Discussion Topics

Implementation of feedback mechanisms, direct and indirect effects of aerosols

- **Scientific hypotheses/questions to be tested/addressed**
  - Understand importance
- **Processes/feedbacks to be considered**
  - Identify important processes and feedback mechanisms
- **Priorities**
  - Determine priorities for implementation
- **Implementation**
  - Develop implementation strategies for coupled models
  - Design short- (1-2 yrs) and long-term (3-5 yrs) milestones/steps
- **Coordination**
  - Develop coordination plan among COST-728 members and between Europe and North America

Topic 1
Scientific hypotheses/questions to be tested/addressed

- **Hypothesis**
  - **Feedback mechanisms are important in accurate modeling of NWP/MM-ACT and quantifying direct and indirect effects of aerosols.**
- **Key questions**
  - **What are the effects of climate/meteorology on the abundance and properties (chemical, microphysical, and radiative) of aerosols on urban/regional scales?**
  - **What are the effects of aerosols on urban/regional climate/meteorology and their relative importance (e.g., anthropogenic vs. natural)?**
  - **How important the two-way/chain feedbacks among meteorology, climate, and air quality are in the estimated effects?**
  - **What is the relative importance of aerosol direct and indirect effects in the estimates?**
  - **What are the key uncertainties associated with model predictions of those effects?**
  - **How can simulated feedbacks be verified with available datasets?**

Topic 2
Processes/feedbacks to be considered

- **Direct effect - Decrease solar/thermal-IR radiation and visibility**
  - **Processes needed: radiation (scattering, absorption, refraction, etc.)**
  - **Key variables: refractive indices, ext. coeff., SSA, asymmetry factor, AOD, visual range**
  - **Key species: cooling: water, sulfate, nitrate, most OC**
    warming: BC, OC, Fe, Al, polycyclic/nitrated aromatic compounds
- **Semi-direct effect - Affect PBL meteorology and photochemistry**
  - **Processes needed: PBL/LS, photolysis, met-dependent processes**
  - **Key variables: T, P, RH, Qv, WSP, WDR, Cld Frac, stability, PBL height, photolysis rates, emission rates of met-dependent primary species (dust, sea-salt, biogenic)**
- **First indirect effect – Affect cld drop size, number, reflectivity, and optical depth via CCN**
  - **Processes needed: aero. activation/resuspension, cld. microphysics, hydrometeor dynamics**
  - **Key variables: int./act. frac, CCN size/comp., cld drop size/number/LWC, COD, updraft vel.**
- **Second indirect effect - Affect cloud LWC, lifetime, and precipitation**
  - **Processes needed: in-/below-cloud scavenging, droplet sedimentation**
  - **Key variables: scavenging efficiency, precip. rate, sedimentation rate**
- **All aerosol effects**
  - **Processes needed: aero. thermodynamics/dynamics, aq. chem., precursor emi., water uptake**
  - **Key variables: aerosol mass, number, size, comp., hygroscopicity, mixing state**

Topic 3
Implementation Priorities

- **Highest priority (urgent)**
  - **Aerosol thermodynamics/dynamics, aq. chem., precursor emi., water uptake**
  - **Radiation, emission, PBL/LS schemes, photolysis, aerosol-CCN relation**
  - **Coding standard and users' guide for parameterizations**
- **High priority (pressing)**
  - **Aero. activation/resuspension, Brownian diffusion, drop nucleation scavenging**
  - **Other in-/below-cloud scavenging (collection, autoconversion, interception, impaction)**
- **Important**
  - **Hydrometeor dynamics, size representation, hysteresis effect, DMRH**
- **Other**
  - **Subgrid variability, multiple size distributions**

Topic 4

Implementation Strategies and Milestones

- **Strategies**
  - **Support both offline and online coupled model frameworks (1-2 yrs)**
  - **Implement empirical approaches/simple treatments (1-2 yrs)**
  - **Release β-v. for community testing (1-2 yrs)**
  - **Develop benchmark modules to characterize accuracy tradeoff (1-2 yrs)**
  - **Acquire adequate computational resources (1-2 yrs)**
  - **Design field/lab studies (e.g., closure experi.) to obtain data for evaluation (3-5 yrs)**
  - **Train graduate/post-D researchers via formal courses/summer schools (3-5 yrs)**
- **Milestones**
  - **Direct effect (1-2 yrs)**
  - **Indirect effect with empirical approaches/simple treatments (1-2 yrs)**
  - **Process analysis to isolate feedbacks/estimate relative importance (1-2 yrs)**
  - **Indirect effect with parameterized modules (3-5 yrs)**
  - **Verification of simulated feedbacks (3-5 yrs)**
  - **Estimate associated uncertainties (3-5 yrs)**

Topic 5
Coordination Plan and Logistitics

- **COST728 members**
  - **1-2 progress review meetings annually**
  - **Identify country delegate for coordination**
- **Europe and North America**
  - **Establish a feedback mechanism working subgroup focusing on parameterizations allowing for interactions**
  - **Acquire funds/identify workshop sponsors**
  - **Annual workshop alternating in Europe and North America**
  - **Working group meeting in conjunction with annual workshop**
  - **Special journal issues dedicated to workshop papers**