

news from the



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Progress in Arctic Ocean Research over the Past Two Decades:

Summary of the findings presented at a conference organized by the
Swedish Royal Academy of Sciences
November 5-7, 2001
Stockholm, Sweden

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During the 1980s, a major effort was started to study the hydrography and circulation of the Arctic Ocean, at this time one of the least understood regions of the world ocean. Besides understanding the main features of the water mass structure and circulation in the Arctic Ocean itself, major emphasis was on establishing the links between the Arctic Ocean and the global oceanographic circulation, as well as global climate. An immediate surprise during these studies was the recognition that at the time when we tried to establish a baseline description of the Arctic Ocean, it seemed to be in the midst of major changes. The changes observed in the Arctic Ocean could also be recognized in other elements of the coupled Arctic ocean/ice/atmosphere system. Although many of these changes can be correlated with the AO or NAO indices, their fundamental nature is not yet understood. For example, we do not yet know to which extent the observed changes are driven externally or the result of internal processes. It is also unclear if they represent a large amplitude in natural variability or, at least in part, anthropogenically induced changes.

With these words, Peter Schlosser, Lamont-Doherty Earth Observatory and Columbia University, introduced the first presentation at the conference on *Progress in Arctic Ocean Research over the Past Two Decades* held November 5-7, 2001 in Stockholm.

The purpose of this summary is not to reiterate the presentations of the different speakers but rather to highlight some of the main scientific topics brought up during the conference. Many of these presentations were focused on climate: the evolution of Arctic climate through geological time; how climate affects the Arctic Ocean of today; and how might the Arctic system affect future climate on a regional and/or global scale? Consequently the scientific disciplines covered during the conference were wide ranging, representing different sampling media: solid earth (deep-sea sediments), water masses from surface to abyssal depths, sea-ice, and the atmosphere, and included both observations and modelling.

The dynamic nature of the present Arctic Ocean was emphasized. Ocean circulation and water mass properties clearly vary over time. This has been illustrated nicely, for example, by the warming of the Atlantic Layer at the North Pole during the 1990s. Furthermore, the warming of the Atlantic Layer in the Makarov Basin has been attributed to a shift in the circulation pattern, causing the Fram Strait branch of the inflowing warm Atlantic water to flow over the Lomonosov Ridge and fill up the Makarov Basin during the same time period. Another shift in the circulation is the disappearance of the cold halocline over the Amundsen Basin because the river runoff flowed off the Laptev shelf further to the east during the mid 1990s. The absence of the cold halocline made the heat flux from the Atlantic Layer to the ice cover stronger. However, it has not been possible to evaluate this effect as the cold halocline returned and covered a large fraction of the Amundsen Basin in 2001.

There have been observations of changes in extent and thickness of the ice cover, but there is no

consensus about the cause of these changes. When it comes to the distribution of the sea-ice cover, satellite observations indicate a continuous decrease of about 20% during the last two decades. The ice thickness issue is less certain as no continuous record is available, and the proposed decrease is based on comparisons of submarine records from the 1990s and the 1950s.

Many processes are variable on short time-scales. For example, the biological productivity is patchy in the ice-covered sea. This has implications on carbon flux, both through sedimentation and in air-sea exchange. Another climate related aspect is the inhomogeneous biogenic productivity of DMS, which through a chain of reactions form cloud condensation nuclei. These play an important role in the formation of the low altitude clouds, and hence, directly affect the albedo.

The cooling of the Atlantic water flowing north and into the Arctic Ocean has, together with extensive biological productivity, a significant effect on the air-sea flux of carbon dioxide. The combined effect makes the Nordic and Barents Seas some of the largest sinks of atmospheric carbon dioxide per unit area.

All these issues are in one way or the other coupled to the climate system, with many having a direct feedback to a changing climate. Examples of such feedbacks are: retreat of the cold halocline → increased melting of sea ice → decrease in albedo → warming, or; less ice cover → more light to surface water → more biological production → more DMS production → more cloud condensation nuclei → more clouds → change in albedo → change in temperature. Many more examples can be given, and they all stress the sensitivity of the Arctic Ocean climate.

Climate models also indicate that the high latitude regions will experience the largest mean temperature increase in a scenario of doubled atmospheric carbon dioxide concentration.

