Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-185-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A dedicated flask sampling strategy developed for ICOS stations based on CO_2 and CO measurements and STILT footprint modelling" *by* Ingeborg Levin et al.

Jocelyn Turnbull (Referee)

j.turnbull@gns.cri.nz

Received and published: 15 April 2020

This paper outlines a strategy for collection of flask samples at the ICOS atmospheric stations. To my knowledge this is the most careful, detailed strategy available for utilising combined in situ and flask greenhouse gas measurements together. The paper discusses the reasons for using flask samples (quality checks on in situ measurements, measurement of additional species that are not or cannot be measured in situ). They discuss the strategy for when to collect flasks, and how to collect flasks, and the reasons that integrated sampling is useful. This is a very nice paper, and I recommend publication with minor revisions as detailed below.

Printer-friendly version

Discussion paper

Specific comments:

Edit for English grammar is needed throughout, but particularly in the introduction.

Abstract Line 33. The intent of this phrase is unclear.

Abstract Line 36. This is explained in the paper text, but it is unclear in the abstract why 4-5ppm is important.

Line 224. Six not sic

Line 246-248. This method differs somewhat from the Turnbull 2012 approach, which used a 15L integrating volume. In the ICOS case, the 3L flask itself is being used as the integrating volume. It would be helpful to see the weighting function that is used and a discussion of any impact the smaller integrating volume might have on the final integrated sample. This could be added as supplementary material.

Line 255. I'm guessing that this is because the flask itself is used as the integrating volume? If that is correct, please say so explicitly.

Line 271. Is there enough air for all these analyses in a single flask?

Line 395. This is a very nice demonstration of the utility of flask measurements in quality control. It is worth emphasizing in the conclusions that fast turnaround on the flask measurements AND speedy analysis of the results is needed to achieve outcomes like this.

Lines 468-469. I understand the motivation to measure 14C when the signals are large, but I wonder if this biased sampling methodology will be a headache in the end. If flask samples are biased towards high ffCO2 values, then the observed emission ratios might also be biased. For example, Turnbull et al 2011 measured 14C and CO from flasks collected in South Korea. The high ffCO2 values were associated with air masses coming from (nearby) Korea, which had low CO:ffCO2 ratios. Lower ffCO2 values were associated with air masses coming from China, which meant the ffCO2

signals were diluted. However, these Chinese samples had much higher CO:ffCO2 ratios. I could imagine a similar scenario in Europe. A secondary concern is that this data will presumably be shared across the wide ICOS network, and if these many and varied users are not aware of the deliberate sampling bias, there is a risk of misinterpretation of the results.

Line 479-480. References please.

Lines 525-527. I would argue that the 14C analysis would be most important in summer when the biospheric signals are larger and 14C is going to be even more critical for partitioning the fossil fuel and biospheric signals. This could be motivation to work towards higher precision 14C measurement capability.

Lines 546-547. In this case, will there be sufficient air remaining for a high precision 14C analysis?

Lines 553-555. Absolutely.

Lines 557-558. The NOAA tall tower network has an analogous flask program used for the same three goals. They collect flasks every 3 days (I think), but don't use integrated sampling. A point of difference would be that ICOS has taken a more thoughtful approach to design a sampling strategy to maximise the information from a minimum number of flasks.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-185, 2020.

Printer-friendly version

Discussion paper