AMS Talk Summaries from STAR & CIs

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

STAR

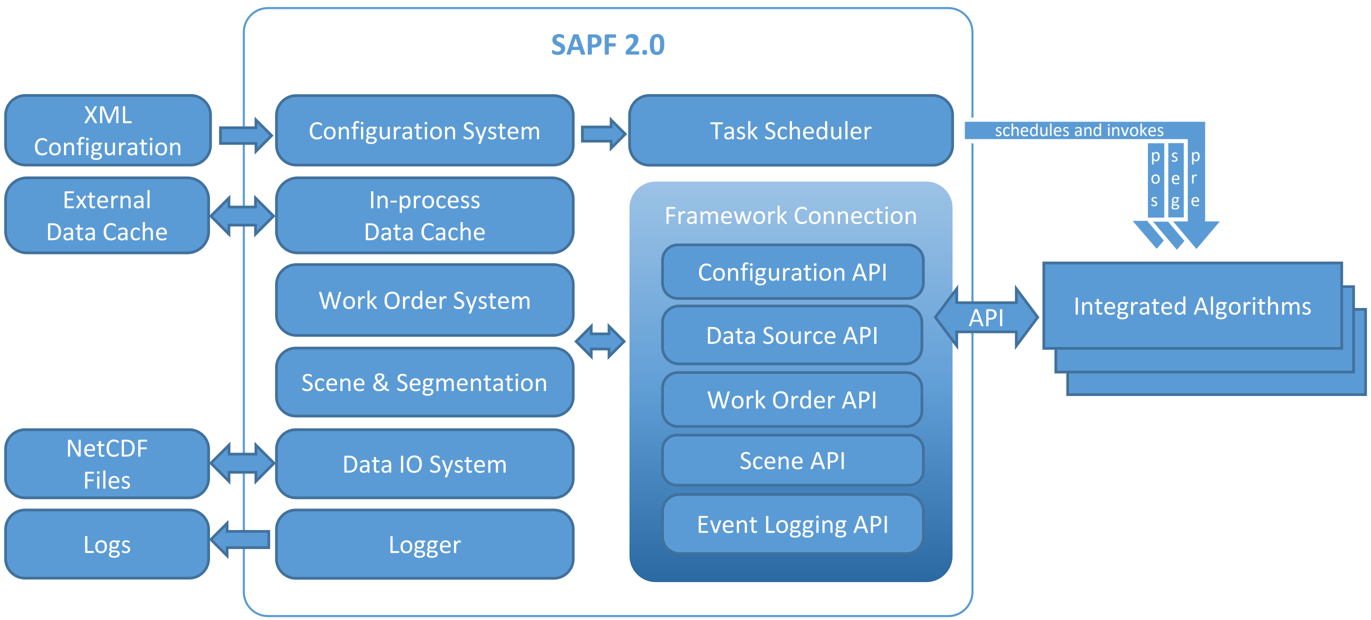
- Alexander Ken
- Priya Pillai
- Kurtis Pinkney
- Ryan Smith
- Haibing Sun
- Jerry Zhan
- Zhihua Zhang

ADVANCED CAPABILITIES OF STAR ALGORITHM PROCESSING FRAMEWORK (SAPF) VERSION 2.0

Alexander Ken[2], Arthur Russakoff[2], Brian Helgans[3], Thomas King[2], Walter Wolf[1]

[1]NOAA/NESDIS/STAR, [2]IMSG, [3]GAMA-1

- The STAR Algorithm Processing Framework (SAPF) software is developed by the NOAA STAR Algorithm Scientific Software Integration and System Transition Team (ASSISTT) to facilitate and support transition of satellite remote sensing algorithms from research to operations.
- SAPF version 1.0 is being replaced by a new, completely redesigned version 2.0 in early 2019. Version 2.0 brings significant improvements in resource efficiency, scalability, run time performance, simplified configuration for users, as well as additional features such as parallel processing.



Algorithm Scientific Software Integration and System Transition Team (ASSISTT) in Transition from Research to Operations

Priya Pillai, Hua Xie, Eric McWilliams, Kelly Neely, John Lindeman, Kerrie Allen and Aiwu Li (IMSG), Veena Jose and Shanna Sampson (GAMA-1), Walter Wolf (NOAA)

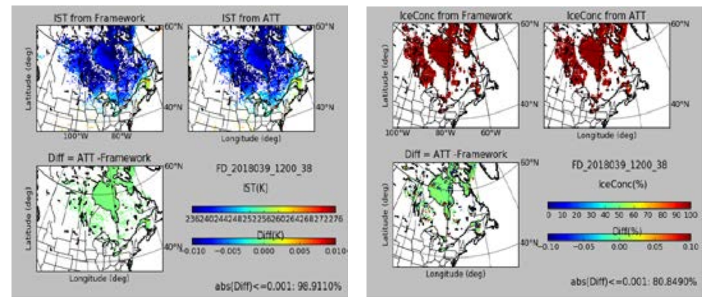
The GOES-R Algorithm Working Group (AWG) ASSISTT in Transition from Research to Operations

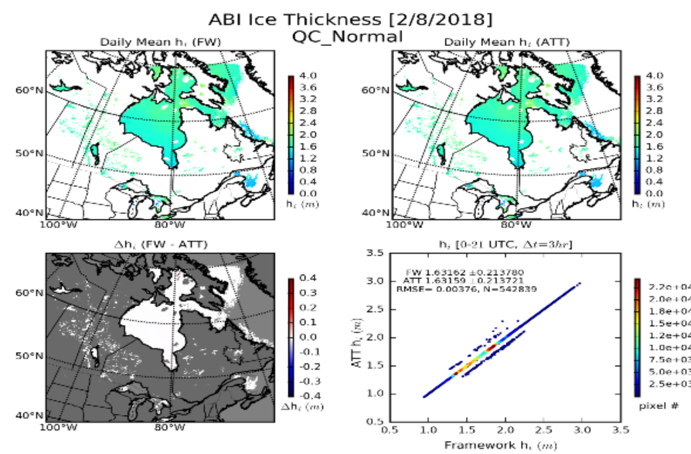
- Designed, developed, and implemented the GOES-R AWG Product Processing System Framework (FW) to maintain and update algorithms offline
- Develop Algorithm Description Documents to serve as guidance for algorithm integration into the GOES-R Ground System (GS) Algorithm Testing Tools (ATT)
- Validate ATT test case outputs against FW and AWG outputs
- Deliver developed operational GOES-R algorithms to the GS
- Provide quality assurance and maintain scientific integrity of algorithms throughout this transition process

The National Weather Service (NWS) Operational Advisory Team's (NOAT) top new priority algorithms

Cloud Cover Layer **Aerosol Particle Size**	Final Delivered Algorithm Package (DAP) delivered [Sep, 2018]
Sea/Lake Ice Concentration/Extent **Ice Thickness/Age** **Ice Motion**	Algorithm Readiness Review (ARR) & DAP delivery [Mar, 2019]

ABI CRYOS output, February, 2018





Differences in cloud/land masks and segment sizes may lead to ATT/FW output discrepancies

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

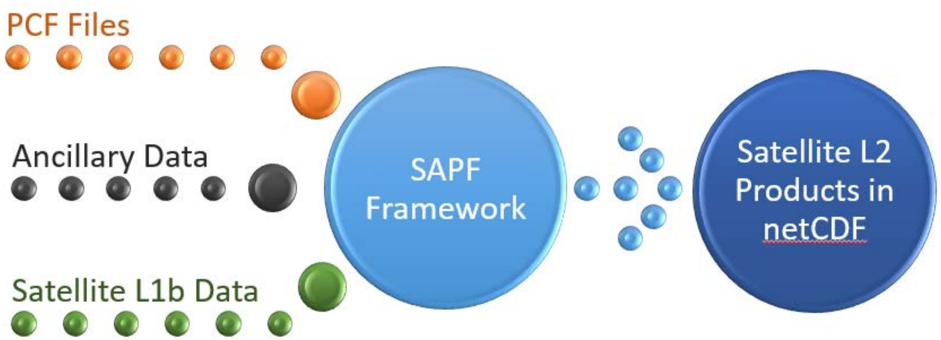
CIMSS

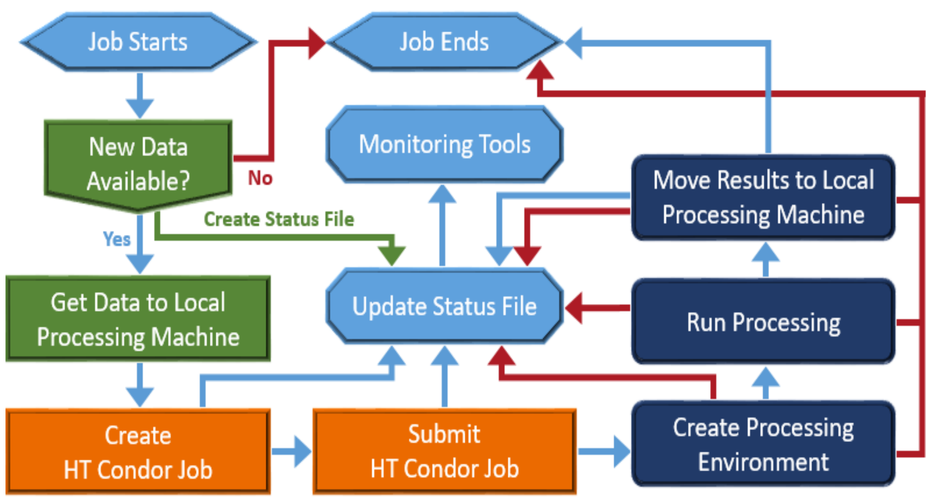
Use of ASSISTT's Computing Cluster for R20

Kurtis Pinkney, Claire McCaskill, Valeria Guadelupe-Cruz, Eric Buzan (IMSG); Michael Walters, Meizhu Fan, Shanna Sampson (GAMA-1) Walter Wolf (NOAA/NESDIS/STAR)

- ASSISTT's computing cluster is used to generate a number of products using algorithms hosted within our framework
  - Cluster makes use of the HTCondor high throughput computing software
  - Framework provides controlled environment to create scientifically reliable meteorological products
  - Each product requires L1b data, ancillary data, and configuration/process control files to generate L2 products

- Computing cluster is used for near-real time, validation processing, and regression testing of framework algorithms
  - Any given process goes through data staging phase (green), cluster job production (orange), cluster processing (dark blue)
  - Allows for large volumes of data to be processed

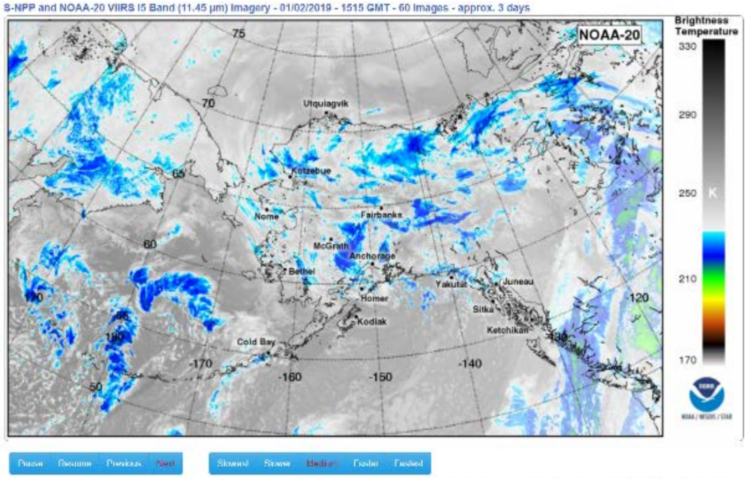


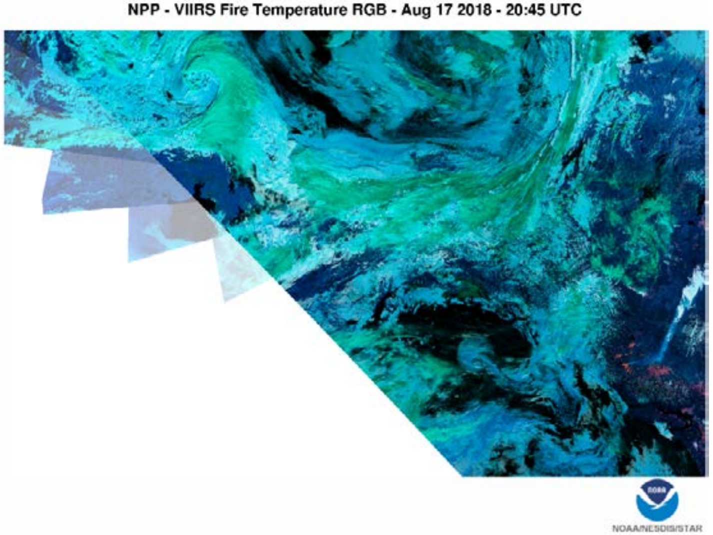


Utilizing Joint Polar Satellite System (JPSS) Coverage to Monitor Meteorological Conditions in the Alaska Region

Ryan Smith, Thomas Atkins, Charles Brown, Lori Brown

- The JPSS EDR LTM team unveiled their new site, AlaskaWatch
  - Displays SNPP and NOAA-20 orbits over Alaska region
  - Takes advantage of increased temporal resolution that two polar orbiting satellites provide
  - Images show snow event over Anchorage, AK (top) and fires in British Columbia Canada (bottom)
  - Available products include I5-Band, VIIRS Sea Ice Concentration, Dust RGB, Natural Color, Fire Temperature RGB





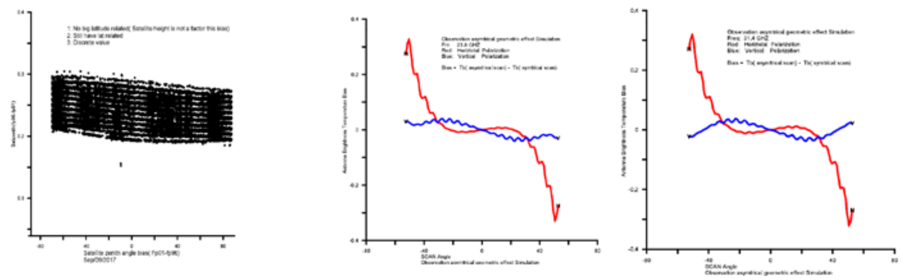
Geometry-Related ATMS Signal Asymmetrical Pattern Analyses

Haibing Sun[1], P. Keehn[1], Shanna Sampson [1] ,Thomas King[2] Walter Wolf[3] [1] GAMA-1 Technologies, 7500 Greenway Center Drive, Suite 100,Greenbelt, MD 20770 [2] I.M. System Group, 3206 Tower Oaks Boulevard, Suite 300,Rockville, MD 20852 [3] NOAA/NESDIS/STAR, 5830 University Research Ct, NCWCP , College Park, MD 20740

ATMS/AMSU,MSU along scan asymmetrical pattern problem is reviewed. ATMS/AMSU,MHS Stokes antenna temperature formulation is derived using the general Stokes antenna temperature Formulation.

- The contribution from observation geometry is analyzed with ATMS data.
- The Stokes Antenna temperature formulation is developed. The Stokes parameter 3rd , 4th parameter and antenna pattern phase character are included in the formulation to fully describe the effect from Polarization mixing , antenna Polarization crossing coupling.
- The ATMS/AMSU/MSU plane reflector emissivity effect and antenna pattern are included.
- Including all the related factor to evaluable the multiple factor combined effect. The along scan asymmetry pattern is the result from multiple contribution factors, it is necessary to analyze the combined effect from antenna pattern and other possible contribution factors together.
- The contribution factors for the ATMS asymmetrical scanning are analyzed and discussed.

ATMS: The asymmetrical geometry and related asymmetry



Operational Antenna brightness Temperature Formulation

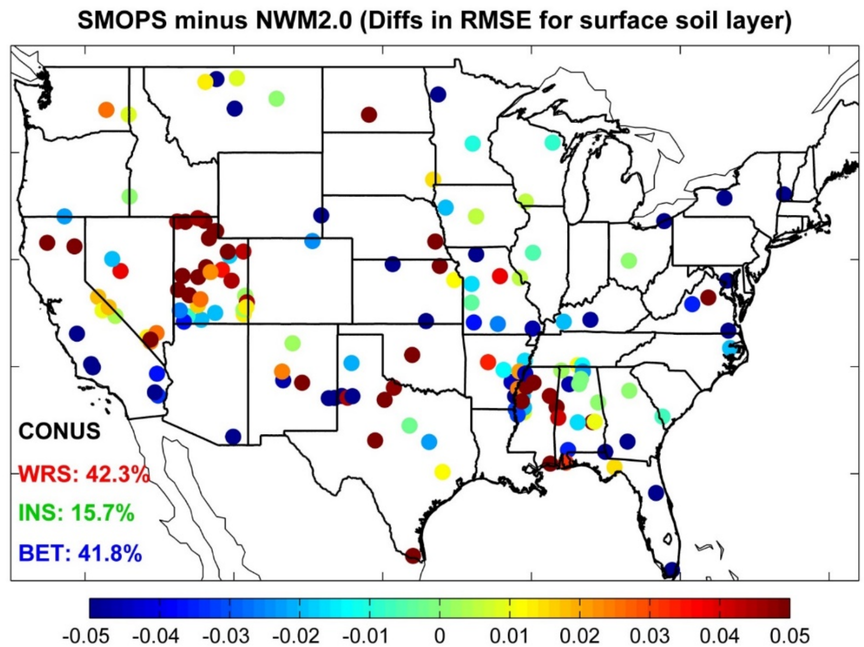
$$
\begin{aligned}
T_v^{qa} = {} & \eta^{vv}\left[T_v cos\varphi^2 + T_h sin\varphi^2 + \varepsilon_s(T_m - T_v)cos\varphi^2 + \varepsilon_p(T_m - T_h)sin\varphi^2 + 1/2\ \sin 2\varphi\,(1-\varepsilon_s)^{3/2}T_3\right] + \\
& \eta^{vh}\left[T_v sin\varphi^2 + T_h cos\varphi^2 + \varepsilon_s(T_m - T_v)sin\varphi^2 + \varepsilon_p(T_m - T_h)cos\varphi^2 - 1/2\ \sin 2\varphi\,(1-\varepsilon_s)^{3/2}T_3\right] + \\
& \eta^{vU}\left[(T_h - T_v)sin2\varphi + (\varepsilon_p(T_m - T_h) - \varepsilon_s(T_m - T_v))sin2\varphi + \cos 2\varphi(1-\varepsilon_s)^{3/2}T_3\right] + \\
& -\eta^{vV}\left[(1-\varepsilon_s)^{3/2}T_4\right]
\end{aligned}
$$

$$
\begin{aligned}
T_h^{qa} = {} & \eta^{hv}\left[T_v cos\varphi^2 + T_h sin\varphi^2 + \varepsilon_s(T_m - T_v)cos\varphi^2 + \varepsilon_p(T_m - T_h)sin\varphi^2 + 1/2\ \sin 2\varphi\,(1-\varepsilon_s)^{3/2}T_3\right] + \\
& \eta^{hh}\left[T_v sin\varphi^2 + T_h cos\varphi^2 + \varepsilon_s(T_m - T_v)sin\varphi^2 + \varepsilon_p(T_m - T_h)cos\varphi^2 - 1/2\ \sin 2\varphi\,(1-\varepsilon_s)^{3/2}T_3\right] + \\
& \eta^{hU}\left[(T_h - T_v)sin2\varphi + (\varepsilon_p(T_m - T_h) - \varepsilon_s(T_m - T_v))sin2\varphi + \cos 2\varphi(1-\varepsilon_s)^{3/2}T_3\right] + \\
& -\eta^{hV}\left[(1-\varepsilon_s)^{3/2}T_4\right]
\end{aligned}
$$

Integrating Satellite Soil Moisture Retrievals for Hydrological Prediction Operations

X. Zhan[1], **J. Liu[1,2] ***, L. Zhao[3], J. Yin[1,2], Li Fang[1,2] , N. Wang[1,2], R. Ferraro[1], T. Vukicevic[4]
1 NESDIS-STAR, 2 UMD-CICS, 3 NESDIS-OSPO, 4 NWS-OWP, * Presenter

- *NESDIS Soil Moisture Operational Product System (SMOPS) has been in operational mode to integrate all available satellite soil moisture observations into one blended data layer for NOAA operational NWP and the National Water Model (NWM)*
- *NESDIS and NWC have started to benchmark the satellite soil moisture products with operational NWM simulations*
- *Preliminary comparison result indicated that satellite soil moisture data from SMOPS perform better (worse) than NWM simulations at different locations in CONUS*



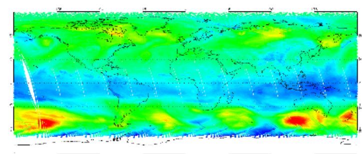
RMSE differences between SMOPS and NWM2.0 surface SM against SCAN measurements Site in blue (red) color indicates SMOPS is better (worse) than NWM2.0.

Validation of Operational NOAA-20 OMPS Environmental Data Records

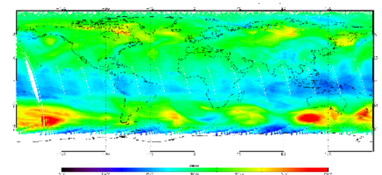
Zhihua Zhang, Lawrence E. Flynn, Eric Beach, Jianguo Niu & Trevor Beck (NESDIS/STAR)

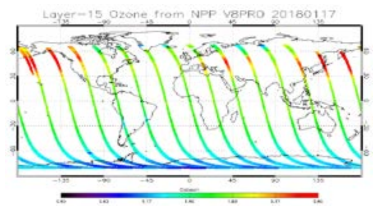
- OMPS V8TOz Soft-Calibration
  - NOAA OMPS/S-NPP and OMPS/NOAA-20 V8TOz was adjusted to agree with NASA/V8TOz
  - Making ozone, reflectivity and aerosol index to natural "truth"
- OMPS V8PRO Soft-Calibration
  - NOAA OMPS/S-NPP and OMPS/NOAA-20 V8pro was adjusted to agree with NOAA-19 SBUV/2
  - Making total ozone and ozone profiles over Pacific box the same as NOAA-19 at a chasing orbit date
- Comparison and Monitoring
  - NOAA/NESDIS/STAR has well designed Integrated Cal/Val System(ICVS) to monitor the performance of instrument, to compare products from different instruments or algorithms, to alert the occurrence of natural disaster events, as well as to monitor the long-term environmental change

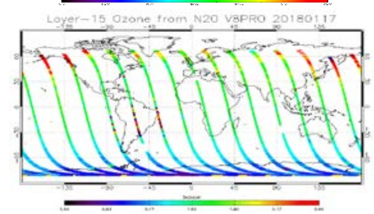
V8TOz Total Column Ozone after Soft-Calibration

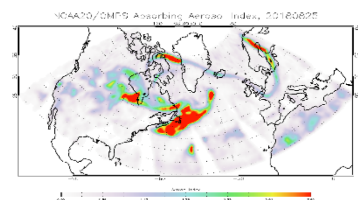


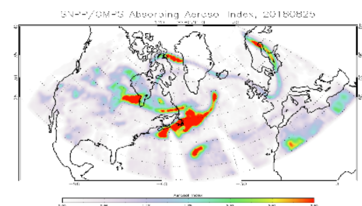
V8TOz Total Column Ozone before Soft-Calibration

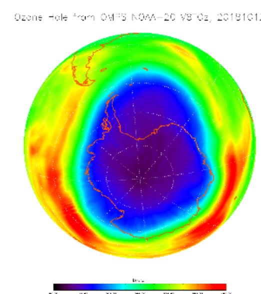


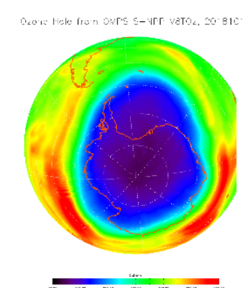


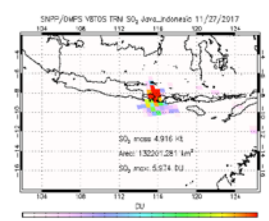












CICS-MD

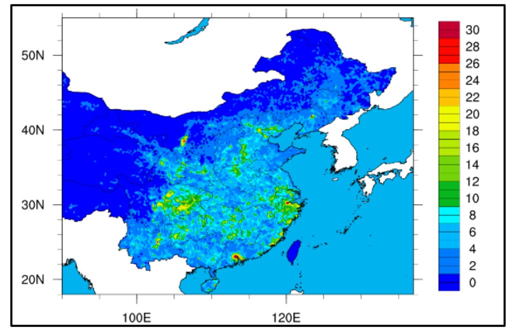
- Chris Grassotti (2)
- Yong-Keun Lee
- Erin Lynch (4)
- Mitch Schull
- Jifu Yin
- Jun Zhou
- Xiaolei Zou

Intercomparison of Rain Rates From NOAA's Microwave Integrated Retrieval System With Surface Gauge Observations Over China During 2016-2017

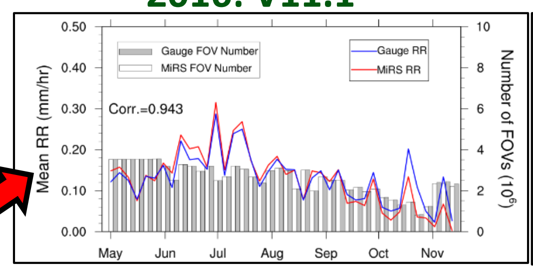
Hao Hu, <u>Christopher Grassotti</u>, Shuyan Liu , Ryan Honeyager, Yong-Keun Lee, Quanhua Liu

AMS 33rd Conference on Hydrology

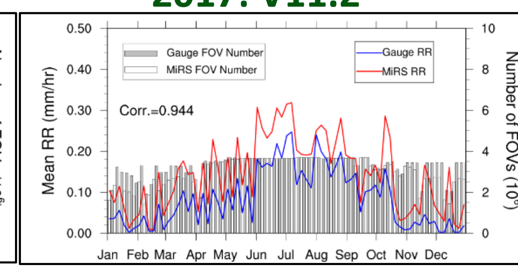
- An assessment and validation of MiRS rain rate retrievals over China was performed using Chinese rain gauge observations from the regional network. A total of four years were analyzed but the poster focuses on the period 2016-2017
- In late 2016, MiRS experimental versions switched from v11.1 to v11.2
- Chinese regional network contains approximately 30,000 gauges.
  - Map shows spatial density of gauges, with number of gauges per 0.2 x 0.2 degree grid
- Performance Time Series
  - **5-Day Averaged Rainfall**: temporally and spatially averaged rainfall correlates well with gauge observations, but 2017 retrievals show a higher bias relative to gauges
  - **Heidke Skill Score**: left panel shows dependence of Heidke score on rain/no rain threshold; right panel shows that Heidke score is systematically improved in 2017 due to algorithm changes in v11.2

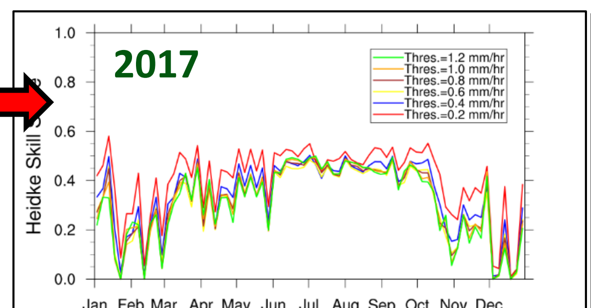


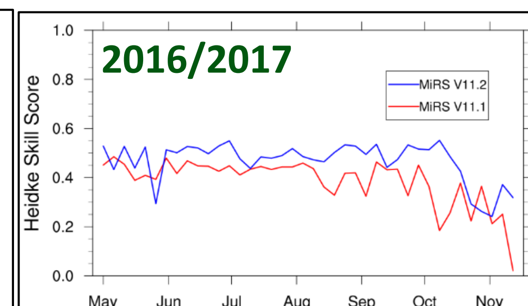
2016: V11.1



2017: V11.2





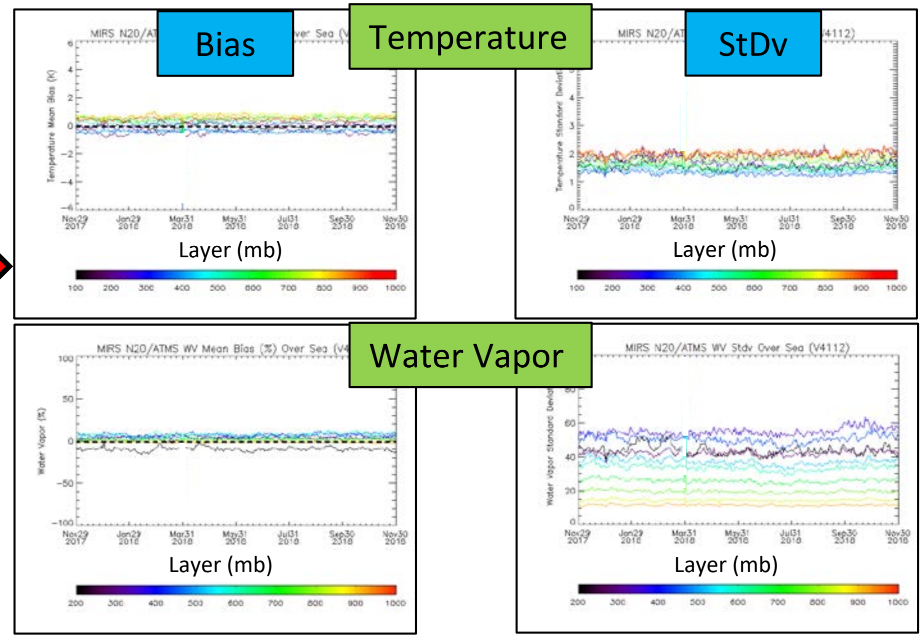


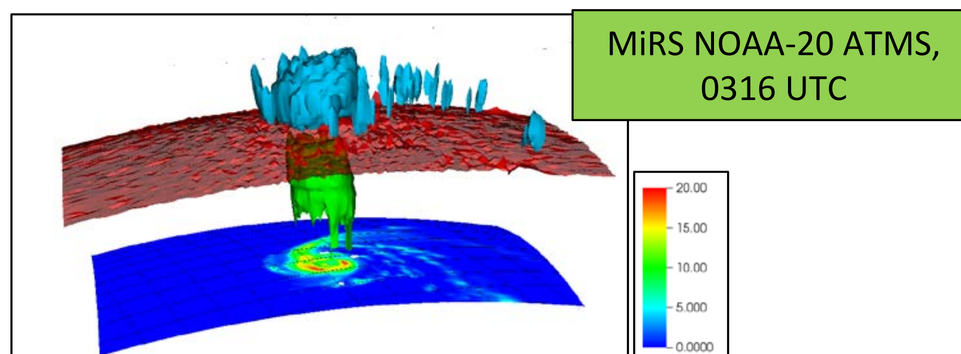
Microwave Integrated Retrieval System (MiRS) and NOAA-20: Cal/Val and Science Developments One Year Post Launch

Christopher Grassotti, Quanhua Liu, Shuyan Liu, Yong-Keun Lee, Ryan Honeyager

AMS 15th Symposium on New Generation Operational Environmental Satellite Systems

- Time Series of MiRS N20 Temperature and Water Vapor Retrieval Performance over Ocean from 29 Nov 2017 – 30 Nov 2018
  - Comparisons with ECMWF analyses show stable performance with only small seasonal dependence
  - Bias and Std Deviation meet JPSS requirements
- 3-D Visualization Application
  - Super Typhoon Yutu on 24 October 2018 as it crossed N. Mariana Islands
  - 3-D depiction of MiRS NOAA-20/ATMS retrievals of surface rain rate, graupel water (blue), rain water (green), and freezing level (red) about 2 hours after Yutu reached maximum intensity with 180 mph winds.
  - Complex storm structure is revealed, including warm core, and rain rates exceeding 20 mm/h



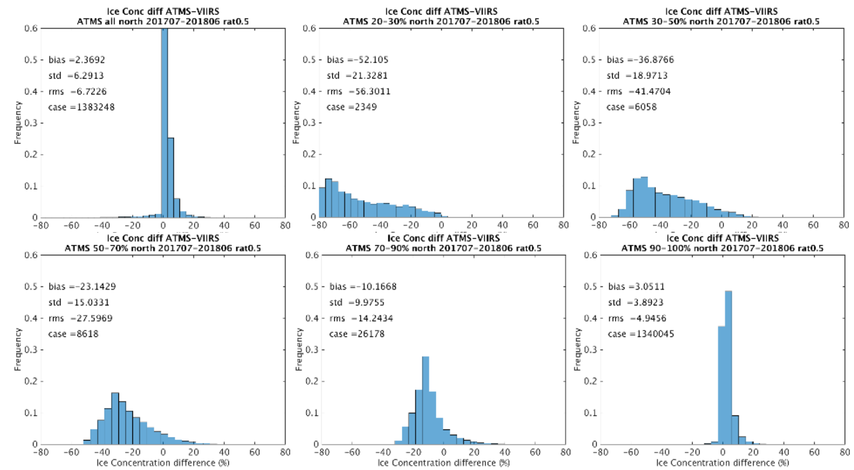


Comparison of Sea ice products from MiRS ATMS and VIIRS

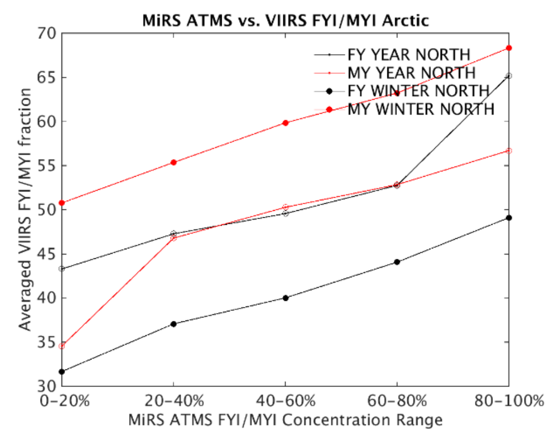
Yong-Keun Lee & Christopher Grassotti (CICS-MD); Quanhua (Mark) Liu (NESDIS); Shuyan Liu (CIRA); Ryan Honeyager (IMSG)

- Sea ice concentration
  - Data between July 2017 and June 2018, three days from each month
  - Sea ice concentration from MiRS NPP ATMS and VIIRS
  - Sea ice concentration from both instruments are based on totally different algorithm
  - Underestimation of sea ice concentration from MiRS ATMS compared to that from VIIRS when the MiRS ATMS sea ice concentration is small.

- Sea ice age
  - Data period: same as sea ice concentration from MiRS NPP ATMS and VIIRS
  - VIIRS sea ice age was re-categorized by the sea ice thickness 0.9m.



Arctic region July 2017 – June 2018



First-year ice and multi-year ice comparison between MiRS NPP ATMS and VIIRS over Arctic region when MiRS ATMS total sea ice concentration=100%

Recent Advances in GNSS-RO Technology and Their Potential Impacts on Operational Weather Forecasting

Erin Lynch (CICS-MD), Changyong Cao (STAR)

- Radio occultation (RO) measurements have a significant impact on numerical weather prediction (NWP)
  - They offer direct improvement to forecast when assimilated by providing independent information.
  - They also serve as unbiased anchor for the assimilation of satellite radiances.
  - The number of RO profiles for NWP has decreased as the COSMIC constellation ages.
  - Saturation of positive impact due to assimilating RO measurements has not yet been realized. More improvement expected with more profiles for assimilation.

- Recent and upcoming RO missions and advances in technology will increase the number and quality of RO profiles for NWP and continue to improve operational weather forecasting
  - Upcoming COSMIC-2 (US/Taiwan) and EPS-SG (EUMETSAT) missions will increase the spatial and temporal density of RO observations.
  - Next generation RO receivers can take advantage of multiple GNSS constellations increasing the number of occultations.
  - Improved antennas and advanced tracking and processing techniques improve the quality of profiles at both low and high altitudes.
  - Potential for advances in modeling and forecasting from improved measurements of the lower troposphere, particularly in the tropics, from COSMIC-2 profiles.

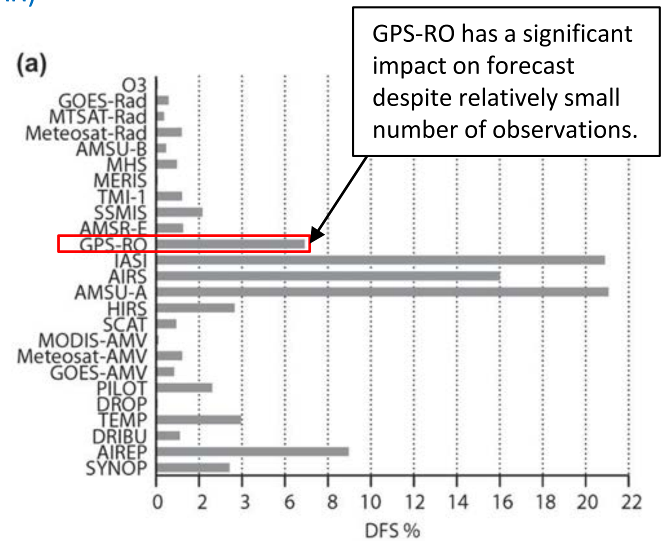


Figure from Cardinali and Healy (2014)

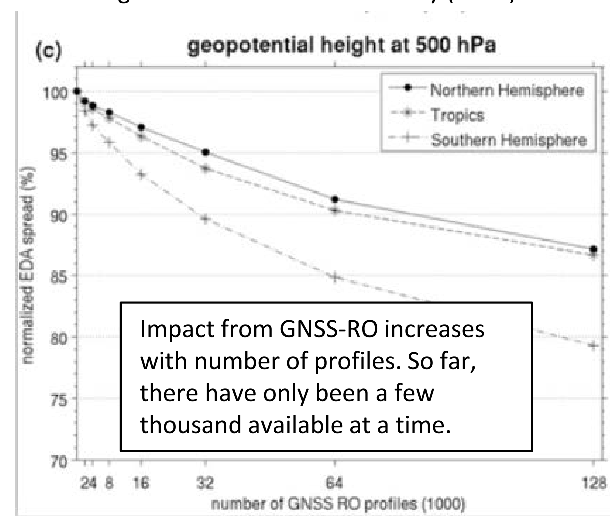


Figure from Harnisch et al. (2013)

GNSS-RO Data Quality Assurance for NWP using the Integrated Cal/Val System (ICVS)

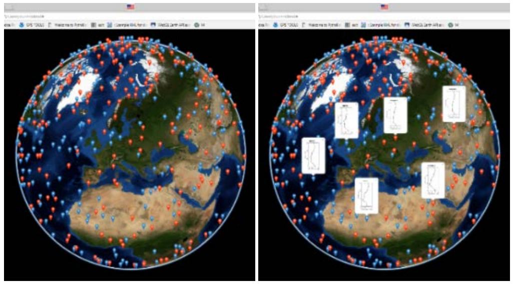
Changyong Cao (STAR), **Erin Lynch (CICS-MD)**, Bin Zhang (CICS-MD), Ben Ho (STAR)

- As GNSS-RO (Radio Occultation) has become increasingly important, STAR has taken initiatives to develop support for RO as for other satellite instruments.
  - Includes providing SDR and EDR expertise and data quality assurance, as well as supporting research to operations, conducting impact studies, and processing data
  - STAR RO team has expanded to include one civil servant (Dr. Ho) and four contractors working on several RO projects including support for COSMIC-2 cal/val

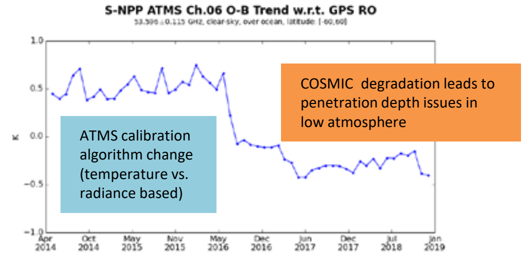
- STAR has developed a comprehensive integrated cal/val system (ICVS) to ensure the data quality of all satellite measurements, including RO.
  - Web-based system that supports instrument performance monitoring, inter-comparisons with independent measurements, and data assimilation
  - Provides support for COSMIC, KOMPSAT-5, the commercial weather data pilot, and upcoming missions like COSMIC-2

- This system is backed by deep dive analysis on the fundamental measurements, leveraging expertise in measurement technology, traceability and standards.
  - GNSS-RO measurements are traceable to time or the Atomic Frequency Standard. Infrared sounders like CrIS are traceable to the blackbody radiance standard maintained by NIST through an unbroken chain of calibrations.
  - Direct comparisons to CrIS measured radiances can be made using Community Radiative Transfer Model (CRTM) from JCSDA to simulate RO radiances, however there are some challenges in matching RO profiles to CrIS pixels.
  - Sensitivity analysis can provide a different perspective on stability and accuracy of RO data. Analyzing the characteristics helps to better understand the performance.

