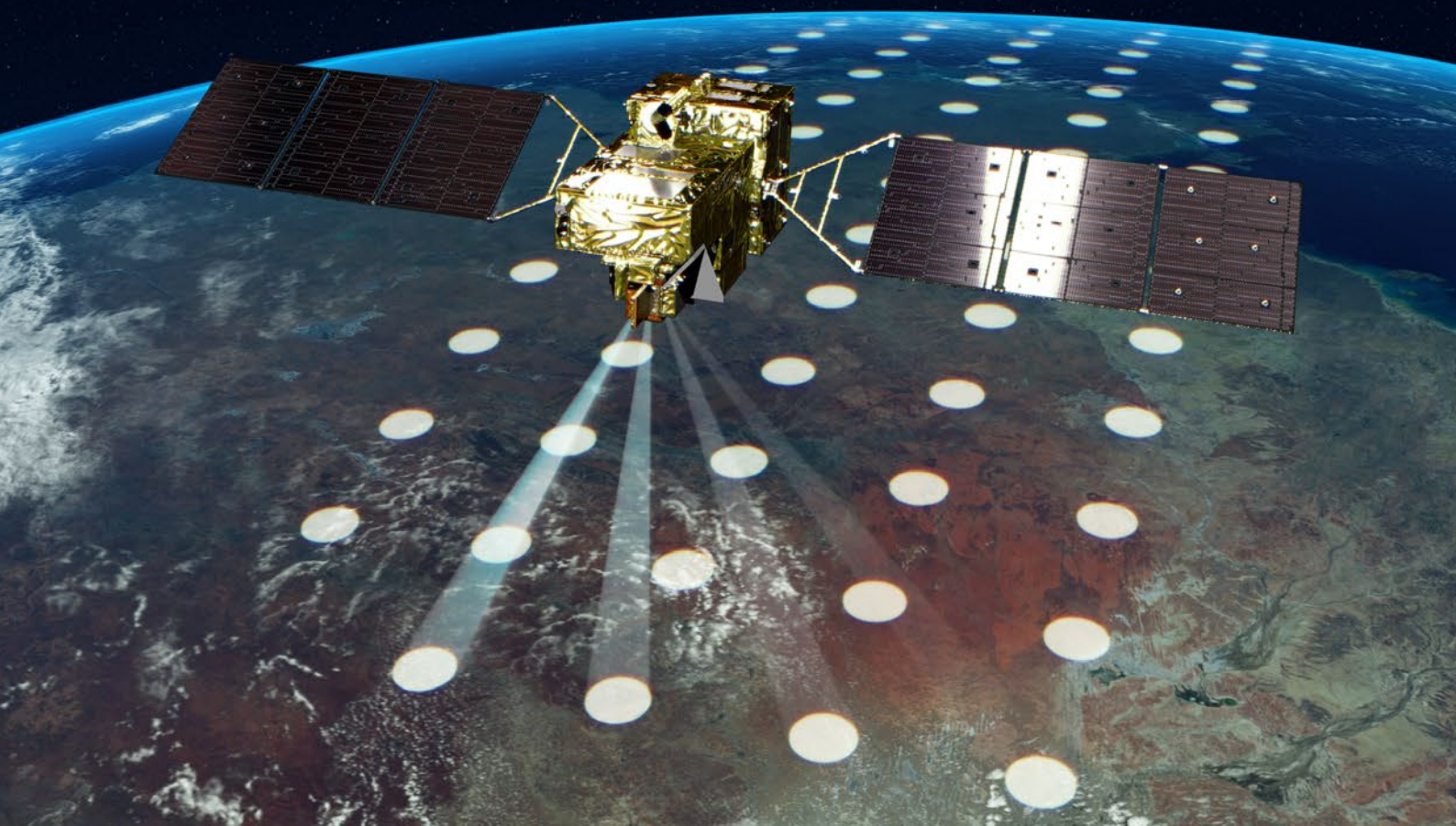
Observing Climate Change from Space and Earth

the challenges of the GOSAT series

The Greenhouse gases Observing SATellite (GOSAT) was launched in January 2009 as the first satellite in the world dedicated to greenhouse gas observation. It has conducted continuous observations of the global distribution of carbon dioxide and methane.

In order to reduce net greenhouse gas emissions to zero as called for under the Paris Agreement, we will need accurate knowledge of actual emissions, which may be possible by combining observations from land, ships and aircrafts with those from satellites.

