How global warming can modify hydrological extremes in the Italian Alps

NH33B-06 How global warming can modify hydrological extremes in the Italian Alps

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Abstract

This work aims to provide quantitative elements to the expected rate of change of flood frequency curves in Alpine basins due to global warming, focusing on the implications of rising temperatures and rainfall amounts on natural processes leading to floods.

The approach undertaken develops the concepts presented in the FloodAlp model (Allamano et al., 2009), that allows to build simplified flood frequency curves based on a derived distribution methodology. The model accounts for within-year fluctuations in the snow-covered portion of the catchment area and considers the interaction of seasonal changes in the freezing elevation with the basin's hypsographic curve. To model the basin hypsometric features, and to mote thoroughly assess the model sensitivity to the distribution of elevations, we improve the curve representation using a two-parameter Strahler function, which is shown to be more accurate than the simple one-parameter function originally used in the model.

In this paper, we managed to build conditions for a systematic application of the FloodAlp model to nearly 200 gauged watersheds across the Italian Alps, all with an average elevation higher than 1000 m a.s.l.

To assess the variation in flood frequency distributions due to climatic perturbations, we started by calculating the flood frequency distribution under "undisturbed" conditions, assuming no attenuation performed by snow. We then computed, through FloodAlp, the 100-year return period undisturbed specific discharge q_{100}. The effects of climate change are assessed through the return period ratio (RPR), defined as the ratio between the return period of a flood discharge corresponding to the undisturbed q_{100} under current climatic conditions and the return period of the same discharge under modified climatic conditions. The

analysis reveals that RPR values can vary significantly across space, depending on the high spatial heterogeneity of the involved watersheds.

This study provides a comprehensive and regionally representative understanding of potential flood risks faced by communities in the Italian Alpine region. Moreover, the approach presented offers a tool that can straightforwardly aid in distinguishing basins, within a wide-area context, concerning the potential increase in flood frequency.

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