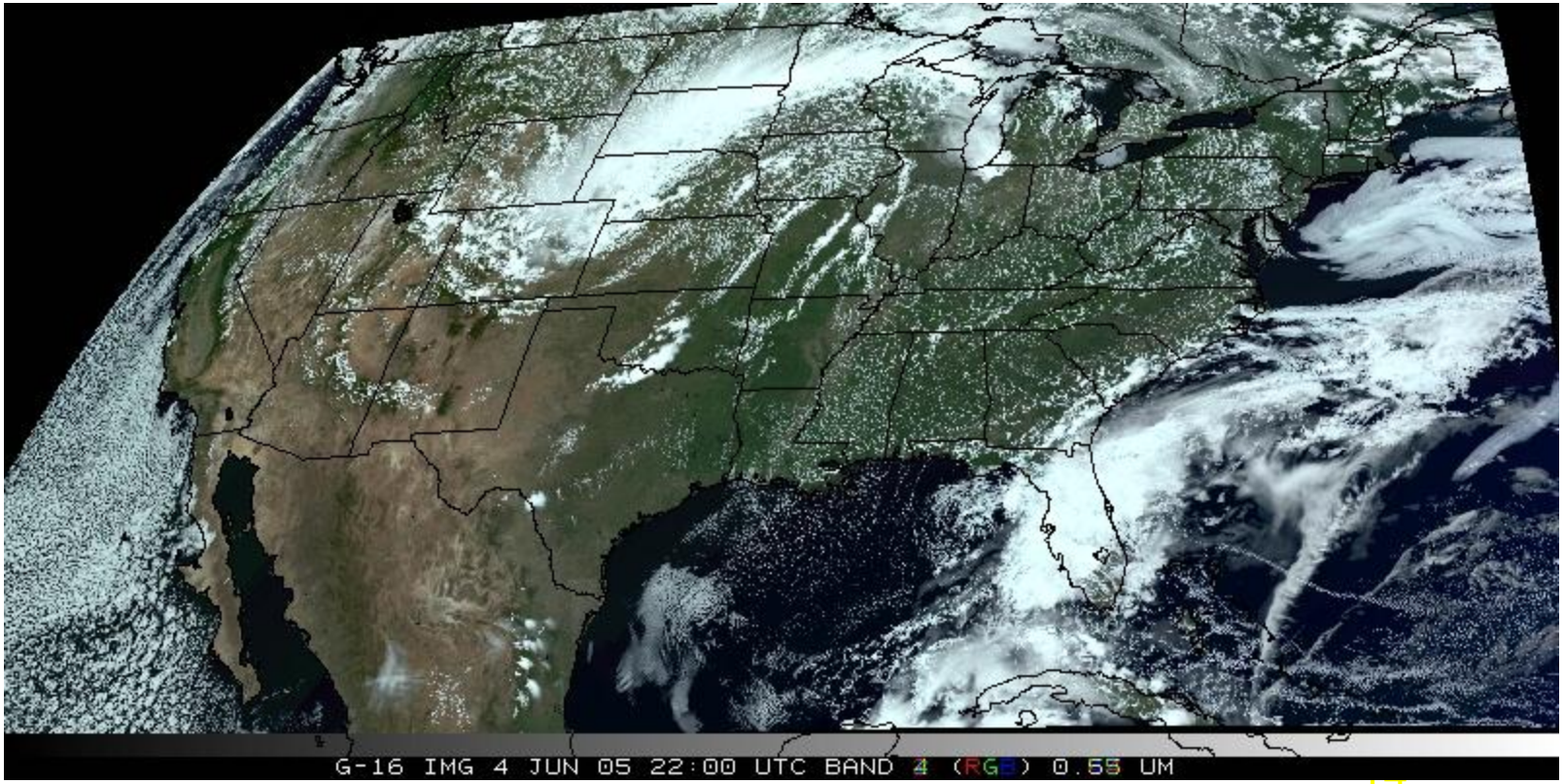


- Run in near-realtime each day.
- Future plans call for all ABI bands to be simulated, currently only 8 or 9 are being generated.

Visualization

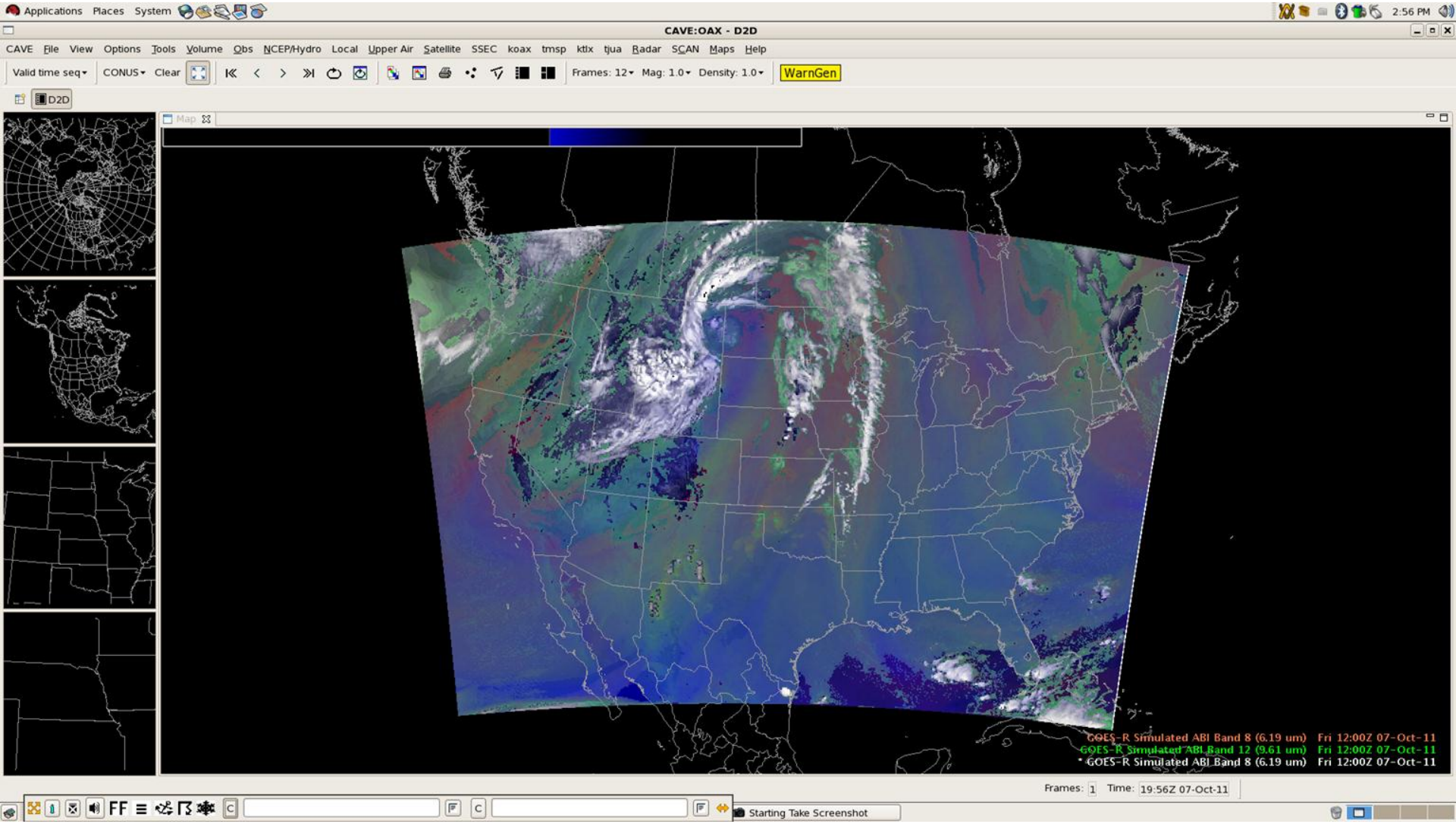
Decision aid…

- “True Color” with “synthetic” green from ABI simulated data (from CIMSS); image from Don Hillger, RAMMB.



Building an RGB: Composite

For NWS AWIPS-II…



Red-Green-Blue (RGB) channel composites simulating ABI capabilities – *more information than a single channel*

Jordan Gerth, UW/CIMSS

GOES-R Products

Baseline Products

Advanced Baseline Imager (ABI)

Aerosol Detection (Including Smoke and Dust)
Aerosol Optical Depth (AOD)
Clear Sky Masks
Cloud and Moisture Imagery
Cloud Optical Depth
Cloud Particle Size Distribution
Cloud Top Height
Cloud Top Phase
Cloud Top Pressure
Cloud Top Temperature
Derived Motion Winds
Derived Stability Indices
Downward Shortwave Radiation: Surface
Fire/Hot Spot Characterization
Hurricane Intensity Estimation
Land Surface Temperature (Skin)
Legacy Vertical Moisture Profile
Legacy Vertical Temperature Profile
Radiances
Rainfall Rate/QPE
Reflected Shortwave Radiation: TOA
Sea Surface Temperature (Skin)
Snow Cover
Total Precipitable Water
Volcanic Ash: Detection and Height

Geostationary Lightning Mapper (GLM)

Lightning Detection: Events, Groups & Flashes

Space Environment In-Situ Suite (SEISS)

Energetic Heavy Ions
Magnetospheric Electrons & Protons: Low Energy
Magnetospheric Electrons: Med & High Energy
Magnetospheric Protons: Med & High Energy
Solar and Galactic Protons

Magnetometer (MAG)

Geomagnetic Field

Extreme Ultraviolet and X-ray Irradiance Suite (EXIS)

Solar Flux: EUV
Solar Flux: X-ray Irradiance

Solar Ultraviolet Imager (SUVI)

Solar EUV Imagery

Future Capabilities

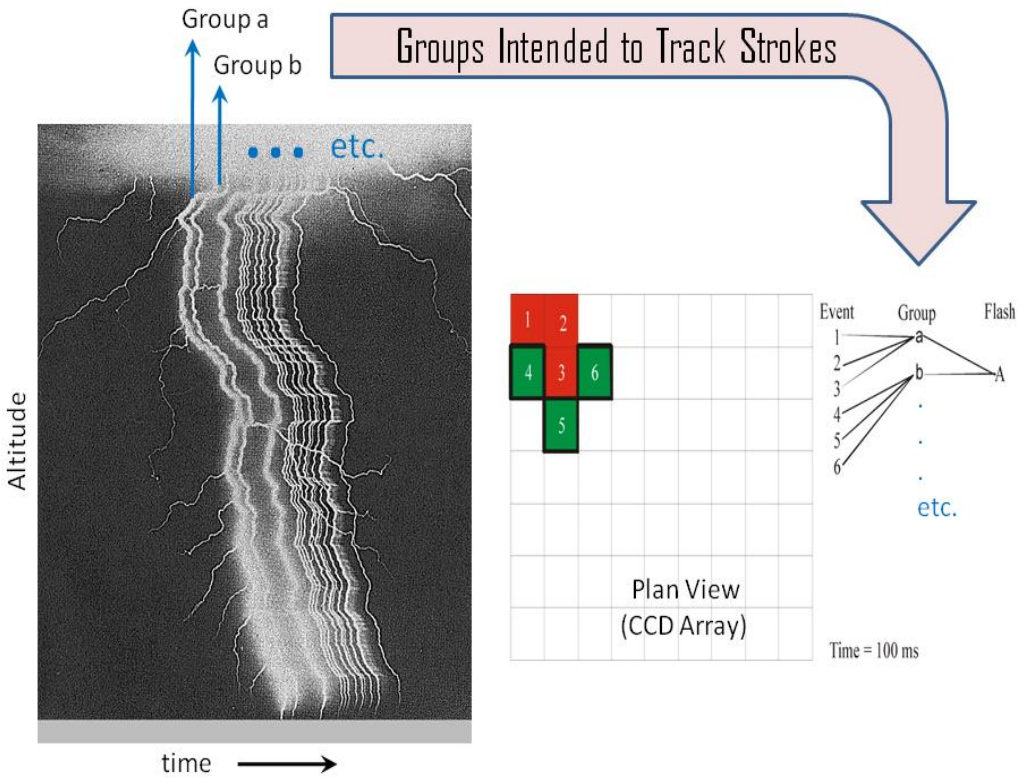
Advanced Baseline Imager (ABI)

