Appendix A: OPAG on Integrated Observing Systems Team, Members, Rapporteurs

Implementation/Coordination Team on Integrated Observing Systems
Dr James Purdom, Chair
Mr Mahaman Saloum, Co-Chair OPAG IOS and representing RA I
Dr Paul Menzel, Chair, ET Observational Data Requirements and Redesign of the GOS
Mr Hans Peter Roesli, Chair, ET on Satellite Utilization and Products
Mr Miroslav Ondras, Chair, ET on Requirements of Data from AWSs
Mr Yongqing Chen, representing RA II
Mr Luis Farias Briceño, representing RA III
Mr Guillermo Vega, representing RA IV
Mr Terry Hart, representing RA V
Mr Harald Daan, representing RA VI
Mr Mario Garcia, Servicio Meteorologico Nacional, Argentina
Mr Frank Grooters, representing CAeM

Expert Team on Observational Data Requirements and Redesign of the GOS
Dr. W.P. Menzel, Chair, Dr. T. Schlatter, Mr Alan Sharp, Dr Florence Rabier, Dr Wenjian Zhang, Mr Horst Böttger, Mr Herbert Pümpel, Dr Johannes Schmetz

Rapporteurs on Scientific Evaluation of Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs)
Mr Jean Pailleux for Global Scale
Dr Nobuo Sato for Regional Scale

Rapporteur on GCOS Matters
Mr Stefan Rosner

Expert Team on Satellite Utilization and Products
Mr Hans Peter Roesli, Chair, Mr Wolfgang Benesch, Dr V. Asmus, Mr James Kongoti, Mr Anthony Mostek, Prof. Xu Jianmin, Mr Ryoji Kumabe, Mr Jeffrey Charles Wilson, Mr Richard Francis, Dr M'Pié Diarra, Mr Louis Finke Ficktime

Expert Team on Requirements for Data from Automatic Weather Stations
Mr Miroslav Ondras, Chair, Mr Herbert Gmoser, Mr Malcolm Gifford, Mr Darryl Lynch, Mr Jorge Emilio Rodrigues, Dr. Jeffrey Andresen, representing CAgM, Mr Michel Leroy - representing EUMETNET, Mr Wil Van Dijk, representing CAeM, Dr Jitze P. van der Meulen - representing CIMO

Rapporteur on Regulatory Material
Dr Alexander V. Vasiliev

Rapporteur on Improvement of Volume A
Mr Harald Daan

Appendix B

SCIENTIFIC EVALUATION OF GLOBAL OSEs AND OSSEs

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

November 2001

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 upate: 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 becasue 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.

Appendix C: CGMS Working paper on Virtual Lab for Satellite Data Utilization
CGMS-XXIX

WMO WP-17
Plenary

CGMS VIRTUAL LABORATORY FOCUS GROUP

Summary and purpose of document

To inform CGMS Members on the proposed structure, goals and implementation plan for the CGMS Virtual Laboratory Focus Group.

ACTION PROPOSED

CGMS Members to note and approve the structure, goals and implementation plans for the CGMS Virtual Laboratory Group, and provide advice as appropriate.

Appendices: A. Proposed Structure and Goals for the CGMS Virtual Laboratory Focus Group
B. Implementation Plan

DISCUSSION

BACKGROUND

CGMS-XXVIII was informed of WMO discussions concerning a Virtual Laboratory (VL) for Training in Satellite Meteorology. WMO noted the importance of the coordination and overseeing needed for the VL and thus suggested that CGMS, in partnership with WMO, form an "International Satellite Data Utilisation and Training Focus Group". CGMS-XXVIII agreed to activities that could lead to the formation of such a focus group and endorsed a proposed structure for the "International Satellite Data Utilisation and Training Focus Group". In doing so, CGMS-XXVIII agreed to the following action item:

> ACTION 28.14 WMO to work with CGMS Secretariat to initiate the establishment of a focus group on satellite data utilisation and training within the Virtual Laboratory Framework and report back to CGMS XXIX on its findings and need for future activities in this area.

1. FIRST SESSION OF THE CGMS INTERNATIONAL SATELLITE DATA UTILIZATION AND TRAINING FOCUS GROUP

The first session of the CGMS International Satellite Data Utilization and Training Focus Group to discuss coordination and overseeing requirements for the Virtual Laboratory for Education and Training in Satellite Matters (VL) was held at the EUMETSAT Headquarters at Darmstadt, Germany, 16-18 May 2001. Presentations were made by EUMETSAT, WMO, NOAA/NESDIS, NSMC/CMA, JMA and the "centres of excellence" at the RMTCs in Barbados, Costa Rica, Niger, Kenya, China and the BMTC in Australia. The first session suggested that henceforth the CGMS International Satellite Data Utilization and Training Focus Group be called the CGMS Virtual Laboratory Focus Group.

