ECN

Energy research Centre of the Netherlands

WG 2

Detecting change in atmospheric ammonia following emission changes

Working Group 2

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Working group 2:

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Harmonization ….

"Sinterklaas", most important Dutch (holy)day

Working group objectives

- To quantify the extend to which estimated regional changes in ammonia emissions have been reflected in measurements of ammonia and ammonium in the atmosphere;
- To assess the extent to which atmospheric measurements verify the effectiveness of ammonia abatement policies;
- To make recommendations for future air monitoring and systems for assessing the national implementation of ammonia abatement policies.

Update the current scientific understanding based on new datasets and assessments

- Conclusions from the Bern report
- Background document Albert et al.
- Individual presentations
- Reporting WG findings

Working group items

- Update the current scientific understanding based on new datasets and assessments.
- Is there still an ‘ammonia gap’ in the Netherlands?
- Exist such a gap in other countries, Europe?
- Are we confident about the effectiveness of ammonia mitigation policies?
- How can we best address the relationships between emission and deposition using atmospheric modelling and improved monitoring activities?

Conclusions from Bern

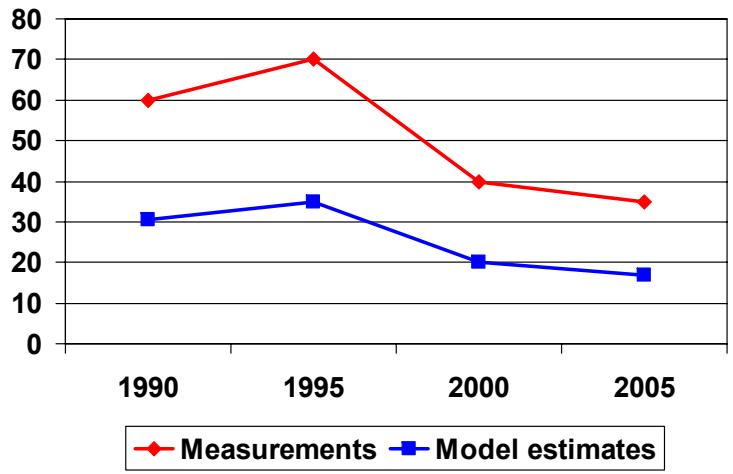
- Difficulties and uncertainties in assessing the emissions and the effectiveness of NH_3 abatement from monitoring networks;
- in assessing the success of any abatement policy based on technical methods, a combination of appropriate modelling and sufficient measurements should be able to determine whether the abatement measures are broadly effective.
- requirement for sound monitoring methods implemented at sufficient sites and over a sufficiently long period;
  - for NH_4^+ aerosol and NH_4^+ in rain, a modest number of sites can be used to indicate trends, whereas for NH_3 in source areas a high density of sites is essential (low-cost);
  - requirement for high temporal resolution NH_3 concentration data at selected sites;
- quantifying the interactions of NH_x, necessary to interpret long-term trends, requires improved mechanistic understanding & modelling:
  - better generalization on the bi-directional controls on NH_3 exchange
  - the chemical interactions that are recognized for atmospheric chemistry also need to be treated in relation to dry deposition
  - advancement of the regional-temporal modelling of NH_3 emissions in relation to environmental conditions.

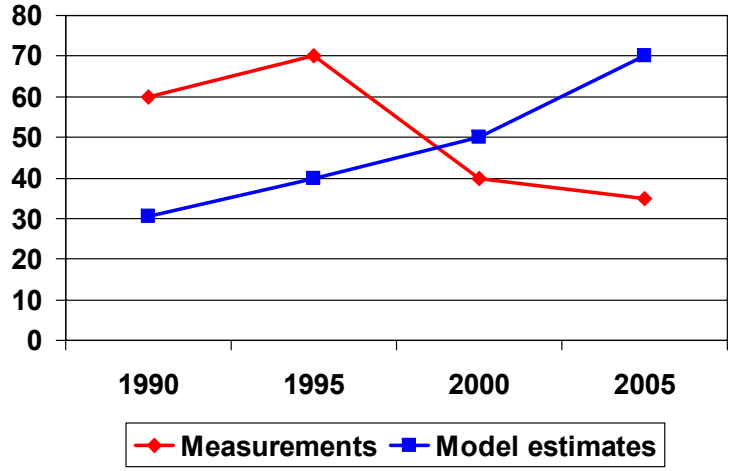
Major advances in our understanding

- We have seen some clear advancement in closing the gap between the observed and expected values for reduced nitrogen, where we do get a better understanding of the reasons behind it
- Long-term measurements follow the emission trend.
- Current measurements make it possible to evaluate policy progress on ammonia emission abatement
- Instrumentation (models, monitoring equipment) has improved

