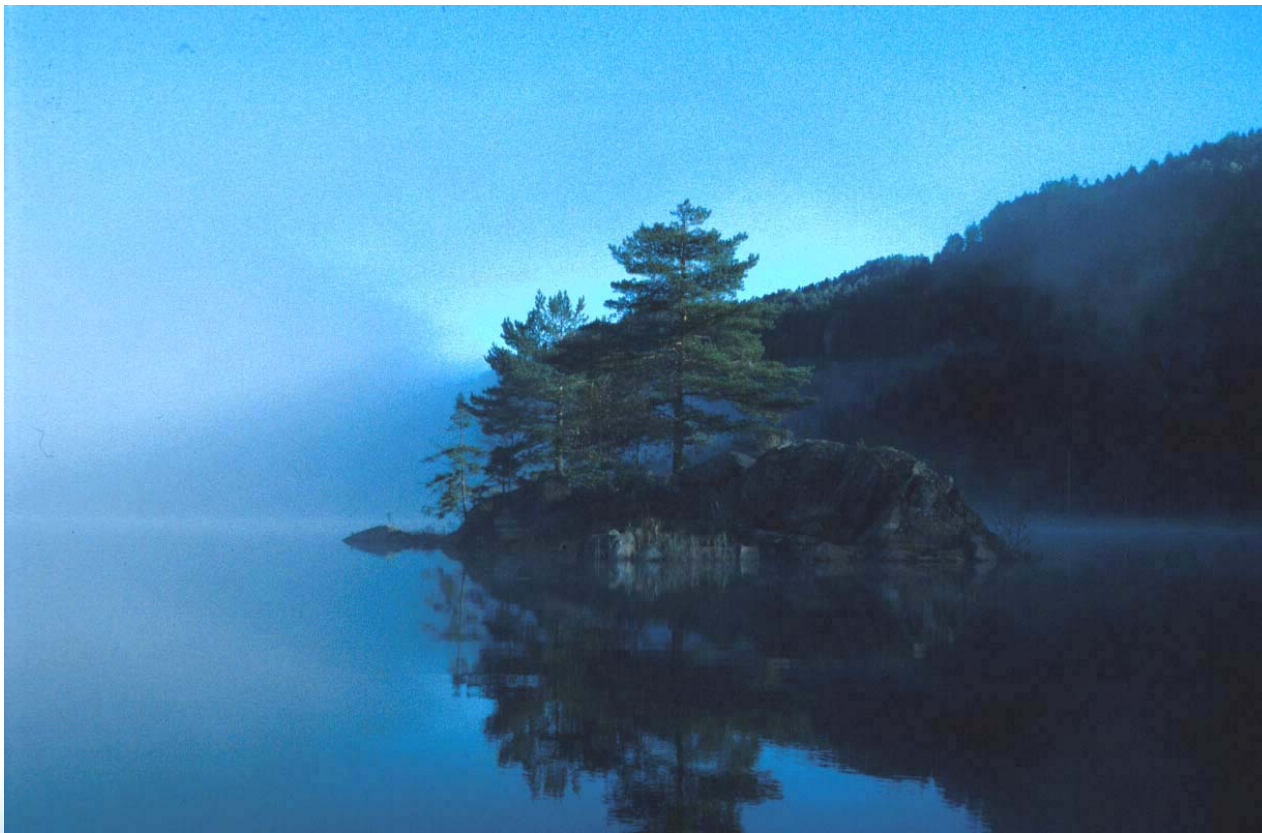


Reactive nitrogen in surface waters

Some experiences from Norway

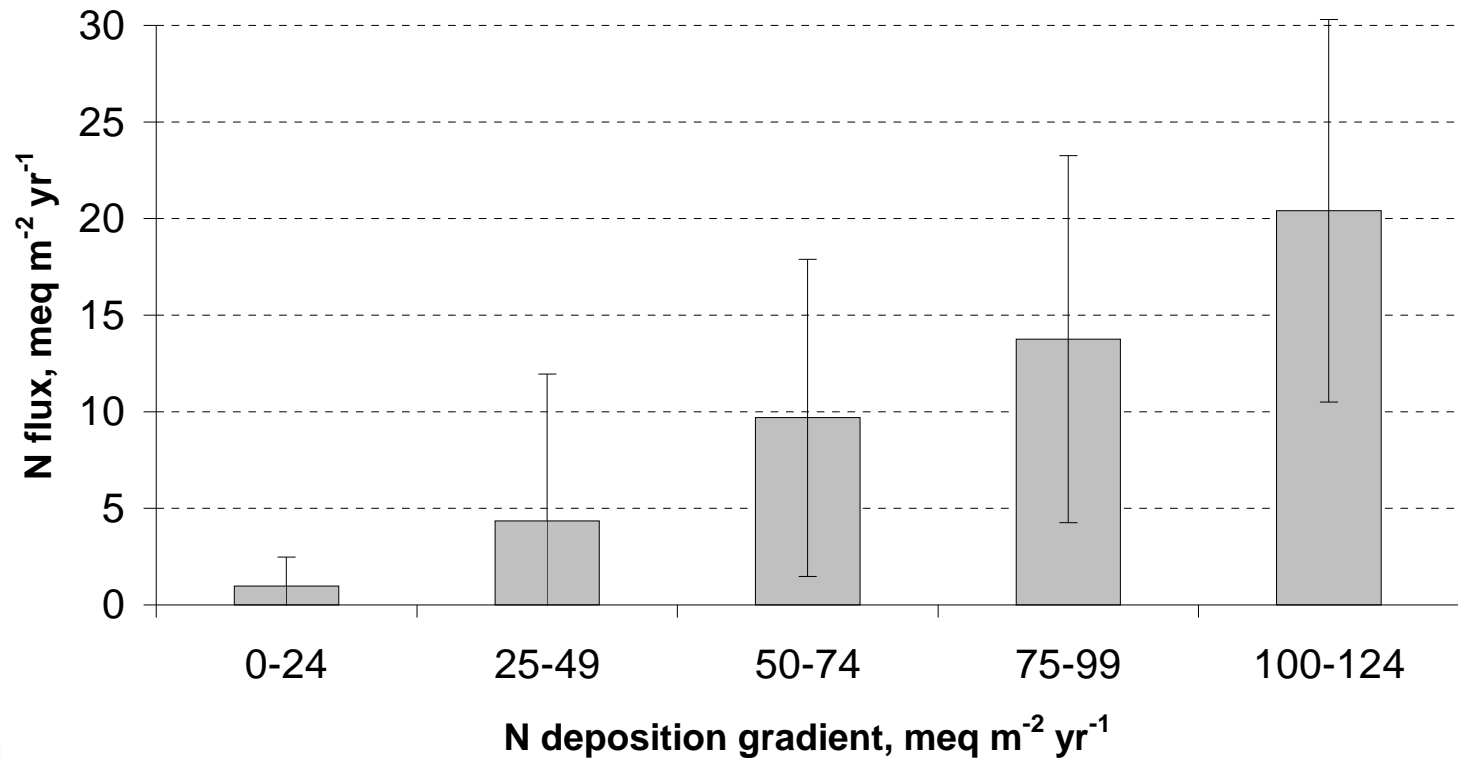


Outline

- NO₃ status in Norwegian surface waters:
 - Regional pattern
 - Long-term trends
- Large-scale experiments (two examples)
- Data sources:
 - ICP Waters
 - National monitoring programme on long-range transported air pollution (*SFT*)
 - CLIMEX and CLUE research projects (*Wright 1998, Stuanes et al. 2008*)

Regional pattern in NO₃

From the Norwegian 1000 lakes survey 1995
(SFT 1997, Henriksen et al. 1998)



Long-term data series

- Streams
(since 1980)



