Reply to Interactive comment on "Variations in global methane sources and sinks during 1910–2010" by A. Ghosh et al.

Anonymous Referee #1

Thank you very much for appreciating the work and helping us with helpful comments and suggestions for further improving the clarity of the paper. In addition to incorporating changes as per your comments, we have made following major/notable changes; (1) Figure 1 now uses new dating of the air Firn air bubbles in NEEM ice core, (2) Figure 5 is considerably remade by using new air aged NEEM data, and includes the inter-polar differences for individual data points (in addition to corrected observation, calculated from spline fitted line).

General comments:
This study is able to reproduce well the observed variations in global atmospheric methane over the last century, providing some insight into changes in particular sources (principally biomass burning) and sinks (principally stratospheric atomic chlorine). The authors use a chemistry transport model with initial estimates of anthropogenic emissions taken from bottom up inventories and wetland emissions simulated by a biogeochemical model. A mass balance approach is then used to minimize the difference between the initial forward modeling results and a range of global observations (direct atmospheric measurements, firn and ice core data) and thereby optimize global total emissions. A further constraint, using d13C observations allows the authors to attribute the high CH4 growth period largely to increases in biomass burning.

The manuscript is well written, clearly structured and is likely to be of considerable interest to others in the greenhouse gas research community. The referee recommends publication in ACP.

Minor comments:
P27621, L24: insert 'the' between 'estimate' and 'global'.
P27622, L22: with -> to
P27623, L11: latest -> last
Ans. These changes have been made

P27624, L24: The authors say that the use of zonal mean winds does not affect the long term simulation as it only results in a 5 Tg CH4/yr higher loss rate than when the model is nudged to JRA-25. Giving this variation in loss rate as a percentage would make it easier for the reader to assess this claim.
Ans. We have added the values in percentage, which is about 1% as the global total loss rate is about 500 Tg/yr for the recent decades.

P27627, L11: insert 'a' between 'used' and 'consistent'.
P27631, L1: insert 'the' before ACTM
P27631, L20: isotopes -> isotopologues
P27632, L5: insert 'the' before ACTM
P27632, L6: suggest replacing 'will' with 'should'
P27633, L15: fractionations effect -> fractionation effects
P27633, L23: insert 'of' after because
P27636, L5: insert 'the' before CH4
P27636, L6: insert 'the' before CH4
P27637, L15: insert 'the' before 'Antarctic'
P27637, L17: insert 'the' before 'IPD'
P27637, L27: insert 'the' before 'period'
P27639, L8: insert 'the' before 'Global'

P27639, L28: Supplement -> supplement
P27640, L25: leaving -> leave
P27640, L26: suggest changing ‘erroneous’ to uncertain
P27642, L13: insert ‘the’ before 1990s.
Ans. These changes have been made

P27656: Frin -> Firn in the legend for NGRIP and NEEM data
Ans. The Figure 2 legend is corrected. We also have modified lines/colour etc. for better clarity.

P27660. Legend difficult to read in Figure 6. Increase font size.
Ans. The Figure 5 is modified for better clarity.