



*Supplement of*

## **Atmospheric observations consistent with reported decline in the UK's methane emissions (2013–2020)**

**Mark F. Lunt et al.**

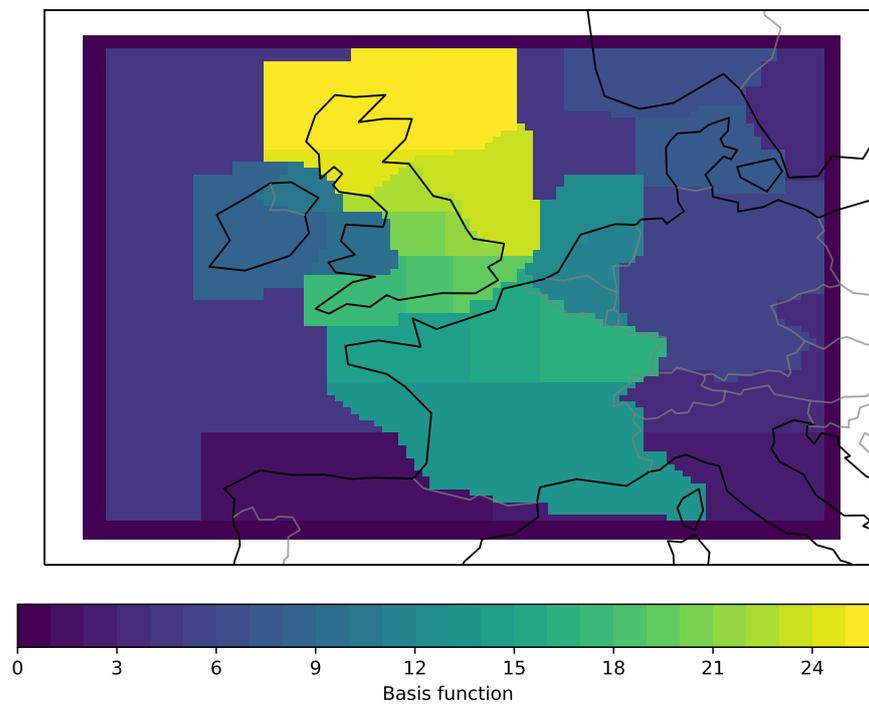
*Correspondence to:* Mark F. Lunt ([mark.lunt@ed.ac.uk](mailto:mark.lunt@ed.ac.uk))

The copyright of individual parts of the supplement might differ from the article licence.

## List of Figures

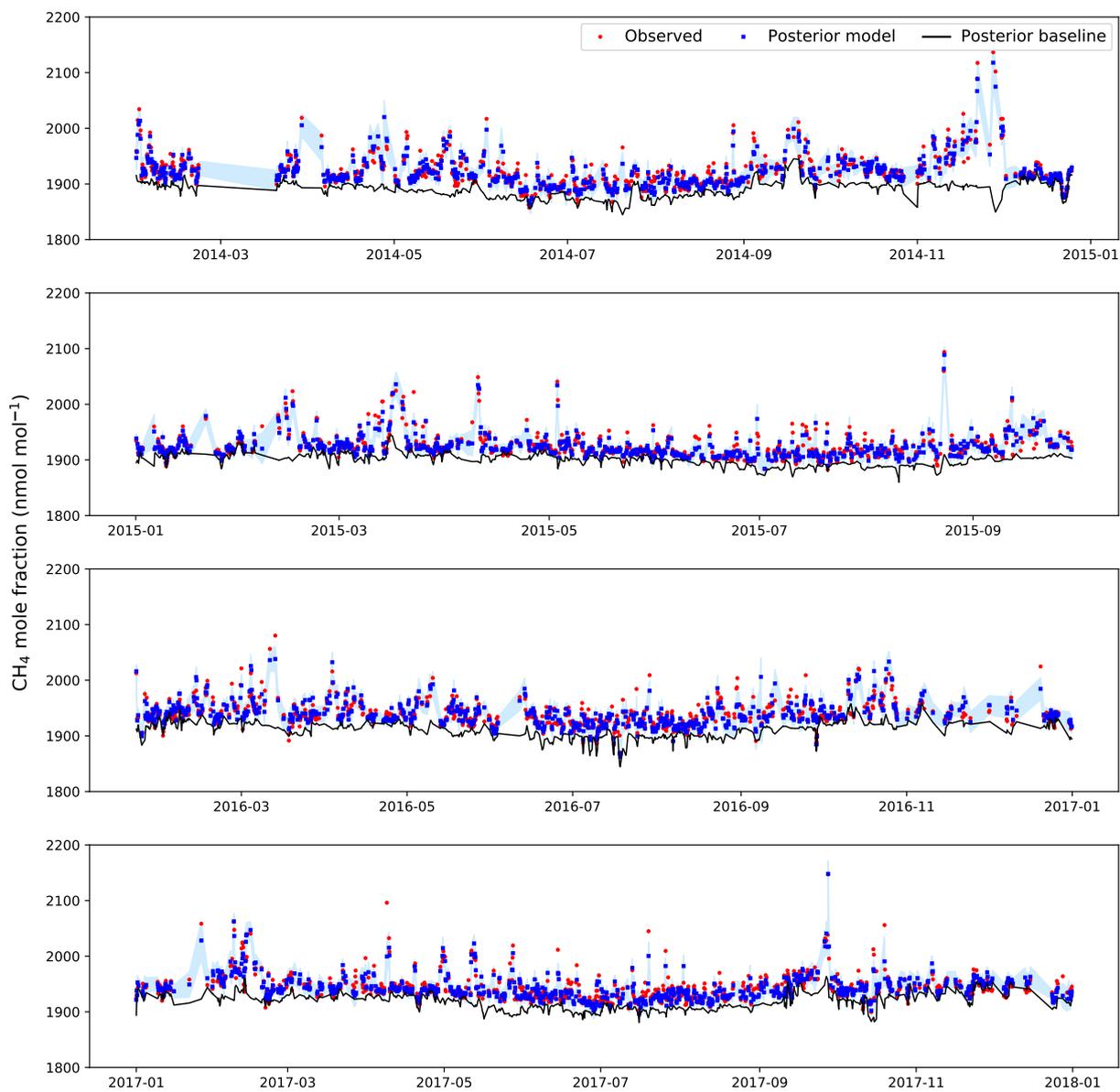
	S1	GEOS-Chem basis functions . . . . .	2
	S2	Bilsdale CH <sub>4</sub> data 2014–2017 . . . . .	3
	S3	Bilsdale CH <sub>4</sub> data 2018–2020 . . . . .	4
5	S4	Heathfield CH <sub>4</sub> data 2014–2017 . . . . .	5
	S5	Heathfield CH <sub>4</sub> data 2018–2020 . . . . .	6
	S6	Mace Head CH <sub>4</sub> data 2013–2016 . . . . .	7
	S7	Mace Head CH <sub>4</sub> data 2017–2020 . . . . .	8
	S8	Ridge Hill CH <sub>4</sub> data 2013–2016 . . . . .	9
10	S9	Ridge Hill CH <sub>4</sub> data 2017–2020 . . . . .	10
	S10	Tacolneston CH <sub>4</sub> data 2013–2016 . . . . .	11
	S11	Tacolneston CH <sub>4</sub> data 2017–2020 . . . . .	12
	S12	Angues CH <sub>4</sub> data 2013–2015 . . . . .	13
	S13	Glatton CH <sub>4</sub> data 2015 . . . . .	14
15	S14	Ferry CH <sub>4</sub> data 2014–2016 . . . . .	15
	S15	FAAM aircraft CH <sub>4</sub> data 2014 . . . . .	16
	S16	Observation count per site . . . . .	17
	S17	Posterior emission maps from rj-mcmc and InTEM . . . . .	18
	S18	Posterior difference maps from rj-mcmc . . . . .	19
20	S19	Summer 2018 anomaly maps from rj-mcmc and InTEM . . . . .	20
	S20	Differences between NAEI, EDGAR, flat and posterior distributions . . . . .	21
	S21	Impact of different priors on posterior emission estimates from MHD-TAC inversions . . . . .	22

