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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

SUMMARY REPORT ON A JCOMM/GOOS POLAR REGION STRATEGY
Geneva, 6-8 December 1999

Until the formation of JCOMM, Arctic operational observations and services have been dealt with by one of the specialist groups of the WMO's Commission for Marine Meteorology (CMM). With the creation of JCOMM, the activities of this group needed to be expanded to take into consideration ocean requirements. One of the concerns raised at the Initial JCOMM-TRANS meeting in St. Petersburg, Russia, in July 1999, was that the mechanisms for making operational observations and providing operational services were inadequate in all polar regions. Because there is much in common in terms of observations and kinds of services between the Arctic and other ice-covered seas, the JCOMM-TRANS group considered that the most efficient and effective way forward would be to develop a mechanism to address operational marine meteorological and oceanographic requirements in all ice-covered sea areas, including both the Arctic and the Southern Ocean around Antarctica. To consider the way forward, the JCOMM-TRANS group organised a meeting of polar experts, who met in Geneva, December 6-8, 1999. The group of experts recommended replacement of the initial CMM Arctic group by a joint WMO/IOC JCOMM Working Group on Polar Seas and Other Sea Ice Regions (POSSIR). Creation of this group would make redundant the considerations of the IOC Southern Ocean Committee on operational activities (like those carried out through GOOS). Those considerations have not been carried out in conjunction with experts from WMO, and are not connected to considerations of other sea-ice regions. This raises the question of the future focus of the IOC Southern Ocean Committee, which (given the development of POSSIR) may in future be more usefully directed towards the co-ordination of research rather than operational activities.

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

MEETING OF EXPERTS ON A JCOMM/GOOS POLAR REGION STRATEGY

Geneva, Switzerland, 6-8 December 1999

FINAL REPORT

GENERAL SUMMARY OF THE WORK OF THE MEETING

1. OPENING

1.1 Opening of the meeting

1.1.1 The WMO/IOC Meeting of Experts on a Polar Region Strategy for JCOMM and GOOS opened at 0930 hours on Monday, 6 December 1999, in the 7th floor conference room (lake side) of the WMO headquarters building, Geneva. The Director of the World Weather Watch Department of the WMO Secretariat introduced the Secretary-General of WMO, Professor G.O.P. Obasi.

1.1.2 Professor Obasi welcomed participants to the meeting, and to the new WMO headquarters building, on behalf of both WMO and IOC. In doing so, he noted that WMO had a long and on-going concern for both polar regions, encompassing observing networks, operational services and, more recently research into the role of polar regions and the cryosphere in the global climate system. These activities and concerns had been coordinated at the international level by a substantial number of different WMO, or joint WMO and IOC, bodies. The advent of JCOMM and GOOS, however, provided both an opportunity and an incentive to adopt a more strategic approach to enhanced coordination and integration of observing systems, data management and services in polar regions. The objective of the present meeting was therefore to develop concrete proposals to both JCOMM and GOOS, based on a thorough review of existing activities, for such enhanced coordination and integration of polar region activities, including appropriate institutional arrangements. Professor Obasi concluded by wishing participants a successful meeting and enjoyable stay in Geneva, and assured them of the on-going support of the WMO Secretariat in their work.

1.1.3 The list or participants in the meeting is given in *Annex I.*

1.2 Election of the chairman

1.2.1 Dr Albert Tolkatchev (Russian Federation) was elected chairman for the duration of the meeting.

1.3 Adoption of the agenda

1.3.1 The agenda adopted for the meeting is given in *Annex II.* A list of acronyms is in *Annex VI.*

1.4 Working arrangements

1.4.1 Participants agreed working hours and other necessary arrangements for the meeting. The documentation was introduced by the Secretariats.

2. REVIEW OF EXISTING POLAR REGION OBSERVING SYSTEMS

2.1 The meeting noted that existing polar region ocean observing systems include surface drifters, ships (providing surface, upper air and sub-surface data), sea level measurement networks and remote sensing systems (ground, aircraft and satellite based). These are largely operated nationally, but in many cases coordinated internationally by a number of different groups (IABP, IPAB, GLOSS, WCRP, space agencies, etc.). The meeting therefore reviewed the status of these systems, on the basis of reports from groups and countries concerned, with a view to making recommendations on enhanced implementation and coordination. The following paragraphs contain references to the different activities which were presented, together with any action items arising. It was agreed that the full reports should be published separately in a special JCOMM Technical Report. *Annex III* to this

meeting report contains lists of web site addresses where further information on the various polar region programmes and activities may be found.

2.2 The meeting first was presented with a global overview of the status of a number of existing **in situ** ocean observing networks, including drifting and moored buoys; the WMO Voluntary Observing Ships (VOS, surface meteorology and oceanography); the Automated Shipboard Aerological Programme (ASAP); and the Ship of Opportunity Programme (SOOP, upper ocean temperature and salinity). It recognized that these networks, which would in the future be coordinated under JCOMM, and which formed part of the GOOS Initial Observing System, were already providing some valuable polar region meteorological and oceanographic data, and that they had the potential to contribute substantially towards satisfying user requirements for a number of important variables. In this context, it noted with interest the diagnostic analyses produced by Météo France showing the status of these networks in comparison to the World Weather Watch requirements for specific variables (pressure, air temperature, SST, wind). The meeting agreed that such analyses constituted valuable management tools, and that consideration should therefore be given to a possible extension of their scope to include other variables relevant to polar regions, as well as other requirements. The Secretariats were requested to follow this question, both with Météo France and also other major operational meteorological centres.

