Weekly Report

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

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Products and Applications

HPCC Proposal Submitted: T. Smith submitted a proposal to the NOAA High Performance Computing and Communications (HPCC) Program to work with Samuel Shen, Climate Informatics Lab and Department of Mathematics and Statistics, San Diego State University (SDSU) on improved data visualization and analysis. The visualization and analysis methods were developed by the SDSU group and the proposal is to adapt them to data important to NOAA to show their utility. Here is an example of their approach, called 4-Dimensional Visual Delivery (4DVD).

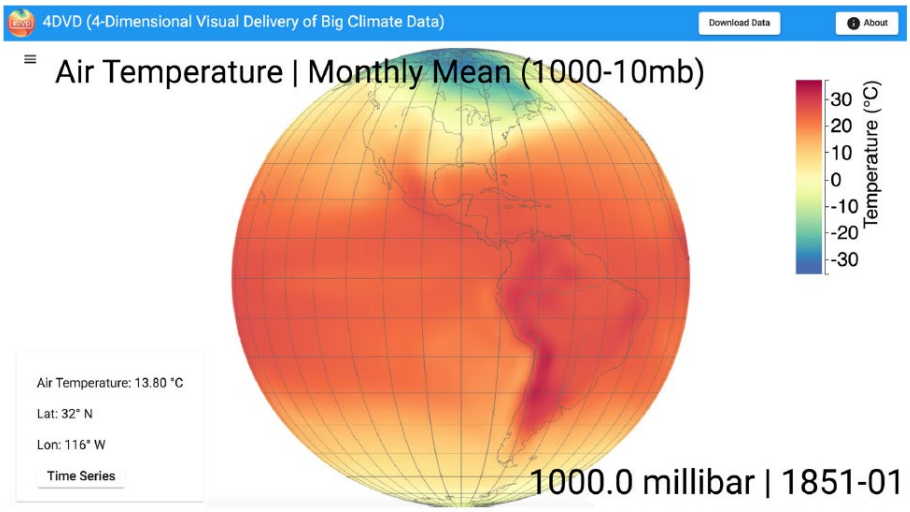


Fig. 1 The 4DVD display of the January 1851 mean temperature at 1000 mb level. The lower-left corner is the temperature value 13.8008 °C at the grid box (32° N, 116° W). When a user clicks on another point on the globe, new latitude, longitude, and temperature value will show

From: Shen, S.; J. Pierret, I. Dorado and S. Ilawe, 2020: 4DVD visualization and delivery of the 20th century reanalysis data: methods and examples. *Theor. Appl. Climatol.*, 142, 243–254, https://doi.org/10.1007/s00704-020-03288-z.

Follow-up work can be done to expand the number of data sets adapted for use in the system.

(POC: T. Smith, tom.smith@noaa.gov, Funding: pending)

Publications

Using Satellite Microwave Data for Water Vapor over Land: CISESS scientists Chris Grassotti and Yong-Keun Lee were coauthors along with NOAA STAR scientists Quanhua (Mark) Liu and Changyong Cao of a paper published last week in the open access journal *Remote Sensing*. The paper titled "How Can Microwave Observations at 23.8 GHz Help in Acquiring Water Vapor in the Atmosphere over Land?" examined the role of the microwave channel at 23.8 GHz in obtaining total integrated water vapor over land. The question arises because while single channel measurements from this channel are very effective in obtaining integrated water vapor over the ocean, they do not provide great sensitivity over land due to the much higher emissivity of land surfaces. Furthermore, when measurements from this channel are excluded from multichannel satellite retrieval algorithms, the accuracy of the total water vapor estimates is reduced (see Figure).

Retrievals without ATMS Ch1 will lead to over-estimation of TPW over land during Hurricane Harvey in August 2017.

