WORLD METEOROLOGICAL ORGANIZATION
=======================================

COMMISSION FOR BASIC SYSTEMS

OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM

ON OBSERVATIONAL DATA REQUIREMENTS AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM

THIRD SESSION

GENEVA, SWITZERLAND

19-23 JUNE 2000

REPORT

WMO General Regulations 42 and 43

Regulation 42

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

Regulation 43

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

1. ORGANIZATION OF THE SESSION

The third session of the Expert Team on Observational Data Requirements and Redesign of the Global Observing Systems (ET-ODRRGOS) was held in Geneva, Switzerland from 19 to 23 June 2000 at the WMO Headquarters Building. The session was opened at 10:00 a.m. on 19 June by the Deputy-Secretary General of WMO. The list of participants is attached as Annex I.

1.1 Opening of the meeting

The Deputy-Secretary General, Mr. M. Jarraud, in his opening remarks noted the importance of the work of the expert team as well as the complexity of the many tasks assigned to it. He recalled that the Global Observing System had been built up painstakingly over the past forty years or so, successfully in some areas, while not so in other areas, for a variety of reasons. In so doing advantage has been taken of developing technology including radar, aircraft, automated weather stations, on land and sea, and satellite imagery and sensing. Despite its imperfections, the GOS has been the mainstay of the World Weather Watch in meeting requirements for weather analysis and forecasting on all time scales at the local, regional and global levels.

The last few years, however, had seen a gradual erosion of the GOS, again for a variety of reasons, not the least of which is financial. WMO Members, therefore, were anxious to optimize their investments in observational systems, including the GOS. Hence, Thirteenth Congress strongly endorsed the initiative of CBS, in creating this expert team whose prime tasks were to review and update the observational data requirements of WMO and other international programmes, and to evaluate the capabilities of new observing systems, as well as improvements to existing systems, to meet these requirements. He noted that the Team will also study scenarios of hypothetical changes to the GOS, prepare a prioritized list of proposals and suggest mechanisms for testing such proposals through Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs). Finally, the Team is expected to develop design criteria for a future GOS which should be responsive to the needs of WMO and other international programmes and conventions including the UNFCCC and the WCRP.

1.2 Adoption of the agenda

The agenda for the meeting was adopted and is reproduced in Annex II.

2. CHAIRMAN’S REPORT

2.1. The Chairman reviewed the development of the CBS approved Rolling Review of Requirements process. He noted that the Expert Team was charged with continuing the process by comparing an expanded suite of user requirements with observing capabilities from both *in situ* and space-based observations. Furthermore, the Expert Team should consider options for the redesign of the Global Observing System (GOS) that would lead to more comprehensive observations for the World Weather Watch (WWW) and other WMO programmes.

2.2. He recalled that the Expert Team, at its last session, had conducted another iteration in the Rolling Requirements Review (RRR) process of the space-based capabilities for meeting WMO user requirements in six applications areas resulting in the publication of the *Statement of Guidance Regarding How Well Satellite Capabilities Meet WMO User Requirements in Several Application Areas, WMO/TD No. 992 (SAT-22).*

2.3. The Chairman was of the opinion that the goals for the third session should include completion of a first review of combined satellite and *in situ* observing systems practices for meeting user requirements in several applications areas including seasonal to inter-annual forecasts. The third session should also continue consideration of possible changes to the GOS regarding the observing systems in maritime regimes and developing countries. Finally, the third session should review results from the recent CGC/WMO NWP workshop and discuss some possible OSEs for consideration at NWP centres.

3. CANDIDATE OBSERVING SYSTEMS UPDATE

3.1. The third session recalled that it had reviewed recommendations from a Technical Conference on Integrated Upper-air Observing (Karlsruhe, September 1998) during its second session. During its second session, the Expert Team had also agreed to review, on an annual basis, a report on "Candidate Observing System Technologies and Their Use".

3.2. The meeting reviewed the first update of the report on "Candidate Observing System Technologies and Their Use". It was impressed by the content and comprehensiveness of the report which included sections on:

- *In situ* upper air measurements, which provided information on AMDAR and ASDAR, ASAP, GPS, radar system development, radiosonde system modernization, radiosonde substitutes, profiling systems, radio acoustic sounding systems, lidar aerosol detection and lightning detection;

- *In situ* surface measurements, including drifting buoy systems, ice buoys, moored buoys, sub-surface floats and ship based systems;

- Satellite measurements (this brief summary will be expanded), and;

- Adaptive strategies for specific events supporting NWP and the Basic Climate Monitoring Network.

3.3 The meeting believed that the information contained in the report could benefit many potential users. It proposed a number of additions to the text to improve the homogeneity of the contents and suggested that the report also include a summary of the components of the present GOS. The session also noted the need for a focal point to edit the report with the expectation that it could be published in a suitable form and under a title which would better reflect its contents.

4. DEVELOPMENT OF THE "CRITICAL REVIEW"

4.1 *In situ* expected performances

4.1.1 The meeting reviewed the process utilized during the second session in preparing expected performances for *in situ* observing systems. In order to refine the expected performances for use at the third session, it had been decided to use the results of the WMO Special MTN Monitoring (SMM) for October 1999. Additionally, an extra data-set was used to supplement the data obtained from SMM to provide more detailed buoy data. It was noted that user provided expected performances still need updating (imperfections remain) and a number of observing systems must still be entered (e.g. atmospheric chemistry).

4.1.2 The meeting noted that the CEOS/WMO database was populated with expected performances derived from the WMO/SMM for each parameter measured by an observing system. Based on the new expected performances, selected Critical Review charts for each geophysical parameter in six application areas (Global NWP, Regional NWP, Atmospheric Chemistry, Hydrology, Synoptic Meteorology and Nowcasting & Very Short Range Forecasting (VSRF)) were prepared. The Critical Review charts were used in the preparation of the Statements of Guidance as discussed under agenda item 5.

4.2 Database review

4.2.1 The meeting noted that the last full review of user estimates of expected observational performances found in the CEOS/WMO database was performed in 1997. It proceeded therefore, to review all user estimates of expected observing system performances as contained in the CEOS/WMO database. Changes and amendments to the database were made. The meeting also agreed that additional available data particularly from ocean areas would be included. Data describing the microwave sounder (ATMS) and multi-spectral imager (VIIRS) anticipated for NPOESS would be added when available. The Secretariat was requested to update the database accordingly. It was also noted that a review of the database manual was required in order to add the names, definitions and unit descriptions for geophysical parameters not contained in the database.

4.3 Geographical charts

4.3.1 The meeting reviewed the status in the development of a prototype chart that would portray expected performances from a geographical perspective. Although there were noted limitations in the geographic displays, the session encouraged the further development of the prototype since it provided a different and valuable means to view the data.

