AMS Talk Summaries from STAR & CIs

AMERICAN METEOROLOGICAL SOCIETY
100TH ANNUAL MEETING | BOSTON | 2020

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

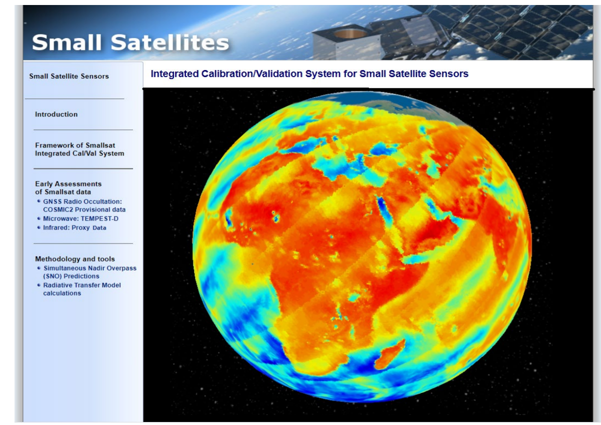
STAR

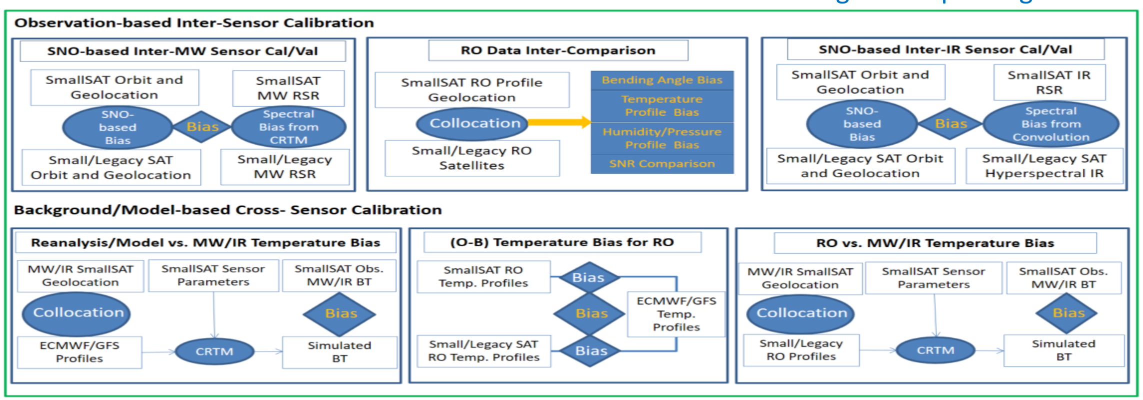
- Changyong Cao
- Bigyani Das
- Kevin Gallos (2)
- Robert Iacovazzi
- Nick Nalli (3)
- Houria Madani
- Gian Vilamil-Otero

Smallsat Data Quality Assurance in the Transition from R2O

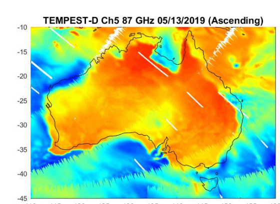
C. Cao (NESDIS), X. Shao(CISESS), F. Iturbide-Sanchez(NESDIS), S. Ho(NESDIS)

- Developed a framework of Integrated Calibration/Validation System (ICVS) for Smallsat MW, RO, and IR sensors
- Implemented well-established satellite instrument Calibration/Validation techniques for SmallSat
  - Radiometric bias; Geolocation accuracy; Spectral calibration
- Evaluated available SmallSat data using the system developed for demonstration
  - TEMPEST-D geolocation improvement assessments
  - Radiometric Bias Evaluation of TEMPEST-D with four Legacy Sensors (SNO method)
  - Evaluated Radio Occultation data with 3D visualization during orbital phasing

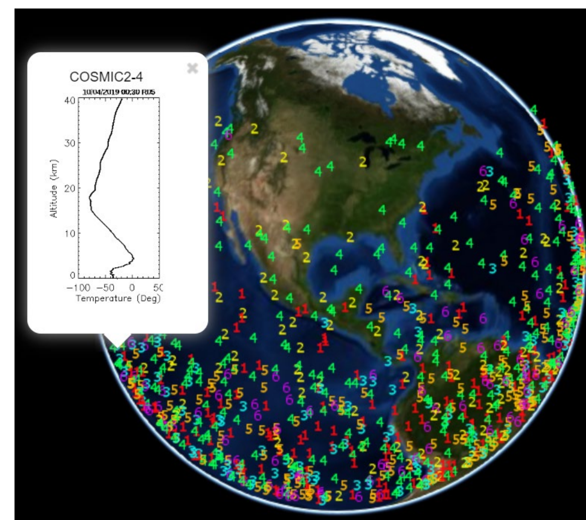




87 GHz channel		V1.3		V2.0	
Reference sensor Channel (GHz)		Qualified SNOs	ΔBT	Qualified SNOs	ΔBT
MetOp-A/MHS	89	25	-0.16±2.29	67	-0.03± 1.27
MetOp-B/MHS	89	31	0.42±1.82	63	0.09± 1.37
NPP/ATMS	88.2	28	-0.44±1.98	51	-0.96± 0.82
NOAA-20/ATMS	88.2	24	-0.35±1.81	56	-0.34± 0.88



Geolocation improvements



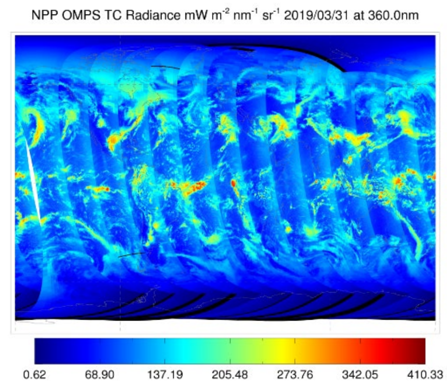
Website: https://ncc.nesdis.noaa.gov/SmallSatellite/index.php

Facilitating Research to Operation (R2O) Activities of JPSS-1 Algorithms Using The Algorithm Development Library Block 2.1

Bigyani Das (IMSG/STAR); Weizhong Chen (GAMMA-1/STAR); Thomas King & Walter Wolf (STAR)

- JPSS algorithm updates are currently made with Block 2.1 ADL MX7 baseline which includes several changes to the previous version MX6. These changes were integrated and tested by STAR ASSISTT and packages were submitted for regression tests by DPES and implementation by Raytheon. Below are a few examples:
  - Update N20 OMPS Calibration Tables
  - VIIRS SDR Remove COEFF-A and COEFF-B and GAIN LUTs
  - VIIRS GEO PARAM LUT format change
- Currently weekly and bi-weekly OMPS updates are made using the active baseline version of ADL, i.e., ADL Block 2.1 MX7
  - Weekly Dark Table updates for both NM and NP
  - Bi-Weekly Solar and Wavelength table updates for OMPS NP
- Monthly VIIRS updates are made
  - DNB DN0 and Gain Ratios Monthly LUT Updates
  - DNB Stray Light Correction Monthly LUT update

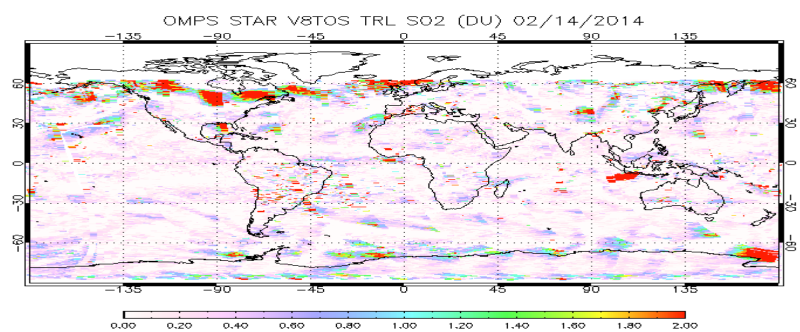
ASSISTT: Algorithm Scientific Software Integration and System Transition Team
DPES: Data Products Engineering and Services



S-NPP and N-20 Nadir Mapper Radiance Anomaly - Submitted by OMPS Science Team

Black stripes started showing up in radiance maps for both S-NPP and NOAA-20 since 3/25/2019 after MX5 TTO.

OMPS SDR accuracy is cross-checked by analyzing downstream products such as Ozone and SO2



Detecting Hail Damage Using the GOES ABI

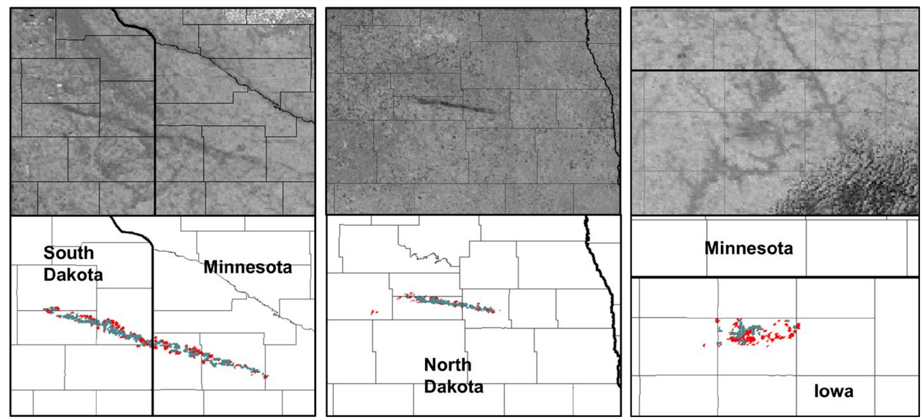
Philip Schumacher (NWS); Samantha Koehler (Salisbury Univ.); Kevin Gallo (NESDIS)

- Post – pre GOES ABI *normalized difference vegetation index* (NDVI) evaluated for three storm events.
  - MODIS and Maximum Estimated Size of Hail (MESH) data from storm events in 2014 used to develop methodology.
  - NDVI computed from ABI visible and near-IR bands.

- Highlights
  - Observer reports indicate that there was damage observed where the algorithm identifies hail damage.
  - Areas with hail damage also correspond to issued severe thunderstorm warnings.
  - Research results suggest that hail damage is also dependent on wind speed.
  - This technique can be used to for warnings validation and provide supplemental information for the *Storm Data* publication.

Results for GOES-16 ABI

22 June 2017 | **21 July 2017** | **28 June 2019**

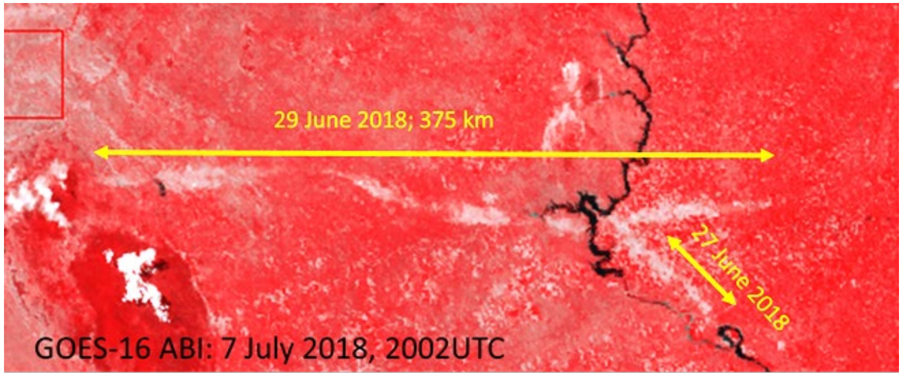


GOES ABI ΔNDVI = NDVI$_{post\text{-}storm}$ – NDVI$_{pre\text{-}storm}$ (top) from GOES-16 ABI associated with hail storms on 22 June 2017 (left), 21 July 2017 (middle), and 28 June 2019 (right). Darker colors denote more negative ΔNDVI. GOES-16 ABI predicted hail damage is displayed in lower figures.

Land Cover Influence on Detection of Hail Swaths Using the GOES ABI

Samantha Koehler (Salisbury Univ.); Philip Schumacher (NWS); Kevin Gallo (NESDIS)

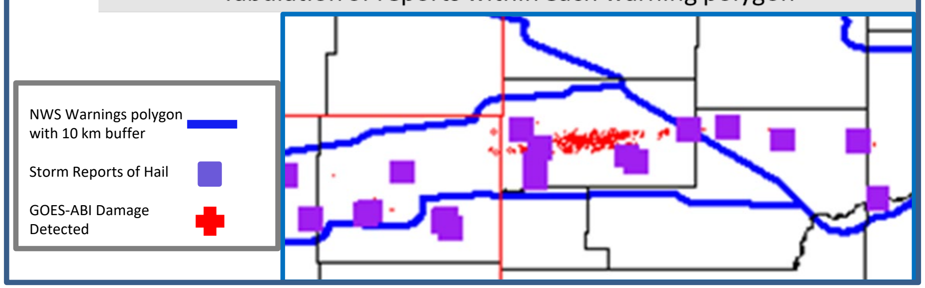
- Post – pre GOES ABI *normalized difference vegetation index* (NDVI) evaluated for storm events that included multiple land cover types.
  - NDVI computed from ABI visible and near-IR bands and Maximum Estimated Size of Hail (MESH) data used in analysis.
  - Storm events analyzed are from S. Dakota (June 27, June 29) and July 29, 2018 (primarily WY and CO).
  - Land cover identified from USDA Cropland data layer.



Hail swaths for 27 and 29 June 2018 events.

- Highlights
  - Detection of hail damage is less robust without consideration of land use.
  - Areas with hail damage also correspond to issued severe thunderstorm warnings.
  - Research results suggest that hail damage is also dependent on wind speed.
  - Results suggest that this analysis can be used for warnings validation and provide supplemental information for the *Storm Data* publication.

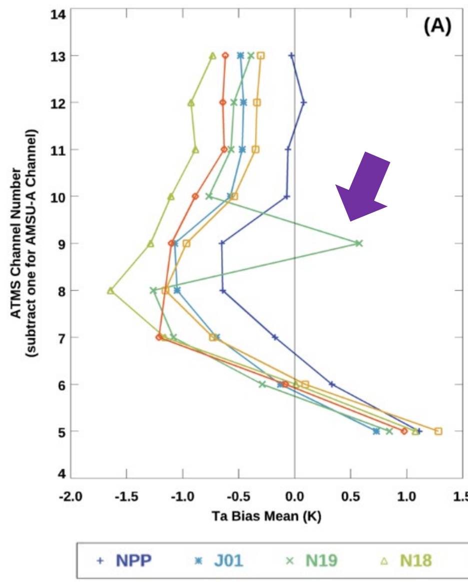
- Evaluation of issued warnings included:
  - Overlay of observer reports and satellite-derived estimates of damage
  - Tabulation of reports within each warning polygon



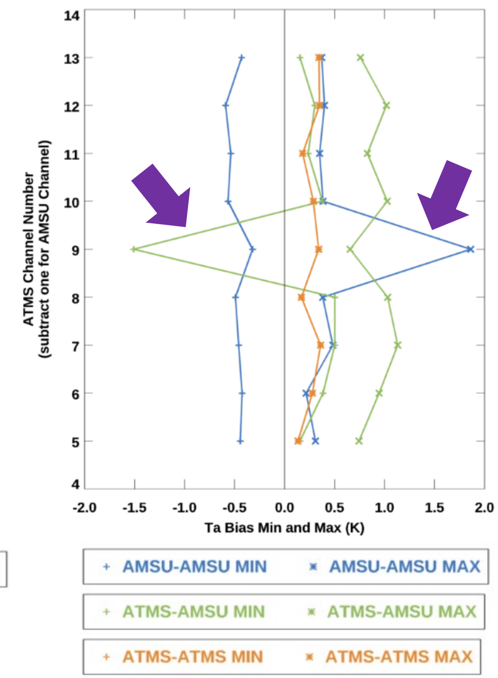
Monitoring NOAA Operational Microwave Sounder Data Quality Using CRTM-simulated Measurements Based On COSMIC GNSS-RO Atmospheric Profile Inputs

Robbie Iacovazzi (GST Inc.), Lin Lin (UMD/ESSIC), Ninghai Sun (GST, Inc.), and Mark Liu (NOAA/NESDIS/STAR)

- Operational ATMS and AMSU-A microwave sounder observations, and collocated forward CRTM simulations using COSMIC GNSS-RO sounding profile input, create the O-B Ta bias values needed for tracking and trending data quality.
- The O-B Ta bias parameter "double difference" between instrument make and models can be used to estimate inter-satellite MW sounder Ta biases.
- These bias parameters, together with engineering and housekeeping data from the NESDIS/STAR ICVS, have been found to be key to monitoring MW sounder data quality and performing initial instrument anomaly investigations.

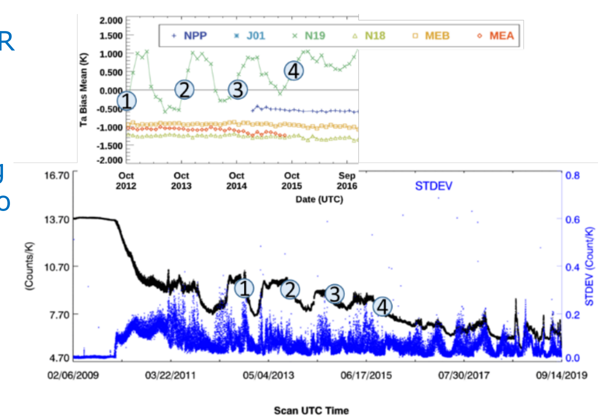


Mission-life O-B Ta bias statistics for N18, N19, MEA, and MEB AMSU-A, and NPP and J01 ATMS plotted for each channel in the analysis.



Min and max double-difference Ta biases computed from operational overlap period monthly means of the AMSU-A to AMSU-A, ATMS to AMSU-A and ATMS to ATMS instrument pairs

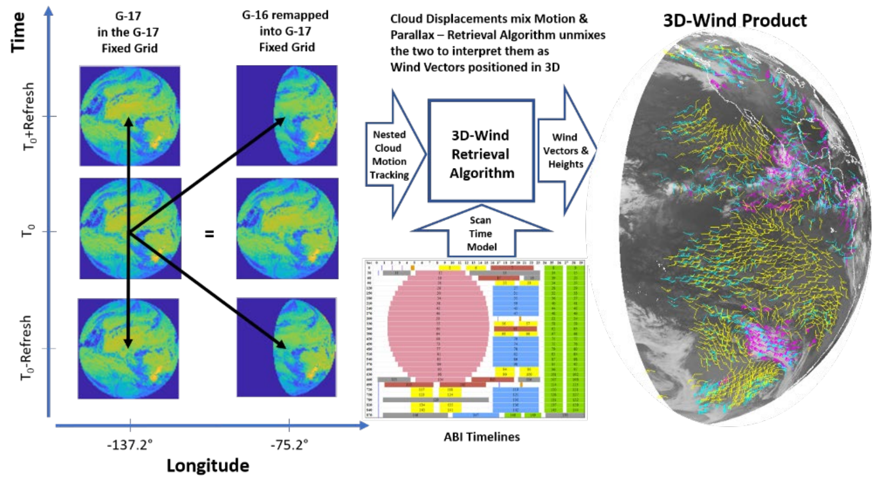
N19 AMSU-A Ch 8 Gain from NOAA/NESDIS/STAR ICVS (Right-Bottom) and monthly-mean O-B Ta bias (Right-Top). The four circled numbers on these figures represent the October 1 date for years 2012-2015. Shows gain anomaly (resulting from excess instrument noise – not shown) led to radiance anomaly.

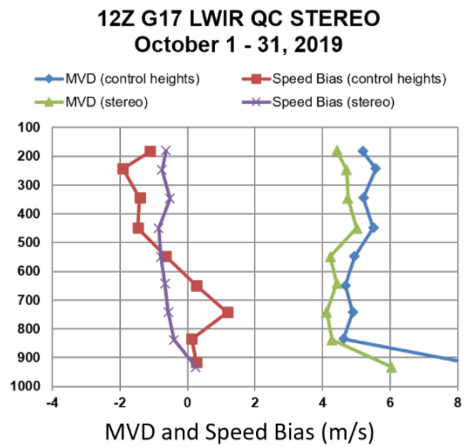


Prototype GOES-GOES Stereo 3D Winds with a Path into NOAA Operations

Houria Madani, James Carr (Carr Astronautics), Wayne Bresky (I.M. Systems Group), Jaime Daniels (NOAA/NESDIS)

- A stereo 3D Winds capability was developed to perform a joint retrieval of Atmospheric Motion Vectors and their Heights at a selected site.
  - It is based on using imagery where target scenes are viewed from different angles to determine cloud heights using the parallax displacement of observed features such as clouds
  - It does not require thermal IR for height assignment which makes it a valuable tool for mitigating the Loop Heat Pipe (LPH) issue of GOES-17.
  - It can be applied to several combinations of GEO-GEO and GEO-LEO satellites.
  - It has been ported into Fortran and integrated with the existing feature tracking capability in the STAR Algorithm Processing Framework (SAPF).
- Validation/Results with GOES-GOES
  - Heights validated against terrain heights from the GLOBE digital elevation database.
  - Wind vectors compared to radiosonde data at collocated sites show improvements over the baseline winds.



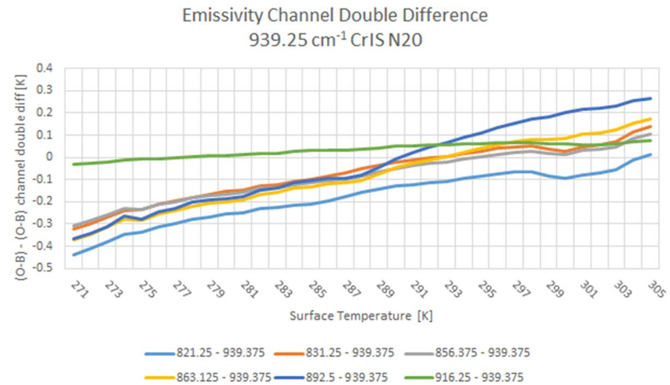


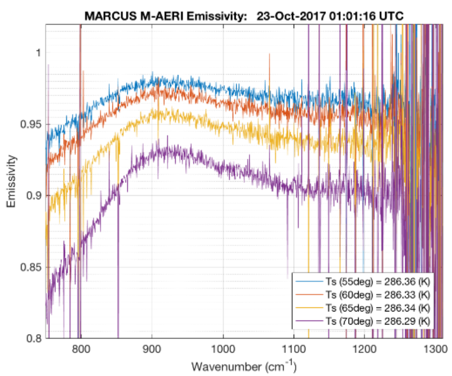
Temperature-Dependent Infrared Sea Surface Effective-Emissivity (IRSSE) Model: Theoretical Development and Validation

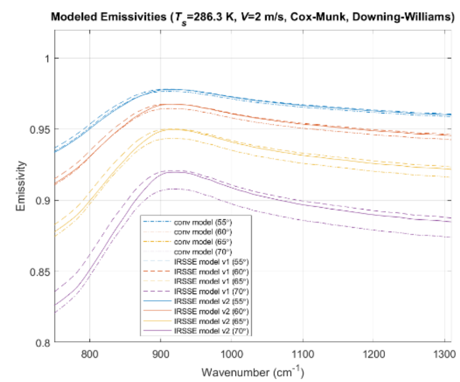
Nicholas R. Nalli, J. A. Jung, B. T. Johnson, T. Zhu, M. Chen, E. Liu, P. J. Gero, R. O. Knuteson, and L. Zhou

- For satellite IR remote sensing applications, the surface emissivity/reflectance spectrum must be specified with a high degree of absolute accuracy.
  - A 0.5% uncertainty can result in ≈0.3–0.4 K error in LWIR window channels...
  - Conventional IR sea-surface emissivity models have gained widespread acceptance (e.g., *Masuda et al.* 1988), but only after they were validated
  - The Marine Atmospheric Emitted Radiance Interferometer (MAERI) (*Smith et al.* 1996; *Minnett et al.* 2001) led to acceptance and application of emissivity models
  - However, recent findings of *Liu et al.* (2019) have shown a significant systematic bias (on the order of 0.5 K) on a global scale, thus bringing this issue back into focus for support.

- This presentation provides an overview the CRTM IRSSE (effective emissivity) model (*Nalli et al.* 2008) along with current progress on an upgrade to include temperature dependence.
  - The model will be conveniently rendered as 4-D and 5-D (instead of 3-D) lookup tables (LUT)
  - We plan to have the preliminary test model ready this fall, with testing to commence after that
  - Pending successful results, the theoretical model will then be parameterized and implemented within CRTM release version
  - We will continue our collaboration with UW/CIMSS and UM/RSMAS using MAERI data, including cold-water cruises.
  - We plan to extend this effort toward an upgrade of the ocean emissivity used by SARTA.







NOAA STAR CENTER FOR SATELLITE APPLICATIONS AND RESEARCH

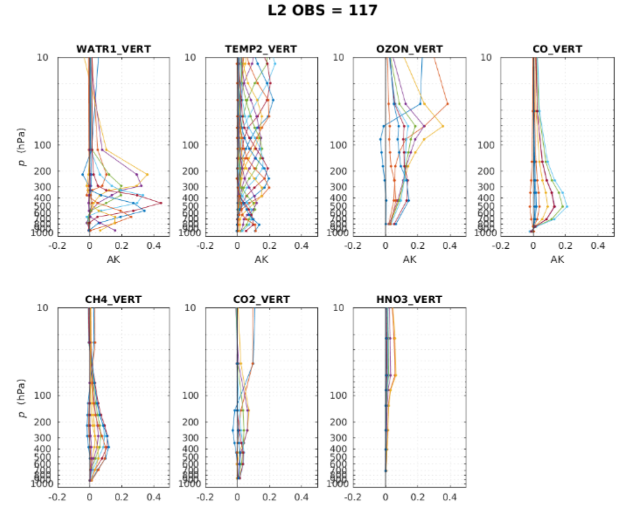
CISESS CIRA CUNY NOAA - Cooperative Remote Sensing Science and Technology Center CIMSS

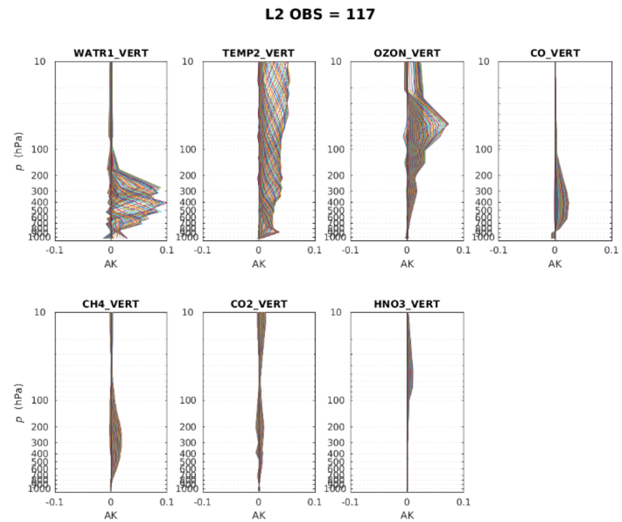
Using Averaging Kernels (AKs) for Validation of IR Sounder EDRs: Application to the NOAA Unique Combined Atmospheric Sounding System (NUCAPS)

Nicholas R. Nalli, C. Tan, L. Zhou, A. Gambacorta, K. Pryor, et al.

- This presentation overviews the application of averaging kernels (AKs) toward the validation of IR sounder retrieved environmental data records (EDRs) versus high-resolution correlative datasets.
  - Rigorous validation of these products are conducted with respect to various baseline in situ correlative (or "truth") datasets
  - In situ measurements typically have higher vertical resolution than the resolution afforded by hyperspectral IR sensors (viz., CrIS, IASI, AIRS).
  - Validation assessments provide estimates of the total retrieval system uncertainty, coupled with uncertainties in the truth measurement and collocation "mismatch error." Total system error also includes the so-called “null-space” error, that is, the error arising from the limitation of the retrieval vertical resolution.
  - By applying retrieval AKs to correlative data, we obtain smoothed profiles that represent what the sounding system theoretically “sees” given its resolution limitations, thereby removing these null-space errors.

