Land Use Regression Models revealing spatio-temporal covariation in combustion related air pollutants in the Netherlands

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Introduction

Air pollution is estimated to cause 2 million premature deaths per year worldwide (WHO). Combustion fumes form a large part of air pollution. Epidemiologist who wish to assess personal exposures, combine human activity patterns with pollution models, often using land use regression (LUR) models.

Most studies on air pollution focus on the temporal *or* the spatial domain. Also, most studies focus on an individual air pollutant.

Our aim is to address both issues, by temporal land use regression modelling of O_3, NO_2 and NO, and studying the co-variability of these pollutants.

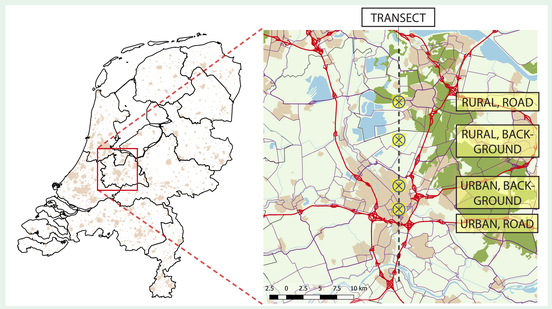


Figure 1. Map of the Netherlands indicating the study area. The right pane shows the transect and the four locations that are used for visualisation of the modeled concentrations.

Data & Approach

- **Hourly measurements - Dutch National Institute for Public Health and the Environment**
- **10 predictors with 7 buffer sizes are offered to the LUR modelling process**
- **Step 1 determine optimal model using 5y average of all measurements**
- **Step 2a aggregate measurements by hour, month and weekdays/weekends**
- **Step 2b calculate coefficients per mentioned time steps, using predictors from step 1**
- **Step 3 calculate concentrations!**

Predictors & Coefficients

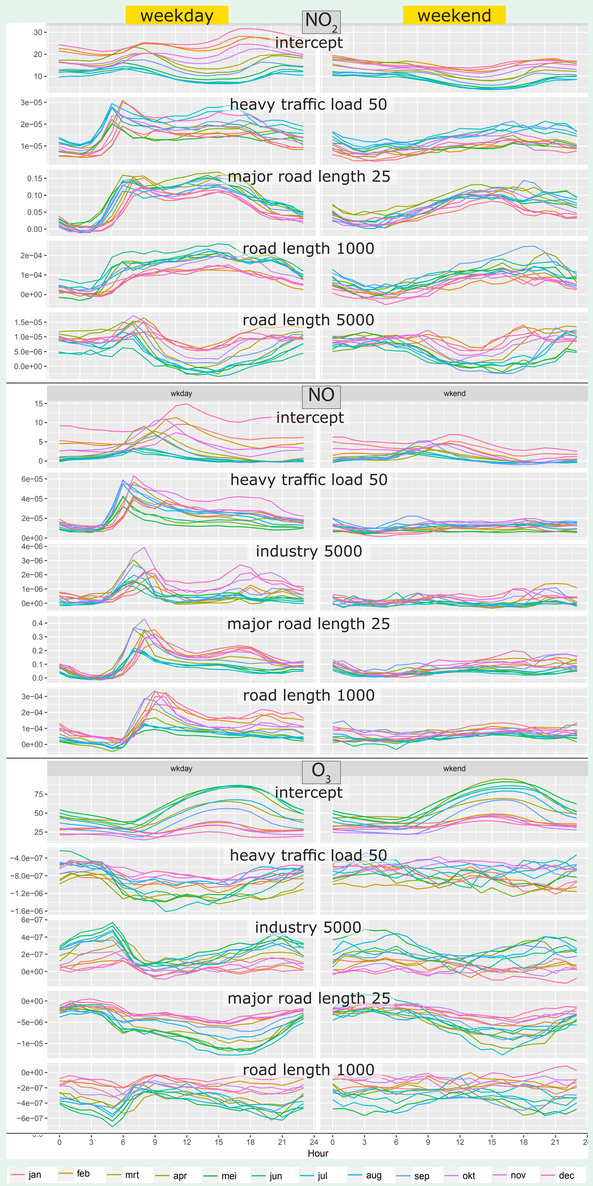


Figure 2. Predictors and their coefficients for the LUR models of NO_2 (top), NO (middle) and O_3 (bottom).

