Supplementary part

Table S1: Correlation coefficients (R) between observed and model simulated seasonal cycles of XCH_4. Model simulations are obtained from ACTM using two different emission scenarios, AGS and CTL. The details of these scenarios are given in Patra et al (2016).

Site/ Tracer	ACTM_AGS	ACTM_CTL
Arid India	0.77	0.88
WIGP region	0.86	0.90
EIGP region	0.69	0.88
Northeast India	0.55	0.55
Western India	0.87	0.95
Central India	0.89	0.97
East India	0.78	0.86
South India	0.92	0.91
Arabian Sea	0.86	0.87
Bay of Bengal	0.84	0.86

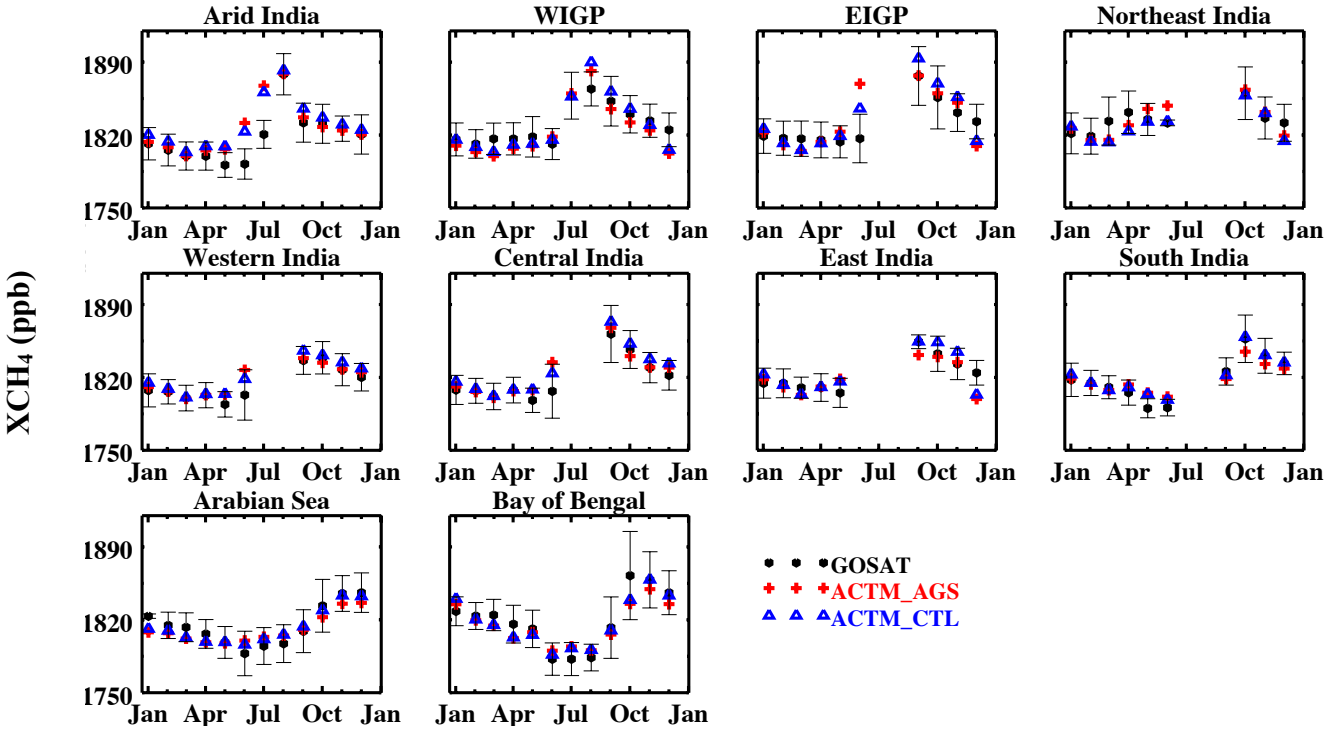

Figure S1: Observations and model simulation climatology of the XCH_4 data used in Figure2 for the period of 2011-2014.

