Evidence of a super-convergence zone in the subtropical Indo-Pacific Ocean

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In order to study the dynamics of marine debris at global scales, a non-stationary solution of particle trajectories based on Lagrangian diagnostics combined with an ocean reanalysis of surface currents is explored over the period 1985-2013. The methodology is based on determining the forward evolution of an initially homogeneous array of particles located on each grid point of the model (1/4° resolution). Results exhibit the relatively well-known five main convergence zones of surface aggregation, located in the subtropical regions and maintained by converging Ekman currents. However, two important differences relative to the present knowledge of these zones are evidenced by our analysis. First, the central position of the convergence zone in the south Indian Ocean is located in the eastern part of the basin, a displacement toward the East larger than 40° in longitude while its position in latitude remains similar (near 30°S). Second, in the Indo-Pacific Ocean, the present analysis reveals, for the first time, the permanent presence of a convergent dynamics connecting the south Indian and Pacific zones through the Great Australian Bight, the Tasman Sea and the southwestern region of the Pacific Ocean. Like the "super-gyre" that connects the thermocline waters of the subtropical gyres of the South Pacific, Indian, and South Atlantic Oceans, this surface "super-convergent" route connects the cores of the convergence zones of the Indian and Pacific Ocean. At timescales longer than 20-yr the results show a slow decrease in the accumulation rate of particles in the southeastern part of the Indian Ocean, while the concentration in the south Pacific region is still increasing after 29 years. By way of comparison, the rates in the three other convergence zones are stabilized after a 10-yr period. Implications for the dispersion of the marine litter and debris will be briefly discussed.