Full Proposals for International Polar Year 2007-2008 Activities

Proposed IPY Activity Details

1.0 PROPOSER INFORMATION

(Activity ID No: 13)

1.1 Title of Activity
Sea level and tidal science in the polar oceans

1.2 Short Form Title of Proposed Activity
Sea level and tidal science in the polar oceans

1.3 Activity Leader Details
Philip Woodworth
Proudman Oceanographic Laboratory
UK

1.4 Lead International Organisation(s) (if applicable)
Intergovernmental Oceanographic Commission (GLOSS, GOOS)
Scientific Unions (IAPSO, IAG)
International programmes (e.g. CLIVAR, SEARCH)
National and international space centres (NASA, ESA)

1.5 Other Countries involved in the activity
USA
Denmark
Norway
Russia
Canada
Australia
Jaoan
France
Chile
NULL
NULL
NULL
NULL
NULL
NULL
NULL

1.6 Expression of Intent ID #'s brought together in this proposed activity
211,580,761,304,590,732

1.7 Location of Field Activities
Bipolar

1.8 Which IPY themes are addressed
1. Current state of the environment
2. Change in the polar regions
3. Polar-global linkages/tele-connections

1.9 What is the main IPY target addressed by this activity
1. Natural or social science

2.0 SUMMARY OF THE ACTIVITY

The measurement of sea level along polar coastlines presents great technical challenges for the Global Sea Level Observing System (GLOSS) of the WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM). The need for measurements in these data sparse regions has been clearly made in the scientific literature. For example, in oceanography, Arctic sea level data presently available suggest a common-mode of variability which provides insights in the quasi-resonant dynamics of the Arctic Ocean. Arctic sea level data are of particular interest within water balance studies concerning the freshening of the Arctic Ocean and its relationship to the Arctic Oscillation. Antarctic sea level changes have also been found to demonstrate considerable coherence related to the Southern Annular Mode and transports in the Antarctic Circumpolar Current. The need for measurements for climate studies by the Intergovernmental Panel on Climate Change has also been clearly made. Monitoring of levels in both high-latitude regions is necessary to understand more completely the spatial pattern of long term sea level change due to ocean warming and ice melt. Climate and sea level changes also affect the stability of ice shelves and fast ice and the glaciers behind them.This project will use existing and new Arctic sea level recorders (there are no sites currently operational in Greenland, for example) and will make enhancements to the existing network of gauges in Antarctica. Past and future tide gauge data sets will be used in combination with satellite altimeter and space gravity data where possible to understand further the regional ocean dynamics and climate change (EoI 580). Differences between Arctic and Antarctic in ocean dynamics and sea level response to climate change are particularly interesting. The new recorders will be high technology devices providing data at high frequency and real time, comprising the core of ongoing polar sea level monitoring networks. This will be an essential component of GLOSS and a major legacy of IPY (EoI 211).
Benefits from enhanced polar networks can be anticipated in many ways not yet clear. However, sea level data are indispensable in many countries for practical applications such as flood warning, navigation, civil engineering and environmental monitoring, in addition to their scientific applications. Consequently, Arctic communities can be expected to benefit from investment in this collaborative sea level research. For example, the GREENSEAL project (EoI 761) will focus on developing the GLOSS network in Greenland which will benefit Arctic ocean circulation and sea ice flow studies, as well as providing essential practical data sets to local communities. The LEVANS project (EoI 304) will enhance corresponding data sets and understanding in Nordic Seas, while the Russian Arctic networks project (EoI 732) will see similar benefits to Russian science and coastal communities.
The further understanding of ocean tides in polar regions is a particularly important component of sea level studies, being relevant to a range of geophysical (e.g. dissipation), physical oceanographic (mixing), glaciological (sea ice formation) and biological studies (EoI 590). High latitude bathymetry and sub-ice-shelf topography are needed in addition to tidal measurements from coastal and bottom tide gauges and (where possible) altimetry over ocean and ice-shelves.

2.1 What is the evidence of inter-disciplinarity in this activity?
The project will encompass inter-disciplinary studies of measurements, causes and potential prediction of polar sea levels on temporal scales from seasons to years and to decades. The measurement system will be based on tide gauges, but will also include existing and new oceanographic, geophysical, geodetic and glaciological observations, and complementary satellite observations. Each of these techniques requires its own expertise.

