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A coupled atmosphere-ocean-wave modeling approach for a Tropical Like Cyclone in the Mediterranean Sea.

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In November 6-8, 2011, an Atlantic depression developed into a Tropical-Like Cyclone (TLC) in the Balearic island region, leading to pressure values of about 991 hPa, wind speeds higher than 40 m/s around the eye and very intense rainfall especially in the Gulf of Lion, in the Ligurian, Sardinian and Balearic region. The TLC gets formed in the southeast portion of the Balearic region on November 6 and moved slowly towards North-East, increasing its intensity off the Gulf of Lion, until reaching the maximum in the early hours of November 8. Several simulations attempting to reproduce this TLC have been produced, but some characteristics, especially in the later stage of the cyclonic lifetime when the cyclone was weaker, were found to be very complex to reproduce, in particular the trajectory, the minimum pressure and the landfall at coast, generally anticipated with respect to the effective timing.

In this work we used the coupled model COAWST system (including the ROMS model for the hydrodynamic part, the WRF model for the meteorological part and the SWAN for the surface wave modeling) in Stand Alone (SA) mode (that is with only the WRF model), in coupled mode (AO) atmosphere-ocean, and in a fully coupled version including waves (AOW) by adding the wave model. The simulations show that, although the landfall timing remains a challenge, the pressure minimum is depicted more correctly by coupled models when compared to the SA configuration.

The intensity of the wind is simulated more closely, with higher intensity, in the coupled cases. The trajectory of the “medicane” appears to be better reproduced in the coupled cases, particularly by the AOW case including the wave module. Precipitations rates were also differing, appearing to be less distributed but more intense in the SA case, and covering a wider region in the coupled cases. The study will also address the 2 m air temperature, wind, pressure and heat fluxes at some selected stations (Mallorca, Marseille, Nice).