Geophysical Research Abstracts
Vol. 18, EGU2016-14108, 2016
EGU General Assembly 2016

Biogeochemical characteristics of mesoscale eddies in the generation zone off Valparaíso, Chile

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The coastal area off Valparaiso is characterized by an intense mesoscale activity associated with eddies, which transport highly productive-coastal waters to the oligotrophic areas of the Subtropical Gyre. Among these, the Intrathermocline Anticyclonic Eddies (ITE's) which are forming in the eastern South Pacific, transport low oxygen- and high nutrients- subsurface water of Equatorial Subsurface Water (ESSW). These eddies have been well characterized in terms of generation rate, direction, speed and water transport. However, biogeochemical conditions in their origin and its temporal variability are not well assessed.

The present study aims to determine the variability, spatially and temporally, of the biogeochemical properties in the water column at the eddies generation zone, off Punta Ángeles, Valparaíso (33° S). For this, a monthly time series was conducted between January and August 2016 where a cross-shore transect with six-stations was deployed (from coast to 16 nm). Each station was sampled with CTD-OF, while only in station 5 (1300 m depth) was sampled in 16 depth for biogeochemical variables: nutrients (NO_3^-, NO_2^-, PO_4^{-3}, $Si(OH)_4$), greenhouse gases (CO_2, CH_4 and N_2O), chlorophyll a, stable isotopes in particulate organic material (^{13}C, ^{15}N), content of organic carbon and nitrogen in POM.

The spatial and temporal distribution shows the presence of subsurface cores (100 - 300 m) with water with high salinity ($>$ 34.7 psu) and low oxygen content ($<$ 0.5 mL·L^{-1}), associated with mesoscale subsurface structures. The largest vertical and horizontal extension of these structures was observed in January 2015. These subsurface structures showed a significant deficit of reactive nitrogen (N* $<$ -10 μM), nitrite accumulation ($>$ 0.6 μM) and the highest supersaturations of CO_2 (110 - 344%) and N_2O (107 - 407%). Along with this, the eddies generation zone presented a temporal variability of air-sea gases fluxes with the highest in the austral summer and autumn (from 67.64 to 9.12 mmol·m^{-2}·d^{-1}, from 3.00 to 0.94 μmol·m^{-2}·d^{-1}, and from 19.62 to 5.77 μmol·m^{-2}·d^{-1}, for CO_2, CH_4 and N_2O, respectively), while between June and August, the ocean-atmosphere flows were close to equilibrium (from 0.09 to -1.93 mmol·m^{-2}·d^{-1}, from 0.40 to 0.03 μmol·m^{-2}·d^{-1}, and from 0,29 to -0.02 μmol·m^{-2}·d^{-1}, for CO_2, CH_4 and N_2O, respectively).

Acknowledgment: This work is part of the PIA 037.474 Project (PUCV) and the Instituto Milenio de Oceanografía (IMO-Chile).