Weekly Report – June 06, 2025

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

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HIGHLIGHTS FOR NESDIS LEADERSHIP

Use-Inspired Science

Presenting the Surface Ocean CO_2 Atlas Database Version 2025

CISESS Scientist Alex Kozyr announces the latest version of the Surface Ocean CO_2 Atlas (SOCATv2025) data synthesis product published by NCEI/OCADS and the International SOCAT Group. The annual mean growth rate of atmospheric carbon dioxide (CO_2) was 3.77 ppm (µmol mol^{-1}) in 2024, a record high, highlighting the urgent need for quantification of the ocean carbon sink. Since 2011, the community-led SOCAT offers an annual public update of global in-situ oceanic fCO_2 (fugacity of CO_2) measurements. SOCATv2025 adds 451 new datasets and updates forty-four data sets from ships, yachts, unmanned surface vehicles, moorings, and drifting platforms. Version 2025 contains **41.4 million** quality-controlled, in-situ surface ocean fCO_2 measurements with an estimated uncertainty of better than five µatm collected between 1957 and 2024, which constitute the main SOCAT synthesis and gridded products. In addition, **8.2 million** fCO_2 values with an uncertainty of 5–10 µatm, mostly from membrane-based sensors, are made separately available. Open ocean CO_2 data submissions have stabilized, as shown by the number of monthly, 1° by 1° gridded, surface ocean fCO_2 values in 2020 to 2023. Documentation of datasets has improved. SOCAT is key for quantification of ocean CO_2 uptake and ocean acidification, providing vital information for climate policy. The importance of constraining ocean CO_2 uptake is well recognized by the World Meteorological Organization Global Greenhouse Gas Watch and the UNFCCC Global Stocktake.

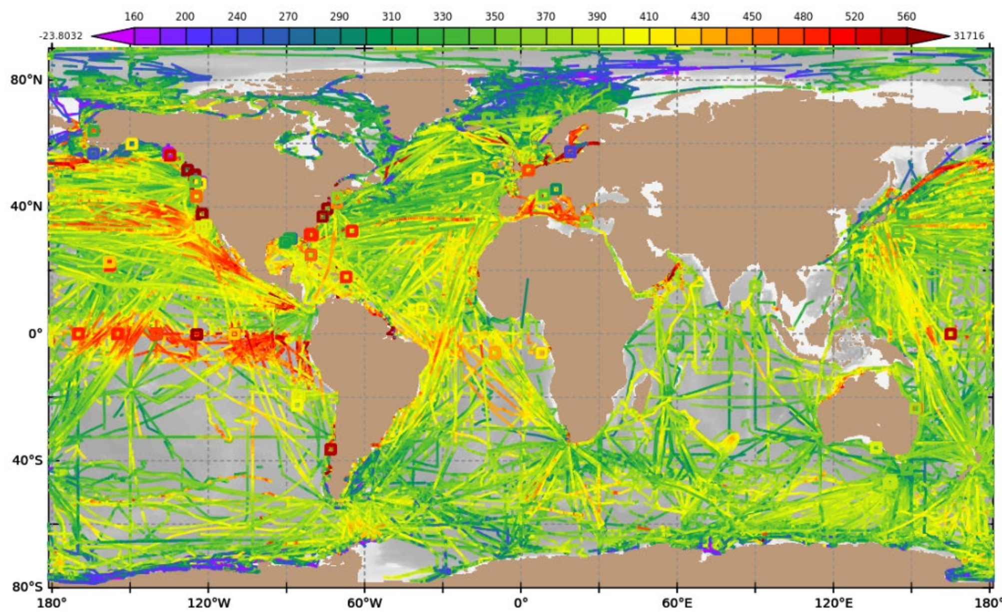

Figure. Map of SOCATv2025 database sampling locations and distribution of partial pressure of CO_2 (pCO_2) in the World Ocean.

(Alexander Kozyr, CISESS, alex.kozyr@noaa.gov; Funding: NCEI)

PUBLICATIONS

Chesapeake Bay Experiencing More Frequent Marine Heatwaves
Citation: Wegener, Rachel, Jacob Wenegrat, **Veronica Lance**, and Skylar Lama, 2025: Spatial variability of marine heatwaves in the Chesapeake Bay. *Estuar. Coast.*, **48**, 113, https://doi.org/10.1007/s12237-025-01546-9.
Summary: Under a CISESS Task guided by the University of Maryland's Atmospheric and Oceanic Science's Professor Jacob Wenegrat in cooperation with Adjunct CISESS Scientist Veronica Lance, graduate student at the time, Rachel Wegener, examined marine heatwaves (MHW) in Chesapeake Bay, a study recently published in the journal *Estuaries and Coasts*. The Chesapeake is the Nation's largest estuary and a major agricultural, aquacultural, and recreational part of the U.S. Eastern Seaboard, located in a U.S. hotspot for MHW, defined as a five-day-or-more period of anomalously hot water. Buoy data can provide a certain amount of information about MHW but cannot provide a full picture of MHW over a large spatial scale. Here, Lance and colleagues used three satellite-derived sea surface temperature (SST) products, all validated using in-situ data from the Chesapeake Bay Program, to characterize Chesapeake Bay's MHWs, namely, NASA's Multi-scale Ultra-high Resolution SST Analyses, NOAA's Geo-Polar Blended SST Analysis, and the Copernicus Marine Operational Sea Surface Temperature and Sea Ice Analysis. The focus was on MHW duration, maximum intensity, cumulative intensity, and rates of onset and decline, and the period covered was 2003 to 2023. The validation exercise

