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Contribution of eddies to the salt transport in the global ocean as revealed by DRAKKAR eddy-resolving simulations

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The spatial distribution of salinity in the world ocean is governed by the ocean circulation that transports salt from evaporative subtropical regions to precipitation-dominated regions (at high latitudes and in the tropics). Observations suggest that in a steady state, up to 30. 10^6 kg/s of salt must be carried by circulation cells with correlated velocities and salinities, in order to compensate for the effect of surface forcings. This transport is both advective and diffusive, the diffusive component being mainly due to mesoscale eddies that are the most energetic agents of lateral mixing at the scale of ocean basins; however this eddy-driven transport cannot be quantified from observations alone.

A suite of global simulations at 1/12° resolution using the NEMO-based ORCA12 model have been performed by the DRAKKAR group. These simulations allow to calculate precisely the eddy contribution to salt transports resulting from the correlation between fluctuating velocities and salinities. At mid latitudes, 40°S and 40°N, the eddy salt transport reaches almost -10. 10^6 kg/s and 10. 10^6 kg/s respectively. This contribution almost as large as the transport by the mean circulation cells at 40°S and 40°N. The latitudinal structure of eddy salt transport agrees qualitatively with estimates from observations based on the hypothesis that mesoscale eddies diffuse high salinity anomalies away from the saline subtropical regions.

Sensitivity experiments demonstrate the robustness of these estimates with respect to atmospheric forcing datasets and numerical parameters, even though these differences between the simulations lead to significant modifications of the eddy distribution and western boundary current characteristics. The comparison with a global eddy-permitting simulation at 1/4° allows us to assess the dependency of the eddy fluxes on model resolution and on subgrid-scale parameterizations. Our calculation of eddy contribution to salt transport at the global scale demonstrates that eddies are likely to play a major role in the redistribution of salinity that is presently occuring due to anthropogenic climate change.