Weekly Report

SCSB/CISESS
Cooperative Research Program Division (CoRP)
STAR/NESDIS
National Oceanic and Atmospheric Administration (NOAA)

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Publications

A New Algorithm to Estimate Noise Equivalent Delta Temperature (NEDT): CISESS Scientists John Xun Yang and Hu Yang have an article published in the latest issue of *IEEE Transactions on Geoscience and Remote Sensing*. The noise equivalent delta temperature (NEDT) represents the radiometric resolution and sensitivity of a radiometer. NEDT is a critical metric that needs to meet the mission requirement. Measuring NEDT allows for monitoring hardware noise and health. NEDT associated uncertainty not only affects the level-1 radiance/brightness temperature but also propagates through higher level science products. NEDT is also an important parameter in simulating and assimilating satellite data for examining radiometric uncertainty propagation. The accurate measurement and estimate of NEDT are a vital component of uncertainty quantification of satellite-based data records. Agencies of EUMETSAT, UK Met Office, and NOAA have developed their own algorithms for calculating and monitoring NEDT of in-orbit microwave radiometers. However, a notable underestimate of NEDT is found at some channels, such as G-band, which is prone to 1/f noise. In addition, inconsistency has been found between different algorithms. The authors reviewed the theoretical basis for determining NEDT and developed a new algorithm of clear physics and mathematics. They conducted comparison and validation with the prelaunch thermal vacuum chamber (TVAC) test, in-orbit data, and simulation. The new algorithm significantly improves the estimate of NEDT, including the G-band, and advances the understanding of algorithm structures and physical foundations.

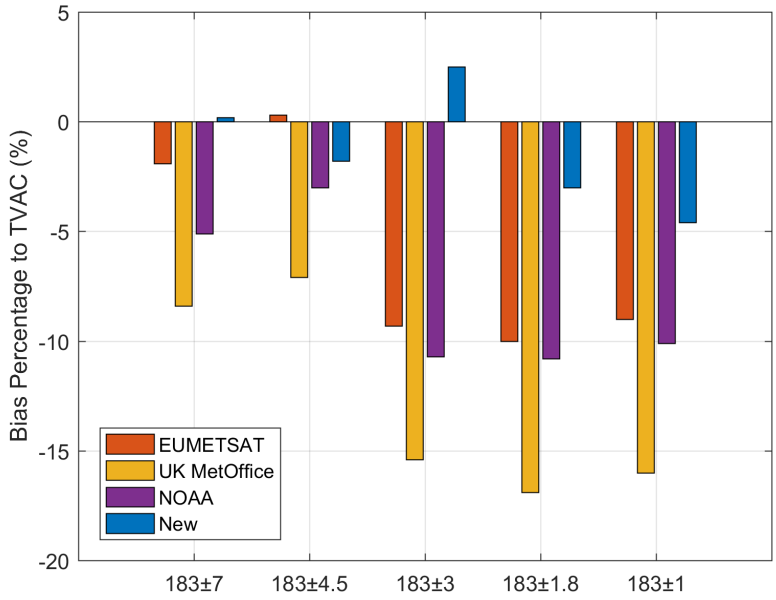

Figure. Comparing different algorithms for estimating NEDT against TVAC measurement. The new algorithm out-performs traditional algorithms of EUMETSAT, UK Met Office and NOAA. While the 183 GHz is prone to 1/f noise, the new algorithm produces an accurate estimate of NEDT and exhibits consistent performance across all channels.

Yang, John Xun; and **Hu Yang**, 2022: A new algorithm for determining the noise equivalent delta temperature of in-orbit microwave radiometers, *IEEE Trans. Geosci. Remote Sens.*, **60**, 1-11, 5301611, https://dx.doi.org/10.1109/TGRS.2021.3097594.

(POC: J.X. Yang, jxyang@umd.edu; Funding: JSTAR)

Microwave Integrated Retrieval System (MiRS) Precipitable Water: The MiRS Science Team has had a paper published this week. The article, entitled "In-Depth Evaluation of MiRS Total Precipitable Water from NOAA-20 ATMS Using Multiple Reference Data Sets" and written by CISESS scientists Yong-Keun Lee, Christopher Grassotti and Yan Zhou, appears in the February issue of *Earth and Space Science* journal. It describes a study of one full year (2019) of MiRS total precipitable water (TPW) retrievals from NOAA-20 Advanced Technology Microwave Sounder (ATMS) measurements were subjected to a detailed validation effort. This included comparisons to Global Data Assimilation System (GDAS) and European Centre for Medium-Range Weather Forecasts (ECMWF) analyses, radiosonde measurements, and ground-based Global Positioning System (GPS) estimates. Both spatial and temporal patterns of retrieval performance were analyzed. Since the MiRS TPW is derived from multiple satellite measurements, which are a major component of the operational blended (and advected) TPW products, the study can serve as a benchmark for both developers and users of the product in their own applications. The figure below shows an analysis of the annual average spatial

distribution of retrieved TPW, along with corresponding differences with ECMWF and GDAS analyses.

