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Combining integrated modelling and multifractal analysis to better evaluate the performance of Nature-based solutions: a peri-urban catchment study case

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Rapid urbanization and climate change increase the extreme flooding risks in urban areas, which has become a significant problem all over the world and a big challenge widely faced by most cities. UN 2030 Agenda and following international agreements (in particular Habitat III) aim therefore to greatly enhance urban resilience, see for instance the UN Sustainable Development Goal 11. Thus, Nature-based solutions (NBS) are more and more considered as the key solution to achieve this goal. However, there is the need to qualitatively reduce the many uncertainties on the effective performance of NBS, which are largely associated to the complexity of both the urban fabric and precipitation.

We therefore show the potentials of combining integrated modelling and multifractal analysis on the case study of a 520 ha peri-urban catchment (Guyancourt) along the Bièvre River in the southwest of Paris. The methodology has three steps: (1) to identify the suitable areas that can be covered by NBS practices (porous pavement, green roof, rain garden, as well as the combination of the three) with high resolution GIS data; (2) to assimilate these data in the integrated modelling platform Multi-hydro (developed by École des ponts ParisTech) and X-band and C-band radar data of three rainfall events from to simulate the hydrological impacts of NBS scenarios on the catchment; (3) the simulated surface runoffs for the different NBS scenarios are compared and analysed with the help of a Universal Multifractal (UM) analysis. The results suggest that the UM parameters can well evaluate the effect of NBS practices and temporal and spatial distribution of precipitation on the runoff, which can contribute to the decision–making process of design of NBS practices in urban planning.