What can we learn from long-term measurements of soil-atmosphere exchange of trace gases? – The Höglwald as a case study

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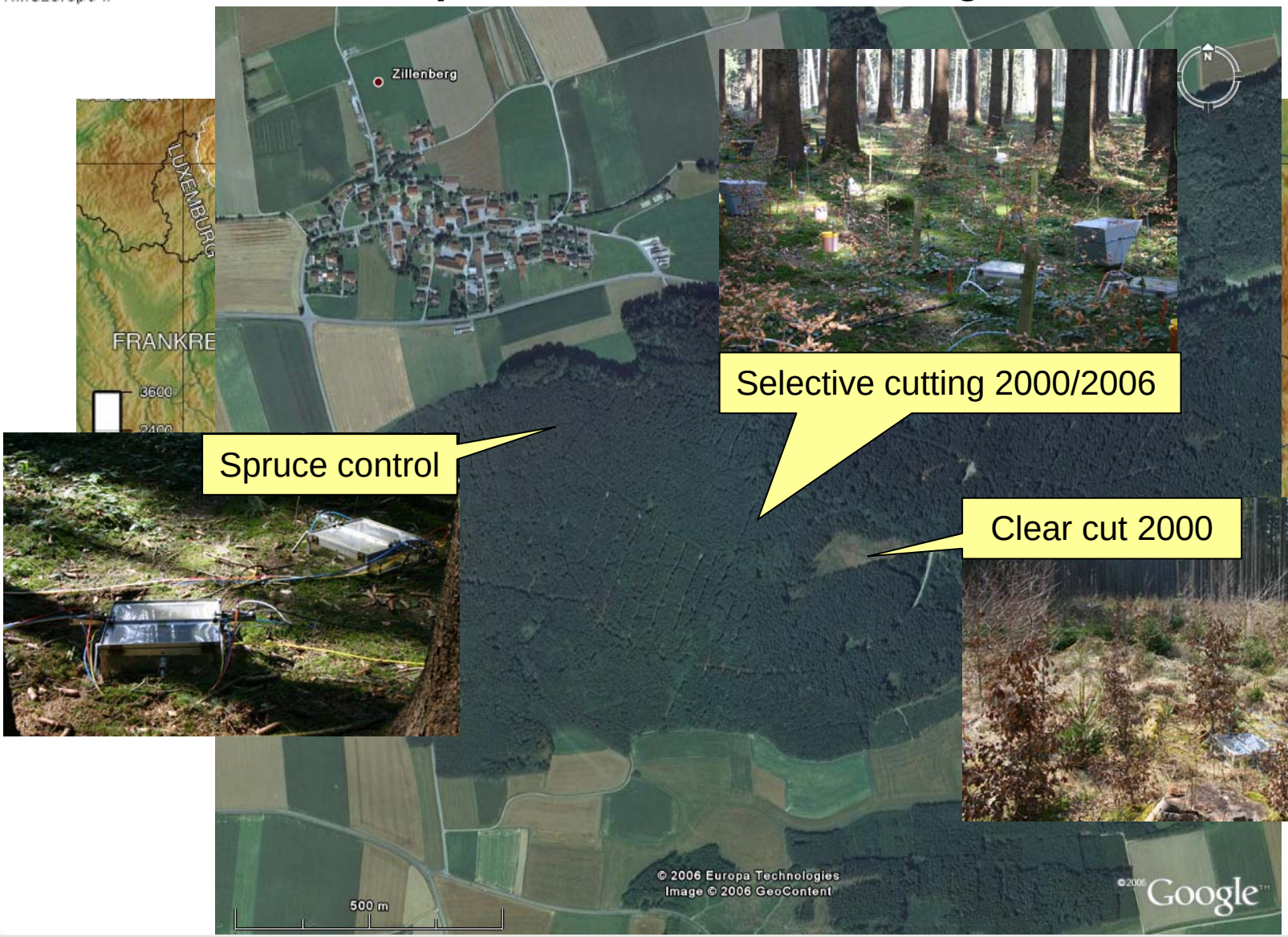
Questions

- Which time is necessary for a reliable quantification of treatment effects on soil GHG fluxes in forest ecosystems?
- What is a realistic time frame for the calculation of response functions?
- How frequent are extreme events like strong freeze-thaw periods?
- What is a suitable time resolution of trace gas flux measurements for the evaluation of relationships between different gas fluxes or between gas fluxes and driving variables?

