Simulation of emission and transport of halocarbons in East Asia

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Hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and Perfluorocarbons (PFCs) are commonly used as substitutes for chlorofluorocarbons (CFCs) which have high ozone depletion potentials (ODP). While their ODP is zero or much lower than CFCs, they still have environmental impact via their high global warming potentials. In view of recent economic growth in East Asia, it is necessary to monitor the emissions of these halocarbons which have been reported and updated poorly until recently. The target of this study is to estimate the amount and the distribution of regional sources in East Asia using observed atmospheric concentrations of the halocarbons by combining a forward calculation to simulate the observed concentration and an inversion calculation to determine the most probable emission distribution from observed and modeled concentration.

The observation data of halocarbons were provided by the hourly measurements using automated online GC/MS system at Hateruma Island. For the forward calculation, the regional meteorological model RAMS (Regional Atmospheric Modeling System) developed by the Colorado state university was employed, utilizing online-tracer function. The emission field in East Asia was divided into 13-20 areas and the tagged simulation was conducted by activating only a single source region for each run. The emission of HCFC-22 was prepared with the data provided by GEIA (Global Emissions Inventory Activity). The annual total emission of HCFC-22 in 2000 was spatially distributed according to the emissions among reporting and non-reporting countries in 1986 estimated by McCulloch et al (1994) and population figures compiled by J .Logan.

The period of simulation was set from January 17th to March 31, 2005 including the spinning up period of approximately 2 weeks. Horizontal resolution was 40km mesh longitude/ latitude and the number of grids was 120 both in the east-west/north-south direction. The computational domain was approximately 8000km x 4800km in the east-south and north-south direction respectively centering at 38^{o}N and 130^{o}E. The horizontal diffusion coefficient was minimized in order to avoid the excess broadening of plumes during transport.

During the period, more than ten sharp peaks were observed over the background level of approximately 170pptv. The calculated values gave one or more corresponding peaks for each observed peak at the same timing, assuring the validity of the transport model simulation as an initial step. However, calculated peak intensity (peak height and area) was far lower than the observed value which indicated the underestimation of input emission dataset. The quantitative discussion will be given on the reason of the discrepancy and the possible correction to the input emission in order to reproduce observed peak intensities.