

news from the



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In This Issue: Arctic Subarctic Linkages. . .Upcoming Discussion Session on Sustained Monitoring of Arctic Fluxes. . . The IAPP North Water Polynya Study (NOW) Update. . .IAPP-SCG Meeting Report. . .Arctic Science Summit Week

ARCTIC SUBARCTIC LINKAGES

Steps Towards Implementation of a New AOSB Research Program

At the 18th Meeting of the Arctic Ocean Science Board, Tokyo, Japan, 28 March-2 April 1999, the Board agreed that a new program on "Arctic-Subarctic Linkages" would form an appropriate new focus for its activity. This report is intended to brief the Board and others on progress since that date.

The first activity, in the two weeks which followed the Board Meeting, was the compilation of a Newsletter article¹ which would describe the rationale for the new program to the delegates at the Arctic Science Summit in Tromsø, 25-29 April. The article was well received as a timely contribution to the planning of Arctic science in general and the Arctic role in global change in particular. The point of the article was reinforced by a talk to the Joint Science Day session on "Marine Climate of the Arctic" by Bob Dickson on "*The influence of the NAO on the Nordic Seas and North Atlantic, with suggestions for the further study of Arctic-subarctic exchanges.*" The message was amply reinforced in several other talks, notably those by Leif Anderson of Göteborg University on "*Chemical and biochemical processes and Arctic Climate*", by Peter Jones of BIO on "*The Recent Arctic Ocean Warming*" and by Peter Schlosser of LDEO on "*Freshwater balance and Arctic Ocean stability in a changing global climate*".

In the following month, the principle related activity was the compilation of an EC proposal for the sort of gear-development we would need to implement a second phase of the present EC VEINS Project (Variability of Exchanges in Northern Seas) which comes to an end in

summer 2000. VEINS-2, intended to continue from that date, will focus on precisely the measurements envisaged in the AOSB Newsletter article and will be submitted to the EC Framework 5 Programme at the appropriate time (February 2000). However, the call for the supporting gear-development work occurred earlier and a three-part VEINS-2 Pilot proposal (V-2P) was duly submitted by the due date of 15 June 1999.

Following a successful workshop on Arctic Change² at the Polar Science Center of the University of Washington in fall 1997, the Science Steering Committee of the Ocean-Atmosphere-Ice-Interactions element of the U.S. Arctic System Science Study (ARCSS-OAII) requested the development of a science plan for the study of such changes. A workshop for the Study of Environmental Arctic Change (SEARCH) was convened at the Polar Science Center on 30 June to 2 July 1999 to begin the process. This meeting was important to our AOSB interests and program for three reasons: First the SEARCH group had been asked by U.S.-CLIVAR to consider the design of a field program which might act as a high-latitude component of the WCRP CLIVAR program. Second, as our Newsletter article points out, the study of Arctic-Subarctic linkages should ideally seek to make the necessary measurements *simultaneously* at all the main inflow and outflow points, since advanced models now anticipate that the time-dependence of the main fluxes may be linked; the SEARCH workshop was an ideal venue to begin the task of persuading a long-term simultaneous pan-Arctic coverage. Third, we envisaged a

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need to conduct, as part of our study, a retrospective analysis of an earlier episode of Arctic warming that occurred in the middle decades of this century, and publicising this task at the SEARCH workshop would be an ideal means of promoting the necessary data rescue effort. As invited participants, Bob Dickson and Roger Colony were able to describe these aspects of our intended program and its requirements. A report of the meeting is currently in draft.

Two steps were made in September, one positive, one less so. On 9-11 September, a small UK-Norway Workshop was convened in Bergen to begin the task of designing a modern research programme which might address questions of *"Rapid Climate Change and the Northern High-latitude Ocean"*. The two main issues of the many which surround this topic seem to centre on whether Arctic-subarctic change can be expected to disrupt the thermohaline circulation and its warm salty return flow, and what model developments would be necessary to improve our ability to predict such effects. As lead-off speaker, Bob Dickson again made the case for collecting improved numbers for modelers, particularly those which describe the heat and salt flux to the Arctic through all its main gateways of inflow, and the freshwater flux from the Arctic to lower latitudes via the Canadian Arctic Archipelago and East Greenland shelf. The minutes of the Bergen workshop are in final draft form at present. This sort of initiative might potentially complement the North American SEARCH program in forming a high-latitude component of CLIVAR.

