

Report for the year 2022 and future activities

SOLAS 'Mexico'

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This report has two parts:

- **Part 1:** reporting of activities in the period of January 2022 - Jan/Feb 2023
- **Part 2:** reporting on planned activities for 2023 and 2024.

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 of high sensitivity systems;
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).*

First things first...Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

PART 1 - Activities from January 2022 to Jan/Feb 2023

1. Scientific highlight

- **For the first time, 5TH INTERNATIONAL SYMPOSIUM ON THE OCEAN IN A HIGH CO2 WORLD. was held in Latin America**, which brought together more than 250 researchers from different countries and students from the region, in person and remotely. International acidification networks such as GOA ON and LAOCA were present, highlighting the Coastal Marine Stressors Research Network - REMARCO, in which Peru actively participates,

developing the IAEA RLA 7025 regional research project for the strengthening of marine-coastal studies, being one of the axes is acidification. During four days, this meeting allowed us to have a better understanding of the impacts of ocean acidification on the different marine ecosystems. Plenary sessions, presentations and poster presentations were held, as well as parallel events that sought to make visible to different actors in society this topical issue and concern such as ocean acidification. For its part, the multidisciplinary nature of the symposium allowed addressing aspects associated with monitoring and observations, modelling, field and laboratory studies, experimentation with multiple stressors. The sessions emphasized the processes and impacts, as well as the consequences for humans and possible responses through policy and management. Interest groups, artisanal fishermen and representatives of the aquaculture sector of Chile, Ecuador and Peru participated in order to socialize the issue and generate an exchange of potential solutions and strategies, which allow progress in the adoption of a State policy to face the acidification of the ocean, in line with UN SDG 14 on Life Underwater, and target 14.3.1 to "minimize and address the impacts of ocean acidification, including through increased scientific cooperation at all levels. In this way, Peru successfully joins the realization of this event, preceded by the one in Paris in 2004, Monaco in 2008, Monterey in 2012 and Hobart in 2016.

- New Gulf of Mexico Initiative Seeks to Address Ocean Acidification Across International Borders.** A team of scientists from the U.S., Mexico and Cuba met recently to exchange information and begin development of a new tri-national initiative designed to address the socioeconomic impacts of ocean acidification (OA) in the Gulf of Mexico based on common needs across nations. The Gulf of Mexico International Ocean Acidification Summit, which took place Oct. 18-19 in Mérida, Yucatan, Mexico, and included representatives from government agencies, universities, research institutes, non-governmental organizations and students, was sponsored by the Furgason Fellowship of the Harte Research Institute for Gulf of Mexico Studies (HRI) at Texas A&M University-Corpus Christi.

2. Activities/main accomplishments in 2022 (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).

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3. List SOLAS-related publications published in 2022 (only PUBLISHED articles). If any, please also list weblinks to models, datasets, products, etc.

Emily Osborne, Xinping Hu, Emily R. Hall, Kimberly Yates, Jennifer Vreeland-Dawson, Katie Shamberger, Leticia Barbero, J. Martin Hernandez-Ayon, Fabian A. Gomez, Tacey Hicks, Yuan-Yuan Xu, Melissa R. McCutcheon, Michael Acquafredda, Cecilia Chapa-Balcorta, Orion Norzagaray, Denis Pierrot, Alain Munoz-Caravaca, Kerri L. Dobson, Nancy Williams, Nancy Rabalais, Padmanava Dash, Ocean acidification in the Gulf of Mexico: Drivers, impacts, and unknowns (2022). Progress in Oceanography, 209,102882.DOI:10.1016/j.pcean.2022.102882.

Jiang Li-Qing, Pierrot Denis, Wanninkhof Rik, Feely Richard A., Tilbrook Bronte, Alin Simone, Barbero Leticia, Byrne Robert H., Carter Brendan R., Dickson Andrew G., Gattuso Jean-Pierre, Greeley Dana, Hoppema Mario, Humphreys Matthew P., Karstensen Johannes, Lange Nico, Lauvset Siv K., Lewis Ernie R., Olsen Are, Pérez Fiz F., Sabine Christopher, Sharp Jonathan D., Tanhua Toste, Trull Thomas W., Velo Anton, Allegra Andrew J., Barker Paul, Burger Eugene, Cai Wei-Jun, Chen Chen-Tung A., Cross Jessica, Garcia Hernan, Hernandez-Ayon Jose Martin, Hu Xinping, Kozyr Alex, Langdon Chris, Lee Kitack, Salisbury Joe, Wang Zhaohui Aleck, Xue Liang., (2022). Best Practice Data Standards for Discrete Chemical Oceanographic Observations. Frontiers in Marine Science: 8, 2022. /10.3389/fmars.2021.705638

