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Mathematical models for urban and metropolitan traffic air pollution

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Abstract

The growing concern about air quality and its impact on public health has intensified interest in mathematical models capable of predicting and understanding traffic-related air pollution in urban and metropolitan areas. As cities expand and the number of vehicles increases, these models become essential tools for assessing environmental risks, supporting regulatory decisions, and guiding sustainable mobility strategies. In this work, we first present a model that combines two classic approaches: a 1D system for vehicular traffic and a 2D model for air pollution ([1]). This combination adequately captures emissions along major avenues and it can be used, for example, to design green corridors or manage the main road network of a metropolitan area ([2]). However, it presents significant limitations when applied to dense urban zones, since the 1D traffic system can only estimate emissions along some avenues, but is not able to address the full complexity of the street network. To overcome this limitation, we propose a second model that treats the entire metropolitan area as a porous domain, replacing the 1D traffic formulation with a novel 2D-model ([3]). This idea of considering the city as a porous medium can easily be extended to the air pollution simulation, resulting in a very complete model that provides a more detailed and realistic representation of urban air pollution dynamics ([4]). This second model can be useful, for example, in the design of speed limits and low/zero emission zones in urban areas.

References

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