STAR Contributors to the 102nd AMS 24-27 January 2022

Summary slides

Building an Enterprise NOAA/NESDIS Satellite Precipitation Validation System

Malarvizhi Arulraj[1,2], Veljko Petković[1,2], Ralph R. Ferraro[2], Huan Meng[3]
(1) CISESS, University of Maryland; (2) ESSIC, University of Maryland, (3) NOAA/NESDIS/STAR

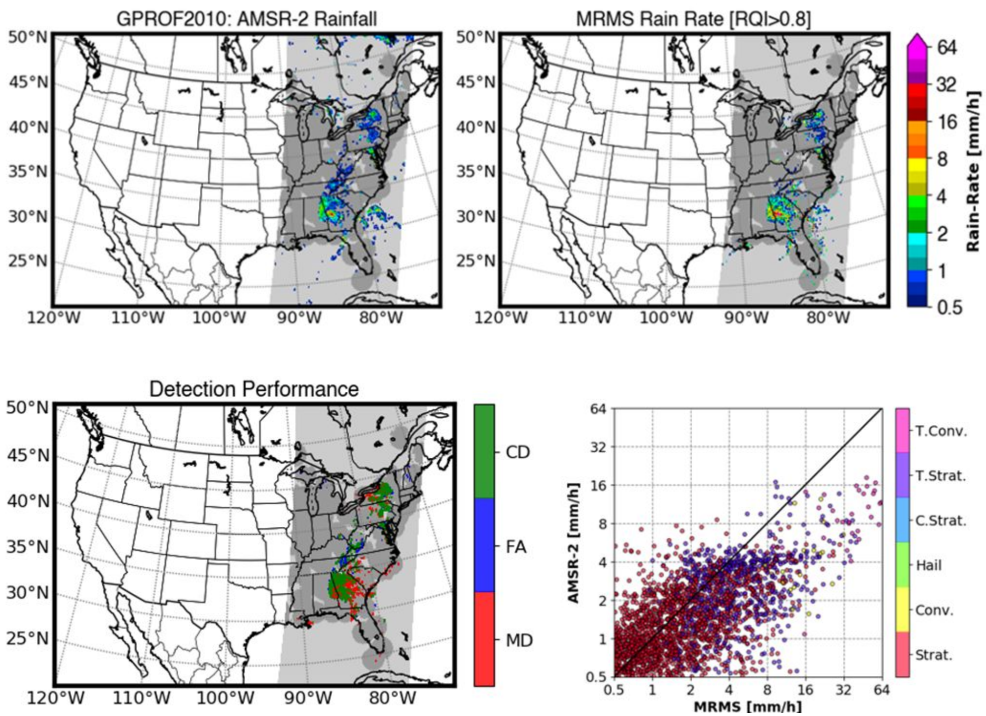
An automated, near-real-time validation system for satellite precipitation products was developed following the road-map set by NOAA users and developers.

The system validates different types of Level-2 and Level-3 precipitation products:

1. Instantaneous Rainfall:
   GPROF - AMSR2, MiRS – NOAA-20 and Suomi-NPP, Blended Rain Rate, SCaMPR
2. Accumulated Rainfall products:
   PERSIANN and IMERG
3. Snowfall rate products:
   F16, F17, F18, MetOp-B, MetOp-C, NOAA-19, NOAA-20 and Suomi-NPP.

The output available at public FTP site:
ftp://rain.umd.edu/precip/

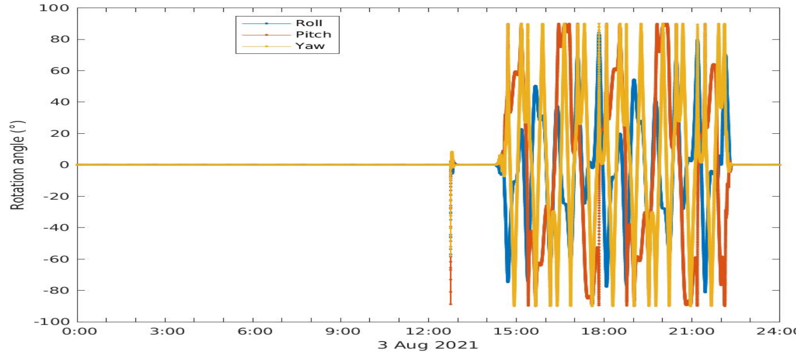
Development of an user-interactive webpage to deliver the validation outputs was encouraged.

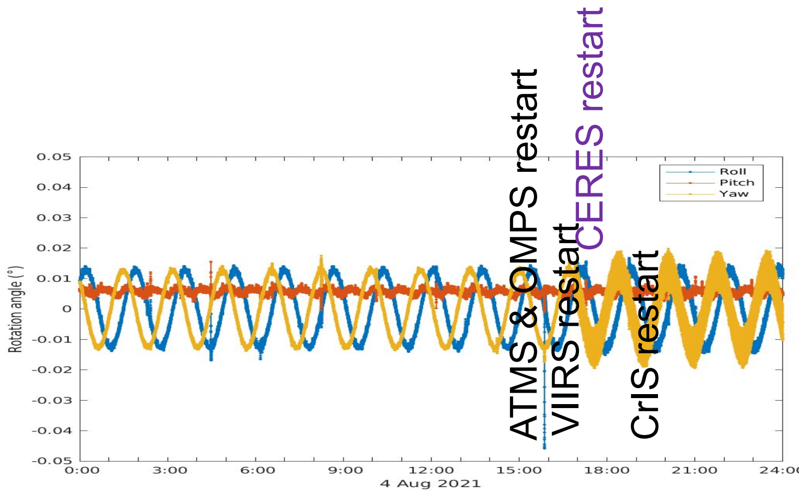


STAR Cal/Val Support to the Rapid Recovery of Suomi NPP Instruments from the Spacecraft Anomaly in 2021

Changyong Cao [1], Slawomir Blonski [2], Quanhua Liu [1], Ninghai Sun [2], Flavio Iturbide-Sanchez [1], Banghua Yan [1], Chunhui Pan [3], and Alisa Young [1]
[1] NOAA/Center for Satellite Applications and Research(STAR); [2] GST Inc.; [3] University of Maryland, CISESS

- Suomi NPP had a major spacecraft anomaly on August 3, 2021 which puts all instruments on safe-hold
  - Recovery effort started on August 4. After intensive cal/val, ATMS and VIIRS recovered and resumed data distribution on August 5
  - CrIS required additional spectral calibration, and was fully recovered by August 9 (resumed data distribution on August 9, 2021)
  - OMPS resumed data distribution on August 13, followed by a calibration update on August 15
- The successful recovery demonstrates the importance of dedicated support by the STAR radiance science team, and close collaboration with OSPO flight project, JPSS program, and the data users at NWP centers, as well as all other users
- The team gained experience in instrument recovery from major anomalies and is better positioned to address future instrument anomalies





Suomi NPP Spacecraft Roll, Pitch, Yaw changes during the anomaly

Simultaneous Radio Occultation Predictions for Inter-satellite Comparison of Bending Angle Profiles

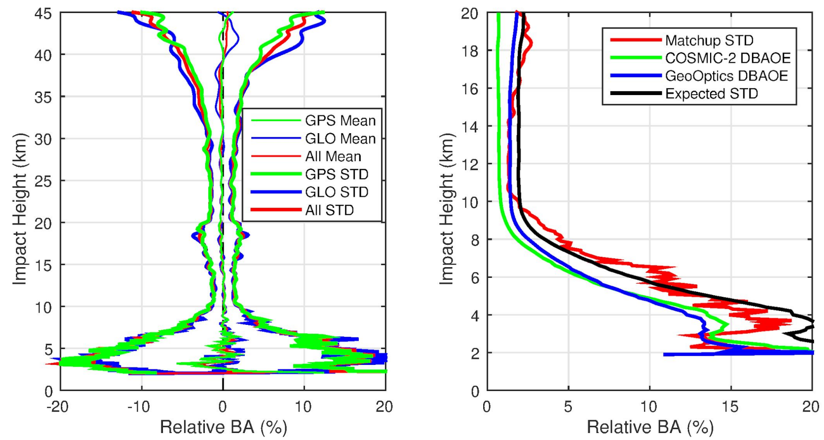
Yong Chen[1], Xi Shao[2], Changyong Cao[1], and Shu-Peng Ho[1]
[1]NOAA/NESDIS/STAR, [2] UMD/ESSIC/CISESS

- We present a method that predicts all the potential RO events by giving the TLEs from a GNSS satellite and a LEO satellite. COSMIC-2 RO observations are used to validate the method in terms of ground track, RO events number, and RO event distribution as a function of antenna view angle. The prediction method can successfully predict all the observed COSMIC-2 RO events, and the prediction accuracy compared to the observation is within 10 minutes and less than 15 km distance.

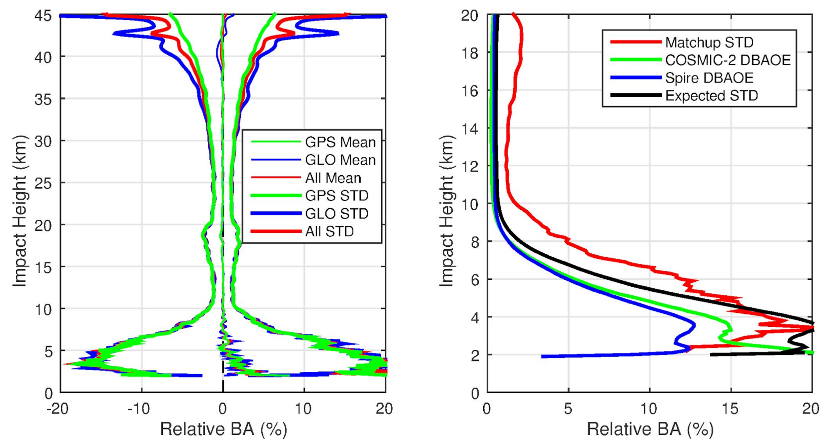
- The main advantage of SRO comparisons of bending angles is the significantly reduced uncertainties due to the much shorter time and more minor atmospheric path differences than traditional RO comparisons. It can be used to validate/inter-calibrate GNSS RO measurements from different missions

- The results show excellent agreement in the bending angles between COSMIC-2 RO measurements and those from GeoOptics and Spire, although systematic biases are also found in the inter-comparisons. Instrument and processing algorithm performances for SNR, penetration height, and bending angle retrieval uncertainty are also characterized.

COSMIC-2 vs. GeoOptics



COSMIC-2 vs. Spire



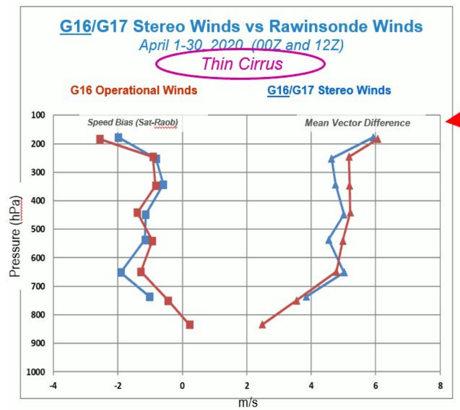
Inter-Comparison Results of SRO Bending Angle

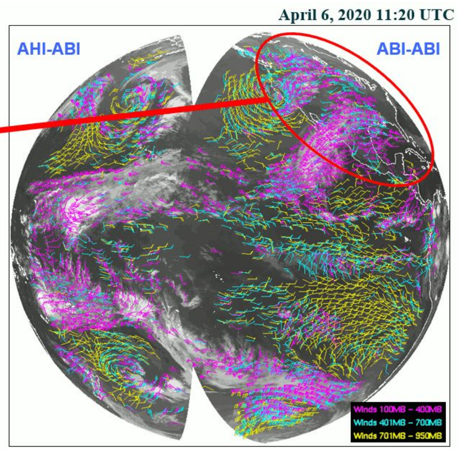
Status of GEO-GEO and GEO-LEO Stereo Winds Development at NOAA

Jaime Daniels[1], Jim Carr[2], Dong Wu[3], Wayne Bresky[4], Houria Madani[2], Mariel Friberg[5]
NESDIS/STAR[1], Carr Astronautics[2], NASA[3], IMSG Inc.[4], USRA[5]

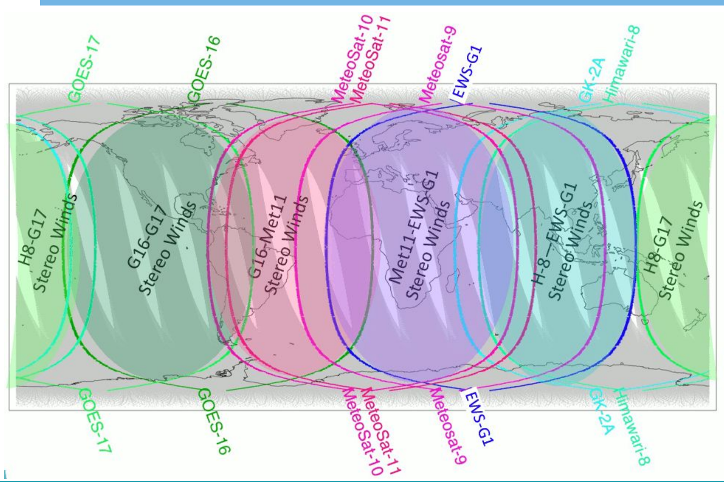
- Strong collaboration between NOAA/NESDIS and NASA has expedited the development of stereo capabilities (GEO-GEO, GEO-LEO, Polar triple-LEO)
- Motivation
  - Stereoscopic approach to cloud height retrieval is another tool to add to the cloud height retrieval toolbox
  - Stereo tracking of cloud, moisture, and smoke features in VIS, IR, and WV channels to simultaneously retrieve both height and horizontal motion of these features
  - Improve wind height assignments of tracked features; NWP model independence
- Applications
  - Assimilation in operational global and regional Numerical Weather Prediction (NWP) forecast systems
  - Fire Plumes/Smoke; Smoke dispersion modeling/forecasting and smoke forecast verification
  - Cloud height characterization; Planetary Boundary Layer (PBL) cloud processes
  - Deep Convection (Tropical Cyclones)

G-17 ABI/H-8 AHI Stereo Winds (Band 14)





Excellent geographic coverage; Quality of stereo winds associated with Thin Cirrus clouds show significantly improved quality over operational G17 winds



Global stereo winds coverage is possible via combined use of various GEO-GEO, GEO-LEO, and LEO-LEO data

- Full diurnal coverage
- Limited to overlapped regions
- Coarser pixel resolution at edge

NUCAPS Atmospheric Composition and Trace Gas Products: Performance, Recent Advances, and Future Improvements

Murty Divakarla[1], Ken Pryor[2], Shu-peng Ho[2], Chris Barnet[3], Changyi Tan[1], Mike Wilson[1], Nick Nalli[1], Tong Zhu[1], Juying Warner[2], Tianyuan Wang[1], Letitia Soulliard[4], and Satya Kalluri[2]
1IMSG, Inc., STAR, 3STC, Inc., , 4GAMA-1 Technologies

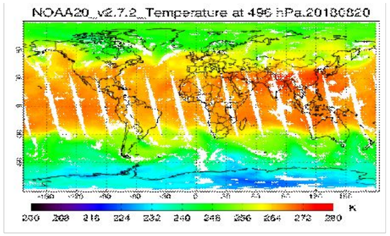
Oral, AMS-2022, 7B.3, Tuesday, January 25, 3:00 – 3:15 PM (EST)
https://ams.confex.com/ams/102ANNUAL/meetingapp.cgi/Paper/391264

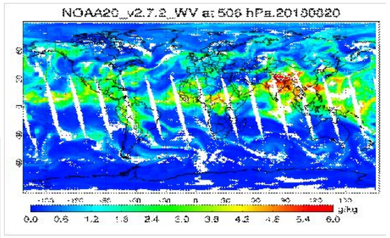
Presented an outline of the NUCAPS Products

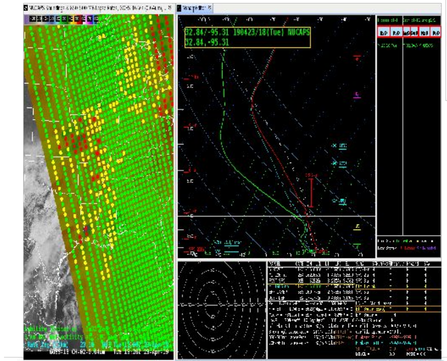
- T/H2O/O3/CO/CH4/CO2 products are all of Validated Maturity in the current operational version.
- Produces consistent products JPSS S-NPP/NOAA-20 (CrIS), MetOp-B/C (IASI)
- NUCAPS CO, CH4 and CO2 are being used for trace gas monitoring of environmental events and by many PGRR initiatives, and field campaigns.
- Product Availability: NRT operations OSPO/PDA, CLASS, CSPP Direct Broadcast (DB), and through AWIPS for Weather Forecast Offices (WFO)

On-going Activities/Future Improvements

- Averaging kernels for T/H2O/O3/CO/CH4/CO2 - implementation into NUCAPS OPS code
- Mission-long reprocessing for S-NPP/NOAA-20 NUCAPS EDR products on NCIS Cloud Infrastructure
- Ammonia algorithm into NUCAPS/NPP/N-20 CrIS
- Augmenting the NUCAPS system for EPS-SG IASI-NG hyperspectral sounder.







