NUMERICAL ANALYSIS OF FLOW CHARACTERISTICS NEAR NEIGHBOURING VEGETATION PATCHES OF DIFFERENT DENSITIES

River vegetation provides a lot of benefits to its environment, such as improving the water quality and providing a habitat for aquatic animals. However, the presence of vegetation can also lead to negative effects. River vegetation is responsible for contributing to additional drag, which could lead to a rise in water levels and possibly result in flooding. In order to manage river vegetation it is important to gain a better understanding of the effect it has on the flow.

Up to this point, not much research has been done into understanding the processes surrounding two emergent vegetation patches with different densities, and when this was considered, the location between the patches was not varied to study the additional influence of that aspect. The objective of this research was to study the effect of vegetation patches with different densities and interpatch distances on the flow velocity distribution and sediment deposition. In order to do this, a numerical model with the CFD code FLUENT® was set up.

After the model validation determined that the model worked sufficient for a chosen set of demands, a second vegetation patch with a different density was added to the model domain. Multiple scenarios were evaluated in which the second patch varied in density and location with respect to the first patch. For every run, the wake behind one of the patches was evaluated. Results concluded that changing the density of patches placed upstream did not have a significant effect on the wake velocity of the downstream patch. Changing the density of a downstream patch did have a large effect on the flow velocity and turbulence in the wake of the upstream patch. With a denser downstream patch, the steady wake length of the upstream patch was shortened and turbulence levels increased. This was similar when the patches were placed further apart in the transverse direction. When patches were placed further apart in the longitudinal direction, the influence of a downstream patch of different density was not as significant in the steady wake behind the upstream patch. However, in this scenario the highest turbulence peaks were observed, which resulted from a steep velocity gradient. Sediment deposition patterns were evaluated with two different methods. Both methods had their own shortcomings and highlighted the need for additional research, although individually they resulted in a decent estimation of the most prominent locations for sediment deposition and, consequently, new vegetation growth.

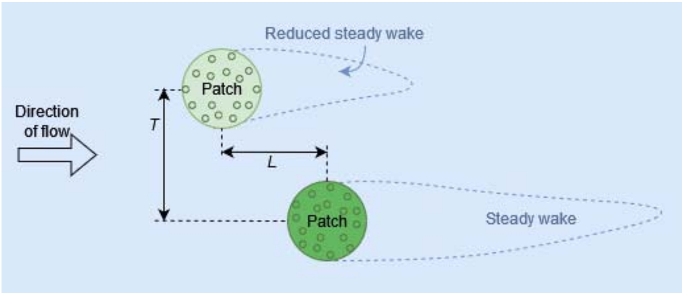

Figure 1: Top view of the model domain with neighbouring vegetation patches of a different density. The diameter of each patch is 22 cm, and the transverse distance (T) varies between 29 and 55 cm. The longitudinal distance (L) varies between 88 and 132 cm. The flow velocity is 0.098 m/s.

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