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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY

MEETING OF EXPERTS ON A JCOMM/GOOS POLAR REGION STRATEGY

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STATUS REPORTS FROM EXISTING POLAR REGION OBSERVING SYSTEMS

JCOMM Technical Report No. 2

C O N T E N T S

POLAR REGION OBSERVING SYSTEMS REPORTS

DATA MANAGEMENT MECHANISMS REPORTS

RESEARCH PROGRAMMES

International Programme for Antarctic Buoys (IPAB)

The WCRP/International Programme for Antarctic Buoys (IPAB), an Action Group of DBCP, is a consortium of 18 agencies and institutions with interests in near-surface meteorology and oceanography in the Antarctic and Southern Ocean. It seeks to develop and maintain an observational network of drifter buoys and other appropriate data collection systems south of 55°S, a region within the maximum Antarctic seasonal sea-ice extent. The majority of IPAB buoy deployments are made to support specific research programs, rather than as part of operational networks, and much of this research is concerned with the movement of Antarctic sea ice. The drift and deformation of the ice, not just thermodynamic processes, determine the thickness and other characteristics of the ice cover which control air-sea interaction at high latitude. A number of specialised platforms and techniques are used by IPAB members to both suit the environment, and to provide high-resolution ice deformation data. Compilations of IPAB data have provided new insight to the pattern and variability of Antarctic sea-ice drift. Further applications of the IPAB data will be illustrated with results from a recently completed winter research cruise to the Mertz Glacier Polynya. This polynya, an area of open ocean on the Antarctic coast at 145°E, is an area of high sea ice production and export, and is believed to be an important source region for Antarctic Bottom Water.

GLOSS Polar Region Activities and Status of Sea-level Observations

GLOSS does not have a specific focus on the polar regions. The GLOSS Handbook (Version 4.0; February 1998; see http://www.nbi.ac.uk/psmsl/gloss.info.html) lists a total of 27 tide gauges located in the polar regions (10 on Antarctica, 17 at the coasts of the Arctic Ocean, Greenland or the northernmost part of the North Atlantic). However, the station map in the Handbook indicates only 5 and 7 of the Antarctic and Arctic stations, respectively, as fully operational while 4 and 6 of these sites are out of operation. Nevertheless, for the Arctic this picture appears to be too optimistic. A recent report (Plag, 1999; the manuscript will be distributed at the meeting) reveals that all Canadian Arctic tide gauges have been closed down and attempts to re-establish at least one or two of these gauges have not been successful yet. Recent meetings to define a Canadian GOOS indicated that there was little support for Arctic observations, in part because the international GOOS did not define an Arctic component. The U.S. operate 7 tide gauges north of 60 degrees N, of which only Prudhoe Bay is at the Arctic Ocean while all others are at the Pacific Coast of Alaska. The status of the Russian tide gauges is rapidly deteriorating and some of the Arctic gauges are broken or completely destroyed. Data available from some Russian gauges in international databases may be erroneous while for most gauges, the data is not available at all. On Greenland, seven tide gauges are currently operational and they are operated by two different Danish governmental organisations (RDANH and DMI). There is, however, a possibility that some of these tide gauges may be closed down or moved to other places in the near future. A more promising situation is found in Iceland, where, in addition to the old gauge in Reykjavik, 15 new tide gauges have been established from 1992 on more or less equidistant along the coast. Norway operates currently 23 tide gauges, of which 12 are located north of 66 degrees N including one on Svalbard and another one on Jan Mayen. In summary, it can be stated that in the Arctic the status of sea-level observation by tide gauges is degrading with time and only for two countries the present situation is acceptable with an optimistic perspective for the future.

An attempt has been made over the last two years to initiate a project to connect most of the Arctic tide gauges (at least the GLOSS gauges) by GPS and to set up at some tide gauges continues GPS stations. Such a project would require participation of the responsible organisations in the USA, Canada, Denmark, Norway, Russia, and, possibly, Iceland. However, up to now no constructive dialog between all potential partners could be established. A more integrated observing strategy for the polar regions and particularly the Arctic would be very helpful in stimulating such a project.

