

Reviewer 1

We thank the reviewer for the constructive comments. In the following, the comments are reproduced, followed by our response in italics.

Specific

Although the Pentland Firth has been leased by the Crown Estate for 800MW of installed capacity, I don't really believe that this number is likely any time soon. At the moment there is great talking over the potential for 8MW(ish) in the Meygen site. Is it really right to think that 800MW is realistic?

A: Time will tell. But investments in technology like this are only economically viable at sufficient scale. Analogy with the offshore wind industry, which is further advanced, suggests that it is possible. We do not think it is appropriate in this paper to speculate on how much capacity will ultimately be installed. We will add a remark to the introduction stating that for the purpose of this paper it is assumed that the 800 MW capacity will be realised.

Pg 20484 - The 800MW is being uniformly distributed throughout the Pentland Firth and beyond. This is not what has been proposed with the main channel of the Firth actually being relatively empty and the consented sites being either near Orkney or near the main-land. Did you do this because you don't have the resolution to put them in their consented location, and what impact do you expect that this may have? I think that this would change the effective blockage ration of the channel in your model.

A: The reviewer is correct that the resolution is not sufficient. We agree that it's an omission not to state this in the paper, and will add a line to this effect, and come back to it in the discussion. Having said that the model does not show much of a response for the 800 MW case. It is not unreasonable to assume that a realisation of the hypothetical 8 GW implementation would occupy a substantial area of the Pentland Firth; we will also add a remark to this effect to the paper.

Pg 20485 - The differences in the reference runs speak about issues around water depths over several hundreds of metres, which if this refers to depth is surely outside the depth of the entire shelf. If it means horizontal length then it is not clear to me at all what you are trying to say.

A: The reviewer is correct that this refers to water depth, and applies to areas off the shelf. We will clarify the text.

Results of

tide validation. The models tidal results are shown as a scatter plot which shows some issues with the model. These are explained to be issues with the Celtic Seas and thus can be safely ignores as the area around the Pentland Firth is OK. The issue though is that this paper is examining impacts at the far field extent and therefore the model must be reasonable in these far field areas. It would be helpful to see a plot of the tidal errors spatially rather than as a scatter plot only. The reader can then understand the potential tidal anomalies in the North Sea and beyond.

A: The reviewer has a point here. We did not include larger-scale versions of Figure 4, because showing such results on a single map would result in a cluttered and un-readable plot, and additional figures would add to the already large number of figures in this paper. We can, however, include an additional four-panel figure showing the difference in M2 tidal elevations and phases for the southern North Sea and for the Irish and Celtic Seas, and add some related text in the appropriate locations. The figures would show good correspondence in the southern North Sea. For the Irish and

Celtic Seas, it would show over-estimation in the Bristol Channel and North Channel, and under-estimation in the Irish Sea, all in the order of up to several tens of cm.

Discussion on Tides - A good agreement of the hydrodynamic tidal model within the region of the Pentland Firth does not indicate suitability for examining the impacts of renewable energy across the far field scale. One might ask why the model is failing elsewhere, such as the Celtic Seas, and do these failure mechanisms come into play in the modified tidal system? Just because a model is in agreement with observation in one area does not make it suitable, necessarily, for use in other areas!

A: Agreed, we think this is a local issue limited to the Celtic Seas, see response above.

Technical

Pg 20479, Line 13: "during the last decades" should be changed to either "last decade" or something like "previous few decades" depending on which you are referring to.

A: Agreed, we will make this clearer.

I assume model "confirmation" means validation?

A: This is a matter of definition, we have followed Oreskes, N., K. Shrader-Frechette, and K. Belitz (1994), Verification, validation, and confirmation of numerical models in the Earth sciences, Science, 263(5147), 641– 646, doi:10.1126/science.263.5147.641. We will add this reference.