Photo: Ø. Kaste

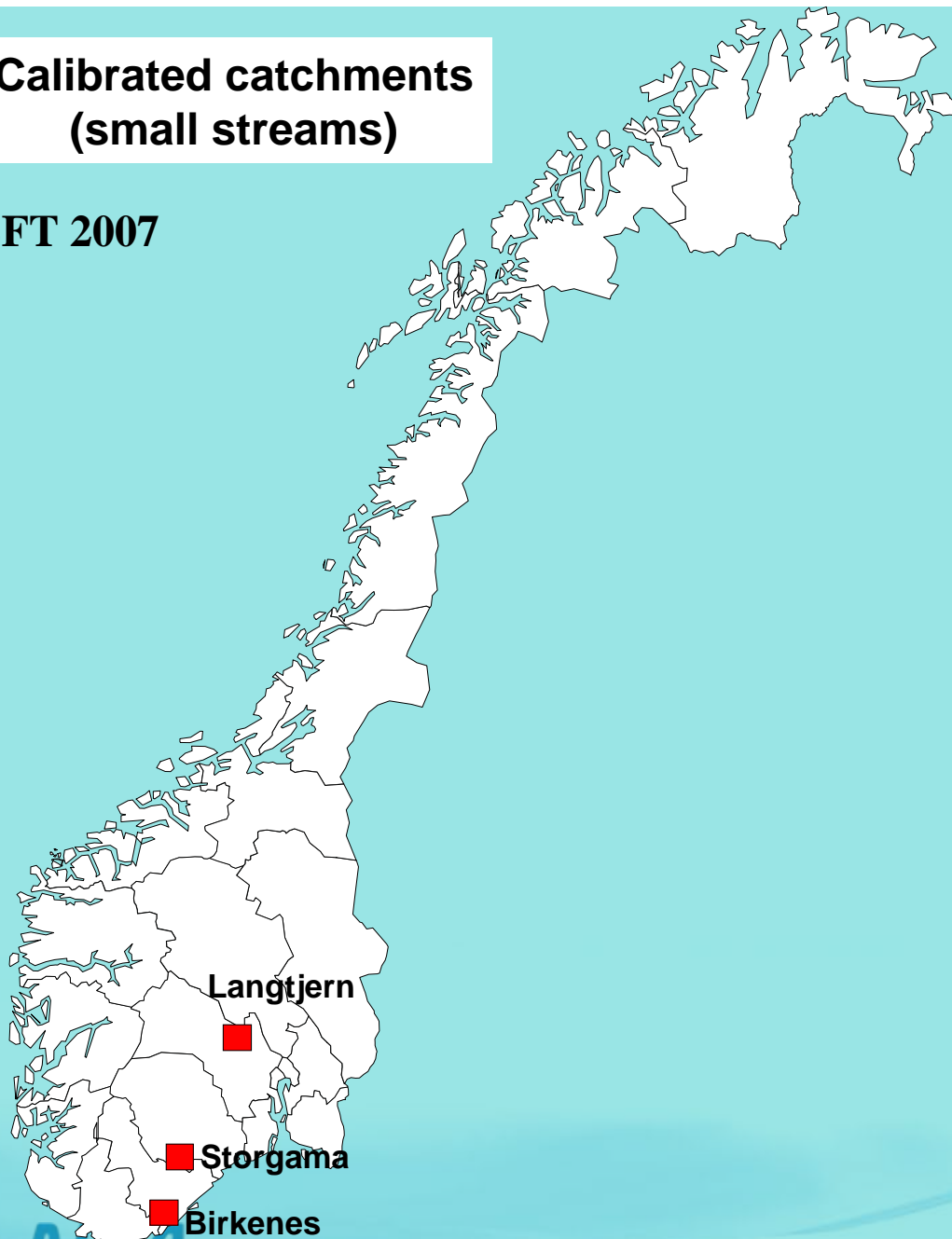
- Lakes
(since 1986)



Photo: R.F. Wright

Calibrated catchments (small streams)

