



evropský
sociální
fond v ČR



EVROPSKÁ UNIE



MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY



OP Vzdělávání
pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

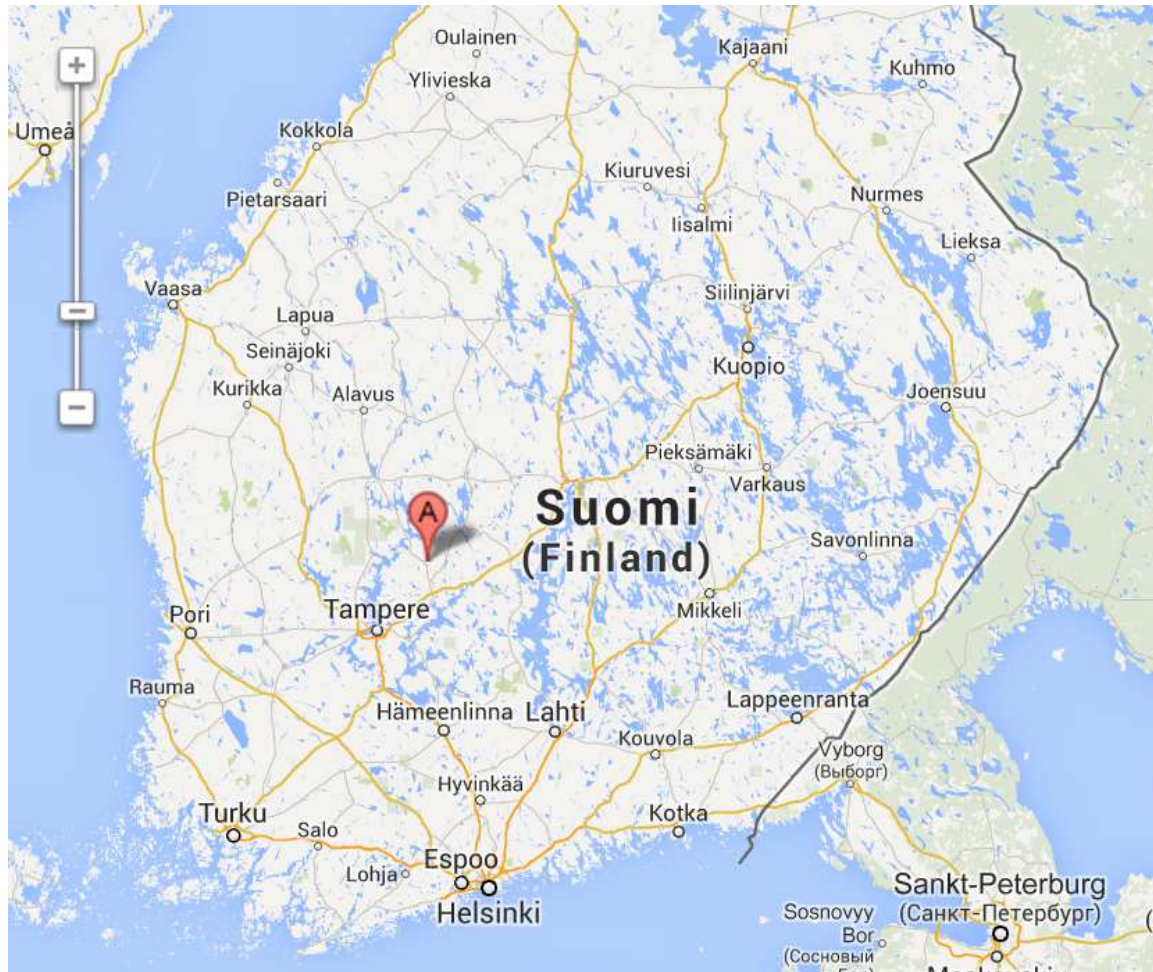
Nitrous oxide and methane emissions from *Pinus sylvestris*

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E. Halmeenmäki, H. Aaltonen, P. Kolari, J. Aalto,
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Tato akce se koná v rámci projektu:

Vybudování vědeckého týmu environmentální metabolomiky a ekofyziologie a jeho zapojení do mezinárodních sítí (ENVIMET; r.č. **CZ.1.07/2.3.00/20.0246**) realizovaného v rámci Operačního programu Vzdělávání pro konkurenceschopnost.

