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Temperature and Precipitation Anomalies at Mount Zugspitze in Relation to Large-scale Atmospheric Circulation Patterns and North-Atlantic European Modes of Variability

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Based on daily temperature and precipitation time series 1950-2015 for Mount Zugspitze, Germany's highest mountain site, anomalous months with respect to both variables are selected in terms of (positive and negative) differences of more than one standard deviation from the long-term monthly mean values. The re-analysis grids of 500 hPa geopotential heights for these anomalous months (separately for temperature and precipitation and the meteorological seasons, but combined for positive and negative anomalies) in the North-Atlantic European region are submitted to T-mode PCA in order to derive basic circulation patterns linked to these high-mountain climate anomalies. The preference for warm or cold and dry or wet anomalies of these circulation patterns is indicated by the patterns' time coefficients (loadings in case of T-mode). If no general preference is indicated, separate composite geopotential height patterns for the opposite climate anomalies point to internal changes within the affected circulation patterns. Additionally, large-scale modes of variability (derived by S-mode PCA) being important for the North-Atlantic European region like NAO, East Atlantic, East Atlantic West Russia and Scandinavian patterns are analyzed with respect to temperature and precipitation signals at Mount Zugspitze: frequency and amount of positive or negative deviations are recorded for months with distinct phases of these modes of variability (time coefficients (scores in case of S-mode) differing more than one standard deviation from CPC mean values). Altogether these studies should lead to an understanding of climate variability at this high-mountain site in terms of atmospheric circulation dynamics.