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# Hydrodynamics in the near-wake of cylindrical obstacles in a turbulent open channel flow

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The research concerns the hydrodynamic processes around obstacles of cylindrical shape installed across an open channel flow at a subcritical Reynolds number of $Re_D$ = 1 x $10^4$ (based on the cylinder diameter), and the forces exerted by the turbulent flow on these obstacles. Based on field measurements performed on the Plizska River, Poland, this study is mainly on cylinders representing large wood trunks that traverse a river.

The first aim of the study is to reproduce the flow pattern around an inclined single tree trunk of quasi constant diameter and without branches measured in the field and to enable a more detailed analysis of the underlying turbulent flow processes. These field measurements have shown that horizontal near bank recirculation zones, scour below the trunk and plunge scour overtopping it occurred.

The second aim is to compare the mean flow and vortex shedding around inclined and horizontal cylinders across the flow. The effects of inclined and horizontal cylinders on the flow field are very different: the former create a higher variability in flow processes. These configurations differ in gap width below the cylinder and in approach velocity, as the inclined cylinder is located at different elevations in the bottom boundary layer. Both parameters affect the vortex shedding frequency and the wake structure.

Results show that a transversally inclined cylinder generates more complex flow patterns and creates a high heterogeneity in the flow as well as the depth. The analysis of the dimensionless shedding frequency also suggests the suppression of vortex shedding near both banks when the gap ratio is small. However, vortex shedding characteristics in the central part of the cross-section are similar for the horizontal and inclined cylinders, i.e. the changing gap ratio below the inclined cylinder does not affect significantly the vortex shedding. In the central part of the cross-section, the wake flow is governed by the interaction of the nearly symmetrical shear layers generated above and below the cylinder. Near the banks, the shear layer near the bed or water surface is suppressed, which could explain the suppression of the vortex shedding.