Response to Reviewer #3

We thank the reviewer for the positive comments and review. Each comment is addressed in detail directly under each comment of the reviewer below. The original comments of the reviewers are given in italics, followed by our response in normal letter type.

Many quantitative ex-ante studies have indicated the value of NBS interventions in urban areas, because of various Ecosystem Services, including mitigatin of urban heat island impacts, reduced impacts on the water cycle and mitigating flood risk. Especially for mitigation of flood risk many studies have indicated detailed approaches for quantification of the expected impacts.

On the other hand very few studies have been perfomed ex-post to verify the validity of the assumptions of the investments made to install NBS interventions. This study is therefore highly welcomed because the scope is exactly what the flood risk modelling community has repeatedly requested: to perform ex-post analyses to enable structured learning and inform future projects of the learnings of past projects.

However, this is also the most important limitation of the study. I would therefore encourage the authors to expand and improve their study prior to finalizing the paper. Most importantly to include information from the ex-ante study leading to the NBS interventions: What were the expected reduction in Expected Annual Damage (EAD), how was this linked to properties of rainfall, and did the reductions in damages occur at the expected locations?

We observe a reduction in the treatment area. Thus, the reduction occurred at the expected location. We agree with the reviewer that including an EAD would be of value. This would ask for a modelling study, which would be a new study that is outside the scope of this research.

To our knowledge, there are no publicly available sources on EAD and expectations of reduction of damage by the municipality. We therefore reached out to our contacts at the municipality of Amsterdam to ask if they could provide us with damage reduction expectations before the intervention. However, they replied that they could not provide us with this information. They did mention that the treatment and control areas are known for often having water nuisance after rain. We know the ex-ante research was more qualitative than a full technical assessment. Even though it would be interesting to write about expected damage reduction beforehand, we are not able to add this to the paper.

Validating and/or falsifying assumptions of the ex-ante study would be a truly interesting study and probably the information is readily at hand from the documents leading to the

strategy of NBS implementation. The transferability would also be improved if changed to an indicator related to EAD.

Another limitation of the study is the use of insurance data for buildings. There are always losses that are not covered by insurance and hence this should be mentioned in the discussion of the findings.

We agree with the reviewer that this could be done more extensively.

Most rain damage losses are covered by insurance. For households and businesses, rain damage is insured by default (Dutch Association of Insurers, 2025). In our dataset, the data of households of all members of the Dutch Association of Insurers (over 95% of the Dutch market) is used (Dutch Association of Insurers, 2024). We plan to add the following line:

' The Dutch Association of Insurers registers claims of households filed by insurance companies that are member of the association. Since rain damage is covered by default (Dutch Association of Insurers, 2025), we expect that the vast majority of the claims gets accepted.'

We do not know the percentage of the people who are insured but do not claim their damages, since there are no public numbers available on this topic. We argue that most people claim their damage when they are insured, and that when they are insured they will get compensated. Rain coverage is by default part of property and contents insurance products in the Netherlands (Dutch Association of Insurers, 2025). Very minor damages (e.g. of a few euros) may not be claimed, but we expect these damages to not alter the main findings of our study. On the other side, bad maintenance or negligence can be a ground to not accept a claim.

In the discussion, under section 4.3 'Limitations and research implications' we plan to add the following sentences:

'It would be of value to look into uninsured damages (e.g. public infrastructure) and claims of businesses as well. Insured damage of households is only a part of total damage of extreme rain, but can still give valuable insights into the effectiveness of FDM measures.'

'Further, it would be valuable to understand how much separate measures contribute to damage reduction.'

Figure 1 is difficult to interpret. I assume it is the median of the daily damages for days with more than X mm rainfall for each year? Make it more explicit and use more space to explore this data, e.g. by plotting the distributions for a suitable year and also aggregating to EAD for each catchment by year.

We agree with the reviewer that figure 1 is difficult to interpret. It was shown to add a visual representation to the placebo test. However, we plan to move the figure to the appendix and add tables on data description that are shown further below.

We do not have information about an EAD, and this information could not be provided by Amsterdam Weerproof. The initiative Amsterdam Weerproof started after the extreme precipitation in 2014 (then, called Amsterdam Rainproof).

Based on the figure alone I would assume that there would be no impacts of the NBS. This points to a more general issue with providing the readers with enough information about the data to validate the findings. More plots of both input and output data and model residuals would be an asset.

