

Interactive comment on “The influence of $^{14}\text{CO}_2$ releases from regional nuclear facilities at the Heidelberg $^{14}\text{CO}_2$ sampling site (1986–2014)” by Matthias Kuderer et al.

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This paper describes a new modelling study that evaluates the influence of local (<100 km distant) nuclear power plant ^{14}C emissions on $^{14}\text{CO}_2$ measurements at Heidelberg, Germany. They transport detailed reported emissions from the nearby power plants using the HySPLIT model at several different meteorology resolutions. They identify which power plants contribute significantly to $^{14}\text{CO}_2$ at Heidelberg, and how that varies through time. The results show that higher resolution meteorological fields are helpful in evaluating the influence of point source emissions such as these. More importantly, they show that when looking at individual sites with nearby nuclear ^{14}C

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sources, annual or monthly emission data may be insufficient.

This paper has a well-defined topic that is clearly explained, it is well-written, and the results are clear. It is a nice contribution to the literature and will be particularly relevant to the atmospheric ^{14}C community. I have only a few extremely minor comments to clarify particular points, and recommend that this paper be accepted with these very minor changes.

Specific comments: Pg 2 line 3 and Pg 3 line 1-2. You say “in order to quantify the $^{14}\text{CO}_2$ signal”, but I think you mean to say “in order to quantify the fossil fuel CO_2 signal”. The $^{14}\text{CO}_2$ signal naturally includes all sources including nuclear contributions, it is the fossil fuel CO_2 calculation that needs to be adjusted to account for nuclear emissions. Pg 2 line 14. Naegler and Levin 2009 and Graven 2016 are not in the reference list. Please check referencing throughout. Also, please use hanging indents or numbering for the reference list to make it easier to scan through. Pg 2 line 22. I am not sure that “contaminate” is the right word, “influence” would be better. Pg 2 line 22-24. There are a number of studies that have looked at ^{14}C emissions from nuclear power plants, please reference some from research groups other than your own. For example: Povinec, P.P., Chudáň, M., Šivo, A., Šimon, J., Holáň, K., Richtáriková, M. Forty years of atmospheric radiocarbon monitoring around Bohunice nuclear power plant, Slovakia(2009) *Journal of Environmental Radioactivity*, 100 (2), pp. 125-130. Dias, C.M., Santos, R.V., Stenström, K., Nicoli, I.G., Skog, G., da Silveira Corrêa, R. ^{14}C content in vegetation in the vicinities of Brazilian nuclear power reactors(2008) *Journal of Environmental Radioactivity*, 99 (7), pp. 1095-1101. Koarashi, J., Akiyama, K., Asano, T., Kobayashi, H. Chemical composition of ^{14}C in airborne release from the Tokai reprocessing plant, Japan (2005) *Radiation Protection Dosimetry*, 114 (4), pp. 551-555. Stenström, K., Erlandsson, B., Hellborg, R., Wiebert, A., Skog, S., Vesanen, R., Alpsten, M., Bjurman, B. A one-year study of the total air-borne ^{14}C effluents from two Swedish light-water reactors, one boiling water- and one pressurized water reactor(1995) *Journal of Radioanalytical and Nuclear Chemistry Articles*, 198 (1),

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pp. 203-213. Uchrin, G., Hertelendi, E., Volent, G., Slavik, O., Morávek, J., Kobal, I., Vokal, B. ¹⁴C measurements at PWR-type nuclear power plants in three middle European countries(1998) *Radiocarbon*, 40 (1), pp. 439-446. Pg 4 line 5-8. Please include references to back the statement that BWR reactors mostly emit ¹⁴CO₂ whereas others emit ¹⁴CH₄. Table 1. Please include references for the information shown in the table. Pg 8 line 21-28. Are there previous studies that examined the performance of HySPLIT with met data at different resolutions? What did they conclude? Pg 11 line 5 and throughout. Through most of the paper, the nuclear facilities are identified by their names – “Phillipsburg”, etc. Here they are identified by the 3 letter codes, which are particularly confusing since KPP is not obviously the same place as Phillipsburg. Choose either the names or 3 letter codes and stick with them throughout the text. Pg 14 lines 1-10. I agree that the detailed emissions and LaGrangian model used in this paper give more detail (and more variability) than Graven and Gruber showed in their earlier paper. Yet a little more nuance in this paragraph would be helpful. In cases where nuclear facilities are nearby and have a strong influence, the detailed studies such as this one will be necessary. But for continental-scale studies looking at monthly or annual resolution, the gridded datasets provided by Graven and Gruber will likely be sufficient – and in many cases, it may be difficult to get more detailed information, so the Graven and Gruber dataset may still be the best choice.

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