Estimation of GHG emission/absorption using satellite data in Mongolia

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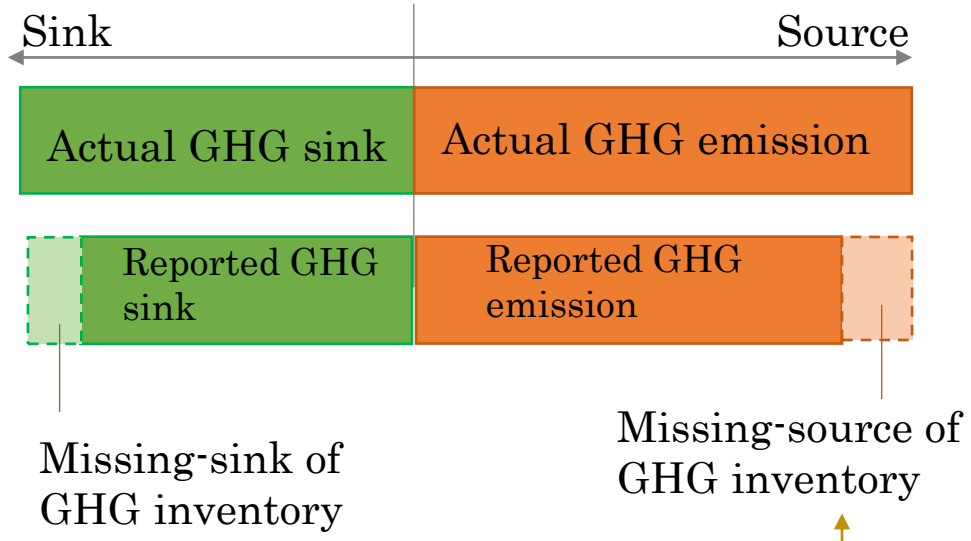
Focus Points on Needs for Satellite Monitoring

1.Missing-source and missing-sink

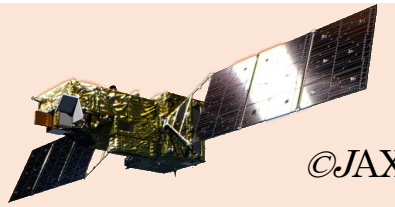
There has the difference between actual GHG emission/sink and reported emission/sink due to the data quality of national statistics and limitation of the emission factor of the IPCC guideline

2. Difficulties on biennial reports of the GHG inventory

Biennial national publication is hard for many countries, non-Annex I parties in particular, due to (1) human resource limitation, (2) internally long process for completing reports, (3) shortage of budget, etc.…



Supporting accurate GHG inventory



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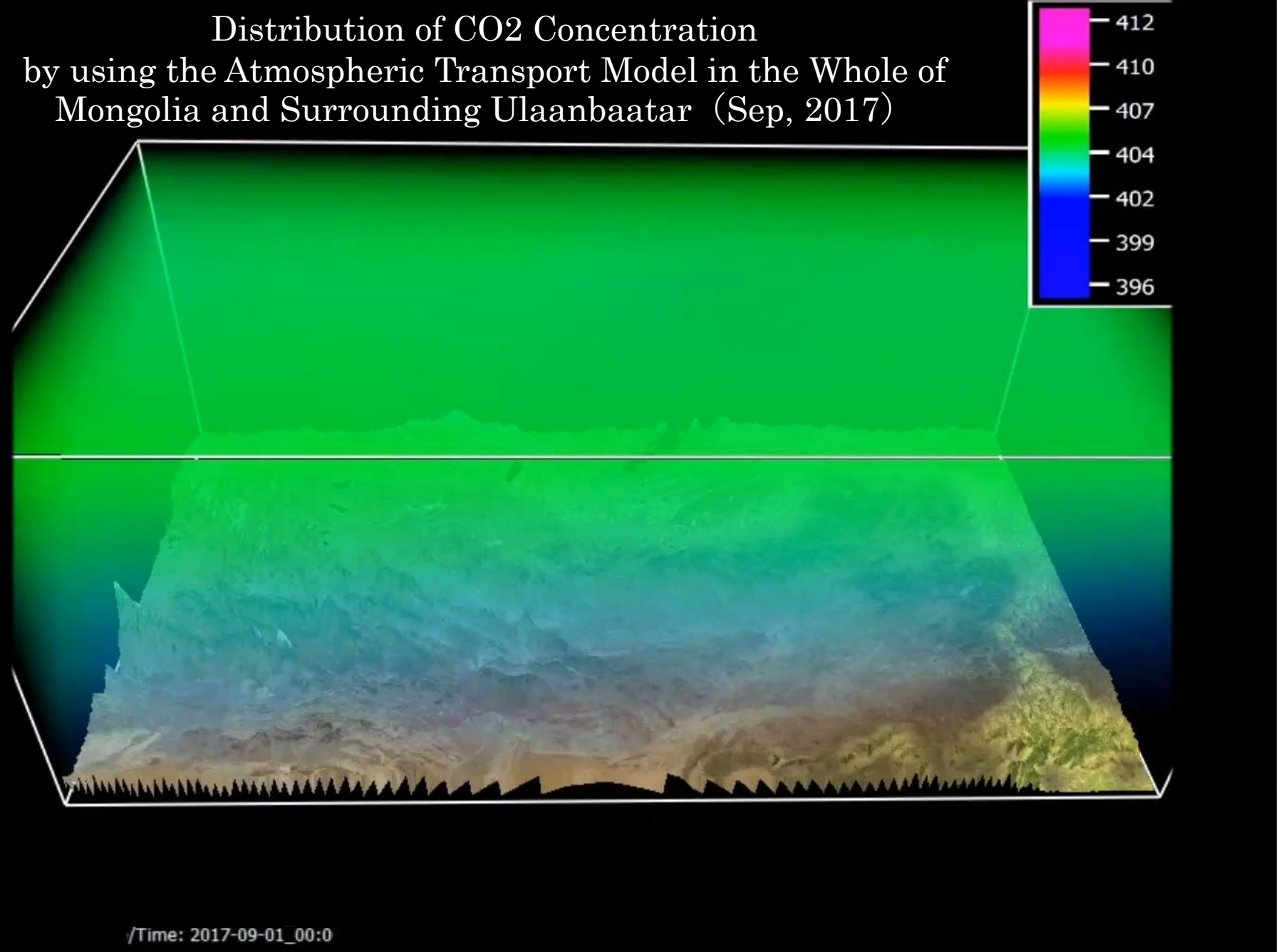
GOSAT based estimation of GHG emission/absorption

