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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Inter-comparison of Atmospheric Trace Gas Dispersion Models: Barnett Shale Case Study" *by* Anna Karion et al.

Anonymous Referee #2

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General remarks This is an expert study of a difficult and important problem. The paper is well written and the logic is clear. It should be published, and only very minor revision is needed.

Quantifying trace gas fluxes by using atmospheric measurements around known and unknown sources is very difficult. The problem is extremely important, especially for greenhouse gases. Mitigating emissions, especially methane, will depend on prioritizing the sources to be targeted, for example in a gasfield, so that the most cost-effective reduction measures can be carried out. But the problem is that it is very difficult to get accurate flux estimates from airborne (and indeed, also vehicle-borne) atmospheric measurement, so it is hard to quantify and thus rank emissions.

Karion et al. address this important problem by comparing a variety of modeling ap-

proaches, testing them against observational data, and seeking out the weaknesses in the different modeling approaches. The focus is on methane. This is an extremely important problem. There is a substantial gap, both globally and in major emitting regions, between bottom-up inventories of emissions and top-down flux quantification. Curiously, globally the bottom up estimates are much higher; regionally, top-down assessments tend to be greater.

The paper begins with a strong introduction to the problem: most current flux assessments rely on very simple mass balance methodologies, and are likely both imprecise and inaccurate. Karion et al. investigate the use of meteorological and tracer dispersion models, tested against observations. In particular, they find that the models differ substantially in their vertical dispersion, and their work points to the need for better understanding of vertical mixing in calculating regional inversions.

Karion et al. are fortunate in their wealth of observational data and in the power and choice available for their tracer dispersion modeling. Most teams studying this problem worldwide, especially in tropical countries, do not have access to these sophisticated techniques. Aircraft are expensive but UAV measurement by grab-bag or lofted hose is becoming feasible, and simple HySPLIT trajectory analysis becoming accessible even to school-project landfill studies in tropical Africa. With luck, as UAVs evolve and dispersion models become more accessible, work such as this study by Karion et al. will lead eventually to the spread of accurate modeling by less resourced teams in less-developed regions. Eventually, that may close the top-down vs bottom-up gaps.

The study is well defined, the methodology is well explained, the analysis is thorough, and the findings are both convincing and useful. The paper should be published with minor changes.

Trivial points Page 4 Section 2.1 line 1. Figure 1 shows the regional map, or the map of the region, not the "region map". Page 9 line 7 give the year for Karion et al. References: generally, use et al. when there is a telephone book of austhors. For Lauvaux

et al. and also for Pillai et al, use CO2, not format script. For Stein et al, decapitalise title.

Conclusion Accept, after very minor technical revisions

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