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SHORT ABSTRACT

Abstract title: The DAnish Lagrangian Model (DALM): High-Resolution Long-Term Air Pollution Modeling in Denmark

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Abstract

The *DAnish Lagrangian Model* (DALM, www.au.dk/DALM, Andersen et al., 2023) is a 3D model being developed at the Department of Environmental Science, Aarhus University, to compute the local-scale concentration of air pollutants more accurately. DALM is developed from the relatively simpler Gaussian plume-in-grid *Urban Background Model* (UBM, www.au.dk/UBM) and is progressively going to replace or substitute UBM in future studies, first and foremost related to long-term exposure in Denmark.

DALM is a *Lagrangian particle dispersion model* (LPDM) in which advection and dispersion are modeled by computing a huge number of particle trajectories that are governed by the local mean wind and a random motion, mimicking dispersion. Based on a larger literature review, a sizeable set of *planetary boundary layer* (PLB) parameterizations has been implemented in DALM together with land use categories, NO-NO_2-O_3 chemistry, and dry deposition of a few gases. The model is offline coupled to different emission data and to the *Weather Research and Forecasting* (WRF, Skamarock et al., 2019) model for meteorology and the *Danish Eulerian Hemisphere Model* (DEHM, www.au.dk/DEHM) for chemical boundary conditions.

Numerical tests have been conducted to test and verify the implementation of the different modules and parameterizations in DALM. Furthermore, the model has been validated against measurements at Danish rural and urban background routine monitoring stations for different chemical species (NO_x, NO_2, O_3, CO, $PM_{2.5}$, PM_{10}, and BC), and the performance of the model has been compared to that of UBM, showing that the performance of DALM is better than or comparable to UBM. A proof-of-concept study has demonstrated the feasibility of applying DALM for higher-resolution emission setups, in this case covering Copenhagen and its surrounding areas (Figure 1). Aside from ongoing model development, there is an increased focus on using FAIRMODE (Janssen and Thunis 2022) metrics for model evaluation of not only DALM (Figure 1) but also for the models that are a part of the Danish DEHM/UBM/AirGIS modeling system (www.au.dk/AirGIS).

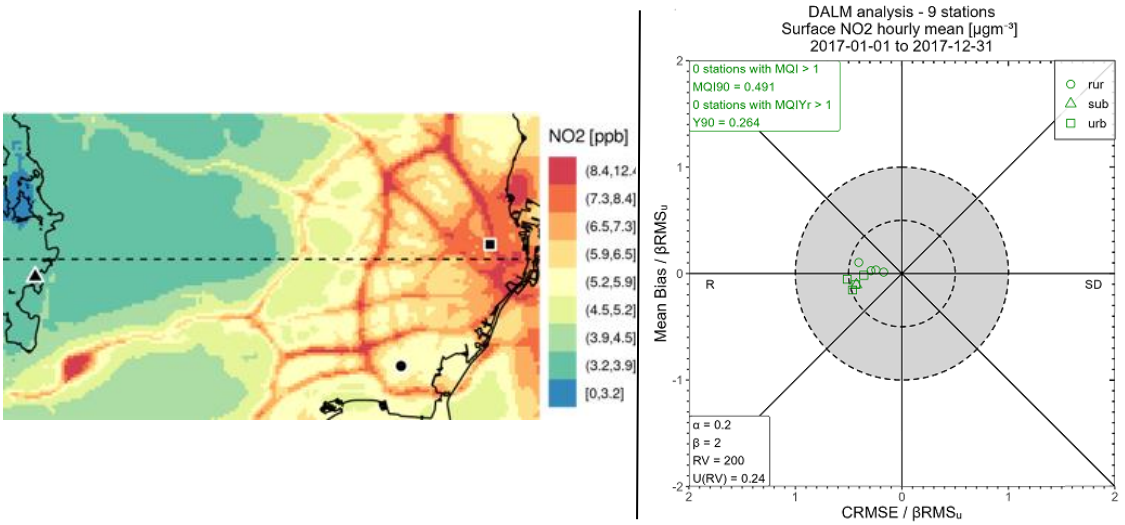

Figure 1. (left:) Map of the 200 × 200 m^2 modeled yearly NO_2 concentration over Copenhagen and its surrounding areas. (right:) Target diagram of DALM evaluated against NO_2 measurements at Danish routine monitoring stations.

References

Andersen, C. (2023). High-Resolution Modeling of Air Pollution in Denmark: With the DAnish Lagrangian Model (DALM), Aarhus University.

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