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Analysis of different soil properties using Universal Multifractals Framework – application on green roof substrate

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Green roofs have significant influence to mitigate urban runoff during (extreme) rainfall events. In order to quantify its hydrological impacts, it is necessary to know basic characteristics of the particular substrate it is made of, such as the grain / pore size distribution (GSDC / PSDC), water retention (WRC) and hydraulic conductivity curves (HCC). Even though mentioned soil characteristics can be experimentally determined, their determination is very often based on a "representative sample" approach, meaning that the space heterogeneity is ignored. In order to take into account the heterogeneity of porous medium structure and to link it with its retention and transfer properties, a new physically based soil model is required.
It has been demonstrated that already mentioned soil properties (GSDC / PSDC, WRC, HCC) can be described using the fractal theory, such as the pore-solid fractal (PSF) approach, firstly developed by Perrier (1994). However, in numerous studies, using different techniques (micro-tomography among others), it has been proved that the soil structure follows multifractal rather than fractal behavior. So far different soil properties have been independently analyzed using the multifractal theory, but universal approach that links these properties (as in the PSF model) still does not exist.
The goal of this study is to propose a new approach based on the Universal Multifractal Framework (UMF) that would be able to link grain / pore size distribution of the substrate with its retention and transport characteristics. The main idea behind this kind of approach is to create a physically based soil model, which is able to link heterogeneous structure of porous medium with its hydraulic properties. First results concerning its development are presented here. This kind of soil model should then be used for more reliable estimations of hydrological responses of green roofs.