## 1 Supplementary Figures



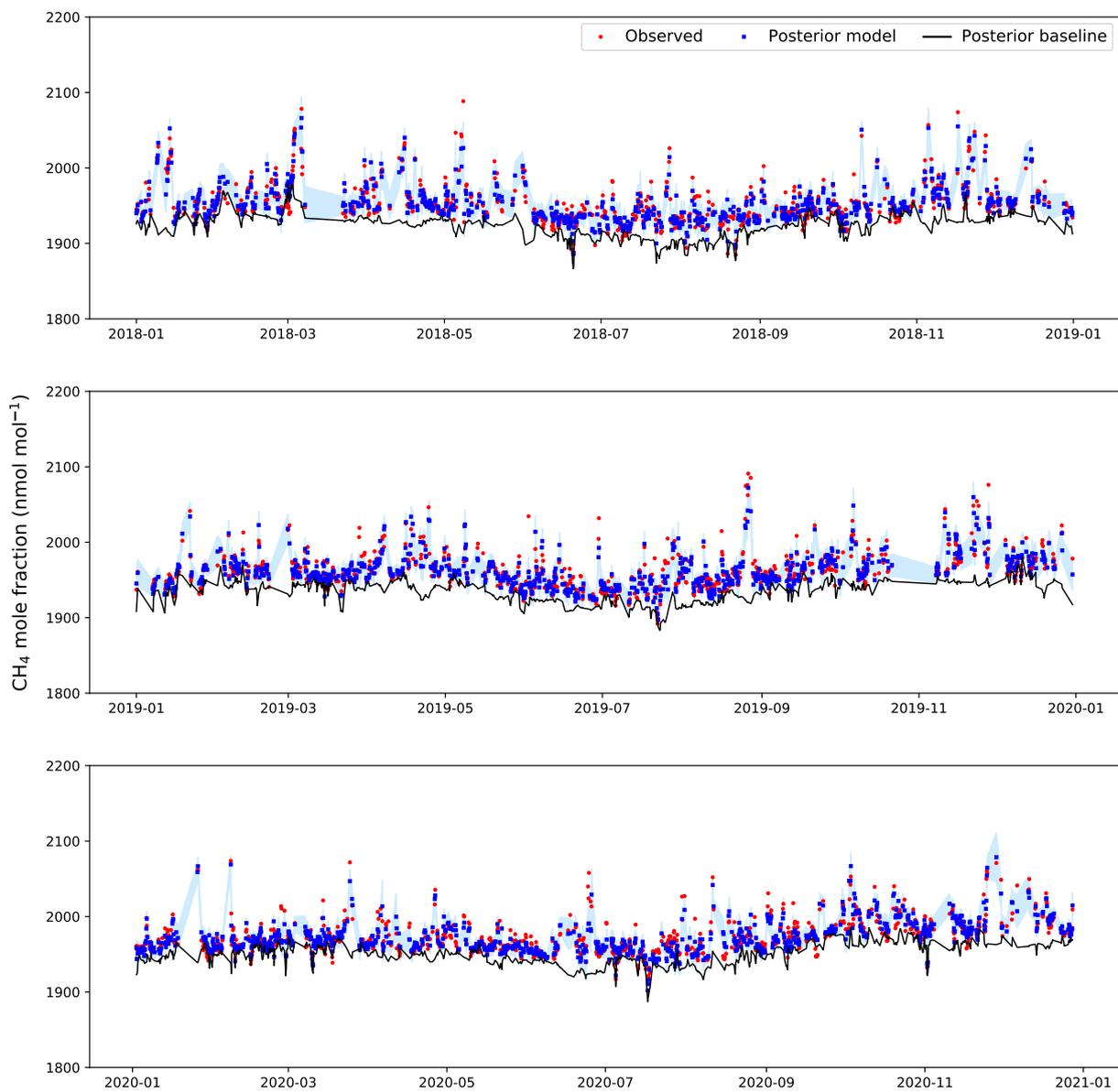
**Figure S1.** Arrangement of the fixed spatial basis functions used in the GEOS-Chem inversions.

BSD

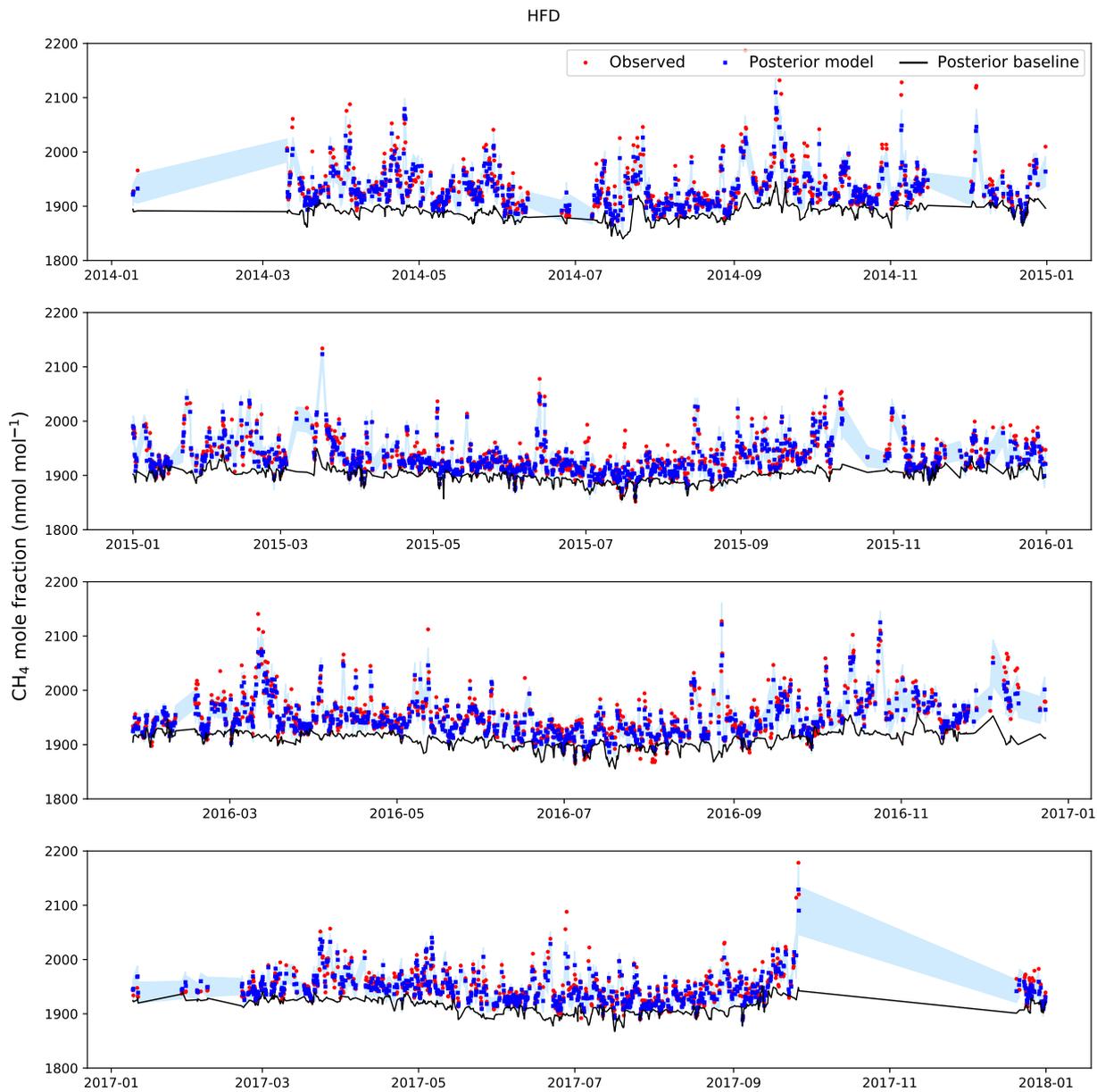


**Figure S2.** Observed (red) and modelled mole fractions (blue) at BSD between 2014–2017. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

BSD

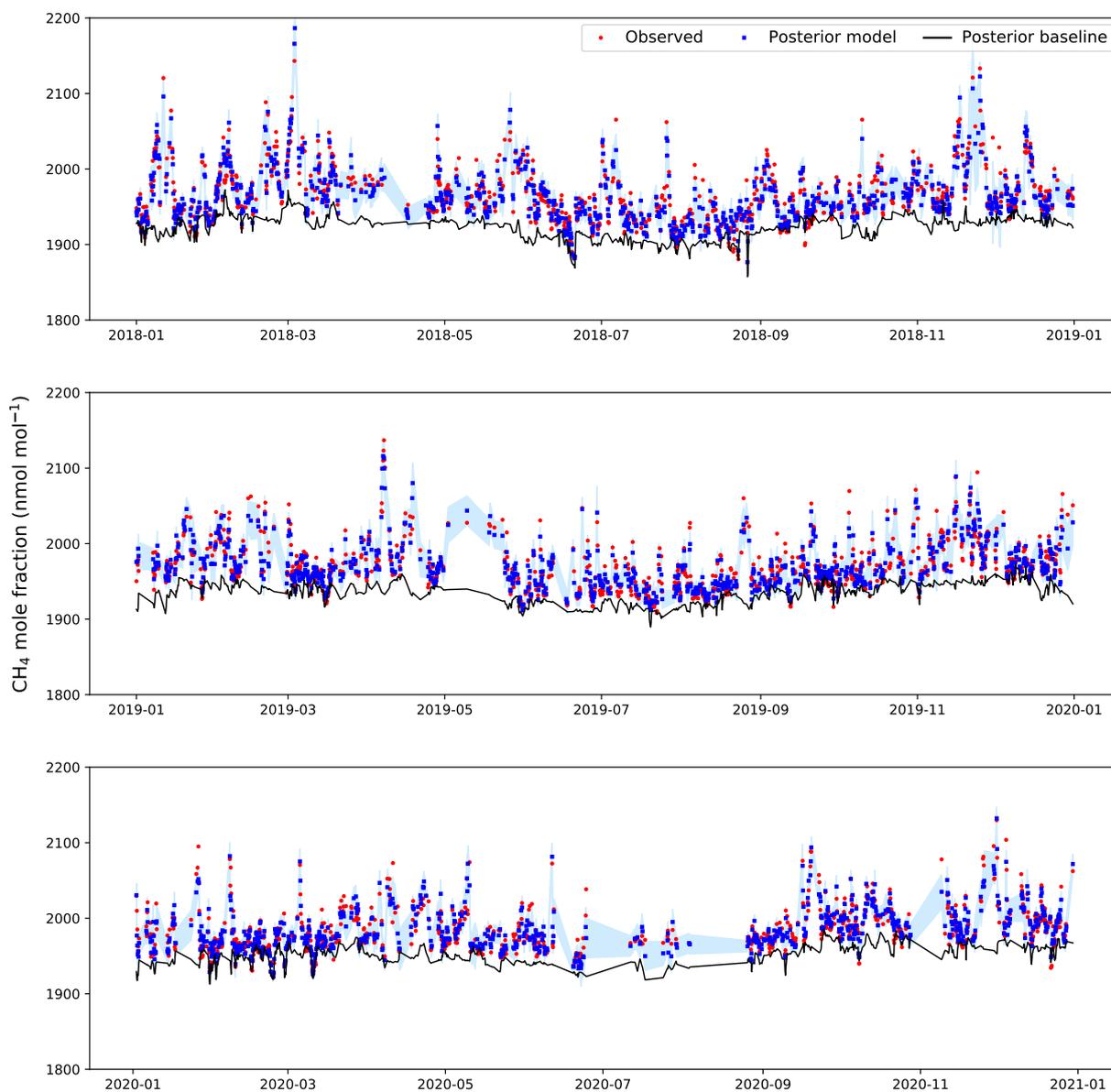


**Figure S3.** Observed (red) and modelled mole fractions (blue) at BSD between 2018–2020. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.