2.3 The meeting was informed on activities carried out by WMO Members - Parties to the Antarctic Treaty - in Antarctica. It noted that the Executive Council Working Group on Antarctic Meteorology had responsibility for promotion and coordination of the operations of the basic elements of the World Weather Watch and for collaboration with other international organizations related to the Antarctic. The meeting learnt that major activities of WMO were concentrated on the implementation of the Antarctic Basic Synoptic Network (ABSN), the collection of data at several Antarctic centres and timely transmission of data via GTS. In addition to that, there are several ground-based satellite receiving stations in Antarctica that provide satellite data and products in support to meteorological services of the Antarctic operations and research. The meeting also noted that some of the ABSN stations were included in the GCOS Upper Air and Surface Networks to provide long time series data for climate monitoring and climate research.

2.4 The meeting noted that ice services have been provided for many years now for the Baltic Sea and parts of the North Sea regions by government agencies in countries bordering the Baltic Sea and in the Netherlands. Ice observations are made and exchanged daily via the GTS in a special Baltic Sea Ice code and in plain language. Telefax and email are also used for the exchange of data, information and ice charts. All ice information activities are coordinated and harmonized through regular Baltic Sea Ice Meetings, which assemble representatives of governmental ice services and icebreaker services. Close bilateral cooperation also helps to improve services for the public.

2.5 The meeting noted that GLOSS has a well-developed strategy to meet clearly identified scientific requirements for sea-level observations which are documented in the GLOSS Implementation Plan (GLOSS, 1997). In this document there is no specific focus on polar regions and no particular requests concerning these areas are specified. However, recognizing the importance of the Arctic for the GLOSS objectives and taking into account that the use of satellite altimetry over the Arctic Ocean is limited, in 1995 the GLOSS Group of Experts requested a report on the status of the Arctic tide gauges. This report is available now. Moreover, GLOSS has focused on the technical problem of operating tide gauges in an arctic environment in several working group meetings on observing sea level in "hostile" regions.

2.6 To a large extent, the implementation of GLOSS is being based on existing tide gauges operated by national authorities which are committed to GLOSS. It is important to note here that almost all tide gauges are operated for primarily non-scientific purposes such as coastal protection, navigation, water laws, water resource management, hydrology and hydrography, and geodetic datum

control. Therefore, long-term operation is often affected by changes in these non-scientific requirements. In most geographical areas, the implementation of the GLOSS tide gauge network is satisfactory, while the geodetic control of tide gauges in many cases is just starting to be implemented. However, in many areas of the polar regions, a decline of the tide gauge network in general as well as at GLOSS sites is taking place. Operational tide gauges on Antarctica are few, thus sampling the coasts insufficiently. In large parts of the Arctic, no tide gauge data are available, due to either a lack of operational tide gauges or restrictions in data exchange.

2.7 The meeting noted with interest that an Arctic Task Team had been established under EuroGOOS. The main objective of this task team is to develop operational monitoring and forecasting of the European sector of the Arctic Ocean and adjacent seas. The methodology is to use coupled ice ocean models which use data from satellites and from available **in situ** platforms. For ice monitoring, various satellite data (e.g. passive microwave, synthetic aperture radar) are used, both in near real time for daily observations, as well as for long term climate monitoring. The ice observations are obtained on two scales: (i) large scale, covering the whole Arctic Ocean with relatively coarse resolution (~ 30 km); and (ii) regional scale at high resolution (better than 1 km), including the marginal ice zone where the ice conditions change more extensively than in the interior of the ice pack. The sea ice parameters include ice area, concentration, ice type classification and ice motion, all of which are important for sea transportation, ice navigation and offshore activities. The satellite data and forecasting models will also focus on environmental monitoring of water quality, chlorophyll and transport of pollutants by currents and ice. The EuroGOOS Arctic activities aim to serve the needs of industry, fisheries, and climate research, and provide environmental data and prediction for governmental institutions.

2.8 The meeting noted with interest a summary report on Argentine activities in Antarctic seas relating to sea ice and oceanographic observations. The information presented included operational coastal and shipboard observations of sea ice and sea level, with data being contributed to the National Ice Center (USA), National Snow and Ice Data Center (USA), Arctic and Antarctic Research Institute (Russian Federation) and GLOSS. The meeting further noted a complementary presentation from the WMO Secretariat covering operational meteorology, climate research and communications facilities of the Argentina National Meteorological Service (SMN). Other Argentine institutions involved in Antarctic sea ice and oceanographic activities include the Argentine Antarctic Institute, the Argentine Navy Hydrographic Service and the National Oceanographic Data Center.

