Partnership for Observation of the Global Oceans

www.ocean-partners.org

REPORT ON POGO WORKING GROUP

Observing and Understanding the Ocean below Antarctic Sea Ice and Ice Shelves (OASIIS)

Working Group Leader: Richard Coleman (UTAS/IMAS) and Esmee van Wijk (CSIRO) (co-leads WG)
Contributors to the organisation of the WG: Louise Newman (SOOS IPO), Jenna Patterson (UTAS/Antarctic Gateway), Stephanie Thielebeule (AWI), Olaf Boebel (AWI).

Names of Participants: Please see Attachments 1a and 1b.

Total expenditure to be reimbursed (please attach a financial report with copies of receipts):
Please see Attachment 2 for the report.

1) Please provide a brief description of the activities undertaken during the reporting period.
The major activity of this WG was a four-day meeting held in Bremerhaven, Germany from the 14-17 June 2017. The meeting comprised three days of science talks and discussions including plenary presentations from 44 speakers and an additional 15 speakers sharing their polar field work highlights and plans for future field work aimed at enhancing collaborations across the community. A total of 67 scientists from 16 countries* and 5 continents participated in the meeting (*UK, USA, Australia, Sweden, Germany, New Zealand, Canada, Italy, France, Norway, China, Japan, South Korea, Brazil, Argentina and India). The OASIIS WG was planned to be adjacent to the 31st international Forum for Research into Ice Shelf Processes (FRISP) meeting that was held in Bergen, Norway during June 19-22. The back-to-back meetings of OASIIS-WG and FRISP provided a larger participation and engagement of the science community.

2) Please describe the milestones achieved.

1. Working group to identify and commission discussion papers/status reports:
The WG originally proposed commissioning a series of discussion papers to address key topics prior to the WG meeting. After feedback from the community, the WG modified the original plan from a series of discussion papers to a series of curated and invited plenary talks for the meeting. This was a more practical path forward for the community given tight deadlines and removed the duplication in effort required to produce both a report and a plenary talk containing the same information. The WG commissioned talks from 44 invited speakers to address targeted topics, such as “The under-ice observational gap”, “An update of the scientific motivation for under-ice observations from the past 5 years”, “How do we get year-round measurements of the Antarctic continental shelf?”, “Operating Seagliders for extended under-ice missions” and “Using Ocean and Ice-sheet models to inform observations”. The plenary talks presented at the meeting were curated to ensure an overview of the main topics and balance between the different platforms, techniques and regions. This was a highly successful structure, in that the targeted nature of the talks led directly into productive discussion sessions that were held after each morning and afternoon series of talks. A full list of presentations is provided in Attachment 3. The WG will maximise distribution and uptake of the information presented at the meeting by making the presentations publically available on the SOOS OASIIS WG website (when authors have given permission) - http://www.soos.aq/activities/capability-wgs/oasiis.

The WG also leveraged information by asking members to report on other related groups working in this research area, i.e. Marginex, Robotica, air-sea fluxes WG, etc.

WG participants were also asked to submit future field plans so that they could be summarised and discussed at the WG meeting to enhance collaboration between members.

2. **Workshop to be hosted by AWI in June 2017**
The OASIIS WG meeting was held at the Atlantic Sail City Hotel in Bremerhaven, Germany from the 14-17 June 2017. The mix of curated talks, field work highlights/plans and discussion and synthesis sessions was highly successful. The afternoon of the third day was devoted to discussion time and a smaller group remained for the fourth day of the meeting to continue discussions and draft an outline for the peer-reviewed article. One of the aims for the WG meeting was to have as broad participation as possible, including science and technical experts from traditional polar research countries as well as those from developing and non-traditional countries. In addition to capacity building, the WG aimed at increased participation of female scientists and participation from graduate, post-graduate and early career researchers. Approximately 25% of the meeting participants were next-generation researchers, and many of the talks were given by PhD, post-doc or early-career scientists. There were 18 female scientists/11 speakers at the meeting. The sharing of information on recent field campaigns and future plans was highly successful, with new collaborations and partnerships being a highlight as well as updates on the vast expansion in new observation platforms and technological developments over the past 5 years. In addition, significant growth in engagement with the ice shelf community occurred at this meeting compared to the 2012 meeting.

3. Publication of a peer-reviewed community-led paper:
The main output of the WG and from the OASIIS meeting will be a peer-reviewed article (journal such as BAMS). The draft text is underway, expected submission by 30/06/2018.

