

## ***Interactive comment on “Spatial distribution of $\Delta^{14}\text{CO}_2$ across Eurasia: measurements from the TROICA-8 expedition” by J. C. Turnbull et al.***

### **Anonymous Referee #1**

Received and published: 6 September 2008

#### General comments:

The paper presents observations of delta  $^{14}\text{CO}_2$  in air samples collected along the Trans-Siberian railway. The observed east-west gradient is attributed mainly to fossil fuel  $\text{CO}_2$  emissions in the European area, which are transported and gradually dispersed eastward across Eurasia. The delta  $^{14}\text{CO}_2$  measurements along the track and in particular their variability are discussed in detail using also additional information from other (simultaneously observed) trace gases and trajectory analysis to explain and reject outliers. The selected delta  $^{14}\text{CO}_2$  observations are then compared to model simulations of  $^{14}\text{CO}_2$ . The simulated large-scale gradient across Eurasia agrees quite well with the observations. In the model this gradient seems to be more sensitive to vertical mixing than to uncertainties in fossil fuel  $\text{CO}_2$  emissions.

Although it is demonstrated in the paper that the gradient of fossil fuel CO<sub>2</sub> across Eurasia can be inferred from the observations of <sup>14</sup>CO<sub>2</sub>, it still remains open whether reductions (or increases) in fossil fuel emissions could be identified from this type of measurements (if they would be repeated regularly), given the small size of the signal. It would be helpful if the authors could comment on this in their conclusions.

The paper is well written. Measurements, model set-up, and results are presented in a structured and clear way. The measurement method and data selection procedure are described with the necessary amount of details. Also the modelling section is clear and detailed with respect to the implementation of <sup>14</sup>CO<sub>2</sub> in the TM5 model.

The manuscript is suitable for publication in ACP and I suggest only some minor revisions.

Specific comments:

Page 15208, line 4: ...can be used to constrain fossil fuel emissions... might be more logical 'to constrain fossil fuel emission estimates'

Page 15209, line 24: ... disequilibrium between the oceans (and to a lesser...) dominated... please insert 'and the atmosphere' before 'dominate' to make this sentence clearer

Page 15214, line 12: Please specify whether you use the CO<sub>2</sub> fluxes provided by Takahashi et al. or the pCO<sub>2</sub> values. In the latter case please specify which gas transfer formulation was used.

Page 15214, line 23: How is the <sup>14</sup>CO<sub>2</sub> background in Eq. 1 determined? Is it an arbitrary offset value or is the model integrated over a very long time or...? Please specify this.

Page 15215, line 20: Do you use the same gas transfer formulation for <sup>14</sup>CO<sub>2</sub> as for CO<sub>2</sub>?

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Page 15216, line 25: This is difficult to understand, please clarify why net  $^{14}\text{CO}_2$  fluxes are necessarily zero.

Page 15223, line 27: Actually one would expect that the gradient should scale linearly with the emissions if there is a linear relation between fossil fuel  $\text{CO}_2$  and  $\Delta^{14}\text{CO}_2$ . Please try to explain why this is not the case.

Technical corrections:

Page 15209, line 2: better use yr instead of y (like in the rest of the manuscript), put mean lifetime... in parentheses

Page 15210, line 1: base all numbers on (Marland et al., 2006), delete redundant reference Marland et al., 2003

Page 15213, line 17: ... sample uncertainties range from...

Page 15216, line 17 and Page 15217, line 7: either reference for (Krol et al., 2004) missing or should be (Krol et al., 2005)

Page 15223, line 11: Is the horizontal resolution of TM5 6x4 or 4x6 as stated on Page 15214, line 10 ?

Page 15224, line 19: (Marland et al., 2006) to be consistent with Page 15211, line 18

Page 15224, line 27: ... $^{14}\text{C}$ -free derived fossil fuel ... please remove 'derived'

Page 15230, line 12: check spelling of authors' names

Page 15230, line 14: ...Atmos. Environ. ...

Page 15231, line 4: please correct doi

Fig. 1: please mark the exact location of the cities by a dot or a small cross so that it would be easier to see their distance to the railway line

Fig. 4: delete (you may...)

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