CGMS-XXXII
WMO WP-7
Prepared by WMO
Agenda item: E.1

REDESIGN OF THE WWW GLOBAL OBSERVING SYSTEM

(Submitted by WMO)

Summary and purpose of document

The Chairman of the CBS/IOS Expert Team on Observational Data Requirements and Redesign of the Global Observing System (ET-ODRRGOS) reports on progress attained at the Third WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction, Alpbach, Austria, 9-12 March 2004.

ACTION PROPOSED

CGMS is invited to consider the Workshop Report and provide feedback

1. Introduction

The World Meteorological Organization organized the third WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction, which took place in Alpbach, Austria, 9–12 March 2004. Results from Observing System Experiments (OSEs) both with global and regional aspects were presented. Messrs. H. Boettger, J. Pailleux, and P. Menzel were the conference organizers; 31 papers covering global NWP, regional NWP, and observing network design studies were presented. Some of the satellite-related highlights were as follows:

(1) ECMWF showed that one AIRS added to a Global Observing System without satellites provides more impact than one AMSU;

(2) Five numerical weather prediction centres are using MODIS winds in operations or case studies with a majority reporting significant positive impact;

(3) Surface pressure observations from ships or buoys are still needed to anchor satellite surface wind observations;

(4) GPS is beginning to show skill in defining the tropopause thus complementing satellite infrared and microwave measurements;

(5) Including data that arrive after cut-off times in NWP models increases the forecast accuracy substantially.

Proceedings of the workshop will be published by WMO in CD-ROM.

2. NWP Impact

2.1 Global impact of some global observing systems

The table below shows an up-to-date summary of the impact from different observation types and parameters over the northern and southern hemisphere extra-tropics and tropics. The value given for each observation type represents results from all recent studies including those presented at the workshop. The results are expressed in terms of gain in large scale forecast skill at short- and medium-range (unit = hour). The gain is obtained by adding the observing system to all the other ones used routinely in the assimilation. As the number of observing systems routinely used varies considerably from one centre to the other, this marginal gain may also vary considerably from one study to the other. The table shows also these variations of gain whenever it is supported by significant studies, otherwise general comments are inserted in the table.

One can find also notes in the table to indicate if on average the contribution has increased/decreased with respect to the evaluation of the last workshop. More and more satellite data are used by the more advanced data assimilation systems (but not necessarily by all the operational assimilation systems); this explains the increasing contribution of the whole satellite system, but also the relative decrease of the radiosonde contribution over the northern hemisphere, as well as the large range of level impact for satellite data and radiosondes. As an example, the ensemble of satellite systems is the main contributor, including in the northern hemisphere, for ECMWF, whereas the radiosonde network is the main northern hemisphere contributor for many other operational centres.

The table is only meant to be a rough guide. It is accepted that the magnitudes of impact depend upon the model and assimilation scheme used, upon the impact variable and also the forecast range. The following specific remarks have also to be kept in mind when using the table.

(a) Some observing systems that are rated low individually (e.g., several grey bullets in the table which correspond to “neutral to a few hours”) may have a significant impact when acting together (modest but complementary contributions). Some of them also have a large impact on the very-short range forecast (e.g.: aircraft reports), which does not appear in this table;

(b) Some global observing systems (such as scatterometer data or surface wind observations in general) have an impact which grows with the resolution: these data have a modest impact on the long waves but they are important for determining, for example, the exact position and characteristics of a cyclone;

(c) Very local observing systems cannot be rated globally and do not appear in the table (for example MODIS winds).

