STAR Center for Satellite Applications and Research
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6th Annual Symposium on Future National Operational Environmental Satellite Systems-NPOESS and GOES-R

Oral – STAR Science Forum AMS Walk Through

Bruce H. Ramsay

- Objective
  - Conduct science and outreach activities that are needed for users to fully explain their tasks to colleagues
- Method
  - Oral and Poster Presenations on Land, Ocean, Atmosphere, Space
- Results
  - New applications for wide variety of objectives

Oral – Upcoming STAR Science Forum AMS Walk Through
Bruce H. Ramsay

- *GOES-R Satellite Mission: Land Product Development, Validation and Applications*
  - *Y. Yu*
- NPOESS Preparatory Project Validation Program for the Ozone Mapping and Profiler Suite (OMPS)
  - L.E. Flynn
- Impacts of Mismatch between Radiosonde Launch and Satellite Overpass on Satellite Sounding Evaluation
  - B. Sun
- Development of a statistical hail prediction product for the GOES-R Proving Ground (and other GOES-R Products)
  - D. Lindsey
- The Effect of Smoke on Pyrocumulonimbus : A Satellite Perspective
  - D. Lindsey
- A Weather Event Simulator (WES) for the GOES-R Advanced Baseline Imager (ABI)
  - T.J. Schmit
- The ABI on GOES-R
  - T.J. Schmit
- Evaluation and Quality Control of *in situ* SSTs for Use in the Cal/Val of Satellite Retrievals at NESDIS
  - F. Xu

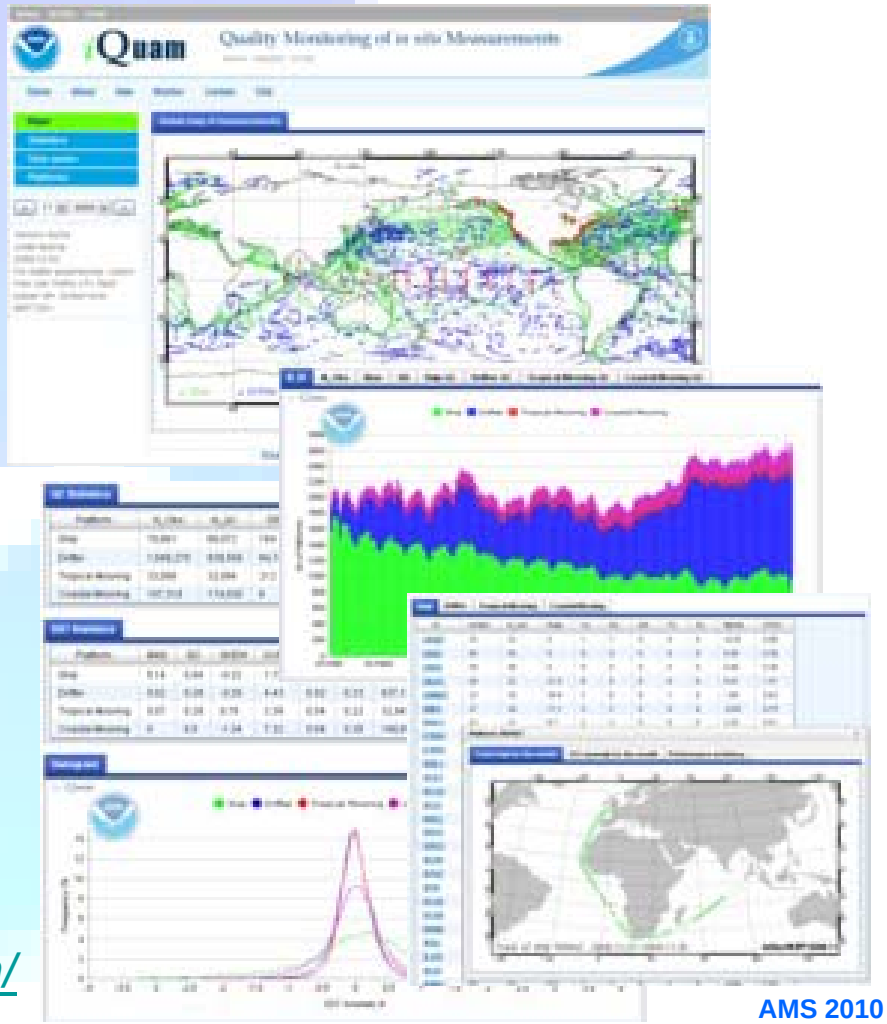
Oral – Upcoming STAR Science Forum AMS Walk Through
Bruce H. Ramsay

- NOAA Products Validation System (NPROVS) and Summary Archive System (NARCSS) for real-time and long-term monitoring of environmental satellite products
  - T. Reale
- Integrated polar-GOES-GPSRO satellite product comparisons using the NOAA Products Validation System (NPROVS)
  - T. Reale
- The GOES-R Cal/Val Plan (oral)
  - C. Cao
- NPOESS Preparatory Project Validation Program for the CRIS/ATMS Sounder Environmental Data Products
  - C.D. Barnet
- NOAA Aerosols and Ocean Science Expeditions (AEROSE): Dedicated Marine Radiosondes for CrIMSS and GOES-R PROXY Datasets
  - N. R. Nalli
- Expected Operational Cloud Observation Improvements with VIIRS on NPP/NPOESS
  - A. Heidinger
- Towards Integrated Cloud Mask and Quality Control for ABI SST Product: Prototyping with MSG SEVIRI
  - N. Shabanov
- A New Infrared Land Surface Emissivity Database for the Community Radiative Transfer Model
  - R. Vogel
- GOES-R Risk Reduction
  - I. Guch

Oral - Evaluation and Quality Control of *in situ* SSTs for Use in the Cal/Val of Satellite Retrievals at NESDIS

Feng Xu, Alexander Ignatov

- Inventory of available *in situ* data sets
  - NCEP GTS (NRT, 1991 - pr, No QC)
  - ICOADS (1980s-2009, QCed)
  - FNMOC (NRT, 1998 - pr, QCed)
- Development of advanced QC for satellite Cal/Val applications
  - Preprocessing and cleaning
  - Duplicate Removal, Travel-Speed Check, SST-Gradient Check
  - Bayesian methods for Reference Check and Cross-platform Check
- iQuam – online monitoring *in situ* SSTs
  - Provide QCed NCEP *in situ* data on FTP
  - Global maps, statistics, time-series of Nobs/Bias/SD wrt Reynolds
  - Individual platforms: Statistics, track map, SST anomalies, performance history
  - Feedback to QC system: platform blacklist, *a priori* information…



http://www.star.nesdis.noaa.gov/sod/sst/iquam/

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"*GOES-R Satellite Mission: Land Product Development, Validation and Applications*"

Y. Yu, M. Goldberg, I. Csiszar

Baseline Products:

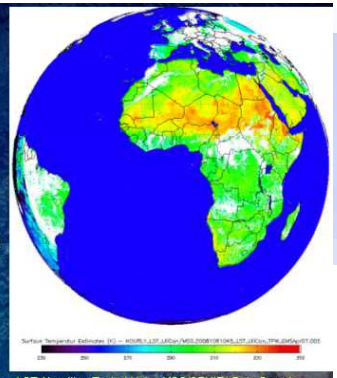
- Land Surface Temperature (LST)
- Fire Detection and Characterization (FDC)

Option 2 Products:

- Normalized Difference Vegetation Index (NDVI)
- Surface Albedo
- Flood and Standing Water (FSW) monitoring
- Green Vegetation Fraction (GVF)

