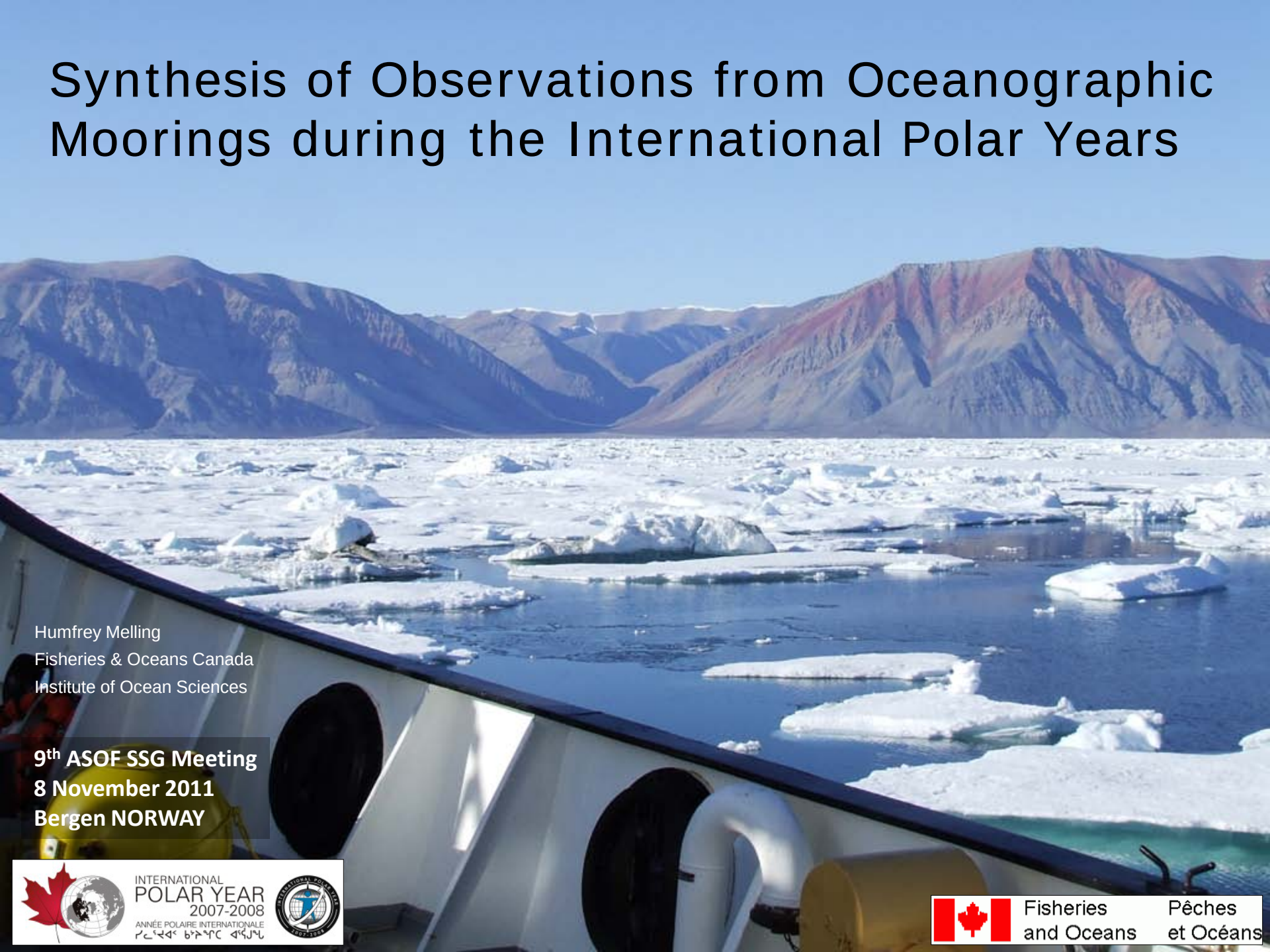
Synthesis of Observations from Oceanographic Moorings during the International Polar Years