Needs for supporting GHG national inventory by GOSAT based estimation of GHG emission/absorption

Distribution of CO2 Concentration by using the Atmospheric Transport Model in the Whole of Mongolia and Surrounding Ulaanbaatar（Sep, 2017）



Unit: ppm
(Absolute)

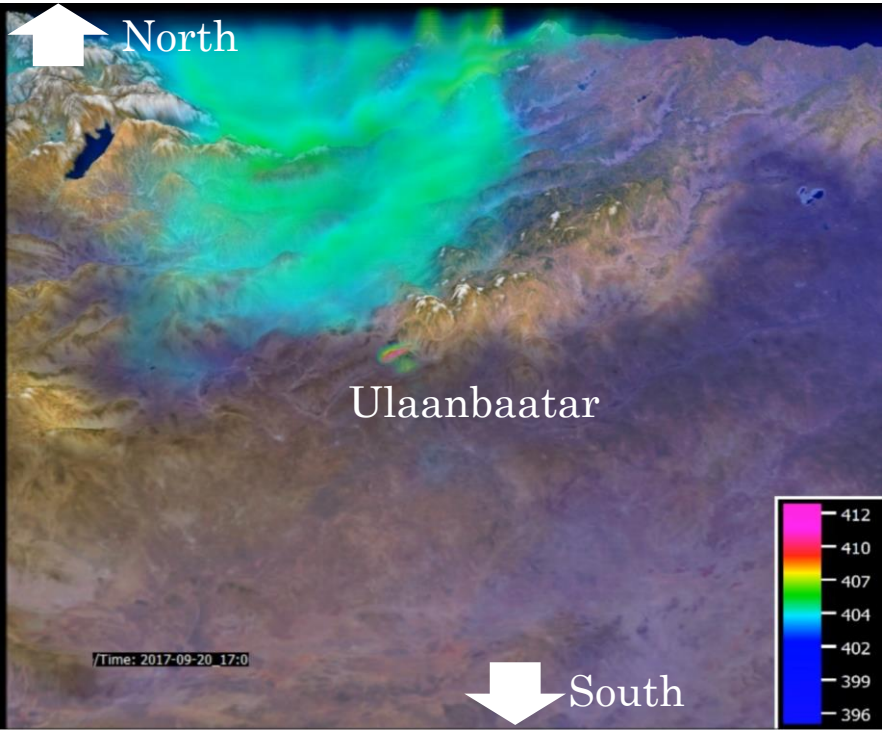
Source：Chuo University. Information And Research Institute Of Meteorology, Hydrology And Environment, Mongolia. Ministry of Environment, Japan.

