Referee comment on "Estimating dune erosion at the regional scale using a meta-model based on Neural Networks" by Panagiotis Athanasiou et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-106-RC2, 2022

Anathasiou et al. present a framework that combines artificial neural networks and process-based modelling (XBeach) to derive estimates of dune erosion during storms on the entire Dutch coast. The approach yields a prediction skill with an RMSE of 19 m³/m, which is reasonable given the 1D-approach and the simplification of the hydrodynamic boundary conditions. The model can provide estimates of dune erosion volumes within seconds, making it a crucial new approach for assessing potential dune erosion hot spots as storms develop and hit the coast.

The authors provide a very well-written and clearly structured manuscript. The relevance and need for their work is clearly outlined in the introduction section, and reflected upon in the discussion section. The approach is detailed in an elaborate manner, making it reproducible for application of the technique elsewhere. Assumptions and limitations underlying the approach are made explicit and tested as part of the results. There is room for improvement, which is clearly addressed by the authors and this work forms a solid basis to do so. The inclusion of oblique wave incidence would be a crucial next step. As such, this work is relevant to the research field and the readers of NHESS and, after taking the comments below into account, I recommend this manuscript to be published with minor revisions.

COMMENTS

- L84-86 A preview into the method is given here, by introducing the two-step approach with (1) a classifier and (2) a regressor. This is further elaborated in the methods section. It is unclear to me why the first step is needed if the regressor may also yield DEV=0. Please elaborate on why this choice was made.
- L227 Here the reader is referred to the discussion section on the impact of assuming...
shore-normal wave-incidence for dune erosion predictions; this may lead to an underprediction of dune volumes. Please briefly mention (1-2 sentences) the implications of this here, in section 2.4, so it is clear to the reader before starting to interpret the results.

- L233-235 DEV<0 was predicted by XBeach, and the presence of newly-formed dunes is mentioned as a possible cause and deemed non-representative of the dune response. Such local accretion has been observed elsewhere, e.g. Cohn et al, GRL (2018) or Harley et al., Nature (2022), and may result from alongshore variability in pre-storm morphology. This cannot be accounted for by the 1D model used in this study, but such variations may develop during relatively small SSL, as pointed out by the authors. I feel this should be mentioned for completeness and for the translation of the model results to field observations.

- Section 4.2
  - I agree that including oblique wave angles would be an important next step, as storms on the Dutch are not shore-normally incident everywhere along the coast.
  - Would this model be able to capture the response (DEV) to a storm of a dune that has not yet recovered from a previous storm? Or is this captured in the morphological inputs fed to the ANN? I.e. can this model structure deal with sequences of storms?
  - In addition to the parameters mentioned that may also be of interest and are reported in the literature, the authors may consider adding nearshore bar morphology, as observed by e.g. Castelle et al 2015 and touched upon by the authors in the introduction section. This also relates to the possible future expansion of the method discussed in L540-544.

- L549-550 The presented framework would be a very useful starting point for application elsewhere. Will the code be made openly available (e.g. a Jupiter notebook, or through GitHub)? If so, please include the link.