EGU2020-22115, updated on 27 May 2022
https://doi.org/10.5194/egusphere-egu2020-22115
EGU General Assembly 2020

Evaluating the signature of oceanic striations on the distribution of biogeochemical properties in the Eastern Pacific Ocean off Chile

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In recent years, quasi-zonal mesoscale jet-like features, also called "striations", have been ubiquitously detected in the time-mean circulation of the world ocean using satellite altimetry and in situ data. These alternating bands of eastward/westward flow are able to advect and mix physical properties. Yet, their impact on biogeochemistry, and potentially marine ecosystems, has not been assessed yet.

In eastern boundary upwelling systems, a mesoscale structuration of biogeochemical properties may be associated to striations through the interaction of zonal flows with sharp coastal-offshore background gradients (stirring). Transport patterns by mesoscale eddies (trapping) may also be involved as striations were noticeably suggested to result from the organization of the mesoscale eddy field as preferred eddy tracks in the eastern South Pacific upwelling system (off central Chile).

In this region, we evaluate the expression of striations in satellite records of ocean color and in a set of numerically simulated biogeochemical tracers (chlorophyll, carbon, primary production, oxygen, nutrients). A multi-decadal hindcast simulation of the physical-biogeochemical dynamics was run over the period 1984-2013 using the ROMS-PISCES (for Regional Oceanic Modeling System - Pelagic Interactions Scheme for Carbon and Ecosystem Studies) platform at an eddy-resolving resolution. High-pass spatial filtering is used to remove the large-scale signal in time-averaged satellite data and model outputs, and subsequently evaluate the match between striations and biogeochemical tracer anomalies in the model and observations. The relation between striations and the shape of the coastal-offshore gradient of the phytoplankton biomass and the oxygen-minimum zone is then deduced in the CTZ, and further in the open ocean region. The fraction of tracer anomalies associated to striations is quantified, and the respective potential role of stirring and eddy trapping is explored by matching quasi-zonal bands of sea level anomaly, geostrophic currents and biogeochemical tracers on moving frames of variable widths from 3 months to several years. The role played by eddy trapping is then confirmed by a composite analysis based upon automated eddy tracking.