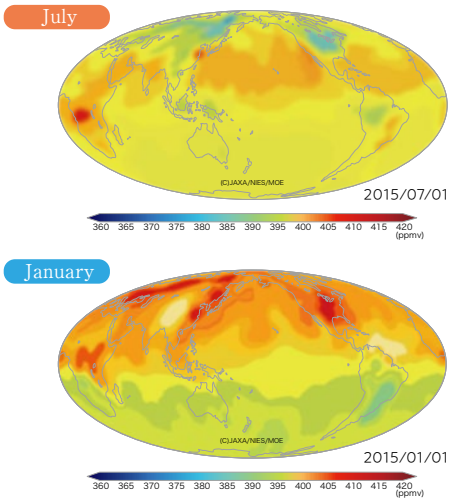
The GOSAT series, namely GOSAT and GOSAT-2, will contribute to climate action taken by countries under the Paris Agreement.



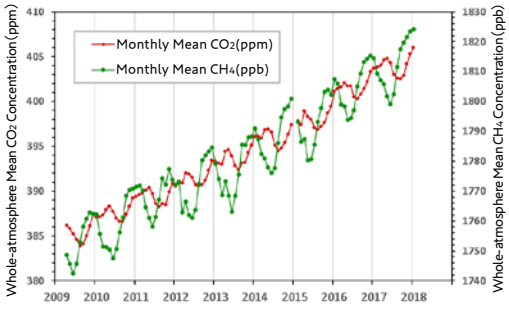
What can we learn from satellite observations?

GOSAT has revealed details on the **global distribution of carbon dioxide (CO_2) and methane (CH_4) concentrations**, as well as on where and how much greenhouse gas is **absorbed or emitted**.

Map of global CO_2 concentrations



Annual change in monthly mean concentrations



Global atmospheric concentrations of CO_2 (red) and CH_4 (green) in all layers of the atmosphere from the ground surface to the top of the atmosphere **rise yearly** accompanied by seasonal oscillation. Particularly in the northern hemisphere, we have observed **seasonal changes**: lower CO_2 concentrations in summer due to vegetation-related impacts and higher concentrations from winter to spring.

How can we learn from space?

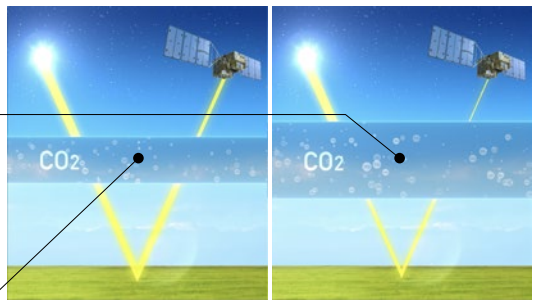
GOSAT mainly observes **sunlight reflected from the earth's surface**. By measuring the intensity of the sunlight observed by GOSAT, we can estimate atmospheric concentrations of CO_2 and CH_4.

High concentrations

Sunlight is weakened in high concentrations.

Low concentrations

Sunlight is not weakened in low concentrations.



GOSAT-2's challenge ①

Avoiding clouds

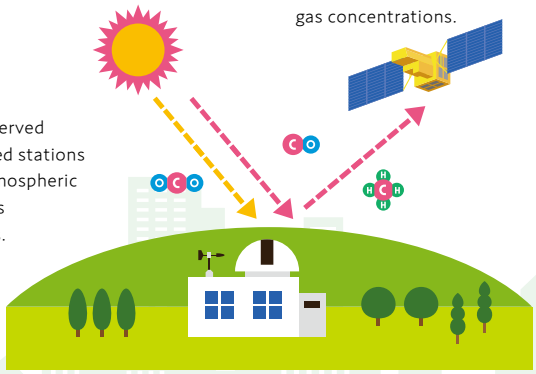
It is difficult for a satellite to make accurate observations when obstructed by clouds. A new **"intelligent pointing"** function aims to allow GOSAT-2 to automatically avoid clouds, thus increasing valid observation data.

Are space observations accurate?

Observation data from the satellites are **periodically compared** with highly precise data from observation points such as ground-based stations to **constantly make sure that they match**.

