Weekly Report – July 22, 2022

Satellite Climate Studies Branch (SCSB)/CISESS

NOAA/NESDIS/STAR

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HIGHLIGHTS FOR NESDIS LEADERSHIP

People

New Visiting NOAA Scientist at CISESS:

Jonathan Wynn Smith (formally CISESS, now at NOAA Geophysical Fluid Dynamics Laboratory) has obtained a Visiting Scientist appointment with ESSIC/CISESS. His tasks at GFDL include lightning frequency and lightning NOx (LNOx) parameterization model development and sensitivity testing. He will be comparing flash frequency (ff) from the GOES-16 Geostationary Lightning Mapper (GLM) gridded product Flash Extent Density (FED) with recent GFDL climate model ff output from 2018-2020 to inform model development. The UMD lightning group is excited to have a former member return in a new capacity. (Scott Rudlosky, SCSB, scott.rudlosky@noaa.gov, PDRA)

PUBLICATIONS

Noise Reduction for Satellite Microwave Radiometer Data

Citation**: Yang, John Xun; Yalei You,** William Blackwell, Quanhua Liu, **Ralph Ferraro,** David Draper, Nigel Atkinson, Tim Hewison, Sidharth Misra and Jinzheng Peng: 2022: An adaptive calibration window for noise reduction of satellite microwave radiometers. *IEEE Trans. Geosci. Remote Sens*., **60**, 5304616, https://doi.org/10.1109/TGRS.2022.3184670. Both NOAA and EUMETSAT use a fixed window in calibration of satellite microwave radiometers for smoothing radiometer cold-space and warm-load counts and processing brightness temperature. This fixed window parameter is determined through pre-launch testing and is matched to other radiometers for consistency. However, once the instrument is in orbit, this parameter may no longer be optimal. The authors suggest an adaptive window that can take into account temporal jumps and shifts in counts and gains, thereby reducing the time-varying noise in the data.

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Summary: CISESS Scientist John Xun Yang and Yalei You have released an important article on calibration that questions some of the legacy approaches to optimizing calibration parameters for satellite microwave radiometers. Optimal calibration parameters are determined by pre-launch testing and from older instruments. Even though some of these parameters involve testing in a thermal vacuum chambers (TVACs) that mimics the space environment to some degree, these parameters may not be optimal for an in-orbit instrument. They look specifically at the fixed window used for correcting radiometric noise and gain fluctuation – this is a triangular or rectangular window with a fixed length used for smoothing variations. While this works well for stationary noise, which remains constant with time, an adaptive window based on temporal jumps and shifts in counts and gains can reduce nonstationary (time-varying) noise by 50%. The adaptive window size is determined for each orbit and each channel. In particular 1/*f* noise (flicker noise) increases with time so it can best be addressed with this method. Below is a comparison of the fixed and adaptive window results (see figure).

