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Hydrology and Earth System Sciences Discussions

Interactive comment on "A statistical analysis of insurance damage claims related to rainfall extremes" *by* M. H. Spekkers et al.

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We thank the reviewer for his time and effort in commenting our manuscript. Our response:

RC1: *Based on the amount of data many models could be conceived and much more information extracted from the nice data set. However, the focus on one model can also be regarded as a virtue, since it makes the paper more focused and easy to follow.*

AC1: A similar remark was made in RC1 by Van Dyck. It is indeed a good point by

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the reviewer that many more models could be derived, based on the available data. In this paper, however, we have focused on the model that describes probability of rainfall damage as a function of the maximum rainfall intensity. We would like to add the following paragraph to the discussion section to substantiate our choices: "In an exploratory study, different damage statistics were correlated with rainfall intensity, and the number of claims was found to correlate the best with rainfall intensity. The rainfall intensity was selected as it was hypothesized to be the most critical rainfall characteristic in relationship to functioning of sewer systems. In the Netherlands, sewer systems are designed to cope with rainfall intensities up to 21.6 mm/h; thus, theoretically, the short-duration intense rainfall events are likely to contribute to damage the most."

RC2: *Page 6, line 1: Spekkers et al (2011) is important and only grey literature. Consider making it available or to include more information in the paper.*

AC2: Good suggestion. We will add the following (slightly adapted) tables from Spekkers et al. (2011), Table 1 and 2, to section 2.2. The following sentences will be will be added on page 11620, line 1: "Table 1 lists the key characteristics of the insurance databases. Damage values before 2002 were converted from guilder to euro (1 guilder = 0.45 euro). All values are in 2009 euros. Every value associated with a year before 2009 was adjusted for inflation using the Consumer Price Index (Statistics Netherlands, 2012)." On page 11620, line 24 will be changed in: "The variables that are included in the database are listed in Table 2. The address of the insured household is available at 4-position district (i.e. neighbourhood) level."

RC3: *Page 7, line 5: Removing data as indicated introduces a bias when assessing the overall probability of damage when using the developed model. It is therefore important to indicate how much data is actually discarded, just like the rate of coverage*

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of insurances is provided.

AC3: Only 1% of the records were related to zero damage values. We will change line 5 on page 7 as follows: "Records with damage value equal to zero were also removed (around 1% of the records), as they are damage claims that did not meet the policy conditions."

RC4: *Page 7, line 16: The discussion about distance between district centers and rain gauges can be discussed in a more quantitative manner based on correlation properties of precipitation extremes. I usually cite either Niemczynowicz or Mikkelsen for properties of Danish extremes. Most likely similar work has been done, if not for the Netherlands, then for Belgium. I would start by looking for literature by G. Vaes and/or P Willems.*

AC4: In Overeem et al. (2011) a brief note was made on decorrelation distances for Dutch precipitation. We will add the following in section 2.3: "In Overeem et al. (2011) it is expected that the decorrelation distance for Dutch rainfall events is larger than 15 km. They refer to a study by Berne et al. (2004) were a decorrelation distance of 15 km was found for typical intense Mediterranean rain events, which are on average more intense and more convective compared to rainfall events in the Netherlands. This justifies selecting the claims within 10 km from a rain gauge.".

RC5 *Page 8, line 6: The insurance companies uses data up to 3 days. I would suggest to expand the range of time windows to more than 4 hours. If it generates problems with the daily time steps of the claims I would consider a more event based procedure. This would also imply a discussion of what types of rainfall (convective or frontal) that are the main contributor to the observed claims.*

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AC5 Although the definition of 'extreme rainfall' used by the insurance companies (page 11620, line 14) suggest that they consider data up to 3 days, in practice this is certainly not the case. Insurance companies have indicated that it lacks detailed rainfall data to examine these rainfall intensity criteria. Moreover, we have checked for long rainfall events within the period 2003–2009 and we only found one rainfall event longer than 24 hours with significant claims over consecutive days. Therefore we do not see any reasons to consider scales beyond that of a day. From the results it become clear that correlation coefficients (Table 3) and performance index scores (Table 6) have reached their optimum values within the range of considered time windows. We like, however, to include an 8-hour time window to the analyses and results to confirm that this is indeed the case.

