RC2: 'Comment on nhess-2022-210', Guy J.-P. Schumann, 06 Nov 2022
This paper is a comparison of the ArcticDEM vs LiDAR for urban flood simulation which uses Helsinki as an example case.

The paper is generally well written and follows a clear structure. The methodology used is sound and fairly straightforward. The results are well presented.

This type of analysis is quite timely as there are at present substantial efforts and initiatives under way to get better accuracy global DEM data sets and a DEM like the ArcticDEM may become available sson for global low-lying lands.

Thank you so much Dr Schumann for reviewing our paper, the kind words, and the helpful comments.

In my opinion this paper can be accepted for publication after some minor points are addressed:

- Please verify that referring to DigitalGlobe is correct or should it be Maxar?

We are aware of that the DigitalGlobe was acquired by Maxar in 2017, but in this paper, we followed the term used in the Polar Geospatial Center (where ArcticDEM was distributed) as DigitalGlobe.

- It seems to me that the vertical error of the bare earth ArcticDEM in the urban area is about 0.5 m and the simulated water depth RMSE is almost double. If this is correct, could the authors comment on this in the context of whether this type of water depth RMSE in urban areas is still acceptable?

Thank you for this comment. Actually, it is the other way around. As shown in Figure 6, the generated bare-earth ArcticDEM has a RMSE error of 1.02 m (the lowest one). Using this bare-earth ArcticDEM the simulated water depth error (RMSE) is 0.3 m. This can be caused by that the error values of the ArcticDEM-SMRF in inundated areas or possibly inundated areas are likely smaller than the numbers reported for the overall areas. Because most of the residual errors are in hilly areas that were flattened incorrectly and forest areas with large patch sizes, while these areas have relatively small overlap with the inundated areas.

- It would be useful I think if the authors could comment on the resolvability of individual buildings within the ArcticDEM - I imagine some kind of density measure should allow a comparison between LiDAR DSM and ArcticDEM DSM, the results of which could explain the significant differences in water depth RMSE obtained. Maybe some kind of DSM surface roughness measure comparison.

We appreciate this comment. In this manuscript, we used the LiDAR DTM as the reference DEM input instead of the DSM. We used DTM because that we chose to build our model at 10 m (which is likely greater than typical building gaps) considering the computational cost of simulating all the 234 ArcticDEM realizations in an area of 192 km^2.

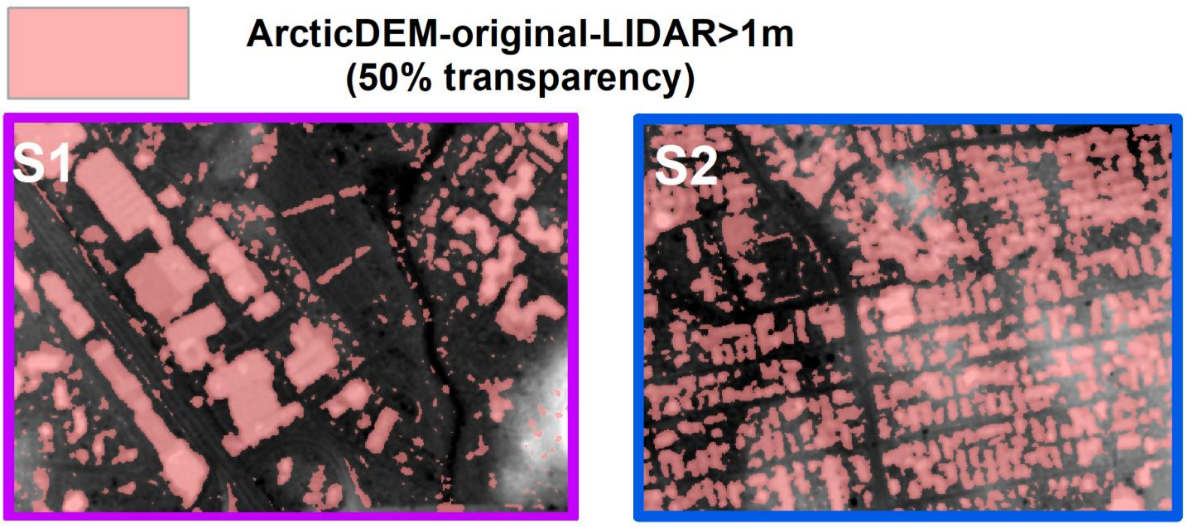
Analyzing the resolvability of ArcticDEM of individual buildings would be very interesting. However, the building footprint data is not publicly available for the city of Helsinki.

Neither does the DSM of the same spatial resolution of the LIDAR DTM (2 m). If the building footprint or the DSM at 2 m or better spatial resolution becomes available, this will allow analyzing the flood inundation performance by linking to the building resolvability and surface roughness.

We tried to compute the building footprint from the difference between the original ArcticDEM and the LIDAR DTM. But we found the derived patch sizes heavily depend on the elevation difference threshold and the smallest object size threshold.

We showed an example here using the difference with the elevation difference threshold as 1 m (i.e., the ArcticDEM-original-LIDAR >1 m as objects) and the smallest object size as 1 pixel (Figure below). We found that the narrow streets between the buildings are not captured in the ArcticDEM, which is obvious for sample S2 (demonstrated in the Figure below). The filter can identify these as objects and flattens the streets to the same level as the adjacent buildings.

Figure. The patches (pink in 50% transparency) defined by the ArcticDEM-LIDAR>1m overlay the original ArcticDEM of sample S1 and S2.



- Could the authors comment on how transferable their presented method and error statistics would be to other urban use cases.

The robustness and the pattern of parameter response to the error of the filtered DEM is transferable to other study sites as this is inherent in the filter algorithm. From both the theory of the algorithm and our result, we argue that starting from the mean values of the artefact sizes and slope threshold and varying them up and down has a greater chance to find the optimum parameter combinations quickly. Please refer to details in our response to the comment L361, L589 above.

The error statistics will likely change depending on the study site. There are two scenarios that the error might be larger than the values reported in this study. First, if the study site has a high ratio of artefacts with large sizes (much larger than typical building sizes such as closed forest canopy), both the identification of these objects and the interpolation of the terrain in these areas will likely introduce some errors. Second, if the study site has a high ratio of hilly areas, distinguishing them from objects identification will be difficult and the residual error of the filtered DEM will likely be greater than reported in this paper. We include this in the discussion and conclusions.