Aerosol representation
- Aerosol types (mixing state): Semi-externally mixed secondary particles (SP): (sulfate + nitrate/ammonium/SOA)
  - Primary particles (PP): (BC, POC, dust, sea salt) + coated SP species
- Size structures:
  - Bins with variable resolution + log-normal modes
  - SP: 40 bins; Sea salt: 20 bins; Dust: 15 bins; BC: two log-normal modes (one for fossil fuel, the other for biomass burning)

Primary OC: two log-normal modes

Computing cost
(On Quad Core AMD Opteron, 2.7 GHz)

GEOS-Chem (4×4.5°, 47 layers, 1 yr)

Original model
- With APM
  - 59 tracers + full chemistry + full microphysics
  - 1 day ~ 2 days

GEOS-Chem + APM simulations have been compared with land-ship based data obtained around the globe (Figs. 1-2)

Fig. 3. Comparison of meteorological parameters simulated by WRF-Chem + APM and the aircraft observations obtained during INTEX-A (6 July to 14 August 2004): (a) observed temperature by aircraft; (b) simulated temperature along the flight paths; (c) scatter diagram of the observed and simulated temperature; (d, e, f) same as (a, b, c), except for wind speed; (g, h, i) same as (a, b, c), except for relative humidity. The aircraft observations are obtained from INTEX-A minutely average data. The simulations are obtained according to the date-time and location of each observation along the flight paths. The output of WRF-Chem + APM is hourly mean. Horizontal resolution: 143 x 107 grids with 27 km; Vertical: 34 layers from surface to 50 hPa; Anthropogenic emissions: EPA-2005, and CBMZ gas chemistry.

Fig. 4. Comparison of CN10 simulated by WRF-Chem + APM and the aircraft observation obtained during INTEX-A: (a) observed CN10 by aircraft, view from the top; (b) scatter diagram of the observed and simulated CN10; (c) the vertical profile of aircraft observation; (d) the vertical profile of model simulation along the flight paths.

Fig. 5. Simulated horizontal distributions of SO2 concentration (a, b), nucleation rate (c, d), and number concentration of particles larger than 10 nm (e, f) in the boundary layer (~ 1 km) by WRF-Chem + APM and GEOS-Chem + APM (2004 July).

In this study, we seek to improve simulations of the aerosol processes in the WRF-Chem by incorporating an advanced particle microphysics (APM) model into the framework of the WRF-Chem. The resulting model has been validated by a large set of INTEX-A data. Major differences between particle microphysics over North America predicted by GEOS-Chem + APM and WRF-Chem + APM are discussed.