Observations of Mesoscale Eddies in Satellite SSS and Inferred Eddy Salt Transport

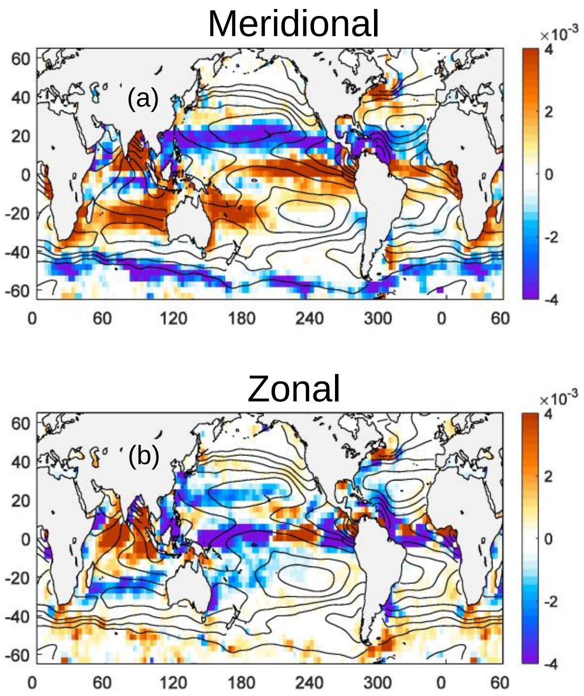

Figure 1. Eddy salt fluxes in the surface mixed layer estimated from SMAP SSS data. (a) Meridional salt flux. Positive (negative) values indicate northward (southward) salt flux. (b) Zonal salt flux. Positive (negative) values indicate eastward (westward) salt flux. Units are kg m^{-2} s^{-1} . Shown on top of each figure are contours of mean SSS (C.I. = 0.5 psu).

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Observations of sea surface salinity (SSS) from NASA's Soil Moisture Active-Passive (SMAP) and ESA's Soil Moisture and Ocean Salinity (SMOS) satellite missions are used independently, using two different analysis methods, to characterize and quantify the contribution of mesoscale eddies to the ocean transport of salt. Comparing the two missions, we find that the estimates of the eddy transport of salt agree very well, particularly in the tropics and subtropics. The transport is divergent in the subtropical gyres (eddies pump salt out of the gyres) and convergent in the tropics. The estimates from the two satellites start to differ regionally at higher latitudes, particularly in the Southern Ocean and along the Antarctic Circumpolar Current (ACC), resulting, presumably, from a considerable increase in the level of noise in satellite retrievals (because of poor sensitivity of the satellite radiometer to SSS in cold water), or they can be due to insufficient spatial resolution.

The study confirms that the eddy transport of salt (or, equivalently, freshwater) is an essential component of the marine hydrological cycle. The regions of major eddy transport of salt occur in the tropical belt, across the equatorward limbs of the subtropical gyres, and across the ACC.

Overall, the study demonstrates that the possibility of characterizing and quantifying the eddy transport of salt in the ocean surface mixed layer can rely on the use of satellite observations of SSS. However, new technologies are required to improve the resolution capabilities of future satellite missions in order to observe mesoscale and sub-mesoscale variability, improve the signal-to-noise ratio, and extend these capabilities to the polar oceans.

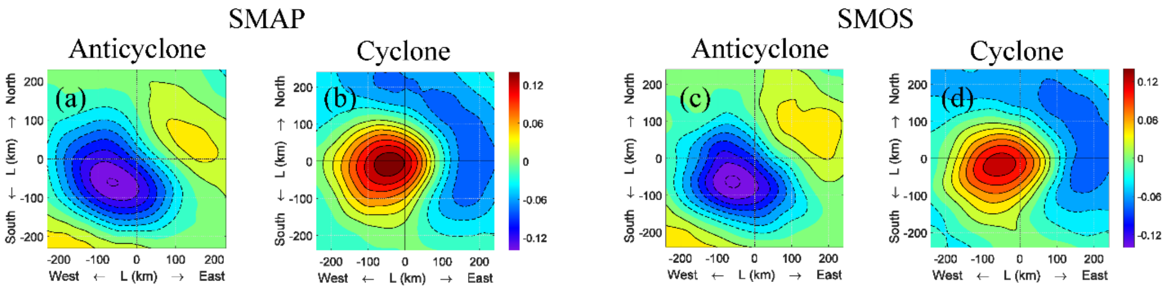

Figure 2. SSS anomalies (psu) associated with anticyclonic (a,c) and cyclonic (b,d) composite eddy in the South Indian Ocean (25-15º S, 90-100ºE). The left and right pairs of panels compare SMAP (left) and SMOS (right) SSS analyses. The two datasets result in virtually identical SSS anomaly patterns corresponding to an average eddy, despite the high level of noise and discrepancies in individual snapshots.