Weekly Report

RAMMB / CIRA
Cooperative Research Program Division (CoRP)
STAR/NESDIS
National Oceanic and Atmospheric Administration (NOAA)

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Products and Applications

New Products added to CIRA SLIDER: New products were recently added to geostationary Satellite sectors (GOES-16 and -18, Himawari-9, GEO-KOMPSAT-2A, Meteosat-9 and -10) on the CIRA SLIDER. New products developed by Bill Line (CoRP/RAMMB) include the Sea Spray RGB, Blowing Snow RGB, Dust-Fire RGB, and Color Vision Deficiency (CVD) Dust RGB (see figure below). Also added were the Tropical Airmass RGB and Severe Storms RGB, from EUMETSAT, and the Next Generation Fire System (NGFS) Microphysics RGB. (POC: B. Line, CoRP/RAMMB, Curtis Seaman, Zayd Amundson, CIRA bill.line@noaa.gov, Curtis.Seaman@colostate.edu, zayd.amundson@colostate.edu) Funding: PDRA, GOES-R

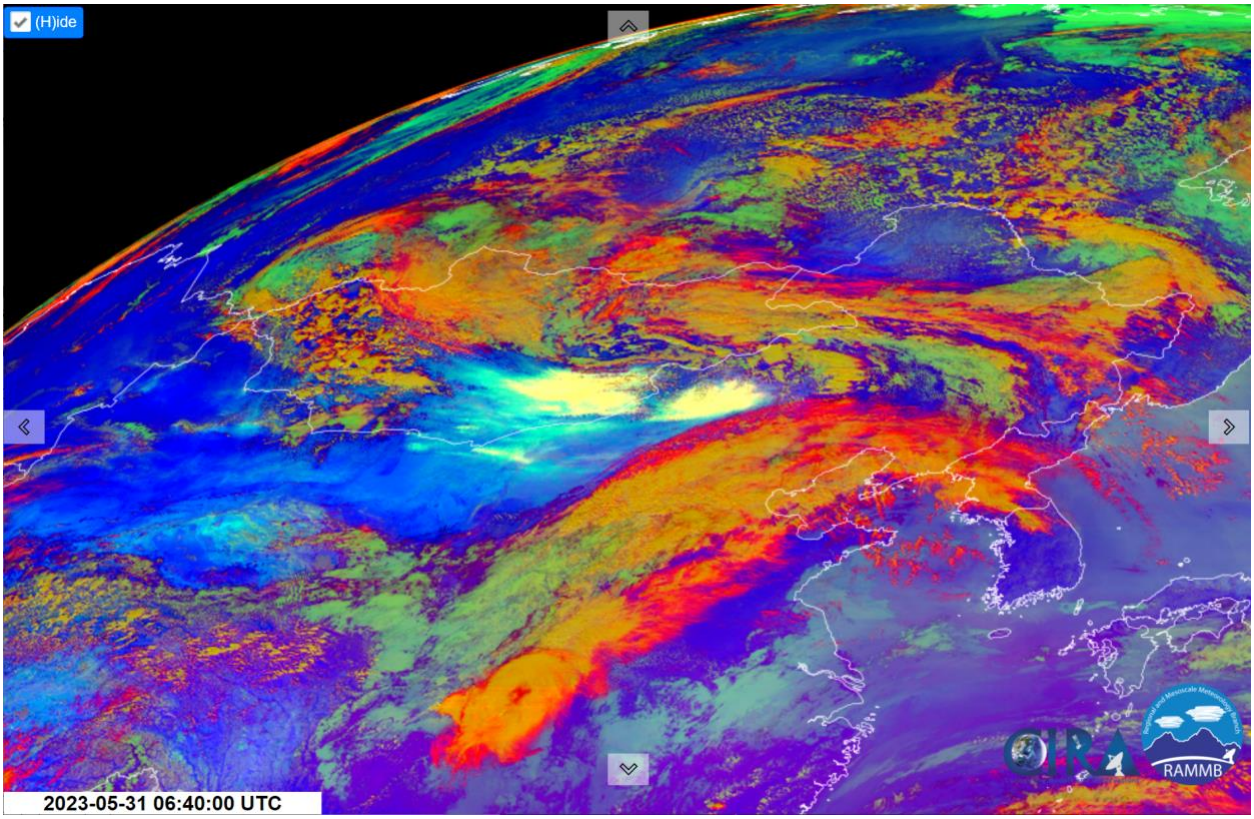

Figure: 0640 UTC 31 May 2023 GEO-KOMPSAT-2A CVD Dust RGB, captured from CIRA SLIDER. The product highlights blowing dust as bright green to yellow across southeast Mongolia and northeast China, over the blue of the clear-sky background surface and amongst reds and dull greens of clouds. The CVD Dust RGB was designed to provide people with color vision deficiency (CVD) a more appropriate option for detecting blowing dust.

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

Citation: Chen, Xiaomin, Christopher M. Rozoff, Robert F. Rogers, Kristen L. Corbosiero, Dandan Tao, Jian-Feng Gu, Falko Judt, Eric A. Hendricks, Yuqing Wang, Michael M. Bell, Daniel P. Stern, Kate D. Musgrave, John A. Knaff, and John Kaplan, 2023: Research advances on internal processes affecting tropical cyclone intensity change from 2018–2022. *Tropical Cyclone Research and Review,* https://doi.org/10.1016/j.tcrr.2023.05.001 **Summary:** As the title indicates this paper provides an overview of research advances on internal processes affecting tropical cyclone intensity change from 2018–2022, which was a topic discussed at the WMO's International Workshop on Tropical Cyclones-10 in December of 2022. Topic areas included surface and boundary layer processes; TC internal structure and microphysical processes; and, radiation interactions with TCs. Recent studies better frame the uncertainty in the surface drag and enthalpy coefficients at high wind speeds. These parameters greatly impact TC intensity and it is therefore important that more direct measurements of these