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Numerical study of the impacts of vegetation changes in Asian tropical region

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The new land surface model (Biosphere - Atmosphere Interaction Model: BAIM) (Mabuchi et al., 1997) for use within climate models was developed. Use of the BAIM can result in estimates of not only the energy fluxes, but also the carbon dioxide flux between terrestrial ecosystems and the atmosphere. After some off-line verifications of BAIM, BAIM was incorporated into a spectral general circulation model. The vegetation type of each grid point is specified and the interactions between the land surface vegetation and the atmosphere are estimated by BAIM at each grid point. A control run using this global climate model was performed. In this control run, an actual global vegetation map and the climate SST values were used. Using the soil values obtained by the pre-run, the experimental control time integration was continued for 20 years. After the control time integration, the vegetation types of Southeast Asia and India areas were changed. A 10-year pre-run was performed, and then the experimental impact time integration was continued for 20 years under the changed vegetation type condition. The results of the impact time integration were compared with the results of the control time integration.

The results of the control integration were examined. The distributions of soil moisture, permafrost, and soil temperature indicate reasonable results. The seasonal changes of snow depth and the heat balance at the land surface also indicate reasonable results. The carbon dioxide balance at the land surface also exhibit reasonable global distribution pattern. Although the model results of the height and the temperature at 850 hPa indicate slightly lower values than the analysis data, global distribution patterns of the model results correspond to those of the analysis data. The wind vector distributions of the model results also generally correspond to those of the analysis data. At 500

hPa, the height and the temperature of the model exhibit slightly higher values than the analysis data. The distribution patterns of the model results, however, indicate good agreement with those of the analysis data. The model wind vector patterns at 500 hPa also coincide with those of the analysis data. The seasonal changes of the model precipitations are in agreement with those of the observed data. The seasonal change patterns of the atmospheric carbon dioxide concentrations calculated by the model indicate reasonable results comparing with the observed results.

The heat and water balances and the carbon dioxide balance in the impact integration were compared with those of the control integration at the area vegetation types were changed. In general, the latent heat increases, the sensible heat decreases, the land surface temperature becomes higher, and the net carbon dioxide absorption decreases in the results of the impact integration. In the impact integration results, the summer precipitations increase at the Philippines and surrounding area, and winter precipitations increase over the equatorial area of the central Pacific Ocean and at the South Pacific convergence zone (SPCZ). It is considered that these precipitation changes are mainly due to the changes of seasonal circulation induced by the vegetation change.

REFERENCE

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