

Predator-prey plankton dynamics in turbulent wakes behind islands

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Plankton constitutes the productive base of marine ecosystems and plays an important role in the global carbon dioxide cycle through the process of photosynthesis. The impact of ocean hydrodynamic conditions on the biological activity of plankton species has been a subject attracting the interest of researchers during several decades.

In the present study, we perform a well-resolved direct numerical simulation of a turbulent flow around an island, coupled to a predator-prey model of planktonic population dynamics, with the aim of investigating the conditions under which an algal bloom is observed. The impact on the plankton dynamics of the turbulent regime as well as of the island shape is studied, through the investigation of spectra of velocity and plankton population density. Moreover, we focus on the correlation between the flow structures and the plankton patchiness, particularly by analyzing the effect of the sub-grid scale dynamics. The main outcome is that the response and the spatial distribution of plankton depend crucially on the relation between the time scale associated to the flow and the time related to biological growth, while they are fairly independent on the geometrical details of the obstacle.

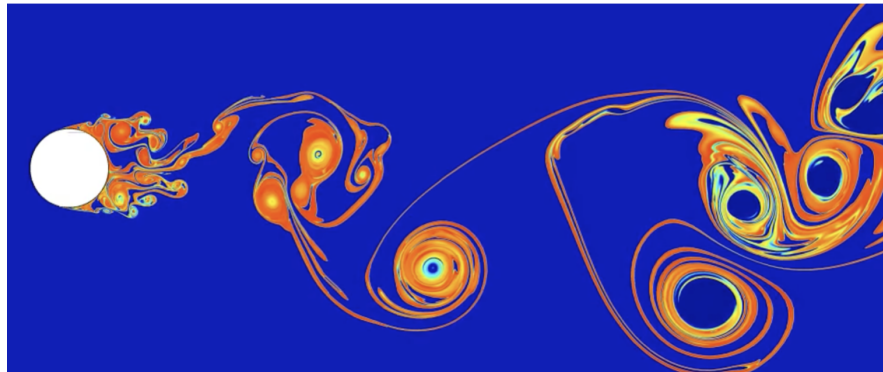


Figure 1. Snapshot of phytoplankton density at a certain instant of time for the simulation at Reynolds number equal to 20000.