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On the impact of the hydrological model and catchment hydrology on the design flood estimation in a small catchment in Central Italy affected by the recent 2016 earthquake events

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Flood is one of the most frequent disasters which dangerously impacts societies and economies worldwide. Floodplain management and hydraulic risk analysis based on design flood estimation are essential tools to reduce damages and save human lives. Flood Frequency Analysis (FFA) has been classically used to derive design river discharge estimates, however, the scarce availability of discharge observations, especially in small catchments (<150 km2), makes its application not always possible. In addition, with the projections foreseen by the International Panel on Climate Change (IPCC) the use of FFA might lead to incorrect estimates of design river discharge as FFA is based on the concept of stationarity. Generally, long rainfall and temperature time series are much more available than discharge observations but their temporal coverage is often not sufficient for carrying out FFA via a hydrological simulation.

To handle these drawbacks, the combination of a stochastic generation of rainfall and temperature time series, Regional Circulation Model (RCM) projections and continuous hydrological models provides a reliable tool for obtaining long river discharge time series to implement FFA. However, design flood estimations can be significantly uncertain due to several factors such as 1) the specific model structure, parameterizations and processes representation, 2) the catchment hydrology and 3) the specific climate change scenario.

The primary objective of this study is to explore the sensitivity of the design river discharge estimates to the hydrological model complexity and parameterization. For this, three continuous hydrological distributed models named the Modello Idrologico SemiDistribuito in continuo (MISDc), the Soil & Water Assessment Tool (SWAT) and GEOFrame NewAGE model are forced with long timeseries of rainfall and temperature obtained via the Neyman-Scott rectangular pulse model (NSRP) for stochastic rainfall generation, and the fractionally differenced ARIMA model (FARIMA) for stochastic temperature generation. A secondary objective is to understand the impact of climate change and the catchment hydrology on the design river discharge estimates via the use of different RCM projections.

The study is carried in the Upper Nera catchment in Central Italy which was impacted by the recent 2016 earthquake and for which is necessary to identify hydraulic risk mitigation measures and adaptation for a forward planning in the floodplain areas where new settlements will be rebuilt.

Preliminary results suggest the high dependency of the design river discharge estimates to the chosen hydrological model and a different response of the sub-catchments to the climate change scenario.