Climate Change - Methane

Title	**Differential effects of environmental stressors on physiological processes and methane emissions in pea (*Pisum sativum*) plants at various growth stages**
Author Name	Plant Physiology and Biochemistry
Journal Name	Awatif M.Abdulmajeed & Mirwais M. Qaderiab
Year	2019
Volume and Issue	139
Pages	715-723
Abstracts	Many studies have investigated the effects of one or two environmental factors on methane (CH_4) emissions from plants at a single growth stage, but the impact that multiple co-occurring stress factors may have on emissions at different growth stages has rarely been studied. The objective of this study was to examine the effects of temperature, ultraviolet-B (UVB) radiation, and watering regime on CH_4 emissions and some relevant physiological characteristics of pea (*Pisum sativum L. cv. 237 J Sundance*) plants at three growth stages. We grew plants under two temperature regimes (22/18 °C and 28/24 °C; 16 h light/8 h dark), two UVB levels [0 and 5 kJ m^{-2} d^{-1}] and two watering regimes (well-watered, watering plants to field capacity, and water-stressed, watering plants at wilting point). Measurements were then taken after 10, 20, and 30 days of growth under experimental conditions, following seven days of initial growth under 22/18 °C. Higher temperatures, UVB5, and water stress adversely affected photosynthesis and chlorophyll fluorescence, but increased CH_4 emissions, which decreased with increased plant age. Also, interaction of higher temperatures and UVB5 reversed the pattern of CH4emissions at growth stages, compared to that of other treatments. We conclude that CH_4 emission decreases with plant age, and it is affected by stress factors through changes in physiological activities of plants.
Keywords	High temperature; Methane emission; Pea; Physiological processes; Pisum sativum; UVB radiation; Water stress

Title	**Plant species effect on CO_2 and CH_4 emissions from pilot constructed wetlands in Mediterranean area**
Author Name	Ecological Engineering
Journal Name	Carmelo Maucieri, Maurizio Borin, Mirco Milani, Giuseppe L.Cirelli, Antonio C. Barbera
Year	2019
Volume and Issue	134
Pages	112-117
Abstracts	The aim of this research was to evaluate the role of constructed wetland (CW) horizontal sub-surface flow pilot-plant beds vegetation, comparing four perennial herbaceous plant species with an unvegetated bed, on carbon dioxide (CO_2) and methane (CH_4) emissions, and CO_2(eq) budgets. The research was conducted from April 1st to November 30th in 2012 and 2013 in a pilot plant located in San Michele di Ganzaria (*Sicily, Italy*) that treated urban wastewaters, studying *Phragmites australis*(Cav.) Trin. ex Steud. (*common reed*), *Arundo donax L.* (giant reed), *Chrysopogon zizanioides* (L.) *Roberty* (vetiver) and Miscanthus x giganteus Greef et Deu. (miscanthus). Results showed a greater aboveground biomass yield in the second experimental year than the first one for all species except vetiver, which showed a 10.5% reduction. Considering CWs gases emission, a significantly higher CO_2 emission (+52.5%) was monitored in 2013 than 2012 whereas CH_4 had the opposite trend (−97.0%). Seasons and plant species influenced gases emission. The lower CO_2 emission (median value 5.2 g m−2 d−1) was monitored during the spring seasons when instead was monitored the highest CH_4 emission (median value 0.232 g m^{-2} d^{-1}). Opposite CO_2 and CH_4 emissions were found in fall. A. donax, M. giganteus and P. australis determined significantly higher (2.9 times) CO_2 emission than *C. zizanioides* and unvegetated bed. Vegetated beds showed a positive CO_2 (eq) total balance with the best results calculated for A. donax whereas, as expected, it was negative for the unvegetated bed, with a cumulative CO_2(eq) emission of 6.68 kg m−2. Obtained results confirm the active and key role of plant species used in the CW systems and indicate A. *donax* as the most environmentally friendly species to use under Mediterranean climate conditions, followed by P. *australis*.
Keywords	Arundo donax L.; Phragmites australis (Cav.) Trin. ex Steud.; Chrysopogon zizanioides (L.) Roberty; Mischantus x giganteus Greef et Deu.; CO_2(eq) balance

