EGU2020-20999
https://doi.org/10.5194/egusphere-egu2020-20999
EGU General Assembly 2020

Blockage and sheltering effects of vegetation in turbulent flow

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The interaction between aquatic vegetation and water flow is investigated here focusing on the drag coefficient. Compared with the standard drag coefficient of isolated cylinder, the phenomena of "blockage effect" and "sheltering effect" are put forward for vegetation clusters with different vegetation densities and Reynolds numbers. "Blockage effect" occurs when the drag coefficient of vegetation cluster is greater than the standard drag coefficient of isolated cylinder. The reason is that viscous boundary layer attached to the surface of vegetation items, resulting that the effective flowing width between adjacent vegetation items is less than the spacing of them, which brings a greater flow resistance and the drag coefficient of vegetation array is greater than the standard drag coefficient. On the other trend, "sheltering effect" is formed when the drag coefficient of vegetation array is less than the standard drag coefficient. This effect usually occurs for flow with large Reynolds numbers. In this case, Karman vortex streets forms and these vortexes are filled in the vegetation interval, thus causing the drag coefficient of vegetation cluster to be less than the standard drag coefficient of isolated cylinder.