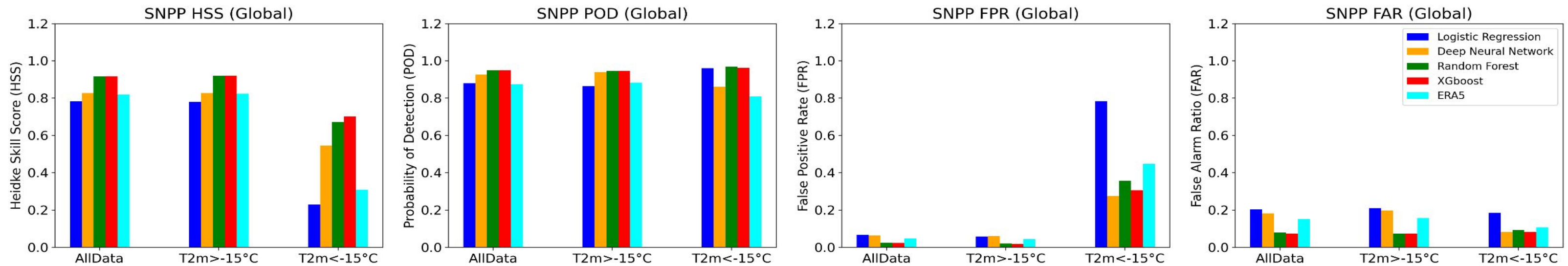
Dot Color Meaning

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

New Developments to the NOAA/NESDIS Satellite Snowfall Rate Product

Jun Dong[1], Huan Meng[1,2], Yongzhen Fan[1], Cezar Kongoli[1], Ralph Ferraro[3]
[1]CISESS/University of Maryland, [2]NOAA/NESDIS/STAR, [3]ESSIC/University of Maryland

- Several machine learning models were trained to detect snowfall; the XGBoost model was selected because of its excellent performance and ease of implementation
- Machine learning models were also trained for elements of the snowfall rate (SFR) estimation algorithm
  - Ice water path initialization
  - SFR bias correction
- Louis Cantrell from NOAA/NESDIS/OSAAP/TPIO will add SFR to the NOAA value tree of products and services after learning about this product from this poster



Apply V-CRTM to NOAA-20 and S-NPP OMPS Nadir Sensor Radiance Simulations

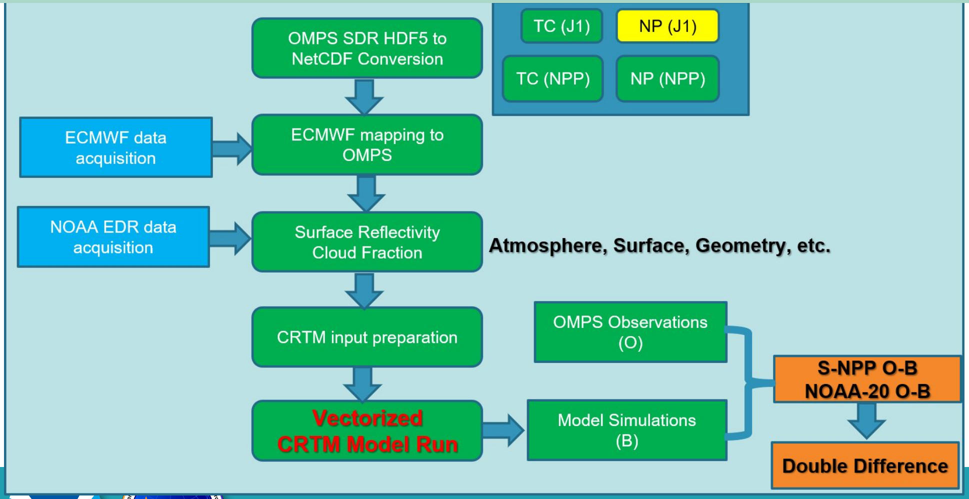
J. Huang[1,2], B. Yan[3], X. Jin[1,2], C. Pan[4], T. Beck[3], M. Chen[4], Q. Liu[3], Y. Chen[3], Y. Ma[5], K. Garrett[3], D. Liang[1], X. Xiong[6], X. Liang[4]
1.GST, 2. SSAI, 3.NOAA STAR, 4. UMD, 5. AER, 6. NASA LARC

- ❑ V-CRTM Interface was successfully developed and applied to the OMPS nadir sensor radiance simulation, with main challenges identified;
- ❑ Preliminary observations vs. simulation results indicate valuable skills in the O-B and Double Difference assessment that has great potential for broad applications in intersensor comparisons;

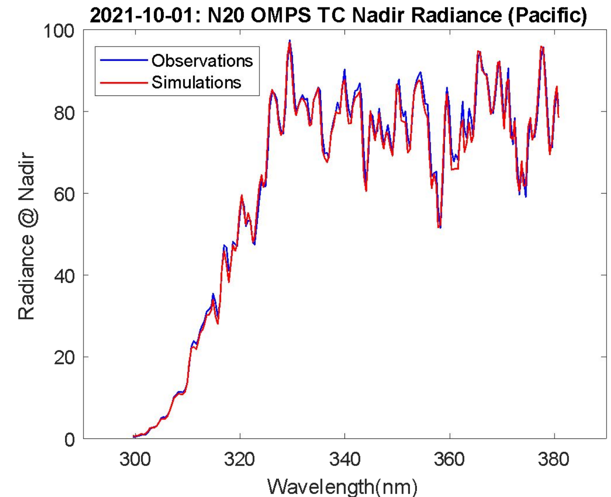
Path Forward:

- ❑ Improve the V-CRTM Interface to better address bandpass cross-track dependency
- ❑ Improve the V-CRTM Interface by adding wavelength shift considerations
- ❑ Improve the V-CRTM with more accurate surface reflectivity inputs
- ❑ Transfer the O-B and DD modules to operation to provide long term monitoring for intersensor cross calibrations, to support OMPS nadir sensors' calibration and validation

V-CRTM based Interface for OMPS SDR Cross Calibration



Observations vs. V-CRTM model simulations



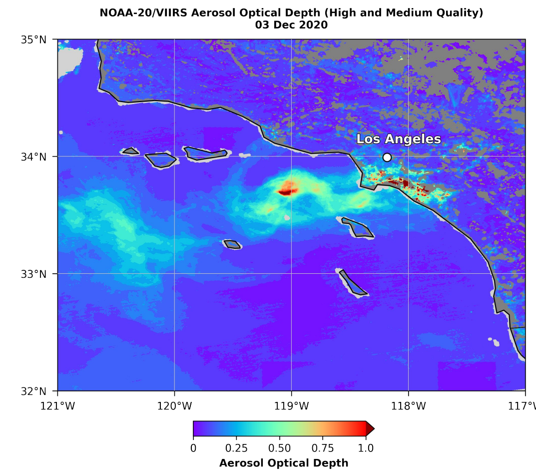
Training and Outreach on NOAA Satellite Products for Atmospheric Smoke, Blowing Dust, and Urban Pollution using Python

Amy K. Huff[1], Shobha Kondragunta[2], Istvan Laszlo[2], Hongqing Liu[1], Mi Zhou[1] & Pubu Ciren[1]
[1]IMSG at NOAA/NESDIS/STAR [2]NOAA/NESDIS/STAR

- New **STAR Atmospheric Composition Satellite Product Training Program**
  - VIIRS, ABI, TROPOMI level 2 aerosol, fire & trace gas products
  - Training & outreach to end users (inside and outside NOAA)
  - Free! All Python skill levels accommodated, including new users!

Interested in a training?
Email us at:
nesdis.star.aerosoltraining@noaa.gov

- Goals:
  1. Increase access to aerosol, fire & trace gas satellite data
  2. Promote proper use of the satellite products for air quality applications in operations & research
- Focus on **real-world learning** with satellite data **using Python from start to finish**:
  1. Download satellite files from NOAA Amazon Web Services (AWS) GOES or JPSS archive, Sentinel 5-P Data Hub
  2. Open netCDF data files, read metadata, understand data variables
  3. Process satellite data using quality/confidence flags & visualize in professional quality figures
- 8 trainings conducted as of mid-Feb 2022; very well-received!



Example: using VIIRS AOD to track smoke from wildfires near Los Angeles in Dec 2020

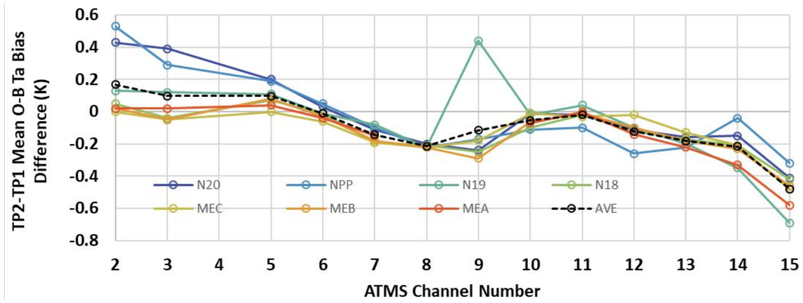
Check out our new website for training materials & resources!

https://www.star.nesdis.noaa.gov/aerosoltraining/

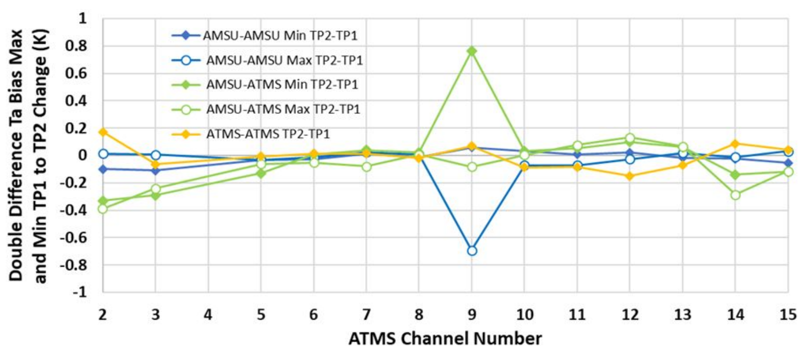
COSMIC-2 Soundings Impacts on a RO-based NOAA Microwave Satellite Data Quality Monitoring System

Robbie IACOVAZZI[a], Mark LIU[b], Xinjia ZHOU[a], Stanislav KIREEV[a], Ninghai SUN[a], Ben HO[b]
[a]GST, Inc. Greenbelt, MD and [b]NOAA, NESDIS, STAR, College Park, MD

Analysis shows impacts of adding STAR COSMIC-2 (C2) RO data to the ICVS ATMS/AMSU-A monitoring system on October 1, 2019



Post-C2 minus pre-C2 mean of global monthly mean O-B Ta bias values



Post-C2 minus pre-C2 mean of double-difference monthly inter-sensor Ta bias min and max

- Sample number increases by ~10X, and distribution shifts to the tropics and subtropics
- Individual sensor changes in long-term mean observed minus CRTM-simulated (O-B) Ta bias
  - Most instruments and monitored channels (< 0.2K shift)
  - ATMS Ch 2-3 has 0.5 K shift due to antenna emissivity correction in October 2019
  - ATMS(AMSU-A) Ch 15(14) has -0.5 K shift and 1.5 K semi-annual variability, due to C2 replacement of ECMWF NWP gap-filler data between 40-60km.
- Inter-sensor double differences show very robust extensions for all monitored sensor pair groups

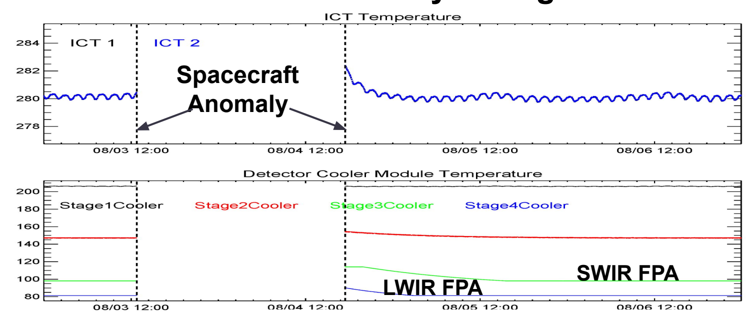
Successful Recovery of High Science Impact Observations from SNPP CrIS after Recent Sensor and Spacecraft Anomalies

Flavio Iturbide-Sanchez[1], Larrabee Strow[2], David Tobin[3], David Johnson[4], Kun Zhang[5], Denis Tremblay[5], Zhipeng Wang[6], Erin Lynch[7], Peter Beierle[8], Robert O. Knuteson[3], Michelle Loveless[3], Dan DeSlover[3], and Joe Taylor[3]

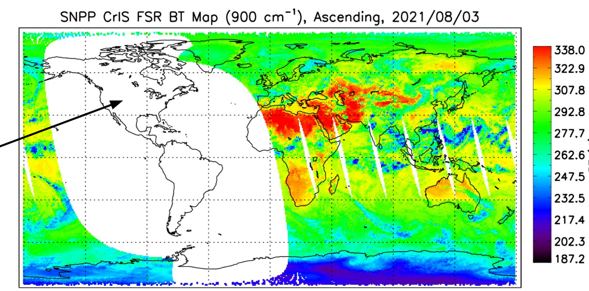
[1] NOAA/NESDIS/Center for Satellite Applications and Research, College Park, MD 20740, USA.; [2] University of Maryland Baltimore County; [3] Space Science and Engineering Center/University of Wisconsin-Madison; [4] NASA Langley Research Center; [5] Global Science and Technology, Inc.; [6] Science Systems and Applications Inc.; [7] NOAA/NESDIS/Office of Projects, Planning, and Analysis; [8] University of Maryland

- After 10 Years in operations, the SNPP CrIS sensor continues providing high quality and stable calibrated observations.
- The SNPP CrIS observations are one of the most impactful observations providing critical information to support weather forecasting, environmental monitoring and climate studies.
- The experience gained with the SNPP CrIS sensor has helped to enhance the robustness of the succeeding CrIS instruments (NOAA-20, JPSS-2, -3 and -4) and the quality of their calibrated observations.
- The CrIS observations are expected to satisfy present and future satellite needs and to be the foundation of new applications with significant societal, economic and scientific benefits.

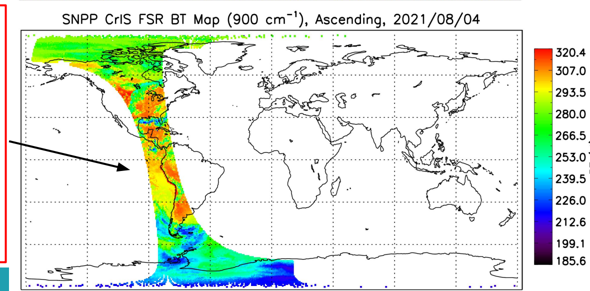
Suomi NPP CrIS Recovery in August 2021

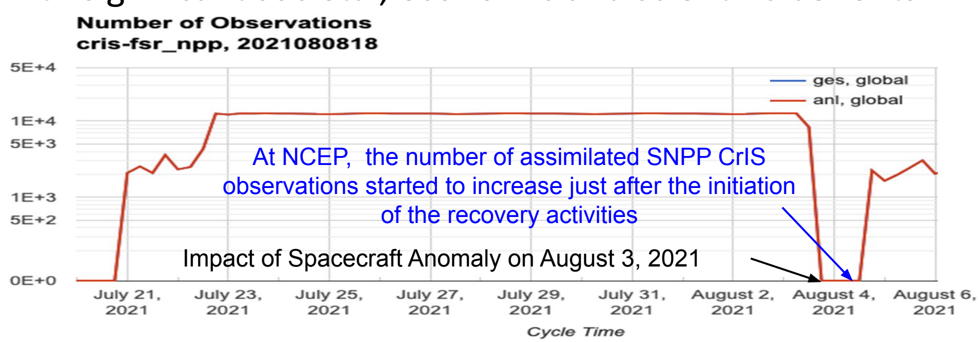


Data Gap Associated with the Spacecraft Anomaly on August 3, 2021



Data Recuperation After Sensor Recovery Completed on August 4, 2021 at 19:13 UTC



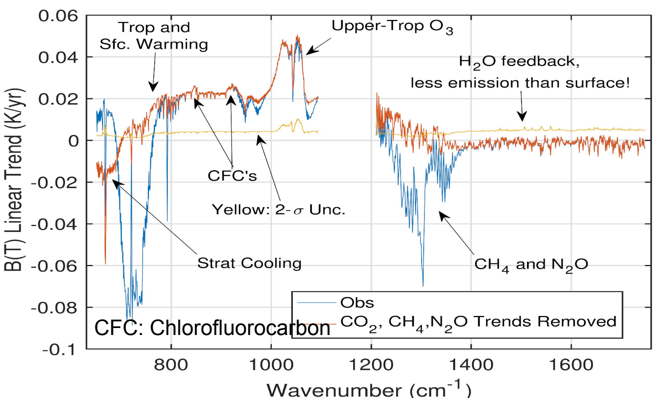


Successful Continuation of Hyperspectral Infrared Observations during the CrIS Program: 10 Years Providing Science Data

Flavio Iturbide-Sanchez[1], Larrabee Strow[2], David Tobin[3], Kun Zhang[4], Denis Tremblay[4], Zhipeng Wang[5], Erin Lynch[6], Peter Beierle[7], David Johnson[8], Lawrence Suwinski[9], and Joe Predina[10]

[1] NOAA/NESDIS/Center for Satellite Applications and Research, College Park, MD 20740, USA.; [2] University of Maryland Baltimore County; [3] Space Science and Engineering Center/University of Wisconsin-Madison; [4] Global Science and Technology, Inc.; [5] Science Systems and Applications Inc.; [6] NOAA/NESDIS/Office of Projects, Planning, and Analysis; [7] University of Maryland; [8] NASA Langley Research Center; [9] L3Harris Technologies; [10] Logistikos Engineering LLC.

- The CrIS sensors have been provided high quality and stable calibrated observations for more than 10 years.
- The CrIS observations are one of the most impactful observations providing critical information to support weather forecasting, environmental monitoring and climate studies.
- Due to its high quality and stability the CrIS sensors have gained the status of in-orbit IR calibration radiometric reference.
- Presently, there are still efforts to take full advantage of ALL the information content of the CrIS observations.
- The excellence performance of the CrIS sensors on SNPP and NOAA-20 will continue with the J2, J3 and J4 CrIS sensors.
- The CrIS observations are expected to satisfy present and future satellite needs and to be the foundation of new applications with significant societal, economic and scientific benefits.



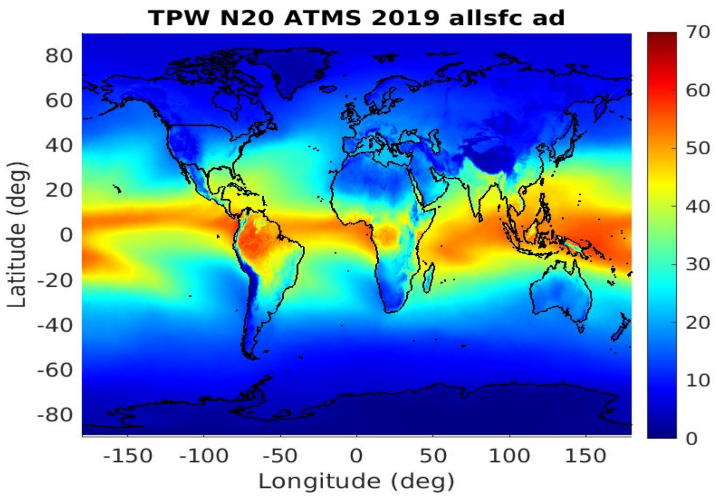
Application of CrIS Observations to Climate Science

- CrIS observations are capable to measure the infrared Climate Forcings (changes of minor greenhouse gases: CO_2, CH_4, O_3, N_2O) and the Climate Responses (surface and air temperature increases).
- CrIS observations detect the water vapor feedback to increasing temperatures, which increases warming. Spectral channels dominated by water vapor have decreased emission to space relative to channels dominated by surface and atmospheric temperature. As temperatures increase, water vapor increases such that relative humidity stays nearly constant. Increases in thermal Planck emission due to increasing temperatures are effectively canceled in water channels by the emission shifting to higher, colder pressures.
- The statistical uncertainty of associated with these results is often much smaller than the actual BT trends and they provide stringent tests of climate models.

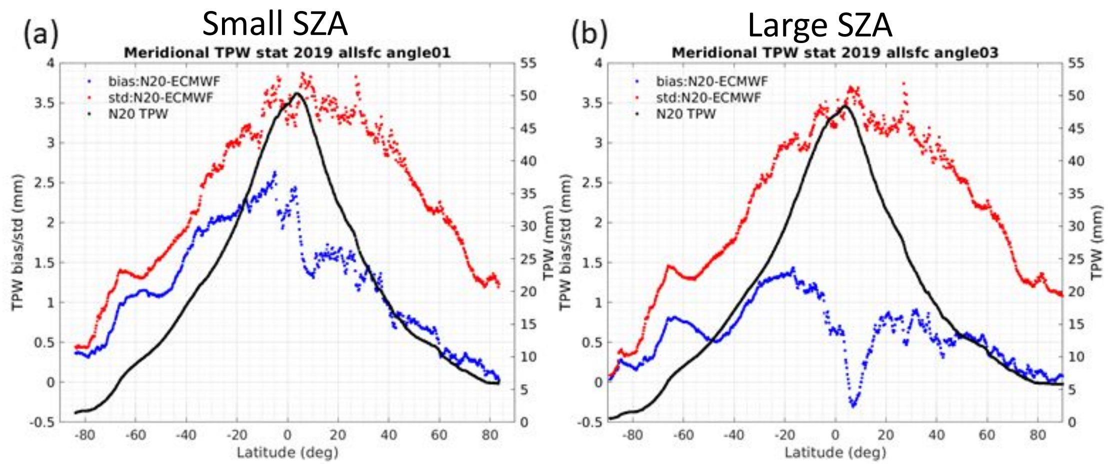
Validation of MiRS NOAA-20 ATMS Total Precipitable Water in 2019 Using Multiple Reference Data Sets

Yong-Keun Lee (CISESS), Christopher Grassotti (CISESS), Quanhua Liu (NOAA), Shuyan Liu (CIRA), Yan Zhou (CISESS)

- Seasonal (meridional) movement of high TPW bands encircling the equatorial area well matched to the movement of the ITCZ.
- Global horizontal distribution of bias and standard deviation of MiRS TPW with respect to ECMWF and GDAS reflects the distribution of intense precipitation, frequent occurrence of high level cloud (ISCCP), and strong convection
- There is a satellite zenith angle dependence in MiRS TPW with respect to ECMWF and GDAS.
- Generally, higher values of standard deviation with respect to the references were noted over land than over ocean.
- Monthly comparison with ground-based GPS and conventional radiosonde observations shows that there is seasonal dependence in standard deviation values against the references and both bias and standard deviation values have diurnal differences when compared to radiosonde observations.