Location of the different experimental sites in the Höglwald

Experimental site: Höglwald



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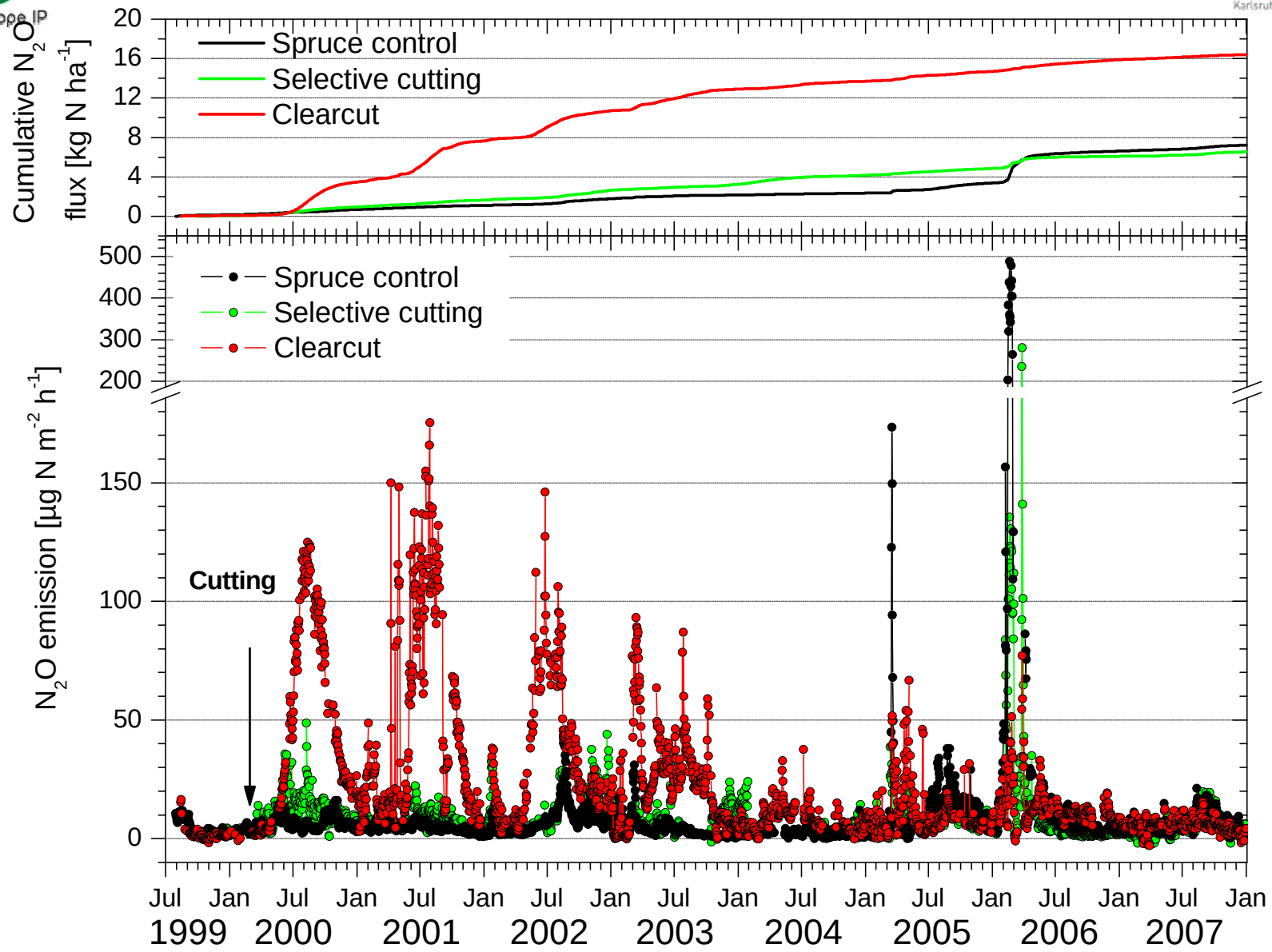
Effect of forest management on soil N_2O fluxes



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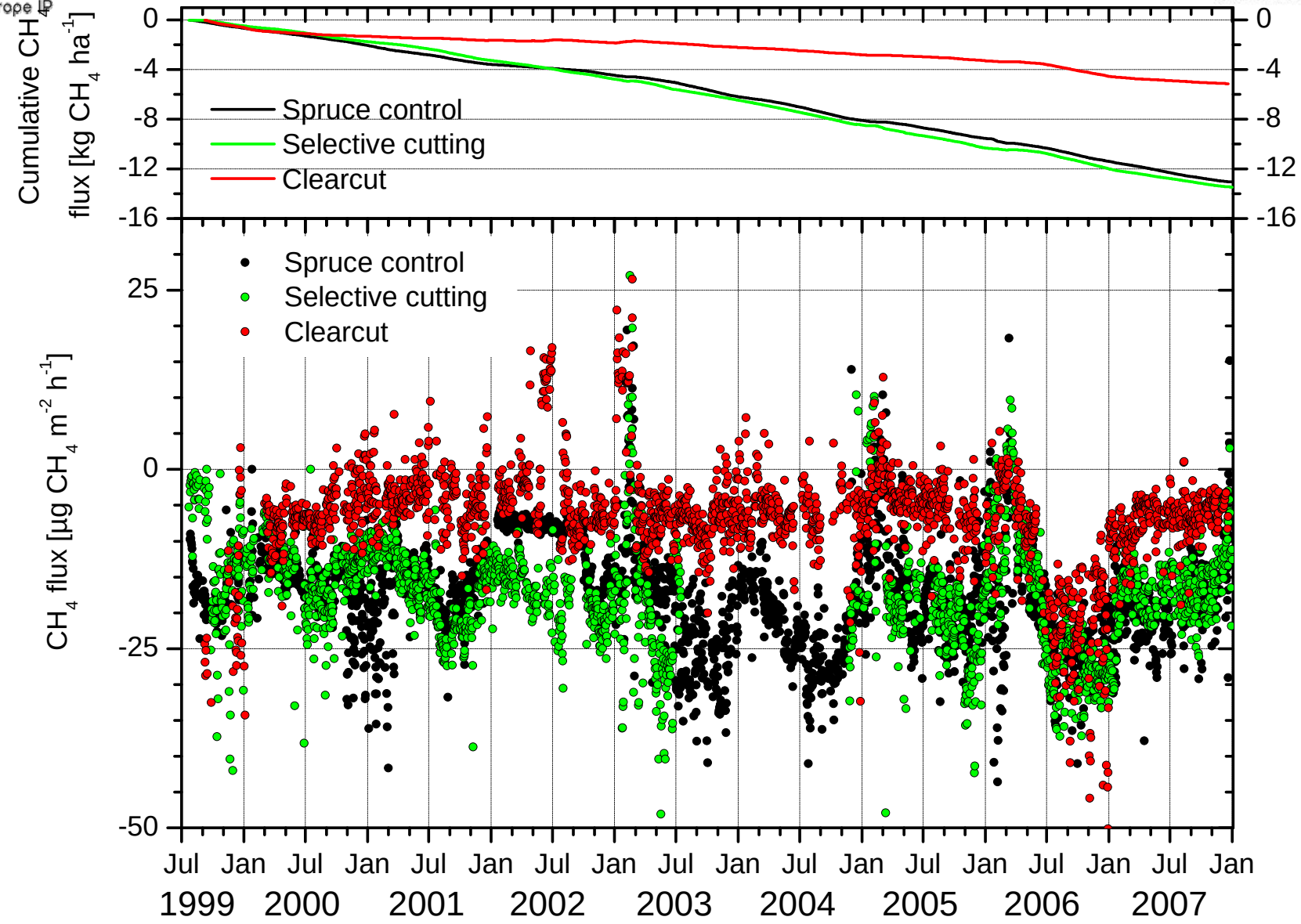
Effect of forest management on soil CH_4 fluxes



