Using $\delta^{13}C$-CH_4 observations to constrain european CH_4 emissions

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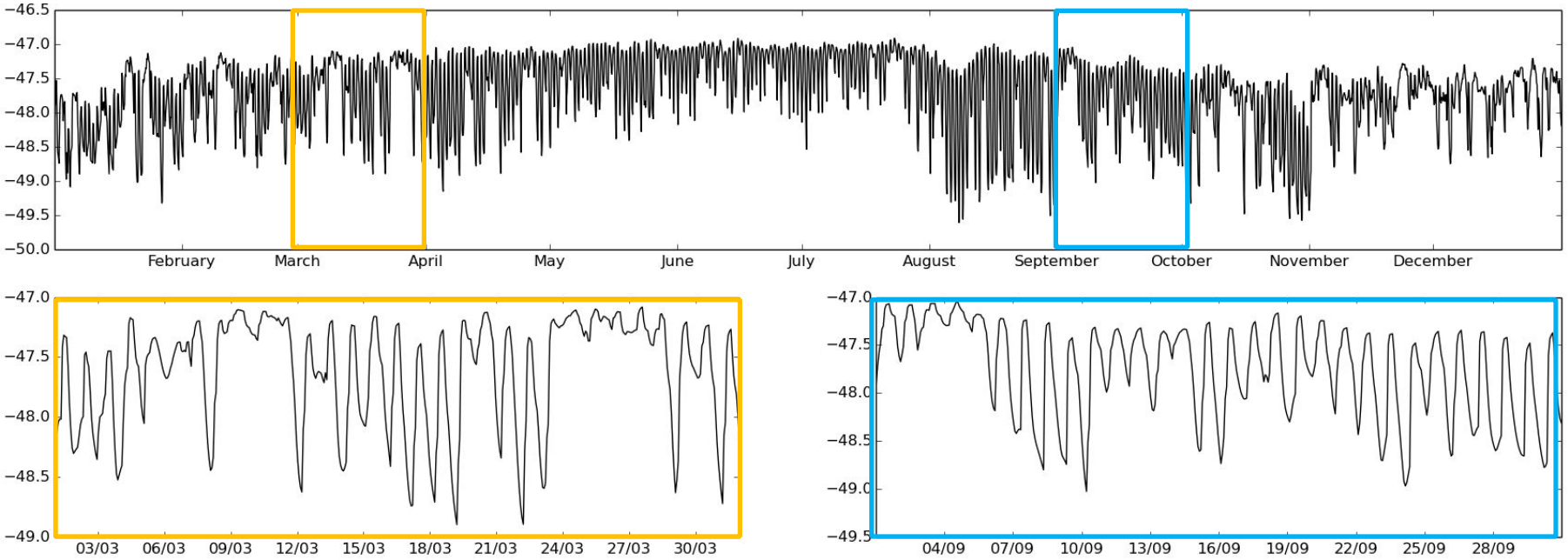
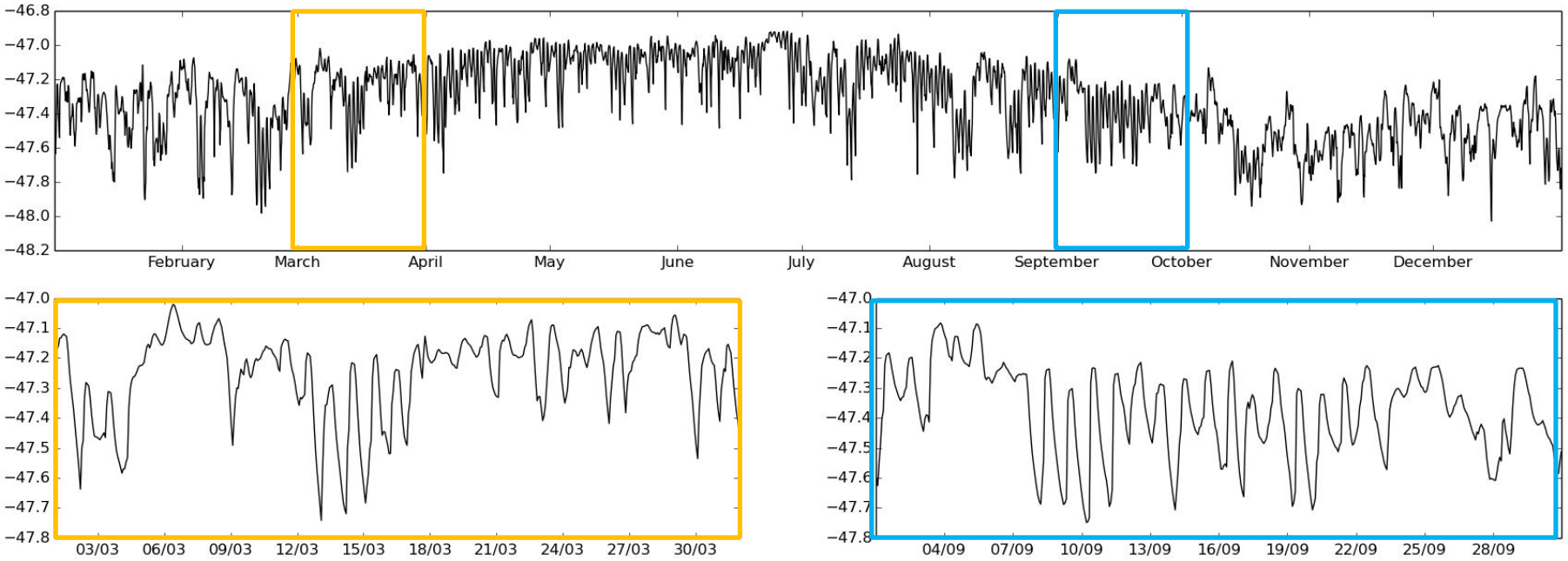
Model results: base scenario

Dubendorf (Switzerland)



