

Supplement

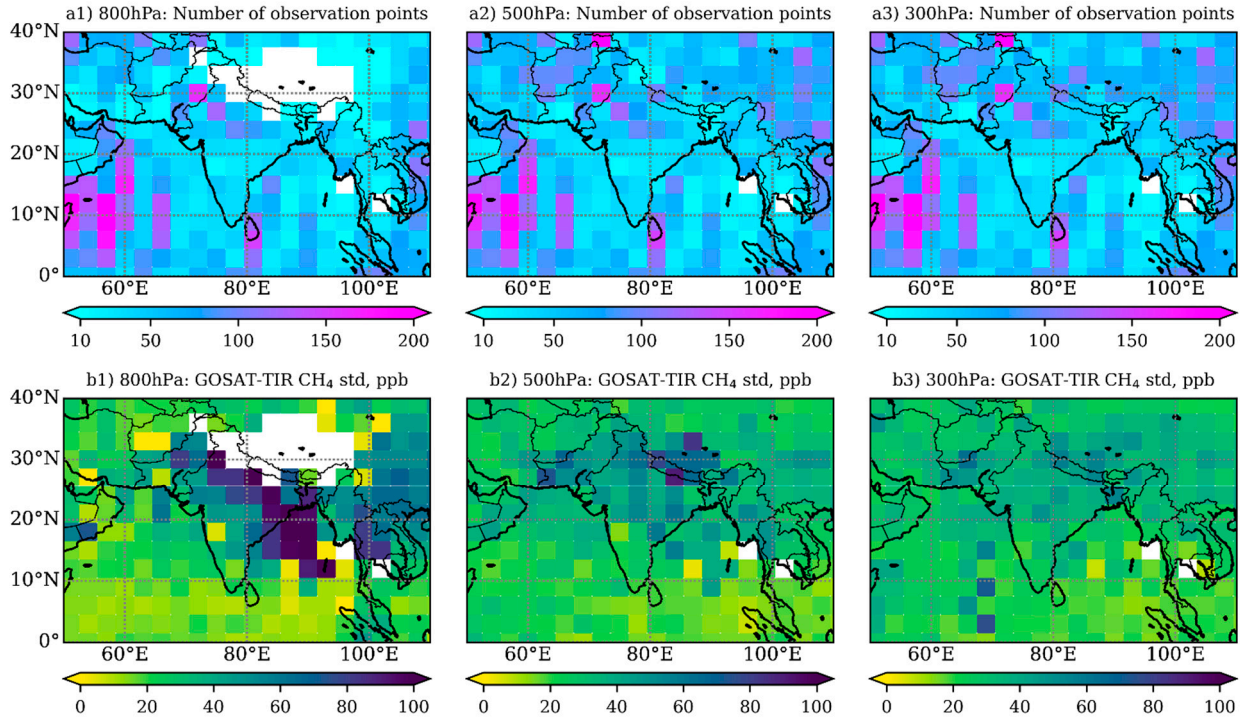


Figure S1. Latitude-longitude distributions of TIR CH₄ properties at the levels of 800, 500, and 300hPa (the left, middle, and right panels respectively) for the season JAS 2011. The first upper panels (a1-a3) show GOSAT-TIR CH₄ observation points numbers, the bottom panels (d1-d3) show GOSAT-TIR CH₄ 1- σ SD, respectively.

