AN INTEGRATED BaP (PAHs) APPROACH TO ESTIMATE CHILDREN AND ELDERLY EXPOSURE IN THE CITY OF ROME, ITALY

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Summary
The identification and quantification of population exposure of children and elderly people to PAHs in urban areas are the major goals of the EXPAH LIFE+ Project (www.ispesl.it/expah). To reach these objectives, an integrated approach, based on measurements and modelling techniques, has been set up to: 1) reconstruct PAH levels in the Rome metropolitan area; 2) evaluate and correct model results; 3) estimate PAHs exposures according to the mean time spent in the main visited microenvironments using observation-derived outdoor/indoor infiltration factors and time activities data collected from a dedicated statistical survey. Results show that the integrated model is able to catch the mean exposure levels of the target population.

Introduction
PAHs are known to induce health effects on population due to the ability of airborne particles to absorb and transport these species in the lungs. Since some PAHs are potent carcinogens by a genotoxic mode of action, their levels in air should be kept as low as possible (WHO, 2013). Consequently, the assessment of PAHs exposure of the most sensitive populations living in urban areas, such as children and elderly people, represent a relevant issue, addressed by the EXPAH project.

Methodology and Results
In order to estimate PAHs exposure for the target population, a newer version of the three-dimensional Eulerian chemical-transport model FARM (Flexible Air quality Regional Model), which includes the PAHs reactions with hydroxyl radical and their partitioning between gas and aerosol phases, has been applied to an high spatial resolution (1x1 Km^2) domain including the Rome conurbation. Simulations were carried out for one year period (June 2011-May 2012) to estimate gridded PAHs in both gaseous a aerosol phases.
Experimental data (particulate PAHs and $PM_{2.5}$), collected during field campaigns performed in different sites and microenvironments (homes, schools, cars, buses, offices) from December 2011 to July 2012, permitted: 1) to evaluate simulated PAHs concentrations; 2) to obtain microenvironments I/O infiltration factors necessary to estimate the indoor PAH levels; 3) to collect actual PAHs exposure data by means of personal exposure measurements. Modelled outdoor PAHs concentrations showed overestimation, particularly during colder seasons, that have been corrected, using observed values. Based on these results, a microenvironments exposure model was developed. It calculates exposures of children and elderly people according to the time spent in different environments (indoors (I), outdoors (O), in traffic and living ambient), by using observed outdoor/indoor infiltration factors and time-activities data. The latter ones were collected from a statistical survey carried out for the target population living in Rome, according to type of days (workday; weekend), season (autumn-winter; spring-summer) and microenvironment visited.
Results show that the exposure model is able to reproduce the mean seasonal behaviour of PAHs exposure, with higher values during the domestic heating season and much lower ones during warmer periods. Agreement was found with personal exposure data, although the day-by-day variations were poorly reproduced. The yearly BaP exposure was found lower than legal limit, although during the colder seasons an exceedance is foreseen for most parts of the city.

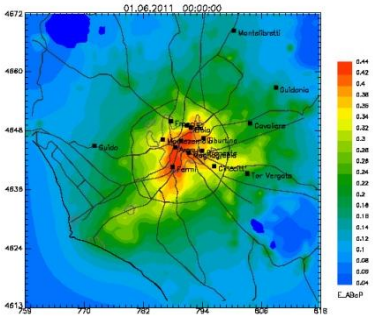

Fig. 2. Yearly BaP exposure for children.

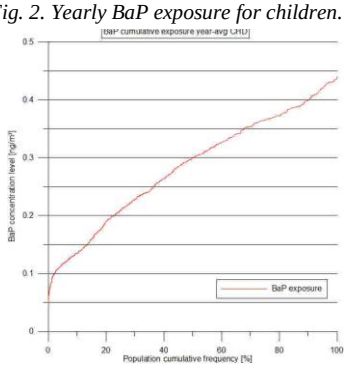

Fig. 1 Cumulative BaP exposure for children.

Conclusions
The integrated approach, developed within the EXPAH project, has demonstrated its capability to assess the impact of PAHs environmental exposures on children and elderly people. PAHs emissions and their spatialization were recognized as the most critical aspects in PAHs modeling at urban scale. Inclusion of uncertanties in both I/O infiltration factors and variations of population time-activities, can improve the exposure assessment.

Acknowledgement
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References
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