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Modeling sensitivity study of the possible impact of snow and glaciers developing over Tibetan Plateau on Holocene African-Asian summer monsoon climate

L. Jin¹, Y. Peng¹, F. Chen¹, and A. Ganopolski²

¹Key Laboratory of Western China's Environmental Systems (Ministry of Education), Lanzhou Univ., Lanzhou 730000, China

²Potsdam Institute for Climate Impact Research, Potsdam, Germany

Abstract. The impacts of various scenarios of a gradual snow and glaciers developing over the Tibetan Plateau on climate change in Afro-Asian monsoon region and other regions during the Holocene (9 kyr BP–0 kyr BP) are studied by using the Earth system model of intermediate complexity, CLIMBER-2. The simulations show that the imposed snow and glaciers over the Tibetan Plateau in the mid-Holocene induce global summer temperature decreases over most of Eurasia but in the Southern Asia temperature response is opposite. With the imposed snow and glaciers, summer precipitation decreases strongly in North Africa and South Asia as well as northeastern China, while it increases in Southeast Asia and the Mediterranean. For the whole period of Holocene (9 kyr BP–0 kyr BP), the response of vegetation cover to the imposed snow and glaciers cover over the Tibetan Plateau is not synchronous in South Asia and in North Africa, showing an earlier and a more rapid decrease in vegetation cover in North Africa from 9 kyr BP to 6 kyr BP while it has only minor influence on that in South Asia until 5 kyr BP. The precipitation decreases rapidly in North Africa and South Asia while it decreases slowly or unchanged during 6 kyr BP to 0 kyr BP with imposed snow and glacier cover over the Tibetan Plateau. The different scenarios of snow and glacier developing over the Tibetan Plateau would result in differences in variation of temperature, precipitation and vegetation cover in North Africa, South Asia and Southeast Asia. The model results suggest that the development of snow and ice cover over Tibetan Plateau represents an additional important climate feedback, which amplify orbital forcing and produces a significant synergy with the positive vegetation feedback.

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