In the last week of September came the less-welcome news that although our EC V-2P proposal had given a mark which would normally imply acceptance, it lay slightly below the threshold set for funding in this particular call, so that effectively the proposal failed.

In October, two further steps were made towards implementing the "Linkages" project as an AOSB programme. On 18-22 October, Bob Dickson visited the present VEINS Coordinator, Dr. Jens Meincke at the University of Hamburg to carry out the initial stages in the drafting of the main VEINS-2 proposal for submission to the EC Framework 5 program in February 2000. The central motivating objective will be the same as that of VEINS-1: *"To measure and model the variability of fluxes between the Arctic Ocean and the Atlantic Ocean with a view to implementing a longer term system of critical measurements needed to understand the high-latitude ocean's steering role in decadal climate variability"*. Despite the failure of its gear-development pilot project, the prospects for VEINS-2 remain good since it maps

closely onto three specific objectives of Key Action 2 of Framework 5 on *"Global Change, Climate and Biodiversity"*. These are, first, action 2.1 *"To understand, detect, assess and predict global change processes"*, and its task 2.1.4 on *"Climate variability and abrupt climate changes"* which specifically aims for *"a better understanding of the role of the ocean in the climate system, in particular the thermohaline circulation, deep water formation.....polar processesand interactions with ocean circulation, cryosphere, atmosphere and natural resources..."*. Second, the priorities of VEINS-II seem ideally matched to action 2.4 of Framework 5 in developing *"A European component of the global observing system"*, and its two subtasks: namely task 2.4.1 on *"better exploitation of existing data and adaptation of existing observing systems"* and task 2.4.2 on *"Development of new long term observing capacity"*. The outline plan drawn up in Hamburg is presently on circulation to the VEINS community for approval, modification and construction.

During the same week, 18-22 October, a paper describing precisely *where* that new long term observing capacity should be applied was being presented at the St. Raphael Conference on The Ocean Observing System for Climate by Dr. Howard Cattle, the current ACSYS chairman. Once again this presentation stressed the three essential points of the AOSB proto-program: that our main priority should lie in measuring the exchange of heat and freshwater between the Arctic and the subjacent seas, that we need to conduct such measurements for a long enough period of time to describe the decadal variations in Arctic climate that are now known to exist, and that we have much to gain if we can coordinate our measurement programmes so that the measurements of these fluxes are made simultaneously at all main gateways connecting the Arctic Ocean to lower latitudes. A pre-conference transactions volume is available³.

Though much of this report has concerned the necessary but not yet productive business of programme planning and proposal writing, other areas have shown real scientific progress. Despite the failure of the V-2P, CEFAS, Lowestoft and IFM Hamburg have been able to purchase much of the hardware that will be needed to deploy moored strings of SEACAT-SBE-16 salinity sensors under the ice of the East Greenland Shelf. We are thus in prospect, for the first time, of being able to monitor this important component of the freshwater flux as it passes south to the North Atlantic. Collaboration between the CCMS-Proudman Oceanographic Laboratory at Bidston and IFM Hamburg has provided sufficient equipment to build and test prototypes of the

cheap, fishing-reel-based profiling CTD systems that will be an essential component of our moored array north of Svalbard. Trials in a deep aquarium tank have proved the system and further deeper trials to 300m are planned for Loch Etive, Scotland, next spring.