Definition of ‘Ammonia gap’

Emission based indicators differ significantly from measurements

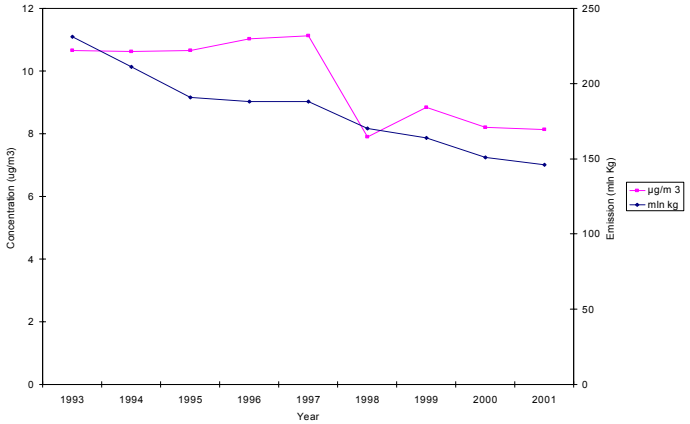




If the model resolution is too large, there is always a gap

Is there still an ‘ammonia gap’ in the Netherlands?

- One of the two ammonia gaps in the Netherlands is solved
- Trend in emissions follow concentration measurements
- Systematic difference between emission based concentrations and measurements (30%)
- Both emissions and dry deposition contribute to the gap
- Lack of quantitative uncertainty analysis



Does such a gap exist in other countries, Europe?

- In most countries where monitoring takes place the concentrations did not change much (UK, Switzerland, ..), mainly because emissions did not change, except NL, DK-
- No systematic gap such as in the Netherlands is signalled (UK, DK, Switzerland)
- Evaluation of the absolute emissions in Europe and the changes therein difficult because of lack of monitoring data
- EMEP monitoring strategy: existing sites not aimed to detect ammonia from agriculture; lack of implementation especially in Eastern Europe
- The lifetime and transport distance of NH_3 and the NH_4 wet deposition and aerosol trends are affected by the change in atmospheric chemistry due to SO_2 reductions:

Recommendations for gap closure

- Use high resolution site data to interpret difference between model and measurements (ammonia gap): emission modelling (including meteo effect on emission factors)
- Model intercomparison (DK, UK, NL, US)
- Quantify uncertainty in the measurement and models, emissions

Are we confident about the effectiveness of ammonia mitigation policies?

- Effectiveness is determined by studies on individual abatement options, which have been done only to a limited extent
- Big changes in emissions have been detected using monitoring data (Netherlands, Denmark, Eastern Europe?…). The trend in emissions (including abatement measures) are in agreement with trends in measurements.
- Sectoral changes or individual abatement options can currently not be detected with existing monitoring data. Process studies are relevant to find sectoral changes (FMD)
- Confounding factors: SO_2 reduction, influence of meteorology on emission/deposition, ….
- Recommendations: initiate local studies when big changes are expected (e.g. FMD)

How can we best address the relationships between emission and deposition?

- Evaluate CLRTAP/EU/national policy objectives, based on impacts (biodiversity, PM and human health, climate change): what should be the focus?
- Determine the indicators and the expected changes at the different scales (emission, concentration, deposition)
- Implement the EMEP monitoring strategy and improve it by focussing on:
  - Monitor the spatial variations in emissions
  - Detect the expected changes
  - Focussed on all output parameters of the model relevant for changes in ammonia (e.g. N-balance)

How can we best address the relationships between emission and deposition?

- Pre-study based on current knowledge to optimise the spatial and temporal resolution of monitoring data, using
  - Emission modelling
  - Dispersion/deposition
  - Impacts/integration
- Outcome could be a combination of regional low cost samplers with a few high temporal resolution measurements and tower measurements
- Use monitoring equipment with enough and known quality for specific applications; harmonised, intercompared, QA/QC, ISO14001 …... The past years instrumentation has been improved
- Improve models to do good assessment of monitoring results (emissions, dry deposition, atmospheric chemistry, dispersion, transport)
- Additional local studies and impact assessment for special issues.