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## Impact of Interactive Aerosol Feedbacks on Photolysis Rates and Air Quality for Urban and Industrial Areas in Canada using the GEM-MACH Air Quality Model

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The photolysis module in Environment and Climate Change Canada's on-line chemical transport model GEM-MACH (GEM: Global Environmental Multi-scale – MACH: Modelling Air quality and Chemistry) was improved by using the on-line chemical composition and size-resolved representation of atmospheric aerosols in GEM-MACH to calculate the attenuation of radiation in the photolysis module.

We coupled both the GEM-MACH aerosol module and the MESSy-JVAL (Modular Earth Sub-Model System) photolysis routine through the use of the on-line aerosol modeled data and a new Mie lookup table for the model-generated extinction efficiency, absorption and scattering cross sections of each aerosol. The new algorithm applies a lensing correction factor to the black carbon absorption efficiency (core-shell parametrization) and calculates the scattering and absorption optical depth and asymmetry factor of black carbon, sea-salt, dust and other internally mixed components.

In order to evaluate the effects of these modifications on the performance of the GEM-MACH model, a series of simulations with the updated version of MESSy-JVAL and wildfire emission inputs from the Canadian Forest Fire Emissions Prediction System (CFFEPS) were carried out, and the model aerosol optical depth (AOD) output was compared to the previous version of MESSy-JVAL, satellite data, ground-based measurements, and re-analysis products. The comparison of the updated version of MESSy-JVAL with the previous version showed significant improvements in the model performance with the implementation of the new photolysis module and adopting the online interactive aerosol concentrations in GEM-MACH.