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Impacts of Meteorological Modulation of Fugitive Dust Emissions on Regional Air Quality Forecasts

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Anthropogenic fugitive aerosol particle emissions are associated with re-suspended dust originating from sources such as paved and unpaved roads and industrial, construction, and agricultural activities. These emissions make up a sizable fraction of the total particulate matter (PM) emissions that are used for regional air quality modelling. Emissions inputs to the Canadian air quality forecast model GEM-MACH have up until now combined fugitive and non-fugitive sources for all of the aerosol chemical components (except sea-salt) represented in the model for predicting the surface PM2.5 and PM10 concentrations.
However, fugitive dust emissions are known to be modulated by meteorology: precipitation, snow cover, and soil wetness may all reduce fugitive dust emissions. As part of recent improvements to the GEM-MACH model, the input aerosol emissions were split into non-fugitive and fugitive components, and an online algorithm to reduce fugitive aerosol emissions due to meteorological conditions was implemented.
In this work, we present analyses of the impact of this meteorological modulation on the model prediction of PM2.5 and O_3 surface concentrations over North America. The modulation improved the model performance in two areas: total PM2.5 mass and PM2.5 chemical speciation. Based on measurements from three North American PM2.5 chemical speciation networks, crustal material component concentration was found to have improved significantly and other PM2.5 components also improved by varying degrees. O_3 concentrations were also influenced slightly due to the cycling of HNO_3 via inorganic heterogeneous chemistry changing with the fugitive dust modulation, but overall O_3 performance was unaffected. The impacts of this new algorithm were considered to be sufficiently positive that operational parallel simulations including the new parameterization have been scheduled for later in 2019.