2.9 The meeting noted with interest a summary of observing systems and data management in the polar regions of Canada under three broad headings: cryospheric; oceanographic; and meteorological. This summary considered the activities of the Departments of Environment and of Fisheries and Oceans, and drew heavily from the April 1999 "Plan for Canadian Participation in the Global Climate Observing System", prepared for the Climate Research Board of the Atmospheric Environment Service. Of note is the general decrease in the number of long term polar region **in situ** monitoring sites in favour of research project-specific data collection. On the other hand, satellite observing systems have greatly increased the amount of data available for certain variables, particularly sea ice extent (Radarsat and SSM/I).

2.10 The meeting noted with interest a review of polar GOOS-oriented activity in the Russian Federation. In particular, recently the Russian National Oceanographic Committee proposed and advised the Arctic and Antarctic Research Institute to be the coordinator of the future national Polar GOOS. As a first step, AARI will prepare a concept and subsequently a programme describing the scope of Russian activities in Polar GOOS that should be provisionally adopted by the appropriate authorities. Also, a special department covering topics of operational oceanography and providing support to GOOS may be organized at the AARI.

2.11 The next part of the report briefly described a) the past and the present state of the meteorological polar station network in the Russian Arctic, pointing out that it is now under a process of decline, though this is mainly for the least important stations; b) the system of marine meteorological data streams, starting at the coastal stations and leading to the operational sea ice data processing centre at the AARI; and c) the scope of operational analysis and forecast output products compiled at AARI, including sea ice charts of different complexity and different scale, meteorological charts and others. Some operational sea-ice products for the Arctic region are now available at the AARI web site.

2.12 With regard to activities carried out by the IOC in the Southern Ocean, the meeting was informed of the results of the first Southern Ocean Forum followed by the sixth session of the IOC Regional Committee for the Southern Ocean (IOC/SOC) held in September 1996 in Bremerhaven, Germany. It noted that, following the session recommendation, the IOC Executive Council at its twenty-ninth session decided to revise the terms of reference of IOC/SOC in order to promote plans for a comprehensive study of the Southern Ocean, within the context of the global scientific issues, and to coordinate the development of joint ocean research and systematic ocean observations in the Southern Ocean, in particular within the framework of WCRP, GOOS and GCOS. In this context, the meeting noted that a Southern Ocean Workshop was planned to be held in 2001, sponsored by WMO and IOC.

2.13 The meeting noted with interest a presentation on polar region activities under the World Climate Research Programme (WCRP), specifically the Arctic Climate System Study (ACSYS) and the planned Climate and Cryosphere (CLIC) project. This presentation covered **in situ** observing systems established and operating in support of these projects and other polar region activities (including the International Arctic Buoy Programme (IABP), and the International Programme for Antarctic Buoys (IPAB), both of which are also Action Groups of the DBCP; Arctic and Antarctic sea ice thickness projects); various data management activities and databases maintained under the projects; and detailed requirements for meteorological, oceanographic and sea ice data to support the projects. The meeting recognized the value of these observing networks and data management activities also to the future operational polar region activities under JCOMM, and at the same time agreed that the WCRP data requirements should be addressed, to the extent possible, as part of the proposed JCOMM polar region strategy.

2.14 From the discussions which followed these presentations, the meeting noted in particular the following points and specific actions:

(i) A serious decline in recent years in some countries in observing networks covering a large part of the in polar regions, coupled with the known difficulties in obtaining national commitments to long-term monitoring;

(ii) In response, the meeting proposed that WMO and IOC should jointly write to relevant national authorities in polar region countries, through a JCOMM letter, to draw attention to these problems and their consequences;

(iii) The meeting further proposed that JCOMM, through GCOS, should bring the situation to the attention of the Conference of the Parties (COP) to the Framework Convention on Climate Change (FCCC), in the context of the expressed concern of COP for enhanced climate monitoring.

(iv) Particular commitments to Argo for float deployments in the Southern Ocean are required.

3. REVIEW OF EXISTING DATA MANAGEMENT ARRANGEMENTS

3.1 The meeting recognized that observational data, analyses and historical information from polar regions are managed and archived through a variety of existing mechanisms including the World Data Centres, GDSIDB (sea ice), MEDS (drifters), GTSPP (sub-surface temperature and salinity), PSMSL (sea level), WWW (meteorology), and some centres established under the WCRP. It therefore reviewed some of these mechanisms, based on reports from management groups and the Secretariats. Information on relevant web sites is given in *Annex III*, and the detailed reports are presented in the JCOMM Technical Report noted above in paragraph 2.1. Brief summaries of the contents of the reports are contained in the following paragraphs, together with any actions arising from the discussions.

3.2 The meeting was informed that the IOC Committee on International Data and Information Exchange (IODE) coordinates and promotes the exchange and archival of oceanographic data from the whole world ocean, except the Arctic Ocean. Within the IODE scheme, two Responsible National Oceanographic Data Centres (RNODCs) were established, one in Argentina for the Southern Ocean and the other in Australia for GLOSS Southern Ocean Sea Level Data.

3.3 The meeting noted with interest the report of the RNODC for drifting buoys, operated by the Marine Environmental Data Service (MEDS), Canada. At the end of 1998, the drifting buoy database contained 14,151,318 messages, an increase of 13.3% over last year's total. MEDS has developed a web site page on the RNODC activities. Regional and global monthly maps are available for the different DBCP action groups, including both the IABP and the IPAB. A database of buoy QC messages has been built and can be searched on the web by the users.

