



# **EFFECT OF PERSISTENT SUBSOIL COMPACTION ON N<sub>2</sub>O EMISSIONS FROM ARABLE SOILS**

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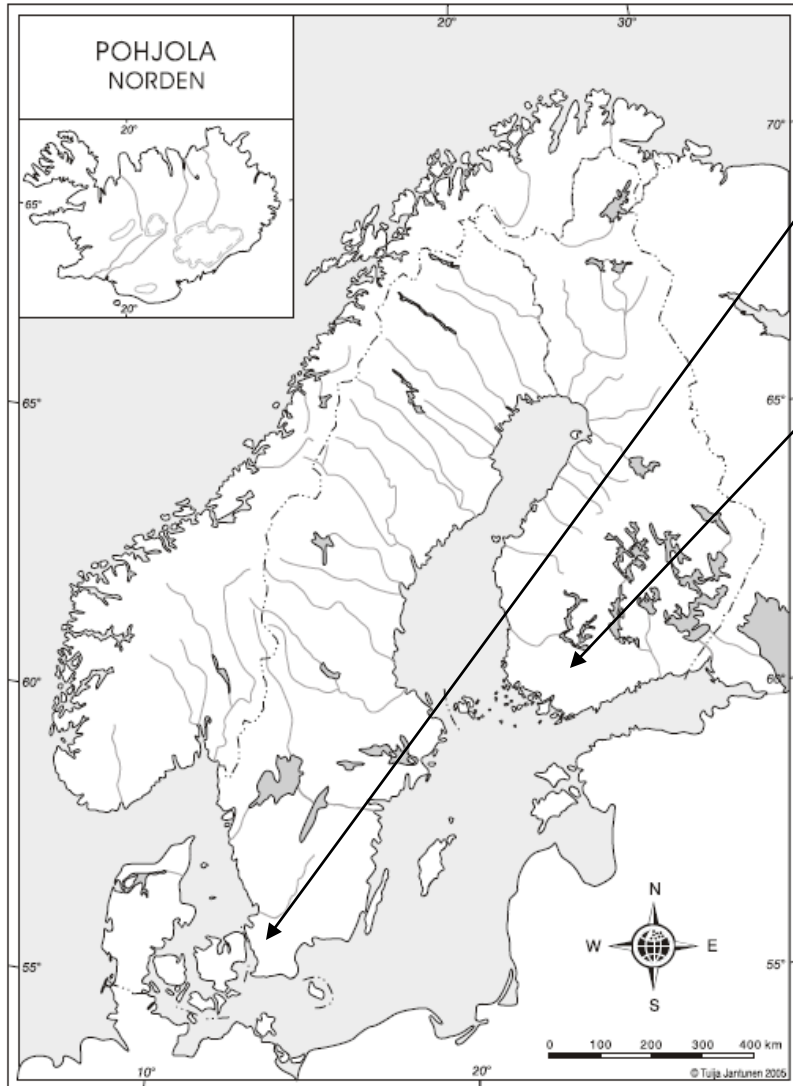
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Thomas Keller (Swedish University of Agricultural Sciences)

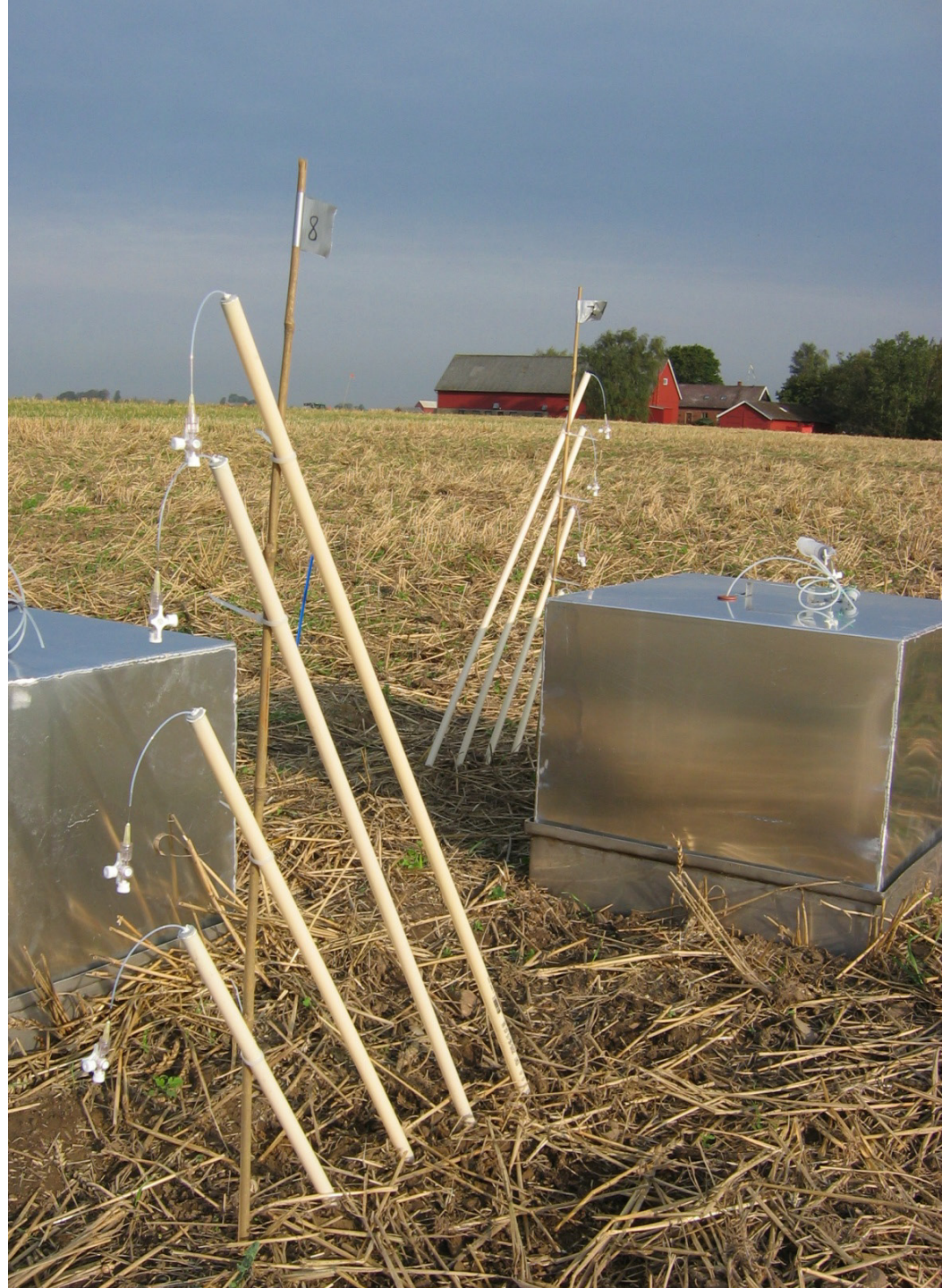
# The sites

- Treatments: control and compacted
- Kävlinge: Sandy clay loam, compacted in 1995, cereal-sugar beet-rapeseed rotation
- Jokioinen: Clay soil, compacted in 1981, cereal cultivation
- Compaction was done using heavy machines; effect still seen as higher penetrometer resistance, lower air permeability and lower gas diffusivity in the layer 30-50 cm
- N<sub>2</sub>O flux and soil air sampling Oct 2009-Sep 2010