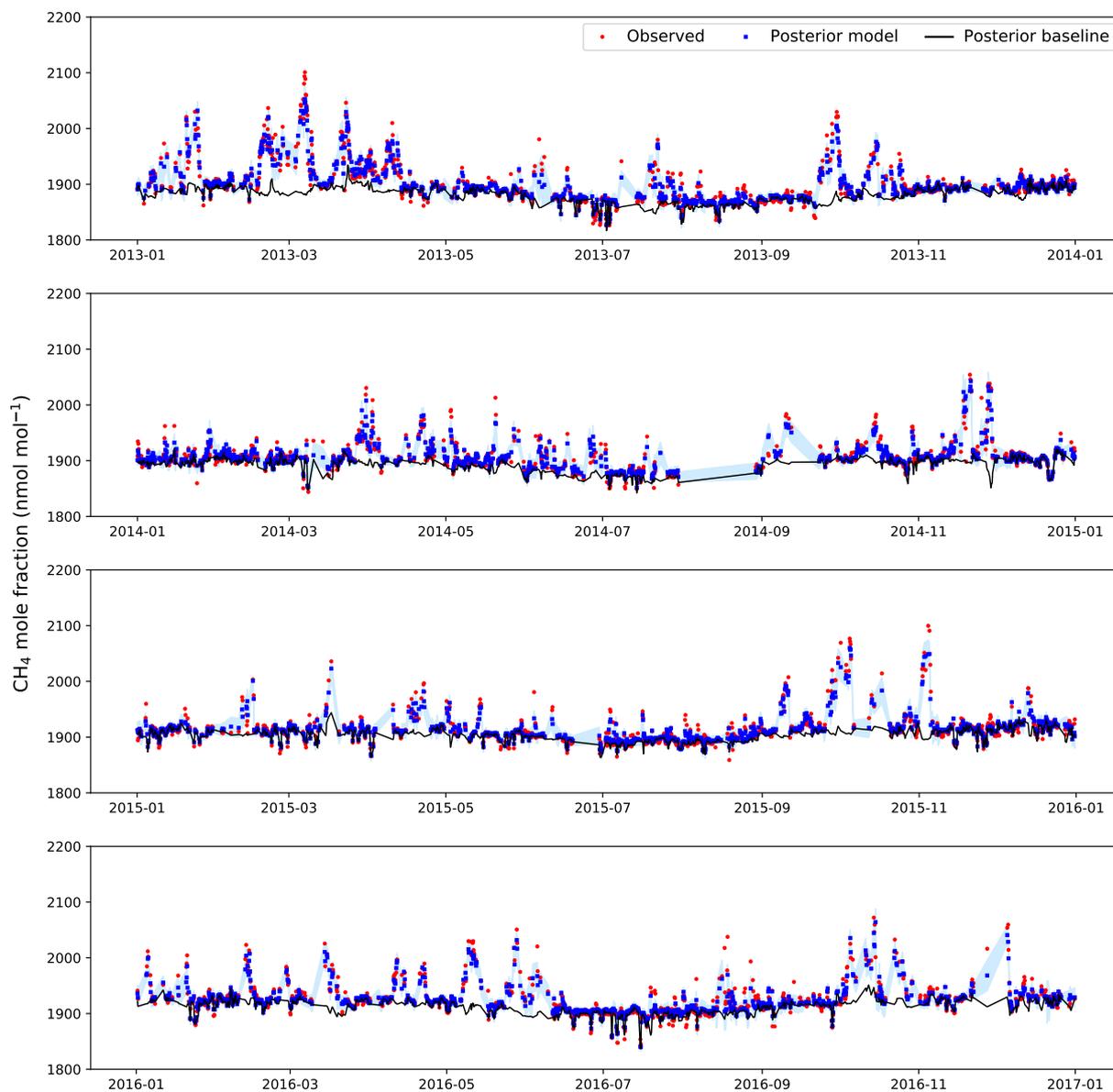
**Figure S4.** Observed (red) and modelled mole fractions (blue) at HFD between 2014–2017. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

HFD

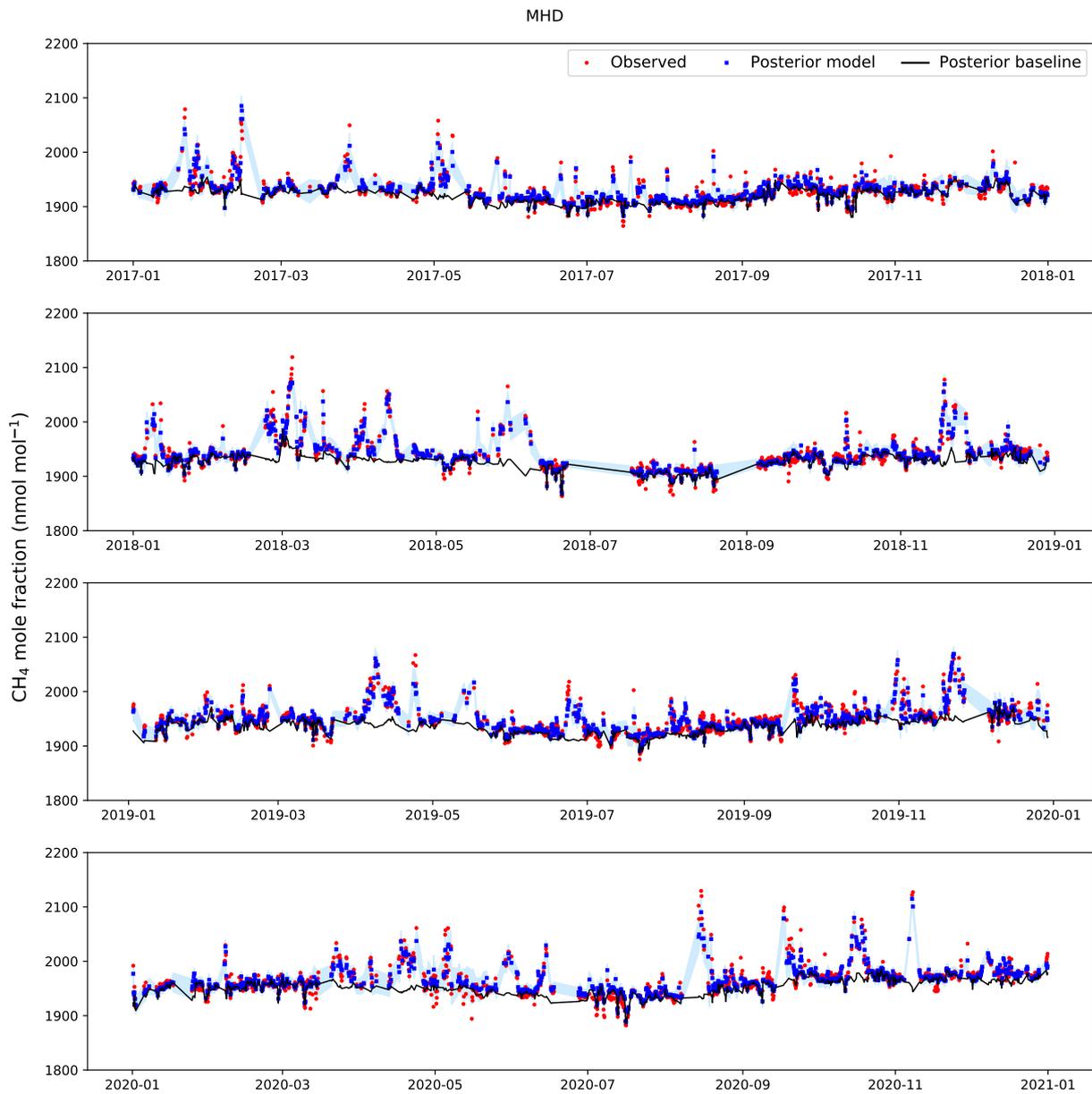


**Figure S5.** Observed (red) and modelled mole fractions (blue) at HFD between 2018–2020. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

