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Storm development over the Gulf Stream - role of the SST-front in modifying heat flux and low-level baroclinicity

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Atlantic extra-tropical cyclones that propagate across the Gulf Stream respond actively to the SST-front in the region. The responses are, however, diverse, and no single typical response exists. This is shown in a sensitivity experiment where the regional climate model HCLIM-ALARO is used to simulate 24 historic wintertime storms at 10km resolution. Each storm is simulated twice, first using the observed SST field, and again using a smoothed SST field that has the same spatial-average value as observed, but lacks the gradients. Differences in along-track 10m wind speed (maximum within 100km distance of track centre) are found to be between -25% to +25%. The sign and amplitude of these changes in storm-strength are constrained by the differences in along-track: i) surface latent heat flux (diabatic heating) and ii) low-level baroclinicity. South of the SST-front the smoothing leads to lower SST, reduced latent heat fluxes and generally weaker storms. North of the SST-front, windspeed changes can be either sign. Although increased heat fluxes tend to favour cyclogenesis, the accompanying changes in baroclinicity are not always favourable. The two mechanisms explain up to 80% of the variability of the maximal wind speed differences of the 24 storms. The results indicate that a good representation of the SST-fields in the Gulf Stream region is important for correct modelling of the storm activity in this region, both in NWP and climate models.