Geophysical Research Abstracts
Vol. 21, EGU2019-11826, 2019
EGU General Assembly 2019

Physical and Biogeochemical Structure of the Southern Ocean Eddies

Ramkrushnbhai Patel (1,2), Joan Llort Jordi (1,2), Sebastien Moreau (1,3), Peter G. Strutton (1,4), Helen E. Phillips (1,4), Andrew Lenton (5,6,7)

(1) Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia (ramkrushnbhai.patel@utas.edu.au), (2) Australian Research Council Center of Excellence for Climate System Science, University of Tasmania, Hobart, Australia, (3) Norwegian Polar Institute, Fram Centre, Langnes, Tromsø, Norway, (4) Australian Research Council Center of Excellence for Climate Extremes, University of Tasmania, Hobart, Australia, (5) Commonwealth Scientific and Industrial Research Organisation (CSIRO), Oceans and Atmosphere, Hobart, Australia, (6) Centre for Southern Hemisphere Oceans Research, CSIRO, Hobart, Australia, (7) Antarctic Climate and Ecosystems Cooperative Research Centre, University of Tasmania, Hobart, Australia

Space-based observations of temperature, altimetry and chlorophyll have provided great insight into the role of mesoscale eddies in the meridional transport of properties across the Antarctic Circumpolar Current (ACC) and their influence on biogeochemistry. To understand the influence of these eddies on the subsurface properties, composite studies have been conducted by combining altimetry with Argo profiles, along with several direct observations of eddy structure. While composite studies have successfully provided the mean structure of eddies, they are limited by the inherent assumption that each eddy has the same distribution of properties over its depth. Furthermore, composite studies can't explain the physical-biogeochemical interactions within the eddies. To address this gap, we conducted a comprehensive physical-biogeochemical survey of a mesoscale cold-core eddy during an expedition aboard RV Investigator in the late Austral spring, 2016. In this study, we utilized eighteen CTD profiles, six uninterrupted ADCP transects and a detailed transect across the eddy using an undulating towed vehicle.

The physical structure showed that long-lived cyclonic eddies transport about 21% of the required meridional heat flux across the Subantarctic Front (SAF) and the annual volume of freshwater carried into the Subantarctic Zone (SAZ) is of the same order of magnitude as that delivered by Ekman flux south of Tasmania. The biogeochemical structure showed that the eddy core was poor in particulate organic carbon and chlorophyll, despite high nutrients concentration and intense uplifting of isopycnals compared to its surrounding waters. This is against the common belief that cyclonic eddies are productive. We also observed high concentrations of oxygen below the mixed layer associated with high ammonium and nitrite concentrations. These nutrients are usually indicative of strong remineralization and low dissolved oxygen, suggesting an interplay between physical and biological processes. Compared to SAF waters where the eddy was originated, the eddy was lower in nitrate and phosphate but higher in silicate. Such eddies are commonly spawned from the SAF, and because 50% of them decay in the SAZ (the rest being reabsorbed by the SAF such as ours), they may represent a significant meridional transport for material across the ACC and may alter properties of SAZ waters.