- Attention is given to the ongoing validation of operational atmospheric profile EDR retrievals obtained by the NOAA Unique Combined Atmospheric Processing System (NUCAPS) onboard the NOAA-20 and SNPP satellites.
  - NUCAPS is a NOAA operational algorithm designed to retrieve global EDRs from the Cross-track Infrared Sounder (CrIS) and Advanced Technology Microwave Sounder (ATMS).
  - The presentation will include an overview of the NUCAPS "effective AKs“ (*Maddy & Barnet* 2008) along with examples in application to NUCAPS carbon trace gas retrievals.





CISESS

- James Beauchamp
- Tianfeng Chai
- Gwen Chen
- Eli Dennis
- Russ Dickerson
- Jun Dong
- Steve Goodman
- Erin Jones
- Yong-Keun Lee
- Xingming Liang
- Hui Liu
- Katherine Lukens (3)
- Patrick Meyers
- Fong Ngan
- Allison Ring
- Jonathan Wynn Smith
- Tianning Su
- Sirish Uprety
- Jeannette Wilde
- Jifu Yin
- Hyelim Yoo
- Bin Zhang

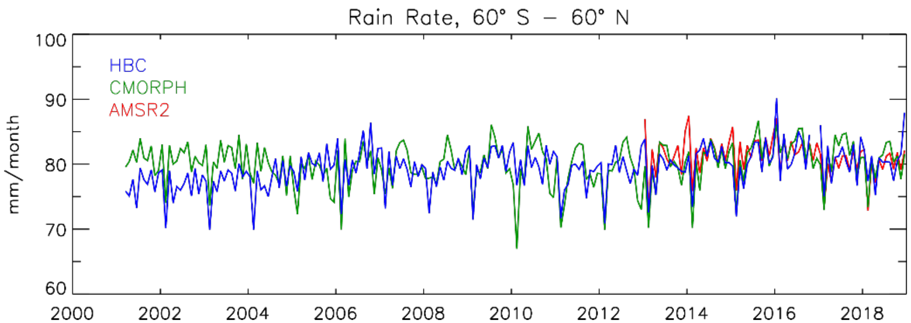
AMSU Climate Data Records and their Use in Hydrological Climate Studies

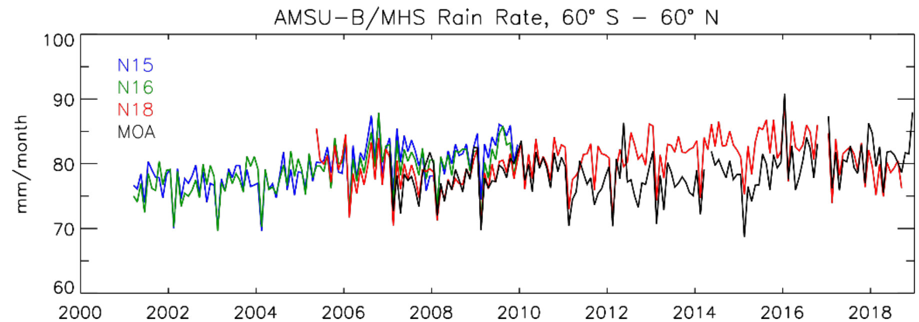
James Beauchamp and Yalei You (CISESS); Ralph Ferraro (NESDIS)

- Briefly described AMSU-A and AMSU-B/MHS sensors.
- Described inter-satellite calibration of their TBs.
- Presented TCDR products.
- Compared AMSU rain rate, CLW, TPW, and LST with CMORPH (RR), AMSR2 (RR, CLW, TPW) and MERRA-2 (LST).

AMSU-A and AMSU-B/MHS TCDRs

Product	Sensor	Units	Surface Type
Total Precipitable Water (TPW)	AMSU-A	mm	Ocean
Cloud Liquid Water (CLW)	AMSU-A	mm	Ocean
Land Surface Temperature (LST)	AMSU-A	mm	Land
Land Surface Emissivity (LSE)	AMSU-A	%	Land
Sea-Ice Concentration (SIC)	AMSU-A	%	Ocean
Rain Rate (RR)	AMSU-B/MHS	mm/hr	Land and Ocean
Ice Water Path (IWP)	AMSU-B/MHS	mm	Land and Ocean
Snow Cover (SC)	AMSU-B/MHS	Yes/No	Land
Snow Water Equivalent (SWE)	AMSU-B/MHS	mm	Land

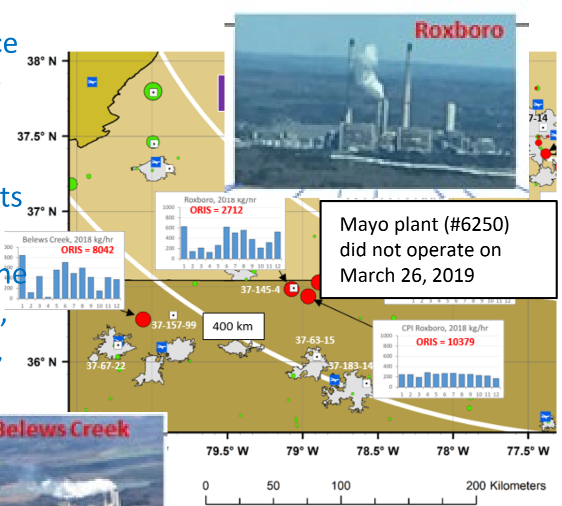




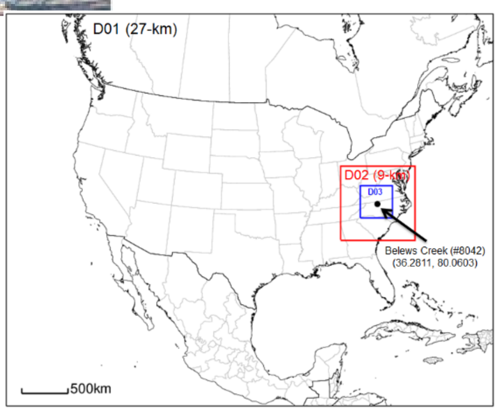
HYSPLIT Inverse Modeling Using Flight Observations to Estimate SO_2, CO_2, and NO_x Point Source Emissions

Tianfeng Chai[1,2,3], Xinrong Ren[1,2,3], Ariel Stein[1], Mark Cohen[1], Allison M. Ring[1,2,3], Alice Crawford[1], Christopher P. Loughner[1,3], Fong Ngan[1,2,3], Winston Luke[1], Paul Kelly[1,2,3], Phillip Stratton[2], Russell R. Dickerson[2], Anna Karion[4], Israel Lopez Coto[4], and James R. Whetstone[4]

Point source locations- Three operating power plants at VA/NC border on the flight date, March 26, 2019

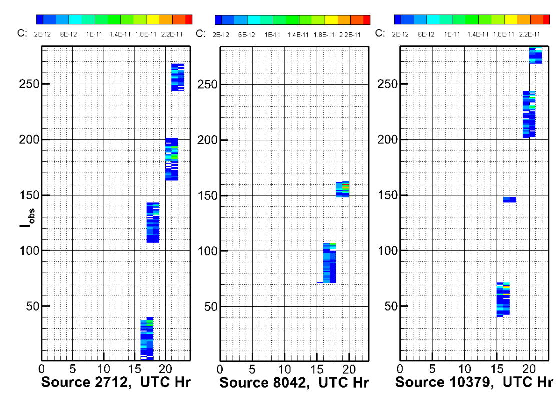


WRF domains used to generate meteorological inputs that drive HYSPLIT dispersion model



- Point source emissions are estimated using HYSPLIT and flight observations. Emission results are evaluated against CEMS data;
- Average SO_2 emissions are well estimated even without a good prior;
- CO_2 and NO_x emissions are overestimated due to low (CO_2) and no (NO_x) background values.

Transfer Coefficient Matrix (TCM) – for SO_2 at three power plants



Emission inversion result sat Roxboro (#2712) for SO_2, Unit: kg/hour

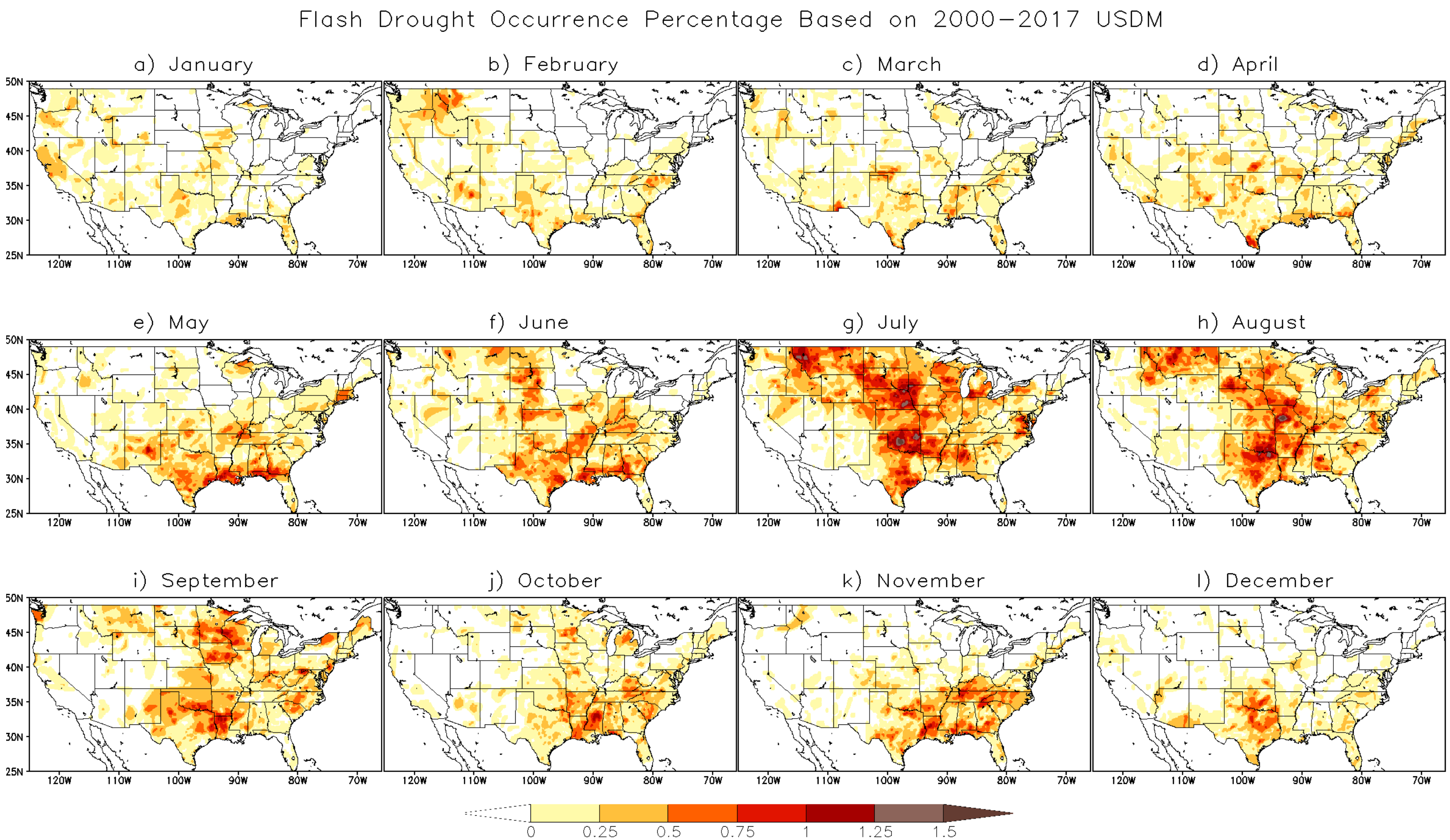
#2712	15:00Z	16:00Z	17:00Z	18:00Z	19:00Z	20:00Z	21:00Z	Average
CEMs	582	345	360	(509)	465	486	508	458
Case 1	1315	1899	420	-	561	292	28	752
Case 2	292	363	0	-	867	237	0	293
Case 3	892	1276	274	-	431	243	54	528
Case 4	292	363	0	-	873	234	0	294

Metric variable: ln(Y)- cases 1&3; Y- cases 2&4. First guess: 1±10000, cases 1&2; 500±450 , cases 3&4.

Flash Drought Characteristics Based on U.S. Drought Monitor

L. Gwen Chen (CISESS), Jon Gottschalck (CPC), Adam Hartman (CPC), David Miskus (CPC), Rich Tinker (CPC), and Anthony Artusa (CPC)

- Flash drought has distinct characteristics from conventional, slowly-evolving drought.
- Flash drought mostly occurred in the warm season and over the central U.S.



The Role of Soil Texture in Land–Atmosphere Interactions

Eli Dennis and E. Hugo Berbery
34th Conference on Hydrology, Poster

- Soil texture is a necessary component of land surface models
  - Soil texture categories are linked to soil hydraulic properties via a look-up table
  - Existing soil hydraulic properties are constant and empirically derived
  - The simplicity of this representation limits our ability to model sub-surface processes
- Land surface–atmosphere interactions are strongly driven by soil moisture
  - Because soil texture influences soil moisture, it also influences land–atmosphere interactions
  - Systematic soil texture differences between two "state-of-the-art" datasets resulted in non-random differences in multi-season surface fluxes
  - Stationary surface flux differences, related to soil texture, propagated through the planetary boundary layer and influenced regional climate

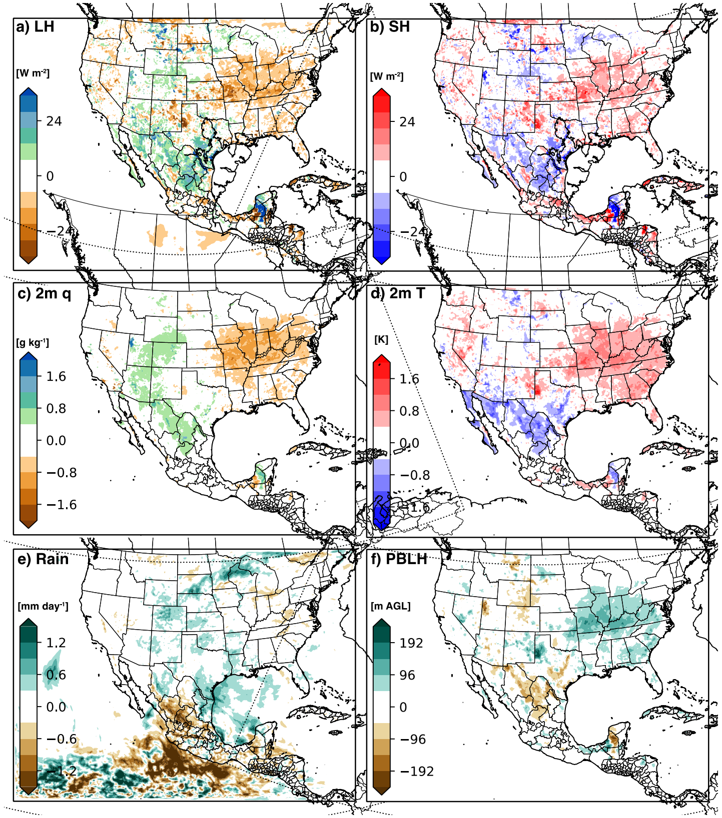
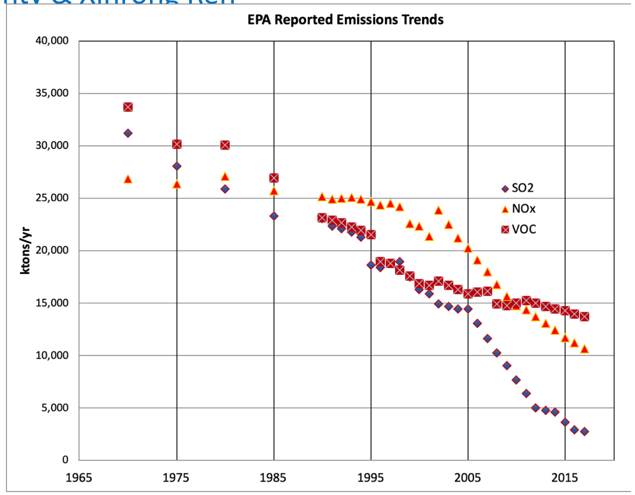


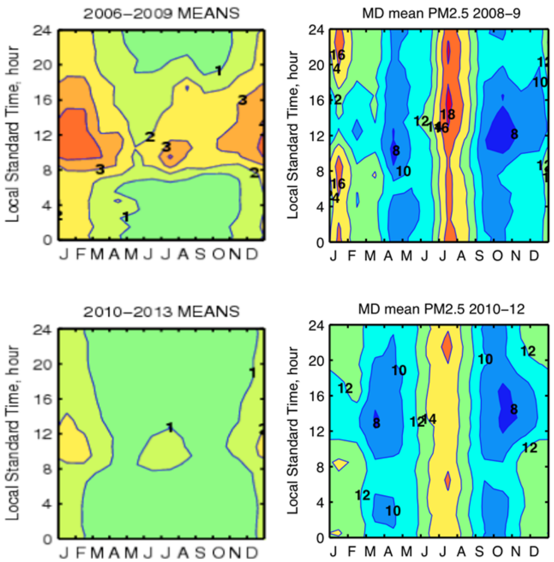
Fig. 1: Reductions in latent heat flux (a) are co-located with reductions in soil grain size, consistent soil hydraulic theory. These differences propagate through the boundary layer. Sensible heat flux (b), 2-m Mixing Ratio (c), 2-m temperature (d), precip (e), and PBLH (f)

Decadal Trends in Air Pollution over the Eastern United States: A Remarkable Success Story

Russell R Dickerson, Tim Canty & Xinrong Ren



- For the United States:
  - Steady reductions in SO_2;
  - NOx did not start improving until 2003; and
  - VOCS improved until ~2000.
  - Particulate matter ($PM_{2.5}$) only fell modestly.



- Current Challenges
  - Get NOx emission right, especially from vehicles;
  - Focus on the right VOCs;
  - Go down to micrometeorology and up to higher resolution; and
  - Match standard to health science.

Recent Development in NOAA/NESDIS Snowfall Rate (SFR) Product and Its Applications

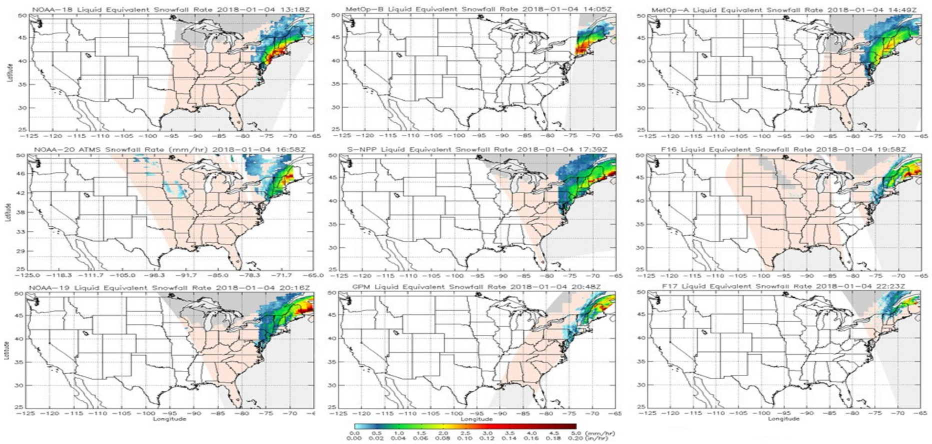
Jun Dong & Cezar Kongoli (CISESS), Huan Meng, Ralph Ferraro, Banghua Yan, Limin Zhao (NESDIS), Pingping Xie & Robert Joyce (NCEP)

- New bias-correction
  - Significant improvement to performance metrics against NCEP Stage IV radar and gauge combined precipitation analysis

NOAA-20	Corr Coeff	Accuracy (mm/hr)	Precision (mm/hr)
Before	0.49	0.26	0.84
After	0.66	-0.07	0.57

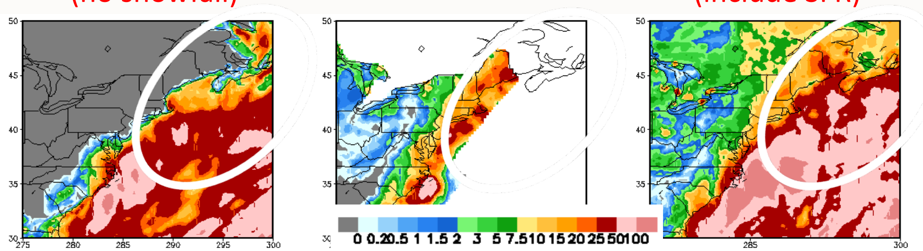
  - Additional improvement to snowfall detection through adjustment to snowfall rate estimation and SFR low limit threshold
  - All ATMS and MHS SFR algorithms from five satellites have been updated with the bias-correction
- SFR applications
  - Radar and satellite blended snowfall rate, mSFR
  - Input to the NCEP/CPC CMORPH2 global pole-to-pole blended precipitation analysis

Winter Storm Grayson, 3-5 Jan, 2018
(Images from 4 Jan, 2018, 13:18 - 22:23UTC)



Winter Storm Grayson 3-5 January 2018

CMORPH (no snowfall) | Stage IV Radar | CMORPH2 (include SFR)



NWS Use of Near Real-Time Lightning Data from the Lightning Imaging Sensor (LIS) on the International Space station (ISS)

S. J. Goodman[1], R. J. Blakeslee[2], B. P. Pettegrew[3], A. Terborg[3], M. J. Folmer[4], S. S. Lindstrom[5], S. G. Harrison[6], K. S. Virts[6], S. N. Stevenson[3], and G. T. Stano[6]
[1]GOES-R/TGA, [2]NASA MSFC, [3]NWS (AWC, NHC)/CIRA, [4]NOAA/NWS/OPC, [5]CIMSS, [6]UAH

- As with GOES-R GLM, the Lightning Imaging Sensor (LIS) on the International Space Station (ISS) continuously observes the amount, rate, and radiant energy of lightning within its field-of-view as it orbits the Earth.

  (https://lightning.nsstc.nasa.gov/isslisib/isslisnrt.html)

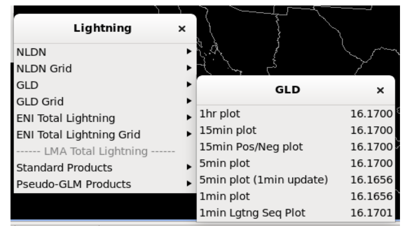
- ISS-LIS and GLM provide total lightning observations that will complement lightning data already available to NWS forecasters in AWIPS (at right).

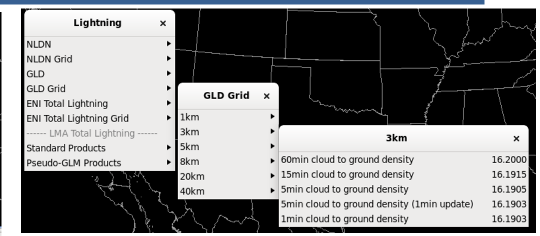
- LIS, GLM, and multiple ground network group/stroke/flash counts for offshore storms on 2018-01-04 and 12-01-2019. None of the GLD strokes were classified as IC. Only lightning within the nominal LIS field of view is included.

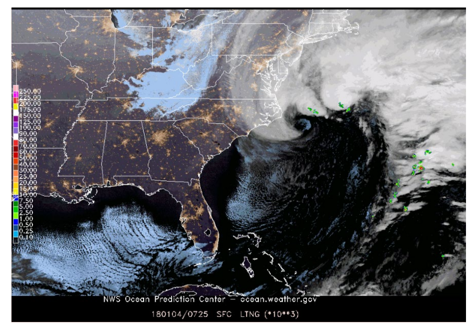
- (Lower left) Gray dots indicate the LIS swath. Previous studies have shown lightning in storms passing over the Gulf Stream can have considerable lightning.

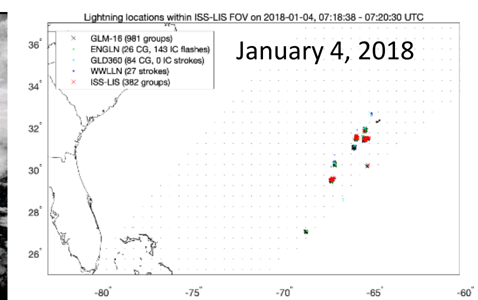
- (Lower right) GLD360 lighting for Nor'Easter with 431,535 lightning strokes, 37 of which had very large peak currents >300 kA (Superbolts?). Such large peak currents are not uncommon in winter and oceanic storms having extensive electrified clouds extending over hundreds of kilometers.

