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Comparative studies of different radiation schemes within vegetation in land model

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Abstract: Since the accurate estimation of the albedo is required in climate modeling and there are some shortages in either the accuracy or the application area for radiative transfer scheme within a canopy, it is necessary to develop an accurate and simple four-stream radiation transfer model within a canopy based on the second vegetation radiative transfer model. The four-stream model can simulate the process of short-wave solar radiative transfer within a canopy.
The four-stream solar radiative transfer model within a canopy in the land surface process model is based on the two-stream short-wave radiative transfer model. The radiative transfer theory within a canopy is based on the radiative transfer theory in the atmosphere. Each parameter in the basic canopy equation canopy accounts for the special geometry and optical character of the leaf or canopy. The upward or downward radiative fluxes are related to the diffuse phase function, G-function, leaf reflectivity and leaf transmission, leaf area index, and the solar angle of incident beam direction. The four-stream model and the two-stream model can simulate the reflectance, transmittance and absorption of the canopy. The newly developed the four-stream model can reduce the calculate difference of land surface radiative in theory.

To compare and determine differences between the results predicted by the two models, several experiments were carried out to examine the effects on the canopy albedo by varying the leaf area index, leave angle distribution and the optical properties of the leaf and ground surface under the canopy. To better assess the simulation performance of the new four-steam model in the application for a land surface model, we needed to determine the parameters for the four-steam scheme and the second-stream scheme to utilize in an off-line test. These parameters also included calculating the reflectance, absorbance and transmission at different sun angles and different leaf area indexes for the 16 kinds of vegetation canopy. The offline test results showed that the sun angle had a significant impact on the solar radiative transfer process within vegetation and on the simulations of two schemes for reflectance and transmittance and absorption varies with different vegetation types. The offline test results show that the sun angle have significantly impact on the solar radiative transfer process within vegetation, and the simulations of two schemes for reflectance and transmittance and absorption varies with different vegetation types.
To evaluate the simulations of the four-stream model for solar radiative flux reflected by the land surface in the land surface model, the four-stream model and the two-stream models were coupled into a land surface process model. These tests indicated that the simulation of the land surface process model coupled to the four-stream scheme outperformed two-stream scheme radiative transfer models regarding the global surface albedo, leaf area index and net primary productivity.