Funded Research Opportunities

ENSO-Climate Change and the Carbon cycle in the Pacific South East (ECLIPSE)

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Research: We are looking for highly motivated undergraduate and graduate students, as well as postdoctoral fellows, willing to conduct their research theses/work investigating the carbon dynamics and fate in the Large Chile-Peru Upwelling Ecosystem and their relationship with the diversity of the El Niño Southern Oscillation (ENSO) in different climate conditions. Candidates will join a multidisciplinary group of highly qualified and motivated researchers.

This multidisciplinary research proposal is aimed at providing the necessary information for interpreting historical data sets, including proxy data,, interpreting the new generation of Global Earth System Models (CMIP6) and for better understanding the sensitivity of the carbon cycle to global warming in an emblematic Eastern Boundary Upwelling system. Additionally, the project is oriented towards improving a regional biogeochemical-coupled model by incorporating fine-tuned parametrizations of key processes of the carbon cycle.

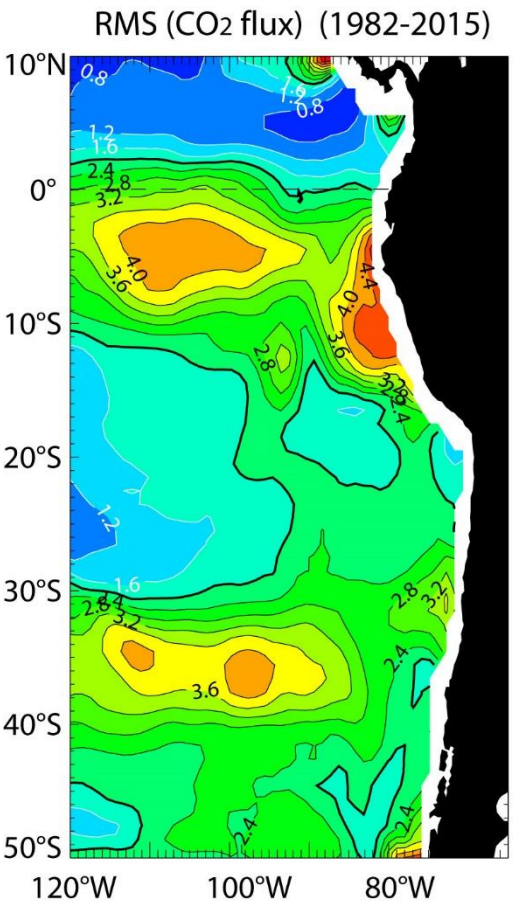

Figure 1. Standard deviation of total surface downward CO_2 flux (kg m^{-2} s^{-1}) over 1982-2015.

We are looking for highly motivated undergraduate and graduate students as well as postdoctoral fellows interested in the three following topics:

Biological oceanography and Carbon cycle

Desirable/necessary skills:

- Experience in handling/managing oceanographic time series
- Interests in processes associated with carbon flows
- Experience in upwelling systems
- Questions? Please, contact Drs. Victor Aguilera and Ruben Escribano **victor.aguilera@ceaza.cl and ruben.escribano@imo-chile.cl**

Chemical oceanography

Desirable/necessary skills:

- Analytical chemistry, carbon chemistry, ocean acidification.
- Carbon related biogeochemical processes in the water column and sediments
- Experience in upwelling systems
- Carbon chemistry measurements
- Questions? Please, contact Drs. Práxedes Muñoz and Victor Aguilera **praxedes@ucn.cl and victor.aguilera@ceaza.cl**

Physical oceanography and biogeochemical coupled modeling

Desirable/necessary skills:

- **Knowledge in tropical** dynamics and eastern boundary upwelling systemsExperience in regional ocean modeling withcommunity models (preferably CROCO)
- Interests in processes associated with oxygen and CO2 oceanic variability

- Questions? Please, contact Dr. Boris Dewitte **boris.dewitte@ceaza.cl**

We expect to provide support to 7 undergraduate student positions, 2 graduate student positions, and 3 postdoctoral fellow positions.

