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Mesoscale dynamics in the tropical atlantic ocean: characteristics and seasonal cycle

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In this study, an automatic eddy detection and tracking algorithm is applied to 23 years of daily satellite altimetry sea level anomaly data (multi-mission product) to characterize mesoscale eddies in the tropical Atlantic ocean (30°N-30°S). We first propose an index, based on the ratio between the potential vorticity gradient of the detected vortices (βvortex) and the local meridional gradient of planetary vorticity (β) that allows us to distinguish coherent vortices from wave-like structures. In the tropical Atlantic ocean, this index suggests that about 6% of the automatically detected structures are wave-like structures rather than coherent eddies and 80% of them are located in the southern hemisphere.

Then, from the analysis of more than 32000 coherent eddy trajectories, we show that eddies are mainly found in the subtropical regions compared to the equatorial area (5°N-5°S).The vortices are mainly generated both in the eastern part of the Atlantic ocean, especially in the Eastern Boundary Upwelling Systems (Canary and Benguela/Angola) and in the western part along the Brazil current (BC). They propagate westward almost zonally during several weeks, with velocities reaching 10-15 cm s-1 in the equatorial band (5°N-5°S), and less than 5 cm s-1 at higher latitudes. At the equator, some of these eddies can also propagate eastward within the North Equatorial Counter-Current with speeds weaker than 10 cm s-1. The detected eddies present generally amplitudes, radii and kinetic energies around 2-3 cm, 60-100 km and 50-100 cm2 s-2, respectively. The most energetic eddies are observed in the equatorial region, in particular in the retroflection of the North Brazil Current (NBC). The seasonal cycle of the main eddy characteristics (amplitudes, radii and kinetic energies) are then studied. A marked seasonal cycle is found along the NBC retroflexion offshore of the North Brazilian coast associated with the seasonal cycle of the circulation (currents).

Keywords: Mesoscale eddies, Tropical Atlantic ocean, altimetry, seasonal variability