Press Releases

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JAMSTEC
National Institute for Environmental Studies

Reliable Estimation for Terrestrial CO_2 Exchange Using Ground and Satellite Observations ~ Evaluation of Consistency between Two Different Approaches ~

Overview

A joint research group led by Dr. Masayuki Kondo, Department of Environmental Geochemical Cycle Research, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC: Asahiko Taira, President) and National Institute for Environmental Studies (NIES: Sumi Akimasa, President) examined consistency between two global terrestrial carbon dioxide (CO_2) exchanges based on ground and satellite observation data. It confirmed that using both ground and satellite observations data allows reliable estimation of terrestrial CO_2 exchanges at mid and high latitudinal regions in the Northern Hemisphere.

Terrestrial CO_2 exchange has usually been evaluated with numerical models that articulate eco-physiological processes of terrestrial carbon cycle based on empirical relations and assumptions. This research was the first attempt to evaluate two different approaches for data-driven terrestrial CO_2 exchanges. Specifically, the study group examined how terrestrial CO_2 exchange would be consistent between data-driven top-down and bottom-up approaches; the former estimates CO_2 exchanges based on atmospheric CO_2 concentration measured by the Greenhouse gases Observing SATellite"IBUKI" (GOSAT), and the latter is empirical eddy flux upscaling based on a support vector regression (SVR) model.

As a result, at mid and high latitudinal regions in the Northern Hemisphere, terrestrial CO_2 exchanges showed considerable consistency between the two different methods, though large seasonal differences were observed in tropical regions. These differences are likely to be due to lack of sufficient data from ground observation in tropical regions, where estimation of CO_2 uptake tends to become higher by the ground-based observation network than that by the GOSAT observations. To estimate terrestrial CO_2 exchange more accurately, it suggests that the ground observation network needs to be improved in tropical regions.

In predicting climate changes caused by global warming and other factors, it is important to obtain accurate estimate of the CO_2 absorption/emission from land. These research findings can be utilized for such data to improve process models for predicting future climate changes, contributing to higher accuracy of global warming effects.

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Publication

Title: Comparison of the data-driven top-down and bottom-up global terrestrial CO_2 exchanges: GOSAT CO_2 inversin and empirical eddy flux upscaling

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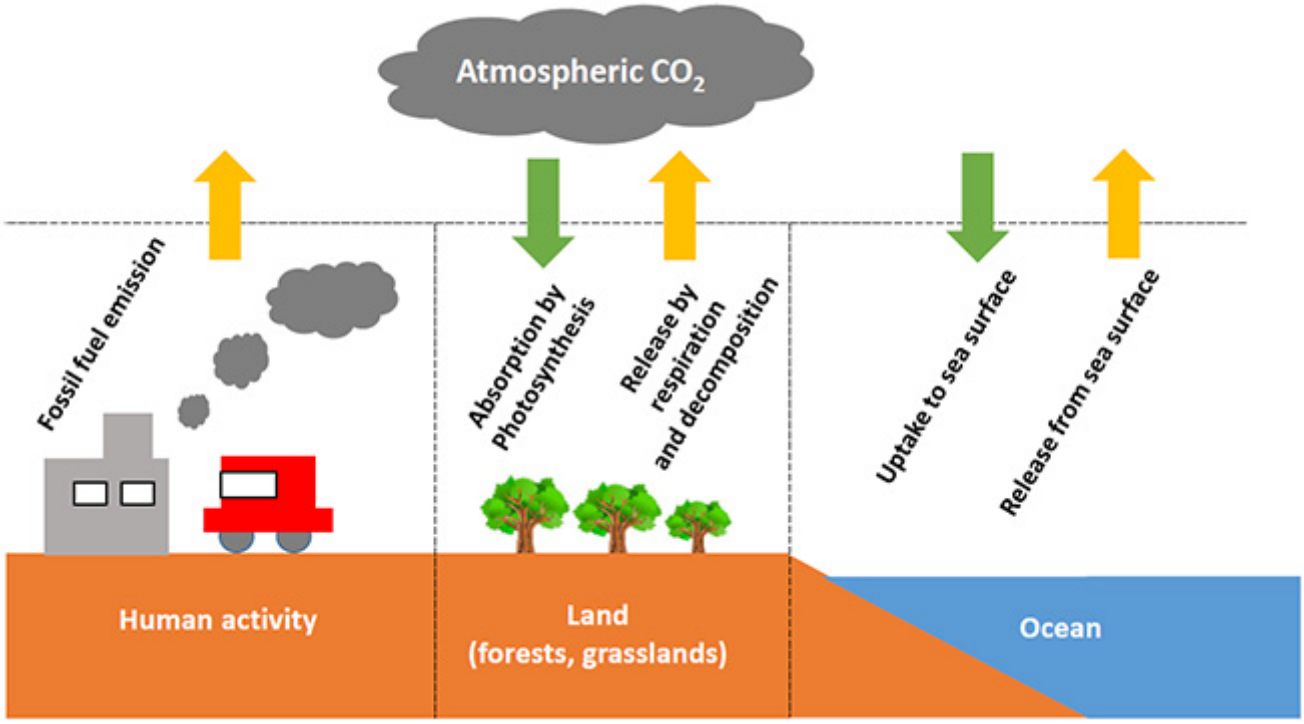