Current status
- A TIR split window, explicit emissivity application algorithm was developed for the LST retrieval.
- Examined using a comprehensive simulation dataset.
- Tested using current GOES Imager and SEVIRI datasets.
- Evaluated using *in situ* LST estimation from SURFRAD stations.
- Critical design review, test readiness review have been done
- 80% readiness ATBD and software have been delivered, and received approval comments

Planned accomplishment
- Collecting more ground LST and satellite data for comprehensive *in situ* validation
- 100% readiness ATBD and software delivery in 2010.
- Development for validation system/tools

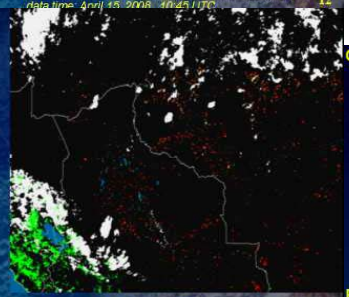


LST Algorithm Tested Using MSG/SEVIRI Data Sample data time: April 15, 2008, 10:45 UTC

12

Current status
- Adapted wildfire automated biomass burning algorithm (WA_ABBA): a dynamic, multi-spectral, thresholding contextual algorithm using visible and infrared bands to locate fires and characterize sub-pixel fire characteristics.
- Examined using a comprehensive simulation dataset from proxy satellite data via a point spread function (PSF)
- Tested using MODIS data and SEVIRI data.
- Critical design review, test readiness review have been done
- 80% readiness ATBD and software have been delivered, and received approval comments

Planned accomplishment
- Collecting ground Fire and satellite data for comprehensive *in situ* and multi-satellite validation
- 100% readiness ATBD and software delivery in 2010.
- Development for validation system/tools



GOES-R WF_ABBA Fire Mask tested using MODIS data on Sept. 7, 2004, at 17:50 UTC.

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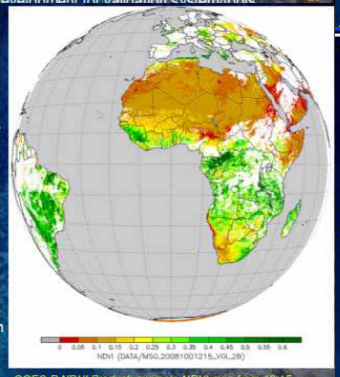
Current status
- A maximum-value composite algorithm is determined for the NDVI generation.
- Examined cloud contamination effect
- Tested using a comprehensive proxy satellite dataset including MODIS and SEVIRI datasets
- Critical design review, test readiness review have been done
- 80% readiness ATBD and software have been delivered, and received approval comments

Planned accomplishment:
- Analyzing anisotropic effect and its impact to the NDVI product
- Perform multi-satellite data comparison
- Collecting and perform *in situ* data comparison
- 100% readiness ATBD and software delivery in 2010.
- Development for validation system/tools



GOES-R NDVI Product: example NDVI map from 12:15 UTC April 9, 2008 produced from SEVIRI on Meteosat-8

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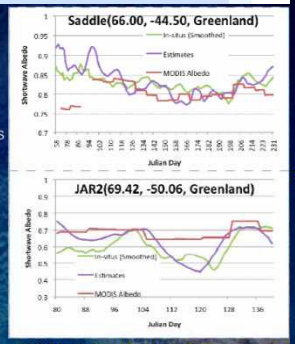
Current status
- A regression analysis approach is determined for estimating the surface albedo from TOA radiances.
- Three-kernal model is applied for determining the surface BRDF characters.
- The broad band albedo is estimated from narrow band albedos from visible to short wave infrared channels), through a pre-determined linear combination formula, which is inherited from MODIS and VIIRS approaches.
- Surface reflectance determined from the BRDF characters is available as bypass product.
- The algorithm is tested using MODIS data and SEVIRI data.
- Algorithm design review has been done
- Draft ATBD has been delivered in 2009.

Planned accomplishment
- Cross comparison using different satellite data
- More simulation and proxy data analyses for improving the regression coeffs
- Conduct the algorithm critical design review
- 80%, 100% readiness ATBD and software delivery in 2010 and 2011, respectively
- Development for validation system/tools

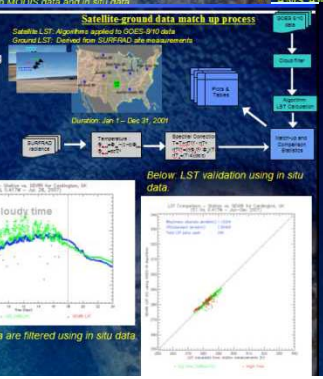


GOES-R Albedo Product Tested using SEVIRI data, compared to MODIS data and in situ data.

17

Current status
- A satellite-ground data match up tool has been developed, which includes a stringent cloud filtering processes.
- A large set of *In situ* data has been collected covering areas in the U.S. and Europe.
- A site characterization model is developed for estimating measurement difference between the satellite pixel and the *in situ* spot.
- Validation plans for LST, NDVI and FDC products have been set up.

Planned accomplishment
- Collecting more *in situ* data and corresponding satellite data for better temporal and spatial representativities.
- Selecting proper *in situ* sites for high quality validation process.
- Set up and conduct validation plans for Albedo, FSW and GVF products.
- Development for validation system/tools

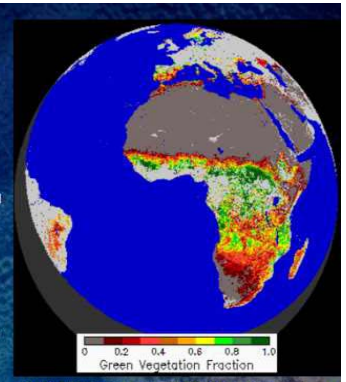


Above: Cloudy data are filtered using in situ data.

Below: LST validation using in situ data.

Current status
- The algorithm will use NDVI product with pre-determined maximum and minimum NDVI values as references of full and zero vegetation fractions, respectively.
- Algorithm for determining global maximum and minimum NDVI values have been tested using 4-year SEVIRI data (as proxy)
- Impact of anisotropic effect in NDVI data is analyzed, resulting that surface BRDF information will significantly improve the GVF product.
- Algorithm is primarily tested using MODIS data and SEVIRI data.
- Algorithm design review has been done
- Draft ATBD has been delivered in 2009.

Planned accomplishment
- Develop a approach for the BRDF correction
- Conduct the algorithm critical design review
- 80%, 100% readiness ATBD and software delivery in 2010 and 2011, respectively
- Development for validation system/tools



GOES-R GVF tested using SEVERI data, in the week of 2007155-2007161

16

Current status
- A decision tree algorithm is determined for detecting the flood/standing water area
- A ratio (visible and short wave infrared bands) comparison algorithm is applied for estimating sub-pixel water fraction.
- Algorithm is primarily tested using MODIS data and SEVIRI data.
- Algorithm design review has been done.
- Draft ATBD has been delivered.