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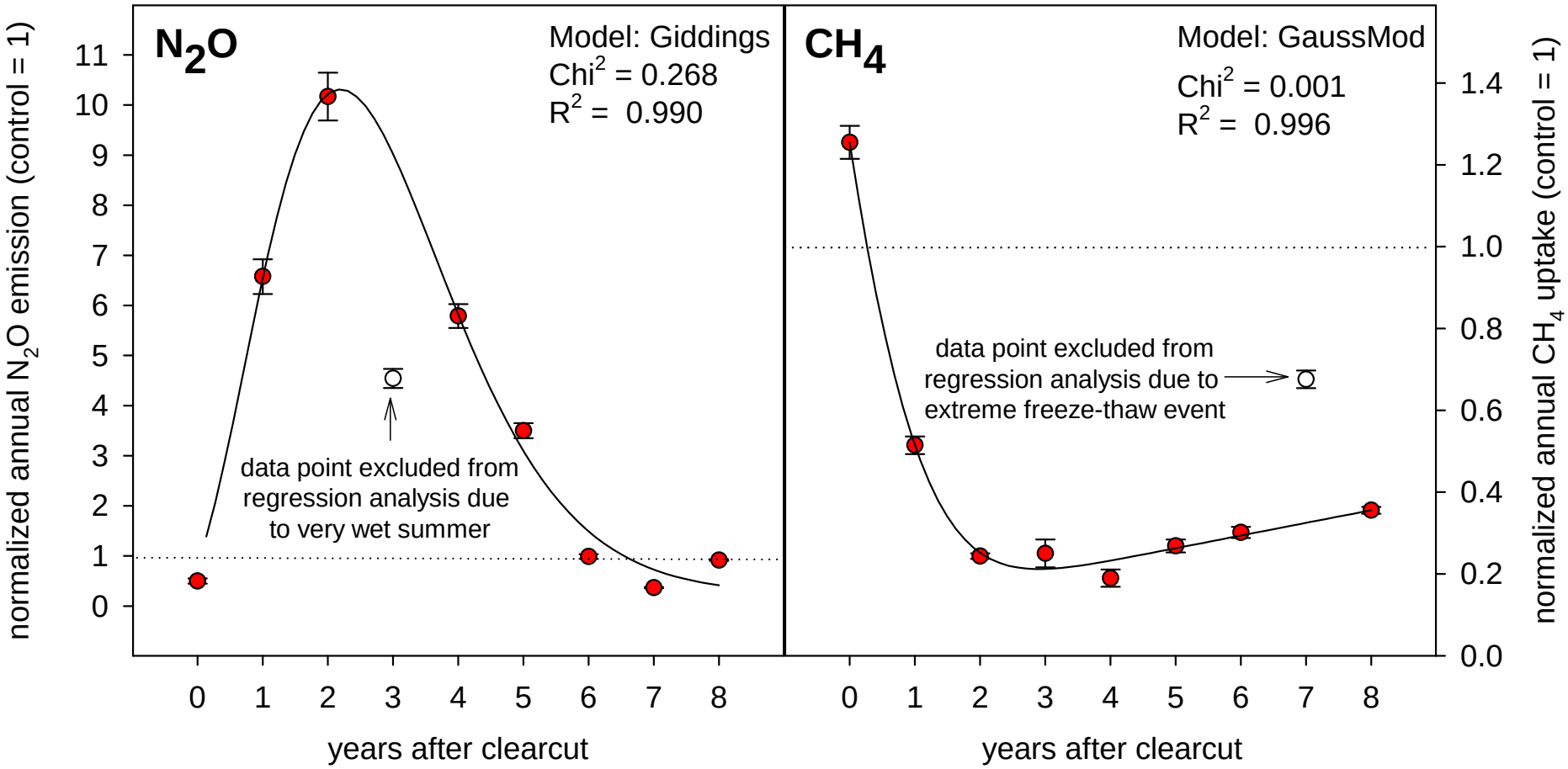
Response functions for soil N_2O and CH_4 fluxes after clearcut



