Boundary Systems Task Team (BSTT)

An OOPC-led Task Team

Provides guidance to GOOS observing networks and GOOS Regional Alliances on observing asset deployments in coastal and boundary current regions that would complement GOOS objectives.

Leads: Marjolaine Krug, Maria Paz Chidichimo, John Wilkin, Robert Todd

OOPC Secretariat: Belén Martin Miguez

OOPC 25th meeting, Oct 2022, Darmstadt, Germany

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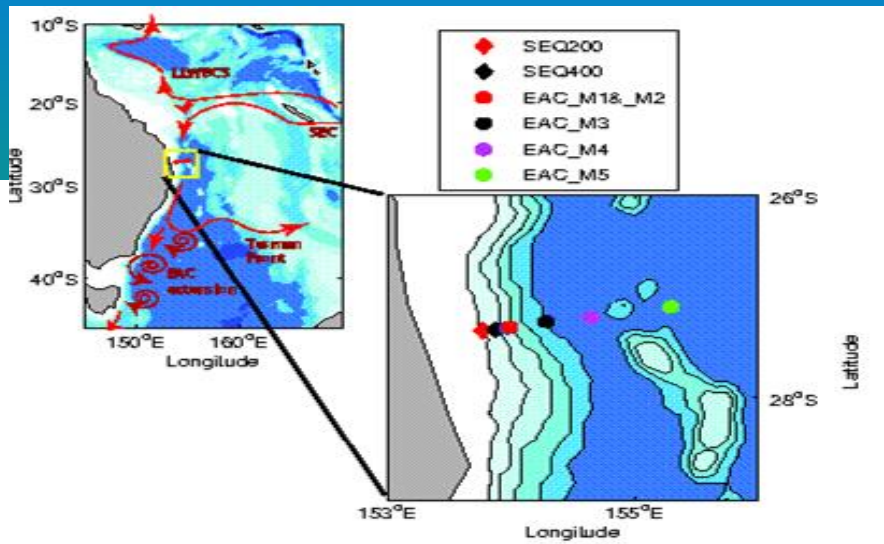
GCOS GLOBAL CLIMATE OBSERVING SYSTEM

The Global Ocean Observing System GOOS

WCRP World Climate Research Programme

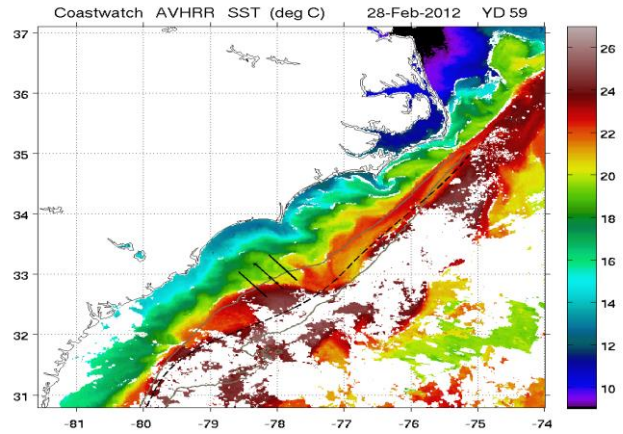
jcomm OCEANOGRAPHY & MARINE METEOROLOGY

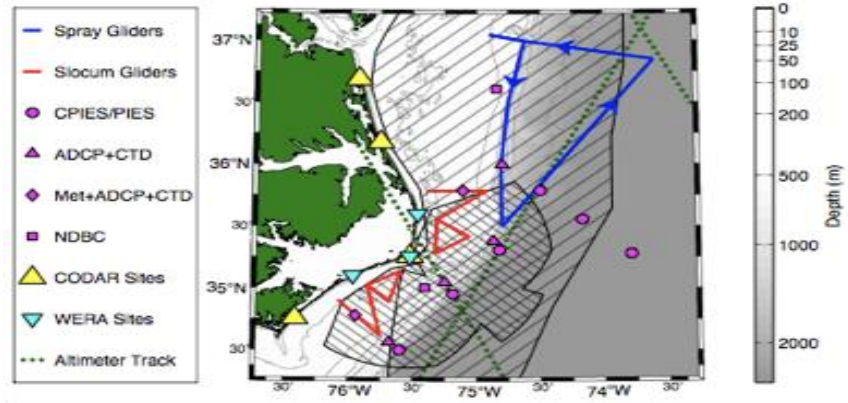
BSTT over-arching goals



AIM: Establish an ongoing project to guide, support the development of boundary current observing systems

