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The tip of Istria region response to bora wind: observations and modeling

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Bora is a gusty, katabatic wind with gusts frequently reaching 45 m/s. The main local bora characteristics are its sudden occurrence and strong variations. Direction and intensity of bora are profoundly influenced by channelling effect of the mountain passes in the Dinaric Alps; over the Kvarner Bay islands the additional lifting of air takes place. When it breaks through the passes and spreads over the northern Adriatic it imposes laterally heterogeneous wind stress at the surface, provoking pronounced cooling evaporative fluxes and strongly affecting the pre-existing circulation.

In this paper we concentrate on the region surrounding the tip of the Istrian peninsula, and the winter 2003 time period using both field data and numerical modelling to address the aforementioned phenomena. The field component was implemented through the West IStria Experiment (WISE); the original mooring layout was somewhat modified to fit better the ONR-funded Adriatic Circulation Experiment (ACE) eastern-end mooring lines. It comprised three 600 kHz Acoustic Doppler Current profilers (ADCPs) deployed in trawl resistant bottom mounts (TRBMs) for about 4.5 months (late December 2002 - end of May 2003; an unfortunate midterm failure of the TRBMs caused almost a month long gap in the data).

The modelling component has been based on a very-high resolution, three-dimensional circulation model (Quoddy) employing finite elements horizontally, and terrain following coordinate vertically. It has been run on a computational grid comprising 17284 nodes, and 28669 elements over the northern Adriatic, successfully resolving well-developed eastern Adriatic coast (with the smallest triangles having sides of only 500m, and area of about 9000 m^2).

The ALADIN/HR model was selected to provide the atmospheric forcing. ALADIN/HR is a spectral, hydrostatic model, using initial and boundary conditions from the global ARPEGE model. It has horizontal resolution of 8 km (grid of 169x149 points, and 37 levels), and relies on dynamic adaptation (2 km resolution over 72x72 points applied at 15 vertical levels) to take into account the local orographic influence. The Senj dynamic adaptation domain covers our present area of interest.

Although the atmospheric model is structured to provide fluxes of momentum, heat and moisture at the air-sea interface only wind stress has been routinely used in the present study, in a one-way fashion. Wind measurements available at several meteorological stations were used to check the validity of the forcing wind fields. Several bora episodes registered in January and February 2003 have been simulated. Wind field, potential vorticity, turbulent kinetic energy, potential temperature and relative humidity (among other variables) have been calculated and examined at selected vertical cross-sections. Their modelled behaviour in the lower troposphere in relation to orographic obstacles and island-provoked air lifting appears to explain observed intensification of the surface currents and circulation in the area during intense bora events.