2.2 What will be the significant advances/developments from this activity? What will be the major deliverables? What are the outputs for your peers?
The main advances and developments will include:
•Collaborative enhancements to the Arctic and Antarctic sea level monitoring networks as part of GLOSS.
•Understanding of the ocean dynamics which result in coherence, or spatial difference, in sea level variability. •Understanding of the meteorological, oceanographic, glaciological and hydrological forcings which contribute to sea level variability (e.g. we note that a large number of tide gauges exist in the Barents, Norwegian and Greenland Seas for which data have yet to be properly data banked and analysed).
•Insight into warming and freshening of polar oceans via observations of long term sea level change.
•Compilation of tidal and extreme level statistics for a range of engineering purposes in relatively unstudied regions.
•Improved models of polar ocean tides for application to a wide range of studies.
Main deliverables will be:
•Data sets of tide gauge data etc.
•Scientific insight into ocean processes in polar regions.
•Engineering data sets.
•Polar tide models and (indirectly) improved ocean circulation models.
•Maintenance and development of polar environmental networks.

2.3 Outline the geographical location(s) for the proposed field work (approximate coordinates will be helpful if possible)

Locations	Coordindates
Tide gauge fieldwork will take place along Arctic and Antarctic coastlines and at Arctic and Southern Ocean islands.	
'Fieldwork' using space remote sensing techniques will encompass all polar seas	
Ocean tide studies will take place in the central Arctic, Antarctic margins and on major Antarctic ice shelves.	

2.4 Define the approximate timeframe(s) for proposed field activities?

Arctic Fieldwork time frame(s)	Antarctic Fieldwork time frame(s)
06/06 - 06/09	01/06 - 01/09

2.5 What major logistic support/facilities will be required for this project?

Further details – The primary support required is access to polar sea level stations by land, air or ship as appropriate, and the availability of local contacts for regular maintenance of equipment. In practice, tide gauge measurement sites will be limited to relatively open-ocean locations which have good infrastructure (e.g. telephone links). This implies either population centres or manned polar bases. These will be identified by the national sea level agencies. Icebreaker vessels and aircraft are needed for deployment and retrieval of bottom pressure gauges and GPS equipment for ocean tide studies. Main locations are the central Arctic, Antarctic margins and on major Antarctic ice shelves.

2.6 How will the required logistics be supplied? Have operators been approached?

Source of logistic support	Likely potential sources	Support agreed
Consortium of national polar operators		Y
Own national polar operator	Y	Y
Another national polar operator		

National agency	Y	Y
Military support	Y	
Commercial operator		
Own support		
Other		

2.7 If working in the Arctic regions, has there been contact with local indigenous groups or relevant authorities regarding access?

3.0 STRUCTURE OF THE ACTIVITY

3.1 Origin of the activity
This is a pulse of activity during 2007-2009 within an existing programme

If part of an existing programme please name the programme – GLOSS

3.2 How will the activity be organised and managed? Describe the proposed management structure and means for coordinating across the cluster
We envisage that initial coordination will be by means of an international workshop, repeated at regular intervals as required. Most of the groups involved in this proposal have close links to the Global Sea Level Observing System (GLOSS) (see http://www.pol.ac.uk/psmsl/programmes/gloss.info.html) which will provide an essential framework for coordination. It is envisaged that by this means a large number of other groups and individual researchers will be able to participate eventually.
We expect that the project will be subsequently coordinated by a group of representatives of each of participating organisations (i.e. the names given in section 4.2), and will report formally in a first case to GLOSS Group of Experts meetings. The IOC Technical Secretariat will provide the necessary linkage and resourcing. It is envisaged that this activity will be adopted as a formal regional activity of GLOSS. The European members of the project will also coordinate their activities through a sub-group of the European Sea Level Service (ESEAS).

3.3 Will the activity leave a legacy of infrastructure and if so in what form?
The project contributes to the Global Sea Level Observing System (GLOSS) which was established by IOC in 1985. GLOSS is a component of the Global Ocean Observing System (GOOS) of JCOMM (IOC/WMO). The project will leave core Arctic and Antarctic sea level networks which will serve monitoring requirements of GLOSS/GOOS for the next decade.

3.4 Will the activity involve nations other than traditional polar nations? How will this be addressed?
The main involvement in this project will be by nations with Arctic and Antarctic experience and responsibility. However, all data sets acquired will be freely available to the international community via the GLOSS programme.

3.5 Will this activity be linked with other IPY core activities? If yes please specify
The proposal links to several other Arctic and Antarctic clusters in so far as they focus upon ocean circulation and climate change. This linkage is in some sense automatic given the general interest in (and relevance of this proposal to) themes 1-3 of the six IPY themes.

