Application for Consent to conduct
Marine Scientific Research

Date: 01-December-2014

1. General Information

1.1 Cruise name and/or number:
Seaglider Greenland

1.2 Sponsoring Institution(s):	
Name:	Scottish Association for Marine Science (SAMS)
Address:	Scottish Marine Institute, Oban , PA37 1QA, UK
Name of Director:	Prof. Axel Miller

1.3 Scientist in charge of the Project:	
Name:	Prof. Mark Inall
Country:	UK
Affiliation:	Scottish Association for Marine Science
Address:	Scottish Marine Institute, Oban , PA37 1QA, UK
Telephone:	+44 1631 559 419
Fax:	+44 1631 559 001
Email:	Mark.Inall@sams.ac.uk
Website (for CV and photo):	www.sams.ac.uk/mark-inall

1.4 Entity(ies)/Participant(s) from coastal State involved in the planning of the project:	
Name:	Hedinn Valdimarsson
Affiliation:	Marine Research Institute
Address:	Hafrannsóknastofnunin, Skulagata 4, 121 Reykjavik, Iceland
Telephone:	+354 575 2063
Fax:	+354 575 2001
Email:	hv@hafro.is
Website (for CV and photo):	http://www.hafro.is/Sjora/ www.researchgate.net/profile/Hedinn_Valdimarsson

2. Description of Project

2.1 Nature and objectives of the project:
Project name: Fluxes Across Sloping Topography of the North East Atlantic (FASTNEt) Project funding: UK Natural Environment Research Council (NERC). Prioject lead: Prof. Mark Inall, SAMS Project website: http://www.sams.ac.uk/fastnet Project overview: FASTNEt recognises that shelf seas are a critical interface, linking the terrestrial, atmospheric and oceanic carbon pools and acting as a physical gateway to key biogeochemical fluxes. We are therefore seeking to establish collaborations within our field and modelling programmes to combine our physical science advances with linked advances in biogeochemical processes and exchanges in shelf seas and at ocean margins. Four objectives underpin our aim of constructing a new paradigm of Ocean/Shelf exchange: - To determine the seasonality of physical gradients and exchange across the shelf edge by deploying new observational technologies (Gliders, Autosub Long Range) and established techniques (long term moorings, drifters). - To quantify key exchange mechanisms and to collect new data targeted at testing

and improving high resolution models of the shelf edge, by carrying out detailed process studies in contrasting regions of the shelf edge of the North Atlantic margin
- To develop a new parameterisation of shelf edge exchange processes suitable for regional-scale models, using improved resolution numerical, and new empirical models constrained by the observations.
- To test the new parameterisations in a regional model in the context of making an assessment of inter-annual variability of ocean-shelf exchange.
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Amongst the various observing techniques, gliders represent a fundamental leap in our ability to observe the ocean. Gliders are buoyancy driven and energy-efficient autonomous vehicles that can undertake independent journeys for up to seven months at depths between the surface and 1000m making continuous measurements of a range of seawater properties. They relay the collected data in real-time to the scientists and communicate with a pilot back at base using an Iridium satellite link. The glider pilot receives position, scientific and technical data and based on this can instruct the glider on waypoints to aim for during its mission. Although limits in depth range, sensor availability and power supply mean that gliders will supplement rather than fully replace ship borne observations, the novel use of gliders to monitor the state of the global ocean opens up huge opportunities not only for understanding the state of the ocean, but also for undertaking new research that will build on our ability to predict future climate states.

FASTNEt uses gliders to measure fluxes at several contrasting shelf edge locations: the Celtic Sea, the Malin Shelf, the North Scotland Shelf, and the South-East Greenland coast. The latter is of particular interest in terms of oceanic heat fluxes, and of great relevance to deepen our understanding of the heat interactions between the glaciers, fjords and ocean. As outlined by the SEaTrEx project: "There is mounting evidence that there is a critical link between ocean temperatures and glacier dynamics which in turn are the primary control of the Greenland Ice Sheet to sea-level rise. Tidewater glaciers discharge into deep fjords which are themselves connected to the ocean by deep troughs (or canyons) that cut across the shallow continental shelf. Clearly the fjords and troughs are an important component in understanding how ocean waters are delivered to the glacier. The troughs are currently an oceanographic "black box". An important requirement to be able to develop our understanding of ocean-glacier interactions is to be able to accurately model the adjacent shelves. This requires observations of the troughs in a bid to understand and quantify the process within the "black box". "

The glider survey proposed here would be located from the mouth of the Kangerdlugssuaq Fjord, across the cross-shelf trough in a "zig-zag" pattern (see map at the end of this document), up to the Greenland shelf edge.
The glider would be launched from the UK research ship RRS Discovery in late May or early June 2015 in Icelandic waters, around position 62.8° N, 20° W, then make its way to the survey site across Icelandic and Greenland territorial waters, as shown on the map attached. At the end of its mission (autumn 2015, exact dates to be confirmed) the glider would head to an agreed recovery point in Icelandic waters (exact location to be confirmed), for recovery by a research vessel from the Icelandic Marine Research Institute during one of their routine annual scientific cruises. The contact for this cruise is Dr Hedinn Valdimarsson (Hafrannsóknastofnunin, Skulagata 4, 121 Reykjavik, Iceland, phone: +354 575 2063).

