

Interactive comment on “Atmospheric CO₂ observations and models suggest strong carbon uptake by forests in New Zealand” by K. Steinkamp et al.

Anonymous Referee #1

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This paper presents the first regional CO₂ inversion for New Zealand. The inversion yields posterior spatiotemporal CO₂-flux distributions which are surprisingly different from the priors (calculated with the Biome-BGC model) and also different from the National Inventory Report.

My overall judgment of the paper is quite favorable, and I recommend publication with minor revisions provided the questions below can be handled satisfactory. A good use has been made of the literature, and the language needs in my opinion but very little correction. The methods are generally well-considered, though some questions remain (see below). Some details, especially the methods to solve the difficult problem of determining the “background” (influence of lateral boundary conditions for the con-

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centration) I find difficult to judge from my own experience, but I would trust them from what I have read here.

Descriptions are mostly clear and complete. Some descriptions are quite lengthy, however, and my impression is that especially the descriptions of the observations methods at the Lauder station (Appendix A), and the footprints etc. for each station, could probably be condensed. The discussion about discrepancies between posterior fluxes and inventories seems unusually comprehensive, and of great value. The discussion about the discrepancy between prior and posterior fluxes leads to the important remark that the Biome-BGC model has not been tested for New Zealand conditions, which is a subject which may deserve more emphasis than it gets now in the paper.

Specific comments

Page 5, lines 24-27: It is a bit odd that the observation time (with respect to the mean solar time) differs between summer and winter ! To my knowledge, this is unusual. Can it cause a bias in the annual course of the fluxes ?

Page 10, lines 23-25: crops cover a small area, but does this imply that their contribution is small ? They might still contribute at certain times if their flux density is high.

Page 11, line 28: Are the fossil fuel emissions taken time-independent within the years ? Emissions from heating etc. depends on the season.

Page 16, lines 11-12 (and also page 18, lines 16-17): Does this mean that the time-dependency of the fluxes within the week is neglected ? If so, wouldn't this lead to systematic errors (of the kind of rectifier errors or something like that) ? If not, where is the time-dependency described ? This is an important question.

Page 19, line 2: “We excluded the ocean prior”: How is this done exactly ? The description is unclear.

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Page 19, lines 4-29: This text is so long that it would be logical to make a separate numbered subsection of it.

Page 26, line 1-3: Add more about the background of these findings.

Page 26, lines 21-23: Unclear piece.

Page 27, lines 24-25: Does this hold for all regions ?

Page 28, lines 9-12: I don't understand this. It would seem that with a deeper PBL, the diurnal course in CO₂ concentration would be smaller, hence afternoon concentration would be *higher*. Or does neglecting of the diurnal course of the flux play a role here ?

Page 29 end-30 begin: A fuller explanation is found on page 22, line 20, and I suggest to include this also here because it is important for anyone doing research with the biome model. I would also recommend to mention it in the abstract.

Page 44, Table 1: (1) The division into north/south and east/west is not shown in the figures; (2) Only posterior results are given here, it might be interesting to show priors too.

Small corrections

Page 17, line 14: instead of "equivalent" I would use "similar" as "equivalent" is a very strong term in mathematics.

Page 25, line 22: add comma after "eddy-covariance".

Page 44, Table 1: "parantheses" should be "parentheses".

Page 50, figure 8: I don't understand the interior legend for the black color (it seems to pertain to Australia).

Page 53, figure 11: "per area fluxes": I would prefer "flux densities" (also page 24, line 2).

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