Air pollution exposure assessment for the ELAPSE project using hybrid LUR models

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Background. In order to investigate associations between air pollution and adverse health effects fine spatial air pollution surfaces are needed to provide cohorts with exposures. In the ELAPSE project we developed hybrid LUR models for multiple pollutants and linked these to 11 cohorts plus 7 administrative cohorts in 10 countries for a total of 35 million participants.

Methods. Europe-wide hybrid land use regression models were developed for 2010 estimating annual mean PM2.5, BC, NO2, and O3 (including cold and warm season estimates for O3). The models developed were based on AIRBASE routine monitoring data for PM2.5, NO2 and O3, and ESCAPE monitoring data for BC and incorporated land use and traffic data supplemented with satellite observations and dispersion model estimates as additional predictor variables (Fig 1). Universal kriging was performed on the residual spatial variation for PM2.5 and O3 (warm and cold seasons). One model was developed using all sites (100%). To evaluate the robustness of the models, five more models were developed, each built on 80% of the monitoring sites with the remaining 20% used for validation (sites selected at random, but stratified by site type and country). Models were applied to a 100*100 m grids across Europe to allow for exposure assignment for all ELAPSE cohorts (Fig 2). To evaluate the stability of the model’s spatial structure over time, separate models will be developed for different years, depending on the number of monitoring sites (NO2 and O3; 2000 and 2005, PM2.5; 2013).

Results. The PM2.5, BC, NO2, O3 annual, O3 warm season and O3 cold season (100% sites) models explained respectively 71%, 51%, 58%, 62%, 69% and 83% of spatial variation in the measured concentrations (Fig 3 & 4). Kriging proved an efficient technique to explain a part of residual spatial variation for the pollutants with a strong regional component explaining respectively 12%, 25% and 16% of the R2 in the PM2.5, O3 warm and O3 cold models.

Conclusions. We were able to develop robust NO2, PM2.5, BC and O3 hybrid LUR models to provide exposure estimates for all cohort participants in the ELAPSE project. The evaluation of the stability of the spatial structure of the models over time are ongoing.