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Understanding the physical dynamics and ecological interactions in tidal stream energy environments

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Tidal stream energy devices are intended to operate in energetic physical environments characterised by high flows and extreme turbulence. These environments are often of ecological importance to a range of marine species. Understanding the physical dynamics and ecological interactions at fine scales in such sites is essential for device/array design and to understand environmental impacts. However, investigating fine scale characteristics requires high resolution field measurements which are difficult to attain and interpret, with data often confounded by interference related to turbulence. Consequently, field observations in tidal stream energy environments are limited and require the development of specialised analysis methods and so significant knowledge gaps are still present. The seabed mounted FLOWBEC platform is addressing these knowledge gaps using upward facing instruments to collect information from around marine energy infrastructure. Multifrequency and multibeam echosounder data provide detailed information on the distribution and interactions of biological targets, such as fish and diving seabirds, while simultaneously recording the scales and intensity of turbulence. Novel processing methodologies and instrument integration techniques have been developed which combine different data types and successfully separates signal from noise to reveal new evidence about the behaviour of mobile species and the structure of turbulence at all speeds of the tide and throughout the water column. Multiple platform deployments in the presence and absence of marine energy infrastructure reveal the natural characteristics of high energy sites, and enable the interpretation of the physical and biological impacts of tidal stream devices. These methods and results are relevant to the design and consenting of marine renewable energy technologies, and provide novel information on the use of turbulence for foraging opportunities in high energy sites by mobile species.