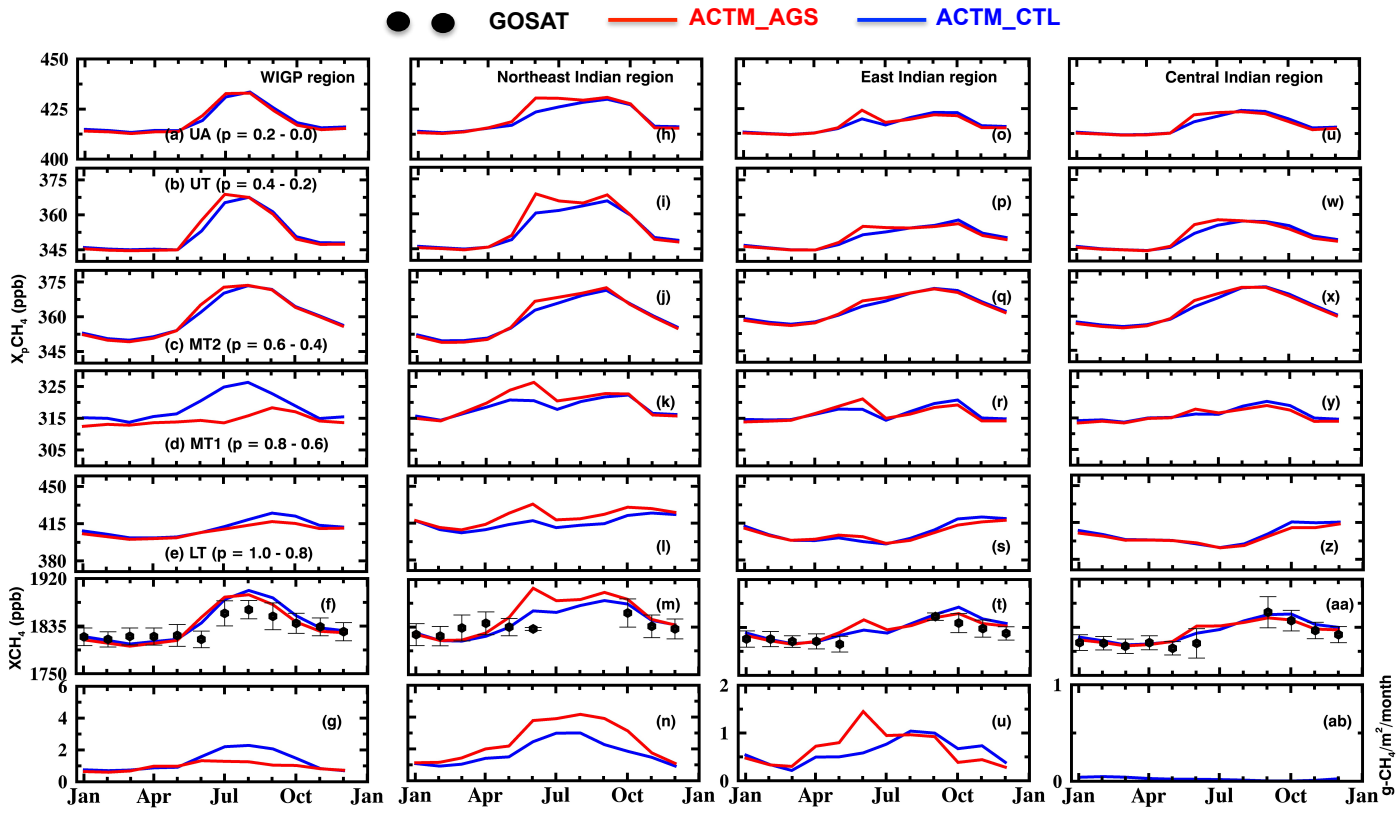

Figure S2: Monthly distributions of total optimized CH_4 emissions (g,n,u, ab) estimated after performing the global inverse analysis (Patra et al., 2016). Columnar dry-air molar fraction of methane (XCH_4) obtained from the GOSAT observations (black circles in f, m, t and aa panel) and ACTM simulations (f, m, t, aa) over the Western IGP (WIGP: first column), northeast Indian region (second column), east Indian region (third

column) and central Indian region (fourth column). Climatology is based on monthly mean values for the period 2011-2014 and the error bars in the GOSAT monthly mean values depict the 1-sigma standard deviations for the corresponding months. The 1-sigma values for model simulations are not included to maintain figure clarity. Simulations are based on two different emission scenarios CTL (blue lines) and AGS (red lines), based on the different combinations of emissions. The upper five panels show the monthly climatology of partial columnar methane (denoted by x_pCH_4) calculated at five different partial sigma-pressure layers; 1.0-0.8 (e, l, s), 0.8-0.6 (d, k, r), 0.6-0.4 (c, j, q), 0.4-0.2 (b, I, p) and 0.2-0.0 (a, h , n). Please note that the y scales in the emission plots over east India and central India (u and aa) are different than over WIGP (g) and northeast Indian region (n).

