



EBUS 'Eastern Boundary Upwelling Systems: diversity, coupled dynamics and sensitivity to climate change'

# First Face-to-Face Meeting

2-3 June 2018, Washington, DC, USA



**Meeting Report**

## **Attendance**

### *Members*

Ivonne Montes (co-chair, IGP – Perú), Ruben Escribano (co-chair, UdeC-Chile), Andreas Oschlies (GEOMAR - Germany), Baye Cheikh Mbaye (University of Dakar, Senegal), Boris Dewitte (LEGOS, France), Enrique Curchitser (RUTGERS, USA), Francisco Chavez (MBARI - USA), Salvador Lluch-Cota (CONACYT - México), Ryan Rykaczewki (University of South Carolina, USA)

### *Invited*

Veronique Garçon (LEGOS - Francia), Olaf Duteil (GEOMAR - Germany)

### *SCOR*

Ed Urban (Delaware University - USA)

## **Sponsors:**



Scientific Committee on Oceanic Research (SCOR)



Surface Ocean-Lower Atmosphere Study (SOLAS)



North Pacific Marine Science Organization (PICES)

## **Cover photo:**

SCOR WG 155 EBUS participants.

### *From the left:*

Salvador Lluch-Cota, Enrique Curchitser, Ryan Rykaczewki, BayeMbaye, Andreas Oschlies, Véronique Garçon, Boris Dewitte, Olaf Duteil, Hal Batchelder (PICES), Ruben Escribano, Francisco Chavez.

### *Missing from the photo:*

Ed Urban, Ivonne Montes (taking the picture).

## Contents

Contents.....	3
Introduction.....	4
Meeting structure and objectives.....	4
I. On the proposal adjustment .....	5
A. Terms of reference.....	5
B. Deliverables .....	5
C. Working and action plans .....	6
II. On complementary material .....	7
A. Webpage.....	7
B. Logo .....	8
III. On the link with other international programs.....	8
IV. On Scientific discussion .....	8
Appendix .....	10
SCOR WG 155 EBUS Participants List.....	10
Agenda.....	11
Workshop presentations.....	12
List of SCOR WG 155 EBUS members.....	12

## Introduction

Eastern Boundary Upwelling Systems (EBUS) (California, Humboldt, Benguela and Canary Current System as major systems and, e.g., Iberian, Leeuwin and West Coast of India as minor ones) are characterized by complex dynamical processes spanning a wide range of spatio-temporal variability due to the strong coupling between the ocean and atmosphere. They are among the most productive marine ecosystems in the world, supporting some of the world's major fisheries, yet occupying only 0.1% of the global surface. Trade winds flowing equatorward produce coastal upwelling, which uplifts cold and nutrient-rich waters to the surface, where favorable light conditions sustain high phytoplankton growth. Below the surface, intense Oxygen Minimum Zones develop due to high organic matter export, in conjunction with a sluggish ventilation. When these waters upwell, they release CO<sub>2</sub> and N<sub>2</sub>O, potent greenhouse gases, to the atmosphere. Locally, the mesoscale low-level atmospheric circulation is affected by air-sea-land interactions, which impact the upwelling and productivity, while remote forcing can modulate upwelling at timescales from intraseasonal to interdecadal and longer. EBUS are natural laboratories for studying the breadth of interactive processes between land, ocean and atmosphere at the regional scale. This SCOR Working Group 155 'Eastern Boundary Upwelling Systems (EBUS): Diversity, Coupled Dynamics and Sensitivity to Climate Change' is focused on reviewing the existing knowledge on EBUS and formulate a strategic recommendation white paper for setting up regional observational systems and climate modeling approaches to monitor and understand physical and biogeochemical ocean-atmosphere processes. These observational systems will be instrumental in improving the performance and reliability of climate models in these socio-economically relevant regions of the world ocean.

## Meeting structure and objectives

In June 2018, the working group 155 'Eastern Boundary Upwelling Systems (EBUS): Diversity, Coupled Dynamics and Sensitivity to Climate Change' held its first meeting in conjunction with the 4<sup>th</sup> International Symposium on 'The Effects of Climate Change on World's Oceans', Washington DC, USA.

