Report for the year 2023 and future activities

SOLAS ‘Peru
compiled by: ‘Ivonne Montes’

This report has two parts:

- **Part 1**: reporting of activities in the period of January 2023 - Feb/Mar 2024
- **Part 2**: reporting on planned activities for 2024 and 2025.

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 Core Themes or Cross-Cutting Themes.

**Core Theme 1**: Greenhouse gases and the oceans;
**Core Theme 2**: Air-sea interfaces and fluxes of mass and energy;
**Core Theme 3**: Atmospheric deposition and ocean biogeochemistry;
**Core Theme 4**: Interconnections between aerosols, clouds, and marine ecosystems;
**Core Theme 5**: Ocean biogeochemical control on atmospheric chemistry;
**Cross-Cutting Theme**: Integrated studies of high sensitivity systems (upwelling systems, Indian Ocean, polar oceans and sea ice);
**Cross-Cutting Theme**: Climate intervention;
**Cross-Cutting Theme**: Science and society.

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

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<th>First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?</th>
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<td>There is a diverse academic community, ranging from young to seasoned scholars, particularly at the university level, that needs to take a step forward in the advancement of Peruvian science, as well as increase the number of people involved in the high-level science. In this regard, SOLAS IPO can play a significant role in facilitating collaboration. For instance, it can help connect researchers, scientists and organizations within the SOLAS community to organize conferences, workshops, networking meetings, as well as summer schools, among other activities. Additionally, it can provide technical advice by linking individuals with experts in specific areas related to SOLAS, such as ocean chemistry, marine biogeochemistry, and ocean dynamics. Furthermore, it can offer valuable information and resources, including up-to-date technical documents, research reports, oceanographic and meteorological data, and other relevant materials.</td>
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<th>PART 1 - Activities from January 2023 to Feb/Mar 2024</th>
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<td><strong>1. Scientific highlight</strong></td>
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El Niño Southern Oscillation (ENSO) is one of the most important modes of climate variability in the Pacific Ocean, which has a strong influence on global and regional precipitation. In Peru, during the cold phase of ENSO, La Niña in the central Pacific Ocean increases precipitation in the southern highlands as well as in the northeastern region of the highlands-Puno. On the other hand, El Niño in the eastern Pacific Ocean is the one that causes the greatest impacts through increased precipitation and heat waves on the northern coast, while El Niño in the central Pacific Ocean can result in droughts in the Andes and the Amazon. This widely affects the socioeconomic sphere since it causes damage to infrastructure, agriculture, fishing, among others.

Peru, as part of the public management strategy to confront ENSO, especially with respect to El Niño, establishes the Results-Based Budget Program (PPR) 068 “Vulnerability reduction and disaster emergency response.” The Geophysical Institute of Peru (IGP), like other institutions that make up the Multisector Commission in charge of the National Study of the “El Niño” Phenomenon, participates in this PPR with the product called “Studies for disaster risk estimation.” This product consists of the timely delivery of scientific information on the monitoring and forecasts of this natural oceanic-atmospheric event, through monthly technical reports, which allow decision-making by authorities at the national and regional level.

The IGP, a pioneer in numerical modeling in Peru and as part of the aforementioned product, has implemented the IGP Regional Earth System Model CROCO-OASIS-WRF v.1 (IGP RESM-COW v1); whose ultimate purpose is its use as a forecasting tool. The IGP RESM-COW v1), with a resolution of 12 km for the ocean and 30 km for the atmosphere, covering the entire Peruvian territory and part of the eastern Pacific Ocean, providing 7-month forecasts for both the ocean and atmosphere. Regarding the realism of the simulation, the preliminary validation of the implementation in forecast mode for the period January-July 2023 shows that the coupled model can reproduce the dynamics of the study region. This is seen in Figure 1, where the simulated sea surface temperature (SST) in the Niño 1+2 region is compared with the observed SST extracted from the OISST AVHRR product (i.e., the satellite/sensor daily optimal interpolation SST [NOAA/AVHRR: Advanced Very High-Resolution Radiometer]) with a resolution of 25 km. In the medium term, the aim is to use other global models to improve the model’s boundary conditions. Likewise, it is expected to integrate other components of the Earth system, such as the biological component, which could include changes in the type of vegetation cover on the continent, the carbon cycle or the contribution of microorganisms in the ocean to nutrient stocks and concentration of gases (mainly oxygen).

