Weekly Report

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

Submitted by: Maranda Hutson
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Prepared by: CIRA and STAR contributors

Products and Applications

GOES-19 Imagery Generation: Bill Line integrated GOES-19 L1b files into AWIPS and generated a range of single-band and multispectral imagery examples to be considered for the upcoming first light imagery release. (POC: B. Line, SMCD/APDB, bill.line@noaa.gov) Funding: PDRA (submitted to SMCD report)

Publications (Citation: followed by a short **Summary:** (Why & so what)**, & detailed summary):**
Citation: Eyring, V., Collins, W.D., and coauthors (including **M. McGraw**): Pushing the frontiers in climate modelling and analysis with machine learning. *Nat. Clim. Chang* (2024). doi:10.1038/s41558-024-02095-y.

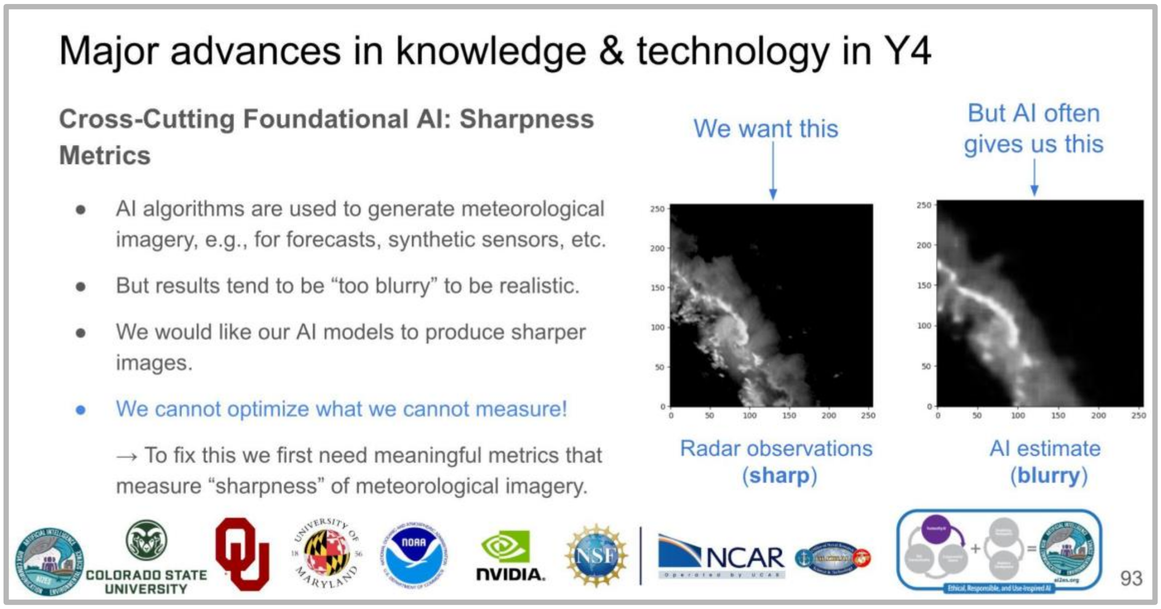
Summary: This Perspective article discusses the role of machine learning in climate modeling– including developing climate and Earth system models, analyzing climate modeling experiments, benchmarking climate data, and simulating extreme events. The computational and scientific challenges posed by machine learning approaches are also discussed.

Detailed Summary: This Perspective article discusses machine learning and its role in climate modeling and climate science. Specific topics and challenges, such as hybrid Earth system models; transfer learning and causal discovery; extreme event simulation, detection, and attribution; and subgrid scale parameterization are discussed, as well as possible opportunities to confront these challenges. Big-picture challenges in machine learning and climate modeling that cut across many topics are identified and discussed. These cross-cutting challenges include enforcing physical consistency upon purely data-driven models, and generating physically consistent and interpretable results; generalizing model predictions for out-of-sample and nonstationary prediction problems like those associated with climate change; understanding and quantifying uncertainty in climate projections; and understanding machine learning model decision making with tools such as explainable artificial intelligence, causal inference, and interpretable results. Finally, the article discusses the role of machine learning and artificial intelligence in the IPCC Seventh Assessment and the CMIP7 project; and the necessity of academic researchers, government scientists, and the private sector to work collaboratively to tackle these problems. (POC: M. McGraw, CIRA; marie.mcgraw@colostate.edu).

Awards and Recognition

Travel, Workshops, Conferences, and Meeting Reports

CIRA research presented to NSF panel at annual site review of AI institute (AI2ES): The fourth annual review of the *NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography (AI2ES)* took place virtually on Sept 4-5, 2024. It featured numerous presentations from CIRA on work (partially) funded by AI2ES. Imme Ebert-Uphoff presented on "Measuring Sharpness for Meteorological Imagery", including contributions from Lander Ver Hoef, Kyle Hilburn, and Jacob Radford. She also presented on "Using mathematical feature engineering and Explainable Boosting Machines to detect convection in satellite imagery", which featured work by Lander Ver Hoef, Nathan Mitchell, Kristina Moen, and Kyle Hilburn. Kate Musgrave presented on various AI topics for tropical cyclones, primarily featuring work by Kathy Haynes (synthetic passive MW) and Marie McGraw (PCA analysis of synthetic passive MW for science discovery) and with contributions from Imme Ebert-Uphoff. Chuck White presented his work on "Super Resolution of GOES-16 ABI Channels to a Common High Resolution" with contributions from John Haynes, Yoo-Jeong Noh and Imme Ebert-Uphoff. Jacob Radford demonstrated several visualization tools he developed for weather forecasting applications, including contributions from Jebb Stewart (NOAA-GSL). Other presenters from CSU included Elizabeth Barnes (ATS) and Jason Stock (CS). The CSU team received many compliments for both the amount and quality of their work. The team is proud of the many contributions to this AI institute and to the development of resources for the meteorological community for the effective and responsible use of AI. (POC: I. Ebert-Uphoff, iebert@colostate.edu; K. Musgrave, Kate.Musgrave@colostate.edu; M. McGraw, marie.mcgraw@colostate.edu; K. Haynes, Katherine.Haynes@colostate.edu; Jacob Radford, jacob.radford@noaa.gov; Chuck White, Charles.White@colostate.edu; Kyle Hilburn, kyle.hilburn@colostate.edu; all CIRA. Funding: NSF and NOAA)



