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# Use of an ensemble-based Method to study the Impact of the Geoid on Ocean Circulation

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Thanks to current and future gravity missions (CHAMP, GRACE, GOCE), the accuracy of geoid models is increasing rapidly. This offers the possibility to estimate an accurate dynamic topography from sea-level observations of satellite altimeters.

An estimate of global mean sea level, and the corresponding ocean circulation, is made by combining Jason-1 and TOPEX/Poseidon altimeter data with the French Ocean General Circulation Model OPA. We apply a novel, ensemble-based assimilation method which is straightforward to implement, and which accounts for non-linear processes in the ocean.

The ensemble is generated in several manners: by varying initial conditions, adapting mixing parameters, and perturbing wind-stress fields. The different approaches are compared and discussed. Our results indicate that errors in mixing parameterization can be corrected when geoid height is accurately known. As the dynamic response to errors in mixing parameterization can be highly nonlinear, this demonstrates the advantage of the ensemble method compared to more traditional assimilation methods which require linearization of the model physics. Likewise, our results indicate that the ensemble method is capable of reducing systematic errors in wind-stress forcing and/or initial conditions through assimilation of sea-level height.

Differences between dynamic topographies based on recent geoid estimates in combination with Jason-1 and TOPEX/Poseidon altimetry and those from ocean circulation models are large, and can be attributed to both geoid errors and inaccuracies of the ocean model. Realistic experiments point out that the a priori estimates of these errors determine the performance of the assimilation method.