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Examining the role of management practices and landscape context on methane dynamics from subtropical wetlands

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Globally, wetlands are the largest natural source of atmospheric CH4, an important GHG with a warming potential 25 times stronger than CO_2 (IPCC 2008; Forster et al. 2013). In sub-tropical climates where precipitation and temperatures are high, land-use change and agricultural management practices often intersect with extensive wetland systems. The Everglades watershed in South Central Florida represents a large areal extent characterized by a high density of wetlands nested within agricultural fields dominated to a large extent by grazed rangelands. Soils are primarily Spodosols and Histosols and sustain a relatively high water table, even during the dry season. Here, rangelands dominated by native vegetation have been converted to agronomically 'improved pastures' suitable for large scale cattle ranching through high intensive agronomic practices including vegetation homogenization, fertilization and drainage. In this study we first tested the hypothesis that CH4 fluxes from small ephemeral wetlands are indirectly influenced by management practices associated with the agricultural fields in which they are nested. We found that wetlands embedded in agronomically 'Improved' pastures exhibit significantly higher CH4 fluxes compared to wetlands embedded in 'Native' pastures. Next, we sought to determine the mechanisms by which the surrounding landscapes affect methane production processes to better predict how expanding or intensifying agriculture will affect wetland methane fluxes. We focus on substrate supply in the form of substrate quality and quantity available to methanogens as it is a principle control over CH4 production and susceptible to ecosystem perturbations. This research was conducted at the McArthur Agro-Ecology Research Center on Buck Island Ranch, Lake Placid, Florida. Wetland CH4 fluxes were measured using static canopy chambers coupled with infrared gas analysis of CH4, CO_2 and water vapor. Additionally, soil manipulation incubations were prepared in which soil cores to 50 cm were extracted from wetlands. Soil cores were separated into 0-25 cm and 25-50 cm increments to account for vertical stratification of CH4 production and transportation. Soils were incubated anaerobically. Two methods involving ethanol additions (Valentine, Holland, and Schimel 1994) and organic matter additions (Delwiche and Cicerone 1993) determined the influence of substrate quality and quantity on CH4 production. The results from this study provide empirical evidence of higher CH4 fluxes from wetlands following land-use change to surrounding rangelands and will improve mechanistic understanding of how the role of management decisions can influence CH4 production from wetlands nested within agricultural fields.