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

STATEMENT OF GUIDANCE AND THE FEASIBILITY OF MEETING WMO REQUIREMENTS

(*Submitted by the WMO)*

Summary and purpose of document

This document informs CGMS of a Preliminary Statement of Guidance and of the Feasibility of Meeting WMO Requirements.

ACTION PROPOSED:

CGMS Members to note the results of the second iteration for the Preliminary Statement of Guidance and of the Feasibility of Meeting WMO Requirements

Appendices:

A. Preliminary Statement Of Guidance Regarding How Well Satellite Capabilities Meet WMO User Requirements In Several Application Areas

B. Analysis Charts

DISCUSSION

1. The CBS Extraordinary Session held in Karlsruhe, Germany October 1999 recalled that, at its eleventh session, it endorsed a general procedure, the Rolling Review of Requirements (RRR), within which the users' requirements for observations and the capabilities of existing, planned and proposed observing systems to provide them would be reviewed. This procedure would then provide guidance on the development of appropriate observing systems to meet the users' requirements. The role of the Statement of Guidance was to provide an interpretation of the output of the Critical Review, to draw conclusions and to identify priorities for action. The Commission agreed that the Statement of Guidance would be most valuable to space agencies as well as aid to help them obtain funding.

2. The Commission noted that a Statement of Guidance regarding how well satellite capabilities met WMO User Requirements in several application areas, including NWP, synoptic meteorology, nowcasting, hydrology and agricultural meteorology, had been published as a WMO Satellite Activities Technical Document, TD No.913, ((SAT-21) available on the WMO Satellite Activities web pages) as well as presented to the Twenty-sixth session of the Coordination Group for Meteorological Satellites. The Statement of Guidance was approved by CBS Ext. 98 and the Executive Summary from the Statement of Guidance published as an annex to its report. The Executive Summary can also be found in Appendix A.

3. At the direction of CBS, the Open Programme Area Group on Integrated Observing Systems (OPAG IOS) Expert Team Meeting on Observational Data Requirements and Redesign of the Global Observing System held in Madison, Wisconsin, 23-25 June 1999 started a second iteration to the Statement of Guidance that (1) added *in situ* systems to satellite based systems in the analysis of observing capabilities, and (2) added the applications area of atmospheric chemistry to the five initial areas.

4. A Critical Review and an associated Statement of Guidance for atmospheric chemistry were added to the RRR. In addition, the Expert Team reviewed the Statement of Guidance in three applications areas (global NWP, synoptic meteorology, and nowcasting and VSRF); these statements were confined to the space-based capabilities for meeting user requirements. **The review found that no major changes were necessary in the statements of guidance related to these three applications areas, other than noting that the advent of AMSU had produced positive initial impact on global NWP**. The review further suggested changes in a few of the user requirements, another iteration of the Critical Review for some geophysical parameters, and some possible changes in the summaries of the statements of guidance in these applications areas. It was recommended that the review of the remaining three application areas (hydrology, agricultural meteorology, and atmospheric chemistry) be achieved by consulting with experts in these areas.

5. The Expert Team Meeting further discussed the incorporation of *in situ* observing systems into the Rolling Review of Requirements process. The meeting considered the following factors with regard to *in situ* observing systems:

- Types of *in situ* observing systems,
- Capabilities of *in situ* observing systems, and
- Creation of a sample to test the Critical Review process in order to perform a subjective evaluation.

6. The Expert Team Meeting also recognized that it was necessary to categorize the surface-based sub-system of the Global Observing System (GOS) into homogeneous regions before it could describe the associated observing system capabilities. In doing so, it would allow the representation of the variability of *in situ* observing systems over the globe. The meeting then identified a sample set of *in situ* observing systems to include:

- Aircraft reports;
- Balloon-based observations;
- Land surface observations;
- Buoys;
- Ship observations;
- Remote sensing (to be further elaborated);
- Ocean sub-surface profiles; and
- Others.

7. In order to test the proposed categorization of the *in situ* observing systems, a sample data set for land surface observations of air pressure and another data set for aircraft ascent and descent profiles of temperature, humidity and winds were developed. The data, while not fully validated, were felt to be of sufficient accuracy to be representative of the actual observing performances for the two systems. The data were then analyzed through the Critical Review component of the Rolling Review of Requirements. Appendix B contains a graphical representation of these analyses. Appendix B clearly shows that very useful information can be easily discerned in the process. For example, the high performance of the observing systems over Europe and North America was evident whereas the performance over large areas of Africa was poorer. In addition, the review of the combined space based and aircraft observation capabilities demonstrated the richness of the ascent / descent aircraft data over land where space based data are still under-utilized. The meeting agreed that the various observing systems in the analysis showed a good spectrum of performance results between the various regions. Thus the meeting agreed the regionalization and categorization of the *in situ* observing systems appeared to give realistic results and that further development of data describing *in situ* observing systems should proceed.

