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Ocean Science Discussions

Interactive comment on "Rapid subduction in the deep North Western Mediterranean" *by* J. A. Aguilar et al.

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This is an intriguing paper presenting novel data. I was interested to read the paper and I am sure it will be of interest to many oceanographers; so I hope that this work can be published. The manuscript raises a number of questions some of which need to be addressed before publication. These are:

1) A striking feature of the results is the very large vertical velocities that are reported. Because the results are unusual the authors need to describe clearly in the paper how the data have been processed and demonstrate that the error in the reported velocities is small compared to the signal. The authors present the "error" velocity, this gives an indication of the magnitude of the errors of the velocity in a coordinate frame fixed with the instrument. But there is very little mention of the attitude of the instrument (a few

words on l5 of p746). How was the correction for tilt and rotation made? Is it possible that there are biases in the attitude sensors?

2) The hypothesis that instabilities of a near-surface boundary current give rise to large vertical velocities O(1,000m/day) throughout the water column (including near the bottom) and that such motions rapidly subduct material from the surface to the bottom is a departure form the normally accepted understanding of such processes. Such a hypothesis needs to be examined in greater depth. Theoretical considerations and model studies (e.g. Nurser and Zhang 2000) suggest vertical velocities associated with baroclinic instability will have maximum amplitude at the depth of the thermocline and tend to zero at the surface and at the bottom (assuming that the bottom is flat). In fact, if the bottom is flat, then it would be reasonable to assume that there is uniform divergence of the horizontal flow beneath the thermocline and that the vertical velocity decreases approximately linearly with depth to zero at the bottom. So a vertical motion of 2cm/s 150 m above the bottom would suggest much larger motion in the water column above. This seems unlikely and leads to comment 3) below.

3) What is the topography around the mooring site? The data in Figure 2d around day 80 indicates that there is a large downward vertical velocity that is roughly uniform between 50m and 150m above the bottom. This suggests that either there is a very strong divergence of the horizontal flow in the bottom 50m or the bottom is sloping. The former would imply large vertical shear of the horizontal current and seems unlikely. Was the bathymetry at the deployment site surveyed? It is important to give details of the bathymetry around the mooring site. There appears (Figure 2c,d) to be a high correlation between the vertical velocity and the horizontal current speed and this too suggests that the vertical motion may be due to down slope flow, however, such a correlation could also arise from a bias in the tilt sensor. This should be investigated further by a quantitative comparison of the vertical velocity with the down- and along-slope flow speeds and the direction and tilt of the instrument.

4) Alternative hypotheses merit further examination. If the comments in 3) above are

correct then one also needs to consider why there is such a strong down-slope flow, sub-inertial flows usually go more along than down slope. The authors dismiss cascading flows in canyons but I think this merits further consideration. Are there canyons nearby? Although weaker events occur later in the year the strongest events are in winter and spring where cascading off shelf is most likely, debris flows are also possible throughout the year.

Interactive comment on Ocean Sci. Discuss., 7, 739, 2010.