Long series of Swiss seasonal precipitation: Homogenization, regionalization and trends

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Abstract
The knowledge of precipitation trends and variability is vital for many aspects of life and socio-economic sectors. However, confidence in precipitation trends is still limited and merits regular reassessment. Here, seasonal and annual homogenized precipitation series in Switzerland are investigated for the period 1901-2013 in terms of trends, interannual variability and the influence of large-scale European flow patterns. The homogeneity assessment was performed using the MeteoSwiss homogenization procedure THOMAS. An objective spatial clustering was applied to 305 stations resulting in 32 distinct precipitation regions. The hierarchical clustering with complete linkage resulted in station groups with internal correlation coefficients of 0.79 or higher. Single stations of all groups were used for regional trend assessments. Moving window trend periods from 33 to 113 years length have been analysed on a seasonal and annual basis.

Of 2720 analysed moving trend windows, 194 (7.1%) show a significantly positive precipitation trend, and 10 (0.4%) a significantly negative trend. Most of the significantly positive trends are found for long precipitation series (50+ years) for winter, autumn and annual series. 81 (72)% of the annual (winter) series in the 1901-2013 period show positive trends and for 34 (22)% of the regions the trends are significant. Significantly negative trends are only found in winter for some short time series in the most recent decades. Interannual variability is varying considerably regionally and seasonally. No clear long-term trends could be identified. The same conclusions hold for changes in moderate seasonal extremes. The influence of large scale flow strongly depends on the season and region. The strongest link between large scale flow and Swiss precipitation variability is found for winter. With the variability of only four major patterns of sea level pressure, precipitation sums of individual years can be reconstructed with a mean relative error of about 15-25% for northern and 25-35% for southern Swiss regions. The most important pattern for northern Switzerland is a Euro-Atlantic blocking like pattern. For southern Switzerland, an Eastern Atlantic like pattern is dominant in winter and a Scandinavian like pattern in autumn.