WORLD METEOROLOGICAL ORGANIZATION

Distr.: RESTRICTED
CBS/OPAG-IOS (ODRRGOS-4)/Doc. 7/Add.1
(14.I.2002)

COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP
ON INTEGRATED OBSERVING SYSTEMS

ITEM: 6

EXPERT TEAM ON OBSERVATIONAL DATA REQUIREMENTS
AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM

Original: ENGLISH

FOURTH SESSION

GENEVA, SWITZERLAND, 28 JANUARY-1 FEBRUARY 2002

# Redesign of the Global Observing System: Some implications of the Statements of Guidance (SOGs) for Synoptic Meteorology

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**Summary and Purpose of Document**

Following the agenda item 6, the meeting should review SOGs for various applications areas to infer appropriate implications for redesign of the GOS. This document outlines certain implications of the SOG for Synoptic Meteorology which has a strong link with NWP. Specific information on this issue is presented in the Appendix to this document.

**ACTION PROPOSED**

The meeting is invited to take into consideration the information contained in this document when discussing implications of SOGs for redesign of the GOS.

**Appendix:** **Some implications of the Statements of Guidance for Synoptic Meteorology**

**Some implications of the**
**Statements of Guidance for Synoptic Meteorology**

## *Introduction*

1. As already stated in the SOG document there is a strong link between NWP and Synoptic Meteorology. As a first consequence any improvement of the Global Observing System (GOS) does benefit to the Synoptic Meteorology field. The reader is referred to the corresponding document on NWP aspects. The present document therefore focuses on the aspects of the GOS which complement, from the synoptician's point of view, the direct use in NWP.

2. With the aim of making the reference to the SOG document easier the consequences are discussed following the same structure, i.e. data source by data source rather than parameter by parameter.

3. Before going along these lines, the main deficiency of the current GOS should be recalled which is its highly geographically-variable density. The first objective of any re-design should be to seek a more homogeneous coverage. The oceans and the deserts, and more generally the data sparse areas, are the main areas of concern. Due to their better ability of using satellite sounding data over sea, the NWP modellers now more and more consider the oceans as relatively well covered. This is not really the case in synoptic meteorology, since the forecaster's "mental observation operators" are less adapted to this particular type of data. Given the meteorological importance of the phenomena developping there, the improvement of the ocean coverage remains a primary goal. This first re-design objective of more geographical homogeneity won't be repeated in every paragraph of the document, however it is of general applicability and it is the most important one. Among others this is especially valid for radiosonde and surface measurements, which can be installed in principle anywhere (including ships/buoys) but of course with some costs.

## *Data source by data source*

### Satellites

4. Due to the technical complexity and to the induced costs, the satellite programs are defined a long time in advance. What is written here may not be fully compatible with the current plans and should be seen only as long-term guidances.

5. By nature the satellites meet the first re-design requirement of geographical homogeneity, at least at first order (the unavailability of geostationary data over the polar caps or the land/sea different parameters being seen as second order aspects).

#### *Geostationary satellites*

6. The most important is to ensure the continuity in terms of coverage and data access to the users, regardless of the origin of the satellite. At short term the Indian Ocean coverage is the most critical issue: the current EUMETSAT platform (Météosat-5) is old, and its replacement is essential. It doesn't matter to the tropical cyclone forecasters in this region (as an example) whether the substitute is european, chinese, russian, indian or anything else provided they are able to receive and use data having about the same (or ideally better) characteristics.

7. Less crucial than the presence/absence of a satellite, but still important, is the continuity of the operational scanning programm: it happens sometimes that satellites focus on a certain restricted geographical area for some time, leading to data absence outside of this area, even if there are adverse meteorological situations there. The continuity of the operational scanning programmes is recommended, possibly implying the use of backup satellites for restricted-area special services.

8. At the occasion of satellite replacements, the available channels sometimes evolve. In general this means an increase of the channel number; sometimes it is just a wavelength change. These evolutions should be as far as possible co-ordinated in view of product continuity (which allows improvements) and multi-satellite product generation which is quite useful for forecasters working on geographical areas involving more than one satellite. Since the satellite generations of the different space agencies do not change synchronously, this should obviously be understood with some time flexibility.

9. The main challenge for the future in this field is the precipitation detection. The current precipitation estimates made by statistical linking of infra-red pictures and ground-based radars don't have the required quality, and the polar satellite systems don't have the required time resolution. The important point is to have frequent and reliable precipitation estimates (at least qualitatively like absence of – low – moderate – intense precipitation), over the regions where ground-based radars are not available, which in particular means over sea. The required horizontal resolution is not necessarily the same as for ground-based radars or as for IR imagery; of course it would be ideal, but technological constraints may prevent it; data at 10-20 km (to give an idea) would be already very useful.

*Polar orbiting satellites*

10. An effort should be made to increase the number of operational platforms having a common basic payload, in order to increase the product frequency. This could be made via a better and wider co-ordination of the efforts made by the various satellite agencies (America, Europe, Asia) in terms of instruments and orbit time. The american-european already decided partnership could serve as a model for further extension. A 4-satellite system (with 3h interval between 2 consecutive spacecrafts) or even a 6-satellite system (2h interval) could be envisaged, knowing that this will be about the number of such platforms flying anyway by the end of the decade. This would also allow the nordic countries to have with polar satellites about the same quality of satellite weather monitoring as the mid-latitude and tropical countries with geostationary platforms.

11. As far as classical IR+Visible imagery is concerned the horizontal resolution is already too good given the relatively poor time frequency (even with the above suggested impreovement), and also with respect to the useful scales in synoptic meteorology. Increasing it is therefore not a requirement in this domain, possibly contrarily to other application domains like forest fire detection e.g. . Given the progress made by the geostationary imagery, the spectral performance improvement, allowing to derive elaborated products which could not be obtained from geostationnary channel combinations, would be much more profitable.