revealed that the Geo-Polar dataset was the best one to use for this location. Overall, analyses show that MHWs are becoming more frequent in the Bay, consistent with global results, with an average of 25 MHW events per year. Also, MWHs occur more frequently in the summer but tend to last longer in December and March. The authors note that their novel approach involving the use of satellite data to examine temporal and spatial variabilities of MHWs could be applied to other estuaries. A conversation about this study provides more interesting details and highlights how publicly funded satellite data can benefit society.

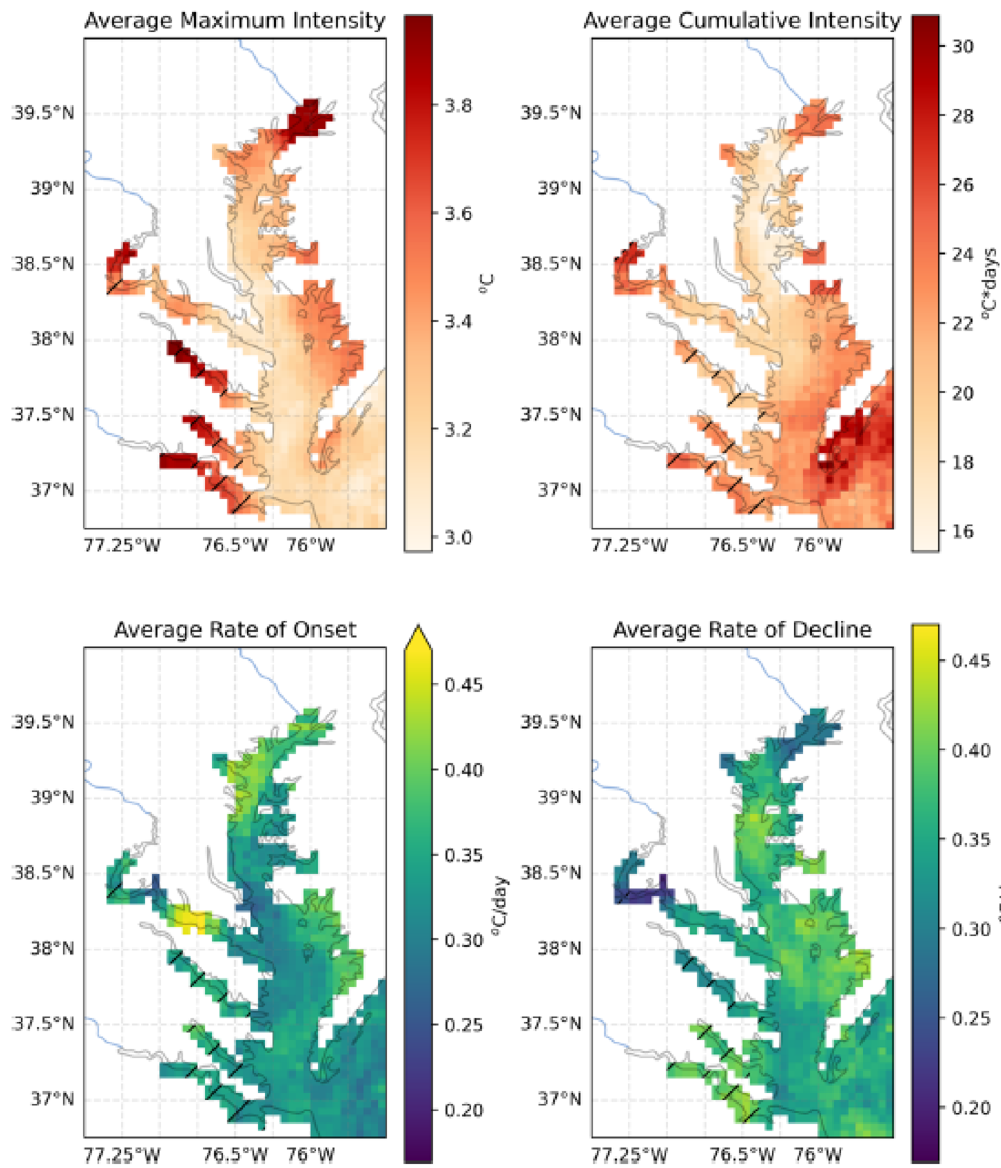

Figure. Spatial distribution of four MHW characteristics. Hashed lines show areas where anomaly SST validation data are not available.