Challenges for Satellite Monitoring on GHG in Mongolia

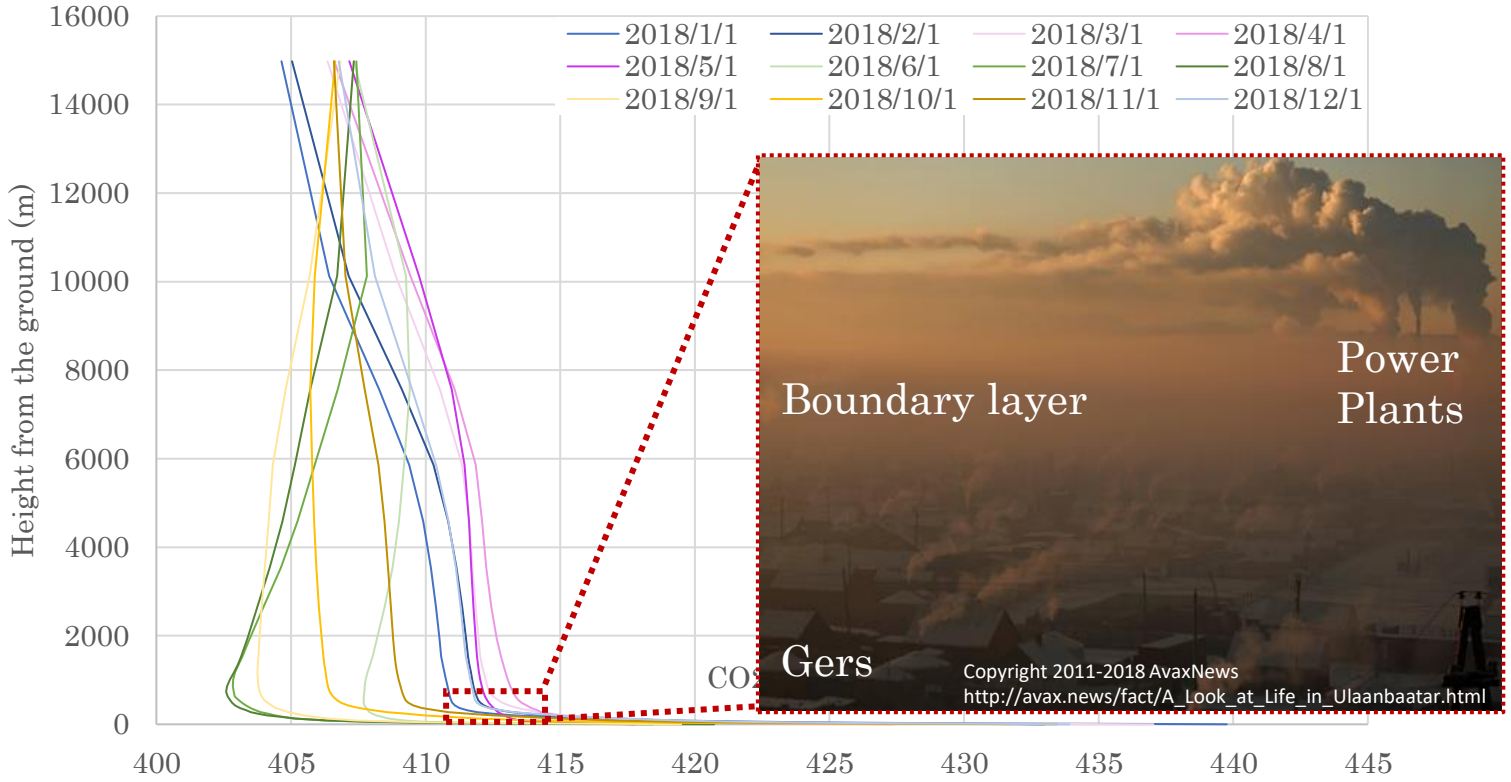
Challenge (1): Highly concentrated GHG flows to Mongolia and Ulaanbaatar city across the national border.
GHG observation becomes hard when the satellite retrieves CO2 emission.

Challenge (2): GHG emission comes from the ground, which was under the inversion layer in winter.
The vertical profile of satellite-based GHG observation is necessary to retrieve.

Challenge: (3) Serious air pollution in Ulaanbaatar city disturbs satellite observation of GHG concentration due to the highly concentrated particle matters such as PM2.5.



