

Author comments (AC) to reviewer 1 comments (RC1), manuscript Gomez de la Pena et al. “On the use of Convolutional Deep Learning to predict shoreline change” submitted to EGU sphere

Before addressing the comments, we would like to thank reviewer Andres Payo for the time invested and comments made. All comments have been incorporated and the clarity of the manuscript has certainly improved.

RC1.1. My main concern is on the lack of some methodological important details (see also specific comments) and most critically on the rationale for constraining the prediction to a single location (not shown) to assess the shoreline predictions. This is important, as the authors indicated the oscillatory nature of the shoreline changes (L370). Should the location being close to a nodal point, the same time series of drivers will have produced virtually no changes in the cross-shore location. The ability of the model capturing the shoreline position, simultaneously at different locations is not presented and the claimed improvement over ShoreFor and SPADS remains unclear.

The camera system provides images of a section of the Tairua beach but only the cross-shore position at one location has been used as a target but neither the rationale for choosing this location or a map showing the location is presented.

AC1.1: We realize this was not clear in the submitted version and that the manuscript requires some additional lines to avoid misunderstandings. Similarly to previous published works (e.g., Montaña et al. 2020, Montaña et al. 2021), we have analyzed and predicted the evolution of the average shoreline. More specifically, we have taken the alongshore-averaged cross-shore position time series as the target of our DL models. We have hence modified the manuscript to describe this in a clearer way. We notice that in Montaña et al. (2020), an international effort to model Tairua’s shoreline was carried out, where 19 models of different institutions were tested on the alongshore-averaged shoreline time series of Tairua.

Lines 170-177 now read:

170 position was captured with approximately daily observations over a period of 18 years (1999-2017) using a camera system at the south end of the beach. The image analysis and tidal correction applied to the images of the camera system are in line with previous works (e.g. Guedes et al., 2011; Blossier et al., 2017; Montaña et al., 2020), where daily shoreline images with tidal levels between 0.45 and 0.55 m were selected in order to limit tidal influence. The images obtained were georectified and processed to extract shoreline time series. Then, in line with previous works (e.g. Montaña et al., 2020; Montaña et al.,
175 2021), an alongshore-averaged cross-shore position was taken in order to obtain a single time series — the DL models’ target. A weekly moving average is applied to the alongshore-averaged shoreline time series to filter noise affecting the small (less than daily) time scales following Blossier et al. (2017); Montaña et al. (2021).

We have also included a new figure in section 2.4 (Data), where a map with the predominant features of the study site are highlighted:

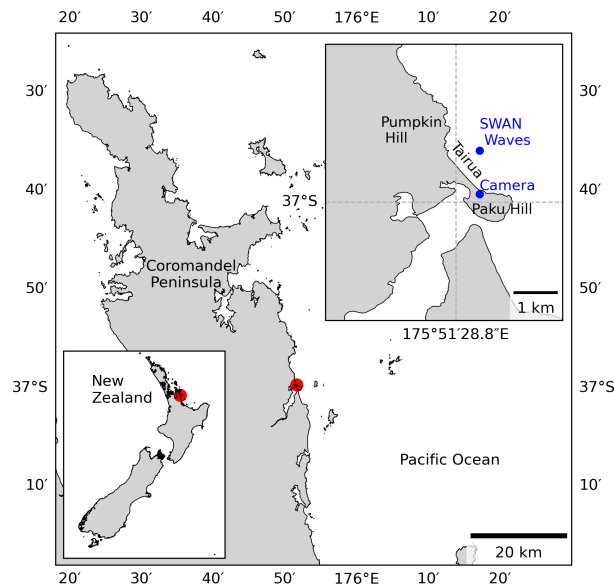


Figure 4. Location of Tairua on the Coromandel peninsula in the North Island of New Zealand. Blue dots represent the installed camera system and the SWAN wave bulk parameters location.