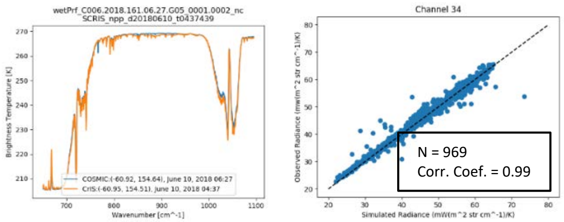
ICVS interactive globe monitors location of profiles.



Long term monitoring of bias (O-B) between ATMS and GPS-RO reveals anomalies.

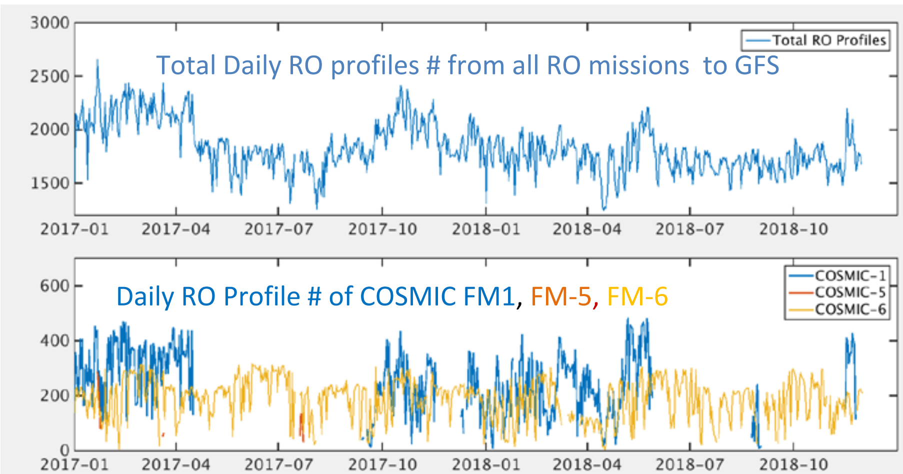


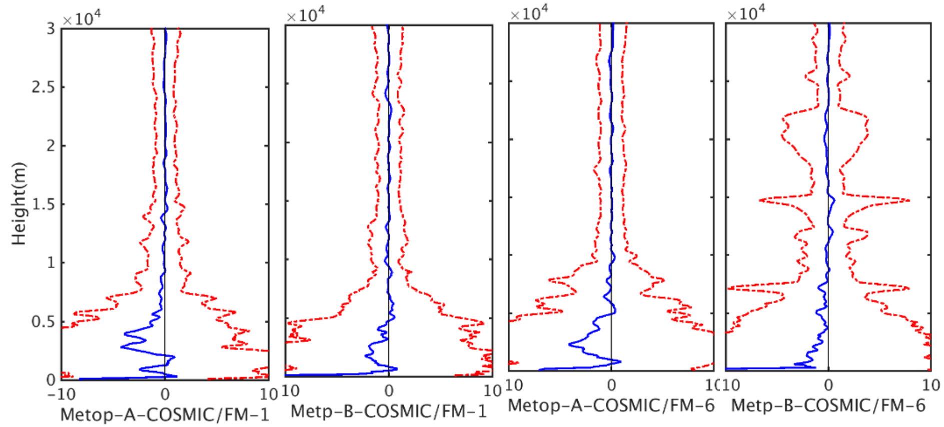
Good agreement between simulated COSMIC radiances and observed CrIS radiances in CO2 absorption channels.



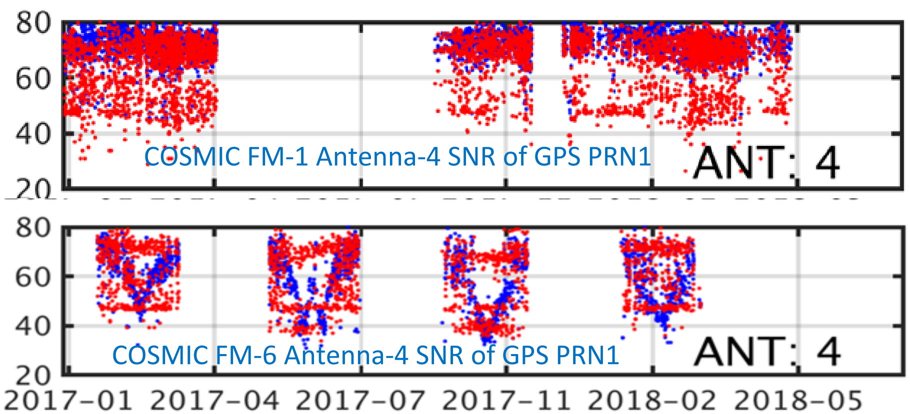
Recent Results in the Validation and Monitoring of COSMIC Radio Occultation Performance

Bin Zhang (CICS), Erin M. Lynch (CICS), Changyong Cao(NESDIS/STAR),Xi Shao(CICS), Lin Lin(CICS)





Bending angle relative difference between COSMIC (FM1/FM6) and MetOp-A/B

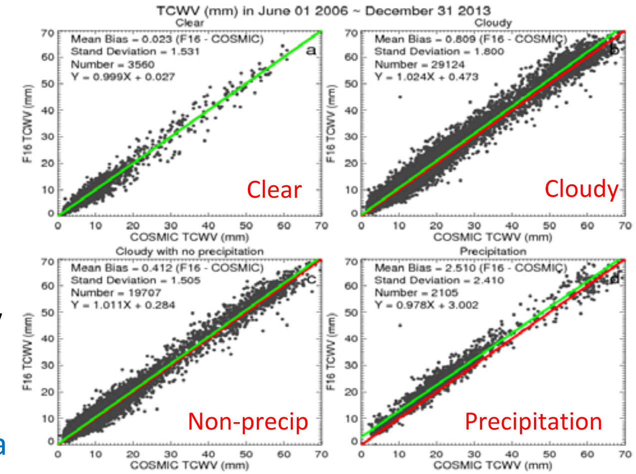


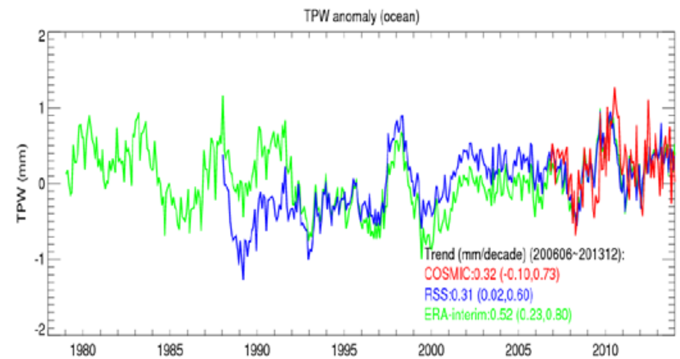
- COSMIC has less number of profiles currently (<400/day) than originally designed (>2500)
  - Only 2 satellites (FM-1 and FM-6) of 6 are still working
  - FM-1 has performance gaps, and FM-6 has only one RO receiver working normally
- Bending Angle Bias between COSMIC (UCAR) and MetOp (ROM SAF) is generally less than 0.02%(±0.2%) between altitude of 10-30km.
  - Significant difference below 10km or above 30 km, likely due to algorithm in dealing with multiple path, ionosphere correction, actual atmospheric difference near surface due to collocation criteria (3 hours, 50km)

Global Validation of Atmospheric Total Precipitable Water Derived COSMIC Radio Occultation Using Microwave Radiometers over Oceans under Clear and Cloudy Skies

Shu-peng Ben Ho (STAR), Liang Peng, Carl Mears and Rick Anthes (UCAR)
presented by Erin Lynch (CICS-MD)

- COSMIC derived Total Precipitable Water (TPW) is used to quantify RSS SSM/I daily data products under different atmospheric conditions.
  - RSS SSM/I ocean products for F15, F16, F17, and WindSat are compared to COSMIC TCWV between June 2006 and Dec. 2013.
  - Matching pairs of observations from COSMIC and RSS are close in space and time and identified as clear or cloudy.
- Positive biases are seen in the data with cloudy conditions. This is mainly due to uncertainties in MW retrieval under precipitating conditions.
  - Under clear skies, TCWV differences between pairs are close to zero.
  - Further separating the cloudy cases into precipitating and non-precipitating, a larger bias is seen when precipitation is present.
  - RO is not affected significantly by clouds or precipitation, therefore bias is attributable to uncertainty in MW retrievals in the presence of clouds and precipitation.
- The global trend in TPW from 60N-60S from COSMIC is in close agreement with that derived from MW radiometers.
  - The global mean trend from COSMIC observations is 0.32 mm/decade whereas that from RSS is 0.31 mm/decade.
  - COSMIC RO measurements and MW radiometer measurements are completely independent, thus the close agreement lends credence to the estimates.





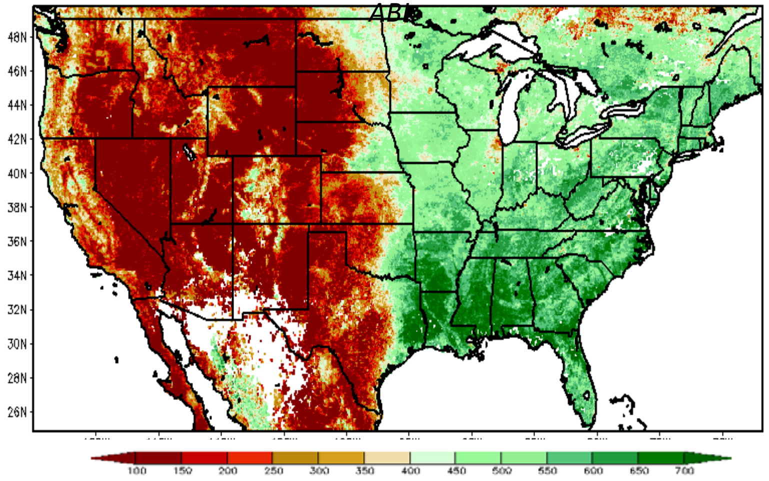
Reference: **Ho, S.-P.**, L. Peng, C. Mears, R. Anthes (2018), Comparison of Global Observations and Trends of Total Precipitable Water Derived from Microwave Radiometers and COSMIC Radio Occultation from 2006 to 2013, *Atmospheric Chemistry and Physics*, 18, 259–274, https://doi.org/10.5194/acp-18-259-2018, 2018.

An Evapotranspiration Data Product from NOAA GOES-16 and 17

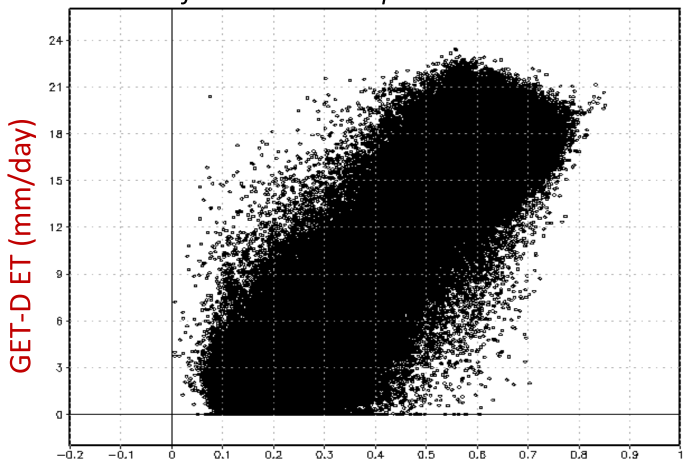
S. Kalluri[1], L. Fang[1,2], **M. Schull[1,2]**, X. Zhan[1], C. Hain[3], M. Anderson[4]
1 NESDIS-STAR, 2 UMD-CICS, 3 NASA-MSFC, 4 USDA-ARS

- NESDIS GOES ET & Drought (GET-D) product system has been generating **ET** (λET = latent heat flux) and evaporative stress index (ESI) data products from GOES-13/15 since 2016
- GET-D is updated successfully to generate **ET** at **4km** spatial resolution using **GOES-16** ABI observations
- Spatial patterns and scatter plots of ABI ET agreed well with vegetation index from VIIRS

Latent Heat Flux λET (W/m2) from GET-D Based on GOES-16 ABI



ABI ET from GET-D Compared with VIIRS EVI



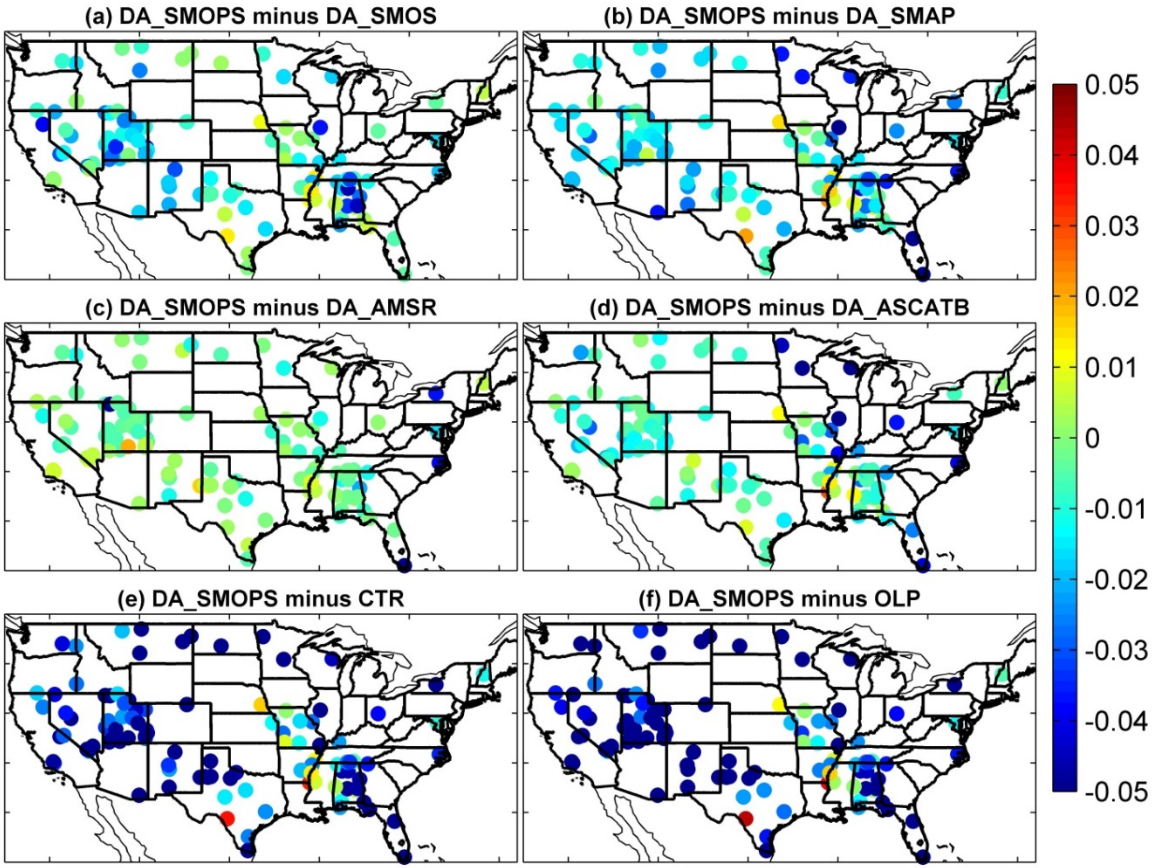
An Inter-comparison of Noah Model Skills with Benefits of Assimilating SMOPS Blended and Individual Soil Moisture Retrievals

Jifu Yin (UMD-CICS, NOAA-STAR); Xiwu Zhan (NOAA-STAR), Jicheng Liu (UMD-CICS, NOAA-STAR), Mitch Schull (UMD-CICS, NOAA-STAR)

CTR: natural state of the Noah LSM;
OLP: model runs with perturbed forcing data;
DA: model runs with benefits of data assimilation.
The DA_SMOPS assimilates the SMOPS blended SM data, while the DA_SMOS, DA_SMAP, DA_AMSR, DA_ASCATA, and DA_ASCATB assimilate the SMOS, SMAP, AMSR2, ASCATA and ASCATB retrievals, respectively.

Significant improvements of assimilating individual and blended satellite SM retrievals on model SM simulations versus the OLP are evident with reducing the SCAN observations-based RMSE.

Compared to the individual SM assimilations, model SM estimations with benefits of *assimilating the SMOPS blended data provide the more remarkable improvements* in surface soil layer.



Differences in SCAN observations-based RMSE for 0-10 cm soil layer during 1 April 2015 -30 June 2017 period. *Site in blue indicates assimilations of SMOPS blended soil moisture perform better.*

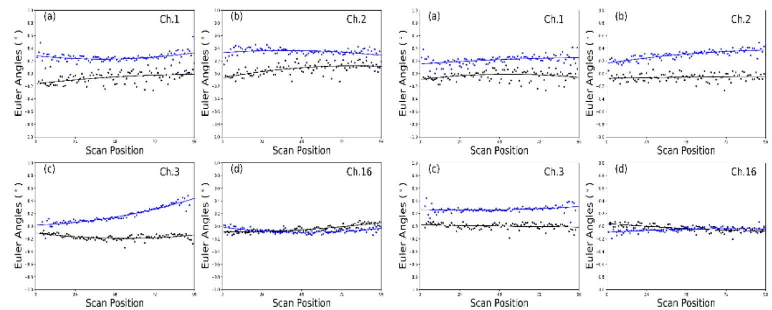
Comparison of Geolocation Accuracy between ATMS on SNPP and NOAA-20

Jun Zhou (ESSIC), Hu Yang (ESSIC), Ninghai Sun (NESDIS)

- An algorithm is developed to retrieve boresight pointing error of ATMS onboard SNPP and NOAA-20
  - A mathematical model is built to link Earth surface point to beam vector in spacecraft frame.
  - Coastline inflection point method is refined to assess geolocation error. It is disclosed that the boresight pointing error of ATMS on both satellites have scan-angle dependent feature, which cannot be corrected by a single set of Euler angles.
  - The objective function is built and the L-BFGS-B algorithm is used to retrieve the boresight pointing error in terms of Euler angle roll and pitch at each FOV position.
- The retrieved Euler angles are further applied to operational process to enhance the on-orbit geolocation accuracy of ATMS onboard both satellites
  - The correction matrices are built through the Euler angles and then applied to operational geolocation process.
  - After correction, the scan-angle dependent feature in geolocation error is largely removed. .
  - For ATMS on NOAA-20, the total geolocation error at nadir before/after correction is 3.7/1.1 km at K band, 4.8/1.2 at Ka band, 4.0/0.6 at W band, and 0.6/0.3 at G band. While for ATMS on SNPP, the numbers are 3.9/0.9 at K band, 6.2/1.6 at Ka band, 3.4/0.1 at W band, and 1.9/0.5 at G band.

Retrieved Euler angles of ATMS onboard SNPP and NOAA-20

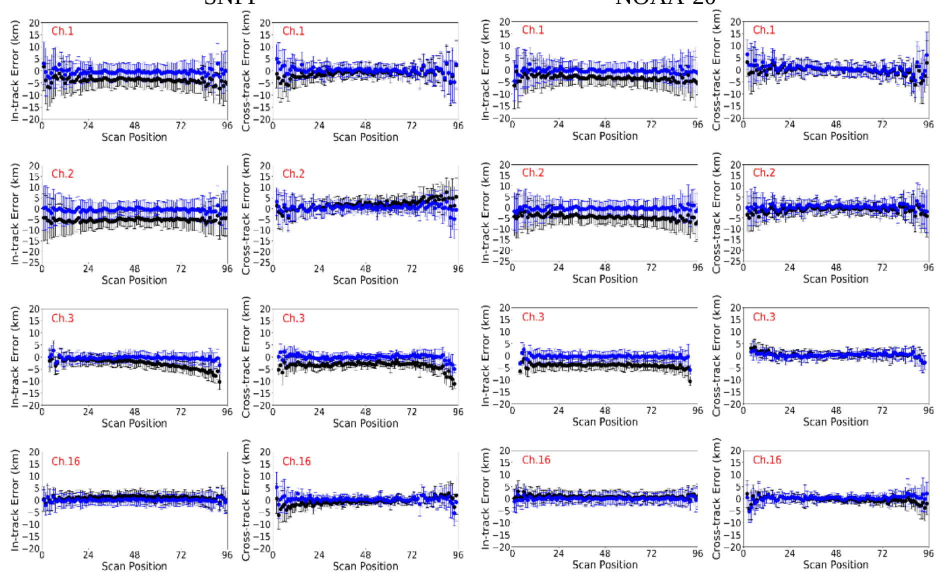
SNPP NOAA-20



- Roll
- Pitch

ATMS geolocation error before and after correction

SNPP NOAA-20



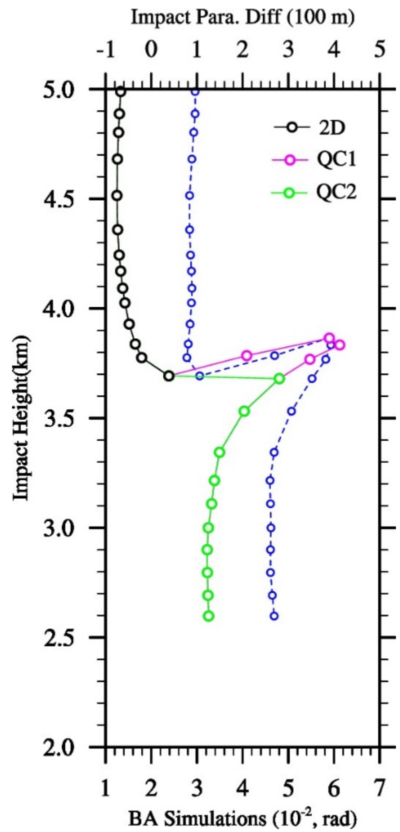
Before correction After correction

Bending Angle Raytracing Operator with Limited Ray Path for COSMIC-2 RO Data Assimilation

—— X. Zou and H. Liu

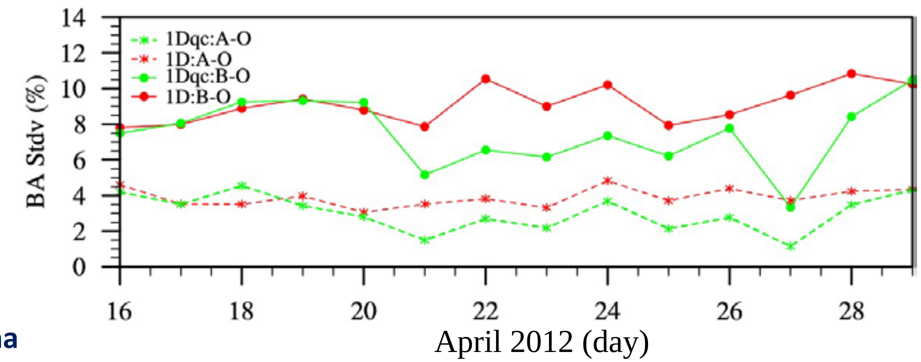
- A limited-path-length raytracing operator — Integration of the ray equation over a limited ray path length (250-400 km away from the perigee) gives the highest accuracy (bias=0) and precision (std.<1%) for both simulations and data assimilation
- The physically based quality control on the occurrence of multipath simulations improved COSMIC data assimilation results (analyses and forecasts of water vapor) using either the 1D or the 2D observation operators of bending angle in the tropical lower troposphere

Zou et al., 2019: Occurrence and detection of impact multipath simulations of bending angle. *Quart. J. Roy. Meteor. Soc.*, (accepted with minor revision)



A new impact multipath quality control (QC)

- ✓ QC1 removes data within the layer of the multivalued bending angle simulations
- ✓ QC2 removes additional data points if the differences in the impact parameter between the perigee and the LEO satellite are greater than 200 m
- ✓ QC3 removes all data points below the multivalued levels



CICS-NC

- Jim Biard
- Jennifer Dissen (5)
- Kenneth Kunkel (2)
- Ronald Leeper
- Ge Peng
- Olivier Prat
- Jared Rennie
- Tim Schmidt
- Carl Schreck (3)
- Scott Stevens

NetCDF-CF: Supporting Earth System Science with Data Access, Analysis, and Visualization

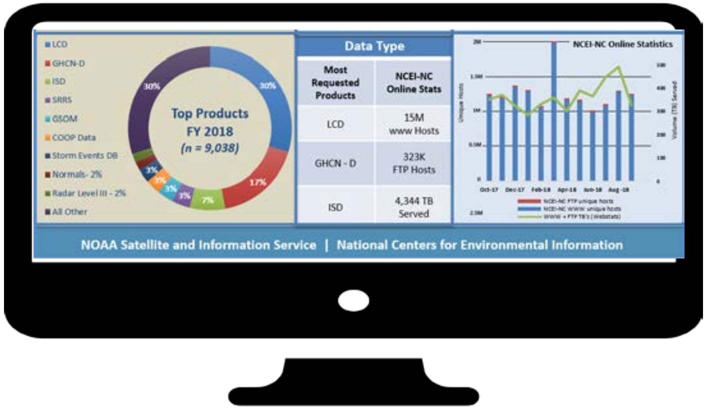
Ethan R. Davis, Charles S. Zender, David Arctur, Kevin M. O'Brien, Aleksandar Jelenak, David Santek, Michael J. Dixon, Timothy Whiteaker, Kent Yang, Jonathan Yu, James C. Biard (CICS-NC), David Hassell

- NetCDF-CF is a community-developed convention for storing and describing Earth system science data in the netCDF binary data format. It is an OGC recognized standard with numerous existing FOSS (Free and Open Source Software) and commercial software tools that can explore, analyze, and visualize data that conform to this convention.Recent projects and community efforts have developed several extensions to netCDF-CF that have or soon will be proposed to the netCDF-CF community. Work on these extensions involved broad participation by members of the existing netCDF-CF community as well as members of ESS domains not traditionally represented in the netCDF-CF community.
- Several of the extensions that are furthest along the development / proposal / acceptance process include:
  - The Geometries proposal (which has been accepted by CF) allows Hydrologists to represent, e.g., river flow data for a network of river segments as well as precipitation for a collection of drainage basins.
  - The Satellite Swath proposal supports satellite remote sensing scientists to represent satellite swath data in the original instrument viewing geometry.
  - The CF-Radial proposal supports storing radar and lidar data in polar coordinates and with metadata important to represent data from pulsed, scanning instruments.
  - The netCDF-LD proposal enables encoding Linked Data descriptions in netCDF files with explicit bindings to conventions, vocabularies and other online Linked Data resources.
  - The Group proposal enables data and metadata to be stored in a way that captures hierarchical directory-like structures.
- The presentation provides an overview and update of this work. It presents some of the data analysis and visualization tools that have been prototyped as well as work to improve performance and usability.

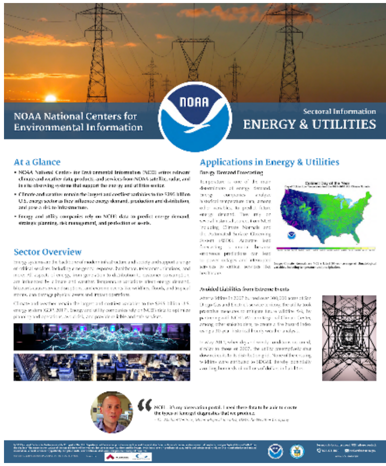
Exploring and Advancing Customer Engagement at NOAA National Centers for Environmental Information

Annette Hollingshead (GST), Michael J. Brewer (NCEI), Najimah Jones (GST), and Jenny Dissen (CICS-NC)

- NCEI Information Services and Engagement
  - Leads to understanding how customers use NCEI data
  - Understanding leads to insights about benefits to the U.S. economy
  - And understanding of deeper impacts to other sectors

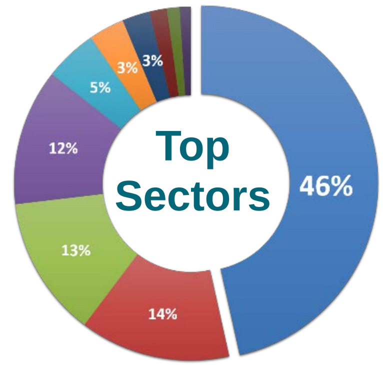


- NCEI Activities in Engagement
  - Customer analytics
  - Applications and benefits through videos and reports
  - Sectoral impacts through reports and case studies



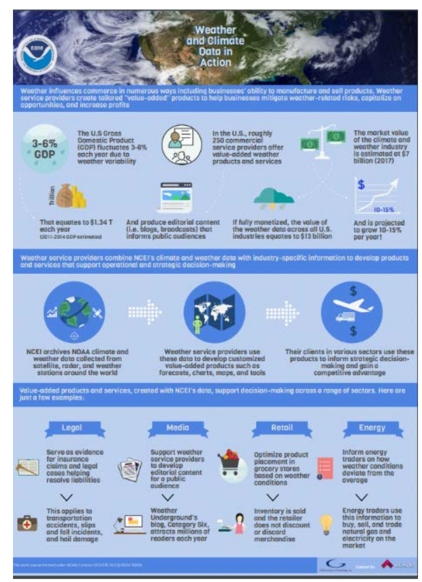
Lessons Learned from Implementation of Customer Requirements Solution

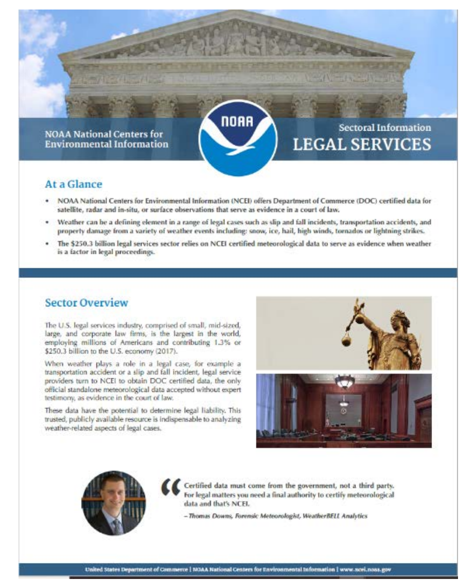
Jenny Dissen (CICS-NC), Annette Hollingshead (GST), Najimah Jones (GST), Michael J. Brewer (NCEI)



- NCEI Information Services Journey
  - Evolving ability to capture and explore use and application of environmental data
  - Inform NCEI science and other priorities
  - Explore deeper connections with select sectors

- Initial data analysis and outcomes
  - Improved sector analysis
  - Identified need for more input via increased internal stakeholder engagement
  - Identified needs for process refinement
  - **Define customer needs early on**

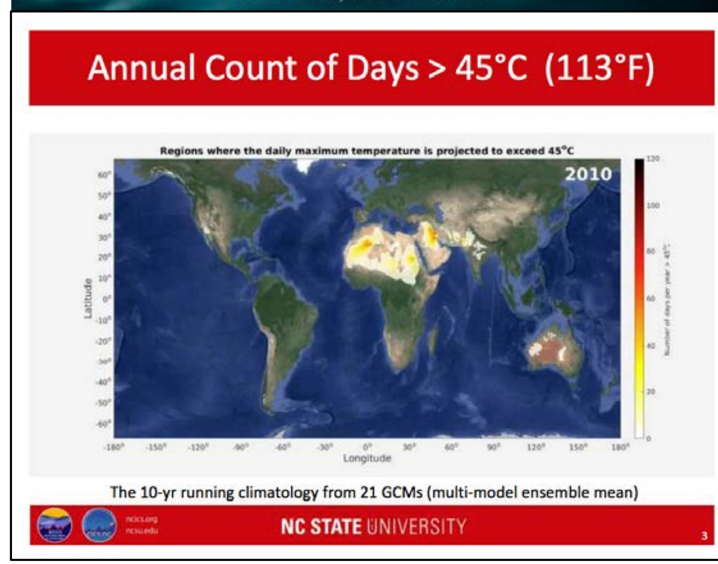




Climate-Induced Displacement: Where Social and Climate Sciences Intersect

Marjorie McGuirk, Eileen Shea, Maya Prabhu, Dane Ratliff, Jenny Dissen (CICS-NC), Edward (Ned) Gardiner (CASE Consultants International)

- Held technical workshop “Climate Induced Displacement”
  - Key drivers of displacement
  - Implications for policy frameworks
  - Data and information needed to support decision-making and planning
  - Use downscaled climate model projections to identify the global regions most vulnerable to extreme temperature in a warming climate
  - Reports and assessments on limits of habitability
  - Opportunities for building interdisciplinary connections between science and policy and legal frameworks.