1.1 Review Draft Terms of Reference for CGMS Virtual Laboratory Focus Group

The first session reviewed the proposed structure for the CGMS Virtual Laboratory Focus Group as proposed at CGMS-XXVIII. It also noted that CGMS-XXVIII had requested the Focus Group to review and make proposals for changes to the draft Terms of Reference as appropriate for consideration at CGMS-XXIX.

The first session drafted a proposed structure and goals for the CGMS Virtual Laboratory Focus Group, as contained in Appendix A for consideration and approval by CGMS-XXIX.

The first session reviewed lessons learned from previous training events conducted under the Strategy for Education and Training in Satellite Meteorology and in particular those conducted under the Virtual Laboratory for Education and Training in Satellite Meteorology.

The first session noted that the activities at the RMTC and the recent training event in Nanjing highlighted several key factors to be considered in furthering the VL. The important factors included:

- distribution of all training materials, preferably in advance of the training event, on the VRL or CD ROM as appropriate;
- the need for input from the participants in advance of the training event as to their data access, data reception systems, level of experience with satellite data and primary forecasting requirements;
- linking together the “six centres of excellence” into a network;
- provision and availability of satellite data by each satellite operator into the RAMSDIS format;
- each "centre of excellence" should have internet telephonic capability to allow full exploitation of the VISITview software;
- participants should be provided in advance of the training event with information concerning RAMSDIS “Online” software;
- the need to attract students;
- better exposure of digital satellite imagery interpretation and McIdas basics;
- use of mailing list;
- the use of looped imagery for comments on every day situations;
- achieving a local satellite climatology;
- better communication between RAMSDIS users through VISITview and other software for voice communication;
- promotion of the use of any existing computer aided learning, multimedia or web-based platforms of instruction, including videos;
- the urgency to improve internet in every country;
- the benefits from refresher workshops;
- RAMSDIS Online imagery was now an integral part of satellite training;
- research in satellite meteorology; and
- distribution at the end of a training event of any additional training materials on CD ROMs.

1.2 Develop Recommendations and Implementation Plan for CGMS and for the second session of the CGMS Virtual Laboratory Focus Group

The first session recalled the request from CGMS-XXVIII to develop recommendations as well as an implementation plan for the VL. With regard to the implementation plan, the first session discussed the following items: the resource library, its role, how it should be structured, how it should be "peer reviewed," and other pertinent

matters; VISITview, how it should work, how it should fit into the Virtual Laboratory construct, etc.; expectations for the RMTCs that were participating in the Virtual Laboratory especially in the area of a review of the questionnaire to help focus their training, and as an input to WMO; coordination of training activities that could lead to a schedule of "classes" for each year; Virtual Laboratory participant roles and responsibilities; archiving of training class presentations as a future training resource; development of a web-based training resource available to WMO and others, how it should be managed, and what would be the corresponding role of the “centre of excellence”.

The first session recalled that the VL was a global network of specialized training centres created to meet user needs for increased skills, knowledge in using satellite data. With regard to the Virtual Resource Library (VRL), it should be the core of the VL and reflect the 3 cornerstones of the WMO Strategy to Improve Satellite System Utilization by providing access to training and educational material, software and expertise on how to the utilize data, and case study and near real time data. The VRL should contain a suite of standard software packages and applications for use on those packages. Used in combination with the case study data, it should provide bench marking capabilities for adapting algorithms and software. The VRL should have strong links to specialized science groups such as the ITWG and the Wind Workshop Group and provide access to case study data in a variety of standard formats. The data should be linked to training sessions or could be used independently (e.g., for application development and testing). The VL resources will have two components: a core of baseline information to be exchanged (mirrored as appropriate) to all “centres of excellence”, and a repository of data and specialized information for local use. Local use distribution will be decided by the data provider. Local use distribution could range from complete distribution to all “centres of excellence” to restricted distribution to only the local “centre of excellence”.

The first session then discussed in-depth several components of a VL including goals, data flow and formats, management and the Virtual Resource Library (VRL).

With regard to VL management, the first session felt it important that the management group review progress, assimilate inputs/feedback and assign actions. As appropriate, the management team should address relevant training programmes, e.g., within PUMA, EUMETNET and Project Mitch, and synergy and consistency with the VL goals. There should be regular and extensive use of teleconferencing (initially 3-monthly). The first session agreed that two co-chairs, one from a “centre of excellence” and one from a satellite operator, should be given responsibility for day-to-day management. The two co-chairs would report to the VL Focus Group which would provide overall guidance for the VL. The first session nominated Mr R. Francis (EUMETSAT) and Mr J. Wilson (BMTC) to serve as the first two co-chairs.

The first session noted the importance of initiating training events based around the VL concept (as was done in Nanjing 2000 and planned for APSATS 2002). Such events would naturally bring together VL participants and the latest materials, and should be used to regularly inject impetus into further VL development.

