National Satellite and Information Service

NOAA - Cooperative Remote Sensing Science and Technology Center

AMS Talk Summaries from STAR, CIs & More

AMS101

101st Annual Meeting

VIRTUAL | 10-15 January 2021

Compiled by Ralph Ferraro, STAR/CoRP/SCSB, & Deb Baker, CISESS

National Satellite and Information Service

NOAA - Cooperative Remote Sensing Science and Technology Center

STAR

- Yong Chen
- Sean Helfrich
- Don Hillger
- Flavio Iturbide-Sanchez
- John Knaff
- Veronica Lance
- Bill Line
- Tim Schmit
- Banghua Yan
- Yunyue Yu

National Satellite and Information Service

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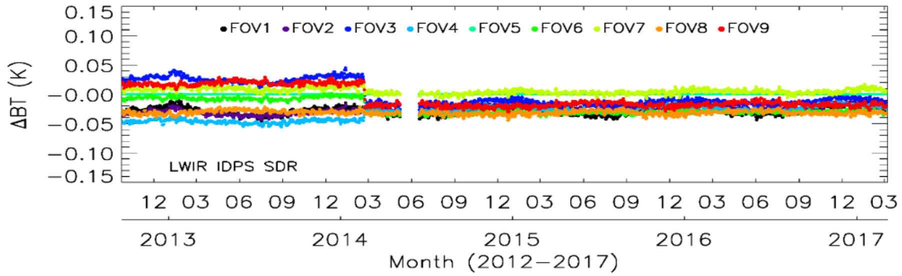
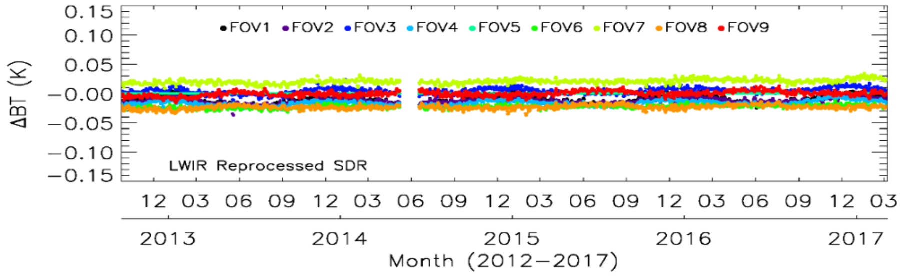
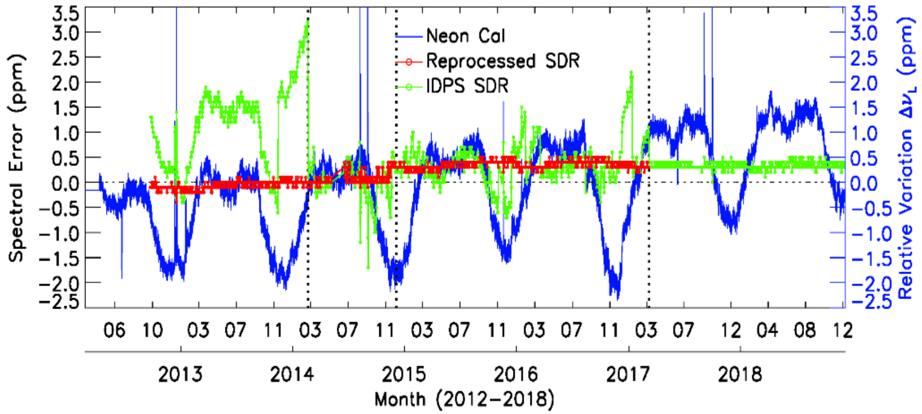
Reprocessing of S-NPP and NOAA-20 CrIS to Improve Sensor Data Records Consistency

Yong Chen and Flavio Iturbide-Sanchez (STAR), Denis Tremblay and Ninghai Sun (GST)

Major Improvements in CrIS SDR Reprocess Version 1







Major Aspects for CrIS SDR Reprocess Version 2

- Using the latest major version of CrIS reprocessing system (based on IDPS Block 2.1 Mx8)
  - ❑ Fringe Count Error Detection and Correction Algorithm (03/08/2017, IDPS Block 2.0 Mx0)
  - ❑ Spike Detection and Correction Algorithm (10/02/2018, IDPS Block 2.1 Mx3)
  - ❑ Lunar Intrusion Detection Algorithm (12/17/2018, IDPS Block 2.1 Mx4), with updated thresholds (05/10/2019, IDPS Block 2.1 Mx5)
  - ❑ Polarization Correction Algorithm (01/29/2020, IDPS Block 2.1 Mx8)
- Using the latest fine-tuning of calibration coefficients to replace the coefficients in the Engineering Packet (EP) from RDR data stream
  - ❑ EP v37 for S-NPP CrIS SDR side 1 (before 06/24/2019)
  - ❑ EP v40 for S-NPP CrIS SDR side 2 (after 06/24/2019)
  - ❑ EP v115 for NOAA-20 CrIS SDR
- Using the same calibration algorithm for both S-NPP and NOAA-20, including the interferogram data points

Available Reprocessed CrIS SDR Version 2 Data

CrIS Data	NSR SDR	FSR SDR
S-NPP side1	02/20/2012-08/31/2017	12/04/2014-08/31/2017
NOAA-20	09/26/2019-01/30/2020	09/26/2019-01/30/2020

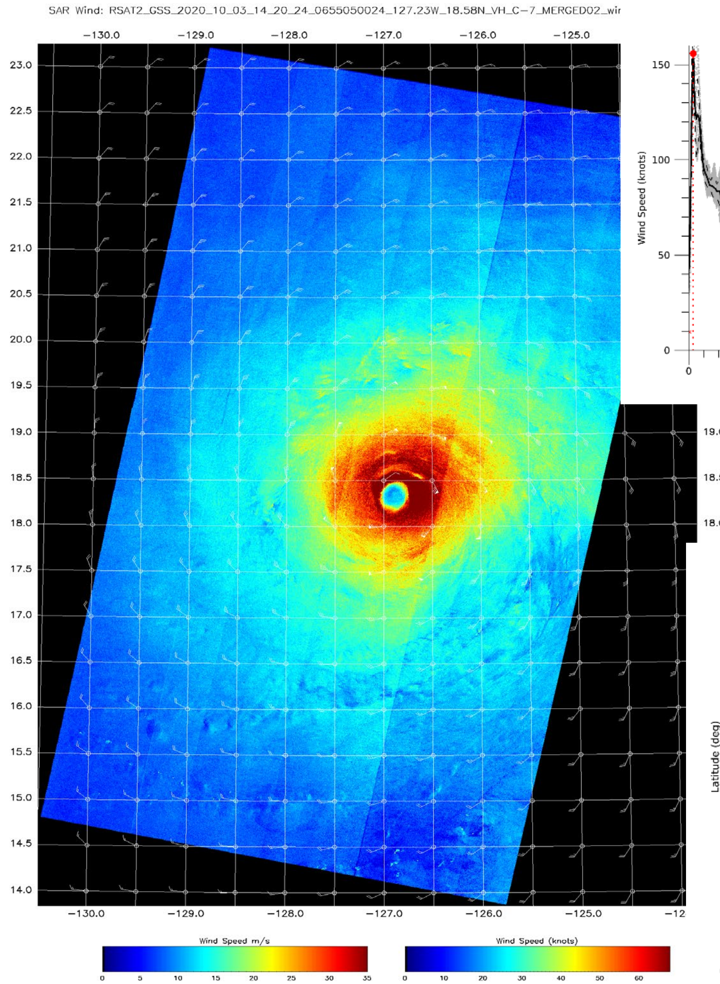
- Continue to generate the reprocessed CrIS SDR version 2 data for both S-NPP and NOAA-20 to cover the whole mission
- Work on the assessment of the accuracy of CrIS radiometric and spectral calibration and its stability using the reprocessed SDR and compared to the operational IDPS SDR data as well as the reprocessed baseline version (only available for S-NPP)
- Work on the assessment of the consistency between S-NPP and NOAA-20 CrIS

Evaluation of High Resolution Tropical Cyclone Wind Speeds from Synthetic Aperture Radar (SAR)

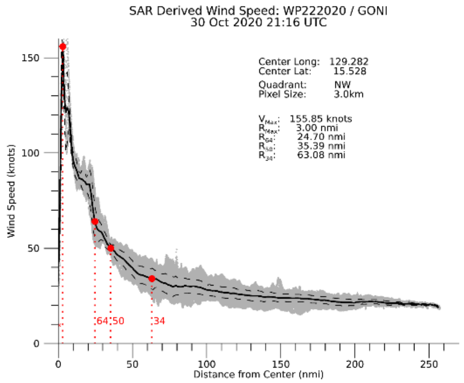
Sean Helfrich (STAR)

- NOAA is now generating high resolution (< 500 m) wide swath (> 250 km) SAR Tropical Cyclone Wind Speeds imagery. Hundreds of images available.
- Products include the detailed eye formation, maximum wind speed, the radius of maximum winds, the radius of the 34, 50 and 64 knot winds and the eye area.
- SAR Resolutions offers higher resolution and more details compared to other satellite wind products.
- Winds extends right up to the coastlines
- Products in NetCDF, PNG, KMZ, ATFC, and Geotiff format
- Evaluations suggest a high degree of accuracy compared to aircraft and SATCON products.
- SAR products (tropical and non-tropical) are available at:

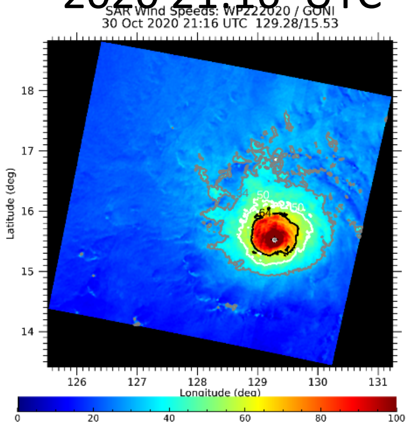
www.star.nesdis.noaa.gov/socd/sar/



Radarsat-2 SAR Cross-Pol Winds for Hurricane Marie 3 October 2020 14:20 UTC



Super Typhoon Goni - 30 October 2020 21:16 UTC



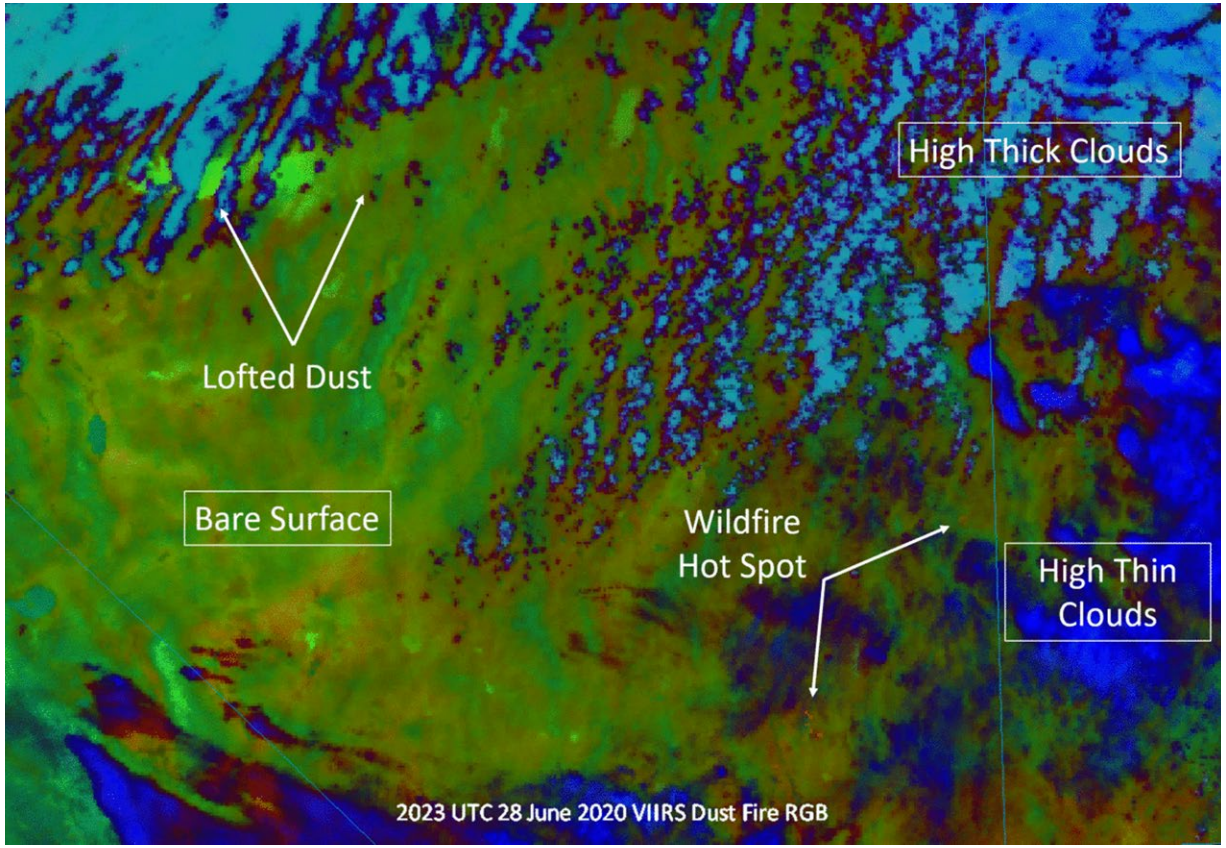
Sixteen M-band VIIRS EDR Imagery for JPSS-2

17th Annual Symposium on Operational Environmental Satellite Systems (AMS 2021 Annual Meeting)

Don Hillger, NOAA/NESDIS/StAR/CoRP/RAMMB

Co-Authors: Bill Line, Deb Molenar, Thomas Kopp, Daniel Compton, Weizhong Chen, Steve Finley, Curtis Seaman, Steven Miller, and Susan Venter

- **More Imagery EDRs and Imagery product availability!**
  - All M-bands are not "created equal" (treated equally) at this time
  - Users should have all (not just 6) M-band EDR Imagery available, not just as SDRs
  - New bands and new multi-spectral image products are possible
- **Steps to implementation:**
  - Code changes to be developed by Raytheon and monitored and verified by the VIIRS Imagery Team
  - Various stages of testing of Imagery EDRs will occur before being ready for operations (JPSS Program)
- **Implementation time frame**
  - Implementation into operations in FY21, **well before launch of JPSS-2**
- **Thanks from the EDR Imagery Team Lead**
  - VIIRS Imagery Team working with Raytheon and ASSISTT



THE JPSS-2 CRIS PRE-LAUNCH CALIBRATION PROCESS

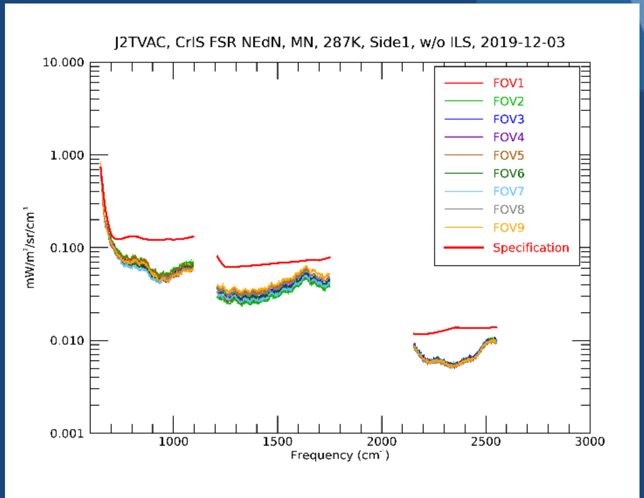
101st American Meteorological Society Annual Meeting
17th Annual Symposium on Operational Environmental Satellite Systems
Paper 10.1

Flavio Iturbide-Sanchez (STAR)

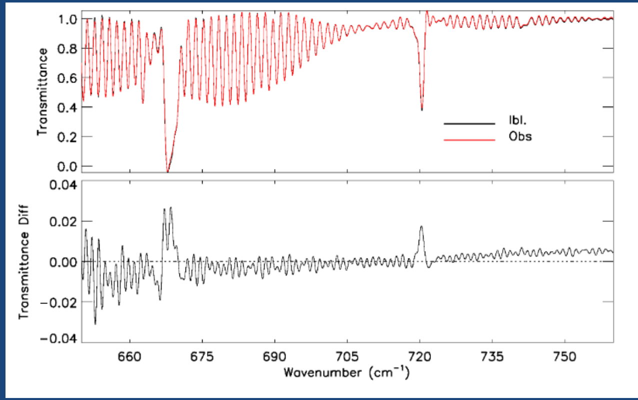
Co-Authors: Yong Chen (STAR), Denis Tremblay (GST), Peter Beierle (Univ. of Maryland), Dave Tobin (Univ. of Wisconsin), Larrabee Strow (Univ. of Maryland Baltimore County), David Johnson (NASA), Joe Predina (Logistikos), Lawrence Suwinski (L3Harris), and Daniel Mooney (MIT)

Thursday, 14 January 2021, 10:40am-10:45am

The J2 CrIS noise from TVAC Measurements



Simulated vs J2 CrIS TVAC Measured Transmittance

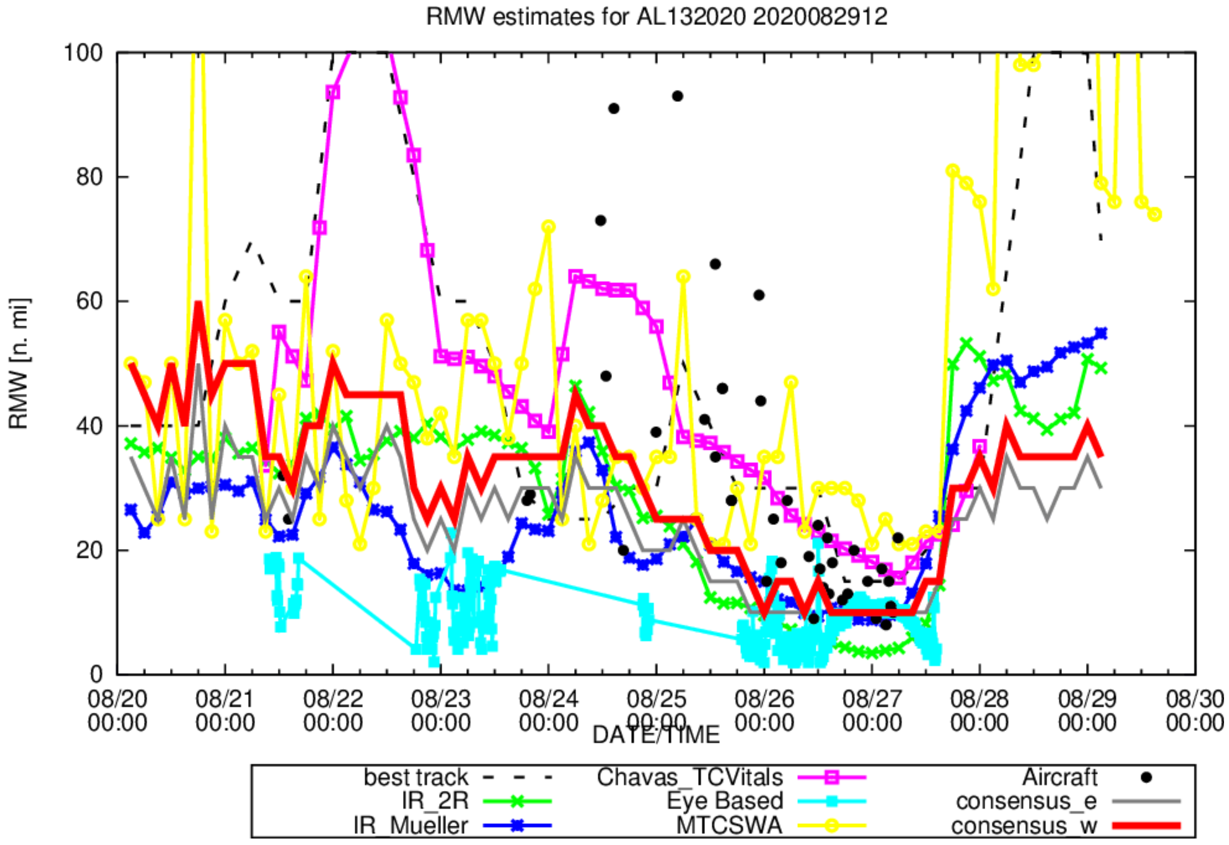


- The J2 CrIS instrument builds on the successful design of SNPP and NOAA-20 CrIS Sensors.
- J2 CrIS TVAC data analysis has show the successful implementation of the J2 CrIS instrument. All required on-ground test and analysis have been successfully completed.
- The instrument meets requirements and is ready for spacecraft integration.
- **The excellence performance of the CrIS instruments will continue with the J2 CrIS Sensor, planned to be deployed into space around September 2022.**

Efforts to Estimate the Radius of Maximum Winds in Tropical Cyclones

John Knaff (STAR) and Daniel Chavas (Purdue)

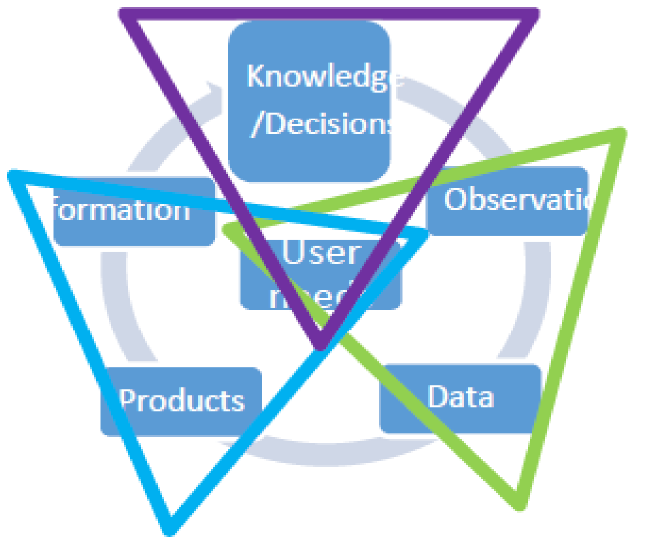
- The radius of maximum wind (RMW) is a highly variable and difficult to estimate keystone structure of the Tropical Cyclone (TC) vortex
- RMW variations impacts risk, damage, and mitigation activities as it is related to the extent and duration of the highest winds.
- This work discusses five individual methods (Mueller, 2-regime IR, eye-based, Chavas diagnostic, & multi-satellite wind analysis) to estimate RMW and a couple consensus approaches
- These methods are verified versus independent aircraft-based RMW estimates to determine what methods or combination of methods provides the best estimates.
- Results suggest that RMW estimation is still challenging with the best methods explaining roughly 30% of the variance and having RMSE around 20 n mi/37 km
- Findings also provide guidance on a better approach to a consensus estimate combining an IR based method, a multi-platform wind analysis and a theoretical diagnostic approach.
- We also discuss the need for improved developmental data, updates and plans for the future RMW estimation as we tackle this important, yet difficult problem.



Caption: Example of Radius of maximum wind estimates for Hurricane Laura based on five methods (IR_2d, Mueller, Chavas, Eye, MTCSWA). two consensus methods (equal, weighted) and aircraft-based observations (black dots)

Operational Satellite Oceanography at NOAA: Enabling the transition of ocean satellite data products into applications and information.

The "operational" paradigm is **expanding**

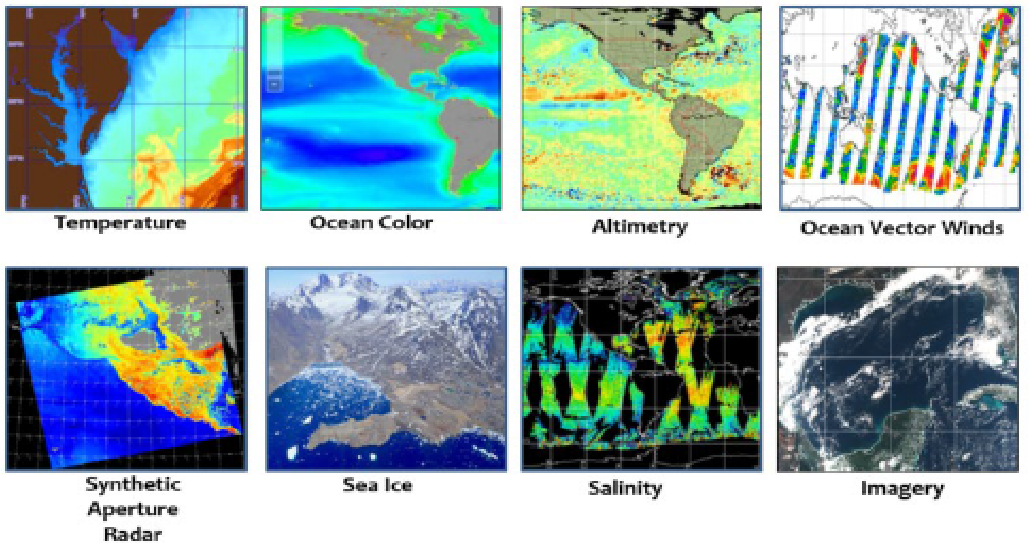


Value-chain links from data to knowledge and decisions

24th Conference on Satellite Meteorology, Oceanography, and Climatology
Lance and DiGiacomo
Paper Number: 3.9
Mon. 11 Jan. 2021
4:20 PM EST

AMS101
101st Annual Meeting
VIRTUAL | 10-15 January 2021

"Golden Age" of Satellite Oceanography



Abstracts open for virtual

OSOS-2

25-27 May 2021

Plus optional training day

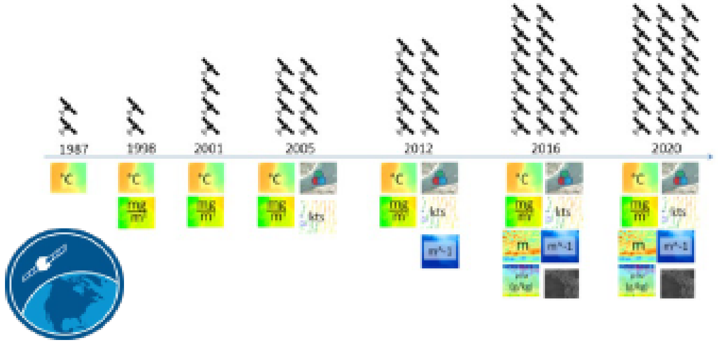
28 May 2021

https://www.eventsforce.net/eumetsat/frontend/reg

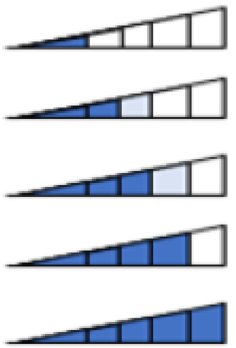
EUMETSAT

Ocean and coastal satellite products, tools and services

CoastWatch.NOAA.gov



Level of Assistance



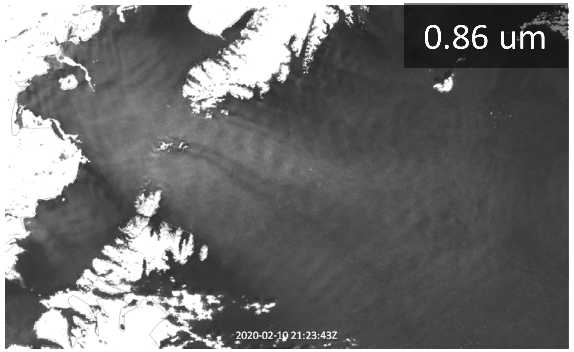
Using GOES-R and JPSS Satellite Data to Detect and Track Hazardous Sea Spray in the High Latitudes

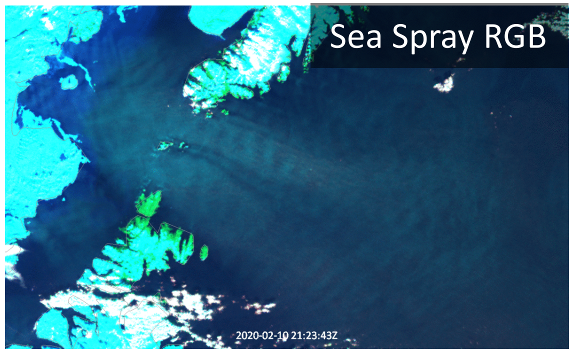
Bill Line (STAR); Louie Grasso (CIRA); Aaron Jacobs and Sam Shea (NWS); Carl Dierking (UAF)

- Freezing Spray is a hazard to vessels in the high latitudes
- NWS issues forecast products and provides DSS related to freezing spray
- Observations of sea/freezing spray are scarce
- Cases Shown:
  - 10 Feb 2020 Sea Spray in Cook Inlet and western Gulf of Alaska
  - 05 Mar 2020 Sea Spray in southeast Alaska inner channels

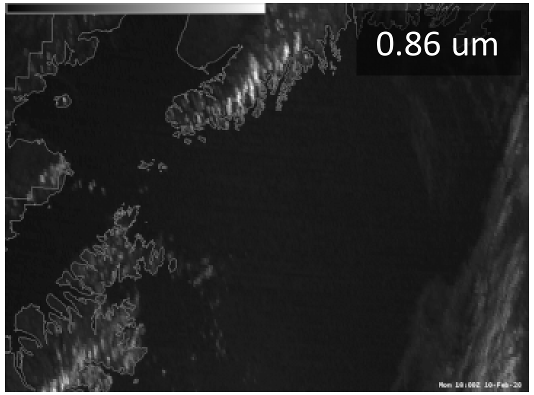
❖ This work shows that ABI and VIIRS imagery can be used, with the right enhancements and channel combinations, to detect and track potentially hazardous sea spray under clear sky conditions

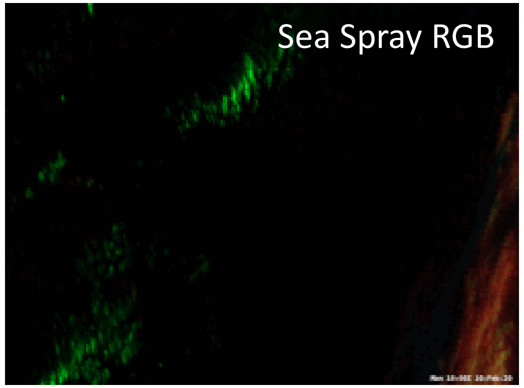
SNPP and NOAA-20 VIIRS





GOES-West ABI





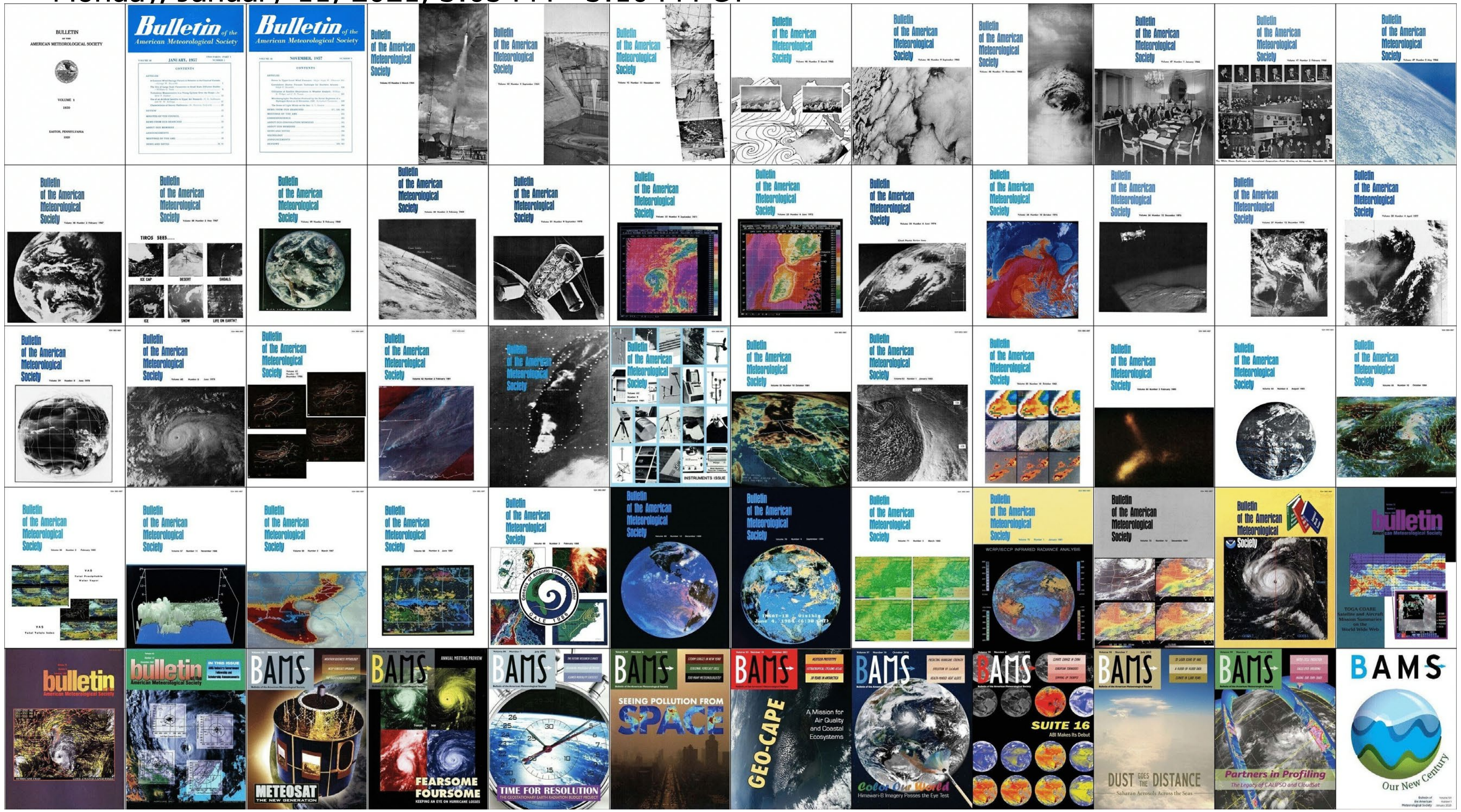
* Sea spray appears as relatively medium gray in 0.86 um imagery, medium cyan in RGB

The History of Geostationary Imagers as seen through the prism of the BAMS

17th Annual Symposium on Operational Environmental Satellite Systems
3.6

Tim Schmit, NOAA NESDIS STAR CORP ASPB, Madison, Wisconsin
Mat Gunshor, Jean Phillips, Jim Nelson, CIMSS/SSEC
Monday, January 11, 2021, 3:05 PM - 3:10 PM CT

- The AMS has digitized the BAMS "cover to cover"
- The rapid progress of remote sensing is evident
- *http://cimss.ssec.wisc.edu/goes/covers/BAMS_geo_covers.html*



Exploring New Developments in JSTAR Integrated Calibration/Validation System (ICVS) Long-Term Monitoring

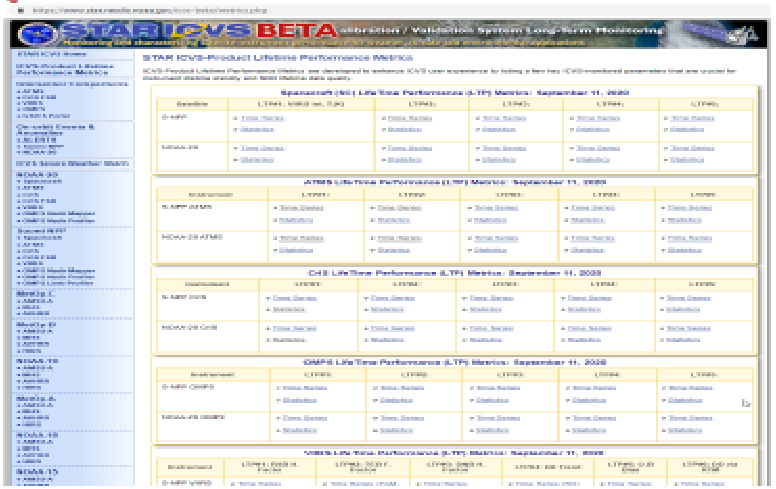
Banghua Yan (STAR), N. Sun, X. Jin, J. Huang, D. Liang, W. Porter, L. Zhou, M. Goldberg, Y. Chen, C. Cao, and L. Brown

National Satellite and Information Service

- **Created three new technical developments in ICVS LTM System**
  - ICVS-LTM Top Product Matrix Table
  - ICVS Anomaly Watch Portal:
  - ICVS Hurricane Warm Core Animation System
- **Advanced the ICVS LTM science development from three aspects**
  - ICVS-GSICS Portal: an improved ABI-CrIS SNO method
  - New 32D-AD method for SNPP/NOAA-20 Inter-sensor bias assessments
  - A New NEDT calculation method for onboard MW instrument

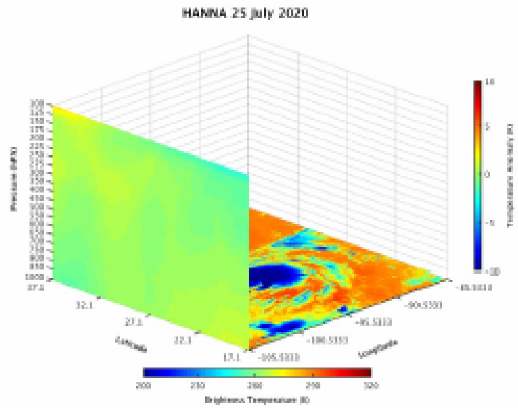
Examples:

(1) ICVS-LTM Top Product Matrix Table

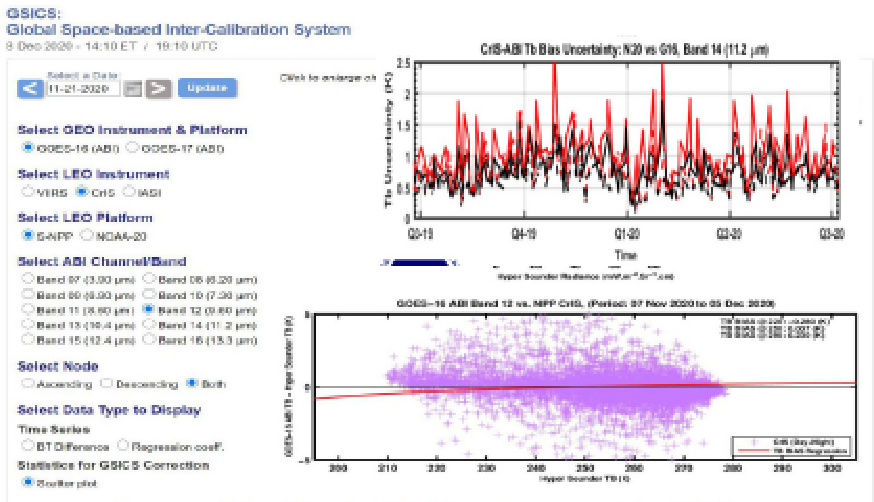


(2) ICVS Hurricane Warm Core Animation System

(https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2019EA000961)

