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Global resource-led optimisation of tidal-stream energy power curve

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The need for renewable energy is clear and the harvesting of electricity from tidal current kinetic energy appears crucial within a future renewable energy mix. Indeed, tidal energy could provide a high-tech and low-carbon future economy; with the industry producing turbines, and associated services, for countries around the world. Many hydro-kinetic device designs now exist, with much information on predicted power curves and designs. Firstly, we consolidate this information using normalised units, and find many common features between these devices. If we assume the cost associated with tidal energy can be reduced through mass-production techniques, we can identify the features of a globally optimal device design (i.e. one design that could be viably deployed in as many locations around the world). We therefore, aim to use features of the tidal energy resource (water depth, tidal current speed, phase, and associated variability) to understand a globally optimised design. Tidal currents around the world have high spatial and temporal variability, and this tidal variability will affect the power produced (thus profit) from a hydro-kinetic device. For example, variability in tidal form factor (change between semi-diurnal and diurnal tides) and changes in speed and mechanism that drive these fast tidal flows (from baroclinic flows to barotropic standing-wave (resonant) or progressive-wave tidal systems). We apply the global tidal constituent data (FES2012) and bathymetry (GEBCO) to all potential turbine features to estimate aggregated power – with the optimal design identified using a greedy algorithm. The globally-optimum power curve and swept area is therefore assessed using net power and capacity factor as variables. Potential sites and markets for this optimised turbine design are then identified around the world. Future work will investigate the addition of other variables, such as distance to grid connection.