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Evaluation of roadway Gaussian plume models with large-scale measurement campaigns

R. Briant[1], C. Seigneur[1], M. Gadrat[2], and C. Bugajny[2]
[1]CEREA, Joint Research Laboratory École des Ponts ParisTech/EDF R&D, Université Paris-Est, 6–8 avenue Blaise Pascal, Cité Descartes, Champs-sur-Marne, 77455 Marne-la-Vallée Cedex 2, France
[2]CETE Nord-Picardie, Equipment Technical Study Center for the Nord-Picardie region in France, 42 bis rue Marais Sequedin – BP 10099, 59482 Haubourdin Cedex, France

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Abstract. Gaussian models are commonly used to simulate atmospheric pollutant dispersion near sources because they provide an efficient compromise between reasonable accuracy and manageable computational time. The Gaussian dispersion

formula provides an exact solution to the atmospheric diffusion equation for the dispersion of a pollutant emitted from a point source. However, the Gaussian dispersion formula for a line source, which is convenient to model emissions from on-road traffic, is exact only when the wind is perpendicular to the line source. A novel approach that reduces the error in the line source formula when the wind direction is not perpendicular to the road was recently developed. This model is used to simulate NO_x concentrations in a large case study (1371 road sections representing about 831 km). NO_2, NO and O_3 concentrations are then computed using the photostationary-state approximation. NO_2 concentrations are compared with measurements made at 242 locations in the domain area. Model performance is satisfactory with mean normalised errors of 22% (winter month) to 31% (summer month). Results obtained here are also compared with those obtained with a previous formulation and with a standard model used for regulatory applications, ADMS-Urban. Discrepancies among the results obtained with those models are discussed.

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