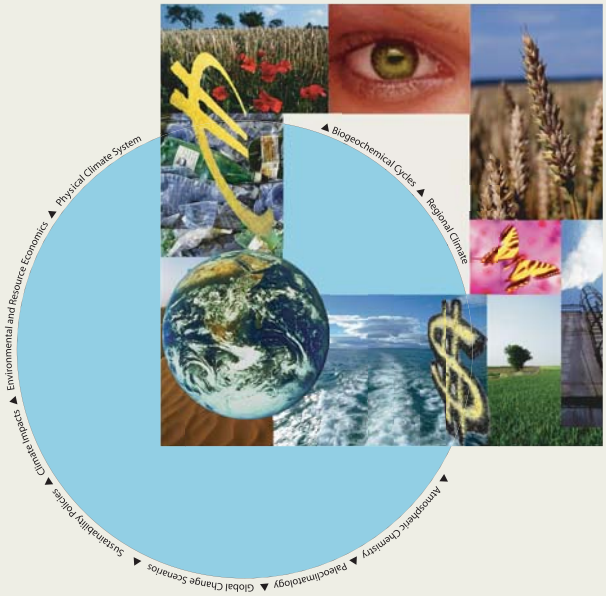
International Max Planck Research School on
EARTH SYSTEM MODELLING

"Interactions between Climate and Land Cover Changes on the Tibetan Plateau"

Xuefeng Cui

PhD Thesis prepared within the
International Max Planck Research School on
Earth System Modelling



Abstract

Climatic impacts of land cover changes on the Tibetan Plateau, which happened extensively during the last half century, are investigated through numerical simulations with the atmospheric general circulation model ECHAM5. The control simulation demonstrates a reasonable production of the large-scale characteristics of seasonal climate in the Asian region in terms of atmospheric circulation and surface climate. A sensitivity experiment with current land cover over the Tibetan Plateau replaced by non-anthropogenic land cover reveals a drier and warmer climate on the Tibetan Plateau and remote impacts on the Indian and East Asian monsoon. Global implications are small, however with larger regional effects. Another experiment with forest replacement at the southeast Tibetan Plateau is conducted to investigate the climate influences of deforestation. It turns out that evaporation is decreased and precipitation is increased at the deforested areas, pointing to increased runoff and influences downstream. Deforestation at the southeast Tibetan Plateau leads to a warmer Indian continent throughout the year, whereas South China is cooler and wetter in spring. We also found remote impacts of land cover changes on the Tibetan Plateau mainly through teleconnections in atmospheric circulation changes. By simulation of deforestation influences at the southeast Tibetan Plateau under warmer climate conditions assuming doubled atmospheric CO_2 concentration, it is found that the impacts of deforestation are non-linearly modulated by the warmer climate condition.

For downscaling global climate model results the regional climate model REMO is applied over the Tibetan Plateau. Summer 1998 is chosen as a case study and a “double-nesting” technique is implemented. Results reveal that REMO can represent reasonably well the regional characteristics in terms of atmospheric circulation and surface climate when “perfect boundaries” are provided. REMO is able to produce daily precipitation as well as the onset of the monsoonal rainfall on the Tibetan Plateau. For future studies, it is suggested to apply the REMO/ECHAM5 nesting system to understand the climate impacts of land cover changes on the Tibetan Plateau by providing more realistic local responses and transferring global scale information.