Replies to comments of Reviewer #1

Major comments:

Page 1: Line 18: It is mentioned as 'Amphan struck the coasts of Bangladesh and India'. But from figure 1, it is clear that the track has crossed the Indian coast and passes through the Bangladesh mainland, but not actually crossed the Bangladesh coast. Modify the sentence accordingly.

Reply: We acknowledge that the center of the cyclone Amphan made landfall in West Bengal, India. However, the overall impact of the storm, be it wind (34 knots radial band in Figure 1) or associated surge (Figure 5), largely exceeded the borders of West Bengal, and spanned the shorelines of both India and Bangladesh. Thus, we tried to avoid the common wording about "landfalling" and used "struck" to indicate that both India and Bangladesh were impacted by Amphan. We propose to revise the line as follows:

"… Amphan made landfall in West Bengal (India), with a sustained wind speed of 112 km per hour and gusts of 190 km per hour, causing massive damage in India and Bangladesh and claiming at least 116 lives."

Page 3: Line 57: 'reduced-physics modeling', what it means? It seems Murty et al. 2017 used the ADCIRC+SWAN model to investigate the wave, surge interaction in the shallow waters.

Reply: By "reduced-physics modelling" we meant a storm surge model without coupling with a wave model. For clarity, we propose to replace "reduced-physics modelling" by "modelling without waves coupling". From our reading, Murty et al. (2017) did not use any storm-surge - waves coupled model, but only a storm surge model (ADCIRC) for real-time forecasting (which is the concern of this particular statement). On a related topic, we acknowledge that Murty et al. (2016) did use a storm-surge - waves coupled model (ADCIRC+SWAN) to investigate storm surges and wave setup for cyclone Hudhud. It is noteworthy that both these papers are cited in the manuscript.

Page 4: Lines 96-98: Explaining the tide surge interaction. I suggest citing the article Srinivasa Kumar et al. 2015 entitled 'Modeling Storm Surge and it's Associated Inland Inundation Extent Due to Very Severe Cyclonic Storm Phailin' here. Their work was clearly investigated how the phase of the tide alters the surge height and inundation extent. I feel this citation suits here. However, this is up to the author's choice.

Reply: Thank you for the suggested reference. We propose to cite it accordingly in the corresponding part of the manuscript at L96-98

Page 7: Line 164: What is the resolution of the mentioned bathymetry? Whether the 77,000 points are really sufficient to cover the entire Bengal and Bangladesh coasts especially while computing the inundation extent?

Reply: As we have mentioned in the manuscript (L164), the current bathymetry is an updated version of the bathymetry produced by Krien et al. (2016).