However, the modelers pointed to several uncertainties in these model calculations. First, many of the processes that are active in the Arctic Ocean are not resolved in the present GCMs. Second, the modelers stressed the quite large uncertainties caused by the high natural variability and regional active feedback mechanisms discussed above.

It has long been recognized that our lack of knowledge about the role the Arctic played in the maintenance and development of Cenozoic climates (past 65 million years), from the Paleogene greenhouse world lacking glaciation to the Neogene icehouse world with bipolar glaciation, is a major gap in our ability to understand and model global environmental change. But systematic sampling of short cores from the Arctic seafloor over the past two decades reveals rhythmical variations in the sediment system, making it possible to characterize the effects of glacial cyclicity in the Arctic Ocean during the last one million years. Huge progress has been made with respect to a classical problem in stratigraphy, namely accurate dating of Arctic Ocean sediments. Future work should be focussed on the sampling of Arctic seafloor sediments that are older than one million years (1-50 million years - for a start).

The acquisition of geophysical seismic reflection data and seafloor topography data have resulted in a much more accurate and quantitative view of Arctic Ocean bathymetry, and a much firmer understanding of the origin and structure of the major topographic features, including the Lomonosov Ridge. High-resolution seismic reflection data and sidescan sonar data have revealed scours from ice-grounding events down to

1 km (present) water depth, indicating presence of >1 km thick ice on the Siberian shelves, during the penultimate glacial maximum.

The geological and geophysical evidence unanimously points to the existence of a highly dynamic Arctic environment in the geological past. It follows that the recovery of Cenozoic stratigraphic sediment sections would represent a fundamental step to a quantitative description of global change that incorporates the influence of the Arctic Ocean.

The conference ended with a panel discussion of the future of Arctic Ocean research. Among the most important topics highlighted were:

- Drilling and recovery of long sediment sequences in order to decipher the geological and paleoenvironmental history of the Arctic Ocean;
- Oceanographic and sea ice time series in order to investigate variability, utilizing ship investigations, moorings, remote sensing, etc; and
- Process studies needed to elucidate how the present system works, with special emphasis to feedbacks to the climatic system.

Furthermore, there still are some uninvestigated regions which merit increased attention, including the area north of Greenland and the Canadian Archipelago.

In addition, a total of 35 posters were presented encompassing all disciplines covered by the conference.

ASOF Developments

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Chairman, ASOF ISSG

In the spring 2001 edition of this Newsletter, we described “developing plans for an Arctic-SubArctic Ocean Flux Array (ASOF)” as ASOF began to move from Science Plan towards Implementation. Here we aim briefly to describe important developments that have taken place since then in the funding of ASOF and associated programs, and to provide a calendar of ASOF or ASOF-related next steps in the outlook period.

Regarding *ASOF-East*, which aims to measure the two-way ocean exchanges between the Arctic Ocean and the North Atlantic through the Nordic Seas, the principal news has been the apparent success of the bid for EC funding of ASOF.

In mid-October 2001, a three-part ASOF-EC cluster bid was submitted to EC FP-5 under the “*Energy, Environment and Sustainable Development Programme*”, to cover exchanges through Denmark Strait [[ASOF-EC \(W\)](#)], Fram Strait –Barents Sea [[ASOF-EC \(N\)](#)], and Faroe-Shetland Channel [[ASOF-EC \(W\)](#) or “MOEN”], respectively. In late December 2001, all three elements of the cluster bid were given a provisional ‘GO’ rating by the Research Director General of the European Commission, and we now await the decision of the EC Programme Committee on the confirmation of funding for each element of that ASOF Cluster (due late February 2002). Though funding amounts have still to be finalised on this Framework-5 bid, the ASOF-East program is now sufficiently assured to begin negotiations for the inclusion of a successor ASOF bid in the 6th EC Framework Programme, 2002-6. Following earlier announcements, the EC is expected to ask for Expressions of Interest for

Integrated FP-6 Projects in April, with a submission deadline of June 2002. [<http://europa.eu.int/comm/research/nfp/networks-ip.html>].

