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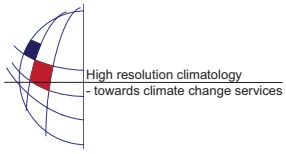

The complex bora flow in the lee of Southern Velebit

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The strong bora winds are a common occurrence along the eastern mountainous Adriatic coast, especially in winter. Bora is known to be particularly severe in the lee of the Velebit range in the northern Adriatic, where leeward slopes are particularly steep and mountain passes scarce but prominent. The Velebit range is highest at its southern part, where it abruptly ends, resulting in steep terrain slopess. The highest bora wind gust ever recorded in Croatia (69 m/s) was measured in the lee of the southern tip of Velebit. This is also the area where bora winds are extremely spatially variable. Located only a short distance away from the locus of the bora maximum, the area of the city of Zadar, in the lee of one of the highest Velebit peaks (1757m), is characterized climatologically by weak winds, considerably weaker compared to its surroundings. The primary aim of this study is to investigate small-scale characteristics and spatial variability of the severe Bora flow in the wide Zadar area and to identify reason for the “Zadar calm”.

The complex flow structure in the lee of southern Velebit is investigated with very high-resolution numerical simulations carried out with the NRL COAMPS model. The focus is placed on two wintertime severe bora episodes. A synoptically-induced critical level at the altitude ranging from 3 to 5 km depending on the time period defines the upstream bora flow layer and leads to the formation of a hydraulic jump in the lee of the highest terrain. The complex and temporally highly variable three-dimensional flow structure is characterized by a pronounced wake in the Zadar area surrounded by two jets, one emanating from a pass at the northern end of southern Velebit and the second one originating as a southern tip jet. The wake flow is highly nonstationary and is influenced by both the change in the upstream profile as well as boundary layer evolution. Reversed flow and rotors develop within the wake region in connection with the hydraulic jump.

Sensitivity experiments were conducted to examine the effects of the Zadar peninsula topography and the height of southern Velebit on the structure of the bora flow. The influence of Velebit is particularly strong, governing the onset and strength of the bora flow within the domain. The terrain of the Zadar peninsula, although significantly lower than Velebit, is also shown to influence the characteristics of the developed bora flow, especially the location of the point of flow separation. Certain types of gravity wave response within the bora flow appear to be particularly sensitive to the small scale topography of the Zadar peninsula.