**Sensitivity of flood hazard and damage to modelling approaches**

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**Supplementary information 2**

The outputs from each simulation for Dec 12, detailed in Table 1, have been displayed over Ordnance Survey 1:250,000 (Ordnance Survey, 2019) scale map to highlight infrastructure and communities impacted by inundation. Figure 1 and Figure 2 shows the flood at its maximum extent during the Dec 12 event. The flood maps show water depths above 0.05 m, which is the depth saltwater inundation is considered damaging, and is standardised up to the average 99th percentile water depth for run 8 of each coastal hazard conditions (1.6 m for Dec 12) to more clearly present inundation with shallower depths. It can be seen that Dec 12 shows greater depths of shallow water inundation when using the HP approach; however, inundation is minimal and less than Jan 14 event.

2.1 Dec 12 Hazard Proxy (HP)

Figure S1 shows the maximum depth and extent of flood inundation for Dec 12 using the HP approach. Inundation is substantially less for the Dec 12 event, compared to the Jan 14 event. Inundation occurs on tidal flats at Severn beach only for run 3 and 4 and is focused around Oldbury Naite rhine for all other runs. Run 8 shows greatest extent of inundation, as the rhine exceeds the bank crest to flood Chapel Road and Church Lane in Oldbury-on-Severn, and agricultural areas to the west surrounded by Cowhill rhine. The 90th percentile water depth for run 8 is 1.65 m, 50th percentile water depth is 0.34 m and 0.06 m for 10th percentile water depth, which shows that the majority of floodwater is shallow.

A close up of a map

Description automatically generated

**Figure S1.** Depth and extent of flooding at Oldbury-on-Severn for HP approach to forcing the model boundary where maps 1-8 represent coastal hazard uncertainty (see Table 1) for Dec 12.

2.2 Dec 12 Wave Runup (WR)

Figure S2 shows the maximum depth and extent of flood inundation for Dec 12 using the WR approach. No inundation occurs for run 3 and 4. Inundation in run 1, 2, 5 and 7 is focused around Oldbury Naite rhine, with some inundation occurring at Oldbury-on-Severn and on agricultural land to the south of the rhine. WR for runs 1, 5 and 7, with no local atmospheric forcing, does not reach a limit to cause overwashing along the coastline. Run 4, 6 and 8 also shows inundation at Oldbury Naite rhine, which is deeper, in addition to some inundation of agricultural land directly behind the earthen embankments along the coastline at Oldbury-on-Severn. The 50th percentile water depth for run 8 is 0.25 m and 0.03 m for 10th percentile water depth, which shows that the majority of floodwater is shallow. Berkeley Pill is filled in all model runs, but the bank crest is not exceeded and no inundation occurs in the northeast of the domain.

A close up of a map

Description automatically generated

**Figure S2.** Depth and extent of flooding at Oldbury-on-Severn for WR approach to forcing the model boundary where maps 1-8 represent coastal hazard uncertainty (see Table 1) for Dec 12.