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A Hidden Markov Model of Daily Precipitation over Western Colombia.

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The western Pacific coast of Colombia (Chocó Region) is among the rainiest on earth, largely due to low level jet activity and orographic lifting along the western Andes. A hidden Markov model (HMM) is used to characterize daily rainfall occurrence at 250 gauge stations over the Western Pacific coast and Andean plateau in Colombia during the wet season (September - November) from 1970 to 2015. Four "hidden" rainfall states are identified, with the first pair representing wet and dry conditions at all stations, and the second pair North-West to South-East gradients in rainfall occurrence.

Using the ERA-Interim reanalysis data (1979–2012) we show that the first pair of states are associated with low level jet convergence and divergence, while the second pair is associated with South Atlantic Convergence Zone activity and local convection. The estimated daily state-sequence is characterized by a systematic seasonal evolution, together with considerable variability on intraseasonal and interannual time scales, exhibiting a strong relationship with ENSO.

Finally, a nonhomogeneous HMM (NHMM) is then used to simulate daily precipitation occurrence at the 250 stations, using the ERA-Interim vertically integrated moisture flux anomalies (two weeks lagged) and monthly means of the sea surface temperatures (one month lagged). Simulations from the NHMM are found to reproduce the relationship between the ENSO and the western Colombian precipitation. The NHMM simulations are also able to capture interannual changes in daily rainfall occurrence and dry-wet frequencies at some individual stations. It is suggested that a) HMM provides a useful tool that contributes to characterizing the Colombian's Hydro-Meteorology and it's anomalies during the ENSO, and b) the NHMM is an important tool to produce station-scale daily rainfall sequence scenarios for input into hydrological models.