Simulation result of CO2 concentration by transport model in central Mongolia

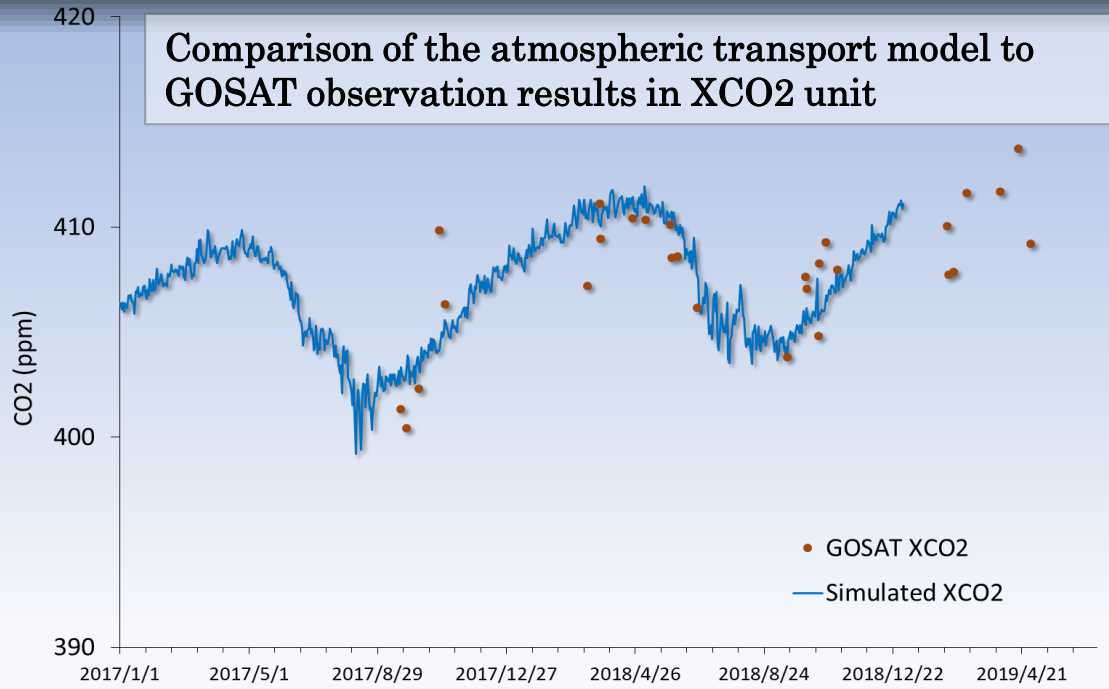


Monthly averaged vertical CO2 concentration simulated by the atmospheric transport model

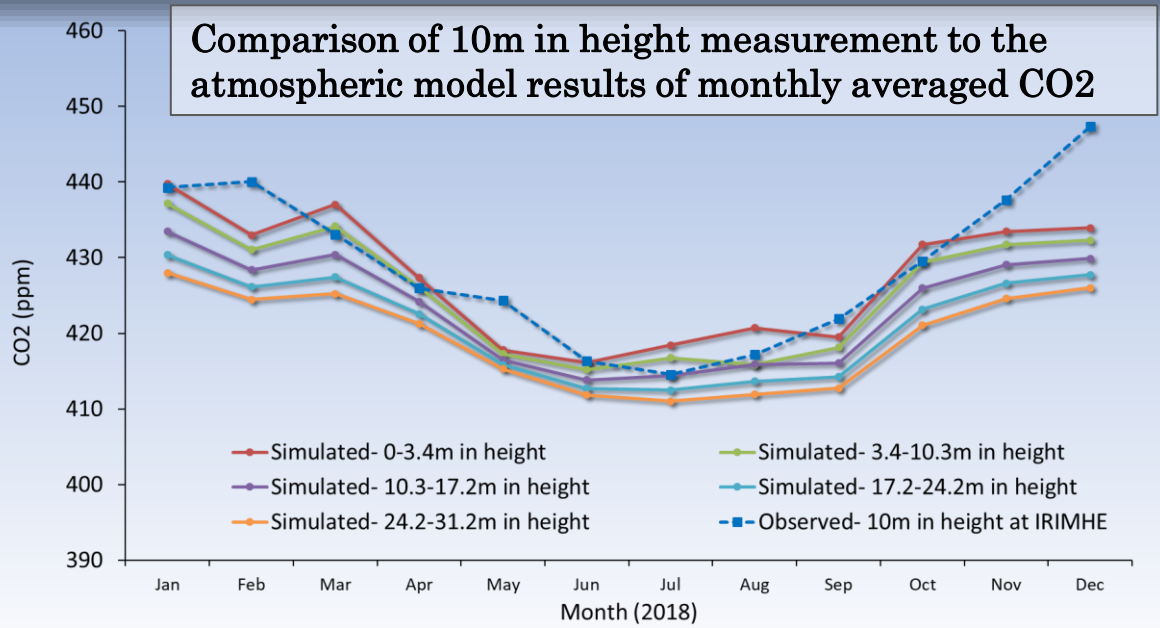
The condition of the air pollution in Ulaanbaatar city

Approach to Three Challenges

Comparison of the atmospheric transport model to GOSAT observation results in XCO2 unit



