# AMS Talk Summaries from STAR & CIs

22-26 JANUARY

American Meteorological Society

97th ANNUAL MEETING | SEATTLE

Compiled by Ralph Ferraro, STAR/CoRP/SCSB & Deb Baker, CICS-MD

# STAR

- Csiszar, Ivan (3)
- Heidinger, Andrew
- Hilger, Don
- Meng, Huan
- Nalli, Nicholas (3)
- Rudlosky, Scott
- Schmit, Tim (4)
- Wang, Wenhui
- Xiong, Xiaozhen (Shawn)
- Zeng, Jian
- Zhou, Yan (2)

# Operational Land Data Products from Suomi NPP and their Integration into NOAA's Enterprise Algorithm Suite

I. Csiszar, M. Vargas, Y. Yu , L. Zhou, J. Daniels, W. Wolf (STAR); M. Román (NASA GSFC)

12th Annual Symposium on New Generation Operational Environmental Satellite Systems

- Evaluation of the IDPS land algorithms is complete
  - Products achieved validated stage 1 as defined by NOAA JPSS
  - Reactive maintenance continues
  - Long-term monitoring in systematic production
- Land products are transitioning to NOAA ESPC implementation
  - Development of algorithm updates, interfaces and dependencies
  - Additional and added value products

| Product | JPSS | GOES-R | Comments |
|---|---|---|---|
| Surface Refl | IDPS >NDE | AWG Opt 2 | GOES-R: combined SR/albedo |
| Vegetation Ind | IDPS >NDE | AWG Opt 2 | TOA/TOC NDVI, TOC EVI; G: TOA NDVI |
| Green Veg. Fr. | NDE | AWG Opt 2 | High priority for NWP applications |
| Veg Health | NDE | Proposed | NDE implementation is ongoing |
| Phenology | PGRR | PGRR | Predictive capability |
| Albedo | IDPS >NDE | AWG Opt 2 | GOES-R: combined SR/albedo |
| Land Surf Temp | IDPS >NDE | AWG basel. | Key product for NWP verification |
| Active Fire | IDPS->NDE | AWG basel. | JPSS: also NGDC NightFire |
| Surface Type | External | None | Single product on a global grid. |
| Flood/St. Water | PGRR | AWG Opt 2 | Key end user applications |

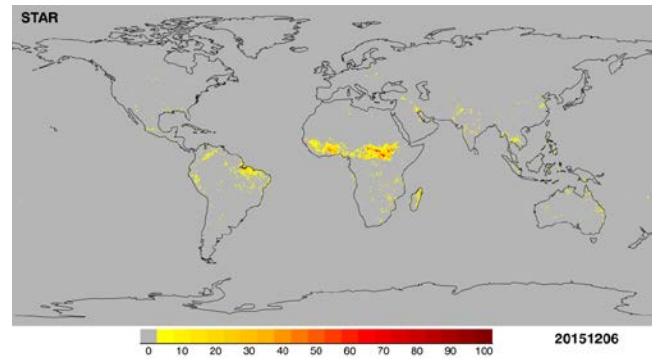
***IDPS: Interface Data Processing Segment – current, fully operational capability***
***NDE: Suomi NPP Data Exploitation – current and upcoming operational capability***
***PGRR: Proving Ground / Risk Reduction – experimental products for future operational implementation***
***AWG: Algorithm Working Group – operational capability after GOES-R launch. Option 2 product development is currently not ongoing for all products.***

# The New Operational VIIRS Active Fire Product in NOAA'S NDE System

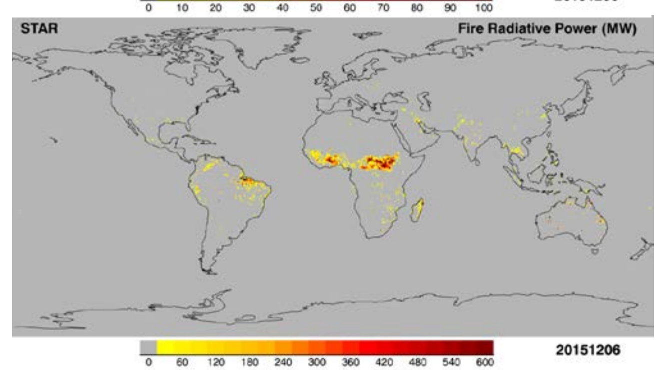
Ivan Csiszar, Walter Wolf – STAR; Wilfrid Schroeder, Louis Giglio – UMD; Marina Tsidulko – IMSG

12th Annual Symposium on New Generation Operational Environmental Satellite Systems

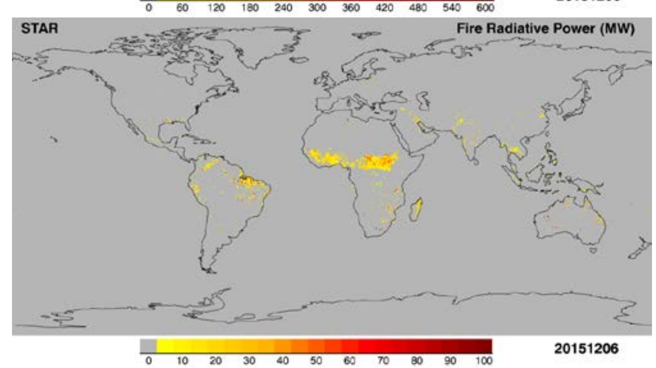
- A new VIIRS active fire product is transitioning to NOAA operations
  - Full fire mask
  - Fire Radiative Power
  - Implemented in NDE
  - Consistent with NASA science product and MODIS heritage
- Long-term science monitoring of the operational product is ongoing
  - Current IDPS product is stable
  - Interface with new product is in development




*Fire frequency*




*Integrated fire radiative power*




*Mean fire radiative power*

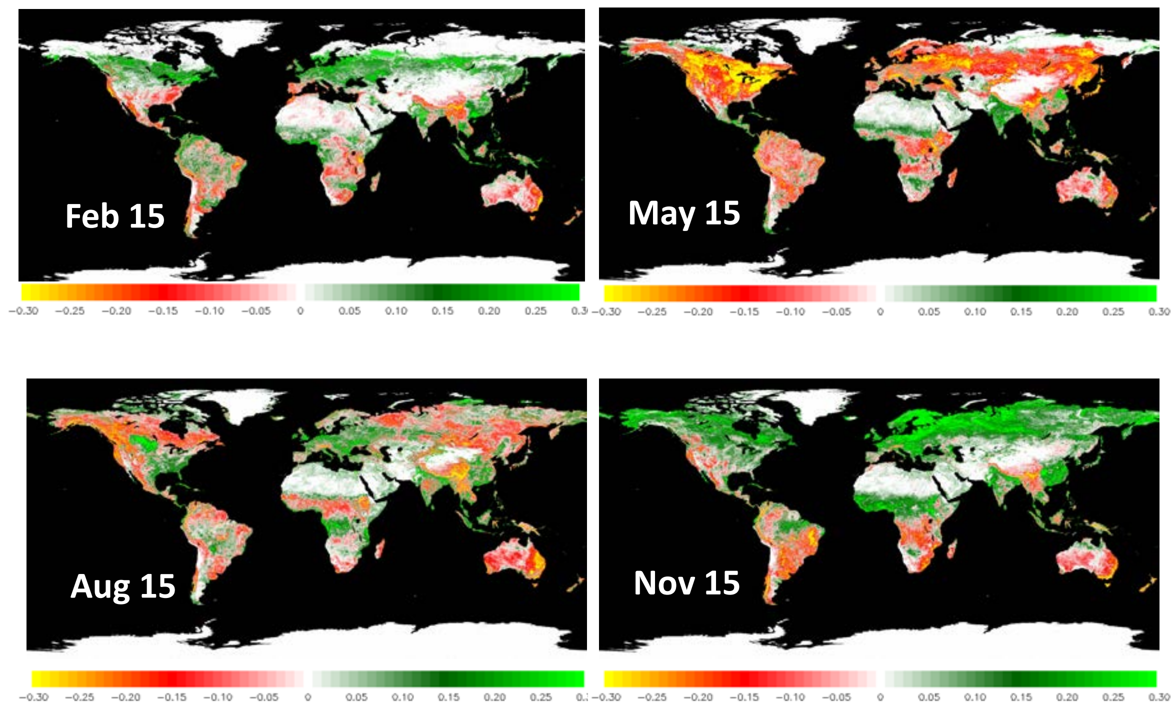
# Incorporation of near-real-time Suomi NPP Green Vegetation Fraction and Land Surface Temperature data into the NCEP Land modeling suite

I. Csiszar, M. Vargas, Y. Yu (STAR); Z. Jiang (Riverside); A. Song (UMD); M. Ek (NCEP); Y. Wu, W. Zheng, H. Wei (IMSG)

Fourth AMS Symposium on the Joint Center for Satellite Data Assimilation

- The operational real-time VIIRS Green Vegetation Fraction product is tested in NCEP models
  - Replace old multi-year AVHRR product
  - Initial tests show impact
  - Further model adjustments are necessary
- VIIRS Land Surface Temperature is ingested for model verification
  - Development of global gridded product ongoing
  - Temporal matchup issues are being worked on

***Weekly VIIRS GVF – 5-year AVHRR GVF climatology 2014***



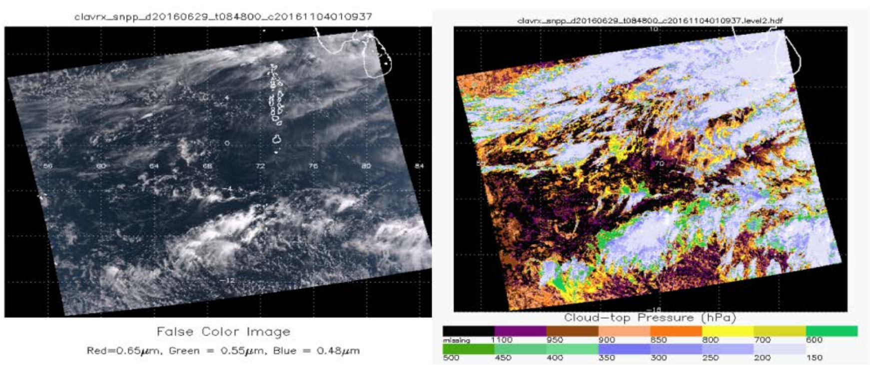
# Progress Towards MODIS and VIIRS Cloud Height and IR Phase Climate Data Record Continuity

**<u>Andrew Heidinger</u>, Yue Li, Steve Wanzong, Steve Platnick, Steve Ackerman, Rich Frey and Robert Holz**

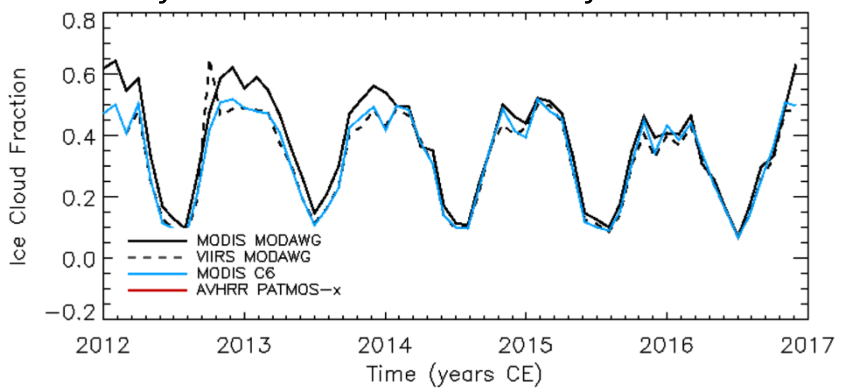
**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

- MODAWG Status
  - MODAWG is the MODIS C6 system augmented with NOAA AWG cloud (aka Enterprise) algorithms.
  - MODAWG meant to generate consistent VIIRS and MODIS products from same channels.
  - MODAWG run on SNPP record over Brazil to test consistency.
- Remaining Issues
  - Ice cloud fraction shows good consistent though MODIS 8.5 µm calibration issues with be driving differences early in record.
  - Impact of microphysical models still needs to be investigated on cloud top height.

*Example SNPP MODAWG CTP*




*Time series of VIIRS and MODIS ice cloud fraction over Brazil*

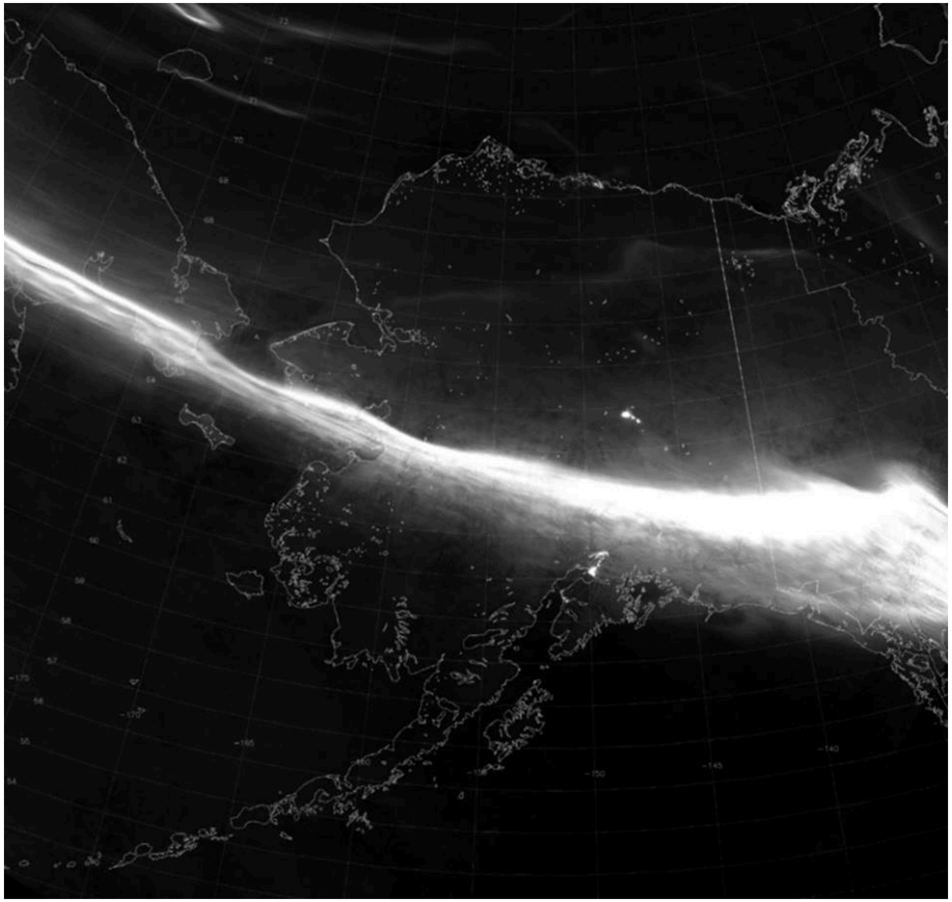


# Validating VIIRS Imagery from JPSS-1

Don Hillger, Tom Kopp, Curtis Seaman, Steven Miller, Dan Lindsey, and Jorel Torres

**13th Annual Symposium on Future Operational Satellite Systems**

- VIIRS Imagery validation
  - Key Performance Parameters (KPPs)
    - M and I band EDR Imagery
    - DNB/NCC Imagery
- Imagery changes/updates
  - Terrain-corrected (TC) to replace ellipsoid geo-locations
  - Increased DNB aggregation and extended granule
  - Potential underlap between scans
  - Block 2.0 Focus Day Imagery compared to that from Block 1.2
  - M11 at night still awaiting implementation
- Social Media Imagery outlet



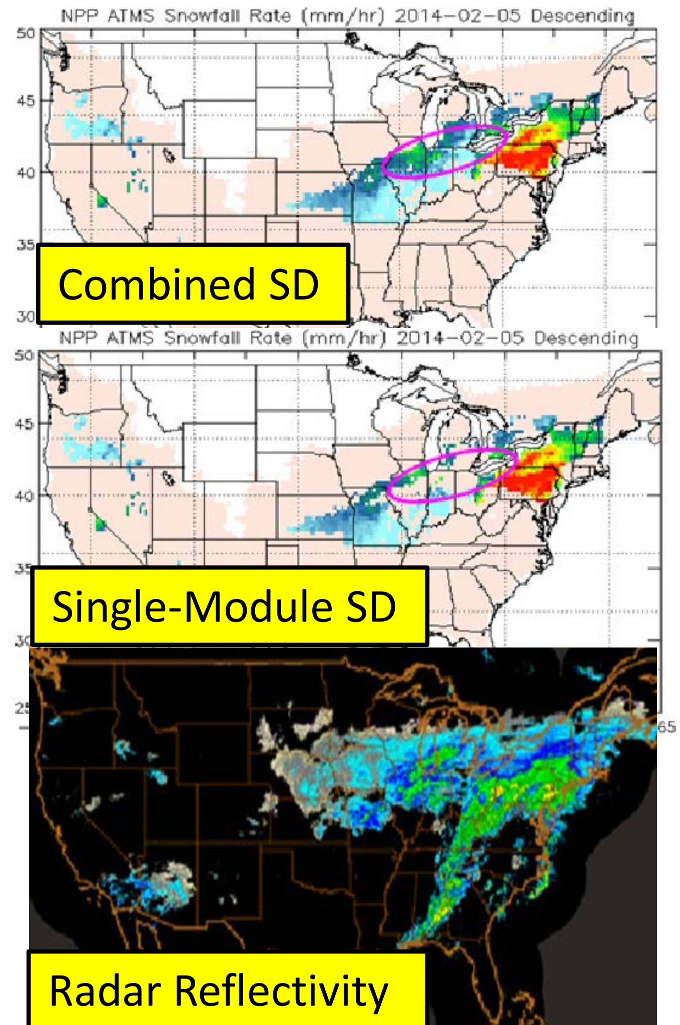
**NCC, 3 January 2017**

# ATMS Snowfall Rate Product and Its Applications

Huan Meng, Ralph Ferraro, Cezar Kongoli, Jun Dong, Bradley Zavodsky, Banghua Yan, Nai-Yu Wang

13th Annual Symposium on New Generation Operational Environmental Satellite Systems

- An ATMS Snowfall Rate (SFR) product was developed
  - Continuation of the operational MHS SFR product
  - Consisted of two algorithms: snowfall detection and snowfall rate
  - A new SD algorithm optimally combines a satellite-based module and a NWP model-based module; the new algorithm improves snowfall detection of snowfall from both shallow clouds and deep clouds
- Applications of the SFR product
  - Hydrology: NCEP CMORPH global blended precipitation analysis
  - Weather forecasting: Fill in observational gaps in radar void regions



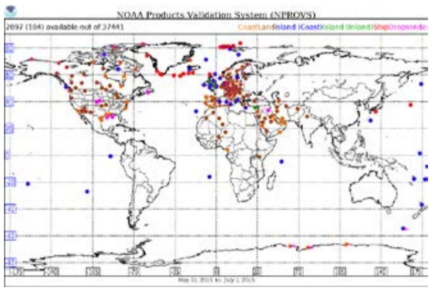
# Validation and Long-Term Monitoring of the Operational SNPP NUCAPS Sounding Products

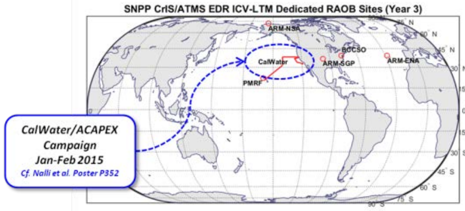
**Nicholas R. Nalli**, Q. Liu, T. Reale, C. Tan, B. Sun, C. D. Barnet, A. Gambacorta, F. Tilley, F. Iturbide-Sanchez, M. Wilson, T. King, *et al.*

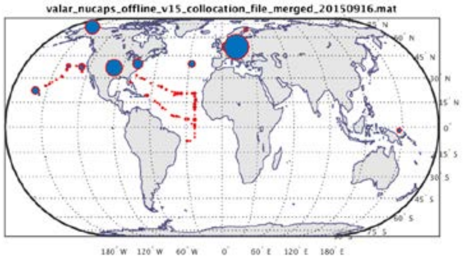
## 12th Symposium on New Generation Operational Environmental Satellite Systems

- The JPSS Cal/Val program for SNPP CrIS/ATMS sounder Environmental Data Records (EDRs) was overviewed.
  - Operational EDR algorithm: NOAA-Unique Combined Atmospheric Processing System (NUCAPS)
  - JPSS Level 1 requirements
  - Validation methodology hierarchy (*Nalli et al.*, 2013)
  - Datasets and tools used for analysis
    - STAR Validation Archive (VALAR)
    - NOAA Products Validation System (NPROVS)
- Using our datasets, tools and methodology, the NUCAPS temperature, water vapor and ozone profile EDR products are demonstrated to meet coarse-layer JPSS Level 1 requirements.
  - Temperature and water vapor profile EDRs are validated using a statistical global sample of collocated conventional, dedicated and reference radiosonde observations.
  - Ozone profiles are validated using a statistical global sample of collocated ozonesondes (dedicated and opportunistic).

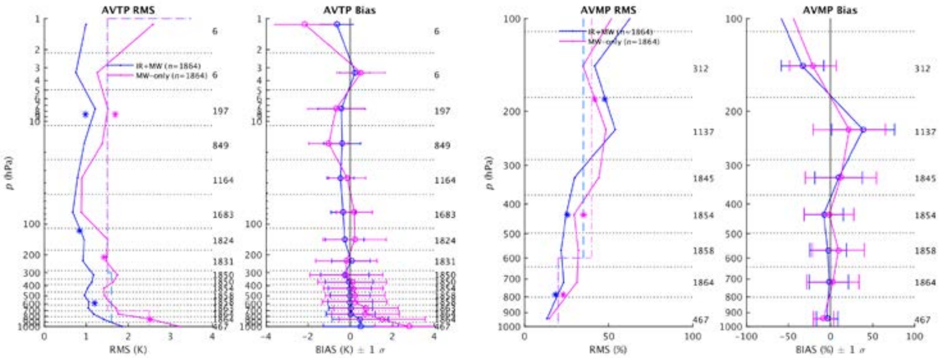
RAOB Data Samples




Coarse-Layer Statistical Summaries

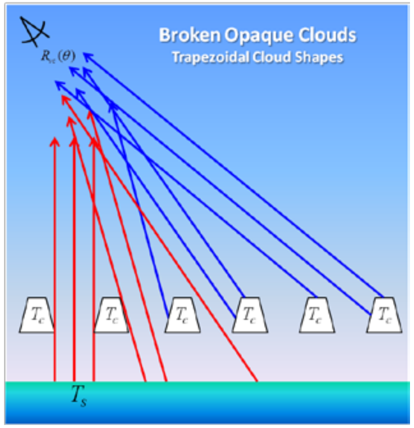


# Angular Effect of Undetected Clouds in Infrared Window Radiance Observations: Aircraft Experimental Analyses

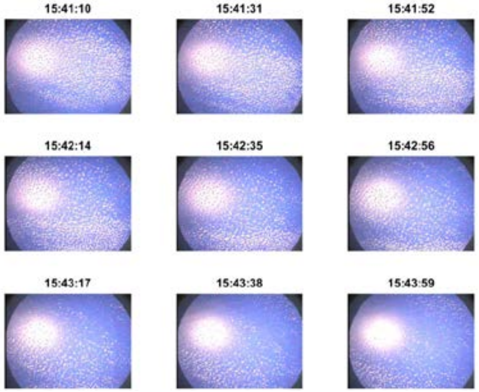
**Nicholas R. Nalli**, W. L. Smith, and Q. Liu

## 8th Symposium on Aerosol-Cloud-Climate Interactions

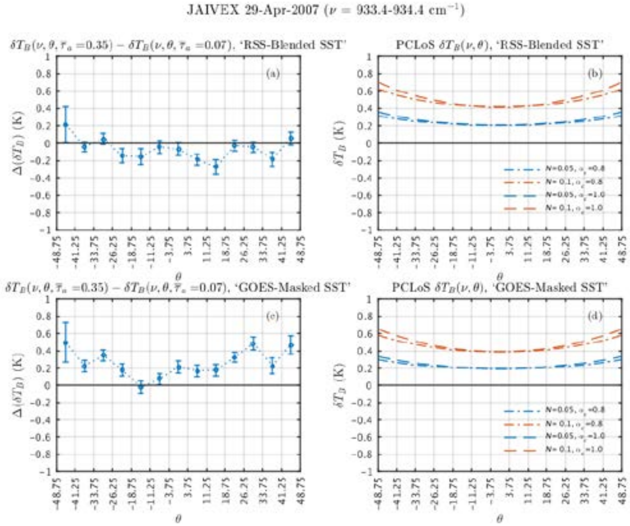
- Aircraft-based (NAST-I) hyperspectral microwindow radiance observations support hypothesis that contamination by residual clouds and/or aerosols within clear-sky observations can have a small, but measurable, concave-up impact (i.e., an increasing positive bias symmetric over the scanning range) on the angular agreement of radiance observations with calculations.
  - We observed distinct concave-up signals in double-differences of $\delta T_B$ ranging from ≃0.2–0.4 K.
  - These magnitudes are consistent in magnitude with those predicted by the sensitivity equation derived by *Nalli et al.* (2012).
- We also found the impact of sunglint in LWIR microwindows can reach magnitudes of ≃+0.05–0.1 K in brightness temperature
- Our work on the angular effect of clouds (*Nalli et al.,* 2012, 2013, 2016) has methodically extended the application of the PCLoS model, including three general cloud shapes, from visual based remote sensing and radiative flux applications to passive IR remote sensing applications.




All-Sky Camera Images




Double Differences



# Marine-Based Field Campaigns Supporting JPSS SNPP CrIS/ATMS Sounder Validation and User Applications

**Nicholas R. Nalli**, V. R. Morris, E. Joseph, C. D. Barnet, T. Reale, Q. Liu, D. Wolfe, C. Tan, B. Sun, F. Tilley, J. W. Smith, *et al.*

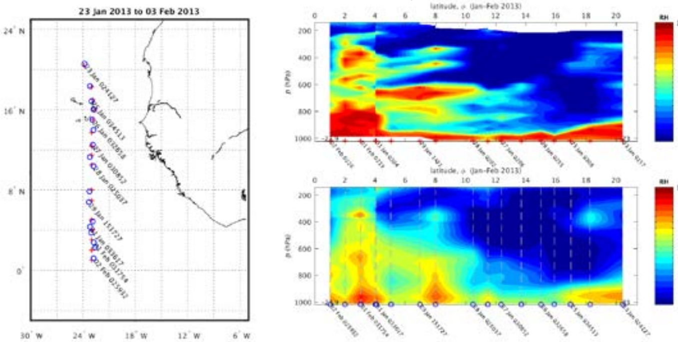
## $12^{th}$ Symposium on New Generation Operational Environmental Satellite Systems

- The NOAA Aerosols and Ocean Science Expeditions (AEROSE) have compiled a multiyear set of ship-based, marine in situ cross-sectional truth measurements over the tropical Atlantic Ocean.
  - The cruise domains span a region of meteorological interest to NOAA sounder product users
    - Atlantic region: Saharan air layers (SALs), tropical storm formation, and tropospheric ozone/carbon/aerosol chemistry and transport.
    - Pacific region (CalWater/ACAPEX): atmospheric rivers (ARs)
  - There are numerous interdisciplinary applications of these data.
- AEROSE contribution to satellite sounder EDR intensive cal/val includes (e.g., Nalli et al. 2011)
  - AEROSE/CalWater domains are an important regions for observations from satellite sounder missions.
  - Oceans cover ~70% of Earth surface area and it is the satellite data over oceans that have the biggest impact on NWP.
  - Ocean-based truth data carries unique value for cal/val given that the ocean surface is far easier to characterize radiatively.
  - Ancillary data (MAERI, ozone, etc.) enable the possibility of cal/val “dissections” (Nalli et al. 2013.
- SNPP NUCAPS (and IASI) EDRs within AEROSE domain fall within JPSS Level 1 global performance specifications

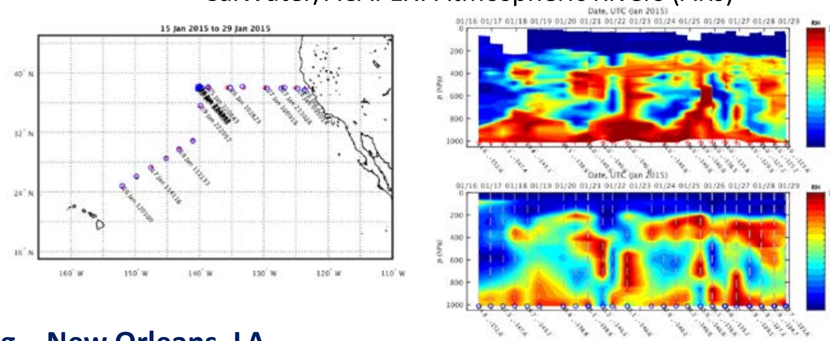
NOAA Ship *Ronald H. Brown*

NATO RV *Alliance*

AEROSE: Saharan air layers (SAL)




CalWater/ACAPEX: Atmospheric Rivers (ARs)

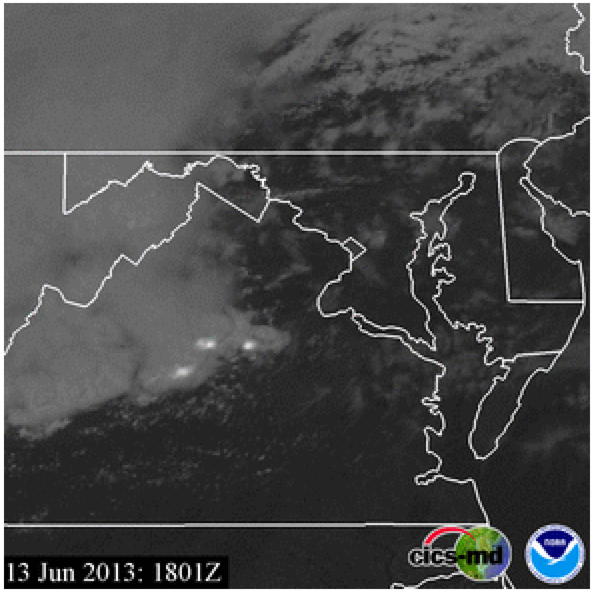


# Applications of Lightning Data Outside the Contiguous United States

Scott Rudlosky, Michael Folmer, Andrea Schumacher, and Amanda Terborg

Eighth Conference on the Meteorological Applications of Lightning Data

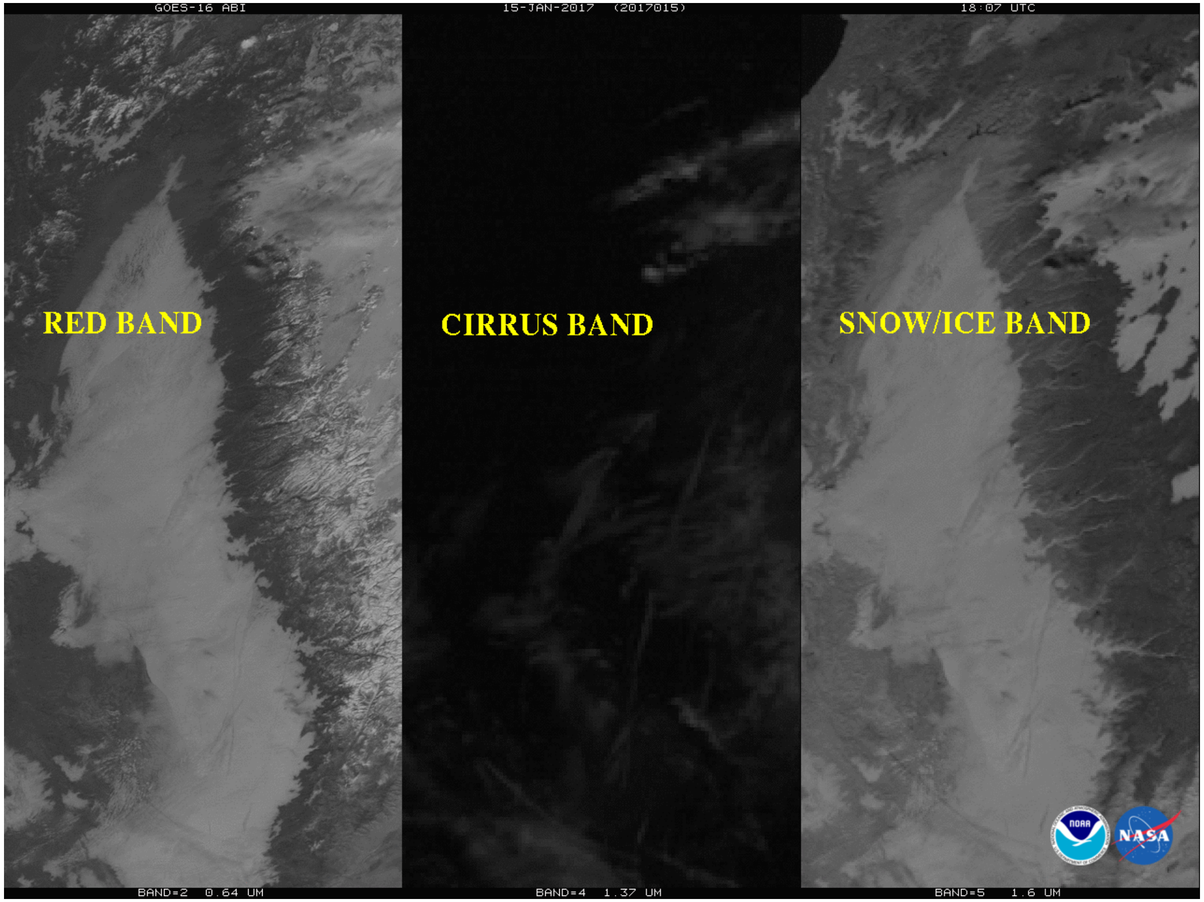
- Forecasters and scientists have documented a wide range of operational applications for lightning data
- Lightning data have been shown useful for
  - Identifying strengthening or weakening convection
  - Tracking convective cells beneath cold cloud shields
  - Monitoring convective storm mode and evolution
  - Supplementing radar data where coverage lacks
  - Distinguishing thunderstorms from rain-only areas
  - Providing insights into tropical cyclone intensity changes



# The Advanced Baseline Imager (ABI) on the GOES-R series, Schmit et al. (with CIMSS and CIRA, etc.)

**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

- GOES-R was launched, became GOES-16.
  - Preliminary ABI data looks good.
- The ABI on the GOES-R series continues the critical continuity of geostationary imagers




Spectral (ABI bands 2, 4 and 5) over California.

