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Simulating sub-Milankovitch climate variations associated with vegetation dynamics

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Abstract. Climate variability at sub-Milankovitch periods (between 2 and 15 kyr) is studied in a set of transient simulations with a coupled atmosphere/ocean/vegetation model of intermediate complexity (CLIMBER-2). Focus is on the region influenced by the African and Asian summer monsoon. Pronounced variations at periods of about 10 kyr (Asia and Africa) and about 5 kyr (Asia) are found in the monsoonal runoff in response to the precessional forcing. In the model this is due to the following mechanism. For low summer insolation (precession maximum) precipitation is low and desert expands at the expense of grass, while for high insolation (precession minimum) precipitation is high and the tree fraction increases also reducing the grass fraction. This induces sub-Milankovitch variations in the grass fraction and associated variations in the water holding capacity of the soil. The runoff does not exhibit sub-Milankovitch variability when vegetation is kept fixed. High-latitude vegetation also exhibits sub-Milankovitch variability under both obliquity and precessional forcing. We thus hypothesize that sub-Milankovitch variability can occur due to the dynamic response of the vegetation. However, this mechanism should be further tested with more sophisticated climate/vegetation models.

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