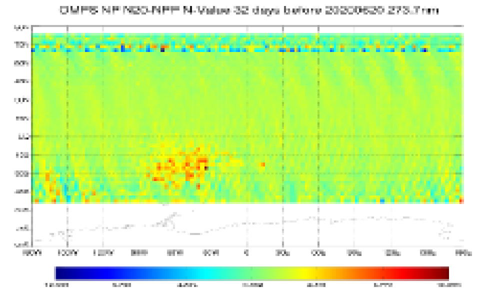


(3) ICVS-GSICS Portal: an improved ABI-CrIS SNO method

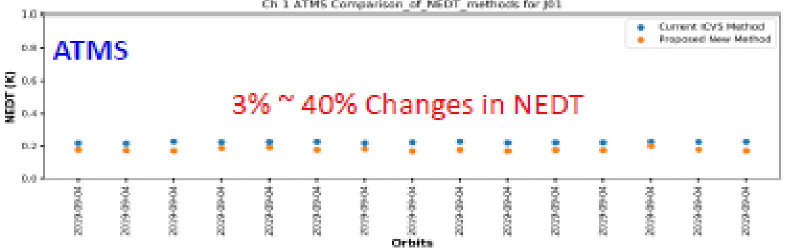


(Courtesy of Likun Wang for IASI-ABI portion to support the GSICS)

(4) 32D-AD SNPP/NOAA-20 NP 32D-AD Biases



(5) A New NEDT calculation method for ATMS



(3.4) Development of Level 3 Land Surface Temperature Product for JPSS Mission

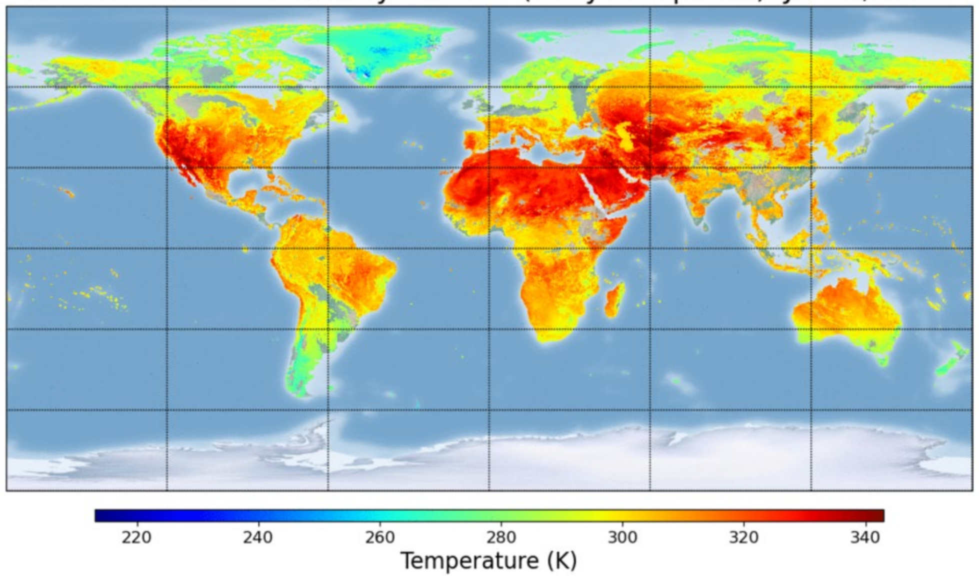
Conferences: 24th Conference on Satellite Meteorology, Oceanography, and Climatology; 3:55 - 4.00pm, Jan 11, 2021

Authors: Yunyue Yu[1], Yuling Liu[2], Heshun Wang[2], Peng Yu[2], Ivan Csiszar[1], Lihang Zhou[3]

[1] *NOAA/NESDIS/STAR*, [2] *UMD/CISESS* , [3]*NOAA JPSS Program Office*

Overview

- Satellite: JPSS series (currently SNPP, NOAA-20)
- Orbit equatorial overpass time 13:30/01:30
- Global gridded product: 1km res; daytime and nighttime
- Sinusoidal projection
- Algorithm: split window approach; VIIRS thermal infrared channels; linear regression algorithm; explicit emissivity



Quality

Comprehensive validation:

- ground stations – SURFRAD, ARM, BSRN
- cross-satellite LSTs – MODIS, SEVIRI, ABI, AHI etc.
- Consistency analysis between SNPP and NOAA-20
- Daily monitoring

Station Sites	JERD Threshold A(P)	On-orbit Performance A(P)
BON	1.4 K(2.5K)	-0.13(1.85)
DRA	1.4 K(2.5K)	-1.8(2.02)
FPK	1.4 K(2.5K)	-0.16(1.41)
PSU	1.4 K(2.5K)	0.73(1.26)
SXF	1.4 K(2.5K)	0.52(1.51)
TBL	1.4 K(2.5K)	-0.11(1.72)
CAB	1.4 K(2.5K)	-0.05(3.37)
GOB	1.4 K(2.5K)	-0.41(1.68)

Access

Data access at CLASS site (sign in is required) :
https://www.avl.class.noaa.gov/saa/products/psearchJPSS_NGRN
Detail Info at STAR JPSS site:
https://www.star.nesdis.noaa.gov/jpss/lst.php

Contact

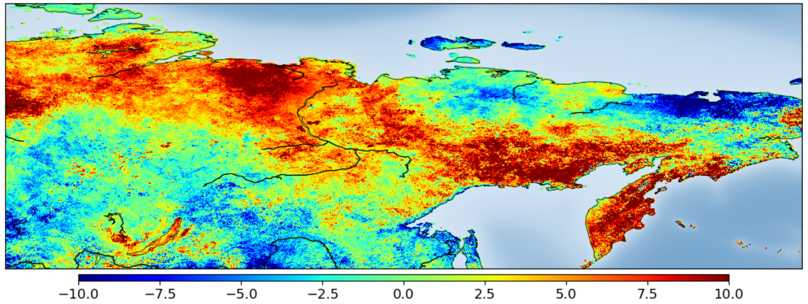
STAR Land Product Development Team
https://www.star.nesdis.noaa.gov/smcd/emb/land/lst.php
POC: Dr. Yunyue Yu, Yunyue.yu@noaa.gov
301-683-2566

Users Engagement

Continue supporting to Users (samples):

- NOAA and NASA land surface and Hydrology models
- USDA users
- High accurate/resolution Soil Moisture
- Researchers from worldwide institutions

Extreme Event Response --- >



LST difference between the summer of 2020 and 2019 over Siberia

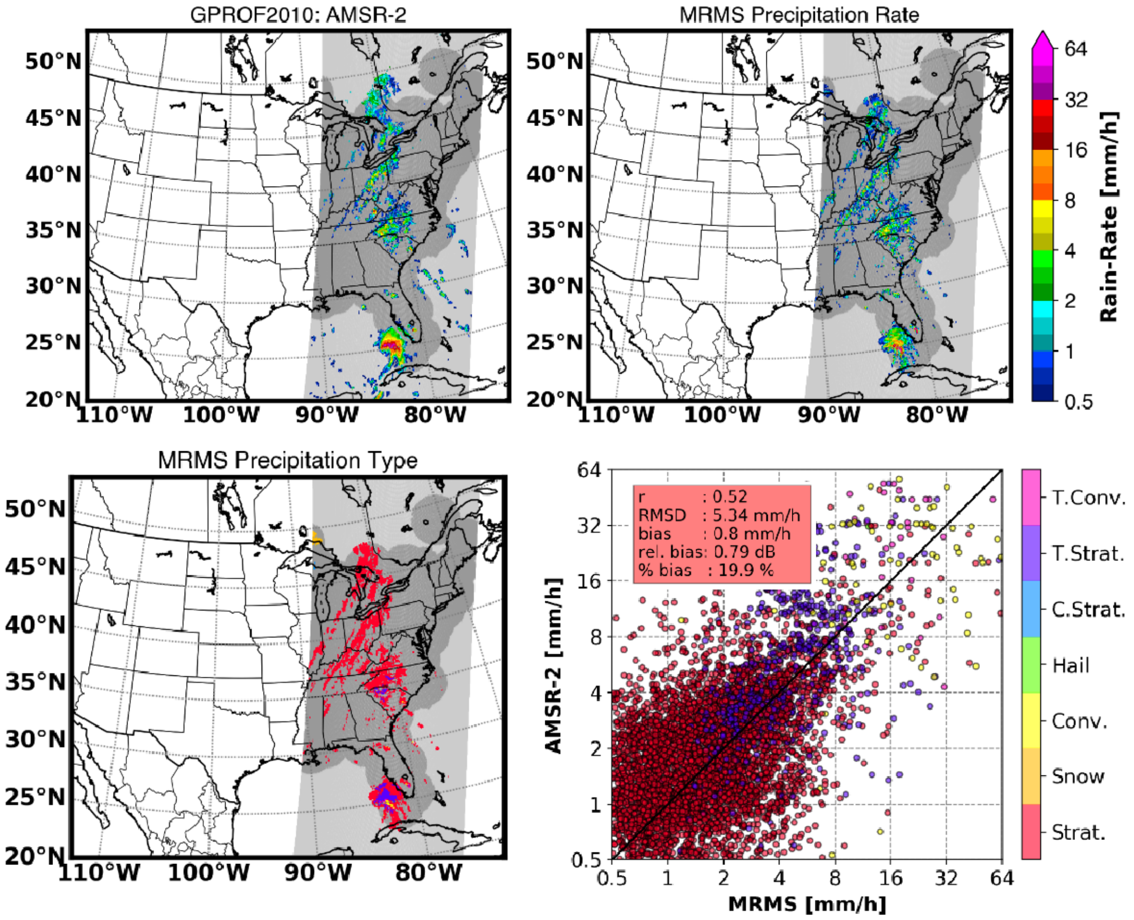
CISESS

- Malarvizhi Arulaj
- Ken Kunkel
- Yong-Keun Lee
- Ronald Leeper
- Hui Liu
- Katherine Lukens
- Tom Maycock
- Veljko Petkovic (3)
- Oliver Prat
- Jared Rennie
- Allison Ring
- Carl Schrek
- Emma Scott (2)
- Cristiana Stan
- Laura Stevens
- Scott Stevens
- Liqiang Sun
- Sirish Uprety
- Zhipeng Wang
- Jifu Yin
- Bin Zhang
- Daile Zhang

An Overview and Design of the STAR precipitation and water vapor Validation System

Malarvizhi Arulraj (CISESS); Ralph Ferraro (STAR); Veljko Petković, Patrick Meyers (CISESS); Pierre-Emmanuel Kirstetter (NOAA/NSSL); Mark Kulie (STAR)

- A system for validation of satellite-based quantitative precipitation estimates is developed to perform event and long-term assessments at satellite FOV-level against ground observations from the Multi-Radar/Multi-Sensor (MRMS) network.
- Event Validation is produced in real-time and made available at ftp://rain.umd.edu/precip/ for GCOM-W1 AMSR-2, Blended-RR, MiRS NOAA-20 and MiRS SUOMI-NPP.
- Long-term validation capabilities are available per request. Capability of the system is demonstrated by comparing the performance of GPROF2010 and GPROF2017 precipitation retrievals.
  - Detection and Quantification metrics are offered as a function of precipitation rate, type, geographical location, sensor type and algorithm version.
  - Based on these, GPROF2017 retrieval was identified as better performing than GPROF2010 (e.g., FAR decreased by 0.2; POD increased by 0.2).



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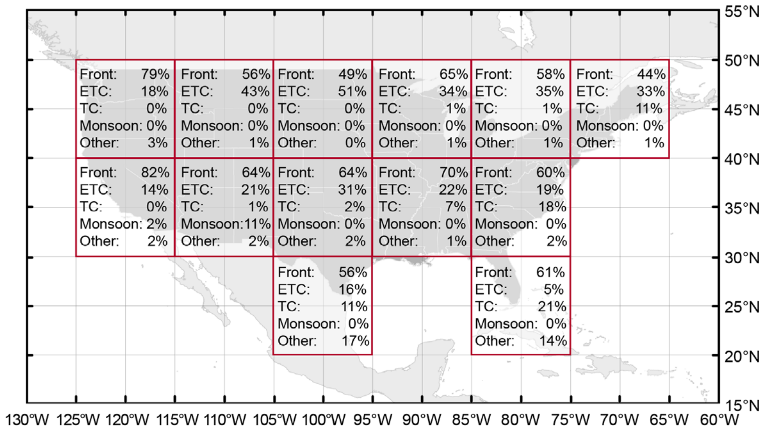
Extreme Precipitation: The Merging Streams of Meteorology, Climatology, and Hydrology

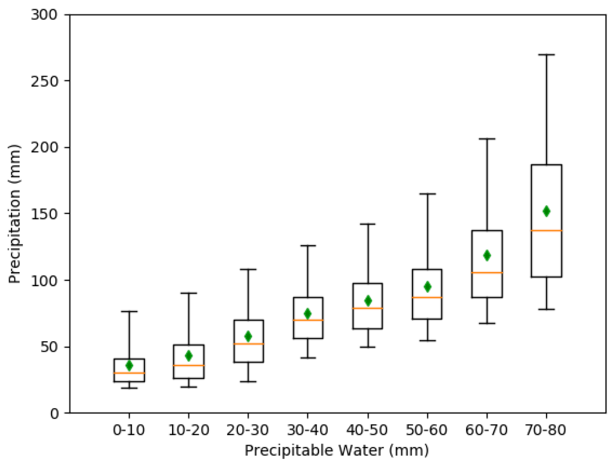
Kenneth E. Kunkel (CISESS)

- Recommended future research directions
  - Understand meteorology causing trends
  - Better understanding of extreme tails of precipitation distribution
  - Explain the strong regional variations in extreme precipitation trends
  - More cloud-resolving model simulations
- Urgent to incorporate climate change into heavy rainfall design values

Weather Systems Causing Extreme Precipitation Events



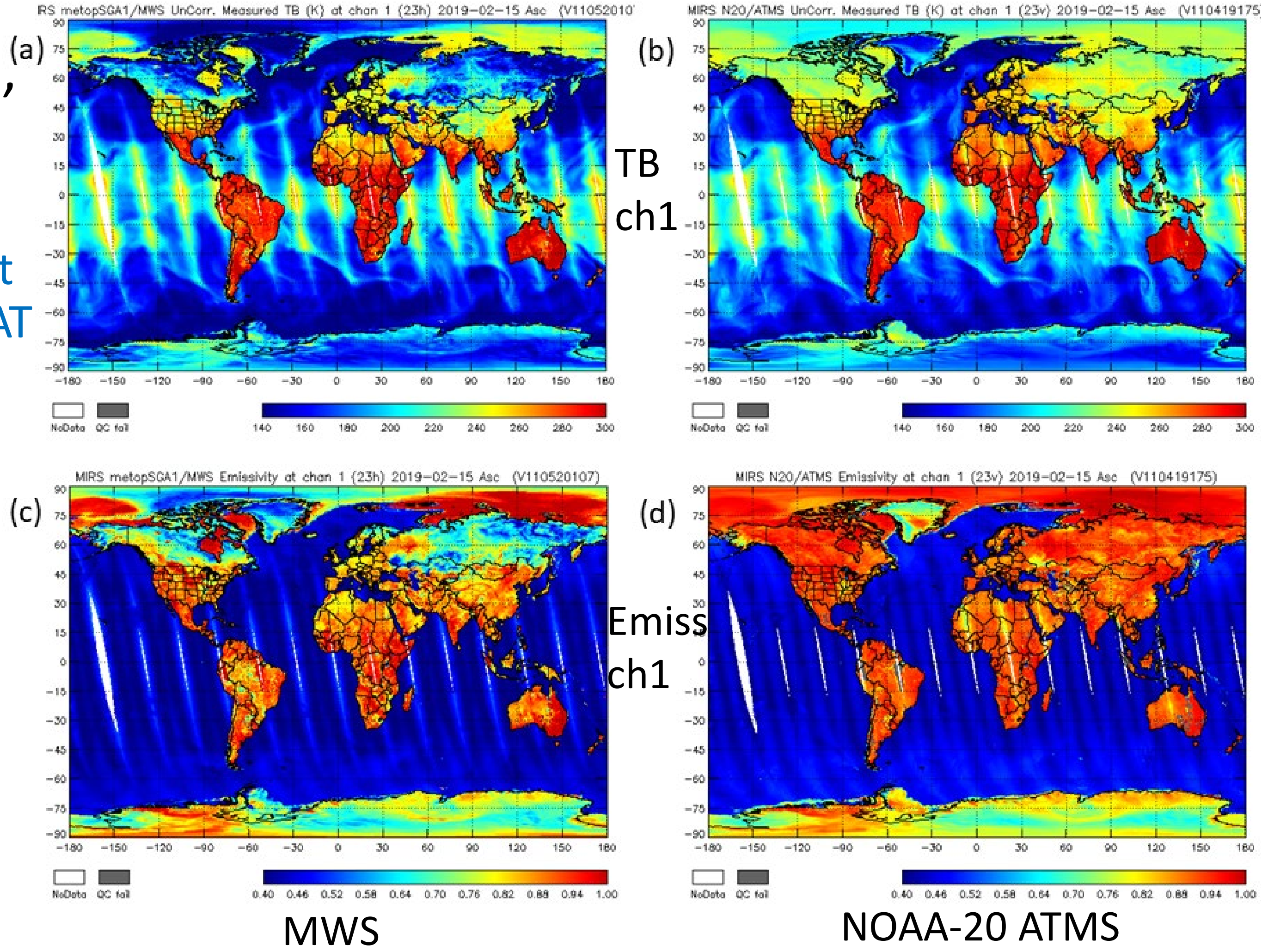
Water Vapor vs Extreme Precipitation Magnitude



Preparation of Metop-SG A1 Microwave Sounder Proxy Data and Testing with the NOAA Microwave Integrated Retrieval System

Yong-Keun Lee, Christopher Grassotti, XingMing Liang and Yan Zhou (CISESS); Quanhua Liu (STAR); Shuyan Liu (CIRA); Ming Fang (IMSG)

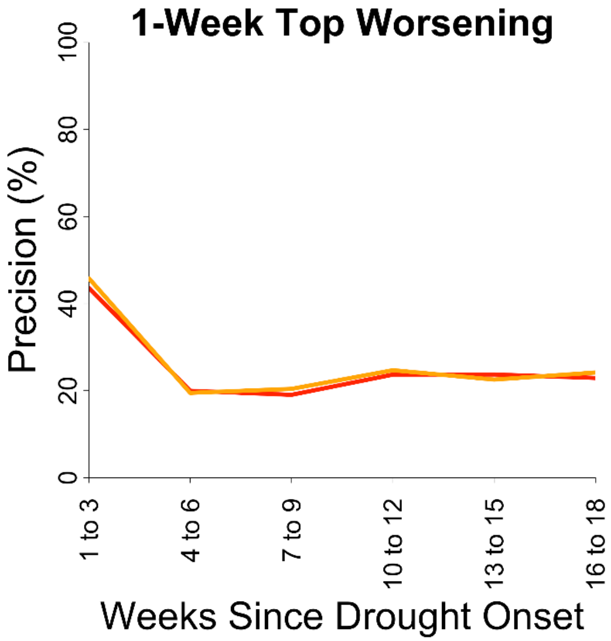
- Proxy data for the microwave instrument, MWS, on board Metop-SG A1 satellite have been generated and tested.
  - Metop-SG A1 to be launched in 2023, the first satellite in EPS-SG satellite series of EUMETSAT
  - A proxy data simulator was developed at NOAA to generate MWS proxy data using NOAA-20 ATMS measurements and ECMWF data.
  - Two days of MWS proxy data have been generated and applied to MiRS.
  - The MiRS MWS results are reasonably simulated compared to ECMWF and MiRS ATMS operational and simulated results.

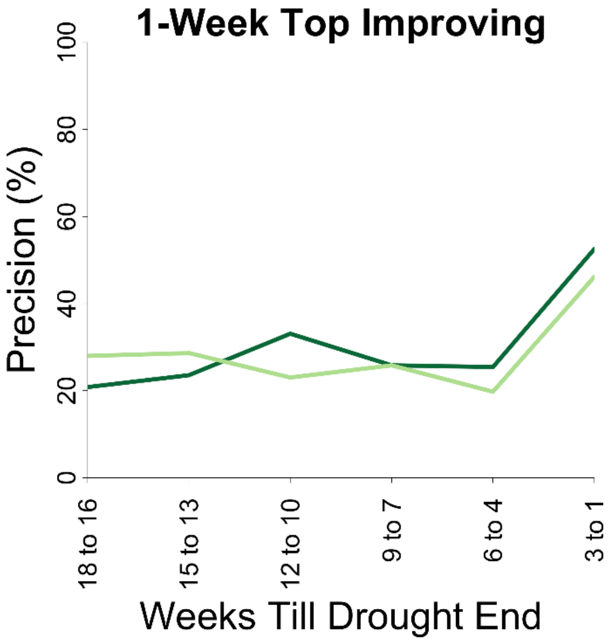


Exploring the use of Standardized Soil Moisture as a Drought Indicator

Ronald D. Leeper (CISESS); Bryan Petersen (ISU); and Michael A. Palecki (NCEI).

- Compared standardized soil moisture metrics against changes in drought conditions
  - Upper level depths (<= 20 cm) were more responsive to evolving drought conditions.
  - Measures of precision were highest during drought initiation and amelioration weeks.
  - Soil moisture provided up to a 4-week lead time to drought onset for 78% of drought events in this study.





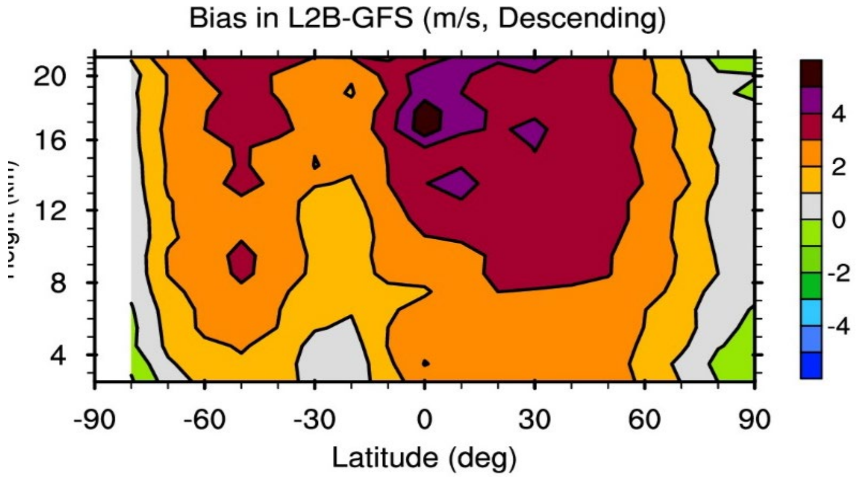
Bias Correction and Error Specification of Aeolus Winds for NOAA Global Data Assimilation System (GDAS)

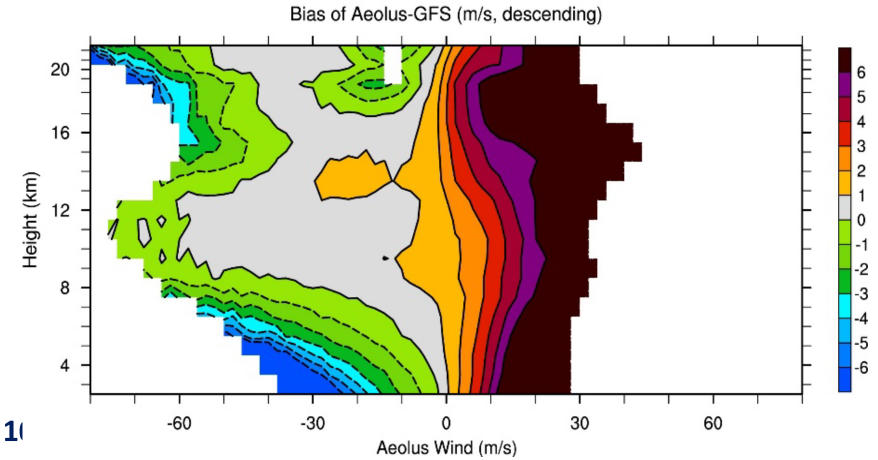
24th Conference on Satellite Meteorology, Oceanography, and Climatology

Hui Liu, CISESS, K. Ide, UMD, K. Garrett, STAR, R.N. Hoffman, K. Lukens, CISESS, L. Cucurull, and K. Apodaca, AOML

National Satellite and Information Service

Rayleigh O-B bias (Aug-Sep 2019)





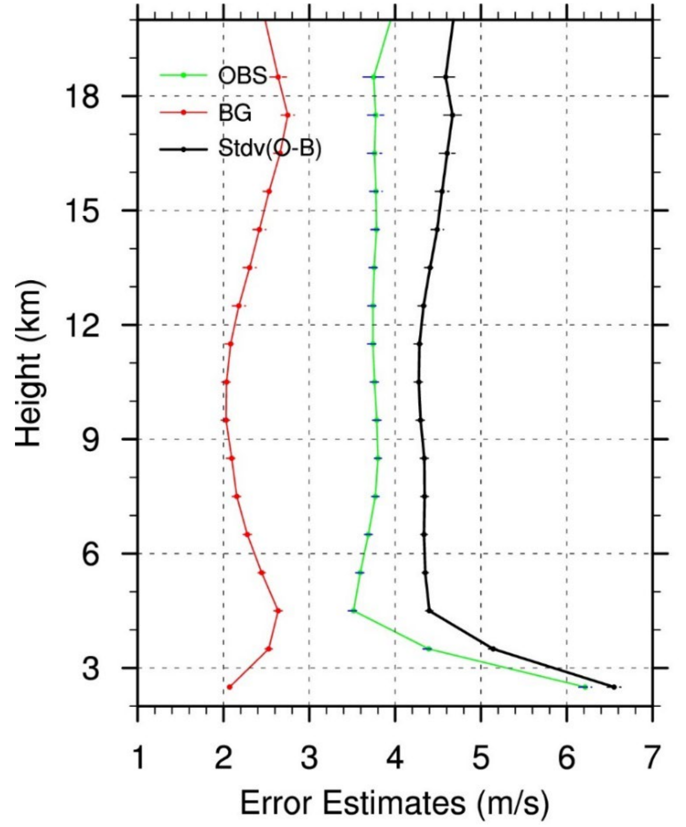
- Impact assessment of Aeolus winds on GFS forecast, see Kevin Garrett's presentation

- Aeolus winds (w/o M1 correction) show biases vs GFS background, varying on latitude (φ), layer (z), orbit (n), and Aeolus wind (y^o)
- Simple linear regression of (O-B) to Aeolus wind (y^o) to determine coefficients $c_{0(\varphi,z,n)}$ and $c_{1(\varphi,z,n)}$, in each bin of latitude (10° deg), layer, and orbit:

$$BC_{(\varphi,z,n)} = c_{0(\varphi,z,n)} + c_{1(\varphi,z,n)}\, y^o$$

- The bias correction is calculated by weekly O-B data, and applied to each Aeolus wind of next week
- Coefficients are linearly interpolated to the latitude of Aeolus wind
- (Impact of noises in Aeolus winds on the bias correction is being investigated)

Rayleigh Random error by Hollingsworth-Lonnberg method



Rayleigh random error is ~ 4 m/s

Exploiting Aeolus Wind Profiles to Better Characterize Atmospheric Motion Vector Bias and Uncertainty

Katherine E. Lukens (CISESS); Kayo Ide (UMD); Kevin Garrett (STAR); David Santek (CIMSS); Brett Hoover (CIMSS); and Ross N. Hoffman (CISESS)

Objective

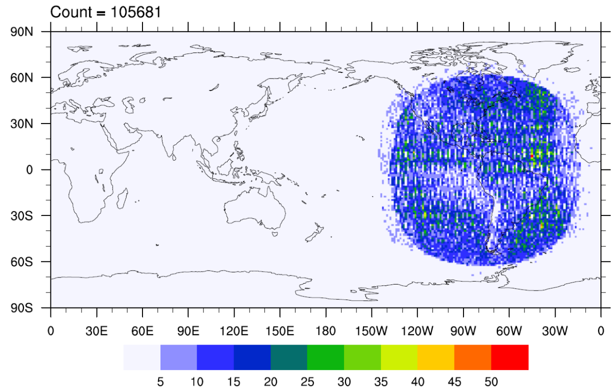
This study aims to leverage Level-2B Aeolus wind LIDAR data provided by the European Space Agency (ESA) to better characterize AMV bias and uncertainty, with the ultimate goal of potentially improving NWP and AMV algorithms.

- Aeolus wind observations are collocated with AMVs projected onto Aeolus horizontal line-of-sight (HLOS) direction.
- Good quality Aeolus winds are retained following ESA-recommended quality controls (QC). Good quality AMVs have a quality indicator (QI) > 80%.

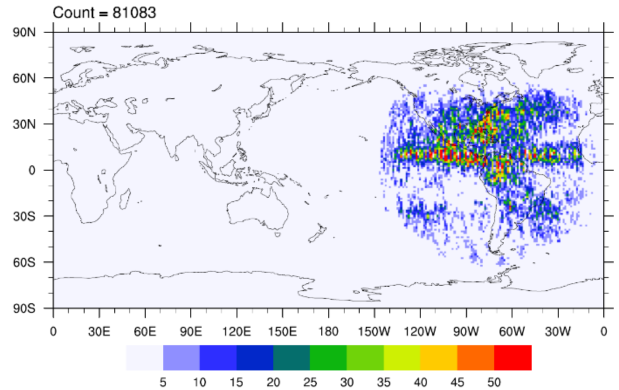
Findings

- **Good quality AMVs correspond well with good quality Aeolus winds.** GEO satellite comparisons outperform LEO.
- GOES-16 AMV wind bias and RMS estimates tend to depend on AMV channel type (IR, water vapor clear, water vapor cloudy) and Aeolus orbit type (ascending, descending).
  - Remaining outliers in Aeolus Mie-cloudy comparisons likely contribute to higher bias and RMS estimates.

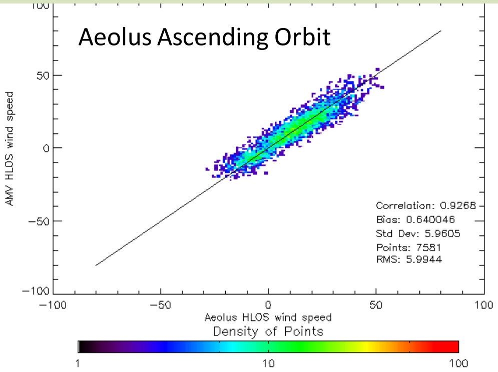
Aeolus Rayleigh-clear Winds vs GOES-16 AMV Collocated Obs Number Density



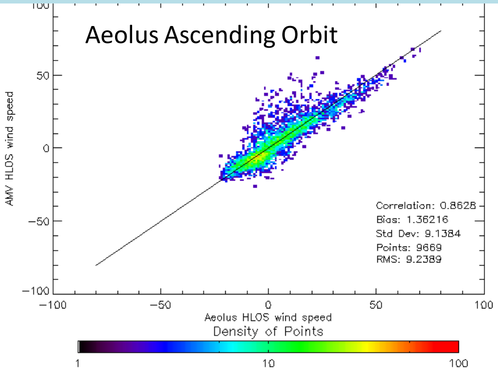
Aeolus Mie-cloudy Winds vs GOES-16 AMV Collocated Obs Number Density



Aeolus Rayleigh-clear HLOS Winds vs GOES-16 Water Vapor Clear (HLOS) AMVs



Aeolus Mie-cloudy HLOS Winds vs GOES-16 Water Vapor Cloudy (HLOS) AMVs



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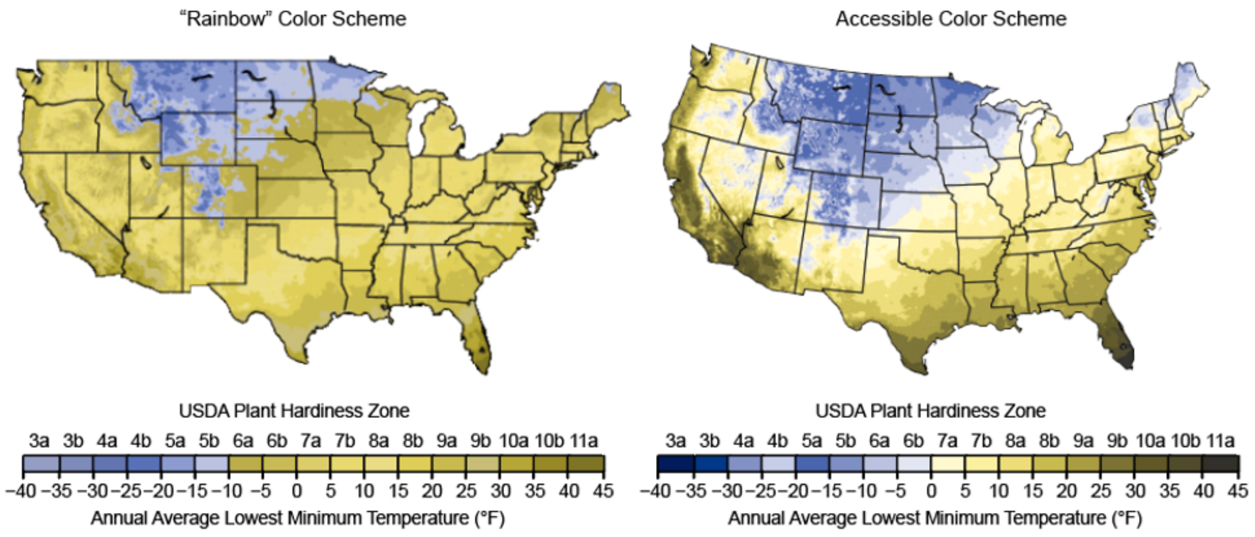
Making Climate Change Assessments Accessible

Thomas K. Maycock[1], Laura E. Stevens[1], Katharine M. Johnson[1], Andrea McCarrick[1], Jessicca Allen[1], Sara Veasey[2], Brooke C. Stewart[1] ([1]CISESS, [2]NOAA NCEI)

- Making the U.S. National Climate Assessment accessible to persons with visual, physical, and other limitations
  - Legal requirement AND the right thing to do
  - Scope and scale (400,000+ words, 300 figures and images) pose challenges
- PDF and web accessibility
  - Tags/reading order, color contrast, font size, navigation on the web, etc.
  - Need to test, PDFs will require remediation
  - Start early, allow time and/or budget to address
- Figures
  - Clarity, simplicity. Keep accessibility in mind throughout design process
  - Descriptive alternative text for all figures
  - Design for color vision deficiency (color blindness)

Projected Plant Hardiness Zones by the Late 21st Century



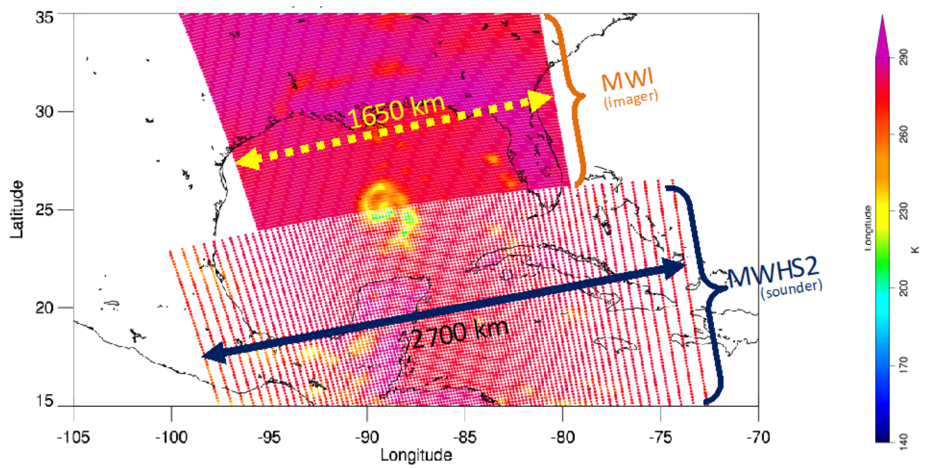
Implementation of EPS-SG MWI Observations into NOAA Precipitation EDR

Veljko Petković (CISESS) and Ralph Ferraro (STAR)

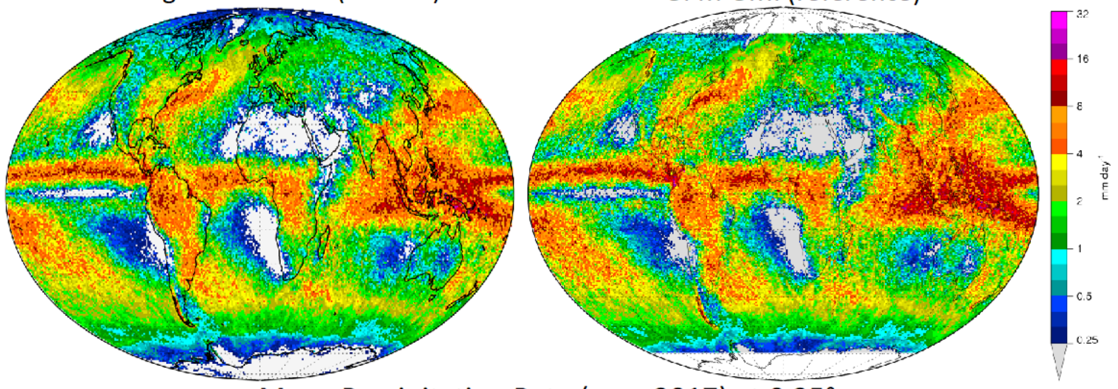
In preparation for the EUMESAT Polar System Second Generation (EPS-SG) launch, EPS-SG Microwave Imager (MWI) algorithm package will adapt the existing GCOM-W1 AMSR2 software, adjusting for the new microwave frequency channel selection.

Top panel: Generation, preparation and processing of level-1 proxy data

Bottom panel: Production of day-1 retrievals for the environmental data records recommended and approved through the NOAA unique products design reviews. Presented is design, implementation plan, and performance of the day-1 EPS-SG MWI precipitation algorithm (using AMSR2 as a heritage instrument).



Precipitation Algorithm Performance



Mean Precipitation Rate (year 2017) at 0.25°

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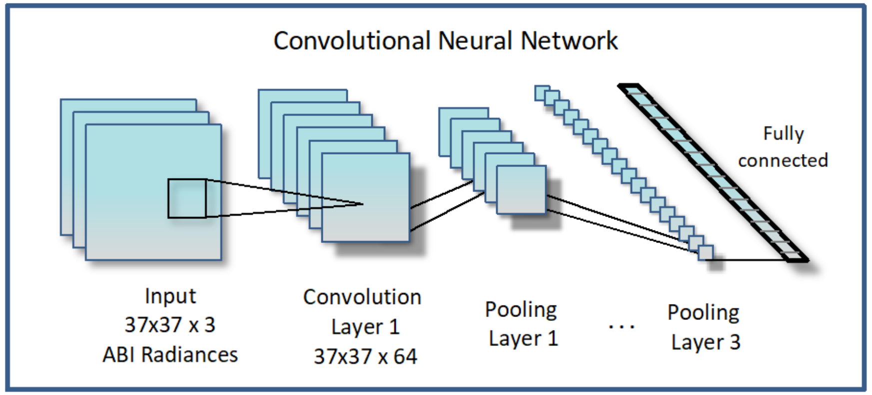
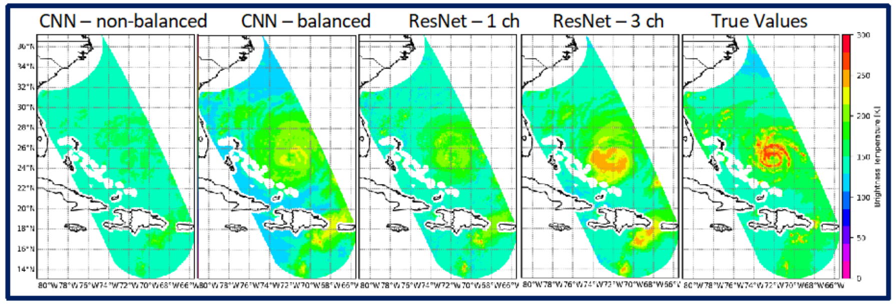
Predicting Satellite PMW Brightness Temperature from the GOES ABI

Veljko Petković (CISESS), Ralph Ferraro (STAR), Marko Orescanin(NPS) and Malar Arulraj (CISESS)

- A set of deep neural networks is developed and trained for a regression task of predicting PMW brightness temperature from ABI VIS-IR radiances
- The importance of balanced training dataset and models' architecture complexity are highlighted through a set of experiments.
- While spatial resolution of the training features affects model's performance, information content gained through inclusion of multiple ABI channels is likely to be more beneficial.

