Author:
Sangram Ganguly
Bay Area Environmental Research Institute
NASA Ames Research Center

NF1676B TN 29594

Contribution of Phenological and physiological Variations on Northern Vegetation Productivity Changes over last three decades

Plant phenology and maximum photosynthetic state determine spatiotemporal variability of gross primary productivity (GPP) of vegetation. Recent warming induced impacts accelerate shifts on phenology and physiological status over Northern vegetated land. Thus, understanding and quantifying these changes are very important. Here, we investigate 1) how vegetation phenology and physiological status (maximum photosynthesis) are evolved over last three decades and 2) how such components (phenology and physiological status) contribute on inter-annual variation of the GPP during last three decades. We utilized both long-term remotely sensed (GIMMS NDVI3g and MODIS) to extract larger scale phenology metrics (growing season start, end and duration) and productivity (i.e., growing season integrated vegetation index, GSIVI) for answering these questions. For evaluation purpose, we also introduced field measured phenology and productivity datasets (e.g., FLUXNET) and possible remotely sensed and modeled metrics at continental and regional scales. From this investigation, we found that onset of growing season has advanced by 1.61 days/decade and growing season end has delayed by 0.67 days/decade over circumpolar region. This asymmetric extension of growing season results in longer growing season trend (2.96 days/decade) and widespread increasing vegetation productivity trend (2.96 GSIVI/decade) over Northern land. However, regionally diverged phenology shift and maximum photosynthetic state contribute differently characterized productivity inter-annual variability and trend. We quantified that about 50%, 13% and 6.5% of Northern land's inter-annual variabilities are dominantly controlled by onset of growing season, end of growing season and maximum photosynthetic state, respectively. Productivity characterization over other approximately 30% region has been driven by these codominant drivers. Our study clearly shows that regionally different contribution of phenological and physiological components on characterizing vegetation production over last three decade.