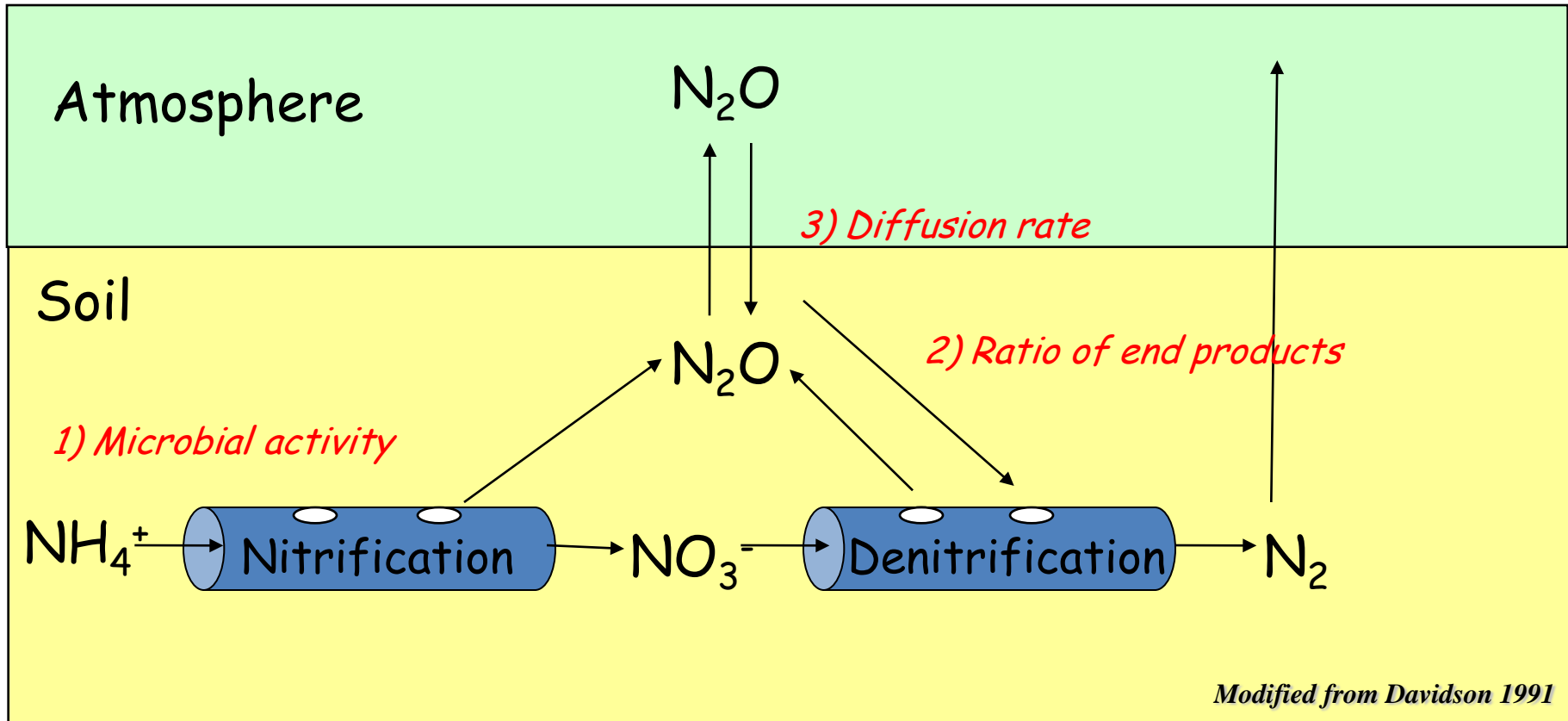


# Set up

- 8 (SE) or 4 (FI) replicate chambers and 16 sets of soil air samplers at 15, 30, 50 and 70 cm depth in each treatment.
- Soil moisture and temperature loggers were installed in some plots.
- Sampling was carried out at 2-4 wk intervals
- No soil air sampling in winter



# Regulation of N<sub>2</sub>O fluxes



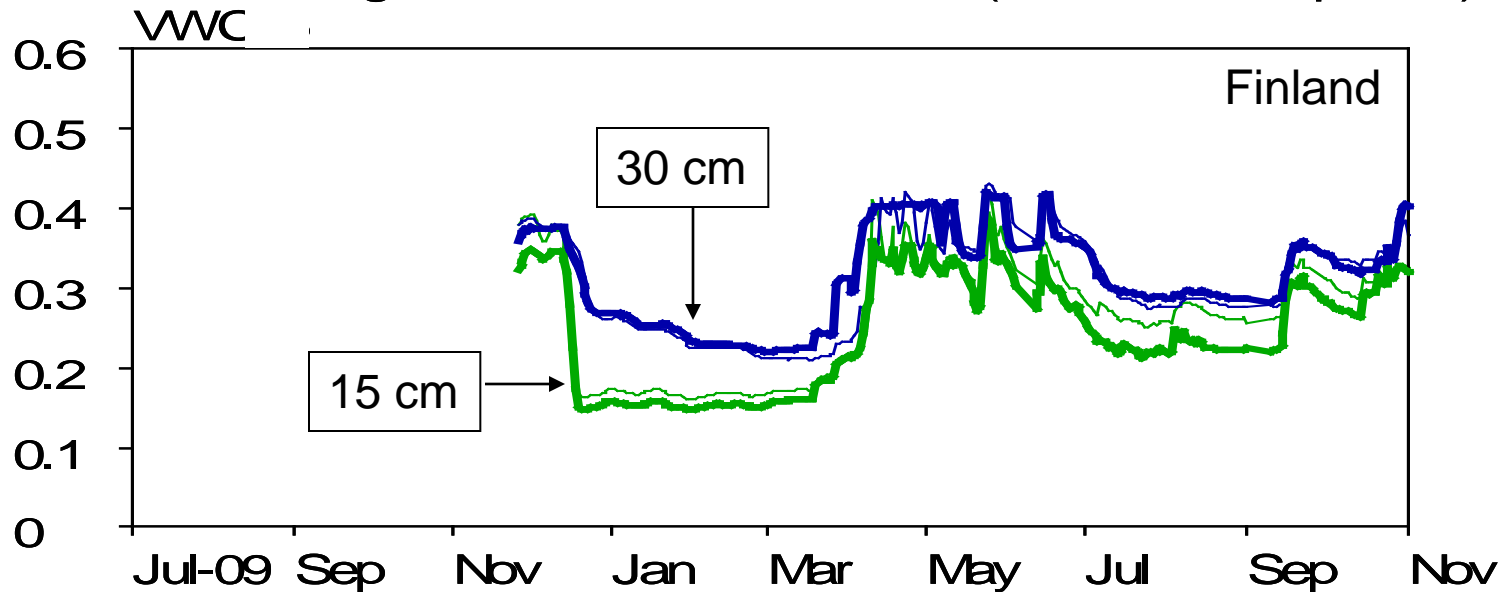
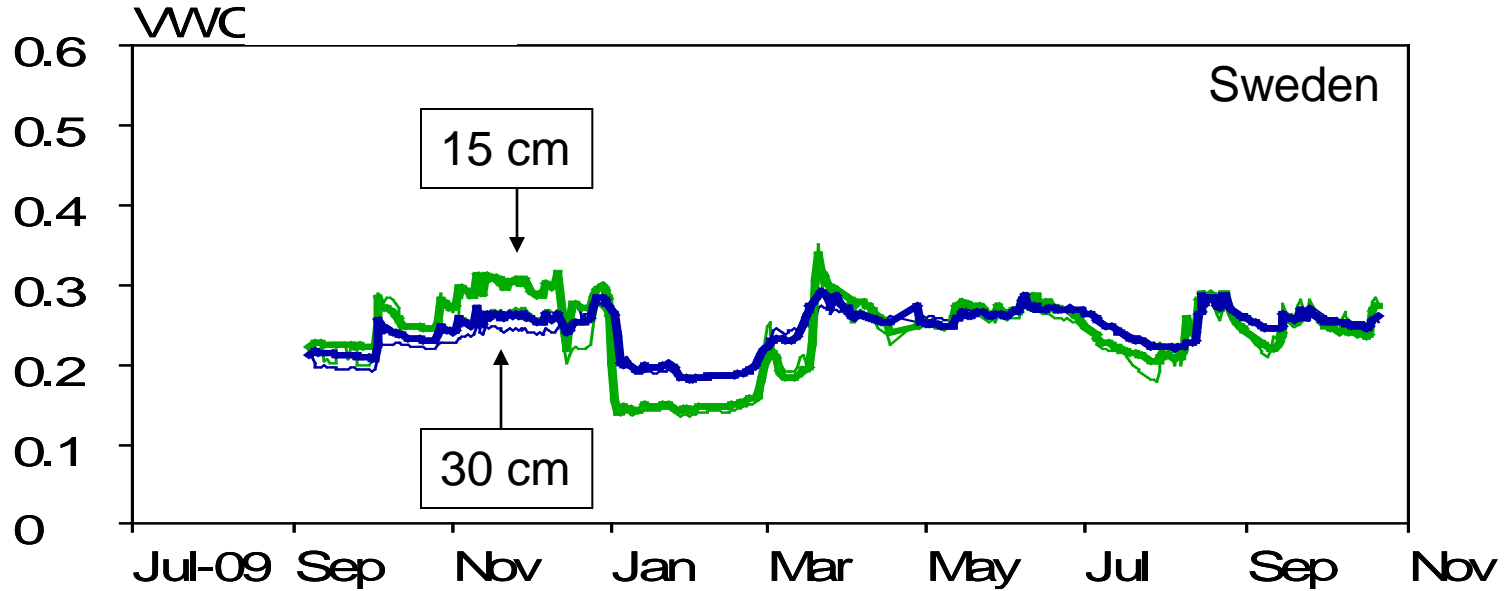
Soil compaction can affect N<sub>2</sub>O flux by

