Response to David Lyon.

Referee comments are in ***red italics***, our responses are in black text.

The observed increase in methane and ethane emissions may be partially attributable to decreased oxidation of methane and ethane by soil microbes. The surface flux of natural gas leaks can be reduced by microbial oxidation. GRI/EPA 1996 reports up to 40% of leak emissions can be oxidized within the soil. Several factors including moisture content and temperature affect the methane oxidation rate of the soil microbial community. Van den Pol-van Dasselaar 1998 report that methane oxidation in sandy grassland soils is highest at intermediate soil moisture and ceases below 5% moisture content. The severe, extended drought in southern California since 2012 might cause local distribution emissions to increase if inhibited microbial oxidation allows a greater fraction of underground leak emissions to reach the surface. It is possible that decreased microbial oxidation may also increase emissions from geologic seepage and biogenic sources. I recommend that you address this issue in your discussion.

http://link.springer.com/article/10.1007/BF00425043
https://www.epa.gov/gasstar/documents/emissions_report/9_underground.pdf
http://link.springer.com/article/10.1023/A:1004371309361
http://droughtmonitor.unl.edu

We thank Dr. Lyon for bringing this issue to our attention. It seems likely to be a small effect. A brief discussion has been added to the paper:

Droughts such as the one plaguing Southern California since 2012/2013 [Swain2014,Griffin2014] can reduce the ability of soil microbes to remove methane and ethane released underground into the soils [vandenPol-vanDasselaar1998,Adamse1972]. The constant CH4 emissions and growing C2H6 emissions since 2012 would require a compensating decrease in biogenic emissions of CH4 to offset this effect. However, biogenics are reported to have decreased by about 1% between 2012 and 2014 [CARB], so this effect is likely to be small.