EMS Annual Meeting Abstracts
Vol. 15, EMS2018-814-1, 2018

Dynamics and wind-wave interaction of a Bora wind jet: a very high resolution simulation using WRF model

Antonio Ricchi (1), Davide Bonaldo (1), Mario Marcello Miglietta (2), Renato R. Colucci (3), Marko Korosec (4), and Sandro Carniel (1)

(1) Institute of Marine Sciences (ISMAR-CNR), Venice, Italy, (2) Institute of Atmospheric Sciences and Climate (ISAC-CNR), Lecce/Padua, Italy , (3) Institute of Marine Sciences (ISMAR-CNR), Trieste, Italy, (4) DARS RWIS, Kozina, Slovenia

Several studies show how very high resolution can improve the simulation of wind speed in term of variability and intensity. In this work, we study an intense Bora event using the WRF (Weather Research and Forecasting) model with very high horizontal resolution. The Bora is a katabatic wind mainly associated to two different atmospheric configurations: 1) Cold Air Outbreak events (CAO) triggered by thermal continental anticyclones that transport cold and dry air masses from Siberia to the central Mediterranean sea, and 2) the displacement of a low pressure minimum from the Tyrrhenian Sea towards the Slovenian and Croatian coast. The first case activates a dry and cold air flow from the Dinaric Alps to the Adriatic Sea that extract a large quantity of heat and moisture fluxes from the sea (Adriatic Lake Effect). In the second case, Bora winds are activated by local dynamics and amplified by topography.
Many papers have already studied the Bora dynamics, but the present work is one of the first with very-high resolution that adopts a 2-way coupling between atmosphere and waves.
In this work, we study a Bora event caused by CAO, using a WRF model with 600 m grid spacing and 60 vertical terrain-following levels. Initial and boundary conditions are taken from ERA-interim dataset. SWAN (Simulating Waves in Nearshore) model is used for simulating wave generation and evolution, and its coupling to WRF is carried out via the COAWST system. In the coupled run, WRF and SWAN exchange data every 600 second. Model results are compared with data recorded every 10 minutes from three stations located inside a Bora jet, namely Vida Buoy (Piran), Paloma Buoy (Trieste) and the “Acqua Alta” tower (close to the Venice coast). Results show that the use of very high resolution increases the model performances both in terms of wind speed (in particular during the peak), and in terms of variability as well; moreover, it reduces bias and RMSE in all stations. The use of coupled atmospheric-wave models, at least for this specific case when winds are larger than 20 m/s, generates larger surface roughness due to waves and, as a consequence, a larger heat and moisture extraction from the sea.
References
Ricchi, A.; Miglietta, M.M.; Falco, P.P.; Benetazzo, A.; Bonaldo, D.; Bergamasco, A.; Sclavo, M.; Carniel, S. On the use of a coupled ocean-atmosphere-wave model during an extreme cold air outbreak over the Adriatic Sea. Atmos. Res. 2016, 172, 48–65.

Warner, J.C.; Armstrong, B.; He, R.; Zambon, J.B. Development of a Coupled Ocean- Atmosphere-Wave-Sediment Transport (COAWST) Modeling System. Ocean Model. 2010, 35, 230–244.