RC1.2. A short description on the set up used for the ShoreFor and SPADS model need to be included. At present, the manuscript contains very detailed information on how CNNs model has been set-up but no information is provided on the set up of the ShoreFor and SPADS models. To be consistent with authors closing remark (L373), I encourage them to make the model configuration publicly available.

AC1.2: We have modified the manuscript and added a description on how the coefficients for each model are determined. We need to point out that we are not running the models Shorefor and SPADS, but only reproducing the results previously presented in Montañó et al. (2021). We have also made this last point clear in the updated version of the manuscript. The end of section 2.4 (Data) now reads:

To test the DL models, we use the time series previously presented in Montañó et al. (2021) generated with models SPADS (Montañó et al., 2021) and ShoreFor (Davidson et al., 2013); the coefficients for both SPADS and ShoreFor are determined in the models' calibration phase following optimization rules, no *a priori* information — besides wave model inputs and a shoreline target — is required.

195 The formulation of the equilibrium-based model ShoreFor (Davidson et al., 2013) used in Montañó et al. (2021) follows the modifications of Splinter et al. (2014) allowing for a general model with inter-site variability of model coefficients. The model contains two coefficients linked to wave-driven processes: (1) the memory decay parameter (ϕ) that describes the "memory" of a beach to previous wave conditions (notice this use of the concept "memory" is different than the one used in LSTMs) and (2) the rate parameter (c) that describes the sediment exchange efficiency between the beach face and surf zone. At Tairua, the
200 memory parameter ϕ has been found to be around 220 days (Montañó et al., 2021).

The data-driven model SPADS (Montañó et al., 2021) uses non-stationary time series decomposition methods to reconstruct shoreline oscillations at specific time-scales (S_j) with statistically significant driver information (Y). Coefficients c that best fit the relation $S_j = \sum_i^N c_i Y_i$ are optimized, where $N = 1, 2, \dots, i$ correspond to the number of drivers that are significant at the time scale considered, and the subindex j corresponds to the time scale of the shoreline being reconstructed.

RC1.3. Figure 4 shows both the target and drivers time series, but it is unclear if all time series have the same frequency (daily, hourly, ...) and if the shoreline position was corrected for any differences in tidal elevation at the time of the camera image was captured.

AC1.3: The reviewer is correct and we have modified the manuscript to specify the frequency of the weekly averaged target shoreline time series, the tidal correction applied, and that the frequency of the wave time series is daily. All of these details are in line with previously published works in Tairua (e.g. Guedes et al. 2011, Blossier et al. 2017, Montaña et al. 2020, Montaña et al. 2021):

is Tairua Beach, which is located in the Coromandel Peninsula, North Island of New Zealand (Figure 4). Tairua is a 1.2 km embayed beach with median sediment diameters (D_{50}) of ~ 0.3 mm, where the tidal range varies between 1.2 - 2 m. Shoreline position was captured with approximately daily observations over a period of 18 years (1999-2017) using a camera system at the south end of the beach. The image analysis and tidal correction applied to the images of the camera system are in line with previous works (e.g. Guedes et al., 2011; Blossier et al., 2017; Montaña et al., 2020), where daily shoreline images with tidal levels between 0.45 and 0.55 m were selected in order to limit tidal influence. The images obtained were georectified and processed to extract shoreline time series. Then, in line with previous works (e.g. Montaña et al., 2020; Montaña et al., 2021), an alongshore-averaged cross-shore position was taken in order to obtain a single time series — the DL models' target. A weekly moving average is applied to the alongshore-averaged shoreline time series to filter noise affecting the small (less than daily) time scales following Blossier et al. (2017); Montaña et al. (2021).

The traditional inputs for modelling shoreline position are wave bulk parameters (i.e. significant wave height H_s , peak period T_p and direction θ). We include these drivers by using the wave characteristics (at 10 m water depth) daily-averaged time series in Montaña et al. (2020), obtained with a SWAN nearshore wave model (Figure 5), validated with in situ measurements in 8

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The Authors

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