- 1) Increasing soil moisture → more denitrification → more N<sub>2</sub>O
- 2) Decreasing aeration → less N<sub>2</sub>O than N<sub>2</sub> in the end products
- 3) Reducing diffusion from the soil → less N<sub>2</sub>O flux

→ Positive or negative net effect?

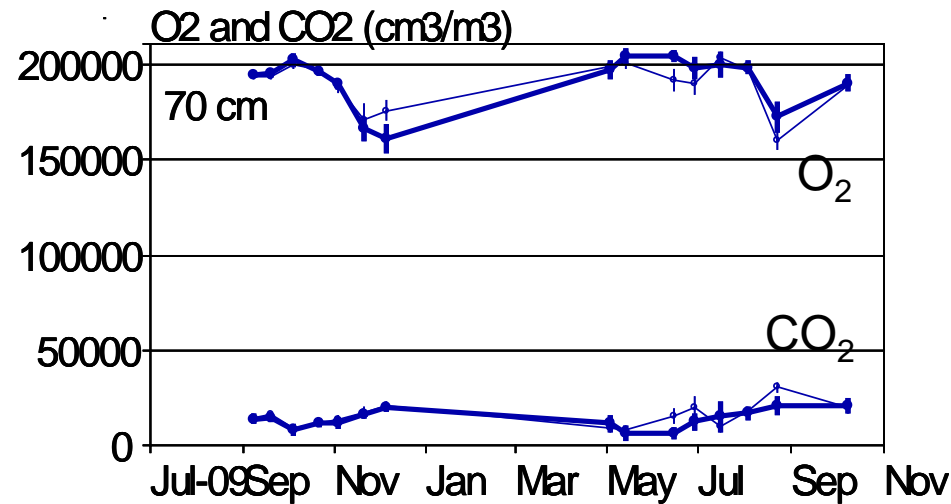
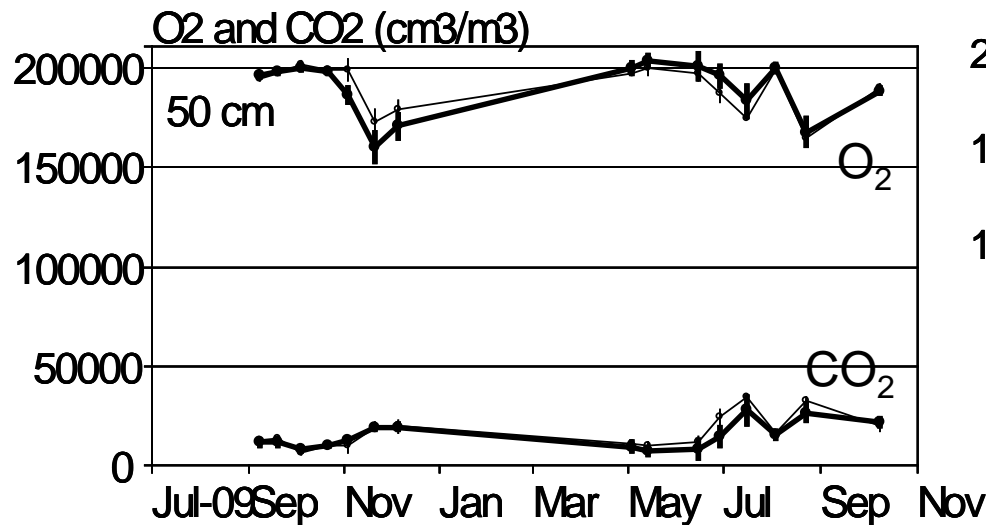
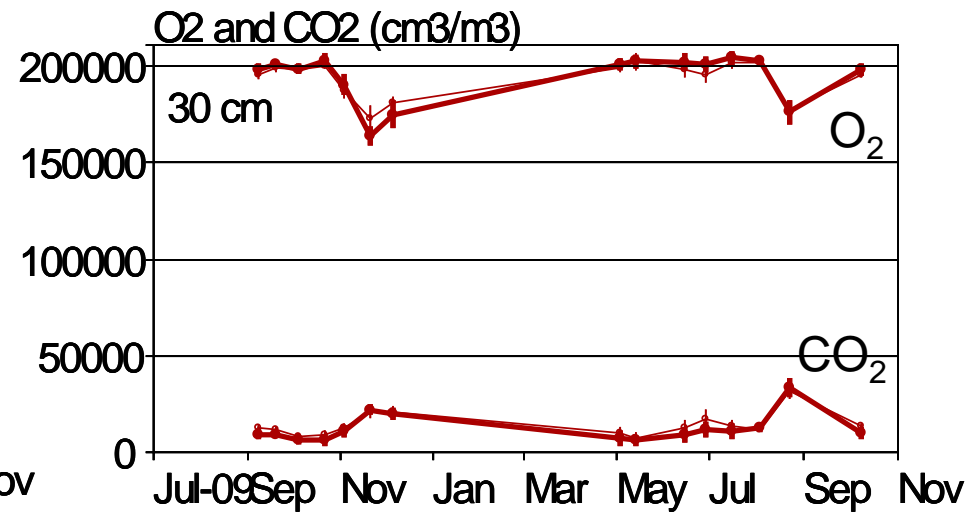
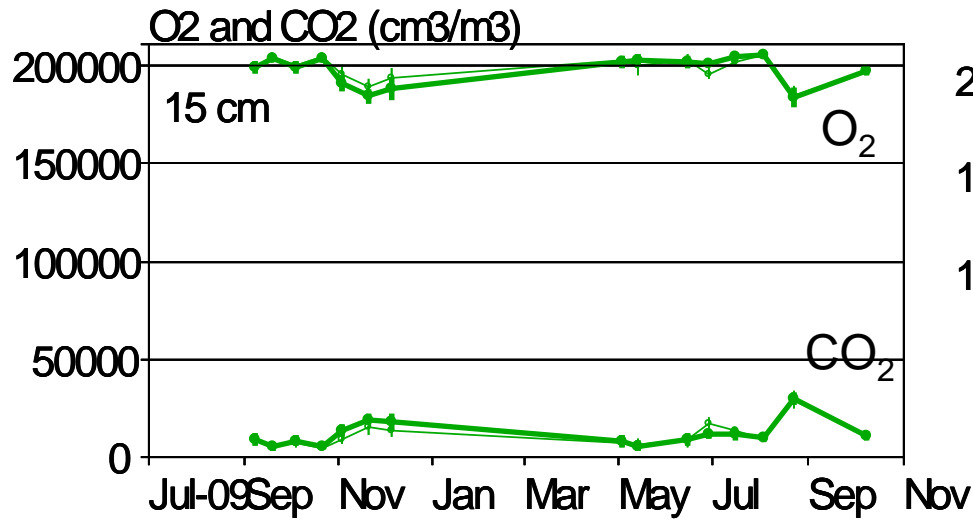
# Soil moisture

green: 15 cm blue: 30 cm (thick line: compacted)



