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## Spatio-temporal variability of droughts in Peruvian Andes and associated risks related to ENSO

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Droughts in Peru are one of the disasters with major losses in economic activities as agriculture or energy production, affecting livelihoods of the population. The occurrence of droughts can be explained by climatic variability of precipitation, where El Niño Southern Oscillation (ENSO) seems to have an important influence. For the first time, this study addresses the spatio-temporal variability, characteristics and trends of droughts in Peruvian Andes for the 1970-2018 period. The regionalization of droughts was performed combining Principal Component Analysis (PCA) and Cluster method, for which the Standardized Precipitation Index (SPI) was used. Finally, a characterization using a trend analysis, correlation with oceanic-atmospheric indices and a drought risk assessment during El Niño Southern Oscillation (ENSO) was performed.

We found that the spatio-temporal variability of droughts could be best investigated by distinguishing eight homogeneous regions with different regional drought characteristics. Thus, the trend analysis indicates a reduced duration and severity of droughts in the northern Pacific divide and a lower intensity in the south. In addition, the depicted trends seem to indicate increasing droughts in the Altiplano (high plateau) divide. Additionally, considering a decadal analysis of droughts (1970-2010), the number of drought months in the last decade (2000-2010) has reduced in all regions compared to previous decades.

From the drought risk assessment during ENSO, only remarkable results were obtained using the Oceanic Niño Index (ONI). Thus, under positive anomalies of ONI, an increasing risk of droughts was identified in the southern part of the Pacific divide, in the divide of Titicaca and in the south and north of the Amazon divide.