The SIO:LDEO “Consortium on Ocean’s Role in Climate: Abrupt climate changes study” (CORC ARCHES) of the NOAA Global Change Program continues to contribute moderate but vital funding to support direct measurements of Denmark Strait Overflow speed and layer thickness off SE Greenland and this phase of the program will continue to December 2005. Both the Norwegian NoClim Project and the UK RAPID thematic program of NERC have a similar, though not identical, focus to that of ASOF on the role of the high-latitude ocean on the Thermohaline Circulation and hence on climate. The former has a greater emphasis on process studies than ASOF, while the latter extends its operations further south than the ASOF southern bound to measure the rate of the Atlantic Meridional Overturning Circulation. Both will nonetheless supplement ASOF research in the main ASOF study area. RAPID which is a £20 million project over 6 years (2002-2007) has advertised 28 March and 15 June 2002 as its closing dates for outline and full bids respectively [<http://rapid.nerc.ac.uk>]. NoClim is running at 5M NOK per year 2000-2002 but is likely to continue through 2006 [<http://www.NoClim.org>]. NoClim tasks 6 and 7 on long observational ocean time-series are most congruent with the interests of ASOF.

The ASOF-West component is currently debating and prioritising the content of its Implementation Plan. Though the separation between ASOF-West and ASOF-East is based less on geography than on funding, ASOF-West will nonetheless expect to

develop programs to study some of the most important, unknown and intractable elements of the entire ASOF study, including the flow of freshwater through the passages of the Canadian Arctic Archipelago, the fate of these waters in the Davis Strait and Labrador Sea, the changes in character and thickness of Labrador Sea Water with time and the influence of all these ocean-change components on the rate of the Atlantic overturning Cell—modelled but so far unobserved. The ASOF–West effort forms a subprogram of the US Study of Environmental Arctic Change (SEARCH), itself developing towards implementation. In view of the importance of freshwater fluxes to both studies, a significant and most helpful development has been the Announcement of Opportunity by the NSF

Office of Polar Programs for research bids on the “*Arctic Freshwater Cycle: Land/Upper Ocean Linkages*” that was made in late February 2002. The program description “*emphasises particularly the research planning of the Arctic/Subarctic Ocean Fluxes (ASOF...)*” and makes explicit mention of its intention to understand the “*Arctic freshwater system and its connections with the subpolar oceans and arctic environmental change*”. Full proposals are due June 3, 2002 [see <http://www.nsf.gov>].

ASOF, therefore, has interests in a number of developing lines of work and funding as it moves towards implementation. The following calendar outlines the next steps in terms of key meetings and deadlines.

Calendar for ASOF and ASOF-related events

1 February 2002, London, UK http://www.nerc.ac.uk/funding/thematics/rcc/	NERC RAPID Town meeting, DTI, London, UK.
22 February 2002, Lowestoft, UK	HOMER moored profiler meeting, CEFAS, Lowestoft, UK.
28 February 2002, EC	Funding confirmation expected for ASOF-East, EC programme committee.
18-21 March 2002, Halifax, Nova Scotia www.ices.dk/committe/occ/wgohyd.htm	ICES Oceanic Hydrography Working Group including mini symposium on Arctic and sub-Arctic Oceanography, Halifax, Nova Scotia, Canada.
28 March 2002, UK www.nerc.ac.uk/funding/thematics/rcc/	Deadline for NERC RAPID Outline proposals.
17 April 2002, London, UK www.royal-met-soc.org.uk	Royal Meteorological Society meeting – Rapid Climate Change and the Thermohaline Circulation, Imperial College, London, UK.
21-26 April 2002, Groningen, The Netherlands www.aosb.org www.let.rug.nl/assw	Arctic Ocean Science Board and Arctic Science Summit Week, Groningen, The Netherlands.
30 April 2002, UK www.nerc.ac.uk/funding/thematics/rcc/	NERC RAPID SSC Meeting – Bid Assessment
13-15 May 2002, Norway www.noclim.org/	NoClim Science Meeting Clarion Hotel Oslo Airport, Gardemoenn, Norway.
3 June 2002, USA www.nsf.gov/home/polar	Deadline for proposals to the NSF AO- Arctic Freshwater Cycle: Land/Upper ocean Linkages NSF02-071 www.nsf.gov/home/polar
June 2002 http://europa.eu.int/comm/research/nfp/networks-ip.html	Deadline for receipt of Expressions of Interest for Integrated Projects under EC Framework Programme 6
23-24 June 2002, Iceland www.rannis.is	North Atlantic Science Connections, US-Icelandic Science Day, re-arranged from September 2001. Reykjavík, Iceland.

