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Human impacts on hydrological change: the relative role of soil type and irrigation networks

Giulia Sofia (1), Andrea Gazzin (1,2), Giancarlo Dalla Fontana (1), and Paolo Tarolli (1)

(1) University of Padova, Department of Land, Environment, Agriculture and Forestry, Legnaro (PD), Italy (giulia.sofia@unipd.it), (2) University of Padova, Department of Agronomy, Food, Natural resources, Animals and Environment, Legnaro (PD), Italy

In a changing climate, highly concentrated weather events are expected to generate an increasing number of floods threatening urbanised landscapes, increasing people's vulnerability. Understanding how land use changes and soil types control water fluxes in this type of landscape remains a crucial challenge in water resource research. Aside from land use, especially in anthropogenic floodplains, irrigation network shapes and properties modify drastically runoff production and flood developments (Sofia and Tarolli, 2017). Adding to the mentioned drivers, soil properties (antecedent soil moisture conditions, soil texture) play a fundamental role in runoff production, with multiple outcomes, depending also on rainfall characteristics. The purpose of this study is to use a simple, physically based approach to examine the effect of soil moisture conditions, soil texture, rainfall characteristics as drivers for runoff production in a floodplain agricultural area. We observed the interaction between changes in the abovementioned properties and different artificial drainage network shapes covering a time-span of 100 years. Historical maps from 1924 offered the basis to retrieve the past network conformation, while LIDAR topography automatically described the current network shape (Cazorzi et al., 2013). The hydrological response is modelled in two steps. At first, we evaluated the soil infiltration. Once the storage offered by the soil is saturated, a portion of the surface storage offered by the drainage network is used to satisfy the infiltration capacity, thus delaying runoff. A generalised multilayer Green-Ampt approach (Downer and Ogden, 2003) has been applied, considering multiple soil horizons in the landscape (ARPAV, 2015). The beginning of the runoff is then defined by the uNSI (updated Network Saturated index), proposed by (Sofia and Tarolli, 2017), that indicates the moment the available storage (soil+network) is 100% saturated. The results highlighted that key elements that can enhance or reduce differences in the hydrologic response are the antecedent soil conditions and the climate characteristics. Soil texture parameters as independent driver play a critical role in average saturation conditions, but they produce important interactions with both climate and network properties, especially in dry or almost saturated conditions. Quantifying these effects is indeed crucial for many environmental problems, including the prediction of impacts of a changing climate and land use and the associated pressures.

References

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