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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Using discriminant analysis as a nucleation event classification method" *by* S. Mikkonen et al.

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The authors would like to thank the referees for many helpful comments and suggestions. In the following, we clarify several technical points in the work and answer questions raised in these reviews. Changes to the manuscript are noted.

Answers to comments from Referee 1:

Specific comments:

The study started from the premise that there were no pre-assumptions for the parameterization of the model but the best classification variables were determined only on the basis of the data. In our opinion, the result (estimating ability for nucleation days) is good; we presume that current process models cannot give more rigorous results.

It is also interesting to see how different set of variables gave the best classification

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result compared to Hyvönen et al. (2005).

Several different time windows were tested, including daylight hours (used in Hyvönen et al., 2005) and morning hours i.e. hours before and during the usual event start times, but 24 hour averages gave the best classification results. It appears that 24 hour averages are the best estimators for the conditions needed for nucleation taking place. (This clarification added to page 8488)

Seasonal separation of data was considered but it did not give significant addition to the classification results.

Technical corrections:

Key variables presented in Introduction.

P 8487 L 14: Name of the section changed to Methods

P 8489 L7-8-9: Sentence changed to suggested form

Section 2.1.1: Some readers may be interested to see how the probability of event is computed, thus we have not removed the section.

P 8494 L 12: Unclassified class may contain misclassified event or nonevent days and this may cause bias to the analysis. Clarification made to the manuscript.

Section 4, Discussion: Since we used nonparametric estimation method in our analysis, it is impossible to write the model in functional form. The classification of the observations in the test set is based only on the locations of the observations in the training set.

P 8494 line 26: Changed to form: ozone is a good indicator for new particle formation

P 8496 L21-23: Added sentences: "High ozone concentrations are detected on nucleation event days, and it is a good indicator for new particle formation, but it is not known for sure if it participates into the nucleation process. It is possible that O3 ox-

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idises VOC's, which produces condensable organic compounds (Hamed et al., 2006; Kulmala et al., 2004a) and thus participates into the new particle formation."

Answers to comments from Referee 2:

page 8487, row 20-23: The classification method of nucleation events we used was visual analysis, based on the methods described by Mäkelä et al. (2000) and Dal Maso et al. (2005). References will be added to text. Event subgroups were not used in this analysis and the clause referring to them will be removed.

page 8488 row 11-13: As stated in the answers to Referee 1, 24 hour averages are the best estimators for the conditions needed for nucleation event.

Measured variables are not normally distributed during 24h day, and there is no reason why they should be. Nonparametric kernel method does not demand that and 24h averages can also be calculated without normality assumption.

page 8488 row 25-29: multicollinearity is usually defined to occur when the absolute value of pair wise correlation is more than 0.8. Correlation between RH and rad is 0.6, so the limit is not exceeded. Multicollinearity was also tested with tolerance analysis.

RH+log(CS) was the best two-variable model (P8492, L10). Other two-variable models (RH+rad and RH+O3) had nearly the same total classification error (for 3-class data) but they missed 5-10% more events.

page 8492 row 14: Polynomial fit gave the best classification result.

The use of SO2 or NO2 in would have reduced the total number of observations by more than 20% and the number of event days by 25%. This is why they were left out from the final analysis, but there is still enough data to observe that these variables could be significant predictors. Word "analysis" changed into "final analysis" (P8497, L4). Notable is, that O3 was the best of the three predictors (SO2, NO2, O3) also for the reduced data.

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Technical Correction:

We used natural (e-based) logarithm for the condensation sink. Clarification added to text.

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