Unraveling the global impact of marine heatwaves on air-sea CO2 exchange

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The ocean plays a pivotal role in the global carbon cycle. Recent studies indicate a substantial impact of marine heatwaves on air-sea CO2 exchange in specific regions. However, a global assessment of the impacts and drivers of marine heatwaves on air-sea CO2 fluxes is currently lacking. Here we use six different observation-based air-sea CO2 flux data products spanning 1990 to 2019 to demonstrate that while global average CO2 uptake is minimally reduced during marine heatwaves, there are substantial regional variations in air-sea CO2 flux anomalies. Specifically, a diminished release of up to 31 % (spread across data products: 3 – 49%) occurs in the equatorial Pacific during marine heatwaves, whereas reduced uptake of 30% (20% to 39%) is observed in the low-to-mid latitudes. The dominant driver of these anomalies is changes in the oceanic partial pressure of CO2, resulting from a combination of thermal and dissolved inorganic carbon (DIC) effects. The tropics are predominately influenced by DIC effects (strongly reduced DIC during MHWs), while thermal effects, mainly through enhanced air-sea heat fluxes and associated high ocean temperatures, dominate in the low-to-mid latitudes. In the Southern Ocean, we find anomalous ocean carbon uptake during marine heatwaves. However, considerable uncertainties in Southern Ocean pCO2 datasets hinder a comprehensive assessment in this region.