

## ***Interactive comment on “Cluster analysis of European surface ozone observations for evaluation of MACC reanalysis data” by Olga Lyapina et al.***

**Anonymous Referee #1**

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This is a review of the manuscript titled "Cluster analysis of European surface ozone observations for evaluation of MACC reanalysis data" authored by Lyapina et al. The manuscript describes a clustering analysis of MACC model data and Airbase observations for four years using 1492 Airbase sites using three-hourly ozone data over Europe. The authors apply a K-means clustering technique to subset the Airbase sites into five and four clusters, depending on the ozone metric used. The authors compare/contrast the different clusters based on various characteristics of the sites including location, landuse, emissions profile, etc. The work has implications for evaluating models, particularly coarse grid-scale models, since the model data used were at 80km grid spacing, which is much coarser than most regional scale model applications.

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General Comments: Overall, the manuscript is very well written and the authors do an excellent job explaining the clusters technique applied and supporting the results of the cluster analysis. In addition, the authors show that the cluster analysis is robust enough to withstand the remove of a large number of the initial sites and be applied to smaller time periods and still retain the integrity of the clusters. It's interesting to see how the different sites across Europe fall into the various clusters. And there does appear to be some regionality to the clusters themselves, although the authors do not focus heavily on that. Overall, I recommend that the manuscript be published with some minor technical corrections and perhaps some clarifications in a few areas.

#### Specific Comments:

Page 2, Line 1: Provide references for the adverse effects of ozone on human health and agriculture.

Page 8, Line 23: Reword "2nd CA is containing both" to "2nd CA contains both"

Page 8, Line 25: Reword "...cluster is semi-elevated with the mean altitude 433 m for the 2nd CA." to " ...cluster of the 2nd CA with a mean altitude of 433 m."

Page 9, Line 1: Change "...data are both show a positive bias by 9 nmol/mol." to "... data both show a positive bias of 9 nmol/mol."

Page 9, Line 17: Remove the comma after broader.

Page 9, Lines 29-30: Is titration really the only cause of the very low ozone concentrations during the winter? It's seems as though in the winter, which is already non-conducive for ozone formation, that the meteorological conditions could just be very poor for any ozone production to occur. Just suggesting that titration may not be the sole cause of the low ozone concentrations.

Page 10, Line 19: The wording "has twice less probability" is awkward. Suggest re-wording.

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Page 10, Line 22: Change "then follow" to "followed by" and "at the end is" to "finally".

Page 10, Line 27: Change "This" to "The".

Page 10, Lines 28-29: Suggesting changing "25%-ile to 75%-ile" to simply "25th to 75th percentiles".

Page 12: It would be useful to the reader to explain exactly how the weekly amplitudes were devised. The analysis seems to suggest that the data were split by day of the week, since the authors refer to specific week days in their discussion. Is that what was done? So more clarification would be helpful here.

Page 12, Lines 28-30: How do the authors know that elevated/residual ozone is the compensating mechanism?

Page 13, Line 20: Change "strong disagreements" to "large differences".

Page 13, Line 22: Change "likewise the distributions" to "likewise for the distributions".

Page 13, Line 23: Change "underestimating observed ones" to "underestimate the observed amplitude".

Page 13, Line 25: Change "give also" to "show".

Page 13, Line 30: Change "gives as a result" to "shows".

Page 13, Line 32: Change "expressed as difference" to "expressed as the difference".

Page 13, Line 33: Change "amplitudes as well as variability decrease" to "amplitudes, as well as variability, decrease".

Page 16, Line 31: Suggest changing "deficits and pros" to "pros and cons".

Page 17, Line 7: Change "mostly always" to "almost always".

Page 17, Line 24: Change "Besides," to "Finally,".

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