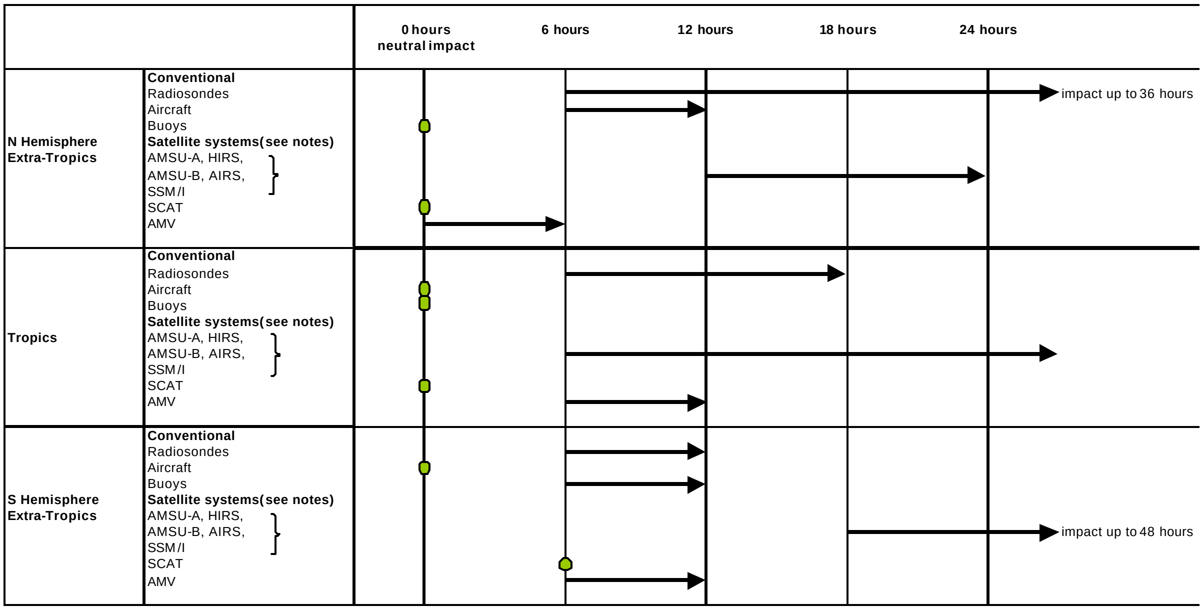

Table 1: Current contributions of some parts of the existing observing system to the large-scale forecast skill at short and medium-range

Notes:

1. SATELLITE SYSTEMS

AMSU-A................The dominant and more largely used sub-system
HIRS.......................Less important than AMSU-A, useful complement for humidity
AMSU-B................Not used yet in many centres: important for humidity over land
AIRS.......................Evaluation just starting (equivalent to one AMSU-A)
SSM/I......................Important impact on humidity fields (esp. tropics and SH)

2. OBS. PARAM. TYPE

Surf. Pressure Ps.....Important to anchor model Ps. (large model biases otherwise)
Surf. Wind...............Less important than Ps, useful complement (see SCAT)
Wind profiles..........the more important information to observe, esp. in the tropics

2.2. Impact of some regional observing systems

A significant number of studies presented at this workshop deal with the impact of observations on regional and mesoscale NWP. These studies are able to evaluate the impact of systems which are deployed only on a local basis: radars, profilers, GPS networks. This was not the case in the previous similar workshops. One can now try to summarize the impact of observations on regional and mesoscale NWP (then the impact is often concentrated on very short range forecasting).

(a) High density aircraft data also with ascent and descent observing phases (such as the ACARs in the US) contribute to an important reduction of the RMS error in the forecast range 3 to 12 hours. When they are not available (during the night) profiler data are an interesting substitute, because they can report very frequently. When neither aircraft data nor profiler data is available for a region, it is important to have a dense radiosonde network reporting at least every 12 hours;

(b) MODIS winds (AMV from polar orbiting satellites) show a positive impact, very significant to the north of 60N. This is obviously related to the lack of wind observations on the polar cap in all the other observing systems;

(c) Radiances and high resolution winds from geostationary satellites also show a positive impact, especially on the location and intensity of specific weather events;

(d) Precipitation data from radars are now assimilated in various mesoscale systems. They do improve the location and intensity of precipitation forecasts at very short range; the improvement seems larger in sophisticated data assimilation systems;

(e) GPS observations (Zenithal Total Delay or Precipitable Water) obtained from surface networks show occasionally some modest positive impact; this is encouraging for a system that is still in development.

3. Workshop conclusions and recommendations

The workshop reviewed the recommendations for the evolution of the GOS from the OPAG-IOS Expert Team on Observational Data Requirement and the Redesign of the Global Observing System. These recommendations together with an implementation plan are given in Annex IV of the ET-ODRRGOS Report from its 6th Session held in Geneva, 3-7 November 2003. The recommendations from this 3rd workshop on the impact of various observing systems on NWP should be viewed in conjunction with the ET recommendations; the discussion focused mainly on complementary issues raised in the presentations and during the discussions.

3.1 Interaction between NWP centres, data providers and users

(i) Data assimilation and modelling capabilities have grown and are under constant development to make optimal use of current and future observing systems. NWP centres require:

- early (advance) information about new data types;
- early access to test data and observations during the cal/val phase to prepare for the operational use of the data;
- information on the characteristics of the data and products (e.g., AMVs over layers).

(ii) Research satellites provide valuable data for NWP, which should be made available in a timely fashion. Research satellite data provide NWP centres with an excellent opportunity to prepare for new satellite data streams, which will become part of the operational global observing system;

(iii) Effective learning of how to make use of new data types can best be achieved through operational use of any experimental data streams;

(iv) It was recognized that NWP centres will be doing more work relevant to other environmental areas. This will require a wider data exchange and more cooperation on model developments (issues of environmental monitoring, atmospheric chemistry and transport processes will need to be addressed).

