Weekly Report – December 05, 2025

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

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HIGHLIGHTS FOR NESDIS LEADERSHIP

Data and Information

2025 Tropical Storm Imelda: SAR FIM for Coastal Flood Mapping

The effective management of coastal hazards requires high-latency, all-weather observation capabilities. Storm Imelda, which impacted the United States Mid-Atlantic region in late September 2025, presented a distinct remote sensing challenge. Although the system remained offshore, its interaction with high pressure to the north generated a significant fetch, driving prolonged storm surge and wave run-up that coincided with perigean spring tides ("king tides"). Optical remote sensing platforms, such as the Visible Infrared Imaging Radiometer Suite (VIIRS), are often limited during such events. The monitoring of hydrological extremes in coastal environments is frequently compromised by the inability of optical sensors to penetrate the dense cloud shields associated with tropical cyclones. This necessitates the use of Synthetic Aperture Radar (SAR), which can image the surface regardless of solar illumination or atmospheric conditions. CISESS Scientist Qingyuan Zhang and the NOAA STAR Flood team have produced VIIRS flood inundation map (FIM) products and RAPID1.1-based SAR FIM products during the passage of Tropical Storm Imelda along the U.S. East Coast in late September/early October 2025.
The VIIRS FIM products for late September and early October 2025 reveals a critical failure mode of optical sensing in tropical cyclone environments. The extensive cloud shield (September 30 – October 2) associated with Imelda's circulation prevented the optical sensor from observing the surface. Consequently, the VIIRS products failed to capture the flood extent, rendering them ineffective for real-time tactical decision-making during this specific event (see figure). In contrast to VIIRS, the RAPID1.1-based FIM maps using Sentinel-1 data captured the flood extent from the Chesapeake Bay, Raleigh to Emerald Isle, to Bald Head Island.

