surface ocean solas lower atmosphere study

Report for the year 2020 and future activities

SOLAS *'Brazil'*
compiled by: 'Leticia Cotrim da Cunha'

This report has two parts:

***- Part 1:** reporting of activities in the period of January 2020 - Jan/Feb 2021*
***- Part 2:** reporting on planned activities for 2021 and 2022.*

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. ?

Social networks have "boomed" as science outreach vehicles in Brazil, especially since the pandemic. It reflects the current need in the country to fight back negationists (anti-vaccine, -climate, -social sciences etc). I would suggest considering the use of another network, at the same time as Twitter, and post short "science bits", show the SOLAS community and what is going on, for instance.

This helps connecting people. This is also a mea culpa as I have been awfully busy since 2018 with the IPCC, but I have the impression the SOLAS-related community rely a lot on the representative – me – to engage in any actions. Young scientists are by far the most enthusiastic people, and I had the impression that many of them submitted applications for the last Summer School, for instance. Young scientists are also the target public for more social network content.

I am also open to talk to other SOLAS representatives and see which is the best way to engage scientists in the country.

Another suggestion is to have partnerships or joint actions with other programmes/projects/networks such as SOCAT, GLODAP, GOA-ON, GEOTRACES, for instance.

PART 1 - Activities from January 2020 to Jan/Feb 2021

1. Scientific highlight

*Describe one scientific highlight with a title, text (**max. 300 words**), a figure with legend and full references. Please focus on a result that would not have happened without SOLAS, and we are most interested in results of international collaborations. (If you wish to include more than one highlight, feel free to do so).*

Tropical estuarine deltas generally present poorly buffered waters in their freshwaters and are usually considered as CO2 sources to the atmosphere. Mixing of riverine freshwater with seawater creates the conditions to draw down atmospheric CO2 because of the rapid consumption of the freshwater carbon dioxide (CO2) by the carbonate buffering capacity of the seawater. A study conducted in a river plume in SE Brazil, the Paraiba do Sul River, investigated the local CO2 thermodynamics along the estuary to the river plume on the inner shelf, and compared it to effect of biological processes, gas exchange, and tidal advection from mangroves along the shore. This river is one of the most important water sources to a highly populated area in the country, comprising São Paulo and Rio de Janeiro states.
The main results revealed that the low buffering capacity in the main channel of tropical estuarine deltas can be the predominant driver of pCO2, generating CO2 undersaturation along the mixing zone, a process overlooked in estuarine systems, especially in tropical areas. Moreover, air-water CO2 exchange, thermal variability, and biological activities contribute to deviation of the carbonate system from conservative mixing in specific estuarine areas, also modulating pCO2 variability.
The biological CO2 uptake, from phytoplankton activity, was restricted to the freshwater endmember

