Review for manuscript Atmos. Meas. Tech. Discuss., doi: 10.5194/amt-2016-98, 2016 by Sreejith et al.,

The present paper reports on novel instrument for balloon-borne limb measurements of atmospheric radiance in the UVA, UVB, and UVC spectral ranges. From the measurements profiles atmospheric extinction and some atmospheric trace gases (O_3, NO_2, BrO, …) can be inferred using the well-known DOAS approach, together with radiative transfer modelling and mathematical inversion. Results from some first test flights are reported, but little on the post-flight data analysis. As such the paper is potentially worthy to become published in AMT, if it were to report on a consolidated instrument configuration and some final results together with validation exercise against any other measurements or model prediction. In this respect the manuscript does not really report on exciting novel achievements. Hence in the present form the manuscript may not really capture the interest of many AMT readers because it comes rather prematurely. Therefore I do not recommend the manuscript for publication.

Major comments:

(1) Section 2 starts with a description of the major features of the instrument, with some redundant information, c.f., for example the rate by which visual images were taken by an aboard camera, …. provided in section 3, while other information is largely missing. These include
   a. The field of view of the entrance telescopes
   b. The transmission of the instrument
   c. The slit size
   d. Information the spectrometer's f-number
   e. Optical stability with respect to spectrometer's temperature and ambient pressure, i.e. the T and P dependence of the parameters C1, C2, and 3 of the equation (1)
   f. The line shape as function of T, and p
   g. Sampling/pixel per full width half maximum as function of wavelength and line shapes
   h. Amount and wavelength dependence of the spectrometer stray-light
   i. Stability of the offset current with respect to T.
   j. Information how you calculated the signal to nose ratio (on page 6 denoted 2.06:1 by and in table 1 denoted by 45:1). For such an instrument, the SNR for single spectra could (and should) typically be several hundred, and for co-added spectra it could be some thousands or even better. In any case if true it is much too low for any type of reasonable scientific application.
   k. Also how is the chosen spectral interval justified (200 – 420nm), since in the limb the wavelength band (200 – 320 nm) may hardly provide any information on the targeted species.

(2) Measurements

In order to assess the usefulness of the measurements, some information is missing.

   (a) Since the instrument (or the telescope) is not azimuth controlled, according to which criteria did you select the measured spectra for further analysis.
   (b) If true, the accuracy or stability of the elevation angle to within ±1° degree is rather coarse, and certainly too coarse to finally infer profile information on the targeted parameters. In order to assess the required elevation angle stability and FOV of the telescope (see point a. under (1)), information regarding the so-called averaging matrix need to be provided.
   (c) What is the sampling rate per altitude interval, and the targeted altitude resolution?
   (d) ….

(3) Analysis

(a) Equation 2) does not express a relative radiance, but rather a wavelength band integrated radiance. What are the wavelength limits of the integral?
(b) Equation 3 is rather poor mathematical representation of your measurements. How does the slit function, any broad band characteristics of the instrument, the spectrometer stray-light, et cetera… contribute to measured I(λ).
(c) In Figure 6, what are the dotted lines and why the data scatter so much? Is the scatter telescope orientation dependent, and if yes how?
(d) Why should the (wavelength band integrated) relative counts (what is it? I guess it is a count rate) change with solar zenith angle. Explain and justify the result shown in Figure?
(e) How and to what accuracy the so-called Fraunhofer contribution is determined (i.e. amount of absorption in the reference spectrum).
(f) How can the spectral residual range between 12 order of magnitudes (Figure 8, panel b.), if the signal of noise ratio range at 45.1 at best?
(g) ….