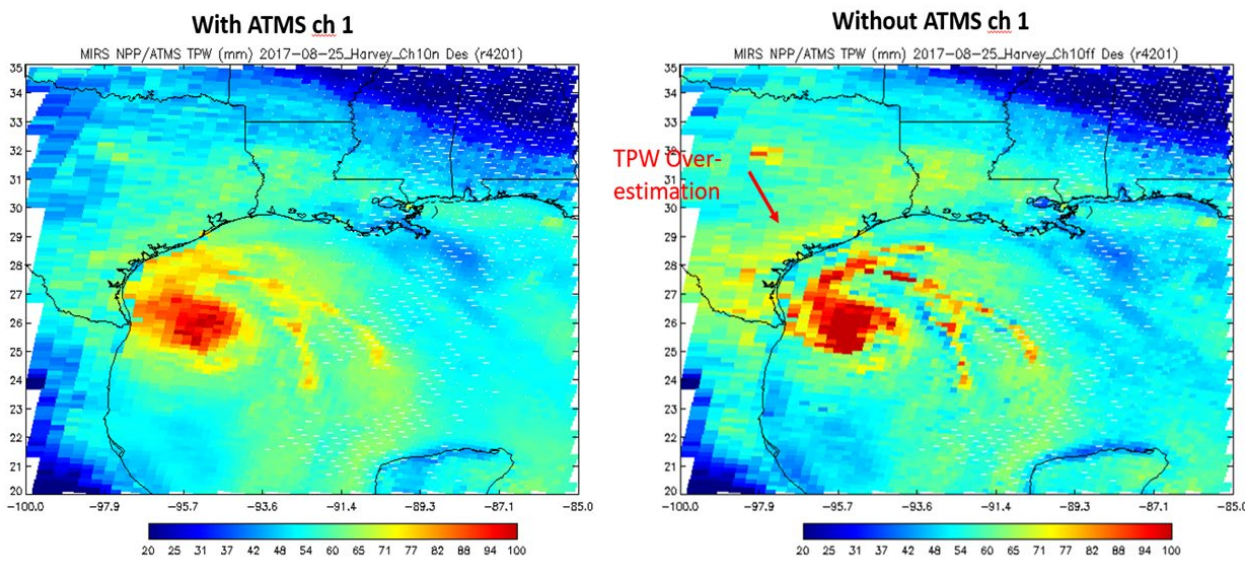


Figure: The graphic above shows the impact of removing ATMS channel 1 (23.8 GHz) on the retrieval of total integrated water vapor (TPW) by the NOAA Microwave Integrated Retrieval System (MiRS). The case shown is of Hurricane Harvey in August 2017 and shows that without the channel 1 measurements, the water vapor is overestimated over the Texas coastal region.

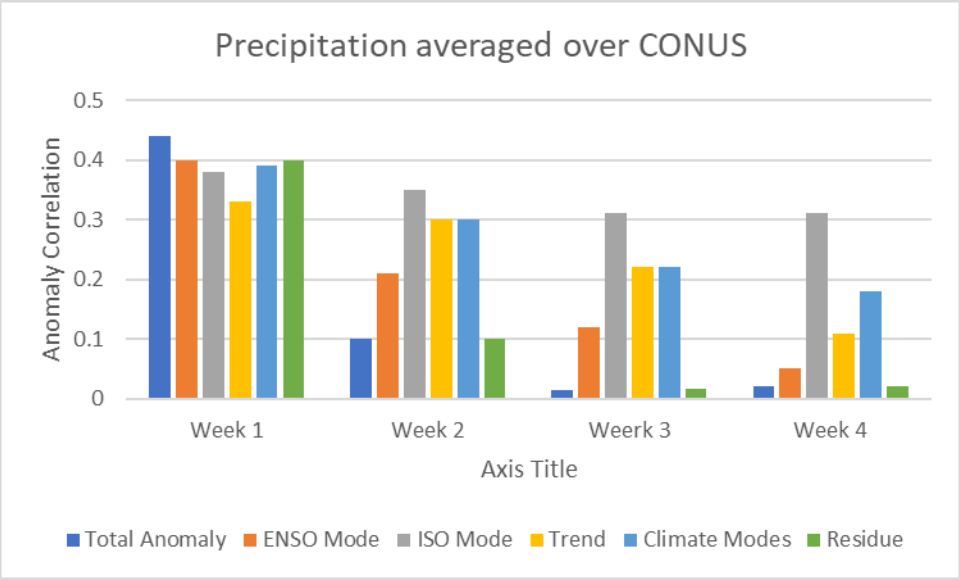
The analysis showed, however, that over land the sensitivity of this single channel to lower tropospheric water vapor is still high, and when used in combination with measurements in other microwave frequencies that are sensitive to upper tropospheric water vapor, accurate estimates of total water vapor are still possible. This study was motivated by concerns about the rapid development and deployment of 5G telecommunications technology, which operates

in frequencies very close to 23.8 GHz and which could pose a risk of interference in the passive microwave measurements.

