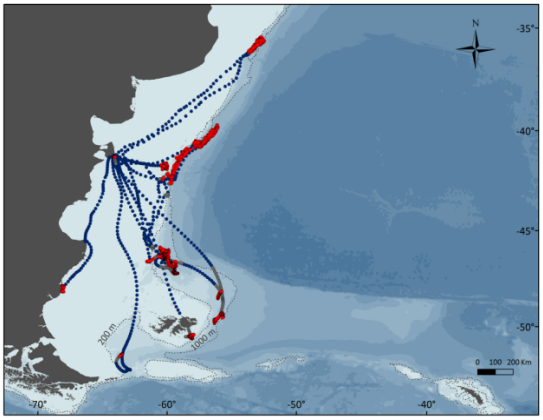
**Regional ecosystems & physical process in the Southwestern Atlantic**

PhD Subject Announcement




Interested candidate please send a one page motivation letter and a CV to Christophe.GUINET@cebc.cnrs.fr and to saraceno@cima.fcen.uba.ar **before 15 of February 2019**.

**Main goals:**

- Establish the main drivers of the large productivity observed over the Patagonian Shelf-Break (PSB).
- Evaluate the differences in the elephant seal prey occurrence according to oceanographic features and foraging success by female elephant seal according to their foraging habitat (PSB versus oceanic waters).

**Framework:**

As part of a collaboration between CNRS (France) and World Conservation Society (www.wcs.org) 9 seals have been instrumented from October-January 2018 with Argos and GPS tags including Temperature, Conductivity, Pressure and Fluorimeter (for 5 of them) and light sensors. This parameters are sampled at 0.5 hz continuously through a 3 month period with the exception of fluorescence profiles which are measured (4 time a day) but light attenuation allow to reconstruct chlorophyll-a concentration profiles through daylight hours (Bayle et al. 2015). In addition, high frequency (1,5 MHz), low energy active micro-sonars have been deployed to assess zooplankton and micro-nekton density within the water column while bioluminescence events are detected using highly sensitive high frequency light sensors (5 seals). Furthermore, acoustic tags fitted with pressure sensor, accelerometers and magnetometer were deployed in two seals allowing estimating wind strength and direction as well as swell frequency and amplitude. Real time low resolution CTD-F data are being acquired via the Argos system while High-resolution data will be available after recovery of instruments.

**Background:**

Along the Patagonian shelf-break color images show chlorophyll-a concentration as large as those present on eastern boundary upwelling systems. This productivity spreads throughout the food-web, reaching top predators and significant fisheries. Along the continental slope flows the Malvinas Current (MC), the northernmost extension of the Antarctic Circumpolar Current that carries cold and nutrient-rich waters. The MC is thought to be a major source of nutrients to the SW South Atlantic. The interaction of the

MC with the sloping bottom is presumably responsible for sustaining upwelling along the shelf-break. There are three main mechanism that have been proposed to explain the large concentration of chlorophyll-a values observed: (i) numerical and analytical models indicate that the upwelling intensity is modulated by the MC transport; (ii) the propagation of internal waves along the shelf-break might supply regularly nutrients to the euphotic layer and (iii) wind stress might cause divergence and thus induce the vertical currents that bring the necessary nutrients to the surface. Apart from the numerical models and the use of satellite data, the quantification of the above mechanism with in situ data has been elusive so far. The current PhD subject proposes to use a unique data set that is being collected by elephant seals with the main goal of helping untangle the physical forcing that might explain the large productivity observed over the PSB. Also, the PhD candidate will address the following ecological questions:

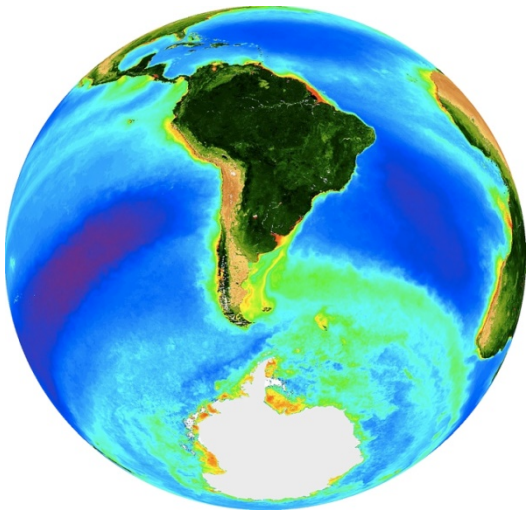


Figure 1: Mean austral summer satellite-derived chlorophyll-a concentration (source: http://oceancolor.gsfc.nasa.gov). Colors indicate concentration values with blue and purple for low values (<0.1 mg/$m^3$), green, yellow and red for intermediate (<0.5 mg/$m^3$), large (<1.5mg/$m^3$) and very large (>1.5 mg/$m^3$) values, respectively. The yellow band offshore Argentina corresponds to the shelf-break front. The PCS is comprised between that front and the South American continent.