The meeting objectives were set as to

1. Adjust the proposal, i.e. terms of reference, deliverables and working plan,
2. Define action plans
3. Define material for project visibility,
4. Identify strategic partners for collaborating and networking,
5. Discuss the current state of scientific knowledge, gaps and challenges across EBUS,

The complete list of workshop participants and agenda can be found in the .

## I. On the proposal adjustment

### A. Terms of reference

Based on the following goals:

1. To identify key feedback mechanisms, establish similarities, differences and knowledge gaps across all EBUS,
2. To facilitate the access to all developed scientific information across all EBUS,
3. To identify the current limitations of numerical models and necessary improvements,

the terms of reference (ToRs) were modified as follow:

**ToR#1. Synthesize available information** on important EBUS processes, their time and space scales (i.e., diurnal, intraseasonal, interannual, decadal, multidecadal) and their implications on water column properties, biogeochemical cycles, biodiversity/ecosystem structure and functioning, and the ecosystem services they provide. Seek to identify key feedback mechanisms, establish similarities, differences and knowledge gaps across all EBUS. A scientific review paper and a summary for policy makers will be the key deliverables.

**ToR#2. Develop a Web portal for EBUS** by creating a web-based platform to graphically query integrated information on published data, model outputs, as well as protocols for measuring key properties and indicators in EBUS.

**ToR#3. Determine the strengths and weaknesses of existing EBUS coupled physical-biological models.** Such an analysis will have mostly a regional focus, but it will also attempt to address subregional scales building upon past and ongoing research programs on upwelling centers (e.g., Bay of Hann near Dakar (Senegal), Monterey Bay (USA), Bay of Concepcion (Chile)). This TOR will require interaction with the CLIVAR EBUS Research Focus. The key product will be a publication in a high-impact journal.

**ToR#4. Recommend a framework for regional interdisciplinary (physics to biology) EBUS observing and modeling systems.** This stems from TORs 1-3. The observation system will be designed to improve the performance and reliability of forecast models in these socio-economically relevant regions of the world ocean. Such a recommendation brief will also address needs for fostering interactions between the observational and modelling communities (e.g., coordinated experiments with common forcing; recommendations on resolution of specific processes or a specific scale, etc). The recommendations will be included in the summary for policy makers.

### B. Deliverables

Based on the terms of reference adjustment, deliverables are:

**Deliverable #1:** A scientific review paper on key feedback mechanisms and knowledge gaps across all EBUS, and which presents similarities and differences amongst EBUS. The paper is also meant to identify research lines that can help in bridging the gap between regional and local/coastal scales from a modeling and observational perspective.

**Deliverable #2:** A web-based platform dedicated to providing information on meta-data (data and/or associated databases with the responsible scientist/people in charge if it is available), key

published papers from observations and model results (including information on reanalyses used for forcing regional models), where the EBUS databases can be queried graphically, and useful information about measurements and protocols will be provided.

**Deliverable #3:** A high-impact publication on comparing EBUS based on modelling results.

**Deliverable #4:** A summary for policy makers, where a strategic recommendation on how to more cost effectively design and improve regional observational systems and synthesize available information are presented.

### *C. Working and action plans*

One of the aims of the meeting was to refine the working plan timeline (Figure 1), Being supported by bimonthly online meetings, the working and action plans are being organized as follow:

**On 2018:** This year is focused on organizing the working group and assembling the information needed to achieve Terms of Reference 1-4, having one face-to-face meeting where available members and invited scientists are involved to build a clear plan of the strategies required to achieve the goals. This year also will serve to develop material for making the working group accessible to the wider community and public; such as a web page and logo. The WG will also begin the elaboration of the scientific review paper, define place and needs for a summer school, and look for strategic partners for organizing the open science conference. Note that these discussions could take place through the group communication dedicated to the White paper for OceanObs'19 (on-going). Other informal meetings will take place taking opportunity of the attendance of members to conferences (Kiel - September 2018; AGU - Dec 2018)

**On 2019:** The second year will be dedicated to finish the scientific review paper that will be submitted and published hopefully at the end of that year. Also, the SCOR group web portal will be released. The WG will also organize the second review paper, in which strengths and weaknesses of existing EBUS coupled physical-biological models will be presented. In addition, proposals for requesting funds to organize the summer school will be submitted.

