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Characterization of soil respiration rates along a temporal restoration gradient in a degenerated wetland of the arid region in NW-China

Z. wu (1,2,3), T. Behrendt (2), B. Mamtimin (2), and F. Meixner (2)

(1) Department of Geography,Geography and Tourism Science Institute, Xinjiang Normal University, (wuzhaopengxj@sina.com), (2) Max Planck Institute for Chemistry Biogeochemistry Department, Mainz, Germany(z.wu@mpic.de, +49-(0)6131-305-579), (3) Research Center Earth System Sciences–Geocycles, University Mainz, Mainz, Germany

The wetland ecosystem contributes greatly to terrestrial ecosystems playing an important role in the soil carbon budget. Soil respiration is the main loss for soil carbon and consequently an important source of atmospheric CO_2, which in turn has a great impact on the global atmospheric CO_2 concentration and the climate change.
The Xinjiang Uygur Autonomous Region in NW-China is dominated by arid and semiarid landscapes. Since the 1950s, due to excessive land reclamation, the wetlands of Xinjiang became more and more subject of severe ecological degradation. In 2004, the government started operational measures to restore degenerated wetlands and the construction of cofferdams.
In our study we measured soil respiration rates to characterize a wetland in an arid landscape during the restoration process. Soil samples have been taken from the Jinhe river estuary wetland (44° 48' 27" N, 82° 53' 56" E). The aim our study was to compare soil respiration rates from wetland sites at different temporal restoration phases and to discuss these soil respiration rates in relation to their physical influencing factors (temperature and moisture).
For that, four restoration periods have been chosen: 2004 (early-stage restoration), 2006 (medium-stage restoration), 2008 (end-stage restoration), and 2009 (reference). An automated dynamic soil chamber system (Li-COR-8100) was applied to measure the CO_2 respiration flux. Corresponding to the seasonal behavior of the CO_2 respiration flux , we took two-hourly flux measurements between 08:00-14:00 in spring and autumn, in summer we made half hourly measurements, and in winter we performed hourly measurements between 08:00-21:00. The soil physical-chemical properties were measured on soil samples taken on each of the study sites; soil temperatures at 0.1, 0.15, 0.2, 0.4, 0.6, and 1.0 m depth were monitored by an automatic meteorological station.
Our results indicate that:
(a)soil respiration rates gradually increase with the length of the restoration period,
(b)soil physical-chemical properties show a de-salinization trend,
(c)annual course of soil respiration at the end-stage restoration site (only one year of restoration) is characterized by a single maximum occurring in autumn. The soil respiration at the medium- and long-term restoration sites is characterized by two maxima, one in spring and one in autumn, where the value in springtime was higher than that in autumn,
(d)soil respiration rates gradually increase with the vegetation recovery,
(e)near-surface air temperature (at 0.1 m above the soil) was closely correlated with soil respiration rates at the sites of different restoration periods.
We found, that (1) the restoration project was useful for the degenerated Jinhe wetland, resulting in the enhancement of soil activity and soil quality, (2) near-surface air temperature seems to be the most important factor which impacts the soil respiration (and not soil moisture), (3) the degenerated wetland will return to its initial status, if sufficient water could be supplied, (4) along with the increase of soil respiration rates the eco-environment of the degenerated wetland obviously has been improved. However, with more CO_2 the wetland will also emit more CH4 unfortunately from the perspective of climate change.