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Simulating sub-Milankovitch climate variability at low latitudes

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Some low-latitude geological records show climatic variations at sub-Milankovitch periods (less than 15,000 years). The mechanisms for these variations are not clear. A proposed mechanism is that the non-linear response of climate to insolation forcing produces combination tones of the primary orbital components, which are present as secondary periods of lower amplitude in the geological records. Another hypothesis is that the African summer monsoon the twice overhead passage of the sun in one year could produce periods of about 10,000 years in equatorial signals.

We will present long (130,000 years) transient simulations with an Earth model of intermediate complexity (Climber-2) to test these hypotheses. For the Asian and African monsoonal precipitation only a precession signal is found. However, for the monsoonal runoff the model also simulates a 10,000 year signal for both the African and the Asian summer monsoon. In addition, for the Asian monsoon a (weak) 5,000 year period is found. Additional experiments show that including interactive vegetation is crucial for obtaining sub-Milankovitch periods in the monsoonal runoff. The dynamical response of the waterholding capacity of the soils, associated with changes in the vegetation cover, is necessary for the 10.000 year response observed in the model.