SMEAR II measuring station in Hyytiälä, Finland

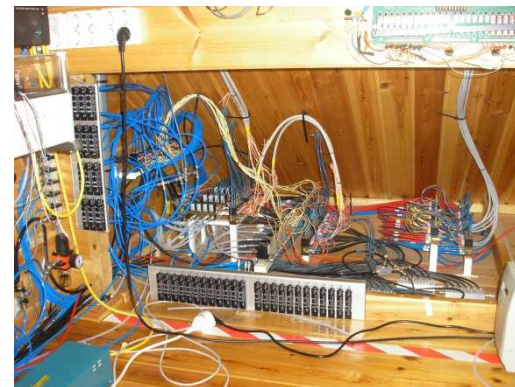
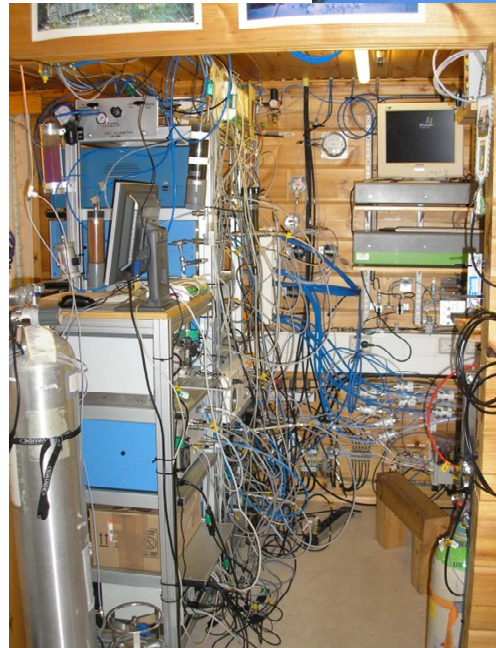


SMEAR II measuring station in Hyytiälä, Finland

- SMEAR (Station for Measuring Ecosystem-Atmosphere Relations)
- operated continuously since 1996
- 50 years old *Pinus sylvestris* forest
- 181 m a. s. l.
- annual mean temp. 3°C, precipitation 700 mm
- research: e.g. leaf, stand and ecosystem measurements of greenhouse gases, volatile organic compounds, pollutants (e.g. O₃, SO₂, NO_x) and aerosols, meteorological measurements.



SMEAR II measuring station in Hyytiälä, Finland

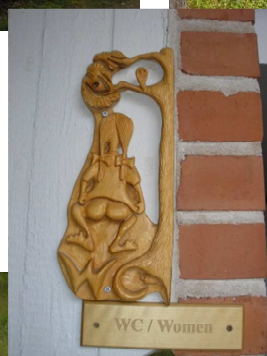


Mysterious device



???

Hyytiälä, Finland



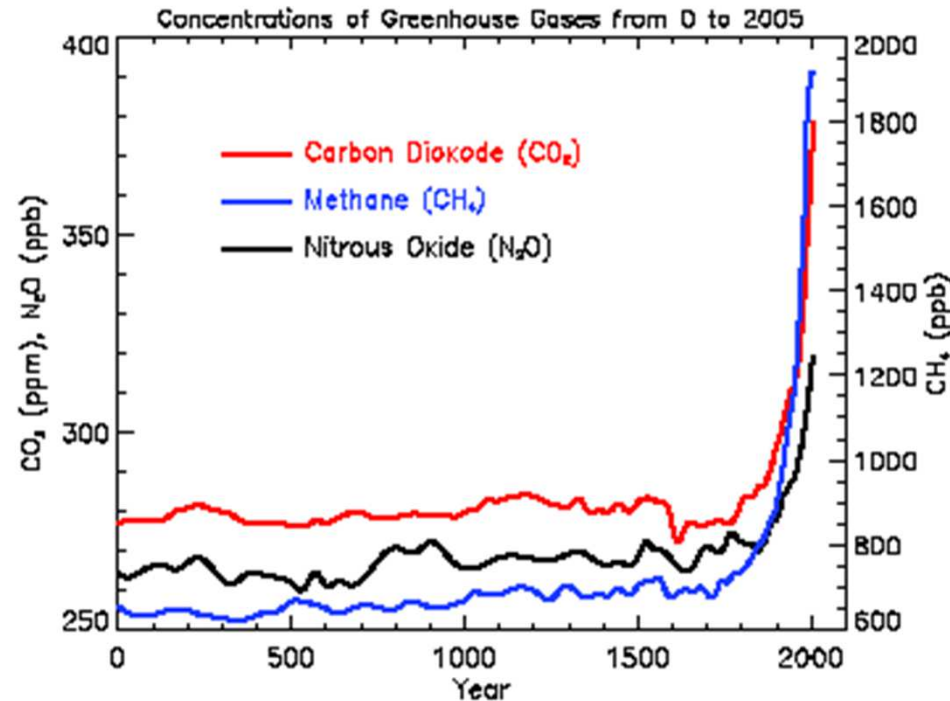
Measurement campaign - objective

- characterization and quantification of CH₄ and N₂O emissions from stems and shoots of Scots pine (*Pinus sylvestris*), as affected by soil moisture

