INITIATIVES BY CBS TO ESTABLISH A SYSTEM FOR MONITORING THE QUALITY OF OBSERVATIONS

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1. INTRODUCTION - HISTORICAL BACKGROUND

The first attempt to use synoptic fields for the assessment of the quality of radiosonde data was by Hawson and Caton (1961). They compared reported values of 100-mb geopotential height with values deduced from manual analyses for the summer months. Since the winds at that level and season are almost geostrophic it was possible to analyse the charts by using the British Mk IIb sonde as an arbitrary standard and then drawing to the winds. Means and standard deviations of the differences between the observed and analysed values were derived from a series of 28 cases for Europe, the North Atlantic and the east coast of North America. This technique was used in the Meteorological Office until 1976 to derive bias corrections, known as Hawson corrections, to radiosonde data for both manual and machine analysis. Since 1976, Hawson corrections have been determined by comparison with the numerical objective analysis.

Following Resolution 7 of CIMO-VI, Spackman (1978) produced the first report in a series which still continues, evaluating different types of radiosondes by comparing observations of geopotential in the lower stratosphere with operational objective analyses.

In succeeding years the Meteorological Office archived differences between objective analyses and a variety of data types, and used these on an ad hoc basis to assess the quality of the observations and thus determine how they should be used in the objective analysis. Statistics were also accumulated on the rejection of ships by forecasters and again these were used to assist subsequently in the manual quality control of the data. Information on similar activities in other countries is not

readily available, as such practical work is not usually published.

By 1983, ECMWF had implemented a much more systematic method of monitoring the quality of observations by comparison with the first guess fields in their numerical weather prediction system. This work is described by Hollingsworth et al. (1986). It was becoming clear that such techniques could provide a valuable source of information on the performance of observing systems and could be useful to the operators of those systems as a means of helping to identify faults. There have been several cases where information provided by ECMWF has enabled such faults to be corrected. However, the technique not only brought to light problems with observations but also systematic errors in the analysis/forecast system. It was recognized that the comparison of similar statistics from different centres would help to eliminate the effects of such systematic errors.

In 1984 the CBS Working Group on the Global Data Processing System set up a study group to consider, amongst other things, the setting up of a system to monitor the quality of observations using the capabilities of advanced data processing centres. Their recommendation was eventually adopted, with a few small changes, by CBS as Recommendation 3 of CBS-Ext(85) and approved by EC in 1986.

2. CBS RECOMMENDATION ON MONITORING THE QUALITY OF OBSERVATIONS

Recommendation 3 of CBS-Ext(85) was in the form of an amendment to the Plan for Monitoring the Operation of the World Weather Watch, which appears in the Manuals on the Global Data Processing System (GDPS), the Global Observing System (GOS) and the Global Telecommunications System (GTS). This amendment has been incorporated into those manuals and is effective from 1st November 1987. The text of the amendment is as follows;

> "Centres with global, hemispheric or near-hemispheric models should monitor the quality of conventional observations, in particular upper-air stations (TEMPs and PILOTs), surface land stations (SYNOPs), surface ships (SHIPs) and buoys, using techniques such as those listed in Table E. Statistics should be compiled separately for each land station by station index

number, for each ship by call sign and for each buoy by identifier.

The centres should analyse the results and produce lists in an agreed format of stations, ships and buoys believed to be persistently producing erroneous data together with information on which element of the observation (pressure, temperature etc.) is thought to be in error and the evidence for considering it incorrect. These lists should be based on data received over one month and should be exchanged monthly between participating centres.

The lead centre should co-ordinate all the results, inform the WMO Secretariat immediately of obvious problems and produce every six months a consolidated list of stations, ships and buoys producing suspect data with similar information on which element is considered suspect and why. The list should be passed to the participating centres and the WMO Secretariat who should notify Members responsible for the stations, ships and buoys providing the data which appeared in error and ask them to make an investigation with a view to identifying and correcting any possible cause of error. The Members should be asked to reply in a fixed time period, reporting on any remedial action and stating if any assistance is required. Monitoring results including follow-up action should be made available to CBS, the Executive Council and Congress.

TABLE E

(1) Compilation of statistics on the difference between observed values and the analysis and first guess field;

(2) Compilation of statistics on observations which fail the routine quality control checks;

(3) Examination of time series of observations from a particular station (particularly useful in sparse data areas);

(4) Compilation of statistics on the differences between reported values of geopotential height and geopotential height re-calculated from significant level data for radiosonde stations, using common formulae for all stations;

(5) For surface stations which report both mean sea-level pressure and station-level pressure, compilation of statistics on the differences between reported mean sea-level pressure and mean sea-level pressure re-computed from reported station-level pressure and temperature and published values of station elevation.

(6) Compilation of colocation statistics."

The Commission was unable to agree on the designation of the lead centre at its Extraordinary session in 1985 and deferred the decision until CBS-IX, when it was hoped that more experience would have been gained in the monitoring procedures. In the meantime a format for the exchange of monitoring results between participating centres has been agreed and Members of WMO have been requested by the Secretary General to start exchanging monitoring results on a monthly basis.