End June 2002, Canada www.innovation.ca	Canadian Foundation for Innovation to announce decision on Canadian Research Icebreaker proposal.
10-12 July 2002, Bermuda, www.clivar.org/organization/atlantic	CLIVAR Atlantic Panel with focus on "MOC: theory and change mechanisms"
15 July 2002, UK www.nerc.ac.uk/funding/thematics/rcc/	Deadline for full proposals to the first AO of the NERC RAPID Thematic Programme.
26-29 August 2002, Canada. www.mar.dfo-mpo.gc.ca/science/ocean/chapman/home.html	AGU Chapman Conference on High-Latitude Ocean Processes, L'Estérel, Québec, Canada
17-19 October 2002, Hamburg, Germany	2 nd ASOF ISSG meeting, Institut für Meereskunde, Troplowitzstr. 7, D-22529 Hamburg, Germany

CONVECTION

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The CONVECTION programme is designed to study the physics of the winter convection process in the central Greenland Sea gyre. It, therefore, builds on the previous work of ESOP and ESOP-2, but with the narrower aim of elucidating the specific physics governing the mode of convection and the factors governing its variability.

Ten laboratories from seven countries are taking part. The co-ordinator is Peter Wadhams (Scott Polar Research Institute, Cambridge University). The other partners are Jan Backhaus (University of Hamburg), Rudiger Gerdes and Gereon Budeus (Alfred Wegener Institute, Bremerhaven), Robert Ezraty (IFREMER, Brest), Vladimir Pavlov (Norsk Polarinstitut), Rashpal Gill (Danish Meteorological Institute), Leif Toudal (Danish Technical University), Ingibjorg Jonsdottir (University of Iceland), Barry Uscinski (Dept. of Applied Mathematics and Theoretical Physics, Cambridge University), and Flavio Parmiggiani (ISAO-CNR, Bologna), with Giacomo de Carolis (IT IS-CNR, Matera, Italy) as an associated contractor.

The strategy of the project involves a mixture of field work, remote sensing, historical analysis and modelling. Direct measurements of convection have been made during winter cruises in 2001 and 2002. During the 2001 cruise, a deep convective chimney of depth 2500 m and diameter 10 km was discovered at the gyre centre at 75N, 0E. This was a surprising discovery, since convection to such depths was believed to have ceased during the 1970s, with 1000-1200 m being the more normal depth during the positive phase of the NAO. Equally surprising was the stability of the feature, since it was still present at the same location during a summer 2001 cruise by *Polarstern* and an autumn cruise by *Lance*, although capped by fresher water. The current 2002 winter cruise of *Lance* seeks to investigate this chimney further, including the installation of moorings and a float. It also involves the use of the Maridan Martin 150 AUV to map convective plume structures and the thickness and morphology of the ice cover. Acoustic moorings were installed over Vesterisbanken during autumn 2001 to measure convective plume activity during winter, to be recovered in April 2002.

The modelling work includes application of an ice-ocean-atmosphere model of the whole region, the use of small-scale convective plume models, and the development of a salt flux model to simulate the salt refinement process as local ice forms in the Odden ice tongue and is advected elsewhere to melt. The role of the ice tongue is investigated further in the remote sensing programme, which involves the analysis of QuikScat, Radarsat and SSM/I imagery of the region to study the seasonal and interannual variability of the Odden; the provision of airborne remote sensing coverage over the winter cruise; and an analysis of wave data from SAR imagery to yield ice thickness within the

Odden. Long-term variability of Odden is studied by a historical analysis of ice data.

The intended accomplishment by the end of the project (December 2003) is to have an understanding of the physical processes involved in convection and, via modelling and remote sensing analysis, to set these within the context of the driving forces from ice and atmosphere that result in a highly variable wintertime phenomenon, of major importance for the Atlantic thermohaline circulation.

Joint Swedish-U.S. Investigation of the Nordic Seas

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In May – June 2002, a two-ship operation to study the Nordic Seas will be performed, with the overall objective to understand the interaction between the Arctic Ocean, the Nordic Seas, and the Atlantic Ocean and how this interaction affects the Arctic Mediterranean and global thermohaline circulation. Specific objectives are:

1. Determine the sources and pathways of fresh water out of the Arctic Ocean and study the processes by which this fresh water becomes incorporated into and influences the formation of water masses in the Nordic Seas and the properties of the waters exported into the North Atlantic Ocean.

