

Effects of nitrogen deposition on growth of Norway spruce in Norway

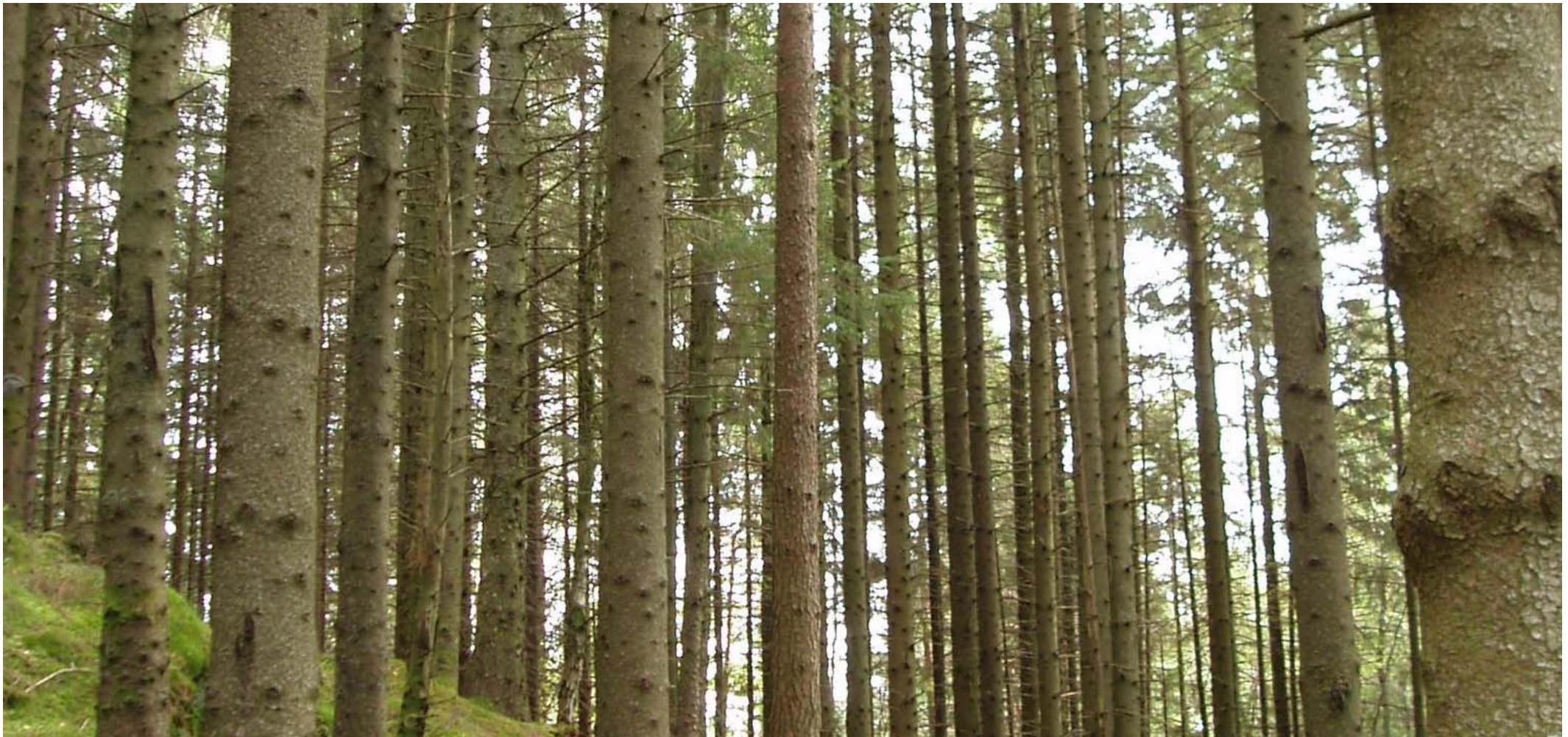


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Norwegian Forest and
Landscape Institute

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Background

- Several investigations indicate a positive effect of Nitrogen deposition on forest growth
- Most investigations with short observation period - e.g. 5 yr
- Longer observation period – can this influence the results?
- A large no. of homogenous plots within a country – can this provide any additional information?

Outline and objectives

- Will nitrogen deposition increase forest growth over a long period as 33 years?
- How much is the fertilising effect?
- In which forest types affects nitrogen deposition most?
- In which regions is the influence of Nitrogen deposition strongest?
- Is the fertilising effect on growth linear with the amount of N-dep?

Methods

Relative growth:



$$\frac{\text{Observed growth (Measured with calliper)}}{\text{Estimated growth from standard growthmodels}} * 100\%$$

- Filter out anthropogenic influences
- Site index (productivity) at plots based on height growth ca 1914-1987 (mean)
- Growth models: Basic data from 1900 to 1980

Growth data

Variable	Mean	Minimum	Maximum
Mean height (m)	185	6,7	31
Mean diameter (cm)	222	7,5	43
Stand age (yr)	73	20	200
Stems/ha	972	17	3585
Volume m3/ha	291	8	1243
Site index Top height at 40 yr (m)	16	2	29
Relativ Growth (%)	75	24	219
Observation period	1995	1978	2011