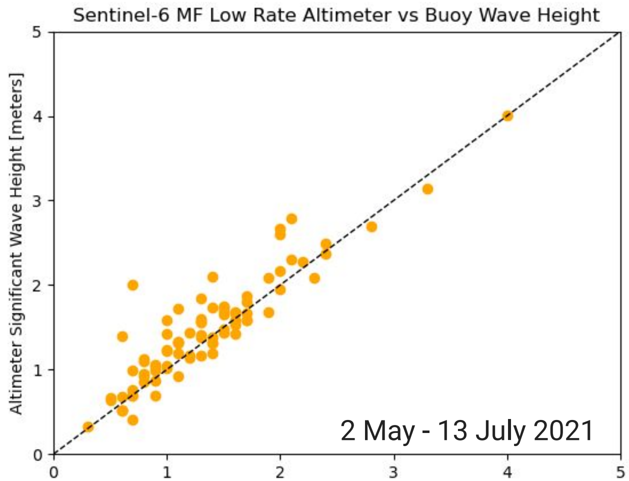
Global distribution of MiRS NOAA-20 ATMS TPW in 2019

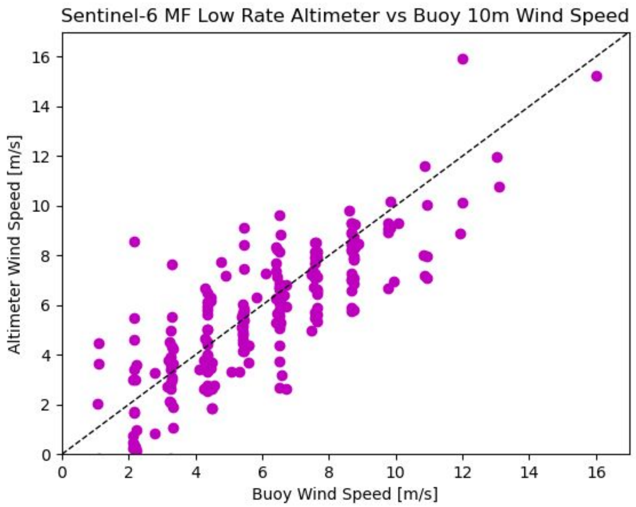


Meridional distribution of MiRS NOAA-20 ATMS TPW

Comparing Sentinel-6 Altimeter Wind and Wave Measurements to NDBC Buoy Data

Lauren Vocke (University of North Dakota), Dr. Eric Leuliette (STAR)



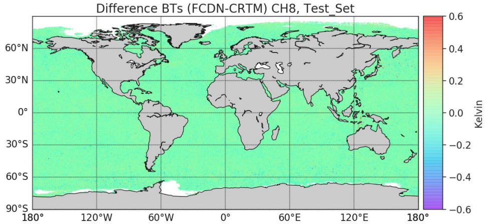


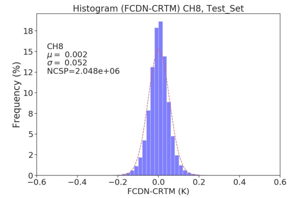
- Data from the Sentinel-6 Michael Freilich altimeter mission is critical for accurately measuring global sea level, ocean wave heights, and marine winds. Forecasters use this data to issue warnings for navigation, shipping and offshore platforms.
- Compared Near-Real Time (NRT) altimeter 10m wind speed and wave heights to NRT buoy observations to validate the accuracy of of both the low rate and high rate altimeter data.
- Discovered large bias errors for wind speed where the altimeter was underpredicting compared to buoy observations for both low rate and high rate. Additionally a large bias was found for the high rate waves in which the altimeter was overpredicting SWH compared to the buoy observations
- The source of the errors in the S6 processor have been identified and will be corrected in 2022. Once the fixes are in place, the new processor can be validated with buoys.

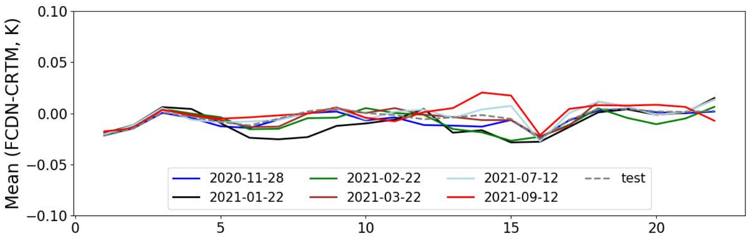
Assessment of Deep Learning Based Forward Microwave Radiative Transfer Emulator

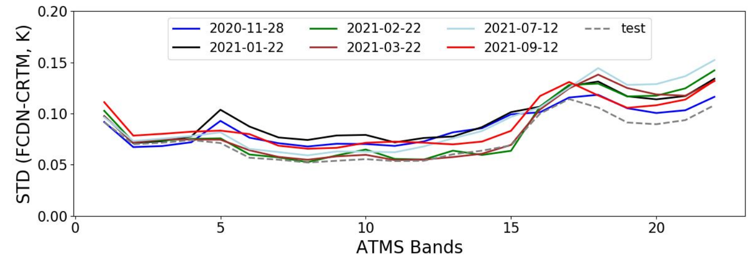
Xingming Liang[1,2], Kevin Garrett[2], Eric S. Maddy[2,3], Sid Boukabara[4], Quanhua Liu[2], and Kayo Ide[5]
1: CISESS, University of Maryland; 2: STAR/NESDIS/NOAA; 3: Riverside Tech. Inc.; 4: OSAAP/NESDIS/NOAA; 5: University of Maryland

An early developed fully connect deep neural network algorithm with the community radiative transfer model (FCDN_CRTM) for VIIRS TEB/M bands has been successfully upgraded to emulate BTs for 22 ATMS bands to explore the improvement of accuracy and efficiency for data assimilation









# of NOBS	FCDN_CRTM(s)	CRTM clear-sky(s)
2.1 million	17.12	900

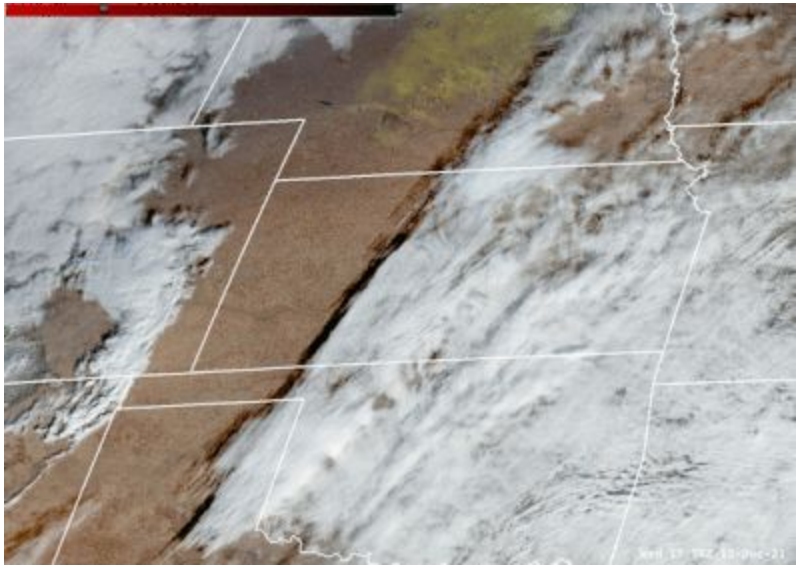
- FCDN_CRTM input data were from ATMS SDR, ECMWF and CMC SST products, and the model used CRTM simulation as reference labels
- The model was reconstructed by three sensitivity experiments to improve prediction accuracy, including training sample size determination, three-model design, and using emissivity as new features
- The well-trained model can predict BTs accurately for all ATMS bands about one year after the end of training data set (FCDN-CRTM: -0.03K-0.03K; STDs: 0.05-0.15K).
- To process 2.1 million data, the FCDN_CRTM was 53-fold speedup compared to CRTM simulation
- ATMS-FCDN were pretty consistent with ATMS-CRTM, the differences both mean and STDs were within 0.02K.
- Next step will extend the FCDN_CRTM model to include cloud information and land analysis

AMERICAN METEOROLOGICAL SOCIETY
AMS 2022
102nd ANNUAL MEETING | HOUSTON | 23-27 JANUARY

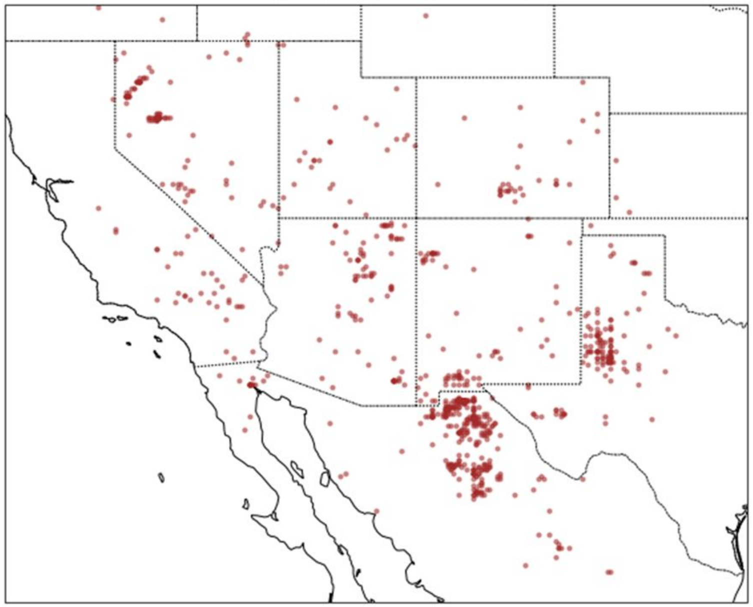
Using Advanced NOAA Satellite Imagery to Detect Blowing Dust

Bill Line (NOAA/NESDIS), Don Hillger (CIRA), Max Bleiweiss (NMSU), Jesse Turner (CIRA)

- Highlighted traditional, new, and future methods for detecting blowing dust in ABI and VIIRS Imagery
- Introduced a satellite-derived blowing dust event climatology



ABI Blended "High Wind Event" Imagery Composite

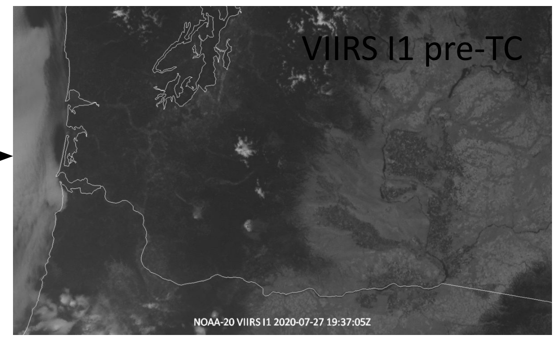


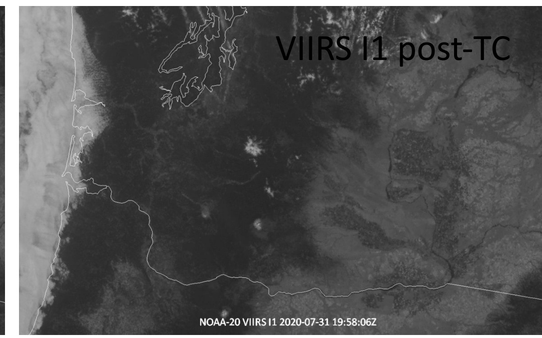
2001-2008 Satellite-Derived Blowing Dust Events

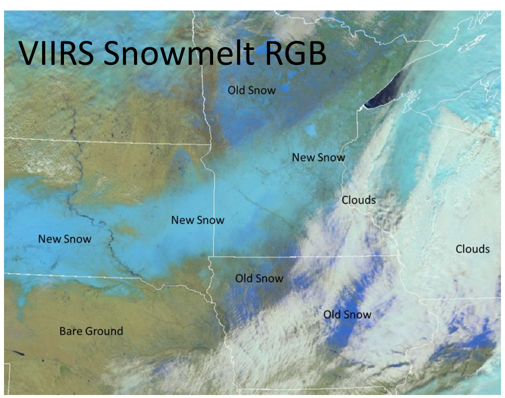
VIIRS EDR Imagery Changes and Improvements (over the past 10 years)

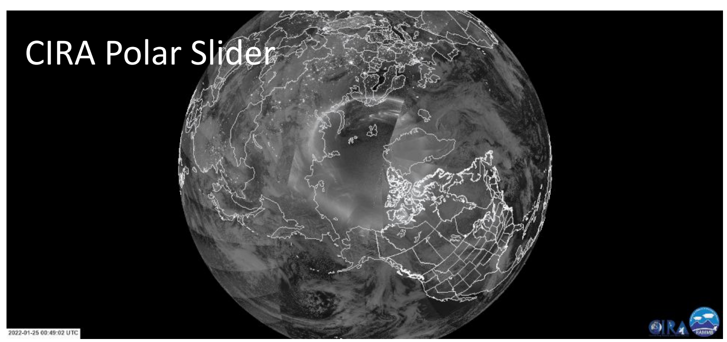
Don Hillger (CIRA), Bill Line (NOAA/NESDIS), Thomas Kopp (The Aerospace Corporation)

- The imagery team monitors/validates imagery and continuously engages users and addresses user needs, and has made several major accomplishments:
  - 16 M-Band EDRs
  - NCC Banding Anomaly Fix
  - Terrain Correction (TC) →
  - Zenith-angle expansion/ update of NCC LUT





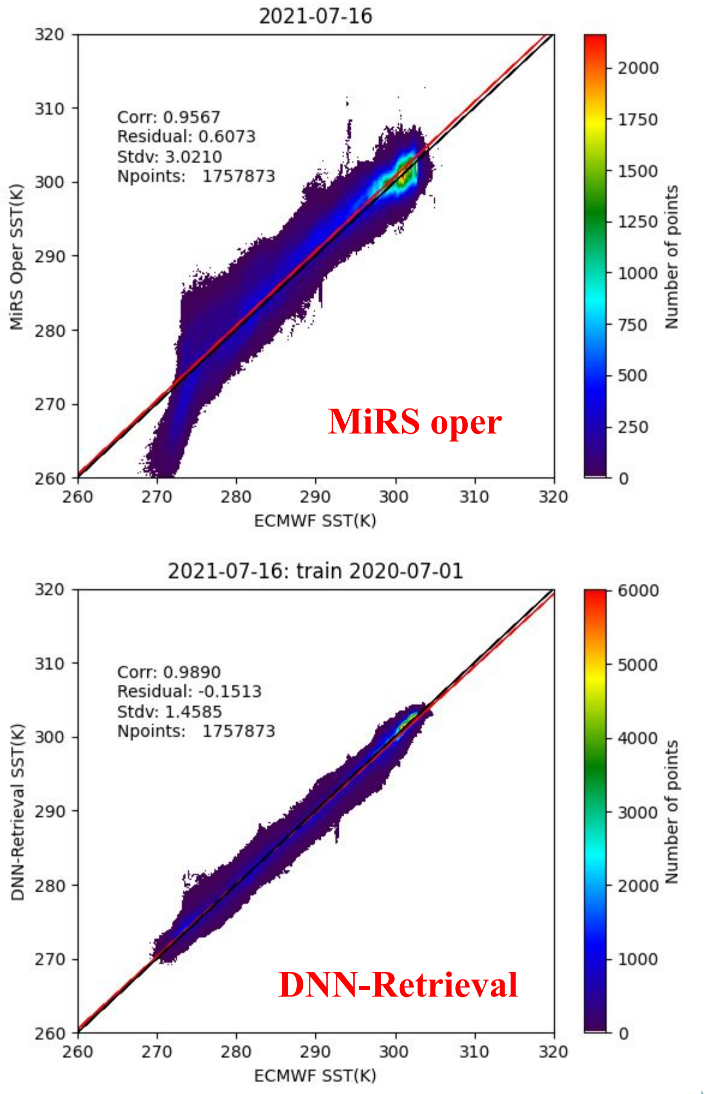




Improvement of MiRS Sea Surface Temperature Retrievals through a Machine Learning Approach

Shuyan Liu (CSU/CIRA), Christopher Grassotti (UMD ESSIC/CICS), Quanhua (Mark) Liu (NOAA/NESDIS/STAR), Yan Zhou (UMD ESSIC/CICS), Yong-Keung Lee (UMD ESSIC/CICS)

- We report on development of a machine learning approach to improving sea surface temperature (SST) retrievals based on microwave channel measurements at frequencies higher than 23 GHz for cross-track instrument of ATMS onboard NOAA-20.
- The approach uses deep neural network (DNN) trained using MiRS physical retrievals as inputs and collocated ECMWF analyses for training and validation.
- The DNN was designed to characterize SST retrieval residual, then used to correct the original retrieval.
- The DNN model trained on MiRS retrievals showed best performance among the three experiments with significantly reduced residual and stand deviation. The scan angle dependency significantly reduced too.
- It appears that inclusion of the geophysical information already extracted from the brightness temperatures by the MiRS 1DVAR retrieval provides valuable information that can be exploited by the DNN to produce a much improved SST estimate.
- Sensitivity tests indicated that, while training the model using one month results in a DNN prediction that loses skill within 2-3 months from the training month, the same model retains a high level of skill when applied to data exactly one year later. This suggests that for operational purposes, it may be sufficient to train a static model using (approximately) monthly data for one full annual cycle.



Impact Assessment of Loon Stratospheric Balloon Winds Assimilated in NOAA's Finite-Volume Cubed-Sphere Global Forecast System (FV3GFS)

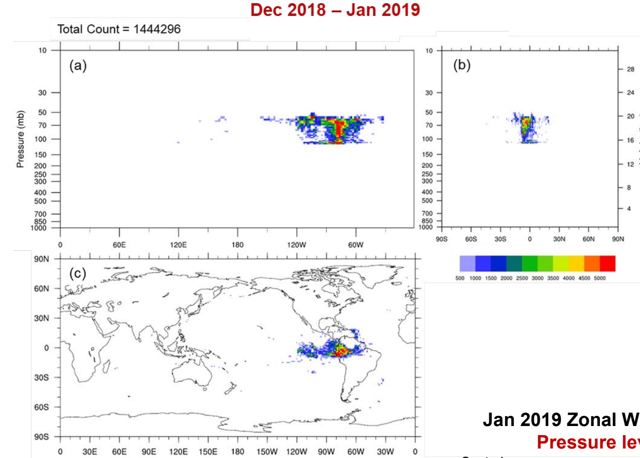
Katherine E. Lukens[1,3], Kayo Ide[2], and Kevin Garrett[3]
[1]Cooperative Institute for Satellite Earth System Studies (CISESS), University of Maryland (UMD), College Park, MD
[2]University of Maryland, College Park, MD
[3]NOAA/NESDIS/STAR, College Park, MD

Objective: To investigate potential value of near-space wind observations towards improvements in NWP by conducting two-month OSEs using NOAA's FV3GFS.

- Until 2021, Loon deployed networks of stratospheric superpressure balloons that observed flight-level environment for months at a time.
- During study period (Dec 2018 – Jan 2019), Loon wind assimilation in tropical lower stratosphere has statistically significant localized effect on analysis winds in Jan 2019 (bottom right figure).
  - This hints at potential for *in situ* stratospheric winds to help reduce large uncertainty in operational analysis winds in tropical stratosphere during study period (bottom left figure).
- Loon wind assimilation leads to overall improvement in NWP in Jan 2019.
  - Most significant positive impact is in SH for Day 5-10 forecasts indirectly related to improvement of global residual zonal mean circulation in troposphere.

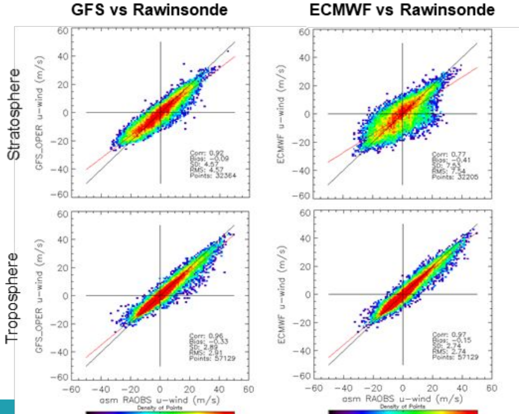
Findings emphasize potential value of supplementing global Earth observing architecture with additional near-space observing systems like Loon towards improvements in global NWP.