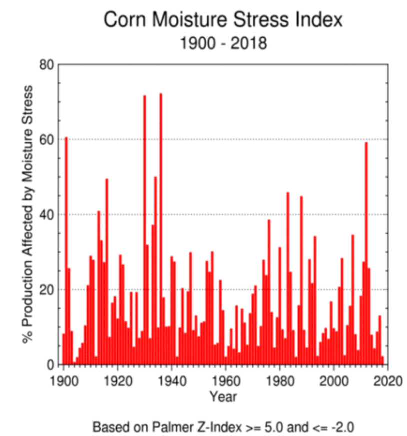


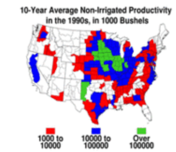
Upcoming NCEI Data Users Conference: An Agriculture Example

Town Hall Discussion

Annette Hollingshead (GST), Najimah Jones (GST), Michael J. Brewer (NCEI) , Jenny Dissen (CICS-NC)

- NCEI Products of Agriculture
  - GHCN Monthly and Daily
  - Integrated Surface Daily and Hourly
  - Radar
  - Satellite Derived NDVI
  - Climate Monitoring
  - US Drought Portal





National Centers for Environmental Information

- Example Uses and Impacts
  - US Corn Growers uses NCEI GHCN Daily to determine how much fertilizer to apply to minimize waste
  - $2.7B/yr saved in application costs

- More Discussions at NCEI Users' Workshop
  - www.ncei.noaa.gov/success

Indo-U.S. Partnership for Climate Resilience (PCR)

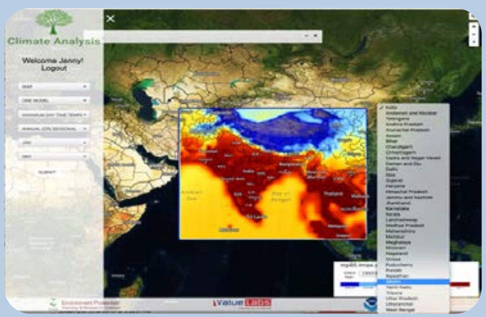
David R. Easterling, Kenneth E. Kunkel (CICS-NC), Jenny Dissen (CICS-NC), Andrew Ballinger, Ashwini Kulkarni, Farhan Akhtar, Katharine Hayhoe, Dr. Sesha Srinivas

As part of the PCR initiative, NOAA and CICS-NC, with its academic partners, conducted and led 4 workshops on development and applications of climate projections and co-led session

- Workshop and engagement with
  - IITM (Pune), TERI (Delhi), EPTRI (Hyderabad)
  - WSDS Summit (TERI Delhi)
- Focus on climate modeling, projections and downscaling, including
  - WCRP CORDEX and NASA NEX-GDDP
  - GFDL-NCPP "Perfect Model" Model Approach to
  - Introduction to Asynchronous Regional Regression Model (ARRM)
- Discussion on Uses and Applications for Decision Making
  - Case Study in Uttarakhand
  - India State Action Plans and Vulnerability Risk Assessments ... cases from several Indian states
  - Sectoral examples: agriculture, infrastructure and urban planning, water resources management

As a Result:

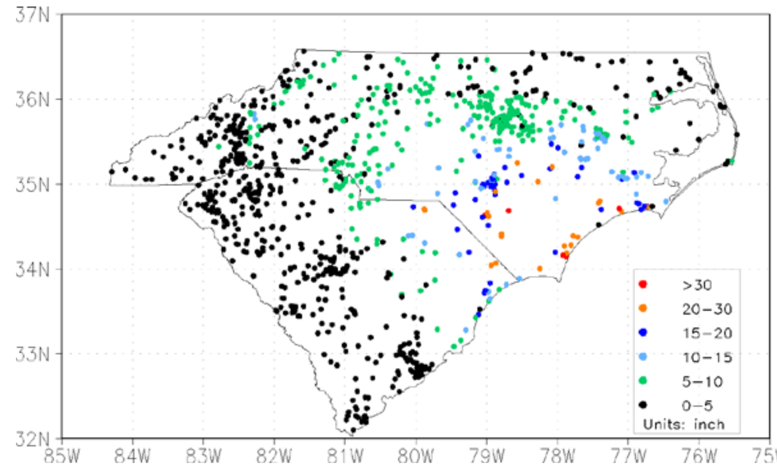
- Co-developing a prototype web-based platform to visualize climate projections
- Building multi-lateral and stakeholder partnership and collaboration for climate adaptation risks, needs and solutions



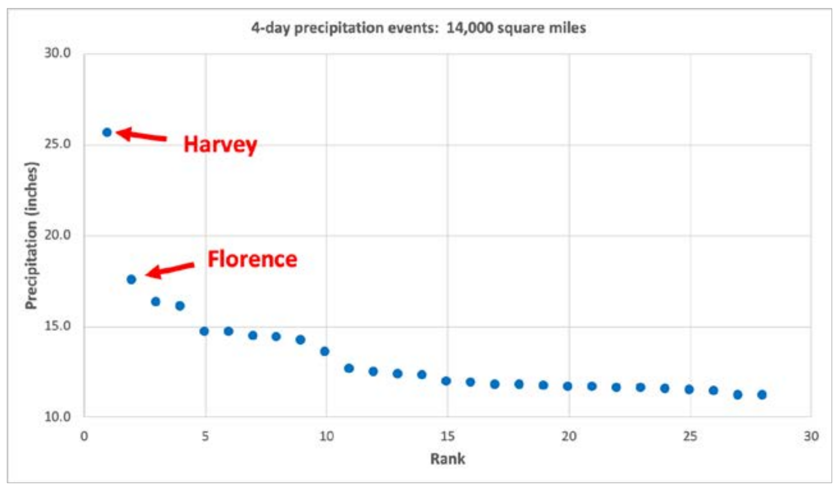
Historical Perspective on Rainfall from Hurricane Florence

Kenneth E. Kunkel (CICS-NC)

- Hurricane Florence rainfall
  - totaled more than 15 inches in most of southeastern North Carolina
  - A few locations received more than 30 inches



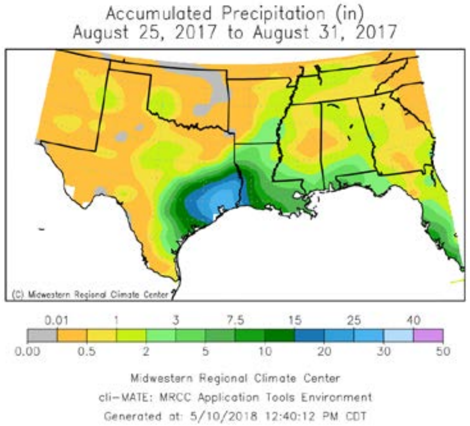
- Historical Perspective
  - Compared area-averaged rainfall for various area sizes for whole U.S. for the period of 1949-2018
  - 4-day duration
  - Florence is the second largest event at an area size of 14,000 sq. miles, after Harvey

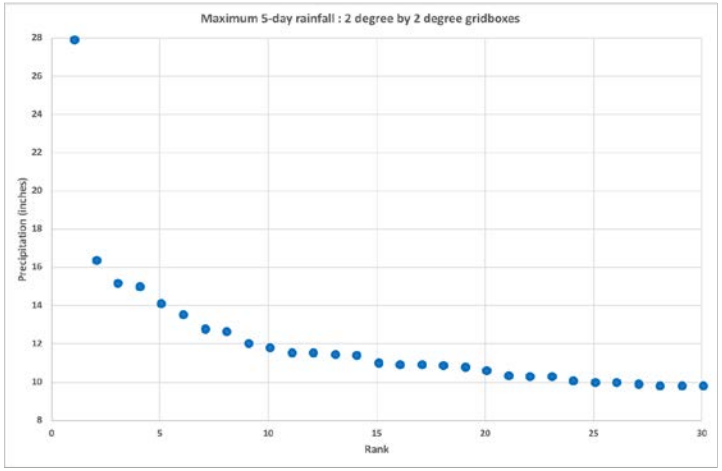


Historical Perspective on Hurricane Harvey Rainfall

Kenneth E. Kunkel (CICS-NC)

- Hurricane Harvey rainfall
  - 40-60 inches at some locations in southeastern Texas
  - Compared area-averaged rainfall for various area sizes for southeast quadrant of the U.S. for 1949-2017; 5-day duration
  - Harvey is largest multi-day event, by far, for area sizes up to at least 100,000 km2
- Statistical Perspective
  - GEV analysis of top 100 events in southeast U.S. for 1949-2017
  - Gulf of Mexico SSTs and CO2 concentration used as co-variates
  - 2017 values increased likelihood of Harvey-level event by at least a factor of 2



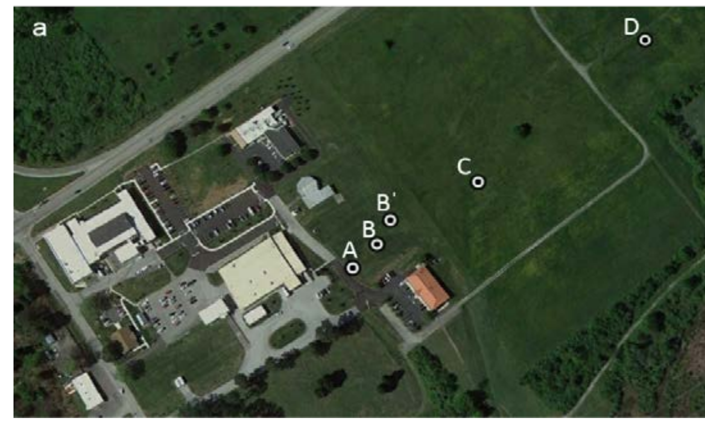


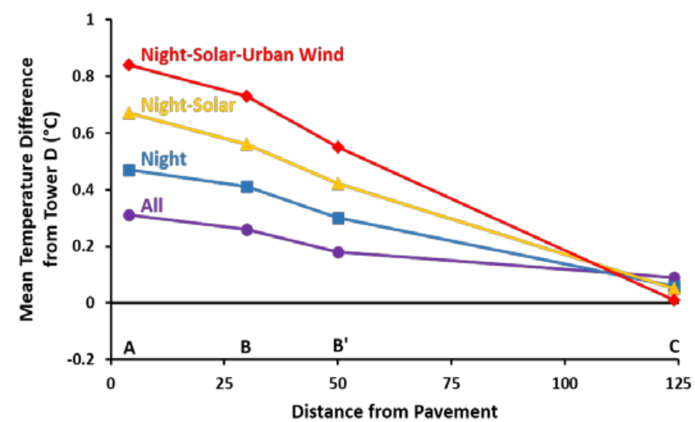
Impacts of Urban Encroachment on Air Temperature Observations

Ronald D. Leeper (CICS-NC) and Michael A. Palecki (NCEI)

- A series of stations were deployed from a urban center to simulated the affects of encroachment on temperature observations
  - Stations were located 4, 30, 50, 124, and 305 m from urban area (A-D)
  - Aspirated and unaspirated air temperatures were compared to observations at station-D
  - Experiment conducted from Nov. 2012 to April-2014

- Urban effects diminished with distance.
  - Urban induced warming was greater during evening than daytime hours
  - Particularly for evenings following sunny days that had light winds from the urban area
  - Aspirated sensors had a slightly larger urban bias than unaspirated instruments



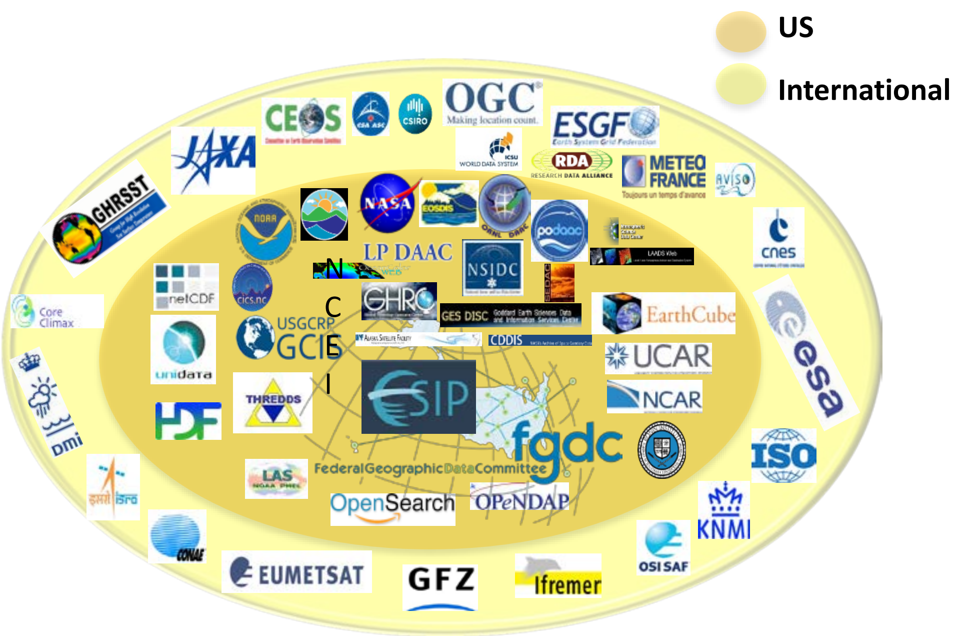


Operational Solutions for Increasing the Value and Usability of Earth Science Data via a Data Quality Framework

David Moroni (JPL), Yaxing Wei (ORNL), Hampapuram “Rama” Ramapriyan (NASA GFSC), Donna Scott (NSIC), Robert Downs (CIESIN), Zhong Liu (GMU), Ge Peng (CICS-NC)

In summary, this presentation intends to provide an expository summary of both the individual and joint multi-year efforts of the NASA DQWG and ESIP IQC.

- An overview of the Data Quality Working Group, one of NASA’s Earth Science Data System Working Groups (ESDSWG)
  - Trajectories and outcomes in 2014-2018.
  - Forthcoming Publications of Standards and Practices.
  - Operational Solutions Master List.
- An overview of the ESIP Information Quality Cluster
  - Many players around the world
  - Scope and Definitions of Information Quality.
  - Overview of IQC Objectives.
  - IQC Community Support.

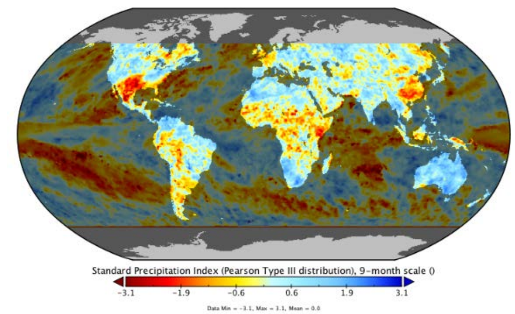


Global Drought Detection using Remotely Sensed Information

Olivier Prat (CICS-NC), Ronald Leeper (CICS-NC), Jessica Matthews (CICS-NC), Brian Nelson (NCEI), Steve Ansari (NCEI)

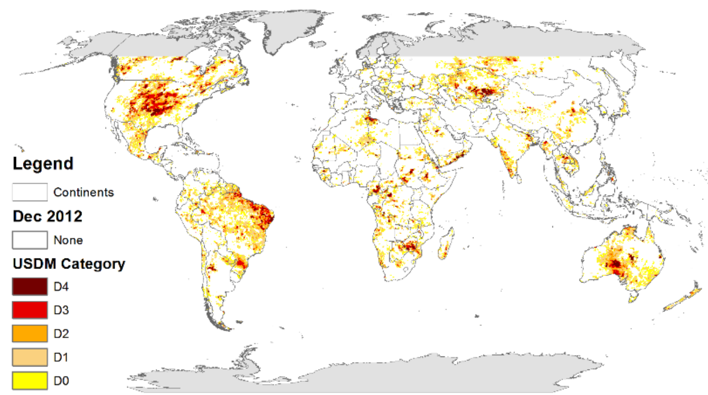
- Monthly and daily Standardized Precipitation Indexes (SPI) were computed over various time scales using the satellite Climate Data Record (CDR) CMORPH .
  - The SPI is evaluated primarily over CONUS where long-term drought monitoring based on in situ data exists such as the U.S. Drought Monitor (USDM).
  - Using geographic information system (GIS) technologies, gridded SPI results were intersected with geopolitical boundaries (i.e., U.S. States and Countries) to compute regional mean and counts of threshold exceedance.

9-month CMORPH SPI: July 2011



- Both monthly and daily SPIs presented the same timing and area for the major drought episodes over CONUS as well as for selected drought events around the globe. Next steps include:
  - Evaluate Monthly and Daily SPI against in situ data (USDM, NCEI nClimGrid, WWDT, GPCC-DI).
  - Use other satellite precipitation datasets such as IMERG (increased spatial) and PERSIANN-CDR (increased period of record).
  - Use routinely updated SPI and NDVI products as a complement to in situ derived drought indices (SPI, SPEI, PDSI).

9-month CMORPH SPI (USDM Classification): December 2012



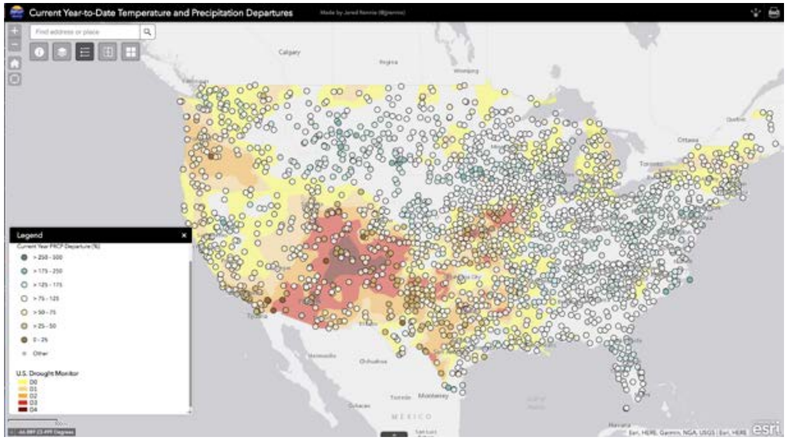
Climate in Your Neck of the Woods

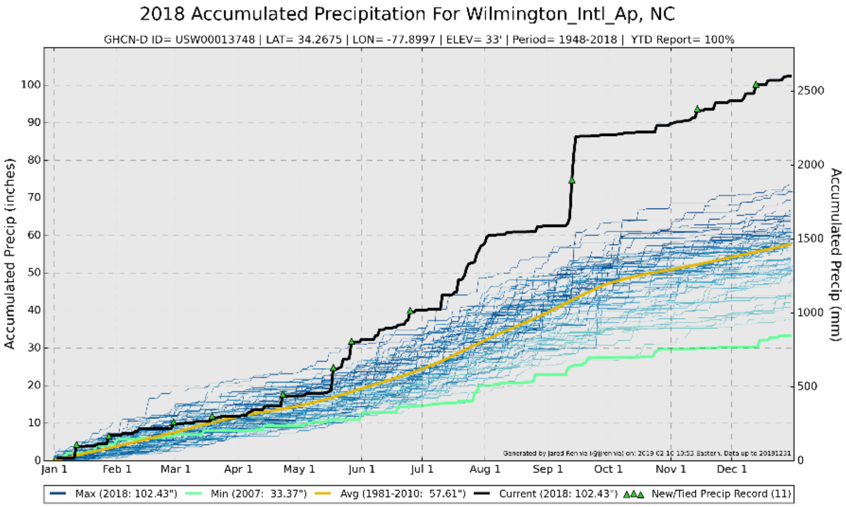
Jared Rennie (CICS-NC)

- ArcGIS Online tool to analyze near-real time temperature and precipitation information for the United States, including Alaska, Hawaii, and Puerto Rico.

- Built using NCEI's Global Historical Climatology Network (GHCN), and software tools include Python and ESRI,

- Users can interact with the map and choose nearby station, which brings up historical information, including a visualization.

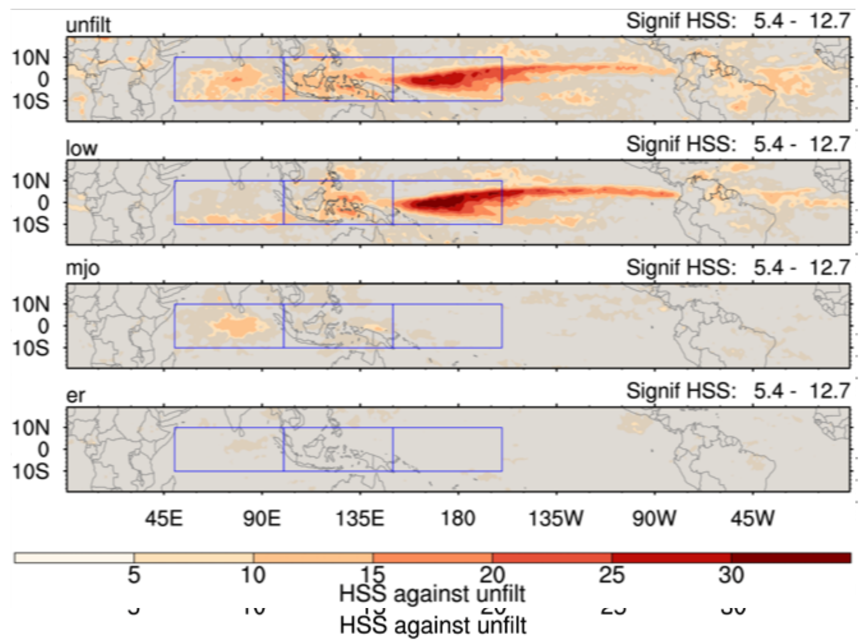




CFSv2 Hindcast Skill for the MJO and Equatorial Waves

Carl Schreck (CICS-NC), Matthew Janiga (NRL), Anantha Aiyyer (NCSU)

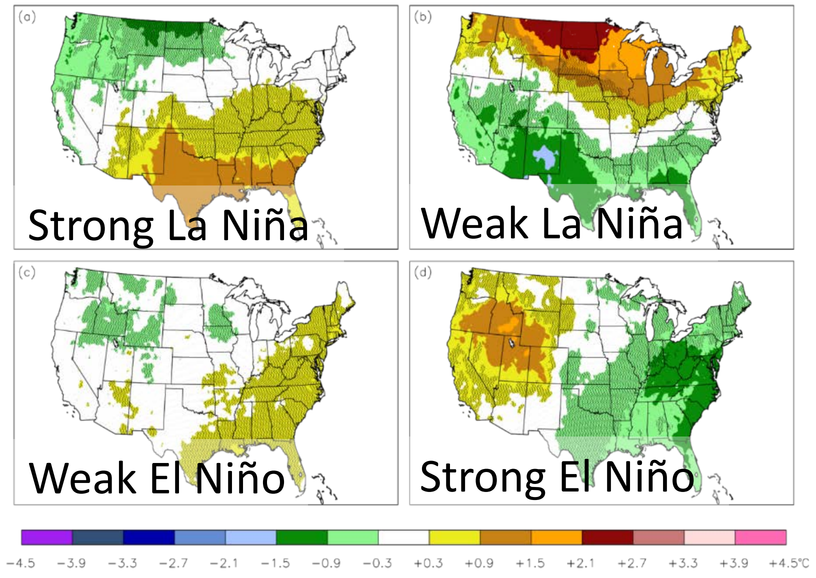
- Much of the skill comes from persistence in the ENSO region
- Low-frequency filtered anomalies actually beats the model there
- MJO helps in the Indian Ocean



ENSO Normals

Carl Schreck (CICS-NC), Anthony Arguez (NCEI), Anand Inamdar (CICS-NC), Mike Palecki (NCEI), Alisa Young (NCEI)

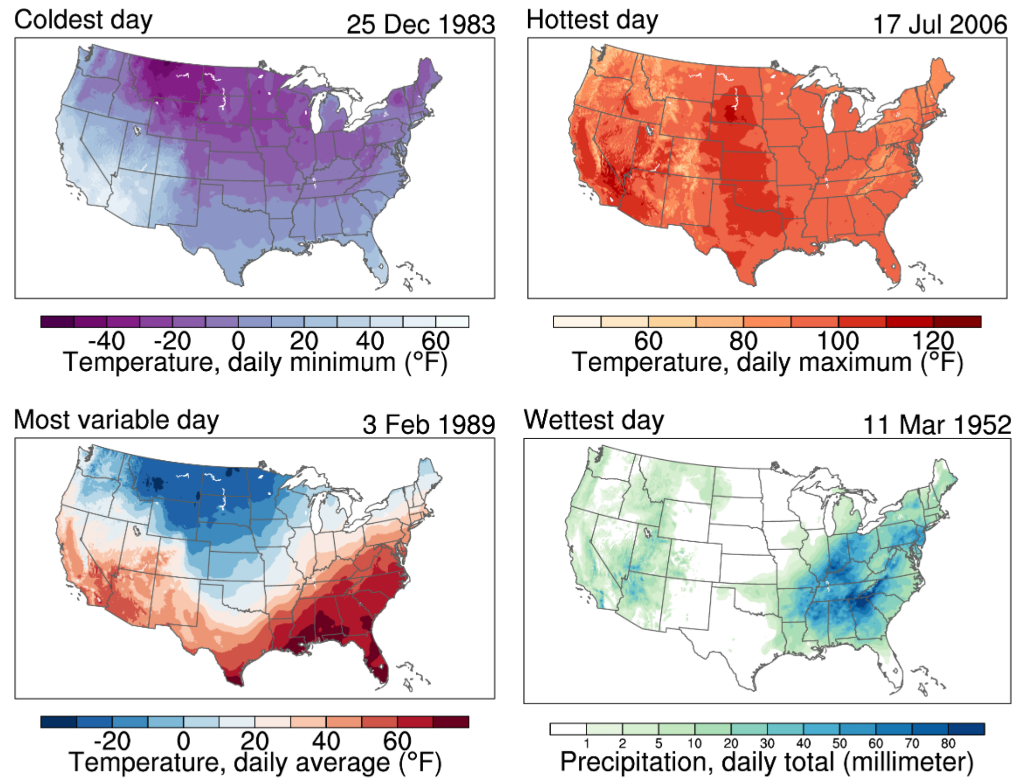
- New method for deriving US Normals that combine the effects of ENSO and trend
- Identifies distinct patterns for weak and strong events in all 12 months
- Providing percentiles along with mean



nClimGrid-Daily Beta Release

Imke Durre (NCEI), Russ Vose (NCEI), Carl Schreck (CICS-NC)

- **Coverage:**
  - Contiguous U.S.
- **Spatial Resolution**
  - Nominal 5-km grid
  - Census tracts, counties, climate divisions, states
  - WFO regions, HUC1 units, NCEI & NCA regions, whole domain
- **Period:**
  - Jan 1951 to present
- **Update Frequency:**
  - Soon to be daily
- **Beta Access:**
  - http://www1.ncdc.noaa.gov/pub/data/daily-grids/



Trends in IFR Conditions at Major US Airports

Scott Stevens (CICS-NC)

- Hourly weather observations (1973-2017) were analyzed for 30 major airports in the United States
  - Specifically focused on cloud ceiling and visibility

- Low-visibility conditions are becoming less common at nearly every location
  - Allows pilots to land visually rather than by instruments
  - Increases capacity for landing aircraft at crowded airports

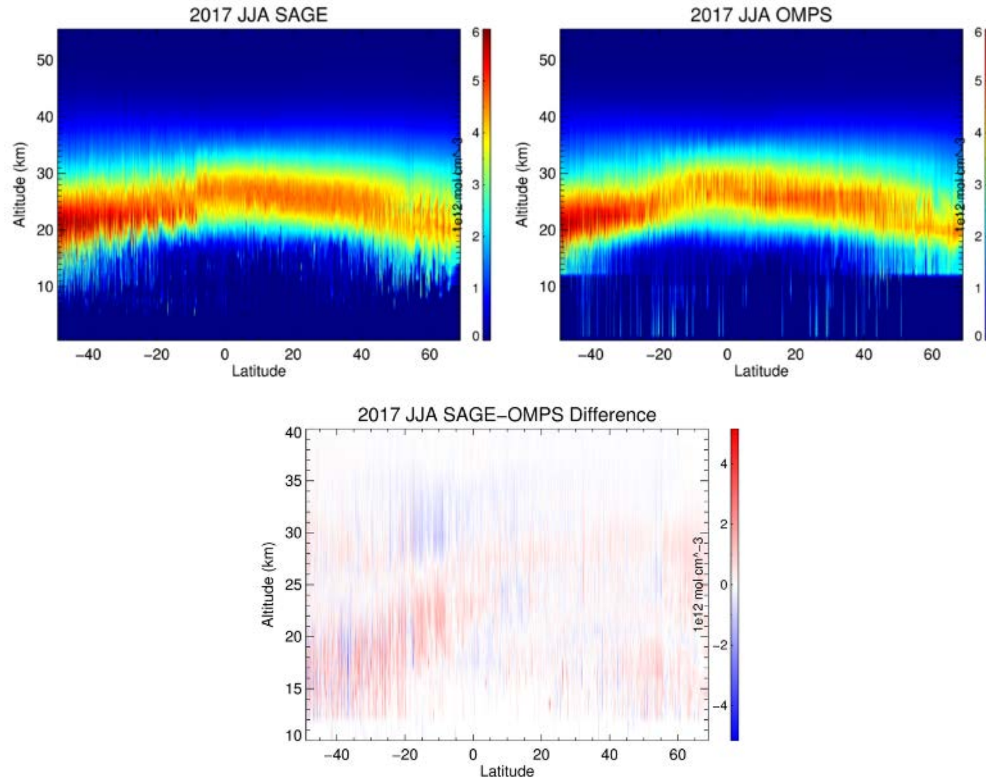
CREST

- Steven Buckner
- Jessica Chiu
- Siena Dante
- Ruben Delgado
- Harold Gamarro
- Matthew Hilding
- Tarendra Lakhankar
- Nicolas Maxfield
- Shakila Merchant (2)
- Lorenzo G. Reyes Sostre
- Jean Pierre Valle
- Khaing Hsu Wai
- Valerie Were

Comparisons of Stratospheric Ozone Measurements from SAGE III-ISS and OMPS-LP

Steven Buckner (CESSRST-Hampton U. Fellow); Larry Flynn (NESDIS), Pat McCormick (NOAA-CESSRST), John Anderson (NOAA-CESSRST)

- Compared over 7,000 profiles from SAGE III ISS with corresponding OMPS-LP profiles
  - Separated into seasons to better examine differences
  - Used all available SAGE III ISS data, from June 2017 through May 2018
- Examined correlation values for individual profiles and seasons as a whole
  - Average correlation of individual profiles ranged between 94.2% and 96.2% for each season
  - Seasonal correlation values ranged between 93.1% and 95.6%
  - Began to examine changes in correlation as a function of distance and time between compared profiles



Figures: Seasonal plots for SAGE III ISS and OMPS-LP for June-July-August 2017 can be seen in the top 2 figures. The bottom figure shows the difference between the 2 sets of profiles, with red colors representing higher SAGE values and Blue representing higher OMPS values.

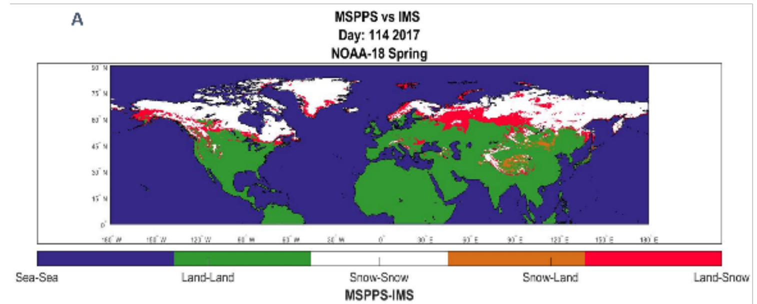
Assessment of Snow Cover Using MIRS, MSPPS, and IMS Measurements

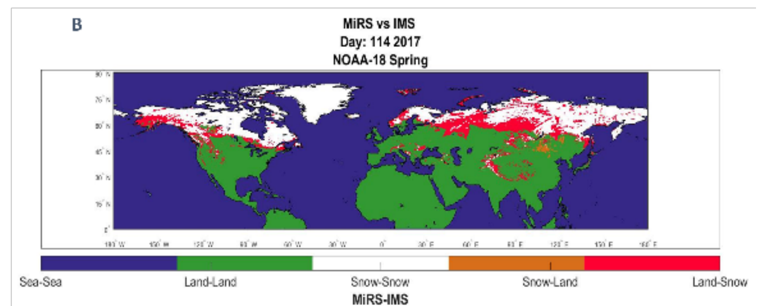
Jessica Chiu (CESSRST-CUNY Fellow), Stephany Paredes Mesa (CESSRST-CUNY Fellow), Tarendra Lakhankar (NOAA-CESSRST), and Reza M. Khanbilvardi (NOAA-CESSRST Director)

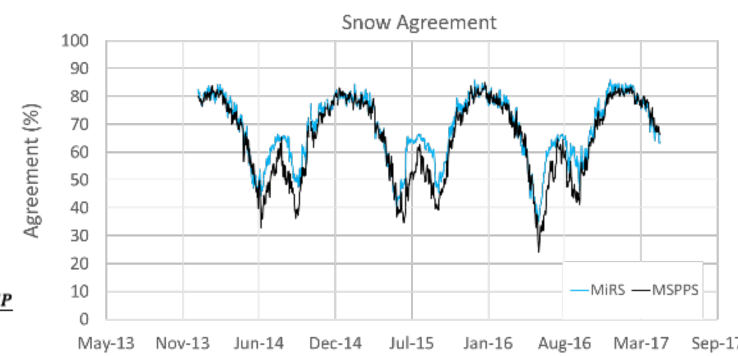
- Snow cover plays an important role in regional weather and Earth's climate system; 98% is located in the Northern Hemisphere and can extend 46 million km^2. Snow helps:
  - Increase the Earth's surface albedo.
  - Recharge reservoirs and rivers in certain regions of the world.
  - Regulate temperature of the Earth's surface.
- The goal of the project is to asses accuracy of the Microwave Integrated Retrieval System (MIRS) and the Microwave Surface and Precipitation Products System (MSPPS) snow cover data with the snow cover analysis made interactively within NOAA Interactive Multisensor Snow and Ice Mapping System (IMS):
  - Each product was remapped into an equal distance coordinate grid of approximately 3 km in the equator to asses the comparison.
  - Each cell grid of microwave product was compare to the IMS and given a classification of False Positive/Negative and True Positive/Negative.
  - Area of each pixel was calculated to asses the comparison of the products as follows:

$$Snow\ Agreement\ (\%) = \frac{A_{TP}}{A_{TP} + A_{FN}}$$

$$Overall\ Agreement\ (\%) = \frac{A_{FP} + A_{TP}}{A_T + A_F}$$



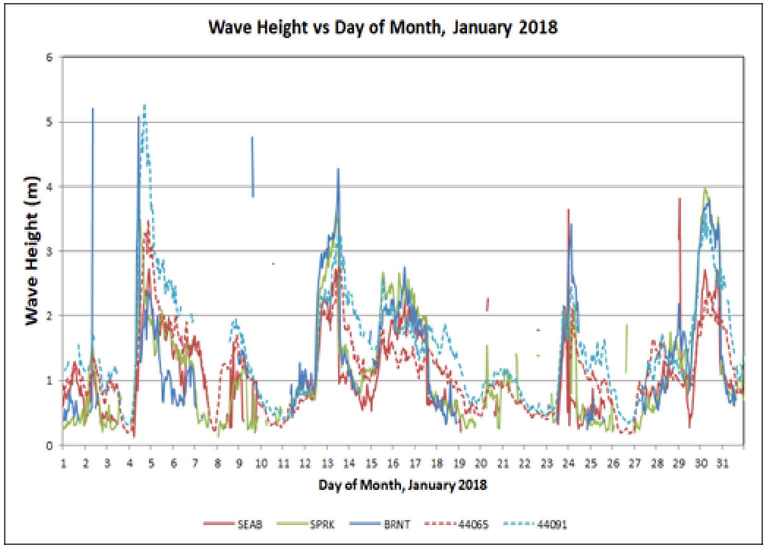




HF Radar and Near-Shore Buoy Ocean Wave Measurement

Siena Dante (CESSRST-CUNY Fellow), Dr. Tarendra Lakhankar (NOAA-CESSRST), Alan Cope (NWS), and Dr. Hugh Roarty (Rutgers)

- Supplementing near-shore buoy data with HF Radar data to increase accuracy of National Weather Service operational marine forecasts
- Must determine the strengths and limitations of HF Radar data in order to use it with confidence
  - Compare buoy and radar data and determine trends in which the data is similar or different
  - Determine why the data might be different
- Buoy and HF Radar data compared for each month (image below) and for time periods of increased wave height
- Determine times when the radar data might be erroneous or missing
- Incorporate data from Jason satellites to further compare the data



Ad-Hoc Ceilometer Evaluation Study (ACES): Mixing Layer Heights and Network

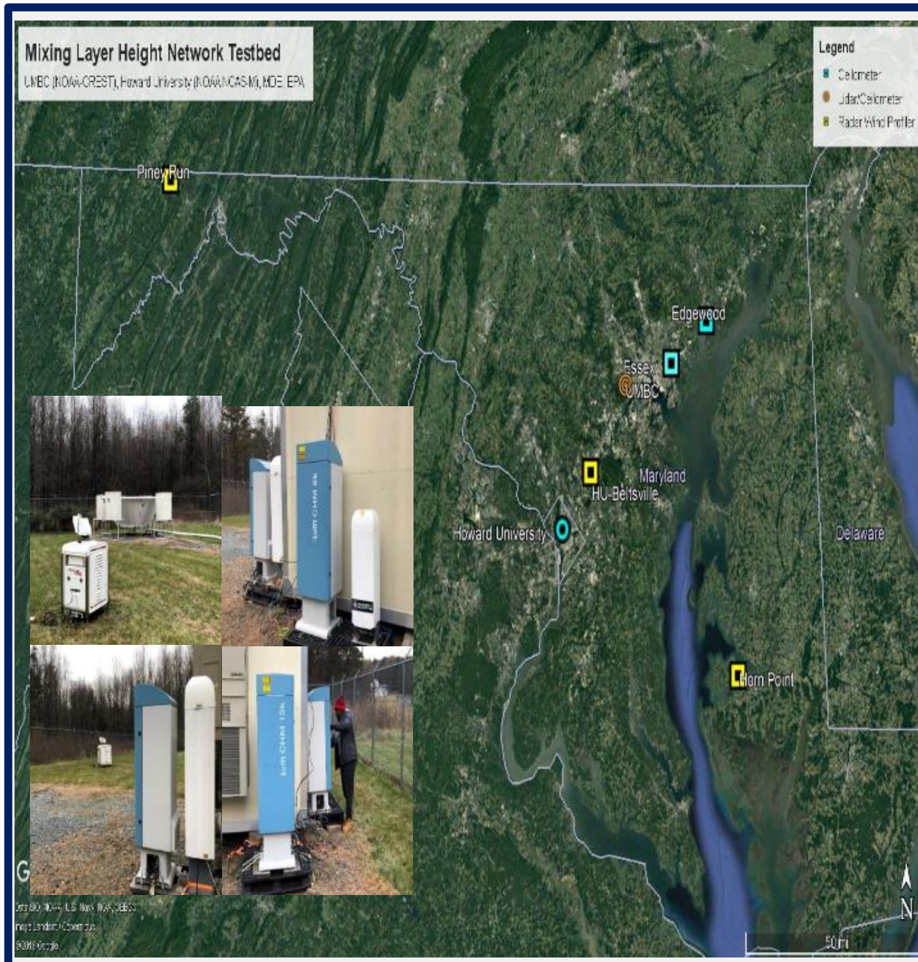
Ruben Delgado (UMBC/JCET, NOAA CESSRST), Vanessa Caicedo (UMBC/JCET), *Belay B. Demoz(UMBC/JCET/NOAA CESSRST and NCAS-M), Innocent Kironji (UMBC/NCAS-M), Jenna Westfall (UMBC/JCET), Ben Ireland (UMBC/JCET), Ricardo Sakai (NCAS-M), Micheal Hicks (NWS), Dennis Atkinson (NWS), James Szykman (EPA), M. Woodman (MDE), David Krask (MDE)*

ACES Objectives

- Evaluate aerosol backscatter from commercial ceilometers.
- Assess the daytime mixing layer height determination from commercial remote sensing technology .
- What additional information can be gained from remote sensing technology (ceilometer, microwave radiometer, lidar, wind lidars, radar wind profilers, etc), such as elevate. layers aloft and entrainment?

Results

- Software/Firmware retrievals displayed low correlations to radiosonde MLHs and therefore are not recommended for continuous automated MLH retrievals.
- A Haar wavelet algorithm including clouds signal identification and removal, continuation parameters, and dual nighttime retrievals is recommended for the consistent automated retrieval of the MLH across varying ceilometer instrumentation.
- Additional studies to aid in the implementation of algorithm constraints are suggested for the algorithm application that will improve diurnal and seasonal retrievals, and retrievals in complex planetary boundary layer environments.



Evaluating Urban WRF-Solar for photovoltaic power forecasts in New York City

Harold Gamarro (CESSRST-CUNY Fellow), Jorge E. Gonzalez (CESSRST-CUNY), Luis Ortiz (City College of New York)

NOAA EPP Scholar Harold Gamarro won the best poster Award

- Urban Solar forecasts were validated using the WRF model using the following parametrizations:
  - WRF-Solar
  - Building Environment Parametrization
  - Building Energy Model
- Photovoltaic Power forecasts maps were created in NYC using the WRF output variables including:
  - Three components of solar irradiance (GHI, DNI, DIF)
  - Temperature
  - Wind

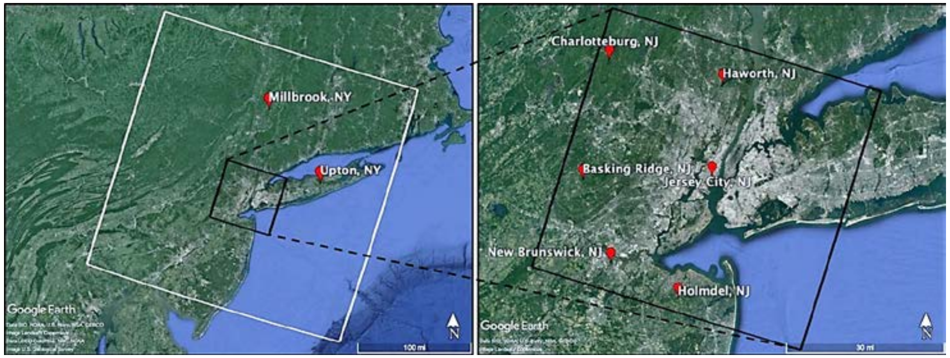


Figure 1: Map detailing the location of all the meteorological stations used for validation (a-left) Two stations within the 3km x 3km domain as shown with the white outline (b-right) Six stations within the 1km x 1km domain as shown with the black outline

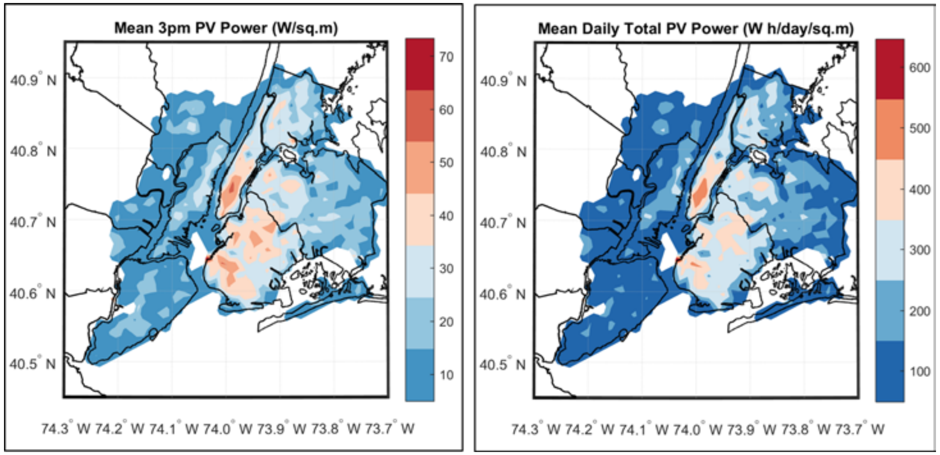
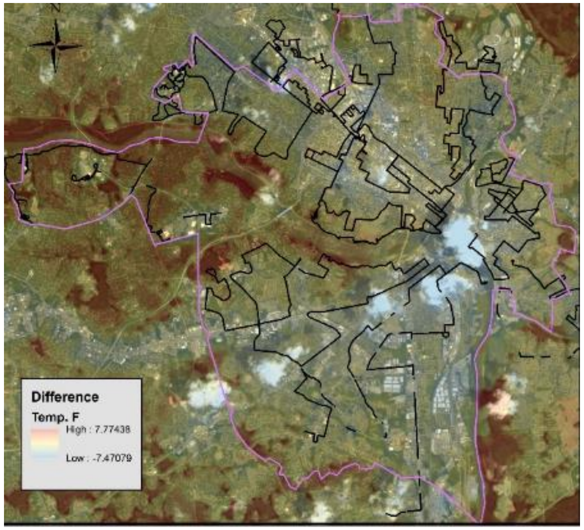


Figure 2: PV Power maps over NYC

Analysis of the Urban Heat Island Effect on LST in Richmond, VA

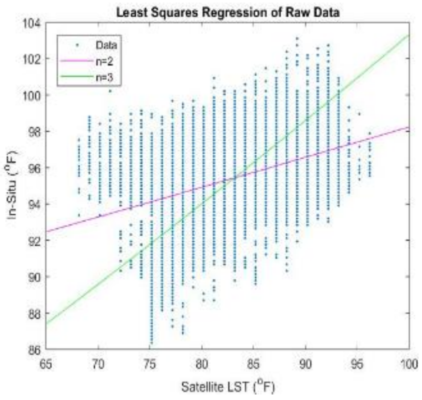
Matthew Hilding (CESSRST-UTEP Fellow); Hunter Jones (NOAA CPO), Miguel Velez-Reyes (CESSRST-UTEP)

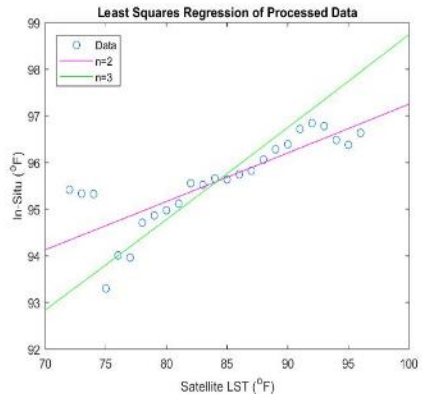
- NERTO Project by Matthew Hilding in Summer 2018 at NOAA CPO
  - Goal: study the correlation between the measured air temperature from in-situ data and Land Surface Temperature (LST) from remote sensing to assess Urban Heat Island (UHI) effects.



