CGMS

CGMS-35, WMO-WP-26
Prepared by WMO
Agenda Item: E.2
Discussed in Plenary

JOINT WMO-IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM)

JCOMM is maintaining a Strategic Work Plan for Building a Sustained Global Ocean Observing System in Support of GEOSS. Although this baseline system is designed to meet climate requirements, the system is supporting global weather prediction, global and coastal ocean prediction, marine hazard warning, marine environmental monitoring, naval applications, and many other non-climate uses.

Fifty-nine percent of the global in situ network was completed in August 2007 (drifter and Argo components are completed). Outreach is being continued to remind Members/Member States that a global system cannot be achieved with existing resources and that commitments must be increased to ensure a sustained global system.

JCOMM is investigating the need to develop global in situ wave observing capability for assimilation, model validation, satellite validation, wave climate, research (roles of waves in coupled ocean-atmosphere systems).

The initial ocean observing system for climate depends on space based global measurements of 1) sea surface temperature (SST), 2) sea surface height, 3) surface vector winds, 4) ocean colour, and 5) sea ice. These satellite contributions are detailed in other international plans, but continued close coordination with the in situ systems is essential for comprehensive ocean observation. Satellite observations (wind, SST, ocean colour) with higher temporal and spatial resolutions are required for Met-ocean Products and Services (MOPS) because their major activities are carried out in the coastal seas. Potential of very high-spatial resolution sensors for JCOMM programme areas is pointed out.

JCOMM is working on a strategy of action to make satellite observations more accessible through expansion of a data assembly and data delivery model pioneered as the GHRSST Pilot Project. Broadening the number of data sources for each variable important to JCOMM (e.g. SST, ocean surface topography, ocean vector winds) through international cooperation and data sharing reduces the impact of loss or outage of any single data stream.

In the context of the WMO Integrated Global Observing System, and following recommendations of the 15th WMO Congress, JCOMM is proposing to establish four pilot projects. One of them is a pilot project for the data collection of ocean observations using new satellite data telecommunication systems (e.g. Iridium).

JOINT WMO-IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM)

1 INTRODUCTION

The JCOMM Observations Programme Area strategic work plan

1.1 The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) Observations Programme Area (OPA) Strategic Work Plan for Building a Sustained Global Ocean Observing System in Support of the Global Earth Observation System of Systems (April 2007) was reviewed at the second session of the JCOMM Observations Coordination Group, Geneva, 23-25 April 2007. The JCOMM cross-cutting Task Team on Satellite Data Requirements is taking an active role in the development of the work plan.

1.2 The plan recognizes that there is presently significant international momentum for implementation of a global ocean observing system. The GCOS *Implementation Plan for the Global Observing System for Climate in support of the UNFCCC* (GCOS-92) has now been endorsed by the United Nations Framework Convention on Climate Change (UNFCCC) and by the Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan Reference Document. The ocean chapter of GCOS-92 provides specific implementation targets for building and sustaining an initial global ocean observing system.

1.3 This initial ocean observing system represents the climate component of the Global Ocean Observing System (GOOS), and the ocean component of the Global Climate Observing System (GCOS). JCOMM is the intergovernmental body that has primary responsibility for implementation of the *in situ* elements. The work plan provides details on how JCOMM is planning implementation of the initial ocean observing system in support of GOOS and GCOS, and consequently contributing to the Global Earth Observation System of Systems (GEOSS).

1.4 The ocean observing system documented in GCOS-92 is a composite system of systems, made up of sustained high-quality satellite measurements of the atmosphere and ocean surface, *in situ* measurements of the ocean surface and the sub-surface ocean, and *in situ* measurements of the atmosphere over the ocean. Each component subsystem brings its unique strengths and limitations; together they build the composite system of systems. In addition to the observing platforms comprised in the plan, two more components are essential: data and assimilation subsystems, and product delivery.

1.5 Although this baseline system is designed to meet climate requirements, marine services in general will be improved by implementation of systematic global observations called for by the GCOS-92 plan. The system will support global weather prediction, global and coastal ocean prediction, marine hazard warning, marine environmental monitoring, naval applications, and many other non-climate uses.

1.6 Amongst the challenges ahead are (i) achieving global coverage by in situ networks thanks to appropriate funding, (ii) ensuring their sustainability thanks to the transition of research funding to an operational one, and (iii) developing comprehensive system-wide monitoring and performance reporting.

1.7 JCOMM OCG is preparing a revised plan which represents fiscal realities out to 2012 for completion of the initial system. Outreach is being continued to remind Members/Member

States that a global system cannot be achieved with existing resources and that commitments must be increased to ensure a sustained global system.