2. Determine the sources and characteristics of intermediate and deep waters of Arctic origin in the Nordic Seas, how Arctic and Nordic water masses modify each other within the Nordic Seas, and how

these modified water masses are exported into the Atlantic Ocean.

3. Determine the Arctic and Nordic Sea components of Denmark Strait Overflow Water and Iceland-Scotland Overflow Water.

4. Determine the pathways of Atlantic water through the Nordic Seas and into the Arctic Ocean and how it transforms Nordic Sea water masses, for example by recirculation and mixing.

5. Obtain a synoptic survey of the major water masses in the Nordic Seas. This survey will provide a key baseline observation to bridge past and future studies of the link between the Arctic Ocean, the Nordic Seas, and the Atlantic Ocean.

6. Use the new survey in conjunction with previous observations to determine the evolution of 1) deep and intermediate water mass characteristics in the

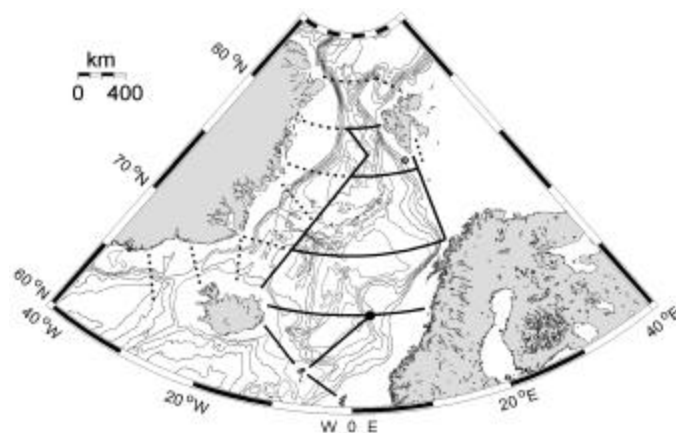
Nordic Seas and 2) deep exchange between the Arctic Ocean and the Nordic Seas, in response to the major reduction in Greenland Sea Deep Water formation in the early 1980s, as well as the increased penetration of Atlantic-derived water into the Arctic Ocean since the late 1980s. This will include quantitative determination of these decadal shifts in balance between Arctic, Nordic, and Atlantic components at all depths in several key regions of the Nordic Seas.

Identical shipboard oceanography programs will be carried out on both ships with scientists from Canada, Norway, England, Finland, as well as Sweden and the United States. Stations will be sampled with a CTD/rosette/LADCP package. Water samples will be analyzed on board for salinity, oxygen, nutrients, carbonate chemistry, CFCs, and SF₆ and will be collected for shore based analysis for tritium, He-3, oxygen isotopes, and I-129.

On Oden there will also be projects investigating: a) the bacterial composition, viruses and microplankton, and their role in the carbon cycle; b) the

response of plankton on increased UV radiation; c) the biogenic production of volatile organic halocarbons; and d) the spreading of persistent organic pollutants.

The sections planned to be occupied by the vessels are illustrated in the figure.



International Polar Year 2007 A Discussion Paper

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EDITOR'S NOTE

The following article was prepared by Leonard Johnson at the request of the AOSB. The proposal for an International Polar Year in 2007 has not been endorsed by the AOSB, but will be discussed during the AOSB annual meeting in Groningen, The Netherlands, on April 21-23, 2002. Comments may

also be made directly to Leonard Johnson at gljgreg1@aol.com.

BACKGROUND

Austrian Navy Lieutenant Karl Weyprecht after a cruise in the Barents Sea aboard *Tegethoff* became convinced that scientific study should take

preference over exploration and began a campaign that led to the International Polar Year (IPY) from 1882-1883. Unfortunately, Weyprecht died before the field work commenced. Ten countries participated. Eleven stations collected data in the Northern Hemisphere: Point Barrow, the mouth of the Lena, Novaya Zemlya, Spitsbergen, Bossekop, Sodankyl', Jan Mayen, Godthaab-West Greenland, Fort Rae, Lady Franklin Bay, and Kingua Fjord on Baffin Island and two in the subantarctic: Royal Bay, South Georgia and Orange Bay, Tierra del Fuego. Data included magnetic variation, temperature, atmospheric pressure, relative humidity, and visual observations of clouds and aurora (Liljequist, 1993, Korsmo, 2001).