Liu, Q.; Cao, C.; **Grassotti, C.; Lee, Y.-K.** How can microwave observations at 23.8 GHz help in acquiring water vapor in the atmosphere over land? *Remote Sens*. 2021, **13**, 489. https://doi.org/10.3390/rs13030489

(POC: C. Grassotti, christopher.grassotti@noaa.gov, Funding: JSTAR, PSDI JSTAR)

Sources of Subseasonal Predictability in UFS: A new study conducted collaboratively by V. Krishnamurthy and CISESS Scientist Cristiana Stan from GMU and a group of Unified Forecasting System (UFS) developers evaluated one of the first prototypes of the UFS Sub-seasonal to Seasonal (S2S) application with the goal of assessing the forecast skill of surface weather over CONUS. The study first focused on finding new sources of predictability in observations. Applying a data adaptive method known as the multi-channel singular spectral analysis (MSSA), observations reveal that in addition to ENSO and long-term climate trends, another mode, which manifests as an intraseasonal oscillation (ISO) with a period of about 50 days, influences the daily variability of precipitation and surface air temperature. This mode has a strong signature in the lower troposphere large-scale circulation over 180^0-15^0W in the latitudinal band between 20^0S – 41^0N, and projects well onto the surface air temperature and precipitation.



Spatial correlation of weekly-average precipitation over CONUS between CPCU and UFS reforecasts during June-September 2011- 2017. Adapted from Krishnamurthy et al. 2021.

The second part of the study, which compared the valuation of seven years of reforecasts produced by UFS Prototype 2 with observations, shows an overall good agreement between the climate modes simulated by the model and their observed counterparts. Some regional disagreements between the model and reforecasts still exists and they show at all Week 1 through Week 4 lags, but this kind of analysis offers some guidance on where the model development needs to be directed. The forecasts skill of the climate modes signal in precipitation over CONUS shows that beyond Week 2 the ISO mode is the leading source of predictability. While the anomaly correlation based on the daily anomaly is almost zero, the correlation for the ISO mode is slightly higher than 0.3. This result is a strong indication that more work needs to be done to unveil all sources of predictability hidden in the mist of chaos.

Krishnamurthy, V., J. Meixner, L. Stephanova, J. Wang, D. Worthen, S. Moorthi, B. Li, T. Sluka, and C. Stan, 2021: Sources of subseasonal predictability over CONUS during Boreal Summer. *J. Clim.,* in press, doi:10.1175/JCLI-D-20-0586.1.

(POC: Cristiana Stan, cstan@gmu.edu , Funding: WPO)

Workshops, Conferences, and Meetings

Satellite Improvement to Flood Monitoring and Forecasts: The NOAA Disaster Supplemental project on "Accelerating the Exploitation of Satellite Observations to Improve Flood and Inundation Monitoring and Forecasts," had a NESDIS team science meeting on February 5th. The participants included from SCSB and CISESS **R.Ferraro**, **Q.Zhang**, **F. Monaldo, and H. Meng**. Project milestones were reviewed, then the VIIRS reprocessed products for Mississippi River flood in the spring of 2019 were closely examined. It was found that over the 6 week period of the flood, only 20% of the daily Flood Inundation Maps (FIM) were under cloud-free conditions. Several team members presented progress on Synthetic Aperture Radar (SAR) retrievals of FIM, including the developing SAR data portal (remotesensing.earth – see figure). As part of the project, four JPSS era products will be reprocessed – rain rate, snowfall rate, precipitable water and soil moisture. These will be initiated on the FLOOD2 server that is now fully functional at CISESS. Lastly, the validation team provided updates on the Iowa flood event cases, including preliminary validation statistics.