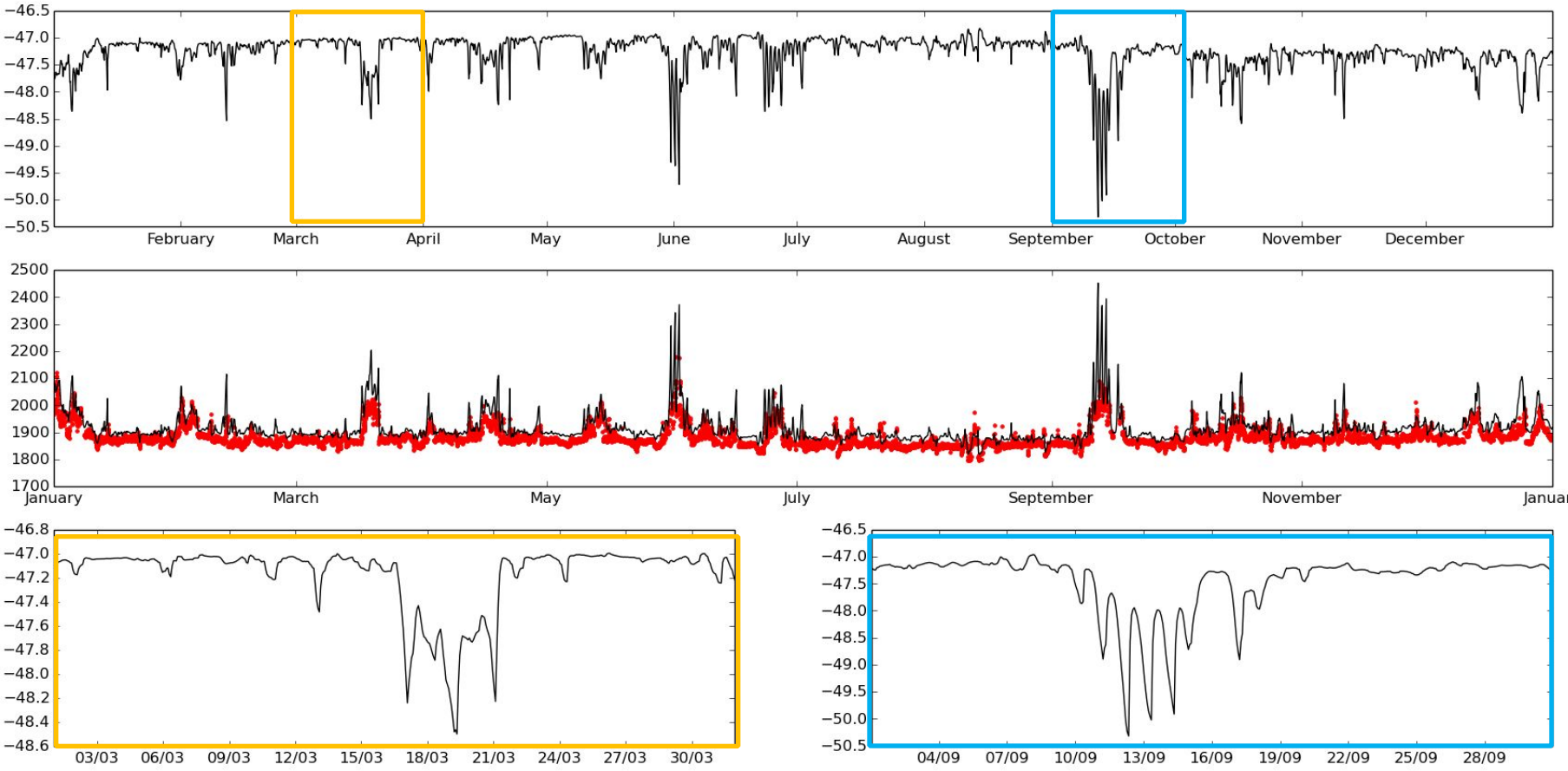
Model results: base scenario

Bialystok (Poland)



Model results: base scenario

Mace-Head (Ireland)



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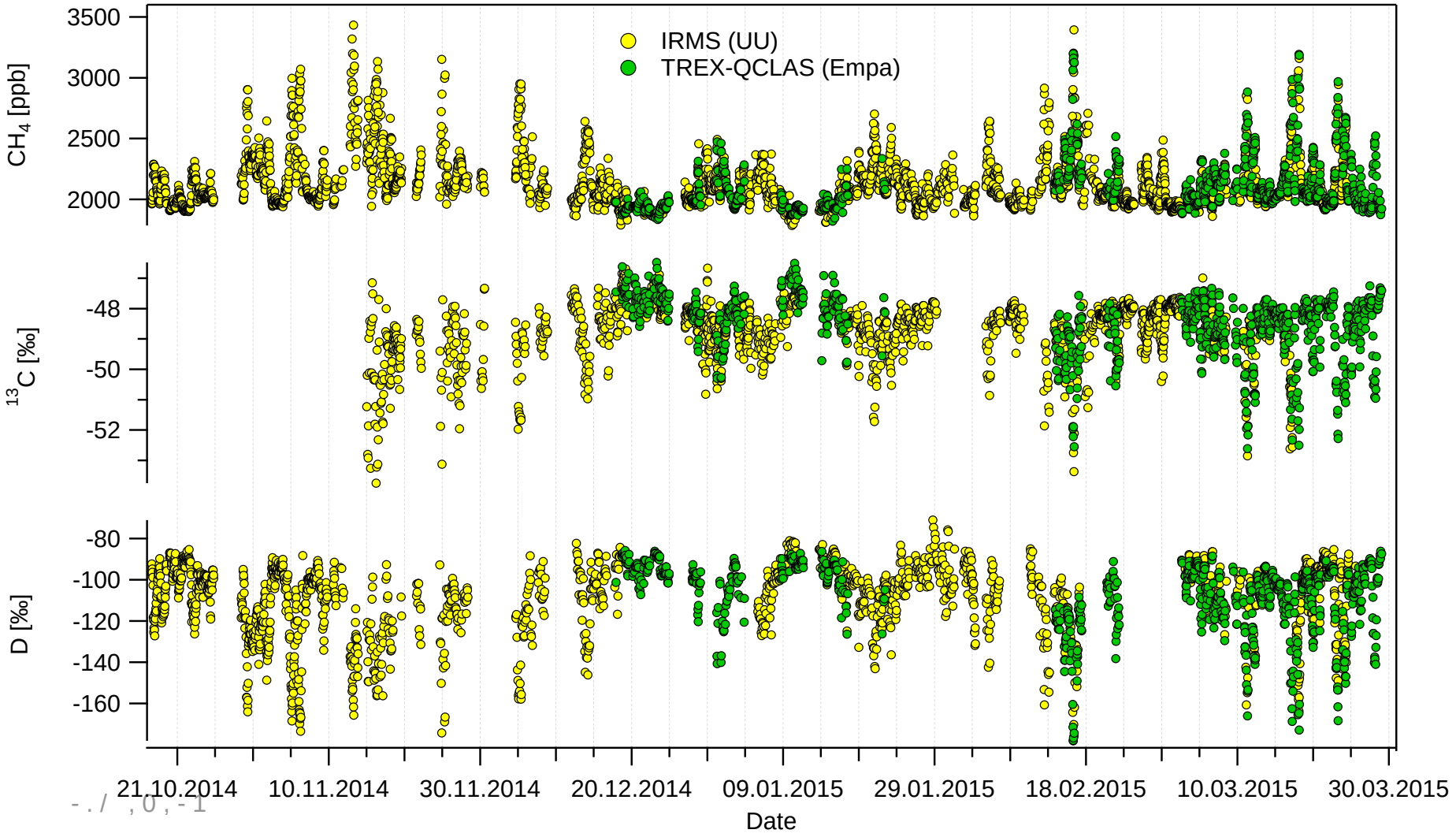
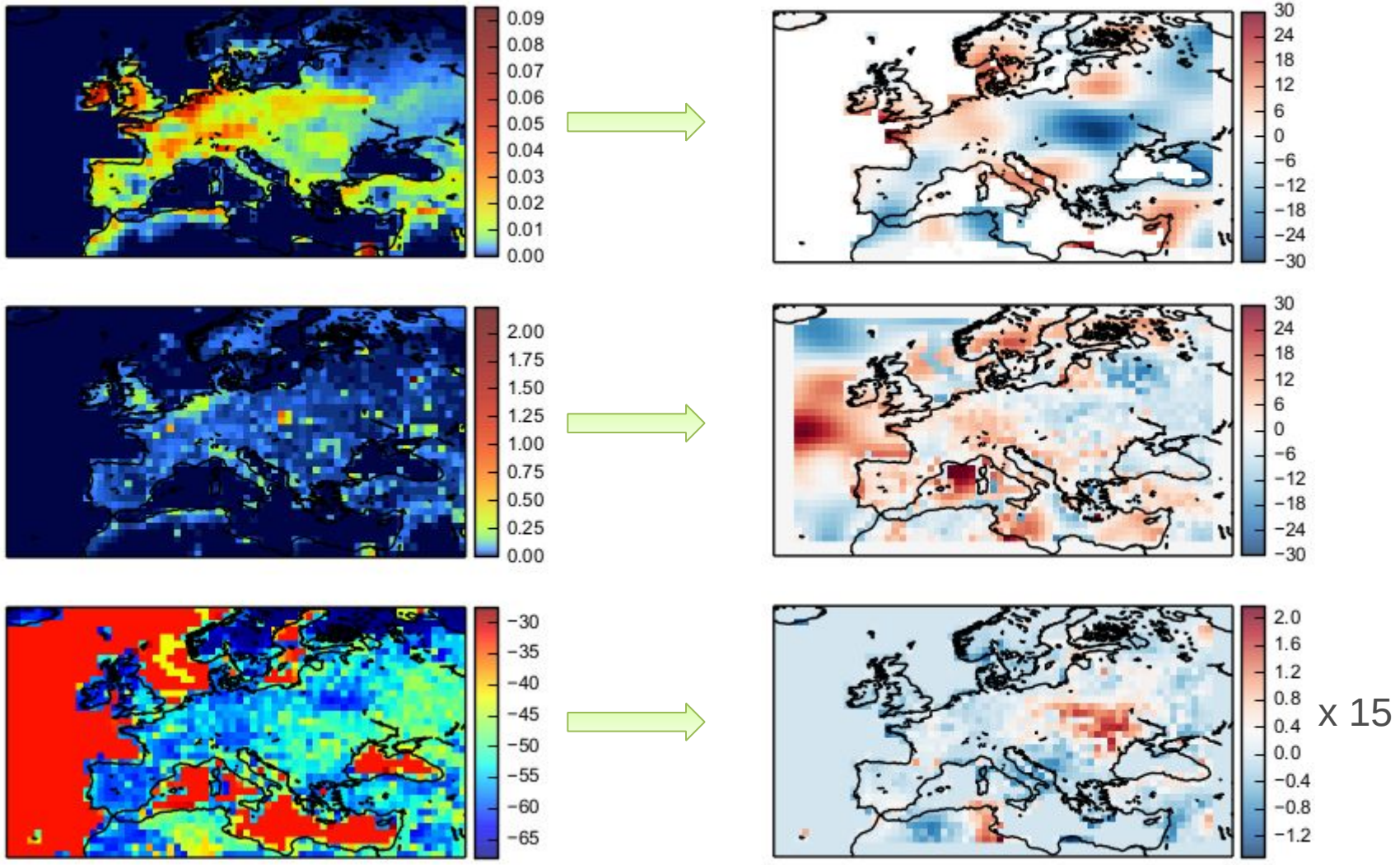


