



Supplement of

Model simulations of atmospheric methane (1997–2016) and their evaluation using NOAA and AGAGE surface and IAGOS-CARIBIC aircraft observations

Peter H. Zimmermann et al.

Correspondence to: Peter H. Zimmermann (p.zimmermann@mpic.de)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.

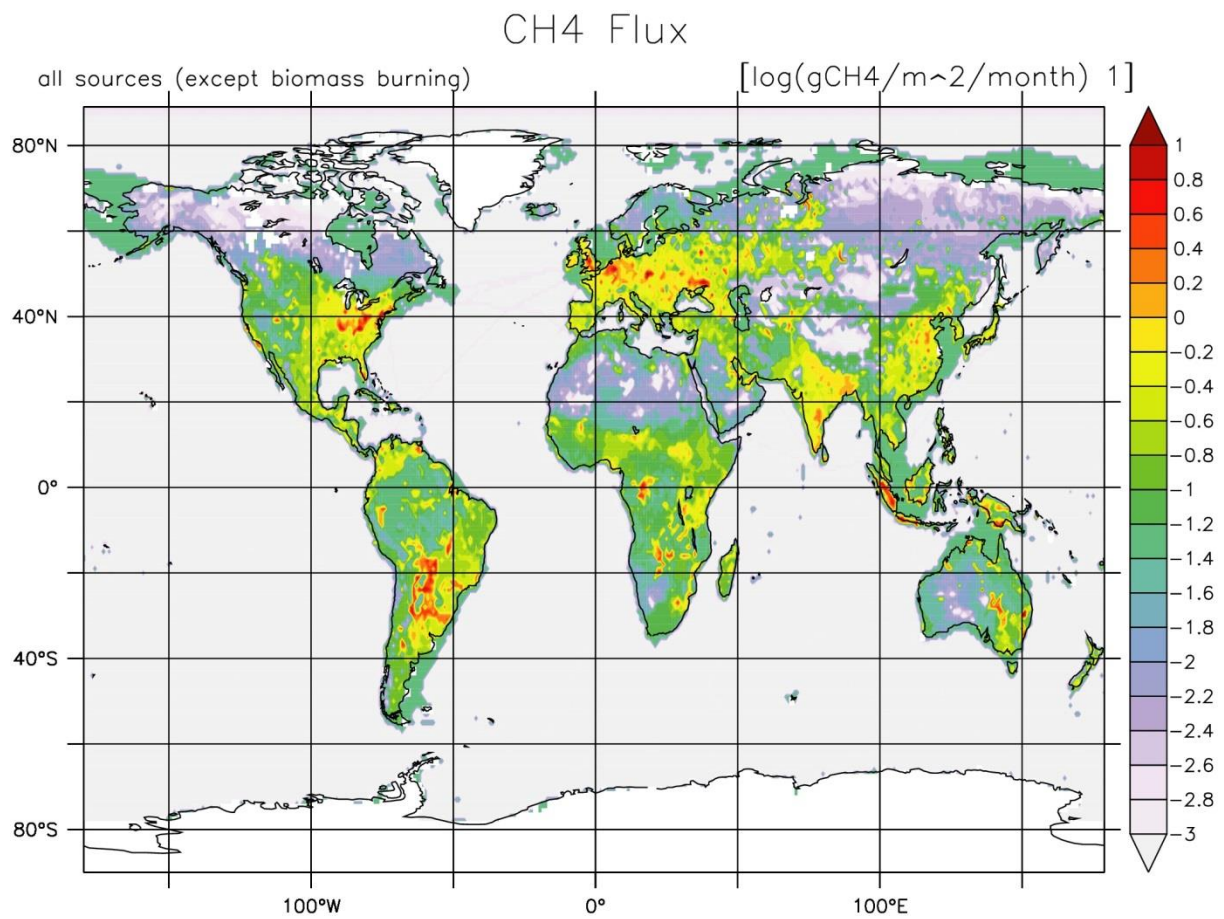
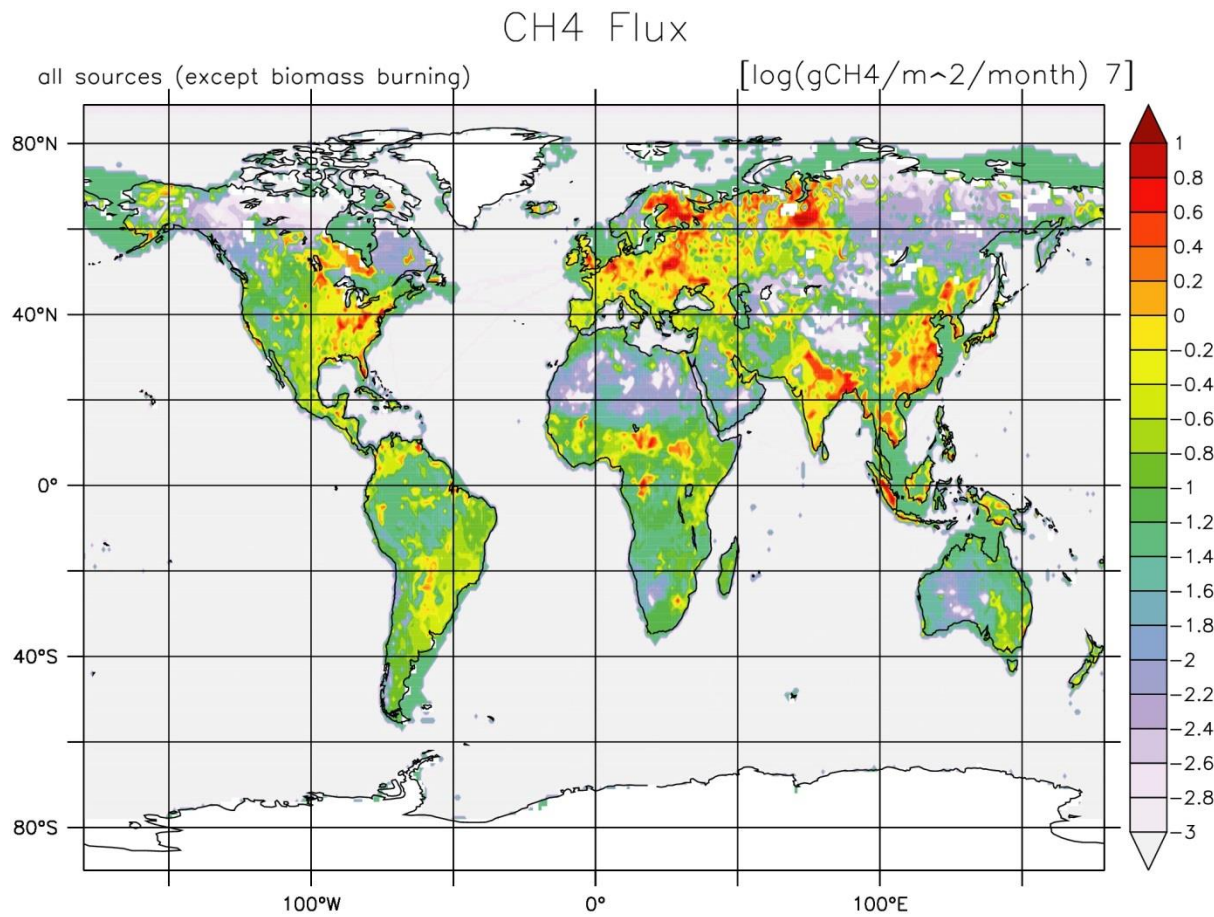
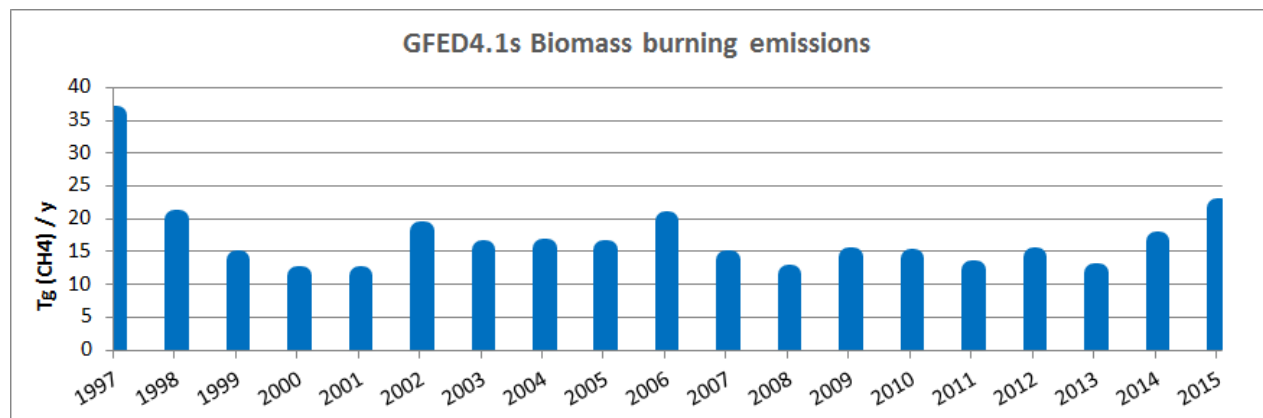