Geolocation of Loon obs for study period:
Dec 2018 – Jan 2019

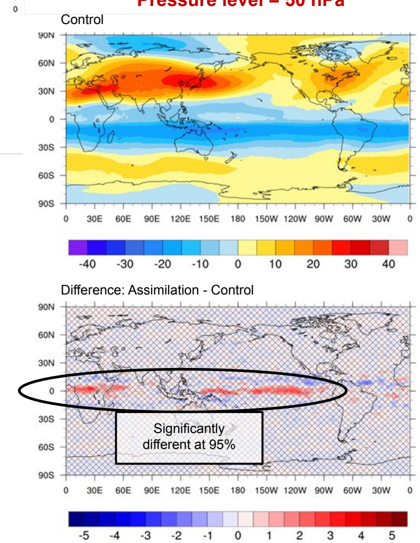


Tropical Operational Zonal Wind Comparisons (m/s)
Dec 2018 – Jan 2019

GFS vs Rawinsonde | ECMWF vs Rawinsonde



Jan 2019 Zonal Wind Analysis (m/s)
Pressure level = 50 hPa



On the Potential Utility of a Novel Archive for the Intercomparison of Winds from Multiple Observing Platforms

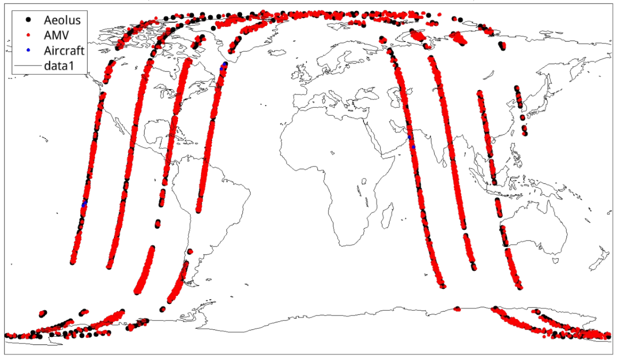
Kevin Garrett[1], Kayo Ide[2], David Santek[3], Brett Hoover[4], and Katherine E. Lukens[1,5]
[1]NOAA/NESDIS/STAR, College Park, MD
[2]University of Maryland, College Park, MD
[3]University of Wisconsin-Madison/Cooperative Institute for Meteorological Satellite Studies (CIMSS), Madison, WI
[4]NCEP/Environmental Modeling Center (EMC) - IMSG
[5]Cooperative Institute for Satellite Earth System Studies (CISESS), University of Maryland (UMD), College Park, MD

A public wind data archive and collocation code package are in development through a collaboration between NOAA/NESDIS/STAR, UMD/CISESS, and UW-Madison/CIMSS in response to the need for highly accurate wind observations.

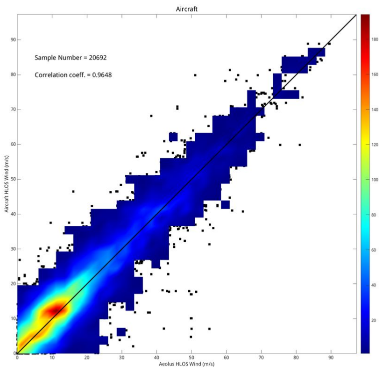
- Archive is on S4 supercomputer
  - Currently includes Aeolus, AMV, and Aircraft winds as well as index files containing indices of collocated winds between the datasets
  - Datasets are converted to NetCDF and will cover the entire Aeolus record
- Collocation and visualization/statistical analysis tools will be available to users soon.
  - Collocation approach is flexible and designed to handle additional/different datasets
  - Examples of utility of wind archive (see figures) include collocation maps, density scatterplots, histograms of wind differences, pressure distribution plots, time series of statistical quanitities

Access to archive is available on S4 and upon request.

Collocation Check for 2019-08-03 12 UTC

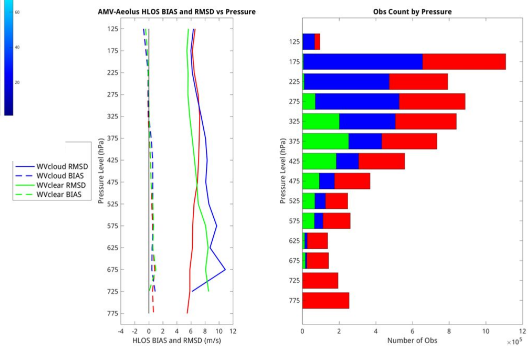


Aircraft Wind vs Aeolus Wind



Example Period:
2019-08-02 to 2019-10-31

AMV-Aeolus Wind Bias and RMSD per AMV type

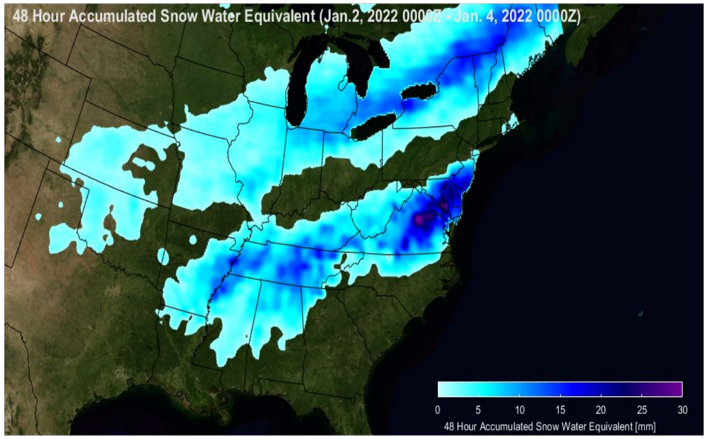


NOAA Satellite Snowfall Rate Products and Applications

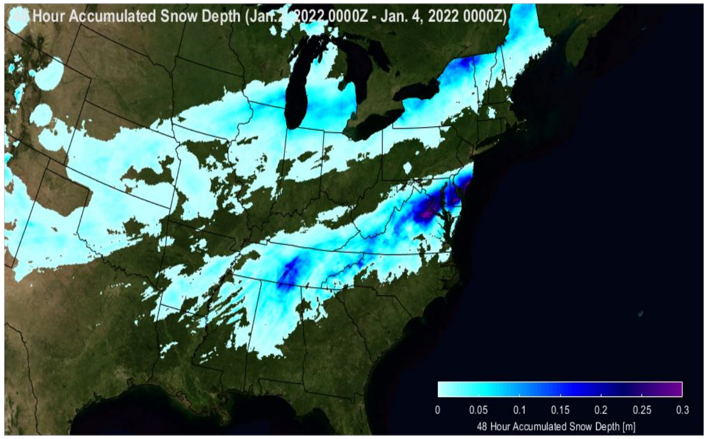
Huan Meng[1], Yongzhen Fan[2], Jun Dong[2], Yalei You[2], Guojun Gu[2], Ralph Ferraro[3]
[1]NOAA/NESDIS/STAR, [2]CISESS/University of Maryland, [3]ESSIC/University of Maryland

- STAR and CISESS-MD continue to improve the quality of the satellite snowfall rate (SFR) product, currently produced from 9 satellites including 5 operational SFRs
- Besides SFR, the team also developed a radar-satellite merged snowfall rate product, mSFR
  - Satellite fills in radar gaps
  - Very low latency, 3-min
  - Looping capability, 10-min temporal resolution
- SFR and mSFR applications
  - Nowcasting, provides situational awareness
  - Input to global blended precipitation product (NCEP/CPC CMORPH2) with wide-ranging applications, e.g. hydrology, NWP modeling, climate, etc.

48 hour Accumu. Snow Water Equivalent from SFR



48 hour Accumu. Snow Depth from SNODAS



Evaluating the Impacts of COSMIC-2 Radio Occultation Bending Angle Assimilation on HWRF Tropical Cyclone Forecasts

William Miller[1,2], Yong Chen[2], Shu-Peng Ho[2], and Xi Shao[1,2]

[1]Cooperative Institute for Satellite Earth System Studies (CISESS), Earth System Science Interdisciplinary Center (ESSIC), University of Maryland, College Park, MD
[2]NOAA National Environmental Satellite, Data, and Information Service, Center for Satellite Applications and Research, College Park, MD

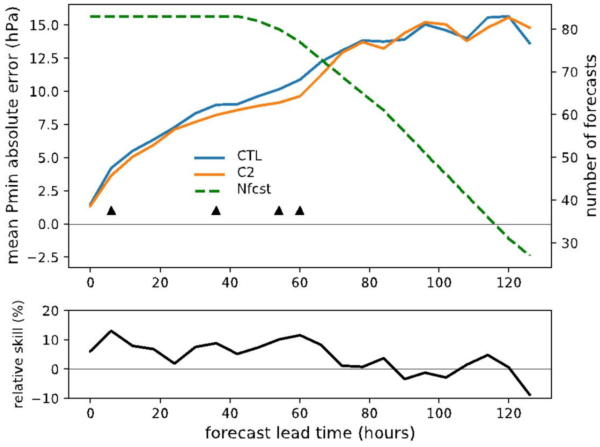
- **Summary:** Assess COSMIC-2 radio occultation (RO) observation data assimilation statistics and forecast impacts using cycled regional Hurricane Weather Research and Forecasting (HWRF) model experiments simulating five Atlantic hurricanes from the 2020 season.

- **Significance/Impact:** To the authors' best knowledge, this is the first study evaluating the impacts of COSMIC-2 RO observation assimilation on tropical cyclone forecasts from an operational regional forecast model that also assimilates satellite radiances.

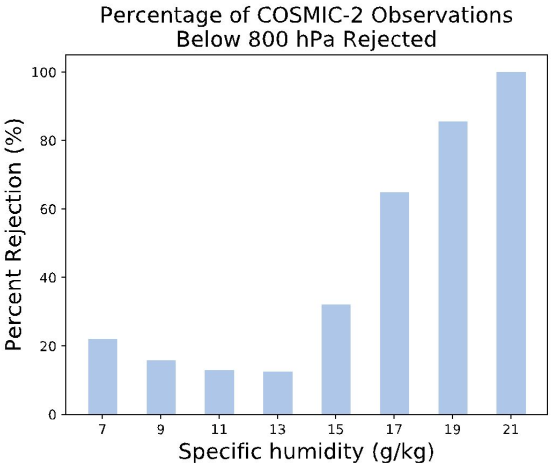
CTL: operational. HWRF configuration

C2: Same as CTL, but with COSMIC-2 observations assimilated

Triangles: forecast times when C2 – CTL differences are statistically significant



All COSMIC-2 observations assimilated in 83 HWRF analyses in the lower troposphere, grouped by background specific humidity.



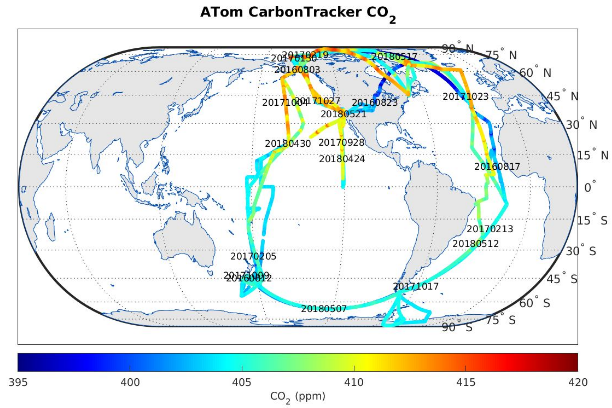
- **Key takeaways:**

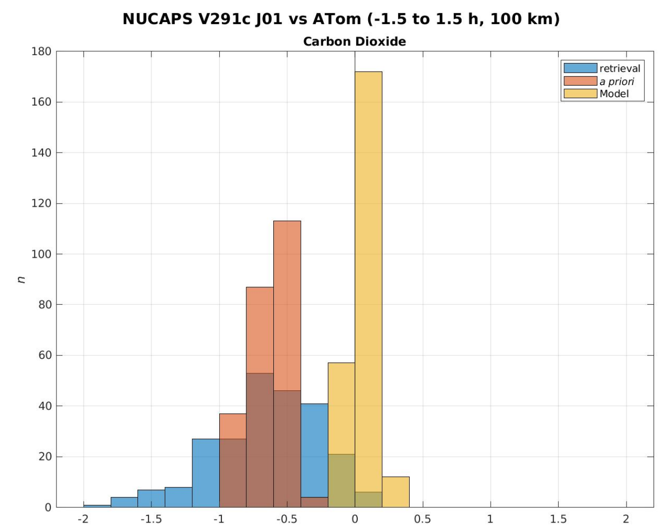
1) COSMIC-2 RO bending angle assimilation leads to a modest 5-10% short to medium-range HWRF minimum central pressure intensity forecast improvement when considering all 83 forecasts run over five case study experiments.
2) A large fraction (~ 30%) of lower troposphere COSMIC-2 observations are rejected from the HWRF regional domain, with the highest rejection rates above 60% occurring at locations where HWRF background water vapor mixing ratios are highest.
3) These results motivate further research efforts toward optimizing COSMIC-2 RO observation error specification, quality control criteria, and forward operators used in NOAA's weather forecast models so that atmospheric moisture and temperature information provided by good-quality COSMIC-2 RO observations can be most effectively utilized for improving weather forecast model initial conditions, especially for the tropical lower troposphere where sharp horizontal moisture gradients add additional uncertainty to forward operator estimates.

Validation of NOAA Unique Combined Atmospheric Processing System (NUCAPS) Version 3

N. R. Nalli, J. Warner, C. Tan, M. Divakarla, K. Pryor, T. Zhu, M. Wilson, B. C. Baier, A. Jacobson, C. Sweeney, K. McKain, D. Wunch, T. Wang, S. Kalluri, L. Zho, et al.

- Overviewed the current validated maturity status of operational atmospheric profile EDRs retrieved from NUCAPS v3
- Attention was given to the NUCAPS carbon trace gas profile EDRs (especially CO_2), using well-established independent truth datasets as part of the GML-NESDIS Theme 1 "Tracking Greenhouse Gases and Understanding Carbon Cycle Feedbacks"
  - Statistical analyses versus AirCore, TCCON, and OCO-2 were highlighted, as well as GML CarbonTracker model intercomparisons

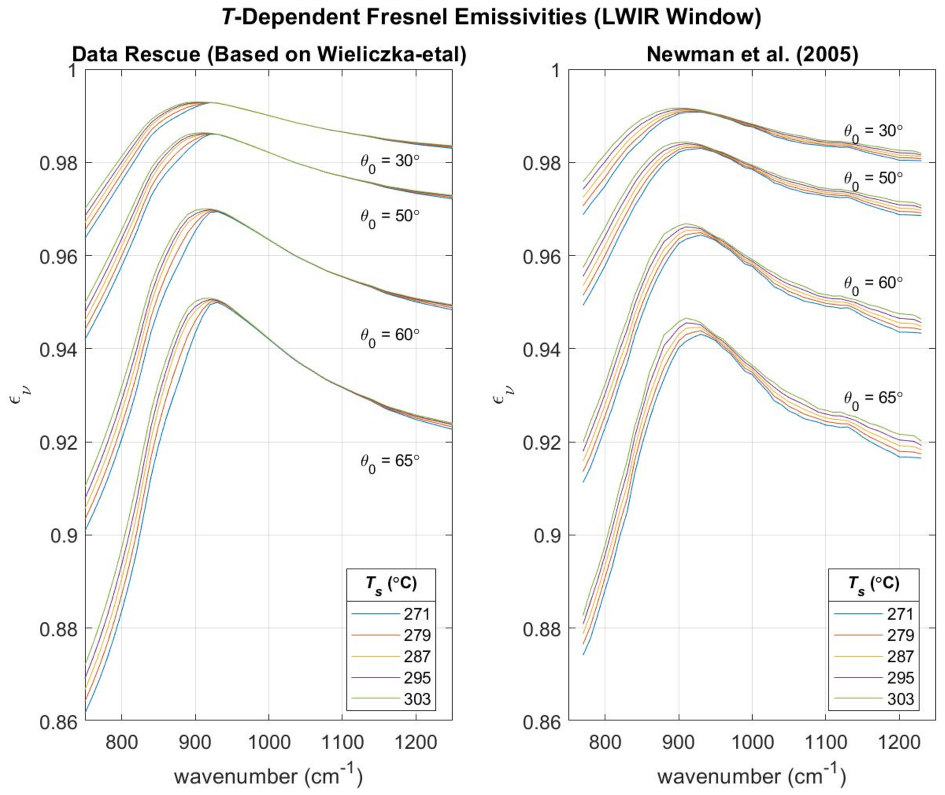




Data Rescue of Temperature-Dependent Optical Constants of Water for the Thermal Infrared

Nicholas R. Nalli, Jim Jung, Patrick Stegmann, Ben Johnson, and Lihang Zhou

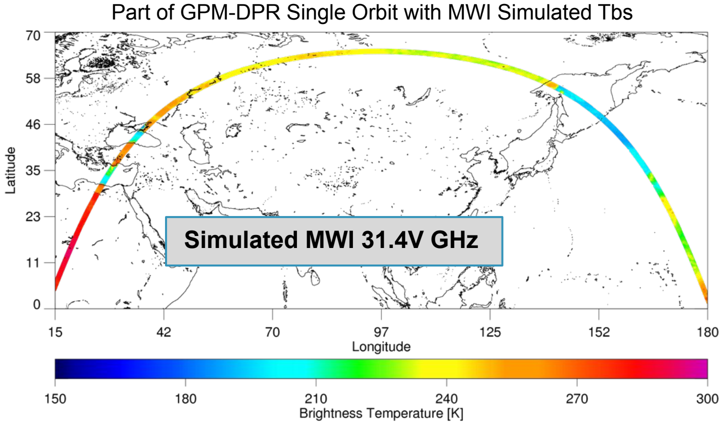
- Overviewed a rigorous "data archeology and rescue" of temperature-dependent IR optical constants of water based upon digitization of a figure found in a earlier paper (*Pinkley et al.* 1977) showing temperature-dependent reflectance measurements.
- Using the digitized data, we performed Kramers-Kronig (KK) analysis to derive temperature-dependent optical constants from existing standard datasets taken at room temperatures for the entire thermal IR spectrum.
- The rescued data are currently being used for the upgraded CRTM IRSSE v2.2 and are available to radiative transfer modeling (RTM) teams upon request

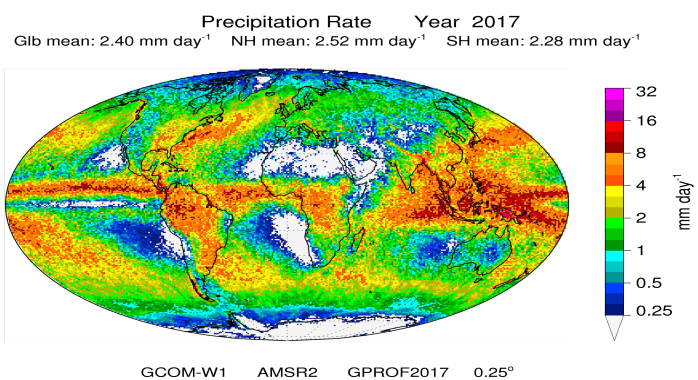


NOAA/STAR Environmental Data Record Suite for EPS-SG: Microwave Imager

Veljko Petkovic[1,2], Ralph Ferraro[2] and Huan Meng[3]
1: ESSIC, University of Maryland; 2: CISESS, University of Maryland; 3: NOAA/NESDIS/STAR

EUMETSAT Polar System - Second Generation MicroWave Imager (EPS-SG MWI) proxy data generation, review of a design, implementation plan and performance of the Day-1 rainfall algorithm are presented.