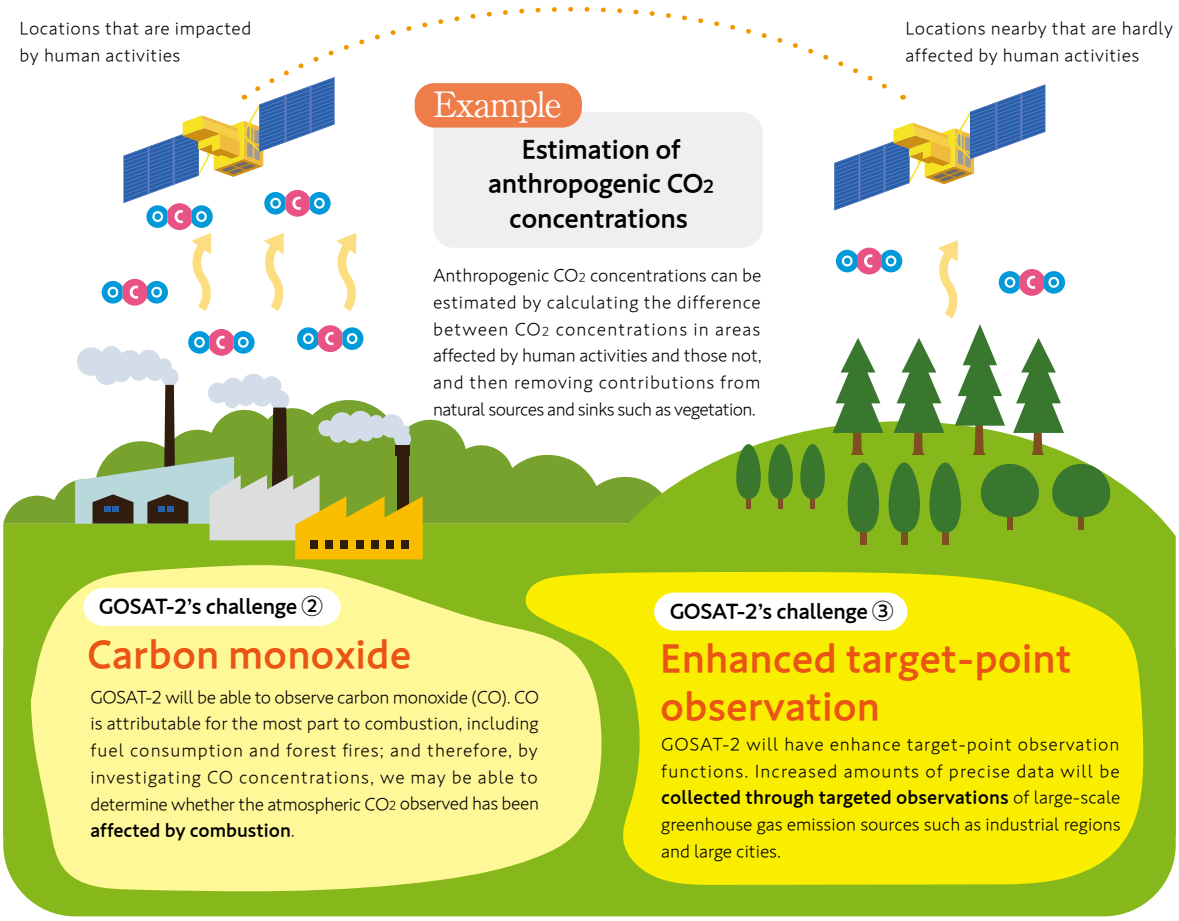
Sunlight reflected from the earth's surface close to ground-based stations is observed to measure atmospheric greenhouse gas concentrations.

Sunlight is observed at ground-based stations to measure atmospheric greenhouse gas concentrations.



Can we identify human-induced emissions from space?

Observation data from GOSAT shows that in areas **affected by human activities**, such as large cities, CO_2 and CH_4 **concentrations are higher** than surrounding areas.



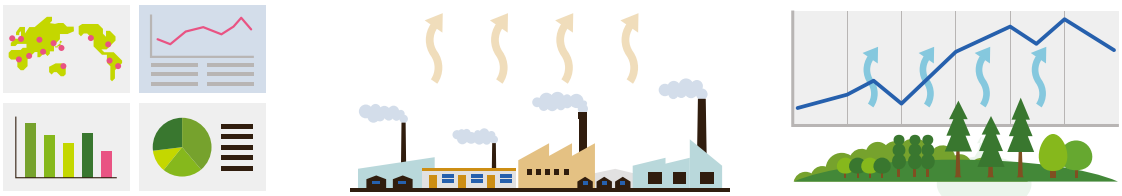
What can we do with human-induced emissions data?

Human-induced emissions data can be used to conduct **comparative evaluations** with emission inventories that identify the location and amounts of greenhouse gases emitted, to provide **technological support** for the development of emission inventories in areas where high-quality inventory data is unavailable, and to **examine the effects** of emission reduction measures.

