

Interactive comment on “Statistical analysis of the precision of the Match method” by R. Lehmann et al.

Anonymous Referee #3

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General Comments

This paper describes a statistical assessment of the Match method, which has been used previously to estimate chemical ozone loss in the polar stratosphere from the difference between ozone measurements made at two points along the trajectory of an air parcel. In practice, the method involves the application of statistical methods to a number of Match events to determine the mean ozone loss rate. This approach assumes that the errors in the measured ozone mixing ratios are independent, which may not be true because one ozone measurement may be included in several Match events. The objective of the work described in this paper is thus to investigate the impact of correlated errors on the uncertainty of Match results.

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The paper begins with a simple example to show how correlated errors affect the random error on the derived ozone loss rate. It then provides a description of the uncertainties that are involved in the Match method, along with the mathematical basis for performing the statistical analysis. The resulting formulation is summarized as a useful algorithm for calculating the precision of the Match results. Finally, this approach is applied to data from four Arctic Match campaigns and to Antarctic data from POAM III, showing that the uncertainties increase, on average, by 15% and 60% respectively.

The paper is well written and provides a careful step-by-step derivation of the underlying definitions and statistical analyses, with detailed derivations included in three appendices. The paper is necessarily quite mathematical, and may be rather difficult to follow for those unfamiliar with such statistical methods. The discussion of the application of the resulting error bar equations to the ozonesonde and satellite data sets is relatively brief, although sufficient.

The Match technique has been a powerful tool for determining polar chemical ozone loss rates over the past decade, and continues to be used for this purpose. This paper therefore represents a useful contribution to the field, by providing a thorough statistical analysis of the uncertainty in the derived ozone loss rate that accounts for correlated errors due to different Match events sharing an ozone measurement. I recommend publication in ACP after the minor issues below are addressed.

- 1) Does the paper address relevant scientific questions within the scope of ACP? Yes
- 2) Does the paper present novel concepts, ideas, tools, or data? Yes
- 3) Are substantial conclusions reached? Yes
- 4) Are the scientific methods and assumptions valid and clearly outlined? Yes
- 5) Are the results sufficient to support the interpretations and conclusions? Yes
- 6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes

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- 7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes
- 8) Does the title clearly reflect the contents of the paper? Yes
- 9) Does the abstract provide a concise and complete summary? Yes
- 10) Is the overall presentation well structured and clear? Yes
- 11) Is the language fluent and precise? Yes
- 12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes
- 13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? No
- 14) Are the number and quality of references appropriate? Yes
- 15) Is the amount and quality of supplementary material appropriate? Yes

Technical Corrections

Page 3228, lines 15-16 This sentence states that there “was no ozone loss the corresponding two trajectories” but line 18 then refers to “the ozone loss rate”. Please clarify.

Page 3230, line 25 and page 3231, line 1 Change to “statistical methods allow AN estimate OF the random error”

Page 3233, line 19 Could underline the n in number, for consistency with subsequent variable definitions

Page 3234, line 10 “information ABOUT which sonde”

Page 3247, lines 6-7 Combine the two sentences that both start with “If $D=0$ ”

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