-Bob Dickson

References

- ¹Dickson RR, L. Anderson, M. Bergmann, R. Colony, and P. Malkki. 1999. *Arctic-Subarctic Linkages to form a new Focus of AOSB Activity*. AOSB Newsletter 3, (2) 5 pp.
- ²Morison, J, K. Aagaard, and M. Steele, 1998b. Report on the Study of the Arctic Change Workshop, November 10-12, 1997, Univ. of Washington, ARCSS Rept. No. 8. 63 pp
- ³Cattle, H., R. R. Dickson, A. L. Gordon, O. M. Johannessen, and C. Mauritzen. (in press). High-Latitude Processes and the Ice Covered Ocean. Proc. St Raphael Conference on The Ocean Observing System For Climate, (OCEANOBS 99) October 1999

Discussion Session On Sustained Monitoring Of Arctic Fluxes

6 April 2000
Cambridge, U.K.

Dr. Robert Dickson is organising and will chair a small discussion session during the Arctic Science Summit Week (ASSW) to advance planning for sustained monitoring of Arctic fluxes. This session will be held on Thursday, April 6th. Participation in this session is limited by space and time considerations to about thirty scientists and thus will be by invitation only. Nominations (including self-nominations!) may be sent to Bob via email or fax (these communications addresses are provided below).

Dr. Dickson will then consider all such nominations and invite those most likely to be able to contribute to the discussions. Please bear in mind that this is expected to be the first step in a comprehensive scientific planning process that will provide opportunities at a later stage (probably at multiple stages) for all interested scientists to become involved in the planning process.

In order to make the maximum progress at the meeting, Bob is inviting some session participants to prepare for circulation before the meeting a set of condensed 1-page statements (plus figures) on "present understanding" that apply to the several key parts of the programme participants will be discussing. This should avoid the need to go over agreed ground during the session itself. Such strawmen are not expected to emerge unscathed, but experience indicates that kind of preparation would enable participants to get more rapidly to the point -- ***defining what the optimal long-term Arctic observing system for climate might/should look like.***

The preparations will focus on four issues:

1. The Science Driver - why we are interested in the Arctic freshwater flux and thermohaline shutdown in the first place;
2. Observations - what and where would we measure to keep pace with any change in the thermohaline circulation and determine its causes;
3. Programs – what programs underway now or planned for the immediate future could contribute to such an effort; and
4. Applications and Funding

Specific issues that are likely to be addressed in these preparations include the following:

The Science Driver

- (1) paleo evidence that increased freshwater accession has caused rapid shutdown of the MOC in the past;
- (2) what is the range and consensus of the present models of how the thermohaline circulation is expected to be affected by rising CO₂ and what are the control variables;
- (3) how close are we to shutdown at present;
- (4) where their main observational needs presently lie for coupled models; and
- (5) what is the climate of the sector likely to do as we move from the extreme NAO-positive state of the 1990's to the extreme anthropogenic forcing expected around 2100?

Observations

- (6) ice and freshwater flux in the western Fram strait;
- (7) the freshwater flux array under the ice of SE Greenland shelf (i.e., how much of the Arctic efflux reaches the open North Atlantic);
- (8) the freshwater flux through the Canadian arctic archipelago;

- (9) poleward heat/salt flux west of Norway;
- (10) the heat/salt flux into the Arctic via E. Fram Strait;
- (11) these same fluxes via the cooler fresher pathway through the Barents Sea;
- (12) heat, freshwater, and nutrients via the Bering Strait;
- (13) ice extent and thickness in the Eurasian Basin; and
- (14) where would the meridional overturning circulation be monitored?

Programs

- (15) SEARCH;
- (16) VEINS-2;
- (17) the proposed UK-Norway initiative;
- (18) ACSYS/CLIC; and
- (19) others

Applications and Funding

No one-pagers are planned for this section. Topics that are expected to be covered in this section include: potential applications such as initializing or verifying models; preparation of data products (gridded fields, etc.); and possible contributions to periodic assessments (e.g., the proposed Arctic Climate Impact Assessment), etc.; options for sustained measurement programs and observatories; and the key issue: how might we best achieve some sort of long-term stamina in funding (prospects for funding for sustained observations in the Arctic from both national and international sources).

