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Local scale air quality modelling based on CMAQ forecast data

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This paper proposes a methodology for studying the air quality in a region with stack emissions using the forecasted data from CMAQ. To couple CMAQ and finite element method model is necessary to calculate a mesh, interpolate the wind field and perturbing it with plume rise, using CMAQ data as initial and boundary conditions, and to simulate transport and reaction in the local scale.

To mesh the area of interest, the next strategy is proposed. Using a Digital Terrain Model (DTM) of the area of interest, we mesh the terrain using a background mesh prescribing element size based on curvature. Next we mesh subsequent layers (following the CMAQ layer approach), smoothing curvature recursively on subsequent layers. Smoothing curvature is important in order to increase element size in the top layers.

In order to interpolate the wind field is proposed an interpolation in layers of the CMAQ wind data, and modify wind field perturbing it with plume rise. The plume rise formulas by Briggs are used.

When the mesh and the wind field is calculated it's time to get the pollutant concentrations from CMAQ and distribute them on the mesh nodes. The values of concentration, diffusion rates and velocity deposition will be interpolated from those in CMAQ.

Finally, a convection-diffusion-reaction equation is solved using and finite element method stabilised with Least Squares. The resulting equation system is solved using a gradient conjugate method preconditioned with an incomplete Cholesky factorisation.

The CMAQ tutorial case has been used with the presented methodology giving promising results.