MHD

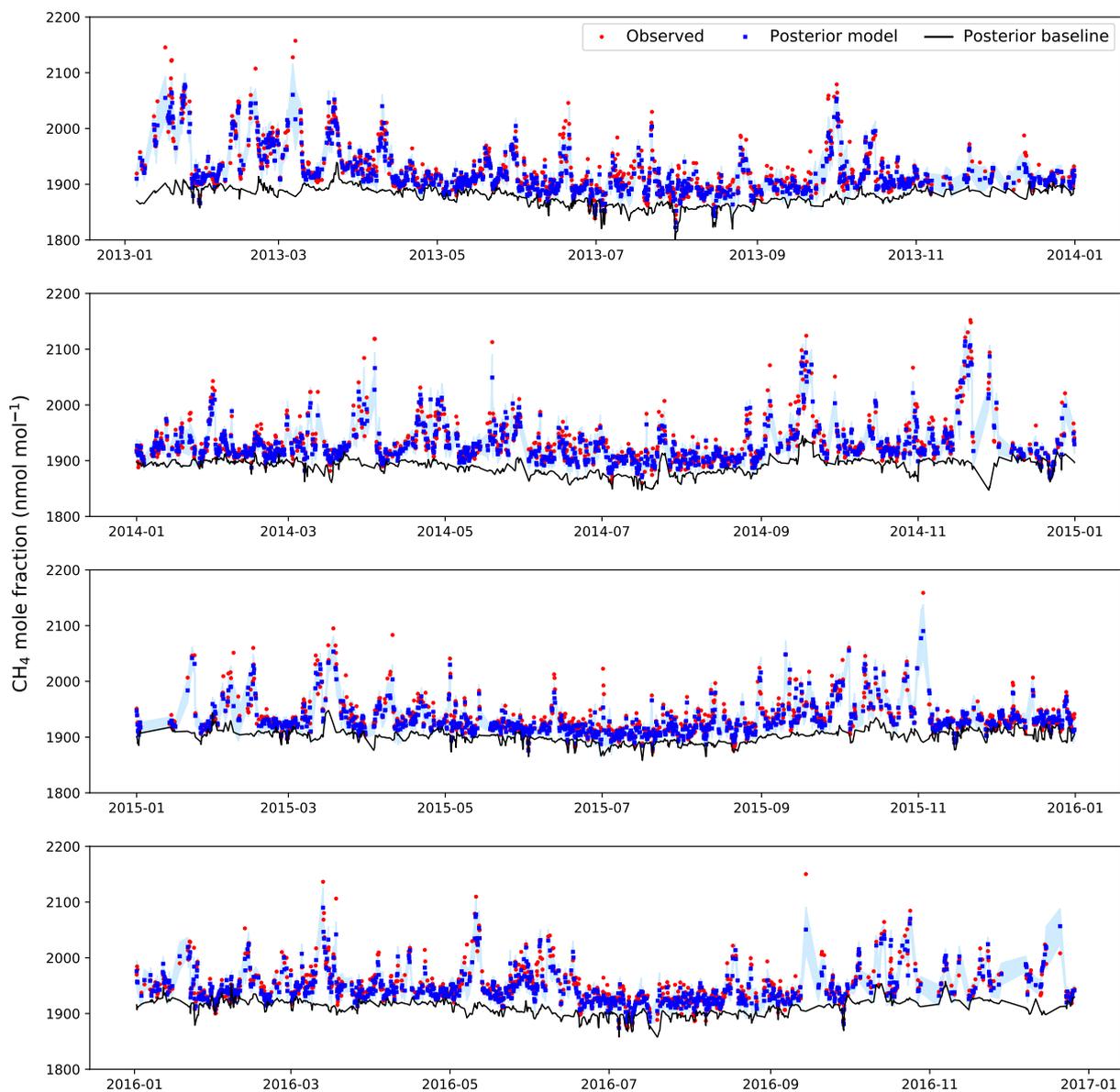


**Figure S6.** Observed (red) and modelled mole fractions (blue) at MHD between 2013–2016. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.



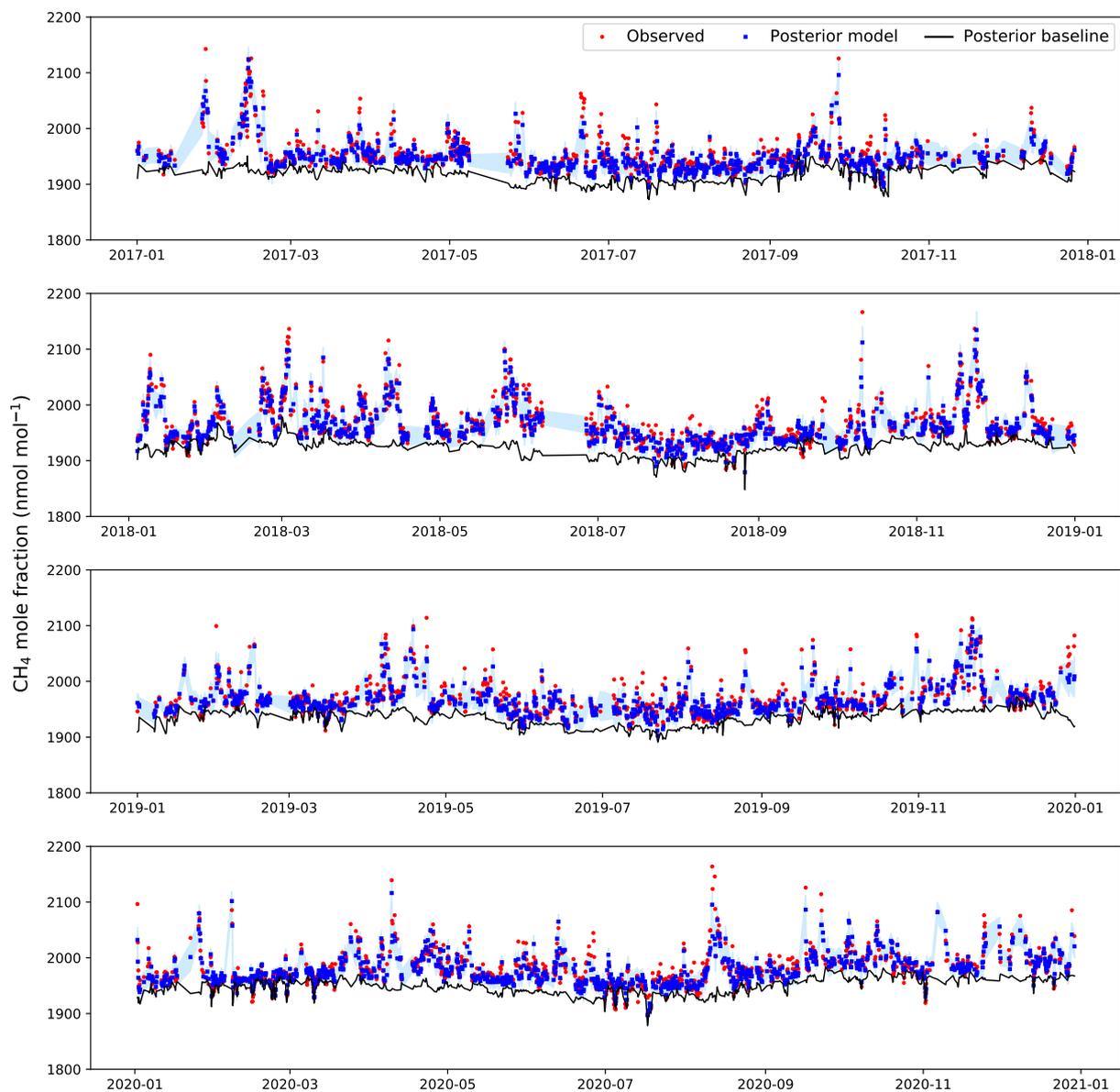
**Figure S7.** Observed (red) and modelled mole fractions (blue) at MHD between 2017–2020. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

RGL

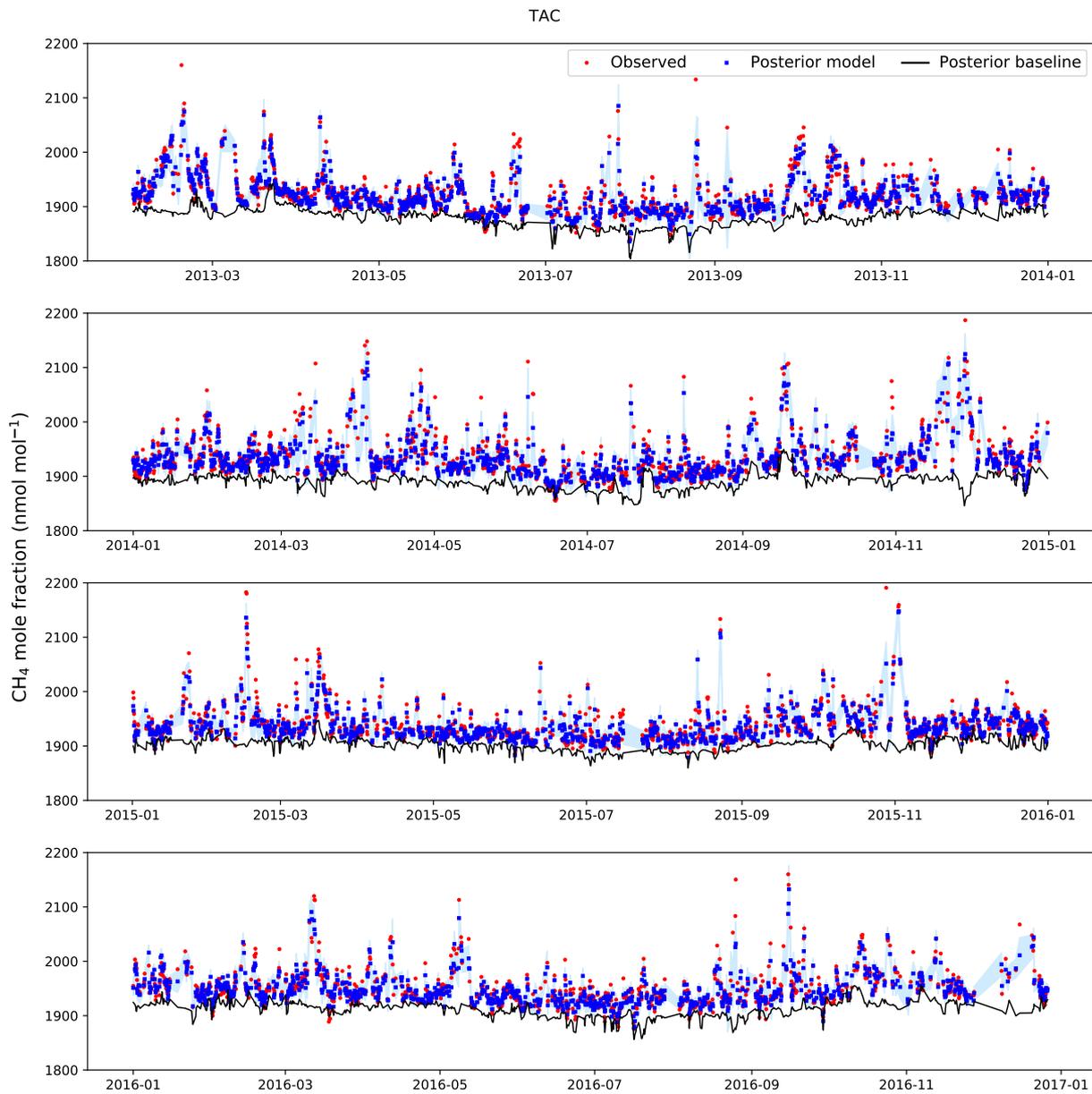


**Figure S8.** Observed (red) and modelled mole fractions (blue) at RGL between 2013–2016. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