SFT 2007



Langtjern



Foto Thorjørn Larssen

Storgama



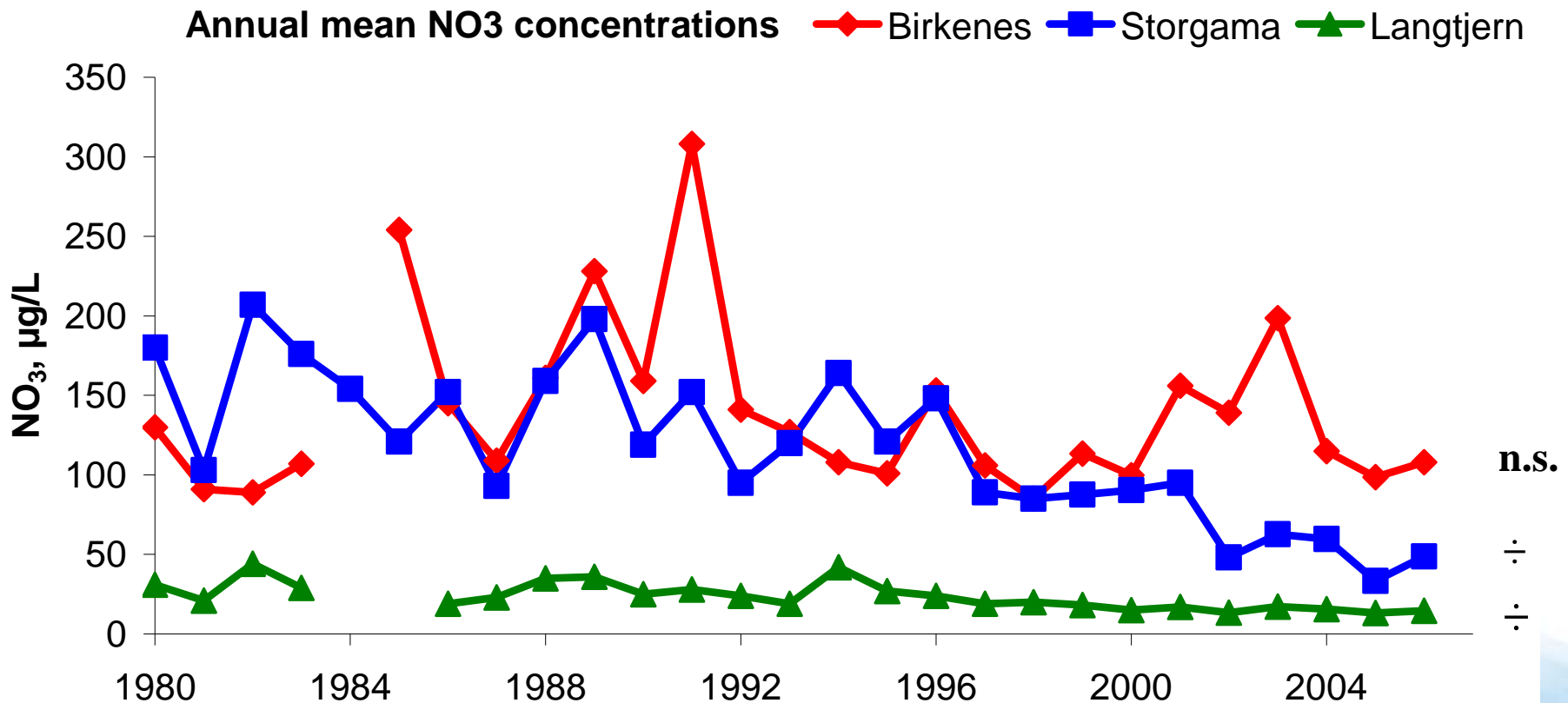
Foto Ståle Haaland

Birkenes



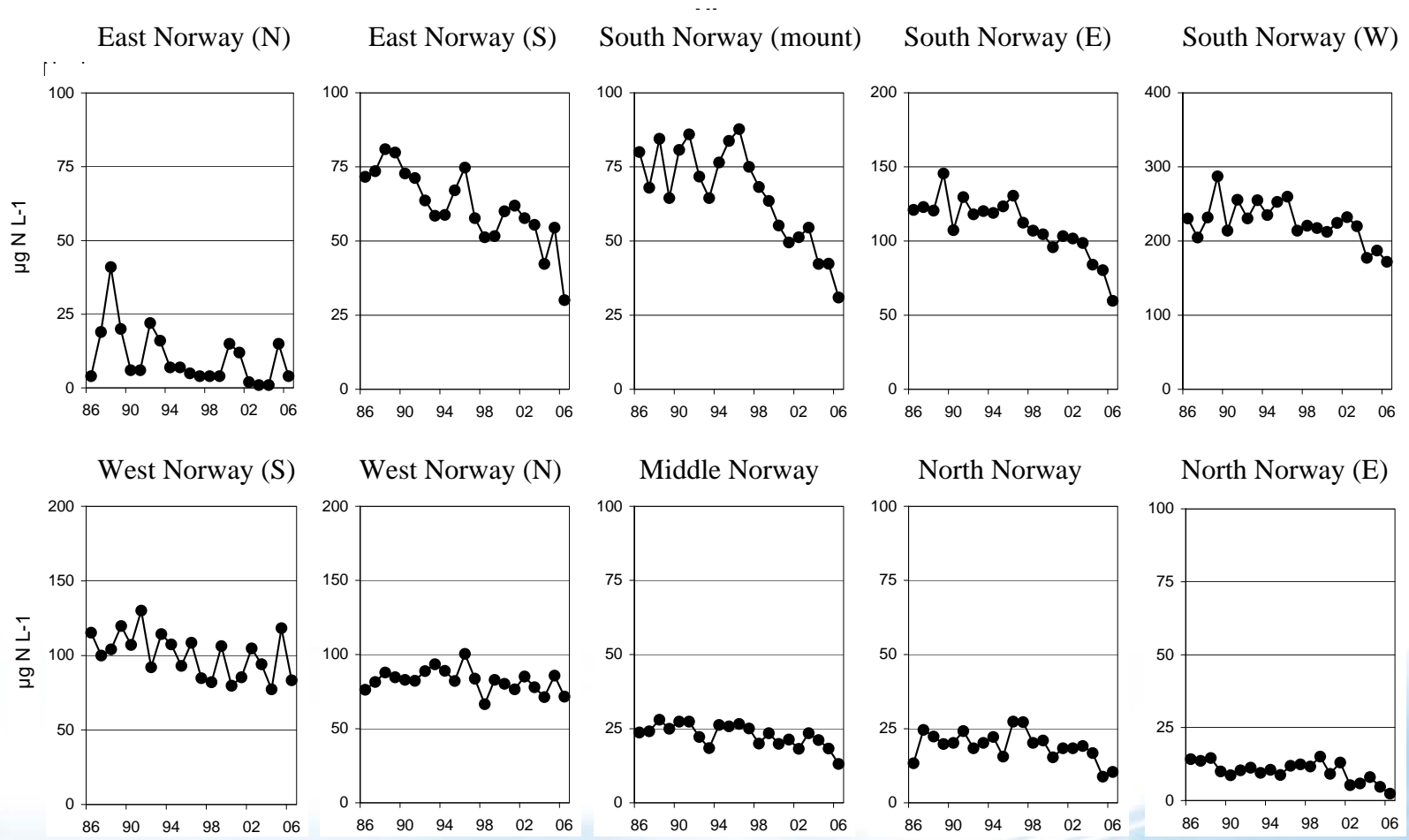
Foto Thorjørn Larssen