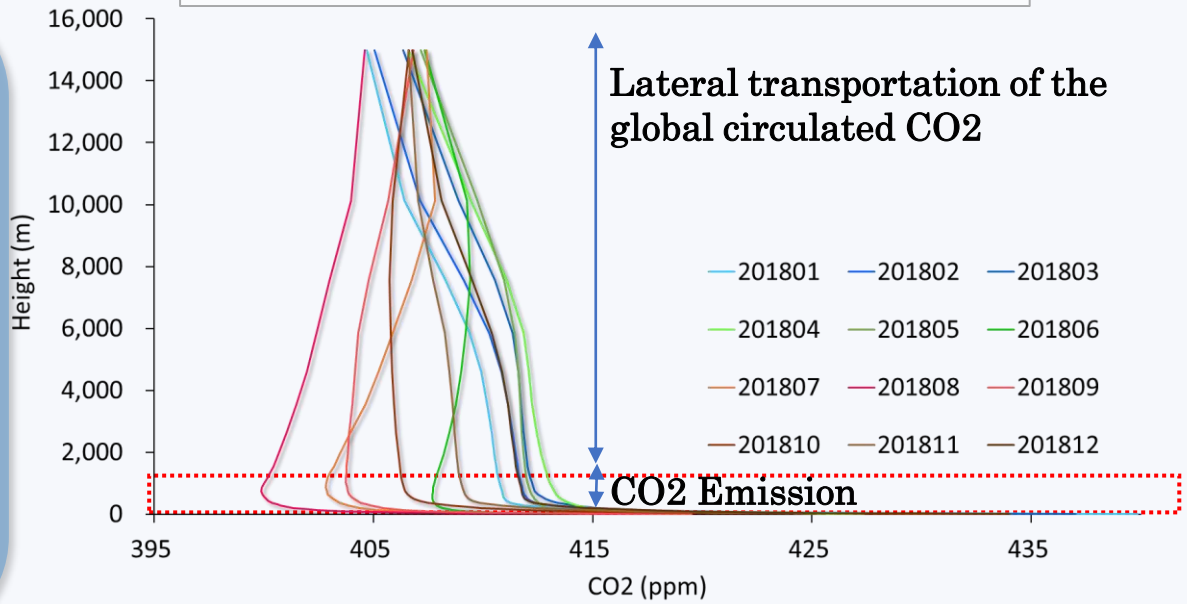
Comparison of 10m in height measurement to the atmospheric model results of monthly averaged CO2



Solutions to three challenges

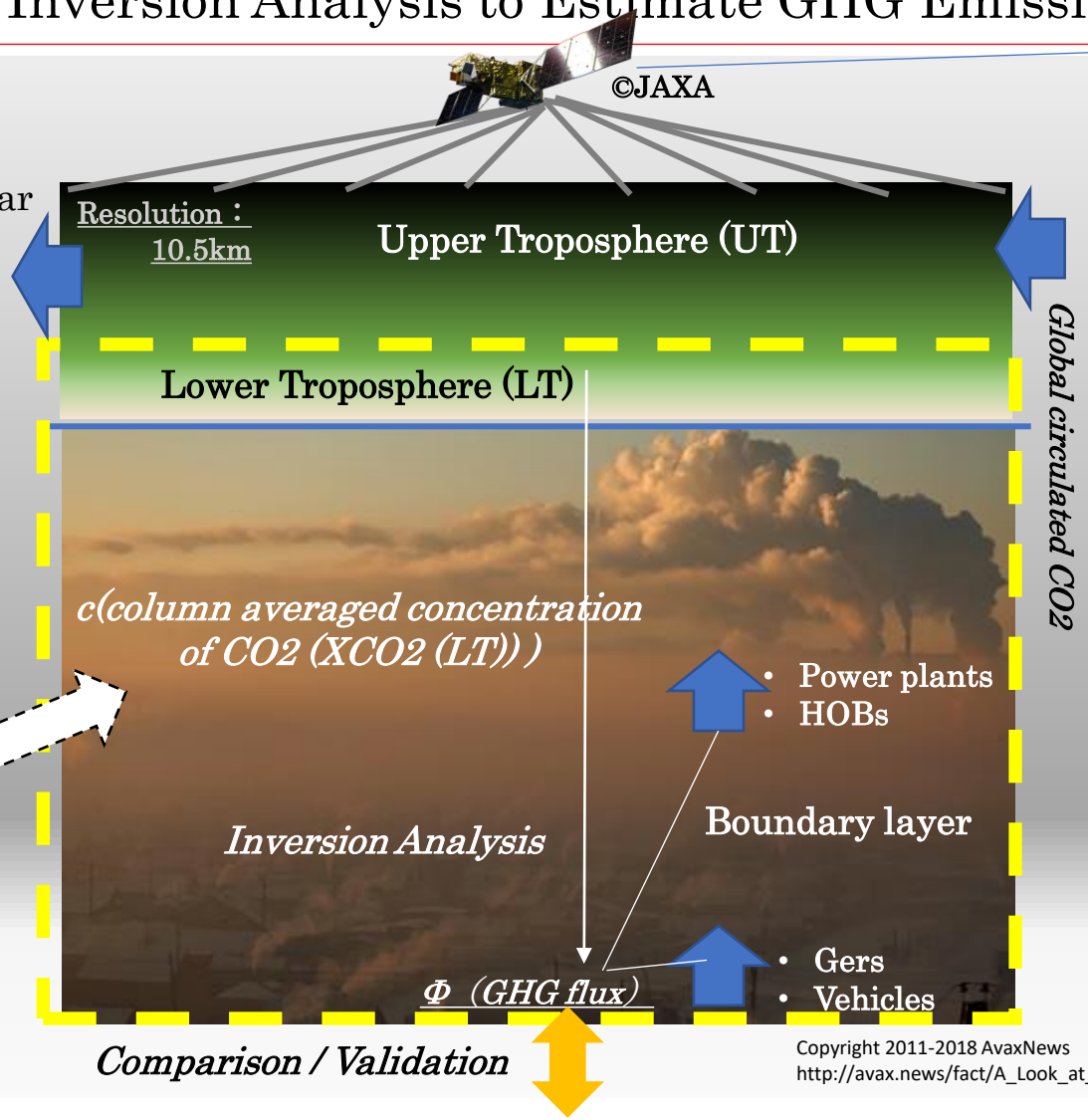
- The atmospheric model was in good agreement with GOSAT observation in XCO2 unit.
- The model was in good agreement with in-situ measurement in the monthly averaged CO2 of 10m height.
- The model can simulate globally-lateral CO2 flows in the upper layer as well as CO2 emission from the ground.
- Current Mongolian policies of forcing briquette use for heating improved air pollution and satellite observations UB city