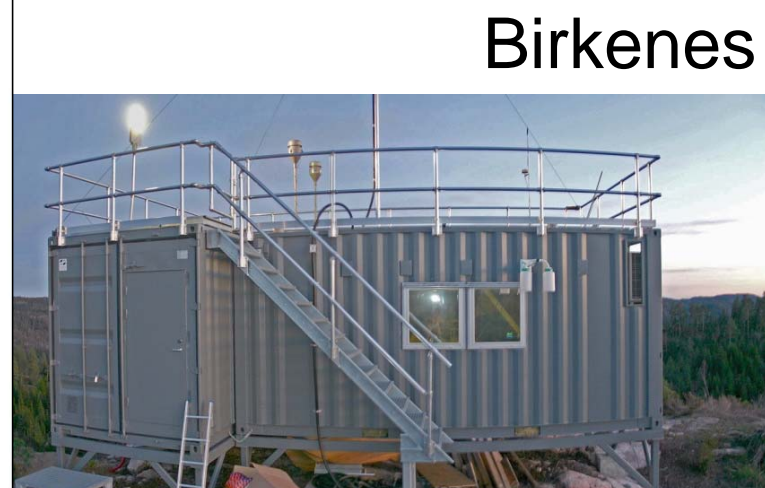
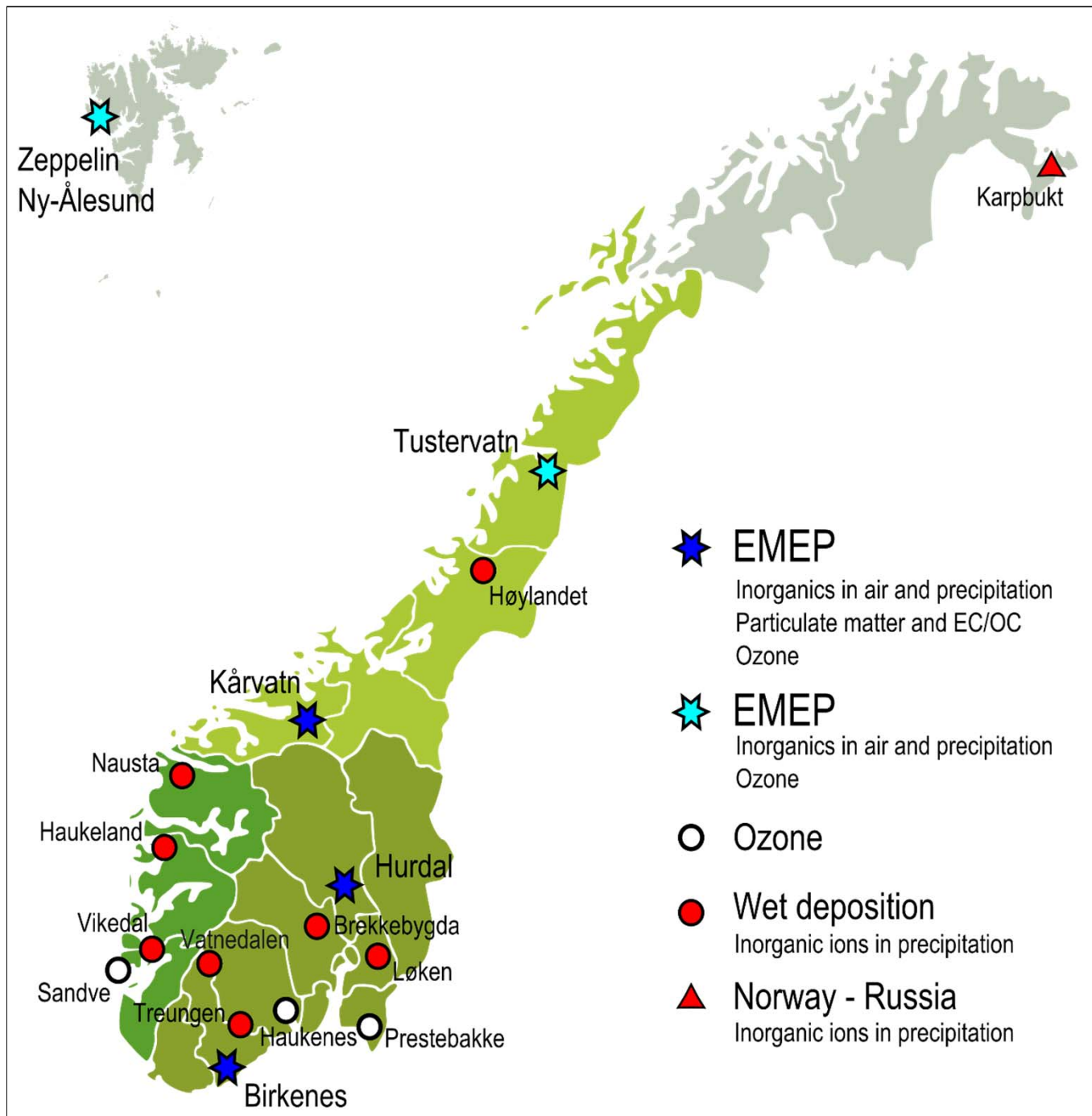
Localisation of the plots



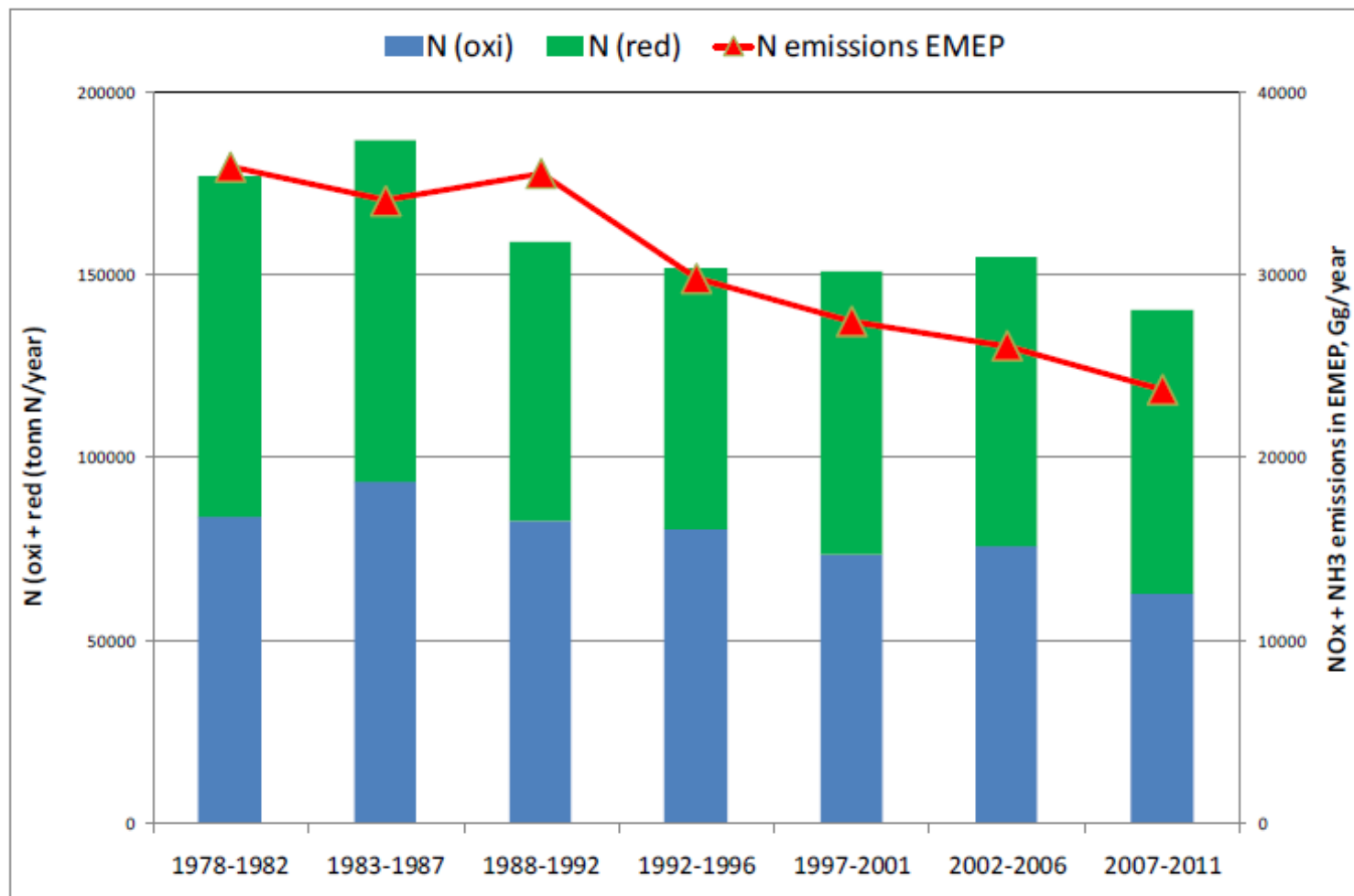
Deposition data

Variable	Mean	Minimum	Maximum
Nitrogen deposition (kg/ha/yr)	7	1,1	24
Sulphur deposition (kg/ha/yr)	5	0,9	17

