Projected amplification of summer marine heatwaves in a warming Northeast Pacific Ocean

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Marine heatwaves are expected to become more frequent, intense, and longer-lasting in a warming world. However, it remains unclear whether feedback processes could amplify or dampen extreme ocean temperatures. Here we impose the observed atmospheric flow in coupled climate simulations to determine how the record-breaking 2019 Northeast Pacific marine heatwave would have unfolded in preindustrial times, and how it could unravel in a +4 °C warmer world compared to present-day conditions. We find that air-sea interactions, involving reductions in clouds and ocean mixed-layer depth and air advection from fast-warming subpolar regions, modulate warming rates within the marine heatwave. In a +4 °C warmer climate, global oceans are +1.9 °C warmer than present levels, and regional mean warming in the Northeast Pacific can reach +2.3–2.7±0.25°C. Our identified feedback processes are projected to further amplify the intensity and spatial extent of analogous Northeast Pacific summer marine heatwaves beyond those thresholds, with a warming reaching +2.9±0.15°C above present levels. Such an event-specific amplification would place even greater stress on marine ecosystems and fisheries.