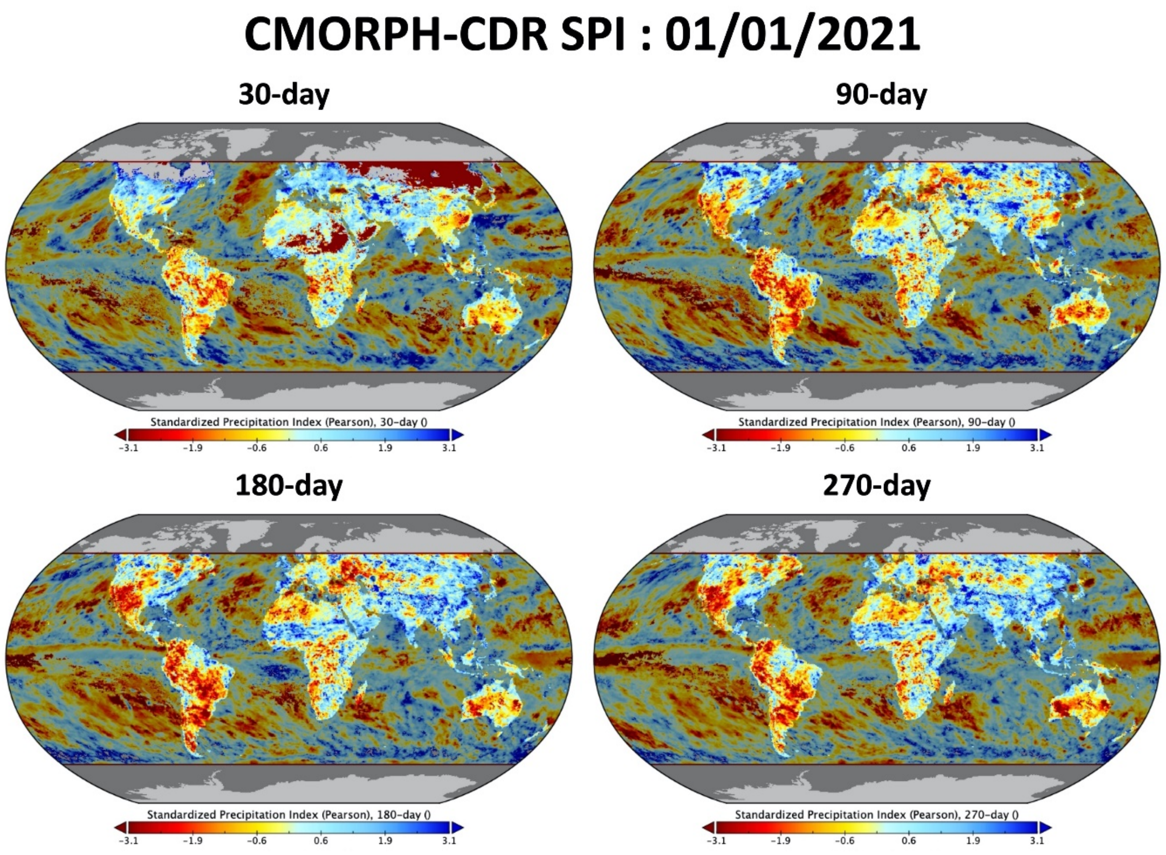




Operational Near-real Time Drought Monitoring Using Global Satellite Precipitation Estimates

Olivier Prat (CISESS), Alec Courtright (ISciences), Ronald Leeper (CISESS), Brian Nelson (NOAA/NCEI), Rocky Bilotta (ISciences), and Steve Ansari (NOAA/NCEI)

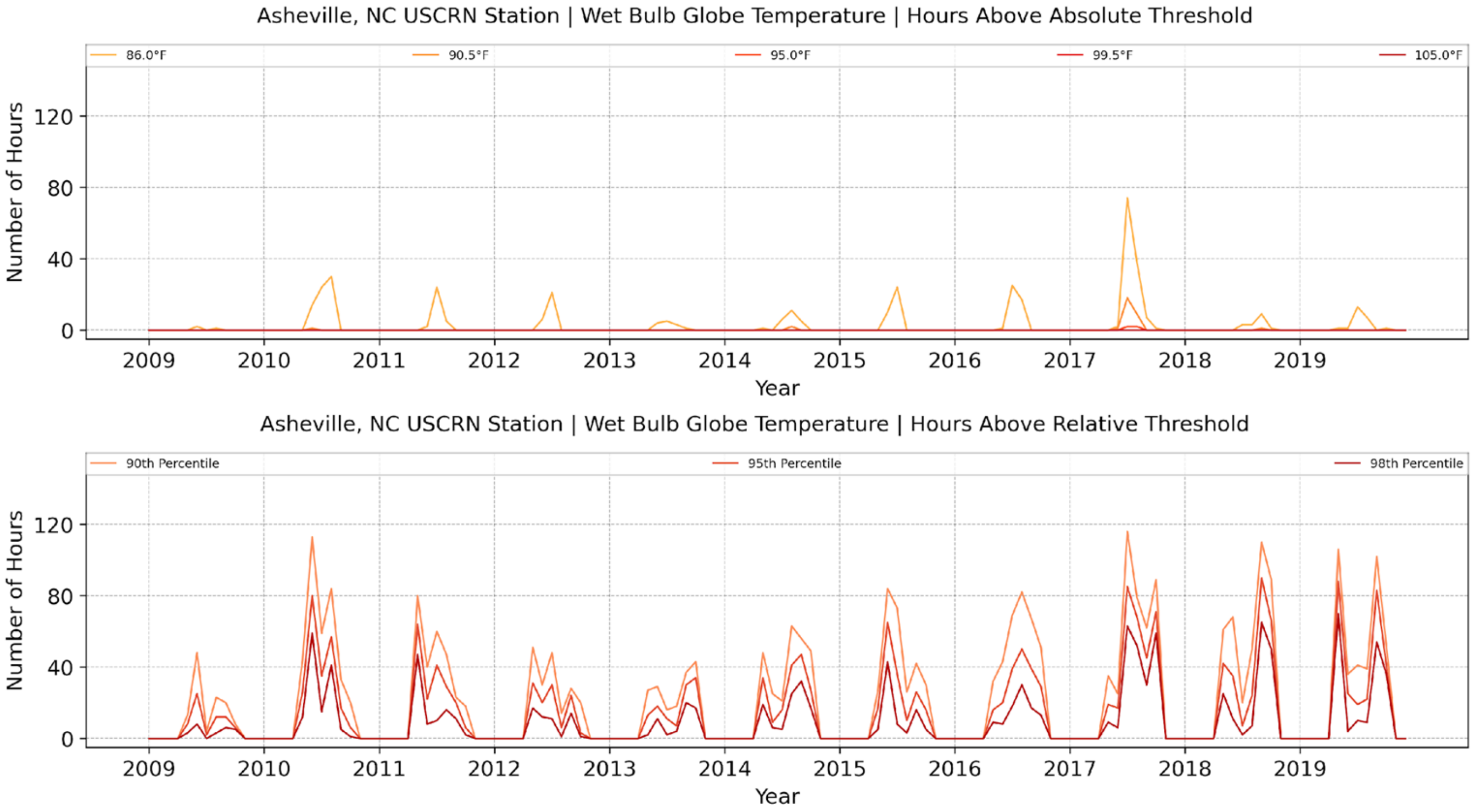
- Satellite precipitation products can be used for near-real time global drought detection and monitoring.
  - We developed an operational near-real time drought monitoring framework on a global scale that uses daily quantitative precipitation estimates (QPEs) from Satellite Precipitation Products (SPPs).
  - Daily SPIs are computed from CMORPH-CDR (NOAA/Climate Data Record) from 1998 to present.
- A good agreement is found for the percent area drought coverage between satellite SPIs and in-situ data from the United States Drought Monitor (USDM).
- Further validation is needed as results may differ in terms of frequency, magnitude, and severity when compared to SPI derived from other sensors or to other drought indices derived from in-situ data (ex. USDM).
- We develop an interactive global drought information dashboard to communicate drought information in near-real time (https://gdis-noaa.hub.arcgis.com/pages/drought-monitoring).



Using Wet Bulb Globe Temp. to Evaluate Heat Events

Jared Rennie (CISESS); Michael Palecki (NOAA NCEI)

- USCRN Heat Exposure Product (2009-Present)
  - Heat Index, Apparent T, Wet Bulb Globe T
- Relative Thresholds
  - 90th / 95th / 98th Percentile
  - Can capture more heat events, instead of using arbitrary threshold (105F)



Volcanic Emissions Forecasting Techniques using HYSPLIT and VOLCAT Observations

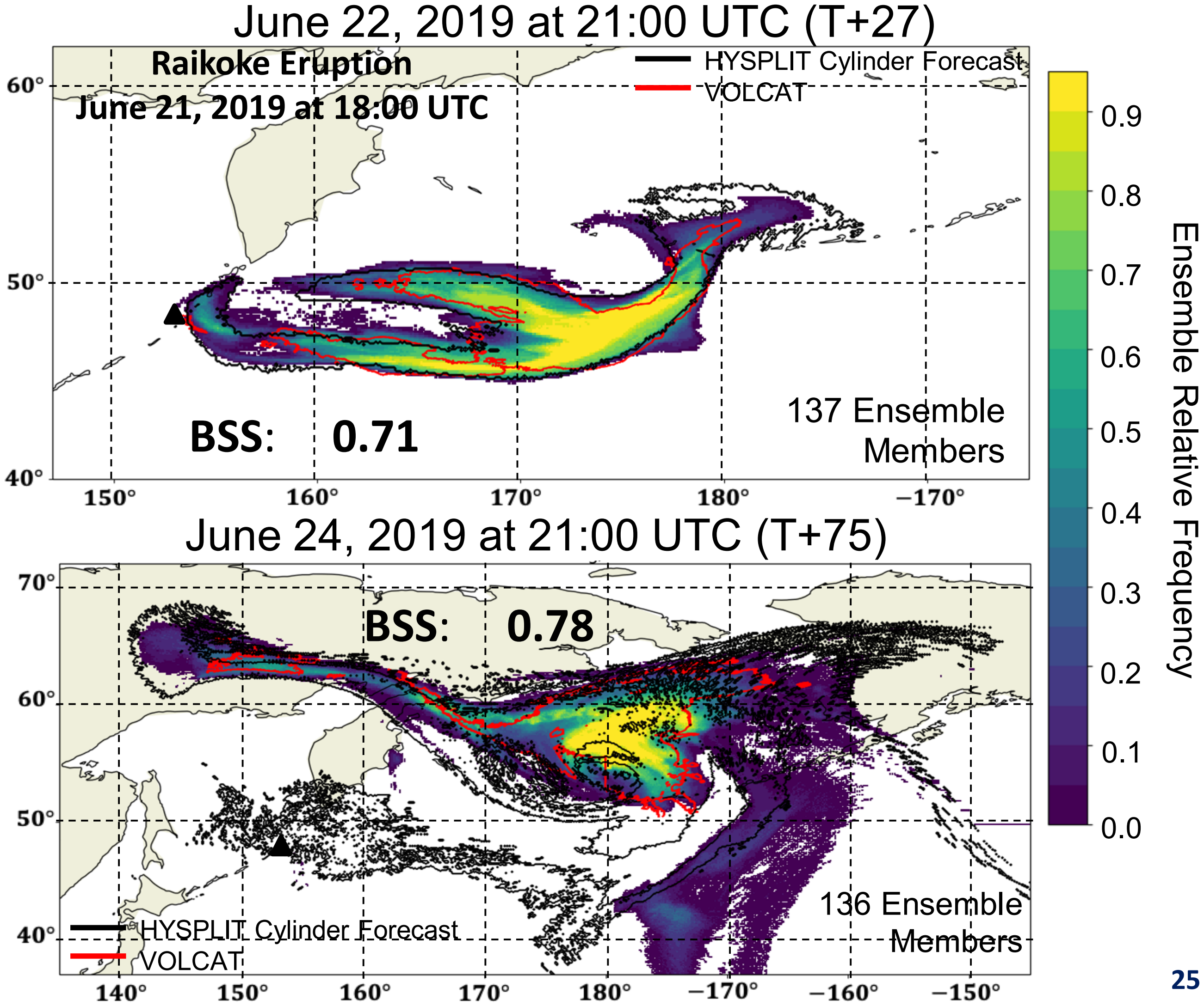
By: Allison M. Ring (CISESS), Alice Crawford, Michael Pavolonis (NOAA),
Justin Sieglaff (CIMSS), David Hyman (USGS)

Motivation

- Integrate observations into modeling framework and reduce uncertainty
- Produce reliable probabilistic and quantitative ash forecasting products to meet new ICAO requirements.

Significance

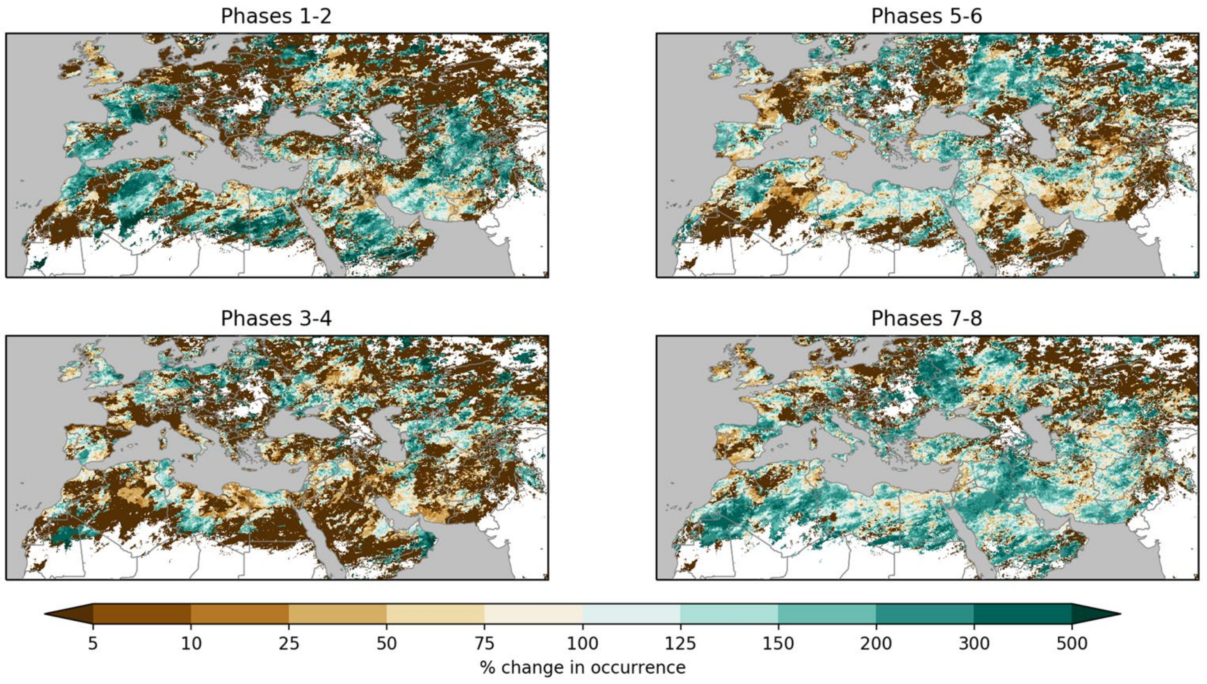
- Developing probabilistic ensemble dispersion model capabilities of quantitative ash forecasts to meet ICAO requirements
- Data-insertion ensemble forecasts show improved skill based on statistical verification - Brier Skill Scores above 0.7
- Developing framework for near real-time forecasting capabilities of volcanic ash using HYSPLIT specifically for VAACs



How does the MJO affect extreme rainfall around the Tropics?

Carl Schreck (CISESS)

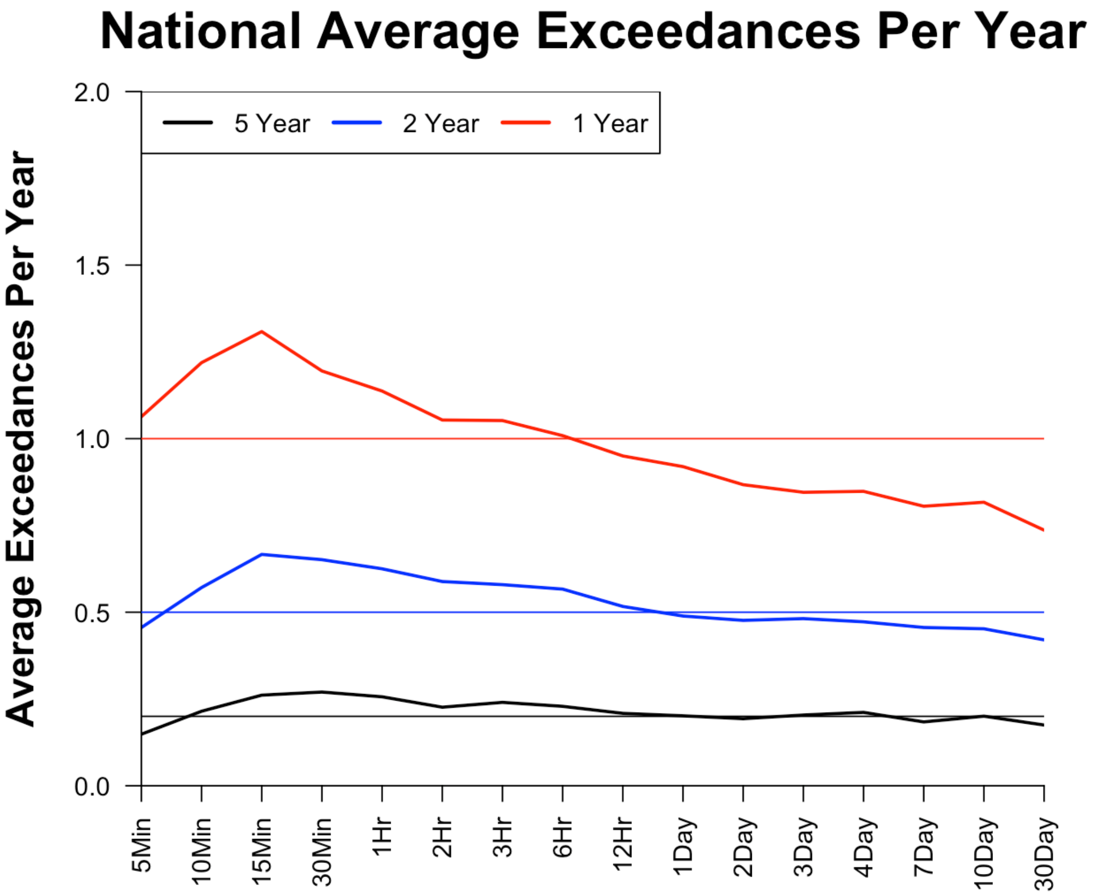
- MJO affects extreme rainfall events (2-year events) all around the tropics
- Strong signals in the subtropics like the Mediterranean and Middle East that have not been documented before
- Results could be applied for subseasonal forecasts of flooding



Extreme Precipitation Event Frequency Observed by the USCRN

Emma Scott and Ronald Leeper (CISESS); Michael Palecki (NCEI)

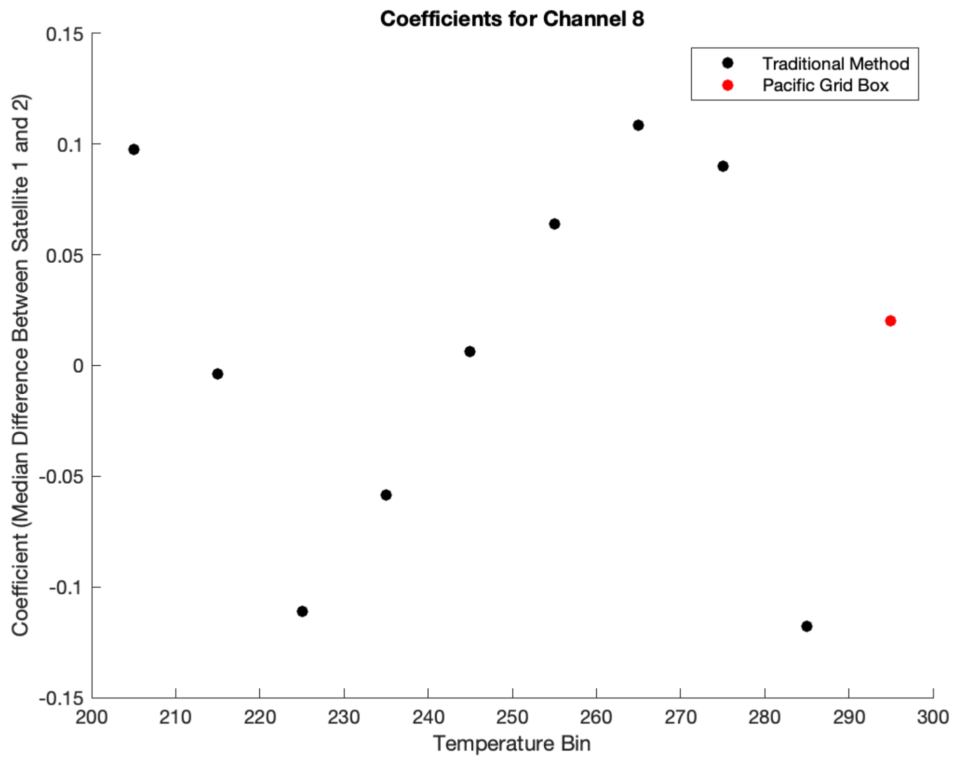
- Network events compared to NOAA Atlas thresholds for extreme precipitation
- Performance depends on event duration and region
  - On average, more short-duration extreme precipitation events were captured by the network than expected
  - Some regions show far fewer exceedances of the threshold value than expected due to the impact of long-lasting regional drought on the relatively short period of record



Colocation-Based Calibration of High-Resolution Infrared Radiation Sounder Brightness Temperatures

Emma Scott (CISESS); Lei Shi (NCEI)

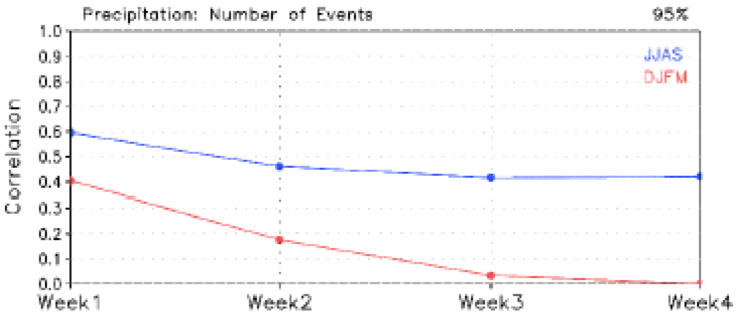
- Inter-satellite calibration was performed for channels 1-12 of HIRS instrument measurements taken on board the NOAA series of satellites and METOP I and II
- Co-located brightness temperature measurements were compared for satellite pairs after outlier filtering
  - Pairs with few overlapping measurements outside of the polar regions were supplemented with monthly average T_b comparison for a Pacific Ocean grid box
- Calibration was highly sensitive to the temperature bin, channel, and satellite pair

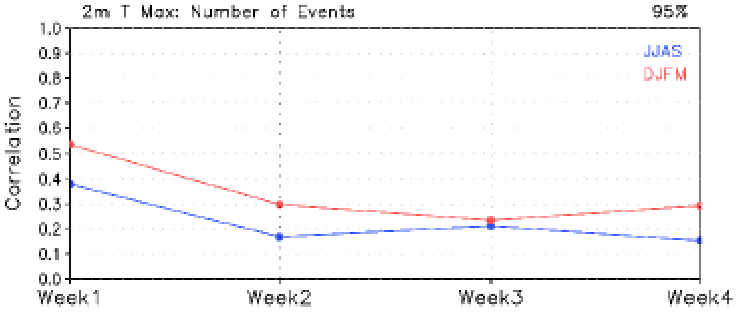


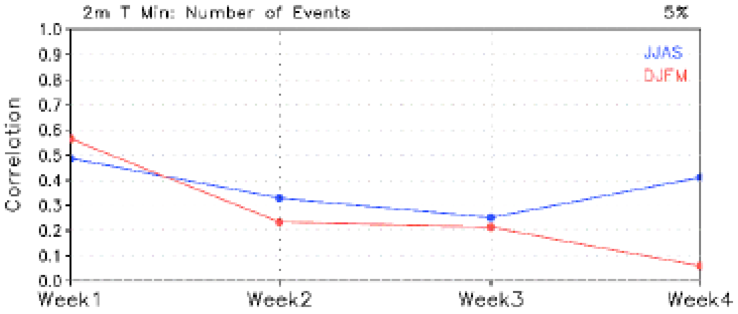
Predictability of Extreme Events in UFS at Subseasonal Time Scale

Cristiana Stan. and V. Krishnamurthy, George Mason University

Spatial Correlation







UFS Prototype 2 – Forecast of Extreme Events

- Extreme events based on the 95%:
  - forecast error grows very little from week 1 to week 4
  - some regions show a small improvement of errors
  - all fields show some seasonal dependence of errors:
    - precipitation: higher skill for the number of events in the summer and also a longer persistence of the skill than in winter, but a higher skill for the amplitude of winter events than for the summer events
    - 2m Tmax: slightly higher skill for the number of events in winter and no difference for the skill in amplitude.

- Extreme events based on the 99%:
  - high missing rate
  - captured events have good magnitude from week 1 to 4

- Acknowledgement: NOAA/EMC Coupled Model Development Team

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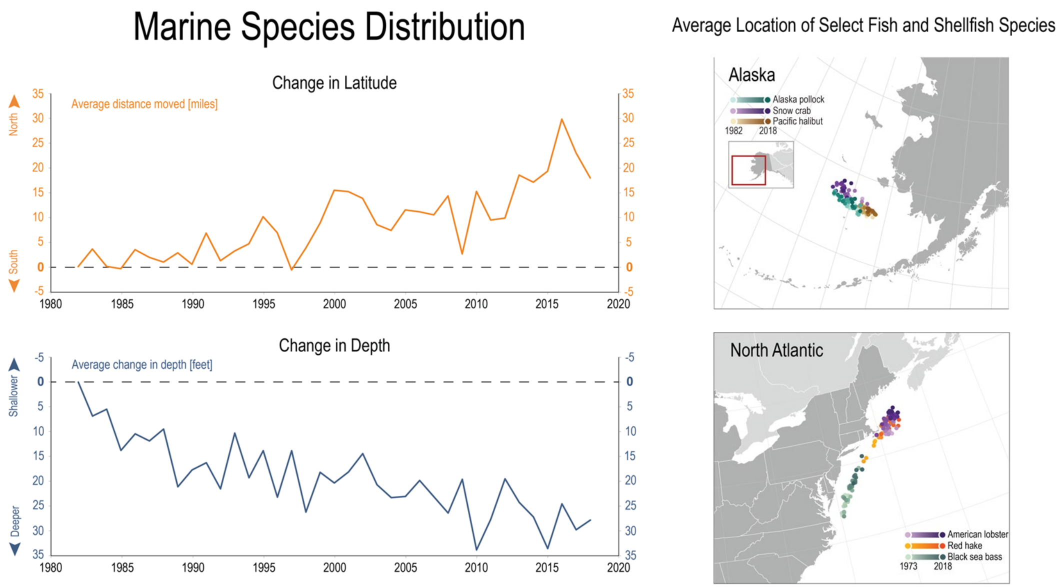
Cultivation, Management, and Value of Interagency Indicators

Laura Stevens (CISESS); Derek Arndt, Jessica Blunden, and David Easterling (NOAA NCEI)

- Climate Change Indicators
  - The U.S. Global Change Research Program (USGCRP) facilitates an indicators effort via the Indicators Interagency Working Group (IndIWG)
  - Goal is to advance the science and breadth of indicators to better characterize the risks and impacts associated with climate change
- USGCRP Indicator Platform: [*globalchange.gov/indicators*](globalchange.gov/indicators)
  - The Platform currently contains 17 indicators (such as *Marine Species Distribution*, shown here) and aims to:
    - Leverage operational and research-oriented indicator efforts from USGCRP's 13 agencies
    - Provide readily accessible, well-documented climate science to stakeholders and the public
    - Support USGCRP sustained assessment activities
- Agency Engagement
  - Interagency collaboration and partnerships benefit all involved, and ultimately advance indicator science



USGCRP gets indicators for the platform, and potentially the NCA

Agency gets tools to advance part of their mission and elevate their work

Scientist gets context, endorsement, and feedback to advance their indicator

Advance Indicator Science

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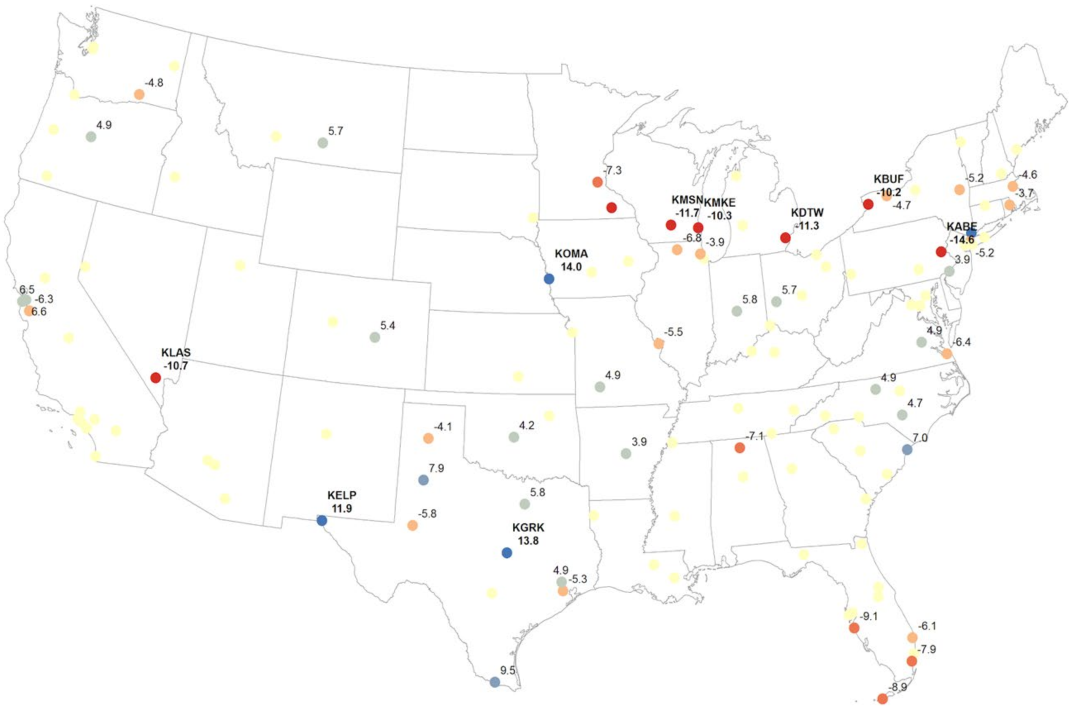
The Crosswind Doth Blow

Scott Stevens (CISESS)

- Quantified incidence of strong winds and crosswinds at 150 major airports in the United States
- Demonstrated significant downward trend in high winds and crosswinds in the Great Lakes region, with little pattern elsewhere in the United States
- Incidence of crosswind mostly related to airport geometry



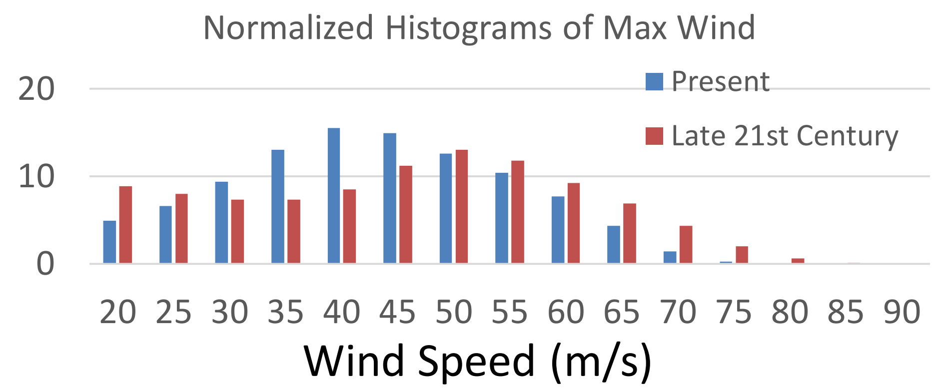
Dynamical Downscaling Projections of Landfalling Tropical Cyclone Activity over the United States: CMIP5/RCP4.5 Scenarios

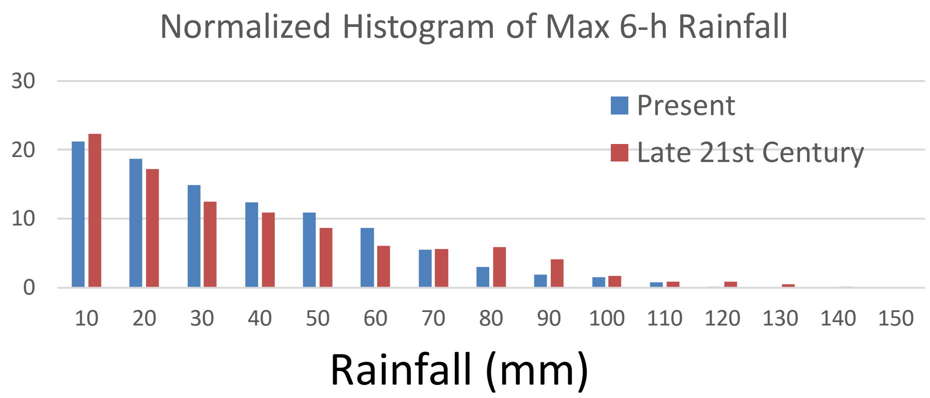
Liqiang Sun and Kenneth Kunkel (CISESS); David Easterling (NCEI); Chia-Ying Lee (Columbia Univ.) and Thomas Knutson (GFDL)

The GFDL triply nested moveable mesh hurricane model was used to downscale tropical cyclones (TCs) identified in the GFDL High Resolution Atmospheric Model. Simulations were performed using observed SSTs (1982–2005) for a ‘‘control run’’ with 20 repeating seasonal cycles and for a late-twenty-first-century projection using an altered SST/sea ice seasonal cycle and atmospheric greenhouse gases as obtained from CMIP5 RCP4.5 multimodel ensemble.

Future changes of U.S. landfalling TCs for the late 21st Century from dynamical downscaling using CMIP5 RCP4.5 scenarios are,

- An decrease of TC frequency along the East Coast, particularly in Florida
- An crease of TC frequency from the middle Gulf Coasts to Louisiana, Mississippi, and Arkansas
- A significant decrease of TC average lifespan, which is likely attributed to the enhanced meridional gradient of geopotential height.
- An increase of strong hurricane frequency
- An increase of max winds for the top 10% TCs
- An increase of max rainfall rate, particularly for the top 10% rainiest TCs

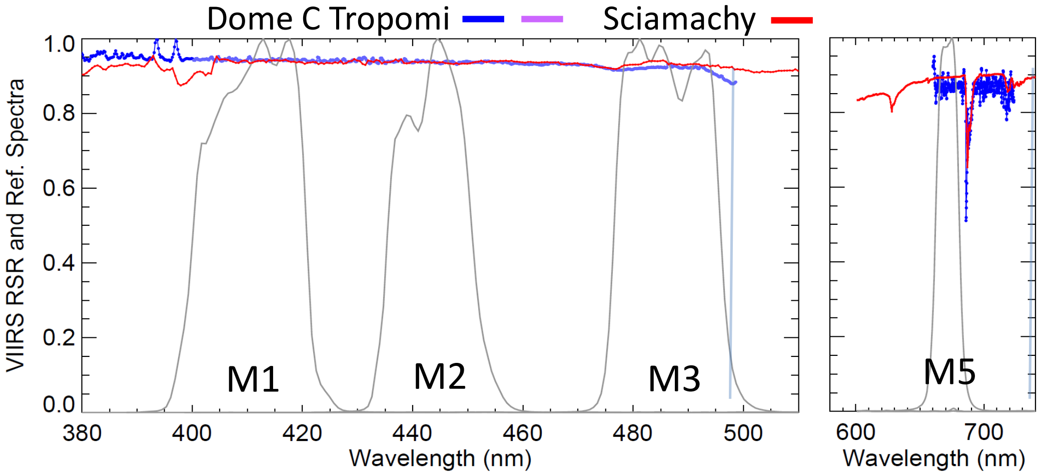


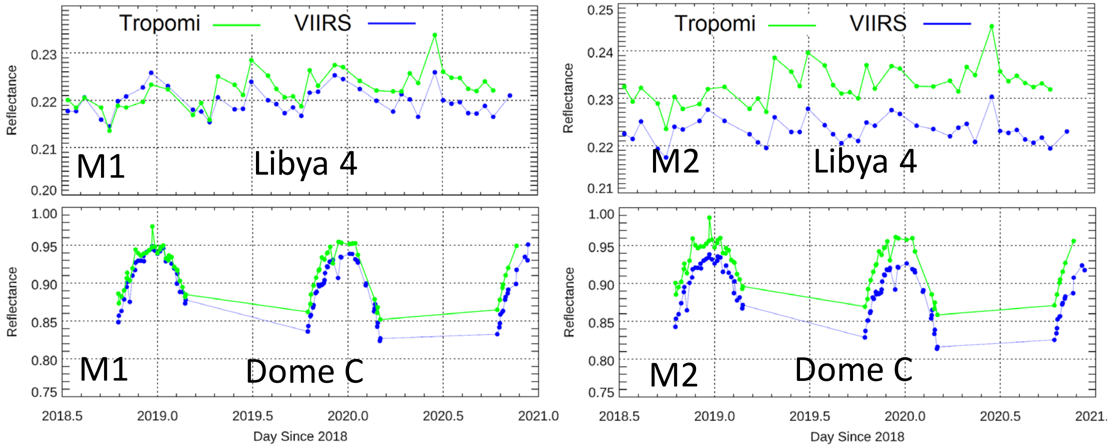


Recalibrated Science Quality SNPP VIIRS SDR for the Synergistic Use with Sentinel-5P Tropomi

Sirish Uprety (CISESS); Changyong Cao (STAR); Xi Shao (CISESS); Bin Zhang (CISESS); Slawomir Blonski (GST); Wenhui Wang (CISESS); Taeyoung Choi (GST); Yalong Gu (GST); Yan Bai (CISESS); and Khalil Ahmad (GST)

- Completed VIIRS recalibration/reprocessing from 01/2012-05/2020 (TROPOMI 2018-2020) and data servers established for distribution
  - Consistent calibration throughout the mission
  - Kalman Filter for VNIR bands, excellent stability <0.3% change in 8 years.
  - SRRS model for SWIR bands, excellent temporal stability, <0.15%
  - Improved EBBT LUT, WUCD bias correction for TEB
  - Time dependent RSRs, airglow impacts removed and straylight correction over entire DNB archive
- Sentinel-5P satellite follows Suomi NPP with ~ 5 minutes in time
  - Cloud information from VIIRS used in methane and aerosol retrievals
- Evaluated the radiometric consistency between VIIRS (M1-3, M5) and TROPOMI using Libya 4 and Dome C (CEOS endorsed sites)
  - Tropomi agrees with VIIRS M1-3 to mostly within 3.5%
  - VIIRS M5 suggests larger bias, ~-7% (Dome C) and ~-5% (Libya 4)
  - Major uncertainties: calibration uncertainties in Tropomi and VIIRS, uncertainty in Tropomi measured solar irradiance, uncertainty in bias for VIIRS M3 and M5 due to the incomplete spectral overlap with Tropomi
  - Impacts due to incomplete spectral overlap for VIIRS M3 and M5 needs to be investigated in future using radiative transfer models and hyperspectral data from other sensors such as Sciamachy.





