Runoff and recharge in Piemonte

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**Abstract.**

Both agricultural and forest hydrology topics have been treated in the scientific works of the group at the University of Torino. This work presents some main papers which can show the path followed by the group. The first paper is 50 years old, the second is 30 years old, the third 7 years, and the last was published in 2022. All papers have results that are still useful in the field of runoff studies.

We start from a forest hydrology paper of Merlo (1973) where it is presented a procedure to calculate peak discharges from mountain catchments proposed by Tournon. In that paper Merlo did a very comprehensive analysis of thousands of hydrographs in 9 catchments (between 30 and 170 square kilometers) in Piemonte, and in close by areas of Liguria and Emilia Romagna.

The calculation procedure presented in that paper is used up to now in many flood evaluation and can be found in several textbooks (e.g.: Greppi, 1999; Ferro, 2006). It is an example of “science for management”, in this case of the risk of flooding. The very detailed analyses of Merlo (1973) can be discussed in light of the literature of 50 years, which is particularly abundant in this topic. Some points can be linked to the talk of Jeff Mc Donnell "Which future for catchment hydrology?", held in the Agicultural Hydraulics Department of Firenze in 2019. In that occasion he presented a very inspiring review about the runoff theme in relatively small catchments.

Another paper which can be cast in the Mc Donnell’s framework is the one of Ferraris and Acutis (1994), presented at the AIIA conference of Milano, about twenty years after the Merlo’s paper. This is instead a typical “positive science”, where the authors collected experimental hydrographs from agricultural hillslopes in the Piemonte plain. They are 0.4 hectare catchments, with a uniform very mild slope. The data were well reproduced by optimizing only two parameters in a finite difference numerical solution of the kinematic wave, together with a Yves Parlange equation of soil infiltration.

The next paper, the one of Canone et al. (2015) is again in the line of the work about soil moisture of Yves Parlange, and more specifically of his friend Randel Haverkamp. The latter worked in the group in Turin for the years 2008 and 2009 and died few months ago in France. The Institute of Agricultural Hydraulics, now named Labflux, in this paper was in between the “science for management” and the “positive science”, providing guidelines for managing the surface irrigation on borders, the most spread method in Piemonte. Three farms were monitored and a model was used to fit the data and to simulate different scenarios of real world irrigation.

It is in the frame of “positive science” that still the group is doing research in the Critical Zone Observatories field, with several experimental installations. One has a 25 meters high eddy covariance mast and cosmic ray apparata in a forest, and another is at 2600 meters asl with hydrological fluxes measurements. The new issue will be to see if the discharge data collected in the different mountain catchments, together with stable isotopes data will allow to follow the inspiring talk of Mc Donnell previously cited.

However the activity of “science for management” issues is continuing now. It has been published very recently a study for the Water Authority with the objective to forecast the recharge of the aquifers around Turin: in Brussolo et al. (2022) the time series from 1959 and the simulations to 2050 are presented, calculating the actual evapotranspiration both in the past and in the future with a model. The temporal and spatiaò variability of past time series of recharge is shown.

**References.**

Brussolo E. et al. (2022). Aquifer recharge in the Piedmont Alpine zone: Historical trends and future scenarios (OPEN ACCESS) Hydrol. Earth Syst. Sci. (2) 26, 407-427.

Canone D., M. Previati, I. Bevilacqua, S. Ferraris (2015). Field measurements based model for surface irrigation efficiency assessment. Agricultural Water Management (156) 30 – 42

Ferraris S. and Acutis M. (1994). Overland flow measurements and kinematic wave calibration, World Congress CIGR, Milano.

# Ferro V. (2006). La sistemazione dei bacini idrografici, McGraw Hill.

Greppi M. (1999). Idrologia, HOEPLI.

Merlo C. (1973). Determinazione mediante il metodo razionale delle portate massime di piena di data frequenza nei piccoli bacini, Tipografia Bona,Torino.