

Weekly Report – November 14, 2025
Cooperative Institute for Satellite Earth System Studies (CISESS)
NOAA/NESDIS/STAR

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HIGHLIGHTS FOR NESDIS LEADERSHIP

Data and Information

Hurricane Melissa: A Catastrophic Natural Warning for the Caribbean

Hurricane Melissa, which made landfall in Jamaica in late October 2025, stands as a cataclysmic marker in the nation's history, surpassing all previous tropical cyclones in intensity at landfall. This rare and exceptionally powerful Category 5 storm delivered a devastating one-two punch of record-setting wind and catastrophic flooding, causing an estimated \$6 to \$7 billion in damage and exposing the extreme vulnerability of Caribbean Island nations. This event secured its place in history as the strongest hurricane to ever strike Jamaica directly. Beyond the destructive winds, heavy rainfall and a life-threatening storm surge of up to 13 feet caused widespread, prolonged flooding, especially in low-lying areas. Churning northward, Hurricane Melissa then struck Cuba as a major storm, making its second official landfall as a powerful Category 3 hurricane. While Cuba successfully executed a massive evacuation to prevent loss of life, the storm's torrential rainfall caused widespread and persistent inland flooding, confirmed by satellite monitoring data. While high winds caused extensive damage to over 60,000 homes and major infrastructure, the most challenging and long-lasting disaster was the flooding caused by the accompanying torrential rains.

CISESS Scientist Qingyuan Zhang and the NOAA STAR Flood team have produced flood inundation map (FIM) products showing the severe and protracted flooding caused by Hurricane Melissa, particularly in the coastal town of Black River in Jamaica, described as "ground zero" for this hurricane event, and the central-eastern part of Cuba, which includes the Cauto River Basin area (see the figure). Analysis of FIM products, available from the days surrounding the event, provided critical real-time monitoring. The use of Visible Infrared Imaging Radiometer Suite FIM data was instrumental in visualizing the extent of this specific type of disaster, confirming that the combination of storm surge and torrential rainfall was as destructive as the record-breaking wind speeds. Hurricane Melissa serves as a powerful and costly reminder of the urgent need for enhanced preparedness for future extreme weather events and resilient infrastructure in the Caribbean.

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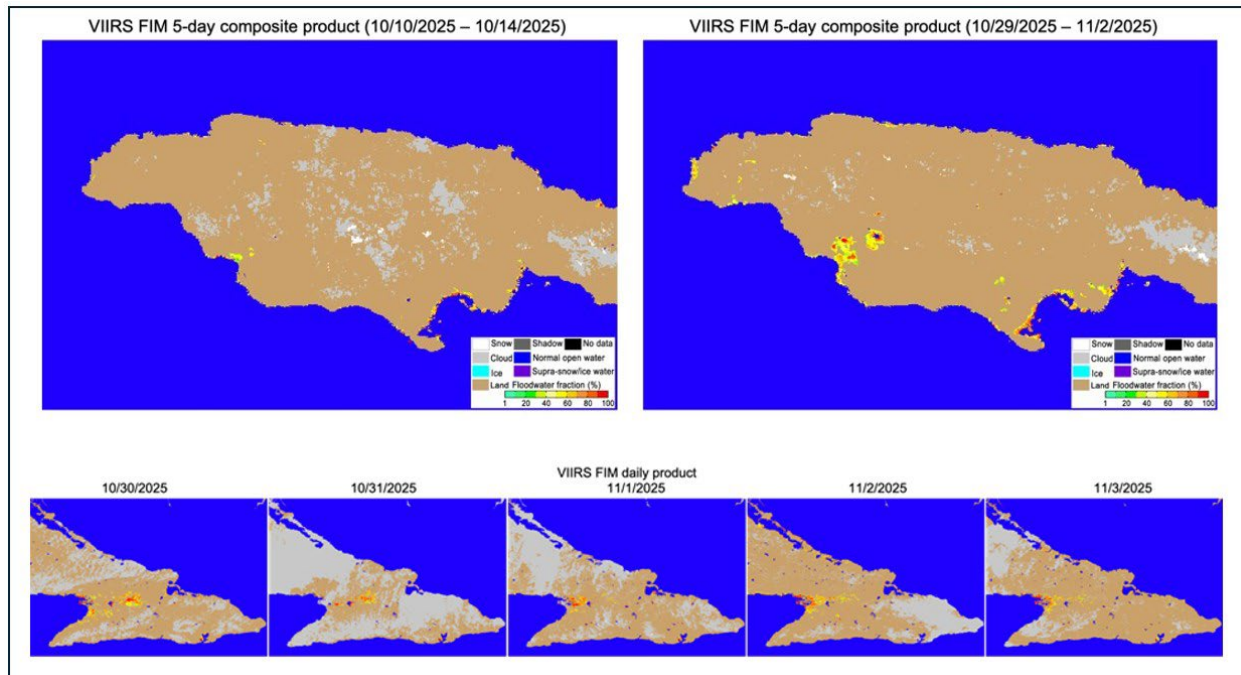