Transects

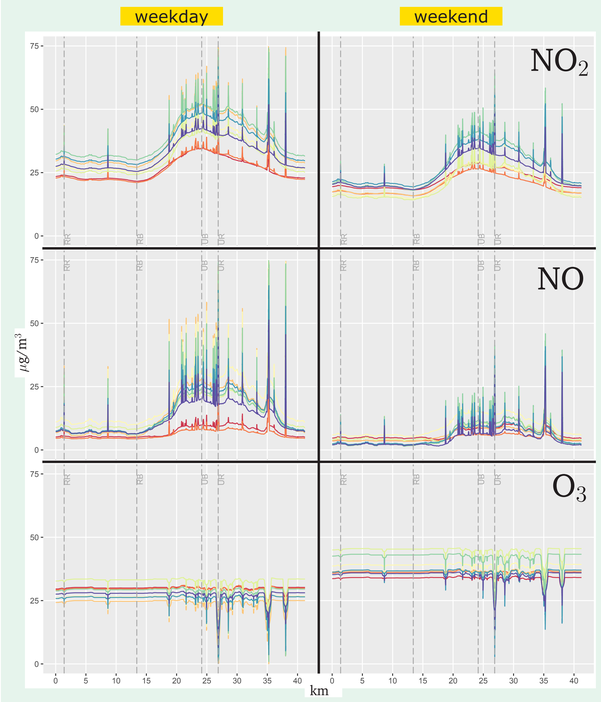


Figure 3. Modeled concentrations for each hour of the day, on a North-South transect (see figure 1), intersecting the country side (0-17km) and the city (17-42km), for January. Only every third hour is printed for clarity. Y-axis is limited to 75 but values extend to a maximum of 130. The slashed lines indicate the time series locations, RR: rural near road, RB: rural background, UR: urban near road, UB: urban background.

Temporal variability

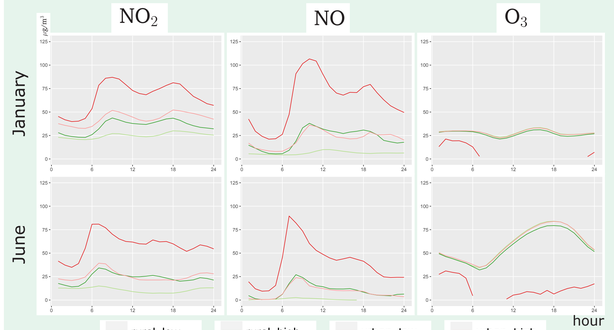


Figure 5. Time series of modeled concentrations on weekdays. See figure 1 for location of each time series.

Spatial variability

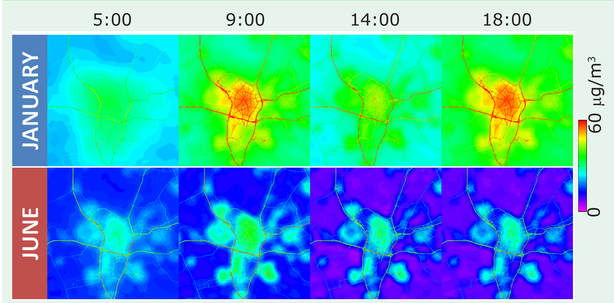
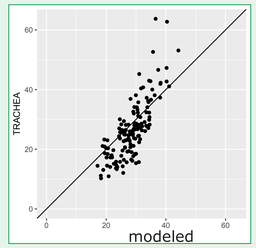


Figure 6. Maps of modeled NO_2 concentrations on weekdays for Utrecht city and surrounding area, during peak and valley hours.

Validation

Figure 4. The NO_2 LUR is validated against NO_2 measurements from the Traffic Related Air pollution and Children's respiratory HEalth and Allergies (TRACHEA) study, returning an R^2 of 0.61.



Conclusions

- **For all pollutants, the optimal LUR was achieved with 4 predictors**
- **Spatially and temporally detailed description of the space-time pattern in air pollution levels over the whole of the Netherlands**
- **Our LURs for O_3, NO_2, and NO reflect the photochemical processes in both space and time**

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