3) Is this Working Group likely to continue to meet beyond the dates outlined in the original proposal?
Yes. The meeting in Bremerhaven was highly successful and collaborations/field work plans initiated at this meeting will extend beyond the dates outlined in the original proposal. One of the co-leads of this WG (E. van Wijk is a co-convener of a session OS-6 “Polar Ocean Dynamics” at POLAR-2018 (SCAR & IASC Conference) which will solicit contributions related to this WG. The WG is also considering using the outcomes from this meeting to inform a white paper on this topic for the forthcoming OceanObs’19 meeting.

The original end date outlined in the proposal was 30/06/2018. We aim to deliver the draft community paper by that date. Several future plans are in progress – how best to continue this WG initiative under SCAR/SCOR/SOOS umbrella as an international community contribution to ‘observations under ice’. The WG is still considering options for continuation beyond June 2018, and intend to submit a proposal for a 2nd year of funding.

4) Please provide your comments on the POGO-funded Working Group Initiative (e.g. has the funding made a significant difference in the progress of this Working Group?).
Yes. The funding grant of 10,000 Euro from POGO was critical in enabling the meeting of the OASIIS WG in Bremerhaven, Germany to proceed. With this initial seed funding confirmed we were able to source additional funds from SOOS, AWI and the ARC Antarctic Gateway Partnership to enable the full costs of the meeting to be met.

Of note, POGO WG funds were leveraged to expand the community engagement, with other significant contributions (cash and in-kind) from AWI, SOOS, IMAS/UTAS, and the ARC Antarctic Gateway Partnership project. All of the meeting logistics were organised by SOOS, IMAS and AWI, with IMAS/UTAS providing the secretarial and finance reporting for the WG activities. Overall, POGO WG funds were not fully expended and contributed ~50% to the full costs of running the WG meeting (see Attachment 2).

Attachment 1a: POGO WG members

Name	Position	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 ocean physics, chemistry and biology	Y (Robert Goodman)
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)
Richard Coleman	Professor	Institute for Marine and Antarctic Studies, University of Tasmania	Australia	Antarctic mass budget and sea-level, ocean/ice shelf interactions, ice shelf dynamics	Y (POGO Exec member)
Esmee van Wijk (Co-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	N

				processes in coastal polynyas and ice shelf cavities	
Sebastiaan Swart	Principal Scientist (SOOS Rep)	Council for Scientific and Industrial Research / University of Cape Town	South Africa	Southern ocean circulation and carbon dynamics, glider technology, satellite/observation data integration	N
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

Attachment 1b: Participants in the OASIIS Meeting, Bremerhaven, 14-17 June 2017

Name	Affiliation and Country
Alberto Naveira Garabato	University of Southampton, National Oceanography Centre, United Kingdom
Alexander Brearley	British Antarctic Survey, United Kingdom
Alex Forrest	University of California Davis, USA (did not attend in person, talk via Skype)
Anna Wåhlin	University of Gothenburg, Sweden
Britney Schmidt	Georgia Tech, USA
Carmen Boening	JPL/Caltech USA
Christian Haas	AWI, Germany
Craig Lee	Applied Physics Laboratory, University of Washington, USA
Craig Stevens	NIWA, New Zealand
Natalie Robinson	NIWA/Univ Auckland, New Zealand
Daniel Costa	Univ of Calif Santa Cruz, USA
David Gwyther	IMAS, Univ of Tasmania, Australia
David Holland	New York University, USA
Eric Rehm	Takuvik Joint Laboratory, Université Laval / CNRS, Canada
Esmee van Wijk	CSIRO, Oceans and Atmosphere, Australia
Giorgio Budillon	Universita di Napoli Parthenope, Italy
Hanne Sagen	Nansen Environmental and Remote Sensing Center, Norway
Hanumant Singh	Northeastern University, USA
Hartmut Hellmer	AWI, Germany
Ian Fenty	NASA Jet Propulsion Laboratory/Caltech, USA
Ilse Van Opzeeland	Alfred-Wegener Institut, Bremerhaven, Germany
Inga Smith	University of Otago, New Zealand
Irena Vankova	New York University, USA
Jacob Buffo	Georgia Institute of Technology, USA
Jamin Greenbaum	University of Texas Institute for Geophysics, USA
JB Sallée	LOCEAN, Paris, France
Jiuxin Shi	Ocean University of China, China
Jordan Hisel	NYU, Courant, CAOS, USA
Justin Lawrence	Georgia Institute of Technology, United States
Karen Heywood	Centre for Ocean and Atmospheric Sciences, UEA, United Kingdom
Karen Wiltshire	AWI, Germany
Kay I. Ohshima	Institute of Low Temperature Science, Hokkaido University, Japan
Keith Nicholls	British Antarctic Survey, United Kingdom
Lars Boehme	Uni of St. Andrews, Scotland, United Kingdom
Laura de Steur	Norwegian Polar Institute, Norway
Laura Herraiz-Borreguero	National Oceanographic Centre, United Kingdom
Louise Biddle	University of Gothenburg, Sweden
Louise Newman	SOOS IPO, Australia
Marcel Babin	Universite Laval/CNRS, Canada
Mario Hoppmann	AWI, Germany
Matthew Meister	Georgia Institute of Technology, USA
Mauricio M. Mata	FURG-Instituto de Oceanografia, Brazil
Mat Mazloff	Scripps Institution of Oceanography, USA
Michael Schodlok	JPL/UCLA, USA
Mike Schroeder	AWI, Germany
Mike Williams	NIWA, New Zealand
Olaf Boebel	AWI, Germany
Parli V Bhaskar	NCAOR, India
Paul Chamberlain	Scripps Institution of Oceanography, USA

