Evaluation of NOx emissions in the western U.S.
using WRF-Chem model simulations and satellite observations

S.-W. Kim1,2, A. Heckel3, G. Frost1,2, A. Richter3, J. Gleason4, J. Burrows3, S. McKeen1,2, E.-Y. Hsie1,2, and M. Trainer2

1 NOAA Earth System Research Laboratory, Chemical Sciences Division, 325 Broadway, R/CSD4, Boulder, CO 80305
2 Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309
3 Institute of Environmental Physics and Institute of Remote Sensing, University of Bremen
4 NASA Goddard Space Flight Center

In the western U.S., there are many isolated sources of NOx emissions such as power plants, cities, and highways. Thus, errors in bottom-up NOx emissions from various sectors could be evaluated separately with atmospheric chemistry models and satellites in this part of the U.S. We carried out simulations with the Weather Research and Forecasting-Chemistry model (WRF-Chem) for the western US domain during the summer of 2005. The sensitivities of simulated NO2 columns to chemical mechanism and scalar-advection scheme are examined. These factors explain 10-20 % variability of model NO2 columns, exhibiting larger variability over more polluted regions. Model NO2 columns are compared with SCIAMACHY and OMI satellite observations. For SCIAMACHY satellite data, the effects of a priori NO2 profile and aerosol loadings on the retrieved NO2 columns are investigated. These factors explain 10-30% variability of satellite NO2 columns, indicating significant impact of aerosols on the retrieval over the big western cities such as Los Angeles, Fresno, Sacramento, and San Francisco. To check the accuracy of satellite retrieval, the two satellite data are compared with the model NO2 columns over Four Corners and San Juan power plants. Because emissions from these power plants are well monitored, uncertainties in model emissions from these power plants are much less than those from cities and highways. Thus, model NO2 columns over this region can be regarded as a surrogate for in-situ measurements. Overall, both SCIAMACHY and OMI NO2 columns over these power plants agree well with model NO2 columns with discrepancies between the two being within the variability of model or satellite. In contrast to this power plant region, model NO2 columns over big cities along the west coast are approximately twice as large as satellite NO2 columns from SCIAMACHY and OMI, implying overestimations of the bottom-up emissions over these cities. Possible causes of these discrepancies will be suggested.