

Interactive comment on “Estimating regional scale methane flux and budgets using CARVE aircraft measurements over Alaska” by Sean Hartery et al.

Anonymous Referee #1

Received and published: 28 March 2017

Sorry - latex error with percentages. Sepecific comment 5 is here in full without the hanging sentence....

5. P.6. Section 3.3 - Mixed layers: This relates very closely to the comment above. If mixed layer height (i.e. instantaneous local PBL height plus residual layer height) is used to derive the fluxes later on, how do you differentiate between the true PBL (which is in contact with the local surface) and the residual layer (which may represent the previous day's local PBL ventilation, or advection from a more distant regional source)? This is very confusing. The method states (page 6, line 26) that the authors use the integrated mixed-layer partial column concentration (not the vertically-resolved measurements) to calculate flux in Section 3.4. This must then surely convolve any local emissions (in the true local PBL) and non-local emission (in any residual layer). The authors later go to great lengths to show that any residual layer is not influence

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by long-range (non-regional) transport but this does not solve the problem of varying airmass histories for the true PBL versus the residual layer when these get clumped into a partial column for the purposes of the inversion. When this singular column concentration is used in STILT and coupled to the footprint described in Section 3.1 (and the issues alluded to in the previous comment), it seems impossible to deconvolve spatially-resolved flux with any true or traceable footprint sensitivity as the column represents an unknown mix of local and non-local surface contact. Again, I have a lot of sympathy (more than it may sound like) with the approach and doing the best job possible with adjoint models. But there is currently no awareness or clarity of these issues in the text which would alert the reader to the challenges and limitations in the approach. Page 7 goes on to demonstrate that 50 percent of profiles were discarded from flux analysis because mixed layers could not be reliably separated or that PBL was “over-estimated” when compared to trace gas profiles. What does over-estimated mean here, and why are the remaining profiles more trustworthy for analysis than those retained? Discarding half of the dataset to select only those data that agree with a contrived and questionable model is a little worrying. I would have liked to know more as to why >50 percent of the dataset is at odds with the model/assumptions and to know what the sensitivity to including the data might be. Can you be confident that the way the remaining 50percent has been retained hasn't led to some systematic bias in the data and model treatment?

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2017-72, 2017.

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