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Impact of gustiness in turbulent heat flux parameterization on the air-sea coupling and ocean feedbacks in climate 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 circulations and are parameterized in climate models. To improve the representation of turbulent fluxes in low wind speed regimes, a new parameterization has been developed in the IPSL model. It takes into account the gustiness effects which are calculated thanks to the coupling of the bulk formula used to compute the surface turbulent fluxes with the thermal and the convection schemes that provide respectively the deep and free convection instabilities on surface winds.

Here we investigate how this parameterization affects the ocean-atmosphere interactions and feedbacks. We focus on the representation of latent heat fluxes in the tropics over weak wind speed regions (principally the warm pool), considering single-column, atmosphere only and coupled ocean-atmosphere simulations with the IPSL climate model. The results are analyzed with regard to other simulations where different parameterizations were included in the model. They highlights that the ocean feedback dampens most of the regional disturbance caused by the parameterizations. The ocean plays a large role in energy storage, affecting the Hadley and Walker cells through the modification of the sea surface temperature gradient. It also impacts the atmospheric boundary layer humidity and the oceanic mixed layer depth, and thereby the large scale ocean and atmosphere heat and water transport, as well as the spatio-temporal distribution of precipitation.