

Weekly Report

CIRA
STAR/NESDIS
National Oceanic and Atmospheric Administration (NOAA)

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Products and Applications

Improvements to the National Hurricane Center (NHC) Gridded Tropical Cyclone forecast advisory Message (GTCM) surface wind model: Improvements to NHC's GTCM model were developed and made available to NHC for operational implementation for the 2026 Hurricane Season. The GTCM provides a 2-D surface wind field at hourly intervals using input from the NHC official forecast, which is a text product that includes the tropical cyclone (TC) center location, maximum wind and radii of 34, 50 and 64 kt winds out to 5 days. Improvements include a new wind gust parameterization, dynamic grid adjustment to account for large TCs, and a better method for fitting the NHC forecast input to the parametric vortex used by the GTCM. The GTCM is used as guidance by the National Weather Service for TC watches and warning and their gridded forecast products. The figure below shows an example of a cumulative swath of sustained wind and wind gusts for the landfall of Hurricane Helene (2024). (POCs: M. DeMaria, A. Brammer, Mark.DeMaria@colostate.edu, Alan.Brammer@colostate.edu, Funding NWS/STI and NOAA/JTTI).

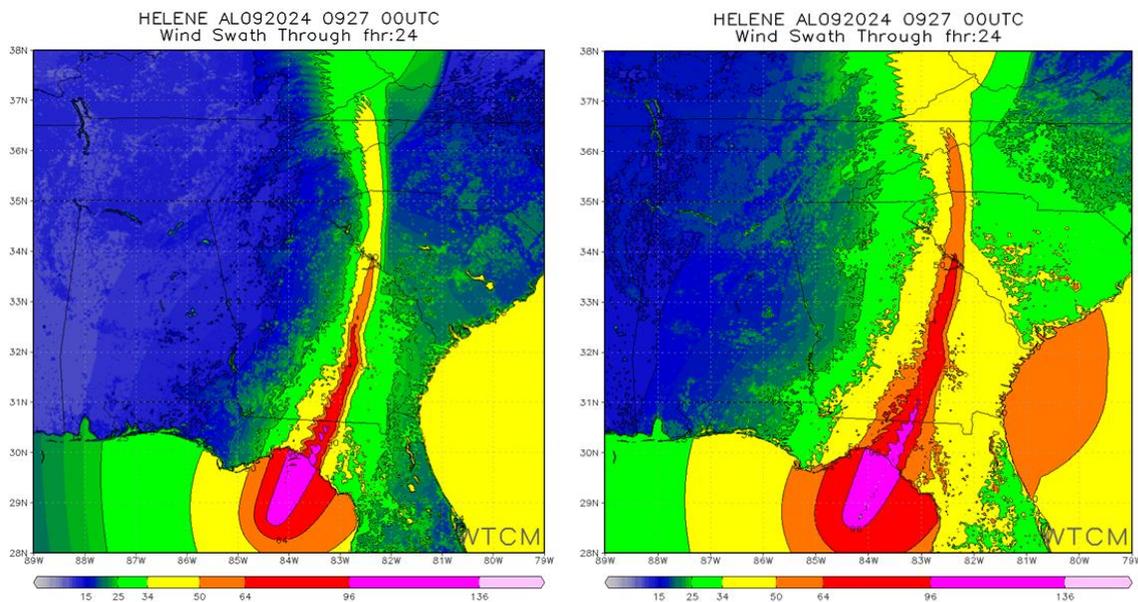


Figure Caption: (Left) Maximum sustained winds (kt) and (right) wind gusts (kt) for Hurricane Helene from the GTCM initialized at 00 UTC on 27 September 2024.

Annual updates and improvements to the National Hurricane Center (NHC) Windspeed

Probability algorithm: Updates to the error characteristics were delivered to NHC to incrementally improve the spread characteristics of the probability model in line with reductions in NHC track and intensity forecasts over the past 5 years. The algorithm was also improved to produce more realistic time-varying track characteristics for the 1000 individual ensemble members. This improvement maintains the spread characteristics of the ensemble but enables downstream applications to use the more realistic individual ensemble members. Additional updates also included incorporating track spread at hour 0 in the forecast, as well as the ensemble following the forecast storm size more closely.

