Geophysical Research Abstracts
Vol. 17, EGU2015-3198, 2015
EGU General Assembly 2015

Extreme surface turbulent heat fluxes during bora events

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Bora events, associated with the strong seaward wind blowing from the coastal mountains, frequently occur in the Mediterranean and Black Seas and result in off-shore natural hazards such as icing of the off-shore infrastructures, stormy conditions and associated impact on marine structures and carriers. Furthermore, bora events are associated with extreme sea-air temperature and humidity gradients and locally strong winds which result in extreme surface turbulent fluxes of heat and evaporation. We present diagnostics of several bora events in the Adriatic and Black Seas which resulted in extremely strong turbulent sea-air exchanges. Diagnostics were performed using very high resolution simulations with non-hydrostatic WRF-ARW-3.5 model whose set-up included for 3 domains (2 outer and 1 inner) with the sub-grids corresponding to 27, 9 and 1 km respectively going from the external outer to the inner domain. For all three domains model had 36 vertical levels in vertical and realizes a set of physical parameterizations whose choice has been justified by sensitivity experiments. Validation of the numerical experiments was based upon in-situ data from buoys, coastal and island meteorological stations. Simulations of bora events captured extreme air-sea fluxes amounting to more than 2000 W/m2 for the latent heat flux and corresponding to very high percentiles of probability distribution of surface fluxes. These events are insufficiently resolved (or not captured at all) by even relatively high resolution modern era reanlayses, and, thus, can hardly be diagnosed without using mesoscale resolutions. Using Modified Fisher-Tippett (MFT) distribution of surface turbulent fluxes, we estimated the fractional contribution of bora events in long-term integral air-sea fluxes for Mediterranean and Black Seas. Further we discuss the role of bora events in forming climatological air-sea exchanges over the semi-enclosed seas and in the heat contents of surface layer as well as importance of bora events in forming high sea-air CO_2 fluxes.