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Co-variability of near-surface wind speed statistics and sea surface temperature

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The atmospheric (ABL) and ocean (OBL) boundary layers are intimately linked via mechanical and thermal coupling processes. In many regions over the world oceans this results in a strong co-variability between anomalies in wind speed and SST. At oceanic mesoscale this coupling can be driven either from the atmosphere or the ocean. Gridded SST and wind speed data show that over the western North Atlantic the ABL mainly responds to the OBL, whereas in the eastern North Pacific and in the Southern Ocean the OBL largely responds to wind speed anomalies. This general behaviour is also verified by in situ buoy observations. A stochastic non-dimensional 1-d coupled air-sea boundary layer model is utilized to assess the relative importance of the coupling processes. For regions of little intrinsic SST fluctuations, i.e. most regions of the world ocean away from strong temperature fronts, the inclusion of entrainment at the thermocline is crucial. In regions with strong frontal activities, e.g. the western boundary regions, the coupling is dominated by the SST fluctuations and the frontal variability needs to be included in models. Generally, atmospheric and ocean-driven coupling lead to an opposite relationship between SST and wind speed fluctuations. This effect can be especially important for higher wind speed quantiles