

## ***Interactive comment on “First space-borne measurements of methanol inside aged tropical biomass burning plumes using the ACE-FTS instrument” by G. Dufour et al.***

### **Anonymous Referee #1**

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The paper "First space-borne measurements of methanol inside aged tropical biomass burning plumes using the ACE-FTS instrument" by G. Dufour et al. contains a concise description of the retrieval strategy, provides a thorough error analysis, reports interesting results, poses the results into the context of other measurements and explains the results in a sense that there is no evidence of secondary production paths in aged biomass burning plumes. The paper is clearly structured, well written, contains highly original material; further, I consider the paper conclusive and I have not detected any logical flaw or major error or misconception (Unless retrievals are 'onion peeling' retrievals; in this case the error estimation would be incomplete; see below). Thus I recommend to accept the paper for publication in ACP after mostly minor revisions:

1. The title says "tropical" biomass burning plumes. The plume crosses a typical biomass burning mass area over southern Africa which is not tropical. Please make either sure that only tropical plumes have indeed been observed, or change the wording accordingly.
2. Is the vertical resolution of 3-4 km determined by the tangent altitude spacing? If so, please mention this. Since the ACE-FTS retrieval is an unconstrained retrieval (maximum likelihood in Rodgers terminology (Inverse Methods for Atmospheric Sounding, Theory and Practice, World Scientific 2000) terminology, it is correct to report the tangent altitude spacing as vertical resolution, if the retrieval is performed on the tangent altitude grid. However, this should be stated explicitly.
3. Par 2 of Sect.2.1: I assume that not the isotopologues 4 or 5 of were fixed but their fractionation w.r.t. the main isotope. Please clarify.
4. Par 2 of Sect.2.1: "aged plumes" and "relativeLY long-lived species" are quite vague expressions. Please quantify.
5. While well established, the term "atmospheric state parameters" is misleading, because the x-values are variables, not parameters. For the b-values, the term "parameters" is correct, because these are not varied but fixed.
6. I assume that the retrieval is a global fit retrieval in a sense that spectra of all tangent altitudes are analyzed simulataneously (Carlotti, Applied Optics, 27(15) 3250ff, 1988). The statement "... in which y is the vector of measurements" is a bit vague here because it does not clarify if measurements of all tangent altitudes are considered in one run. Please clarify in the first paragraph of 2.2. if global fit or onion peeling retrievals have been performed.
7. If onion peeling retrievals have been performed, then Eq. 2 is not the complete random error because it neglects the error propagation from higher atmospheric layers to lower ones. This would imply a major revision of the error budget.

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8. The model parameter error caused by uncertainties in  $b$  is called systematic error. This, however, is misleading, because the resulting error typically has random characteristics (E.g. temperature can either be higher or lower than assumed). A typical systematic error would be spectroscopic data, because this error has the same sign and the same percentage size in the entire set of measurements. Please be more careful with terminology here and avoid to mis-use the term "systematic".

9. The elements of vector  $b$  are profiles, whose elements may vary in a correlated manner. The correct way to evaluate this error would be to consider the covariance matrix of vector  $b$  instead of considering only the uncertainties of its elements. This rigorous approach may not always be feasible, but a clear statement is needed, if each element of  $b$  was perturbed individually, or if a scalar perturbation of the entire profile was performed.

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