Absorbed Shortwave Radiation: Surface
Aerosol Particle Size
Aircraft Icing Threat
Cloud Ice Water Path
Cloud Layers/Heights
Cloud Liquid Water
Cloud Type
Convective Initiation
Currents
Currents: Offshore
Downward Longwave Radiation: Surface
Enhanced “V”/Overshooting Top Detection
Flood/Standing Water
Ice Cover
Low Cloud and Fog
Ozone Total
Probability of Rainfall
Rainfall Potential
Sea and Lake Ice: Age
Sea and Lake Ice: Concentration
Sea and Lake Ice: Motion
Snow Depth (Over Plains)
SO_2 Detection
Surface Albedo
Surface Emissivity
Tropopause Folding Turbulence Prediction
Upward Longwave Radiation: Surface
Upward Longwave Radiation: TOA
Vegetation Fraction: Green
Vegetation Index
Visibility

GLM Level-2 Product

GLM Total Lightning Product

- **Algorithm Highlights**
  - ***Lightning Cluster Filter Algorithm (LCFA)*** that receives input Lb pixel-level optical "event" data and separates out the lightning signal from background noise
  - LCFA based on the **heritage** Optical Transient Detector (OTD)/Lightning Imager Sensor (LIS) algorithm
  - Data is processed into lightning data products (**Events, Groups, and Flashes)** that are more easily utilized by users
- **Operational Applications**
  - ***Situational awareness product for monitoring convection***
  - Forecasters will use in conjunction with radar data/products to improve issuance of severe weather warnings.



Event: The occurrence of a single pixel exceeding the background threshold during a single frame

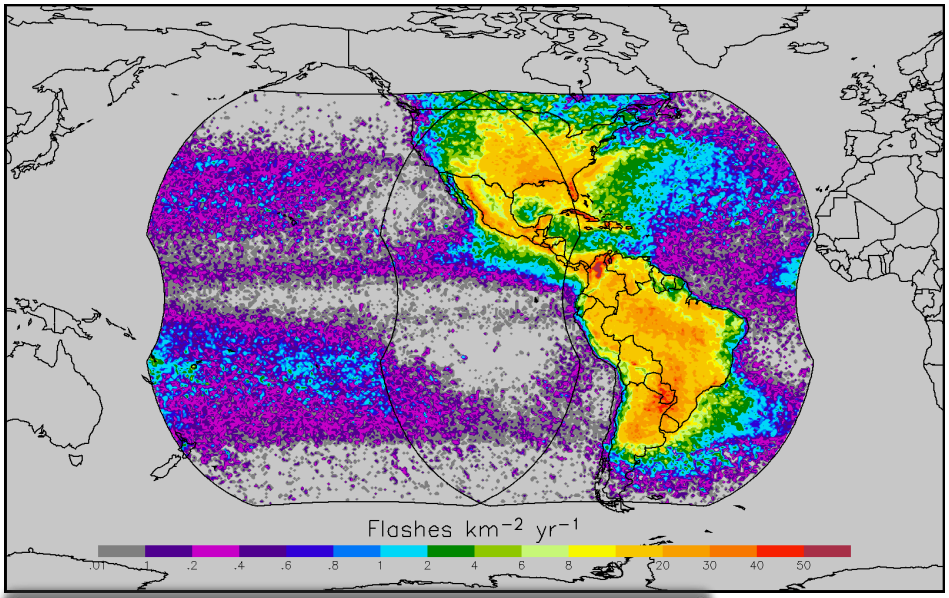
Group: Two or more adjacent events in the same time frame

Flash: A set of groups sequentially separated in time by no more than 330 ms and in space by no more than 16.5 km

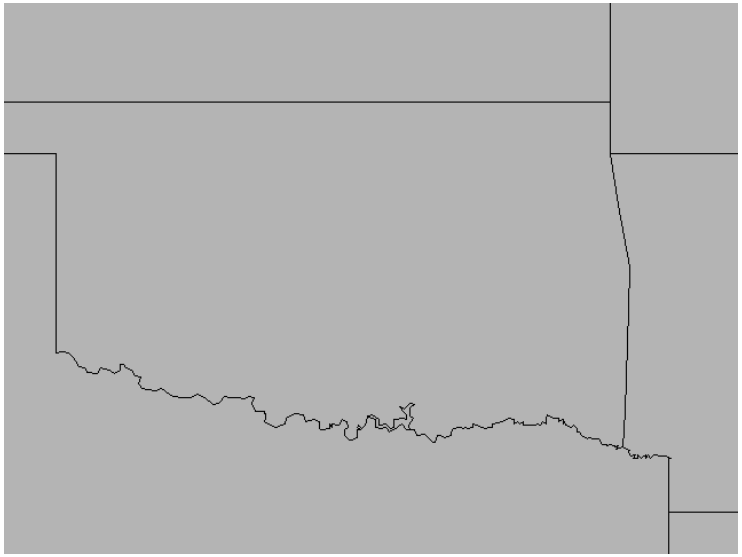
Steve Goodman, NOAA GOES-R Program

What the GOES-R GLM Will See

GLM Combined E-W Coverage

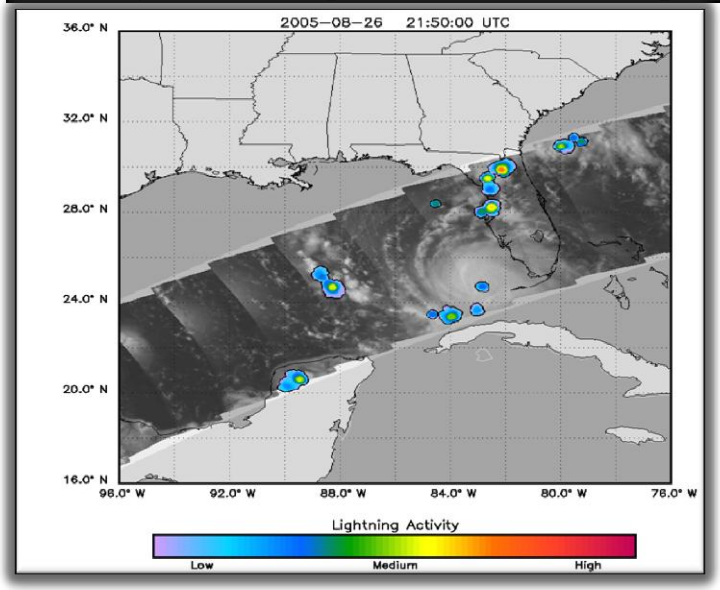


May 3 1999 Oklahoma Tornado Outbreak



Stroud Animation

1-minute of observations from TRMM/LIS

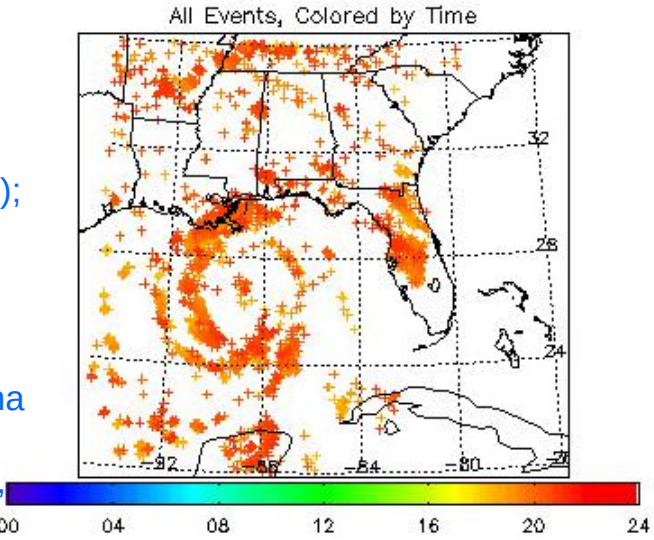


What GLM will see:

(left) LIS background with lightning events superimposed);

(upper right) May 3, 1999 OK tornado outbreak,

(lower right): Hurricane Katrina lightning from the Los Alamos Sferics Array, August 28, 2005, Shao et al., EOS Trans.,86.



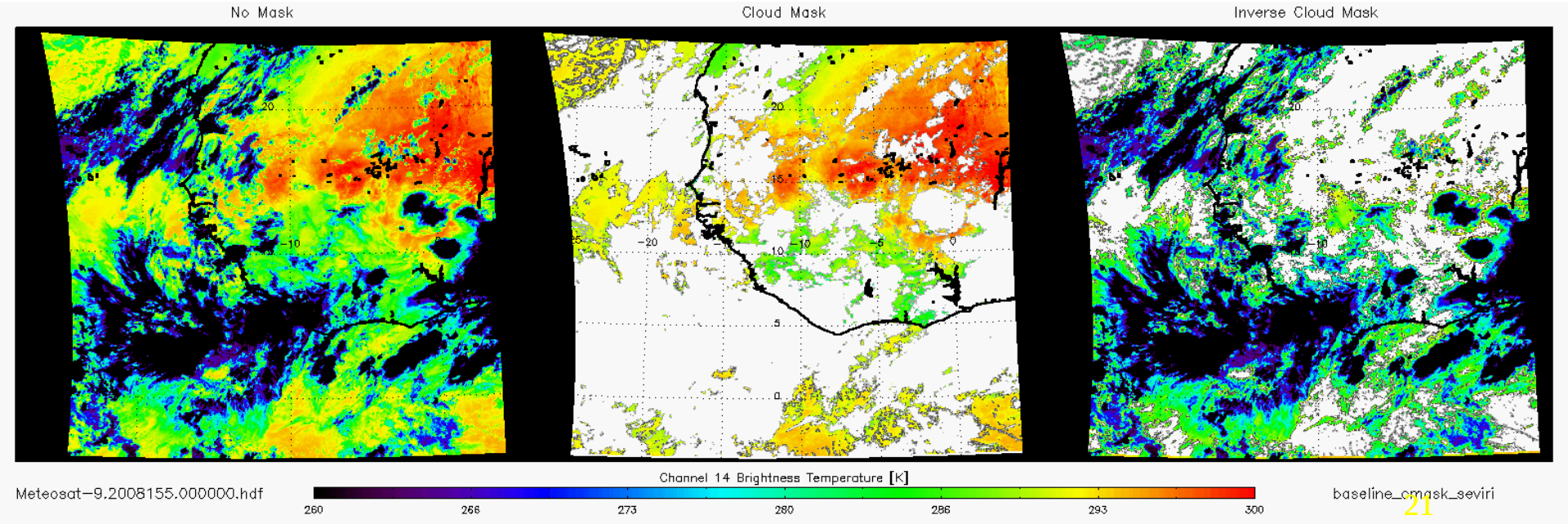
Steve Goodman, NOAA/NESDIS

ABI Level-2 Products

Clear Sky Mask

"Cloud Detection"…

- **Algorithm Highlights**
  - Designed to maximize flexibility and use
  - Mask built with multiple individual tests that could be turned on and off by the downstream applications.
  - Uses new ABI Bands (1.38um, 1.6um)
  - Design allows for additional of new tests easily as warranted.
  - Determination of test thresholds accomplished through the use and analysis of CALIPSO data.
- **Operational Applications**
  - Used extensively by downstream level-2 product algorithms
  - Identifies clear pixel radiances for NWP data assimilation

