Experiments and Modeling of Microphysical Properties

Leader: Merete Bilde

Serena Chung

Juliane Fry

Chris Hoyle

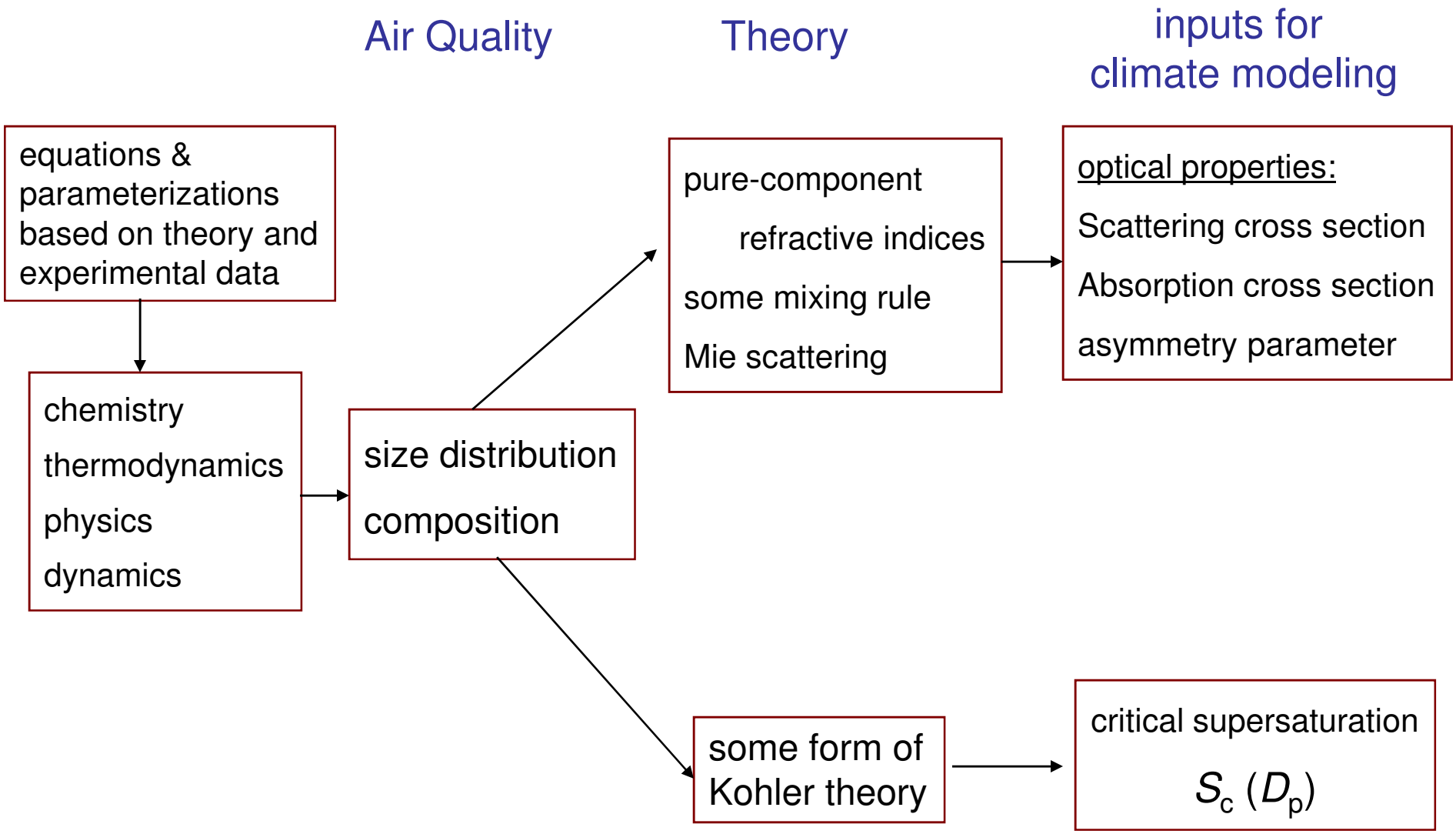
Hannele Korhonen

Radovan Krejci

Thomas Rosennoern

Alessandro Zardini

What models need



Physical Properties

- Interaction with water vapor
  - hygroscopicity
  - wettability
  - solubility
- Interaction with radiation
  - Absorption and scattering cross sections and their wavelength dependence
- ⊤ Vapor pressure dependence on ambient conditions (T, RH)

→ gas to particle partitioning

→ nucleation

→ degree of internal mixing

Modeling

- What we think we know or can do
  - There are a lot of organic aerosols
  - We know how to solve equations numerically given the right input parameters
    - chemical reactions
    - partitioning of condensible material and condensational growth
    - coagulation
    - nucleation
  - Given the equation/parameterization, we can do sensitivity studies

Modeling

- What we don't know or don't have
  - lumping of species (by volatility or other properties)--can we "add up" properties of pure components to represent complicated mixtures of compounds?
  - Good emissions inventories. What can cause emissions to change and how much?
  - Evolution of aerosol properties that affect aerosol removal.
  - Nucleation

Experiments

- What we know or what we can do:
  - techniques for measuring hygroscopicity:
    - supersaturated and subsaturated conditions

    We still need both kind of measurements (?)
  - techniques for measuring vapor pressure:

    We have several of them producing different results and solid/saturated liquid don't match ↑
  - techniques for measuring kinetic uptake coefficients
    - entrained aerosol flow-tube experiments
  - many reaction mechanisms and rates

Experiments

What we don’t know

- What compounds matter ? To which extent they matter?
- If properties are additive in mixtures
- mixing state of aerosols: the degree of internal mixing will influence the DRH and ERH.
- How the fuctional groups are distributed in the aerosol particle.
- unknown reaction mechanisms and sources of aerosols

Field Measurements

Priorities for measurements of microphysical parameters (and which compounds):

- Emissions of semivolatiles and SOA precursors currently unidentified
- Total VOC---carbon balance (gas and aerosol phase)
- ???????

Given the huge number of different aerosol components in OA, does it make sense to investigate single components

?

The answer is NO

- Because experimentalists must give information on actual ambient aerosol

The answer is YES

- Because the speciation is far from being resolved, there's the need to investigate properties based on pure compounds and mixtures of a few compounds.

ACTION ITEMS

- "Outdoor" chamber experiments
  - bringing in ambient air and incrementally add oxidants and VOC
  - measure change in ecosystem
  - e.g., take over the BIOSPHERE experiment
- Experiments with gradually increased complexity, e.g. gradually add more VOCs.
  - measure hygroscopicity, CCN properties of mixtures of organic compounds
  - carbon balance