Reply to Referee 1

We thank the Referee for his appreciation of our work and his constructive and very useful comments. We think that the changes to the manuscript and the underlying dataset have improved the manuscript's quality and will meet the Referee's agreement.

Please find the Referee's comments (COM), our reply (REP), and the according underlined changes (CHA) to the manuscript below:

1) *COM: The choice to use maximum wind speed to define the impacted area is not well explained. Other choices could be the duration of strong winds or the annual frequency of strong winds. Beyond winds, rainfall or surge could also have been chosen. I realize adding other dimensions are beyond the scope of this study but I think it's important to state that this dataset emphasizes wind speed effects over other aspects of the tropical cyclone hazard.*

   REP: We agree with the Referee that other dimensions of hazard impact (e.g. rainfall or storm surge) are also valid impact categories to measure exposure. As mentioned by the Referee, introduction of different impact categories needs to be and will be subject of future work. In order to highlight that maximum wind speed was used to define exposure, we changed the writing in the manuscript at various instances, see e.g. P2, L14 in the introduction:

   CHA: Exposure in TCE-DAT is defined per TC event as the number of potentially affected people and the sum of potentially affected assets <u>purely due to TC maximum wind speed. Additional impact categories to quantify exposure could account for duration or gustiness of strong winds, TC-related precipitation, and or storm surges.</u>

2) *COM: Significant effort went towards creating the population and exposure data on a 0.1 degree grid, but then the resulting data are aggregated to the country level. It seems a missed opportunity not to retain the spatial TCE data on the 0.1 degree grid.*

   REP: We agree with both Referees that spatially-explicit exposure data could further enhance the usability of TCE-DAT. We therefore added spatially-explicit TC exposure data for both historically-consistent and time-independent socio-economic exposure at the event level available at http://doi.org/10.5880/pik.2017.008. All TCE-DAT data sets are additionally summarized by a new data collection DOI at http://doi.org/10.5880/pik.2017.011.

   CHA: We amended this information to the manuscript at numerous instances; please see the new manuscript with tracked changes for details.

3) *COM: The impacted exposure will be sensitive to the defined spatial extent of the cyclone's strong winds. The section describing sensitivity of the TCE-DAT to accounting for storm size is therefore very important. I agree that accounting for size does not affect the impacted exposure over many storms, but clearly differences will be significant for some individual storms. Your note of caution against using the data for individual storm analysis could easily be missed. Why not include a third version of the dataset that includes size information where available? The Holland model includes an option to include an outer wind value to tie down the wind decay function with distance. Using this would retain consistency across the different dataset versions. It would also be interesting to show the impact of accounting for observed size on the timeseries of exposure*

by adding this third dataset to figure 3. Maybe on global scales the impact would be small but for single basins the timeseries, and even the long-term trend could differ.

REP: We agree with the Referee that wind field simulations must not always agree well with observed wind fields and therefore a more observation-based version of TCE-DAT would be desirable. We now highlight the cautionary note again and more prominently for the usage of TCE-DAT for single events in the conclusion on page 13 (see below). However, we refrain from adding a third version of TCE-DAT at this stage for two reasons: 1) Observations for wind field radii in different basins vary tremendously in time and space. This version of TCE-DAT would be less globally-consistent and would probably also require ad-hoc estimates of missing wind field radii for various time steps for a single event. 2) To treat effects mentioned in 1) would require a more thorough analysis and is therefore beyond the scope of the present work. We are thankful for this comment, though, and will account for it in our future work.

CHA: While this approach has some limitations, in particular potentially large deviations from actually realized exposure for selected events because of the generic wind field model, it also overcomes various other issues that arise due to biased and/or changing reporting standards across time and space.

4) COM: *Brooke Anderson and colleagues at Colorado State University conducted a closely related, but regionally limited, study to assess historical tropical cyclone wind, rain, flood and tornado, and related impacts. This was published on github, for application to epidemiology research. Please reference this work. https://github.com/geanders/hurricaneexposure. https://github.com/zailchen/noaastormevents.*

REP: The reference was added to the manuscript's introduction section on page 2, line 7.

5) COM: *The first paragraph of the introduction lists the harmful impacts of tropical cyclones. But it's important to note that tropical cyclones can bring benefits such as alleviating drought.*

REP: We incorporated this comment and changed the introduction accordingly (P1, L34).

CHA: In addition to these direct damages tropical cyclones have the potential to exercise negative influence on long-term development such as dampening of economic output [*Hsiang*, 2010; *Hsiang and Jina*, 2014], e.g. by reduced education achievements, mortality, and displacement, but can also cause indirect benefits such as alleviating drought.

6) COM: *Introduction, lines 9 and 10. In addition to facilitating reproducibility, standardized datasets also accelerate science discovery.*

REP: We incorporated this comment and changed the introduction accordingly (P2, L10).

CHA: Moreover, standardized methods of data selection and preparation facilitate the reproducibility and comparability of research results and also accelerate science discovery.

7) COM: *Page 4, line 20: Can you explain how you filtered landfalling storms? What resolution landmask did you use and did you only consider Islands above a minimum size? Did you also include land-grazing storms, i.e., storms whose center did not make landfall but still brought strong winds onshore?*

REP: We incorporated this comment by adding an explanation to the specific section (P4, L28).

CHA: We here define a TC to make landfall if at least one grid cell (of the hazard grid) of the TC's simulated wind field is above land with at least 34 kn maximum winds, thereby also counting land-brazing storms as landfalls. This landfall definition also depends on the resolution of the underlying grid. We here use a country mask of 0.1° x 0.1° resolution (360 arcsec) that is upscaled from an original resolution of 150 arcsec to provide best possible coverage of the coastline. To further reduce inconsistencies with the socio-economic gridded data we globally extend the land area of the hazard grid by one grid cell (0.1°) into the oceans. Thus, we artificially increase the number of landfalls but, on the other side, minimize the number of socio-economically relevant grid cells that would be labeled as water otherwise. This procedure is particularly relevant for small islands and coastal cities for which the calculation of exposure would otherwise result in a gross underestimation.

8) COM: *Page 5, line 10: The vector addition of the translation speed to the vortex wind is fairly simple. Others have shown that surface frictional effects reduce magnitude and rotate the direction of the translation speed seen in the surface winds (e.g., Lin and Chavas 2012).*

REP: We agree that our treatment is fairly simple and can be improved in future work. We somehow corrected for the reduction in magnitude of translation speed by assuming that the contribution of this effect decreases as a function of distance from the storm's center, see page 5, line 28. We also added a discussion of the Referee's comment to this specific section.

CHA: Although this attenuation factor can be thought to resemble surface friction effects, we neither explicitly account for surface friction and the resulting reduction and rotation in the translational speed's magnitude and direction, respectively [*Lin and Chavas*, 2012], nor do we incorporate that the magnitudes of the motion-induced asymmetries at the surface do not necessarily increase proportionally with the translation speed [*Uhlhorn et al.*, 2014].