Geophysical Research Abstracts
Vol. 21, EGU2019-17120, 2019
EGU General Assembly 2019

Southern Ocean Circulation and Frontal Dynamics from Cryosat-2 Along-track Radar Altimetry

Erik Mackie (1,2), Rory Bingham (2), Paul Holland (1), and Michael Meredith (1)

(1) British Antarctic Survey, Cambridge, United Kingdom (eriie98@bas.ac.uk), (2) University of Bristol, School of Geographical Sciences, Bristol, United Kingdom

The Southern Ocean plays a key role in the global climate system. Due to a paucity of observations, however, there remain many uncertainties regarding the dynamics of its circulation. Here, the large-scale circulation of the Southern Ocean is investigated through the use of Dynamic Ocean Topography (DOT). The DOT can be calculated via the geodetic method, by subtracting a geoid from the sea surface height (SSH) measured by radar altimetry. The geoid in turn is obtained from global gravity models, which are constructed using gravimetry data, including from GRACE and GOCE.

This study presents a novel along-track DOT of the Southern Ocean, which is obtained by applying the geodetic DOT calculation directly to along-track SSH measurements from the Cryosat-2 radar altimeter, thus exploiting its increased spatial coverage of the Southern Ocean whilst also preserving the high resolution data inherent in the along-track SSH measurements. This along-track DOT calculation is performed using different geoids in turn, in order to investigate the differences in the DOT and geostrophic velocities obtained when using higher resolution combined gravity models, compared to those using lower resolution satellite-only gravity models.

The new along-track DOT is then used to analyse inter-annual and seasonal variability in the DOT and currents of the Southern Ocean, revealing relationships with the large-scale climate modes of the El Nino Southern Oscillation and the Southern Annular Mode. The physical drivers behind these links are shown to be related to variability in wind forcing and the time-variable ocean mass signal observed by GRACE. Additionally, the along-track DOT is used to detect locations of fronts and jets in the Antarctic Circumpolar Current, and to investigate inter-annual variability in these frontal positions. Increased inter-annual variability is observed in regions of weak bathymetric constraints, while frontal locations remain fixed in regions of tightly constrained bathymetry such as ridges or plateaus, where the fronts converge.