Geophysical Research Abstracts
Vol. 15, EGU2013-1697-1, 2013
EGU General Assembly 2013

Impacts of large-scale reforestation programs on the regional climate change: A case study on Loess Plateau, China

Lang Wang and Kevin Cheung
Department of Environment and Geography, Macquarie University, Sydney, Australia, kevin.cheung@mq.edu.au

Reforestation programs have been widely implemented in recent years as one of the measures to restore environmental conditions. Since the 1980s, China has initiated a series of aggressive reforestation projects aiming at improving the conditions of local ecosystems. Due to the altered land surface properties, reforestation projects may alter the regional climatic conditions, and probably contribute to wider climate changes as well. The main aim of this study is to explore the responses of local climate to reforestation programs, and provide references for reforestation strategies and climate policies in the future.
The regional climate model RegCM version 4.3 developed by the Abdus Salam International Centre for Theoretical Physics was employed to simulate the present climate (from 1990 to 2000) and the projected climate (from 2000 to 2030). The research area focused on the Loess Plateau, a typical reforestation area in central China. Four experiments were designed with altered land surface in the model with 20-km spatial resolution. The first experiment used the default land use and land cover (LULC) database (implemented in 1992) to simulate the local present climate. Since most reforestation programs were intensively implemented after 1992, this experiment represented the climate without perturbations by reforestation. In contrast, the second experiment employed two modified LULC maps available in 2000 and 2008 when the reforestation program achieved remarkable progress. The third and fourth experiments then simulated the projected climate up to 2030 by using the old and modified LULC maps, respectively.
Preliminary results showed that the RegCM model was able to capture the key features in the spatial distribution and seasonal cycles of temperature and precipitation, which provided a robust foundation for the subsequent analyses with LULC changes. In particular, the second experiment exhibited encouraging results in comparison with observed climatology, indicating that the up-to-date LULC database was essential to improve model accuracy. While similar spatial patterns of the climate variables have been simulated in all four experiments, significant variations were obtained among them. Climatologically, annual mean temperature in the south Loess Plateau region is higher and larger precipitation is found in the eastern part, which is mainly controlled by latitude and monsoon circulation. Compared with the first experiment, the second one simulated higher mean temperature over the region, and generated excessive (reduced) rainfall in the western (eastern) part. On the other hand, the comparison between the third and fourth experiment showed similar patterns. In particular, the highest annual mean temperature and the largest variability in precipitation were generated in the fourth experiment. Preliminary analysis showed that these variations may be attributed to the altered surface albedo, which subsequently modified the surface radiation budget and latent heat flux. Taken together, these findings revealed that reforestation may potentially introduce warming effect and increased variability of precipitation in the Loess Plateau region. These climatic feedbacks have important implications for the reforestation program as a mean for ecological conservation. Further studies are being carried out to study the feedbacks of the LULC-induced changes to the wider atmospheric environment. Further, more reforestation domains covering longer periods and consideration of the trade-offs between biophysical and biochemical effects on the regional climate will be explored.