Garcia-Orozco, J., Huerta-Diaz, M. A., Mejia-Piña, K. G., Delgadillo-Hinojosa, F., Valdivieso-Ojeda, J. A., & Árcega-Cabrera, F. (2022). Pyrite and reactive iron fluxes in deep (> 966 m) sediments of the Gulf of Mexico. *Chemical Geology*, 612, 121148.

Lee-Sánchez, E., Camacho-Ibar, V. F., Velásquez-Aristizábal, J. A., Valencia-Gasti, J. A., & Samperio-Ramos, G. (2022). Impacts of mesoscale eddies on the nitrate distribution in the deep-water region of the Gulf of Mexico. *Journal of Marine Systems*, 229, 103721.

Cervantes-Díaz, G. Y., Hernández-Ayón, J. M., Zirino, A., Herzka, S. Z., Camacho-Ibar, V., Norzagaray, O., ... & Delgado, J. A. (2022). Understanding upper water mass dynamics in the Gulf of Mexico by linking physical and biogeochemical features. *Journal of Marine Systems*, 225, 103647.

Barranco, L. M., Ayón, J. M. H., Pech, D., Enriquez, C., Herrera, J., Mariño, I., & Herguera, J. C. (2022). Physical and biogeochemical controls of the carbonate system of the Yucatan Shelf. *Continental Shelf Research*, 244, 104807.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2022? If yes, who? How did you engage?

A panel we call "Con-Science in OA for society and decision makers" September 10, 2022 and Sunday, September 11, 2022. Universidad Científica del Sur, Lima Peru. Side Event: 5TH INTERNATIONAL SYMPOSIUM ON THE OCEAN IN A HIGH CO2 WORLD.

PART 2 - Planned activities for 2023 and 2024

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

Project 2021-2023: Phytoplankton Blooms in a Loop Current Eddy (PhytBloomEddy)

- This project is running since 2021 last year, the conceptual framework is inconsistent with recent Bio-Argo floats observations scattered in the GoM reported by several authors that show constant vertically integrated content of Chl_a and phytoplankton production in the Gulf of Mexico (GoM) throughout the year. However, a regionalization of the open waters of the Gulf of Mexico based on the seasonal and interannual variability of chlorophyll concentration using a coupled physical-biogeochemical model shows that the central and northern Gulf of Mexico appears to be affected by winter convection and phytoplankton bloom driven by the increase of nutrient concentration in the euphotic layer. While the importance of mesoscale eddies in physical and biological processes has been recognized, above cited literature shows that contrasting results exist regarding the role of the anticyclonic warm core eddies in the upper ocean ecosystem and their role in the annual cycle of phytoplankton biomass and community structure. A better understanding of the influence of the mixed-layer depth on biological activity in the GoM is clearly needed. The project target is to understand, from observational and numerical approaches, how physical transport mechanisms, (turbulent) winter convection and (advective) eddy-induced Ekman pumping, influence nutrient, dissolved organic carbon (DOC), glider-inferred particulate organic carbon (POC), and dissolved inorganic carbon (DIC) fluxes; phytoplankton biomass and community structure, and ultimately how are they linked in the context of the *biological carbon pump*. A new report based on 25-years (1993-2017) of daily satellite data (Delgado et al., 2019) shows three main aspects of physical-biogeochemical interactions in the Gulf of Mexico: 1) The intrusion of the subtropical underwater (SUW) by LC- LCEs extends further into the western GoM than was previously known; 2) Chl_a concentrations respond to the dynamics inside the GoM and are influenced by the LC anticyclonic and cyclonic eddies and 3) Since 2002, near surface Chl_a concentrations over bathymetry deeper than 250 m have decreased, and GoM surface waters may be turning more oligotrophic than in the previous decade. This work emphasizes the role of climatology in determining GoM circulation and its productivity and suggests that further climatologically-induced changes are probably imminent. It explores the ability of the LCEs to export carbon into the deep ocean, in response to increasingly frequent extreme wind events

(tropical storms and cold-fronts) in the Gulf of Mexico. The project is led by Dr. Enrick Pallas with institution involved as Centro de Investigacion Cientifica de Educacion Superior de Ensenada (CICESE) and two researchers from the University of Baja California.