**On 2020:** This year will be mainly focused on organizing and developing the summer school, either in South America or Senegal; involving PhD students and early-career scientists mostly from Africa and South America, having the objective to 'Provide an overview of the main processes occurring in EBUS (including physical, biogeochemical, biological, fish and fisheries processes and trends), in order to understand ocean-atmosphere interactions, combining lectures and hands-on sessions, and practical lessons' as well as 'to identify potential students to integrate the capacity building strategy' (i.e., create an early career network from alumni of the summer school). The WG will finish the second scientific review paper that will be submitted and published hopefully at the end of the first year. During this year, we will also start organizing the open science conference that would take place in Lima in 2021. The WG will release the web portal about EBUS in this year also.

**On 2021:** The last year will be oriented towards organizing the Open Science Conference. The WG will present the summary for policy makers, in which a strategic recommendation brief on

how to best set up regional observational systems to monitor and understand physical and biogeochemical ocean-atmosphere interactions in the EBUS will be presented. In addition, the final report of the SCOR WG will be delivered.

Figure 1 summarizes the working plan, activities and action that the WG would follow.

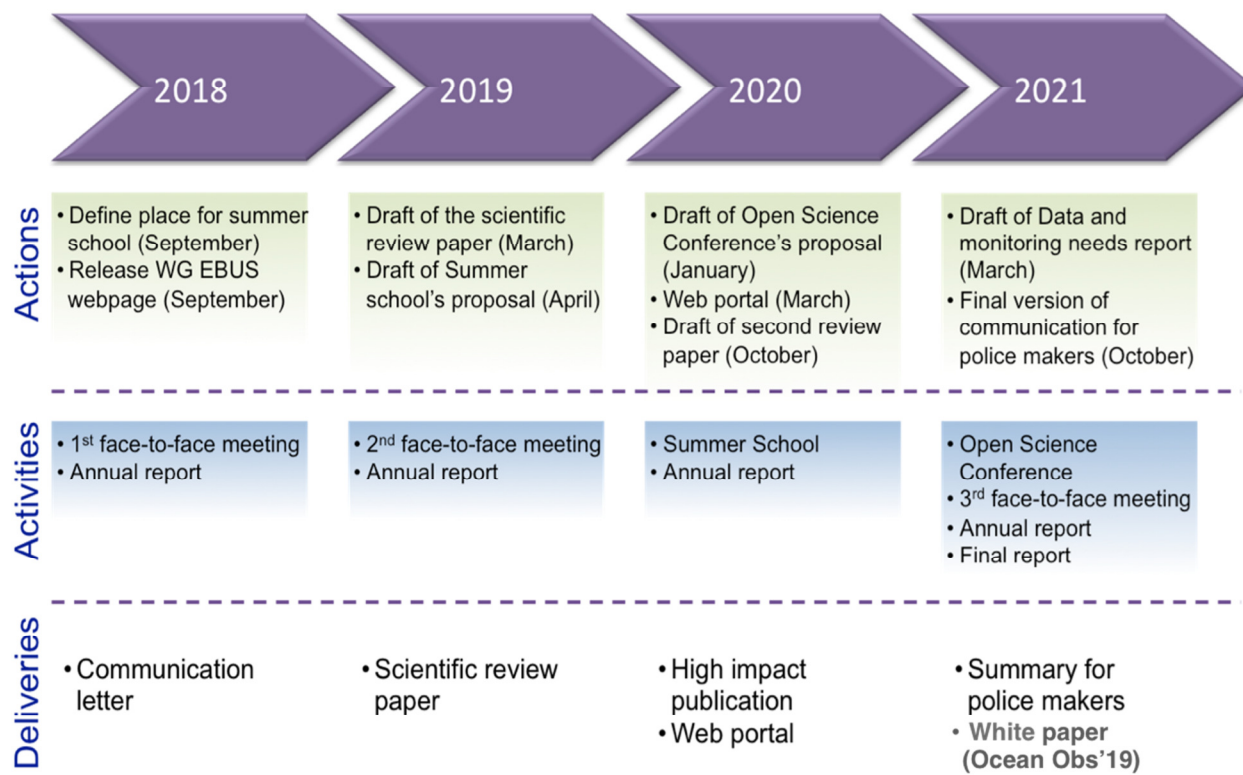


Figure 1. The working and action plans timeline of the SCOR working group 155 on EBUS.