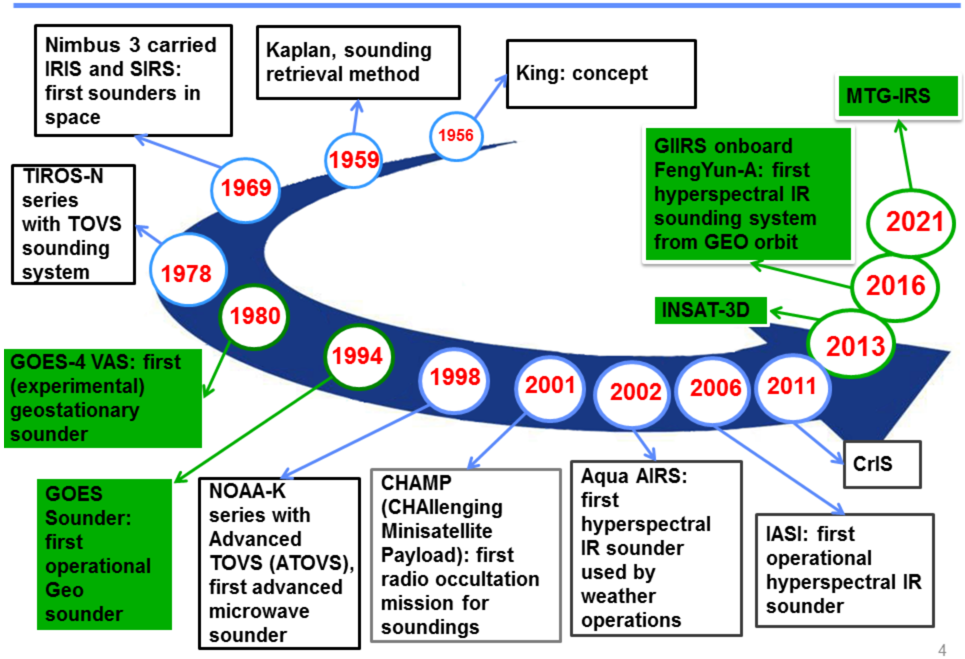
# Satellite Measurements of Atmospheric Temperature and Moisture Profiles (Invited Presentation)

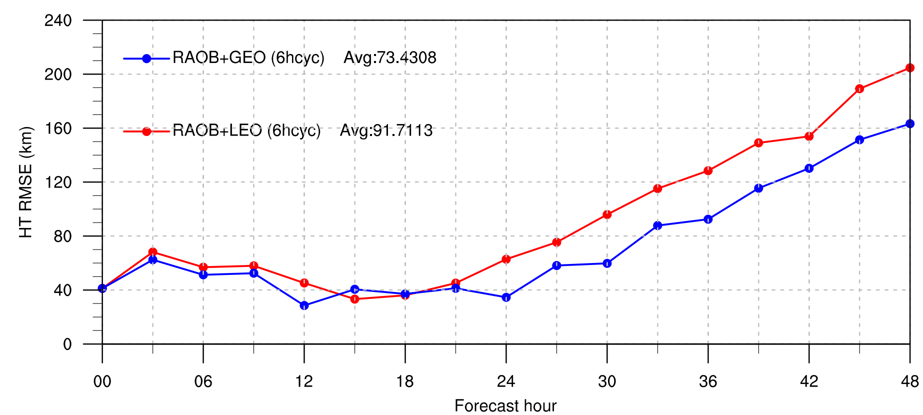
Observation Symposium: Progress, Problems, and Prospects

**Timothy J. Schmit** (STAR), Jun Li (CIMSS)

- Great progress, especially from polar-orbiters, has been made with respect to estimating atmospheric temperature and moisture vertical profiles from space. Estimate of temperature and moisture profiles, along with many derived parameters, as well as the direct use of radiances through assimilation into Numerical Weather Prediction (NWP) models;
- Each instrument type, and orbit, brings unique information, with the most information being when all the data are combined. E.g., Radio occultation plus infrared are better than either alone, Microwave plus infrared are better than either alone;
- The largest remaining observational gap is the high time resolution temperature and moisture profile measurements with high vertical resolution which need high spectral resolution instruments. While there are operational missions planned for over Europe and China, the U.S. has no defined current plans for similar sensors to monitor North America. While temperature and moisture profiles from polar-orbiting platforms are useful, there are many high impact weather situations where the structure of the atmosphere is changing more frequently.

## A (short) history of atmospheric sounding from space



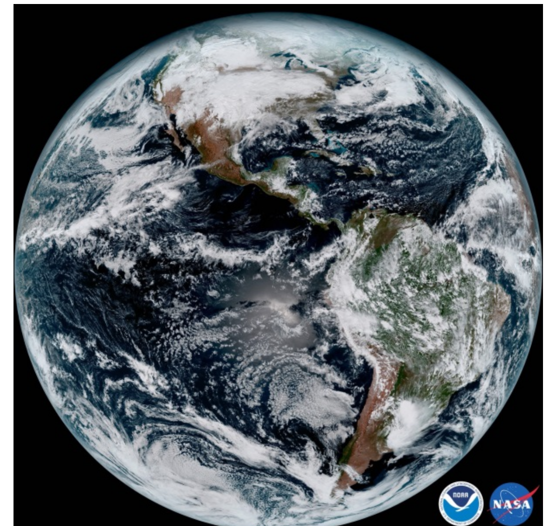

(1) Value-added impact of GEO IR sounder over LEO on tropical cyclone track forecasts in a regional NWP due to larger spatial coverage (see the above figure), in a quick regional OSSE conducted at CIMSS. None cycling and 3-hour cycling assimilation show similar results;

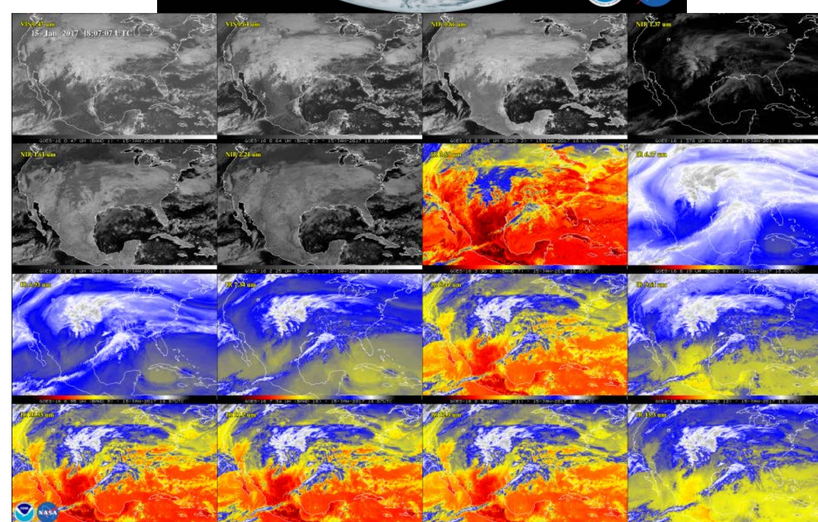
(2) Impact from GEO IR sounder: 1-hourly cycling > 3-hourly cycling > 6-hourly cycling, indicating the advantage of frequently assimilation of GEO IR sounder data.

# ABI First Light Images

Tim Schmit & Dan Lindsey (NESDIS); Mat Gunshor, Kaba Bah, Joleen Feltz, Jim Nelson, & Hong Zhang (CIMSS); Steve Miller (CIRA)

- ABI First Light Images were provided to NOAA from the AWG Imagery Team
  - 16-panel of all bands by CIMSS
  - Enhanced True Color from CIRA
  - Data from 15 January 2017 at 18:07 UTC
  - Public release was 23 January 2017
- First Light Images were used in many presentations at AMS
  - Exhibit Hall: NASA booth "Hyperwall," NOAA booth, Harris booth, Lockheed booth, SSEC booth
  - Images appeared in multiple sessions across the conference in at least 10 presentations.
  - Images were used by multiple media outlets both online and on television.





# GOES-R Preview for all GOES Users

AMS Annual Meeting Short Course with co-chairs: Tim Schmit (NOAA/NESDIS), Mat Gunshor (CIMSS), and Jim Gurka (GOES-R).

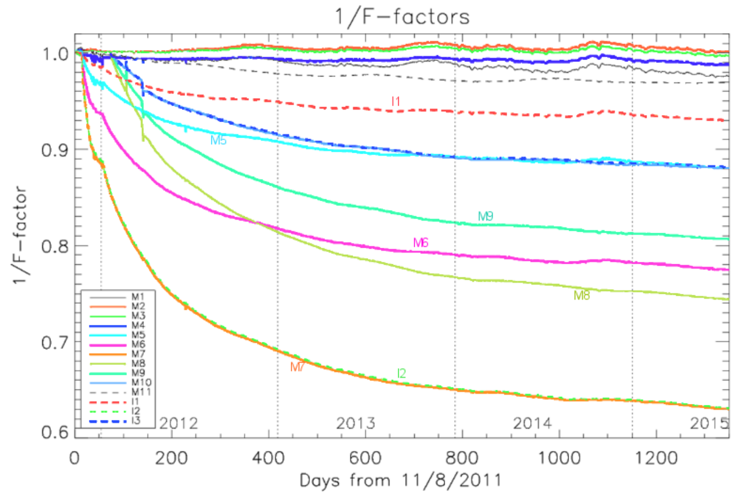
- Nearly 40 Attendees
  - The course goal: make users aware of the new GOES-R series capabilities and how they will improve environmental observations and forecasts.
  - Mix of presentations and hands-on exercises on the ABI, GLM, space weather instruments, and GOES-R derived products
- Positive Feedback From Attendees
  - 32 of the participants filled out AMS eval forms.
  - "Excellent learning experience and demonstrations regarding the new GOES-16 features. Wish we had real data to demo, but the hands-on experience was well taught and put together."
  - "Repeat next year using real data."
- Other contributors, instructors, and support staff:
  - Jordan Gerth, Scott Lindstrom, Chris Schmidt (CIMSS)
  - Geoffrey Stano (NASA SPoRT)
  - William Denig (NOAA/NESDIS)
  - Steve Goodman, Jim Gurka, Michael Stringer, Janel Thomas (GOES-R)
- Presentations and hands-on links
  - http://cimss.ssec.wisc.edu/goes/shortcourse/seattle2017.html

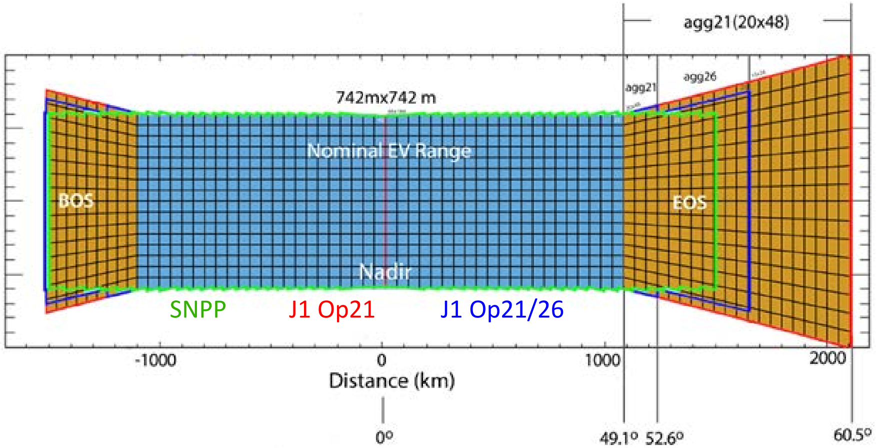
- Mike Stringer, GOES-R System Program Director, presenting a GOES-R overview to a packed room at the AMS Annual Meeting Short Course: GOES-R Preview for all GOES Users.

# Suomi NPP/J1 VIIRS SDR Performance Highlights and Cal/Val Update

Changyong Cao, NOAA/NESDIS/STAR (presented by Wenhui Wang)

- SNPP VIIRS has performed well:
  - TEB: very stable based on ICVS monitoring;
  - RSB: RTA mirror degradation has leveled off since mid 2013;
  - Excellent DNB performance leads to expanding applications
- J1 VIIRS performance is comparable to that of SNPP
  - Issues resolved for J1: mirror contamination; single event upset; sync loss
  - However, there are performance waivers (13): DNB nonlinearity; DNB stray light; SWIR nonlinearity; polarization sensitivity in M1-M4, …
  - Op21 recommended as baseline for J1
  - VIIRS GEO code modified to accommodate J1 DNB AggMode change
  - Extended validation capability developed by the VIIRS SDR team.



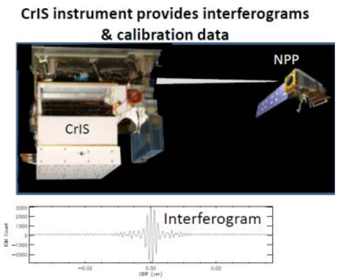



# Near-Real Time Processing of S-NPP CrIS Full Spectral Resolution SDR Data at NOAA/STAR

**Xiaozhen (Shawn) Xiong [1,2], Yong Han[2], Yong Chen[2,3], Likun Wang[2,3] , Denis Tremblay[2,4], Xin Jin[1,2], Lihang Zhou[2]**

**[1]ERT, Laurel, MD 20723, USA, [2]NOAA/NESDIS Center for Satellite Applications and Research, College Park, MD 20740, USA**
**[1]ESSIC, University of Maryland, College Park, MD 20740, USA [4]Science Data Processing Inc., Laurel, MD 20723, USA**

The Cross-track Infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP) is a Fourier transform spectrometer that provides a total of 1305 channels in normal mode and 2211 channels in the full spectral resolution (FSR) mode for sounding the atmosphere. FSR data is available since December 4, 2014, and the resolutions in all three bands are 0.625 $cm^{-1}$ . CrIS full resolution Processing System (CRPS) has been developed to generate the near real-time FSR Sensor Data Record (SDR) at NOAA STAR using an algorithm based on CrIS Algorithm Development Library (ADL). These data are delivered to all users via STAR FTP and GRAVITE websites with a latency of 12-18 hours (Figure 1), and data quality is monitored via ICVS. Over 99.9% data have been successfully processed and achieved since December 4, 2014 to present (Fig.2).



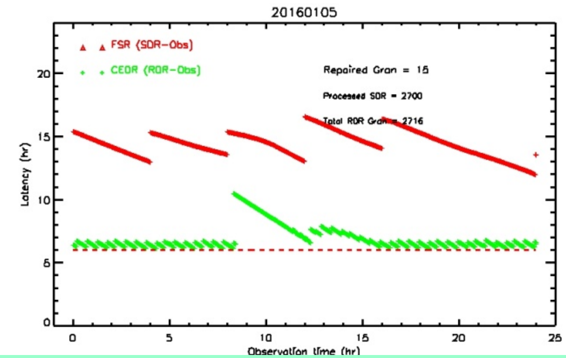
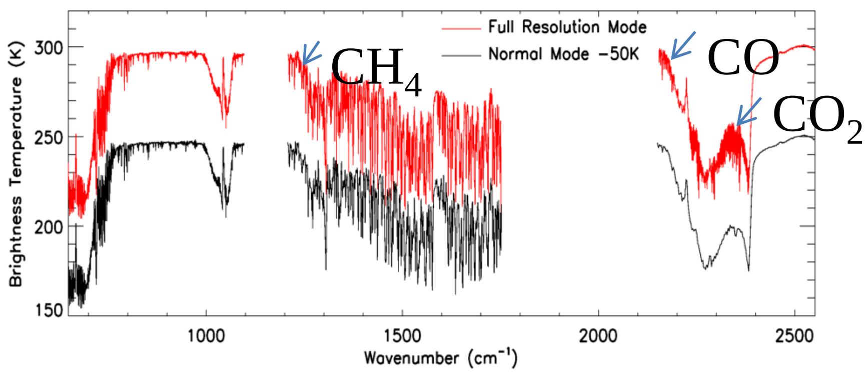




**Fig 1. Latency of CrIS FSR generation and delivery at NOAA STAR**



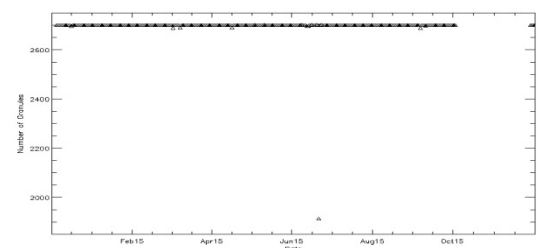



**Fig 2. Over 99.9% data has been processed since Dec.4, 2014 to present, and data is achieved at STAR**

NOAA STAR CENTER FOR SATELLITE APPLICATIONS AND RESEARCH
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cics-md Cooperative Institute for Climate & Satellites UNIVERSITY OF MARYLAND
CIRA
CUNY NOAA - Cooperative Remote Sensing Science and Technology Center
CIMSS

# Evaluation of S-NPP OMPS Radiometric Calibration Update and Its Influence on SDR/EDR Products


Jian Zeng[1], Fuzhong Weng[2], Chunhui Pan[3], and Zhihua Zhang[4]

[1] ERT Inc. [2] NOAA/NESDIS/STAR [3]CICS-MD [4] IMSG Inc.


## Overview:

- Product Evaluation and Testing Element (PEATE) calibration update analysis (CBC, IRF, IRD, and RAD)
- Influence evaluations on Sensor Data Record (SDR) and Environmental Data Record (EDR), which are generated by ADL4.2 MX8.8 with updated SDR LUTs
- Simultaneous Nadir Overpass(SNO) validation between OMPS and the Global Ozone Monitoring Experiment-2 (GOME-2) on EUMETSAT METOP-A/B

## Results:

- PEATE recent calibration adjustments improve EV reflectance agreement between OMPS and GOME-2, especially for OMPS NP, which improved by ~5% compared to METOP-B and by ~4% compared to METOP-A.
- This study also shows that 95% of NM/TC EV reflectance modifications are within 1%; 82.3% of OMPS NP EV reflectance modifications are within 2%.
- OMPS TC EV reflectance modifications are smaller than the Day 1 Solar Irradiance adjustment (~78%) and the radiance calibration coefficient adjustment (99%).
- OMPS NP EV reflectance modifications are ~7% larger than the Day 1 Solar Irradiance adjustment and 0.1% larger than the radiance calibration coefficient adjustment.
- OMPS EDR Ozone vertical profile modifications caused by updated calibrations can be as high as 10% in the lower 5km in the polar region.

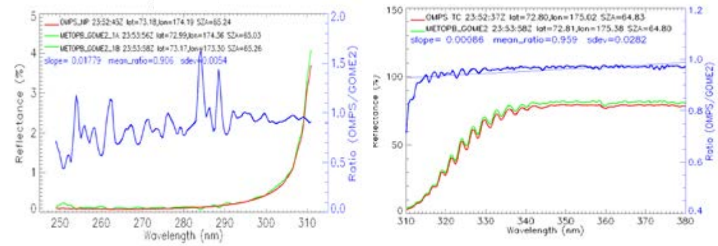



Figure 1: SNO Validation in reflectance comparisons between OMPS NP and GOME-2 Band 1A and between OMPS NM/TC and GOME-2 Band 2B.

Table 1 shows EV reflectance ratios of OMPS over GOME-2 on EUMETSAT METOP-A and METOP-B. The baseline refers to ADL4.2 MX8.8.

| PEATE CAL Update | OMPS_NP/ METOP_B | OMPS_NM/ METOP_B | OMPS_NP/ METOP_A | OMPS_NM /METOP_A |
|---|---|---|---|---|
| BASELINE | 0.905654 | 0.959161 | 0.721043 | 0.866655 |
| IRF | 0.997713 | 0.962509 | 0.794335 | 0.869832 |
| RAD | 0.867468 | 0.955949 | 0.690644 | 0.863909 |
| CBC | 0.905654 | 0.959161 | 0.721043 | 0.866655 |
| IRD | 0.905654 | 0.959161 | 0.721043 | 0.866655 |
| IRF_CBC_IRD_RAD | 0.955644 | 0.95928 | 0.760846 | 0.867073 |

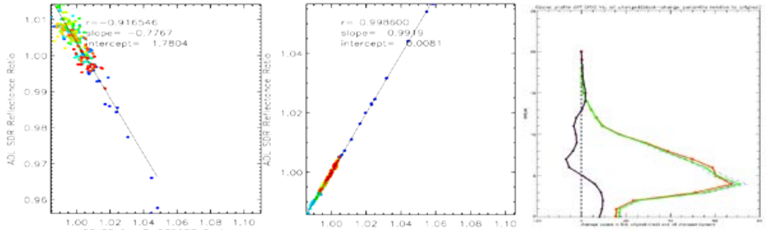


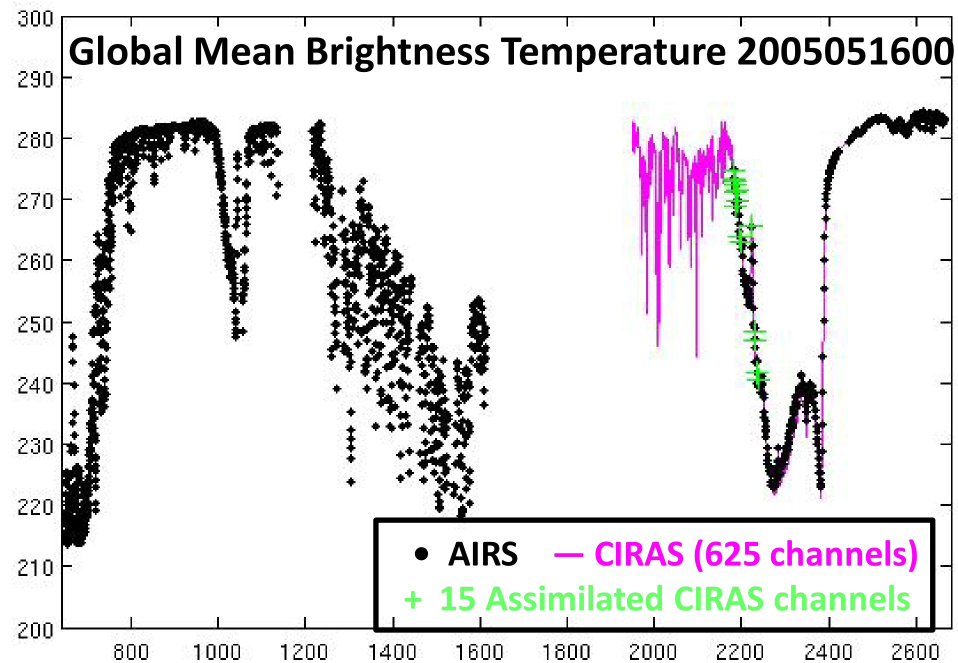
Figure 2: OMPS NM/TC Reflectance Response to Calibration Adjustments of Day 1 Solar (left) and Radiance Calibration Coefficients (middle). The right figure shows the Influence of PEATE OMPS Calibration update on Ozone vertical profile.

# Assessment of CIRAS Impact through the Community Global OSSE Package

*Yan Zhou[1,2], N. Shahroudi[2,3], K. Ide[1], S. A. Boukabara[2], T. Zhu[2,4], R.N.Hoffman[5], and R. Atlas[5]*
*1. UMD 2. NOAA/NESDIS/STAR, JCSDA 3.Riverside Technology, Inc. 4. CSU/CIRA 5. NOAA/AOML*

21st Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface

- Developed a CGOP framework.
  - CGOP is a modular extensible framework for conducting OSSEs
  - Use CGOP to assess the impact of CIRAS on global analysis and forecast



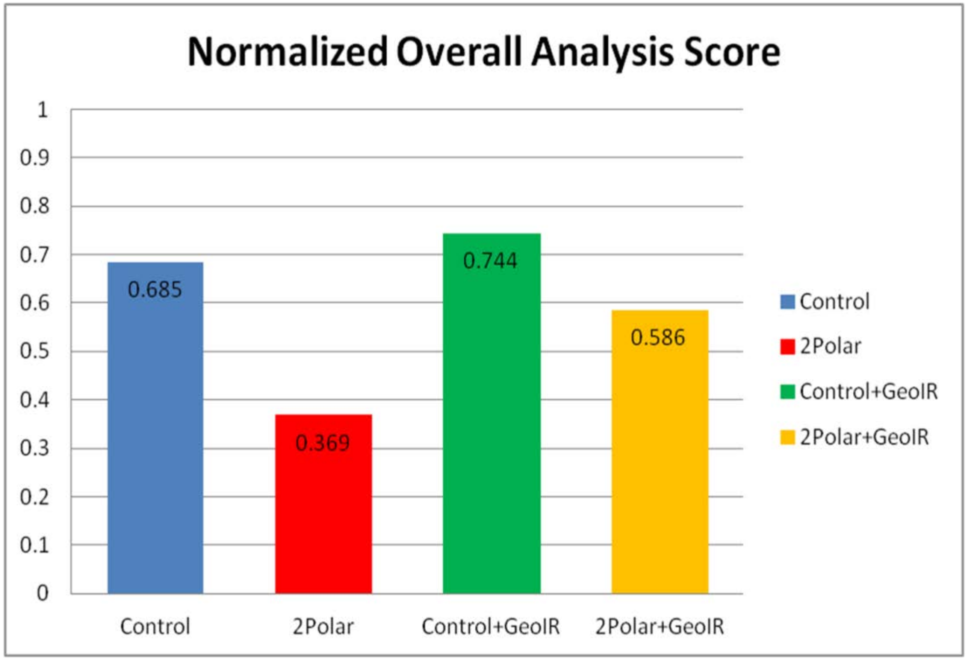

- Added value under a data gap scenario
  - A data gap scenario withholding early-afternoon orbits from the operational satellite constellation.
  - assimilating 15 channels of perfect CIRAS improves the global analysis, as well as the regional, i.e. NH, SH, and Tropics RMSE

# Assessment of Geo-HSS Impact through the Community Global OSSE Package

*Yan Zhou[1,2], N. Shahroudi[2,3], K. Ide[1], S. A. Boukabara[2], T. Zhu[2,4], R.N.Hoffman[5], and R. Atlas[5]*
*1. UMD 2. NOAA/NESDIS/STAR, JCSDA 3.Riverside Technology, Inc. 4. CSU/CIRA 5. NOAA/AOML*

21st Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface

- Developed a CGOP framework.
  - CGOP is a modular extensible framework for conducting OSSEs
  - Use CGOP to assess the impact of Geostationary Hyperspectral Sounders (Geo-HSS) on global analysis and forecast
- Added value under a control and a data gap scenario




  - A data gap scenario withholding early-afternoon orbits from the operational satellite constellation (2Polar).
  - Geo-HSS is adding value to the global analysis under both control and data gap scenarios, measured by Overall Analysis Score.

# CICS-MD

- Chen, Yong
- Folmer, Michael (2)
- Grassotti, Chris
- Huang, Jingfeng
- Lukens, Katherine
- Lee, Seoung So
- Moradi, Isaac
- Qin, Zhengkun
- Schull, Mitchell
- Tian, Xiaoxu
- Augustin Vintzileos
- Wang, Likun
- Zhang, Rui
- Zheng, Youtong
- Zou, Xiaolei

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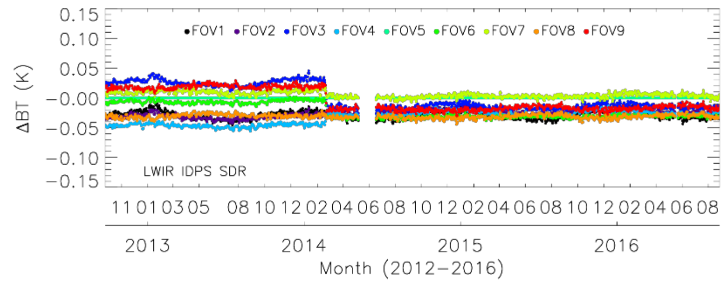
cics-md Cooperative Institute for Climate & Satellites UNIVERSITY OF MARYLAND
CIRA
CUNY NOAA - Cooperative Remote Sensing Science and Technology Center
CIMSS

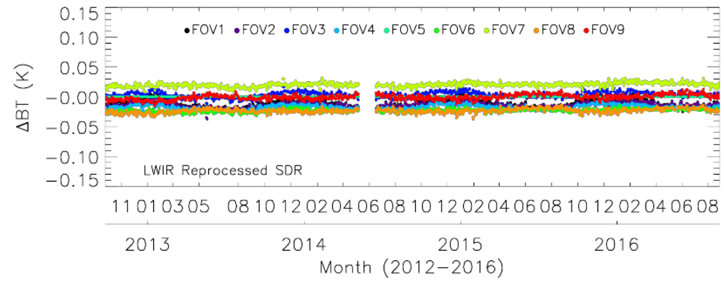
# Suomi NPP CrIS Reprocessed SDR Long-term Accuracy and Stability

**Yong Chen**, Yong Han, Likun Wang, Fuzhong Weng, and Ninghai Sun

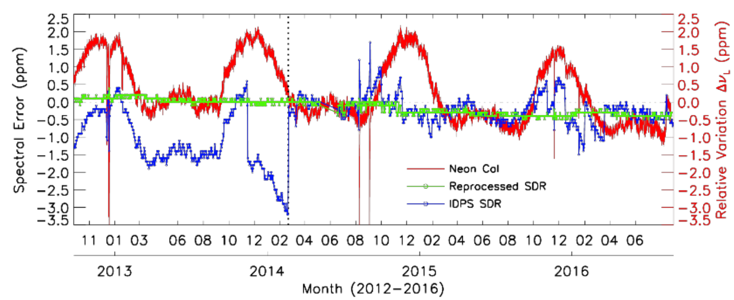
- Reprocessed CrIS SDR will benefit the inter-calibration and climate applications
- Reprocessed SDR long-term radiometric accuracy and stability are improved compared to the operational SDR
  - Overall radiometric biases (O-S) are small and stable over time
  - FOV-2-FOV differences are less than ~10 mK
- Reprocessed SDR long-term spectral accuracy and stability are improved compared to the operational SDR
  - The reprocessed SDR have spectral errors less than 0.5 ppm, is much better than the operational SDR with about 4 ppm.

**Daily mean FOV-2-FOV radiometric difference wrt FOV5**




**CrIS SDR Long-Term Spectral Accuracy and Stability**

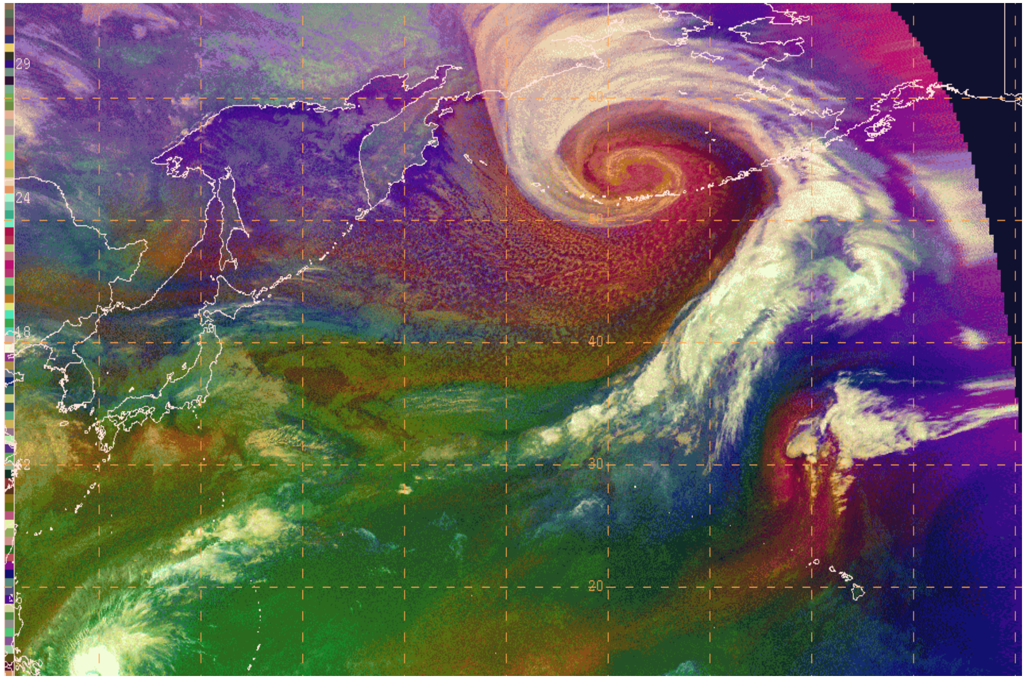


# Applying Himawari-8 and JPSS Satellite Products for Forecasting Hurricane-Force Wind Events

Michael J. Folmer, Emily Berndt, Eric Stevens, Carl Dierking, Joseph Sienkiewicz, James Clark, Steve Goodman, and Mitch Goldberg

13th Annual Symposium on New Generation Environmental Satellite Systems

- OPC-AK Region Collaboration on the precursors of hurricane-force wind events
  - Case studies chosen and analyzed by OPC intern.
  - Make the connection among Air Mass RGB, 3 Water Vapor Channels, and Ozone products from IASI and NUCAPS.
- Develop a training strategy for forecasters
  - Set up collaboration calls for Fall 2017
  - Develop a “tool-kit” so forecasters don’t get overwhelmed with amount of products.

