Meteorologische Zeitschrift, Vol. **11**, No. 5, 367-370 (October 2002)

Short Article

Verification scores for the operational GPCP-1DD product over the European Alps

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(Manuscript received August 9, 2002; in revised form September 3, 2002; accepted September 5, 2002)

Abstract

The *Global Precipitation Climatology Project* has provided, beginning October 2000, operational 1 degree/daily multi-satellite precipitation fields. Purpose of the present study is to verify this GPCP-1DD product with ground truth over the Alpine area. The surface fields for the verification were gained from 3 100 daily rain gauge measurements operating during the European MAP project (June/July 1997). We compare the earlier experimental version of the GPCP-1DD with the present operational version. The latter is now free of systematic errors and can therefore be recommended as quantitative precipitation estimate on a monthly scale. On the daily scale, however, the operational precipitation pattern exhibits no better accuracy than already achieved by the experimental version.

Zusammenfassung

Das *Global Precipitation Climatology Project* bietet seit Oktober 2000 operationelle, tägliche 1-Grad Niederschlagsfelder. In der vorliegenden Arbeit wird dieses Multi-Satellitenprodukt mit Ombrometermessungen über den Alpen verifiziert. Für die Bodenwahrheit wurden Werte von 3 100 Stationen aus dem Europäischen MAP-Projekt (Juni/Juli 1997) analysiert. Wir vergleichen die frühere experimentelle Version des GPCP-1DD Produkts mit der operationellen Version. Diese ist jetzt frei von systematischen Fehlern und kann daher als quantitative Niederschlagsbestimmung auf der Monatsskala empfohlen werden. Allerdings ist die Genauigkeit der operationellen Niederschlagsfelder auf der Tagesskala nicht höher als die der experimentellen Version.

1 Introduction

Real-time daily precipitation fields with global high resolution are required today for many applications. Since this cannot be achieved with the existing surface network, precipitation algorithms from multiple satellites have been developed within the Global Precipitation Climatology Project (GPCP). Regional ground truth data are now asked for in order to estimate the accuracy of these products. Goal of this paper is to present verification scores for the operational Global Precipitation Climatology Project 1-degree daily (GPCP-1DD) fields (HUFFMAN et al., 2001). The ground truth for this purpose will be high quality analysed precipitation data over the European Alps as provided by the *The Mesoscale Alpine Programme* (MAP).

The experimental version of the GPCP-1DD product, together with the operational t+6 to t+30 hours model predictions from the *European Centre for Medium Range Weather Forecast* (ECMWF), have recently been compared with the analysed surface observations of precipitation over the same area (RUBEL and RUDOLF, 2001). The domain of MAP covers a region over Europe with the Alps in the middle where data from a high resolution rain gauge network are available. Verification results have been given in terms of continuous statistical measures such as mean error, mean absolute error, RMS error, rank-order correlation coefficient as well as categorical scores such as probability of detection (POD), false alarm ratio (FAR) and true skill statistics (TSS). A major outcome of the study was, that the ECMWF predictions have a higher performance in forecasting the spatial distribution of the precipitating areas, while the GPCP-1DD satellite estimates have lower mean errors. Both global precipitation products underestimated the ground truth precipitation (mean error GPCP $= -0.59$ mm/day; ECMWF $= -1.13$ mm/day).

Since October 2000 the NASA provides the new operational version of the GPCP-1DD precipitation product[1]. For this reason the verification procedure has been repeated by replacing the experimental with the operational version of the GPCP-1DD product. The new

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[1] Available at http://precip.gsfc.nasa.gov/

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DOI: 10.1127/0941-2948/2002/0011-0367