Figure 1: CO_2 circulation between the atmosphere and earth surface
Increase in atmospheric CO_2 level depends on emission from combustion of fossil fuels, and absorption and emission from terrestrial ecosystems and oceans. This research focuses on CO_2 exchange between atmosphere and terrestrial ecosystems, which is a balance between absorption by photonic synthesis and emission from plant respiration and decomposition of organic matters.

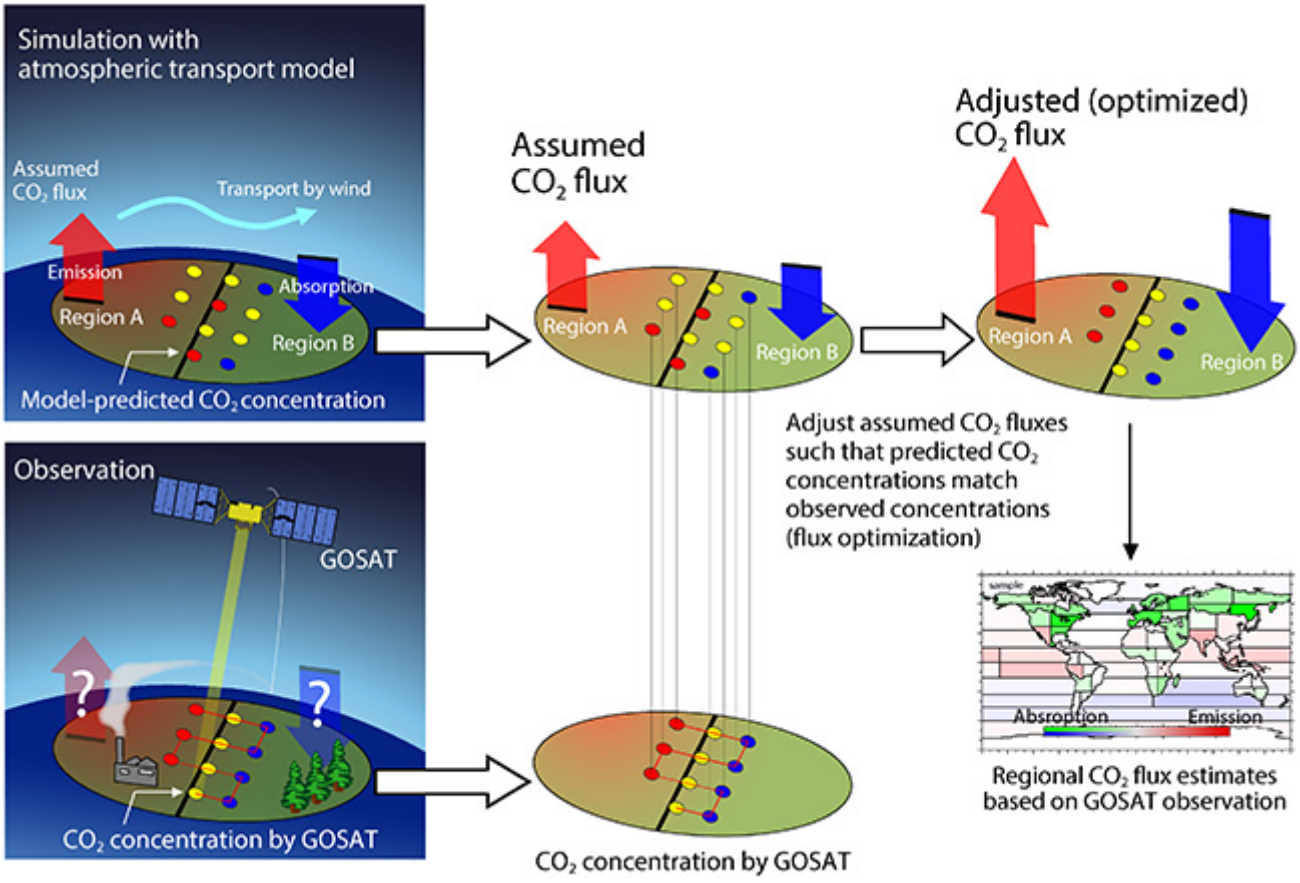

Figure 2: Scheme for CO_2 exchange estimation by GOSAT observation

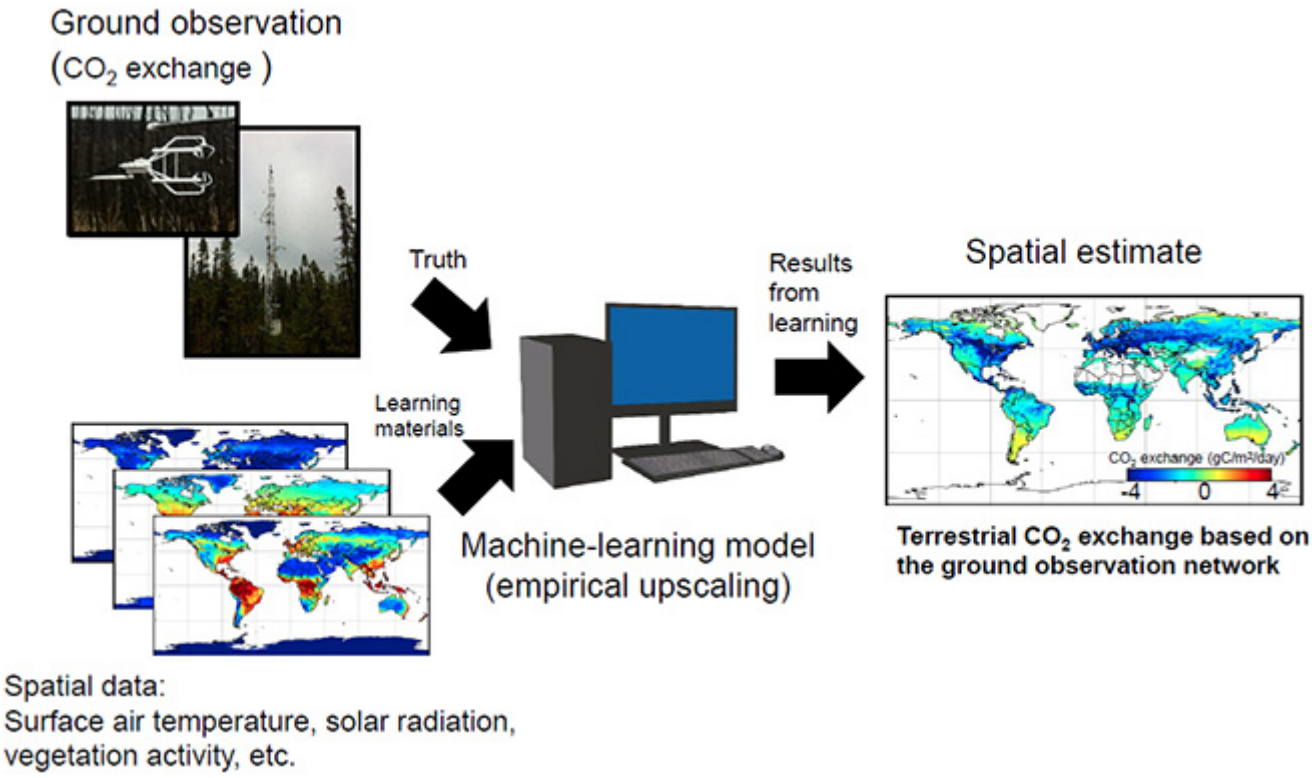

Figure 3: Scheme for CO_2 exchange estimation by ground-based observation network