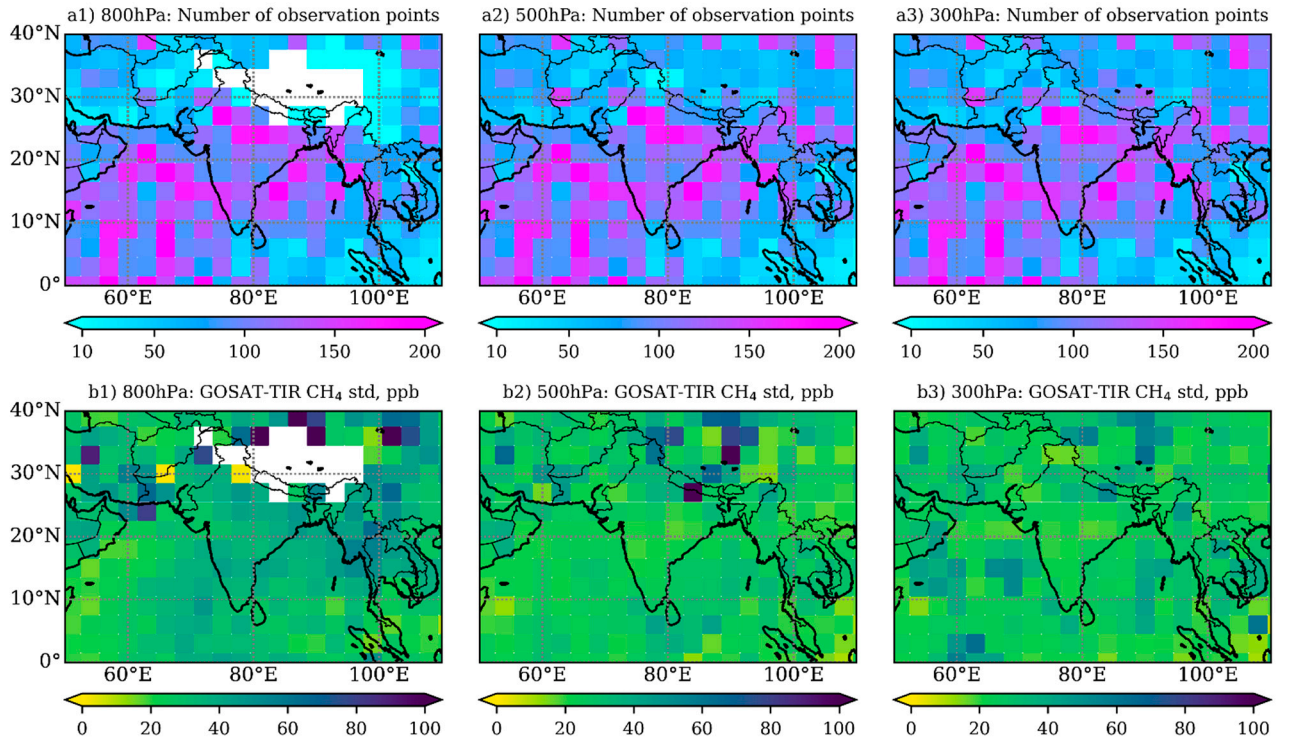
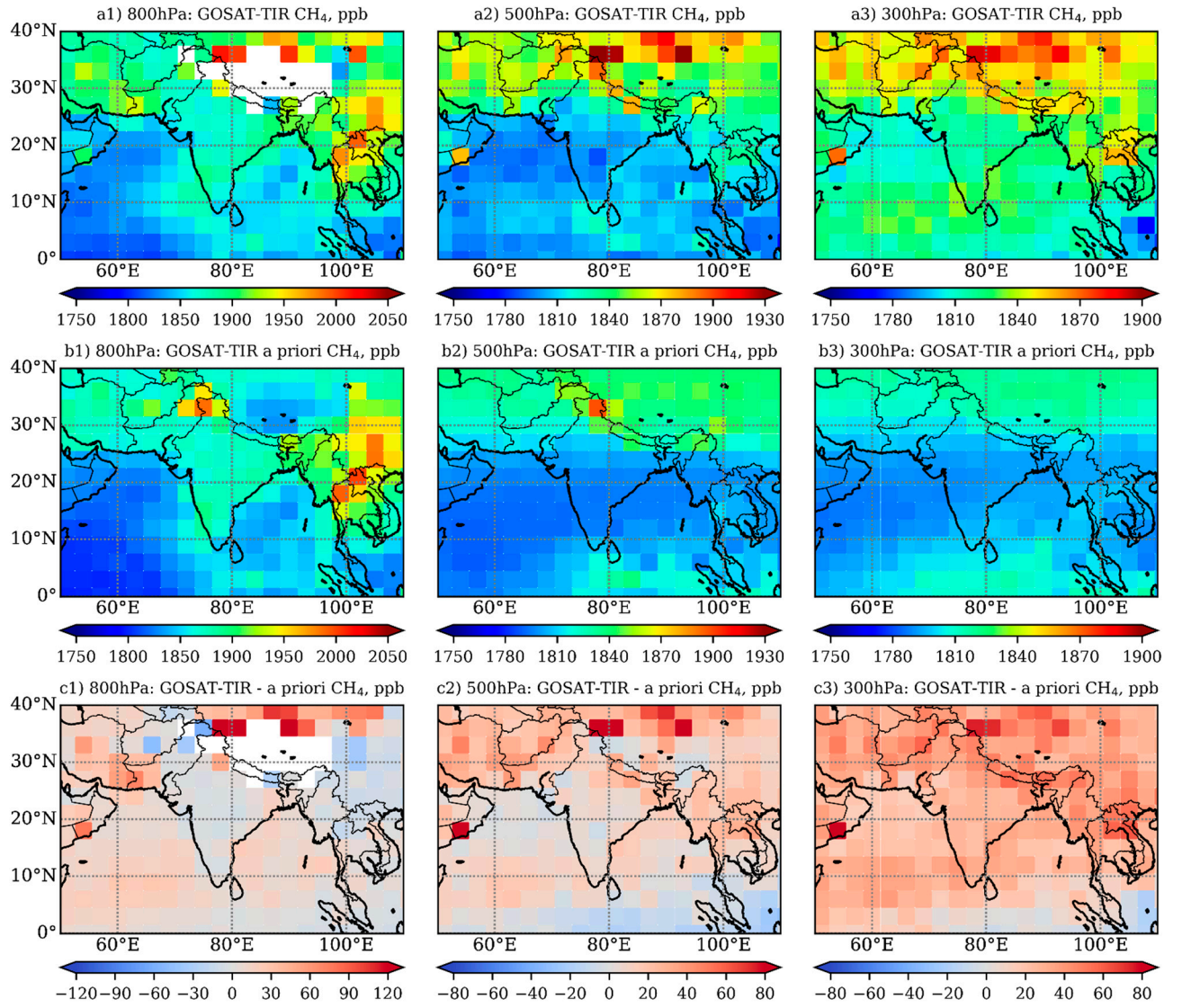


