

## Report for the year 2017 and future activities

### SOLAS Peru

**compiled by: Michelle Graco**

*This report has two parts:*

- **Part 1:** reporting of activities in the period of January 2017 – Jan-Feb 2018
- **Part 2:** reporting on planned activities for 2018/2019 and 2020.

*The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan. As much as possible, please indicate the specific SOLAS 2015-2025 Science Plan Themes addressed by each activity or specify an overlap between Themes or Cross-Cutting Themes.*

- 1 Greenhouse gases and the oceans;
  - 2 Air-sea interfaces and fluxes of mass and energy;
  - 3 Atmospheric deposition and ocean biogeochemistry;
  - 4 Interconnections between aerosols, clouds, and marine ecosystems;
  - 5 Ocean biogeochemical control on atmospheric chemistry;
- Integrated studies;**  
**Environmental impacts** of geoengineering;  
 Science and society.

**IMPORTANT:** *This report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups, cities).*

#### **PART 1 - Activities from January 2017 to Jan/Feb 2018**

##### **1. Scientific highlight**

###### ***OMZ and upwelling system variability***

A new study of the OMZ of the Humboldt system, particularly off Peru reveal a rich spectrum of variability in the OMZ that includes frequencies ranging from seasonal to interannual scales not observed before. A monthly time series (1996–2011) recorded off the coast of Callao (12 020 S, 77 290 W) by the Instituto del Mar de Peru (IMARPE) confirm the efficient oceanic teleconnection off Peru and the equatorial Kelvin wave activity. Two OMZ regimes were observed: a “strong” regime associated with the strong 1997–1998 equatorial Pacific El Niño and biogeochemical properties largely constrained by the wave-induced downwelling conditions reflected in extreme oxygenation, reduced nutrient availability and decreased nitrogen loss processes.; and a “weak” regime corresponds to the post-2000 period associated with the occurrence of moderate central Pacific El Niño events and less intense downwelling conditions that determine a less intense OMZ (oxygen concentration increases weakly) and a higher nitrate concentration, and nitrogen loss processes appear not to be significant.

The data also reveal a long-term trend from 1999 corresponding to a deepening of the oxygen deficient waters and warming. This is in contrast to the long-term deoxygenation trend over the last decades in the eastern tropical Pacific observed by Stramma et al. (2008, 2010). This results suggests that either the low-frequency oxygen variability in the coastal area could be not representative of the low frequency changes in the offshore OMZ.

*The OMZ and nutrient features as a signature of interannual and low-frequency variability in the Peruvian upwelling system*  
*Biogeosciences*, 14, 1–17, 2017. <https://doi.org/10.5194/bg-14-1-2017> 2017 M. Graco, S. Purca, B. Dewitte, C. Castro, O. Morón, J. Ledesma, G. Flores, and D. Gutiérrez.

## 2. Activities/main accomplishments in 2017 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, social sciences, and media).

### 2.1 KOSMOS PERU 2017 A MESOCOSM EXPERIMENT IN OXYGEN-MINIMUM ZONE OFF PERU

The aim of this project is to study the impacts of increasing deoxygenation/acidification on the ecology and biogeochemistry of the Peru upwelling system. It is expected that this will have major implications for the functionality and productivity of the upwelling system, with potential cascading effects on the food web and fishery harvest. This complex system has been captured by scientists in “giant test tubes” off the coast of Peru: In an experiment with the KOSMOS mesocosms (KOSMOS: Kiel Off-Shore Mesocosms for Ocean Simulations), they monitor how the declining oxygen influences the productivity of plankton and material cycling in the upwelling region off Peru.

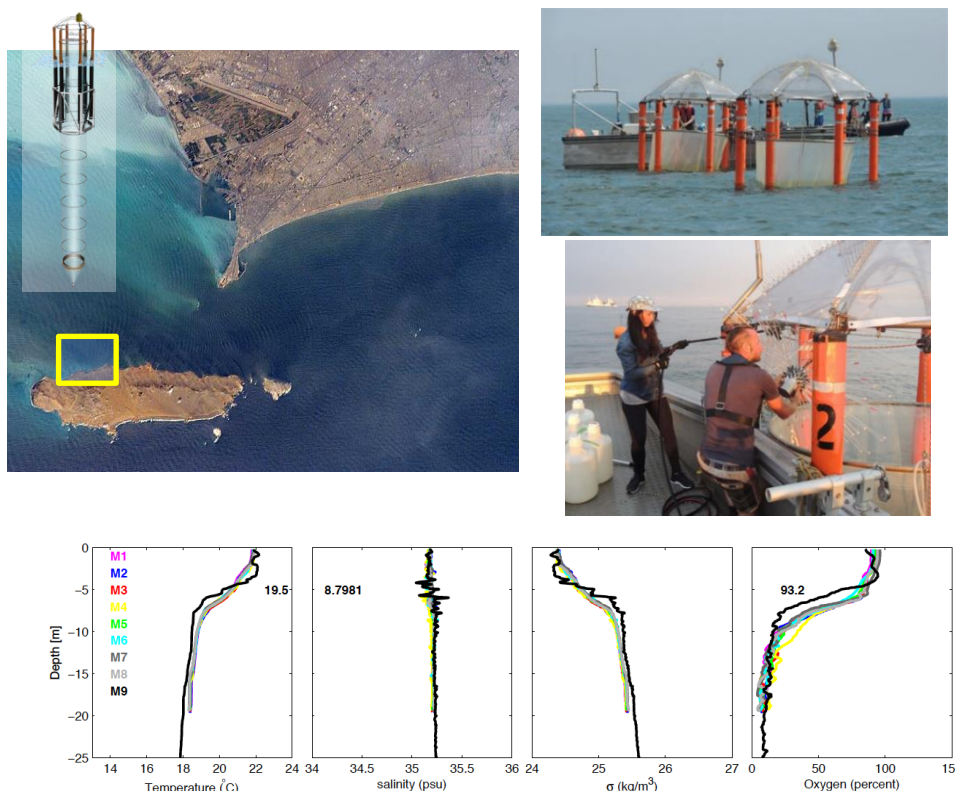


Figure: Mesocosm location (8 platforms), sampling activities and CTD preliminary data. Photos courtesy of Ulf Riebesell (GEOMAR).