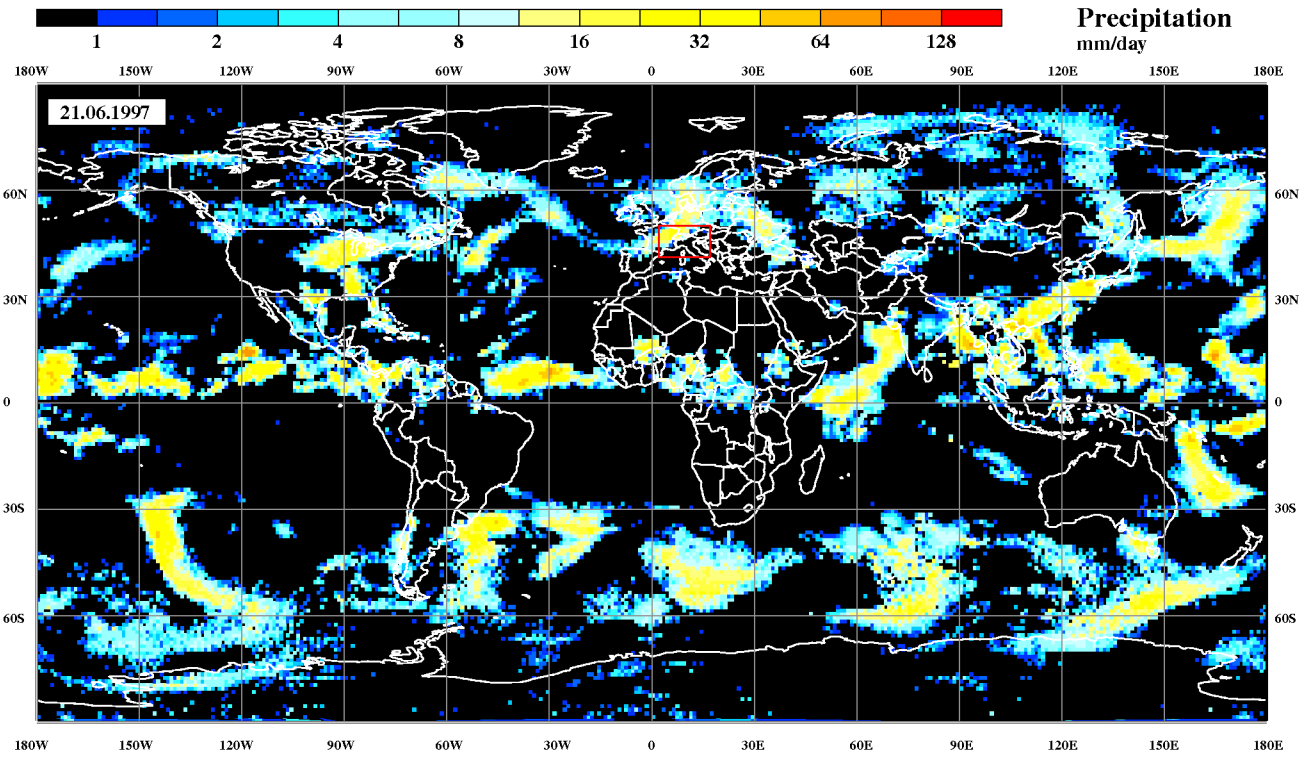


Figure 1: Global 1-degree daily estimate of precipitation (GPCP-1DD) from satellite data of 21 June 1997 with the MAP verification region of 15 × 9 grid boxes (longitude: 2°E to 17°E, atitude 41°N to 50°N) marked by a red rectangle. Units mm/day.