Reasons:

- never measured coniferous tree species
- mature trees under natural field conditions
- both stem and shoot measurements

Introduction: Methane (CH₄) and Nitrous oxide (N₂O)



(Forster et al. 2007)

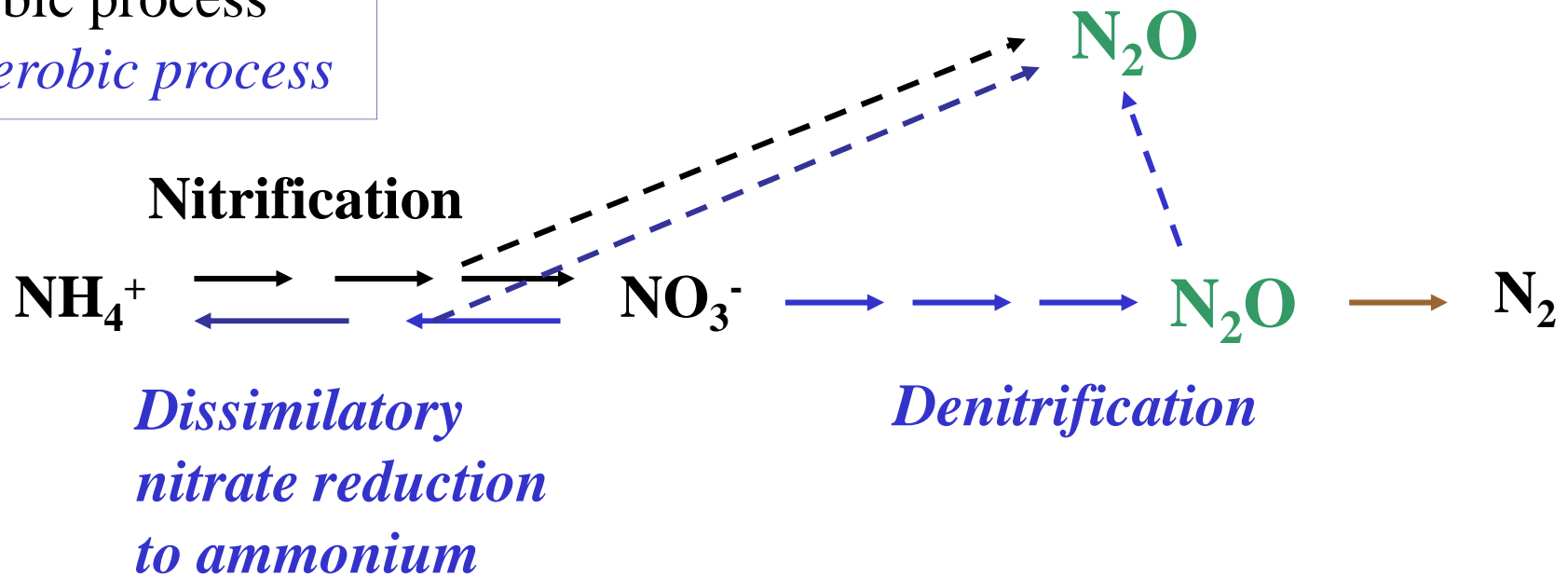
Sources of atmospheric methane and nitrous oxide:

	CH ₄	N ₂ O
Anthropogenic	63 %	36 %
Natural	37 %	64 %
(wetlands)		

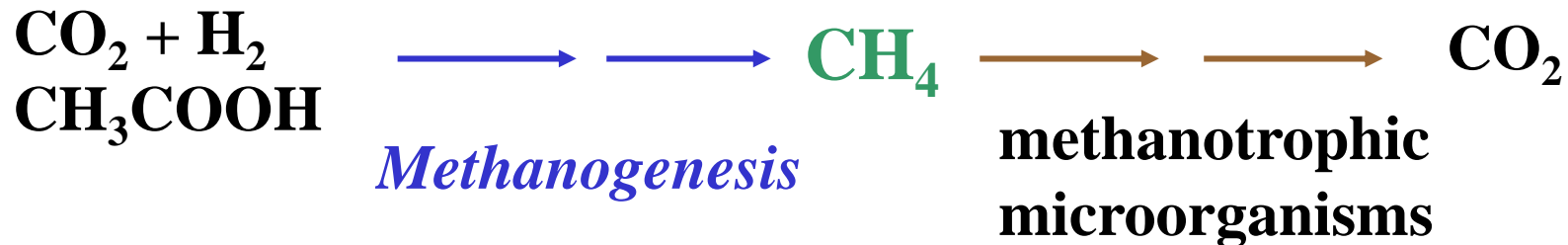
Introduction:

Soil microbial production of N_2O and CH_4

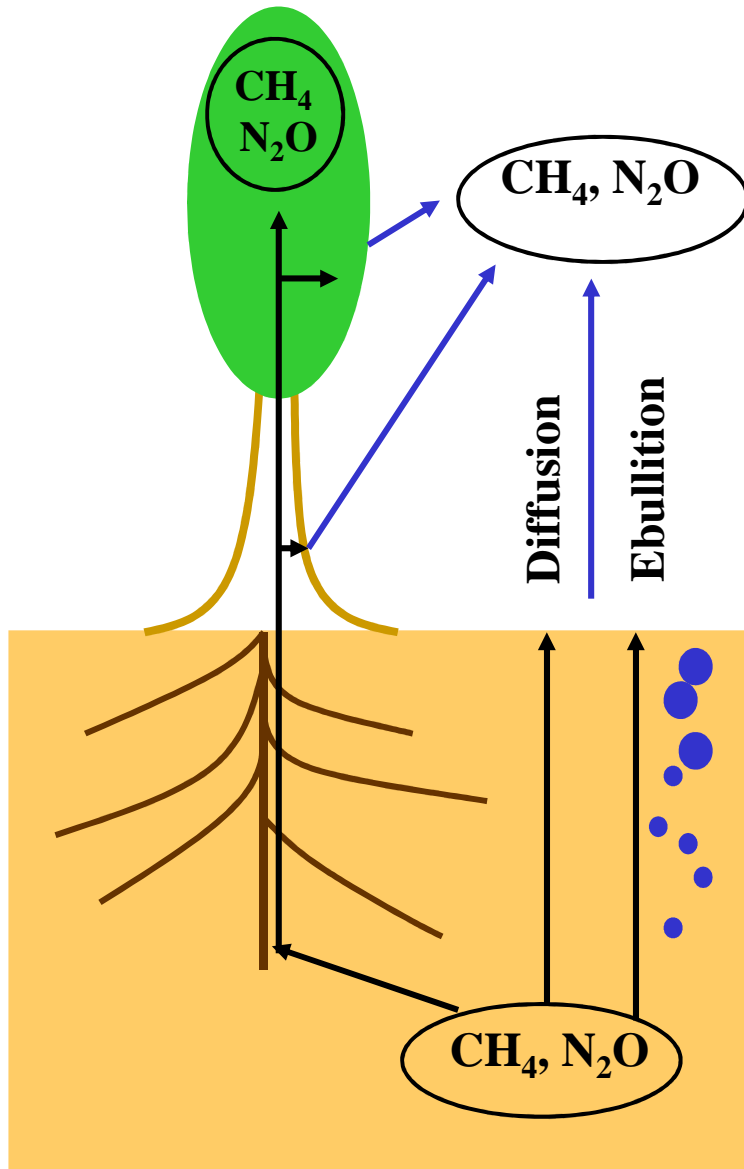
aerobic process
anaerobic process



e.g.



Introduction: Emissions of N_2O and CH_4 to atmosphere



Transport pathways through plants:

- Intercellular spaces and aerenchyma system (lenticels, stomata, micropores)
- xylem (transpiration stream) (lenticels, stomata)

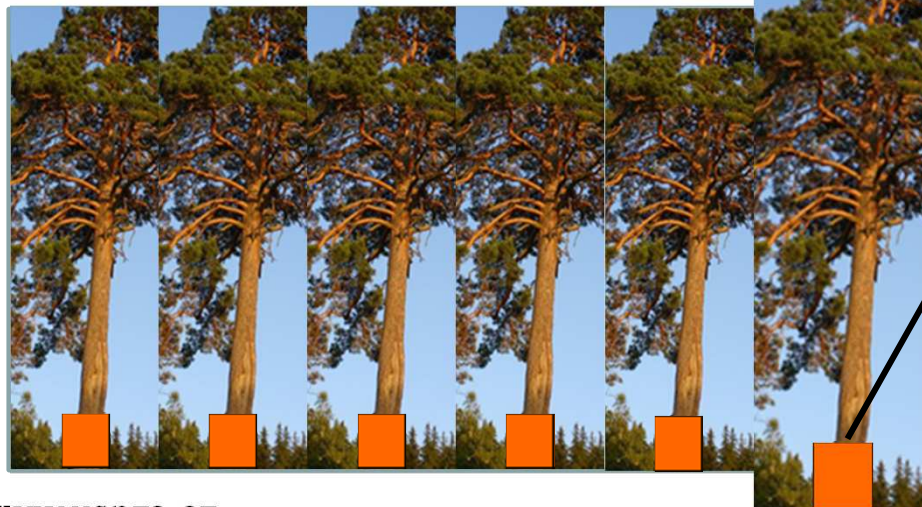
Hypotheses

- i) Mature *P. sylvestris* can emit measurable quantities of N_2O and CH_4 from its aboveground tissues.
- ii) N_2O and CH_4 emission fluxes from tree stems are lower compared to forest floor emission fluxes.
- iii) Trees growing under higher soil moisture exhibit higher emission rates of both gases than trees growing under lower mean soil humidity.