Assessment of Radiometric Calibration Consistency between CrIS and ABI IR Bands through Intercomparison

101th AMS Annual Meeting, Paper 10-4
Zhipeng (Ben) Wang University of Maryland/Earth System Science Interdisciplinary Center
Flavio Iturbide-Sanchez, Yong Chen, Erin Lynch and Peter Beierle
Jan. 14th 2021, 10:55 AM-11:00 AM (EST)

- Results of radiometric intercomparison between S-NPP CrIS and GOES-16/17 ABI IR bands are presented.
- The accuracy is better than 0.1 K for daily average values for all ABI bands. (Fig. 1)
- Proper selection of collocated pixels for comparison is critical to get reliable results. (Fig. 2)

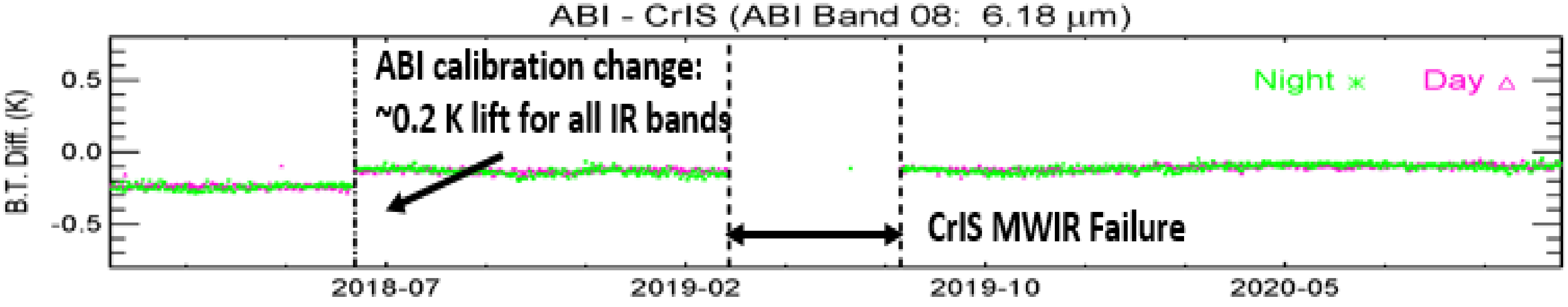


Fig. 1

- Potential cold bias is observed. (Fig. 3)

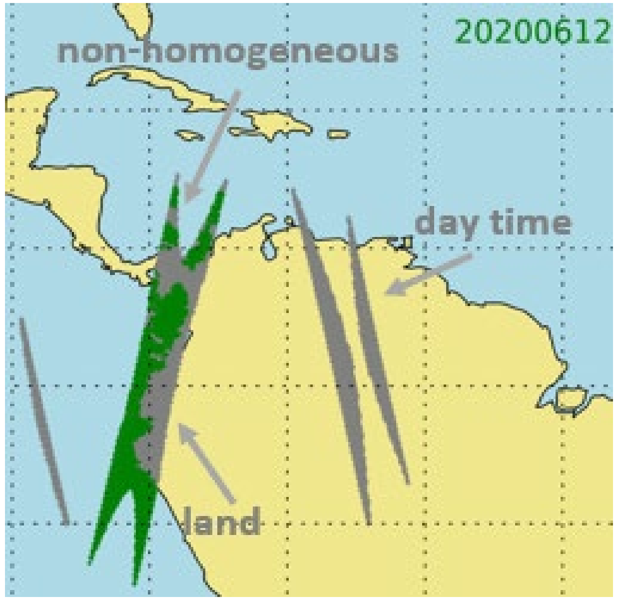


Fig. 2

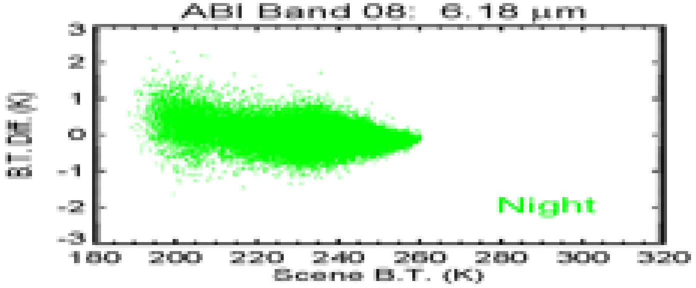


Fig. 3

Enhancing Noah Model Skills with Assimilation of SMOPS V3.0 Blended Soil Moisture

Jifu Yin (jifu.yin@noaa.gov), Xiwu Zhan, Ralph Ferraro, Jicheng Liu, Nai-yu Wang, Yanjuan Guo

- *SMOPS soil moisture product presents a significant advantage in data availability in comparison with the individual SM retrievals.*
- *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.

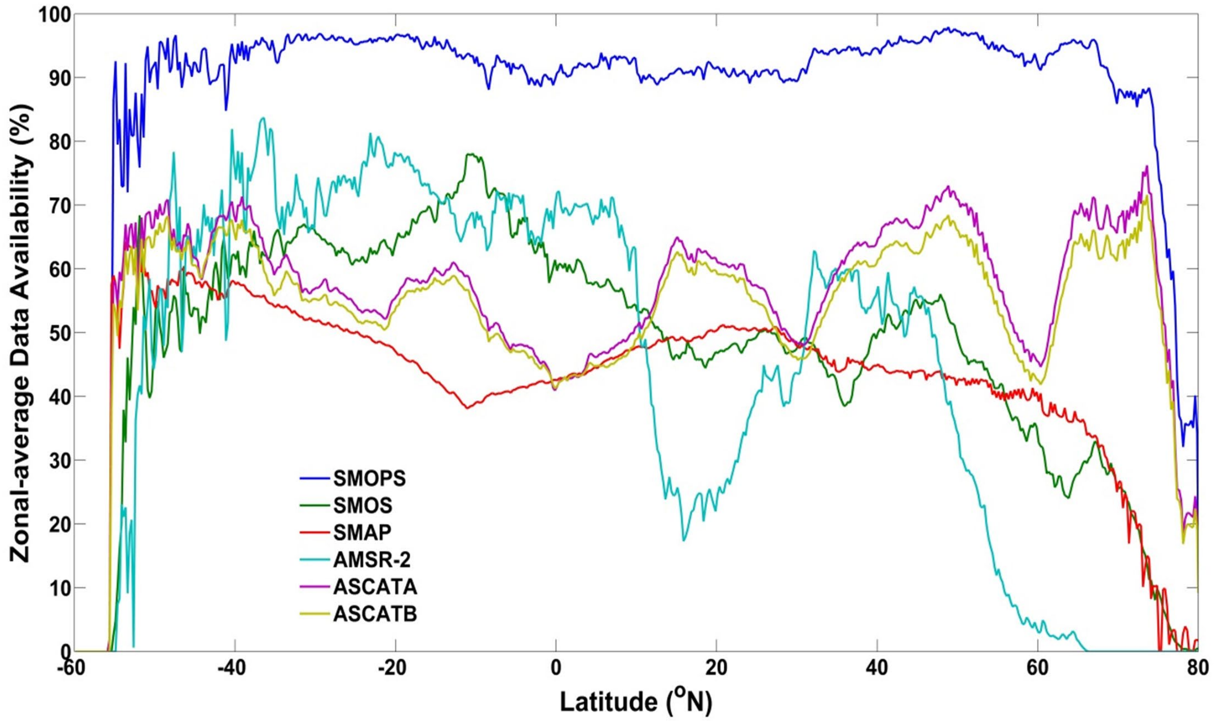


Fig. 1. Zonal-average data availability (%) for SMOPS and each of the 5 individual satellite remote sensing SM observations over 1 April 2015 -30 June 2017 period.

Validation of STAR GNSS RO Bending Angle Profiles Converted from the COSMIC-2 Carrier Phase

Bin Zhang, Shu-peng Ho, Changyong Cao, Xi Shao, Jun Dong and Yong Chen

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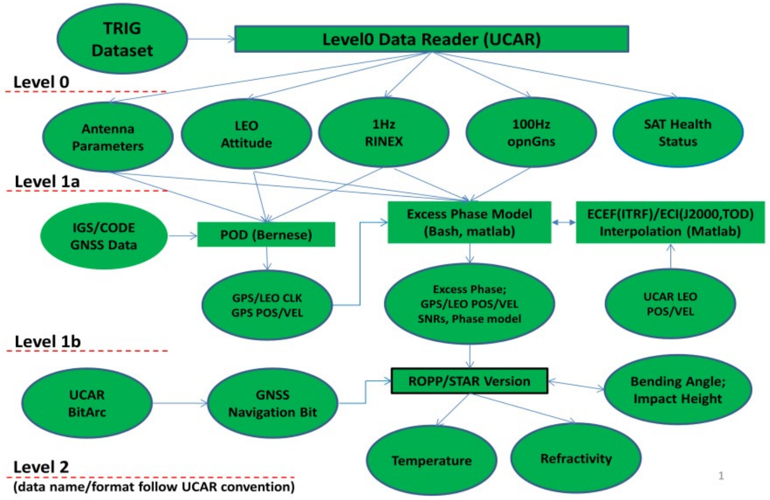
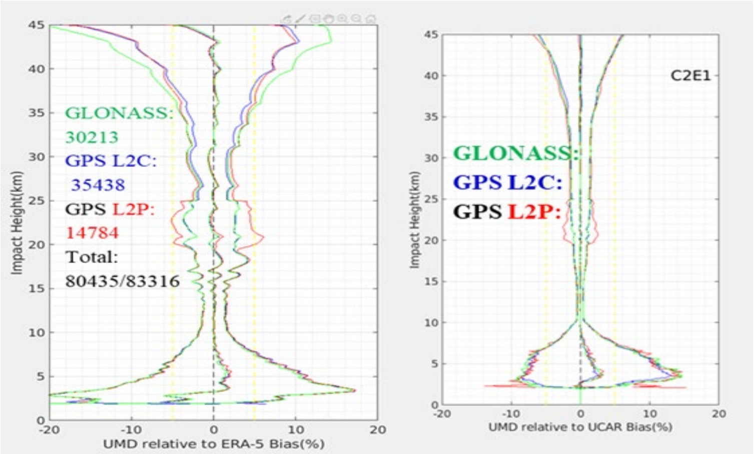
- A COSMIC-2 RO processing package has been developed for converting raw RO observations (carrier phase and pseudorange) to bending angle for better RO quality control and Cal/Val at STAR/NOAA and CISESS/UMD using Bernese, Matlab and ROPP.
- Derived bending angle profiles agree well with ERA-5 and UCAR results on 10-35km height , with standard deviation increases toward surface and high altitude.
- SNR values are correlated with the bending angle difference.
- The RO processing package can be applied to other RO missions, such as COSMIC-1 and CWDP.

RO Processing with COSMIC-2 data





An Initial Inter-comparison of GLM and ISS-LIS Lightning Observations

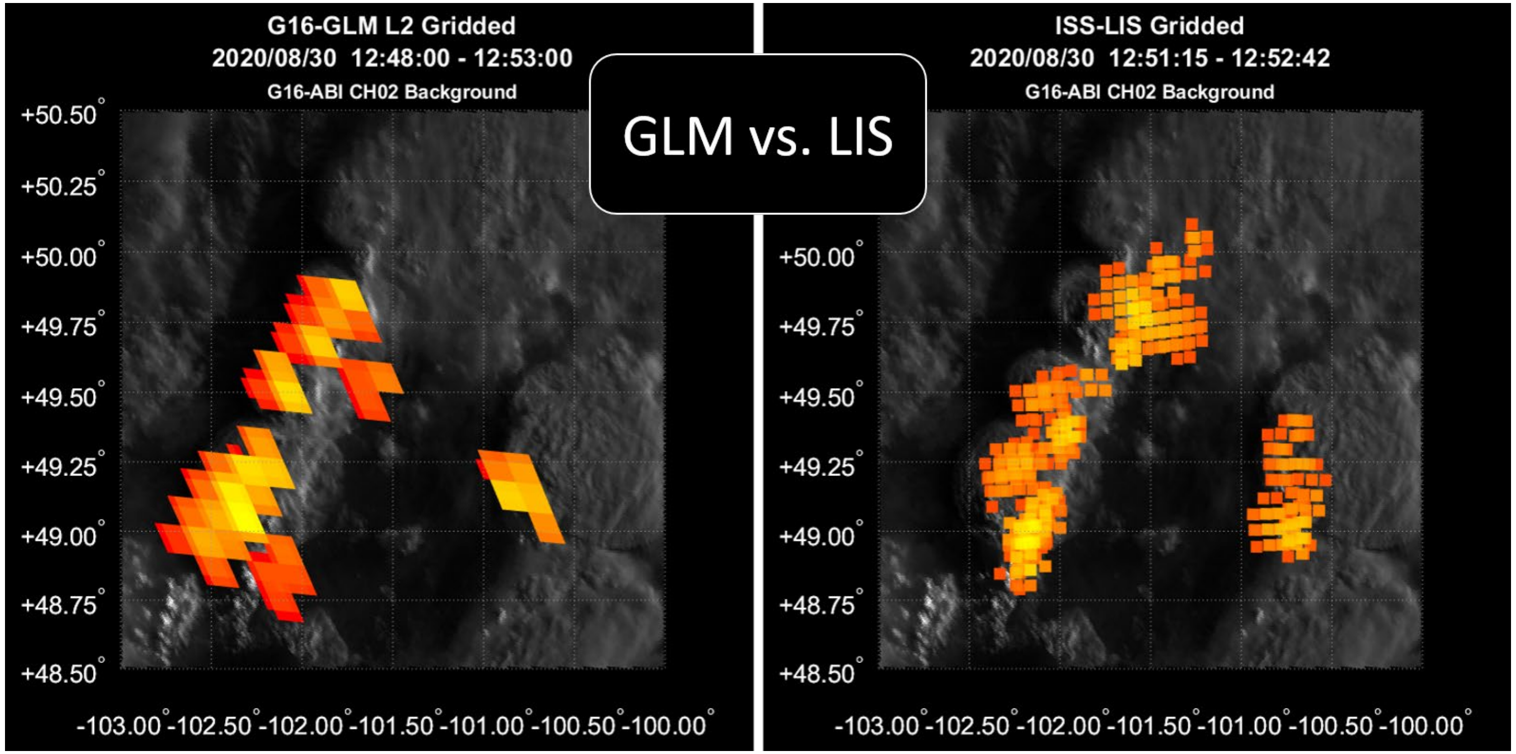
Daile Zhang and Mason Quick (CISESS, Univ. of Maryland)
Michael Peterson (LANL)

Model Development Progress

- A full evaluation of ISS-LIS is constructed
- A combined coincidence dataset of GLM and ISS-LIS is built
- The cloud-top optical products empirical relationship is being developed
- A statistical (ML) model based on the relationship will be built
- The GLM downscaled datasets (both level-2 and level-3) will be constructed

Goals

- To increase GLM detection efficiency
- To reduce the GLM parallax errors



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CIMSS

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- John Cintineo
- Lee Cronce
- Geoff Cureton
- James E. Davies
- Sarah Griffin
- Mathew M. Gunshor (2)
- Zhenglong Li
- Brett Hoover
- Robert Knutson
- Agnes Lim (2)
- Scott Lindstrom (2)
- David Loveless
- Jessica Maier
- Margaret Mooney
- Alexa Ross
- David Santek
- Christopher C. Schmidt
- Kathleen Strabala
- William Straka III
- Pei Wang
- Charles White

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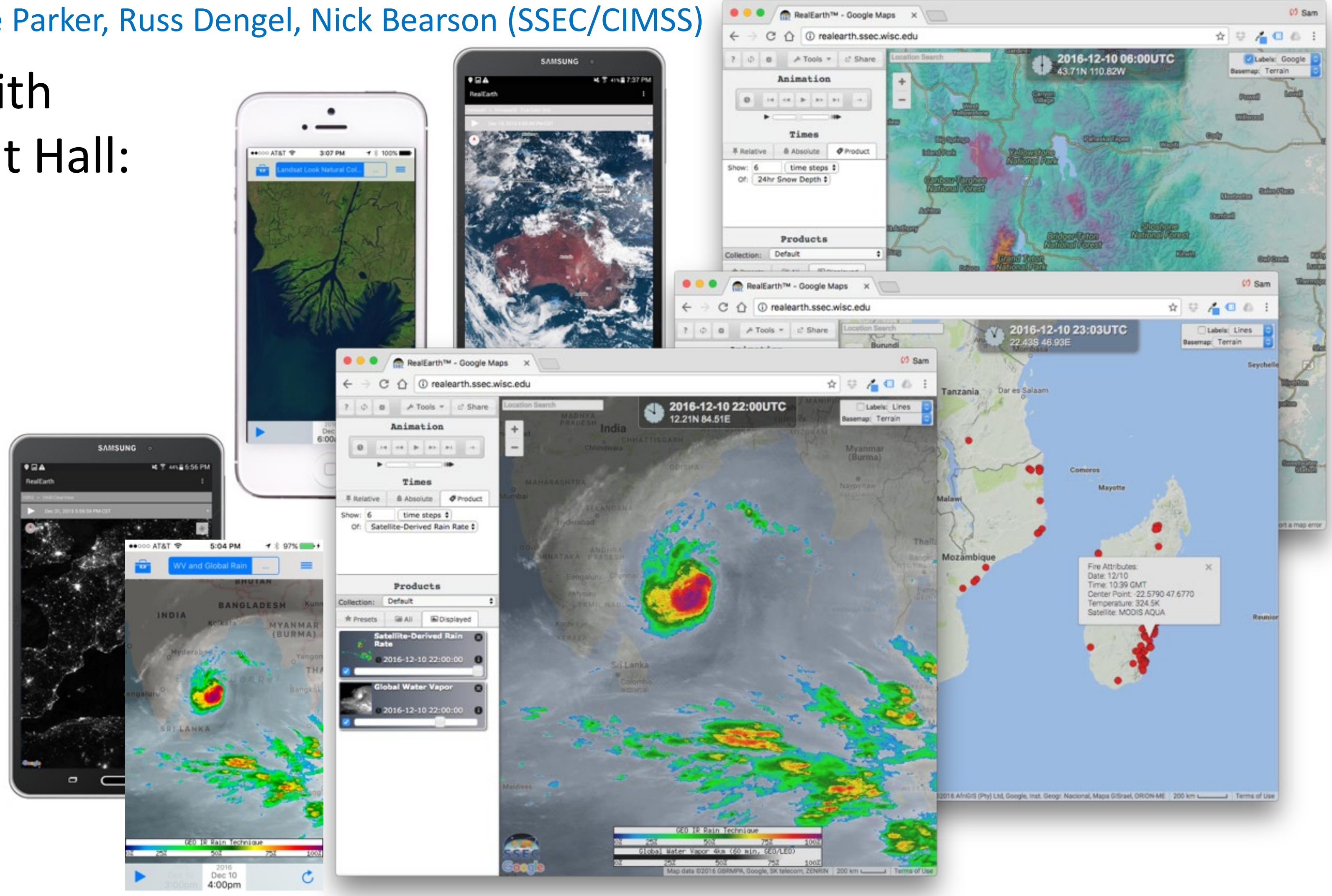
RealEarth - A Flexible and Interoperable Visualization Platform for Satellite Imagery and Related Data

Sam Batzli, Dave Parker, Russ Dengel, Nick Bearson (SSEC/CIMSS)

We Described these Capabilities with Follow-up Live Demos in the Exhibit Hall:

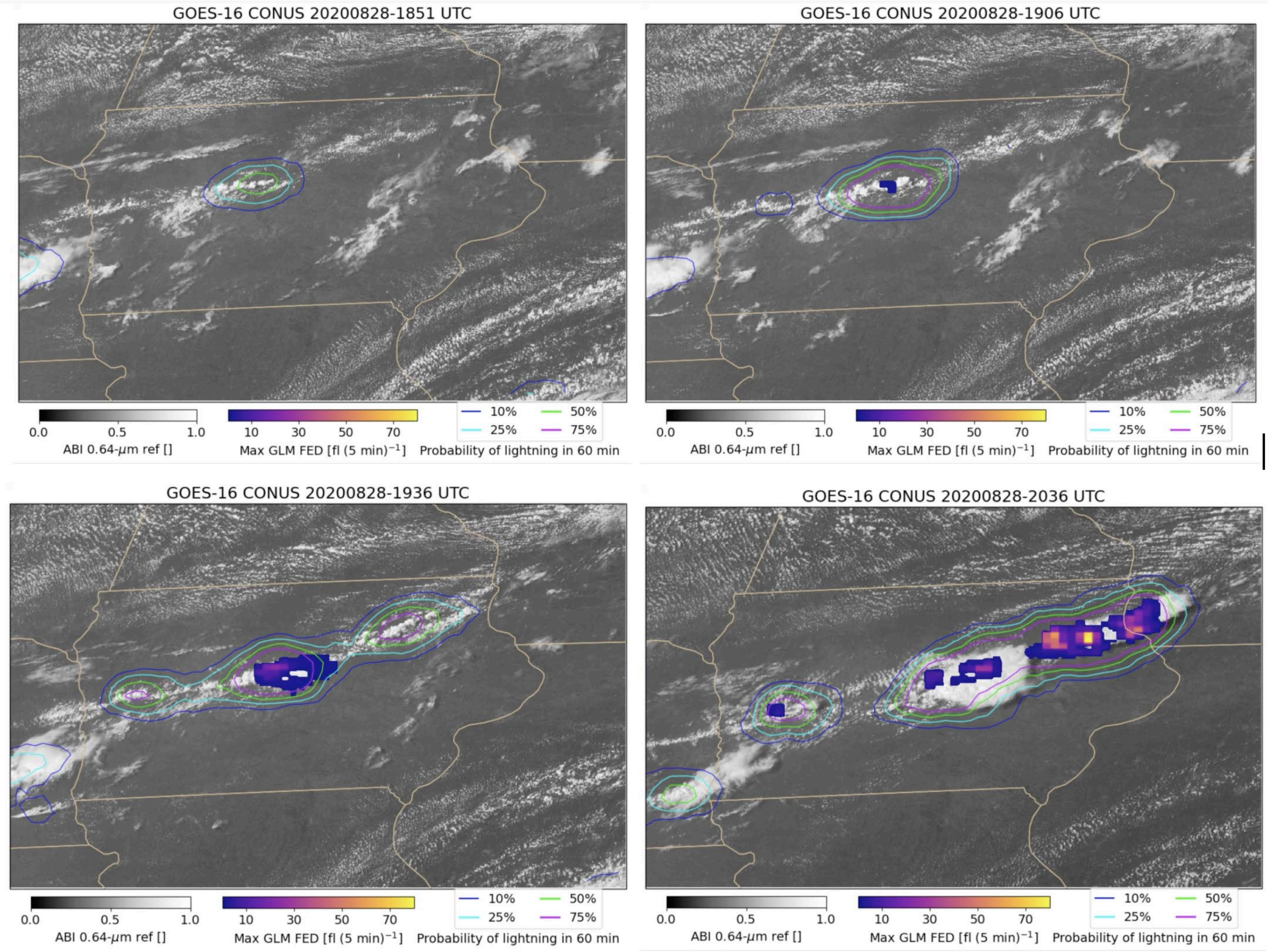
- **Overlay** imagery and data
- **Upload** GeoTIFF, GeoJSON easily
- **Auto-update** in near real-time
- **Animate** and share movies
- **Share** to apps and social media
- **Embed** map in your website
- **Use our API** for mapping and GIS
- **Support** decisions with situational awareness
- **Develop** classroom exercises
- **Set-up your own** as a VM



Using GOES ABI and Deep Learning to Nowcast Lightning

John Cintineo (UW-CIMSS); Mike Pavolonis (NOAA/NESDIS/STAR); Justin Sieglaff (UW-CIMSS)

- Trained a CNN to predict lightning up to 60 min in the future, using U-Net architecture.
- Inputs: GOES-16 ABI CH02 (0.64-µm), CH05 (1.6-µm), CH13 (10.3-µm) and CH15 (12.3-µm)
  - 23,100 training patches; 5,100 validation patches; 5,500 testing patches (~800-km by 800-km patches over Southeast US offshore)
- Target/truth: maximum GLM flash-extent density in t_0 + 60 min.
- Output: 2D grid of probabilities
- Good skill day and night over land and sea (best CSI = 0.5 at probability threshold = 32%).
- Lead-time to initial flashes regularly 10-30 minutes from 30% threshold.

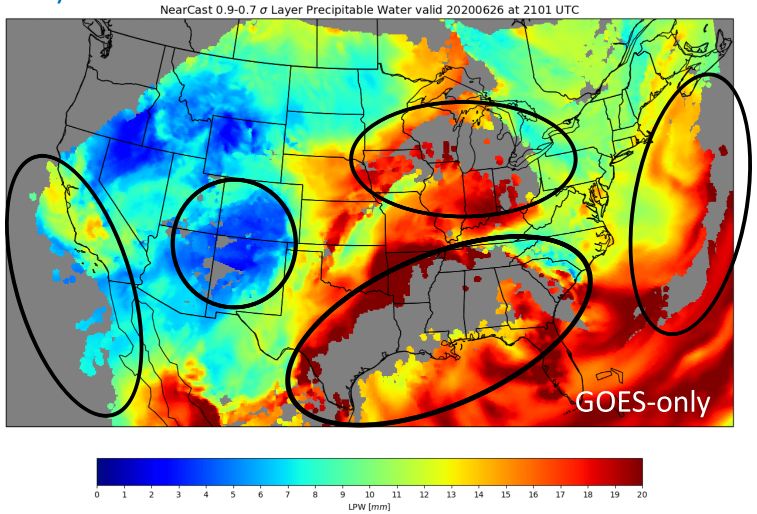


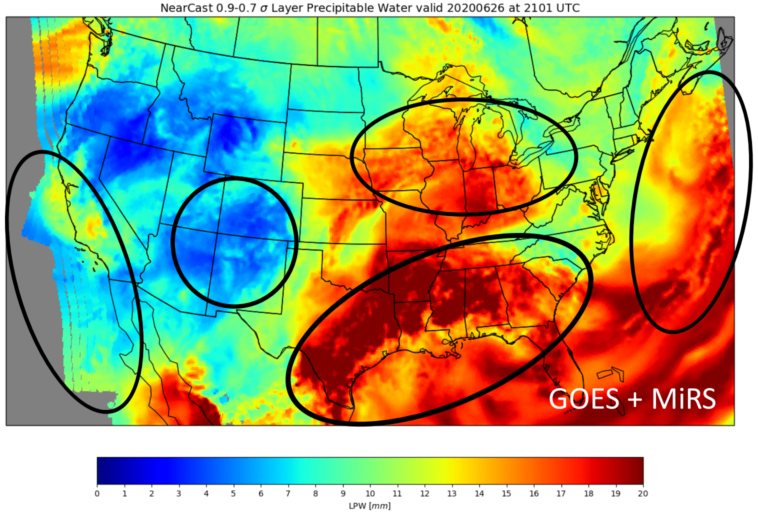
A sequence of images with probability of lightning (contours), GOES 0.64-µm reflectance (shaded grayscale), and 5-min maximum GLM flash-extent density (shaded color) for a developing cold front in Iowa.

A Multi-satellite Platform Approach to Nearcasting short-term Significant Weather Potential

Lee Cronce and Ralph Petersen (CIMSS)

- Short-term forecasts from satellite temperature and moisture obs to support high impact weather analysis
- Frequently updated with large area of coverage at asynoptic times
- Numerical approach retains important extrema and spatially apparent gradients
- Cloudy areas, however, produce inconsistent fields in IR-based products, so NearCast supplemented with MiRS microwave data sets
- Provides marked improvement in coverage and continuity leading to better environmental analysis with enhanced confidence in significant weather
- Products are available within minutes of data acquisition

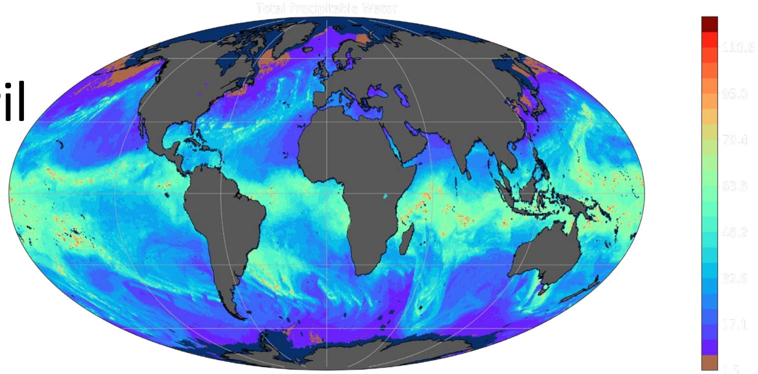


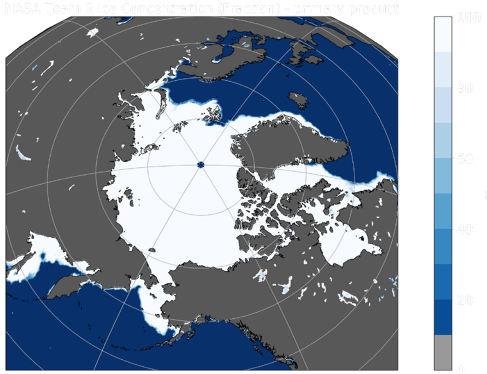


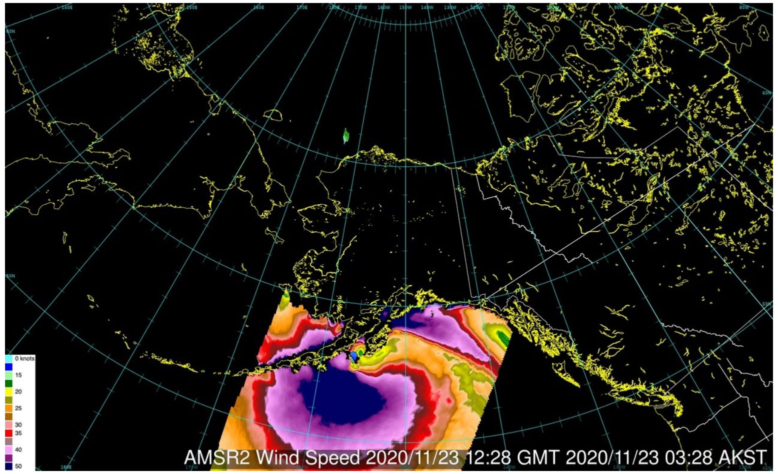
Support for Near-Real-Time GCOM-W1 AMSR2 Algorithm Software Package (GAASP) Level-2 Products via Direct Broadcast Using the Community Satellite Software Package

Geoff Cureton, Liam Gumley, Allen Huang (CIMSS)

- CSPP-GAASP (with GAASP v2r2) released April 2020
- Flexible L2 product and ancillary ingest
- Outputs L2 products: Precipitation, (SST), Winds, TPW, Cloud Liquid Water, Soil Moisture, Surface Type, Snow Cover, Snow Depth, Sea Ice (and more)
- New CSPP-GAASP release: Q2 2021



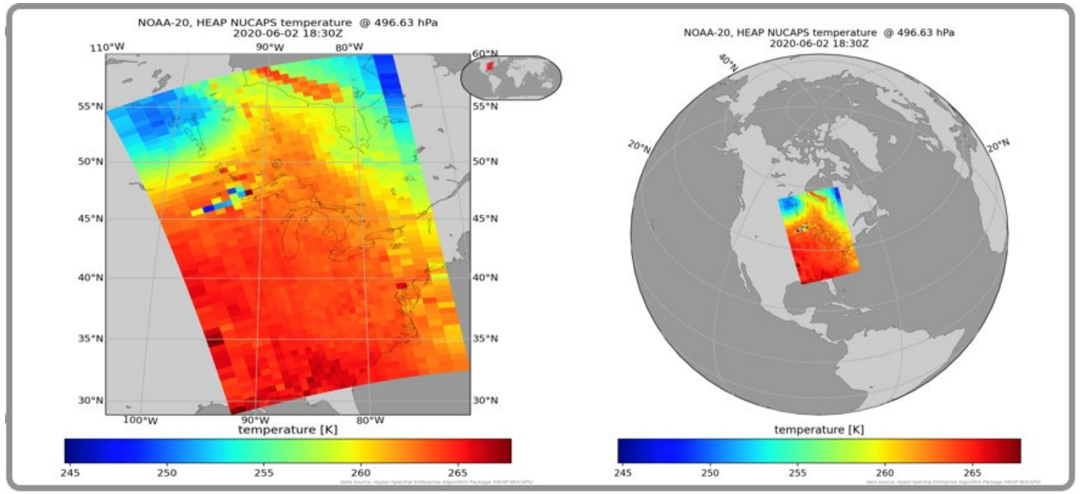


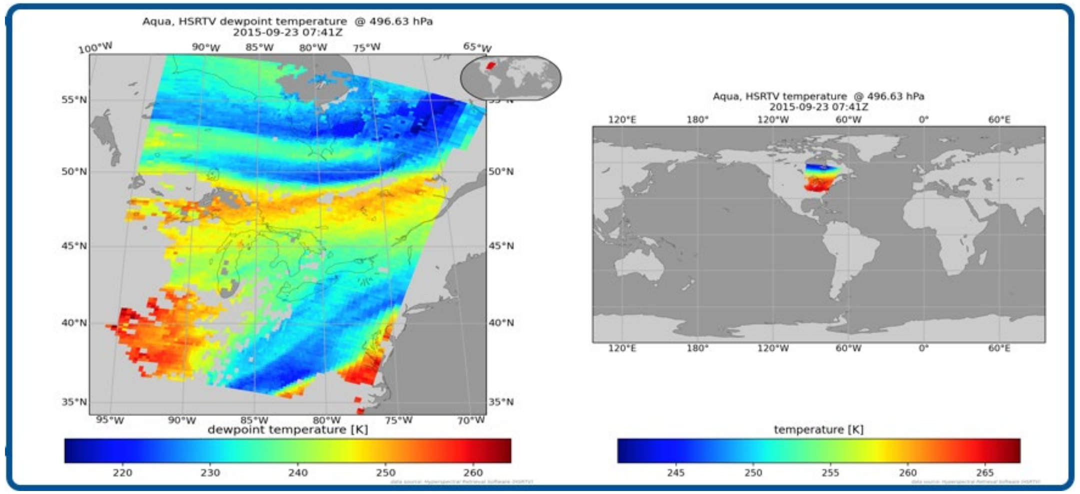


Community Satellite Processing Package (CSPP) Sounder Packages for Direct Broadcast Users

James E. Davies & Geoff Cureton (Space Science and Engineering Center/University of Wisconsin-Madison)

- Four atmospheric sounder processing packages to support direct broadcast
  - HEAP (last updated Nov 2020)
  - UW_HSRTV (last updated Mar 2020)
  - MiRS (last updated Oct 2020)
  - IAPP (last updated Mar 2017)
- A quick-look package (update Jan 2021)
  - generates images of temperature, dew point, water vapor, relative humidity at a specified pressure level, supports multiple map projections with local & global views & can make SkewT plots.





