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A stochastic approach for the description of soil water balance at basin scale: application to semiarid environments

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The present study extends the analytical work proposed by *Manfreda* (2008) and *Manfreda and Fiorentino* (2008) for the description of the soil water balance in a humid river basin. The model is based on a stochastic differential equation, where the rainfall forcing is interpreted as an additive noise in the soil water balance. Spatial heterogeneity of a basin is incorporated by a parabolic function describing the distribution of soil water storage capacity. This distribution is a key factor for a correct interpretation of the soil water balance that have been modified proposing a generalized expression adequate for both humid and arid basins. In the previous version of the model, the soil water storage distribution was set with a minimum in zero. This imply that the relative saturated portion of the river basin areas have an infinitesimal probability to be zero and consequently runoff rate is equal to rainfall rate. This approach has been generalized adopting a distribution of soil depths bounded between two non zero-values allowing to reproduce the condition of zero runoff under some rainfall events. The model, characterized by parameters that depend on soil, vegetation and basin morphology, allowed to derive analytically the probability density function of the relative saturation, portion of the saturated area and the surface runoff of a basin. Its application over a set of river basins belonging to a semiarid region of Southern Italy provides a formal description of the role played by climate, soil, and vegetation interactions in relative basin saturation and runoff production.

References

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