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Inter-ocean fluxes south of Africa in an eddy-permitting model

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Exchanges of water south of Africa between the South Indian Ocean and the South Atlantic Ocean are an important component of the global thermohaline circulation. Evidence exists that the variability in these exchanges, on both meso- and longer time scales, may significantly influence weather and climate patterns in the southern African region and the significance of these regional ocean-atmosphere interactions is discussed. Observations of the inter-ocean exchange are limited and it is necessary to augment these with estimates derived from models. As a first step in this direction, this study uses an eddy-permitting model to investigate the heat and volume transport in the oceanic region south of Africa and its variability on meso, seasonal and interannual time scales

Two runs were performed with the eddy-permitting model. The first run used climatological monthly wind forcing to show the substantial variability in inter-ocean fluxes south of Africa. Volume transports of the Agulhas Current through 35˚S range from 58 to 60 Sv in summer/autumn to 65 Sv in winter/spring, with an annual mean of 62 Sv, which is comparable to observations. About 1.32 PW of heat flows west into the South Atlantic across 20˚E on the annual mean, with just over 1.2 PW flowing north into the South Atlantic across 35˚S, a value which is larger than previous model estimates. The seasonal variations in this transport are about 24% through 20˚E and 15% through 35˚S.

Similar analyses were performed on the second run, which examined the effect of a southward shift in the wind field, south of Madagascar. In general, there was less volume flux through the Agulhas Current through 35˚S, yet an increase into the South Atlantic. There was an increased volume flux in the Agulhas Return Current, resulting

in an increase in the southwest Indian Ocean recirculation. The occurrence of interannual variability in the volume and heat fluxes in both runs, lends support to the models ability to reproduce internal ocean instabilities as no interannual variability occurred in the forcing.

The model results suggest that the inter-ocean exchange south of Africa is highly variable on seasonal through to interannual scales. If this variability is also the case in the real ocean (and the limited observations suggest that this is so), then there are likely to be significant implications for climate.