RC6 *Page 9, line 14: I would have liked to have entered other covariates into equation (4). Allowing beta_0 to change over time and space as a function of wetness indices, urbanization, age of infrastructure and settlement, ... would be very interesting. However, it could also be postponed to another paper, since it might also impact the formulation of the modeling of the non-rainfall-related claims, which is critical to the study.*

AC6 We agree with the reviewer that additional explanatory factors would be worthwhile to study, but we would like to postpone this to another paper. We would like to address this in the discussion section as follows: "A considerable fraction of the variance is left unexplained, which emphasizes the need to study other explanatory variables. There are a few aspects that need to be considered when taking other explanatory factors into account: 1) the explanatory variable should be available and parameterized at the level of 4-position districts, as this is the scale at which insurance data is available, 2) data should be available nationwide if the analysis is performed

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on the whole insurance database and 3) since additional data come from different sources, different levels of data quality need to be taken into account. Explanatory factors that are worthwhile to investigate in a future study are topographical properties, urban drainage system properties (e.g. drainage capacity, age of infrastructure, percentage of surface water), level of urbanization, socio-economic indices (e.g. income of households, property value), district properties (e.g. percentages of low-rise and high-rise buildings, percentage paved surface)."

RC7 *Page 11 and onwards: Much emphasis is put on theta = 0.5. However, the logit-model could also be interpreted as an assessment of when the variable is significant. That implies that theta = 0.05 or 0.95 is much more interesting. I discussed this shortly in a paper in Nordic Hydrology in 1994 and believe that my co-author Spliid made some good publications on how to make such interpretations later.*

AC7 We do not entirely agree with the reviewer on this part. The cutoff point, used to create contingency tables (Table 5) and to derive scores in Table 6, could be used to consider a more risk-seeking ($\theta = 0.95$) or a more risk-averse ($\theta = 0.05$) attitude of a potential decision-maker. The significance of the regression coefficients, however, is determined by the significance level, see page 11624, line 17. We would like to add the follow line after line 22 on page 11627 to clarify this a bit more: "In general, a more risk-seeking attitude (accepting some damage) of a potential decision-maker allows a larger cutoff point ($\theta > 0.5$) and a more risk-averse attitude (accepting no damage) allows a smaller cutoff point ($\theta < 0.5$)"

RC8 *Page 13, line 6-24: This is really a discussion section. Please make that clear by adding a separate heading.*

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AC8 Good suggestion. We will add the heading “Discussion” before line 6 on page 11627 in the final version of the paper. This will also be the section in which we include the changes as mentioned in AC1 and AC7.

References

Berne, A., Delrieu, G., Creutin, J.-D., and Obled, C. (2004). Temporal and spatial resolution of rainfall measurements required for urban hydrology. *Journal of Hydrology*, 299(3-4):166–179.

Overeem, A., Leijnse, H., and Uijlenhoet, R. (2011). Measuring urban rainfall using microwave links from commercial cellular communication networks. *Water Resources Research*, 47(12):1–16.

Statistics Netherlands (2012). StatLine online database: http://statline.cbs.nl (viewed on August 2012).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 11615, 2012.

Table 1. A brief overview of variables recorded in insurance databases held by the Dutch Association of Insurers. The damage claim records can be linked to the policy holder information through the policy ID key.

Damage claim records	Policy holder information
Damage value claimed	Type of building
Damage value paid out	Policy coverage
Date damage occurred	Start date of policy
Damage cause	End date of policy
Policy ID key	Insured sum of property
	Insured sum of content
	4-position district code
	Policy ID key

Table 2. Key characteristics of insurance databases held by the Dutch Association of Insurers for the period 2003–2009.

	Number of policies in millions per year	Number of claims	Damage per claim in euros			
			Mean	P10	Median	P90
Property	0.9	111000	1486	205	825	3140
Content	1.8	96000	1015	144	564	2202

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