Monthly averaged vertical CO2- simulated



Inversion Analysis to Estimate GHG Emission/Absorption

Approach:
Inversion analysis for estimation of accurate XCO2 and GHG flux from Ulaanbaatar including power plants, HOBs, Gers, and Vehicles by minimizing the difference of XCO2 between model and GOSAT observation in Ulaanbaatar city



XCO2 (LT), provided by "GOSAT/GOSAT-2 EORC Daily Partial Column GHGs (JAXA/EORC)", was used for our inversion analysis

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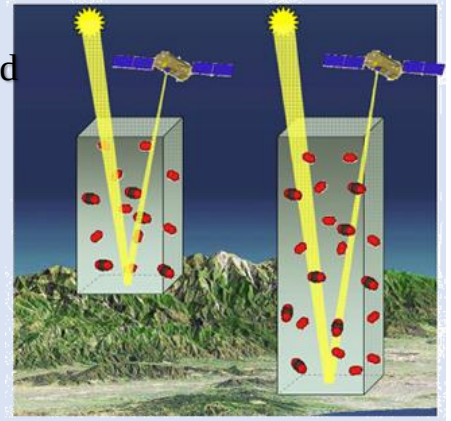
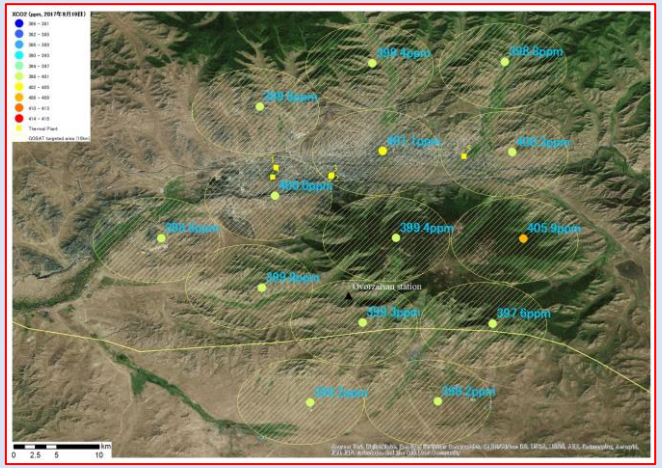
http://avax.news/fact/A_Look_at_Life_in_Ulaanbaatar.html

GOSAT: A satellite that observes column averaged GHG concentration (Resolution: 10.5km)



http://www.meted.ucar.edu/EUMETSAT/atmos_comp/media/graphics/crisp_whatisXCO2.jpg



Targeted Observation of XCO2 in Ulaanbaatar city by GOSAT（19 Sep. 2018）

- We co-developed the model to estimate posterior emissions volumes of a GHG emissions inventory by inverse analysis based on the Green Function using GOSAT-series satellite observation results
- Compared with the Mongolian National GHG emissions inventory (estimated by GDP growth rate), we need to continue efforts for LULUCF even more than for anthropogenic emissions.