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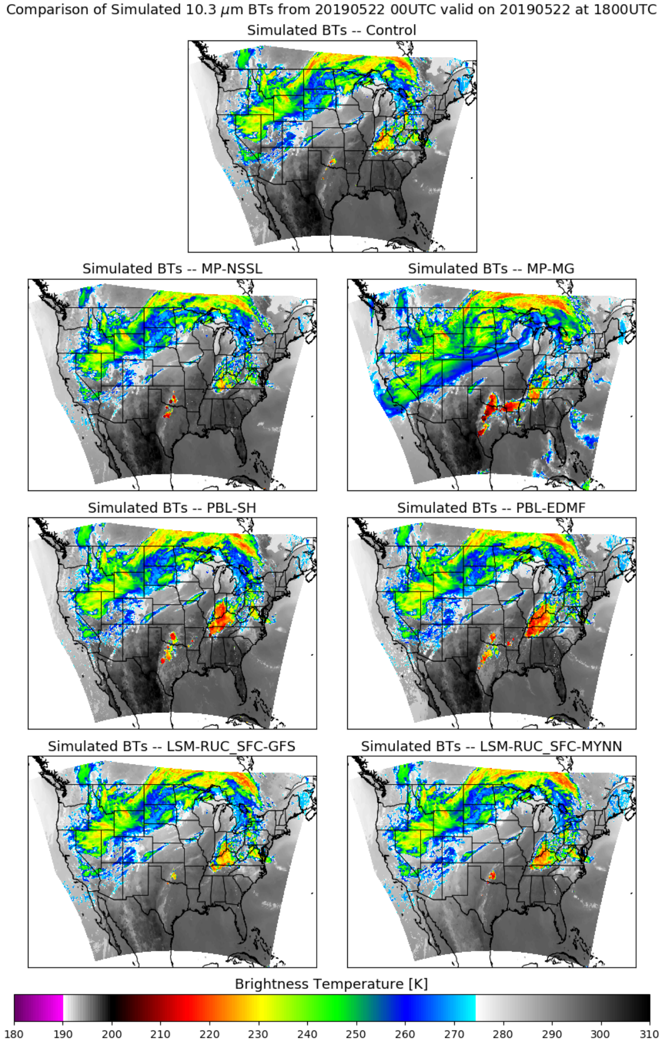
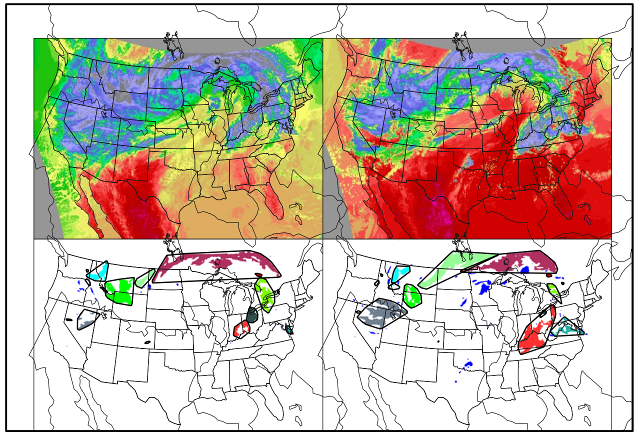
Evaluating the Impact of Planetary Boundary Layer, Land Surface Model, and Microphysics Parameterization Schemes on Cold Cloud Objects in Simulated GOES-16 Brightness Temperatures

Sarah Griffin, Jason Otkin, and Sharon Nebuda (CIMSS); Tara Jenson and Eric Gilleland (NCAR); Patrick Skinner (CIMMS); Timothy Supinie and Ming Xue (CAPS)

- Assessed accuracy of simulated cold cloud objects when using different parameterization schemes in the FV3 limited area model (FV3-LAM)
  - Microphysics (MP) schemes
    - Thompson scheme was more accurate than the NSSL and Morrison-Gettelman schemes
  - Planetary Boundary Layer (PBL) schemes
    - MYNN results in a high bias in BTs
  - Surface Layer (SFC) and Land Surface Model (LSM)
    - Changing from GFS reduced BT accuracy





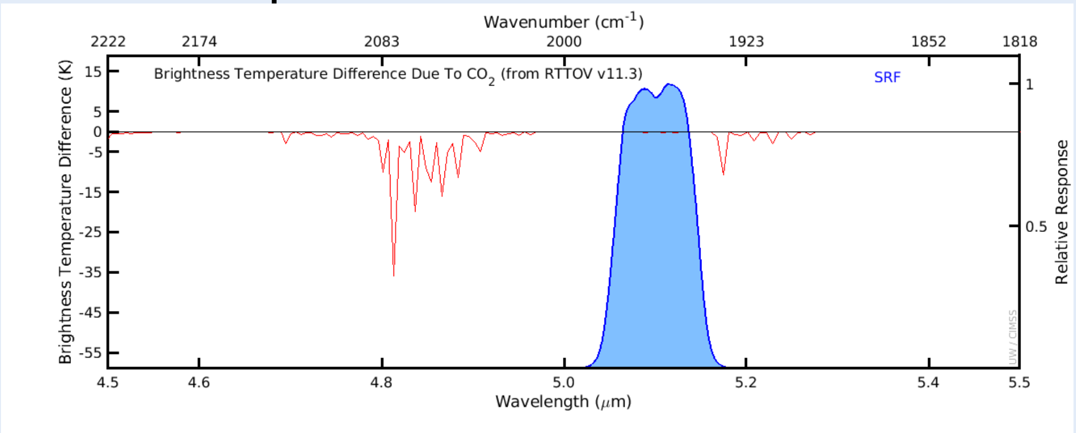
Example of Object Identification using the Method for Object-based Diagnostic Evaluation (MODE)

Exploring the Shortwave Side of the Infrared Water Vapor Absorption Band (For GeoXO)

Mathew M. Gunshor; Tristan L'Ecuyer (CIMSS/UW-Madison); &Timc

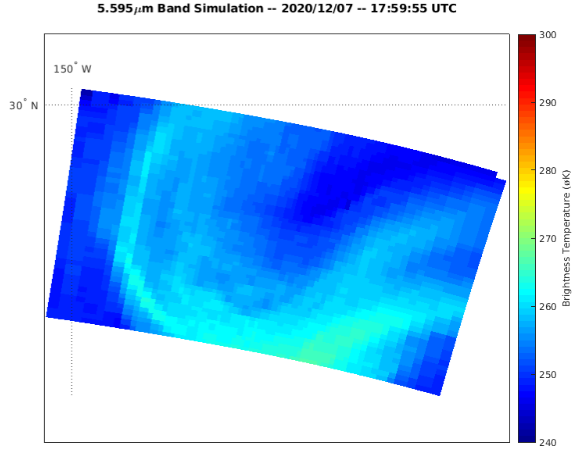
For the GeoXO Imager:

- Is it possible to get a band to sense lower level water vapor?

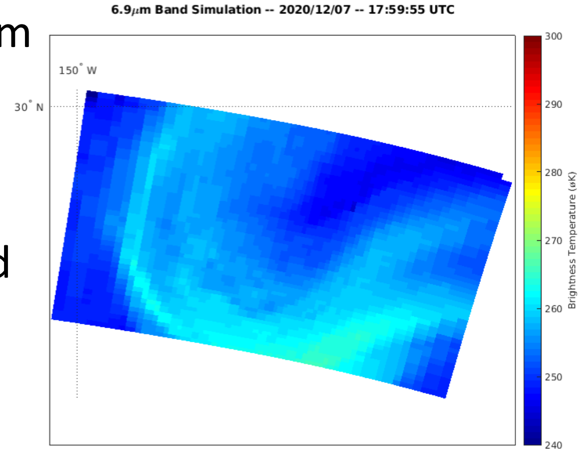


- Can a ~5.5um band replace/augment the ~6.9µm band from ABI on the GeoXO Imager for "mid-level" water vapor?
  - Is it possible to do 1km resolution?

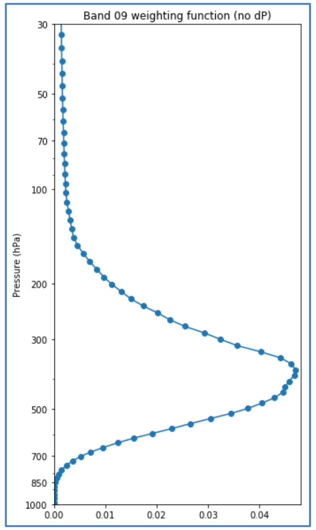
Simulated 5.595µm looks a lot like…



The 6.9µm from ABI…



Both simulated from an IASI granule.



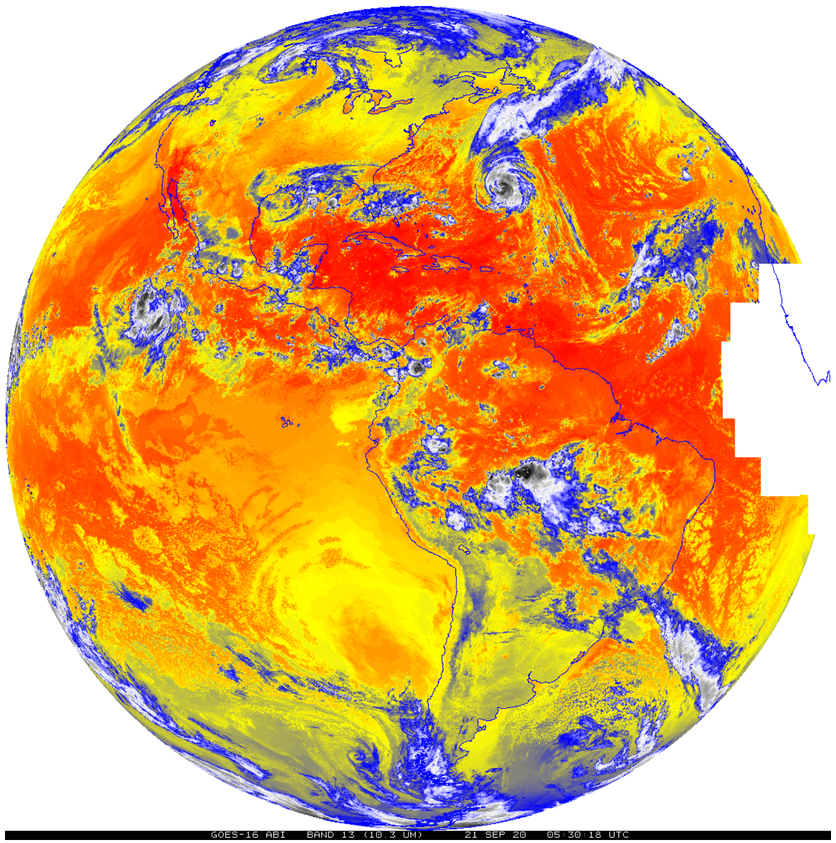
The ABI 6.9µm weighting function for the US Std Atmosphere (from PCRTM). Thanks to Nico Gordillo (CIMSS/UW-Madison).

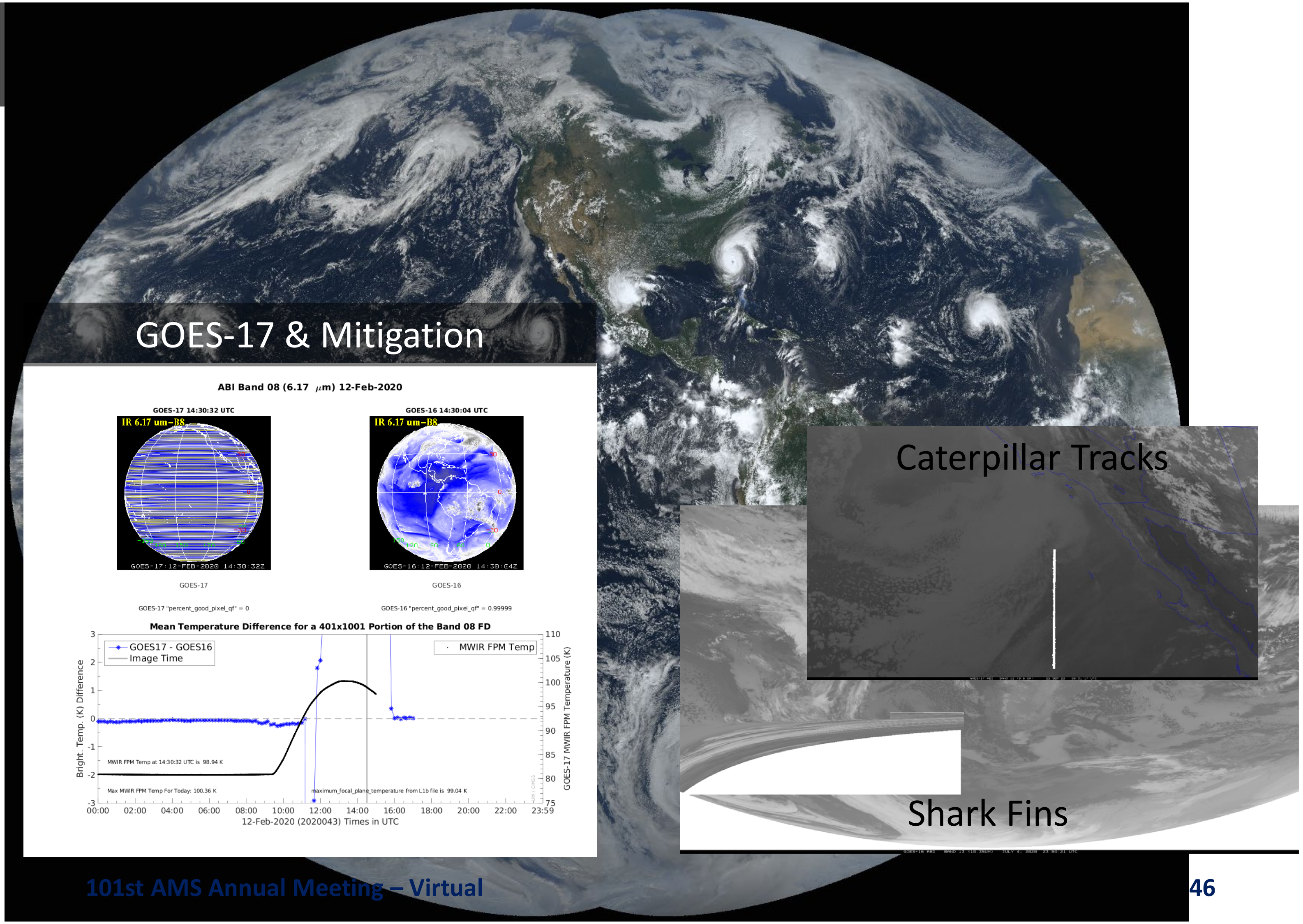
ABI Imagery Anomalies

Mathew Gunshor, CIMSS/UW-Madison; Timothy J. Schmit & David Pogorzala, NOAA/NESDIS

Gunshor, Mathew M., T. J. Schmit, D. R. Pogorzala, S. S. Lindstrom, J. P. Nelson, "GOES-R Series ABI Imagery Artifacts," J. Appl. Rem. Sens. 14(3) 032411 (28 August 2020) https://doi.org/10.1117/1.JRS.14.032411

Cookie Monster





The Imaging Capabilities of Tundra Orbits

Zhenglong Li (CIMSS), Jun Li (CIMSS), Timothy J. Schmit (STAR), Mathew Gunshor (CIMSS), and Frederick Nagle (CIMSS)

- A Tundra simulation package was developed at CIMSS/SSEC, including orbit simulator, navigation simulator, and radiance simulator
- Two criteria were developed to quantify the imaging capability: one focuses on temporal coverage and the other on footprint size
- Comparisons between ABI/Tundra, ABI/GEO, and VIIRS/LEO show
  - Two Tundra constellation provides GEO-like imaging capability for a large domain in high latitude and polar region. The domain size can be further improved when combined with existing GEO
  - Three Tundra constellation provides GEO-like imaging capability for the whole high latitudes and polar regions in both hemispheres, and for the whole globe when combined with 3 GEOs.
  - Having more than 3 GEOs allows individual agencies/countries to improve spatial resolutions over their sub-point locations

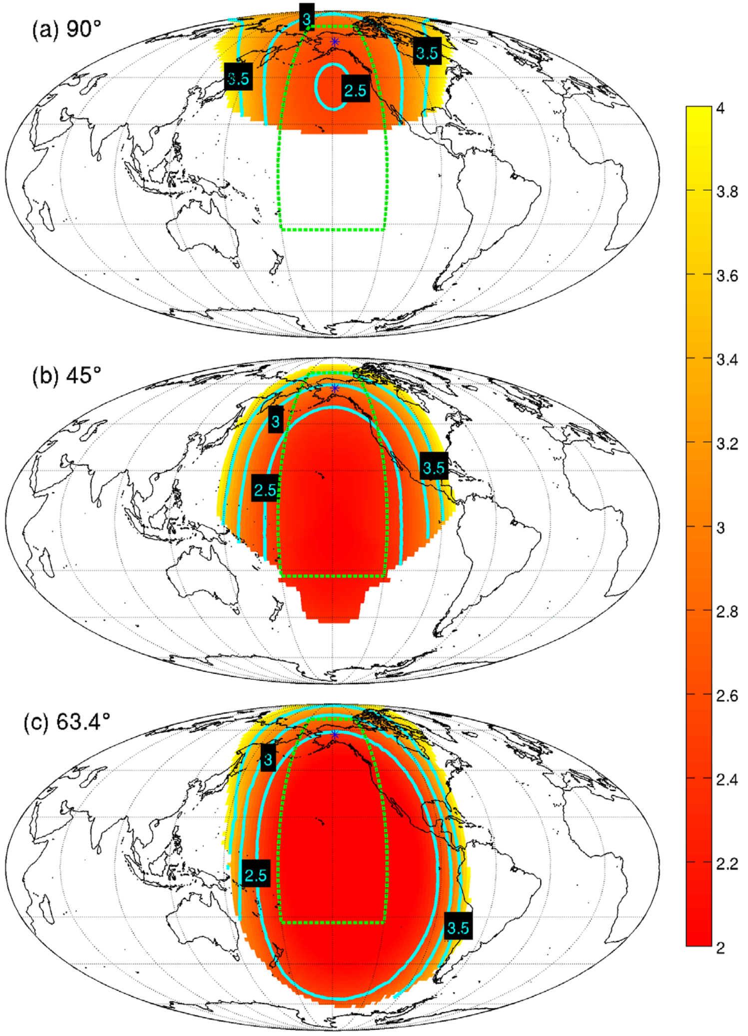
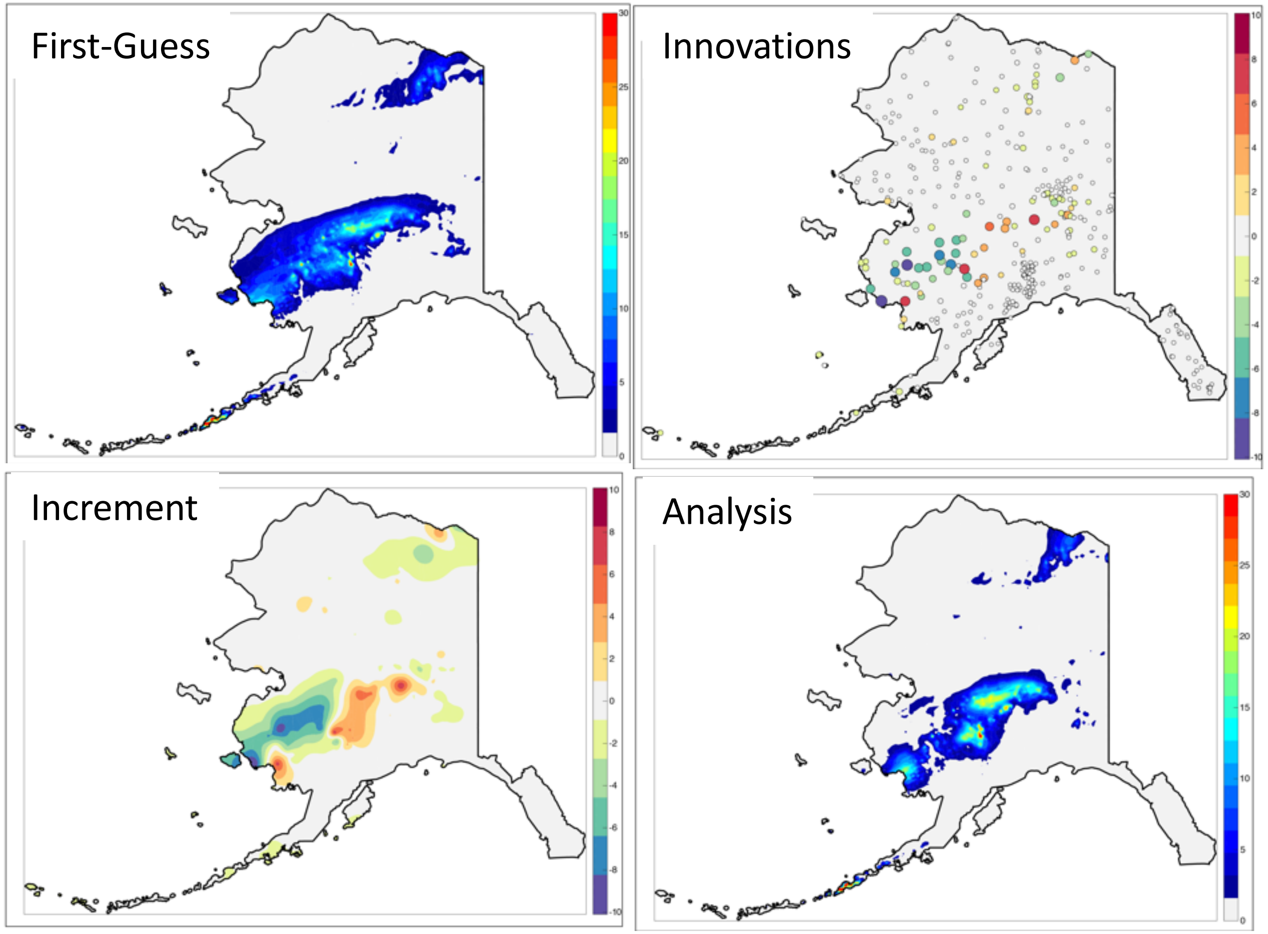


Fig. 1. The effective footprint size imagery (better than 4 km only) of the 2 ABI/Tundra constellation for area with full temporal coverage for the inclination angles of (a) 90°, (b) 45° and (c) 63.4° plus ABI/GOES-17. The cyan contours show the effective footprint size as well. And the green dash lines denote the NWS domain with requirements of full temporal coverage and footprint size better than 4 km. The horizontal black dashed lines denote the boundaries between polar regions, high latitudes, and mid-latitudes. The blue star shows the location of Fairbanks Alaska.

A Quantitative Precipitation Estimate for Alaska

Brett Hoover and Jason Otkin (CIMSS); Eugene Petrescu and Emily Niebuhr (NWS Alaska)

- QPF from high-resolution NWP is merged with rain gauges to produce QPE
  - QPF first-guess from HRRR-AK, NAM-AK, RDPS; testing GEFS as a potential member
  - Innovations from rain gauges (MesoWest, Alaska-Pacific RFC) are interpolated to the grid via kriging
  - Potential for using remote sensing precipitation products to improve first-guess and produce better fit of QPE to observations
- Real-time distribution of QPE
  - CIMSS website providing 6-hourly QPE to NWS Alaska and Alaska-Pacific RFC
  - Potential application in AK hydrological modeling



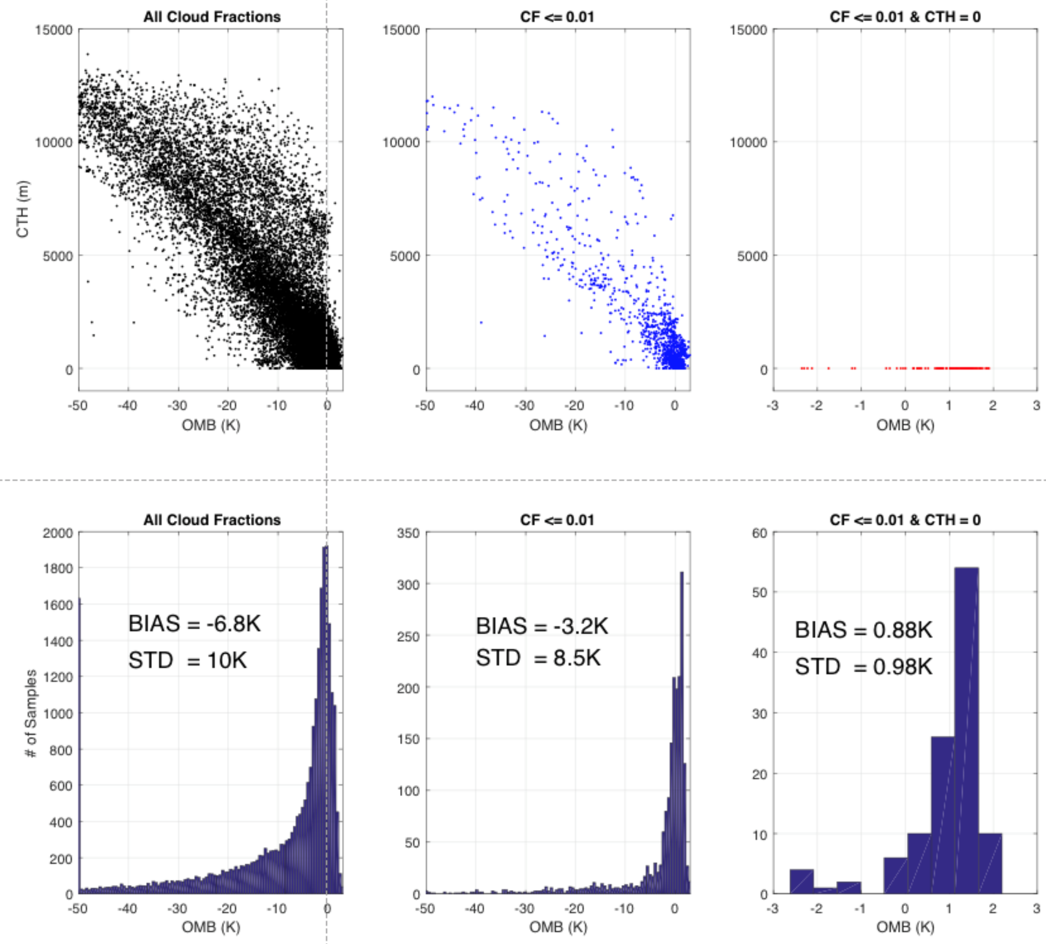
Use of FY4A AGRI Imager Products in NWP Data Assimilation of FY4A GIIRS Geostationary Hyperspectral Infrared Sounder Radiances

Robert Knuteson, Michelle Loveless, Jessica Maier (Uni. of Wisconsin-Madison SSEC/CIMSS) Dr. Wei Han (JCSDA)

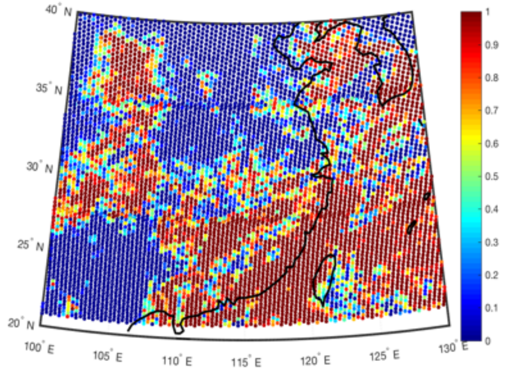
Filter OMB for Cloudy Scenes with AGRI collocated to GIIRS
900 cm^{-1} (11.1 μm)

AGRI/GIIRS Cloud Fraction
(middle column is CF < 1%)

AGRI/GIIRS Cloud Top Height
(vertical scale is CTH)
(right column is CTH = 0)



AGRI Cloud Fraction within GIIRS Footprint



<u>Preliminary Finding:</u>

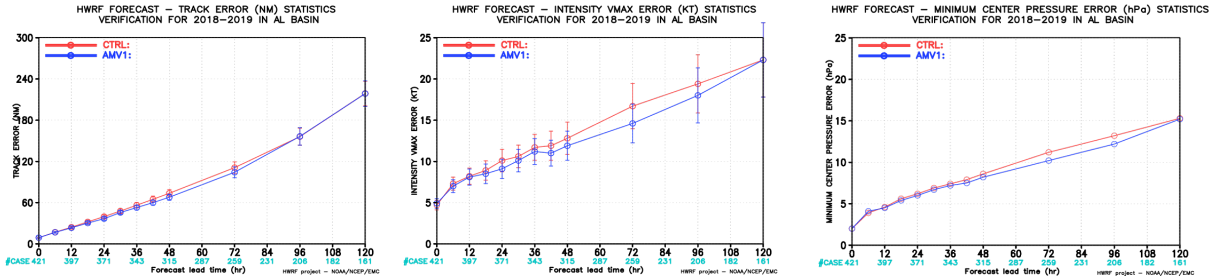
11 m OMB Bias reduced from -7K to -3K using Cloud Fraction only (This is inadequate.)

However, use of CTH= 0 reduces BIAS to +0.9K and greatly reduces standard deviation. (A few outliers still get in.)

Assimilation of the GOES-16/17 Atmospheric Motion Vectors in the Hurricane Weather Forecasting (HWRF) model

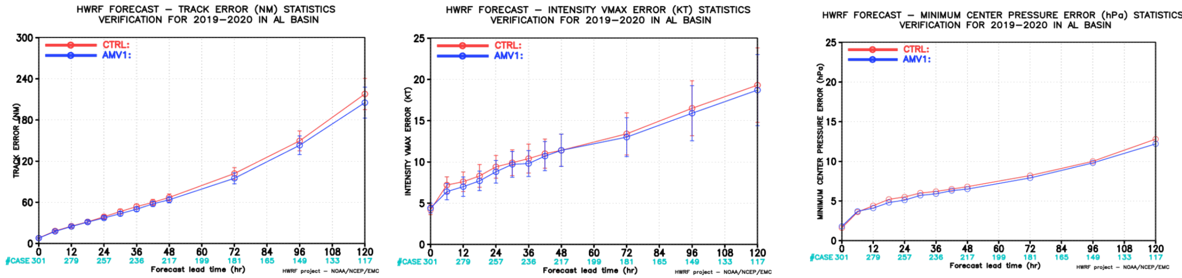
Agnes Lim1, Sharon Nebuda1, James Jung1, Jaime Daniels2, Wayne Bresky3, Li Bi3,4 and Avichal Mehra4
1. Cooperative Institute for Meteorological Satellite Studies, UW-Madison 2. NOAA NESDIS/STAR, 3. I.M. Systems Group, 4. NOAA/NWS/NCEP/EMC

- Evaluate GOES-16/17 AMVs for use in the HWRF to support a quick transition from the heritage AMVs of GOES-13/15 to the nested tracking GOES-16/17 AMVs.
- Infrared, cloudtop water vapor , clear air water vapor, shortwave and visible AMVs.
- Update error profiles used for assimilation
- Apply new hurricane specific quality control procedures.
- Relax gross error check to allow observations with higher wind speeds.
- 20-40% more AMVs assimilated
- Improved normalized wind speed bias between observations and analysis.
- Improve hurricane forecast metrics.



CTRL - operational version of 2020 HWRF with hourly GOES-16 IR, CTWV and CAWV AMVs .
AMV1 – CTRL + hourly GOES-16 SWIR and VIS AMVs and new QCs and error profiles.

Verification statistics for 14 tropical cyclones from 2018 and 2019 hurricane seasons in North Atlantic basin. Error bars are 95% confidence interval. The secondary x-axis shows the number of samples used in deriving these statistics. (left) Track error in nautical miles. (center) Intensity error in knots. (right) Minimum center pressure error in hPa.



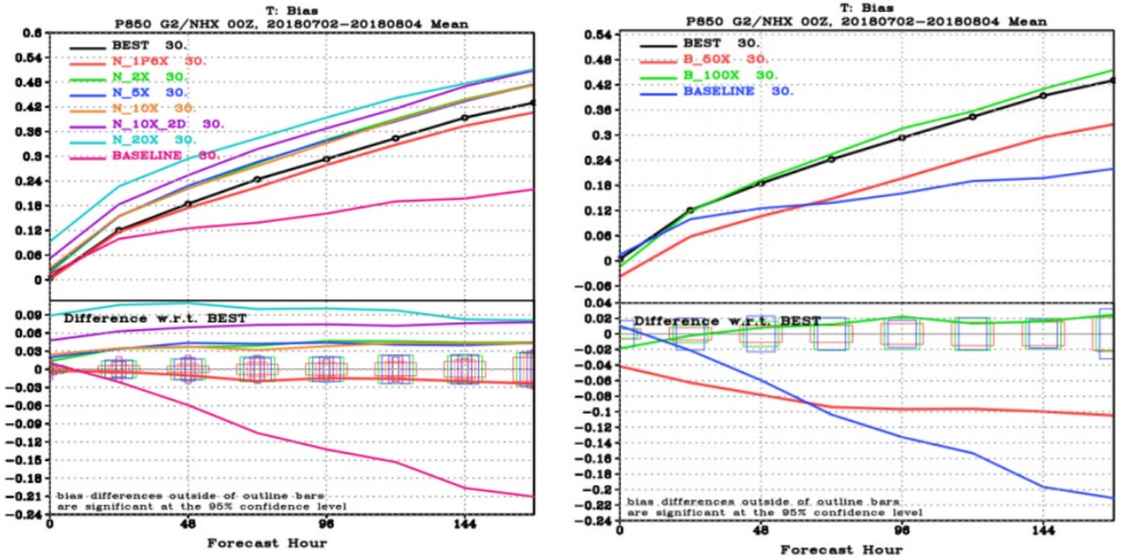
CTRL - operational version of 2020 HWRF with hourly GOES- 16 IR, CTWV and CAWV AMVs .
AMV1 – CTRL + all GOES-16 hourly and 15 min wind AMVs with new QCs and error profiles.

Verification statistics for 10 tropical cyclones from 2019 and 2020 hurricane seasons in North Atlantic basin. Error bars are 95% confidence interval. The secondary x-axis shows the number of samples used in deriving these statistics. (left) Track error in nautical miles. (center) Intensity error in knots. (right) Minimum center pressure error in hPa.

Investigation of Potential CrIS Detector Heterogeneity Impact on NCEP GFS/GDAS

Agnes Lim1, Sharon Nebuda1, James Jung1, Dave Tobin1 and Mitch Goldberg2
1. Cooperative Institute for Meteorological Satellite Studies 2. NOAA /JPSS Program Science Office Joint Polar Satellite System National Oceanic and Atmospheric Administration

- Understanding what level potential (CrIS) inter-detector differences begins to affect NWP analysis and forecasts
- GSI thinning selection criteria using surface channel 501 favors detectors with increased measured radiance and reduces selection for detectors with negative bias.
- Radiance Bias Correction (BC) incorrect due to lack of bias predictor in GSI that can characterized detector heterogeneity.
- Addition of bias to a detector can have complicated impacts on BC by reducing or switching sign of O-B detector bias.
- For this test configuration, significant impact is seen by 1.6x FOV NEdN and at 50x the bias of FOV 7.



Northern hemisphere forecast bias for GFS 850 hPa temperature. (Left) Detector Noise (Right) Detector bias. The outline bars represent the 95% confidence level.

National Satellite and Information Service

Training Activities at CIMSS

[30th Conference on Education Joint Session 9.6]

Scott Lindstrom, A. S. Bachmeier, W. Straka III, M. Gunshor, J. Nelson, C. C. Schmidt, L. Cronce, T. Schmit, M. Mooney, and K. Strabala

- https://cimss.ssec.wisc.edu/training/
  - https://cimss.ssec.wisc.edu/training/AMS2021/TrainingAtCIMSS.mp4
- https://cimss.ssec.wisc.edu/education/
- Blogs: https://cimss.ssec.wisc.edu/satellite-blog/ https://fusedfog.ssec.wisc.edu/
- https://cimss.ssec.wisc.edu/wf/
- ProbSevere
  - https://cimss.ssec.wisc.edu/severe_conv/probsev.html [includes training links]
  - https://cimss.ssec.wisc.edu/severe_conv/probtor.html
- VOLCAT: https://volcano.ssec.wisc.edu
- DB Seminars: https://cimss.ssec.wisc.edu/dbs/
- For K-14:
  - http://cimss.ssec.wisc.edu/education/goesr/intro.html
  - http://cimss.ssec.wisc.edu/education/goesr/vsf.html
  - https://cimss.ssec.wisc.edu/wxcamp
  - https://cimss.ssec.wisc.edu/wxfest

- McIDAS-V: https://www.ssec.wisc.edu/mcidas/software/v/
- Geo2Grid: http://cimss.ssec.wisc.edu/csppgeo/
- Polar2Grid: https://www.ssec.wisc.edu/software/polar2grid/

– https://cimss.ssec.wisc.edu/geocat/

- https://realearth.ssec.wisc.edu/
- http://floods.ssec.wisc.edu/ (CMORPH data)
- https://www.ssec.wisc.edu/flood-map-demo/flood-products/
- https://cimss.ssec.wisc.edu/goes/webapps/parallax/
- http://cimss.ssec.wisc.edu/goes/goesdata.html#training
- http://data.ssec.wisc.edu/jpssdata.html
- https://cimss.ssec.wisc.edu/satellite-blog/archives/category/training

The talk discussed all of these websites, this one-pager was just to summarize all the links included

scott.lindstrom@ssec.wisc.edu

Updates to the VISIT and SHyMet Programs in 2020

Scott Lindstrom and Scott Bachmeier (CIMSS) ; Dan Bikos, Jorel Torres and Ed Szoke (CIRA)

NWS Work from Home has augmented demand for training

New Modules created, old modules updated, to freshen VISIT offerings

Trough of Warm Air Aloft (TROWAL) (updated late 2019)
GOES-R IFR Probability (updated March 2020)
Mesoscale Convective Vortices (updated May 2020)
NUCAPS (updated April 2020)
AACP (new, February 2020)
Satellite detection of Blowing Snow (new, Nov. 2020)
NOAA/CIMSS ProbSevere (updated April 2020)

Created at CIMSS

JPSS/GOES Fire Monitoring Products
VIIRS NCC Imagery in AWIPS
Storm Signatures Observed in Satellite Imagery
Integrating GOES into Mesoanalysis
Severe Weather Applications of the Split Window Difference Product
Advected Layer Precipitable Water Product

Created at CIRA

- SHyMet Severe Lessons has been updated.