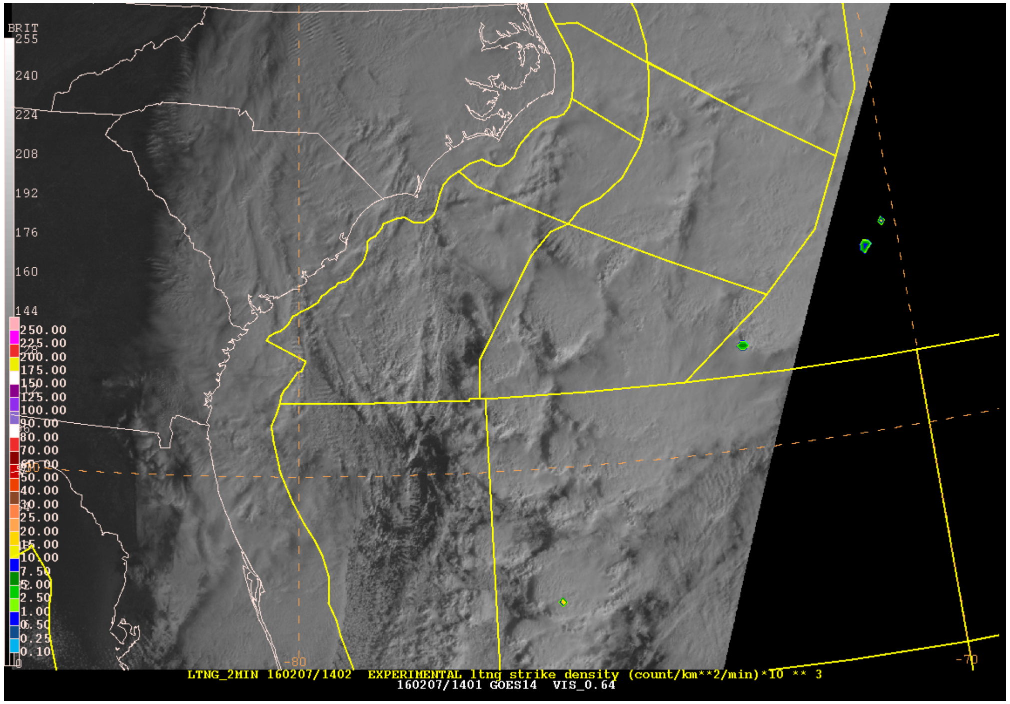


# Operational Lightning Products Improve Forecasting Capabilities in OPC and TAFB Offshore Zones

Michael J. Folmer, Joseph Phillips, Joseph Sienkiewicz, James Clark, Hugh Cobb, Nelsie Ramos, Scott Rudlosky, and Steve Goodman

Eight Conference on the Meteorological Application of Lightning Data

- Part 1: Characterize convection (supercells) in OPC offshore zones
  - Use GLD360 Lightning Density, Overshooting Tops Detection, imagery
  - Due to lack of radar data, find ways to quantify the products to provide “radar quality” replacements.
- Part 2: Apply the findings of Part 1 to TAFB Offshore zones
  - Work with CICS, NESDIS, and CIMSS on a Prob-Severe-like product for Offshore Convection

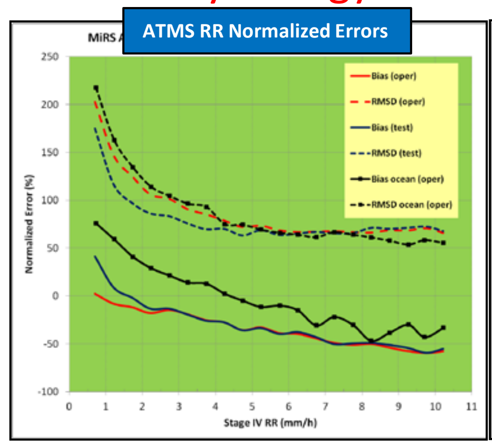


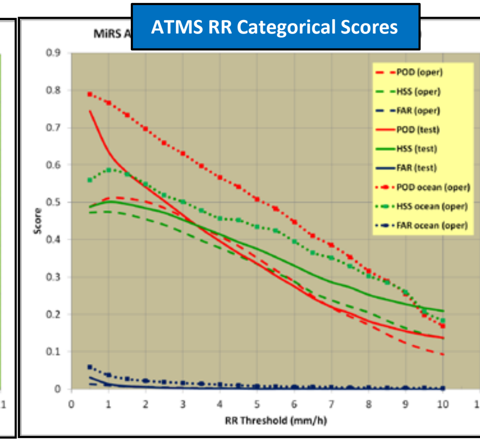
# Precipitation Products from the Microwave Integrated Retrieval System (MiRS): Recent Developments, Improvements, and Validation

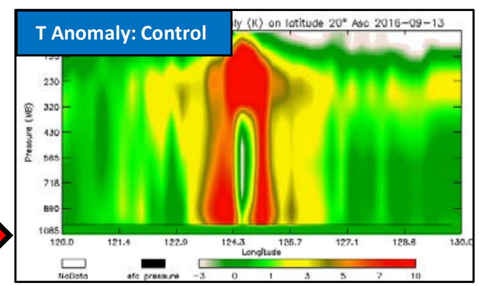
**Christopher Grassotti**, Shuyan Liu, Junye Chen, Quanhua Liu, and Flavio Iturbide-Sanchez

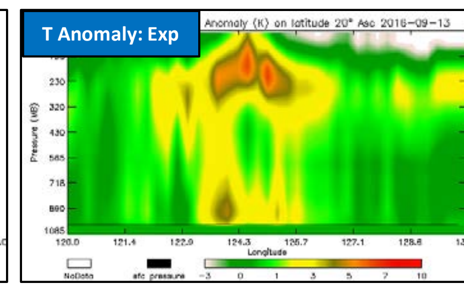
AMS 31st Conference on Hydrology

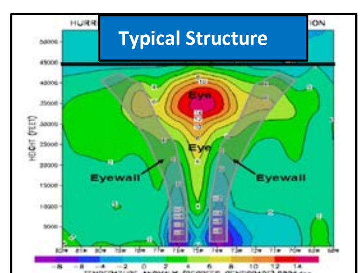
- Validation of MiRS SNPP/ATMS and GPM/GMI Experimental Rain Rates Over Land That Incorporate Cloud Liquid Water
  - Period: Sept-Nov 2016 over CONUS using Stage IV as reference
  - Normalized RMS errors reduced (oper vs. test)
  - Correlations, PDFs and contingency-based scores improved (POD, HSS)
- Impact of Hydrometeor Correlations on Retrieved Tropical Cyclone Warm Core Structure (Typhoon Meranti)
  - Decorrelating the temperature with other geophysical parameters, including hydrometeors, in the 1dvar retrieval improves depiction of temperature anomaly structure (Control vs. Exp)

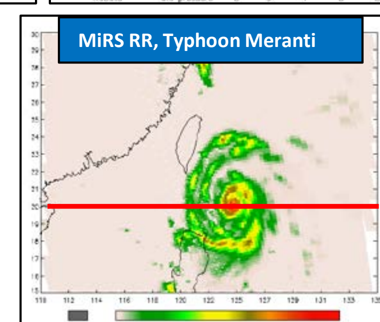


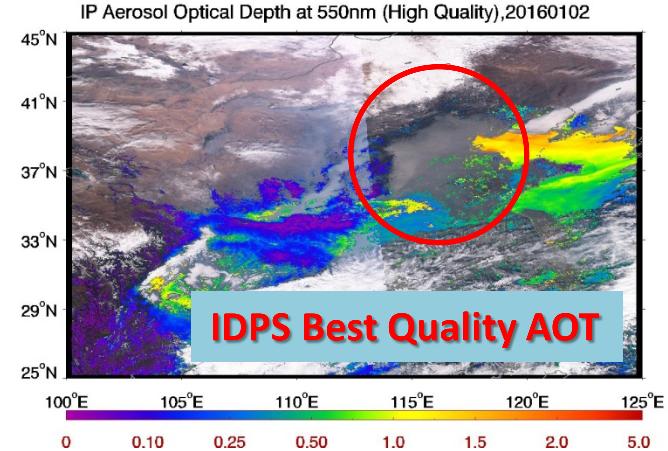



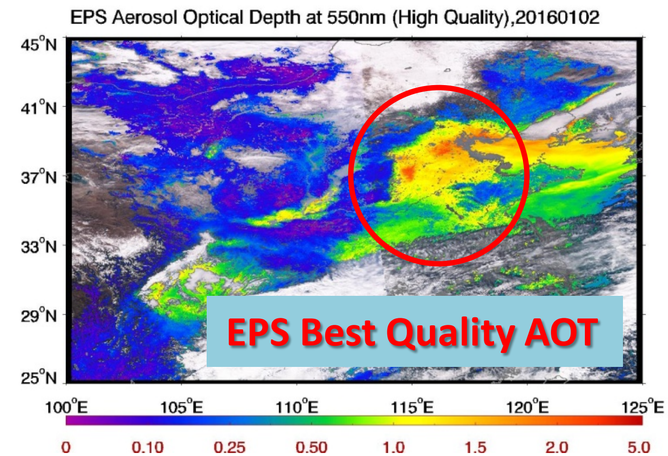



# AOT Retrievals of China Smog Events Using Two Different S-NPP VIIRS Algorithms

**<u>Jingfeng Huang</u> (ESSIC,CICS@NOAA STAR),** Hongqing Liu, Hai Zhang, Shobha Kondragunta, Istvan Laszlo, Pubu Ciren, Lorraine A. Remer, Stephen Superczynski

- **EPS vs. IDPS Best Quality AOT Retrievals**
  - China Smog cases were used to demonstrate the major improvements in the EPS VIIRS aerosol algorithms in comparison to the IDPS algorithm
  - The EPS VIIRS aerosol algorithm regained most AOT retrievals over China Smog pixels which were previously not produced in the IDPS algorithm
  - Internal snow test and AOT out of range were found as major factors for the missing AOT retrievals in IDPS
- **China Smog evaluation using the EPS VIIRS AOT**
  - Best quality EPS VIIRS Aerosol Products are used to evaluate China Smog AOT levels and spatial coverage
  - A large China Smog event can be as large as 200,000 km2 with AOT > 1.0, and 500,000 km2 with AOT > 0.5
- **The EPS VIIRS aerosol algorithm becomes operational in Spring 2017**



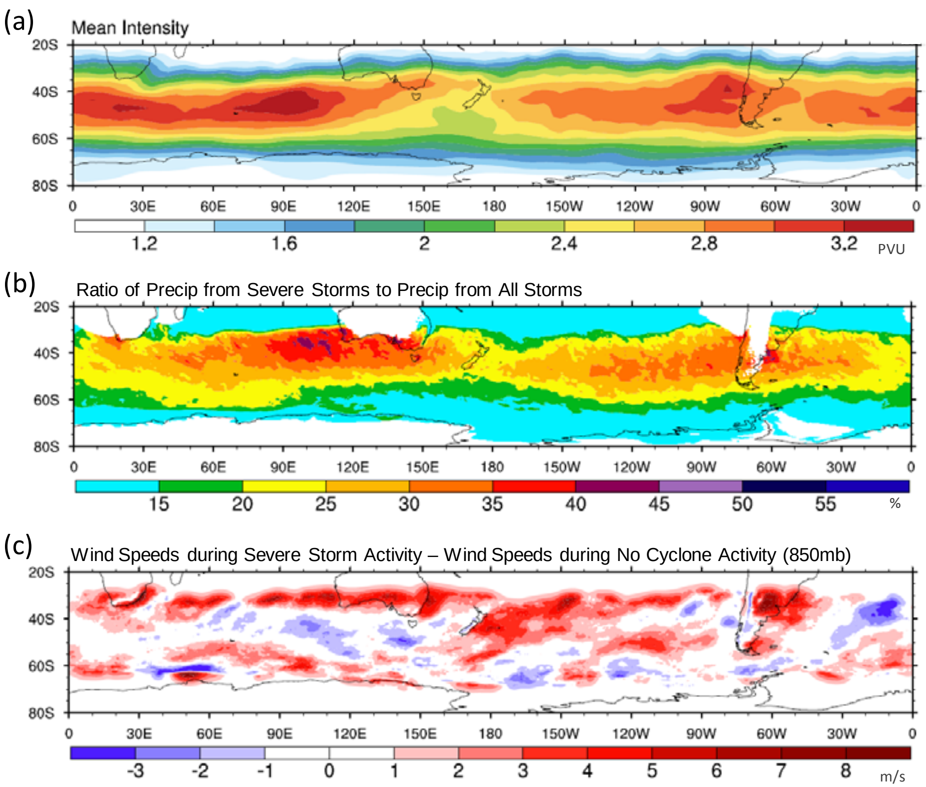
# Storm Tracks and their Influence on High Impact Winter Weather in the Southern Hemisphere

**Katherine E. Lukens[1] and E. Hugo Berbery[2]**

[1]Department of Atmospheric and Oceanic Science, University of Maryland, College Park, MD
[2]ESSIC/CICS-MD

29th Conference on Climate Variability and Change

- (a) Storm tracks are most intense over the oceans and upwind of high orography.
  - Important for trade and shipping routes!
- Severe storms make up 13% of all winter storms, (b) yet they contribute up to 40% of the precipitation from all storms.
  - Coastal cities in southern Australia and in southern South America are prone to intense flooding.
- Severe storms almost double the low-level wind speeds in deep convective areas and leeward of high orography.
  - (c) Cities in southern Australia and eastern South America as well as ships in the South Pacific are most prone to damage from high winds.



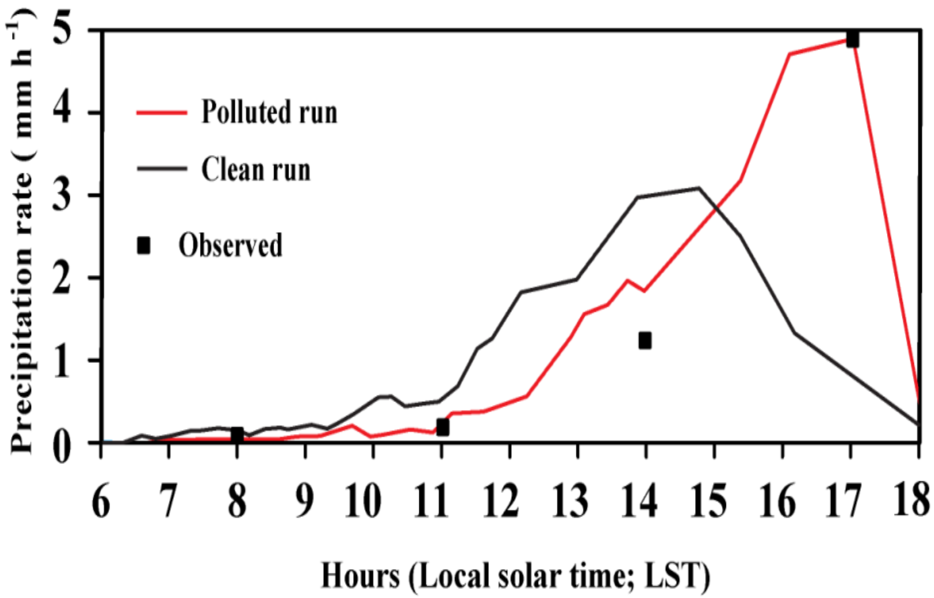
# Effect of aerosol on the diurnal variation of precipitation

Seoung Soo Lee, Zhanqing Li, and Jungbin Mok

**9th Annual Symposium on aerosol-cloud-climate interactions**

- Finding a tipping time point in the variation
  - Perform simulations for a system of deep convective clouds
  - At the tipping time point, the transition from aerosol-induced suppression of precipitation to aerosol-induced enhancement of precipitation occurs
- Competition between aerosol radiative effects and aerosol invigoration effects
  - Before the tipping point, aerosol radiative effects cause the suppression
  - After the tipping point, aerosol invigoration effects become dominant over aerosol radiative effects
  - This causes the enhancement after the point

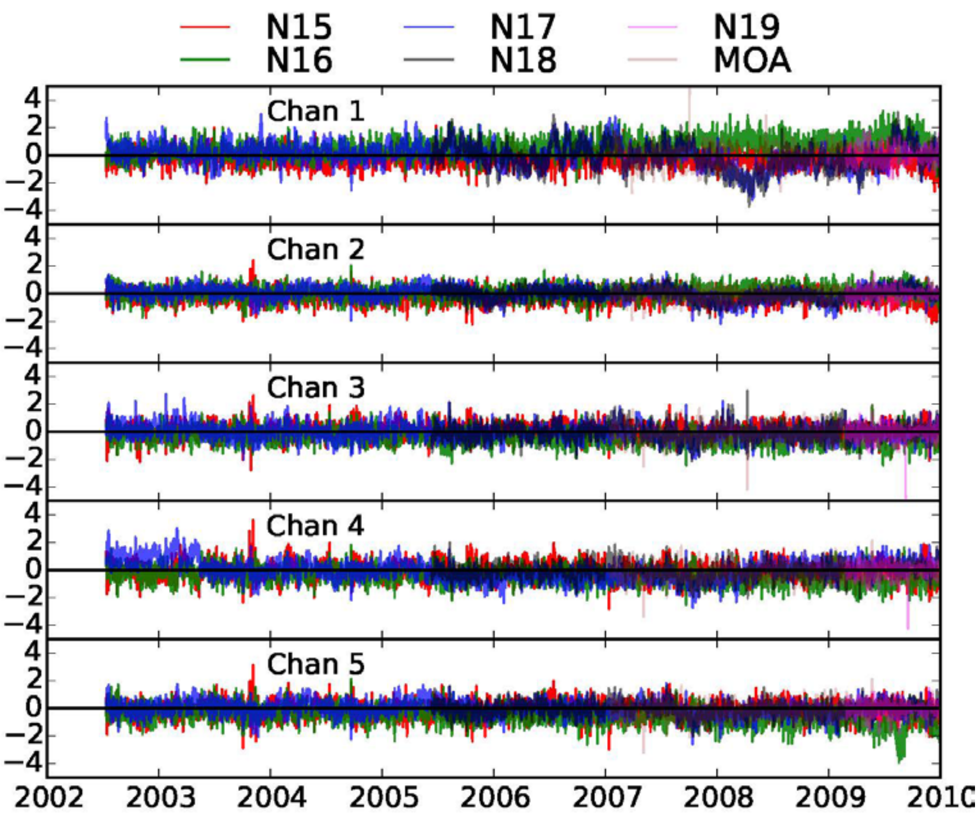
## Precipitation evolution



# The Impact of Satellite Bias Correction on the Assimilation of Satellite Microwave Water Vapor Channel (Isaac Moradi)

Fifth AMS Symposium on the Joint Center for Satellite Data Assimilation

- Variational Bias Correction Doesn't distinguish between different error sources
- Biases in satellite observations can be corrected using different techniques such as intercalibration
  - A Climate Data Record was developed for MW humidity sounders
  - Some instruments (e.g., AMSU-B onboard NOAA-16) show very large biases over time
  - Assimilation of CDR can improve the bias correction results compared to level-1b observations



# Impacts from Assimilation of One Data Stream of AMSU-A and MHS Radiances on Quantitative Precipitation Forecasts

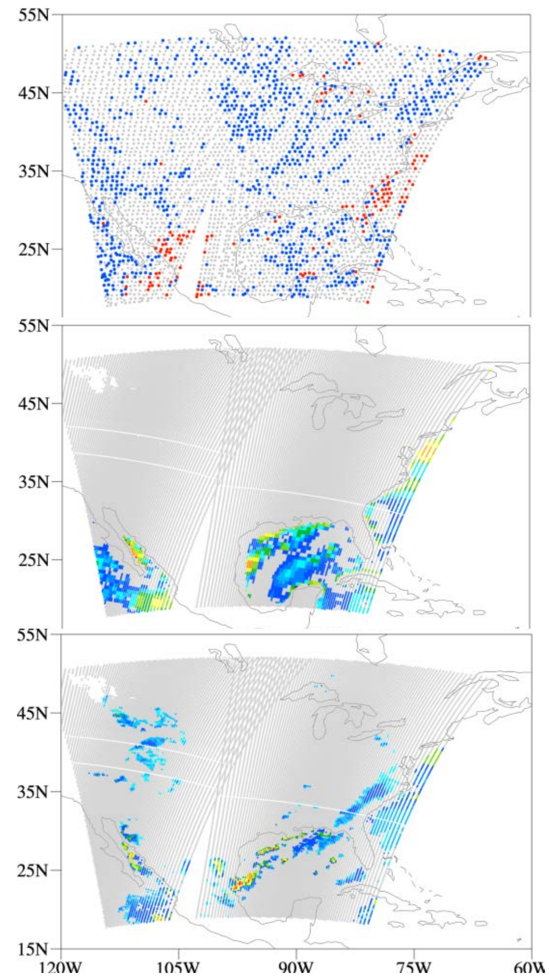
Z. Qin[1], X. Zou[2], and F. Weng[3]

[1]Nanjing University of Information Science and Technology

[2]University of Maryland, ESSIC

[3]NOAA/NESDIS/STAR

- Radiance of AMSU-A and MHS are combined into one data stream (ODS) for their assimilation
  - Spatial collocation between MHS and AMSU-A FOVs in the ODS allows for an improved quality control of MHS data.
- The QPF skill is improved over a 10-day period when Hurricane Issac made landfall
  - The ODS experiment allows more cloud affected MHS data to be detected by the two AMSU-A low frequency channels
  - A single BUFR data file with both AMSU-A and MHS is suggested



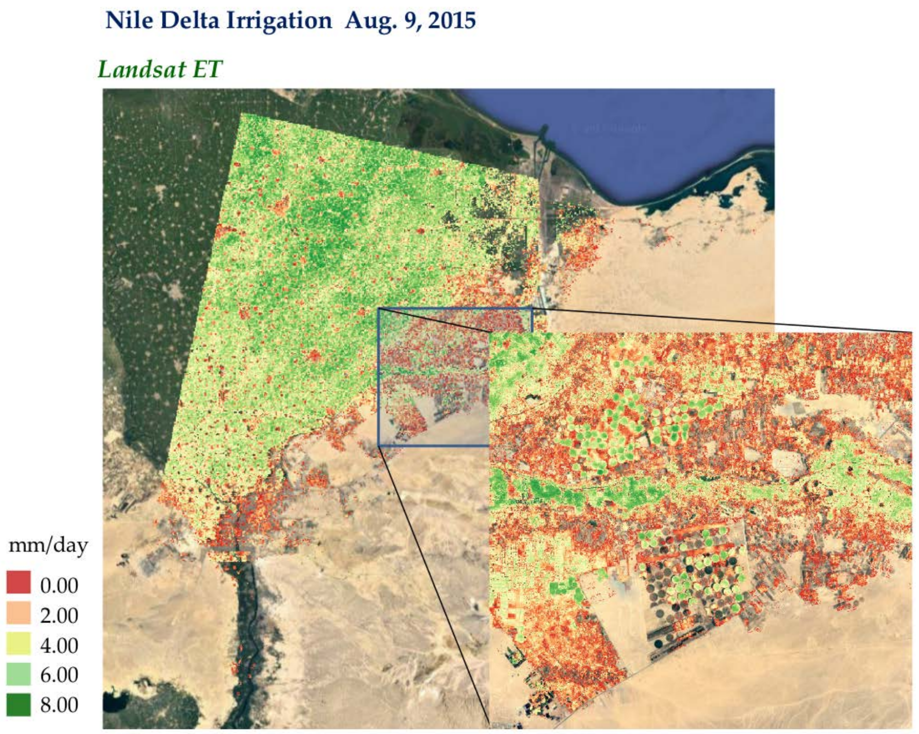
# An Open Source Implementation of the DisALEXI ET data fusion suite

Mitch Schull[1], Chris Hain[2], Martha Anderson[3], Feng Gao[3],Christopher Neale[4], and Xiwu Zhan[5]

[1]Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD
[2]Marshall Space Flight Center, Huntsville, AL
[3]USDA-ARS Hydrology and Remote Sensing Lab, Beltsville,MD
[4]Daugherty Water for Food Institute, University of Nebraska, Lincoln,NE
[5]NOAA NESDIS/STAR, College Park,MD

**31st Conference on Hydrology**

- DisALEXI has been ported to python for open source implementation.
  - Scientific code from proprietary programs (IDL) has been replaced with pythonic versions.
  - All datasets can be accessed (OpeNDAP, RESTful services) and processed on the fly.
- Parallel processing is important!
  - PyDisALEXI divides Landsat scenes into over a thousand parts and runs in parallel
  - Cannot run without parallelism as it will run out memory.

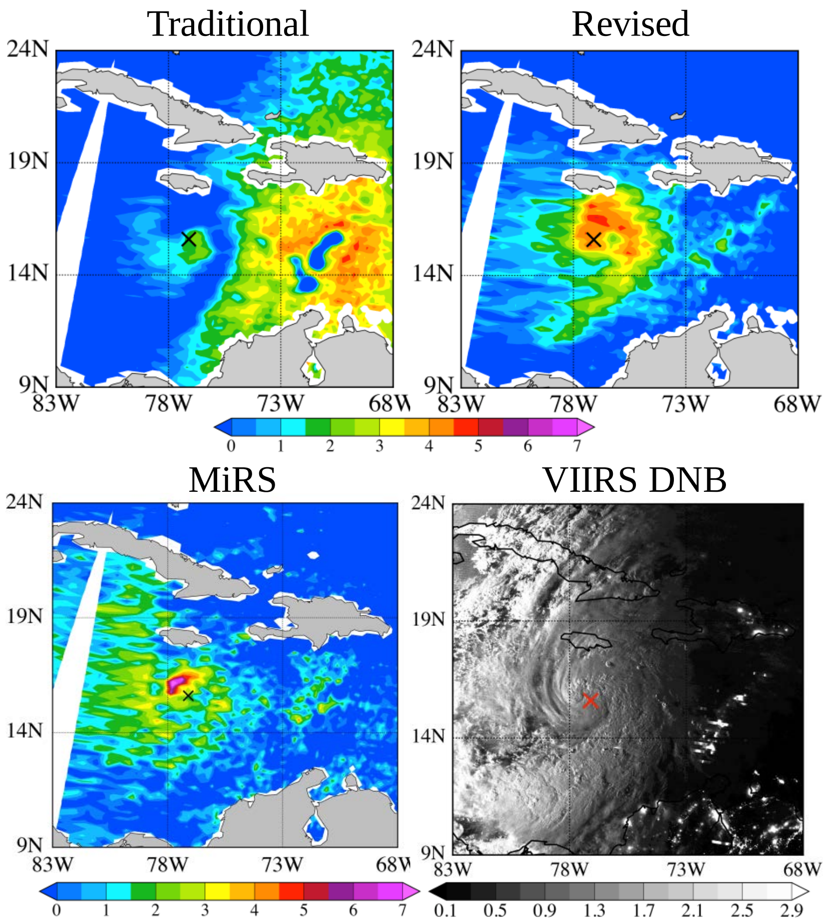


# ATMS- and AMSU-A-derived hurricane warm corestructures using a modified retrieval algorithm

Xiaoxu Tian[1], Xiaolei Zou[1], and Fuzhong Weng[2]

[1]University of Maryland, ESSIC [2]NOAA, NESDIS, STAR

- Scan biases are removed from the retrieved temperature using the revised algorithm
  - Warm cores of both Hurricanes Sandy and Michael can be retrieved regardless of their relative positions in a swath
- More realistic warm core features are obtained by using the revised algorithm
  - Comparison among the traditional method, revised method and MiRS results for Hurricane Sandy (see right panels)



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NOAA - Cooperative Remote Sensing Science and Technology Center

# Enhancing Resilience to Heat Extremes:

## Multi-model Forecasting of Excessive Heat Events at Subseasonal Lead Times


Augustin Vintzileos and M. Halpert, J. Gottschalck, A. Allgood

University of Maryland College Park-ESSIC/CICS & NOAA/CPC


**Eighth Conference on Environment and Health**

- **Excessive Heat Events can be described by sub-seasonally predictable environmental variables**
    - o A description of the July 2015 Excessive Heat Event based on predictable meteorological fields (**Figure 1**)
- **State-of-science models can predict Excessive Heat Events**
    - o ROC based forecast score (AUC) for forecast Week-2 for the combined GEFS and ECMWF models (**Figure 2**).

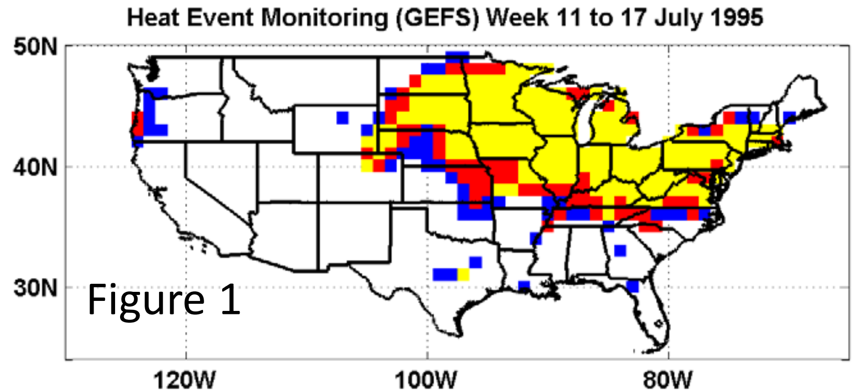


Figure 1

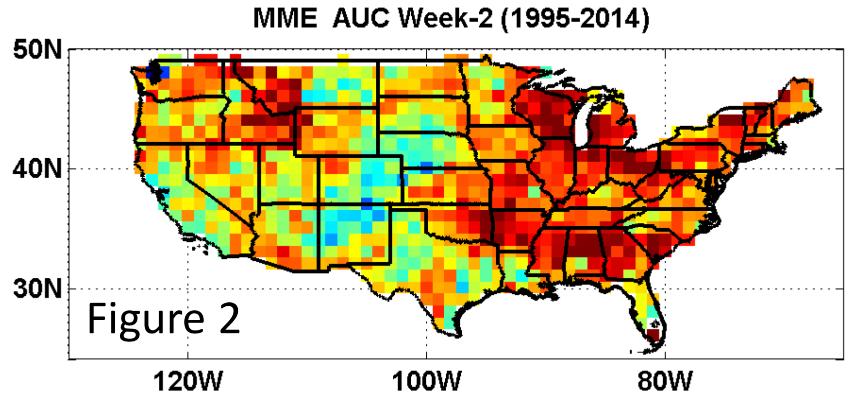


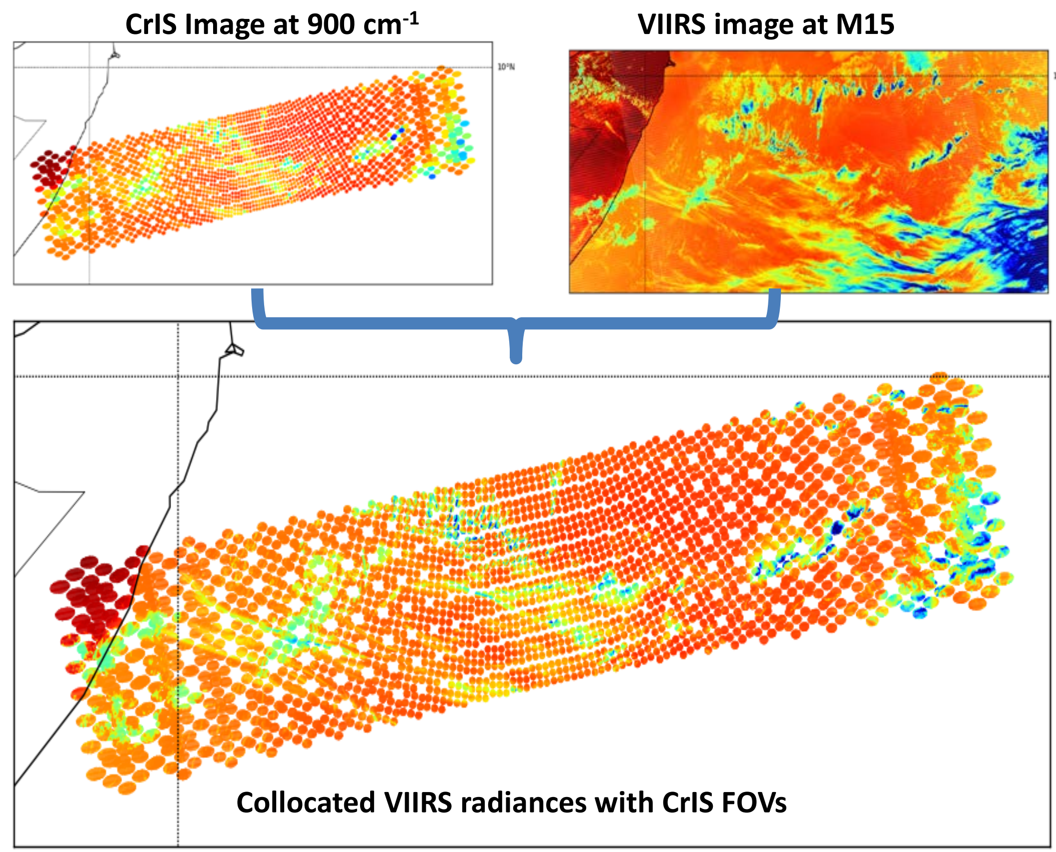
Figure 2

# VIIRS Radiance Cluster Analysis under CrIS Field of Views

Likun Wang, Yong Chen, Denis Tremblay, Yong Han

13th Annual Symposium on Future Operational Satellite Systems

- Fast and accurate collocation method of CrIS and VIIRS has been developed, which is suitable for operational use.
- CrIS geolocation has been adjusted to better align with VIIRS.
- VIIRS radiance cluster analysis shows some potentials for data assimilation and geophysical parameter retrievals.

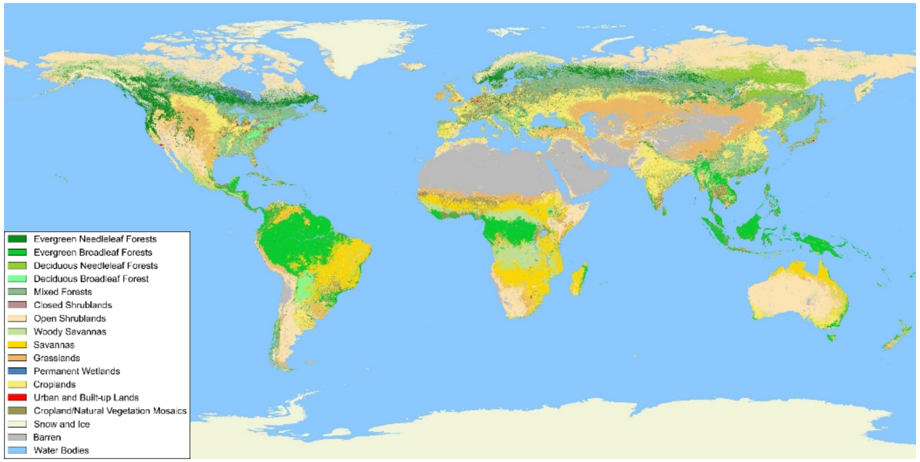


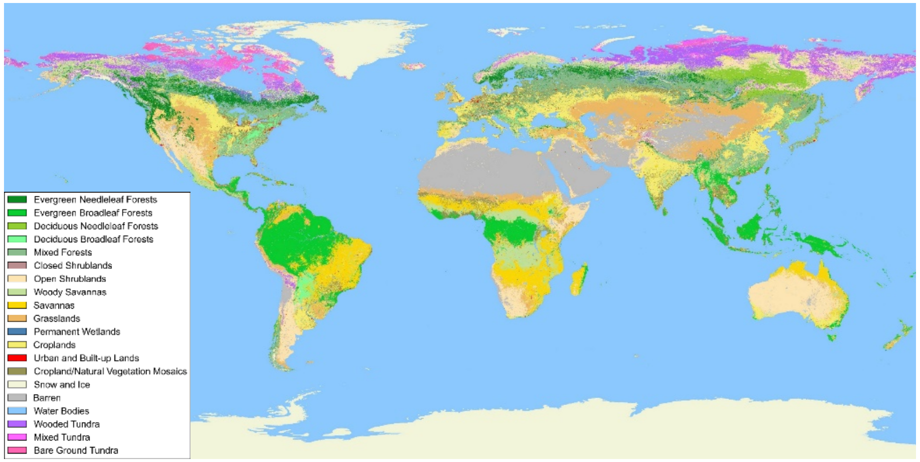
# Development of new global surface type maps from VIIRS data

**Rui Zhang**, **Chengquan Huang, Xiwu Zhan, Huiran Jin**

**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

- VIIRS global surface type map generated for NOAA's mission
  - VIIRS moderate bands (M1-M11) were composited into annual metrics and SVM classified as 17 IGBP map
  - Update annually
  - Validated and in operation
- Other legends
  - NCEP specific use (IGBP+3 tundra)
  - LAI/fPAR use (Biome legend)
- Publication
  - Zhang, R., et al. (2015), Development and validation of the global surface type data product from S-NPP VIIRS, *Remote Sensing Letters*. 7, 51-60
  - Zhang, R., et al. Development of S-NPP VIIRS global surface type classification map using support vector machines, *IJDE*, in revision.



