



Can tidal stream turbines change the tides in the Pentland Firth, Scotland?

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Around half of Scotland's tidal stream resource is located in the Pentland Firth and Orkney Waters (PFOW), with most of it in the Pentland Firth. This work investigates the effect that extracting tidal stream energy in the region may have on the tide (tidal amplitudes, speeds, phases and transport) and addresses the following questions: (i) what is the maximum energy that can be extracted, and (ii) is there a sustainable upper limit of energy extraction? A hydrodynamic model of the PFOW was used to study a number of idealised tidal stream array layouts in the Pentland Firth. The tidal stream turbines were represented as sub grid scale objects using a momentum sink. A number of idealized scenarios were considered with differing degrees of realism.

This work shows that, on average, 5.3 GW could be extracted from the Pentland Firth using tidal stream turbines, but that doing this would cause a large change in water levels and tidal currents in specific areas within this region. It is therefore important to consider how much energy to extract from this region, taking into consideration the potential environmental impact. This work shows that it is important to consider where and how to extract energy, as this will influence the degree of change to the tides and, consequently, the marine environment.