Goal-oriented placement of depolluting panels in urban areas - application to a Paris district

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ABSTRACT

According to the World Health Organization, every year more than 4 million premature death worldwide are due to outdoor air pollution. Many sectors, *e.g* traffic, agriculture, industry, and housing, contribute to this. Herein, we focus on NO_2 pollution in urban areas caused by traffic. In fact, at Université Gustave Eiffel, on the one hand, experimental works are in progress to develop operational depolluting panels based on ZnO photocatalysis [1]. On the other hand, to reduce air pollutant human exposure we propose a full numerical strategy from diagnosis — *via* the determination of critical highly polluted areas — to remediation *via* the smart placement of the depolluting panels in urban areas. Firstly, a city digital twin and computational fluid dynamics (CFD) are used to get detailed cartography of the NO_2 concentration at the district scale. From these numerical simulations, we retain high-concentration areas in the frequented zone as a quantity of interest. Then, a goal-oriented placement of depolluting panels is proposed to improve the selected quantities of interest using the adjoint framework. This work can be seen as an extension of previous works from the authors dealing with goal-oriented error estimation [2], goal-oriented model updating [3] and goal-oriented sensor placement [3, 4]. The proposed numerical strategy will be illustrated over a district in Paris. We consider two wind scenarios (directions and amplitudes), which are characteristic of the Paris region, and realistic NO_2 sources on each road provided by the regional air quality agency "Airparif". First practical recommendations for depolluting panels deployment will be presented.

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