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A relationship between mesoscale meteorological formations and the anomalous propagation conditions over Croatia

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Here we study the impact of three mesoscale processes (over the wider area of the northern Adriatic) on the occurrence of anomalous propagation (so called anaprop) of radio waves: radioducts, superrefractions and subrefractions. The chosen formations are sea/land breeze, the bora wind and cumulonimbus clouds that were observed during 13 - 20 August 2000. For the purpose of the analysis we used radiosoundings in Udine, with 6 hours sampling period and numerical WRF-ARW model at the horizontal resolution of 1.5 km every hour. Results show that the model can successfully simulate the occurrence of anaprops in Udine, although the intensity is sometimes underestimated. The model has certain difficulties in reproducing the correct height and intensity of anaprops since the faithful vertical profile of the modified refractive index is the most dependent on the accuracy of the modeled vertical changes of relative humidity.

Spatial anaprop distributions show that the sea surface (between 30 and 100 m a.s.l.) is mainly covered by superrefractions and radioducts during the entire studied period. Sea breezes (SB) are thoroughly associated with the anaprop formations: (i) in the first 100 m above the ground within SB body where superrefractions and radioducts form due to advection of colder and moist air, (ii) in upper region of the SB front which are usually related connected with elevated radioducts and superrefractions, (iii) inside transition layer between the SB body and anti-SB current with subrefractions. When a deep convection over land appears, we observe the elevated superrefractions and subrefractions between 0.5 and 1 km above ground. Subrefractions are caused by downdraft beneath the cumulonimbus cloud base in its mature phase that creates smaller pools of cold and dry air. Below subrefractions in the lowermost 200 m, the type of anaprop is changed from superrefractions to radioducts. The bora wind usually creates radioducts and superrefractions (inside the hydraulic jump in the shallow surface layer) due to advection of colder and drier air that are caused by advection. Bora is also associated with subrefractions: (i) over the sea surface along the edges of bora jets where a lateral exchange of air with different moisture content occur due to the convergence of flow and increased horizontal vorticity, and (ii) on the windward side of Dinaric Alps where the formation of the local vortices below the mountain top affect the moisture profile.