Weekly Report – January 19, 2024

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

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HIGHLIGHTS FOR NESDIS LEADERSHIP

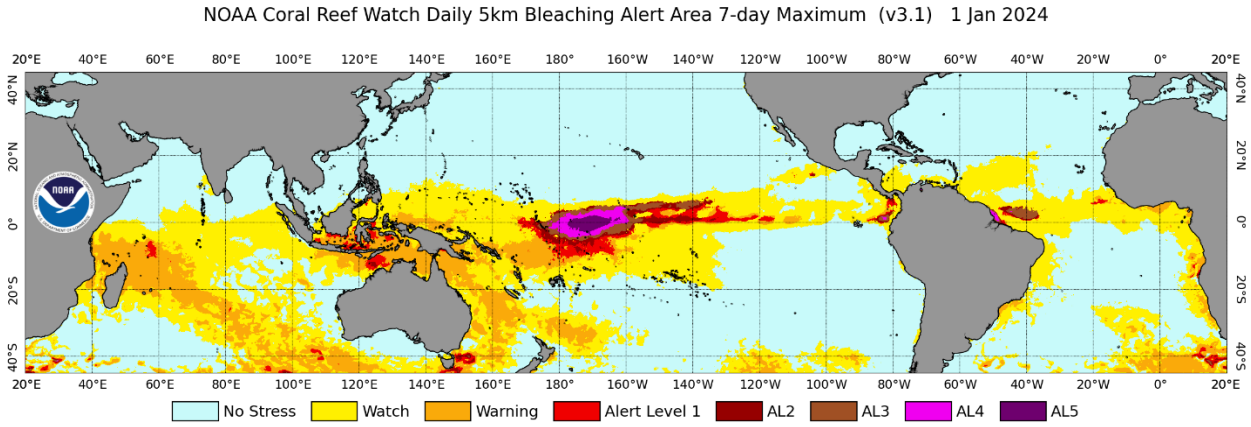
Use-Inspired Science

NOAA Coral Reef Watch (CRW) Introduces New Coral Bleaching Alert Levels

As NOAA Coral Reef Watch (CRW) and its partners have been reporting for months, extreme marine heatwaves (MHWs) engulfed much of the eastern tropical Pacific (ETP) and wider Caribbean in 2023. Many Caribbean reefs experienced historically high heat stress that started much earlier (one-to-two months) and was sustained for much longer than normal. July 2023 was Earth's warmest July on record, and it was the fourth month in a row of record-high global SSTs. Anomalously high SSTs in the ETP and wider Caribbean were more extensive in 2023 than any other year in the satellite record. Individual coral reefs reached record levels of heat stress up to 12 weeks ahead of previously recorded peaks. Heat stress puts immense pressure on fragile yet vital tropical ecosystems such as coral reefs, mangrove forests, and seagrass meadows. In the Florida Keys National Marine Sanctuary, the shallow coral patch reef, Newfound Harbor (a *Mission: Iconic Reefs* site) accumulated heat stress of almost three times the previous record, with this occurring six weeks ahead of what was predicted. This trend occurred not only along Florida's Coral Reef, but also at reefs throughout the Caribbean basin. On December 15, 2023, NOAA CRW implemented a revised coral bleaching heat stress category system for its daily global 5km satellite coral Bleaching Alert Area product. The extreme accumulations of bleaching heat stress in 2023, which were confirmed by in-water observations, necessitated the introduction of additional Bleaching Alert Levels. This development is a refinement of the original system that only used Bleaching Alert Levels 1 and 2. As shown below, the new Alert Levels 3-5 provide important, added detail, for when the magnitude of extreme heat stress exceeds the threshold of Alert Level 2 conditions. NOAA CRW understands that coral bleaching response plans, action plans, and restoration plans around the world rely on its Bleaching Alert Levels, to assist with planning and implementation of work by in-water monitoring and management networks. Any actions managers would have taken previously at Bleaching Alert Level 2 still apply. However, discussions may need to occur now, among coral reef stakeholders in many areas, regarding appropriate actions for their networks, when the extreme Bleaching Alert Levels 3-5 are predicted.