5. STATEMENT OF GUIDANCE ON FEASIBILITY OF MEETING REQUIREMENTS BY SATELLITE AND IN-SITU SYSTEMS

5.1 The meeting reviewed draft Statements of Guidance for Global NWP, Regional NWP, Nowcasting & VSRF, and Seasonal and Inter-Annual Forecasts (SIA) and made a number of proposals to improve the content of each of the Statements.

5.2 Two session working groups were established to review the Statements of Guidance in the noted applications areas. In reviewing the statements, the groups were invited to take the following matters into account:

- The need for a common format for each of the Statements;
- Parameters should be considered in their order of importance;
- Each Statement should have a final section summarizing the main conclusions.

5.3 Summaries of the Statements of Guidance on Global NWP, Regional NWP, Nowcasting & VSRF, Aeronautical Meteorology and Seasonal and Inter-Annual Forecasts are given in Annex III. The meeting agreed that the completed Statements of Guidance should be published as a WMO Satellite Activities Technical Document. Draft observational requirements for Seasonal and Inter-Annual Forecasts are given in Annex IV. The meeting noted the need for subsequent reviews of the SIA requirements by CAS, CCl and CBS.

6. PROPOSALS FOR REDESIGN OF THE MARINE PART OF THE GOS

6.1 The meeting was informed of the ongoing activities by the WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM). At the first transition planning meeting for JCOMM held in Saint Petersburg, Russian Federation in July 1999, it was agreed that a process should begin in which oceanography and marine meteorology would transition from the existing largely unconnected set of monitoring, data management and services activities to a fully integrated system.

6.2 The meeting was informed of the status with regard to the Drifting Buoy Coordination Panel (DBCP), Voluntary Observing Ships (VOS), Ships of Opportunity (SOOP) and ARGO.

6.3 The meeting was informed that the Rolling Review of Requirements process would be of importance in activities related to the joint WMO/IOC Technical Commission. JCOMM would use the Rolling Review of Requirements process in developing a statement of how well their requirements would be met by present, planned and proposed observing systems.

7. REVIEW OF USER REQUIREMENTS FOR AERONAUTICAL METEOROLOGY

7.1 The meeting recalled that at its first session it had suggested that the Commission for Aeronautical Meteorology (CAeM) should review requirements in the existing application areas that could meet its needs and consider further new requirements as necessary. The first session suggested further that such new aeronautical meteorology requirements should be quantified as to their horizontal and vertical resolutions, accuracy, observing cycles, and delay of availability.

7.2 The representative from CAeM informed the meeting that an interim and preliminary review of existing data requirements under Global NWP, Regional NWP, and Nowcasting & VSRF with regard to their applicability for Aeronautical Meteorology had been conducted. The Commission had found that requirements for global/regional NWP for aviation were congruent with those for general NWP and included shorter cycle times to reflect plans for an increase in the number of forecast runs per day. Higher vertical resolution of humidity, wind and temperature fields were found essential for the development and verification of turbulence and icing algorithms. The requirements for aeronautical nowcasting and meteorological watch purposes were found to include additional parameters with higher spatial and temporal resolution. These parameters include liquid water and ice content and estimates of drop size distribution for icing forecasts, cloud ceiling height and visibility for route and terminal area forecasts, wind shear in the boundary layer and high-resolution vertical profiles of wind and temperature in mountainous regions for gravity wave prediction, including information on the depth of boundary layer in complex terrain.

7.3 With regard to the need for volcanic ash information, the meeting noted that it has grown during the past decades due to threats to the safety of flights that volcanic ash hazards have caused. The meeting noted a number of issues related to volcanic ash monitoring. These included data resolution requirements, derived product specifications and observational frequencies already recommended by the Committee on Earth Observing Satellites (CEOS) Volcanic Hazards Team and endorsed by the third Meeting of the ICAO Volcanic Ash Warning Study Group (VAWSG) held in Brisbane, Australia, from 2 to 5 May 2000. It was felt that although requirements for horizontal and vertical resolution in the detection of position and extent of ash cloud could be given, the estimates of required precision for the concentrations of ash and gaseous components should be regarded as preliminary.

7.4 The meeting was pleased to note the draft list of observational requirements unique to aeronautical meteorology (see Annex V). It further noted that the draft list would be reviewed by CAeM.

8. REPORTS ON IMPACT ASSESSMENTS CONDUCTED BY NWP CENTRES UNDER COSNA, EUCOS AND NAOS

8.1. The meeting was briefed on impact assessments studies being conducted by NWP Centres under COSNA, EUCOS and NAOS.

8.2 The meeting noted results from the recent OSE and the sensitivity study performed under the responsibility of EUCOS (EUMETNET Composite Observing System) Programme. The studies were conducted to test the hypotheses that a reduction by half - but with systematically four ascents per day - of the European continental radiosonde network may be compensated by adding AMDAR profile data over major airports without impacting on the numerical forecast quality up to 72 h. Statistically significant impacts on the ECMWF average forecast quality were not identified during the period (20 September 1999 to 15 November 1999); a similar study performed in Météo-France on the Arpège system came to a similar conclusion. Observation and forecast simulation data for this OSE are available at ECMWF. The next step for EUCOS will be to test an adaptative observation strategy for ASAP ships during the 1st quarter of 2001.

8.3 The meeting was informed about recent NAOS activities. NAOS had concluded wintertime tests of a hypothesis that ascent/descent soundings from commercial aircraft at busy U.S. airports can substitute for nearby radiosonde soundings. Forecasts with three operational U.S. models were relatively insensitive to the removal of 14 radiosondes except during the first 12 h in the Eta and Rapid Update Cycle models. In particular, moisture analyses were significantly degraded, but this handicap disappeared by 12 h into the forecast. Wind forecasts in the Rapid Update Cycle model were slightly degraded out to 24 h with removal of the radiosondes. A final report is awaiting NOAA approval. In coming years, NAOS intends to focus efforts in two areas: (1) developing the infrastructure to accommodate data from advanced radiometers and interferometers aboard satellites soon to be launched, and the techniques to assimilate these data into NWP models and (2) designing a mesoscale surface-based and *in situ* observing network for U.S. regional forecasting.

8.4. The meeting was also informed of the Hemispheric Observing System Research and Predictability Experiment (THORPEX). Its primary objective was to test the hypothesis: that the accuracy of Northern Hemispheric cool-season 2-10 day weather forecasts can be significantly improved by additional observations in critical areas of the extra-tropical oceanic storm tracks and other data sparse remote areas; and that cost-effective new *in situ* observing systems can be developed to provide these additional observations. It was noted that the project addressed a number of important issues and that in addition, the real time data to be produced would provide an opportunity for relevant NWP studies. The meeting expressed a wish to stay closely informed on the project.