Long-term trends; streams



Source: SFT 2007

Long-term NO₃ trends in lakes

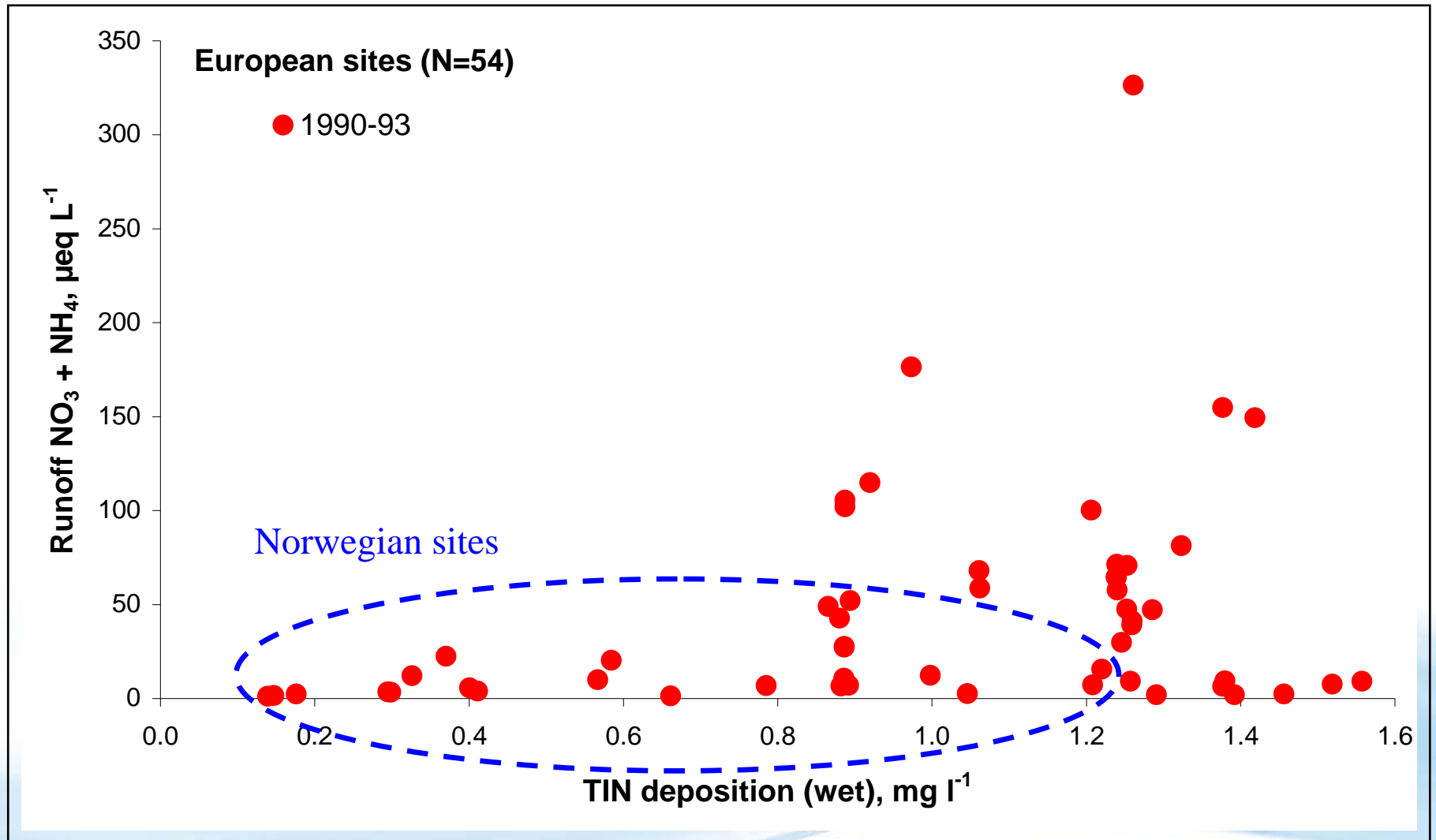


Why more distinct trends in lakes?

- Sampling strategy? (weekly vs. autumn samples)