Approach for estimating National GHG Inventory in Mongolia and Global Stocktake

- We co-developed the CU model of a GHG emissions inventory using GOSAT series data and need to continue efforts for LULUCF even more than for anthropogenic emissions.

- The next Mongolia's emission inventory report would utilize and include this co-developed emission estimation results using the CU model as reference information.

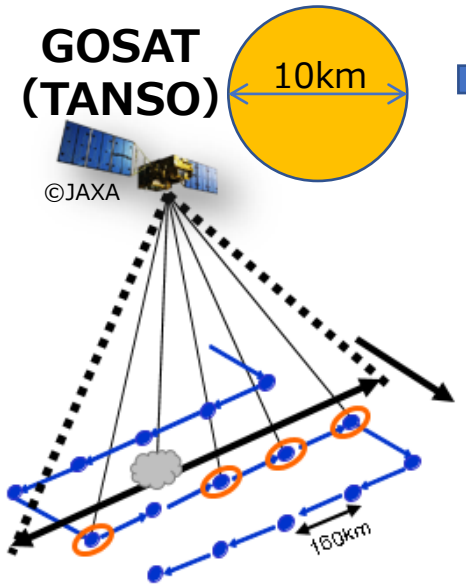
- We hope to promote the outcome of this project for the Global Stocktake in Mongolia and other countries under the cooperation of the UNFCCC.

- After FY2023, those targeted countries can also join with using the data of GOSAT-GW.

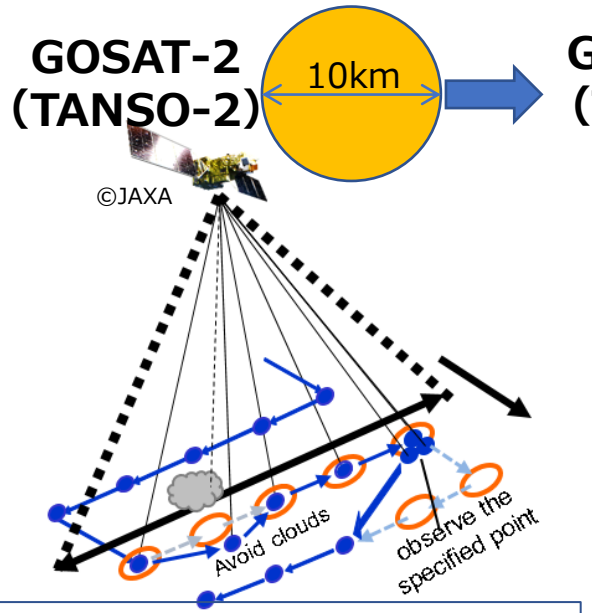
Overview of the GOSAT-GW (TANSO-3)

GHG sensor	TANSO-FTS	TANSO-FTS-2	**TANSO-3**
satellite	GOSAT	GOSAT-2	**GOSAT-GW**
method	FTS	FTS	**grating**
Observation gas	CO2, CH4	CO2, CH4, CO	**CO2, CH4, NO2**
Others		Function to automatically avoid clouds and observe	**Wide mode, Focus mode*1**

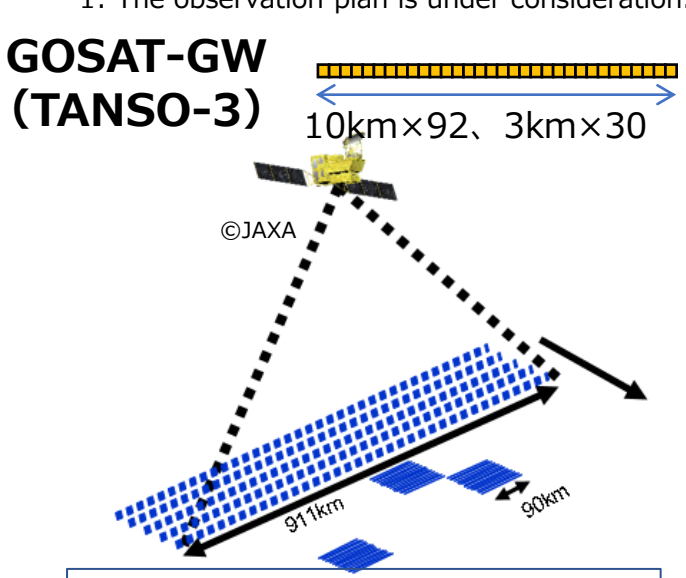
*1: The observation plan is under consideration.



Observing one element with a FOV Φ10km intervals grid width 160 km. If there are clouds in the FOV ,the GHG concentrations cannot be calculated.

