

Response to Reviewer 3:

We thank the reviewer for their careful reading of the manuscript and their thoughtful comments which we discuss below.

- *I am missing more information on the additionally included data (number of new measurements per day etc.), their QC processing. What was the observation error assigned? Also it would be relevant to include marine data in the coverage plots.*

The ship observations available are already included as filled circles in the bottom row of Figure 3, but there are just very few of them! We have added a sentence to the figure caption to clarify this. The cited Craig & Hawkins (2020) paper discusses the collection and QC of most of the new pressure data, but we include more details about the number of stations and their assumed uncertainty in the text and in Appendix A. In the 20CRv3 system the land stations are all assigned an uncertainty of 1.2mb (surface pressure) or 1.6mb (sea level pressure), and ship observations are assigned an uncertainty of 2.0mb. This is unchanged in our experiments.

- *This concerns specifically also the tide gauge record. The authors mention that the QC is not yet done and this work is in process, but it is hard to get a feeling for the error.*

The precision of the tide gauge data is 1 inch and this section of the record has been screened for quality control; we add these details to Appendix A. There remain a few issues with the data from earlier decades which were later to be digitised, which is why the rest of the record has not been published yet, and we can't give a precise answer about the surge statistics. The error on individual data points is hard to constrain without contemporary levelling information, but the coherence of the Liverpool and Hilbre data suggests it is within a few tens of cm.

- *How does the assimilation system digest the quite massive increase in the input? Given the decreased spread, are some of the "original" observations now rejected or vice versa?*

This is an excellent question, and we have gone back to check this. We were already aware of one observation being rejected during the storm in the original 20CRv3 – the existing Stornoway morning observation on 27th February (1002.1mb) appears to be 1 inch/Hg (around 33mb) too high, suggesting a mis-reading or mis-transcription in that record. This is a common feature of such data and that individual observation was not corrected in our experiments. In addition, we discovered that the new data for Nairn was rejected frequently in the reanalysis experiments; this was due to a typo putting Nairn in the incorrect location. This has not negatively affected the reanalysis as the data is rejected, but it is slightly unfortunate as Nairn happens to have been near the centre of Storm Ulysses and the 961mb observation that was taken was rejected due to being inconsistent with the reanalysis as it was in the wrong place. If it had been in the right place then the uncertainty in the experiments would have been further reduced slightly. The corresponding data file has now been fixed and the filled symbol was not plotted on Figure 3. No other new or existing observations were rejected during the storm and no changes to the manuscript are made.

- *Fig. 3: Is the ensemble mean of the version "with new data" captured in the ensemble spread of the "raw" 20CRv3? This would be interesting for users that*

cannot rerun 20CRv3. The figures in the Appendix on the spread and RMSE ratio are nice, but do not directly answer the question for this case.

Thanks. We now highlight in the text that individual members in 20CRv3 are more uncertain in the position of the storm rather than the depth of the storm itself. This leads to the ensemble mean in 20CRv3 showing a storm that is shallower than when the position is constrained by adding additional observations.

- *Say a bit more on the storm surge model already in the main text (at least mention the resolution and start of integration).*

Thanks - we have added some additional text giving more specifics about the storm surge model in the main text and retain the details in Appendix C.

- *L. 367: https://digital.nmla.metoffice.gov.uk/SO_7c59f237-7add-4d78-9c99-4e4210a926e1/ produces a "not found" in my browser*

This link works for us, and points to the Land Observations component of the National Meteorological Archives.

- *The reference list is a bit messy (punctuation, initials, use of "et al.", use of "and", "&" or nothing, etc.).*

Noted. This will be fixed.