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Atmospheric Measurement Techniques Discussions

Interactive comment on "How well do tall tower measurements characterize the CO_2 mole fraction distribution in the planetary boundary layer?" *by* L. Haszpra et al.

Anonymous Referee #2

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Review of the manuscript: "How well do tall tower measurements characterize the CO2 mole fraction distribution in the planetary boundary layer? " by L.Haszpra et al.

The main idea presented in this paper is about using every sample point in aircraft vertical CO2 profiles as the top sampling point of hundreds of virtual towers of different heights. This ensemble of virtual towers allows the authors to discuss how to find the best instrumentation fitting for the real tall towers from where Green House Gases are measured. And to look for whose height they should have to obtain the best estimations of the PBL CO2 mixing ratios. Data were obtained from CO2 measurements of vertical profiles from 250 m to 3000m over the Tall Tower of Hegyhátsál in Hungary.

The authors used a model derived from the Virtual Tall Tower Concept for calculating a virtual CO2 profile in the PBL for every single data in the real profiles, trying to understand "how a given point measurement in the PBL relates to the entire vertical profile". Those virtual profiles estimate the CO2 concentrations at the different heights above the top of all the virtual towers. Every point in the virtual profiles is made of a lot of estimations, and it can be represented by a frequency distribution of these values (I recommend to see the nice Figure 2, as a more much clear description). The authors discuss all their results mean in relation to height of real towers and to the accuracy reached in the estimates of CO2 mixing ratios in the PBL. Among the conclusions there are useful advices on instrumentation needed at real towers too: a) have an eddy covariance system high at the tower to retrieve fluxes, b) have a good measurement of the gradients between the free troposphere and the PBL to calculate entrainment, and c) have enough instruments at different heights below the top of the tower to characterize the bottom gradient.

In fact, the paper opens full of more suggestions to be discussed. I would like highly recommending this paper for publication.

There are some minor comments to be addressed. I think figure captions need to be improved. In general the figures contents are well described in the paper text, but not enough in the figure captions. They are too much short for a good comprehension. I think on the lack of a plain description of what means "tower height" (maybe describing it as "virtual tower top height" or "aircraft measuring points height used as virtual tower top heights"). Another example is the description of Y-axis as "estimation height" that could be "height of the top of virtual towers relative to the PBL (%)".

I suggest improving the figure 2 captions too. The asymmetric frequency distributions are full of interest as they represent atmospheric (PBL) structure, and I am sure much more work can be done on them in the future. I thank the authors for the use of the median along the paper to describe these differences.

Finally it is to say aircraft campaigns often measure many air masses in the PBL horizontal transects: advection, plumes, and different convection patterns form structures we can find there. Do you think this methodology can be applied on these transects? Now is time to focus on the transect issues to expand our knowledge, like the authors have done here with vertical aircraft profiles.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 12249, 2014.