Extreme Compound Events in the Tropical and South Atlantic

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Marine heatwaves (MHWs) are analogues to atmospheric heatwaves and have devastating effects on marine ecosystems, ranging from habitat shifts and changes in population structure to high mortality of various marine species. The impacts of MHWs can be amplified when combined with other extreme events that can act synergistically. Here we investigate the temporal-spatial distribution of compound events of MHW, high acidity and low chlorophyll in the tropical and South Atlantic, using observational datasets and reanalysis products. We show that the frequency and intensity of these compound events have increased dramatically over the past two decades in the tropical and South Atlantic, peaking in the most recent years, putting in check the capability of the marine ecosystems to recover from these compound extremes. We analysed the drivers of triple compounds for six regions in the tropical and South Atlantic and found that, for the Angola Front and Brazil-Malvinas Confluence regions, triple compounds are associated with the poleward shift of the fronts. For the Agulhas Leakage region, an increase in the number of eddies with warmer waters from the Indian Ocean leads to compound extremes. In the western tropical and subtropical Atlantic, compound extremes are caused by changes in the heat fluxes between the ocean and the atmosphere. In the eastern equatorial Atlantic, the Bjerknes feedback response to a weakening of the trade winds is responsible for the triple compounds. In addition, our results show that triple compounds are widespread over the tropical and South Atlantic during El Niño events. This is important because, according to recent studies, MHWs can be skilfully predicted mainly due to ENSO. Thus, the results presented here can help improve models' performance that, in turn, will be used in early warning systems and integrated into disaster preparedness and long-term adaptation.