The first session agreed to a proposed implementation plan for the VL with corresponding action items and timetable as shown in Appendix B. Appendix B is for consideration and approval by CGMS-XXIX.

The first session also reconfirmed the validity of the structure for the VL as proposed in Lannion Meeting. A schematic representation of the relationships between the various components of the Virtual Laboratory is shown in Figure 1.

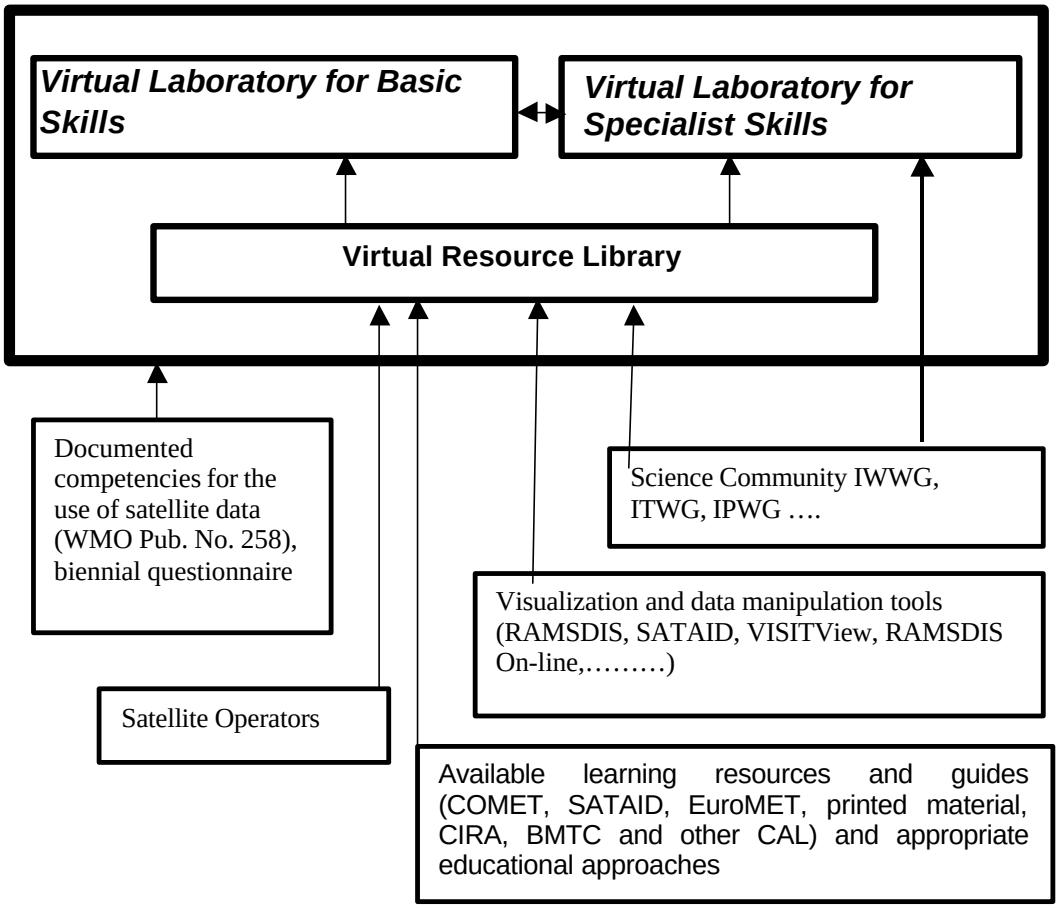

Figure 1: Schematic of the Virtual Laboratory

1.3 Action Plan For APSATS-2002

The first session noted that Asia Pacific Satellite Application Training Seminar (APSATS) workshop would be co-sponsored by WMO, Japan Meteorological Agency and the Bureau of Meteorology and held at the BMTC in Melbourne, Australia. The China Meteorological Agency and the Korean Meteorological Agency have also offered guest presenters. The next workshop, APSATS 2002, is currently scheduled for early 2002.

The APSATS 2002 workshop will continue many of the practices used at the recent WMO Regional Training Seminar on *"The Use of Environmental Satellite Data in Meteorological Applications"* held at the RMTC in Nanjing, China, in December 2000. The APSATS 2002 workshop will consist of lectures, hands-on case studies and discussions using real time satellite data from around the world. Dr Roger Weldon (NOAA/NESDISS) will be the main invited speaker.

Case studies are currently being devised using the SATAID programme, with data also available for use under the RAMSDIS system. It is proposed to use the VISITview software to link the actual workshop with other "centres of excellence" for some of the real time discussions. Practice lessons on creating VISITview sessions and other training material will be incorporated into the workshop programme. Participants will be encouraged to bring material to create their own training packages using authoring packages such as VISITview, PowerPoint or simple Web editors.

Resource material from APSATS 2002 is expected to be available on the VRL after the training event.

Lecture, case study and resource material will be written onto CD-ROMs for the participants to take home on completion of the course.

