Downscaling of daily rainfall occurrence over NE Brazil using a Hidden Markov Model
How predictable is weather-within-climate?

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1. The Hidden Markov Model (HMM)

As part of this endeavor to produce seasonal climate forecasts that are useful in societal decision-making, it is important to understand how regional seasonal performance of the “weather-within-climate” are predictable on a season or more time scales. To help with this question, we construct a hidden Markov model (HMM) to examine interannual changes in daily rainfall in two regions across Brazil, and modes of subseasonal convergence and intraseasonal variability for the Northern Atlantic, mid-latitude region (1950-2005). This paper focuses on the daily rainfall occurrence is governed by few different states, and the interannual changes in rainfall can be represented by a few states. However, the interannual rainfall sequence is characterized by a systematic seasonal variation, together with considerable variability on interannual timescale and larger time scales. Figure 1 shows the transition probabilities between the states. The states are defined as: (1) low rainfall, (2) mid-rainfall, (3) high rainfall, and (4) very high rainfall. The HMM allows for a flexible representation of the transitions between the states and provides a probabilistic framework for modeling rainfall occurrence.

2. The Non-homogeneous HMM (NHMM)

A non-homogeneous HMM is used to examine daily rainfall occurrences generated from daily rainfall sequences from the NOAA CPC global precipitation data. By using this model, we can simulate the rainfall occurrence at daily scale in terms of large-scale atmospheric states and (d) to produce station-wise daily rainfall sequence statistics for input into crop models.

Acknowledgements: This work was supported by a US Department of Energy grant, and by NOAA through a block grant to the IRRI.

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