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Assessment of the hydropower management effect on floods in the Verbano Lake area (Switzerland, Italy)

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The role of the artificial lakes for hydropower production in the Alps has always been discussed, especially after major floods. It is still not well known how the dams can affect magnitude of floods and how they can be helpful in an integrated alarm system for flood prevention. This is essentially due to the limited amount of available hydrometeorological data before the construction of the dams and the non-stationarity of other factors affecting the magnitude of the floods.

The study presented here is part of the INTERREG IIIA project involving Italian and Swiss partners and aiming at developing a management system of the hydrological and geological risks in the Verbano Lake. It is focused on the Maggia basin, which is one of the major contributors to the inflow in the Verbano Lake and has been strongly affected by hydropower management since 1950.

One possible approach is a comparative flood frequency analysis using data series available before and after the dams' construction. This approach, however, fails to distinguish between the various factors affecting the homogenity of the flood data series. Indeed, not only the hydropower management, but also the soil cover (forestation, urbanization) and the climatic conditions may have changed. In addition to that, apparent changes in the flood regime can also be due to sampling variability because of the limited amount of available data.

The alternative approach presented here uses a deterministic, conceptual and 'storage oriented' rainfall-runoff model. The choice of such a model is the result of parameter parsimony and adequate representation of the modelled system. The total rainfall is divided into net rainfall and infiltrated rainfall. The latter enters directly into the soil reservoir while net rainfall produces direct runoff. The model has only 3 parameters.

The originality of our methodology is the calibration of the model in natural conditions combining daily data available from the studied catchment before the construction of the dams and hourly data available from neighbouring catchments. This enables a maximal use of the available data, provides regional relationships between hourly and daily parameters and leads to synthetic flood data generation corresponding to natural conditions, but under present climatic and soil-cover conditions. The major results, the advantages and the limitations of such an approach are discussed in the presentation.