Figure S1:

a: Methane emission flux distribution in January - $\log(\text{gCH}_4 \text{ m}^{-2} \text{ month}^{-1})$.



b: Methane emission flux distribution in July - log scale.



c: Interannual biomass burning-methane emission variability.

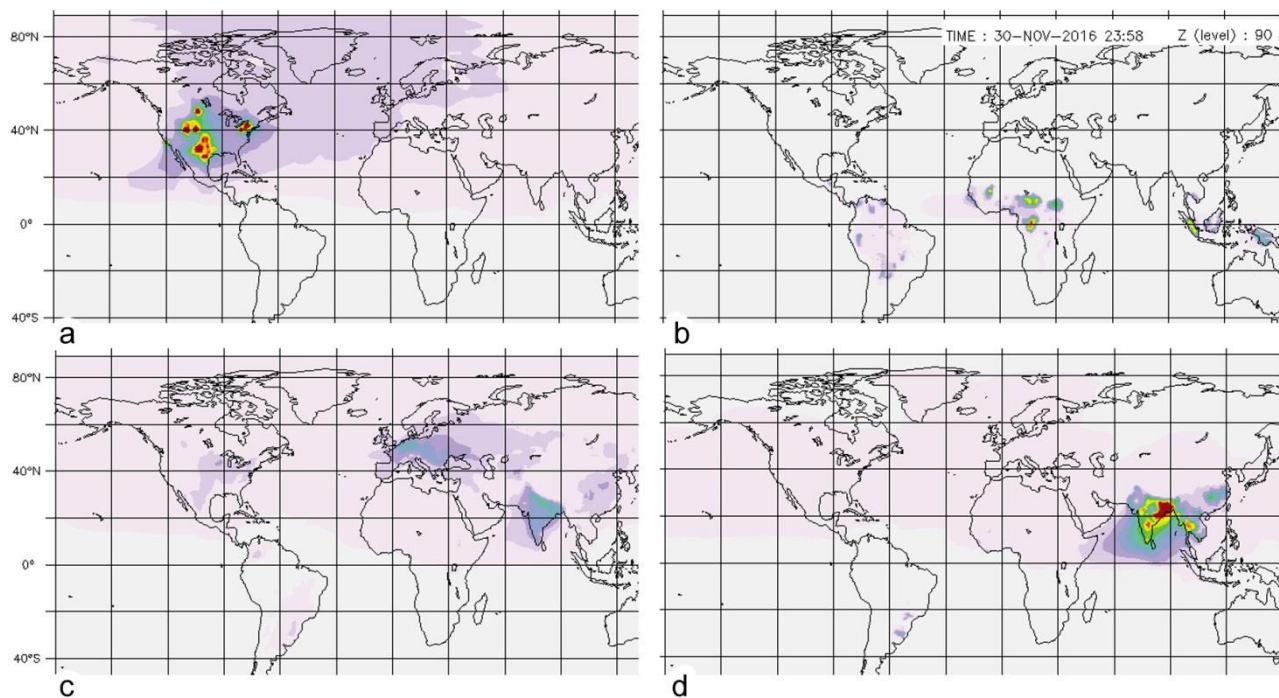


Figure S2:

The geographical distribution of the global CH₄ mixing ratios near the surface, logarithmically scaled for better visibility, marking the respective hypothetical sources (.

- a: U.S. shale gas production, b: Tropical wetlands (Nov. excerpt of annual cycle)
c: Ruminant animals d: Rice cultivation

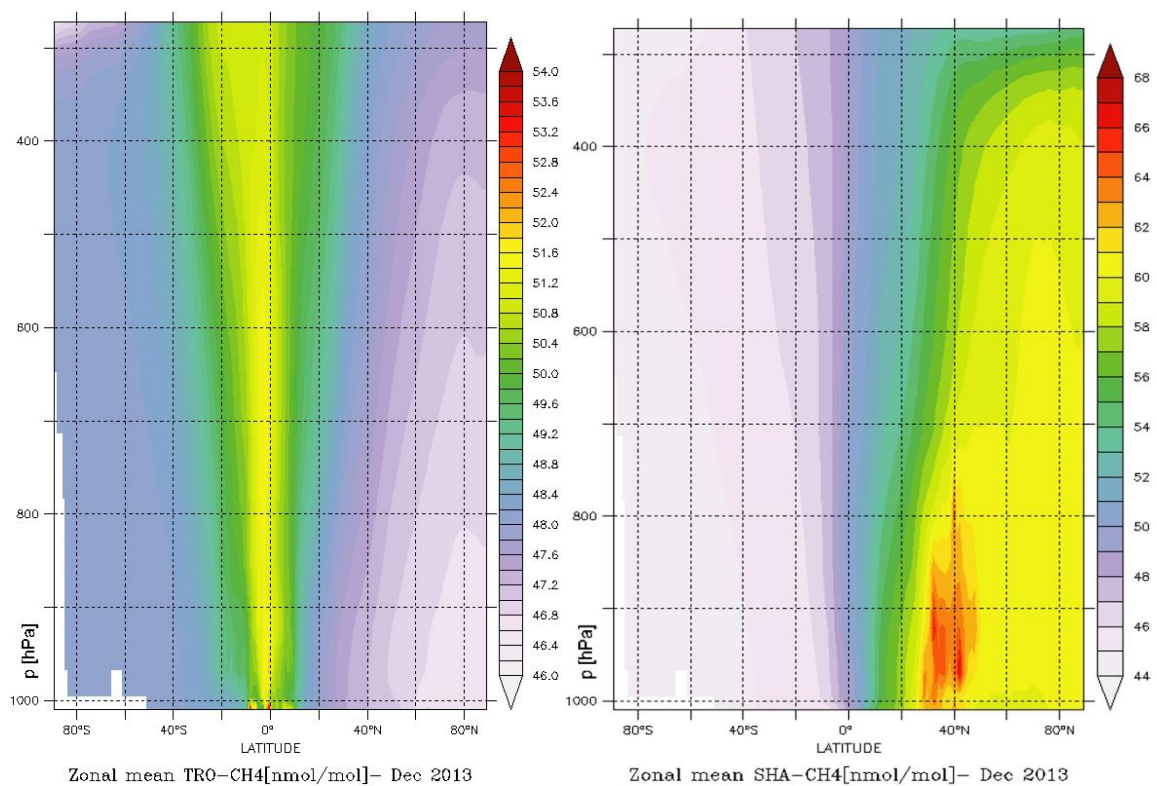


Figure S3:

Vertical methane mixing ratio distribution of tagged TRO (left) SHA (right) emissions (note the different scales).

