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GOSAT CO2 AND CH4 EMISSIONS FROM THAWING PERMAFROST REGIONS IN CENTRAL ASIA (2009-2018): CASE AREAS IN YAKUTSK, MONGOLIA, AND TIBETAN PLATEAU

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ABSTRACT

Permafrost of high latitude ecosystems contains an estimated 1700 Gt of carbon dioxide (CO2) and methane (CH4), which is almost twice as much greenhouse gas (GHG) as is currently contained in the atmosphere. GHG emissions are a great concern for the sustainable development of central Asia because of the future projections of global warming and related effects of permafrost. Under climate warming, central Asian permafrost regions should not be neglected and this area is very important components of global permafrost. The magnitude and timing of GHG emissions thawing permafrost regions in central Asia and their impact on climate change remain uncertain. The critical question focus on how much thaw out in the current and when it will be emitted GHG into the atmosphere? If policymakers and governments of regional knew how much GHG could be emitted from thawing permafrost, it could help them decide what to do about it. The main objective of the research is to estimate the actual magnitude of the CO2 and CH4 emissions from thawing permafrost in central Asia such as Mongolia, Yakutsk in Russia, and Tibetan Plateau based on high-resolution remote sensing approaches and observation datasets. This study directly addresses 3 of the 17 UN's Sustainable Development Goals; SDG13 Climate Action, SDG15 Life on Land, and SDG 17 Partnership for Goals. The results of the research will not only be valid for central Asia, but can also be applied to large areas in northernhemisphere with similar climatic and cultural conditions. The Greenhouse Gases Observing Satellite (GOSAT) affords and ability to assess and monitor CO2 and CH4 near-surface atmospheric concentrations globally a monthly scales pertaining. The GOSAT TANSO-FTS datasets used in the study to estimate the temporal and spatial distributions of CO2 and CH4 emissions from 2009 to 2018. During the June 2009 through December 2018 validation campaigns were performed using three Total Carbon Column Network (TCCN) sites that use ground based FTS. The results show that the annual CO2 emissions increased gradually between 383 ppm and 407 ppm from thawing permafrost regions in central Asia during the last 10 years, with the highest value being in spring and the lowest in summer and autumn. The annual CH4 emissions raised significantly from 1780 ppb to 1834 ppb which are high in Tibetan Platea in China and low in Mongolia between 2009 and 2018, while seasonal variations of CH4 emissions similar results with CO2 trend. The

CO2 and CH4 emissions from thawing permafrost in central Asia have an annual increasing trend both. The annual mean rate of increase is CO2 (2.417 ppm/a) and CH4 (6.904 ppb/a). The CO2 and CH4 concentrations of each season increase compared with the preceding years. The CO2 and CH4 of each month are higher than those of the corresponding months of the previous year in central Asia. This research have addressed gap in our understanding of the efforts of GHG emissions from thawing permafrost regions in these key areas, and it is very important to improve datasets for regional and national GHG inventories. Furthermore, this newly generated datasets will be contributed to support for GHG inventories of national and regional and capacity development of policy makers, governments, and regional professionals.

KEYWORDS: GOSAT, CO2, CH4, Thawing Permafrost, Yakutsk, Mongolia, and Tibetan Plateau.