(POCs: A. Brammer, Alan.Brammer@colostate.edu; J. Martinez, Jon.Martinez@colostate.edu; Funding NWS/STI and NOAA/JTTI).

Publications (Citation: followed by a short Summary: (Why & so what), & detailed summary):

Citation: Lagerquist, R., G. Chirokova, R. DeMaria, M. DeMaria, and I. Ebert-Uphoff, 2026: Center Fixing of Tropical Cyclones Using Uncertainty-Aware Deep Learning Applied to High-Temporal-Resolution Geostationary Satellite Imagery. *Weather and Forecasting*, **41**, 265-294, <https://doi.org/10.1175/WAF-D-24-0187.1>

Short Summary: Estimating the location of a tropical cyclone's (TC) surface circulation center is a critical first step in the TC-forecasting process. Current and future estimates of several TC properties, including the TC track, intensity, and structure, are highly sensitive to this initial location estimate, called the "center fix." This paper describes a new deep learning algorithm for center fixing called GeoCenter whose main input is an animated time series of infrared (IR) satellite imagery. GeoCenter performs competitively with existing methods for center fixing and provides skillful estimates of uncertainty in the TC-center location. GeoCenter has potential to improve TC analysis and forecasting and was designed to facilitate operational implementation.

Detailed Summary: Determining the location of a tropical cyclone's (TC) surface circulation center ("center fixing") is a critical first step in the TC-forecasting process, affecting current/future estimates of track, intensity, and structure. Despite a recent increase in automated center-fixing methods, only one such method [the Automated Rotational Center Hurricane Eye Retrieval, version 2 (ARCHER-2)] is operational, and its best performance is achieved when using microwave or scatterometer data, which are often unavailable. This paper

describes a new deep learning algorithm called GeoCenter, which relies only on a first guess position and geostationary infrared (IR) satellite imagery, which are available for all TC basins at high frequency (10 min) and low latency (<10 min) during both day and night. GeoCenter ingests an animation (time series) of IR images, including nine channels at lag times up to 4 h. The animation is centered at a “first guess” location, offset from the true TC-center location by 48 km on average and sometimes >100 km; GeoCenter is tasked with correcting this offset. On an independent testing dataset, GeoCenter achieves a mean/median/root-mean-square (RMS) error of 26.6/22.2/32.4 km for all systems, 24.7/20.8/30.0 km for tropical systems, and 14.6/12.5/17.3 km for category 2–5 hurricanes, respectively. These values are similar to ARCHER-2 errors with microwave or scatterometer data and better than ARCHER-2 errors when only IR data are available. GeoCenter also performs skillful uncertainty quantification (see figure below), producing a well-calibrated ensemble of 150 TC-center locations. Furthermore, all predictors used by GeoCenter are available in real time, which would make GeoCenter easy to implement operationally.

