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Detection of subsurface eddies from satellite observations

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This study aims to develop an index that allows distinguishing between surface and subsurface intensified eddies from surface data only, in particular using the sea surface height and the sea surface temperature available from satellite observations. To do this, we propose the use of a simple index based on the ratio of the sea surface temperature anomaly (SSTa) and the sea level anomaly (SLA). This index is first derived using an academic approach, based on idealized assumptions of geostrophic balance and Gaussian-shaped vortices. This index depends on the vertical extent (or decreasing rate) of the eddy and because of its sensitivity to the exact shape of the vortex, we were not able to evaluate these depths from the surface fields and our results remain qualitative. Then, in order to examine the pertinence and validity of the proposed index, SSTa and SLA were computed using outputs of a realistic regional circulation model in the Peru-Chile upwelling system where both surface and subsurface eddies coexist. Over a seven year simulation, the statistics shows that 71% of eddies are correctly identified as surface or subsurface intensified. Multi-core eddies are also largely present and represent an average of 37% of all vortices. These multi-core eddies contribute to a large number of the wrong identification (15%). Finally, the index was successfully applied on in-situ data to detect a previously observed subsurface-intensified Swoddy (slope water eddy) in the Bay of Biscay. This study suggests that the index can be successfully used to determine the exact nature of mesoscale eddies (surface or subsurface- intensified) from satellite observations only.