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Atmospheric Measurement Techniques Discussions

Interactive comment on "Measurement of NO_x and NO_y with a thermal dissociation cavity ring-down spectrometer (TD-CRDS): Instrument characterisation and first deployment" *by* Nils Friedrich et al.

Anonymous Referee #1

Received and published: 24 June 2020

This paper reports the development of an instrument to measure NO2, total NOy and total particulate nitrate based on Cavity Ring-Down spectroscopy for measuring NO2 and thermal dissociation for NOy. The accurate measurement of NOx down to low (ppt) levels is crucial for understanding the chemistry of remote atmosphere and combining such an instrument with thermal dissociation to measure total reactive nitrogen compounds and particulate nitrate further adds to the potential uses of such an instrument. Whilst a few examples of this type of approach exist in the literature, CRDS is a relatively new method and so work like this is important.

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Discussion paper

In general the paper details a comprehensive laboratory study of the instrument, including the thermal decomposition of different NOy species and the performance of the denuder for the particulate measurements. It is well written, easy to follow and within scope of the journal. I recommend publication subject to the following, largely minor amendments and additions.

A detailed description of the CRDS NO2 / NOx instrument is given in a previous paper (Thieser et al 2016), however I feel this new paper would benefit from some more details on the performance of the instrument to NO2 and NO. There is no mention of how these species are calibrated, or what the precision / accuracy are. Whilst this data may be able to be found elsewhere, I believe the authors should include it here as well. It would greatly assist readers wishing to get a full understanding of the performance of the instrument. I would suggest at least adding what calibration gases were used for NO and NO2, what is the accuracy and precision of these measurements at various time resolutions and what is the magnitude of any interferences.

On page 8 lines 17-20 it is stated that complete conversion of HNO3 to NO2 occurs at temperatures above 800oC, but then that the amount of NO2 detected of 13ppb is 85% of that expected based on the permeation and dilution flows. These two things do not seem to be consistent with each other – could the authors please clarify? Also, no mention is made of any potential losses of HNO3 to the surface of the instrument or the inlet, something that is often a problem with this type of instrument?

Could the authors comment on if there would be an effect of HONO on the NOy channel?

In section 3.3.1 could the authors make some comment as to how much particles greater than 414nm in diameter are transmitted? I would have thought that, especially in remote marine environments, particulate nitrate have a significant fraction on larger particles and thus provide an interference to the instrument.

In section 3.3.2 could the authors comment on how the efficiency of the denuder

changes with age and how often it may need to be regenerate or replaced.

In section 4.1 the authors state that they do not present an analysis of the NOz data s it will be presented in a future publication. I think they should at least comment on the NOz data observed. This paper is about the development of an instrument to measure NOz and to not comment on the measurements made even a little seems very strange.

Likewise section 4.2 would also benefit from an expanded discussion of the NOz data. For instance why is the diurnal cycle observed as it is, especially the nighttime peak values.

Finally I wonder if the authors could comment on now the particulate nitrate measurement could be improved. There are some suggestions given in section 3 but I think there should be something in the conclusions about this. Currently I read the paper like there was not much hope that the technique could be used for accurate particulate nitrate measurements but I am sure this is not the case, thus the authors should say so.

Page 13 line 6: 'humidified significant' does not make sense.

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