We agree with the reviewer that more information could be given about the data. However, since it is damage data that is guided by extremes, real life outliers can occur. Distributions are then not too helpful to interpret, because these are far apart. What can give more information are extensive tables with descriptive data. We expanded table 2 and table 3 with the following tables, that we plan to add to appendix 4:

Table 1: Distribution insured rain damage data full dataset (from 2007)

	1%	5%	10%	25%	50%	75%	90%	95%	99%	Largest
All observations (n=12568)	€0.00	€0.00	€0.00	€0.00	€0.00	€0.00	€169.00	€1000.00	€3761.00	€169305.00
Only damages (n=1360)	€1.00	€119.13	€202.57	€498.23	€956.75	€1727.25	€3470.00	€5325.44	€17703.44	€169305.00

Table 2: **Detailed description insured rain damage data full dataset (from 2007)**

Variable	Mean (standard deviation if non-binary in parentheses)		Median		Range	
From 2007	*From 2007*	*From 2016*	*From 2007*	*From 2016*	*From 2007*	*From 2016*
Insured rain damage	€202.12 (€1928.92)	€242.32 (€3029.46)	€0.00	€0 .00	€0 – €169305.00	€0 – €169305.00
Insured rain damage (damages only)	€1867.82 (€5594.01)	€2191.74 (€8883.30)	€956.73	€1000.00	€1 – €169305.00	€1 – €169305.00

Table 3: **Distribution of rain data (from 2007)**

	1%	5%	10%	25%	50%	75%	90%	95%	99%	Largest
Sum of rain per day (in	0	0	0	0	1	26	76	115	202	672

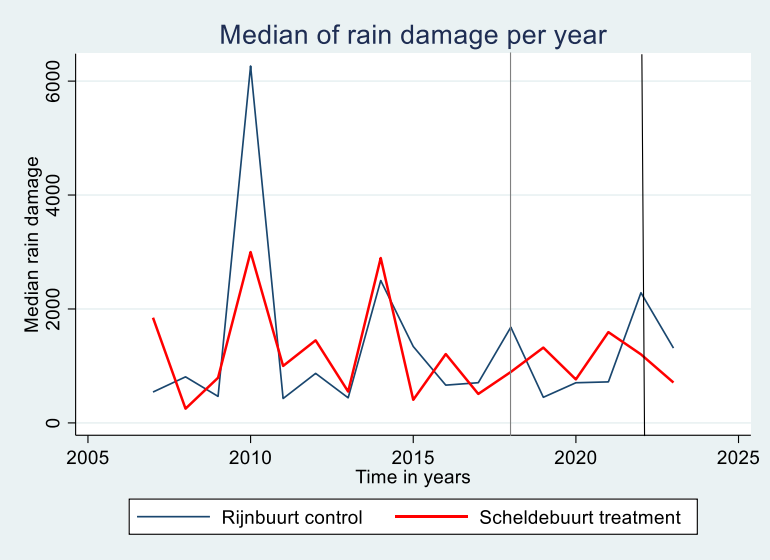
0.1 mm, n=12568)										
Maximum rain in an hour (in 0.1 mm, n=12568)	0	0	0	0	1	11	26	39	89	281

Minor points

The interventions occur in 2018 in the text but in the figure it looks like the intervention is in 2017? Is the x-asis correct?

The line is not precisely on the year 2018, but slightly before. We adjusted the line of the intervention slightly, in order that it lines up with the year 2018 (even though the intervention started in November 2017). See the change below, where the grey line corresponds to the year 2018. We plan to move the graph from the main text in the manuscript to the appendix.

Figure 1: Median of rain damage per year



You could consider removing 2010 from the study all together, it would make for a more robust analysis.

The reviewer is correct. This is indeed driven by extreme events. Specifically, August 2010 was a month where extreme damages occurred. We performed a robustness test by deleting this month and rerunning the analysis again. However, this caused only minor changes to the results. We plan to add a footnote to describe this in section 4.1:

‘ In an additional analysis, we omitted the month August 2010, with the large damages in the control group. This month is an outlier and seemed to impact the interaction result and the coefficient. We observe minor changes in the results:

the interaction coefficient is -704,461, compared to the -646,963 in the model with August 2010 included, and the relation is significant on the same level ($p < 0.01$).'

References

Dutch Association of Insurers, Overstroming en droogte: schade en verzekeringen: https://www.verzekeraars.nl/verzekeringsthemas/klimaatbestendig-verzekeren/overstroming-en-droogte, last access: 1 August 2024.

Dutch Association of Insurers: Ledenlijst / Lid worden: https://www.verzekeraars.nl/over-het-verbond/lid-worden, last access: 18 March 2025.

Dutch Association of Insurers: Dutch Insurance Industry in Figures 2016: verzekerd-van-cijfers-2016-eng.pdf, last access 18 March 2025.