Inverse modeling of black carbon emissions over China using ensemble data assimilation

*Ping Wang[1]

1. Chinese Academy of Meteorological Sciences

Emissions inventories of black carbon (BC), which are traditionally constructed using a “bottom-up” approach based on activity data and emissions factors, are considered to contain a large level of uncertainty. In this paper, an ensemble optimal interpolation (EnOI) data assimilation technique is used to investigate the possibility of optimally recovering the spatially resolved emissions bias of BC. An inverse modeling system for emissions is established for an atmospheric chemistry aerosol model and two key problems related to ensemble data assimilation in the top-down emissions estimation are discussed: 1) how to obtain reasonable ensembles of prior emissions; and 2) establishing a scheme to localize the background-error matrix. An experiment involving one year long simulation cycle with EnOI inversion of BC emissions is performed for 2008. The bias of the BC emissions intensity in China at each grid point is corrected by this inverse system. The inversed emission over China in January is 240.1 Gg, and annual emission is about 2539.3 Gg, which is about 1.8 times of bottom-up emission inventory. The results show that, even though only monthly mean BC measurements are employed to inverse the emissions, the accuracy of the daily model simulation improves. Using top-down emissions, the average root-mean-square error of simulated daily BC is decreased by nearly 30%. These results are valuable and promising for a better understanding of aerosol emissions and distributions, as well as aerosol forecasting.

Keywords: Inverse modeling, black carbon, ensemble optimal interpolation