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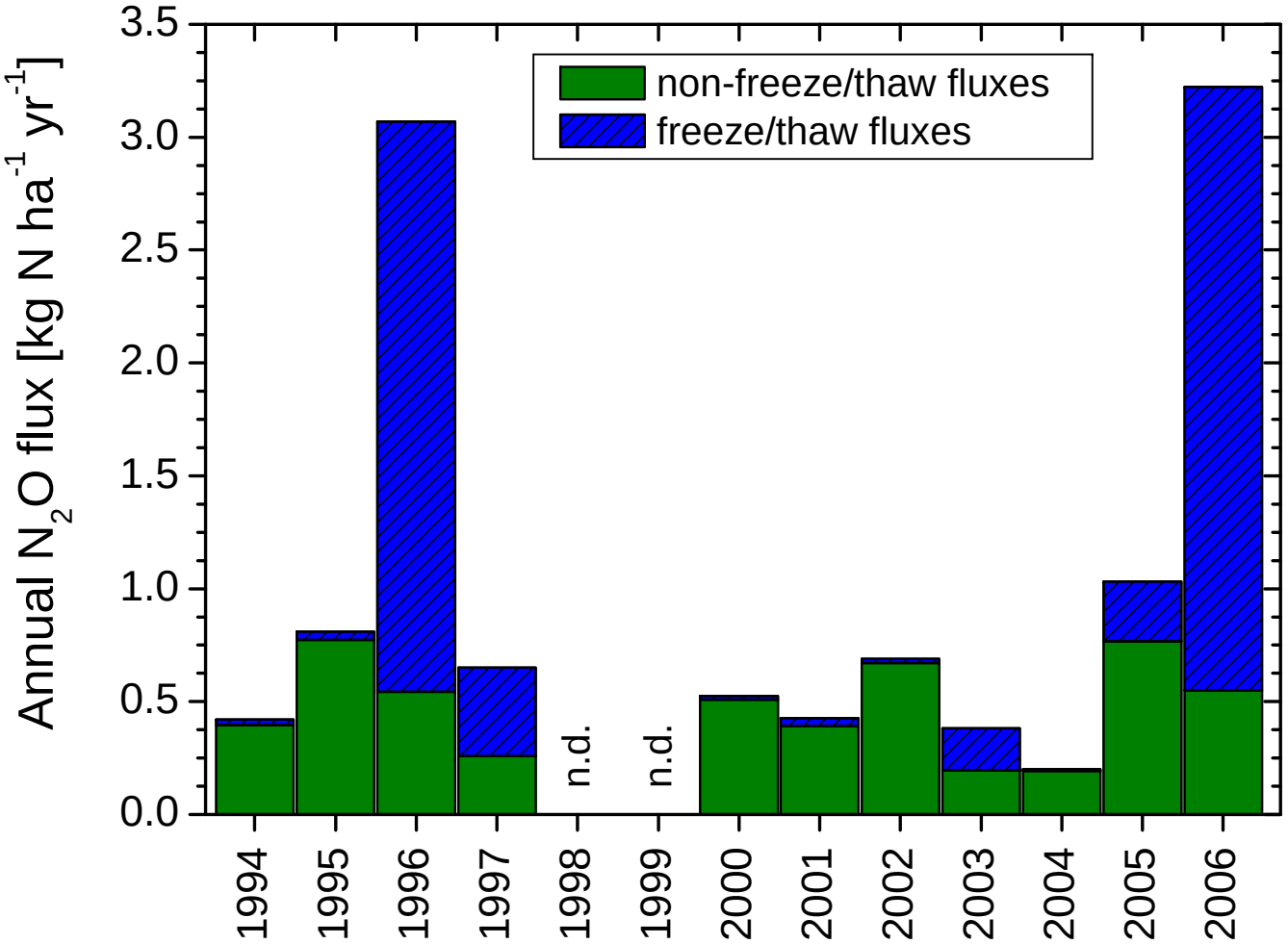
Importance of freezing/thawing events for the annual N_2O budget



year	%
1994	5.7
1995	4.4
1996	**82.3**
1997	**60.2**
2000	3.2
2001	8.2
2002	2.8
2003	**49.1**
2004	5.0
2005	25.5
2006	**82.9**

