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ON INTEGRATED OBSERVING SYSTEMS

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SCIENTIFIC EVALUATION OF GLOBAL OSEs AND OSSEs

Submitted by the Rapporteur (Jean Pailleux - Meteo-France - Toulouse)

Summary and Purpose of Document

This document contains a review of global OSEs and OSSEs undertaken NWP centres, proposals and guidance for some new specific global OSE/OSSEs which we thought to be of particular interest to meteorological community.

ACTION REQUIRED

The meeting is invited to take into consideration the information contained in this document when discussing implementaiton and preliminary of OSEs and OSSEs and developing draft proposals for the redesign of the GOS.

SCIENTIFIC EVALUATION OF GLOBAL OSEs AND OSSEs

1. Introduction.

Two rapporteurs have been appointed by CBS (CBS management group; January 2001) in order to improve the coordination of activities related to the impact studies: Observing System Experiments (OSEs) and Observing System Simulation Experiment (OSSEs). One rapporteur should concentrate on "global / large-scale impact studies", the other one on "regional / mesoscale studies". This report is the one coming from the first rapporteur, i.e. dedicated to global OSEs / OSSEs. The goal of this report is:

- To prepare a review of global OSEs and OSSEs that are undertaken by the Numerical Weather Prediction (NWP) centres;
- To develop proposals and guidance for new specific global OSE/OSSEs which are felt as especially useful for the meteorological community.

In addition, a mechanism is proposed in this report, which tries to keep under constant review the planning, the execution and the evaluation of these impact studies, in the future. It was noted that the subject is one important preoccupation of two existing working groups: the Expert Team (ET) on Observing Data Requirement and Redesign of the Global Observing System (ODRRGOS), working under the auspices of the OPAG IOS, and the Scientific Evaluation Group (SEG) working under the auspices of the Coordinating Group for COSNA. Indeed this report relies on two key documents which were produced by these two groups or in cooperation with their chairmen:

- **Appendice 1: "Suggested Observing System Experiments (OSEs)"**, is the annex V of the report of the ET-ODRRGOS (Geneva – April 2001);
- **Appendice 2: "OSE plans for 2001-2002"**, produced and updated by Paul Menzel, following also the indications from Horst Böttger and the two rapporteurs.

These documents, initiated in Spring 2001, are the main scientific basis of the present report, but they are also seen as the key documents for the future coordination work (if properly updated). Starting from these documents, the work of the rapporteur on global OSEs has consisted in:

- Establishing new contacts with scientists from some NWP groups which were not represented in the initial versions of the documents (see section 2);
- Adding personal ideas on priorities for impact studies (sections 3 to 5);
- Proposing a procedure for a follow-up mechanism in charge of a permanent monitoring of OSEs and OSSEs.

2. The OPAG basic documents and their evolution.

2.1. The two above-mentioned documents are appended to this report in their form of October 2001, **which is then purely indicative and not necessarily up-to-date**. App.1 contains a list of 7 types of OSEs which were judged important for the

future evolution of the GOS. App.2 gives indications on the NWP centres which are likely to carry out some of these OSEs.

2.2. App.1 has been discussed by several groups of scientists involved in OSEs (e.g.: SEG or WGNE). It has also been submitted to some scientists working on OSEs in NWP groups which were not involved in the document production (e.g.: BMRC in Australia and RPN in Canada). A general agreement appears on the interest / importance of most of the OSEs. However some discussions occurred on the importance of OSE V-2: "the impact of denial of radiosonde data globally above the tropopause". Some scientists think such an experiment would be very useful to answer questions about satellite data calibration and optimal height for radiosondes. On the other side, there is a fear that a too quick OSE, not properly designed, would lead to an immediate reduction on the maximum height reached by operational radiosondes, and then to an immediate degradation of the GOS. Studies and debates are also going on about experiment V-3: "information content of the Siberian radiosonde network". The debate is mainly "whether or not the 1999 degradation of the Siberian radiosonde network produced a significant degradation of the NWP models". The more recent indications seem to say that indeed the model degradation was significant, especially in Autumn 1999. The network was very poor in October 1999, but in January 2000 (already used for some studies) the network situation had recovered to some extent.