Pierre Dutrieux	Lamont-Doherty Earth Observatory of Columbia University
Richard Coleman	IMAS, Univ of Tasmania, Australia
Roland Warner	ACE CRC, Australia
Rudiger Gerdes	AWI, Germany
Sandra Barreira	Argentine Naval Hydrographic Service, Argentina
SangHoon Lee	Korea Polar Research Institute
Sebastiaan Swart	Gothenburg University, Sweden
Stefanie Arndt	Alfred Wegener Institute, Germany
Steve Rintoul	CSIRO and ACE CRC, Australia
Steve Riser	Uni of Washington, USA
Svein Osterhus	Uni of Bergen, Norway
Ted Scambos	NSIDC, USA
Tim Stanton	Naval Postgraduate School, USA
Torsten Kanzow	AWI, Germany
Volker Strass	AWI, Germany
Xylar Asay-Davis	Potsdam Institute for Climate Impact Research, Germany
Yoshihiro Nakayama	NASA Jet Propulsion Laboratory, USA

Attachment 2: Finance report for the OASIIS WG meeting, Bremerhaven, 14-17 June, 2017

INCOME ($A)				
Australian Research Council SRI for Antarctic Gateway Partnership				9,000.00
Alfred Wegener Institute ($A equivalent)				4,029.82
Total Income from Collaborators				**13,029.82**
EXPENSES ($A)				
Name	**Flights**	**Accommodation**	**Other costs**	**Total**
Natalie Robinson	1,488.52			1,488.52
Ted Scambos		927.36		927.36
Sandra Barreira		488.55		488.55
Dan Costa		614.33		614.33
Esmee van Wijk	2,709.67	891.27		3,600.94
David Gwyther		908.65	450.49	1,359.14
Total Travel AUD				8,478.84
Total for Catering				16,941.92
Total OASIIS WG Expenses				**25,420.76**
TOTAL REMAINING EXPENSES for POGO to cover ($A)				**12,390.94**
TOTAL REMAINING EXPENSES for POGO to cover (Euro)				(based on current conversation rate) **8065.97**

Attachment 3: Agenda and plenary talks for the OASIIS WG meeting, Bremerhaven, 14-17 June, 2017

