

## ***Interactive comment on “Assessment of parameters describing representativeness of air quality in-situ measurement sites” by S. Henne et al.***

**S. Henne et al.**

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**I believe this paper addresses an important issue relating to the appropriateness of comparisons between ground-based in situ and satellite remote sensing observations and/or model output. In the abstract, the authors highlight the importance of being able to identify or categorize sites to identify those which will be more or less suitable for comparison with satellite data or use in data assimilation. However, no further mention is made in the manuscript of how the analysis carried out would help in this task. I feel the paper would be strengthened by some more concrete examples of how this approach is helpful.**

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**For example, would one restrict comparisons to sites whose 12 hour catchment area is smaller than the satellite footprint or model grid box.**

We had included an example of how the results of our study could be used in data comparison in the concluding section (P20046, L6-12). We will extend this discussion elsewhere in the text and give some more concrete examples. However, there is no direct link between the size of the catchment area and grid size of a satellite pixel or model simulation. Therefore, the selection of sites according to the size of the catchment area is not appropriate. In fact, it might be more beneficial to make such a choice based on the categorisation.

**In general, I was a little confused with some of the terminology in the manuscript. The terms 'catchment area' and 'footprint' are used before they are defined. P20025, L22-24 is the first time in the text that the term 'catchment area' is used. How is differentiated from the area of representativeness? You state that the catchment area is independent of the pollutant - does it only take into account advection and not the impact of emission/deposition? Later in Section 2.2.2 it is stated that the catchment area is defined to include areas from which fluxes will make a significant impact on the receptor site, so how is it that the catchment area is independent of the emission sources? Does the catchment area calculation assume hypothetical evenly distributed fluxes on constant magnitude?**

As also mentioned in the reply to referee 1 we will clarify the used terminology by introducing an additional paragraph in the methods section discussing the connections and limitations of individual terms used to describe sites' representativeness.

The catchment area of a site simply indicates the area significantly influencing that site when surface fluxes were homogeneous. Therefore, it only reflects advection. In

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contrast, the area of representativeness of a site is the area in which the concentration does not differ by more than a certain threshold from the concentration at the site itself. There is no direct connection between both areas! A large catchment area does not automatically indicate large area of representativeness, but rather suggest a faster dispersion regime. We chose to define the catchment area independently of a specific surface flux to describe a more general concept. Surface fluxes outside the catchment area would need to be several orders of magnitude larger than those closer to the site to cause the same effect on pollutant concentrations. The difference between both approaches is touched on in the publication of Folini et al. (2009). Reconsidering this we will revise our statement in Sec 2.2.2 and mention that for surface emissions remote cities might at times have a significant influence at distant sampling location even if they are situated outside the sites' catchment area.

**P20024, L20-23 When you say emission and deposition data are proxies for concentrations, do you really mean that the mixing ratios will scale with the rates, or that the variability in the mixing ratios will have similar spatial and temporal scales to the rates of emission and deposition? As written, it's a little unclear.**

We actually mean both. However, the scaling between emissions and concentrations does not need to be linear.

**P20029 L17-22 This sentence is too long and difficult to understand.**

We will revise it for the updated version of the manuscript.

**P20033 L13, supplementary, not supplementing (also P20044, L3)**

We will revise this for the updated version of the manuscript.

**Section 3.1 and Figure 1 - this is the first time that the term footprint is used in the analysis. What does it represent? What are the units of the colour scale?**

The term "footprint" is actually equivalent to the term "annual total surface residence time", which was introduced in eq.1. We will add this in the manuscript to avoid confusion. The footprint is given in units of time (seconds in Fig.1).

**In Section 3.6, a less computationally expensive approach is presented (with results in the Supplementary material). Could the authors be more explicit about the type of application for which this approach could be sufficient?**

As mentioned in Sec2.1, advection is more important for the analysis of representativeness of more remote sites than for sites close to the emission sources. Therefore, a study focussing on typical air quality sites as those of the European Airbase network, which does not include remote mountain top and coastal sites, would probably yield reasonable results without taking detailed dispersion simulations into account. This topic is revisited in the conclusions section and we will add the above information there.

**The standard deviation of mixing ratios at each site as calculated from a full year of data, whereas the deposition velocity used for ozone was specifically for summertime conditions. Do you think your agreement with observations might change if you had allowed the deposition velocity to vary seasonally?**

We expect that ratios of deposition velocities between the different land cover categories, which were important for the selected sites, do not change significantly during the year, since they are all mainly driven by changing vegetation. In addition, deposition parameters were given only half the weight of population parameters in the site clustering, therefore their influence will be considerably smaller and thus including seasonality would most likely not influence the categorisation.

## References

Folini, D., Kaufmann, P., Ubl, S., and Henne, S.: Region of influence of 13 remote European measurement sites based on modeled CO mixing ratios, *Journal of Geophysical Research*, D08307, doi:10.1029/2008JD011125, 2009.

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