App.2 (document maintained by Paul Menzel) represents the contributions that some NWP groups plan or hope to do by the end of 2002, without any formal commitment. They include the NWP centres contacted directly by the Rapporteur. However this document cannot be considered as comprehensive, as there may be other NWP centres in the world which have not been contacted by anyone at this stage.

2.3. In this report, one does not try to present a status of the current results of the impact studies of App.1. The status is limited to the aspects mentioned in section 2.2 about experiments on the radiosondes above the tropopause and on the Siberian radiosondes. The general evolution of the OSEs and OSSEs can still be followed to a large extent through existing events like:

- The ECMWF workshop of November 2001 on operational aspects, taking place at the precise moment when this report is produced;
- The coming ATOVS conference (ITWG) in Melbourne in February 2002, which will cover many of the satellite aspects.

2.4. In addition to the work mentioned in App.1 and 2, there are probably many OSEs which are carried out in various NWP groups, especially on satellite data and on emerging systems. These experiments may be carried out for special reasons related to one particular assimilation scheme, even outside weather services, or for studying a particular aspect of a local observing system, without any goal related to the GOS redesign. The comprehensive view of this activity is difficult to obtain, and will remain difficult in the future.

3. Priorities for the GOS optimisation.

For the optimisation of the future GOS, the more important and urgent task is to design and carry out impact studies helping to define **an optimal network of radiosonde and aircraft observations.** Choices have to be made in various WMO

regions and various countries on these conventional observations (sometimes the important decision is just to maintain observations, or to prevent then from disappearing!). This type of experiment has already been carried out in the context of programmes such as EUCOS and NAOS. The guide-line is to try to obtain more experiments of this type in other areas of the world in order to come out with a better idea on the "optimal RS and aircraft network". Experiments V.2 to V.5 of App.1 are already along this line, especially experiment V.5.

Satellite impact studies are nevertheless important. Many studies are suggested by satellite groups. These studies are generally necessary for the NWP people to improve their assimilation techniques applied to new satellite data. However the satellite OSEs have less impact on the future GOS redesign. Except when an important decision has to be taken (e.g.:on the inclusion / non-inclusion in the GOS of a new satellite mission), the satellite based observing systems can almost be taken as "boundary conditions" to the problem of "optimising the conventional upper-air network".

To work efficiently on the optimisation of the future GOS, at least three important satellite subjects have still to be kept in mind, which all lead to an important activity in OSEs and OSSEs:

- The importance and the utilisation of the new generations of satellite sounders, especially infra-red sounders in cloudy areas;
- The importance and the utilisation of radio-occultation GPS data (which are normally insensitive to clouds);
- The importance and the utilisation of satellite missions (such as the ESA ADM-AEOLUS mission) which will produce wind profiles globally by space-borne Doppler Lidars.

Both OSEs and OSSEs are (and will be) carried out in this context, very few of them being documented in the appendices to this report. But again, this can be taken as "boundary conditions" for the GOS redesign.

4. **Another priority: targetting strategies.**

Some oceanic areas and deserts will never be covered properly by conventional meteorological observations. It is known that some extreme meteorological events are sensitive to small details which can be observed only by accurate and high-resolution vertical systems. It is also unlikely that the envisaged future satellite systems will be accurate and flexible enough to observe these small details, especially because of the limitations due to clouds. Consequently the RS/aircraft studies mentioned in the previous section must include experiments addressing some "targetting strategies".

Targetting strategies have already been tested successfully during FASTEX in 1997, although it cannot be concluded at this stage that "targetting" is ready to be used operationally. For Europe and the North Atlantic, the EUCOS programme has defined different "levels of targetting":

- The simplest one consists, for some ASAP ships making soundings, to be flexible about the time of the observation. For example ships can launch radiosondes at 06 and 18UTC, instead of 00 and 12, when they are close to a fix radiosonde station operating at 00 and 12UTC. This is just optimisation of the time / space distribution of the

observations without any knowledge of the type of meteorological situation.

