Eastern Boundary Upwelling Systems (EBUS) Research Focus

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RF overview

The EBUS RF began in October 2015 with a scoping workshop in Ankara, Turkey and the submission of an original EBUS RF prospectus in April of 2016. Progress continued, with a RF meeting in Qingdao in September 2016 and the outline of a collaboration with OMDP on exploring the upwelling dynamics in forced global ocean simulations. However, concern for the potential overlap with activities of other groups in the research community and changes to the leadership and membership of the group necessitated shifts in the focus of the efforts. A plan for revisions to the group to address these concerns was submitted to the SSG in November of 2017, and after encouragement from the SSG, the RF group membership was revised in April and May of 2018. The RF group submitted a revised prospectus in June of 2018.

The activities of the group are on schedule. A first meeting of the reconfigured RF group is scheduled for December 9, 2018, prior to the annual assembly of the AGU in Washington, DC. The main item on the agenda for this meeting is the preparation of a syllabus and teaching schedule for a summer school on EBUS that we are organizing with ICTP and scheduled to take place in July 2019 in Trieste, Italy. The school is intended as a scientific educational, networking, and capacity-building activity for the benefit of students and early-career scientists from countries that have a stake in EBUS.

In additionally to capacity building, the current goals of the RF group are two-fold: to develop research recommendations for synergistic activities between the modeling and observational communities, and to improve the quantification of potential impacts of climate change on the marine ecosystem and the potential consequences on their dependent societies.

Regarding impediments to progress over the past year, the shuffling of the group membership and revision of the prospectus has generated some extra administrative work, but we think these revisions and the complimentary activities of the SCOR WG-155 on EBUS can reinvigorate progress on understanding the connections among.

Achievements for 2017-18

- Workshops
  None

- Scientific results from activities

Collaboration among current RF members (and past RF members) continues. Recent efforts to compare the upwelling variability and ecological responses to this variability have included RF members from the US, Mexico, and South Africa (García-Reyes et al. 2018, Lamont et al. 2018). Other research on EBUS sensitivity to climate processes has focused on individual regions, but includes collaboration of past and present RF members from multiple countries (e.g., Black et al. 2018, Diakhaté et al. 2018, Jacox et al. 2018, Kolodziejczyk et al. 2018, Rykaczewski, 2018, Turi et al. 2018, van der Sleen et al. 2018). A first effort towards systematically measuring in-situ wind profiles along the Benguela EBUS and comparing the results with reanalysis has been initiated by one of the co-chairs (Thomas Toniazzo) in November-December 2017; its evaluation is underway.

RF members participated in the writing of a series of white papers (wp) for Oceanobs 2019 (boundary currents wp, EBUS wp).

- Scientific capacity building and career support

  Former (Enrique Curchitser) and current co-chairs collaborated on a proposal to the International Centre for Theoretical Physics (ITCP) to organize a summer school on EBUS.

  A co-chair of the RF (Alban Lazar) received a pre-approval from a French Research Institution (IRD) for an International Research Group on eastern and western boundary current observing system for Africa and Latin America. A kick-off meeting (10 countries) is scheduled for mid-November 2018.

- Knowledge exchange

  CLIVAR RF and SCOR WG-155 co-chairs and members were co-convenors of a session titled “Biophysical dynamics of eastern boundary upwelling ecosystems in a changing ocean: closing the gap between wind stress and ecosystem productivity” at the Ocean Sciences Meeting in February 2018 in Portland, OR.

  Rykaczewski and Paquita Zuidema presented the goals of the EBUS RF at a meeting of CLIVAR’s Atlantic Regional Panel in Portland, OR in February 2018.

  CLIVAR RF and SCOR WG-155 EBUS co-chairs were co-convenors of a session titled “Eastern Boundary upwelling systems: diversity, coupled dynamics and sensitivity to climate change” at the ECCWO conference in June 2018 in Washington, DC. Presentations from this session are posted at https://meetings.pices.int/publications/presentations/2018-Climate-Change#session7.

  A co-chair of the RF (Rykaczewski) participated in a SCOR WG-155 meeting in June 2018 where he communicated the plans of the “new” CLIVAR RF on EBUS and helped to ensure that the activities of the two groups will continue on complimentary paths.

RF member Antonio Bode presented the aims and work of the EBUS FG at the September 2018 meeting of the Canary Current Large Marine Ecosystem IOC-project in Tenerife, Spain.

A co-chair of the RF (Rykaczewski) is co-convening a session with CLIVAR co-sponsorship at the 2018 Annual Meeting of the North Pacific Marine Science Organization (PICES). The meeting will take place in October 2018, and the session is titled "Ecological responses to variable climate changes and their applicability to ecosystem predictions." A portion of the talks will focus on predictability of EBUS processes.

Plans for 2019 and beyond

We plan to have our first face-to-face meeting of new RF members in December 2018 in Washington, DC. The main focus of this meeting will be to plan the summer school scheduled for July 2019, but we also plan to review our terms of reference and update each other on progress towards those goals.

In July 2019, we will host a summer school on EBUS in Trieste, Italy (http://indico.ictp.it/event/8702/). We also plan to have a RF group meeting adjacent to this summer school, thereby leveraging the funding that is supporting the participation of lecturers in the summer school.

Other key activities for 2019 include discussions with the SCOR WG-155 (EBUS) on planning an Open Science Conference on EBUS and beginning analysis of JRA reanalysis characteristics in EBUS and JRA-forced ocean simulations.