Title	**The role of methane in future climate strategies: mitigation potentials and climate impacts**
Author Name	Mathijs Harmsen, Detlef P. van Vuuren, Benjamin Leon Bodirsky, Jean Chateau, Olivier Durand-Lasserve, Laurent Drouet, Oliver Fricko, Shinichiro Fujimori, David E. H. J. Gernaat, Tatsuya Hanaoka, Jérôme Hilaire, Kimon Keramidas, Gunnar Luderer, Maria Cecilia P. Moura, Fuminori Sano, Steven J. Smith & Kenichi Wada
Journal Name	Climatic Change
Year	2018
Volume and Issue	155, 431
Pages	1-17
Abstracts	This study examines model-specific assumptions and projections of methane (CH_4) emissions in deep mitigation scenarios generated by integrated assessment models (IAMs). For this, scenarios of nine models are compared in terms of sectoral and regional CH_4 emission reduction strategies, as well as resulting climate impacts. The models' projected reduction potentials are compared to sector and technology-specific reduction potentials found in literature. Significant cost-effective and non-climate policy related reductions are projected in the reference case (10–36% compared to a "frozen emission factor" scenario in 2100). Still, compared to 2010, CH_4 emissions are expected to rise steadily by 9–72% (up to 412 to 654 Mt CH_4/year). Ambitious CO_2 reduction measures could by themselves lead to a reduction of CH_4 emissions due to a reduction of fossil fuels (22–48% compared to the reference case in 2100). However, direct CH_4 mitigation is crucial and more effective in bringing down CH_4 (50–74% compared to the reference case). Given the limited reduction potential, agriculture CH_4 emissions are projected to constitute an increasingly larger share of total anthropogenic CH_4 emissions in mitigation scenarios. Enteric fermentation in ruminants is in that respect by far the largest mitigation bottleneck later in the century with a projected 40 - 78% of total remaining CH_4 emissions in 2100 in a strong (2°C) climate policy case.
Keywords	methane (CH_4) emissions; mitigation; climate impacts; frozen emission factor; fossil fuels; reduction potential; anthropogenic & fermentation

Title	Methane production and emissions in trees and forests
Author Name	Kristofer R. Covey & J. Patrick Megonigal
Journal Name	New Phytologist
Year	2018
Volume and Issue	222
Pages	35 - 51
Abstracts	Forest ecosystem methane (CH_4) research has focused on soils, but trees are also important sources and sinks in forest CH budgets. Living and dead trees transport and emit CH produced in soils; living trees and dead wood emit CH produced inside trees by microorganisms; and trees produce CH through an abiotic photochemical process. Here, were view the state of the science on the production, consumption, transport, and emission of CH by living and dead trees, and the spatial and temporal dynamics of these processes across hydrologic gradients inclusive of wetland and upland ecosystems. Emerging research demonstrates that tree CH emissions can significantly increase the source strength of wetland forests, and modestly decrease the sink strength of upland forests. Scaling from stem or leaf measurements to trees or forests is limited by knowledge of the mechanisms by which trees transport soil-produced CH, microbial processes produce and oxidize CH inside trees, a lack of mechanistic models, the diffuse nature of forest CH fluxes, complex overlap between sources and sinks, and extreme variation across individuals. Understanding the complex processes that regulate CH source – sink dynamics in trees and forests requires cross-disciplinary research and new conceptual models that transcend the traditional binary classification of wetland vs. upland forest.
Keywords	Forest ecosystem; microorganisms; photochemical; wetland; sink dynamics; upland forest.