Stress Level	Definition	Potential Bleaching and Mortality
No Stress	HotSpot <= 0	No Bleaching
Bleach Watch	0 < HotSpot < 1	
Bleaching Warning	1 <= HotSpot and 0 < DHW < 4	Risk of Possible Bleaching
Bleaching Alert Level 1	1 <= HotSpot and 4 <= DHW < 8	Risk of Reef-Wide Bleaching
Bleaching Alert Level 2	1 <= HotSpot and 8 <= DHW < 12	Risk of Reef-Wide Bleaching with Mortality of Heat-Sensitive Corals
Bleaching Alert Level 3	1 <= HotSpot and 12 <= DHW < 16	Risk of Multi-Species Mortality
Bleaching Alert Level 4	1 <= HotSpot and 16 <= DHW < 20	Risk of Severe, Multi-Species Mortality (> 50% of corals)
Bleaching Alert Level 5	1 <= HotSpot and 20 <= DHW	Risk of Near Complete Mortality (> 80% of corals)

NOAA Coral Reef Watch's revised coral bleaching heat stress category system for its daily global 5km satellite coral Bleaching Alert Area product, introducing new Bleaching Alert Levels 3-5.



NOAA Coral Reef Watch's daily global 5km satellite coral Bleaching Alert Area product, of January 1, 2024, showing accumulated heat stress on tropical coral reefs around the world.

(Jacqueline De La Cour, CISESS & STAR/SOCD, jacqueline.shapo@noaa.gov, Funding: NOS)
This item was submitted in the SOCD Weekly Report.

MEDIA INTERACTIONS AND REQUESTS

CISESS Scientist Daile Zhang Interviewed by IEEE Spectrum Magazine

CISESS scientist Daile Zhang was interviewed by the IEEE Spectrum Magazine on a newly published paper "Assimilation of GOES-R Geostationary Lightning Mapper Flash Extent Density Data in GSI 3DVar, EnKF, and Hybrid En3DVar for the Analysis and Short-Term Forecast of a Supercell Storm Case" by Rong Kong from University of Oklahoma and her team. The study implemented NOAA's Geostationary Lightning Mapper (GLM) data in their data assimilation framework. Zhang

explained how the GLM data is currently used in the operational forecast and the potential to help data assimilation in NOAA's models. The full article is at https://spectrum.ieee.org/severe-weather-forecast-lightning.
(Daile Zhang, CISESS, dlzhang@umd.edu, Funding: GOES-R AWG, GOES-R PGRR, NOAA ROSES and CISESS Seed Grant.)

PUBLICATIONS

Using Deep Learning to Categorize the Vertical Structure of Precipitation
Citation: Arulraj, Malarvizhi, Veljko Petkovic, Ralph R. Ferraro, and **Huan Meng**, 2023: Precipitation vertical structure characterization–a feature-based approach. *J. Hydrometeor.*, **24**(12), 2281–2297, https://doi.org/10.1175/JHM-D-23-0034.1.
Summary: This study used six months of the 3D spatially dense precipitation data from the Multi-Radar Multi-Sensor (MRMS) network as the training dataset for a deep-learning-based neural network. This deep-learning system was then used to identify different patterns or regimes in the vertical structure of precipitation systems based on clustering methods. It found 18 regimes within the data that went beyond the usual classifications of convective vs. stratiform and precipitation phases. These regimes are now being studies to determine what we can learn from them about precipitation systems.
(Malar Arulraj, CISESS, marulraj@umd.edu; Funding: JSTAR)