The first session agreed that the second session of the Focus Group should occur in two years time and conduct an initial assessment of the VL. The third session should occur in five years and conduct a comprehensive review of the VL.

APPENDIX A (to CGMS WP on VL)

PROPOSED STRUCTURE AND GOALS FOR THE CGMS VIRTUAL LABORATORY FOCUS GROUP

Management structure

Co-chaired by one satellite operator and one representative from the "centres of excellence". Served by the WMO Satellite Activities Office as the Secretariat. Membership should include:

- representatives of science teams as appropriate;
- remaining satellite operators and "centres of excellence";
- other interested parties as appropriate.

VL Strategic Goals

(1) To provide high quality and up-to-date training resources on current and future meteorological and other environmental satellite systems, data, products and applications;

(2) To enable the "centres of excellence" to facilitate and foster research and the development of socio-economic applications at the local level by the NMHS through the provision of effective training and links to relevant science groups.

VL Immediate Goal

(1) To implement a baseline VL and to foster its logical growth.

VL Connectivity Goal

(1) To assure links between the 6 "centres of excellence" (and supporting satellite operators) with a **minimum** data rate of 56 kbs, to support communication (email, voice), the exchange of software and limited image data sets (e.g., case studies and some near real-time data sets);

(2) "Centres of excellence" to consider means to increase link capacity to a minimum of T-1 within 5 years;

(3) A preferred method in the short-term would be the direct insertion of data from a ground receiving station into the Virtual Laboratory servers. As an alternative, the Internet can be used to route data and products to the VL servers.

VIRTUAL RESOURCE LIBRARY (VRL) GOALS

(1) To establish a list of usable training resources (includes image data sets, s/w, tools);

(2) To implement a structure for the depository of training resources which will allow easy access by the “centres of excellence” trainers;

(3) To populate this structure with a core set of material from the training resources list;

(4) To consider a more general access to the resource library by students (forecasters);

(5) To consider the provision of additional (enhanced) material from the resource library to all 6 “centres of excellence”.

VL UTILIZATION GOALS

(1) To establish a VL user tracking and feed-back mechanism, from the outset, (for analysis, refinement, reporting to VL management, and to assess overall usefulness);

(2) To keep abreast of user requirements for the VL (baseline being WMO Pub No. 258). Assume: analysis of user responses focused on education and training to questionnaires within their region and other user feed-back is carried out by “centres of excellence” and results are reported to VL management;

(3) To train meteorological students to an operational level of expertise as well as to allow daily weather discussions during training events, near real-time data and products are a strong requirement. Near real-time data are needed to train forecasters on the effective use of new satellite reception and processing systems. Depending on the application, the need for near real-time data availability may not be as stringent.

Long-Term Evaluation of the VL

(1) After five years, conduct a comprehensive review of the VL.

Typical activities to be undertaken to meet the goals

- Consolidate documentation of the range of skills/competencies for operational meteorologists and specialists;
- Examine which online (Web-based learning), Computer Aided Learning. CDs and hard copy learning materials are currently available for use in the Virtual Laboratory. This activity will include contacting groups such as ASMET, COMET, CIRA, EuroMET, BMTC and CIMSS who have complementary projects under way and relevant science groups (such as the EUMETSAT SAFs, the TOVS Working Group, the Winds Working Group and the proposed quantitative precipitation working group);
- Negotiate with the copyright holders of the training material rights to either link to their material and/or to acquire the rights to use their material at the designated centres of satellite training expertise (this includes the centres making the material available to on- and off-site users);
- Working with groups such as ASMET, COMET or EuroMET, design and test possible user interfaces, educational approaches for delivering the material, and examine methods for online tracking of student participation;

- On a trial basis, evaluate the proposed Virtual Laboratory material in conjunction with one of the WMO satellite training workshops for more user feedback;
- Incorporate user feedback into the educational approach and review the content of the Virtual Laboratory;
- Move to a wider implementation of the material;
- Undertake a periodic review of the Virtual Laboratory sites in conjunction with reviews of the skills and competencies of the operational meteorologists and specialists;
- Prepare sample data sets for the various data streams now being provided or planned for in the near future. The data sets would be used within the VL concept;
- Provide for continuous monitoring of user requirements for Education and Training as well as the effectiveness of the Virtual Laboratory

APPENDIX B (to CGMS WP on VL)

IMPLEMENTATION PLAN

Action items:

Prepare an inventory of which training resources and materials are presently available for the core VRL by the end of July 2001 and provide response to J. Wilson (Wilson and all VL participants).

Each satellite operator should identify which data and products could be linked into the core VRL by the end of July 2001 and provide information to R. Francis (Francis and satellite operators)

CIRA to establish a web server for an initial set near real time data and products by the end of November 2001 and report to the VL list-server (Purdom).

