Dynamics of the atmospheric boundary layer response to ocean mesoscale sea surface temperatures

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The impact of the mid-latitude ocean on the atmosphere has been a long standing area of research, that was upended with observations of ubiquitous imprints of ocean meso-scale sea surface temperatures on near surface winds. Here, we test a recent theory for the mid-latitude atmospheric response to ocean mesoscale sea surface temperature (SST) in the Southern Ocean. The theory is based on a linearization about a spatially uniform, large-scale Ekman spiral of the steady state, atmospheric boundary-layer dynamics, and yields the atmospheric response as classical Ekman dynamics extended to include advection, and sea surface temperature induced changes of atmospheric mixing and hydrostatic pressure. The theoretical response is governed by spectral transfer functions between sea surface temperature and boundary layer variables. Transfer functions estimated from an extended integration of an atmospheric general circulation model, AFES, are consistent with the theory, and suggest that it faithfully captures the underlying physics. Regressions or 'coupling coefficients' between surface wind stress and sea surface temperatures are explained by SST induced changes of the surface stability, that directly impact surface stress, and changes of the surface winds as described by the theory.

Keywords: air-sea interaction, sea surface temperature, ocean mesoscale

