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On the improvement of surface currents from ocean/waves coupled simulations : Sensitivity to wave forcing

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The climate is evolving rapidly and there is a strong need of better description on momentum and heat fluxes exchanges between the ocean and the atmosphere. Recently directional wave observations from CFOSAT shed light on the improvement of dominant wave direction and better scaling of wind-wave growth in critical ocean areas such as the Southern Ocean (Aouf et al. 2021). This work examines the validation of coupled simulations between the ocean model NEMO and the wave model MFWAM including assimilation of directional wave observations. The coupling experiments have been performed for austral summer and fall seasons during 2020 and 2021. The objective of this work is on the one hand to assess the impact of waves on key parameters describing the ocean circulation and on the other hand to evaluate the contributions of different processes of the wave forcing (stress, Stokes drift and wave breaking inducing turbulence) on the mixing in upper ocean layers. The outputs of the coupled simulations have been validated with in situ observations of ocean surface currents, temperature and salinity. The results clearly reveals an improvement in the estimation of the Antarctic Circumpolar Current (ACC) with an increase in the intensity of the current for example in the region between Tasmania and Antarctica. We also observed a significant improvement of the surface currents in the tropics, for instance the ascending brazilian current. In other respects, we have examined the contribution of improved surface stress on inertial oscillations of the current in the Southern Ocean.

Comparison of the surface currents from the coupled simulations with those provided by altimeters showed an increase in current intensity and a better description for small scales in regions of strong currents such as the Agulhas, ACC and Kuroshio regions. We also investigated the impact of wave forcing depending on the mixing layer length.

Further discussions and conclusions will be presented in the final paper.