3.4 The meeting noted that tide gauge data from GLOSS stations are archived in long-term data centres (international centres) such as the PSMSL or the Southern Ocean Sea Level Center. In some cases, project or programme-related data centres are established. GPS data necessary to achieve the required accuracy are still under discussion. Most likely, a global analysis utilizing an internal reference frame will be required. For that, the establishment of a dedicated analysis centre of the International GPS Service (IGS) has been proposed.

3.5 With regard to data exchange, GLOSS requires that all committed tide gauges sites deliver monthly means plus sufficient metadata to an International Centre. In addition, the raw data from GLOSS tide gauges has to be made freely available either to an International Centre or via a ftp/www site. Making the raw data available allows for independent quality checks of the particular site, gives access to high frequency data (for example, required for storm surge statistics), and enables building up long-term archives of the raw data. Free data exchange of particular high frequency data is currently blocked due to economic reasons and for national security reasons. However, free access to high frequency data has helped to discover analysis problems through independent checks. The GLOSS International Centres give free access for all users to all data and the Centres are linked to each other. The applications of GLOSS basically are to provide quality-controlled databases of tide gauge data with the main focus on scientific users. Taking into account the fact that tide gauges are most often operated for non-scientific reasons, the COST Action 40 "European Sea Level Observing System" (EOSS) has proposed the establishment of a "European Sea Level Service" (ESLS). The draft of the Terms of Reference of the ESLS state that "the primary objective of the European Sea Level Service (ESLS) is to provide sea-level and sea-level related information for the European waters to scientific and non-scientific users both from inside and outside Europe. The primary task of the ESLS is to guarantee the quality, ensure a sufficient quantity and improve the accessibility to sea-level information." The GLOSS Group of Experts supports this initiative among other reasons as a test case for the regional implementation of GLOSS.

3.6 The meeting was informed of the existing arrangements and procedures concerning the transmission and global exchange of observational data and products through the GTS within the WWW, that were applicable for the Arctic region. It noted that the EC Working Group on Antarctic Meteorology had developed special telecommunication arrangements for transmission of Antarctic data and products inside and outside Antarctica and felt that these arrangements may also be used for an exchange of oceanographic data and products from the Southern Ocean.

3.7 The meeting noted with interest progress achieved within the GDSIDB project. The Steering Group of the project incorporates representatives from 11 ice services or data centres and works in close cooperation with the JCOMM (former CMM) Subgroup on Sea Ice. Co-chairs of the project are the AARI Director, Dr Ivan Frolov, and Director of the WDC-A on Glaciology – US National Snow and Ice Data Center, Professor Roger Barry. Starting from 1989 the project held 7 sessions of the Steering Group (the next 8th is planned for May 2000 in Ottawa). The project has proved to be a particularly successful one, now incorporating digital sea ice mapped material for both the Arctic and Antarctic regions, the Baltic Sea and the Sea of Okhotsk, from 6 ice services or organizations (Argentina, BSIM, Canada, Japan, Russia, USA).

3.8 The project archive is managed cooperatively by the AARI and NSIDC, both centres using the same SIGRID and SIGRID-2 formats for data archival. Existing prime material for the Arctic in SIGRID format with approximately 15 geographical minutes spatial resolution covers the period from March 1950 up to December 1994 (with a number of temporal and spatial gaps) and for subregions (Canadian Arctic and the Sea of Okhotsk) up to the winter of 1998. Prime material for the Antarctic in the same SIGRID format now covers the period from January 1973 up to December 1994. Specialists and experts involved in the project are carrying out constant work (mainly extra-mural) on data QC, improving of syntax etc. Anticipated for the near future are contributions which will include AARI data for the Antarctic (for 1971 – 1990), data from the Danish Meteorological Institute (possibly covering the period from late 19th century), higher resolution data for the Canadian Arctic from the Canadian Ice Service (CIS), data for the Baltic Sea from the Federal Maritime and Hydrographic Agency of Germany, etc.

3.9 The meeting further noted a set of statistical parameters assessed on the basis of GDSIDB data including estimation of linear trends of sea ice cover extent. The conclusion could be drawn that the problem of the recently discovered decrease of Arctic ice may be more complicated. The level and even the sign of the trend is not uniform for specific Arctic sub-regions and, importantly, dependant on the time period of the trend calculation.

3.10 In order to facilitate access of users to GDSIDB information, a set of www-pages was constructed at AARI and NSIDC and in October 1999 also mirrored at DMI. The users can use the following URLs:

http://www.aari.nw.ru/gdsidb/content.html (www-site at AARI)
http://www.dmi.dk/pub/GDSIDB_mirror/content.html (mirror at DMI)
http://www-nsidc.colorado.edu (NSIDC).

In conclusion, the meeting noted with interest an introduction to the Joint Russian-USA Arctic Sea Ice Atlas on CD-ROM. The Atlas is developed within the intergovernmental Russian-USA commission, it will be completed in the first part of 2000 and distributed free of charge by the WDCs. The Atlas is based on the ideas and initial material of the GDSIDB project, and it may be said that the creation of the Atlas became possible largely thanks to the efforts of the GDSIDB experts and specialists. The meeting further noted the availability of the Joint US-Russian Atlas of the Arctic Ocean, Oceanography Atlases for the Winter and Summer Periods, 1997/98.

