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Geoscientific Model Development Discussions
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Interactive comment on "On the model uncertainties in Bayesian source reconstruction using the emission inverse modelling system FREARtool v1.0 and the Lagrangian transport and dispersion model Flexpart v9.0.2" *by* Pieter De Meutter et al.

Anonymous Referee #1

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The proposed manuscript presents important question regarding uncertainties associated with inverse modelling problems for unknown atmospheric releases. It is used ensemble approach which is applayed to the ruthenium 106 case from 2017. The study is interesting and clear to read, but more questions remain in conection with the selected case and its suitability for the cause. Although the goal of the paper is not to find the origin of the ruthenium in 2017, the estimated probability regions of the release far from the actual release site need more discussions. It is difficult to draw and to

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Discussion paper

follow conclusions based on results inconsistent with state-of-the-art knowledge about the ruthenium case. Perhaps, wider ruthenium dataset or another case with known location and known release profile could be more appropriate for this type of study.

Specific comments:

Although there is dataset with hudreds positive measurements regarding Ru-106 case in 2017 available (Masson et al., 2019), the authors choose data from 5 locations with 12 positive measurements. This is quite suprising and authors should comment this. Moreover, the choice of CTBT stations seems problematic in this case since the main activities have been observed around Mayak and then south-west-wind in Ukraine, Romania etc. (Masson et al., 2019). Hence, my opinion is that the used data can contain rather fractions of information about the release and the results are dominated by the fact that the release period is preselected in the algorithm. This is probably closely related also to the fact that the probable location, Mayak, is not estimated within the probability region in any case (in fact, Dimitrovgrad is much more probable in all cases). This should be discussed in the paper.

p. 6, l. 131: The authors claimed that "the release rate is assumed constant during the release period". This assumption seems to be quite strong since the release rate may vary and, in this particular case of Ru-106 release, did vary during the time as estimated by e.g. (Saunier et al., 2019). Is this assumption necessary and what is the impact of it?

p. 6, l. 141: The authors assume that "the release is assumed to have occurred between 25 September 2017 0000 UTC and 28 September 2017 0000 UTC", however, the release was estimated before e.g. in (Saunier et al., 2019; Western et al., 2020). Could you, please, comment this choice?

p. 6, l. 154: The Currie critical threshold, L_C, is used extensively in the paper. Could you please briefly explain basics about this value?

p. 9, l. 203: σ_{obs} seems to be fixed in your scenario. Do you have uncertainties associated with measurements? How are these uncertainties related to this σ_{obs} value?

Technical corrections:

It is not necessary to have new paragraph after each equation. The abraviation FREAR (in title) is not used and define in the manuscript. p. 8, l. 189: consider to remove "used". p. 10, l. 219: there is no s_i in Eq. (13), please, clarify. Sec. 4.1: you should specify that this is related to the Fig. 3, LEFT.

Literature:

Masson, O., et al.: Airborne concentrations and chemical considerations of radioactive ruthenium from an undeclared major nuclear release in 2017, Proceedings of the National Academy of Sciences, 116:16750–16759, 2019.

O. Saunier, D. Didier, A. Mathieu, O. Masson, and J.D. Le Brazidec. Atmospheric modeling and source reconstruction of radioactive ruthenium from an undeclared major release in 2017. Proceedings of the National Academy of Sciences, 116(50):24991–25000, 2019.

L.M. Western, S.C. Millington, A. Benfield-Dexter, and C.S. Witham. Source estimation of an unexpected release of Ruthenium-106 in 2017 using an inverse modelling approach. Journal of Environmental Radioactivity, 220:106304, 2020.

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