8. The next Expert Team Meeting on Observational Data Requirements and Redesign of the Global Observing System will take place in Geneva, Switzerland from 28 November to 2 December 1999. Objectives for the meeting will be the more complete representation of *in situ* observing systems in the database as well as completing the Statement of Guidance for the remaining three application areas (hydrology, agricultural meteorology, and atmospheric chemistry).

PRELIMINARY STATEMENT OF GUIDANCE REGARDING HOW WELL SATELLITE CAPABILITIES MEET WMO USER REQUIREMENTS IN SEVERAL APPLICATION AREAS

A review of how well satellite capabilities meet WMO user requirements has been exercised by the Working Group on Satellites for some WMO applications (NWP, synoptic meteorology, nowcasting, hydrology, and agricultural meteorology). This review has utilized a maturing database of satellite capabilities and user requirements. An objective critical review has produced evaluation charts. A subjective interpretation by satellite experts has generated statements of guidance in these applications areas. Some preliminary conclusions regarding satellite capabilities are:

- There is a continuing need in all application areas for operational continuity of a suite of instruments deployed from at least two polar orbiting platforms and at least five geostationary platforms;

- NWP will benefit from the recent microwave enhancements of AMSU to the polar satellites (for a clear and cloudy sky sounding capability) and is awaiting high spectral resolution measurements from instruments such as AIRS, IASI, and CrIS (for enhanced vertical resolution in clear sky soundings), planned for the 2000s. Measurement of wind profiles remains the most challenging (remote sensing lidar systems offer promise, but need the opportunity to mature). Variational data assimilation techniques offer potential for improved exploitation of observations with high temporal frequency, such as radiances from instruments on geostationary satellites; for this reason, user requirements are evolving as assimilation techniques mature. It is becoming clear that expansion of geostationary capabilities to include high vertical resolution clear sky soundings from high spectral resolution infrared systems and all sky soundings from microwave systems will be very useful;

- Current satellite systems are unable to satisfy all the user requirements for synoptic meteorology simultaneously with those for nowcasting; at present, rapid small-scale observations impede the regular larger scale observations. The timely delivery of satellite data and information to users remains a major challenge. Accurate precipitation estimates remain elusive. Both application areas have need of higher temporal and spatial resolution of measurements such as those to be offered by MSG in the next decade;

- Hydrology is anticipating some improvement in estimates of snow cover, snow water equivalent, and soil moisture from the experimental ADEOS-II and EOS microwave instrument (AMSR). Operational implementation of microwave capabilities and expansion of VIS/IR and TIR capabilities remain challenges for basin scale modeling of water and energy balances;

- Agricultural meteorology needs Leaf Area Index and land cover measurements with higher spatial resolution; the polar orbiting instruments need to be enhanced to resolve sub 1 km features. Multifrequency synthetic aperture radar systems should be considered as they could offer significant improvements to canopy structure and water content determinations useful in this application area.

Air pressure over land surface

Analysis for In-situ SFC OBS performance for Global NWP

1. Requirement Summary and assessment key

Colour key	Hor km	Cycle h	Delay h	Acc hPa
Optimum	50.0	1.0	1.0	0.5
Median	85.5	2.3	1.6	0.8
	146.2	5.2	2.5	1.3
Threshold	250.0	12.0	4.0	2.0

Note:
This chart is a comparison between a Global NWP requirement for surface air pressure and expected performances from in-situ observing systems in various geographic regions. It is a component of a Critical Review process and was prepared at the CBS OPAG IOS Expert Team Meeting held in Madison, Wisconsin 23-25 June 1999.