9. SUMMARY OF RESULTS OF THE CGC/WMO WORKSHOP 2000

9.1 The meeting reviewed the results of the CGC/WMO Workshop 2000 whose major goal was to present and discuss new results of the global and regional data impact studies carried out by leading NWP Centres, and attempt to establish an updated assessment of contributions of traditional and new components of the observing system to forecasting skill. The meeting felt that the conclusions and recommendations of this Workshop would provide an essential input to the redesign process of the GOS.

9.2 The results from the workshop were summarized for the meeting as follows:

- The workshop strongly endorsed recommendations from previous workshops and the CAS Working Group on Numerical Experimentation (WGNE) that studies should be carried out for a sufficiently long period, preferably separate periods in all four seasons and that the significance of the results should be established. This criterion had not been fulfilled for most of the results reviewed at this workshop.

- Very positive impact of TOVS/ATOVS data. For the first time, satellite and radiosonde data have been shown to have a similar impact in the medium-range in the Northern Hemisphere but radiosondes still dominate in the short-range in the northern hemisphere. In the southern hemisphere, satellite data is the main contributor to forecast quality.

- Positive impact from scatterometer wind data and SSM/I wind speed data (mainly in the southern hemisphere).

- Noticeable impact from aircraft data, but smaller than radiosondes in the Northern Hemisphere. Both systems provide complementary information and together improve forecast skill.

9.3 These results led to recommendations for future benefits for observations as follows:

- an operational system should be developed for the collection of commercially available aircraft data, i.e. off-time flights from otherwise data-void areas especially near jets and whole geographic regions (southern Africa, west Pacific, Asia, southern America, Canadian arctic and Siberia).

- valuable observations in automated aircraft reports taken during ascent and descent should be included.

- Development of water vapour sensors on aircraft and efforts to make the observations available for NWP should be continued.

10. CONSIDERATION OF PROPOSALS FOR OSES AND OSSES

10.1 The meeting recalled the need to consider a prioritized list of proposals or scenarios prepared on the basis of the review of hypothetical changes to the GOS and to suggest appropriate mechanisms for testing through OSEs or OSSEs by advanced GDPS centres. In this regard, the meeting considered guidelines for OSEs/OSSEs as follows:

- All experiments (global and regional) should be done in each of the four seasons

- The credibility of the system should be established through proper calibration (e.g. test the impact of simulated real data and proceed with the OSSE only if results are in agreement with measured impact of data).

- Consider the interesting concept of OSRE (Observing System Replacement Experiment) introduced at the CGC/WMO Workshop. The idea is to test if real data could be substituted by new observations simulated from the analysis.

- Request from manufacturers of instruments, specifications for ranges of performances rather than discrete values.

- Consideration should be given to the impact on severe weather event prediction.

10.2 Guidelines about evaluation of OSEs/OSSEs include:

- Validation should include the use of analyses and observations.

- In global impact studies, validation should take regional aspects into account, stratification by weather events, severe weather, etc.

- Consideration should be given to the use of ensemble forecasts to increase the significance of the results.

- Ensure that forecasters/users are involved in the evaluation of the experiments.

11. IMPACTS OF THE REDESIGN OF THE GOS IN DEVELOPING COUNTRIES

11.1 The meeting considered three responses to a preliminary call for comments on the impact of the redesign of the GOS in developing countries. It noted that the Implementation Coordination Team for the GOS had not yet had the opportunity to discuss the Expert Teams' recommendations in this area developed during its second session (1999). The Implementation Coordination Team would address the matter at is upcoming session in September 2000.

12. ANY OTHER BUSINESS

12.1 Consultative Meetings

12.1.1 The meeting was informed that the WMO Executive Council had supported the convening of consultative meetings between WMO and the satellite operators. The purpose of such meetings would be to discuss policy questions related to operational and research & development issues of relevance to WMO activities. WMO would be represented at the highest level by its Bureau (President and Vice Presidents plus key regional representations). A preliminary meeting was held in January 2000 and a formal meeting is now scheduled for early 2001.

12.2 Climate Change Detection and Attribution

12.2.1 The meeting noted the recommendation of the CCl/CLIVAR Working Group on Climate Change Detection, endorsed by the WMO Executive Council, that a scientific evaluation of stations designated as part of the GSN and the GUAN be carried out to assess their suitability and priority for climate change detection and attribution studies. It looked forward to the results of such evaluations with a view to maintaining an up-to-date awareness of the composition of the GSN and the GUAN which it should take into account in its assessment of the GOS and recommendations for its eventual redesign. An applications leader for climate applications was also identified. The Expert Team expressed its enthusiasm for a strong working relationship in this applications area.

12.3 Southern hemisphere pressure sensors

12.3.1 In response to an Expert Team request at its second session, some studies were conducted at ECMWF and BMRC assessing the impact of removing pressures sensors from drifting buoys in the southern hemisphere. A noticeable impact was found, in particular at short range, with degradations in southern hemisphere scores equal to half a day in forecast skill. These results were summarized in a paper presented at the CGC/WMO Workshop 2000 and will be included in the proceedings from that workshop. The meeting thanked ECMWF and Australia for their prompt response to its concerns in this area. The meeting agreed to forward this information to the OPAG chair.

12.4 Estimates of Instruments Performance

12.4.1 The meeting noted that instruments used in many regional and local observational networks (visibility meters, ceilometers, lightning detection sensors, METARs, scanning Doppler radar, etc.) were not listed under the current review. It acknowledged the importance of such networks and agreed that some measures should be taken to improve the situation. It proposed that Application Leaders identified in each applications area not only review and update data requirements but also provide information to the Secretariat on special observation systems and instruments.

13. FUTURE WORK PROGRAMME

13.1 The meeting summarized its accomplishments for the three meetings to-date and remaining tasks to be performed (see Annex VI). The summary will be forwarded to the OPAG IOS Chairman for presentation at CBS-XII in November 2000.

13.2 The meeting noted the need for a closer interaction between WMO and those entities involved with the scientific evaluation of OSEs and OSSEs including the preparation of scenarios, analyses and support to focussed workshops where such topics would be discussed. The session recalled the rapid response to its suggestion for an evaluation of the loss of Southern Hemispheric pressure sensors on drifting buoys. Although the evaluation had been responsive, it was established through an ad hoc initiative. The meeting was of the opinion that a more formal involvement by WMO was necessary, especially in light of the anticipated increase in the need for special OSEs and OSSEs when redesigning the GOS. Thus, it suggested that the Chairman OPAG IOS bring this matter to the attention of CBS with the expectation that the WMO would act as the primary facilitator of such activities.

13.3 The actions resulting from the third session of the Expert Team are given in Annex VII. Tasks suggested for the future work plan are given in Annex VIII.

14. CLOSURE OF THE MEETING

14.1 The Chairman thanked the Expert Team members and other participants for their excellent preparation, cooperation, and dedication. The Chairman further noted that WMO Secretariat had facilitated a very productive session and thanked them for their excellent support. The Chairman closed the session at 13:10 on Friday 23 June 2000.