EUMETSAT to establish a server for an initial site for training resources and materials by the end of July 2001 and report to the VL list-server (Francis)

Additional specific actions and timetable:

0 to 1 year

- During the next 6 months, all “centres of excellence” to evaluate content, and how and what can be maintained on a server at the “centre”;
- Train satellite operators and “centres of excellence” on the use of RAMSDIS using VISITview;
- Increase training event effectiveness through the use of VISITview;
- Add the SATAID training resource to the VRL and utilize VISITview on the use of that tool.

1 to 2 years

- Within 1 ½ years, all satellite operators to strive to have a server online and connected to the VL;
- Each “centre of excellence” will strive to have a server online and connected to the VL;
- To establish a voice channel capability within VISITview;

- To evaluate and ways to improve the VRL;
- To evaluate the quality of submitted materials by the “centres of excellence”, completeness (e.g., speaker notes), appropriate deletion dates, compatibility issues, and virus protection.

5 years

- Conduct comprehensive review

Appendix D: CGMS Working Paper on the International Precipitation Working Group
CGMS-XXIX

WMO WP-14

INTERNATIONAL PRECIPITATION WORKING GROUP

Summary and purpose of document

To inform CGMS Members on the status of activity related to the formation of the International Precipitation Working Group (IPWG).

ACTION PROPOSED

CGMS Members to note the latest status of activity related to the formation of the International Precipitation Working Group (IPWG) and approve the draft Terms of Reference and structure for IPWG as contained in the Appendix.

Appendix: Draft Terms of Reference for the International Precipitation Working Group (IPWG)

DISCUSSION

BACKGROUND

1. CGMS-XXVIII noted that WMO had analysed the benefits from and agreed upon the need to foster further development of focused science groups. The success of both the International TOVS Working Group (ITWG) and the CGMS International Wind Workshop (IWW) in focusing the scientific community on a specific application area’s issues and problems, strongly suggested similar benefits could be gained by development of science teams and workshops that could deal with application areas of satellite meteorology such as quantitative precipitation estimates, NWP and ocean and land surface properties. The current existence of many scientific groups operating in these areas could facilitate this task. For example, in the area of quantitative precipitation estimation, groups of scientists are currently involved in the Global Precipitation Climatology Project (GPCP) of the World Climate Research Programme (WCRP) and have already exchanged information on data requirements, algorithm development, data set production, validation and data distribution.

2. CGMS-XXVIII also noted that the fifty-second session of the WMO Executive Council had recommended involving relevant science groups in a systematic manner and the positive indication from the GPCP for WCRP’s GEWEX to serve as a nucleus for such a working group. Thus, WMO strongly encouraged the formation of an International Precipitation

Working Group with active participation by WMO and GPCP within the framework of CGMS. As a result, CGMS-XXVIII agreed to the following action item:

ACTION 28.13 The CGMS Secretariat to initiate the establishment of a Working Group on Precipitation, with co-sponsorship of WMO and CGMS, and to report to CGMS XXIX on progress.

1. FIRST SESSION OF THE INTERNATIONAL PRECIPITATION WORKING GROUP (IPWG)

The first session of the Coordination Group for Meteorological Satellites (CGMS) International Precipitation Working Group was held at the CSU Tamasag Conference Facility, Fort Collins, Colorado, USA, 20-22 June 2001.

1.1 Current status of precipitation estimation

The first session reviewed the current status of precipitation estimation from satellite-based observing systems and the plans and capabilities of proposed future satellite systems. Detailed descriptions of the current status can be found in the CD ROM version of the first session of the IPWG as distributed by the CGMS Secretariat. Additionally, the first session discussed the importance of the WMO Virtual Laboratory for Education and Training in Satellite Meteorology and the relevance of the IPWG towards helping it achieve its goals.

In conducting the review, the first session noted several issues that should be considered in the formation of the IPWG:

- validation and independent verification of precipitation estimates in the context of the scale of observation and the type of precipitation phenomena being characterized;
- the importance of the full implementation of the GCOS Surface Network (GSN) to help in the validation effort;
- the importance of water vapour and cloud micro-physics for the development of the next generation of satellite rainfall estimation techniques;
- the relevance of planned field experiments within the World Weather Research Programme especially for warm season precipitation events and the assimilation of precipitation observations in forecast models;
- the relevance of missions including the Global Precipitation Measurement (GPM) mission that would tie together active and passive instruments on polar-orbiting satellites with the high temporal observing capabilities afforded by geostationary satellites;
- the importance of international cooperation in the areas of missions, validation, algorithms, new techniques, and education and training;
- the importance of the IPWG covering the needs of various communities including hydrometeorology, weather and climate.

1.2 Terms of Reference for IPWG

The first session reviewed the draft terms of reference for an International Precipitation Working Group. The session was guided by the terms of reference for the ITWG and CGMS Winds Working Group and the issues identified in its review of the current status of precipitation estimation from satellite-based observing systems.

