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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Development of high-resolution multi-scale modelling system for simulation of coastal-fluvial urban flooding" *by* A. I. Olbert et al.

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Dear Reviewer,

Thank you very much for reviewing our paper; your valuable comments were much appreciated. We spent a considerable amount of time to address your comments. Please find below our responses:

1. Line 266 to 268: 'The domains of CG30 and CG06 models only partially overlap. Water elevations computed on CG30 are passed to the eastern boundary of CG06 while River Lee flow data are specified at the western boundary of CG06.' So is there any problem of inconsistency between the CG30 data and River Lee flow data? What

approach was applied to reduce it?

CG30 water levels that are specified to CG06 are compared with water levels measured at Tivoli tidal gauge (located on the CG06 eastern boundary) in Figure 11. Very good agreement is achieved showing that at the location of the CG06 boundary, the CG30 model accurately reproduces the water levels recorded during the flood event. Given that the flow data specified at the western boundary of CG06 is for the same time period, the two datasets are therefore consistent.

2. Line 360 to 363 and Figure 7: While the elevation results of PG90 and CG30 are both accurate, further analysis is necessary to explain why accuracy of velocity using PG90 was much lower than that of CG30.

When model grid resolution is too coarse, some flow features such as small-scale gyres may not be accurately resolved or even lost. PG90 does not resolve bathymetry and topography as well as CG30 and therefore produces less accurate flow solutions. This is particularly important in Lough Mahon, which is quite shallow and has complex bathymetry. The errors in Figure 6 are naturally higher in areas of complex bathymetry and coastline where spatial resolution is of most importance.

3. Line 423 to 425 and Figure 13: The analysis on infrequent random oscillations in water levels occurring in CG06 (Fig. 13 a-c) should be more detailed.

The MSN_Flood model used in this research utilises an alternating direction implicit (ADI) algorithm in its solution procedure. The models using ADI are generally very accurate numerically in modelling flows. However, in the presence of a discontinuity, such as a sharp elevation gradient, high elevations or velocity gradients numerical models using such schemes are prone to generate spurious numerical oscillations in the region of sharp gradients (Kvočka et al., 2015). A common solution used to reduce these oscillations is to increase the grid resolution so the slopes over numerical grids are milder. Comparing time series outputs from CG06 and CG02 it is evident that increasing resolution of the model significantly reduces numerical errors and hence

oscillations. This response will be incorporated to the manuscript. Kvočka, D, Falconer, RA, Bray, M (2015) Appropriate model use for predicting elevations and inundation extent for extreme flood events. Natural Hazards 79, 1791-1808

4. Line 413 to 425 and Table 4: In order to estimate the accuracy of GC02, error statistics of water elevations simulated by the CG02 and measured data should be more suitable than comparing CG06 and CG02 (Table 4). So why use CG06ïij§

The only observational data within the extent of CG02 were the maximum water levels during flood event. The comparison of modelled and observed maximum water levels for 38 stations is showed in Figure 18. In the absence of any other measured data CG02 was compared with CG06, which was already showed highly accurate.

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