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Material exchange via shear instabilities above flexible aquatic vegetation GUILHERME VIEIRA, MICHAEL ALLSHOUSE, Northeastern University, AMALA MAHADEVAN, Woods Hole Oceanographic Institution — Aquatic vegetation is typically flexible and streamlined, which allows it to passively reconfigure to reduce the fluid load. By altering the hydrodynamic conditions, submerged vegetation can affect the transport of sediment, nutrients, dissolved oxygen, and planktonic fauna in aquatic systems. Flows through submerged canopies can develop instabilities; when the velocity shear at the top of the plant canopy exceeds a threshold, waves develop in the flow and evolve into vortices. These vortices induce a synchronous waving of the vegetation, known as monami. Modeling this phenomenon is challenging because of the two-way coupling between vegetation and flow. We develop a multiphase model in which the vegetation is represented by buoyant, flexible stems of fixed length that deform and change the canopy height, which is accounted for by conformal mapping. This approach reproduces the monami dynamics in an open channel and is used to investigate how the instability affects tracer exchanges between the vegetation and freestream. The transport dependence is studied as a function of the stem flexibility, canopy to free-surface height ratio, and flow Reynolds number, from both Eulerian and Lagrangian perspectives.

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