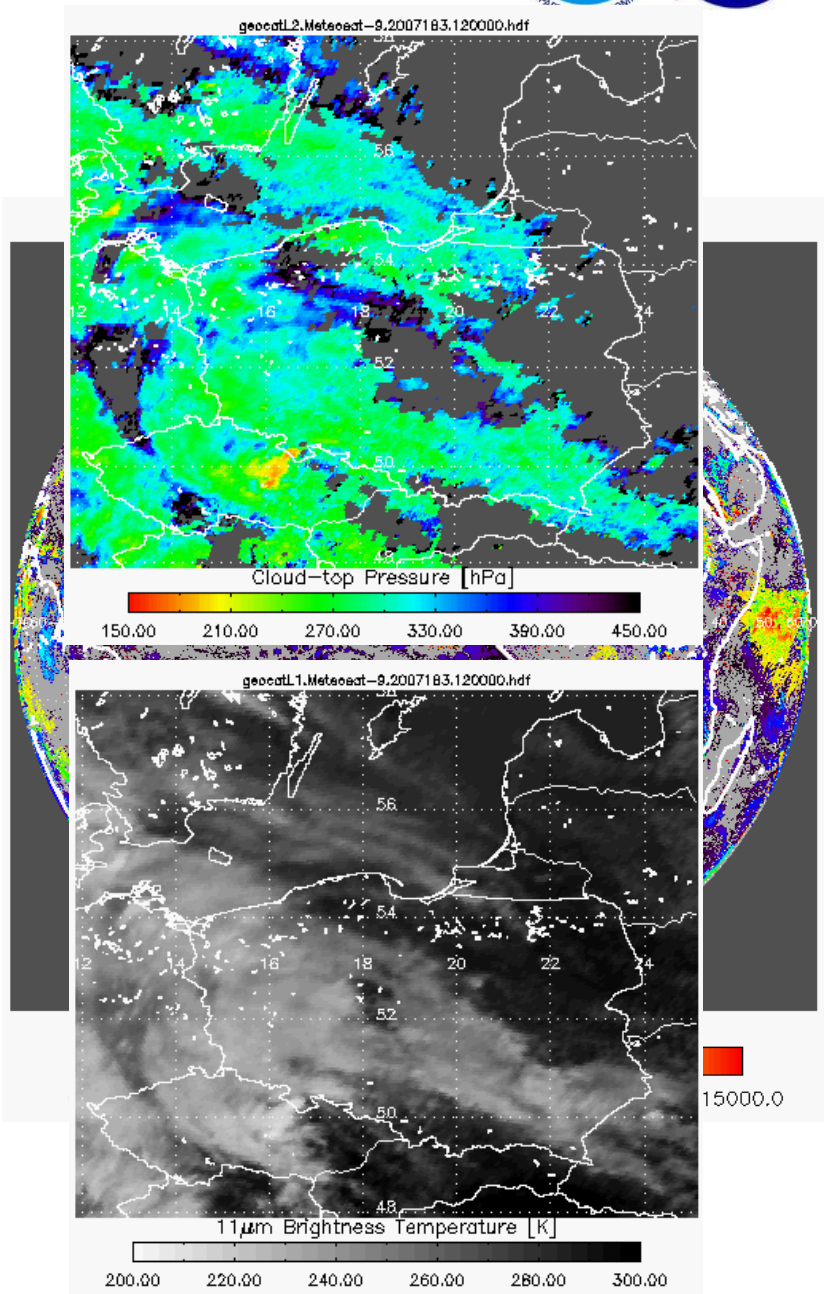


Andrew Heidinger, NOAA/NESDIS/STAR

Cloud-Top Pressure Product

- **Algorithm Highlights**
  - Algorithm uses the 11, 12 and 13.3μm channels to estimate cloud temperature, cloud emissivity and a cloud microphysics.
  - Algorithm uses an **optimal estimation approach** that provides error estimates.
  - Cloud pressure and height are computed from NWP profiles.
  - For multi-layer clouds, lower cloud height estimates obtained from surrounding pixels.
  - Cloud heights in the presence of low level inversions are handled using similar logic that is employed in the MODIS algorithms.

- **Operational Applications**
  - Used to assign heights to derived motion winds
  - Aviation Terminal Aerodrome Forecasts (TAFs)
  - Supplements Automated Surface Observing System (ASOS) with upper-level cloud information
  - Cloud initialization; Assimilation into NWP models
  - Climate prediction

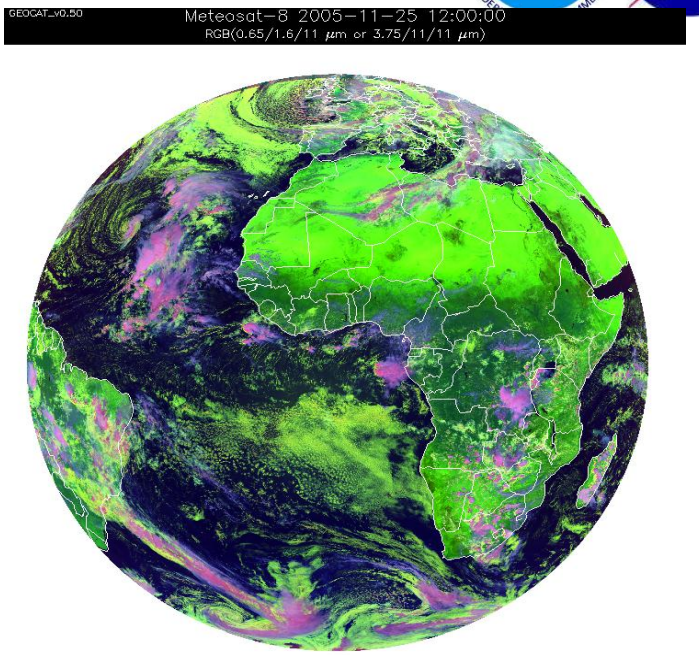


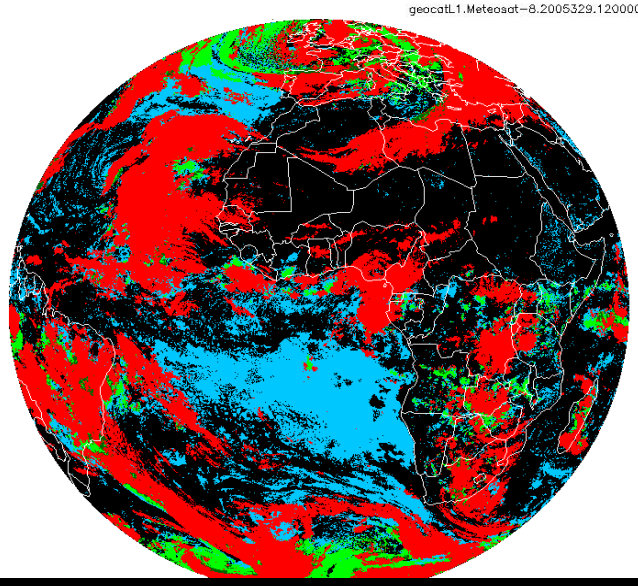
Andrew Heidinger, NOAA/NESDIS/STAR

Cloud Phase

- **Algorithm Highlights**
  - An Infrared only algorithm that **exploits the rich IR information** (7.4, 8.5, 11.2, and 12.3 μm) provided by the ABI
  - Algorithm determines the cloud top thermodynamic phase of the highest cloud layer (layer that the radiometer senses)
  - Exploits recent improvements in fast clear-sky radiative transfer models and ancillary data (land cover, surface emissivity)
  - Makes advanced use of spatial information

- **Operational Applications**
  - Prerequisite for other cloud property retrievals (height, temp)
  - Climate prediction
  - Aviation forecasting (Aircraft icing)



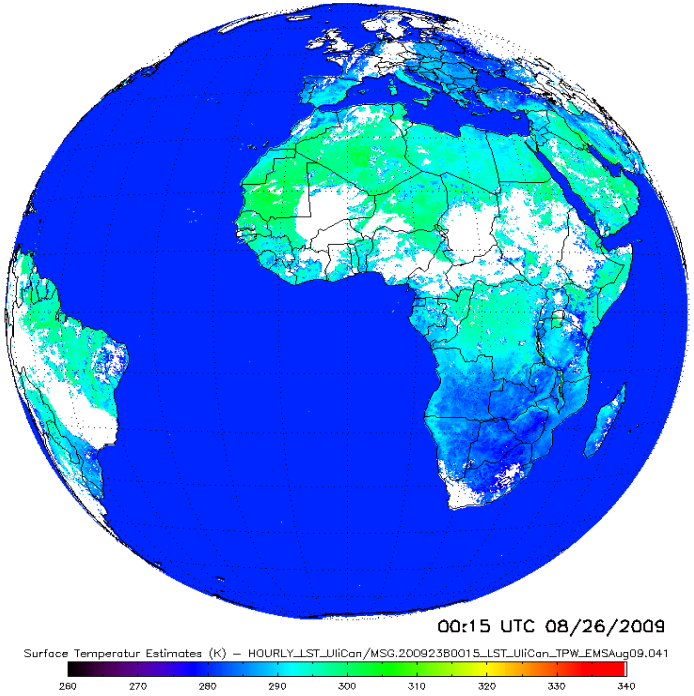


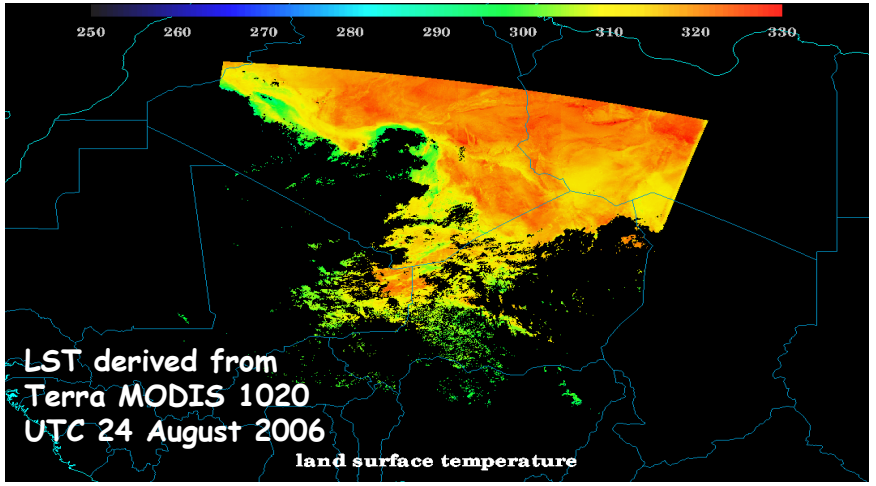
Water, Super-cooled Water, Mixed Phase, Ice