12. Wind vectors are measured with scatterometers using different frequency bands. In some of them the data can't be used in precipitating areas, while other bands are insensitive to the precipitations and therefore deliver constant quality data regardless of this aspect. The importance of having surface wind data also in precipitating areas, where crucial meteorological phenomena happen, should be stressed.

13. The availability of microwave-based imagery in a more general framework than now should be encouraged. Contrarily to the NWP trend going more and more to raw data, the requirement is clearly for post-processed derived products such as surface wind speed, water vapour content, and of course precipitation info).

Ground-based teledetection

*Weather radars*

14. These systems have no concurrent for high temporal and spatial precipitation detection. The first general requirement is to extend the coverage by adding new systems. This of course applies first to regions that are not covered until now. But even on covered regions the benefit of increasing

the network density can be important, recalling that the area on which quantitative use of a given radar is possible is significantly smaller than the area where a qualitative approach is only possible.

15. The "advanced" functionalities like doppler capacity, double polarization, vertical exploration are now less and less expensive with respect to the basic price of a radar. Effort should be made on the development of methods for taking advantage of these features and on the exchange of their results.

16. The initiatives aiming at data exchange between neighbouring countries should be encouraged.

*Wind profilers (and wind sodars)*

17. The characteristics of wind profiler data are in principle very well adapted to synoptic meteorology (representative scales, measurement frequency etc.). However the data quality of the currently available systems is very heterogeneous, from very good to very bad, and often fluctuating in time for a given instrument. The first objective is to better understand the reasons of that, which are not obvious, for harmonizing the quality (of course on the "good" side). Then it will become possible to really introduce the wind profilers into the synoptic meteorology practice, which is not the general case now. After that it will be easier to investigate the possible network extensions, including the observation onboard ships if it is proved to be possible.

18. In terms of vertical coverage there is in general a preference in synoptic meteorology for measurements reaching the tropopause, while some other applications focus more on details in the PBL. This is due to the particular role of phenomena occuring at he vicinity of this level, including of course the jet-stream description. But this doesn't mean at all that the data from boundary layer systems are useless since synoptic motions have in general consequences at low level.

*Other ground-based teledetection systems*

19. Some systems like lidars, GPS, radiometers, RASS etc. can be used for teledetection from the ground, isolated or in combined mode. Right now the data are not used (or very marginally) by the operational synoptic forecasters. They may provide useful data. For instance humidity profiling is a domain where accurate and frequent observations are not widespread. Development with the aim of "operationalization" of such systems is encouraged.

Iin-situ measurements

*Radiosondes*

20. The main point is to keep in mind the direct use of radiosonde data by forecasters (providing very fine vertical strucure information for instance), and not only the NWP assimilation, when optimizing the existing networks.

21. In tropical areas the pertinent vertical range for synoptic meteorology significantly exceeds the potential of aircraft data, the 10000-15000m layer (even slightly higher) being very important for the deep convection conditions. This is also true, but to less extent, in mid-latitude regions, having the whole troposphere as an approximation of the required vertical range, recalling also that the tropopause itself is a region where a fine vertical resolution is required, finer that what could be brought by satellite data at least for some time. Therefore the idea of substituting radiosondes with aircraft measurements, even including humidity data in future, should be very carefully considered. The idea of rather complementing the former by the latter (or vice versa) is preferred. This can lead to moving radiosonde stations far enough from any airport from which aircraft quasi-profiles are available: there will never be airports and therefore no ascent/descent observations in most places on the earth surface, on land and obviously on the oceans !

22. The observations have been made until now at 00 and/or 12 UTC (plus 06 and/or 18 UTC for a very few stations mostly in Europe). There is no strong requirement for keeping these times forever. But the reasons for changing could lead to contradictory results: the availability of fine stability information at the end of the night and at the middle of the afternoon would push to a certain type of local time which could be different from the one expected by the forecasters themselves for feeding the NWP models they use. Furthermore going to local time would imply the lost of the synchronism advantages like the availability of a spatial view before any NWP analysis has run (and with finer vertical resolution). But going to other UTC times than 00 and 12 would make some countries happy and some other unhappy. Adopting a weather-dependent programme would be more complicated: the impact at day 1 or 2 (or later) downstream and the usefulness just at observation time may not always coincide. Having more stations running 4 times a day, taking advantage of savings allowed by automation, would somehow simplify the problem (the more frequent the data the higher the probability of having it at the desired time...) but may not be fully realistic from economical point of view. As a conclusion the question is just open, and any decision should be made only after thorough study.

*Aircraft data*

23. Efforts should be made in different directions, which are to some extent already being followed up.
The vertical resolution in ascent/descent phases should continuously vary from very dense close to the ground to coarse at upper levels (currently it is most often constant over the vertical).
Humidity sensors should be added, recalling that this upper-air basic parameter is until now available almost exclusively from radiosondes, contrarily to the wind or the temperature.

24. At longer term the possibility of having dropsondes dropped by commercial aircrafts over the oceans and deserts, and to have the dropping program established in relation with the meteorological situation, should be investigated.

*Surface data*

25. Despite of having written in the introduction that the need for a more homogeneous geographical coverage would not be repeated further in the text, this is first stressed (or recalled) here. The usefulness of buoys/ships data for synopticians leaving not far from coast, or simply the indispensable presence of observations where human beings are living, for allowing to really make and verify forecasts there, is of no doubt but unfortunately not enough concretely translated in most of the regions of the earth.

26. In addition to that, progress in the field of automated sensible weather, visibility, cloud cover measurements etc. and of deployment of the corresponding sensors should be encouraged. The ability of such systems to deliver reliable data also by night is important.