



## **Phenological indicators derived with CO<sub>2</sub> flux, MODIS image and ground monitor at a temperate mixed forest and an alpine shrub**

Leiming Zhang (1), Peiyu Cao (1), Shenggong Li (1), Guirui Yu (1), Junhui Zhang (2), and Yingnian Li (3)

(1) Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, (2) Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, China, 110016, (3) Northwest Institute of Plateau Biology, Chinese Academy of Sciences, Xining, China, 810008

### **Abstract:**

To accurately assess the change of phenology and its relationship with ecosystem gross primary productivity (GPP) is one of the key issues in context of global change study. In this study, an alpine shrubland meadow in Haibei (HBS) of Qinghai-Tibetan plateau and a broad-leaved Korean pine forest in Changbai Mountain (CBM) of Northeastern China were selected. Based on the long-term GPP from eddy flux measurements and the Normalized Difference Vegetation Index (NDVI) from remote sensed vegetation index, phenological indicators including the start of growing season (SOS), the end of growing season (EOS), and the growing season length (GSL) since 2003 were derived via multiple methods, and then the influences of phenology variation on GPP were explored. Compared with ground phenology observations of dominant plant species, both GPP- and NDVI-derived SOS and EOS exhibited a similar interannual trend. GPP-derived SOS was quite close to NDVI-derived SOS, but GPP-derived EOS differed significantly from NDVI-derived EOS, and thus leading to a significant difference between GPP- and NDVI-derived GSL. Relative to SOS, EOS presented larger differences between the extraction methods, indicating large uncertainties to accurately define EOS. In general, among the methods used, the threshold methods produced more satisfactory assessment on phenology change. This study highlights that how to harmonize with the flux measurements, remote sensing and ground monitoring are a big challenge that needs further consideration in phenology study, especially the accurate extraction of EOS.

**Key words:** phenological variation, carbon flux, vegetation index, vegetation growth, interannual variability