Planned accomplishment
- Collecting/generating ground database for *in situ*, multi-satellite comparisons.
- Further testing the decision tree algorithm/ procedure and optimizing threshold values applied
- Conduct the algorithm critical design review
- 80%, 100% readiness ATBD and software delivery in 2010 and 2011, respectively
- Development for validation system/tools

Top: SEVIRI RGB image in Namibia on Feb. 4, 2008 Bottom: water fraction calculated using the FSW algorithm

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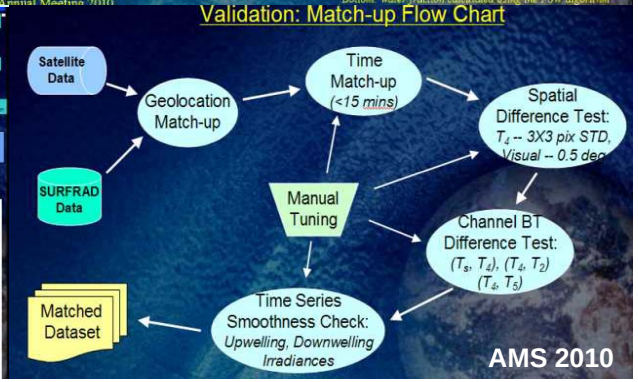


6th Annual Symposium on Future National Operational Environmental Satellite Systems-NPOESS and GOES-R

Session 9 Calibration and Validation Plans for NPP/NPOESS and GOES-R - II

ORAL: NPOESS Preparatory Project Validation Program for the Ozone Mapping and Profiler Suite (OMPS)

L.E. Flynn, D. F. Rault, S. Janz, I. Petropavlovskikh, C. S. Long, S. K. Yang, and S. Farrow

Objectives: Provide an overview of the collaborative data, techniques, and team for the validation of the NPP OMPS environmental data products.

Pre-Launch Phase (L-24M to L)

- Improve Ground-based assets operations and access
- Develop Match-up and statistical analysis tools and readers
- Implement and exercise forward models for radiative transfer
- Create and manipulate sample, synthetic, and proxy SDR (Level 1), EDR DIP (Level 2) data sets
- Collect and exercise calibration parameters
- Implement alternative/heritage algorithms

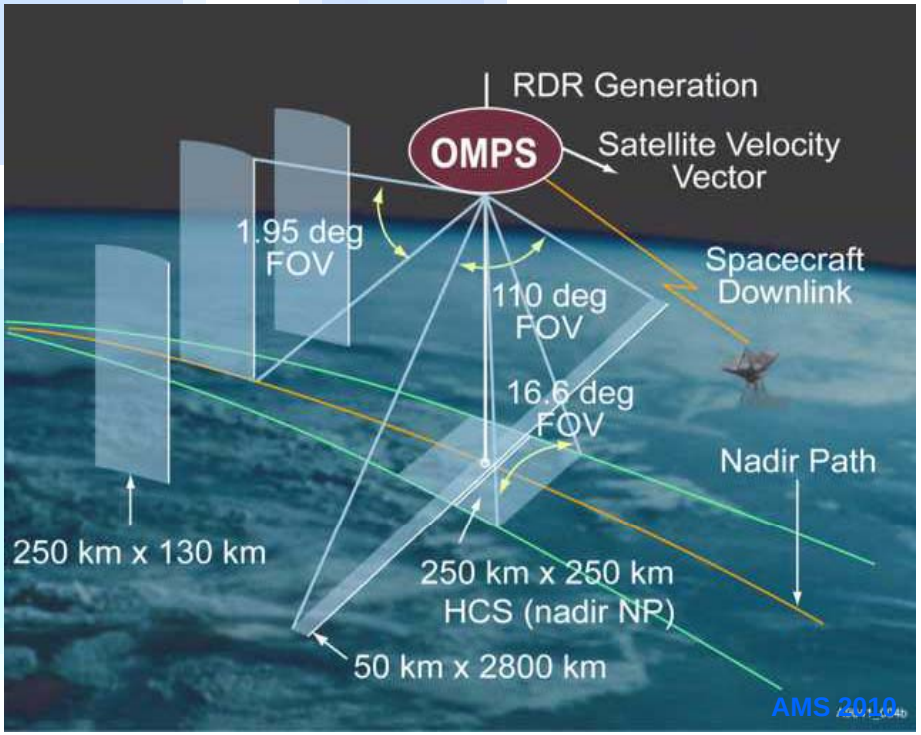
Early Orbit Check Out Phase (L to L+3M)

- Check parameters and instrument behavior
- Perform internal consistency checks
- Provide feedback to SDR Team
- Test tools and alternate algorithms with real data

Intensive Cal/Val Phase (L+3M to L+24M)

- Perform external comparisons to satellite products
- Perform sub-orbital comparison/validation
- Provide feedback to IPO and NGAS
- Evaluate product applications
- Begin trending and automated monitoring

Transition to regular operations & long-term monitoring



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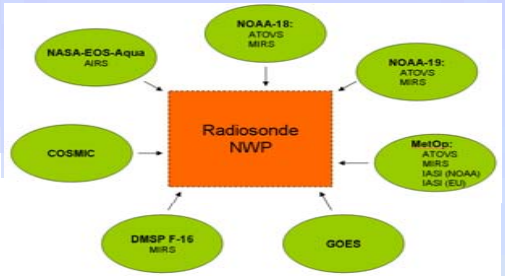
26th Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology

Oral – Impacts of Mismatch between Radiosonde Launch and Satellite Overpass on Satellite Sounding Evaluation

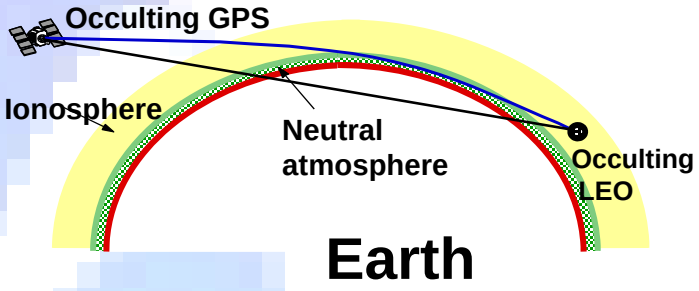
Bomin Sun (I.M.Systems Group), Anthony Reale and Cheng-Zhi Zou (NOAA/NESDIS/STAR),
Dian Seidel (NOAA/ARL), Michael Pettey and Frank Tilley (I.M. Systems Group)

- Motivation: Quantify the uncertainty in validation due to temporal and spatial mismatch between raob and satellite

