Appendix B. Draft text for the Part IV (Satellites) and amendments to Introduction, Parts II and V of the Manual on the GOS, Volume I.

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-NO. 544) – VOLUME 1

THE COMMISSION FOR BASIC SYSTEMS,
Noting:

Considering:

Recommends:

ANNEX TO RECOMMENDATION n (CBS…)

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-NO. 544) VOLUME 1, INTRODUCTION

Replace the final sentence of paragraph 1 by:

The CBS has continued to review and recommend amendments to the Manual to in order to maintain its currency. The present edition contains amendments that have been approved by the Executive Committee.

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-NO. 544) VOLUME 1, PART II

Replace Section 2 by:

2. RESPONSIBILITY FOR THE ELABORATION OF REQUIREMENTS

2.1 The formulation of observational data requirements is a complicated process that consists of several stages. At various levels this process involves groups of end-users, regional associations, WMO technical commissions and other bodies. In order to rationalize the formulation of the observational data requirements the following a procedures (schematically shown in Figure II. 1) are applied.

2.2. Users present to WMO Members their needs for observational data for various applications (e. a. meteorological services for aviation, marine navigation, industry, agriculture, climate research, etc.). Meteorological data might be used in two ways: directly in the provision of meteorological services, and in the preparation of meteorological products (weather analysis and prognoses) by GDPS centres. In the latter case, GDPS centres are considered as users.

2.3 WMO technical commissions are responsible for the consolidation of data needs presented by Members and for the formulation of statements on observational data requirements/goals (usually in the form of tables) in various WMO Programmes. This should include explanatory notes and a rationale for the requirements/goals and, if possible, statements on the incremental value of partially meeting these goals and any lower limits of usefulness (in terms of accuracy, density, frequency, timeliness etc.). Often this will include a feedback process with users to ensure that enough information and understanding about users' needs are available. If a statement on requirements/goals is addressed to the World Weather Watch, and in particular to the WWW Global Observing System, it should be presented to the Commission for Basic Systems for consideration.

2.4 The Commission for Basic Systems:

(a) Evaluates the feasibility of stated requirements/goals through expertise provided by appropriate Expert Teams, working under the guidance of the Open Area Group on Integrated Observing

Systems. Where appropriate, the evaluation of technical and instrumental feasibility should be conducted in collaboration with the Commission for Instruments and Methods of Observation, the WMO body responsible for the Instruments and Methods of Observation Programme (IMOP). This would probably involve a feedback process between working groups and technical commissions. The evaluation process will result in the formulation (in the form Statements of Guidance) of what portion of the statement of requirements/goals is feasible and can be achieved;

(b) Formulates system requirements to provide observational data to meet the requirements/goals defined by the technical commissions;

(c) Develops any amendments to the WMO regulatory and guidance publications based on system requirements and submits them (in case of regulatory publications) to the Executive Council.

NOTES: (1) The primary responsibility for the evaluation of the feasibility of meeting stated observational data requirements related to the global atmosphere watch, and for the development of associated guidance material rests with the Commission for Atmospheric Sciences.

(2) Further discussion on the elaboration and evaluation of user requirements is contained in the *Guide on the Global Observing System* (WMO-No. 488), Part II, Section 2.

2.5 The Executive Council approves the amendments and requests the Secretary-General to incorporate them in appropriate WMO Manuals.

2.6 The Members will be advised on the performance of observing systems and programmes through updated WMO Manuals and Guides to meet users' needs for observational data.

[Retain Figure II.1]

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-NO. 544) VOLUME 1, PART IV

Replace by:

1. COMPOSITION OF THE SUB-SYSTEM

The space-based sub-system shall be composed of a ground segment in addition to the space segment consisting of geostationary and near-polar-orbiting operational satellites.

NOTE: Information on the characteristics, capabilities and uses of the current system of meteorological satellites is contained in the *CGMS Directory of Meteorological Satellite Applications.* Additional up-to-date information can be found via the *WMO Satellite Activities Homepage:* http://www.wmo.ch/hinsman. *Information on Meteorological and Other Environmental Satellites* (WMO-No. 411) contains further relevant information.

1.1 Space segment

The space segment shall provide for a global coverage.

