A computational fluid dynamics study of flow over submerged coastal canopies

MARINE 2023

Zhijing Xu *

* Ningbo Institute of Dalian University of Technology

Ningbo 315016, China

Email: jim.xuzhijing@gmail.com

ABSTRACT

Coastal canopies, such as seagrass meadows and kelp forests, provide food, habitat and shelter for many marine organisms. These submerged canopies positively influence water quality by recycling nutrients, producing oxygen and stabilizing sediment. The dominant characteristic of the flow is a shear layer generated at the top of the canopy, and the shear layer generates coherent vortices because of the Kelvin-Helmholtz (KH) instability. Consequently, these vortices control the vertical exchange of mass and momentum, and flush the canopy to complete the nutrient and sediment transport. In this study, we numerically examine the flow over submerged coastal canopies based on the coupling of a finite volume computational fluid dynamics (CFD) toolbox, OpenFOAM, and a lumped-mass mooring solver, MoorDyn. Within this framework, the bull kelp (*Nereocystis luetkeana*) is specifically selected as the target species, with concentrated mass and buoyancy supported by a tethered stripe. The results show that the coherent vortices could induce the secondary flow circulations, resulting in the mass and momentum exchange in the canopy flow.

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