Predicted minus the in-situ Air Temperature. The black lines represent the transects from measurements, and the magenta line is Richmond county.

- Methods and Results
  - Air temperature data was collected by Dr. Jeremy Hoffman.
  - Landsat-8 LST imagery
  - Multiple regression models were evaluated wit best model ($R^2 = 0.67$)
  - $\text{Prediction} = 2.83 \cdot 10^{-5} \times (LST +$



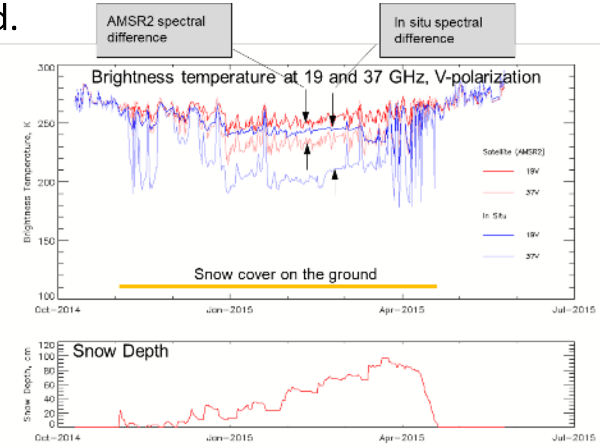


CREST-SAFE Field Experiment: Comparison and Validation Remote Sensing Observations of Snow Surfaces

Tarendra Lakhankar, Peter Romanov, and Reza Khanbilvardi
NOAA-CESSRST, The City College of New York, New York, NY

- CREST-SAFE establish in 2010 in Caribou ME in premises to regional airport and National Weather Service, Regional Forecasting Center provides data improve, develop and/or validate snow physical and microwave retrieval techniques and field work training for students and testing new instrumentation for research. (https://www.noaacrest.org/snow/)
- These longer time records of field observations can greatly help for calibration and validation of analogous parameters derived from satellites or help in developing inversion algorithms.
- Collected field experiment data present a good source for information for validation of snowpack physical models, microwave RT models, satellite retrieval algorithms. In situ microwave data are realistic: Agreement to AMSR2 is within 3-4 K over snow-free land.

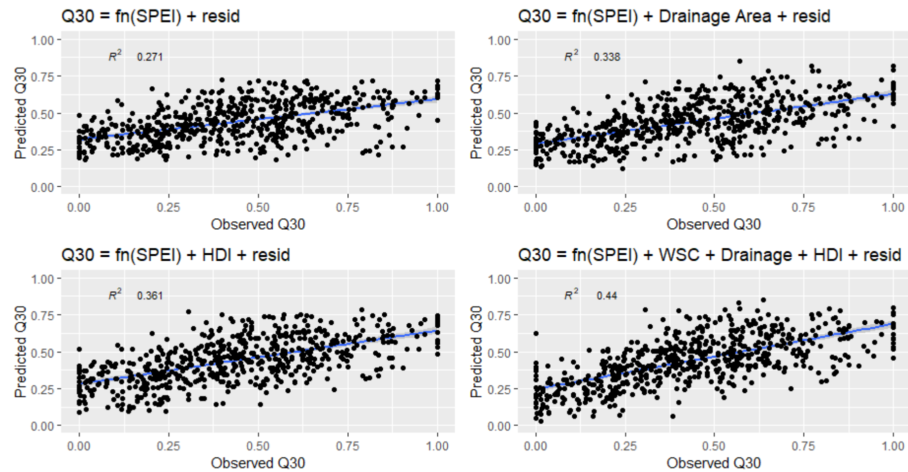
CREST-SAFE	SSMI	AMSR-E/2	TMI	WindSAT	GMI (GPM)
		6.93 VH		6.8 VH	
10.65 VH		10.65 VH	10.7 VH	10.7 VH	10.65 VH
19 VH	19 VH	18.7 VH	19.4 VH	18.7 VH	18.7 VH
	22 V	23.8 VH	21.3 V	23.8 VH	23.8 V
37 VH	37 VH	36.7 VH	37 VH	37.0 VH	36.5 VH
89 VH	87 VH	89 VH	85.5 VH		89.0 VH

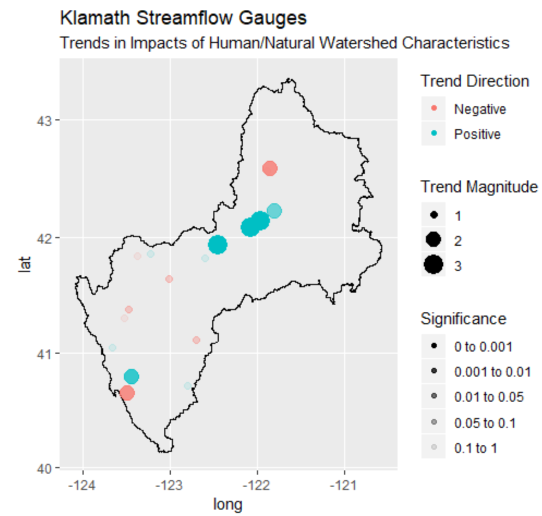


Improving Predictability of Low Streamflow Magnitude

Nicolas Maxfield (CESSRST-CUNY Fellow), Indrani Pal (NOAA CREST Faculty), Cameron Speir (NMFSSWFSC)

- Coupled natural-human factors improve predictability of low streamflow magnitude
  - All characteristics improved fit over SPEI alone
- There are trends in the magnitude of human impacts
  - Gages downstream of dams show positive trend in human impacts

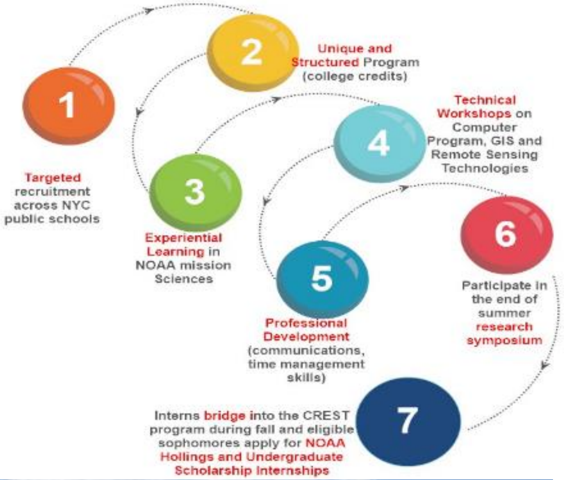


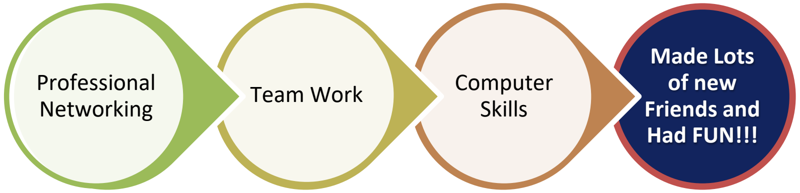


High School Initiative in Remote Sensing of the Earth System Engineering and Sciences (HIRES): Experiential Learning and College Readiness Program for NYC High School Students

Shakila Merchant, CUNY CREST Institute, The City College of New York, New York, NY

- HIRES is a summer – out-of-school program that is geared toward emphasizing “E” of STEM for HS students and prep them for college careers in STEM fields.
- Main objective of HIRES is to motivate, inspire, engage and increase the number of underrepresented minority (URM) HS students in inter-disciplinary STEM fields of Earth System Sciences and Engineering, by introducing curriculum with hands-on experiential modules.
- HIRES is a 7-week program with 70 hours instructional and 110 research contact hours with and provide 3-college credits to all HIRES students through City College of CUNY.
- The program includes technical workshops, experiential and peer-based-project based research opportunities to help students attain “college-and job-ready skill sets”. The program also exposes the interns to professional development and training. It include ample opportunities network and develop/enhance public speaking and communication skills.
- The program culminates with a end-of summer research symposium that provides the interns with an opportunity to showcase their summer research to their peers, mentors, and administrators and sponsoring agencies/foundations.
- HIRES is in existence since 2014 and is funded by the Pinkerton Foundation through American Museum of Natural History, NY’s Science Research Mentoring Program (SRMP).
- Preliminary post-graduate tracking reveals that HIRES alumni go to universities like Columbia, Cornell, Boston U, Yale, MIT, SUNY, U of Michigan and CUNY to pursue college degrees in STEM fields





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

Place-Based Research and Professional Experiential Learning Models through NOAA's Investment

Shakila Merchant and Reza Khanbilvardi

NOAA-CESSRST, The City College of New York, New York, NY

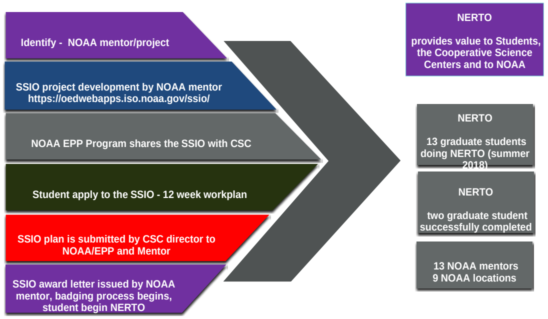
- The presentation focused on the best practice(s) initiated through NOAA's investments by the four NOAA Cooperative Science Centers by creating synergistic partnership between NOAA Federal, Private Sector, and Academic Partners across the country.

- Two such initiatives (1) NERTO (NOAA Experiential Research and Training Opportunities) and (2) JPSS SPARKS (Joint Polar Satellite Systems – Students Professional and Academic Readiness with Knowledge in Satellites were highlighted during the presentation.

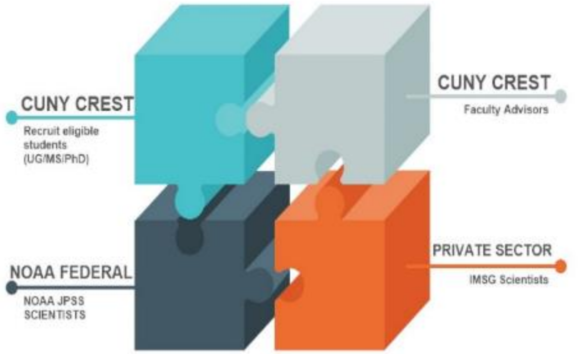
- The talk focused on the Summer 2018 NERTO internships undertaken by the CSC funded graduate students (MS and PhD) from NOAA Center for Earth System Sciences and Remote Sensing Technologies. It also provided the purpose and history of JPSS SPARKS initiative and future plans.

- A preliminary assessment results were shared that indicated value-added to the student training and core competency/professional development to help build a diverse and competent STEM workforce in NOAA Mission Enterprise.

NERTO: Standard Operating Process NERTO: 2018 updates



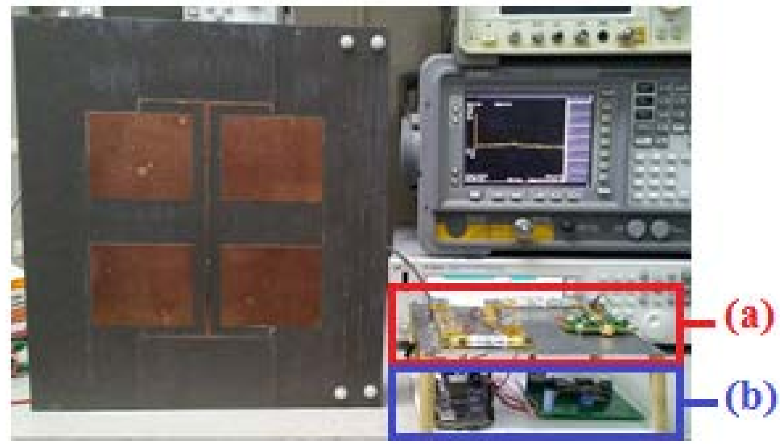
Synergistic Partnership



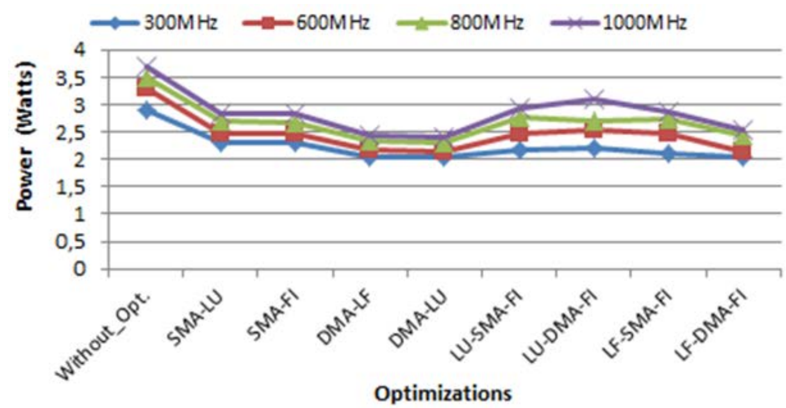
Power and Performance Analysis for a Small L-Band Total Power Radiometer

Lorenzo G. Reyes Sostre[1], Daniel Mera Romo[1], Dr. Rafael Rodriguez Solís[1,2]
[1]Department of Electrical and Computer Engineering, University of Puerto Rico at Mayagüez, Mayagüez and [2]NOAA CESSRST

- Image used for AMS Poster Session of complete L-BAND Radiometer
  - 30cm x 30cm microstrip antenna
  - (a) amplifying system composed of low noise amplifiers and band-pass filters
  - (b) Embedded ARM Cortex A8 Microprocessor
  - Image appeared on AMS poster and official NOAA-CREST Report



- Radiometer Power Consumption chart
  - Information chart that explains the power consumption of radiometer at several frequencies
  - Image appeared on several documents summited to NOAA-CREST and AMS poster.



Hydrological Modeling at Watershed Scale: A Case Study with WRF-Hydro for Western Puerto Rico

Jean Pierre Valle (CESSRST-UPRM Fellow), Jonathan Muñoz Barreto (CESSRST-UPRM), Tarendra Lakhankar (CESSRST-CUNY)

Background

- Some of the largest unit discharge flood peaks in the stream gaging records of the U.S. Geological Survey (USGS) have occurred in Puerto Rico.
- Currently the Flash Flood Guidance divides the island in multiple areas and provides a single value for each one of them. Due to the drastic changes in topography and weather patterns in the island, this guidance value can be improved to create a more accurate representation of the conditions.

Results & Future Work

- A validation of GSF re-analysis precipitation was completed for the period of 2015-2017, the average annual precipitation for the watershed is underestimated annually by 9.01 inches, which is substantial. Still, modeled precipitation shows some correlation and captures most of the low intensity events.
- To improve WRF-Hydro simulations over Puerto Rico and obtain realistic river discharges (cfs), different precipitation forcing will be tested along with other GSF-reanalysis based forcing inputs. As well, different data forcing including the developed AMSR-2 Soil Moisture data for Puerto Rico are going to be tested as initial conditions.

Figure 1. Location of the watershed

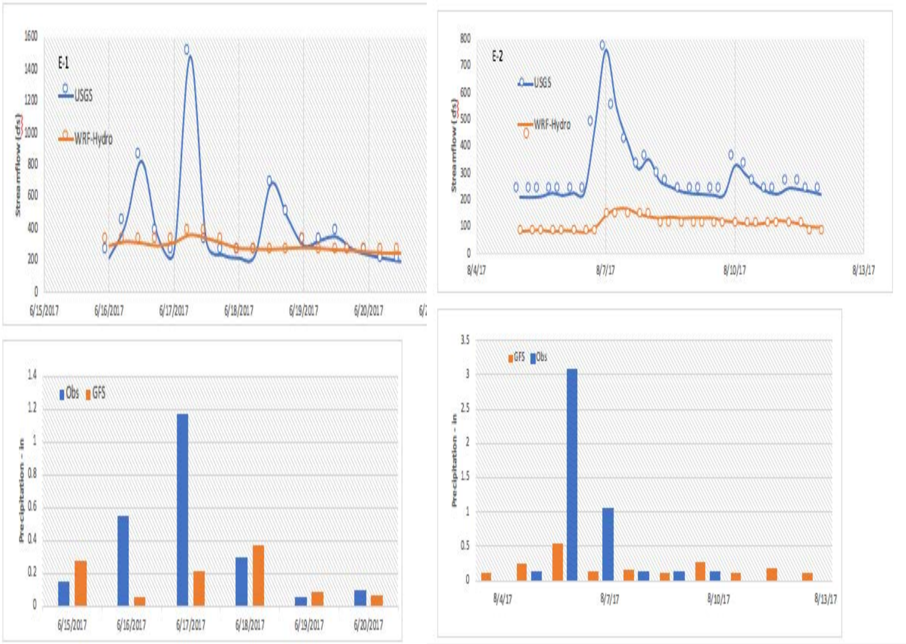


Figure 2. Precipitation and streamflow for the selected events

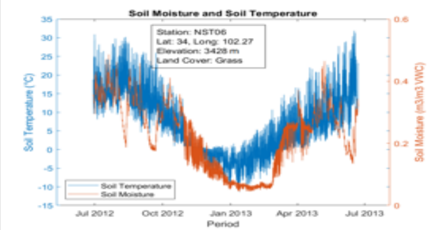
Analysis of Freeze and Thaw Dates in High Mountain Asia using Satellite Remote Sensing

REU Scholar: Khaing Hsu Wai[1]

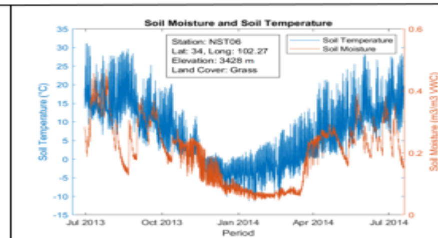
Mentors: Jessica Chiu[2], Tarendra Lakhankar[2], Nir Krakauer[2], Nick Steiner[2] and Kyle McDonald[2]

[1]NSF-REU site at NOAA-CREST, [2]NOAA-CREST Center, The City College of New York, New York, NY 10031 USA

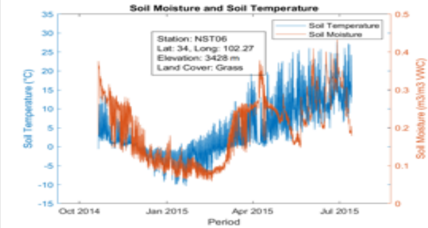
- Soil moisture and temperature measurements over 2008-2016 were obtained from TPE stations in the Tibetan Plateau for the validation of satellite data.
- Soil temperature data is compared with the Daily Freeze/Thaw/Melt (F/T/M) data from NASA ASCAT satellites over the period 2008 to 2016.
- Based on the results, the snow freezes from the months of October to April and thaws in May to around October for these stations.
- Soil moisture and temperature can be different based on elevation, land cover and location topography.
- The topography with the lower elevations such as river valleys and grass land covered areas in humid climate regions are the most affected geographical areas and expected higher melt.
- The topography such as plain, slope and flat areas with higher elevation are the less affected geographical areas and have lesser days of freeze/thaw melt.



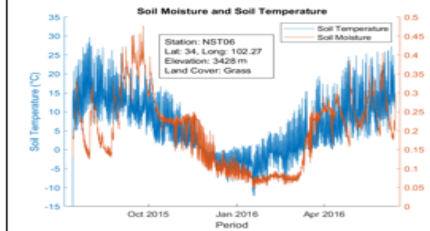
Soil Moisture and Temperature over Period (2012-2013) from Station NST06.



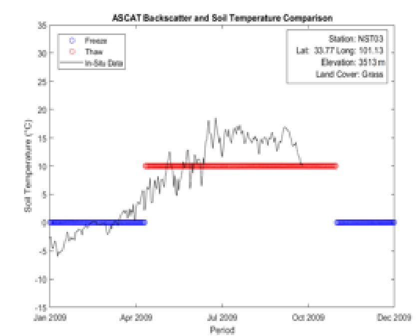
Soil Moisture and Temperature over Period (2013-2014) from Station NST06.



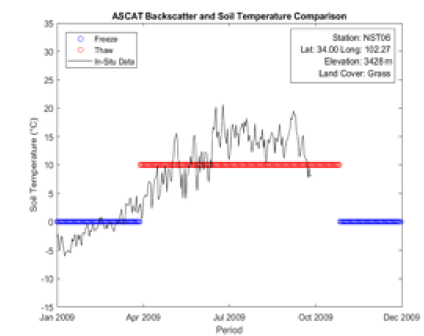
Soil Moisture and Temperature over Period (2014-2015) from Station NST06.



Soil Moisture and Temperature over Period (2015-2016) from Station NST06.



Comparison of ASCAT Snow Freeze/ Thaw data and Soil moisture and Temperature from Station NST03.



Comparison of ASCAT Snow Freeze/ Thaw data and Soil moisture and Temperature from Station NST06.

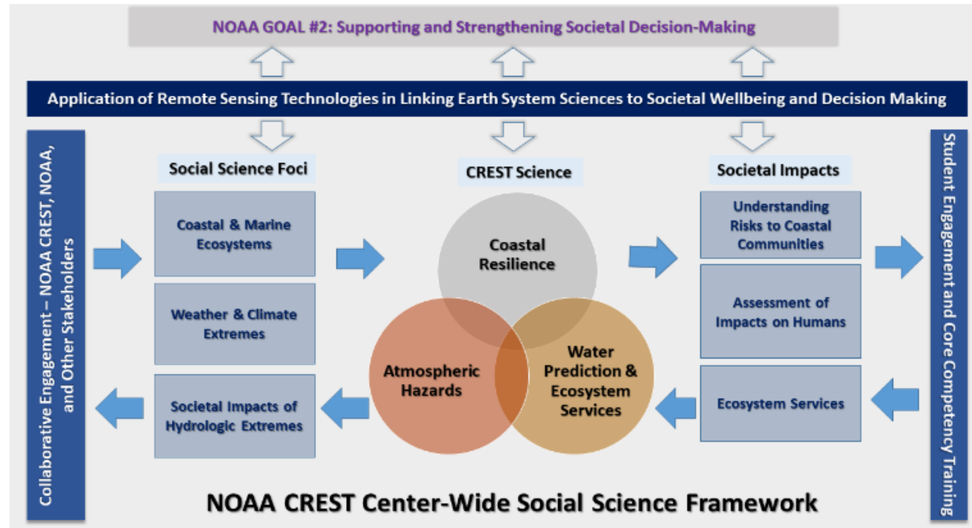
When Disciplines Collide: Integrating Social Science at the NOAA Center for Earth System Sciences and Remote Sensing Technologies

Valerie Were, NOAA-CESSRST, The City College of New York, New York, NY

"…Social science must be an integral component of the Center's education and training and scientific research…" - NOAA Educational Partnership Program, 2016

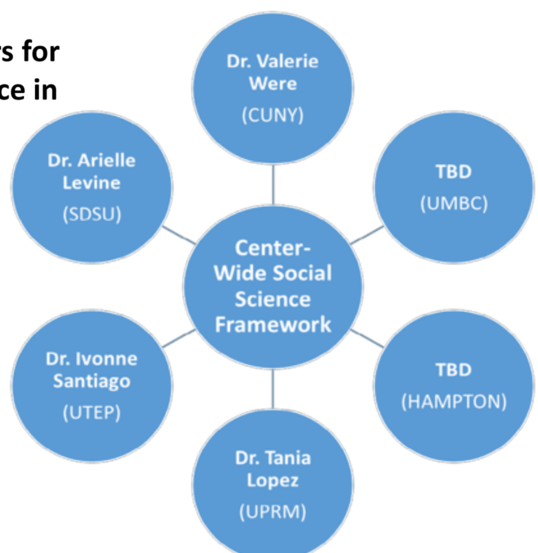
Overarching Goals for the Center's Social Science

1. Impart what Social Science Is (and Is Not!)
2. Demonstrate how NOAA uses Social Science
3. Enhance the Center's student training and research by integrating social science



NOAA CREST Center-Wide Social Science Framework

Coordinators for Social Science in Research



Social Science in Education and Training

NOAA Social Science Basics Mini Course	Student Story Map	Social Science Research Question (as appropriate)

• Agency-developed webinar
• Added benefit of putting social science in a NOAA context
	• Goals are to
	  • Communicate science to a non-technical audience, and
	  • Think about the decision-making implications
		• All students required to link their research to decision making
		• Some students combine social and natural science

CIMSS

- Sam Batzli
- Callyn Bloch
- John Cintineo
- Geoff Cureton
- Jordan Gerth (3)
- Tom Greenwald
- Liam Gumley
- Mat Gunshor (3)
- David Hoese (2)
- Bob Knuteson
- Jung-Rim Lee
- Jinlong Li (2)
- Jun Li
- Zhenglong Li

CIMSS (cont.)

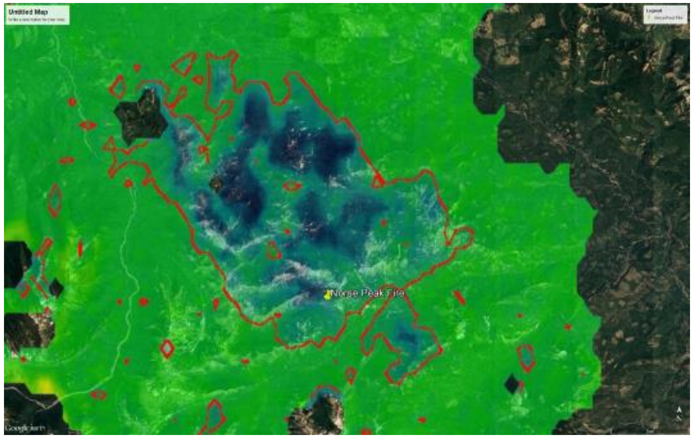
- Scott Lindstrom
- Yinghui Liu (3)
- Graeme Martin
- Paul Menzel
- Jason Otkin (2)
- Christopher Schmidt
- William Leo Smith Sr.
- William Straka III (2)
- Joe Taylor
- Pei Wang
- Anthony Wimmers
- Yunheng Xue

Support for Burned Area Debris Flow Forecasting Using VIIRS NDVI

Sam Batzli, Dave Parker, Russ Dengel, Nick Bearson (SSEC/CIMSS); Ivan Csiszar (NESDIS-STAR); Katherine Rowden (NWS-Spokane WFO)

- Poster: 35EIPT: Part-1 Monday 4pm
  - Described value of VIIRS: low-latency, broad coverage, high frequency, quality spectra, direct broadcast
  - Described Burn Intensity Delta greenness Estimation (BRIDGE) maps made from before/after difference NDVI (Normalized Difference vegetation Index)
  - Visitors expressed concern about the large number of historical burn scars that continue to pose a risk for debris flow events even as new scars accumulate.

- Presentation: 15GOESRJPSS: 4B Wed 8:30AM
  - Was asked to fill-in for absent federal speaker
  - Presented to audience of approximately 50
  - Included more info about burn scar/debris flow forecasting support tools, including adaptation of RealEarth 6.0 and visualization capabilities



Norse Peak Fire: Difference between VIIRS NDVI on 20:43Z September 28, 2016 (pre-burn) and 20:41Z on September 26, 2017 (post-burn). Blue regions indicate reductions in NDVI following the Norse Peak Wildfire. Feasibility study by Pierce, Cisizar, Rowden, Batzli

Montecito, CA, January 7, 2018. Source: "Your Questions About The California Mudslides, Answered." Huffingtonpost.com, By Lydia O'Connor January 11, 2018

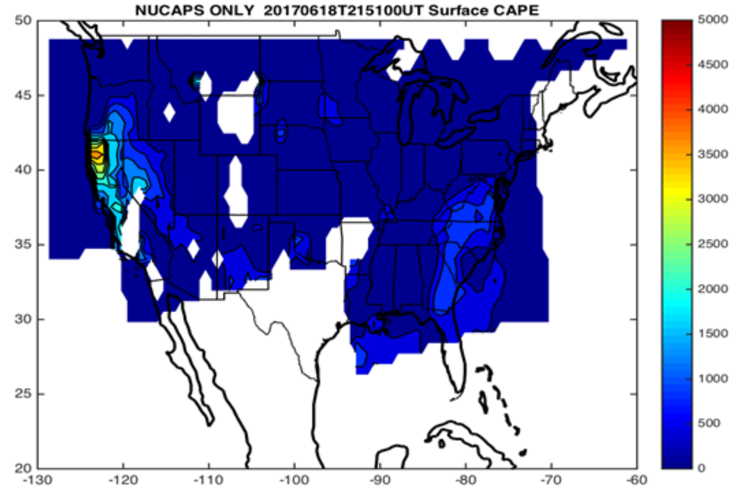
Funding Source: NOAA JPSS PGRR

NUCAPS + MADIS SBCAPE

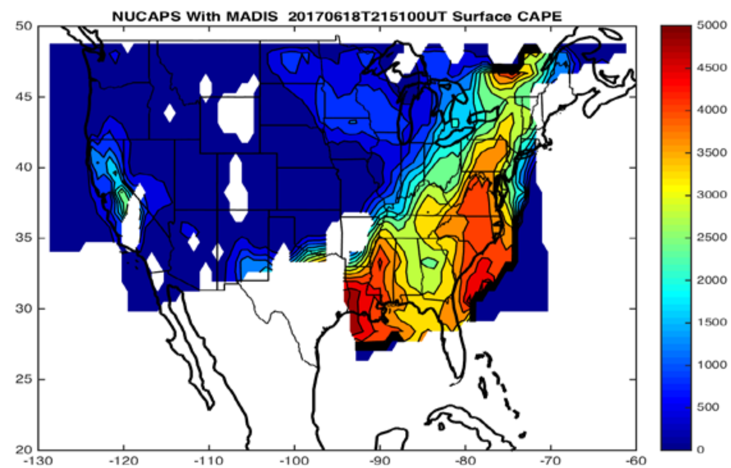
Callyn Bloch, Robert Knuteson, Jessica Gartzke (CIMSS); Antonia Gambacorta, Nicholas Nalli (IMSG); Lihang Zhou (STAR)

- Combined NUCAPS profile with MADIS surface observed temperature and dewpoint
  - Images show case study day 18 June 2017
  - NUCAPS only estimate missed non-zero values of SBCAPE along east coast where storms occurred.
  - Accurate measure of surface temperature/dewpoint lead to an accurate estimate of SBCAPE important in forecasting severe weather
- Use of CSPP NUCAPS allows for near-real time product using Direct Broadcast antennae
  - Using data from 3 sites for complete coverage of CONUS
  - Product currently displayed and running in near-real time on SSEC's RealEarth under the JPSS-NUCAPS tab.
  - https://realearth.ssec.wisc.edu/
- Session: 9R2O: 4B: Improving R2O & O2R in 0-18 Hour Forecast Range: Addressing Frecasters' Needs – Analysis and Nowcast Tools: Part II, Tuesday, Jan 8

NUCAPS only CAPE



NUCAPS+MADIS CAPE

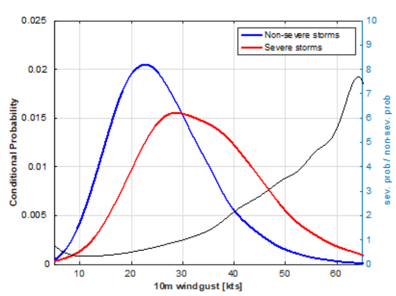


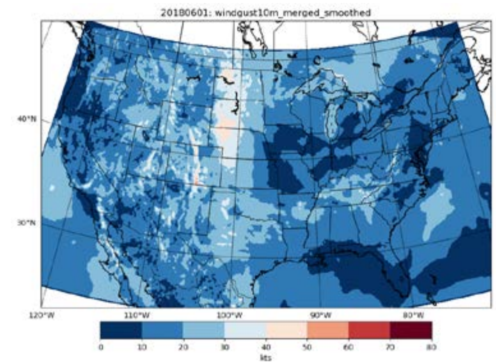
Funding Source: NOAA JPSS PGRR

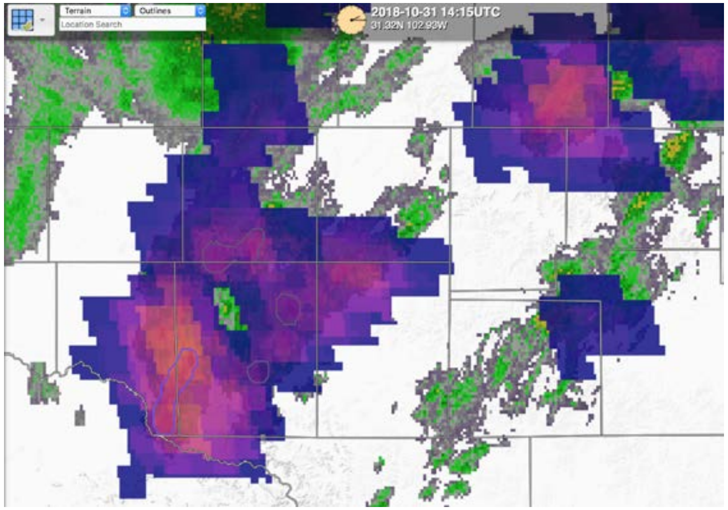
Development, R2O, and O2R of the NOAA/CIMSS ProbSevere Model

Mike Pavolonis (NESDIS); John Cintineo, Justin Sieglaff, Lee Cronce, and Jason Brunner (CIMSS)

- ProbSevere v1 will be operational at NCEP by 30 June 2019
- Sustained NWS interaction has been crucial to model development and R2O
- R2O needs to be more nimble to keep with science development
- ProbSevere development is ongoing and doesn't end with R2O





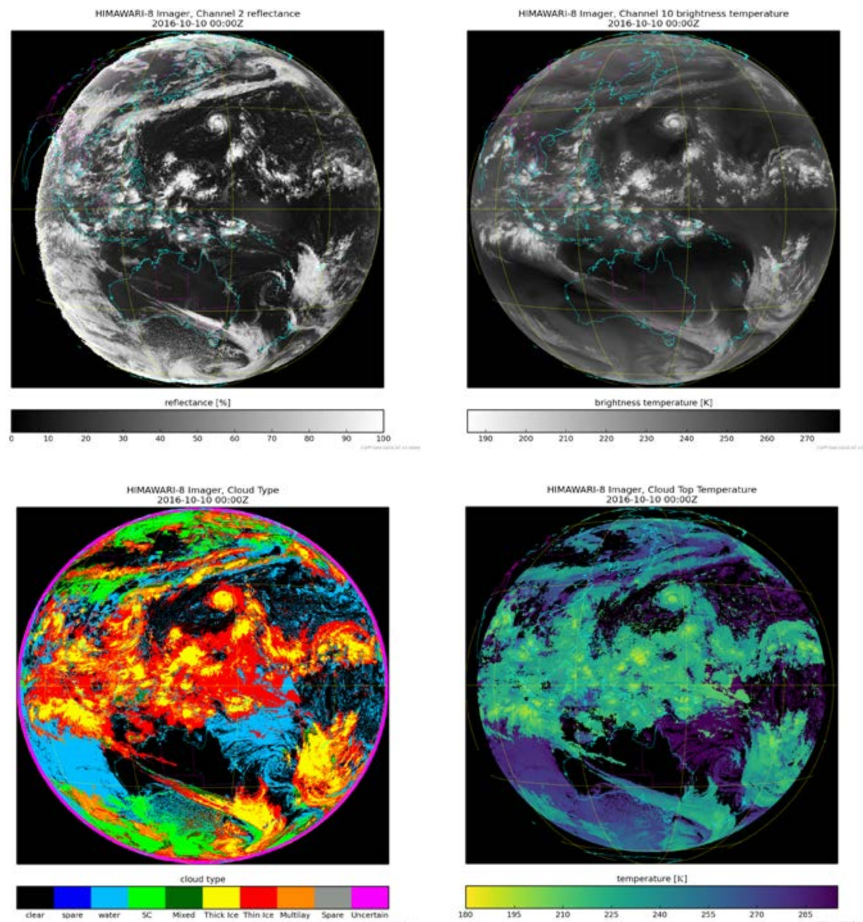


Funding Source: NOAA NWS MDL R2O

Himawari Support In The CSPP-GEO Direct Broadcast Package

Geoff Cureton,(CIMSS)

- CSPP GEO-Geocat package v1.0 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 post- release 1.0:
  - Enhancement quicklook generation.
  - Expected Q1 2019 release.