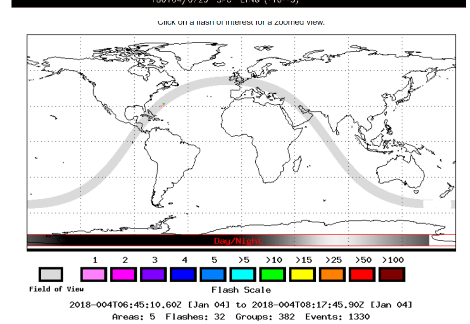
NWS Lightning Products

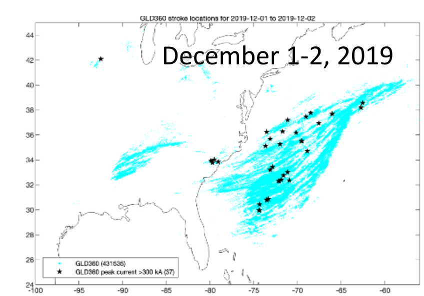










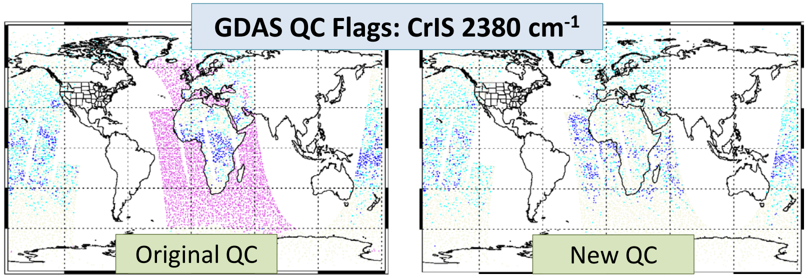


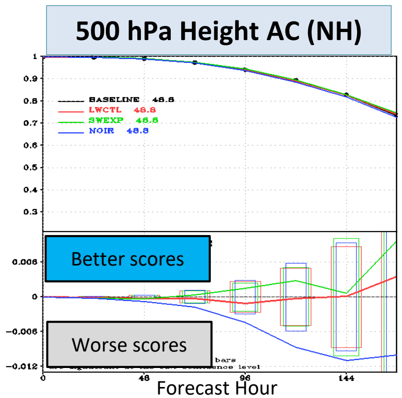
Efforts to Evaluate Shortwave Observations from the CrIS Hyperspectral Infrared Instrument in the NOAA Global Data Assimilation System

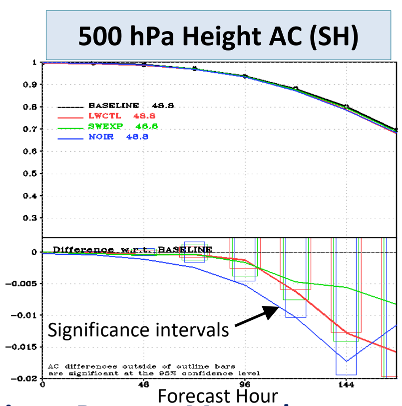
Erin Jones and Yingtao Ma (UMD/CISESS at STAR), Chris Barnet (STC), Kevin Garrett (STAR), Kayo Ide (UMD/CISESS), Sid Boukabara (STAR)

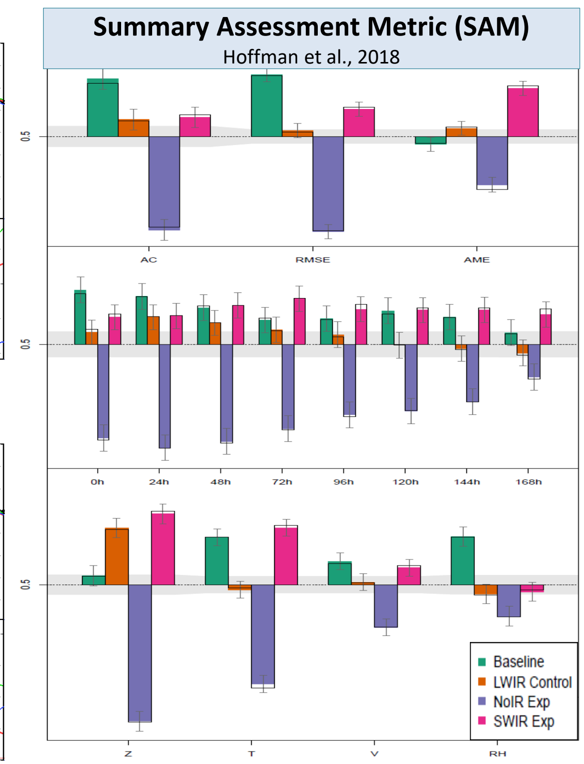
- The NOAA Global Data Assimilation System (GDAS) was updated for CrIS shortwave (SWIR) observations
  - SWIR observations are not currently assimilated operationally
  - Goal is to assess whether value can be derived from using observations from a SWIR instrument in data assimilation
  - QC modifications made in GDAS for CrIS SWIR
    - New check for sun glint, check for daytime observations over ocean removed
    - Cloud detection done using SWIR channels instead of LWIR channels
  - Scene-dependent observation error implemented for colder/higher peaking CrIS SWIR channels

- Experiments assimilating CrIS SWIR observations were performed
  - Updates to QC and observation errors allowed more SWIR observations to pass QC without degrading OmA/OmB statistics
  - Assimilating SWIR CrIS observations showed similar or better impact on the forecast to assimilating longwave (LWIR) CrIS observations when verified against ECMWF, and considerably better impact than assimilating no hyperspectral infrared observations
  - Results indicate that there is value in using SWIR observations in data assimilation for numerical weather prediction









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The Microwave Integrated Retrieval System (MiRS):

Validation Activities for NOAA-20/ATMS Products and New Science Developments

Yong-Keun Lee & Christopher Grassotti (CISESS); Shuyan Liu (CIRA); Yan Zhou (CISESS); Ming Fang (IMSG); Quanhua Liu (NESDIS)

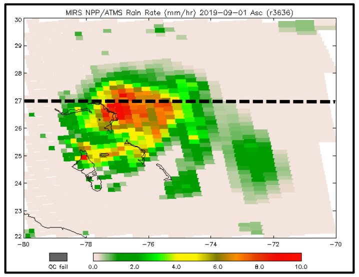
- MiRS is in validated maturity status since Sep. 2019. All official products have been compared with independent reference data globally and in different seasons.

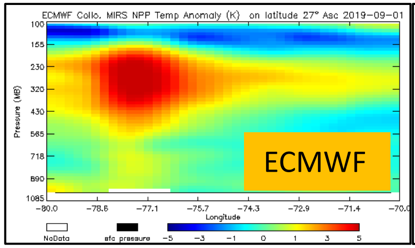
- MiRS-TC is being developed for retrievals in the tropical cyclone (TC) environment.
  - MiRS products (T & WV) are used in the operational TC Intensity Algorithm (HISA)
  - Currently testing the usage of high frequency channels, varying first guess/background constraints, and varying the number of EOFs
  - MiRS TC retrieval for rainy (dist < 100km) provide promising results for T & WV retrievals and warm core structure

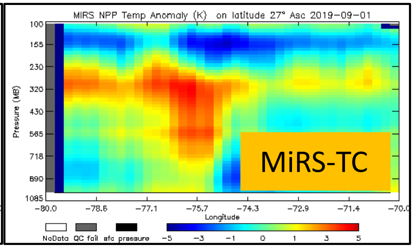
- Maching learning Dynamic bias correction is being developed.
  - Alternative to the current operational static bias.
  - To remove potential systematic bias between the measurements and the CRTM simulations
  - Machine learning based bias correction provides promising retrieval results over the globe, especially in cloudy and light rain cases.

Rain rate and Temperature Anomaly Cross-section

Dorian: 2019-09-01, NPP ascending

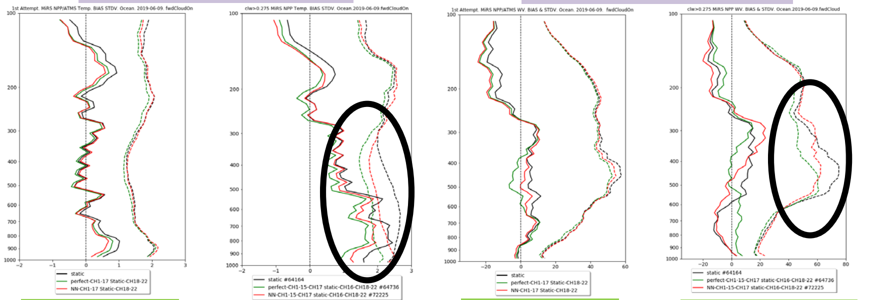






NN TB_bias applied in MiRS

Temperature Profile | Water Vapor Profile

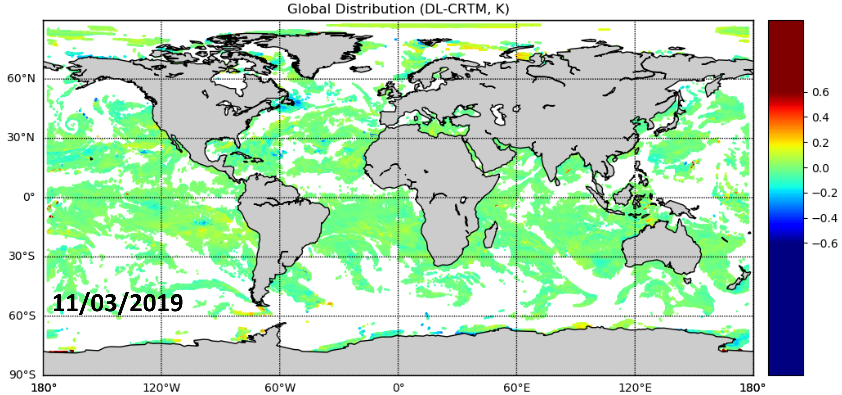


All conditions | CLW > .275mm | All conditions | CLW > .275mm

Applying Deep Learning to Top-of-the-Atmosphere Radiance Simulation for VIIRS by Community Radiative Transfer Model

Xingming Liang[1,2] and Quanhua Liu[1]   [1]*NOAA STAR*, [2]*UMD ESSIC*.

- **A Deep-Learning (DL) algorithm was proposed to simulate TOA BTs for VIIRS TEB/M Bands with CRTM as references**
  - 278 features were selected from ECMWF as model input
  - The objective is to improve the efficiency of model simulation
- **Sensitivity analysis showed:**
  - BN introduction much improve the performance of cost function
  - Multi-band training are more efficient than single-band
- **The DL model trained with 12-day data in 2018 was applied to predict 11/03/2019**
  - Mean and STDs are -0.01±0.04 K for dependent Data, and -0.02±0.1 K for independent data
  - Indicated DL model has capability to accurately reproduce BTs for VIIRS TEB/M bands, which are comparable with CRTM.
  - Reproducing global BTs for five TEB/M bands without GPU support, DL model took ~10 seconds, compared with 2-3 minutes of CRTM.



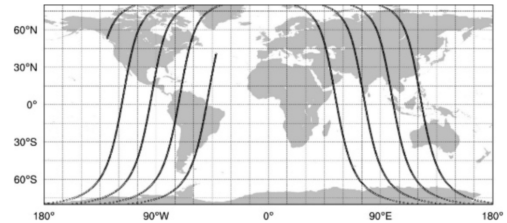
11/03/2019	Dependent Data		Independent Data	
	μ	σ	μ	σ
M12	-0.0080	0.0319	-0.0082	0.0911
M13	-0.0081	0.0357	0.0057	0.1118
M14	-0.0100	0.0355	-0.0190	0.0960
M15	-0.0094	0.0362	-0.0152	0.0928
M16	-0.0097	0.0417	-0.0123	0.0957

Initial Impact Assessment of ADM-Aeolus Wind Observations on NCEP global Analysis and Forecast

Hui Liu[1], K. Ide[1], K. Garrett[2], R. N. Hoffman[1]
[1]University of Maryland/CICESS; [2]NOAA/NESDIS/STAR

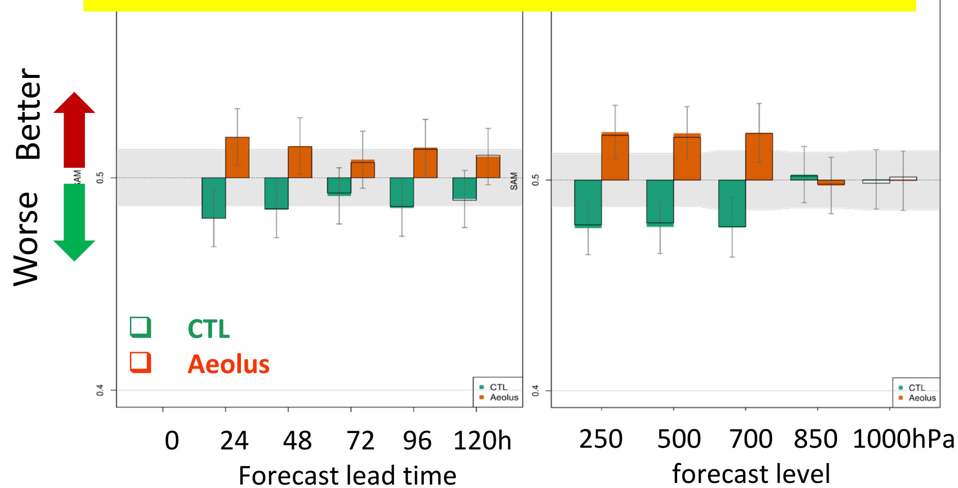
- Global wind profiles from 1st satellite wind Lidar (Aeolus)
  - Vertical range 0-24km
  - Averaging resolutions: 10 and 87km in horizontal; and 0.5 and 1km in vertical.
  - ~ 1600 profiles every 6-hour cycle
  - Data available since Aug 22, 2018

- Initial impact assessment on NOAA global forecast from Observing System Experiment
  - Experiments at C384/C192 resolution
  - NOAA GDAS Operational 4DEnVar system
  - Control run (CTL): assimilates all operational observation types
  - Aeolus experiment: adds Aeolus wind
  - Positive impact of Aeolus wind on GFS forecast in the Southern Hemisphere and Tropics
  - Neutral impact in the Northern Hemisphere



Aeolus wind locations, Oct 16 12UTC cycle, 2018

A summary score of forecast verifications vs. ECMWF analysis (Hoffman et al., 2018). The scores in Southern hemisphere are shown below.



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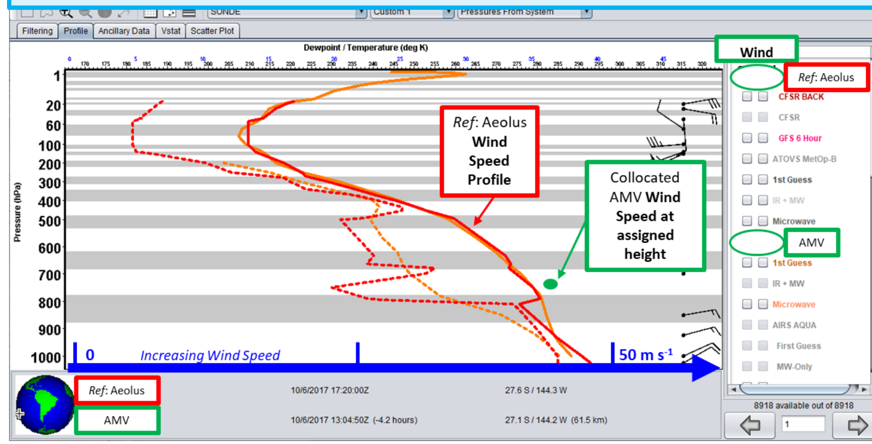
Toward Error Characterization of Atmospheric Motion Vectors through Intercomparisons with Aeolus Wind Profiles – So Far

Katherine E Lukens (CISESS, STAR), Kayo Ide (CISESS), Kevin Garrett (STAR), Hui Liu (CISESS, STAR), Ryan C Smith (IMSG), Ross N Hoffman (CISESS, STAR), and Tony Reale (STAR)

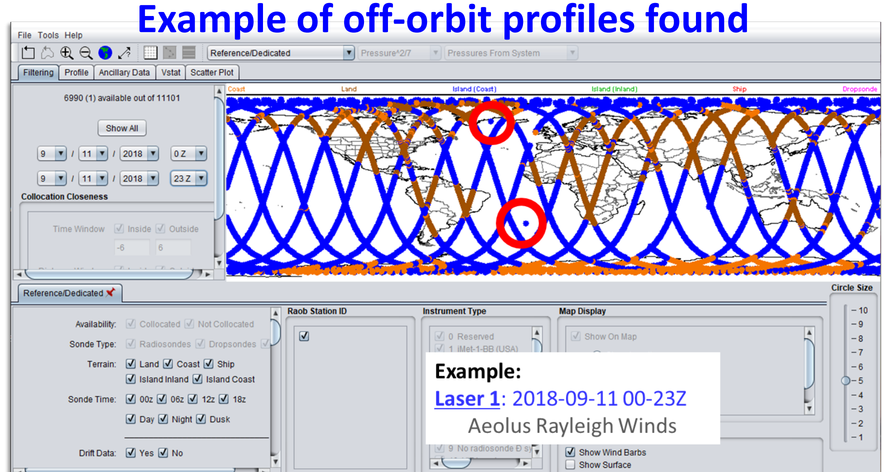
- **To exploit Aeolus wind profile information to better characterize (and potentially improve) AMV height assignment error**, we will leverage an existing assessment tool and extend it to include wind assessment capabilities: *NOAA PROducts Validation System (NPROVS) Enterprise*
  - ***Conceptual Example →***
    ProfileDisplay application:
    Pressure (y-axis) vs Wind Speed (x-axis)

NPROVS Enterprise Illustrative Concept



- **Off-orbit profiles were found in datasets from both lasers onboard Aeolus.**
  - Issue is only evident in EE files, *not* in BUFR. Reported issue to ESA.
  - **Resolution**: ESA to include source code fix in next data release: L2BP v3.30 (~end of Jan 2020)
  - Full discussion on Aeolus Confluence page: https://www.aeolus.esa.int/confluence/display/CALVAL/OFF_001

Example of off-orbit profiles found



Winter Storm Tracks and Related Weather in the NCEP Climate Forecast System (CFS) Weeks 3-4 Reforecasts for North America

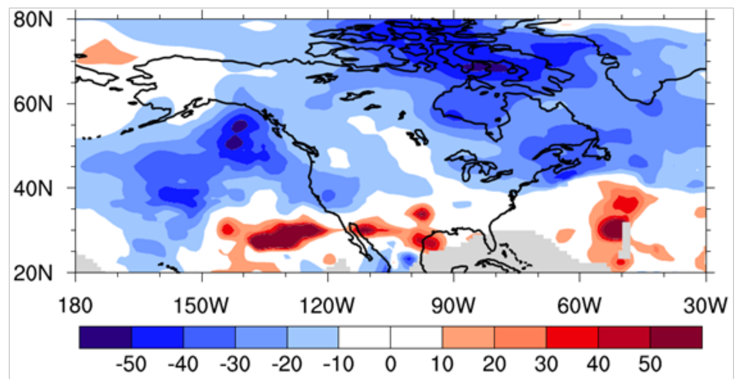
Katherine E Lukens and E Hugo Berbery (CISESS)

<u>Hypothesis</u>: **If storm tracks (ST) contain S2S signals, their characterization in long term forecasts could advance S2S prediction of severe weather** by providing information at longer lead times that may not be acquired from standard wind and precipitation forecasts.

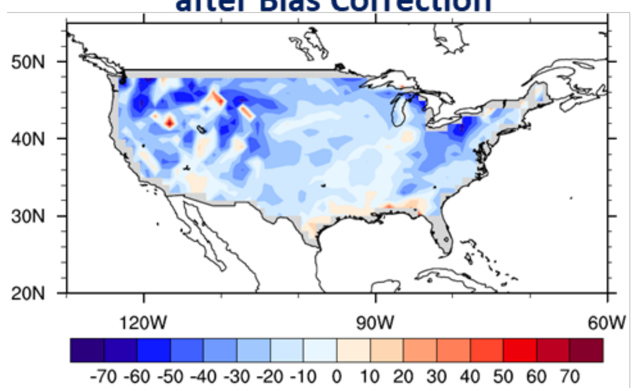
- **Weeks 3-4 CFS reforecasts (CFSRR) are found to contain useful storm track-related information that could supplement existing severe winter weather outlooks**.
  - Statistically significant positive biases are found in PV storm intensity. **Bias correction (CFSRR – CFS reanalysis) reduces error by as much as 50% in ST regions**.
  - **Bias correction improves representation of storm track-related winter weather**:
    - **Storm wind bias correction further reduces small yet significant reforecast error on average by 12% in ST regions.** Bias-corrected fields better show increase in frequency of high impact wind events relative to uncorrected fields.
    - **Storm precipitation bias correction reduces reforecast error on average by 25% over CONUS.**

Publication: Lukens and Berbery (2019): https://doi.org/10.1175/WAF-D-18-0113.1

% Change in Storm Intensity RMSE after Bias Correction



% Change in Storm Precip RMSE after Bias Correction



Assessment of Stratospheric Balloon Observations towards Assimilation in NOAA's Global Data Assimilation System (GDAS)

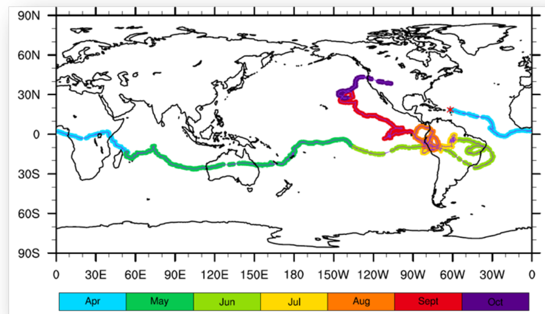
Katherine E Lukens (CISESS, STAR), Kayo Ide (CISESS), Kevin Garrett (STAR), and Likun Wang (RTI at STAR)

- **To provide a comprehensive evaluation of the value, capability, and potential benefit of long-duration stratospheric balloon data to NOAA missions**, we evaluate observations from an existing balloon network deployed by Loon™.
  - Balloons are capable of withstanding harsh stratospheric conditions for months at a time.
  - 1182 balloons were launched in 2014-2018, with 142 balloons launched in 2018.
- Loon stratospheric balloon observations provide in situ data in information-sparse upper atmosphere.
  - Loon winds and nighttime temperatures (T) provide good quality data for assimilation.
- Impact assessment in preparation.
  - Building capability to assimilate Loon wind and night T observations in FV3GFS.

Loon is a registered trademark of Loon LLC.

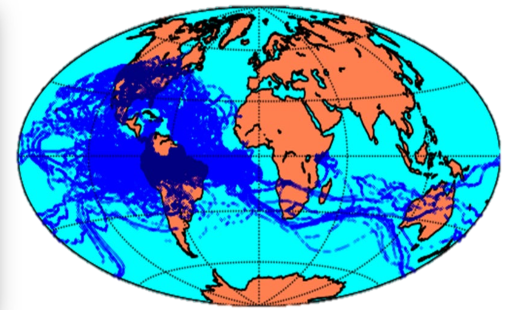
***Example*: Flight path of single balloon in 2017**

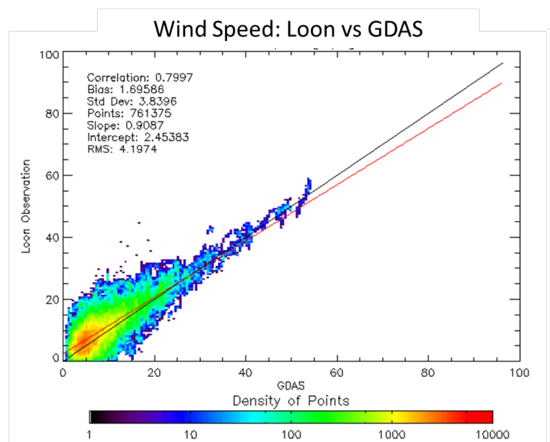
Red star indicates approx. launch site



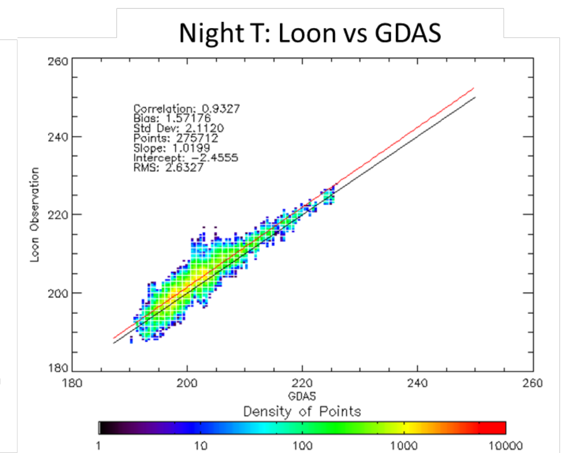
Loon Trajectories in 2018

142 balloons launched





Density scatter plot comparing Loon wind speed observations on y-axis with GDAS analysis on x-axis for all flights in October 2017. Colors indicate the number of observations. Red line indicates the best linear fit. Black line is the one-to-one line. A list of statistics are provided in the top left corner. Units are m/s.

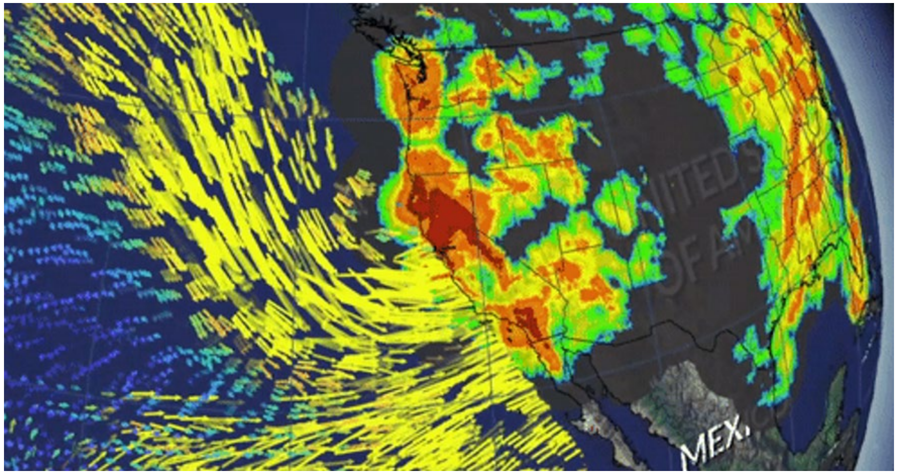


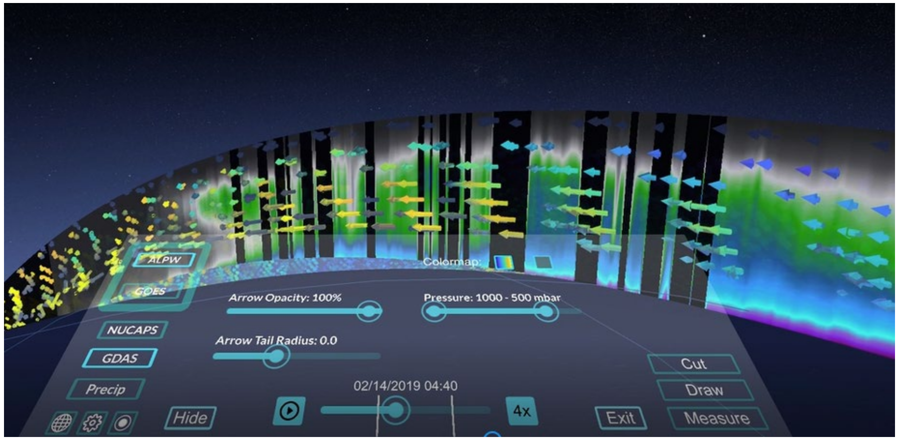
Density scatter plots comparing Loon temperature observations on y-axis with GDAS analysis on x-axis for all flights in October 2017 for local nighttime T. Colors indicate the number of observations. Red line indicates the best linear fit. Black line is the one-to-one line. A list of statistics are provided in the top left corner of each plot. Units are K.

Exploring Satellite Observations in Virtual Reality

Patrick Meyers and Mason Quick (CISESS); Scott Rudlosky (STAR); Eric Lee, David Lee, and Coauthors (Univ. of Maryland)

- Created an interactive demonstration of weather data in Virtual Reality
  - GOES ABI; Advected Layered Precipitable Water; NUCAPS, GDAS winds; MRMS rainfall; SMOPS Soil Moisture; JPSS Snowfall Rate
  - Users can zoom, rotate, navigate, create cross-sections, draw, measure distances, and loop over time
- Three-minute narrated video of an Atmospheric River event
  - Highlights the software's ability to interrogate 3D atmospheric data

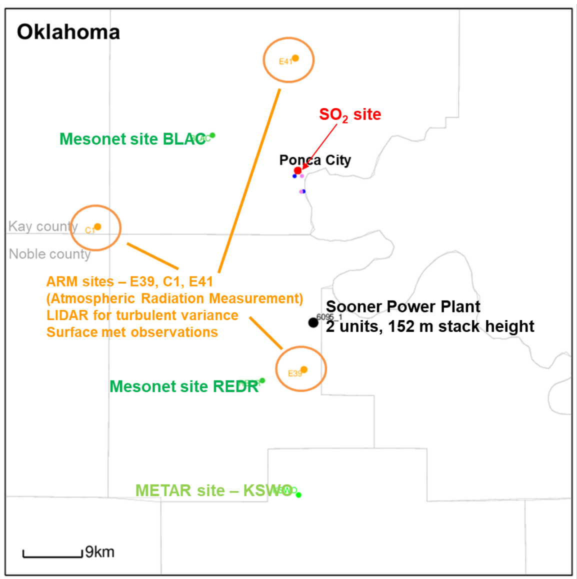




Evaluation of Turbulent Mixing in HYSPLIT Using a Tracer of Opportunity Dataset

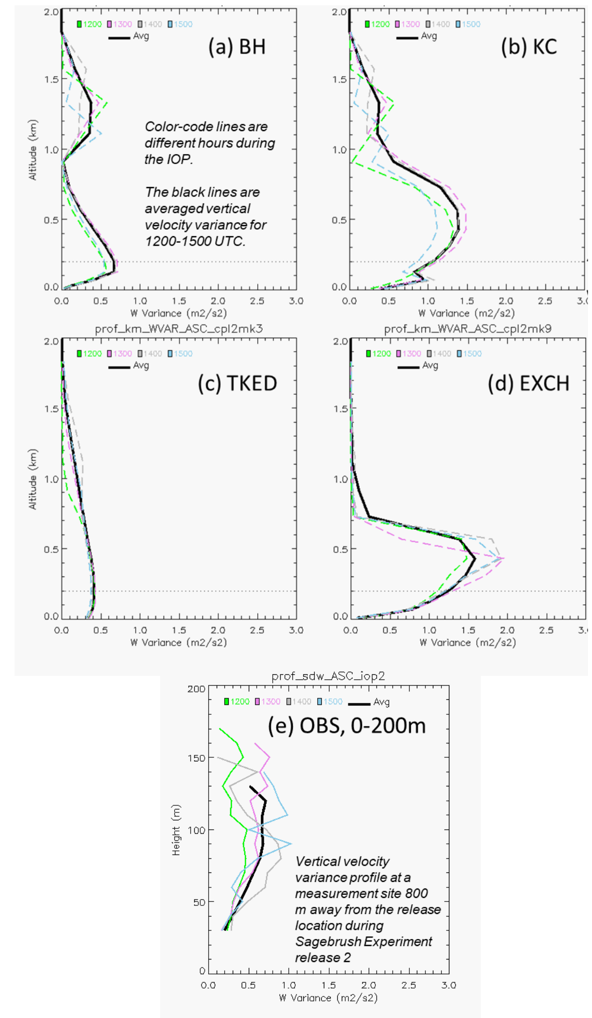
Fantine Ngan (CISESS); Alice Crawford & Mark Cohen (NOAA/ARL), Christopher Loughner (CISESS, ESSIC); Ariel Stein (NOAA/ARL)

- NOAA's dispersion model, HYSPLIT, was evaluated with measurements of the velocity variance and downwind tracer concentrations from the Sagebrush tracer experiment.
- An alternative dataset also used to evaluate turbulent mixing:
  - SO2 emissions from power plants
  - Ground measurements of downwind SO2 concentration.
  - Velocity variance measurements from Lidar.



