Climate, Land Cover, and Management Practice Influences on N_2O Fluxes in South Korea

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Research Questions and Goals of the Project:

How do climate and typical management practices influence N_2O emissions of typical land use systems in Korea?

1) What are the major drivers of N_2O fluxes of typical deciduous forests in South Korea?

2) Does plastic mulching affect the N_2O emissions of agricultural soils where typical dry crops are being grown?

3) In what way do different water management practices affect the N_2O emissions of rice paddies?

Goals:

→ To obtain an overview of the amounts of N_2O being emitted from dominant land use systems in Korea

→ To obtain a better understanding of soil processes which underlie the N_2O emissions.

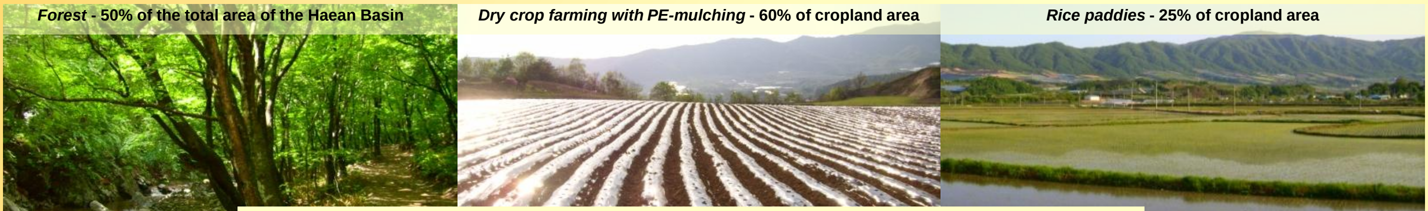

Figure 1: Dominant land use systems in Haean-Basin: deciduous forest, dry crop fields with PE-mulching and rice paddies

Methods:

Closed Chamber Measurements of N_2O fluxes

Isotope abundance analysis of ^{15}N-N_2O and determination of N_2O concentrations along soil profiles

Several other techniques to determine, for example, nitrate concentrations in the soil water, presence or absence of oxygen along rice paddy soil profiles, C- and N-Isotope signatures of soils at different depths and of leaves

Results:

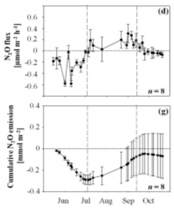

Figure 2: N_2O fluxes and cumulative N_2O emissions at forest site with sandy-loam soil

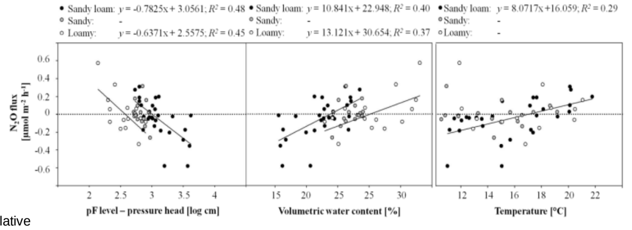

Figure 3: Correlations of N_2O fluxes with soil moisture [Volumetric water content and pF-level] and soil temperature.

1. Forest sites

Early summer drought turned the forest soils into an *unexpectedly persistent sink of N_2O*.

During the monsoon season the soils emitted N_2O.

Soil moisture and soil temperature explained the measured N_2O fluxes of the forest soil with *sandy-loam soil texture* very well.

2. Dry crop fields

An unexpected finding was the strong reduction of soil moisture underneath the PE-mulch, which is in contrast to earlier findings.

Drier PE-mulch-covered ridges showed less emissions of N_2O than moister non-covered ridges.

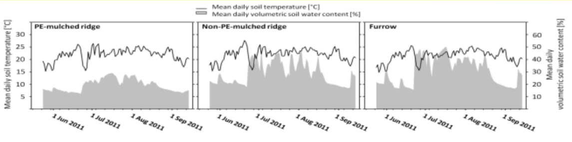

Figure 4: Mean daily soil moisture and mean daily soil temperature of PE-mulched ridges, non-PE-mulched ridges and furrows

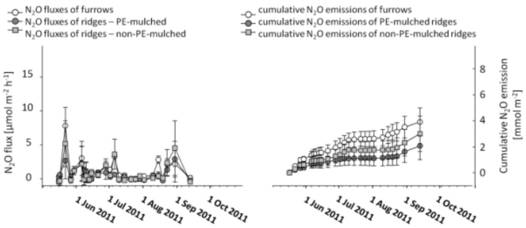

Figure 5: N_2O fluxes and cumulative N_2O emissions of ridges and furrows of a soybean field.

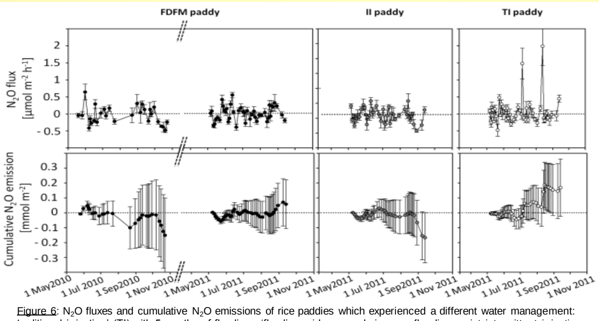

Figure 6: N_2O fluxes and cumulative N_2O emissions of rice paddies which experienced a different water management: traditional irrigation' (TI) with 5 months of flooding, 'flooding-midseason drainage-reflooding-moist intermittent irrigation without water logging' (FDFM) with 2.5 months of continuous flooding before the drainage and 'intermittent irrigation' (II) without continuous flooding.

3. Rice Paddies

The paddy which experienced the most flooding showed the most N_2O emissions, whereas the driest paddy showed the least emissions, which is an unexpected result. Soil investigations suggested that N_2O producing or consuming processes occurred at 40-50 cm soil depth.

High concentrations of nitrate along the soil profiles leached quickly, independent of the water management practice applied.

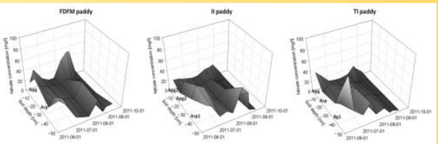

Figure 7: Nitrate concentrations along the soil profiles at the three investigated rice paddies

Conclusions:

N_2O emissions of the study region are in general quite low, which is very pleasing, but raises the question "why?".

There is evidence that huge amounts of NO_3^- - as the terminal electron-acceptor for denitrification - leach easily due to the soil conditions, so that not much denitrification can occur.

To understand why the N_2O emissions are so low requires a more detailed investigation of the fate of NO_3^-.