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Analysis of spatial variability of extreme rainfall events influenced by decadal oscillations in the Paute River Andean basin

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Paute River basin is located in southern Ecuador, has an area of 5066 km^2 and an elevation range of 1840-4680 m a.s.l. Its importance relay in different water uses as human consume for the city of Cuenca (near 400.000 inhabitants), irrigation, industry and an important hydropower plant for nearly 30% of the national system energy. Rainfall perturbations found in 1963-1993 period cause decadal oscillations of precipitation, which identifies the climate variability of the region. Positive perturbation belong to wet period and the negative belong to dry period, and between both there are transition periods. These oscillations seem to have influence of regional weather patterns such as ENSO. Consequently, the importance in knowledge of spatial and temporal variability of rainfall and it extremes is necessary for a better water resources management. Further, unimodal precipitation region (UM) with one yearly rainy season at the eastern basin, and bimodal precipitation region (BM) with two rainy seasons at the western and middle part of the basin explain the complexity of rainfall spatial variability.

Therefore, this study analyses extreme rainfall events at 10 rain gauges sites distributed along the basin for the complete period of records (CPR), its wet and dry periods, and transition periods. Gumbel, Gamma and the Log-Pearson type III probability distributions were used to assess yearly annual maximum events of each rain gauge record, the best fitted was chosen. Subsequently, extreme events of each site and for all analysed periods were compared. In addition, the analysis of IDF curves considering the Merrill Bernard and the Wenzel models was performed.

It was found that yearly annual maximum events in the eastern basin (UM) are better described by the Gamma type distributions. On the other hand, the Gumbel distribution performed better for rain gauges at the middle and western basin at higher elevations (BM). However, the adjustment of any probability distribution also depended of the period analysed. In general, for wet periods the three-parameter Gamma distribution was better adjusted.

The magnitudes of the wet period extreme events were higher than extreme events of the CPR, and much higher than the dry period ones. However, there were two rain gauges sites as exemption. This exemption is due to the presence of high magnitude events of El Niño phenomena during the analysed period, which influenced the probability distribution performance.

The 50-year return period event of dry and wet periods are equivalent to 15-year and 133-year return period of the CPR, respectively. In addition, it was evidenced the existence of hysteresis in two of the four rain gauge located at the central part of the basin (BM).

The Merrill Bernard model best describes the precipitation performance at the eastern part of the basin (UM), while in the central-western and highest part of the basin the Wenzel model fits better. In general, IDF equations determined for each period and station revealed that rainfall intensity magnitude of wet period is 25% higher than dry period's one, with the complete series magnitude between both.