boundary layer parameters are made. To complement research in the boundary layer, in-depth observational field campaigns and assiduous data analysis have made significant headway into verifying theory and modeling studies of intensification processes related to TC vortex alignment, efficient latent heating distributions, and overall 3D structure. In addition, substantial efforts have also been made to better understand the intricate roles radiative processes play in TC evolution and intensity change. Finally, some promising progress has been made in the development of time-dependent theories of TC intensification and the predictability of the internal TC intensity change.
(POC: John Knaff, STAR, Kate Musgrave, CIRA John.Knaff@noaa.gov, Kate.Musgrave@colostate.edu, (970) 279-1611, Funding: PRDA, HFIP).

Citation: Knaff, J. A., C. R. Sampson, A. Brammer, and C. J. Slocum, 2023: A Rapid Intensification Deterministic Ensemble (RIDE) for the Joint Typhoon Warning Center's Area of Responsibility. Wea. Forecasting, https://doi.org/10.1175/WAF-D-23-0012.1. **Summary:** The Rapid Intensification Deterministic Ensemble (RIDE) is an operational method used to estimate the probability of tropical cyclone rapid intensification in the Joint Typhoon Warning Center's Area of Responsibility. Inputs to RIDE are current intensity, storm latitude, intensity change forecasts from seven routinely available operational deterministic models of intensity change, and the number of those models exceeding their individual 90th percentile of intensity change. Deterministic model inputs come from four numerical weather prediction models, two statistical–dynamical models, and one purely statistical model. In RIDE, logistic regression combines the deterministic inputs to form a probabilistic rapid intensification forecast model. RIDE then also generates deterministic intensity forecasts from these probabilistic forecasts that serve as forecaster guidance and as input to intensity consensus aids. Results based on a year of

independent verification suggest good reliability and discrimination with a general tendency to underpredict rapid intensification events, but with few false alarms (Figure below). The RIDE model provides one of eight methods for predicting probabilities of rapid intensification used in an operation consensus forecast of rapid intensification at JTWC. And, since RIDE is fairly independent with low false alarms, it is a stodgy but important consensus member.