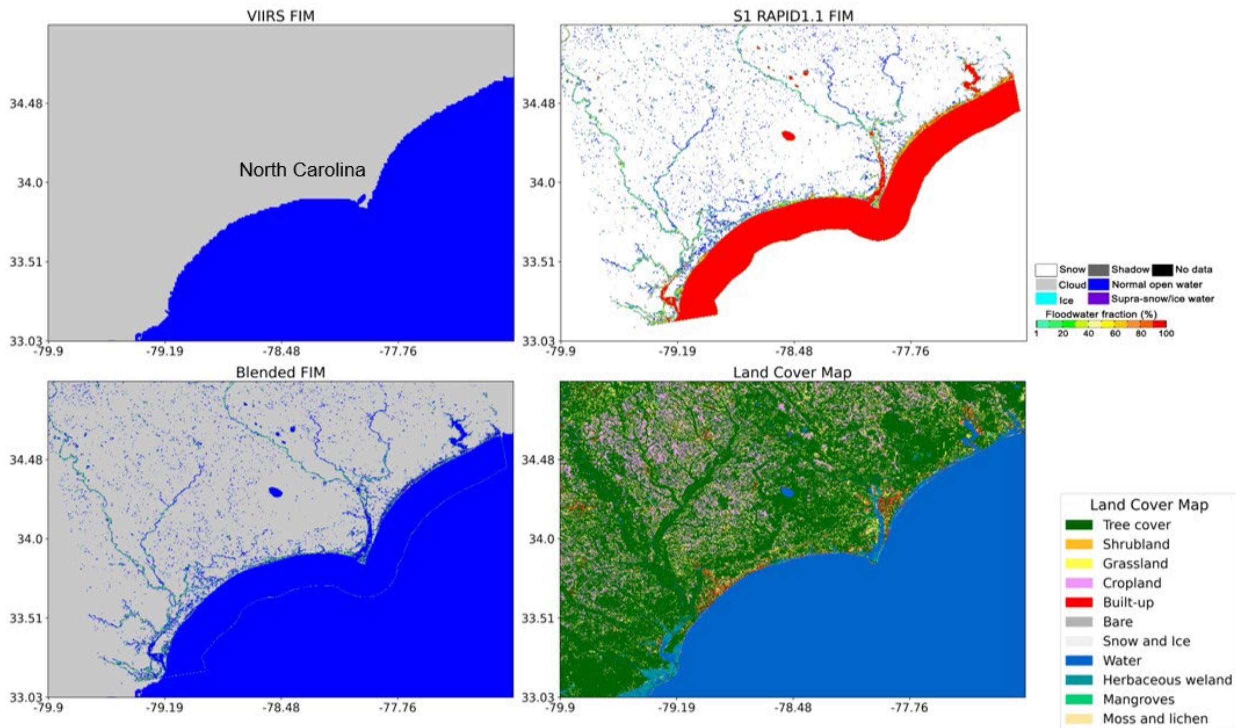

Figure: The NOAA STAR satellite flood inundation monitoring team routinely produce VIIRS flood inundation map (FIM) products and RAPID1.1-based SAR FIM products. This figure shows the VIIRS daily FIM product, the Sentinel-1 RAPID1.1-based SAR FIM product, and the blended FIM product along coastal North Carolina on 30 September 2025.

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

SOCIAL MEDIA AND BLOG POSTS

More Flooding Washes Over Texas Hill Country

Highly susceptible to flooding and still reeling from July's catastrophic flooding event, Hill Country prepared itself for another flash flooding event on 20 November 2025, reports Christopher Smith, CISESS Scientist and GOES-R Satellite Liaison for the NWS Weather Prediction Center and Ocean Prediction Center. Meteorological conditions were such that a large complex of slow-moving storms developed, crawling across Texas and dropping up to nine inches of rain in some places.

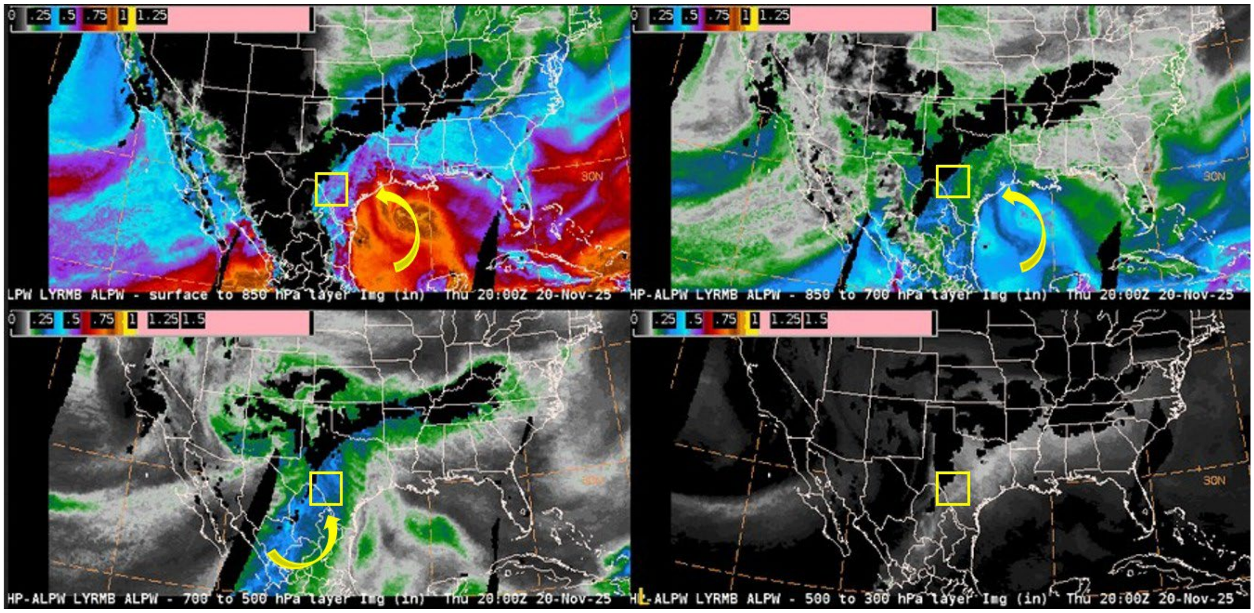

Figure: The NESDIS Advected Layered Precipitable Water (ALPW) product for different layers of the atmosphere (at 20 UTC on 20 November 2025), showing the influx of moisture from the surface to 700 mb from the Gulf (top images) and from the tropical East Pacific from 700 to 500 mb (bottom left image). The yellow box roughly outlines the Texas Hill Country.