The glider progress will be available in near real-time from http://velocity.sams.ac.uk/gliders/

2.2 If designated as part of a larger scale project, then provide the name of the project and the Organisation responsible for coordinating the project:
N/A

2.3 Relevant previous or future research projects:
SEaTrEx: South East Greenland Trough Experiment, NERC Small Grant run by SAMS and Swansea Glaciology Group. The project focuses on studying the major cross-shelf trough that transports warm oceanic waters to the fjord of Kangerdlugssuaq Glacier in South East Greenland.

Website: http://www.sams.ac.uk/finlo-cottier/seatrex

GLIMPSE: project supported by the Leverhulme Trust based in the Glaciology Group at the School of the Environment and Society, Swansea University. The aim of the project is to investigate the controls on thinning at the margin of the Greenland Ice Sheet. SAMS participated in a scientific cruise in South-East Greenland in September 2011 as part of this project.
Website: http://www.swansea.ac.uk/glimpse/

NERC-funded PhD studentship: Impact of variable ocean/shelf exchange on glacial dynamics in South-East Greenland. SAMS

2.4 Previous publications relating to the project:

Inall, M. E., T. Murray, F. R. Cottier, K. Scharrer, T. J. Boyd, K. J. Heywood, and S. L. Bevan (2014), Oceanic heat delivery via Kangerdlugssuaq Fjord to the south-east Greenland ice sheet, J. Geophys. Res. Oceans, 119, doi:10.1002/2013JC009295.

Bevan, S. L., A. J. Luckman, and T. Murray (2012), Glacier dynamics over the last quarter of a century at Helheim, Kangerdlugssuaq and 14 other major Greenland outlet glaciers, Cryosphere, 6, 923–937, doi:10.5194/tc-6-923-2012.

Rignot, E., I. Fenty, D. Menemenlis, and Y. Xu (2012), Spreading of warm ocean waters around Greenland as a possible cause for glacier acceleration, Ann. Glaciol., 53(60), 257–266, doi:10.3189/2012aog60a136.

Christoffersen, P., R. I. Mugford, K. J. Heywood, I. Joughin, J. A. Dowdeswell, J. P. M. Syvitski, A. Luckman, and T. J. Benham (2011), Warming of waters in an East Greenland fjord prior to glacier retreat: Mechanisms and connection to large-scale atmospheric conditions, Cryosphere, 5(3), 701–714, doi:10.5194/tc-5-701-2011.

Murray, T., et al. (2010), Ocean regulation hypothesis for glacier dynamics in southeast Greenland and implications for ice sheet mass changes, J. Geophys. Res., 115, F03026, doi:10.1029/2009JF001522.

Luckman, A., and T. Murray (2005), Seasonal variation in velocity before retreat of Jakobshavn Isbræ, Greenland, Geophys. Res. Lett., 32, L08501, doi:10.1029/2005GL022519.

3. Geographical Areas

3.1 Indicate geographical areas in which the project is to be conducted (with reference in Latitude and longitude, including coordinates of cruise/track/way points)
62° N to 69° N, 18° W to 34° W.

3.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical Areas of the intended work and, as far as practicable, the location and depth of sampling Stations, the tracks of survey lines, and the locations of installations and equipment.
Chart attached at the end of the form.

4. Methods and means to be used

4.1 Particulars of vessel:	
Name:	
Type/Class:	
Nationality (Flag State):	
Identification Number (IMO/Lloyds No.):	

Owner:	
Operator:	
Overall length (meters):	
Maximum draught:	
Displacement/Gross Tonnage:	
Propulsion:	
Cruising & maximum speed:	
Call sign:	
INMARSAT number and method and capability of communication (including emergency frequencies):	
Name of Master:	
Number of Crew:	
Number of Scientists on board:	

4.2 Particulars of Aircraft:	
Name:	
Make/Model:	
Nationality (flag State):	
Website for diagram & Specifications:	
Owner:	
Operator:	
Overall Length (meters):	
Propulsion:	
Cruising & Maximum speed:	
Registration No.:	
Call Sign:	
Method and capability of communication (including emergency frequencies):	
Name of Pilot:	
Number of crew:	
Number of scientists on board:	
Details of sensor packages:	
Other relevant information:	