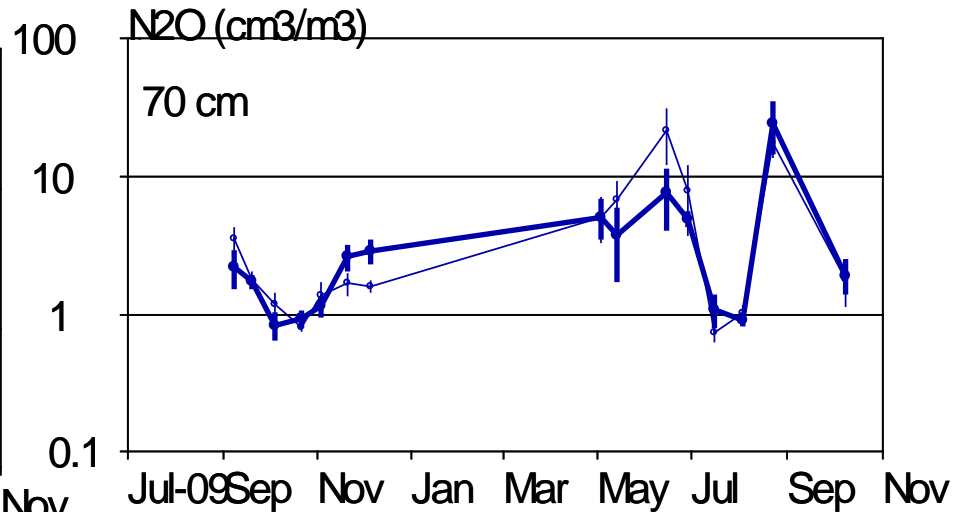
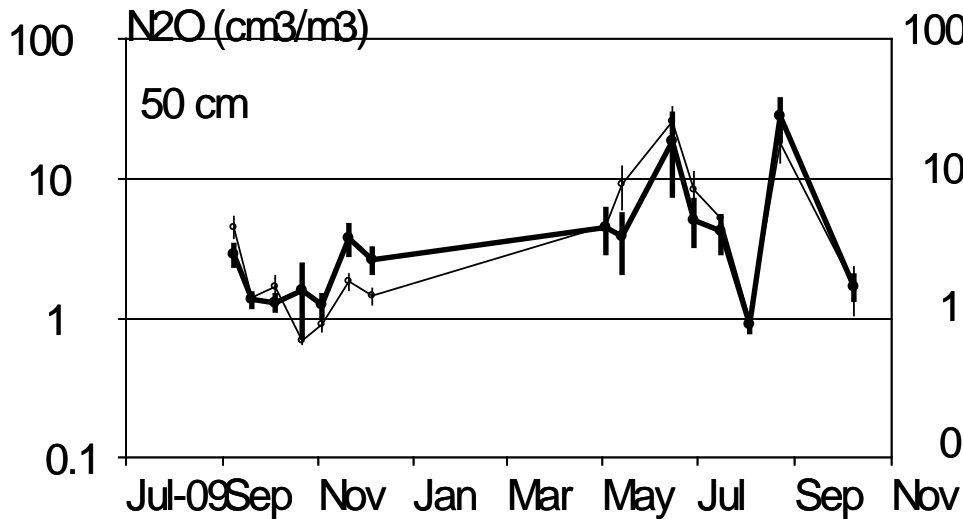
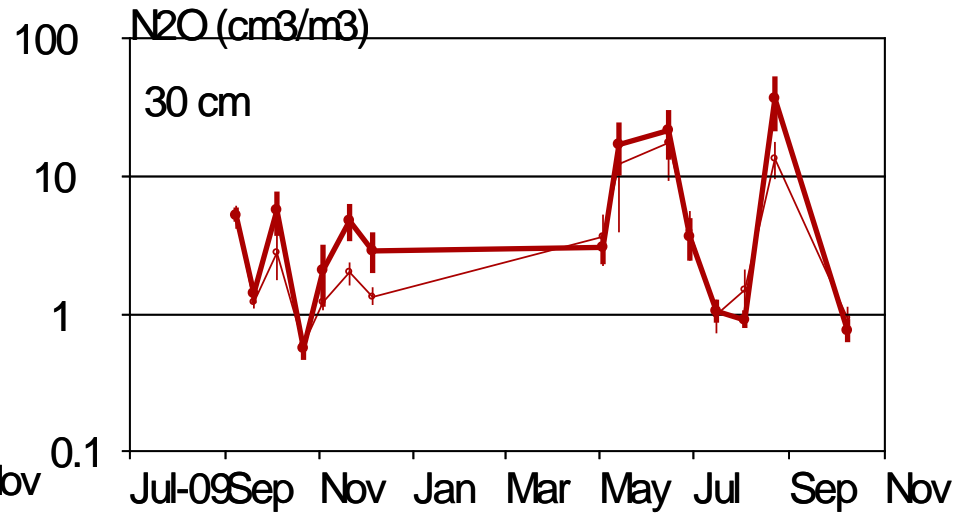
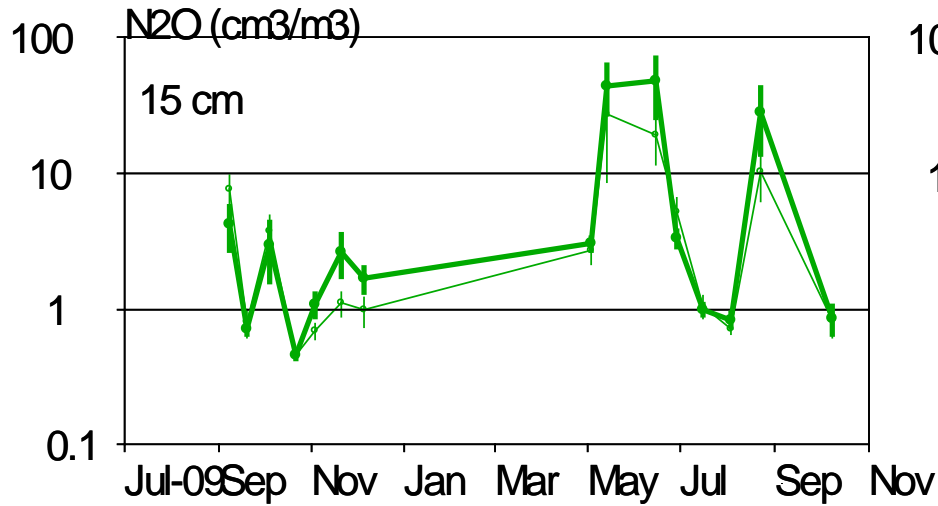
# O<sub>2</sub> and CO<sub>2</sub> in soil air - Sweden

