Partnership for Observation of the Global Oceans

www.ocean-partners.org

PROPOSAL TEMPLATE FOR POGO WORKING GROUPS

Please send this form to pogoadmin@pml.ac.uk by ***18 March 2016.***
Proposals should be submitted by a POGO member (officially the Director of a POGO institution). Participants from institutions that are not part of POGO may be included as WG members to address geographical balance or gaps in expertise.

Important note: POGO funds are very limited. This system provides a means of directing POGO's efforts and funding from membership dues through a more open process, and also of coordinating and supporting the efforts of its Members. It is therefore anticipated that Members and/or other organisations would provide additional support for these initiatives. It is anticipated that applications will be in the range 5K - 8K EUR, and in any case should not exceed 10K EUR.

1. Title of proposed Working Group:

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

Proposed start date: 01/06/2016
Proposed end date: 31/06/2018
(* Please note dates are flexible and can be extended if required).

2. Background and rationale

Scientific rationale, societal benefits and policy relevance –max. 300 words:

Understanding the interactions between the Southern Ocean, atmosphere and cryosphere is fundamental to our understanding of global climate, biogeochemical cycles, biological productivity and sea-level rise. Despite this global imperative, the ocean beneath the Antarctic sea ice and ice shelves remains one of the least observed physical systems on the planet. This has limited our progress in understanding air-ice-ocean interactions and their sensitivity to climate change. The only way to fill this gap - the largest 'blind spot' in the global ocean observing system – is an internationally coordinated, integrated and circumpolar under-ice observing system in the Southern Ocean.

A "truly global" ocean observing system must include observations of the ocean beneath Antarctic sea ice and ice shelves as these are of critical importance to understanding the impacts of climate change on society. For example, the greatest uncertainty in future sea-level rise is the contribution from the Greenland and Antarctic Ice Sheets. We now know that the fate of the Antarctic Ice Sheet is directly coupled to changes in the surrounding ocean. The Southern Ocean takes up vast amounts of anthropogenic heat and carbon dioxide, helping to slow the rate of climate change, but the future of the Southern Ocean sinks are uncertain. Changes in Southern Ocean sea ice, circulation and chemistry (e.g. acidification) will affect Southern Ocean ecosystems and fisheries and alter nutrient transports with impacts on global productivity. There is increasing demand for short-term ocean

forecasts and seasonal predictions that depend on assimilation of observations from the high latitude oceans. Effective policy to mitigate and adapt to climate change requires knowledge of how the ocean-ice-atmosphere system will respond to a warming climate. Sustained observations of the Southern Ocean, including the ocean beneath sea-ice and ice shelves are critical to anticipate and respond effectively to these societal challenges.

Global context –max. 300 words:

The Southern Ocean drives the movement of heat and freshwater around the globe, exports nutrients that support 75% of global productivity north of 30°S, and has absorbed 40% of anthropogenic CO_2 taken up by the ocean. The expansion and contraction of Antarctic sea ice is one of the most dramatic seasonal phenomena on Earth. This pattern influences albedo and hence the energy budget of the planet, while sea ice impacts climate and biogeochemical cycles by driving ocean circulation and regulating air-sea exchange of momentum, heat and gases.

Changes in the Southern Ocean will have widespread consequences for circulation, heat and carbon budgets, sea-level, biogeochemistry and biology on a global scale. Warming of the oceans has been linked to accelerating mass loss from the Antarctic Ice Sheet and more rapid sea-level rise. Models suggest that changes in the Southern Ocean will reduce the efficiency of the ocean carbon sink, providing a positive climate feedback. The combined effect of changes in sea-ice, ocean warming and acidification, and harvesting may have substantial but poorly known impacts on ecosystems. There is increasing evidence that changes are already underway but our current understanding is limited by a lack of observations, particularly measurements from beneath sea ice and ice shelves.

An integrated under-ice observing system is a critical component of the global ocean observing system that is championed by POGO, GOOS and SOOS who have highlighted the paucity of observations in the Southern hemisphere compared to the Northern hemisphere. The international community has articulated the need for enhanced under-ice observations in many fora including; IPCC AR5, SCAR Horizon Scan, WMO Year of Polar Prediction and WCRP Polar Challenge. By building on the significant national and programmatic efforts that already exist, a truly integrated under-ice observing system will fill the remaining gaps in this critical polar region.

Relevance to POGO and fit with the new POGO Strategy –max. 300 words:

POGO is uniquely placed to facilitate coordination across the global ocean observing community from among its diverse and world-leading member institutions. Support from POGO makes a clear, global statement on the importance of an under-ice observing system, and will deliver the international clout required to drive the uptake of the recommendations resulting from this WG effort. POGO can be the catalyst to bring together the expertise, capabilities and capacity required to push the observing system into the high latitudes in a sustained and integrated way.