- Identify study areas with available meteorological observations (especially for turbulent parameters).
- Deploy additional instrumentation if needed.
- HYSPLIT-based inverse modeling could be applied to refine estimates of less-characterized emission sources.

Vertical velocity variance profile generated by different mixing options in HYSPLIT



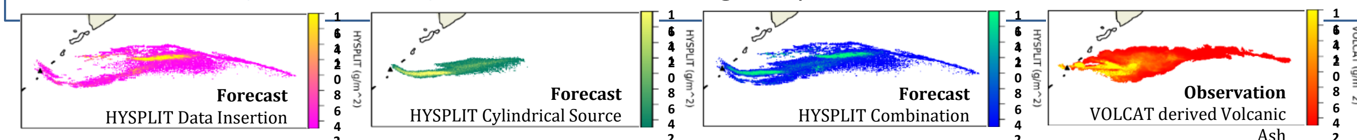
Volcanic Ash Forecast Verification using HYSPLIT and Satellite Ash Observations identified by VOLCAT

By: Allison M. Ring, Alice M. Crawford, Barbara J.B. Stunder, Justin Sieglaff, and Michael J. Pavolonis

1. Motivation

- Improve volcanic ash forecasting tools and capabilities for Volcanic Ash Advisory Centers (VAACs)

3. Raikoke Eruption Example: HYSPLIT modeling components at forecast time T1 + 6hr

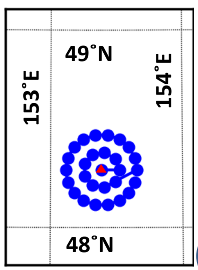


2.

Modeling methods used:

Cylindrical Source:

- Line source at vent
- Two concentric circles
- Total of 28 source points
- Columns from 2km-12km
- Emissions for 3 hours



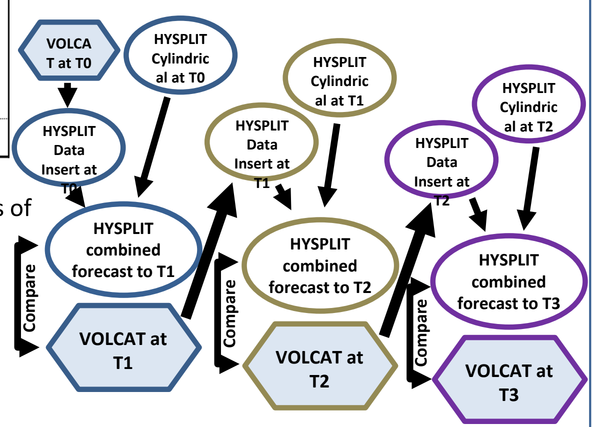
Data Insertion:

- Initializes HYSPLIT with satellite observations of *ash mass loading* and *ash top height*
- Models ash already emitted by volcano

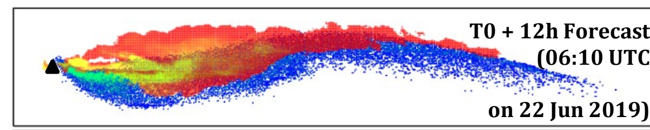
Combination:

- Adds the cylindrical source (ash to be emitted) and data insertion (ash already emitted) together

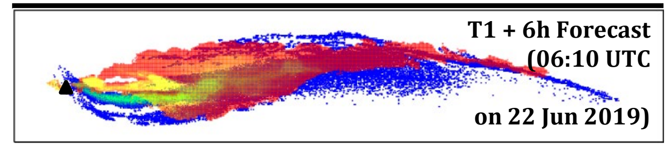
HYSPLIT Modeling of Volcanic Ash Workflow



4. Statistical Verification of HYSPLIT Forecasts



CSI	FSS (3x3 km)	FSS (9x9 km)	FSS (15x15 km)
0.33	0.50	0.58	0.60



CSI	FSS (3x3 km)	FSS (9x9 km)	FSS (15x15 km)
0.45	0.62	0.70	0.72

5. Conclusions:

HYSPLIT combination method is most appropriate for modeling ongoing volcanic eruptions – HYSPLIT ash forecasting capability improves with combination method.

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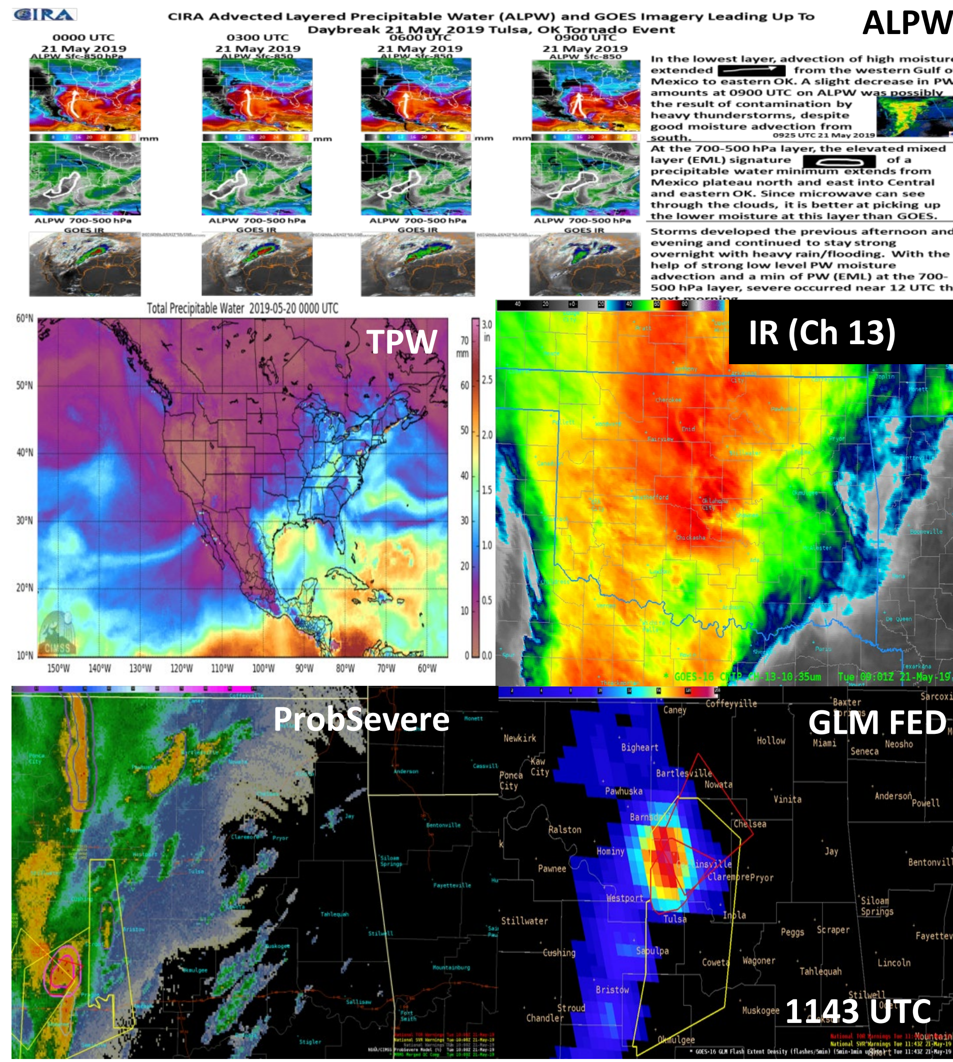
Severe Convection: NOAA Satellite Ever-Watchful After Dark

AMS 2020 Short Course: From GOES-R and JPSS Satellites to Disaster Response: Every Decision Counts

Jonathan W. Smith (CISESS/UMD/ESSIC); Steve Goodman (GOES-R Program Sr. Advisor)

- JPSS and GOES-R Products predicts the onset of severe convection in Northeastern Oklahoma on 20-21 May 2019
  - Synoptic-dynamic regime present for the development of severe convection
  - Tulsa, OK in Moderate severe weather risk and 15% tornado risk
  - Total Precipitable Water depicts strong moisture advection from Gulf of Mexico
  - Advected Layer Precipitable Water identifies Surface-850 mb moisture and an instability cap (Elevated Mixed Layer) from 700-500 mb

- The Clean IR (Channel 13), ProbSevere, and GLM Flash Extent Density (FED) supplement radar data for nowcasting and warning issuance
  - CIMSS ProbSevere suggests 80-90% probability of bow echo being severe as it moved northeastward ahead of squall line
  - GLM FED shows a rapid increase in lightning flash rate prior to the issuance of the 2nd tornado warning at 1143 UTC
  - Two tornado warnings issued for Tulsa County, OK based on velocity couplets and circulations evident on radar
  - Decision makers should consider having JPSS/GOES-R satellite products as resources in the event radar is not available during severe weather

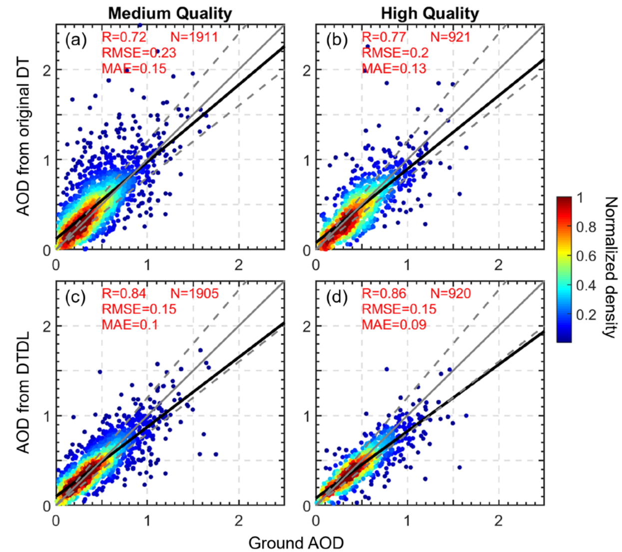


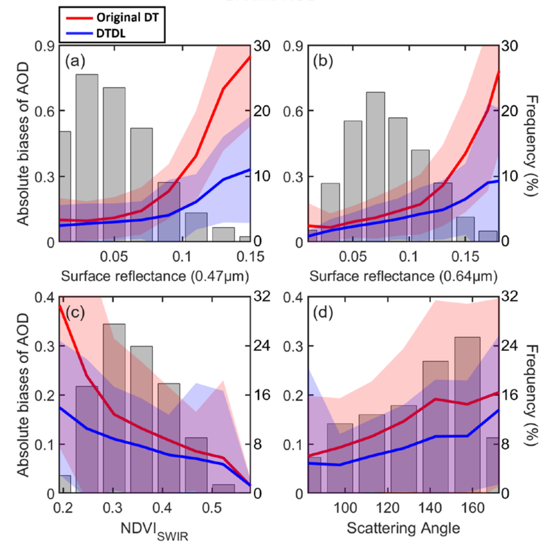
Retrieving aerosol optical depth retrievals over land by constructing the relationship of spectral surface reflectances through deep learning: application in Himawari-8

TIANNING SU

- We develop a new method combined with traditional physical approaches and deep learning techniques to retrieve AOD from Himawari-8 geostationary satellite.
  - A scheme is developed to construct surface reflectance relationships (SRR) through deep learning techniques.
  - DL-SRR scheme has been implemented to the AOD algorithm developed at NOAA/STAR for the Advanced Himawari Instrument (AHI) aboard the Himawari-8.

- The new algorithm (DTDL) demonstrates better performance over the study region.
  - There are considerable reductions in random noises, especially for low NDVI and high surface albedo cases.
  - Robust independent tests indicate this algorithm can be applied for untrained regions.
  - Our study provides insights into how artificial intelligence could significantly improve the AOD retrievals from multi-spectral satellite observations.

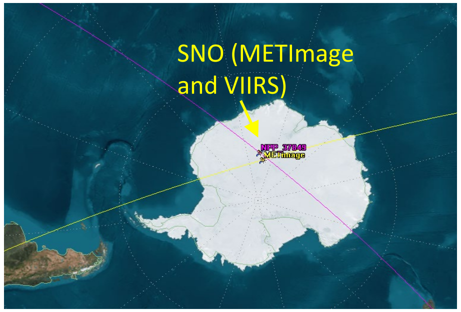


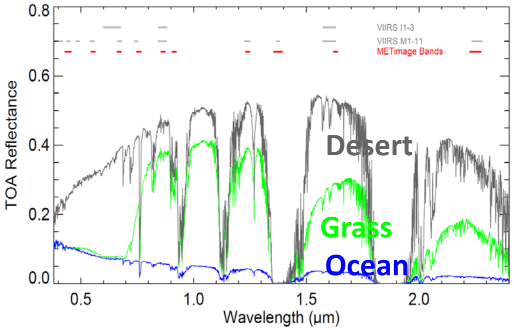


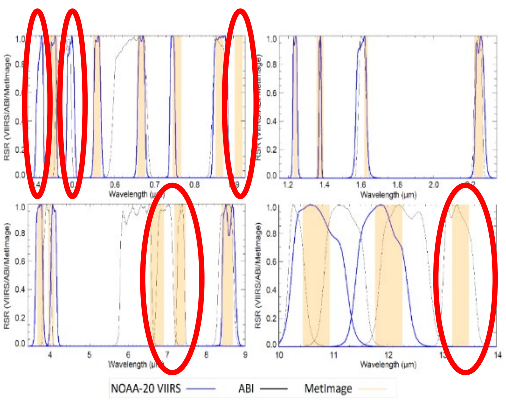
Establish operational Earth observation data continuity with VIIRS and METImage

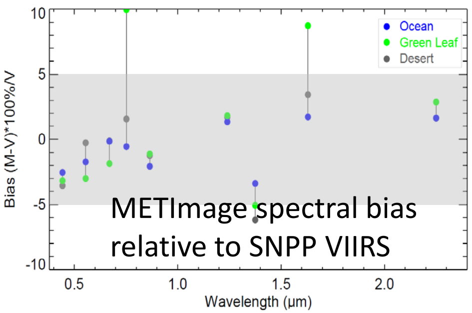
Sirish Uprety, Changyong Cao, and Xi Shao

- VIIRS and METImage have similar characteristics, but significant differences exist as well.
  - VIIRS supports ocean color capabilities, and low light imaging (Day/Night Band)
  - METImage enables water vapor products (NIR channels: 0.914 µm, 0.86 µm, 1.24 µm and Infrared bands: 6.725 µm, 7.325 µm)
- METImage radiometric performance and consistency with VIIRS can be analyzed after launch using
  - SNOs, PICS (such as Libya 4, Sudan 1, Dome C), Deep Convective Cloud (DCC), Lunar observations
- METImage measured radiance and reflectance can differ from VIIRS by mostly to within 5% mainly due to RSR mismatch and possible differences in solar models.





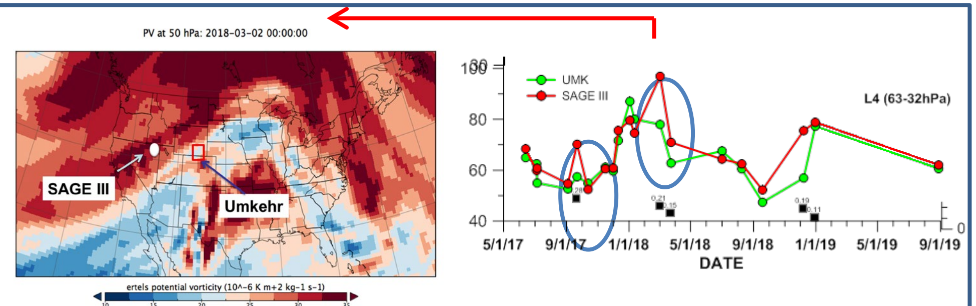




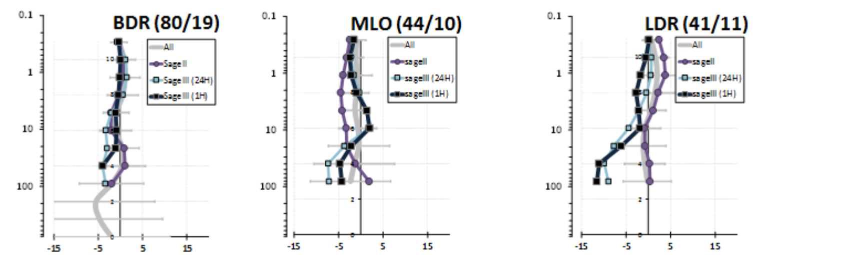
Validation of SAGE III-ISS Ozone with NOAA OMPS and Ground-based Instruments

Jeannette Wild (CISESS), Irina Petropavlovskikh (CIRES), Sean Davis (NOAA/ESRL), Karen Rosenlof (NOAA/ESRL), Craig Long (NOAA/CPC)

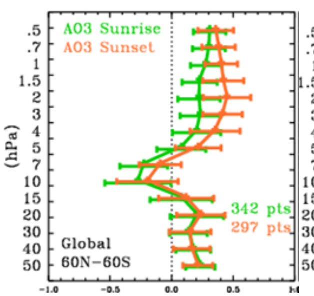
- Project Goal:
  - Discern if SAGE III on the International Space Station (ISS) is of comparable quality to be included in trend quality ozone profile datasets by comparison to ground and satellite datasets.
- Results:
  - For overpass/ground-based comparisions, smoothing, position in the same air mass, and time difference of measurements are factors to consider.
- Key Message:
  - SAGE III ISS is comparable in character and accuracy to SAGE II and should be suitable for inclusion in composite ozone profile data records for use in trend studies.



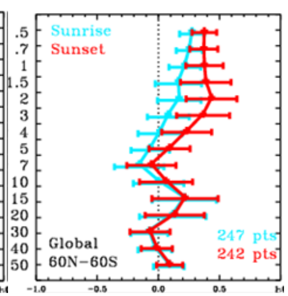
PV correlates with large differences in overpass ozone.



Lower stratosphere biases improve with shorter time differences; SAGE III results within a few % of SAGE II.



SAGE III – OMPS S-NPP Bias



SAGE II - SBUV2 N11 Bias

Comparisons of Global bias SAGE III to OMPS and SAGE II to SBUV2 have similar characteristics.

A Method for Objectively Integrating Soil Moisture Satellite Observations and Model Simulations toward a Blended Drought Index

Jifu Yin (jifu.yin@noaa.gov), Xiwu Zhan, Christopher R. Hain, Martha C. Anderson, Mitchell Schull

- An optically blended drought index (BDI_b) that objectively integrates drought estimations with the lowest TC-derived RMSEs was developed.
- Relative to the weighted blending index, the developed BDI_b performs more consistently with the drought monitoring benchmarks.
- In addition to operational insights, the BDI_b is recommended as an indicator which can merge new upcoming satellite SM products and more available drought evaluations

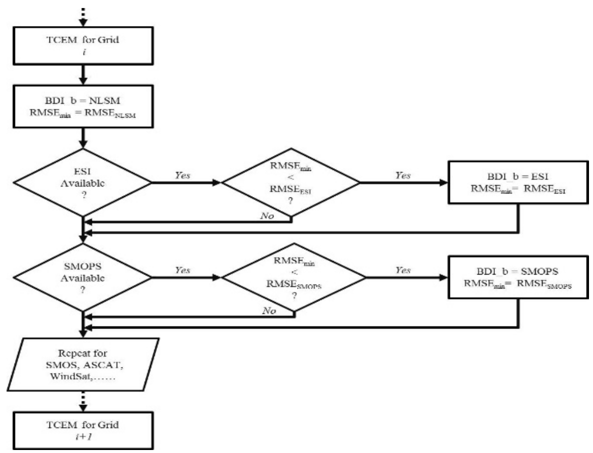
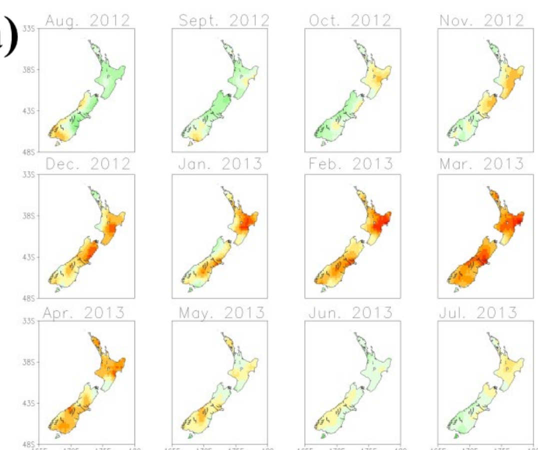


Fig.1 The procedure for constructing the BDI_b using the TC-RMSEs for each grid in each calendar month (*Yin et al., 2018, WRR*).

(a)



(b)

(c)

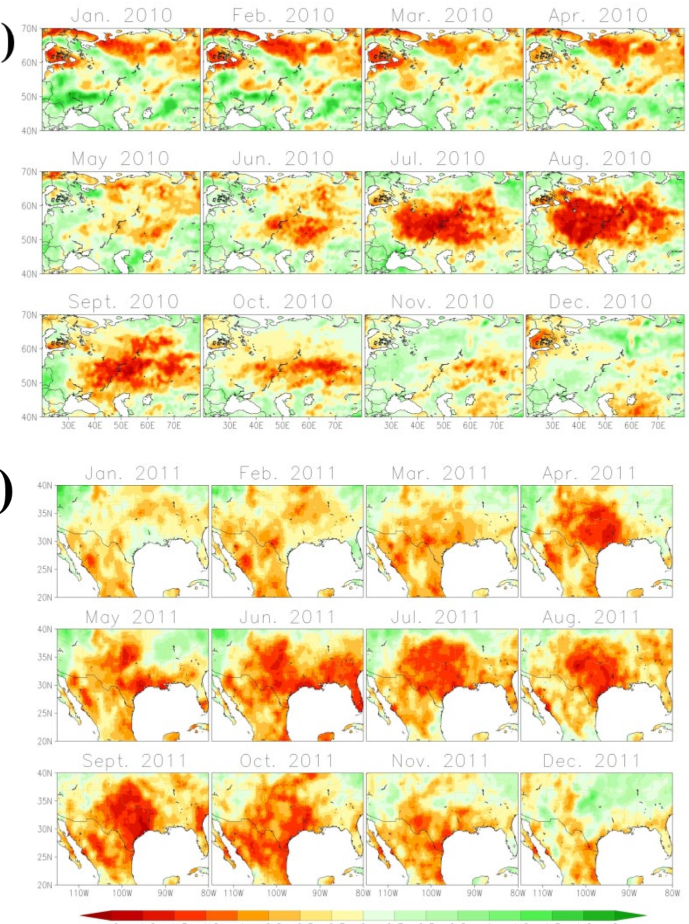
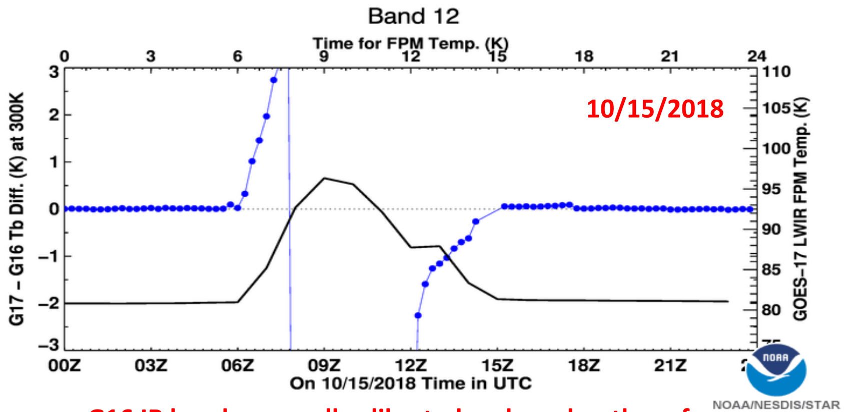


Fig.2 Monthly BDI_b for: (a) 2012-2013 New Zealand, (b) 2010 West Russia, and (c) 2011 U.S. Southern Great Plains droughts (*Yin et al., 2018, WRR*).

GEO-GEO Inter-Comparison as a Tool for Performance Validation and Monitoring

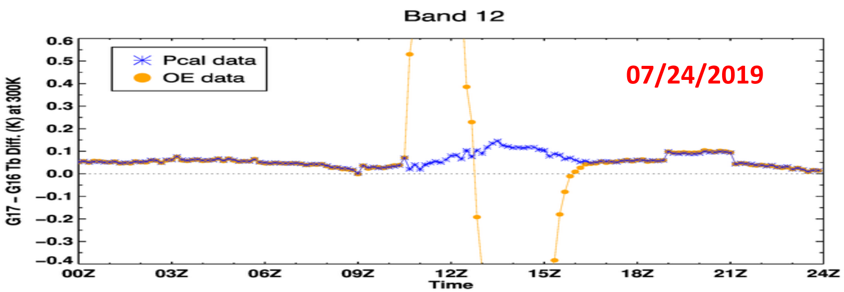
Hyelim Yoo (CISESS), Fangfang Yu (CISESS), Xiangqian Wu (NOAA/STAR)

- **Comparison of two geostationary satellites (GEO-GEO) can help to evaluate and monitor their performance. The algorithm runs over the target when**
  - 20° S < Lat < 20° N
  - View zenith angle difference less than 2 %
  - DQF information, pixel based comparison
  - Avoid parallax effect in comparison
  - 5 x 5 arrays Tb STD on centered pixel < NEdT noise values
- **GEO-GEO inter-comparison is a powerful tool in the G17 ABI Cal/Val activities.**
  - Anomaly detection
  - Diurnal variation
  - Algorithm update validation



G16 IR bands are well calibrated and used as the reference.

1. GEO-GEO Tb difference is stable and consistent when the FPM temperature is stable.
2. There is no data around the unstable FPM time due to G17 ABI data saturation.

