SST fronts along the Gulf Stream and Kuroshio affect the atmospheric winter climatology primarily in the absence of storms

Thomas Spengler, Leonidas Tsopouridis, and Clemens Spensberger
Geophysical Institute, University of Bergen, and Bjerknes Centre for Climate Research, Bergen, Norway
(thomas.spengler@uib.no)

The Gulf Stream and Kuroshio regions feature strong sea surface temperature (SST) gradients that influence cyclone development and the storm track. Smoothing the SSTs in either the North Atlantic or North Pacific has been shown to yield a reduction in cyclone activity, surface heat fluxes, and precipitation, as well as a southward shift of the storm track and the upper-level jet. To what extent these changes are attributable to changes in individual cyclone behaviour, however, remains unclear. Comparing simulations with realistic and smoothed SSTs in the atmospheric general circulation model AFES, we find that the intensification of individual cyclones in the Gulf Stream or Kuroshio region is only marginally affected by reducing the SST gradient. In contrast, we observe considerable changes in the climatological mean state, with a reduced cyclone activity in the North Atlantic and North Pacific storm tracks that are also shifted equator-ward in both basins. The upper-level jet in the Atlantic also shifts equator-ward, while the jet in the Pacific strengthens in its climatological position and extends further east. Surface heat fluxes, specific humidity, and precipitation also respond strongly to the smoothing of the SST, with a considerable decrease of their mean values on the warm side of the SST front. This decrease is more pronounced in the Gulf Stream than in the Kuroshio region, due to the amplified decrease in SST along the Gulf Stream SST front. Considering the pertinent variables occurring within different radii of cyclones in each basin over their entire lifetime, we find cyclones to play only a secondary role in explaining the mean states differences between smoothed and realistic SST experiments.