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The role of the non-linear relief-rain interaction in the rainfall intensity structure.

Gilles Molinie (1), Theodoros Karakasidis (2), Athanasios Triantafyllou (2), Jean Dominique Creutin (1), and Sandrine Anquetin (1)

(1) LTHE, University of Grenoble, UJF, LTHE, Grenoble CEDEX 09, France (gilles.molinie@ujf-grenoble.fr), (2) UNIVERSITY OF THESSALY DEPARTMENT OF CIVIL ENGINEERING LABORATORY OF HYDROLOGY AND AQUATIC SYSTEMS ANALYSIS, Volos, Greece

To determine areal rainfall amounts, point rainfall records are usually interpolated using structure functions of the rainfall amount. Structure functions are often identified at the resolution of meteorological radars or operational raingauge networks e.g. few kilometers. This is about the size of the smallest of the rain cells. Moreover in region of rough relief where the rainfall variability is supposed to be increased and where measurements undergo even more limitations than over a flat area, the undersampling of rainfall gets worse. The characterization of the rainfall structure/relief interactions should help in the future to better take into account the rainfall variability in complex terrain. This work intends to depict the temporal structure of the rainfall intensity in a region of complex orography. The rainfall structure is depicted in terms of fractal dimension and Hurst exponent, the first being a measure of the chaotic behavior of the rainfall series, the second oppositely, of their persistency.

In South of France, a rainfall event featuring a cumulative rainfall above the 75th percentile of the daily rainfall intensity, has been observed by a meteorological radar. This event occurs in a kind of bottleneck along the Rhône river valley. The rainfall amount is quite homogeneous in the study region of about 20x20km^2. We will demonstrate that however the time series structure varies in space.

The methodology is based on the complementarity of the Hurst exponent and of the fractal dimension in case of Gaussian variable. Complementarity means that an increase of the persistency (increase in the Hurst exponent) decreases the roughness (fractal dimension). It has been demonstrated that these characters can be determined by only one statistics, the transitive co-variogram.

Applied to the rainfall intensities deduced from radar observations of the rainfall event described above, this methodology highlights the non-linear interactions between clouds and terrain elevation. When crossing a succession of two mountains, the rainfall series relatively steady on the upwind slope becomes more chaotic in between the two mountains to retrieve its steadiness on the last downwind slope.

Questions remains on the space time variability of the fractal dimension and Hurst exponent which we will address in a near future using the rainfall series recorded by 19 raingauges distant from 1m to few kilometers and installed since fall 2010 in a hilly region of South of France for the HyMEx international field campaign.