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Atmospheric Measurement Techniques Discussions

Interactive comment on "Tropospheric Emission Spectrometer (TES) satellite validations of ammonia, methanol, formic acid, and carbon monoxide over the Canadian oil sands" *by* M. W. Shephard et al.

Anonymous Referee #1

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The manuscript by Shephard et al. presents detailed validations of the Aura TES retrievals (including ammonia, CO, formic acid, and methanol) using airborne vertical profiles over the Canadian oil sands region. There have been few direct validations of these TES products due to various in-situ measurement challenges. The aircraft observations reported in this study were performed both coincidentally and downwind of the TES footprints, providing good validation opportunities. In addition, the validated satellite ammonia/CO datasets were intercompared with GEM-MACH air quality model. In general, this manuscript is well-written, the validation methodology is appropriate, and

it should be published after addressing the comments below.

General comments:

1. The uncertainties in the aircraft estimated comparison profile were neglected in the validation (page 9519, lines 23-25). While the instrumentation errors presented in section 2 could be averaged out, the representation errors should be more carefully discussed. Vertically, mapping the high resolution aircraft profile to the satellite retrieval levels could induce representation errors due to the turbulent nature of the atmosphere, even assuming that the measurements were accurate. Horizontally, the majority of the validated satellite pixels was not collocated with aircraft spirals, and could be up to 35 km away (more for ammonia). There could be errors due to the spatial variation of concentrations. The author briefly mentioned that the spatial variability was small for ammonia according to TES data (page 9526, lines 10-13). Is it possible to be more quantitative and estimate the related errors? The aircraft data may be a better choice to estimate the spatial scale of variability than historically satellite data.

2. During the comparison, all TES pixels seem to be treated equally regardless the spatial/temporal differences from airborne observations. The comparison errors are presumably larger for profile D (aged air mass, large spatial/temporal mismatch) than for profile A (ideal spatial/temporal match). Are there larger discrepancies (TES - aircraft) for larger spatial/temporal mismatch?

3. Are the oil sands strong sources of CO and ammonia? If so, the spatial variation long the TES transect should be substantial, because pixel 11 and 12 are immediately downwind of sources, while the other pixels cover boreal vegetation. The dispersion and losses (for ammonia) should to be considered when comparing TES profiles and downwind/aged airborne profiles.

Specific comments:

Page 9507, line 3: what are these processes of ammonia evaluated in the model-

satellite intercomparison?

Page 9508, lines 20-21: formic acid is the dominant source of what? Please clarify this sentence.

Page 9514, lines 9-11: the authors have the data to quantify the dispersion/aging processes of the air mass. Is it possible to assess the error induced by spatial/temporal mismatch?

Page 9515, line 25: does the “delay time” mean response time? If it is only a constant time delay, the measurements should be just shifted by 2s.

Page 9517, lines 7-10: the propagation of all these errors (10-15%, 5-10%, 10-15%, 10%, and < 5%) seems to be larger than 20-25%. Is it possible to show how it is propagated?

Table 1 and 2: are these volume mixing ratios of the a priori or from observations? Please clarify.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 9503, 2015.