The Southern Ocean Observing System (SOOS) field and modeling capabilities of relevance to YOPP

Year of Polar Prediction in the Southern Hemisphere (YOPP-SH) meeting: June 28–29, 2017

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Exploiting ocean predictability is vital for 2-month atmospheric prediction.
SOOS coordinates and facilitates incorporating ocean observations into YOPP-SH.

- SOOS aims to improve the observing system via working groups.
- SOOS inventories the observing system: data management.
- Southern Ocean data assimilation capabilities.
Significant changes in sea-ice (extent, concentration)
Return of the open ocean Weddell Polynya?!

https://earthobservatory.nasa.gov/IOTD/view.php?id=88656

Image of Weddell Polynya on August 14, 2016 from NASA’s Aqua satellite.

Will the Weddell Polynya open this austral winter?
Predictive skill lies in ocean preconditioning:
How weak is the halocline?
SOOS Goals Summarized

1. An international program to deliver sustained observations
2. Regional implementation built upon national programs.
3. Facilitation and promotion to improve observations through international coordination and technological R&D
4. Efficient and internationally integrated data management systems to access observations and synthesis products
DueSouth: A Database of Upcoming Expeditions in the Southern Ocean

User-provided information on voyages, leadership, and onboard projects. The database can be searched by text, dates, or geographic location.
YOPP Explorer synergy with DueSouth?

SOOS has compiled a list of many SO projects (e.g. ORCHESTRA, ROBOTICA, SOCCOM) These are not on YOPP Explorer. YOPP may want to utilize DueSouth or SOOS Maps.

. SOOS databases are open. We can share databases and are open to looking into what would be involved in connecting DueSouth and YOPP Explorer
SOOS Map

- Development in collaboration with EMODnet: www.emodnet-physics.eu/Portal
- Embedded in SOOS website, but EMODnet provides back end and hosts.
- Front end being constructed, estimated launch time end of this year.
- SOOS Map capabilities:
  - Filter by time or platform
  - Search by text
- SOOS will add layers:
  - Argo
  - SOCCOM
  - GO-SHIP
  - DueSouth
  - CPR Tows
  - Tide Gauges
  - AWS
  - XCTD/XBTs
  - NECKLACE (ApRES)
  - OceanSITES
  - Moorings
  - MEOP Seals
  - Gliders
  - Ship obs/GOSUD underway data
  - Drifting Buoys
  - DueSouth
Southern Ocean Mooring Sites:
http://www.soos.aq/activities/soos-at-sea/moorings

Fig. 1. Map of Southern Ocean mooring locations. Red = currently deployed, yellow = retrieved, grey = unknown deployment status, white = failed, turquoise = planned.
West Antarctic Peninsula (WAP), Indian Sector, and Ross Sector working groups established.
Capability working groups

1. Censusing Animal Populations from Space (CAPS)
2. Ecosystem Essential Ocean Variables (eEOVs)
3. Observing and Understanding the Ocean below Antarctic Sea Ice and Ice Shelves WG (OASIIS)
4. Southern Ocean Air-Sea Fluxes (SO-FLUX)
   - Enhancing Air-Sea Flux Observations Southern Ocean

ERA-Interim July Heat Flux (color)
Mooring sites & available ship obs
SOFLUX is developing four Task Teams

www.soos.aq/activities/capability-wgs/soflux

**Task Team 1) Coordinating in situ obs.**
Coordinating proposals for enhanced efforts building existing moorings (OOI and IMOS-SOTS).

**Task Team 2) Defining Requirements for Flux Obs.**
Developing a community statement on flux requirements

**Task Team 3) input to GCOS/GOOS**
Recommendations to coordinating bodies such as Global Climate Observing System and the Global Ocean Observing System, in particular on ECVs and EOVs

**Task Team 4) Modelling and Satellite Synthesis**
Sensitivity to bulk formulae. Flux obs to improve model physics at air-ice-sea interface.
SOFLUX working group
www.soos.aq/activities/capability-wgs/soflux

Task Team 1) Coordinating in situ obs.
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Task Team 4) Modelling and Satellite Synthesis

- SOFLUX is not exclusive, and anyone who would like to be on the distribution list and/or participate in a task team should contact Sarah Gille or Louise Newman
- There will be SOFLUX-related sessions at Ocean Sciences (Portland, February 2018) and Polar 2018 (Davos, June 2018)
- The IMOS/SOFS mooring and the OOI mooring shown on the map both face uncertain futures, and if YOPP would like to see them continue, that should be articulated (strongly!) in the next 2-3 months.
SOSE effort is a biogeochemical-sea ice-ocean model using 4D-Var with multi-year assimilation windows to solve for the atmospheric fluxes necessary to bring the solution into consistency with observations.

**SOSE products: sose.ucsd.edu**

- 2005—2010 sea ice–ocean at 1/6°
- 2008—2012 biogeochemical–sea ice–ocean at 1/3°

**In production**

- 2013—2016 biogeochemical–sea ice–ocean at 1/3°. Evolving to higher resolution and extending in time.

**SOSE for YOPP-SH**

- Part of 2013 to 2019 product
- A targeted YOPP-SH ocean reanalysis?
Ocean state estimates inform biases in atmospheric reanalysis

2008-2012 mean: SOSE minus ERA-Interim atmospheric temperature at 2m in °C.

2008-2012 mean: SOSE minus ERA-Interim precipitation in mm/day.
Tropical Pacific prediction skill

Forecast interval with skill greater than climatology:

Persistence $\approx 25$ days

Forecast model (w/clim. atm.) $\approx 50$ days

With actual atm. state $> 120$ days!

(Verdy et al, J.Tech. 2017)
SOOS-YOPP-SH relevant questions. What is our predictive skill regarding:

- Sea ice cover and freshwater export?
- Mixed layer evolution? Upper ocean heat content and SST?
- Modulation of air-sea fluxes by ocean eddy variability
- Modulation of air-sea fluxes by sea ice variability?
- Partition of local wind work on the ocean into surface currents, mixing layer turbulence, and energy radiated away as swell?