WEDNESDAY 14 JUNE 2017 – DAY 1		
Time	**Topic**	**Presenter**
INTRODUCTION AND SETTING THE SCENE		**CONVENOR: OLAF BOEBEL**
08:00 – 08:30	Registration and coffee/tea	
08:30 – 08:40	Welcome from AWI and POGO	Karen Wiltshire (10 mins)
08:40 – 09:00	Local arrangements, setting the scene, scientific rationale, building on the 2014 Strategy, POGO WG, meeting objectives	Esmee van Wijk/ Richard Coleman (20 mins)
SESSION 1: OBSERVATIONS OF THE OCEAN BENEATH SEA ICE		
09:00-09:20	The under-ice observational gap	Anna Wahlin (20 mins)
09:20-09:40	Seeing below the ice: an update of the scientific motivation for under-ice observations	Steve Rintoul (20 mins)
09:40-10:00	How do we get year round measurements on the Antarctic continental shelf?	Karen Heywood (20 mins)
10:00-10:20	How sea-ice impacts large-scale ocean circulation in Antarctica	Jean-Baptiste Sallee (20 mins)
10:20 – 10:50	*Morning Tea*	
SESSION 2: OCEAN ICE SHELF INTERACTION		**CONVENOR: LOUISE NEWMAN**
10:50-11:10	Direct observations of coastal polynyas and glacier-ocean interaction in the East Antarctica	Kay Ohshima (20 mins)
11:10-11:30	Observing the polynya and ocean under sea ice in Prydz Bay, Antarctica	Jiuxin Shi (20 mins)
11:30-11:50	Ice shelf-ocean interaction and tracers in East Antarctica	Laura Herraiz-Borreguero (20 mins)
11:50-12:10	The fate of the meltwater outflows from beneath Amundsen Sea ice shelves	Alberto Naveira Garabato (20 mins)
12:10-12:40	**Discussion**	Chairs: JB Sallee/Karen Heywood (30 mins)
12:40 – 13:40	*Lunch*	
13:40-13:55	Ocean observations near and beneath West Antarctic ice shelves: warm and cold ocean modes	Pierre Dutrieux (15 mins)
13:55-14:10	Ocean and coupled dynamics controls on the spatio-temporal variability of ice shelf melt in the Amundsen Sea	Pierre Dutrieux and Adrian Jenkins (15 mins)
14:10-14:30	Long-term observing system for the oceanic regime of Filchner-Ronne Ice Shelf, Antarctica	Svein Osterhus (20 mins)
14:30-14:50	Long term monitoring of the Filchner Ice shelf	Harmut Hellmer (20 mins)
SESSION 3: BOUNDARY LAYER OBSERVATIONS		**CONVENOR: RICHARD COLEMAN**
14:50-15:10	Heat and salt fluxes in the buoyant boundary layer under the Pine Island Ice Shelf	Tim Stanton (20 mins)
15:10 – 15:40	*Afternoon Tea*	
15:40-16:00	Lessons from New Zealand observations under sea ice and ice shelves	Mike Willams (20 mins)
16:00-16:20	McMurdo Sound: An accessible laboratory for ice shelf / ocean processes	Natalie Robinson (20 mins)
16:20-16:40	Airborne mapping of platelet ice thickness under Antarctic fast ice	Christian Haas (20 mins)
16:40-17:30	**Discussion**	Chairs: Richard Coleman/ Mike Williams (50 mins)

THURSDAY 15TH JUNE – DAY 2		
Time	**Topic**	**Presenter**
SESSION 4: MODELLING PERSPECTIVES AND OSSE'S		**CONVENOR: STEVE RINTOUL**
08:30-08:50	Observation System Simulation Experiments in under-ice environments	Ian Fenty and Matt Mazloff (20 mins)
08:50-09:10	Using Ocean and Ice-sheet models to inform observations	David Gwyther and Ben Galton-Fenzi (20 mins)
09:10-09:30	Physics of the ocean boundary layer below ice shelves: the relationship between modeling and observations	Xylar Asay-Davis (20 mins)
SESSION 5: PLATFORMS AND PROXIES		**CONVENOR: LAURA HERRAIZ-BORREGUERO**
09:30-09:45	Status and outlook for under-ice Argo	Esmee van Wijk (15 mins)
09:45-10:00	Biogeochemical Observations Under Antarctic Sea Ice: Observations from Profiling Floats	Steve Riser (15 mins)
10:00-10:20	Weddell Gyre circulation and water mass formation	Olaf Boebel (20 mins)
10:20 – 10:50	*Morning Tea*	
10:50-11:10	Operating Seagliders for extended under-ice missions in Baffin Bay and the Beaufort Sea	Craig Lee (20 mins)
11:10-11:25	Glider observations beneath the Ross Ice shelf	Inga Smith (15 mins)
11:25-11:40	Heat transport in the West Antarctic from autonomous glider observations	Alex Brearley (15 mins)
11:40-11:50	Gliders, ships, other in Weddell region MIZ	Seb Swart (10 mins)
11:50-12:20	**Discussion**	Chairs: Ian Fenty/Laura H-B (30 mins)
12:20 – 13:20	*Lunch*	
SESSION 5: PLATFROMS AND PROXIES CONTINUED…		**CONVENOR: PIERRE DUTRIEUX**
13:20-13:40	Seals	Dan Costa (20 mins)
13:40-14:00	Animal-borne instruments in the seasonal ice zone	Lars Boehme (20 mins)
14:00-14:15	An evolving multipurpose acoustic network for Baffin Bay	Eric Rehm (15 mins)
14:15-14:30	Under-ice navigation in Arctic (Baffin Bay) with autonomous platforms	Eric Rehm and Marcel Babin (15 mins)
14:30-14:45	Acoustic environment of the Weddell Sea	Ilse van Opzeeland (15 mins)
14:45-15:05	Use of acoustic thermometry and passive acoustics in the marginal ice zone of the Arctic	Hanne Sagan (20 mins)
15:05 – 15:40	*Afternoon Tea*	
15:40-16:00	New technology to conduct under-ice observations using instrumented autonomous underwater vehicles and rovers	Ian Fenty (20 mins)
16:00-16:20	AUV's for Under-ice studies	Hanumant Singh (20 mins)
16:20-16:40	Getting under Antarctica's skin	Britney Schmidt (20 mins)
16:40-17:00	Charting ice-ocean interactions within subglacial channels of an Antarctic ice shelf	Alex Forrest (20 mins)
17:00-17:30	**Discussion**	Pierre Dutrieux/Dan Costa (30 mins)
19:00	*Workshop Dinner TBA*	