2. IN SITU COMPONENT

2.1 The *in situ* networks include moored and drifting buoys, tide gauge stations, profiling floats, and ship-based systems. Coordination of national contributions to implementation of these networks is the job of JCOMM, in cooperation with other global programmes. Within the ocean chapter of GCOS-92, JCOMM is identified as the implementing agent, or a contributing implementing agent, for 21 of the specific actions. These specific actions for implementation of the *in situ* elements have been adopted by JCOMM as an implementation roadmap. The initial work plan outlines the ongoing work and the challenges ahead for JCOMM in building the global ocean component of a Global Earth Observation System of Systems.

2.2 Fifty-nine percent of the global *in situ* network was completed in August 2007: VOSClim (88% of 250 ships), drifting buoys (completed with 1250 units), tide gauges (62% of 170 real-time stations), XBT sub-surface temperature network (81% of 51 occupied ship lines), Argo profiling float programme (97% of 3000 floats, completion planned for November 2007), repeat hydrography and carbon inventory (43% of full ocean survey in 10 years), ocean time series reference stations (24% of 58 sites, 48% of 29 moorings), global tropical moored buoy network (74% of 119 moorings).

2.3 JCOMM is investigating the need to develop global wave observing capability for assimilation, model validation, satellite validation, wave climate, research (roles of waves in coupled ocean-atmosphere systems). Adding wave observations to drifting buoys and Ocean Reference stations whenever possible are possible ways. The Expert Team on Wind Waves and Storm Surges (ETWS) recommended that hourly significant wave height, peak period, 1-D spectra are particularly required in the Tropics and the Southern Ocean. Meanwhile, the development of an observing system monitoring capability to assess wave observations is being initiated.

3. SPACE BASED COMPONENT

3.1 The initial ocean observing system for climate depends on space based global measurements of (-i) sea surface temperature, (ii) sea surface height, (iii) surface vector winds, (iv) ocean colour, and (v) sea ice. These satellite contributions are detailed in other international plans, but continued close coordination with the *in situ* systems is essential for comprehensive ocean observation. Satellite observations with higher temporal and spatial resolutions are required for Met-ocean Products and Services (MOPS) because its major activities are carried out in the coastal seas. Concerning the requirements for the coastal phenomena, potential satellite products for MOPS are high-resolution coastal wind, high-resolution SST, and high-resolution ocean colour. Potential of very high-spatial resolution sensors for JCOMM programme areas is pointed out.

3.2 Collaboration with space agencies should be strengthened to ensure better continuity and overlap of relevant space-based and in situ ocean observing systems, and to move experimental observing systems into operational status.

3.3 **Sea surface temperature:** Satellite measurements provide high-resolution sea surface temperature data. Both infrared and microwave satellite data are important. Microwave sea surface temperature data have a significant coverage advantage over infrared sea surface temperature data, because microwave data can be retrieved in cloud-covered regions while infrared cannot. However, microwave sea surface temperatures are at a much lower spatial resolution than infrared. In addition microwave sea surface temperatures cannot be obtained within roughly 50 km of land. In the coastal region SST has a large variability due to the diurnal cycle of solar radiation, which enhances surface characteristics of the land and sea and forces land-air-sea interactions, i.e., land-sea breezes. Therefore high-resolution sea surface temperature data are needed in coastal regions. A combination of both infrared and microwave data are needed because they have different coverage and error properties. Drifting buoy and other *in situ* data are critically important in providing calibration and validation in satellite data as well as providing bias correction of these data. Satellite biases can occur from orbit changes, satellite instrument changes and changes in physical assumptions on the physics of the atmosphere (e.g., through the addition of volcanic aerosols). Thus, drifting buoy and other *in situ* data are needed to correct for any of these changes.

3.4 **Sea surface height:** The value of spaced-based altimeter measurements of sea surface height has now been clearly demonstrated by the TOPEX/Poseidon and Jason missions. Changes in sea level during major El Nino events can now be discerned at high resolution and provide realistic model initializations for seasonal climate forecasting. The same data, when calibrated with island tide gauge observations, are also able to monitor the rate of global sea level change with an accuracy of 1 mm per year. The planned NPOESS altimeter would have been adequate for shorter term forecasting; but for monitoring long-term sea level change, continuation of precision altimeter missions in the TOPEX/Poseidon/Jason orbit is necessary. Jason follow-on altimeter missions (Ocean Surface Topography Mission, OSTM) are necessary to continue the long-term sea level record. In addition altimeter wave data are routinely assimilated into wave forecast models, providing support to offshore operations around the world.