At the sixth meeting of the GLOSS Group of Experts in Toulouse, May 1999, the following recommendation concerning the Arctic was accepted, reflecting both the present situation and the need for a better coordination:

Realizing the importance of the Arctic Ocean for studies of climate variability and the early detection of climate change, and taking into account that the presently available satellite altimetry observations do not cover the Arctic ocean sufficiently, the GLOSS group of experts:

- *recommends that in each country bordering the Arctic Ocean efforts are made to maintain a network of tide gauges conforming to GLOSS standards;*
- *in particular, strongly recommends that the Canadian GLOSS tide gauges are re-established;*
- *urges the international funding agencies to support projects that will help to reverse the current downward trend in the maintenance of Russian Arctic tide gauges;*
- *urges Denmark to secure the long-term operation of the GLOSS tide gauges in Greenland;*
- *urges Norway to establish and operate tide gauges corresponding to GLOSS standards on Jan Mayen and Bjornoya;*
- *recommends that international support is given for the continued operation and maintenance of the tide gauge in Barentsburg;*
- *recommends that efforts are made to co-locate an approximately equidistant subset of the Arctic tide gauges with space-geodetic techniques (GPS) and to carry out absolute gravity measurements at these gauges.*

Reference:

Plag, H.-P., 1999 (ed.): Arctic tide gauges: a status report. Manuscript in preparation. To be published as IOC report.

GLOBAL STATUS CHARTS FOR VOS AND ASAP

DIAGNOSTIC STATUS ANALYSIS FOR SPECIFIC VARIABLES

WMO OBSERVING NETWORKS IN ANTARCTICA

Introduction

1. Antarctica is one of the two large regional sinks of heat in the world. The Southern Ocean is an area of intensive interaction between the ocean and the atmosphere, and accordingly it also plays a significant role in the formation of global weather and climate. The influence of Antarctica on the weather and climate of other parts of the Southern Hemisphere or globe has still to be quantified, but polar-region processes are turning out to be of crucial importance to human-induced global environmental changes.

2. The comprehensive long-term series of high-quality meteorological data obtained on land and at sea are needed for better understanding of the atmospheric processes and climate variations in Antarctica and their prediction. To meet the requirements for both meteorological services and research, including monitoring of climate change and environment, the WMO Antarctic activities concentrate on the promotion and co-ordination of meteorological programmes carried out in the Antarctic by nations and groups of nations and their interface with other WMO programmes in particular the World Weather Watch (WWW), the Global Atmosphere Watch (GAW) and the Global Climate Observing System (GCOS).

3. The Executive Council Working Group on Antarctic Meteorology was set up in 1964 to coordinate the implementation of the WWW basic components namely: Global Observing System (GOS), Global Telecommunication System (GTS) and the Global Data-processing System (GDPS) in the Antarctic and to collaborate with other international organizations and programmes in operational and research activities in Antarctica.

Land-surface and upper-air networks

4. As a part of the Global Observing System, the observing system in the Antarctic comprises almost all observing facilities on land, at sea, in the air and in outer space which form the GOS.

5. The Antarctic Basic Synoptic Network (ABSN) is an important element of the GOS.

The operation and maintenance of this network and the timely transmission of the observational data by means of the GTS are essential. Meteorological data are thus provided for global numerical weather analysis and prediction models as well as forming the data bank for climate research, including the monitoring of climate change and the environment.