Mike Pavolonis, NOAA/NESDIS/STAR

Land Surface Temperature

- **Algorithm Highlights**
  - Utilizes ABI clear sky mask product
  - Regression-based algorithm that uses the 11.2 and 12.3 μm channels
  - Split-window algorithm has significant heritage (geo & leo)
  - Leverages ABI's higher spatial resolution data
- **Operational Applications**
  - Fog forecasting
  - Frost/freezing temperature forecasting
  - Assimilation into land surface models
  - Assimilation into mesoscale and climate NWP models
  - Climate prediction





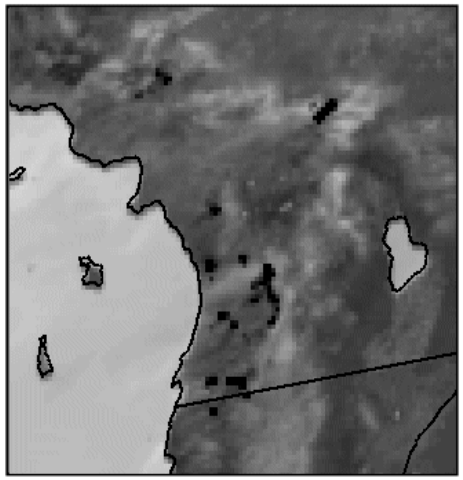
Yunyue Yu, NOAA/NESDIS/STAR

Fire/Hot Spot Characterization

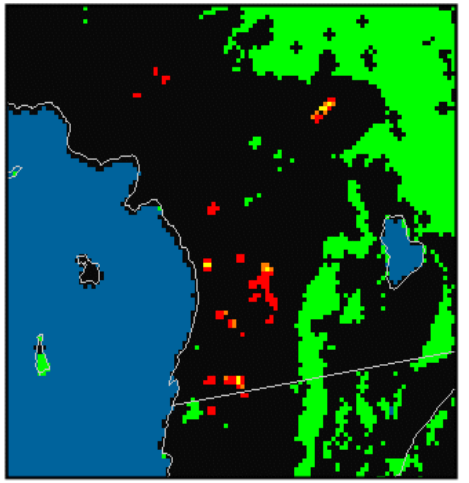
- **Algorithm Highlights**
  - Heritage lies with the GOES operational Wildfire Automated Biomass Burning Algorithm (WF_ABBA)
  - **Dynamic, multi-spectral, thresholding contextual algorithm**
  - Utilizes the 0.64, 3.9, 11.2 and 12.3 μm channels
  - Leverages ABI's higher spatial and temporal resolution data
- **Operational Applications**
  - Fire weather forecasting
  - Air quality forecasting

MODIS Simulated ABI Data in Southern California

Date: 23 October 2007 **Time: 18:25 UTC**



GOES-R ABI 3.9 μm data



CIMSS GOES-R ABI WF_ABBA Fire Mask Product

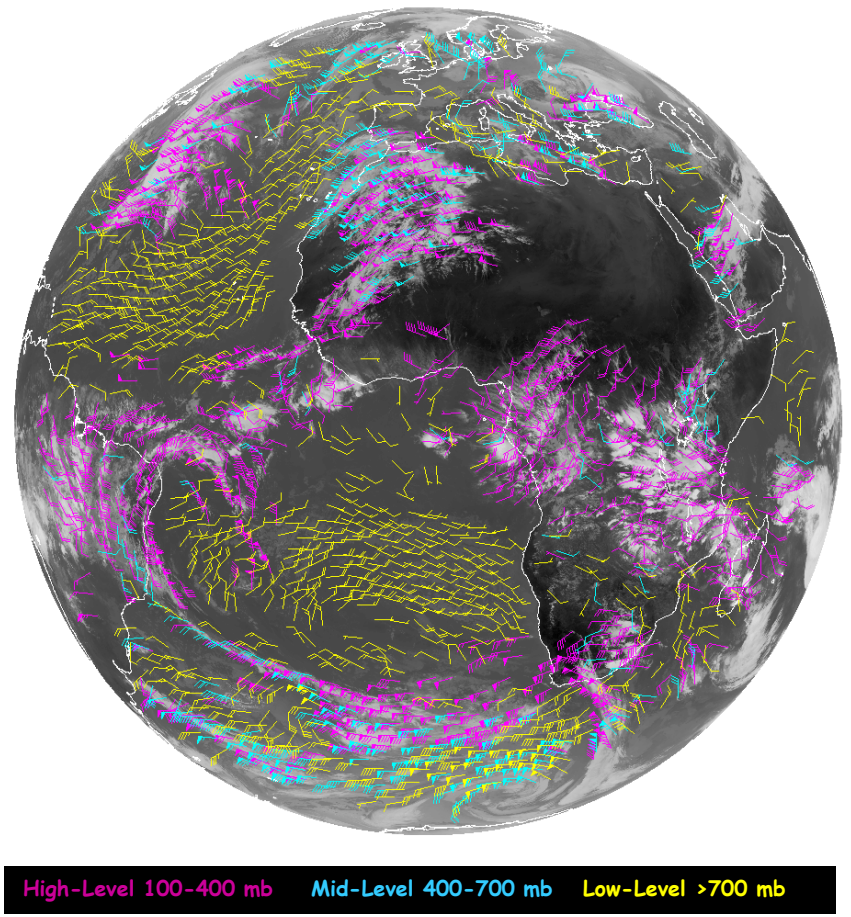
Chris Schmidt, CIMSS

Derived Motion Winds

- **Algorithm Highlights**
  - Heritage in targeting, tracking, and QC algorithms lie with current NESDIS operational winds algorithms
  - **New nested tracking algorithm** introduced that makes use of a two-dimensional clustering algorithm to capture the dominant motion in each target scene
  - Utilizes clear sky mask product
  - Wind height assignment will rely on utilization of pixel level cloud heights generated upstream via algorithms delivered by AWG cloud application team
  - Leverages ABI's higher spatial and temporal resolution data

- **Operational Applications**
  - Weather Forecasting
  - Assimilation into mesoscale and global NWP models
  - Aviation (flight routing)

Cloud-drift Winds derived from a Full Disk Meteosat-8 SEVERI 10.8 µm image triplet centered at 1200 UTC 01 February 2007



Jaime Daniels, NOAA/NESDIS

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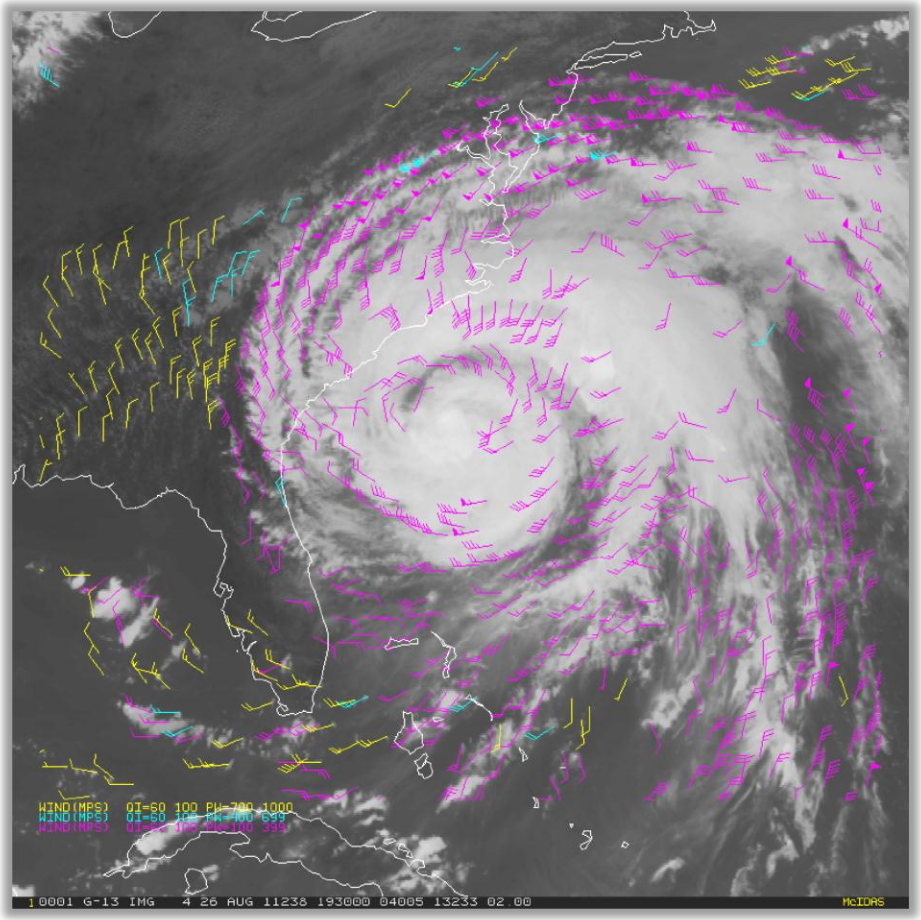
- **Operational Applications**
  - Weather Forecasting
  - Assimilation into mesoscale and global NWP models
  - Aviation (flight routing)

Cloud-drift winds derived from 15-minute GOES-13 imagery over Hurricane Irene at 1930 UTC on 26 August 2011

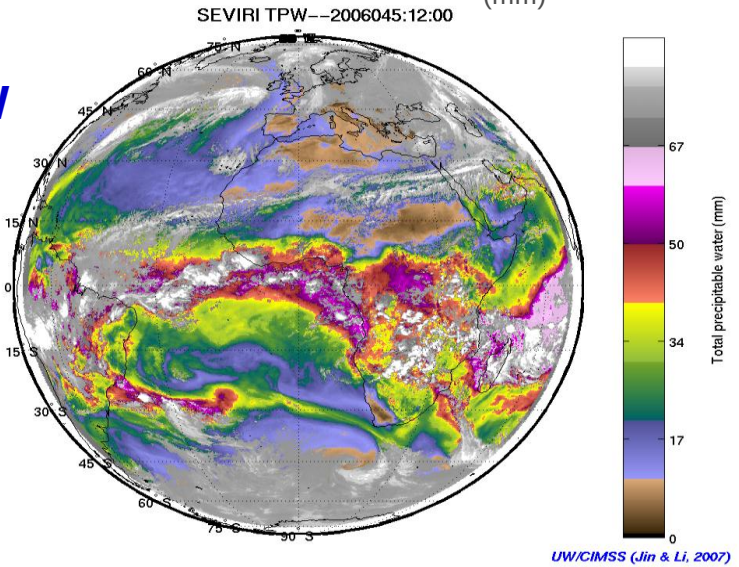


Jaime Daniels, NOAA/NESDIS

Temperature & Moisture Soundings, Precipitable Water, Atmospheric Stability Products

- **Algorithm Highlights**
  - 1D-variational physical retrieval algorithm that has heritage with MODIS and current operational GOES sounder physical retrieval algorithms
  - Regression-based initial guess T/Q profiles
  - Utilizes NWP forecast T/Q profiles
  - Utilizes the 6.15, 7.0, 7.4, 8.5, 9.7, 10.35, 11.2, 12.3, and 13.3 μm bands)
  - Exploits recent improvements in fast clear-sky radiative transfer models and ancillary data (surface emissivity)