LIST OF PARTICIPANTS

Dr P. Menzel (Chairman)
NOAA/NESDIS
University of Wisconsin
1225 West Dayton Street
MADISON
Wisconsin 53706
USA
Tel: + 608 263 4930
Fax: + 608 262 5974
Email: paul.menzel@ssec.wisc.edu

Mr H. Böttger
ECMWF
Shinfield Park
READING, Berkshire RG2 9AX
United Kingdom
Tel: (44 118) 949 9060
Fax: (44 118) 986 9450
Email: horst.bottger@ecmwf.int

Mr E. Charpentier
C/o CLS
8-10, rue Hermès
31526 Ramonville St. Agne
France
Tel: (+33) 5 61 39 47 82
Fax: (+33) 5 61 75 10 14
Email: charpentier@cls.fr

Mr H. Daan
Groenekanseweg 82-2
3732 AH De Bilt
The Netherlands
Tel: (3130) 220 3921
Fax: (3130) 221 1195
Email: hdaan@knoware.nl

Mr D. R. Decker
Office of Meteorology, NWS
National Weather Service
1325 East-West Highway
Silver Spring
Maryland 20910
USA
Tel: (001) 301.713.0462
Fax: (001) 301.713.1520
Email: rick.decker@noaa.gov

Dr J.R. Eyre
Head of Satellite Applications
Numerical Weather Prediction Division
The Met Office
London Road
BRACKNELL
Berkshire RG12 2SZ
U.K.
Tel: + 44 1344 856 687
Fax: + 44 1344 854 026
Email: jreyre@meto.gov.uk

Mr J. M. Nicholls
18 Heath Close, Wokingham
Berkshire RG41 2PG
United Kingdom
Tel: (44 118) 978 10 20
Fax: (44 1344) 85 49 48
Email: mike@nichollsvp.freeserve.co.uk

Dr H. Pümpel
Austro Control Aeronautical Met Office
P.O. Box 97
A-6026 Innsbruck
Austria
Tel: (43) 5 17 03 4660
Fax: (43) 5 17 03 4646
Email: herbert.puempel@austrocontrol.at
Mobile: 0043 676 507 4681

Dr F. Rabier
Météo-France, CNRM / GMAP
42 Avenue G. Coriolis
31057 Toulouse
France

Tel: + 33 5 61 07 8438
Fax: + 33 5 61 07 8453
Email: florence.rabier@meteo.fr

Prof I. Robinson
SOES, Southampton Oceanography Centre
European Way, Southampton
SO14 3ZH, United Kingdom

Tel: (+44) 23 80 59 34 38
Fax: (+44) 23 80 59 30 59
Email: Ian.S.Robinson@soc.soton.ac.uk

Mr H. P. Roesli
Meteo Svizzera
CH-6605 Locarno Monti
Switzerland

Tel: (+4191) 756 23 19
Fax: (+4191) 756 23 10
Email: roe@sma.ch

Mr M. Saloum
Service Météorologique du Niger
B.P. 218
Niamey
Niger

Tel: (227) 732 517
Fax: (227) 735 512
Email: acmadem@acmad.ne

Dr T.W. Schlatter
NOAA Forecast Systems Lab
325 Broadway
BOULDER
Colorado 80303-3328
USA

Tel: + 303 497 6938
Fax: + 303 497 7262
Email: schlatter@fsl.noaa.gov

Mr A. Sharp
Bureau of Meteorology
G.P.O. Box 1289 K
MELBOURNE
Victoria 3001
Australia

Tel: + 61 3 9669 4251
Fax: + 61 3 9669 4168
Email: a.sharp@bom.gov.au

Ms A. Simard
Canadian Meteorological Centre
2121 North Service Road
Trans-Canada Highway
DORVAL
Quebec H9P 1J3
Canada

Tel: + 514 421 4765
Fax: + 514 421 4703
Email: angele.simard@ec.gc.ca

Dr W. Zhang
National Satellite Meteorological
Center of China (NSMC)
China Meteorological Administration
46 Baishiqiaolu Road
Beijing 100081
China

Tel: (8610) 6840 6226
Fax: (8610) 6217 2724
Email: wjzhang@nsmc.cma.gov.cn
wjzhang@public.fhnet.cn.net

WMO Secretariat:

Dr A. Karpov
Acting Chief, Observing Systems Division
World Weather Watch Department
WMO
7 bis Avenue de la Paix
Case Postale No. 2300
CH-1211 GENEVA 2
Switzerland
Tel: 0041 22 730 8222
Fax: 0041 22 730 8021
Email: Karpov_A@gateway.wmo.ch

Dr D. E. Hinsman
Senior Scientific Officer
Satellite Activities Office
WMO
7 bis Avenue de la Paix
Case Postale No. 2300
CH-1211 GENEVA 2
Switzerland
Tel: 0041 22 730 8285
Fax: 0041 22 730 8181
E-mail: hinsman@www.wmo.ch

Mr. L. Breslin
WWW Consultant
WMO
7 bis Avenue de la Paix
Case Postale No. 2300
CH-1211 GENEVA 2
Switzerland
Tel: 0041 22 730 8004
Fax: 0041 22 730 8181
E-mail: Breslin_L@gateway.wmo.ch

Dr H. W. Teunissen
WMO
7 bis Avenue de la Paix
Case Postale No. 2300
CH-1211 GENEVA 2
Switzerland
Tel: 0041 22 730 8086
Fax: 0041 22 730 8052
Email: teunissen_h@gateway.wmo.ch

Mr S. Benarafa
WMO
7 bis Avenue de la Paix
Case Postale No. 2300
CH-1211 GENEVA 2
Switzerland
Tel: 004122 730 8408
Fax: 0041 22 730 8021
Email: benarafa_s@gateway.wmo.ch

ANNEX II

AGENDA

1. ORGANIZATION OF THE SESSION
1.1 Opening of the meeting
1.2 Adoption of the agenda

2. CHAIRMAN'S REPORT

3. CANDIDATE OBSERVING SYSTEMS UPDATE

4. DEVELOPMENT OF THE "CRITICAL REVIEW"
4.1 In situ expected performances
4.2 Database review
4.3 Geographical charts

5. STATEMENT OF GUIDANCE ON FEASIBILITY OF MEETING REQUIREMENTS BY SATELLITE AND IN-SITU SYSTEMS

6. PROPOSALS FOR REDESIGN OF THE MARINE PART OF THE GOS

7. REVIEW OF USER REQUIREMENTS FOR AERONAUTICAL METEOROLOGY

8. UPDATES ON IMPACT ASSESSMENTS CONDUCTED BY NWP CENTRES UNDER COSNA, EUCOS AND NAOS

9. SUMMARY OF RESULTS OF THE CGC/WMO WORKSHOP 2000

10. CONSIDERATION OF PROPOSALS FOR OSEs AND OSSEs

11. IMPACTS OF THE REDESIGN OF THE GOS IN DEVELOPING COUNTRIES

12. ANY OTHER BUSINESS
12.1 Consultative meetings
12.2 Climate Change Detection and Attribution
12.3 Southern Hemisphere Pressure Sensors
12.4 Estimates of Instrument Performance

