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Can we uncover submesoscale vertical velocities from in-situ and satellite altimetry observations? Answers using a process study ocean model.

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Vertical motions associated with mesoscale and sub-mesoscale ocean features, such as fronts, meanders, eddies and filaments, play a critical role on the exchanges of heat, fresh water and biogeochemical tracers between the surface and the ocean interior. Direct observations of these vertical velocities are still lacking so they are usually computed from hydrographic data (through the omega-equation) or estimated by numerical models. In this study we have tested and compared these two methods to characterize vertical velocities in a context of submesoscale motions.

The Process Study Ocean Model (PSOM) has been implemented in an area of the Western Mediterranean Sea located in the south of Balearic Islands. This region is one of the calibration/validation and science sites, which will be targeted by in situ experiments during the wide-swath satellite altimeter (SWOT) fast sampling phase. For this reason hydrographic data were collected during the PRE-SWOT multi-platform experiment that took place in May 2018.

Model simulations have been initialized with CTD and glider data and were spinned up with a resolution up to 500m to resolve submesoscale. In this way it was possible to properly simulate the observed salinity gradient forming a meander between Mediterranean and Atlantic waters. Horizontal velocities derived from the model are in good agreement with ADCP and drifter observations in terms of patterns and magnitude.

The impact on vertical velocities, including the generation internal waves, of several parameters such as wind forcing (obtained from buoy data), and bathymetry is also explored. In addition, the validity of QG approximation is investigated implementing an omega equation solver in the model. Finally, we perform a sensitivity test using the model output to analyze the impact of the scales resolved by different configurations: present altimeter constellation, future coming SWOT and oceanographic campaigns.