Integrating GOES Into Mesoanalysis
Storm Signatures observed in satellite imagery
Tracking the EML with a new GOES-R water vapor band
Above Anvil Cirrus Plumes
Severe weather applications of the GOES Split Window Difference product
MCV (updated)
NOAA/CIMSS ProbSevere

Can total lightning help with warnings for non-supercell tornadoes

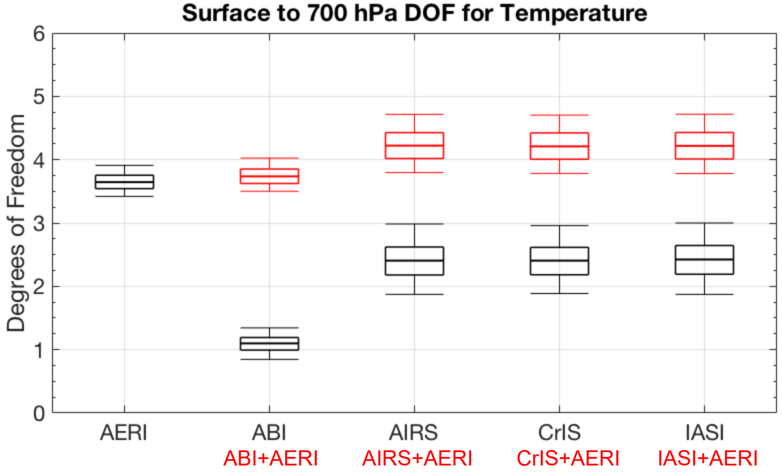
- Ongoing work to update other lessons

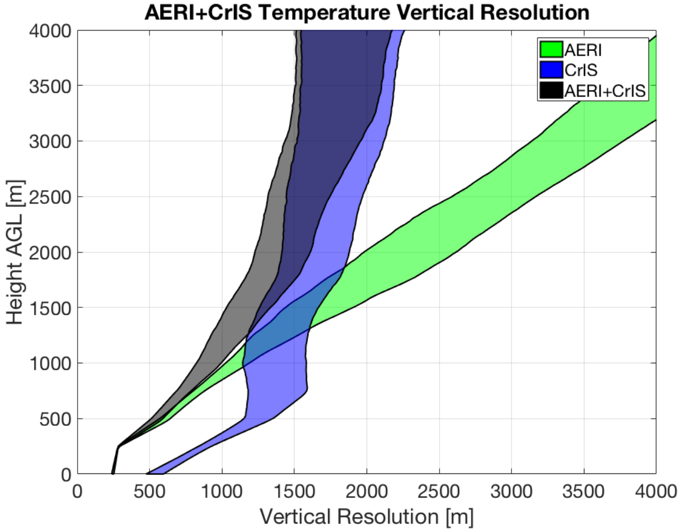
scott.lindstrom@ssec.wisc.edu

Integrating a Future Ground-based Profiling System with the Existing Satellite Observing System: The Benefits of a Synergy of Profilers

David M. Loveless, Timothy J. Wagner, Robert O. Knuteson (Univ. Wisconsin/CIMSS); David D. Turner (NOAA ESRL); and Steven A. Ackerman (Univ. Wisconsin/CIMSS)

- Created a synthetic information content study to assess the value of a synergy between the ground-based Atmospheric Emitted Radiance Interferometer (AERI) and a variety of space-based sensors
  - Radiosonde profiles from ARM-SGP site used for radiative transfer
- The synergy of AERI plus any space-based sounder nearly doubles the DOF that is offered by a space-based sounder alone
  - AERI alone has about 1.5 times the DOF provided by a space-based sounder in the near surface layer
- Vertical resolution of the synergy of AERI+CrIS is better than either instrument alone from 500 m to 4000 m AGL
  - AERI provides nearly double the vertical resolution of the space-based sounders in the bottom 1000 m AGL
- *Synergy of sensors provides better performance for thermodynamic sounding than either instrument alone*

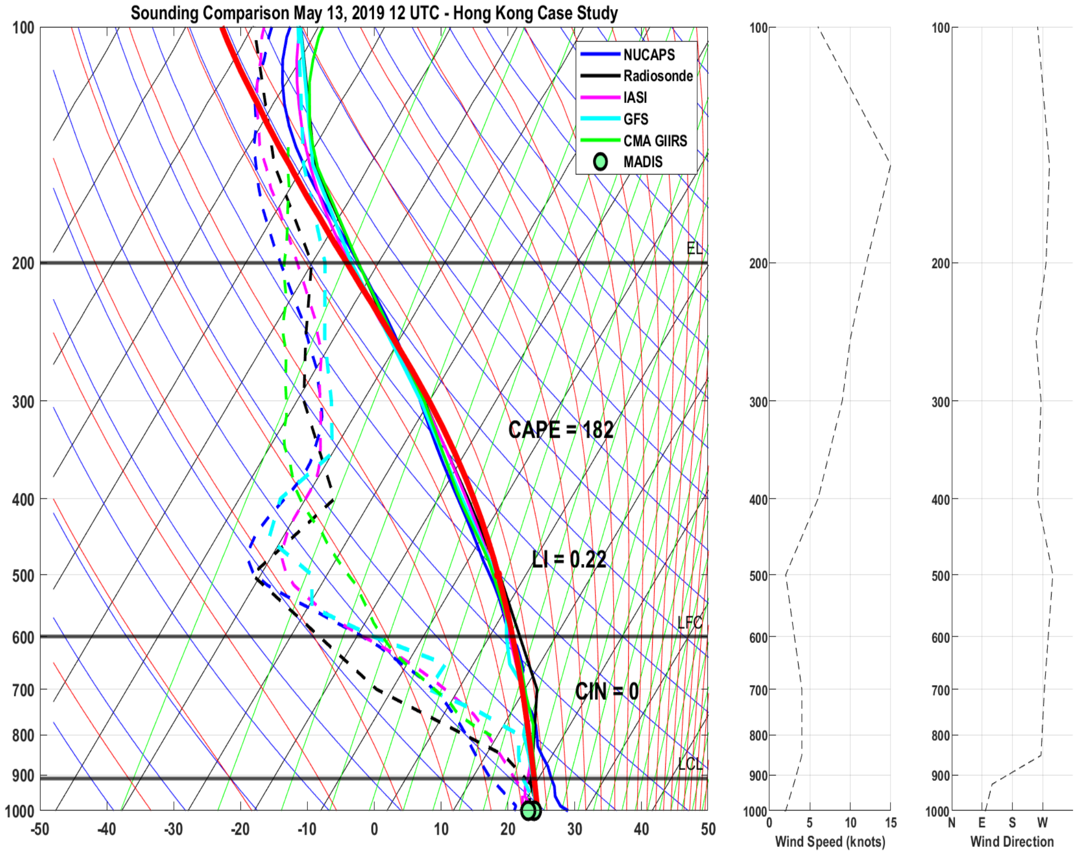




Data Fusion of GEO FY4A GIIRS and LEO Hyperspectral Infrared Sounders with Surface Observations: A Hong Kong Case Study

Jessica Maier, Robert Knuteson, William L. Smith Sr. and Elisabeth Weisz
Cooperative Institute for Meteorological Satellite Studies (CIMSS)

- Analyzed a multi day cases study covering May 10-16, 2019 near Hong Kong, China
  - FY4-A GIIRS, EUMETSAT IASI, GFS and NUCAPS vertical temperature and moisture profiles.
  - Produced mixed results in the fusion of satellite-based soundings and MADIS surface observations
- A more sophisticated approach, such as the consideration of local topography, for the fusion of satellite and surface observations is needed for characterization of coastal environments.
  - This study is in support of a larger project to develop validation methods for the evaluation of Geo and Leo sounders to assess the ability of satellite passive sounders to monitor the diurnal characteristics of the planetary boundary layer.



NOAA - Cooperative Remote Sensing Science and Technology Center

A Nationwide Virtual Science Fair to Encourage Student Use of Satellite Data

Margaret Mooney, NOAA's Cooperative Institute for Meteorological Satellite Studies (CIMSS)
Co-Author: Tim Schmit, NOAA ASPB

The 2021 Virtual Science Fair will be accepting projects until May 22nd

Students submit individual projects from home or in small teams with classmates.

The main requirement is using data from GOES-16 or GOES-17 to investigate weather and natural hazards!

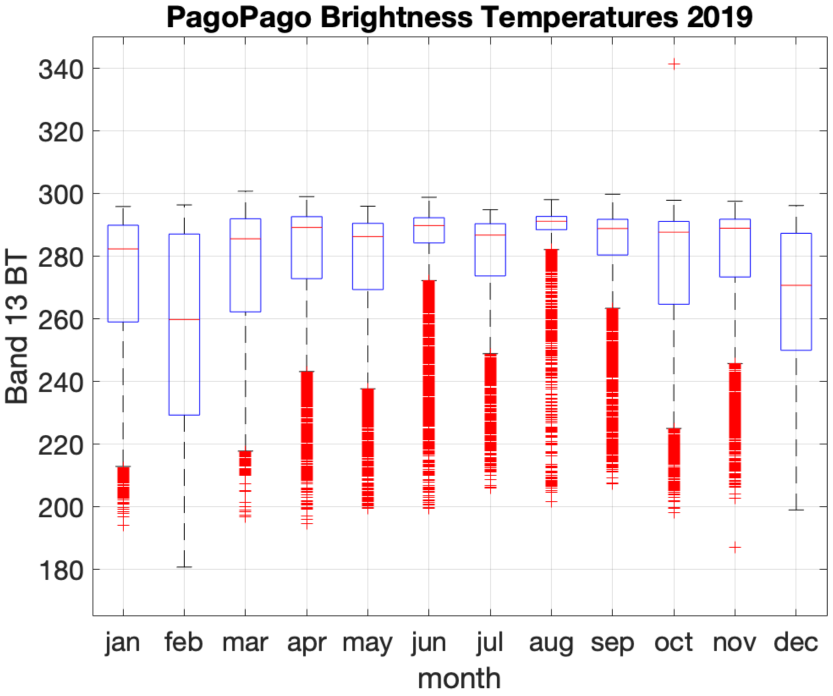
Students from the winning teams will receive $25 gift cards AND official GOES-T launch viewing invitations to KSC (but no travel support). Teachers coaching the winning teams will also garner launch invites (but no travel support).

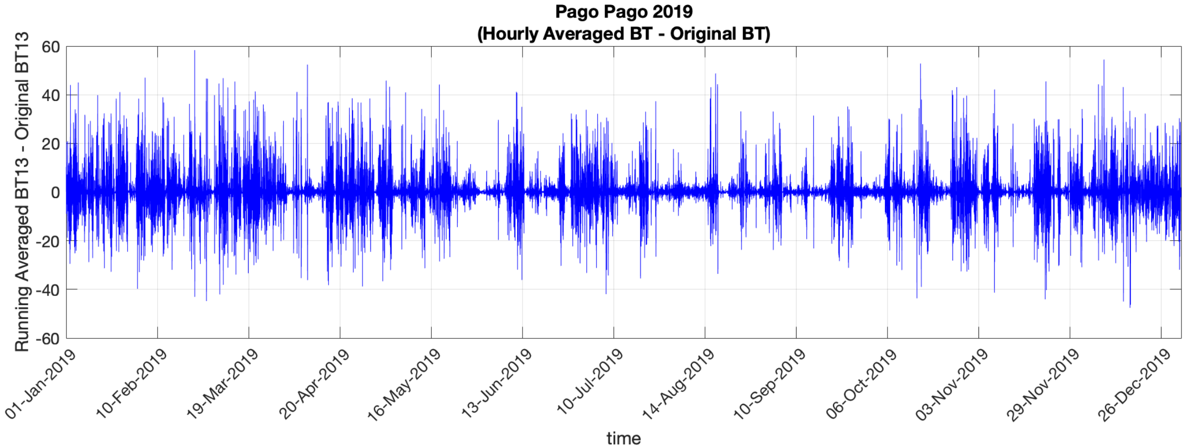
http://cimss.ssec.wisc.edu/education/goesr/vsf.html

GOES-16 and *GOES-17* Clean Window Monthly Station Means for 2019

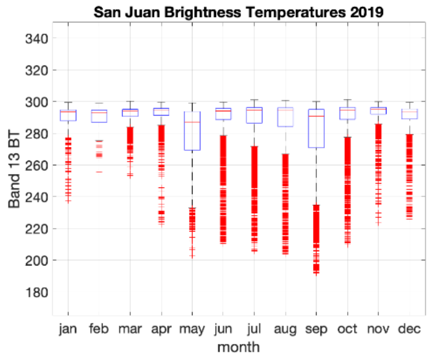
Alexa Ross and Scott Lindstrom

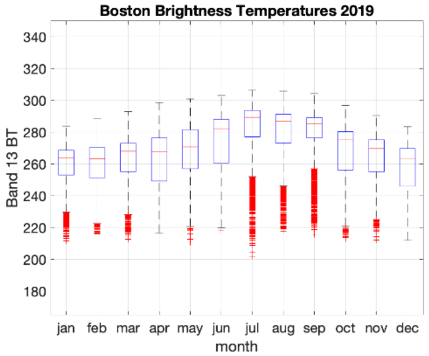
- Computed monthly statistics for GOES-16/GOES-17 Clean Window (10.3 µm) at various stations
- Reason: SW Pacific forecasters may be unfamiliar with GOES-R satellite climatology

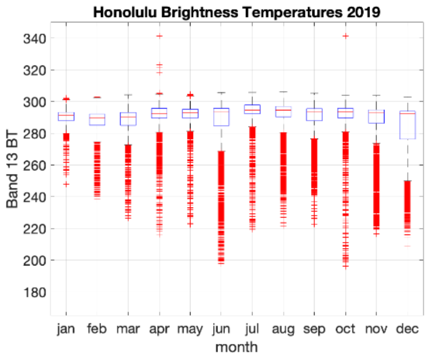




Ongoing work to reveal dominant time-scales







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Comparison and Validation of Aeolus Winds with AIRS 3D Winds in the Polar Regions

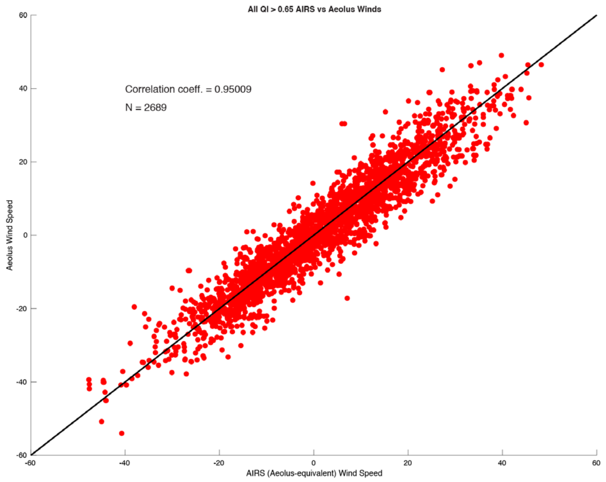
24th Conference on Satellite Meteorology, Oceanography, and Climatology
14.9

David Santek, CIMSS
Co-Authors: Brett Hoover, CIMSS; Hong Zhang, CIMSS

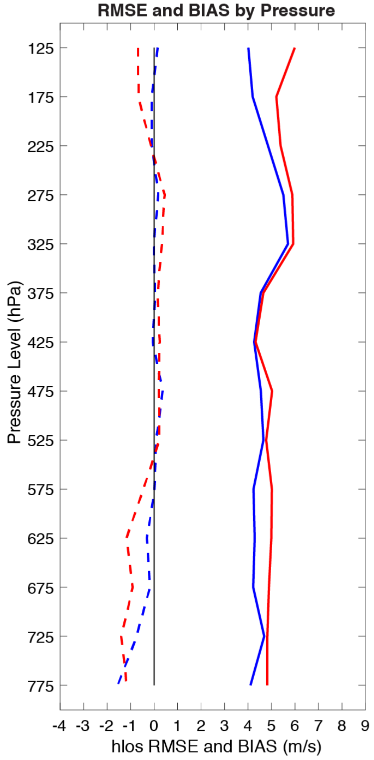
Friday, 15 January 2021, 12:50pm-12:55pm

- 3D winds: Vertical distribution of wind information in the troposphere and stratosphere. Compare two measurements:

Aqua AIRS retrieval winds	Aeolus Rayleigh clear-sky
Humidity & ozone feature tracking	Molecular motion using Doppler Lidar
Total wind	Horizontal Line of Sight (HLOS) wind component
Better spatial coverage	Better vertical resolution
Average motion spanning 200 minutes	Near instantaneous



Aeolus vs AIRS retrieval winds



AIRS, Aeolus speed bias (dash); RMSD (solid) to ERA-5

- Compare well to each other (middle) and with ERA5 reanalysis (right)
- These two sources of 3D winds may be complementary, with similar quality

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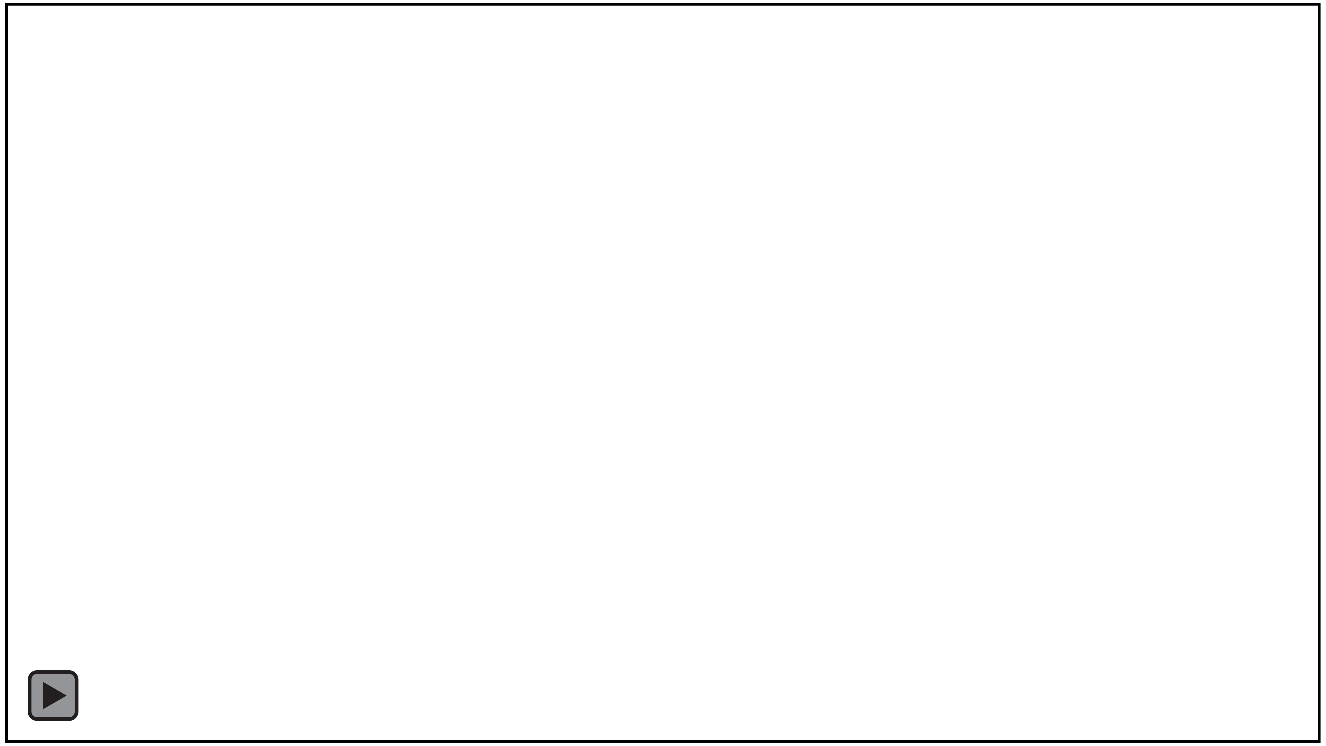
GOES-R ABI Fire Detection: Performance of Updated Operational Algorithm

Christopher C. Schmidt (CIMSS), Ivan Csiszar (STAR), Wei Guo (IMSG)

- Provided update on ABI Fire Detection
  - Discussed improvements in latest updates, including GOES-17 loop heat pipe anomaly mitigation
  - Demonstrated performance strengths and weaknesses with case studies from recent major events
  - Reported on short, mid-term, and long-term plans for ABI fire detection, including development of the Enterprise Fires algorithm



The Kincade Fire. ABI imagery and fire product synced with Barham ALERTWildfire camera on October 23, 2019. Camera first saw fire between 9:19:51 and 9:19:54 pm PDT. GOES-17 picked up the first signs at 9:21 pm PDT, and by 9:25 pm PDT the FDCA had detected the fire. Panels (left to right): 3.9 µm, 11.2 µm, 3.9 µm-11.2 µm radiance difference in 3.9 µm radiance space, FDCA Mask (algorithm output), and fire radiative power (algorithm output of FRP)

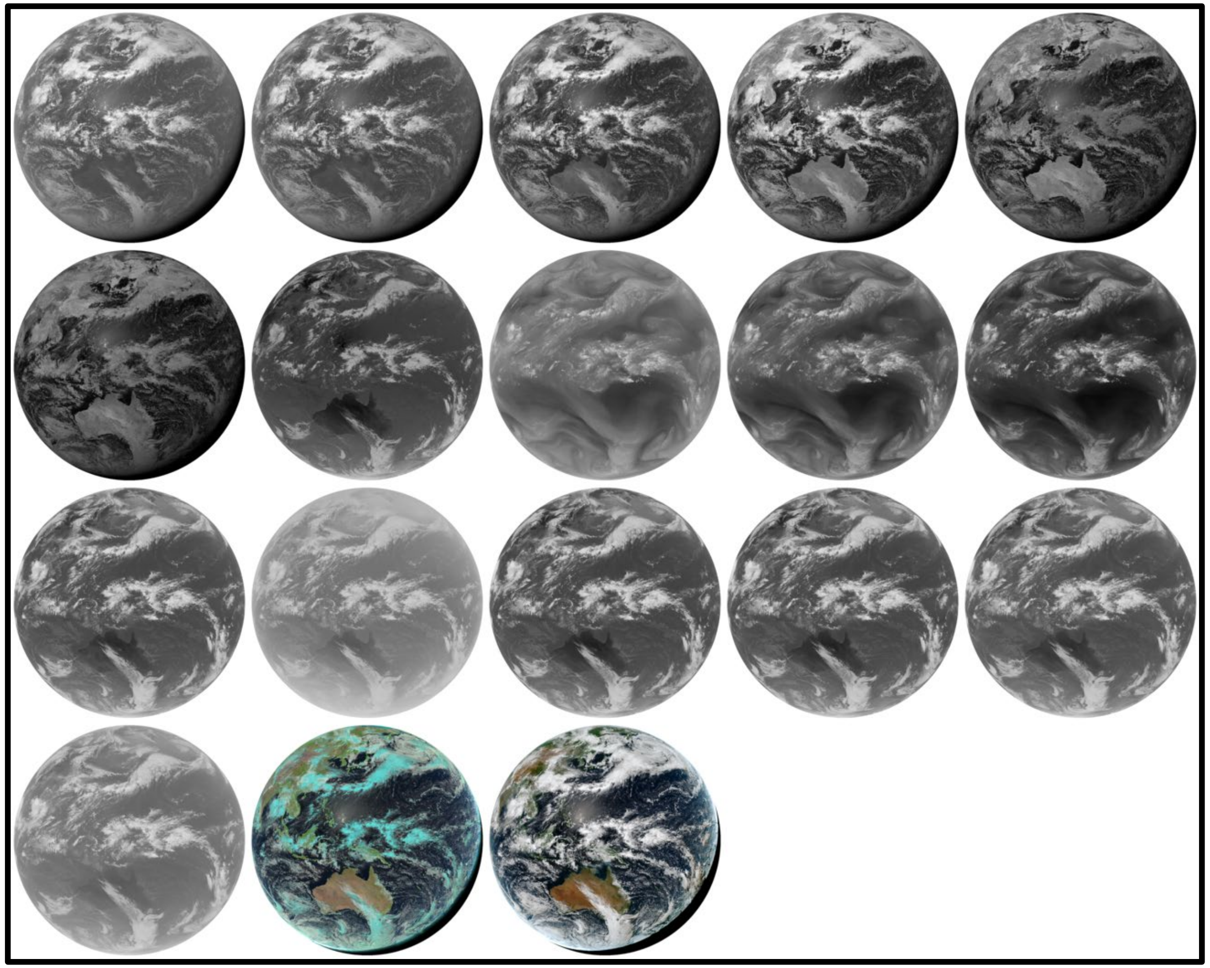
Polar2Grid and Geo2Grid: Image Creation Software Supporting Environmental Applications

Kathleen Strabala and David Hoese, CIMSS, University of Wisconsin-Madison

- Polar2Grid and Geo2Grid
  - Open source software that makes it easy to create high quality Geostationary and Polar Orbiter Satellite Images.
  - Simple bash shell script execution wrapping underlying python.
  - Global User Base including creating real-time imagery for AWIPS.
  - Freely distributed as part of the NOAA Community Satellite Processing Package (CSPP) for Low Earth Orbit (LEO) and Geostationary (Geo) satellite projects:

http://cimss.ssec.wisc.edu/cspp

http://cimss.ssec.wisc.edu/csppgeo/



Examining the Economic and Environmental Impacts of CoVID-19 Using Earth Observation Data

William Straka III (CIMSS),Bandana Kar (ORNL), Shobha Kondragunta (STAR), Zigang Wei (IMSG), Hai Zhang4, Steven D. Miller (IMSG), Alexander Watts (BlueDot Inc.)

National Satellite and Information Service

NOAA - Cooperative Remote Sensing Science and Technology Center

Purpose: Understand the change in NO_2 concentration as well as economic activities due to reduction in mobility – a result of lockdowns implemented due to CoVID-19.

Objectives:

•Demonstrate the impact of lockdown using satellite imagery over three sites (LA, Chicago, Washington DC) by

- *Exploring the variation in economic activities (measured by the radiance from the VIIRS Day/Night Band – a proxy for energy consumption) in economic activity centers*
- *Examining the variation in NO_2 concentration using TROPOMI and aerosol concentrations from surface observations and SNPP VIIRS*
- *Changes in surface PM2.5 observations and VIIRS AOD.*

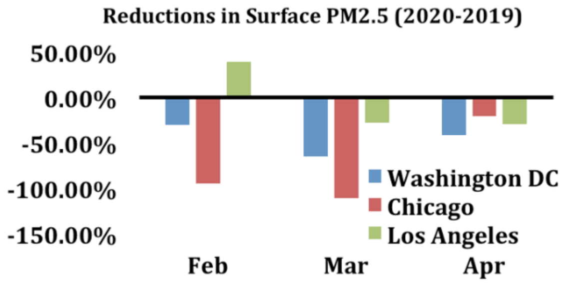
Results:

•Following the lockdown in February, NO_2 concentration dropped significantly in LA (35%), Chicago (14%) and DC (60%). Surface $PM_{2.5}$ significant reductions in all three regions as for the corresponding month in 2019, with the exception of LA. Note that the lockdowns did not start until March and the differences could be due to the unique seasonal differences between the two years.

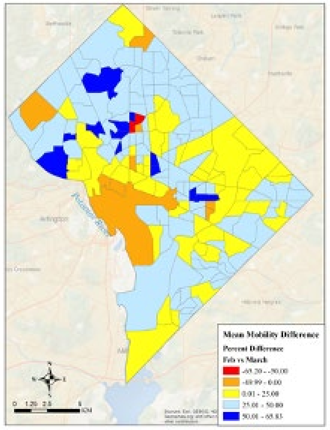
•The nearly 53% reduction in economic activities (as seen from DNB data) in LA in April appears to be a result of complete shut-down of all businesses. Chicago and Washington DC only implemented partial lockdowns resulting in less reduction in nighttime lights in March, but had an increase from March to April as restrictions were lifted.

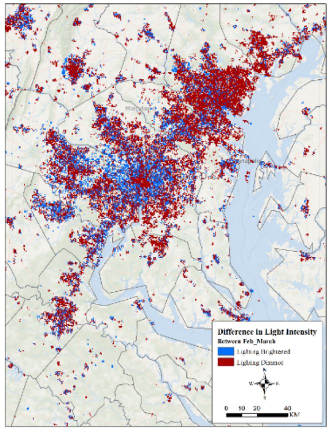
•Mobility reduction was more pronounced in low-income and poor neighborhoods of LA and Chicago rather than in the affluent areas, which probably are occupied by service sector employees.

Research is currently underway to further explore the correlation between the Day Night Band, economic indicators and mobility patterns



	NO2 (µmoles/m^2)			Mobility (km)		
City	February	March	April	February	March	April
Washington, DC	89.6	62.7	36.1	13.3	10.1	5.4
Chicago	123.9	102.7	82.1	12.4	9.2	5.4
Los Angeles	108.8	65.6	51.3	24.1	17.6	11.5





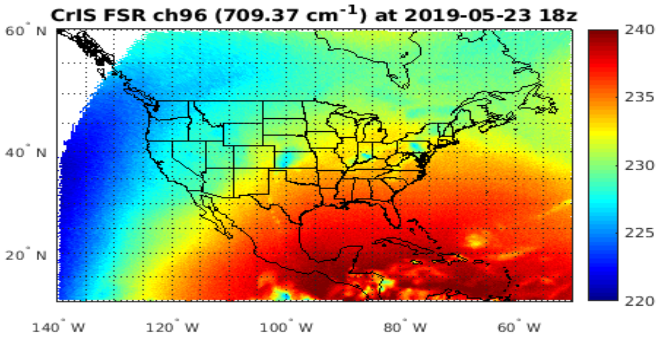
National Satellite and Information Service

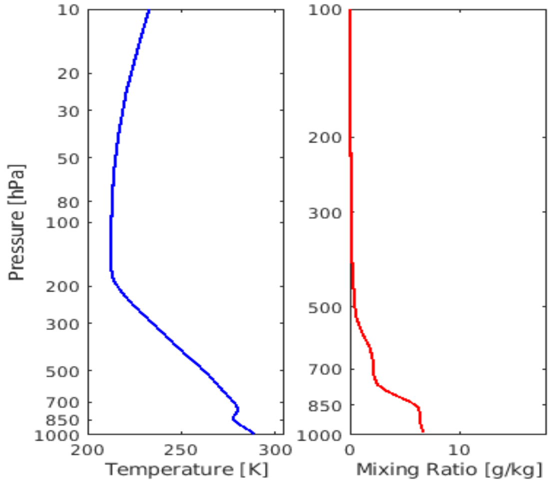
NOAA - Cooperative Remote Sensing Science and Technology Center

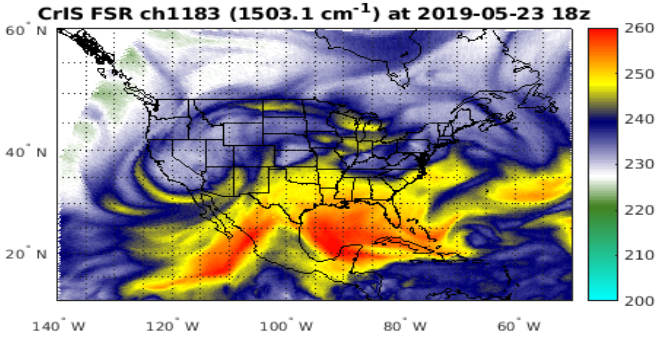
Evaluating the added value of GEO-Hyperspectral Infrared Radiances for Local Severe Storm with a Hybrid OSSE

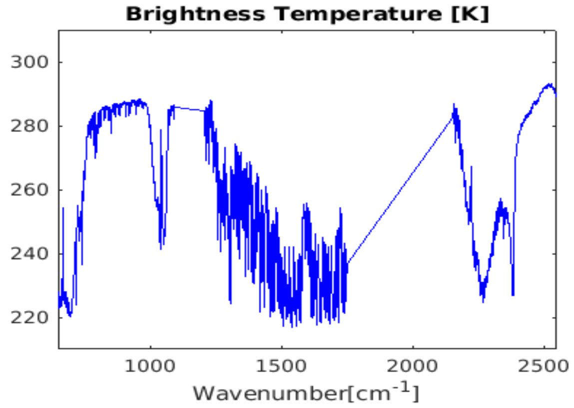
Pei Wang, Zhenglong Li, and Jun Li (CIMSS); Timothy J. Schmit (NOAA)

- Simulation the GEO-hyperspectral Infrared (IR) sounder
  - Nature Run (NR) -- ERA-5 reanalysis
  - Hybrid OSSE – All observations are real except those from a future observation system
  - GEO CrIS-FSR – Simulate CrIS FSR onboard GOES-16 orbit
- Assimilation the GEO CrIS-FSR for LSS forecast
  - Two local severe storm (LSS) cases were selected for the impact study
  - The forecast error is reduced by approximately 5% from the added value of assimilating GEO CrIS-FSR data





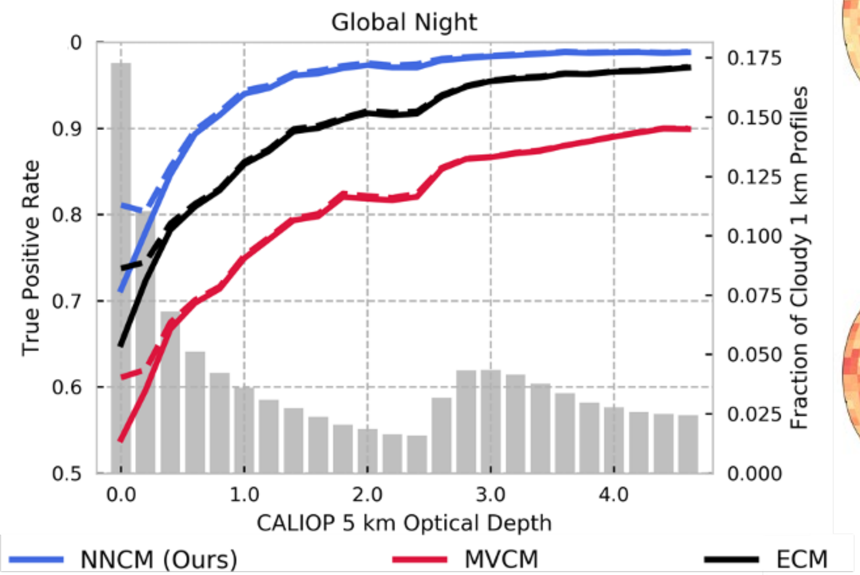


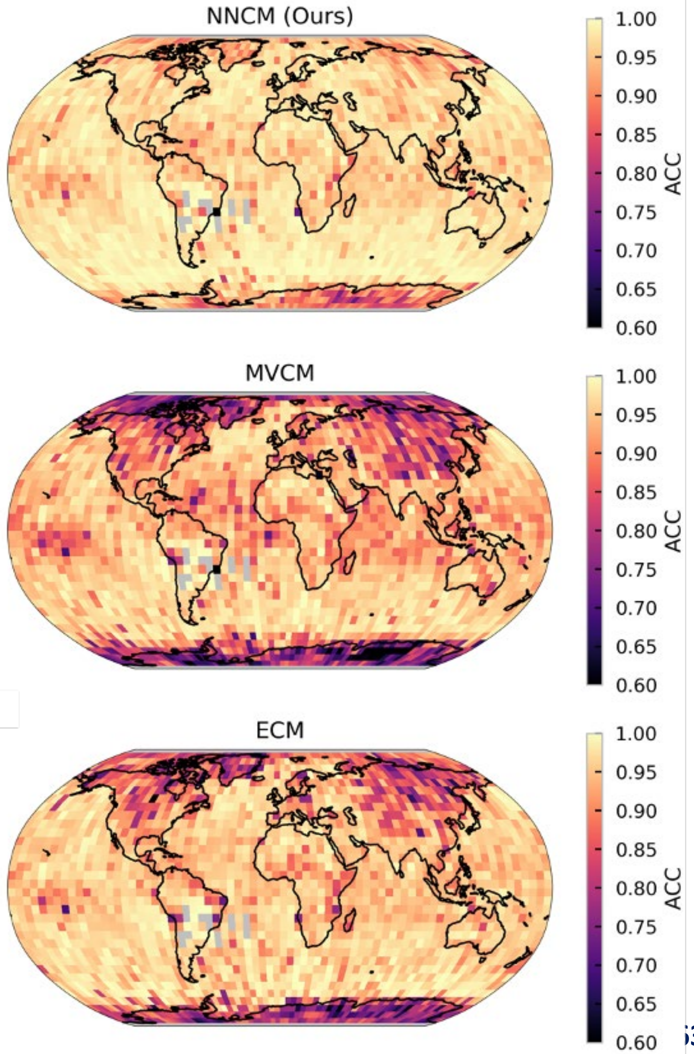


Intercomparison of VIIRS Neural Network Cloud Detection and Current Operational Methods

Charles White; UW-Madison / CIMSS
Andrew Heidinger; NOAA/NESDIS

- Developed neural network approach for VIIRS cloud masking trained with CALIOP
- Neural Network significantly outperforms NOAA Enterprise Cloud Mask (ECM), and Continuity MODIS-VIIRS Cloud Mask (MVCM) for most conditions especially in high-latitudes
- Important downsides: loss of interpretability and relatively poor characterization of boundary layer clouds





CIRA

- Jason Apke
- John Forsythe
- Ryan Lagerquist (3)
- Peter J. Marinescu
- Steven Miller
- Yoo-Jeong Noh
- Curtis Seaman
- Jorel Torres (2)
- Lander Ver Hoef
- Milija Zupanski

Validation of Dense Optical Flow Products Derived from Geostationary Satellite Imagery

Jason Apke, Matt Rogers, and Steven Miller (CIRA); Kristopher Bedka (NASA-LRC)

- Demonstrated a validation methodology for dense (every image pixel) optical flow on satellite imagery
  - Included comparison of optical flow-derived GOES-R Atmospheric Motion Vectors to wind-profiling Lidar on board the NASA-DC-8
  - Also included comparison of 1-min optical flow-derived image temporal interpolation to actual 30-second imagery of Hurricane Michael
- Presented a dense optical flow algorithm that uses GOES-R data and products
  - Algorithm showed proficiency in tracking targets ordinarily missed by atmospheric motion vectors
  - Algorithm improved temporal interpolation skill over open-source optical flow products

Figure 1. GOES-17 1-min Visible Imagery (0.64-µm) of stratocumulus off the California coast on 23 Apr 2019. Shown with Optical Flow wind estimates subsampled for clarity (Magenta Wind Barbs).

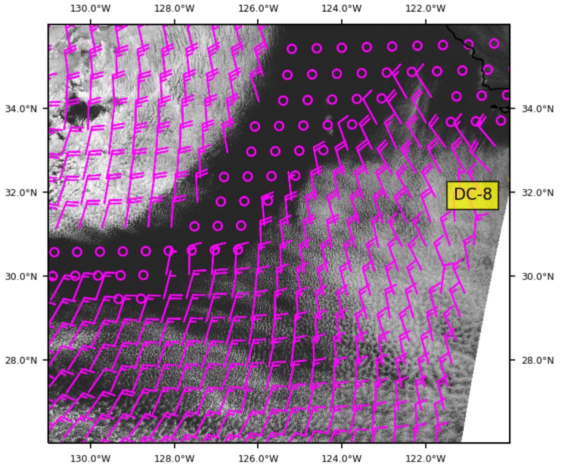


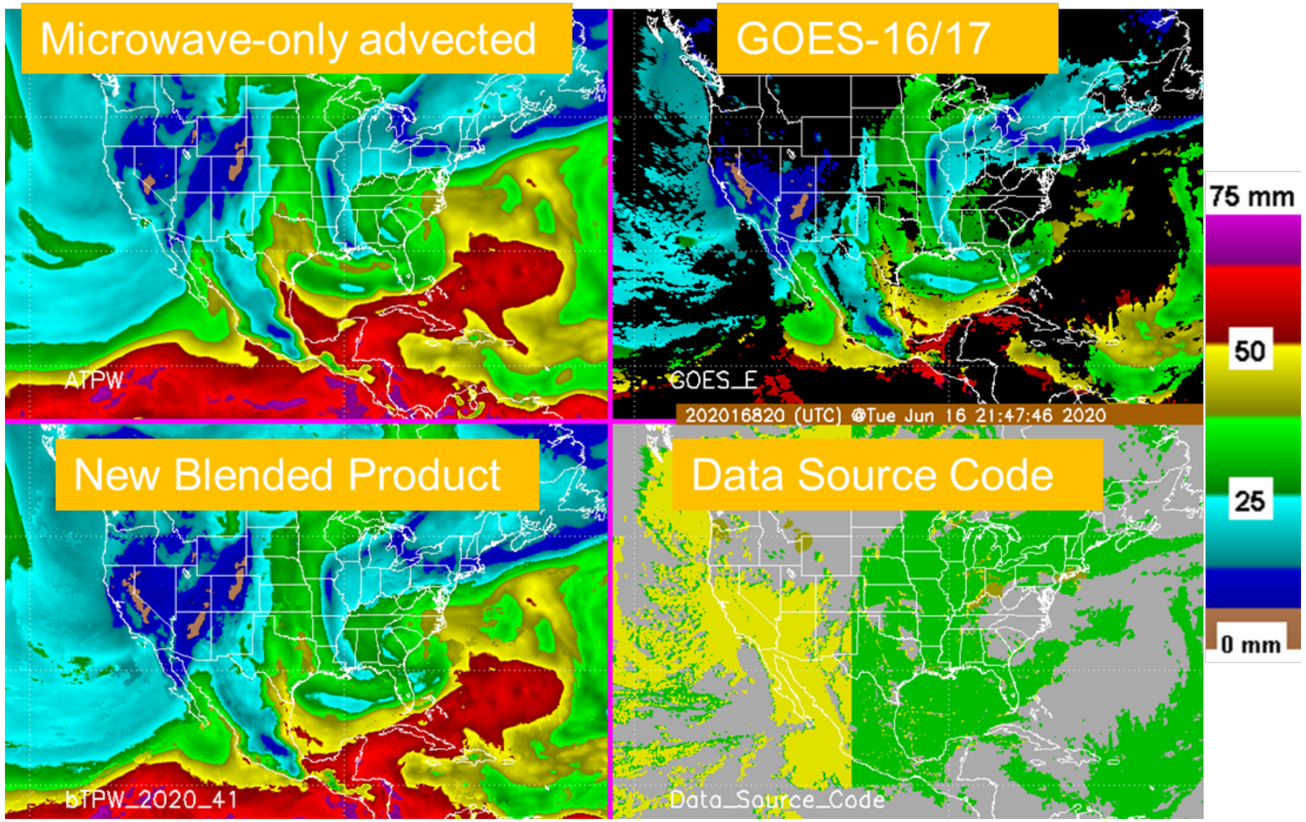
Table 1. Comparison statistics of CIRA/Sun optical flow algorithm to the DAWN lidar wind.

