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Interactive comment on "On the potential of ICOS atmospheric CO_2 measurement network for the estimation of the biogenic CO_2 budget of Europe" *by* N. Kadygrov et al.

Anonymous Referee #2

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Top-down/inverse estimation of CO2 surface fluxes largely depend on the quality of forward model transport and density of atmospheric measurement network. This study present idealistic tests of CO2 measurement network over Europe. They have used various scenarios of ICOS infrastructure. The topic of this is study is appropriate for ACP(D). However, I not sure how much of an impact this study will leave in the mind of scientists who are developing the ICOS network. Some of the ICOS project members are probably involved as coauthor. I am not convinced that this manuscript brings significant knowledge on how to optimally extend a regional measurement network. I get a feeling that the best network optimisation policy is to fill up the gaps (Section 3.2).

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However, I am not against publication of this manuscript in ACP. The authors have put large amount of resources to come up with reasonable conclusions.

Some of the common problem remains in the manuscript.

1) In my opinion bias is the major in CO2 inverse modelling, even for the surface measurement sites. For example you choose to select data differently for inversion, depending in the site location, i.e., mountain vs valley. Actually, this introduced an "unknown" bias. This could be checked, say, by using data for all day vs afternoon or nighttime only.

2) Although this paper is mostly about 'surface network' optimisation, it doesn't cite early works in the field going back to 1990s. It would be interesting to get a review of how this paper is different from the earlier optimisation tools, methods, and results. I understand that this paper is regional and the earlier papers did global analysis.

3) There are many other claims, I did not feel comfortable with (a couple are listed):

-Furthermore, its complex terrain also requires a high resolution of the topography when modeling the atmospheric transport (Peters et al., 2010).

there are older regional modelling paper papers more appropriate here.

- Broquet et al. (2013) have demonstrated, based on comparisons to independent 5 flux tower measurements, that there is a high confidence in the Bayesian estimate of the European NEE

in statistical sense, yes may be, but not at the level of carbon budget. check out the results of European CO2 fluxes estimated by three of the papers you cite (Roedenbeck, Peters, Chevallier).

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 14221, 2015.

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