Figure: (Top panels) The top left figure is a VIIRS FIM 5-day composite product for Jamaica from 10–14 October 2025 before Hurricane Melissa made landfall. The top right figure is a VIIRS FIM 5-day composite product from 29 November to 2 November 2025 showing the slow recession of floodwaters, which complicated rescue and relief efforts in marooned communities. (Bottom panels) Hurricane Melissa made its second landfall in the early morning of 29 October 2025, on the southern coast of eastern Cuba, specifically near Chivirico in the province of Santiago de Cuba. VIIRS FIM daily products on 30–31 October and 1–3 November 2025 display the major flood risks in the Cauto River Basin and the slow recession of the floodwaters in this low-lying agricultural area. Cloud cover is shown in grey, and red/yellow colors indicate up to 100% flood coverage.

(Qingyuan Zhang, CISESS, qyzhang@umd.edu; Funding: IJJA & IRA)

SOCIAL MEDIA AND BLOG POSTS

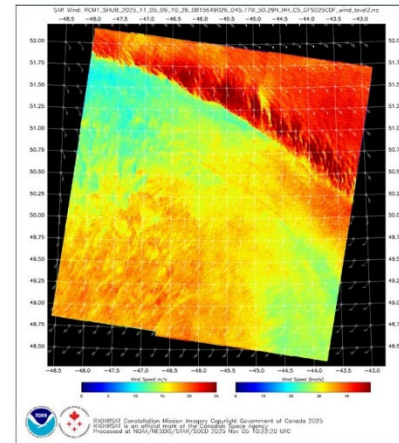
“The Rock” Bears the Brunt of an Extratropical Hurricane-Force Low

Jutting into the North Atlantic, Newfoundland is no stranger to harsh weather. Christopher Smith, CISESS Scientist and GOES-R Satellite Liaison for the NWS Weather Prediction Center and Ocean Prediction Center, [describes an early-November battering of “the Rock”](#) by an historic “weather bomb”. Formed along the Gulf Stream off the coast of North Carolina and moving toward the northeast, this ferocious fall storm deepened rapidly to the tune of ~3.2 [Bergeron](#), leading to winds of up to 75 mph and wave heights in excess of 30 feet, not to mention the

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heavy rain and locally heavy snowfall. Forty-eight hours later, it was “blowin’ a storm” again as another hurricane-force low cut across the province.

Figure: RADARSAT Constellation Mission-1 Synthetic Aperture Radar Winds imagery valid at ~0910 UTC 5 November 2025. This area is to the east of Fogo Island. RADARSAT Constellation Mission Imagery Copyright Government of Canada 2025. RADARSAT is an official mark of the Canadian Space Agency. Credit: NESDIS/STAR



(Christopher Smith, CISESS, csmith70@umd.edu; Funding: GOES-R PGRR)

PUBLICATIONS

Cross-calibrating Satellite Observations via Machine Learning

Citation: Moradi, Issac and Satya Kalluri, 2025: ML-driven cross-calibration of microwave and infrared instruments. *Mach. Learn.: Earth*, in press, <https://doi.org/10.1088/3049-4753/ae1cce>.

