



An analysis of change in alpine annual maximum discharges: implications for the selection of design discharges

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The contribution presents an analysis of 17 long annual maximum series (AMS) of flood flows for Swiss Alpine basins. We apply Pettitt's change point test, non parametric sign test and Sen's test on trends. We also apply a parametric goodness-of-fit test for assessing the suitability of distributions estimated on the basis of annual maxima collected up to a certain year for describing the frequency regime of later observations. For a number of series the tests yield consistent indications for significant changes in the frequency regime of annual maxima and increasing trends in the intensity of annual maximum discharges. In most cases, these changes cannot be explained by anthropogenic causes only (e.g., streamflow regulation, construction of dams). Instead, we observe a large number of statistically significant changes in the mean of the study AMS, and we also observe a strong correlation between the years of change and elevations of catchments' outlet. This evidence is consistent with the findings of recent studies that explain increasing discharges in alpine catchments with an increase in the temperature controlling the portion of mountain catchments above the freezing point.

Finally, we analyze the differences in return periods (RP's) estimated for a given flood-flow on the basis of recent and past observations. For a large number of the study AMS we observe that, on average, the 100-year flood for past observations corresponds to a RP of approximately 10 to 30 years on the basis of more recent observation. From a complementary perspective, we also notice that estimated 100-year increases on average by a factor of 10-50% for the study area. Practical implications of the observed changes are illustrated and discussed.