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Assessment of great ocean currents as a source of renewable energy using recent OGCM simulations of the global ocean

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The great wind-driven ocean currents (e.g. Gulf-Stream or Kuroshio) are relatively constant in strength and direction, and they carry a great deal of energy because of the density of water. Technologies are being developed to extract energy from those currents and convert it into a usable power. The paper presents a methodology used to select regions of the global ocean where the properties of the great ocean currents are favourable to the implementation of Turbine Power Plants (TPP) made of submerged rotors driven by the motion of water. The methodology relies on a state-of-the-art eddy-resolving global ocean general circulation model used for real-time ocean forecasting, in which the implementation of a large TPP is represented by an additional drag force applied locally. This system is able to simulate the flow changes induced by the implementation of a power plant in the current, and consequently provides an assessment of the renewable energy that could be recovered and of the possible environmental impact.
Our results demonstrate that the flow changes induced by a large TPP (covering the area of a model grid size, i.e. a few km) are highly dependent on the details of local topography, leading to a reduction of the available power that can vary from 25% to 85% according to location. We shall also show that impact of a TPP on the flow can be felt a few 100 kilometres upstream and may in some cases not only impact the flow speed, but also induce a large shift of the main current path.