We thank you for your time and effort in providing comments on this paper.

The paper explores the global dataset on fluvial flood risk prepared and discussed by Philip Ward and co-authors on city level. This is potentially a good idea; although the data has been explored in a series of papers by these authors there are still room for further studies. In its scope the current paper is rather close to Winsemius et al (2016); the current paper focuses on cities while the original paper focuses on river catchments.

As mentioned, Winsemius et al (2016) analyses the data set with respect to river basin and income level. Our analysis is based on city-level flood impacts. Whilst similar, these studies are not the same, and the insights revealed in this paper do not overlap with those provided in Winsemius et al (2016).

There are however a number of important shortcommings that should be addressed before I potentially can recommend publication.

First of all I would like to see a discussion of what new knowledge the authors think they can gain by considering cities rather than river catchments. At least the findings of the current paper should be compared to Winsemius et al (2016).

The comparison of cities allows an understanding of conditions that can be expected on a city-level, and identification of cities facing similar circumstances. As climate change, development, and urban administrations transcend river basin boundaries, it is sensible to investigate impacts and determine potential mitigation strategies at the city level (as well of course as basin level, but that has been covered in Winsemius et al (2016)).

This is discussed in the conclusion of this paper, p19 lines 12-26, which is reproduced here:

> 'This study adds to the understanding of natural hazards in a global context, which is an important aspect of regional disaster risk management due to the dependency of local situations on global processes (UNISDR, 2015). The complex nonlinear socio-environmental relationships make it difficult to foresee local responses to global changes (UNISDR, 2015), and therefore this study focuses on risk communication (the process between risk perception and adaptation planning (Cardona et al., 2012)) to provide a visual analysis of the global patterns of evolving flood impacts, socioeconomic development and climate change, and the local city-level consequences of these changes.
>
> Cities have major implications for climate change mitigation and adaptation (Revi et al., 2014). Unplanned development and urban migration are increasing vulnerabilities to natural hazards (UNEP, 2016) and land cover change and greenhouse gas emissions are intensifying urban hydrology. Understanding the relationship between flood impacts and social vulnerability is a necessary step for prioritizing flood mitigation and prevention strategies (Doocy et al., 2013). Whether the main driver of increased urban flood impacts is development or climate change, cities will benefit from development restrictions and planning standards for urban expansion, sustainable land development, management of population distribution and migration, and early warning systems and preparedness (Revi et al., 2014; UN-DESA, 2014; Doocy et al., 2013).'

Next, the introduction is rather long and gives a thorough introduction to flooding. Unfortunately the authors does not distinguish between the different types of flooding that can occur, i.e. sea surges, groundwater induced flooding, pluvial flooding and, fluvial flooding.

It is stated on p4, lines 13-14, that this paper only considers fluvial flooding:

> ‘This data is solely related to the influence of fluvial flooding on metropolitan areas, and does not include coastal or pluvial flooding.’

If this statement would be better placed in the introduction, it can be moved, however we are conscious that the introduction is already ‘rather long’.

The paper is based on a specific data set that only considers fluvial flooding. Hence references to authors that specifically refer to pluvial flooding should be removed, e.g. Willems et al (2012).

We refer to Willems a few times, for example in the following statement (p2 lines 36-37):

> ‘Increases in rainfall intensity at urban hydrology scales of up to 60% are anticipated by 2100 (Willems, 2012).’

Though Willems may be generally interested in pluvial flooding, any references made here concern Willems’ statements on increases in rainfall, not flooding.

Perhaps differences in fluvial flood risk between cities can be explained by different exposures to other types of flood risk? If the authors do not wish to enter such discussions they should stick to considering only one type of flooding.

The comment ‘if the authors do not wish to enter such discussions they should stick to considering only one type of flooding’ is confusing for three reasons.

First, we have made it clear we are only considering one type of flooding - fluvial flooding (see previous comment).

Second, we have ‘entered such discussions’. The exposures of various cities to other types of flood risk is discussed in the ‘discussion’ section of the paper (eg. p18 lines 22-28, as reproduced here). Unfortunately, the reviewer has stated (below) that they have not read this part of the paper.

> ‘Though this study does not consider coastal flooding, it may be noted that due to their locations near river mouths, many of the cities in the lower left of the map that are projected to experience high increases in impacts from river flooding are also at risk of increased coastal flooding from intensified storms and sea level rise due to climate change. Mumbai, Guangzhou, Shanghai, Ho Chi Minh City, Kolkata, Bangkok, and Dhaka are 7 of the top 14 cities (out of 136) ranked by current population exposure to coastal flooding. These same cities also comprise the top 7 cities (in this order: Kolkata, Dhaka, Mumbai, Guangzhou, Ho Chi Minh City, Shanghai, Bangkok) ranked by future (2070) estimated population exposed to coastal flooding (UNEP, 2016; Nicholls et al., 2008).’

