

Interactive comment on “Comparison of four inverse modelling systems applied to the estimation of HFC-125, HFC-134a and SF₆ emissions over Europe” by Dominik Brunner et al.

Anonymous Referee #2

Received and published: 13 March 2017

The paper by Brunner et al. reports on the inverse estimation of hydrofluorocarbon (HFC) and SF₆ emissions in Europe exploiting the respective atmospheric concentrations variability measured at three monitoring sites. Four state-of-the-art inverse modelling systems are compared with respect to their performance in modelling the observed concentrations and with respect to their consistency in inverting surface fluxes. The model-median emissions are then discussed for country-wide regions and compared to reported bottom-up inventories.

The study contributes important insight into model performance for providing top-down constraints on anthropogenic greenhouse gas emissions. Comparing the top-down emission estimates to bottom-up inventories yields significant discrepancies for some

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European countries which indicates that more research is required to consolidate emission reporting and verification.

The paper is very well written, the methods are state-of-the-art, and the topic is interesting for the atmospheric sciences community. Therefore, I recommend publication after addressing my few comments below.

The conclusions on country-wide emissions appear somewhat unconsolidated given that the model-to-model differences are as large as the estimated emissions for some countries (e.g. Figure 12). While I accept the approach to use model versions that are as close as possible to the respective production settings, it is quite unsatisfying that the reasons for these model differences are essentially unresolved. In that context, I am also not convinced by using the model median value (of only 4 models). I would suggest making abstract and conclusions somewhat humble by adding some more discussion on how the discrepancies between bottom-up and top-down emissions compare to model differences.

A detail that came to my attention is that the release height for the particles at Jungfraujoch was adjusted for the NAME model to match the FLEXPART footprints. Essentially, this adjustment appears arbitrary and contradicts the general philosophy to use production settings for each model. If the adjustment was not made (transport induced) model differences would be even larger. So, given that (at least one of) the transport models are not able to correctly model transport at the mountain sites, how confident are you with respect to your overall conclusions?

P2,L24: regulated reported -> reported

P9,L6 and following: Occasionally, I got confused by the naming conventions. I would suggest using NAME and FLEXPART when referring to transport issues and the others names when referring to the entire modelling systems: P9,L6: UKMO -> NAME, P9,L13: NAME->UKMO, check other places.

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