General remarks

We sincerely thank the reviewers for the careful and constructive assessment of our manuscript. We particularly appreciate that the reviewers made the additional effort to consider the full, somewhat unusual review history of this submission, including the previous round of reviewer comments and the two editorial reviews. Reviewer #3 caught some important inconsistencies, and his comments helped us to further improve the clarity of the manuscript. In the revised version, we have addressed all points raised, as detailed below.

- **Original reviewer comments are printed in bold**
- Our answers are printed in regular font

Detailed responses to Reviewer #3

1) Equation (1) defines the weighted least-squares cost using the inverse measurement covariance, C_Y^{-1}, but Eq. (9) currently shows C_Y without the inverse in both weighting factors. The standard weighted generalized inverse corresponding to Eq. (1) would be:

$\bar{J}_x = (J_x^T C_y^{-1} J_x)^{-1} J_x^T C_y^{-1}$.

I ask the authors to verify Eq. (9) against the actual retrieval implementation. If the code uses C_Y^{-1}, the printed equation should be corrected. If the code uses the expression currently printed, the authors should make clear whether it affects the reported retrievals and uncertainties.

Thanks for catching this! The code uses C_Y^{-1}, we corrected Eq. (9) accordingly.

2) I find Several headline quantities are not stated consistently. Please check the consistency between the fitted measurement range, any displayed/derived range, and the recommended parameterization range: the abstract gives 310-440 nm, Sect. 3.4 lists measurement wavelengths from 308 to 440 nm, Sect. 4.6 recommends 300-450 nm, and the conclusions state 310-477 nm.

The “477 nm” in the conclusions was indeed a typo. Regarding the recommended range for the parameterization, there is certainly some margin to extend it beyond the retrieval range, but to keep everything accurate and consistent, we reviewed and adapted all wavelength ranges mentioned in the manuscript and supplement:

1. Retrieval range is now consistently 308-440 nm
2. The recommended range for the parameterization is 308-440 nm as well.

3. The averaging for the plume age dependency plots is now stated accurately as 308 to 347 (consistent with the wavelengths used in the retrieval).

Likewise, the imaginary-RI half-life is 13 ±3 h in the abstract and Sect. 4.4 but 15 ±4 h in the conclusions.

The 13+/-3 h is the correct number. We adapted the number in the conclusions.

Meanwhile the statement that the uncertainty in α_k is <10% should be reconciled with α_k = 4 ± 1 and 3.5 ± 0.5, with an explicit indication of what each uncertainty represents (such as retrieval uncertainty, between-transect variability, or fit/parameterization uncertainty).

We thank the reviewer for pointing this out. We have revised the manuscript to more clearly distinguish between propagated retrieval uncertainty and variability between individual transects. In doing so, we also found that the previously stated uncertainty of <10 % for the Angstrom exponent was based on an outdated retrieval summary. The figures and the underlying data analysis already used the current retrieval results, but the corresponding text had not been updated consistently. We have corrected this statement to <20 % and revised the surrounding text accordingly. Please see the Latex-Diff file for the detailed changes.

3) As the authors described, SAEB involves aircraft filter collection followed by offline solvent extraction and spectrophotometric analysis; it is therefore not strictly an in situ technique as in situ PAS. The authors should address this issue appropriately.

We agree that SAEB is not strictly an in situ technique. We have revised the manuscript to refer to SAEB as an aircraft filter-sampling method followed by offline extraction and spectrophotometric analysis, and now reserve “in situ” for PAS measurements. Where both datasets are discussed together, we use “coincident aircraft-based measurements” or “comparison datasets.”

4) A careful proofread is still needed for the correctness or accuracy. Representative examples in ATC4 include 'dependece' (line 134), 'a values' (line 159), 'observations where complemented' (line 163), 'volume fracions' (line 239), 'these comparison' (line 440), 'half-live times' (line 470), 'the plotted data has' (Fig. 9 caption), repeated 'the the' (lines 530 and533), 'remote sending' (line 535), and 'have consolidate' (line 544). Please also correct the CAFS actinic-flux unit at lines 157-159 to photons s^{-1} cm^{-2} nm^{-1} and standardize spelling and hyphenation (e.g., ultraviolet/visible, in situ, filter-based, and core-shell) throughout.

We have proofread the manuscript again and corrected the listed typographical and grammatical errors, including “dependence”, “a value”, “were complemented”, “volume fractions”, “this comparison”, “half-lives”, “data have”, the repeated “the”, “remote

sensing", and "have consolidated". We also corrected the CAFS actinic-flux unit to photons s^{-1} cm^{-2} nm^{-1} and standardized spelling and hyphenation throughout the manuscript, including "ultraviolet/visible," "in situ," "filter-based," and "core-shell."