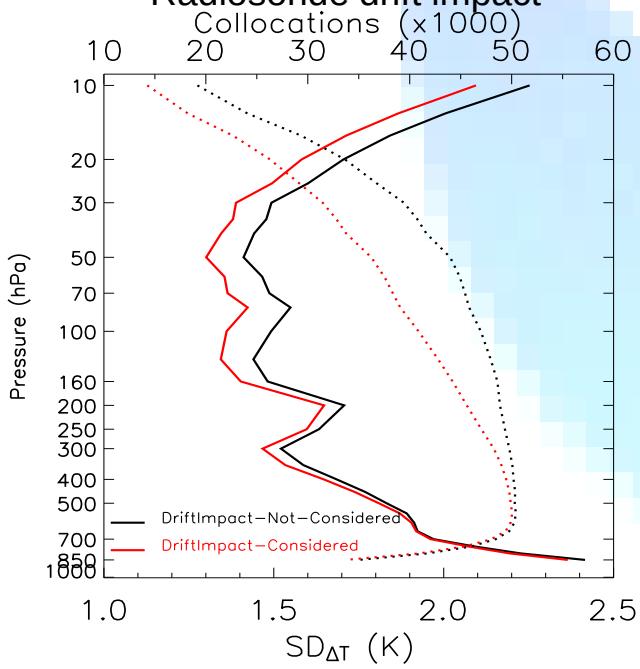
NPROVS



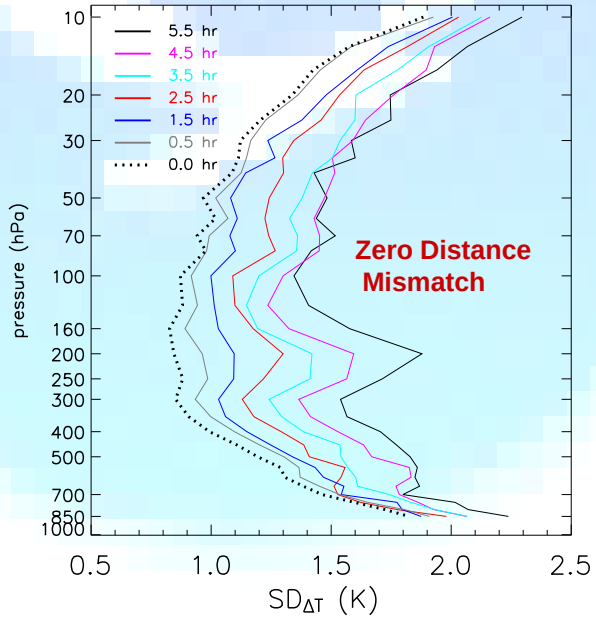
COSMIC data used

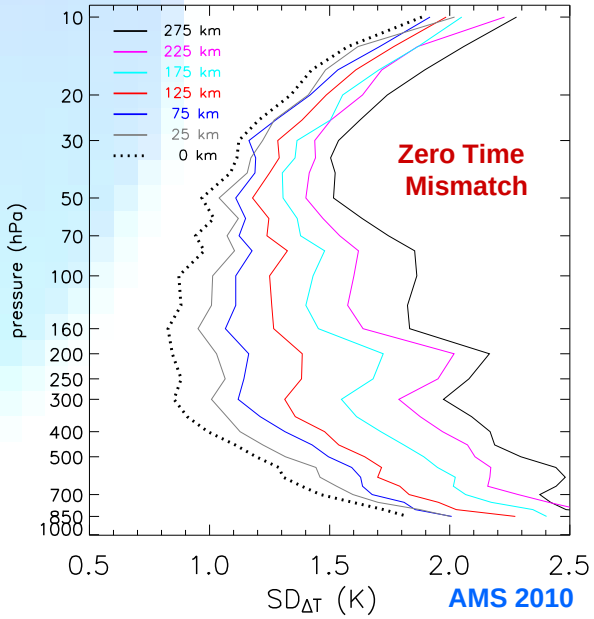


Radiosonde drift impact



Time and Distance mismatch impact





AMS 2010

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6th Annual Symposium on NPOESS and GOES-R at the AMS 2010

Title: The GOES-R Cal/Val Plan (oral)

C. Cao, B. Iacovazzi, and the CWG team

- Objectives
  - Provide an overview of the GOES-R cal/val plan and recent progress in executing the plan
  - Ensure well calibrated & navigated level 1b data for GOES-R mission success
- Method
  - Developed a comprehensive cal/val plan for all GOES-R instruments (ABI/SWX/GLM)
  - Detailed cal/val in the four phases (prelaunch, early checkout/PLT, intensive OV, and longterm monitoring)
  - Leverage current GOES and GSICS capabilities
- Results (plan execution)
  - Major progress in developing core capabilities in radiometric, spectral, and geo-spatial calibration toolkits
  - Vicarious (desert, SST ocean, lunar) site characterization, and ground sys. support
  - Baseline the plan at GPO

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Oral – GOES-R Risk Reduction

Ingrid Guch and Mark DeMaria

- Objective
  - Conduct science and outreach activities that are needed for users to fully exploit all GOES-R instruments and capabilities
- Method
  - Funding for Research: Exploratory Algorithms, New Products and Applications
    - Land, Ocean, Atmosphere, Space
  - Funding for demonstrations and training
    - Science arm of proving ground and user training modules
    - Nowcasting and Nearcasting
    - Data Assimilation
- Results
  - New applications for ABI, GLM and Space Weather instruments that exploit improved spatial, spectral and temporal resolution

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17th AMS Conference on Satellite Meteorology & GOES-R/NPOESS Symposium:

Poster - A Weather Event Simulator (WES) for the GOES-R Advanced Baseline Imager (ABI)

Timothy J. Schmit, Kaba Bah, Jordan Gerth, Marcia Cronce, Jason Otkin, Justin Sieglaff, Gary Wade

- Leveraging existing simulated AWG Proxy data to showcase the abilities of ABI for use by forecasters.
- The ABI spectral bands have been added to a NWS Weather Event Simulator (a version of the real-time, operational AWIPS forecasters use but with a historical case study).

Beta release of the ABI WES cast study

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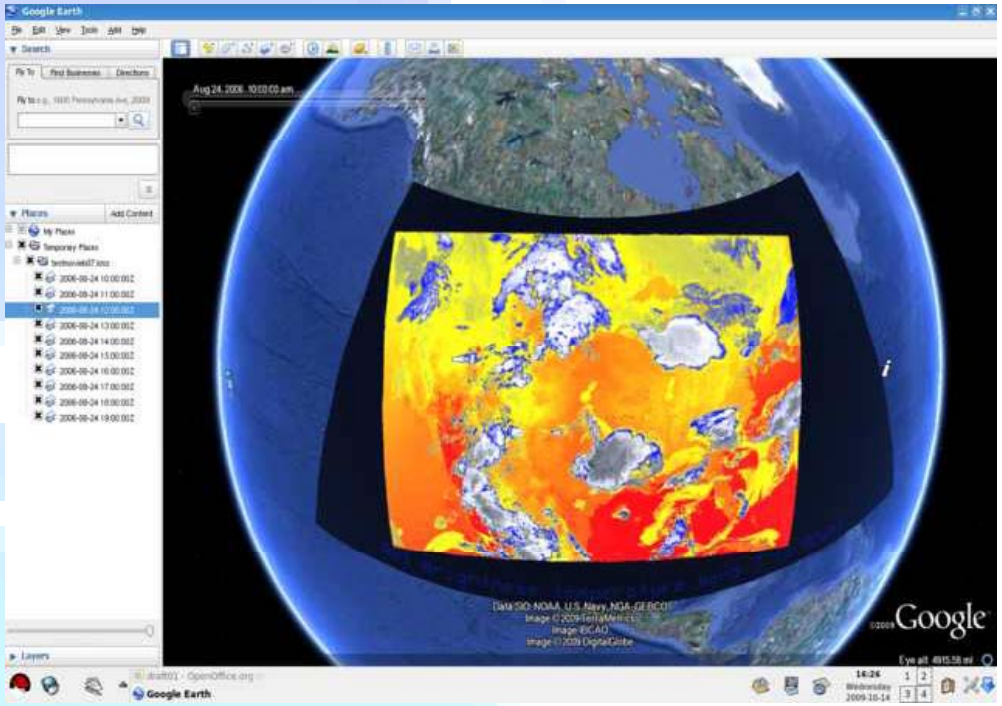
17th AMS Conference on Satellite Meteorology & GOES-R/NPOESS Symposium:

Oral - The ABI on GOES-R

Timothy J. Schmit, James J. Gurka, Mathew M. Gunshor, Kaba Bah

- The ABI will improve upon the current GOES Imager with more spectral bands (3x), faster imaging (5x), higher spatial resolutions (4x), better navigation and registration, and more accurate calibration.



