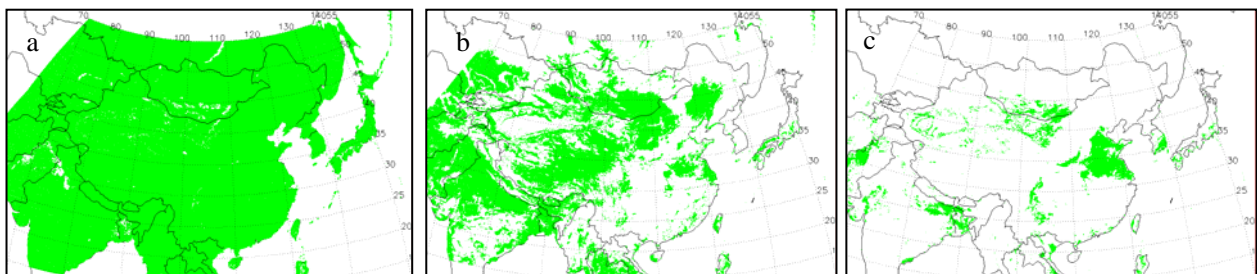


Monitoring the Effects of Human Activities and Climate on Land Surface using an Harmonic Analysis of Remotely Sensed NDVI data in China

Xingkui Xu, J. Kevin Levy, Hiromasa UEDA

Abstract:

Seasonal and climatic changes include variations in the duration of sunlight, precipitation, temperature and other life-controlling factors. Vegetation responds to these changes through periodic phenomena such as plant budding and floral blooms. However, human activities, such as settlement, agricultural practices, and pollution, can significantly impact vegetative cycles. To ensure accurate monitoring, Land Surface Models (LSM) must consider the impact of both human influences and phenology on vegetative canopies. The effect of these human and natural disturbance regimes on land cover is herein investigated with the use of remotely sensed Normalized Difference Vegetation Index (NDVI) data from the National Oceanographic and Atmospheric Administration's (NOAA) Advanced Very High Resolution Radiometer (AVHRR). In this paper, NDVI NOAA AVHRR data from 1982 to 2000 is used to capture the influence of both human activities and climate using the Discrete Fourier transform (DFT). Harmonic analysis of temporal NDVI in southern China shows that the first harmonic(fig a) is in-phase with atmospheric temperature, while the second and third harmonic capture human activity information(fig b,c). But in northern China and the Qingzang plateau, sandstorms and snow cover are confounding variables which make it difficult to correctly interpret the second and third harmonic components. In all, meteorological data from 760 observations are analyzed in order to ascertain the degree to which vegetation is affected by human activities and natural processes.



Precipitation and temperature distributions allow us to accurately estimate whether land surface changes are caused by human activities or climatic variables. The temperature distribution shows that in the region of the second and third harmonics the annual minimum, mean, and maximum temperatures are more than 2°C, 8°C and 14°C higher on average. The second and third harmonics are also found to be highly dependent on the precipitation distribution.

For example, there is a higher cropping index in the North-China plain and Yangtse River delta than in regions to their west; these western regions possess little vegetation due to a lack of precipitation and corresponding dry climate. Even if a region has higher temperatures, giving rise to a larger cropping index, the lack of precipitation will restrict vegetation growth. The monthly mean precipitation in a region should exceed 50mm in order to match the cropping index of warmer regions. The results are consistent with a large body of literature which has shown rainfall to be a critical variable determining ecological health. For example, depending on rainfall variability, rangeland ecosystems have been characterized as intrinsically stable, unstable, fragile and extensively degraded, or highly resilient.