TPW



- **Operational Applications**

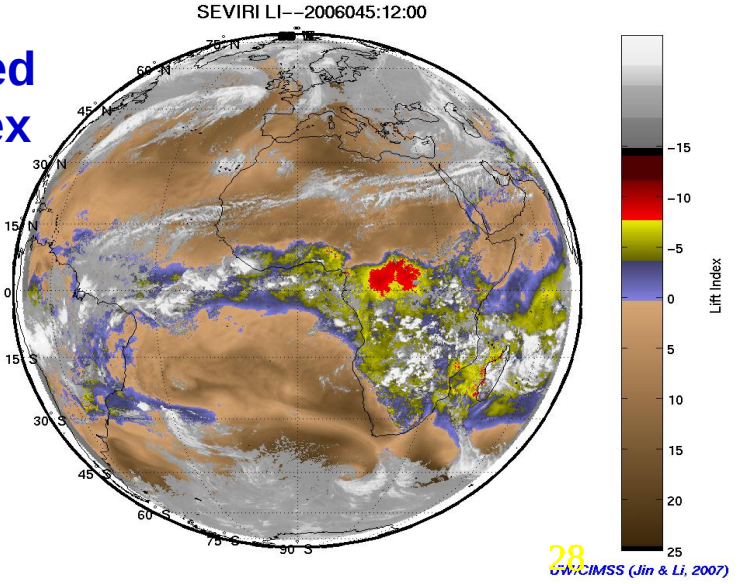
Nowcasting

  - Gulf of Mexico return flow
  - Southwest US monsoon
  - QPF (heavy rain, flash flooding)
  - Convective potential and morphology
  - Fog potential
  - Situational awareness in pre-convective environments for potential watch/warning scenarios

NWP

  - Assimilation into regional and mesoscale NWP models (TPW)

Lifted Index



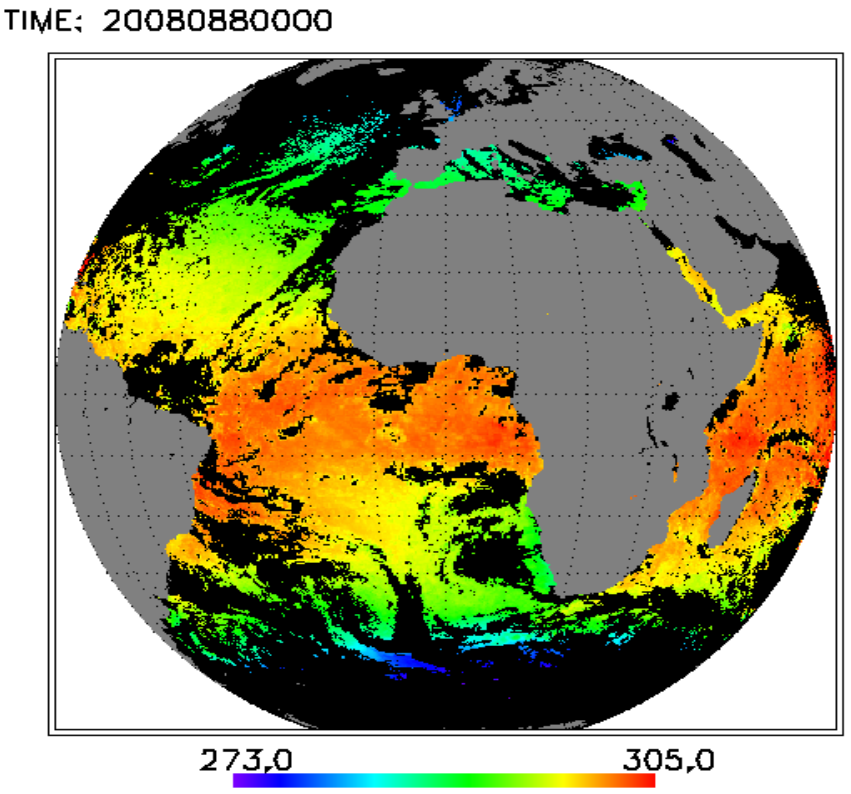
Tim Schmit, NOAA/NESDIS/STAR

Sea Surface Temperature

- **Algorithm Highlights**
  - Hybrid approach that combines regression (heritage approach) with a physical retrieval approach (optimal estimation)
  - Utilizes the 3.9, 8.5, 10.35, 11.2, 12.3μm bands
  - Exploits recent improvements in fast clear-sky radiative transfer models
  - Leverages increased ABI temporal resolution

- **Operational Applications**
  - Assimilation into atmospheric and oceanic models
  - Climate monitoring/forecasting
  - NOAA' Coast Watch Program
  - Harmful Algal Bloom monitoring
  - Sea turtle tracking
  - Vessel positioning
  - Upwelling identification
  - Commercial fisheries management
  - NOAA's Coral Reef Watch Program
  - Coral bleach warnings and assessments

SST product derived from MSG2/SEVIRI observations for 28 March 2008



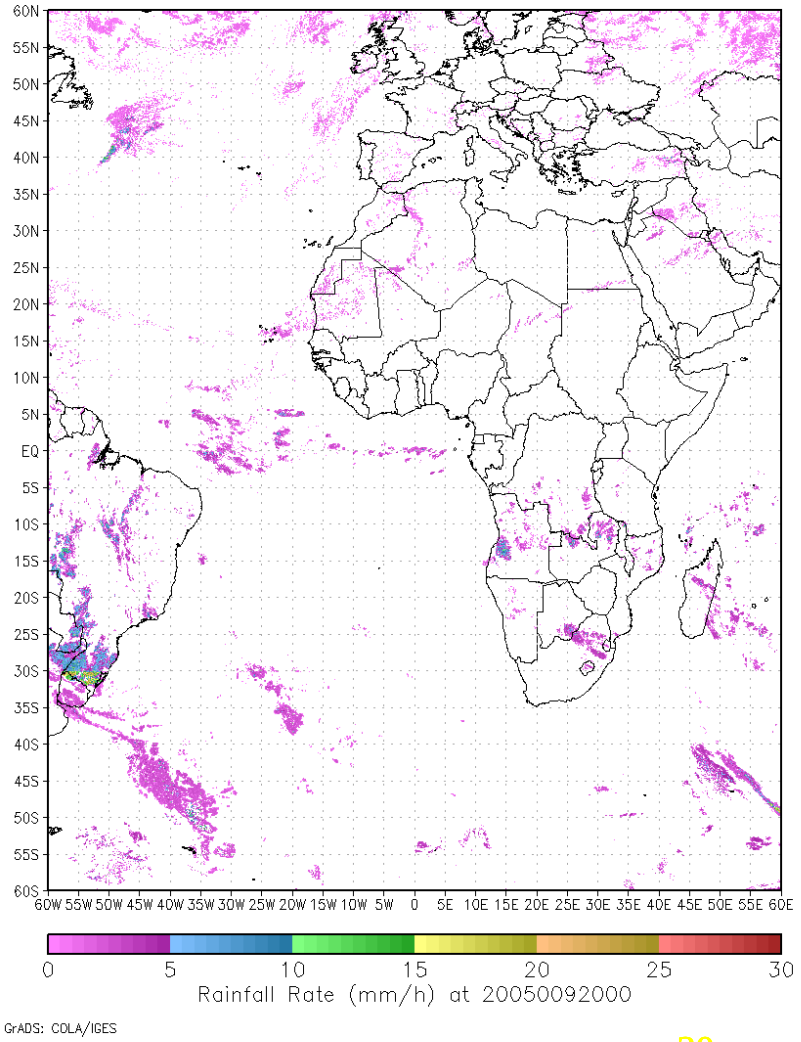
Alexander Ignatov, NOAA/NESDIS/STAR

Rainfall Rate/QPE

- **Algorithm Highlights**
  - Self-Calibrating Multivariate Precipitation (SCaMPR) retrieval algorithm
  - VIS/IR-based algorithm that is dynamically calibrated against satellite-based microwave (MW) derived rain rates (SSM/I, AMSU, AMSR-E and TRMM)
  - Calibration is continuously updated to reflect time changes in MW-IR relationship
  - Dynamic channel selection
  - Leverages ABI's higher spatial and temporal resolution data

- **Operational Applications**
  - Flash flood forecasting
  - Nowcasting
  - Assimilation into hydrologic models

Rainfall rate derived from Meteosat-8 SEVIRI 2000 UTC on 09 January 2005



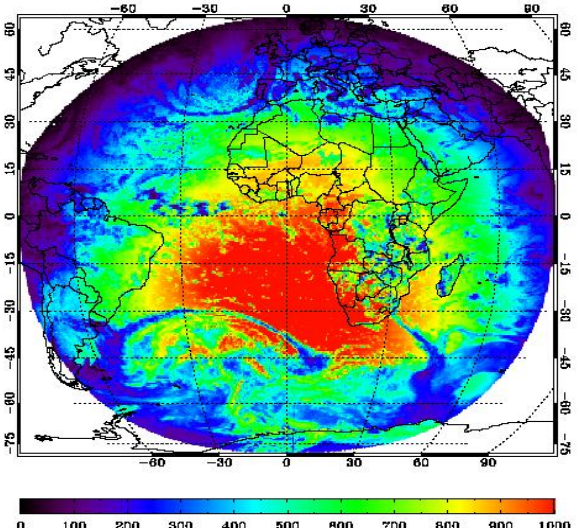
Bob Kuligowski, NOAA/NESDIS/STAR

Downward Shortwave Radiation: SFC
Reflected Shortwave Radiation: TOA

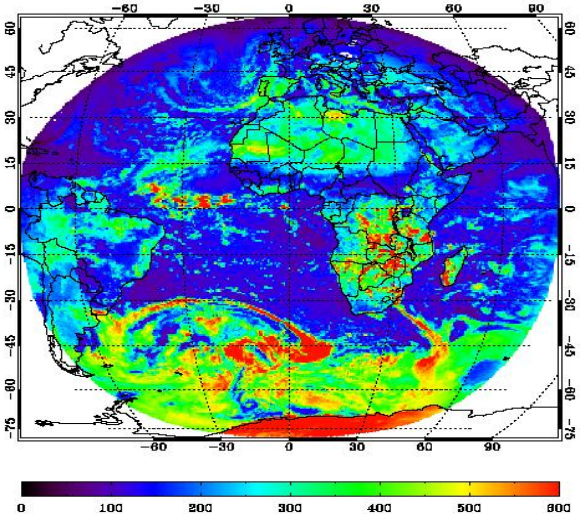
- **Algorithm Highlights**
  - Hybrid algorithm that combines the merits of NASA (“direct path“) and STAR/UMD (“indirect path”) algorithms
  - Physically-based retrieval by using a Look-Up Table (LUT) representation of the RTM
  - Based on the NASA/CERES, NOAA/GOES and GEWEX/SRB heritages
  - Leverages ABI’s higher temporal resolution data and spectral coverage (VIS/near IR)

- **Operational Applications**
  - Climate studies
  - Surface (land and ocean) energy budget models
    - Assimilation into
    - Independent verification of
  - Crop modeling
  - Fire risk assessment
  - Earth energy budget studies

