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Analysis of the Sensitivity of GEM-MACH PM2.5 Forecasts to the Representation of Wet and Dry Deposition Processes

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Environment Canada produces 48-hour operational air quality forecasts for Canada twice daily (at 00 and 12 UTC). At the core of the forecast system is the GEM-MACH model, an on-line coupled meteorology and chemistry model that considers gas-phase, aqueous-phase, and heterogeneous chemistry and a number of size-resolved particulate matter (PM) processes, including wet and dry deposition. Predicting PM concentrations, especially for fine particular matter (PM2.5), remains a challenge for air quality models. In this poster we analyze the maximum sensitivity of predicted PM2.5 concentrations to the representation of both wet and dry deposition. For wet deposition, both in-cloud and below-cloud scavenging are considered.

An analysis of the impact of wet and dry deposition on PM2.5 concentrations was performed using GEM-MACH model output over the summer and winter seasons of 2012 for a base case and two sensitivity runs, one in which the parameterization of dry deposition was turned off and one in which the parameterization of wet deposition was turned off. The results obtained show that the predicted wet deposition of PM2.5 over North America is generally greater than predicted dry deposition, but both processes can reduce predicted PM2.5 concentration by 25% or more on average. However, the impact of both processes varies significantly from one region to another and is strongly dependent on modelled meteorology, especially the occurrence of precipitation. These results suggest that the details of the treatments of wet and dry deposition of PM2.5 do matter and can enhance or detract from model performance.