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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Extreme weather events in the Sneeuberg, Karoo, South Africa: a case study of the floods of 9 and 12 February 2011" *by* R. C. Fox and K. M. Rowntree

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Thank you to the three referees for their constructive comments on our paper. The three sets of comments covered essentially the same points so we will limit our responses in the first instance to answering Referee 1 who gave the most structured set of comments. A fourth set of comments was received from Kamruzzaman. Our response to these is also included where appropriate.

Referee 1 raised four main points:

Structure: focus unclear, paper needs restructuring.

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Interactive Discussion

Discussion Paper

Methods and data: more technical details needed.

General scientific context: how do the research findings relate to others; how do we extend scientific knowledge in a general sense?

Lack of a critical discussion on methods used, their limitations and recommendations for further research.

Referee 1 presented recommendations as to how we could restructure the introduction, study area, methods & data (points 1 and 2). These recommendations make sense and we will be guided by this structure in rewriting. We agree that we need to provide clearer focus near the beginning of the paper, with a clearly stated aim. We will include the details of the floods in the study area section and move the details of rainfall data to the methods section.

One of the key objectives of the paper is to compare the data accessed via the Giovanni portal with observed data at different time scales - a severe storm event, monthly time series and annual time series. Giovannni is designed to give a wide range of users access to complex data sets. These users may not be climate specialists (ourselves included) who would necessarily be aware of the short comings of such data. We will make this context more explicit.

The abstract. Referee 1 claims (point 3) that our statement 'These analyses add to our understanding derived from existing rainfall gauge information' is not followed through. This should read 'This empirical analysis of observed data contributes to our knowledge of localized extreme storm events that contribute to severe flooding.'

A projected increase in the intensity of future rainfall events is proposed by the Department of Science and Technology (2011) using climate change models for South Africa. We refer to this on page 10824 line 25-28. We can refer to this work in the introduction, as part of the motivation for the study (point 4).

The data. We can tabulate details of the rain gauge stations as suggested (point 5).

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We will cover issues of missing data. The farm record was close to complete so we had not considered it an issue that needed to be addressed. There was only one data point missing in the monthly time series data, and no missing data in the spatial analysis (data sets derived from Giovanni). We can also tabulate the characteristics of the six sets of Giovanni data (point 8) with reference to the product concerned, web address, duration and spatial extent.

The regression equations to identify possible non-linearity between stations were based on annual records. We will present the graphs in addition to the correlation coefficients so that the absence of any break points will become clear (points 6 and 7).

Data analysis. We agree that little information was given in the methods section on how we analyzed the data (point 9); this should be apparent from the way in which the results are presented, but we can give more information in the methods section. This will include explaining how regional averages were estimated from the rain gauge data (points 11 and 15). The average for the rainfall data is a simple average for the four stations that represent a reasonable spread over the area covered by the Giovanni data. The spatial extents of the Giovanni and empirical data will have been detailed in the data section. We will also explain further how the data was extracted from Giovanni and manipulated in a GIS. An important point here is that Giovanni is a dynamic platform and data is continually being updated. It may not, therefore, be possible to retrieve the same data sets. The TRMM data, for example, was used for one of the rainfall maps and this had to be modified as we worked on the data analysis.

We can include a statistical test (t-test) to compare the data from rain gauge data and satellite derived data at the annual and monthly time scales. The hypothesis of no difference can be rejected on the basis of a 2-tailed paired T-test. P-values are 0.0001 for annual values and 2.73753E-09 for monthly values.

Results. Conversations with local farmers confirm the intense nature of the storm, and the rapid hydrological response, over the wider catchment on the 9 Feb. The flood

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wave hit Ganora at 17h25, shortly after the main fall at Ganora, which indicates high intensity rainfall over the upper catchment. Our own experience of similar events in the area is that they are short lived and of high intensity. Ganora provides the only recorded data to confirm this (point 12). So although rainfall may often be localized, if all stations recorded heavy rainfall on the 9 February the storm timing and duration was likely to be similar to that at Ganora. We will justify this better in the text.

We will address the vagueness of certain statements (point 10). We can provide a more nuanced discussion of the relationship between the observed storm data and the satellite derived hourly data, acknowledging the different temporal and spatial scales (these can now be seen in the information about each data set) over which data were collected (point 13). We have replotted the data in Figure 6 so that the two data sets are shown on one graph (point 14). We can also include the maximum 5 minute intensity as a reference point as recommended by Kamruzzaman. In terms of cumulative amounts, the Giovanni data gives a 5-day total of 26 mm and the Ganora gauge 117 mm. For the 9 Feb the values are 11 mm and 27 mm. Note also that observed Ganora values are lower than most of the other gauges. We therefore feel confident in our statement that the Giovanni data greatly underestimates storm volumes and intensities.

We have also simplified Figure 5 to make its derivation and intent clearer (point 5 from Kamruzzaman). We do not feel a statistical analysis is justified here as there are only five days of data over which a comparison could be made. The difference between the observed and modeled data sets is very clear.

We accept that certain figure captions will need to be expanded (point 18).

Kamruzzaman suggests changing the heading of Section 5.2 from Spatial comparison to Spatial data analysis. We have no problem with that.

Discussion. We will expand the discussion to include a fuller comparison with other relevant literature and attempt to position our results in this context. An additional 25 have been sourced. We will also look more critically at the limitations of our findings

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(point 16 and 17). Thank you for suggestions about relevant literature.

Conclusion. We will provide a separate conclusion that summarizes the main points.

Additional responses to Kamruzzaman (point 7). We do not understand what is meant here. We present both monthly and annual data sets - is the annual set not 'deseasonalized'. We are not trying to look at the nature or causes of long term rainfall patterns here - only the extent to which the two types of data correlate.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 10809, 2013.