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The MedCORDEX Flagship Pilot Study on air-sea interactions.

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The mechanisms through which air-sea coupling can modify the regional climate will be investigated in the MedCORDEX Flagship Pilot Study (FPS) on air-sea interactions, with special emphasis on the role of small scale ocean processes and waves. This FPS is a natural continuation of the activities of MedCORDEX, HyMeX and MedCLIVAR. The selected region is the area surrounding the Mediterranean Sea, which is often referred to as an ocean in miniature due to the variety of processes occurring therein. These include strong air-sea interactions, active mesoscale and submesoscale dynamics and a permanent thermohaline overturning circulation. Moreover, this area is one of the best observed regions in the world. Besides the dense observational network of meteorological stations over Europe, the Mediterranean Sea is regularly sampled by different monitoring programs (e.g HyMeX, the regional component of Gewex) providing observations of the ocean-atmosphere coupled system over the last decades. The Mediterranean region is therefore a particularly suitable candidate for this FPS.

Ocean mesoscale in the Mediterranean Sea is characterized by a Rossby deformation radius of 5-10 km. In consequence, the SST often shows narrow and sharp fronts (e.g. in upwelling regions) as well as filaments with associated strong temperature gradients that can significantly modify the air-sea interaction (Chelton et al., 2004) and affect the climate evolution (Artale et al., 2009). Ocean mesoscale also plays a crucial role in the main mechanism of heat uptake by the ocean, namely dense water formation, which modelling requires both atmospheric ($\sim$25 km) and oceanic ($\sim$5-10 km) high spatial resolution that present GCMs are not able to achieve. Last, the Mediterranean wind-wave climate is characterized by high temporal and spatial variability due to the channeling of winds acting over the sea by the orography (Lionello et al. 2005). Wave effects on the turbulent heat fluxes are known to be important and the inclusion of this interaction in regional models is also expected to have a significant impact on long term simulations.

A detailed analysis of how air-sea coupling at high resolution can modify the regional climate, and consequently the global climate, is still missing in the literature. There are some indications that it can provide an added value to RCMs in both present climate (Artale et al 2009, Nabat et al., 2015) and future scenarios (Somot et al., 2008), but the mechanisms underlying such impact are not completely understood. Global climate modelling should therefore benefit from this FPS as it will give clues for the future design of GCMs.