1. Design a coupled CH4/ C-CH4 model (and test it)
2. Propagate uncertainties in CH4 emissions to atmospheric C-CH4
3. Propagate uncertainties in source signatures to atmospheric C-CH4
4. Compare the uncertainties

Impact of CH4 emission uncertainties on atmospheric C-CH4



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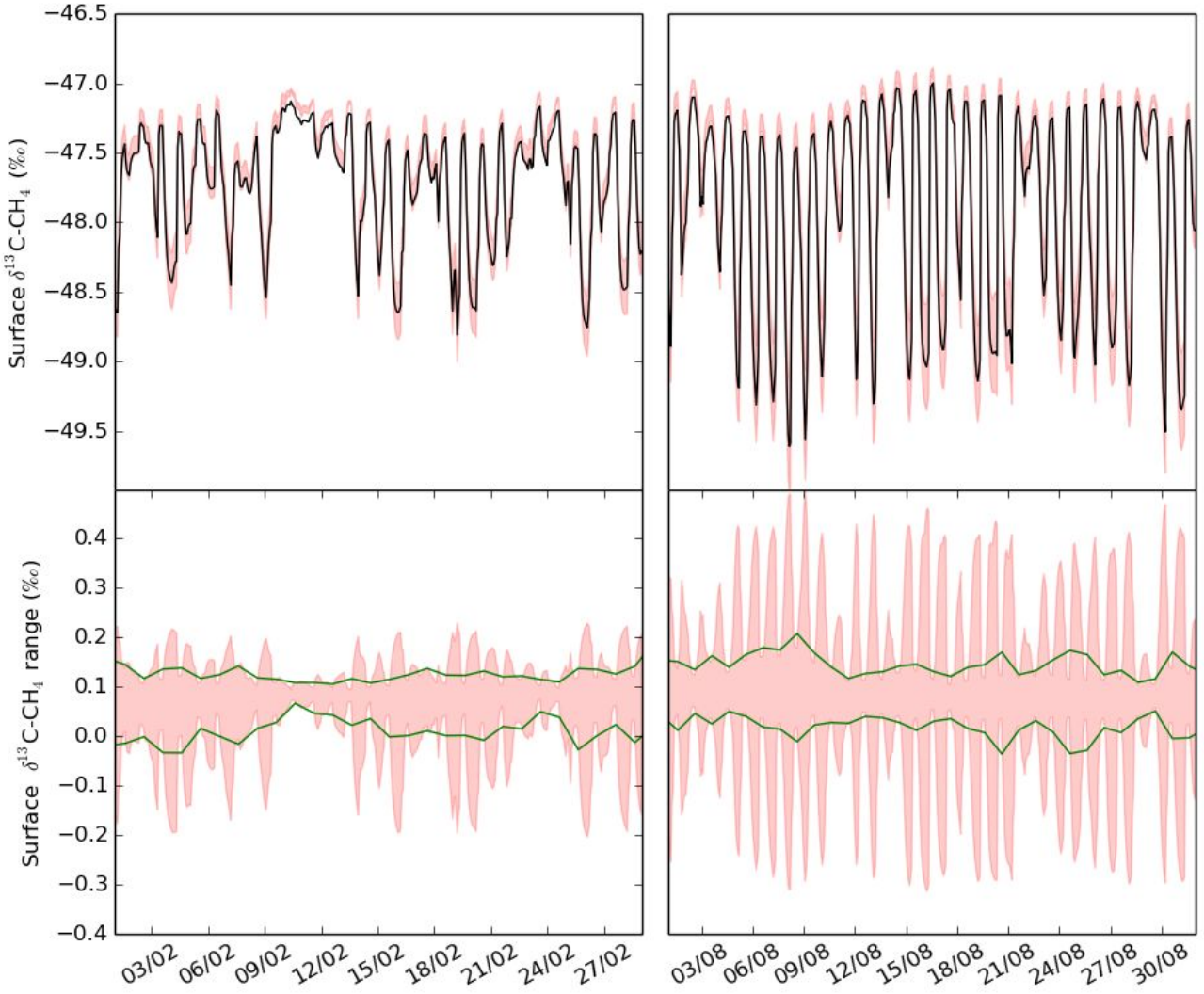

