



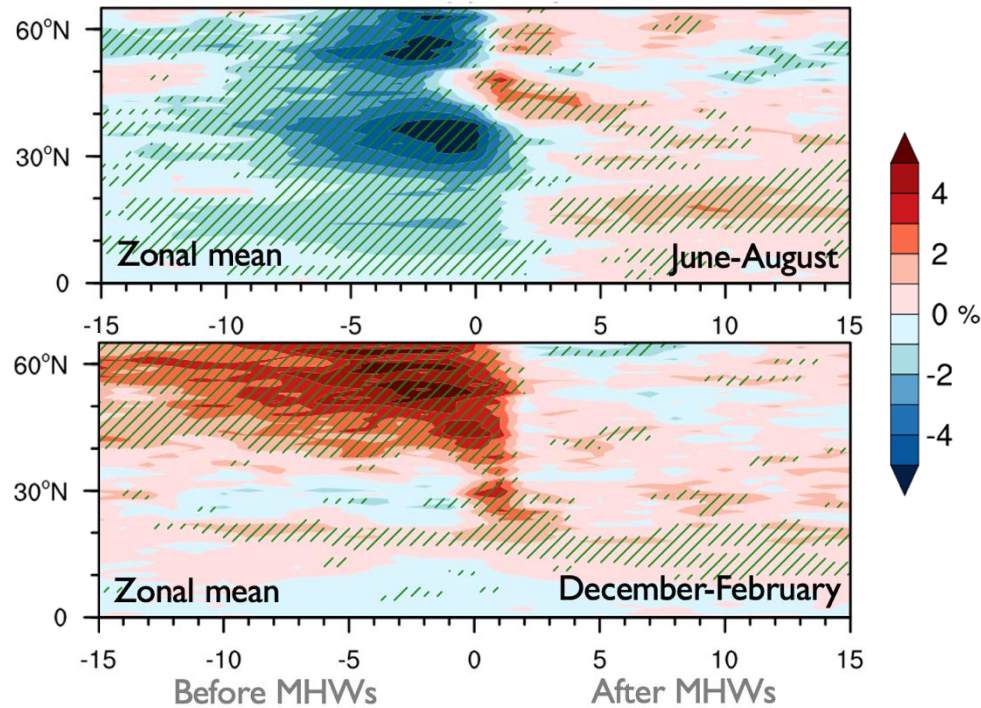
Detected impacts of atmospheric rivers on marine heatwaves



Marine heatwaves (MHWs) can cause widespread ecological and economic disruptions year-round, including mass mortalities of marine organisms, severe impacts on fisheries, and major losses to coastal economies. **We detect observed impacts of atmospheric rivers on MHWs, highlight seasonal dependence, and investigate physical mechanisms.**

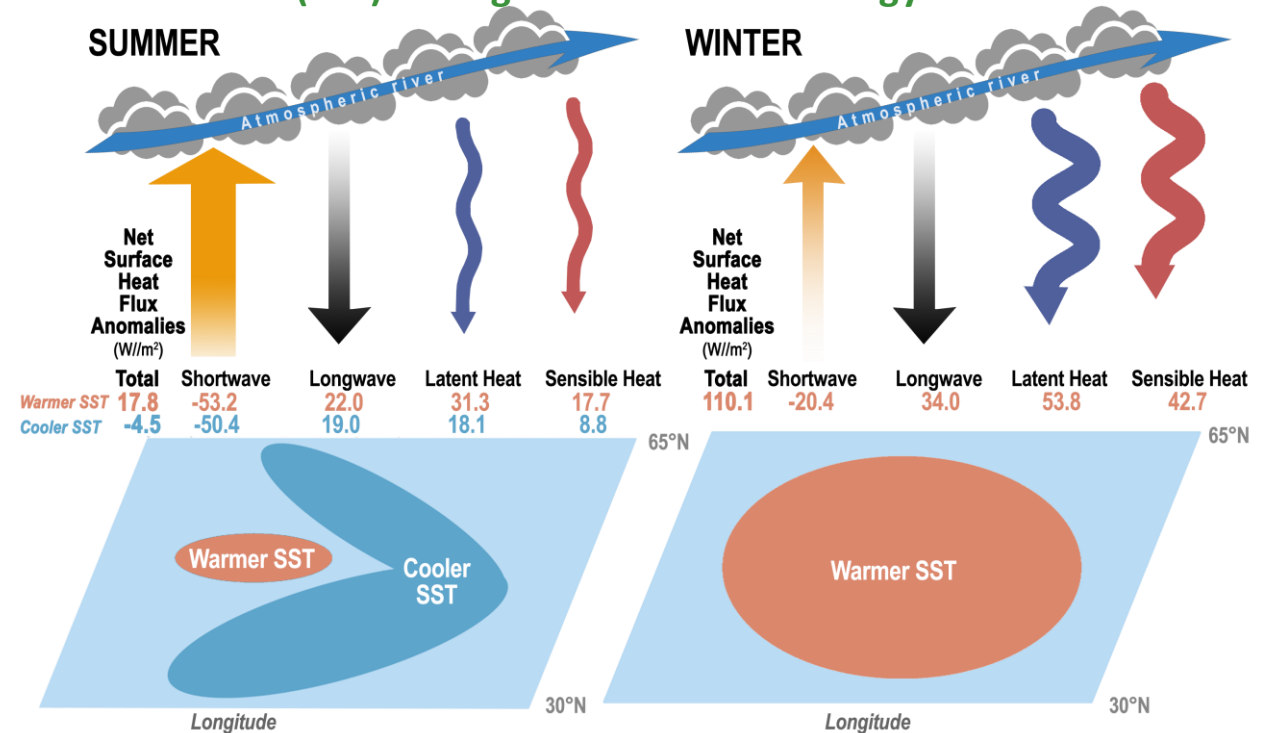
We analyze [satellite observations](#) and [reanalysis datasets](#) to reveal **previously overlooked impacts of atmospheric rivers (ARs) on MHWs**. We further demonstrate that **ARs' impacts on MHWs vary in space and with season**, modulated by ocean-atmosphere background states.

AR frequency anomalies before and after the MHW peak date (day 0) in the Northern Hemisphere



Weaker AR activity is detected within 1-2 weeks before the peak of extratropical MHWs in summer. Conversely, stronger AR activity is detected 1-2 weeks before the peak of extratropical MHWs in winter.

A schematic for the seasonal impacts of ARs on sea surface temperature (SST) through ocean surface energy flux



Associated with an AR, the **cloud-induced shortwave cooling** effect on the ocean is stronger in summer and has a horseshoe pattern. Basin-wide **warming effects due to suppressed turbulent heat fluxes** are stronger in winter.