1200 UTC on 15 January 2006



DSR



RSR

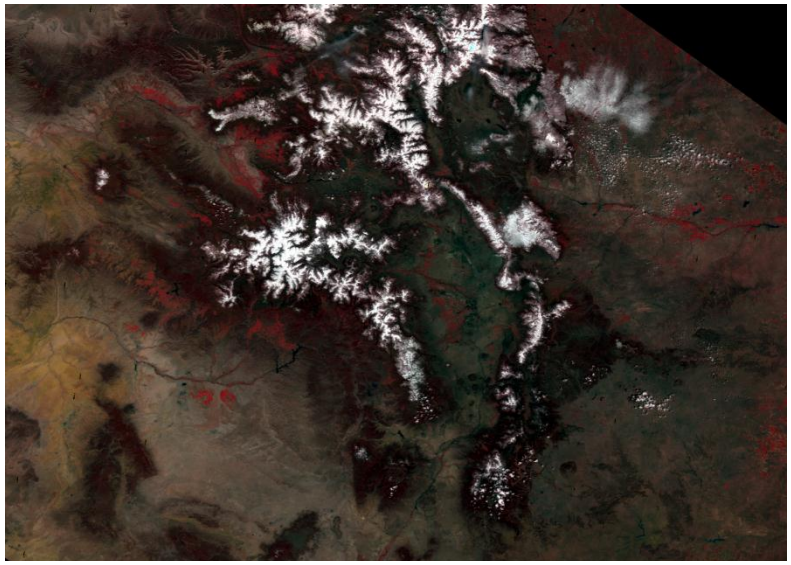
Istvan Laszlo, NOAA/NESDIS/STAR

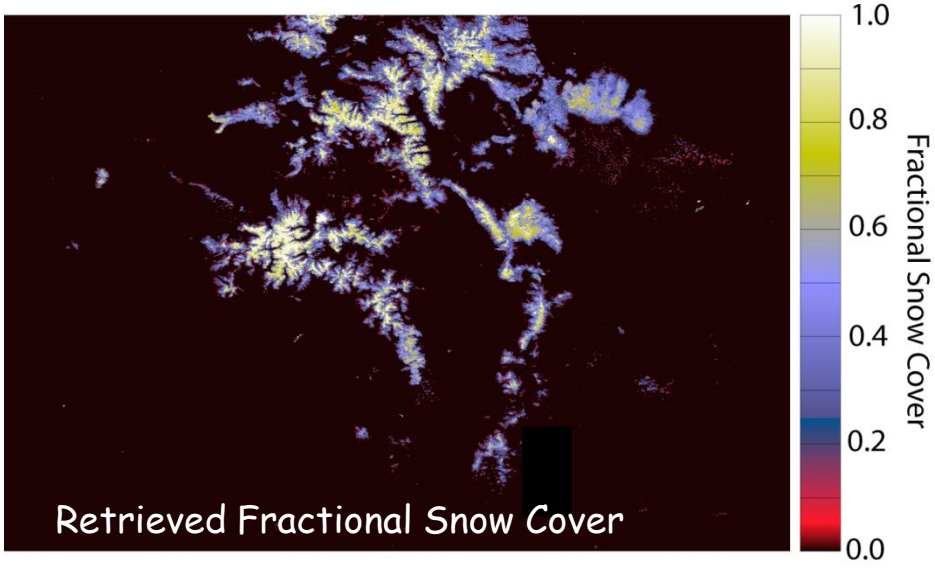
Snow Cover

- **Algorithm Highlights**
  - Retrieves sub-pixel fractional snow cover and grain size estimates via computationally efficient spectral mixture modeling
  - Heritage derived from
    - MEMSCAG (Multiple Endmember Snow Covered Area and Grain size) algorithm for imaging spectrometers (AVIRIS, Hyperion, HYDICE, ARTEMIS)
    - MODIS-based fractional snow cover and grain size (MODSCAG) algorithm
  - Leverages ABI's higher temporal resolution data and spectral coverage (VIS/near IR bands :0.47, 0.64, 0.86, 1.6, and 2.25 um)

- **Operational Applications**
  - Assimilation into NOAA/NOHRC snow model
  - Hydrologic forecasts and warnings, including river and flood forecasts
  - Stream-flow forecasting/modeling
  - Snowpack monitoring, analysis
  - Water management
  - Climate studies

MODIS Color Composite (Colorado Rockies)
30 April 2007





Tom Painter, JPL

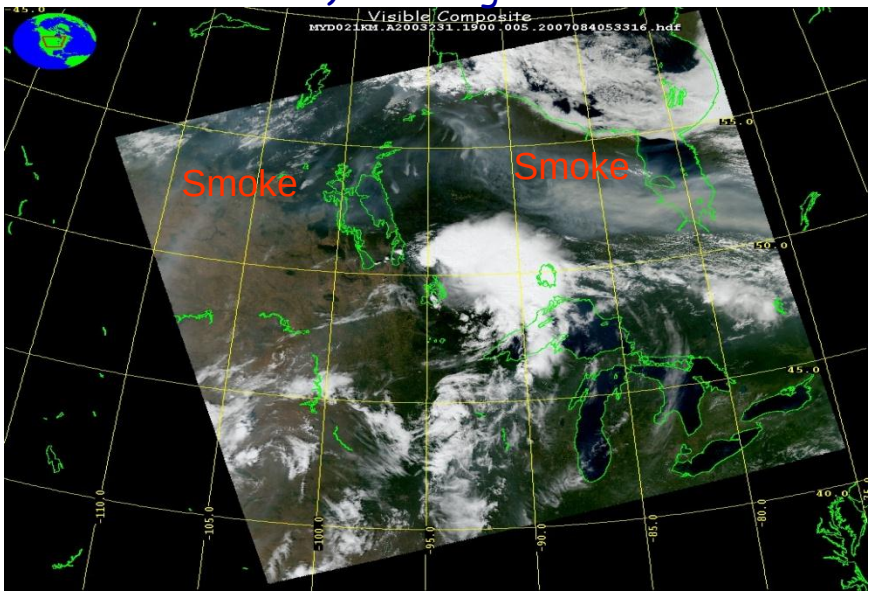
Aerosol Detection

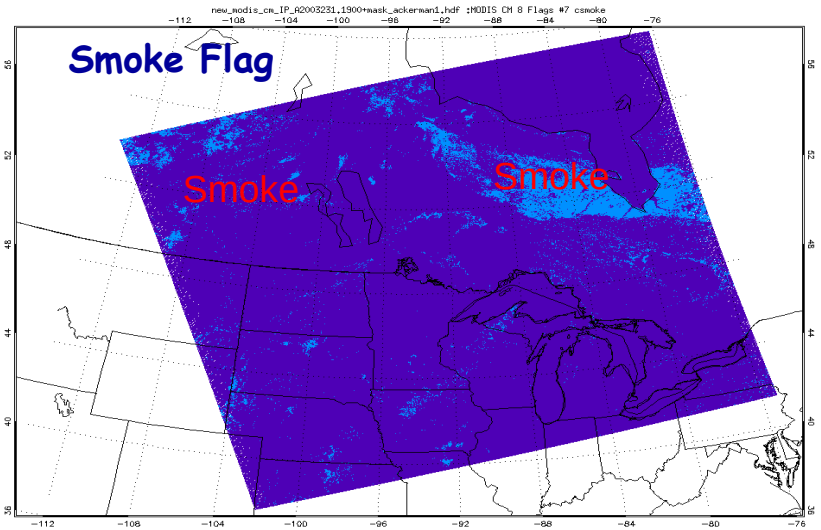
Smoke & Dust Detection…

- **Algorithm Highlights**
  - Spectral threshold algorithm that uses spectral (wavelength dependent) characteristics of surface, aerosols, and clouds to identify aerosols
  - Heritage derived from AVHRR and MODIS-based aerosol detection algorithms
  - Synergy with VIIRS aerosol retrieval algorithm
  - Leverages ABI's higher spectral (VIS/near IR portion) coverage data

- **Operational Applications**
  - Air quality forecasting
  - Air quality assessment and management
  - Climate studies

MODIS Color Composite (British Columbia, Canada Fire Event) 19 August 2003





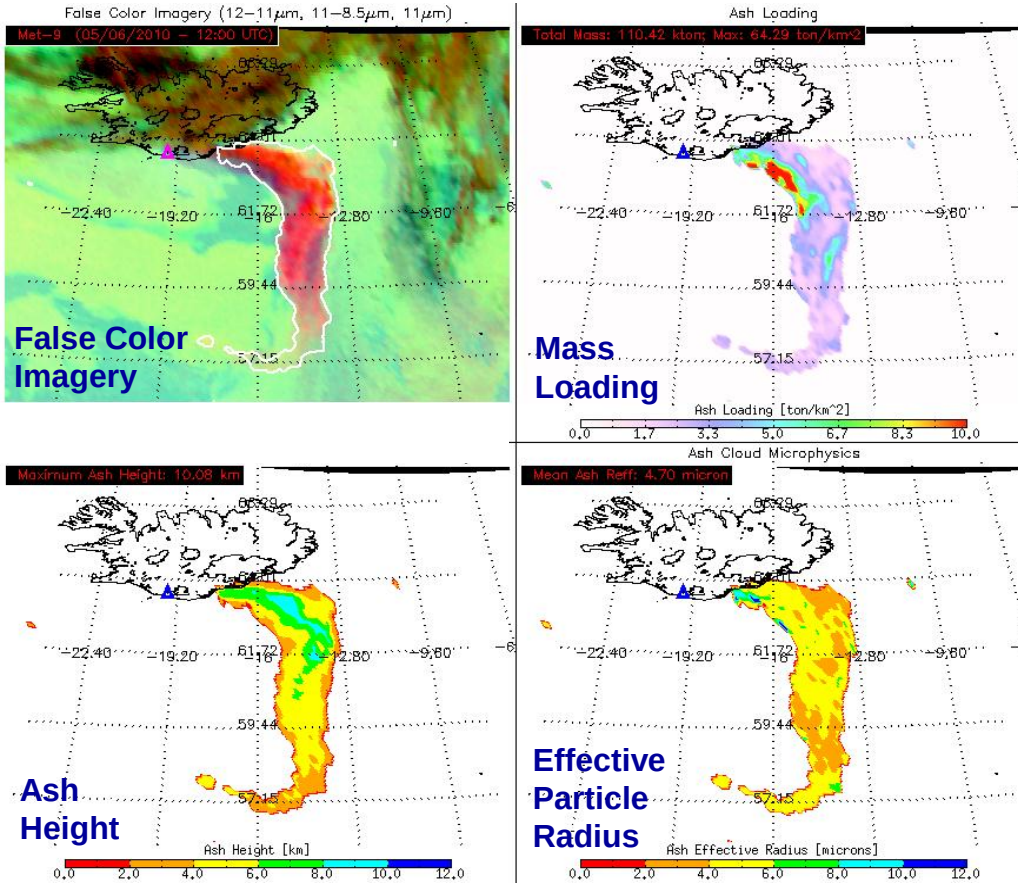
Shobha Kondragunta, NOAA/NESDIS/STAR

Volcanic Ash

- **Algorithm Highlights**
  - Detects volcanic ash and estimates its height and mass loading
  - Leverages the new ABI 8.5 μm band, The 8.5 μm, 11.2 μm, and 12.3,11.2 μm channel pairs are used to detect volcanic ash
  - An optimal estimation approach is used to estimate ash cloud temperature, emissivity and microphysical index.
  - Ash cloud height determined from NWP profiles.
  - Mass loading estimated from computed optical depth and effective particle size
  - Leverages ABI's new 8.5 μm channel, along with 11.2 μm and 12.3 μm for sensitivity to cloud microphysics (including composition)

