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Published in:
Proceedings from the 7th SWS 2012 European Chapter Meeting

Publication date:
2012

Document version
Tidlig version også kaldet pre-print

Flooding-induced N_2O emissions following extreme weather flooding of a non-managed wetland soil

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Flooding of wetland soil promotes subsurface N_2O production in the soil and potential emission to the atmosphere in distinctive emission pulses. Changes in flooding frequency of wetland soil following future climate change will likely affect the timing and magnitude of nitrous oxide (N_2O) emissions from the soil to the atmosphere. In this study we focused on the N_2O emission effects of extreme precipitation events happening in a typical growing season of *Phalaris arundinacea* in a non-managed Danish wetland.

Rapid flooding of the wetland was observed twice during the growing season of 2010 in response to high precipitation events, but a flooding-induced N_2O emission pulse was only observed when the soil conditions had been oxidized to soil depths below approximately 30 cm in more than 2-3 weeks before the flooding. The flooding events observed in this study are likely examples of the pattern of future climatic conditions, where prolonged drainage during dry summers are combined with late season precipitation events with increasing intensity and frequency.

Under current climatic conditions and nitrification rates in the soil, flooding-induced N_2O emission pulses at the studied field site constitute only a small percentage of the net annual N_2O emission budget. Laboratory experiments mimicking the flooding events showed that the surface emission patterns are linked to variations in plant-mediated gas transport via *P. arundinacea* and N_2O producing/consuming processes in the root-zone.

We conclude that unless the future balance between the inherent N_2O consumption capacity in the peat soil and the rates of NO_3^- formation and net availability is markedly altered, a future increase in extreme weather flooding events is not expected to increase net N_2O emissions significantly or play a major role in the annual N_2O emission budget from this type of non-managed natural wetland.

References

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