- Change in NO_3 seasonal pattern (longer growing season)?

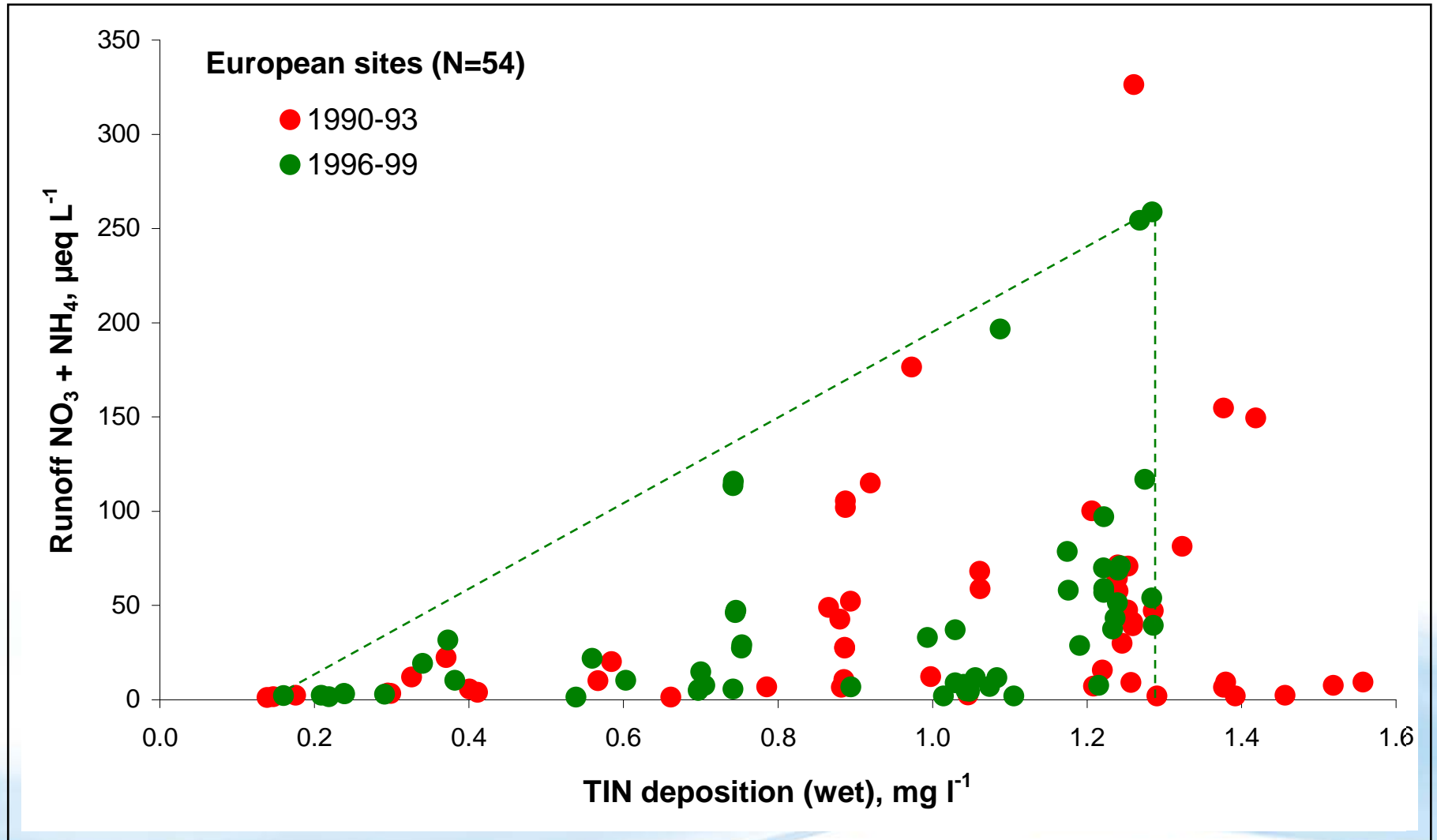
TIN runoff vs. TIN deposition

Data from ICP Waters (de Wit & Skjelkvåle, 2007)