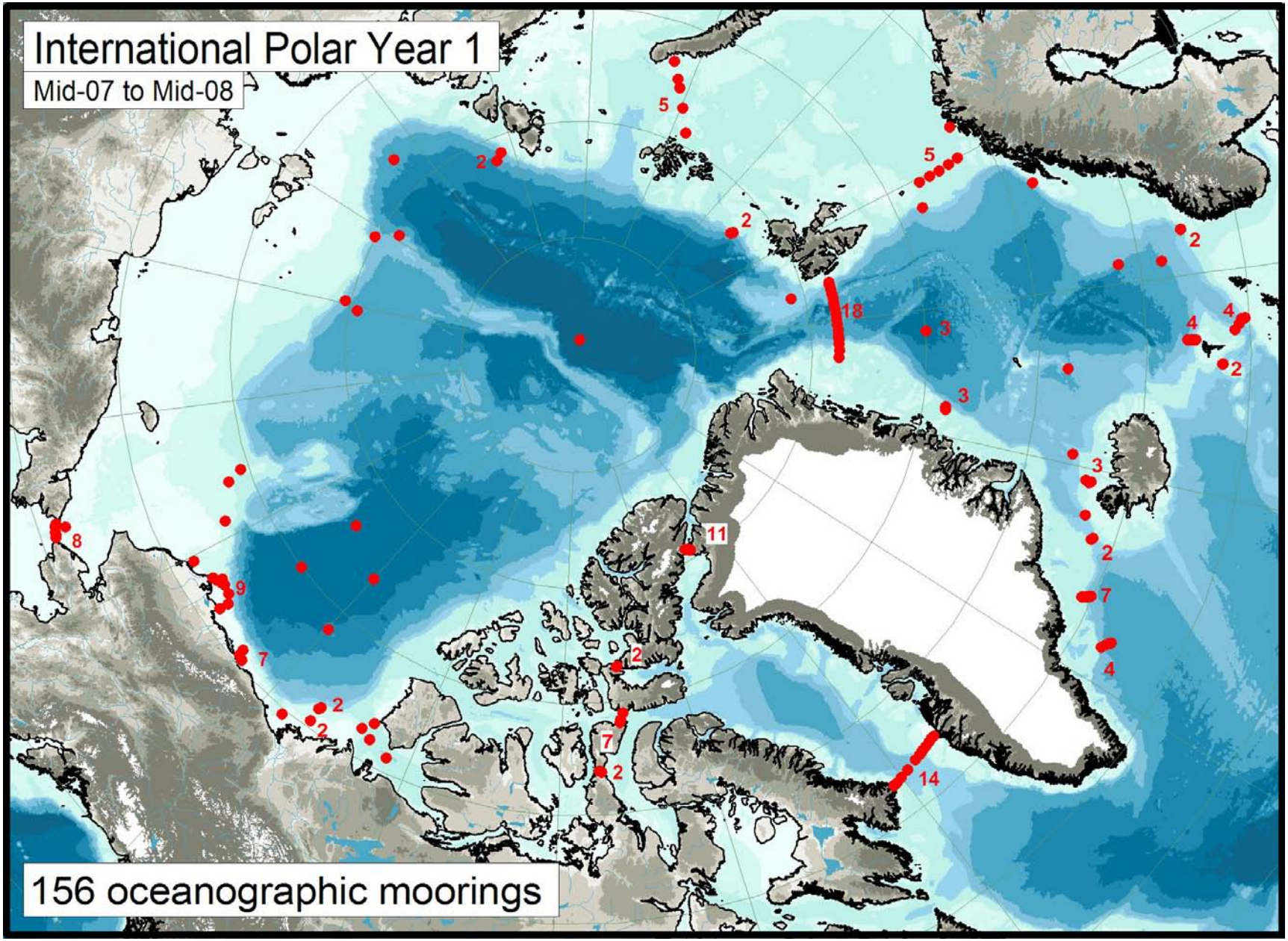
Humfrey Melling
Fisheries & Oceans Canada
Institute of Ocean Sciences

