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Aerosol effects on photochemistry in Mexico City during MCMA-2006/MILAGRO Campaign

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In the present study, the impact of aerosols on the photochemistry in Mexico City is evaluated using the WRF-CHEM model during the period March 24-29 in association with the MCMA-2006/MILAGRO campaign. An aerosol radiative module has been developed with a detailed consideration of aerosol size, composition, and mixture. The module has been coupled into the WRF-CHEM model to calculate the aerosol optical properties, including optical depth, single scattering albedo, and asymmetry factor. Calculated aerosol optical properties are generally in good agreement with the in situ observations and aircraft and satellite measurements during daytime. The photolysis rates are generally reduced due to the absorption by carbonaceous aerosols, particularly in the early morning and late afternoon with a long aerosol optical path. However, with the growth of aerosol particles and the decrease of the solar zenith angle around noontime, aerosols slightly enhance photolysis rates due to the domination of scattering of UV radiation. The changes in photolysis rates due to aerosols produced lead to about 2-17% surface ozone reduction during daytime in the urban area of Mexico City, and result in a decrease of OH level by about 9%. The impact of aerosols on photolysis rates also leads to a decrease of the daytime concentrations of nitrate and secondary organic aerosols by about 5-6% in the urban area. In addition, the rapid aging of black carbon aerosols and the enhanced absorption of UV radiation by organic aerosols contribute significantly to the reduction of photolysis rates, resulting in a further decrease of other chemical species.