Case Study	Time (UTC)	Bias (CH 1 | 2 | 7 ; m s⁻¹)	MVD (CH1 | 2 | 7; m s⁻¹)	Samples (CH 1,2 | 7)
April 17-18	2330-0100	-0.16 | -0.86 | -0.13	2.5 | 2.56 | 3.09	31
April 22-23	0040-0220 | 0040-0400	-1.24 | -0.48 | -0.81	1.92 | 1.68 | 2.31	208 | 443
April 25-26	1940-2230	0.11 | -0.27 | 0.32	1.67 | 1.55 | 2.21	365
April 27-28	1700-0100	-0.21 | -0.31 | -0.09	3.64 | 3.32 | 3.27	582
April 29-30	2000-0300	0.09 | -0.25 | 0.751	2.352 | 2.18 | 2.65	679
Total	-	-0.153 | -0.306 | 0.100	2.57 | 2.36 | 2.68	1865 | 2100

New Developments in Multisensor Blended Water Vapor

John Forsythe, Stan Kidder, Andy Jones, Sheldon Kusselson, Dan Bikos (CIRA)

- Blended Total Precipitable Water
  - New blending approach with GOES-16/17, advected polar and surface GPS outperforms operational product.
  - Effort to add enhancements to operational product could begin in Summer 2021.
- Advected Layer Precipitable Water (ALPW)
  - Continues to by widely used by WPC, NHC and 25 WFO's via CIRA distribution.
  - Project to transition to operations could begin in Spring 2021.



Using GOES-16/17, advected microwave data and GPS to improve performance of the blended Total Precipitable Water (TPW) product

Deep learning for short-term forecasting of convective initiation and decay over Taiwan

20th Conference on Artificial Intelligence

Dr. Ryan Lagerquist (CIRA, NOAA ESRL/GSL), Jebb Stewart, Christina Kumler, Imme Ebert-Uphoff

- **We have trained a U-net to detect convection from satellite data over Taiwan.**
- Predictors: time series of brightness-temperature maps in seven spectral bands from Himawari-8.
- Target: convection mask (0 or 1 at each grid point), based on applying SL3D to radar data.

- **The good:**
  - U-net achieves impressive CSI given low event frequency
  - U-net-based climatology does not contain radar artifacts present in training data
- **The bad:**
  - Probability calibration is not perfect (can hopefully be fixed with isotonic regression)
  - U-net performs much worse in winter than in summer
- **Future work:**
  - Train U-nets without northern radar
  - Train U-nets for prediction (non-zero lead time)
  - Iterate until skill is acceptable (hope to beat persistence at all but very short lead times)
  - Use interpretation methods to understand what U-nets have learned
  - Transfer code to Taiwan Central Weather Bureau
  - Publish paper

Using significance tests and physical constraints to interpret a neural network for tornado prediction

20th Conference on Artificial Intelligence
Dr. Ryan Lagerquist, CIRA, NOAA ESRL/GSL
Amy McGovern, David John Gagne II, Cameron Homeyer

- We used four interpretation methods to understand physical relationships learned by CNN that predicts next-hour tornadoes.
- Interpretation methods often produce noise, so we developed a formal significance test or physical constraints for each method.
- **Main findings of "augmented" interpretation methods are generally consistent with observational and modeling studies. Examples:**
  - Most important part of sounding is low-level wind and thermal profile.
  - Most important of storm (especially for supercells) is right-rear flank, where a tornado would be expected
  - Tornadoes are more likely for discrete storms
- **To our knowledge, this is one of few studies to use formal significance tests for ML interpretation.**
- **Robust interpretation is crucial in building ML systems that are properly understood and trusted.**
- For more details, see:
  - Lagerquist (2020)
  - Lagerquist *et al.* (2020)
  - Lectures 4-5 of CIRA machine-learning short course have code for basic (not augmented) interpretation methods: https://docs.google.com/document/d/1SPNxZrbHMaIEaS2dbntDow9x_tgSuFTUTOugfa2NuRo/edit
  - Upcoming BAMS paper (hopefully early 2021) – will include code for augmented methods

Deep learning for parameterization of shortwave radiative transfer

20th Conference on Artificial Intelligence

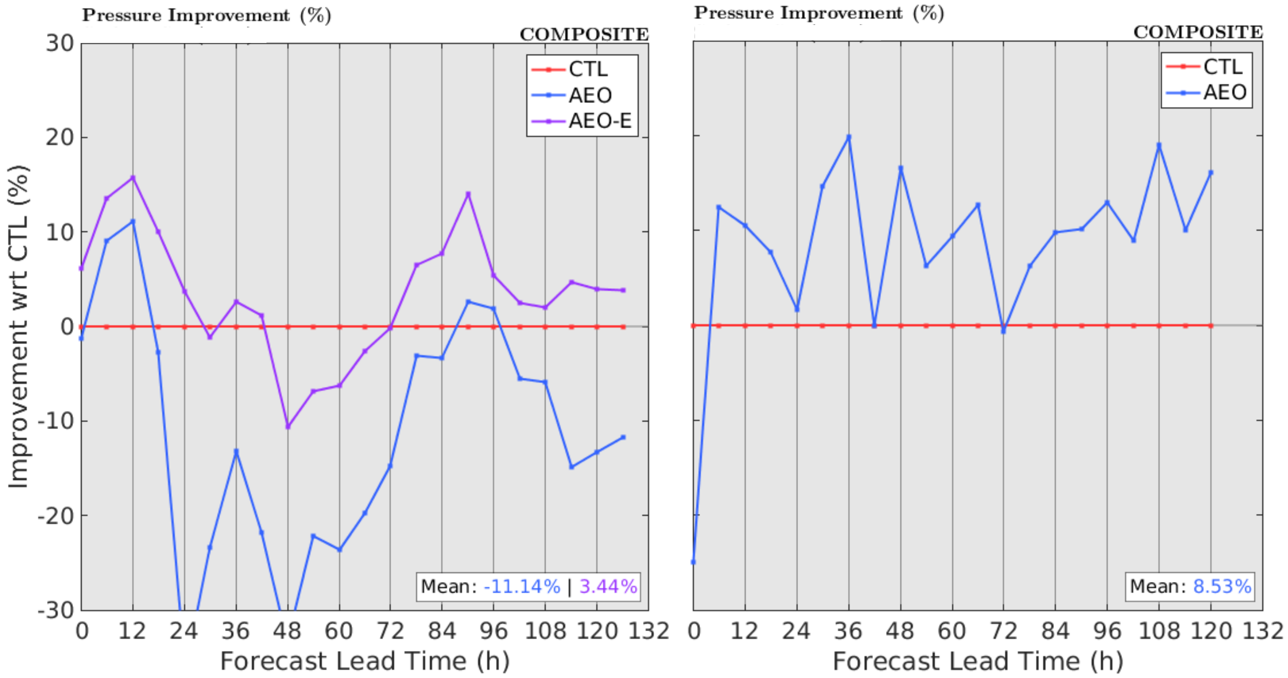
Dr. Ryan Lagerquist (CIRA, NOAA ESRL/GSL), David Turner, Imme Ebert-Uphoff, Venita Hagerty, Christina Kumler, Jebb Stewart

- We have developed a U-net++, a type of deep-learning model, to emulate the shortwave RRTM.
- We trained and validated on non-tropical sites, then tested on tropical sites (extreme spatial generalization).
- **The U-net is ~10^4 times faster than the RRTM and performs well on tropical sites, except:**
  - Poor reliability for low F_{up}^{TOA} predictions in examples with single-layer liquid cloud
  - Negative bias for flux components and tropospheric heating rates at zenith angle < 20°
- **Future work:**
  - Submit manuscript
  - Emulate full shortwave RRTM, with aerosols, precip, and non-climatological ozone
  - Emulate longwave RRTM
  - Make U-net agnostic to grid setup (specific heights)
  - Integrate U-net into FV3GFS

Impacts of Assimilating ADM-Aeolus Wind Profiles on Tropical Cyclone Structure and Forecasts: HWRF Model Experiments

Peter J. Marinescu (CIRA/CSU) and Lidia Cucurull (NOAA/AOML); Karina Apodaca (CIMAS/Uni. of Miami); Lisa Bucci (NOAA/AOML), and Iliana Genkova (IMSG/EMC)

- Assimilated ADM-Aeolus wind observations into the NOAA tropical cyclone forecast model (HWRF)
  - First space-borne doppler wind lidar
  - Forecasts of 4 2019 Tropical Cyclones both with (AEO) and without (CTL) Aeolus observations
  - ~100 total forecast comparisons
- Atlantic Basin results sensitive to global-model-based observation error values utilized in HWRF (AEO versus AEO-E)
  - Additional testing being conducted to determine HWRF-specific observation errors for data assimilation
  - Consistent near-term improvement, with mixed results at longer time-scales
- Eastern Pacific results (Hurricane Lorena) show intensity improvement at almost all forecast lead times



Left: Composite results for 3 2019 Atlantic-Basin storms (Hurricanes Dorian, Humberto, and Jerry). % improvement in intensity (MSLP) when assimilating Aeolus (AEO, AEO-E) with respect to forecasts without assimilating Aeolus (CTL). AEO and AEO-E represent two different observation error inflation methods, which are based on global-model statistics. Right: Composite results for 1 Eastern-Pacific storm (Hurricane Lorena). Same figure explanation as in left figure.

Exploring the Potential of SmallSats in the Future NOAA Architecture

—*Big Things in Small Packages*

2021 AMS Annual Meeting: 11th Conference on Transition of Research to Operations

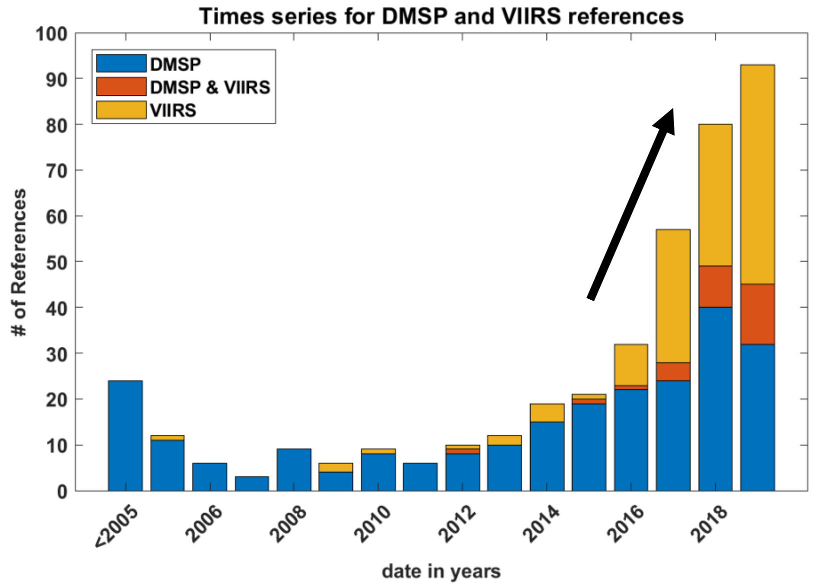
Steven D. Miller*[,1], D. Pack[2], C. Combs[1], Y.-J. Noh[1], S. Kidder[1], C. Seaman[1], A. Heidinger[3], J. Forsythe[1], L. Gelinas[2], and G. Chirokova[1]

11 January 2021, 10:50-10:55 AM (Eastern)

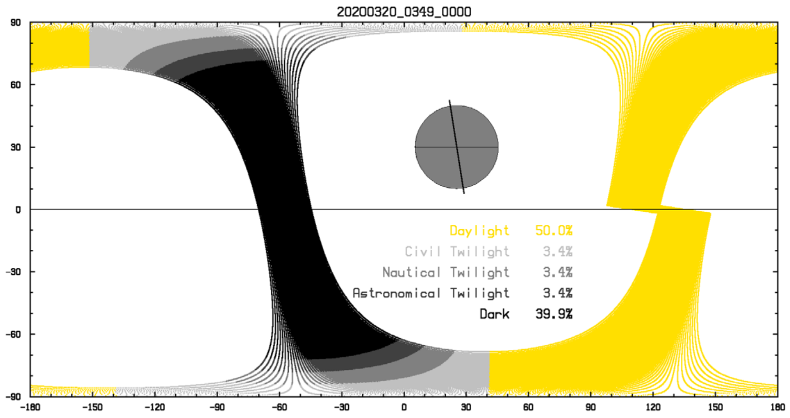
[1] Cooperative Institute for Research in the Atmosphere, Colorado State University

[2] The Aerospace Corporation

[3] National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service

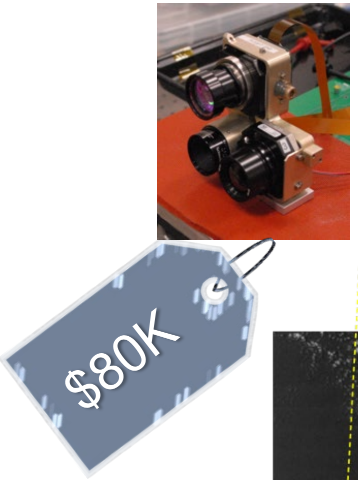


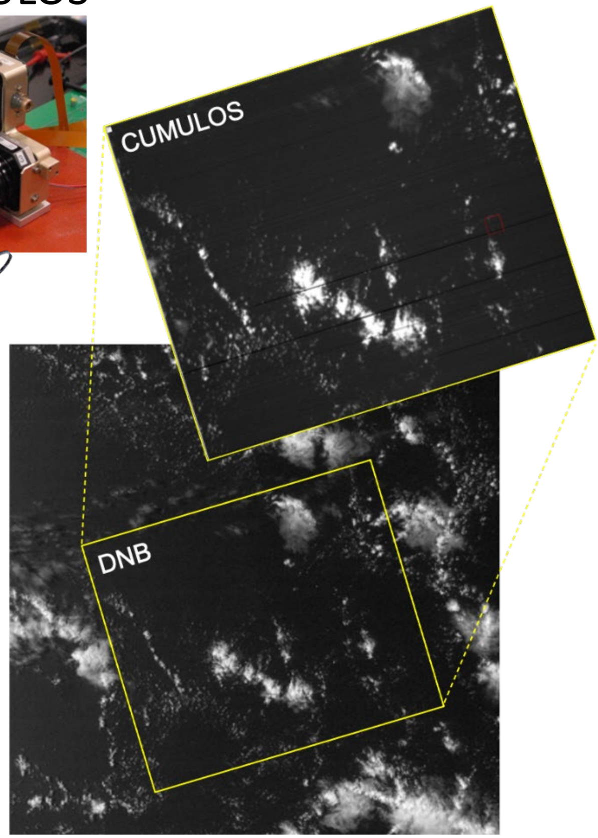
Use of low-light visible satellite data, such as the Day/Night Band (DNB) is on the rise!



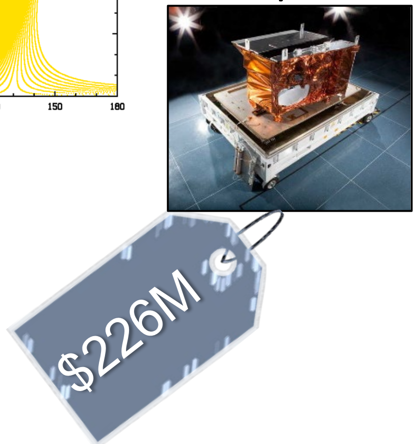
Orbital selection makes a big difference in determining nighttime availability!

CUMULOS





VIIRS/DNB



We show the promising, cost-effective potential of SmallSats as part NOAA's future satellite observing system architecture.

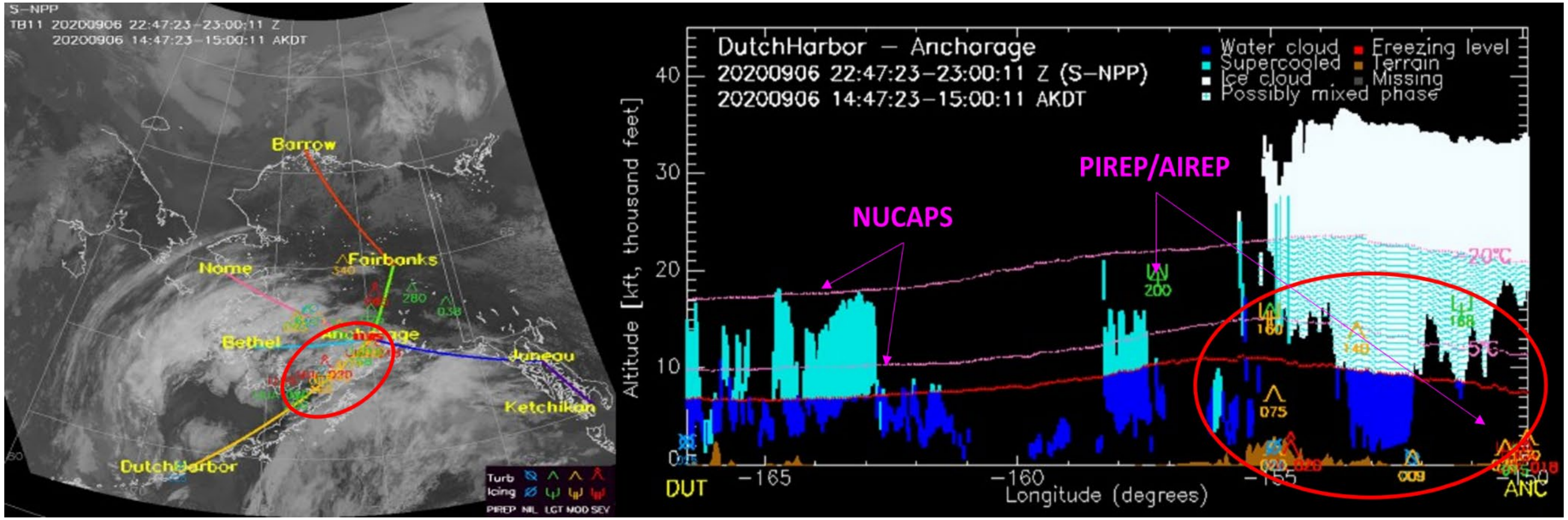
National Satellite and Information Service

NOAA - Cooperative Remote Sensing Science and Technology Center

Development of Satellite Cloud Vertical Structure Products for Aviation Weather Monitoring

Y. J. Noh (CIRA/Colorado State University), J. Haynes (CIRA), S. Miller (CIRA), A. Heidinger (NOAA/NESDIS/STAR), J. Weinrich (STC)

- The full 3D cloud structure information is critical to many aviation weather applications
- Developed a statistical CBH/CCL algorithm to construct the satellite 3D cloud field
- Introduced Cloud Vertical Cross-section products along flight paths for aviation users
- Improvements based on user feedback through the NOAA JPSS Aviation Initiative



Experimental satellite cloud products for aviation users (Alaska, CONUS)

- http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs_arctic_aviation.asp
- http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs_conus_aviation.asp

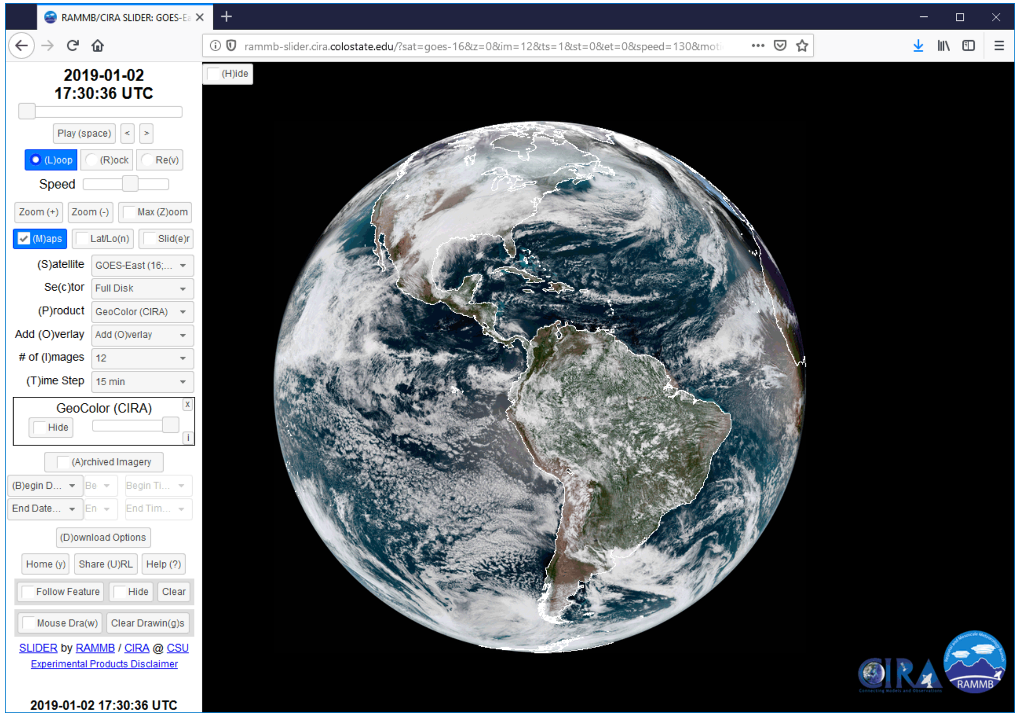
SLIDER: A Website for Displaying Realtime, Global Satellite Data at Full Resolution

30th Conference on Education – OpenSource Tools for Accessing, Displaying, and Analyzing Environmental Satellite Data

Curtis Seaman, CIRA/Colorado State University

K Micke, D Lindsey, S Miller, YJ Noh, N Tourville, S Finley, D Hillger, J Dostalek, G Chirokova, and M Niznik

- Geostationary and polar-orbiting satellite data in realtime at full resolution
- GOES, JPSS, Himawari, Meteosat



Type "CIRA SLIDER" into your favorite search engine and it should be the first link

Alternately, scan the QR code with your phone

https://rammb-slider.cira.colostate.edu

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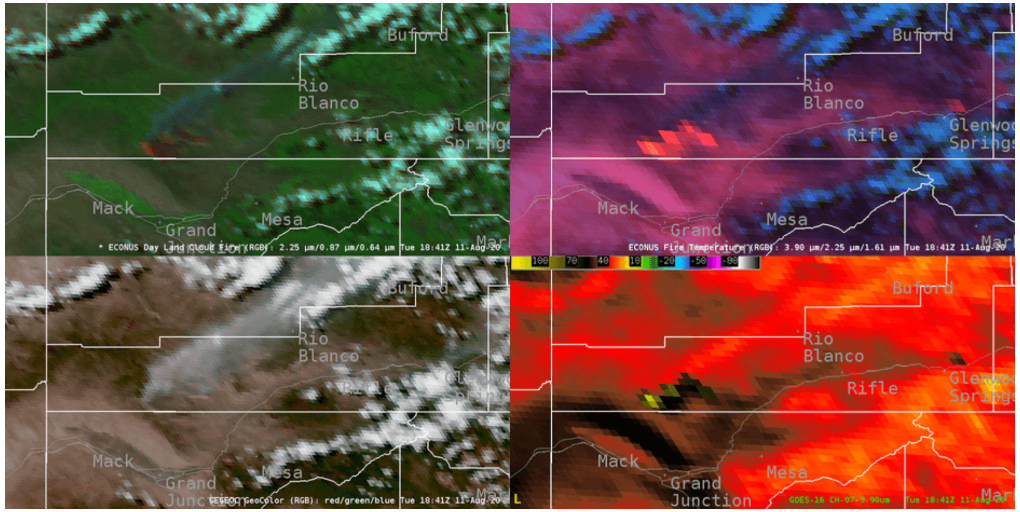
JPSS and GOES Fire Monitoring Capabilities and Observations of the Pine Gulch Fire in Western Colorado

Jorel Torres (Cooperative Institute for Research in the Atmosphere, CIRA)

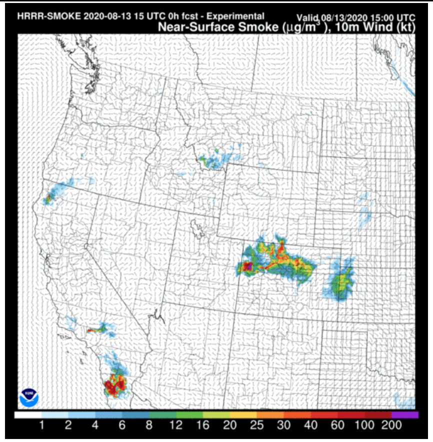
- ✓ Pine Gulch Fire Overview. Recap of existing JPSS/GOES Capabilities.
- ✓ **How can users employ satellite imagery with respect to fire monitoring?**
- ✓ Products highlighted: NCC, VIIRS Active Fire, GeoColor, 3.9um, Fire Temperature RGB, Day Land Cloud Fire RGB, NUCAPS, HRRR-Smoke, GOES Fire/Hot Spot Products, VIIRS Fire RGBs.
- ✓ Satellite Training Materials and web-links available for Users.

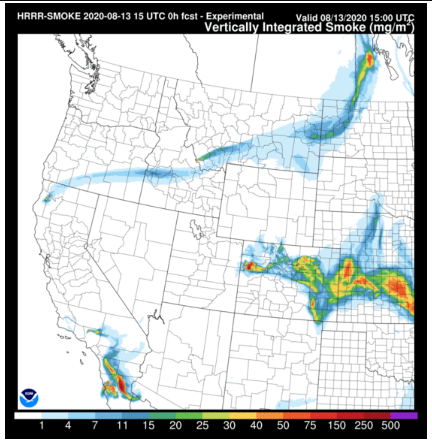
Contact Information:
Jorel.Torres@noaa.gov, Jorel.Torres@colostate.edu

GOES Product / Channels / RGBs



HRRR-Smoke: Near-Surface Smoke & Vertically Integrated Smoke

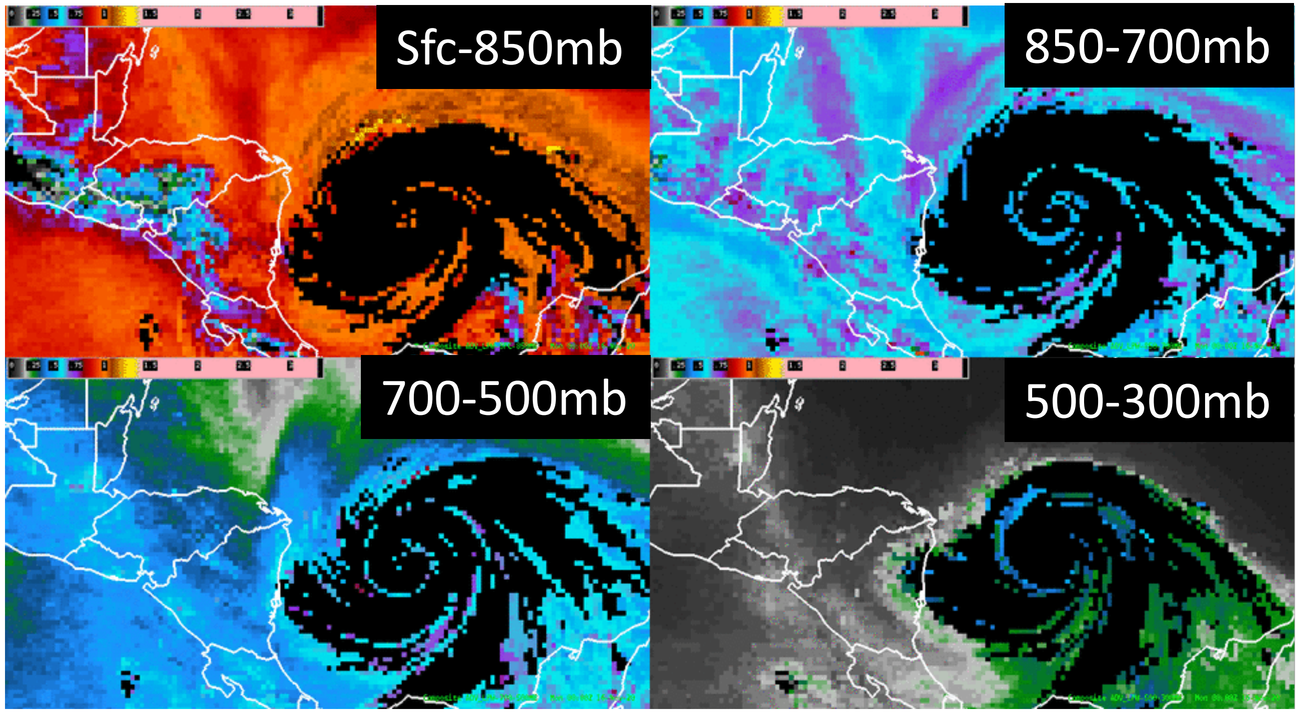




2020 Weather Events Observed by Joint Polar Satellite System (JPSS)

Jorel Torres (Cooperative Institute for Research in the Atmosphere, CIRA)

- ✓ Presentation focused on selected JPSS products and applications during 2020 containing AWIPS and non AWIPS imagery.
  - Snowfall Rates / Totals - Winter Storm Gail and its impact across CONUS
  - Power Outages - Iowa Derecho
  - Blowing Snow – Northern High Plains
  - Hurricane Iota – Nicaragua
  - Fires – Western US
- ✓ Provided links to access JPSS near-real time imagery along with JPSS Training Resources available for users.



Advected Layered Precipitable Water (ALPW) observations of Hurricane Iota as it approaches Nicaragua.

Contact Information: Jorel.Torres@noaa.gov , Jorel.Torres@colostate.edu

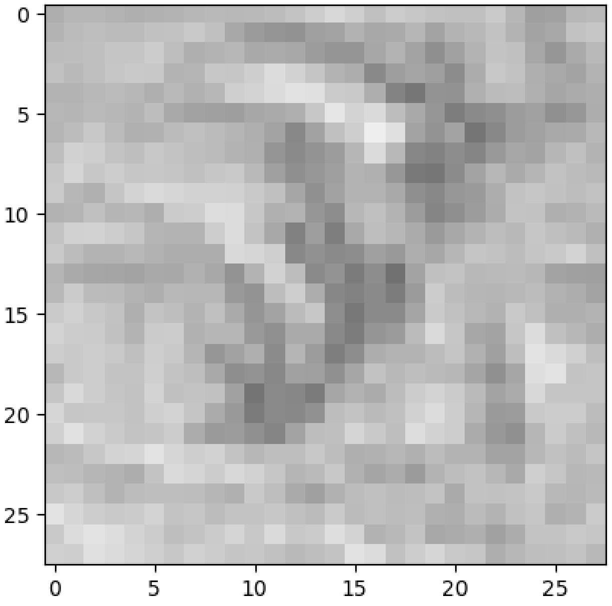
National Satellite and Information Service

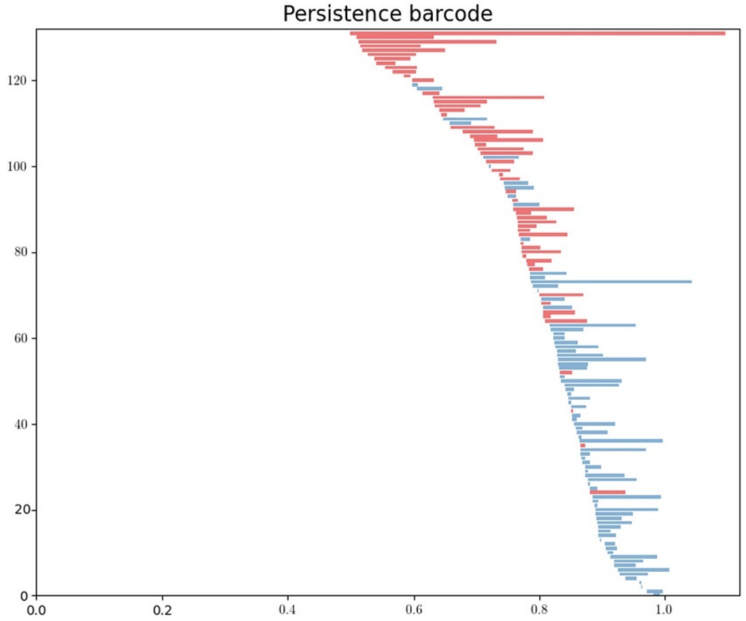
NOAA - Cooperative Remote Sensing Science and Technology Center

Topological Data Analysis for Identifying Convection in GOES-R Imagery

Lander Ver Hoef (CSU), Yoonjin Lee (CIRA), Henry Adams (CSU), Emily J. King (CSU), and Imme Ebert-Uphoff (CSU and CIRA)

- Identifying Convection
- Explainable solutions
- Quantifying texture
- Sublevelset Persistent Homology
- Convective vs. Non-convective Barcodes
- Time-varying
- Web app: tinyurl.com/tda-app





Regional Strongly Coupled Aerosol-Atmosphere Data Assimilation

Milija Zupanski (CIRA) and co-authors

- Strongly coupled aerosol-atmosphere data assimilation system based on using RAMS model and MLEF data assimilation has been developed and tested

- Preliminary results indicate positive impact of atmospheric observations on aerosol, in the analysis and in the 6-hour short range forecast

- Novel verification based on geostationary satellite imagery has been developed

- Future plans include accounting for aerosol-cloud interactions in data assimilation

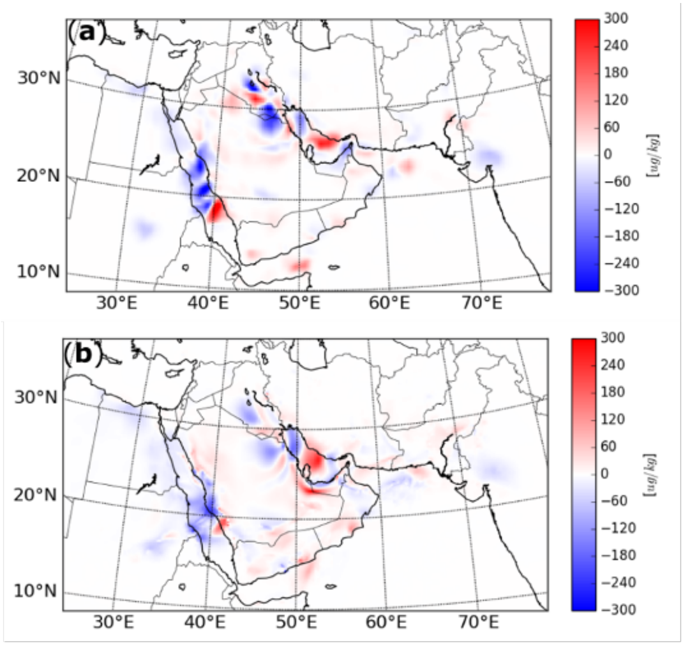


Figure 1. Total dust (ug kg^{-1}) difference between data assimilation with and without atmospheric observations, at the lowest model level for (a) the analysis at cycle 06, valid 0600 UTC 04 August 2016, and (b) the 6-h forecast valid 1200 UTC 04 August 2016.

CESSRST

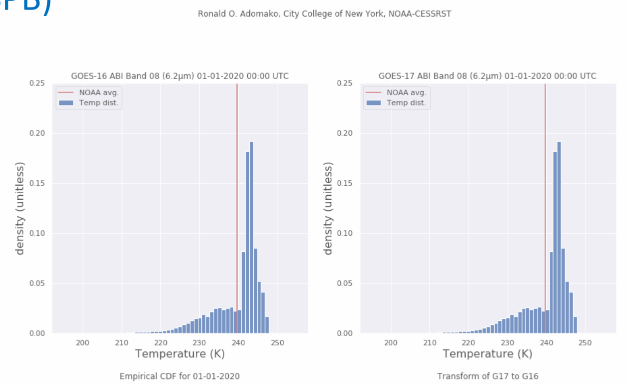
- Ronald Adomako
- Michael Mandel

National Satellite and Information Service

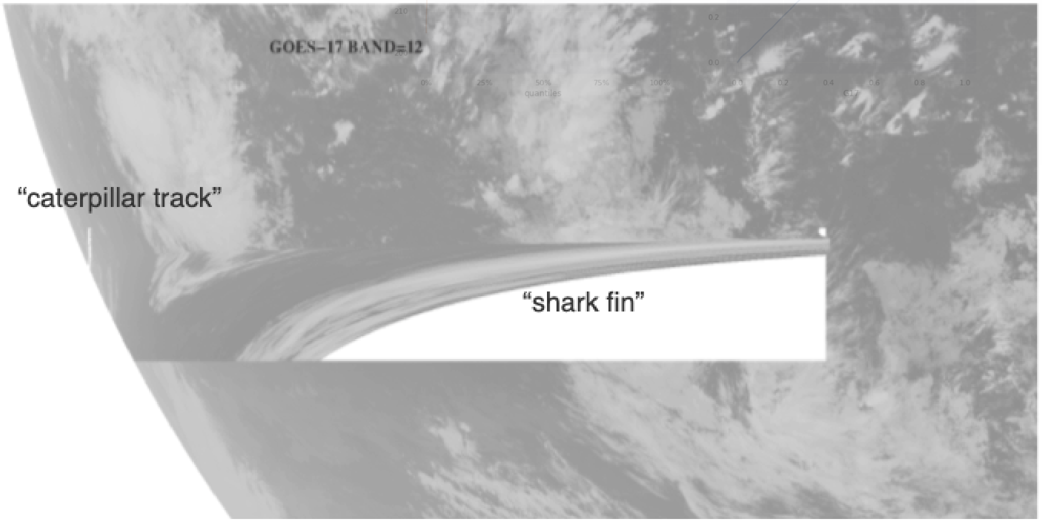
Machine Learning for GOES-R ABI Radiance Anomalies

Ronald Adomako and Michael Mandel (NOAA-CESSTST); Timothy Schmit (ASPB)

- Created an interactive plot to examine GOES-R via Histograms
  - Described study of using machine learning to detect GOES-17 Loop Heat Pipe anomalies
- Introduced current study of GOES-R artifacts artificial intelligence detection
  - Motivated by U-Net model
  - Developed using PyTorch



Artifact (both GOES-16 and -17)



Contractors

GAMA-1 Tech

- Pamela Perez
- Haibing Sun

GST

- Taeyoung Choi
- Denis Tremblay
- Kun Zhang

IMSG

- Murty Divakarla
- Nicholas Nalli (2)
- Hua Xie
- Tong Zhu

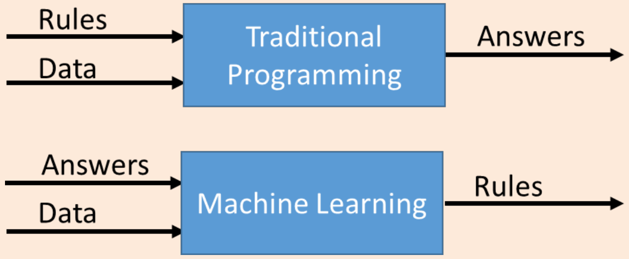
An MLOps Approach to Address the Complexities of Delivering an ML/AI Product

Pamela Perez[1,2], Shanna Sampson[1,2], Walter Wolf[2]

[1]GAMA-1 Technologies, College Park, MD, USA 20740, [2]NOAA/NESDIS/STAR, College Park, MD, USA 20740

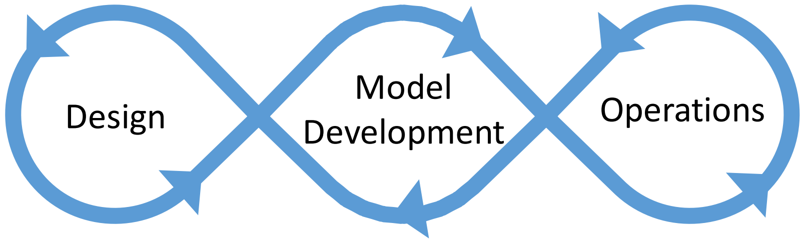
Background

- **Accelerate the Transition of AI Research to Applications**: One of five goals reported in *The NOAA Artificial Intelligence Strategy* released February 2020.
- Machine Learning systems are complex with many components presenting challenges not addressed by traditional software deployment strategies.
- Models generated automatically from training data:
  - Data is part of the model
  - Rules are not well understood
  - Failures not attributed to a single point in code



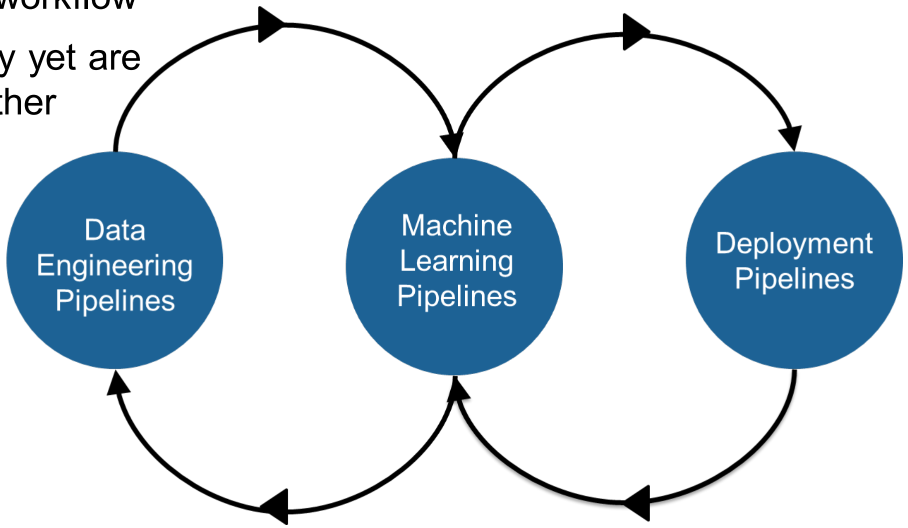
Machine Learning to Operations(MLOps)

A Set Of Best Practices For The Management of the ML Model Life Cycle.