Uncompacted = thin line, Compacted = thick line

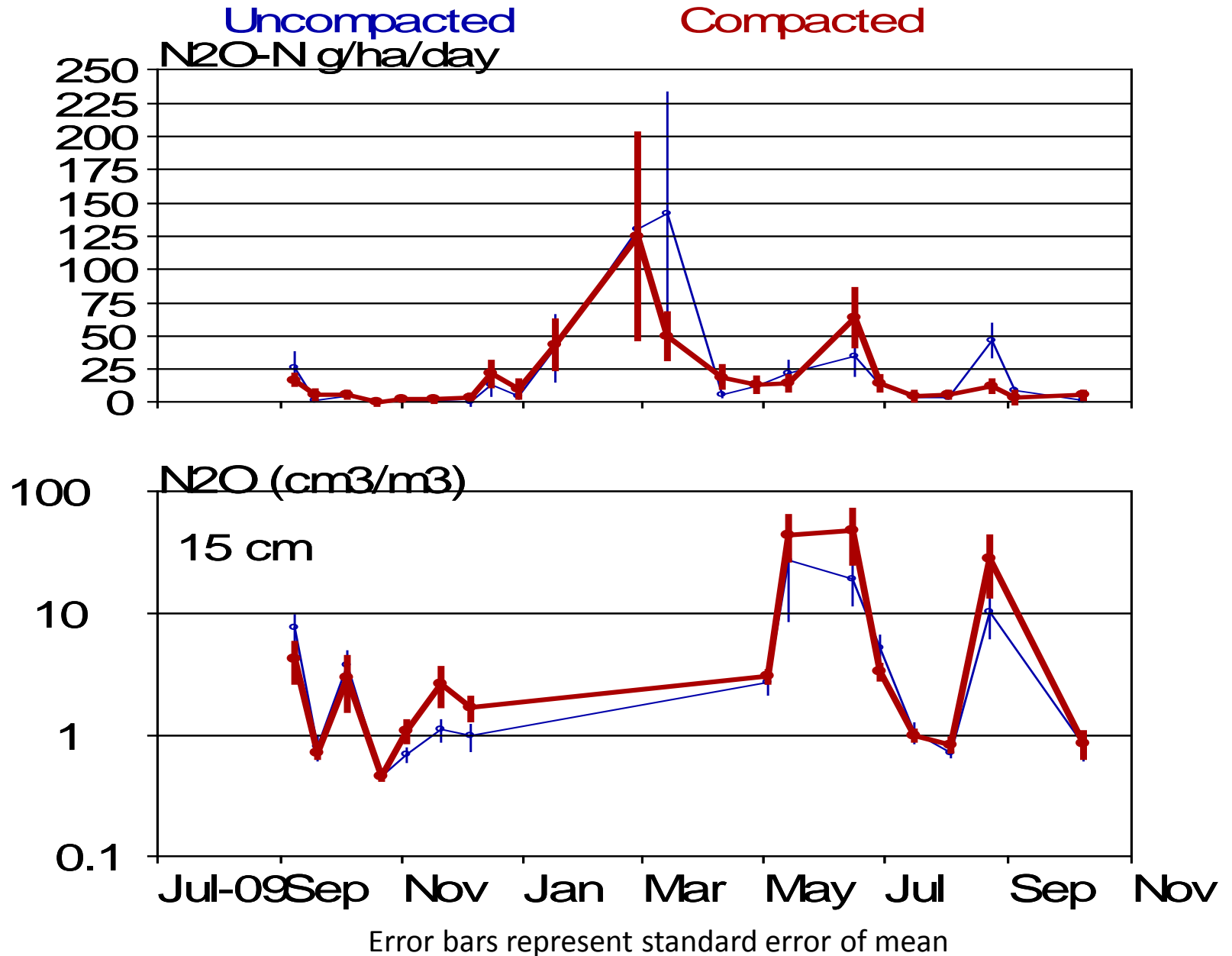


# N<sub>2</sub>O in soil air - Sweden

Uncompacted = thin line, Compacted = thick line

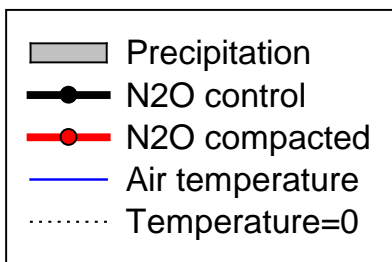
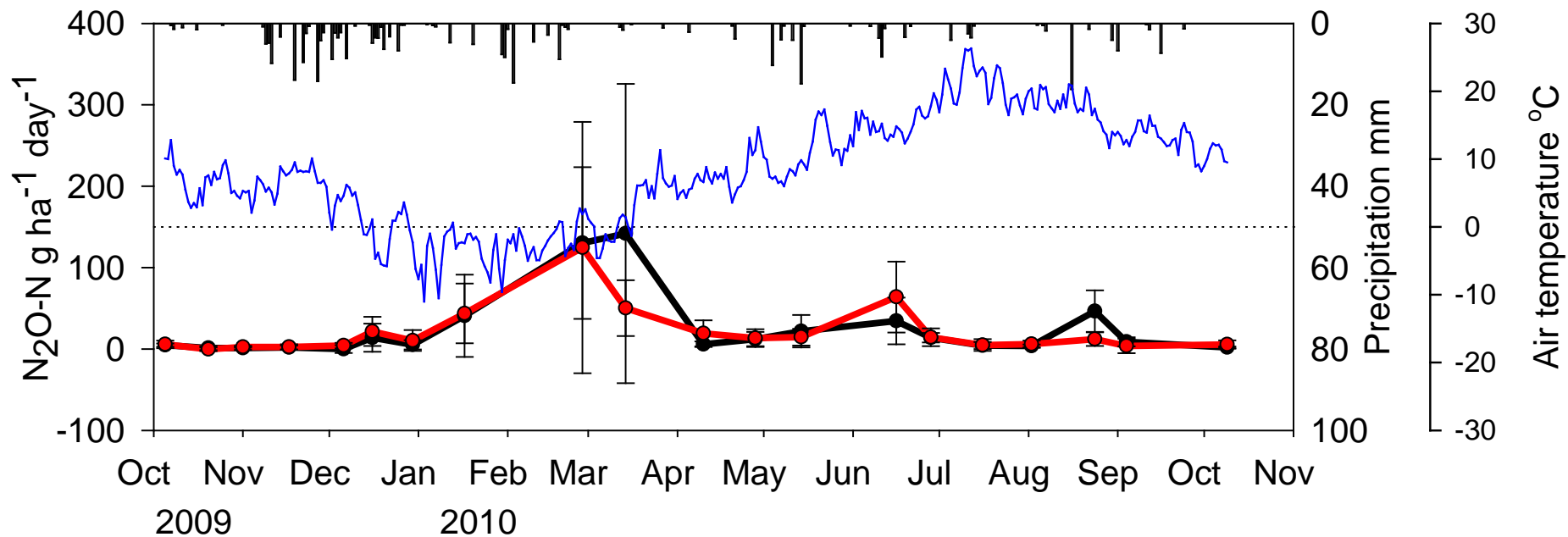