- A slightly more sophisticated technique consists in increasing the observation frequency (e.g.: 4 instead of 2 observations per day) when the ship passes through an area defined as “climatologically sensitive”. The “sensitive areas” have been pre-computed, and are sensitive “on average” (for one particular season, e.g.) and may not be sensitive at all on one particular day.
- The higher level of targetting consists in computing in real time the sensitive areas for one particular day, for some particular elements of the weather forecast, and to send in real time ad hoc platforms (planes with dropsondes, aerosondes,etc…) to the right place and at the right time.

Special actions or field experiments related to targetting, such as the EUCOS aerosonde experiment (planned for February 2002), or the THORPEX experiment, are believed to be crucial for the future evolution of the GOS. Case studies, dedicated to specific meteorological events, have to be carried out in this context, for complementing standard OSEs (which give an average impact).

5. OSSEs.

The current documents appended to this report contain plans and suggestions on OSEs only, nothing on OSSEs. This is because OSSEs are not believed to be very important for defining the future GOS, at least less important than OSEs. The reason is related to basic limitations of OSSEs already discussed in several workshops and working groups: difficulty for an OSSE to anticipate and model all the error sources of a non-existing observing system, expensive in computer and scientist resources, difficult to interprete, etc… It is known that some OSSE tasks are (and will be) carried out, for example for future satellite Doppler Wind Lidars as mentioned in section 3. However they are not seen as crucial for a WMO plan on the future GOS.

6. Toward a WMO mechanism for regular exchange of information on global OSEs/OSSEs.

Impact studies are carried out regularly in most of the NWP centres in the world, for many different purposes. Sometimes the purpose is purely “NWP or data assimilation oriented” (e.g.: improving one particular data assimilation scheme). Sometimes it is completely “network design” oriented (e.g.: keeping or not keeping one particular observing system). For a correct optimisation or redesign of the GOS, it is very important to have a constant exchange of information on these impact studies, at the global level, among a mixed community of meteorologists: scientists involved in NWP and data assimilation; forecasters using models; instrument and observing system managers. This exchange of information is very helpful:

- for NWP people, to choose the more appropriate impact studies for the decisions on the GOS evolution;
- for people designing new observing systems (to make the proper choices on the specifications).

For several years, groups such as the COSNA SEG have kept under constant review this work on OSEs and OSSEs. However, in the case of SEG, this exchange and this coordination were kept at the regional level most of the time (North Atlantic for the main area of concern, Europe for the people involved). Moreover SEG is limited to a group of NWP scientists. On two occasions, the exchange of information and the discussions were "raised to the global level" through two workshops organised by the COSNA SEG and WMO: Geneva (April 1997) and Toulouse (March 2000); 2 to 3 days each. About 25 people attended the Geneva workshop in 1997, about 50 for the Toulouse workshop in 2000. The size of the Toulouse workshop seems to be the appropriate one to allow a good exchange of information on the scientific results, as well as fruitful discussions on "what is appropriate to do in the future". **Such a type of regular workshop (say every 3 years) should be kept as one important element of the global coordination. However SEG should not be any more the main actor for defining the content and the programme of the workshop,** especially for the following reason.

It is very difficult for someone like the SEG chairman to have a good global view of all the OSEs/OSSEs performed everywhere, and also a good global view of all the crucial areas/aspects of the GOS which have to be studied. Consequently, the programme and the list of invited speakers, for the last two workshops, were mainly influenced by the personal contacts (direct or indirect) which were existing between the SEG chairman and the leaders of various NWP groups in the world. These contacts are believed to be good, but not optimal and also a bit too "Europe-oriented" (also for funding reasons, as the Coordinating Group for COSNA was the main body providing money). This report (and the one provided by the Rapporteur on meso-scale OSEs) is indeed an attempt to keep this global view, and to keep informed all the relevant bodies.