Funding Source: NOAA GOES-16 and NWS Risk Reduction

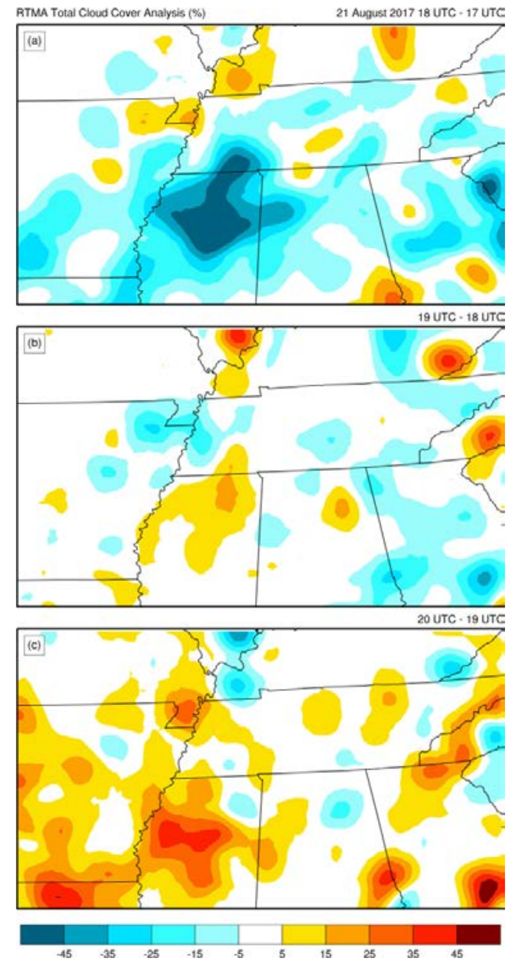
Sky Cover during the 2017 Solar Eclipse

Jordan Gerth (CIMSS)

- **Investigated:** Based on satellite and surface observations, were the National Weather Service (NWS) forecasts adequate in assessing the trend in sky cover during the course of the solar eclipse?

- **Concluded:** The cloudiness decreased ahead of totality, but NWS forecasts of sky cover for the Tennessee Valley did not predict it, even as solar eclipse totality was approaching.

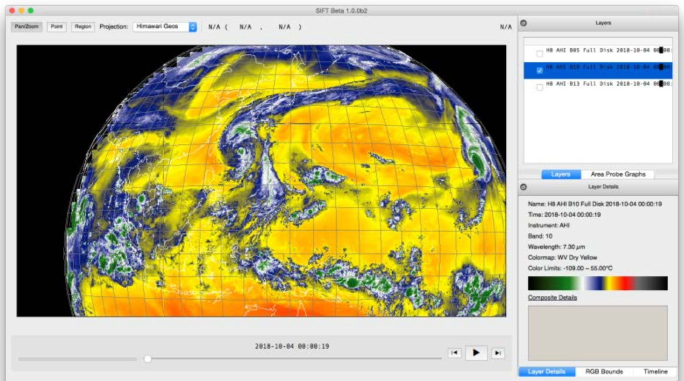
- **Published:** SPIE Journal of Applied Remote Sensing (https://doi.org/10.1117/1.JRS.12.020501)



Funding Source: NOAA NWS

SIFT: A Python-based user interface for visualizing meteorological satellite imagery

Jordan Gerth, Ray Garcia, Dave Hoese, Scott Lindstrom (CIMSS), and Tim Schmit (NOAA)



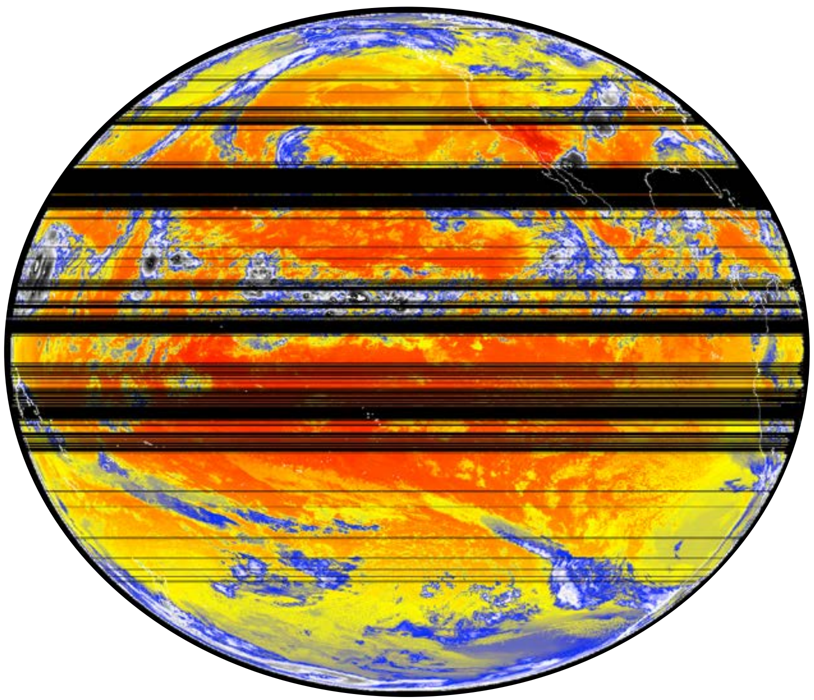
Satellite Information Familiarization Tool

- An easy graphical user interface that enables meteorological satellite users to:
  - Loop across multiple bands or multiple times
  - Create Red-Green-Blue (RGB) composites
  - Calculate arithmetic composite for multiple bands
  - Change or customize color enhancements
  - Compare fields over a user-defined area using a density plot
  - Click to probe layers at a latitude-longitude coordinate
- Open source and free to download:
  - http://sift.ssec.wisc.edu/

Funding Source: NOAA NWS

The Wizard Behind the Curtain?—The Important, Diverse, and Often Hidden Role of Spectrum Allocation for Current and Future Environmental Satellites and Water, Weather, and Climate

Renee Leduc Clarke (Narayan), Jordan Gerth (CIMSS), Ron Marotto (Ventura County), Sidharth Misra (JPL)



Issue: Increasing pressure to share earth sciences and meteorological satellite observing and transmitting frequencies with developing 5G telecommunications networks

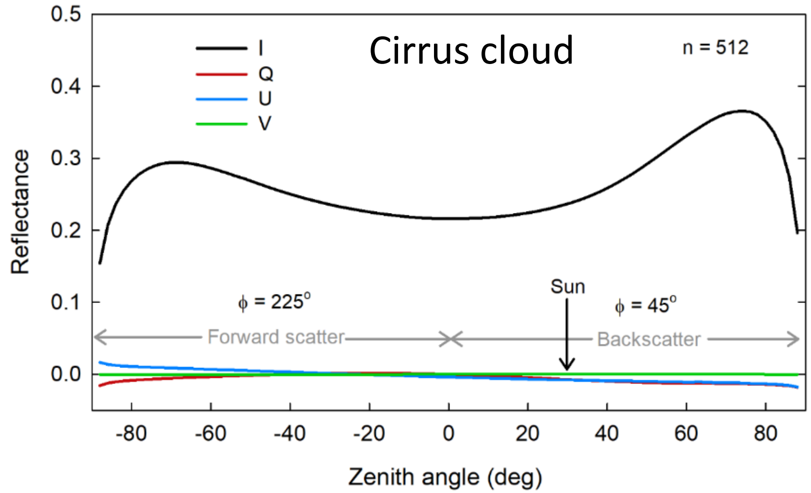
Action: Improve awareness and increase research on impacts of delayed or lost data to weather prediction and warnings

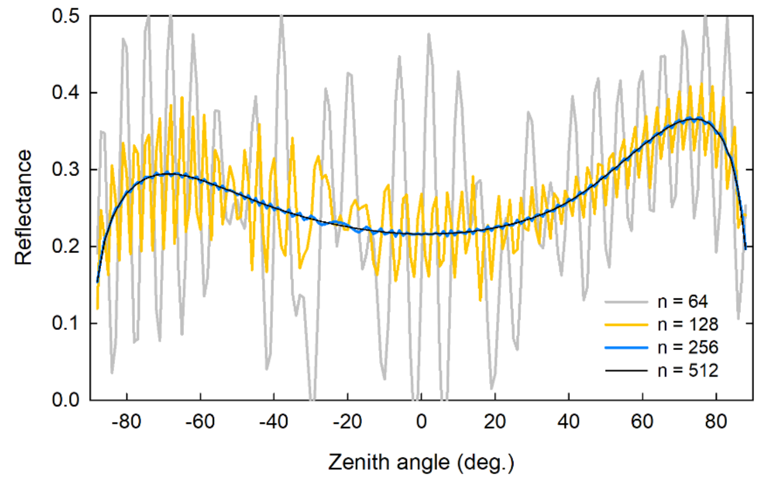
↖ **GVAR Reception Interference**, 6 UTC 17 August 2015

Polarized Radiative Transfer in the CRTM

Tom Greenwald (CIMSS), Ben Johnson (JCSDA), Ralf Bennartz (U Vanderbilt, SSEC)

- Full polarization capability is needed in the CRTM for producing more accurate radiances for clouds, aerosols and polarized surfaces
- Has importance in operational all-sky radiance data assimilation systems by exploiting satellite sensors that measure all polarization parameters
- Preliminary results for a vector adding-doubling solver (solar wavelengths only) show that at least 256 streams are needed for reasonable accuracy (far fewer streams are possible using a better phase matrix truncation)

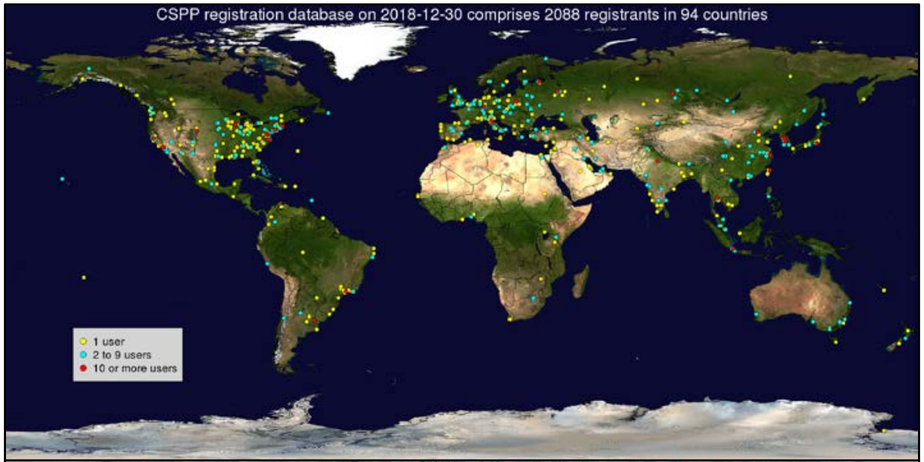


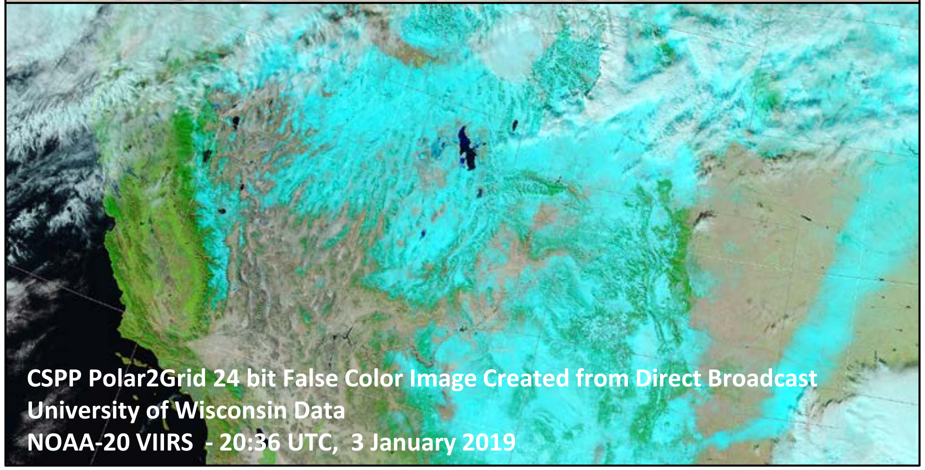


CSPP for Polar Orbiter Satellites: Open Source Software in Support of Environmental Decision Makers

Liam Gumley, Kathleen Strabala, Allen Huang, Scott Mindock, James Davies, Geoff Cureton, Nick Bearson, Graeme Martin, Ray Garcia and Jessica Braun (CIMSS)

- Community Satellite Processing Package (CSPP) Users Reach >2000
  - Users in 94 different countries
  - Users on 7 continents
  - Supports a wide variety of environmental applications
  - EUMETSAT Uses CSPP software to create products distributed on EARS
- CSPP distributes 14 different software packages for stand alone processing
  - All NWS forecast regions supported by direct broadcast using CSPP software
  - CSPP NOAA algorithms include MiRS, ACSPO, NUCAPS, CLAVR-x, Active Fires and Flood Detection





CSPP Polar2Grid 24 bit False Color Image Created from Direct Broadcast University of Wisconsin Data
NOAA-20 VIIRS - 20:36 UTC, 3 January 2019

Funding Source: NOAA JPSS PGRR

GOES-R Series: Forecasting Applications

AMS Annual Meeting Short Course Sunday with Mat Gunshor, Scott Lindstrom, and Chris Schmidt (CIMSS)

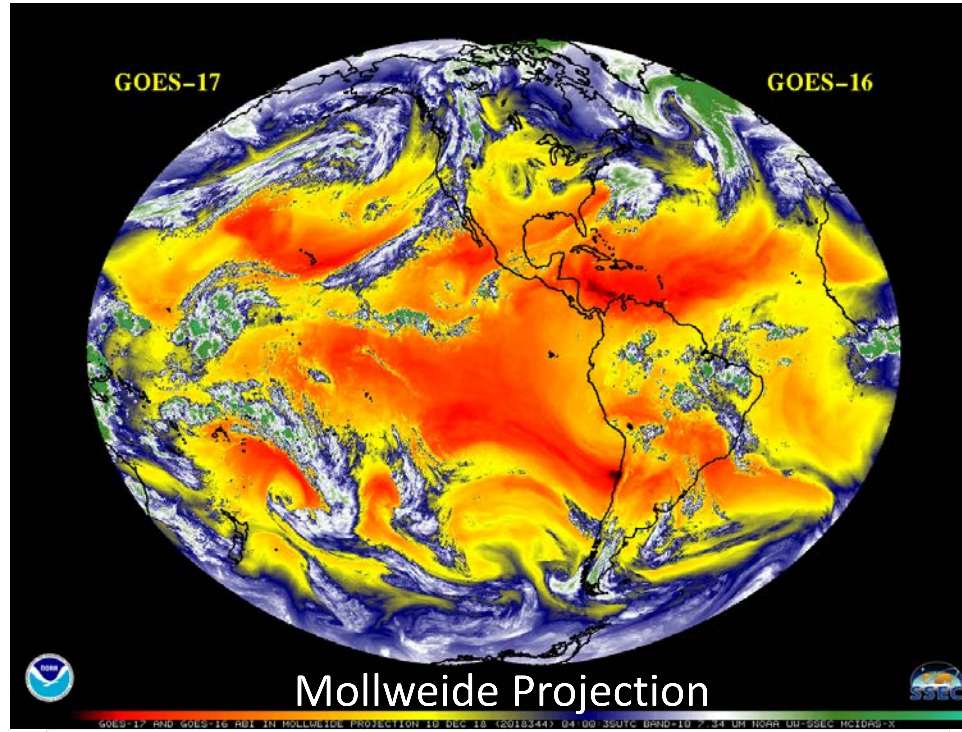
- Over 20 Attendees
  - The course goal: make users aware of the new GOES-R series capabilities and how they will improve environmental observations and forecasts.
  - Mix of presentations and hands-on exercises on the ABI ,GLM, and GOES-R derived products.
- Positive Feedback From Attendees
  - Most participants filled out AMS eval forms.
- Other contributors:
  - Geoffrey Stano (NASA SPoRT)
  - Tim Schmit (NOAA) – Presentation given by Mat Gunshor (CIMSS)
  - Jim McNitt (NOAA) – Presentation given by Scott Lindstrom (CIMSS)
- Agenda and more information:
  - https://annual.ametsoc.org/index.cfm/2019/programs/short-courses-workshops/goes-r-series-forecasting-applications/

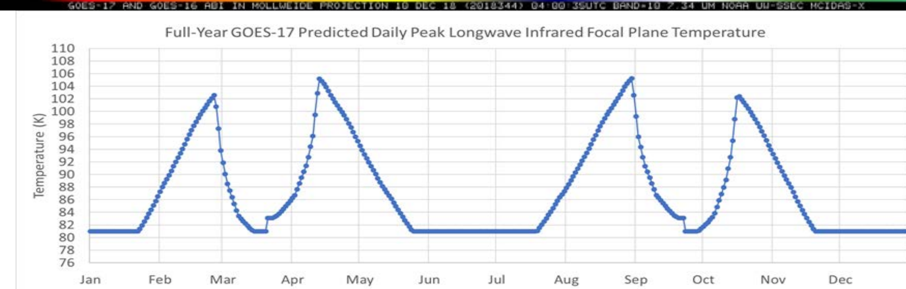
- Participants at the AMS Annual Meeting Short Course: GOES-R Series: Forecasting Applications

ABI Imagery: From Beta to Full Maturity

Poster by Mat Gunshor, Jim Nelson (CIMSS); Tim Schmit (NESDIS)

- The process getting the GOES-16 ABI Cloud and Moisture Imagery Product (CMIP) from beta status, to operational, and to full maturity status. by AWG Imagery Team
  - GOES-R launched: Cape Canaveral, FL Nov 19, 2016 6:42pm EST (23:46 UTC).
  - GOES-R reached geostationary orbit, renamed GOES-16 on Nov 29, 2016.
  - GOES-16 reached the check-out location of 89.5W on Dec 6, 2016.
  - ABI “First Light” images were generated from Jan 15, 2017 data.
  - There were test visible data sent on January 7, 2017
  - Official press release was Jan 23, 2017 (First day of 2017 AMS Annual)
  - GOES-16 Drift to 75.2 West Nov 30, 2017 – Dec 11, 2017
  - Data flowing again on Dec 14, 2017
  - GOES-16 became The Operational GOES-East on Dec 18, 2017
  - GOES-16 ABI declared Full Maturity on Jun 1, 2018
- GOES-17 launch to pre-operational status.
  - GOES-S launched: Cape Canaveral, FL Mar 01, 2018 05:02pm EST (22:02 UTC).
  - GOES-S reached geostationary orbit, renamed GOES-17, on Mar 12, 2018.
  - GOES-17 ABI “First Light” Vis images from May 20 released on May 31, 2018
  - GOES-17 ABI “First Light” IR images from Jul 29 released on Aug 8, 2018.
  - GOES-17 ABI L1b and Imagery declared “Beta” status on Aug 27, 2018 (GRB on August 28, 2018).
  - GOES-17 Drift to 137.2 West Oct 24, 2018 – Nov 13, 2018
  - GOES-17 ABI L1b and Imagery declared “Provisional” status on Nov 28, 2018.
  - GOES-17 could become operational GOES-West Jan 2019.





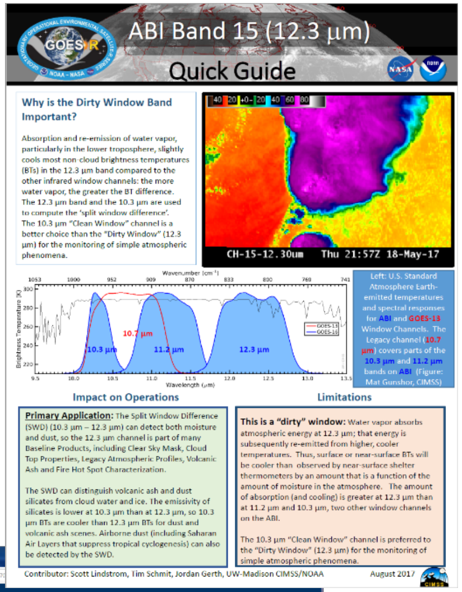
Plot courtesy Harris Corp.

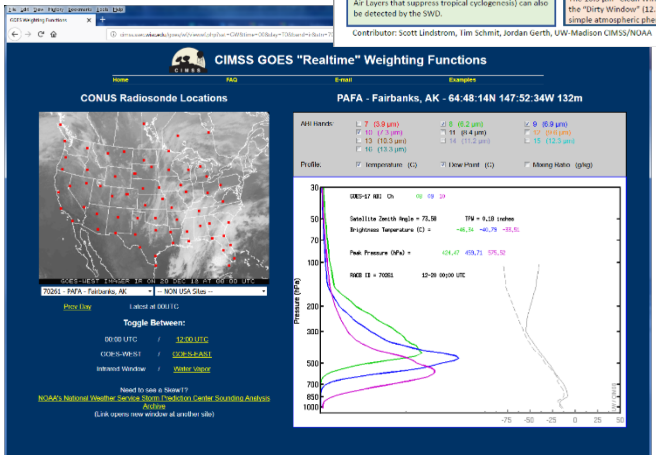
Helping Prepare Users for the GOES-R era: ABI Imagery and Products

Mat Gunshor, Jordan Gerth, Chris Schmidt, Scott Lindstrom, Szu-Chia Moeller (CIMSS); Tim Schmit (NOAA/NESDIS/STAR/ASPB)

- To help meet the challenges of the GOES-R era, a wide range of preparation, training, and outreach activities have been developed CIMSS in coordination with stakeholders at NWS and NOAA to prepare operational users, forecasters, industry, and international partners for the ABI
- Training CIMSS/ASPB contributed to in the past year include:
  - The 2018 AMS Annual Meeting
  - 2018 NWS IMET Continuity of Excellence Exercise
  - AMS 12th Fire and Forest Meteorology Symposium
  - Canadian Met. and Ocean. Society's 2018 Congress
  - A NOAA GOES-16 workshop at the National Autonomous University of Mexico in Mexico City
  - AMS 10th International Conf. on Urban Climate
  - Ahead of RELAMPAGO field campaign (Argentina).
  - The 2019 AMS Annual Meeting (separate slide)

- Many tools have been developed including
  - Interactive training web applications (webapps)
  - Distance learning modules
  - Specialized training software (called SIFT)
  - Updated ABI band fact sheets
  - Improved "realtime" GOES weighting functions webpage.
- These tools have aided the team's delivery of short courses and NWS training sessions.Exhibit Hall: NASA booth "Hyperwall," NOAA booth, Harris booth, Lockheed booth, SSEC booth



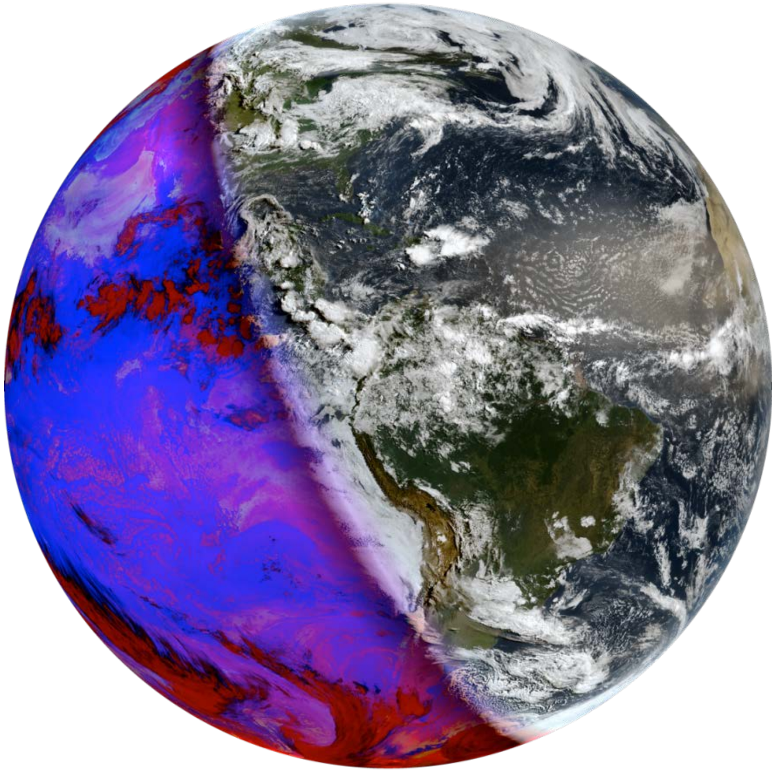


Shouldn't this be easy?

NOAA Open Source Software For Creating High Quality Satellite Images

David Hoese & Kathy Strabala (SSEC/CIMSS)

- CSPP LEO Polar2Grid and CSPP Geo Geo2Grid command line tools make it simple to go from satellite data files to high quality output images.
- RGB composites like True Color and Natural Color with atmospheric corrections and sharpening techniques applied
- Custom user RGBs
- Easy resampling and gridding to custom user grids and regions of interest
- Simple commands with logical defaults



```
geo2grid.sh -r abi_l1b -w geotiff -f /path/to/files/
```

<u>Geo2Grid 1.0 Coming Soon!</u>

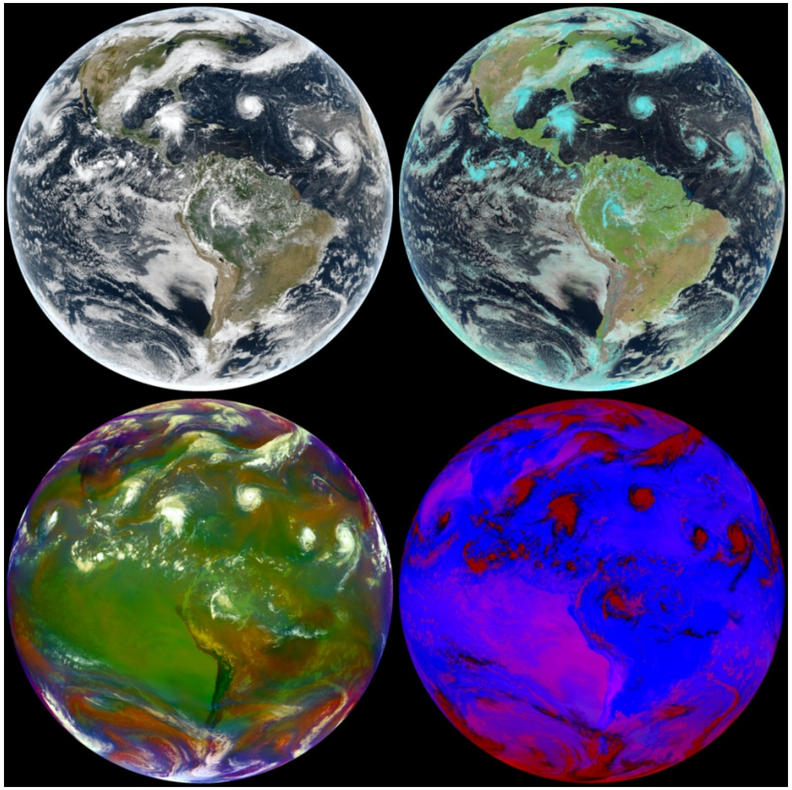
Funding Source: NOAA JPSS PGRR

SatPy: A Python Library for Weather Satellite Processing

David Hoese (SSEC/CIMSS)

- Open source python software with contributors from around the world (PyTroll Community)
- Used by the CSPP LEO Polar2Grid and CSPP Geo Geo2Grid command line tools which make it simple to go from satellite data files to high quality output images.
- Easily read over 27 data formats from NOAA, NASA, EUMETSAT, and others.
- Easily write to Geotiff, AWIPS SCMI, PNG, and other common formats.
- Uses Xarray and Dask libraries for compatibility with other scientific python tools.

```
from satpy import Scene
scn = Scene(reader='abi_l1b', filenames=[…])
scn.load(['C01', 'true_color'])
new_scn = scn.resample(resampler='native')
new_scn.save_datasets()
```



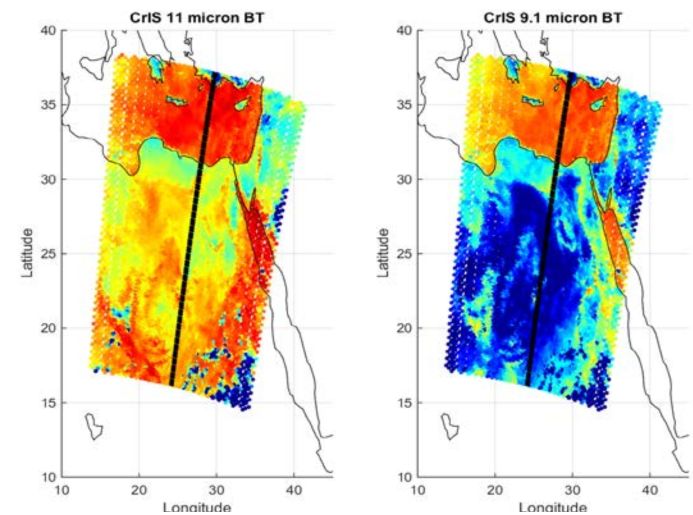
SatPy 0.11.1 now available!

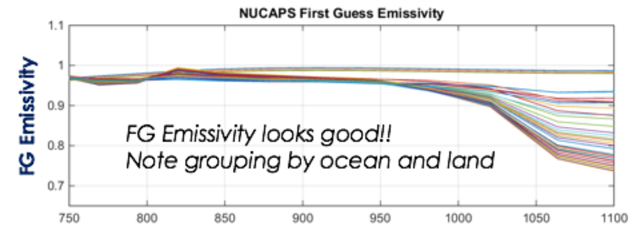
Funding Source: NOAA JPSS PGRR

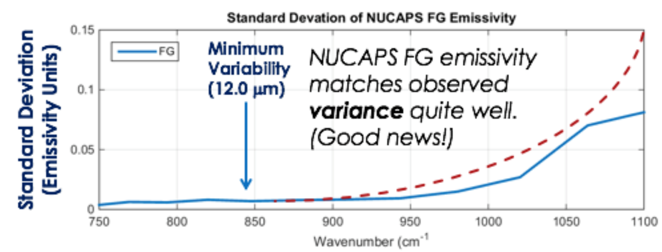
Calibration and Validation of NUCAPS Infrared Surface Emissivity

Bob Knuteson, Cally Bloch, Jessica Gartzke, Eva Borbas, Michelle Feltz (CIMSS); Antonia Gambacorta, Nick Nalli (IMSG), Lihang Zhou (STAR)

- Simple analysis of variance of CrIS radiance observations over the Eastern Mediterranean Sea and Egyptian desert was used to compare SDR radiance, Cloud Cleared Radiances (CCR), and EDR First Guess versus Final Emissivity and skin temperature.
- The top figure shows a CrIS brightness temperature image at 11 and 9.1 microns over the eastern Mediterranean Sea and the Sahara Desert in Egypt.
- The lower figure shows that the NUCAPS first guess emissivity correctly represents the ocean and land emissivity along the nadir track shown as a black line.
- Variance of SDR, CCR, and First Guess emissivity are self-consistent, however EDR final emissivity variance is unphysically high (and with some emissivity values > 1). This is reflected in unphysical skin temperature variance.
- The recommended solution is the use of the covariance constraint computed from the UW-SSEC/CIMSS infrared emissivity dataset named CAMEL (2000-2016). http://cimss.ssec.wisc.edu/iremis/







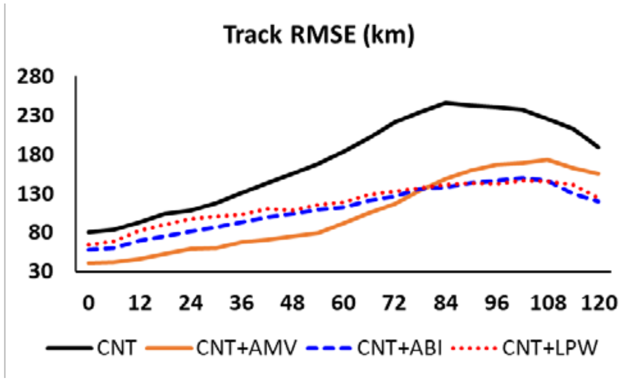
Funding Source: NOAA JPSS PGRR

<Analysis difference, CNT – CNT+ABI>

The Impact of GOES-16 Data on TCs Forecasts

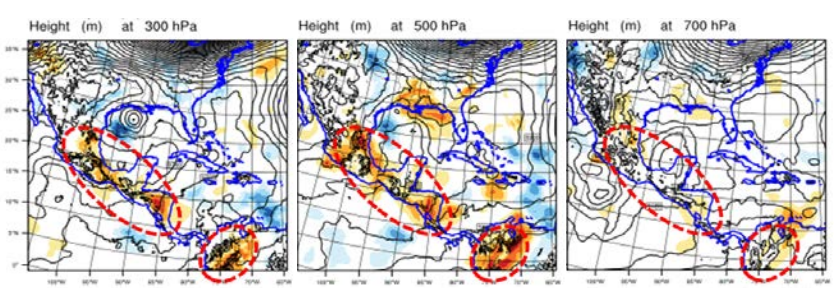
Jung-Rim Lee (CIMSS, KMA), Jun Li, Zhenglong Li, Pei Wang, Jinlong Li (CIMSS)

- GOES-16 data helped improving the track on Hurricane Irma (each of AMV, Rad & LPW)



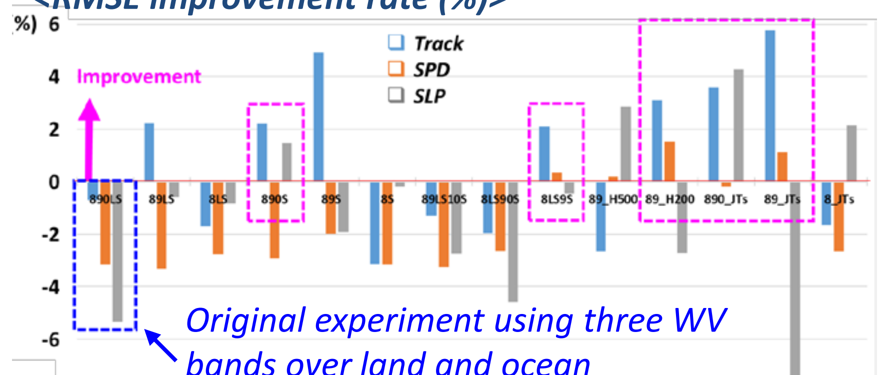
- Harvey (2017) domain includes high surface
  - It turned out there is surface impact on WV radiance assimilation

<Analysis difference, CNT – CNT+ABI>



- Handling surface impact for ABI radiance assimilation on Harvey
  - By removing land, or high surface area, or not assimilating when the Jacobian function of skin temperature (J_{TS}) is high
  - Both track and intensity are improved When using
    - Three WV bands over only ocean
    - Band 8 over land/ocean and Band 9 over ocean
    - Bands 8/9 when surface height < 200 m
    - Three bands or bands 8/9 with thresholds of J_{TS}

<RMSE improvement rate (%)>

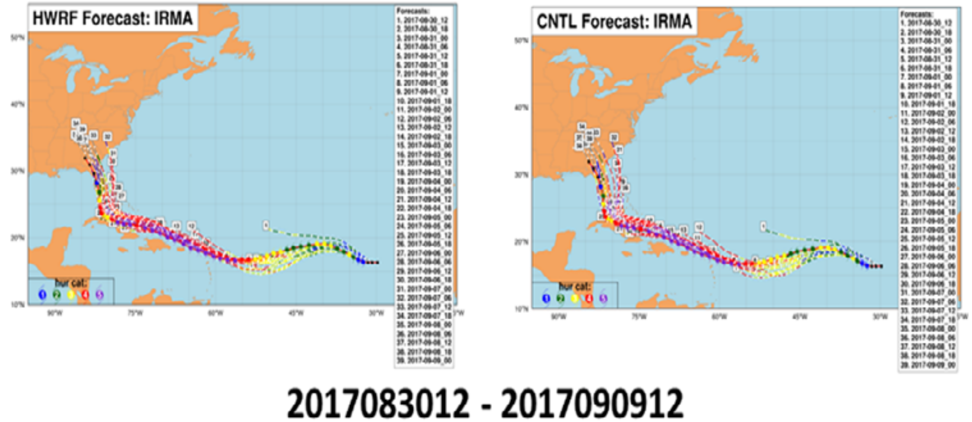


Funding Source: NOAA GOES-16/17 Risk Reduction

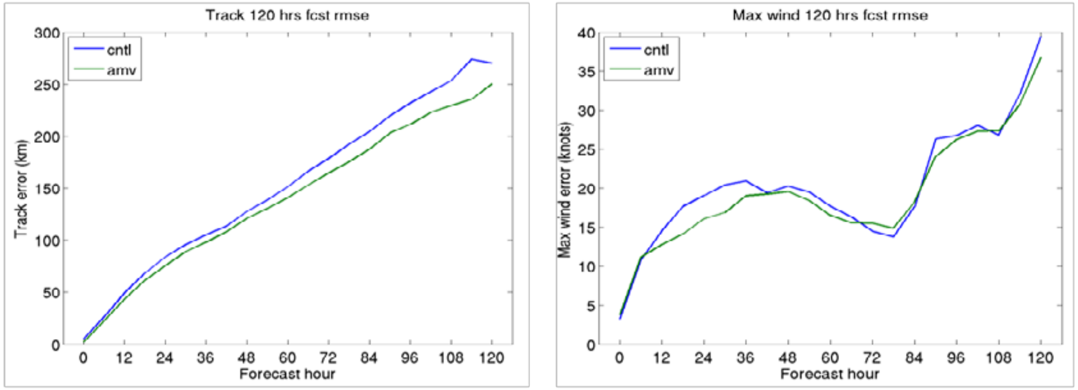
The Impact of GOES-16 Derived Products on HWRF Analyses and Forecasts

Jinlong Li, Jun Li, Christopher Velden, Pei Wang, Jung-Rim Lee, William E. Lewis, David Stettner (CIMSS), Jason A. Sippel (NHC), and Zhan Zhang (EMC)

- Based on the GOES-16 1-minute meso scan mode observation, CIMSS has developed high spatial and high temporal targeted AMV research product in TC inner core region;
- Assimilating these high densely targeted AMVs around storm have positive impacts on the hurricane track.



Forecasts from HWRF/Op (upper left), HWRF/S4 (HWRF_v3.9a from DTC , upper right) for hurricane Irma (2017) (cntl is the results from HWRF/S4, avno is the results from GFS). HWRF/Op and HWRF/S4 are close enough.



