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High resolution surface circulation of the Mediterranean sea from the synergy between SSH and SST satellite observations

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Sea Surface Height (SSH) measurements provided by satellite altimeters have been widely used to recover surface velocities in the Mediterranean Sea. However, its sampling geometry and the presence of noise in the observations, restricts its spatial resolution and can induce important errors in the location of mesoscale features. On the contrary, Sea Surface Temperature (SST) measurements provided by infrared radiometers are able to accurately locate ocean structures and its higher spatial resolution allows to fully resolve Mediterranean mesoscales. Unfortunatelly, it is difficult to quantitatively retrieve ocean velocities. To overcome these limitations, we have developed a methodology to reconstruct the 3D ocean velocities based on the Surface Quasi-Geostrophic (SQG) equations that combine existing SSH and SST observations. Indeed, within the SQG framework, SSH and SST are closely related, which can be exploited to develop a synergetic approach that combines existing satellite measurements of SSH and SST. First, the validity of this approach has been assessed using numerical simulations of the circulation in the Mediterranean sea. And then, our methodology has been validated using in situ observations and independent altimetric measurements in the area. Results showed that the best reconstructions are obtained during winter, when SST is a proxy of the density anomaly below the Mixed Layer. Consequently, we have reconstructed winter surface circulation from the existing simultaneous Meteosat and Jason data and compared it with surface circulation retrieved from altimetric maps. Finally, we have also developed the methodology to retrieve high resolution vertical velocities from satellite observations exploiting the SQG approach. The methodology has been validated using numerical simulations and, resulting vertical velocities in the Mediterranean sea have been qualitatively compared to ocean color measurements.