Impact of Reduced Mass LCVs on CO_2 Emissions, Air Quality, and Socio-economic Costs

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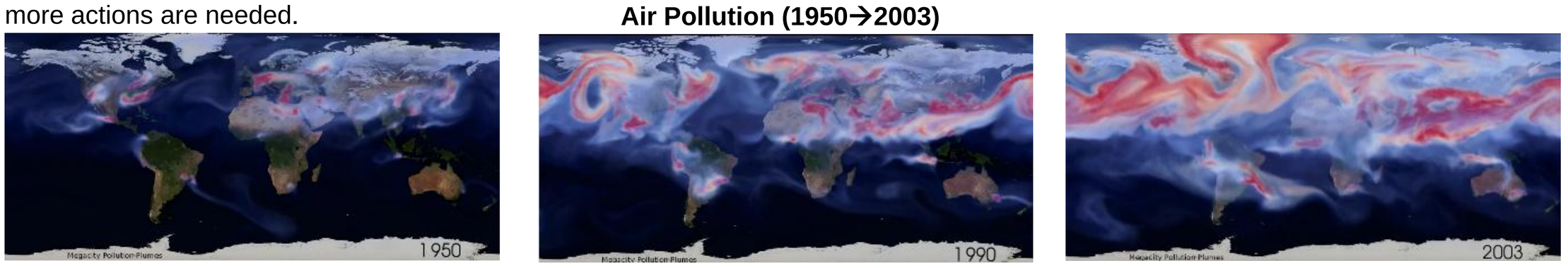
CONTEXT

This study presents a modelling system to evaluate the impact of weight reduction in light commercial vehicles with diesel engines on air quality and greenhouse gas emissions. Measures for the lightweighting were previously studied and implemented on these vehicles, showing technical viability, high potential applicability and economically feasibility. This work applies the tools in a case study in the Lombardy region (Italy), a high-density industrial center.
The PROPS model assesses the emissions of one vehicle and its corresponding reduced- weight version. The results serve as an input to the RIAT+ tool, an air quality integrated assessment modelling system.
These kinds of evaluations help manufacturers to understand if their efforts comply with anti-pollution laws are in the right direction or if more actions are needed.

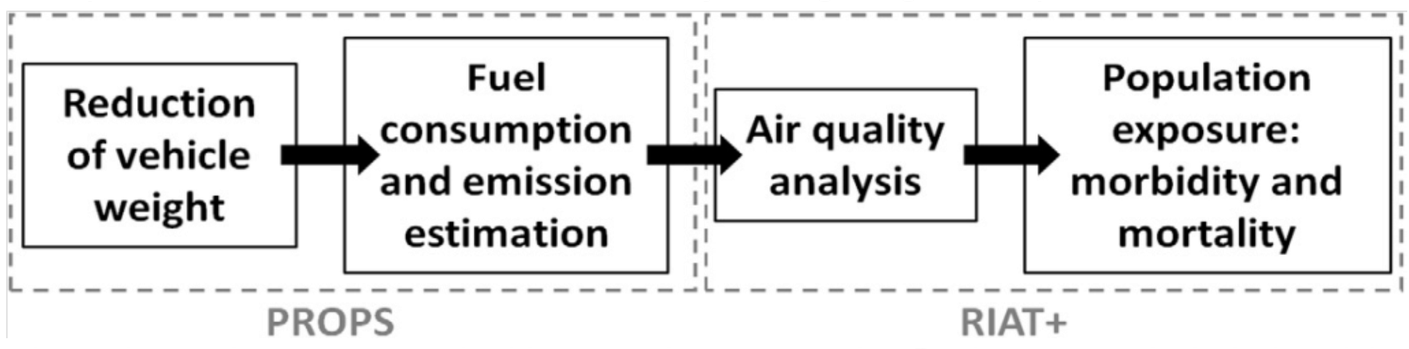
Air Pollution (1950→2003)



MATERIALS AND METHODS

Lightweighting is a new topic in this vehicle class, we analyzed a weight saving of 20% for each vehicle based on the implementation of previous projects.
The PROPS model simulates the powertrain behavior and evaluates fuel consumption and emissions of a traditional, hybrid, or fully electric vehicle, after being given a driving mission expressed with specific speed and altimetry profiles.
RIAT+ purpose is to support regional authorities in the selection of effective emission abatement measures to reduce air pollutants at minimal implementation costs. The tool incorporates specific features of the area under study through regional input datasets such as:

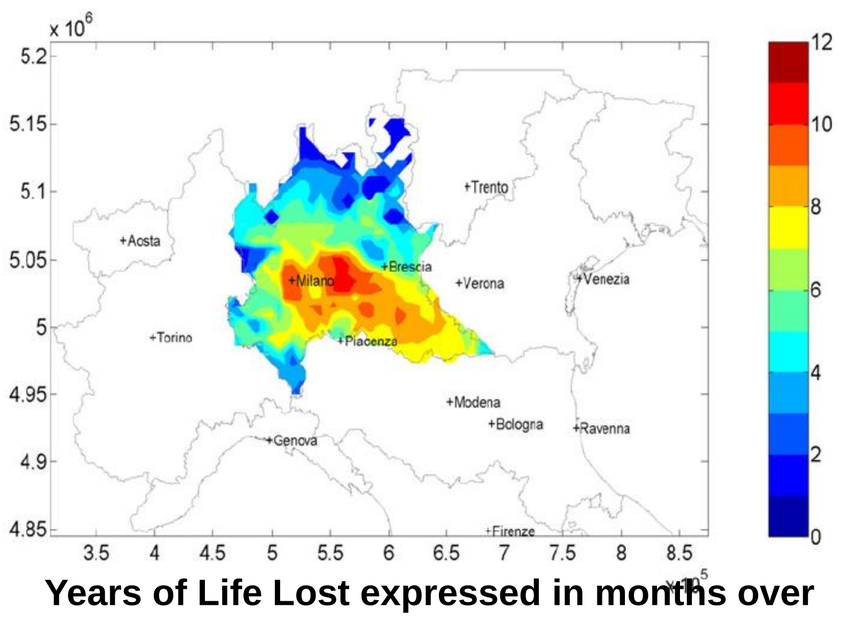
- Emissions of local (detailed data) and surrounding sources (aggregated data);
- Emission abatement measures (technical and non-technical) detailed for each sector Technology;
- Site, specific source/receptor functions considering chemical regimes and meteorology.



In order to evaluate the reduction impact, results have been then compared with an optimal scenario. Such a scenario is built mixing different cases and considering the highest efficiencies.

OUTCOMES

- This measure allows reduction of traffic emissions from 1% to 5% for Nox and from 1% to 7% for PM10. These reductions for NOx are about one fifth of the optimal scenario's reductions and, for PM10, they amount to almost 50%.
- Lightweighting is an important measure for improving traffic emission reductions that would otherwise have to be achieved by the forced substitution of new vehicles into the vehicle fleet.
- The introduction and dissemination of this measure would significantly contribute to the reduction of PM10 concentrations from road traffic alone.
- The impact on PM10 reductions in the region is limited; however, the effects of these reductions on mortality and morbidity are not negligible.



Years of Life Lost expressed in months over the study domain for year 2020

TRANSFERABILITY

The method presented in this work can be used to highlight the impact of lightweighting also on other vehicle categories or on a combination of them; thanks to RIAT+ modularity every possible scenarios can be tested as well.