# N<sub>2</sub>O emissions and concentrations in soil at 15 cm - Sweden



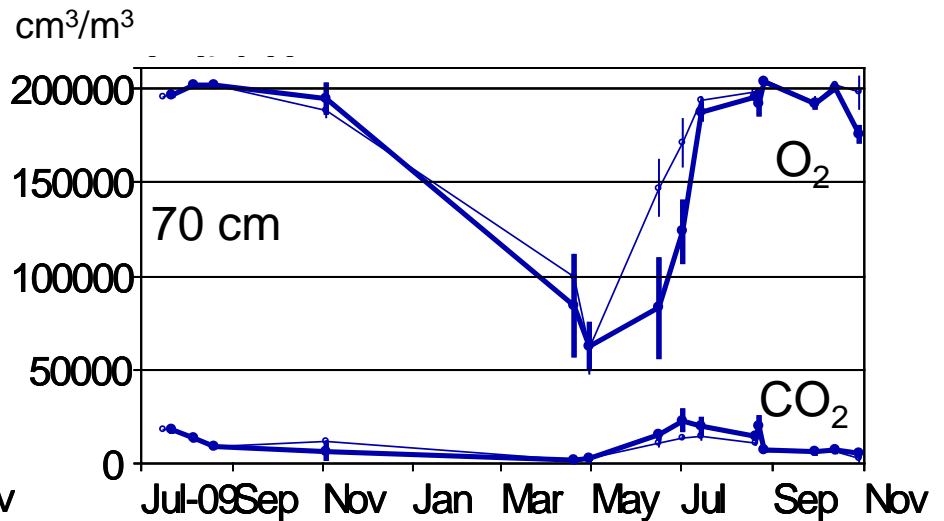
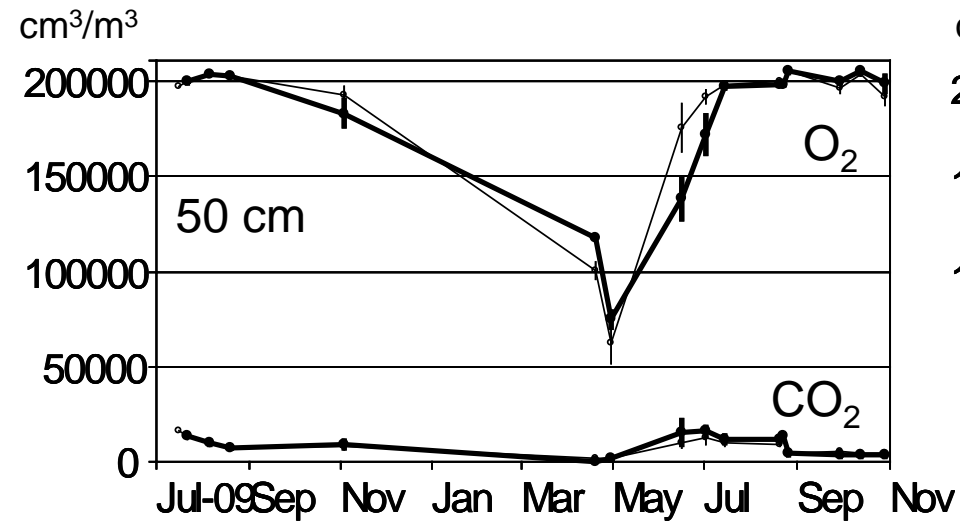
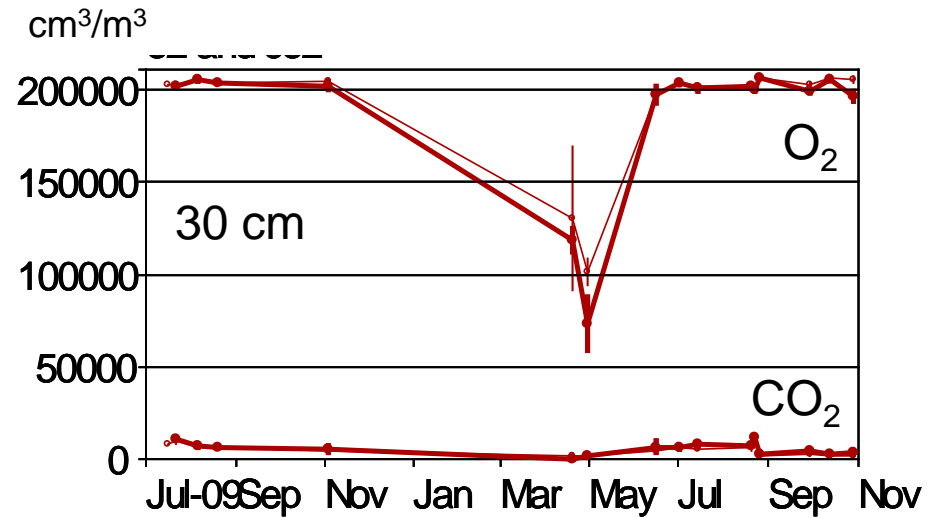
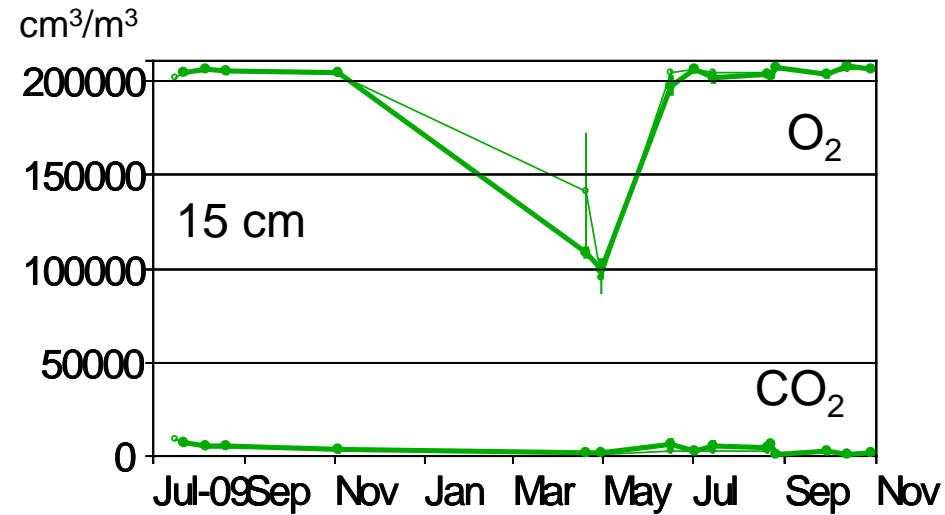