New Satellite Error Simulator Released
Citation: Yang, John Xun, Yalei You, William Blackwell, **Cheng Da, Eugenia Kalnay, Christopher Grassotti,** Quanhua (Mark) Liu, **Ralph Ferraro, Huan Meng**, Cheng-Zhi Zou, Shu-Peng Ho, **Jifu Yin, Veljko Petkovic,** Timothy Hewison, Derek Posselt, Antonia Gambacorta, David Draper, Sidharth Misra, Rachael Kroodsma, and Min Chen, 2024: SatERR: A community error inventory for satellite microwave observation error representation and uncertainty quantification, *Bull. Amer. Meteor. Soc.*, **105**(1), E2316–E2335, https://doi.org/10.1175/BAMS-D-22-0207.1.
Summary: Satellite observations different types of errors:

- Measurement errors,
- Operator errors,
- Representativeness errors, and
- Preprocessing errors.

When testing of new satellites, models, and data assimilation is done, simulated errors are used. These are usually based on empirical errors, which do not represent the full range of errors. To fix this problem, CISESS Scientist John Xun Yang has collaborated with other NOAA and CISESS scientist to develop an error inventory simulator, the Satellite Error Representation and Realization system (SatERR). SatErr generates errors from root sources and forward propagates them through radiance and science products (see figure below). The system allows

different errors to be quantified and tested. This is an open source code on GitHub, and its initial focus is on microwave sensors from the major NOAA satellites.

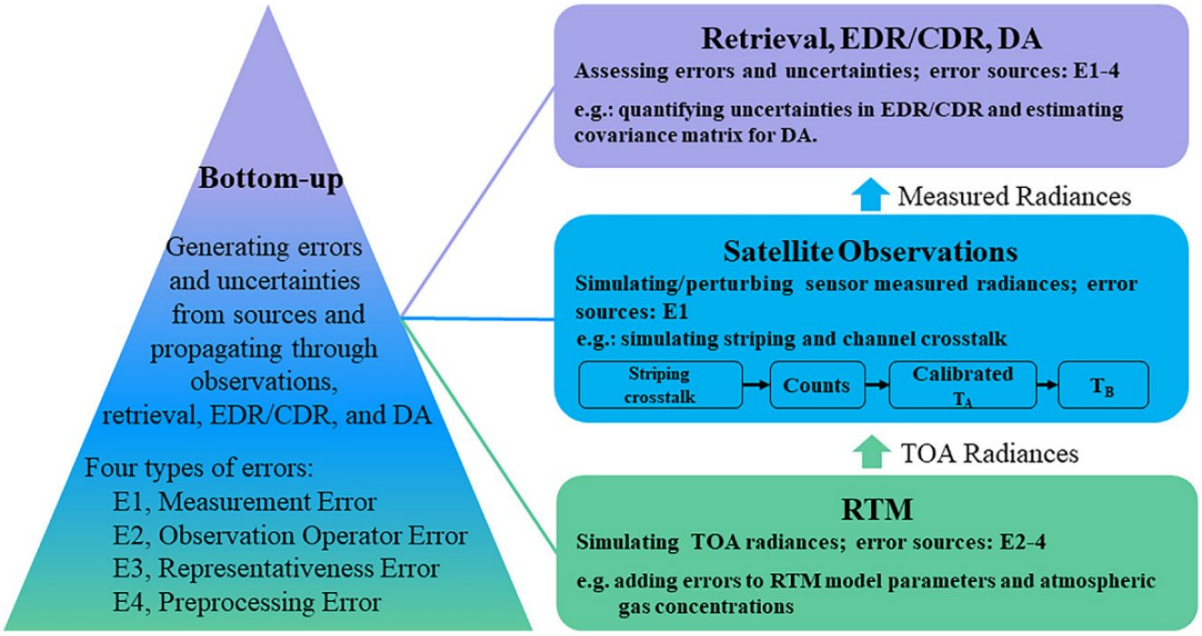


Figure: Schematic of the different process steps in SatERR.
(John Xun Zhang, CISESS, xun.yang@noaa.gov; Funding: JSTAR)