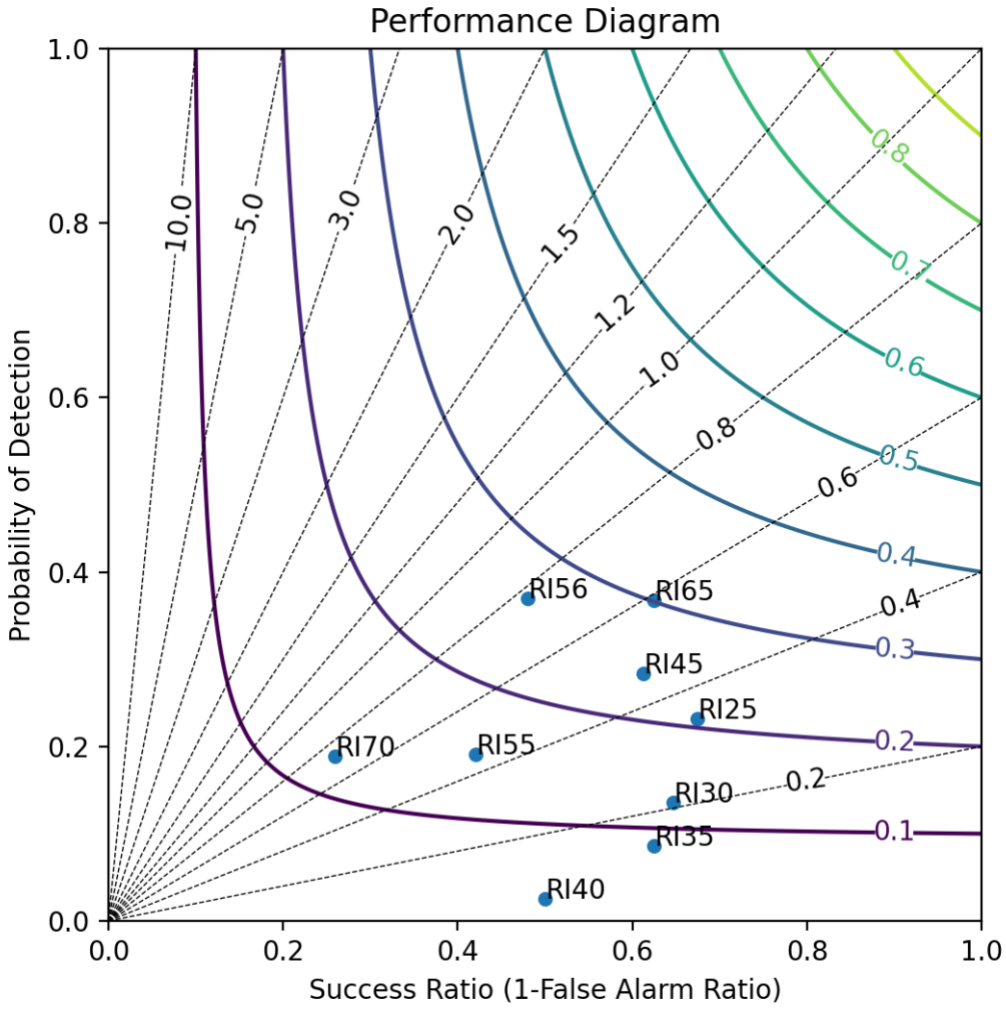

Figure. Performance diagram for RIDE deterministic forecasts made in JTWC's Area of Responsibility during the 2021 season. Shown are rapid intensification thresholds of 25, 30,35,& 40 kt/24h (RI25, RI30, RI35, RI40), 45 and 55 knots in 36 h (RI45, RI55), 55 and 70 knots in 48 h (RI56, RI70), and 65 knots in 72h (RI65).

