Using Observations to Understand Regional CH_4 Budgets

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May 24th 2017

45th Global Monitoring Annual Conference

Boulder, CO

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Regional Emissions

East Anglia as case study

Alone and within national inversions

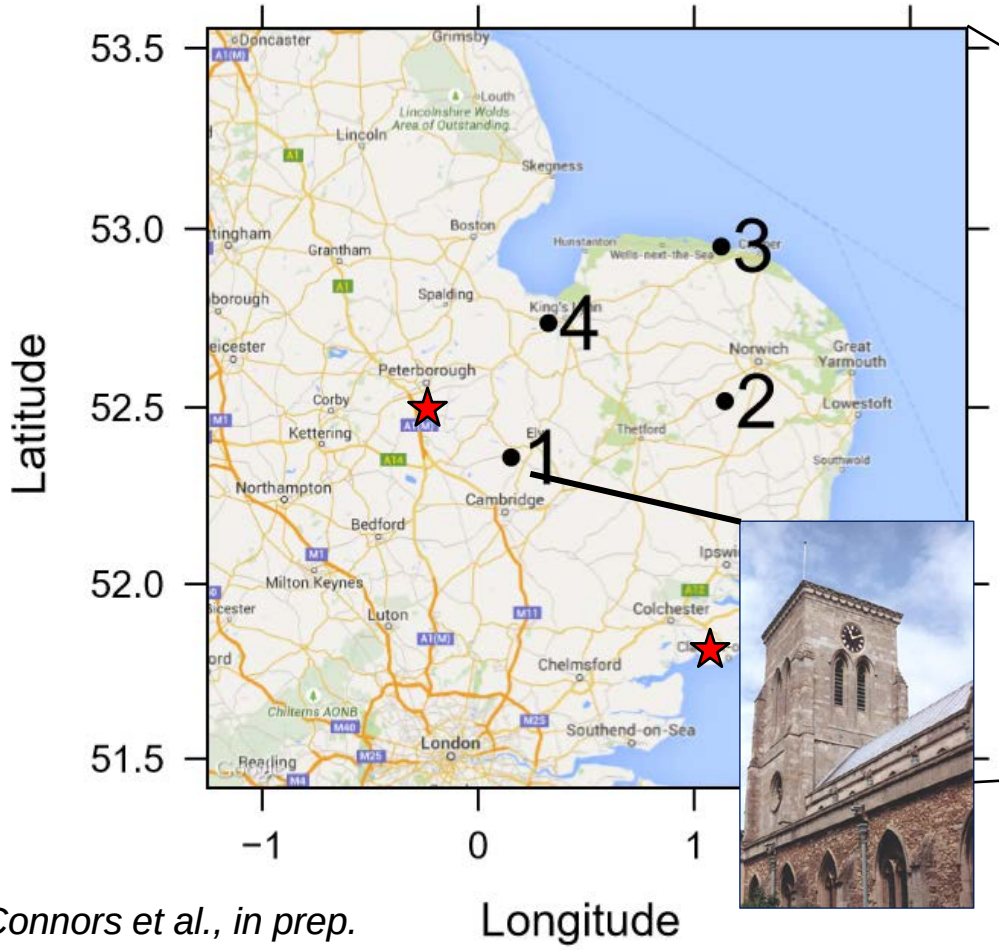
NAME InTEM with Met Office analyses

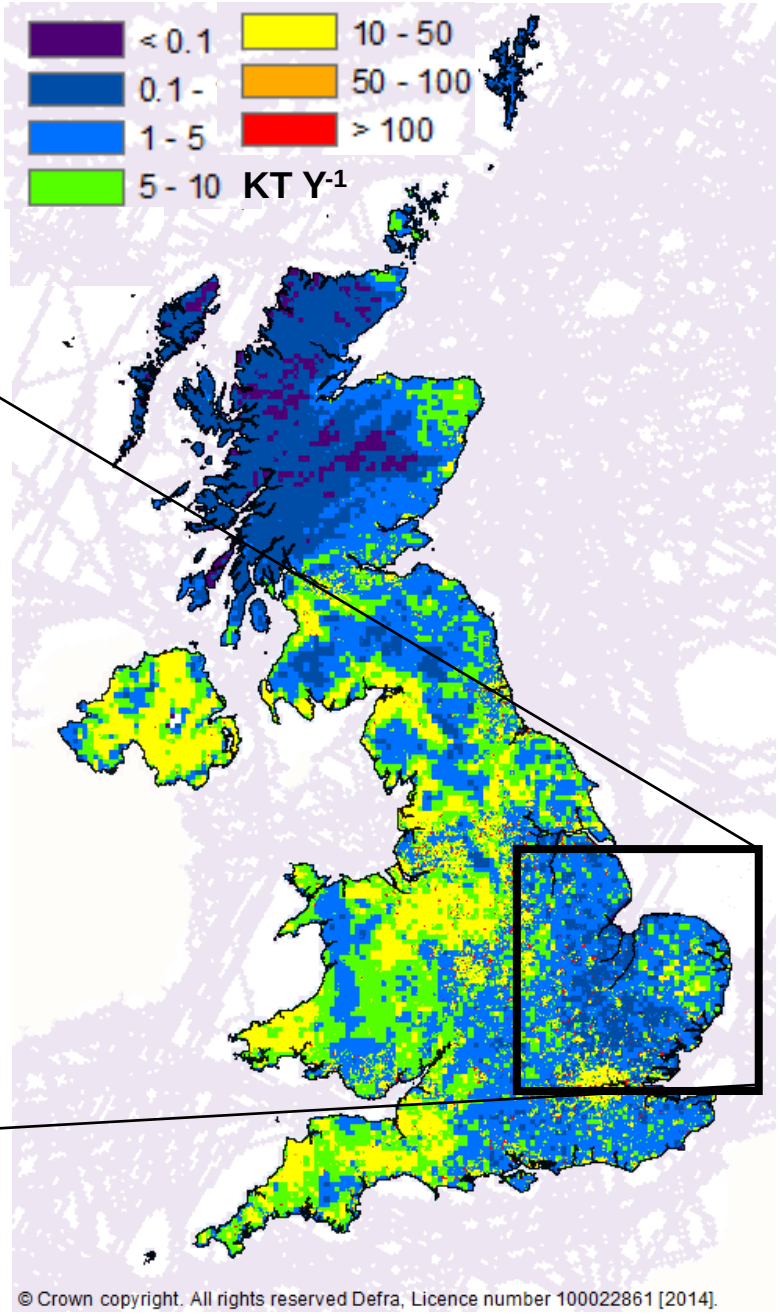
Looking ahead

Regional Emissions in the UK

The network: 4 sites (+2 not used so far)

