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Particle tracking methodology for Lagrangian numerical simulations

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Highlights:

- Development of numerical tools capable of extracting and reproducing particle trajectories from stochastic Lagrangian simulations.

Keywords:

Numerical tools, Visualization, Marine current,

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1. Abstract

As an alternative to the wide range of classical numerical modeling, the numerical Stochastic Downscaling Method SDM-OceaPoS code presents an innovative and effective approach to simulate turbulent flows around marine current energy converters (MCEC), where the behavior of individual fluid particles is described as a stochastic process. However, this approach being relatively new, there is a lack of available tools, both in commercial and open source libraries, capable to exploit the results obtained from the Lagrangian nature simulation.

The present work aims to provide a visualization tool from output file of the SDM-OceaPos model, with the objective of reproducing the trajectories of a pre-selected set of fluid particles, which withhold an accurate description of the physical processes involved in the flow. Through this "tracking" methodology from SDM-OceaPoS, it is possible to validate the particle's behavior affected by the Lagrangian algorithm. Moreover, it provides additional representation elements, such as snapshots and animations, which are intuitively easier to be interpreted, even by a non-accustomed audience.

In the SDM-OceaPoS model, the fluid particles motions are governed by a random turbulent component, making it impossible to predict their position in advance. As it is intended to analyze the flow in particular sections of the domain involving bathymetry profiles and solid 3-dimensional obstacles (such as porous disks or rotating mills, for instance), it is necessary to extract the data from the simulation to reconstruct a fortiori the trajectories of pre-selected particles at definite periods of time. Additionally, a new module is developed to process the extracted data and reproduce the particle trajectories.

During the conference, we will present the first study cases developed with the objective of validating the modifications performed in the SDM-OceaPos model. Here, it was possible to detect and follow individual particles at each time iteration step as their positions vary subjected to different boundary layer treatment methods, the presence of recirculation zones after variations in the seabed, and interactions with non-rotative and rotative turbine mills. We will also expose the difficulties that led to evolution and the final version of the proposed tracking methodology.