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Analysis of measurements of the Bora wind in Vipava valley

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Bora wind is a phenomenon observed on the lee side of mountain chains, where the cold air-masses flowing over the barrier cause strong downslope winds. The relief profile of the SW Slovenia, which within 30 km of the coastal line first rises to a Karst plateau (300 m above sea level), then falls into the Vipava valley (100 m a.s.l.) and rises again to a mountainous barrier with maximum altitudes of about 1500 m a.s.l., creates an ideal setting for the occurrence of downslope winds in the Vipava valley. The occurrence of strong winds is correlated to the presence of cold NE air-flows in the higher, stably stratified layer, flowing over the SW-oriented orographic barrier, and warmer air on the lee side of the mountain range. These conditions lead to the flow of cold air from behind the barrier sinking into the valley bellow, generating very gusty and strong winds.

Our data sample includes wind and gust speed measurements in the period from 27 January to 24 April 2012, which was selected due to strong Bora wind outbursts at that time. Wind speeds were measured using 15 wind sensors, out of which 5 were dedicated cup anemometers, positioned 4 meters above the ground and arranged in a two lines perpendicular to the barrier, line A consisting of 3 and line B of 2 instruments. The remaining wind sensors were ultrasonic, positioned at various heights above the ground at 10 different locations along the Vipava valley.

The obtained gust speed measurements were analyzed in order to evaluate the frequency distribution of the wind gusts. In order to eliminate longer time intervals with light- or no wind, which can not be characterized as Bora and do not add any information to the gust frequency analysis, Fourier transform of the data was made for short time periods, taking into account single Bora wind outbursts only. Wind speed measurements were studied separately for each instrument line. In the line A, the first instrument was positioned in an elevated up-wind location on the mountain slope, while the other two were located at the opposite sides of the valley floor at approximately same heights. Data from the line A shows, as expected, downslope acceleration of the air-masses with wind speeds almost doubling on the valley floor as compared to those measured on the mountain barrier slope. Wind speeds on the valley floor were found to be comparable. Greater variability of the wind speed data was found in the line A as compared to the line B, which can be attributed to their positioning, line A being located directly below a col in the barrier mountain range.