Experimental design



12x *P. sylvestris* trees (50 y. old)



www.uspza.cz



4 to 5 replicates



3 to 6 replicates

Dry site
(VWC
 $0.33 \text{ m}^3\text{m}^{-3}$)



3 chambers,
9 replicates

Wet site
(VWC
 $0.75 \text{ m}^3\text{m}^{-3}$)



2 chambers,
6 replicates

Gas sample uptake and analyses



Closure time 5.5 h



Closure time 5.5 h



Closure time 40 min

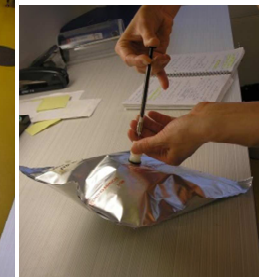


6 samples
a`chamber

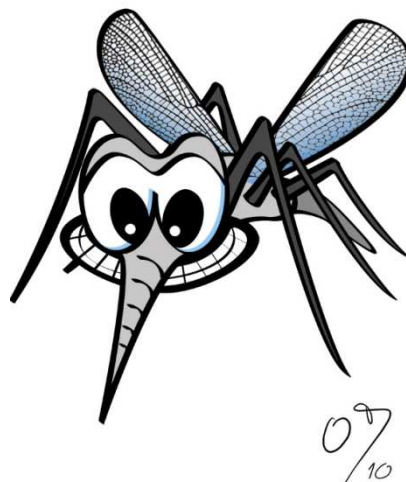
Storage at 4°C



Standard gases



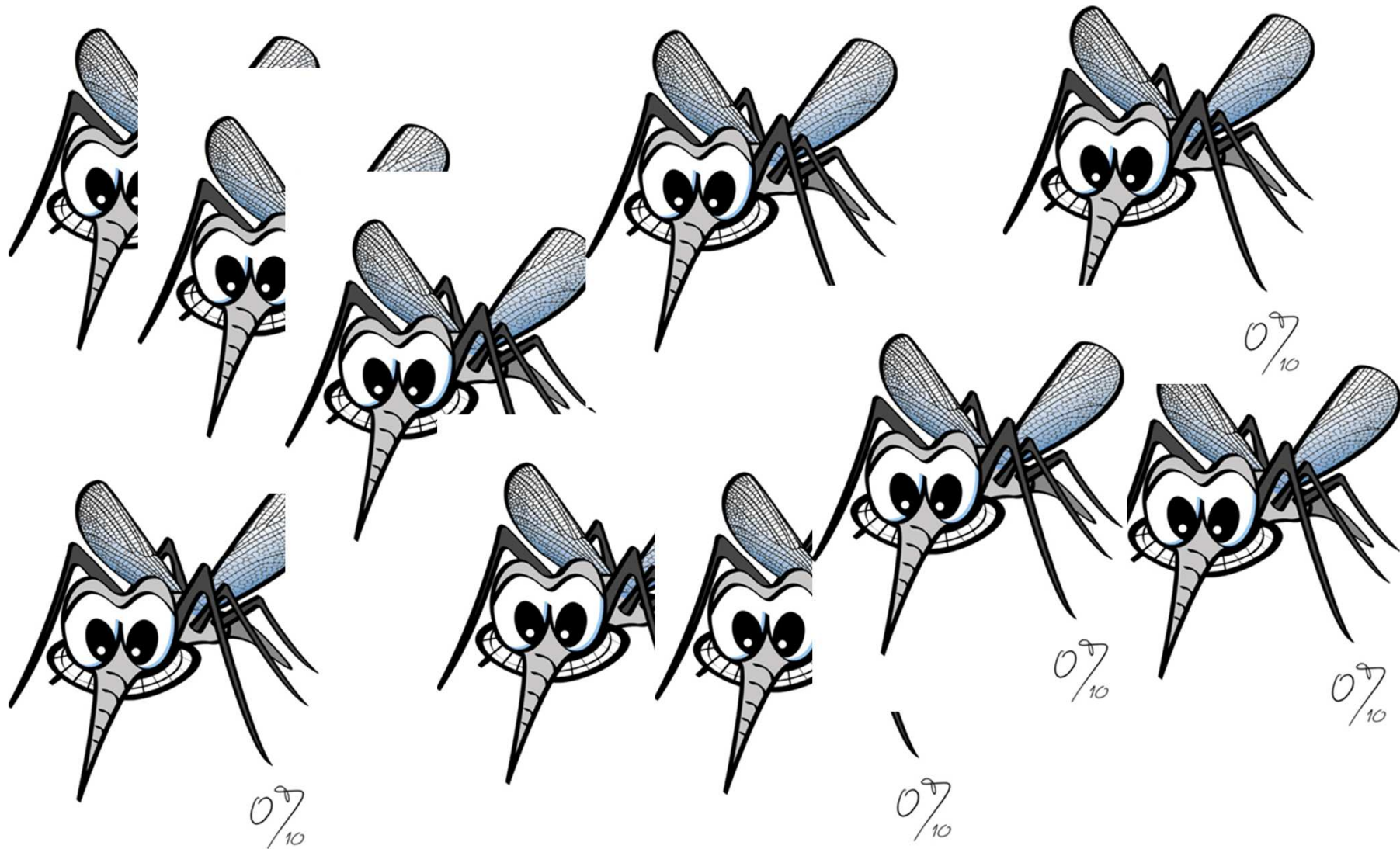
Euphoria and reality...



