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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Reconstruction of flow conditions from 2004 Indian Ocean tsunami deposits at the Phra Thong island using a deep neural network inverse model" *by* Rimali Mitra et al.

Anonymous Referee #3

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This paper applies a massive forward modeling of tsunami sediment transport and machine learning by deep learning neural network to invert tsunami characteristics, such as inundation distance, flow depth and speed, and input sediment concentration based on sedimentary data of the 2004 Indian Ocean Tsunami collected from the Phra Thong island, Thailand. The authors previously used the inversion model for the deposits of the 2011 Tohoku earthquake tsunami from the Sendai Plain, Japan, and demonstrated the model performance and applicability. Their inversion model is a promising tool to

quantify hydrodynamic parameters of paleotsunamis based on sedimentary deposits, and will benefit assessing hazards from future tsunami inundations and modeling their sources worldwide. Application with different field dataset is necessary to verify, validate and improve the model.

Although the scope is interesting and the achievements are valuable, an extensive improvements will be needed before the publication. One of the major concerns is the technical problems on writing. Sentences in the body text are often complicated and difficult to understand the author's intent. A complete English proofreading by professional services or native speakers is needed. Section 3.2.1, which explains the sedimentary data from the Phra Thong island, must be placed before the description of the inversion results. In addition, earlier papers sometimes were inappropriately cited, and the order of some figures (and insets) are not consistent with the structure of the paper. Therefore, comprehensive reorganization and correction are required to improve the readability of the paper.

Another concern is that whether the model assumption is valid for the study area. For example, both the transect of the tsunami deposit sites and the reference line (Figure 6) is oblique to the coastline, meanwhile the model assumes that the coordinate x for the forward simulation is perpendicular to the shoreline (equation 2). I'm curious that how likely the direction of tsunami inundation was consistent with these lines. Satellite imageries show that the geometry and directions of the sandy ridges are quite complex, implying the tsunami inundation might have been affected the local topography. Fujino et al. (2010) mentioned that the measurement of the flow direction was not many and in fact only single measurement was made near the coastline of the transect. There may be an uncertainty in the tsunami inundation direction (and probably the sediment source). If this is the case, additional computation of the forward and DLNN model using reference line with different directions are needed.

With regard to Section 4.3, I think the flow speed comparison is problematic, since the model assumes a constant flow speed over the inversion region and it is not clear

whether it represents either an average, maximum or something else. This also applies to the measured flow speeds. Unless the attributes of the measured flow speeds (i.e. average, maximum or other) are specified, the measured values cannot be compared with inversion results. The comparison to the inversion results of the TsuSedMod also needs a careful discussion, since the TsuSedMod employs different model assumptions and formulations. It is not clear how the comparison of the two different inversion results are justified.

The idea of coupling DLNN with other tsunami hydrodynamic model, such as the well-validated TUNAMI-N2, is very interesting. Although it must be computationally expensive, the DLNN inversion can include much more physically plausible hydrodynamic models to improve the model performance. I suggest to expand on this aspect, such as outlining a road map and future challenges.

Other minor specific comments are found in the annotated PDF. I hope the authors may find my comments useful for revising the manuscript.

Please also note the supplement to this comment:
https://nhess.copernicus.org/preprints/nhess-2020-373/nhess-2020-373-RC4-supplement.pdf

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