Multiscale Atmospheric Chemistry Modelling with GEM-AQ

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A multiscale atmospheric chemistry model has been developed by the Multiscale Air Quality Modelling Network (MAQNet) – a consortium of seven Canadian universities and government departments. The strategic goal of the project was to develop a modelling platform for tropospheric air quality modelling and chemical data assimilation.

The host meteorological model is the Global Environmental Multiscale (GEM) model developed by the Meteorological Service of Canada for operational weather prediction (Côté et al., 1998). GEM can be configured to simulate atmospheric processes over a broad range of scales, from the global scale down to the meso-gamma scale.

Atmospheric chemistry modules are implemented on-line in the host meteorological model. In this version of GEM-AQ (tropospheric air quality), there are 37 advected and 14 non-advected gas phase species in the model. Transport of the chemically active tracers by the resolved circulation is calculated using the semi-Lagrangian advection scheme native to GEM. The vertical transfer of trace species due to subgrid-scale turbulence is parameterized using eddy diffusion calculated by GEM.

The gas-phase chemistry mechanism currently used in this version of GEM-AQ comprises 51 species, 120 chemical reactions and 16 photolysis reactions representing air quality and free tropospheric chemistry. All species are solved using a mass-conserving implicit time stepping discretization, with the solution obtained using Newton's method.

The modelling system can be used to plan field campaigns, interpret measurements, and provide the capacity for forecasting oxidants, particulate matter and toxics. It will also be able to provide guidance to evaluate exposure studies for people, animals, crops and forests, and possibly for epidemiological studies.

The presentation will focus on the modelling strategy and model applications. Results from a long term global simulation and regional scale episodes will be described. Also, application of the modelling platform to photochemistry on Mars will be presented.