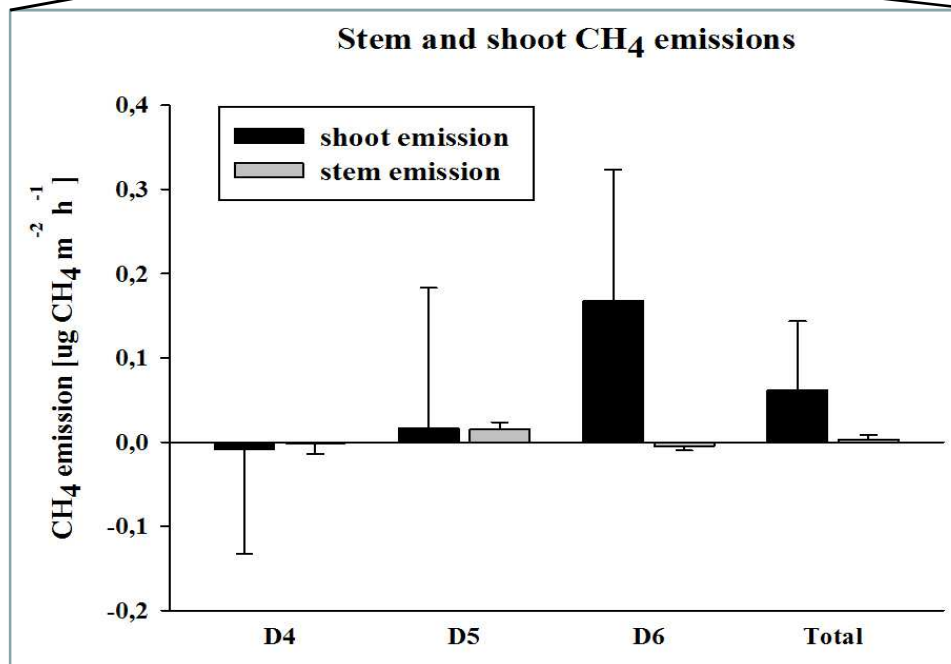
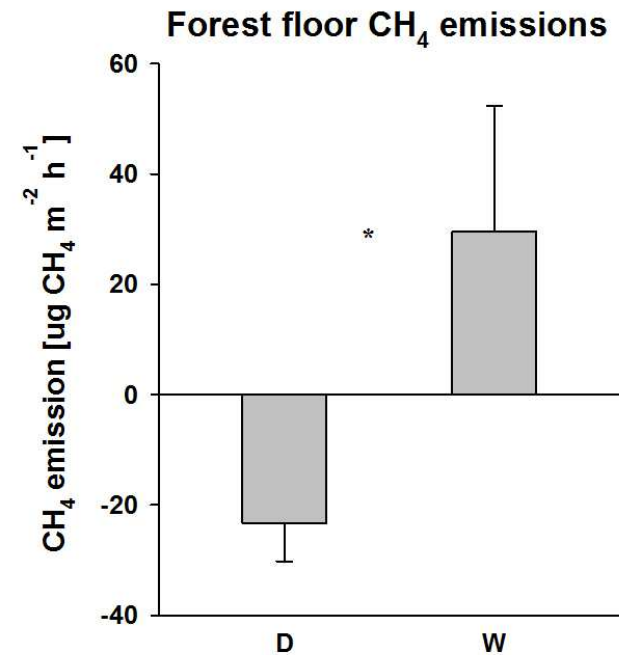
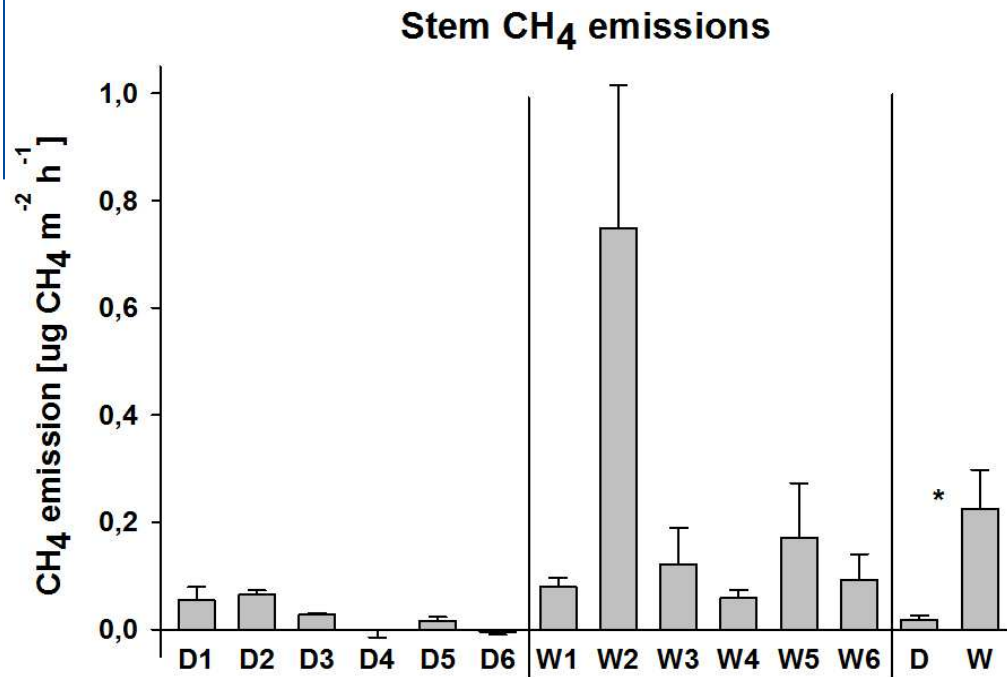
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Results: how many? --Bad luck!--infinite amount...