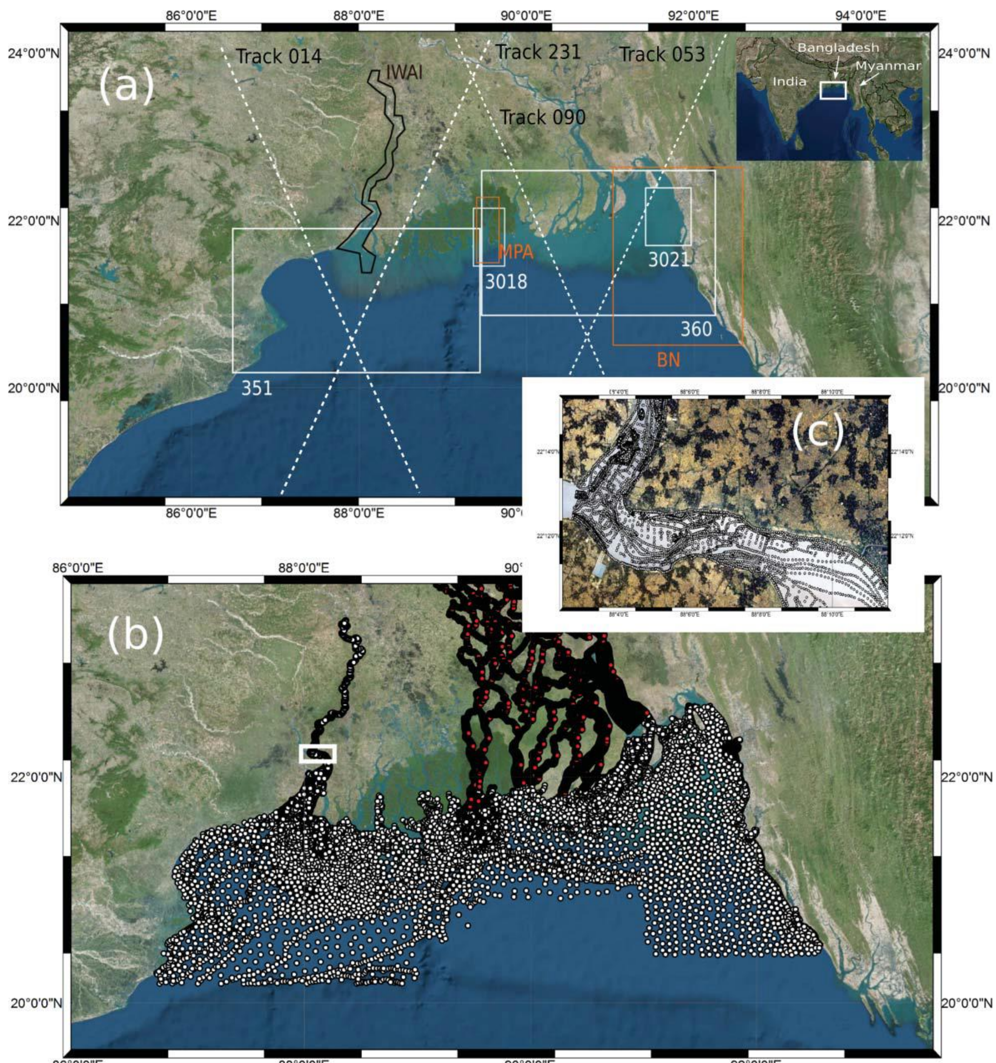

Fig C1. (a) Navigational charts of NHO (India) digitized in this study (white rectangles) as well as maps given by Bangladesh Navy and Mongla Port Authorities (BN and MPA respectively). (b) Display of digitized data (in white) and data from bathymetric surveys in rivers (in red). (c) Zoom of digitized data in the Hooghly river. (Adapted from Krien et al., 2016).

This dataset is complemented by additional 77k digitized points, which is shown in Fig C2. The resolution of the chart points ranges from 200 m to 5 km, with a prevalence of 300-500 m as the most common spacing.

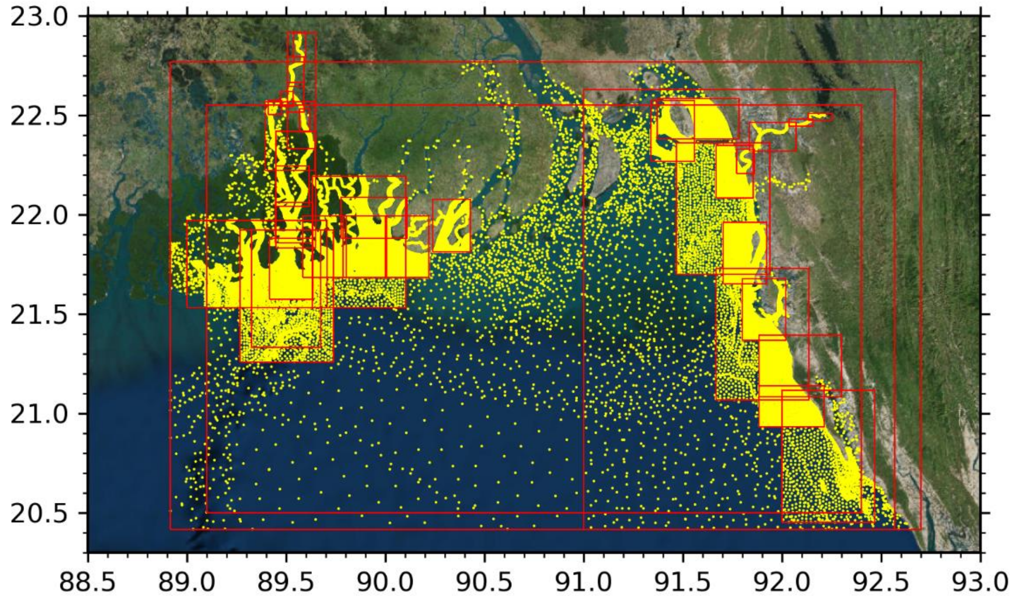

Fig C2. Digitized sounding points from Bangladesh Navy charts (in yellow), the red boxes show the individual chart outlines.