To comment on this paper or to submit nominations, please contact Dr. Dickson at: r.r.dickson@cefas.co.uk (email) or +44 1502 513 865 (fax)

The IAPP North Water Polynya Study (NOW)

Progress Report on Field Work (1997-1999) with emphasis on the 23 August to 2 October 1999 expedition to the North Water on the CCG ice breaker *Pierre Radisson*

Background

The North Water in northern Baffin Bay is perhaps the most productive ecosystem north of the Arctic circle. It is located at latitudes that will be impacted early and most strongly by the present trend in climate warming. The functioning of the North Water ecosystem, its role in the overall Arctic biota and its potential response to global warming are the subjects of the International North Water Polynya Study (NOW), conducted by the NOW Research Network with funding from the Natural Sciences and Engineering Research Council of Canada, U.S. National Science Foundation and Japan. After three expeditions to the North Water in 1997 (August-September), 1998 (April-July) and 1999 (August-October), scientists are now in a position to assess inter-annual variability in the biological productivity of the ecosystem in relation to ice cover dynamics and climate.

Synopsis of operations

The main scientific objectives of the third and last expedition (NOW99) were (Leg 1) to recover the instruments moored in July 1998, which recorded circulation and the deep flux of particles in the polynya from August 1998 to August 1999, and (Leg 1 & 2) to quantify pre-winter primary and secondary productions in the area, and identify the biological sources of the significant deep particle flux measured in the fall of 1997 by the moored instruments. A third objective was to strengthen communications with the Grise Fjord (Canada) and Qaanaaq (Greenland) Communities. All

three objectives were fulfilled and the overall operation, which entailed major logistic difficulties, was a great success.

Four types of stations were carried out during the mission. **CTD stations** consisted of continuous profiles of temperature, salinity, light transmittance and chlorophyll *a* fluorescence. Sampling at **Basic stations** included the same continuous profile plus DOC, DIC, nutrients, total and fractionated Chl *a*, microbial densities and picoplankton densities at selected depths; plankton nets for the determination of zooplankton and juvenile fish areal densities (bottom to surface tows). Operations at **Full stations** included Basic sampling plus additional CTD-rosette casts and plankton nets for the determination of bacterial, phytoplankton and zooplankton physiological rates and the concentration of macrozooplankton and juvenile fish in the surface layer (multiple oblique tow from surface to 70 m); the deployment of cameras and floating sediment traps for the determination of particle concentration and flux; box coring of bottom sediments, and thorium pumping profiles. The priority at **Mooring stations** was the recovery of the instruments moored in 1998 and 1997. In between stations, salinity, temperature and chlorophyll *a* fluorescence, atmospheric conditions, heat fluxes and bird and mammal abundances were continuously monitored along the ship's track in the North Water and in Baffin Bay and the Labrador Sea during the return trip to Quebec City.

Leg 1 (23 Aug to 12 Sep)

Thirty-six scientists boarded the *Pierre Radisson* in Resolute on 23 August. The ship sailed first to Pond Inlet to receive fuel from the *Des Groseillers* (25 Aug) and then towards the North Water. Thereafter, operations for Leg 1 generally proceeded according to the plan, with moorings recovered in succession at D1 (26 Aug), S4 (28 Aug), S5 (29 Aug), D2 (31 Aug) and E2 (02 Sep). At each of these Mooring stations, a Full station was completed (see above for definition of station types). We reached stations N2 and N3 on 03 September. Ice conditions prevented the recovery of moorings but a Full station was completed at N3. After several attempts at locating the moorings, we sailed back South to E1 (05 Sep), S2 (06 Sep) and S1 (08 Sep). Instruments moored in 1998 were recovered at E1 and S2 and an unsuccessful attempt was made to recover the bottom half of a 1997 mooring at S1. A Full station was also completed at each of these Mooring stations. We then sailed to S4 again (09 Sep) where we completed a second Full station and successfully retrieved an American sediment trap that could not be recovered in July 1998. Enough time remained in Leg 1 for a second attempt at recovering moorings N2 and N3. After unsuccessfully trying to contact and grapple the moorings in relatively mild ice conditions from 10 to 13 September, it was concluded that the said moorings had probably been carried away by the strong currents prevailing in the narrows, and that they should be considered lost. Overall, 34 of the 43 instruments moored in 1998 and 1 trap moored in 1997 were recovered. Overall, 6 CTD stations were carried out, 10 Mooring stations were occupied (more than once for some) and 10 Full stations were completed.

