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INVESTIGATION OF GRASSLANDS BIOMASS IN MONGOLIA WITH MODIS AND ICESat/GLAS MEASUREMENTS

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Abstract: In this study, the amount of grassland biomass is estimated by using NDVI and LAI from Terra/MODIS, in order to improve estimation accuracy of biomass, it was examined the possibility to the grass height measurements by ICESat/GLAS. As result, Biomass map was created from MODIS LAI because estimating equation of biomass using LAI was higher accuracy than the equation using NDVI. The seasonal change pattern of biomass was similar tendency in all survey sites. It is difficult to detect the information of grass height by ICESat/GLAS due to terrain was rough.

1. INTRODUCTION

Problem in Mongolian grasslands : The grassland degradation rapidly induced by overgrazing in a few decades, therefor biomass distribution information in grassland is essential to preserve from degradation grassland.

Previous study: Many study of biomass estimation by remote sensing were deal with forest areas, such as tropical rainforest[1)] and mainly focusing on correlation between biomass and NDVI which is index of spatial evaluation.

Objective: The estimating equation of biomass was calculated by using field survey data and vegetation index from Terra/MODIS. Moreover, in order to improve estimation accuracy of biomass, it was examined the possibility of the grass height measurements by ICESat/GLAS.

2. Methodology

- In order to calculated biomass estimating equation, the regression analysis was performed using amount of biomass from field survey, NDVI and LAI from MODIS.
- Elevation was compered to GLAS and SRTM data which is DTM (Digital Terrain Model) in poorly vegetated area, it was investigated that possibility of grass height detection by GLAS.

Field survey

Field survey was conducted around the city of Ulan Bator in Central Mongolia (Fig.1). In order to measure the above-ground biomass, the 50 m quadrat was established, and three arbitrarily sub-quadrat (1 m^2) were selected within each 50 m quadrat for each site.

Because the growth of plants depends heavily on precipitation in Mongolia[2)], all of field survey site can be classified into three areas according to annual precipitation (Table 1).

Table 1. Classification of survey site by precipitation

Area	Precipitation(mm)[3)]	Survey site
North	250-300	10sites Q, R, S, T,U, 1, 2, 3, 4, 6
Central	200-250	15sites E,F,L,M,N,O,P,V,Y, Z,10,13,16,17,19
South	150-200	3sites G, H, W

Satellite data

- MODIS Vegetation Indices (MOD13, 16-day composite), Aug. 2003- 2012
- MODIS Leaf Area Index (MOD15, 8-day composite), Aug. 2003- 2012
- ICESat/GLAS, 2003- 2009

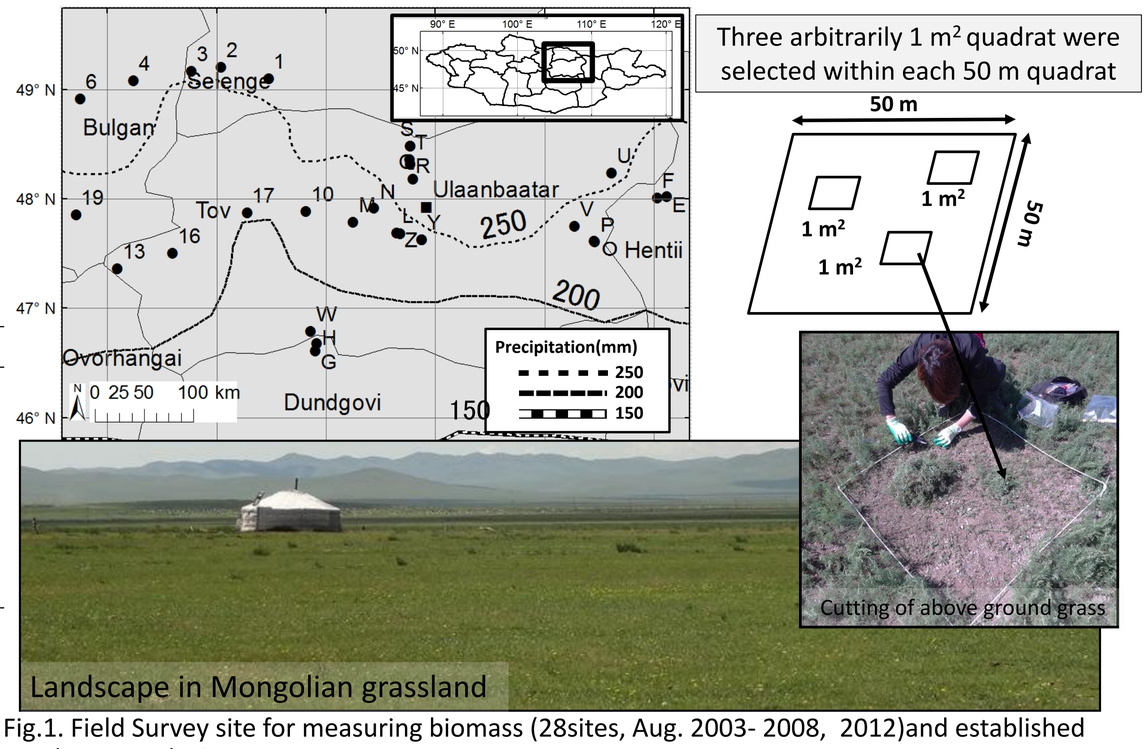

Fig.1. Field Survey site for measuring biomass (28sites, Aug. 2003- 2008, 2012)and established quadrat at each site

3. Results and discussions

Biomass estimating equation by Robust estimation

Fig. 2 shows that result of robust estimation using amount of biomass and NDVI and LAI respectively. The Weight of outliers with sampling data is able to minimized by using robust estimation.