3.5 **Surface vector winds, ocean colour, sea ice, and coasts:**

3.5.1 High-resolution coastal wind: The surface wind is a key parameter to nowcast and forecast of the coastal marine meteorological and oceanic conditions. It is strongly influenced by the coastal topography and land-sea surface conditions. Traditional global/regional NWP products do not have enough spatial resolution for Met-ocean Products and Services. The microwave scatterometer has limited spatial resolution (25km), and the wide swath SAR measurement has limited temporal resolution (one measurement every few days) and provides no wind direction.

3.5.2 The ocean colour remote sensing provides images of biological/non-biological parameters with high-spatial resolution of 250m to 1 km. The ocean colour can detect several types of marine pollutions and harmful biological activities. Parameter retrieval algorithm in turbid waters is not established yet, but developments of an observation system based on the OC remote sensing have presented promising results for a future operational observing system.

3.5.3 Very high-resolution visible/infrared imagers (i.e., Landsat, Spot) and synthetic aperture radar (SAR): These provide information on the coastline, which gradually changes through erosion and accretion processes relating to coastal meteorological/oceanic phenomena (e.g., waves and sea ice). However, their images are rather expensive and not freely available to the community. In order to design efficient observing systems for Met-ocean Products and Services in the near-coast sea region, a mechanism to incorporate these high-resolution images needs to be considered.

3.5.4 The best methods of sustaining satellite measurement of surface vector winds, ocean colour, and sea ice are still research and development questions. Over the next five years, satellite agencies will weigh the alternatives and determine the long term strategy for maintenance of these elements.

3.6 JCOMM approach with regard to satellite observations

3.6.1 The JCOMM Management Committee, at its fifth session (JCOMM MAN-V, Geneva, Switzerland, October 2006), noted that the evaluation and intercomparison of global surface flux products (over ocean and land) from the operational analyses of a number of the main NWP centres (i.e. the SURFace Flux Analysis (SURFA) project) remains a priority for the Working Group on Numerical Experimentation (WGNE) within CAS. Both the atmospheric and coupled modelling communities and oceanographers have a very strong interest in advancing SURFA, which could provide a good opportunity for progress in estimating and determining surface fluxes. Efforts are continuing through a liaison with the newly-formed WCRP Working Group on Surface Fluxes (WGSF) to address the requirements of research, observations, analysis and modelling of surface fluxes within WCRP and closely-related programmes such as GODAE and GCOS. The importance of adhering to data standards has been noted, with the Programme for Climate Model Diagnosis and Intercomparison (PCMDI) and GODAE being active in this area.

3.6.2 The JCOMM Services Programme Area (SPA) Coordination Group (SCG), at its third session (JCOMM SCG-III, Exeter, United Kingdom, November 2006) suggested that a better link with the CAS WGNE should be defined. It recommended that the first approach would be established by the SPA Coordinator jointly with the OFS Rapporteur, in order to create an appropriate liaison mechanism between the CAS and JCOMM. It also requested the Secretariat to follow-up activities of the CAS WGNE.

3.6.3 The forthcoming sixth meeting of the JCOMM Management Committee, that will take place in Paris, in December 2006, has a specific agenda item to discuss 'Ocean Forecasting Systems' and the transition of operational aspects of GODAE activities into JCOMM, possibly through a new Expert Team under the SPA (ET-OOFS). GODAE will formally end in 2008, and the International GODAE Steering Team (IGST) is currently considering options for the continuation of components of the project, in association with existing bodies of WMO and IOC. It is likely that the further development, standardization, intercomparison, etc, of ocean forecast systems in an operational environment (e.g., BLUElink>, the MyOcean project and USA activities) will be carried forward through the suggested JCOMM Expert Team. A mechanism for continuation of the GODAE work on the main science issues facing operational oceanography over the coming decade is still under discussion, but may involve coordination with both CAS and the WCRP. Substantial crossover will be required between ET-OOFS and the science mechanism, to ensure that the work is complementary, and that science results are carried through to operations in a coherent way.

3.6.4 The JCOMM Observations Programme Area and its Task Team on Satellite Data Requirements are working on a strategy of action for JCOMM to make satellite observations more accessible. The central element of the proposed approach is expansion of a data assembly and data delivery model pioneered as the GODAE High Resolution Sea Surface Temperature Pilot Project (GHRSST). GHRSST is nearing the end of its initial phase and has enhanced the availability of near-real-time satellite sea surface temperature observations for both operational and research purposes. Recent independent discussions in the satellite altimetry community suggest a parallel evolution of similar data management and data assembly structure to GHRSST developing in the next few years for ocean surface topography data. Likewise the operational use of scatterometer data for ocean vector winds has expanded and numerous international satellite data resources for this data are coming online in the next few years. Near-real-time data assembly of the various data sets in a common format with appropriate metadata would make these data both more useful and more accessible to operational users and the scientific community. A "GHRSST-like" structure for all three variables – sea surface temperature, ocean surface topography, and ocean vector winds – would set global standards for reporting and accessing these observations in near-real-time for operational purposes and document the data sets for purposes of establishing climate data records for these geophysical fields.