9th ASOF SSG Meeting
8 November 2011
Bergen NORWAY

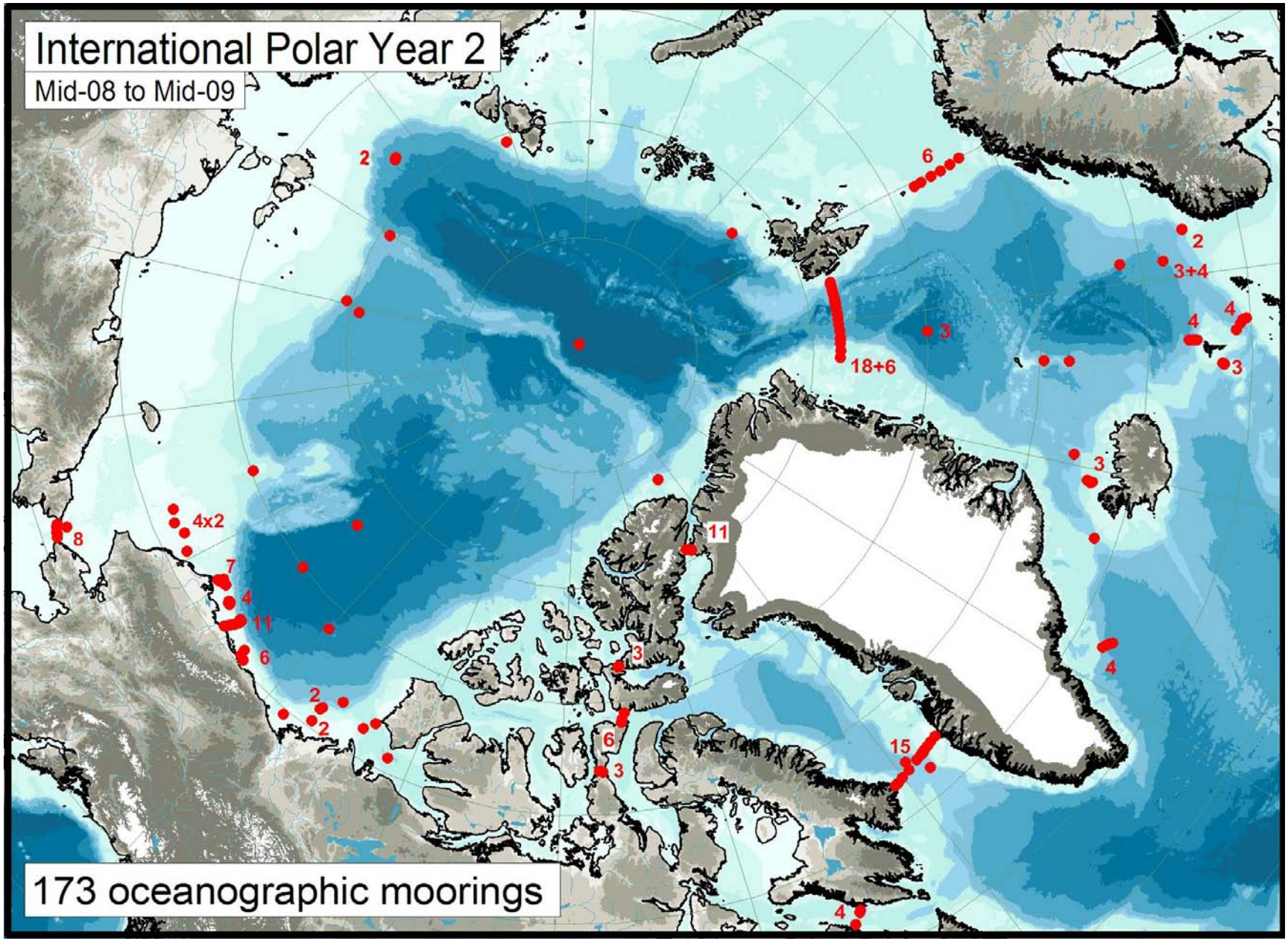
INTERNATIONAL POLAR YEAR 2007-2008
ANNÉE POLAIRE INTERNATIONALE

Fisheries and Oceans | Pêches et Océans

The 1st famous map … for 2007-08



The 2nd famous map … for 2008-09



The Movers and Shakers

Bob Dickson, who requested maps of IPY oceanographic moorings for iAOOS annual reports.