The first session developed terms of reference as shown in the Appendix for consideration and approval by CGMS-XXIX.

The first session agreed that the IPWG will be served by two Co-Chairmen and a Rapporteur to CGMS. The Co-Chairmen for IPWG are Dr Arnold Gruber (USA) and Dr Vincenzo Levizzani (Italy). It suggested that Dr Purdom serve as the Rapporteur.

The first session recommended that CGMS review and give favourable consideration to the structure and terms of reference for the IPWG as contained in the Appendix.

The first session also suggested that the Co-Chairs take into consideration the terms of reference contained in the Appendix and the following points in developing the second session:

- Identify producers of routine (or operational) rainfall products and engage them in quarterly reporting of remote sensing product comparisons with other rainfall estimates in a standard format;
- Address compatible and interchangeable algorithms, as appropriate, early-on with a group of specialists from both the research and operations communities. This will facilitate the early transition from research to operations
- Consider validation, with a group of specialists involving standard and specialized measuring systems,
- Consider new techniques for estimating precipitation that include water vapour, cloud microphysics and the utilization of new multi-spectral data;
- Consider frequency allocation and protection activities for current and future instruments;
- Consider the role of IPWG in direct assimilation of precipitation and related observations in NWP models at all scales. WWRP/THORPEX is important to the IPWG in this context.

The first session requested that the Co-Chairs make an initial indication of the time and venue for the second session of the IPWG and to inform CGMS-XXIX. The first session requested that the Chair of the OPAG IOS inform CGMS-XXIX of the proposal for the formation of the International Precipitation Working Group as contained in the Appendix.

1.3 EUMETSAT's Nowcasting SAF

In November 1992 EUMETSAT adopted the concept of a distributed Application Ground Segment, including the Central Facilities in Darmstadt, Germany, and a network of elements known as Satellite Application Facilities (SAF), as specialised development and processing centres. Utilizing the specific expertise available in EUMETSAT's Member States, the SAF will complement the production of meteorological products derived from satellite data at EUMETSAT's Central Facilities and will also distribute user software packages.

Among the seven SAFs under development, one is dedicated to Nowcasting and Very Short-Range Forecasting. This SAF develops software packages for the extraction of geophysical products in the areas of clouds, precipitation, air mass parameters, winds, rapidly developing thunderstorms and automatic recognition of conceptual models. The SAF Consortium comprises the Spanish National Meteorological Service (NMS), which is acting as Host Institute, and the NMSs from Austria, France and Sweden. The development phase

of this SAF started in February 1997, and it will enter its Initial Operations Phase (IOP) in 2002. However, due to the delay of the launch of MSG-1, validated/tuned software packages will not become available before 2003.

Two precipitation products are being developed in the Nowcasting SAF: the first, the Precipitating Clouds (PC) product (developed by the Swedish NMS) will provide probabilities of precipitation intensities in pre-defined intensity intervals. The objective of the PC product is to support detailed precipitation analysis for nowcasting purposes. The focus will be on the delineation of non-precipitating and precipitating clouds for light and heavy precipitation, rather than quantifying the precipitation rate. Particular attention will be given to the identification of areas of light rain caused by stratiform clouds. From the probabilities, categories of precipitation intensity may be derived. Two different versions of the product generation software will be derived: i) one based on MSG SEVIRI VIS/IR input data, and ii) one based on AVHRR/AMSU input data. In addition, two sub-versions are being developed, one with a dependency on NWP data and one based entirely on satellite imagery. Prototype PC products are available at http://www.smhi.se/saf.

The second precipitation product will be the Convective Rainfall Rate (CRR) developed by the Spanish NMS. This will be complementary to the Precipitating Cloud product, since it will concentrate on the detection of areas of heavy convective rainfall. The CRR product will be an image-like product providing information on the rainfall intensity in mm/hour for pre-defined intensity classes for clouds identified as convective cells. There will be 5-6 intensity classes. The main use of this product is the monitoring of convective systems, i.e., of their rain intensity, however the CRR product could also be useful for hydrological applications. The CRR method is based on the "Rainsat" algorithm (Bellon *et al*., 1980) and on the NOAA Auto-Estimator technique (Scofield, 1987, Vicente *et al*., 1998).

DRAFT TERMS OF REFERENCE FOR THE INTERNATIONAL PRECIPITATION WORKING GROUP (IPWG)

Background

It was proposed at the first session of the IPWG (20-22 June 2001) to establish the International Precipitation Working Group (IPWG) as a permanent Working Group of the Coordination Group for Meteorological Satellites (CGMS). The IPWG will focus the scientific community on operational and research satellite based quantitative precipitation measurement issues and challenges. It will provide a forum for operational and research users of satellite precipitation measurements to exchange information on methods for measuring precipitation and the impact of space borne precipitation measurements in numerical weather and hydrometeorological prediction and climate studies.