Figure S2. Same as Fig. S1, but for JFM 2011.



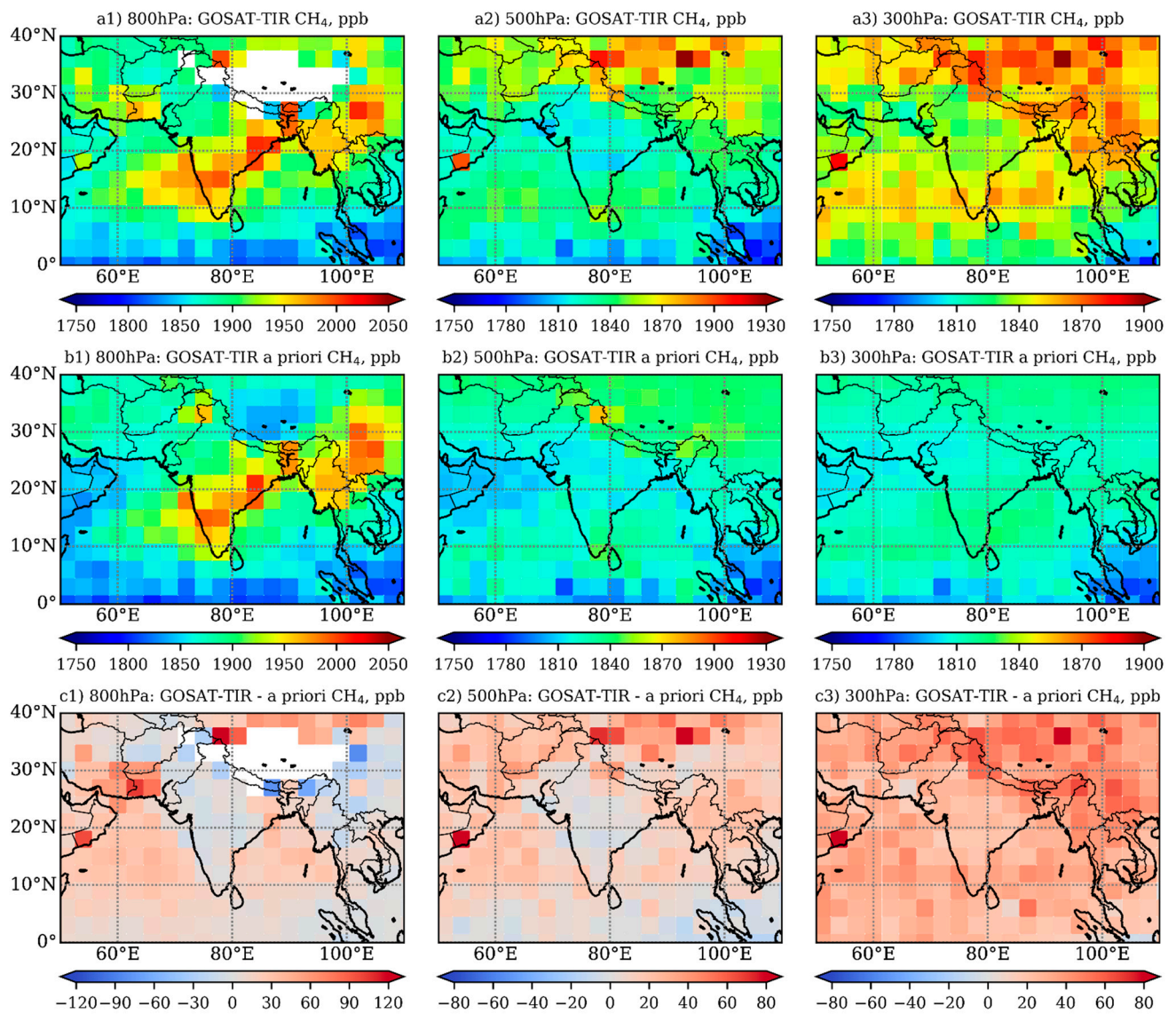


Figure S4. Same as Fig. S3, but for OND 2011.

