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Improvement of the thermal conductivity parameterization schemes and its application in the simulation of soil temperature at permafrost area

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Abstract

The substance and energy exchange between land surface and atmosphere is one of the most important physical processes which determine the atmospheric circulation and climate state. As a special kind of soil, permafrost not only affects the energy exchange between the land surface and the atmosphere, but also changing the infiltration of rain, snow, which play an important role in surface runoff and hydrological cycle. Additionally, soil temperature is one the most important physical properties of soil. Therefore, based on the previous work, optimizing the soil thermal conductivity parameterization schemes in order to improve the simulation results of permafrost soil temperature has very important significance.

In this paper, a numerical simulation experiment at Budongquan/NewD66 site in the Tibetan Plateau is present by using the Frozen Soil Model (FSM) developed by SUN Shu-Fen et al of Institute of Atmospheric Physics, Chinese Academy of Sciences. The results show that the soil thermal conductivity parameterization schemes in the model overestimated the real soil thermal conductivity, resulting higher simulated soil temperature. Therefore, an improved soil thermal conductivity parameterization schemes are re-build in FSM. Another numerical simulation experiment is carried out again using new soil thermal conductivity parameterization schemes. The results show that the soil temperature are represented better than that with original soil thermal conductivity parameterization schemes. The calculation result of the soil thermal conductivity of the new schemes in 5cm depth is 0.79 W/m/K, which is much closer with the observed value(0.78 W/m/K) compared with the calculation result of the original schemes which is 1.19 W/m/K. In 10 cm depth we also work out with the same result.

Keywords: Frozen soil model; Soil thermal conductivity; Northern Tibetan Plateau

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