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Measuring urban resilience to flooding under climate change

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Flooding is one of the most challenging weather-induced risks in urban areas, due both to the typically high exposures in terms of people, buildings, and infrastructures, and to the uncertainties lying in the modelling of the involved physical processes. The modelling of urban flooding is usually performed by means of different strategies in accordance with the specific purpose of the analysis, ranging from detailed simulations, requiring large modelling and computational efforts, and typically adopted for design purposes, to simplified evaluations, particularly feasible for scenario analyses, when a large number of simulations is required perturbing one or more input parameters.

According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, intensity of precipitation events could be greatly impacted by the expected climate change primarily due to the increase in temperature, entailing an increase in the atmospheric moisture retention capability. However, the effect of climate change on the rainfall regime of local areas is not straightforward, but deeply depends on local features such as latitude, topography, distance from the coast. Over Europe, an ensemble of climate simulations coming from the application of different Regional Climate Models (RCMs) (able to perform a dynamical downscaling of General Circulation Models, GCMs, available at the global scale) is freely available within the EURO-CORDEX initiative, which is the current standard for climate change analysis over EU countries. The spatial resolution of EURO-CORDEX simulations (about 12km) is too coarse to be directly used in local impact analyses; in this case, bias corrections are usually performed using local rainfall observations, to adjust climate simulation results to the local rainfall regime. The availability of

multiple climate projections coming from different Climate Simulation Chains (in other words, different RCM/GCM couplings) allows to quantify the uncertainty in climate modelling, that should be accounted for in impact analyses.

In the present work, an approach is proposed that aims to quantify the uncertainty caused by the use of an ensemble of climate projections on urban flood modelling, taking a limited area within the City of Naples (Italy) as test case. The specific purpose is that of understanding the resilience of the area with respect to any variation in rainfall intensity such as those possibly caused by climate change, building on 19 climate projections available within the EURO-CORDEX initiative and bias-corrected to make them suitable to be used for impact analyses at the local scale. The concept of resilience is expressed by a selection of indicators considered useful both in the framework of classical hazard analysis and for transport network, considered a strategic service for the test case. Urban flood modelling is undertaken by using two different numerical codes characterized by two different levels of complexity. In this way, it will be possible to draw conclusions about the computational costs that are actually needed, in terms of input data and resources, when integrating uncertainties due to climate projections in urban flood modelling for multi-purpose analyses.