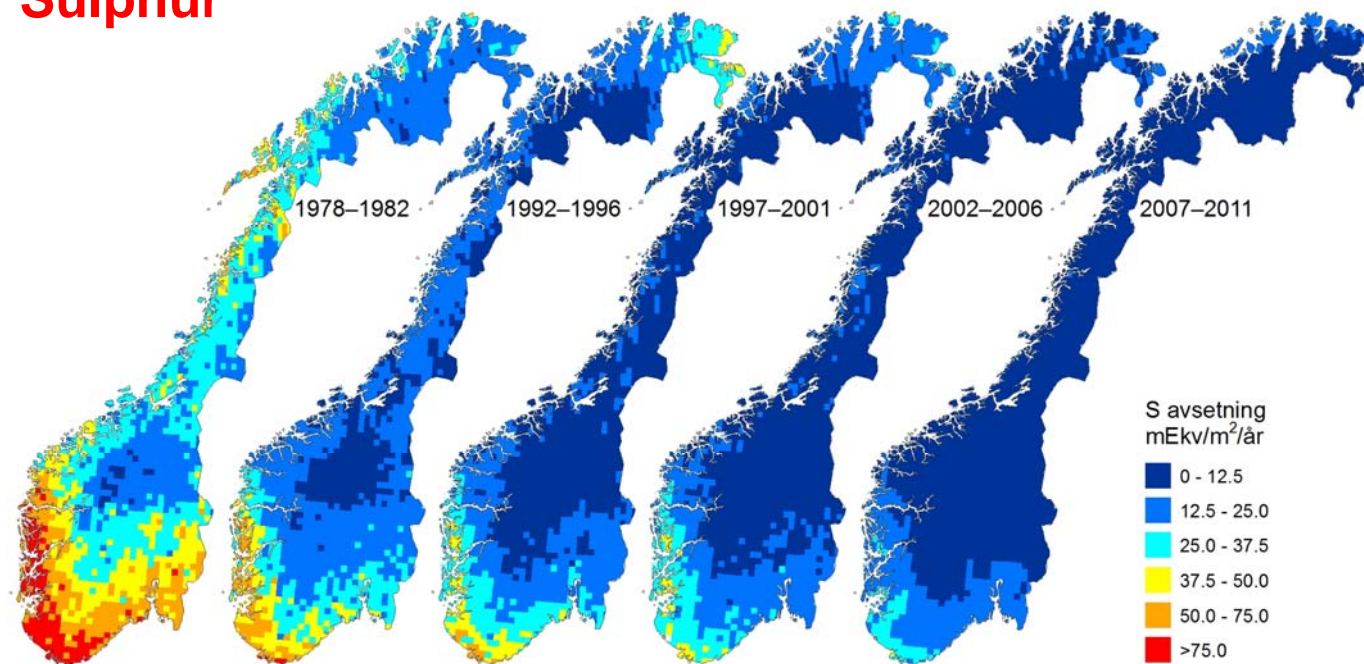
Norwegian background sites for atmospheric composition