6. The current basic synoptic network in the Antarctic comprises 31 staffed stations, including 13 upper-air stations and in addition 50 automatic weather stations (AWS). Most staffed stations are located on the coast at sites that can be reached by ships. The coast of West Antarctica from 180°E to 85°W does not have a single staffed station. Automatic weather stations located in various places inside Antarctica therefore provide an essential contribution to the maintenance of a meaningful meteorological network over the continent, and particularly over the interior ice sheet where only two staffed stations are located. AWS are maintained by the USA (University of Wisconsin) – 30 AWS, by the Australian Antarctic Division - 12 AWS and few by other countries. The AWS data are collected via the ARGOS Data Collection System on the NOAA polar-orbiting satellites and then they are inserted into the GTS.

7. The monitoring of the availability of real time observational data (SYNOP, TEMP, and CLIMAT messages) from Antarctic stations at Regional Telecommunications Hubs (RTHs) is an important function. For the purposes of monitoring WMO recommends the following cut off times for the counting of SYNOP reports 1, 3 and 12 hours, and for TEMP reports: 3 and 12 hours. The results of specific monitoring on the exchange of Antarctic data monitoring carried out from 1 to 15 February 1999 showed that maximum daily average (%) of SYNOP reports from Antarctica received at RTHs was 74% and maximum daily average of TEMP reports received was 71%. The percentage of SYNOP reports received from staffed and automatic weather stations comprising the Antarctic Basic Synoptic Network for the main standard times (00, 06, 12 & 18 UTC) was between 50% and 100% for 62 of 75 stations. The percentage of TEMP reports received from upper-air stations included in the ABSN for the main standard times (0 & 12 UTC) was between 50% and 100% for 11 of 13 stations. In considering these results, the Thirteenth WMO Congress (May, 1999) noted that despite the difficult conditions and problems of logistics, the ABSN was well implemented and the number of reports received at RTHs was higher than the global average (72% for SYNOP and 59% for TEMP reports). It also noted with satisfaction that OMEGA-based equipment had been replaced by GPS-based equipment at all six upper-air stations concerned resulting in

little loss of upper-wind data from the region due to the closure on 30 September 1997 of the OMEGA radionavigation system on which 25% of the global upper-air network was dependent. The Congress requested Executive Council Working Group on Antarctic Meteorology (EC WGAM) to maintain close contact with the Council of Managers of National Antarctic Programmes to ensure continued meteorological observations, particularly of upper-air stations in the Antarctic, the number of which unfortunately had decreased from 19 to 13 since 1993. Since the cessation of upper-air soundings at Vostok in 1992, the Amundsen-Scott station at the South Pole has been the only station in the interior of the continent still conducting an upper-air observational programme. This contrasts with the situation during the International Geophysical Year (IGY) of 1957-58 when there were 9 manned scientific stations, providing meteorological data from the Antarctic plateaus of East and West Antarctica from stations with elevations of 1500 m or higher above sea level. Clearly the current lack of rawinsonde stations makes conventional upper-air analysis impossible over much of the continent without the input of data obtained by satellite remote sensing.

8. The current economic recession is affecting the ability and willingness of many nations to continue to maintain costly facilities in Antarctica. This may threaten the continuity of many long-established stations with valuable long-term climatic records. With this in mind, the Thirteenth Congress invited Members, particularly those who are parties to the Antarctic Treaty to consider the possibility of cooperating with other Members in sharing the costs of re-opening and operating previously functioning stations. It might be noted as an excellent example of international cooperation in the Antarctic, that the operation of the station Faraday, now renamed Vernadsky was taken over by the Ukraine from the UK. If funds were available, new synoptic stations could be installed in the West Antarctic and the continental interior of East Antarctica. Automated Geophysical Observatories currently operated by the USA, UK and Japan have the potential to fill the gaps in the meteorological network over the continental interior of East Antarctica with little additional costs.

