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Earth Surface Dynamics Discussions

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Interactive comment

Interactive comment on "Storm-induced sediment supply to coastal dunes on sand flats" *by* Filipe Galiforni-Silva et al.

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Dear reviewer, Thank you very much for your valuable comments and time when evaluating our work. Your feedback truly helped our manuscript, highlighting essential aspects that were not clear in the previous version. You can find our specific comments below. Comments that need editing in the text will be acknowledged here but addressed in the revised version.

Specific comments

- The Xbeach model runs comprise 12 surge events but only one bathymetry (surveyed in 2009) is used. Would this introduce error in the simulations? Do you have any idea? You might want to address and discuss whether or not changing bathymetries might affect you results.

R: The idea behind using the same bathymetry was to analyze only the effects of the water level and the waves onto the sand flat. With that said, we think that changing the bathymetry may lead to different results quantitatively, but not necessarily qualitatively. The process leading to sediment deposition seems to be independent of the bathymetry since it is mainly driven by the inundation and the consequent on-shore wave-driven current that develops at the start of the surge. Moreover, LiDAR data shows that the deposition onto the sand flat occurred in different bathymetric settings. However, we do acknowledge that, with different bathymetries, local changes may lead to more or less sediment being transported/deposited.

- I am also somewhat surprised that you use ADCP data from the tidal inlet to validate the simulations over the sand flat. The inlet is a totally different environment with different processes (tidal currents vs wave-driven currents) being dominant. Moreover, the fit between the simulated and measured current speeds (Figure 4) is not great. I doubt that the validation exercise is relevant for conditions at the tidal flat and I actually suggest you leave out the validation and just go with the fact that you use the model in default mode.

R: We agree with everything, as briefly stated in validation subsection in the previous version. We take the reviewer suggestion, and the validation section will be removed in the revised version. We will maintain a short paragraph explaining our limitations regarding validation and our choices on using the model as default.

- Sediment deposition at the sand flat is caused by 'an onshore-directed water flux' (p.15, l.9). Could you be more specific? What drives this current? Is it homogeneous in the vertical? Are the simulated current speeds averages over the water column, or is there vertical segregation? Why is the current onshore when the flat is inundated?

R: Indeed, the current text needed more details, which will be added in the revised version. The model is depth-averaged, though it includes known processes that induce vertical segregation of the flow (i.e. undertow). The way we see the process is as follows: At the start of the event (i.e. before sand flat inundation), wave breaking induces pressure gradients that are higher at the shoreline, causing the development of the undertow and a depth-averaged offshore barotropic flow. As the water level increases and the sand flat gets inundated, the pressure gradient induced by the surf bore reduces, as it starts to flow over and enter the sand flat. That leads to a reduction of the offshore flow, and the surf bore starts to lead the net flow component, resulting in an onshore-directed flow. It is important to note that currents driven by gradients on the momentum flow, which usually leads the development of other types of nearshore circulation (e.g. longshore currents) did not lead to any statistically significant relationship with the deposition.

- The sediment deposition is calculated through regression techniques (p.18). Could you tell us a bit more about how you actually calculate those volumes? Do you use the scatterplots in Figure 10?

R: For this part of the text, specifically, we estimate the potential amount of sand deposited using time-series of water level and waves as predictors, as shown in Figure 15. As we have seen a good agreement between both in Figure 10, we attempted such a quantification of the volume of sand. With that said, it is important to note that, in reality, several other variables may influence such a deposition. Moreover, as our model is not validated for this specific site, uncertainties around quantitative estimates arise.

- In the discussion section, you compare the volume increase in the dunes with the volume increase from annual Lidar data, and with the results of numerical simulations of storm events. You conclude that between 27% and 67% of the sand added to the dunes come from the sand flat. Where does the rest come from, then? I do not think you can make this direct comparison. The annual Lidar surveys would miss all the sediment being bypassed across the sand flat during the period between two surveys, and the simulations comprise only surge situations with non-storm events left out. In short, I believe all the sand comes from the subtidal and is subsequently transported across the sand flat. If the sand flat were not replenished from offshore/longshore sources, it would have disappeared a long time ago.

R: Indeed, we also believe that all the sediment comes from the subtidal part depending on the time-scale. It has also been framed in the discussion (page 11, lines 1-30). We believe that the remaining sand would come from the intertidal zone during mild periods, after being transported and deposited in this zone by onshore cross-shore sediment transport from the subtidal zone. The point that we try to make is that storm surges would facilitate this process by either remobilizing the top layer of the sand flat and also by depositing a significant amount of sand in an always exposed area. We completely agree that there is a lot of missing information due to the time-resolution of our LiDAR data. However, the comparison is only to show the order of magnitude that we refer when talking about the deposited sand onto the sand flats.

Technical corrections

- p.4, lines 8 & 10: 'storms surges' should be 'storm surges'.

R: We will correct in the revised version.

- p.5, l.1-3: The dune area has been defined as the area lying above the +3 m contour and the sand flat is located between +1.5 m and the MSHTL (earlier defined as +0.66 m). What lies in between?

R: We limit the extent of the sand flat up to 1.5 meters since above such an elevation there are already signals of aeolian deposition and incipient dune formation, which would add an error on the hydrodynamic deposition estimates. We will add a further explanation in the revised version.

- p.9, l.3: . . . ..deposition patterns in the supra-tidal zone occur between at least ten different years'. What does this passage mean?

R: Will be rephrased for clarity.

- Figure 7: What do the black and the red boxes represent?

R: Colours represent accretion and erosion. Further information will be added to the Figure caption.

- p.16, l.15: ‘interdal’ should be ‘intertidal’.

R: We will correct in the revised version.

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