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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Emissions of methane in Europe inferred by total column measurements" *by* Debra Wunch et al.

Anonymous Referee #2

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General comments:

This paper presents a study to extract regional methane emission information from long-term, stationary, ground-based solar absorption measurements of atmospheric total columns. The observations at the five selected sites are part of the Total Carbon Column Observing Network (TCCON) and are used for verifying annual methane emissions of two state-of-the art inventories EDGAR v4.2FT2010 and TNO-MACC_III. Anomalies are computed for methane and carbon monoxide between observations at two TCCON stations considering abundances measured at the same solar zenith angle and solar azimuth angle on the same day. The pair-wise anomalies between the TCCON stations are used to calculate the slope (CH4/CO) and then infer the methane emissions considering that the carbon monoxide emissions are well known. The au-

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Discussion paper

thors conclude that both the inventories significantly overestimate methane emissions and point to a large uncertainty in the spatial distribution of country level emissions of methane. Finally, the authors highlight the importance of long-term monitoring of total column measurements and simultaneous measurements of multiple atmospheric constituents.

I have some concerns which are mentioned below in the major and minor comments section. I recommend the publication of the manuscript after these points are addressed.

Major comments:

The paper relies on a set of five stations which are distributed far apart from each other and assumes that the CO and CH4 emitted between the stations are completely measured. – Can the authors show some evidence that for the majority of the days when the airmass was sampled by an upwind station then it was a few days later also sampled by the downwind station? It also assumes that the typical emissions are consistent over time periods longer than a few days so that the CO and CH4 are advected together. – This can only be true considering that no CO is lost, is that true especially as the major source of CO in Europe is coming from the urban area? As the author points out the TNO-MACC_III CO emissions are on average 15% higher and CH4 emissions are about 2% lower than the EDGAR v4.3.1 emissions in the study area. This indicates that the variability of CO is much higher for the selected study area and its surroundings. How does this variability propagate into the emission estimates of CH4? The author partly correlates the dip in CH4 emissions in 2013 shown in Fig. 14 to the small up-tick in CO in the same year. However, there is a similar CO up-tick in 2010 but no CH4 dip can be seen in the measurement. – Any explanation?

Minor comments:

Page 4 line 6-7: but each slope for each season has

Page 4 line 13: is the reference to the fig 4 correct?

Page 5 line 33: check your argument – if winter is cold it should rather result in increased heating needs

Page 8 line 29: reference of the European Environment Agency National Database (?) missing

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