Atmospheric Measurement Techniques Discussions

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Comment on amt-2022-208

Niels Munksgaard (Referee)

Referee comment on "A modular field system for near-surface, vertical profiling of the atmospheric composition in harsh environments using cavity ring-down spectroscopy" by Andrew W. Seidl et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-208-RC3, 2022

General comments:

I found this to be a clearly written paper, well-structured and systematic. It is a little long for the content so an attempt to shorten some sections would be welcome.

It provides a detailed account of the design and testing of a well engineered set of enclosures for the isotope analyser and some peripheral equipment. It looks to be quite costly - please provide the cost of the parts to build this. Many users of these instruments would look for low-cost solutions to building enclosures and peripherals and in many cases sensible cost cutting can be made without substantially affecting performance.

The paper would benefit from a better justification of the need for this design, i.e the advantages of this design compared to other solutions to obtain such data. For example, given that a power source must be nearby (presumably within a few 10's of meters) why couldn't instruments be installed indoors with inlet tubing to the outdoors? Long inlet tubings are routinely used on tall masts with an appropriate pump rate? Are there particular problems regarding lag time? Or memory effects? Or disturbance of the air stratification? Why couldn't an existing mast be used with multiple inlet heights and the use of a manifold? A nearby EC tower is mentioned in the paper.

The publication could be seen as premature given the preliminary and incomplete parts (cold trap, pivot arm and standard gas supply module). However, it may be that the authors had limited opportunities to test the device in this remote location.

The paper is mainly an account of environmental measurements (T and P, spectral

characteristics etc) of the analytical instrument when placed inside the housing under cold and windy conditions, rather than a more complete account of a test of actual isotopic measurements. Ultimately the most critical isotope test, i.e. a comparison of one or more constant gas supplies both in the field and the laboratory, could not be carried out due to the lack of a working standards gas supply module. Also, there seems to have been a missed opportunity to compare the real time isotope data with isotope data obtained from the cold trap sampling, why wasn't this done (or presented) here?

Given the anticipated degradation of isotope ratio precision at low H2O mixing ratios (typical of polar regions), and the possible instrument drift due to the changing environmental conditions, it would be important to check standard gasses a regular interval (likely several times daily) in an actual measuring campaign, hence the need for a standard gas supply device. As mentioned, this has not been demonstrated in the current manuscript.

A more thorough explanation of the stratified air column data obtained would benefit the paper as it would demonstrate the useful application of the enclosure and pivot arm. The need for an operator to use the pivot arm seems to risk disturbing the stratified air column, depending on wind direction (creating turbulence)

Specific comments:

P1 L12: I don't think you can claim it would be satisfactory in all environments, e.g. in the tropics, overheating, condensation of humidity may be a different challenge, in environments with high day – night temperature contrast drift may be problematic

P2 L41: What are the conventional approaches?

P2 L49: But you have a nearby power source so why not house the instrument there?

P2 L52: But long inlet lines (fluorinated plastics) are routinely used in tall towers

P3 L64: Is it pneumatic? Maybe just gas or airtight connectors?

P4 L85: Isn't a lower flow rate preferable to increase precision in dry air? Especially since there's a separate high-flow pump to deliver the air sample close to the inlet?

P5 L106: So why wasn’t this done when there was no available standard gas module available?

P6 L144: Does the presence of an operator disturb the stratification?

P7 L161: This would have been the most complete test of the system

P10 L211: Please state if these are liquid or vapour values

P10 L220: This sentence is unclear – does it mean that measurements were within +/- 1 sigma?

P10 L229: Not sure this is correct, there are numerous field applications documented on the Picarro web site.

P11 L247: Don’t think ‘minutely’ is a word (?)

P11 L259: Please specify where DAS is measured

P16 L355: As mentioned above, wouldn’t the normal low flow setup have been preferable?

P22 L454: add ‘for d18) and dD, respectively