Summary: CISESS Scientist Isaac Moradi and NESDIS/NOAA’s Satya Kalluri have demonstrated how machine learning (ML) can effectively cross-calibrate satellite observations from different spectral domains, a key step toward improving the accuracy of global weather and climate data. Their study published in the journal *Machine Learning: Earth* uses data from the Cross-track Infrared Sounder and the Advanced Technology Microwave Sounder (ATMS) onboard NOAA-20 (N20) and Suomi National Polar-orbiting Partnership (NPP) satellites. The ML model predicts microwave measurements from infrared data with a bias below 0.1 K and a coefficient of determination exceeding 90%, showcasing the potential of data-driven methods to cross-calibrate diverse satellite observations. This work opens a promising pathway for future multi-sensor satellite calibration and enhanced environmental monitoring capabilities.

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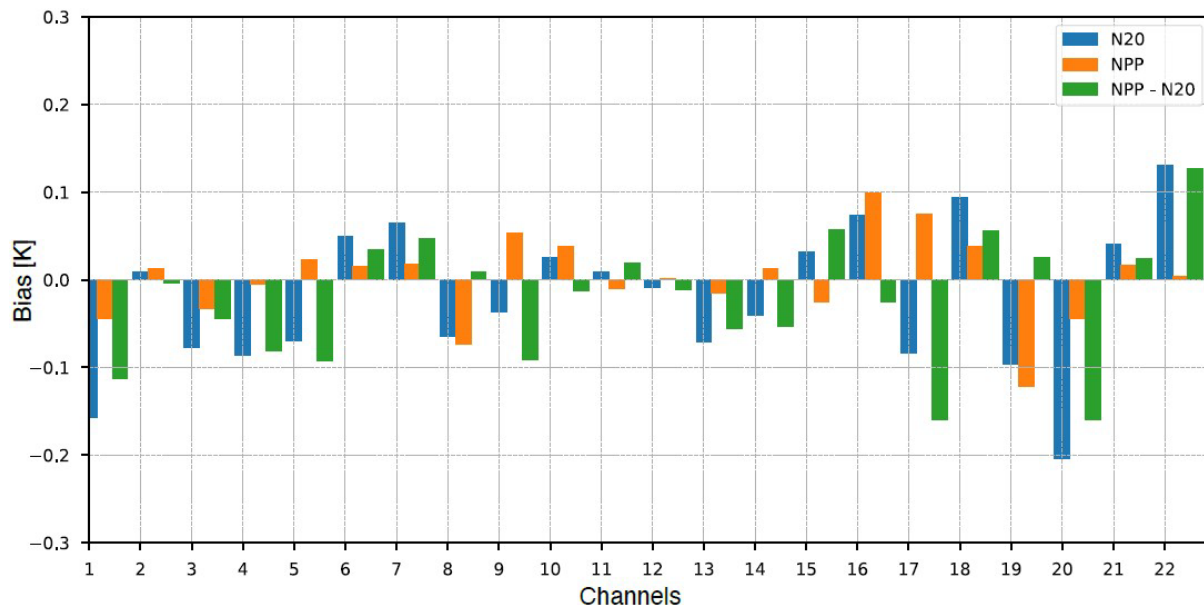


Figure: Mean difference between ML-predicted and observed values for ATMS onboard NPP (orange) and N20 (blue) as well as the double difference between the two instruments (green).