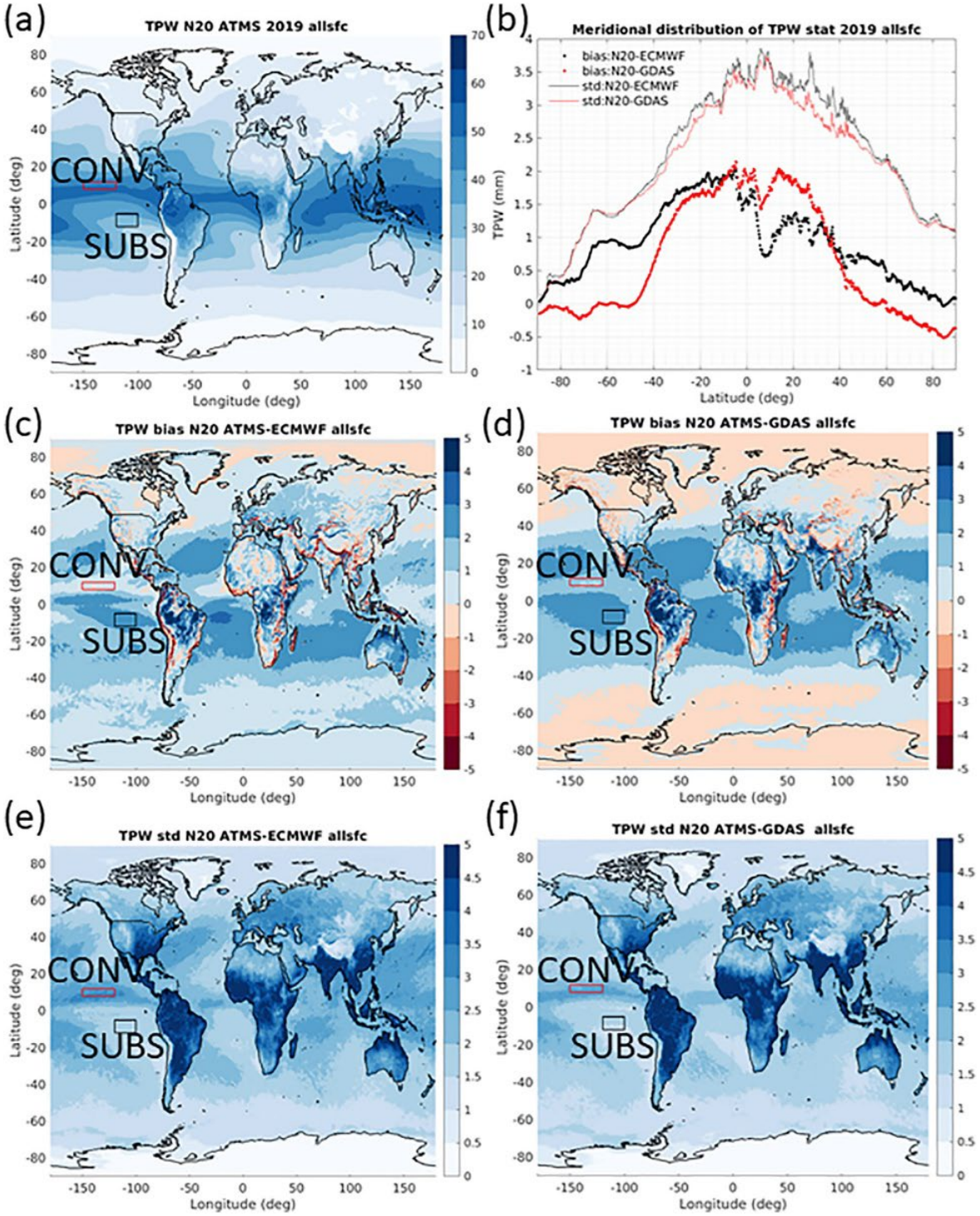

***Figure**: (a) Horizontal distribution of MiRS NOAA-20 ATMS TPW for all of 2019, (b) meridional distribution of statistics for MiRS NOAA-20 ATMS TPW versus ECMWF (black) and GDAS (red) [dots are bias (mm) and lines are standard deviation (mm)]: number of pixels are more than 1.2*

million for each latitude between 80°S and 80°N. Beyond this area the number of pixels decreases significantly. Global distribution of bias (mm) of (c) MiRS NOAA-20 ATMS TPW – ECMWF TPW, (d) MiRS NOAA-20 ATMS TPW – GDAS TPW, standard deviation (mm) of MiRS NOAA-20 ATMS TPW versus (e) ECMWF TPW and (f) GDAS TPW. All results are for combined ascending and descending orbits in 2019. The red box (120°W ∼150°W & 8°N ∼12°N) in each plot indicates an area typically characterized by strong convection (CONV area) and the black box (100°W ∼120°W & 5°S ∼12°S) indicates an area typically dominated by subsidence (SUBS area).

Lee, Yong-Keun, Christopher Grassotti, Quanhua (Mark) Liu, Shu-Yan Liu and **Yan Zhou**, 2022: In-depth evaluation of MiRS total precipitable water from NOAA-20 ATMS using multiple reference data sets. *Earth Space Sci.*, **9**, e2021EA002042, https://doi.org/10.1029/2021EA002042.