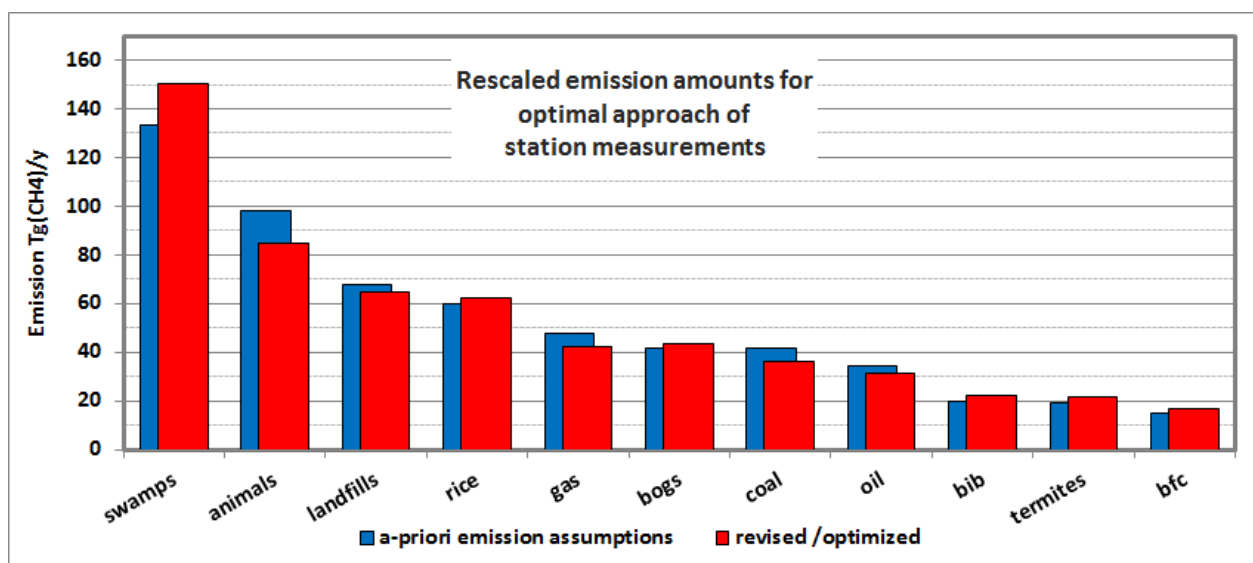


Figure S4: Re-scaled methane emissions in Tg (CH₄)/y (red bars) vs a-priori assumptions (blue).

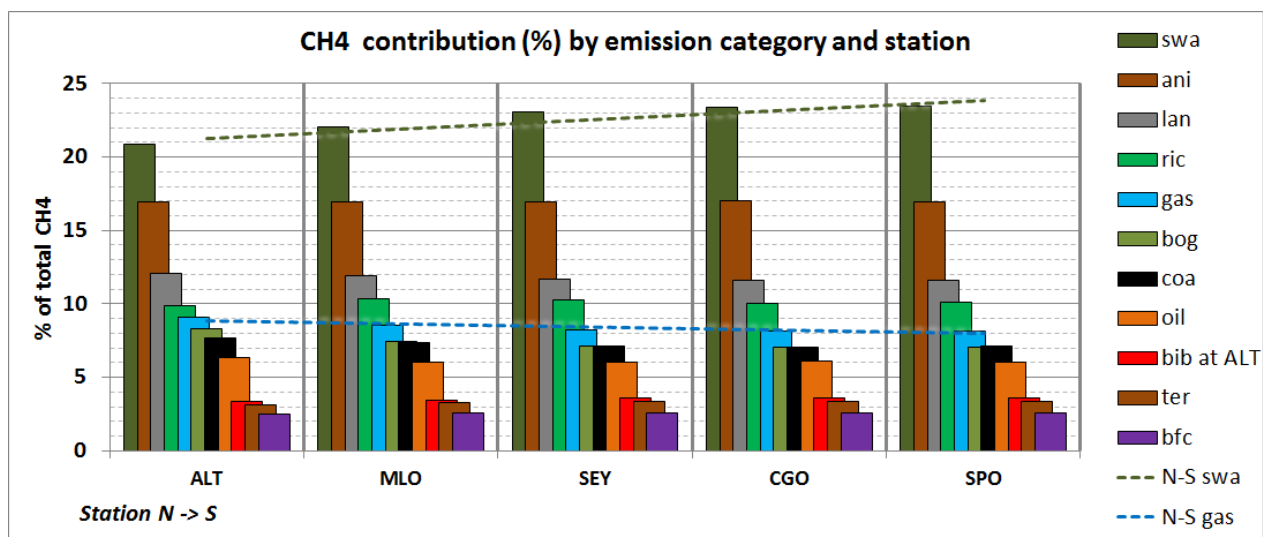


Figure S5: Atmospheric methane composition calculated at selected NOAA AGAGE stations (from north to south) during the no-trend period 1997 - 2006.