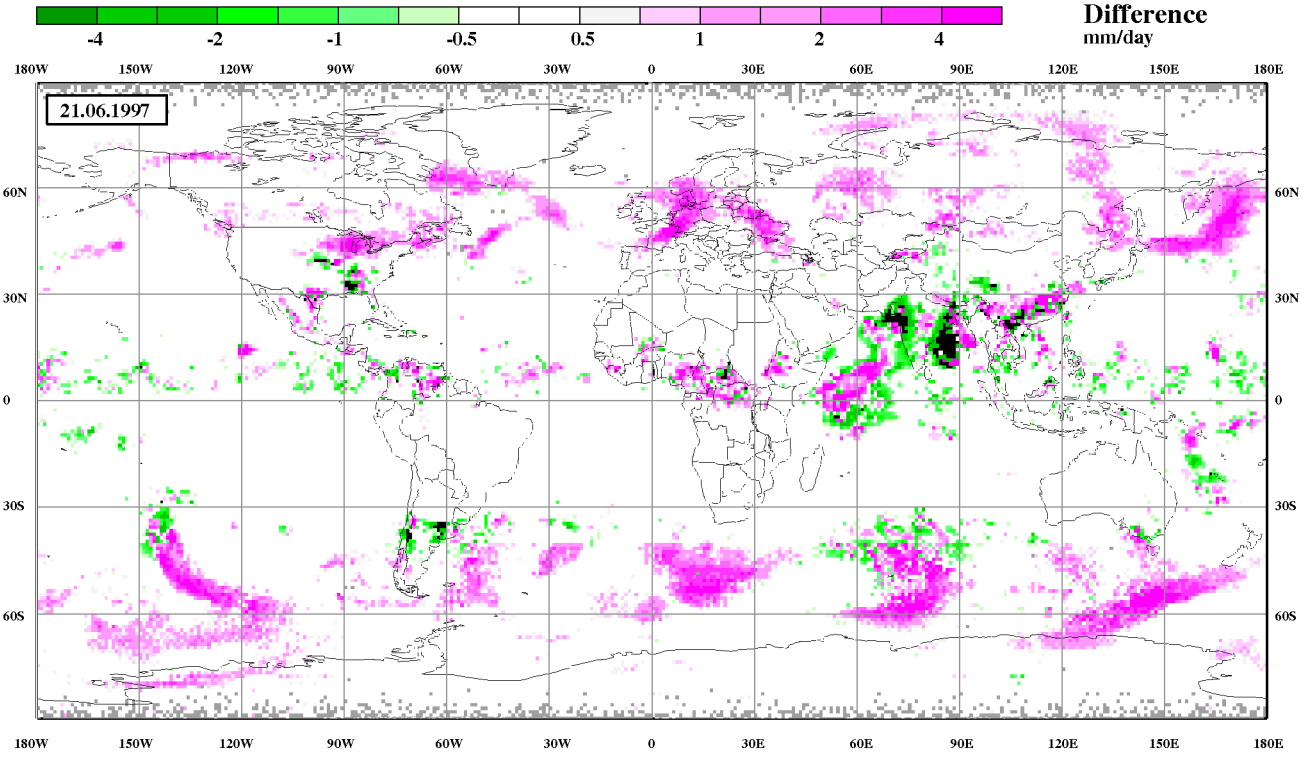


Figure 2: Difference of the operational minus the experimental version of the GPCP-1DD product for 21 June 1997. Units mm/day.

verification scores should point out possible improvements in the performance of the operational GPCP-1DD product.

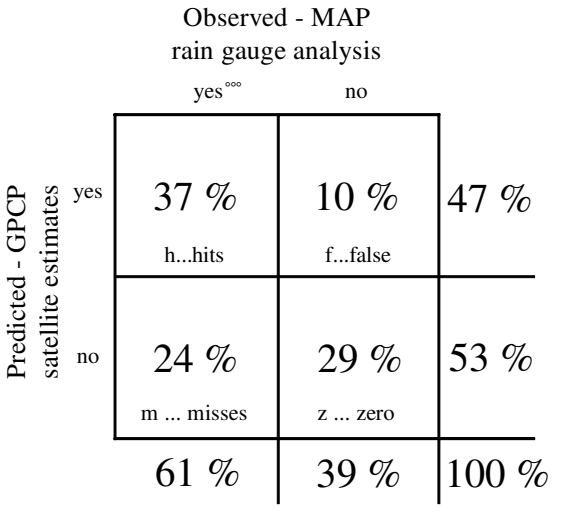
2 Data and method

For this study the same data base as described by RUBEL and RUDOLF (2001) was used, merely the experimental version of the GPCP-1DD data has been replaced by the operational version. The surface observations consist of 3100 rain gauges located in the MAP domain, which have been interpolated onto the grid of the GPCP-1DD precipitation fields by applying a statistical analysis method (block kriging). Both, the precipitation estimates from satellite (GPCP-1DD) and the analyzed surface observations (MAP) are treated as areal assessments. Thus, the GPCP-1DD as well as the MAP data base represent the same spatio-temporal scale which is the basis for a consistent verification. This verification procedure, opposite to a verification at the scale of a single rain gauge, is also favoured by other authors, e.g. CHERUBINI et al. (2002).