## II. On complementary material

The whole group agreed that it would be necessary to develop complementary material for making the working group accessible to the wider community, such as a webpage, logo and scientific presentation to introduce the working group.

### A. Webpage

The host for the website will be IGP, where relevant information includes preamble (conceptual view of EBUS), about the working group (Terms of reference, members, meetings) and resources (scientific presentation on EBUS, publications and relevant websites (e.g., [www.oxygen-ocean.org](http://www.oxygen-ocean.org), <http://www.ioccp.org/oxygen>), link to others projects (e.g., GO<sub>2</sub>NE, IMBeR, SOLAS, SFB754, CLIVAR), relevant links to existing data portal).

### ***B. Logo***

Inspiration for our logo could come from CUEA (Coastal Upwelling Ecosystem Analysis program, first project funded in 1972 focused on coastal upwelling) logo, encompassing air-sea interfaces and ocean processes. We plan to circulate the tentative logo and all members are encouraged to provide ideas and comments.

### **III. On the link with other international programs**

This EBUS theme is an integral part of different international projects (e.g., SOLAS, IMBeR, CLIVAR) and initiatives such as GO<sub>2</sub>NE (an interdisciplinary network launched by IOC-UNESCO with particular concerns about the low oxygen concentrations in both the open ocean and coastal areas, which will be involved in the regional database initiative), VOICE (science plan that ultimately provides a blueprint of a multi-disciplinary sustained OMZ observing system) and TPOS2020 (scientific program aimed at designing the future of the observing system in the Pacific). Currently, members from those groups are part of the SCOR WG EBUS; therefore, this WG will strive to integrate in its synthesis outcomes of relevant regional modeling and observational projects through collaborations of its members.

Related to the collaboration with CLIVAR, although the SCOR WG EBUS and CLIVAR RF EBUS share common interests, we have to make sure there is no overlapping in the activities. In this context, SCOR WG 155 EBUS will focus on high spatial and temporal variability of associated upwelling processes that are modulating productivity of the EBUS, which are poorly represented in global models, and affecting the ecosystem services that they provide. SCOR WG EBUS is willing to focus on actions to be taken related to current knowledge from all published literature (observational and regional modelling approaches) and our own work in progress. This will be done in order to seek to identify key feedback mechanisms, establish similarities, differences and knowledge gaps across all EBUS. For that, this WG will need to identify important EBUS processes, their time and space scales (i.e., diurnal, intraseasonal, interannual, decadal, multidecadal) and their implications on water column properties, biogeochemical cycles, biodiversity/ecosystem structure and functioning, and the ecosystem services they provide. Ryan Rykaczewski, co-chair of CLIVAR RF EBUS, is the contact point to help us to develop a plan for cooperation and also to coordinate actions from both programs to avoid overlapping.

Our SCOR Group will also collaborate with IMBeR more directly through Ruben Escibano, currently member of the IMBeR SSC and co-chair of SCOR WG 155. Within IMBeR it will be proposed that the SCOR WG 155 will take over activities and actions of the former IMBeR upwelling WG. For next IMBeR meeting (virtual one), scheduled by the end of 2018, this decision will be presented to the IMBeR SSC.

### **IV. On Scientific discussion**

There were six oral presentations about the scientific advances on EBUS as well as available tools



that are being used to study these areas. From the fruitful discussion, the main questions that would involve the review paper are the following:

- a. Is upwelling intensity increasing in the EBUS or not (i.e., what is upwelling? What can we measure and compare among EBUS and other upwelling systems? What can we say about trends in temperature (SST and WCT), salinity (i.e., stratification), nutrients, primary productivity?
- b. Is deoxygenation a common trend in upwelling regions (stronger than in other regions)?
- c. Are we measuring/observing the correct variables? (wind-only is too simplistic, importance of stratification, pulses versus mean, BACs)
- d. How are food webs structured in EBUS (wasp-waist, pyramidal, fully disorganized; dynamic), how resilient/sensitive?
- e. To what extent can we think of EBUS as climate change-resilient systems due to frequent resetting?
- f. Is total available energy entering food webs close to constant (sardine-anchovy alternation), or highly variable? Spatially (BACs)?
- g. What is the best fishing strategy (eco-eco considerations)? Take all you can when you can, take care of temporary food webs (sardine-to-birds), flexible industry, carbon quotas (*Spp*-independent biomass), etc.