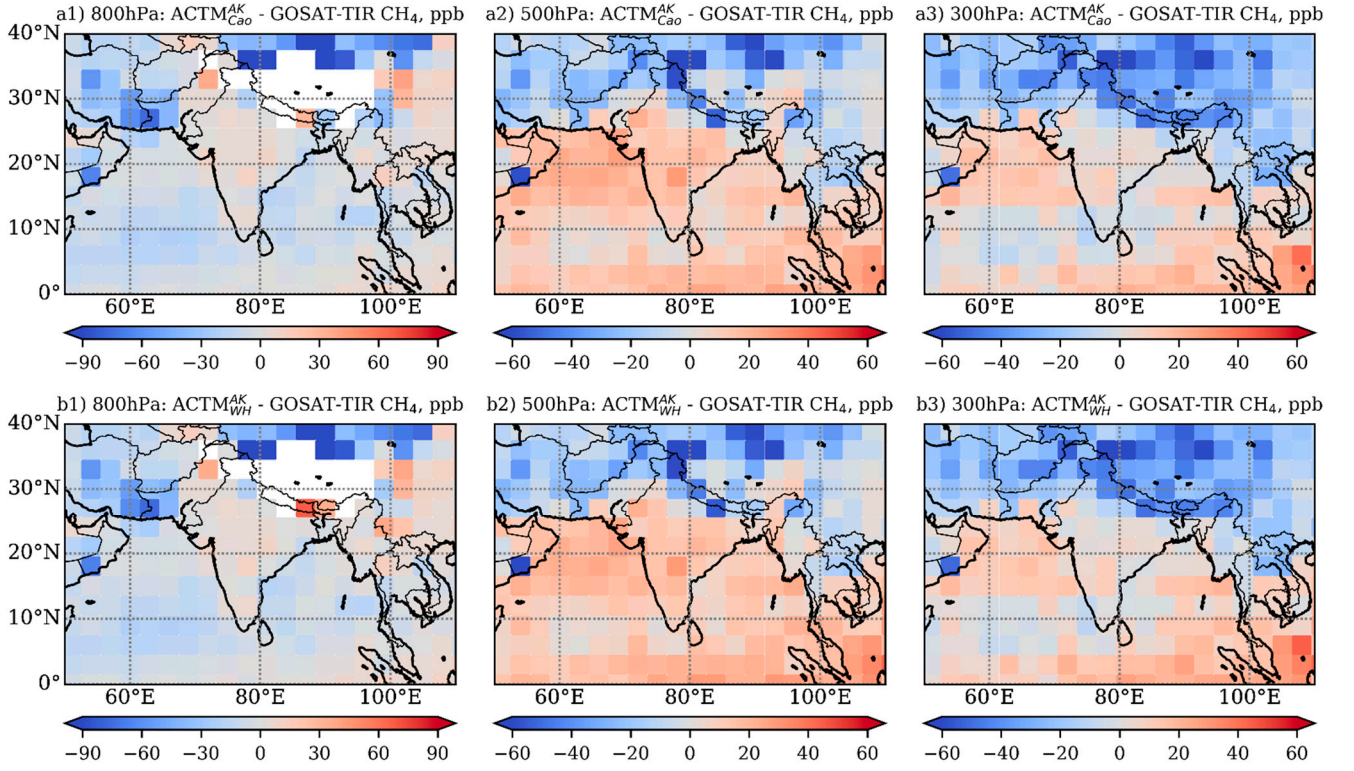


Figure S5. Latitude-longitude difference in CH_4 distributions simulated by MIROC4-ACTM and observed by GOSAT-TIR at the levels of 800, 500, and 300 hPa (the left, middle, and right panels, respectively) for