

Proposed SOOS Capability Working Group:
Enhancing Air-Sea Flux Observations in the Southern Ocean

SOOS Request for Assistance

The Southern Ocean Observing System (SOOS) is an international initiative that aims to facilitate the collection and delivery of essential observations on variability and change of the Southern Ocean systems to all international stakeholders through the design, advocacy, and implementation of cost-effective observing and data delivery systems. SOOS requests assistance in developing the community, best practices, and initiatives through community Working Groups (WG). These WGs will provide critical information that will be incorporated into a maturing SOOS. SOOS will provide the WG with (i) a means of incorporating ideas originating from scientists into a lasting international system, (ii) mechanisms for enhancing collaboration and resources, and (iii) a means for achieving citations of developed products along with a presence on the world-wide web.

SOOS Working Group Objective

The focus of the WG is to understand, quantify, and, where possible, reduce uncertainties in air-sea and ice-ocean exchanges. A key objective of the WG will be developing and facilitating a pilot field experiment that will be focused on addressing the fundamental requirements for enhancing air-sea flux observations in the SO. More broadly, the WG will design and facilitate the implementation of an observing system to support investigations on dynamics and change in Southern Ocean air-sea fluxes. This will include the formal definition of Essential Ocean Variables (EOVs) and input to GCOS regarding Essential Climate Variables (ECVs) for fluxes (along with targets for accuracy and precision at different spatial/temporal resolutions for different research applications), the development of priority measurements, standardized methodologies for collecting and archiving data, the optimal design of field programs, and strategies for implementing field observations, including supporting regional working groups and networking with existing and emerging programs. The working group will utilize field data to characterize the fidelity of current state-of-the-art bulk flux parameterizations in the presence of time-varying waves, winds, and sea ice typical of the Southern Ocean.

Terms of Reference

The working group (WG) will fulfill the following terms of reference over the next 5 years:

1. Guide development of a pilot study (or series of coordinated pilot study projects) for SO air-sea fluxes across the Southern Ocean. The pilot studies can include observations of the atmospheric boundary layer and upper ocean state over selected regions of the Southern Ocean (using ships, planes, wave gliders, profiling floats, autonomous underwater vehicles), and should address turbulent and non-turbulent components of fluxes and should evaluate bulk parameterizations relative to direct flux covariance observations.
2. Facilitate the identification and development of candidate air-sea flux EOVs for the Southern Ocean, and progress these to a mature state of readiness for inclusion in SOOS. Provide input to GCOS regarding air-sea flux ECVs with relevance to the Southern Ocean.
3. For those with a mature state of readiness, provide standardised methodologies for collecting and archiving data
4. Identify and assemble legacy data sets from ships and stations that may assist in validating and furthering our knowledge of SO air-sea fluxes
5. Promote and coordinate existing programmes and platforms to collect essential observations that are identified as scarce and required for validation purposes

6. Develop standardized methods that are easily understood by different stakeholders (including policy stakeholders), which are repeatable, and easily transferrable
7. Develop methods for validation/ground truthing of satellite-derived flux estimates using in situ observations
8. Define targets which will make the flux products more usable and enable progress to be assessed.
9. Perform spatial and temporal gap analysis (including key regions – sea ice, upwelling, islands etc) of Southern Ocean air-sea flux observations and knowledge; links to optimal sampling strategies and data assimilation
10. Identify ‘fast-track’ approaches to obtaining observations that address existing spatial and temporal gaps, including new technologies available to contribute to observing these fluxes.
11. Identify end users of such data and provide guidelines to facilitate the delivery of this data to end users; develop procedures to achieve efficient sharing of data across the science community according to SOOS data policy and via the SOOS Data Portal
12. Use observations to
 - a. validate satellite air-sea fluxes and mapped (e.g. reanalysis) products.
 - b. improve models in terms of atmospheric state and coupling to the ocean
 - c. assess air-sea coupling parameters in evolving sea states
 - d. evaluate the impact of the improved coupling parameters on ocean model performance
13. As part of the pilot study, augment the observing program with coupled ocean-surface wave-ice-atmosphere process modeling to evaluate model physics at the air-sea interface, the sensitivity to bulk formulae, and perform a comparative analysis of varying resolution models. Although sea ice may not be central to the initial pilot study, it should be considered as part of the longer-term planning.
14. Evaluate infrastructure issues, including flow distortion for existing ships, design criteria for ships and moorings, and optimal measurement strategies in high wind and high wave conditions.
15. Development of white paper(s) that inform the community of recent gains and paths forward
16. Hold annual meetings of the working group, and source funding to enable WG sustainability and “spin-off” flux-related initiatives
17. Convene focussed sessions at national and international meetings, including SCAR and SCOR, and facilitate synthesis products, to increase the awareness of the science community to the importance of the air-sea fluxes. Provide annual reports to the SOOS SSC on activities and outcomes of the WG, and regular updates for the SOOS newsletter

