Variations of vegetation net primary productivity and its responses to climate change from 1982 to 2015 in Mongolia

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Abstract: In last half century, intensity of global warming has been increasing due to climate change and mankind-caused carbon dioxide emission into the atmosphere. Climate warming in Mongolia is relatively high, with extreme dry climate, and low precipitation, the input of green vegetation on the ecosystem functioning is relatively high. The impacts of climate change are critically affected to desertification, biodiversity loses, decreases of water sources, land degradation of rangeland in Mongolia.

In order to better adapt to such changing climate, it is important to understand the long terms vegetation dynamics and its relation with precipitation.

In this study, the third-generation GIMMS NDVI data of NOAA satellites and CASA (Carnegie-Ames-Standford Approach) model with metrological data have been used to estimate net primary productivity (NPP) between 1982 and 2015 throughout Mongolia. Results show that during 34 years mean NPP seems to have decreased greatly from semi-arid in the North to desert in the South across natural zone in Mongolia. The average NPP value was averaged at 166.1 g C/m^2 and ranged between 19 and 643.1gC/m^2 for the terrain land. 60% of total NPP was relating to annual precipitation about R^2=0.78 (p=0.000). Total amount of NPP between 1982 and 2015 was estimated to be 0.32 P g C/year and 0.29 P g C/year in 1982 and 2015, respectively, with an average amount of NPP was 0.3 Pg ($1Pg=10^{15}g$) for 34 years. These results indicate that during most of vegetation growing season, NPP decreased by 0.03 P gC/year.

Field measurement data of 2007, 2009, 2014 and 2015 were used for correlation with the NPP estimation. As a result, R^2=0.742 (p<0.001) in 2007 for forest steppe, R^2=0.74 (p<0.001) in 2009 for meadow steppe and grassy steppe, R^2=0.73 (p<0.001) in 2014 for meadow steppe, R^2=0.715 (p<0.001) in 2015 for a desert steppe, respectively.

The results obtained in this study contributes to understanding productivity of pasturelands of semi-arid ecosystems of Mongolia and Central Asia. By providing insights on the relationship between pasture productivity and climate variables such as precipitation and temperature, this study could be useful for national and regional scale climate change adaptation strategies.

Keywords: Net primary productivity; aboveground biomass; spatial-temporal patterns; climatic constraint; Mongolia