Former champion of ASOF & iAOOS, now retired

Humfrey Melling, who made the maps that Bob requested.

Institute of Ocean Sciences, Canada

John Calder, who saw the maps that Humfrey made, that Bob requested.

NOAA Arctic Climate Office, USA

Sara Bowden, guided by John, who saw the map, that Humfrey made, that Bob requested.

Executive Secretary, IASC

Savithri Narayanan, who picked up the ball, prompted by Sara, guided by John, who …

Director General, Fisheries & Oceans Canada. Chair of IASC Marine Working Group

Patrice Cousineau, who took up the task, directed by Savi, prompted by Sara, guided by John ...

Integrated Science Data Management, Fisheries & Oceans Canada.

Humfrey Melling, still engaged, hoping to move knowledge to action …

Marine Working of IASC (formerly AOSB)

Current Initiatives:

Overcoming Barriers to Arctic Ocean Scientific Drilling

Distributed Biological Observatory

Arctic in Rapid Transition

IPY Data Synthesis Efforts

The international Arctic Ocean Observing System (iAOOS) supported many new observational initiatives in the Arctic Ocean during the International Polar Years. For two years the iAOOS augmented pre-existing observations, national operational programmes and other public or private sector initiatives (e.g. oil and gas development) with a coordinated observational program providing unprecedented coverage of the Arctic Ocean.

The Marine WG envisions bringing together the technical capacity, human resources & good will to compile Arctic Ocean data acquired during the IPY, and to complete its standardization, synthesis and timely migration from project archives to a single internally consistent public resource.

The WG is proposing a modest demonstration project to address this challenge. The demonstration will focus attention only on observations from moored instruments during IPY. The Marine WG will assemble and provide easy access to as much data as possible.

The consolidated data will further be integrated to form a preliminary synthesis of the state of the Arctic Ocean during the IPY.

The Scientific Vision

IPY observations are presently dispersed among dozens of organizations, not universally accessible and stored in a multitude of formats.

The promise of the IPY and iAOOS for a better understanding of the Artic Ocean can best be realized if observations are shared and easily accessible for integration within comprehensive analyses.

Even an integrated set of observations derived from all four sources (moored recorders, drifting recorders, ship-surveys, satellite surveillance) is not sufficient to describe the 4-dimensional (x, y, z, t) characteristics and behaviour of the Arctic Ocean.

The optimal use of observations within Arctic system science is achieved via their integration, accessibility and consequent use for:

~ Broadly based scientific analysis

~ Assimilation into numerical models that embody our understanding of ocean dynamics, thus providing a complete picture of the ocean that is consistent both with observations and with the laws of physics.

A demonstration of viability?

Of an internationally coordinated Sustained Arctic Observing Network

The immediate objective of this project is to collect and integrate the Arctic mooring-data acquisitions of all nations during the IPY. This output has intrinsic value for present scientific research, maximizing the benefit of IPY field projects.

The initiative is also viewed as a pilot project for a future SAON, because demonstrated capability for effective and timely integration of independently acquired data is an essential component of an operational Arctic observing network.

The time series from moorings comprise only one component of the iAOOS suite.

The complementary components are:

- ~ Time series observations from moving installations (ice, floats, ships)
- ~ Single-time data at discrete locations visited by ships or aircraft (generally CTD and hydro-chemical stations)
- ~ Repeated surface surveillance of the ice and ocean surfaces from satellites

Relevance to ASOF II

ASOF II continues a focus on fluxes, but now strives to apply the knowledge gained during ASOF I to broader issues of scientific & societal importance.