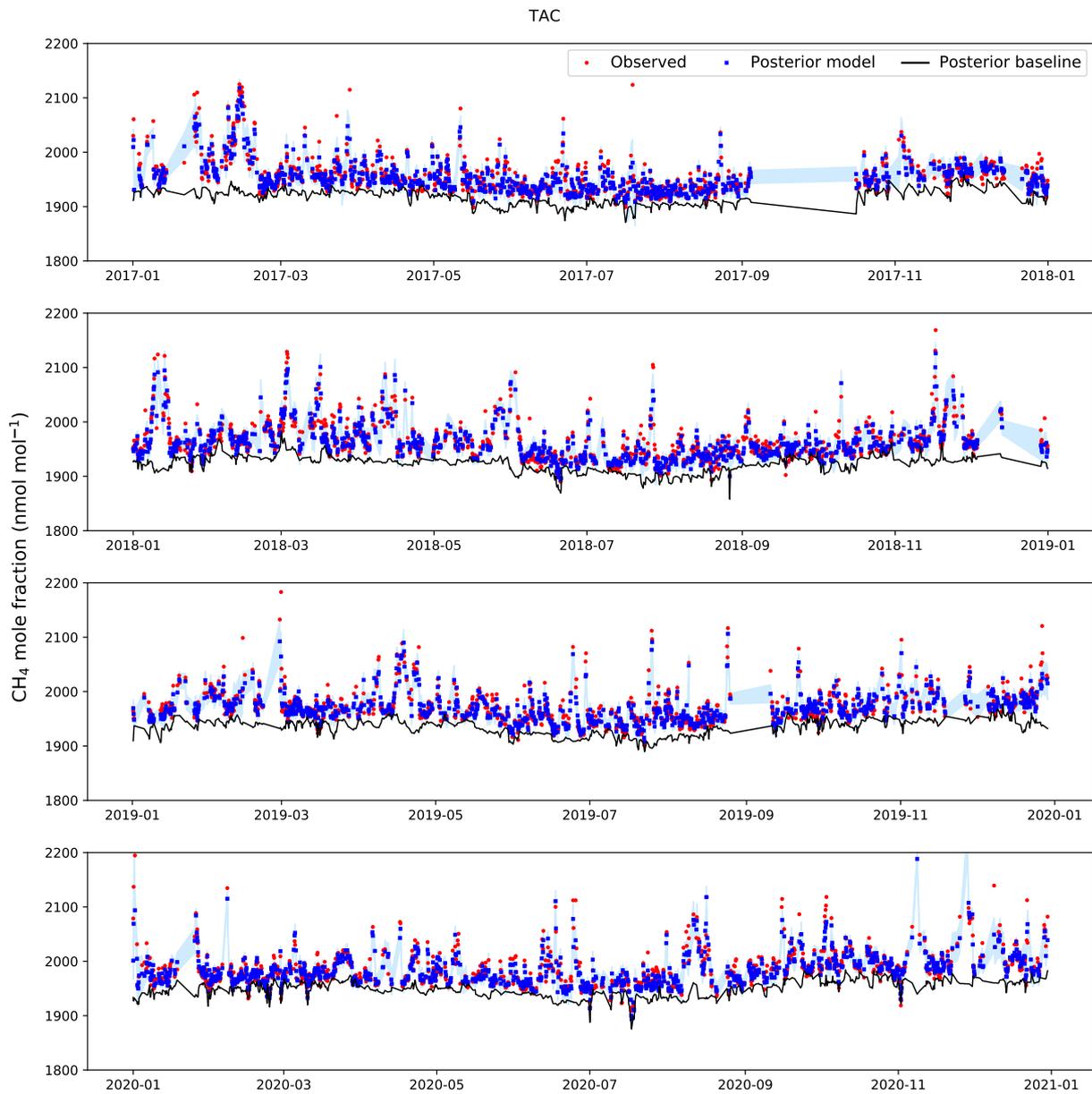
RGL



**Figure S9.** Observed (red) and modelled mole fractions (blue) at RGL between 2017–2020. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

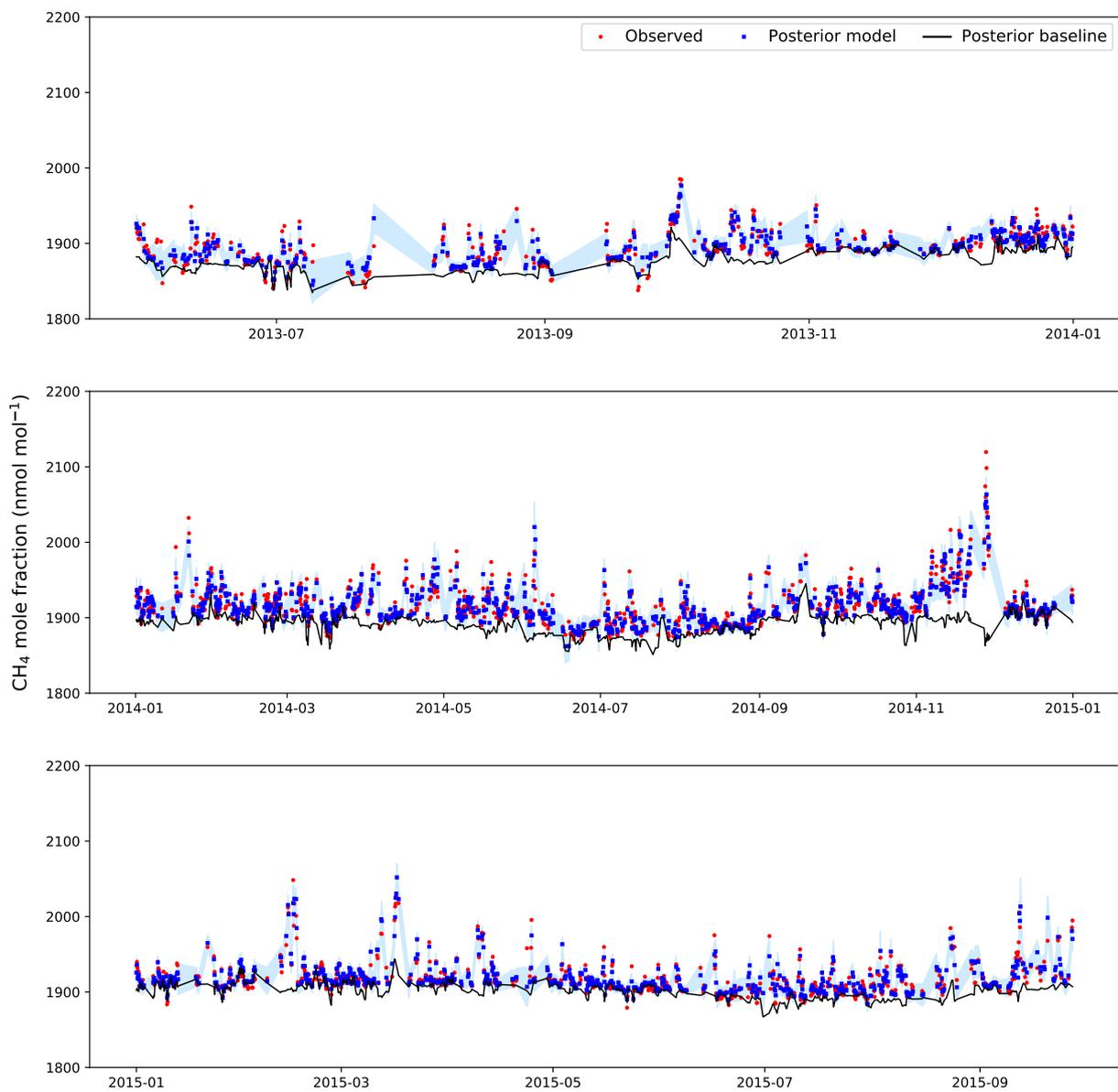


**Figure S10.** Observed (red) and modelled mole fractions (blue) at TAC between 2013–2016. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.



