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Statistical Downscaling of WRF-Chem Model: An Air Quality Analysis over Bogota, Colombia

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Statistical downscaling is a technique that is used to extract high-resolution information from regional scale variables produced by coarse resolution models such as Chemical Transport Models (CTMs). The fully coupled WRF-Chem (Weather Research and Forecasting with Chemistry) model is used to simulate air quality over Bogota. Bogota is a tropical Andean megacity located over a high-altitude plateau in the middle of very complex terrain. The WRF-Chem model was adopted for simulating the hourly ozone concentrations. The computational domains were chosen of 120x120x32, 121x121x32 and 121x121x32 grid points with horizontal resolutions of 27, 9 and 3 km respectively. The model was initialized with real boundary conditions using NCAR-NCEP's Final Analysis (FNL) and a 1ox1o (∼111 km x 111 km) resolution. Boundary conditions were updated every 6 hours using reanalysis data. The emission rates were obtained from global inventories, namely the REanalysis of the TROpospheric (RETRO) chemical composition and the Emission Database for Global Atmospheric Research (EDGAR). Multiple linear regression and artificial neural network techniques are used to downscale the model output at each monitoring stations. The results confirm that the statistically downscaled outputs reduce simulated errors by up to 25%. This study provides a general overview of statistical downscaling of chemical transport models and can constitute a reference for future air quality modeling exercises over Bogota and other Colombian cities.