The ideal organisation is still beyond the task of two rapporteurs. At least for the organisation of workshops on impact studies (maybe also for the permanent monitoring of the OSE/OSSE work), this ideal (not necessarily achievable!) organisation could be described as a small committee representing:

- all the different regions;
- different types of expertise (NWP, deployers/designers of observing systems, perhaps non-NWP users of observations);
- both the CAS and CBS aspects of WMO (as this task is really overlapping research aspects and operational aspects).

A suggestion along these lines could be to have a small ad-hoc committee with this mixed expertise, with a composition worked out by CBS (and CAS). As WGNE has always been involved in discussing OSEs and OSSEs, if one member of the committee could belong to WGNE, it would be an advantage. The main task of the committee would be to organise the regular workshops by email (say every 3 years). Special meetings of the committee are not believed to be necessary: if the workshop is kept to the reasonable size mentioned before, the workshop itself plus the regular meetings held under the OPAG-IOS should be sufficient. The last two workshops were organised entirely by 2 or 3 persons through email exchanges, one of these persons being a staff member of the WMO secretariat providing the logistic support. The new proposed structure would not then be much heavier than the light organising structure used in the previous workshops: the only difference would be to involve more experts in the scientific content of the workshop, and its programme. For COSNA, it would mean that the SEG work would be incorporated, through RA VI, into the WMO work on the GOS redesign. During the organising phase of the workshop, the committee would necessarily have to keep under review the work on impact studies (world-wide). If in addition, this review was made

permanently (by, e.g., a continuous monitoring and update of documents such as the appended ones), it would be even better!

APPENDICE I
(Originally Annex V of ET-ODRRGOS meeting report – April 2001)

SUGGESTED OBSERVING SYSTEM EXPERIMENTS (OSEs)

V.1. *Impact of hourly SYNOPs*

In a data denial experiment using 4D-var in a global NWP system, observations from surface stations (observations of surface pressure and any other variables normally assimilated) would be reduced to a frequency of 6 hours. Results would be compared with a control experiment in which such data are assimilated at the highest available frequency, which in some areas will be hourly.

The purpose of this experiment is to measure the impact on short- and medium-range forecasts of hourly surface observations from those areas where they are currently exchanged internationally. Conclusions could then be drawn about the benefits to be expected from more widespread international exchange of other hourly surface observations, potentially leading to changes in practices concerning the exchange of these data. In addition to the potential for direct impact of forecast accuracy, increased exchange and archiving of hourly surface observations may benefit the verification of NWP products (particularly for precipitation) and climate monitoring (particularly for precipitation and temperature).

V.2. *Impact of denial of radiosonde data globally above the tropopause*

It is proposed to truncate radiosonde reports above (in height) 70 hPa, which is near the upper limit of the tropical tropopause. Satellite observations will be used exclusively in the stratosphere. This OSE will investigate the NWP impact from exclusion of radiosonde measurements above the tropopause in any part of the world.

- The radiosonde is the only in situ instrument platform capable of routine measurements in the stratosphere. Aircraft usually fly below the tropopause except at middle and high latitudes in winter. (Very few aircraft fly above 70 hPa.)
- The OSE will lead to discussion of the following questions:
- Can satellite observations of various types compensate for the loss of stratospheric radiosonde observations? For numerical weather prediction? For climate monitoring? (Many in the climate community consider the radiosonde indispensable for providing a stable, long-term record for climate monitoring.)
- What is the effect on tropospheric forecast accuracy of the loss of stratospheric radiosonde observations? How immediate is the effect?
- How important are the stratospheric radiosonde observations for calibration and validation of satellite observations in the stratosphere? (Implies comparisons of radiosonde and satellite observations, in some cases, made possible by forward models.)
- This OSE should be undertaken with a model of suitable vertical resolution in the stratosphere. Possible outcomes and suggested actions from this OSE on the impact of no stratospheric radiosonde data include:
- Strong or clear impact – Encourage tracking of all radiosondes to maximum altitude, where balloon bursts. Encourage use of larger balloons to sample greater altitudes.

