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Interactive Comment

Interactive comment on "Method for evaluating trends in greenhouse gases from ground-based remote FTIR measurements over Europe" *by* T. Gardiner et al.

T. Gardiner et al.

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The authors would like to thank the reviewer for an extremely useful set of comments. In our response we would first like to discuss some of the general issues raised by the comments, and then address the specific points not covered by the general discussion.

The main point to make is that the purpose of this paper is to describe a generic tool for the statistical analysis of long-term trends and their confidence limits that is applicable to this type of atmospheric data. The tool uses a relatively straightforward model to account for intra-annual behaviour. This model could be used in a standard least squares analysis, appropriate for independent, Gaussian noise. In practice, the data could have outliers (so that a Gaussian model is inappropriate) and there is likely to be some correlation over time. The use of the bootstrap technique is designed to accommodate outliers but, at the same time, provide estimates comparable with least squares estimates when a Gaussian model is appropriate. In this way, the method gives a suitable generalisation of a standard approach that provides an important advantage in data of this type where outliers are an issue.

It is recognised that, with the relatively simple intra-annual model used here, the residuals are unlikely to be fully independent. Taking into account correlation over time, for example, by using an auto-regression model would be advisable for a more detailed analysis. With some minor modification, the approach described could be extended to accommodate these more complex models, for example, that capture atmospheric processes such as the QBO or solar cycles and thereby reducing any structure/dependence within the residuals. The trend data presented here result from a common algorithm with a compact set of coefficients across the full set of UFTIR species and sites to give an overview of the basic trend behaviours. Follow up papers are in preparation that address the specific issues and scientific interpretation of the results for the different species.

The question of homoscedasticity is an interesting one that was discussed at some length. If there is sufficient evidence that the uncertainties associated with different data points are significantly different, then we would recommend applying an appropriate weighting scheme prior to using the analysis tool. For the data provided, there was no strong quantitative evidence of heteroscedasticity and so a weighting scheme was not applied in this initial analysis. The non-negative issue would indeed be relevant for some trace gas measurements, but is not thought to be a major issue for these data: a check of ethane residuals does not show the skewed distribution that would be expected if such an effect was present.

The reviewer correctly points out that the uncertainties in Table 3 are presented as symmetric, rather than the different positive and negative uncertainties given by the 2.5 and 97.5 percentiles. While the magnitude of the positive and negative uncertainties are

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different, these differences are much smaller that the magnitude of the uncertainties. Therefore, for reasons of clarity given the size of the table, the uncertainty given in Table 3 is the mean magnitude of the positive and negative uncertainties. This will be clarified in the text.

The comments regarding emphasis on the sign of the trend values rather than the confidence limits are correct. In addition, our use of the term - validation - with reference to the atmospheric model is inappropriate. The comparison between the measured and modelled trends simply confirms that similar long-terms behaviours are observed in both datasets. The text will be changed to reflect these points.

Finally, the suggested corrections in the minor points will be implemented.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 15781, 2007.

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