Impact of Gulf Stream SST biases on the global atmospheric circulation

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The role of winter Gulf Stream biases are examined with a focus on the tropospheric response. The UK Met Office Unified Model in the Global Coupled 2 (GC2) configuration has a warm bias of up to 7 K, which is associated with surface heat flux biases and linked to eddy-driven jet biases in the North Atlantic. To test the tropospheric response to the Gulf Stream bias, three sensitivity experiments were performed. These imposed the SST biases on the atmosphere-only version of the model over three different-sized regions, to cover a small and medium section of the Gulf Stream, and the wider North Atlantic. The dynamical response to this anomalous Gulf Stream heating is to further enhance deep vertical ascent over the Gulf Stream, rather than balance the heating with a meridional wind or storm track response. This deep ascent is already stronger in the control versions of the model relative to ERA-Interim reanalysis. Together with the imposed Gulf Stream heating bias, the response affects the troposphere not only locally but also in remote regions of the Northern Hemisphere via a planetary Rossby wave response. The wave response, as opposed to storm track changes, appears to provide a pathway to the North Atlantic eddy-driven jet biases. These pathways may have implications for the ability of the model to respond correctly to variability or changes in the Gulf Stream.