- To perform an Arctic/Sub-Arctic synthesis of mass, heat & freshwater fluxes
- To interact with studies of Arctic/Sub-Arctic ocean ecosystems and biology
- To assist testing of ocean circulation & biophysical models.

On-going synthesis of the physical measurements across the whole ASOF region is an essential component of this activity.

ASOF recognizes that …

Applying the knowledge that exists or presently accumulating is critical to leveraging the success of the initial phase to broaden the scope of the program.

The high latitude ocean will influence decadal climate variability through its effect on the Atlantic thermohaline circulation

ASOF is ‘decadal’. ASOF’s objectives will not be met until our shorter term research 'snapshots' can be seen within a context of decadal change.

Continuing ASOF measurements must be coordinated geographically, to be concurrent rather than consecutive.

From the ASOF web site

Scope of the Initiative

Observations obtained from 329^{+} moored platforms during 2007 & 2008 in the Arctic Ocean and adjoining seas.

Include moorings sponsored under iAOOS plus contemporary installations under other sponsorship (e.g. independent national projects, offshore petroleum initiatives).

A variety of instruments measuring ocean & sea-ice properties at intervals ranging from seconds to days.

An average mooring may have delivered about 20 year-long time series, for a total of 6000-7000 year-long time series for the two-year IPY period.

Some partners will be able to provide well organized data sets in standard format; others will not.

The proposed initiative will consolidate meta-data & processed data from all cooperating sources, and will coordinate comprehensive access though a single web portal.

We will strive for as complete a collection as practical within an acceptable period of time (18 months?).

Success will be predicated on in-kind contributions from cooperating sources. The cash budget will be modest.

Stage 1: Metadata Assembly

Presently amassed information is not complete.

The maps reveal only the locations of moorings placed during the IPY.

Information on the instruments used, their depths & their sampling is incomplete.

I do not know which moorings were successfully recovered.

I do not know which instruments returned useful data, & for how long.

I do not know the state of processing, confidentiality constraints & archival status.

There may be more installations than originally mapped. Another sweep of contacts is probably worthwhile.

Stage 2: Data Collection

This may be the most challenging components of the project

Some data will be fully processed, quality controlled, interpreted, archived & easily accessible.

Others will be in less tractable form, perhaps still unprocessed, without error correction or calibration.

We will ‘collect’ data in the most advanced stage available.

‘Collect’ does not imply a physical transfer. Where sources are well managed, a simple web link will likely suffice.

‘Collection’ will also embody provisions for a period of restricted release of data, subject to the preferences or legal constraints of the sources.

Stage 3: Data Marshalling

The action of this stage will fall on one or more national ocean data services … NOT us.

e.g. Canada's Integrated Science Data Management, USA's National Ocean Data Center, A-CADIS initiative under USA's SEARCH

Simplicity, timeliness (& low cost) will be key factors. Something as simple as a database of metadata linked to NetCDF files might serve our purpose.

We will consider standard approaches & existing data repositories in preference to starting from scratch.

Progress is being made designing metadata & data structures for the IPY.

IPY Metadata Profile: http://ipydis.org/data/metadata.html

IPY Data Portal: http://gcmd.nasa.gov/portals/ipy/

Not all sources will provide structured data files. Marshalling such data into accepted structures will be our task. Our legacy will be a system to do this automatically.

Quality control, calibration & interpretation are not consider within the scope.

However, we will strive fro completeness by encouraging temporary archival of raw data until such time as final data can be submitted.

Stage 4: Data Access

This stage involves the design & implementation of a DDP (?) as well as an access portal

We will be to re-use existing infrastructure to the largest extent possible.

It may suffice to provide access to NetCDF files (binary or text) through the IODE Ocean Data Portal (ODP) that would link to a repository of such files.

The goal of this project would be to provide a simple access system that can provide connectivity to more sophisticated access interfaces that may be developed in the future.