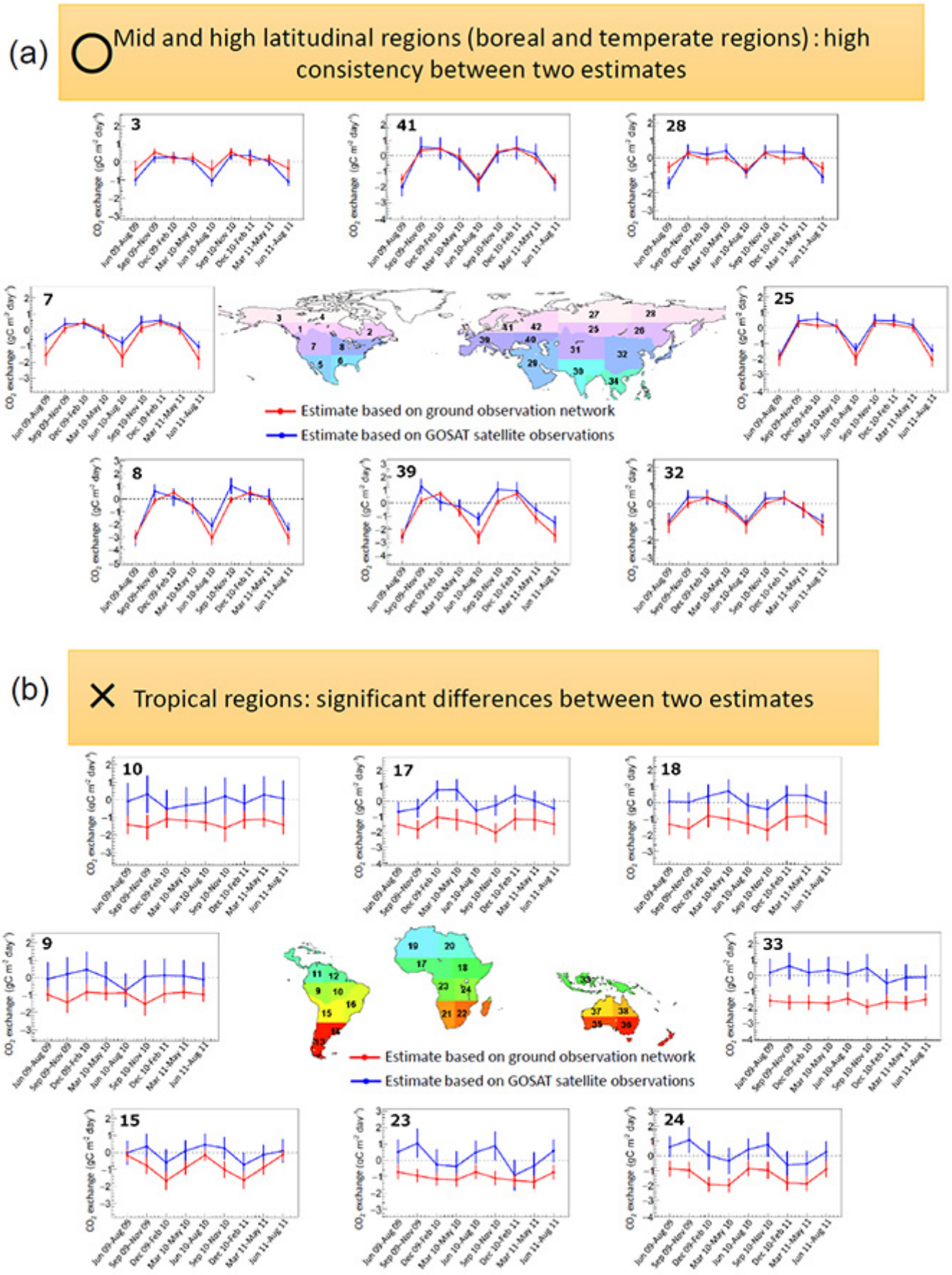

Figure 4: Seasonal variations of CO_2 exchange by ground-based observation network and GOSAT
(a) Results by two methods are highly consistent at mid and high latitudinal regions in the Northern Hemisphere (in particular, in boreal and temperate regions).
(b)Inconsistent seasonal variations are observed near the equatorial regions and tropical zones in Southern Hemisphere.

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