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Global wave resource classification and application to marine energy deployments

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Understanding and classification of the global wave energy resource is vital to facilitate wave energy converter technology development and global roll-out of this promising renewable energy technology. To date, many wave energy converters have been developed based on Northern European wave climates; these are not representative of wave climates worldwide and may not be the best for large scale energy extraction. Classification of resources will highlight alternative wave resource types that may prove fruitful for deployment of future technologies; equally it will enable existing technology to define regions worthy of site exploration. Therefore k-means clustering is used here to classify the global resource from a data-driven, device agnostic perspective.

Parameters relevant to energy extraction (significant wave height, peak wave period, extreme wave height, spectral and directional properties) were extracted from the ECMWF ERA5 reanalysis dataset and used to split the global resource into 6 classes. Only areas within 3 degrees of land (feasible energy transport to user) were considered. The 6 classes returned by the analysis consisted of: 1) low energy high variability areas in enclosed seas; 2) low energy moderate variability areas in semi-enclosed seas and sheltered ocean coasts; 3) moderate energy areas, largely on eastern oceanic coastlines and influenced by local storm activity; 4) moderate energy areas primarily influenced by long period swell and largely on western oceanic coastlines; 5) higher energy areas, with variable conditions, primarily in the northern hemisphere; 6) highest energy areas, primarily on the tips of continents in the southern hemisphere. Consideration of device power matrices show that existing devices only perform well in classes 5 and 6, despite these areas having limited global coverage, which suggests devices should be developed for lower energy classes.

To refine global roll-out planning for existing devices, based on a request from a wave energy converter developer, a second classification is currently being developed with two additional constraints on the areas tested. These constraints are excluding any areas with a mean wave power of less than 15 kW/m (an often-used value for the lower power limit for commercial viability) and a maintenance constraint whereby wave heights must drop below 3m for a minimum

of 48hrs per month. These newer results will be presented at the annual assembly and contrasted with our more device agnostic classification.

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