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Numerical mesoscale air-sea coupling over the Gulf of Lions during two Tramontane/Mistral events

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The near-sea surface meteorological conditions associated with strong wind events constitute a strong forcing on the ocean mixed layer. The Gulf of Lions is one of the most windy region of the Mediterranean basin, with frequent Mistral and Tramontane events. These northerly and north-westerly low-level flows, generally induced by a cyclogenesis in the Ligurian basin, are channelled and accelerated in the Rhône and Aude valleys, respectively. They transport cold continental air over sea and induce strong momentum and heat exchanges at the air-sea interface. The local continental shelf circulation with sometimes transient coastal upwellings is also sensitive to these intense meteorological events.

This study addresses the question of the sea surface scheme used in mesoscale atmospheric numerical modelling to represent the ocean mixed layer response under these severe wind events. Several slab ocean models have been used coupled with the Weather Research and Forecasting (WRF) model at 21 and 7-km resolution and applied on two Mistral/Tramontane cases (23-26 March 1998 and 5-9 November 1999): (i) a slab model based on the transport divergence equation where the mixed layer evolution is only driven by the wind stress; (ii) a slab model where the temperature is the only prognostic variable and evolves according to the net surface heat budget and (iii) the complete slab scheme from Price [1981]. The coupled simulations were also compared to two basic simulations, one using a constant sea surface temperature (SST) field during all of the model integration and another using a 6 hourly-update SST reanalysis. In this study, we mainly focused on the slab models performances. We identified the processes involved in the ocean mixed layer response under Mistral and Tramontane situations at mesoscale, i. e. local and fast cooling and deepening, and finally we investigated the feedbacks of an interactive ocean mixed layer on the atmospheric simulation.