Leg 2 (13 Sep to 02 Oct)

Leg 2 officially started on 13 September, but stations 2 and 3 of transect 1 were completed during the attempts at recovering moorings at N2 and N3 on 11-12 September. Transect 1 was completed on 13 September (stations 3-6). While weather deteriorated, the ship sailed to Grise Fjord (14 Sep) for an exchange of scientists (11 left the ship and 9 boarded), a meeting with the Community (see below) and the calibration of the compasses of the recovered instruments. Scientific operations resumed on 15 September with the completion of transect 5 (stations 43 to 58, 17-20 Sep), followed northward by transect 4 (stations 42 to 31, 20-23 Sep). Time was running short and given some uncertainties in the timing of the visit to Qaanaaq, it was decided to sail along transect 3 without completing the station work, only the continuous, between-station, monitoring being carried out (23 Sep). Normal

operations resumed along transect 2 (stations 20 to 14, 23-25 Sep). After obtaining diplomatic clearance to enter the Greenland 3-mile limit, the ship sailed on 26 September to Qaanaaq in Inglefield Fjord for a meeting with the Community (see below). The ship left Inglefield Fjord on 28 September, en route to a 3rd Full station at S4, which had to be cancelled because of residual rough weather from the storm that prevailed in the area during the visit to Qaanaaq. Scientific work resumed at station 62 at the Canadian end of transect 6 (stations 62 to 82, 29 Sep to 02 Oct). The completion of transect 6 ended Leg 2, NOW99 and the 3-year field program of NOW. Overall, 29 CTD stations, 20 Basic stations and 11 Full stations were completed during Leg 2.

On 2 October, the ship sailed to Pond Inlet to debark one Inuit student and then headed South for the return voyage. Scientists being what they are, some additional sampling was carried out at 4 basic stations in Baffin Bay and Davis Strait. The *Radisson* dropped anchor in Pangnirtung on 6 October to refuel the CCGS *Henry Larsen* and for a visit of the village. We reached Rimouski (St-Lawrence Estuary) on 11 October to unload some scientists and scientific equipment. The ship arrived in Quebec City on 12 October for final unloading.

Strengthening contact with local populations

In previous years, establishing contact with the Inuit communities nearest to the North Water proved a difficult and costly process. The Hunter and Trapper Associations (HTA) on both shores had some concerns (mild in Grise Fjord and severe in Qaanaaq), about the potential impact of the scientific program on hunting activities. In 1999, careful preparation made possible a call of the ship to both villages. During the visits, the Community was invited onboard to see for themselves the work of the scientists and to discuss with them. Community Council and HTA representatives were also invited to dinner and discussion of the program. The scientists and crew visited the villages. Exchanges were congenial and allowed in-depth discussions of concerns. In Grise Fjord, over 200 persons (adults and students) visited the ship and two students remained onboard as observers and collaborators for the remainder of the mission. In Qaanaaq, over 500 people visited the ship and the crew and scientists were invited to a traditional dance followed by a discothèque.

Overall, the scientists and crew felt that discussions and information provided during the visits resolved any concerns that the local populations may have had about the impact of the scientific operations on the region. Also, these activities certainly increased the awareness

of local people about the importance of the research in a context of climate change, and the potential benefits to their Community.

Networking at its best

The spectacular success of the NOW field program reflects months of careful preparation by scientists and professionals all over the world. From August 1997 to October 1999, the different teams have logged 169 days of shiptime in the North Water (190 days at sea when including voyages to and from the area). This total very favourably compares with the 95 days planned in the original proposal funded by NSERC. Overall, this represents 6543 scientist-day at sea, not including the field work of our teams at Cape Hershel, Coburg Island and Hakluyt Island.

Much of our success at sea can be attributed to the savoir-faire of our closest collaborators, the officers and crew of the Canadian Coast Guard ice-breakers *Pierre Radisson*, *Louis S. St-Laurent* and *Terry Fox*. Over the years of planning and field work, we have developed with these men and women a remarkable complicity that has

enabled us to carry out one of the most complex and complete oceanographic program in ice-infested waters ever. In particular, the *Pierre Radisson*, which supported the 1998 (124 days) and 1999 (51 days) field operations and voyages, has become for many of us a second home.