Fig. 1 depicts as an example the global precipitation estimate for 21 June 1997 as well as the MAP domain marked by a red rectangle. The verification has been performed during the MAP observing period June/July 1997. The verification method for this period comprises time series of daily verification scores calculated according to the scores previously presented by RUBEL and RUDOLF (2001) as well as scores for the entire period. Additionally, daily precipitation fields, analysed (MAP), estimated from satellites (GPCP) and modelled (ECMWF) as well as the areal distribution of the major verification measures have been calculated (not shown). Further details on the verification of the GPCP-1DD precipitation fields may be found in SKOMOROWSKI (2002).

3 Results

First of all, a new characteristic of the operational GPCP-1DD data is that they are free of missing values. For this reason the GPCP-1DD data have improved relevance to be used as model input, where missing values are hindering. As an example Fig. 2 depicts the difference between the new operational and the experimental version of the GPCP-1DD data for 21 June 1997. The grey coloured grid boxes in the polar regions indicate the missing values in the experimental data, that are now filled with precipitation values (see Fig. 1). Further, Fig. 2 depicts the re-calibration, showing increased precipitation values in the mid-latitudes. In the tropics, where satellite algorithms generally lead to better results, the re-calibration trend is not uniform.



Continuous statistics		Categorical statistics	
Observed	3.58	Hit rate, HR	0.66
Estimated	3.76	Critical success index, CSI	0.52
Mean error	0.18	Prob. of detection, POD	0.60
Mean absolute error	3.44	False alarm ratio, FAR	0.21
RMS error	6.20	Bias score, BIAS	0.78
Rank-order correlation	0.51	True skill statistics, TSS	0.36

Figure 3: Contingency table for the calculation of categorical verification scores as well as continuous and categorical scores for the operational GPCP-1DD product. For a more detailed description and comparisons with the experimental GPCP-1DD product as well as ECMWF predictions see RUBEL and RUDOLF (2001). Units of observed and estimated precipitation as well as errors are given in mm/day. Period June/July 1997.

The statistical verification measures have been calculated in analogy to those for the experimental version of the GPCP-1DD product. They are shown in Fig. 3 and are directly comparable to Fig. 9 given by RUBEL and RUDOLF (2001). The mean daily precipitation analysed in the MAP model domain is now 3.58 mm/day. Note that the small deviation of the observed value compared to the value calculated for the experimental version is caused by the different number of grid boxes considered in the verification procedure. The satellite estimate for the same period is 3.76 mm/day resulting in a mean error of 0.18 mm/day. This is about 5% of the observed precipitation and is equivalent to the expected systematic measurement error of the rain gauges.

The systematic error of the MAP data set has not been considered since it is on the high frequency daily scale. On the other hand, this systematic error has been duly implemented in the GPCP-1DD calibration. For these reasons it can be stated that the new GPCP-1DD data has negligible bias. Consequently, the monthly precipitation estimates from the GPCC, the Global Precipitation Climatology Centre (RUDOLF et al., 2001) which have been used for calibration have been shown to be consistent with the high resolution rain gauge analysis over the MAP domain.

All other verification scores for the operational GPCP-1DD product remain nearly unchanged. There

are no significant differences compared to the scores for the experimental version. Thus, all statements about the experimental GPCP-1DD precipitation fields given by RUBEL and RUDOLF (2001) are valid also for the operational version of the GPCP-1DD product. Especially, this is true for the time series of the daily correlation coefficients and skill scores.

4 Conclusions

The GPCP-1DD precipitation fields are unique in various respects. They are now available online, updated with about 3 months time delay and free of charge; this update interval is considered short by climatological criteria so it is referred to as *near real-time*. The product has by now been released for the period Oct. 1996 to Jan. 2002. The GPCP-1DD data set gives the scientific community a quick and easy access to well documented, global, daily precipitation fields.

We have shown here that the calibration of the operational version of the GPCP-1DD data has been improved as compared to the preliminary experimental version. The calibration over the European Alps is now perfect on the monthly scale. On the other hand, daily precipitation values, even when averaged over the entire region of MAP, may still differ significantly from observations. The daily verification scores (Fig. 3) are identical to those for the experimental version [see Fig. 9 of RUBEL and RUDOLF (2001)]. This indicates that research and development in the field of satellite precipitation estimates has not yet come to an end.

Acknowledgement

This research was supported by the DWD project *Verification of GPCP products using BALTEX and MAP precipitation analyses*. The data used in this study have been provided by the MAP Data Centre and the NASA Goddard Space Flight Center.

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