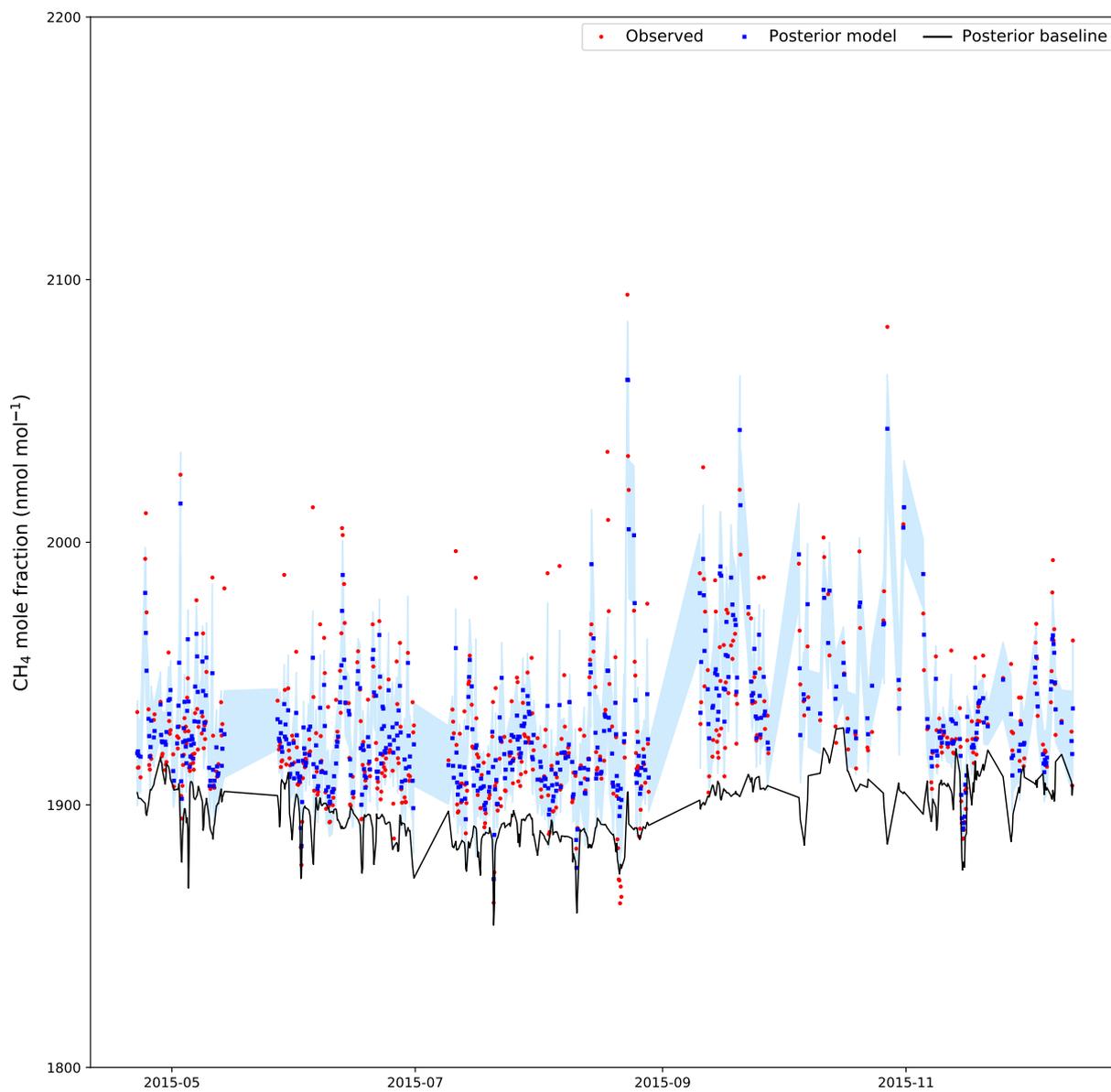
**Figure S11.** Observed (red) and modelled mole fractions (blue) at TAC between 2017–2020. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

TTA

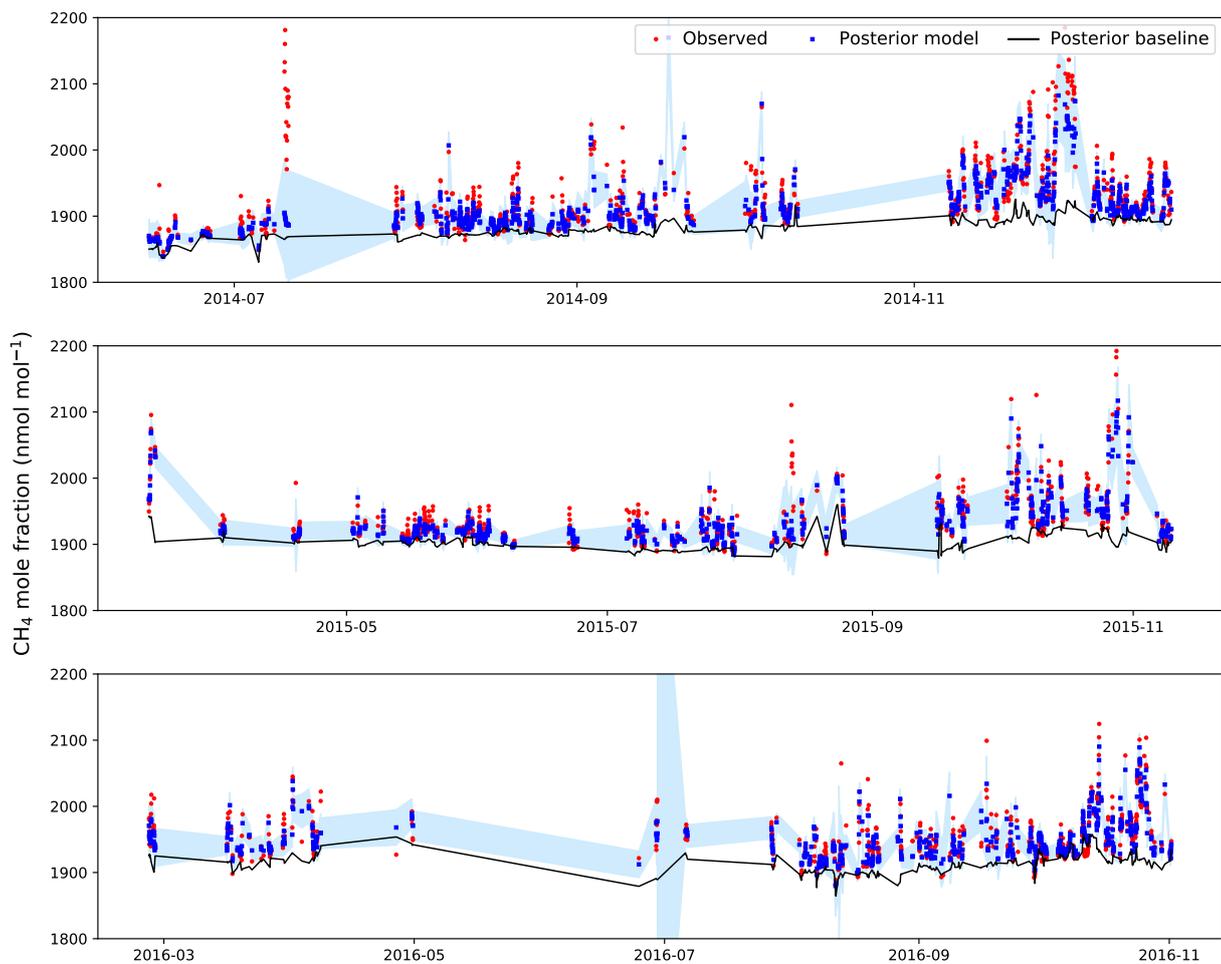


**Figure S12.** Observed (red) and modelled mole fractions (blue) at TTA between 2013–2015. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.