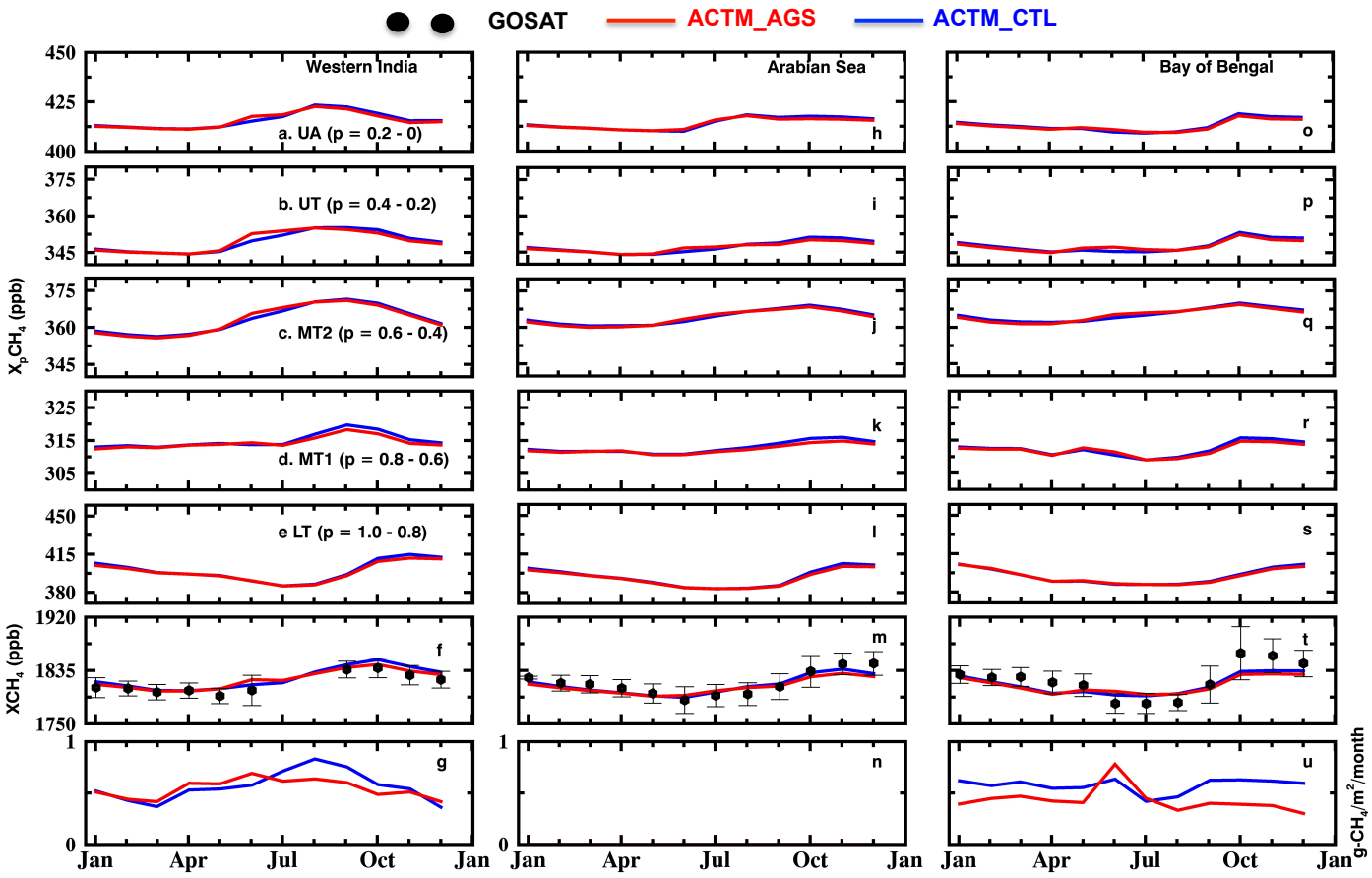

Figure S3: Monthly distributions of total optimized CH_4 emissions (g,n,u) estimated after performing global inverse analysis (Patra et al., 2016). Columnar dry-air molar fraction of methane (XCH_4) obtained from the GOSAT observations (black circles in f, m, t) and ACTM simulations (f, m, t) over western India (first column), the Arabian Sea (second column), and the Bay of Bengal (third column). Climatology is based on monthly mean values for the period 2011-2014 and error bars in the GOSAT monthly mean values depict 1-sigma standard deviations for the corresponding months. The 1-sigma values for model simulations are not included to maintain figure clarity. Simulations are based on two different emission scenarios, ACTM_CTL (blue lines) and ACTM_AGS (red lines), based on different combinations of emissions. The upper five panels show the monthly climatology of partial columnar methane (denoted by x_pCH_4) calculated at five

different partial sigma-pressure layers; 1.0-0.8 (e, l, s), 0.8-0.6 (d, k, r), 0.6-0.4 (c, j, q), 0.4-0.2 (b, i, p) and 0.2-0.0 (a, h, o).