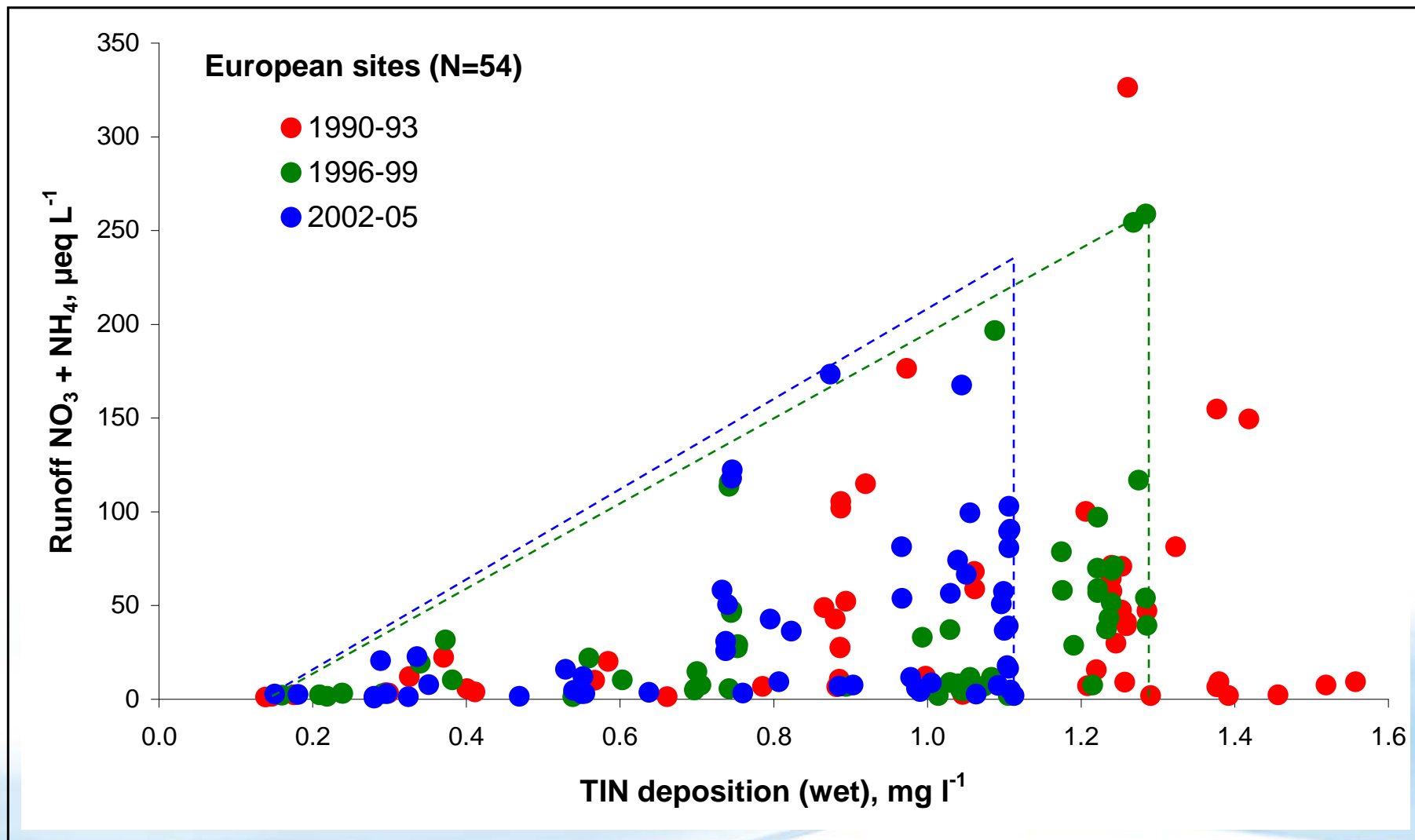
TIN runoff vs. TIN deposition

Data from ICP Waters (de Wit & Skjelkvåle, 2007)



