

Review report on paper esurf-2016-35, 'Complex coastlines responding to climate change: do shoreline shapes reflect present forcing or 'remember' the distant past?', by Thomas, Murray, Ashton, Hurst, Barkwith and Ellis.

This paper examines the morphodynamics of sandy coasts driven by wave-induced alongshore sediment transport. It is well known that for large wave incidence angles with respect to shore-normal, the coupling between wave field, morphology and sediment transport may become unstable and give rise to complex shorelines featuring sand waves, cusped capes and spits. When trying to test this assumption against observations, all the existing literature considers the present wave climate as the forcing agent. However, the climate changes and that assumption implicitly assumes either no change or very slow change with respect to the characteristic time scale of the features. This paper explores to which extent this assumption is valid by means of model experiments for two different features: cusped capes and flying spits. It is found that the characteristic time of spit dynamics is long enough for the quasi-equilibrium with present climate assumption to be not valid. This implies that present coastal morphologies may respond not only to the present conditions but also to past wave and morphological conditions, possessing a sort of memory. This is relevant for coastal management, for interpretation of geological records and for paleo-climate insight. It also makes more difficult the comparison between models and observations regarding coastline features.

I find the results innovative, relevant and well-funded. The manuscript is generally clear and well-written. I therefore recommend publication after addressing some comments I list here below.

- 1) In the abstract it is claimed that the characteristic scales vary with the square of the aspect ratios. Where is it proven in the paper? I can't find it. Please check or remove.
- 2) There is some confusion regarding the duration of the model runs. According to the figure caption, "after 450 yr" is wrong in Figure 3. It should be "after 200 yr". I would change "static wave climate" → "static wave climate during 1000 yr", for the sake of clarity. I presume the 200 yr or the 750 yr include the spin up 100 yr, isn't it? Page 6, line 23: "the new wave climate is held constant for a further 600 yr". Shouldn't be for 650 yr? =1000-(250+100)? Please clarify!
- 3) Page 8, line 30: "the resulting strong gradients in these fluxes are directed towards the inter-cape bays, causing cape tips to erode and bays to prograde". This sentence is formally incorrect, is the sediment flux that is directed towards the bays, not the gradient. The gradients are directed with the x-axis at the tips and against it at the bays. But there is no need to say this; the key point is that there is divergence of flux at the tips and convergence at the bays.
- 4) For $U=0.45$, spits are also smoothed out but more slowly than capes. It is said "over a time scale of many centuries". According to the modeling runs, is it possible to be

- more specific? Could the authors run the model for longer time than 1000 yr? Or perhaps this could be approximately inferred from the runs already made?
- 5) Eq. 1. $dy/dt \rightarrow \partial y/\partial t$, $dQ/dt \rightarrow \partial Q/\partial t$. Also, it is said that “y” is the cross-shore position. This is too vague. You should specify that $y(x,t)$ is the cross-shore position of the shoreline.
 - 6) Line 22: the net diffusivity is the sum of the individual diffusivities. This is only true due to the linearization of the dynamic equations with respect to shoreline displacement. A recall or warning would be appropriate.
 - 7) Eq. 3. “... individual diffusivities are calculated ... using:”. This might be misleading for the readers. The diffusivity is not computed “using”. In this context, this is THE expression of the diffusivity obtained by Ashton and Murray 2006a. Although this reference is already cited earlier it should be emphasized that this equation comes out from this paper. Otherwise, the readers could erroneously think that this formula is straightforward. So I would rephrase a bit indicating that eq. 3 is the shoreline diffusivity obtained by Ashton and Murray 2006a. Also, it is a bit strange talking about diffusivity and not writing down the corresponding diffusion equation. Perhaps it is better to include the equation.
 - 8) How the time scales would change with wave height and shoreface depth? A guess? In relation with this, it is said in the conclusions that the adjustment time scales depend on the spatial scale of the feature in a diffusional scaling. However it also depends on the wave energy incident on the coast (and on the depth of the shoreface) and this should be acknowledged here for the sake of clarity. Otherwise, readers (sometimes reading only the conclusions) could be misled.
 - 9) Eq. 2. H_0 is significant or rms? Please specify.
 - 10) I find a bit strange the expression in line 13, page 4, “the principle underlying...”. Which principle? Sediment conservation? One-line approximation? Perhaps something like “principles” is more appropriate.
 - 11) Page 7, line 11: “small, relatively low-amplitude reconnected spits” shouldn't be sand waves (according to diagram C in Figure 2)?
 - 12) Page 8, line 22: “potential net flux” \rightarrow diffusivity?
 - 13) Page 9, line 1: “The fluxes are proportional to the maximum net flux divided by the alongshore length scale”. I guess the authors refer to the gradients.
 - 14) Is the difference in sediment fluxes needed to be plot in Figure 6a,b? I think the necessary information is in the other two lines. The third one complicates unnecessarily the panels.
 - 15) Page 10, lines 4-5. Looking at Figure 6b I also see strong gradients in sediment flux for spits. I agree in that they are not as strong as for capes, but maybe the wording in the paper is a bit exaggerated regarding this difference.
 - 16) Figure 6b. Why the span for Q is larger than that in Figure 6a? Any line exceeds the upper value of 300. Why using 500 as upper limit?
 - 17) Page 10, lines 21-22. “Coastline morphology should not be assumed ... from many centuries ago”. Not always, it depends on the time scales, in some cases the morphology can be in quasi-equilibrium with current wave conditions. Please, account for this here (it is already said elsewhere, but I miss it here).

Typos:

- Page 1, line 15: "cusplate cusps" → cusplate capes.
- Page 7, line 11: "with with" → with
- Page 10, line 3. "chore" → shore