This Working Group (WG) aims to meet the need for global coverage in the ocean observing system and help address the imbalance between the northern and southern hemispheres identified by the POGO strategy.
In addition, the WG will draw on existing expertise in the Arctic and Southern Ocean and both build on, and leverage the respective expertise of these communities.

Potentially transformative technologies that could greatly advance under-ice observing have been identified but need a development pathway. Rapid developments in new sensors and platforms are already underway and will be particularly important to fill the large gap in biological and biogeochemical measurements. However, current technology development is piecemeal and driven by individual institutions and manufacturers; global coordination could accelerate progress and POGO is well-placed to help make this happen.

3. Work plan, deliverables and milestones

What does the WG aim to achieve and how? How will this advance POGO's mission? Describe measures of success that could be used to evaluate the impact –max 1000 words:

The goal of the WG is to develop a detailed implementation plan for an under-ice observing system, including definition of quantitative sampling requirements and identification of leaders (teams) to take implementation of key elements of the observing system forward.

This WG will build on the success of the 2012 SOOS workshop that articulated the scientific rationale and justification for an under-ice observing system in the Southern Ocean in the report "Seeing Below the Ice: A strategy for observing the ocean beneath Antarctic sea and ice shelves" (http://soos.aq/resources/science-strategies?view=product&pid=26). This included a strawman proposal for an under-ice observing system but lacked a detailed implementation plan.

The absence of a clearly articulated implementation plan, with quantitative design requirements, is stalling efforts to establish an internationally coordinated under-ice observing system. The next step forward (and the goal for this WG) is to prepare a detailed community-led implementation plan for this integrated, circumpolar Antarctic under-ice observing system.

The goals of this WG are directly tied to POGO's core mission statement to lead the innovation and development of crucial components of the ocean observing system. Articulating a strong case to the community for an under-ice observing system with clear steps as to how this might be realized, and the societal benefits, will enable POGO members/national programs to approach funders with a clear rationale and justification for funding field campaigns, observational infrastructure and technology and capability development.

Over the past decade, technological advancements in ocean observing mean we now have the capability to observe beneath the Antarctic sea-ice and ice shelves. Many key platforms such as Argo

floats, ice-tethered profilers, gliders, instrumented-seals, moorings, passive and active acoustics, satellites, etc. have proven successful in returning data from these harsh environments and are deployment-ready now. The WG will outline how we can effectively use existing platforms to form the backbone of an under-ice observing system as well as identifying important new technologies/sensors and how to advance them. Rapid development of technology into the future will allow us to expand upon this core capability and enhance under-ice observations even further.

A key part of building an under-ice observing system is to articulate what we can do now with existing platforms and technology, and to identify areas for future technological development and innovation (a key priority for POGO). The WG anticipates developing close links with engineers and manufacturers who are progressing efforts to make their platforms/sensors under-ice capable and provide opportunities for them to collaborate with scientists on field-campaigns to test equipment in-situ and help drive the technology forward.

The WG will speed progress by identifying and commissioning specific discussion papers before the workshop. Topics might include, but are not limited to;

1. What is the optimal and feasible strategy for deployment of acoustically and non-acoustically tracked floats?
2. How can we combine under-ice (e.g. AUV), through-ice (e.g. boreholes) and on-ice (e.g. radar) measurements to observe the ocean and bathymetry beneath ice shelves?
3. What is the right mix of platforms to observe under-ice ecosystems?
4. How do we best integrate observations and modelling efforts?
5. What are robust means to enable navigation and data telemetry with autonomous platforms (eg floats, glides, AUVs) under ice?
6. What is the status of biological and biogeochemical sensors appropriate for deployment on autonomous vehicles in the sea ice zone?
7. What products can an under-ice observing system deliver that are of value to users?
8. What regions are particularly suitable for pilot deployments of an integrated under-ice observing system?
9. How do we allocate resources between broad-scale sampling and focused regional or process studies?
10. What is the status of key technologies in terms of readiness and relevance for an integrated under-ice observing system (e.g. floats, gliders, ice-tethered platforms, acoustic navigation, biogeochemical sensors, expendable moorings, AUVs and UAVs)
11. What role can sensor networks play in providing a coherent picture of physics, chemistry and biology on time-scales from months to decades?

Our success will be measured by:

1) Publication of a community-led, peer-reviewed paper that articulates the implementation strategy for the core components of an under-ice observing system.