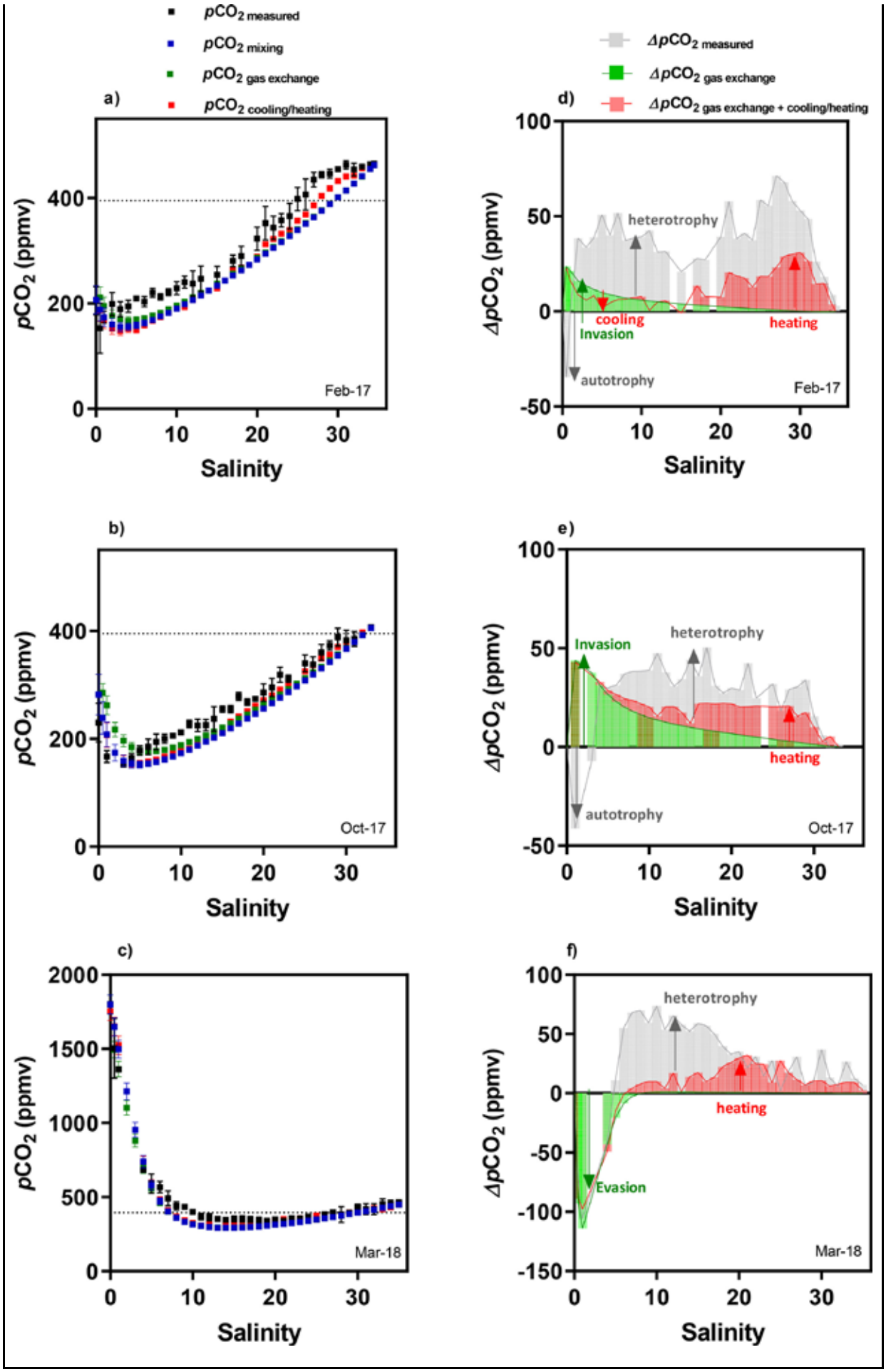
a)
pCO_2 measured
pCO_2 mixing
pCO_2 gas exchange
pCO_2 cooling/heating
pCO_2 (ppmv)
Salinity
Feb-17
b)
Oct-17
c)
Mar-18
d)
ΔpCO_2 measured
ΔpCO_2 gas exchange
ΔpCO_2 gas exchange + cooling/heating
ΔpCO_2 (ppmv)
heterotrophy
cooling
Invasion
heating
autotrophy
e)
f)
Evasion

Figure: Comparison between mixing model and pCO2 measured in the mixing zone, including corrections performed for gas exchange and thermal variability and deviations from the conservative mixing. Graphs a), b) and c) show the means and standard deviations of pCO2 measured (black dots),pCO2 mixing (blue dots), pCO2 gas exchange (green dots) and pCO2 cooling/heating (red dots) for each salinity unit. Graphs d), e) and f) show the difference between pCO2 measured and pCO2

cumulative difference between pCO2 gas exchange + pCO2 cooling/heating and pCO2 mixing

compared with pCO2 mixing (influx or efflux of CO2). The red arrow indicates the effect of thermal variability (cooling and heating). The grey arrow indicates the residual difference between pCO2 measured and pCO2 mixing attributed to biological activities.

CITATION:
Cotovicz, L. C., Vidal, L. O., de Rezende, C. E., Bernardes, M. C., Knoppers, B. A., Sobrinho, R. L., et al. (2020). Carbon dioxide sources and sinks in the delta of the Paraíba do Sul River (Southeastern Brazil) modulated by carbonate thermodynamics, gas exchange and ecosystem metabolism during estuarine mixing. Mar. Chem. 226, 103869. doi:10.1016/j.marchem.2020.103869.

2. Activities/main accomplishments in 2020 (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).

In 2020, due to the pandemic many field work activities and oceanographic campaigns did not take place. In 2021, the situation is slightly better, although not all groups have returned to normal research activities.

Participation into conferences was also postponed, such as the Symposium of Oceans in a High CO2 World.