4. DATA REQUIREMENTS IN POLAR REGIONS FOR OPERATIONAL SERVICES, CLIMATE PREDICTION, CLIMATE AND OTHER RESEARCH

4.1 The meeting recognized that observational data and analyses from polar regions are required in support of operational meteorology and services, ice services, oceanographic services, global climate prediction and research and other polar region research. It therefore carefully reviewed these requirements, based on summary documentation provided by the Secretariats, in particular in the context of adopting an overall coordinated strategy for addressing them, within both JCOMM and GOOS. Brief summaries of the contents of these presentations are given in the following paragraphs, together with any specific actions arising from the discussions. Relevant web sites are recorded in *Annex III*, while the full reports are published in the JCOMM Technical Report.

4.2 Requirements for seasonal to interannual climate prediction have been developed by the Ocean Observations Panel for Climate (OOPC), and are now published in the Implementation Action Plan for GOOS/GCOS. The implementation of these requirements is a major component of the overall JCOMM work plan. The detailed requirements include, **inter alia**, meteorological, oceanographic and sea ice variables from polar oceans. The meeting noted these requirements with interest, at the same time recognizing that they were under continuous review by the OOPC, with specific input coming from specialist groups such as GLOSS. At the same time, it agreed that there was a need for OOPC to further refine and clarify the requirements relating to polar oceans. A specific recommendation in this regard is given in *Annex IV*. A related recommendation concerning the need to enhance **in situ** sea level observations in polar regions, in view of the limited value there of satellite altimetry, is also given in *Annex IV*.

4.3 World Weather Watch requirements for meteorological, oceanographic and sea ice data from the oceans are contained in a comprehensive requirements WMO-CEOS database maintained by the WMO Secretariat. The meeting noted the value of this database, which also covered requirements for global climate studies and a number of related applications. It further noted that the database was being continuously updated through a Rolling Requirements Review process undertaken by the WMO Commission for Basic Systems (CBS). At the recent planning meeting for JCOMM, it had been agreed that JCOMM would also participate in this process, which would thus also cover data requirements in polar regions, including sea ice. The meeting welcomed this information and urged JCOMM to seek appropriate advice from polar region experts and bodies in developing its input to the process.

4.4 The meeting noted the extensive requirements for remotely sensed polar region and sea ice data to support the WCRP, including ACSYS and CLIC. These requirements have also been included in the WMO requirements database, and JCOMM was therefore urged to address these also when implementing and managing ocean observing systems in support of global climate studies generally.

4.5 The meeting clearly recognized that requirements existed for polar region and sea ice data for many applications other than climate and operational meteorology. These included data to support services for activities such as transport and ice navigation, offshore industry, environment protection, conservation of living marine resources, etc. Details of such requirements already exist in many national agencies or were being developed in the context of GOOS modules other than the climate module. The meeting therefore formulated recommendations related to the compilation and updating of such requirements, directed variously to JCOMM and GOOS, which are also recorded in *Annex IV*.

5. INSTITUTIONAL ARRANGEMENTS

5.1 The meeting noted that it was expected to make recommendations to both JCOMM and GOOS on appropriate institutional arrangements for addressing, in an integrated way, the international coordination and management of polar region observing systems and data management to meet

specified requirements. Such arrangements may include, **inter alia**, a JCOMM working group, and a GOOS Polar Region Panel. As an introduction to this item, it therefore first reviewed briefly the status of JCOMM, including work towards the development of its structure and overall work programme.

5.2 The new Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) was established by WMO Congress and the IOC Assembly as the reporting and coordination mechanism for all operational marine bodies and activities of the two organizations. It is also now the primary implementation mechanism for GOOS and the ocean component of GCOS. A first transition planning meeting for JCOMM took place in St Petersburg in July 1999.

5.3 The meeting agreed that JCOMM represented a very significant and potentially far reaching step on the road to truly operational oceanography, in the same sense as operational meteorology. JCOMM now provides a mechanism for the international implementation, coordination and management of operational oceanography, as well as an implementation mechanism for global physical ocean observations for GOOS and GCOS, and a mechanism for enhancing integration of operational ocean observing systems, data management and services. It can also, importantly, serve as a way of raising the profile of operational oceanography and ocean observing systems, both within national Meteorological Services and related agencies, and with governments in general. JCOMM could, additionally, be used nationally and internationally as a mechanism for governments to fulfill their agreed international obligations under the Framework Convention on Climate Change (FCCC) to enhance climate monitoring networks.

5.4 In this context, the meeting agreed on the importance of JCOMM having available a mechanism to review, coordinate and advise on appropriate matters relating to polar seas and other areas affected by sea ice. It therefore recommended that the Commission should establish a Working Group on Polar Seas and Other Sea Ice Regions (POSSIR), with terms of reference as detailed in *Annex IV*. The meeting noted the importance of this new working group coordinating and interacting closely with other bodies active in polar oceans and other sea ice areas. These included the Baltic Sea Ice Meeting, the International Ice Charting Working Group, relevant SCAR working groups, the Antarctic Treaty Consultative Meeting, the WMO Executive Council Working Group on Antarctic Meteorology, IODE and a range of other international committees and bodies.