Simulated ABI data as shown in google earth

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90 AMS Annual Meeting and 6th GOES Users' Conference

Expected Operational Cloud Observation Improvements with VIIRS on NPP/NPOESS

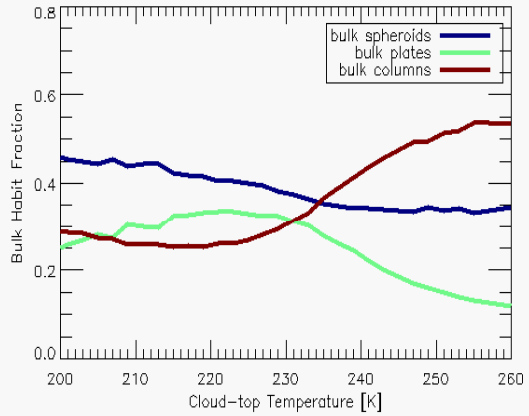
A. Heidinger

- **Objectives**
  - The VIIRS on NPOESS offers an additional window channel (8.5 μm) in the IR compared to its predecessor, the AVHRR.
  - Compared to MODIS, VIIRS lacks the IR absorption bands used for cloud height determination.
  - This paper will illustrate the impact of the VIIRS IR spectral information in the context of cirrus cloud remote sensing.

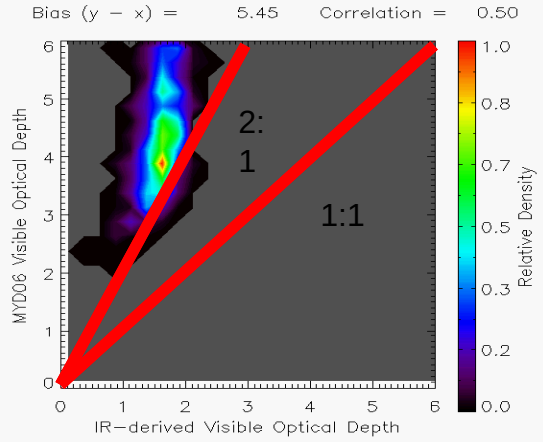
- **Methods**
  - Use MODIS IR observations and apply VIIRS algorithms
  - Demonstrate impact on skill via comparison with Lidar (CALIPSO)
  - Demonstrate new information over that provided by AVHRR due to the presence of 3 IR window channels on VIIRS via global processing of MODIS.

- **Results**
  - CALIPSO analysis demonstrates the window channels offered by VIIRS provide little sensitivity to the height of thin cirrus. (*bad*)
  - Implementation of VIIRS microphysical algorithms onto MODIS demonstrate that accurate estimates of cirrus optical depth and particle are possible. (*good*)
  - Additional channel (compared to AVHRR) allows for estimation of the dominant ice habit at cloud top. (*very good* - top image)
  - Knowledge of ice habit may help resolve the long-standing inconsistency between IR and solar-reflectance based measures of cirrus properties. (bottom image)

Example of a New Cloud Products from VIIRS that is not possible from AVHRR (ice cloud habit – a measure of shape).



Example of Inconsistency in IR and Solar Reflectance Derived Estimates of Cloud Optical Depth



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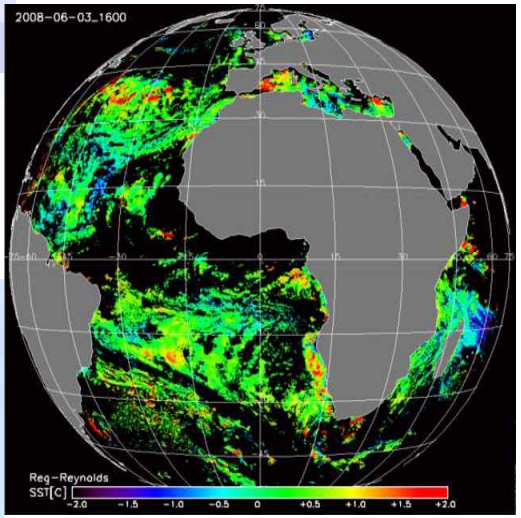
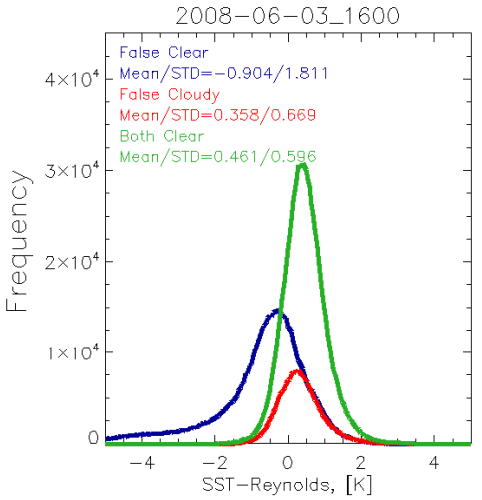
Towards Integrated Cloud Mask and Quality Control for ABI SST Product: Prototyping with MSG SEVIRI

N. Shabanov, A. Ignatov**,** B. Petrenko, Y. Kihai and A. Heidinger

- **Objectives**
  - ABI CM is the upstream cloud masking system designed for clear-sky identification for downstream ABI applications
  - SST QC is a quality control module inside ABI SST system, designed to asses SST retrievals accuracy contaminated by environmental conditions (ambient clouds, aerosols, radiometric noise, etc)
  - The objective of this research is to intercompare performance and assess integration possibility of ABI CM and SST QC
- **Methods**
  - Side-by-side comparison of ABI CM and SST QC
  - ABI CM vs. SST QC Confusion Matrix analysis
  - Analysis of performance of individual ABI CM and SST QC tests
- **Results**
  - ABI CM performs according to ATBD specs (<~12% misclassification compared to SST QC)
  - However, to achieve fine SST accuracy ABI CM mask needs to be further refined with SST QC (run sequentially)
  - For the SST applications (1) use only thermal channel-based tests to avoid temporal/spatial discontinuity; (2) adjust ABI CM uniformity filters to minimize 'False Cloudy' misclassification and allow sequential execution (ABI CM -> SST QC); (3) Fine tune SST QC and match SST retrieval algorithm.





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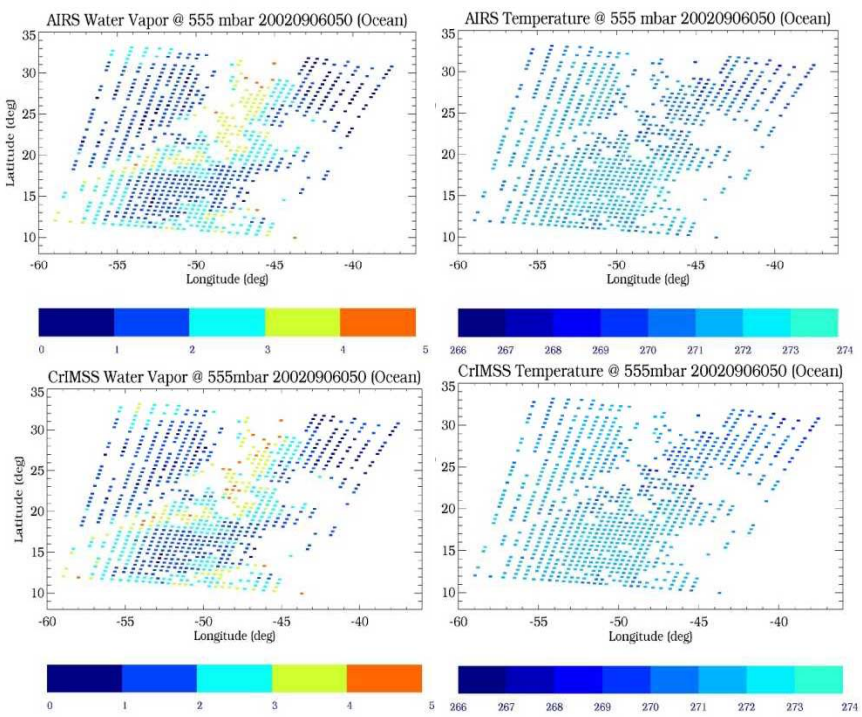
6th AMS Symposium on Future National Operational Environmental Satellite Systems-NPOESS and GOES-R:

Oral 5.2 – NPOESS PREPARATORY PROJECT VALIDATION PROGRAM FOR THE CRIS/ATMS SOUNDER ENVIRONMENTAL DATA PRODUCTS

Christopher D. Barnet, Nicholas R. Nalli, *et al.*

- Objectives
  - Validate the NPOESS Algorithm
- Method
  - Incorporate lessons learned from Aqua/AIRS, F16/SSMIS, and METOP/IASI validation activities.
    - Concentrate on datasets proven valuable for global validation for AIRS (ECMWF, NCEP/GFS, RAOBs, etc)
  - Discussions with key users to ensure our Cal/Val plan meets their needs.
  - Define the details of computing statistics from sparse *in-situ* measurements.
    - Details on how to "roll-up" regional statistics need to be worked out and *tested* prior to launch.
  - Characterize performance of EDRs in various ensembles of cases.
    - Test concepts pre-launch with simulated CrIMSS "proxy datasets" and compare results with heritage instruments.
  - Build team of Subject Matter Experts (SMEs) from both user and science communities to leverage heritage knowledge and tools as well as assure understanding of customer mission success.
  - Leverage existing capabilities wherever possible.
- Results
  - Completion and public release of Cal/Val Plan
  - Risk Reduction using AIRS and IASI
  - Porting of IDPS EDR algorithm
  - Development of Proxy datasets
  - NOAA PNE/AEROSE mission (cf. 14IOAS Oral 2.1, Nalli et al.)

555 hPa temperature and moisture over the Atlantic Ocean (from AIRS/AMSU and CrIMSS)



Courtesy of Guong Guo and Xu Liu (EDR Cal/Val Team).

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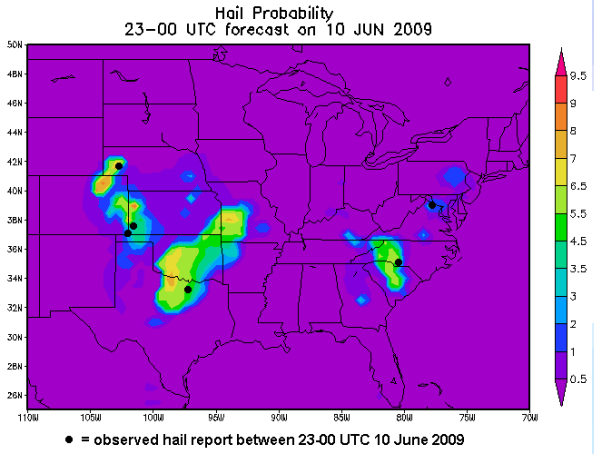
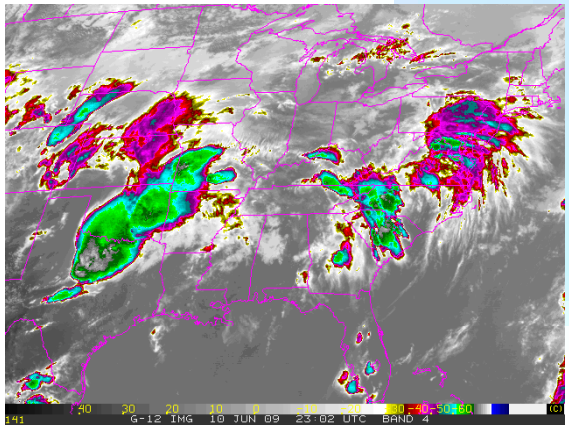
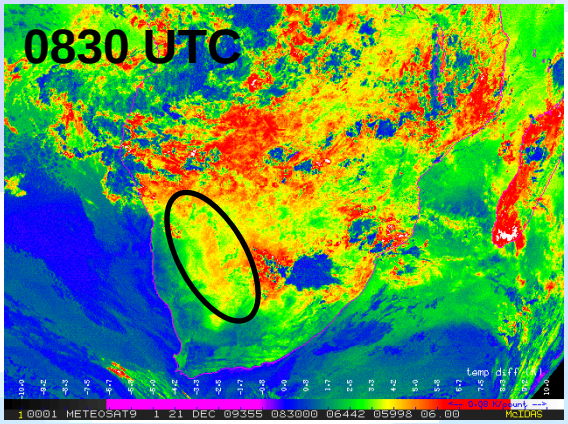
Development of a statistical hail prediction product for the GOES-R Proving Ground (and other GOES-R Products)

D. Lindsey (STAR/RAMMB), C. Siewert, L. Grasso, W. MacKenzie

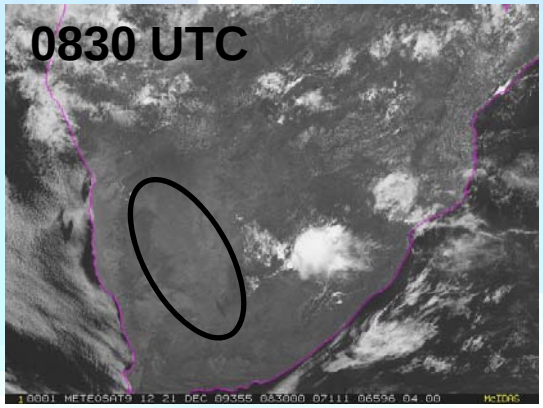


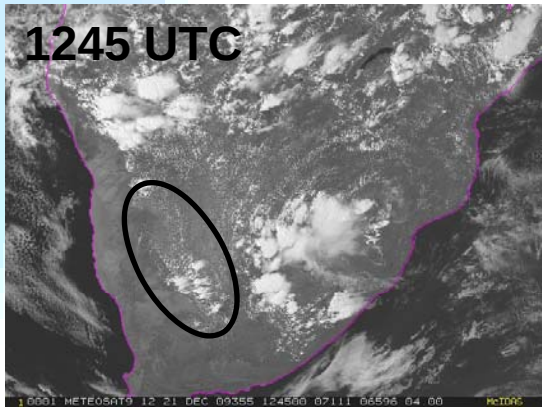


Example of the hail probability product (top) and corresponding GOES IR image (bottom)



Note the local max in 10.8 – 12.0 µm when no clouds are present, but convective clouds later form in that region