- No impact – Rely more on satellite observations (e.g. AMSU) of the stratosphere for NWP. Possible future help would come from radio occultation measurements, whose vertical resolution in the stratosphere is expected to be between 1 and 1.5 km with an expected accuracy of 1K.

V.3. *Information content of the Siberian radiosonde network and its changes during last decades*

The decrease in the number of radiosonde launches from the Asian part of the Russian Federation provided impact on NWP. It is therefore, suggested that a study of the information content of the Siberian radiosonde network in full and reduced form be conducted; trends over the past decade would also be investigated. This will involve the following tasks:

- Evaluation of changes in impact areas from the ten year retrospective
- Determination of homogeneous zones and optimal network configuration
- Exploration of proposed network variants responding to different weather regimes

The results expected from this OSE include:

- Recommendations for redesign of the network, in terms of number of stations and their locations
- Estimation of expected improvement of geopotential and wind velocity field analysis due to restoration of Siberian network in optimal mode.

V.4. *Impact of AMDAR data over Africa*

Data monitoring statistics of the Global Observing System (GOS) have in the past indicated that the African continent is a notoriously data sparse area, in particular with respect to in situ observations in the free atmosphere. In recent years some of the airlines with long haul routes across Africa have to an increasing extent contributed to the AMDAR component of the GOS. Initially all the wind vector and temperature data were provided as in-flight observations taken automatically through onboard sensors at flight level only. More recently the in-flight measurements have been complemented by ascent and descent data taken during take-off and landing of the aircraft. In any 24 hour period the coverage of the African continent with AMDAR data is suitably uniform and is considered to be a valuable contribution to the GOS over Africa.

It is proposed to study the impact of the AMDAR data over the African continent with an appropriate NWP forecasting system through denial of the AMDAR data in the experiments. The operational analyses produced with the identical forecasting system may serve as the control. The data impact should be evaluated with respect to improvements in the accuracy of the analysis and background fields and the ensuing forecasts. The study should analyse the impact of AMDAR data on regional and global upper-air wind, temperature and height fields in the short and medium range. Forecasts of near-surface weather parameters, including precipitation over Africa, should be considered if feasible.

AMDAR data are mainly available at asynoptic times. A 4D variational data assimilation system (4D-Var) is considered to be the most suitable test bed for such a study, although a 3D-Var system with background fields at the appropriate times may also be a candidate. The study should be conducted during an active period in the Atlantic hurricane season with easterly waves moving out of Africa and the

subsequent development of tropical cyclones in the Atlantic, as well as dynamically active periods in either hemisphere's winter.

V.5. *Impact of tropical radiosonde data*

Although the impact of radiosonde data has been evaluated through several OSEs (either global OSEs, or limited to some specific areas), little attention has been given to the tropics in these studies.

It is therefore suggested to test the impact of removing all in situ profile data (e.g. radiosonde and AMDAR) in the tropical belt (20S-20N), checking how the analyses and forecasts would be affected, not only in the tropics, but also in mid-latitudes. A second experiment would consist in removing the same data in a latitude-longitude box corresponding to the current highest density in radiosondes. These two tropical OSEs should be carried out in priority. However, many other impact studies could also be carried out in order to understand the role and needs of profile type observations more, in the tropics:

- Repetition of these two experiments with and without satellite winds, as it is known that these winds considerably affect the tropical circulation. It is also known that there are problems in assimilating these observations in an optimal way;
- Separation of the overall radiosonde impact into wind impact and temperature/humidity impact;
- Varying the latitude/longitude box of the second experiment (e.g. one Indonesian box, one South American box).