The correlation coefficient between LAI and biomass was higher than between NDVI and biomass, RMSE was almost same. Regarding with relationship between NDVI and LAI, NDVI increases with exponentially increasing LAI (Fig.3). Therefore, it was expected that NDVI value was saturated in rich vegetation area, biomass estimating equation from LAI was used.

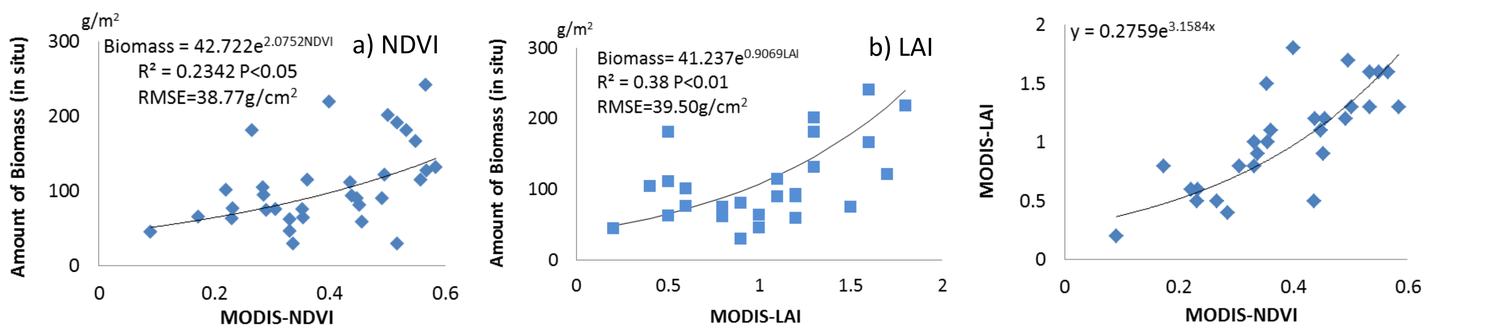

Fig.2. Relationship between vegetation index from MODIS and amount of biomass. a) NDVI b) LAI

Fig.3. Relationship between NDVI and LAI from MODIS

Grass height measurements using ICESat/GLAS

It was attempted that detection of flat area as possible. GLAS data was investigated in grassland area(Fig. 4), however it was difficult to detect the information of grass height by GLAS due to terrain was rough (Fig. 5).

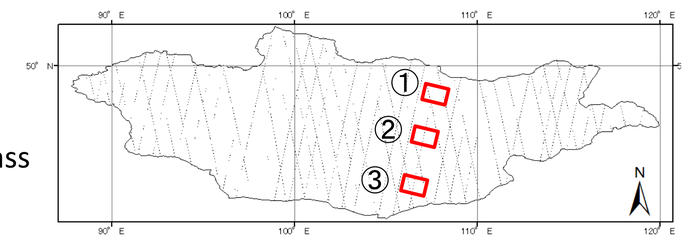

Fig.4. Orbit of ICESat/GLAS in 2009
Red flame is elevation detection area

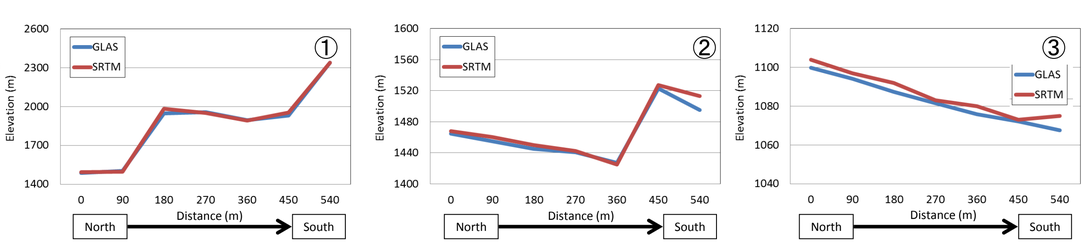

Fig.5. Elevation from ICESat/GLAS and SRTM inside red flame in Fig.7

4. Biomass distribution map in Mongolian grassland

Biomass distribution map was created from Terra/MODIS LAI image (Fig. 6). In order to extract the grassland, the map was masked by threshold value of NDVI (forest area NDVI≧0.75, bare soil area NDVI≦0.15). The threshold value is established by visual detection. Similarly, LAI error value is checked and the pixel of more than 7.0 were excluded.

