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Hydrology and Earth System Sciences Discussions

Interactive comment on "Climatology of daily rainfall semivariance in The Netherlands" *by* C. Z. van de Beek et al.

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The authors would like to thank the reviewer for the comments. Our replies are

listed below.

This paper investigates how semivariograms of daily rainfall over The Netherlands change in time, and models are fitted to these changes. I believe this paper may be interesting to learn about temporal patterns and/or trends and to model spatial dependence in time. Unfortunately, the paper restricts to the geostatistical analysis, elaborating in depth to all sinusoidal trends in semi-variogram parameters without revealing any additional insight and without coming to real conclusions

This is clearly answered in the first lines of the conclusion.

or without using the obtained model for generating spatial rainfall fields for new time steps (i.e. how robust are the semivariograms for simulating rainfall over The Netherlands based on 33 raingauge measurements).

This was not a purpose of the paper. This paper tried to give more insight in the space-time variability of rainfall by applying simple semi-variograms. We only mentioned random field generation as a possible application of our research.

The abstract mentions that these semivariograms could be employed to estimate the accuracy of the rainfall input to a hydrological model when only a few gauges are available within the catchment area: this was never demonstrated in the paper.

As for generation of random fields, this was only mentioned as a possible application. We will therefore remove this part from the abstract.

What is the accuracy of the different gauges: can they all be considered to be of the same quality?

The quality of the gauges can be considered the same for the automatic gauges. The network around Cabauw that was operated by Wageningen University used similar tipping-bucket rain gauges for all locations and was quality checked.

What is the resolution of the gauges? 0.05 mm or less? If less, then why are daily values <0.05 mm set to 0.05 mm? If the resolution is 0.05 mm, then how could you know that less than 0.05 mm was observed?

The automatic rain gauge network has a higher output resolution than what is ultimately stored. The accuracy of the gauges is such that a resolution of 0.1 mm is sufficient, and hence the data are stored with this resolution. This was also mentioned in our reply to the related point raised by Anonymous Referee 1: The hourly accumulations are available with an accuracy of 0.1 mm. Non-zero rainfall accumulations below 0.05 mm have been set to 0.05 mm in this dataset to indicate nonzero rain (this would otherwise be rounded to zero). While this might give a slight overestimation for rainfall at very low intensities it allows for full coverage of all precipitation.

The temporal behaviour of semivariogram parameters do not show any trend. How about the actual data? Is there any trend to be seen in e.g. increase in rainfall during the last years? (Or can this be referenced)

We fitted a trendline to the data in Fig. 3a and no clear trend was found.

Why is the KNMI volunteer network mentioned if you state that you don't trust the data and therefore you don't use is?

This network is a logical inclusion in a paper like this as it offers a great amount of additional rainfall data for the Netherlands. We therefore looked at it and came to the aforementioned conclusions for this dataset. While we could leave mentioning this dataset out of this paper it would then definitely lead to questions from fellow

researchers why we did not include the dataset.

Only 33 raingauges can be applied to construct the semivariogram: it is not clear, how many couples are available per binned 5-km lag to calculate the semivariance for the given lag. This is especially important for the short lags if the semivariograms would be used for interpolation.

We will add a histogram of with the number of gauge-pairs at each distance.

The spherical variograms was chosen; however, its fit is not validated and compared to other semivariogram shapes. In summer, the spherical variogram is not well fitted: could another shape have solved this?

We wanted to present a simple method where it is possible to describe rain fields using only very few parameters. We considered other types, but did not find a simple model that outperformed the spherical model. We did not test more complex variogram models because of the potential interdependence among the different parameters. See also our reply to the related comment by Anonymous Referee 1. Another advantage of the spherical model is that its parameters can easily be interpreted as physical variables. The paper: "Berne, A., Delrieu, G., Creutin, J.-D., and Obled, C.: Temporal and spatial resolution of rainfall measurements required for urban hydrology, J. Hydrol., 299, 166–179, 2004" also gives more insight in the use of spherical variograms for rainfall.

Averaging the semivariance over 90 days to get rid of the day-to-day variability probably is needed to overcome the noise due to a fairly small dataset at one day (i.e. 33 points). Can this approach be backed up by references?

Unfortunately we cannot give references as this has not been done before (as far as we are aware). We chose 90-days not only to get rid of day-to-day noise, but also to avoid longer periods of no rainfall. Additionally we looked at 60-day intervals as well and those yielded similar results. We will add a short mention of this in the article.

It is not clear what error is made by averaging over 90 days: if one would use these temporally averaged semivariograms for interpolating rainfall between gauges, what error can be made? I.e. how accurate is the modelled daily variogram? From figure 11, it looks as if this is not too good. A detailed analysis is needed for which (maybe) a metric that summarizes the fit should be used.

We used the 90-days to reduce the effect of single events and get a more climatological signal. The reference to figure 11 is correct for this case, and of course there will always be year-to-year variations, but the expected average variation is shown in Fig. 9 where the modelled variogram is actually quite good.

I don't believe that using these temporally averaged semivariograms are the best way to check for broken gauges. Simply plotting the cumulative amounts for one gauge against another, or against the average of all others would reveal a defect of the instrument through a change in slope.

Agreed, we will remove it from the text.