1) Does differences in the oceanographic context of the foraging habitat visited by southern elephant seal females result in different structure in biological communities and prey items being targeted (benthic versus pelagic) by the seals?

2) How the different trophic levels (phytoplankton, intermediate trophic levels, elephant seal prey) are structured within the water column according to the oceanographic conditions associated with the foraging habitat (Patagonian shelf, Patagonian Shelf Break, and oceanic water beyond the MC) targeted by southern elephant seal females?

The assessment of the different trophic levels will be performed from the following measurements:
- Phytoplankton: fluorescence measurements completed by phytoplankton concentration profiles assessed by light attenuation profile (see Bayle et al. 2015)
- Intermediate levels (i.e. zooplankton, gelatinous organisms…): active echo sounding from the µ-sonar (Goulet et al. submitted) combined with the assessment of bioluminescence form the high sensitive light sensor (Campagna et al. 2001, Vacquié-Garcia et al. 2012 and 2017).
-Elephant seal prey: Prey Catch Attempt and prey size will be assessed from the processing of the acceleration signal recorded during the dive (Guinet et al. 2014).

**Suggested references:**

Bayle S., Monestiez P., Nerini D, Guinet C. (2015) Moving toward finer scales in oceanography: predictive linear functional model of chlorophyll a profile from light data. Progress in Oceanography. 134:221-231. Doi: 10.1016/j.pocean.2015.02.001

Campagna, C., J. Dignani, S. B. Blackwell and M. R. Marin (2001) Detecting bioluminescence with an irradiance time depth recorder deployed on southern elephant seals. Mar. Mammal Sci.: 17: 402-414.

Carranza, M. M., S. T. Gille, A. R. Piola, M. Charo, and S. I. Romero (2017), Wind modulation of upwelling at the shelf-break front off Patagonia: Observational evidence, J. Geophys. Res. Oceans, 122, 2401–2421, doi:10.1002/2016JC012059.

Guinet C., Vacquié-Garcia J., Picard B., Bessigneul G., Lebras Y., Dragon A.C., Viviant M., Arnould J.P.Y., Bailleul F. (2014) Southern Elephant Seal foraging success in relation to temperature and light conditions: insight on their prey distribution. Marine Ecology Progress Series. 499:285-301.

Matano, R. P., & Palma, E. D. (2008). On the upwelling of downwelling currents. Journal of Physical Oceanography, 38(11), 2482-2500.

Paniagua, G. F., Saraceno, M., Piola, A. R., Guerrero, R., Provost, C., Ferrari, R., et al. (2018). Malvinas Current at 408S–418S: First assessment of temperature and salinity temporal variability. Journal of Geophysical Research: Oceans, 123. https://doi.org/10.1029/2017JC013666

Saraceno, M., C. Provost, and A. R. Piola (2005), On the relationship between satellite-retrieved surface temperature fronts and chlorophyll a in the western South Atlantic, J. Geophys. Res., 110, C11016, doi:10.1029/2004JC002736.

Vacquié-Garcia J., Royer F., Dragon A.C., Viviant M., Bailleul F., Guinet C. (2012) Foraging in the darkness of the Southern Ocean: influence of Bioluminescence on a deep diving predator. PLoS ONE 7(8): e43565. doi:10.1371/journal.pone.0043565

Vacquié-Garcia J, Mallefet J, Bailleul F, Picard B, Guinet C (2017) Marine Bioluminescence: Measurement by a Classical Light Sensor and Related Foraging Behaviour of a Deep Diving Predator. Photochemistry and Photobiology. https://doi.org/10.1111/php.12776

**Requirements:**

Motivation for field work. Availability to travel and live abroad for several months. Good domain of written and oral English. Must accomplish PhD grant requirements (see below). Knowledge of physical oceanography & of an advanced programming language (as Matlab, Pyhton or R) preferred.

Candidate selected will be presented to obtain a grant with the following agencies in the dates specified:

- UBA, deadline to submit candidature: March 2019. Expected to begin in September 2019. http://cyt.rec.uba.ar/Paginas/Financiamiento/Becas/UBACYT/Convocatorias/2019.aspx
- CONICET, deadline to submit candidature: June-July 2019. Expected to begin in April 2020. https://convocatorias.conicet.gov.ar/becas/
- CNRS, according to availability.

PhD thesis will start as soon as we have a positive notice from one of the grants. Successful candidate will work at the *Instituto Franco-Argentino sobre Estudios de*

*Clima y sus Impactos* (UMI-IFAECI, http://www.cima.fcen.uba.ar/UMI/) in Argentina and at the *Centre d'Etudes Biologiques de Chizé* (CEBC, www.cebc.cnrs.fr) in France.

Advisors: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