

Interactive comment on “Variability and quasi-decadal changes in the methane budget over the period 2000–2012” by Marielle Saunois et al.

Anonymous Referee #1

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Comment on Saunois et al: Variability ...in the methane budget

General This is a valuable update analysis of the GCP dataset used in the earlier 2016 paper by Saunois et al. This paper now focusses on understanding what is driving variability in methane mole fractions. This work is detailed and thorough, and is a valuable contribution to understanding what causes variability. The key ‘missing factor’ in the paper is a discussion of the impact of variability in the methane sinks. This gap is acknowledged, but could perhaps be discussed in more detail and paid more attention in qualifying the validity of the results. That said, the paper’s implication that a step-change took place in 2006-8 (page 12, line 19) is very interesting and will need much future testing. A key factor not really discussed in much detail in this paper is

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the time-response factor – how quickly do latitude-zonal methane mole fractions and particularly isotopes respond to a change in either sources or sinks?

Overall this paper is a valuable contribution and should be published with minor revision.

Specific Points Page 3 line 6 – models are not really ‘data’. Line 9 – mention sinks? Line 24 – inconsistency with isotopes needs a little more highlighting here? Line 30 – This is the major weakness in the analysis and needs a bit more explanation. Page 4 Line 13 – maybe mention destruction of methane in caves/karsts, as it could be large? Line 19 – mention Rigby et al and Turner et al 2017? Line 34 – no trends from wetlands? – this is surely a very counter-intuitive finding given the enormous amount of water transferred onto the land in 2011, so much that the oceans fell (Boening et al, GRL, 39, L19602 ? Page 5 Line 14 – note Sherwood update of isotopic signature, 2017. Line 17 – agreed: ethane/methane is very uncertain and the source ratios may have changed greatly as the energy sources have changed. Line 21 – Rigby et al? Turner et al? Page 6 Line 13-14 – note that there is important seasonal, regional and latitudinal zonal information in the isotopes: cows - India; wetlands - SH S. America. Line 22 – OH – this is the missing elephant in the paper. Page 7 Line 10 – The problem with taking 2000-2012 is that the modelling may effectively seek to smooth over the really sharp year-on-year meteorological changes in the 2007-2011 period. Page 9 Line 18 – typo ‘anomalies ...shows’ Page 10 Line 4 – note that gas use and coal use are heavily and variably dependent on meteorology – cold winter heating in China, or coal/gas fuelled electricity demand for air conditioning in the US and southern China in hot weather, etc etc. Line 19 – are cow populations in very cattle-rich Kenya, South Sudan, Cameroon, etc etc ‘relatively stable?’ – I doubt it. Are African cow populations increasing continuously? In Zimbabwe for example, cattle populations crashed in 2014. Page 11 Lines 1-10– all this assumes OH, soil sink, CI destruction are not major factors. Line 16 – note the major reorganisations in the Chinese coal industry, and modernisation from many small gassy mines to fewer mines with better safety control

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(methane). Line 19 – dry years in tropics Line 34- note Levin et als comment on Kai et al. Page 12 Line 3 – the problem of priors being EDGAR-dependent. . .could be discussed more? Line 13 – English problem – leads (?us) robustly to infer” Line 19 – key point of the whole paper. . .step change. Page 13 Line 5 – note major coal industries in S Africa and Australia, and major Australian gas industry. Line 9 – lack of tropical observations – point also made by Bousquet et al some years ago – needs emphasis. Line 20 – choice of month – indeed. Page 14. Line 6 – N America: important point, needs emphasis. Line 14 – Arctic – another important point, needs emphasis. Line 18 – ditto. Page 15 Line 5 – this is very counter-intuitive given the flooding in Bolivia and the Amazon flows! Line 30 – maybe earlier estimates are over-dependent on production figures, and does not consider modernisation of mines. See also P 17 L7, which seems more realistic. Page 16 Line 4 – 2006-8 step change again. Line 15 – wetland variability near-zero?? Puzzling, given the la Nina 2011 flooding. – (also discussed on P 17 line 23: maybe it would be an idea to gather all this together?) Page 18 Line 32-33 – see new Sherwood inventory (ESSD 2017) Page 19 Line 14 – typo 20002 Line 20 – also better latitudinal information, especially in the tropics. Page 20 Line 6 – it is not clear that fracking in 2017 is now a major growth factor in emissions. Perhaps the opposite is happening. Various studies imply the frackers have really cut their gas losses in the past few years. Line 20 – ‘even less changes’ – clumsy English. Maybe rewrite whole sentence to make it clearer? Also Line 25 could be in clearer language, especially as it is an important sentence.

Conclusion

This is a valuable and interesting analysis of causes of variability. It does not properly address the sink problem, but nevertheless, once that gap is clearly acknowledged, it is a useful and significant contribution that should be published with minor revision.

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