Obs. uncertainty: 0.05-0.2

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Impact of CH4 emission uncertainties on atmospheric C-CH4

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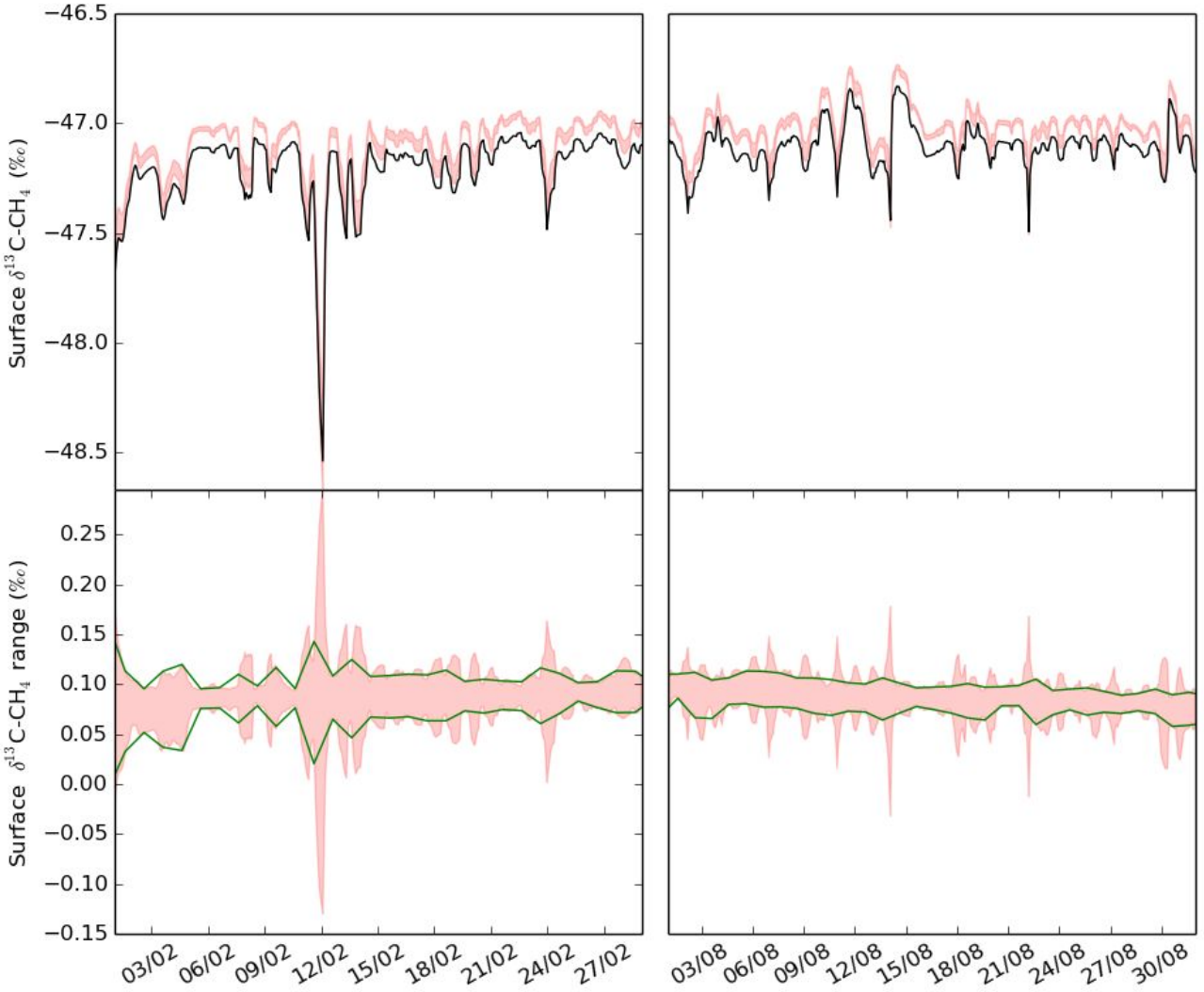

