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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Description of a formaldehyde retrieval algorithm for the Geostationary Environment Monitoring Spectrometer (GEMS)" *by* Hyeong-Ahn Kwon et al.

**Anonymous Referee #2**

Received and published: 28 March 2019

This is a useful and timely manuscript on the algorithm for HCHO retrievals with the GEMS geostationary sensor that will observe the atmosphere in the near future over eastern Asia. It is useful because the algorithm is discussed in a step-by-step manner, and a thorough uncertainty assessment is included, and a comparison to independent data is provided. The discussion of the systematic component of the uncertainty is very strong. It is timely because the launch of GEMS is imminent, and the community would like to learn how retrievals are different or better than what we know from OMI and TROPOMI.

I recommend publication of the paper after the following issues are accounted or con-



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Discussion paper

sidered for.

Major issues

1. The paper focuses on testing the retrieval algorithm for OMI-type viewing conditions. It therefore remains unclear how the GEMS HCHO retrieval approach will account for diurnally varying measurement conditions. Surface reflectivity, HCHO profile shape, clouds will all change throughout the day, and it is unclear how these changes will affect the retrieval and their uncertainties. This is a major hiatus in this paper should be addressed.

2. Even though the instrument is still to be launched, the paper should give more information on the GEMS instrument and how its data will be explored. What is the anticipated signal-to-noise for the HCHO spectral window, or how would it compare to OMI and TROPOMI? How will the cloud retrieval from GEMS work? What surface reflectivity data will be used for the cloud and HCHO retrievals? How does the GEMS team address the issue of viewing geometry dependent surface reflectivity? These issues are not discussed, and thus the paper runs the risk of being read as just another OMI HCHO approach, i.e. of little specificity to GEMS.

3. The paper would be strengthened if the authors would provide a break up of the uncertainty budget for typical polluted and clean conditions, e.g. in the form of a table.

4. I'm missing a discussion of the GEOS-Chem 2x2.5 a priori profile shapes. These are much coarser than the 7x8 km2 viewing scenes, and this will result in a substantial AMF uncertainty. It is true that this can be accounted for via application of the averaging kernels, or by recomputing the AMFs with high-resolution profiles from a regional CTM or zoom-version of GEOS-Chem. In any case this issue should be discussed in more detail, and also included in the uncertainty budget.

5. It remains very much unclear how the latitude-bias is being determined. The text on page 11 (lines 9-11) is not clear, and the patterns shown in Figure 5(d) need explana-

tion.

Minor comments

P2, L12: suggest to remove ‘instrument’ after SCIAMACHY.

P3, L15: suggest to use air quality in the singular

P3, L16-17: compared to TROPOMI’s 7x7 km2 pixels, the 7x8 km2 resolution from GEMS is not that superior, so I suggest to nuance that statement.

P6: eq. (3) and (4) – suggest to use that mathematical e rather than exp which reads as computer code.

Eq. (15) appears wrong.

Figure 7: what are the relative uncertainties in the AMF?

Validation: which spatio-temporal selection criteria were used?

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