Trends in European nitrogen emission and total atmospheric deposition in Norway

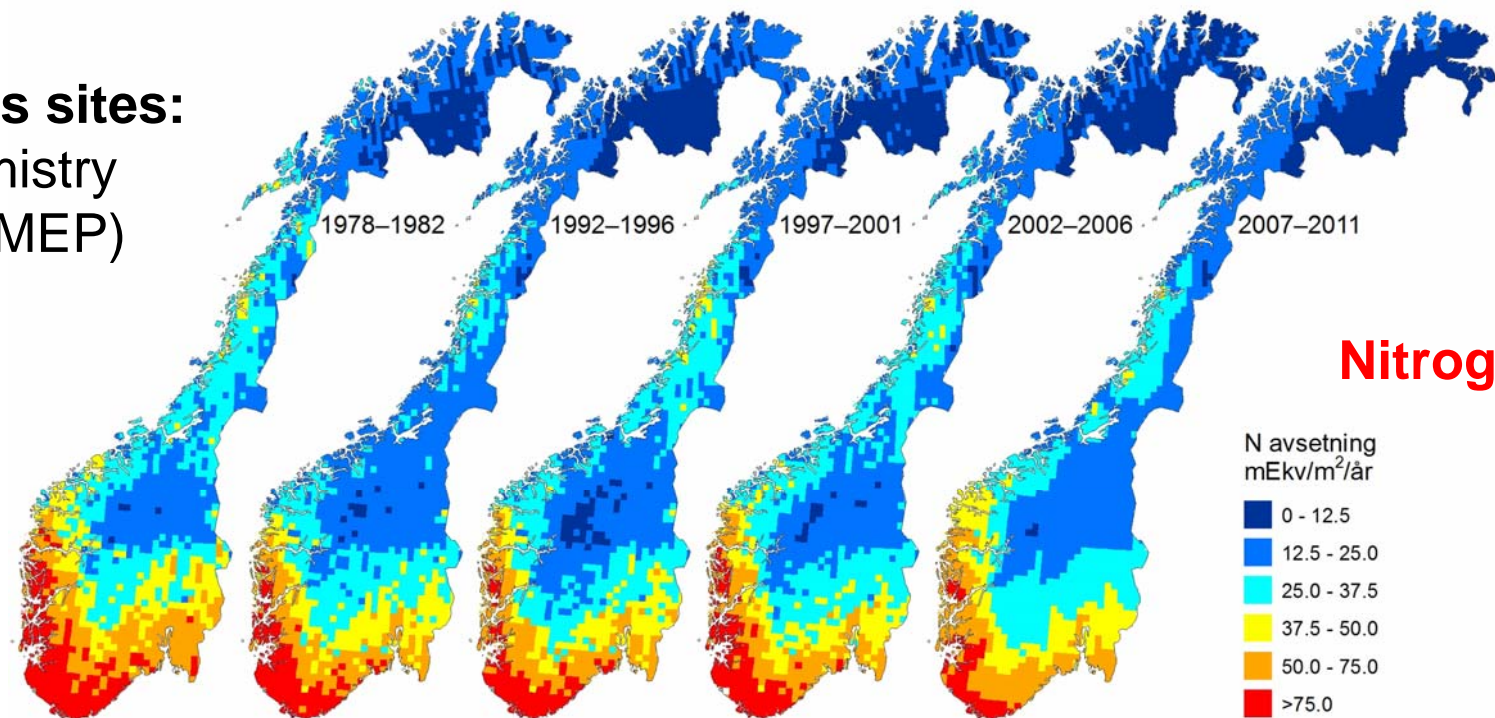


Sulphur



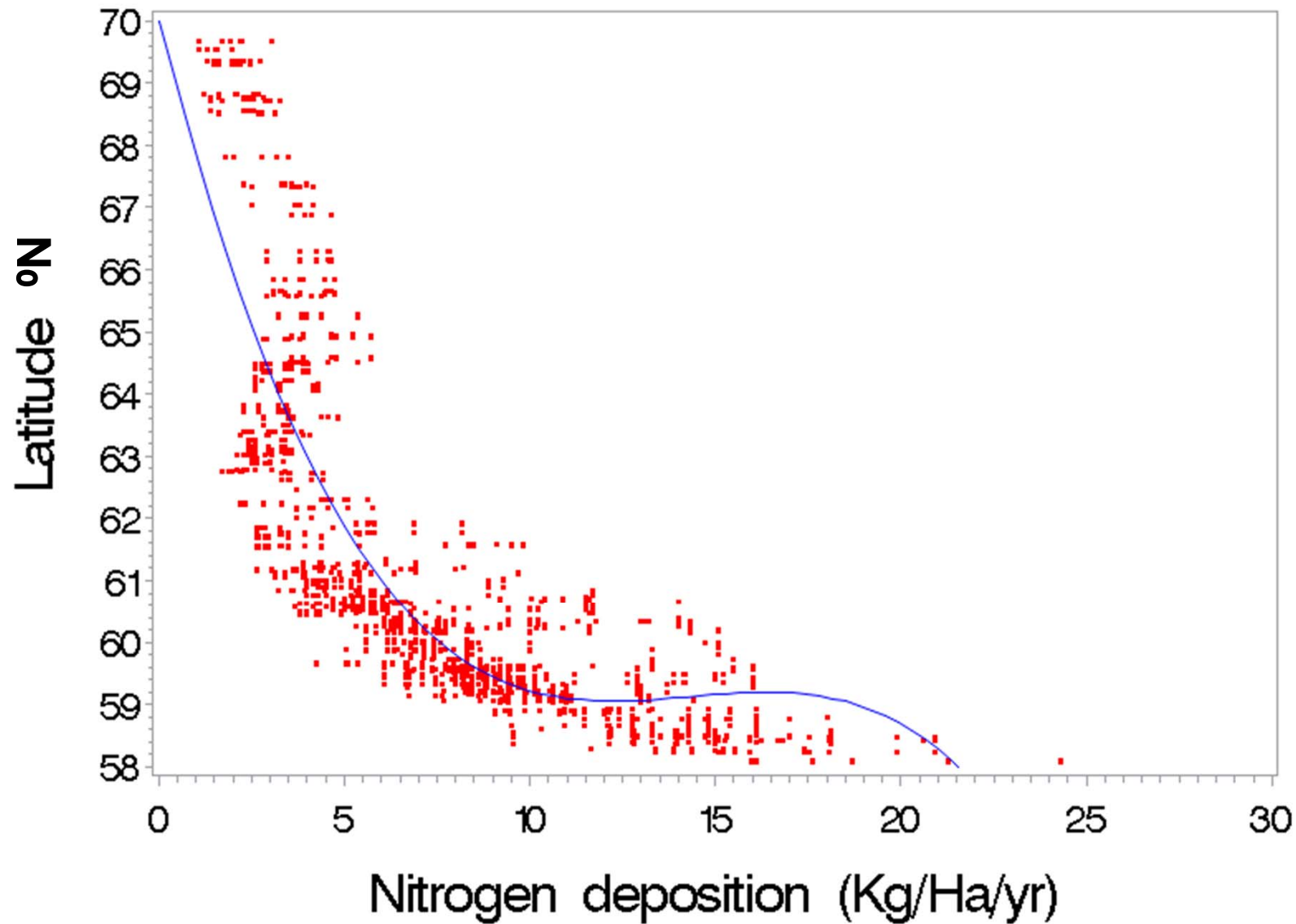
Trends in
atmospheric
deposition
1978 til 2011.

Data from various sites:
13-14 precip chemistry
5 air chemistry (EMEP)
500 met station
(+ SE;FI,RU)



