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Response of Extratropical Cyclones when Crossing a Sea Surface Temperature Front

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Sea surface temperatures (SSTs) can influence the development of extratropical cyclones by providing latent and sensible heat through surface fluxes as well as by modifying the environmental low-level baroclinicity. As surface fluxes as well as low-level baroclinicity maximize along the prominent SST fronts associated with the Gulf Stream and Kuroshio, the influence of these mechanisms on cyclone development is anticipated to be strongest along SST fronts. To map the sensitivity to the structure and position of SST fronts during the development of extratropical cyclones, we examine the response of cyclones when they cross an SST front at different directions and speeds. The results are based on idealized numerical simulations with the WRF model, where we prescribe moving SST fronts and a baroclinically unstable environment with an incipient cyclone. Cyclones moving towards the warmer side of the SST front deepen faster and have a faster crossing speed. The diabatic production of eddy available potential energy through latent heating, mainly associated with convection, plays a dominant role in the deepening. Cyclones that move to the colder side of the SST front weaken due to a reduction of available moisture for diabatic processes. However, before these cyclones weaken, they experience a brief period of faster deepening attributable to the enhanced environmental low-level baroclinicity associated with the SST gradient.