- **Operational Applications**
  - Aviation safety
  - Health safety
  - Climate studies

Eruption of Iceland's Eyjafjallajökull Volcano (May 6, 2010)



Mike Pavolonis, NOAA/NESDIS/STAR

Future Capabilities
Products

GOES-R Products

Baseline Products

Advanced Baseline Imager (ABI)

- Aerosol Detection (Including Smoke and Dust)
- Aerosol Optical Depth (AOD)
- Clear Sky Masks
- Cloud and Moisture Imagery
- Cloud Optical Depth
- Cloud Particle Size Distribution
- Cloud Top Height
- Cloud Top Phase
- Cloud Top Pressure
- Cloud Top Temperature
- Derived Motion Winds
- Derived Stability Indices
- Downward Shortwave Radiation: Surface
- Fire/Hot Spot Characterization
- Hurricane Intensity Estimation
- Land Surface Temperature (Skin)
- Legacy Vertical Moisture Profile
- Legacy Vertical Temperature Profile
- Radiances
- Rainfall Rate/QPE
- Reflected Shortwave Radiation: TOA
- Sea Surface Temperature (Skin)
- Snow Cover
- Total Precipitable Water
- Volcanic Ash: Detection and Height

Geostationary Lightning Mapper (GLM)

- Lightning Detection: Events, Groups & Flashes

Space Environment In-Situ Suite (SEISS)

- Energetic Heavy Ions
- Magnetospheric Electrons & Protons: Low Energy
- Magnetospheric Electrons: Med & High Energy
- Magnetospheric Protons: Med & High Energy
- Solar and Galactic Protons

Magnetometer (MAG)

- Geomagnetic Field

Extreme Ultraviolet and X-ray Irradiance Suite (EXIS)

- Solar Flux: EUV
- Solar Flux: X-ray Irradiance

Solar Ultraviolet Imager (SUVI)

- Solar EUV Imagery

Future Capabilities

Advanced Baseline Imager (ABI)

- Absorbed Shortwave Radiation: Surface
- Aerosol Particle Size
- Aircraft Icing Threat
- Cloud Ice Water Path
- Cloud Layers/Heights
- Cloud Liquid Water
- Cloud Type
- Convective Initiation
- Currents
- Currents: Offshore
- Downward Longwave Radiation: Surface
- Enhanced “V”/Overshooting Top Detection
- Flood/Standing Water
- Ice Cover
- Low Cloud and Fog
- Ozone Total
- Probability of Rainfall
- Rainfall Potential
- Sea and Lake Ice: Age
- Sea and Lake Ice: Concentration
- Sea and Lake Ice: Motion
- Snow Depth (Over Plains)
- SO_2 Detection
- Surface Albedo
- Surface Emissivity
- Tropopause Folding Turbulence Prediction
- Upward Longwave Radiation: Surface
- Upward Longwave Radiation: TOA
- Vegetation Fraction: Green
- Vegetation Index
- Visibility

GOES-R Future Capabilities Products

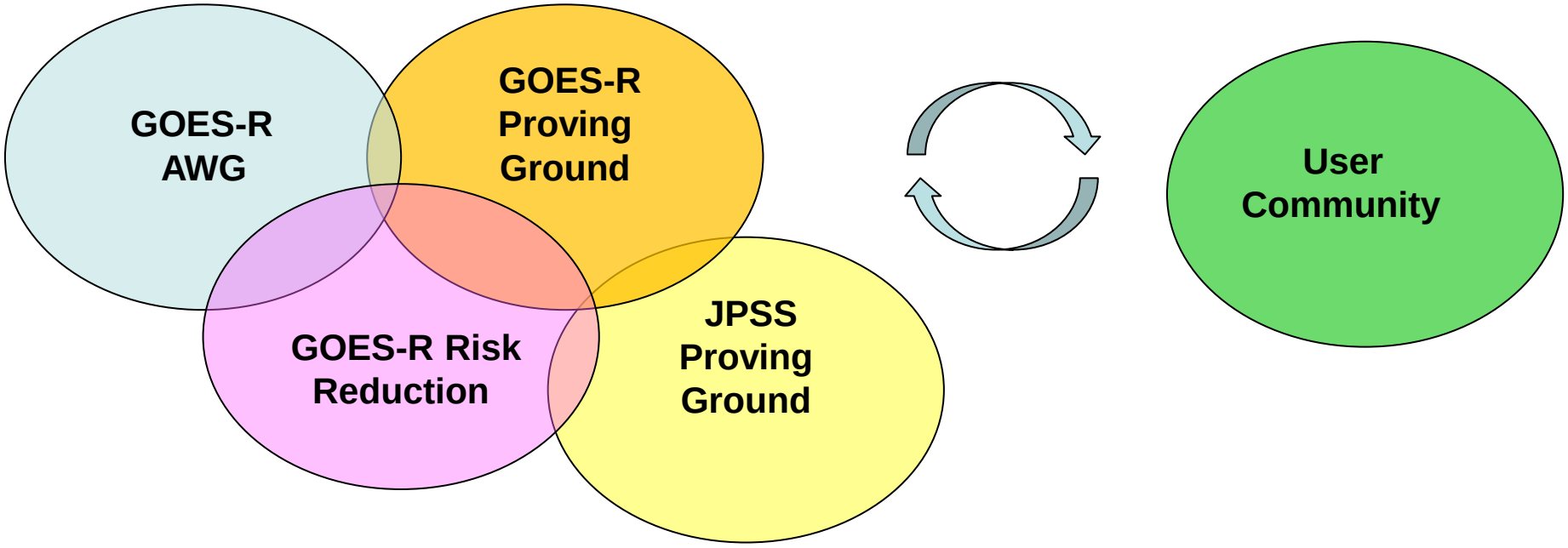
- GOES-R AWG has developed algorithms for these products
  - Most are new; a few heritage
- Effort to ***prioritize***
  - Discussions with NWS to identify which of these would best support forecast/warning operations
    - Identify ***synergies*** with polar products (NPP/JPSS)
- Consider more ***integrated*** approaches and decision aid tools

Advanced Baseline Imager

Absorbed Shortwave Radiation: Surface	Probability of Rainfall
Aerosol Particle Size	Rainfall Potential
Aircraft Icing Threat	Sea and Lake Ice: Age
Cloud Ice Water Path	Sea and Lake Ice: Concentration
Cloud Layers/Heights	Sea and Lake Ice: Motion
Cloud Liquid Water	Snow Depth (Over Plains)
Cloud Type	SO_2 Detection
Convective Initiation	Surface Albedo
Currents	Surface Emissivity
Currents: Offshore	Tropopause Folding Turbulence Prediction
Downward Longwave Radiation: Surface	Upward Longwave Radiation: Surface
Enhanced "V"/Overshooting Top Detection	Upward Longwave Radiation: TOA
Flood/Standing Water	Vegetation Fraction: Green
Ice Cover	Vegetation Index
Low Cloud and Fog	Visibility
Ozone Total	

Addressing Evolving User Needs

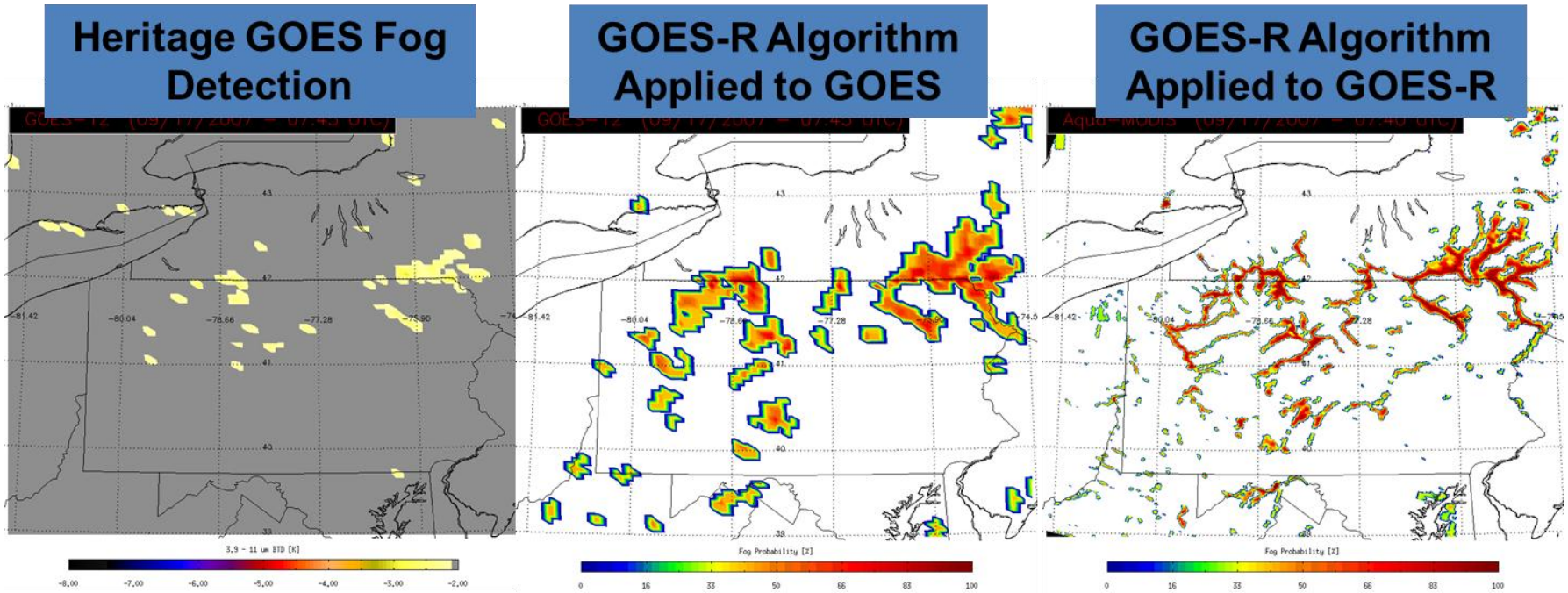
- GOES-R Level-2 algorithm development has fostered discussions and development of new decision support applications (GOES-R and JPSS)
- Vested interest in fused decision support products



Future Capability: Fog Detection

The GOES-R fog detection product will significantly improve geostationary satellite fog monitoring capabilities because:

- ***Improved algorithm technology*** - the GOES-R algorithm provides quantitative information on fog probability, while heritage GOES fog detection products are more qualitative in nature
- ***Improved sensor technology*** - the ABI has greatly improved spectral information, spatial resolution, and temporal resolution