Haddenham church shown

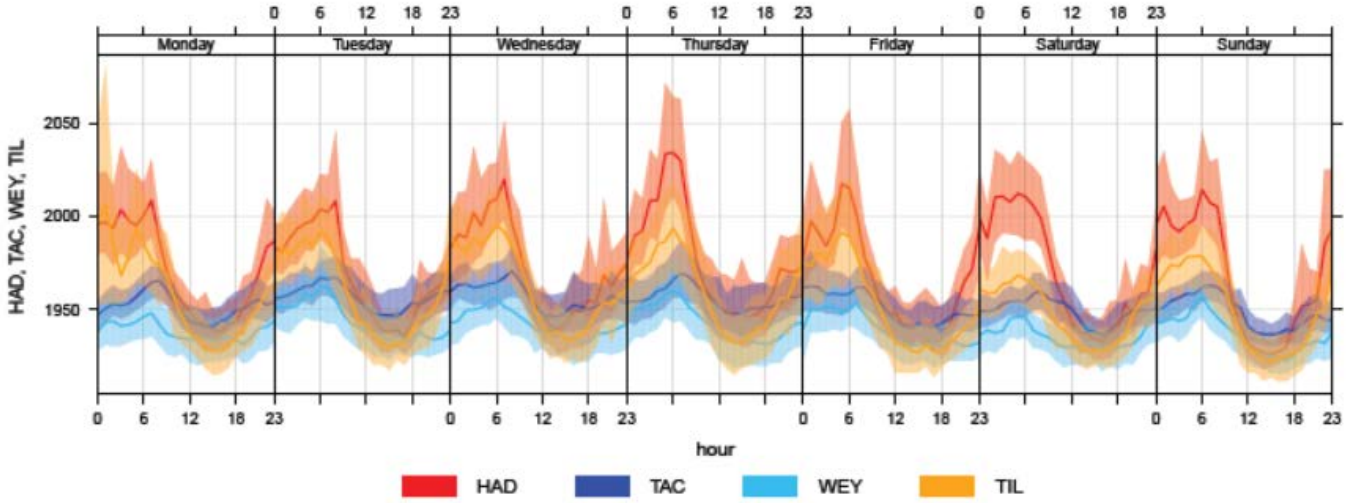




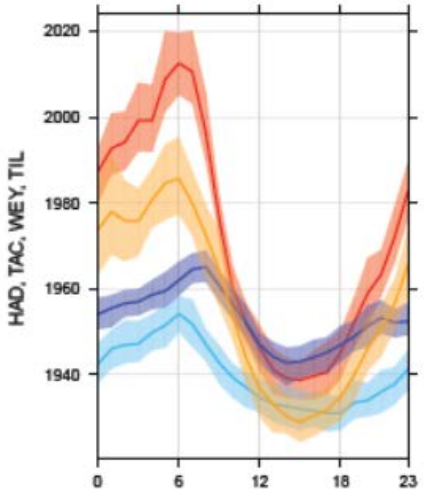
Connors et al., in prep.

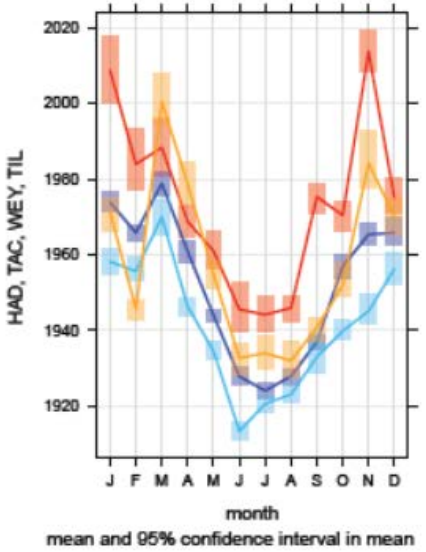
Regional Emissions in the UK

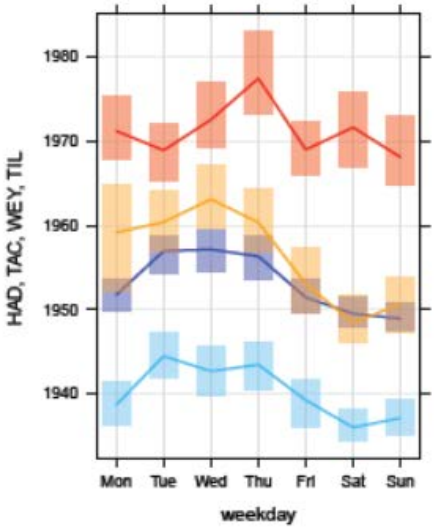
Methane variations for 4 sites using data from July 2012 - June 2014



