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Simulated atmospheric response to Gulf Stream variability

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Though the ocean variability has a distinct low-frequent component on interannual to interdecadal timescales, a better understanding of the main features of air-sea interaction in the extratropical ocean might increase the predictive skill of climate models significantly. An insufficiently understood region in this context are the sharp SST-fronts connected to western boundary currents, which interact with the overlaying atmosphere by forcing low-level winds and evaporation. Recent studies show, that this response extends beyond the marine boundary layer and so might influence also the large-scale atmospheric circulation.

In this work a 5 member ensemble of model runs from the AGCM ECHAM5 was analyzed focussing on the atmospheric response to the Gulf Stream. The analyzed experiment covered a time period of 138 years from 1870 to 2007 and was forced by observed SSTs and sea-ice concentration from the HadISST dataset. The experiment was performed at T106 horizontal resolution ($\sim$100km) and with 31 vertical levels up to 1 hPa. Simulated seasonal mean circulation indicate a convective response of the atmosphere in the Gulf Stream region similar to observations, with distinct low-level wind convergence, strong upward motion, and low-pressure over the warm SST flank of the Gulf Stream.

An analysis of variance (ANOVA) suggests, that up to 25-30% of the variability of the summer precipitation in the Gulf Stream region are connected to the boundary conditions. The link between oceanic and atmospheric variability on seasonal to interannual timescales is investigated with composite and linear regression analysis. Results indicate that increased (decreased) precipitation is associated with stronger (weaker) low-level wind convergence, enhanced (reduced) upward motion, low (high) pressure, and warm (cold) SST anomalies in the region of the Gulf Stream. Currently sensitivity experiments with the same AGCM configuration are in progress.