A regional perspective on main drivers of N deposition

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Introduction

Future climate change with more precipitation and higher air temperatures in Norway will affect the biogeochemical N cycle. The REGCLIM project (*regclim.met.no*) has recently published scenarios for the period 2071-2100 suggesting that the annual precipitation in Southern Norway can increase with between 0.2 and 19.6% while the winter precipitation can increase with 2.0 to 35.6% compared to the present situation.

The CLUE project was established to better understand climate change effects on the N cycle in Norway in a combination of field experiments and model studies including coupling to regional climate models (*www.umb.no/ipm/forskning/clue/*).

According to Hanssen-Bauer (*2005*) the annual precipitation in Norway has increased in 9 of 13 regions with a 15-20% increase in north-western regions. The same study shows that there is a correlation between the North Atlantic Oscillation index (NAOI) and winter air temperature in all regions and a correlation between NAOI and winter precipitation in the western regions. However, this correlation varies with time. One explanation may be that the atmospheric circulation over Norway is not only dependent on NAOI but also the position of the Icelandic low.

Nitrate concentration reductions in precipitation follow emission reductions in the EMEP area (*Vestreng et al., 2005*). It has been a steady decrease in most of Europe since 1990 and in 1980-2004 the decrease has been particularly strong in Eastern Europe.

Hole and Tørseth (*2002*) reported the total sulphur and nitrate deposition in Norway in five-year periods from 1978-1982 to 1997-2001 and found that the total (wet+dry) Nr deposition in the last period had been reduced with 16% although the total

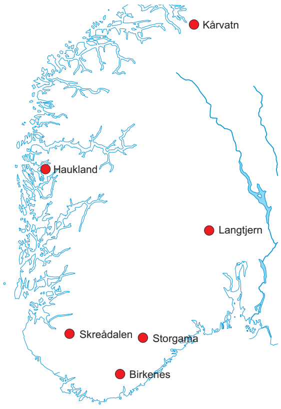

Figure 1: The sites studied.

precipitation had increased with 10%. However the decline in deposition since the early 1980s is not steady since EMEP area NO_X emissions reached a peak around 1990 and the period 1988-1992 was the wettest in Norway of the periods studied.

Regional nitrate deposition gradients are partly caused by large differences in annual precipitation (a factor of 10). South-West Norway has the highest precipitation and consequently the highest deposition, while dry deposition dominates in the north and along the Swedish border.

Precipitation data from six monitoring stations were tested with the nonparametric Mann-Kendall as a two-tailed test (*Gilbert, 1987*). Secondly the estimate for the slope of a linear trend was calculated with the nonparametric Sen's method (*Sen, 1968*).

Results

- There is a significant increase in both summer and winter precipitation since 1980 at the most coastal station (Haukeland).
- Because 1990 was the warmest (and consequently one of the wettest) year on record in Norway, there are no significant trends in precipitation in 1990-2003.
- There are significant reductions in nitrate concentration in precipitation at several stations, particularly at the driest station (Langtjern).
- NAOI is best correlated with nitrate deposition at the coastal stations (Haukeland and Skreådalen). This is particularly true in winter.
- The European blocking index is strongest (and negatively) correlated with winter deposition at the drier sites.
- Increasing precipitation seems to compensate for decreasing nitrate concentrations at several sites in the south (Birkenes, Storgama and Langtjern).
- More detailed statistical analysis is in progress as part of the CLUE project. (*www.umb.no/ipm/forskning/clue/*).

Figures

All figures: Triangles are winter month data (December, January and February) and dots are summer month data (June, July and August). Blue lines are winter trends and red lines are summer trends. Significant trends (p<0.1) are shown for 1980-2003 and 1990-2003.

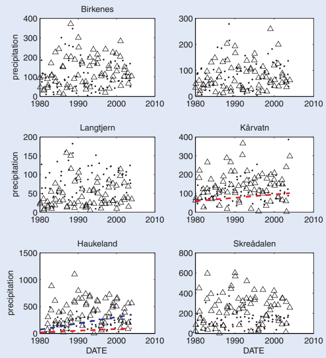

Figure 2: Monthly precipitation (mm).

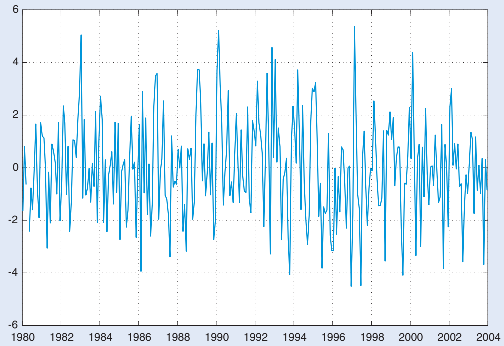

Figure 5: Time series of monthly NAO index 1980-2003.

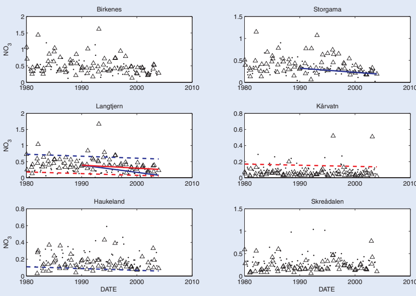

Figure 3: Monthly average NO_3 concentration in precipitation (mg/l).

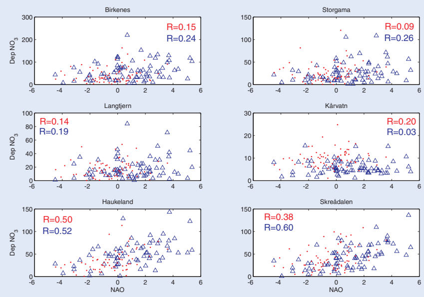

Figure 6: Monthly average NO_3 wet deposition (mg/m^2) vs monthly NAO index

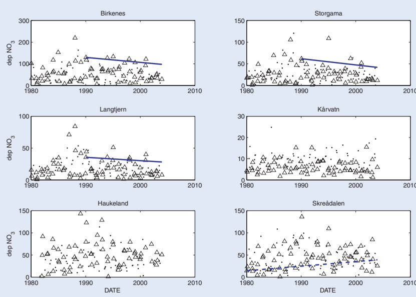

Figure 4: Monthly average NO_3 wet deposition (mg/m^2).

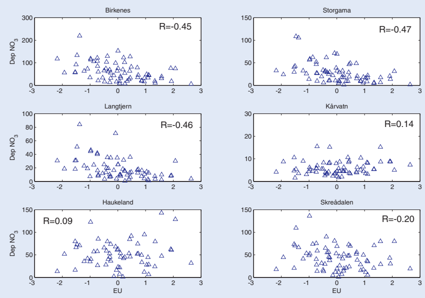

Figure 7: Monthly average NO_3 wet deposition (mg/m^2) vs monthly European blocking index.

Acknowledge-ments

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