NOTES: (1) The different capabilities of the two groups of satellites complement each other and are necessary parts of the space-based sub-system of the GOS.

(2) Both groups are also capable of accomplishing data-collection and data-dissemination missions.

1.1.1 Near-polar-orbiting satellites

1.1.1.1 Missions

The following missions should be performed:

(a) Imagery missions;

(b) Data-collection missions;

(c) Direct broadcast missions;

(d) Sounding missions.

1.1.2 Geostationary satellites

1.1.2.1 Missions

The following missions should be performed:

(a) Imagery missions;

(b) Data-collection missions;

(c) Dissemination missions.

1.2 Ground segment

Receiving and processing stations should provide for the reception of signals and DCP data from operational satellites and/or the processing, formatting and display of meaningful environmental observation information, with a view to further distributing it in a convenient form to local users, or over the GTS, as required.

2. IMPLEMENTATION OF THE SUB-SYSTEM

Members operating environmental observation satellite programmes shall make the satellite data reliably available to other Members and shall inform the Members of the means of obtaining these data.

2.1 Space segment

Members operating environmental observation satellites should meet, to the extent possible, the accuracy, timeliness and the time and space resolution requirements of the GOS.

2.1.1 Number, distribution and availability of operational spacecraft

2.1.1.1 The number of satellites in near polar orbit should be sufficient to provide global coverage at least four times per day for instruments with horizon-to-horizon scanning. Typically this will require one satellite in ante-meridian (a.m.) orbit and one in post-meridian (p.m.) orbit.

2.1.1.2 The number of satellites in geostationary orbit should be sufficient to obtain observations, typically at 30 or 15 minute intervals, throughout the field of view between 50^0 S and 50^0 N. This implies the availability of five satellites, near-equally spaced around the equator.

2.1.1.3 Processed imagery and sounding data should be available from at least one polar orbiting satellite, in a.m. or p.m. orbit, on not less than 99% of occasions. The system design should provide for ground segment, instrument and satellite redundancy, and rapid call up of replacement launches, to achieve this.

2.1.1.4 Processed imagery from five equi-spaced geostationary satellites should be accessible on not less than 90% of occasions and from four such satellites on 99% of occasions. Contingency plans, involving the use of in-orbit stand-by flight models and rapid call up of replacement systems and launches, should be in place to maximise the utility of the available data.

2.1.2 Missions

2.1.2.1 The satellites should be equipped at a minimum to provide the following missions:

(a) Imagery and sounding missions: satellites should be equipped to provide, with the greatest accuracy possible, independently or in conjunction with surface-based observations, quantitative data and qualitative information to enable determination of:

(i) Vertical profiles of temperature and humidity;
(ii) Temperatures of sea, land and cloud-top surfaces;
(iii) Wind fields at the surface and aloft;
(iv) Cloud amount, type and height of cloud tops;
(v) Snow and ice cover;
(vi) Radiation balance data.

NOTES (1) The movements of clouds and water vapour features provide a useful determination of the wind field between 400 to 100 hPa and at approximately the 850 hPa level from low-level clouds. It is also possible to obtain wind data by this method at middle levels, but to a lesser extent.

(2) Passive and active microwave missions have demonstrated their value to operational meteorology, in particular by providing data that allow the inference of surface wind and wave properties over otherwise data sparse oceans, and there are plans to include some such missions in future operational environmental satellites.

(3) Sounding from geostationary orbit has been implemented successfully at national level.

(4) Operational environmental satellites have made useful contributions to many of the information types listed in 2.1.3

(b) Direct broadcast and data-dissemination missions: All operational environmental observation satellites should be equipped to provide direct broadcast or near-real-time data dissemination of the cloud imagery and, to the extent possible, of other real-time data of interest to Members. Additionally:

(i) Members responsible for satellites with these facilities should ensure the greatest possible compatibility between their different systems, and publish details of the technical characteristics of their instrumentation, data processing and transmissions, as well as the dissemination schedules.

(ii) Frequencies, modulations, formats and orbital de-phasing between the a.m. and p.m. satellites should be such as to allow a particular user to acquire data from either satellite by a single antenna and signal processing hardware. To the extent possible, the existing frequency bands should continue to be used.