- Production of EPS-SG MWI simulated brightness temperatures in underway, to support NOAA-unique EDR products retrieval development
- Two sets of Tb simulations: CRTM and Edington-approximation, to include modeled (ERA5) and observed (GPM-DPR) state vectors
- An enterprise rainfall algorithm (GPROF2017) is adopted to rely on NOAA products (GFS, AutoSnow) to support MWI retrieval
- The rainfall retrieval is successfully tested using AMSR2 level1 product, proving its readiness to serve as Day-1 MWI algorithm

There was some interest in expected quality of level1 MWI product (Tbs) wrt data assimilation applications

Introducing a GOES ABI Rocket Plume

Tim Schmit, NOAA/NESDIS
Bill Line, NOAA/NESDIS
Jordan J. Gerth, NOAA/NWS
Mathew Gunshor, UW-CIMSS
Scott Lindstrom, UW-SSEC
Anthony Crespo, NOAA/NWS & UW-AOS

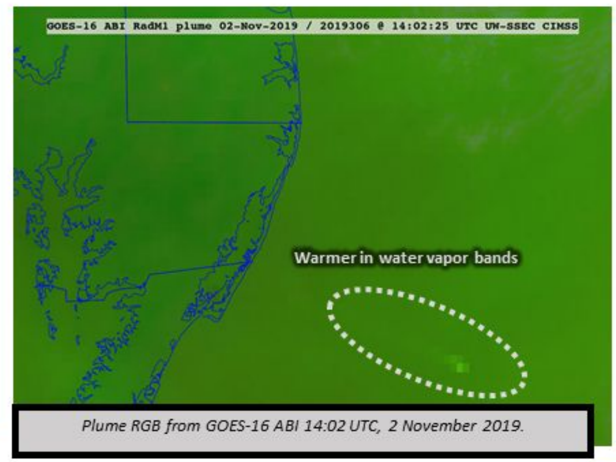
- Developed a new "rocket plume" RGB
- Unique in that it includes both ABI band 7 (3.9 um) and a water vapor band 8 (6.2 um)
- Quick guides developed for both day and night RGBs

Rocket Plume RGB Quick Guide (day)

Why is the Plume RGB Important?

The improved spatial, temporal and spectral attributes of the ABI allow for monitors plumes associated with rockets and other hotspots.

Instead of needing to show 3 or 4-panels with separate spectral bands, these RGBs combine information on the plumes from several key spectral bands: 3.9 micrometer or the "fire band", the upper-level water vapor band (8), and a visible or "near-visible" band. ABI band 2 is used during the day, while the 7.3 micrometer (water vapor) band at night.



Plume RGB from GOES-16 ABI 14:02 UTC, 2 November 2019.

How is the Plume RGB Created?

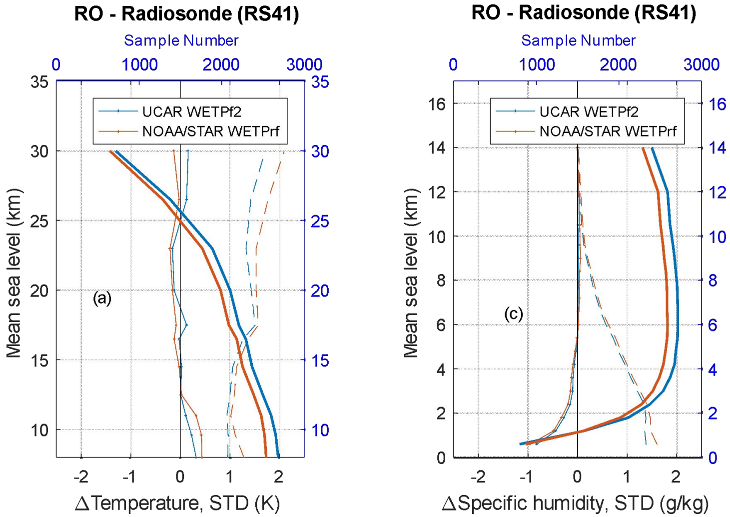
Color	Band / Band (µm)	Range (Min –> Max)	Physically Relates to...	Gamma	Large Contribution to pixel indicates...
Red	7 / 3.9	273 to 338 K	Plume temperature	1.0	Warm plume
Green	8 / 6.2	233 to 253 K	Plume warming	1.0	Plume cloud
Blue (day)	2 / 0.64	0 to 80 %	Reflective clouds	1.0	Plume location

Inter-Comparison of Multi-Radio Occultation Retrieval Products with Radiosonde Water Vapor and Temperature Measurements

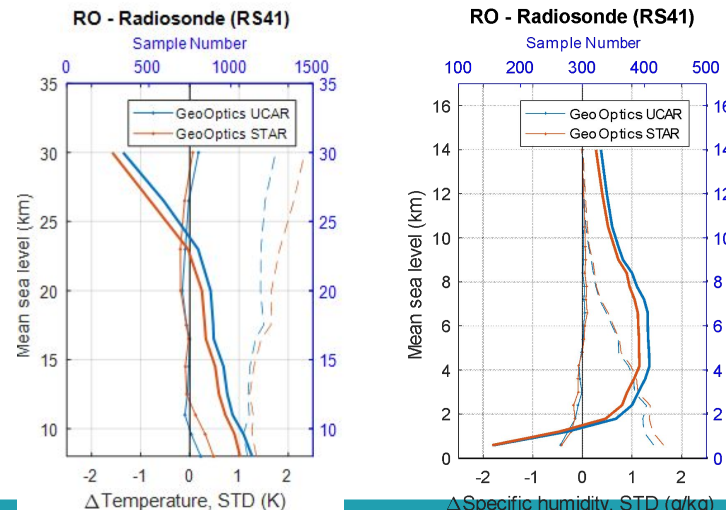
Xi Shao[1], Shu-Peng Ho[2], Bin Zhang[1], Xinjia Zhou[3], Stanislav Kireev[3], Yong Chen[2], and Changyong Cao[2]
[1]CISESS/ESSIC, University of Maryland, College Park
[2]NOAA/NESDIS/STAR
[3]Global Science & Technology, Inc.

- Comparison of temperature and humidity profile data between
  - Retrieved by University Corporation for Atmospheric Research (UCAR) and NOAA Center for Satellite Applications and Research (STAR) from COSMIC-2 and GeoOptics RO data
  - In-situ Vaisala RS41 and RS92 radiosonde observations (RAOB).
- Comprehensive evaluations of the temperature and humidity difference and uncertainty
  - RAOB data vs. COSMIC-2 and GeoOptics RO data
  - Differences between UCAR and NOAA/STAR wet profile retrievals
  - Investigate height and day-night (solar zenith angle) dependence of temperature and humidity differences
  - Consistency between COSMIC-2 and GeoOptics RO data
- The RO vs. RAOB comparison helps quantify the temperature and humidity differences among different radiosonde sensor types and different RO retrieval algorithms

COSMIC-2 vs. RS41



GeoOptics vs. RS41



Talk: Assessment of Emerging Vaisala Radiosonde Humidity Observations Using Satellite Hyperspectral Infrared Measurements

Bomin Sun[1], Xavier Calbet[2], Tony Reale[3], and Steven Schroeder[4]
1 IMSG, 2 AEMET, Spain, 3 NOAA/NESDIS/STAR, 4 Texas A & M University

- Vaisala RS41 has replaced RS92, becoming the dominant sonde type in the global conventional network and Global Reference Upper Air Network (GRUAN).
- Accuracy of upper tropospheric humidity observations made by those two sondes are assessed through comparing with NOAA Products Validation System (NPROVS) collocated humidity-sensitivity MetOp-B IASI infrared radiance measurements.
- LBLRTM is utilized to compute the radiances for RS41 and RS92 respectively in comparison with IASI radiance measurements.
  - RS41 shows significant improvement over RS92 in the upper tropospheric humidity observations particularly during daytime.
  - Given the data and collocation uncertainties , RS41 appears to be consistent with the satellite infrared measurements in the context of GSICS.

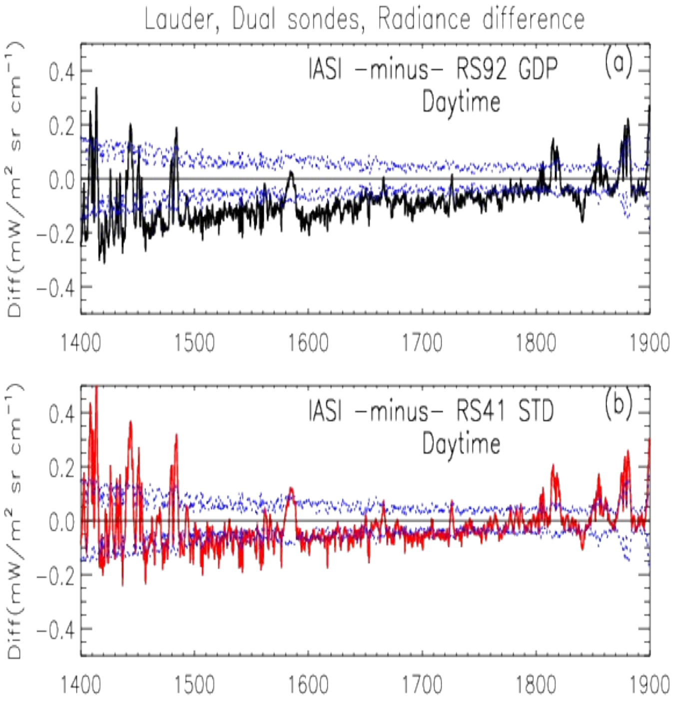


Figure. Lauder, New Zealand. Mean radiance differences based on 14 dual launches, daytime within 1 h of IASI overpass. (**a**) The solid line is the mean difference between IASI observed radiances and calculated radiosonde radiances (OBS–CAL, IASI minus RS92 GDP). Dotted lines show 2 standard errors . (**b**) As in (**a**) except for IASI minus RS41 STD based on the same dual flights.

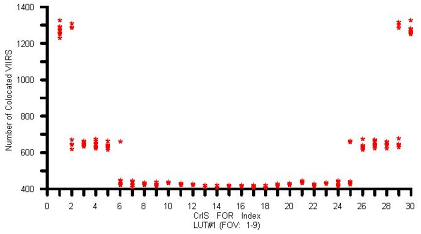
JPSS Operational Satellite Data Integration and Collocation Algorithms Development and Evaluation

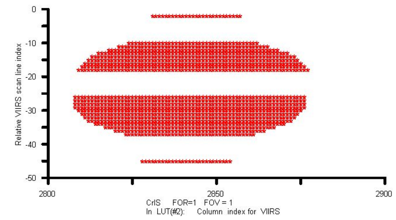
Haibing Sun[1], Walter Wolf[2], Thomas King[2], L. Soulliard [1]
[1] GAMA-1 Technologies, Greenbelt, MD, USA[2]
NOAA/NESDIS/STAR, 5830 University Research Ct, NCWCP, College Park, MD 20740

The NOAA Unique Combined Atmospheric Processing System (NUCAPS) package provides collocated VIIRS content to the CrIS BUFR product. The sensor data and cloud products on the VIIRS pixels are collocated to the CrIS fields of view (FOVs) using a Lookup Table (LUT) based collocation algorithm developed in NESDIS. Two new updates have been developed to the collocation processing algorithms recently. Firstly, the VIIRS adjacent Table is applied when the off-line CrIS/VIIRS collocation LUT is generated to help remove Bowtie effect. Secondly, the CrIS/VIIRS radiance clustering algorithms from AAPP maia4 is integrated to collocation package. Along scanning/Along track sampling density corrections are added to the integration processing.

UT Training with adjacency algorithm:

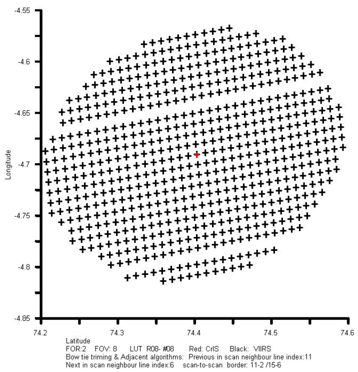
16 set LUTs are generated for each CrIS FOV to account for the related position variance with VIIRS Adjacency algorithm for Ascending /Descending.

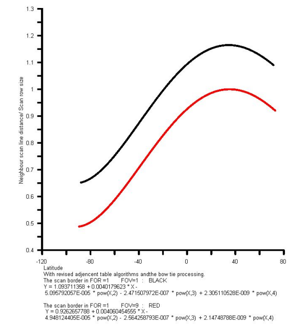




Sampling density correction:

Along track direction: $w_{k-adjust} = (0.5 + \mu/2) * w_k$

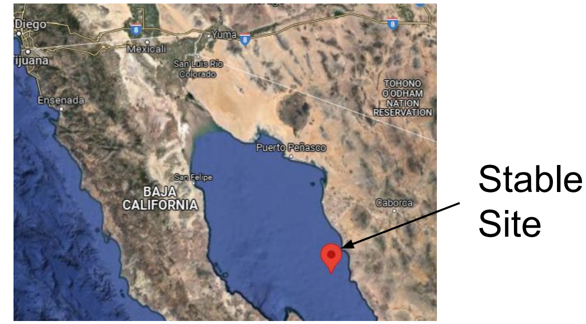


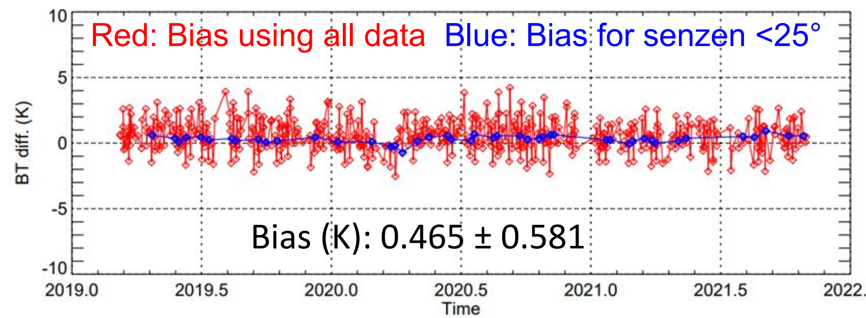


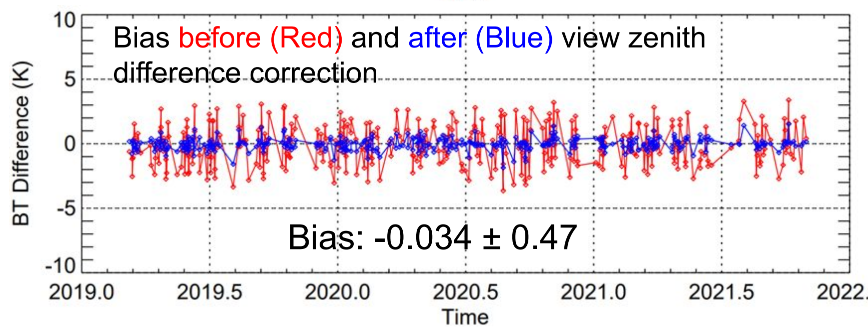
Stable Ocean Site for Thermal Emissive Band Inter-Calibration

Sirish Uprety[1], Changyong Cao[2], Bin Zhang[1],and Xi Shao[1]
[1]University of Maryland, College Park, MD, USA, [2]NOAA/NESDIS/STAR

- A thermally stable ocean site with small diurnal variability in brightness temperature (BT) can help assess radiometric consistency among satellite radiometers such as VIIRS and METImage.
- GOES-16 ABI channel 7 (3.9 µm) nighttime observations used to identify a thermally stable ocean site over Gulf of California (30N/113W)
- The intercomparison between NOAA-20 VIIRS (M12-16) and TERRA MODIS over the site indicated bias on the order of ~0.3 K to ~1 K.
- NOAA-20 and SNPP VIIRS intercomparison indicated radiometric consistency to within 0.1 °K.
- strong view zenith dependency observed and needs further investigation using existing models
- *study strongly indicated that the location (30N/113W) could be a potential reference site for TEB intercalibration*



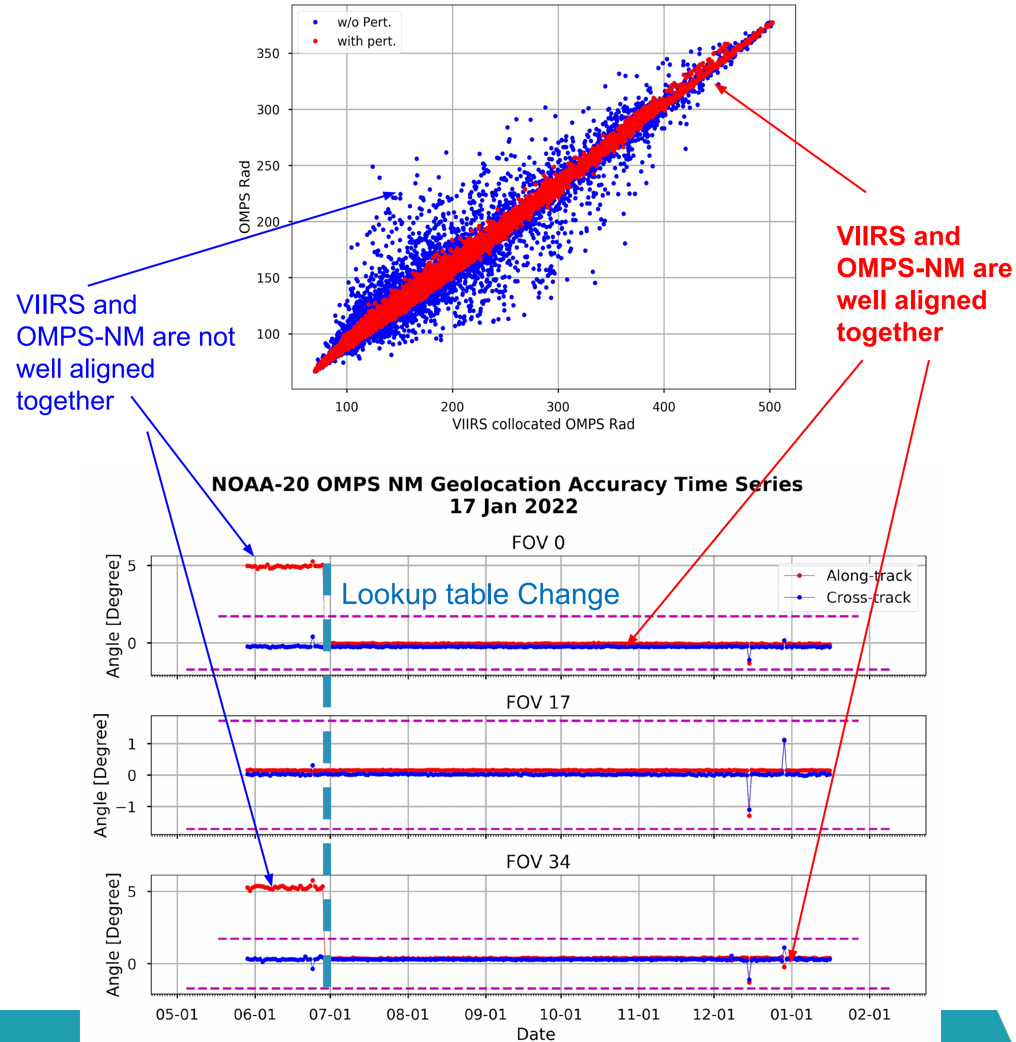




Geolocation Assessment and Optimization for Ozone Mapping and Profiler Suite (OMPS) Nadir Mapper Using Visible Infrared Imaging Radiometer Suite (VIIRS)

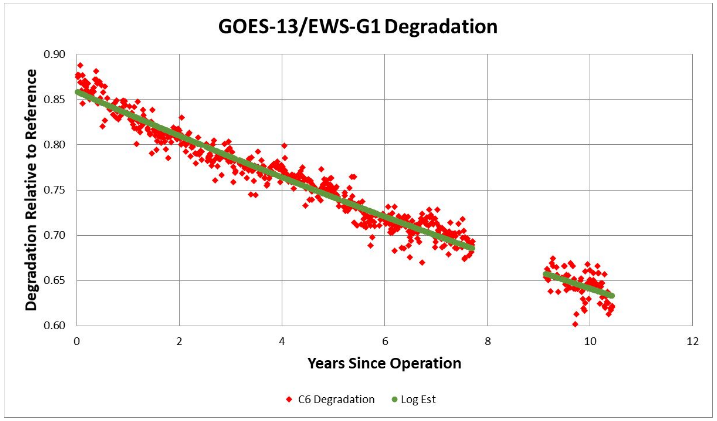
Likun Wang, Banghua Yan, Chunhui Pan, Trevor Beck, Junye Chen, Lihang Zhou, Mitch Goldberg, Satya Kalluri

- A method for OMPS-NM geolocation assessment using the high spatial resolution VIIRS observations and geolocation fields is presented in this study.
- The proposed method has been successfully employed to evaluate the OMPS-NM geolocation accuracy on both NOAA-20 (50x17km spatial resolution at nadir) and SNPP (50x50 km) satellites and optimize its optical view angles.
- Potentials of the proposed method is explored to detect the geolocation error for future high-resolution OMPS-NM on JPSS-2 Using NOAA-20 mediate resolution data as a proxy.



