

## ***Interactive comment on “Global atmospheric carbon budget: results from an ensemble of atmospheric CO<sub>2</sub> inversions” by P. Peylin et al.***

**Anonymous Referee #1**

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It has been a pleasure to review this manuscript. It provides a very nice overview of flux inversion results of a multitude of flux inversion systems, and is well-readable, clear and concise. The authors have done a very good job in describing the various systems, provide an overview of their differences, and summarize the results both on different spatial and time scales. It is very interesting to see that the problem that triggered setting up TransCom (the inability to compare inversion results, because they were too different) has been overcome to a significant degree. Inversion results from quite different systems start to produce comparable results. This paper is therefore very timely showing where the different systems agree and especially where they still do not agree. This information can be used to further develop atmospheric flux inversions.

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I therefore fully support publication of this manuscript, although I have some comments that I would like to see addressed.

Page 5308, lines 6-7: I would rephrase this sentence to something like: "... descent algorithm using the gradient of J at each iteration. Such computation usually employs the adjoint technique..." Page 5308, line 10: "Hessian" should be written with a capital H. Page 5309, line 2: please write "years" full, when used in a normal sentence. Page 5309, line 4: I would suggest to replace "rest upon" by "are based on" Page 5312, lines 1-4; This is true, but it should be reflected in the posterior error estimates. Observations are just one piece of information going into the problem. I think the real issue is to inform/educate users of the results how to properly interpret the values and their errors. Page 5319: My main comment on the whole paper is that I miss some information about the prior errors. This is a very important part of the inversion problem and it is needed to properly interpret the results. I would really like to encourage the authors to provide a map with some indication of the prior errors that have been used. I know different inversion systems use different prior errors, so it will be difficult to come up with one map, but if the authors can think of a way to do this, that would be very helpful. It would indicate where the prior constraint is strong and where the observations can influence the results significantly. Page 5322, lines 7-9: What was done differently in the new JENA inversion? Does this provide a clue about the noted difference of JENA with the rest? Page 5327, lines 1-4: There is also a corresponding strong ocean sink in the NICAM results. Is this related? Page 5329, lines 9-15: Did you test this trend for its significance level? It seems rather small, so it would be good to test it against the errors.

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