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Synergetic approach of bottom-up/top-down studies on CO2 and CH4 emissions from biomass burning and rice paddy in East A

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There has been still a large discrepancy in estimations between bottom-up and top-down approaches for both CO_2 emissions from biomass burning and CH4 from rice paddy in East Asia. The purpose of this study is to update the emission inventory databases as to be more consistent between these two approaches through a synergetic usage of satellite data, ground-based remote sensing measurements, and in situ data. The most important parameter to estimate total CO_2 emissions from biomass burning is the biomass amount of the forests. In this study the amount is estimated based on the normalized vegetation index (NDVI) observed by satellites and, CO_2 emissions from burning area are estimated by multiplying the fire strength evaluated from hot spot data with some auxiliary data such as soil moisture and groundwater level. As for the top-down approach, CO_2 concentration data observed from space are useful for constraining the inverse analysis of CO_2 emission strength. The greenhouse gas observing satellite (GOSAT) dedicated to observe atmospheric CO_2 and CH_4 concentrations was launched in 2009 and has been operated for more than five years. The main band of its sensor can measure the columnar CO_2 concentration, however, it cannot be directly converted into the concentration near the surface. One of our attempts is to develop a retrieval method to estimate CO_2 concentration in the lower troposphere, particularly in the boundary layer, from a synergy of spectrum data in a wide spectral range covering from short wavelength infrared to the thermal infrared. In order to validate this method we have carried out CO_2 sonde observations around Tokyo city where GOSAT has been operated in a specific observation mode (targeting mode) to obtain sufficient number of data over this area. Based on the validated results, this method will be applied to analyze the data observed in biomass burning areas. One of our important targets is Kalimantan (Indonesia) where peat fire is the main CO_2 emission source. We started the ground-based measurement of columnar CO_2 concentration using an optical spectrum analyzer (OSA), and expect that these temporally continuous data would be effective for achieving the consistency between bottom-up and top-down approaches. Also started are observations of columnar CH_4 concentration using the same type of spectrometer in Sichuan basin (China) and Karnal (India) where are identified as the extremely high CH_4 concentration area based on the almost decadal record of observations by SCIAMACHY and GOSAT. It is expected that the synergetic analysis of data from satellite and ground-based measurements could contribute to make clear the cause of high concentration of CH_4 in these areas.

Keywords: carbon dioxide, methane, GOSAT, top down approach, bottom up approach, ground-based remote sensing