Vortrag gehalten auf dem Internationalen Workshop:

„Biogeochemistry of submerged agro-ecosystems: Properties, processes, cycles and functions"

Freising, 24.09.2014

Ground cover rice production systems (GCRPS) increase soil carbon and nitrogen stocks and reduce greenhouse gas emissions

Michael Dannenmann[1], Liu Meiju[2,1], Yao Zhisheng[3], Lin Shan[2], Gustavo Saiz[1], Yan Guangxuan[1,3], David Pelster[4], Tao Hongbin[2], Sebastian Sippel[1], Tao Yue yue[2], Zhang Yanan[2], Zheng Xunhua[3], Zuo Qiang[2], Klaus Butterbach-Bahl[1, 4]*

[1]Institute of Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU), Karlsruhe Institute of Technology, Garmisch-Partenkirchen, 82467, Germany

[2]College of Resource and Environmental Science, China Agricultural University, Beijing 100193, China

[3]Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China

[4]Livestock Systems and Environment, International Livestock Research Institute, Box 30709-00100, Nairobi, Kenya

oral presentation

*Presenting author: Dr. Michael Dannenmann

Karlsruhe Institute of Technology, 82467, Garmisch-Partenkirchen, Germany, Tel.:+49-8821-183136, email: klaus.butterbach-bahl@kit.edu

Abstract

Rice production is increasingly challenged by irrigation water scarcity. Covering paddy rice soils with films (ground cover rice production system: GCRPS) can significantly reduce the irrigation water demand of rice, overcome temperature limitations at the beginning of the vegetation period and increase grain yields. However, it has been speculated that increased soil aeration and temperature under GCRPS may result in losses of soil organic carbon (C) and nitrogen (N) stocks. Moreover, while CH_4 emissions for GCRPS system have been shown to decrease, greater N_2O emissions may cause such systems to emit more greenhouse gases than conventional paddy rice cultivation (Paddy). Against expectations our study showed the contrary. Based on a pair wise comparison of 49 neighbouring fields in a cultivation region of ca. 5.000 km^2 in Shiyan County, Hubei Province, PR China, managed using either GCRPS or Paddy cultivation, we demonstrate that the water-saving GCRPS: 1) significantly increased soil organic C and N stocks within 5-20 years following conversion of production systems; 2) decreased mineralization potential for soil organic C; 3) showed lower $\delta^{15}N$ in the soils and plant leafs indicating less NH_3 volatilization and 4) increased crop yields significantly. Moreover, we demonstrate that GCRPS also reduced overall GHG emissions (i.e. lower CH_4

emissions were not offset by increased N_2O emissions). Our results suggest that GCRPS is an innovative rice production technique that not only increases yields using less irrigation water, but that it also is environmentally beneficial due to increased soil C and N stocks and reduced net GHG emissions.