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Geoscientific Model Development Discussions

Interactive comment on "EXPLUME v1.0: a model for personal exposures to ambient O_3 and $PM_{2.5}$" *by* Myrto Valari et al.

Anonymous Referee #1

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General comments:

The manuscript describes a population-based human exposure model that simulates exposure to ozone and PM2.5 for a representative set of individuals and presents results from application of the model to the population of Paris, France for the year 2017. The model combines spatially and temporally varying ambient outdoor concentrations from an air quality model with data on population demographics, time-location sequences created for each simulated individual, and indoor/outdoor ratios for different types of buildings or transportation modes in a stochastic framework to estimate exposures. The modeling approach is consistent with previously developed population-based human exposure models for the U.S. and other European countries, but also takes advantage of available data for the region to advance certain aspects of the

approach including development of individual activity sequences that are defined geographically in space and time, and modeled seasonal distributions of indoor/outdoor ratios by building type and age. These features of the model support the originality of the work and make it of broader interest for publication. The manuscript should more directly note these unique aspects of the model and differences from previous approaches. In addition, output from the human exposure model were analyzed to examine the impact of certain factors on the exposure estimates including population mobility for daily activities (work, school, shopping), infiltration of air pollutants indoors, transportation mode, and projected future changes in building stock. These analyses demonstrate the utility of the model results to address a variety of research questions.

Specific comments:

1. Introduction - Line 20-25: epi studies cited are 10+ years old and for the U.S. only, cite current epi studies and at least some for Europe/France for relevancy. - Line 55-60: other references may be more appropriate e.g. review paper by Dias and Tchepel (2018) doi:10.3390/ijerph15030558 - Line 71 or 85: some motivation needs to be stated in this last paragraph of intro as to why the model was developed, what was the aim (e.g. for health impact assessment, epi study, etc.)? or just that now have essential components to combine in modeling approach? - Line 76-77: include important detail that SIREN model used to develop seasonal distributions of indoor/outdoor ratios for each type of building. This is a unique feature that could be highlighted as it is not reliant on measurements for a few locations that may not represent the area's buildings and people spend the majority of time in these microenvironments.

2. Personal exposure calculation - Line 90-93: repeated from intro so delete here or make 1 sentence for versus modeling. - Explanation of exposure calculations with 3 equations seems excessive; don't need first equation (general text is fine) and equation 3 is also in Fig. 1 so consider edits to reduce repetitive text. - Fig 1: could be improved . . . make more clear the two calculations of inputs (concentrations, population activity sequences) with different color boxes within first and second horizontal boxes (also

include ‘microenvironment’ with concentrations); add ‘modeled’ to ‘PM2.5, O3’ in first bullet under Outdoor concentrations, and ‘buildings (modeled)’ for first bullet under Indoor/Outdoor ratios; third box is really the population exposure calculation (as stated in figure title), include output as another box (maps, population distributions?); also would be helpful to include reference to Sections 3, 4 and 5 in figure for where described. - Although details on methods are generally well described, the Monte Carlo sampling aspects are not clear. Some attention is needed in methods to more clearly describe when and how Monte Carlo sampling is utilized vs. when a modeled value is used.

3. Pollutant concentrations - Modeled outdoor concentrations Model performance for the CHIMERE application (Table 1 and text) should include the number of measurement sites used and note the relative spatial coverage for each type of site. Would be helpful to include Box plots showing the distribution of the statistics across sites in supplemental material. Fig 2: Text and figure title should note that figures are maps of specific date/hour. Suggest including maps of annual average concentrations in same figure with these of the example hours. Line 148-149: Also include box plots comparing the diurnal trend in modeled and measured concentrations or in supplemental material. Since activity patterns have a diurnal pattern, it is important to understand how well the air quality model captures the diurnal pattern in concentrations. Line 151-153: is this adjustment what is described in 3.2.2 Transportation (Table 3)? Unclear why units for ozone are micrograms/m3, when parts per billion (ppb) is typical. - Indoor concentrations Fig 3: provide the actual distributions used as input to exposure calculations for all microenvironments in table similar to Table 3.

4. Population data - Line 243: add a concluding sentence that summarizes that Monte Carlo sampling method is used to randomly generate a data set of simulated individuals based on these steps - Line 288: not clear why quotes are used - Line 292-296: these could be a sentence list rather than bullet list. - Fig 8: figure is small and should be enlarged. Or add a few other small plots showing different examples (children <4 vs. adults 25-64)

5. Results - First sentence should be improved to convey that each of the sections looks at a different aspect of the model output as examples of its use in applications. - Line 354: add ‘population’ . . . “to provide population exposure maps” - Line 369-370: sentence needs more explanation or refer to differences in indoor/outdoor ratios by age of buildings as done on line 361. - 5.2 could be improved by including comparisons such as between male/female and/or age groups in Fig 10.

6. Conclusions - Authors should compare/contrast the modeling approach or results with other similar work, e.g. Smith et al (2016) DOI: 10.1021/acs.est.6b01817, Shekarrizfard et al (2016) http://dx.doi.org/10.1016/j.envres.2016.02.039

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