

Monitoring and Evaluating CO₂ Flux in the Grassland Areas of Mongolia

*Qinxue Wang¹, Tomohiro Okadera¹, Deni Eer¹, Masataka Watanabe², Tomohiro Shishime², Akihiro Oba², Ochirbat Batkhishig³

1. National Institute for Environmental Studies, 2. Research and Development Initiative, Chuo University, 3. Institute of Geography and Geoecology, Mongolian Academy of Sciences

For verification of data products of the Greenhouse Gas Observing Satellite (GOSAT), in this study, we monitored and evaluated CO₂ flux, that is, the absorption and emission of CO₂ by ecosystems in the grasslands of Mongolia by the eddy correlation method. Two flux towers were established in 2015 at the Nalaikh site near Ulaanbaatar City and the Hustai site with less influence of cities, respectively. The CO₂ analyzers installed on the towers were calibrated every year by using the standard gas imported from Japan. Up to now, about 4-year monitoring data have been accumulated since 2015. The data analysis shows that the CO₂ absorption was larger than emissions at both sites, which indicated that the ecosystem at both sites are carbon sinks. The annual mean value of the CO₂ absorption at the Nalaikh site was about $2.66 \mu\text{mol m}^{-2} \text{s}^{-1}$ and the emission was about $1.53 \mu\text{mol m}^{-2} \text{s}^{-1}$, but the absorption at the Hustai site was about $2.11 \mu\text{mol m}^{-2} \text{s}^{-1}$, and the emission was about $1.37 \mu\text{mol m}^{-2} \text{s}^{-1}$ (Figure 1). Generally, the net CO₂ absorption at the Nalaikh site ($0.76 \mu\text{mol m}^{-2} \text{s}^{-1}$) was found to be larger than that at the Hustai site ($0.36 \mu\text{mol m}^{-2} \text{s}^{-1}$).

To compare the GOSAT L4B data with the ground observation at both sites, we extracted the monthly mean value of CO₂ absorption/emission from the grid data of GOSAT during 2009-2015 and compared with the observed data. We found that although the seasonal changing pattern and fluctuation range are similar, the CO₂ emission derived by GOSAT were larger than absorption, which suggested that the steppe ecosystems at both sites are the carbon sources. However, the ground observations showed that the CO₂ absorption at both sites was larger than emission, which suggested that the grassland ecosystems at both sites are carbon sinks (Figure 2). It is essential for us to find the reasons of this difference in the future.

Finally, to evaluate the spatiotemporal distribution of carbon absorption and emission in the whole country, we have developed a carbon budget model considering the influence of grazing density. The primary simulation results showed that the percentage of carbon loss by grazing (CLG) accounted for 19-38% of the net ecosystem production (NEP) in the Nalaikh area around the city of Ulaanbaatar, where the grazing density was 1.5-2.3 sheep/ha during 2012-2016. On the other hand, CLG accounted for only 7-20% of NEP in the Hustai area away from the city, where the grazing density was only 0.4-0.6 sheep/ha (Figure 3). The result implied that the carbon budget was greatly influenced by animal husbandry near cities, where the grazing density is large. The monitoring cameras installed at both sites show that the biomass inside and outside the fence was greatly influenced by the ingestion of livestock.

This study was funded by “the Project to implement MRV and related technological improvements contributing to the Joint Crediting Mechanism (JCM) in Mongolia”, Ministry of the Environment, Japan.

Keywords: Carbon flux, Grassland ecosystem, The Greenhouse Gases Observing Satellite (GOSAT)

