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International Doctorate in Civil and Environmental Engineering

Linkages between flow, morphodynamics and vegetation

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Abstract

Vegetation is commonly recognized to play an important role in flow dynamics and sediment transport. The physical processes governing their interactions are still poorly understood, which makes it difficult to predict sediment transport and morphodynamics in a vegetated river environment. Indeed, an understanding of the effects of vegetation on flow and sediment transport is of fundamental importance for the development of efficient and even sustainable river management strategies.

Recently, several studies have shown that bed load transport is controlled by turbulence rather than bed shear stresses. Yang and Nepf (2018) developed a turbulence-based bedload model to predict sediment transport. The authors verified the model in presence of rigid vegetation and small-scale bedforms only.

My research aims to overcome these gaps of knowledge by investigating the links between turbulent kinetic energy (k_t) and plants of more complex morphology and k_t and large-scale bedforms (i.e. dunes). To achieve the objective, three different phases were planned:

- _ experiments with flexible leafed plant and mobile bed conditions.
- experiments that aim to investigate the turbulent flow over fixed 3D dunes, without vegetation.
- analysis on vegetation-related k_t under fixed bed conditions, both plane bed and 3D fixed dunes.

By combining and comparing the results of each step it will be possible to quantify the individual shares of k_t related to vegetation, related to the presence of dunes, and that associated to mobile bed conditions. Subsequently it will be possible to validate or not Yang and Nepf (2018)' turbulence-based model to predict solid transport even in complex flows characterized by the presence of large-scale bedforms and leafed flexible vegetation.



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