Estimating pollutant emissions from aggregated traffic variables: the influence of data sources and sampling methods

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ABSTRACT

Classical methods for assessing traffic-related pollutants emissions are based on an aggregated description of the vehicle behavior(André & al., 2000 and EMEP-EEA, 2013). Indeed, emission model like COPERT (COPERT 4, 2007) only need mean speed and travel production (total distance travelled by vehicle for a given period of time) to calculate the related emissions. However, when the traffic description comes from a static approach, the consequences of traffic congestion are often misestimating. Congestion periods induce important speed reduction and may also modify the travel production due to dynamic re-routing. It is then important to get accurate estimates for both traffic mean speed and travel production when calculating the emissions.

Dynamic traffic simulators can directly provide good estimates of these two variables but at the cost of extensive works for setting and calibrating the simulations. Traffic data from loops or probe vehicles can also be used to assess the variables. However, monitoring technics never provide a full picture of the traffic behaviorover the whole network because (i) loops only give punctual information for equipped links and (ii) probes often correspond to a small subset of all vehicles. The aim of this paper is to quantify the errors that occurwhen assessing mean speed and travel production from partial information and the associated errors on emission calculations.

The proposed methodology is the following. The reference situation will be gained through a dynamic traffic simulator, the Symuvia platform (Leclercq& al., 2007 andLaval& al., 2008). The case study corresponds to the simulation of the 6th district of Paris and a demand profile synthetizing the most significant six hours of a typical day and especially the onset and the offset of congestion during the morning peak hour. From the simulation, we can first get the trajectories for all vehicles and thus properly calculate the mean speed and the travel

production by applying Edie's definitions (Edie, 1963). We can also test different monitoring scheme based of virtual loops and/or probes to get estimates for these two variables and compare with the reference. Discrepancies will be studied in terms of related errors on emission calculations.

Different tests will be performed. First of all, we will investigate the hypothetical case where all links are equipped with a loop. Two questions will be addressed: (i) the relevance of loops when deriving mean global speed and travel production and (ii) the influence of the aggregating time step. Second, we will focus on the influence of sampling either for loops and trajectories (probes). This second part aims to determine the optimal sampling rates and the optimal mix between loop and probe information to derive accurate estimations of the two targeted traffic variables. It is already known (Gayah& al.,2013andLeclercq& al.,2014) that probes are very efficient even for low sampling rates (<10%) when calculating the mean network speed. Using probes clearly outperforms speed estimation from loops. However, probes are useless when calculating the travel production expect if the sampling ratio is exogenously known and steady enough. Specific tests will be undertaken to precisely tackle the influence of uncertainties on this particular ratio.

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