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# Methane fluxes in the high northern latitudes for 2005–2013 estimated using a Bayesian atmospheric inversion

**Rona L. Thompson et al.**

*Correspondence to:* Rona L. Thompson (rlt@nilu.no)

**Table 1**. Inversion cost a priori and a posteriori for the three different scenarios shown for 2009 (other years were analogous).

| Scenario | Cost a priori | Cost a posteriori |
|---|---|---|
| S1 | 57737 | 17531 |
| S2 | 57278 | 17378 |
| S3 | 51472 | 13352 |

**Table 2**. Comparison of the prior and posterior mixing ratios (scenario S1) with observations shown for 2009 (other years were analogous). Note the mean error is calculated as the mean of the prior (or posterior) minus the observed mixing ratio.

| Site ID | Prior | | | Posterior | | |
|---|---|---|---|---|---|---|
| | R | NSD | mean error | R | NSD | mean error |
| ZEP | 0.36 | 0.95 | -4.66 | 0.40 | 0.89 | -3.71 |
| PAL | 0.65 | 1.25 | 2.29 | 0.68 | 1.05 | 0.51 |
| IGR | 0.49 | 0.34 | -81.55 | 0.67 | 0.83 | -27.93 |
| YAK | 0.35 | 0.68 | -6.96 | 0.68 | 0.83 | -0.83 |
| DEM | 0.68 | 0.78 | -33.02 | 0.75 | 1.13 | -5.89 |
| KRS | 0.63 | 0.64 | -38.11 | 0.82 | 1.00 | -7.11 |
| AZV | 0.38 | 1.39 | -20.15 | 0.42 | 1.39 | -14.21 |
| VGN | 0.49 | 0.89 | -13.10 | 0.74 | 0.98 | -1.94 |
| ZOT | 0.55 | 0.75 | -12.26 | 0.72 | 1.14 | 0.54 |
| CHL | 0.51 | 0.70 | -4.97 | 0.74 | 1.04 | -5.90 |
| LLB | 0.66 | 0.21 | -68.10 | 0.80 | 0.67 | -21.48 |
| ETL | 0.49 | 0.29 | -24.41 | 0.74 | 0.89 | -0.64 |
| FSD | 0.35 | 0.71 | -13.95 | 0.57 | 0.80 | -8.97 |
| CHM | 0.10 | 0.64 | -10.89 | 0.35 | 0.67 | -7.55 |
| ESP | 0.08 | 0.44 | -5.40 | 0.20 | 1.10 | -1.20 |
| CBA | 0.18 | 0.42 | -6.66 | 0.54 | 0.58 | -2.09 |
| MHD | 0.45 | 1.25 | 1.81 | 0.45 | 0.93 | -0.37 |
| BAL | 0.44 | 0.92 | 3.89 | 0.62 | 0.88 | 0.20 |

**Figure 1a**. Comparison of atmospheric $CH_4$ mixing ratios in winter 2008 – 2009 (left) and in summer 2009 (right). The error bars show the calculated observation uncertainty used in the inversions (observations = black, background = green, S1 prior = blue, S1 posterior = red). The full site names and details are provided in Table 1.

