Geophysical Research Abstracts
Vol. 18, EGU2016-292, 2016
EGU General Assembly 2016

CO_2 and CH_4 emission patterns of alpine peatland on the eastern Qinghai-Tibet Plateau and their controlling factors

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Though covering only 3% of the Earth's land surface, peatlands contain more than 600 Pg C, which is equivalent to one third of the world's soil organic carbon pool. Peatlands are sensitive to climate change, and remain an important carbon sink and CH_4 source. There were 4.6×10^9 m^2 peatlands developed in the eastern Qinghai-Tibet Plateau (average 3400 m above sea level), while 69% of them are intact peatlands. These peatlands climatologically located in the overlapping area of East Asian summer monsoon and Indian Ocean summer monsoon, thus are more sensitive to the global change. However, little is known about the carbon emission patterns of those peatlands and how they react to climate change. For assessing the magnitude of diurnal, seasonal and inter-annual variations in CH_4 flux, Net Ecosystem CO_2 Exchange (NEE) and Ecosystem Respiration (ER), and identifying the dependence of these fluxes on environmental factors, from August 2012 to May 2015, an eddy covariance tower with open-path CH_4 and CO_2 analyzer, and a LI-8100 automated soil flux system were established in Hongyuan Peatland, which is a typical intact alpine peatland in the eastern Qinghai-Tibet Plateau region. During growing season, there was a clear sinusoid-like diurnal pattern in ER with peaks occurred at 14:00 and valleys occurred at 10:00, the NEE peak values occurred between 12:00-15:00, and the diurnal peaks and valleys in CH_4 fluxes appeared at approximately 17:00 and 1:00, respectively. Daily mean NEE were negetive values and daily mean ER were above 1 μmol $CO_2/m^2/s$, the lowest NEE is -4.65 μmol $CO_2/m^2/s$, and the largest ER was 5.78 μmol $CO_2/m^2/s$, and they all appeared in July; daily mean CH_4 fluxes varied between 0.05-0.25 μmol $CH_4/m^2/s$ with peak value appeared in June and July. While during non-growing season, NEE, ER and CH_4 fluxes varied at a relatively low level and showed no clear diurnal patterns, daily mean NEE and ER are between 0 to 1 μmol $CO_2/m^2/s$, and daily mean CH_4 fluxes are between 0 to 0.05 μmol $CH_4/m^2/s$. The annual NEE, ER, and CH_4 emission of Hongyuan peatland were -286.2 g C/m^2, 599.98 g C/m^2 and 47.04 g CH_4/m^2, respectively. And the growing season NEE, ER, and CH4 emission account for 121%, 78%, and 75% of the annual sum, indicating that emissions in non-growing season were of great importance. Soil temperature at 10 cm depth and soil moisture at 10 cm depth are key environmental factors controlling the variation of NEE (R^2=0.70) and ER (R^2=0.98), while CH_4 flux variations can be explained by soil temperature at 25 cm depth and soil moisture at 10 cm depth (R^2=0.87).