Instrument	**Hor**		**Obs Cyc**		**Delay**		**Acc**		**Mission**	
	km		**h**		**h**		**hPa**		**Name**	**rating**
SFC OBS RA-II E	30.0		3.0		1.0		0.50		WWW	
SFC OBS RA-II W	50.0		3.0		1.0		0.50		WWW	
SFC OBS RA-III S	30.0		3.0		1.0		0.50		WWW	
SFC OBS RA-IV C	50.0		3.0		1.0		0.50		WWW	
SFC OBS RA-VI E	40.0		3.0		1.0		0.50		WWW	
SFC OBS RA-VI W	20.0		3.0		1.0		0.50		WWW	
SFC OBS MED	100.0		3.0		1.0		0.50		WWW	
SFC OBS RA-I S	100.0		3.0		1.0		0.50		WWW	
SFC OBS RA-II S	100.0		3.0		1.0		1.00		WWW	
SFC OBS RA-IV S	100.0		6.0		1.0		0.50		WWW	
SFC OBS SPO OPN	100.0		3.0		2.0		0.50		WWW	
SFC OBS RA-V N	200.0		3.0		1.0		0.50		WWW	
SFC OBS RA-V S	200.0		3.0		1.0		0.50		WWW	
SFC OBS RA-II N	200.0		6.0		1.0		0.50		WWW	
SFC OBS RA-III N	200.0		6.0		1.0		0.50		WWW	
SFC OBS RA-IV N	200.0		3.0		1.0		0.50		WWW	
SFC OBS RA-I C	100.0		12.0		2.0		1.00		WWW	
SFC OBS RA-I N	1000.0		6.0		1.0		0.50		WWW	
SFC OBS RA-VII	500.0		6.0		2.0		0.50		WWW	
SFC OBS ARO CST	1000.0		3.0		1.0		0.50		WWW	
SFC OBS ARO OPN	1000.0		3.0		1.0		0.50		WWW	

Atmospheric temperature profile 1000-500 hPa (LT)

Analysis for ACARS performance for Global NWP

1. Requirement Summary and assessment key

Colour key	Hor km	Vert km	Cycle h	Delay h	Acc K
Optimum	50.0	0.3	1.0	1.0	0.5
Median	107.7 232.1	0.6 1.4	2.3 5.2	1.6 2.5	0.9 1.7
Threshold	500.0	3.0	12.0	4.0	3.0

Note:
This chart is a comparison between a Global NWP requirement for air temperature profile in the lower tropsphere and expected performances from aircraft profile ascent/descent reports over the USA and space-based observing systems. It is a component of a Critical Review process and was prepared at the CBS OPAG IOS Expert Team Meeting held in Madison, Wisconsin 23-25 June 1999.

2. Instruments for: Atmospheric temperature profile 1000-500 hPa (LT)
Showing relevant instruments for which details are available

Instrument	Hor		Vert		Cycle		Delay		Acc		Mission	
	km		km		h		h		K		name	rating
SOUNDER	50.0		1.0		1.0		0.5		2.50		GOES-8,,M	
ACARS RA-IV C	500.0		0.1		3.0		0.3		2.00		WWW ACARS	
CrIS	25.0		1.0		12.0		2.0		1.00		NPOESS-1	
IASI	25.0		1.0		12.0		2.0		1.00		Metop-1,,3	
ATOVS	40.0		1.0		12.0		2.0		2.00		NOAA-15,,N'	
AMSU-A	50.0		1.0		12.0		2.0		2.50		ESA Future Missions	
AMSU-A	50.0		1.0		12.0		2.0		2.50		Metop-1,2	
AMSU-A	50.0		1.0		12.0		2.0		2.50		NOAA-15,,N'	
AMSU-A	50.0		1.0		12.0		2.0		2.50		NPOESS-1	
HIRS/3	40.0		1.0		12.0		2.0		2.50		ESA Future Missions	
HIRS/3	40.0		1.0		12.0		2.0		2.50		Metop-1,2	
HIRS/3	40.0		1.0		12.0		2.0		2.50		NOAA-15,,N'	
HIRS/3	40.0		1.0		12.0		2.0		2.50		NPOESS-1	
TOVS	80.0		1.0		12.0		2.0		2.00		NOAA-9,,10	
HIRS/2	80.0		1.0		12.0		2.0		2.50		NOAA-9,,10	
MSU	160.0		1.0		12.0		2.0		2.50		NOAA-9,,10	
SSM/T-1	200.0		1.0		12.0		3.0		2.50		DMSP-8,,14	
AIRS+	25.0		1.0		12.0		24.0		1.00		EOSpm-1	
MODIS	5.0		1.0		12.0		24.0		2.50		EOSam-1	
MODIS	5.0		1.0		12.0		24.0		2.50		EOSpm-1	
GRAS	300.0		1.0		120.0		2.0		2.00		Metop-1,,3	
MTZA	80.0		1.0		12.0		24.0		2.50		Meteor3M-1,,4	
IMG	100.0		1.0		984.0		336.0		1.00		ADEOS-1	