JFM 2011. The top row (a1–a3) and bottom row (b1–b3) show the difference in CH_4 between GOSAT-TIR, and ACTM_Cao and ACTM_WH, respectively.

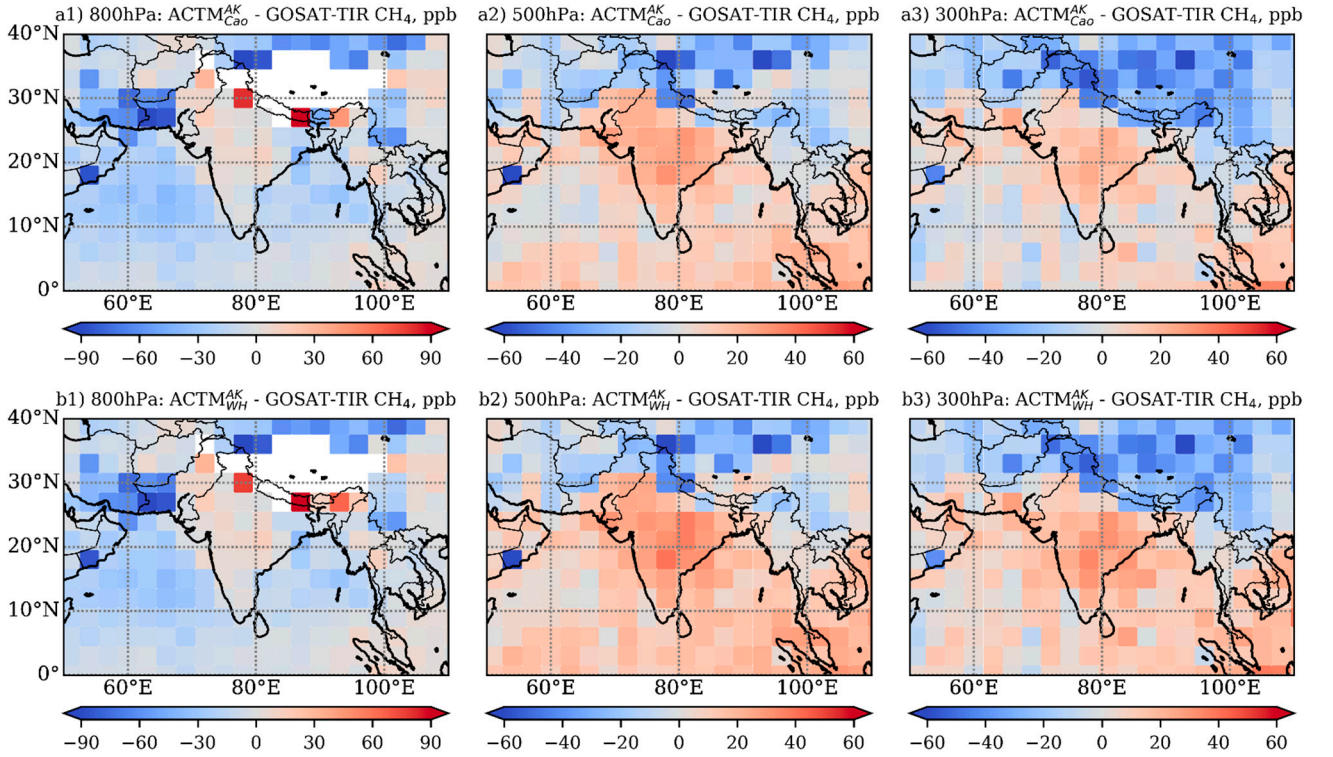


Figure S6. Same as Fig. S5, but for OND 2011.

