Author Comments on “A method for parameterising roughness and topographic sub-grid scale effects in hydraulic modelling from LiDAR data” by A. Casas et al.

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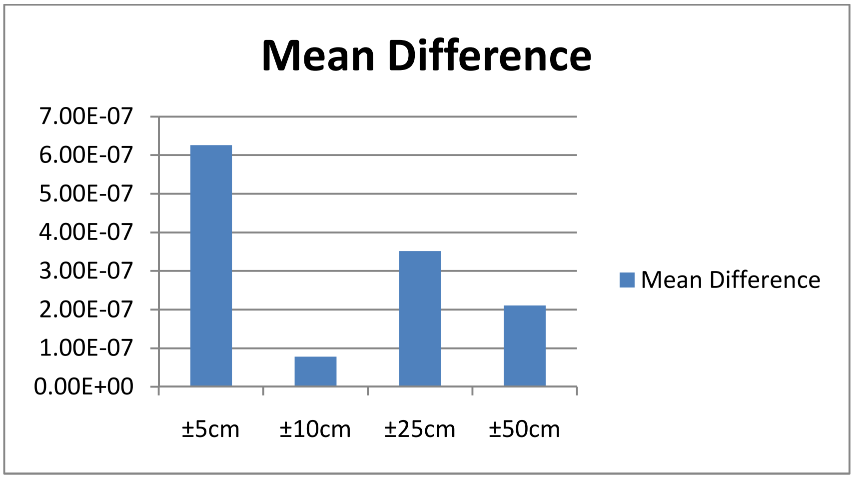
We appreciate very much the supportive comments of the reviewer regarding the interest of the paper. The comments were very valuable and the authors have attempted to address them. The reviewer notes three important points of the paper: first, the fact that the current use of the mixing layer theory considers vegetation as rigid obstacles. Therefore, the method do not consider the flexibility of the vegetation nor the reduction of the resistance due to this as well as the possibility of an alignment of foliage with flow at higher velocities. Secondly, acknowledges the three-way interaction of the methodology between mesh resolution, topographic content of the DEM and the roughness parameterisation upon flow depths (in magnitude and spatial distribution) and flood extent (see Results). And finally, the reviewer remarks the importance of a comparison between a distributed scale dependent methodology against a constant empirically derived roughness parameterisation as a first step towards the comprehension of a model- and scale-dependent roughness definition.

In relation to the sensitivity of the roughness parameter to interactions between the roughness height and the topographic content, the reviewer notes that the roughness height and hence the roughness parameter should reduce as topographic content is increased. We assume that the reviewer means that this should happen if the separation were “good” not “poor”. For each scheme ±5cm, ±10cm, ±25cm and ±50cm the separation is made according to that threshold in relation to a smoothed ground reference surface (DEM^{ref}). The procedure is detailed in section 2.1 and Figure 2. A LiDAR measurement may be within the Δz threshold and then it included in the DEM or if it is outside, above or below, it will be consider roughness and used to calculate the roughness height (z_0). In this way, Figure 2.a shows the point marked as “LiDAR point” outside the ±25cm, therefore the DEM is built without it and the point it is considered to calculate the roughness height (the difference between the elevation of the LiDAR point and the DEM±25cm at that location.

According to this methodology, the premise of higher roughness parameter as topographic content decrease is not right so it cannot be reflected in the table or graphs as the reviewer says. The reason is that the topographic content is considered within a positive and negative threshold from the reference surface (see Figure 1.a). The premise would be true if Δz were considered only above the reference DEM. However, the case may be that the DEM (measured LiDAR point) is bellow the reference DEM in a certain location for the ±25cm scheme, e.g. if the topographic content is of -23cm in the ±25cm DEM. In this hypothetic case, the roughness height will be larger than that in a location where the topographic content is +3cm in the ±5cm DEM. So, roughness heights can still be higher in the case of high topographic content. This may also explain the reason why “n” variations within the ± 5cm model may be larger than those for ± 50cm. However, the mean difference plot has been graphed as suggested by the reviewer.



We agree with the reviewer in that even with no vegetation there would still be the friction due to sub-grid topographic variation. And this is quantified in section 3, where depth derived results (p.2275, l.3) are modified due only to changes in the topographic content, given that a constant value of roughness height of 0.02 m (bare earth) is considered. The topographic content is not included in the term “D” as the reviewer note but in the DEM for each modelling case. The model (Yu and Lane, 2005) calculates the depth change at each time step based on the difference in water surface elevation between cells, so the model is basically topographically driven. It is also because of this fact, that we propose that the final behaviour of the roughness parameter and model derived results is due to an interaction between both components of subscale topography (roughness height and topographic content).

Finally, we agree with the reviewer also in the fact that LiDAR measurement may be underestimating the top of the vegetation, and in that field survey would have been extremely useful. However, in this paper, the main interest was in the comparison of the behaviour according to the roughness scheme for different models and any underestimation is present in any scheme so the comparison is considered to be reliable.

In relation to the minor comments:

In equation 3 the numerator has been changed as suggested

In figure 1, the corner of the rectangle corresponds to the point downstream closer to the bank and this would be noted in the original figure

2271, line 9: Option 2 requires downstream depth and upstream velocity. Table 2 provides these input data for the model.

2271, line 13: The model is run for the 2 km reach and table 6 shows results obtained for the full area (large white rectangle). The analysis of the roughness impact is analysed for the detailed rectangle in Figure 1.

2273, line10: The phrase has been modified as suggested