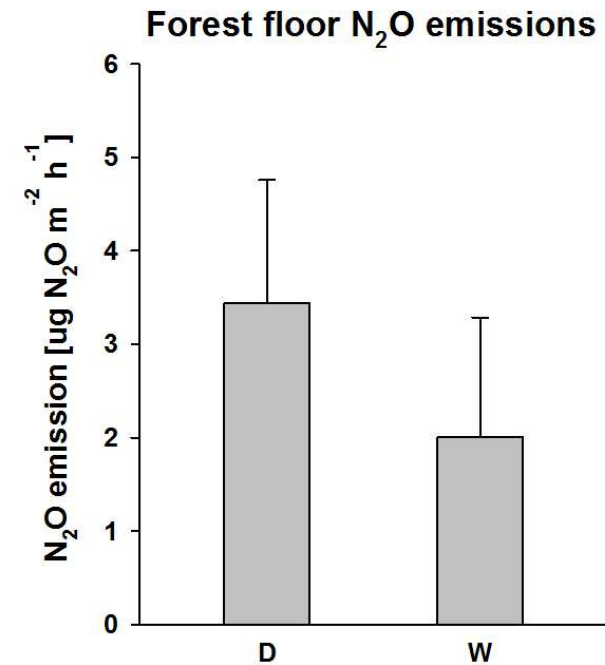
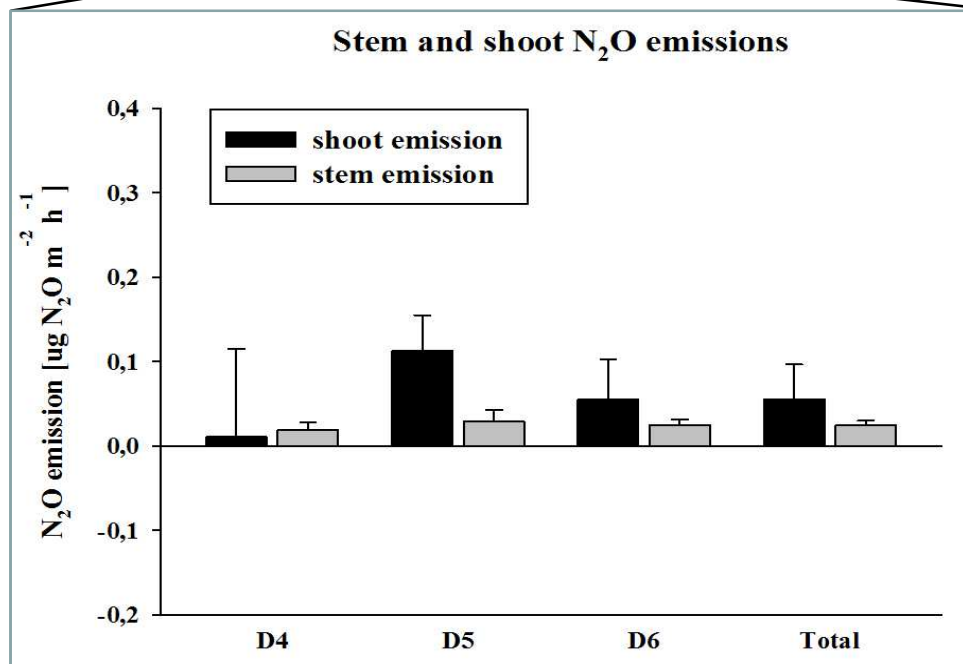
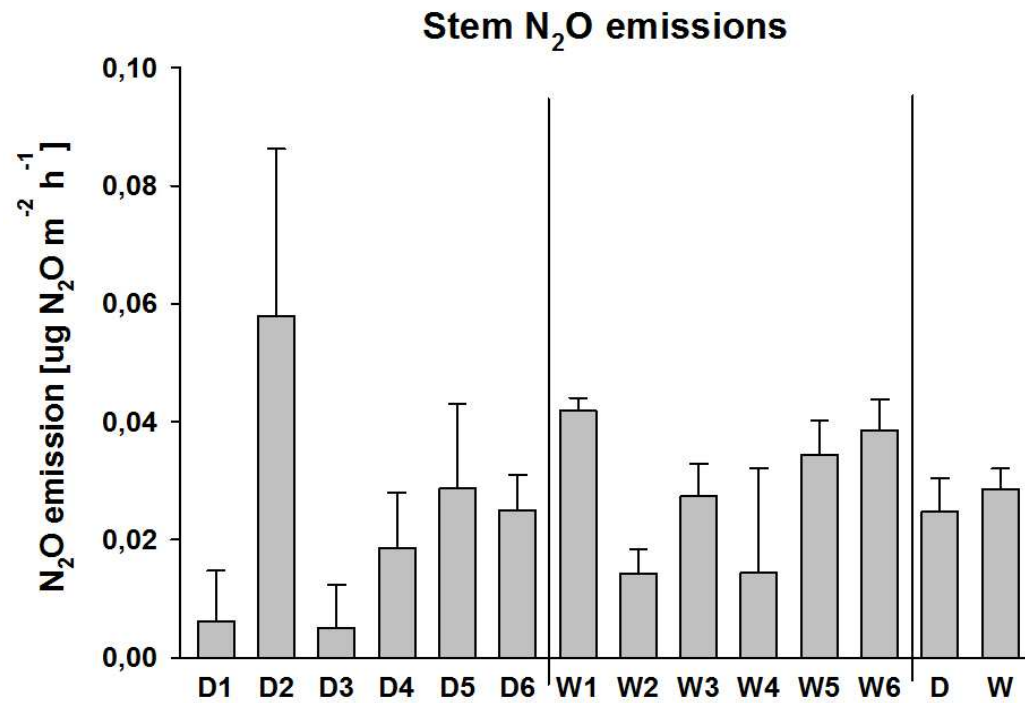