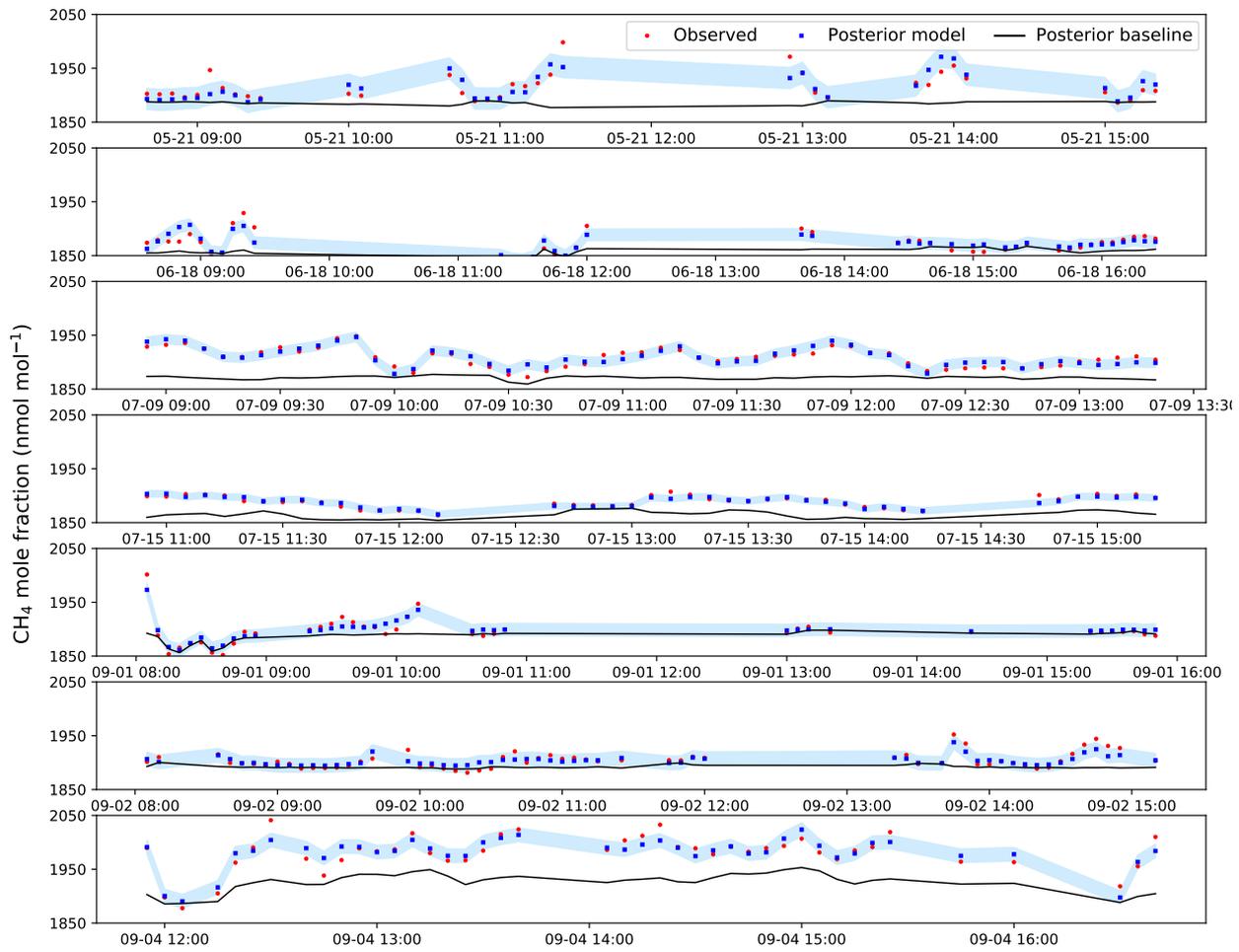
GLA



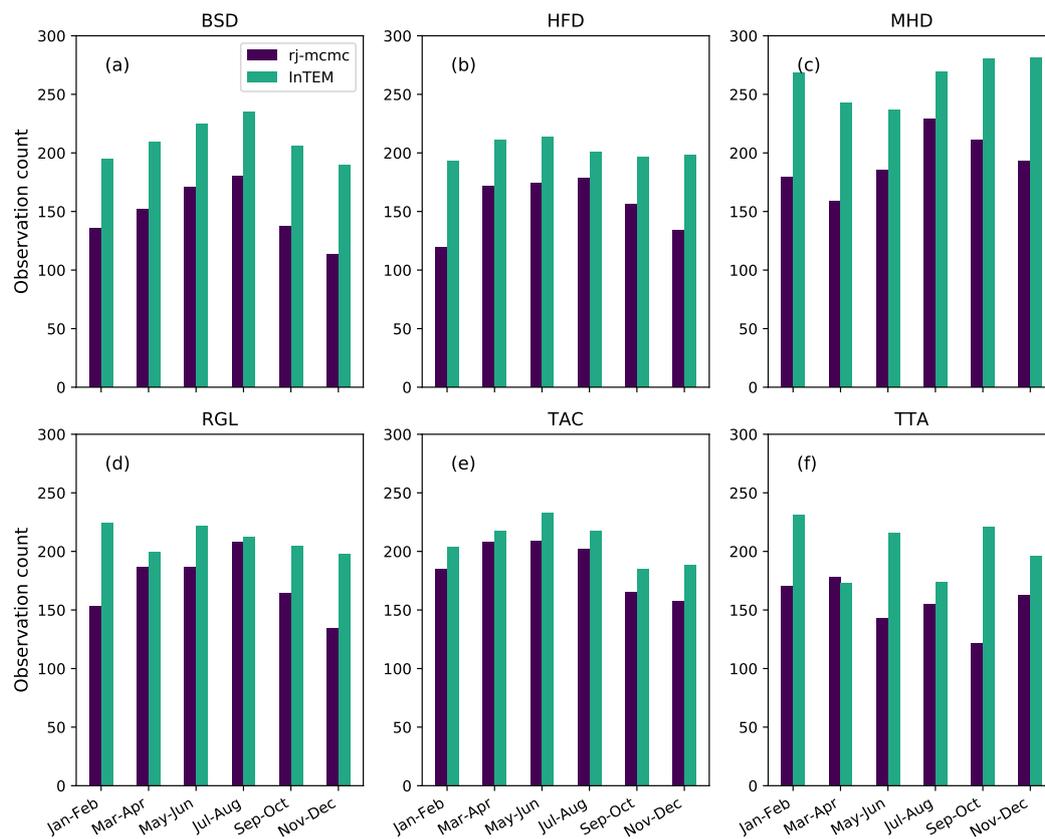
**Figure S13.** Observed (red) and modelled mole fractions (blue) at GLA during 2015. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.



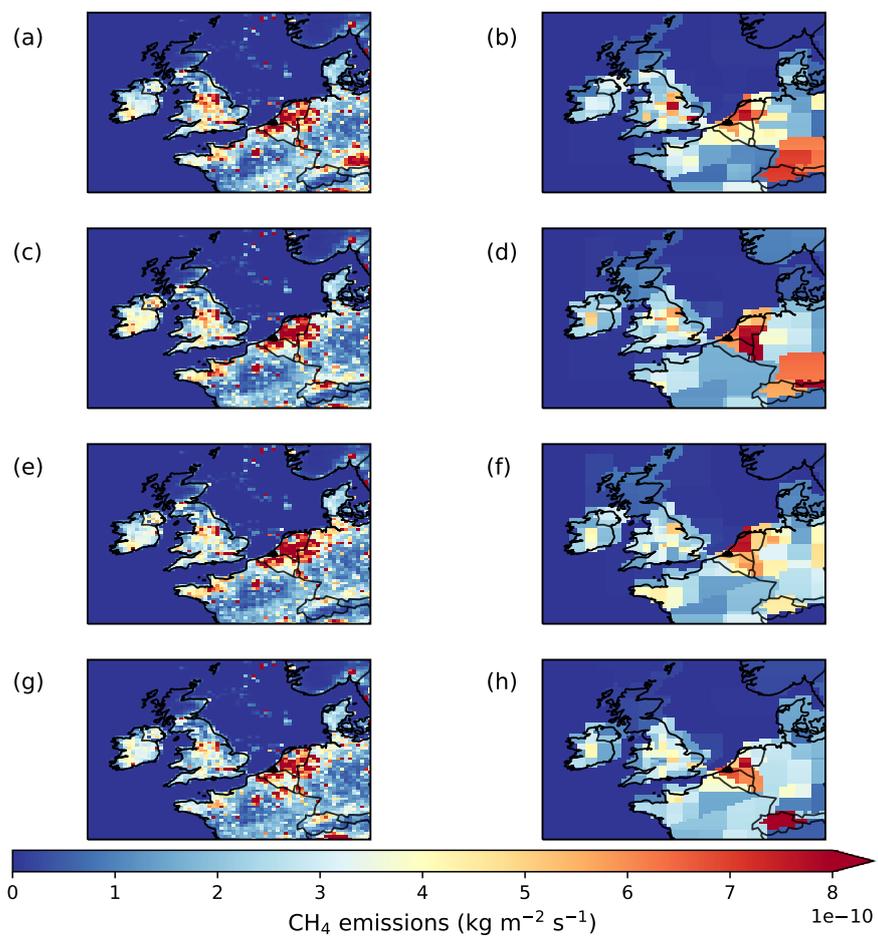
**Figure S14.** Observed (red) and modelled mole fractions (blue) from the DFDS ferry between 2014–2016. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.



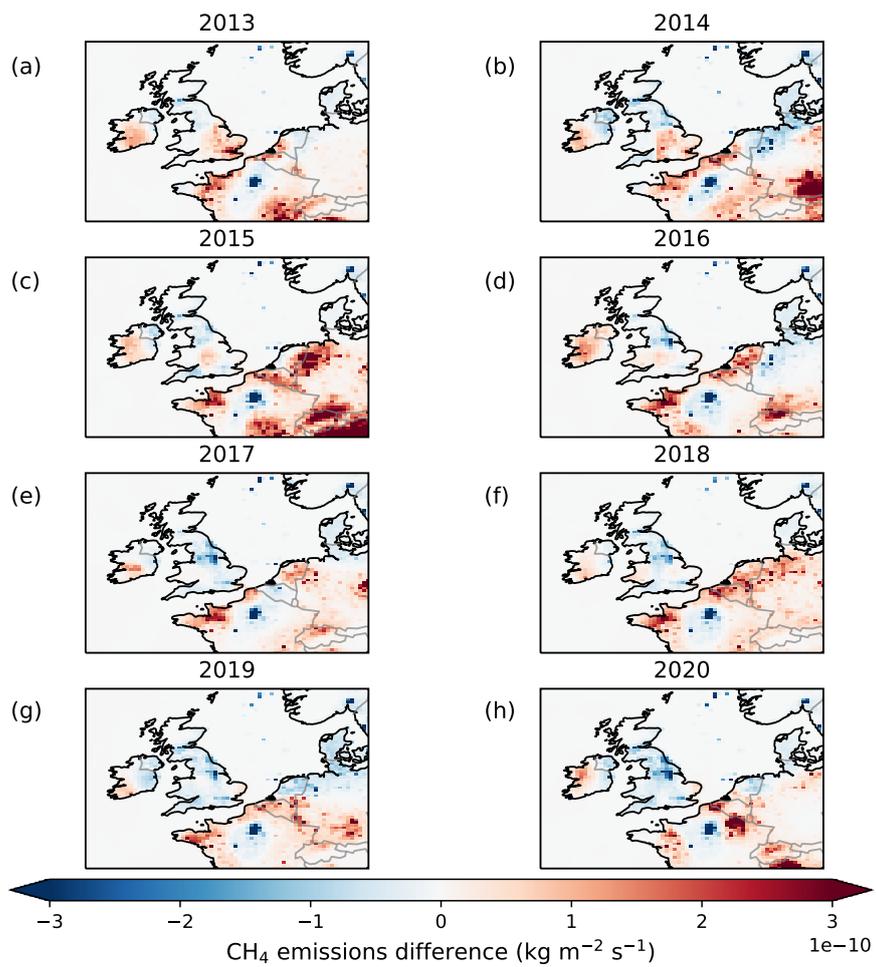
**Figure S15.** Observed (red) and modelled mole fractions (blue) from the FAAM aircraft during 2014. The posterior modelled baseline is shown in black. Shading represents the posterior model-measurement uncertainty.