Purpose

In the area of quantitative precipitation estimation, the IPWG intends to build upon the expertise of scientists who are currently involved in precipitation measurements from satellites with emphasis on derivation of products. The IPWG is established to foster the:

- Development of better measurements, and improvement of their utilization;
- Improvement of scientific understanding;
- Development of international partnerships.

Objectives

The objectives of the IPWG are:

(a) to promote standard operational procedures and common software for deriving precipitation measurements from satellites;

(b) to establish standards for validation and independent verification of precipitation measurements derived from satellite data; including:

- reference standards for the validation of precipitation for weather, hydrometeorological and climate applications;

- standard analysis techniques that quantify the uncertainty of ground-based measurements over relevant time and space scales needed by satellite products;

(c) to devise and implement regular procedures for the exchange of data on inter-comparisons of operational precipitation measurements from satellites;

(d) to stimulate increased international scientific research and development in this field and to establish routine means of exchanging scientific results and verification results;

(e) to make recommendations to national and international agencies regarding the utilization of current and future satellite instruments on both polar and geostationary platforms; and

(f) to encourage regular education and training activities with the goal of improving global utilization of remote sensing data for precipitation measurements.

Membership

The Working Group shall be comprised of representatives nominated by the satellite operators of the CGMS, other members of CGMS and relevant research satellite operators. The CGMS or the IPWG may invite other experts from the community to participate in the activities of the group.

Working Arrangements

The Working Group will be chaired by two Co-Chairmen appointed by the plenary of the CGMS. The Co-Chairmen shall compile a report on relevant activities for the scheduled plenary meetings of the CGMS. The interactive connection with satellite operators will be performed through the use of a Rapporteur who will attend and report to the CGMS meetings.

Under the lead of the two Co-Chairmen, the IPWG will organize Workshops, co-sponsored by CGMS and WMO, approximately every two years. The Workshops will promote the exchange of scientific and operational information between the producers of precipitation measurements, the research community, and the user community.

Appendix E: CGMS Working Paper on WMO Activities toward redesign of the GOS

CGMS-XXIX
WMO WP-21
Plenary

WMO ACTIVITIES TOWARDS THE REDESIGN OF THE GLOBAL OBSERVING SYSTEM

Summary and purpose of document

To inform CGMS Members of WMO activities related to the redesign of the Global Observing System.

ACTION PROPOSED

CGMS Members to note WMO activities related to the redesign of the Global Observing System and comment as appropriate.

DISCUSSION

1. Within the CBS OPAG IOS, a number of important activities are underway dealing with the Global Observing System and its "Redesign," or more appropriately perhaps, its "systematic evolution." The future GOS is being vigorously investigated by a team of experts within the Expert Team on Observational Data Requirements and Redesign of the GOS (ET ODRRGOS) which is led by Dr W.P. Menzel of NOAA. That team is charged with the responsibility of recommending a "Redesign" for consideration by CBS 2002. As can be seen by inspection of the ET ODRRGOS terms of reference, below, they are taking a total systems approach in their activity by comparing user requirements to total observing system capabilities, both present and future. They are also considering the role of research satellite contributions to the GOS. The ET ODRRGOS works in close coordination with two Rapporteurs that deal with the Scientific Evaluation of Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs). One important component of a "Redesign" is scientific experimentation using numerical models, and the activity of the ET ODRRGOS has benefited from the support of the Rapporteurs and NWP centers from around the globe.

Terms of Reference for the Expert Team on Observation Data Requirements and Redesign of the Global Observing System (ET ODRRGOS)

(a) Update and report on observational data requirements of the WWW as well as other WMO and international programmes supported by WMO;

(b) Review and report on the capability of both surface-based and space-based systems that are candidate components of the evolving composite Global Observing System;

(c) Carry out the Rolling Requirements Review of several application areas using subject area experts (including atmospheric chemistry, marine meteorology and oceanography through liaison with JCOMM, aeronautical meteorology through liaison with CAeM, and seasonal to inter-annual forecasting as well as climate change detection through liaison with CCl and GCOS);

(d) Review the implications of the Statements of Guidance concerning the strengths and deficiencies in the existing GOS and evaluate the capabilities of new observing systems and possibilities for improvements of existing observing systems to reduce deficiencies in the existing GOS; taking particular care to examine the implications

of changes in observing technology, in particular changes to automated techniques (such as Automated Surface Observing Stations), on the effectiveness of all WMO Programmes, and report on major consequences in a timely fashion;

(e) Carry out studies of hypothetical changes to the GOS with the assistance of NWP centres;

(f) Prepare a prioritised list of proposals for modification to the GOS that are both practicable and amenable to testing, and propose mechanisms for testing them; offer redesign options for CBS consideration;

(g) Develop criteria for dealing with design issues of the composite GOS, paying particular attention to developing countries and the southern hemisphere;

(h) Prepare a document to assist Members, summarising the results from the above activities.

