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Comparison of boundary conditions from Global Chemistry Model (GCM) for regional air quality application

Yun fat LAM (1,2), Hung Ming CHEUNG (1), Joshua FU (3), and Kan HUANG (3)

(1) City University of Hong Kong, School of Energy and Environment, Hong Kong, (2) Guy Carpenter Asia-Pacific Climate Impact Centre, City University of Hong Kong, Hong Kong SAR, China, (3) Department of Civil and Environmental Engineering, University of Tennessee, Knoxville, USA

Applying Global Chemistry Model (GCM) for regional Boundary Conditions (BC) has become a common practice to account for long-range transport of air pollutants in the regional air quality modeling. The limited domain model such as CMAQ and CAMx requires a global BC to prescribe the real-time chemical flux at the boundary grids, in order to give a realistic estimate of boundary impacts. Several GCMs have become available recently for use in regional air quality studies. In this study, three GCM models (i.e. GEOS-chem, CHASER and IFS-CB05 MACC provided by Seoul National University, Nagoya University and ECWMF, respectively) for the year of 2010 were applied in CMAQ for the East Asia domain under the framework of Model Inter-comparison Study Asia Phase III (MISC-Asia III) and task force on Hemispheric Transport of Air Pollution (HTAP) jointed experiments. Model performance evaluations on vertical profile and spatial distribution of O_3 and PM2.5 have been made on those three models to better understand the model uncertainties from the boundary conditions. Individual analyses on various mega-cities (i.e. Hong Kong, Guangzhou, Taipei, Chongqing, Shanghai, Beijing, Tianjin, Seoul and Tokyo) were also performed. Our analysis found that the monthly estimates of O_3 for CHASER were a bit higher than GEOS-Chem and IFS-CB05 MACC, particularly in the northern part of China in the winter and spring, while the monthly averages of PM2.5 in GEOS-Chem were the lowest among the three models. The hourly maximum values of PM2.5 from those three models (GEOS-Chem, CHASER and IFS-CB05 MACC are 450, 321, 331 μg/m3, while the maximum O_3 are 158, 212, 380 ppbv, respectively. Cross-comparison of CMAQ results from the 45 km resolution were also made to investigate the boundary impacts from the global GCMs. The results presented here provide insight on how global GCM selection influences the regional air quality simulation in East Asia.