Marine Renewable Energy

Mapping the Ocean Current Strength and Persistence in the Agulhas to Inform Marine Energy Development.

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Abstract:

The potential for energy extraction from the fast-flowing Agulhas Current along South Africa's East Coast is examined. Potentially suitable regions are evaluated using state-of-the-art satellite remote-sensing, predictive modelling, and in situ observation technologies. A mid-shelf location (91 m depth) and an offshore location (255 m depth) at approximately 32.51°S and 28.83°E are evaluated using these tools, and it is found that the current core borders on the mid-shelf location and passes over the offshore location with mean velocities of 1.34 m/s and 1.59 m/s, respectively, at the 30 m depth. Current velocity data derived from satellite remote-sensing and predictive models were compared to in situ current measurements from Acoustic Doppler Current Profilers to determine their ability to accurately capture current velocities for future use in the evaluation of energy extraction sites. Although the modelled data's representation of the Agulhas Current's velocities was a better comparison than the satellite product, the predictive model was less representative of the variability in the Agulhas Current. Further examination of the data showed that both the satellite and the predictive model are only able to accurately capture variability in the Agulhas Current on time scales longer than monthly. Despite this, the data provide useful insight into the unique challenges encountered when exploiting the Agulhas Current as a resource for energy generation; in particular, the irregular occurrence of large Agulhas Current meanders (known as Natal Pulses) . The proposed energetic region is well positioned with respect to environmental, economic, and social aspects because the nearest medium voltage substation is 30 km from the point of contact at the coastline. The sites are not located within any existing or proposed marine protected areas or prime fishing grounds. If the mooring challenges in water depths of 250 m or greater are overcome, then such a turbine array can make a significant contribution to the South African electricity grid.