

REGIONAL CLIMATE RESPONSES TO THE LAND USE AND LAND COVER CHANGE IN HEIHE RIVER BASIN, CHINA

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1. INTRODUCTION

Land cover refers to the physical and biological cover over the surface of land, including water, vegetation, bare soil and artificial structures, and it is the critical input for modeling global and regional climate. The changes of land use and land cover changes tremendously affect climate and weather systems through complex ways, including the variation of surface albedo and soil hydrology. During this process of changes, human activity plays a significant role in altering land cover characteristics. On the one hand, rapid human population growth needs more food and more living space, and consequently causes more forests and grasslands to convert into croplands. On the other hand, with the strengthening of environmental conservation awareness, people have paid more and more attention on ecological restoration by planting trees and grass. All these shifts bring the change of underlying surface, and further alter the characteristics of regional climate. Heihe river basin, located in the arid area, northwestern China, consists of three parts, namely the upper mountainous area in the south, the middle oasis area and the lower terminal arid area in the north. Its distinctive geographic location and landscape make this research be more important and meaningful.

2. MATERIALS & METHODS

In this paper, a regional climate model, RegCM3, was used to explore the impacts of land cover change on regional climate. RegCM3 is a popular regional climate model and has been applied in many places of the world, including China. It is a hydrostatic limited area model, with finite-difference discretization and a sigma coordinate in the vertical. In RegCM3 model, the processes of soil-vegetation-atmosphere interaction are parameterized using the Biosphere-Atmosphere Transfer Scheme (BATS), in which land cover is classified into 20 categories. After optimizing model parameters, including one-way nesting and modification of physical

parameterization schemes and buffer area, RegCM3 was applied to simulate water and energy distribution in summer of 1998 in Heihe river basin with 10 km horizontal resolution. The input data sets include NCEP reanalysis data, sea surface temperature data from NOAA, vegetation data from satellite image and measured data, and topography data from USGS. Three sets of sensitivity experiments were performed to analyze the climate response to the land cover change. The first one focused on vegetation restoration, supposing the area of evergreen coniferous forest in mountainous region would be extended. In the second experiment, agriculture would be considered and the short grass land in the oasis would be changed into farmland. The last one focused on land desertification, and the short grass land in oasis area would be changed into desert.

3. RESULTS

Results show that RegCM3 can basically represent the climate characteristics in Heihe river basin. But the modeled temperature in desert and semi-desert area is 1-4°C higher than its actual value, and the total precipitation is lower than the observation data. In mountainous and oasis area, there are some numerical points storms in modeled precipitation. These errors may be related with initial and boundary conditions of the model. From sensitivity analysis we found that: 1) the increase of vegetation area in mountainous area will bring temperature decline and precipitation growth in summer. 2) With the expansion of farmland, precipitation will increase slightly in the mountainous and oasis area, and temperature will rise and precipitation will decrease in desert and semi-desert. 3) The spread of desert area will cause temperature rise and precipitation decrease in whole area.

4. CONCLUSION

From the study we can draw some conclusion that land cover and land use is a critical factor contributing to the regional climate change. Vegetation restoration will generate more suitable climate circumstance for local environment. Even through the climate in oasis area will not be disrupted by enlarged farmland area, the warmer and drier climate in desert or semi-desert area near the oasis will accelerate the speed of desertification. The desertification will make the climate at basin scale be much warmer and drier, and finally exacerbated the deterioration of ecological environment.

5. REFERENCE

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