

## ***Interactive comment on* “The characterisation of pollution aerosol in a changing photochemical environment” by M. J. Cubison et al.**

**M. J. Cubison et al.**

Received and published: 10 February 2006

The referee's concerns about the positive probability of particles having a growth factor greater than 1.75 in figs 9 and 11 are understandable, given the large body of evidence to the contrary in previous studies in the literature. However, these values are a function of the method of retrieval and averaging rather than real atmospheric values.

The data were retrieved using the optimal estimation method (Rodgers 1976,1990,2000, cited in the paper). We have described the method, as applied to HTDMA retrieval, in Cubison et al., 2005 and this is clearly referenced in the paper. A further detailed discussion in this paper would, in our opinion, make the paper hard to read and detract from the scientific arguments made.

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We appreciate that this type of analysis of HTDMA data is not widespread in the literature, but its advantage is that it retrieves the shape and width of the growth factor distributions as well as the position of the centre of the growth modes. This is important information and in our opinion makes the more complex retrieval we have conducted important and necessary in the interpretation of our data.

The inversion problem is under-constrained, so there exists a null space - those parts of the measurement space for which we have no information due to the non-continuous nature of the measurements. This induces an inherent uncertainty in the retrieved distribution, and any attempt to retrieve a profile with a growth factor resolution that is finer than the information content available in the measurements will result in a retrieved profile that displays oscillatory behaviour (numerical noise). This oscillatory behavior can produce some unphysical growth factors, which are the product of the numerical procedure.

For individual measurements, it is therefore prudent to carefully select the resolution of the retrieval bins to be wide enough such that any numerical noise is avoided, but not so wide so as to lose too much information in the retrieved distribution. However, when dealing with time-series measurements, it is necessary to select a bin width suitable for all the measurement distributions as an ensemble, which may induce slight oscillatory behaviour in some of the retrievals depending on the nature of each individual measurement distribution. Average retrieved distributions may therefore reflect some numerical noise.

It is thus intended to insert a paragraph explaining the advantages of the OEM method in the revised edition of the paper, including a description of the features of the retrieval and the propagation of errors through the inversion space, such that the reader may easily and correctly interpret the retrieved distributions

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 10055, 2005.

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