Geophysical Research Abstracts, Vol. 7, 05862, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05862

Mesoscale-resolving simulations of summer and winter bora events in the Adriatic

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The DieCAST ocean model is used to simulate the circulation and variability in the Adriatic basin with a 2-km resolution, and reproduces the variability of filaments, meanders and eddies on the correct length and time scales. After an initial spin-up with climatic hydrography and Hellerman-Rosenstein winds, 4-km resolution COAMPS winds are used for simulating the effects that bora events have on the circulation and dynamics of the Northern Adriatic basin.

Because the response of the sea depends in large part on the existing stratification, two specific bora events were selected, one in summer (mid-August 2001) when initial vertical stratification was significant and the other in winter (mid-February 2003) when the waters were nearly well mixed over the vertical. The winter event was well captured by field data during the observational phase of the DOLCE VITA program and permits comparisons.

Results confirm an earlier theory that the wind-stress curl imparts vorticity to the surface waters and creates alternating cyclonic and anticyclonic gyres. The scenario is, however, more complicated as vertical mixing does not occur evenly and the wind-driven structures succumb to instabilities. In summer, the wind-driven jets remain on the surface, although some vertical mixing takes place in the upwind corners where bora jets originate. The northernmost jet originating from the Gulf of Trieste remains narrow and extends westward across the northern basin all the way to the Po River mouth, then becomes unstable and disappears. To the South, the jet originating from Kvarner Bay is comparatively wider and makes a pronounced anticyclonic turn, entraining surface Po River water eastward across the basin toward Istria. It, too, becomes unstable and generates finer mesoscale variability, which persists well after the

bora wind has ceased. The Western Adriatic Current (WAC) along the Italian coast undergoes a squeezing effect under bora and later relaxes with a set of growing meanders and eddies.

In winter, the absence of stratification in the northern basin distributes the wind-induced momentum over the entire depth of the sea. Although the general circulation pattern remains the same, currents are less strong and gyres more coherent. The near absence of baroclinicity limits decay to barotropic instability, which operates on longer scales than baroclinic instability does in summer. Also, the flow rate in the WAC is significantly intensified during winter bora.