An ocean modelling framework for mitigating oceanic projections from global climate models present-day biases

Matthieu Langaigne*[1]

[1]UMR MARBEC, IRD – UMR MARBEC, IRD – France

Résumé

This paper presents an ocean-only general circulation model framework designed to (i) reduce the influence of climate models present-day biases on future ocean physical and biogeochemical projections, and (ii) assess the mechanisms driving these projected changes. The control simulation is forced by detrended air-sea fluxes from an atmospheric reanalysis, excluding climate change signals. For climate change simulations, air-sea flux anomalies diagnosed from historical and future climate model ensembles simulations, are added to these control fluxes. Heat flux anomalies are decomposed into components independent of and tied to local sea surface temperature (SST) changes, with the later modelled as an online relaxation to the control simulation' SST. This approach results in a more realistic ocean state than in climate models, while still explicitly accounting for evaporative cooling and net longwave radiation feedback. Our results demonstrates that climate models biases can significantly compromise the reliability of projected patterns. For instance, the strong cold-tongue bias in the IPSL-CM6A-LR model leads to greater warming and chlorophyll decrease in the western equatorial Pacific, while our bias-corrected simulation shows a larger response in the eastern Pacific. Sensitivity experiments, where changes in heat, freshwater and momentum fluxes anomalies are applied separately, show that both thermodynamical (i.e., heat and freshwater-driven) and dynamical (i.e., wind-driven) processes contribute equally to this warming pattern, emphasizing the importance of Bjerknes feedback. This cost-effective method can improve oceanic projections from any climate model and offer insights into driving mechanisms.

*Intervenant