CONCLUSIONS

Deposition

1. Trace gases

- Fluxes of the acidifying compounds NO_2, NH_3, SO_2 and aerosols to forests and short vegetation have not only been measured directly, overcoming important uncertainties in methods and interpretation, but also have been monitored over long periods.
  This work provides the basis for greatly improved accuracy of input estimates of pollutants to forests and the landscape in The Netherlands and across Europe.

2. Ammonia / ammonium

- The highest uncertainty in estimates of NH_3 deposition is caused by uncertainties in temporal and spatial variations in NH_3 emissions.
- The conversion rate of NH_3 to NH_4^+ aerosol is not known accurately. It is likely that it shows temporal and spatial variations, that e.g. depend on the concentration of acidic compounds in the atmosphere. This information should be known as it determines where NH_x will be deposited, because the dry deposition velocity of NH_3 is much larger than the dry deposition velocity of NH_4^+ aerosol. For that reason reduction of emissions of acidic compounds in the air only could lead to a change in the dry deposition pattern of NH_3.
- The concentration of NH_3 at the surface of vegetation and seawater determines partly the flux of NH_3 to or from the surface. It should be taken into consideration in transport modelling. NH_3 emissions from agricultural crops could be potentially important in the growing season.

3. Particle deposition

- Dry deposition of particles to forests has often been underestimated until now. Furthermore, the role of particles in regulating water layer (chemistry) on vegetation and thus influencing gaseous dry deposition is important.

4. Generalization

- Deposition should be determined at a scale that enables the estimation of risk for ecosystem damage. Furthermore, most important factors determining deposition (edge effects, slopes, topography, roughness transition zones, etc.) should be taken into account in estimating input to sensitive ecosystems. For model development it is necessary to obtain key parameters by field experiments and validate the models by further field measurements.

Effects of acid deposition

1. No direct relationship exists between tree health and acid deposition.
2. Atmospheric deposition of N and S compounds on forests leads to:

- changes in vegetation composition into the direction of nitrogen-loving species and monocultures;
- high concentration of Al and NO_3 in soil solution and groundwater and to loss of biodiversity in non forest ecosystems.

3. Ozone has a significant adverse impact on plants. Not only crops, but also forest trees can be affected. The impact on natural vegetation is largely unknown as yet. In The Netherlands the contribution of NO_x to the total nitrogen deposition is currently less than 20%. But its adverse impact through formation of ozone must not be neglected.
4. The impact of atmospheric deposition on forest trees should be evaluated in terms of risk rather than in terms of visible effects.

The future

1. Global climate change and land use change will influence acidification processes;
2. A shift is necessary from effect oriented to system oriented research;
3. Ecologists, studying acidification effects, have to include climate factors;
4. Scientific uncertainties have to be reported explicitly.
5. Long term monitoring programmes are necessary to evaluate effects of acidification and of policy actions.
6. "Local" processes are largely unknown (especially for N). Knowledge on "local" processes will improve knowledge on causal relations.