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Schneider et al. “CARIBIC-AMS: A fully automated aerosol mass spectrometer for operation on routine passenger flights (IAGOS-CARIBIC): Instrument description and first flight application in the UTLS”

Reply to Reviewer #1

Reviewer comments in black

Our replies in red

This manuscript describes the modification of a commercial aerosol mass spectrometer for fully autonomous operation on board a commercial jetliner and provides some example data resulting from some flights. The scientific goals and context are well-motivated. The manuscript is clearly organized and well-written. I have a few minor comments I would like the authors to address, but otherwise I find this suitable to publish.

We thank the reviewer for this positive rating of our manuscript

Given the description of the use of the new particle time-of-flight mode, I would’ve expected to see some particle size-dependent example data in this manuscript, or an explanation of why none was included. Was this mode used in flight? Is there any promise for new, useful results from the size-resolved data?

We have not used the ePToF mode in flight yet. The synchronization between the ToF pulser and the chopper was not ready during the IAGOS-CARIBIC flights between 2018 and 2020. For the TPEx mission, we did not use ePToF but decided to maximize the time spent in mass spectrum mode to obtain the best possible signal-to-noise ratio with a highest possible time resolution. The reason for this was that the objective of TPEx was small scale mixing at the tropopause.

We are confident that the ePToF mode will be operating reliably in future application. When IAGOS-CARIBIC continues the airborne operation, we expect important results from size-resolved data.

Line 346-354. (Why) should we expect the ePTOF mode to result in a narrower distribution of particle transit times? Is it just improved statistics for a distribution that is fundamentally the same? Do you get the same central time of flight estimate for both modes?

The graph in Figure 7 shows the raw data as they are measured. We assume that the narrower distribution is a result of better statistics.

From the Gauss fit to the peaks we obtain the same central time of flight: PToF: 2545 µs, ePToF: 2555 µs. This difference of 10 µs is in the order of the resolution of the measurement (12 µs)

Section 3.1.1 it would be useful to know the detection limits of the instrument under optimal conditions in the lab as well.

In the laboratory, we measured (August 2024) the following detection limits:

NO_3: 0.056 µg m^{-3} STP
SO_4: 0.025 µg m^{-3} STP
Organics: 0.25 µg m^{-3} STP
NH_4: 0.35 µg m^{-3} STP

This applies to the following settings:

Pressure in front of the CPI: 300 hPa
Ionization efficiency: 6.8×10^{-8} ions/molecule
Time step: 25 seconds

These values are comparable to the in-flight values for nitrate and ammonium, but better for sulfate and organics.