Results: CH₄



D dry site
W wet site
D1-6, W1-6 tree number
* p ≤ 0.05

Results: N₂O



D dry site
W wet site
D1-6, W1-6 tree number
* p ≤ 0.05

Conclusion

The results demonstrate for the first time that mature *P. sylvestris* can emit small amounts of CH₄ and N₂O not only from stems but also from shoots under field conditions. (= Hypotheses 1)

N₂O (wet and dry site) and CH₄ (wet site) emission rates from tree aboveground surface area are lower compared to forest floor emission rates. (= Hypotheses 2)

CH₄ emission from the dry plot seems to occur predominantly via *P. sylvestris* and not via soil surface (≠ Hypotheses 2)

Conclusion

CH₄ emissions from stems of *P. sylvestris* are significantly positively affected by soil moisture. (= Hypotheses 3)

N₂O emission rates from stems of trees growing under higher and lower mean soil humidity do not differ significantly. (≠ Hypotheses 3)

Future plans

Extensive correlation analyses between:

- emission rates from stems/shoots and forest floor,
- tree/forest floor emission rates and soil/air physico-chemical characteristics

Rough estimation of CH₄ and N₂O emissions from whole tree =>

Rough estimation of contribution of mature *P. sylvestris* to N₂O and CH₄ fluxes from the ecosystem



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