There were many online activities, mostly dedicated to outreach, transmitted via social networks or YouTube, and it is hard to keep track of all of them. One can cite the national workshops for building Brazil's Ocean Decade plan in 2020, and the establishment of regional nodes, organized by the federal government (Ministry of Science and Technology). A dedicated website from the Ministry of Science and Technology can be found here:

http://decada.ciencianomar.mctic.gov.br/

Participation in the TRIATLAS online project meeting (EU H2020 funded project) on a dedicated session to Prediction and Moored Array in the Tropical Atlantic (PIRATA). Link for the abstracts:

https://triatlas.w.uib.no/consortium_meetings/

There was also a relevant participation in the Global Ocean Acidification Network week in September/2020 – GOA-ON :

http://www.goa-on.org/webinars/OaWeek2020/webinar.php

All sessions are available on YouTube:
https://www.youtube.com/watch?v=IYoSJYfzj4c&list=PLZ2ci3xomXhsm3lS3v-rL3QlHVLfyt_gn

Participation as Lead Author in the Sixth IPCC Assessment Report (from 2018 to 2021): Leticia Cotrim da Cunha – chapter 5: Global Carbon and other Biogeochemical Cycles and Feedbacks.

Prediction and Moored Array in the Tropical Atlantic (PIRATA) cruise started in October 2020 but was resumed before servicing all buoys due to problems with the dedicated vessel.

3. Top 5 publications in 2020 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Cotovicz, L. C., Vidal, L. O., de Rezende, C. E., Bernardes, M. C., Knoppers, B. A., Sobrinho, R. L., et al. (2020). Carbon dioxide sources and sinks in the delta of the Paraíba do Sul River (Southeastern Brazil) modulated by carbonate thermodynamics, gas exchange and ecosystem metabolism during estuarine mixing. Mar. Chem. 226, 103869. doi:10.1016/j.marchem.2020.103869.

Monteiro, T., Kerr, R., and Machado, E. da C. (2020). Seasonal variability of net sea-air CO2 fluxes in a coastal region of the northern Antarctic Peninsula. Sci. Rep. 10, 14875. doi:10.1038/s41598-020-71814-0.

Avelina, R., da Cunha, L. C., Farias, C. de O., Hamacher, C., Kerr, R., and Mata, M. M. (2020). Contrasting dissolved organic carbon concentrations in the Bransfield Strait, Northern Antarctic Peninsula: insights into ENSO and SAM effects. J. Mar. Syst. 212, 103457. doi:10.1016/j.jmarsys.2020.103457.

Casagrande, F., Buss de Souza, R., Nobre, P., and Lanfer Marquez, A. (2020). An inter-hemispheric seasonal comparison of polar amplification using radiative forcing of a quadrupling CO2 experiment. Ann. Geophys. 38, 1123–1138. doi:10.5194/angeo-38-1123-2020.

Rosa, E. B., Pezzi, L. P., Quadro, M. F. L. de, and Brunsell, N. (2020). Automated Detection Algorithm for SACZ, Oceanic SACZ, and Their Climatological Features. Front. Environ. Sci. 8. doi:10.3389/fenvs.2020.00018.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2020? If yes, who? How did you engage?

N.A.

PART 2 - Planned activities for 2021 and 2022

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

1) 2022: Southern Ocean cruise by invitation of AWI – Island Impact (Dr. Christine Klaas), with the participation of scientists from Rio de Janeiro State University and Federal University of Rio Grande
2) 2021/2022: PIRATA cruise, not yet decided whether it will be a full science cruise or only buoy servicing, and maybe installing of a CO2-sensor in one of the PIRATA buoys, funded by EuroSEA project (EU-Funded H2020, with participation of UERJ and UFPE as Brazilian partners)
3) 2022: installing the first SOOP line in Brazil, in partnership with GEOMAR (Germany), under the project C-SCOPE, financed by BMBF and coordinated by Prof. Arne Körtzinger

Since 2016 the country budget for science (projects, fellowships, ship time, participation in conferences) has been decreasing year by year. From 2019 to present, the situation has become critical, despite the efforts of the scientific community, and worsened along year 2020 and 2021 with the pandemic sanitary crisis.

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

1) Participation to the virtual EGU 2021 and 2022
2) Participation to the 24th PIRATA/TAV meeting in 2021: https://cpaess.ucar.edu/meetings/2021/pirata-24-tav
3) Participation to the Symposium Oceans in a High-CO2 World. There are abstracts submitted in 2020 from many Brazilian researchers covering ocean biogeochemistry, sea-air gas exchange and ocean acidification effects on biota

3. Funded national and international projects/activities underway.

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.

Comments