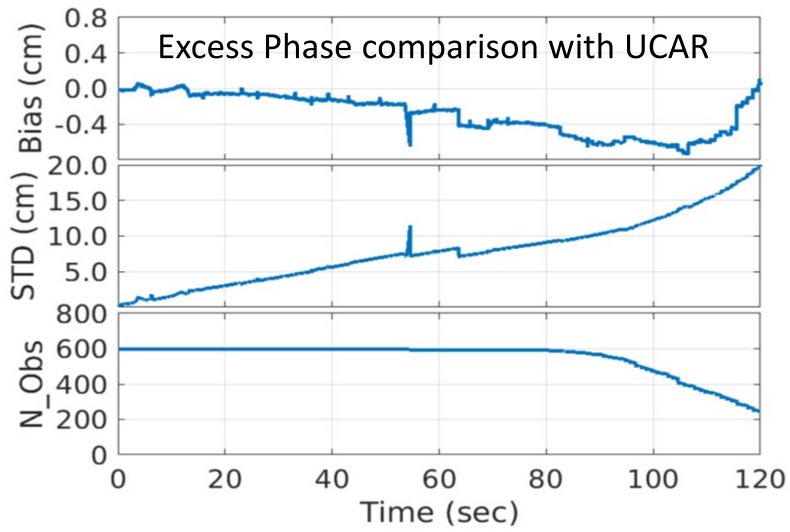


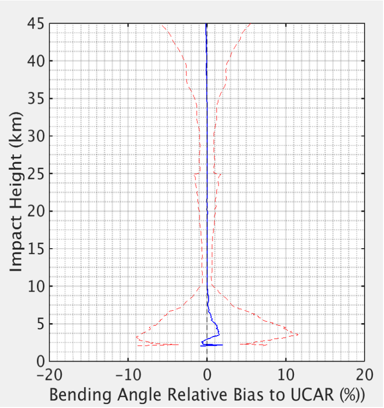
The pCal algorithm significantly improves the G17 IR radiometric calibration accuracy at the unstable FPM time and GEO-GEO comparison can be used a tool for pCal validation.

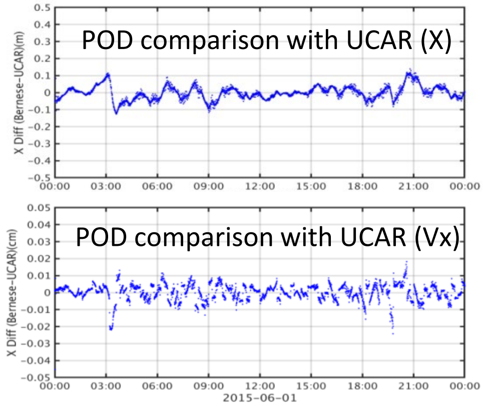
Error Assessments in the GNSS Radio Occultation Excess Phase/Bending Angle Calculation

Bin Zhang (CISESS/UMD), Shu-peng Ho (NOAA/STAR), Xi Shao(CISESS/UMD) and Changyong Cao (NOAA/STAR)

- Established the (Re)processing procedure from raw Radio Occultation observations to bending angle to understand processing steps.
  - LEO Satellite Precise Orbit Determination with using Bernese
  - Single differencing receiver clock error removal with using high rate POD data
  - Considering GNSS and LEO attitude information for antenna positions in ECEF/ECI.
  - Radio Occultation Processing Package (ROPP) is used for conversion to bending angle.
- Reprocessed one month COSMIC (FM-1) data and compared with UCAR results
  - POD errors in 10 cm range in 3D.
  - Excess phase agrees with UCAR in centimeter difference.
  - Bending angle agrees well with UCAR results within 1% standard deviation in 10-30km.
  - Larger bias near the surface in BA comparison
- This RO data processing capability will help for COSMIC-2 data processing and other RO missions for NOAA Cal/Val activities.







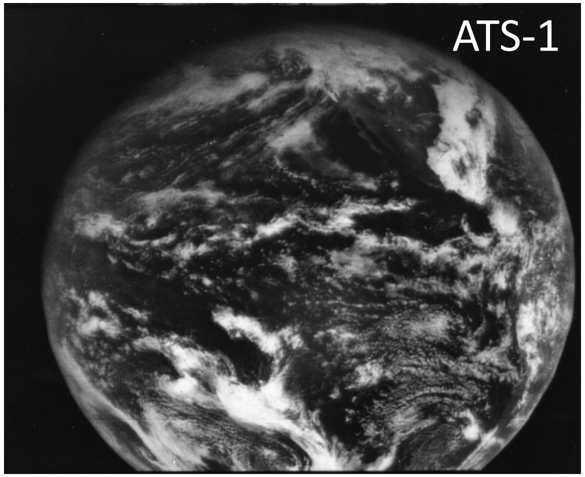
CIMSS

- Tim Schmidt
- Graeme Martin
- Jason Otkin (2)
- Agnes Lim (2)
- Brett Hoover
- Geoff Cureton
- William Straka III (2)
- Mathew Gunshor
- Zheng Ma
- Deming Meng
- James Anheuser
- Scott Lindstrom (2)
- Dan Bikos
- David Sanek
- Tom Greenwald (2)
- Callyn Bloch
- David Loveless
- Margaret Mooney
- Chris Schmidt
- Sam Batzli
- Ester Nikolla

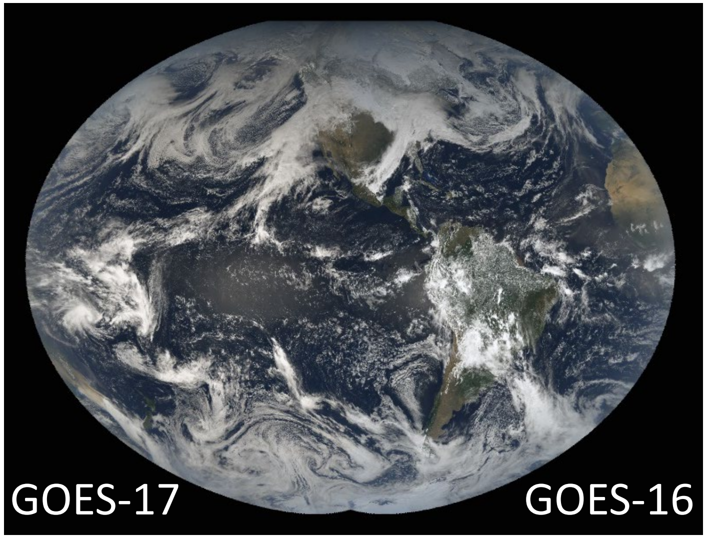
Imaging from ATS-1 to the GOES-R Series: What has Changed and What has Stayed the Same

Tim Schmit, Mathew M. Gunshor, Paul Menzel, Jean Phillips, Daniel T. Lindsey

- Major “game-changers” regarding US geo imaging
  - ATS-1 (First)
  - GOES-1 (First operational)
  - ABI on GOES-R Series (100x better)
- What has Changed and What has Stayed the Same
  - Changed: operational, improved all attributes (spatial, spectral, temporal, INR, calibration, bit depth, MTF, less outages, etc.), international ring of GEO’s, etc.
  - Same: the continuity of observations, the excitement and how each day shows new features in the imagery.



NASA&SSEC



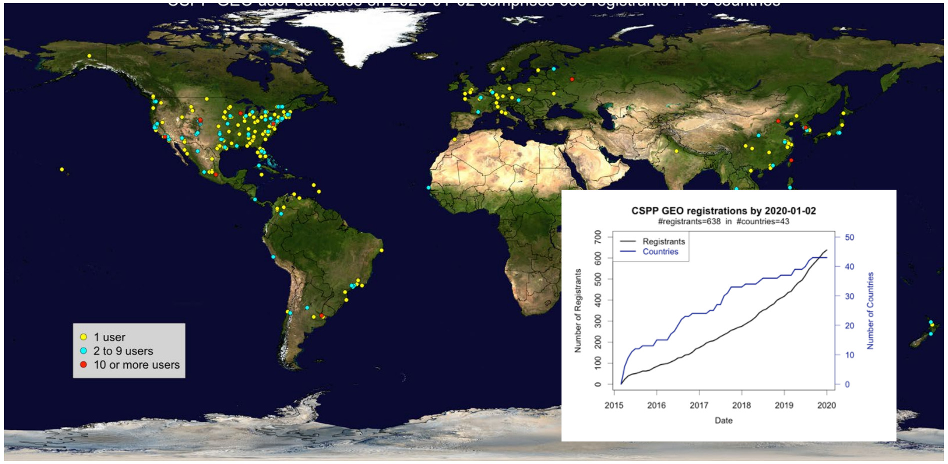
NOAA&SSEC
(R. Kohrs)

Update on CSPP Geo Software for Geostationary Direct Broadcast

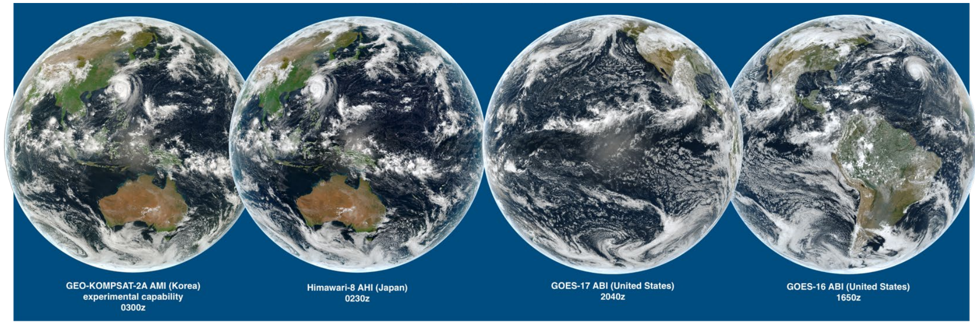
Graeme Martin, Liam Gumley, Nick Bearson, Jessica Braun, Geoff Cureton, Alan De Smet, Ray Garcia,
Dave Hoese, Tommy Jasmin, Scott Mindock, Eva Schiffer, Kathy Strabala (CIMSS)

- CSPP Geo users
  - User base continues to grow, with 638 registrants from 43 countries
  - NWS has successfully transitioned to CSPP Geo software on their 24 GRB and Himawari systems at 8 sites
  - CSPP Users' Group Meeting was held in Chengdu, China in June 2019
- 2019 project highlights
  - 3 releases of the GRB (ingestor) software, including critical updates to support changes to the GOES-R ground system
  - Version 1.0 milestone release of the AIT Framework Level 2 package
  - Version 1.0 milestone release of the Geo2Grid package for generating high-quality RGB and single-band images in geoTiff format

CSPP Geo registration database



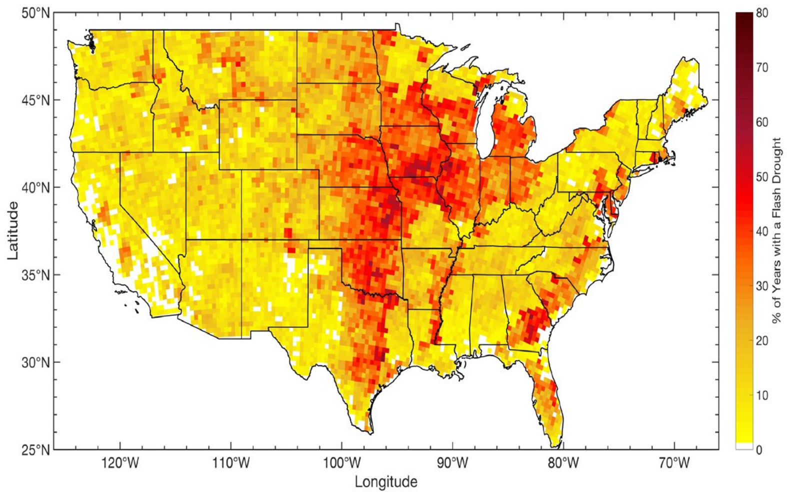
Geo2Grid true color images: Views from four ABI-Class imagers in Geo orbit, Sept 30, 2019



Flash Droughts
(Keynote Oral Presentation)

Jason Otkin, Jordan Christian (U. Oklahoma), Ryann Wakefield (U. Oklahoma), Jeff Basara (U. Oklahoma), and Andrew Hoell (NOAA ESRL)

- This was an AMS Centennial presentation that provided an historical overview of flash droughts and recent research that has been performed to better understand their characteristics and driving mechanisms
    - Flash droughts are characterized by a period of rapid intensification over sub-seasonal time scales



- Flash drought climatology from Christian et al. (2019; *J. Hydrometeorology*)
- Computed using NARR analyses from 1979-2016 during the growing season
- Flash droughts are most common over the Great Plains and Midwest, along with parts of the southeastern U.S.

Assimilating All-Sky Infrared Brightness Temperatures in an Ensemble Data Assimilation System Using A Nonlinear Bias Correction Method

Jason Otkin, Roland Potthast (German DWD), and Amos Lawless (U. Reading)

Experiment	U	V	T		RH	
	RMSE	RMSE	RMSE	BIAS	RMSE	BIAS
OBSCTH-0TH	-0.2%	-0.2%	-0.1%	-4.7%	-0.6%	-36.2%
OBSCTH-1ST	-0.7%	-0.1%	-0.3%	-3.1%	-0.9%	-29.1%
OBSCTH-2ND	-0.9%	-0.5%	-0.3%	-5.0%	-1.5%	-25.6%
OBSCTH-3RD	-1.0%	-0.8%	-0.2%	-1.3%	-1.8%	-30.2%

- Percentage reductions in radiosonde obs. errors relative to the No-BC experiment (computed from prior analyses)

- Cycled data assimilation experiments performed using an ensemble DA system, with hourly assimilation of all-sky SEVIRI 6.2 μm brightness temperatures
- Results are substantially improved when bias corrections are used – largest improvements in the relative humidity observations
- Advantageous to use higher order nonlinear bias correction terms (bottom two rows) when assimilating all-sky infrared brightness temperatures

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

Agnes Lim[1], Sharon Nebuda[1], James Jung[1], Jaime Daniels[2], Wayne Bresky[3], Li Bi[3,4] and Avichal Mehra[4]
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.
- August 2019 version of the HWRF trunk is used with same setup as in operational.
- Four sets of assimilation experiments (Table 1) conducted using three tropical cyclones.
- Neutral impact on tropical cyclone forecasts (Figure 1).
- Closer examination of Hurricane Michael.
  - Very limited AMVs from any types below 500hPa.
  - Very limited AMVs near TC center (Figure 2).
  - 50% of the AMVs in the assimilation domain has been rejected.
  - Assimilation statistics vary little with increase number of AMVs used.
- Next steps
  - Investigate impact of increase acceptance rate on forecast through relaxing QC.
  - QC and error profile review with the addition of 15-minute winds.
  - Forecast impact assessment using 2018 and 2019 hurricane seasons.

Table 2 Configurations for assimilation experiments. Infrared (IR), cloud top water vapor (CTWV), clear air water vapor (CAWV), shortware IR (SWIR) and visible (VIS)

	CTRL	AMV1	AMV2	AMV3
AMV types	IR, CTWV, CAWV	IR, CTWV, CAWV	IR, CTWV, CAWV, SWIR and VIS	IR, CTWV, CAWV, SWIR and VIS
Gross check	1.3 For IR and CTWV 2.5 for CAWV	1.3 For IR and CTWV 2.5 for CAWV	1.3 For IR and CTWV 2.5 for CAWV, SWIR and VIS	1.3 for IR, CTWV, CAWV, SWIR and VIS
Error Profile	1.7m/s (1100hPa) and 3.5m/s (0 hPa)	3.8m/s (1100hPa) and 7m/s (0 hPa)	3.8m/s (1100hPa) and 7m/s (0 hPa)	7.6m/s (1100hPa) and 14m/s (0 hPa)
Allowed range of AMVs = gross *error	2.2 – 4.6m/s 4.2 - 8.8m/s	4.9 – 9.1m/s 9.5 -17.5m/s	4.9 – 9.1m/s 9.5 -17.5m/s	9.9 – 18.2m/s
QC	IR AMVs removed between 400-800mb	IR AMVs removed between 400-800mb	IR AMVs removed between 400-600mb PCT1 check for VIS	IR AMVs removed between 400-600mb PCT1 check for VIS

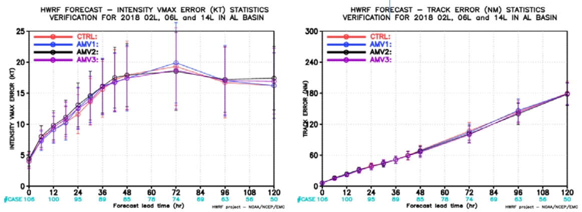


Figure 1 Combined verification statistics for Hurricane Beryl, Hurricane Florence and Hurricane Michael for different assimilation configurations. Error bars represent a 95% confidence interval. The secondary x-axis shows the number of samples used in deriving these statistics. The variables verified are intensity max error (left) and track error (right).

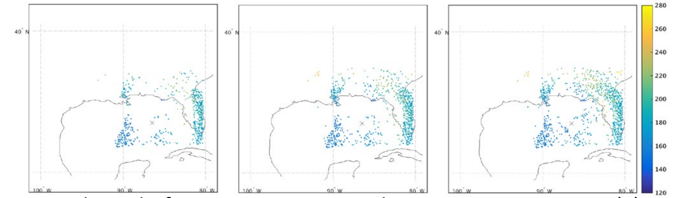


Figure 2 Single cycle for HWRF innermost domain on 2018101012 (a) Location of CTWV AMVs assimilated for CTRL (left), AMV2 (center) and AMV3 (right). (b) Location of CTWV AMVs rejected. '**X**' indicates location of the TC center. The AMV pressure level is color coded. There are barely any AMVs from any types below 500hPa. IR AMVs above 500hPa has similar pattern as CTWV AMVs.

Quantifying the Sensitivity of NCEP's GDAS/GFS to CrIS Detector Differences

Agnes Lim[1], Sharon Nebuda[1], James Jung[1], Dave Tobin[1] and Mitch Goldberg[2]
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 these inter-detector differences begins to affect NWP analysis and forecast systems.
- Use of array detectors to make simultaneous observations for advanced IR sounders.
- Detectors have different radiometric characteristics.
- NWP centers: not desirable to treat each detector as an independent instrument => reduced usage of the observation if choose to select data from one detector to avoid complication.
- Assimilation experiments using perfect CrIS observations simulated from GEOS-5 analyses with different amounts of delta radiances added to FOV 7.
- 2017 GFS with GSI version from Dec 2018.
- Assimilates only surface channel at 962.5cm^{-1}.
- Data system modifications
  - Aqua planet assumption for CrIS.
  - Bypassed cloud detection and emissivity check for CrIS.
- Increase positive delta radiance added to FOV 7 leads to selection preference (Figure 1) due to GSI selection criteria.
  - First guess warmer than the surface channel (chan501) BT.
  - Warmest cloudy profile nearest to the center of the thinning box.
- Preference selection introduce biases into analysis.

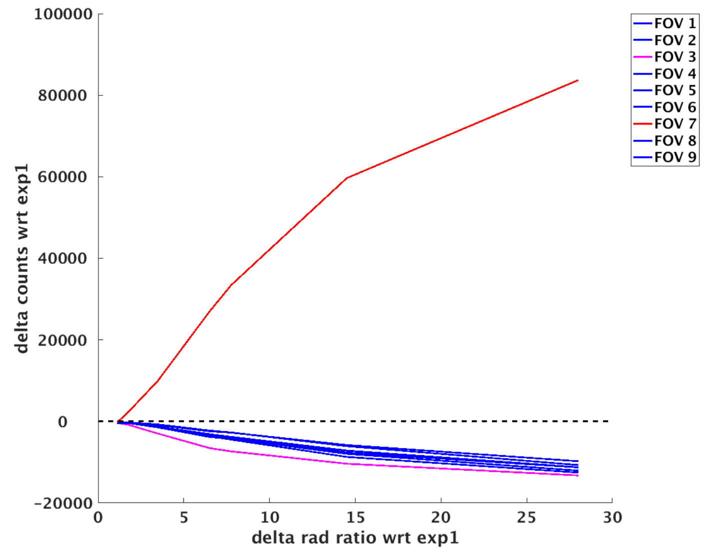


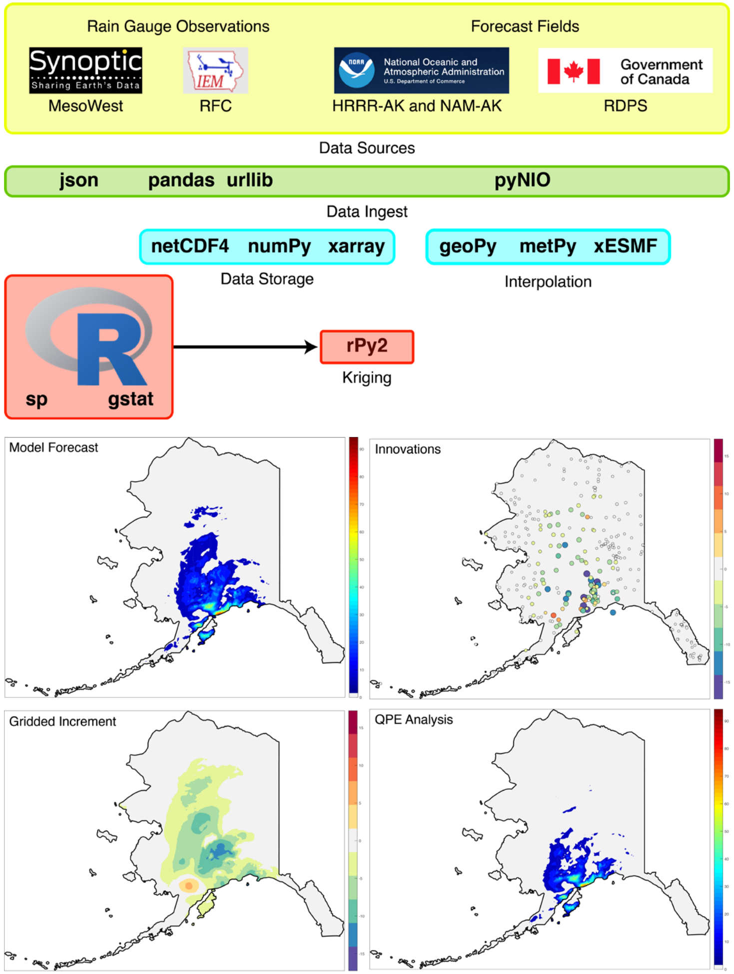
Figure 1 Change in number of counts selected for each FOV with respect to control for different amount of delta radiance added to FOV 7.

- Upcoming tasks
  - Generation of CrIS observations with realistic surface and clear sky extent.
  - Assimilate all operational active CrIS FSR channels.
  - Quantify impact on GFS forecast skill

A Quantitative Precipitation Estimate for Alaska

Brett Hoover and Jason Otkin (CIMSS); Eugene Petrescu and Emily Niehbur (NOAA, NWS Anchorage)

- A Python-based algorithm was developed to produce a gridded QPE product for Alaska
  - First guess from short-range regional model forecasts (HRRR-AK, NAM-AK, RDPS)
  - Rain gauge observations from Alaska River Forecast Center and MesoWest define innovations at observation points
  - A gridded increment is produced from innovations via kriging
- Developing strategies to account for uncertainty in model first-guess
  - Nonlinear bias correction is being developed for HRRR-AK, may be incorporated into other NWS products relying on HRRR-AK as a first guess
  - QPE analysis includes 5% and 95% confidence intervals to provide probabilistic guidance
  - Future applications in hydrological modeling

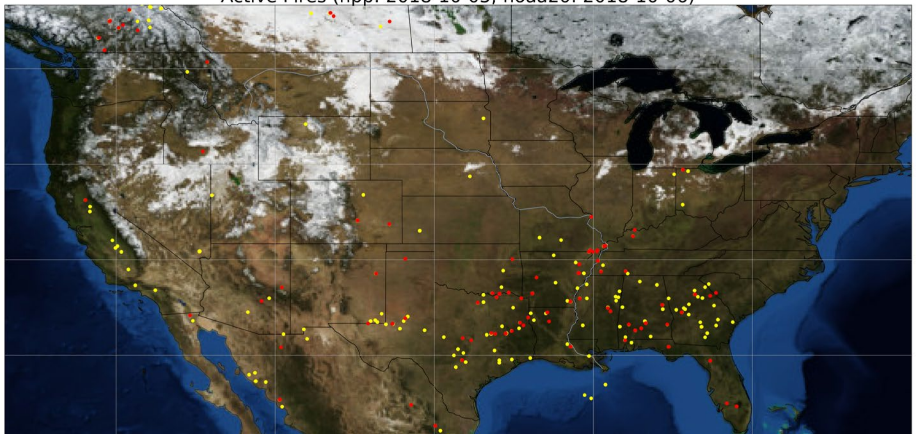


Python in the Community Satellite Processing Package

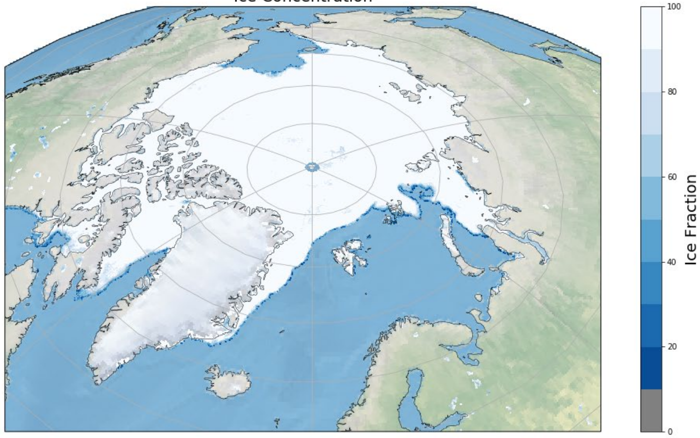
Geoff Cureton, Graeme Martin , Jessica Braun, Jim Davies, Kathy Strabala, Nick Bearson, David Hoese, Ray Garcia, Scott Mindock,
Liam Gumley, Allen Huang (CIMSS)

- New releases for CSPP packages:
  - CSPP VIIRS SDR
  - CSPP MIRS
  - CSPP ASCI (VIIRS EDR)
  - CSPP GEO Geo2Grid
  - CSPP GEO AIT
  - CSPP GEO GRB
  - CSPP Clavr-X
  - CSPP ACSPO SST
  - CSPP Polar2Grid
- Upcoming releases:
  - CSPP Active Fires (VIIRS I-band)
  - CSPP GAASP (GCOM-W1 AMSR-2)
  - CSPP GEO Geocat (Himawari-8 L1,

Active Fires (npp: 2018-10-05; noaa20: 2018-10-06)



Ice Concentration



Usage of the VIIRS and other instruments other channels in Disaster Response and monitoring

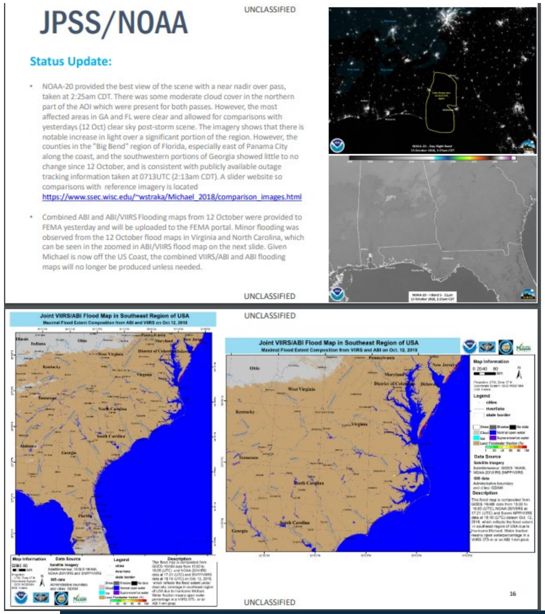
William Straka III, Mitch Goldberg (NOAA/JPSS), Bill Sjoberg (GST/JPSS), Steve Miller (CIRA), Sanmei Li (GMU)

- The JPSS program has been effective in interacting with emergency stakeholders in providing tools that are useful in disaster recovery

- As JPSS Program transitions to incorporating all NOAA LEO satellites, so have the products that have been provided to stakeholders

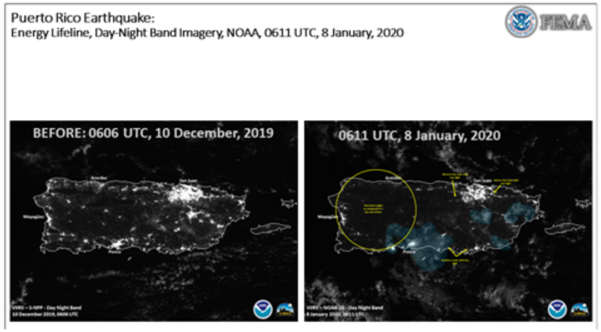
- Like other agencies, JPSS Program has developed a method to disseminate products to stakeholders in an effective manner. This includes a single point of contact who interacts with various stakeholders, both providing products as well as feedback to product developers

- This method has proved effective in providing products which are now being routinely used by emergency response agencies (FEMA, DoD, International Charter) as part of their tool box in response to disaster events. This included providing imagery during AMS for the recovery in Puetro Rico



Day-Night satellite

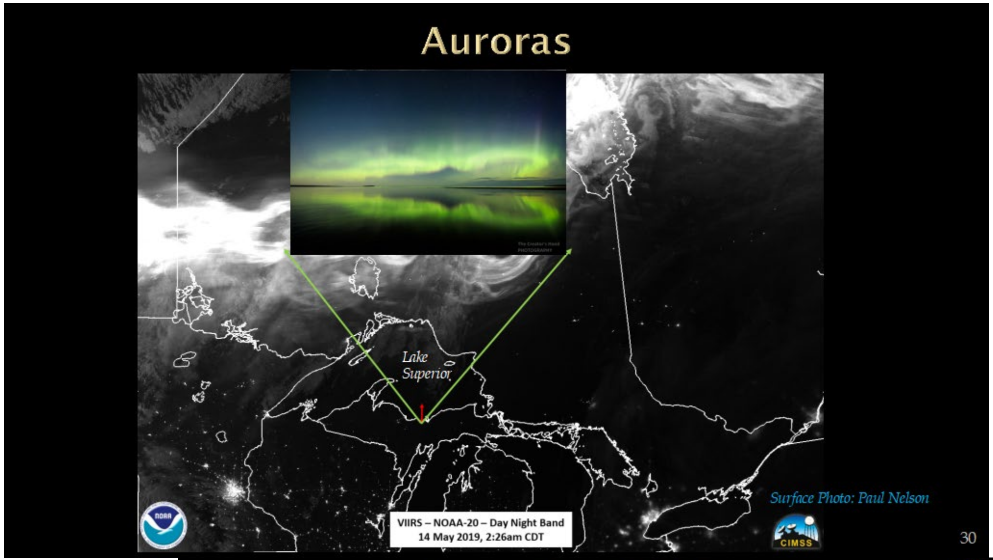
Graphic depicting most recent Day-Night satellite view of night lights (indicating electrical grid status) over Puerto Rico as of 0611 UTC, 8 January, 2020.