The year 2007 will be the 125th anniversary of the initial IPY and it seems appropriate to launch another polar effort. Georg von Neumayer, as the president of the International Polar and National Polar Commission, was influential in bringing about this first international polar year and in making it a success (Kretzer, 2001).

This was followed by a second polar year during the years 1932 to 1933 that was significantly reduced due to the worldwide depression during these years. The third IPY evolved into the International Geophysical Year (IGY) 1957-1958 with a broader geographical scope (Weber and Roots, 1990).

INTRODUCTION

June 24-26, 2001, an international symposium "Perspectives of Modern Polar Research" was convened in Bad Durkeim, Germany to celebrate the 175th anniversary of the birth of Georg von Neumayer (Johnson, 2001). The symposium was sponsored by Pollichia which is a scientific organization founded in 1840 to promote the study of natural sciences in the Rheinland-Pfalz region. Additional support was provided by the Bundesamte fur Seeschifffahrt und Hydrographie and the Alfred-Wegener Institute fur Polar- und Meeresforschung.

Arising from the participant discussions was a strong consensus that a program should be formulated to commemorate the 125th anniversary of the IPY in 2007 (Johnson, 2001).

The Neumayer Declaration adopted was:

A 125th year IPY program be initiated using new and present technologies to determine:

- 1. Causes and effects of climatic variability--air/sea/ice interactions*
- 2. Lithosphere dynamics--evolution and history of crust and sedimentary cover.*

SCIENTIFIC RATIONALE

It is clear that a complex suite of significant, interrelated, atmospheric, oceanic and terrestrial changes has occurred in the polar regions in recent decades. These events are affecting every part of the polar environment and are having repercussions on society (SEARCH, 2001). Solar variations are also believed to influence climate through the formation of high altitude clouds, influencing the ionosphere of Earth, and other effects. Polar contributions to and the effect of global climate change are still a matter of conjecture, and to a large extent so are the extraterrestrial contributions. As part of the global heat engine, the polar regions have a major role in the world's transfer of energy, and the ocean/atmosphere system is known to be both an indicator and a component of climate change.

The Arctic Ocean is the last oceanic basin remaining to be fully explored and probed for its formation, evolution and contained resources, both renewable and non-renewable. The Earth's surface veneer of sediments and extrusive volcanic rock represents the most recent snapshot of geologic time. Beneath that veneer, buried in sedimentary sections and the underlying crust, is a rich history of the waxing and waning of glaciers and sea ice, the creation and aging of the oceanic lithosphere, the evolution and extinction of microorganisms and the building and erosion of continents. The tectonic evolution of terrestrial and marine polar regions and their relationship to the evolution of the continents

from Precambrian time to the present, the crustal structure and determination of the effect of the dispersal of Antarctic continental fragments on the paleocirculation of the world oceans, the evolution of life, and on global paleoclimates and present climate require definition.

Polar ice sheets need reconstruction of their detailed history, identifying geological controls to ice sheet behavior, and defining geological responses to the ice sheets on regional and global scales.

Adaptation to high latitude environments and how ecosystems both terrestrial and marine may respond to global change is another field of endeavor that requires attention. Drilling has also revealed that deep within marine sediments, rock pore spaces and fractures is an active environment where ocean water circulates, microbes thrive and natural resources accumulate (IODP, 2001).

Polar oceanic and terrestrial ecosystem studies should focus on the structure and processes of the environment from the sea floor to space and their relationships with the global geosphere, the atmosphere, biosphere and climate change.

The polar regions have been called Earth's window to outer space. An end-end modeling capability is the ultimate goal of solar terrestrial physics so that physical processes can be tracked throughout the entire Sun-Earth system. It has been proposed to implement CAWES in the period of 2003-2007 to foster a scientific approach to understanding the short term (Space Weather) variability of the integrated solar-terrestrial environment (SCOSTEP, 2001). In a similar vein, an International Heliophysical Year (IHY) has been proposed for 2007 to obtain a coordinated set of observations to study at the largest scale the solar generated events that affect life and climate on Earth (Davila et al., 2001).

It should be noted that polar and space research presents exceptional opportunities to integrate

educational outreach into research projects by communicating the unique results to the interested scientific community and to all peoples of the Earth. The social applications include the ozone hole and humans in space.