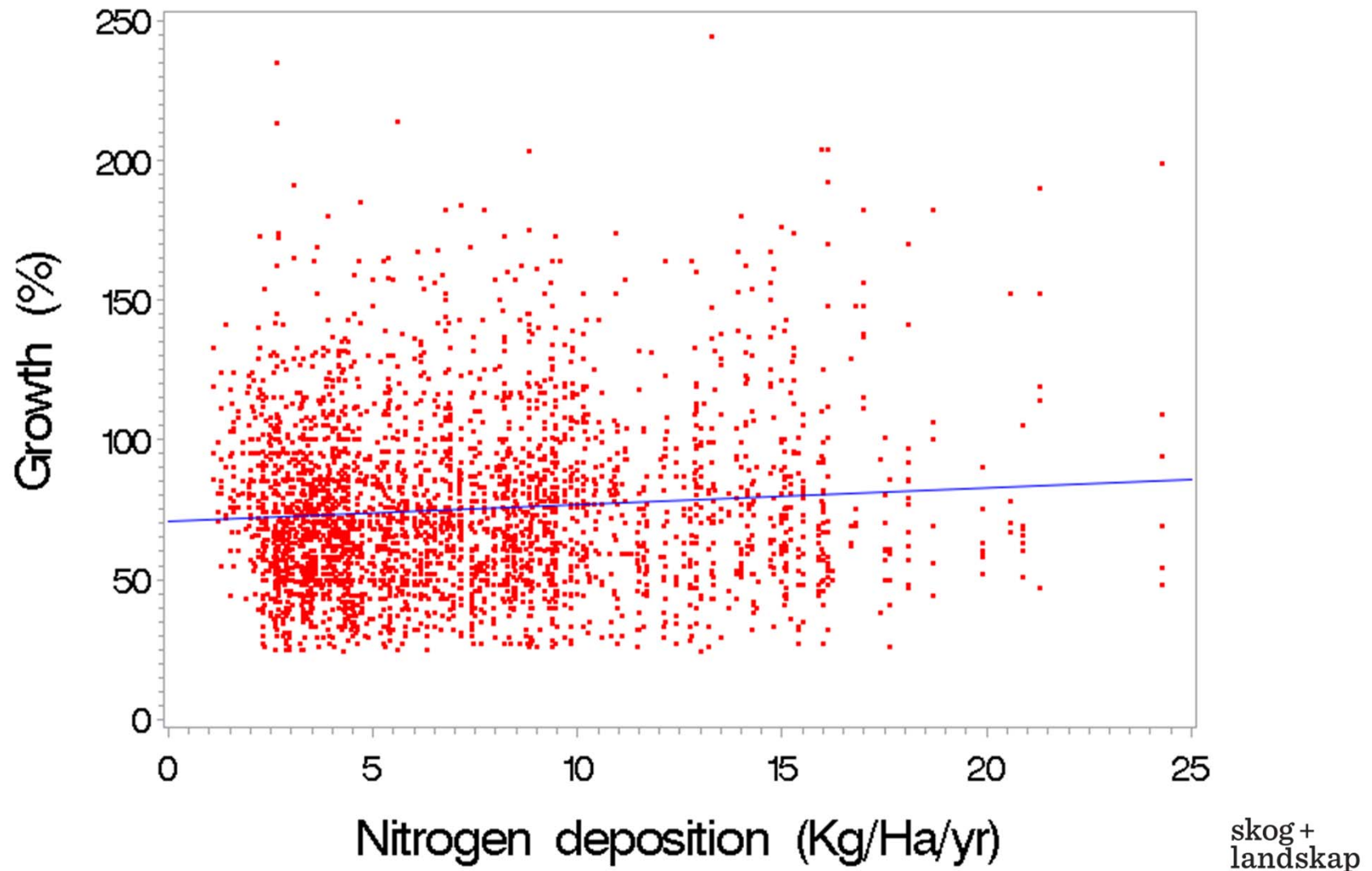
Nitrogen

Nitrogen deposition vs Latitude °N

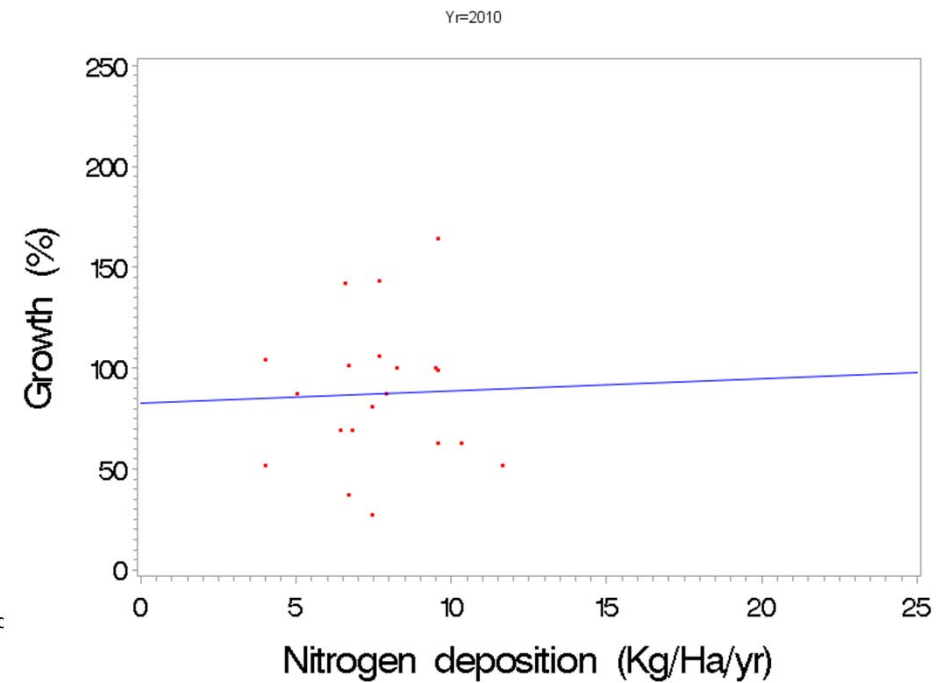
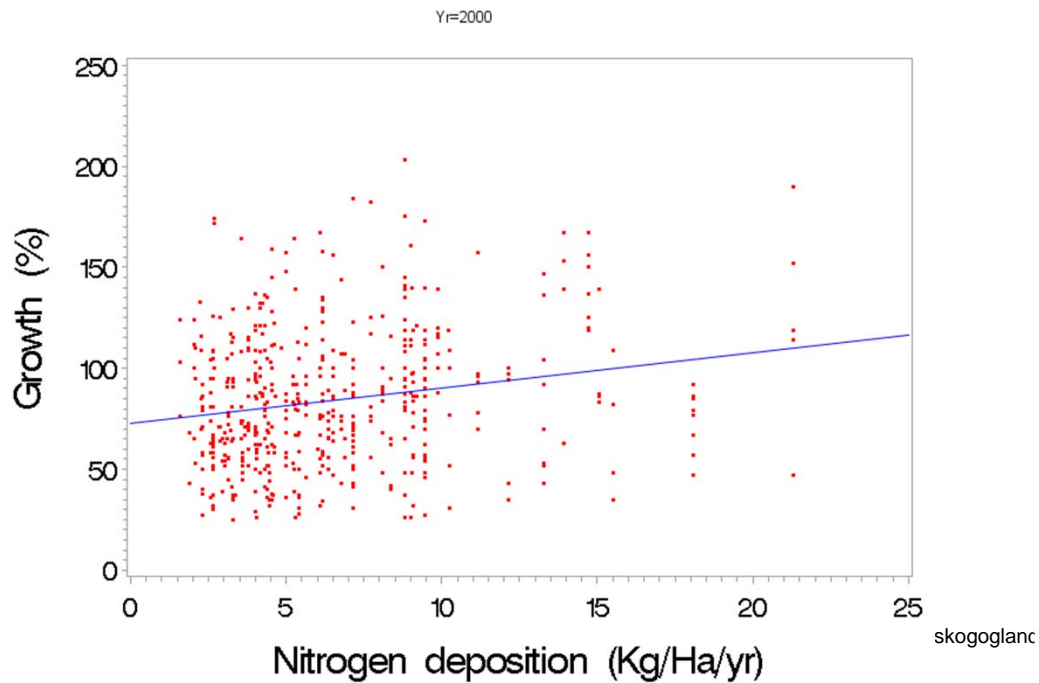
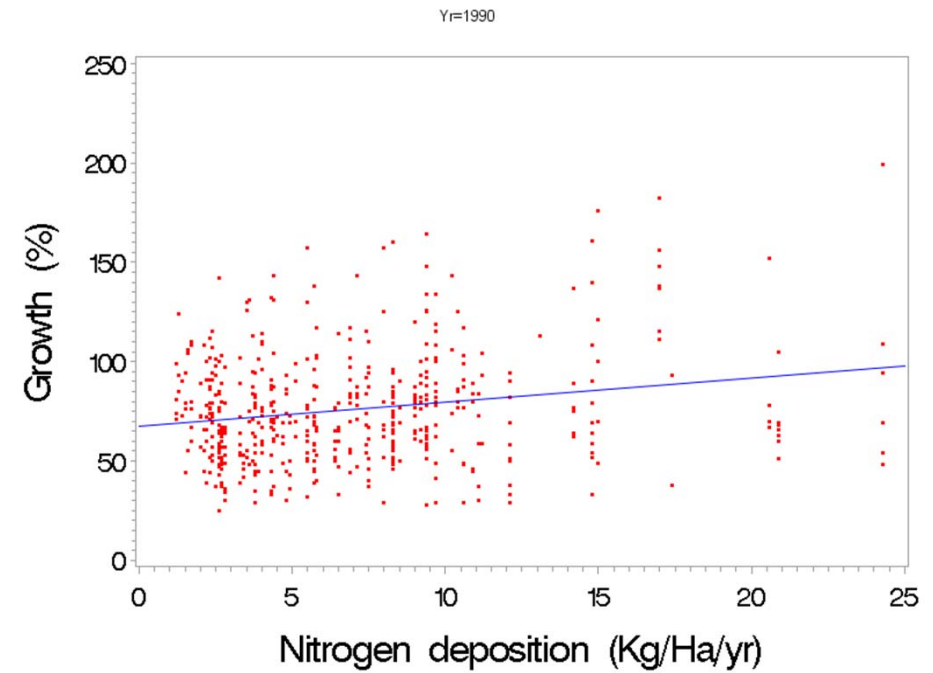
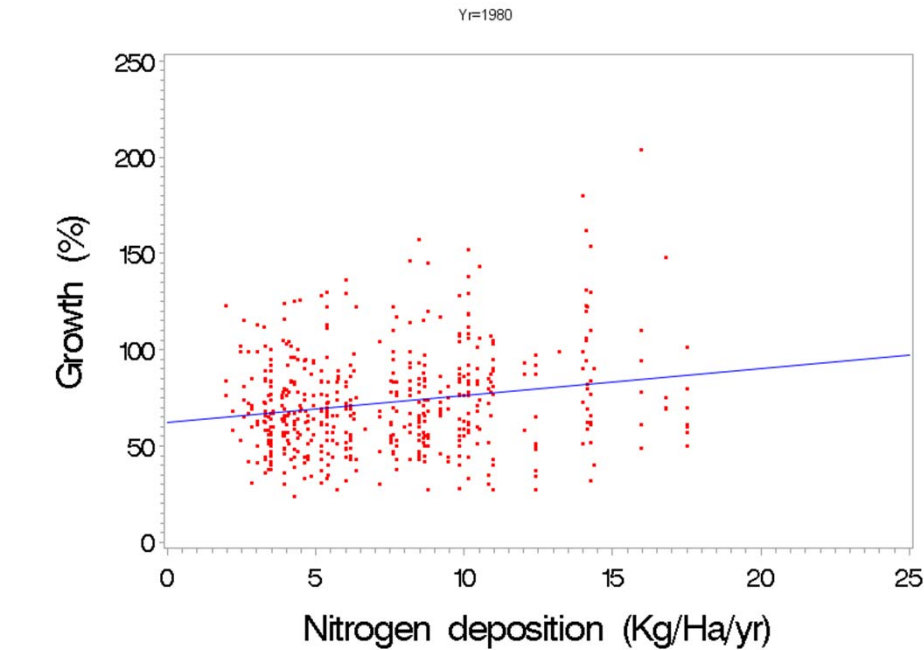