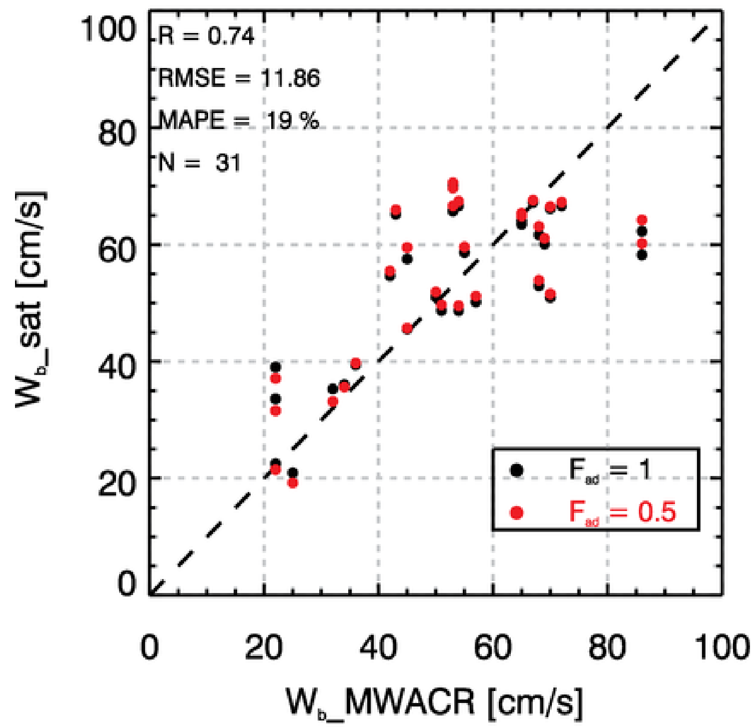
# Satellite remote sensing of cloud-base updrafts for marine stratocumulus


Youtong Zheng [1], Daniel Rosenfeld[2] and Zhanqing Li [1]

[1]University of Maryland, [2]Hebrew University of Jerusalem


**Joint Session 4: Select Student Research for New Generation Environmental Remote Sensing and for Transition of Research to Operations**

- Satellite retrieval of **updrafts** is Possible!
  - The RMSE is 0.12 m/s validated by ground-based Doppler radar
  - We infer the updrafts ($W_b$) by cloud top cooling rate (CTRC)
  - The estimation equation is simple: $W_b$ = -0.43 CTRC + 22.46.
- New publication
  - **Zheng, Y.**, D. Rosenfeld and Z. Li (2016), Quantifying cloud base updraft speeds of marine stratocumulus based on cloud top radiative cooling, Geophys. Res. Lett., 2016GL071185, doi: 10.1002/2016GL071185

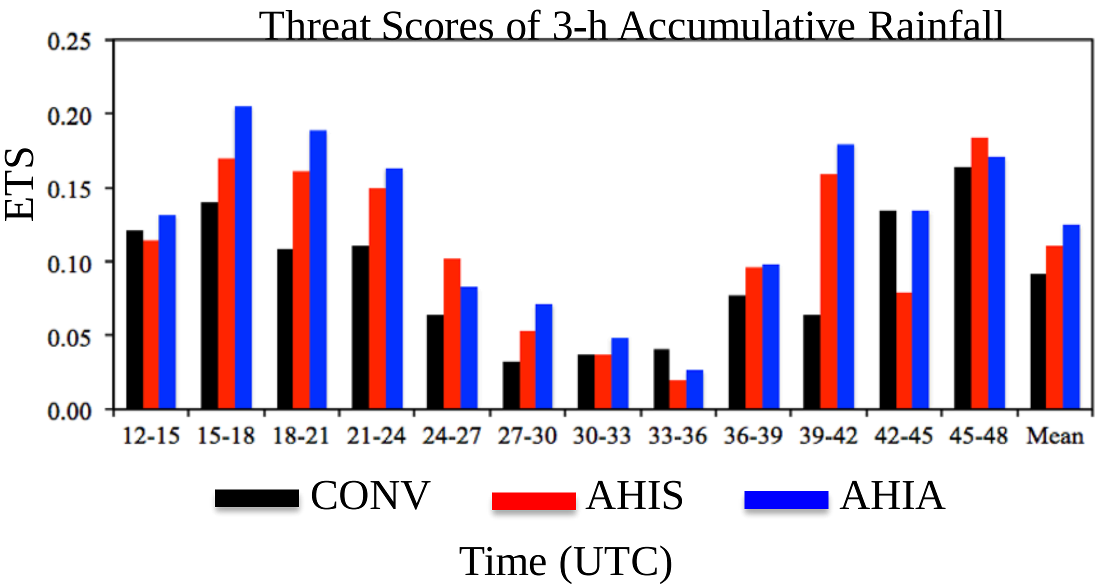


# Impacts of AHI Radiance Assimilation on Quantitative Precipitation Forecasts over Eastern China

Zou, X.[1], Z. Qin[2], and F. Weng[3]

[1]University of Maryland, ESSIC, [2]Nanjing University of Information Science and Technology,[3]NOAA/NESDIS/STAR

- AHI infrared radiance observations are assimilated into forecast model through GSI analysis system
  - Cloudy and precipitation affected radiances are removed through an infrared only cloud detection algorithm




- AHI DA significantly improves QPFs in a typical summer case over eastern China
  - More water vapor channels (8, 9, and 10) are especially important for heavy precipitation forecast

# CIMSS

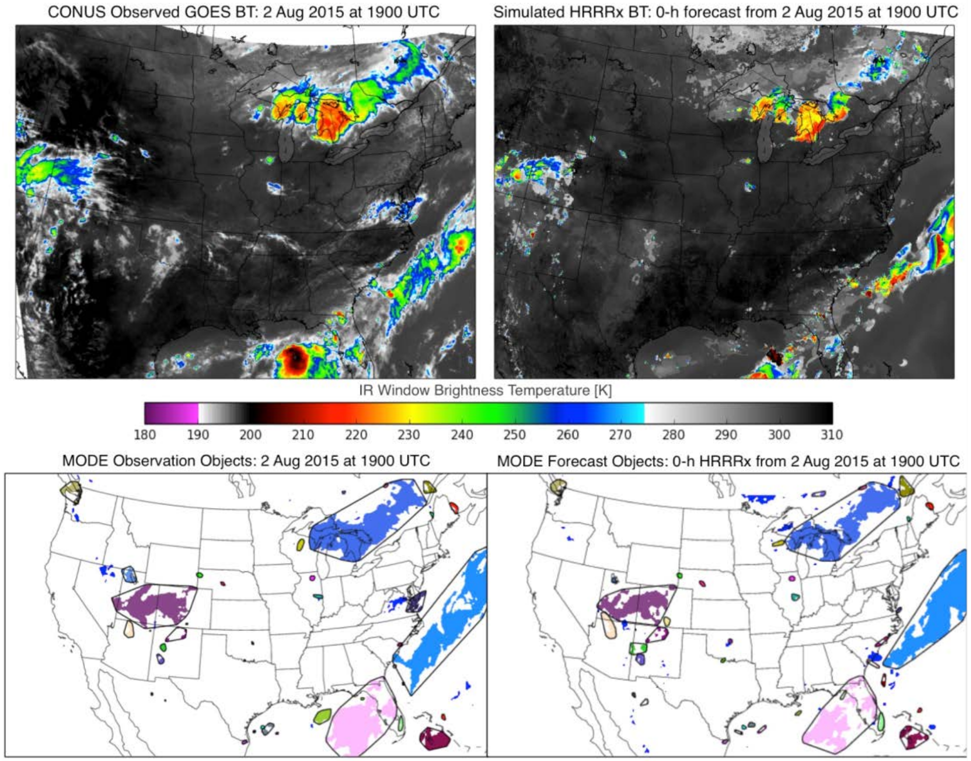
- Griffin, Sarah
- Li, Jun
- Greenwald, Thomas
- Cureton, Geoff
- Li, Yue
- Lee, Yong-Keun
- Weisz, Elisabeth
- Walther, Andi
- Lim, Agnes (2)
- Wang, Pei
- Gartzke, Jessica
- Straka, William
- Li, Zhenglong
- Wagner, Tim
- Rozoff, Christopher
- Otkin, Jason
- Mooney, Margaret
- Strabala, Kathleen
- Lindstrom, Scott (2)
- Santek, Dave
- Knuteson, Robert (2)
- Gerth, Jordan (2)

# Object-based Verification for the HRRR Model Using Simulated and Observed GOES Infrared Brightness Temperatures

Sarah Griffin, Jason Otkin, Chris Rozoff, Justin Sieglaff, Lee Cronce, Curtis Alexander, Tara Jensen, and Jaime Wolff

28th Conference on Weather Analysis and Forecasting and the 24th Conference on Numerical Weather Prediction Conferences

- Cloud objects generated using GOES BTs show that 1-h HRRR forecasts are more accurate overall than the 0-h analysis
  - Smaller displacement errors between forecast and observed cloud objects when objects are small
  - Larger forecast object sizes are more representative of the observed objects in 1-h forecasts
- Cloud objects are more accurate in August compared to January
  - Smaller location errors between forecast and observed objects
  - Better representation of larger HRRR forecast object sizes



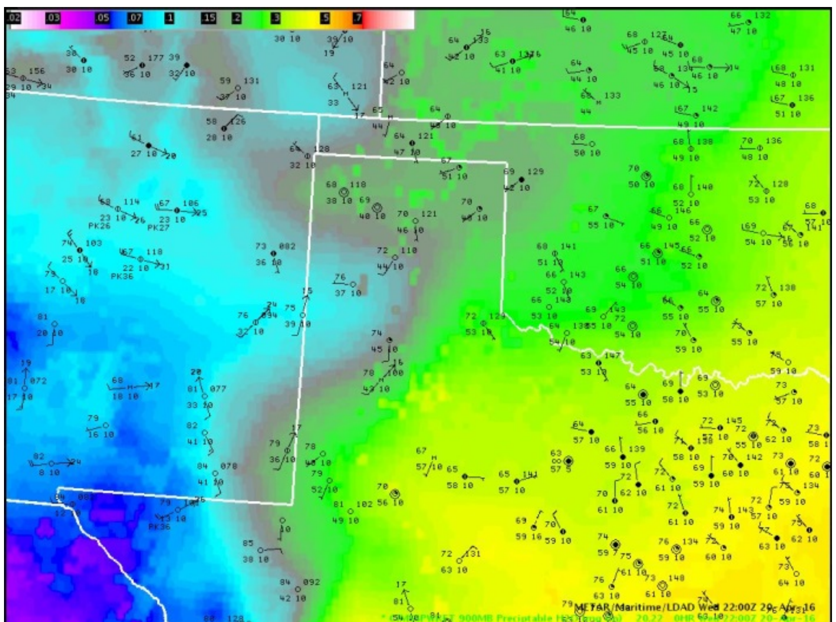

GOES (top-left) and HRRR (top-right) BTs and objects (lower) generated by the Method for Object-Based Diagnostic Evaluation.

# Near Real-time High Resolution All-Weather Total Precipitable Water and Layered Precipitable Water Products from ABI and their applications in weather forecasts

13th Annual Symposium on New Generation Operational Environmental Satellite Systems

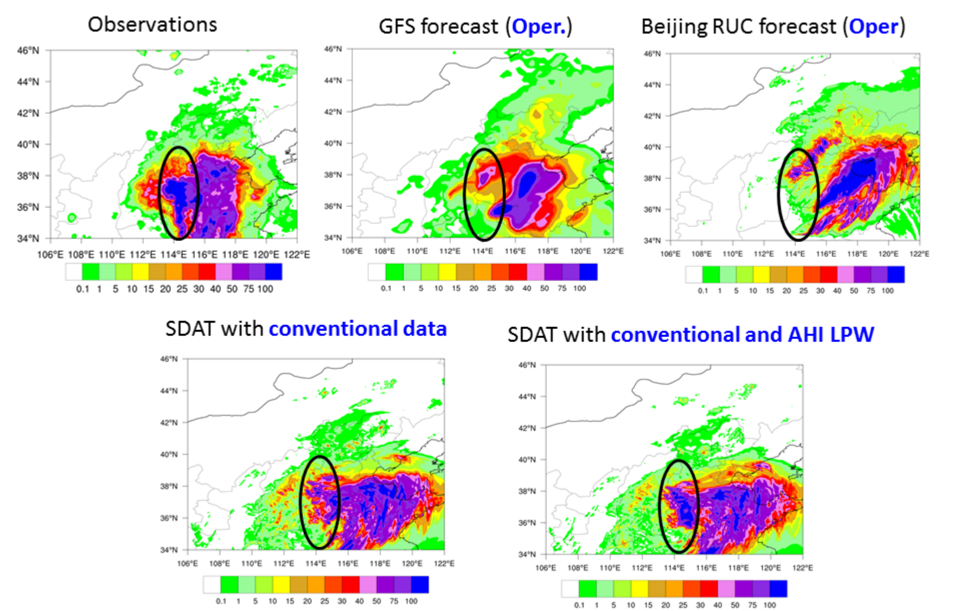
**Jun Li**, Jordan Gerth, Yong-Keun Lee, Zhenglong Li (CIMSS), Timothy J. Schmit (STAR), Pei Wang , and Scott Bachmeier (CIMSS)

- Algorithms have been developed for high temporal resolution all-weather Total Precipitable Water (TPW) and layered PW (LPW) from new generation of geostationary satellites (GOES-16 ABI, Himawari-8/AHI);
- Very positive feedback on TPW/LPW from forecasters during 2015 and 2016 Hazardous Weather Testbed (HWT) spring experiments;
- Temporal and spatial gradient information from TPW/LPW is very helpful for assessing the pre-convective environment;
- Assimilation of AHI LPWs in a storm scale NWP model indicates positive impact on local severe storm (LSS) forecasts, especially in the heavy rain situations. Upper layer and lower PW information is more useful for regional/storm scale NWP, which is consistent with findings on the assimilation GOES Sounder LPWs over CONUS for LSS forecasts.



LPW (900 hPa – SFC) from GOES Sounder using GOES-R legacy atmospheric profile (LAP) algorithm at 22:00 UTC on 20 April 2016.during 2016 HWT spring experiments, indicates the dryline.

**12-hour accumulative precipitation: 2016-7-19 12z - 20 00z**



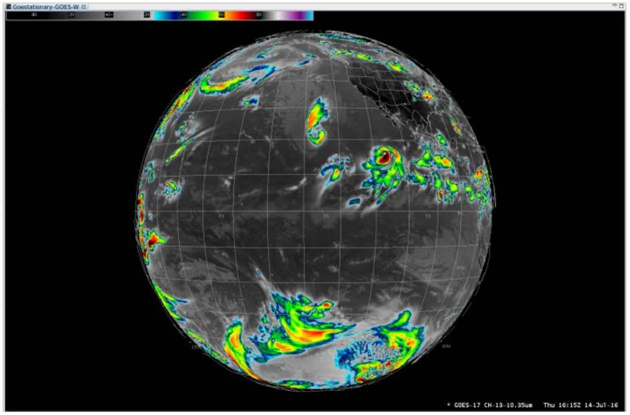

Observations (upper left), forecasts with conventional data assimilation (lower left) and with conventional+AHI LPW assimilated (lower left), along with from two operational models (GFS and CMA BJ-RUC) (upper middle and upper right panels).

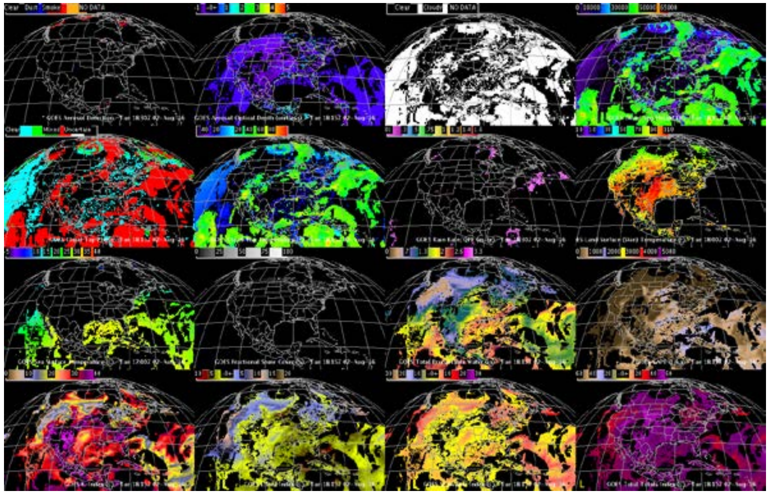
# Real-Time GOES-R ABI Proxy Data for User Readiness, Ground System Support and Product Evaluation

**Thomas Greenwald, R. Bradley Pierce, Kaba Bah, Joseph Zajic and Allen Lenzen**

**13th Symposium on New Generation Operational Environmental Satellite Systems**

- Simulated proxy data played an integral role in training NWS forecasters in ABI capabilities
- Reduced risk in post-launch operations by providing robust, real-time, simulated GOES-R imagery through a series of pre-launch ground system data exercises



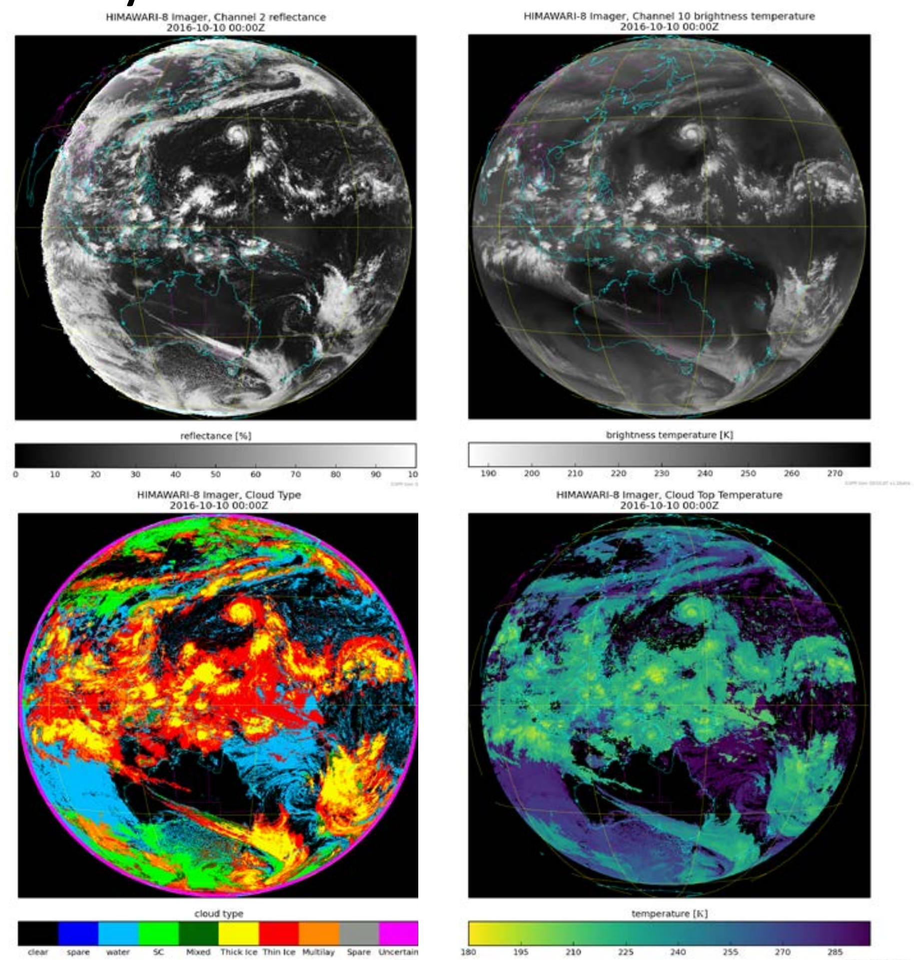


# Himawari Support In The CSPP-GEO Direct Broadcast Package

**Geoff Cureton and Graeme Martin, CIMSS, UW-Madison**

**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

- CSPP GEO-Geocat package v1.0b released to beta testers
  - GOES 13/15, level 1 & 2
  - Himawari 8, level 1 & 2
- Near-Real-Time Support for Himawari level 2
  - Processes cloud mask, type, COT, cloud top press/temp/height, fog
  - Runs in less than 10min Him8 FD duty cycle by parallel processing.
- For release 1.0:
  - Enhancement of parallel processing capability.
  - Support for temporal processing
  - Expected Q1 2017 release.

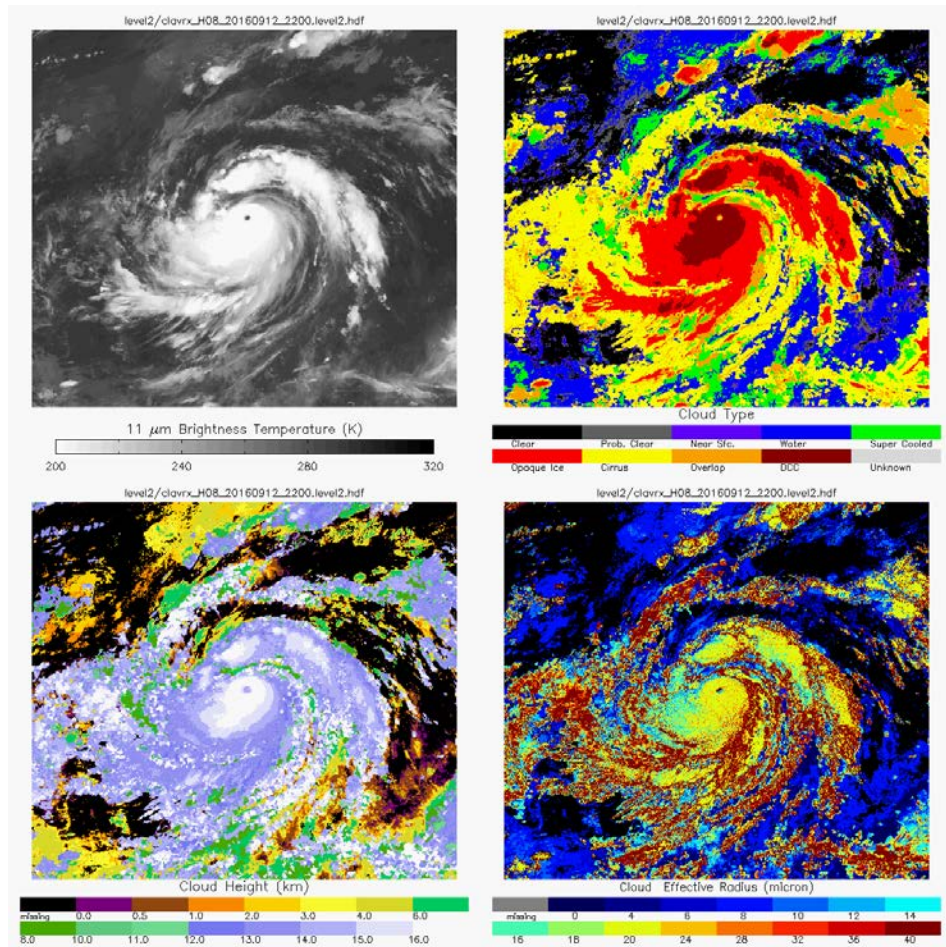


# Evolution of Cirrus and Deep Convection Property associated with West Pacific Typhoons

Yue Li, Andrew Heidinger, Steve Wanzong, Michael Foster, and Andi Walther

13th Annual Symposium on New Generation Operational Environmental Satellite Systems (GOES-R/JPSS)

- High resolution geostationary satellite data can
  - Reveal detailed evolution of typhoon structure
  - Make retrieval and study of cloud properties possible as typhoon develops
- An evident change in cirrus and deep convection properties
  - Nearly all cloud variables show diurnal and shorter timescale variations
  - Strong updrafts at early stage of the storm transport a large fraction of small particles to cloud top

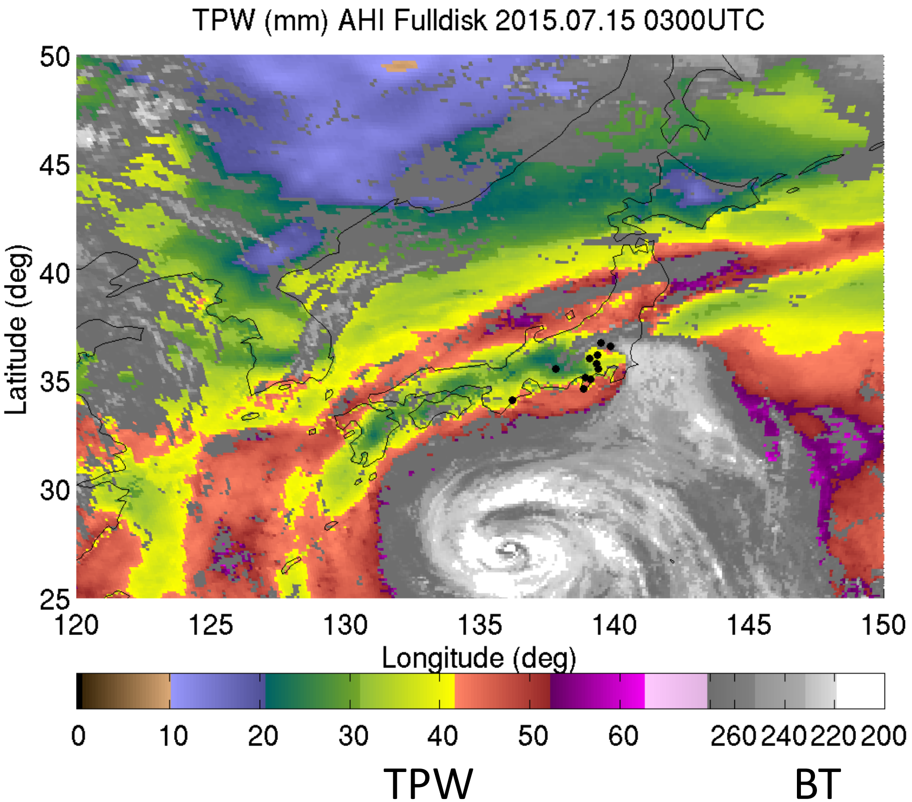


# The pre-landfall atmospheric environment of a typhoon observed by the Himawari-8 AHI

**Yong-Keun Lee, Jun Li, Zhenglong Li, and Timothy Schmit**

**13th Annual Symposium on Future Operational Satellite Systems**

- Application of the GOES-R ABI LAP algorithm to the measurements of the Himawari-8 AHI
  - The application of the GOES-R ABI LAP algorithm to the Himawari-8 AHI data generated reasonable results when compare to the ECMWF data.
  - The LAP and derived products from the Himawari-8 AHI successfully indicate the pre-landfall environment for the heavy rainfall which occurred well in advance of the landfall of Typhoon Nangka (2015).
- Preparing publication
  - Lee and 3 co-authors, 2017: Atmospheric temporal variations in the pre-landfall environment of Typhoon Nangka (2015) observed Imagery. *Asia-Pacific. J. Atmos. Sci.* in revision.



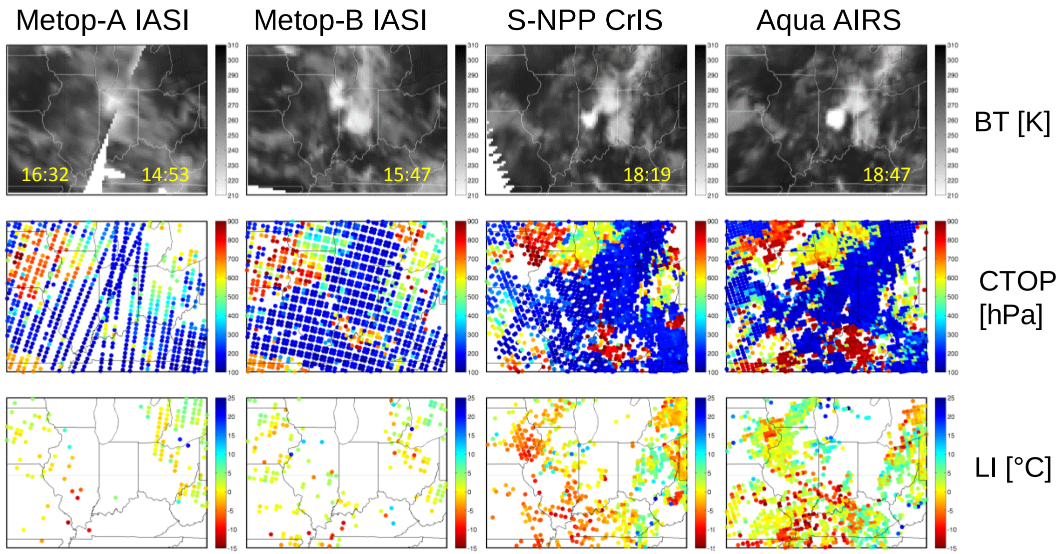

TPW (Total Precipitable Water) over clear skies with 11 µm brightness temperature in gray valid at 00 UTC July 15, 2015. Black dots indicate the selected 11 ISD locations.

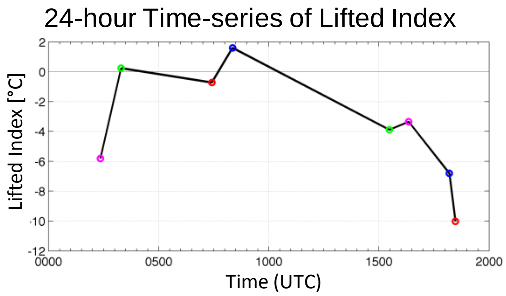
# Expanding Existing Observations of the Pre-Storm Environment Using A Time-Series of High-Spectral Resolution Infrared Sounder Retrievals

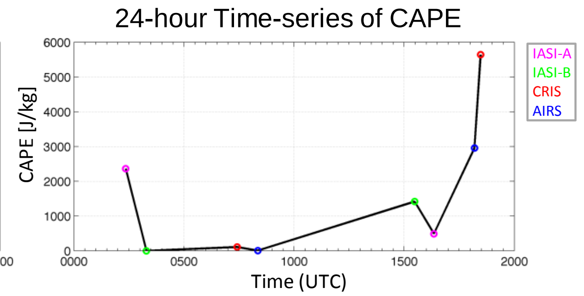
Elisabeth Weisz, Rebecca Schultz, William L. Smith Sr., Kathy Strabala, Allen Huang
Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison

Special Symposium on Severe Local Storms: Observation needs to advance research, prediction and communication

- Atmospheric conditions before and during the 24 August 2016 tornado outbreak across central Indiana and northwestern Ohio are investigated
- Temporal resolution is improved by using consecutive overpasses from all the polar-orbiting satellites carrying advanced hyperspectral (HS) sounders
- Retrievals derived from AIRS, IASI and CrIS measurements provide useful information about important parameters such as convective stability and cloud top changes related to storm intensities
- Real-time HS single-FOV retrieval products complement traditional data and have the potential to improve the accuracy and timeliness of severe weather forecasting



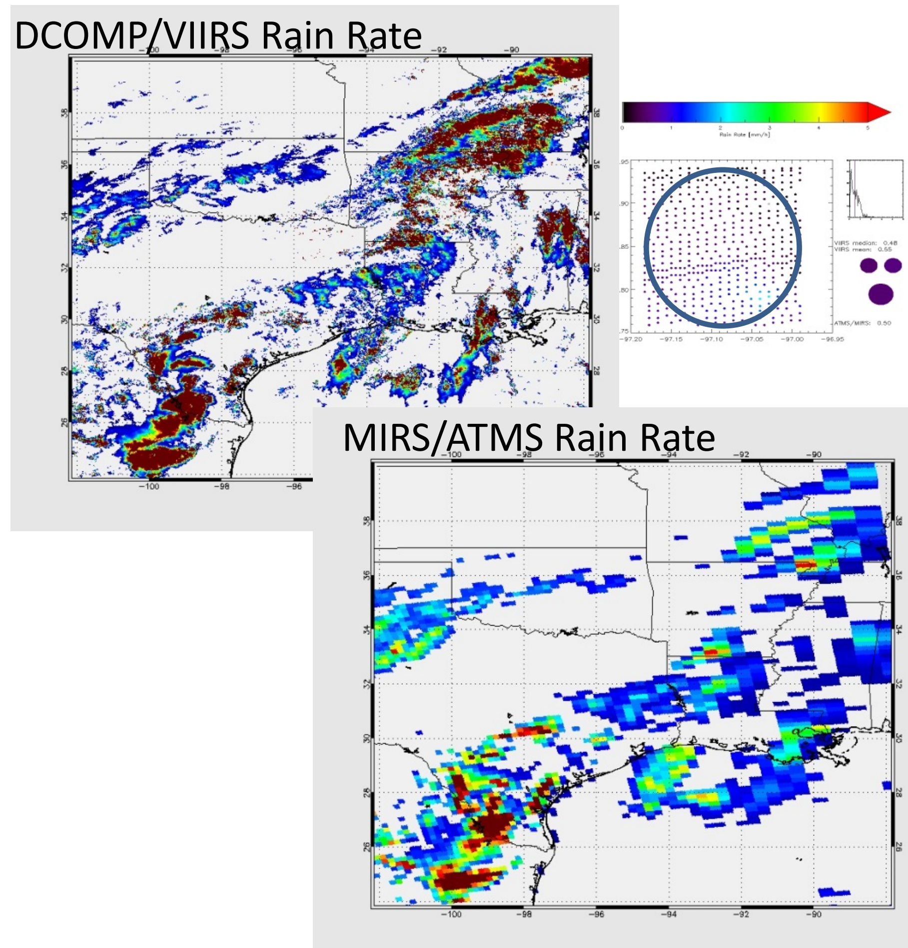



# Feasibility Study for a Hybrid Precipitation Retrieval from VIIRS and ATMS on Suomi

**<u>Andi Walther</u>, Samantha Tushaus, Andrew Heidinger**

**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

- VIS/NIR-based VIIRS rain detection and rain rate retrieval
  - Developed from DCOMP and NLCOMP for day and night observations from Suomi NPP
- Comparison to ATMS rain retrieval
  - Matching tools
  - Rain detection agrees well
- First steps of a hybrid retrieval
  - Correct for saturated clouds
  - Conserves textural pattern



# J7.5 Impact Analysis of LEO Hyperspectral Sensor IFOV Size on the Next Generation High-Resolution NWP Model Forecast Performance

Agnes Lim[1], Allen Huangi[1], James Jung[1], Zhenglong Li[1], Jack Woollen[2], Greg Quinn[1], Fred Nagle[1], S. B. Healy[3], Jason Otkin[1,], Mitch Goldberg[4] and Robert Atlas[5]

1. Cooperative Institute for Meteorological Satellite Studies
2. IMSG/NOAA/NCEP/EMC
3. ECMWF
4. NOAA/JPSS Program Science Office
5. NOAA Atlantic Oceanographic and Meteorological Laboratory

- **To assess the impact obtained from assimilation of next generation CrIS observations with increased spatial resolution in a high resolution global mode.**
- **G5NR, OSSE, GFS T1534**
- **Conventional data – All observation types simulated except dropsondes, NEXRAD winds and satellite track winds.**
- **Satellite radiances from current observing system (2 IASI, CrIS, AIRS, ATMS, 6 AMSU-A and 4 MHS)**
  - **Flying satellites in the simulated atmosphere**
  - **Orbit simulator developed - Generate sensor geometry use in radiance simulation for any given set of start and end time**
- **Increased number of clear FOVs with increased spatial resolution (Figure 1)**
- **OSSE calibration is progress:**
  - **Statistics of number of observations assimilated and rejected between real world and OSSE world have been tuned to match (Figure 2).**
  - **Variance of innovation for various observations are closer to real world after 1 iteration of assimilation of noise added observations as shown in Figure 3 and 4.**

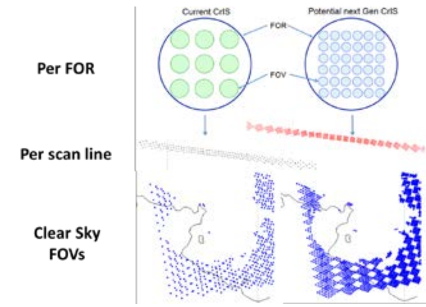



Figure 1 Comparison of current CrIS and future CrIS

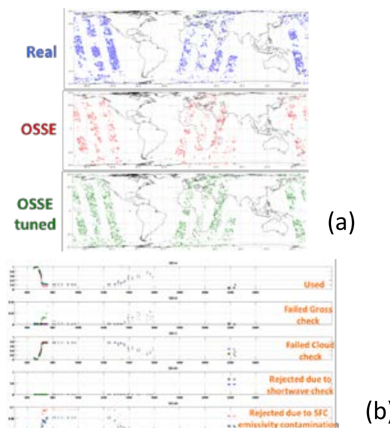



Figure 2 Comparison of observation statistics assimilated in the real world, before OSSE tuning and after OSSE tuning (a) observation distributions and (b) observation quality control.

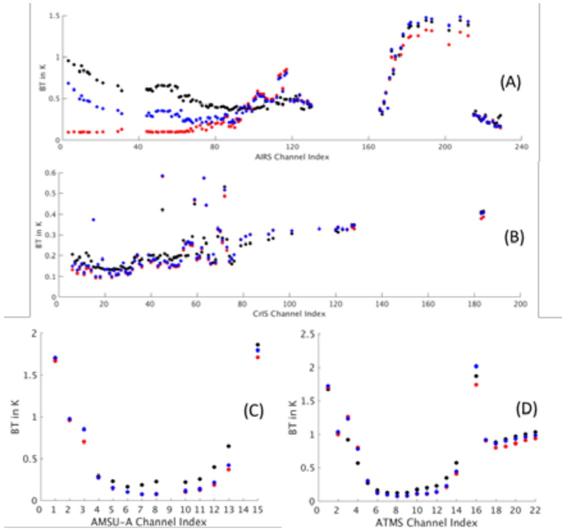



Figure 3 Standard deviation for innovation of BT in K for (A) AIRS, (B) CrIS (C) NOAA-18 AMSU-A and (D) ATMS. Real world in black, before variance calibration in red and after 1 iteration of variance calibration in blue.

