WORKSHOP/MEETING SUMMARIES

GEWEX/GPCP WORKSHOP ON OBJECTIVE ANALYSIS OF PRECIPITATION

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The Workshop was sponsored by the GEWEX/ Global Precipitation Climatology Project (GPCP) and the European Center for Medium-Range Weather Forecasts. **The primary goals of the workshop were to improve our understanding of the issues involved in the objective analysis of precipitation using the many sources of information available (e.g., gauges, satellite-derived estimates, radar observations, and model output data); and to make recommendations for GPCP to advance its efforts to provide global analyses of precipitation**.

Twenty-six participants from seven different nations presented their latest work on analysis procedures, data assimilation and observational error characteristics. The various precipitation analysis methods were reviewed on the first day. The focus of the presentations was somewhat different between the observation only and data assimilation analysis groups. In the former, the center of attention was placed on the problem of precipitation observations, bias corrections and merging of different types of observations, while in the latter, the use of the observations were limited to the Tropical Rain Measuring Mission (TRMM) and radar/rain gauge measurements, and the focus was placed on the methods for using precipitation observations in the data assimilation system. This difference clearly contrasted the major interests of the two groups, one is more concerned with the precipitation observations themselves, while the other is concerned with the utilization methods. However, there are many common subjects between the activities of the two groups which came out as very useful working group recommendations. In the second day, quality control of precipitation observations, precipitation characteristics observed from TRMM, and monitoring of the precipitation in polar region were discussed. The presentations were concluded by a talk promoting international collaboration through the International Precipitation Working Group.

The late afternoon of the second day and the third day was used for the Working Group deliberations. The participants were separated into observation only analysis, data assimilation and quality control groups. These three groups are summarized in the following paragraphs.

The observation-only analysis needs to continue. **The precipitation analysis from advanced data assimilation is still not sufficiently accurate, and observation only analyses need to be used as a baseline.** The quality of the observation-only product should continue to improve. Various analysis issues, including data collection, bias correction and merge procedures should be also be investigated further. The requirements from the Numerical Weather Prediction (NWP) community were subdivided into the validation of the global model (analysis and forecast), climate (monthly data), the use of precipitation observations for data assimilation (6-hourly), and the validation of extreme event forecasts (hourly). It was stressed that all data levels should be made available to allow the wide range of applications of precipitation information in NWP. This includes Level 1b (calibrated, navigated raw instantaneous observations), Level 2 (first-order products; instantaneous), and Level 3 (merged, accumulated products; gridded) data of rainfall, rainfall frequency of occurrence, and associated errors. It was pointed out that for the optimum utilization of precipitation data in NWP data assimilation systems, a very close collaboration between algorithm/product developers and modelers is needed.

It is clearly recognized that there is a need for providing error statistics more useable for data assimilation. This includes error statistics of individual observations, rather than the merged products, of each component of errors, namely, the errors associated with a) instruments, b) physical retrieval, c) assumptions on spatial representativeness, and d) assumptions on temporal representativeness. It is also desirable to provide spatial and temporal correlations of observational error, error in precipitation detection and the uncertainties in the bias.

Active collaboration between modelling/observation/validation groups is needed for a complete description of the analysis errors: biases (their uncertainties), error covariances, their state dependence, and methodologies for the description of their dependence on space and time scales and synoptic

conditions. The GPCP analysis project can provide additional valuable information to the NWP community, but more communication between the two groups is needed. This can be achieved through the GPCP, GEWEX Radiation Panel (GRP) and the International Precipitation Working Group.

As to the future analysis method for GPCP, the data assimilation group believes that developing an assimilation method is not recommended and some other more nonlinear methods (such as Krieging) suitable for analysis of precipitation should be developed. Such work will also complement the data assimilation analysis.

There was an indication that the data assimilation precipitation is known to be more accurate than satellite estimates over some areas, particularly in higher latitudes, orographic areas, snow covered areas and snowfall. Addition of data assimilation precipitation analysis into the observation-only analysis should be considered for providing more accurate, fully global precipitation analysis to general users. In this regard, the examination of the accuracy of data assimilation precipitation needs to be encouraged.

For the observation-only analysis, several improvements were discussed. The analysis of frozen/snow precipitation, analysis over complex terrain and the use of new satellite observations are the major recommendations.

Observations/products are required on smaller scales (space/time) because data assimilation will increasingly employ time-series of data and focus on more regional applications.

There is a need to continue developing high-quality, unbiased reference sites across the range of climate regimes for validation of precipitation analyses. There is also a need for research on radar precipitation estimates, which are increasingly used by regional data assimilation analysis.

Finally, the data assimilation analysis holds the key to the future for precipitation analysis, since its greatest advantage is that it can provide the analysis of observed and derived meteorological variables (together with precipitation) in a dynamically, physically and hydrologically consistent manner. However, it will take several more years before the assimilated precipitation analysis becomes as accurate as currently available observation-only analysis. The collaboration with the GPCP group will certainly accelerate this important development.