13. FUTURE WORK PROGRAMME

14. CLOSURE OF THE MEETING

ANNEX III

SUMMARIES OF THE STATEMENTS OF GUIDANCE ON

- Global NWP
- Regional NWP
- Nowcasting and VSRF
- Aeronautical Meteorology
- Seasonal and inter-annual forecasts

Summary of Statement of Guidance regarding Global NWP

- Global Numerical Weather Prediction (NWP) models are used to produce short and medium-range forecasts of the state of the troposphere and lower stratosphere. Observations of the 3-D field of wind, temperature and humidity, and of surface pressure and wind are of primary importance, with a growing role for observations of other surface variables and of cloud and precipitation.

- Global NWP centres make use of the complementary strengths of in-situ and satellite-based observations. In the Northern Hemisphere in-situ data from radiosonde, aircraft and surface observations have the larger impact on forecast skill but satellite data now provide comparable benefit, particularly in the medium range; in the southern hemisphere and Tropics satellite data have the dominant impact.

- Recent enhancements in available satellite data (such as AMSU, SSM/I and scatterometer data) have shown positive impacts.

- Recent advances in 4 D data assimilation systems are allowing benefits to be derived from more frequent measurements (e.g. from geostationary satellites, aircraft and surface observations) and from measurements of cloud, precipitation and ozone.

- Global NWP centres are preparing to take advantage of data from high spectral resolution satellite sounders (such as IASI, AIRS and CrIS).

- They could also benefit from increased coverage of aircraft data, particularly from ascent/descent profiles.

- Critical atmospheric/surface variables that are not adequately measured by present or planned observing systems are:

    - wind profiles at all levels (over oceans and sparsely-inhabited areas),
    - surface pressure (over oceans and sparsely-inhabited areas),
    - snow equivalent water content,
    - precipitation, and
    - soil moisture.

- Global NWP centres can now make use of high-frequency *in situ* observations, and their availability should be extended

Summary of Statement of Guidance regarding Regional NWP

Regional (mesoscale) NWP is motivated by a desire to provide enhanced weather services to large population centers and is aided by the availability of comprehensive observations. Oceanic areas are included in the geographical domain for regional weather prediction primarily as a buffer zone upstream from populated land areas, where accuracy is most important. Lateral boundary conditions supplied by global models eventually govern the forecast in the interior of the domain except for locally forced events.

Where observational and computational resources support regional prediction, the following is true:

- NWP centers rely rather more on surface-based and in situ observing systems than on space-based systems.
- Weather radars supply the highest resolution information, but the coverage is spatially limited, vertically and horizontally.
- Satellites supply information at high horizontal resolution; infrared sounding coverage is limited primarily by clouds.
- Accurate estimates of moisture flux are critical for good mesoscale forecasts, especially of clouds and precipitation; the forecasts thus rely heavily upon wind and humidity observations.
- Lower boundary conditions can quickly affect a mesoscale forecast; observations of screen-height temperature (2m air temperature), dew point, wind, and pressure are often good to adequate in coverage and frequency whereas observations of surface conditions, for example, soil moisture, are not.
- In many cases, mesoscale observations are not fully exploited in mesoscale prediction, e.g., radar reflectivity, cloud images, and microwave sounders.
  This is more a problem in data assimilation than in the character or distribution of the observations.

The greatest observational needs for regional prediction are:

- More comprehensive wind and moisture observations, especially in the planetary boundary layer. Enhancement of the AMDAR data collections and the addition of moisture sensors aboard aircraft are recommended. Numerous ground-based GPS receivers need only the addition of simple surface observations to be able to deliver estimates of integrated water vapor. Wind profiles are needed at closer spacing.
- More accurate and frequent measures of surface and soil properties, in that these influence surface fluxes strongly. More accurate estimates of precipitation are sorely needed.

More comprehensive observations of cloud base, cloud thickness, and other cloud properties.

Summary of Statement of Guidance regarding Nowcasting & VSRF

- Nowcasting & VSRF and VSRF consists of analyzing primarily observational data to make forecasts from 0 to a few hours. It addresses phenomena of tens of kilometers in size lifetimes from a few minutes to a few hours.

- Nowcasting & VSRF and VSRF can be applied to many phenomena including severe weather, but is most frequently used to forecast:

  - convective storms with attendant phenomena
  - mesoscale features associated with extratropical and tropical storms
  - fog and low cloud
  - locally forced precipitation events
  - sand and dust storms

- Key Nowcasting & VSRF and VSRF parameters for which observation data are required are:

  - Clouds and precipitation
  - Surface variables; pressure, wind, temperature, present wx, visibility and precipitation accumulation
  - 3 D wind field
  - 3 D humidity field
  - 3 D temperature field

- Well defined high spatial and temporal resolution multispectral imagery from space will provide important immediate benefit to nowcasting phenomena such area as cloud, fog and severe weather monitoring.

- While few in number, scanning weather radar (especially Doppler) provide excellent information critical to improving Nowcasting & VSRF/VSRF of convective, stratiform and local precipitation events with their attendent potential for flash flooding, tornadoes, hail, low ceilings and visibilities and high winds.

- In the intermediate term, the most efficient way of improving the analysis of 3 D wind, humidity and temperature fields important for Nowcasting & VSRF/VSRF is the expansion of AMDAR equipped aircraft providing high resolution wind, humidity and temperature data.

- Doppler wind profilers have proven valuable for Nowcasting & VSRF because they provide high vertical and temporal resolution as a complement to other upper air observing systems.

- Rapid imaging (on the order of minutes) is critical for nowcasting, but it is not yet provided by all geostationary satellites. With some systems, the rapid scan for small areas competes with broader coverage.

- Reliable precipitation estimates still remain elusive, however they will benefit from continuing enhancements to satellite measurement capabilities.

Summary of Statement of Guidance regarding Aeronautical Meteorology

- For upper level temperature and wind forecasts the SOG for global NWP apply for operational forecast production, locally higher vertical resolution is required for development and verification of turbulence forecast algorithms

- For Meteorological Watch purposes, Satellite imagery, and higher-level products such as multi-spectral images, provide good guidance for location and intensity of convection, but only scanning radars in networks combined with lightning detection systems only have the cycle times of less than 10 min required for air traffic control

- For turbulence and gravity wave prediction, current in-situ instruments have acceptable vertical resolution, but are not available in sufficient density for all areas of the globe. AMDAR is a data source with a high potential to fill existing data gaps in the medium term.

