

PhD subject 2016 – Physical Oceanography

CNES – EDSM

Statistics of vertical velocity field at submesoscale in the Southern Ocean : perspectives for SWOT

This project is in the context of the future spatial mission SWOT and in continuation of the PhD thesis of Thomas Jaud (CNES 2012-2015) performed in our team using data from the « Elephant seals oceanographers » CNES-TOSCA program (PI :C.Guinet). The original methodology developed in the thesis of T. Jaud enabled 1) the detection of sub-mesoscale SST fronts (1-10km) along the elephant seals trajectories (thousands of km) and 2) the analysis of elephant seals feeding behavior within these fronts. The results are outstanding and demonstrate for the first time with in-situ observations that elephant seals feed optimally in sub-mesoscale regions (Jaud et al. in prep).

A new data set at very high resolution is now available for salinity along elephant seals trajectories that gives an access to density. This new PhD project aims to take advantage of this unique dataset by combining satellite observations in order to calibrate and validate ocean dynamics reconstructions methods in sub-mesoscale regions.

For this we propose two complementary approaches to diagnose vertical velocities at sub-mesoscale (see attached details):

(1) The first approach will take advantage of the very high resolution vertical sections of density along the path of elephant seals. These sections will allow us to diagnose high resolution vertical velocity using the ω -equation (Legal et al. 2007; Chavanne & Klein, JPO in press) and to give statistics of the vertical velocity distribution at submesoscale. Moreover this approach will address questions about the water column vertical stability that is responsible of vertical velocities at sub-mesoscale (Thomson et al 2015).

(2) The second method is the eSQG (Lapeyre & Klein 2006, Klein et al. 2009), which requires knowledge of very high resolution SST field and vertical stratification. The SST field will be diagnosed from satellite data, stratification will be provided by the elephant seals (T.Jaud 2015).

The expected results of this PhD project will evaluate for the first time using in-situ data statistics on vertical velocities at fine scales in the Southern Ocean. They will allow to propose new and more optimal strategies to diagnose vertical velocities from available and future satellite data. This step is crucial in the SWOT program context. These results will also lead to increase our knowledge of elephant seal ecology at unexplored scales.

This thesis will be carried out under the supervision of P.Rivière (LEMAR, Brest) and P.Klein (LPO, Brest) and in collaboration with A.Ponte, B.Chapron and E.Autret (LPO), A. Thompson (CalTech., USA), F.d'Ovidio (LOCEAN, Paris), and C.Guinet (CEBC, Chizé). This research is part of LabexMer Axis 1 and 2.

Profile of applicant : Master in Physical Oceanography. Good background in Geophysical Fluid Dynamics, data processing and associated numerical tools.

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Important : because of co-financial support by CNES, the application is in two steps

1) Application to CNES from 15 January 2016 and **before 31 March 2016** on the CNES website.

Applications will not be considered after this date.

<https://cnes.fr/fr/web/CNES-fr/7418-bourses-de-recherche.php>

<https://cnes.fr/fr/les-ressources-humaines-du-cnes/statistiques-du-champ-de-vitesse-verticale-sous-mesoéchelle-dans>

2) Application to the Doctoral School of Marine Sciences (EDSM) will be performed on the EDSM website **no later than 25 March 2016** for examination and validation of the application.

<https://thesesenbretagne.ueb.eu/edsm>