Weekly Report

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

Submitted by: Maranda Hutson
Date of Submission: 08 August 2025
Prepared by: CIRA and STAR contributors

Products and Applications

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

Citation: Ortland, S. M., and M. J. Pavolonis, 2025: An Object-Based Evaluation of Output from a Deep Learning Model for Thunderstorm Nowcasting. *Artif. Intell. Earth Syst.*, https://doi.org/10.1175/AIES-D-24-0071.1, in press. Early online release: 6 Aug. 2025

Short Summary: Radar-based definitions of thunderstorms in thunderstorm nowcasting models are imperfect due to thunderstorms' physical complexity. This paper demonstrates how an object-based evaluation of the outputs of a deep learning model for thunderstorm nowcasting can be used to understand how the target dataset and predictors selected for a deep learning methodology impact the reliability and applicability of the model from a forecasting perspective. The results can inform improved selections of the model's target and predictors and improve the scientific understanding of thunderstorms from a radar and satellite perspective. The application of object identification and tracking techniques to a deep learning model can be adapted for other machine learning models.

Detailed Summary: To evaluate characteristics of output values from machine learning models in bulk, an object-based technique is developed and applied to a deep learning model called ThunderCast. ThunderCast predicts the occurrence of midlatitude lightning-producing convection (thunderstorms) in the next 0-60 minutes from satellite observations. This paper uses the Tracking and Object-Based Analysis of Clouds (tobac) tool to identify tracks of objects comprised of ThunderCast predictions from 7 randomly selected days per month from April to September 2022. For each track, the maximum Multi-Radar Multi-Sensor (MRMS) radar reflectivity at −10°C (ThunderCast's target) is used to categorize the track as true (≥ 30 dBz at −10°C) or false (< 30 dBz at −10°C) positive. The tracks are further classified by the presence or absence of lightning from the Geostationary Lightning Mapper (GLM-16) or Earth Networks Total Lightning Network (ENTLN). Of the 17,054 tracks identified, 69.4% were true positive, but 62.5% of those true positives lacked associated GLM-16 or ENTLN lightning. A clear radar reflectivity threshold separating lightning-associated tracks from non-lightning tracks was not found. This demonstrates a limitation of using ground-based radar thresholds, indicative of

microphysical characteristics associated with thunderstorm electrification, as the target dataset in thunderstorm nowcasting models. Additionally, cloud-top properties from the 10.3 μm and 1.6 μm Advanced Baseline Imager (ABI) spectral bands are consistent with cloud-top glaciation. This suggests a need for additional predictors to reduce both false positives and true positives without associated lightning in ThunderCast's predictions. The object-based analysis technique presented here can be adapted for evaluating output from other machine learning models. (Funding: NOAA grant NA20NES4320003, POC: Stephanie Ortland, CIRA, stephanie.ortland@colostate.edu)

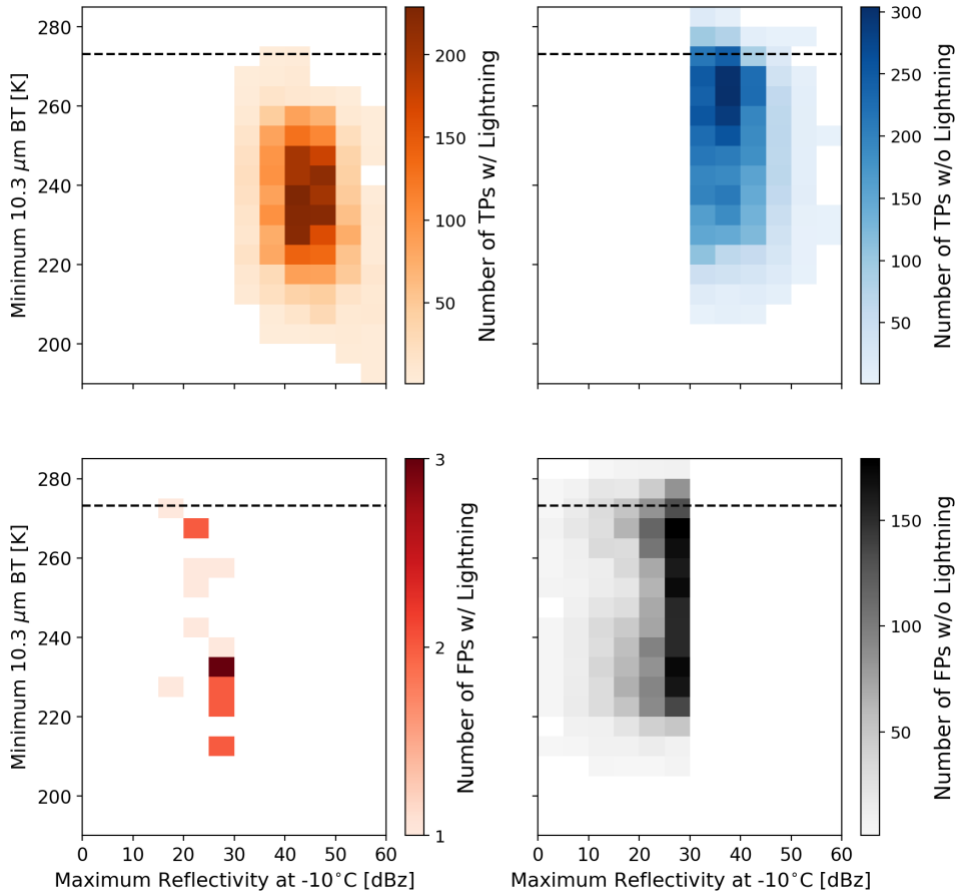

Fig. 11 of Ortland and Pavolonis (2025): *Two-dimensional histogram of the minimum 10.3 μm brightness temperature and the MRMS maximum radar reflectivity at −10°C for ThunderCast's tracks. The maximum radar reflectivities and the brightness temperatures are measured up to the end of the workflow for each track (Fig. 4), which occurs after GLM-16, ENTLN, and 30 dBz at −10°C were observed or the end of the track was reached. The tracks are labeled true positive (TP) and false positive (FP) with (w/) and without (w/o) lightning. The horizontal dashed line marks the freezing temperature of water.*

Awards and Recognition

Media Interactions and Request

Imagery Production Team Satellite Imagery of Hurricane Milton Used in New York Times and National Hurricane Center: In early August, the New York Times used a photo of the National Hurricane Center to discuss the current hurricane season. This photo included imagery made by the Imagery Production Team featured on displays in the National Hurricane Center. More information and links can be found below. (POC: D. Smith, dakota.smith@colostate.edu CIRA) Funding: GOES-R.

The New York Times: "A Fairly Quiet Hurricane Season May Be About to Ramp Up". https://www.nytimes.com/2025/08/07/weather/atlantic-hurricane-season-forecast-update-noaa.html?unlocked_article_code=1.cU8.5oQv.Pkk5xfBwN8Wy&smid=url-share

A Fairly Quiet Hurricane Season May Be About to Ramp Up

Experts at NOAA updated their prediction for the Atlantic on Thursday. Forecasters say there could be up to nine hurricanes before the end of November.

Share full article

Forecasters said they expect to see between five and nine hurricanes before the season ends on Nov. 30. Chandan Khanna/Agence France-Presse — Getty Images

Blog Posts and Social Media

Travel, Workshops, Conferences, and Meeting Reports

Training and Education activities

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

Other

Lander Ver Hoef reviewed a manuscript for Artificial Intelligence for the Earth Systems. (POC: L. Ver Hoef, lander.ver_hoef@colostate.edu)