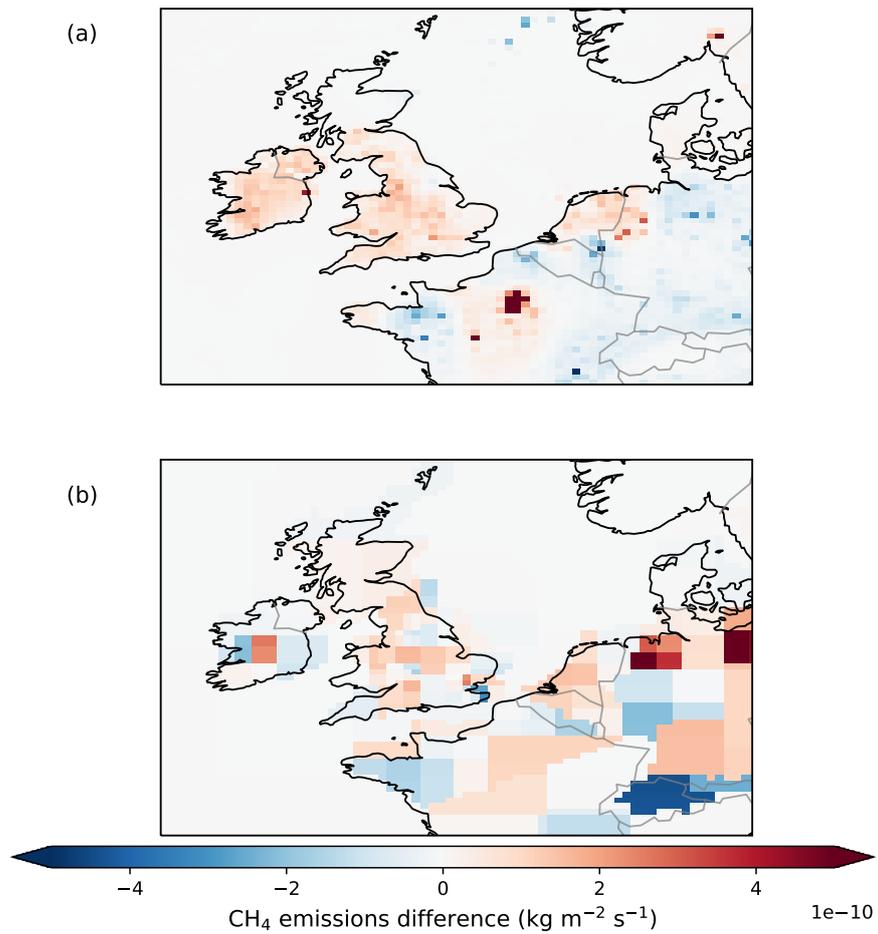
**Figure S16.** Number of 4-hour average observations used in the rj-mcmc and InTEM inversions at each site per 2-month period. 2-monthly counts are the average in each 2-month period across all years.



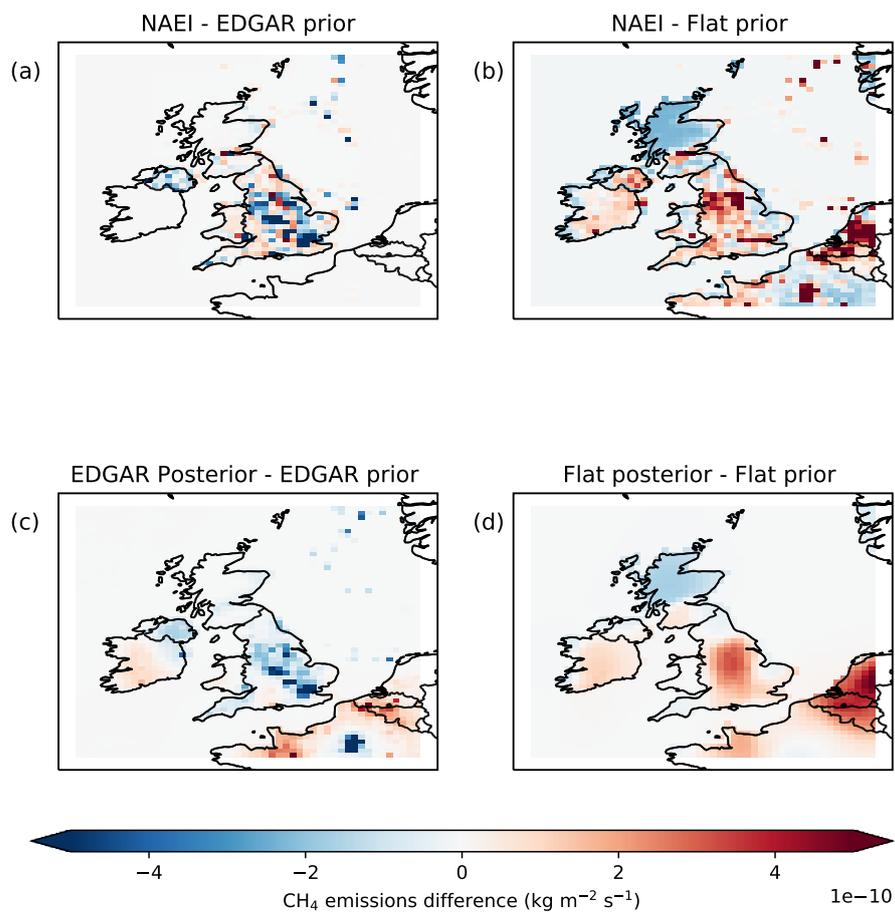
**Figure S17.** Posterior annual mean emissions distribution from rj-mcmc and InTEM inversions. The left column shows the rj-mcmc distributions and the right column InTEM for (a)–(b) 2014, (c)–(d) 2016, (e)–(f) 2018, (g)–(h) 2020.



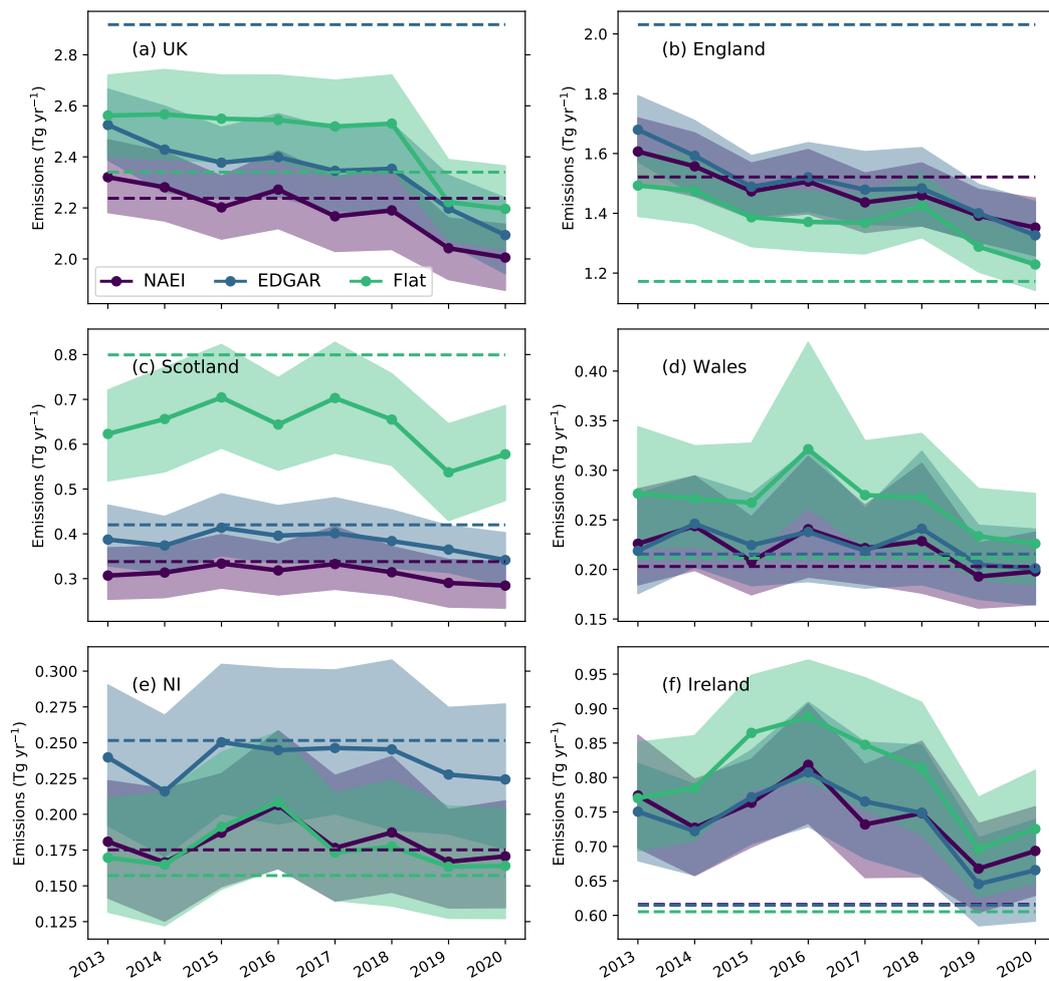
**Figure S18.** Annual mean emissions difference between the posterior and prior distributions from the rj-mcmc inversions between 2013–2020.



**Figure S19.** Posterior distribution of the summer 2018 (May–August) anomaly from the 2018 posterior mean emissions from (a) the rj-mcmc and (b) InTEM inversions. The distribution show the positive anomaly over the UK was fairly uniformly distributed and primarily from central and western areas.



**Figure S20.** Maps of the differences between the different prior distributions and the respective posteriors. (a) the difference between the NAEI prior and EDGAR; (b) the difference between the NAEI and flat prior; (c) posterior mean from the EDGAR prior inversion minus EDGAR prior; (d) posterior mean from the flat prior inversion minus flat prior. The posterior differences are broadly similar to the differences between the NAEI and the respective priors.



**Figure S21.** Annual mean emissions between 2013–2020 for MHD-TAC inversions using different prior distributions from the NAEI (purple), EDGAR (blue) and a flat distribution (green). Estimates are shown for (a) the UK, (b) England, (c) Scotland, (d) Wales, (e) NI and (f) Ireland. Shading represents the 95% confidence interval. Dashed lines represent the magnitudes of the respective priors.