(Isaac Moradi, CISESS, imoradi@umd.edu; Funding: LEO)

OTHER

Seed Grant Mid-Term Report: *Machine Learning-based Hyperspectral Sensor Data Retrieval at the CISESS Remote Sensing Laboratory*

During the first phase of [this project](#), led by CISESS Scientist Xi Shao, unsupervised machine-learning (ML)-based classification algorithms tailored for hyperspectral missions were developed and tested using Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) Ocean Color Instrument (OCI) hyperspectral data. In particular, the Variational Autoencoder (VAE) convolutional neural network model was developed to enable unsupervised learning to efficiently encode hyperspectral data and extract spectral features. The VAE model was implemented to encode hyperspectral remote sensing reflectance spectra into a low-dimensional latent space. The spatial patterns learned by the first two latent dimensions of a VAE trained on global ocean surface data for July 2024 was examined. The mapped latent dimensions over global oceans revealed clear biogeographic structure, reinforcing the idea that hyperspectral data encodes rich information about ocean composition, which the VAE was able to extract in an unsupervised way. Next steps include the development of a pigment spectral database from in-situ measurements and supervised ML model development with this pigment spectral database for spectral feature classification from PACE OCI.

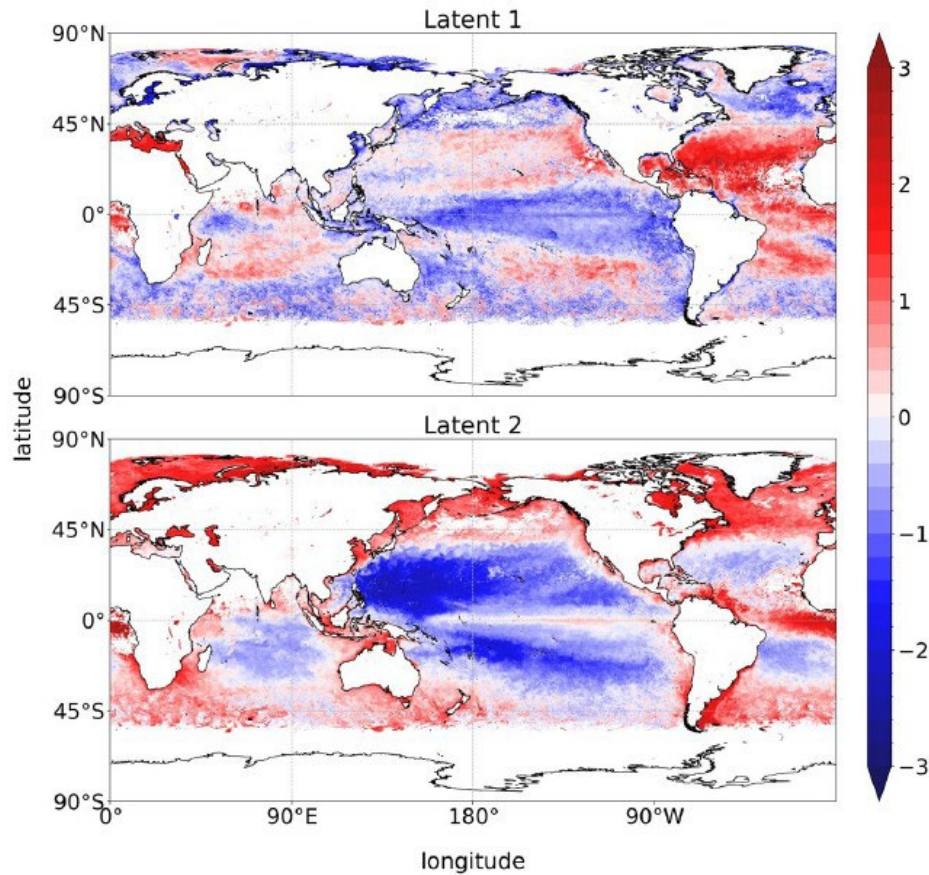


Figure: Spatial distribution of two leading latent dimensions extracted by VAE for July 2024. The maps show global ocean surface patterns represented by Latent 1 (top) and Latent 2 (bottom), with red and blue indicating positive and negative deviations, respectively, in the normalized latent space. Latent 1 was elevated in subtropical, saline gyres and reduced in fresher regions, while latent 2 increased from warm, oligotrophic waters to colder, productive zones, underscoring the ecological significance of the latent space.

(Xi Shao, CISESS, xshao@umd.edu; Funding: STAR)

(Maureen Cribb, CISESS, mcribb@umd.edu, Funding: CISESS Task I)