- Iterative-incremental end-to-end ML workflow
- All three phases iterate independently yet are interconnected and influence each other

Apply MLOps principles to three levels of ML Software



From "MLOps Principles"
https://ml-ops.org/content/mlops-principles

MLOps Principles

- Versioning
- Testing
- Automation
- Reproducibility
- Deployment
- Monitoring

JPSS Operational Satellite Data Integration and Collocation algorithms development and Evaluation

Haibing Sun[1], Walter Wolf[2], Thomas King[2] L. Soulliard [1]
[1] GAMA-1 Technologies, Greenbelt, MD, USA [2] NOAA/NESDIS/STAR, 5830 University Research Ct, NCWCP , College Park, MD 20740

- Physical based collocation algorithms is developed at NOAA/NESDIS/STAR to support the development of the satellite observation integration processing.

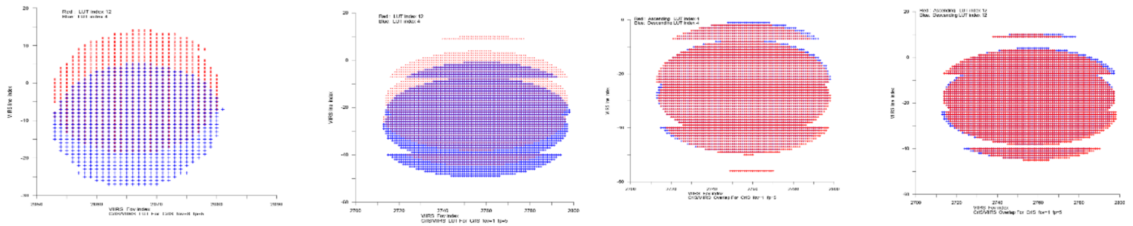
- The collocation algorithms is applied within the Geostationary satellite & Polar satellite (GEO-LEO) integration system & LEO-LEO observation operational integration system.

- This collocation system currently runs operationally in NESDIS within the NUCAPS package provides collocated VIIRS cloud content to the CrIS BUFR product.

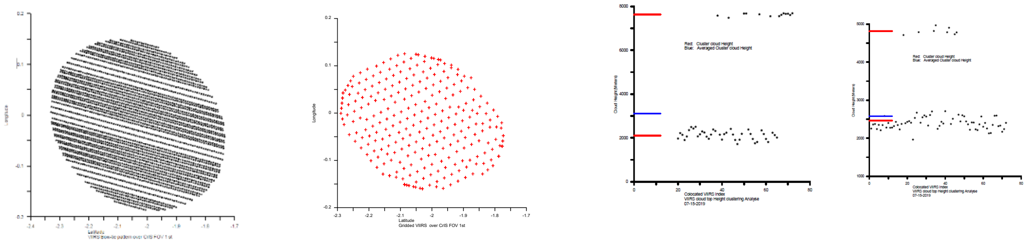
- In this paper, the detail and the update of LUT algorithm are introduced and problems in the collocation processing and the related solutions are discussed.

- The algorithms update include:

1: Multiple LUTs algorithms update 2: LUT update with satellite attitude



3: LUT update for VIIRS Bowie Effect. 4:Cloud Height clustering algorithm



5:Integration averaging algorithms update

JPSS CrIS/VIIRS Integration system provide collocated VIIRS radiance, cloud information and clustered VIIRS radiance/cloud Height product. The present operational product include cloud fraction and cloud top height. The collocated total radiance, cloud/cloud clear radiance and other clustering product are available on requirement.

Haibing.sun@noaa.gov

Estimating the degradation of the Suomi-NPP VIIRS fire band M13 Low Gain

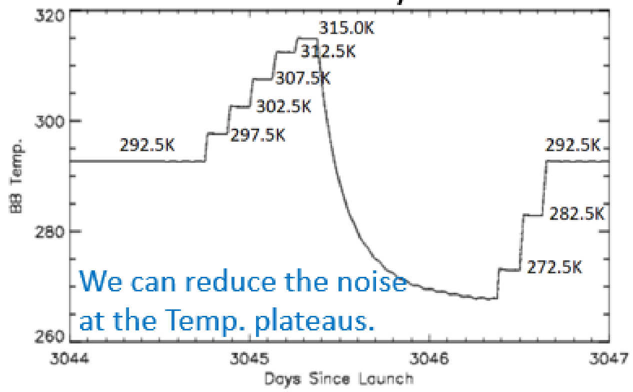
Significant Roles of Calibration/Validation and Verification in the Transition of Research to Operations to Provide the Science to Operations to Societal Benefits; Paper Number:6.7

Taeyoung Choi (Global Science & Tech.), Changyong Cao (NOAA)

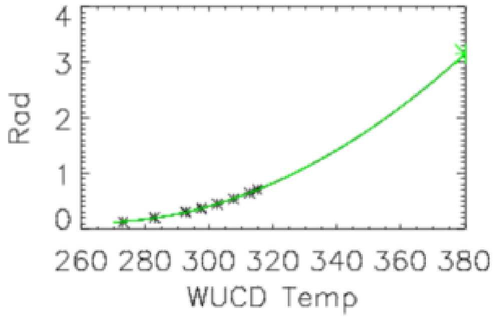
Tuesday, 12 January 2021, 4:40 PM (Eastern)

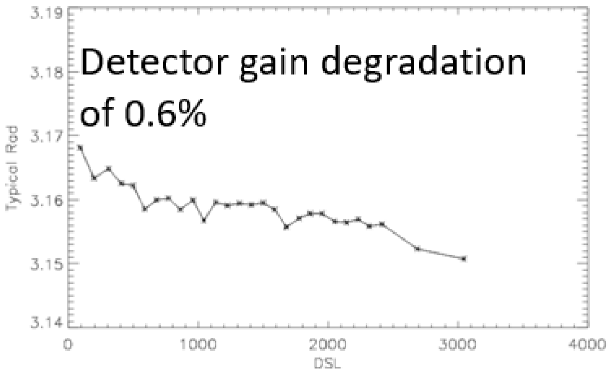
- S-NPP VIIRS band M13 Low gain (fire detection band) calibration was not possible
  - because of its higher typical temperature of (380K) compared to the Blackbody (BB) temperature of 292K.
  - Low signal to noise problem.
- The lifetime detector gain changes of band M13 in the low gain state were estimated using BB Warm-Up Cool-Down events.
- To derive BB radiance change at the M13 low gain typical temperature of 380K, a quadratic model fit was applied at the different temperature plateaus of WUCD events.
- The lifetime radiances at 380K showed slow but steady detector degradation of 0.6% over the 9 years of operation.
- The M13 low gain F-factor (calibration coefficient) trends are almost identical to high gain.
- The gain degradation information can be used for next S-NPP recalibration.

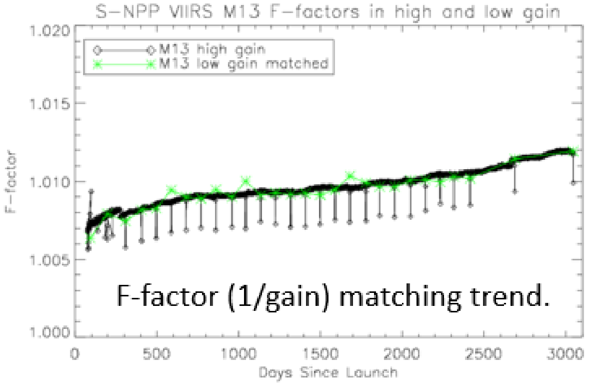
BB Warm-Up Cool-Down lasts about 3 days



Quadratic model fit







Noise and Geolocation Accuracy Assessment of theCross-track Infrared Sounder Instruments

11th Conference on Transition of Reseach to Operations

Paper Number 6.8

Denis Tremblay, GST/NOAA

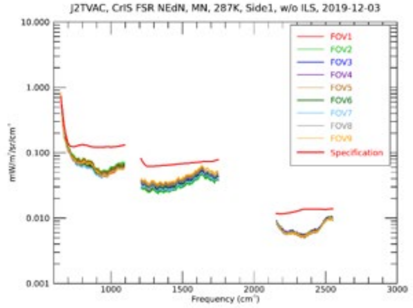
Y. Chen (NOAA), F. Iturbide-Sanchez (NOAA), E. Lynch (GST), P. Beierle (U. Maryland), X. Jin (GST),K. Zhang (GST), Z. Wang (U. Maryland), W. Porter (SSAI)

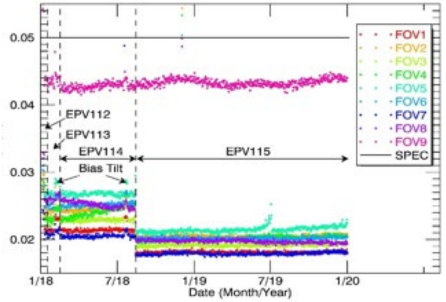
12 January 2021, 4:45-4:50 pm EST

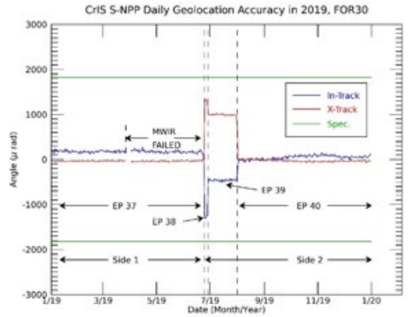
- Radiometric noise estimates meets the requirements for CrIS on S-NPP, NOAA-20 and J2 (exception S-NPP MWIR FOV7).

- Several noise artifacts were observed: 1) Bias tilt setting, 2) PGA gain adjustment, 3) Noise increase event, 4) long term trend, 5) Instrument reset, 6) AD/C differential code non-linearity, and 7) Scene shot (hot Earth scene have higher noise).

- Overall, geolocation accuracy assessment is excellent (< 250 m). Large geolocation accuracy error during the commissioning of the S-NPP CrIS Electronic Side-2 (24 June 2019 to 1 August 2019).







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NOAA - Cooperative Remote Sensing Science and Technology Center

Assessment of the Long-Term Radiometric Consistency between NOAA-20 and S-NPP CrIS SDR Radiances

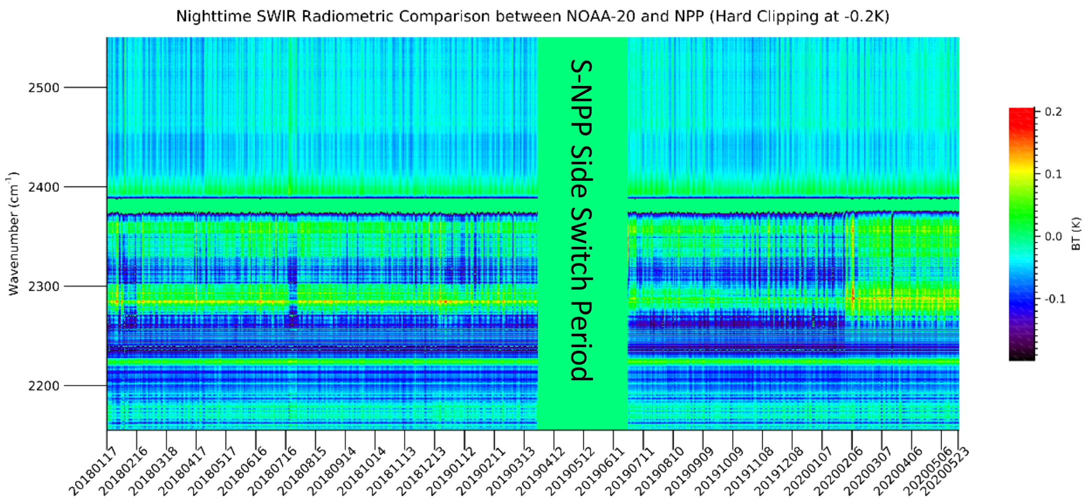
17th Annual Symposium on Operational Environmental Satellite Systems

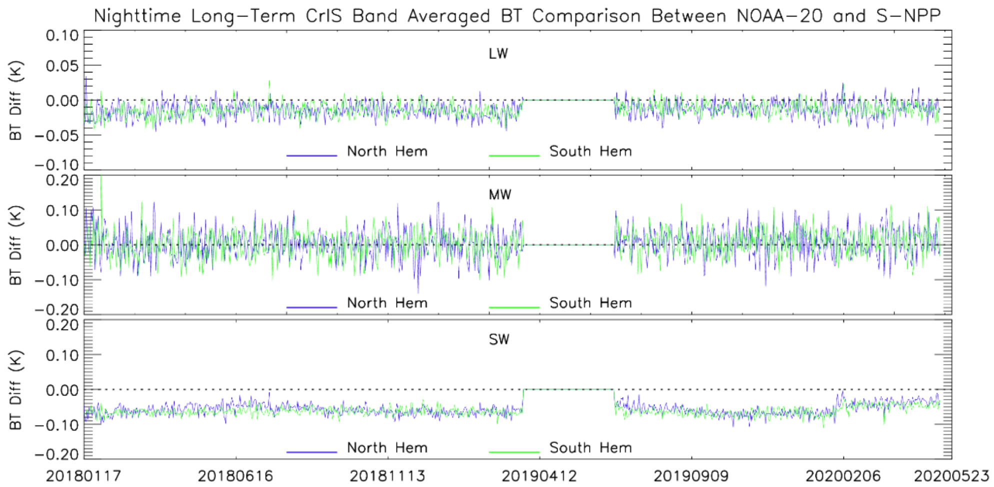
Paper 10.2

Kun Zhang, Global Science and Technology Inc., NOAA/STAR Affiliate

Flavio Iturbide-Sanchez, Yong Chen, Denis Tremblay, Erin Lynch, Peter Beierle and Zhipeng Wang

Thursday, 14 January 2021, 10:45am-10:50am



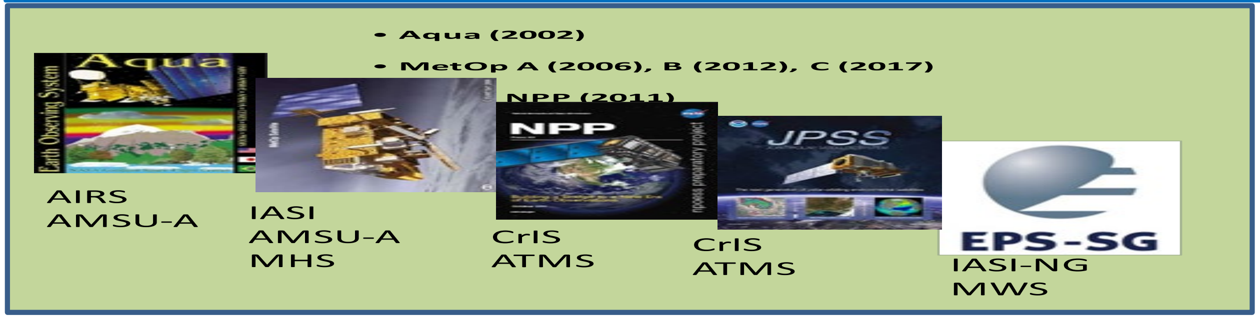


- Radiometric calibration of the operational NOAA-20 and S-NPP CrIS SDR products were compared for 29 months since January 2018 using the double difference method via CRTM simulations as a transfer target
- Long-term radiometric consistency is verified between the operational NOAA-20 CrIS and S-NPP CrIS SDR radiances with the radiometric differences within ± 0.1 K on average.
- The radiometric assessment for both CrIS instruments identifies the long-term impact of calibration updates in the CrIS SDR radiances.
- The calibration updates have positive impacts on CrIS radiometric calibration as expected and show stable performance in the operational CrIS SDR products.

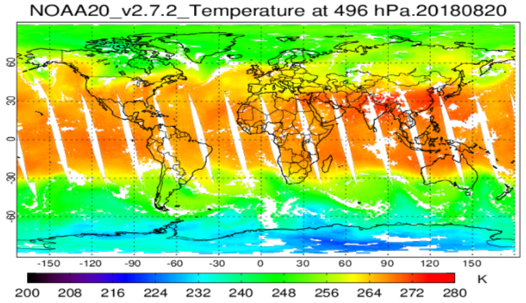
AMS101
101st Annual Meeting
VIRTUAL | 10-15 January 2021

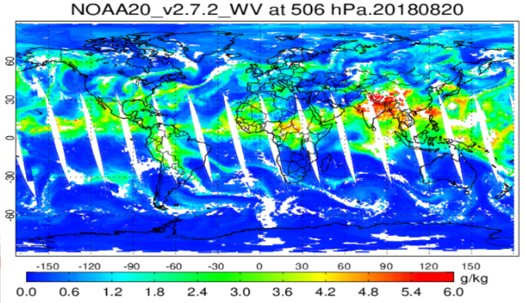
NUCAPS Atmospheric Sounding Product System for JPSS-CrIS and MetOp-IASI Hyperspectral Sounders: Products, Performance, and Recent Advances

Murty Divakarla[1], S. Kalluri[2], K. Pryor[2], C. Barnet[3], C. Tan[1], M. Wilson[1], N. Nalli[1] , T. Zhu[1], J. Warner[2], T. Wang[1], L. Soulliard[4], T.King[2], and L.Zhou[2]
[1]IMSG, Inc., [2]Center for Satellite Applications and Research (STAR), [3]STC, [4]GAMA-1 Technologies, College Park, MD

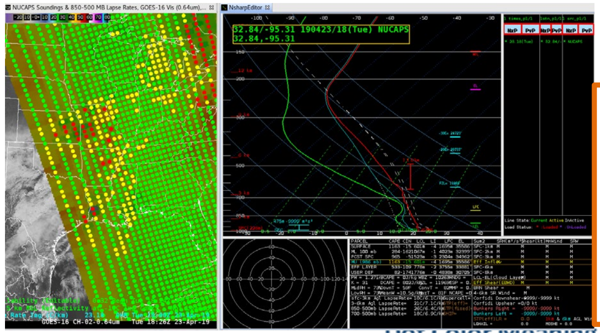


Products	Maturity
AVTP/AVMP	✓ Validated
Ozone	✓ Validated
OLR	✓ Validated
CO	✓ Validated
CH4	✓ Validated
CO2	✓ Validated*
OLR	✓ Validated





- The NOAA Unique Combined Atmospheric Processing System (NUCAPS) is the NOAA operational hyper-spectral enterprise sounding product algorithm to derive hyper-spectral radiance products, vertical profiles of temperature, water vapor, ozone, and trace gas products (CO, CH4, CO2, Volcanic SO2).
- Produces consistent products from JPSS Suomi-NPP and NOAA-20, MetOp-A/B/C (IASI/AMSU-A/MHS
- Augmenting the NUCAPS system for EPS-SG IASI-NG hyperspectral sounder.
- Products are available through CLASS for worldwide users
- NUCAPS has been operationally running on the CSPP/Direct Broadcast (DB) network producing near real time products. NUCAPS products are available through AWIPS for Weather Forecast offices for many regional applications.
- Maturity Review: https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php
- web pages of interest: https://www.star.nesdis.noaa.gov/jpss/mapper
- https://www.star.nesdis.noaa.gov/jpss/EDRs/products_Soundings_N20.php



Gridded NUCAPS provides temperature, moisture, and stability indices (CAPE, lapse rate, etc.) at specific pressure level(s).

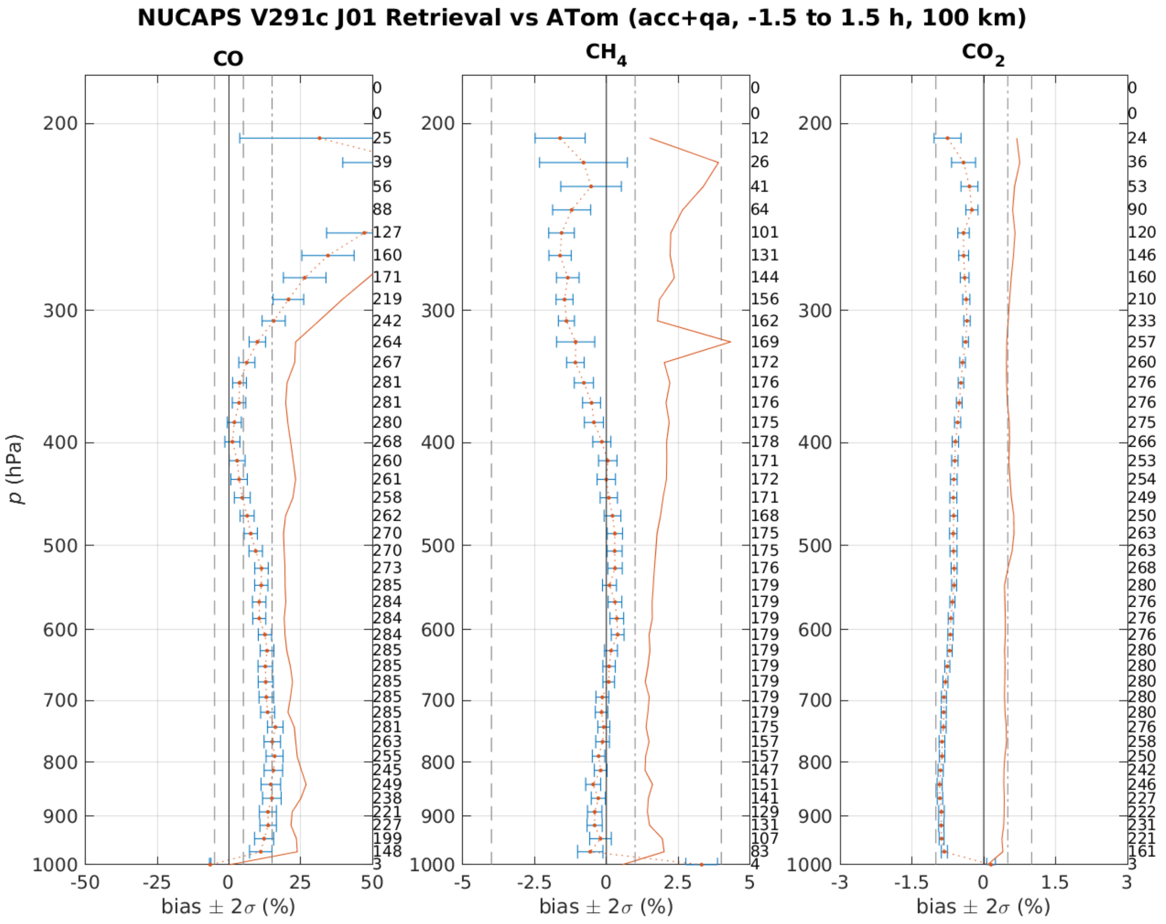
Dot Color Meaning

Green	Yellow	Red
Successful infrared (IR) + microwave (MW) NUCAPS retrieval under clear or partly cloudy conditions	Failed IR + MW NUCAPS retrieval. Successful MW-only NUCAPS retrieval under cloudy conditions	Failed IR + MW NUCAPS retrieval. Failed MW-only NUCAPS retrieval under precipitating cloudy conditions

Validation of Carbon Trace Gases from the NOAA Unique Combined Atmospheric Processing System (NUCAPS)

Nicholas R. Nalli, C. Tan, J. Warner, M. Divakarla, M. Wilson, T. Zhu, K. Pryor, *et al.*

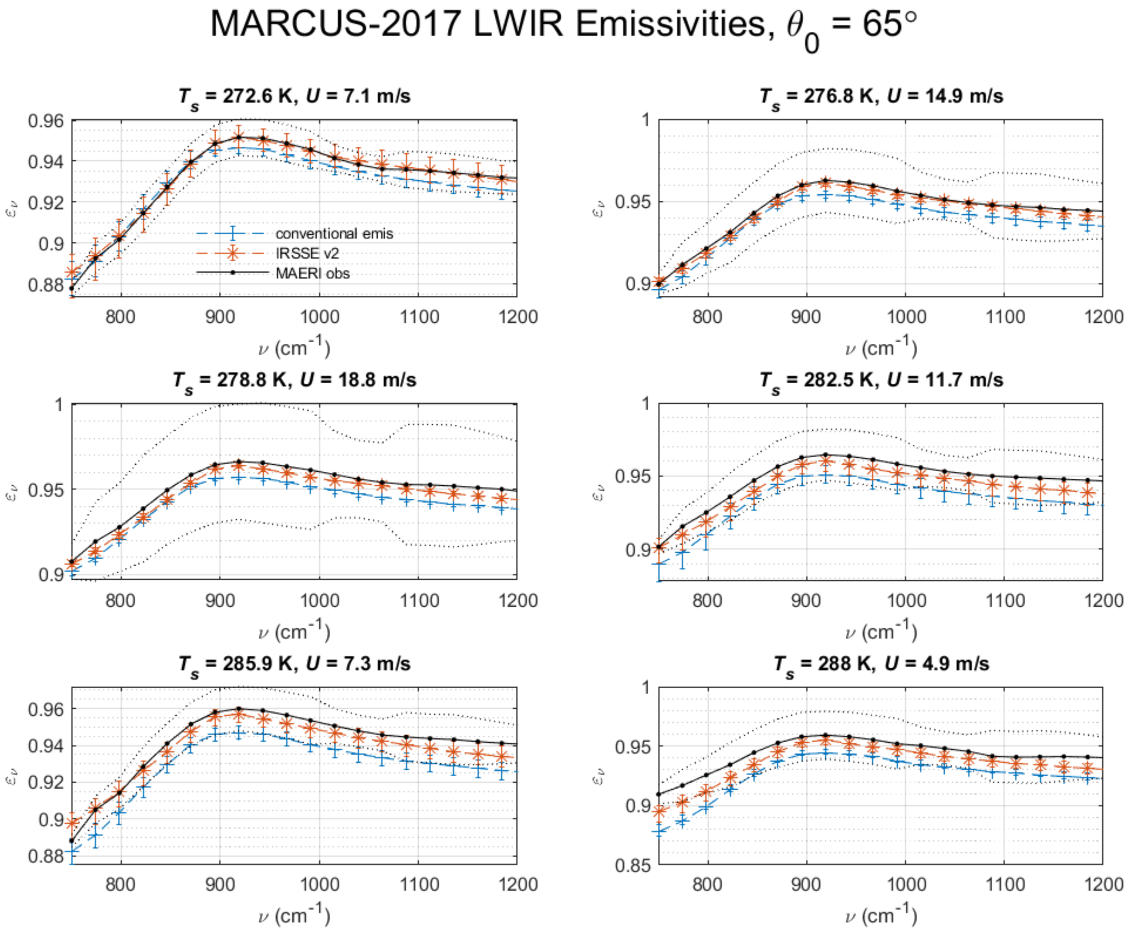
- NUCAPS CO, CH_4 and CO_2 carbon trace gas profile retrievals have been optimized in latest operational version
- The retrievals improve the *a priori* in the layers of sensitivity
- SNPP, NOAA-20 (PM orbit) and Metop-A,-B (AM orbit) retrievals are comparable
- NUCAPS trace gas retrievals generally meet JPSS Requirements in layers of sensitivity versus independent *in situ* truth datasets



Temperature-Dependent Infrared Sea Surface Emissivity (IRSSE) Model for the Community Radiative Transfer Model (CRTM)

Nicholas R. Nalli, J. A. Jung, M. Chen, R. O. Knuteson, P. J. Gero, and B. T. Johnson

- For satellite IR remote sensing applications, the surface emissivity must be specified with a high degree of absolute accuracy
- Recent obs − calc findings (*Liu et al.* 2019) have shown a significant systematic bias ≈0.5 K on a global scale
- An *ad hoc* “data rescue” was performed to obtain temperature-dependent water optical constants published by *Pinkley et al.* (1977)
- Preliminary 4-D lookup tables (LUT) including temperature dimension have been generated and are undergoing testing
  - Improved agreement found with MAERI observations over range of surface temperature and windspeeds
  - Systematic spectral biases (≈0.1–0.5 K) associated with SST dependence and the ocean BRDF have been reduced
- Additional testing and optimizing the model within NOAA operational GSI assimilation is ongoing



NOAA
NOAA/NESDIS STAR
National Satellite and Information Service
CISESS
CIRA
CIMSS
CUNY
NOAA - Cooperative Remote Sensing Science and Technology Center

Regression Testing by NOAA/NESDIS/STAR ASSISTT

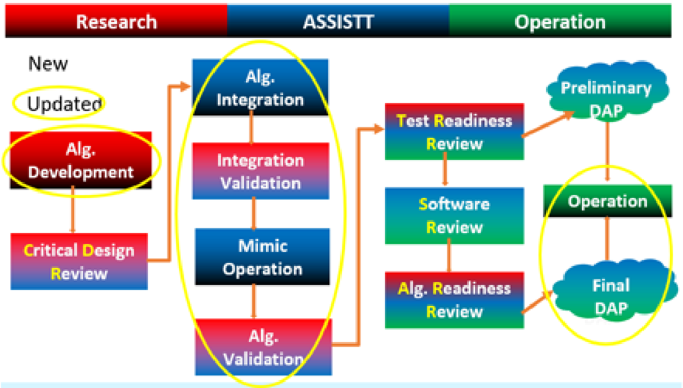
Conferences: 17th Annual Symposium on Operational Environmental Satellite Systems 3.5

Hua Xie, IMSG @ NOAA/NESDIS

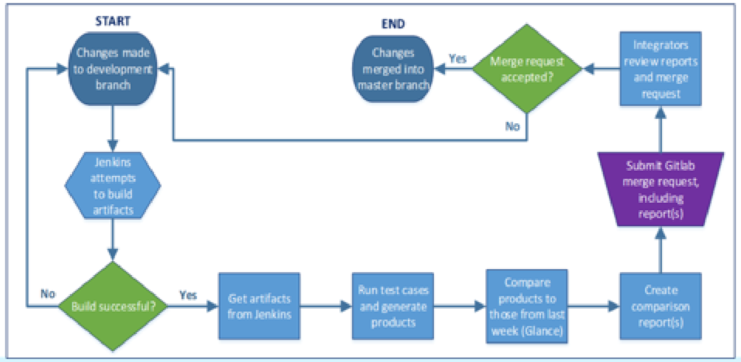
Co-Authors: Mike Walters, John Lindeman, Priya Pillai, Shanna Sampson, Aiwu Li, Kelly Neely, Zhuo Zhang, Emily Doss and Walter Wolf

Monday, 11 January 2021, 4:00-4:05 pm

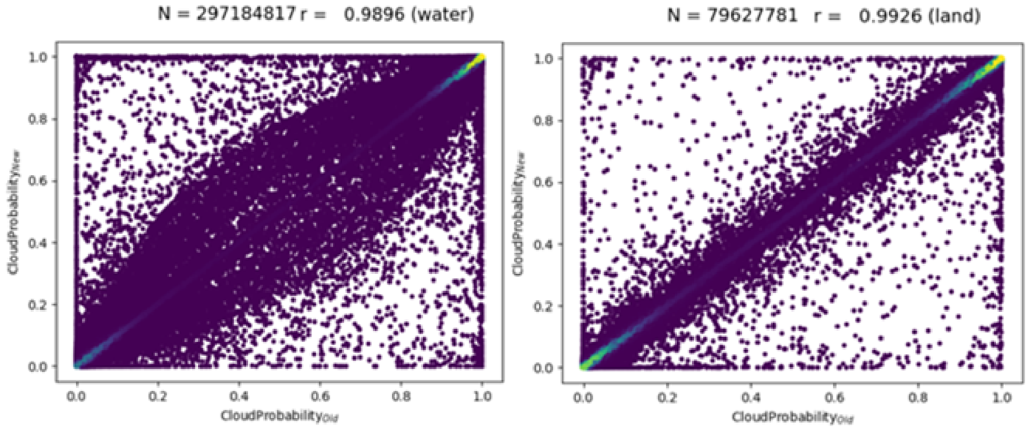
(a)



(b)



(c)

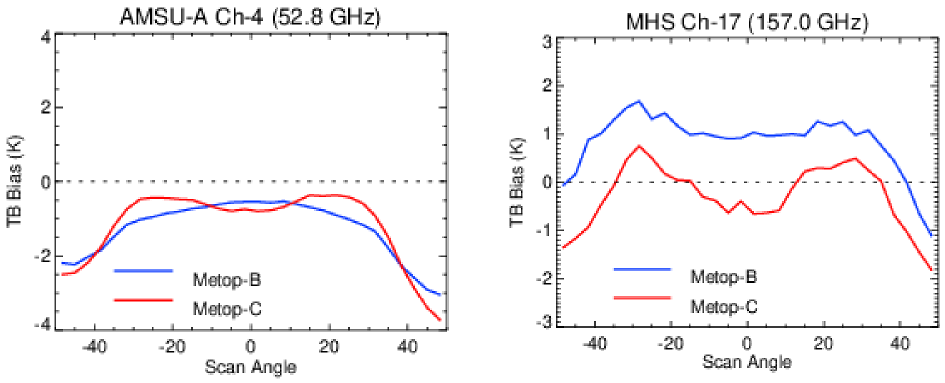


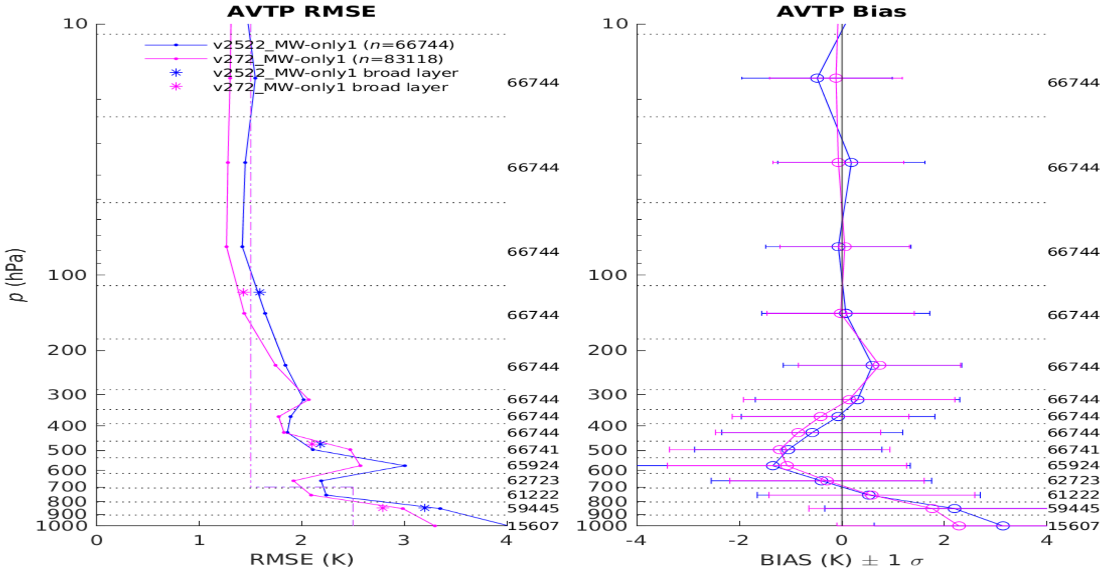
- ASSISTT conducted regression testing to investigate the potential effect of ancillary input data switch from AVHRR to VIIRS SurfaceType, OISST to CMCSST, and GFS 0.5 deg to GFS 0.25 deg on products of Clouds, Aerosols, Lands, Cryosphere, etc. generated in Framework.
- 31 cases including GOES16, GOES17, H8, MSG11, METOPB, NPP and NOAA20 have been selected.
- Tests of 3 each single switch plus 1 combined switches have been conducted and comparisons with original ancillary inputs have been made using Glance.
- Based on ASSISTT's preliminary results, all NESDIS products generated in Framework are ready for ancillary input data switch.

NUCAPS Microwave Tuning for MetOp-C AMSU-A/MHS

Tong Zhu (IMSG Inc.@NOAA/NESDIS/STAR), Changyi Tan, Murty Divakarla, Chris Barnet, Ken Pryor, Michael Wilson,
Nicholas Nalli, Tianyuan Wang, Juying Warner, Satya Kalluri, Lihang Zhou, Mitch Goldberg

- Microwave Model Tuning for NUCAPS Metop-C AMSU-A/MHS
  - A new microwave tuning is created for NUCAPS Metop-C forward modeling. The scan angular dependent biases and STD errors are found for AMSU-A and MHS.
  - By applying the new tuning, the yield of NUCAPS Metop-C retrieval is increased for about 1.5% wher compared with the retrieval using old tuning.
- NUCAPS New Climatology Dataset
  - A new climatology of ECMWF monthly temperatur and water vapor, created by MiRS team, is implemented into NUCAPS retrieval system.
  - The NUCAPS microwave retrievals are improved fo temperature and water vapor fields, especially for the surface temperature bias, which is reduced for about 0.5 K.





AMS Talk Summaries from STAR, CIs & More

Thank You!

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Compiled by Ralph Ferraro, STAR/CoRP/SCSB, & Deb Baker, CISESS