The main expected outcome would be a better understanding of the requirements in the tropical areas for wind, temperature and humidity profile observations. Investigating the impact of the radiosonde data in a tropical area relatively well covered by radiosondes would also give a quantitative indication of the expected improvement, which would be obtained in current data - poor areas by deploying new observations (satellite or in-situ). This technique has already been used in mid-latitudes, by testing (e.g.) the impact of removing North American radiosondes.

V.6. *Impact of three LEO AMSU-like sounders*

The premise is that 3 low earth orbiting microwave instruments of AMSU quality will provide additional significant benefit to global NWP beyond that evidenced with two AMSU-like microwave sounders.

When the SSMI/S and Aqua/AMSU achieve polar orbit in late 2001, there might be the opportunity to evaluate global NWP from microwave sounder instruments spaced every four (or so) hours.

Many NWP centres now depend upon the temperature information provided by the microwave sounding instruments on board the NOAA polar orbiting spacecraft. Experiments have been carried out to measure the impact of these systems in a number of only recently available configurations. The positive impact of one AMSU every twelve hours versus two every twelve hours (930 AM LST and 130 PM LST) has encouraged the premise that an AMSU-like measurement every four hours (or three times every twelve hours) will still provide significant improvement to global short and medium range forecasts. It is estimated that the presently observed impact of one AMSU on NWP is about 8-12 hrs of forecast skill in the NH (about 1 - 1.5 days in SH); for two AMSUs improvement continues to be large and significant. These results suggest the importance of the microwave sounding data in NWP and the need to maintain the best possible operational configuration (i.e. two and maybe

three AMSU-like instruments). Therefore such observations in 3 leo slots should be tested.

V.7. Impact of AIRS data

In an impact experiment using a global NWP system, data from the AIRS instrument on NASA's Aqua satellite would be assimilated. Results would be compared with a control experiment in which AIRS data are denied. Both experiments would assimilate all other observations in normal operational use.

The purpose of this experiment is to provide an early indication of the impact on short- and medium-range NWP performance to be expected from advanced infra-red sounder data. This would benefit preparations for forthcoming operational sounders (IASI on METOP and CrIS on NPOESS and MAIRS on FY3) and provide experience and feedback to improve the real-time processing of the AIRS data themselves. Although forecast impacts from AIRS are expected to be significant and of benefit to operational NWP, early experiments are not expected to exploit the full potential of these data.

APPENDICE II
(last update: October 2001 – Paul Menzel)

OSE Plans for 2001 – 2002

The OPAG-IOS Expert Team on data requirements and the redesign of the global observing system (ET-ODRRGOS) at its recent meeting in April 2001 suggested seven OSEs for consideration by NWP centres and asked the OSE/OSSE rapporteurs (Jean Pailleux and Nobuo Sato) to engage as many as possible in this work. The proposed OSEs and the contributing NWP centers are listed below.

1. impact of hourly SYNOPs (ECMWF),

2. impact of denial of radiosonde data globally above the tropopause (Canadian AES),

3. information content of the Siberian radiosonde network and its changes during last decades (Univ St Petersburg, NCEP),

4. impact of AMDAR data over Africa through data denial in a 4D-Var analysis and forecasting system (ECMWF, Meteo France, NCEP),

5. impact of tropical radiosonde data (Met Office, Meteo France, JMA),

6. impact of three LEO AMSU-like sounders (NOAA 15 and 16 and AQUA), and (Met Office, NCEP, JMA),

7. impact of AIRS data (ECMWF, Met Office, NCEP, BMRC, JMA).

ECMWF plans

For OSE 1, ECMWF will document previous experiments with 6-hour 4D-Var and start a new assimilation experiment high resolution T511/T159 12h 4D-Var.

For OSE 4, ECMWF has two alternative scenarios. One experiment with high resolution (T511/T159) denial of ascent/descent or several experiments with low resolution (T159/T63) (with no wind profiles; US profiler network only; aircraft ascent/descent only; orall available wind profiles)

Regarding OSE 5, there are no radiosonde experiments (tropics) planned.