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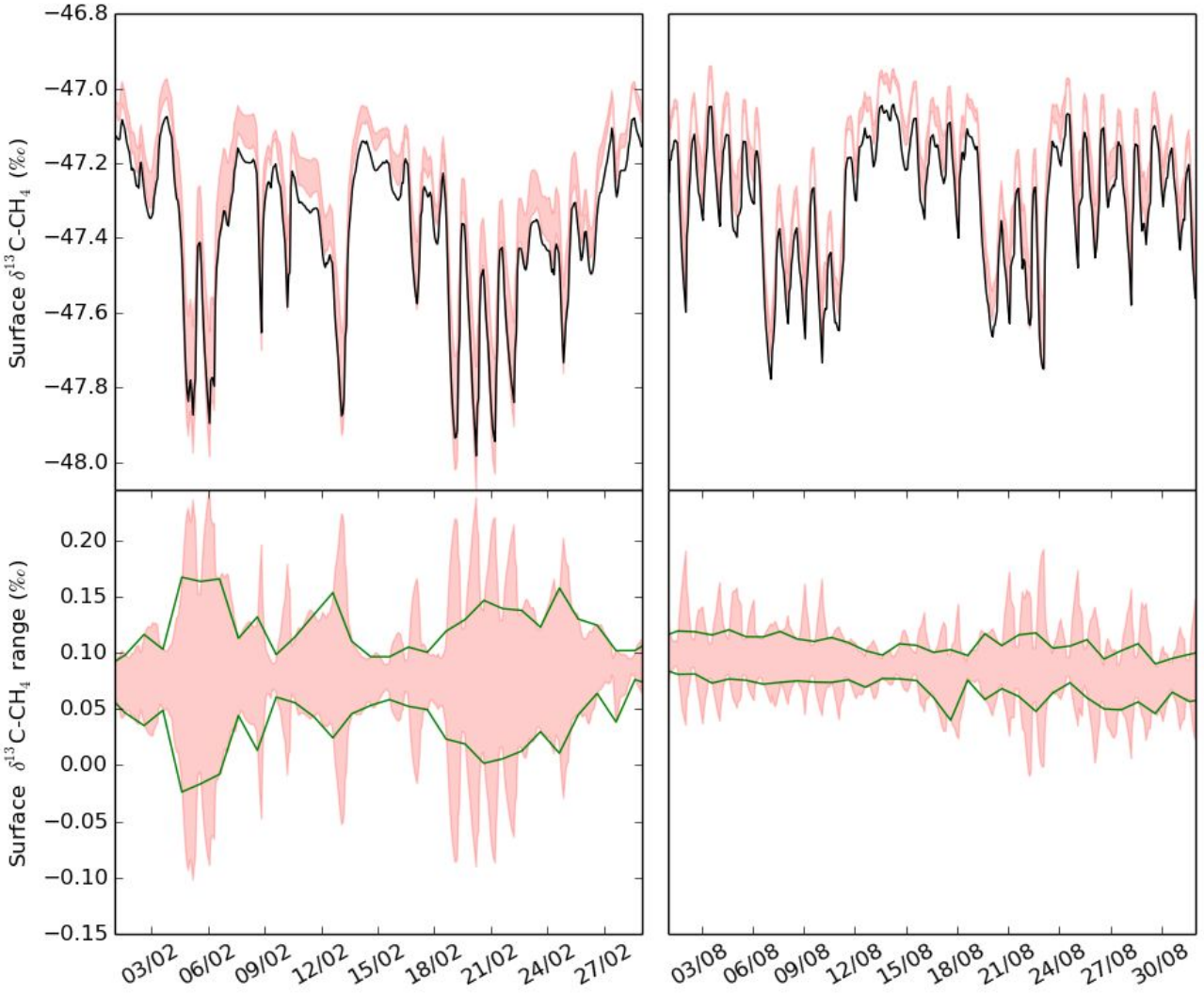

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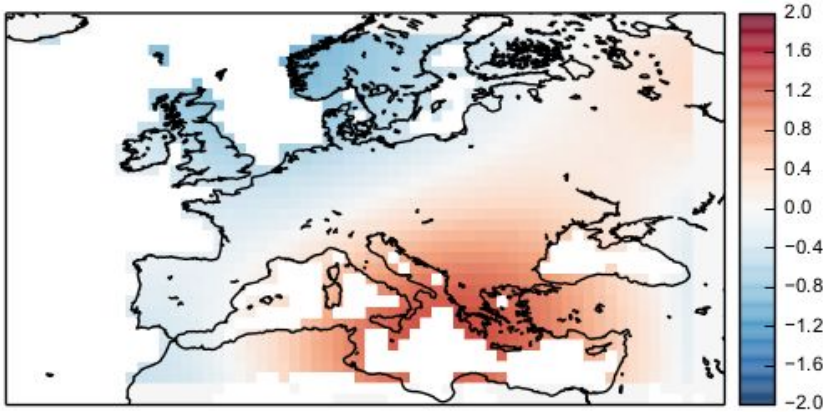
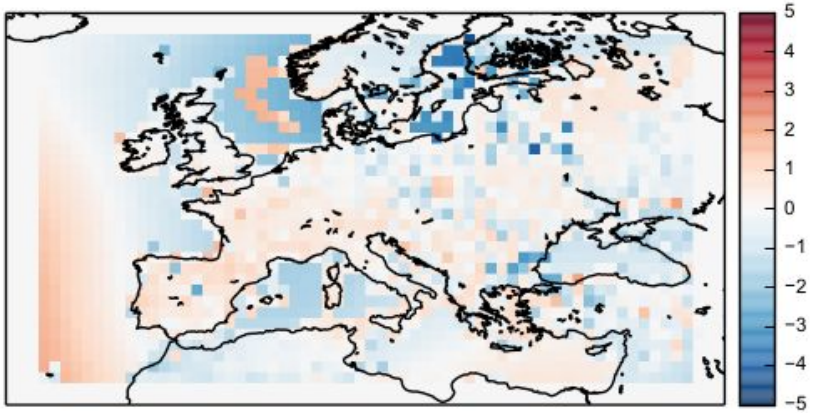




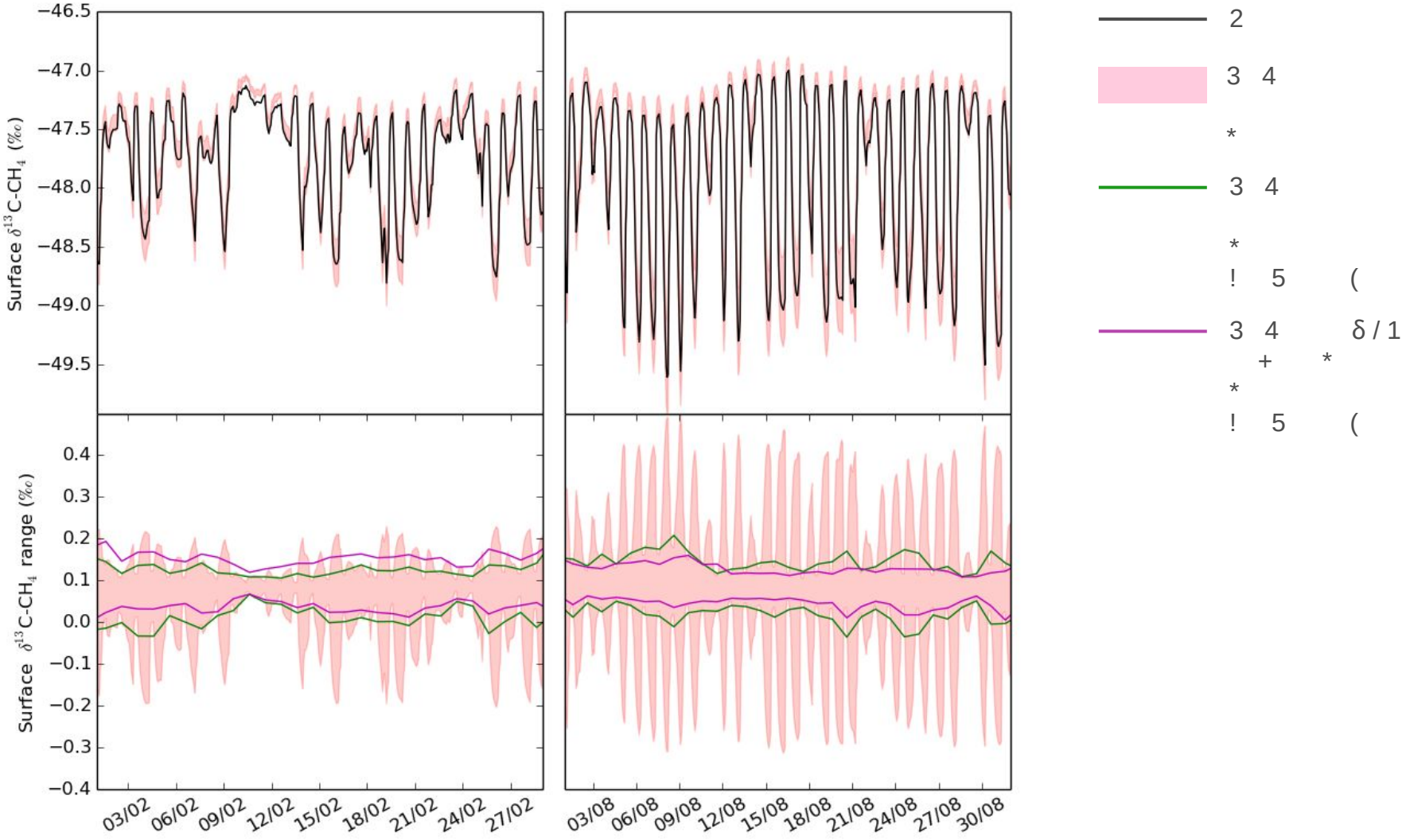
For each source category:

15 perturbed d13C-CH4 maps, transposed to 13CH4 emissions (no change to CH4)

Uncertainty settings based on literature review, 2000 km correlation length, 100% temporal correlation (i.e. no variation in time of the d13C-CH4 maps).

Impact of source signature uncertainties on atmospheric C-CH4

Dubendorf (Switzerland)



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Impact of source signature uncertainties on atmospheric C-CH4

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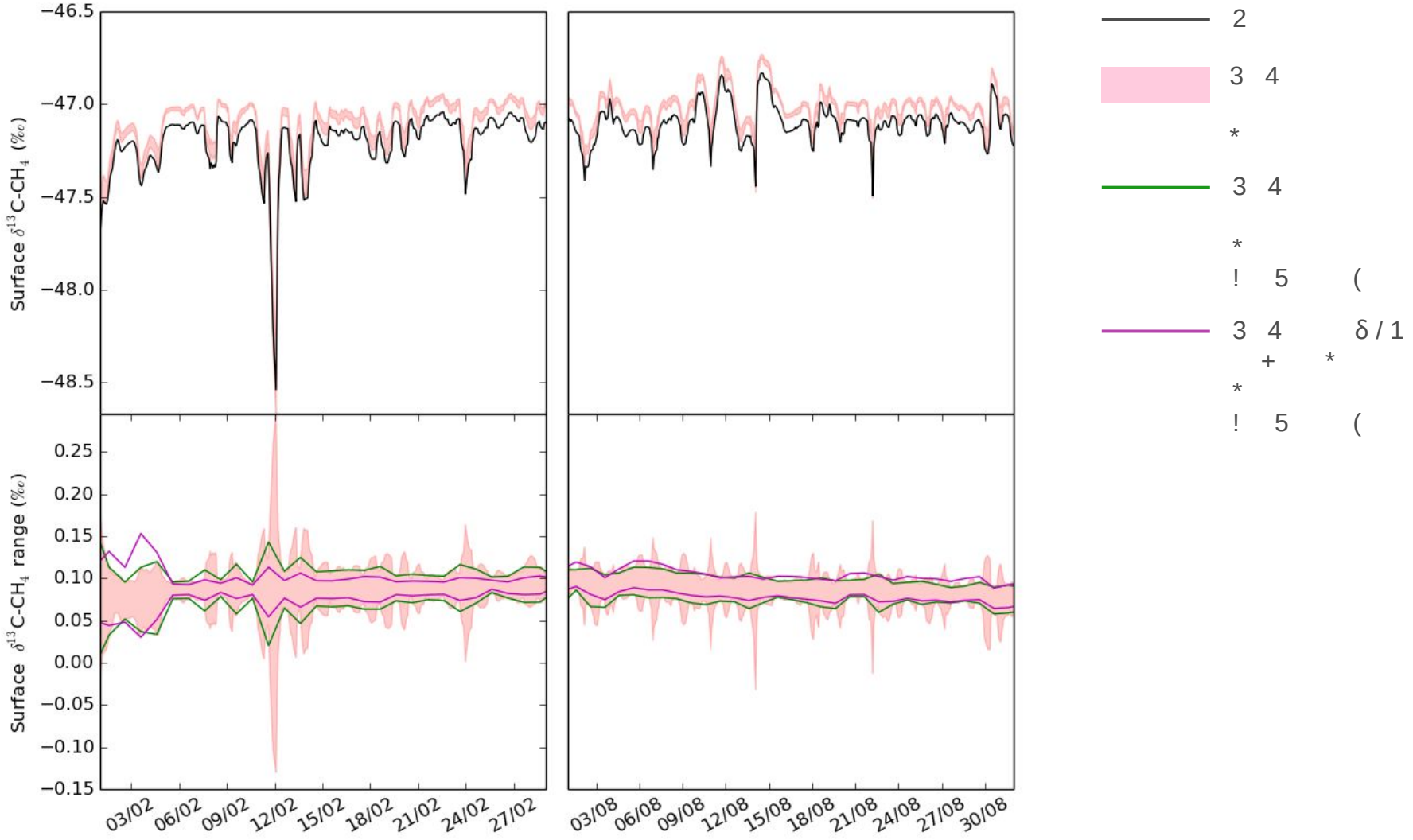