5.5 The meeting further agreed that JCOMM and its new working group should have a particularly close relationship with GOOS and its various panels as already noted under previous agenda items. In addition, it recognized the potential value of a special Polar Region Panel under GOOS, to provide scientific and related advice on polar regions to both JCOMM and other GOOS panels. It recommended the establishment of such a panel to the GOOS Steering Committee, while at the same time cautioning that this panel may need to consider Arctic and Antarctic matters separately, for a number of scientific and political reasons. This recommendation, and a number of others which the meeting considered important and relevant to GOOS, are also given in *Annex IV*.

5.6 The meeting was informed about the recent meeting of the International Ice Charting Working Group (IICWG) and discussed the potential for duplication of effort. It was agreed that, since the IICWG is primarily concerned with coordination of operational activities between national ice services, the POSSIR has a valuable role to play in broader polar region issues and as a formal body to maintain international standards pertaining to sea ice.

5.7 Finally under this agenda item, the meeting recognized that the establishment of the JCOMM working group, together with the possible GOOS panel, largely superceded much of the responsibilities and potential work of the IOC Regional Committee for the Southern Ocean. In view also of the decision of the IOC Assembly that JCOMM should assume responsibilities for all aspects of operational oceanography within the IOC, the meeting therefore suggested to IOC that it should

review both the terms of reference and the role of SOC at an appropriate opportunity, with the objective of streamlining the institutional coordination and management of polar ocean programmes.

6. POLAR REGION STRATEGY FOR JCOMM AND GOOS

6.1 Based on preceding discussions and recommendations, the meeting agreed on the importance of developing an integrated Polar Region Strategy Document for JCOMM. Such a document would serve as primary guidance for the work of the JCOMM working group proposed above, and should also prove useful to GOOS (and in particular the proposed GOOS Polar Regional Panel) in developing its work related to polar regions.

6.2 The meeting therefore discussed in detail the contents of such a strategy document, with the table of contents as finally agreed being given in *Annex V*. The meeting further agreed the following procedures and timetable for completion of the document:

(i) The Secretariats were requested to identify and appoint, as soon as possible, an appropriately experienced consultant to coordinate the preparation of a first draft of the document. This consultant should seek input as necessary from participants in the present meeting, other polar region experts and GOOS advisory panel chairs, and should make the first draft available for review ideally by April 2000.

(ii) The main text of the document should not exceed around 30 pages in length, with additional detail to be included in annexes as necessary.

(iii) The draft should be circulated widely among research and operational polar ocean, sea-ice and other oceanographic experts for review, primarily by email, with the review and revision to be completed ideally in time for presentation of the document to the next session of the JCOMM Management Committee in mid-2000.

(iv) The document should eventually be published by WMO and IOC as a JCOMM Technical Report. It should also be reviewed and updated regularly by the new JCOMM working group (POSSIR).

7. CLOSURE

7.1 In closing the meeting, the chairman, Dr Tolkatchev, expressed his thanks to all participants for their valuable input, which had contributed significantly to the very positive outcome to the meeting. He also thanked the Secretariats for their support and assistance.

7.2 The Meeting of Experts on a JCOMM/GOOS Polar Region Strategy closed at 1200 hours on Wednesday, 8 December 1999.

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AGENDA

1. OPENING

1.1 Opening of the meeting
1.2 Election of the chairman
1.3 Adoption of the agenda
1.4 Working arrangements

2. REVIEW OF EXISTING POLAR REGION OBSERVING SYSTEMS

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4.2 Climate prediction, climate and other research

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5.2 GOOS

6. POLAR REGION STRATEGY FOR JCOMM AND GOOS

7. CLOSURE

LIST OF WEB SITE ADDRESSES

PROGRAMMES AND PROJECTS

Arctic Climate System Study (ACSYS): http://www.npolar.no/acsys/impplan/index.html

Arctic Sea-Ice Thickness Research Project (ASITP):
http://www.npolar.no/oelke/ice_n.html

Antarctic Sea-Ice Thickness Research Project (ANSITP):
http://www.awi-bremerhaven.de/Research/ansitp/index.html

Baltic Sea Ice Meeting (BSIM):

Danish Ice Service:
http://www.sok.dk/info/is/seneste.htm

Finnish Institute of Marine Research (FIMR): http://ice.fmi.fi/main_uk.html

Bundesamt für Seeschiffahrt und Hydrographie (BSH):
http://www.bsh.de/Oceanography/Ice/Ice.htm

Rijkswaterstaat (RIZA):
http://waterland.net/bericht/centrum/engels/index.html

Institute of Meteorology and Water Management (IMWM):
http://www.imgw.gdynia.pl

Swedish Meteorological and Hydrological Institute (SMHI):
http://www.smhi.se/sgn0104/sjofart/text.html#Ice service, ftp://ftp.smhi.se (ftp-server)