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

A POGO meeting will be scheduled be held in Ensenada, Baja California Mexico on the 26th and 27th of April 2023. be held in Ensenada on the 26th and 27th of April. During the workshop, participants will work on detecting key data gaps and prioritize monitoring needs, as well as outlining a plan for engagement with the national or international entities responsible for monitoring efforts, stakeholders and users of information so as to set the foundation for furthering and coordinating monitoring efforts in the GoM. A listing of possible funding national and international agencies will also be compiled. We envision that the work group's efforts will lay the foundation for subsequent efforts aimed at establishing monitoring of key variables and processes within the GoM, which is consistent with POGO's mission. During the workshop, participants will work on detecting key data gaps and prioritize monitoring needs, as well as outlining a plan for engagement with the national or international entities responsible for monitoring efforts, stakeholders and users of information so as to set the foundation for furthering and coordinating monitoring efforts in the GoM. A listing of possible funding national and international agencies will also be compiled. The group envision that the work efforts will lay the foundation for subsequent efforts aimed at establishing monitoring of key variables and processes within the GoM, which is consistent with POGO's mission.

A North American Regional Hub Members OA virtual meeting is scheduled for Monday June 26 12pm - 2:30pm EDT/9am-11:30pm PDT. But also in-person North American Regional Hub Members Hub Meeting for January 17-18, 2024. This will be hosted by Wei-Jun Cai at the University of Delaware.

XIV International Carbon Symposium in Mexico Hosted virtually from the University of Baja California in Ensenada, Baja California 26 - 28 October 2023 Main theme: Ecosystem Restoration and Conservation for Climate Change Mitigation.

3. Funded national and international projects/activities underway.

2021-2022 Seatrec FIND Project Proposed Science Mission

The proposed mission of a frequently profiling (≤ 1 cycle per day) float over a prolonged period (years), sustained by energy harvesting technology, presents a unique opportunity to make scientific discoveries. Most floats profile on the 10-day Argo mission and those that profile more frequently generally carry only physical (and occasionally biooptical) sensors and expend their batteries more rapidly, limiting their science potential. To take advantage of the FIND Project opportunity, we propose to add chemical and bio-optical sensors (costs covered by NOAA) to the NavisSL1 float to study primary production, carbon export, air-sea fluxes of oxygen and carbon dioxide gas, as well as modulation of ocean heat content and physical and biogeochemical transformations driven by ubiquitous mesoscale structures in the Gulf of Mexico (GOM). While some of these processes have been evaluated individually on rapidly profiling floats in other regions, capturing these processes simultaneously and over multiple years will provide new information in a poorly observed region that is characterized by economically important fisheries, extensive physical and biogeochemical gradients, and extreme weather systems. The GOM exhibits a year-round >10 °C temperature gradient within the upper 1000m and is home to one of NOAA's BGC Argo pilot arrays. A deploy of the Navis-SL1 float in the southwestern deep basin of

the GOM was realized during last fall 2022 by a Mexican-lead research cruise. This float would complement four NOAA BGC-Apex floats deployed in US GOM waters during 2021. The Navis-SL1 float deployment will be coordinated with Mexican seaglider fleet deployments and the resulting data will be assimilated into ongoing US and Mexico-led regional modelling efforts.

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

Mexico as a part of the NorthAmerica's HuB is also part of the Ocean Acidification Research for Sustainability (OARS) - Providing society with the observational and scientific evidence needed to sustainably identify, monitor, mitigate and adapt to ocean acidification; from local to global scales. GOAON welcome and thank you for participating in the OARS white paper community review. Each of the seven white papers below outlines the vision for the outcome, highlights the key outputs and products, describes the research and outreach activities and identifies the key inputs and partners necessary to successfully implement each outcome. Details on each outcome and the champions can be found under the Overview and Outcomes tabs on this site. To participate in the review, please download the PDF of the outcome or outcomes you would like to review and download the review template to complete it offline. Use the template to submit your specific comments, referencing the precise outcome and page your comment; one single template can be used to review more than one white paper. Once you have finished the review, please send your completed template to the GOA-ON Secretariat secretariat@goa-on.org no later than 30 April 2023.

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

See the above

Comments