3.6 How will the activity manage its data? Is there a viable plan and which data management organisations/structures will be involved?
Management of sea level data will be undertaken by each national partner in line with GLOSS standards and data will be made available via the GLOSS centres. In addition, in the case of Arctic measurements, the data centres of Norwegian, Danish and UK partners are participants in the European Sea Level Service (ESEAS), while Russian sea level data are held by World Data

Centre B. Antarctic sea level data will be held by data centres in UK, Australia, France, Japan etc. which have close links to the GLOSS programme. All data will be ultimately freely accessible via the web. All other data sets will be contributed to the appropriate National Oceanographic Data Centre.

3.7 Data Policy Agreement
Will this activity sign up to the IPY draft Data Policy (see website)
Yes

3.8 How will the activity contribute to developing the next generation of polar scientists, logisticians, etc.?
The maintenance of environmental monitoring equipment in polar areas is not straightforward and considerable technological and practical experience is required. This can only be obtained over many years with dedicated and well-resourced staff. The IPY activities will build on those undertaken in previous years in installing and operating tide gauges and other equipment in polar areas and will provide one framework by means of which data sets can be maintained and enhanced.
The data sets obtained will be employed throughout the scientific community. Several of the partners in the proposal will work with their own students on the data sets. The practical value of data sets (e.g. extreme levels for civil engineering) is perhaps less well appreciated but are vital to local planners. This proposal should aid the enhancement of such information.

3.9 How will this activity address education, outreach and communication issues outlined in the Framework document?
Education, outreach and communication will be the responsibility of each partner within its own country. GLOSS will provide a wider mechanism via its international training courses, web pages and considerable IOC/UNESCO resources for reports and publications. ESEAS will enable effective communication at European scientific and institutional levels. Several of the partners have considerable experience in educational outreach including media contacts, web sites, classroom programmes and public lectures. Creative use of improved communication methods such as internet access is likely in future to open up the possibility for more people to inspect data sets from remote regions than ever before.

3.10 What are the proposed sources of funding for this activity?
The hardware (tide gauges) and research costs of the project will be funded initially from the budgets of each national partner. In some cases these are already in place (e.g. costs for upgrades to UK Antarctic bases; Danish funds for three new gauges in Greenland). Colleagues in Australia, Japan, France and Chile have confirmed their intention to maintain existing Antarctic tide gauges. It is the intention of all partners to bid for additional funds from national IPY Announcements of Opportunity. For example, this has already taken place in the case of the UK (via a Natural Environment Research Council Arctic IPY initiative), Denmark (additional bids for Greenland resources) and Norway (bids for gauges in Fram Strait, Svalbard and Franz Josef Land). Possibilities for EU co-funding will be investigated.

3.11 Additional Comments
Of the 14 criteria for an IPY project identified in the Framework Document, this proposal satisfies all 1-9 of the main criteria (number 5, funding, is still an issue for some participants) and 2-4 of the additional criteria (number 1, other nations, is not directly addressed in this proposal although data sets will be available to all nations; number 5, national endorsement, is still unclear for some nations.[Note that there is overlap of several of these EoIs with other clusters. The agreement of Dr. Frolov (732) has not yet been confirmed.]

4.0 CONSORTIUM INFORMATION

4.1 Contact Details

Lead Contact
Dr Philip Woodworth
Proudman Oceanographic Laboratory
6 Brownlow Street, Liverpool
L3 5DA
UK

Tel: 44 151 795 4800
Mobile: N/A
Fax: 44 151 795 4801
Email: plw@pol.ac.uk

Second Contact
Prof C.K. Shum
Ohio State University
470 Hitchcock Hall 2070 Neil Ave. Columbus, Ohio
43210-1275
USA

Tel: 614-292-7118
Mobile: N/A
Fax: 614-292-2957
Email: ckshum@osu.edu

4.2 Other significant consortium members and their affiliation

Name	Organisation	Country
Dr. Per Knudsen	Danish National Space Center	Denmark
Dr. Vladimir Pavlov	Norwegian Polar Institute	Norway
Dr. Lawrence Padman	Oregon State University	USA
Dr. I Frolov (not confirmed as yet)	Arctic and Antarctic Research Institute	Russia
Dr. Mark Merrifield	University of Hawaii Sea Level Center	USA
Dr. Thorkild Aarup	Intergovernmental Oceanographic Commission	UNESCO
Dr. Bente Bye	Norwegian Mapping Authority	Norway
Dr. Oleg Zilbershtein	Russian Hydrometeorological Centre	Russia
Prof. Keith Thompson	Dalhousie University	Canada
Mr. Bill Mitchell	National Tidal Centre	Australia
Dr. Minoru Odamaki	Japanese Oceanographic Data Centre	Japan
Dr. Laurent Testut	GRGS, Toulouse	France
Dr. Juan Fierro	Servicio Hidrografico y Oceanografico de la Marina	Chile