SCOR AFFILIATED PROGRAM - International Antarctic Zone (IAnZone)

Report of Activities for Period Ending September 2001

26th General Meeting of SCOR
(Mar del Plata, Argentina)

Introduction

IAnZone originated in the early 1990s as a sequence of informal biennial meetings of Southern Ocean researchers, primarily physical oceanographers, who were interested in understanding the Southern Ocean and its role in climate change. IAnZone was accorded status as a SCOR Affiliated Program in early 1997. Its overall goal is to advance our understanding of climate relevant processes, their seasonal cycles and interannual and decadal variability, within the Southern Ocean's Antarctic Zone (that region poleward of the Antarctic Circumpolar Current). Ocean-atmosphere coupling in this region, and its links with the global ocean and climate system, are emphasized. It approaches this goal by: **(1)** providing a forum for exchange of ideas, plans, results and data; **(2)** identifying, developing and coordinating research projects consistent with the above goals; **(3)** providing coordination among Antarctic Zone and global climate programs, and among other Southern Ocean programs, and; **(4)** advising on the development of appropriate observing systems, datasets and modeling strategies needed to assess the scales and mechanisms of climate variability in the Antarctic Zone. IAnZone was conceived of, and remains, a "grass- root" effort wherein the working scientists involved with the various related studies provide the strategies for program development and exchange of information.

IanZone has had a fruitful past year under SCOR sponsorship. Major activities have included continued planning for an international program to study the processes by which water exits the Antarctic margins to ventilate the global ocean, and continued coordination of the international DOVETAIL program. (DOVETAIL stands for "Deep Ocean VEntilation Through Antarctic Intermediate Layers".) Additionally, iAnZone was represented at the Southern Ocean CLIVAR (Climate Variability and Predictability) meeting held in Perth, Australia in November 2000. A workshop on the equation of state for seawater, with an emphasis on thermobaricity, was held in Monterey, California in October 2000. The next biennial meeting of iAnZone is planned for October 2001 in Ischia, Italy and will follow directly after the Second International Conference on the Oceanography of the Ross Sea. IAnZone maintains a website, with links to other organizational sites, at http://www.ldeo.columbia.edu/physocean/ianzone.

Current Scientific Activities

The International DOVETAIL Program

DOVETAIL, the third and most recent in a sequence of research programs organized under iAnZone over the past decade, is an integrated field and modeling study that addresses the transport of newly formed deep waters from the Weddell Sea through the South Scotia Ridge region whence it contributes to ventilation of the global ocean. DOVETAIL participants have obtained field data annually, either from shipboard, from moored instruments, or both, since the

program start in 1996. Numerical modeling efforts are underway and are being integrated with the field results. Coordination with the WOCE, Southern Ocean GLOBEC and LTER programs, is undertaken on an informal basis. Ongoing activities include a multi-year shipboard program by Brazilian oceanographers, operating under the auspices of PROANTAR (Programa Antartico Brasileiro), a multi-year US moored instrument program to assess interannual variability in the northern Weddell Sea, and a number of modeling efforts. A collection of DOVETAIL papers is presently being prepared for publication in a special issue of *Deep-Sea Research II*. This collection is planned for final publication sometime during 2002.

DOVETAIL has evolved from an initial focussed study of physical processes in the South Scotia Ridge region into a long-term study of interannual variability. The possibility now exists that that we may obtain an unprecedented decade-long time series documenting interannual variability in the region and, in so doing, gain valuable new insight into the interactions among the Southern Ocean and global climate. IAnZone continues to provide international coordination and guidance for the DOVETAIL program. Additional information can be found on the web site at http://www.esr.org/dovetail.

