

## ***Interactive comment on “Chemical Isolation in the Asian monsoon anticyclone observed in Atmospheric Chemistry Experiment (ACE-FTS) data” by M. Park et al.***

**M. Park et al.**

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We thank Carl Brenninkmeijer and Tae Siek Rhee for their helpful suggestions. Our response to the questions and specific suggestions are as follows:

We have a small contribution to the discussion after reading this interesting paper by Park and co-workers. It struck us that the expression "chemical isolation" is a bit strange, but it also stimulated thinking about what exactly was going on. Concerning the point, also mentioned by ref 1, perhaps the authors could provide one additional figure focusing on the anticyclone region, indicating with short lines (if applicable, the

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geographical length of an occultation measurement) the profiles "inside", and with alternate lines the profiles "outside" the region.

The definition of inside vs. outside the anticyclone from a meteorological perspective depends on the synoptic structure when the individual profiles are made. Because the anticyclone is generally associated with low values of potential vorticity (PV), we have included a new Figure 2 demonstrating that the profiles identified as inside using CO also have low PV values (and hence are characteristic of the anticyclone).

The title furthermore states that the "isolation is observed in data". Perhaps the paper is an analysis of observations; in particular satellite based measurements can be viewed clearly as "observations". With data we think about perhaps model output, otherwise words like "measurements" or "measurement results" ought maybe to be considered.

We think the "observed in ACE-FTS"; sufficiently stands for the satellite measurements.

This then leads to our next remark; not all concentrations shown in for instance figure 2 do agree with reality and need "truthing". CH<sub>3</sub>Cl never exceeds 600 pptv in the free troposphere we believe. The authors perhaps could more clearly communicate how these have been derived, and correct them before final publication.

We agree that CH<sub>3</sub>Cl being too high. This turns out to have been caused by the missing spectral information of C<sub>2</sub>H<sub>6</sub> used to CH<sub>3</sub>Cl retrieval, which has been fixed now. We now include results from the revised retrieval and included the new Figs. 3, 5, and 7 in the revised text. However, CH<sub>3</sub>Cl mixing ratios do exceed 600 ppbv when there is a source, for example biomass burning. References are shown below for TRACE-P campaign (Blake et al., 2003; Russo et al., 2003; Singh et al., 2004; Kondo et al., 2004; Yoshida et al., 2004; Wang et al., 2003)

Concerning the correlations of trace gas concentrations in figure 4, we note that although the photochemical age concept may apply to the "inside" conditions, here the

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spread in the results is too large to establish a meaningful correlation. For the "outside" conditions mixing and photochemical removal form a complex inter play, in particular because of mixing with air masses that have a stratospheric "signature" leading to slopes that are hard to interpret, meaning that even though the correlations are rather compact, the agreement with a shown photochemical slope may be coincidental.

The tracer-tracer correlations can be representative both the chemical lifetimes and (or) the mixing. And when the two tracers have common sources and sinks, the correlations can be very compact (as shown in C<sub>2</sub>H<sub>2</sub> and C<sub>2</sub>H<sub>6</sub> vs. CO and O<sub>3</sub> vs. HCl in Fig. 5 in the revised text). And the fact that high CO is correlated with high concentrations of the tropospheric tracers means young air is isolated inside the anticyclone. A rather broader scatter in CO vs. HCN might be related to the different chemical sources of the two species, which is also seen from in-situ measurements. Due to longer lifetimes of CH<sub>3</sub>Cl (1year) and OCS (4.3 year), the correlations are not compact.

Concerning a photochemical age, and referring to figure 5b, we note that it should rather be the ratio between the relative reductions (changes in concentrations) of two tracers that give a measure for photochemical age, and not the ratio itself. Thus, whereas the profiles "inside" being very steep forms a very strong proof of vertical mixing, the lack of mixing (chemical isolation..) based on the tracer correlations is harder to proof. One may like to try to analyze the ratios between the logarithmic changes to find a more valid indicator for photochemical ages.

One can define emission (or enhancement) ratio (ER) by dividing the excess trace species concentrations measured in a plume by the excess concentration of a simultaneously measured reference gas, for example, CO<sub>2</sub> or CO. Alternatively, the ER can be determined as the regression slope of the species concentration versus the reference species (Andrea and Merlet, 2001; Koppmann et al., 2005), which will eventually give the same result. And these ratios can either be represented as linear slopes in log-log spaces and logarithmic slopes in linear scales.

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Finally, as non-satellite colleagues we also are curious if any systematic differences between "inside" and "outside" could instill a bias in some or all results. For instance water vapor, which is more abundant "inside" we presume.

The data used in this study are carefully selected by the quality control and the validation of ACE-FTS data shows good agreement with other satellite-borne, airborne, balloon-borne and ground-based instruments (special issue, Atmos. Chem. Phys., 2007). Since ACE is a high-resolution (0.02-1 cm) instrument, there are no possible systematic errors due to elevated ice or water vapor in the retrievals.

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