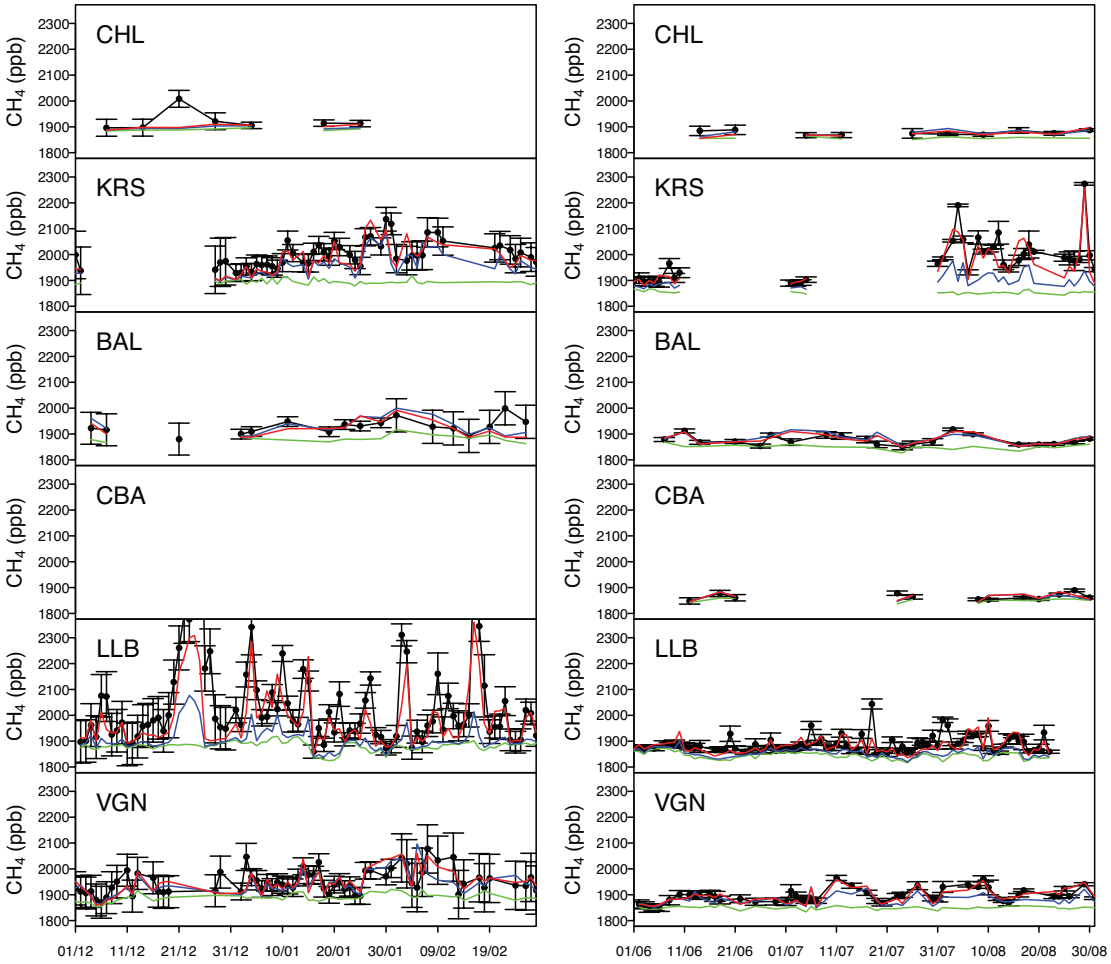

**Figure 1b**. Same as Fig. 1a but for a different set of sites.

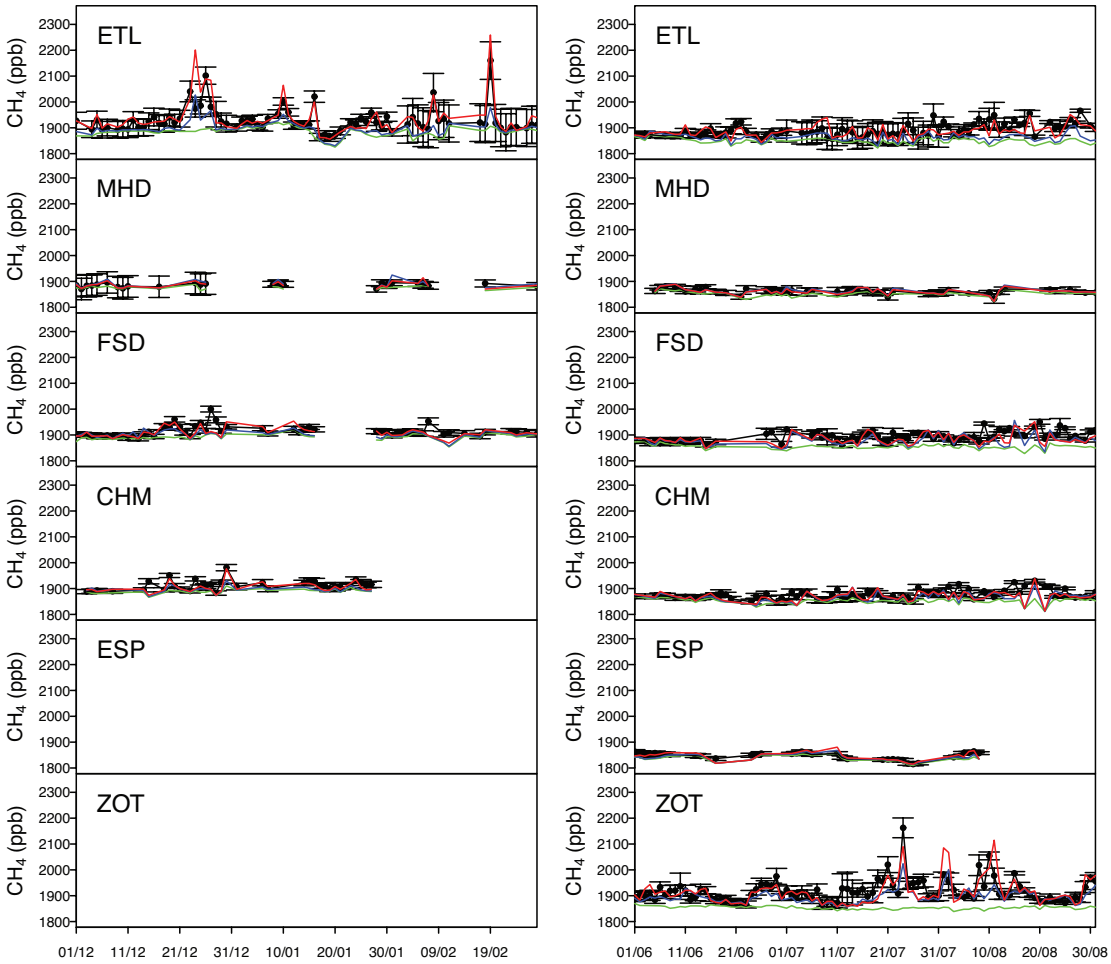

**Figure S1c**. Same as Fig. 1a but for a different set of sites.