Participants

Co-Chairs:

Sarah Gille
Seb Swart

Steering Committee:

Mark Bourassa (GCOS, EOVS)
Carol Anne Clayson
Bruno Delille (ice and CO2)
Simon Josey
Andrew Lenton (SOLAS, Carbon)

Eric Schulz
Inga Smith (SORP, sea ice and heat fluxes)
Brian Ward (SOLAS, WDAC)

Members: Working Group membership can include observational oceanographers, atmosphere/ocean/coupled modellers, and specialists in atmospheric boundary layer processes.

Dorothee Bakker	Ken Melville
Abderrahim Bentamy	Scott Miller
Ivana Cerovecki	Pedro Monteiro
Ronald De Souza	Alberto Naveira Garabato
Jim Edson	Lucian Ponzi Pezzi
Chris Fairall	Marcos Portabella
Giannetta Fusco	Brent Roberts
Judith Hauck	Craig Stevens
Pat Hyder	Sarat Tripathy
Luc Lenain	Bob Weller
Pierre-Philippe Mathieu	Margaret Yelland
Matt Mazloff	Chris Zappa

Products and Outcomes

- 1) Air-Sea Flux EOVs/ECVs for the Southern Ocean with detailed specification sheets highlighting targets for accuracy and precision, temporal/spatial requirements, standardised methodologies, and preferred data management, etc.
- 2) White paper / peer reviewed paper / community report highlighting status, key spatial-temporal gaps, technology/sensor issues and requirements, data management issues/requirements, strategy for way forward (to be used as rationale for funding bids for pilot study)
- 3) Funding and logistics proposals submitted internationally for a coordinated pilot study addressing key air-sea flux observational gaps – likely timed to coincide with, and contribute to the Year of Polar Predictability (YOPP). Ultimate pilot study outcomes could include development of robust sensors (including improvements in ship-based and buoy-based met packages and platform air flow distortion assessment), standard operating procedures/protocols for collecting air-sea flux observations, ground truth data for analyzing air-sea fluxes, improved air-sea coupling parameterizations for the Southern Ocean to be used in climate modeling, improved infrastructure for coupled ocean-ice-atmosphere modeling and assimilation

Mode of Operation

The group will work remotely and opportunistically at scientific conferences until funding can be arranged for the group's activities. The SOOS website will be used to provide information and share resources. All efforts will be made to harmonize the efforts of this group with other relevant efforts, such as EOV/ECV efforts of GCOS, OOPC, and GOOS communities; field efforts of COMNAP ARC, ASPeCt, and many other national and multi-national programs.

Strategy & Milestones

The working group will establish targeted task teams to meet its major objectives:

Task team #1: Define flux requirements. Write journal publications articulating performance requirements for fluxes for specific science applications. This work will build off of analysis of flux-

driven oceanic processes and modeling sensitivity studies. Goal: develop a portfolio of flux requirement metrics and submit a manuscript for publication by January 2017

Task team #2: EO/ECVs. Interface with GCOS, GOOS to define language articulating flux requirements within the observing system. We anticipate a discussion at the ESA Gas Flux meeting in Brest in September. The working group will work with GCOS and GOOS and in the first year will aim to produce a summary list

Task team #3: Develop scientific and logistics planning for pilot study with possible components centered at the southeast Pacific OOI mooring and/or at the IMOS mooring south of Australia. Planning documents to be prepared within the first 12 months, with possible proposal submission to NSF OCE in August 2016 or August 2017. The task team will also circulate a white paper/planning document to seek formal endorsement from YOPP and other relevant international bodies. Task team #3 will focus on sea-going work but will work with remote sensing experts to include remote sensing capabilities in the pilot study.

Task team #4: Modeling capabilities for pilot study. Coordination of remote sensing analysis and retrievals in support of pilot study and extended to full Southern Ocean. In first year, develop working plan.

Facilitator and SOOS SSC Sponsor

SOOS SSC sponsor: Seb Swart