2) Identification of leaders (teams) to drive the implementation of key elements of the observing system; either as mature contributions to the GOOS or as pilot studies that will pave the way forward.

3) Informing the development of a white paper on under-ice observations for the Ocean Observations 2019 conference. This will synthesise efforts from both the workshop and papers developed by this WG.

4) The inclusion of participants from developing or non-traditional polar research countries, in addition to current science leaders in the field and technical experts. By the inclusion of these participants within our workshop, and the involvement of early career scientists and students, we will build capacity for the future and help train the next generation of scientists.

5) The development of strong linkages with existing communities that have deployed, and are developing, the platforms and associated sensors to provide sustained observations from under-ice (including in the Arctic). A key metric of our success will be the degree to which we leverage these links to accelerate progress towards our under-ice observing system.

ACRONYMS
GOOS – Global Ocean Observing System
IPCC AR5 – Intergovernmental Panel on Climate Change Fifth Assessment Report
SCAR – Scientific Committee on Antarctic Research
SOOS – Southern Ocean Observing System
WCRP – World Climate Research Programme
WMO – World Meteorological Organisation

	Milestones	Date to be reached
1	Working Group to identify and commission discussion papers/status reports for key under-ice observing system questions and options (i.e. What is the optimal strategy for deployment of acoustically and non-acoustically tracked floats? What is the right mix of platforms to observe under-ice ecosystems?) Please see the extended list of topics outlined in Section 3 above.	Papers commisioned by 01/06/2016 and received by 01/03/2017
2	Workshop to be hosted by AWI in April, May or June 2017	31/06/2017
3	Publication of a peer-reviewed community led paper articulating imperative and requirements for an under-ice observing system	31/06/2018

4. Would any funding be required for the group to achieve these deliverables?

Choose an item.

Yes, POGO funding is requested to cover the travel costs of key participants to the workshop that are unable to garner travel support from their host institute and would otherwise be unable to attend.

Funding to support a key invited participant from a developing country (or country not traditionally involved in polar research) is included to enable capacity building.

If so, please provide a breakdown of expenses.

Item (e.g. workshop hospitality, travel…)	Cost (EUR)
Travel and accommodation:	
Key participant 1	2,000 (flights, accommodation and meals)
Key participant 2	2,000
Key participant 3	2,000
Participant from developing country	2,000
Partial support for several EU participants	2,000

Note: staff time and institutional overheads cannot be included.

Please include here any information about other sources of funding:
These may be existing funds or funding proposals that have been submitted. If the latter, please indicate when you expect to find out whether you have been successful with other proposals.

- The Alfred Wegener Institute has agreed to host the workshop in April, May or June 2017
- The Southern Ocean Observing System (SOOS) will provide 10k AUD to cover any costs associated with the publication of the community paper in an open access journal. Any remaining funds will be directed to support participant travel to the workshop
- The SOOS International Project Office will also provide in-kind support for workshop organisation, report publishing, Working Group webpages and other communication requirements

5. Membership

Participants should be from a minimum of 4-5 countries on at least 2-3 continents.
For each POGO member institute, please list the Member Director as well as the scientist(s) involved.

Working Group leader:
Name: Richard Coleman
Institute: Institute for Marine and Antarctic Studies, University of Tasmania
Country: Australia
Please describe your expertise in this area and previous experience in leading/coordinating Working Groups or projects –max. 500 words.

Richard Coleman is currently Executive Director of the Institute for Marine and Antarctic Studies at the University of Tasmania, a multi-disciplinary research institute of some 200 academic/professional staff, ~190 graduate students and an annual budget of ~ $A45M. Prior to this appointment, he was Executive Director, Physical, Mathematical and Information Sciences at the Australian Research Council (ARC) for 3.5 years; this Australian Government agency is responsible for delivery of policy and programmes that advance Australian research and innovation globally and benefit the Australian community. The ARC distributes about $800M/year of research funding on a competitive basis to Australian universities and their industry/Government/international partners.

Of direct relevance to this WG, Coleman is also Director of an ARC Special Research Initiative for Antarctic Gateway Partnership project which started in November 2014. This $24M, 3-year project, in collaboration with CSIRO and the Australian Antarctic Division, is designed to advance our understanding of a climatically and ecologically important region, the Antarctic subpolar and shelf seas, ice sheet and fringing ice shelves. The Antarctic Gateway project is undertaken across four themes: Theme 1 (Cryosphere-Ocean Interaction); Theme 2 (Open Water and Under Ice Foodwebs); Theme 3 (Solid Earth-Cryosphere Interaction); and Theme 4 (Marine Technology and Polar Environments), each of these Themes are relevant to this WG, especially Themes 1, 2 and 3. This project employs 10 post-docs, 6 technicians and some 24 PhD students.