FRIDAY 16TH JUNE 2017 – DAY3		
Time	**Topic**	**Presenter**
SESSION 5: PLATFORMS AND PROXIES CONTINUED…		**CONVENOR: CRAIG LEE**
08:30-08:45	New autonomous and remotely operated technologies for interdisciplinary sea ice research	Mario Hoppman (15 mins)
08:45-09:00	Recent and future studies on Remotely Operated Vehicles: Interdisciplinary research under Arctic and Antarctic sea ice	Stefanie Arndt (15 mins)
09:00-09:20	NECKLACE: progress and outlook	David Holland and Peter Davis (20 mins)
09:20-09:40	Southern Ocean Melting Antarctica: how to connect the ice sheet mass balance to the fate of the Southern Ocean	Eric Rignot (20 mins)
09:40-10:00	Warm Water Incursions Trigger Thinning and Speed Up of Jakobshavn Isbrae	David Holland (20 mins)
10:00 – 10:30	*Morning Tea*	
10:30-10:50	Automated Atmosphere-Ice-Ocean Observation on the Nansen Ice Shelf (sub ice-shelf mooring)	Ted Scambos (20 mins)
10:50-11:10	The East Antarctic Grounding Line Experiment: Aerogeophysics for coastal bathymetry and subglacial freshwater discharge in East Antarctica	Jamin Greenbaum (20 mins)
11:10-11:40	**Discussion**	Chairs: Craig Lee/Ted Scambos (30 mins)
SESSION 6: FIELD WORK HIGHLIGHTS		**CONVENOR: ALEX BREARLEY**
11:40-12:20	• Recent and planned Italian activities in the Ross Sea • Dotson and Getz Ice Shelf in the Amundsen sector via IBRV Araon • Ocean data collected under Fimbul Ice Shelf • ROV/AUV operations beneath the McMurdo/Ross Ice Shelves, Antarctica	Giorgio Budillon (10 mins) Sanghoon Lee (10 mins) Laura De Steur (10 mins) Justin Lawrence (10 mins)
12:20 – 13:20	*Lunch*	
13:20-13:50	• Southern Ocean physics, biodiversity, and biogeochemical fluxes in a changing climate • Long term monitoring of deep warm water sources for Helheim Glacier (East Greenland) and Jakobshavn Isbræ (West Greenland) • Under ice uncertainty estimates/ acoustic float tracking	Volker Strass (10 mins) Irena Vankova (10 mins) Paul Chamberlain (10 mins)
SESSION 7: DISCUSSION - INTEGRATION AND SYNTHESIS		
13:50-15:10	**Integration/Synthesis Session Part 1** - Future field work slides - Summary map of planned field work - SOOS mapping tool / Due South	Chairs: Esmee van Wijk/ Alex Brearley (1 hr 20 mins)
15:10 – 15:40	*Afternoon Tea*	
15:40-17:00	**Integration/Synthesis Session Part 2**	Chairs: Steve Rintoul/(1 hour 20 mins)
17:00-17:30	**Conclusions, Future activities, Wrap up**	Chair: Richard Coleman (30 mins)

SATURDAY 17TH JUNE 2017 – DAY 4		
Time	**Topic**	
09:00-09:30	Overview of workshop outcomes, proposed structure of day 4	
09:30-10:30	Outline for BAMS article	
10:30 – 11:00	*Morning Tea*	
11:00-12:30	Break out into working groups	
12:30 – 13:30	*Lunch*	
13:30-15:30	Break out into working groups	
15:30 – 16:00	*Afternoon Tea*	
16:00-17:30	Re-connect as large group for overview, close of meeting, strategy for completion of paper and reports etc.	