# N<sub>2</sub>O flux, precipitation, air temperature - Sweden



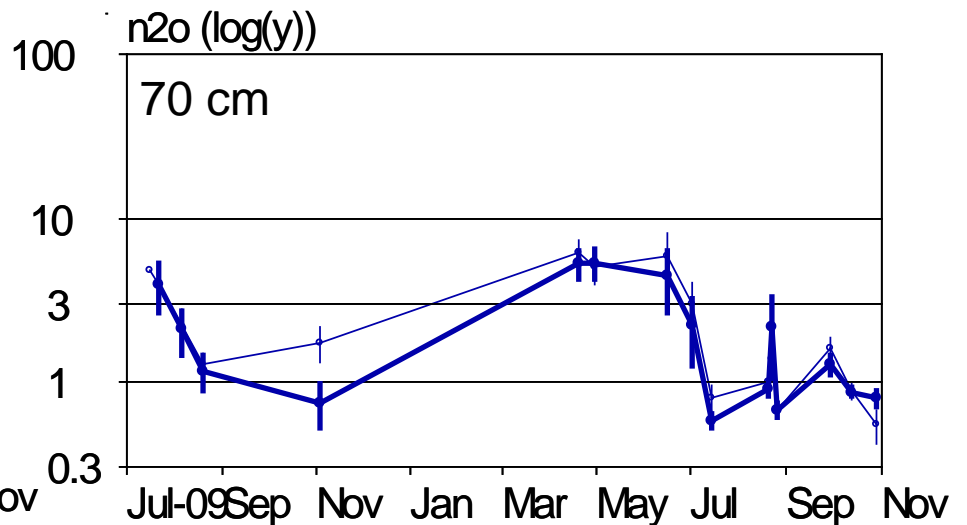
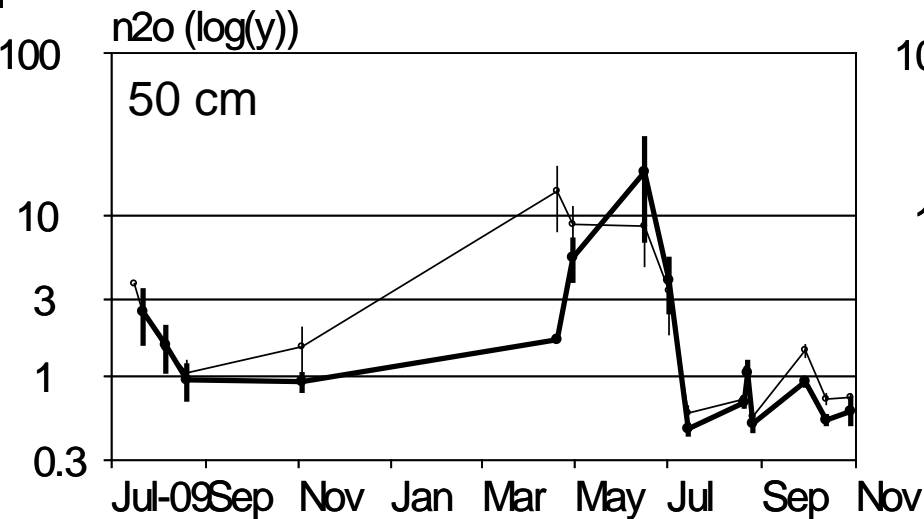
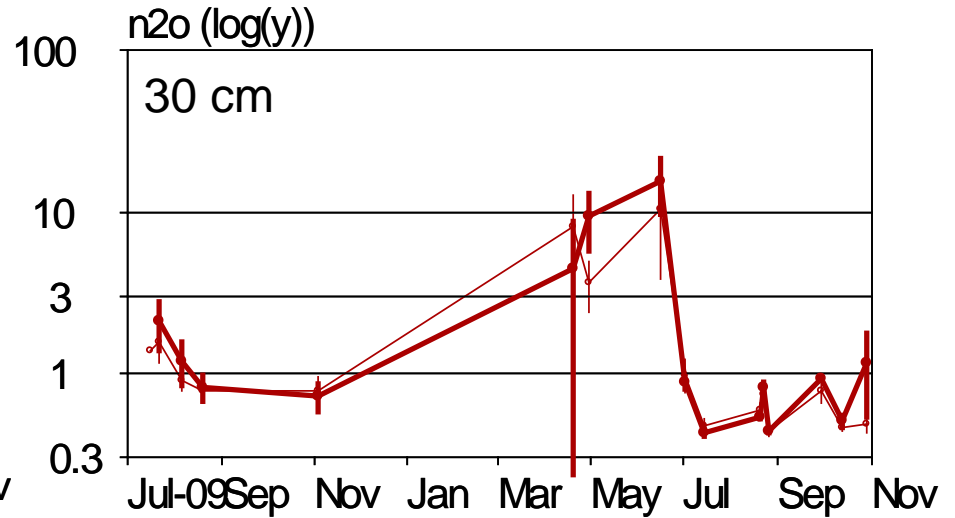
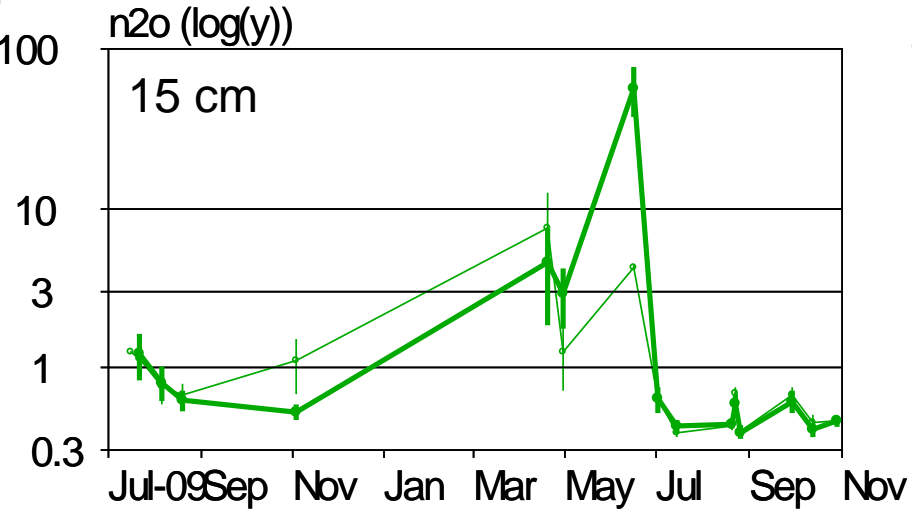
# O<sub>2</sub> and CO<sub>2</sub> in soil air - Finland

