

Interactive comment on “Inverse modeling of GOSAT-retrieved ratios of total column CH₄ and CO₂ for 2009 and 2010” by S. Pandey et al.

Anonymous Referee #2

Received and published: 24 March 2016

General comments.

The study by S. Pandey and coauthors reports inverse modeling experiments testing use of the GOSAT-retrieved ratio of methane and carbon dioxide column average concentrations for inverse modeling of both CO₂ and CH₄ surface fluxes. The manuscript does present new results of considerable interest, and can be accepted with a minor revision. Technical correction and proofreading is needed as there are many mistypes.

Detailed comments.

The ratio in hand is composed of 2 variables that vary very little around mean values. Linear expansion around mean state will transform the difference to a linear combination of XCO₂ and XCH₄, that is $d(XCH_4/XCO_2) = (dXCH_4 - dXCO_2 * XCH_4/XCO_2)/XCO_2$.

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Given the ratio of column mean concentration around 400/1.7 ppm/ppm, XCH₄ gets about 200 times higher weight in the linear combination of the two. Mysteriously, the ratio of the XCO₂ and XCH₄ errors is about same order (2/0.012 ppm/ppm), so the correlated parts of the errors are largely cancelled in ratio. On the other hand, ratio of surface fluxes is in order of 10/0.3=30 for anthropogenic (according to EDGAR data), and 9/0.2=18 GtC/GtC for natural fluxes (growing season net flux by Randerson et al. 1996; wetlands in Melton et al. 2013). Thus, we have ample imbalance of 6-10 times in favor of methane in terms of signal to noise ratio for sensitivity of XCH₄ to XCO₂ ratio to surface fluxes. Accordingly, use of a retrieved ratio for CH₄ flux inversion is better justified than application for CO₂ flux inversion. That makes results of this study interesting to look in. In particular, latitude dependent XCH₄ bias contributed by combination of model (stratosphere) and retrieval biases comes in place of reduced aerosol and cloud effects. It would be useful to add discussion on the contribution of the methane XCH₄ biases to CO₂ inversion constrained by XCH₄/XCO₂ ratio.

Technical corrections.

Page 01- Line 03 Putting here "biased" instead of "heavily biased" would suffice, referring to current state of retrievals.

02-17 and 02-25 Lists of papers are similar, likely to present same information twice, better to put some distinction. Adding Deng et al ACP 2014 and Maksyutov et al ACP 2013 may be useful for completeness.

02-31 "two types of retrieval methods" can be used in place of "two retrieval methods"

03-21 (Fraser et al., 2014) -> Fraser et al., (2014)

04-27 As- sessment -> Assessment

04-26 right spell should be v.4.2 FT2010

05-01 onJacobson -> on Jacobson

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05-12 adding reference to Remotec (Butz?) would help here.

08-04 GOSAST -> GOSAT.

08-20 Should ppm/ppm be used in place of ppb/ppm?

09-01 Units of table 1 need more explanation. Text says it is percentage difference weighted with GOSAT+TCCON error, the value doesn't look like percentage.

25-01 inChevallier -> in Chevallier

28-31 In the reference list initials like A. are appearing as a. in multiple locations.

References.

Randerson, J. T. and coauthors, Substrate limitations for heterotrophs: Implications for models that estimate the seasonal cycle of atmospheric CO₂, *Global Biogeochem. Cycles*, 10(4), 585–602, doi:10.1029/96GB01981, 1996.

Melton, J. R., and coauthors, Present state of global wetland extent and wetland methane modelling: conclusions from a model inter-comparison project (WETCHIMP), *Biogeosciences*, 10, 753-788, doi:10.5194/bg-10-753-2013, 2013.

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