Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-77-RC1, 2018

Atmospheric Measurement Techniques Discussions

Interactive comment on "Preflight Calibration of the Chinese Environmental Trace Gases Monitoring Instrument(EMI)" *by* MinJie Zhao et al.

Anonymous Referee #2

Received and published: 15 May 2018

The manuscript entitled "Preflight Calibration of the Chinese Environmental Trace Gases Monitoring Instrument (EMI)" by Zhao et al. describes the method of the preflight wavelength and radiometric calibration efforts for the EMI instrument. Moreover, it provides an estimate of the expected, on-orbit signal to noise ratio for one particular solar zenith angle.

In my opinion, this manuscript provides valuable information to the community, but requires careful modifications before it is published. My detailed comments are:

(1) There are several editorial and vocabulary issues, possibly due to a language barrier, that make the manuscript hard to read and sometimes result in the incorrect meaning. Please proof-read the manuscript carefully. Several examples are listed in the following:

a. "integral time" should be "integration time"

b. The symbol "∼" is used throughout the manuscript to describe "from/to" intervals or ranges. The correct symbol to use is "-".

c. The word "data" is used to describe "measurements". For example, "...determined by 20 spectral response data..." should be modified to "determined using 20 spectral response measurements...". Similarly, "One hundred observed data is obtained..." should be modified to read: "One hundred measurements were obtained..."

d. "...the spectral response function is better than 0.03nm." should be modified to "the full width at half maximum (FWHM) of the instrumental line shape function is less than 0.03nm."

e. Throughout the manuscript, the abbreviation "FWHM" is used for the FWHM of the instrumental line shape function (ILS). Whenever it is used, it has to be made clear that it describes the ILS and not the width of some other function.

f. In section 3, gain steps between 0-63 are introduced which result in different gain values within the CCD readout electronics (A/D converter). However, the word "Gain" is used for the digital gain steps and the word "magnification" is used for the actual gain value. I strongly encourage the authors to describe the values 0-63 as "gain steps" (or something similar) and the factor with which the raw signal is multiplied as "gain" or "gain value". In the community, the word "magnification" is almost exclusively used for optical magnifications, which can result in confusion here. Please do not use "magnification" in this context.

g. The words "accuracy" and "precision" (and sometimes "non-stability" or "variety") are sometimes used interchangeably and often wrongly in this manuscript. Please familiarize yourself with the different meanings of accuracy and precision and use them appropriately. Do not use non-stability or variety.

h. I assume the CCD names are "e2v..." not "EV2..."

i. The dark signal is incorrectly defined in line 288. The common way to define the signal that is obtained when no photons enter the instrument is to add the “bias value” and the “dark signal”, where the dark signal is the dark current multiplied by the integration time. The dark noise is typically the noise component that is caused by this dark signal, in this case, the shot noise of the dark signal.

j. Figure number is missing in line 366.

k. The unit Watt is typically abbreviated with a capital “W”, not a lower case “w”.

l. Equation number is missing in line 428. In fact, the equations are not numbered at all. Please assign equation numbers to all equations.

m. Please use the greek letter μ to indicate thousandths not the letter u.

n. Figure number is missing in line 430.

(2) It is not sufficiently clear what the wavelength shifts shown in Figure 3 are. Do they represent an additional offset that is included in the polynomial function which is determined for the center?

(3) The manuscript states that the CCDs for the visible channels do not have any temperature control. Since the dark current depends strongly on the CCD temperature, it would be very helpful to quote the expected temperature variations of these detectors throughout the orbit and as a function of orbit beta angle. In addition, it would be helpful to refer to the strategy of periodic dark measurements at this point, so the reader understands how this potential problem is mitigated.

(4) The authors state: “The offset is fairly const, . . .” I believe they mean “The bias value is constant,. . .” This is generally a good assumption for well-designed electronics. Have the authors quantified the precision of the bias values?

(5) I do not understand the traces in the top two panels of Figure 8. For a constant dark current and a constant bias value, the difference between the measurements with 0.5s

and 1.0s integration time should be half of the difference between the measurements with 1.0s and 2.0s integration time. Please explain.

(6) A reference for MODTRAN should be included.

(7) The denominator of the equation on line 414 should be the standard deviation. Thus, the term in the sum needs to be squared. I assume that the actual calculations were performed correctly.

(8) The authors state that the measured SNR in figure 13 is departing from the simulation between 460-500nm due to lower transmittance of the instrument (filter) in this range. However, if the equation in line 394 includes the proper transmission function, this effect should be included in the simulation. Please explain.

(9) It is not clear to me how the PRNU can provide a significant contribution to the lower than expected SNR, unless it is varying in time (line 432). Please explain.

(10) If I understand correctly, the pre-flight, radiometric calibration of EMI was not conducted under flight-like vacuum and possibly thermal conditions. If this is the case, please address in more detail how the in-flight calibration will be used to accomplish absolute radiometric calibration of the flight data.

(11) Finally, while the manuscript shows the performance of the instrument on the ground, the reader is not told what the actual performance requirements are. Presumably, the instrument performance requirements are driven by the scientific objectives. Comparing the measured/estimated performance (e.g. SNR) with the mission requirements would make the conclusion much stronger.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-77, 2018.