- Leveraging OO'19 Whitepapers (Boundary Currents 'super' paper; Coastal BGC/Eco papers; Network based papers; New technologies).
- Collaboration with OceanPredict through OSSEs etc.
- Engage GOOS Regional Alliances on capacity development, open data, collaboration/access to coasts; articulate societal impacts
- Work with observing networks to coordinate multi-platform approaches and model synthesis





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BSTT Team 2022

Name	Gender	Affiliation	Country	Expertise
Marjolaine Krug	F	DFFE-Oceans and Coast	South Africa	Agulhas Current, Satellite Oceanography, Gliders
Maria Paz Chidichimo	F	Scientific and Technology Council (CONICET)/Hydrographic Service	Argentina	WBC dynamics, AMOC variability, mooring arrays, in-situ observing systems, South Atlantic
John Wilkin	M	Rutgers University	USA	Coastal modeling & data assimilation; observing sys. expts.
Robert Todd	M	Woods Hole Oceanographic Institution	USA	Gulf Stream, gliders, shelf-deep ocean exchange
Kiyoshi Tanaka	M	University of Tokyo	Japan	Shelf-basin Exchange, Coastal circulation, Kuroshio Current
Moninya Roughan	F	UNSW	Australia	WBC dynamics, marine heatwaves, ocean observing systems, model-data integration
Nadia Ayoub	F	LEGOS, Toulouse	France	Coastal dynamics, modelling, altimetry
Ed Dever	F	Oregon State University	USA	Ocean observing systems, wind-driven upwelling, physical-biological interactions
Janet Sprintall	F	Scripps Institution of Oceanography	USA	Pacific WBC/LLWBCs; moorings; sustained global observing system
Sung-Yong Kim	M	Korea Advanced Institute of Science and Technology	Korea	
Dr Carl Gouldman	M	NOAA USA	USA	GOOS regional Alliances
Xinyu Guo	M	Ehime University	Japan	Shelf-Kuroshio interaction, nutrient transport and cycle
Secretariat.				
Belén Martín Míguez	F	WMO		OOPC secretariat

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13 members, Covering 6 continents of Africa, Asia, Americas (north and south), Europe and Oceania

Boundary Systems Networking – 2021/2022

UN Ocean Decade – A Predicted Ocean (Sep 2021): BSTT represented at a panel discussion in the main event.

UN Ocean Decade – satellite activity (Sep 2021): Convened satellite activity entitled "Designing observing systems for ocean boundaries".

COP26 (Oct-Nov 2021): Video contribution to Met Office COP26 science pavilion event entitled "Tracking ocean climate change and impacts on our fragile ocean"

OCG boundary current workshop (May 2021): BSTT contributed through a presentation and panel discussions.

6 BSTT virtual meetings (May 2021 – May 2022): Both observing and modelling aspects of mature observing systems.

Ocean Sciences Meeting (Mar 2022): Poster in Ocean Technologies and Observatories Posters (OT06). Several members represented BSTT: Janet Sprintall, Robert Todd, Ed Dever (co-chair session Ocean Observatory Science – Connecting Processes from Events to Climate)

EBUS 2022 (Sep 2022): BSTT contribution and presentation at "Instrumenting and monitoring Eastern Boundary Upwelling Systems (EBUS)", with Tammy Morris (OCG, South Africa) leading session.

CLIVAR-GOOS Workshop - From global to coastal (Aug 2022): Maria Paz part of organizing committee

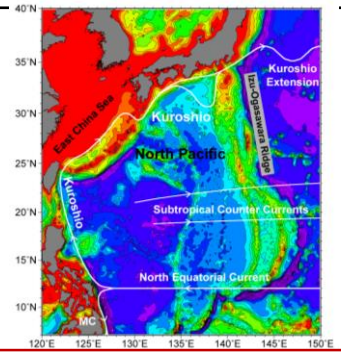
OCG boundary current workshop (June 2022)
BSTT contributed through a presentation and panel discussions.