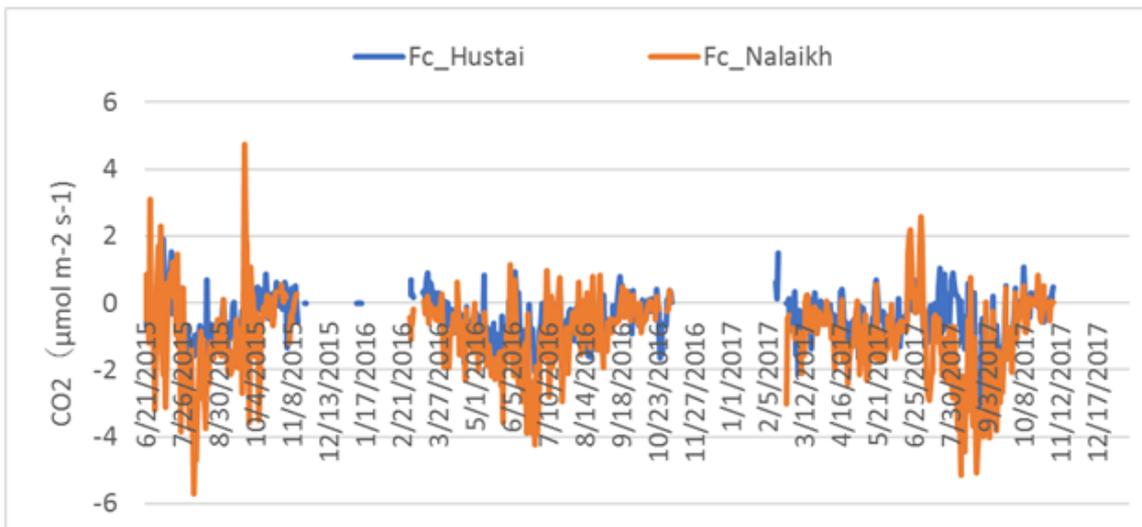


Figure 1 Comparison of CO₂ flux observed at Nalaikh Site and Hustai Site

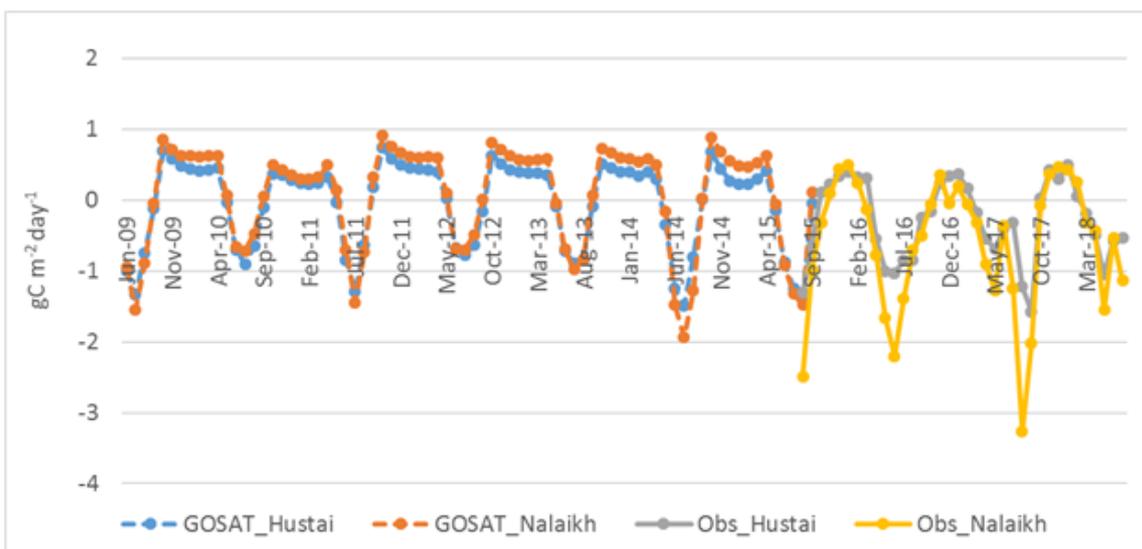


Figure 2 Comparison of GOSAT L4B and observations at Nalaikh Site and Hustai Site

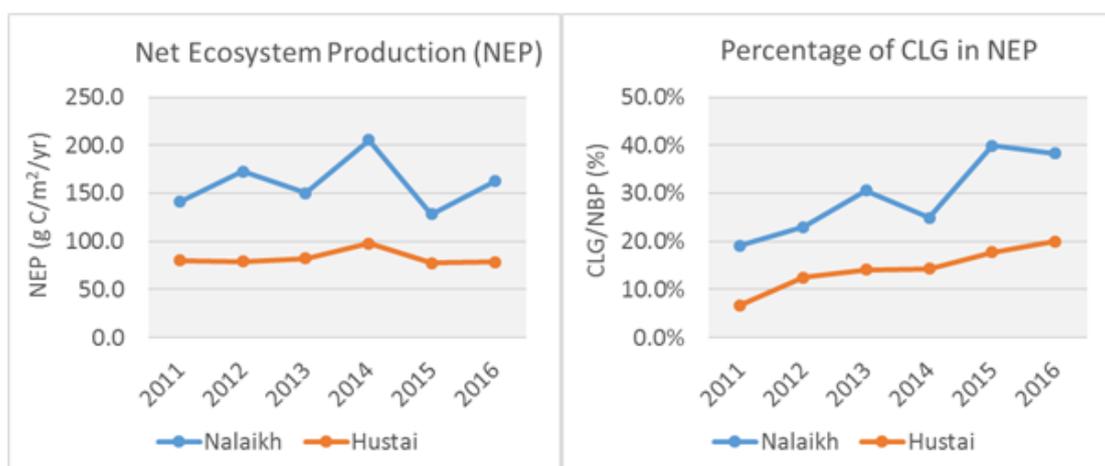


Figure 3 Impact of livestock grazing on NEP at Nalaikh Site and Hustai Site