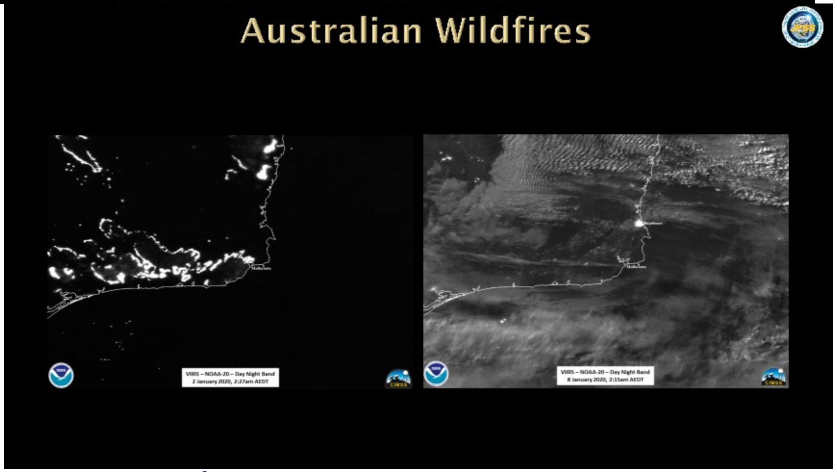


Dark Side Applications: Applications utilizing the Day Night Band on S-NPP and NOAA-20

William Straka III; Steve Miller and Curtis Seaman(CIRA)
NOAA Booth talk on 16 January 2020

- Examples of DNB science
  - Hazard detection
  - Ship light monitoring
  - Mesospheric gravity waves
  - Auroras
  - Fire detection





The Next Generation GOES Imager

Mathew M. Gunshor with A. Wimmers, C. Schmidt, C.S. Velden, A.S. Bachmeier, S.S. Lindstrom, W.P. Menzel (CIMSS), T. J. Schmit and A.K. Heidinger (STAR/ASPB)

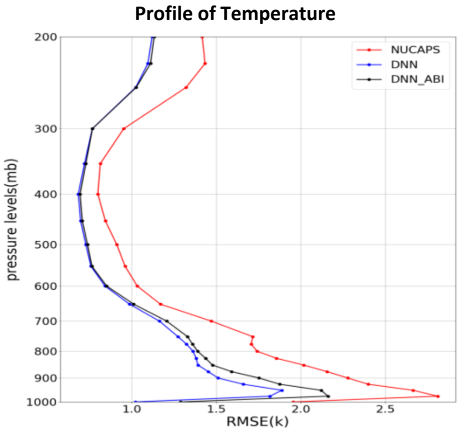
- USA Leadership in GEO Orbit
  - NESDIS Strategic Objective: Advance observational leadership in geostationary and extended orbits
- The case for improved spatial resolutions on the next geostationary imager
  - 3.9um band to find fires sooner
  - 10.3um band for cloud properties, etc.
  - 7.3um band to better detect turbulence
  - Etc.
- Prioritizing potential new spectral bands
  - 0.91um for daytime TPW (EUMETSAT)
  - 0.55um “green” for true color (other nation’s GEO imagers have a “green” band)
  - 0.443um for air quality and ocean color (EUMETSAT)
  - Etc.

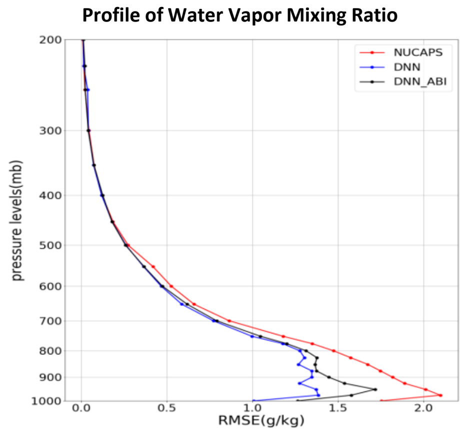
Band Central WL (um)	Improvement	Rank	Use
3.9	Improve Resolution	1	Fire Detection
10.3	Improve Resolution	2	Many Products
7.3	Improve Resolution	3	Turbulence/Air Safety
0.91	Add up to 0.5 km (MTG)	4	Daytime TPW
0.55	Add up to 0.3 km (Most GEOs)	5	Air Quality/Ocean color/true color
0.443	Add up to 0.3 km (MTG)	6	Air Quality/Ocean Color
0.64	Improve Resolution	7	Legacy Visible
3.7	Add up to 1 km	8	Improved Fires/SST/LST
6.9	Improve Resolution	9	Water Vapor Features
DNB	Add (VIIRS)	10	Lights at Night / Power Outages / Smoke Detection at Night

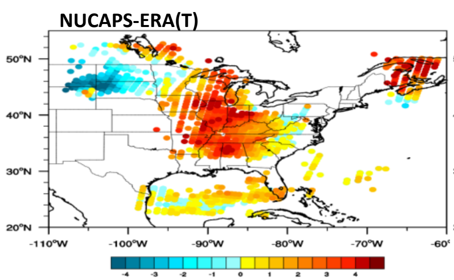
Improving NUCAPS Soundings in the Lower Atmosphere with Multi-source Data using Deep Neural Network

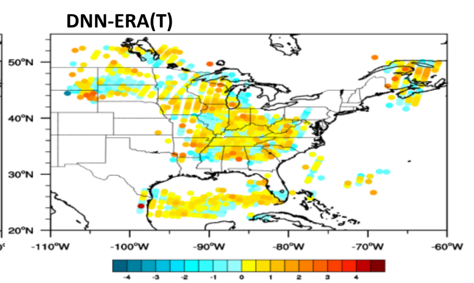
Zheng Ma (CIMSS, IAP), Zhenglong Li (CIMSS), and Jun Li (CIMSS)

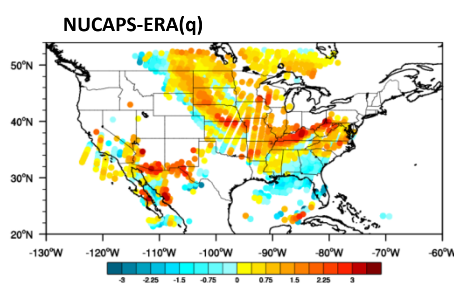
- The temperature and moisture profiles of NUCAPS are improved by using DNN in combination of multi-source data:
  - NUCAPS temperature and moisture profiles and surface pressure
  - ABI Brightness temperature from channels: 6.2, 6.9 ,7.3, 10.3, 11.2, 12.3 and 13.3 µm
  - RTMA surface temperature and dewpoint analysis
  - ERA5 temperature and moisture profile as true values
  - Training data from April to June, 2018. Region: CONUS, 20% FORs extracted as independent testing set
- High spatial resolution ABI provides the main contribution on improving NUCAPS soundings
  - Improvement reduced in lower levels when RTMA is removed from training dataset, but still significant
  - Degradation of improvement is very small above 600 hPa

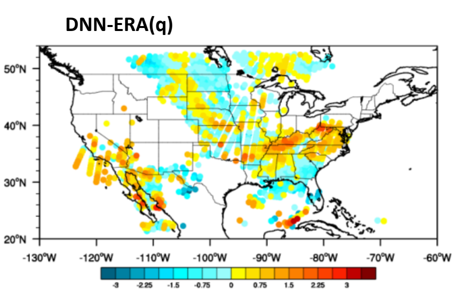










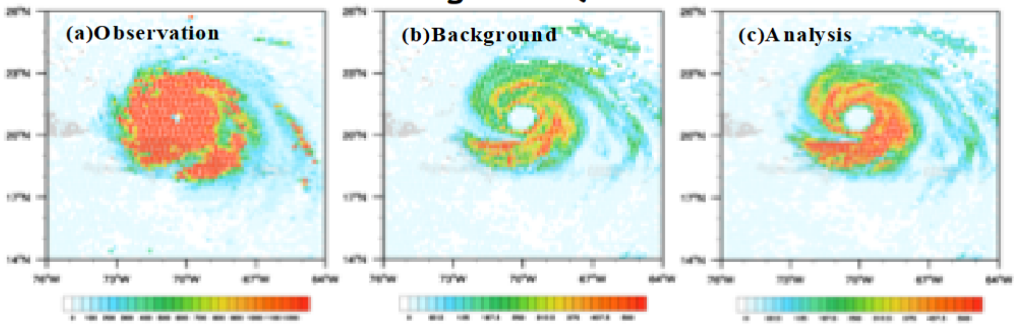


The Impact of Assimilating Cloud Information from ABI on Hurricane with different Microphysics Schemes

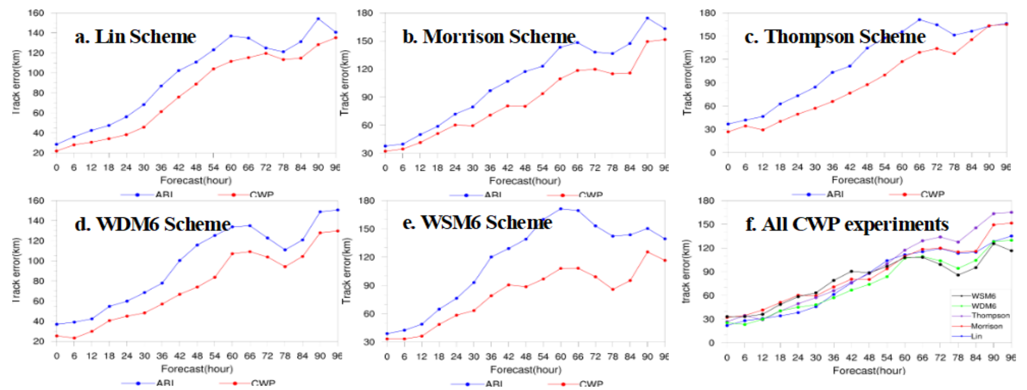
Deming Meng (SSEC/CIMSS, NUIST); Pei Wang (SSEC/CIMSS), Jun Li (SSEC/CIMSS), and Jinlong Li (SSEC/CIMSS)

- **Data:** GOES-16 ABI Cloud Products were provided by the GOES-R Algorithm Working Group (AWG)
  - Liquid water path (LWP) and ice water path (IWP) are produced from Channel 2 ($\lambda_{VIS} = 0.64$ µm; Visible band) and Channel 6 ($\lambda_{NIR} = 2.25$ µm; near-IR band) .
  - Cloud Water Path are actually reflecting the column-integrated ice or liquid in the atmosphere.
- **Method:** new forward operators are developed for CWP assimilation
  - The new forward operators are based on the assumption that the ratios of water species are unchanged in background.
  - The new forward operators can accurately describe the hydrometeors background, while avoid the complicated work of adding hydrometeors control variables in the system.
- **Results:** CWP assimilation affects both intensity and path prediction
  - Assimilating CWP with all microphysics schemes could effectively reduce the track errors, and WSM6 perform best after 60 hours forecasts.
  - Assimilating CWP has minor improvement on intensity forecasts except WSM6 scheme.

Observed vs. simulated integrated Qice



Hurricane track RMSE of the CNTL and CWP experiments



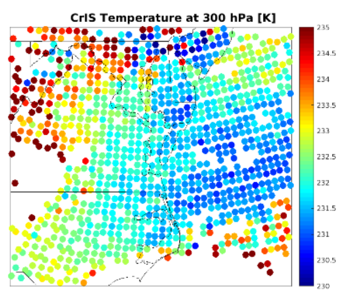
Investigating Low Earth Orbit Sounder Retrieval Products at Geostationary Earth Orbit Spatial and Temporal Resolution

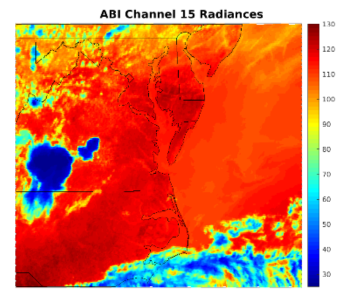
James Anheuser, Elisabeth Weisz, Paul Menzel

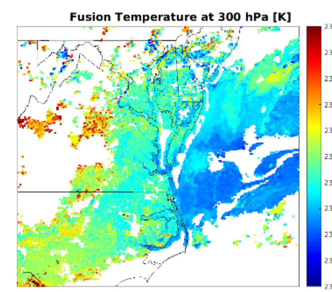
- Here we utilize a data fusion method (developed and previously demonstrated at UW-Madison) to construct high vertical resolution CrIS- like temperature and humidity retrievals at ABI high spatial resolution.

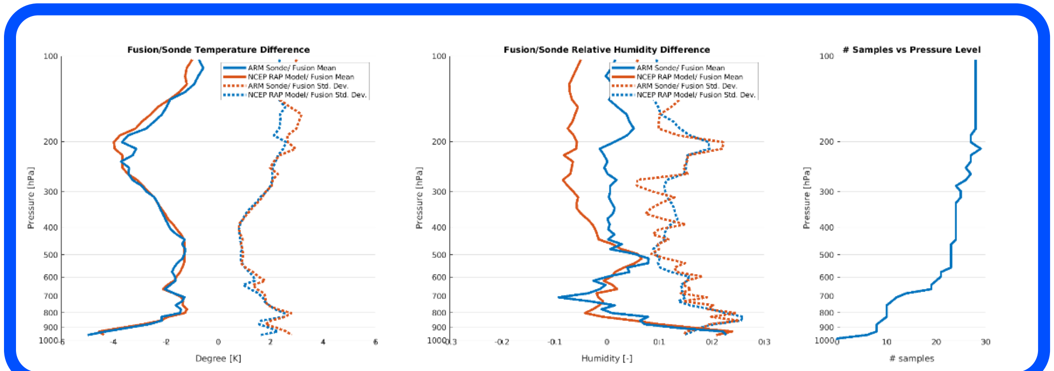
- Results compare well with ARM site radiosonde best estimate products. Bottom Right: Fusion to radiosonde comparison from Feb. 2017- Feb. 2018 over DOE ARM SGP Site. Temperature bias in the troposphere is ~-2K with a standard deviation of ~2 and relative humidity bias in the tropopause is ~0 with a standard deviation of ~0.1%.

INSTRUMENT	# CHANS	SPATIAL RES.	TEMPORAL RES.
CrIS (LEO)	1300+	14 km	12 hrs
ABI (GEO)	16	2 km	.25 hrs or less









Training Activities at CIMSS

S. S. Lindstrom, A. S. Bachmeier, C. C. Schmidt, M. M. Gunshor, (CIMSS), J. J. Gerth (NWS/OBS), T. J. Schmit (NOAA/ASPB)

- VISIT Teletraining, FDTD Webinars
- In-Person training visits
  - WFOs: MKX, GRB, BUF, MEM, ANC, AJK, AFG
- Web Apps such as the new one on parallax

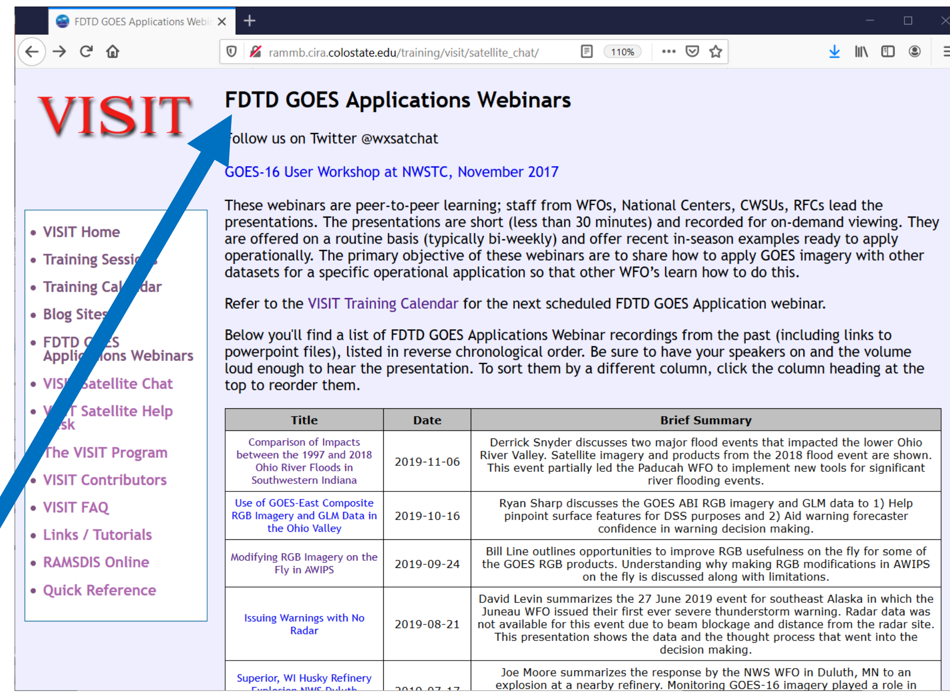
http://cimss.ssec.wisc.edu/goes/webapps/parallax/overview.html

- Blogs and Videos (CIMSS Satellite Blog, Fog Blog, JPSS Advocacy Channel)

Forecast Decision Training Division (FDTD) Satellite Applications Webinars

Dan Bikos (CSU/CIRA), **Scott Lindstrom (CIMSS)**, Brian Motta and Kevin Scharfernberg(NOAA/NWS/OCLO/FDTD)

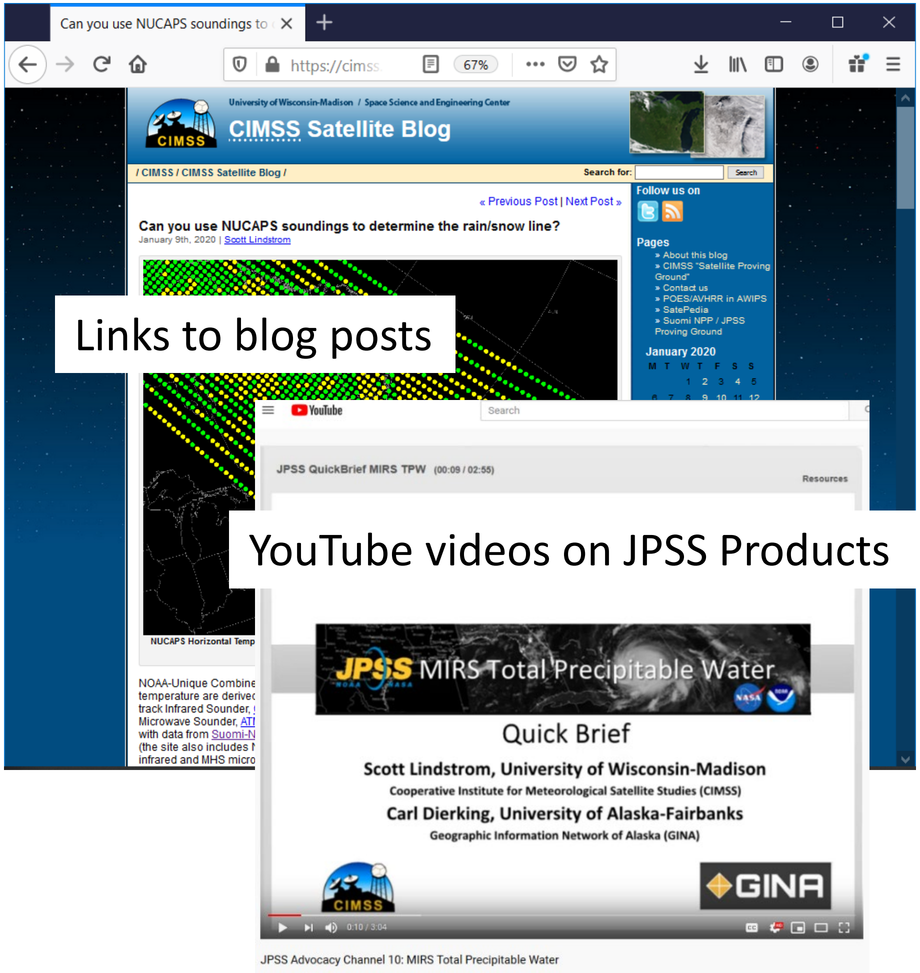
- Organized by Dan Bikos, CIRA and Scott Lindstrom, CIMSS – we recruit the people who give the webinars
- Peer-to-Peer Training given by NWS Forecasters
- 30-minute quasi monthly webinars are available online:
  - http://rammb.cira.colostate.edu/training/visit/satellite_chat/
  - About 8-20 WFOs attend each webinar



Forecast Decision Training Division (FDTD) Satellite Applications Webinars

Scott Lindstrom & W C Straka III (CIMSS), Jordan Gerth (NOAA/OPS), Eric Lau and Nate Eckstein (NOAA/NWS)

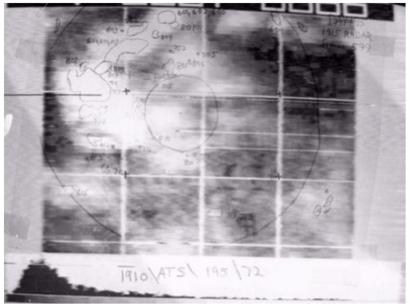
- JPSS Satellite Training is distributed over many sources and websites.
- JPSS Advocacy Channel includes a YouTube video channel (16 videos so far)
- Website creation that links information and training
- https://jpss.ssec.wisc.edu/data/jpssdata.html



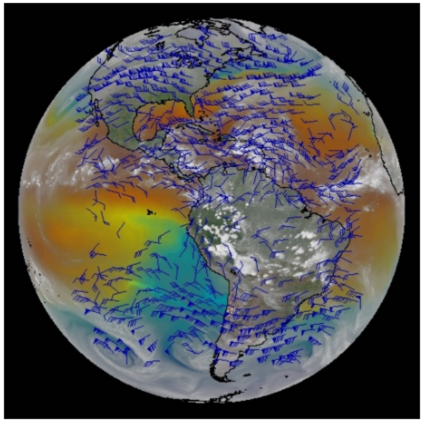
McIDAS: Visualizing Weather Data for Nearly One-Half Century!

David Santek, Becky Schaffer, Matthew Lazzara, Scott Lindstrom (CIMSS)

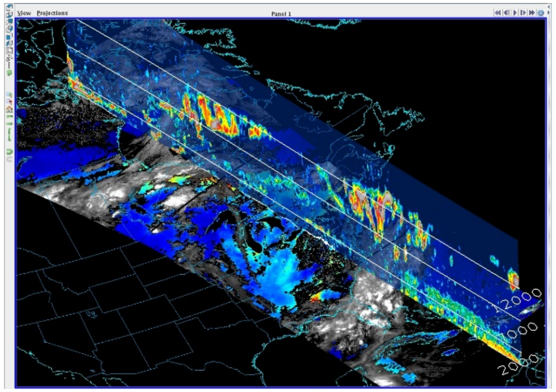
- Man computer Interactive Data Access System (McIDAS)
  - McIDAS was developed in the early 1970s to mass produce cloud drift winds
  - Enhanced through the decades to easily fuse satellite data with observations, model output, and user datasets
  - For the last 47 years, McIDAS has evolved through 5 hardware/software generations as an internationally renowned system
- Used at NOAA in both research and operations
  - ESPC, AWC, NHC, STAR, CLASS, NCO
- And, elsewhere
  - NASA: LaRC, MSFC, JPL
  - EUMETSAT, Weather Services at: Spain, Mexico, Australia
  - Universities and Industry



Early McIDAS 1973



McIDAS-X 1990s



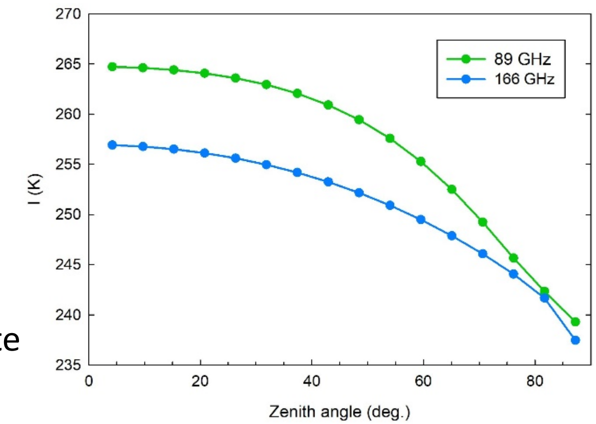
McIDAS-V 2010s

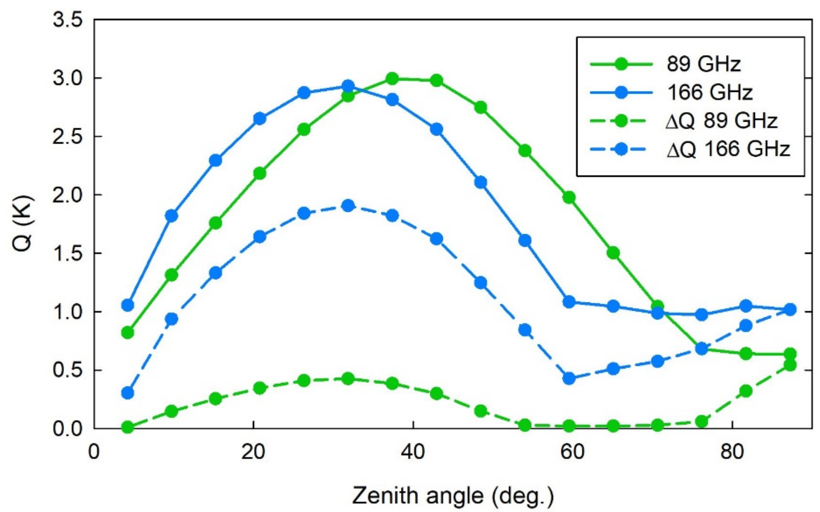
Polarized Microwave Radiative Transfer in the CRTM

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

- Polarization capability in the CRTM is needed in operational all-sky radiance DA assimilation for producing more accurate microwave radiances for clouds and polarized surfaces.
- Accurate forward modeling of microwave radiances in clouds requires non-spherical ice particles and matching the particle size distribution used in the NWP model.
- Preliminary results for a WRF-simulated snow profile using a vector version of the SOI model shows a maximum polarization signal (ΔQ) of 1.9K at 166 GHz.