- for forecasts and warnings in the terminal area, in-situ and ground-based remote sensor technology has the potential to meet requirements, but its high cost inhibits global availability

- for en-route forecasts for VFR flights, ground based observations are not meeting the required data coverage except for some densely populated areas. Satellite imagery and specialised products have acceptable horizontal resolution, but lack the information on ceiling height for low cloud

- for the detection of volcanic ash clouds and eruptions, satellite remote sensing has significantly improved the lack of information in this field. Sonic data from the CTBT agreement are being investigated as a data source for immediate detection of volcanic eruptions.

Summary of Statement of Guidance regarding Seasonal and Inter-Annual Forecasting

The following key points summarize the SIA forecast SOG. Seasonal to Inter-annual forecasts:

- Show useful skill in regions where there is clearly an atmospheric response to ocean temperature fluctuations such as the El Niño cycle;
- Require complementary atmospheric and oceanic observing systems;
- Have benefited substantially from the input of sub-surface ocean measurements in the tropics (e.g. from the TOGA buoys), and require continued sampling of temperature and salinity profiles on an operational basis;
- Will benefit from improved accuracy of sea surface temperature measurement in the tropics;
- Would benefit from the use of available satellite data on vegetation type and cover (instead of climatology), and on windstress;
- Would benefit from continued topography measurements by altimetry;
- Require further development of assimilation schemes to accept the additional data.

In addition to those listed in the guidance statement on global NWP, the following critical parameter is likely to be measured by in situ sensors in the foreseeable future:

- Upper oceanic profiles of temperature and salinity.

In addition to those listed for global NWP, the critical parameters that are likely to be improved by satellite system measurements are:

- Sea surface temperature;
- Wind stress (surface);
- Ocean surface topography;
- Vegetation type and cover;
- Cryospheric (snow and ice) variables;
- Atmospheric liquid water and cloudiness.

It is important to note that the existing in situ measurements of these parameters have calibration and validation value, in addition to their model input value.

The key observational problems affecting improvements in seasonal to inter-annual forecasting are:

- The transition of research networks and outputs to operational status;
- The timely operational acquisition of data from research and non-governmental systems/sources.

Draft Observational Requirements for Seasonal and Inter-Annual Forecasting

22-Jun-00

Application

Requirement	Hor Res	Min	Vert Res	Min	Obs Cycle	Min	Delay avail	Min	Acc	Min	Confidence	Remarks
S & I A												
Aerosol profile - Higher troposphere (HT)	50 km	500 km	1 km	5 km	6 h	168 h	12 h	168 h	10 %	20 %	Tentative	
Aerosol profile - Lower stratosphere (LS)	50 km	500 km	1 km	10 km	6 h	168 h	12 h	168 h	10 %	20 %	Tentative	
Aerosol profile - Lower troposphere (LT)	50 km	500 km	0.1 km	1 km	1 h	168 h	1 h	168 h	10 %	20 %	Tentative	
Aerosol profile - Total column	50 km	500 km			1 h	168 h	1 h	168 h	10 %	20 %	Tentative	
Air pressure over land surface	50 km	250 km			1 h	12 h	1 h	4 h	0.5 hPa	2 hPa	Firm	
Air pressure over sea surface	50 km	250 km			1 h	12 h	1 h	4 h	0.5 hPa	2 hPa	Firm	
Air specific humidity (at surface)	50 km	250 km			1 h	12 h	1 h	4 h	5 %	15 %	Reasonable	
Air temperature (at surface)	50 km	250 km			1 h	12 h	1 h	4 h	0.5 K	2 K	Reasonable	
Atmospheric temperature profile - Higher stratosphere & mesosphere (HS & M)	50 km	500 km	1 km	3 km	1 h	12 h	1 h	4 h	0.5 K	5 K	Reasonable	
Atmospheric temperature profile - Higher troposphere (HT)	50 km	500 km	1 km	3 km	1 h	12 h	1 h	4 h	0.5 K	3 K	Firm	
Atmospheric temperature profile - Lower stratosphere (LS)	50 km	500 km	1 km	3 km	1 h	12 h	1 h	4 h	0.5 K	3 K	Firm	
Atmospheric temperature profile - Lower troposphere (LT)	50 km	500 km	0.3 km	3 km	1 h	12 h	1 h	4 h	0.5 K	3 K	Firm	
Cloud base height	50 km	250 km			1 h	12 h	1 h	4 h	0.5 km	1 km	Tentative	
Cloud cover	50 km	250 km			1 h	12 h	1 h	4 h	5 % (Max)	20 %	Reasonable	
Cloud drop size (at cloud top)	50 km	250 km			1 h	12 h	1 h	4 h	0.5 µm	2 µm	Speculative	
Cloud ice profile - Higher troposphere (HT)	50 km	250 km	1 km	10 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Cloud ice profile - Lower troposphere (LT)	50 km	250 km	0.3 km	5 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Cloud ice profile - Total column	50 km	250 km			1 h	12 h	1 h	4 h	10 g/m2	20 g/m2	Tentative	
Cloud imagery	1 km	50 km			0.5 h	6 h	1 h	4 h			Firm	
Cloud top height	50 km	250 km			1 h	12 h	1 h	4 h	0.5 km	1 km	Firm	
Cloud water profile (< 100 µm) - Higher troposphere (HT)	50 km	500 km	1 km	10 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Cloud water profile (< 100 µm) - Lower troposphere (LT)	50 km	500 km	0.3 km	5 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Cloud water profile (< 100 µm) - Total column	50 km	500 km			1 h	4 h	1 h	4 h	10 g/m2	50 g/m2	Tentative	
Cloud water profile (> 100 µm) - Higher troposphere (HT)	50 km	500 km	1 km	10 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Cloud water profile (> 100 µm) - Lower troposphere (LT)	50 km	500 km	0.3 km	5 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	