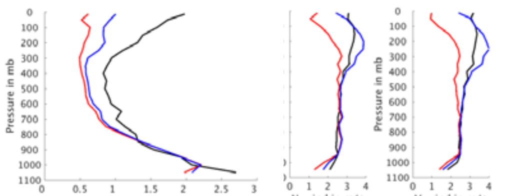



Figure 4 Standard deviation for innovation of (a) rawindonde temperature in K and (b) rawindosnde u and v component winds in m/s. Real world in black, before variance calibration in red and after 1 iteration of variance calibration in blue.

# Assimilation of High Temporal Satellite Derived Atmospheric Motion Vectors to Improve Hurricane Forecasts using HWRF

Agnes Lim[1], James Jung[1], Sharon Nebuda[1], Wayne Bresky[2], Jaime Daniels[3]
Mingjing Tong[2] and Vijay Tallapragada[4]
1. CIMSS/SSEC/UW-Madison, 2. IMSG, 3. NOAA/NESDIS/STAR and 4. NOAA/NWS/NCEP/EMC

- Assimilation of hourly and rapid scan shortwave, infrared, cloud top water vapor, clear air water vapor and visible atmospheric motion vectors derived from GOES-R nested tracking algorithm in the operational Hurricane WRF in preparation for transition to operations.
- Track and intensity verification shown in Figure 1
  - **Increase data counts : positive impact on track for the first 36 hours for both storms, longer improved impact stronger storm in terms of intensity and minimum center pressure error Addition of new satellite wind types improves track out to 72 hours. Near neutral impact on intensity. Negative impact on minimum center pressure error for the weaker storm.**

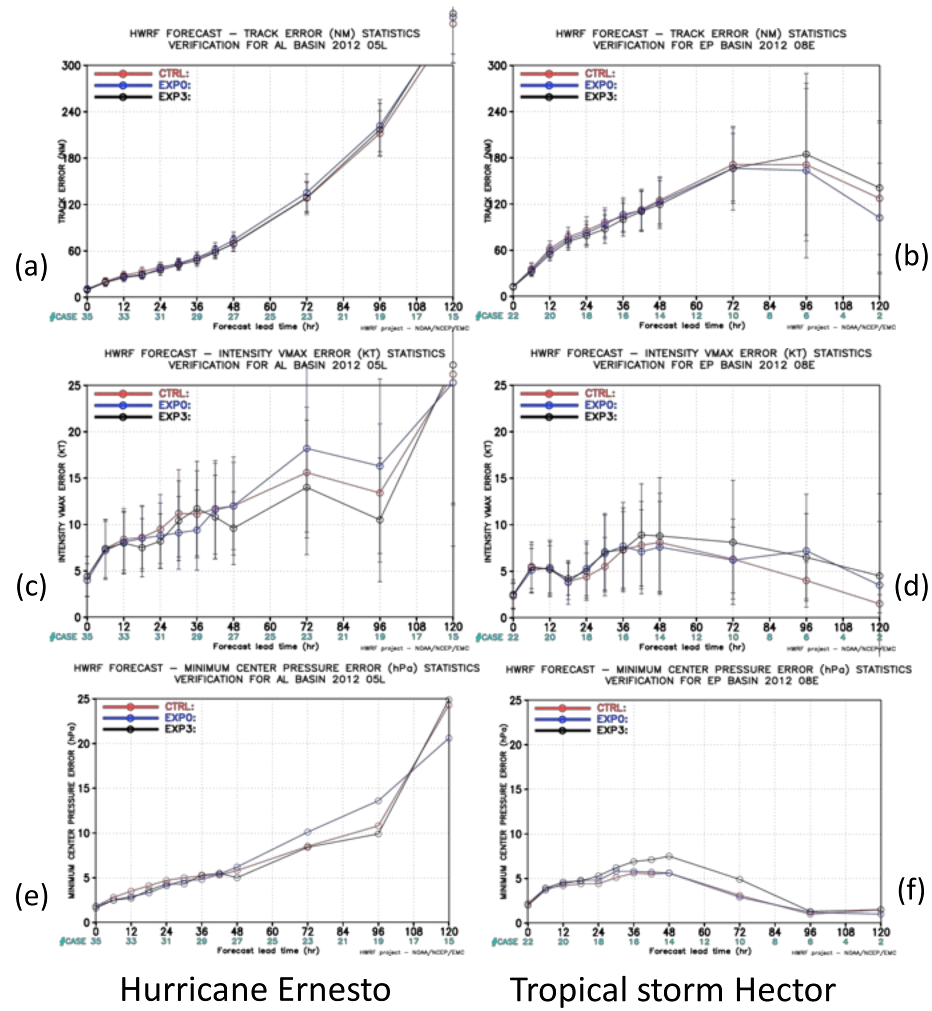


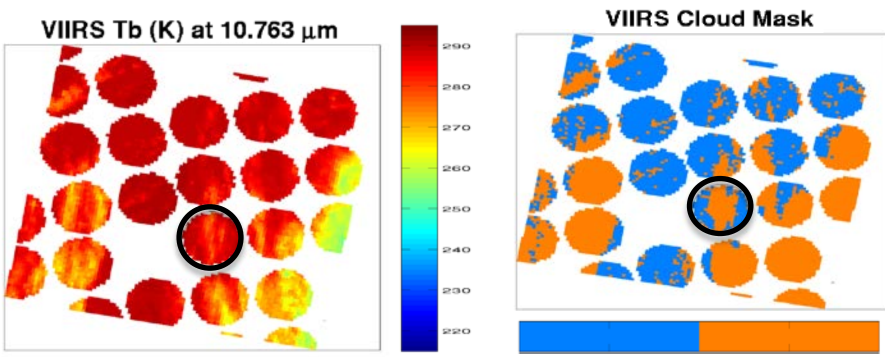

Figure 1 Forecast performance verification for Hurricane Ernesto and Tropical storm Hector. (a) and (b) are track errors, (c) and (d) for intensity error; (e) and (f) for minimum center pressure error. Red assimilates infrared and cloud top water vapor AMVs very 6 hours from heritage algorithm,; blue assimilates the same type of winds as red but from the GOES-R algorith with hourly frequency and black includes hourly and high temporal AMVs for all wind types from GOES-R algorithm.

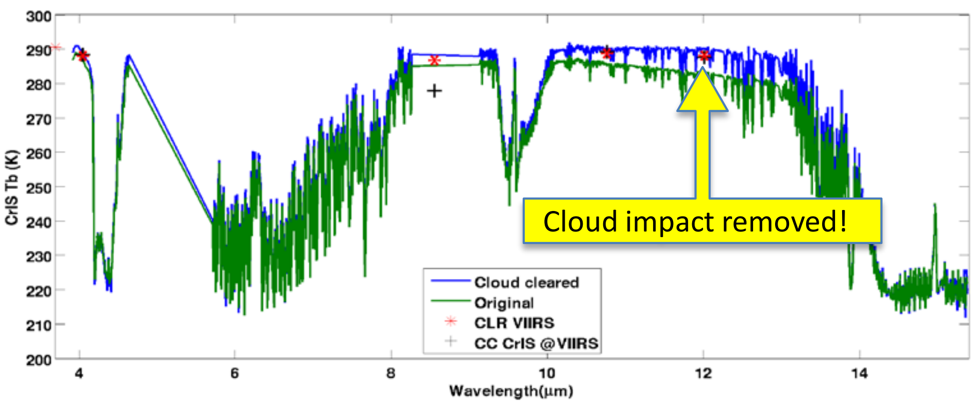
# Improving assimilation of CrIS radiances under cloudy skies using collocated VIIRS data

Pei Wang[1], J. Li[1], Z. Li[1], A. Lim[1], J. Li[1], T. Schmit[2], and M. Goldberg[3]
1 CIMSS, University of Wisconsin-Madison, Madison, Wisconsin; 2 Center for Satellite Applications and Research, NOAA/NESDIS, Madison, Wisconsin; 3 NOAA JPSS Program Office, Lanham, Maryland

97th AMS Annual Meeting: 21th IOAS-AOLS

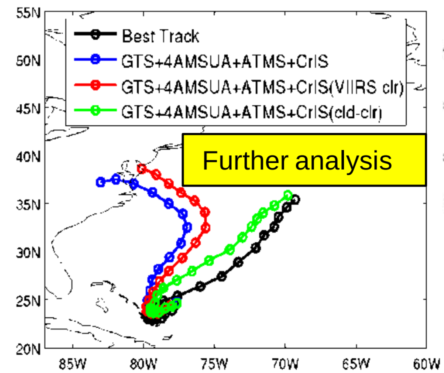
## CrIS/VIIRS cloud clearing case demonstration



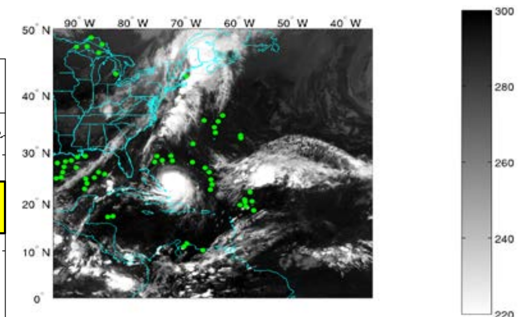




14 % of partially cloudy FOVs are successfully cloud cleared for Hurricane Joaquin

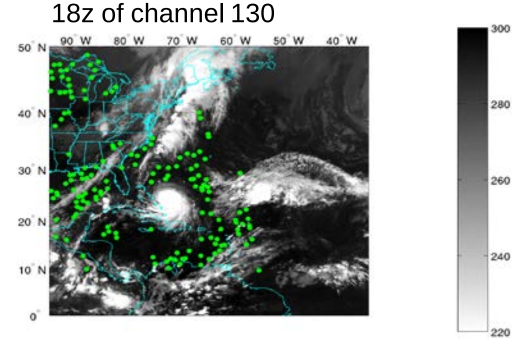
2015-9-30 18z




CrIS Original Data assimilated at 09-30 18z of channel 130



CrIS CCRs Data assimilated at 09-30 18z of channel 130



Collocated high resolution imager data from VIIRS provide cloud mask for CrIS to do clear detection. With the cloudy information, partially cloudy CrIS FOVs can be cloud-cleared successfully.

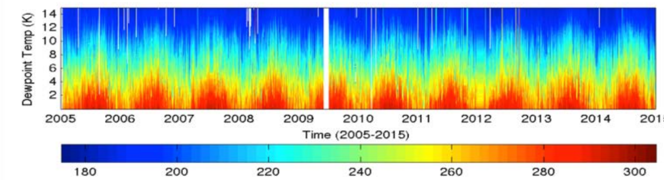
With the assimilation of cloud-cleared CrIS radiances, the atmospheric fields are modified at the analysis time. The temperature fields and geopotential heights are improved in the forecasting fields, which reduced the error of hurricane track forecasts.

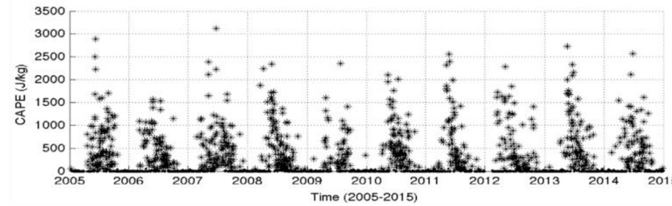
# Near-real time CAPE East of the Rockies combining Hyperspectral IR Satellite Sounding and ASOS Surface Stations: Part I Validation at the ARM SGP Site

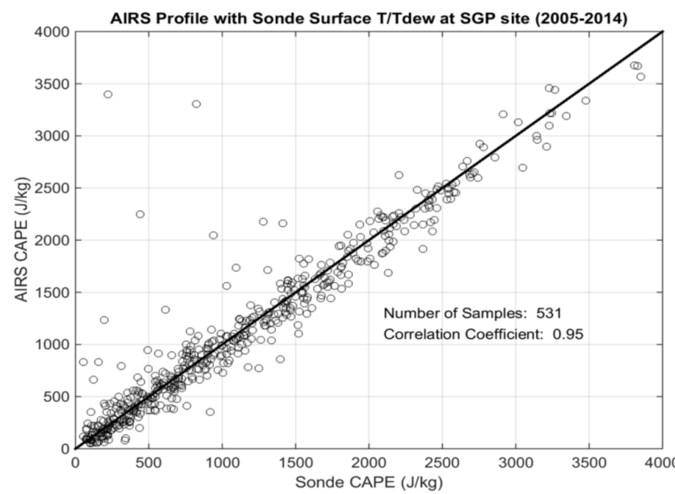
Jessica Gartzke, R. Knuteson, C. Bloch, G. Przybyl, and S. Ackerman, CIMSS

**Seventh Conference on Transition of Research to Operations**

- CAPE Climatology (2005-2015)
  - Coincident observations matched satellite soundings and Vaisala radiosondes at DOE ARM SGP site
  - Correlation of surface CAPE derived from satellite soundings (NASA AIRS and MetOp IASI) with radiosonde CAPE increases from 0.35 to 0.95 when satellite surface T/Tdew is replaced with surface observations.
- Publication
  - Gartzke, Jessica; Knuteson, R.; Przybyl G.; Ackerman, S., 2016: Comparison of Satellite, Model, and Radiosonde derived Convective Available Energy (CAPE) in the Southern Great Plains Region. JAMC, in review.



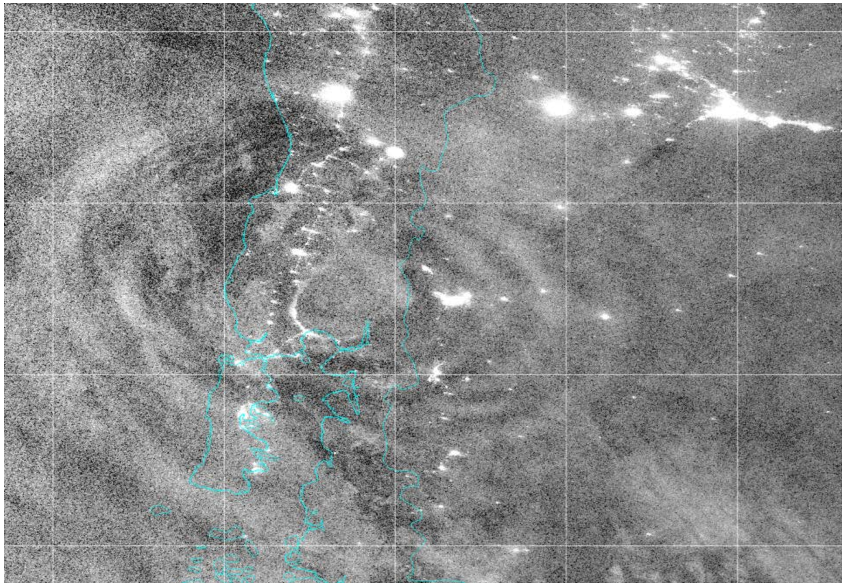



# Usage of the VIIRS Day Night Band as an operational tool

William Straka III (CIMSS), Steven D. Miller (CIRA), Curtis Seaman (CIRA)
2017 AMS Annual meeting – Seattle, WI

- VIIRS Day Night Band is useful in operations
  - The VIIRS DNB has emerged as one of the most exciting new capabilities of the JPSS program.
  - While official VIIRS EDRs exploit DNB for imagery only, there is untapped potential for augmenting other EDRs
- The unanticipated capability to detect nightglow reflection & emission defines a new frontier of research
  - Allows for viewing cloud features at night, extending the usefulness of visible imagery into moonless nights
  - When JPSS-1 launches, the potential for inferring mesopheric GW phase speeds



# Quick regional OSSEs on CubeSat based MW/IR sounders on local severe storm forecasts

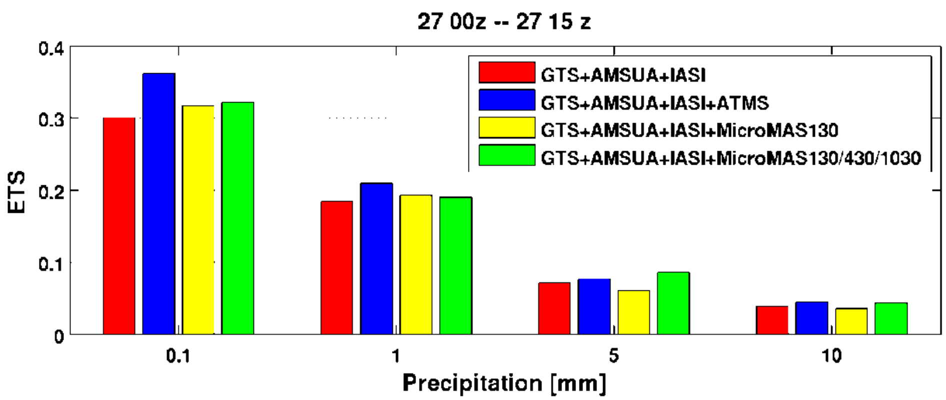
Zhenglong Li[1], Jun Li[1], Pei Wang[1], Agnes Lim[1], Timothy Schmit[2], Jinlong Li[1], Fredrick Nagle[1], Robert Atlas[3], Sid Boukabara[2], William Blackwell[4], Thomas Pagano[5], and John Pereira[6]

[1] Cooperative Institute for Meteorological Satellite Studies, U. Wisconsin-Madison,[2] STAR/NESDIS/NOAA [3] AOML/OAR/NOAA [4] MIT Lincoln Laboratory [5] JPL[6] OPPA/NESDIS/NOAA

21st Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS), Regional OSSEs for Hurricane

- A quick regional OSSE is performed to assess the value of MicroMAS-2 on mitigating data gap of afternoon orbit
  - An orbit simulator developed
  - RTM to simulate CubeSat observations developed
  - Impact study performed
- Preliminary results are
  - Single MicroMAS-2 can hardly mitigate the risk of losing ATMS: can slightly improve the forecast of precipitation, but not for heavy precipitation
  - 3 MicroMAS-2 (10:30am, 1:30pm and 4:30pm) together are more promising, on par of ATMS for heavy precipitation, less so for light precipitation

ETS score on precipitation forecast

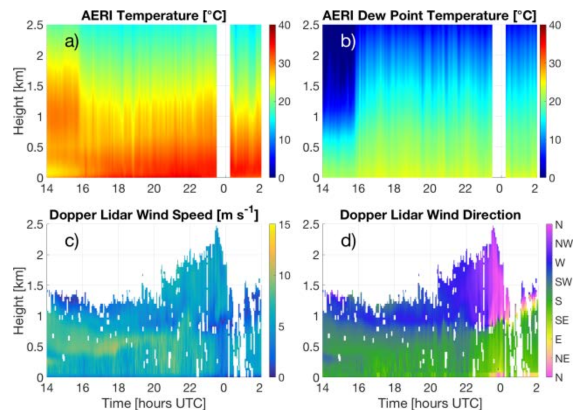


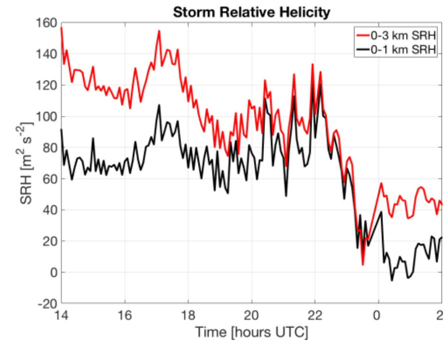
NOAA STAR CENTER FOR SATELLITE APPLICATIONS AND RESEARCH · cics-md · CIRA · CUNY NOAA - Cooperative Remote Sensing Science and Technology Center · CIMSS

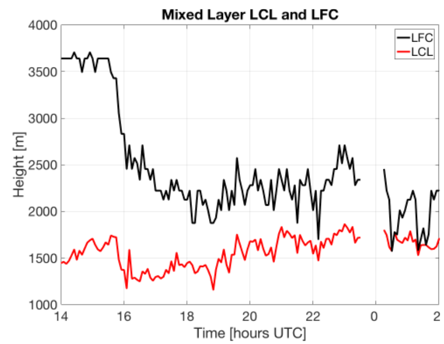
# High Temporal Resolution Profiles of the Near-storm Environment During the 13 July 2015 Nickerson KS Tornado

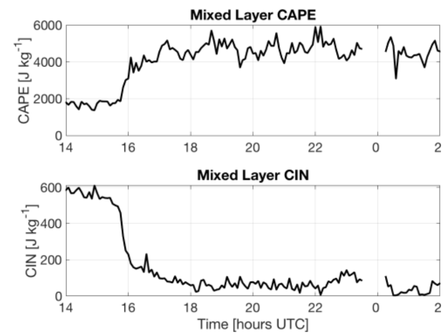
Special Symposium on Severe Local Storms: Observation Needs to Advance Research, Prediction, and Communication (Tim Wagner)

- An atypical F3 tornado passed within 50 km of a surface supersite
  - 1.5 km base
  - 100 F sfc. temp
  - Propagated to the SW
- Surface profilers explain this storm
  - High base caused by low level dryness
  - High base leads to large vertical stretching
  - High temps mean extreme instability
  - Weak flow means motion governed by internal dynamics



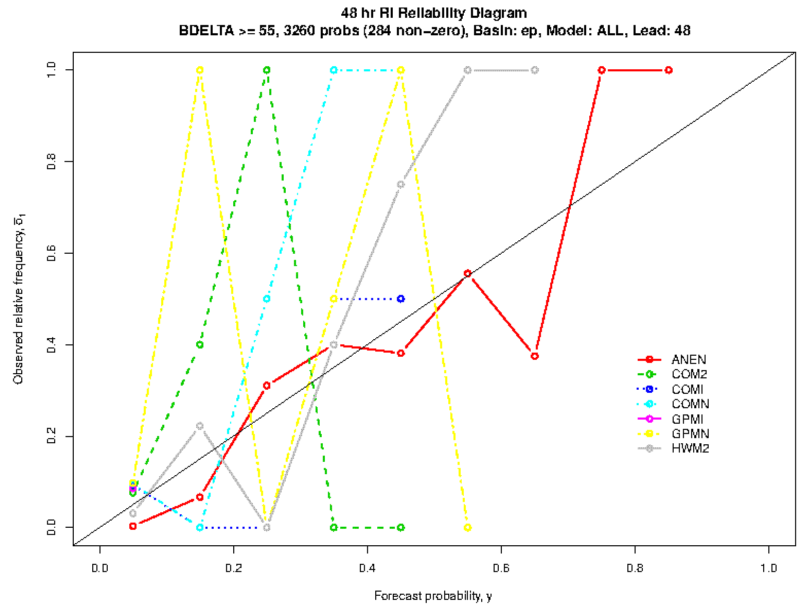



# Probabilistic Prediction of Tropical Cyclone Rapid Intensification with an Analog Ensemble

Stefano Alessandrini (NCAR), Luca Delle Monache (NCAR), Christopher M. Rozoff (CIMSS), and William Lewis (CIMSS)

- Probabilistic Rapid Intensification (RI) Model
  - Developed an analog ensemble (AnEn) model for the prediction of tropical cyclone RI developed from single deterministic HWRF model for the Atlantic and Eastern Pacific
  - Results compared with computationally expensive dynamical ensemble systems
- Results
  - The AnEn significant improves forecast skill with respect to HWRF
  - AnEn's reliability competes or exceeds the reliability of top-performing dynamical ensemble prediction systems




Reliability diagram for 0-48 h rapid intensification probability (55 kt intensity change threshold) for the 2014-2015 eastern Pacific hurricane seasons. Included are HFIP Ensemble Tiger Team models, including the AnEn, COAMPS ensembles, GFDL ensembles, and HWRF ensemble (Image Credit: Ryan Torn and DTC)

**Acknowledgments**

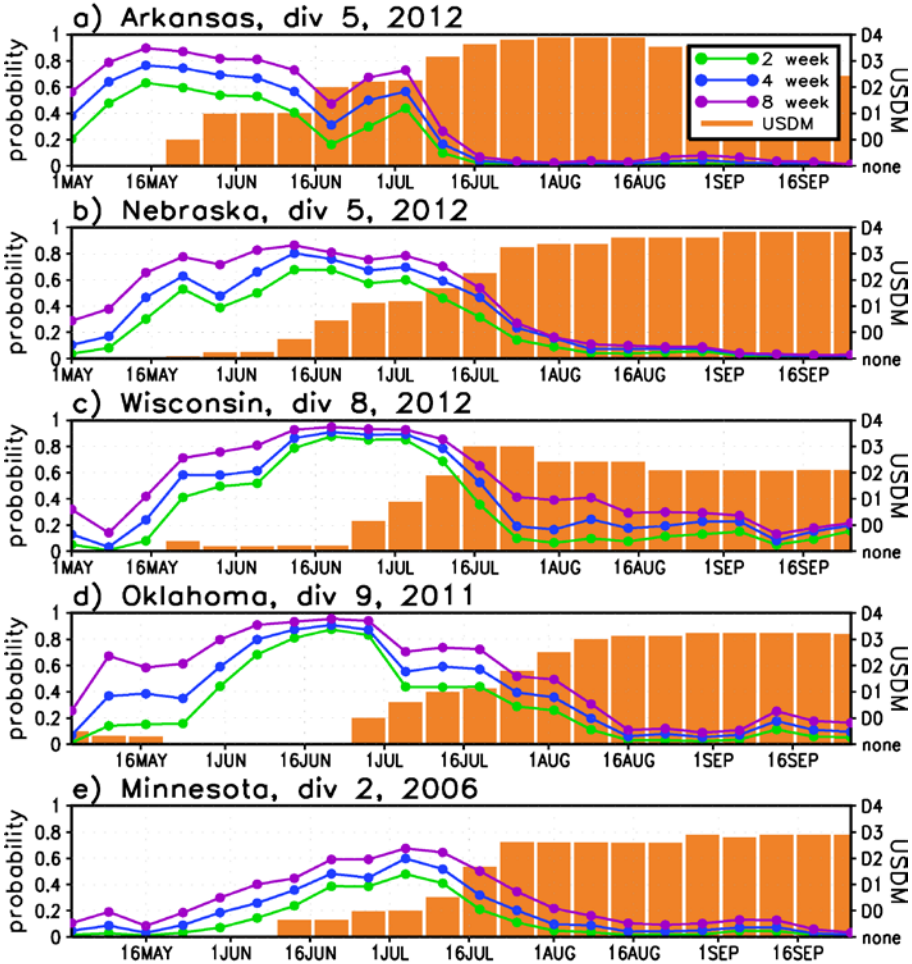
**Funded by the National Oceanic and Atmospheric Administration (NOAA) Hurricane Forecast Improvement Program (HFIP) Grants NA14NWS4680024 and NA16NWS4680027**

# An Empirical Method to Generate Probabilistic Drought Intensification Forecasts Over Sub-Seasonal Time Scales

Jason Otkin (UW/CIMSS), D. Lorenz, M. Svoboda, C. Hain, and M. Anderson

31st Conference on Hydrology

- Empirical method developed to generate probabilistic drought intensification forecasts over sub-seasonal time scales
- Uses precipitation anomalies and time tendencies in soil moisture and evapotranspiration
- Forecasts depicted a high risk for drought development before each flash drought event
- Results show that the method provides useful drought early warning information

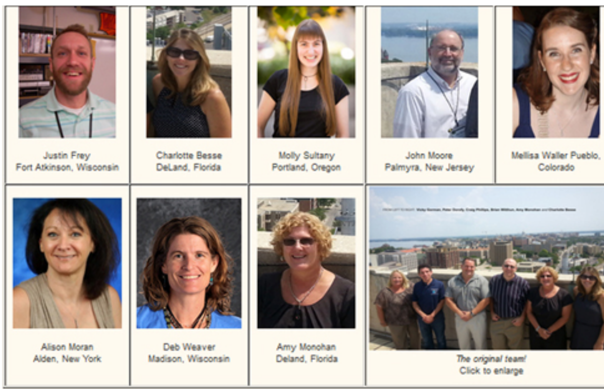


# GOES-R Education Proving Ground

Margaret Mooney, T. Schmit & M. Gunshor

- Expanded from 6 teachers to 33 in 2016





- Launch Workshop

23 teachers from 10 different states and Puerto Rico attended the workshop & watched the launch!

The agenda is on-line at http://cimss.ssec.wisc.edu/education/goesr/workshop.html



# Polar Orbiter Meteorological Satellite Training Workshops – From Theory to Applications

Kathleen Strabala, Liam Gumley, Allen Huang, W. Paul Menzel
Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison

26th Symposium on Education, Remote Sensing Education Experiences

- 14 Polar Orbiter Direct Broadcast workshops taught
  - 6 continents
  - 60 countries attended
- Community Satellite Processing Package (CSPP) product real-time applications presented
  - Fosters the next generation of scientists
  - Promotes operational use of NOAA satellite data

# Hands-on Activities designed to familiarize National Weather Service Forecasters with new data from ABI on GOES-R and AHI on Himawari-8

Scott Lindstrom, Timothy J Schmit, Jordan Gerth, Mathew Gunshor, Margaret Mooney, Thomas Whittaker

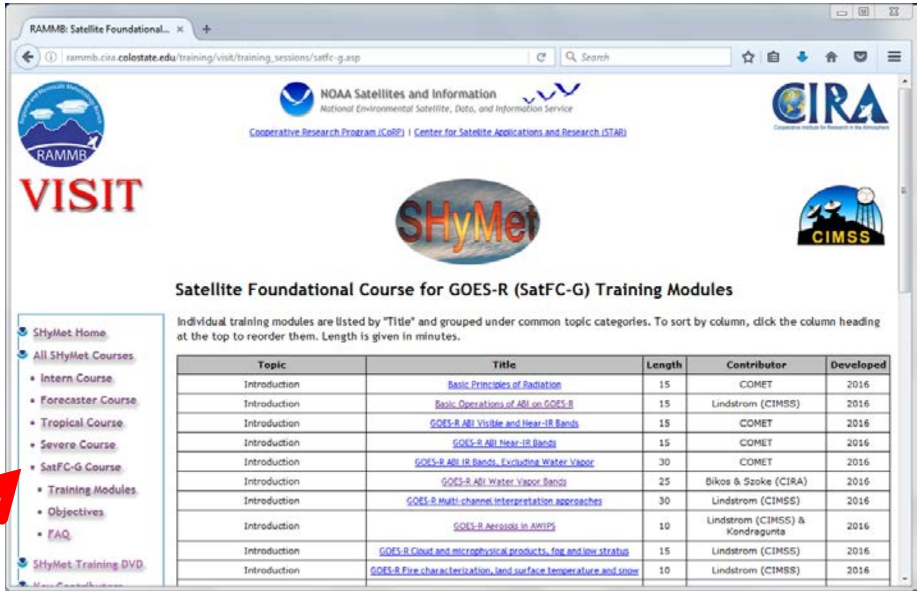
- CIMSS has developed web-based applications to help users understand the different bands on AHI/ABI
  - HTML5-based website works on all devices
- CIMSS also has developed web-based applications to create RGB composites from ABI/AHI band combinations
  - HTML5-based website works on all devices

# The Satellite Foundational Course for GOES-R: A Collection of Lessons to Prepare National Weather Service Forecasters for GOES-R

Bill Ward and co-authors, presented at AMS Conference by Scott Lindstrom, CIMSS

- 40 Modules developed by trainers at COMET, CIRA, CIMSS, CIMSS, SPoRT
  - 10 hours of content plus 2 1-hour WES cases
- Created between February and October 2016 in time for GOES-R launch
- Required training for NWS Forecasters
  - Accessible via LMS
- Also available to regular public via SHyMet

http://rammb.cira.colostate.edu/training/shymet/satfc-g_intro.asp


NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service
Cooperative Research Program (CoRP) | Center for Satellite Applications and Research (STAR)

VISIT

SHyMet Home
All SHyMet Courses
- Intern Course
- Forecaster Course
- Tropical Course
- Severe Course
- SatFC-G Course
  - Training Modules
  - Objectives
  - FAQ

SHyMet Training DVD

## Satellite Foundational Course for GOES-R (SatFC-G) Training Modules

Individual training modules are listed by "Title" and grouped under common topic categories. To sort by column, click the column heading at the top to reorder them. Length is given in minutes.

