Rain gauge data quality revisited: old-fashioned or new trend?

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Abstract

Data quality plays an increasingly important role in the huge amount of data which is being collected nowadays: from traditional meteorological weather stations via weather radar (WMO JET OWR Best Practice Guide for Weather Radar, Michelson et al., 2023) to opportunistic sensing data (Seidel et al., 2023) or IoT sensors (www.opensense.org) - it becomes more and more important which data you can trust. Therefore, efforts are undertaken to prove the quality of data for their specific fields of interest.

Experience from decades of rain gauge data and from two decades of radar data have shown: The quality of rain gauge data is crucial for online applications as well as for climate trend analyses. A manual procedure for data quality control is well established but not feasible for online applications or huge data amounts.

In this paper, we describe steps towards the direction of automated, radar assisted quality control of rain gauge data and ways to automatically document the data quality characteristics.

The past experience has shown that spatial-temporal behaviour of rainfall (especially of convective cells) leads to problems in automatic checks. Therefore, already existing methods of rain gauge quality control have been combined with new variability methods with the objective to only use rain gauge data for adjustment procedures, which are spatially comparable to radar data.

Automatic spatial tests with surrounding gauge stations have been extended with radar data. In addition to the values of four surrounding gauge stations in different directions, the confidence interval with median weighted mean values and standard deviations of radar data in the environment plays an important role. Now, extreme value detection is a combination of rain gauge comparisons and radar data comparisons with set thresholds for different time intervals (5, 60 and 1440 minutes). Radar data should be at least 20% of rain gauge value at the same location.

Because manual checks base often on form observations of cumulative precipitation curves, consistency checks help to transfer this to automatic checks. Therefore, correlation coefficients at one location are calculated for the cumulative rain gauge and radar curve. If the result is below a defined limit, it will be documented. This method has the advantage to be independent of rain amounts and focused on form details of cumulative precipitation curves.

To evaluate the automatic rain gauge checks the results are analysed in two steps: 1. compare number of cases in error categories (s. Fig.1) and 2. control manually time series at found occurrences. The evaluation basis were 42 stations in the Berlin region (Germany) for a period of seven months. The correlation tests based on a time interval of one day.

Our first results of the extended automatic checks have shown an obvious improvement due to the inclusion of radar data. Most (ca. 80%) of the manual found errors could be detected with smart method combinations and set thresholds. This is a good base to improve rain gauge data for online

use and adjustment procedures with radar data. New wrong cases in the consistency check resulted from time shifts around the change of day for example. This effect can be seen more often if the time interval is reduced.

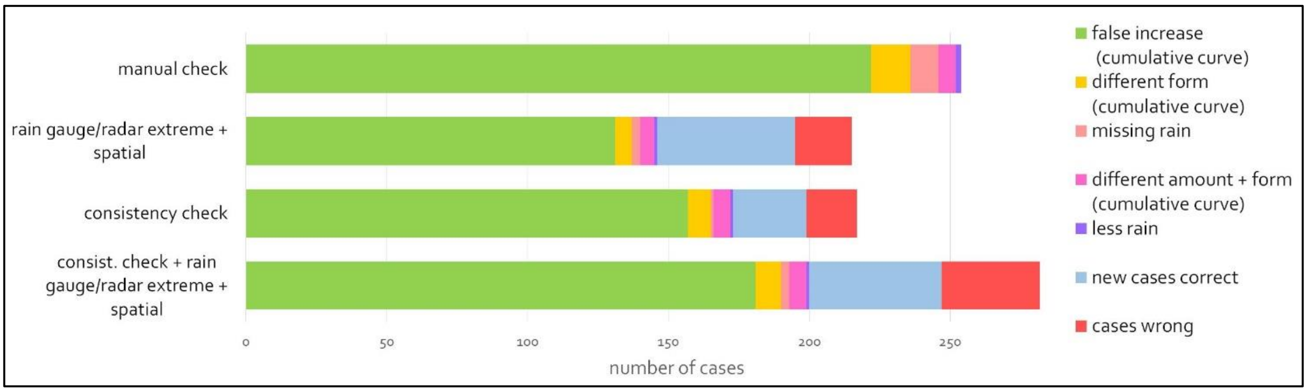

Fig. 1: Comparison of automatic and manual check results

Outlook

For online applications, such as warning systems or real-time flooding modelling, already the time of arrival of station data for further use is important for understanding successive results. Therefore, additionally to the online documentation of the quality control results for each station, a scheme like shown in Fig. 2 on the age of retrieved data is a useful and important information for documentation purposes.

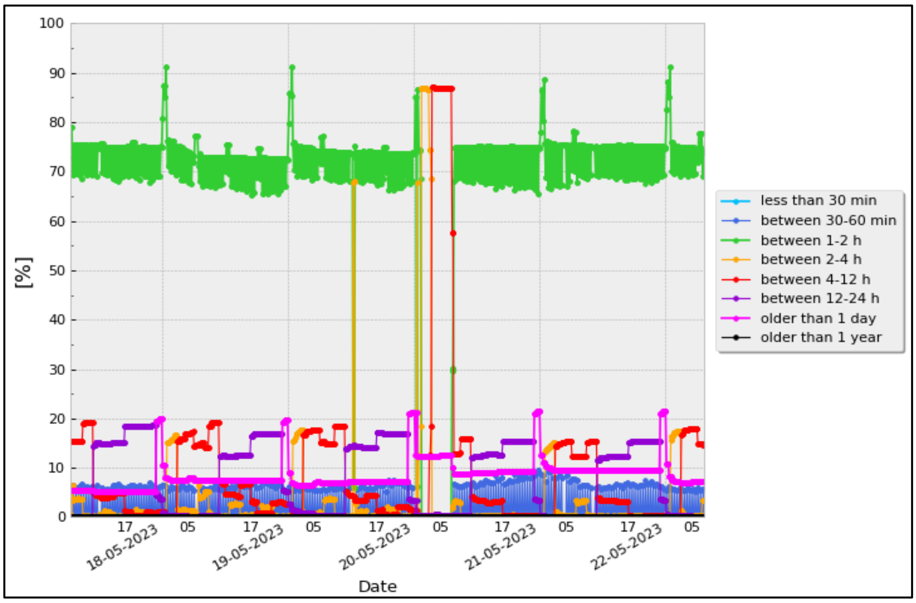

Fig. 2: Documentation of the age of retrieved station data used for radar adjustment

References

Michelson, D. et al. (2023), WMO JET OWR Best Practice Guide for Weather Radar, URL: https://community.wmo.int/en/activity-areas/weather-radar-observations/best-practices-guidance (accessed 24th May 2023)

Seidel, J. et al. (2023) Using personal weather station data for improving precipitation estimates and gauge adjustment of radar data. Abstract submitted to *UrbanRain23.*