These digitized points do not cover the inland area, which is separately covered by a high-resolution (50 m) inland topography dataset over the south-central part of the delta on Bangladesh side (as explained in L169), and rest is complemented by SRTM dataset (refer to L171). The extent of the CEGIS data over inland is shown in Fig C3.

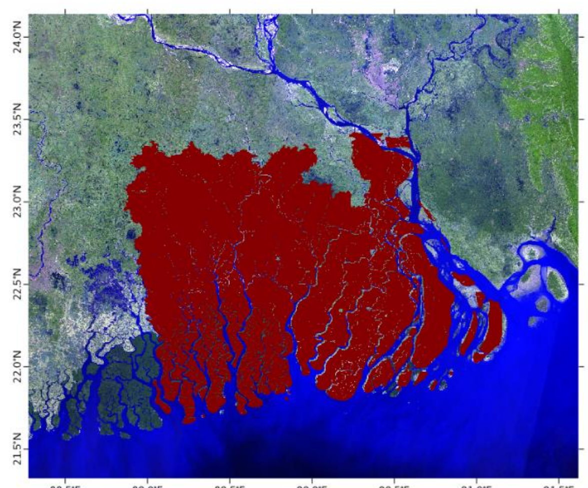

Fig C3. Extent of the 50 m resolution inland topography dataset (in red).

We propose to include Fig. C2 and Fig. C3 as Supplementary materials.

Page 8: Line 173: Is this the whole Bay of Bengal or part of it? Because the latitude extents given in the brackets don't cover the entire BoB. Please check.

Reply: As stated in the manuscript, our domain covers the Bay of Bengal to the North of 11°N. We agree that traditionally, the commonly accepted geographical limit of the Bay of Bengal is rather around 6°N to 8°N. To remove this ambiguity, we propose to reword “whole Bay of Bengal” to “northern Bay of Bengal”.

Page 8: Line 175: 250m resolution near the coast is acceptable for the surge computations. However, is it sufficient for the inland inundation computations?

Reply: Given the current level of detail available for the inland topography, we firmly think that 250 m is a well-suited resolution for inland inundation computation. This resolution is not dictated by the scale of the hydrodynamic features, but rather by the resolution of the topographic databases available over our domain. Indeed, the currently available topographic datasets remain rather coarse, in that they do not resolve the sharp man-made physical features – e.g., embankments, roads etc. By combining separate datasets of embankment geometry and using the flexibility of the unstructured grid, we tried to capture the outlines and heights of the embankments in our model grid. As we showed in Figure 8, these embankments pose the zeroth-order control on the inland inundation, and yet we have limitations of the knowledge of the up-to-date embankment’s heights.

However, at a much finer scale, one will think of implementing road-networks, associated water control structures (culverts, bridges etc.) once such high-resolution information becomes available.

Page 8: Line 176: Mentioned here that the model domain and mesh are shown in figure 9, but no figure in the draft shows the mesh and domain. It seems the figure is missed. The domain and mesh figure are important for the readers and hence it should be provided.

Reply: We are sorry for the misunderstanding here; we were referring to Figure 9 of Khan et al. (2019). Our sentence reads correctly in this regard. This being said, we agree with the reviewer that the inclusion of the figure will make it more convincing to the reader. We propose to include the following Figure C4 showing model domain, mesh, and boundary conditions as Figure 4 in the manuscript.