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

PUBLICATIONS

Examining Salinity Retrievals from Different Spectral Perspectives
Citation: Laliberté, Julien, Guillaume Guénard, Jacqueline Dumas, Peter S. Galbraith, Sarah Hall, **David S. Trossman**, and Steve Vissault, 2025: Evaluation of satellite-based sea surface salinity derived from two distinct spectral domains over the coastal waters of the St. Lawrence Estuary and Gulf. *Front. Mar. Sci.*, **12**, 1672298, https://doi.org/10.3389/fmars.2025.1672298.
Summary: Satellite remote sensing of sea-surface salinity (SSS) in coastal areas is challenging because of the influence of water coming in from rivers, among other things. Brightness temperature (BT) and ocean color (OC) are two remotely sensed quantities that can be used to retrieve SSS, each with their particular retrieval strengths and limitations. David Trossman (no longer with CISESS) and colleagues assess these two retrievals of SSS against copious in-situ SSS measurements made in the St. Lawrence Estuary and Gulf of eastern Canada. They report that TB retrievals of SSS give the best picture of the offshore large-scale circulation, while OC retrievals of SSS do a better job at detecting key nearshore features and are more accurate than the TB-based SSS. They also looked into two case studies, namely, the noticeable freshwater pulse of 2017 and post-tropical storm Dorian of fall 2019, finding that overall, OC retrievals of SSS captured better these transient events. They conclude that there is a great need for higher

spatial resolution satellite salinity sensors and for new ways to leverage multiple satellite products to mitigate their respective limitations.

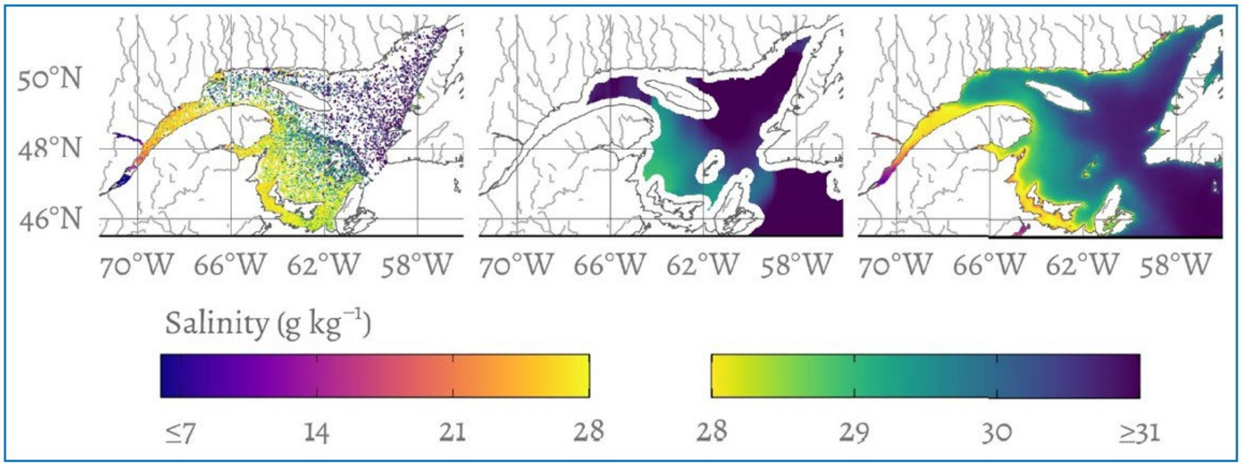

Figure: Qualitative comparison of the different products, showing the extent of data availability color-coded by salinity value. From left to right, in-situ measurements, salinity derived from brightness temperature, and salinity derived from ocean color.

