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Coherence of surface western boundary currents

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Surface western boundary currents (WBCs) like the Gulf Stream, the Kuroshio or the Agulhas Current are among the strongest ocean currents. They account for a large fraction of the eastern branch of horizontal ocean gyres. In the North Atlantic the Gulf Stream also accounts for a large part of the northward branch of the meridional overturning circulation (MOC). Since 1982 the Gulf Stream transport across the Straits of Florida at 26°N has been observed. This provides us with a unique 30-year long timeseries of a WBC which is central for studying both the MOC and North Atlantic subpolar Gyre at 26°N. However, how representative are such local observations for the wider ocean circulation? Is e.g. a peak/trough in the transport trough Florida Straits at 26°N representative for transports further north or south?

Here we study the spatial coherence of WBCs using output from a series of 1/12° eddy-resolving runs performed with the NEMO ocean model in the framework of the DRAKKAR project. The simulations cover the period from 1978 to 2007. Using composite analysis we find a large spatial coherence for the major WBCs. On interannual timescales weak/strong WBC transports coincide with a poleward/equatorward shift in the position of the eastward extensions once the WBCs have separated from the continents. In the North Atlantic increased/decreased WBC transport and southward/northward shifts of the eastward extension coincide with anticyclonic/cyclonic wind stress anomalies over the western North Atlantic. Using the observed transports through Florida Straits and geostrophic surface velocities derived from satellite altimetry reveals spatial WBC coherence patterns similar those simulated in the eddy-resolving ocean model.