For OSE 7, there are several considerations. When will data be available? It is on the Centre´s critical path for operations. It will be subject to a tuning exercise.

With ERA-40, there will be several OSEs done as part of the scientific programme to study the impact of the increments in the ERA 40 observing systems, including the Russian radiosonde network degradation relevant to OSE 3. First results are to be presented at the ECMWF Re-analysis Workshop in November 2001.

Met Office (UK) Plans

UK Met Office hopes to be able to conduct OSE 5 (impact of tropical radiosondes) before next summer, assuming no unforeseen demands on their resources in this area.

They also expect to conduct OSE.6 (impact of three LEO AMSU-like sounders) and OSE.7 (impact of AIRS data) at some point in the future but, with current planned launch dates for DMSP and AQUA, it is clear that they will not be in a position to do these before summer 2002.

Meteo-France Plans

Meteo-France will do as much as possible related to OSE.4 (impact of AMDAR data over Africa) and OSE 5 (impact of tropical radiosonde data). OSE 5 encompasses several OSEs and it is unclear how many can be done with available resources.

Meteo-Fance has already started to prepare observation files for running OSEs on a 2-week (?) period starting 1 June 2000, 00Z (a period which was of particular concern regarding forecasts over Sahara). Two African visitors are going to work with them on this subject for a couple of months. The plan is to start running one "control" plus one "test" assimilation. They will start by running V.5 - removing all the radiosondes in 20S-20N (plus possibly ascents and descents from aircraft) using an unstretched ARPEGE with 3D-VAR.

University of St Petersburg

In 2002, the Main Geophysical Observatory will pursue OSE 3 regarding the information content of the Siberian radiosonde network and its changes during last decades. Dr Pokrovsky is preparing several maps of Russian radiosonde launches corresponding to three month distributions: Oct 1999 (it was a "down month" in the radiosonde number history), Jan 2000 (used in the NCEP study presented at Geneve) and Apr 2001 (current state). The information content corresponding to these three cases will be studied.

NCEP Plans

NCEP will be contributing to OSE 3 by continuing with its study of the impact in the degradation of the Russian radiosonde network.

OSE 4 will be studied with evaluation of AMDAR over AFRICA (working as an advisor to the South African Weather Bureau) and exploring the usefulness of AMDAR data in the Caribbean.

NCEP will evaluate the impact of AMSU from three LEOs for OSE 6.

After AQUA launch, the impact of AIRS data will be studied for OSE 7.

In addition, NCEP will study observation targeting for winter storm experiments and hurricanes and continue to foster progress with assimilation of satellite data over land using a variety of data.

BMRC Plans

Regarding OSE1 (Impact of hourly SYNOPS), BMRC is using hourly data to run a mesoscale surface analysis. They are experimenting with ways of using this in their regional analysis scheme. At this stage their main focus is developing a 3D-var system.

For OSE 2 (Denial of radiosonde data above the tropopause), BMRC notes that radiosonde data is seen to be required for tuning satellite based data and it is thought to be pointless to ignore it.

With respect to OSE 4 (Impact of AMDAR data over Africa) and OSE 5 (Impact of tropical radiosonde data) BMRC expresses considerable interest, particularly experiments with tropical data, but they are unable to commit a substantial effort.

For OSE 6 (Impact of three LEO AMSU-like sounders) and OSE 7 (Impact of AIRS data), BMRC expects to run impact experiments on AIRS data on both global and regional scales when the data is available in March next year.

In addition, BMRC is working on assimilation of quickscat data with some encouraging initial results. They expect to run full-scale impact studies on both the global and regional scales in the near future. BMRC also will continue to monitor the impact of the PAOB data generated here as the amount and type of remotely sensed data in our assimilation system grows.