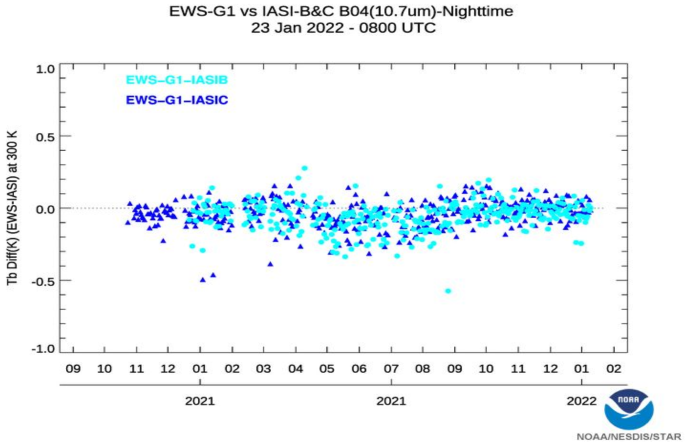
Calibration and Validation of EWS-G

Xiangqian Wu[1], Hyelim Yoo[2], Fangfang Yu[2], and Haifeng Qian[2]
1: NOAA/NESDIS/STAR 2: CISESS, University of Maryland



- Electro-Optical/Infrared (EO/IR) Weather System – Geostationary (EWS-G) has been transferred from NOAA to United States Space Force (USSF), reaching Initial Operational Capability in September 2020.
- NOAA assisted the transition and operation of EWS-G1, including its operational calibration by STAR.
- Calibration coefficients for its visible channel have been updated monthly since October 2020 (left).

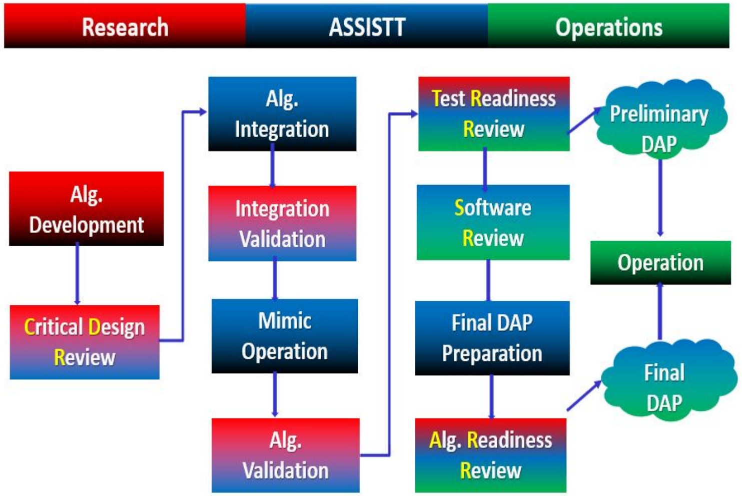
- Near-real-time monitoring of instrument calibration (not shown) and validation of radiance products has started recently. The figure to the right is an example for Channel 4 (11 µm).
- NOAA STAR is communicating with users to deliver customized calibration products and services.



On the Role of Algorithm Scientific Software Integration and System Transition Team (ASSISTT) in Transitions from Research to Operations

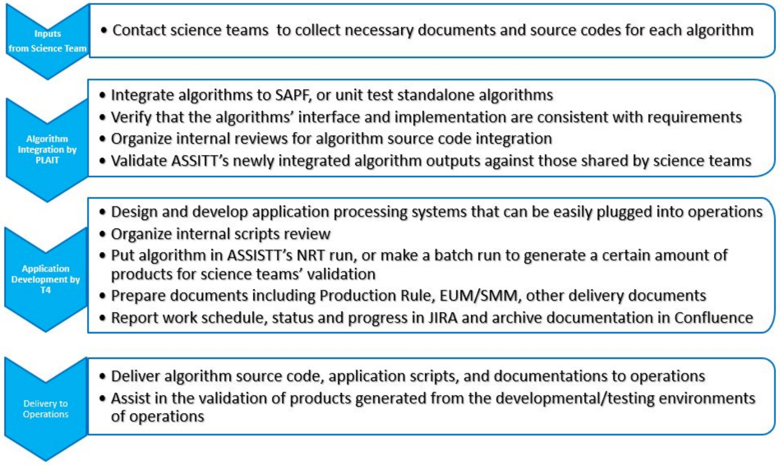
Xie, Hua[1,3], Priya Pillai[1,3], Michael Walters[2,3], John Lindeman[1,3], Emily Doss[1,3], Yunhui Zhao[2,3], Jianning Zeng[2,3], Kelly Nelly[2,3], Shanna Sampson[2,3], Thomas S. King[3], and W. W. Wolf[4],
[1]I. M. Systems Group, Rockville, MD 20852 [2]GAMA-1 Technologies, Greenbelt, MD 20770
[3]NOAA/NESDIS/STAR, College Park, MD 20740 [4]NOAA/NESDIS/OSGS, Silver Spring, MD 20910

- ASSISTT is standardizing application scripts to reduce transition time and the possibility for errors.
- ASSISTT continuously assists in transitions from research to operations, and provides QA throughout the entire algorithm transition process.
- ASSISTT is conducting regression testing to ensure algorithm stability and functionality during continuous software/library/compiler updates.



Research to operations workflow schematic

Procedure for Updating Algorithms

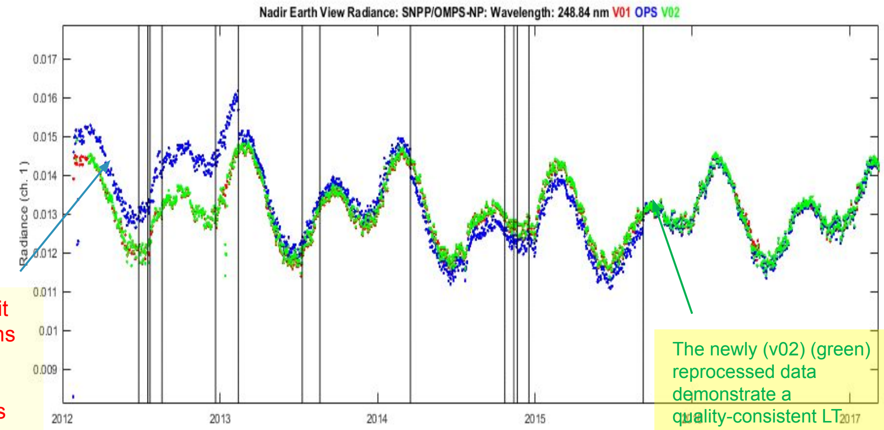


Reprocessing of Sensor Data Records from OMPS Nadir Mapper and Nadir Profiler onboard Suomi NPP Satellite: Improvements and Life Time (LT) Performance Analysis

Dr. Banghua Yan*, STAR/SMCD/Satellite Calibration and Data Assimilation Branch

- A new reprocessing has been conducted to generate science-quality consistent lifetime SNPP OMPS NM and NP SDR datasets until 06/30/2021, by using all validated calibration tables (including dynamic solar wavelength tables) and new improvements such as the updated stray light correction table, geolocation error correction table, and dark correction code error.
- The new reprocessing (v02) demonstrates life-time quality-consistent sensor data records (SDR), having a much better performance than both the operational and previously reprocessed SDR data sets.
- The newly reprocessed SNPP OMPS NM/NP SDR datasets will be archived in the NOAA CLASS that is accessible to public users.

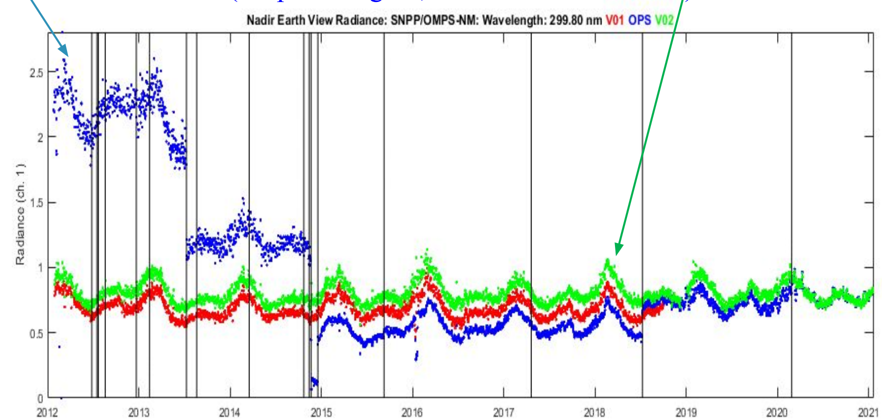
(a) LT Performance of SNPP OMPS NP Nadir Radiance at 147 Channels (Tropical Region; Animated Time Series)



Ops data exhibit large fluctuations due to non-validated calibration LUTs prior to 09/09/2015

The newly (v02) (green) reprocessed data demonstrate a quality-consistent LT performance for all OMPS NM and NP channels.

(b) LT Performance of SNPP OMPS NM Nadir Radiance at 196 Channels (Tropical Region; Animated Time Series)



*Other Contributors: C. Pan, T. Beck, Xin Jin, L. Wang, J. Chen, D. Liang, J. Huang, S. Buckner, L. Flynn, C. Zou, N. Sun, L. Lin, X. Hao, A. Young, L. Zhou, and W. Hao

(11B.5) Land Surface Temperature Production and Monitoring at STAR

Conferences: 18th Annual Symposium on Operational Environmental Satellite Systems;
2:30 - 4.00pm, Jan 26, 2022

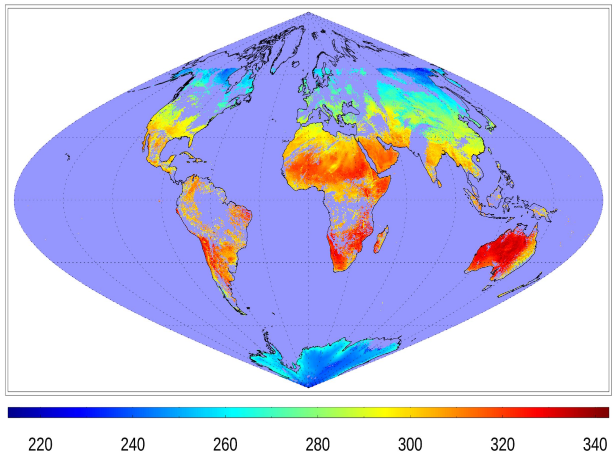
Authors: Yunyue Yu[1], Peng Yu[2], Yuling Liu[2] ; [1]NOAA/NESDIS/STAR, [2]UMD/CISESS

Product Overview

Operational LSTs from satellites:
- *JPSS (SNPP, NOAA-20)*
- *GOES-R (GOES-16, -17)*

Experimental LSTs from satellite
- *Himawari-8*
- *Meteosat-8, -9*
- *Sentinel -3A, -3B*
- *AVHRR of NOAA-15, -18, -19;*
- *METOP-A,-B,-C; METOP-SG*

NPP LST on 20211201 Day



Daily LST map from JPSS/SNPP

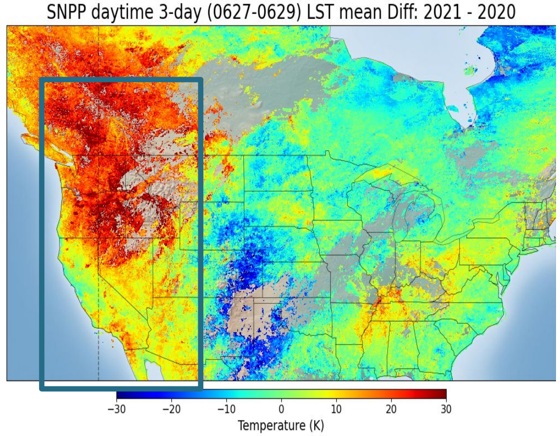
Monitoring and Event Report

Monitoring
- *Daily JPSS LST global maps*
- *Hourly GOES-R LST maps*
- *Weekly Validation alert*
- *Monthly global LST anomaly report*

Extreme Event Reports

Very high temperature in Siberia in Summer 2020; CONUS winter storm in Feb. 2021; vineyard damage of cold temperature in France in April 2021; heatwave of western U.S./south-west Canada in June 2021.

SNPP daytime 3-day (0627-0629) LST mean Diff: 2021 - 2020



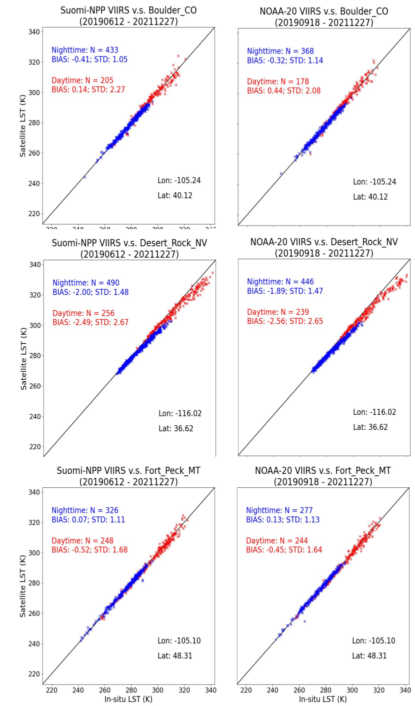
Heatwave observed in western U.S./south-west Canada in June 2021

Quality Assurance

Enterprise Life-cycle Process
- *Series reviews: PDR, CDR, UTRR,ORR, etc.*
- *Validation Plans*
- *Monitoring Plan*

Validation Efforts
- *Preliminary evaluation, routine validation, comprehensive validation*
- *Quality control process of validation dataset*
- *Reference dataset: simulation data, "in-situ" data, cross-satellite data*
- *Representativeness: global coverage, seasonal variation, surface type variety.*

Users Feedback and Applications



In-situ validation of JPSS LSTs

Users Engagement

Continue supporting to Users
- *NOAA and NASA land surface and Hydrology models*
- *USDA users*
- *High accurate/resolution Soil Moisture*
- *Evapotranspiration Product*
- *Researchers from worldwide institutions*

Extreme Event Responses

Enhancements of An Infrared Cloud Detection Algorithm for CrIS SDR Radiometric Assessment

Kun Zhang[1], Flavio Iturbide-Sanchez[2], Erin Lynch[3], Denis Tremblay[1], Zhipeng Wang[4], Peter Beierle[5]
1 Global Science and Technology, Inc. 2 NOAA/NESDIS/Center for Satellite Applications and Research, College Park, MD 20740, USA.
3 NOAA/NESDIS/Office of Projects, Planning, and Analysis. 4 Science Systems and Applications Inc. 5 University of Maryland

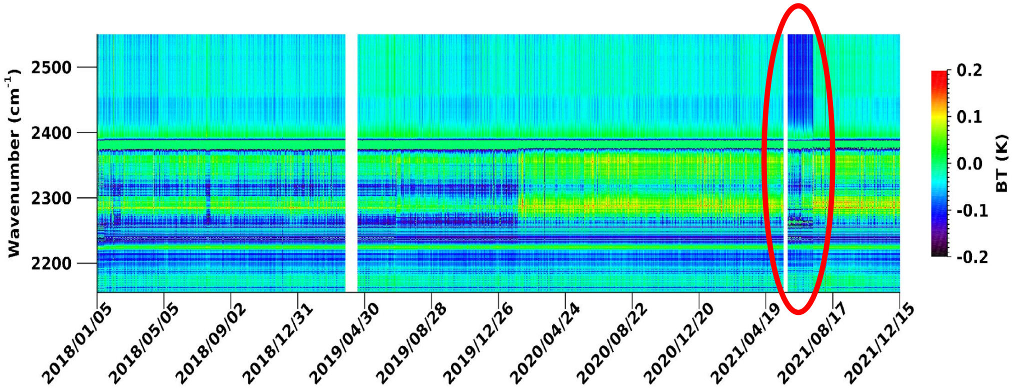


Figure 1: Long-term time series of radiometric comparison between NOAA-20 and SNPP CrIS SWIR band including the SNPP CrIS Side-2 anomaly period.

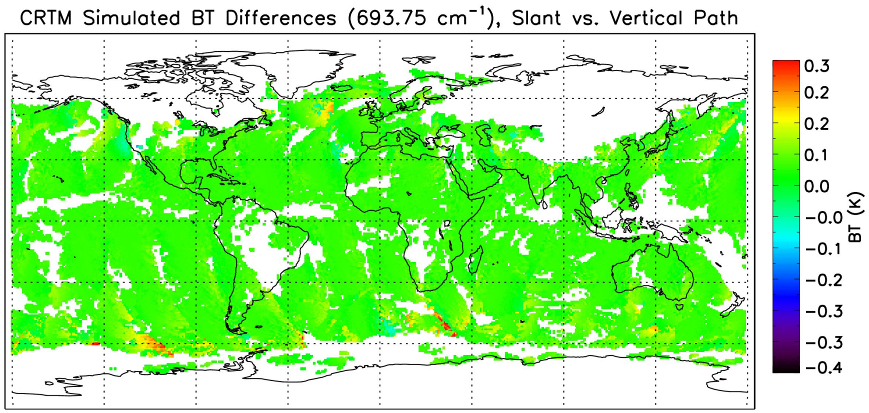


Figure 2: Simulated CrIS brightness temperature changes due to the slant path correction.

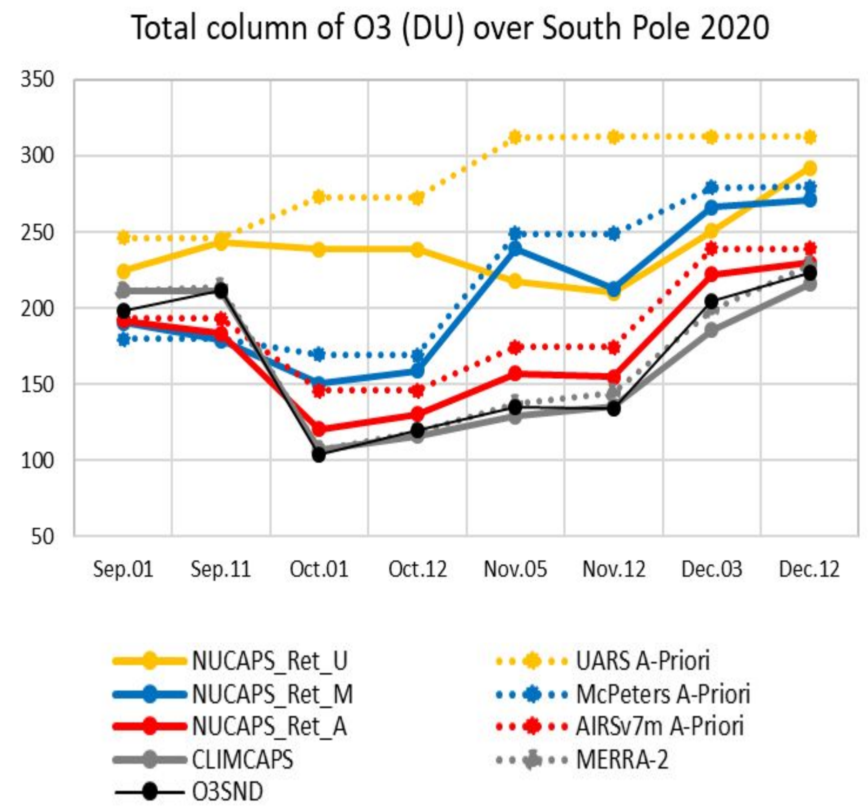
- The CrIS cloud detection algorithm was successfully updated to accommodate the loss of SNPP CrIS Side-2 LWIR band and to support the CrIS radiometric and spectral assessment during the anomaly period (Figure 1).
- The slant path radiative transfer model correction was implemented. It has large impact on the CrIS channels with the weight function peak reaching the upper troposphere with the maximum brightness temperature differences of ~0.3 K (Figure 2).

