BACKGROUND, OBJECTIVES AND APPROACHES:

For millennia, Chinese people have altered the landscape in many ways in pursuit of food, fuel and fiber. China's expanding economy, which is the fastest growing in the world along with continued population growth, will lead to continued land transformations in the next decades, including dramatic urbanization. While we have a qualitative sense that land transformations and other environmental changes across China have affected and will continue to affect the ability of China's ecosystems to provide people with essential goods and services, and to quantify the consequences of land transformations and other environmental changes on terrestrial ecosystems during 1981-2000.

Our approach is to combine remote-sensing data (MODIS, AVHRR, Landsat-TM/ETM) and a set of biogeochemical simulation models (TEM, Biome-BGC and DLEM) to quantify the consequences of land transformations and other environmental changes on productivity, carbon sequestration and water yield in forests and other “natural” ecosystems in China.

Impact of multiple environmental stresses on the carbon cycle:

Fig. 5 Net C exchange between the atmosphere and terrestrial ecosystems during 1981-2000.

For the period of 1981-2000, simulated results with DLEM indicate that China's land ecosystems acted as small carbon sink. Net carbon storage between the terrestrial ecosystems increased in China during 1961-2000 (Fig. 6). Land-use change in China during 1990-2000 led to carbon loss of 14.5 PgC from land ecosystems (Fig. 7).

Impact of multiple environmental stresses on the water cycle:

Fig. 8 Annual NPP as estimated by three models (MODIS-NPP, DLEM and TEM). Both MODIS-NPP and TEM underestimated NPP in cropland. In DLEM simulation, we have taken into account effect of irrigation and fertilization on crop productivity.

Fig. 9 Mean annual water yield during 1961-2000 (A) and water yield anomaly in the 1990s (B) and relative role of climate, land use, and CO2 on historical change in water yield (mm/yr).

According to DLEM results, the distribution of China's water yield shows substantially spatial variability with the highest water yield in southern China. Water yield for the entire nation increased slightly during 1961-2000. In 1990s, water yield depth is 128 mm (millimeter), which is 12% more than that in the 1960s. Southeast China shows an increase in water yield, while North and Central China show a decrease since the 1960s. Total water yield in China is about 20% of total precipitation. Climate variability especially precipitation is the primary factor that controls the magnitude, spatial and temporal patterns of water yield. Our analysis indicates that climate variability caused an increase trend in water yield (5 mm per decade), precipitation and temperature change different for each climate zone in China.