Application method: Please submit an intention letter, CV, and the names of two reference contacts or letters (postdoctoral fellows only) to Miss. Paulina Castillo (paulina.castillo@ceaza.cl) and a copy to Dr. Victor Aguilera (**victor.aguilera@ceaza.cl**)

Start- end dates: April 2022- April 2024. **Application deadline:** April 01 2022.

RESEARCH PROJECT ABSTRACT

The relation between the high diversity of the warm (El Niño, EN) phase of El Niño Southern Oscillation (ENSO) and the hydrographic-oceanographic perturbations affecting the carbon dynamics in the Large Chile-Peru Upwelling Ecosystem (LCPUP) remains largely unknown. The carbon dynamics and fate in this region entail contrasting global climate repercussions, while paucity of long-term and homogeneous data sets prevent the detection of the progression of climate change fostering expansion of hypoxia and ocean acidification. Global warming induced-changes in mean circulation (i.e., increased stratification, enhanced Hadley circulation) combined with increased occurrence of extreme climate events (El Niño, Marine heat waves) may reduce the efficiency of the carbon pump within the LCPUP. To test this hypothesis, the ENSO-Climate Change and the Carbon cycle in the Pacific South East (ECLIPSE) project is aimed at: i) investigate the characteristics of the oceanic ENSO teleconnection on the carbon dynamics from available in situ observations, global Earth System Models (ESM) databases (e.g. CESM-LE, CMIP6) and from the experimentation with a regional biogeochemical coupled model, ii) document the sensitivity of the ENSO-induced variability in the carbon dynamics on mean state conditions based on regional model experiments, global ESM and data in key upwelling centers, and iii) perform and analyze results of goals 1 and 2 in long-term regional simulations using idealized boundary forcing corresponding to different climate conditions as inferred from global model projections. This fundamental information is viewed as a prerequisite for providing guidance for model development and improvement, and yielding a better understanding of the role of external forcing onto the complex of processes mediating ocean carbon dynamics in the ENSO-LCPUP dynamics. ECLIPSE is also motivated by the need to evaluate uncertainty in current-generation global climate projections.

Specific objectives:

- ✓ Investigate the characteristics of the oceanic ENSO teleconnection on the carbon dynamics from available in situ observations, global ESM databases (e.g. CESM-LE, CMIP6) and from the experimentation with a regional biogeochemical-coupled model.
- ✓ Contribute with the synthesis of carbonate system data sets from the entire region the west coasts of North and South America by compiling available hydrographic and ocean carbon chemistry related data under contrasting ENSO variability in the LCPUP.
- ✓ Document processes of the influence of extreme temperature events (e.g. ENSO, regional climate
- ✓ modes, Marine Heat Waves) on the carbon dynamics in the LCPUP based on regional model experiments, global ESMs and data in order to identify key sensitivity processes to mean state conditions.
- ✓ Perform and analyze results of goals 1, 2 and 3 in long-term regional simulations using idealized boundary forcing corresponding to different climate conditions as inferred from global model projections.

To do so, we will tuning of the biogeochemical models (BioEBUS and PISCES) with historical data, document and analyze the evolution of historical strong Eastern Pacific El Nino events (1972/73, 1982/82, 1997/98 and 2015/16) and strong La Niña events (1998/98, 2011/12) based on hindcast runs

with the regional biogeochemical model simulations, and perform sensitivity experiments to mean state changes. Additionally, we will synthesize hydrographic and carbonate system related data from the entire region the west coasts of South America under variable ENSO activity by compiling available hydrographic data. We also will characterize current variations in ocean carbon chemistry by means of continuous and discrete oceanographic measurements, with emphasis on elucidating the progression rate of ocean acidification in the LCPUP.

We will establish an integrative training program for student and young scientists in coupling biogeochemical trends and biological effects and current generation of global-regional models to promote a national and international convergence on integrating carbon dynamics in the LCPUP to global climate predictions. To do so, we will interact with Chilean institutions as well as colleagues from the NOAA (US), LEGOS (France) and JAMSTEC (Japan).