

Reply to technical corrections by the Editor

Dear Dr. Philipp Joppe,

I am pleased to say that your manuscript can be accepted for publication in ACP subject to technical corrections. Please follow the ACP's author guidelines (https://www.atmospheric-chemistry-and-physics.net/policies/guidelines_for_authors.html) to revise the abstract of your manuscript. Specifically, the abstract of your manuscript needs to be more concise (fewer than 250 words) and the importance and implications of your results should be stated in the end of the abstract.

Sincerely,

Jianzhong Ma

Dear Jianzhong Ma,

thank you for taking care of the manuscript, leading the review process and the consideration for publication. Please find below our new formulated abstract for the final version of the manuscript.

Thank you very much for taking care and leading the review process.

Sincerely,

Philipp Joppe

We present measurements from the aircraft-based TPEx (Tropopause composition gradients and mixing Experiment) mission in June 2024 over Europe. The measurement platform, a Learjet 35A, was equipped with in-situ trace gas and aerosol measurements and filter samplers for offline analysis. For vertical gradient measurements of trace species and aerosol, we conducted redundant measurements on a fully automated towed sensor shuttle (TOSS) 200 m below the aircraft. On 17 June 2024, we observed a filament with elevated aerosol number concentrations of up to 800 particles per cm³ between 100 nm and 1 µm. This is higher by a factor of two to four than the local background. Carbon monoxide (CO) mixing ratios were larger than 100 ppbv. Single particle analysis of impactor samples using electron microscopy show characteristic biomass burning (BB) aerosol in the tropopause region. The TOSS measurements also allow the calculation of the potential temperature gradient ($\Delta\theta \cdot \Delta z^{-1}$). Within the polluted filament, we observe changes towards smaller gradients, which is presumably due to an increase of potential temperature at lower altitudes by radiative heating as a consequence of the transported BB aerosol.

Trajectory analysis show air mass origin over Canada with low-level long-range transport and subsequent uplift by a warm conveyor belt (WCB) over Europe as additional pathway of pollution into the UTLS. Furthermore, this analysis yields that BB aerosol can be transported in a WCB into the UTLS there it can be mixed with stratospheric air masses.