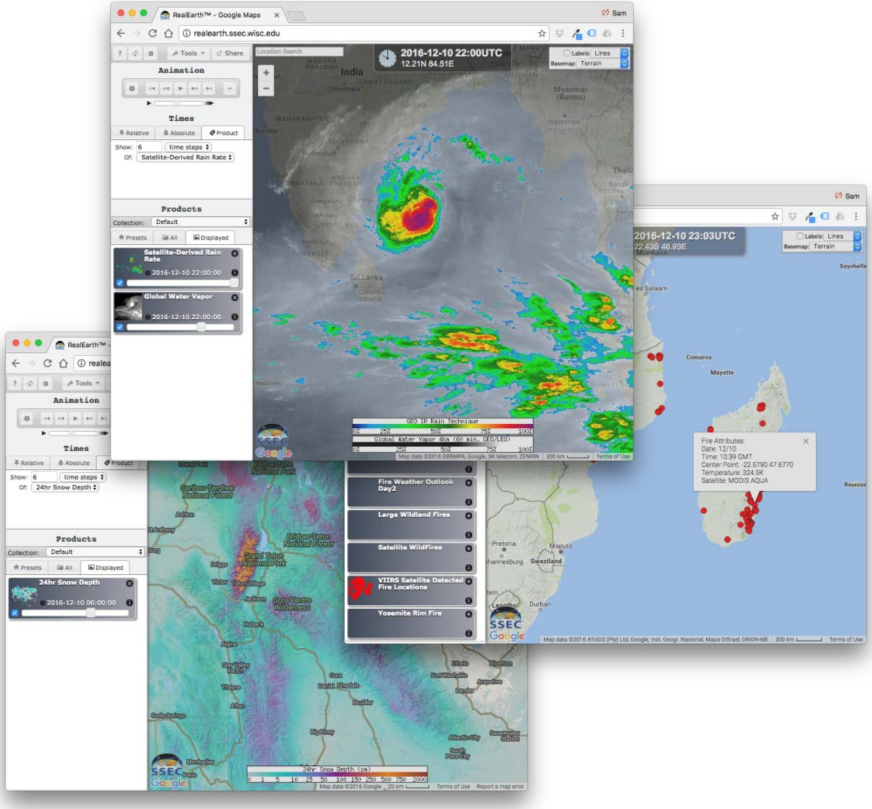
| Topic | Title | Length | Contributor | Developed |
|---|---|---|---|---|
| Introduction | Basic Principles of Radiation | 15 | COMET | 2016 |
| Introduction | Basic Operations of ABI on GOES-R | 15 | Lindstrom (CIMSS) | 2016 |
| Introduction | GOES-R ABI Visible and Near-IR Bands | 15 | COMET | 2016 |
| Introduction | GOES-R ABI Near-IR Bands | 15 | COMET | 2016 |
| Introduction | GOES-R ABI IR Bands, Excluding Water Vapor | 30 | COMET | 2016 |
| Introduction | GOES-R ABI Water Vapor Bands | 25 | Bikos & Szoke (CIRA) | 2016 |
| Introduction | GOES-R Multi-channel interpretation approaches | 30 | Lindstrom (CIMSS) | 2016 |
| Introduction | GOES-R Aerosols in AWIPS | 10 | Lindstrom (CIMSS) & Kondragunta | 2016 |
| Introduction | GOES-R Cloud and microphysical products, fog and low stratus | 15 | Lindstrom (CIMSS) | 2016 |
| Introduction | GOES-R Fire characterization, land surface temperature and snow | 10 | Lindstrom (CIMSS) | 2016 |

# RealEarth™: Access to Real-time and Archive Satellite Data and Derived Products

**33rd Conference on Environmental Information Processing Technologies**

**Sam Batzli, Dave Santek, Russ Dengel, Dave Parker, Nick Bearson, Tommy Jasmin**

- Summary
  - Simple Visualization of
  - Complex Information in
  - Intuitive Interfaces
- Over 450 Products
  - Pan, zoom, animate satellite and derived products
  - API provides universal access
- RealEarth™ Browser & Mobile Apps
  - Available in iOS and Android stores
  - Improved desktop browser interface
- Upcoming JPSS and GOES Apps
  - With notifications and sharing

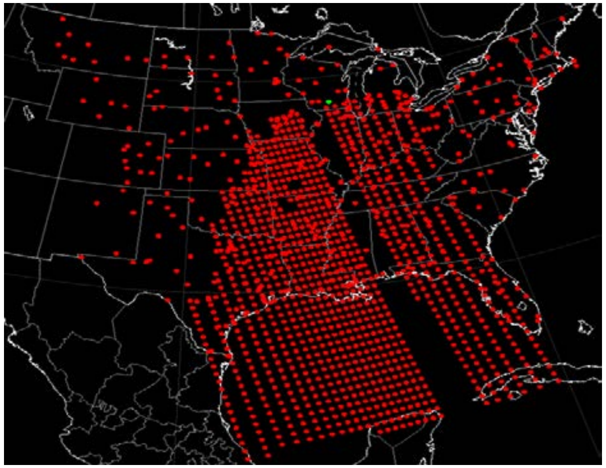


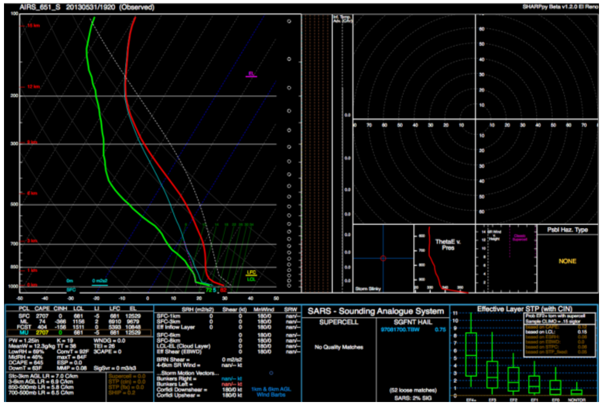
# An Extension of the Python SHARPpy GUI to Display Combined Satellite Soundings and ASOS Surface Data in Near-Real Time

**Grace Przybyl**, R. O. Knuteson, C. Bloch, and J. Gartzke, CIMSS

**16th Annual AMS Student Conference**

- Why Combine  Satellite and Surface Data?
  - NOAA automated surface station observations continuously monitor the surface air parcel
  - NOAA JPSS satellites provide twice daily upper air soundings at satellite footprints
- Satellite Only vs Satellite+ASOS CAPE
  - Insertion of ASOS surface data into the AIRS or NUCAPS profiles  greatly improves Convective Available Potential Energy (CAPE) estimates
  - Improves hourly stability estimates
- Process of Combining and Distributing Data
  - A student project at CIMSS is extending the python SHARPpy software to ingest satellite sounder data and automated surface observations at ASOS sites.
  - ASOS real-time surface observations from MADIS are used to produce hourly average estimates
  - Satellite data is available from SSEC Direct Broadcast
  - Open Source https://github.com/sharppy/SHARPpy



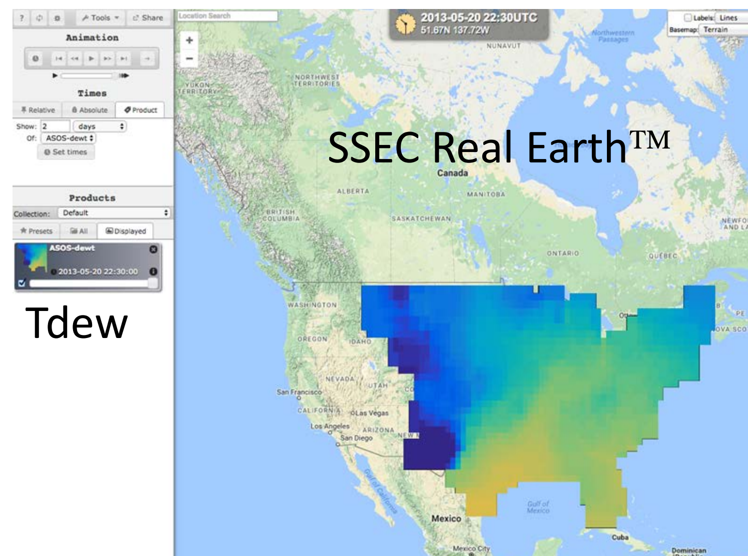


# Near-real time CAPE East of the Rockies combining Hyperspectral IR Satellite Sounding and ASOS Surface Stations: Part II Methodology and Preliminary Results

**Callyn Bloch**, R. O. Knuteson, J. Gartzke, G. Przybyl, and S. Ackerman, CIMSS

**Seventh Conference on Transition of Research to Operations**

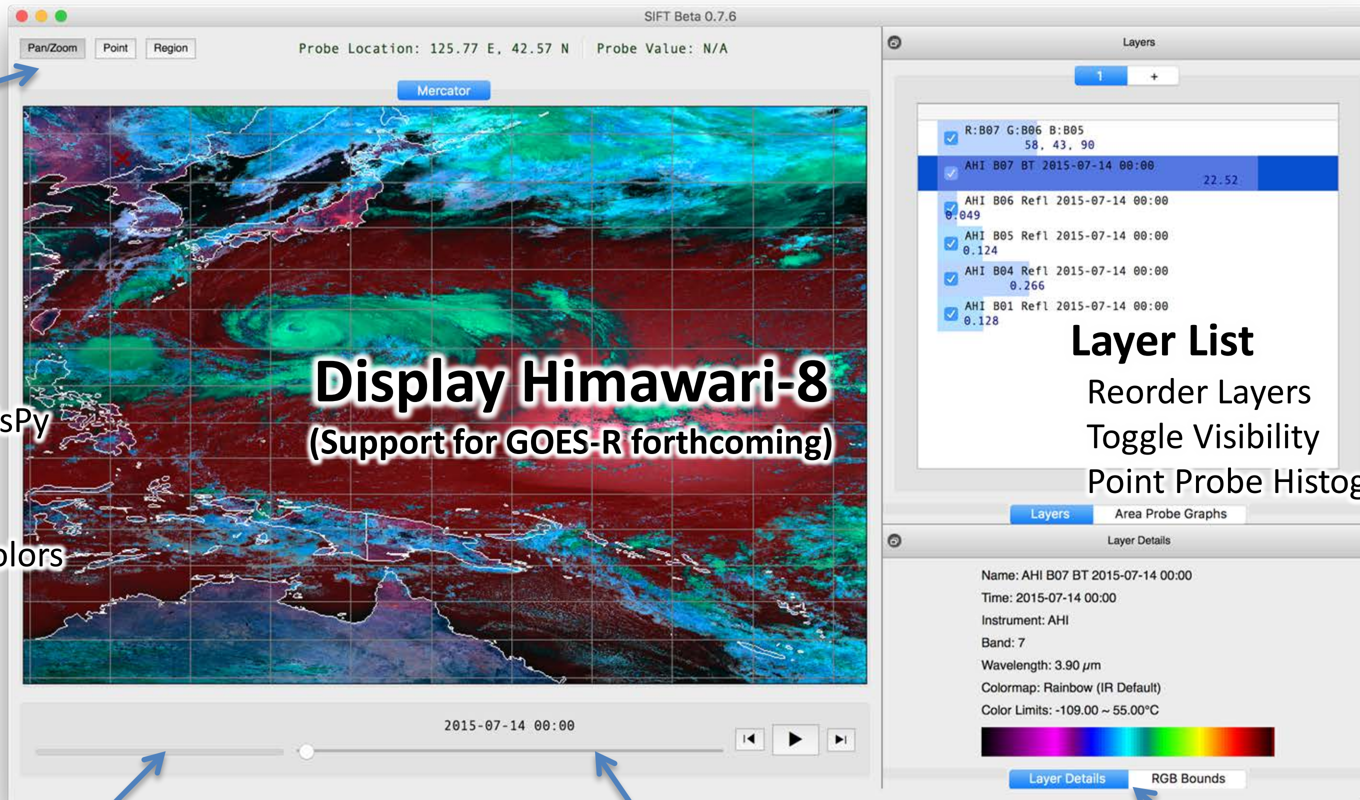
- Merged ASOS Surface and Polar Orbiting IR Satellite Profile Data
  - NOAA MADIS near real-time data is used to create a gridded hourly surface T/Tdew analysis
  - SSEC Direct Broadcast provides satellite soundings within minutes of the satellite overpass.
- Near Real-Time Stability Estimates
  - A python code implementing NWS SHARP software is used to calculate atmospheric stability parameters (SHARPpy).
  - The SSEC RealEarth is used to distribute image products of derived products.
  - Next step is the display of Surface CAPE using JPSS NUCAPS sounding profiles merged with hourly ASOS surface observations.

# Visualizing new-generation geostationary satellite imagery with the Satellite Information Familiarization Tool (SIFT)

**Jordan Gerth, R. Garcia, D. Hoese, S. Lindstrom, K. Strabala**, CIMSS, Madison, WI

*13NGOESS*




**Tools**
- Pan/Zoom
- Point Probe
- Area Selector

**Map Display**
- Powered by OpenGL/VisPy
- Panning and Zooming
- Dynamic Resolution
- Configurable Outline Colors

**Display Himawari-8**
**(Support for GOES-R forthcoming)**

**Layer List**
- Reorder Layers
- Toggle Visibility
- Point Probe Histogram

DOWNLOAD

**Background Task Status**

**Animation Control**
- Step-through or Autoplay
- Adjustable Speed Control

**Layer Metadata**
- Band Information
- Color Bar and Limits

# Evolving R2O in the Era of "Big Data" Meteorology

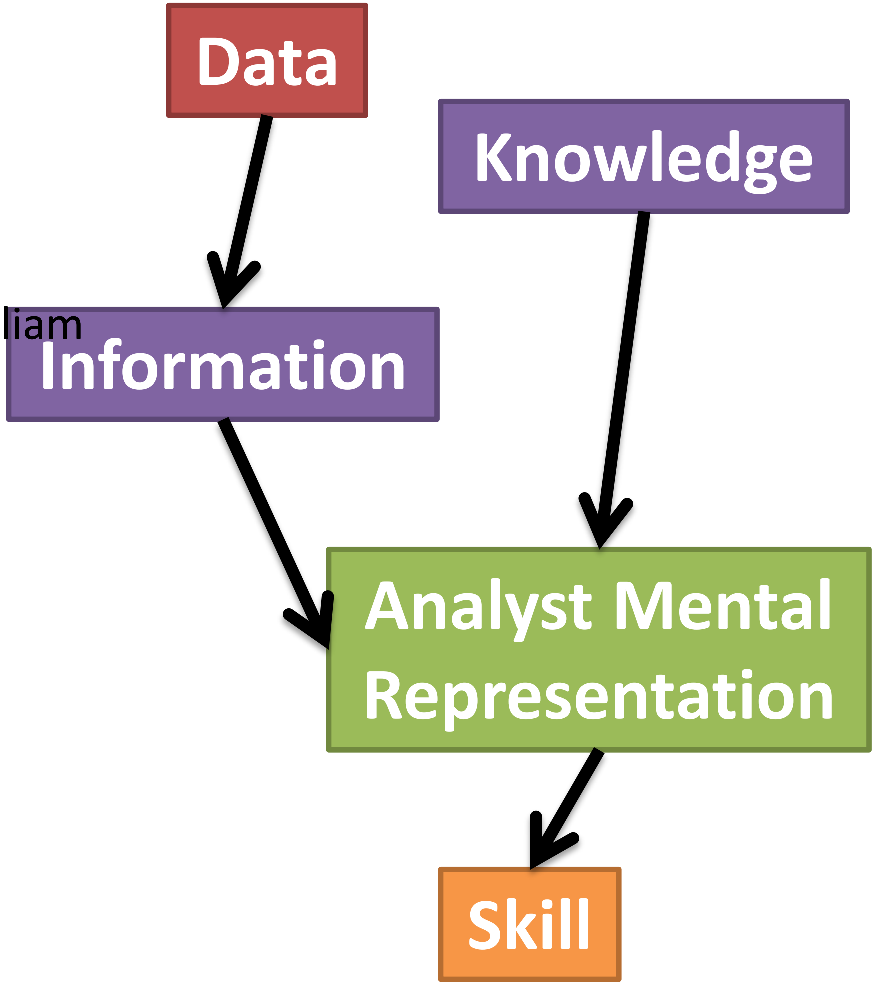
**Jordan Gerth**, Cooperative Institute for Meteorological Satellite Studies, Madison, WI

*Seventh Conference on Transition of Research to Operations (7R2O)*

- Big Data = More Data
- More Data = More Science
- Goal: Convert Data to Skill
- Ideal research to operations sequence to maximize value:

Straka, William

1. Start with a gap in the analyst mental representation.
2. Work backwards to connect the data to the gap.
3. Create integrated information from the data.
4. Determine which improvements can lead to the most sizable skill impacts through an iterative process.



# CIRA

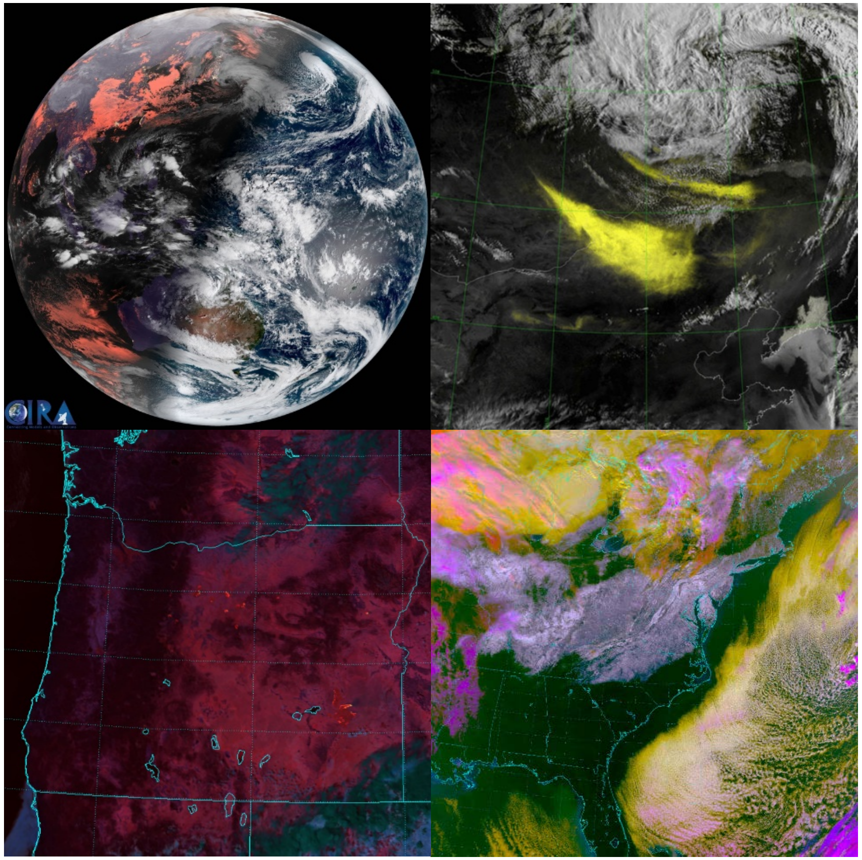
- Seaman, Curtis (2)
- Schumacher, Andrea
- Chirokova, Galina
- Szoke, Ed
- Connell, Bernadette (2)
- Torres, Joel (2)
- Zhu, Tong

# JPSS and GOES-R Multispectral Imagery Applications and Product Development at CIRA

Curtis J. Seaman[1], Steven D. Miller[1], Daniel T. Lindsey[2] and Donald W. Hillger[2]
[1]CIRA/Colorado State University; [2]NOAA/NESDIS/Satellite Applications and Research

## 13th Annual Symposium on New Generation Operational Environmental Satellite Systems

- CIRA continues to develop RGBs and multi-spectral imagery products for GOES-R and JPSS
  - AC True Color (VIIRS) and HAC True Color (Himawari)
  - Synthetic HAC True Color (GOES-R)
  - Geocolor (upper left)
  - DEBRA for Dust (upper right)
  - Snow/Cloud Discriminator (lower right)
  - Fire Temperature RGB (lower left)
  - Day/Night Band Power Outage RGB
  - All of your EUMETSAT favorites
  - And many more!
- Useful for hazard detection, environmental monitoring, nowcasting
- See Poster #259 (Monday afternoon session)

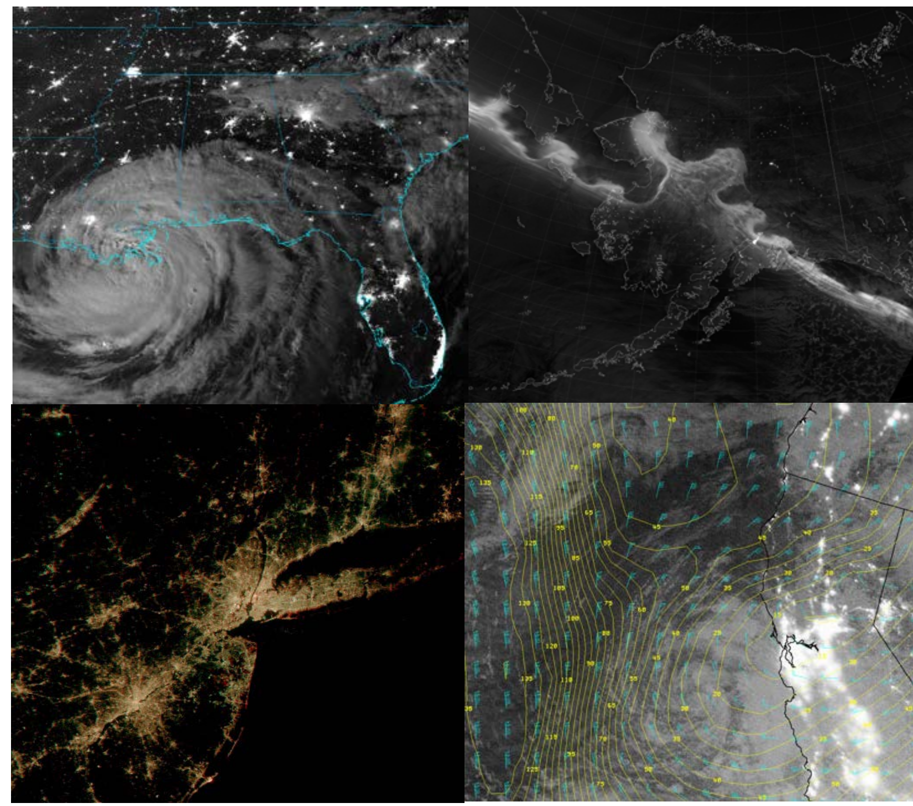


# Night Vision:
# Illuminating the Capabilities of the VIIRS Day/Night Band

Curtis J. Seaman[1], William Straka III[2], Steven D. Miller[1], Daniel T. Lindsey[3], Jorel Torres[1]
[1]CIRA/Colorado State U.; [2]CIMSS/U. Wisconsin-Madison; [3]NOAA/NESDIS/STAR

NOAA Booth Invited Talk, Exhibitor's Hall

- The VIIRS Day/Night Band is revolutionizing nighttime remote sensing and is a perfect compliment to infrared observations
- List of Day/Night Band applications discussed:
  - Low cloud/fog detection
  - Ice and snow detection
  - Fires & smoke
  - Volcanic ash and volcanic eruptions
  - Nocturnal smog
  - Tropical cyclone center fixing/track forecasting
  - City lights/Power outages/Economic activity
  - Ship lights/boat detection and tracking
  - Airglow/Nightglow
  - Auroras
  - Mesospheric gravity waves/upper atmosphere dynamics

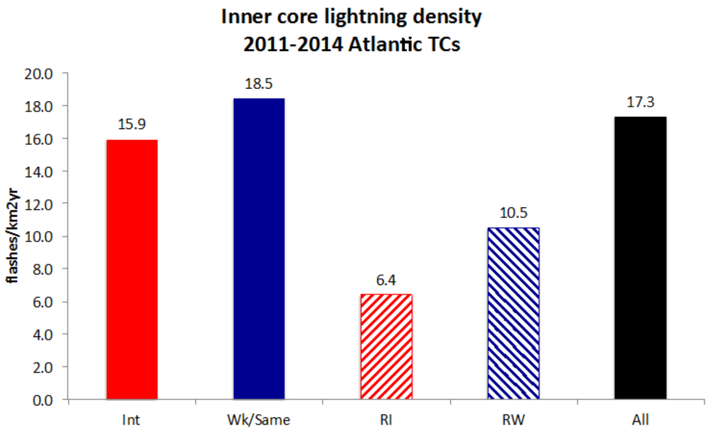


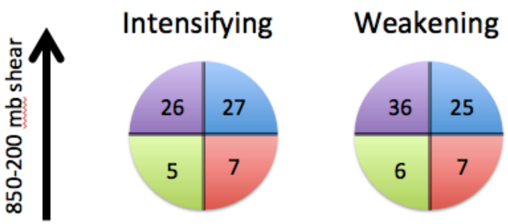
# Improving real-time rapid intensity forecasts with total lightning data

Andrea Schumacher, CIRA/CSU

13th Annual Symposium on New Generation Operational Environmental Satellite Systems

- Network detection efficiency-based bias correction applied to Earth Networks Total Lightning flash data
  - Adequately accounts for both spatial and temporal variations in detection efficiency over the Atlantic basin
- Statistical analyses of tropical cyclone lightning using ENTLN as GLM proxy data yields results similar to prior studies
  - Weakening TCs have larger azimuthal average inner core lightning density
  - Largest increase in inner core lightning in weakening TCs seen in downshear left quadrant
  - New downshear-left quadrant inner core lightning predictor will be tested in TC Rapid Intensification Index in 2017




*ENTLN inner core total lightning in intensifying and weakening Atlantic TCs, 2011-2014. Azimuthal averages are shown at top and shear-relative quadrants at bottom. Units flahses/(km2yr)*

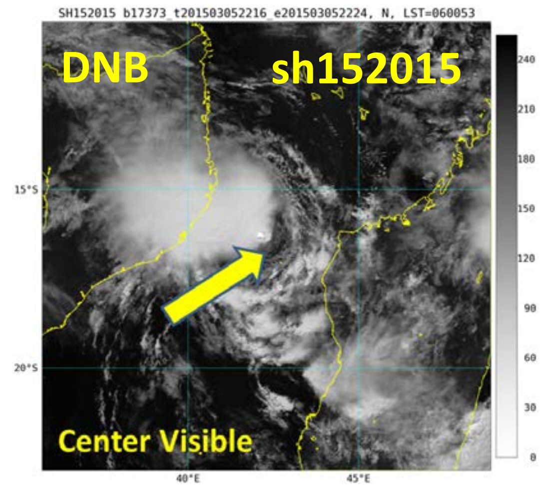
# Use of JPSS ATMS, CrIS, and VIIRS data to Improve Tropical Cyclone Track and Intensity Forecasting

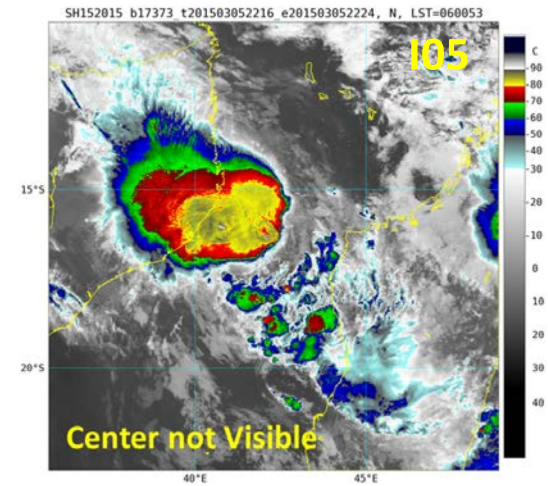
Galina Chirokova, Mark DeMaria, Robert DeMaria, John Knaff , Jack Dostalek, and John L. Beven

**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

## VIIRS TC-Centered DNB Imagery:

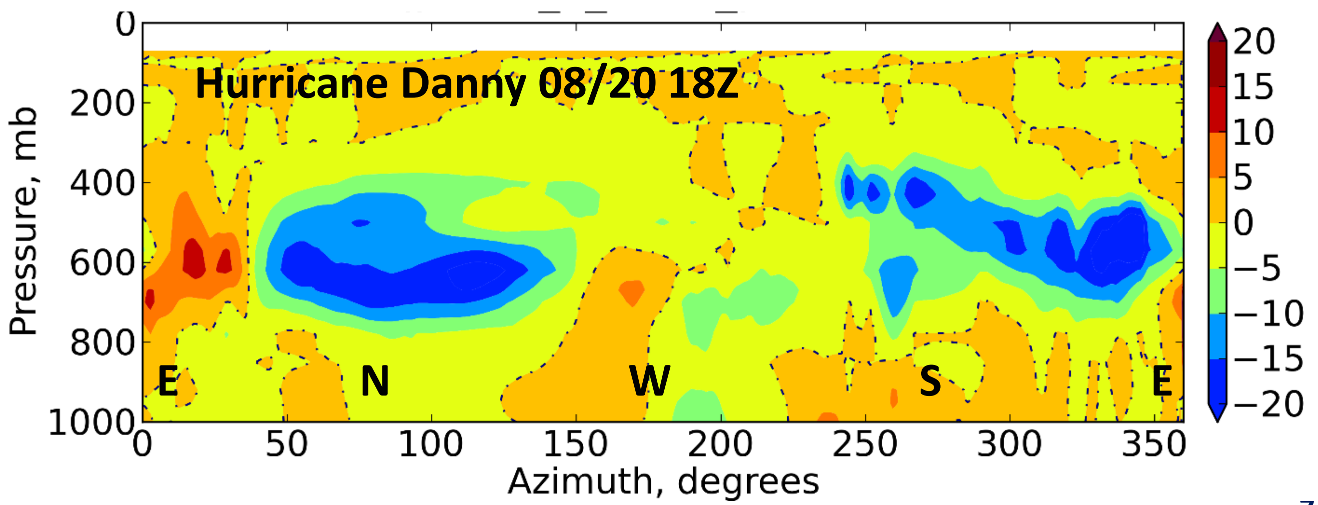
- Useful for center-fixing and eye-detection
- CIRA's high-latency VIIRS DNB imagery is used on NHC's NAWIPS




## Moisture Flux:

- Estimated using ATMS-MIRS
- Negative values at mid-levels indicate dry air entering the storm environment

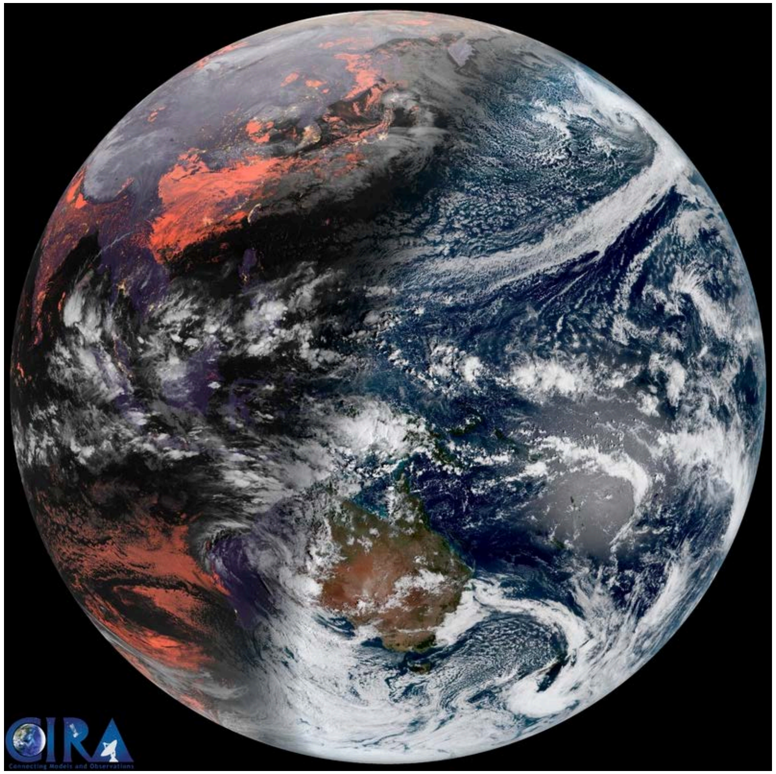


# CIRA's Contribution to the NWS GOES-R Proving Ground: A Look Back at Pre-Launch Activities and a Look Ahead to Post-Launch Interactions

**Ed Szoke, D. Bikos, B. H. Connell, H. Gosden, S. D. Miller, J. Torres, R. Brummer, D. T. Lindsey, D. W. Hillger, D. A. Molenar, and C. J. Seaman**

**13th Annual Symposium on Future Operational Satellite Systems**

- CIRA has been active in the PG
  - Began in 2008 with 2 WFOs
  - Has expanded to over 30 WFOs
  - And all National Centers
  - Many forecasters have seen GOES-R like products and imagery
- Future CIRA participation in the PG
  - In the near term helping to make sure GOES-16 imagery and products are getting into operations properly
  - Future testing should be more appealing to forecasters since we will use the actual GOES-16 data




Example of a CIRA product from Himawari-8 that will be tested in the PG using GOES-16: GeoColor image from 18 January 2017 at 2000 UTC.

# 4.6 Satellite User Readiness through Training: VISIT, SHyMet, WMO VLab, and Liaisons

Bernie Connell[1], D. Bikos[1], S. Lindstrom[2], J. Torres[1], E. J. Szoke[1], E. L. Dagg[1], A. B. Schumacher[1], A. S. Bachmeier[2], A. Mostek[3], B. Motta[3], M. Davison[4], and L. Veeck[1,5]

13th Annual Symposium on New Generation Operational Environmental Satellite Systems

- Users:
  - National and International National Weather Service
  - Academia, weather enthusiasts, managers, media, general public
- Varied training approaches for varied users:
  - In-person: group and one-on-one, virtual presentations and discussions, online modules, blogs, helpdesk

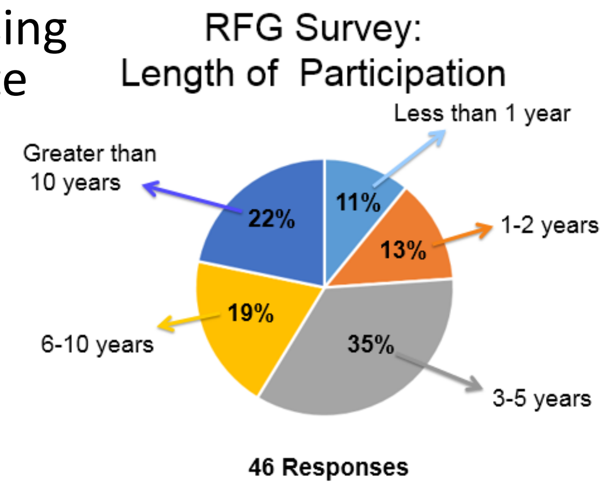
NOAA STAR CENTER FOR SATELLITE APPLICATIONS AND RESEARCH | cics-md | CIRA | CUNY NOAA - Cooperative Remote Sensing Science and Technology Center | CIMSS

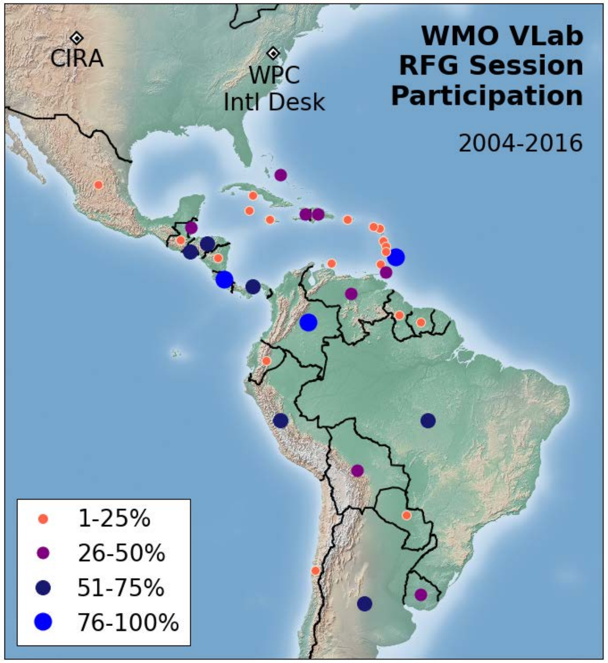
# 257 The Impact of Regional Focus Group (RFG) Activities on the Use of Current Satellite Data and Images by Meteorological Personnel with Implications for New Satellite Use

Bernie Connell[1], L. Veeck[1,2], M. Davison[3], K.-A. Caesar[4], and V. Castro[5]

13th Annual Symposium on New Generation Operational Environmental Satellite Systems

- Active forum to discuss Imagery, Products, and Forecasts related to Weather and Climate using existing and new satellite information.
- Results: Survey of participants
  - Length of participation
  - Recent Participation
  - Benefits of RFG
  - Future needs



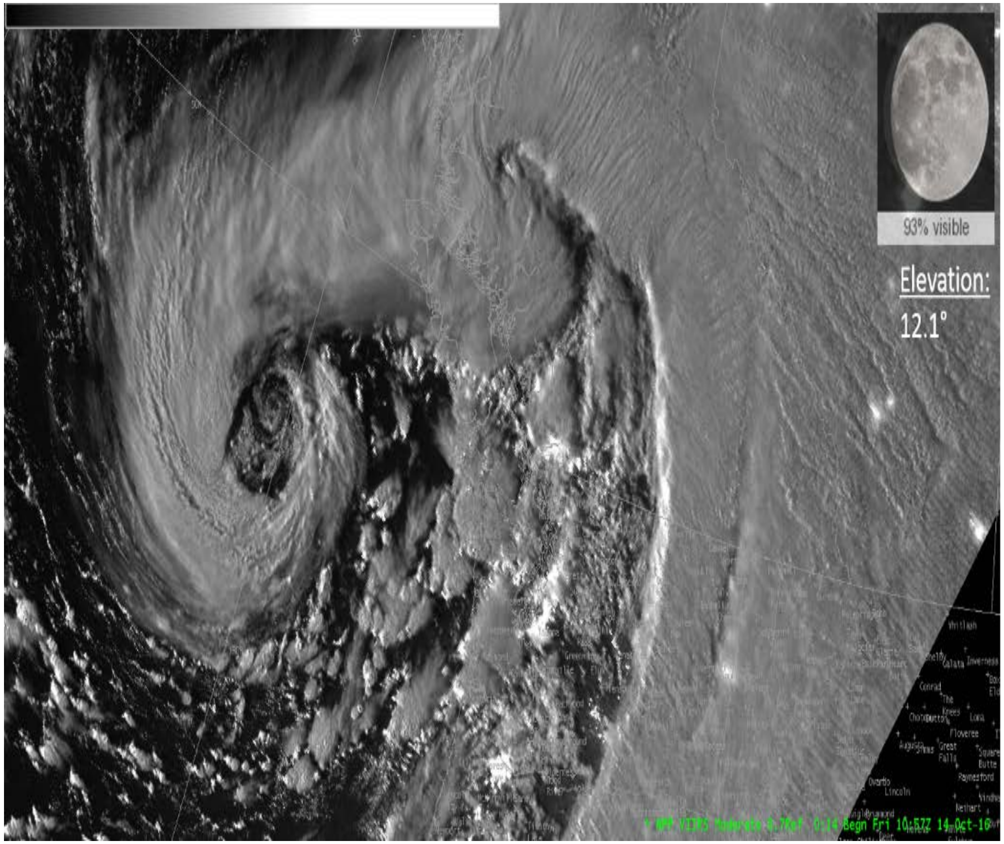



# Utility of JPSS Products for NWS Forecasters

**Jorel Torres, Bernie Connell and Steven Miller**

**13th Annual Symposium on New Generation Operational Environmental Satellite Systems**

- Joint Polar Satellite System (JPSS)
  - Polar-orbiting satellites
    - Metop-A, Metop-B
    - Suomi-NPP
    - JPSS 1-4
- Polar Products in AWIPS-II
  - NCC
  - NUCAPS
  - Experimental Polar Products
- JPSS Training for NWS forecasters
  - *SATellite Foundational Course – JPSS (SatFC-J)*
  - *Supplemental JPSS Training Resources and web-links will be provided in presentation.*



# NOAA CLASS Demonstration

**Jorel Torres**

**AMS Short Course: Experiencing JPSS Capabilities**

- A demonstration on how a user can access the NOAA CLASS system and obtain polar-orbiting data
  - A step-by-step process of showing the user how to register on-line via the NOAA CLASS system, then search, request and receive polar-orbiting data
- Additional data acquisition sites
  - *Data Access via ICVS at STAR*
  - *PDA*
  - *GRAVITE*
  - *SIPS Archive*
  - *AWIPS-II*

# CRTM Development and Support for CubeSat OSSE and JPSS-1 Studies

**Tong Zhu, Quanhua Liu, Paul van Delst, Yong Chen, Yingtao Ma, Ming Chen, Emily Liu, Andrew Collard, David Groff, Sid A. Boukabara, Tom Auligne, Xiwu Zhan, Fuzhong Weng and John Derber**

- Generation CRTM coefficients
  - CubeSat MicroMAS2 and CIRAS
  - INSAT3DR IMGR and SNDR
  - JPSS1 ATMS and VIIRS
- CRTM-OSS alpha release
  - Created CRTM-OSS alpha release
  - TL/AD/FFD Jacobian consistency tests
  - Unapodized radiance simulation
- Preparing CRTM Rel-2.3.0
  - Merged some changes into CRTM trunk
  - Finished some new implementations

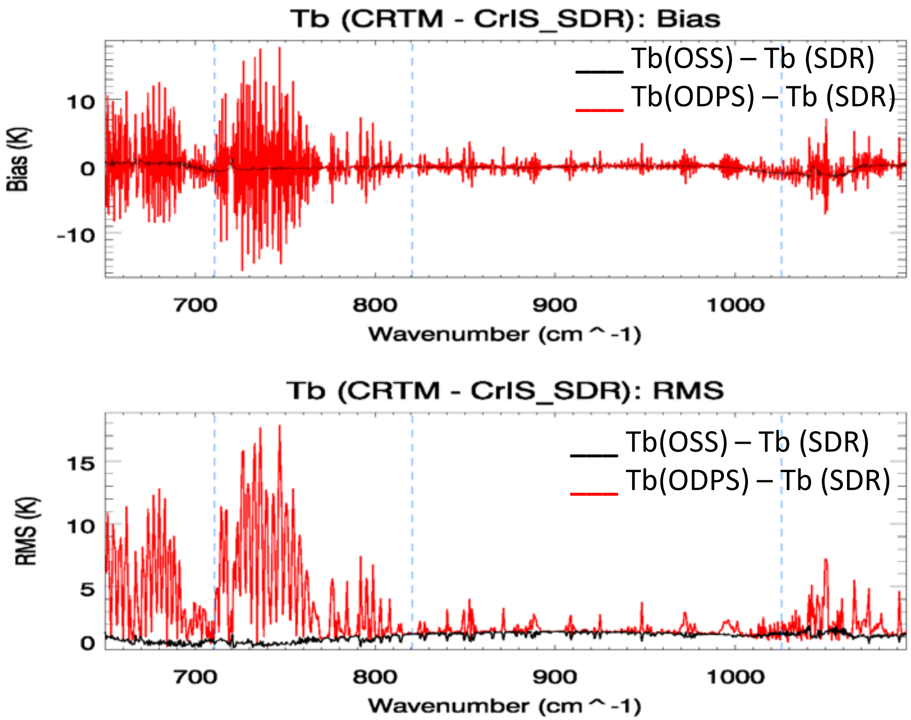



**Figure above:** Difference of CRTM-OSS (black curve) and CRTM-ODPS (red curve) simulated brightness temperatures against CrIS SDR Band1 observations under clear sky condition and with 2 absorber gases (WV, O3) over ocean for 10770 profiles.

