FINAL REPORT PROGRAM LEFE

Program LEFE/ GMMC	Project Title **South Eastern Pacific Circulation from Argo Floats (SEPICAF)**	Years 2019 – 2022
PI: Boris Dewitte, dewitte@cerfacs.fr, CECI/CERFACS Participating Laboratories : LEGOS (France), CEAZA (Chile), Universidad Catolica del Norte (Chile), University of Concepcion (Chile), IGP (Peru)	Contribution to Argo and TPOS2020 Other funding sources : ANID (Chilean National Agency for Research and Development), TASA (Peru)	

Context

The South East Pacific remains historically under sampled despite the fact that climate and forced ocean models have persistent biases in this region. There is a critical need to implement a perennial observing system to gain insights in processes controlling the ocean circulation at a variety of timescales. This region is in particular under the influence of the most emblematic marine heat wave of the planet, the El Niño Southern Oscillation that modulates many features of the circulation, including one of the most extended oxygen minimum zone (OMZ).

Objectives / scientific questions

SEPICAF has been devoted to enhancing our understanding of the processes controlling the OMZ natural and forced variability based on the experiment with a regional coupled biogeochemical model and the analysis of Earth System models participating to the CMIP (Coupled Model Intercomparison Project, Phases 5 and 6). SEPICAF also had the mission to increase the density of Argo buoys along the coasts of Peru and Chile in accordance with the recommendations of the TPOS2020 program for its Eastern Pacific component.
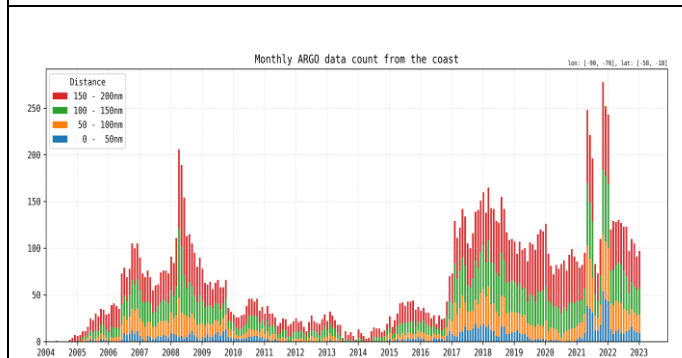

Figure 1: Evolution of the number of Argo vertical profiles along the coast of Peru within a costal fringe of 200 nautic miles between 2004 and 2022. The color code refers to the distance from the coast. Note peaks in 2021 and 2022 that are associated with the 17 SEPICAF floats.

Figure 2: Snapshot of oxygen concentration at 155m (top) and along a section at 30°S (bottom) as simulated by a regional coupled biogeochemical model (CROCO-BioEBUS) at the resolution of 3km.
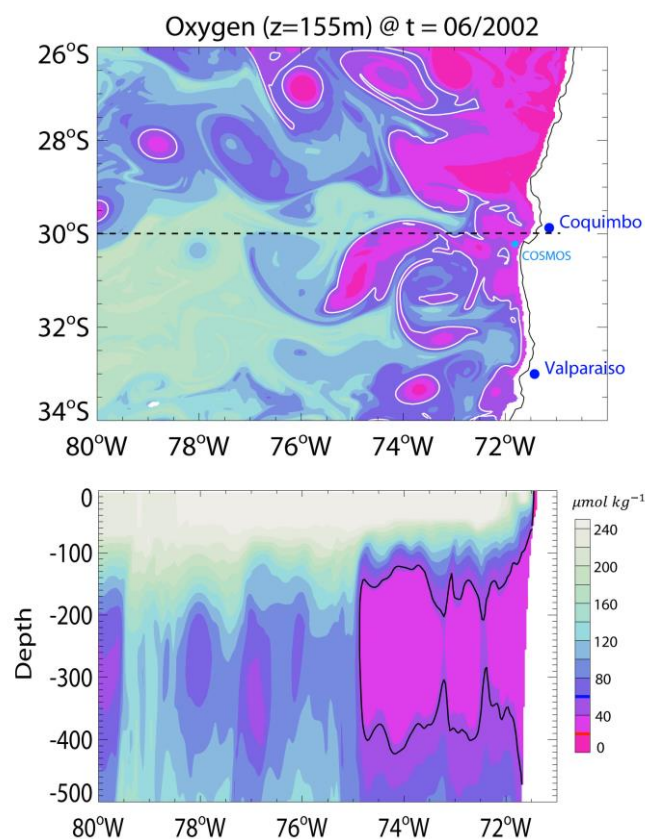
Main results : SEPICAF has been instrumental in uniting the community around the objectives of the TPOS2020 program for its Eastern Pacific component, in particular by mobilizing oceanographic institutes and key partners in the region to deploy the Argo floats. This yielded a significant increase in data (see figure 1). Through its modeling development, SEPICAF has also contributed to scientific breakthroughs. For instance, SEPICAF work indicates that the upper OMZ in the South Eastern Pacific is more likely to shrink than to expand in a warmer climate (Almendra et al., to be submitted). SEPICAF also provided to the community unprecedented multi-decadal high-resolution simulations of the OMZ variability (Figure 2) that served for process and impact studies, as well as training activities.