A slide from the AI2ES NSF review providing motivation for the CIRA-led research effort on "Measuring sharpness of meteorological imagery"

Joint Typhoon Warning Center (JTWC) visitor at CIRA: James Darlow from JTWC visited CIRA on Aug 27 - 29. The purpose of the visit was technical exchange on displaying satellite products in AWIPS2, and coordination on the development and demonstration of new CIRA satellite products to JTWC forecasters. The visit was very productive and included implementing several new CIRA GEO and LEO satellite products in AWIPS2 systems with JTWC localization, meeting with students from the Atmospheric Science Department, and multiple meetings with CIRA scientists. POC: Galina Chirokova, Mark DeMaria, Galina.Chirokova@rams.colostate.edu, Mark.DeMaria@colostate.edu, CIRA. Funding: TROPICS, GOES-R, JPSS, ONR

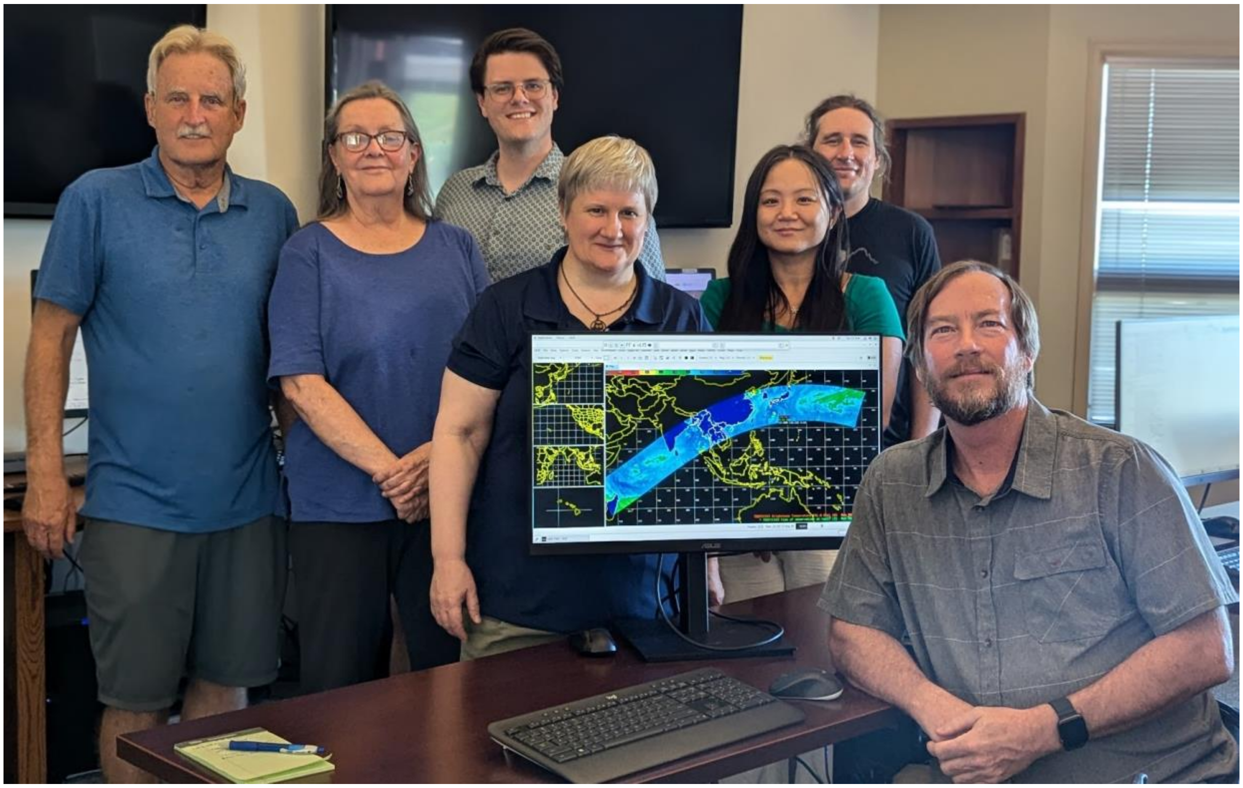


Figure. James Darlow and CIRA scientists at the CIRA weather lab during James' visit. The AWIPS2 display shows a new TROPICS full swath brightness temperature product displayed in JTWC AWIPS2 localization. The new TROPICS displays allows forecasters to see the timestamp for each scanline that enables determining precise TC center location from TROPICS data.

Training and Education activities

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

Other