Third, the reviewer has implied in a previous comment that it is unfortunate different types of flooding are not distinguished: ‘Unfortunately the authors does not distinguish between the different types of flooding that can occur, i.e. sea surges, groundwater induced flooding, pluvial flooding and, fluvial flooding.‘

Therefore, it is unclear what the reviewer is expecting to result from this comment.

Next, the literature on whether flood risk is stationary or has an increasing trend is quite abundant. The findings differ, primarily as a function of the framing, i.e. if the models include corrections for changes in socio-economic development, vulnerability, etc. The author uses the terms ‘impacts’, ‘risks’ and ‘material damage’ more or less inter-changeably throughout the paper. When referring to IDSR and other recognized frameworks I would expect more stringent use of the terminology and more transparent explanations and assumptions.

The terms ‘impacts’, ‘risks’ and ‘material damage’ will be defined and their use updated.

This includes a description of what the scenario for development is between 2010 and 2030 and the rationale for choosing the approximately 100 cities in Table 1, that are then later reduced to 80 cities (without mentioning which of the cities are excluded).

The development scenarios are discussed in the Data section (p4 lines 18-28) with references to the models that were used to produce the data and accompanying documentation. The specific scenario is not described explicitly, however enough detail is provided for an interested reader to find the specific details:

> ‘Three separate scenarios of climate change and socioeconomic development (optimistic, business-as-usual, and pessimistic) are given in Aqueduct, and in this study we use data from the business-as-usual case for our future flood impact scenario.’

The rationale for choosing the cities is explicitly given on p4, lines 6-8:

> ‘The selection of cities used here is based on a list provided by the Lincoln Institute of Land Policy’s Atlas of Urban Expansion (Angel et al., 2010, website 1), spanning all continents except Antarctica, encompassing four economic levels and four population levels.’

The reason that some of these cities have been excluded is explicitly state on p5, lines 5-6:

> ‘Cities with no flood impacts in both 2010 and 2030 were removed (22 cities), though cities with no flood impacts in 2010 but with flood impacts in 2030 have been kept in the study.’

The reviewer is wondering why there is no mention of which cities were excluded - it was decided that a list of cities that are NOT included in this study would not be of interest to the readers hence they have not been listed.

However, my most important concern is that I cannot see what the authors are doing with the data. The closest to an explanation is that the authors state that the calculations are carried out in Matlab using a modified version of the package SOM. Modified in which way? Why are the data transformed the way they are if the SOM approach is particularly good in dealing with non-linear relationships,

The data is log transformed, following Agarwal and Skupin’s (2008) recommendation that highly skewed variable distributions may benefit from log transformation before use in the SOM. *[Agarwal, P. and A. Skupin (2008). Self-organising maps: Applications in geographic information science, John Wiley & Sons.]* This information and reference will be added to the methods section.

how do you treat taking logarithm of the value of zero,

The treatment of the logarithm of values between -1 and 1 is carefully described on p15, lines 12-13.

what are the definitions of QE, TE, DRR, and the Davies-Bouldin Index,

QE, TE, and DRR are defined on p7, lines 16-19. A reference is provided for the Davies-Bouldin Index with the information that it is used to determine the number of clusters (p7, line 31).

and how is a U-matrix visually verified? Without this information the reader will have to do a complete reanalysis to (perhaps) get the same results as the authors.

Further SOM references have been provided for readers who are unfamiliar with the method, though it has been summarised in the Methods section. In an effort to avoid repetition of previously published material, the SOM method has not been reproduced in detail. As the papers and books

outlining the SOM method have already been cited over 40,000 times, it was not felt that this method needed further repetition. With any paper, it is hard to know how much background knowledge to expect the readers to possess, and therefore we provide direction to further reading for those unfamiliar with certain aspects of the background.

Since I expect a thorough revision of the method section before perhaps resubmitting the paper I have not read the results and discussions sections in detail.

We are disappointed to hear this. I expect the reviewer would have found some answers to their questions had they read the paper.

More detailed comments:

I disagree with the use of the term 'spatio-temporal'. It usually denotes something where there is explicit reference to a spatial dimension, in the current example perhaps the physical distance between the cities. I think the authors should find another term to describe the characteristics of their data.

The term 'spatiotemporal' is commonly used to refer to data in which there is a cross-sectional structure to the data as well as a temporal one. In this case these are: 1) the state of flooding at each timestep, 2) and the timesteps themselves. The spatial dimension does not always refer to geographic distance.

The data on the figures cannot be read in the pdf-version of the paper.

The figures could be reproduced with larger text.

I cannot follow the discussion on the cluster. Perhaps it is just me not being able to see the same patterns as the authors.

Which discussion on 'the cluster'?

The list of references should be improved. Just from browsing it I can see dubious referencing to e.g. IPCC (2014) (Use author names) and Willems (2012) (several authors), and Kohonen (2001) (incomplete reference). There are more errors than the ones I have pointed out.

The references will be checked and updated where necessary.