3.2 Observational data requirements

(i) It was recommended that polar wind observations be developed further and an operational follow-on to the MODIS winds be secured (this will require a water vapour channel on the operational imagers on NPOESS and METOP). Timeliness of data delivery can be addressed through direct data read-out. The number of stations with direct read-out capability should be increased. Such data should be made available directly to the processing centres.

(ii) The workshop reiterated the need for a timely distribution of radiosonde observations in BUFR with all observation points included in the message together with the time and the position of each data point; information on instrument calibration prior to launch and information on sensor type and sub-sensor type is also required.

(iii) For regional forecasting systems, a strong requirement was expressed for comprehensive and uniform coverage with at least 12 hour frequency of temperature, wind, and moisture profiles over continental areas and coastal regions. It was noted that the radiosonde network still plays an important role in meeting this requirement.

(iv) The extension of the coverage of vertical soundings into ocean areas (e.g., as pursued in the EUCOS programme) was supported and considered to be a valuable data source for general NWP.

(v) More T, U/V, Q profiles, but especially winds, are needed in the tropics. Rapid development of the AMDAR programme could be one solution.

(vi) Timeliness requirements for observational data are becoming more stringent for NWP centres. HH + 20 to 90-minute data cut-off times are applied at present for many NWP short-range runs. Within the next few years, a data processing and delivery time of approx 20 to 30 minutes is expected to be the an operational requirement.

(vii) Ground based GPS processing (ZTD and PW, priority for ZTD) should be standardized to provide more consistent data sets. Data should be exchanged globally. The coordination of geodetic data between the GPS processing centres is required.

(viii) There is a requirement for exchange of high-resolution radar data (both reflectivity and radial winds, where available) for use in regional models, and also in global models in future.

(ix) Workshop results on the usefulness of stratospheric observations should be consolidated and requirements for a stratospheric global observing system should be refined (need for radiosondes, radiances, wind data, humidity data, noting the availability and required density of existing data sources, including GPS sounders, MODIS winds and other satellite data).

3.3 Proposals for future studies

(i) The capability to make best use of high-resolution observations (space and time) should be developed. This includes:

- assimilation experiments using hourly AMVs together with hourly radiance data;
- optimal extraction of information content from AMV;
- targeted use of high resolution satellite data (implies the development of corresponding assimilation capabilities).

(ii) The conduct and evaluation of impact studies should be revisited. The overall impact of one component of the observing system can be established through denial studies (incremental approach) or through impact assessment by adding the observations to a baseline system.

(iii) Guidelines for the evaluation of impact studies need to be revisited and the need for regional cases studies and time series verification should be included.

(iv) Impact studies have confirmed the positive contribution of the radiosondes to regional and global NWP. Studies to assess the relative value of the radiosondes for use in bias corrections in the RT forward model should be considered.

(v) The value of a properly tuned OSSE system was acknowledged (the huge initial investment was noted). Such a OSSE system would be a useful tool for the assessment of new observing systems in the shorter term, but less relevant for observing system to come on stream 10 to 15 years ahead. Complementary approaches e.g. use of simulated data in ensemble assimilation systems or studies of information content could be applied.

4. ET-ODDRGOS plans for the coming year

ET-ODDRGOS will be meeting 12–16 July 2004 in Geneva, Switzerland to continue pursuing the work plan approved by CBS. The agenda (see below) includes, inter alia, finalizing a draft implementation plan for the Redesign of the Global Observing System as was recommended by the CBS-Ext.(02).

1. Organization of the session

2. Report from the Chairman
   2.1 Guidance from OPAG chair

3. Relevant activities occurring at the WMO Consultative Meetings on High-Level Policy on Satellite Matters, CGMS, AND GEO

4. Report on the Third WMO Workshop on the Impact of Various Observing Systems on NWP (Alpbach, Austria, 9 to 11 March 2004)
   4.1 Implications for Re-design of GOS
   4.2 Implications for future OSEs

5. Review and Update of the Statements of Guidance for Selected Applications
   5.1 JCOMM input on SOGs
   5.2 SOGs for Agrometeorology
   5.3 SOGs for Hydrology and Water Resources
   5.4 SOGs for Atmospheric Chemistry
   5.5 Review of observing system capabilities and user requirements

6. Implementation Plan for the Evolution of Surface and Space Based Components of the GOS

7. Action Item Review
   7.1 Update on Thorpex
   7.2 Data Flow and Distribution of Emerging Sensors

8. Preparation for ICT (6-10 Sep 2004)

9. Preparation of ET-ODRRGOS Input to CBS-XII

10. Any Other Business

11. Closure of the Session