Main result

Nitrogen deposition vs Relative growth in 1978-2011



Nitrogen deposition vs Relative growth



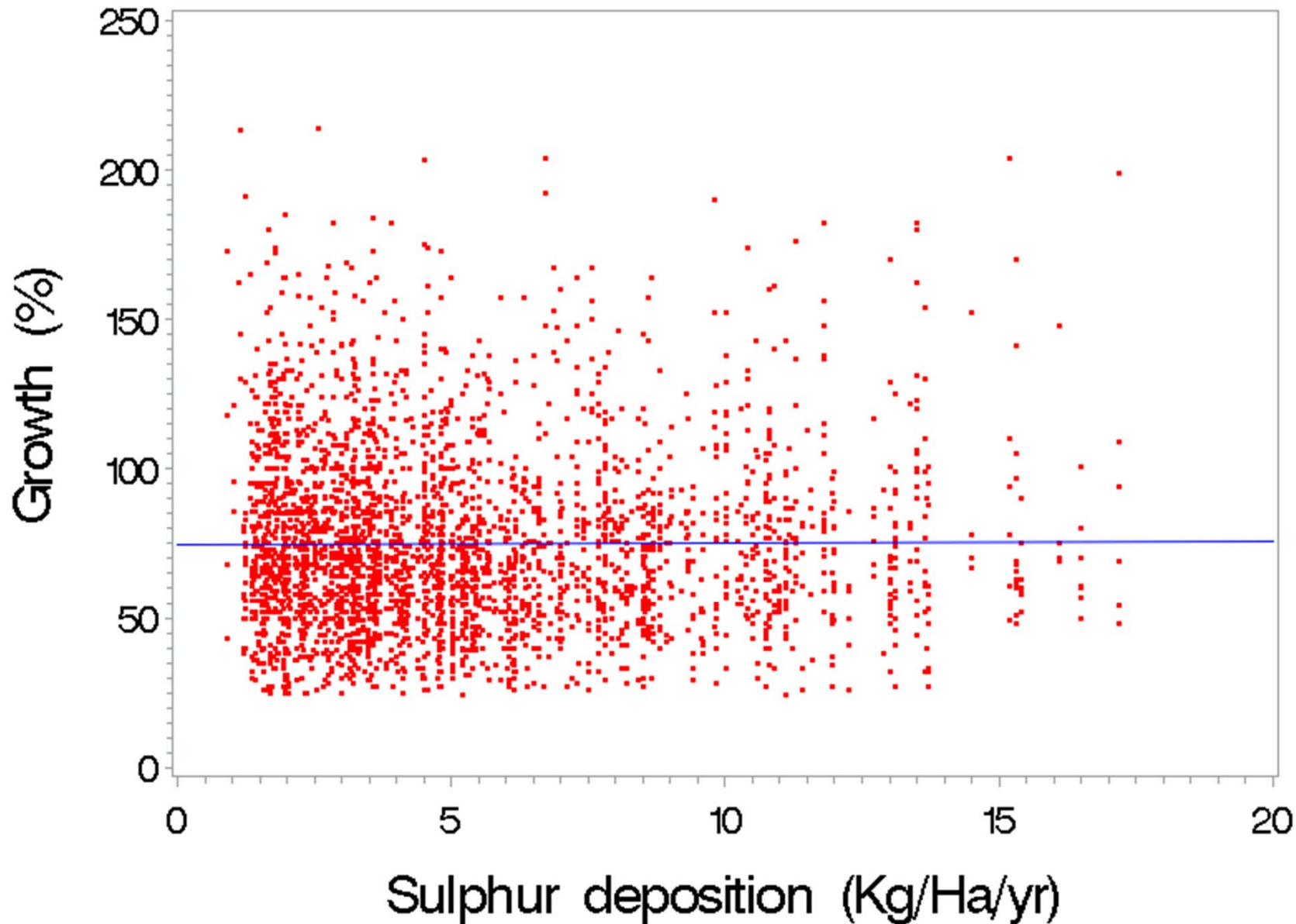
Relative Growth = $71 + 0.6 * N_KgHa.$ ($R^2=0.13$)

Corresponds with previous fertilizing recommendations

Not all periods significant

Other factors affects forest growth?

