Atmospheric Chemistry

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0. Introduction
0.1 Concept
0.2 Atmospheric pressure and composition
0.3 Units for quantification of atmospheric trace substances

1. Reaction types, kinetics *(some 45 slides)*
1.1 Reaction rate coefficient
1.2 Homogeneous gas-phase reactions
1.3 Combinations of thermic reactions- Quasi steady state approximation
1.4 Photochemical reactions
1.5 Heterogeneous reactions *(following 2.2.3)*
    1.5.1 On solids
    1.5.2 In the gas/water droplet system *(following 3.3.4)*
    1.5.2.1 Phase equilibrium
    1.5.2.2 Deviation from phase equilibrium due to kinetic limitations – mass transport considerations

2. Stratospheric ozone chemistry *(some 35 slides)*
2.1 Chapman‘s reactions
2.2 Homogeneous catalysis of the ozone sink reaction
    2.2.1 OH
    2.2.2 Cl, Br
    2.2.3 NO
2.3 Heterogeneous reactions in polar stratospheric clouds
2.4 Long-term trends

3. Tropospheric chemistry
3.1 Tropospheric ozone and hydrocarbon chemistry *(some 60 slides)*
3.1.1 Tropospheric ozone trends
3.1.2 Ozone formation: Photosmog chemistry
    3.1.2.1 In CO oxidation
    3.1.2.2 In aliphatic hydrocarbons oxidation
    3.1.2.3 In aromatic hydrocarbons oxidation
3.1.3 Radical sources
    3.1.3.1 O_3
    3.1.3.2 Peroxides
    3.1.3.3 Aldehydes
    3.1.3.4 NO_2
    3.1.3.5 HNO_2

3.1.4 Sinks of tropospheric ozone
    3.1.4.1 Hydrocarbon and CO chemistry in the absence of NO_x
    3.1.4.2 Ozone as oxidizer
    3.1.4.2.1 Alkene ozonations
    3.1.4.2.2 Halogen oxidation

3.2 Nitrogen oxides chemistry *(some 25 slides)*
3.2.1 Nitric oxide chemistry
3.2.2 Nitrogen dioxide chemistry
    3.2.2.1 Reaction with OH and HO_2 (‚odd H‘)
    3.2.2.2 Reactions with hydrocarbons
3.2.3 Nitrate radical
3.2.4 Nitrous acid
3.2.5 Overview

3.3 Acids: formation reactions and cloud chemistry
(some 30 slides)
3.3.1 Sulfuric acid formation in the gas-phase
3.3.2 Cloudwater - introduction, significance
3.3.3 Sulfuric acid formation in the aqueous phase
    3.3.3.1 Dissolution of gases - thermodynamic equilibrium
    3.3.3.2 Bulk aqueous phase chemistry
3.3.4 Dimethylsulfide
    3.3.4.1 Formation of carbonyl sulfide
    3.3.4.2 Formation of SO_2
3.3.5 Deviation from air/water equilibrium due to organic films
3.3.6 Tropospheric ozone and clouds
3.3.7 Nitrogen compounds in the aqueous phase
3.3.8 Organic chemistry in the aqueous phase
3.3.9 Impacts of atmospheric acidity in ecosystems

3.4 Atmospheric aerosol, its composition, surface and bulk particle reactions
(some 50 slides)
3.4.1 Introduction, significance, sources
3.4.2 Chemical composition
    3.4.2.1 Inorganic, major components
    3.4.2.2 Inorganic, minor components
    3.4.2.3 Particulate organic matter
    3.4.2.4 Soot
    3.4.2.5 Water
3.4.3 Heterogeneous chemistry in atmospheric aerosols
    3.4.3.1 Secondary inorganic aerosol (SIA)
    3.4.3.1.1 SIA formation through condensation
    3.4.3.1.2 SIA formation through radical or ionic reactions
    3.4.3.1.3 SIA formation through catalysis by particle surfaces
    3.4.3.1.4 SIA formation through homogeneous nucleation

3.4.3.2 Secondary organic aerosol (SOA)
3.4.3.2.1 SOA formation through condensation of semivolatile organic compounds (SOC)
3.4.3.2.2 SOA formation through oxidation of volatile organic compounds (VOCs) to SOCs and subsequent condensation
3.4.3.2.2.1 Aliphatic hydrocarbons
3.4.3.2.2.2 Aromatic hydrocarbons
3.4.4 Gas-particle partitioning of organics
3.4.4.1 Condensation
3.4.4.2 Absorption
3.4.4.3 Adsorption
3.4.4.4 Complete approach: poly-parameter linear free-energy relationship

4. Trace substance mass budgets and surface cycling *(some 35 slides)*
4.1 Mass budget equation, residence time
4.2 Emissions
4.3 Deposition
4.3.1 Wet deposition
4.3.2 Dry deposition
4.4 Gas exchange, re-volatilisation
4.4.1 Atmosphere/ocean
4.4.2 Vegetation/atmosphere
4.5 Multicompartmental chemistry
4.5.1 Emissions to the multicompartmental system
4.5.2 Total environmental residence time
4.5.3 Global distribution of re-volatilising substances, grasshopper effect