2. As mentioned above, the ET-ODRRGOS has been studying user requirements versus observing capabilities (for the combined space based and in situ observing systems) and considering options for redesign of the GOS towards more comprehensive observations for the World Weather Watch and other WMO programmes. In late April 2001, the ET ODRRGOS benefited from Coordination Group for Meteorological Satellites (CGMS) Workshop on long-term future of the basic satellite sounding and imaging missions. That workshop, held Geneva, Switzerland at the World Meteorological Organization (WMO) brought together experts from around the world to address questions concerning whether important gaps exist in the post-2000 satellite-based component of the Global Observing System (GOS), how they could be filled, and how to prepare for the replacement of the current satellite systems with the next generation satellite systems in the post-2015 era. The CGMS workshop was held concurrent with a meeting of the ET-ODRRGOS; Dr. Menzel will report results in WMO WP 7.

Other important past activity

3. The OPAG Chairman's report to CBS 2000 identified a potential role for Research Satellites as contributors to the GOS:

- Important realities (not in OPAG Chair report but relevant to this discussion):
  - ERS-1 and ERS-2 demonstrated ocean winds;
  - Windsat providing operational ocean surface winds;
  - JASON altimetry for seasonal to interannual forecasting;
  - NASA contributions to operations:
    - MODIS global direct readout;
    - Planned AIRS data in direct readout and for use in global NWP;
    - Planned GIFTS data for operational utilization both for nowcasting and regional and global NWP;
  - NASDA - The GCOM has from its planning stages included an operational concept:
    - "The GCOM system would support the science community as well as operational users, including JMS, NOAA and JAFIC (Japan Fishery Information Center). Mission operations supports global data acquisition, level 0 processing on a real-time basis, and on-line delivery to sensor providers. It will support near real-time processing for operational users and standard processing for earth science users."

- ESA, ENVISAT – No current plans for operational sharing of data.

4. WMO mechanism for policy level interaction with operators of environmental satellites:

- First Consultative Meeting on High-Level Policy on Satellite Matters January 2001:
  - Guidelines for minimum requirements to provide operational users a measure of confidence in the availability of R&D observational data;
  - Take into account the needs of developing countries;
  - Access to satellite data, products and services and appropriate education and training programmes;

5. At the CBS Management Group Meeting held in January 2001:

- The president of CBS informed the meeting of the results of the recent Consultative Meeting on High-level Policy on Satellite Matters, especially with respect to the possible impacts on the GOS. He noted that the research and development satellites were likely to become components of the GOS and that this presented several interesting opportunities.

6. The fifty-third WMO Executive Council held in June 2001 "requested the Commission for Basic Systems to review, as a matter of urgency in order to provide the fourteenth WMO Congress appropriate input, the space-based component of the Global Observing System with a goal of defining an overall system that included appropriately identified R&D satellite missions." At the first session of the CGMS International Precipitation Working Group (IPWG), there was “recognition of the role of research and operational satellites in both regional and global precipitation estimation (to be reported on in WMO WP 14).

7. The CGMS focus group on Virtual Laboratory for education and training:

- Established global training network to help assure benefits from satellite systems would be utilized by WMO Members in a timely fashion (to be reported on in WMO WP)

8. Some important benchmarks lie in the future for the OPAG IOS concerning the “Redesign” activity:

- The President of CBS will brief the second session of the “Consultative Meetings” in February 2002 on activities within CBS addressing the space-based component of the Global Observing System, including activity designed toward appropriately identifying the role of R&D satellite missions;

- The next OPAG ICT meeting in conjunction with ET ODRRGOS will:
  - Make recommendations on the capability and utilization of composite observing systems comprising different observing networks to meet the requirements of the WMO Programmes;
  - Review deficiencies in coverage and performance of the existing GOS;
  - Co-ordinate the development of standardized high-quality observing practices and prepare related recommendations;
  - Assess the impacts of introducing new technology systems into the GOS;
  - Consider and report on the issues of costing, joint funding and management of the GOS;

- There are ET ODRRGOS meetings in January and July 2002 to:
  - Summarize R&D satellites to be considered for GOS;
  - Hear about progress on non-satellite components to GOS (esp. in situ ocean observations);
  - Plan for the updating of the observing system technologies available in the next decade;
  - Review satellite and in-situ observing system Statements of Guidance (SOGs) and their implications for redesign of GOS;
  - Introduce new applications areas to the SOG (e.g., atmospheric chemistry);
  - Interact with AOPC to revise the seasonal to interannual SOG;
- Review OSEs and their implications for the GOS;
- Before CBS 2002, the OPAG IOS's Rapporteur on Regulatory Material will:
  - Review and update sections of the Manual on the GOS, and harmonise available material on the conventional (in-situ) and satellite components of the GOS; and, with support from others in the OPAG,

Arrange for the review of the revised draft of the Manual on the GOS by a consultant/small expert group with the aim of submitting the resulting text to the 2002 session of CBS.