Long term Sulphur deposition 1978- 2011



Nitrogen deposition

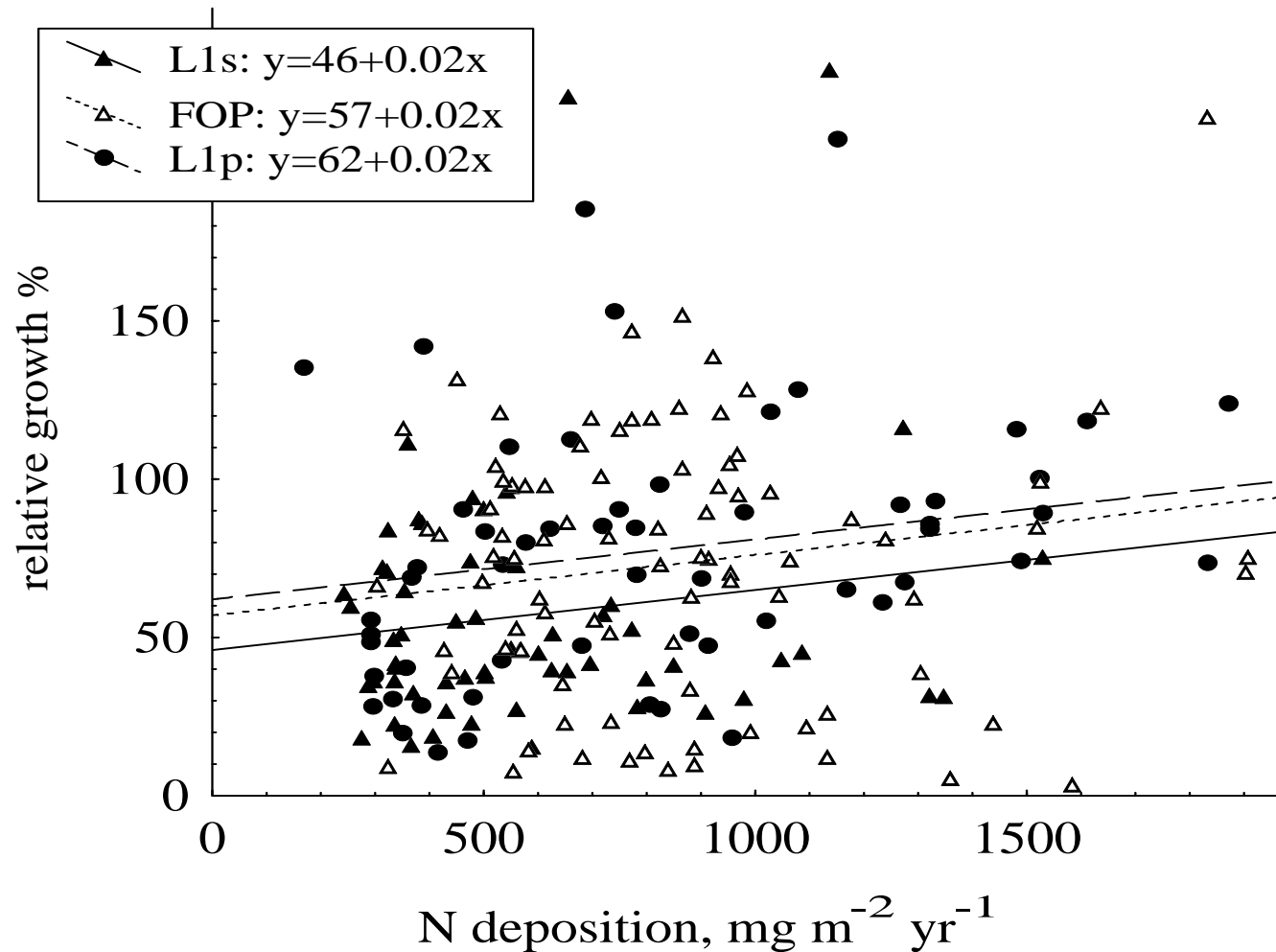
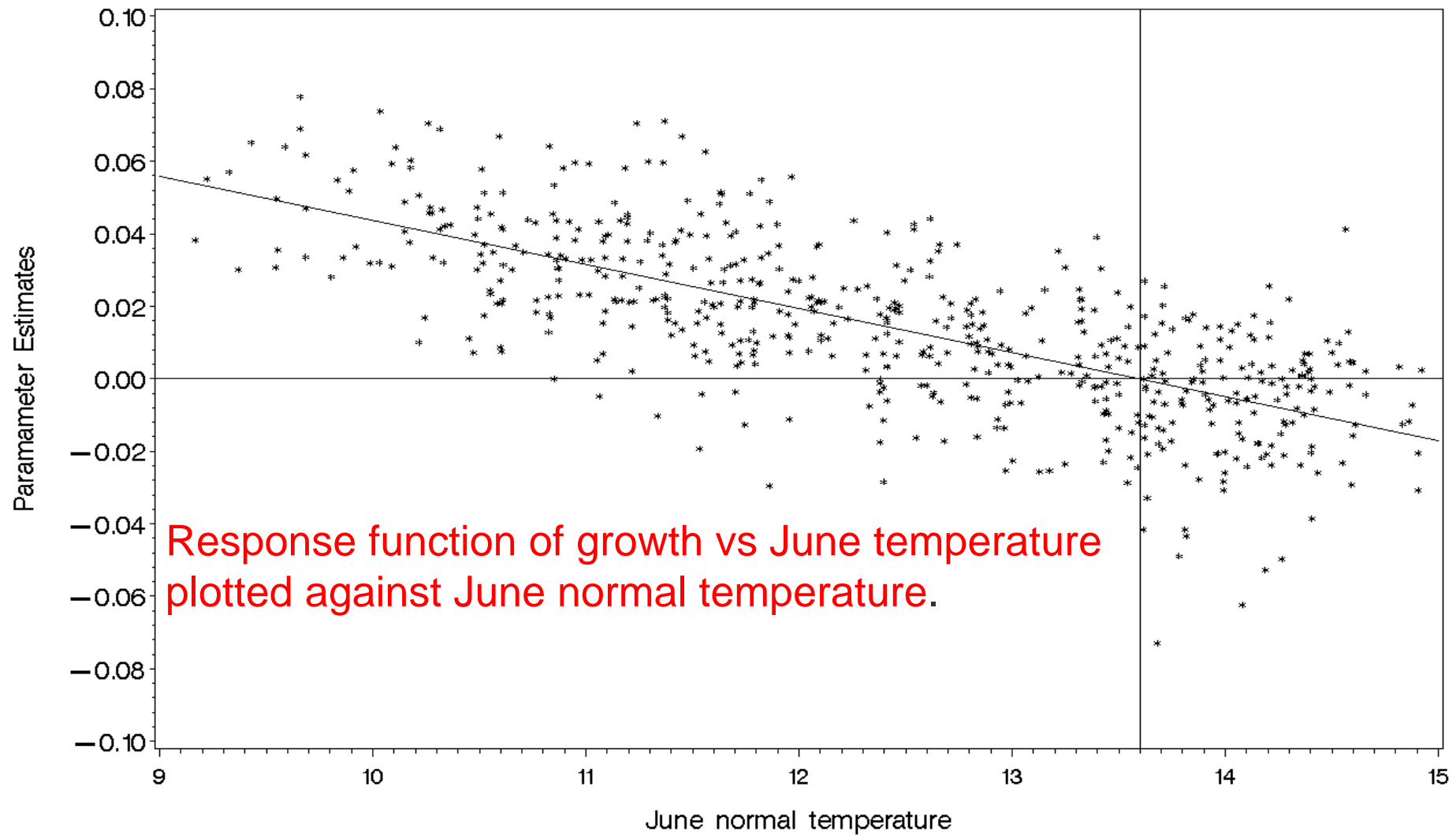
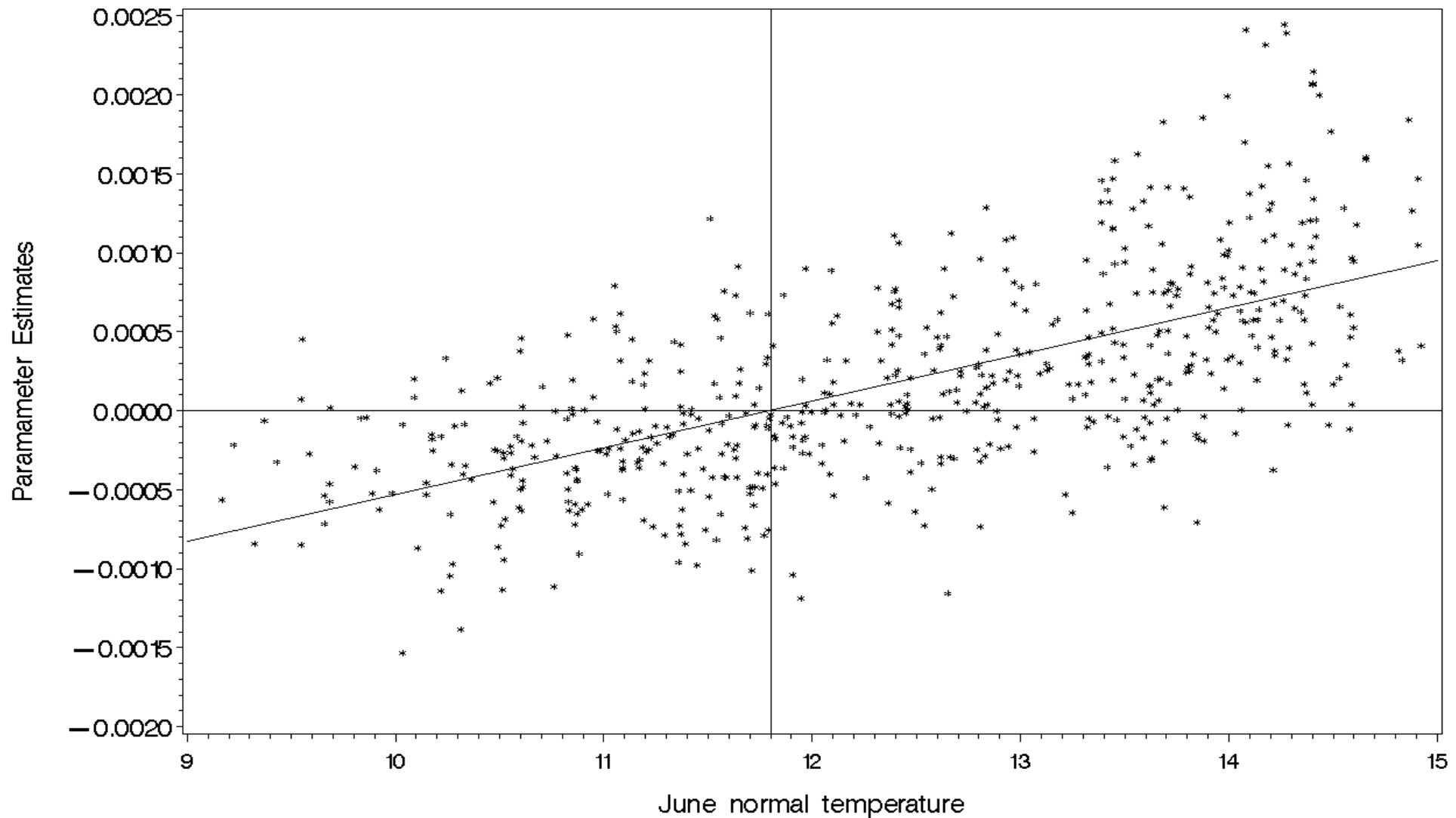


