

## **Low precipitation events in the European Greater Alpine Region and their space-time patterns in the past 210 years.**

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In this study space-time patterns of low precipitation events in the Greater Alpine Region (GAR) of Europe are investigated. A long term gridded dataset of monthly precipitation sums spanning the last 210 years is used to assess abnormally dry states by applying a monthly percentile deceedence threshold. Furthermore, these anomalies are calculated for 1, 3, 6 and 12 months moving averages. Contiguous areas of grid points below the threshold are recorded in a lookup table in order to assess the dry anomalies on an event-based approach. The overall event severity is determined by the mean deviation from the threshold level and the area affected.

With this approach we are able to show that the most severe dry anomalies take place in the 1860s, 1850s and 1940s, although there are some differences in the occurrence over time in summer and winter. Winter dry anomalies are more frequent in the 19th century, whereas in summer no clear patterns are perceptible. A spatial clustering analysis of the anomaly fields also reveals distinct patterns in space, clearly indicating the Main Alpine Crest as a major divide of dry anomalies from North to South.

A joint consideration of detected dry anomaly events and their associated temperature anomalies shows that in winter of the late 19th and early 20th century dry conditions are more often accompanied by cold temperatures in contrast to the last 50 years where dry anomalies are associated with above average winter temperatures. In general dry summers are more likely warmer than the long term mean, but there is also a considerable number of dry events with negative temperature anomalies, particularly in the late 19th and early 20th century.