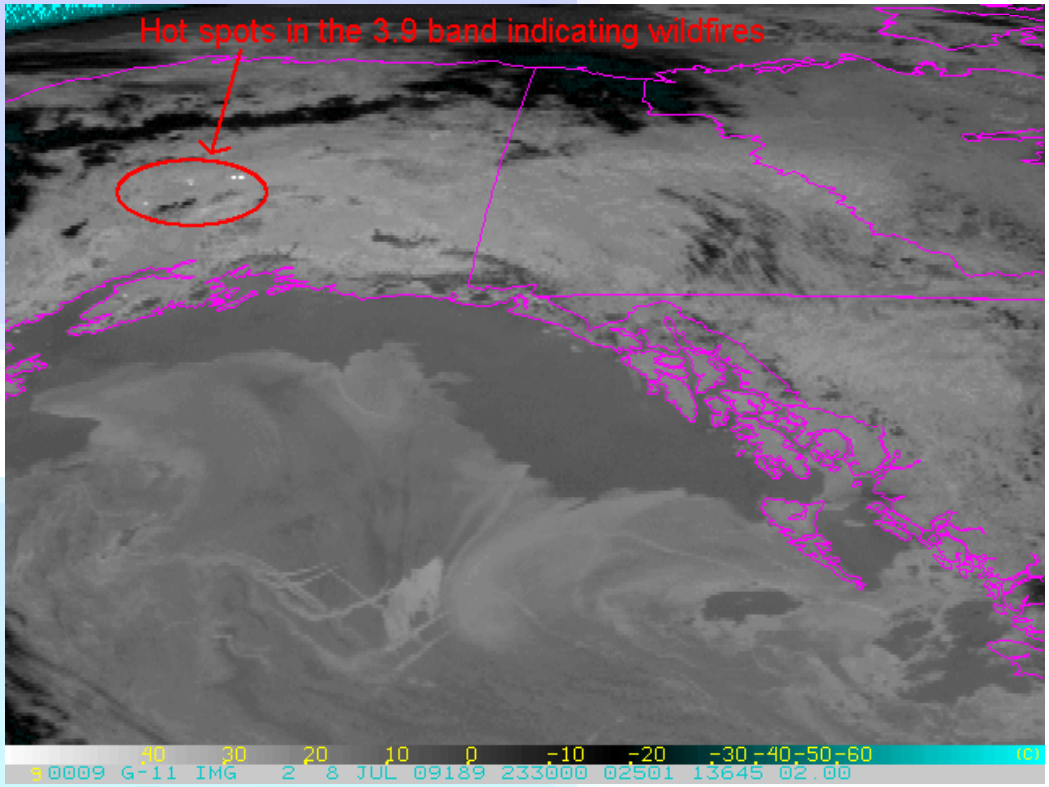
MSG 10.8 – 12.0 µm image (top) over S. Africa from 21 Dec. 2009, and MSG HRV images (bottom)

2nd Symposium on Aerosol-Cloud-Climate Interactions

The Effect of Smoke on Pyrocumulonimbus: A Satellite Perspective

D. Lindsey (STAR/RAMMB) and M. Fromm (NRL)

- A “PyroCb” is a thunderstorm which forms over a wildfire
- Aerosols from the fire can significantly alter the microphysical evolution of the storm, compared to nearby “clean” convection
- PyroCbs often have very small cloud-top ice crystals, and their anvils tend to have long residence times
- Aerosols from pyroCbs can be injected into the lower stratosphere, where they can exist for days



An example of a pyroCb and the resulting anvil/aerosol evolution in central Alaska on 9 June 2009. The loop above is a series of GOES-11 3.9 um images from 8 July to 11 July 2009.

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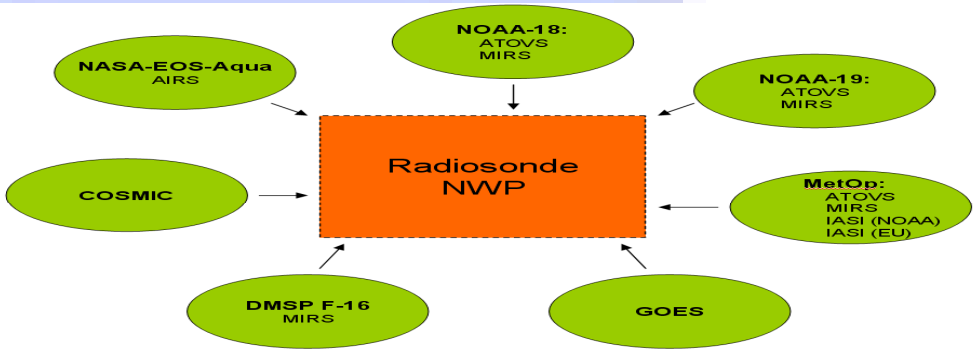
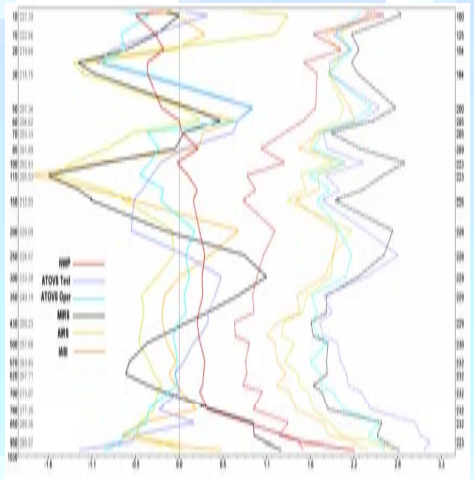
6th Symp on NPOESS and GOES-R

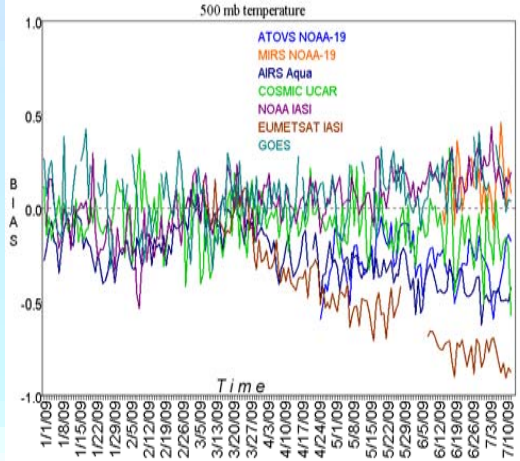
Oral – NOAA Products Validation System (NPROVS) and Summary Archive System (NARCSS) for real-time and long-term monitoring of environmental satellite products

Reale, Sun, Tilley and Pettey

- Centralized STAR facility to inter-compare satellite derived product systems
- Supports IPO NPOESS EDR Cal-Val Program (Chris Barnet)







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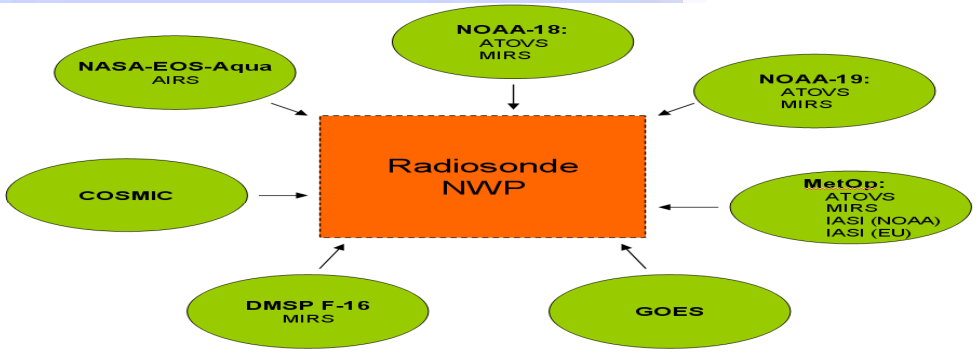
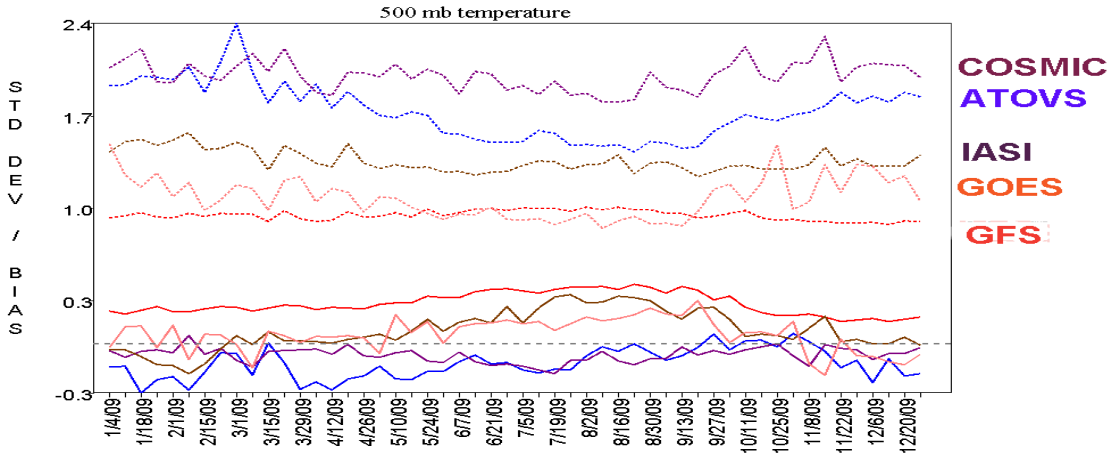
15th Symp on Meteorological Observation and Instrumentation