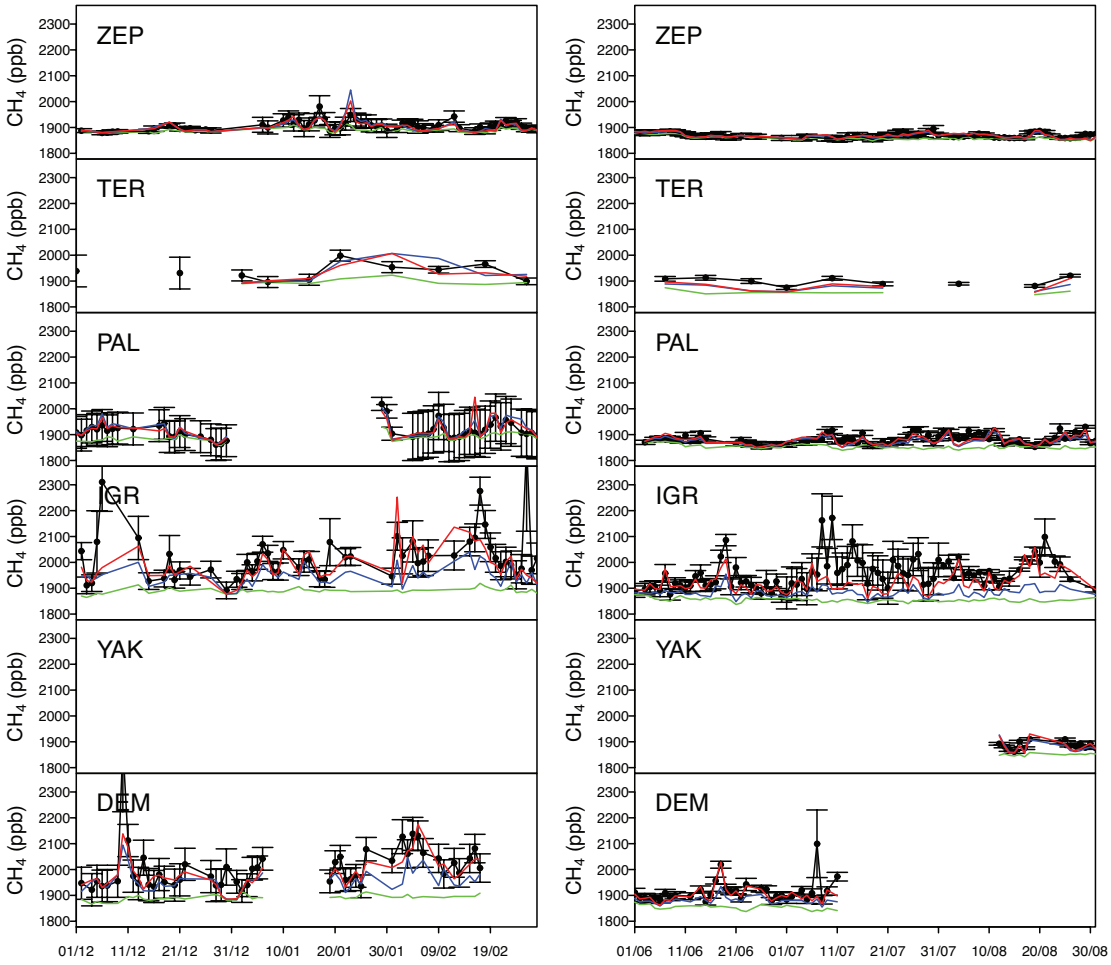

**Figure 2**. Calculated uncertainties by site and month (units of ppb) for the transport within the domain (a) and for the background mixing ratios (b).

