

EFFECTS OF TURBULENCE ON PERFORMANCE AND YIELD OF TIDAL TURBINES

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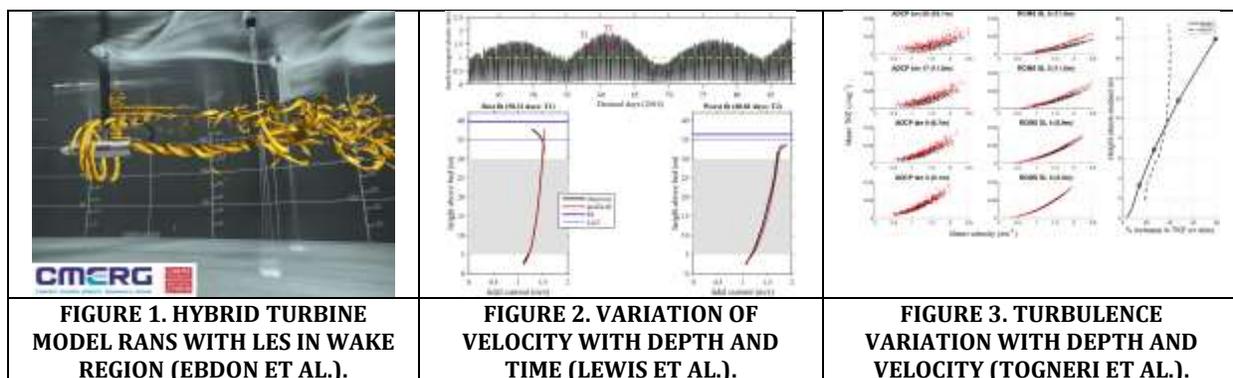
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Through prototype trials at sea, tidal developers understand the significance of fluctuating loads due to turbulence. Results are shown from a series of related research investigations of turbulence, waves and bed friction, and the consequent vertical variations in velocity and the energy extracted. These results show the relationship between flow, performance and yield from tidal turbines. A number of timescales are considered, from seconds to weeks to years. Figure 1 presents a hybrid numerical model with a RANS turbulence in the near wall regions of the domain, such as the turbine blades, and an LES like approach in the wake. This allows variations in turbulence intensity and length scale to be observed in the turbine performance. Figure 2 shows results for vertical variation in velocity and shows curve fitting to the data. The top panel gives depth-averaged velocity time-series. Two examples of the velocity profile fit are shown in the bottom panels: Best fit (T1) with an Absolute Error Squared (AES) of 0.00 m²/s on the left hand bottom panel, and the least-accurate profile fit (T2) with an AES of 0.03 m²/s on the right hand bottom panel. The free surface is shown in the velocity profiles (bottom panels), and grey shaded area indicating the maximum potential swept tidal turbine area, assumed as 5 m above the bed and 5 m below the Lowest Astronomical Tide (LAT). The same data were analysed for turbulence metrics, and Figure 3 shows a scatter plot comparing mean flow velocity and TKE at four depths based on ADCP measurements (left column) and ROMS estimates (central column). Black points correspond to flood phases, red points to ebb phases. Right column shows a profile of flood-ebb asymmetry as a percentage increase in TKE density from flood to ebb. Circles indicate the depths from which the data in scatter plots are taken.



ACKNOWLEDGEMENTS

The authors acknowledge financial support by Welsh Assembly Government, Higher Education Funding Council for Wales via the Sêr Cymru National Research Network for Low Carbon, Energy and Environment.

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