Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Prior biosphere model impact on global terrestrial CO$_2$ fluxes estimated from OCO-2 retrievals" *by* Sajeev Philip et al.

Anonymous Referee #3

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This paper investigates the impact of prior biospheric CO2 flux models on inverse estimates of terrestrial CO2 fluxes when using synthetic satellite observations. The paper is clear written and well prepared. Only some aspects are still not clear to me, as following:

1 It is concluded that "Overall, even with the availability of dense OCO-2 data, noticeable residual differences (up to ∼20-30% globally and 50% regionally) in posterior NEE flux estimates remain that were caused by the choice of prior model flux values and the specification of prior flux uncertainties". From my understanding for inverse problem, if observations contain sufficient information for the target state vector, the results should be, for large part, insensitive to prior. When it strongly depends on prior, either because satellite observations have limited information for flux inversion or the

flux inverse problem is very ill-posed. Could you explain a bit more what is the reason behind?

2 In section 2.4.8, a sanity check has been performed for all the four OSSEs. I am surprised that the check was performed with observational data uncertainty of 0.001%, which is around 0.004 ppm. What assumed is far too unrealistic, current satellite observations can only provide XCO2 observations with uncertainties >= 1.0 ppm. I can understand you do this for sanity check but I am wondering why not give identical inputs (including biosphere model) to all the four OSSEs but under a reasonable observational data uncertainty? You can check if all OSSEs can give similar results which do not have to be the truth. Otherwise, you may still interpret mode-dependent uncertainties as prior dependent uncertainties.

3 Page 10 line 6"The differences between individual model simulations of XCO2 values deviated among themselves by up to ∼10 ppm. These large differences in XCO2 values across the four-different prior NEE flux models show that the choice of prior NEE has a large impact on simulated XCO2 values." Even a very strong anthropogenic CO2 source can only introduce a few ppm variations. Are there any explanations for such a large difference?