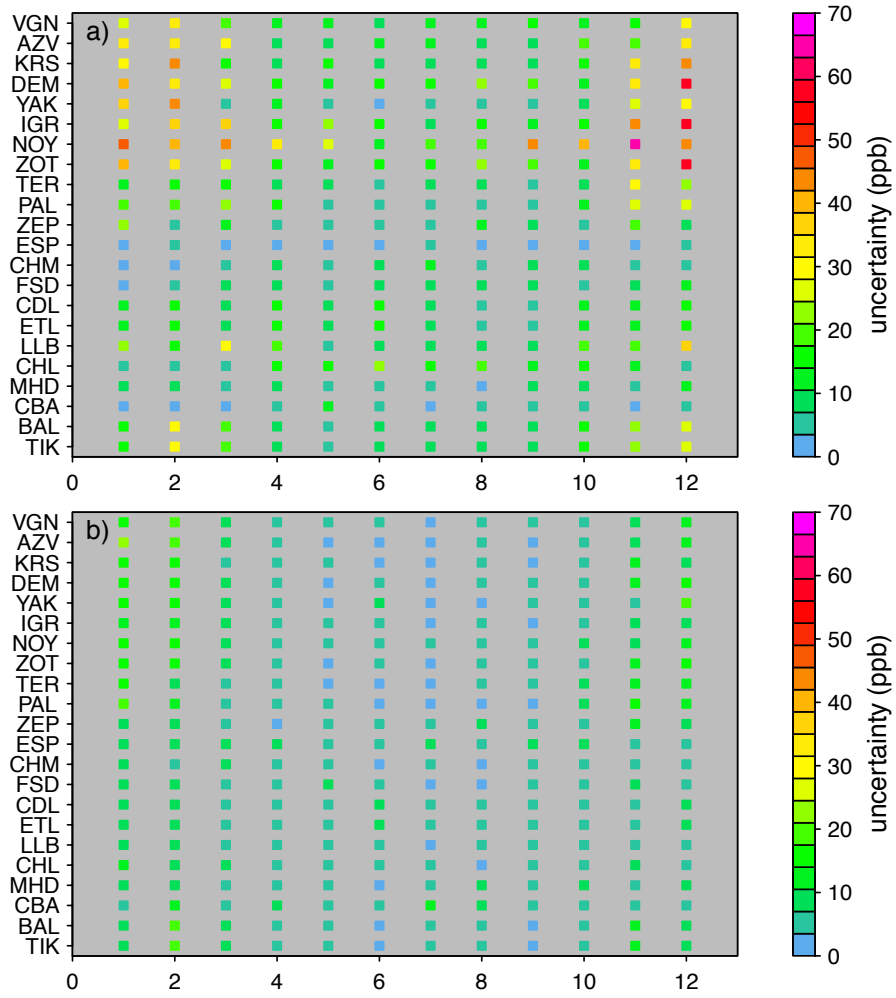

**Figure 3**. Distribution of the observation-model $CH_4$ mixing ratio mismatches a priori (blue) and a posteriori (red). Also shown are the assumed observation uncertainty distributions (grey).

