# SOOS - POGO Working Group FACT SHEET

## Observing and understanding the ocean below the Antarctic sea ice and ice shelves (OASIIS)

**The OASIIS Working Group is a community of scientific researchers working together to improve observations and our knowledge of the oceans beneath Antarctic sea ice and ice shelves.**

Figure 1: Totten Glacier in East Antarctica (credit: © Esmee van Wijk, CSIRO/AAPP)

**Why is it important to observe the oceans beneath ice?**

In 50 to 100 years it is predicted that 90% of the globe's human population will be living within 100 km of an ocean.  It is forecast that global sea level could rise up to 0.5 to 2 m by 2100. Accurate estimates of the future rates of sea level rise due to climate change are therefore critically important. One of the largest 'blind spots' in the global ocean observing system is the ocean beneath Antarctic sea ice and ice shelves. Observations in this region are vital for understanding rates of future sea level rise; including the contributions from melting Antarctic ice sheets and from thermal expansion as the oceans warm. The Antarctic ice sheet is the greatest source of uncertainty in projections of future sea level rise. Increased basal melt of ice shelves from contact with warm, salty water on the continental shelves has been observed in both west and east Antarctica, with rates increasing in the past decade. Yet the dynamics driving warmer oceanic water onto the continental shelves needs to be better understood. The densest and most oxygen-rich waters found in the ocean are formed in the high latitudes and when carried equatorward by ocean currents, these waters ventilate the rest of the global ocean. Measurements and improved ocean modelling are also needed to understand how Antarctic ocean properties (such as heat, freshwater, dissolved oxygen and carbon budgets) and ocean circulation have changed over time and how these changes impact other parts of the Earth through the global network of ocean currents.

**Why are there so few observations of the Southern Ocean?**

Historically, it has been difficult to observe the Southern Ocean due to the expense and logistical challenges in accessing such a remote, ice-covered and hazardous region with ships. This has led to the Southern Ocean being the most poorly observed region of the global oceans. It is particularly difficult to make *in-situ* observations in winter when frequent storms and maximum ice-cover occur. We are now able to observe the under-ice region far better than before with the advent of ocean-observing technologies, such as under-ice Argo floats, ice mass buoys, seals tagged with oceanographic sensors, gliders, autonomous underwater vehicles (AUVs), remotely operated vehicles (ROV's), moorings, boreholes through the ice, automatic weather stations, phase sensitive radar and new satellite sensors and missions (Figure 2).

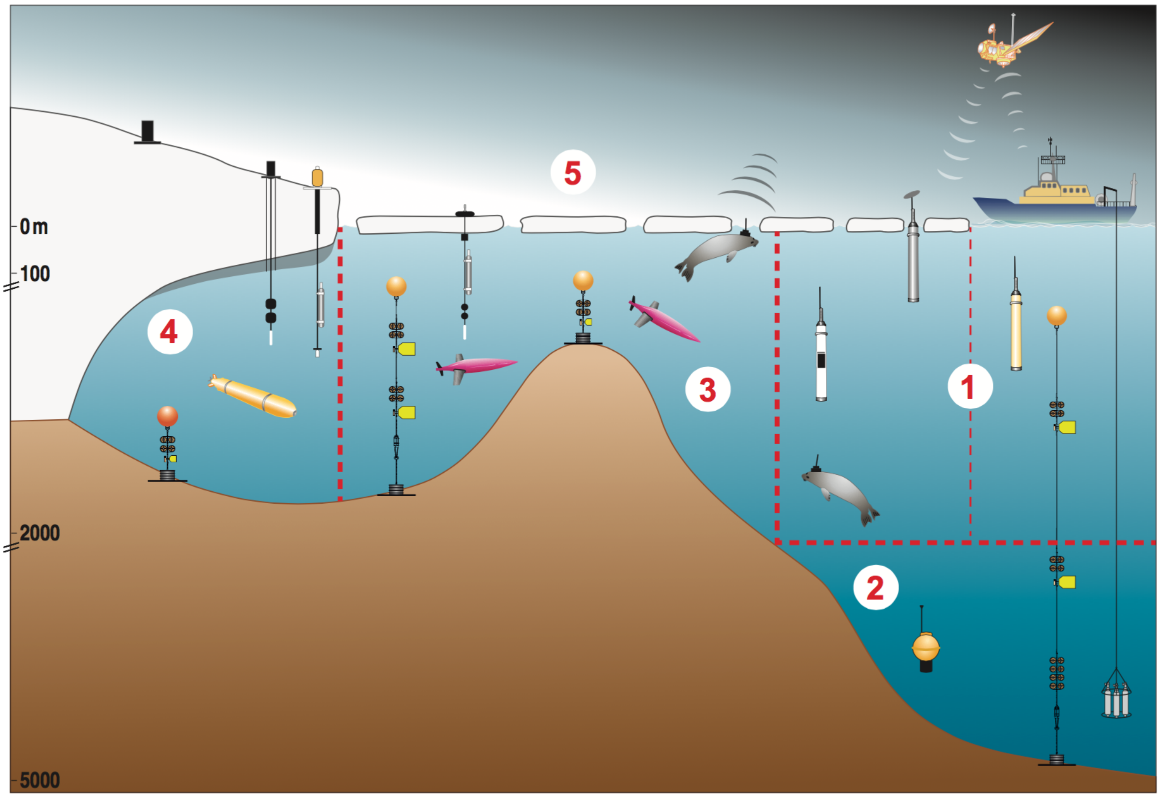


Figure 2: The high latitude Southern Ocean and Antarctic margin includes several physical environments (1-5), each requiring a different mix of platforms 1: Open ocean shallower than 2000m depth, 2: Deep ocean, 3: Continental shelf and slope, 4: Ice shelf cavities, 5: Sea ice and ice-ocean-atmosphere interaction (from "Seeing Below the Ice: A strategy for observing the ocean beneath Antarctic sea ice and ice shelves", 2014).