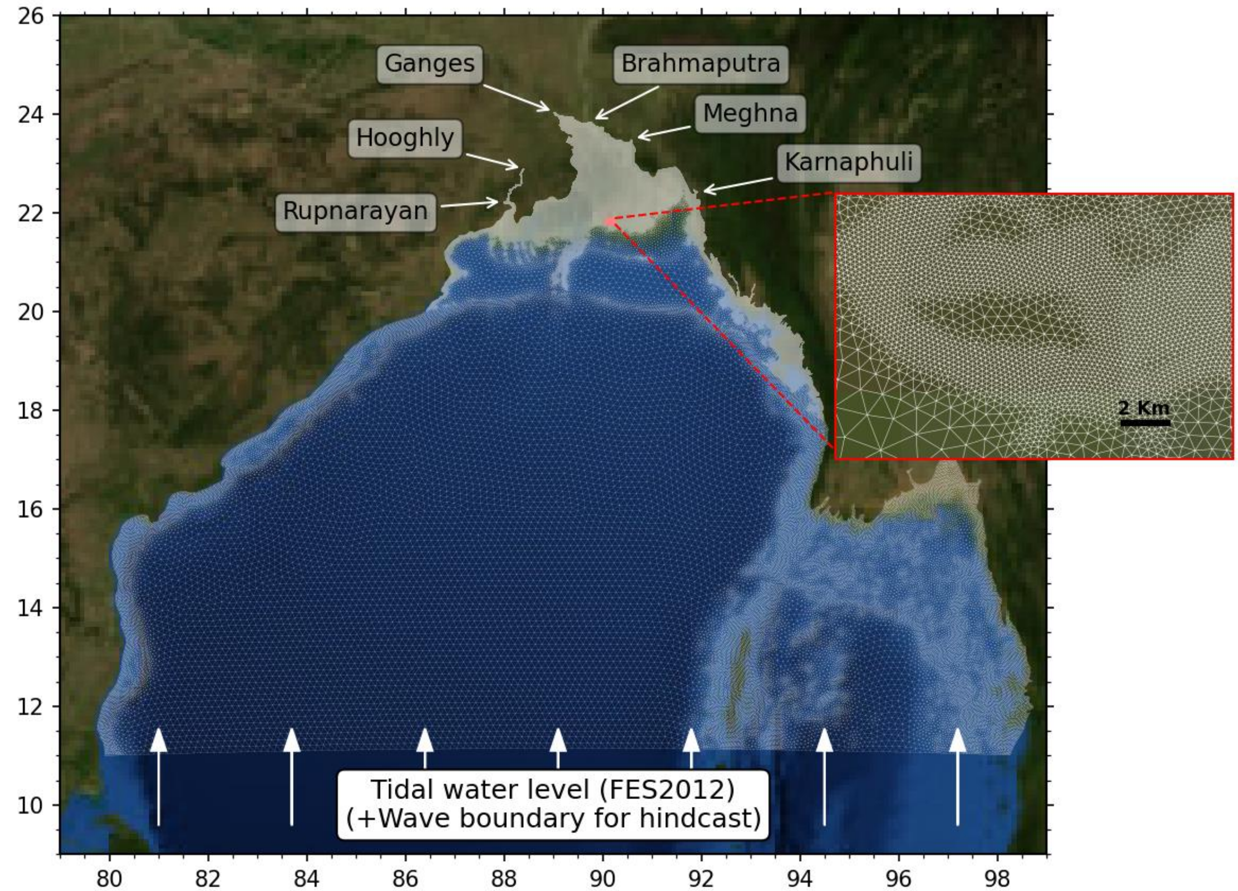

Figure C4. Computational domains and model mesh for SCHISM-WWMIII, as well as model boundary conditions. White arrows on the southern boundary show the forcing with the tidal solution provided by FES2012, and on the northern boundary shows the river discharges. For a hindcast experiment, wave spectra from WW3 are imposed on the southern boundary.

Page 8: Line 178: Mentioned here as 'wave model, is coupled online with SCHISM'. What does it mean? Whether the wave model also uses the same unstructured mesh or it uses the structured mesh? Whether both the models are running at a time (i.e., in parallel)? or running the wave model and then transfer the wave boundary condition to the surge model? These points are to be briefly explained. The given citation Roland et al., 2012 can be used for the complete details.

Reply: By ‘coupled online’ we meant that two models are fully coupled (and run as a unique executable, coupled at source code level without any external coupler). To avoid ambiguity, we propose to reword the segment as ‘coupled at source code level’.

The wave model uses the same unstructured grid, as mentioned in the following line (L179).