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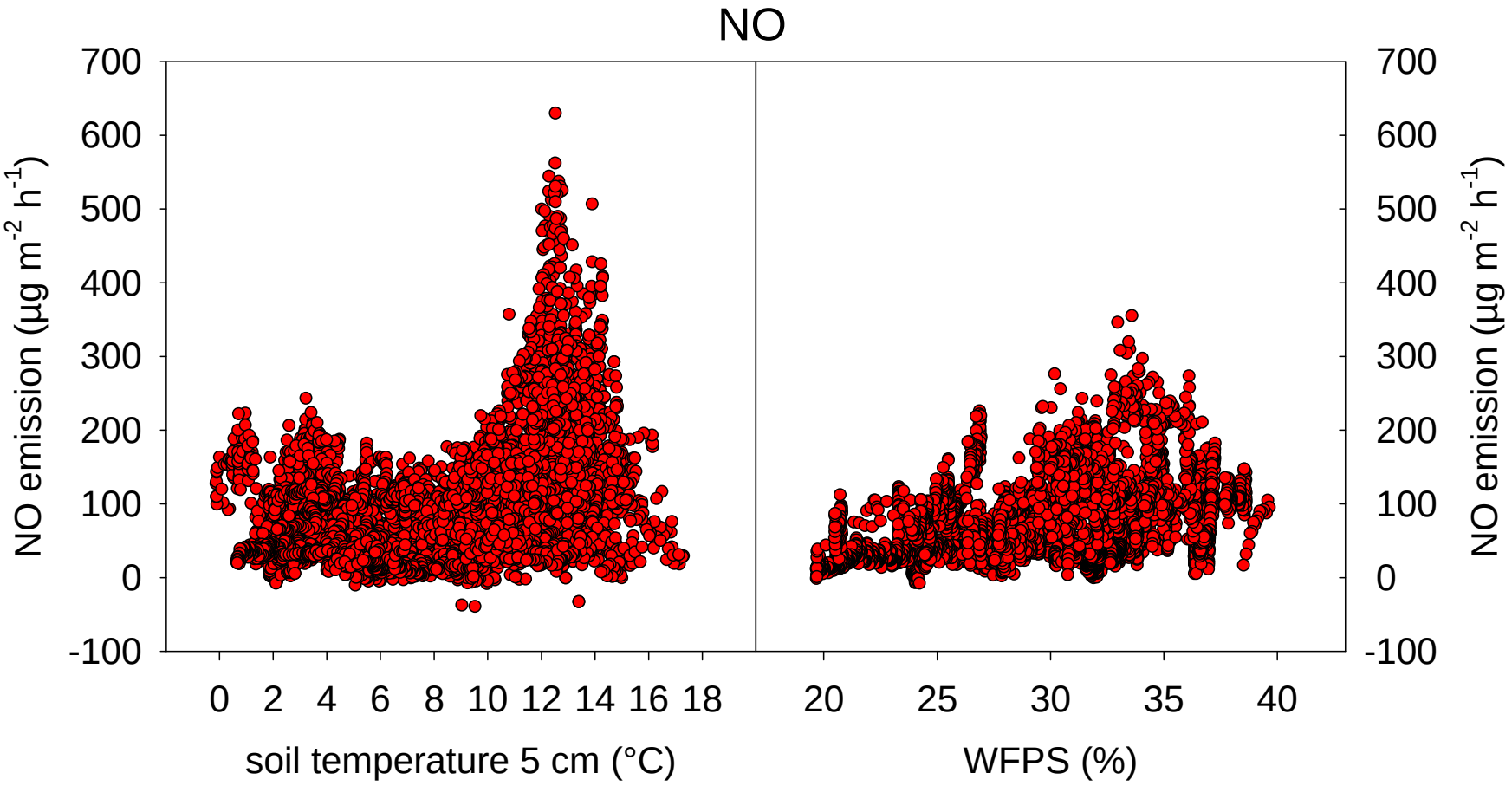
Dependency of soil N_2O and NO fluxes on soil temperature and moisture



