



## **Disentangling drivers of meteorological droughts in the European Greater Alpine Region during the last two centuries**

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This study investigates the atmospheric drivers of precipitation deficit of the most severe meteorological droughts in the Greater Alpine Region during the last 210 years. We use a daily atmospheric circulation type reconstruction tailored to the Alpine region with precipitation as the focus variable. Precipitation deficit tends to be higher during periods with more frequent anticyclonic (dry) and less frequent cyclonic (wet) circulation types, as would be expected. However, circulation characteristics are not the main drivers of summer precipitation deficit, when preceding soil moisture conditions are more important. Dry soils tend to limit precipitation, which is particularly the case for low air pressure gradient circulation types that enhance the propensity for local convection. This mechanism is of specific relevance in explaining the major drought decades of the 1860s and 1940s. Both episodes show large negative anomalies in spring precipitation followed by increasing frequencies of circulation types sensitive to soil moisture precipitation feedbacks, enhancing the drought signal in summer. The dry springs of the 1860s were likely caused by circulation characteristics that were quite different from those of recent decades as a consequence of the large spatial extent of Arctic sea ice at the end of the Little Ice Age. On the other hand, the dry springs of the 1940s developed under a persistent positive East Atlantic/Western Russia pattern, triggered by positive sea surface temperatures in the western subtropical Atlantic.