Oral – Integrated polar-GOES-GPSRO satellite product comparisons using the NOAA Products Validation System (NPROVS)

Reale, Sun, Tilley and Pettey

- Centralized STAR facility to inter-compare satellite derived product systems
- Supports IPO NPOESS EDR Cal-Val Program (Chris Barnet)
- Support GOES-R … *pending*





500mb SAT-minus-Raob Mean (low) and SD (up) weekly trend

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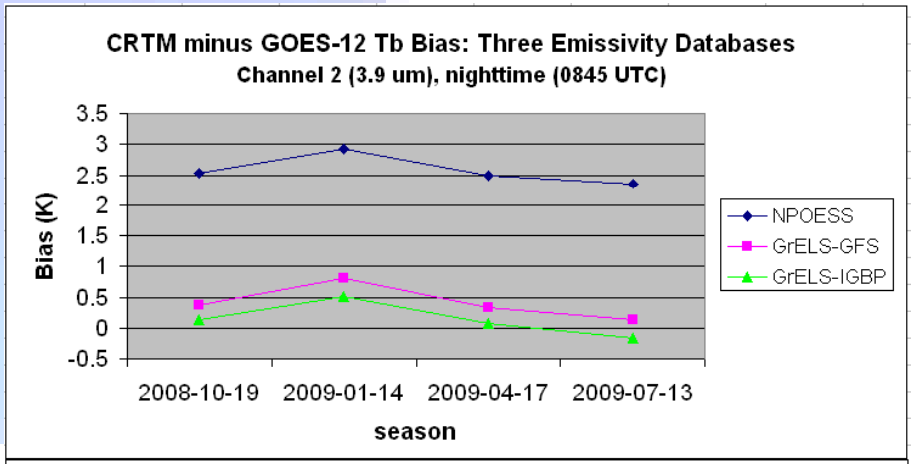
90th AMS Annual Meeting / 6th Symposium on NPOESS & GOES-R

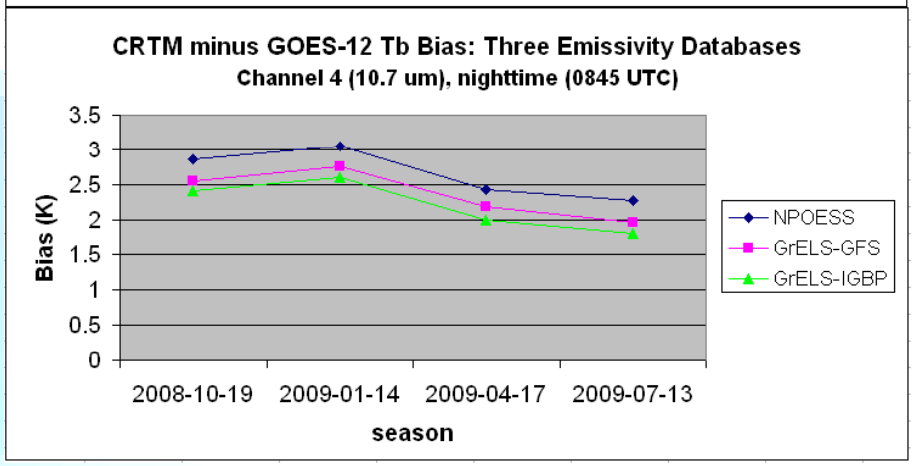
A New Infrared Land Surface Emissivity Database for the Community Radiative Transfer Model

Ron Vogel, Quanhua Liu, Ben Ruston, Yong Han, Fuzhong Weng (STAR & NRL team)

Greenness-adjusted Emissivity for Land Surface (GrELS)
- Improves upon current NPOESS emissivity database for NCEP's satellite data assimilation
- Adds temporal dynamics, improves spectral resolution
- Uses same surface classification as GFS

- Method
  - Uses Green Vegetation Fraction (STAR) to add seasonal vegetation dynamics
  - Uses lab-measured reflectance from JPL Spectral Library for high spectral resolution emissivity
  - Incorporates GFS and IGBP surface classification schemes to meet needs of diverse users
- Results
  - Reduces CRTM-to-satellite bias by 94% for GOES 3.9um and 17% for GOES 10.7um channels, thereby permitting increase in number of satellite observations assimilated
  - Emissivity traceable to JPL Spectral Library reflectance
  - Other uses besides radiative transfer/assimilation:
    - **Land surface temperature retrieval**
    - **Surface-atmosphere interaction**
    - **Earth radiation budget / surface energy balance**





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14th AMS Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface:

Oral 2.1 – NOAA AEROSOLS AND OCEAN SCIENCE EXPEDITIONS (AEROSE): DEDICATED MARINE RADIOSONDES FOR CrIMSS AND GOES-R PROXY DATASETS

Nicholas R. Nalli,* C. D. Barnet, E. Joseph, V. R. Morris, H. Xie, D. E. Wolfe, P. J. Minnett and M. D. Goldberg

- Objectives
  - Provide dedicated marine rawinsondes for *in situ* correlative data over open ocean.
  - Generate CrIMSS and GOES-R ABI proxy datasets.
  - Validate the NPOESS (cf. 6GOESRNPOESS Oral 5.2, Barnet-Nalli et al.) and GOES-R algorithms within the meteorologically challenging regime of the tropical North Atlantic.
- Method
  - Continue support and participation in the NOAA Aerosols and Ocean Science Expeditions (AEROSE).
  - Launch Vaisala research quality RS92 rawinsondes and ozonesondes during MetOp and Aqua (A-Train) overpasses.
  - Acquire other AEROSE shipboard datasets (viz., M-AERI) that provide important atmospheric state measurements.
  - Obtain IASI/AIRS granules within AEROSE domain for generating CrIMSS and GOES-R proxy data.
- Results
  - Each AEROSE cruise has resulted in unique latitudinal and longitudinal cross-sections of thermodynamic variables pressure, temperature, humidity (PTU), plus GPS winds.
    - AEROSE obtained the first trans-Atlantic in situ cross-sectional observations of the SAL (Nalli et al. 2005)
    - Subsequent cross-sections obtained during the 2006, 2007 and 2009 campaigns.
  - AEROSE CrIMSS and GOES-R ABI proxy datasets are currently under development and investigation.