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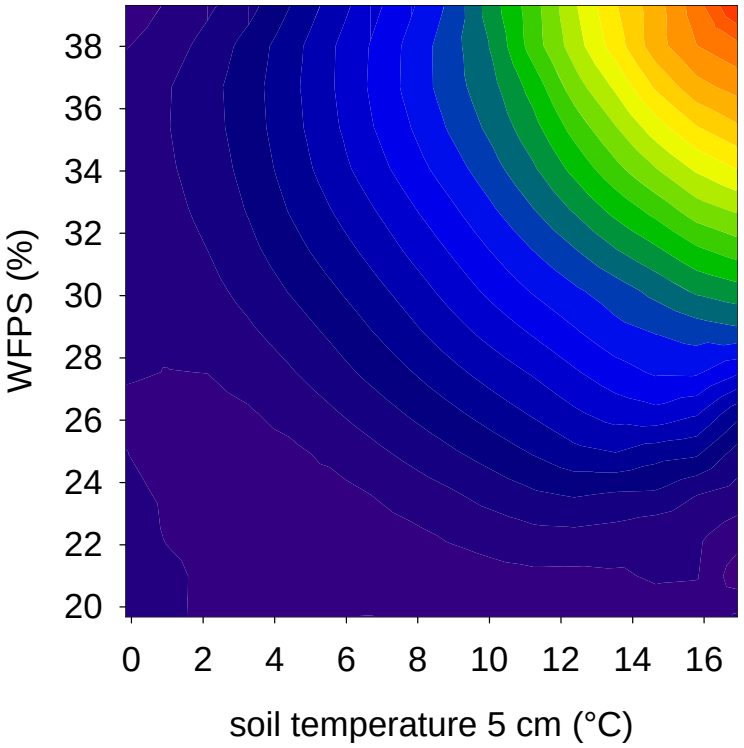
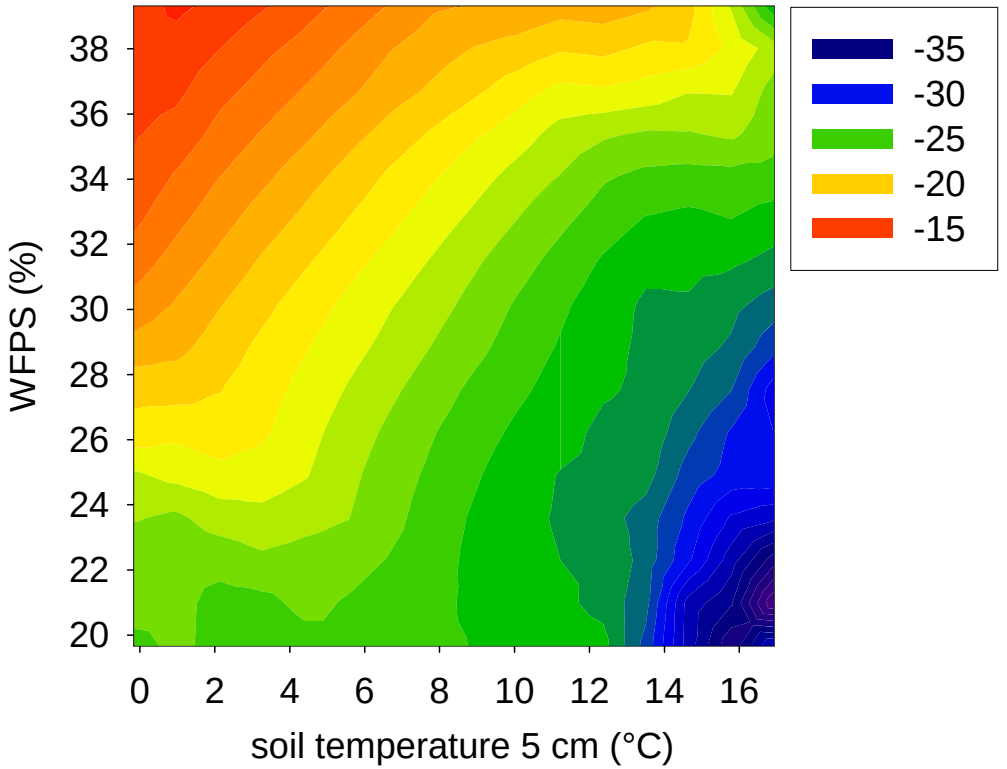
Dependency of soil N_2O and CH_4 fluxes on soil temperature and moisture



N_2O fluxes