TIN runoff vs. TIN deposition

Data from ICP Waters (de Wit & Skjelkvåle, 2007)



CLIMEX project (1992-1998)

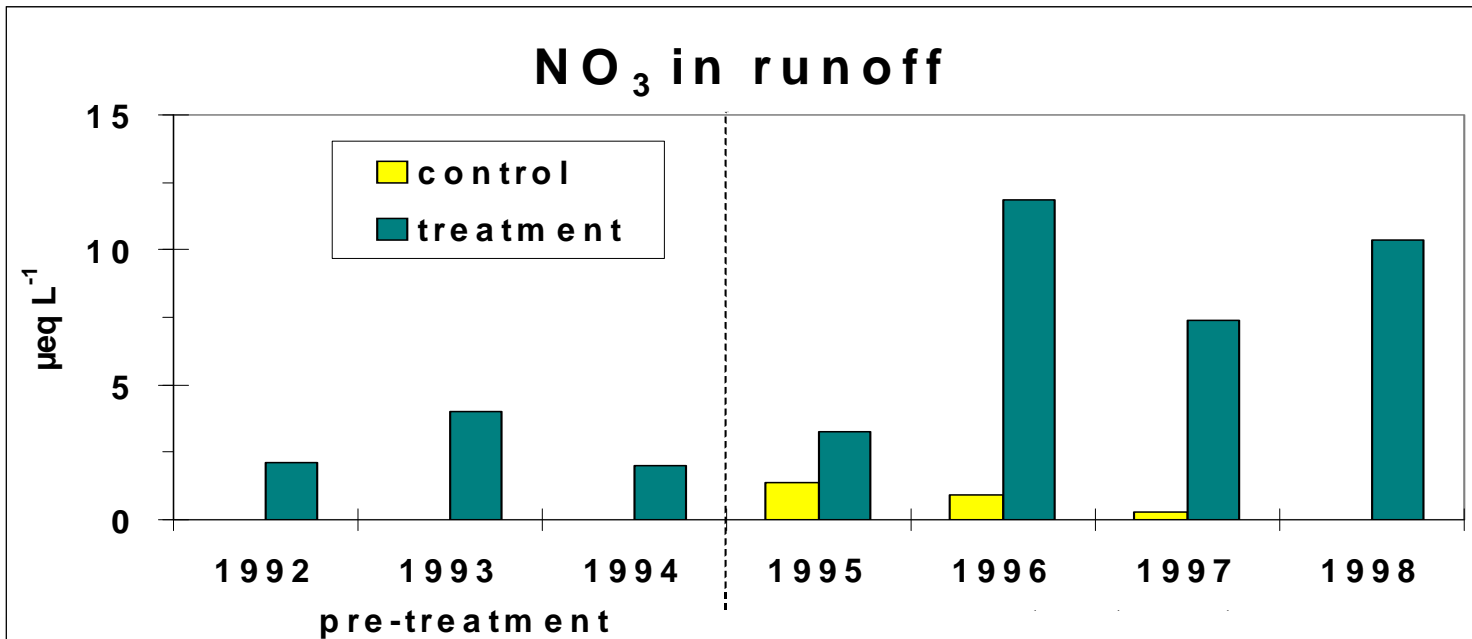
- Whole-catchment manipulation of temperature and CO₂ level



- Temperature: +3.5
- CO₂: 560 ppmv

Wright 1998; Ecosystems

Response: Increased NO_3 leaching



Wright 1998; Ecosystems

CLUE project (2003-2007)

- Manipulation of soil temperature regime in small headwater catchments



Results presented in special issue of AMBIO (vol. 37/2008)

Experiment 1) Snow removal

- To promote severe soil frost (and possible increase in NO_3 runoff)



Photo: Live Vestgarden

**No significant effect on N leaching
(Kaste et al. 2008; AMBIO)**

Experiment 2) Extra insulation

- To prevent the soil from freeezing (surrogate for a thick snowpack)



Photo: Live Vestgarden

Significantly increased leaching of NO_3 and NH_4

(Kaste et al. 2008; AMBIO)

Summary

- Many Norwegian sites have experienced slightly decreased N deposition since 1990
- Nitrate trends differ between streams and lakes
 - Streams: No clear picture
 - Lakes: Downward trends in south-east Norway
- Underlines that N leaching is a result of several interacting factors (including climate)
- Further reduction of N emissions required:
 - To reduce N-loading on freshwater and marine ecosystems
 - N-derived acidification (especially in winter/spring)
 - To reduce the risk of increased N mobilisation under climate change (CLIMEX)

Thank you!

