Weekly Report – October 25, 2024

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

Submitted by: Maureen Cribb
Email: mcribb@umd.edu
Phone: 301-405-9344

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TRAVEL AND MEETING REPORTS

SeungHyun Son Presents Posters at the Ocean Optics XXVI Meeting

The Ocean Optics XXVI Meeting was held in Gran Canaria, Spain during the week of 6 October 2024, organized by The Oceanography Society. CISESS Scientist SeungHyun Son attended in person, presenting his work on the water clarity of the Chesapeake Bay and algal blooms along Florida's west coast in two poster sessions.

The first poster titled "Spatial and temporal variations in water clarity in the Chesapeake Bay as revealed by satellite ocean color data" described using long-term satellite ocean color data to develop a semi-analytical Secchi disk depth (SDD) algorithm. The SDD is a measurement of how clear the water is, a critical water quality parameter useful for better understanding phytoplankton primary production and habitat suitability of submerged aquatic vegetation in the very productive waters of the Chesapeake Bay. This study demonstrated that the proposed algorithm could estimate SDD throughout the entire Chesapeake Bay, providing reliable assessments of water clarity (see figure).

In a second poster titled "Enhancing detection of harmful algal blooms using 1D-Convolution neural networks on OLCI-Sentinel-3 data", the focus shifted to detecting algal blooms along Florida's western coast. The model that Son and colleagues developed can pinpoint the start, peak, and decline of blooms, exemplified by the accurate detection of a bloom that occurred from July to December of 2018. This study marks a significant advancement in satellite applications for oceanography, offering a promising tool for ecological monitoring.