# CREST

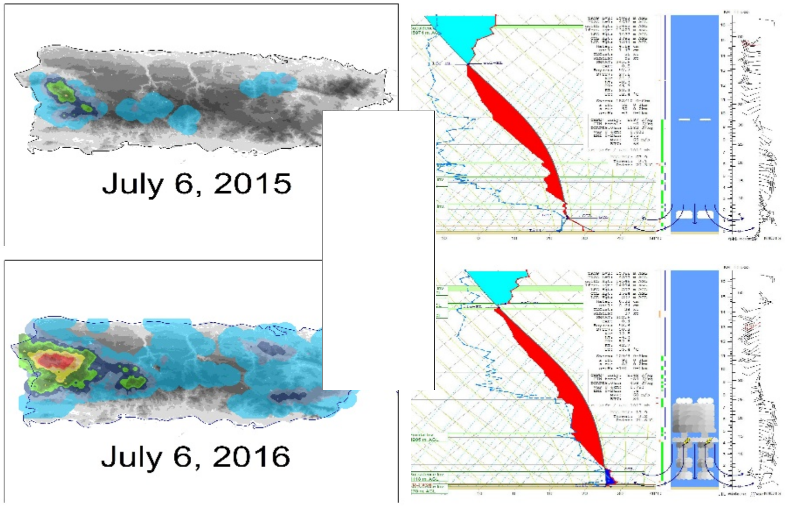
- Lunger, Chris
- Ramamurthy, Prathap
- Vant-Hull, Brian
- Wu, Yonghua
- Arapi, Anjeza
- Buckner, Steven
- Hosannah, Nathan (2)
- Glenn, Equisha
- Melecio-Vázquez, David (2)
- Ortiz, Luis
- Angeles, Moises
- Arend, Mark
- St. Pé, Alexandra
- Tucker, Benjamin
- Carroll, Brian
- Sasser, Christian
- Delgado, Ruben

# Investigation of Changes in Convective Storms Development in Puerto Rico During the Caribbean Mid-Summer Drought from 2015 to 2016

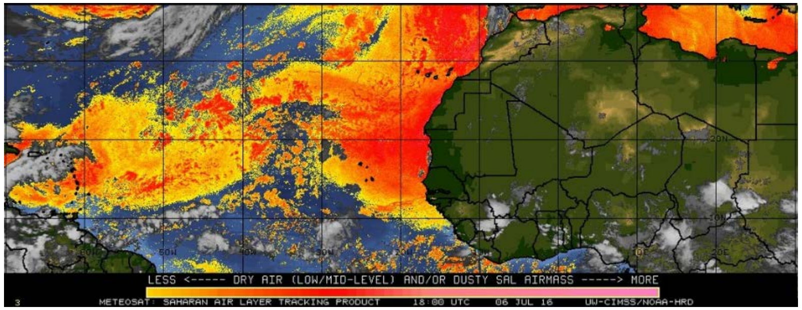
**Chris Lunger, Dr. Jorge Gonzalez, Dr. Nathan Hosannah**

**AMS Student Conference (Chris won the outstanding student poster award!)**

- **Changes in Synoptic Scale Processes ('15-'16)**
  - Dry, hot Saharan Air Layer transports vast amounts of dust to Caribbean annually during MSD suppressing precipitation.
  - 0.6 m/s less Vertical Wind Shear
  - 0.4–0.6 °C higher Sea Surface Temperatures
  - 2-3 kg/m$^2$ more precipitable water
- **Local Conditions Produced Significant Enhancement of Moisture Advection in 2016**
  - 11% to 63% higher Convective Available Potential Energy (CAPE) in 2016.
  - Deep convective cloud formation
  - Greater coastal convergence between moist, westerly sea breezes and prevailing easterly trade winds.
- **Result: Higher Number of Precipitation Events and Totals**
  - 12.7mm to 76.2mm higher diurnal rainfall along western coast of PR in 2016




**AHPS Precipitation Totals and Radiosonde Launches**

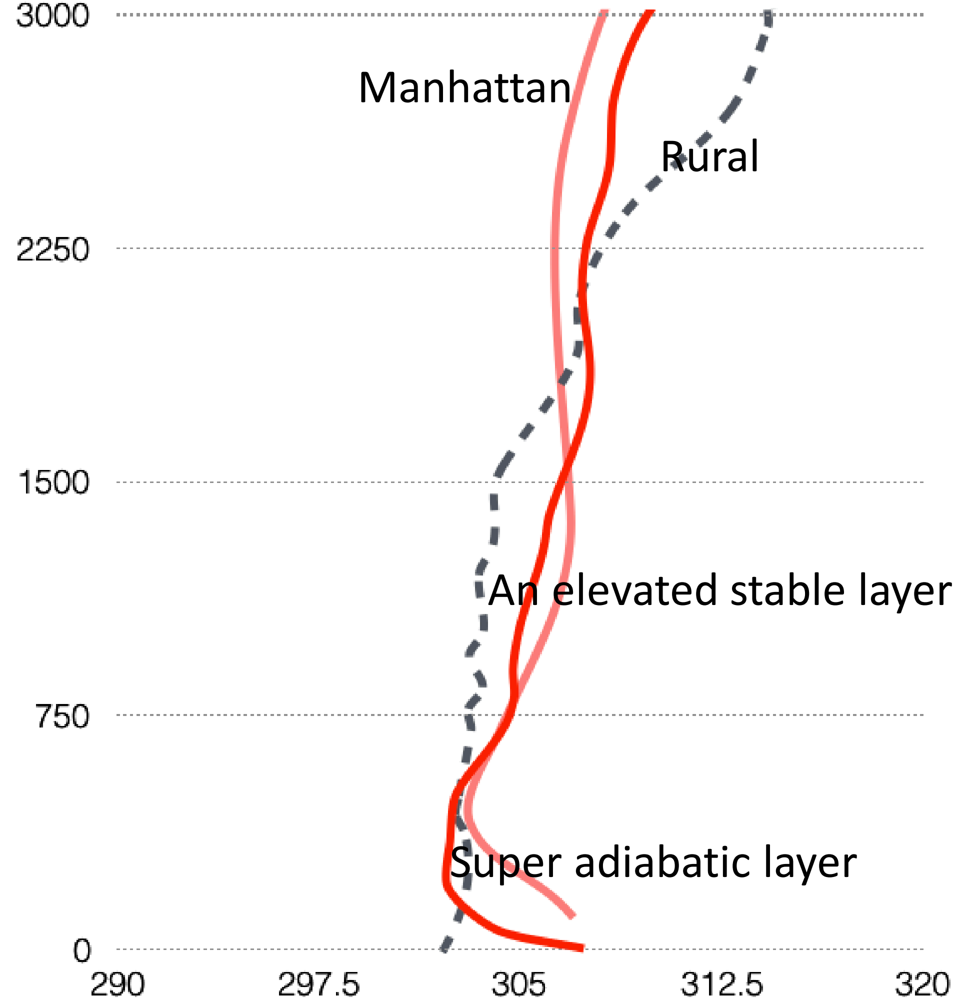



**METEOSAT image of Saharan Air Layer**

# Observing the ***boundary-layer*** *dynamics over NYC*

P Ramamurthy, J Gonzalez, M Arend, F Moshary

- **Multiple factors such as excess anthropogenic heat, high storage flux and increased Bowen ratio work in tandem to amplify the thermal state of urban environment during heatwave**
- **The urban boundary layer (UBL) – marine boundary layer interaction depletes convective efficiency and the excess heat is retained in UBL longer which disproportionately increases near surface air temperature**
- **The inter-connectedness of these factors and the inherent feedback mechanism inhibits adequate representation in models**




- *Article in Review, Environmental Research Letters,*
- *Heatwaves and urban heat islands: A comparative analysis of multiple cities(JGR-A,* **DOI:** 10.1002/2016JD025357*)*

# Indoor Heat Waves

Brian Vant-Hull, Prathap Ramamurthy: CREST/CCNY
Media Partners: WNYC, AdaptNY, ISeeChange  Community: WeAct NY

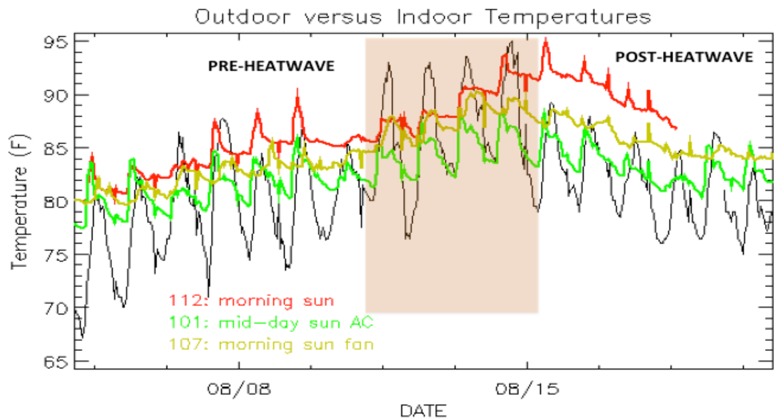
AMS conference on Urban Meteorology, Extreme Heat and Health

## Media Initiated Measurements

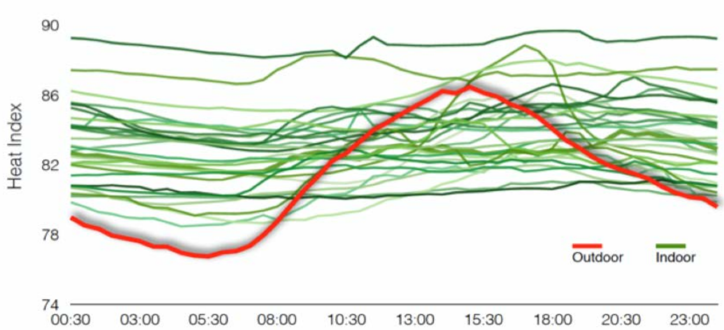
- Gets us Inside Residences
- First Residential Heat Wave measurements in NYC
- Human impacts documented by media

## Statistical Modeling

- Allows forecast of Indoor heat waves, not just outdoor!
- More meaningful warning system




Indoor Heatwaves persist past Outdoors



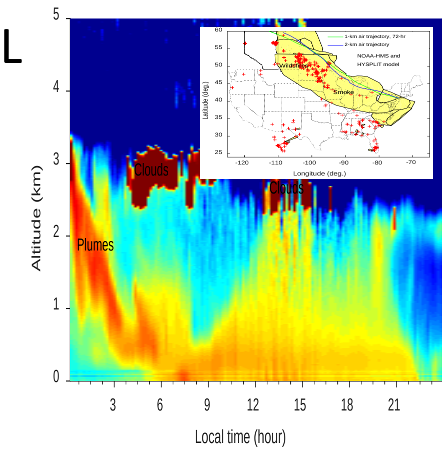

Diurnal avg Heat Index usually above outdoor

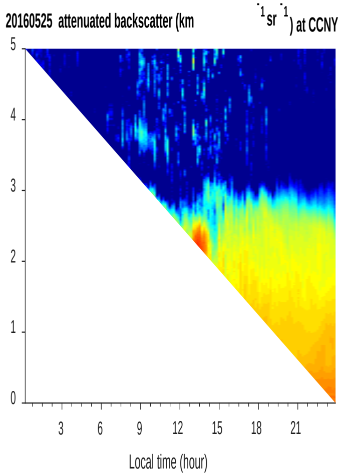
# Wildfire smoke transport and impact on air quality observed with a Multi-Wavelength Elastic-Raman lidar and ceilometer in NYC

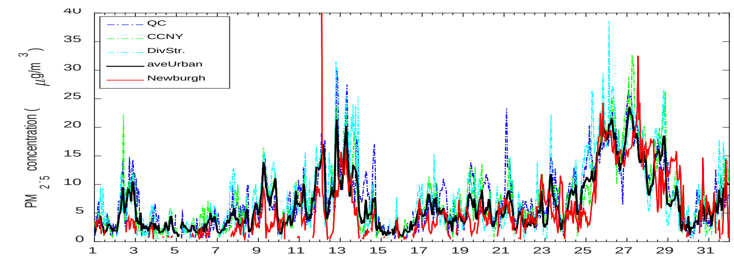
**Yonghua Wu**, W. Peña, A. Arapi, A. Diaz, Jianping Huang, Barry Gross, Fred Moshary

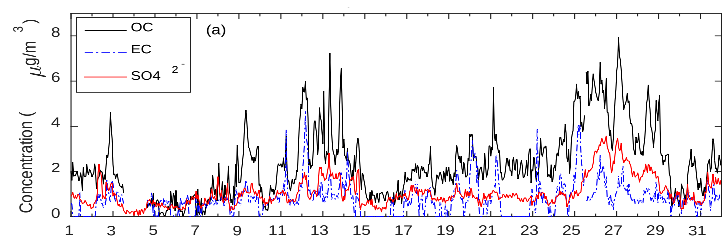
Eighth Symposium on Lidar Atmospheric Applications, 97th AMS Annual Meeting

- Aloft smoke plumes and mixing down into PBL
  - Aloft aerosol plumes intrusions on May 9 and 25 and mixing down into the PBL.
  - PBL-top diurnal variation with the high top at 3-km in the daytime on May 25.
- Ground $PM_{2.5}$ increase in the urban and non-urban areas of NYC
  - Two increase processes of $PM_{2.5}$ on May 9-15 and 25-29, associated with the smoke plume intrusions.
  - Consistent increase in the urban and upwind non-urban areas of NYC, indicating the similar sources (regional transport).
  - Coincident increase of OC, EC and Sulfate.



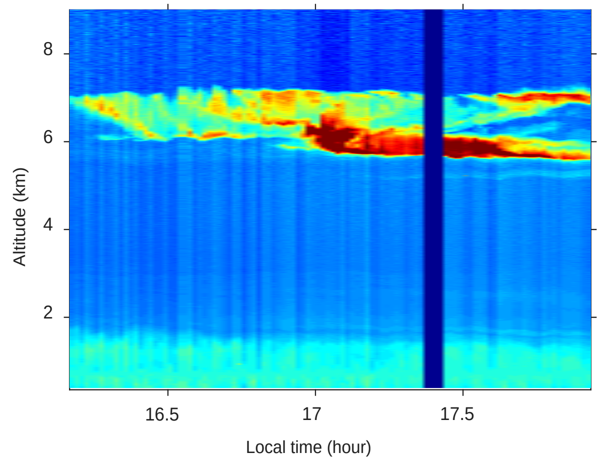



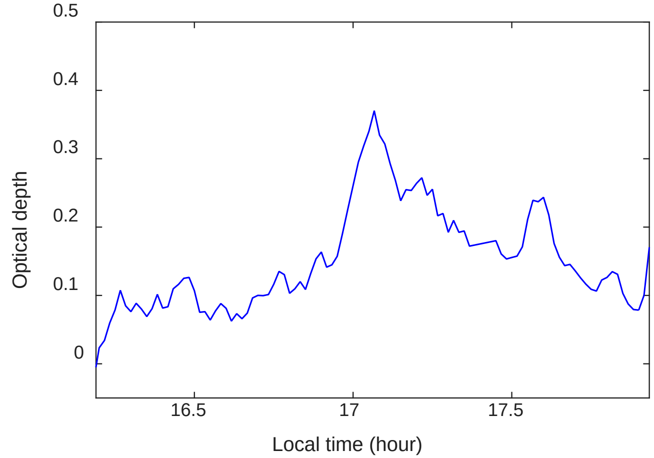
# Measurements of aloft cloud and aerosol layers using a Multi-Wavelength Elastic Raman Lidar

Anjeza Arapi, Yonghua Wu, Fred Moshary

97th AMS Annual Meeting – Seattle, WA

- Data sets of lidar backscatter profile and to provide illustrations of the vertical structure of the cloud layer.
  - The color-ratios can be used for cloud-aerosol discrimination.
  - Aerosol-cloud layer base and top are reasonably estimated.
- The effective optical thickness of high-level thin cloud have been derived.
  - Temporal variation of 0.1~0.4 at 532-nm.



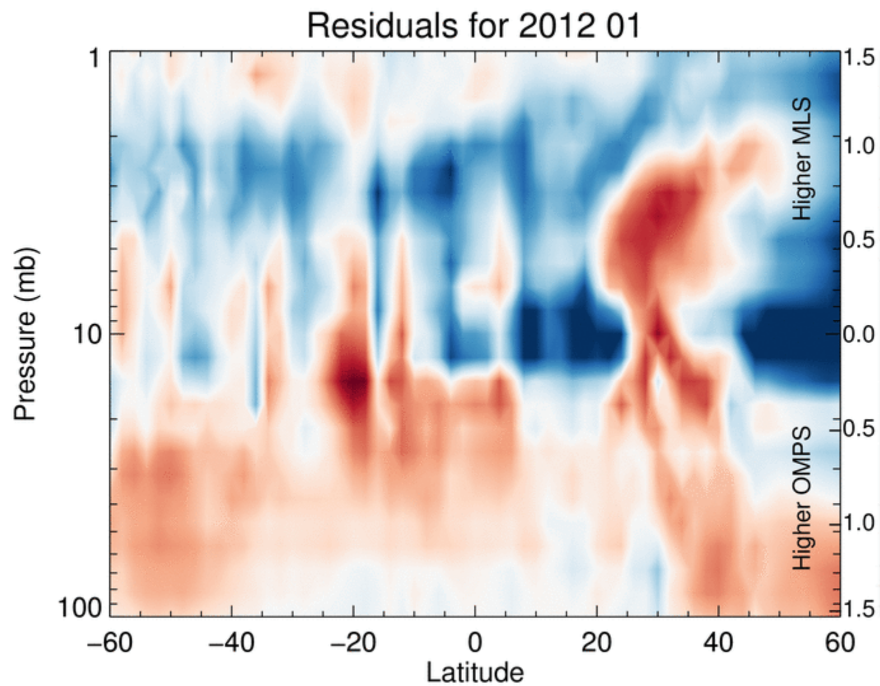



# Monthly Comparisons of Suomi NPP OMPS Limb Profiler Ozone Measurements

**S. Buckner, L. Flynn, M.P. McCormick, J. Anderson**

13th Symposium on New Generation Operational Environmental Satellite Systems

- Monthly Zonal Mean has higher lifetime correlation than Daily Zonal Mean
  - 98.369% average monthly correlation
  - 97.926% average daily correlation
- Characterizing Anomalies
  - Altitude registration issue in the tropics around 10mb
  - High OMPS bias in mid-latitudes during NH winter months



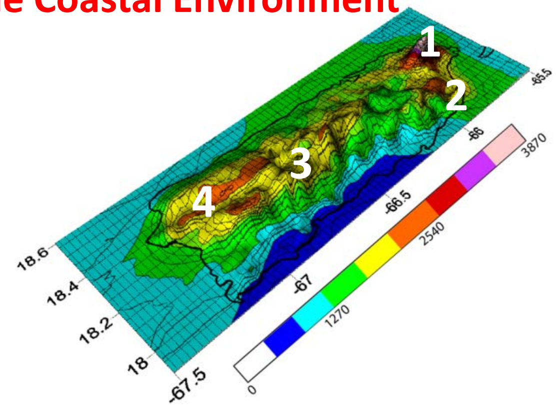
# Impacts of Local Convective Processes on Total Water Budgets in the Coastal Tropics via the Analysis of Multi-Sensor Observational Data from the Convection, Aerosol, and Synoptic-Effects in the Tropics (CAST) Experiment

N. Hosannah, J. E. Gonzalez, and C. Lunger

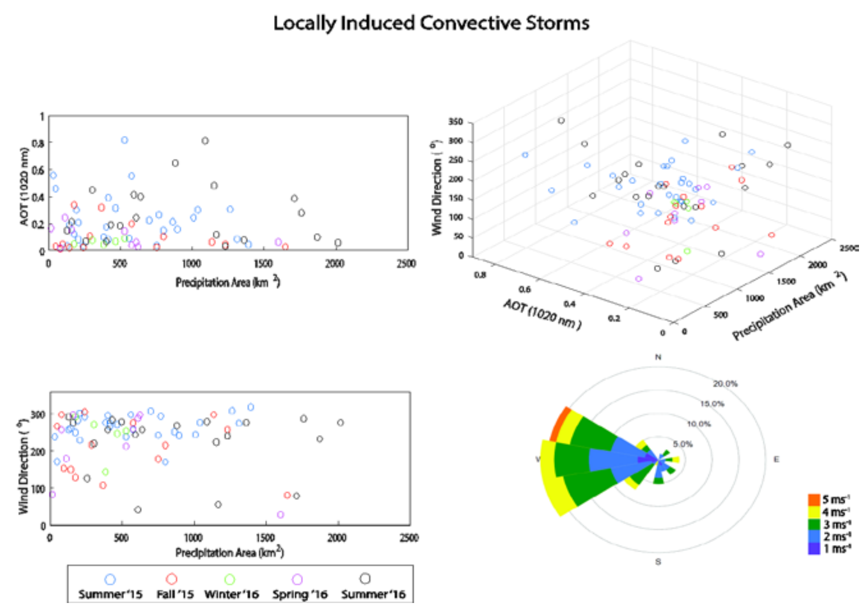
**15th Symposium on the Coastal Environment**

- Locally enhanced (LE) convective storms accounted for 30.1% of all precipitation events.
  - Storms during the summer months (June-August), locally enhanced storms accounted for 34.6% of all rain events.

- Most of these LE storms occurred under southwesterly to northwesterly afternoon sea-breeze conditions. Stronger sea breeze in the summer.
  - Stronger sea breeze in the summer.
  - Storm area decreases with increasing Saharan dust (aerosol optical thickness (AOT)) although storm size often exceeded 1000 km$^2$ under high AOT (> 0.5) conditions with strong westerly sea-breeze.




**30-year precipitation climatology (PRISM, 1981-2010) over Puerto Rico, shows highest precipitation totals (mm) over:**
1. **El Yunque**
2. **At Caguas (windward side)**
3. **In the Northwest**
4. **Over the Cordillera Central mountain range**

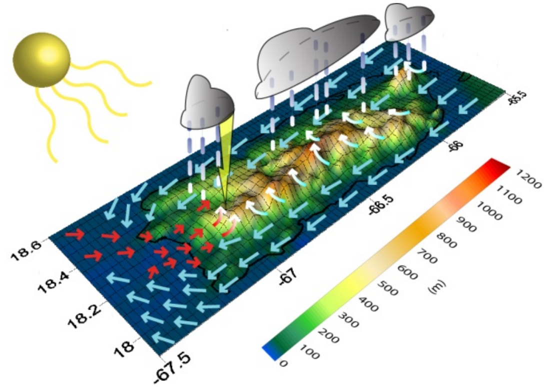


# On Understanding Multi-Scale Precipitation Processes in Tropical Islands Via the Convection, Aerosol, and Synoptic-Effects in the Tropics (CAST) Campaign

N. Hosannah, J. E. Gonzalez, R. Rodriguez, H. Parsiani, F. Moshary, L. Aponte, R. A. Armstrong, E. W. Harmsen, P. Ramamurthy, M. Angeles, L. León, R. D. Bornstein, N. D. Ramirez, D. Niyogi, R. Davis, and W. Peña

**Special Symposium on Meteorological Observations and Instrumentation**

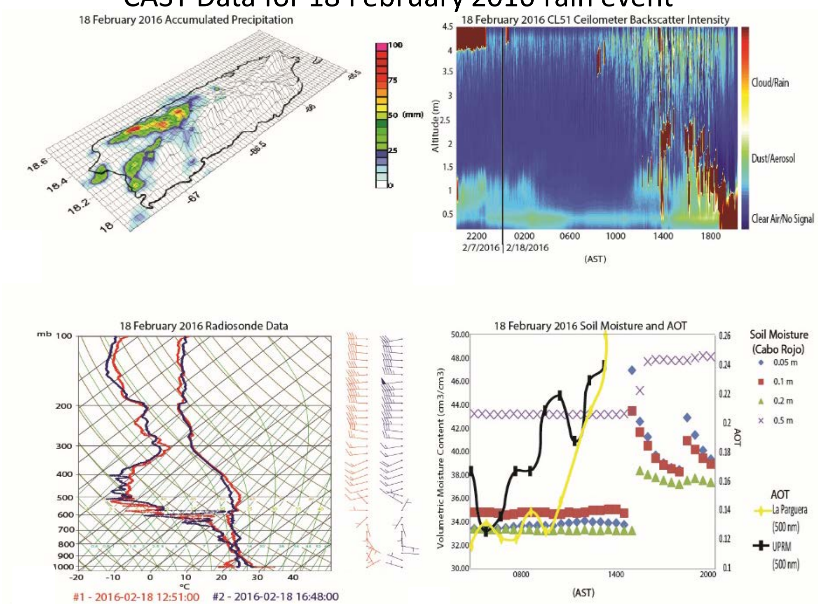
- CAST phases were scheduled to monitor atmospheric conditions in western Puerto Rico during the midsummer drought (Phase I: 22 June–10 July 2015), the dry season (Phase II: 6–22 February 2016), and the early rainfall season (Phase III: 24 April–7 May 2016).
  - Supplemental instrumentation (west side) included up to twice-daily radiosonde launches, three high resolution radars, a ceilometer, a disdrometer, soil moisture sensors, and an aerosol sampler.



In addition to large-scale drivers, island-scale rainfall is also influenced by local convective processes modified by topography, land cover, and proximity to coastal waters.

- CAST observations provide pertinent information about atmospheric conditions in western Puerto Rico during three of the island's distinct seasons, providing a starting point for the analysis of convective storms in the tropics.

CAST Data for 18 February 2016 rain event



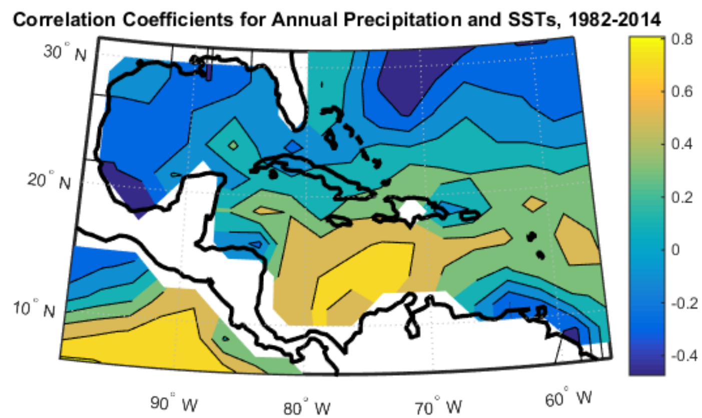

| Phase | Days rain > 40 mm | Days w/ sea breeze | Days w/ Orographic effects | Days w/ AOT > 0.2 |
|---|---|---|---|---|
| I (6/22/15 – 7/10/15) | 5/19 | 9/19 | 4/19 | 12/19 |
| II (2/6/16 – 2/22/16) | 12/17 | 8/17 | 6/17 | 0/17 |
| III (4/24/16 – 5/7/16) | 10/14 | 1/14 | 2/14 | 2/14 |

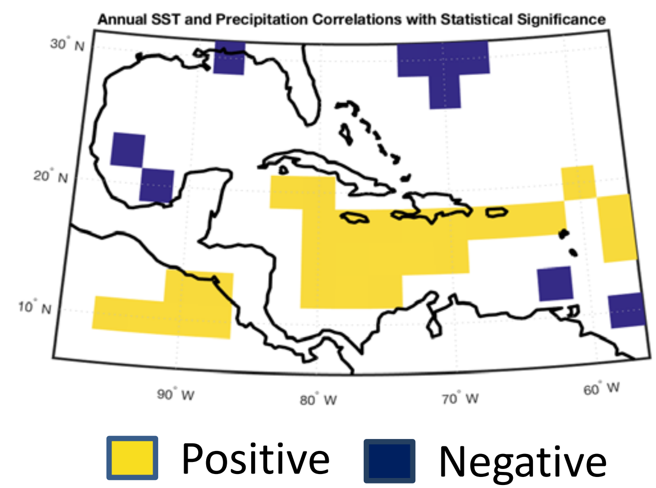
# Precipitation Variations Using Satellite Data During the Recent Sea Surface Temperature Warming Period in the Intra-Americas Region, 1982–2014

**Equisha Glenn, Jorge E. Gonzalez, Thomas Smith, Moises Angeles**

**29th Conference on Climate Variability and Change**

- Satellite data detects general precipitation trends for the Intra-Americas Region (IAR)
  - Precipitation shows decreasing trend for all seasons except the ***Late Rainfall Season***
  - Only the ***Dry Season*** had statistically significant trend
- SSTs show positive correlations with precipitation in the IAR
  - Positive correlations show statistical significance (vs. negative correlations)
  - Southern part of the region has the most positive correlations with statistical significance for all seasons



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# 13th Symposium of the Urban Environment

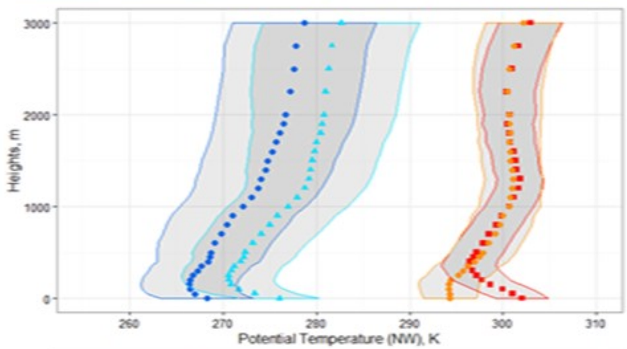
## Modeling and Observations of the Structure and Evolution of the Urban Boundary Layer of New York City

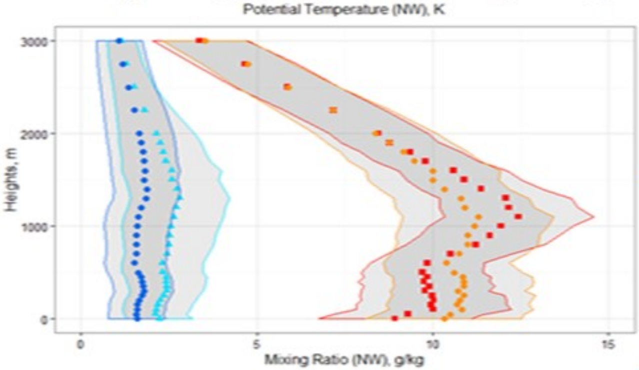

David Melecio-Vázquez*, Jorge E. González-Cruz*, Prathap Ramamurthy*, Mark Arend*


*Problem*: "…datasets of temperature profiles in particular are lacking," and "Nocturnal UBLs are still not fully characterized…." in **urban areas** (Barlow, 2014). These datasets would help in evaluating NWP models such as urban-WRF.