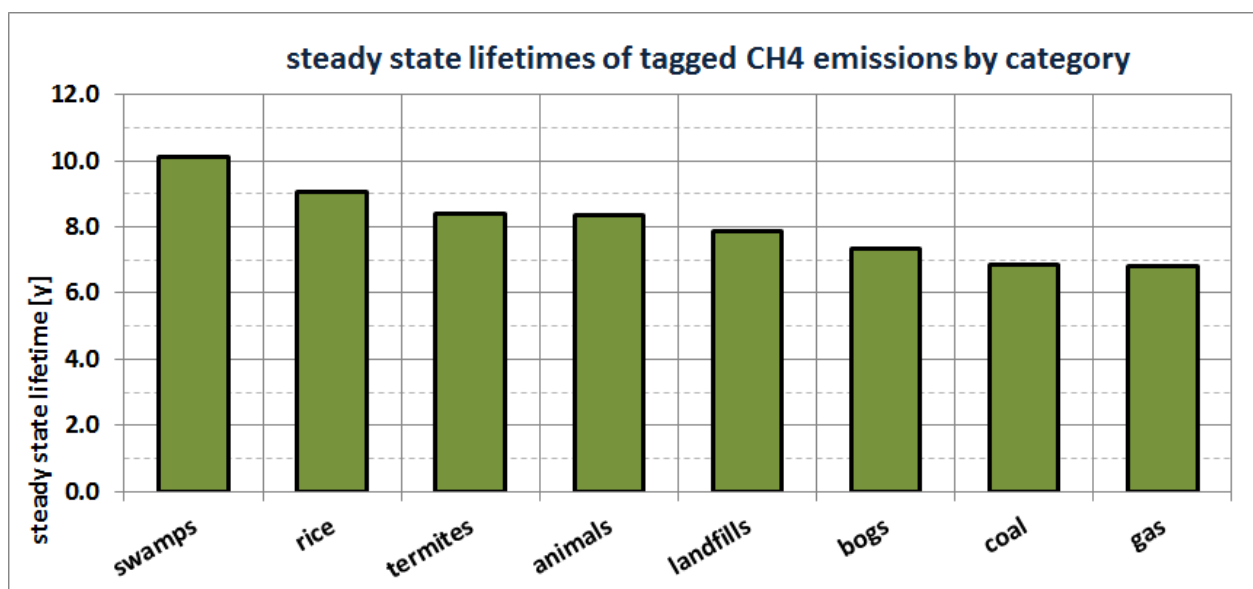
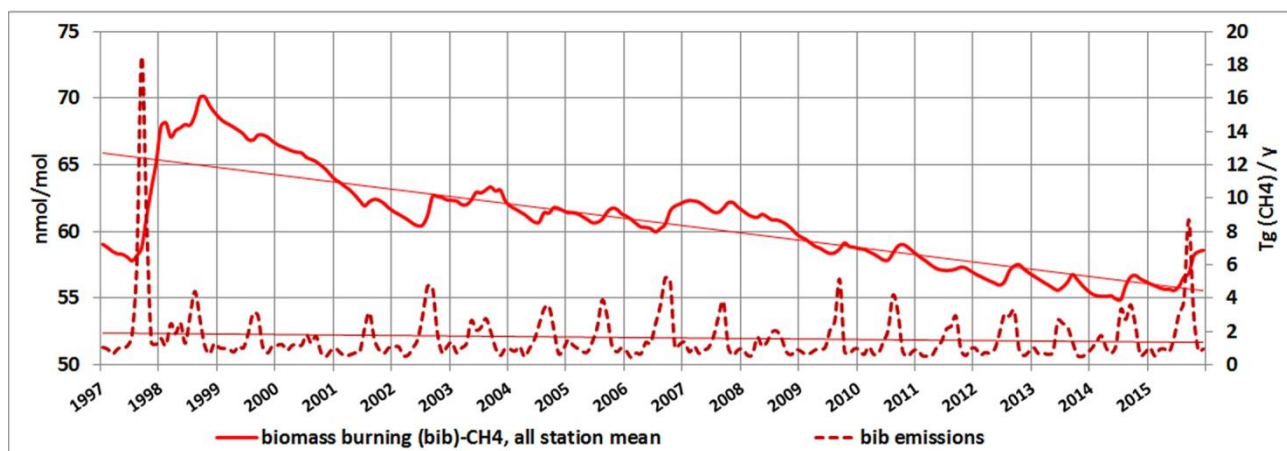


Figure S6 a: Steady-state atmospheric lifetimes (τ) of tagged methane source contributions, 2000 - 2006 (period of relative stagnation).



b: Biomass burning-CH₄ (red solid) is far away from steady state equilibrium because of irregular inter-annual emission intensity of the fire events (dashed line).