From keel to crow nest, these ships are wonderful tools for the study of Arctic marine ecosystems. All departments, from bridge to engineering, from logistics to deck crew, (not omitting the kitchen staff and the stewards) have constantly demonstrated remarkable inventiveness and dedication in solving the problems that necessarily arise at the turn of every iceberg in such an endeavour. In each and every occasion, our difficulties and successes became those of the officers and crew. We are grateful for this complicity which is one of the main ingredient for successful oceanographic work in this adverse environment.

-Louis Fortier, Chief Scientist
Scientific Leader of NOW

The full expedition report with accompanying figures can be downloaded from the NOW FTP site at <ftp://kestrel.fsg.ulaval.ca/home/giroq/nw/1999/Report>

IAPP-SCG Meeting

28 January 2000

San Antonio, Texas

The Scientific Coordinating Group of the International Arctic Polynya Project (IAPP-SCG) met in San Antonio immediately following the 2000 Ocean Sciences Meeting. Dr. Jody Deming, co-chair of the Ocean Sciences polynya sessions, reported there was excellent attendance during both days of the polynya sessions and a good mix of Arctic and Antarctic research. The combination of both north and south polar polynya research was met with enthusiasm by the attending scientists. Dr. Louis Legendre, Chair of the IAPP-SCG, reported that a large number of proposals have been received for the upcoming 2000 ASLO meeting in Copenhagen, though information is not yet available as to how many were submitted for the polynya sessions. IAPP planning efforts are also underway for a Polynya Symposium tentatively scheduled for Fall 2001 in Quebec City.

Dr. Louis Fortier made a short presentation to the IAPP-SCG on the history and progress of the NOW project (see the first article in this newsletter), discussing the success of the field program and plans for NOW's future. He also spoke briefly about the NOW Workshop being held the two days following the IAPP-SCG meeting. Dr. Louis Legendre, Chair of the IAPP-SCG, led discussions on a variety of other topics including publication of a polynya book and publication of a special international journal issue on the NOW polynya. He also discussed possible new and future projects of the IAPP and suggestions for study of the Cape Bathurst polynya, near Banks Island in North Western Canada, met with enthusiastic response. Plans were made for future discussions concerning science, logistics and funding possibilities.

The full IAPP-SCG meeting report is available on the AOSB website at www.aosb.org/IAPP.html

ARCTIC SCIENCE SUMMIT WEEK

**2 - 7 April 2000
Cambridge, U.K.**

The Arctic Science Summit week is held during April each year. This year it will be held in Cambridge, U.K. An initiative of IASC, its rationale is to provide a focus for opportunities for co-ordination, collaboration and complementarity in all areas of Arctic science, and to combine science and management meetings to save time and travel. The week comprises a series of meetings of circumarctic science organisations, organised around a joint science day focussed on topical issues of concern to them all. In addition specially focussed workshops also take the opportunity to meet in parallel.

This year the science focus develops the foundations laid by last year's workshop in Tromso on the impacts of global change on the Arctic. That meeting provided input to the evolution of the Arctic Climate Impact Assessment (ACIA) Plan and identified the importance of addressing the socio-economic implications of global change impacts.

The Science Day this year is part of the preparation for implementing the ACIA Plan, as well as promoting the

ACIA to the Arctic science community at large. The science focus will comprise of an open poster session one evening followed by a Joint Science Day devoted to keynote lectures and associated workshops on aspects of the impacts of global change. In addition there will be three special workshops: 1. Monitoring of Arctic marine fluxes, 2. Carbon cycling in terrestrial ecosystems, and 3. The compilation of geophysical data for the Arctic.

The following circumarctic organisations are at present taking part in the meetings:

Arctic Ocean Sciences Board (AOSB)
European Polar Board (EPB)
Forum of Arctic Operators (FARO)
International Arctic Science Committee (IASC)
Nansen Arctic Drilling (NAD)
Nordic Polar Meeting

For more information go to www.iasc.no/ASSW2000.htm

The 19th Arctic Ocean Sciences Board Meeting

**1 - 4 April 2000
Cambridge, U.K.**

For more information:
www.aosb.org/mtgs/XIX.html

news from the AOSB

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