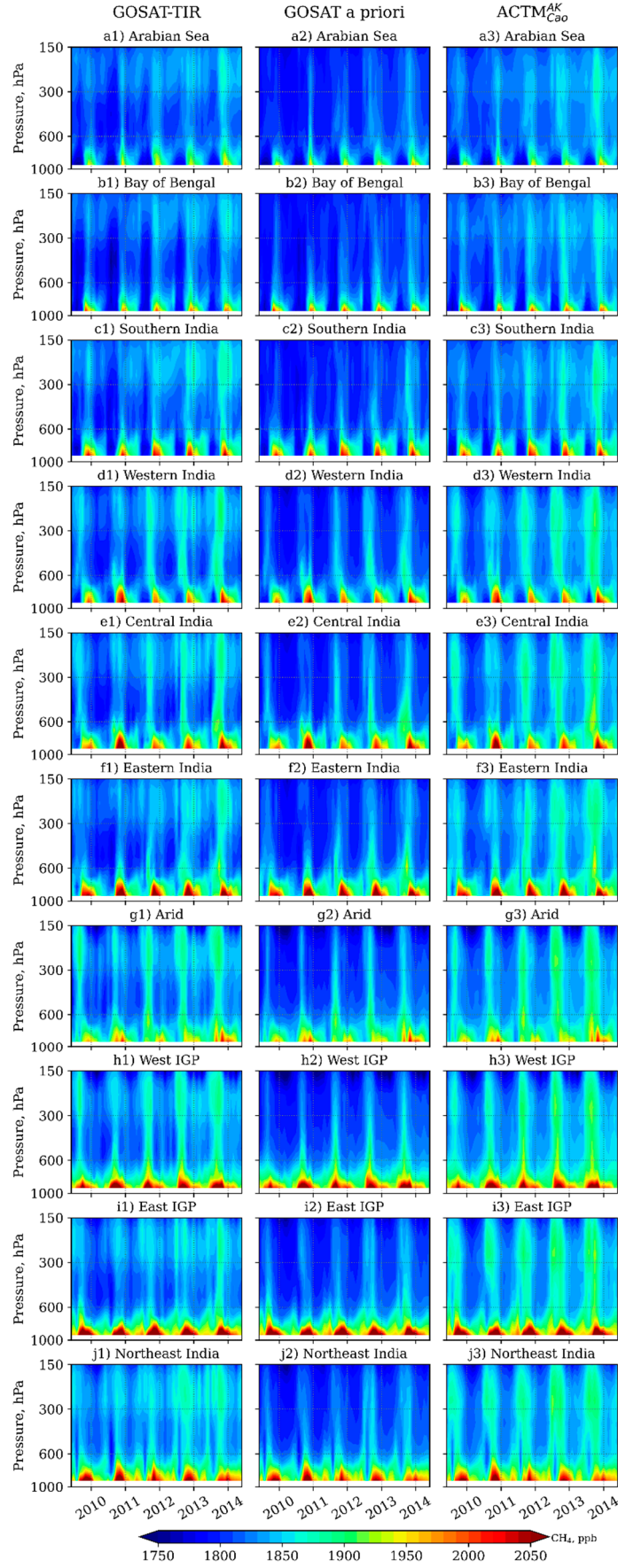


Figure S7. Time-altitude cross-section of CH_4 from GOSAT-TIR retrieval, GOSAT-TIR *a priori* and $\text{ACTM}_{\text{Cao}}^{\text{AK}}$ (the left, middle, and right panels respectively) for considered regions.

