

Impacts of surface cover changes in northern China on East Asian Climate

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ABSTRACT

The changes in the East Asian Summer Monsoon (EASM) were assessed in the ensemble runs of the IPRC regional climate model in the scenario of changing the land surface characteristics (from desert/semi desert to short grass) in the central north China (36N-42N, 90E-110E). This paper reports implications for the sustainability of vegetation under the altered rainfall regime.

A 5-member ensemble simulation with the current vegetation cover and an idealized re-greening scenario for a test area in northern China was performed. The results of the modeling experiment indicate that such a surface cover change has both significant local and regional effects on the atmospheric circulation and rainfall regimes. Rainfall increases significantly over the whole test area, southern China, the lower reaches of the Yangtze River, and eastern parts of the Tibetan Plateau. Significant reductions in rainfall occur mostly over the marginal seas, particularly South China and Yellow Seas and adjacent Korea peninsula.

Replacing desert and semi-desert areas with grass in the test area increases net radiation at the surface, and hence total heat flux from surface to atmosphere, which in turn enhances upward air-motions over the test area and supplies more moisture to atmosphere. This increases rainfall in the test area. The enhanced upward motions over the test area are compensated by increased subsidence to the east, centered over Yellow Sea, which reduces rainfall there. The anticyclonic anomaly associated with this center also weakens the monsoonal flow over the middle reaches of the Yangtze River. This increases shear vorticity to the south and west of the middle reaches of the Yangtze River, causing strong uplift anomalies over southern China and the Sichuan Basin. Consequently, rainfall increases at these locations.

The increased rainfall over the test area largely occurs in intensity rather than in frequency of rainfall. Lack of frequent rainfall, especially in the lowlands of the test area, makes it very difficult to maintain a vegetated surface. On the other hand, the increase in rainfall in the highlands and very eastern parts of the test area, which already receive more frequent rainfall, may help support a restored vegetation cover.