Evaluation and Improvement of NUCAPS Ozone Retrievals over Antarctica Spring to Summer Transition with Matched NOAA-GML Ozonesondes and CLIMCAPS Retrievals

Tong Zhu[1], Murty Divakarla[1], Irina Petropavlovskikh[2], Ken Pryor[3], Shu-peng Ho[3], Changyi Tan[1], Nicholas Nalli[1], Mike Wilson[1], Juying Warner[4], Tianyuan Wang[1], Koji Miyagawa[2], Bryan Johnson[2], Jianguo Niu[1], Lawrence Flynn[3], Christopher Barnet[5], Lihang Zhou[6]

1 IMSG; 2 GML 3 STAR 4 UMD 5 STC 6 JPSS Program

- A new O3 a priori (AIRS.v7) has been implemented into the NUCAPS, which can provide better a priori of the O3 profile, and improve O3 retrievals over Antarctic spring to summer transition period.
- By analyzing the averaging kernels, it indicates that the NUCAPS O3 retrieval less sensitivity over lower stratosphere at South Pole than that at Boulder, CO.
- We will extend evaluations to other regions (like tropics) and seasons to ensure the NUCAPS global/seasonal products meet the validated maturity requirements.
- In this event, the CLIMCAPS retrievals show better agreement with the O3SND measurements. While CLIMCAPS uses MERRA-2 as the a priori, the NUCAPS uses a static a priori LUT. Experiment using the GFS Ozone or the OMPS ozone as the a priori may be needed.



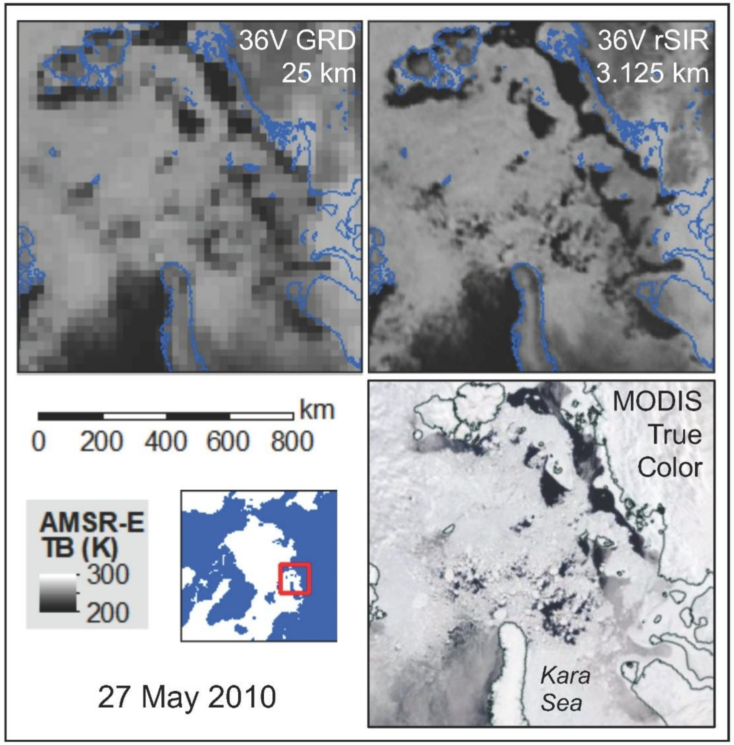
University of Wisconsin-Madison NOAA Cooperative Institute for Meteorological Satellite Studies (CIMSS) 2022 AMS Presentation Summary

Improved Operational Sea Ice Products using Spatially Enhanced AMSR2 Data

Tom Greenwald (Lead), Yinghui Liu (NOAA), Mary Jo Brodzik (CIRES), Walt Meier (NSIDC), Sean Helfrich (NOAA)
Poster – Monday January 24, 2022 5:00 – 6:30 PM

Scott Lindstrom (CIMSS)

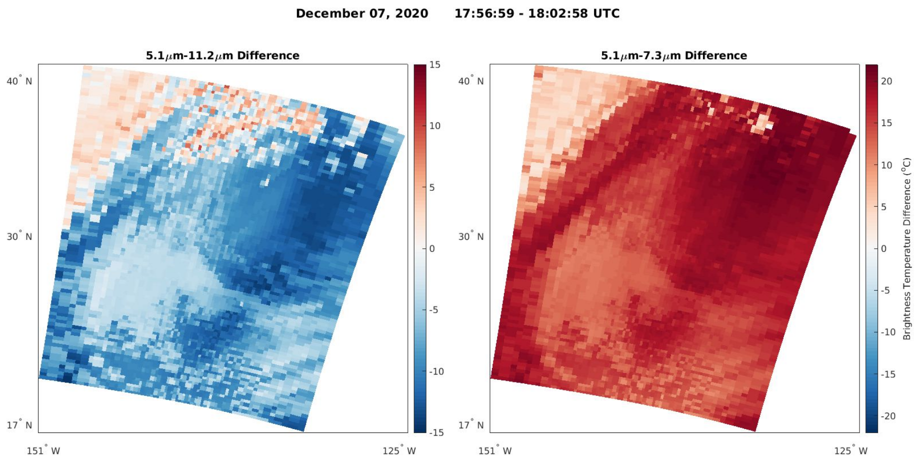
- Goal: To advance operational NOAA sea ice products in the Arctic to meet the needs of users by enhancing AMSR2 spatial resolution and providing new products
- Methods: Leverage existing NASA MEaSUREs system (Brodzik) to sharpen AMSR2 imagery using an image reconstruction method for multiple overlap swaths
- Products: Spatially enhanced imagery (3/6/12km), sea ice concentration (3/6km), and sea ice thickness (12km)
- Validation: Comparisons to SAR and VIIRS data
- User engagement: Forecasters and sea ice analysts at NWS ASIP and USNIC
- R2O: Arctic Testbed and Proving Ground



Potential New Water Vapor Bands on Next-Gen GEO Imagers

Mathew M. Gunshor, Nathaniel B. Miller, Aronne Merrelli, Tristan L'Ecuyer (CIMSS), and Timothy J. Schmit (STAR)
Oral – Wednesday, January 26th, 2022 9:15-9:30 am

- Can there be a NEW water vapor band on GXI?
  - 5.1µm for low level water vapor
  - 5.5µm possible 1km replacement for 6.9µm
- For more details:
  - Miller, N. B., Gunshor, M. M., Merrelli, A. J., L'Ecuyer, T. S., Schmit, T. J., Gerth, J. J., & Gordillo, N. J. (2022). Imaging considerations from a geostationary orbit using the short wavelength side of the mid-infrared water vapor absorption band. *Earth and Space Science*, 9, e2021EA002080. https://doi.org/10.1029/2021EA002080
- Zoom Poster Session: https://go.wisc.edu/8d0uo4
  - January 25, 5:15 PM - 5:35 PM
  - January 27, 5:15 PM - 5:35 PM

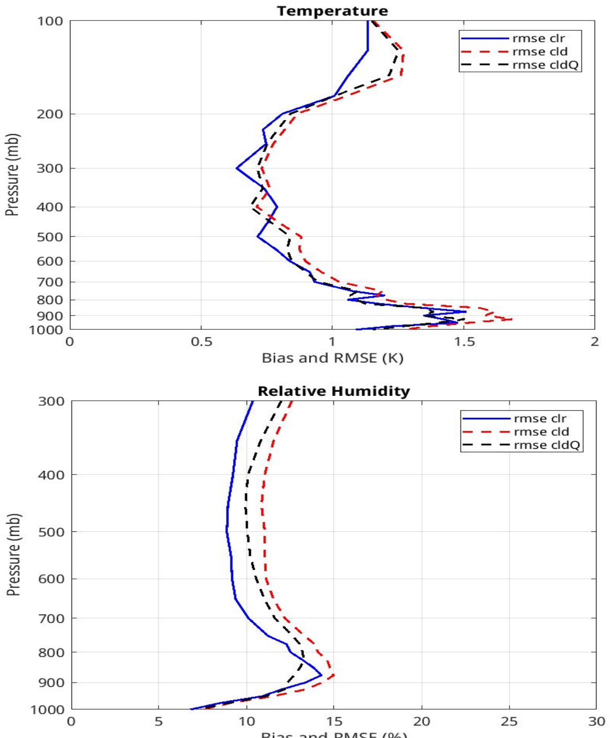


Synergistic Use of Hyperspectral IR Sounder and High Spatial/Temporal IR Imager Data with a Machine Learning Technique

Jinlong Li, Zhenglong Li, Jun Li (CIMSS); Timothy J. Schmit (STAR); Lidia Cucurull (AOML)

Oral – Thursday January 27, 2022 2:15-2:30 pm

- Based on collocated IR Sounder (CrIS) and IR Imager (ABI) measurements along with the ERA5 reanalyses, a preliminary model for hyperspectral partially cloudy sounding retrieval is built with a DNN technique. The results are very promising.
- Adding the partially cloudy retrieval can greatly improve the hyperspectral sounding retrieval yields and double the clear sky only retrieval coverage.
- Geographic and physical parameters (e.g., zenith angle, cloud coverage, brightness temperature difference) can further provide quality information for the application of retrievals.
  - -2K<dtb<5K + 40~99% clear coverage
  - 65% increase in yields vs 14% in CCR

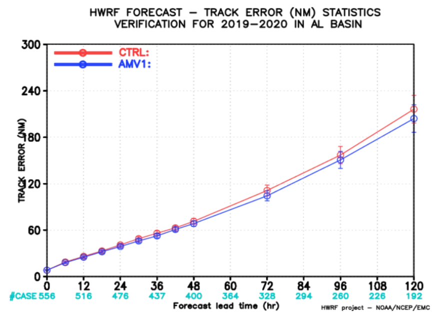


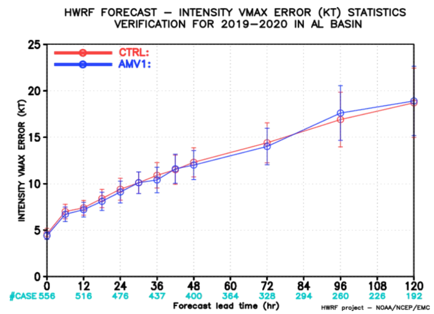
Funded by AOML

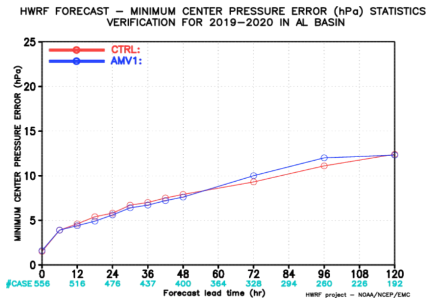
Assimilation of the GOES-16/17 Atmospheric Motion Vectors in the Hurricane Weather Forecasting (HWRF) model

Agnes Lim1, Sharon Nebuda1, James Jung1, Jaime Daniels2, Wayne Bresky3, Li Bi3,4 and Avichal Mehra4
1. Cooperative Institute for Meteorological Satellite Studies, UW-Madison 2. NOAA NESDIS/STAR, 3. I.M. Systems Group, 4. NOAA/NWS/NCEP/EMC
Oral – Wednesday January 26, 2022 9:15-9:30 pm

- Evaluate GOES-16/17 AMVs for use in the HWRF to support a quick transition from the heritage AMVs of GOES-13/15 to the nested tracking GOES-16/17 AMVs.
- Infrared, cloud top water vapor , clear air water vapor, shortwave and visible AMVs.
- Update error profiles used for assimilation
- Apply new hurricane specific quality control procedures.
- Relax gross error check to allow observations with higher wind speeds.
- 20-40% more AMVs assimilated
- Improved normalized wind speed bias between observations and analysis.
- Improve hurricane forecast metrics.
- G16 AMVs
  - Positive impact on track error, intensity error, minimum center pressure error, 34-kt, 50-kt and 65-kt average wind radii.
- G17 AMVs (figures not shown)
  - Positive impact on track error, 24 hour and beyond for intensity error and minimum center pressure error.
  - Slight degradation in intensity error for the first 24 hours. Possibly due to Hurricane Marie which contributed the largest number of cycles to the statistics.







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

Verification statistics for 19 tropical cyclones from 2019 and 2020 hurricane seasons in North Atlantic basin. Error bars are 95% confidence interval. The secondary x-axis shows the number of samples used in deriving these statistics. (ltop eft) Track error in nautical miles. (top right) Intensity error in knots. (bottom left) Minimum center pressure error in hPa.

Assimilation of radiance tendency of water vapor bands from geostationary satellites using FV3GFS

Agnes Lim, Zhenglong Li, James Jung and Sharon Nebuda
Cooperative Institute for Meteorological Satellite Studies
Oral – Thursday January 27, 2022 9:30 – 9:45 am

- Motivation: Small impact from GEO IR radiances in NWP.
- Objective: Develop a new technique for Assimilating Radiance Tendencies (ART) of the WV bands from domestic and international GEO imagers.
- Water vapor tendency (dTB) is defined here as the difference in brightness temperature between two observation times (Fig 1).
- Assumptions
  - RTM error can be ignored. Representativeness error reduced. Hence more weights put on observations.
  - Change in radiance bias within a short period of time is small. Hence no application of bias correction scheme needed.
- A series of assimilation experiments conducted assimilating water vapor tendency with different observational weights.
- Results
  - Gross error check depends on the observation error. A small observation error can artificially reduce the number of observations assimilated.
  - Minimal impact on analysis when O-Bs are too small.

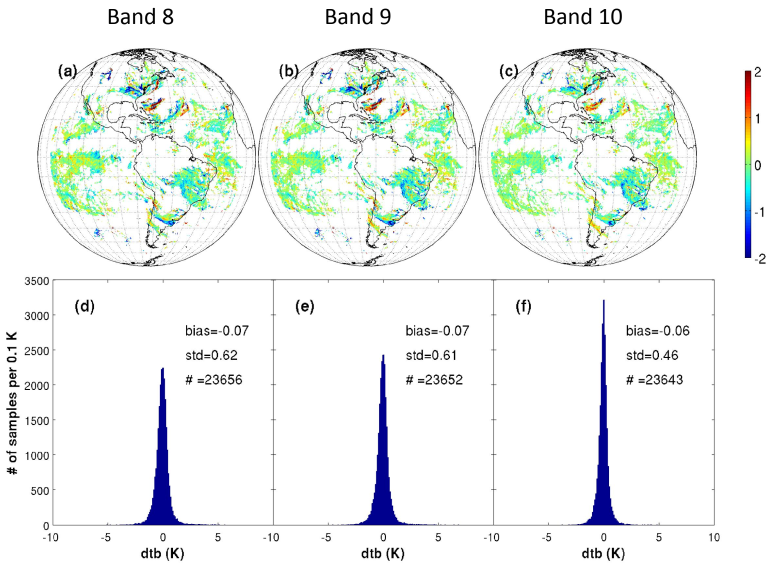


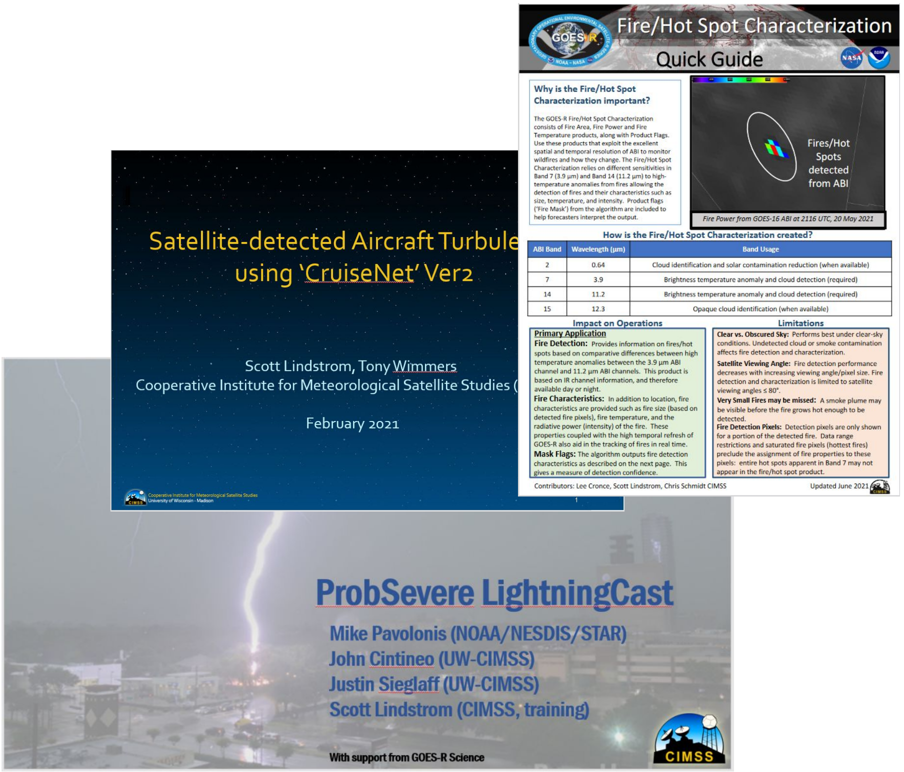
Figure 1 dTb (K) for 3 ABI WV channels at 06-05 UTC
(Top row) dTB is calculated only when observations for both times are valid and clear percentages greater than 70 %.
(Bottom row) histogram of dTB. Mean and standard deviation of dTb change from hour to hour is small.

Satellite Training Activities for the National Weather Service at CIRA and CIMSS

Scott S. Lindstrom (CIMSS), Dan Bikos (CIRA), Ed J. Szoke (CIRA), Jorel Torres (CIRA), Erin Sanders (CIRA)

Poster Thursday January 27th 5:00-6:30 pm

- FDTD Satellite Applications Webinars
  - Coordinated by Lindstrom and Bikos
  - Short (20-minute) Peer-led webinars on how NWS forecasters use satellite data for better decision support
- VISIT Teletraining
  - Scheduled webinars that show how satellite imagery can be used in specific case studies
- Quick Guides/Quick Briefs
  - Short documents / Quick videos (examples at right) on new (or updated) products that can be used by forecasters



A Virtual Satellite Training Course for Graduate and Undergraduate Students

Scott S. Lindstrom, Cara Wilson, Amy K. Huff, J. Wang, S. C. Tucker, B. Sjoberg, S. S. Morris, G. B. McWilliams, E. Goldenstern, and J. J. Gerth

Oral - Wednesday January 26th 2022 9:15-9:30 am

- Created with/for AMS' Satellite Meteorology, Oceanography and Climatology (SatMOC) Committee
- 4 Separate Remote Training events over the course of the Summer 2021
- Included pre-class homeworks, lectures, and in-class work

Date	Title	Lead
16 June	Imagery Sources Online	Scott Lindstrom
7 July	Analyzing Atmospheric Smoke and Blowing Dust using Satellite Aerosol Optical Depth (AOD)	Amy Huff
28 July	Monitoring Marine Heat Waves with Satellite Sea-Surface Temperature data using ERDDAP	Cara Wilson
18 August	Monitoring Changes in Sea Ice at Seasonal and near-real-time time scales	Cara Wilson

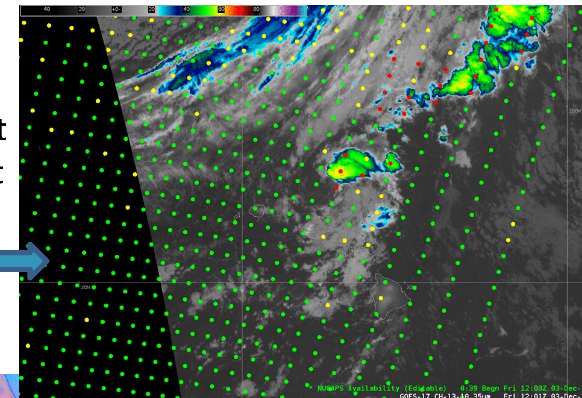
A Blogger's View of How NUCAPS Profiles Can Be Used Operationally

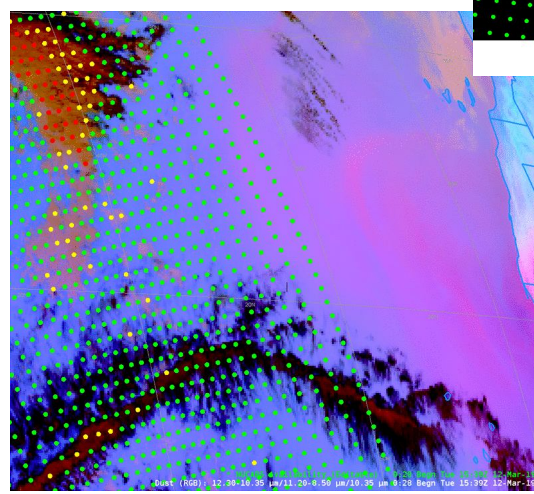
Scott S. Lindstrom

Oral – Monday January 24, 2022 2:15-2:30 pm

- What are NUCAPS Profiles
- How can NUCAPS profiles best be used operationally to enhance decision support
- Where can NUCAPS profiles (and horizontal fields derived from NUCAPS profiles) be found online

NUCAPS profiles just before a snow event in Hawaii, showing freezing levels





NUCAPS profiles across the leading edge of a SAL event

CIMSS Outreach Talks at AMS 2022

Margaret Mooney, Derrick Herndon, Julia Shates, Alexa Ross and Scott Lindstrom

Oral – Wednesday January 26, 2022 2:00-2:15 PM

-**Water, Friend or Foe**

Part of the new ***SCIENCE IS FOR EVERYONE*** series aimed at improving scientific literacy of all community members.