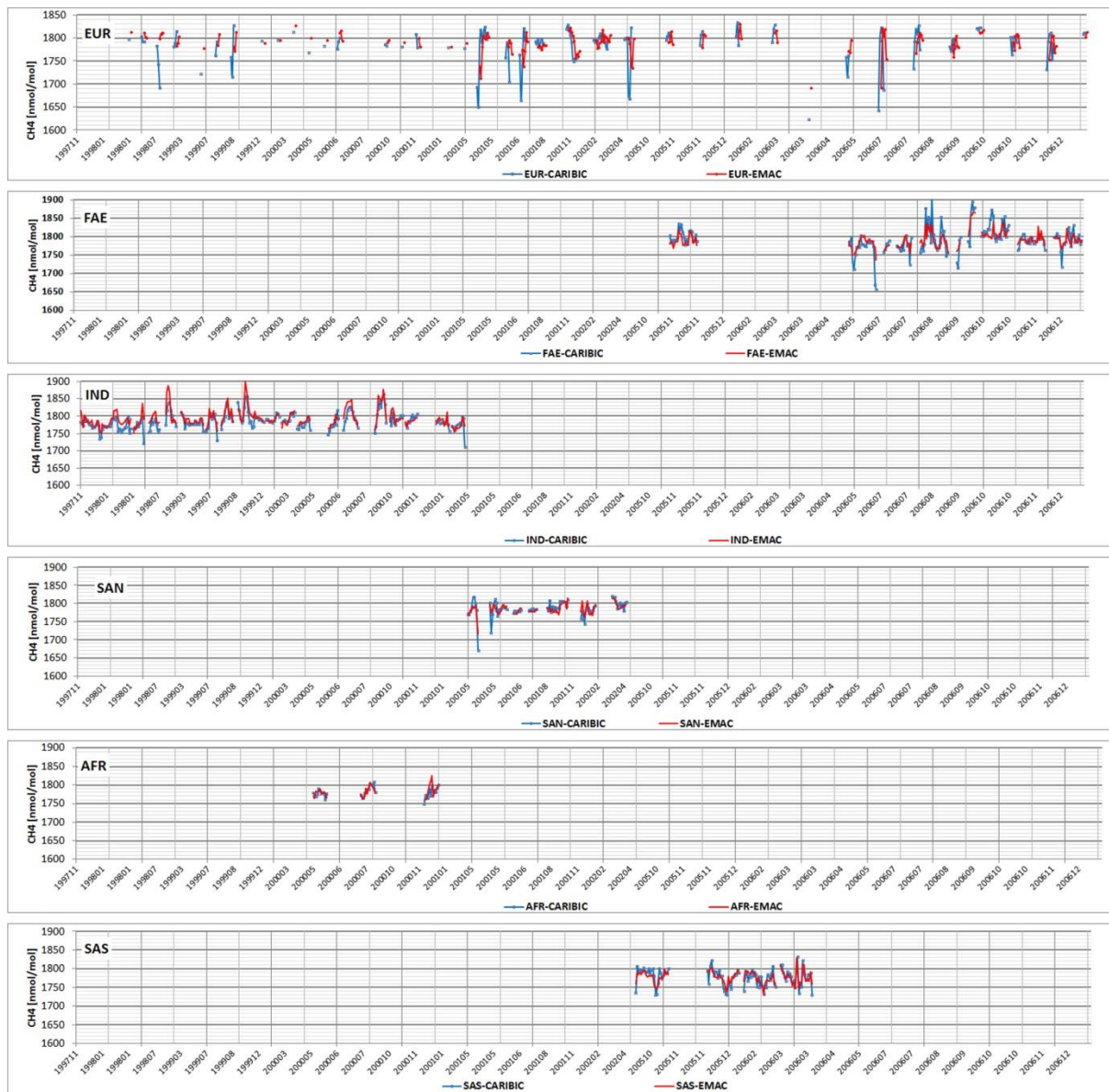


Figure S7:

EMAC CH₄ calculations (red) and CARIBIC-1/2 observations (blue) from 1997 through 2006, separately by flight region.

