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Comparing the effect of low wind speed parameterization on heat fluxes in atmosphere only and coupled ocean-atmosphere simulation

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The turbulent fluxes across the ocean/atmosphere interface represent one of the principal driving forces of the global atmospheric and oceanic circulation. Representation of these fluxes presents a challenge due to the small scale acting turbulent processes compared to the resolved scales of the models. Beyond this subgrid parameterization issue, a comprehensive understanding of the impact of air-sea interactions on the climate system is still lacking.

Here we investigate how differences in the parameterizations of turbulent fluxes affect the water supply of the atmospheric column in the tropics, the ocean heat content and the equator-pole redistribution of heat and water by the oceanic and atmospheric circulation. Focusing on the representation of latent heat fluxes in the tropics, we put some emphasis on the heat transfer coefficient in weak wind speed regime, considering both atmosphere only and ocean-atmosphere coupled simulations with the IPSL climate model.

The results highlight that although the heat transfer coefficients are highly similar for a given parameterization between atmosphere only and ocean-atmosphere coupled simulations the differences in surface heat fluxes are substantial. We analyze in detail the ocean feedbacks and the role of the latent heat fluxes by assessing the energy transport carried out by the atmosphere considering the divergent part of the moist static energy. Differences appear between the coupled and uncoupled simulations due to the role of the ocean which dampens a large part of the disturbance caused by the modification of parameterization and plays a large role in energy storage, affecting the Haldey and Walker cells, and thereby the spatio temporal distribution of precipitation.