4.3 Particulars of Autonomous Underwater Vehicle (AUV):	
Name:	Seaglider
Manufacturer and make/model:	Seaglider 1KA
Nationality (Flag State):	UK
Website for diagram & Specifications:	http://www.apl.washington.edu/projects/seaglider/specifications.html
Owner:	SAMS
Operator:	SAMS
Overall length (meters):	instrument length = 1.8m, with antenna 2.8m
Displacement/Gross tonnage:	52kg (dry)
Cruising & Maximum speed:	cruising: 0.25m/s, maximum: 0.30m/s
Range/Endurance:	3,000km / 6 months
Method and capability of communication (including emergency frequencies):	Iridium satellite network
Details of sensor packages:	Digiquartz pressure sensor Seabird conductivity and temperature sensors Aanderaa oxygen optode Wetlabs fluorescence and backscatter sensor Possibly Acoustic Doppler Current Profiler
Other relevant information:	

4.4 other craft in the project, including its use:
N/A

4.5 Particulars of methods and scientific instruments:		
Types of samples and Measurements:	Methods to be used:	Instruments to be used:
depth	sensor data only – no physical sample	Paine pressure sensor
temperature	sensor data only – no physical sample	Seabird CT sail
conductivity	sensor data only – no physical sample	Seabird CT sail
oxygen	sensor data only – no physical sample	Aanderaa optode 4330
fluorescence	sensor data only – no physical sample	Wetlabs BBFL2 puck
backscatter 700nm wavelength	sensor data only – no physical sample	Wetlabs BBFL2 puck
CDOM	sensor data only – no physical sample	Wetlabs BBFL2 puck

4.6 Indicate nature and quantity of substances to be released into the marine environment:
None

4.7 Indicate whether drilling will be carried out. If yes, please specify:
No

4.8 Indicate whether explosives will be used. If yes, please specify type and trade name, Chemical content, depth of trade class and stowage, size, depth of detonation, frequency of Detonation, and position in latitude and longitude:
No

5. Installations and Equipment

Details of installations and equipment (including dates of laying, servicing, method and Anticipated timeframe for recover, as far as possible exact locations and depth, and Measurements):
No equipment installed.

6. Dates

6.1 Expected dates of first entry into and final departure from the research area by the research vessel and/or other platforms:
AUV expected first entry in research area: 15th May 2015 at the earliest AUV expected final departure from research area:: 15th November 2015 at the latest
6.2 Indicate if multiple entries are expected:
No, one continuous entry of up to 6 months.

7. Port Calls

7.1 Dates and Names of intended ports of call:
None

7.2 Any special logistical requirements at ports of call:
N/A

7.3 Name/Address/Telephone of shipping agent (if available):
N/A

8. Participation of the representative of the coastal State

8.1 Modalities of the participation of the representative of the coastal State in the research Project:

All data will be made available to the Marine Research Institute upon request, and in real time if required.

8.2 Proposed dates and ports for embarkation/disembarkation:
N/A

9. Access to Data, Samples and Research Results

9.1 Expected dates of submission to coastal State of preliminary report, which should include The expected dates of submission of the data and research results:
Six months after completion of AUV deployment.

9.2 Anticipated dates of submission to the coastal State of the final report:
Six months after completion of AUV deployment.

9.3 Proposed means for access by coastal State to data (including format) and samples:
Via the SAMS website and also via FTP to the British Oceanographic Data Centre and thereon to the WMO's Global Telecommunication System for global dissemination. Data will also be sent by ftp to MRI if requested.

9.4 Proposed means to provide coastal State with assessment of data, samples and Research results:
We will keep Dr Valdimarsson informed of our findings and of any papers published using the data collected.

9.5 Proposed means to provide assistance in assessment or interpretation of data, samples And research results:
We can send copies of published scientific papers produced as a result of the data collected upon request. We would also be able to provide scientists with data in various formats adapted to their requirements (ascii, Matlab, NetCDF, plots), and the necessary scripts to read and process the datasets in scientific software (e.g. Matlab).

9.6 Proposed means of making results internationally available:
The data will be used in future scientific papers.

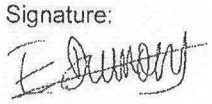
10. Other permits Submitted

10.1 Indicate other types of coastal state permits anticipated for this research (received or Pending):
None

11. List of Supporting Documentation

11.1 List of attachments, such as additional forms required by the coastal State, etc.:
None

Signature:



(on behalf of the Principal Scientist)

Contact information of the focal point:
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Appendix 1: Chart of survey area