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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Inverse modeling of GOSAT-retrieved ratios of total column CH_4 and CO_2 for 2009 and 2010" *by* S. Pandey et al.

Anonymous Referee #2

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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(XCH4/XCO2)= (dXCH4-dXCO2*XCH4/XCO2)/XCO2.

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

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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