Articles published in 2017/18 as part of RF activities (if any)

Black, BA, P van der Sleen, E Di Lorenzo, D Griffin, WJ Sydeman, JB Dunham, RR Rykaczewski, M García-Reyes, M Safeeq, I Arismendi, SJ Bograd. 2018. Rising synchrony controls western North American ecosystems. *Global Change Biology* 24(6):2305-2314, doi:10.1111/gcb.14128.

Diakhaté, M., A. Lazar, G. de Coetlogon and A. T. Gaye (2018). Do SST gradients drive the monthly climatological surface wind convergence over the tropical Atlantic? International Journal of Climatology, DOI: 10.1002/joc.5422.

García-Reyes, M, T Lamont, WJ Sydeman, BA Black, RR Rykaczewski, SA Thompson, SJ Bograd. 2018. A comparison of modes of upwelling-favorable wind variability in the Benguela and California current ecosystems. *Journal of Marine Systems* 188:17-26, doi:10.1016/j.jmarsys.2017.06.002.

Lamont, T, M García-Reyes, SJ Bograd, CD van der Lingen, and WJ Sydeman. 2018. Upwelling indices for comparative ecosystem studies: variability in the Benguela

upwelling system. *Journal of Marine Systems* 188:3-16, doi.org/10.1016/j.jmarsys.2017.05.007.

Jacox, MG, CA Edwards, EL Hazen, and SJ Bograd. 2018. Coastal upwelling revisited: Ekman, Bakun, and improved upwelling indices for the U.S. west coast. *Journal of Geophysical Research*, doi.org/10.1029/2018JC014187.

Kolodziejczyk, N., Testor, P., Lazar, A., Echevin, V., Krahmann, G., Chaigneau, A., ... & Capet, X. (2018). Sub-surface fine scale patterns in an anticyclonic eddy off Cap‐Vert peninsula observed from glider measurements. Journal of Geophysical Research: Oceans.

Rykaczewski, RR. 2018. Changes in mesozooplankton size structure along a trophic gradient in the California Current Ecosystem and implications for small pelagic fish. *Marine Ecology Progress Series*, doi:10.3354/meps12554.

Turi, G, MA Alexander, N Lovenduski, A Capotondi, JD Scott, CA Stock, JP Dunne, J John, and MG Jacox. 2018. Response of O2 and pH to ENSO in the California Current System in a high resolution global climate model. *Ocean Science* 14(1):69-86, doi:10.5194/os-14-69-2018.

van der Sleen, P, RR Rykaczewski, BD Turley, WJ Sydeman. M García-Reyes, SJ Bograd, CD van der Lingen, JC Coetzee, T Lamont, and BA Black. In Press. Non-stationary responses in anchovy (Engraulis encrasicolus) recruitment to coastal upwelling in the Southern Benguela. *Marine Ecology Progress Series* 596:155-164, doi:10.3354/meps12567.

Budget and other needs for 2019

Please keep in mind that the overall budget of CLIVAR is limited and this needs to be distributed between all activities and the SSG meeting.

We request some funding (on the order of 4000 USD) to support participation of RF members in a RF group meeting in Trieste, Italy (preceding or following the EBUS summer school). The majority of the RF meeting participants will receive some support from ITCP as lecturers in the summer school, but for those who will not be lecturers, we hope that WCRP will be able to support their attendance at the RF group meeting.

Annex A

Proforma for CLIVAR Research Focus requests for SSG approval for meetings

1. Panel or Working Group:

EBUS RF

2. Title of meeting or workshop:

Resolving impacts of climate processes on upwelling dynamics

3. Proposed venue:

TBD, but this will be in conjunction with a planned EBUS summer school at ICTP

4. Proposed dates:

either 13-14 or 22-23 July 2019

5. Proposed attendees, including likely number:

17

6. Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:

The main focus of the RF meeting will be on improving understanding of the impacts of large-scale climate anomalies on upwelling processes. This work is critical to CLIVAR's aim to understanding the drivers of regional climate phenomena that provide predictability on different time scales and to develop and evaluate climate simulations and predictive capabilities. The justification and relevance of this work to CLIVAR is described in more detail in the EBUS RF prospectus that was revised in 2017.

The improved understanding is also relevant to several of the WCRP Grand Challenges including Near-term Climate Prediction, Weather and Climate Extremes, and Carbon Feedbacks in the Climate System.

7. Specific objectives and key agenda items:

Progress towards RF scientific aims:

Participants in the RF group meeting will be asked to work in groups and arrive at the meeting ready to present recent progress towards one of the questions outlined in our prospectus.

Factors limiting progress towards understanding dynamics and improved model accuracy.

Planning for an Open Science Conference.

8. Anticipated outcomes (deliverables):

We intend to have outlined a paper that addresses major progress and remaining issues in EBUS. This will be a key product from the RF group.

9. Format:

The first day will focus on short group presentations on one of the RF questions. The second day will focus on progress towards a manuscript(s) draft and planning future activities.

10. Science Organizing Committee (if relevant)

Co-chairs Lazar, Rykaczewski, and Toniazzo

11. Local Organizing Committee (if relevant)

Riccardo Farneti (ICTP)

12. Proposed funding sources and anticipated funding requested from WCRP:

ICTP will be supporting travel of lecturers in the EBUS summer school. We request $4000 to support participation of other EBUS RF members.