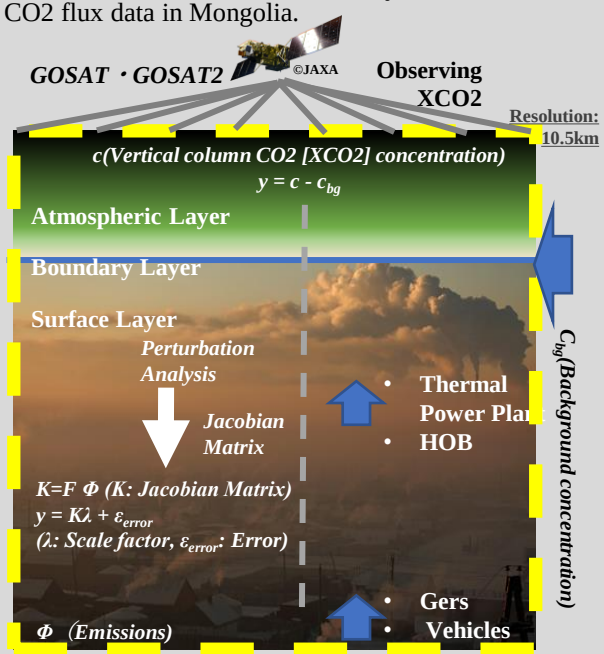
Estimation of GHG emission/absorption using GOSAT satellite data in Mongolia

Masataka Watanabe*[1] , Akihiro Oba [1] , Zamba Batjargal [2] and Gomboluudev Purevjav [3]

[1]Chuo University (Japan), [2] Ministry of Environment and Tourism (Mongolia), [3] Information and Research Institute for Meteorology, Hydrology and Environment (Mongolia)

Objective: For making Biennial Update Report (BUR) and Biennial Transparency Report (BTR) more transparent but with limited resources, vital needs exist to compare and verify their national GHG emission inventory data in BUR, BTR, and the Global Stocktake using the satellite data observed by GOSAT and GOSAT-2. We jointly developed an inverse modeling system that employs the inverse analysis based on the Green function using GOSAT-series satellite observation and the WRF-Chem-based simulation results or WRF- Vegetation Photosynthesis Respiration Model (VPRM) and estimated a posterior CO2 emission in Mongolia.

Method: First, this study created a Jacobi matrix through a perturbation analysis to optimize the difference in XCO2 concentration between the observed by GOSAT and the forward model (WRF-Chem). Next, we conducted the inverse analysis using the Jacobi matrix to estimate CO2 emissions. Finally, we compared CO2 emissions/sink between the national GHG inventory from BUR / observed CO2 flux data in Mongolia.



Results: As a result of emissions, a posterior annual total **CO2 emissions** of the energy sector in 2018 was approximately **1 to 5 % higher** than the Mongolian national GHG emissions inventory (BUR2018, pre-announcement). We compared the amount of CO2 absorbed in forests and the model result in 2018 showed a relatively **bigger absorption** than the Mongolian national GHG emission inventory 2018. Since there is no significant difference between the flux observation result and the model result, it is in the process of further refinement.

Emissions

Table1 Optimization results on CO2 emissions

Date and time (UTC)	A) Standard error of emission 200ton/h, XCO2 observation error 2ppmv				B) Standard error of emission 400ton/h, XCO2 observation error 2ppmv				C) Standard error of emission 800ton/h, XCO2 observation error 2ppmv			
	GOSAT XCO2 (ppmv)	Forward Model XCO2 (ppmv)	a priori emission (ton/h)	a posteriori emission (ton/h)	GOSAT XCO2 (ppmv)	Forward Model XCO2 (ppmv)	a priori emission (ton/h)	a posteriori emission (ton/h)	GOSAT XCO2 (ppmv)	Forward Model XCO2 (ppmv)	a priori emission (ton/h)	a posteriori emission (ton/h)
2018/2/15 6:00	409.6	411.6	2293.0	2279.5	409.6	411.6	2293.0	2239.4	409.6	411.6	2293.0	2083.7
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
2018/12/31 6:00	415.3	414.3	1165.0	1167.2	415.3	414.3	1165.0	1173.8	415.3	414.3	1165.0	1199.3
Average			1927.6	1932.9			1927.6	1948.6			1927.6	2009.8
Correction ratio (a posteriori / a priori *100-100)			0.274%				1.091%				4.265%	

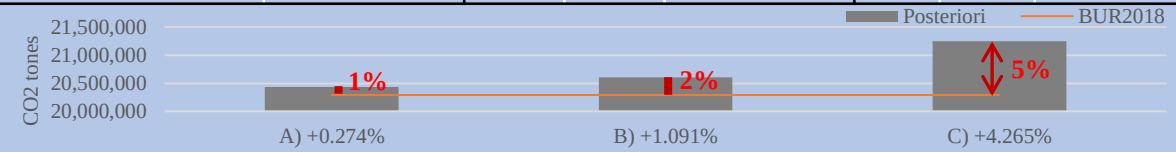


Figure1 Optimization results and BUR2018 on CO2 emissions

Absorptions

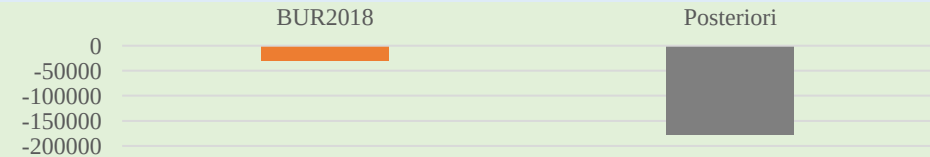


Figure2 Model results and BUR2018 on CO2 absorptions

Conclusion: The approach with this co-development is ideal for building BUR and BTR when Mongolia utilizes it in the Quality Check (QC), Verification part, or a chapter. Furthermore, by jointly preparing GHG emissions using satellite observation with the above methodology for countries without sufficient inventory data, highly transparent emission reports can be realized in the BUR and BTR.

This research has been supported by the Ministry of Environment, Japan.