Atmospheric Chemistry: Overview and Future Challenges

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Modelling and forecasting the chemical composition and dynamics of the troposphere and stratosphere go in the direction of linking Atmospheric Chemical Aerosol Transport Models (ACATMs), Numerical Weather Prediction (NWP) models, remotely sensed and in-situ data, and data assimilation into large-scale comprehensive modelling systems.

Atmospheric Chemical Mechanisms (ACMs) are fundamental components in these comprehensive modelling systems. There is a critical need for improving available ACMs. Important examples include the chemistry of high molecular weight organic compounds, radical reactions, photo-oxidation processes, and heterogeneous processes. ACMs have over the years been based on measured rate constants and mechanistic studies from laboratory experiments. Due to experimental limitations ACMs today represent best the atmosphere at temperatures near 298 K. While an ACM shall be valid over the range from 200 to 300 K in order to represent the troposphere and stratosphere. Furthermore, the uncertainty in rate parameters used in ACMs are usually greater for the more reactive organic compounds.

As a starting point the new European GEMS (Global and regional Earth-system Monitoring using Satellite and in-situ data) project will be presented. Within this project a comprehensive modelling system, as described above, will be build. More than teen different ACATMs (and ACMs) will be included in this modelling system.

An overview of the chemistry of the atmospheric boundary layer and free troposphere will be given together with a presentation of some of the most frequently used lumped ACMs in ACATMs: CBM-VI, EMEP, RADM2 and RACM. A comparison of these ACMs will be shown, and the advantages and disadvantages using the different ACMs will be explained.

There exist several future scientific challenges where these lumped ACMs should be improved before they are used. Some for these issues are:

- the influence of biogenic emissions on the chemical composition (impact: iogenic chemistry and aerosol formation),
- the oxidation of dimethyl sulfide in the marine boundary layer (impact: organic sulphur chemistry, aerosol formation and global change),
- biomass burning (impact: increase of ozone formation, aerosol formation and global change),
- heterogeneous formation of HNO$_3$ in the cities (impact: heterogeneous chemistry and human health), and
- tropospheric ozone depletion in the Arctic and near lakes with a high salt concentration.

The chemistry related to these issues are not fully understood. At the end of the presentation the recent knowledge related to the problems will be outlined.