The hydrodynamic core and the wave model run sequentially. To reflect this, we propose to update L183-184 'Water level, and current are exchanged among the two models every 30 minutes.' to 'Every 30 minutes of SCHISM runtime, water level and currents are passed to WWM for calculating the evolution of the wave fields. Calculated wave radiation stresses, total surface stress, and the wave orbital velocity are passed back to SCHISM before computing the next time step.'

Page 8: Line 200: Given that the blended wind field is used. What is the horizontal resolution of the wind and pressure fields?

Reply: The final resolution of the gridded wind and pressure field is 0.025° (roughly equivalent to 2.8km). We propose to add the following line at the end of L209 – 'The final resolution after merging the analytical wind field with the interpolated background GFS fields is 0.025°.'

Following another review comment, we have updated Figure 6 with a schematic of the spatial merging of wind and pressure fields from various sources. Considering these two revisions, we also propose to update L107-108 as 'The analytical and background wind fields were first temporally interpolated every 15 minutes and overlaid on the background GFS fields using a distance-varying weighting coefficient (from 3xRm to 10xRm, Rm is the radius of maximum wind) to ensure a smooth transition (Figure 6).'

It seems the tide is also included in the computations. What is the spinup time used in the study to get the actual tide levels at the coast?

Reply: Yes, we confirm that the tide is included in the computations, as stated in line 191-194. The spinup time is 2 days or longer in all our numerical simulations (either in hindcast mode, Section 4, or in forecast mode, Section 5). We propose to add the following sentence to make it clear (at L209):

"… Lin and Chavas (2012). For all storm surge simulations, a spinup time of 2 days is considered in this study."

What is the source of the buoy data used in the study?

Reply: buoy data used in this study is collected from INCOIS data portal (https://incois.gov.in/portal/datainfo/mb.jsp) during the time of the study which is mentioned in L222.

Figure 4: There is a clear mismatch between observation and modeled total water level at the given locations especially at Angtihara and Tajumuddin. This might be due to the lack of spinup for tide simulation. The reason given here is 'The local bathymetric error and friction parameterization might be the source of the discrepancy'. But the same model used by Krien et al. while using the digitized sounding points has computed the better tide amplitudes. Please check the spinup time. As mentioned if Angtihara is located in a data-scarce location inside Sundarbans mangrove forest, remove the plot.

Reply: The spinup time for the model (including the tides) is of 2 days, which we believe is much more than the typical time needed for a full tidal spin-up (inferior to 24 h over our domain in our model; not shown). We do not agree that Krien et al. (2016) obtained better tide amplitudes than ours. As seen in our Table A1, their model performance was generally similar to ours, and for several stations worse than ours. What is more, they did not assess the performance of their model in any of these two stations of Angtihara and Tajumuddin. However, we acknowledge that the plot of Angtihara time-series is perhaps misleading, and we agree to remove it.

Provide the water level - tide (surge residual) plots (time series) too, to support the statement in the line numbers 246-247, page 11.

Reply: Given the very limited length of observed tide gauge records that were available to us (13 days, including time period with surges), it is unfortunately not possible to operate a meaningful tidal analysis. Hence it is not feasible to compute any observed surge residual, although we agree it would have improved the clarity of this statement.

Inundation section: The methodology is to be clearer. Though Lewis et al. is cited for the details, a brief description is required here. Whether the model mesh extends on to the land or not? if so up to what extent (i.e., up to which topography contour)? or whether the water level values at the coast are used and extrapolated the inundation extents?

Reply: The model extent of the model mesh is now shown in a new Figure (Figure C4). The model mesh does extend over land, up to beyond the topography contour of 5 m above MSL.

Regarding the calculation methodology, it seems there is a misunderstanding as we did not cite Lewis et al. 2013 "for details" relevant to our own modeling framework. Indeed, unlike Lewis et al. 2013, inundation is modelled seamlessly in SCHISM, considering the same hydrodynamics as estuaries or ocean. To clarify the methodology and avoid misunderstanding we propose to add the following line at L356 –

‘… (Lewis et al. 2013). In our modelling framework, the inland inundation is calculated seamlessly by SCHISM, solving the same hydrodynamics over the model domain, thanks to its wetting-drying algorithm. While the recent improvement…’