Cloud water profile (> 100 µm) - Total column	50 km	500 km			1 h	12 h	1 h	2 h	10 g/m2	50 g/m2	Tentative	
Dominant wave direction	50 km	250 km			1 h	12 h	1 h	4 h	10 degrees	20 degrees	Firm	
Dominant wave period	50 km	250 km			1 h	12 h	1 h	4 h	0.5 s	1 s	Firm	
Fractional Photosynthetically Active Radiation (FPAR)	50 km	500 km			7 d	30 d	1 d	30 d	5 % (Max)	10 %	Firm	
Geoid	100 km	500 km			20 y	30 y	12 y	24 y	1 cm	5 cm	Firm	
Ice thickness	15 km	250 km			1 d	7 d	1 d	7 d	0.5 m	1 m	Speculative	
Land surface temperature	50 km	250 km			1 h	12 h	1 h	4 h	0.5 K	4 K	Firm	
Leaf Area Index (LAI)	50 km	100 km			7 d	30 d	1 d	7 d	5 % (Max)	20 %	Tentative	
Long-wave Earth surface emissivity	15 km	250 km			24 h	720 h	24 h	720 h	1 % (Max)	5 % (Max)	Tentative	
Normalized Differential Vegetation Index (NDVI)	50 km	100 km			7 d	30 d	1 d	7 d	1 % (Max)	5 % (Max)	Tentative	
Ocean chlorophyll	25 km	100 km			1 d	3 d	1 d	3 d	0.1 mg/m3	0.5 mg/m3	Firm	
Ocean salinity	100 km	250 km			30 d	60 d	9 d	120 d	0.1 ‰	0.3 ‰	Reasonable	
Ocean suspended sediment concentration	100 km	500 km			1 d	6 d	30 d	90 d	Missing	Missing	Speculative	
Ocean topography	25 km	100 km			7 d	30 d	2 d	15 d	1 cm	4 cm	Firm	
Ocean yellow substance	100 km	500 km			1 d	6 d	30 d	90 d	Missing	Missing	Speculative	
Outgoing long-wave radiation at TOA	50 km	250 km			1 h	1 h	240 h	720 h	5 W/m2	10 W/m2	Firm	
Outgoing short-wave radiation at TOA	50 km	250 km			1 h	6 h	240 h	360 h	5 W/m2	10 W/m2	Firm	
Ozone profile - Higher troposphere (HT)	50 km	500 km	1 km	10 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Ozone profile - Lower stratosphere (LS)	50 km	500 km	1 km	10 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Ozone profile - Lower troposphere (LT)	50 km	500 km	1 km	5 km	1 h	12 h	1 h	4 h	5 %	20 %	Tentative	
Ozone profile - Total column	50 km	100 km			1 h	6 h	1 h	4 h	5 DU	20 DU	Reasonable	
Precipitation index (daily cumulative)	50 km	250 km			1 h	12 h	24 h	720 h	0.5 mm/d	5 mm/d	Reasonable	
Precipitation rate at the ground (liquid)	50 km	100 km			1 h	12 h	1 h	4 h	0.1 mm/h	1 mm/h	Tentative	
Precipitation rate at the ground (solid)	50 km	100 km			1 h	12 h	1 h	4 h	0.1 mm/h	1 mm/h	Tentative	
Sea surface temperature	50 km	250 km			3 h	12 h	3 h	24 h	0.1 K	0.5 K	Firm	Tropical ocean most important
Sea-ice cover	15 km	250 km			1 d	15 d	1 d	7 d	5 % (Max)	50 %	Firm	
Sea-ice surface temperature	15 km	200 km			1 h	7 h	1 h	4 h	0.5 K	4 K	Reasonable	
Significant wave height	100 km	250 km			1 h	12 h	1 h	4 h	0.5 m	1 m	Firm	
Snow cover	15 km	250 km			0.5 d	7 d	0.5 d	1 d	10 % (Max)	50 %	Reasonable	
Snow water equivalent	50 km	500 km			1 d	7 d	1 d	7 d	5 mm	20 mm	Tentative	
Soil moisture	50 km	500 km			1 d	7 d	1 d	7 d	10 g/kg	50 g/kg	Reasonable	
Specific humidity profile - Higher troposphere	50 km	250 km	1 km	3 km	1 h	12 h	1 h	4 h	5 %	20 %	Firm	Accuracy 5% in RH
Specific humidity profile - Lower troposphere	50 km	250 km	0.4 km	2 km	1 h	12 h	1 h	4 h	5 %	20 %	Firm	Accuracy 5% in RH
Specific humidity profile - Total column	50 km	500 km			1 h	12 h	1 h	4 h	1 kg/m2	5 kg/m2	Firm	
Vegetation type	50 km	500 km			7 d	30 d	1 d	7 d	18 classes	9 classes	Firm	
Wind profile (horizontal component) - Higher troposphere (HT)	50 km	500 km	1 km	10 km	1 h	12 h	1 h	4 h	1 m/s	8 m/s	Firm	
Wind profile (horizontal component) - Lower stratosphere (LS)	50 km	500 km	1 km	10 km	1 h	12 h	1 h	4 h	1 m/s	5 m/s	Firm	
Wind profile (horizontal component) - Lower troposphere (LT)	50 km	500 km	0.4 km	5 km	1 h	12 h	1 h	4 h	1 m/s	5 m/s	Firm	
Wind profile (vertical component) - Higher troposphere (HT)	50 km	500 km	0.5 km	10 km	1 h	12 h	1 h	4 h	1 cm/s	5 cm/s	Speculative	
Wind profile (vertical component) - Lower stratosphere (LS)	50 km	500 km	0.5 km	10 km	1 h	12 h	1 h	4 h	1 cm/s	5 cm/s	Speculative	
Wind profile (vertical component) - Lower troposphere (LT)	50 km	500 km	0.5 km	5 km	1 h	12 h	1 h	4 h	1 cm/s	5 cm/s	Speculative	

Wind speed over land surface (horizontal)	50 km	250 km			1 h	12 h	1 h	4 h	0.5 m/s	3 m/s	Reasonable
Wind speed over sea surface (horizontal)	50 km	250 km			1 h	12 h	1 h	4 h	0.5 m/s	3 m/s	Firm
Wind vector over land surface (horizontal)	50 km	250 km			1 h	12 h	1 h	4 h	0.5 m/s	5 m/s	Reasonable
Wind vector over sea surface (horizontal)	50 km	250 km			1 h	12 h	1 h	4 h	0.5 m/s	5 m/s	Firm

New requirements to be added to the database

Ocean salinity profile (UO)	50 km	500 km	5 m	20 m	24 h	720 h	12 h	72 h	.1 PSU	.5 PSU
Wind stress	50 km	250 km			1 h	12 h	3 h	24 h	1 %	10 %
Ocean temperature profile (UO)	50 km	500 km	5 m	20 m	24 h	360 h	12 h	72 h	.1 K	.5 K