(Veronica Lance, CISESS, veronica.lance@noaa.gov; Funding: DACS, JSTAR, JSTAR GCOM & ORS)

Radiative Forcing Reduced by Increase in Surface Land Albedo

Citation: Hou, Zhengyang, Liqiang Zhang, **Jingjing Peng**, Giovanni Forzieri, Aolin Jia, Zhiqiang Xiao, Ying Qu, Jintai Lin, Duoying Ji, Zidong Zhu, Xin Yao, Shuwen Peng, Lanpu Zhao, Wenjie Fan, Zhaocong Wu, Hao Geng, Qihao Wang, Chenghu Zhou, Suhong Liu, and Liangpei Zhang, 2025: Radiative forcing reduced by early twenty-first century increase in land albedo. *Nature*, **641**, 1162-1171, https://doi.org/10.1038/s41586-025-08987-z.

Summary: To date, the effects of land use or land cover (LULC) and snow variations on land surface albedo across the globe have not been thoroughly assessed. Land surface albedo modifies the amount of solar energy absorbed by the Earth's surface, influencing, among other things, surface temperature. CISESS Scientist Jingjing Peng and colleagues tackle this gap in knowledge in their paper published in *Nature*, where they present a comprehensive analysis of global land surface albedo dynamics and resulting global radiative forcing for the period 2000 to 2020 using satellite data from the Moderate Resolution Imaging Spectroradiometer. The kinds of surfaces studied include snow-covered surfaces, LULC conversion surfaces (associated with urbanization and widespread deforestation), and LULC non-conversion surfaces (associated with natural processes like browning/greening of vegetation and agricultural practices like crop rotation). Several findings are reported. One is that the albedo in snow-free regions increased by 2.2% over the 20-year period, leading to a 0.72% increase in the global land surface mean albedo and attributed to LULC non-conversion regions. These albedo changes translate into a negative global mean radiative forcing of -0.164 W m^{-2}. An important conclusion is that future climate change assessments should include global land surface albedo changes, especially in regions experiencing long-term changes in vegetation and surface water content.

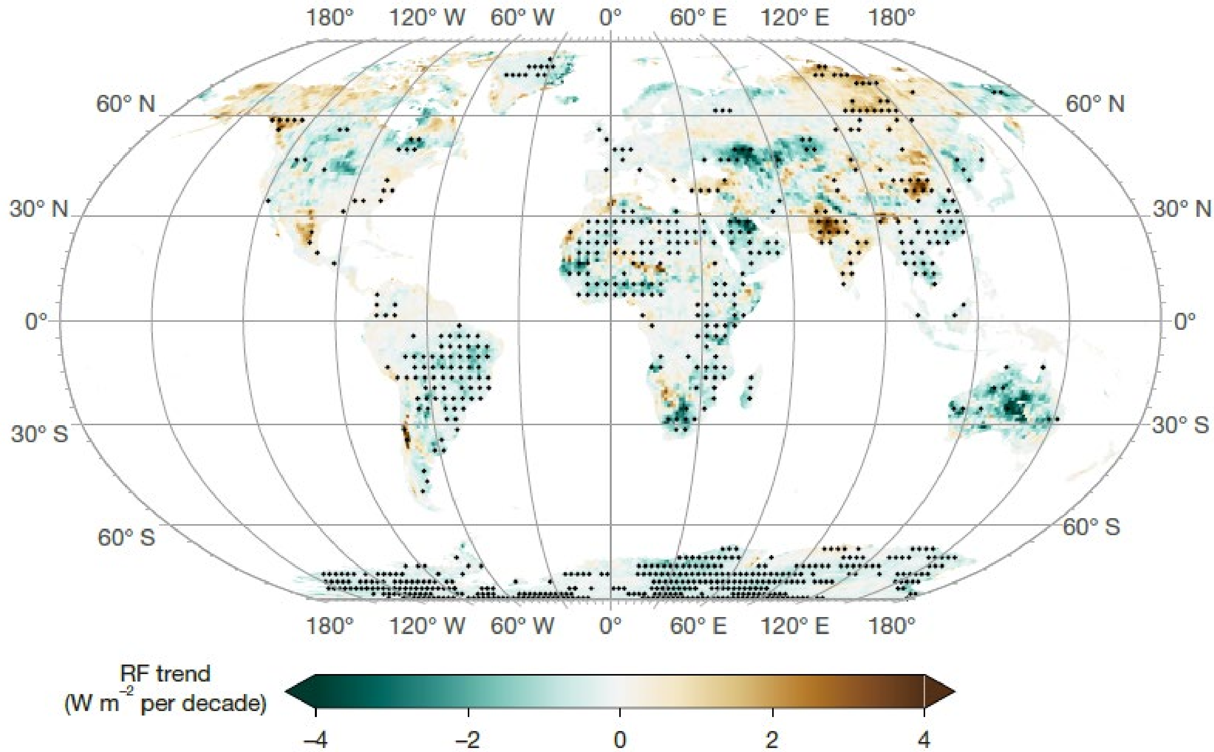

Figure. Spatial distribution of 20-year global land albedo-induced radiative forcing (RF) trends. Black dots represent regions with statistically significant trends.

(Jingjing Peng, CISESS, jingjing.peng@noaa.gov; Funding: GOES-R AWG, JSTAR & METOP-SG)

(Maureen Cribb, CISESS, mcribb@umd.edu, Funding: CISESS Task I)