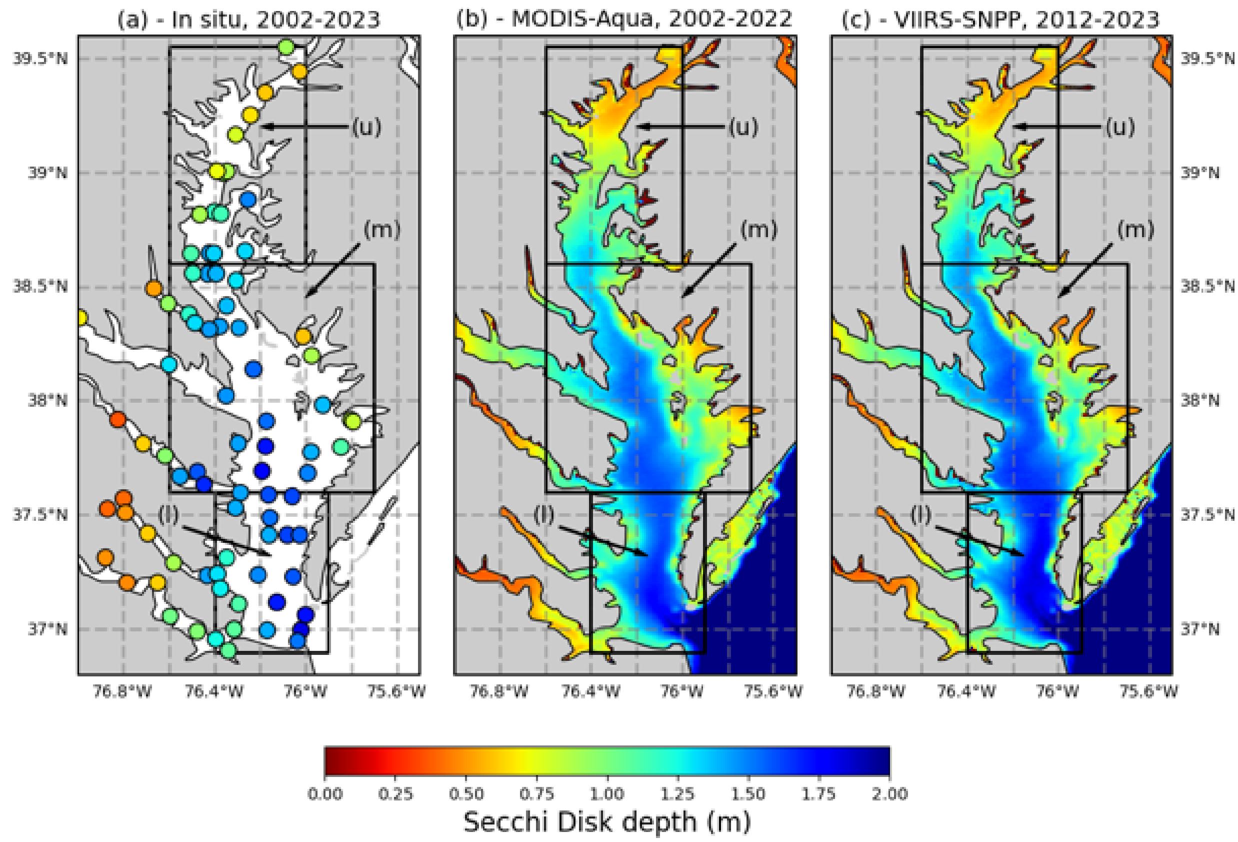

Figure: The new SDD algorithm applied to Moderate Resolution Imaging Spectroradiometer (MODIS) data (middle panel) and Visible Infrared Imaging Radiometer Suite (VIIRS) data (right panel). In-situ measurements are also shown. The spatial distributions of SDD agree well across the board.

(SeungHyun Son, CISESS, shson@umd.edu; Funding: ORS)

TRAINING AND EDUCATION

A Spooky, Electrifying Day in Virginia

On 19 October 2024, the CISESS Lightning and Virtual Reality (VR) research group, led by Dr. Guangyang Fang, participated in the annual Spooky Mad Science Expo at the Patrick Henry Recreation Center in Alexandria, VA. The team included CISESS intern students Damian Figueroa and Samuel Wiggins, along with visiting scholar Dr. Wenjuan Zhang. Together, they set up an outreach booth to promote lightning safety using VR technology.

At the booth, they presented a video demonstration of the CISESS Virtual Proving Ground and Training Center in mixed reality, featuring educational modules, such as the water cycle, lightning and cloud classification, a Faraday cage demonstration, and a gallery of spatial videos.

The group also offered an interactive VR game that explained the principles of the Faraday cage and lightning safety knowledge, which was especially popular with both students and parents.

The Spooky Mad Science Expo, an annual event since 2019, is organized by the Chrysalis Development Group with the support of volunteers from the Smithsonian Air and Space Museum, National Science Foundation, NASA, Boeing, American Chemical Society, University of Maryland, and many more. The event combines Halloween festivities with STEM science projects, creating a fun and educational experience for all attendees.

Figure: (Left photo) Dr. Guangyang Fang, Samuel Wiggins, Damian Figueroa, Yijin Guo (Dr. Wenjuan Zhang's daughter), and Dr. Wenjuan Zhang. Photo credit: Member of the public attending the Expo. (Right photos) Samuel Wiggins and Damian Figueroa in action at the Expo. Photo credit: Guangyang Fang.

(*Guangyang Fang, CISESS, gfang@umd.edu; Funding: GOES-R AWG, GOES-R PGRR)*

PUBLICATIONS

Examining the Impact of a New Observation Operator
Citation: Hoffman, Ross N., Hui Liu, **Katherine E. Luckens**, Kevin Garrett, and **Kayo Ide**, 2024: Assimilating atmospheric motion vector winds using a feature track correction observation operator. *Q. J. R. Meteor. Soc.*, online version, https://doi.org/ 10.1002/qj.4857.
Summary: Atmospheric motion over a wide area can be derived by tracing the movement of individual cloud or water vapor patterns in successive satellite images. These result in atmospheric motion vectors (AMV) that include information about wind speed and direction that have been shown to have a positive impact when assimilated in numerical weather prediction (NWP) systems. However, they have particular error characteristics that limit their

impact. These include wind errors due to height-assignment errors, additional wind-speed biases, and representation of motion in a thick layer rather than a single atmospheric level. Previously, CISESS Scientist Ross Hoffman and colleagues proposed a feature track correction (FTC) to account for these errors. The current study goes a step further, with Hoffman and CISESS Scientists Katherine Lukens and Kayo Ide and colleagues introducing a prototype FTC observation operator (FTC-OO) for implementation in the NOAA/NCEP data assimilation system. To assess the impact of this prototype operator, they conducted four observing-system experiments, namely, a base experiment, a base + FTC-OO assimilation, a base + *Aeolus* assimilation, and a BASE + FTC-OO + *Aeolus* assimilation. The European Space Agency's *Aeolus* is the first satellite to detect global wind profiles from near the surface to about 30 km in height. They report that, overall, improvements in forecast skill due to the FTC-OO were small and marginally significant. Using the FTC-OO method in the presence of the *Aeolus* observations only resulted in improvements for tropical geopotential height forecasts, which is not meteorologically important. On a hopeful note, they end their study by suggesting a number of ways that the FTC-OO could be implemented in the NOAA NWP system to positively impact forecasts.