Comparative evaluations with emissions inventories

Technological support for the development of emission inventories in areas where high-quality inventory data is unavailable

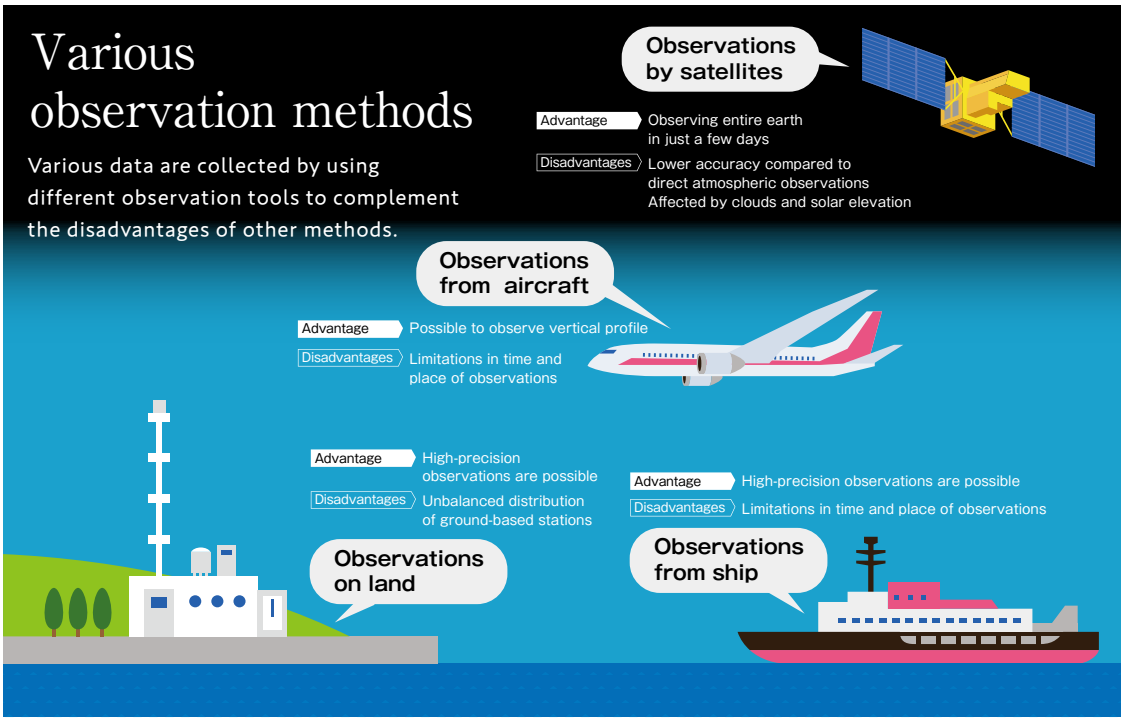
Examination of the effects of emission reduction measures



We seek the effective use of the GOSAT satellites for climate change measures under the Paris Agreement.

What happens when you combine observations from outer space and the Earth?

Observations are conducted worldwide, on land, on the sea, and in the sky. Observations from space and the Earth are **mutually complementary** and contribute to significant improvements in **the accuracy of estimated** absorption and emissions.



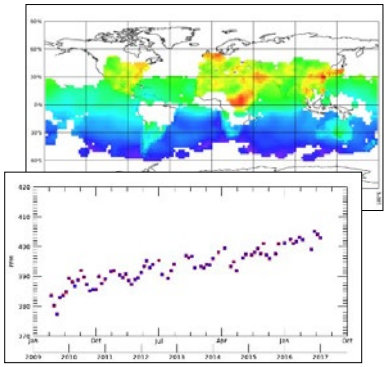
Accumulation of **various long-term data is required** to understand climate change.Japan promotes **joint research among concerned government ministries and agencies, research institutions and universities.** We are also fostering **partnerships with overseas institutions** that also perform observations using other satellites.

Can I use GOSAT data?

GOSAT data products are available **free of charge.**
The GOSAT Data Archive Service
(http://data2.gosat.nies.go.jp/index_ja.html)
should be referred to for details. A “simplified analysis tool” is currently under development to enable users to visualize data by simple operation.

Other videos of the GOSAT series are available. The Ministry of the Environment video channel should be referred to for further details

https://www.youtube.com/watch?v=ErF9IoQqqJo



“Simplified analysis tool”
(image of output)

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