OTHER

Seed Grant Mid-Term Report: *Retrieving Latent Heat from Passive Microwave Satellite Observations*

This project led by CISESS Scientist Veljko Petkovic aims to develop and demonstrate a data-driven approach for retrieving atmospheric latent heating profiles from passive microwave satellite observations. Goals outlined for the first half of the project have been met. A database needed for machine-learning (ML) training incorporating satellite and ancillary information, such as land cover, was created, involving the collocation of products like NASA's Global Precipitation Measurement Microwave Imager and Dual-frequency Precipitation Radar data and ERA5 reanalysis data. Model training and validation was initiated, where ML models, i.e., Extreme Gradient Boost (XGB) and Fully Connected Neural Network (FCNN) architectures, to predict latent heating profiles using passive microwave brightness temperatures as input features. Early results show that when trained for ocean surfaces, FCCN shows more skill than XGB in retrieving the vertical profile of latent heating from passive microwave radiances, agreeing better with radar-based estimates across both convective and stratiform precipitation events. Potential uncertainties stemming from hydrometeor phase complexity are being addressed through validation against radar and subsetting the training by surface type. This project also created an invaluable learning opportunity for a junior University of Maryland student from the Computer Science department, hired as a summer intern to work on this project.

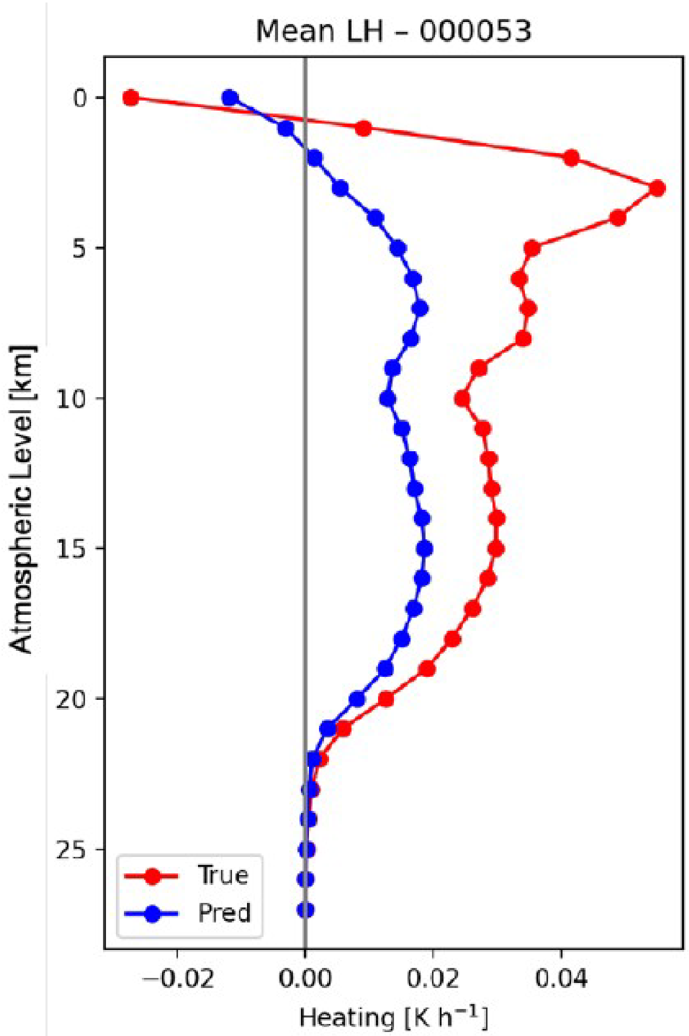

Figure: Predicted (FCCN, blue) versus observed (red) latent heating (LH) profiles. Observed global ocean means correspond to ~12 hours of Global Precipitation Measurement mission Dual-frequency Precipitation Radar observations.

(Veljko Petkovic, CISESS, veljko@umd.edu; Funding: LEO & STAR)

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