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The latest gridded geoid products and altimeter-derived mean sea surface height fields are combined to constrain the mean dynamic ocean topography (MDT) in an observational assimilating ocean model, the Southern Ocean State Estimate (SOSE). Uncertainties in the small-scale MDT are accounted for with a prescribed error variance. Large-scale MDT errors are accounted for by solving for a smooth adjustment field. This adjustment field minimizes the impact of correlated errors in the geoid on the optimization, while providing a consistency estimate of SOSE to the MDT constraints. Structure in the estimated adjustment field is due to errors in the mean sea surface, the geoid, inconsistencies with the other constraints (e.g. Argo), or model errors (e.g. in the bathymetry). The adjustment field is negligible in regions where the model can be brought into consistency with the MDT constraint without having to alter the geoid or mean sea surface. The structure of the adjustment field highlights several prominent bathymetric features, including the Argentine Shelf, the Campbell Plateau, and the Kerguelen Plateau. However other notably complex areas, e.g. the Agulhas retroflection region, do not stand out. These results suggest a new way to merge MDT estimates with ocean state estimation.
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