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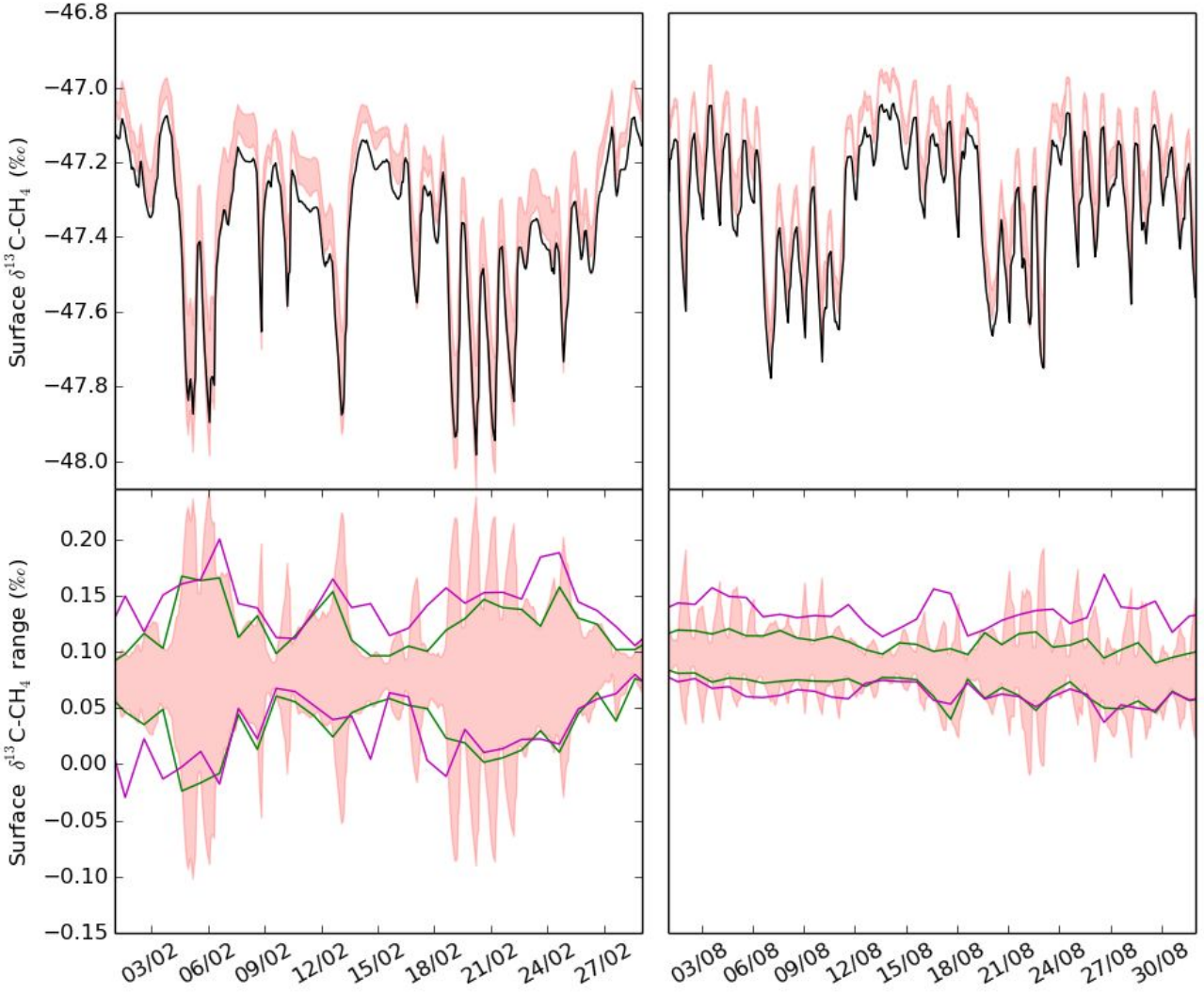

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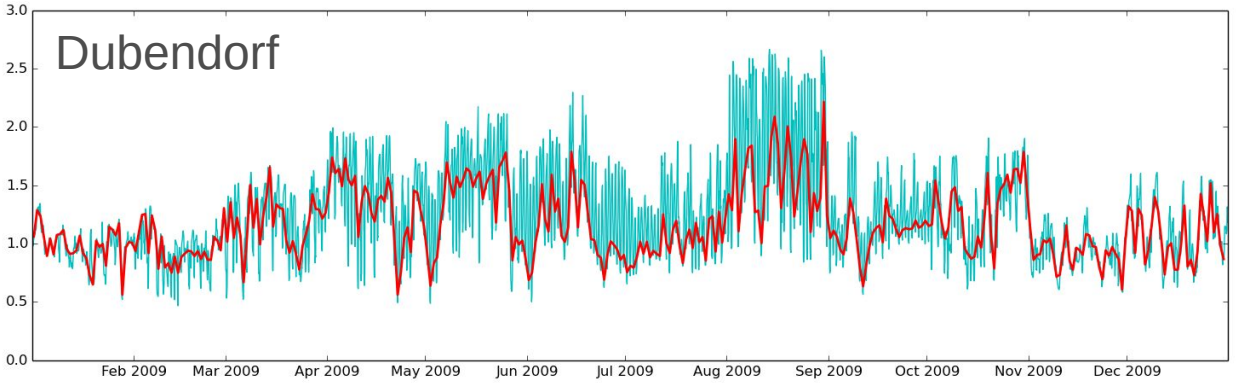
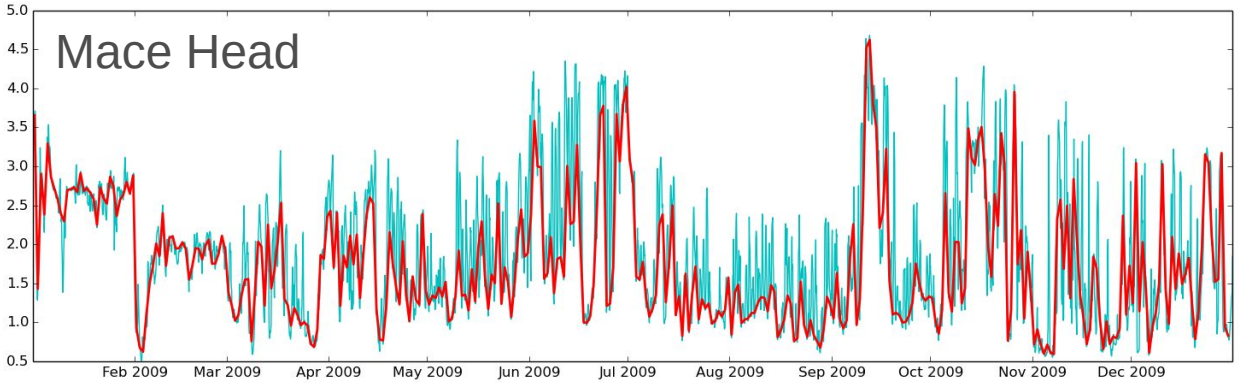
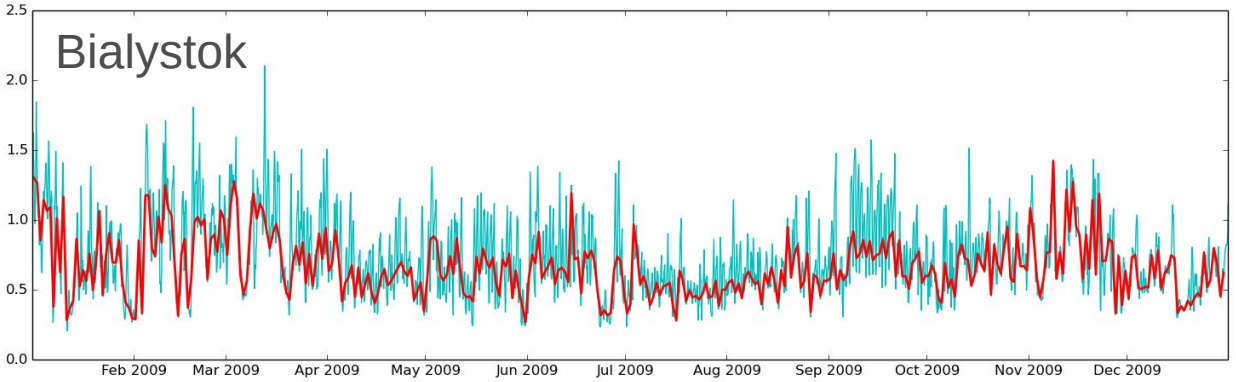
Uncertainties: which is the largest?