Note: UO (0 – 500 metres) upper ocean

ANNEX V

Requirements for Aeronautical Meteorology

22-Jun-00

Application

Requirement	Hor Res	Min	Vert Res	Min	Obs Cycle	Min	Delay avail	Min	Acc	Min	Confidence	Remarks
Aero Met												
Atmospheric temperature profile - Lower troposphere (LT)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	2 K	5 K	Firm	Only in steep topography, deep convection, near inversions and jet streams
Cloud drop size (at cloud top)	50 km	100 km			1 h	3 h	1 h	2 h	15 µm	30 µm	Firm	Only in steep topography, deep convection, near inversions and jet streams
Cloud ice profile - Higher stratosphere & mesosphere (HS & M)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	10 %	25 %	Firm	Only in steep topography, deep convection, near inversions and jet streams
Cloud ice profile - Higher troposphere (HT)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	10 %	25 %	Firm	Only in steep topography, deep convection, near inversions and jet streams
Cloud ice profile - Lower troposphere (LT)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	10 %	25 %	Firm	Only in steep topography, deep convection, near inversions and jet streams
Cloud water profile (< 100 µm) - Lower troposphere (LT)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	10 %	25 %	Firm	Only in steep topography, deep convection, near inversions and jet streams
Cloud water profile (> 100 µm) - Lower troposphere (LT)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	10 %	25 %	Firm	Only in steep topography, deep convection, near inversions and jet streams
Specific humidity profile - Lower troposphere (LT)	50 km	100 km	0.15	0.6 km	1 h	3 h	1 h	2 h	5 %	10 %	Firm	Only in steep topography, deep convection, near inversions and jet streams
Wind profile (horizontal component) - Higher troposphere (HT)	50 km	100 km	0.15	0.6 km	0.083	0.16 h	1 h	2 h	2 m/s	5 m/s	Firm	Only in steep topography, deep convection, near inversions and jet streams
Wind profile (horizontal component) - Lower stratosphere (LS)	50 km	100 km	0.15	0.6 km	0.083	0.16 h	1 h	2 h	2 m/s	5 m/s	Firm	Only in steep topography, deep convection, near inversions and jet streams
Wind profile (horizontal component) - Lower troposphere (LT)	50 km	100 km	0.15	0.6 km	0.083	0.16 h	1 h	2 h	2 m/s	5 m/s	Firm	Only in steep topography, deep convection, near inversions and jet streams

New requirements to be added to the database

Radar reflectivity
Doppler velocities
Visibility
Lightning detection
Ceilings
Volcanic ash
Turbulence
Icing
Gravity waves

ANNEX VI

SUMMARY OF ACCOMPLISHMENTS OF THE EXPERT TEAM ON OBSERVATIONAL DATA REQUIREMENTS AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM (GOS) AND REMAINING TASKS

Completed

Established an expanded data base of user requirements in several applications areas and of observing system capabilities for associated measurements

Updated and documented Candidate Observing Systems for the GOS

Iterated the Rolling Requirements Review (RRR) for several applications areas (Global NWP, Synoptic Met, Nowcasting & VSRF, Atm Chem, Agro Met, and Hydrology) with respect to satellite observing system capabilities

Started the RRR for several applications areas (Global NWP, Regional NWP, Nowcasting &VSRF, SIA, and Aero Met) with respect to satellite and in situ observing system capabilities

Expanded applications areas to include Aero Met, Marine, and Climate

Fostered working arrangements with NWP centres for evaluation of redesign options for the GOS

Established some guidelines for OSE / OSSEs

To be completed

Continue data base additions and updates

Iterate the RRR in applications areas already addressed and start RRR in new ones

Evaluate the implications for the redesign of the GOS from the Statements of Guidance

Explore redesign options for the GOS (upon study of overarching guiding principles)

Develop procedures and criteria to test redesign options for the GOS

Offer redesign options for CBS consideration

ACTIONS RESULTING FROM THE THIRD EXPERT TEAM SESSION

Actions outstanding from the Second Expert Team Meeting:

- Request the Chairman of OPAG/IOS to submit proposal to the CBS with a view to rectify the loss of vertical information from RAOBS (Nov 2000)

Actions outstanding from the Third Expert Team Meeting:

1. Edit and publish an updated "Candidate Observing Systems" (see paragraph 3.3, Chairman ETM, Aug 2000)
2. Develop expected performances for oceanographic observing systems (see paragraph 4.3, E. Charpentier, Jul 2000)
3. Observational SIA requirements to be reviewed by CCl and CAS (see paragraph 5.4, Chairman OPAG IOS and Pres CBS, Aug 2000)
4. Observational Aeronautical requirements to be reviewed by CAeM (see paragraph 7.4, Chairman OPAG IOS and Pres CBS, Aug 2000)
5. Complete Statement of Guidances for Global NWP, Regional NWP, Nowcasting, Seasonal and Inter-Annual Forecasting and Aeronautical Meteorology and publish as a WMO Satellite Activities Technical Document (see paragraph 5.4, Chairman Expert Team, Aug 2000)
6. Prepare draft Statement of Guidance for ocean applications (see paragraph 6.3, I. Robinson, Aug 2000)
7. Update database manual to include new parameters (see paragraph 4.3, WMO Secretariat, Nov 2000)
8. OPAG IOS Chair to recommend to CBS formation of scientific evaluation group for OSEs and OSSEs to include WMO co-sponsorship of workshops (see paragraph 13.2, Chairman OPAG IOS, Nov 2000)
9. Review implications for redesign of the GOS in light of SOGs (see paragraph 13.1, Applications area leaders, Mar 2001)

   Global NWP – Eyre
   Regional NWP- Schlatter
   Synoptic Met - Legrand
   Nowcasting &VSRF – Decker
   Seasonal Inter-Annual – Simard and Nicholls
   Aero Met – Puempel
   Hydrology – Engman
   Atmos Chem – Gille

10. Suggest OSE / OSSEs relevant to exploring redesign options (see paragraph 13.1, Applications area leaders, Mar 2001)
11. Search for information on past ideas for GOS redesign and their status (see paragraph 13.1, Secretariat and ICT chair, Dec 2000)
12. Request chairman of OPAG IOS to coordinate with chairman of OPAG ISS to retain the full vertical information from RAOBs in GTS (Nov 2000)
13. OPAG IOS Chair to inform CBS of impact of loss of pressure sensors on southern hemisphere buoys (see paragraph 12.3, Chairman OPAG IOS, Nov 2000)

ANNEX VIII

TASKS SUGGESTED BY THE EXPERT TEAM ON OBSERVATIONAL DATA REQUIREMENTS AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM (GOS) FOR THEIR FUTURE WORKPLAN

1. Continue to update and document observational data requirements of the WWW as well as other WMO and international programmes supported by WMO.

2. Continue to update and document the capability of both surface-based and space-based systems that are candidate components of the evolving composite Global Observing System

3. Continue 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 as well as climate change detection through liaison with CCl and GCOS).

4. Review the implications of the Statements of Guidance concerning the strengths and deficiencies in the existing GOS and explore the capabilities of new observing systems and possibilities for improvements of existing observing systems to reduce deficiencies in the existing GOS.

5. Begin the study of hypothetical changes to the GOS with the assistance of NWP centres.

6. Prepare a prioritized list of proposals for redesign of the GOS that are both practicable and amenable to testing, and suggest mechanisms for testing them.

7. Develop criteria for dealing with design issues of the composite GOS, paying particular attention to developing countries and the southern hemisphere. Issues of costing, joint funding and management of the GOS will be considered.

8. Offer redesign options for CBS consideration.