## Appendix

### SCOR WG 155 EBUS Participants List

Names of WG co-Chairs are marked in blue.

	FAMILY NAME	GIVEN NAME	AFFILIATION	COUNTRY	EMAIL ADDRESS
1	DEWITTE	Boris	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS)	France	dewitte.legos@gmail.com
2	CHAVEZ	Francisco	Monterey Bay Aquarium Research Institute (MBARI)	USA	chfr@mbari.org
3	CURCHITSER	Enrique	Institute of Earth, Ocean, and Atmosphere Science (Rutgers)	USA	curchitser.ocean@gmail.com
4	DUTEIL	Olaf	GEOMAR   Helmholtz-Zentrum für Ozeanforschung Kiel	Germany	oduteil@geomar.de
5	ESCRIBANO	Ruben	Universidad de Concepción (UdeC)	Chile	ruben.escribano@imo-chile.cl
6	GARÇON	Véronique	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS)	France	veronique.garcon@legos.obs-mip.fr
7	LLUCH-COTA	Salvador	Centro de Investigaciones Biológicas del Noroeste-CONACYT	Mexico	<a href="mailto:slluch@cibnor.mx">slluch@cibnor.mx</a>
8	MBAYE	BayeCheikh	Maurice Lamontagne Institute	Canada	bayecheikha@gmail.com
9	MONTES	Ivonne	Instituto Geofísico del Perú (IGP)	Peru	ivonne.montes@gmail.com
10	OSCHLIES	Andreas	GEOMAR   Helmholtz-Zentrum für Ozeanforschung Kiel	Germany	aoschlies@geomar.de
11	RYKACZEWSKI	Ryan	University of South Carolina	USA	ryk@sc.edu
12	URBAN	Edward	Scientific Committee on Oceanic Research	USA	ed.urban@scor-int.org
13	YANICELLI	Beatriz	Universidad de la República	URUGUAY	<a href="mailto:byannicelli@cure.edu.uy/">byannicelli@cure.edu.uy/</a>

## Agenda



WG 155 EBUS 'Eastern Boundary Upwelling Systems: diversity, coupled dynamics and sensitivity to climate change

### **First WG 155 EBUS meeting**

June 2-3, 2018  
(Washington, DC - USA)

**Venue:** The Washington Hilton (Columbia West and International Terrace)  
**Columbia - 11 room**

#### **Saturday, 2 June 2018 (Moderator: Ivonne and Ruben)**

Welcome

09.15 – 10.00 Short description of our personal research interest (all participants)

10.00 – 10.15 Introduction to SCOR (Dr. Ed Urban)

10.15 – 10.45 Coffee break

About the proposal 'adjustment'

10.45 – 12.40 Review of the terms of reference, working plan and deliveries (Ivonne)

12.45 – 13.00 socio-economic activity (Salvador)

Fancy tasks

14.00 – 14.20 website (animation/figure/graph) (Boris)

14.20 – 14.40 ppt template, logo (Ryan)

Deliveries and task distributions

14.40 – 14.50 Roadmap (Ivonne)

14.50 – 16.50 Summer school: discussion of possible options (Peru, Senegal, Chile), contents, funding scheme and strategy, scientific committee, local organising committee (Baye)

Contributions and Networking

16.50 – 18.30 Ocean Obs'19 (Francisco), IMSOO (Francisco), IPCC WGII (Salvador, Javier), CLIVAR RF (Ryan), GO<sub>2</sub>NE (Veronique)

#### **Sunday, 3 June 2018 (Moderator: Ruben and Ivonne)**

First delivery organization: a multidisciplinary synthesis peer-reviewed publication

09.30 – 14.00 short presentations (Enrique, Andreas, Boris, Ruben, Olaf, Francisco)

15.00 – 16.00 discussion

Next meeting (online and face-to face)

