Atmospheric Measurement Techniques Discussions

Interactive comment on "The development of a nitrogen dioxide sonde" *by* W. W. Sluis et al.

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Dear Dr. Ching-Ho Lin,

Thank you very mutch for you're interest and enthusiasm in the NO2 sonde. I hope my comment will answer you're questions.

1.) The acidification of luminol solution will significantly reduce the response of the luminol solution to NO2. Even the recycle of luminol solution can only reduce the speed of acidification. Do you ever think to just discard the used luminol solution? Does discarding the used solution cause any problem in your design?

Indeed, the recycling system of the luminol solution is only reducing the speed of acidi-

fication. For the design of the instrument we also looked if we could discard the luminol solution, but first of all we faced a lack of space in the polystyrene foam box (dimensions within the box are 8 x 8 x 13 cm). Discarding the luminol solution also means a larger container is required for a long measurements (typical flight time 2 – 2.5 hours). As the flow rate of the liquid pump is not very stable, we could run out of fresh fluid during the flight. (Please note however that we start the flight with a pH slightly above the optimum value, so the signal should not suffer from acidification early in the flight.)

2.) Why the NO2 sonde can only expect to measure NO2 in the range 1 – 100 ppb. Will lower or higher concentrations of NO2 cause any problem in your design?

This instrument is designed for measurements in urban and surrounding environment.. For larger NO2 concentrations we can change the resistors that are used in the electronics of the detector. We have done this for some of our laboratory experiments, where we used bottled NO2 with a concentration in the PPM range. For lower NO2 concentrations were facing the detection limit of the photodiodes. Measuring lower concentrations of NO2, probably requires the use of a photomultiplier tube (PMT). Because PMTs are expensive big and power consuming, we didn't choose for a PMT. We will reconsider using a PMT in the future.

3.) The increase of temperature per degree in the luminol solution will decrease 2% of the reaction rate of luminol – NO2 reaction, scaling factor, as described by the authors. Do you make any correction for this effect? Does the temperature inside the box the same as the solution? I wonder the temperature of the solution is much lower then the temperature in the box because the solution is mixed the sampling (ambient) air. Notably, the temperature of the sampling air may be quite low because the ambient temperature is expected to reduce 6K when the balloon ascending each 1000 m.

Yes, we make a correction for the temperature on the measurements. During the profile measurements at the CINDI campaign we measured the air pump temperature, which we used for the temperature correction. It is indeed true that the temperature of the

solution is slightly colder then the temperature in the inside of the polystyrene foam box. During a laboratory study we saw that the temperature difference of the solution and the inside of the box is 1 to 2 degrees Celsius. For the sondes we make today, we measure pump and solution temperature to remove this small uncertainty.

4.) Do you think the temperature used in Eq (5) by the pump temperature has any problem?

The use of the pump temperature is common practice in the ozonesonde community. The pump from the ECC6A ozonsonde that we use in the NO2 sonde features a hole drilled in the body of the pump specifically for these temperature measurements.

5.) Figure 2 and 3 may be more easily to read if the gas and liquid pathways are expressed in different colours of styles?

Thank you very much for you're suggestion, we will take it in consideration.

6.) The comparison of the depth of boundary layer may be straightforward in Fig. 10 if the meteorological parameters measured by the RS 92 radiosonde are plotting simultaneously.

Thank you very much for you're suggestion, we will take it in consideration.

7.) Can Vaisala standard software for their ozonsonde directly deal with the signals of your NO2 sonde?

We are making use of the RS92SGP radiosonde and the OIF92 digital interface. http://www.vaisala.com/files/Vaisala%20Ozone%20Interface%20Kit%20RSA921.pdf The interface transfers four data channels, three of which are used by the NO2 sonde. The Vaisala ground station includes these channels in the raw data product (called "SPECSENSORS.spf" in our current ground station. I am not aware that this data is present in any other products.