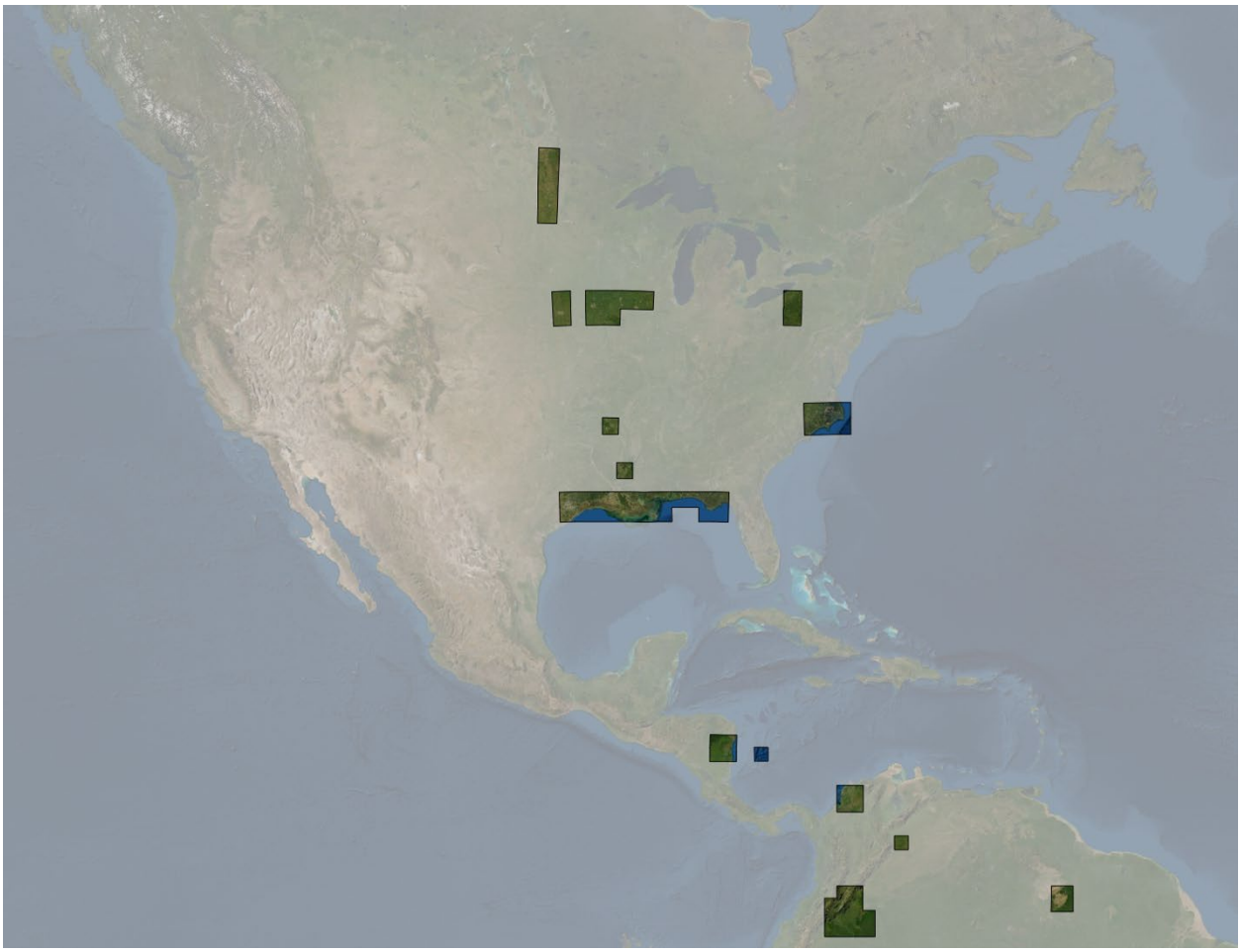


Figure: Target regions of the SAR Flood tool remotesensing.earth *developed by the SAR group (http://remotesensing.earth/visualize/)*

(POC: Qingyuan Zhang, qyzhang@umd.edu, Funding: NOAA Disaster Supplemental: Improving Forecasting of Hurricanes, Floods, and Wildfires)