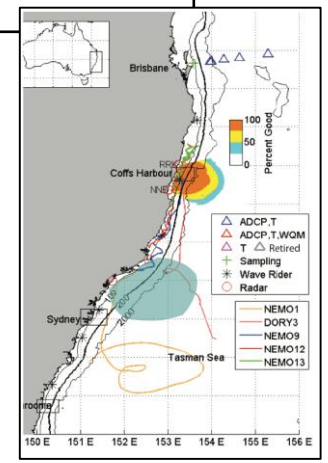
Boundary Systems Reviews

Boundary Systems	Presenter - Observations	Presenter - Modelling	Date
The Iberian System	Dr. Enrique Álvarez-Fanjul	Dr. Enrique Álvarez-Fanjul	6 May 2021
California Current	Dr. Katherine Zaba	Dr. Chris Edwards	8 June 2021
Kuroshio Current	Dr. Eitaro Oka	Dr. Yasumasa Miyazawa	6 July 2021
East Australian Current	Dr. Moninya Roughan	Dr. Colette Kerry	3 August 2021
Gulf Stream Current	Dr. Magdalena Andres	Dr. Jonathan Gula	6 October 2021
Mediterranean northern Current	Dr. Anthony Bosse	Dr Paolo Oddo	4 May 2022

All webinars & presentations can be accessed through the:

- Boundary System Task Team OOPC page
- Through the GOOS website
- On YouTube, search for **OOPC BSTT Series**





Knowledge gained from the webinars was summarized in a presentation and a poster (available on google drive)

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Boundary Systems Reviews

Themes and questions for Observing System presentations

Theme	Suggested Questions
Observing system description	● How was the observing system funded and established (i.e top-down versus bottom-up, motivation used, …) ● What are the science questions that underpin the system design? ● What is the mix of platforms used and how many of these observations are 1) sustained, 2) in the process of becoming sustained and 3) not sustained (this could be presented with a map overview)?
Observing system users	● Who are the main users ? Does the observing system predominantly benefit researchers, intermediate users (eg. data assimilation / validation in models), end users (eg. Fisheries management, Search and Rescue, Pollution response and management) or end users sectors (Fisheries, Tourism, Oil & Gas) ● Are the needs of users taken into consideration as the system design evolves/guiding the selection of the observing platforms ? ● How do the observing system users access the data and services ?
Successes of the observing system	● What are the main successes of the system and demonstrated impacts ?
Adequacy of the observing system	● What physical processes were successfully captured and characterized? ● What gaps are there in the existing observing system?
Recommendations	● Can you determine an optimal mix of observing system platforms for these processes? ● Lessons learned and recommendations for the funding, implementation, coordination and design of the observing system.

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Boundary Systems Reviews

Themes and questions for Modelling System presentations

Theme	Suggested Content
Model limitations	• What are the main sources of uncertainties: e.g. bathymetry ? open-boundary conditions ? runoff ? parameterization ? air-sea fluxes ? etc. • What are the most important processes that need to be represented ? Examples could include submesoscale processes, bottom layer processes, interactions with the coastal circulation, turbulent momentum dissipation. • What processes are models not able to reproduce, including limitations in reproduction of chaotic motions accompanying the strong currents ?
Use of the observations in models	• How are observing system components used by the modelling community (cover all aspects: assimilation, validation, new discoveries). • Which observation data responds best to the modellers needs, comparing usage of high-resolution snapshots, long time-series of sparse-resolution observations, chaotic and abundant observations (such as Argo, fishery-collaboration) or regular and purpose-oriented observations. • How accessible are real-time in-situ observations for assimilation into operational models ?
Adequacy of observing system for the modelling community	• Is the observing system adequate for the quantification of errors in models (eg. observations available at the required spatial and temporal resolution) ? • What new data is needed from the modelling community with potentially some suggestions on new observing technology / instruments required by modellers (e.g., smaller and soft Argo for the coastal region, SSS-measurable satellite, very-far-reaching HF radar, SWOT, air-sea fluxes from AUV/RUV etc.)
Using models to improve the observing system	• What communication and integrative approach has worked best to maintain dialogue on needs of both observationalists and modellers? • How can the modelling community help improve the observing system ? • Suggestions on OSSEs or modelling activities to help develop guidelines for observing system at boundaries