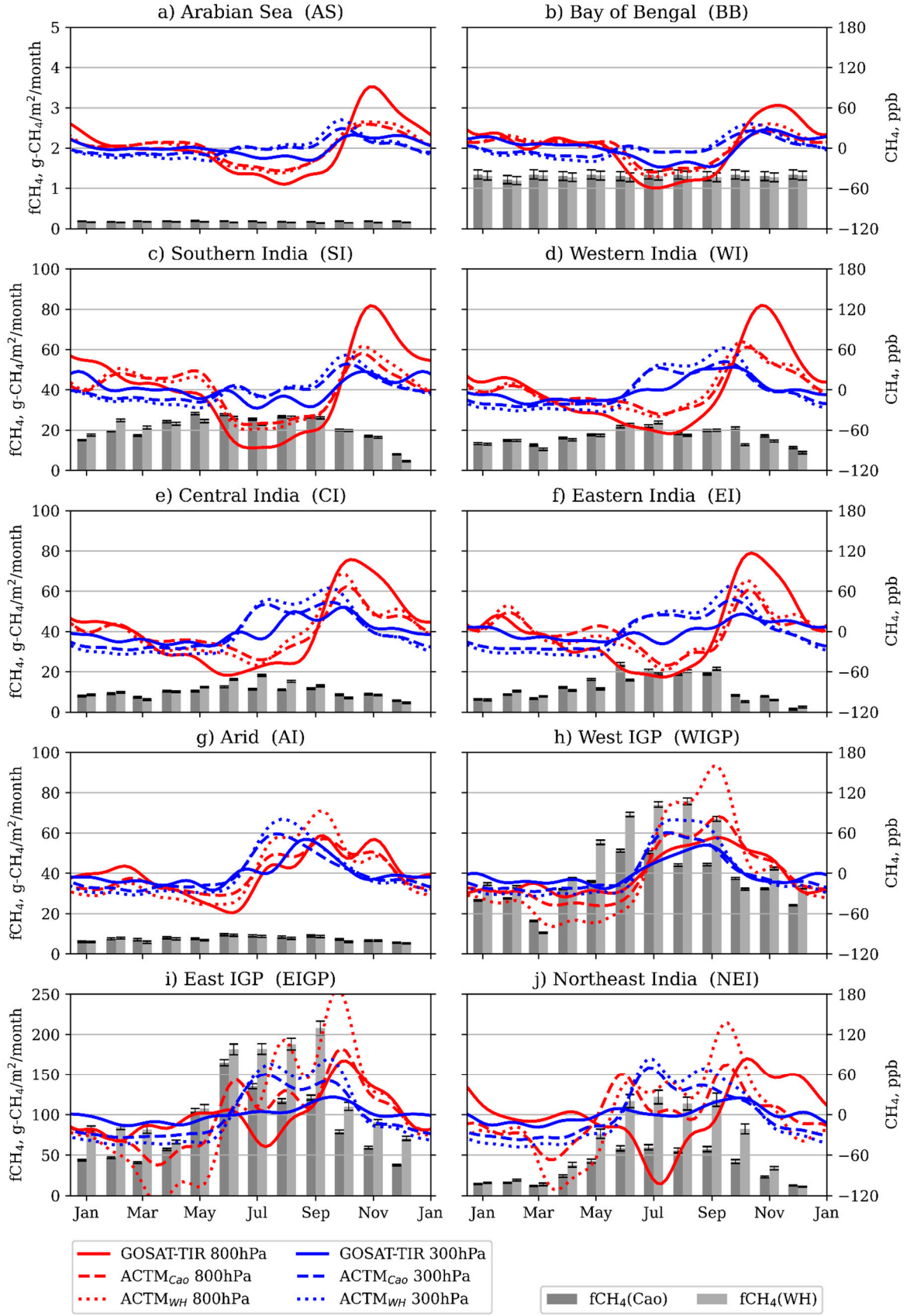


Figure S8. Multi-year (2009-2014) seasonal variation of CH_4 (right y-axis) derived by implementation of the Prophet model for levels of 800 (red lines) and 300 hPa (blue lines) over considered regions from GOSAT-TIR (solid line), ACTM_{Cao} (dashed line), and ACTM_{WH} (dotted line), respectively. At the background bar plots represent Cao (dark grey) and WH (light grey) CH_4 fluxes (left y-axis), respectively. Please note the different scale of y-axes (left) for fluxes.