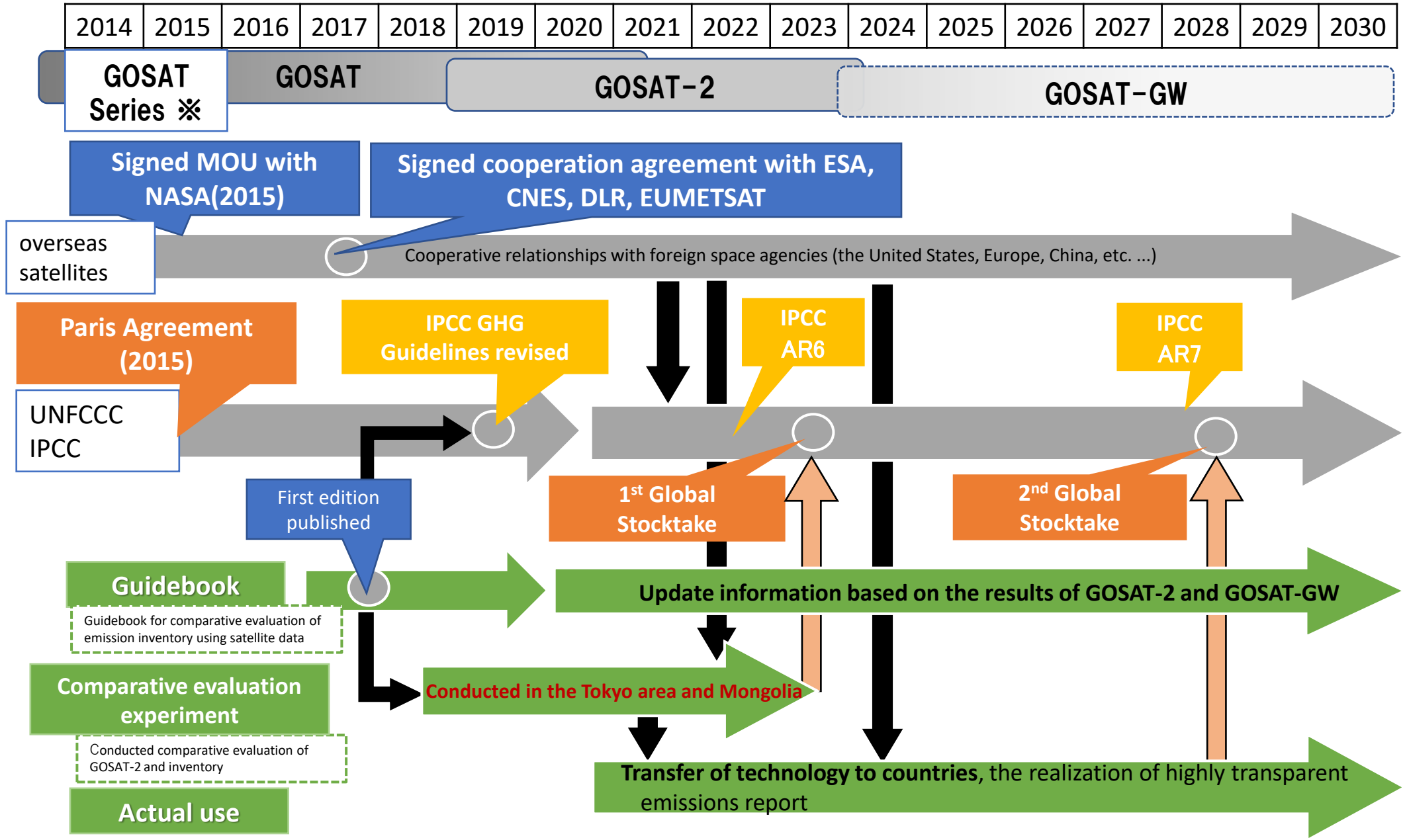


It is possible to observe the specified point with one element with FOV Φ10km.The sensor can detect clouds by itself and automatically avoid them.



It is possible to observe the entire globe with a spatial resolution of 10 km in the wide mode, or the specified range (90 km width) with a spatial resolution of 3 km in the focus mode.

Activities for the progress confirmation of climate change measures



Key messages

1. For the preparation of the UNFCCC BUR

- Develop a standardized methodology on estimating national GHG emissions using satellite data in Mongolia to achieve transparent reporting of emissions
- Contribute to the realization of highly transparent emissions reporting in allowing countries with inadequate inventory data by co-developing/arranging the methodology with the target countries.
- By jointly preparing emissions by satellite observation using the above methodology for countries with insufficient inventory data, participating countries will be able to conduct the demonstration project jointly with the Ministry of the Environment, Japan.
- Those countries can also request the targeting observation of GOSAT and GOSAT-2 (and GOSAT-GW since FY2023) for the focused areas and cities.

2. For Global Stocktake

- This satellite-based methodology enables objective verification of the BURs including missing source and missing sink.

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