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Dynamical parameter estimation for a street-canyon air pollution model

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The Operational Street Pollution Model (OSPM) is a street-scale air pollution model for urban canyons [1] that is widely used in over than 30 cities in more than 17 countries worldwide [4]. It models the contribution from traffic emissions of a single street to receptor points at the building façade, and requires as input the city background concentration levels, street configuration and traffic data. The model is based on a parameterisation of the important processes within the street canyon (e.g., recirculation vortex, direct plume from vehicle emissions, traffic produced turbulence, simple NO-NO_2 chemistry), with the assumption of equilibrium for each 1-hour time-step. This assumption is justified due to the relatively short residence times of the traffic pollution in such street canyons under common meteorological conditions. As such, there is no dependence in the model states from one time-step to the next.

We explored the potential for dynamical parameter estimation with the OSPM, using techniques from data assimilation. In this framework, the time-dependence in the model states (e.g., concentrations of CO, NO_2) results from the dynamical estimation of certain model parameters (e.g., roughness height, emission factors, fraction of NO_x emitted as NO_2) that are otherwise treated as constants. The hypothesis under consideration is that dynamical parameter estimates can improve the quality of the operational street pollution forecasts using OSPM in the air-pollution forecasting system THOR [2].

We implemented an ensemble Kalman filter [3] to dynamically estimate model parameters. A training period was used during which model parameters were estimated, followed by a test period when the model forecasts were used for validation. We will present the results from a series of experiments, and discuss the challenges of parameter estimation in this context.

References

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