9. As it was mentioned, the AWS formed an important part of the ABSN. Data obtained through the AWS constitute a substantial contribution to overall Antarctic data set. With this in mind, the EC WGAM at its seventh session (Hobart, Australia, September 1998) attached special importance to the use of automatic weather stations, which were seen as the basis for future improvement in the Antarctic surface network. Having been informed of the current and planned activities of a number of countries for the establishment of automatic weather

stations and automatic geophysical observatories on land, the session urged Member-countries to try to ensure that data from such stations, even those established temporarily for research purposes, were made generally available through their insertion into the GTS. It was further proposed that the chairman of the Working Group, with the assistance of the WMO Secretariat, should seek information from countries operating such stations about their intentions as regards the long-term nature of the stations and the possibilities of ensuring real-time data collection, with a view to including new automatic weather stations in the Antarctic Basic Synoptic Network.

Space-based Observing System

10. Large streams of meteorological data are provided by environmental observation satellites. The space-based sub-system of the GOS comprises near-polar-orbiting satellites and geostationary satellites, although only the former have the capability to view the polar regions. The polar-orbiting satellite coverage is provided by the Russian Federation METEOR-2 and METEOR-3 systems and USA TIROS series, NOAA-12, operational morning satellite and NOAA-15, the operational afternoon satellite. However, starting in 2003 EUMETSAT`s Meteorological Operational Satellite (METOP) will fly in a sun-synchronous orbit taking over the morning orbit previously provided by the USA. The USA will continue to provide a sun-synchronous satellite in the afternoon orbit. The concept of the METOP mission has been refined in cooperation with ESA, and in close relationship with NOAA/NESDIS, as the EUMETSAT Polar System (EPS) Programme is expected to be the European component of a coherent Joint Polar System with the US converged programmes of polar orbiting environmental satellites.

11. The image dissemination (HRI and WEFAX), MDD, DCP and DRS services were currently provided by Meteosat-7. Meteosat-6 was maintained as a standby satellite.

12. Data from satellites are made available to Members by means of satellite receiving equipment through the Direct Sounding Broadcast (DSB), Automatic Picture Transmission (APT) and High Resolution Picture Transmission (HRPT) services. In addition, the TIROS-type satellites have a Data Collection System (DCS) to receive data from fixed and moving platforms and to process and store the data for later transmission to a central processing (Argos) facility. According to information from Members, there are 11 APT, ten HRPT and

three SAR ground receiving stations in the Antarctic which collect satellite information, for use in weather analysis, forecasting, sea-ice and storm-warning services.

GCOS Upper-air and Surface Networks

13. The Global Climate Observing System (GCOS) was established in 1993 by WMO, IOC, UNEP and ICSU. One of the main tasks of the GCOS action plan was to evaluate the current observational systems and define the Initial Operational System (IOS) to be realized early in the next century.

14. In order to establish two important components of the IOS, namely the GCOS Upper-air Network (GUAN) and the GCOS Surface Network (GSN), the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC) worked jointly with experts nominated by the WMO Commission for Basic Systems (CBS) and the Commission for Climatology (CCl) on the selection of upper-air and surface stations for the GUAN and the GSN accordingly. The selection of upper-air stations from the existing World Weather Watch networks was based on the following criteria:

(1) the remoteness of the station to determine spatial homogeneity;

(2) the performance of a station in producing high quality observations;

(3) the existence of a reasonable length of historical record.

After consultation with the Members concerned and with their agreement, the GUAN was finalized in 1996. It comprises at present 150 upper-air stations.

15. The list of GUAN stations in Antarctica contains 12 upper-air stations. According to the results of WWW monitoring in February 1999, ten of 12 GUAN stations in Antarctica provided from 50 to 100% of the expected reports for two soundings per day, two others less than 50% for two sounding per day. The number of CLIMAT-TEMP reports received in Main Telecommunication Network was 82% of expected reports. Thus, the performance of GUAN stations in Antarctica is at a good level in comparison with GUAN stations in other parts of the world.