-**CIMSS Weather Camp**

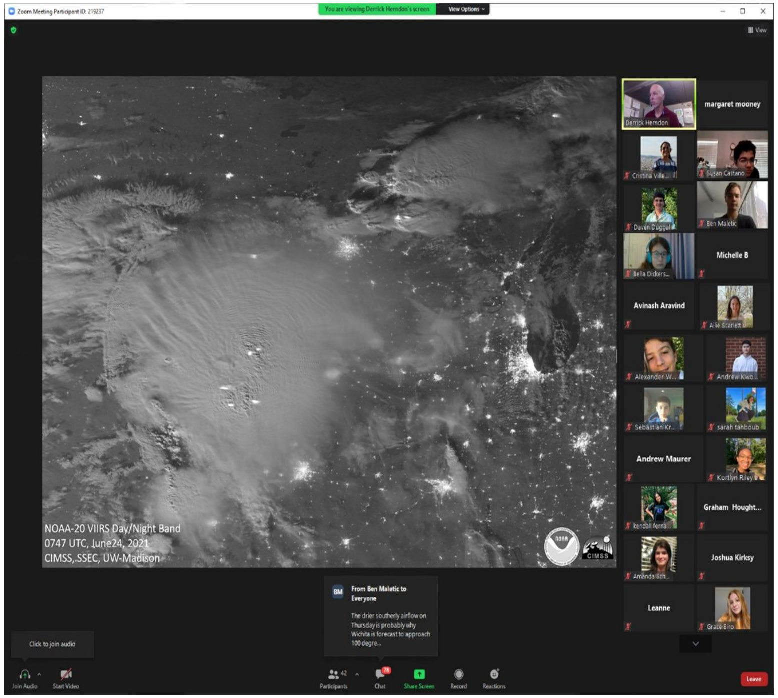
A week-long online event for high school students. The debut offering had 42 students from >30 states, including Alaska and Puerto Rico.

-**JPSS VIIRS Virtual Science Fair**

This VSF also debuted in 2021. Two teachers (2 schools) participated, out of 10 that had indicated plans to participate, for a total of 71 students. A follow-up survey found that teachers are under a lot of stress due to the pandemic.

-Badger Summer Scholars

An SSEC success story with CIMSS involvement engaging underrepresented students in computer science and meteorology.



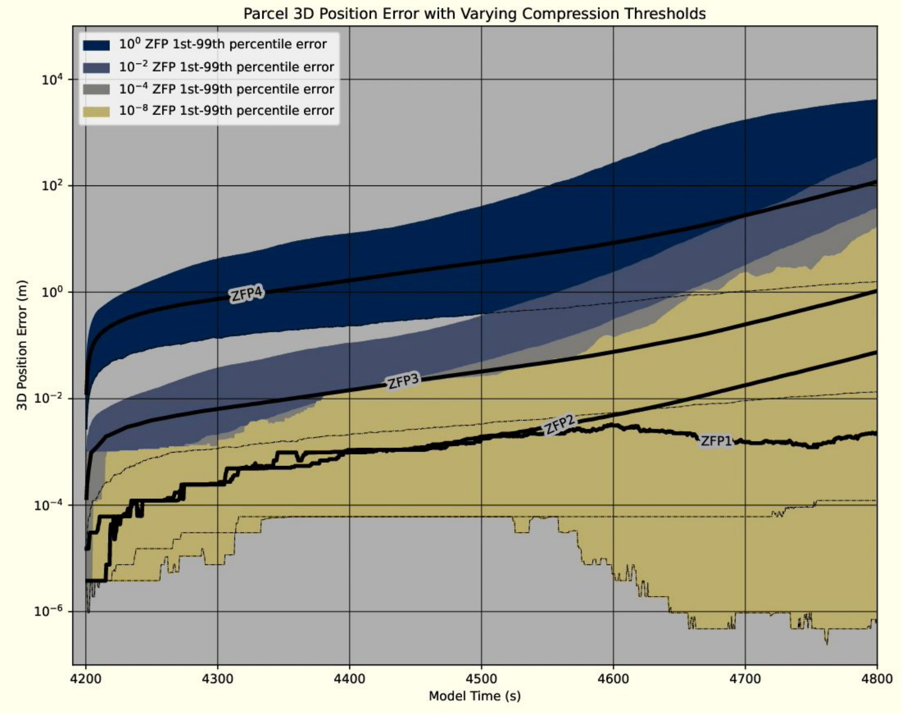
Zoom screen shot from the CIMSS Weather Camp
78 comments in the chat!

The Use of Lossy Compression to Enable Breakthrough Science in Cloud Modeling

Leigh Orf (CIMSS/SSEC), Kelton Halbert (UW-AOS)
Oral – Tuesday January 25th, 2022 4:30 – 4:45 pm

- ZFP compression results in 1-2 orders of magnitude data reduction in 3D 32 bit floating point data
  - Enables high save frequency in supercell simulations (up to dt)
  - Lagrangian parcel analysis not affected appreciably by high levels of compression

8th Symposium on High Performance Computing for Weather, Water, and Climate (AMS 2022)

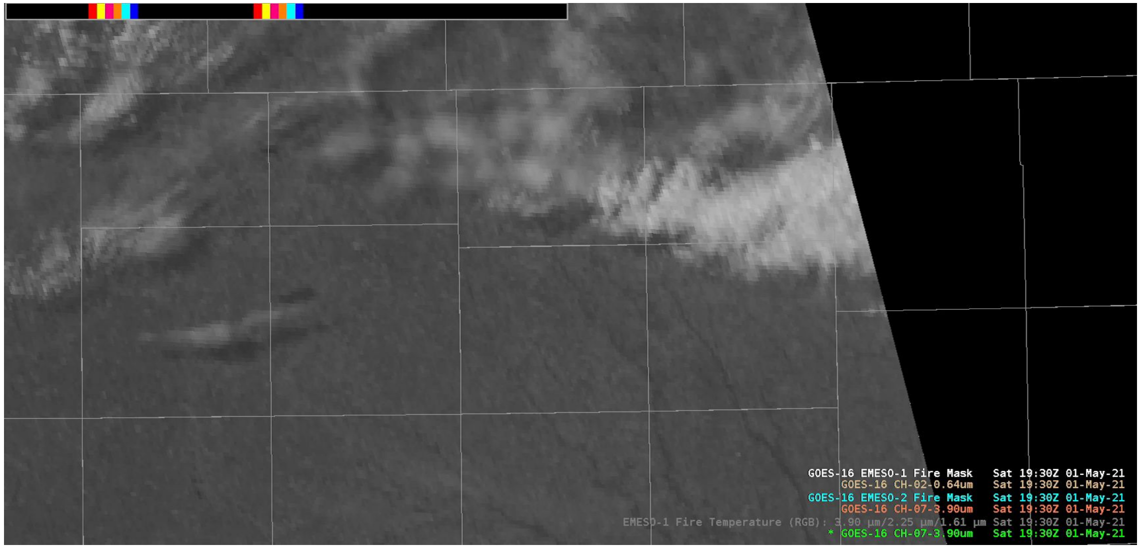


The 2021 Fire Year: Examining ABI Fire Detection and Characterization Algorithm Updates and Performance

Chris Schmidt (CIMSS); Ivan Csiszar (STAR)
Oral – Tuesday January 25th, 2022 4:45 – 5:00 pm

- NOAA began processing the FDCA on mesoscale ABI data
  - Both mesoscale FDCA products and the metadata mask became available through AWIPS for forecasters
  - Some users reported a preference for likelihood categories over the quantitative metrics
- Algorithm updates
  - Terrain correction was developed and is being integrated, along with a persistent anomaly database to screen solar facilities and similarly problematic areas
  - GOES-17 mitigation functioned well despite higher than anticipated focal plane temperatures
  - FDCA was integrated into NOAA's "Enterprise Fire" processing system

AWIPS display of mesoscale FDCA product over Eastern Iowa on 1 May 2021

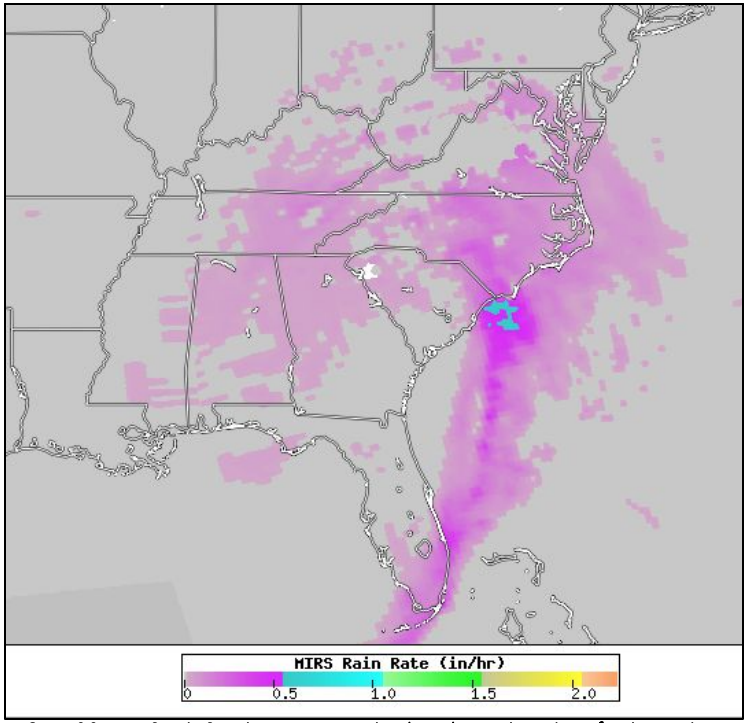


18th Annual Symposium on
Operational Environmental Satellite Systems

The Community Satellite Processing Package (CSPP): Facilitating the Use of Near-Real-Time JPSS Products

K. Strabala, L. Gumley, A. Huang, S. Mindock, J. Davies, N. Bearson, G. Cureton, D. Hoese, and J. Braun, SSEC/CIMSS, Univ. of Wisconsin-Madison
Oral – Thursday January 27th, 2022

- Released 10 Software Packages in the Last Year in Support of the Low Earth Orbit Direct Broadcast Community.
  - NOAA Products: SDR, HEAP NUCAPS, ACSPO SST
  - NOAA VIIRS Products: Surface Reflectance, Vegetation Index, Active Fires, Aerosols, Clouds, Volcanic Ash, Cryosphere, Land Surface Temperature, Land Surface Emissivity, Land Surface Albedo.
  - Other Instruments: GCOM-W AMSR-2 EDRs: Ocean, Precipitation, Soil, Snow and Sea Ice Products



NOAA-20 ATMS MiRS Rain Rates acquired at the University of Wisconsin - Madison and created using CSPP software in near-real-time, 17 January 2022

AMERICAN METEOROLOGICAL SOCIETY
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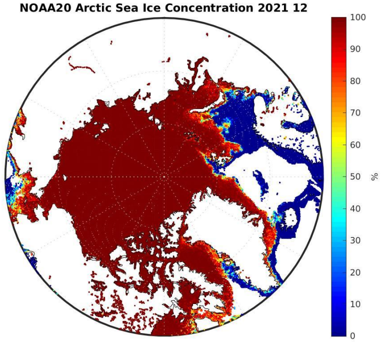
Ice Products from NOAA Operational LEO and GEO Satellites

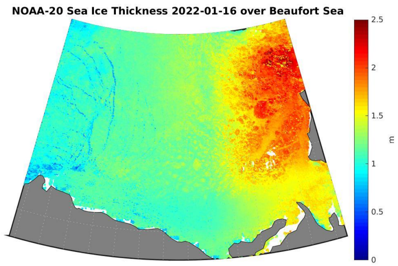
Xuanji Wang (CIMSS), Jeff Key (STAR), Yinghui Liu (STAR), Rich Dworak (CIMSS), Aaron Letterly (CIMSS), Hong Zhang (CIMSS), Feng He (UW/CCR)

Poster – Thursday January 27th, 2022 5:00-6:30 PM

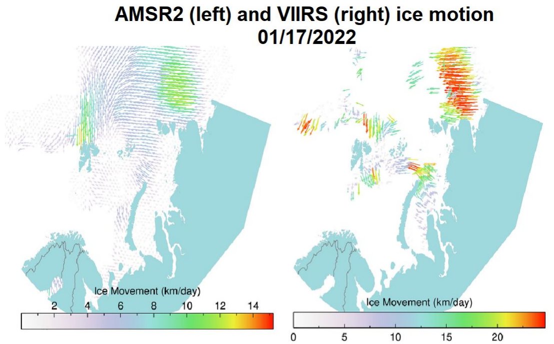
- Introducing our NOAA “Enterprise” ice product retrieval algorithms that have been developed here in CIMSS to retrieve a suite of ice parameters including ice surface temperature, concentration, thickness, and motion. These Enterprise products are now operational for the Visible Infrared Imaging Radiometer Suite (VIIRS) on NOAA-20 and S-NPP, AMSR2 on GCOM-W1, and for the Advanced Baseline Imager (ABI) on GOES-16 and -17.
- Validation studies of these ice products have been performed against measurements from in-situ field campaigns, buoys, IceBridge aircraft campaigns, and other satellite measurements, such as Landsat, MODIS, ICESat, and CryoSat-2.

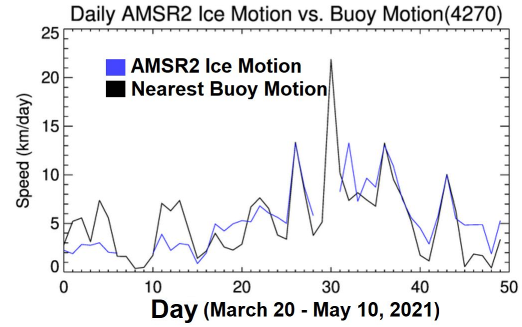


Arctic sea ice concentration in December 2021 from NOAA-20.



Arctic sea ice thickness over Beaufort Sea on Jan. 16, 2022, from NOAA-20.





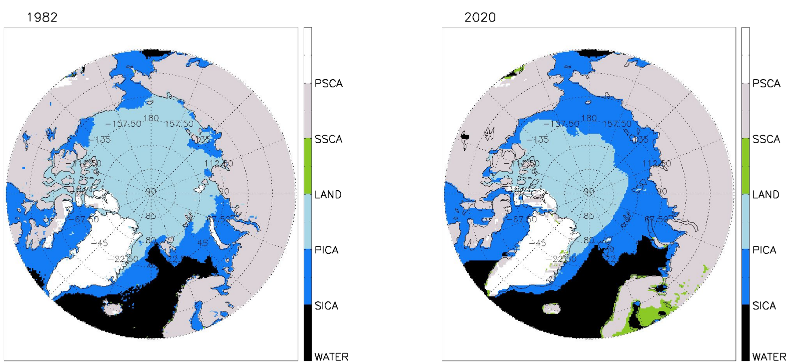
Ice motion in the Kara Sea and surroundings area (top) from AMSR2 and VIIRS on January 17, 2022, and Buoy speeds plotted alongside AMSR2 ice motion in the Beaufort Sea (bottom).

Changing Arctic Sea Ice from Satellite Observations

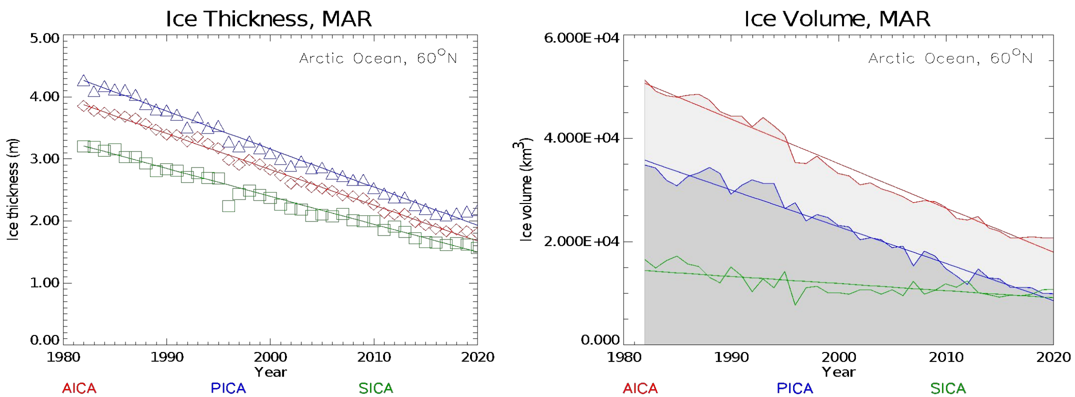
Xuanji Wang (CIMSS), Jeff Key (STAR), Yinghui Liu (STAR), Rich Dworak (CIMSS)

Poster – Thursday January 27th, 2022 5:00-6:30 PM

Using a long-term time series of Arctic sea ice data products from satellite observations, Arctic sea ice physical properties - ice concentration, ice extent, ice thickness, and ice volume - have been investigated. Results of this study show that the Arctic has warmed and become less ice covered in all seasons, especially in summer and autumn. The changing rates of Arctic sea ice properties for the Arctic Ocean north of 60°N have been estimated. Overall, Arctic sea ice concentration, extent, thickness, and volume have decreased significantly in all seasons, especially for perennial ice. The results also show that perennial ice loss is the major factor in total sea ice loss for all seasons. If the current rates of change in sea ice properties continue, the Arctic Ocean would have an ice-free summer in the 2061-2064 timeframe.



The spatial distribution of Arctic sea ice extent in 1982 (left) and 2020 (right). The color bar notation: WATER means open water, SICA stands for seasonal ice-covered area, PICA denotes perennial ice-covered area, LAND means snow-free land, SSCA stands for seasonal snow-covered land area, and PSCA denotes perennial snow-covered land.



Sea ice thickness (left) and sea ice volume (right) time series for the Arctic Ocean north of 60°N over 1982 ~ 2020 in March. PICA (blue) stands for perennial ice-covered area, SICA (green) denotes seasonal ice-covered area, and AICA (red) designates all ice (PI + SI) covered area.

Creating LEO Sounder Products at GEO Imager Spatial and Temporal Resolution Atmospheric Moisture Changes in the Pre-Convective Environment of a Tornado

Elisabeth Weisz, Paul W. Menzel, Eva Borbas

Oral – Thursday January 27th, 2022 11:00 – 11:15 am

- GEO+LEO fusion offers an early look at the remote sensing capabilities that will be possible with new instruments and platforms (e.g., GEO HS sounder).
- Rapidly evolving atmospheric changes during the 5 May 2021 tornadic storm event across US Midwest event are well captured by the spatial-temporal ABI and CrIS fusion process.
- The vertical detail from the HS sounder humidity profiles (from one LEO overpass approx. 2 hours prior tornado) is maintained and realistically transferred by ABI radiances to higher spatial and temporal resolution.
- Figure shows the rapid changes in moisture content (from ABI/CrIS fusion) and increase in atmospheric instability just prior Clay Center (NE) tornado.
- The GEO imager plus LEO hyperspectral (HS) sounder product fusion method combines the strengths and therefore extends the reach of either instrument.