Field Study on Flow Structures Within Aquatic Vegetation under Combined Current and Wind-driven Wave Conditions

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Abstract

Field measurements were conducted to study the influence of aquatic vegetation on flow structures in floodplains with the hydrodynamic conditions dominated by combined current and wind-driven wave. Wave and turbulent flow velocity components were decomposed from the time series of instantaneous velocity and analyzed separately. With the ratio of wave excursion to stem spacing less than 0.5, the interaction between wave and vegetation was weak in present study, leading to the vertical distributions of time-averaged velocity (Uhoriz) and turbulent kinetic energy (TKE) with the presence of vegetation similar with the vegetated flow structures under pure current conditions. For emergent vegetations, Uhoriz and TKE distributed uniformly through the entire water column or increased slightly from bed to water surface. Similar distributions were present in the lower part of submerged vegetations. Within the upper part of submerged vegetations, Uhoriz and TKE increased rapidly toward water surface and TKE reached its maximum near the top of vegetation. With small Ew/S the wave orbital velocity (Uw) within vegetation was not attenuated when compared with the Uw above vegetation, and Uw through the entire water column can be predicted by the linear wave theory. However, wind-driven waves made the turbulence generated near the top of canopy penetrate a deeper depth into vegetation than predictions under pure current conditions.

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