



A simple simulation approach to generate complex rainfall fields conditioned by elevation: example of the eastern Mediterranean region

Fabio Oriani (1), Noa Ohana-Levi (2), Julien Straubhaar (1), Philippe Renard (1), Arnon Karnieli (2), Grégoire Mariethoz (3), Efrat Morin (4), and Francesco Marra (4)

(1) University of Neuchâtel, Centre of Hydrogeology and Geothermics (CHYN), Neuchâtel, Switzerland (fabio.oriani.geo@gmail.com), (2) Jacob Blaustein Institutes of Desert Research, Ben Gurion University of the Negev, Midreshet Ben-Gurion, Israel., (3) Institute of Earth Surface Dynamics, Université de Lausanne, Lausanne, Switzerland., (4) Department of Geography, Hebrew University of Jerusalem, Jerusalem, Israel.

Stochastically generating realistic rainfall fields is useful to study the uncertainty related to catchment recharge and its propagation to distributed hydrological models. To this end, it is critical to use weather radar images as training data, being the single most informative source for rainfall spatial heterogeneity. Generating realistic simulations is particularly important in regions like the eastern Mediterranean, where the synoptic conditions can lead to rainfall fields presenting various morphology, anisotropy and non-stationarity.

The Direct Sampling (DS) technique [Mariethoz2010] is proposed here as a stochastic generator of spatial daily rainfall fields relying on the simulation of radar imagery. The technique is based on resampling of a training data set (in this case, a stack of radar images) and the generation of similar patterns to the ones found in the data. The strong point of DS, which makes it an attractive simulation approach for rainfall, is its capability to preserve the high-order statistical features present in the training image (e.g., rainfall cell shape, spatial non-stationarity) with minimal parameterization. Moreover, factors influencing rainfall, like elevation, can be used as conditioning variables, without the need of a complex statistical dependence model.

A DS setup for radar image simulation is presented and tested for the simulation of daily rainfall fields using a 10-year radar-image record from the central region of Israel. Using a synoptic weather classification to train the model, the algorithm can generate realistic spatial fields for different rainfall types, preserving the variability and the covariance structure of the reference reasonably well. Moreover, the simulation is conditioned using the digital elevation model to preserve the complex relation between rainfall intensity and altitude that is characteristic for this region.

[Mariethoz2010] G. Mariethoz, P. Renard, and J. Straubhaar. The direct sampling method to perform multiple-point geostatistical simulations. *Water Resources Research*, 46:W11536, Nov. 2010.