(POC: Yong-Keun Lee (CISESS), Christopher Grassotti (CISESS), Mark Liu (STAR), yong-keun.lee@noaa.gov , Funding: JSTAR, PSDI JSTAR, JPSS PGRR)

NOAA Coral Reef Watch Data used for National Status Report: CISESS Scientist Erick Geiger coauthored a comprehensive study on United States coral reefs based on seven years of NOAA Coral Reef Watch Data (2012 – 2018). This Report was published on February 3 in *Frontiers in Marine Science*. The process behind this report involved multi-year data analyses of key benthic, fish, and climate indicators. Overall ecosystem scores of Fair were given to all combined Atlantic (70%) and Pacific (74%) jurisdictions and the current trend is downward with a majority of United States coral reefs declining and vulnerable to further degradation. Remote, uninhabited reefs had an advantage with respect to reef fish population scores, i.e., Flower Garden Banks (85%) and Pacific Remote Islands (93%), when compared to populated location scores, i.e., Puerto Rico (63%) and Main Hawaiian Islands (66%). All coral reefs are highly impacted by climate change, and climate impacts were more pronounced than expected on remote reefs, i.e., the Northwestern Hawaiian Islands (58%). Management actions such as expanding protected areas; enforcing existing regulations; increasing climate change education; reducing land-based sources of pollution; and other actions to improve the trajectory of coral reef ecosystem conditions were recommended. The figure below shows the “report cards” for different coral reefs in the Pacific (left) and Atlantic oceans.

90–100% Very good | 80–89% Good | 70–79% Fair | 60–69% Impaired | 0–59% Critical

TABLE 9 | Scoring results for all six Pacific jurisdictions for all indicators in all four themes.

Indicator	Guam	Main Hawaiian Islands	NWHI	NMI	American Samoa	PRI
Coral populations	69	67	69	75	83	75
Partial mortality	71	67	77	73	84	81
Benthic cover	75	65	67	77	80	74
Herbivory	33	51	96	58	80	91
Benthic	**62**	**63**	**77**	**71**	**82**	**80**
Fish Biomass	57	71	90	76	78	99
Sustainability	74	72	91	74	78	94
Sharks and other predators	67	54	94	78	64	87
Fish	**66**	**66**	**92**	**76**	**73**	**93**
Heat Stress	65	71	45	61	65	84
Ocean Acidification	71	65	60	71	82	66
Reef Growth	76	75	69	74	83	71
Climate	**71**	**70**	**58**	**69**	**77**	**74**
Awareness	67	77	n/a	91	87	n/a
Participation in pro-environmental behaviors	88	100	n/a	100	91	n/a
Support for Management Actions	100	67	n/a	100	87	n/a
Human Connections	**85**	**81**	n/a	**97**	**88**	n/a
Overall Score	**71**	**71**	**76**	**78**	**80**	**82**

TABLE 11 | Scoring results for all four Atlantic jurisdictions for all indicators in all four themes.

Indicator	Florida	Puerto Rico	USVI	Flower Garden Banks
Mortality	75	75	85	95
Coral cover	64	75	69	95
Coral reef cover	64	75	71	85
Macroalgae cover	63	75	66	n/a
CCA cover	65	75	75	85
Adult coral	77	65	74	95
Benthic	**70**	**73**	**75**	**93**
Diversity	85	55	65	85
Reef Fish	77	70	73	85
Sustainability	58	65	55	85
Fish	**73**	**63**	**64**	**85**
Heat Stress	71	85	85	85
Ocean Acidification	78	79	77	81
Reef Material Growth	54	60	60	97
Climate	**68**	**75**	**79**	**88**
Awareness	67	68	75	n/a
Participation in pro-environmental behaviors	65	53	53	n/a
Support for Management Actions	67	92	75	n/a
Human connections	**66**	**71**	**68**	**n/a**
Overall score	**69**	**70**	**72**	**89**

Towle, Erica K.; E. Caroline Donovan, Heath Kelsey, Mary E. Allen, Hannah Barkley, Jeremiah Blondeau, Russell E. Brainard, Annie Carew, Courtney S. Couch, Maria K. Dillard, C. Mark Eakin, Kimberly Edwards, Peter E. T. Edwards, Ian C. Enochs, Chloe S. Fleming, Alexandra S. Fries, **Erick F. Geiger**, Laura Jay Grove, Sarah H. Groves, Matthew Gorstein, Adel Heenan, Matthew W. Johnson, Justine Kimball, Jennifer L. Koss, Tye Kindinger, Arielle Levine, Derek P. Manzello, Nathan Miller, Thomas Oliver, Jennifer C. Samson, Dione Swanson, Bernardo Vargas-Ángel, T. Shay Viehman and Ivor D. Williams, 2022: A national status report on United States coral reefs based on 2012–2018 data from National Oceanic and Atmospheric Administration's National Coral Reef Monitoring Program. *Front. Mar. Sci.*, **8**, 812216, https://doi.org/10.3389/fmars.2021.812216 .

(POC: Erick Geiger, erick.geiger@noaa.gov, Funding: NOS)