Figure 1. (Left panel) Monthly average precipitation, surface winds and SST contours (27°C, 28°C and 29°C, yellow, red and purple line, respectively) calculated from the outputs of the IGP RESM-COW v1 in forecast mode during April 2023 with initial condition January 2023. (Right panel) Time series of the monthly average of sea surface temperature in the Niño 1+2 region is compared with the observed SST extracted from the OISST AVHRR product (i.e., the satellite/sensor daily optimal interpolation SST [NOAA/AVHRR: Advanced Very High-Resolution Radiometer]) with a resolution of 25 km. In the medium term, the aim is to use other global models to improve the model’s boundary conditions. Likewise, it is expected to integrate other components of the Earth system, such as the biological component, which could include changes in the type of vegetation cover on the continent, the carbon cycle or the contribution of microorganisms in the ocean to nutrient stocks and concentration of gases (mainly oxygen).

2. Activities/main accomplishments in 2023 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

- The phase 2 of SEPICAF (South Eastern Pacific Circulation from ARGO floats) project was accepted. The project is aimed at making a breakthrough in our understanding of the physical forcing of the Oxygen Minimum Zone (OMZ) in the Southeastern Pacific (SEP) through the consideration of processes not well accounted for in current generation global coupled models (i.e., upwelling dynamics, turbulent flow, oceanic teleconnection), which will provide material for interpreting historical data sets and guide model improvement. It will yield a conceptual understanding of the non-linear response of the OMZ to ENSO forcing in the SEP. The project is lead by France having national partners from Ecuador, Peru and Chile to implement the first step, i.e., the release of ARGO floats along Ecuador, Peru and Chile between 2024-2026.

- Implementation of the observatory of scientific knowledge on climate change of Peru ‘cienciaclimatica’ (https://cienciaclimatica.igp.gob.pe), which allows users, such as climate change authorities, researchers and students, to easily access interpreted scientific knowledge (“interpretations”) for the comprehensive management of climate change and research. It is a living space that allow interaction between members of the academic/scientific community and users and will take full advantage of artificial and human intelligence.

- Participation in the SOLAS Latin-American Workshop ‘Marine biogeochemistry research on Latin American coastal zones’, 26/05/2023, https://www.youtube.com/watch?v=gP3XaAw5MKY).

### 3. Publications in 2023 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

- Linford, P., Pérez-Santos, I., Montes, I., Dewitte, B., Buchan, S., Narváez, D., ... & Altamirano, R. (2023). Recent deoxygenation of Patagonian fjord subsurface waters connected to the Peru–Chile undercurrent and equatorial subsurface water variability. Global Biogeochemical Cycles, 37(6), e2022GB007688
4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2023? If yes, who? How did you engage?

PART 2 - Planned activities for 2024 and 2025

1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).
   - To incorporate the ocean biogeochemical component on the IGP RESM-COW v1.
   - To involve more scientist around the world to contribute with https://cienciaclimatica.igp.gob.pe

2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).
   - The 45th session of WCRP’s Joint Scientific Committee (JSC-45) in parallel with the 2nd Meeting of ANDEX, 27-30 May 2024, Peru, https://www.wcrp-climate.org/jsc45
   - APEC activity ‘Developing best practices to address coastal marine deoxygenation in APEC economies for improving the management of marine living resources’, September 2024.

3. Funded national and international projects/activities underway.
   - https://cienciaclimatica.igp.gob.pe

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

5. Engagements with other international projects, organisations, programmes, etc.
   - GO2NE (Global Ocean Oxygen Network)
   - WRCP (World Climate Research Programme)
   - CLIVAR (Climate and Ocean -Variability, Predictability and Change) Pacific Regional Panel
   - SCOR WG 155 – EBUS
   - ANDEX: A regional Hydroclimate Initiative for the Andes (https://www.gewex.org/project/andex/)