16. As regards the GCOS Surface Network (GSN), some 1000 surface stations were selected by a CCl/CBS group of experts on the basis of the following criteria: length of record; current operational status, including availability of CLIMAT and SYNOP messages; length of homogeneity; station environment (urban, small urban, rural); inclusion in the WMO Reference Climatological Stations List and in the WWW Regional Basic Synoptic Networks; co-location with a GUAN station or GAW station; production of Normals for the year 1961-1990. In order to apply these criteria objectively, including appropriate weighting factors and other information related to the process of selection, a computer algorithm along with related procedures was designed to select the stations for the GSN. A list of selected GSN stations was sent to the Members concerned requesting them to consider the practicability of implementation and the possibility of their undertaking long-term commitments to maintaining and operating the selected stations. After revision and replacement of some stations, most of the Members concerned agreed with the inclusion of their stations in the GSN.

17. EC WGAM at its seventh session approved a list of proposed stations for the GSN in Antarctica contained 20 manned stations most of which were located in coastal areas. The Expert Meeting on the GSN, (De Bilt, the Netherlands, June 1997), stressed the importance of surface data from the continental interior Antarctica for climate research. It expressed a view that collaborative efforts between relevant countries should be encouraged to install and maintain Automatic Weather Stations in the Antarctica at locations where manual observation can not be implemented. In considering this issue, the EC WGAM agreed that an extension of the surface network in the continental interior would be highly desirable to meet the requirements of the GCOS. It urged Member-countries, implementing the network of AWS (Australia, Germany, USA, UK and others) to investigate the possibilities for inclusion of their AWS in the GCOS Surface Network. The session developed a preliminary list of AWS as candidates for inclusion in the GSN and requested the chairman to communicate with appropriate institutions in various countries in order to obtain their agreement and other proposals. A plan should be developed as to where AWS should be installed in future and maintained so as to provide a long-term climate record. An Antarctic network with a spacing, of about 500 km, could be a long-term goal. Some progress towards this could be made in the next 5 years, with encouragement from GCOS and through international cooperation.

18. As regards selected staffed GSN stations in Antarctica, according to results of

specific monitoring carried out from 1 to 15 February 1999, all of them provided CLIMAT messages. In the near future, monitoring of the availability and quality of data from GSN stations will be carried out by Climate Centres in Germany and Japan. The World Data Centres A and B for Meteorology (NCDC Asheville, USA and Obninsk, Russian Federation, respectively) would be the most appropriate locations for central repositories for data from CLIMAT messages transmitted over the GTS, the historical climate data and meta data associated with CLIMAT reports. In view of the importance of long-term series of observational data for climate research, the EC WGAM has produced a preliminary version of a Catalogue on Antarctic Climate Data, based on contributions from Australia, China, France, Italy, Japan, New Zealand, Poland and the Russian Federation. This Catalogue provides a summary of known Antarctic Climate Data, which are available from those agencies and organizations. An electronic version of the UK Catalogue of Antarctic Climate Data had been prepared by the British Antarctic Survey (BAS) and put on the Web Site. Similar electronic version of the overall Catalogue of Antarctic Climate Date is being prepared by the WMO Secretariat in parallel with a print version so that Members who have access to the Internet could obtain an electronic version of the Catalogue. An electronic version will contain, as a minimum, a list of meteorological and related data archived at national data centres and addresses of focal points responsible for these data. This issue become especially important in the light of the establishment of the GCOS Surface Network which required collection of historical data and related meta-data from every Antarctic station included in the GSN.

Further development of Observing Systems in the Antarctic

19. The WWW plan for development of the Observing Systems in the Antarctic will depend largely on the intentions of the Members concerned. Emphasis is, however, placed on the need for a fully-implemented surface-based network of synoptic surface and upper-air stations to provide data sets for short-range forecasting and warning services and also to contribute to the global data sets for medium and longer-range forecasting as well as for climate monitoring and prediction. Efforts should also continue to be made to introduce and benefit from specialized observing systems in the Antarctic, such as automatic weather stations (land and marine), ASAP, AMDAR and modern satellite observing techniques.