3. PROPOSALS FOR THE FUTURE

The decision of CBS-Ext(85) to defer the designation of the lead centre until CBS-IX should be regarded not as a failure but rather as an opportunity, for it leaves the way open to make improvements to the original recommendation. The main weakness in that recommendation was that the way the information from data processing centres was made available to those operating the observing systems was never really properly addressed. This is not too surprising as the recommendation was drafted by the Working Group on the GDPS and that aspect does not lie within their competence. Also, although not specifically stated, the recommendation is mainly directed to the identification of the more obvious errors in observing systems; more detailed investigations are not considered.

There has so far been little experience in comparing the monitoring

results from different centres and it is clear that there is still much to be learnt from this and from dialogue between those carrying out such monitoring and those operating the observing systems. It is therefore very important that any procedures agreed at this stage should be flexible and open ended so that they may be further developed and improved in the light of experience. The suggestions made in the following paragraphs are not intended to solve the problem completely but rather to set up a system which will leave the way open for improvements.

In considering proposals for the future, it may be helpful to identify three time-scales;

I	Real-time	where problems are identified and remedial action taken in time for the data to be useful for forecasting purposes,
II	Non-real-time, short-term	where problems are identified and remedial action taken within a few weeks,
III	Non-real-time, long-term	where problems need more detailed investigation and/or remedial action requires major investment.

As indicated above, Recommendation 3 of CBS-Ext(85) was mainly concerned with problems which fall into category II, hence the monthly exchange of monitoring results and immediate notification of the WMO Secretariat of any obvious problems. However, there was also a recognition that the monitoring activities would bring to light more long-term problems and therefore the six-monthly consolidated list was included. It was recognized that to produce such a consolidated list on a monthly basis would make too heavy a demand on the lead centre and it is also clear that this centre would have little time for detailed investigations of particular problems.

Another way of subdividing the monitoring the quality of observations is to consider each type of data separately. This is the approach adopted at this Workshop where attention is focused is on the radiosonde system but all

aspects of non-real-time monitoring, including the more detailed investigation of problems by such means as intercomparison studies are examined. This division by data type is a more natural way to approach the problem of monitoring the quality of data for those responsible for operating the various observing systems.

The proposals contained in CBS-Ext(85) Recommendation 3 could be extended to take more account of long-term non-real-time monitoring, without placing more demands on the lead centre, by sharing the responsibility for co-ordinating the results among the participating centres. A different centre could be designated as lead centre for each type of data, ie one centre could be responsible for co-ordinating the results for radiosonde data, one for surface ship data, one for buoy data and one for surface land data; the latter could also be subdivided regionally. The monitoring could be extended to other types of data, eg satellites, aircraft reports (AIREPs), ASDAR etc, and a centre could be designated as lead centre for each type. Some centres may act as lead centre for more than one type of data. Moreover, it is not necessary for all centres to actually monitor all types of data. Three centres monitoring each type would be sufficient, although more results would be welcome.

For each data type, the lead centre would not only be responsible for co-ordinating the results in the form specified in Recommendation 3, but would also liaise with the other centres monitoring that type of data and would thus be able to develop further the monitoring techniques in the light of experience. For example it could be agreed that more or different information should be exchanged between them. The lead centre would also act as the GDPS contact point for those conducting intercomparison and other types of studies in the relevant observing system.

There would be similar arrangements to those specified in Recommendation 3 for informing the WMO Secretariat of the results, ie both monthly and six-monthly lists, and the Secretariat would have the same responsibility for contacting Members operating the observing systems. However, Members could also be encouraged to liaise directly with the lead centres and provide relevant information on the operation of their stations/ships/buoys.

In keeping with the philosophy of flexibility, the arrangements for the

designation of lead centres should be such as to allow for future developments. Not all centres may be able or willing to take on this responsibility at the present time but they may wish to do so in the future as their capabilities develop. It may be desirable, in the future, to introduce some form of regional responsibility, particularly for surface stations.

4. CONCLUSION

CBS has already taken initiatives concerned with monitoring the quality of observations, including radiosonde data, by adding a section to the Plan for Monitoring the Operation of the World Weather Watch in accordance with Recommendation 3 of CBS-Ext(85). This new section of the Plan could be easily amended to give a more flexible system for monitoring the quality of observations. Such a system could be easily extended to include more detailed studies of the quality of data and could be adapted to take account of future developments in monitoring techniques and in the capabilities of data processing centres.

5. REFERENCES

Hawson, C.L. and Caton, P.G.F., 1961: A synoptic method for the international comparison of geopotential observations. Meteorological Magazine, 90, 336-344.

Hollingsworth, A., et al., 1986: Monitoring of observation and analysis quality by a data assimilation system. Mon. Weath. Rev. 114, 861-879.

Spackman, E.A., 1978: The compatibility and performance of radiosonde measurements of geopotential height in the lower stratosphere for 1975-76. WMO-No.512, Tech Note No.163, Part II, 27-103.

WMO, 1977: Manual on the Global Data Processing System. WMO-No.485.

WMO, 1981: Manual on the Global Observing System. WMO-No.544.

WMO, 1986: Manual on the Global Telecommunications System. WMO-No.386.