Atmospheric Measurement Techniques Discussions

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Comment on amt-2021-6

Anonymous Referee #2

Referee comment on "In situ observations of stratospheric HCl using three-mirror integrated cavity output spectroscopy" by Jordan Wilkerson et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-6-RC1, 2021

Review of Wilkerson et al, 2021: In situ observations of stratospheric HCl using three-mirror integrated cavity output spectroscopy.

This manuscript presents a novel instrument (RIM-ICOS) for the in-situ measurement of stratospheric hydrochloric acid (HCl), based on off-axis integrated cavity output spectroscopy, and a demonstration of its performance. As anthropogenic chlorofluorocarbons continue to control the chemistry of the stratosphere, it is important that both the levels and the variability of key compounds, such as HCl, are known. This is especially important given projected climate induced changes in stratospheric temperatures and deep convective injection events. The ability of the RIM-ICOS to be deployed as part of a balloon payload provides an incredibly useful capability to measure this important compound in-situ.

The manuscript is well written and describes the instrument in the required level of detail, including important factors such as the minimization and characterisation of HCl surface adsorption. The authors also present data from the instrument from a balloon descent between 18-29 km altitude on 24th August 2018, and compare these data with satellite HCl retrievals and correlations with other collocated measurements. The RIM-ICOS demonstrated a 30 s precision of 26 pptv, more than adequate for the target environment, and agreed with satellite retrievals within the combined uncertainty. Overall, I think that this is an excellent piece of work that warrants publication in AMT once the following minor comments have been addressed.

Minor comments:

- It would be useful for the reader if the dimensions, weight and power requirements of the RIM-ICOS was provided, as it’s deployment on a balloon suggests it could also be

applicable to other platforms with payload constraints.

- The authors state that the instrument inlet and measurement cell are held at a temperature of 310 K in order to reduce temperature-related changes to the HCl spectra being fitted and also minimise surface effects from both HCl and water. One possible consequence of this heating is that sampled HCl in the particle or ice phase could repartition into the gas phase under these warmer temperatures. This potential interference has been discussed previously for both stratospheric and tropospheric HCl observations (e.g., Webster et al. 1994 & Crisp et al. 2014). The authors should discuss the potential impact of this repartitioning of HCl on their measurements.

References

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