Uncompacted = thin line, Compacted = thick line

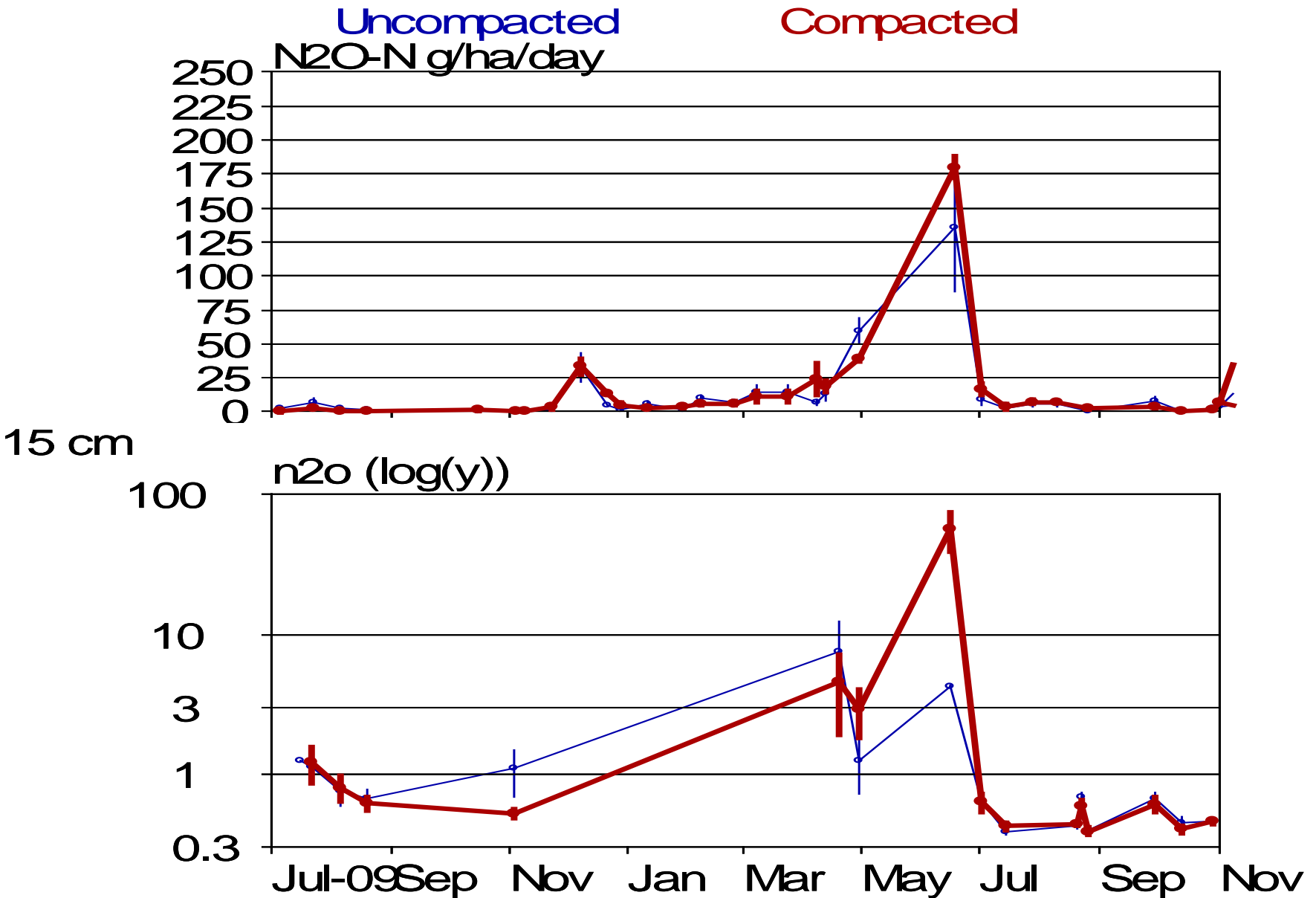


# N<sub>2</sub>O in soil air - Finland

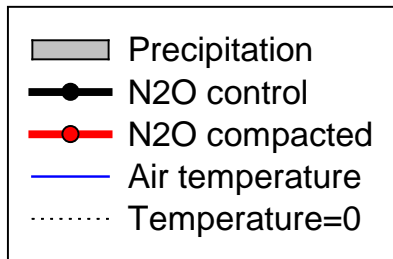
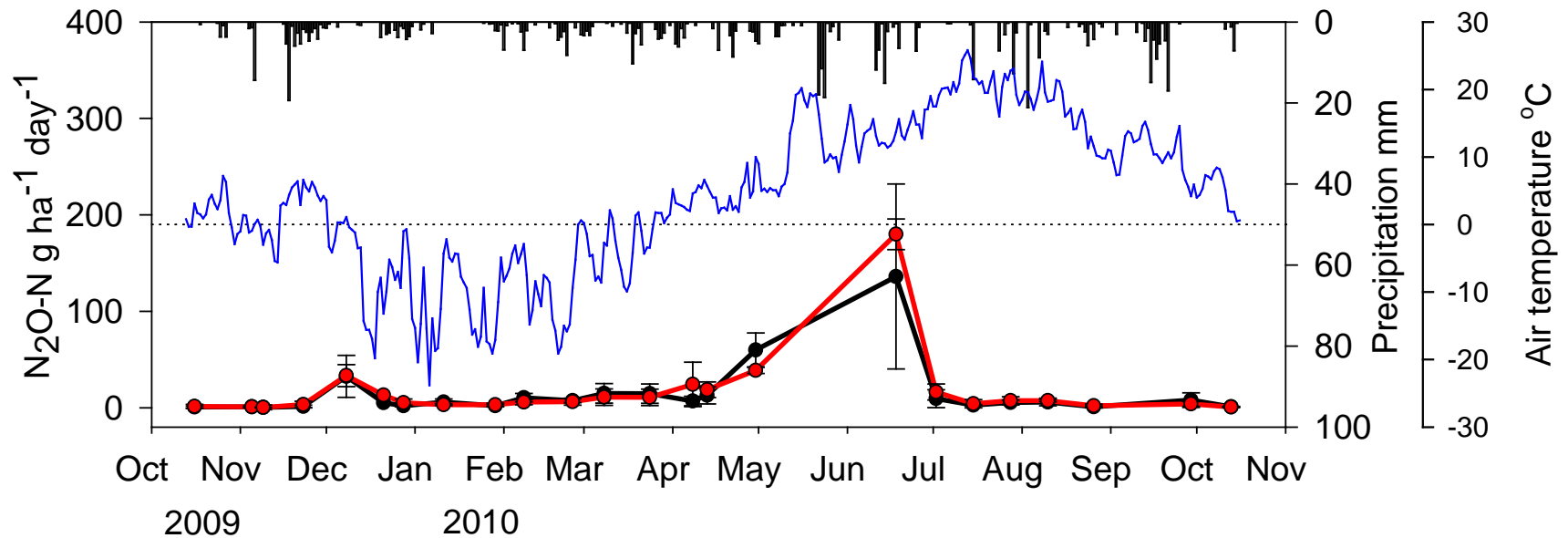
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# N<sub>2</sub>O emissions and concentrations at 15 cm - Finland



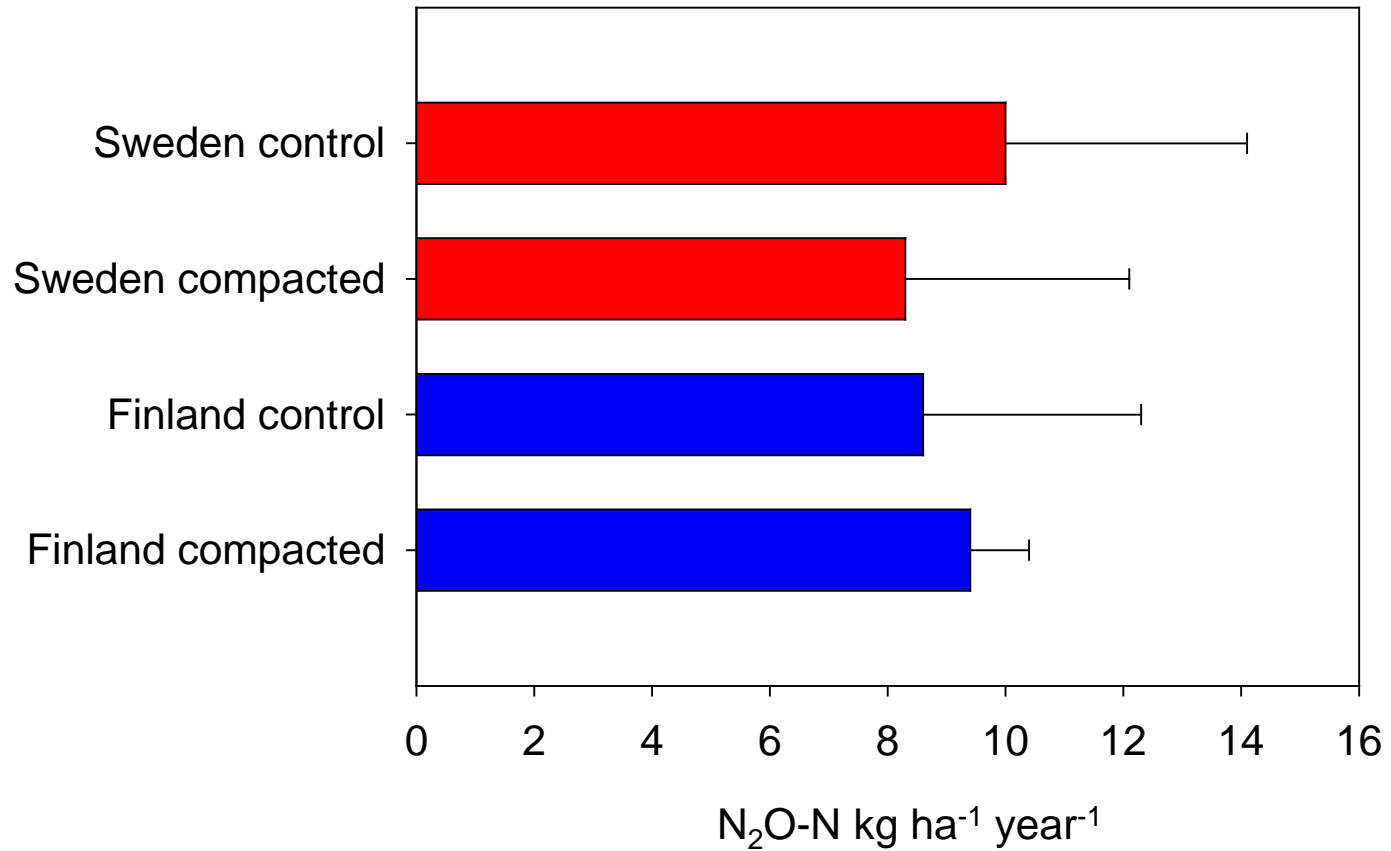
# N<sub>2</sub>O flux, precipitation, air temperature - Finland



# Correlation of N<sub>2</sub>O flux with soil concentrations of N<sub>2</sub>O or O<sub>2</sub>

	Sweden	Finland
soilN2O_15 cm	0.51433	0.67173
	<.0001	<.0001
soilN2O_30cm	0.37505	0.70759
	<.0001	<.0001
soilN2O_50cm	0.52394	0.60144
	<.0001	<.0001
soilN2O_70cm	0.42777	0.49448
	<.0001	<.0001
soilO2_15 cm	0.05764	-0.18579
	0.4117	0.0531
soilO2_30cm	0.13658	-0.19226
	0.0532	0.0462
soilO2_50cm	0.06406	-0.41546
	0.3638	<.0001
soilO2_70cm	0.07765	-0.52309
	0.2781	<.0001

# Annual fluxes



# Conclusions

- Compaction occasionally increased N<sub>2</sub>O in soil air.
- No large differences in soil air composition, N<sub>2</sub>O emissions or moisture content were found between the treatments.
- The N<sub>2</sub>O concentrations at 15, 30, 50 and 70 cm depths correlated positively with the emission of N<sub>2</sub>O from the soil in both fields ( $r = 0.4-0.7^{***}$ ).
- The subsoil O<sub>2</sub> concentrations correlated negatively with N<sub>2</sub>O emission, but only at the Finnish site.
- The results suggest that subsoil compaction does not significantly increase N<sub>2</sub>O emissions from these soils 15-30 years after compaction. This may indicate a minor role of subsoil in the production of N<sub>2</sub>O compared with topsoil.



More information on the results of the  
Nordic project

“Persistent effects of subsoil compaction on soil  
ecological services and functions” (POSEIDON)  
available in the NJF seminar

‘Soil compaction – effects on soil functions and  
strategies for prevention’ 6.-8.3.2012 in Helsinki

Welcome!