Studies of The Antarctic Margins: Water Mass Conditioning and Escape of Modified Waters From the Shelf

A recognition of the importance of shelf and slope processes to the transport of shelf conditioned waters to the deep ocean has led, through discussion at both the 1997 and 1999 biennial meetings, to planning of a fourth international iAnZone project. This project seeks to define the roles of the Antarctic slope front and continental slope morphology in the exchanges of mass, heat and freshwater between the shelf and oceanic regimes, in particular, those leading to deep-reaching outflows of shelf water mixtures. This project proposes to focus on these issues primary through an integrated field and modeling effort in the Ross Sea, where the shelf/slope region remains relatively accessible throughout the year and where dense water is known to form. The Italian CLIMA program is already addressing some of these issues, and a complementary US program called AnSlope has been proposed. The German BRIOS-2 coupled ice-ocean modeling program provides a large-scale modeling capability to complement the proposed US ANSLOPE process-driven studies. These programs will build, also, on some results of J-GOFS work in the Ross Sea. A 1999 international planning workshop held at the Lamont Doherty Earth Observatory of Columbia University assessed our present understanding of Antarctic shelf-deep ocean exchange and structured an integrated observational and modeling research plan to help us develop an undestanding of exchange processes. Workshop reports and subsequent updates can be viewed at the iAnZone website.

Ocean Mixing, Convection, and Equation of State Issues

During austral winter 1994 a field effort studied ocean heat fluxes in the vicinity of Maud Rise, in the eastern Weddell Sea, under the auspices of the ANZFLUX (Antarctic Zone Fluxes) experiment. This was the second of three programs that have come to fruition, to date, under iAnZone auspices. The ANZFLUX program greatly increased our understanding of turbulence and mixing in a weakly stratified ocean and contributed to our knowledge of physical conditions in the eastern Weddell Sea. The results also raised significant issues concerning small-scale processes, such as cabelling and thermobaricity, that involve the equation of state for seawater. These issues were pursued at an international workshop held at the U.S. Naval Postgraduate

School in Monterey, California USA during October 2000, and proposal of a field-based study in the eastern Weddell Sea is planned for submission in the near future.

Southern Ocean Meteorological and Ice Studies: Need for an "Umbrella" Program

There has been concern going back at least as far as 1999 concerning the lack of a coordinated, overarching program for meteorological and sea ice observations in the Southern Ocean. The importance of a long multi-year time sequence of records suitable for assessing climate-related change remains a topic of discussion. Such activities would be encompassed, along with development of sea ice models, under the WCRP (World Climate Research Program) program titled CLIC (Climate and Cryosphere). IanZone fully supports CLIC. This support has been formally communicated to the appropriate WCRP representatives and is also being pursued through Southern Ocean CLIVAR. Finally, a workshop is planned to be held at the Lamont-Doherty Earth Observatory of Columbia University in early October 2001 to discuss and draft up a plan for formation of a US CLIVAR Southern Ocean Working Group. This group would list the foregoing topics among its primary interests.

Methodology and Instrumentation Development

There is ongoing iAnZone interest in the continued development of methods and instruments suitable for use in ice-covered waters. Lagrangian drifters that have been used to good effect elsewhere are not suitable for under-ice use. The same is true for the SeaGliders presently under development, although there are plans to design a version suitable for use under an ice cover. The lack of reliable, consistently recorded ice data remains a concern. These issues are being pursued individually by various researchers, with progress being communicated via email to other iAnZone participants. One area in which development has proceeded apace has been that of AUVs (Autonomous Underwater Vehicles) that can access regions covered by ice shelves and perennial sea ice. Such a system is being tested under the auspices of a UK NERC (Natural Environment Research Council) five-year program. Though funding will be available only to UK scientists, possibilities exist for collaboration. Information on this initiative can be viewed on the web at http://www.nerc.ac.uk/ms/Autosub/index.htm.

Administrative Issues

Membership and Regional Representation

The current membership of iAnZone is given, along with nationality, in Table I.