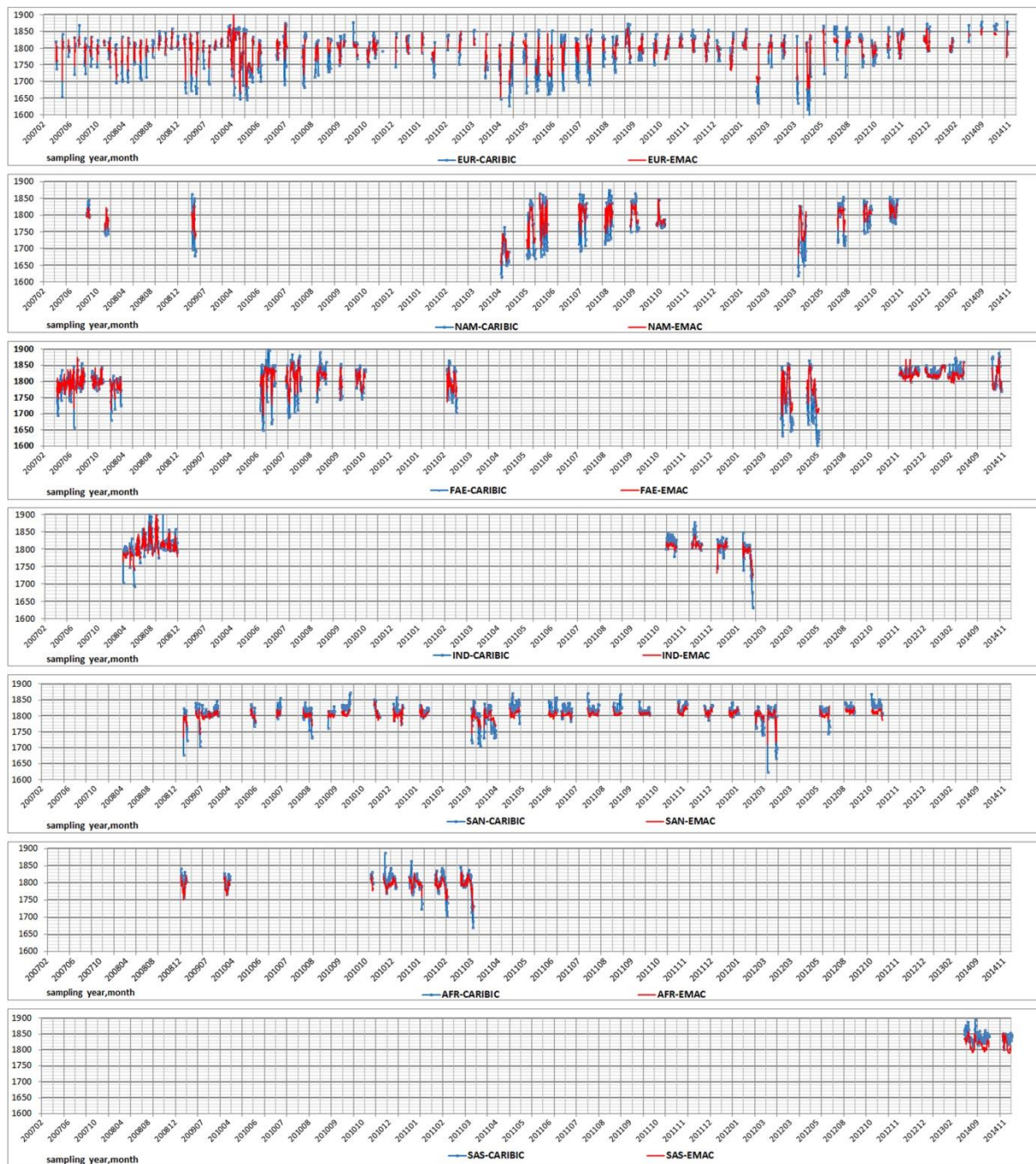


Figure S8: EMAC calculated CH₄, including trend, and CARIBIC-2 observations 2007 through 2014 resolved by flight regions.

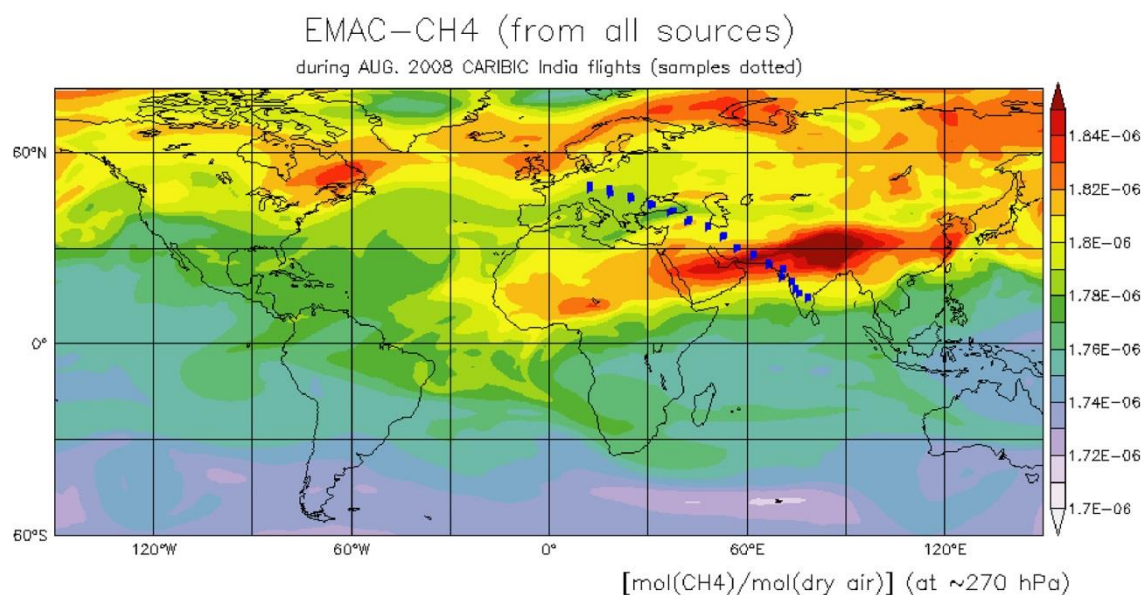
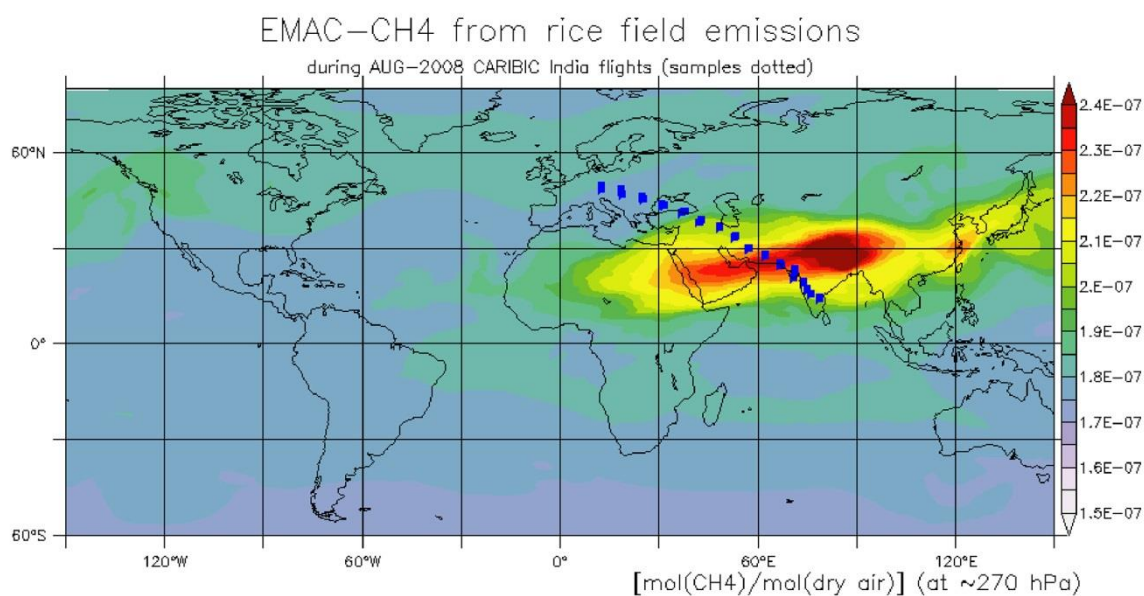


