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Quantifying uncertainty in decadal ocean heat uptake due to intrinsic ocean variability

Bablu Sinha[1], Alex Megann[1], Thierry Penduff[2], Jean-Marc Molines[2], and Sybren Drijfhout[3,4,5]
[1]National Oceanography Centre UK, Marine Systems Modelling, Southampton, United Kingdom of Great Britain and Northern Ireland (bs@noc.ac.uk)
[2]Institut des Géosciences de l'Environnement, UGA, CS 40 700, 38058 Grenoble cedex 9, France
[3]Ocean and Earth Science, National Oceanography Centre Southampton, United Kingdom of Great Britain and Northern Ireland
[4]Royal Netherlands Meteorological Institute, De Bilt, The Netherlands
[5]Institute for Marine and Atmospheric research Utrecht, Department of Physics, Utrecht University, Utrecht, The Netherlands

Remarkably, global surface warming since 1850 has not proceeded monotonically, but has consisted of a series of decadal timescale slowdowns (hiatus periods) followed by surges. Knowledge of a mechanism to explain these fluctuations would greatly aid development and testing of near term climate forecasts. Here we evaluate the influence of ocean intrinsic variability on global ocean heat uptake and hence the rate of global surface warming, using a 50-member ensemble of eddy-permitting ocean general circulation model simulations (OCCIPUT ensemble) forced with identical surface atmospheric condition for the period 1960-2015. Air-sea heat flux, integrated zonally and accumulated with latitude provides a useful measure of ocean heat uptake. We plot the ensemble mean difference of this quantity between 2000-2009 (hiatus) and 1990-1999 (surge). OCCIPUT suggests that the 2000s saw increased ocean heat uptake of ~0.32 W m^{-2}compared to the 1990s and that the increased uptake was shared between the tropics and the high latitudes. OCCIPUT shows that intrinsic ocean variability modifies the mean ocean heat uptake change by up to 0.05 W m^{-2}or ±15%. Moreover composite analysis of the ensemble members with the most extreme individual decadal heat uptake changes pinpoints the southern and northern high latitudes as the regions where intrinsic variability plays a large role: tropical heat uptake change is largely fixed by the surface forcing. The western boundary currents and the Antarctic Circumpolar Current (i.e. eddy rich regions) are responsible for the range of simulated ocean heat uptake, with the North Pacific exhibiting a particularly strong signal. The origin of this North Pacific signal is traced to decadal timescale latitudinal excursions of the Kuroshio western boundary current.