ABI Rapid scan AMVs from inner core region further improve hurricane Irma (2017) forecasts in HWRF/S4

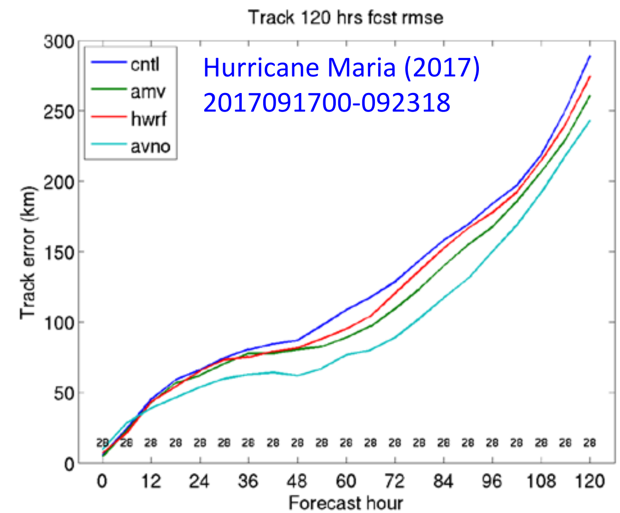
Funding Source: NOAA GOES-16 Risk Reduction

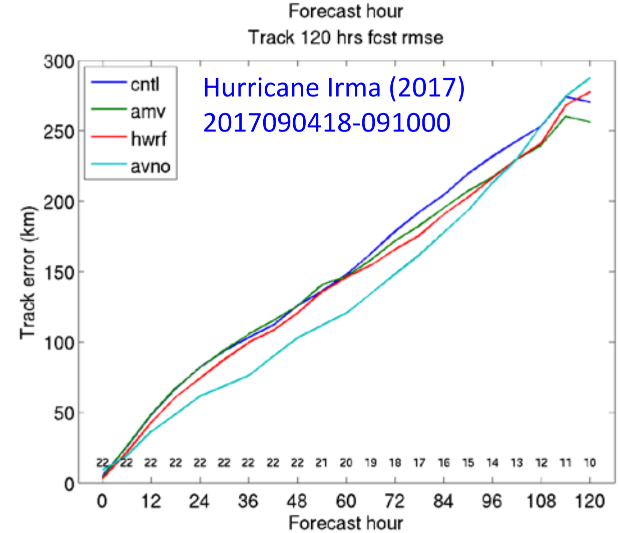
The Impact of GOES-16 ABI Derived Products on HWRF Analyses and Forecasts

Jinlong Li, *Jun Li, Christopher Velden, Pei Wang, Jung-Rim Lee, William E. Lewis, David Stettner (CIMSS)*
Jason A. Sippel (HRD/NOAA), Zhan Zhang (EMC/NOAA)

- Based on GOES-16 meso scan mode observation, CIMSS has developed high spatial and high temporal targeted AMV research product.
  - Data focused on the storm center domain (10 x 10 degree coverage centered on the storm) and follow the storm with time.
  - Datasets produced at 15 minutes interval based on a set of sequential images scanned every minute for targeted meso sectors.

- Assimilating these high densely targeted AMVs around storm have positive impacts on the hurricane track forecasts of Maria and Irma in 2017.



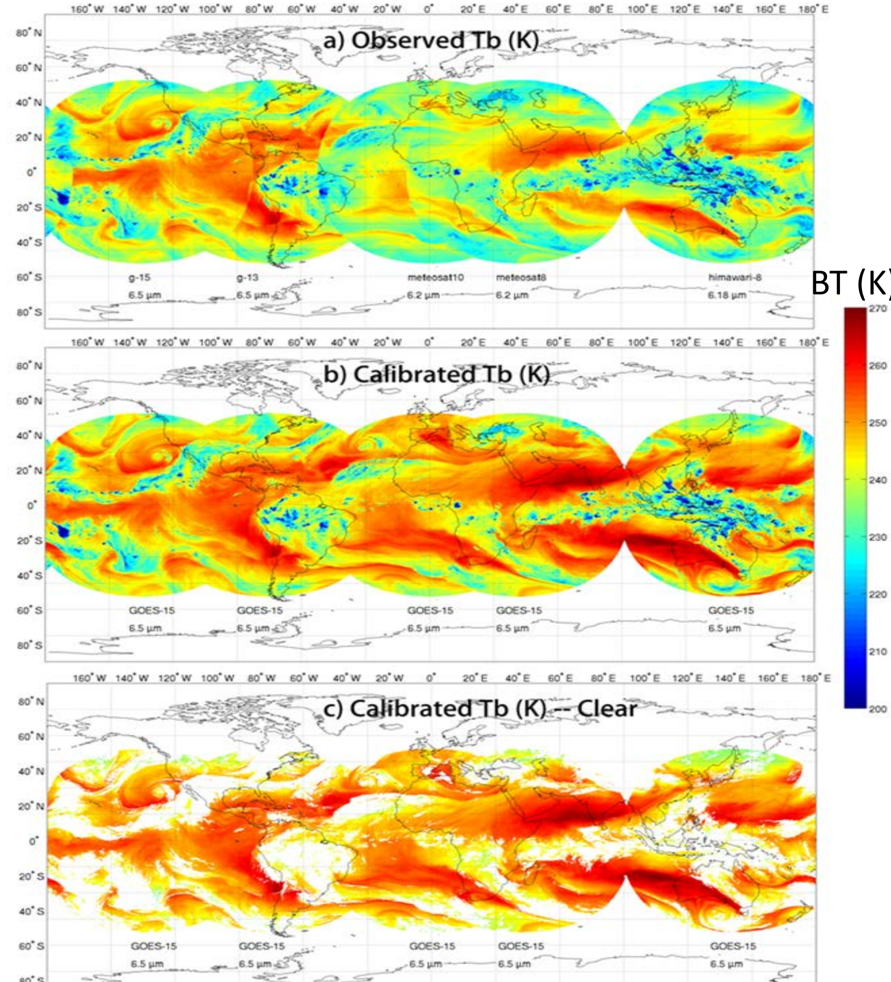


Funding Source: NOAA GOES-16/17 Risk Reduction

Re-calibrate water vapor bands from international geostationary satellites for consistency

Jun Li, Zhenglong Li, Mathew Gunshor, Szu-Chia Moeller (CIMSS), Timothy J. Schmit (STAR), Fangfang Yu (ESSIC), and Will McCarty (GSFC)

- A methodology has been developed to re-calibrate international GEO WV (6.5 µm) radiance observations to for consistent CDR with high temporal resolution;
- Validation with IASI observations show no substantial degradation on radiometric accuracy after re-calibration:
  - The re-calibrated radiances agree well with both IASIs;
  - No artificial temporal trend was found;
  - The limb correction is more effective for sensors with multiple WV bands than single one
- The methodology can be applied to process the 20+ years of GEO data for consistent WV CDR with high temporal resolution for climate studies, reanalysis and model evaluation, it can also be applied to process CrIS, AIRS, and IASI to consistent hyperspectral IR radiance climate data record (CDR).

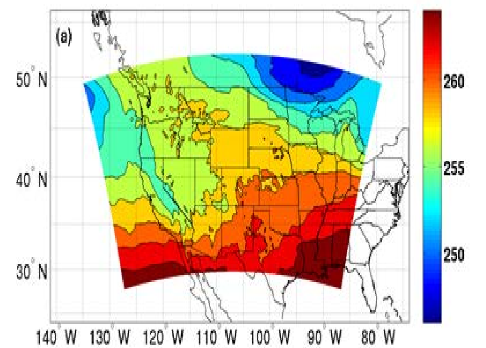


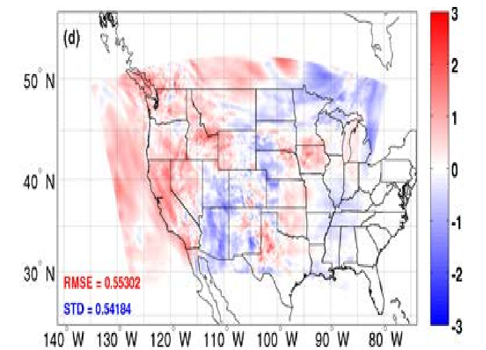
Funding Source: NOAA GOES-16/17 Risk Reduction

Impact of Future High Temporal Resolution Advanced Sounding Systems on Local Severe Storm Forecast - regional OSSE Demonstration

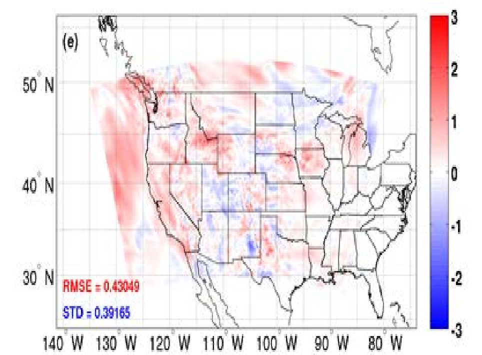
Zhenglong Li, **Jun Li**, Pei Wang, Agnes Lim, Jinlong Li, Fred W. Nagle (CIMSS) , Timothy J Schmit (STAR), Robert Atlas (AOML), R. N. Hoffman (AOML), S. A. Boukabara (STAR), W. J. Blackwell (LL) and T. Pagano (JPL)

- GEO advanced IR sounder OSSE (Li et al. 2018)
  - On top of the existing LEO (low earth orbit) sounders, a GEO advanced IR sounder may provide value-added impact on local severe storm forecasts due to large spatial coverage and high temporal resolution;
  - More frequent assimilations and smaller thinning distances allow more observations to be assimilated, and can further increase the positive impact from a GEO advanced IR sounder data.
- Cubesat based sounding system OSSE (Li et al. 2019)
  - Either MicroMAS-2 or CIRAS on a single CubeSat is able to provide positive impact on the LSS forecasts;
  - More CubeSats with increased data coverage yield larger positive impacts.
  - MicroMAS-2 has the potential to mitigate the loss of ATMS, and CIRAS the loss of CrIS, especially when multiple CubeSats launched.





500 hPa Temp: NR (upper left) at 1200 UTC May 26, NR – CNTRL (upper right), NR – GEO (lower right).

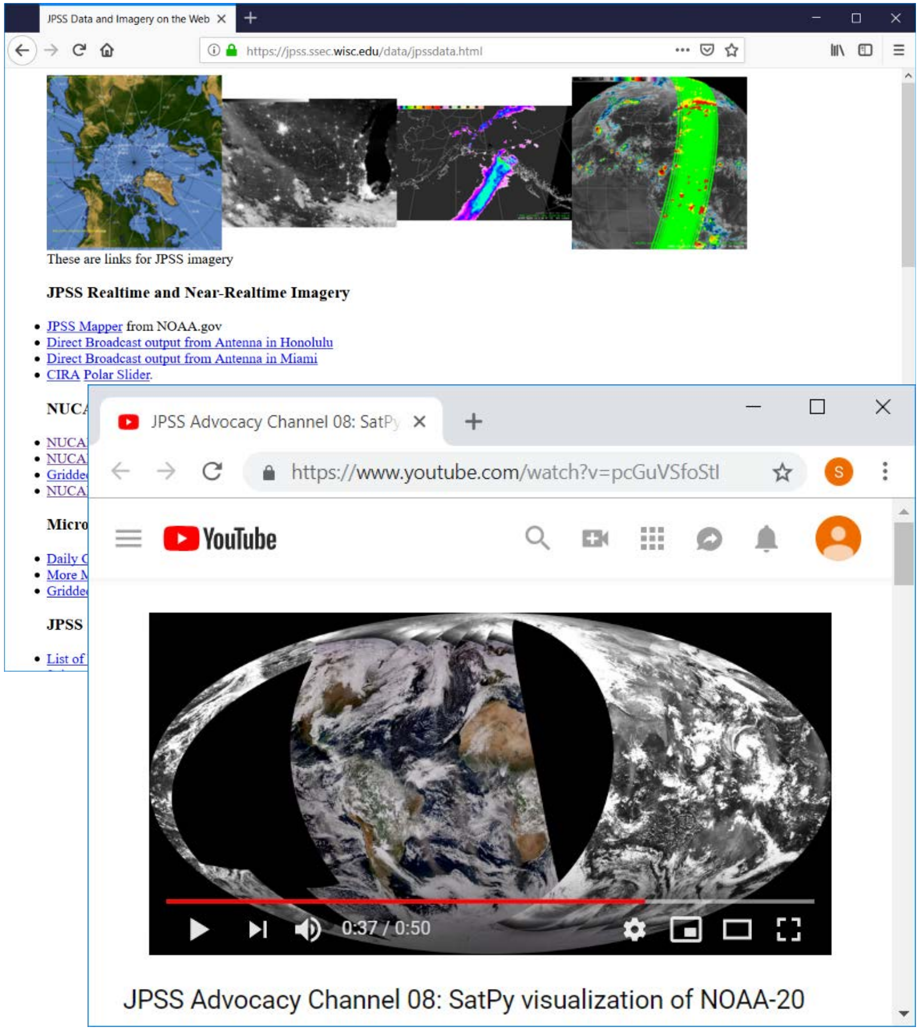


Funding Source: NOAA NESDIS

The JPSS Advocacy Channel

Scott S Lindstrom, Jordan J Gerth, William C Straka (CIMSS)

- Create a Clearing House List of Links to direct users to JPSS-related data, products and training.
  - https://jpss.ssec.wisc.edu/data/jpssdata.html
- Create a YouTube Channel ("JPSS Advocacy Channel") that contains training videos relevant to JPSS data



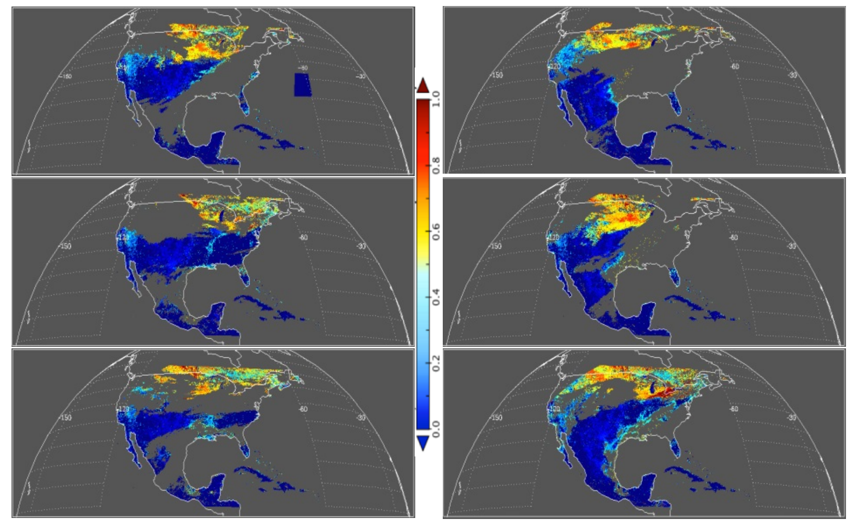
Funding Source: NOAA JPSS PGRR

Validation Status of GOES-R Fractional Snow Cover Product

Yinghui Liu (CIMSS); Jeff Key (NESDIS); and Peter Romanov (CREST)

- The current algorithm is the GOES-R Snow Cover And Grain size (GOESRSCAG) algorithm. It employs an optimized spectral mixture analysis using atmospherically-corrected, surface reflectance in two visible and three near-infrared bands. An operational fractional snow product was also developed for the Visible Infrared Imaging Radiometer Suite (VIIRS). It is based on a single-band, reflectance-based FSC algorithm that was initially used with GOES imagers.

- Our work will evaluate both FSC products and will provide justification for one or the other to become the Enterprise algorithm for snow fraction derived from all NOAA optical instruments. A validation tool package has been designed and developed. A single “enterprise” snow algorithm for use with multiple NOAA satellite instruments will be selected based on upcoming validation results.



GOES-16 Fractional Snow Cover daily composite from February 7, 2018 to February 12, 2018 with quality control (left from top to bottom, then right from top to bottom).

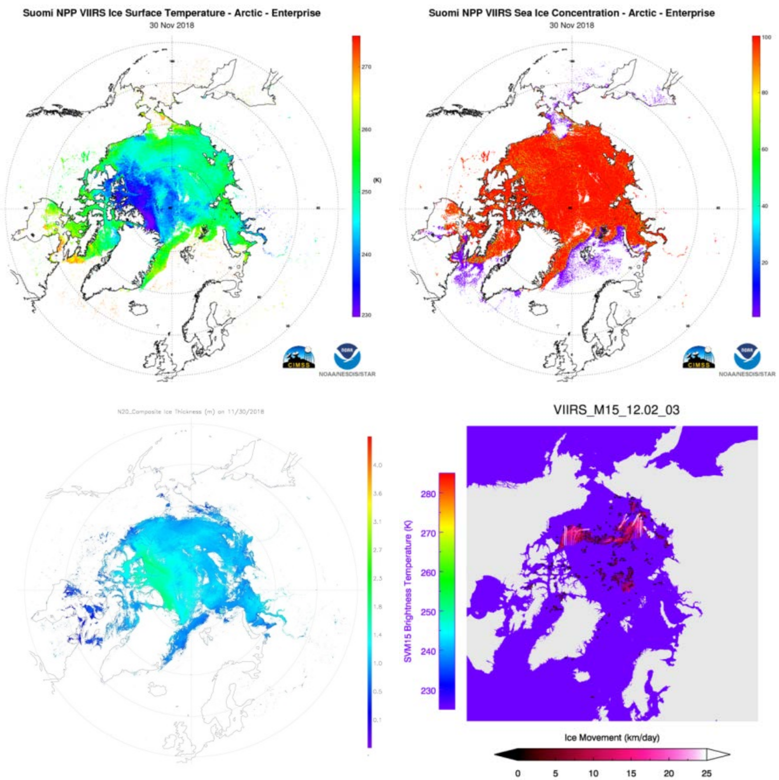
Funding Source: NOAA PSDI Enterprise

Status and Validation of S-NPP and NOAA-20 VIIRS Ice Products

Yinghui Liu (CIMSS); Jeff Key (NESDIS); Xuanji Wang, Richard Dworak (CIMSS); Mark Tschudi (CU); and Aaron Letterly (CIMSS)

- The NOAA-unique S-NPP ice products have been operational since mid-2017. NOAA-20 products have been declared beta and are expected to become provisional pending further validation and review in early 2019. The products include
  - Ice concentration
  - Ice surface temperature
  - Ice characteristics
  - Experimental ice motion, and blended ice concentration and ice motion

- Extensive validation has been performed, with results showing that all the products meet the accuracy and precision requirements:
  - Ice surface temperature validation with in situ observations from IceBridge
  - Ice concentration validation with passive microwave products, and observations with very high spatial resolution
  - Ice thickness with observations from IceBridge and other in situ observations

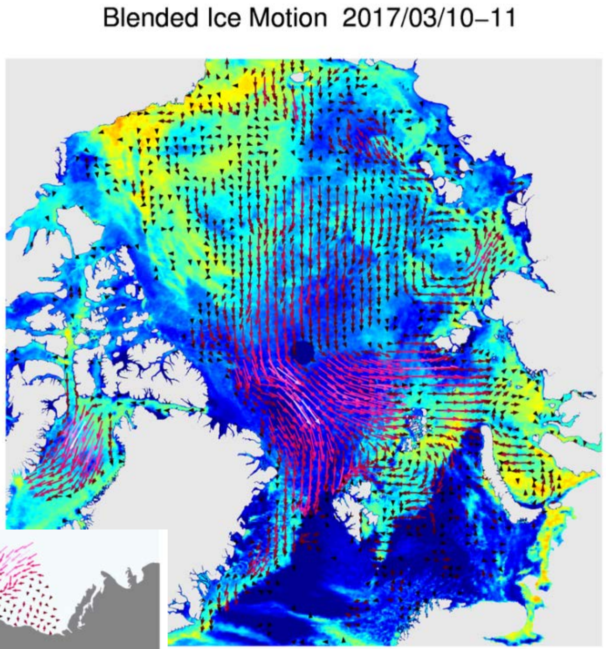


VIIRS ice surface temperature, ice concentration, ice thickness, and ice motion daily composites over the Arctic on 30 Nov and 2 Dec 2018 (motion).

Funding Source: NOAA PSDI Enterprise

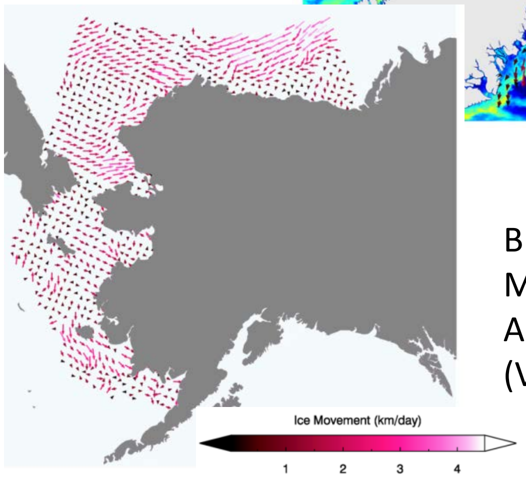
A Blended Ice Motion Product from AMSR2, VIIRS, and SAR

Jeff Key(NESDIS); Yinghui Liu and Aaron Letterly(CIMSS)



Arctic-wide Blended Ice Motion (VIIRS+AMSR2)

- Blended Ice Motion Products show speed and direction of ice features in (near-) real-time
  - Full daily Arctic/Antarctic Coverage
  - High-resolution, all-weather experimental product
  - Combines data from VIIRS M15 band, Day Night Band, and AMSR2
- Blended Ice Motion products are being used operationally by the NWS Alaska Sea Ice Program
  - Used in daily analysis by ice desk staff
  - Used in one case to advise a Bering Sea mariner about inclement ice motion
  - Ice desk analysts provide useful feedback



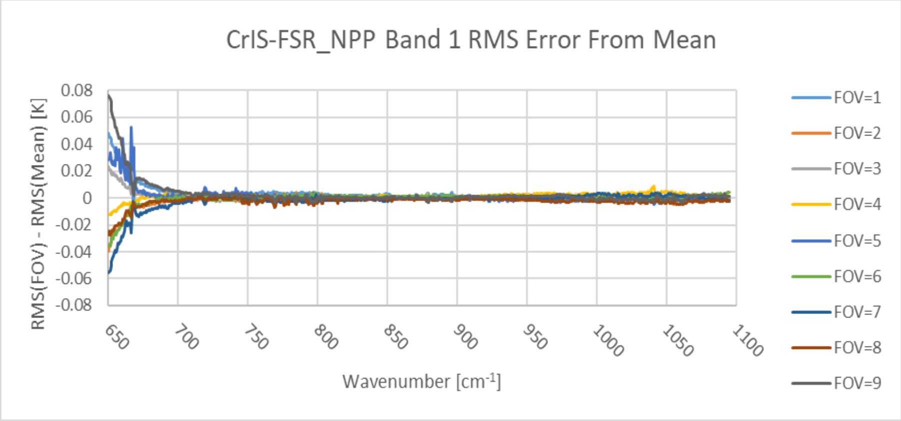
Blended Ice Motion for Alaska (VIIRS+AMSR2)

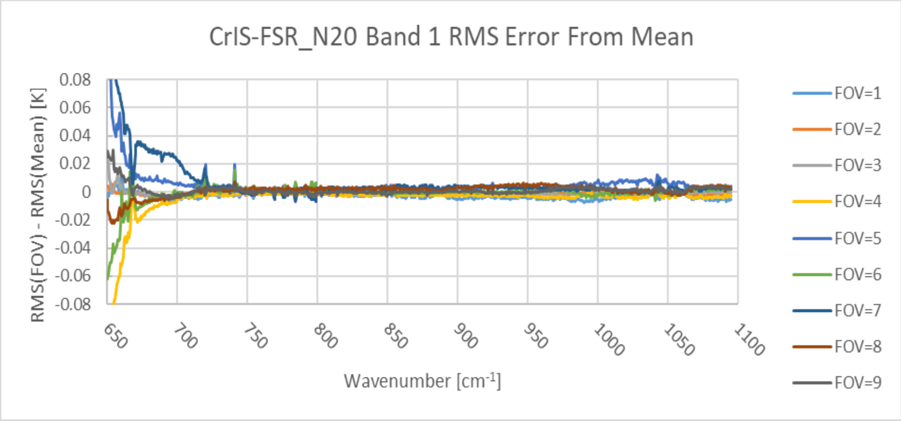
Funding Source: NOAA JPSS PGRR

NPP and N20 CrIS Full Spectral Resolution FOV Differences Derived from the NCEP GDAS

James Jung & Agnes Lim (CIMSS), William McCarty (NASA), Yangrong Ling (NCEP), Mitch Goldberg (NESDIS/JPSS)

- Numerical Weather Prediction Centers require all detectors (FOVs) on instruments similar to CrIS to be as identical as possible to be able to fully exploit their information.
- The CrIS detector differences, or RMS error from mean, on both Suomi NPP and NOAA-20 are small and well below the NEDT for almost all channels.
- The detector differences for the longwave region (band 1) for both SNPP (top) and N20 (bottom) are shown to the right.





Funding Source: NOAA JPSS PGRR

Generating LEO Sounder Products at GEO Imager Spatial & Temporal Resolution

Paul Menzel[1], Elisabeth Weisz[1], Eva Borbas[1], Richard Frey[1], and Bryan Baum[2]
[1]CIMSS & [2]STC

Q(P) from GEO ABI fusion with LEO CrIS retrievals

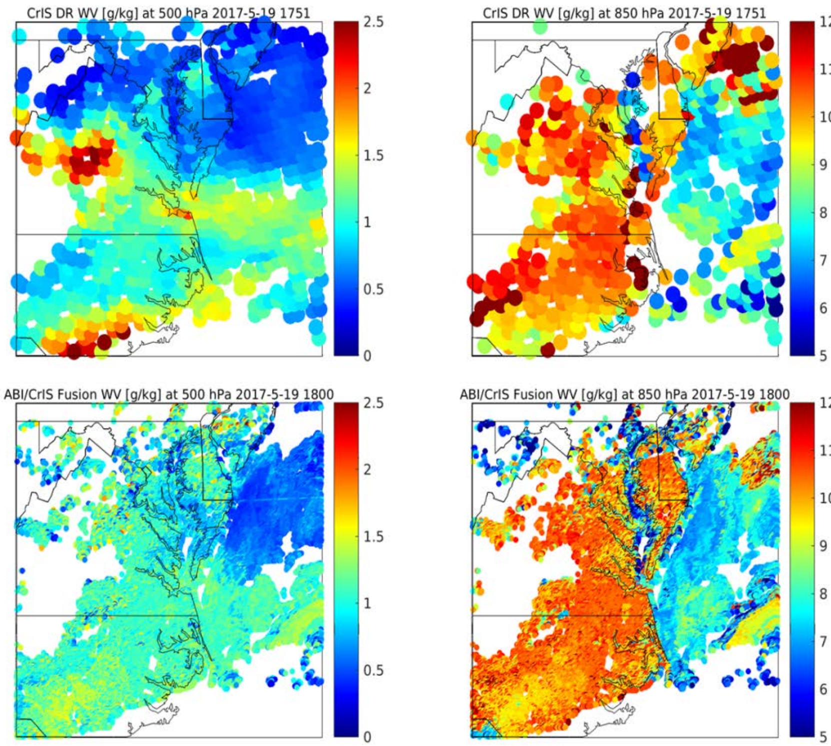
- **k-d tree search of ABI split-window radiances averaged to CrIS FOV resolution indicates five nearby CrIS soundings that can be averaged to represent the sounding at that ABI pixel**
- **Sounder products are generated using the Dual-regression (DR) retrieval algorithm**

ABI images before and after LEO overpass can be fused with CrIS retrievals creating a time sequence of high spatial and high temporal resolution soundings

- **Simulation of GEO hyperspectral IR sounder**

References

- **Weisz, E., B. A. Baum, and W. P. Menzel, 2017: Construction of high spatial resolution narrowband infrared radiances from satellite-based imager and sounder data fusion. J. Appl. Remote Sens. 11 (3), 036022, doi: 10.1117/1.JRS.11.036022**
- **W. L. Smith, E. Weisz, S. V. Kireev, D. K. Zhou, Z. Li, and E. E. Borbas, 2012: Dual-regression retrieval algorithm for real-time processing of satellite ultraspectral radiances. J. Appl. Meteor. Climatol., 51, 1455 – 1476**



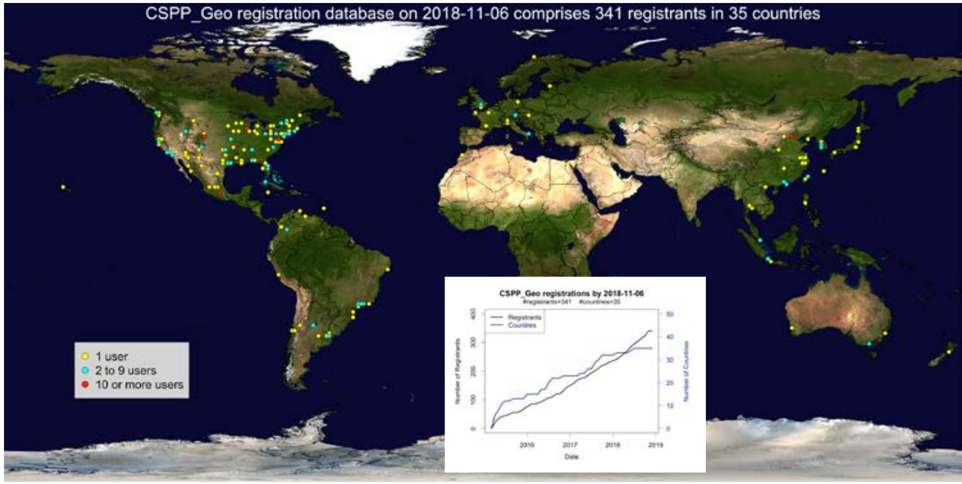
CrIS DR (top) and ABI/CrIS fusion (bottom) 500 hPa (left) and 850 hPa (right) humidity retrievals (g/kg) at 18 UTC 19 May 2017

Funding Source: NOAA GOES-16/JPSS Risk Reduction

Recent Developments in CSPP Geo Software for Direct Broadcast

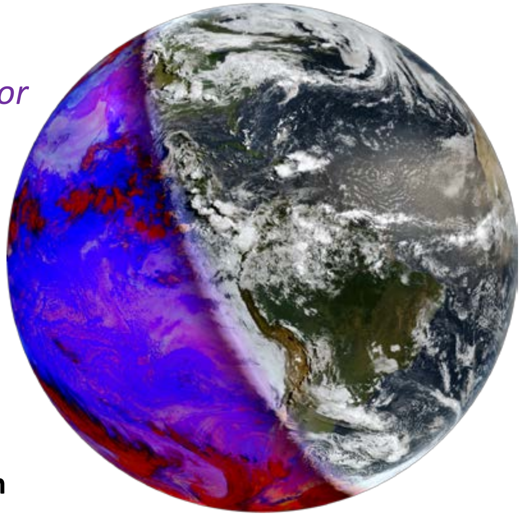
Graeme Martin, Liam Gumley, Nick Bearson, Jessica Braun, Geoff Cureton, Alan De Smet,
Ray Garcia, Tommy Jasmin, Scott Mindock, Eva Schiffer, Kathy Strabala (CIMSS)

- CSPP Geo Users
  - Half of all GRB users report running NOAA-funded CSPP Geo software directly (GRB User Group survey, early 2018)
  - Additional users run CSPP Geo software that is installed by receive station vendors
  - Users include NOAA / NWS, NASA, international met agencies, DB vendors, data and weather service providers, research community



- 2018 project highlights
  - 5 public releases of the GRB (ingestor) package, including
    - V1.0 milestone with support for GOES-17, ABI Mode 6
    - Critical updates to support changes to the GOES-R Ground System
  - Beta release of AIT Framework Level 2 product package
  - Geo2Grid software for high-quality imagery developed; planned for release early 2019

GOES-16 ABI True Color / Night Microphysics image created by the Geo2Grid package



Funding Source: NOAA GOES-16 and NWS Risk Reduction

Flash Droughts: Their Characteristics and A Proposed Definition

Jason Otkin, Mark Svoboda (U. Nebraska), Jeff Basara (U. Oklahoma), Jordan Christian (U. Oklahoma), Trent Ford (U. Southern Illinois), Eric Hunt (AER), Martha Anderson (USDA), and Chris Hain (NASA)

FLASH DROUGHTS

A Review and Assessment of the Challenges Imposed by Rapid-Onset Droughts in the United States

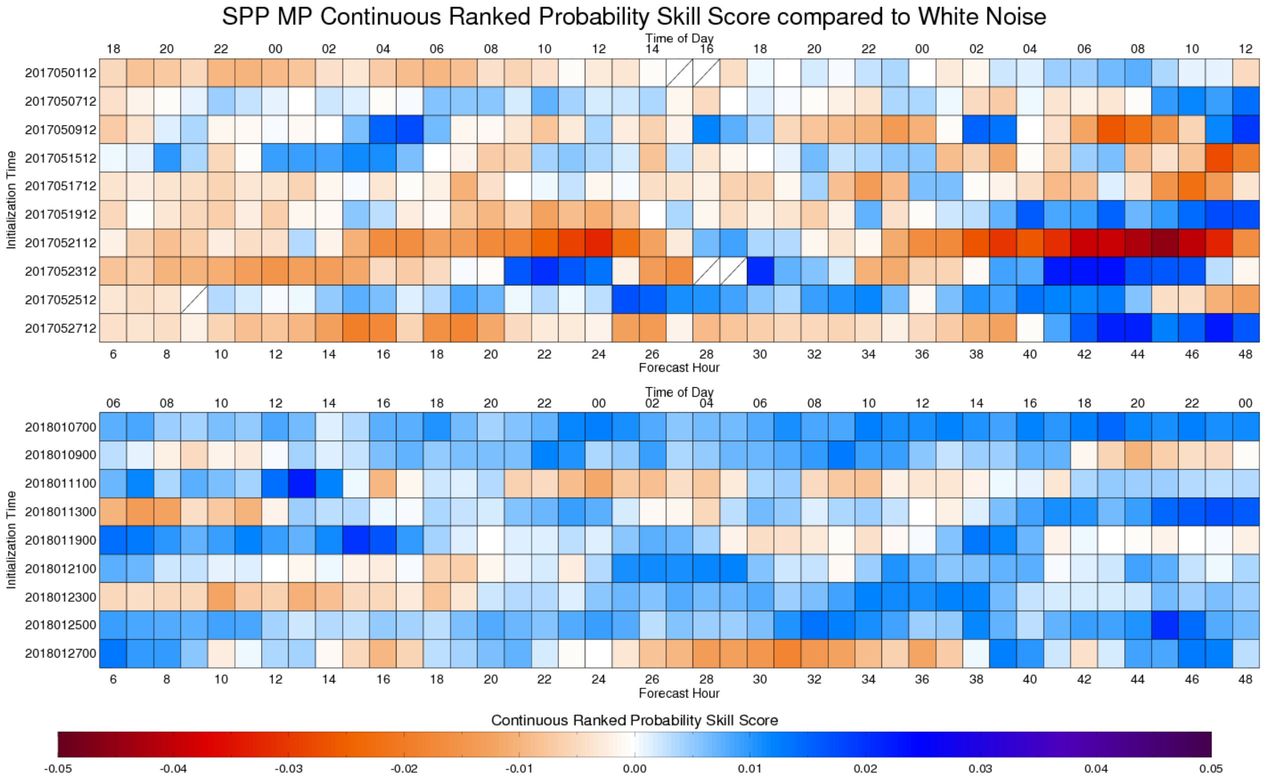
JASON A. OTKIN, MARK SVOBODA, ERIC D. HUNT, TRENT W. FORD, MARTHA C. ANDERSON, CHRISTOPHER HAIN, AND JEFFREY B. BASARA

> It is recommended that the climate features referred to ambiguously as "flash droughts" in the scientific literature be identified based on how rapidly they intensify.

- Review article describing rapidly intensifying flash droughts published in the May 2018 issue of BAMS; Currently the 6th most read article in last 12 months

Assessing the Impact of Stochastic Cloud Microphysics in High-Resolution Models using GOES-16 Infrared Brightness Temperatures

Jason Otkin, Sarah Griffin, Greg Thompson (NCAR), Maria Frediani (NCAR), Judith Berner (NCAR), and Fanyou Kong (U. Oklahoma)

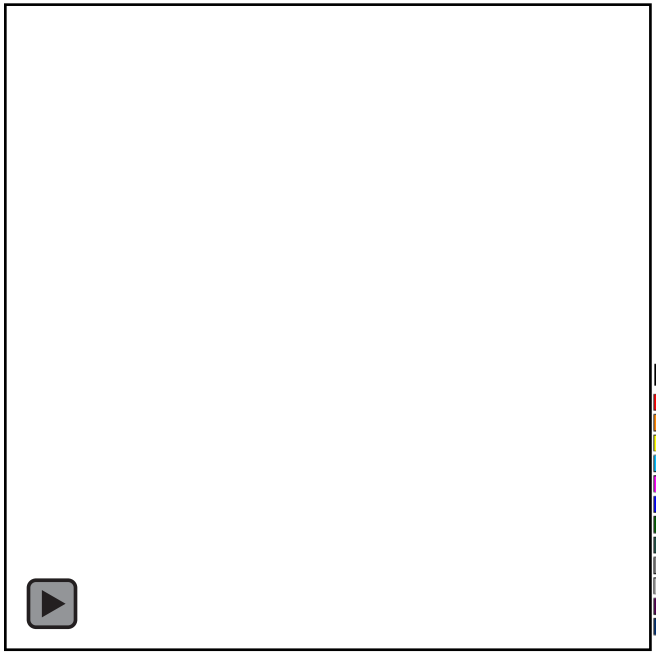


- Time series of Continuous Ranked Probability Skill Score
- Stochastic Parameter Perturbations (SPP) method more accurate than white noise ensemble during the winter (bottom panel, blue colors), but less accurate during the summer (top panel)

Improving, Validating, and Teaching ABI Fire Detection

Christopher C Schmidt (CIMSS)

Camp Fire on 8 Nov 2018



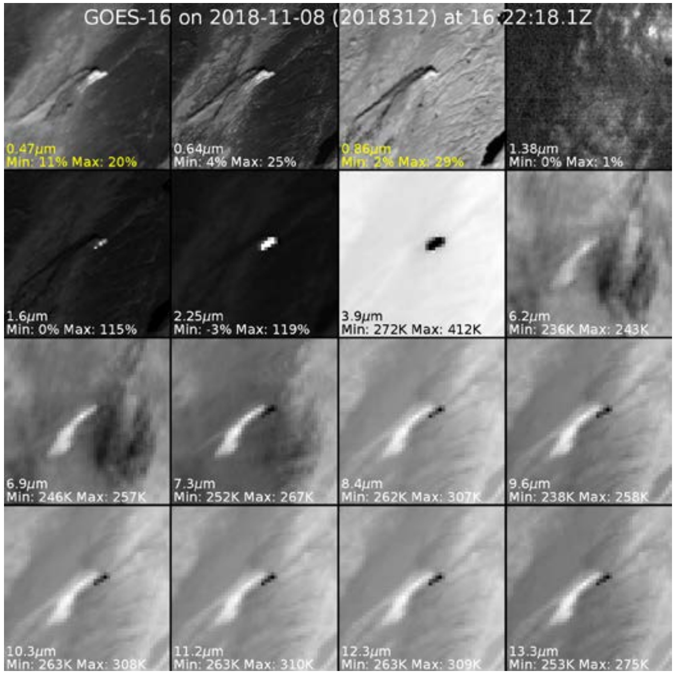
The Fire Detection and Characterization Algorithm (FDCA) is a baseline GOES-R algorithm and its output is used by smoke and aerosol modelers, NWS forecasters, and emergency managers, among others. The algorithm has seen significant improvements in the last year, with more to come in 2019 as additional bands are added to the algorithm.