Recommendations: Users & Funders

Recommendations:

- Engage with industry and stakeholders early on in the process
- Increased efforts among providers of ocean observations to track user groups, their downloads, and use of the data would help identify associated marketable and societal values (as in Rayner et al. 2019).
- Feedback to users and observing community on impact of observations on models
- Allocate resources for stakeholders engagements to collect user requirements, communicate on the science issues and ensure a greater participation and support from industry or local government.
- Allocate resources to move beyond data to data products
- Sustained government/high level funding to ensure cohesion of the system and benefits extending beyond the industry sector.

Recommendations: Observing System Design

Recommendations:

- Open data policy and well designed data portals to ensure user uptake of observations
- Improved co-ordination amongst funders of observing system (eg. Across government department) to ensure continuity in observations and better design.
- More observations of Air/sea fluxes (air/sea interactions identified as a key limitation for ocean models)
- Devise strategy to secure long-term sustained observations (both in-situ and satellite) trough communication with users / scientists / funders.
- Mix of surface (satellite, HFR etc) and subsurface measurements to improve representation of eddies and mesoscale processes in models.
- Models must be used to inform the observing system design.
- More observation impact experiments are needed (e.g. Kerry et al 2018).

Modelling System: Recommendations

- **Air / Sea flux representation in models remains a major challenge:** Recommendation for high resolution wind forcing through downscaling and use of atmospheric models (eg. WRF)
- Sub-daily 3D ocean model data for nesting of high resolution models closer to coast (eg. Use of 3 hourly data from Copernicus for nesting in Iberian coastal models)
- Ensemble model solution better than individual solutions
- Stronger links and collaborations between open ocean and coastal waters modelling communities
- Separate computing environments for Development, Pre-production, Production
- Outsourcing of operations for 24H/7 support
- More research in data assimilation (investigate new data streams for assimilation, improve assimilation schemes)

Boundary Systems: White Paper

Paper objectives:
Develop a synthesis of best ocean observing practices at ocean boundaries and provide guidance for existing and planned sustained observing systems at ocean boundaries

Paper planned in journal Oceanography

- The paper will be lead by Nadia Ayoub with support from the rest of the team.

- Suggestions to invite some of the webinar presenters to be co-authors.

- Recommendation that the paper should aim to be different to Todd et al. (2019) OceanObs paper on Boundary Systems.

- Paper should mention synergies with exiting efforts (OCG Boundary group, CoastPredict, GOOS-CLIVAR workshop etc)

Paper Structure: (sub-sections in developments)

- **Introduction**
- **Section 1: How were observing systems established?**
- **Section 2: Who are the users?**
  - Predominant government agencies (met agencies, fisheries, port authorities, coast-guards, MSP)
  - …
- **Section 3: Observing system Design**
- **Section 4: Successes & Impacts**
  - Impact of observations on models
  - Impact on society, governance and economy ?
  - …
- **Section 5: Recommendations**
  - Users and Funding
  - Observing System Design
  - Modelling Systems
- **Conclusions**

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BSTT Team beyond 2022

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Nadia Ayoub	F	LEGOS, Toulouse		
Ed Dever	F	Oregon State Un		ysical-
Janet Sprintall	F	Scripps Institutio		serving
Sung-Yong Kim	M	Korea Advanced and Technology		
Dr Carl Gouldman	M	NOAA USA		
Xinyu Guo	M	Ehime University	Japan	Shelf-Kuroshio interaction, nutrient transport and cycle
Secretariat.				
Belén Martín Míguez	F	WMO		OOPC secretariat

BSTT Leadership:

- Marjolaine Krug stepping down
- No real interest to lead from any team members
- Janet Sprintall can lead team in the interim until suitable leader can be identified (preferably someone newly recruited in OOPC)

Memberships:

- Existing membership with fairly strong US bias
- New member brought in BSST in 2022 Dr Carl Gouldman has not shown much interest. Replacement suggestions ?
- Suggestion to bring in a new member from Brazil: Suggested names include Janini Pereira (REMO network since 2008), Luiz Paulo Assad (Projeto Azul), Carlos A. E. Garcia (SiMCosta).

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