Future of the project : A second phase of SEPICAF has been recently funded by LEFE-GMMC. SEPICAF products (simulations) are also currently being used in the frame of various projects (e.g. CLAP (https://oceandecade.org/actions/research-program-for-climate-action-planning/), which will enhance its outcomes.

Number of publications, communications and theses

Main publications:

Dewitte B., Conejero C., Ramos M., Bravo L., Garçon V., Parada C., Sellanes J., Mecho A., Muñoz P. and C. Gaymer, 2021: Understanding the impact of climate change in the oceanic circulation in the Chilean oceanic islands ecoregions. Aquatic Conservation: Marine and Freshwater Ecosystems. https://doi.org/10.1002/aqc.3506

Pitcher G.C., et al. (2021). System controls of coastal and open ocean oxygen depletion. Progress in Oceanography, https://doi.org/10.1016/j.pocean.2021.102613

Grégoire M, Garçon V, et al. (2021) A Global Ocean Oxygen Database and Atlas for Assessing and Predicting Deoxygenation and Ocean Health in the Open and Coastal Ocean. Front. Mar. Sci. 8:724913. doi: 10.3389/fmars.2021.724913

Conejero C., B. Dewitte, V. Garçon, J. Sudre and I. Montes, 2020: ENSO diversity driving low-frequency change in mesoscale activity off Peru and Chile, Scientific Reports, 10, 17902. https://doi.org/10.1038/s41598-020-74762-x

Sprintall, J., S. Cravatte, B. Dewitte, Y. Du and A. Sen Gupta, 2020: Oceanic Teleconnections, chapter 15 in "El Nino in a Changing Climate" AGU Book, ISBN: 978-1-119-54816-4, 528 pages.

Main communications

Ocean Observing System Report Card 2021 (https://www.ocean-ops.org/reportcard2021/)

US CLIVAR workshop on Tropical Pacific Observing Needs to Advance Process Understanding and Representation in Models, 24-26 may 2021 (on-line): Yolande Serra and Boris Dewitte: Review of Tropical East Pacific Air-Sea Interface, Ocean and Atmospheric Parameter Spread in Observations, Reanalyses and Coupled Models (Poster)

WMO Technical webinar: Strengthening ocean observations and data exchange in the Southeastern Pacific, 1 December 2021 (on-line): Boris Dewitte and Yolande Serra: Current initiatives to implement TPOS 2020's recommendations for the eastern Pacific (invited talk)

The 53rd International Colloquium on Ocean Dynamics 3rd GO2NE Oxygen Conference - 15-20 May 2022, Liege, Belgium: Dewitte B.: ENSO-induced OMZ variability in the South Eastern Pacific (invited talk)

The Tropical Pacific Observation System meeting, 17 May, 2022, on-line. Dewitte B. and Yolande Serra: Eastern Pacific Task Team Reflections.

Thesis:

Pizarro-Koth Matias, 2021: Seasonal to interannual variability of the transport by the Peru-Chile under Current and its relationship dissolved oxygen off central Chile (30°-38ºS). PhD thesis defended the 19th of July, 2021

Carlos Conejero, 2021: Impact of climate change on the oceanic circulation in the Eastern Boundary Upwelling Systems of the Southern Hemisphere. PhD thesis defended on the 26th of June 2021.

Ivan Almandra, 2020: Variability in sedimentary core data in central Chile: interpretation in terms of oxygenation processes at inter-annual and inter-decadal timescales. Diploma of Professional Empowerment of the University of Concepcion. Defended the 2nd of September, 2020

Data availablility
Data are available via the Coriolis web site or the Euro-Argo web site (https://www.euro-argo.eu/Argo-Data-access). Model simulations are available from the PI on reasonable request.