Fire Legend

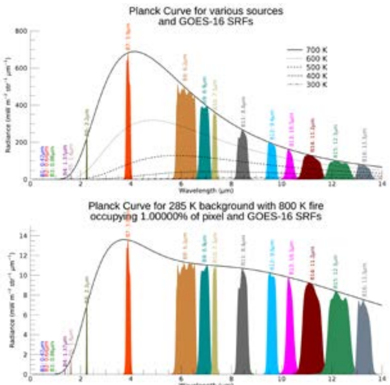
- Processed Fire
- High Possibility Fire
- Saturated Fire
- Medium Possibility Fire
- Cloudy Fire
- Low Possibility Fire
- Fire-free ground
- Cold surface or cloud
- Cloudy (Rad Diff, night)
- Cloudy (Rad Diff, day)
- Background Calc Failed
- Water

Left and right:

Examples from the Camp Fire, 8 Nov 2018, deadliest fire in California's history



Camp Fire near its peak in all 16 GOES-16 bands, dynamically scaled to enhance contrast. The fire appears in most bands.



Teaching the FDCA varies depending on the target audience, but the lessons always include a discussion of the physics of detection and how GOES data is used in the algorithm

Funding Source: NOAA GOES-16/17 AWG

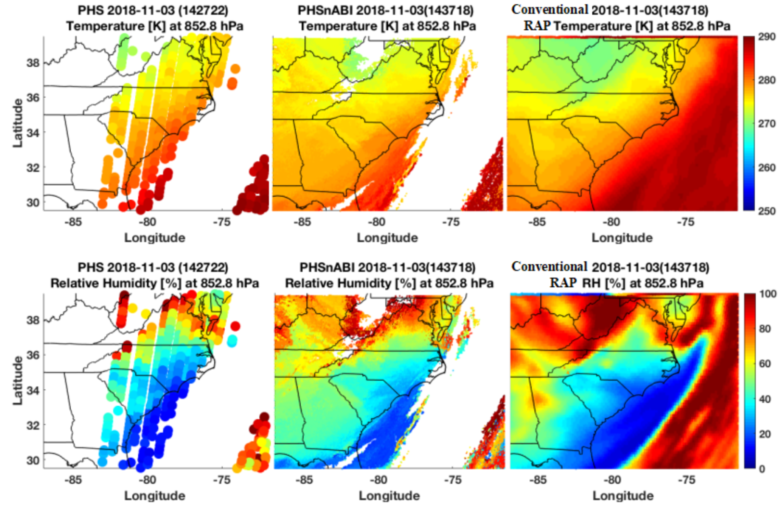
Developing Meteorological Forecast Products in Near Real-time from Hyperspectral Sounder Radiances

W. L. Smith Sr[1,2], E. Weisz[1], A. DiNorscia[2], M. Shao[2], J. McNabb[2], J. Gerth[1], M. Dutter[3], and J. Gagan[3]
[1]University of Wisconsin, Madison WI., [2]Hampton University, Hampton VA. USA, [3]NOAA/NWS

Polar Hyperspectral & ABI Sounding

- Produces high spatial and temporal resolution sounding information for nowcasting/forecasting severe weather
- Provides estimates of errors in the forecast fields used by forecasters to predict severe weather development
- Produce tendencies in atmospheric stability to indicate where and when severe convective storms will develop
- Real-time satellite data forecast products to be evaluated for their operational utility by forecasters at the AKQ (VA) and MKX (WI) weather forecast offices.

Polar & Geo IR Soundings Combined



Polar Hyperspectral & ABI Soundings in NWP

- Polar + Geo soundings being assimilated into a high resolution RAP configured WRF NWP model
- Satellite soundings are assimilated with operational data in a 4-d manner, with a 1-hour time increment
- Forecasts were produced for Hurricane Florence and Hurricane Michael to demonstrate improved numerical prediction of storm intensity, track, and precipitation

Hurricane Florence at Landfall	Eye Pressure (hPa)	Position Error (km)
Without Satellite	19	48
With Satellite	15	15

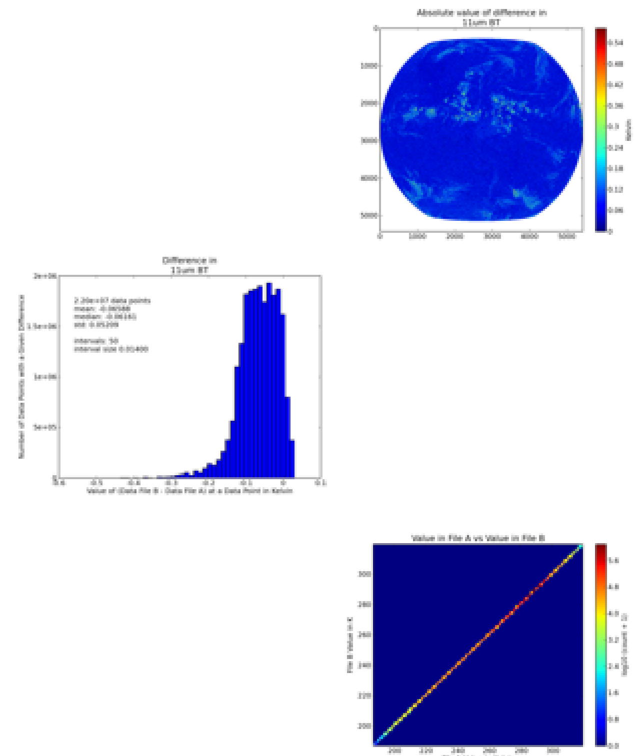
Funding Source: NOAA JPSS PGRR

Routine Validation of the STAR Algorithm Processing Framework (SAPF)

William Straka III[1], S. Sampson[3], R. Kuehn[1], G. Quinn[1], E. Schiffer[1], R. Garcia[1], G. Martin[1], R. Holz[1], T. Yu[3], A. Li[3], R. Rollins[3], W. Wolf[2] and J. Daniels[2]

[1]CIMSS/SSEC, University of Wisconsin-Madison, [2]NOAA/NESDIS/STAR, Camp Springs, MD 20746 USA,
[3]IMSG, Kensington, MD 20895, USA

- Product Visualization
  - McIDAS-V can visualize output from the GOES-R GS as well as the STAR Algorithm Processing Framework (SAPF)
  - McIDAS-V can be used to provide interactive comparisons between various products and satellites
- Product Verification
  - "Glance" tool can be used to compare output from various frameworks to verify proper integration
  - "Glance" output provides a variety of statistics and visual comparisons
  - Glance is being used in the GOES-R Ground Segment's (GS) Product Production Zone (PPZ) Development Environment (DE) by the L2 Product Area Leads (PALs) to compare products against reference datasets, in particular after algorithm updates have been applied.
- Real-time collocation and verification
  - Web interface that provides quick looks and validation products
  - Also provides as physically collocated quantitative performance information searchable by day or month averages.
  - Currently supports comparisons with all most current GEO and LEO imagers (ex. AHI, ABI, SEVIRI)



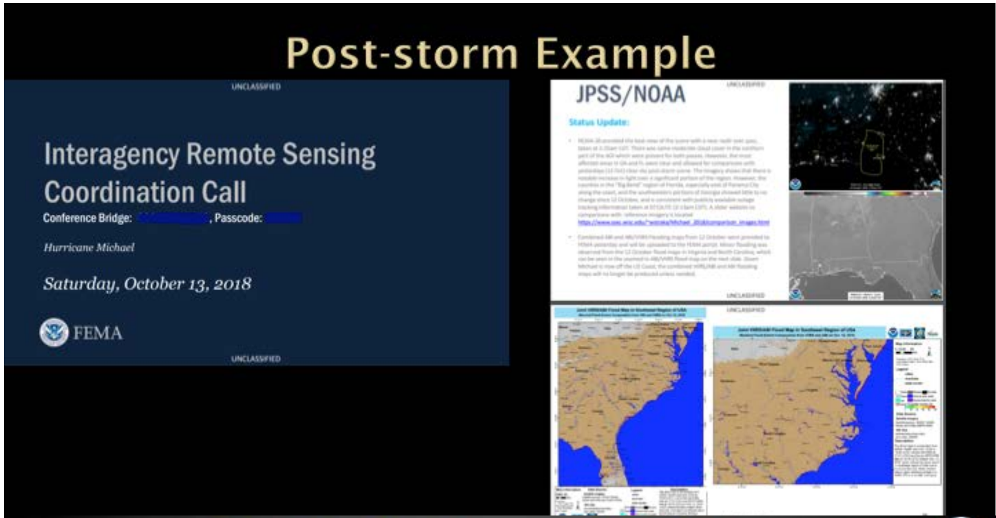
Each image in the detailed report can be selected to show a larger image. In this case the mapped image of the absolute difference between the two datasets (top), a histogram of the differences (middle) and a density-scatter plot comparing the datasets (bottom) are shown.

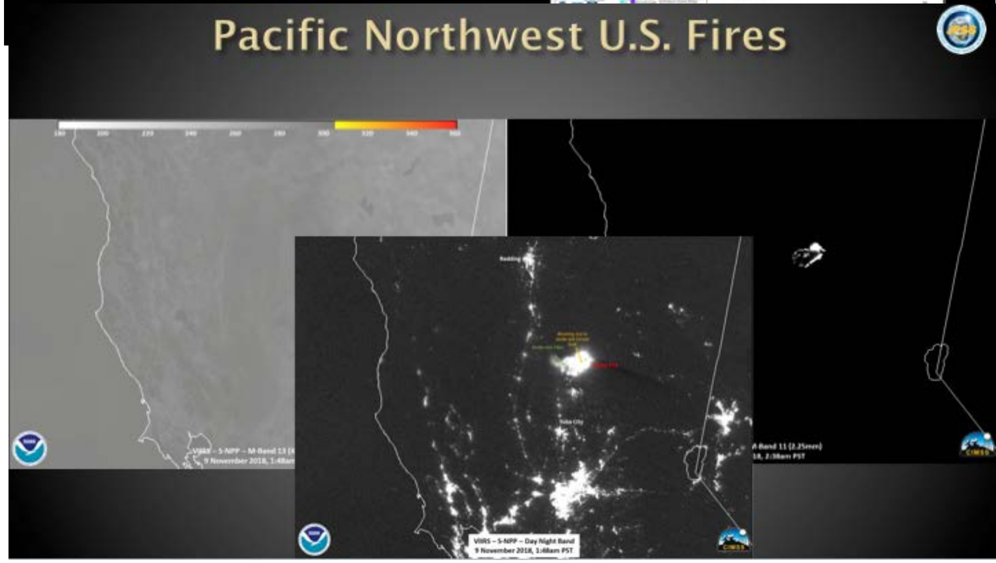
Funding Source: NOAA GOES-16/17 AWG

Usage of the VIIRS Day Night Band and other Products in Disaster Response and monitoring

William Straka III[1], Steve Miller[2],Curtis Seaman[2]
[1]CIMSS/SSEC, University of Wisconsin-Madison, [2]CIRA/CSU

- DNB and VIIRS as a tool for disaster monitoring
  - Since the launch of SNPP, the VIIRS instrument has shown itself useful in observing man-made and natural disasters
  - In recent years, as the community at large has become aware of the capabilities of imagery and derived products from VIIRS and other instruments, they are now becoming used in a variety of pre-disaster and post-disaster response.
  - With the launch of NOAA-20 last year, this has opened up a larger opportunity for both pre and post-event monitoring
- Tropical Systems
  - As the storms have approached the various areas, VIIRS imagery, along with other JPSS products from AMSR-2, have provided insight into the intensity and development of the storm to users not necessarily familiar with those products (ex. NWS Pacific Region)
  - Post storm, both imagery and products derived from VIIRS have proved critical to emergency managers such as FEMA and DoD (US Army North) in their response to tropical systems and other natural disasters
- Wildfire monitoring
  - VIIRS and other products have been critical in the response to wildfires both in the United States and internationally
  - The California Department of Forestry and Fire Protection (CalFire) is currently adding in VIIRS imagery as part of their initial fire response intelligence gathering.

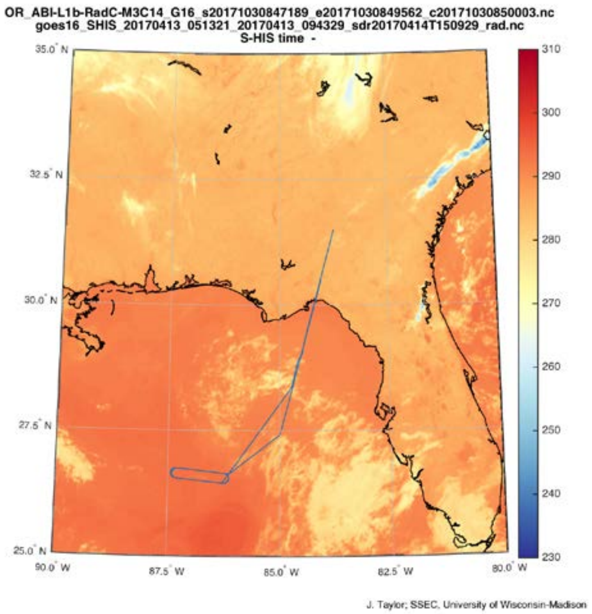


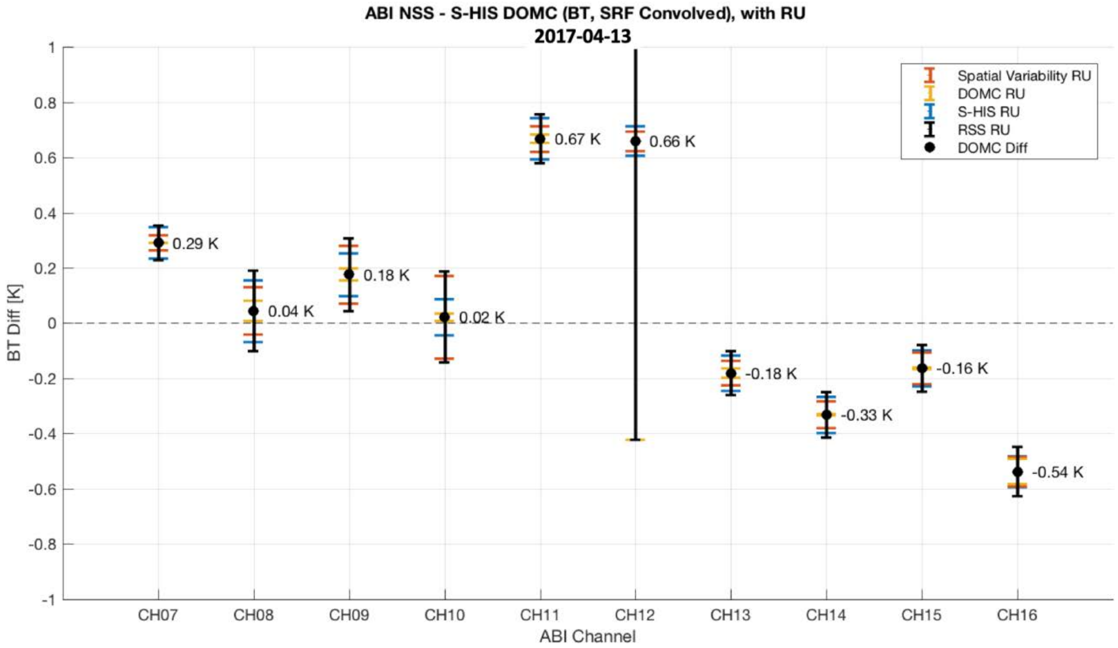


Funding Source: NOAA JPSS PGRR

Calibration Validation of the GOES-16 Advanced Baseline Imager (ABI) with the Airborne Scanning High-Resolution Interferometer Sounder (S-HIS)

Joe Taylor[1], David Tobin[1], Henry Revercomb[1], Fred Best[1], Ray Garcia[1], Robert Knuteson[1], Michelle Feltz[1], Francis Padula[2], Steven Goodman[3]
[1]University of Wisconsin-Madison Space Science and Engineering Center, [2]GeoThinkTank LLC, [3]NOAA/NESDIS/GOES-R Program





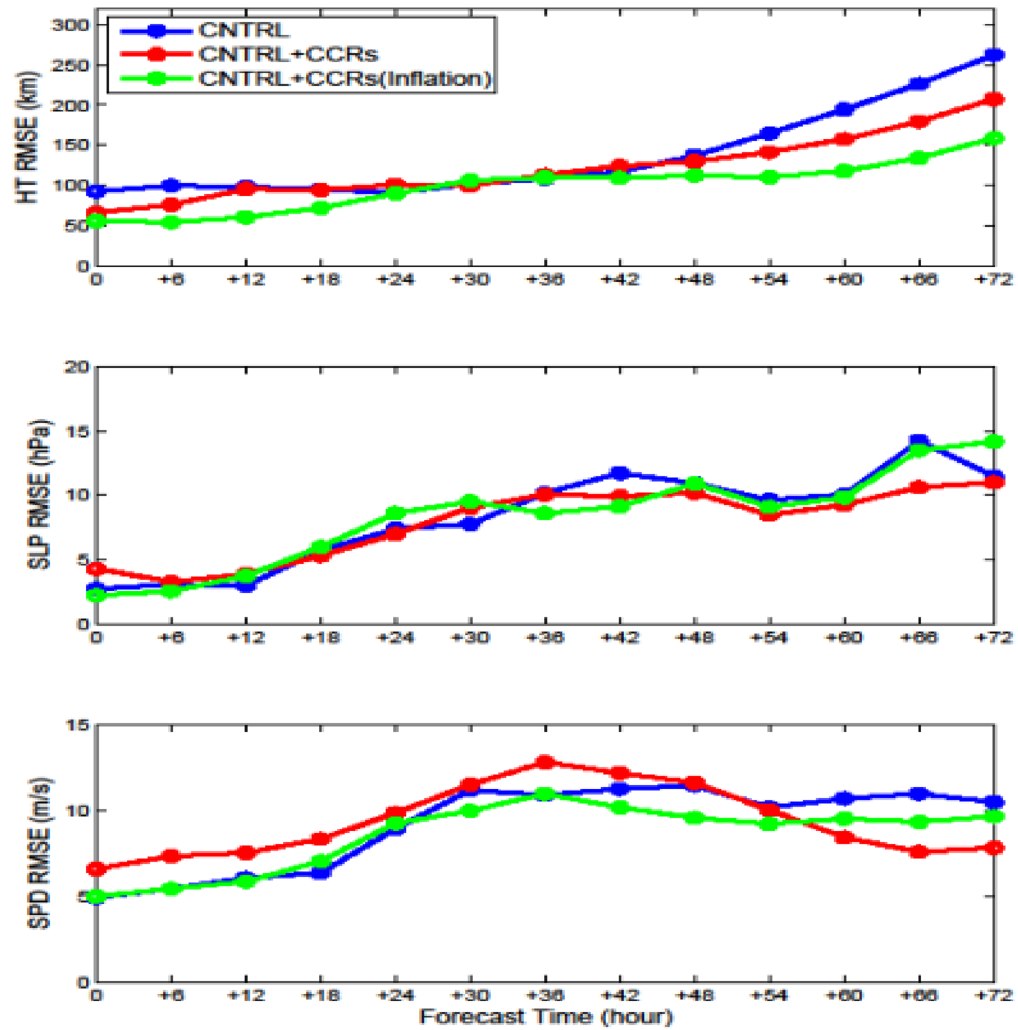
- ABI TEB Band (Bands 07-16) Double Obs Minus Calc (DOMC) comparisons with S-HIS have been completed for all Mode 25 NSS data files from 2017-04-13, 2017-03-23, 2017-03-28
- The results show good agreement between ABI and S-HIS observations, well within 1K @ 300K Equivalent Scene BT ABI specification
- The NSS results are very consistent with Meso results
- High-altitude airborne cal-val campaigns for space-based observing systems provide low total comparison uncertainty with a short and simple traceability chain to absolute standards

Funding Source: NOAA GOES-16 Risk Reduction

Impacts of Observation Errors of Hyperspectral Infrared Sounders under Partially Cloudy Regions on Hurricane Harvey (2017) Forecasts

Pei Wang, Jun Li, Agnes Lim, Zhenglong Li, **Jinlong Li** (CIMSS) , Tim Schmit (STAR) and Mitchell Goldberg

- A noise amplification method is introduced for VIIRS-based CrIS cloud-cleared radiance (CCR) assimilation in partially cloudy skies;
- The inflated observation errors of CrIS CCRs assimilation could further improve the hurricane precipitation and track forecasts of Hurricane Harvey (2017) (see the right panel);
- A paper has written for publishing, the method will be further tested with operational models such as HWRF and GFS.

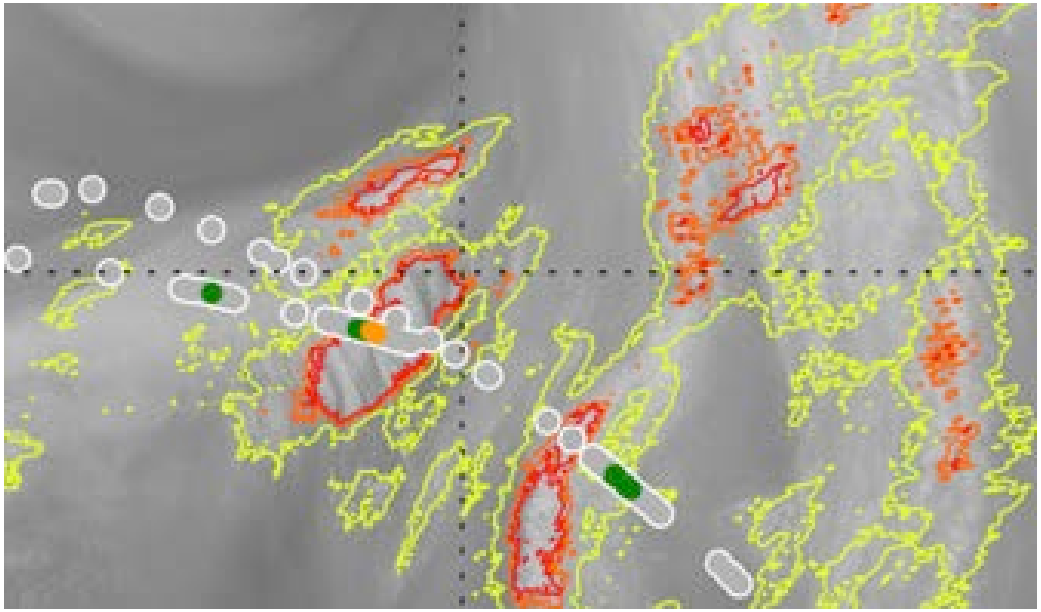


Funding Source: NOAA JPSS Proving Ground/Risk Reduction

Predicting aircraft turbulence with a deep learning model applied to geostationary infrared imagery

Anthony Wimmers, Sarah Griffin (CIMSS)

- A deep learning (artificial intelligence) model is trained on aircraft observations and 4 years of Himawari Band 8 (upper trop water vapor) in the western Pacific
- The model correctly predicts ~40% of the moderate-or-greater turbulence events in the independent test set.
- The model is used to create a 10-minute resolution, full-disk probabilistic prediction of cruising-altitude turbulence (detail shown on the right).



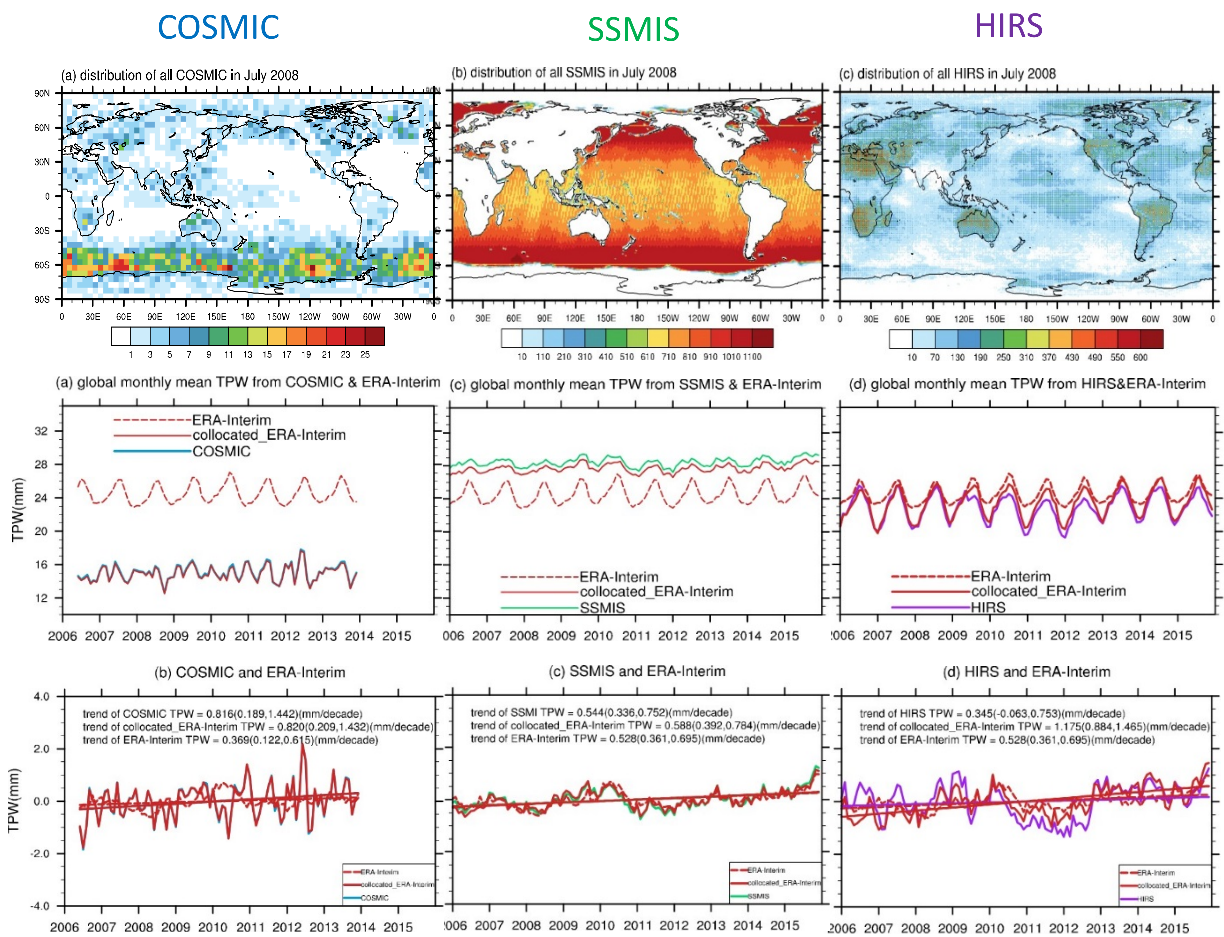
Example from the central Pacific on 21 Feb 2018. Gray, green and orange disks are null, light and moderate aircraft turbulence, respectively. The contours are probability of turbulence, increasing with hotter colors.

Funding Source: NOAA GOES-16/17 Risk Reduction

Impact of Sampling on the Global Trend of Total Precipitable Water Derived from the COSMIC, SSMIS and HIRS Observations

Yunheng Xue(CIMSS,IAP); Jun Li(CIMSS)

- An upward trend in global TPW is shown in all three satellite datasets, the variation and the magnitude of trend are different because of the sampling impact.
  - ✓ COSMIC: spurious trend due to very limited sampling
  - ✓ SSMIS: more reliable trend but no information over land
  - ✓ HIRS: a wildly distributed dry bias leading to a smaller TPW trend.
- It's important to merge multi-satellite data to get a more reliable Climate Data Record (CDR).



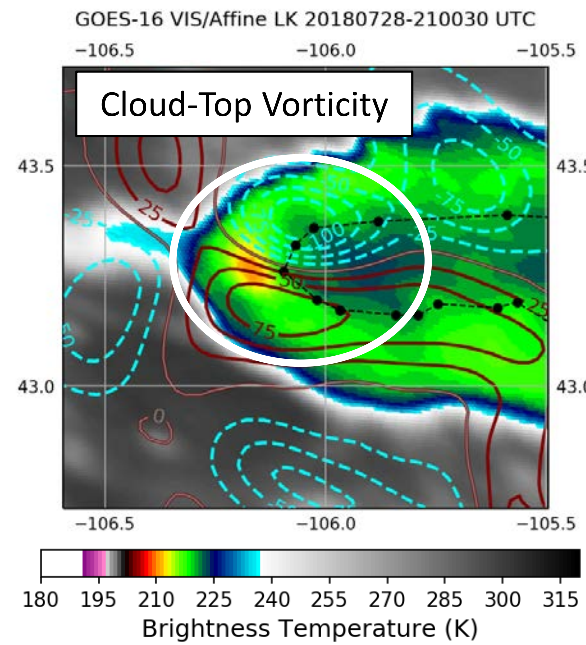
CIRA

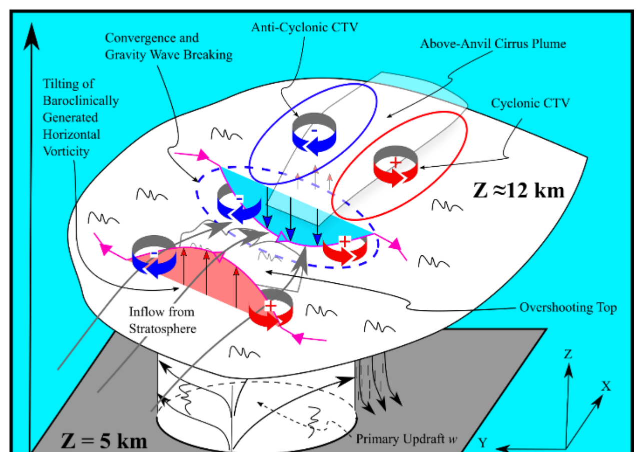
- Jason Apke
- Bernadette Connell
- Robert DeMaria
- John Forsythe (2)
- John Haynes
- Kyle Hilburn
- Don Hillger
- Max Marchand
- Kevin Micke
- Steve Miller
- Kate Musgrave
- Yoo-Jeong Noh
- Curtis Seaman
- Chris Slocum
- Stephanie Stevenson

On the Origin of Storm-top Rotation Derived With GOES-16

Jason Apke, Steve Miller (CIRA)

- Severe thunderstorms often exhibit adjacent maxima and minima of vertical vorticity downstream of overshooting tops in objectively derived cloud-top flow fields using 1-min imagery
  - Couplet-like signature has been derived over dozens of severe thunderstorms (upper figure)
  - Relationship of couplet-like signal to storm severity is currently unknown
  - Origin of derived rotation unknown
- Numerical models and new GOES-16 flow field derivation techniques used to probe origin of derived rotation and possible artifacts in old derivations
  - Models reveal importance of inflow from stratosphere in generating storm-top rotation downstream of overshooting top (lower figure)
  - Rotation near/over the overshooting top held closer relationship to vorticity generated in low- to mid- levels (below ~7 km)
  - Artifacts found to enhance rotation derived flow fields, though not enough alone to create couplet-like signature in rotation
  - New relationships found here will guide future methods on how to infer internal storm kinematics and severity from storm-top flow fields



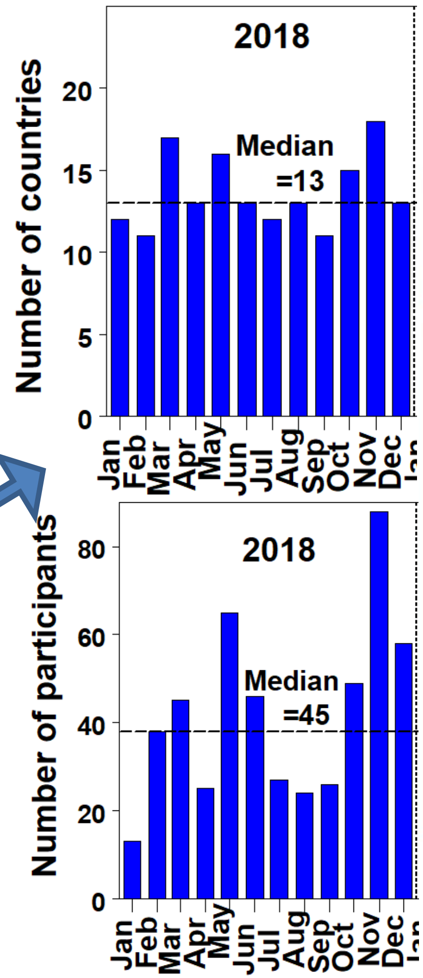


Strengthening National and International Training Activities by Utilizing Similarities and Differences

B. Connell $ E. Dagg (CIRA), L. Veeck (WMO Vlab), K.-A. Caesar (CIMH, Barbados)

- Similarities: Multiple Training Approaches
  - Learning requires a foundation of knowledge (eg. online modules)
  - Hands-on applications strengthen knowledge (case studies and simulations)
  - Learning is deeper and more durable when it requires effort (Why was this a false positive / limitation?)
  - Recall of information strengthens retention (eg. regular monthly online weather sessions)

- Differences: National vs. International
  - Languages: one vs. multiple
  - Country size: large vs. varying sizes

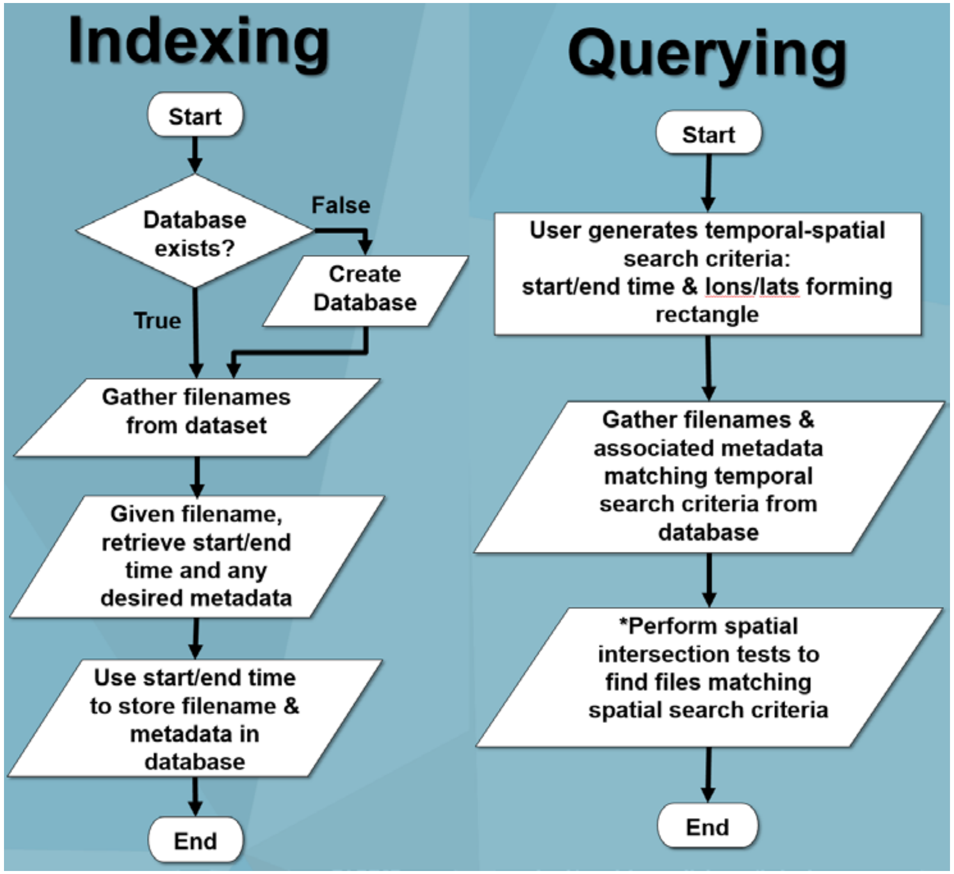


+ Capacity Building

CIRA Polar Orbiters Database Software (C-POD): Python Software to Make Searching Polar-Orbiting Satellite Data Fast and Easy

Robert DeMaria(CIRA), Galina Chirokova(CIRA)

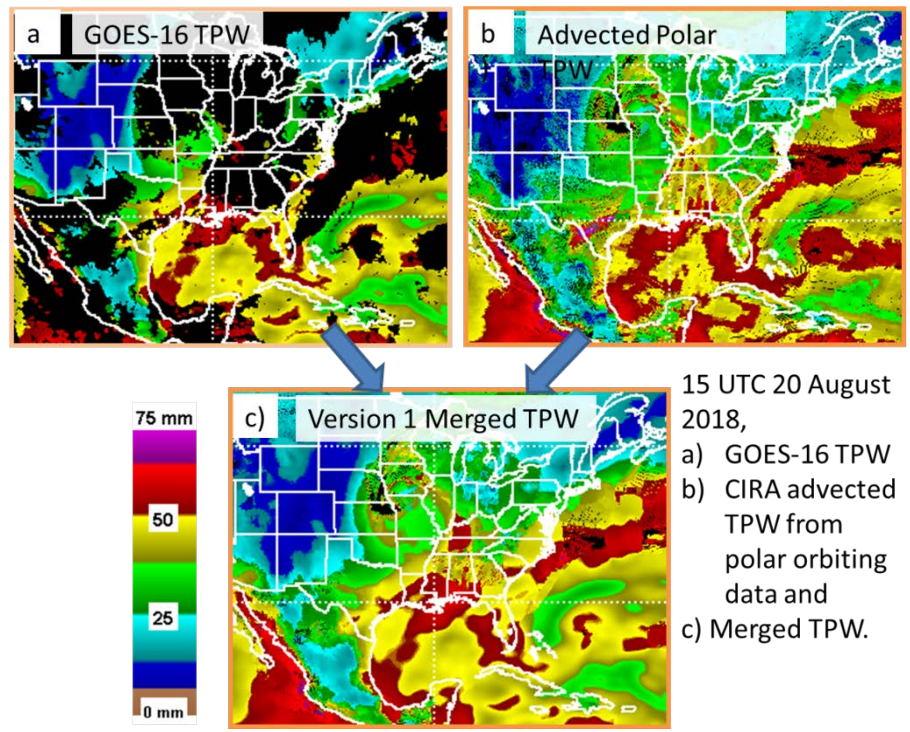
- **Motivation**
  - Software library needed to perform fast temporal-spatial searches of satellite data
- **Key Features**
  - Written in Python 3.6
  - Supports fast searches of wide variety of satellite data
  - Adding support for new types of data typically involves writing 0-50 lines of code
- **How Does It Work?**
  - Create database searchable by time
  - Refine searches with spatial intersection tests
  - Behavior can be customized for each type of data



Using the New Capabilities of GOES-R to Improve Blended, Multisensor Water Vapor Products for Forecasters

John Forsythe, Stan Kidder, Andy Jones, Dan Bikos, Ed Szoke, Louie Grasso (CIRA)

- **Adding GOES-R to Blended Total Precipitable Water (TPW)**
  - Current operational blended TPW does not use GOES-R data
  - initial validations of GOES-R TPW versus GPS, RMS errors ~ 3 mm.
  - Prototype blended product being created to leverage strengths of all sensors
- **GOES-R Water Vapor Imagery Simulated from ALPW**
  - Uses CIRA Advected Layer Precipitable Water (ALPW) to drive radiance simulations of GOES-R water vapor channels
  - Provides forecasters a “cloud-free” water vapor imagery product to evaluate mid- and upper-layer moisture.



