

Empirical assessment of route choice impact on emissions over different road types, traffic demands, and driving scenarios

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Eco-routing is a promising strategy to reduce pollutant emissions. However, the eco-friendliness of different routes may change, especially in roads with capacity constraints and high traffic demand. We have explored this issue empirically by covering about 13,300 km, in 3 different areas: medium sized-city (Aveiro), intercity region (Aveiro-Oporto Corridor), and a metropolitan area (Norfolk, VA, USA). A total of 222 hours of GPS data were collected and a microscopic emission model was used to generate emissions information during off-peak and peak periods according to the site-specific characteristics. This study has reinforced the relevance of the eco-routing concept, namely:

- The selection of an appropriate route can lead to significant emissions reduction, regardless of demand period: CO₂ up to 25%, and local pollutants (NO_x, HC and PM) up to 60%, for these case studies (FIG 1).
- A slight decrease in the differences of total emissions among routes during peak periods was observed. However, for each origin-destination (O-D) pair, the eco-friendliness rating of routes was shown to be constant under different traffic volume levels (FIG 2). This fact

suggests that the infrastructures analyzed could have enough capacity to accommodate a limited extra demand of drivers who would like to select a route with lower emissions levels.

Nevertheless, some limitations must be considered when implementing these systems, namely:

- The eco-route could depend on the type of vehicle used;
- Frequently, the routes that allow a minimization of pollutants can cross urbanized areas. This fact will involve a careful assessment of potential externalities that may arise from a purely dedicated navigation system based on emissions minimization;
- In the intercity OD pair, a trade-off between CO₂ and local pollutants minimization was observed. Therefore, it must be emphasized that the concept of “eco-friendly” should not be strictly confined to CO₂/fuel consumption. In similar cases, strategies for assigning relative weights to pollutants should be considered to optimize traffic operations with a maximum environmental net benefit.

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FIGURE 1
 Study routes map and average daily traffic: a) Intercity (Oporto–Aveiro): Im1, Im2, lh, and lu; b) Urban routes (Aveiro center and suburbs): Um, Ua, and Uc; and c) Metropolitan (Norfolk–Chesapeake): Ma and Mm. Route type: m-motorway, a-arterial, h-highway, u urban).

FIGURE 2
 Eco-friendly route indicator based on environmental damage costs for Diesel (LLDV) and Gasoline (LDGV) passenger cars..

