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Calculating the hydrological response of a mountain catchment using conventional and unconventional (CML) rainfall observations: the case study of Mallero catchment

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Rainfall plays a critical role in the hydrological cycle, being the main downward forcing. It is well known that rainfall exhibits large variability in space and time due to the storm dynamics and its interaction with the topography. It is a difficult task to reconstruct the rainfall over an area accurately. Rainfall is usually collected through rain gauges, disdrometers, and weather radars. Rain gauges and disdrometers provide quite accurate measurements of rainfall on the ground, but at a single site, while weather radars provide an indication of rainfall field variability in space, even if their use is restricted to plain areas.

Recently, unconventional observations have been considered for the monitoring of rainfall. These consist in signal attenuation measurements induced by rain on a mesh of point-to-point commercial microwave links (CML). These data, integrated with the ones collected by a network of conventional rain gauges, can provide further information about rainfall dynamics leading to improvements in hydrological modelling, which requires accurate description of the rainfall field.

The work we are going to describe is part of MOPRAM (MOnitoring Precipitation through a Network of RAdio links at Microwaves), a scientific project funded by Fondazione Cariplo (see also the EGU abstract of Nebuloni et al., 2020). Here we use rainfall data, obtained both from a rain gauge network and from signal attenuation measurements, into a hydrological model in order to evaluate the improvement in the hydrological modelling due to a better description of the rainfall field. We consider a semi-distributed rainfall-runoff model and we apply it to the Mallero catchment (Western Rhaetian Alps, Northern Italy), with the outlet located in Sondrio. This catchment is equipped with 13 microwave links and a network of 13 rain gauges.

Firstly, we implement and test the Rain field Reconstruction Algorithm (RRA), which retrieves the 2D rainfall field from CML data through a tomographic inversion technique, developed by D'Amico et al., 2016. By RRA we generate synthetic rainfall maps from attenuation data measured by 13 links located in the Mallero basin, for a few historical events in the period 2016-2019. To improve the accuracy of rainfall field reconstruction, we also integrate the reconstructed maps with on ground data from 13 rain gauges. These maps are used as input to the hydrological rainfall-runoff

model. Finally, we compare the observed discharge with the calculated one using the hydrological model and different rainfall inputs.