Table 1:

N. Bindoff (Australia)	***E. Fahrbach*** (Germany) - *ex officio*
M. Garcia (Spain)	***C. Garcia*** (Brazil)
A. Gordon (USA) - *ex officio*	***H. Hellmer*** (Germany) - **co-Chair**
K. Heywood (UK)	***A. Klepikov*** (Russia)
J. Launiainen (Finland)	***R. Muench*** (USA) - **co-Chair**
A. Piola (Argentina)	***P. Schlosser*** (USA)
G. Spezie (Italy)	***M. Wakatsuchi*** (Japan)

Of this group, E. Fahrbach and A. Gordon are past co-Chairs and will retain *ex officio* membership until the October 2001 biennial meeting in order to retain a "corporate memory". H. Hellmer and R. Muench will remain co-Chairs until that time and will then retain *ex officio* membership for two years following. In accordance with SCOR guidelines and consistent with the international nature of the group, it is intended that this membership represent as global a group of researchers as feasible. Evolution of the membership is accomplished through member rotation. Ideally, this would have taken place at the May 1999 biennial meeting. However, attendance at this meeting was quite small because of field commitments and minor medical difficulties, and it was decided to delay member rotations until the October 2001 meeting. At that time, 3-4 members will be rotated out of the group and replaced by new members voted in by the current membership. It is planned that a slate of suitable and willing new members be made available prior to the meeting. New chair(s) are selected from, and voted upon by, the current membership.

Active participation in a program of Antarctic ocean research is a primary prerequisite for membership in iAnZone. A second important criteria for membership is the demonstrated capability to contribute actively within an organization that is driven by its members, meets only once every two years, and within which much of the activity takes place via email and at smaller workshops. Members must be able to raise their own funds for travel and lodging costs associated with attending iAnZone biennial meetings, because iAnZone has no provision for paying member travel costs. The biennial meetings are held, as feasible, in conjunction with major international colloquia in order to facilitate member acquisition of travel funds.

Ongoing Coordination with Other International Programs

IAnZone maintains coordination with the ASPeCt (Antarctic Sea Ice Processes and Climate) program, which was represented at the May 1999 biennial meeting. IAnZone was represented at the Southern Ocean CLIVAR conference in Perth, Australia in November 2000, and discussion with CLIVAR members has been ongoing nearly since the inception of CLIVAR. Coordination with the now-underway Southern Ocean GLOBEC program will take place at the level of individual working scientists, particularly as GLOBEC results may be combined at some point with results of the long-term field work in the DOVETAIL region. Efforts continue to establish a relationship with SCAR, which has focussed primarily upon sea ice, rather than subsurface, aspects of the Southern Ocean. Finally, the planned October 2001 workshop at Columbia University will investigate formation of US CLIVAR Southern Ocean Working Group.

Meeting Structure

The most recent iAnZone biennial Meeting was held in Mar del Plata, Argentina at the Servicio de Hidrografia Naval during May 1999 and comprised the primary iAnZone activity for the biennium. This meeting was reported in the Year 2000 iAnZone annual report to SCOR.

The iAnZone biennial meetings have become venues for presentation of research results from all parts of the Antarctic Zone of the Southern Ocean. These results are new and significant, and concern was voiced at the May 1999 meeting that sufficient time be allotted for presentation and discussion. Given that discussion of new and ongoing research can form a core about which coordination and integration then take place, future meetings will attempt to allow more time than in the past for presentation and discussion of new scientific results. A draft agenda for the scheduled October 2001 biennial meeting is appended to this report.

The Next biennial Meeting

The next iAnZone biennial meeting, its second since becoming a SCOR-Affiliated Program, will take place directly following the 2nd International Conference on the Oceanography of the Ross Sea, scheduled on 8-13 October 2001 in Ischia - Naples, Italy. Information concerning the Ross Sea conference is available on the web at http://antartide.uninav.it or by email at Ross-Sea@nava3.uninav.it. Information on the iAnZone meeting is posted on the iAnZone website. Both meetings will take place in the same venue and will use the same lodging facilities. It is hoped that this association with a major international Southern Ocean conference will help to ensure a healthy attendance at the iAnZone meeting. Further, new materials presented for the Ross Sea are of direct interest to the planned AnSlope program in the Ross Sea, and significant participation of iAnZone members in the Ross Sea Symposium is anticipated.