Global Sea-Level Observing System (GLOSS):
http://www.nbi.ac.uk/psms/gloss.info.html

International Arctic Buoy Programme(IABP):
http://IABP.apl.washington.edu

International Programme for Antarctic Buoys (IPAB):
http://www.antcr.utas.edu.au/antcrc/buoys/buoys.html

WCRP JSC/ACSYS) Task Group on Climate and Cryosphere (CLIC):
http://www.npolar.no/acsys/CLIC/clicindex.htm

WMO EC Working Group on Antarctic Meteorology:
http://www.wmo.ch/web/www/osy/antarctic.html

INSTITUTIONS AND SERVICES

AARI- Arctic and Antarctic Institute, St. Petersburg:
http://www.aari.nw.ru/

AMRC – Antarctic Meteorological Research Center: http://uwamrc.ssec.wisc.edu/amrc

ASF – Alaskan Synthetic Aperture Radar Facility:
http://www.asf.alaska.edu

CIS-Canadian Ice Service, Ottawa:
http://www.cis.ec.gc.ca/free/index.html

DCRS-Danish Center for Remote Sensing, Lyngby: http://www.dcrs.dto.dk/DCRS/latest-ice.html

DMI-Danish Meteorological Institute, Copenhagen:
http://www.dmi.dk/vejr/gron/index.html

FIMR-Finnish Institute of Marine Research, Helsinki: http://ice.fmi.fi/main_uk.html

FNMOC – Fleet Numerical Oceanographic Center, Monterrey, USA: http://metoc-ul.fnmoc.navy.mil/otis_nhem_ice.gif,
http://metoc-ul.fnmoc.navy.mil/otis_shem_ice.gif

FU – Freire Universität, Institut für Meteorologie, Berlin: ftp://130.1333.7.203/pub//SEA-ICE/icetext.html

IIP – International Ice Patrol, U.S. Coast Guard, Groton:
http://www.uscg.mil/lantarea/iip/home.html

MEDS – Marine Environmental Data Service, Canada:
http://www.meds-sdmm.dfo-mpo.gc.ca/Meds/RNODC

NGDC – National Geophysical Data Center:
http://www.ngdc.noaa.gov

NIC – National Ice Center, Washington, D.C.:
http://www.natice.noaa.gov/

NCDC – U.S. National Climatic Data Center (NCDC):
http://www.ncdc.noaa.gov

NCEP OMB – http://www.natice.noaa.gov/seaice/Welcome.html

NCRN – NOAA Coastwatch Regional Nodes:
http://coastwatch.noaa.gov

NNODC – NOAA National Oceanographic Data Center: http://www.nodc.noaa.gov

NNESDIS – NOAA National Environmental Satellite Data Service:
http://manati.wwb.noaa.gov/doc/oceanwinds.html

NSIDC – National Snow and Ice Center:
http://www-nsidc.colorado.edu/NSIDC/about.html

RADARSAT SAR – RADARSAT Synthetic Aperture Radar:
http://manati.wwb.noaa.gov/sar/alaska

RGPS – RADARSAT Geophysical Processing System:
http://www_radar.jpl.nasa.gov/rgps/radarsat.html

WDC-A – World Data Center A for Glaciology, Boulder, USA:
http://www-nsidc.colorado.edu

Icelandic Ice Service:
http://www.vedur.is/ur/hafis/enska/enska.html

Japanese Ice Service: http://www.jhd.go.jp/cue/KAN1/ice_center/ice_center.html

Poland Ice Service:
http://www.imgw.gdynia.pl/

NERSC:
http://fram.nrsc.no/Service/seaice.html

Sea ice advisory – Western Arctic – FZAK70 PANC:
http://asp 1.sbs.ohio-state.edu/text/wxascii/marine/FZAK70.PANC

Alaska Region – National Weather Service (NWS):
http://www.alaska.net/~nwsar

Beaufort Sea Ice Charts:
http:/www.alaska.net/~nwsar/html/ice/ice_marine.html

RECOMMENDATIONS OF THE MEETING

RECOMMENDATIONS TO GOOS

The meeting makes the following recommendations to GOOS and GOOS-related bodies.

1. OOPC

- Review, refine and more clearly specify polar region ocean data requirements for climate.
- In conjunction with GLOSS, consider the critical requirement for enhanced in situ sea level measurements in polar regions.

2. GSC

- Consider the requirements for a GOOS Polar Region Panel, possibly with separate treatment for Arctic and Antarctic regions.

3. GOSSP

- Seek advice on the future availability of satellite missions specifically covering polar regions – operational or research; continuity; variables; data availability.

4. Coastal and other panels

- Advise on data requirements other than climate from polar seas.
- Include polar regions in work and science plans.

5. EuroGOOS

- Undertake a survey of user requirements in European Arctic and Baltic Seas.
- Pass the results of this survey to the GSC and/or GOOS Polar Panel, for extension to other Arctic regions.
- Pass examples of operating practices from Baltic GOOS (BOOS) to the GSC and/or GOOS Polar Panel for extension to other Arctic regions.

6. Black Sea GOOS

- Survey user data and service requirements in ice covered waters in the Black Sea.