$$r = \frac{\Delta E_{CH_4}}{\Delta E \delta^{13} C}$$

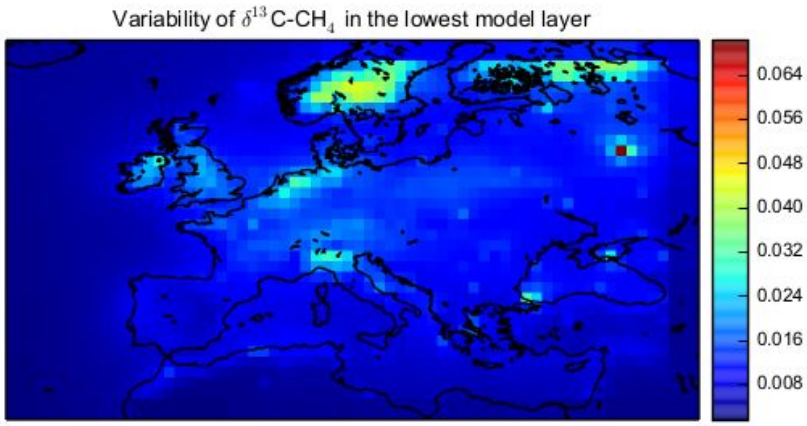
Hourly

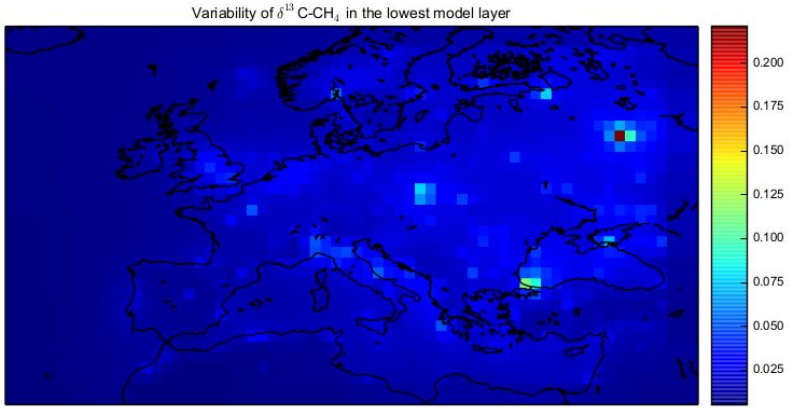
Daily

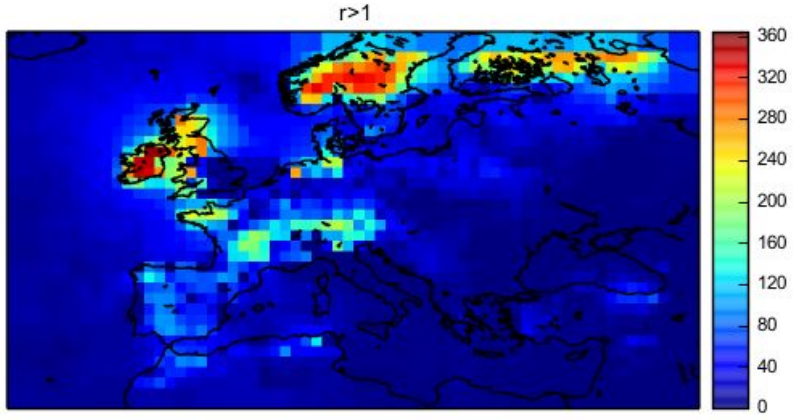
Uncertainties: which is the largest, and where?

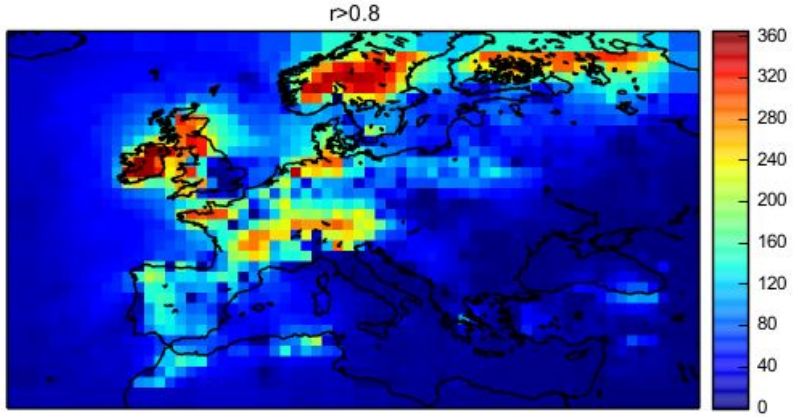
Site	Latitude (°)	Longitude (°)	Altitude (meter a.m.s.l)	$\overline{r_\Delta}$	σ_{r_Δ}
Pallas	24.12	67.97	560	0.59	0.34
Voeikov	30.70	59.95	70	0.32	0.11
Angus	-2.98	56.55	313	0.97	0.42
Lutjewad	6.35	53.40	1	0.91	0.21
Mace Head	-9.90	53.33	25	1.82	0.85
Bialystok	23.01	53.23	183	0.71	0.25
Cabauw	4.93	51.97	20	0.91	0.18
Ochsenkopf	11.81	50.03	1022	0.56	0.17
Heidelberg	8.67	49.42	113	0.83	0.24
Kasprowy	19.98	49.23	1987	0.38	0.13
Gif-sur-Yvette	2.15	48.71	160	0.44	0.13
Trainou	2.11	47.96	131	0.89	0.39
Schauinsland	2.97	47.92	1205	0.54	0.20
Hohenpeissenberg	11.02	47.80	990	1.31	0.40
Dubendorf	8.62	47.40	396	1.24	0.36
Hegyhatsal	16.65	46.95	344	0.55	0.19
Jungfraujoch	7.98	46.55	3588	0.36	0.12
Ispra	8.63	45.81	223	0.51	0.09
Puy-de-dome	2.96	45.77	1465	0.58	0.23
Lampedusa	12.61	35.51	50	0.38	0.12

Uncertainties: which is the largest, and where?









Discussion/Conclusions

The model and the observations are likely good enough

Uncertainties on C source signatures are a bit too large for inverse modelling applications

- With my relatively coarse resolution model
- The target of reducing source signatures uncertainties is reachable
- The uncertainties description can also be improved

No conclusions on the use of C-CH4 isotopes in general ==> finer scale studies possible at interesting sites

Need of an inventory of C source signatures?

Next steps:

- Comparison with real observations
- Synthetic inversion?