(POC: John Knaff, Christopher Slocum STAR, Alan Brammer, CIRA John.Knaff@noaa.gov, Christopher.Slocum@noaa.gov, Alan.Brammer@colostate.edu, (970) 279-1611, Funding: PDRA, ONR).

Citation: Hilburn, K., A., 2023: Understanding Spatial Context in Convolutional Neural Networks using Explainable Methods: Application to Interpretable GREMLIN. *Artif. Intell. Earth Syst.*, https://doi.org/10.1175/AIES-D-22-0093.1. **Summary:** Convolutional neural networks (CNNs) are very powerful tools for interpreting and processing satellite imagery. However, the black box

nature of their predictions makes them difficult to interpret, compromising their trustworthiness when applied in the context of high-stakes decision-making. This paper develops an interpretable version of a CNN model, showing that it has similar performance as the original CNN. The interpretable model is analyzed to obtain clear relationships between inputs and outputs, which elucidates the nature of spatial context utilized by CNNs to make accurate predictions. The interpretable model has a well-defined response to inputs, providing guarantees for how it will respond to novel inputs. The significance of this work is that it provides an approach to developing trustworthy AI models. (POC: Kyle Hilburn, CIRA/CSU, kyle.hilburn@colostate.edu) Funding: GOES-R.

Awards and Recognition

Media Interactions and Requests

Canada Wildfire and Smoke Imagery in the News: Satellite visuals of the Canada wildfires and smoke were featured across many news and media organizations during the first week of June. These animations were created by Dakota Smith and posted in CIRA's Satellite Library. The coverage included a NYTimes.com front page feature and an article in the Washington Post that highlighted multiple animations. Dakota was also interviewed as part of the Washington Post's coverage. More information and links can be found below. (POC: S. Miller, Steven.Miller@colostate.edu, D. Smith, CIRA, dakota.smith@colostate.edu) Funding: GOES-R

New York Times: "Noxious Air in the U.S. Pushes South and West", https://www.nytimes.com/live/2023/06/08/us/canada-wildfires-air-quality-smoke

New York Times: "Roughly 150 fires were active in Quebec alone…", https://twitter.com/nytimes/status/1666591652688060416

Hundreds of blazes are producing dangerous smoke that has clouded a large swath of the U.S. Pierre Markuse/Sentinel Hub

AP News: "Millions breathing hazardous air as smoke from Canadian wildfires streams south over US", https://apnews.com/article/wildfires-canada-quebec-3291016eaa4905177c90feae02a139c5

BBC News: "How far can wildfire smoke travel", https://www.bbc.com/news/live/world-us-canada-65835239/page/3

Washington Post: "Satellite images show wildfire smoke creeping from Canada across U.S.", https://www.washingtonpost.com/weather/2023/06/08/canada-wildfire-smoke-satellite-images/

ABC News: "Air pollution cloaks eastern US for a second day. Here's why there is so much smoke", https://abcnews.go.com/US/wireStory/canada-wildfires-lead-air-quality-alerts-us-stay-99878447

ABC News: "World News Now", https://www.youtube.com/watch?v=YeTok0U2fZA

ABC News: "Canada wildfires: 80 million under air quality alerts as result of the ongoing wildfires", https://www.youtube.com/watch?v=psxAnaKaLC8&t=82s

CBS News: "When will the wildfire smoke clear? Here's what meteorologists say", https://www.cbsnews.com/news/canada-wildfire-smoke-how-much-longer-air-quality-improve-forecast/

Space.com: "Satellite photos show US East Coast engulfed by smoke from Canadian wildfires", https://www.space.com/satellite-photos-canada-wildfire-smoke-us-east-coast

Yahoo! News: "Satellite Imagery Shows Canada Wildfires Smoke Spreading Across North East States", https://uk.news.yahoo.com/satellite-imagery-shows-canada-wildfires-022053571.html

