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Using Dynamic Ocean Topography to probe Southern Ocean Circulation

Alexa Griesel, Sarah T Gille, Matthew R Mazloff, and Bruce Cornuelle
Scripps Institution of Oceanography, La Jolla, USA (agriesel@ucsd.edu)

Dynamic ocean topography (DOT) can be thought of as defining the mean streamfunction of the geostrophic surface flow in the ocean. Key Southern ocean circulation questions, such as eddy-mean flow interactions and Antarctic Circumpolar Current jet positions, depend on accurate knowledge of the DOT. The remoteness, complex topography, and significant variability of the Southern Ocean, however, make determining the DOT in the Southern Ocean difficult.

Satellite altimeters capture the time-varying component of sea surface height, but they are unable to separate the time-mean DOT from the time-invariant geoid. A range of strategies have been developed to compute the mean DOT, either from oceanographic temperature and salinity profiles, from surface drifter data, from gravity measurements, or from hybrid approaches including assimilating ocean state estimates.

Here, we quantify the differences between the suite of available geoids and corresponding DOT fields in the Southern Ocean and evaluate their biases and uncertainties. Available mean DOT fields differ substantially, particularly along the axis of the Antarctic Circumpolar Current frontal zones, near bathymetric features (such as Kerguelen Plateau). DOT products also differ in their depiction of small-scale features. These statistical intercomparions provide the basis for using the 1/6 degree assimilating Southern Ocean State Estimate model to assess which of the available DOT and geoid fields is most consistent with all other available Southern Ocean observations.