# On the preservation of the physical representation of the hydrological processes in model lumping

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Presently, physically based distributed models are recognized to be the most successful and fertile way of simulating and investigating hydrological processes. Nevertheless the power of synthesis of the lumped models makes them scientifically very attractive. The interest in lumped models not only lays in the practical aim of using simpler models but even more in the theoretical implications involved in finding the "dominant processes", namely the essential hydrological features, to be preserved in the lumping process. Historically, the evolution of hydrological models proceeded from the simple conceptual models to the more complex physically based ones, gradually introducing more complicated and comprehensive equations in the efforts of better reproducing reality. An interesting question is whether or not it is possible to directly set up a lumped hydrological model encapsulating the physical meanings and processes, without the need of setting up a distributed model. This would allow the direct transfer of the model to ungauged catchments. Starting from a distributed model, the present work follows two lumping procedures: (1) a "structural lumping" of the catchment, (2) an "empirical lumping" of the dominant processes. The first structural lumping aims at aggregating all the grid cells composing the catchment in just one single cell with equivalent hydrological properties. This requires a "non trivial" aggregation, of the distributed model parameters, defined in each single cell, into a unique lumped parameter value. The empirical lumping exploits the diagnostic skills of the distributed model to infer internal relations (such as the water volume - saturated area relationship or the exfiltration) representing the dominant processes that are now based on average quantities. This empirical lumping, which allows to correctly preserve the description of the internal dynamics at the lumped scale, is achieved by deriving a set of functions via simulation with distributed model. An interesting phenomenon highlighted by this lumping gives is the hysteretic dependency of the saturated area on the mean soil water volume, which was also found by other authors. Following this approach one has to realize that only the distributed model can be exported on physical grounds to ungauged catchments, while its lumped version will again be derived with the proposed approach. An example of application to a real catchment will complement the theoretical description.