Figure S9:

a: Total EMAC-simulated CH₄ mixing ratios during the CARIBIC India flights 244/245 at cruise altitude.



b: Tagged rice paddy released CH₄ in mixing ratios during CARIBIC India flights 244/245 at cruise altitude.

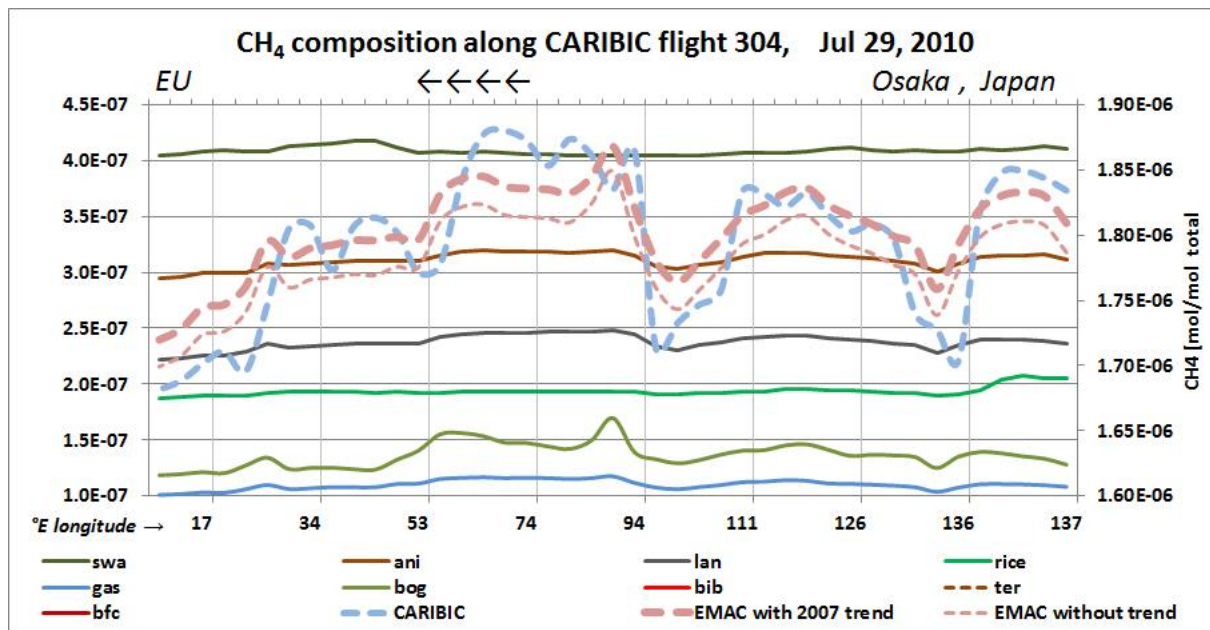


Figure S10: CH₄ mixing-ratios [mol/mol] observed during the CARIBIC Far East flight 304 (light blue dashed, right ordinate) compared to the respective EMAC-model simulation with (light red, dashed, thick) and without trend-period emissions (thin). Tagged results are plotted for swamps-, gas-, bog-, rice-, landfill-, and animal (ruminant) released methane (left ordinate).