Towards understanding the mechanisms of anthropogenic temperature and salinity emergence in the ocean

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Abstract

Ocean temperature and salinity are key markers of climate variability and anthropogenic forcings. Understanding the mechanisms that drive these markers and their time and location of emergence is the goal of this study. Changes in temperature and salinity can arise from additional heat/freshwater uptaken at the ocean surface and transported into the interior by the unperturbed circulation (also known as "passive" heat or salinity), and by the perturbed circulation redistributing pre-existing heat and salt. Here we explore the relative role of these mechanisms as driven by the surface anthropogenic forcing expressed as changes in buoyancy and momentum fluxes. We propose a new modelling study in the context of the IPSL-CM6A-LR large ensemble where a number of simulations are conducted to disentangle these different processes. We first replicate in a fixed-flux ocean-only configuration the response of the coupled model ensemble mean on the period 1850-2100 by forcing the ocean with surface fluxes from the coupled model. We then run sensitivity experiments by applying each perturbation flux individually. Passive temperature and salinity tracers are implemented in every simulation to quantify the evolution of the passive components. We quantify locally and regionally the emergence of the anthropogenic temperature and salinity change from background climate variability for each of the physical processes individually and discuss the attribution of the total response in the large ensemble to these different mechanisms.

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