Yahoo! News: " Flames From 'Raging' Quebec Wildfires Visible in Satellite Images", https://uk.news.yahoo.com/flames-raging-quebec-wildfires-visible-155005764.html

CBS News: "Maps, satellite images show Canadian wildfire smoke enveloping parts of U.S. with hazardous air", https://www.cbsnews.com/news/canadian-wildfire-smoke-maps-air-quality-alerts/?intcid=CNI-00-10aaa3b

The Guardian: "Canada wildfires smoke: climate change 'accelerated conditions', says New York mayor as Canada battles more than 400 blazes - as it happened", https://www.theguardian.com/world/live/2023/jun/07/air-quality-alerts-canada-wildfires-smoke-live-updates

The Atlantic: "Photos: Smoke From Canada's Wildfires Drifts South", https://www.theatlantic.com/photo/2023/06/canada-wildfire-smoke-air-quality-alerts-new-

york/674317/

The Messenger: "Eerie Satellite Photos Show Scale of Canadian Wildfire Smoke in the US", https://themessenger.com/news/eerie-satellite-photos-show-scale-of-canadian-wildfire-smoke-in-the-u-s

CBC News: "Wildfire smoke prompts air quality alert for Chatham-Kent, Sarnia-Lambton", https://www.cbc.ca/news/canada/windsor/wildfire-smoke-chatham-kent-sarnia-lambton-1.6867833

Philadelphia Inquirer: "Millions breathing hazardous air as smoke from Canadian wildfires streams south over US", https://www.inquirer.com/news/nation-world/canada-wildfires-smoke-air-quality-20230607.html

AccuWeather: "How long will the bad air quality continue in NYC, Northeast?", https://www.accuweather.com/en/health-wellness/how-long-will-the-bad-air-quality-continue-in-nyc-northeast/1537537?utm_source=twitter&utm_campaign=breakingweather&utm_medium=social
KPRC 2 Click2Houston: "Flames from 'raging' Quebec wildfires visible in satellite images", https://www.youtube.com/watch?v=C8hJFGqD_xs

The Independent: "Satellite footage shows smoke from Canada wildfires barreling towards US", https://www.youtube.com/watch?v=YMuhLIw3Xgw

Blog Posts and Social Media

New Satellite Liaison Blog Post: Bill Line published a blog post titled "Quebec Wildfire Smoke". The post highlights the Quebec wildfire hotspots and smoke evolution in several ABI and VIIRS Imagery products, and discusses how various NWS offices leveraged satellite imagery during the dense smoke event across the northeast US. See Figure below. The link to the post can be found here. (POC: B. Line, CoRP/RAMMB, bill.line@noaa.gov) Funding: PDRA