Coleman's own research spans multiple disciplines that cover the majority of the research focus of this WG, placing him in an excellent position to oversee this project. His research covers the areas of geodesy, oceanography and cryospheric science and he has served on international scientific working teams for numerous satellite altimeter missions over the last 30 years, such as TOPEX/Poseidon, Jason-1, Jason-2, ERS-1, ERS-2. His international scientific credibility and his senior leadership roles make him suitable to lead and coordinate this WG. He has broad experience across the Australian University sector, Government agencies and engagement with international satellite programs. His publications cover ice shelf dynamics, ice shelf-ocean processes, sea-level studies and large scale oceanography – see https://scholar.google.com/citations?user=_ZAC324AAAAJ&hl=en. Coleman has had continuous grant funding for 30+ years as evidence of leading projects to successful completion – see http://www.utas.edu.au/profiles/staff/imas/richard-coleman .

[NOTE - the membership listed below does not include the full suite of expertise, nations and key institutes that will contribute to the development of the reports, workshop and Implementation Plan – key experts in addition to those below will be invited to participate in the Working Group activities]

Name	**Position (e.g. Director, senior scientist, etc)**	**Institute**	**Country**	**Brief summary of expertise**	**POGO member? (Y/N)**
Mike Meredith	Deputy Director of Science	British Antarctic Survey	UK	Polar ocean circulation, physical forcing of the Southern Ocean ecosystem, emerging ocean observing technologies	Y (Mike Meredith)
Alexander Brearley	Research Fellow	British Antarctic Survey	UK	Heat fluxes, glider technology	Y (Mike Meredith)
Oscar Schofield	Professor (SOCCOM rep)	Rutgers University	USA	Biological oceanographer, integration of	Y (Robert Goodman)

				ocean physics, chemistry and biology	
Lynne Talley	Professor (SORP and SOCCOM rep)	Scripps Institution of Oceanography	USA	Ocean circulation, ocean-ice-atmosphere interactions	Y (Margaret Leinen
Olaf Boebel	Senior Scientist	Alfred Wegener Institute	Germany	Acoustic tracking	Y (Karin Wiltshire)
Esmee van Wijk (Working Group Lead)	Senior Scientist (Southern Ocean Argo rep)	Commonwealth Scientific and Industrial Research Organisation	Australia	Physical oceanographer, under-ice Argo, dense water formation	Y (Ken Lee)
Susan Wijffels	Senior Scientist (Co-Chair Argo)	Commonwealth Scientific and Industrial Research Organisation	Australia	Ocean observing networks, role of ocean in climate, large scale ocean dynamics	Y (Ken Lee)
Steve Rintoul	Senior scientist	Commonwealth Scientific and Industrial Research Organisation/ Antarctic Climate and Ecosystems Cooperative Research Centre	Australia	Southern Ocean circulation, role of Southern Ocean in climate system	Y (Ken Lee)
Ben Galton-Fenzi	Senior Scientist (SORP rep)	Australian Antarctic Division	Australia	Antarctic mass budget and sea-level, numerical modelling of ice and oceans, ocean/sea ice and ocean/ice shelf interactions	N
Jiuxin Shi	Professor (SORP rep)	Ocean University of China	China	Southern Ocean circulation, ice-ocean interactions, thermodynamic processes in coastal polynyas and ice shelf cavities	N
Sebastiaan Swart	Principal Scientist (SOOS Rep)	Council for Scientific and Industrial Research /	South Africa	Southern ocean circulation and carbon dynamics, glider technology,	N

		University of Cape Town		satellite/observation data integration	
Anna Wåhlin	Professor (SOOS Rep)	University of Gothenburg	Sweden	Ocean circulation, polar oceanography, buoyancy driven flows	N
Fabien Roquet	Assoc. Prof (MEOP rep)	Stockholm University	Sweden	Ciculation, Instrumentation of elephant seals, ocean modelling, data analysis/integration	N
Craig Lee	Senior Principal Oceanographer	Applied Physics Laboratory, University of Washington	USA	Ocean physics, interactions with biology and biogeochemistry, instrument development, ice-capable autonomous platforms	N
Dan Costa	Distinguished Professor (SOOS rep)	University of California, Santa Cruz	USA	Tracking and using seals to collect oceanographic data, upper trophic level ecology	N
Kevin Speer	Professor	Florida State University	USA	Polar circulation, air-sea fluxes	N