Fig. 4. Relationships between relative growth and N deposition. The slope estimates of the three data sets were treated as parallel, as their slopes were not significantly different.

Climatic responses in Norway spruce

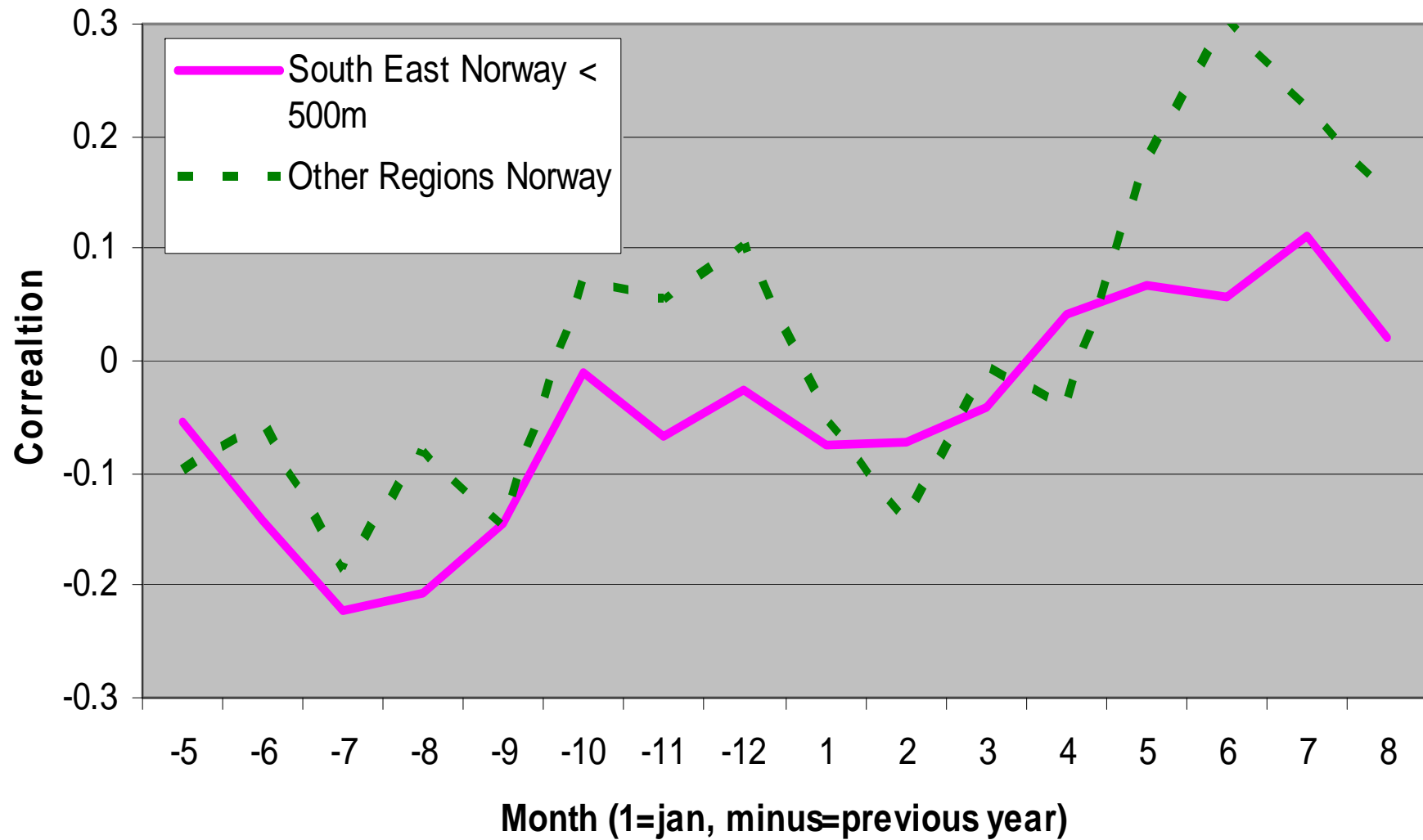


Response function growt vs June precipitation
plotted against June normal temperature.



Effects of different month temperature

Correlations between temperature and growth indices



Conclusion

- Relative Growth increase with Nitrogen deposition (ca 0.6% pr kg/ha/yr N)
- Corresponds with previous fertilizing recommendations
- Not all periods significant
- Most pronounced in southernmost part of Norway - cf. N_dep.
- Youngest forest reacted most – weak effect for old Norway spruce forest
- Climate (drought, temp, prec, length of growth season) influence the results



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Thank you!

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