Variabilities of Western Himalayan Forest Fire with Relation to Primary Productivity

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Forest fire is a regular anthropogenic and physical hazard over western Himalaya during hot and dry pre-monsoon season. The causality factors of forest fire have varied over time and space. The present study has focused on long-term fire variability and its relation with primary productivity over Himachal Pradesh and Uttarakhand, parts of western Himalaya. To characterize the fire occurrences, we have been used monthly burn area product of MODIS (MCD64A1 c6) in 500 meters and fire dataset of Climate Change Initiatives project of ESA (Fire CCI v5.1) with 250 meters spatial resolution. The temporal analysis of fire counts in respect of different forest types has revealed that western Himalaya faced some short cycle or phase (~5 years) of fire events. The spatial variability has been estimated in every 5 years phase which has been identified by temporal oscillation analysis from 2001 to 2018. The spatial intensity and coverage of fire incidences have a propensity of increasing and spreading over the southern mountainous slope. The linear regression functions and Sen’ s Slope accounted that fire events were increasing in 236 and 124 fire counts in every year. The Gross Primary Productivity (GPP) was evaluated over the study periods from (2001-2018). GPP was estimated using a recent developed remote sensing-based model Southampton Carbon Flux (SCARF) and Carnegie Ames Stanford Approach (CASA) model function. MODIS Terra derived GPP in 500 meters (MOD17A2H.006) was used to compare with the model produced GPPs. The MOD17A2H.006 GPP is underestimating in comparison to two models derived GPP. The pre-monsoonal GPP variabilities and trend has a significant connection with spatial clusters and temporal variation of fire. Along the southern slope of western Himalaya, the primary productivity has been degrading in a rate of 2-6 g C m2year1 and 1-50 g C m2year1 GPP (according to Sen’ s slope) in 90% significant-level ($p < 0.1$) of CASA and SCARF model, respectively. The spatial relation reflected that forest and grassland productivity has been degrading over the fire-prone area. We have also used ALOS World 3D - 30m (AW3D30) global digital surface model (DSM) to evaluate the forest fire scenario and its impacts upon primary productivity in respect of elevation. The elevation wise analysis suggested that the southern parts of the study area, range from 173 to ~4000 meters is mostly affected by fire occurrences which directly and indirectly functioning to deteriorate the primary productivity of the area.

Keywords: Forest Fire , Western Himalaya, Primary Productivity, SCARF Model, CASA