Scientists and Institutions (35+)

Edmond Hansen, Norsk Polar Institut, Tromso

Ilker Fer, Geophysical Institute, U Bergen

Kjell Orvik, Geophysical Institute, U Bergen

Svein Osterhus, Geophysical Institute, U Bergen

Oystein Skagseth, Geophysical Institute, U Bergen

Harald Loeng, Institute of Marine Research, Bergen

Kjell Mork, Institute of Marine Research, Bergen

Héðinn Valdimarsson, Marine Research Institute, Reykjavik

Steingrímur Jónsson, University of Akureyri, Iceland

Andrey Pedchenko, State Research Institute on Lake And River Fisheries, St Petersburg

Detlef Quadfasel, U Hamburg

Agnieszka Beszczynska-Möller, Alfred Wegener Institute

Gereon Budéus, Alfred Wegener Institute

Sarah Hughes, FRS Marine Laboratory, Aberdeen

Shell Oil

Conoco-Phillips

Igor Polyakov, IARC, Fairbanks

Tom Weingartner, U Alaska, Fairbanks

Simon Prinsenberg, DFO-BIO, Halifax

Jim Hamilton, DFO-BIO, Halifax

Brian Petrie, DFO-BIO, Halifax

Humfrey Melling, DFO-BIO, Victoria

Svein Vagle, DFO-IOS, Victoria

Yves Gratton, ArcticNet, Quebec

Bob Pickart, WHOI

Andrej Proshutinsky, WHOI

Rich Krishfield, WHOI

Fiamma Straneo, WHOI

Knut Aagaard, APL, U Washington, Seattle (retired)

Craig Lee, APL, U Washington, Seattle

Kate Stafford, APL-UW, Seattle

Rebecca Woodgate, APL, U Washington, Seattle

Koji Shimada, formerly JAMSTEC, Yokohama

Takashi Kikuchi, JAMSTEC, Yokohama

Motoyo Itoh, JAMSTEC, Yokohama

Variables measured: Ocean & sea-ice

Current profiles (ADCP, DCP)

Current (RCM, ACM)

Planktonic back-scatter profiles (ADCP, DCP, WASP)

Temperature-salinity profiles (MMP, I-CYCLER)

Temperature & salinity (SeaCat)

Chlorophyll fluorescence

Turbidity

Dissolved oxygen (SBE43, Optode)

Dynamic height (PIES)

Sea level, surge and tide (IPS, pressure recorder)

Storm waves (IPS, ADCP)

Ice underside topography, draft distribution, concentration (IPS)

Ice velocity (ADCP)

Ambient sound – sea life, natural processes, human activities (AURAL, DASAR)

Sedimentation – rate, sources, characteristics (Traps)

Outcomes

Understanding of the nature of the Northern Ocean & its role in the climate system

Improved models for predicting change in the Arctic ocean-ice-atmosphere system on time scales from days through decades

Demonstrated viability of an international Arctic observing network, providing timely descriptions of the Arctic and data for assimilation into numerical prediction models

Benefits – A Canadian Perspective

Improved scientific basis for societal decisions involving Arctic residents, their infrastructure, Arctic economic development, wildlife, environment and resources.

The scope ranges embraces tactics, strategy & policy. Examples include:

- conduct of traditional lifestyles
- wildlife management – marine mammals, sea birds, invasive species
- weather, sea-state, storm surge and ice forecasting
- coastal and offshore engineering
- offshore environment assessment (e.g. hydrocarbon development)
- Change in the environment & ecosystem

Time for Opinions & Discussion

Frank discussion of the proposed initiative

- Is the concept appropriate?
- If not, how might it be improved?
- What are the perceived benefits to “the cause”? To you?
- Is it worth somebody’s effort?
- Are there other routes to the same result?

Along more personal lines …

- Will you share data?
- Are periods of confidentiality essential?
- What safeguards are needed?
- Does the outcome justify some in-kind contribution from you?
- Where might we find the ingredients –funds, human resources, infrastructure

I will be pleased if we finish having engaged …

- The interest & support of the ASOF/THOR modelling community
- The participation of the ASOF/THOR observational community

If we deliver the goods, perhaps we can continue to have fun doing this!

CANADIAN ARCTIC THROUGH-FLOW
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