National assessments, Norway

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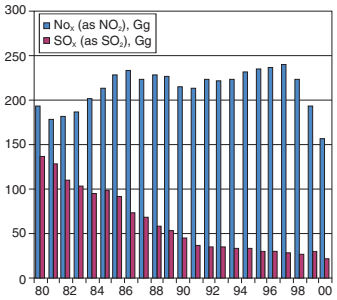
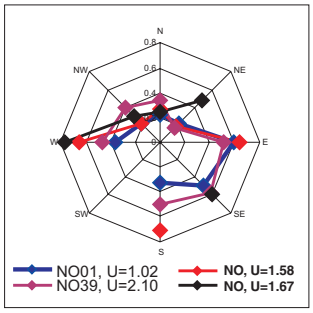
Conclusions

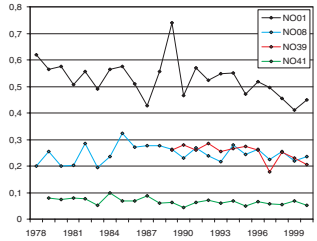
- The national SO_2 emissions have been strongly reduced and were about 19 per cent of the 1980 emissions by the turn of the century.
- The NO_x emissions peaked in 1999, but will have to be reduced further to 156 thousand tones by 2010 in order to comply with the Gothenburg Protocol.
- A small reduction in the NH_3 emissions has taken place from 1996.
- The non-methane VOC emissions peaked in 1996 and should be reduced further to 195 thousand tones in 2010 in order to comply with the Gothenburg Protocol.
- The concentrations of sulphur dioxide and sulphate in air have been strongly reduced in all parts of Norway. The annual averages of SO_2 and SO_4air in 2000 were e.g. reduced by 65 and 58 per cent respectively from the 1978/79 averages at Birkenes. Emission reductions in east, southeast, south, and west gave the strongest contributions to the reduced sulphate concentrations in air. The sulphate concentrations in precipitation and the wet deposition in southern and middle parts of Norway have significant down trends at all sites. In the north there are visual decreasing trends from 1987, these are however not significant. Calculations of the total deposition show a strong reduction in the deposition of sulphur compounds over the last twenty years.
- The NO_2 concentrations in Norway decreased from the late eighties until 1993-1995.
- Concentrations of nitrate in particles and nitric acid have low concentrations in all parts of the country and visual downward trends in the southernmost parts. In northern and middle parts of Norway the concentrations are extremely low. There are significant decreasing concentrations in nitrate in precipitation at Birkenes from the end of the eighties, but no significant trends in other parts of the country. There are no trends in the wet deposition of nitrate.
- Birkenes had significant downward trends in the annual averages of the sum of ammonia and ammonium in air since the measurement started in 1987 as well as in precipitation annual averages and wet deposition. A similar trend was not seen at other sites in southern Norway. The corresponding data series at Jergul in the north indicated decreasing trends in the annual averages of the air concentrations, and in the wet deposition from the end of the eighties.
- Calculations of the total deposition of oxidized and reduced nitrogen components show small changes only over the last twenty years.
- There are indications of decreased concentrations of non-sea salt basecations calcium and potassium in southern Norway from the early eighties until today.
- Annual precipitation weighted pH averages increased significantly at all sites during 1978 -2000.
- The trends in surface ozone for measurements since 1986-1990 are not obvious. Annual statistics indicate a reduction of peak values at the most southern stations, and an increase in the lowest percentiles at several sites. Furthermore, trends estimated for ozone measurements in separate transport sectors give uncertain and mixed results. A marked increase is, however, seen in winter at many sites.



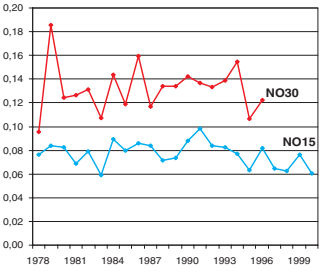
Annual emissions of SO_2 and NO_X



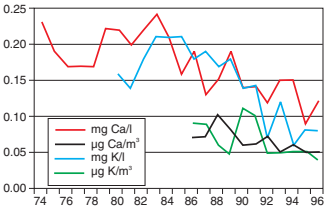
Improvement in SO_4 concentrations in air at the sites in southern Norway during 1985–1996.



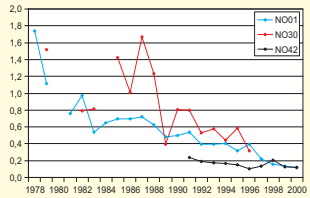
Trends in nitrate in prec. in southern Norway. Unit: mg N/l.



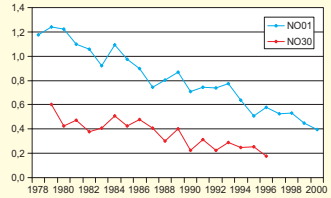
Trends in nitrate in prec. in middle and northern Norway. Unit: mg N/l.



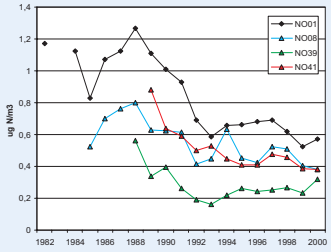
Trends in xCa and xK in prec. and air at Birkenes.



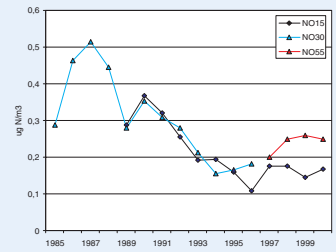
Trends in SO_2. Unit: µg S/m³



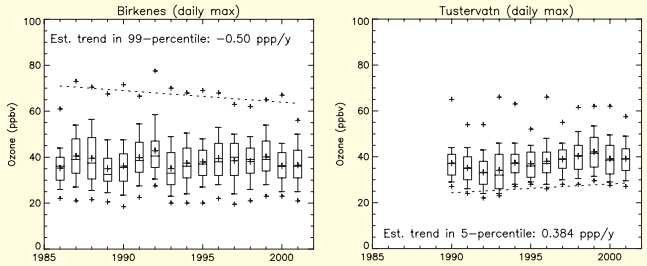
Trends in x SO_4 prec. Unit: mg/l



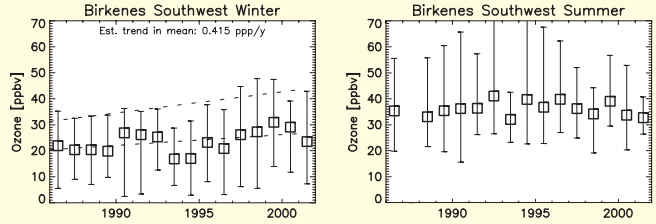
Trends in NO_2. Unit: µg N/m³



Trends in NO_2. Unit: µg N/m³



Annual quartiles of measured ozone based on daily maximum values. The 5-, 10-, 25-, 50-, 75- and 99-percentiles are given. Crosses inside the bars mark the mean values. The linear regression lines of the 5- and 99-percentiles are given if they are significant on a 1-σ level.



Surface ozone trends for winter and summer for the SW sector.

References

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