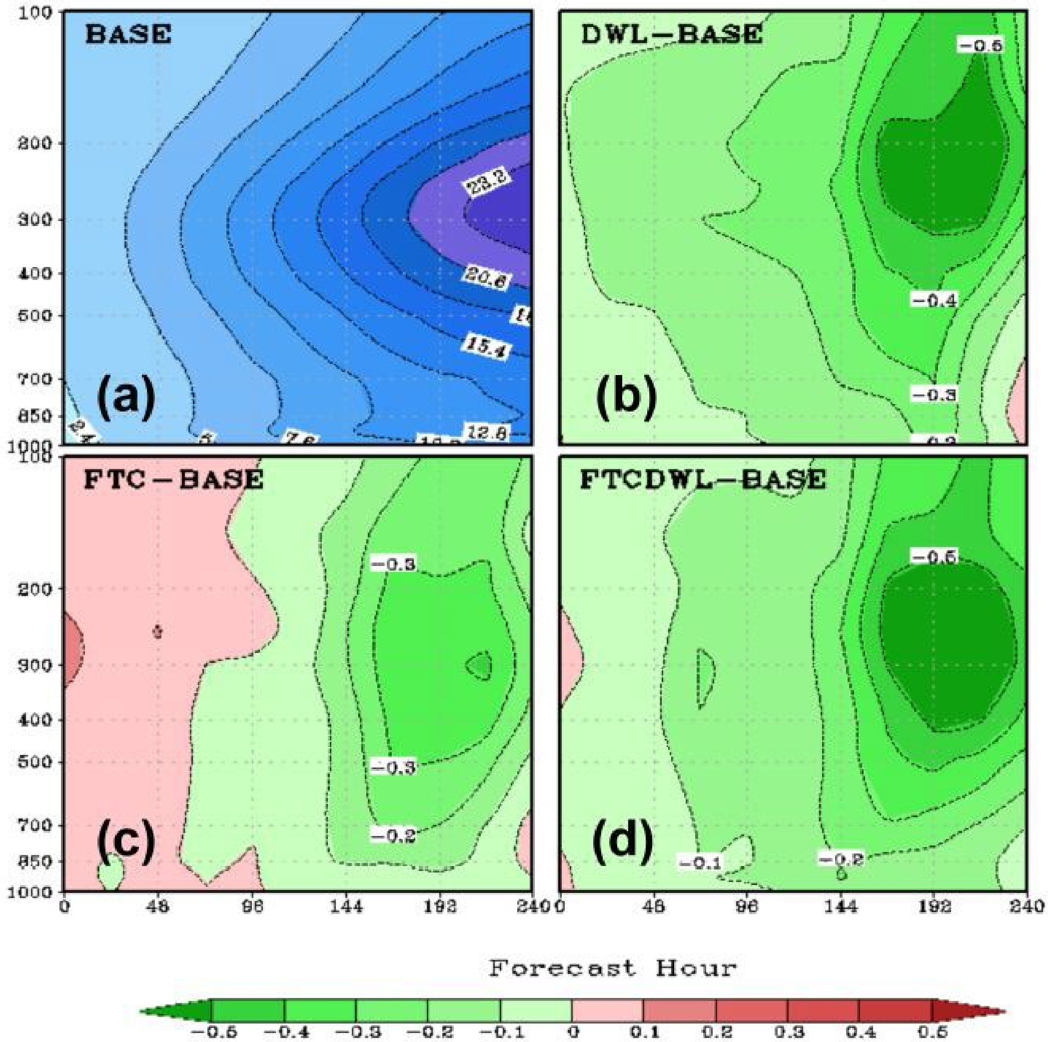

Figure: Southern Hemisphere extratropical forecast wind root-mean-square error (RMSE) statistics (unit: m/s) in time (unit: h) versus pressure (unit: hPa) cross-sections. Panel (a) shows forecast RMSE in the base experiment. Differences in the forecast RMSE with respect to the base are shown for (b) Aeolus, (c) FTC-OO, and (d) FTC-OO + Aeolus. Increasing darker green shades correspond to increasing negative values and, hence, increasing positive impacts.

(Ross Hoffman, CISESS, rnh@umd.edu, Funding: OSAAP Joint Venture; Katherine Luckens, CISESS, klukens@umd.edu, Funding: Disaster, JCSDA, OPPA; Kayo Ide, CISESS, ide@umd.edu, Funding: EMC)

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