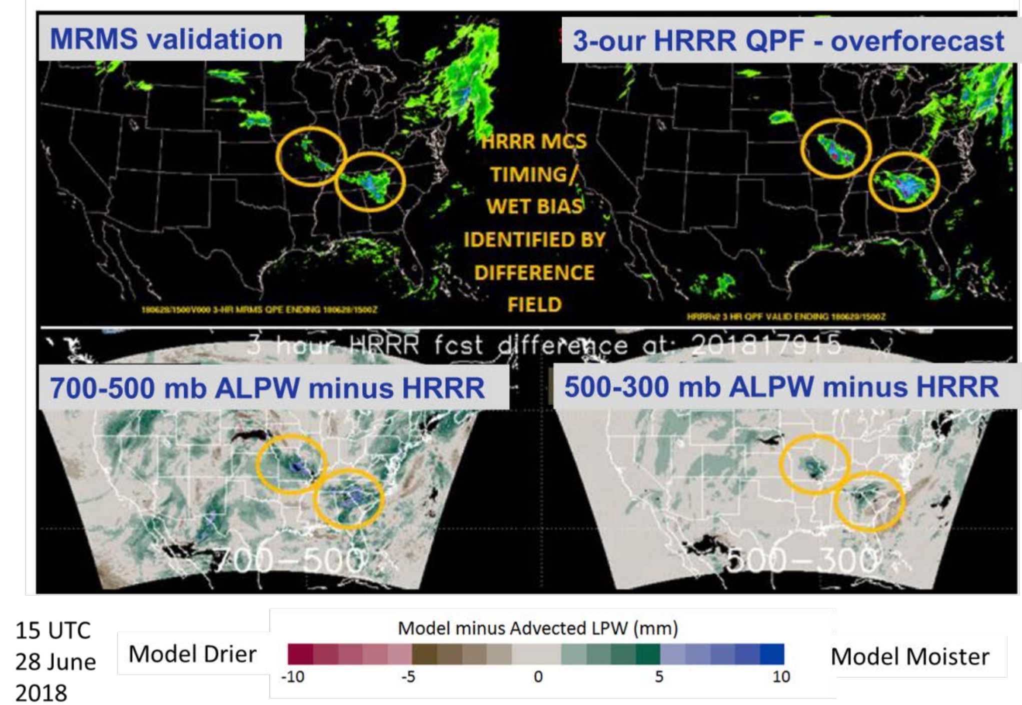
15 UTC 20 August 2018,
a) GOES-16 TPW
b) CIRA advected TPW from polar orbiting data and
c) Merged TPW.

Example of Version 1 Merged TPW creation from (a) GOES-16 TPW and (b) advected passive microwave retrievals from polar orbiting spacecraft. High temporal resolution of GOES-R complements the microwave coverage in cloudy regions.

Satellite and Model Layer Precipitable Water Products to Support Forecasting of Heavy Precipitation Events

John Forsythe, Stan Kidder, Andy Jones, Dan Bikos, Ed Szoke, Steve Fletcher, Sheldon Kusselson (CIRA)

- **CIRA Advected Layer Precipitable Water (ALPW)**
  - Provides forecasters a new view of water vapor from seven polar spacecraft
  - Derived from NOAA Microwave Integrated Retrieval System (MiRS) product
- **Difference fields versus GFS and HRRR LPW**
  - Evaluated in NOAA FFaIR (Flash Flood Experiment at WPC in summer 2018)
  - Shows forecasters where model may be too dry or moist
  - Recommended for transition to operations
  - http://cat.cira.colostate.edu/HMT/ffair_main.htm

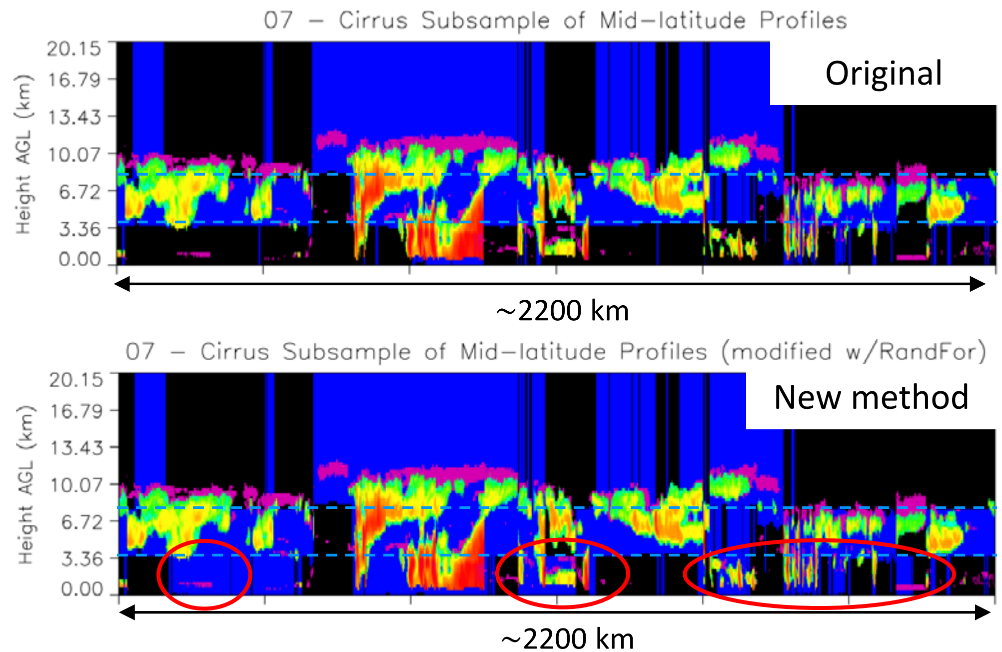


Example of an over-forecast of precipitation by the 3 hour HRRR forecast during FFaIR, as verified by the Multi-Sensor/Multi-Radar precipitation product. Forecasters identified excess mid-and upper layer water vapor (lower panels) in the model difference product at the time of this forecast.

Improved Cloud Boundary Detection with the GOES ABI

John M. Haynes[1], Yoo-Jeong Noh[1], Steven D. Miller[1], Andrew Heidinger[2], John M. Forsythe[1] (1-CIRA, 2-NESDIS)

- **ABI-only cloud detection of low clouds can be challenging in multi-layer scenes**
  - Aviation is particularly concerned with the location of low clouds (IFR conditions, icing, etc.)
- **A method to detect low cloud is being developed that uses ABI multispectral information and layer humidity to identify low clouds**
  - Our method is trained using ‘truth’ from spaceborne radar and lidar
  - Includes a machine learning component
- **Our method shows improvements in ABI-based low cloud detection**



Colors and Purple : Actual cloud locations from CloudSat radar / CALIPSO lidar

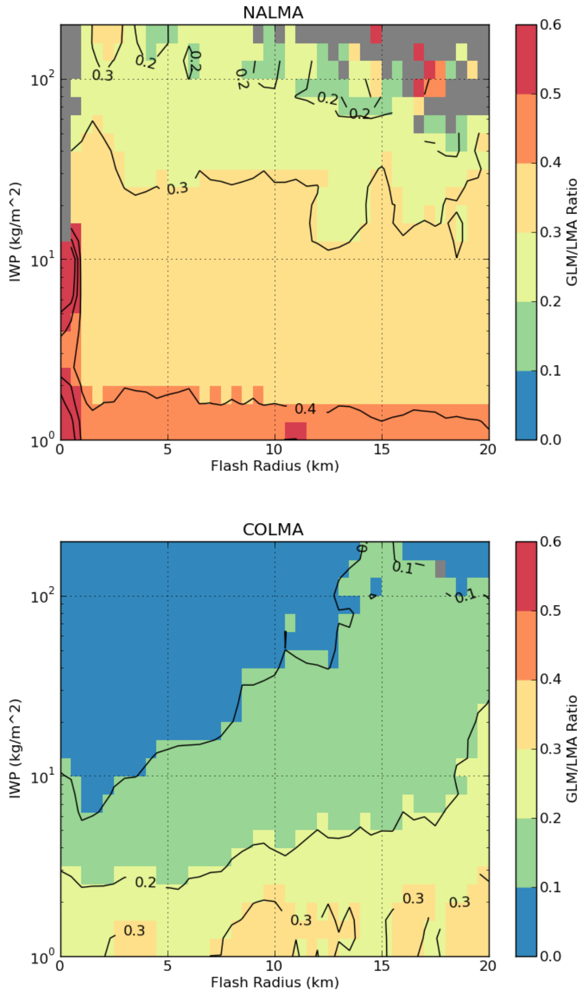
Blue background: “Cloud Cover Layers”: Broad levels where GOES-16 identifies loud

Note general improvement in low cloud detection below the cirrus

Evaluation of GOES-16 GLM to Lightning Mapping Arrays

Kyle Hilburn (CIRA), Brody Fuchs (CSU), Steven A. Rutledge (CSU)

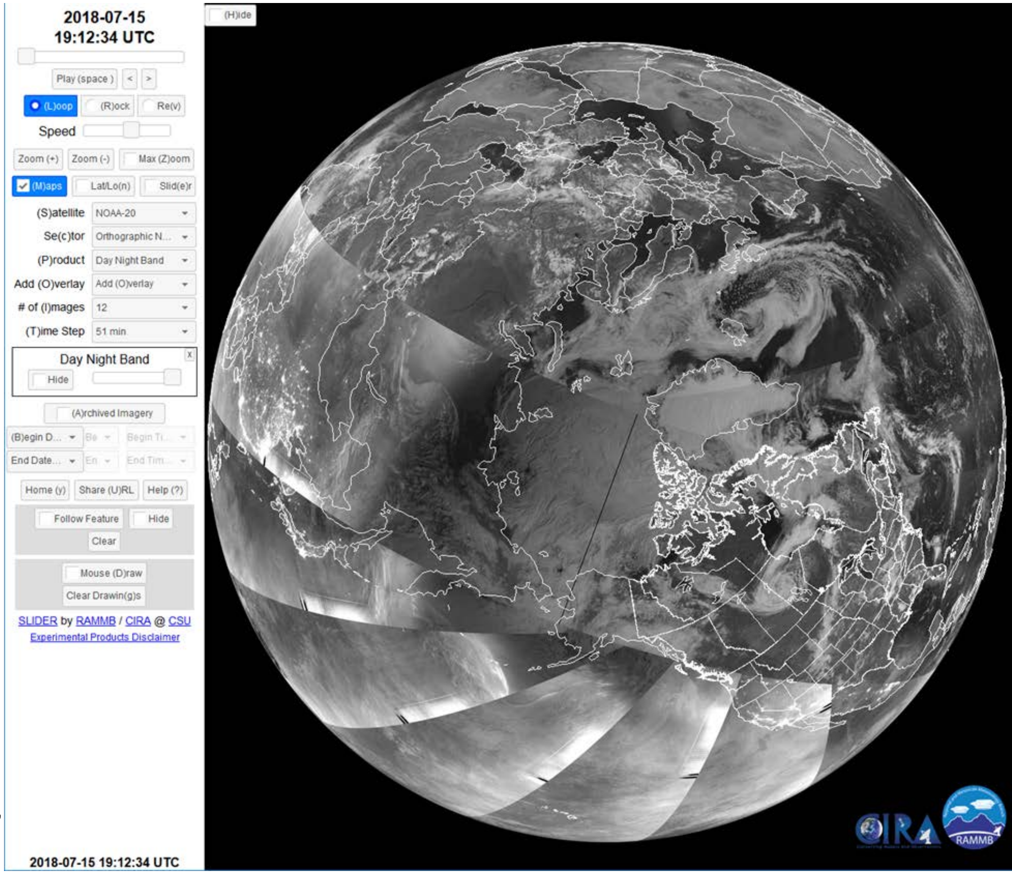
- GLM flash rates were compared with lightning mapping arrays (LMAs) and radar
  - COLMA: Colorado
  - NALMA: North Alabama
  - MRMS: Multi-Radar/Multi-Sensor system
- GLM detection efficiency (DE) depends primarily on:
  - Ice Water Path above the flash
  - Size of the flash
- GLM/LMA time correlation can be high even when DE is low
  - Time variability of GLM lightning provides information



Validating VIIRS Imagery from NOAA-20

Don Hillger (NOAA), Tom Kopp (Aerospace), Curtis Seaman (CIRA), Steven Miller (CIRA), Deb Molenar (NOAA), and Jorel Torres (CIRA)

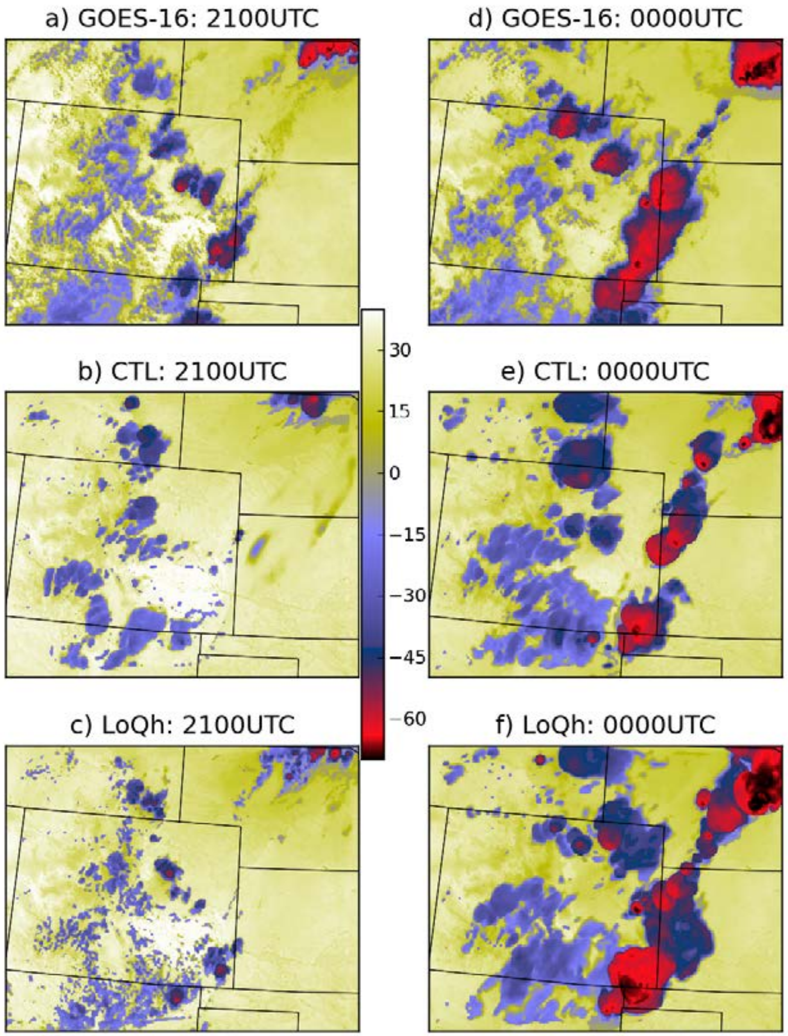
- **Introduction to VIIRS EDR Imagery**
  - EDR vs SDR
  - NCC vs. DNB
- **Checkout (cal/val) of VIIRS from NOAA-20**
- **What's Next for VIIRS EDR Imagery?**
  - **NCC LUT update for NOAA-20**
  - **Terrain-corrected geo-locations for EDRs**
- **Part 2: Polar SLIDER** for S-NPP and NOAA-20 Imagery (see image at right)
  - http://rammb-slider.cira.colostate.edu/?sat=jpss
  - from the SLIDER homepage, choose "JPSS" from the Satellite Menu



Assimilation of ABI and GLM at High Temporal and Spatial Scales

Max Marchand and Kyle Hilburn (CIRA/CSU)

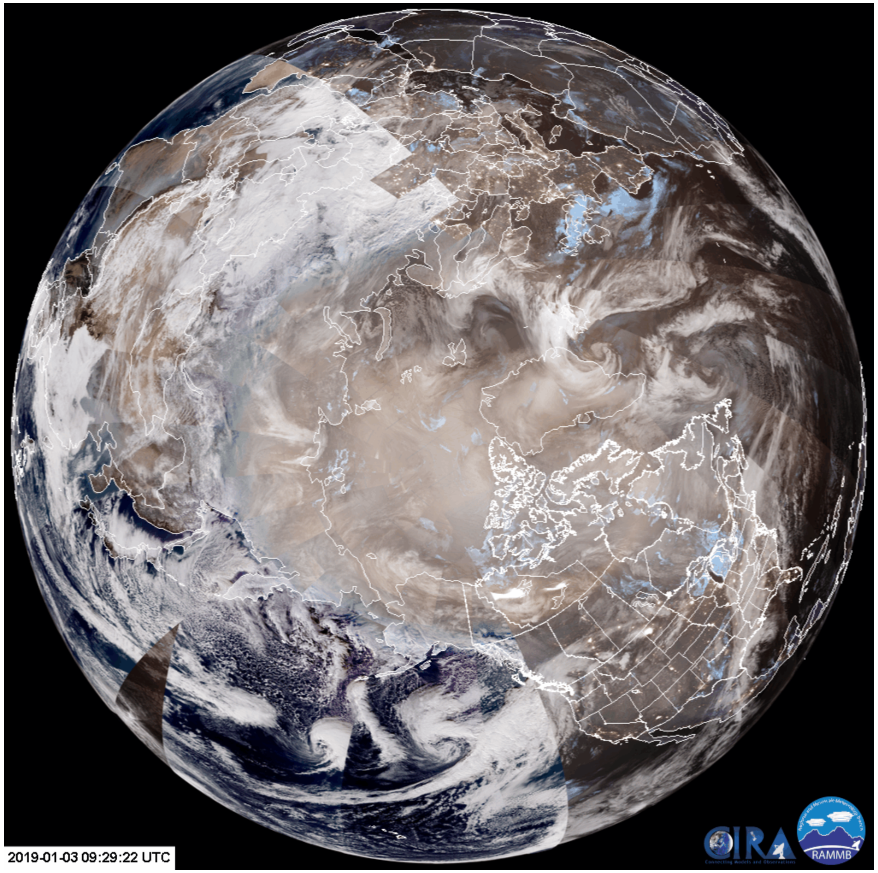
- **New assimilation method for ABI**
  - **Inserts and removes cloud/precipitation hydrometeors based on ABI Cloud Optical Depth and 10.3 µm BT**
  - **Implemented in HRRR-like configuration utilizing WRFV3.9.1**
- **Improves cloud forecast and analysis**
  - **Synthetic 10.3 µm BT (derived with CRTM V2.3.0) better match GOES-16 observations when assimilating ABI (LoQh) compared to no assimilation (CTL)**
  - **ABI assimilation also improves precipitation analysis and forecast (not shown)**
  - **Simulations use 9 h assimilation window (1200-2100 UTC 4 July 2018) followed by 9 h forecast (2100-0600 UTC)**



Exciting New Features, Products, and Satellites Added to SLIDER Satellite Imagery Looper

Kevin Micke (CIRA)

- **New Satellites**
  - GOES-17 prelim/non-op data
  - JPSS imagery added with Dr. Curtis Seaman's innovative code to stitch together granules (see figure)
- **New Products**
  - Global Lightning Mapper (GLM) products created by Dr. YJ Noh
  - MRMS radar data remapped to GOES-16 CONUS projection by Natalie Tourville
- **New Features**
  - Downloadable animated GIFs and PNGs
  - Feature-following loops
  - Longer archive (108 TB total on 3 servers)
  - http://rammb-slider.cira.colostate.edu/



Return to the Dark Side: Visible Applications in Dark Environments, Revisited (VADER)

Steven D. Miller[1]
William Straka, III[2], Curtis Seaman[1], Yoo-Jeong Noh[1], Louie Grasso[1], Jeremy Solbrig[1], Cindy Combs[1], Scott Longmore[1], Kevin Micke[1]
[1] CIRA /Colorado State University, Fort Collins, CO ; [2] CIMSS / University of Wisconsin, Madison, WI

1. Introduction

- The Visible Light Signals of the Night
- The Value of the S-NPP / NOAA-20 Pairing

2. Examples of VADER Science

- Snow Cover Detection at Night
- Revealing IR Low Cloud Detection Issues
- Dual-Satellite Optical Flow

3. Looking Ahead

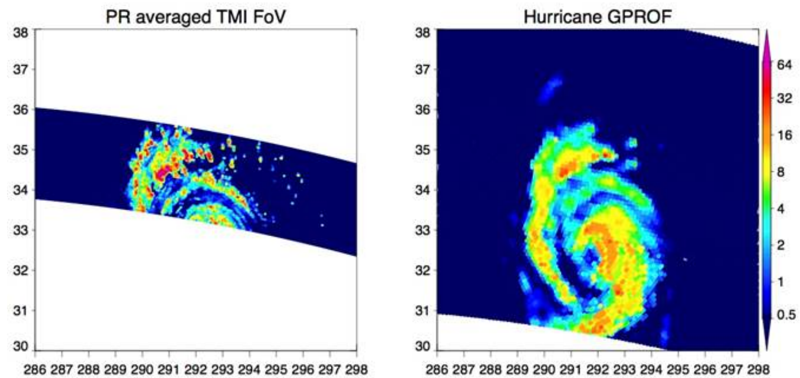
- Exploring the Potential of CubeSats
- Toward a Geostationary-Based Low-Light Visible Measurement Capability

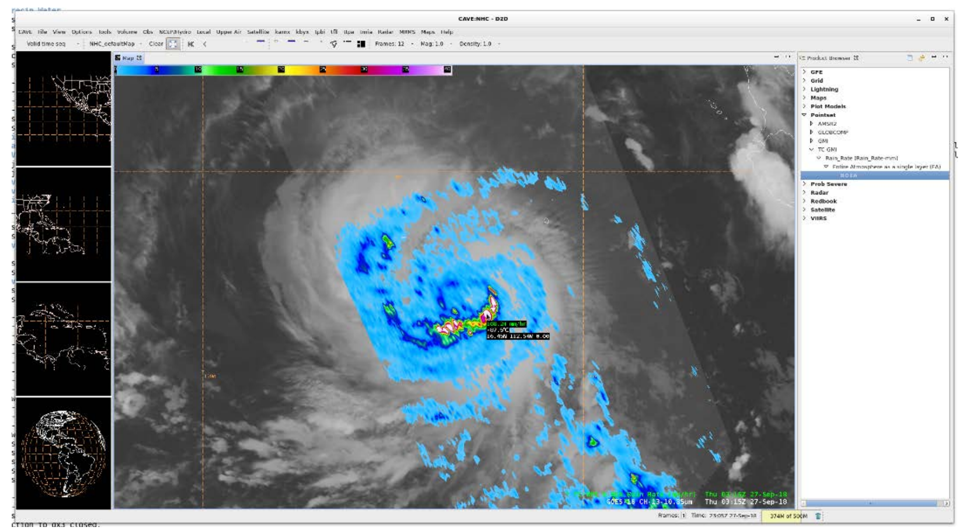
Exploration of Tropical Cyclone Rapid Intensification Using Hurricane GPROF and Impacts on Statistical-Dynamical Intensity Models

Kate Musgrave (CIRA), Paula Brown (CSU), and John Knaff (NOAA)

- **Introduction of Hurricane GPROF**
  - Hurricane GPROF has been developed to provide rain rates and hydrometeor profiles from TMI/GMI, using the TRMM PR as the ground truth in the developmental sample
  - Better representation of higher rain rates in hurricanes than GPROF, with larger areal coverage than PR/DPR
  - Global expansion of tropical cyclone dataset produced over 10,000 overpasses, with over 3,000 in the period surrounding rapid intensification
- **Implementation into AWIPS II**
  - Tropical cyclone overpasses calculated from existing tracks in real-time for each 5 minute granule, combined for each storm
  - Bundled with nearest GOES Channel 13
  - Latency of ~1 hour

Hurricane Bill 22 Aug 2009



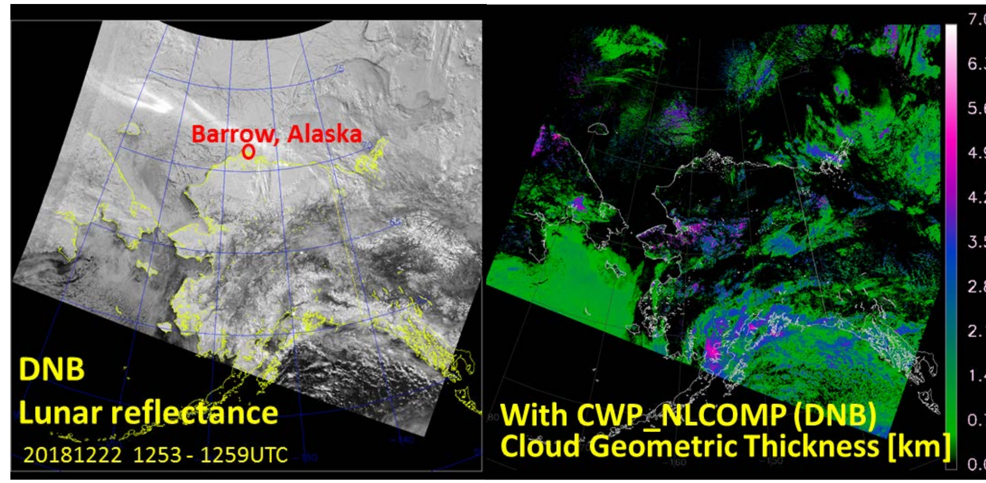


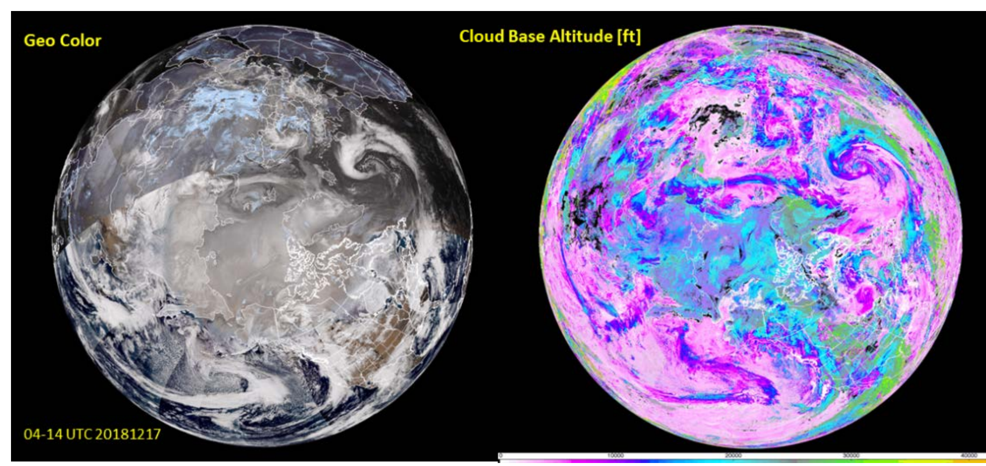
Hurricane Rosa 27 Sep 2018

Improvement of Nocturnal Cloud Base Height and Vertical Layer Retrievals in High Latitudes

Y. J. Noh, S. Miller, J. Haynes, J. Forsythe, C. Seaman (CIRA), A. Heidinger (NESDIS), Y. Li, S. Wanzong, W. Straka, A. Walther (CIMSS)

- A statistical **Cloud Base Height (CBH)** algorithm using NASA A-Train satellites was developed as part of the NOAA operational Enterprise Cloud Algorithms
- Applicable to both polar and geostationary satellite sensors, and used for improved **Cloud Cover Layers (CCL)**
- Leverage resources for improved nighttime performance
  - Nighttime Lunar Cloud Optical & Microphysical Properties (NLCOMP) algorithm using VIIRS DNB lunar reflectance
  - Additional resources from ATMS and NWP for nights without sufficient moonlight
  - Adopting a machine learning tool (“random forest”)
- Ongoing efforts to provide relevant training tools and display capabilities (CIRA’s Polar SLIDER: sample →)

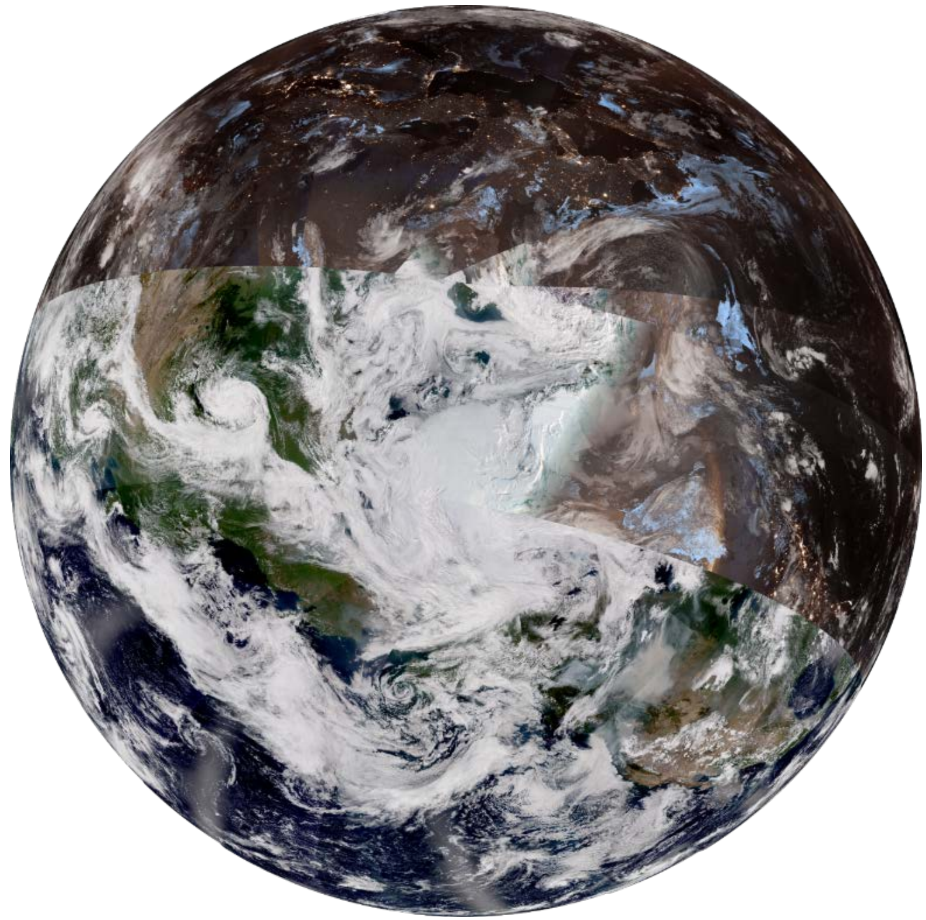




Polar SLIDER: A Website for Viewing Global VIIRS Imagery

Curtis Seaman (CIRA), Kevin Micke (CIRA), Dan Lindsey (NOAA), Steven Miller (CIRA),
Yoo-Jeong Noh (CIRA), Natalie Tourville (CIRA), Steve Finley (CIRA), Don Hillger (NOAA)

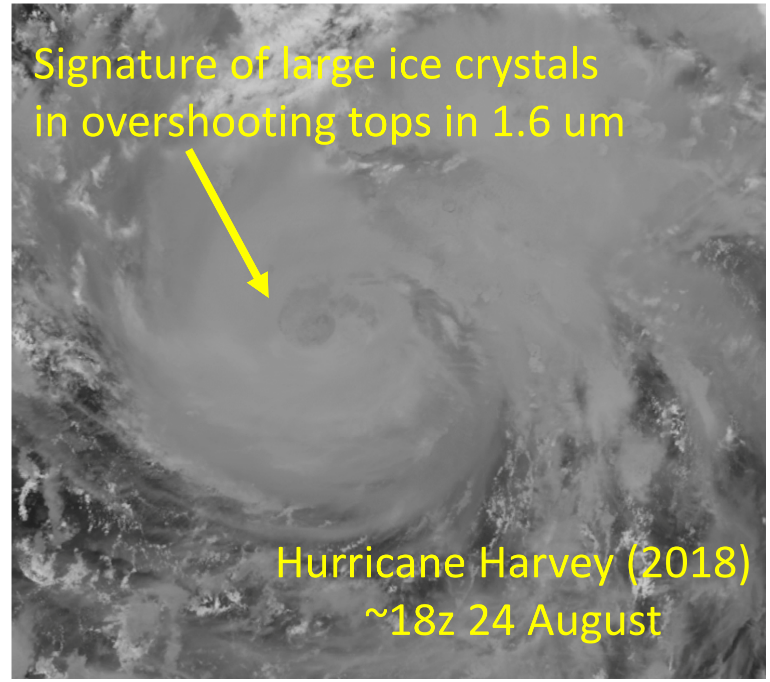
- **Introduction to SLIDER**
  - http://rammb-slider.cira.colostate.edu/
- **New Polar SLIDER**
  - http://rammb-slider.cira.colostate.edu/?sat=jpss
  - from the SLIDER homepage, choose "JPSS" from the Satellite Menu
- **Imagery from all 22 VIIRS bands from both S-NPP and NOAA-20 in near-realtime**
  - Introducing VIIRS GeoColor
  - More multispectral imagery products coming soon
  - NUCAPS Cold Air Aloft product coming soon
- **8 Different VIIRS Cloud Products**
- **Northern and Southern Hemisphere views**
- **New features on SLIDER**
  - Download your own animated GIF
  - "Flow following"/Feature Tracking utility

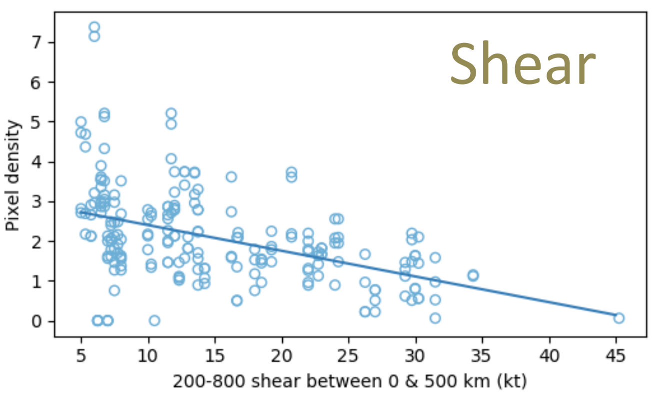


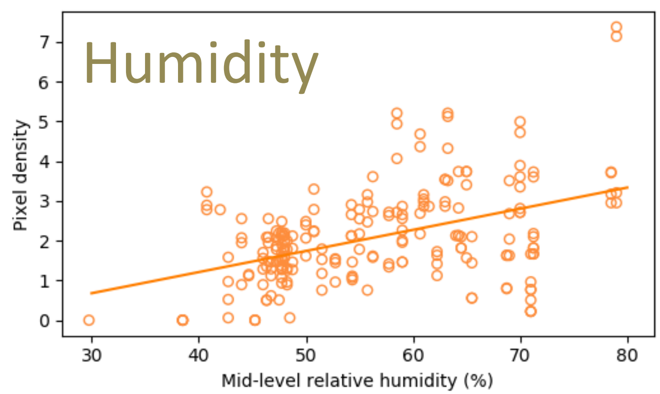
Is GOES-R Seeing “hottish” Convective Towers in Hurricanes?

Chris Slocum (CIRA) and John Knaff (NOAA)

- Investigate short-term forecast applications using GOES-16 ABI near-infrared bands
- Discovered that ice crystal size in hurricane overshooting top are large (darker reflectivity = larger ice crystal in glaciated clouds).
- This ice crystal size signature is opposite to the signal in mid-latitudes
- Larger ice crystals are present only when the environment (humidity & shear) is favorable for vigorous eyewall convective





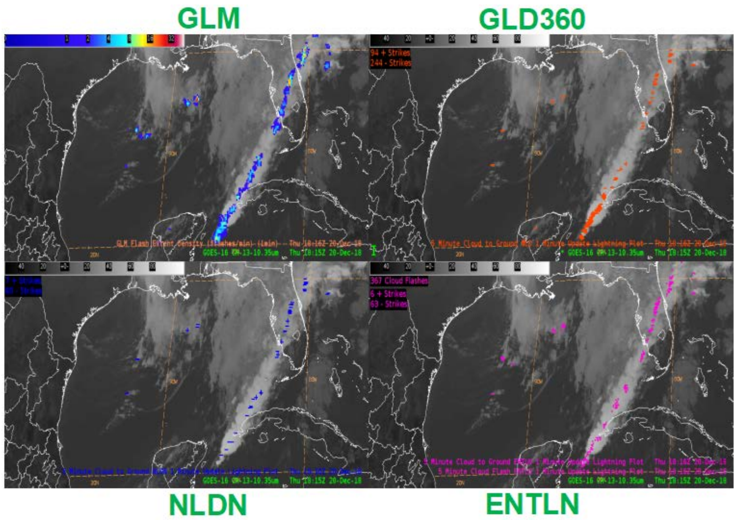


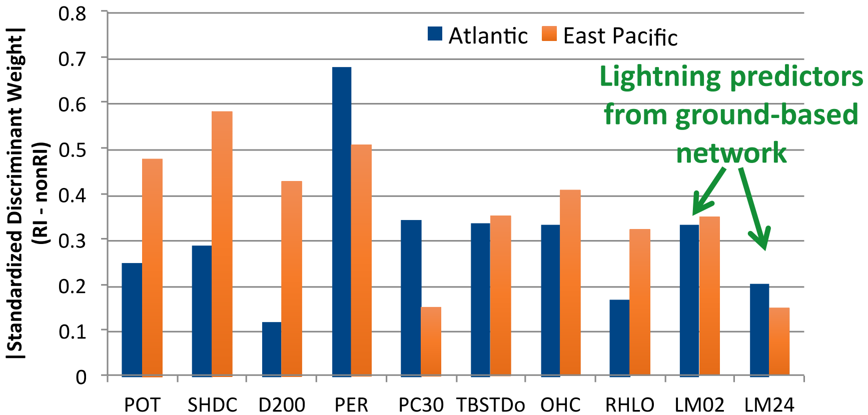
The density of pixels with ice crystals greater than 80 um in diameter relative to humidity and shear

Incorporating GLM observations at NHC

Stephanie Stevenson (CIRA); Mark DeMaria (NOAA)

- GLM provides unprecedented total lightning activity for tropical cyclones over the ocean
- Custom full-disk GLM grids for AWIPS-II are being tested
  - **Time accumulations**: 1-, 5-, 15-, 30-min
  - **Grids**: flash extent density, average flash area, and total optical energy
- Plans for GLM incorporation
  - Add GLM predictor(s) in the Rapid Intensification Index (RII)
  - Combine GLM grids with other satellite & aircraft recon data – including NOAA aircraft Doppler radar for the radius of maximum wind
  - Explore how ground-based networks can complement GLM in tropical cyclones





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