RECOMMENDATION TO JCOMM

The meeting recommends that JCOMM establish a JCOMM Working Group on Polar Seas and Other Sea Ice Regions (POSSIR)

The major task of POSSIR will be to promote and encourage the collection and exchange of marine meteorological, oceanographic and ice data and products in polar seas and other ice-covered seas, which are needed to support safe and efficient marine operations, to protect the environment and living marine resources, to understand the Earth's system and forecast its variability, and to assist with the development of the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS).

To meet this goal the following Terms of Reference are proposed:

1. To review and catalogue the products and services required by the user communities in polar and sea-ice areas;

2. To compile, catalogue and maintain a user requirements database for observational data for polar and ice services and products;

3. To review, coordinate and advise on observing systems to meet users needs in polar and sea-ice areas;

4. To review, coordinate and advise on data and information management (real-time, delayed-mode and historical) and exchange, recognizing in addition the need to:

    a. review and propose amendments to formats, nomenclatures and procedures for sea-ice data and information exchange;
    b. define terminology, coding and mapping standards for sea ice;
    c. provide support for the implementation and operation of the Global Digital Sea-Ice Data Bank (*1)

5. To recommend and promote appropriate quality control and data archiving mechanisms;

6. To encourage the application of numerical models;

7. To assist in building regional capacity through the development of guides, manuals and related documents, software exchange, specialized training and other appropriate means;

8. To develop and maintain linkages with relevant international governmental and non-governmental organizations and bodies.

*1 (Footnote): There may also be special requirements for marine meteorological or oceanographic data, but those will not be unique to polar and other sea-ice areas and so will be addressed by other JCOMM programme areas. Special requirements for sea-ice are identified here because this is the only JCOMM group that will deal with this topic.

JCOMM POLAR REGION STRATEGY DOCUMENT

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- BSIM
- IICWG
- ATCM
- CCAMLAR
- COMNAP
- IMO
- IHO
- AMAP etc

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LIST OF ACRONYMS AND OTHER ABBREVIATIONS

AARI	Arctic and Antarctic Research Institute (Russia)
ABSN	Antarctic Basic Synoptic Network (WMO)
ACSYS	Arctic Climate System Study (WCRP)
AMAP	Arctic Monitoring and Assessment Programme
AOSB	Arctic Ocean Sciences Board
ASAP	Automated Shipboard Aerological Programme (WMO)
ATCM	Antarctic Treaty Consultative Meeting
BOOS	Baltic GOOS
BSIM	Baltic Sea Ice Meeting
CBS	Commission for Basic Systems (WMO)
CCAMLAR	Commission for the Conservation of Antarctic Marine Living Resources
CEOS	Committee on Earth Observation Satellites
CIS	Canadian Ice Service
CLIC	Climate and Cryosphere project (WCRP)
CMM	Commission for Marine Meteorology (WMO)
COMNAP	Council of Managers of National Antarctic Programmes
COP	Conference of the Parties to FCCC
DBCP	Data Buoy Cooperation Panel (WMO/IOC)
DMI	Danish Meteorological Institute
EC	Executive Council
EGOS	European Group on Ocean Stations
EOSS	European Sea Level Observing System
ESLS	European Sea Level Service
FCCC	Framework Convention on Climate Change
GCOS	Global Climate Observing System
GLOSS	Global Sea-Level Observing System (IOC)
GOOS	Global Ocean Observing System
GOSSP	Global Observing Systems Space Panel
GPS	Global Positioning System
GSC	GOOS Steering Committee
GTS	Global Telecommunication System (WMO)
GTSPP	Global Temperature Salinity Profile Programme (IOC/WMO)
IABP	International Arctic Buoy Programme
IASC	International Arctic Science Committee
ICEX	Ice and Climate Experiment (NASA)
IGBP	International Geosphere-Biosphere Programme
IGS	International GPS Service
IHO	International Hydrographic Organization
IICWG	International Ice Charting Working Group
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Oceanographic Data and Information Exchange (IOC)
IPAB	International Programme for Antarctic Buoys
ISABP	International South Atlantic Buoy Programme
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology

LUT	Local User Terminal
MEDS	Marine Environmental Data Service (Canada)
NOAA	National Oceanographic and Atmospheric Administration (USA)
NSIDC	National Snow and Ice Center (USA)
OOPC	Ocean Observations Panel for Climate
POSSIR	Polar Seas and Other Sea Ice Regions (JCOMM Working Group)
PSMSL	Permanent Service for Mean Sea-Level
QC	Quality Control
RNODS	Responsible National Oceanographic Data Centre (of IODE)
SCAR	Scientific Committee on Antarctic Research (ICSU)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SIGRID	Format for the archival and exchange of sea-ice data in digital form
SMN	Argentina National Meteorological Service
SOC	Specialized Oceanographic Data Centre
SOOP	Ship-of-Opportunity Programme (IOC/WMO)
SST	Sea Surface Temperature
VOS	Voluntary Observing Ship (WMO)
WCRP	World Climate Research Programme
WMO	World Meteorological Organization
WMO-EC WG/AM	WMO-EC Working Group on Antarctic Meteorology
WWW	World Weather Watch (WMO)
XBT	Expendable Bathythermograph