Atmospheric Measurement Techniques Discussions

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Comment on amt-2020-461

P. P. Tans (Referee)

Referee comment on "Testing the altitude attribution and vertical resolution of AirCore measurements with a new spiking method" by Thomas Wagenhäuser et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2020-461-RC1, 2021

This paper is a very useful contribution to the literature on AirCore. The spiking idea is new, and the experiment has been carried out carefully, so that the results are solid.

I have a few minor comments:

line 81: The internal diameter is what matters, so please provide that. I assume that the predicted results use the ID.

line 137: The fill gas at the closed end of the tube will not be distributed as a Gaussian. It has to be asymmetric because the end is closed off. What it looks like depends on how much fill gas is left, but close to the end the spatial derivative of each gas fraction has to go to zero. If there is a lot of fill gas left, occupying several diffusion length scales, the fill gas fraction must approach 1 at the closed end. When the fill gas enters the analyzer the transition ought to be rapid, unless the tubing toward the analyzer and the analyzer cell itself cause a lot of mixing. Some years ago I analyzed experiments with "plug" transitions, sudden mole fraction shifts inserted very close to the Picarro. In the hypothetical case that the cell would be perfectly mixed all the time, the insertion of a plug should produce a negative exponential approach toward the new steady state. If there is plug flow within the cell, so that the rapid transition is mostly preserved, the approach to the new state should be linear. It turns out that the actual transition was in between these two cases. The "response function" of each analyzer will depend on pressure, cell volume, and shape of the cell. This subject comes back on line 156.

line 193: I suppose the signal gas mixture is CO-in-natural air. If a larger spike is inserted, you don't want to alter the main gases of interest.

line 234: typo - should be June 17

line 245: "resulting calculated vertical profile" (this is for clarity)

line 350: I would be very surprised if junctions between sections could cause much additional mixing. The flow conditions in the tube are *extremely* far away from any kind of turbulence. My suggestion is to look further into the analyzer contribution to mixing.

line 387: I suggest replacing "proof," with "prove"