A team of 23 Peruvian and 49 Chilean, Ecuadorian, Brazilian, US American, Australian, Spanish, Finnish, Austrian and German researchers has set up their base near the city of Callao. The marine research institute IMARPE (Instituto del Mar del Perú), Callao University, San Marcos University and Cayetano Heredia University together with local authorities and the Peruvian navy as well as the research vessel HUMBOLDT and the navy tug MORALES support the study, which takes place in

the context of the Kiel Collaborative Research Center (SFB) 754 “Climate – Biogeochemical Interactions in the Tropical Ocean”.

The deployment of the experiment occurs at the end of February, and water masses containing a plankton community typical for the region and time of the year was enclosed in the mesocosms. Two different types of deep water: one from a slightly oxygen-deficient area and one from a very low oxygen area, which also contains extremely little nitrogen, but larger amounts of phosphorus and iron were injected in the experiments. Daily sampling and measurements were obtained in order to observe how the productivity in the mesocosms temporarily increases before the system returns to nitrogen limitation. Based on their investigations, the researchers will be better able to predict how this highly productive marine ecosystem will develop in response to climate change.

Citation: GEOMAR Press Release 18/2017 Declining oxygen – is Humboldt’s nutrient boost at risk? Experiment with the KOSMOS mesocosms in Peru ([https://www.geomar.de/uploads/media/pm\\_2017\\_18\\_KOSMOS2017\\_en.pdf](https://www.geomar.de/uploads/media/pm_2017_18_KOSMOS2017_en.pdf))



2.2 1<sup>st</sup> Latino-American Symposium of Ocean Acidification- LAOCA Network. October 24-26 2017. Buenos Aires- Argentina.

By the first time the Latin-American community of ocean acidification participate in a symposium in order to share the advances in research and exchange discussion about action lines of cooperation. More than 70 people from different countries including, Chile, Brazil, Argentina, Perú, Costa Rica, Colombia, México, Cuba, EEUU, UK, France. The presentations and posters including Environmental and biological monitoring studies, models, experiments and some approaches from the economic-social sciences.

### 3. Top 5 publications in 2017 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

*The OMZ and nutrient features as a signature of interannual and low-frequency variability in the Peruvian upwelling system* *Biogeosciences*, 14, 1–17, 2017. <https://doi.org/10.5194/bg-14-1-2017> 2017 M. Graco, S. Purca, B. Dewitte, C. Castro, O. Morón, J. Ledesma, G. Flores, and D. Gutiérrez.

*Strong and Dynamic Benthic-Pelagic Coupling and Feedbacks in a Coastal Upwelling System (Peruvian Shelf).* *Front. Mar. Sci.* 4:29. doi:10.3389/fmars.2017.00029. 2017. Dale AW, Graco M and Wallmann K.

*Impacts of El Niño events on the Peruvian upwelling system productivity.* *J. Geophys. Res. Oceans*, 122, doi:10.1002/2016JC012439. D. Espinoza-Morriberón, V. Echevin, F. Colas, J. Tam, J. Ledesma, L. Vásquez, and M. Graco. 2017.

Breitburg D., Levin LA., Oschlies A., Grégoire M., Chavez FP., Conley DJ., Garçon V., Gilbert D., Gutiérrez D., Isensee K., Jacinto GS., Limburg KE., Montes I., Naqvi S. W. A., Pitcher GC., Rabalais NN., Roman MR., Rose KA., Seibel BA., Telszewski M., Yasuhara M. y Zhang J., 2018: Declining oxygen in the global ocean and coastal waters. *Science*: Vol. 359, DOI: 10.1126/science.aam7240.

**4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2017? If yes, who? How did you engage?**

**PART 2 - Planned activities for 2018/2019 and 2020**

**1. Planned major field studies and collaborative laboratory and modelling studies, national and international (incl. all information possible, dates, locations, teams, work, etc.).**

CUSCO project 2019-2020. Mesocosm and cruises in the Peruvian Upwelling System.

**2. Events like conferences, workshops, meetings, schools, capacity building etc. (incl. all information possible).**

-Participation at the Ocean Deoxygenation Conference | Kiel 2018 (SFB 754). September 3-7, 2018.

-2<sup>nd</sup> Latin-American Symposium of Ocean Acidification- Lima. 2020.

- Ocean observation System, September 16-20, 2019. Hawaii Convention Center, Participation in the programme Committee (M. Graco, IMARPE).

**3. Funded national and international projects / activities underway.**

National projects associated with the Coastal Peruvian upwelling system (IMARPE).

Participation in the SCOR Eastern boundary upwelling systems (EBUS): diversity, coupled dynamics and sensitivity to climate change Ruben Escribano (Chile), Ivonne Montes (IGP, Peru). Reporter David Halpern.

**4. Plans / ideas for future projects, programmes, proposals national or international etc. (please indicate the funding agencies and potential submission dates).**

**5. Engagements with other international projects, organisations, programmes etc.**

LAOCA- regional Acidification network Chairs: M. Graco (PERU, IMARPE) and M. Ayón-Hernández (México), related with GOA-ON and the UICCN.

Global Ocean Oxygen Network (GO2N). participation PERU (IGP, IMARPE)

**Comments**