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The Upper Garonne flood series from discharge gauging data (Bossost, Val d'Aran, Spain) and reconstruction of historical floods (Saint-Béat, France)

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Traditionally, the Val d'Aran in Spain has been considered the headwaters of the Garonne River, an international river that, after a short journey through Spain, goes into France and heads towards its mouth in the Atlantic Ocean after a journey of more than 647 km. Systematic gauging of the Garonne River are recorded in Bossost near the outlet of the Aran Valley (647 km2 of the basin), but the series cover a relatively short period (from 1965 to the present) and prudence must be exercised when extrapolating the flows corresponding to high return periods. One possibility to reduce the uncertainty when carrying out the frequency analysis is to complement the systematic series with the data of maximum flows from the hydraulic reconstruction of historical floods.
In the French town of Saint-Béat (Haute-Garonne), about 20 km downstream of the town of Bossost (Val d'Aran) and in the French part of the basin, the marks reached by the waters in different episodes are available for different floods (flood marks) since the year 1778. This information is not available in the Spanish territory of the Garonne. Therefore, the maximum discharges of the historical floods were obtained by the reconstruction of these episodes using the flood marks registered in Saint-Béat. In each historical flood, the role of the merging of the snow mantle in the headwater as a contributory mechanism to the precipitation in the formation of flood runoff has been analyzed simultaneously.
The peak flows of the historical floods in the town of Saint-Béat (673 km2 of the basin) have been reconstructed with the help of the hydraulic model HEC-RAS v. 4.1.0 on a DTM with a resolution of 1m x 1m, considering the morphological changes of the bed and the floodplains and their roughness from the old cartography, cadastral plans and detail photographs to recompose the land uses and the vegetation occupation of the flooded areas in each period.
The historical reconstructed peak discharges from the floods of the last 250 years clearly surpass those obtained in the systematic flow series of the last 50 years, indicating the lack of extreme values contained in said series. Its inclusion in flood frequency analysis allows reducing the uncertainty of an insufficient time series and improving the prediction of low recurrence quantiles in flood risk planning.