3.6.5 The JCOMM Observations Coordination Group (OCG) is proposing to engage the GHRSST, the Ocean Surface Topography Science Team/PODAAC/AVISO, the ASCAT and Ocean Vector Winds Science Teams, and other bodies as appropriate to establish Pilot Projects modelled after GHRSST to ensure near-real-time data from space-based radar altimeter and scatterometer missions are readily accessible to the JCOMM community.

3.6.6 The three variables slated for action in the near-term - sea surface temperature, ocean surface topography, and ocean vector winds – are all currently used in operational oceanography and marine meteorological services. Few services have full access to all possible data streams and notably under-utilize the full range of data that might be made available. Broadening the number of data sources for each variable through international cooperation and data sharing (with common formats and documented data quality) reduces the impact of loss or outage of any single data stream.

3.6.7 JCOMM may be an appropriate body to provide governance to the evolving GHRSST and similar pilot projects given that tangible benefits are demonstrated for the JCOMM community.

4 JCOMM PARTICIPATION IN THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

4.1 In May 2007, the WMO Fifteenth Congress decided to move towards the enhancement of integration between the WMO observing systems and associated programmes making observations. It identified marine meteorological and other appropriate oceanic observations as one of possible projects for Integration into the WMO Integrated Global Observing System (WIGOS). At its Second Session, Geneva, 9-13 July 2007, the CBS Expert Team on the Evolution of the Global Observing System (ET-EGOS) was invited to address the objectives of the integration process as laid down by Congress with a view of providing guidance for the development of concepts and plans for Pilot Projects. Four potential Pilot Projects for the integration of marine measurements into the GOS have been identified:

(i) Promoting interoperability of ocean data systems with the WMO Information System (WIS) in close cooperation with the ocean community.

(ii) Establishing a Pilot Project for the data collection of ocean observations using new satellite data telecommunication systems (e.g. Iridium). Such technological innovation will address identified deficiencies of the current observing system to better meet the requirements of a number of applications in a cost effective way by (i) permitting the distribution of high temporal and/or vertical resolution data, and (ii) improving data timeliness. Initiatives have already started with the JCOMM Data Buoy Cooperation Panel and the Ship Observations Team, but integration with other ocean or land based observing systems can be promoted (e.g. OceanSITES, Argo).

(iii) Establishing a Pilot Project for in situ wave observations to meet the requirements for maritime safety services, and develop a costed justification for the users of marine services products for increasing such measurements globally.

(iv) Promoting the documentation and integration of best practices and standards being used amongst the meteorological and oceanographic communities.

4.2 The JCOMM Services Coordination Group has been working extensively within the Services Programme Area of JCOMM and its Expert Teams on developing an Observations User Requirement Document for JCOMM services (URD) consistent with the RRR process of the GOS. The document is focusing on met-ocean forecast systems, which includes (i) ocean mesoscale forecast, (ii) met-ocean products and services (e.g., wind waves and storm surges, marine accident and emergency response, and sea ice services). However, the document is still in draft form. It shows different approaches for these applications, but is lacks some of the required variables for the database. Up-to-date estimates of *in situ* instrument performance have been provided to the WMO/CEOS database. An updated version (draft) of the SoG for Ocean Applications was presented to the second session of the ET-EGOS in July 2007. Identified gaps to be included in the plan comprise the need for high temporal in situ SST data, and the increase of the VOSClim fleet. Regarding ocean surface topography, the ET-EGOS agreed that the potential gap in terms of sustainability should be considered with regard to approved satellite missions and recommended JCOMM to update the SoG accordingly. JCOMM is now reviewing again the detailed requirements for its application and planning to provide an update for the WMO/CEOS database by the end of 2007. A new RRR process will then start based on up-to-date information and the SoG will be updated accordingly.

5. OTHER SATELLITE RELATED ACTIVITIES

5.1 The following satellite related activities are also being addressed by the JCOMM Observations Coordination Group:

- GPS monitoring of land levels at GLOSS core network tide gauge sites;
- Development of a surface salinity pilot project in cooperation with the OOPC;
- Development of a work plan for monitoring and documenting satellite system status as a JCOMMOPS task;
- Reviewing the JCOMM Service Programme Area draft User Requirements Document.