(iii) Direct broadcast should be provided in two data streams as follows:
- a high data rate stream, such as the present HRPT and its planned evolution, to provide large and medium-sized meteorological centres with all the data required for Nowcasting and NWP, when required, and other real-time applications;
- a low data rate stream, such as in the present APT and WEFAX services and their planned evolution to LRPT and LRIT services, to convey an

essential volume of data for Nowcasting and short period forecasting to low-cost receiving stations.

(c) Data-collection missions: All operational environmental observation satellites should be equipped to provide for the collection and relay of data from various kinds of observing and data-collection platforms (DCP);

(i) Members responsible for satellites with this capability should establish and maintain the necessary technical and operational co-ordination, in order to ensure compatibility. A number of channels should be identical on all geostationary satellites to allow movement of mobile platforms between their individual footprints.

(ii) The satellite operators should publish details of the technical characteristics and operational procedures of their data-collection missions, including the admission and certification procedures.

NOTE: ARGOS, based on polar orbiting satellites, provides an operational system for locating low power transmitters and relaying small amounts of data from them.

2.1.2.2 The above missions make a useful contribution to the monitoring of climate, but to maximise their effectiveness for this purpose data records possessing long term consistency are essential. Members responsible for operational environmental satellites should consider this requirement when planning their launch, calibration, validation, processing and archival strategies.

2.1.3 Experimental satellites

NOTE: Experimental satellites provide, when possible, information for operational use. The purposes of experimental satellites are to acquire a defined set of research data, to test new instrumentation and/or to improve existing sensors and satellite systems.

Although neither long term continuity of service nor a reliable replacement policy are assured, these satellites provide such information as:

(a) Improved temperature and humidity vertical profiles;
(b) Wind speed and direction at the sea surface
(c) Soil moisture distribution;
(d) Ice type and extent;
(e) Wave properties;
(f) Rainfall intensity
(g) Cloud composition;
(h) Cloud liquid-water content;
(i) Distribution of particulate matter in the atmosphere;
(j) Marine pollution and biological properties;
(k) Ozone distribution;
(l) Land cover and vegetation mapping;
(m) Flood and forest fire monitoring.

2.2 Ground segment

2.2.1 Central stations

2.2.1.1 In order to guarantee that comparable meteorological parameters or information are obtained, all Members operating central stations should do their utmost in co-ordinating the extraction of meteorological information.

2.2.1.2 The satellite operators should establish dissemination schedules that take into account the requirements of users.

2.2.2 Users' stations

(a) Receiving stations

(i) All Members should endeavour to install in their territory at least one direct broadcast receiving station for cloud imagery data from the polar satellite constellation and at least one such station for receiving data from a geostationary satellite;

(ii) *When real-time use is planned of the high-resolution imagery transmission, or the high-resolution digital data from the vertical temperature profile radiometer, Members shall install a station capable of receiving the S-band frequencies.*

(b) Data-collection platforms: In order to extend the Global Observing System by the use of the data-collection and relay capability of the environmental observation satellites, Members should establish fixed or moving DCP/ARGOS systems, in particular to cover data-sparse areas.

2.2.3 Archiving strategy

2.2.3.1 Satellite data should be archived at CEOS Level 1B, together with all relevant metadata pertaining to the location, orbit and calibration procedures used. The archiving system should be capable of providing a browse facility, generating summaries and allowing users to develop new products by refining current or developing new algorithms or products.

2.2.4 Education and Training strategy

2.2.4.1 The highest priority should be given to the education and training of instructors in the use of satellite data and capabilities at a sub-set of RMTCs, in order to build up expertise and facilities at a number of regional growth points. In order to help bring this about, individual environmental satellite operators should focus their assistance, to the extent possible, on one or more of these RMTCs within their service areas.

NOTE (1) The aim of this strategy is to systematically improve the use of satellite data for meteorology and operational hydrology, with a focus on meeting the needs of developing countries.

(2) It is designed to focus the participation of all organizations that have a vested interest in improving the use of satellite data and recognises that the satellite operators are one such, with ready access to much of the necessary infrastructure and expertise.

(3) Implementation requires access to appropriate receiving and processing facilities at the RMTCs but training can be carried out through seminars and/or Internet based communication.

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-NO. 544) VOLUME 1, PART V

Delete Section 2