Title	**Emerging role of wetland methane emissions in driving 21st century climate change**
Author Name	Zhen Zhang, Niklaus E. Zimmermann, Andrea Stenke, Xin Li, Elke L. Hodson, Gaofeng Zhu, Chunlin Huang & Benjamin Poulter
Journal Name	Proceedings of the National Academy of Sciences(PNAS)
Year	2017
Volume and Issue	114, 36
Pages	9647-9652
Abstracts	Wetland methane (CH_4) emissions are the largest natural source in the global CH_4 budget, contributing to roughly one third of total natural and anthropogenic emissions. As the second most important anthropogenic greenhouse gas in the atmosphere after CO_2, CH_4 is strongly associated with climate feedbacks. However, due to the paucity of data, wetland CH_4 feedbacks were not fully assessed in the Intergovernmental Panel on Climate Change Fifth Assessment Report. The degree to which future expansion of wetlands and CH4emissions will evolve and consequently drive climate feedbacks is thus a question of major concern. Here we present an ensemble estimate of wetland CH_4 emissions driven by 38 general circulation models for the 21st century. We find that climate change-induced increases in boreal wetland extent and temperature-driven increases in tropical CH_4 emissions will dominate anthropogenic CH_4 emissions by 38 to 56% toward the end of the 21st century under the Representative Concentration Pathway (RCP2.6). Depending on scenarios, wetland CH_4 feedbacks translate to an increase in additional global mean radiative forcing of 0.04 W•m−2 to 0.19 W•m−2 by the end of the 21st century. Under the "worst-case" RCP8.5 scenario, with no climate mitigation, boreal CH_4 emissions are enhanced by 18.05 Tg to 41.69 Tg, due to thawing of inundated areas during the cold season (December to May) and rising temperature, while tropical CH_4 emissions accelerate with a total increment of 48.36 Tg to 87.37 Tg by 2099. Our results suggest that climate mitigation policies must consider mitigation of wetland CH_4 feedbacks to maintain average global warming below 2°C.
Keywords	global warming potential; climate feedbacks; inundation; radiative forcing; climate mitigation

Title	The growing role of methane in anthropogenic climate change
Author Name	M Saunois, R B Jackson, P Bousquet, B Poulter and J G Canadell
Journal Name	Environmental Research letters
Year	2016
Volume and Issue	11
Pages	1748-9326
Abstracts	Unlike CO_2, atmospheric methane concentrations are rising faster than at any time in the past two decades and, since 2014, are now approaching the most greenhouse-gas-intensive scenarios. The reasons for this renewed growth are still unclear, primarily because of uncertainties in the global methane budget. New analysis suggests that the recent rapid rise in global methane concentrations is predominantly biogenic-most likely from agriculture-with smaller contributions from fossil fuel use and possibly wetlands. Additional attention is urgently needed to quantify and reduce methane emissions. Methane mitigation offers rapid climate benefits and economic, health and agricultural co-benefits that are highly complementary to CO_2 mitigation.
Keywords	growing role of methane; anthropogenic climate change.

Title	**Different responses of nitrogen fertilization on methane emission in rice plant included and excluded soils during cropping season**
Author Name	Gil Won Kim, Hyo Suk Gwon, Seung Tak Jeong, Hyun Young Hwang, Pil Joo Kim
Journal Name	Agriculture, Ecosystems & Environment
Year	2016
Volume and Issue	230
Pages	162-168
Abstracts	Since nitrogen (N) fertilization is the most efficient practice for increasing rice production, N fertilizer consumptions have continued to increase globally. Therefore, the effects of N fertilization on CH_4 emission characteristics have been extensively studied. However, no consistent conclusions to N fertilization on CH_4 cycles have been drawn so far. In order to evaluate the effect of N fertilization on CH_4 fluxes in rice fields, N fertilizer (urea) was applied at different levels (0–180 kg N ha^{-1}) in a typical temperate paddy soil, and CH_4 emissions were characterized under two different soil conditions during cropping seasons (rice plant included and excluded soils). Seasonal CH_4 fluxes responded differently to N fertilization between the rice plants included and excluded soils. In rice plant excluded soils, total CH_4 fluxes significantly increased with increasing N fertilization levels. However, in rice plant included soils, seasonal CH_4 fluxes changed with a quadratic response. Total CH_4 fluxes increased with increasing N fertilization by 115–137 kg N ha^{-1} and later decreased. The difference in seasonal CH_4 fluxes between the two soils might be caused by rice rhizospheric activities and this difference could be defined as the minimum CH_4 oxidation potentials of rice rhizosphere. This CH_4 oxidation potential significantly increased with increasing N fertilization levels, and is highly correlated with total biomass, straw and root biomass productivities. Therefore, the decrease in CH_4 fluxes by high levels of N fertilization in rice plant included soils might be caused by the increasing N fertilization-induced CH_4 consumption.
Keywords	Urea; Methane oxidation; Rice yield; Paddy soil