Satellite and airborne assets can monitor regions from above, while *in-situ* sensors and platforms can measure the circumpolar oceans beneath ice, from the surface to the sea floor. Current research aims to increase the length of deployments of autonomous ocean and ice observing equipment so that measurements can be made over winter and for multiple years. Advances in navigation methods under ice (through the use of acoustics and other techniques) enable us to do things like 'fly' a glider beneath an ice shelf to make measurements within the cavity. Integrated systems of observational platforms are required to investigate the key processes that influence sea ice distribution, thickness and variability (Fig 3) and to determine the contribution of oceanic heat to ice-sheet melt (see Fig 4).

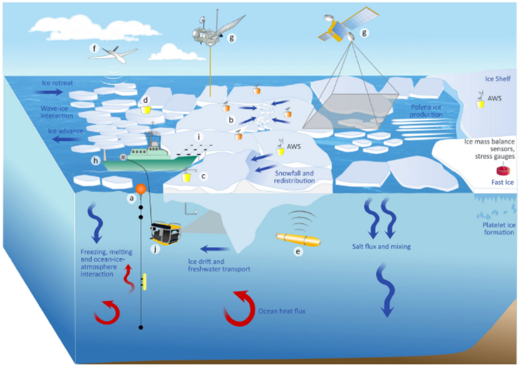

FIGURE 3 | Observing system for sea ice includes: drifting buoys (a); ice-deformation arrays (b); mass-balance- and snow-buoys (c); wave buoys (d); autonomous underwater (e); airborne vehicles (f); satellite altimeters; and radars and radiometers (g); ships (h); underway and in situ sea-ice sampling (i) and ROVs (j). From [Newman et al., 2019](https://www.frontiersin.org/articles/10.3389/fmars.2019.00433/full).

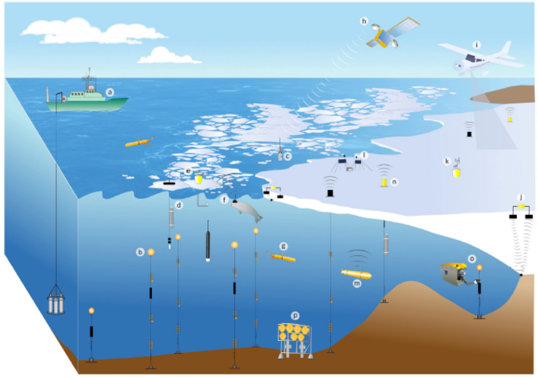

Figure 4 | Observing system for an ice shelf includes: ships (a); moorings (b); ice-capable floats (c); ice-tethered profilers (d); ice-mass buoys (e); seal tags (f); gliders (g); satellite (h) and airborne (i) missions; ApRES radars (j); automatic weather stations (k), GPS (l), AUVs (m); instrumented boreholes (n) moorings deployed by ROV (o) and bottom landers (p). From Newman et al., 2019.

Promising technological developments that are underway include deploying moorings in ice shelf cavities by ROV; inexpensive and expendable bottom landers, and acoustics for data telemetry and navigation. Several state-of-the art modelling efforts for ice sheet/ocean interactions are also underway to estimate basal melt rates for ice shelves and to compare with observations.

**What are the aims of the OASIIS working group?**

OASIIS aims to bring together interested researchers in the oceans, sea ice, glaciology and marine instrumentation communities to collaborate, exchange knowledge and further the collection of observations of the oceans beneath sea ice and ice shelves. Workshops are held every few years; with the first meeting in Hobart Australia in 2012 and a second meeting in Bremerhaven, Germany in 2015. The Working Group aims to increase collaboration between researchers thereby increasing participation and international involvement in field campaigns, leveraging knowledge and resources and providing guidance to the community on key observational gaps and how these might be filled. For further information see: https://zenodo.org/record/4011362#.X076w9MzY8N and https://www.frontiersin.org/articles/10.3389/fmars.2019.00433/full

**What are the societal benefits of this research?**

Measurements of the ocean beneath sea ice and ice shelves will help us to understand future rates of sea level rise, the impacts of climate change on Antarctic and Southern Ocean marine ecosystems and fisheries, and an ability to track global budgets of ocean heat, freshwater and carbon. Increasing our understanding of these remote ice-covered regions will provide stakeholders, such as the Antarctic Treaty System, the Partnership for the Global Oceans (POGO), the Commission for the Conservation of Marine Living Resources (CCAMLR), the international scientific community, policy makers and governments with the knowledge required to manage and preserve Antarctica and its surrounding oceans for future generations.