GOALS

* In a similar thrust to both the IPYs and IGY, the goal would be to obtain synoptic measurements for studying large scale processes at high latitudes. The hypothesis is that if scientific processes can be summed and simplified from a great number of stations over a broad geographic region, they will be easier to understand and predict. Observing systems would ideally be in place over a number of years to separate annual variability from seasonal.

* It is not clear if the profound changes in the polar regions are due in some part to anthropogenic changes or if it is part of a natural fluctuation. The environmental paleohistory of the high latitudes is required by a drilling program as outlined by JEODI (www.jeodi.org).

* The terrestrial solar coupling needs definition by obtaining a coordinated set of observations to study at the largest scale the solar generated events that affect life and climate on earth.

* The efforts would be characterized by a high level of international cooperation and collaboration and interdisciplinary scientific endeavors.

* It should be noted that polar and space research presents exceptional opportunities to integrate educational outreach into research projects by communicating the unique results to the interested scientific community and to all peoples of the Earth. The social applications include the ozone hole and humans in space.

APPROACH

IPY 2007 will require an integrated, holistic system approach encompassing a wide range of disciplines and new and improved technologies for long-term

measurements on the seabed, in the water column and space over all seasons with new platforms. The proposed European research ice breaker (Aurora Borealis) with dual moon pools, dynamic positioning and scientific drilling capability is a prime example of a new technology which would be extremely useful should it be built. Coordination and collaboration with international scientific organizations such as AOSB, SCAR, IASC, SCOSTEP (Scientific Committee on Solar-Terrestrial Physics) and especially their program on Climate and Weather of the Sun-Earth System (CAWES), and the IHY community will be necessary.

WHY 2007?

The next maximum in solar activity will occur in 2010. A coordinated campaign of observations beginning in 2007 and ending in 2010 would be able to sample the Earth response for essentially the full range of solar input, from near minimum activity to solar maximum. In addition, a new fleet of scientific instrumentation in space including Solar Terrestrial Relations Observatory (STEREO), and Solar B will be available providing unprecedented observations of the heliospheric inputs. These data, coupled with comprehensive terrestrial datasets will provide significant new insights into the Sun-Earth connection.

The IODP (Integrated Ocean Drilling Program) will commence in October, 2003 with field operations being launched in subsequent years with the Arctic having a strong potential to be a focal point. The proposed Aurora Borealis may provide unprecedented multi-discipline all season data collection capacity and a scientific drilling capability. The SEARCH program data collection phase will be underway.

ACTION

Formulation of a science plan must start now including coordination with existing programs such as SEARCH [Study of Arctic Environmental Change], CAWES and IHY as necessary components, joint platforms, and development of

automatic equipment. Important ancillary issues will include data management and dissemination, so that discoveries can have maximum impact for research, commercial, regulatory and educational benefit (Presidential Panel, 2001). Educational outreach, in both formal and informal settings to improve science competency and citizenry awareness and information of polar and space sciences will be a vital component (Presidential Panel, 2001).

This will require an international workshop in 2002 to formulate the proposed science plan.

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ARCTIC SCIENCE SUMMIT WEEK

21-26 April 2002

Groningen, The Netherlands

The Arctic Science Summit week is held during April each year. This year it will held in Groningen, The Netherlands. The week comprises a series of meetings of circumarctic science organizations, organized around a joint project day which provides an overview of various Arctic programs. AOSB will hold its 21st meeting on

April 21-23, 2002. More information on the ASSW and the AOSB meeting is available on the AOSB website at www.aosb.org and at the ASSW web site at www.let.rug.nl/assw.

ASSW Schedule

Sunday, April 21	12:00-19:00	AOSB Annual Meeting
Monday, April 22	9:00-11:30	AOSB Annual Meeting Cont.
	8:30-12:00	IASC Regional Board Meeting
	12:00-18:00	Project Day
Tuesday, April 23	9:00-17:00	AOSB Annual Meeting, Cont.
	9:00-17:00	European Polar Board
	9:00-17:00	NySMAC
Wednesday, April 24	9:00-17:00	Science Day
Thursday, April 25	9:00-17:00	IASC Council Meeting
	18:30	Joint Dinner
Friday, April 26	9:00-13:00	FARO
	13:00-17:00	Nansen Arctic Drilling