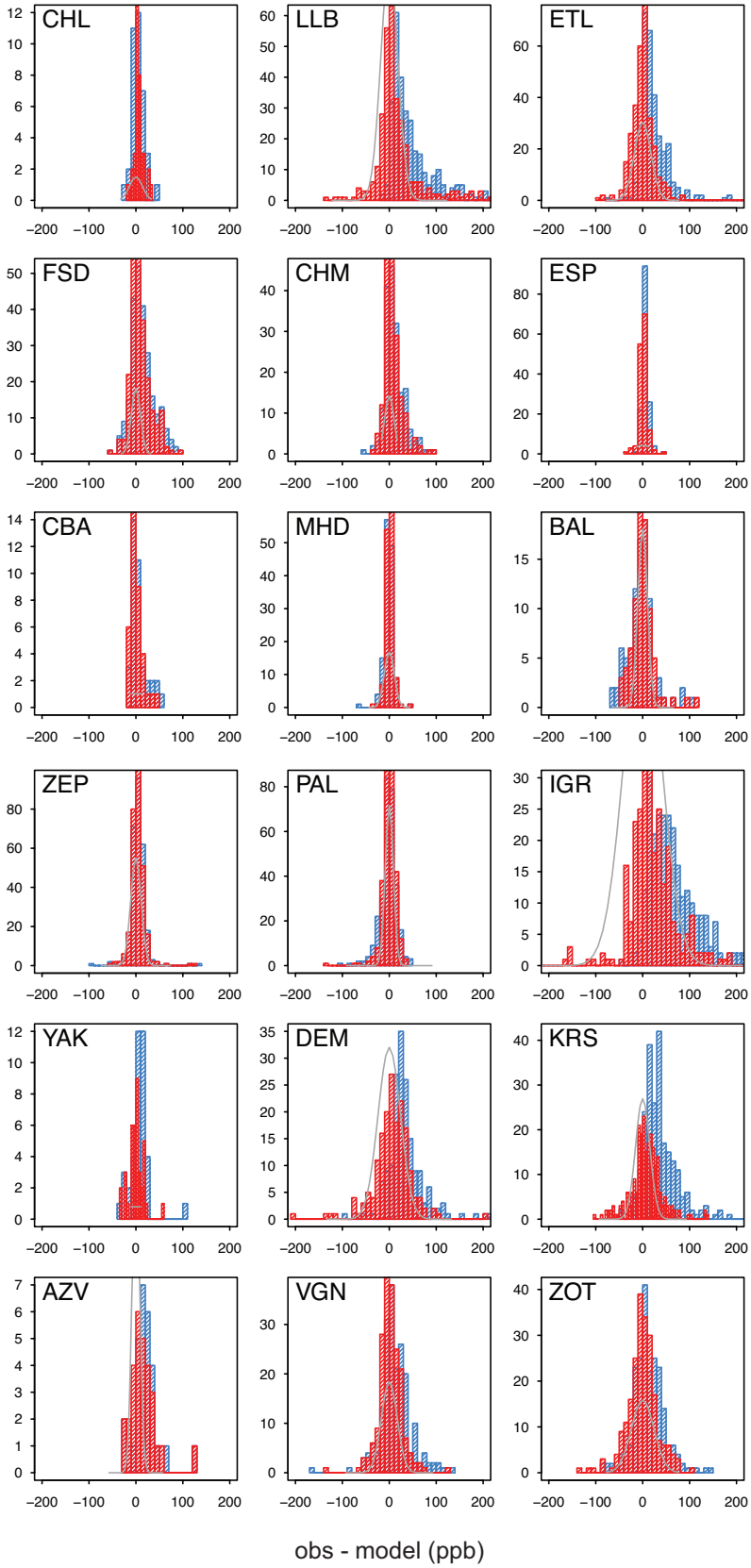

**Figure 4**. Temporal distribution of atmospheric observations (number of observations per month).

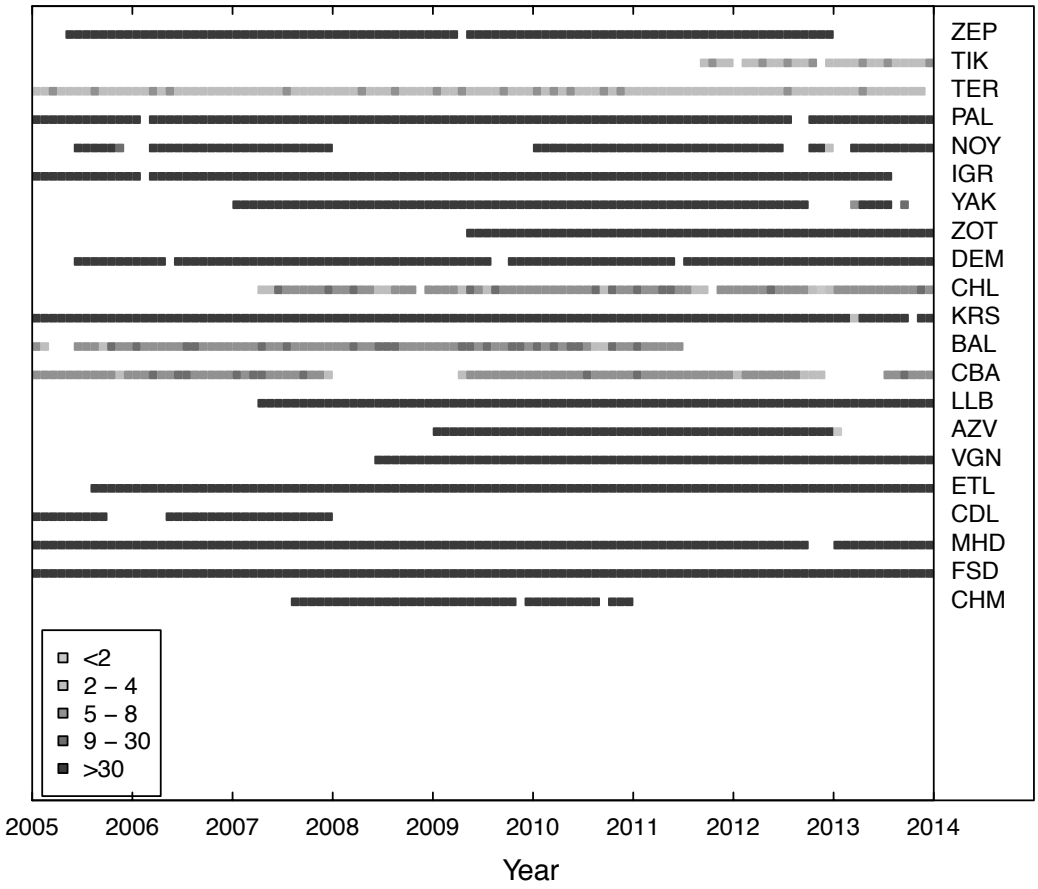

**Figure 5**. Correlation of $CH_4$ fluxes with different environmental parameters for 2005 to 2013. Shown are the correlations with soil temperature (a), soil water volume (b), precipitation (c) and snow depth (d). (Note white means no significant correlation).