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Tidal power plant simulations using large eddy simulations (LES) and the actuator line method (ALM)

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The share of the renewable energy in the gobal energy mix is to be increased according to the sustainable development goals of the UN. Tidal energy can here potentially play a substantial role for the electric power generation. The tidal power plant Deep Green developed by Minesto uses a novel technology with a “flying” kite that, with its attached turbine, sweeps the tidal stream with a velocity several times higher than he mean flow. Eventually these power plants will form arrays requiring knowledge of (1) the interaction between individual power plants as well as (2) how the power plants and the arrays will influence the surrounding environment.

The tidally oscillating turbulent boundary layer flow is in the present study analyzed using Large Eddy Simulations (LES) utilizing two different modeling techniques (pseudo-spectral and finite volume method). The boundary layer flow is analyzed both undisturbed and with a sweeping tidal power plant. The power plant is modeled using the Actuator Line Method (ALM). This method has been reformulated in order to be able to take arbitrary pathways of the actuator line into account. The results for the undisturbed flow simulations show, e.g., variations of the turbulence intensity depending on pre- or post-tidal peak flow for equivalent volume mean flow. The results for the modeled power plant show, e.g., how the wake flow downstream of the power plant that can be related to the size of the pathway size.