

Replies to Referee #1, Jocelyn Turnbull

We wish to thank Jocelyn Turnbull for her comments and suggestions for changes; we have revised the manuscript as follows (our answers are given in blue in the text below)

This paper describes a new modelling study that evaluates the influence of local (<100 km distant) nuclear power plant ¹⁴C emissions on ¹⁴CO₂ 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 ¹⁴CO₂ 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 ¹⁴C. 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 ¹⁴C 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 ¹⁴CO₂ signal”, but I think you mean to say “in order to quantify the fossil fuel CO₂ signal”. The ¹⁴CO₂ signal naturally includes all sources including nuclear contributions, it is the fossil fuel CO₂ calculation that needs to be adjusted to account for nuclear emissions.

This is absolutely correct, we have changed the wording correspondingly.

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.

Thank you for pointing this out. We have added the references. Concerning formatting, it is not our choice but the Copernicus word template, which asks for this formatting, which I also find very unpractical ...

Pg 2 line 22. I am not sure that “contaminate” is the right word, “influence” would be better.

From our point of view it is a “contamination”, and we would like to keep this expression, as “influence” is very unspecific.

Pg 2 line 22-24. There are a number of studies that have looked at ¹⁴C 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., Nícoli, I.G., Skog, G., da Silveira Corrêa, R. ¹⁴C 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 ¹⁴C 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 ¹⁴C 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), 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.

We added as references Uchrin et al., 1998 and Povinec et al., 2009.

Pg 4 line 5-8. Please include references to back the statement that BWR reactors mostly emit ¹⁴CO₂ whereas others emit ¹⁴CH₄.

We added the original reference from Kunz, 1985

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?

There have been earlier studies using HYSPLIT with differently resolved meteorological data, such as the one cited (Su et al., 2015, *Science of the Total Environment* 506-507, 527-537) however, their findings were not directly applicable to our problem.

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.

We have removed the 3 letter codes in the text and use now only real names of the facilities

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.

We do not fully agree to the reviewer: We rather think that a coarse-resolution Eulerian model, similar to that used by Graven and Gruber, is not able to provide reliable results, neither in the near (10s of km) nor in the far field (few 100s of km), simply because - with a spatial resolution of 1.8° x 1.8° - it is principally not suited to simulate properly dispersion from a point source. It may be valuable to estimate the (very diluted) signal at the scale of 1000 km or so. Therefore, we think that for a reliable correction for nearby NPP contamination either a simple (“high-resolution”) Gaussian plume approach (up to 10 km) or a high-resolution Lagrangian model is needed, preferably with higher resolution wind fields than used in the current study.