Canadian Plans

Canada expects that OSE 1 will require 4D-var capabilities which are still under development. That said, they indicate that the use of surface data in combination with satellite data is a very interesting and worthwhile experiment. In the last year they spent considerable time adapting 3D-var to better use of surface data including problems related to differences in model versus true topography. They suggest that some of the reporting practices concerning surface pressure or its equivalent and reporting practices below topography could be revised given how today's systems have evolved. However, OSE 1 is very low priority, and Canada will not participate.

OSE 2 is felt to be very pertinent since there are already doubts about the quality of radiosondes above 70 hPa and this OSE may in fact shed some light on this. Satellite data, particularly from future instruments will undoubtedly bring much more information there which will in the long run most likely replace radiosondes as our best source of stratospheric data. Forecast accuracy, particularly in the 5-10 day range is undoubtedly influenced by the accuracy of stratospheric analyses and we have to quantify this. Calibration using radiosonde data above 70 hPa, given the biases in temperature there, is somewhat doubtful but again only such experiments will help understand the problem. Canadian plans in the current year are to raise the NWP model top to 1 hPa and above which is a pre-requisite to undertake such an OSE, but if everything goes according to plan, they will definitely participate in OSE 2.

Regarding OSE 3, Canada has some reservations as it could be very costly given the time required in the preparation of the 10-year retrospective data. So their requirement in participating to this OSE is that they have access to the re-analysis data from ECMWF. If all the participants would use a common dataset, this will make it a better scientifically controlled OSE. The results from this OSE are felt to be very important; there is often the question regarding impact in the 5 – 10 day range if these raobs are over NA. Canada has looked at few sensitivity analyses related to bust forecasts over NA, and they have pointed directly to large errors over Siberia.

Canada is somewhat interested in OSE 4 since Canada will be producing AMDAR data in the near future. However they are not yet ready with 4D-var and would not likely participate in a study over Africa.

Regarding OSE 5, Canada has noted a significant 12-hour beating in the tropics related to the alternating radiosonde network in the tropics. Satellite winds and radiances should play a larger role in the tropics since very little other data sources are available, particularly during the hurricane season. They are aware of the difficulties related to the tropics, but it is currently low on their priority.

For OSE 6 and OSE 7, Canada is already involved in studies related to SSMI/S and Aqua/AMSU as well as AIRS and would as much as possible try and fit this work with participation to this OSE.

JMA plans

OSE 1 is interesting and worthy of trial.

With regard to OSE 2, it is felt that in-situ data from the stratosphere is essential to remove biases in direct assimilation of TOVS radiances.

OSE 3 is important, but JMA already has results from NCEP and can wait until the results from ERA40 are shown in half a year.

Because of the dramatic increase of AMDAR data around the globe, OSE 4 is felt to be a good OSE.

For OSE 5, JMA thinks the tropical Pacific wind profiler network will be important to predict westerly bursts that trigger El Nino. Their focus will be on this.

OSE 6 will have a large impact to NWP community.

OSE 7 will be taken up by a global group. Every major NWP center is interested in the assimilation of interferometric sounder data and AIRS data assimilation. Progress will be reported in several fora.

Furthermore, JMA would like to propose that an OSE targeted for mesoscale weather phenomena such as heavy precipitation should be added. The mesoscale OSEs proposed are

* impact studies of in-situ data from doppler radar, wind profiler, aircraft, ground based GPS network etc..

* impact studies of satellite data, particularly, moisture and precipitation data.

(regional model impact studies may not be appropriate for OSE/OSSEs because the predicted fields such as geopotential height and wind used in the evaluation of the observational data impact have rather largescale horizontal structure and they are affected by lateral boundary conditions given by the larger model or global model).

To summarize, JMA will carry out OSEs on the impact of tropical PacificWind Profiler network. This may have some relation with OSE 5. They are interested in OSE 7, the impact study of AIRS data. They will do it in collaboration with university researchers and professors using their data assimilation system. OSE 6 is also an interesting OSE and JMA is very much inclined to participate. With regard to OSE 3, they would like to carry out some kind of OSE in the context of THORPEX.