10-plate aggregate

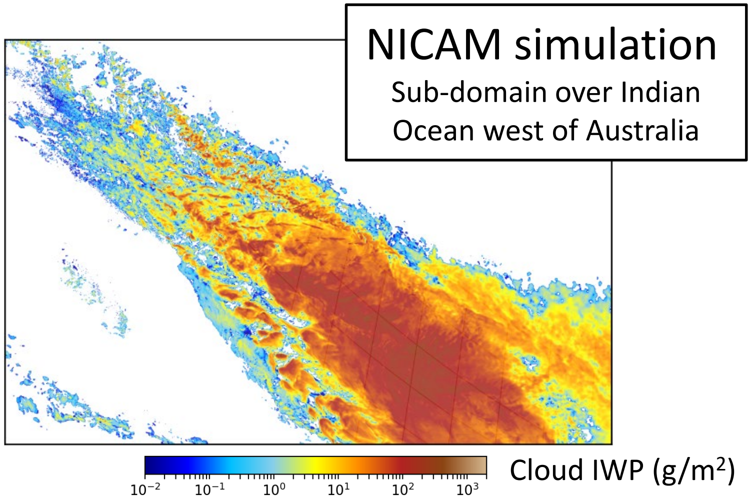


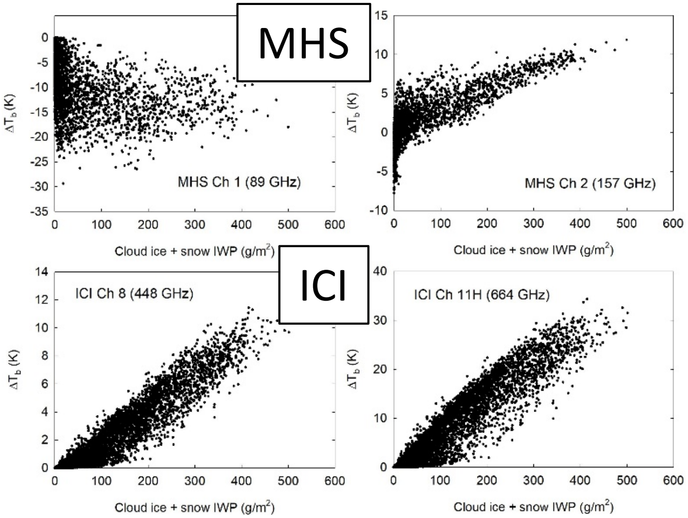


Capabilities of the METOP-SG Ice Cloud Imager

Tom Greenwald (CIMSS), Andrew Heidinger (NOAA ASPB), Mark Kulie (NOAA ASPB)

- Examine sensitivity of the submillimeter-wave Ice Cloud Imager (ICI) to ice cloud properties in relation to heritage sensors (e.g., MHS) for developing NOAA-unique EDRs and establishing NESDIS ICI product requirements.
- Clouds from a 870m-resolution global Non-hydrostatic Icosahedral Atmospheric Model (NICAM) simulation and RTTOV v12.3 were used to produce synthetic ICI and MHS imagery.
- ICI brightness temperature depression (ΔT_b) at 448/664 GHz has strong linear relationship to IWP, whereas the MHS 157 GHz channel has a linear relationship for larger IWP due to precipitation ice.

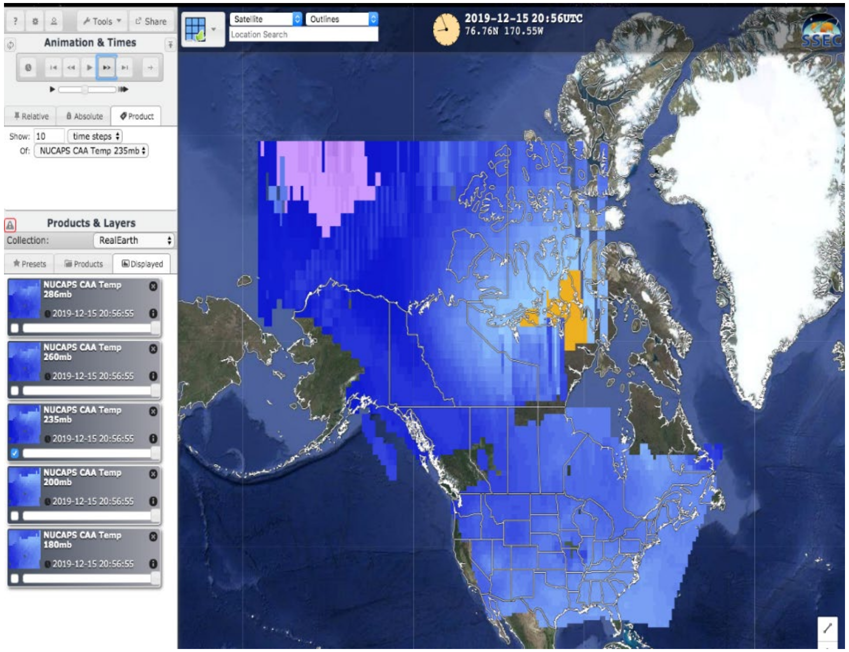




Near-Real Time Monitoring of Cold Air Aloft for Aviation Safety in the United States and Canada

Callyn Bloch, Tim Wagner, Wayne Feltz (SSEC/CIMSS)

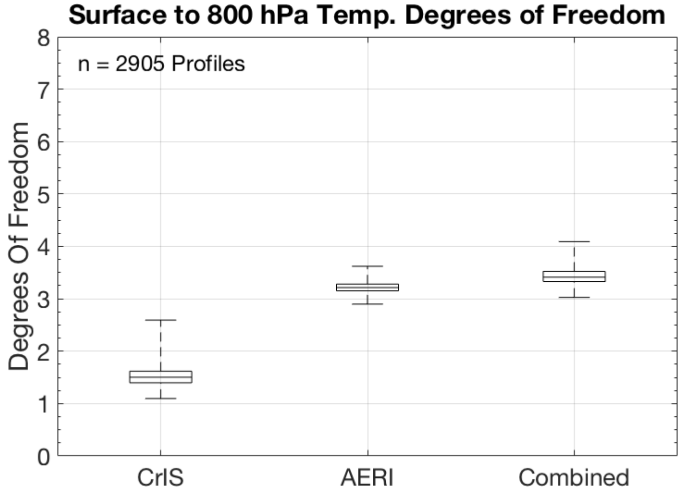
- Cold air aloft (CAA) can be hazardous as jet fuel begins to gel at -65 C, which can cause engine malfunctions and increase risk of aircraft loss.
- To observe and display cold air aloft in near-real time, temperature observations from five pressure levels corresponding to cruising altitudes are retrieved from NOAA-Unique Combined Atmospheric Processing System (NUCAPS) thermodynamic profiles.
  - All displayed on the SSEC RealEarth webpage and mobile app under the JPSS-NUCAPS tab
- Validation of NUCAPS CAA with Aircraft Meteorological DAta Relay (AMDAR) data
  - Case study: 28-31 January 2019 during North American polar vortex

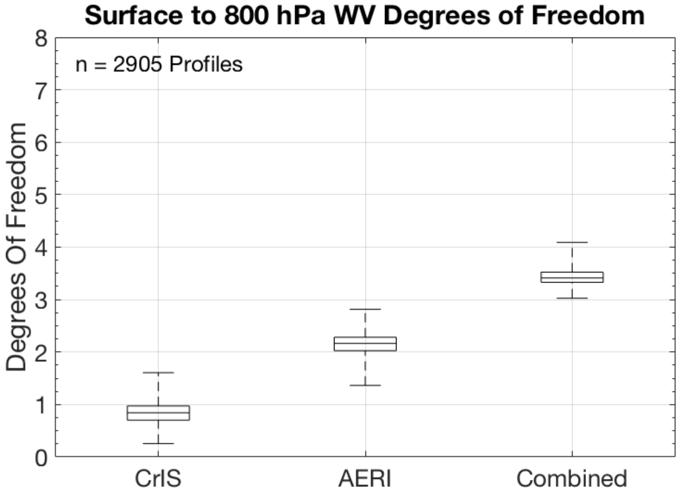


Ground-based Sounders as a Solution to Infrared Sounding in Cloudy Environments

David M. Loveless (UW-AOS/CIMSS), Timothy J. Wagner (CIMSS), David D. Turner (NOAA), and Steven A. Ackerman (UW-AOS/CIMSS)

- Clear sky information content study using radiosondes from the ARM-SGP site:
  - AERI is an improvement for sounding in the PBL compared to CrIS
  - Synergy of AERI and CrIS has greater DOF for water vapor than either instrument operating individually
- Information content in cloudy sky cases to be examined
  - Combination of AERI providing a sounding below the cloud, with CrIS providing sounding above cloud should be a beneficial combination

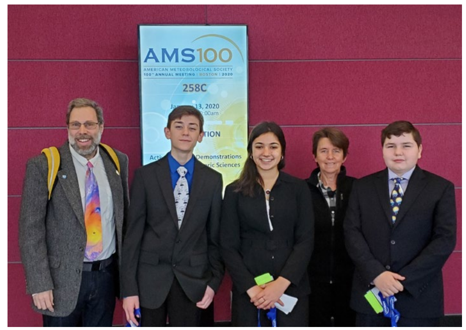


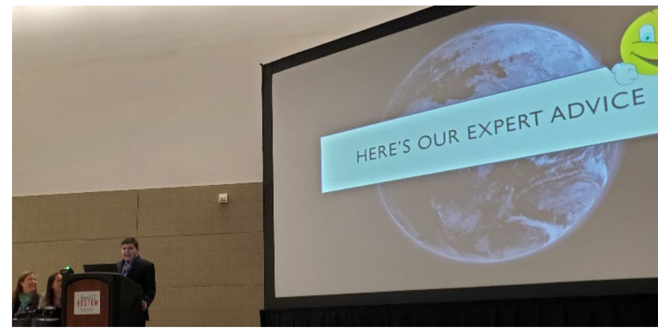


GOES-R Education Proving Ground

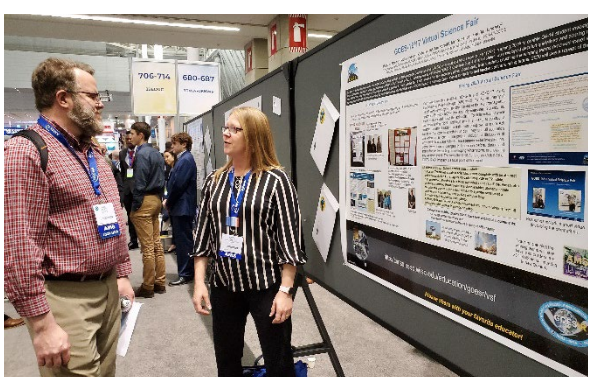
Margaret Mooney (CIMSS); Tim Schmit (NOAA NESDIS); Vicky Gorman (Medford Middle School)

- **An AMS First! –** Middle school students who participated in the Education Proving Ground debut **GOES 16/17 Virtual Science Fair** presented in the AMS Education Symposium.





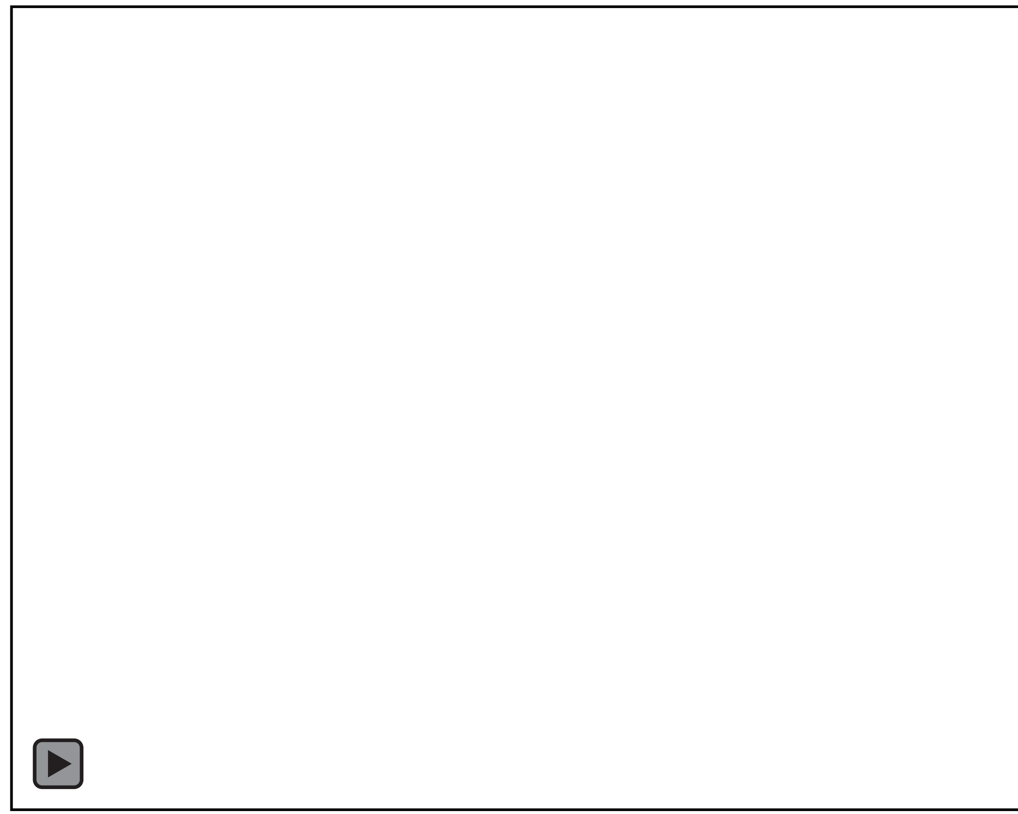
- **GOES-R Educators at AMS –** Vicky Gorman from Medford Middle school in New Jersey and Karin Loach from Auburn Middle School in Massachusetts also attended AMS 100 and presented on their experiences participating in the **GOES-R Education Proving Ground**.



On Updates to the ABI Fire Detection and Characterization Algorithm and GOES-17 Mitigation

Chris Schmidt (CIMSS)

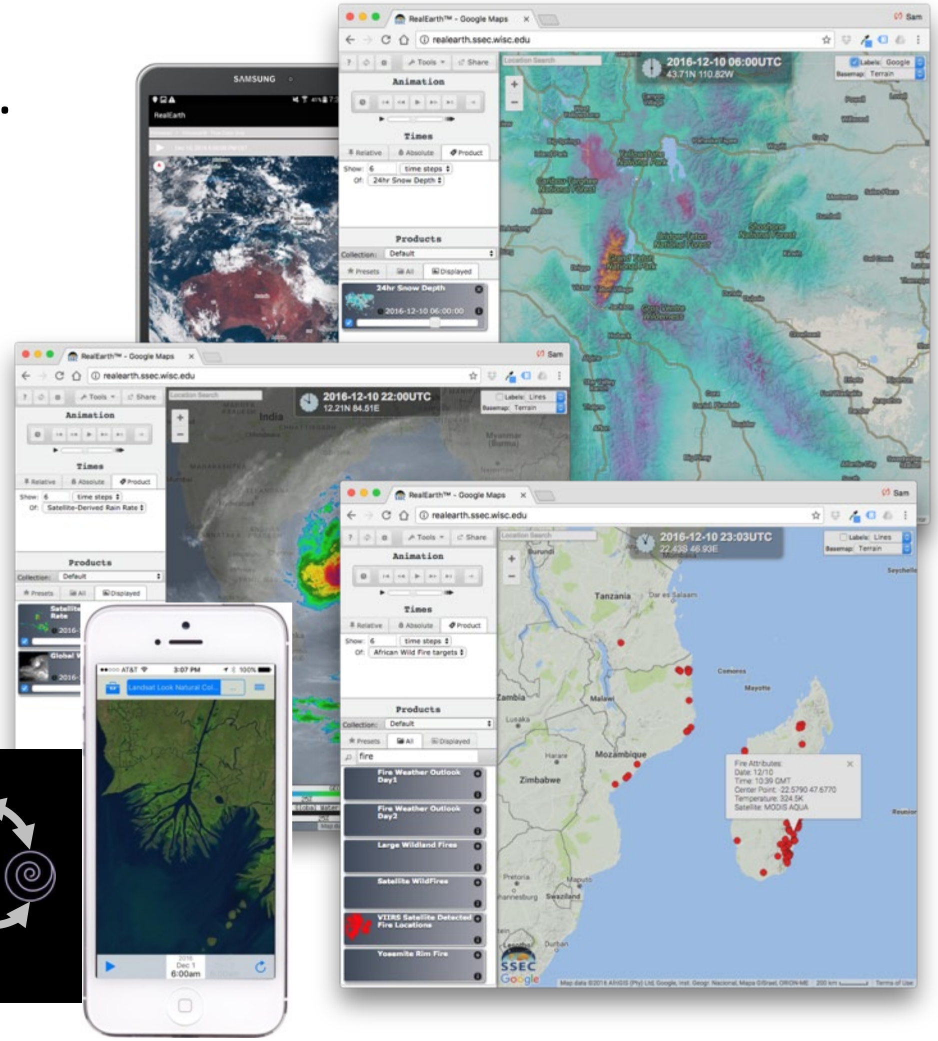
- Improvements from the Summer 2019 upgrade to the FDCA were outlined
  - Lower false positive rate
- Kincade Fire example presented
  - Fire was noticeable in L1b data within one minute of apparent start (based on nearby IR camera footage), detected by FDCA within 4 minutes
- Mitigation of the Loop Heat Pipe Anomaly was discussed
  - 12.3 μm band is disabled as focal plane starts to warm
  - As focal plane warms, a proxy for 11.2 μm band is created by combining it with 10.3 μm data, taking on a pixel basis the value closest to the 3.9 μm data in 3.9 μm radiance space
  - This maximizes utilization of good data
  - Example at right shows the performance of the proxy 11.2 μm band during the peak heating on 29 August 2019. The fire is low intensity and at times escapes detection, but notably false alarms are not introduced while detection capability is maintained

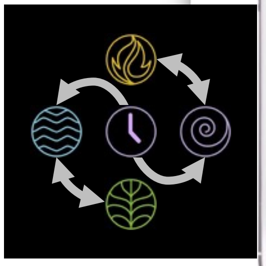


Earth, Air, Fire, and Water: Integrating Visualization of Weather and Land Processes With Map Services

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

- Examples shown from the NOAA's JPSS Thematic Initiatives.
  - JPSS Thematic Initiative: Fire and Smoke
  - JPSS Thematic Initiative: River Ice and Flooding
  - Use of WMTS (OGC) to Support Partner Workflows
- Basic *RealEarth* Features Demonstrated with Emphasis on GIS Interoperability
  - Typical web mapping functions (pan, zoom, layer order and transparency)
  - Choose background map, turn labels on/off
  - Full-featured API, over 450 "products"
  - Animate and share movies through social media
  - Embed map in your website
  - Add your own data: Upload GeoTIFF, GeoJSON easily
  - Interoperable with GIS (WMS/WMTS, QGIS, ArcGIS Pro)
  - Synchronize favorites with our mobile apps
  - "Probe" (right-click) imagery for pixel-level data values

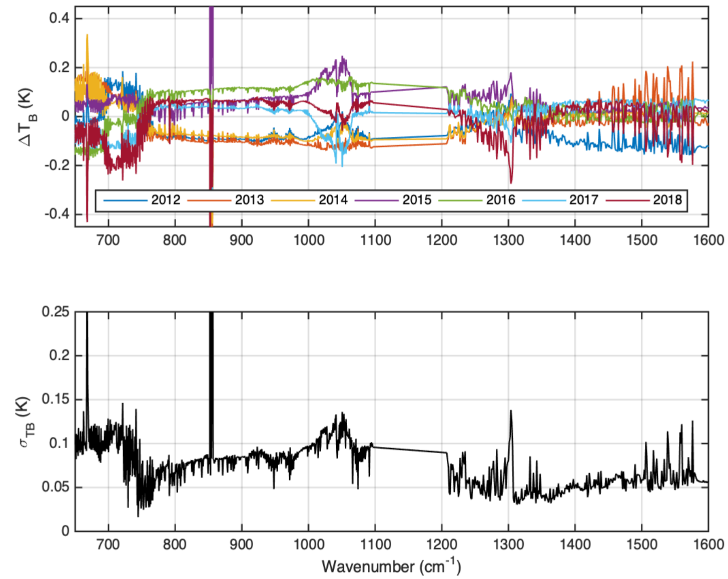




Earth's climate variability over 7 years from CrIS Brightness Temperature, OMPS Ozone, CarbonTracker CO2, and MERRA-2

Ester Nikolla, Robert O. Knuteson, Michelle Feltz,
Henry E. Revercomb, David C. Tobin and Dan H. DeSlover

- Disentangling the trends between brightness temperature, atmospheric temperature, CO_2, and ozone in upper and lower stratosphere at various latitudinal zones.
  - The infrared brightness temperature observations used are from a reprocessing performed at UW SSEC using the NOAA SDR software.
  - Atmospheric pressure and temperature profiles used for forward model radiance calculation in this retrieval algorithm are derived from NASA GSFC Global Modeling Assimilation Office (GMAO) Forward Processing-Instrument Team (FP-IT) GEOS 5.12.4 data.



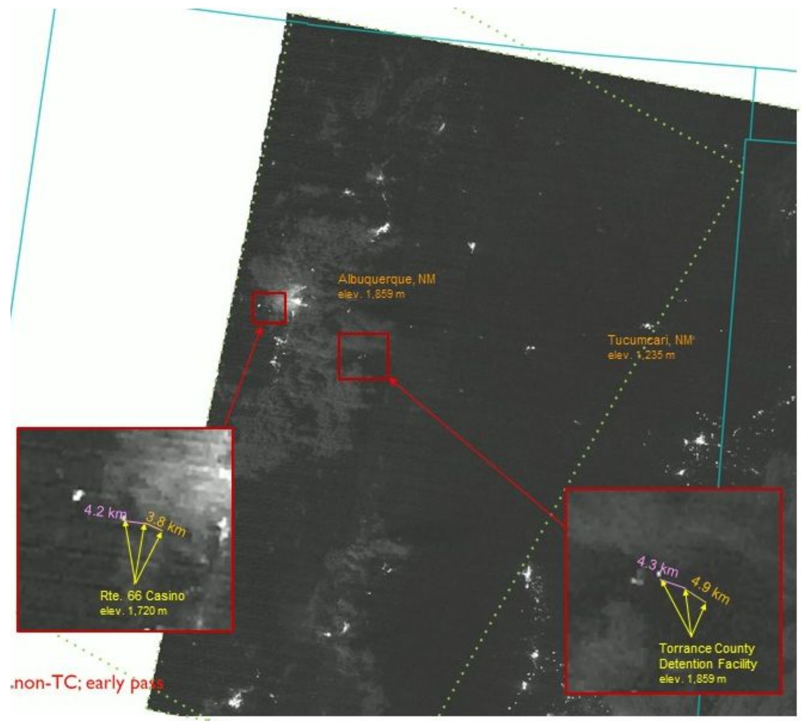
CIRA

- Don Hillger
- Christopher Slocum
- Alan Brammer (2)
- Kate Musgrave (2)
- Imme Ebert-Uphoff
- Yoo-Jeong Noh
- Ed Szoke
- Jorel Torres (2)
- Matt Rogers

Terrain-Correction for VIIRS EDR Imagery in Preparation for JPSS-2

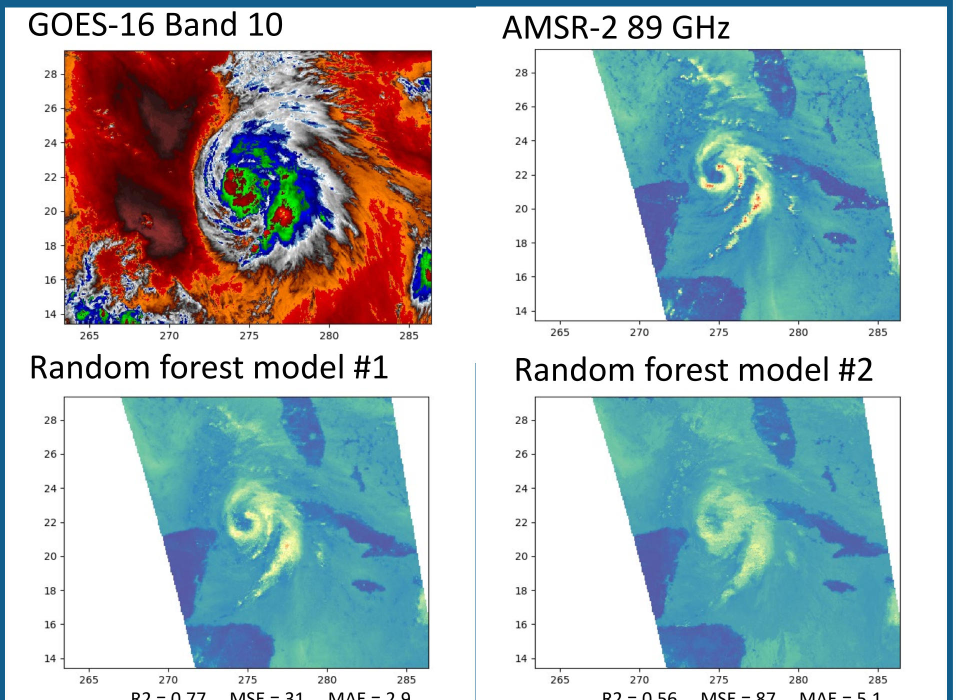
Don Hillger[1], Tom Kopp[2], Gary Lin[3], Ashley Griffin[4], John Dellomo[5], Derek Stuhmer[6], Weizhong Chen[7], Steve Finley[8], Curtis Seaman[8], and John Evans[9]

- **Reasons Terrain-Correction is being implemented:**
  - User requests (NWS and other users) to monitor wildfires (day and night)
  - Requirement for JPSS-2 (FY2022 launch)
- **VIIRS Terrain Correction history:**
  - Implemented for VIIRS SDRs in 2012
  - Was not required for S-NPP and NOAA-20
- **TC especially important for viewing VIIRS at short intervals**
  - NOAA-20 and S-NPP (50 min half-orbit separation)
- **VIIRS code changes were developed, tested, and documented**
  - Use Terrain Correction coding applied to VIIRS SDRs
  - Needed new intermediate files for EDR application.
  - No changes to output file number or size (merely replace non-TC geo-locations with TC geo-locations)
  - Changes to ATBD and OAD documentation



Using Geostationary Imagery to Peer through the Clouds Revealing Hurricane Structure

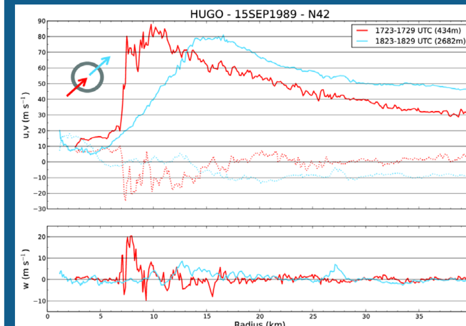
Christopher J. Slocum & John A. Knaff
NOAA/NESDIS Center for Satellite Applications and Research



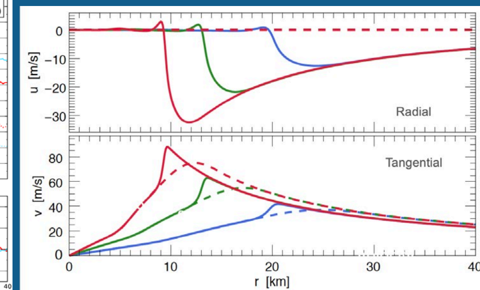
Example model output of synthetic passive microwave generated from GOES-16 ABI data using a random forest machine learning algorithm

Wayne Schubert Symposium-Leaving a Balanced World: Probing the Nonlinear, Unbalanced Dynamics of the Tropical Boundary Layer

Christopher J. Slocum[1] & Alex O. Gonzalez[2]
1. NOAA/NESDIS Center for Satellite Applications and Research
2. Department of Geological and Atmospheric Sciences, Iowa State University



Hurricane Hugo (1989)
P3 flight data



Slab BL model

Simple slab boundary layer model use for explaining:

- the nonlinear dynamics of the tropical cyclone boundary with respect to the development of shock-like structures in the boundary layer and
- understanding its impacts on hurricane forecasting efforts

- 11 - 16 January 2020

100th AMS Annual Meeting – Boston, MA

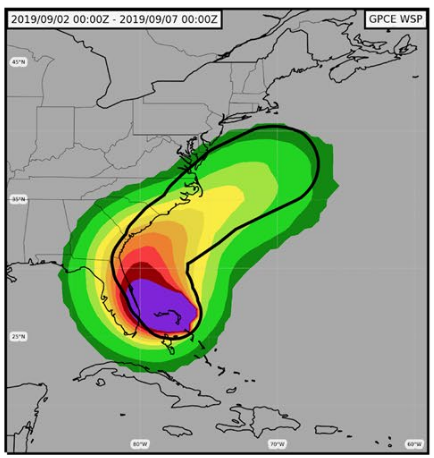
Development and Evaluation of a Multi-Model Global Ensemble Tropical Cyclone Wind Speed Probability Product

Alan Brammer (alan.brammer@colostate.edu), Andrea Schumacher, Kate Musgrave. CIRA / Colorado State University. Funded by NOAA R2O HFIP: NA18NWS4680056

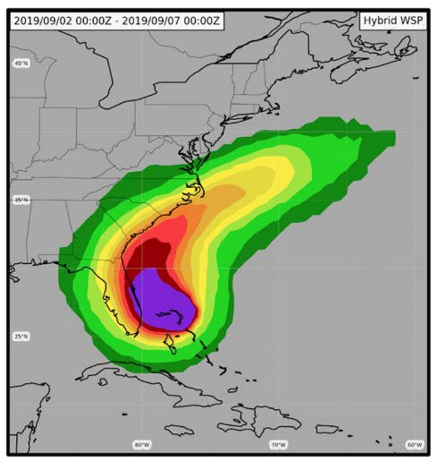
Poster 1220 -- Program: 30th Conference on Weather Analysis and Forecasting (WAF)/26th Conference on Numerical Weather Prediction (NWP)

A new experimental version of the Tropical Cyclone Wind Speed Probability algorithm has been developed to utilise intensity, wind-radii and track information from global multi-model ensemble forecasts.

