Numerical Simulation Study on Aerosol-boundary Layer Interaction

*Zilin Wang[1]

1. Nanjing Univ.

Atmospheric aerosols could interact with boundary-layer meteorology through their radiative effects, exerting an impact on regional and global climate. Black carbon (BC) has been identified to play a key role in aerosol-boundary layer interaction (ABI) and remarkably enhance haze pollution in high emission areas such as eastern China, which was previously defined as "dome effect". Our work aimed to quantify the impact of key influencing factors, i.e. vertical distribution of BC, its aging processes as well as the characteristics of underlying surface, on the formation of such two-way feedback. It turns out that the upper-level BC, especially that near the capping inversion, is more essential in suppressing the PBL height and weakening the turbulent mixing. The dome effect of BC mixed with scattering aerosols during winter haze events tends to be significantly intensified. In addition, the feedback is more substantial in rural areas than that in the urban cities. Since the impact of BC on planetary boundary layer is much sensitive to the altitude of aerosol layer, a set of key-level targeted vertical grids was designed and applied to real-time air quality modelling. Compared with default configurations, optimized grids are more capable of characterizing temperature stratification and extreme fine particle ($PM_{2.5}$) concentration as well as its diurnal variation during haze episodes. The optimization of vertical grid setting could help better simulate ABI and its effect on haze pollution, hence better prediction of extreme near-surface pollution episodes.

Keywords: Black carbon, WRF-Chem, Aerosol-radiation interaction