

Record-breaking 2023 Marine Heatwaves

- 2023 saw an extraordinary surge in marine heatwaves, **setting new records in duration, extent, and intensity**
- We examined warming patterns from *ECCO* and *Optimum Interpolation Sea Surface Temperature (OISST)* across key regions in the Pacific and Atlantic Oceans
- Using ECCO, we conducted a **mixed-layer heat budget analysis to identify region-specific drivers** of the marine heatwaves

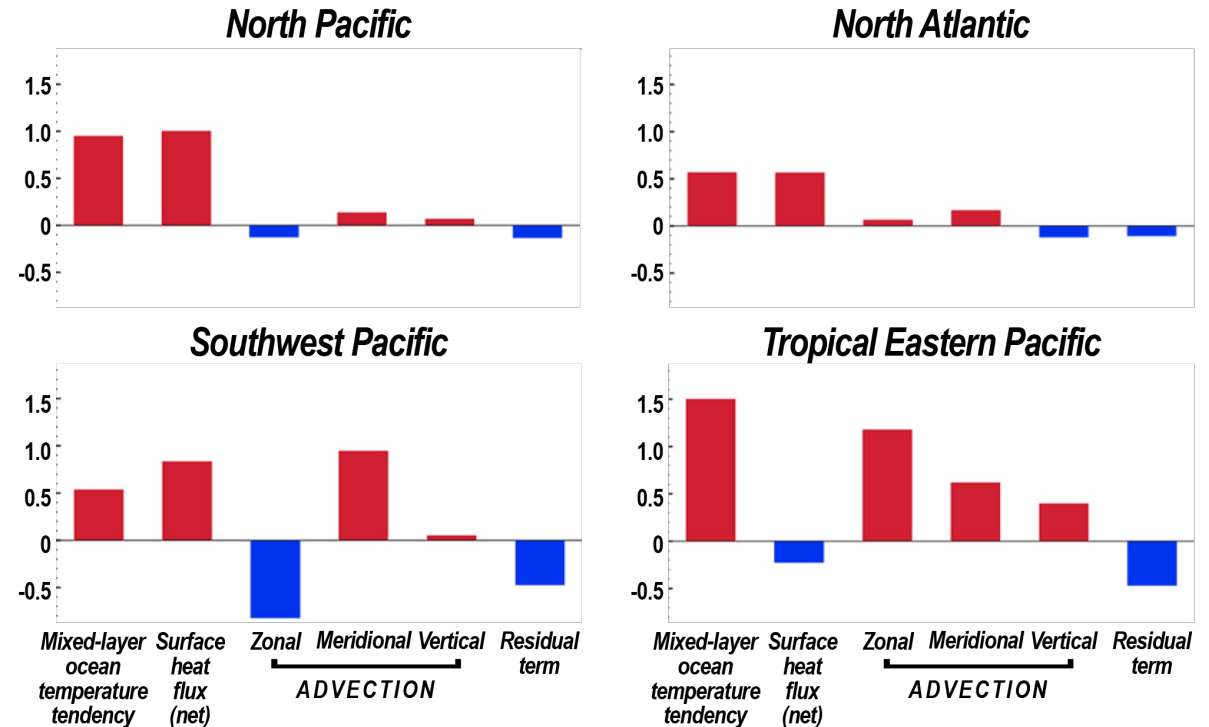
Strong agreement with OISST supports **ECCO's reliability in replicating marine heatwave characteristics**, validating its utility for analyzing underlying physical causes. Our analysis **decomposes the contributions** of ocean temperature tendency, surface net heat flux, horizontal advection, and vertical mixing processes.

Using ECCO, we identified region-specific drivers:

- **Enhanced shortwave flux and a shallower mixed layer in the North Pacific and North Atlantic;**
- **Reduced cloud cover and increased advection in the Southwest Pacific; and Oceanic advections in the Tropical Eastern Pacific.**

Dong, T., et al. (2025) [Record-breaking 2023 marine heatwaves](#), *Science*, 389(6758), 369-374, doi: 10.1126/science.adr0910

Ocean Mixed-Layer Heat Budget (°C per year)



Ocean mixed-layer budget results for the key regions.

Given that 89% of Earth's long-term energy imbalance is stored in the ocean, further research is essential to unravel the ocean's role in driving these unprecedented marine heatwaves.