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Net surface heat fluxes and Meridional Overturning Circulations

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The geographical patterns of the annual mean net surface heat fluxes (NSHF) simulated by the HadGEM3 GC3.1 coupled atmosphere-ocean models are shown to agree well with the CDEEP analyses. The patterns for the coarse resolution (N96O1) and high resolution (N512O12) simulations are shown to be similar (except near the "cold pool of death"). We argue that they can be interpreted relatively simply in terms of (a) regions of net surface heating where Ekman pumping provides a supply of cold water at the sea surface and (b) regions of net cooling where boundary currents have taken warm water poleward. We extend the simple models of Gnanadesikan (1999), Nikurashin & Vallis (2011) and Bell (2015) for the mid-depth Meridional Overturning Circulation (MOC) to a simple model describing the upper and mid-depth MOC cells. As a first step in investigating whether these ideas simulate the model circulations "realistically", we show that in the HadGEM3 Pacific Ocean, time-variations in the annual and zonal mean NSHF within 5^o of the equator are well correlated (r^2=0.6) with those in the annual and zonal mean wind stress along the equator. Finally we explore a warm, salty wedge of water next to the eastern boundary in the north Atlantic N96O1 pre-industrial simulations and interpret its northward heat transport in terms suggested by Bell (2015).

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