CH_4 fluxes



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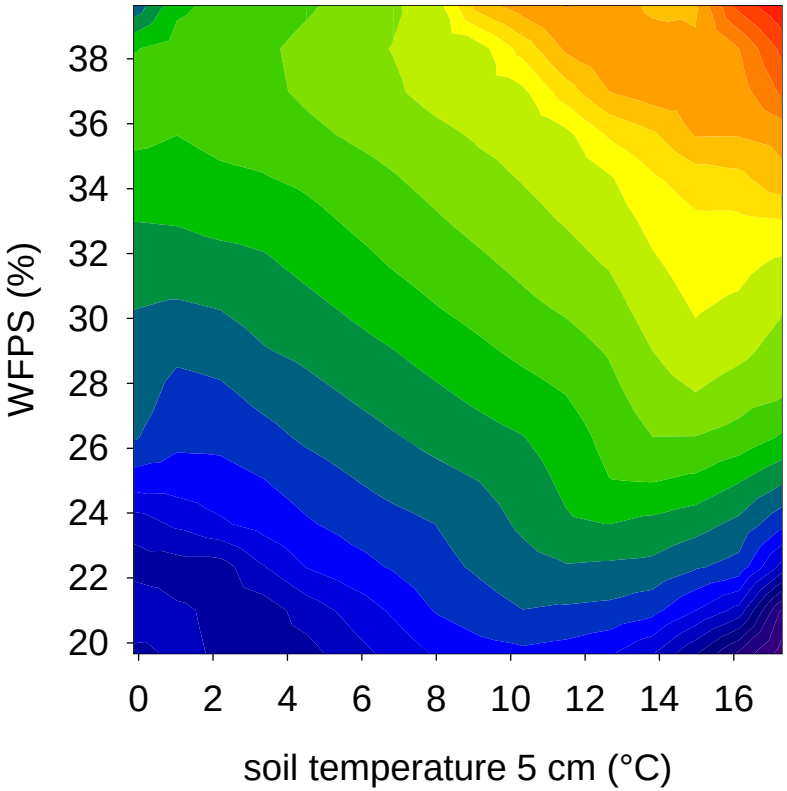
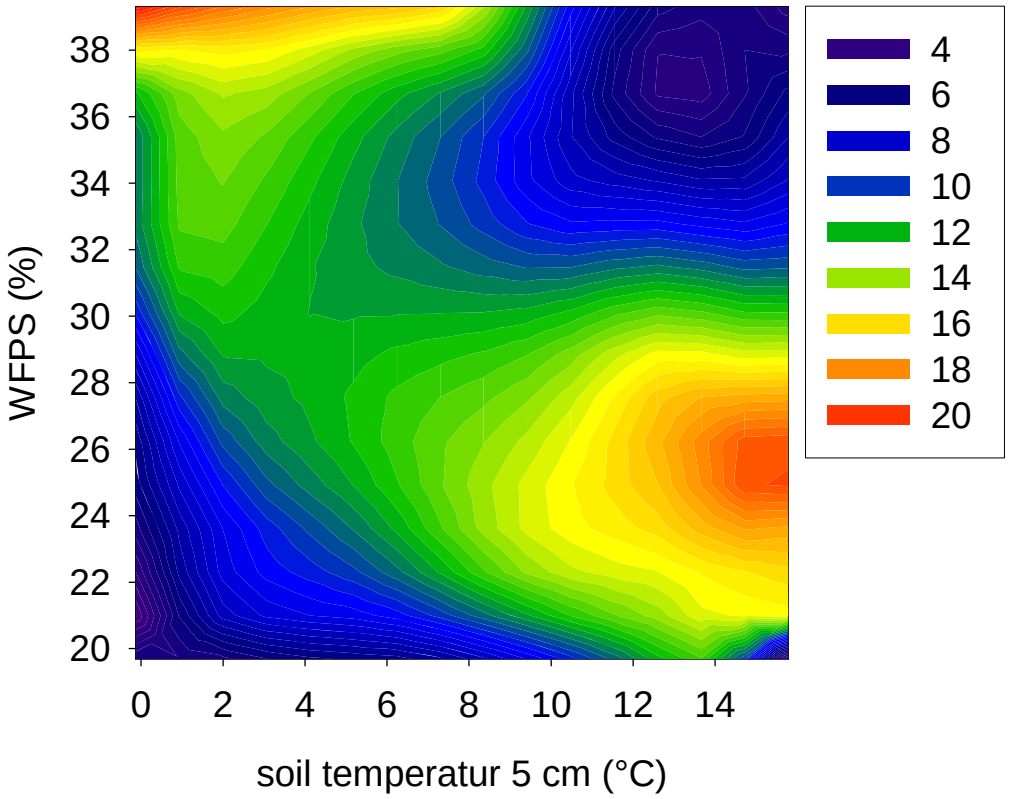
Dependency of soil NO fluxes and $NO:N_2O$ ratios on soil temperature and moisture



