Impacts of climate and reclamation on temporal variations in CH_4 emissions from different wetlands in China: From 1950 to 2010

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During the last 60 years, wetlands have experienced extensive conversion and global impacts from climate warming, which makes the estimation of methane emission from wetlands highly uncertain. In this paper, we present a modeling framework, integrating $CH4MOD_{wetland}$, TOPMODEL and TEM models, to analyze the temporal and spatial variations in CH_4 emissions from natural wetlands (including inland marshes/swamps, coastal wetlands, lakes and rivers) in China. We firstly evaluated the performance of the $CH4MOD_{wetland}$ model in simulating CH_4 emissions from 11 representative wetland sites in five regions of China. Model performance analysis showed that this method effectively simulates differences in the CH_4 fluxes between different sites and regions. The model efficiency for estimating the daily CH_4 fluxes in the northeastern China (NE), Inner Mongolia and northwestern China (NW), the North China plain and the Middle-Lower Yangtze Plain (E) and the Qinghai Tibetan Plateau (SW) was 0.51, 0.20, 0.52 and 0.65, respectively. The efficiency for estimating the annual mean CH_4 fluxes in southern China (S) was 0.99. On a national scale, our analysis revealed an increase of 25.5%, averaging 0.52 g m^{-2} per decade, in national CH_4 fluxes from 1950 to 2010 in Chinese wetland, which was mainly induced by climate warming. Higher rates of increasing CH_4 fluxes occurred in NE, NW regions, associated with large temperature increases. However, decreases in precipitation due to climate warming offset the increase in CH_4 fluxes in these regions. The CH_4 fluxes from the wetland on the SW region exhibited a lower rate of increase, which was approximately 25% of that simulated in NE region. Although climate warming has accelerated CH_4 fluxes, the total amount of national CH_4 emissions decreased by approximately 2.35 Tg (1.91–2.81 Tg), i.e., from 4.50 Tg in the early 1950s to 2.15 Tg in the late 2000s, due to a large wetland loss of 17.0 million ha. Of this reduction, 0.26 Tg (0.24–0.28 Tg) was derived from lakes and rivers, 0.16 Tg (0.13–0.20 Tg) from coastal wetlands, and 1.92 Tg (1.54–2.33 Tg) from inland wetlands.

Keywords: CH4 emissions, wetland, modelling, temporal variation, China