

A simple contributing-area model to assess flood risk in mountainous basins

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Abstract. In high-elevation regions precipitation occurs in a liquid form over the portion of basin laying below the snow line (contributing area), while it is retained as snow in the upper part of the basin. So, in mountainous basins, snow may have a mitigating effect on flood formation, because the area directly contributing to runoff is often smaller than the total area of the basin.

This is an intuitive and significant phenomenon that, however, has seldom been studied quantitatively. In this study a simple model is proposed to account for the reduction of the contributing area in alpine basins due to the seasonal variability of temperature. Robust and simple hypotheses are formulated on the structure of precipitation and on the snow accumulation and melting. The model, tested towards flood data observed in North-Western Italy, proves to be able to quantify the empirical dependence between floods and elevation.

Moreover, thanks to its simple analytical structure, the model is suitable to be used to investigate the vulnerability of alpine areas to climate change. Interesting indications on the increase of flood risk in mountainous areas are obtained by perturbing the temperature regime according to different climate change scenarios. The predicted rise in mean annual temperatures induces a generalized increase of the flood risk that can be practically mapped in terms of characteristic elevation values.