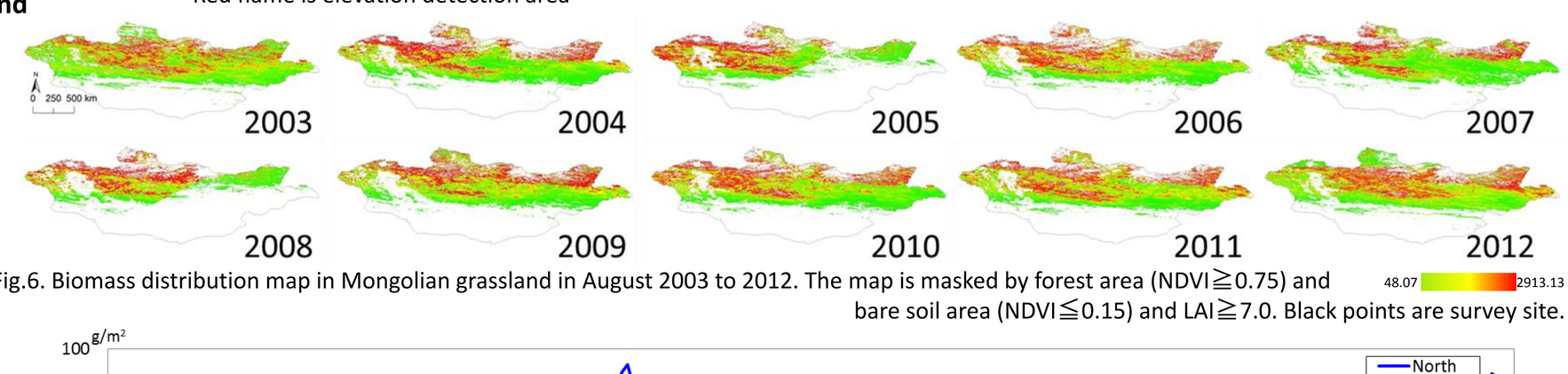

Fig.6. Biomass distribution map in Mongolian grassland in August 2003 to 2012. The map is masked by forest area (NDVI≧0.75) and bare soil area (NDVI≦0.15) and LAI≧7.0. Black points are survey site.

Seasonal biomass change at ground survey site

Fig.7 shown that amount of biomass reached a peak on July to August, and rapidly decreased on September. In the all areas, this pattern was similar every year.

Further studies we will analysis the relationship between Precipitation and Biomass, change of biomass will be discussed.

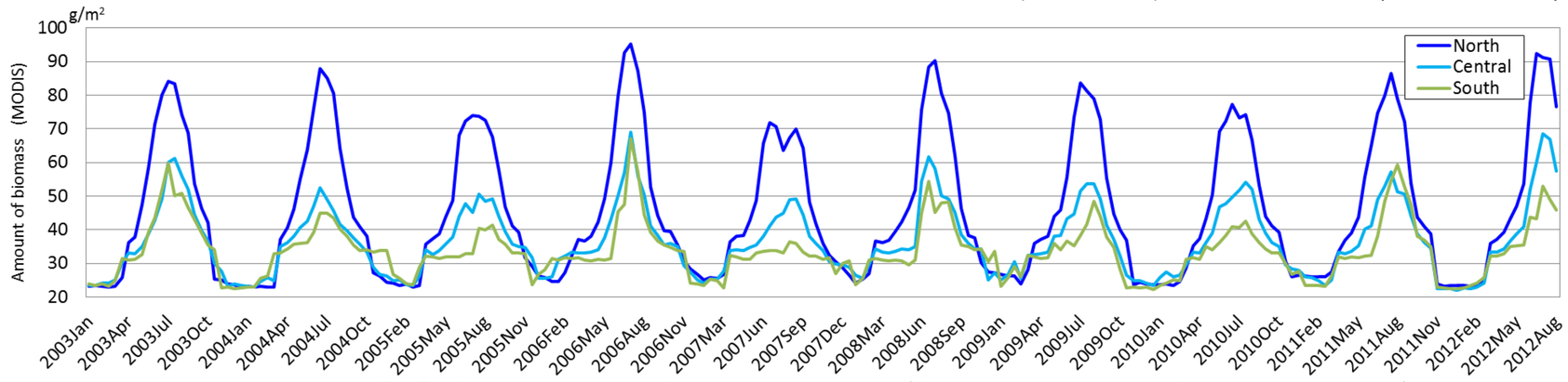

Fig.7. Seasonal changes of biomass in each area (Biomass value is mean of all sites in each area)

5. Conclusion

In this study, the amount of grassland biomass was estimated by using NDVI and LAI from Terra/MODIS, in order to improve estimation accuracy of biomass, it was examined the possibility to the grass height measurements by ICESat/GLAS. Conclusions were as follows:

- The accuracy of biomass estimating equation using LAI was higher than that using NDVI.
- Amount of biomass reached a peak on July or August, and rapidly decreased on September in Mongolian grasslands.
- It is difficult to detect the information of grass height by ICESat/GLAS due to terrain was rough in Mongolian grassland.

Future works

In this study, NDVI is used for extracting grassland, however it is suspected that farm land is misclassified as grassland. Further studies we will create the land cover map of high accuracy. Moreover amount of biomass is calculated over Mongolian grassland , change of biomass will be discussed.

References
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