Hydrodynamics of model Posidonia oceanica patches in shallow water

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ABSTRACT: The hydrodynamics of simulated patches of the Mediterranean seagrass *Posidonia oceanica* were studied in laboratory flume experiments in which the height of the pronated canopy was always greater than half the total water depth. The effects of variations in speed (from 0.08 m s^{-1} to 0.24 m s^{-1}) and patch configuration on the hydrodynamics were investigated. Significant speeds penetrated the patches to approximately half their height. Reducing speed did not change the flow patterns observed, except to weaken and blur them. Flow encountering a single patch formed a turbulent wake at the height of the top of the canopy. Within this wake, the vertical shear stress decreased monotonically downstream, but the Reynolds stress increased initially and then decayed. When a second patch was positioned within the region where Reynolds stress increased (referred to as the "06 patch"), the wake center penetrated it, causing average turbulent velocities with horizontal components 3.3 times higher and vertical components 4.2 times higher than in the upstream patch. When this patch was positioned where the Reynolds stress decayed (referred to as the "14 patch"), the wake center rose above it. Nevertheless, the turbulence in the 14 patch had horizontal components 12% higher and vertical components 22% higher on average than in the 06 patch because its upstream end was closer to the Reynolds stress maximum. Thus the ratio of the patch separation to the length of wake in which the Reynolds stress increased was identified as central to quantifying the turbulence within the downstream patch. The increased turbulence is likely to be important in determining sedimentary and ecological patch characteristics by increasing retention of particulates in suspension and thus reducing depositional rates of, for example, larvae, nutrients, and dead organic matter.