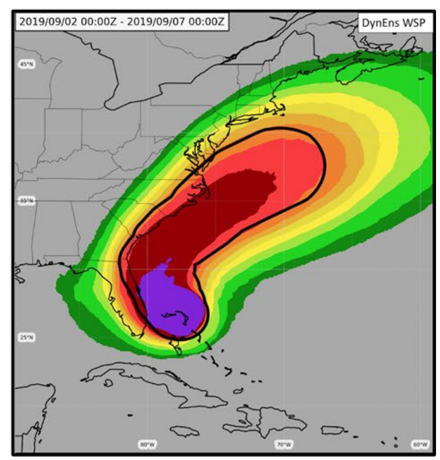
A variety of bias correction methods have been tested and applied to correct for systematic errors in the global ensemble forecasts. This bias correction enables a well calibrated forecast (blue line), even though the raw forecasts (orange line) were under-predictive.



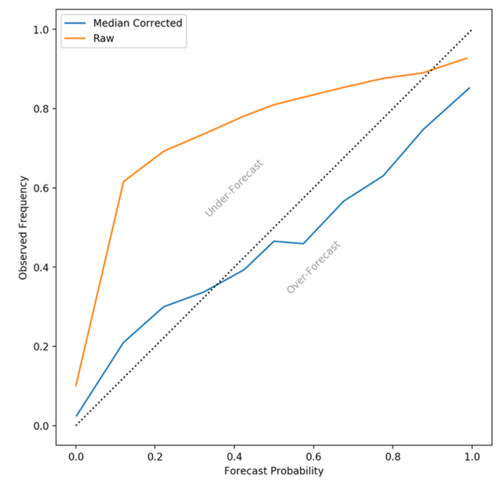
Existing Statistical Method
Black outline shows verifying wind-field



Hybrid Dynamical/Statistical Method



New Dynamical Bias Corrected Method
Black outline shows verifying wind-field



2019 34kt Reliability Diagram

Exploring Latent Heating Profiles from H-GPROF and Tropical Cyclone Intensity Change

Kate D. Musgrave[1], Paula J. Brown[2], and Christopher J. Slocum[3]

[1]Cooperative Institute for Research in the Atmosphere, CSU; [2]Department of Atmospheric Science, CSU; [3]NOAA/NESDIS/STAR

Funded by NASA NNX17AE99G

- Hurricane GPROF (H-GPROF) has been developed to provide rain rates and hydrometeor profiles from TMI/GMI, using the TRMM PR as the ground truth in the developmental sample.
  - Precipitation
  - Vertical profiles of: Rain Water Content (RWC), Cloud Water Content (CWC), Mixed Water Content (MWC), Ice Water Content (IWC), Latent Heating (LH)
  - Example of the vertical profiles from Hurricane Danielle (2010) is shown in Figure 1
- The vertical profiles of LH are being explored for use in tropical cyclone rapid intensification guidance
  - Grouped into radial bins from the center of the hurricane to better distinguish inner core convection
  - While peak values of LH are found outside the innermost radial bin (0-50km); the innermost bin has the most LH throughout the profile on average
  - The distribution of the absolute maximum LH for each radial bin is shown in Figure 2, and the distribution of the average sum of LH over the profile for each radial bin is shown in Figure 3 – both accumulated over the TRMM developmental sample

- Brown, P. J., C. D. Kummerow, and D. L. Randel, 2016: Hurricane GPROF: An optimized ocean microwave rainfall retrieval for tropical cyclones. *J. Atmos. and Oceanic Tech.*, **33**, 1539-1556.

- Real-time H-GPROF graphics for all global basins posted on TC Real-Time: http://rammb.cira.colostate.edu/products/tc_realtime/

Hurricane Danielle
27 Aug 2010

Figure 1

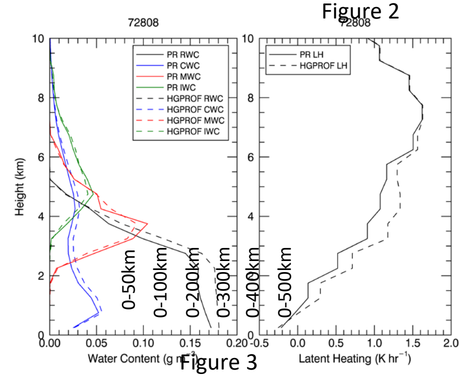


Figure 2

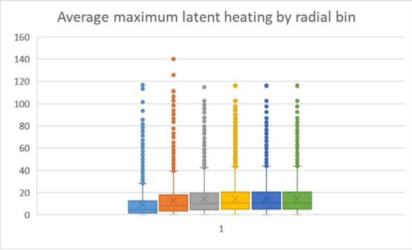
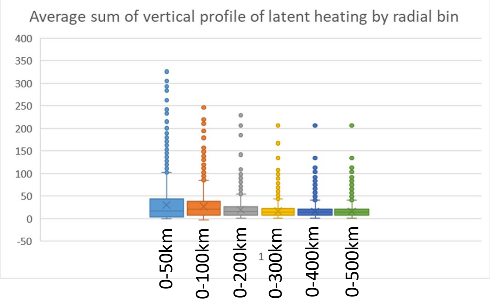


Figure 3



100th AMS Annual Meeting / Wayne Schubert Symposium (Boston, MA, 12–16 Jan 2020) – Poster 1032

A Preliminary Analysis of the RIPA and SPICE Models for the 2019 Hurricane Season

Kate D. Musgrave[1], John A. Knaff[2], Charles R. Sampson[3], and Alan Brammer[1]

[1]Cooperative Institute for Research in the Atmosphere, CSU; [2]NOAA/NESDIS/STAR/RAMMB; [3]Naval Research Laboratory

Funded by NOAA HFIP NA19OAR4320073

- Rapid Intensification Prediction Aid (RIPA)
  - RIPA uses a consensus of two statistical techniques, logistic regression (LRE) and linear discriminant analysis (LDA), to predict thresholds of interest for rapid intensification (RI) of tropical cyclones (TCs).
  - Originally developed for the western North Pacific, it has been running in operations at JTWC since 2017 and has been extended to all global TC basins and run in real-time starting in July 2019 (an example of the deterministic output for Hurricane Dorian is shown in Figure 1)
  - Preliminary* verification from July 2019 – December 2019 is shown in Figure 2 as a reliability diagram for the RI threshold of 30 kt in 24 hr – the consensus shown in green is well-calibrated, with a slight overforecast around 50% probabilities and a slight underforecast at 80% and higher probabilities. Figure 2 shows all global TC basins combined.
  - Knaff, J. A., C. R. Sampson, and K. D. Musgrave, 2018: An operational rapid intensification prediction aid for the western North Pacific. *Wea. Forecasting*, **33**, 799-811. doi: https://doi.org/10.1175/WAF-D-18-0012.1
  - RIPA description and text archives available from: http://rammb.cira.colostate.edu/research/tropical_cyclones/ripa/
  - Real-time RIPA text files and graphics (e.g., Figure 1) posted on TC Real-Time: http://rammb.cira.colostate.edu/products/tc_realtime/
- Statistical Prediction of Intensity from a Consensus Ensemble (SPICE)
  - SPICE is a consensus of an ensemble of SHIPS runs using the GFS, HWRF, and HMON as input, and an ensemble of LGEM runs from the same dynamical model inputs. It has been run in real-time as part of HFIP since 2011.
  - Preliminary* verification from the 2019 season for the eastern North Pacific basin is shown in Figure 3, where the mean absolute errors for SPICE are smaller than both the HWRF and HMON models particularly at days 4 and 5.

Figure 1

Hurricane Dorian (2019)

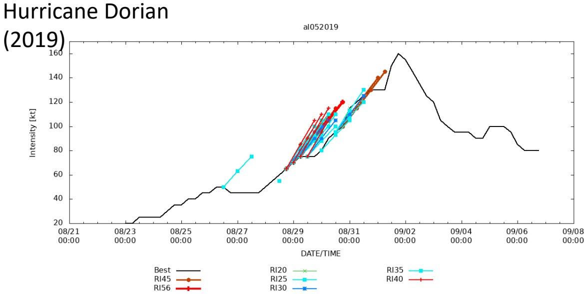


Figure 2

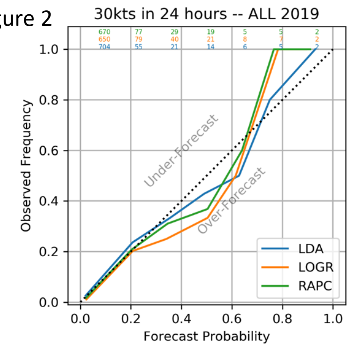
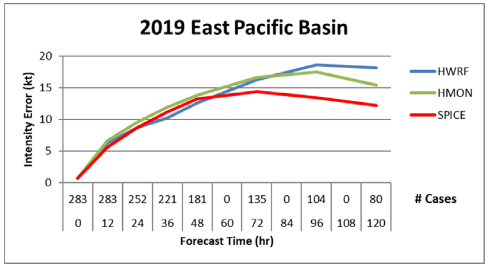


Figure 3



**These numbers are based off preliminary best tracks and are subject to change. Also important to note the small sample sizes involved in assessing a single season.*

100th AMS Annual Meeting / Tropical Meteorology and Tropical Cyclones Symposium (Boston, MA, 12–16 Jan 2020) – Poster 878

Evaluation, Verification, and Deployment of Real-Time Experimental Tropical Cyclone Applications

Alan Brammer (alan.brammer@colostate.edu), Kate Musgrave (CIRA / CSU), & Mark DeMaria (NOAA / NHC)
Funded by NOAA HFIP: NA19OAR4320073
Poster #802 -- Program: 10th Symposium on Advances in Modeling and Analysis Using Python

Deploying Python Applications

Aims:

- Continous Integration / Continous Delivery (CI/CD) for scientific python applications

Hurdles:

- Reliance on conda / system libraries without Docker

A CI/CD way

Utilise conda-pack on a CI/CD server to test, build and deliver versioned environments as well as versioned code.

Demo workflow at: github.com/abrammer/condapack_deploy

New code is commited to branch of master.
Master branch remains stable and functioning.

Unit tests to run any branch commited to repo.
Almost instant feedback on whether code still works.

Pull Requests to master only allowed to merge when automated tests pass.
Master stays stable and functional.

Tagging a commit on the master branch triggers automated relase and build of conda environment and codebase into a single tar file.

Utilize ansible to deploy pre-built environment + code to remote machine. Download release file to remote machine, unpack environment and code, generate configuration files, restart service.

Using Containers for Legacy App Development, Training and Deployment

Legacy Fortran App Hurdles

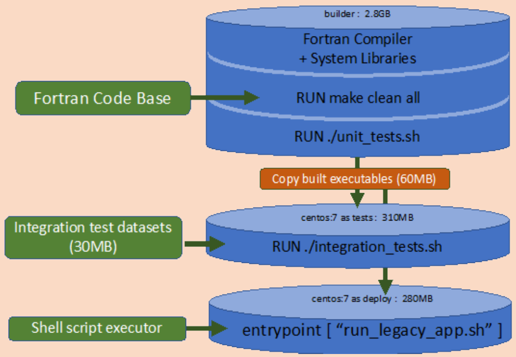
- External Fortran libraries for GRIB output
- Deployed indirectly to multiple servers with different architectures
- Lack of existing unit / integration tests
- Years to decades of code and downstream dependencies
- Operational systems with different compiler dependencies (iFort, gfortran)

Multi-stage Build for Development, Tests and Deploy

Can now develop on any machine with Docker locally or running builder stage on a remote Continuous Integration server.

Include unit tests as well as integration tests. Include in the multistage build so the deployed executable is the tested executable.

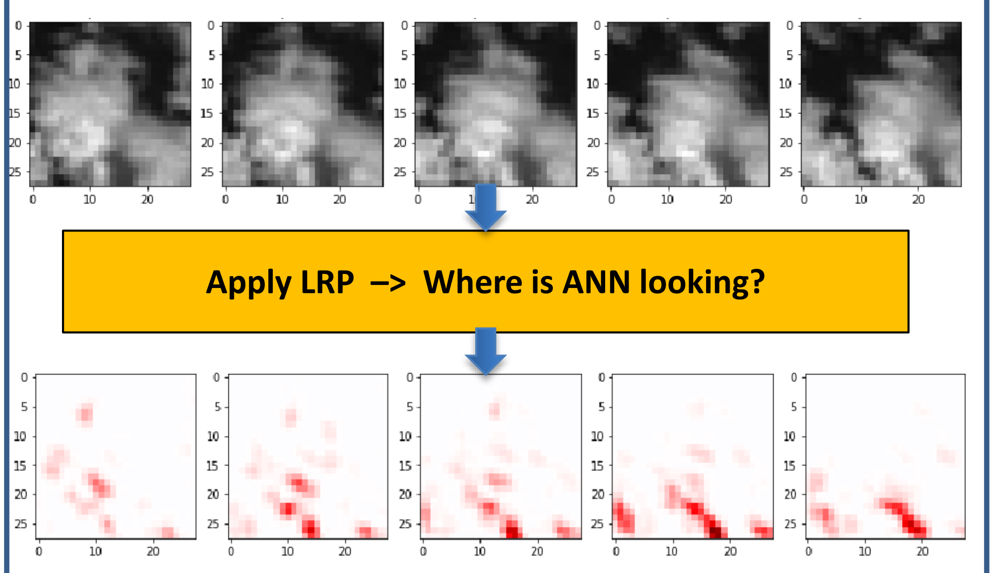
Whole pipeline is tested in a consistent clean OS, to replicate deployment to remote server.



Selected Methods from Explainable AI To Improve Understanding of Neural Network Reasoning for Environmental Science Applications

I. Ebert-Uphoff[1,2], K. Hilburn[1], B. Toms[3], and E.A. Barnes[3] ([1]CIRA [2]ECE [3]ATS All at Colorado State University)

- **Artificial neural networks (ANNs)** are emerging in many climate/weather applications.
- How can we look inside the black box?
- Many visualization methods available.
- Useful method: **Layer-wise relevance propagation (LRP).**
- Can help us gain better understanding of ANN reasoning.
- Demonstrated for sample application:
  - Y. Lee, C. Kummerow, I. Ebert-Uphoff developed ANN to detect convection from satellite imagery.
  - Here - apply LRP to that ANN: found that ANN was mainly looking at high brightness but neglected important texture information ("bubbling").
  - Modified ANN accordingly. Better performance.



Application of LRP to convection detection problem

100th AMS Annual Meeting / 19th Conference on Artificial Intelligence for Environmental Science (Boston, MA, 12–16 Jan 2020)

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

Satellite Cloud Vertical Cross-section Products and User-Engaged Improvement for Aviation Weather Applications

Y. J. Noh*, S. D. Miller, J. Haynes, J. Forsythe, C. Seaman (CIRA/Colorado State University)

J. H. Kim (Seoul Nat'l Univ), and A. Heidinger (NOAA/NESDIS/STAR)

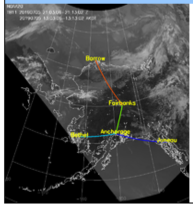
- The statistical CBH/CCL algorithm is operational as part of the NOAA Enterprise Cloud Algorithms (applicable to both polar and geostationary satellite sensors)
- Ongoing research efforts for improvement of nighttime and multilayer clouds using a machine learning approach
- VIIRS Cloud Vertical Cross-section products over Alaska http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs_arctic_aviation.asp
- **User-engaged activities for improvement and evaluation through the NOAA JPSS Aviation Initiative effort!**

Thanks to our collaborators and Alaska users:

Andi Walther, Yue Li, Steve Wanzong, William Straka (CIMSS) , Jeff Weinrich (NOAA JPSS Aviation Initiative), Tom George (Aircraft Owners & Pilots Association), Adam White (AK Airmen Assoc.), David Kochevar (NWS Alaska Region), Andy Dietrick (Unalaska weather), Nadia Smith, Rebekah Esmaili (STCNET), Carl Dierking and Jay Cable (GINA)

Alaska - Aviation Products

Alaska Cloud Infrared Overview with Flight Routes



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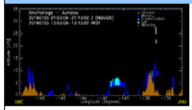
Cloud Vertical Cross-section Anchorage - Juneau (Blue)



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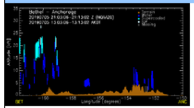
Cloud Vertical Cross-section Bethel - Anchorage (Cyan)



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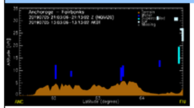
Product Info

Cloud Vertical Cross-section Anchorage - Fairbanks (Green)



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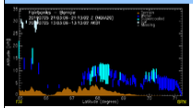
Cloud Vertical Cross-section Fairbanks - Barrow (Red)



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Product Info

- Introduction
- Quick Guide
- Feedback

100th AMS Annual Meeting / 20th Conf. on Aviation, Range, and Aerospace Meteorology (Boston, MA, 12–16 Jan 2020)

Is there a total lightning precursor signal for non-supercell tornadoes?

- Ed Szoke, Dan Bikos, Kyle Hilburn, Rob Cox, Dave Barjenbruch, and Paul Schlatter

- *AMS 100th Annual Meeting, Boston,* 13 - 16 January 2020

  16th Annual Symposium on New Generation Operational Environmental Satellite Systems, Talk 4.2

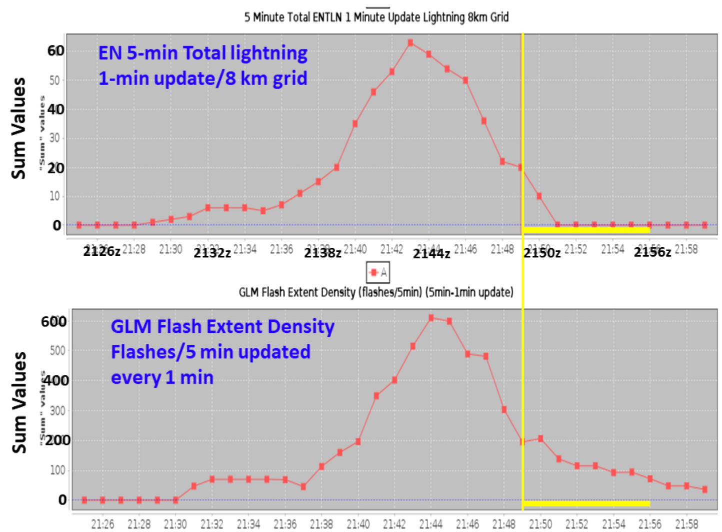
Summary of Research Results:

- **Some of our cases did show a signal before or just before tornadogenesis**
- **However, how we looked at the data sometimes made a difference**
- **Need to gain more experience with what is best to examine**

  - If total lightning is rapidly increasing in this cell (a lightning jump) then this indicates a strengthening updraft that could lead to a non-supercell tornado

  - Future efforts: continue to offer VISIT teletraining and look for additional cases from various WFOs

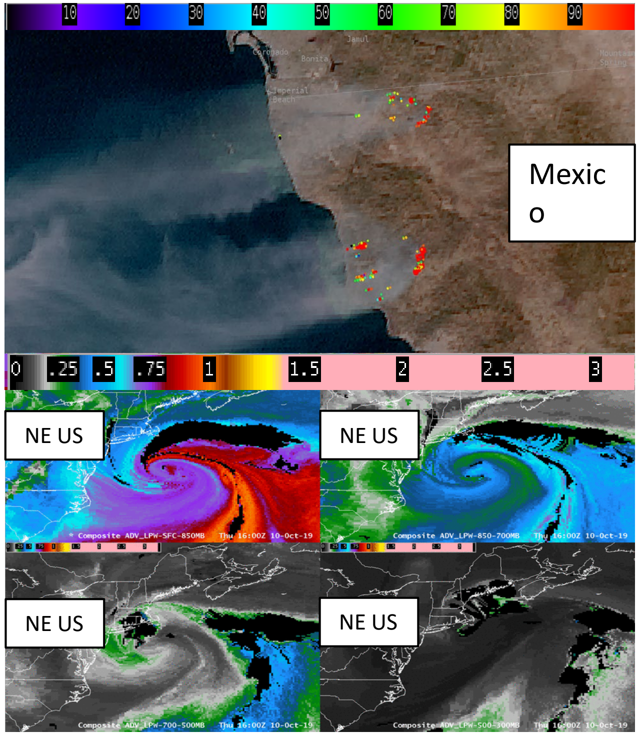
We get a somewhat different picture with the same data plotted in a different way: here the *sum* within the circle area instead of the max value and 5-min values. A similar trend in the EN and GLM data.



JPSS Products, Applications and Training Resources

Jorel Torres (CIRA) & Bernie Connell (CIRA)

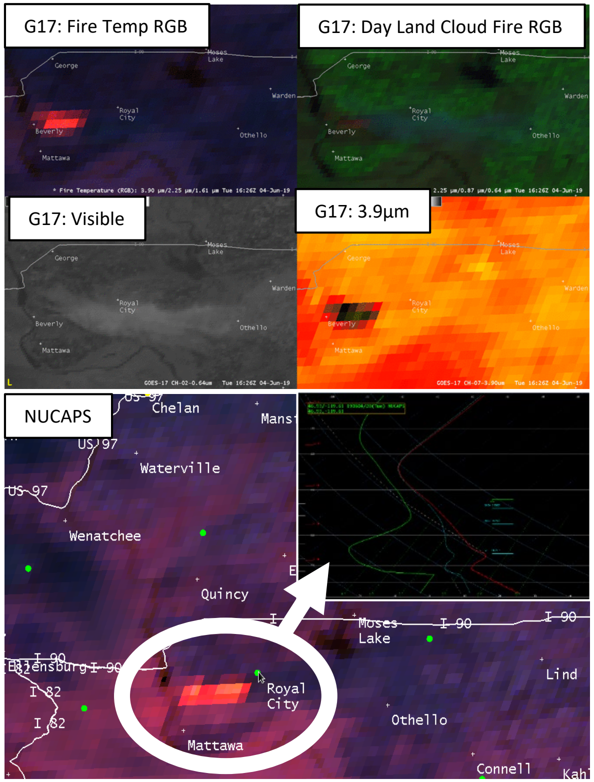
- JPSS Constellation
  - New generation of weather satellites providing environmental monitoring around the globe
    - Contains Suomi-National Polar-orbiting Partnership (S-NPP) and NOAA-20
- JPSS Products
- JPSS Applications
  - VIIRS Active Fires
  - Advected Layered Precipitable Water (ALPW)
  - Additional Applications
- JPSS Training Resources for Users
  - Satellite Foundational Course for JPSS (SatFC-J)
  - JPSS Reference Materials



The Utility of JPSS and GOES Fire Weather Products and Applications in the Operational Forecasting Environment

Jorel Torres (CIRA)

- Influx of New Environmental Monitoring Satellites
  - Suomi-National Polar-orbiting Partnership (S-NPP) and NOAA-20
  - GOES-16 and GOES-17
- How can users employ polar-orbiting and geostationary satellites for Fire Weather Monitoring?
  - Presentation focuses on the utility of JPSS/GOES products and imagery for CONUS and OCONUS fire weather events.
    - CONUS: 243 Command Fire – Central Washington.
      - GOES-17 4-panel (top-right) and NUCAPS (bottom-right)
    - OCONUS: Swan Lake Fire - Alaska
- Satellite Training Resources for Users

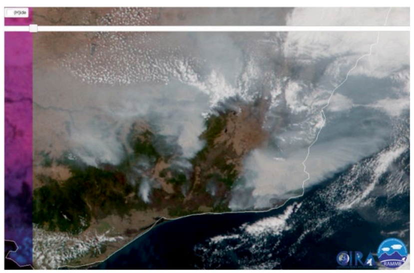


CIRA
Connecting Models and Observations

Bringing Advanced Scientific Imagery to the Studio: Options For Scientists and Broadcasters

Matt Rogers, Kevin Micke, Steven D. Miller

48th Conference on Broadcast Meteorology, 2020 AMS Annual Meeting



Talk covered:

- Online imagery, through SLIDER, more prevalent with public, and now media
- Basics of SLIDER and RGB-derived products
- Examples of SLIDER use in traditional/broadcast media
- Examples of use online
- Online content (non-CIRA) suffers from trust issue – content can be misidentified/misconstrued
- Broadcast journalism has opportunity to integrate compelling and new online observations with journalism to create best-of-both-worlds content delivery – trusted and innovative satellite observations, partnering with CIRA/NOAA

More Information

For more information on these AMS talks and posters, go to:

https://ams.confex.com/ams/2020Annual/meetingapp.cgi/Search/0?sort=Relevance&size=10&page=1

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