NO fluxes

$NO:N_2O$ ratio



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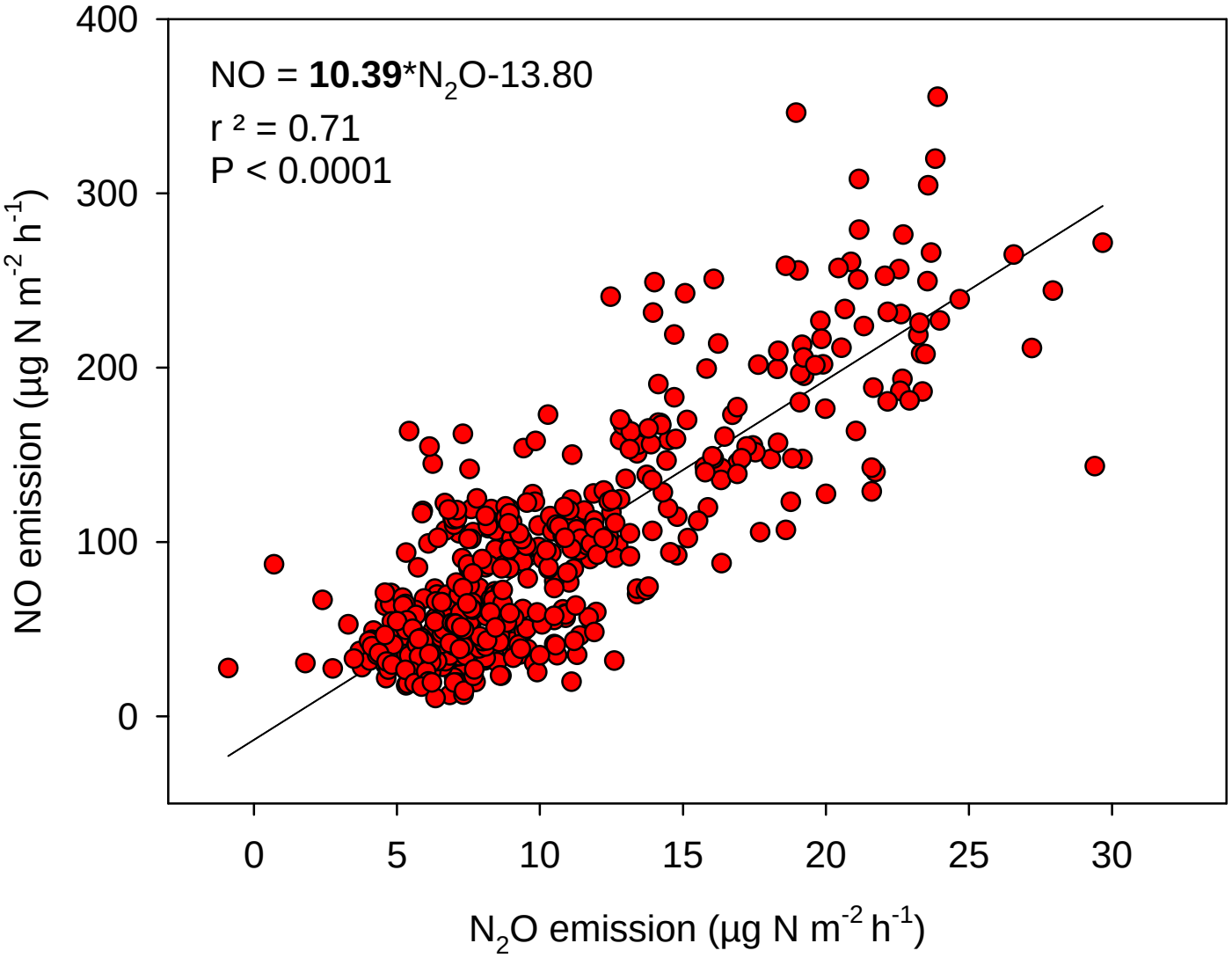
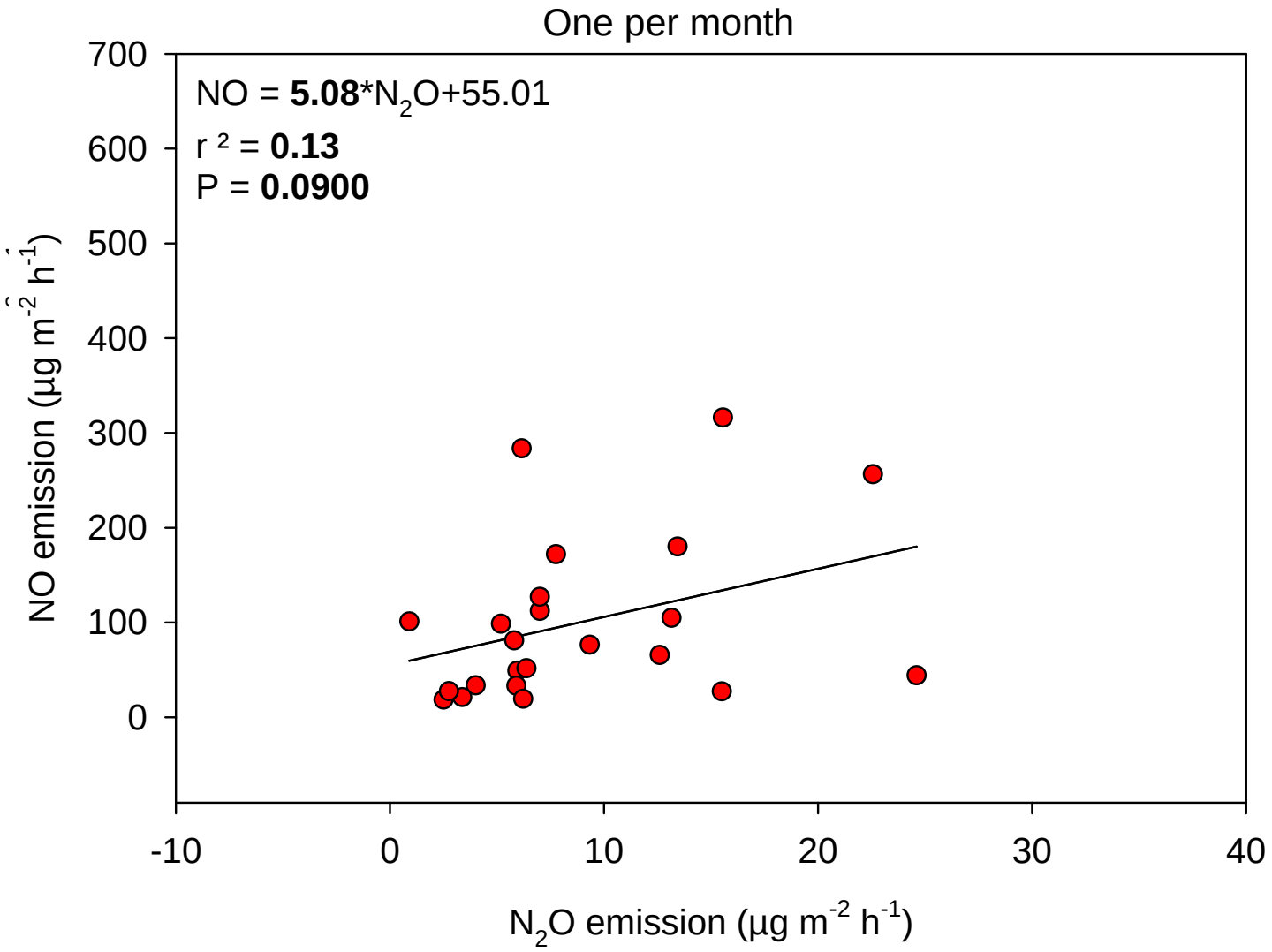
Relationship between N_2O and NO fluxes

Data from Jan-Jun 2008



Relationship between N_2O and NO fluxes

Data from Jul 2006-Jun 2008



Conclusions

- Reliable quantification of treatment effects on soil GHG fluxes in forest ecosystems needs >10 yrs of measurements
- Calculation of response fuctions is only possible after several years of continuous measurements
- Detection of the effect and frequency of extreme events also requires long-term measurements of several years
- However, soil trace gas flux measurements do not necessarily have to be conducted with a daily or even sub-daily time resolution

Measure less often, but longer!