Geophysical Research Abstracts
Vol. 17, EGU2015-3565-1, 2015
EGU General Assembly 2015

The influence of soil type, vegetation cover and soil moisture on spin up behaviour of a land surface model in a monsoonal region

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Model spin-up is the process through which the model is adequately equilibrated to ensure balance between the mass fields and velocity fields. In this study, an offline one dimensional Noah land surface model is integrated recursively for three years to assess its spin-up behavior at different sites over the Indian Monsoon domain. Several numerical experiments are performed to investigate the impact of soil category, vegetation cover, initial soil moisture and subsequent dry or wet condition on model spin-up. These include simulations with the dominant soil and vegetation covers of this region, different initial soil moisture content (observed soil moisture; dry soil; moderately wet soil; saturated soil), simulations initialized at different rain conditions (no rain; infrequent rain; continuous rain) and different seasons (Winter, Spring, Summer/Pre-Monsoon, Monsoon and Autumn). It is seen that the spin-up behavior of the model depends on the soil type and vegetation cover with soil characteristics having the larger influence. Over India, the model has the longest spin-up in the case of simulations with loamy soil covered with mixed-shrub. It is noted that the model has a significantly longer spin-up when initialized with very low initial soil moisture content than with higher soil moisture content. It is also seen that in general, simulations initialized just before a continuous rainfall event have the least spin-up time. This observation is reinforced by the results from the simulations initialized in different seasons. It is seen that for monsoonal region, the model spin-up time is least for simulations initialized just before the Monsoon. Model initialized during the Monsoon rain episodes has a longer spin-up than that initialized in any other season. Furthermore, it is seen that the model has a shorter spin-up if it reaches the equilibrium state predominantly via drying process and could be as low as two months under quasi-equilibrium condition depending on the time of initialization.