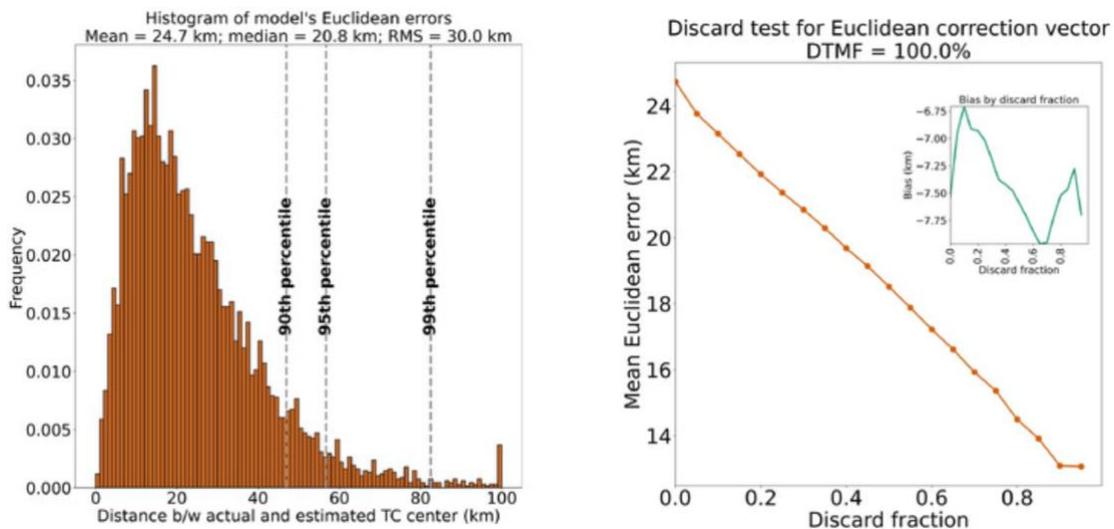


Figure Caption: In addition to estimating the position of the TC center, the AI model also provides uncertainty quantification for its TC position estimate. On left: Histogram of model’s track error. On right: Results from discard test confirm that the model’s own uncertainty estimate is well calibrated.

(POCs: G. Chirokova, R. DeMaria, M. DeMaria, I. Ebert-Uphoff, Galina.Chirokova@colostate.edu, Robert.DeMaria@colostate.edu, Mark.DeMaria@noaa.gov, iebert@colostate.edu. Funding: NOAA HPC).

Awards and Recognition

CIRA Group Achievement Award in NASA-CAMP2EX: Steve Miller and Jason Apke were recognized on 16 Feb 2026 with a Group Achievement Award for outstanding scientific achievements of the Clouds, Aerosol, and Monsoon Processes – Philippines Experiment (CAMP2Ex) airborne Earth Science Mission team in 2020. As part of CAMP2Ex, CIRA provided novel satellite imagery and products such as GeoColor and optical-flow-based winds from the Advanced Himawari Imager that were used in conjunction with high-resolution aircraft sounding data to characterize tropical convection outflow boundary properties. (POC: Steve Miller; steven.miller@colostate.edu; Jason Apke, CIRA, jason.apke@colostate.edu, funding: ONR-MURI, NASA)

Media Interactions and Request

Blog Posts and Social Media

Travel, Workshops, Conferences, and Meeting Reports

NOAA Fire Products at NASA INSPYRE Meeting: On February 18, CIRA scientists presented a summary of their fire products at the NASA Injected Smoke and PYRocumulonimbus Experiment (INSPYRE) Science Team Meeting. Kyle Hilburn was the lead presenter and gave the overall context of CIRA products for the INSPYRE mission. Curtis Seaman presented satellite imagery for fire/smoke detection and monitoring from GOES/ABI and JPSS/VIIRS. The imagery includes the Shortwave Albedo and NGFS Microphysics RGB for early detection of fires, the GeoColor and GeoFire for smoke any PyroCbs during daytime, Fire Temperature RGB and GeoFire for fire intensity, Day Fire RGB for fire detection and burned area estimates, and VIIRS Day/Night Band for fire and smoke detection at night. Jason Apke presented a suite of OCTANE optical flow-based products including speed/imagery blends, direction/imagery blends, and cloud-top cooling and divergence. Those products show convective initiation in strong wind shear, wind profile properties, cloud-top outflow properties related to deep convection intensity, and the intensity of mature PyroCBs. Kyle Hilburn presented WRF-SFIRE coupled fire forecasting initialized using NOAA NGFS fire detections. Coupled physical modeling approaches are important for determining which fires produce PyroCbs and why through quantifying feedbacks between fire intensity, plume dynamics, and atmospheric conditions. The suite of modeling products includes fuel moisture, active fire, winds, plume height, and smoke concentration. (POC: Kyle Hilburn, CIRA, kyle.hilburn@colostate.edu; Curtis Seaman, CIRA, curtis.seaman@colostate.edu; Jason Apke, CIRA, jason.apke@colostate.edu, Funding: NOAA BIL)

Training and Education Activities

JPSS Teletraining this week: J. Torres (CIRA) led a ***VIIRS Flood Map teletraining session*** on 17 February 2026; one forecaster from the North Central River Forecast Center (RFC) attended the session. (POC: Jorel Torres, CIRA, jorel.torres@colostate.edu; Funding: JPSS)

Future Meetings and Events (dates, meeting/event, location, staff involved)

Other

D. Hillger reviewed a manuscript on VIIRS cal/val for the *Journal of Applied Remote Sensing (JARS)* [POC: D. Hillger, CIRA, don.hillger@colostate.edu]