LETTER

Increasing contamination might have delayed spring phenology on the Tibetan Plateau

Using the National Aeronautics and Space Administration (NASA) Global Inventory, Monitoring, and Modeling Studies (GIMMS) Normalized Difference Vegetation Index (NDVI) dataset (1982–2006), Yu et al. (1) found that the trend of advancing spring phenology for alpine steppe and meadow was reversed around 2000, despite the increasing air temperature over the Tibetan Plateau. This phenomenon cannot be explained by changes in precipitation or snow melt. They speculated that the lack of fulfillment of a chilling requirement caused by warming winters could be the reason. This might have significant implications for the ecosystem and economy of the Tibetan Plateau. However, we offer an alternative hypothesis for the delay of spring phenology after 2000: the increasing contamination in spring over the Tibetan Plateau could be the reason.

It is well-known that aerosols reduce the NDVI value sensed by satellite sensors (2), which explains why the GIMMS dataset has been corrected for the effects of aerosols from two volcanic eruptions (El Chichon and Mt. Pinatubo). Unfortunately, the effects of aerosols on NDVI have been neglected for other periods (3).

Using the Total Ozone Mapping Spectrometer (TOMS) dataset (1978–1993 and 1996–2005), we found that aerosol index increased substantially after 2000 (Fig. 1) over the Tibetan Plateau (to exclude the margin of India and Taklimakan Desert, we confined our study area in latitude: 30°–35°N; longitude: 82°–102°E). The aerosol index was highest in May and June of each year. The May aerosol index increased from about 2.5 before 1993 to about 4 in 2000 and more than 11 in 2003. These values might have significant implications for calculating the onset of the growing season based on the NDVI threshold method (1). The onset of growing season for both alpine steppe and meadow usually take place in May and June, when high values of the aerosol index could cause smaller NDVI of the GIMMS dataset after 2000 on the Tibetan Plateau. In the GIMMS dataset, the values of NDVI of alpine steppe and meadow usually vary from ~0.2 to ~0.4 in 1 y (4). The seasonal variations of NDVI are small, and small changes of NDVI could cause relatively big changes in the date of onset of the growing season.

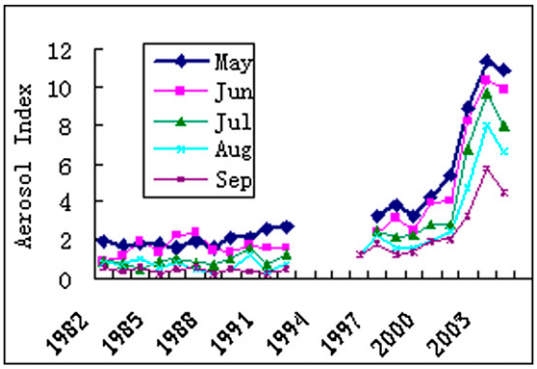

Fig. 1. The time series of aerosol indexes of each month in the growing season (May to September) over the period of 1992–2004 on the Tibetan Plateau (latitude: 30°–35°N; longitude: 82°–102°E).

GIMMS only provides an NDVI value without corresponding near-infrared and red-band reflectance data; thus, we cannot correct for the effects of aerosols to estimate these effects quantitatively. However, we believe that changes of contamination did play an important role in the retrieval of NDVI and should not be neglected in estimating long-term trends in the ecosystem.

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