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Determinants of modeling choices for Mediterranean floods

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This review work investigates the determinants of modeling choices for flood propagation and floodplain inundation, focusing on the specificities of Mediterranean contexts in the wide landscape of available free-surface flow and morphodynamics models. We rely on existing material [Cheviron & Moussa, 2016] enriched with additional references to decipher how Mediterranean contexts stand out from others in terms of spatiotemporal scales (domain length: L, temporal scale T, flow depth: H, spatial step for modelling: ΔL, temporal step: ΔT), flow typologies (Overland: O, High gradient: Hg, Bedforms: B, Fluvial: F) and dimensionless numbers (dimensionless time period T*, Reynolds number Re, Froude number Fr, slope S, inundation ratio Λ_z, Shields number θ) attached to the flow and its erosive effects.

In the general case the interplay between scales, typologies and dimensionless descriptors has been proven to influence the choice of modeling refinement (NS: Navier-Stokes, RANS: Reynolds-Averaged Navier-Stokes, SV: Saint-Venant, ASV: Approximations of Saint-Venant as the Diffusive or Kinematic Wave models) even if "hidden" practical considerations (technical constraints, financial limitations or strategic bias linked to the modeler's background) should not be silenced in the analysis. Specific trends are sought here and expected for Mediterranean contexts, arising from climatic characteristics (typically the so-called "Cévenol episodes" of high intensity and short duration rain periods) combined with topographic effects (high slopes, high runoff coefficients on impervious surfaces, weak structural stability of soils, narrow and tortuous river beds) prone to trigger flash floods.

Finally, once the inverse problem has been addressed (i.e. finding the determinants of given modeling choice) the direct problem still needs to be tackled (i.e. finding relevant modeling choices for given contexts and constraints). The discussion will assist the modeler, according to the principle of parsimony, in seeking the simplest modeling strategy capable of (i) a realistic representation of the physical processes, (ii) matching the performances of more complex models and (iii) providing the right answers for the right reasons.

Cheviron, B., Moussa, R. (2016). Determinants of modelling choices for 1-D free-surface flow and morphodynamics in hydrology and hydraulics: a review, Hydrology and Earth System Sciences, 20, 3799-3830, doi:10.5194/hess-20-3799-2016.