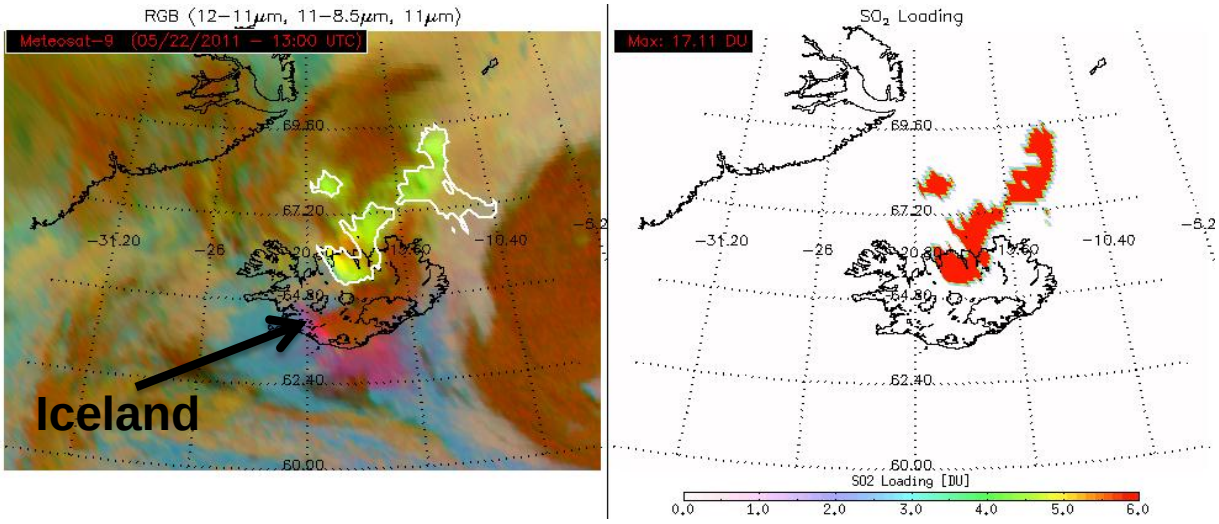
Move from thresholding approaches and binary products to probabilistic approaches/products

Mike Pavolonis, NOAA/NESDIS/STAR

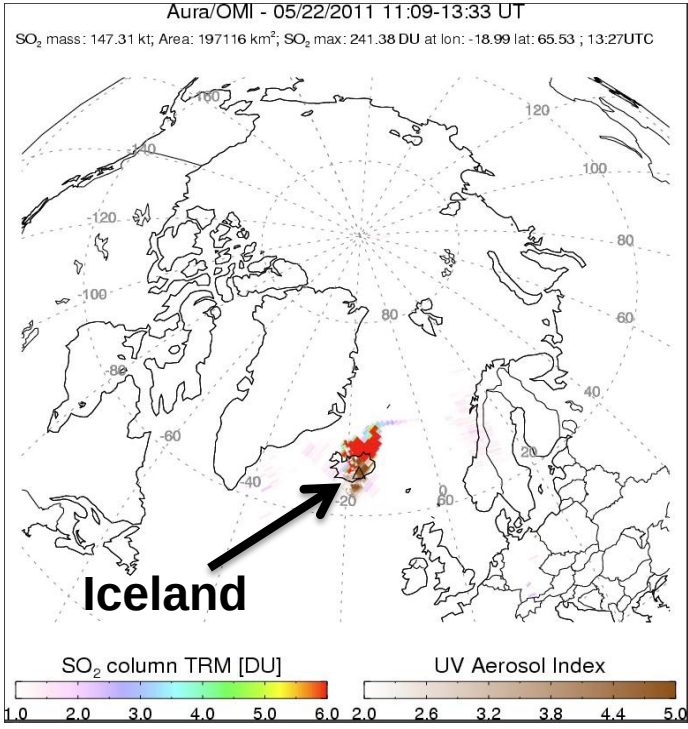
Future Capability: SO_2 Detection & Loading

Grimsvotn, May 22, 2010 - 13:00 UTC

GOES-R SO_2 Product



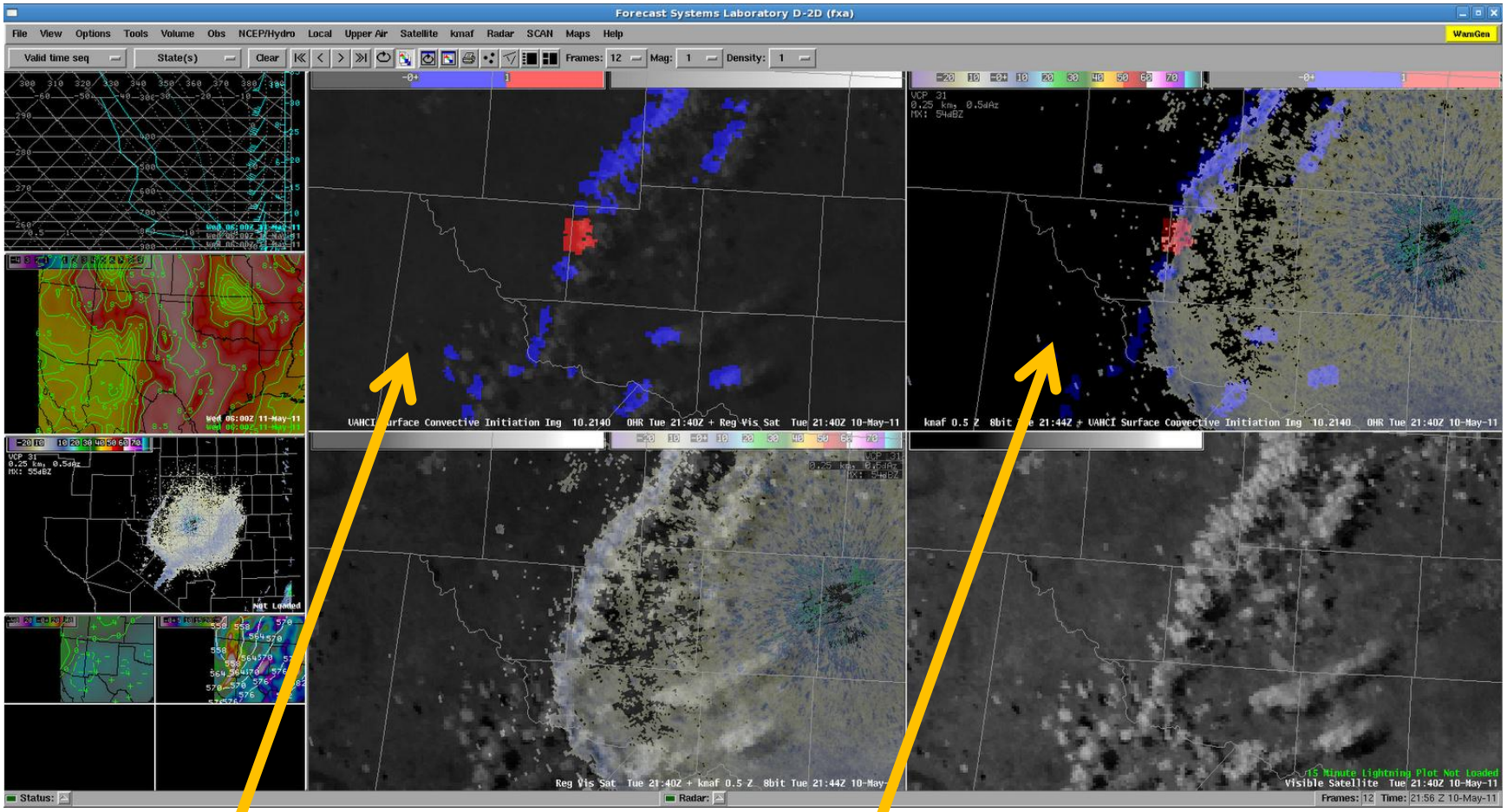
OMI SO_2 Product



The 7.3 μm channel on the GOES-R ABI was specifically designed to be sensitive to SO_2

Mike Pavolonis, NOAA/NESDIS/STAR

Future Capability: Convective Initiation



Null (blue) and **Positive** (red) cloud object CI forecasts are overlaid onto GOES Visible satellite data

CI product is overlaid onto radar data….

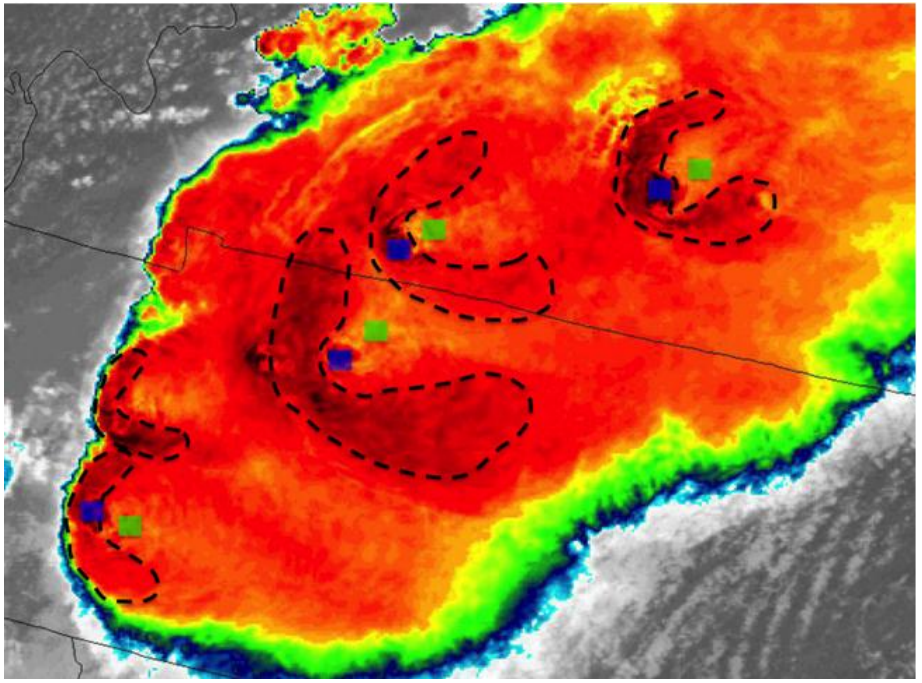
This way the forecasters will know where to focus their attention on the radar for future development, especially in regions where severe weather is expected but not yet initiated.

Future Capability: Enhanced V"/Overshooting Top

- **Algorithm Highlights**
  - Algorithm performs spatial sampling of convective cloud tops in ABI Channel 14 IR window imagery to identify the Overshooting Top (OT) and Anvil Thermal Couplet (ATC) signatures

- **Operational Applications**
  - Situational awareness product for monitoring convection
  - The enhanced-V is often seen in infrared satellite imagery before the onset of severe weather (damaging winds, hail, and/or tornadoes) and is an important indicator of a severe thunderstorm

2 km Proxy ABI From 1 km MODIS 10.7 μm Imagery 4/7/2006 at 1825 UTC



Overshooting top locations (only OTs with thermal couplets are shown)

Enhanced-V Anvil Thermal Couplet detections

Kris Bedka, SSAI/NASA Langley

Summary

- **GOES-R will provide:**
  - More capable instruments (more channels, higher spatial resolution, higher temporal resolution, lightning mapper, etc…)
  - Enhanced imagery
  - Better algorithms that provide more quantitative information
  - Better, more timely products (…showed many examples)
- **Increasing focus on User Readiness/Training**
- **Have an eye on evolving user needs**
  - Can we turn them (baseline and/or future capabilities products) into something even more useful to the user community

Mike Pavolonis, **"New Quantitative Volcanic Cloud and Fog Products for GOES-R"** (Session 4: From Sensors to Data Products II, Wed, Jan 25, 8:30-10:00am) 343/344

Jim Gurka, **"The GOES-R Proving Ground: 2012 Update"** (Themed Joint Session 15: Research to Operations Pathway for Satellite Data Algorithms and Products, Wed, Jan 25,10:30-12:00) Room 343/344