

Interactive comment on “Separation of biospheric and fossil fuel fluxes of CO₂ by atmospheric inversion of CO₂ and ¹⁴CO₂ measurements: Observation System Simulations” by Sourish Basu et al.

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The study presented here by Basu et al. investigates the potential of an inversion framework when assimilating ¹⁴CO₂ and CO₂ using an Observation System Simulation. The authors describe their pseudo-data experiment thoroughly and concisely. The design parameters are driven by previous suggestions to expand the ¹⁴C observing network to improve the capability to estimate annual total fossil fuel CO₂ emissions from the contiguous United States. The assumptions for the modelling framework seem all very well-founded in experience and previous research in this field. Although not all

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aspects of errors and error correlations are discussed in detail this study is definitely a clear step forward. The topic i.e. using independent measurements to assess reported national GHG emissions is timely and presented in a very clear way. Both the quality and topic are well suited for ACP and I fully recommend publication, as is.

Minor comments: Page 3 equation (1b) Please consider that the mass-balance for ¹⁴CO₂ is only valid for d¹⁴C not D¹⁴C. The author discuss the issue of d¹³C corrections impacting D¹⁴C this confusion ca be avoided putting the mass balance for ¹⁴CO₂ and then mentioning the assumptions made to arrive at a mass balance for D¹⁴C. e.g. <https://journals.uair.arizona.edu/index.php/radiocarbon/article/downloadSuppFile/16347/212> The impact of the approximation in (1b) seems negligible.

Page 16/17 conclusions The authors briefly discuss the potential impacts of model transport errors (investigated in section 4.3) and the added value of measurements of auxiliary species. Would you be able to advise on how much more model improvement is needed i.e. should this be an equally/less/more important part of developing the suggested future emission monitoring system?

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