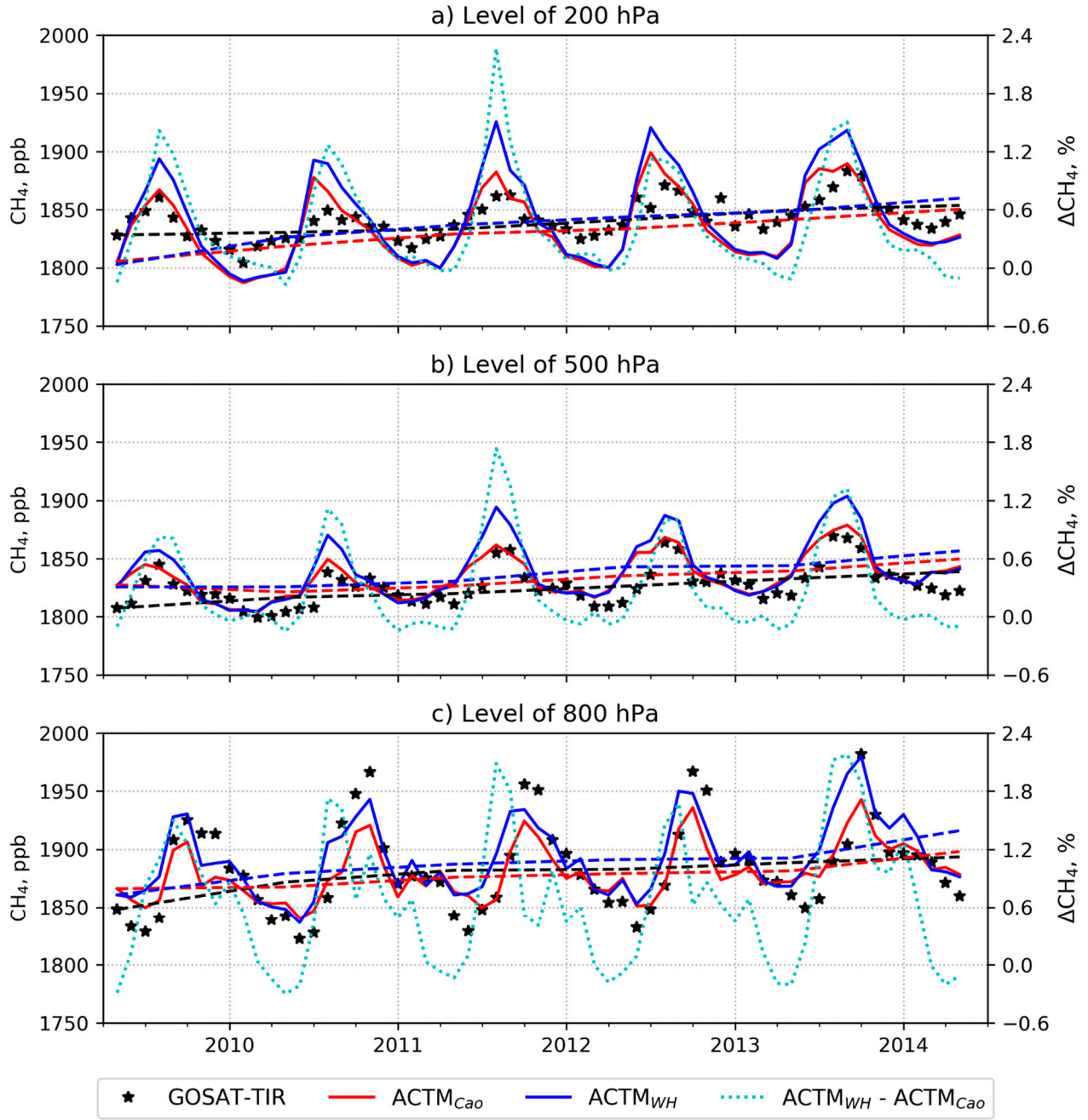


Figure S9. Time series of CH₄ averaged over the area of South Asia for levels of a) 300, b) 500 and c) 800 hPa. Symbols state the GOSAT-TIR observations, red and blue lines are for ACTM_{Cao}, and ACTM_{WH}, respectively. Solid and dashed lines are for monthly and yearly averaged concentrations (left y-axis), dotted line shows the difference between the model simulations (right y-axis), respectively.