*Method:* Use a microwave radiometer to estimate average profiles over New York City and the compare the observations to WRF outputs. Compare observations and models and note where and how the differences are occurring.

### *MWR Seasonal Daytime/Nighttime Comparisons*

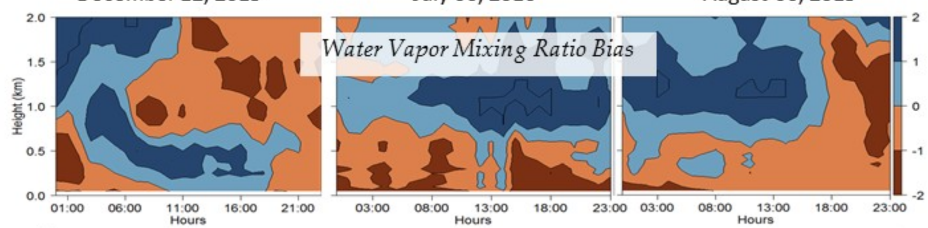



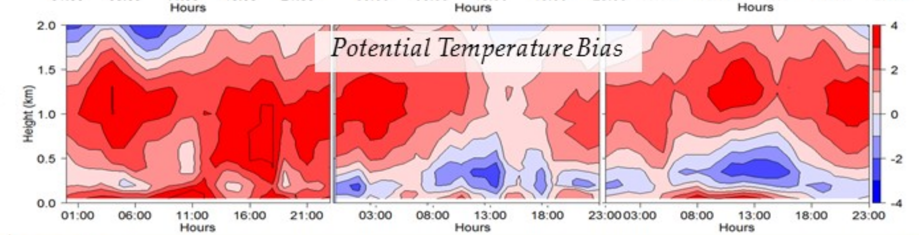

### *uWRF Configurations*


50 vertical levels with a finer resolution in the boundary layer.
Initialized with **North American Mesoscale (NAM) Model.**
Physics Options (number indicates option number):
**Microphysics**: WRF Single-Moment 6-class scheme (d03 only).
**LW Radiation**: Rapid Radiative Transfer Model (RRTM) scheme.
**SW Radiation:** Dudhia Scheme.
**Surface Layer:** Eta Similarity.
**Land Surface:** Noah LSM.
**Planetary Boundary Layer:** Mellor-Yamada-Janjic scheme.
**Urban Surface: Modified** BEP + BEM in d03 (d03 only).
**Cumulus Parameterization:** Kain-Fritsch scheme (d01 + d02).

**Modifications:**

1. PLUTO Tax Lot Building Info.
2. Variable Drag Scheme
3. Cooling Tower Parameterization




Summary:

1. Potential Temperature observations show evidence that internal boundary layers may influence the potential temperature structure over New York City as seen in the lack of a 'fully' mixed layer.
2. Water Vapor Mixing Ratio observations show two peaks in the humidity profile: one near 100m and one at ~ 1km.
3. Comparison with uWRF outputs show that the model induces more mixing in the boundary layer and a drier lower level for the summer cases (wetter in the winter case).

13th Annual Symposium on New Generation Operational Environmental Satellite Systems

# Thermal Boundary Layer Retrievals over the Washington D.C. Metro Area using Satellite-Based NUCAPS-EDRs

David Melecio-Vazquez*, J. E. Gonzalez-Cruz*, P. Ramamurthy*, M. Arend*, N. R. Nalli†‡, Q. Liu†

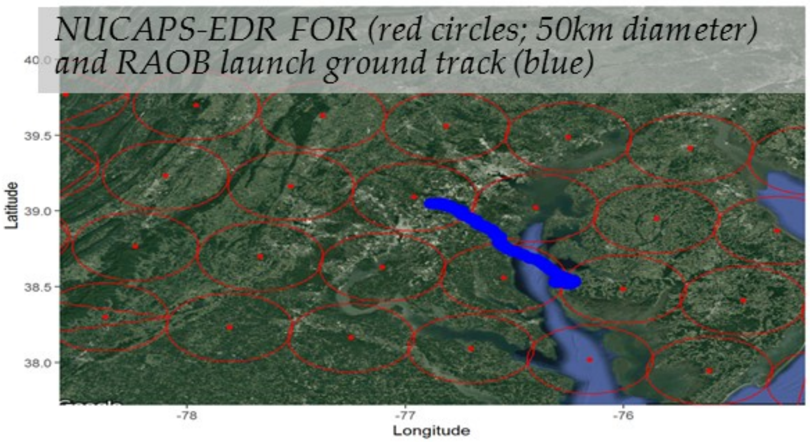
*The City College of New York, New York, NY, †National Oceanic and Atmospheric Administration, ‡IMSG Inc.

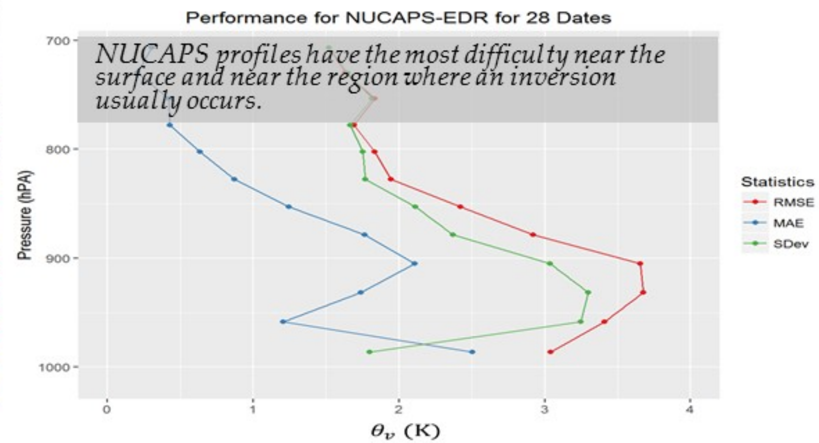
*Problem*: NUCAPS-EDR profiles need to be validated against radiosonde (RAOB) observations, with a focus on boundary layer observations.

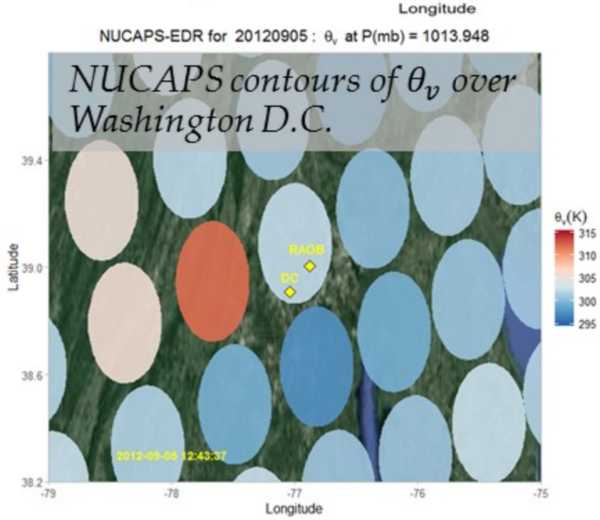
*Method:* Calculate the bias virtual potential temperature ($\delta\theta_v^{BIAS} = \theta_v^{NUCAPS} - \theta_v^{RAOB}$) in the levels between 700-1000mb.

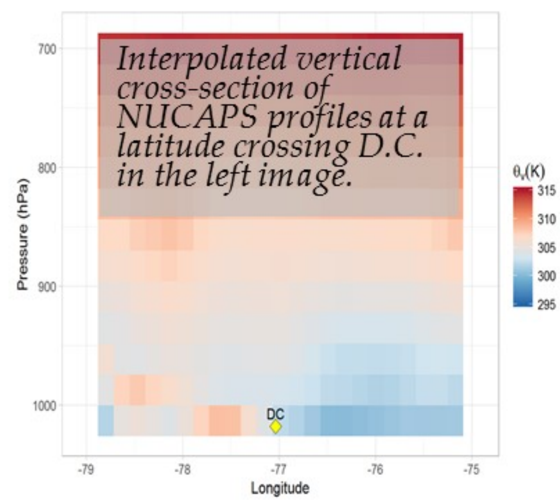
*Metrics Used:* **Virtual Potential Temperature**: $\theta_{v,i} = \theta_i\,(1 + 0.61 r_{v,i})$; **Potential Temperature**: $\theta_i = T_i\left(\frac{P_0}{P}\right)^{0.286}$; **Bias**: $\delta\theta_{v,i} = \theta_{v,i}^{NUCAPS} - \theta_{v,i}^{RAOB}$; **Mean Absolute Error**: $MAE = \frac{1}{n}\sum_{i=1}^{n}|\delta\theta_{v,i}|$;

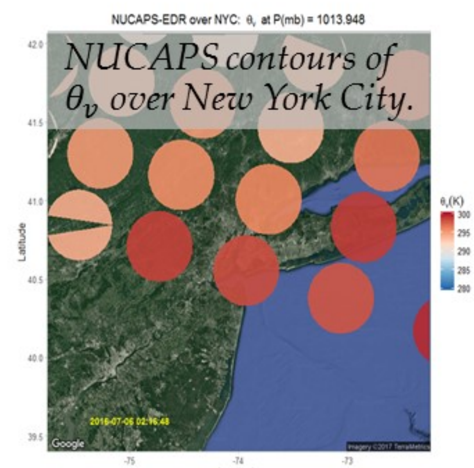
**Root Mean Squared Error**: $RMSE = \sqrt{\sum_{i=1}^{n}\delta\theta_{v,i}^{2}}$



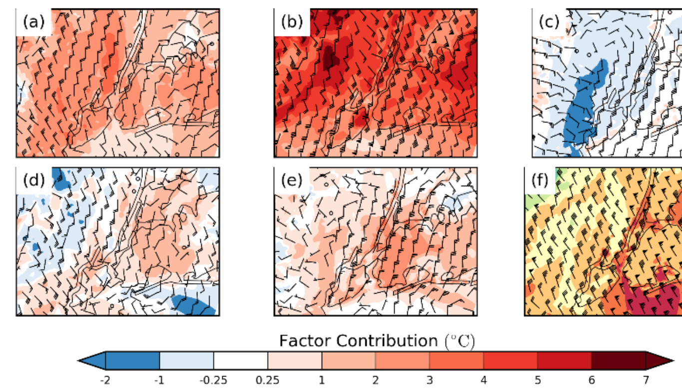



# Urban impacts and mitigation strategies on NYC weather during a regional heatwave

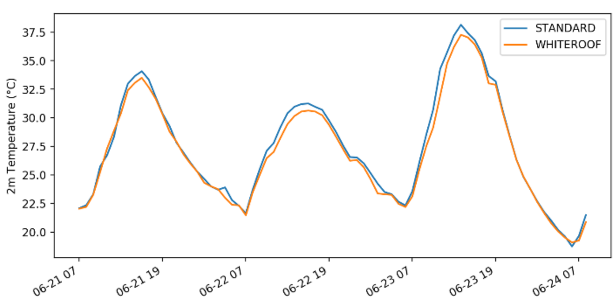
L. Ortiz, J. Gonzalez, W. Wu, R. Bornstein, J. Tongue, M. Schoonen

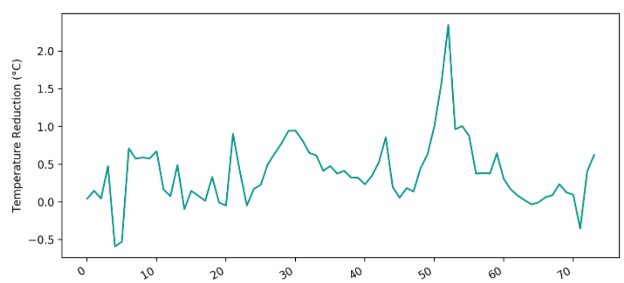
**13th Symposium of the Urban Environment**

- Factor separation analysis applied to NYC, calculating contributions from impervious surfaces, synoptic factors, and urban fluxes
  - UHI magnified at night
  - Shifting of UHI core to northwest of Manhattan in afternoon due to sea breeze.
- Evaluation of Building Energy Demand of buildings from WRF
  - Results within 10% of NYISO data at city-scale
  - White roof mitigation strategy evaluated, finding 0.4 K temperature reduction over Midtown Manhattan, and up to 16% savings in HVAC demand over Brooklyn/Queens




Factor contributions for (a) impervious surface, (b) heatwave only, (c ) impervious surface/urban fluxes, (d) impervious fluxes/heatwave, and (e ) all factor interaction. Panel (f) is the baseline field.




(Left) 2m air temperature during heatwave in Jul 2015. (right) White roof temperature reduction for Midtown Manhattan.

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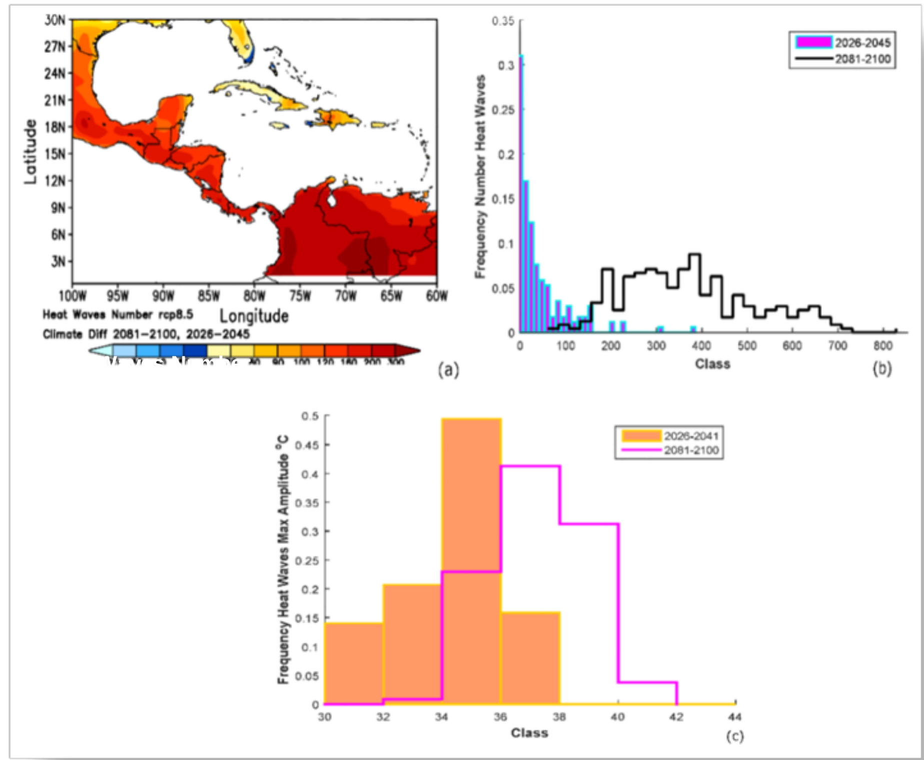
# Extreme Events Projections in The Intra-America Region using GCMs and IPCC scenarios

Moises Angeles and Jorge E. Gonzalez

The City College of New York & NOAA-CREST

## Eighth Conference on Environment and Health

- **HYPOTHESIS**
  - **We Hypothesize that a warmer IAR leads to wetter surface conditions with direct impacts on human health.**
- **OBJECTIVES**
  - **Identify atmospheric variables that drive heat waves events in the IAR region.**
  - **Determine how the heat waves intensity and frequency will change in a warmer future.**




**CONCLUSIONS**

- The IAR could be defined as a region with high caution area for heat strokes based on heat index climatology.
- There is heat waves intensification since 1998 with a clear shift in the heat waves amplitude (mximum heat index during heat waves events).
- Mean Multi-model ensemble projects a future warmer atmosphere with a heat index rate of increase of 0.04°C per year in the scenario rcp4.5 and 0.115°C per year in the scenario rcp8.5.
- In consequence, at the end of the 21st century, more intense heat waves, both in frequency and amplitude will control the IAR with high impact over the population's health.

# Applications of Remote Sensing and Modeling to Study Urban Energy Systems and Processes

Mark Arend, Victor Dominguez, Adrian Diaz, Luis Ortiz,
David Melecio, Jorge Gonzalez and Fred Moshary

13th Symposium of the Urban Environment

## Ground based remote sensing instruments capture diurnal cycles of vertical profiles

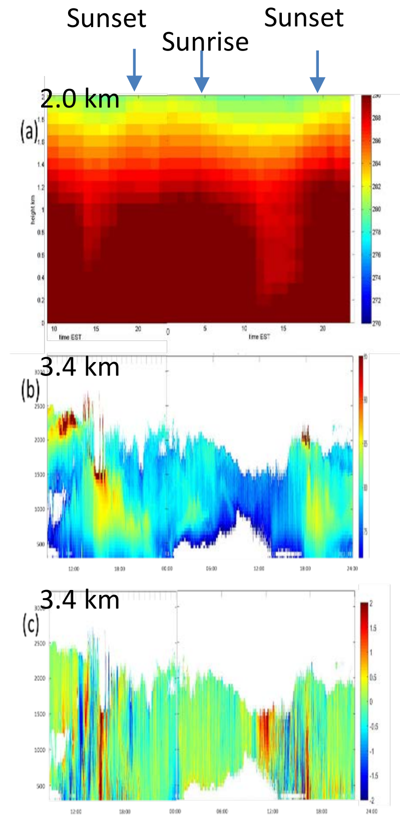
- Temperature profiles
- Attenuated Backscatter profile
- Vertical wind velocity profile

## Urbanized numerical weather prediction modeling system (uWRF) captures diurnal cycles

- Temperature profiles
- Horizontal and Vertical wind velocity

Diurnal Cycle
July 2 and 3 , 2015

**Observation**

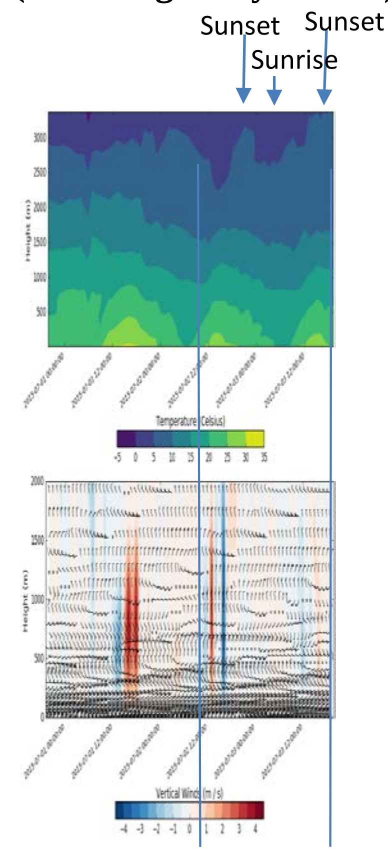



Microwave Radiometer Temperature Profile

Coherent Doppler Lidar Attenuated Backscatter

Coherent Doppler Lidar Vertical Velocity

**uWRF model (including 1 day earlier)**

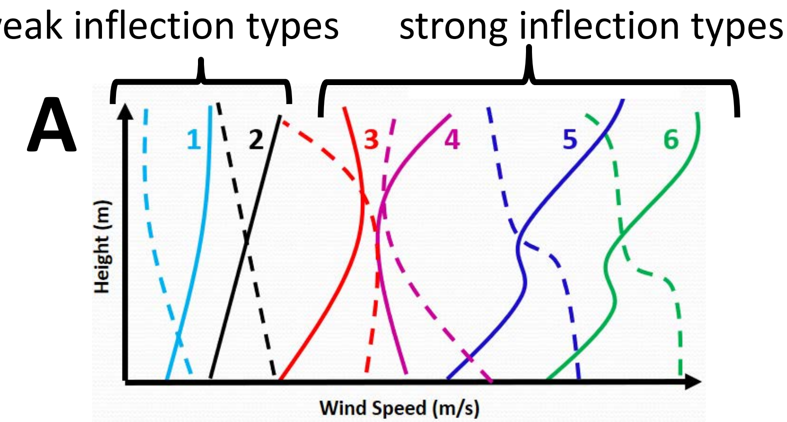


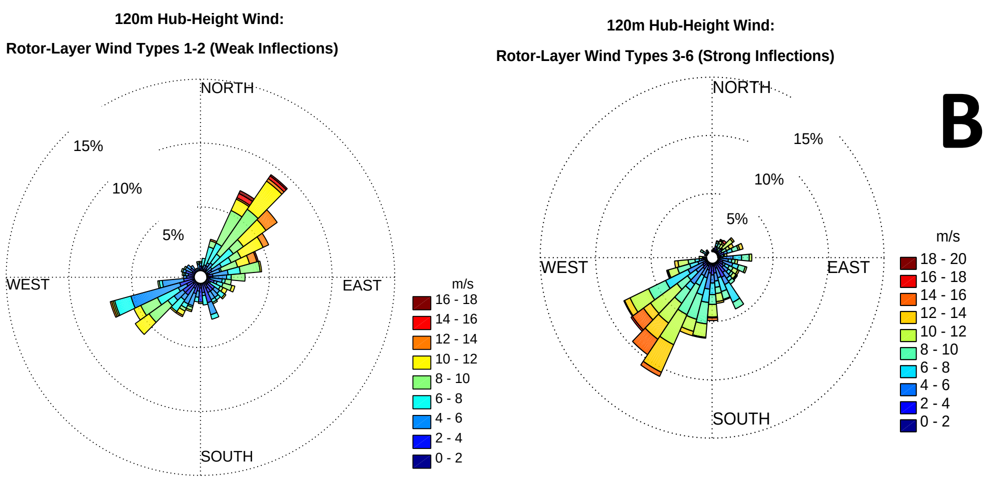
# Classifying Rotor-Layer Winds for Offshore Wind Resource and Available Power Assessment

**Alexandra St.Pé[1], Shelbi Tippett[1], Ruben Delgado[1]**
**[1] University of Maryland, Baltimore County,**

**8th Conference on Weather, Climate, Water, and the New Energy Economy**

- Offshore Classification (Figure A):
  - Power law rotor-layer winds → ~18% of total (expected)
  - Strong inflection rotor-layer winds → ~50% of total (unexpected)
- Rotor-Layer Winds & Local Meteorology (Figure B):
  - Weak inflection types → hub-height NE flow from open water
  - Strong inflection types → hub-height SW flow from continental USA (short offshore fetch) , + ~2 m/s stronger
- New Publication:
  - St.Pé et al. "Classifying Rotor-Layer Winds and Stability for Offshore Wind Resource and Available Power Assessment", in final preparation, to be submitted Wind Energy Journal.



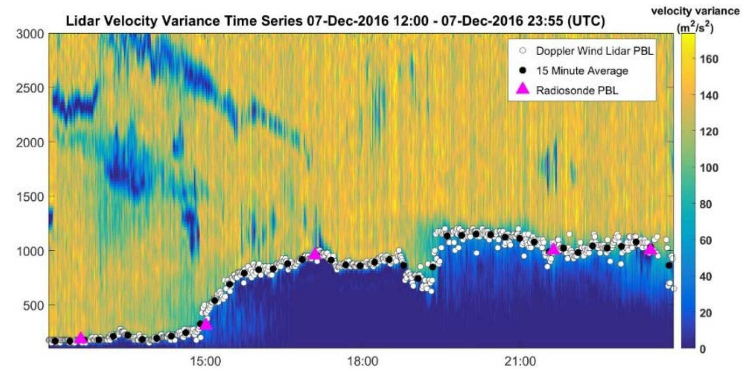



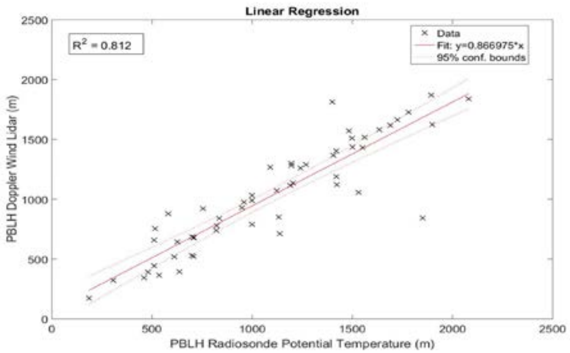
# Determination of Planetary Boundary Layer Heights from Doppler Wind Lidar

**Benjamin Tucker**[1 2], Ruben Delgado[1], Brian Carroll[1], Belay Demoz[1], Thomas Rieutord[3], Alan Brewer[4], Aditya Choukulkar[5], Timothy Bonin[5]
[1]Joint Center for Earth Systems Technology, [2]Department of Mechanical Engineering, UMBC, [3]Météo-France, [4]NOAA Earth System Research Laboratory [5]Cooperative Institute for Research in Environmental Sciences

**16th Annual AMS Student Conference**

- Accurate Planetary Boundary Layer (PBL) height is an important parameter in air pollution and weather forecasting
- CWT was applied to Doppler Wind LIDAR vertical wind velocity variance profiles
- Robust method for PBL determination.
- Doppler Wind LIDAR PBL's were compared to radiosonde PBL's for UMBC 2016 Winter Campaign
  - Correlation coefficient of 0.81 was observed.



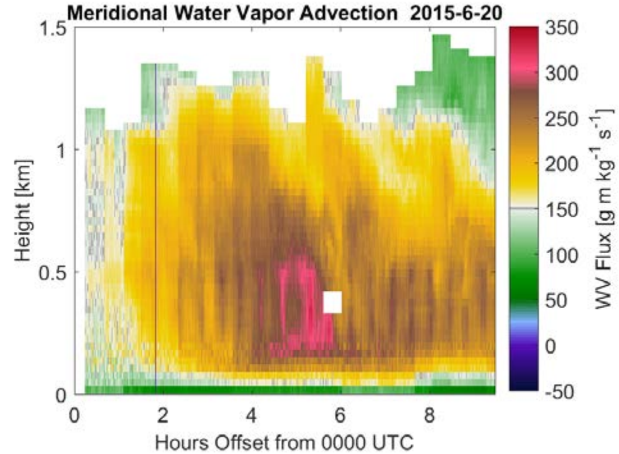

***AMS Outstanding Student Conference Poster Award**

# Low-Level Jets and Mixing Layer Heights in the Plains Elevated Convection at Night (PECAN) Campaign

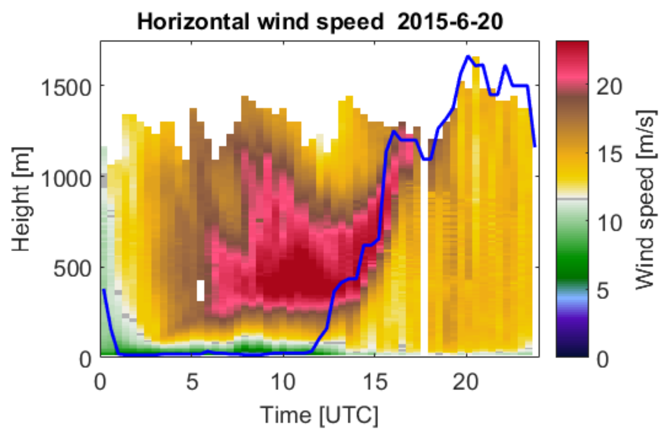
Brian Carroll[1], Belay Demoz[1], Timothy Bonin[2], Ruben Delgado[1], Kevin Vermeesch[1], David Whiteman[3]
[1] University of Maryland, Baltimore County; [2] Cooperative Institute for Research in Environmental Sciences; [3] NASA Goddard Space Flight Center

**8th Symposium on Lidar Atmospheric Applications**

- Moisture transport into Great Plains
  - PECAN had unprecedented high-resolution observation of low-level jet moisture transport, e.g. 6 weeks of lidar data sets
  - Statistical comparison of 33 jets
- New mixing layer height retrieval algorithm from Doppler lidar
  - Validation opportunity
  - Applications to moisture, pollution, and weather events




Strong water vapor transport over Kansas as jet winds reach their peak



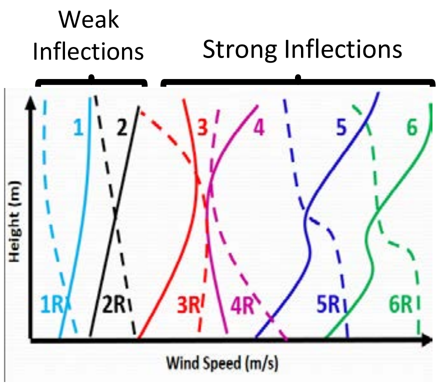

Jet wind speeds with mixing layer height plotted as blue line

# A Novel Approach for Assessing the Impact of Atmospheric Stability on Vertical Wind Profile Evolution During PECAN Low-Level Jet Events

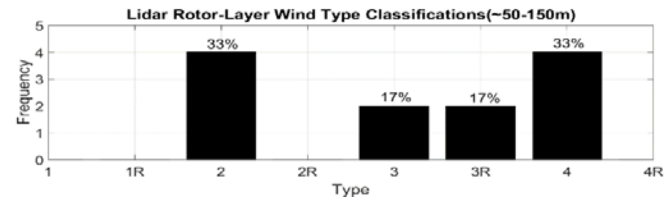
**Christiana Sasser, Alexandra St. Pé, Ruben Delgado, Benjamin Tucker**

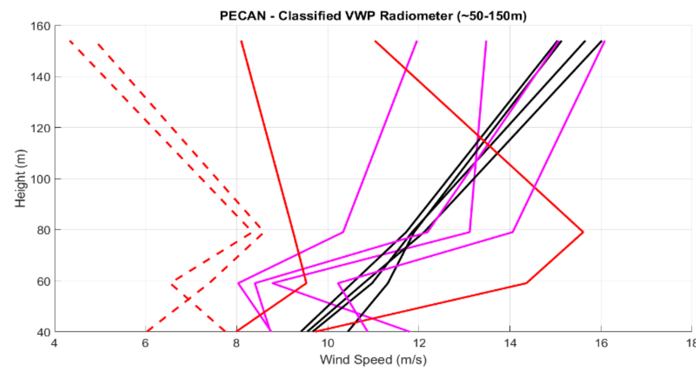
**University of Maryland, Baltimore County,**

## • Rotor-Layer Wind Profile Classification




Criteria RSS ≤ 0.10:
Type 1: Power law Fit
Type 2: Linear Fit
Type 3: Low-Level Wind Max
Type 4: Low-Level Wind Min
Type 5: Fourier Fit (2 term)
Type 6: Fourier Fit (3 term)
Criteria Relative Max/Min:
'R' Types= max and min wind speed at 40m & 220m, respectively




Strong inflection shapes of Types 3 and 4 along with reversed profiles were identified in the lidar data (to the right).
Strong inflection shapes of Type 3, 5, and 6 were identified in the radiosonde data (not shown but similar to lidar/radiometer).

## • Rotor-Layer Stability (RLS) Classification

RLS Equation: $RLS = \sum_{i=1}^{24}(\Delta\theta_{vi})$

- Strong inflection types are associated with higher stability (RLS) on average, slightly weaker hub-height winds, and more westerly flow.
- Table to the right is data from lidar/radiometer.
- Radiosonde had similar results.

| Time (UTC) | VWP Type (50-150m) | Rotor-Layer Stability (Delta VPT Sum) | Hub-Height Wind Speed (~60m) | Hub-Height Wind Direction (~60m) |
|---|---|---|---|---|
| 00:30 | 4 | -0.6035 | 8.784 | 352.043 |
| 6:40 | 2 | 1.8188 | 10.972 | 345.858 |
| 9:40 | 2 | 2.2137 | 10.787 | 340.768 |
| 11:10 | 2 | 2.8020 | 11.318 | 340.649 |
| 11:40 | 2 | 2.6405 | 10.532 | 333.331 |
| 12:30 | 4 | 3.4345 | 8.399 | 333.183 |
| 13:40 | 4 | 4.4543 | 8.032 | 347.655 |
| 14:30 | 3 | 5.0179 | 14.359 | 359.854 |
| 14:50 | 4 | 3.5431 | 10.223 | 357.539 |
| 15:20 | 3R | 4.3381 | 6.539 | 2.546 |
| 15:40 | 3 | 4.5699 | 9.529 | 2.709 |
| 16:10 | 3R | 5.2545 | 7.395 | 352.987 |

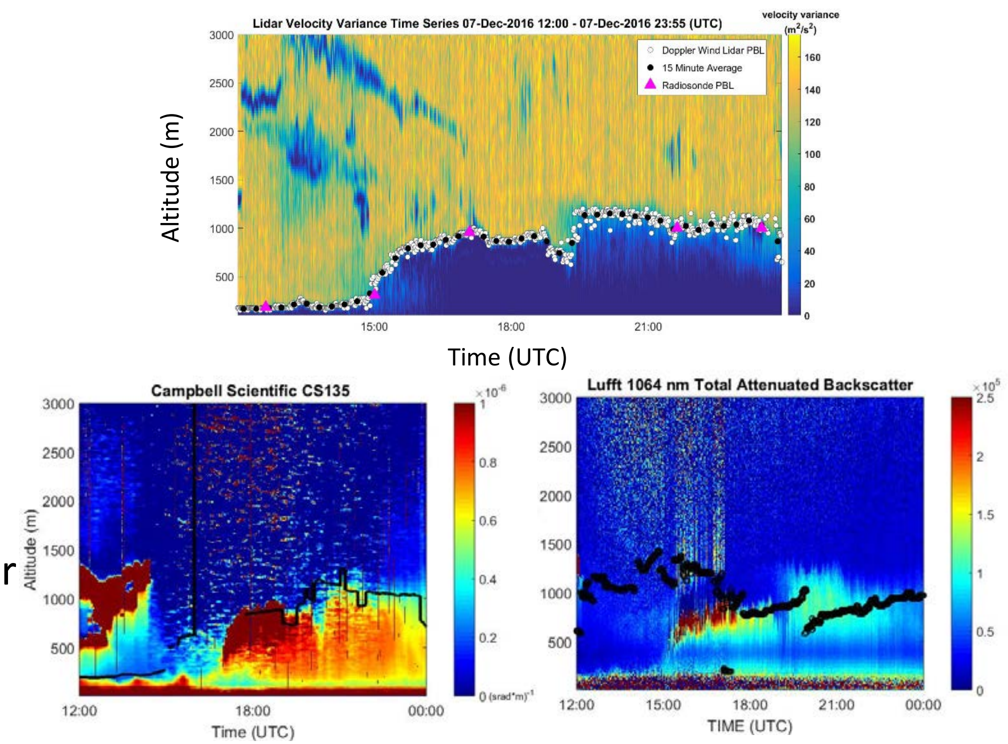
# Evaluation of Lidars and Ceilometers, and Determination of Mixing Layer Heights (MLH) in the National Weather Service Ceilometer Testbed

**Ruben Delgado[1],** Belay B. Demoz[1], Kevin C. Vermeesch[1], Brian J. Carroll[1], Tahmid Abtahi[1], Benjamin Tucker[1], Ricardo K. Sakai[2], Jasper Lewis Jr. [3], Ellsworth J. Welton[4], Michael Hicks[5], Dennis Atkinson[5], Timothy A. Bonin[6], Travis Knapp[7], James Szykman[8]

[1]JCET/CREST/UMBC, [2]NCAS/HU, [3]JCET/NASA GSFC, [4]NASA GSFC, [5]NOAA/NWS, [6]CIRES/NOAA ESRL, [7]SSAI/NASA LARC, [8]EPA/NASA LARC

## 8th Symposium on Lidar Atmospheric Applications

- Objectives of this work is defining the technical details of the retrieval of aerosol mixing height as a proxy of the MLH.
- Quasi-real time algorithm has developed and is being tested and validated (Doppler Wind lidar timeseries, top panel) using the HU/UMBC regional ceilometers/lidar network.
- Daytime mixing layer height determination from commercial ceilometers.
- Commercial MLH prediction under and over estimate. Future work process data with common algorithm and characterization of instrument/system errors.



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