Towards a new friction model for shallow water equations through an interactive viscous layer

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An improved velocity profile is proposed, based on the superposition of an ideal fluid and a viscous layer inspired by the *Interactive Boundary Layer* interaction used in aeronautics [2]. This leads to a new friction law which takes into account the phase-lag between friction and topography, a key-point in the instability mechanism involved in erosion [1]. The resulting system is an extended shallow water model consisting of three depth-integrated equations: the two first ones are mass and momentum conservation in which a slight correction on hydrostatic pressure has been made; and the third one, known as von Kármán equation, describes evolution of the viscous layer. This coupled model is shown to be hyperbolic under the thin viscous layer condition; a Godunov-type finite volume scheme is also proposed. Several numerical examples are provided which emphasize the ability of the model to recover the phase-lag behaviour and possible reverse flow.

Références

[1] F. Charru, B. Andreotti, and P. Claudin, *Sand ripples and dunes*, Annu. Rev. Fluid Mech., 45, p. 469–493, 2013.

[2] P.-Y. Lagrée, *Interactive boundary layer (IBL)*, Asymptotic methods in fluid mechanics: survey and recent advances, Springer, p. 247–286, 2010.

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