

**Light on lantern fish:
A multisatellite and interdisciplinary approach to understand the pelagic
ecosystem of Kerguelen**

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Kerguelen Islands one of the largest populations of marine mammals and seabirds in the Southern Ocean. However, the pelagic ecosystem that sustains those populations is still poorly known. In this area, myctophids (small lantern fish) are suggested to play a major role as they constitute the main prey item for numerous top predators. This area is under the influence of the Antarctic Circumpolar Current (ACC), the most powerful and turbulent physical driver of the Southern Ocean. In order to elucidate the characteristics of this complex ecosystem, the MYCTO campaign (PI: Y. Cherel) was carried out in January 2014 in the area east of Kerguelen on board the Marion Dufresne. This campaign has benefited of near-real time regional multisatellite products (altimetry, ocean color, sea surface temperature and one SAR snapshot) produced and regionally optimised by CLS with support from CNES. The objective of this study was threefold: 1) examine the diversity and 3-dimensional distribution of myctophids, and also zooplankton, in this area, 2) study the influence of dynamic circulation of the ACC on the intermediate trophic levels, and 3) improve our understanding in environmental mechanisms structuring the predator-prey interactions.

In order to reach these objectives, an integrative approach of the ecosystem was adopted by using complementary methodologies to work at the frontier between ecology and physical oceanography (complementary skills of LOCEAN, CEBC, BOREA, LEMAR). The cruise used an adaptive sampling strategy based on Lagrangian multisatellite data analysis and capable of resolving the very dynamical mesoscale (~10-100km) environment of this region. Myctophids were sampled through “classical” pelagic trawling, and also for the first time in this area, active hydroacoustic data were continuously collected using bi-frequency echosounder to estimate the relative abundance over the study area. The oceanographic context was described through the deployment of instruments (XCTD in collaboration with the MAKER program of Y.H. Park, Bio-Argo profilers and drifters), jointly to the use of multisatellite images. These data were pivotal for the program since satellite images together with Lagrangian diagnostics were used to drive the sampling strategy in real-time during the cruise and to define properties of circulation in this area of the ACC. Simultaneously to the campaign, the predator component was examined through biologging of king penguins from Kerguelen using Argos devices providing real-time trajectories of animals, coupled to diving activity recorders.

The study of this important amount data is currently ongoing; however, preliminary analyses already suggest the influence of the Polar Front, of the mesoscale circulation and the thermocline on the distribution of intermediate trophic levels and on the foraging strategies of top predators. The physical environment, particularly the marine circulation, had a pivotal role in the structuring and distribution of myctophids and the foraging behavior of penguins simultaneously tracked during the cruise. The age and the origin of the different water masses occurring around the Kerguelen plateau were investigated to explain the observed pattern of resources and predator together with their

trophic interactions. The influence of submesoscale fronts on biological distribution was especially examined in the Kerguelen area. Physical processes identified from satellite-derived diagnostics are suggested to be of primary importance to understand mesoscale ecosystem functioning and potentially identify areas of high ecological significance. The expected results should substantially improve our knowledge on the coupling between physics and ecology, and particularly on the structuring of the high trophic levels of marine ecosystems (zooplankton, small pelagic fish and top predators) and their multiscale variability.

Title of the figure:

Interdisciplinary campaign MYCTO: to the left, ship trajectory overlaid on turbulent mixing circulation obtained from Lagrangian satellite data reanalysis in the area to the east of Kerguelen plateau; to the bottom right, pelagic trawl used during the campaign; to the middle right, king penguin (*Aptenodytes patagonicus*) from Kerguelen; to the up right: sampling of myctophid (*Electrona carlsbergi*).