A few points remain that have not sufficiently been addressed in my opinion:

We thank the reviewer for the comments and have addressed the remaining questions below.

>>The choice was made to highlight the interannual variations of the posterior CH4 emissions using both OH fields, instead of the systematic differences. We have updated the plot as shown below for clarity.

But if the inversion is not sensitive to the mean OH level, I wonder what can be expected for its IAV. In my opinion it is still important to discuss the insensitivity of the inversion to the mean difference between the a priori OH fields.

We concur with the reviewer on this point. We have added in the manuscript that "The inversion adjusted surface emission levels given the two different prior OH fields (Fig. 2), indicating that there is not enough information to constrain the magnitudes of the sources and sinks of the three species separately with their atmospheric observations." (Line 257-259). Followed by more discussions in Section 3.3.

>>We stated in the manuscript, "This choice is made to avoid prior assumptions about the interannual variations (IAV) or trends in the surface emissions so that IAV in the posterior fluxes are primarily driven by assimilated observations." As the reviewer pointed out earlier, the posterior fluxes are influenced by the prior fluxes, which would impact the derived trends and IAV of the posterior fluxes. Therefore, a climatology prior was preferred (except for fire emissions).

The choice has been well motivated, but not the possible consequence of using a biased prior for the results that are obtained.

We have added Supplementary Table 4 to summarize the statistical comparison of growth rates in the posterior model states against the observed ones. The posterior model states captured the observed growth rate reasonably well, therefore the worry that "Depending on the weight of the prior, the solution will underestimate the trend" is not justified.

Table S4. Summary statistics of monthly growth rates comparison between posterior model states and collocated observations as shown in Figure 2b and c. Shaded area indicates that the compared observations are assimilated in the corresponding versions.

	Compared to Surface Obs (ppb yr^{-1})		**Compared to GOSAT XCH4 (ppb yr^{-1})**	
	Mean Bias	RMS	Mean bias	RMS
$S1_{Surf\_IN}$	0.44	0.96	0.03	0.45
$S1_{Surf\_TR}$	0.11	0.89	-0.33	0.65

$S2_{GOSATonly}\_IN$	0.05	1.44	-0.2	0.48
$S2_{GOSATonly}\_TR$	0.13	1.55	-0.01	0.68
$S3_{Multi}\_IN$	0.21	1.4	0.07	0.62
$S3_{Multi}\_TR$	0.01	1.48	-0.09	0.7

>>We thank the reviewer for this nice suggestion, however, adding inversion results from the six versions would make the plot too busy to read.

With a little more creativity a solution to this problem would have been found. In this case at least some discussion about this comparison should have been added in my opinion. The author's response confirms my suspicion that the comparison raises questions.

We thank the reviewer for the suggestion. We have added our inversion results into this supplementary figure S11 as shown below. In each subplot, the solid lines represent the six inversion results of this study, while the dashed lines represent bottom-up inventories that are different from the ones used in our prior (shown in S3 and S9 instead). The comparison does not raise specific questions.

We note that there are no observational constraints for the sectoral attribution of the total fluxes. Only the total methane emissions are optimized at each model grid, and the sectoral attribution relies solely on the prior knowledge. As climatology priori fluxes are used for most sectors except for fire emissions, no temporal changes in the source structures of the other sectors are accounted for. Hence, such attribution only serves as a step to understand the dominant sources of each region. The different magnitudes of posterior fluxes among the six inversions stem from systematic differences between surface and satellite observational constraints, as well as different prior OH fields (discussed in Section 4.1).

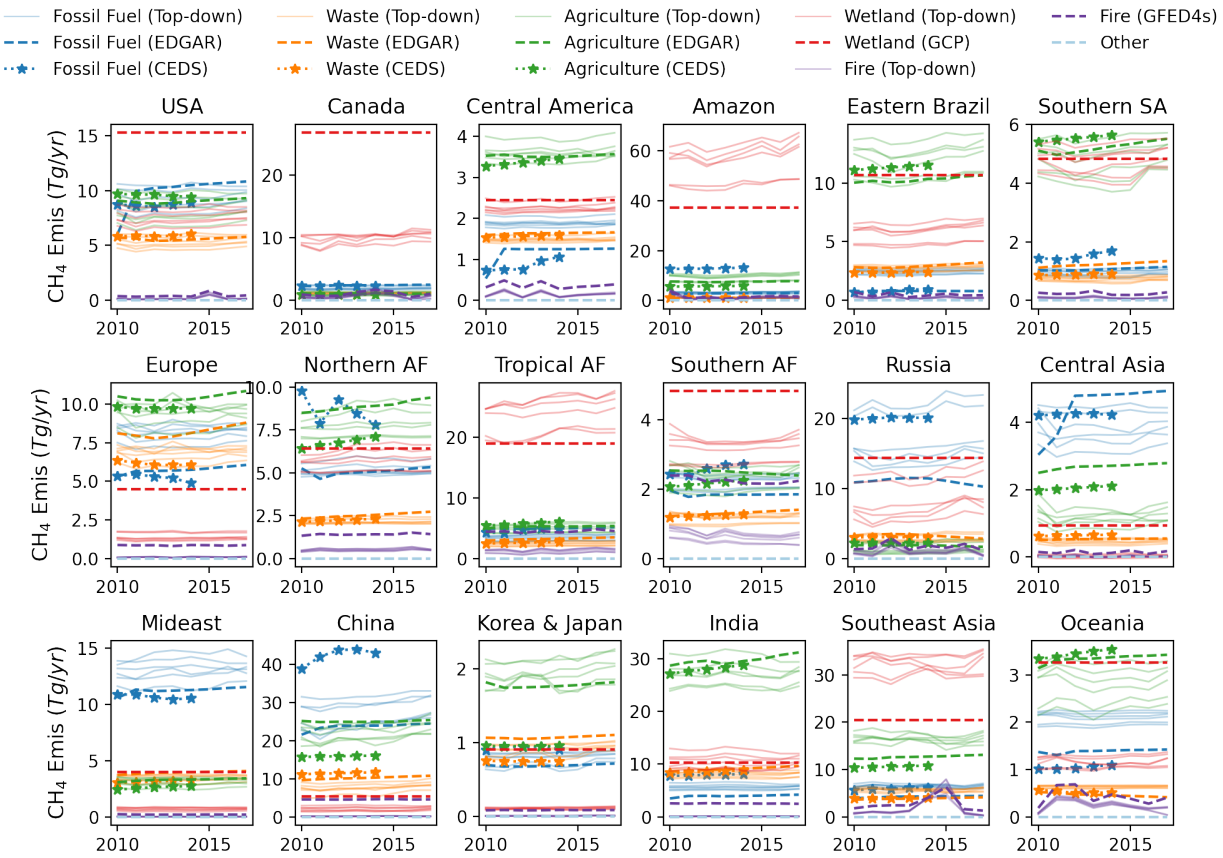

Figure S11. Regional CH_4 emission estimates from inversions and bottom-up inventories. The solid lines represent the six inversion results of this study, where sectoral attribution of the posterior fluxes depend on prior information as shown in Fig. S3. Updated bottom-up inventories are shown here for comparison. The dashed lines show regional anthropogenic emissions based on EDGAR4.3.2 (1970-2012) that are then extrapolated to 2017 using FAO statistics (Saunois et al., 20120), modelled wetland CH_4 emissions from Poulter et al., 2017, and fire emissions from GFED4s and biofuel. The stars denote CEDS (Community Emissions Data System) historical anthropogenic emission estimates updated till 2014 (Hoesly et al., 2018).