16.00 – 17.00 timeline (place for next meeting also)

17.00 Closure

Confirmed participants:

- Andreas Oschlies



WG 155 EBUS 'Eastern Boundary Upwelling Systems:  
diversity, coupled dynamics and sensitivity to climate change

- Baye Cheikh Mbaye
- Boris Dewitte
- Enrique Curchitser
- Francisco Chavez
- Ivonne Montes
- Lynne Shannon (some hours)
- Ruben Escribano
- Salvador Lluch-Cota
- Ryan Rykaczewki
- Veronique Garçon (invited)
- Olaf Duteil (invited)
- Ed Urban (SCOR)

Remote connection:

- Beatriz Yanicelli

### ***Workshop presentations***

All workshop participants have received access to a shared Google Drive folder with all workshop presentations. In case of issues with access to the folder, please contact Ivonne Montes via [imontes@igp.gob.pe](mailto:imontes@igp.gob.pe) or [ivonne.montes@gmail.com](mailto:ivonne.montes@gmail.com).

The folder can be accessed at this link:

<https://drive.google.com/drive/folders/1sRbxRGzrJtaCBBiHIqDYmzzW9EeRx5w?usp=sharing>

### ***List of SCOR WG 155 EBUS members***

#### **Full members**

Ruben Escribano (co-chair)

Departamento de Oceanografía, Facultad de Ciencias Naturales y Oceanográficas, Barrio Universitario s/n, Casilla 160-C, Concepción, Chile

Ivonne Montes (co-chair)

Instituto Geofísico del Perú (IGP), Lima, Perú

Francisco Chavez

Monterey Bay Aquarium Research Institute, Moss Landing, CA 95039, USA

Enrique Curchitser

Department of Environmental Sciences School of Environmental and Biological Sciences, 14 College Farm Road, Rm 350a, New Brunswick, NJ 08901-8551, USA

Boris Dewitte

Laboratoire d'Etudes en Géophysique et Océanographie Spatiales- LEGOS, UMR5566 - CNRS/IRD/UT/CNES, Toulouse, France

Sarah Fawcett  
Department of Oceanography, University of Cape Town, Cape Town, South Africa

Salvador E. Lluch-Cota  
Programa de Ecología Pesquera, Centro de Investigaciones Biológicas del Noreste-CONACYT, La Paz,  
B.C.S. 23096, México

Baye Cheikh Mbaye  
Laboratoire de Physique de l'Atmosphère et de l'océan Siméon Fongang, Université cheikh Anta Diop de  
Dakar, BP 5085 Dakar-Fann, Dakar, Senegal

Andreas Oschlies  
GEOMAR Helmholtz Centre for Ocean Research Kiel, 24105 Kiel, Germany

Parv Suntharalingam  
School of Environmental Sciences, University of East Anglia, Norwich Research Park, Norwich NR4 7TJ,  
United Kingdom

Associate members

Edward Allison  
School of Marine and Environmental Affairs, University of Washington, Box 355685, Seattle, WA 98195,  
USA

Javier Arístegui  
Instituto de Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria, Las Palmas,  
Spain

Xavier Capet  
LOCEAN, IPSL, Pierre and Marie Curie University - Paris 6, 4 place Jussieu, 75252 Paris, cedex 05,  
France

Iris Kriest  
GEOMAR Helmholtz Centre for Ocean Research Kiel, 24105 Kiel, Germany

Eric Machu  
Institute of Research for Development, Laboratoire de Physique des Océans, UMR 6523  
CNRS/IFREMER/IRD/UBO Plouzane, France

Beatriz Yanicelli  
Centro Regional del Este, Universidad de la República, Rocha, Uruguay

Damodar M. Shenoy  
CSIR-National Institute of Oceanography, Dona Paula-Goa 403 004, India

Ryan Rykaczewski  
Department of Biological Sciences and School of the Earth, Ocean, & Environment, University of South  
Carolina, Columbia, USA

Lynne Shannon

Department of Biological Sciences, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Ming Feng  
CSIRO Oceans & Atmosphere, Indian Ocean Marine Research Centre, WA, Australia

Jong-Seong Kug  
Division of Environmental Science and Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, South Korea