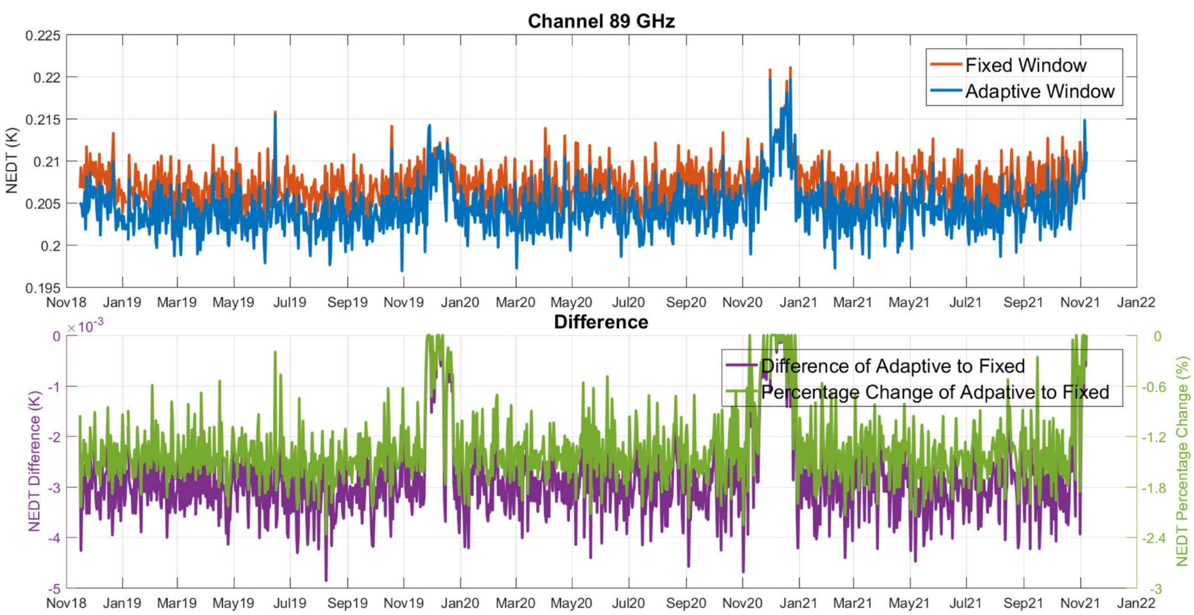

Figure: (Top) the time series for MetOp-C Microwave Humidity Sounder Channel 89 GHz showing the noise equivalent delta temperature (NEDT) for the fixed window (red) and the adaptive window (blue). (Bottom) numerical difference (purple) and percentage difference (green) between the fixed and adaptive window.

(John Xun Zhang, CISESS & STAR/SMCD, xun.yang@noaa.gov, Funding: JSTAR)

Detecting Snowfall over the Ocean

Citation**: You, Yalei; Huan Meng; Jun Dong; Yongzhen Fan; Ralph Ferraro; Guojun Gu;** and **Likun Wang**, 2022: A snowfall detection algorithm for ATMS over ocean, sea ice, and coast. *IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens.*, **15**, 1411–1420, https://doi.org/10.1109/JSTARS.2022.3140768. This study developed three snowfall detection algorithms for snowfall detection over oceans, sea ice, and coasts using the data from the Advanced Technology Microwave Sounder (ATMS) on NOAA-20 and S-NPP. This capability will be added to the existing NOAA Snowfall Rate products.

Summary: SCSB Scientist Huan Meng has led the effort to develop and implement the Snowfall Rate products with CISESS Scientists Jun Dong, Yongzhen Fan and Yalei You. This article tackles a long-standing theoretical problem: how to detect snowfall rate from satellite over the oceans, the coasts, and sea ice. They used the brightness temperature (TB) variables from different channels of the Advanced Technology Microwave Sounder (ATMS) and a series of variables from the NCEP Global Forecast System (GFS) to find the optimal snowfall detection performance. The importance of the GFS variables is different among the three surface types. The ocean snow detection algorithm primarily depends on TB variables but GFS variables were critical to snowfall detection over sea ice and the coasts. The two GFS variables shared by all three of the detection algorithms were total cloud water and relative humidity (RH) at 900 hPa. All the other variables for sea ice and coasts were RH at different levels: 850, 925, 950 & 975 hPa for sea ice and 750, 850, 925, 950 & 1000 hPa for coasts. The probability of detection (POD) was $\geq$0.72, the false alarm ratio (FAR) was $\leq$0.38 and the Heidke skill score (HSS) values are about 0.56 for all three algorithms.

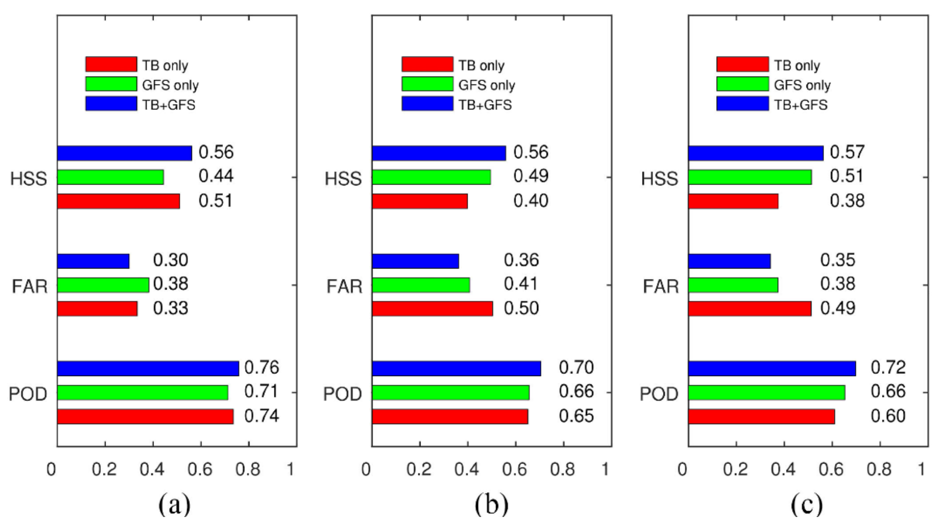

Figure: Snowfall detection metrics Probability of Detection (POD), False Alarm Ratio (FAR), and Heidke Skill Score (HSS) for (a) ocean, (b) sea ice, and (c) coasts using brightness temperatures only (TB only), forecast only (GFS only), and combined TB+GFS algorithm configurations.

(Yalei You, CISESS, yyou@umd.edu , Funding: JSTAR)