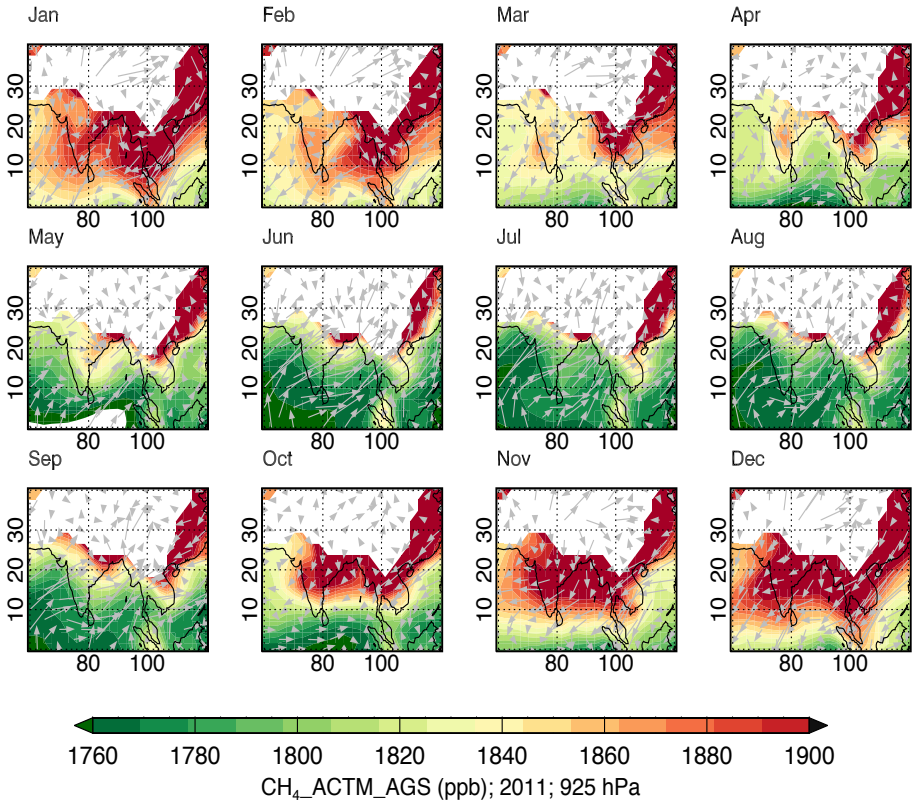

Figure S4: Distribution of CH_4 from the AGS scenario over the Indian region at 925 hPa during different months for the year 2011. The arrow denotes the monthly wind pattern at the same height over the Indian region.

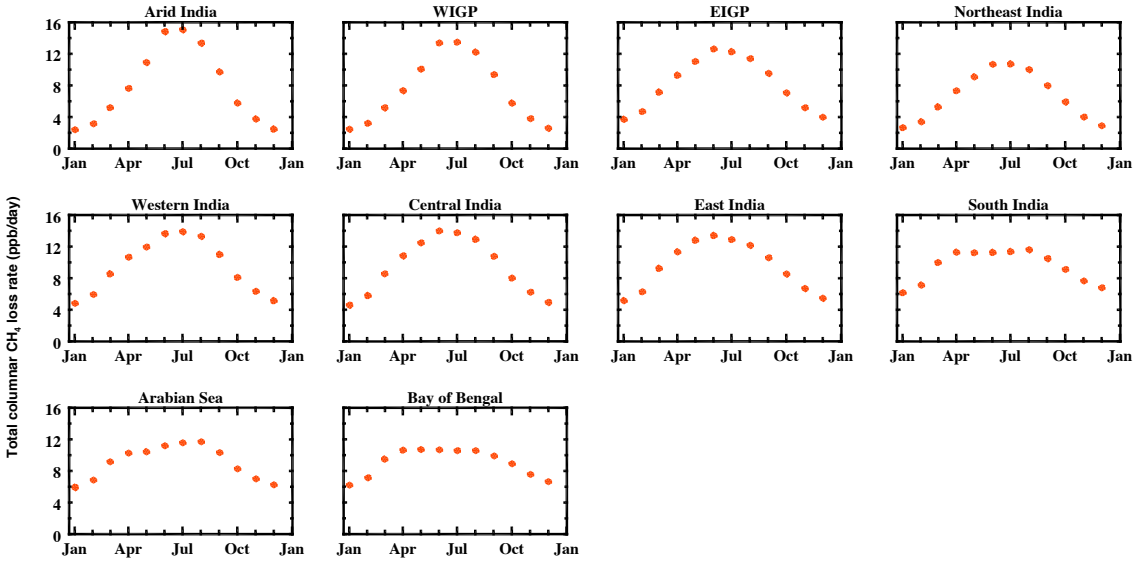

Figure S5. Seasonal distributions of total columnar chemical loss rate of CH_4 simulated using ACTM model over all the selected study regions. Columnar mixing ratios are calculated from the loss rate profile of CH_4 similar to the method used for XCH_4 calculations.