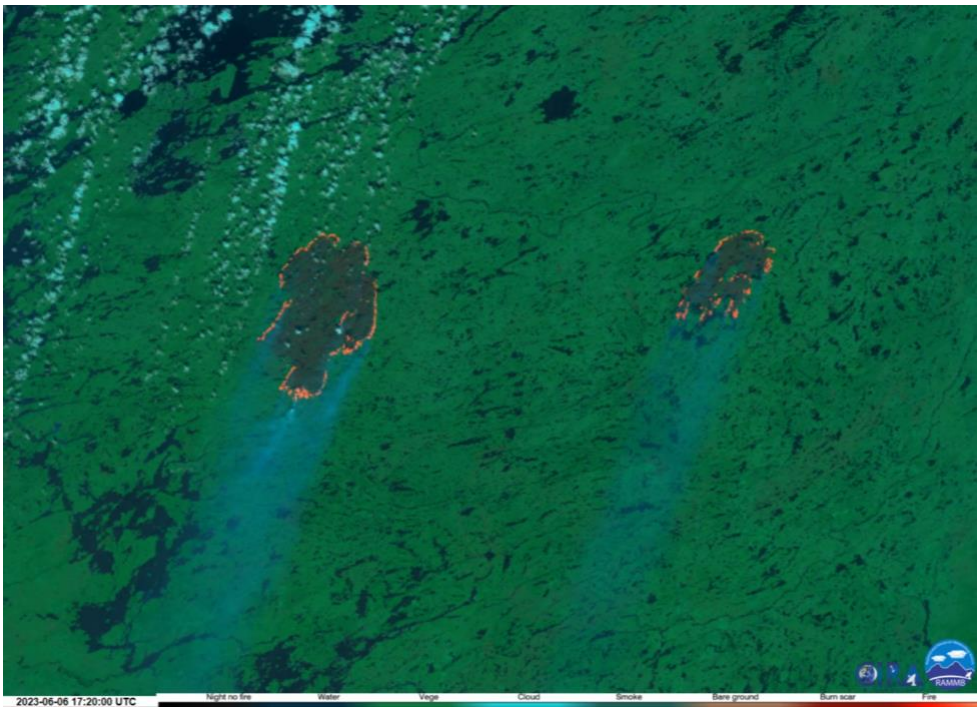

Figure: 06 June 2023 VIIRS Day Fire RGB over Quebec, capturing the details of two large wildfires, including the hot spots (red), burn scars (dark brown), and smoke plumes (blues).

Travel, Workshops, Conferences, and Meeting Reports

RAMMB and CIRA Participation in the HWT Satellite Convective Applications Experiment: Bill Line (CoRP/RAMMB) and Jason Apke (CIRA) participated as product developers, by remote, in week 2 of the 2023 Hazardous Weather Testbed Satellite Convective Applications Experiment in Norman, OK. Jason and Bill led the evaluation of the OCTANE products, which included Speed and Direction fields. OCTANE is an algorithm that retrieves dense cloud-drift/feature motions (or the optical flow) from ABI imagery, and is designed to highlight storms developing in strong shear and cloud-top divergence signals of mature strong convection. Bill also led an evaluation of a few experimental ABI RGBs. The experiment will run for three weeks this year, with the first week being the only in-person week, and the following two weeks being virtual. The first week had seven NWS forecasters participate in-person, while the two virtual weeks will have seven and eight forecasters, respectively. The demonstration plan can be found here, and forecaster blog posts from the experiment can be found here. (POC: B. Line, CoRP/RAMMB, Jason Apke, CIRA, bill.line@noaa.gov, jason.apke@colostate.edu) Funding: PDRA

Training and Education activities

Python Training: C. Slocum provided Scientific Python Programming Basics training to interns at the 2023 CSU Atmospheric Science NSF "Research Experience for Undergrads Site in Earth System

Science". The training covered how to work with geophysical datasets available from NCEI in the Python programming language and statistical packages for basic data exploration. (POC: C. Slocum, StAR, Christopher.Slocum@noaa.gov; Funding: PDRA)

JPSS Teletraining this week: J. Torres led an ***Introduction to Near-Constant Contrast (NCC)*** teletraining session on 5 June 2023; one user from the Weather Forecast Office (WFO) - Omaha, NE attended the session. (POC: J. Torres, CIRA, Jorel.Torres@colostate.edu; Funding: JPSS)

New VISIT Blog: J. Torres produced a blog that highlights the fires in the Canadian province of Nova Scotia. The blog also mentions how the VIIRS Day Fire RGB and the VIIRS Active Fires product can be utilized for fire monitoring applications. Users can access the blog here: https://rammb.cira.colostate.edu/training/visit/blog/index.php/2023/06/02/nova-scotia-fires/ (POC: J. Torres, CIRA, Jorel.Torres@colostate.edu; Funding: JPSS)

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

Other

Manuscript Review: Y. Zhu reviewed a manuscript that was submitted to *International Journal of Disaster Risk Reduction.* (POC: Y. Zhu)