Diurnal cycles differ from site to site







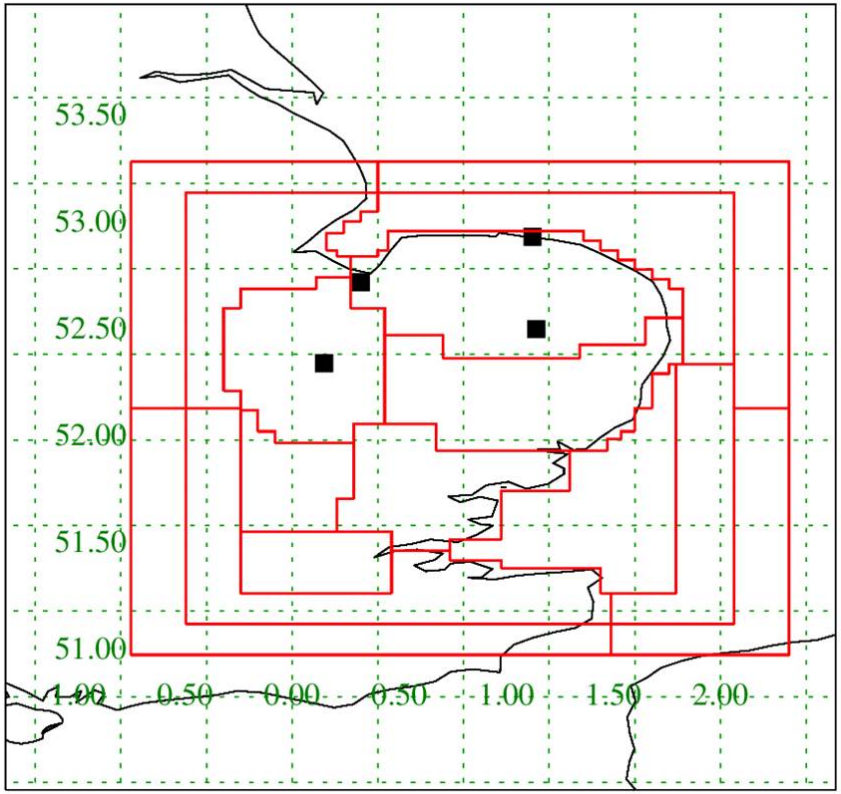
Peaks:

- night
- winter
- mid-week

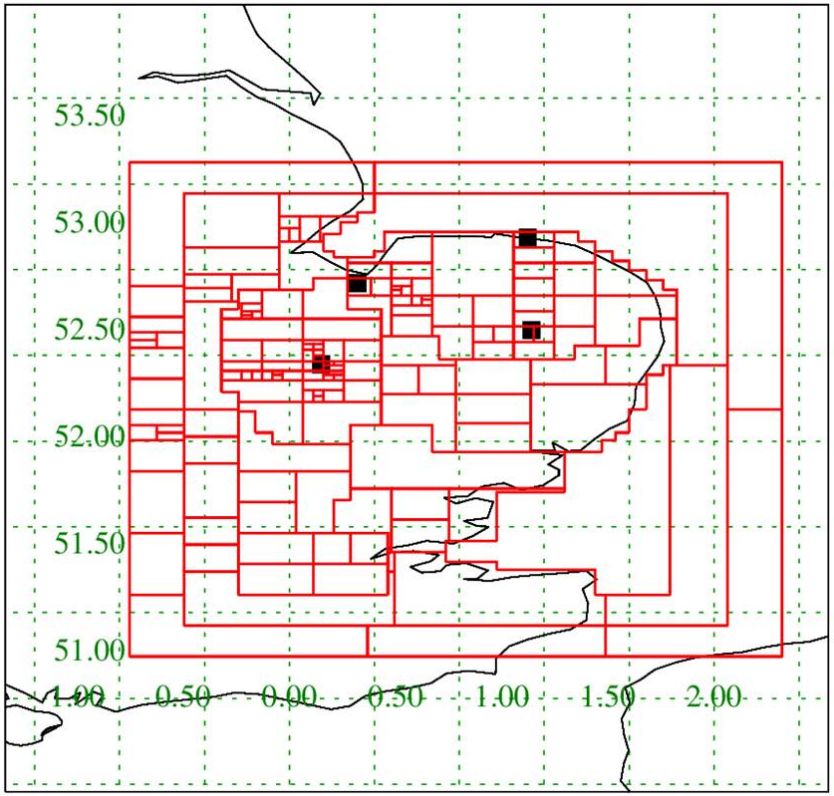
Regional Emissions in the UK

Inversion resolution

Starting grid



Final grid after NAME InTEM



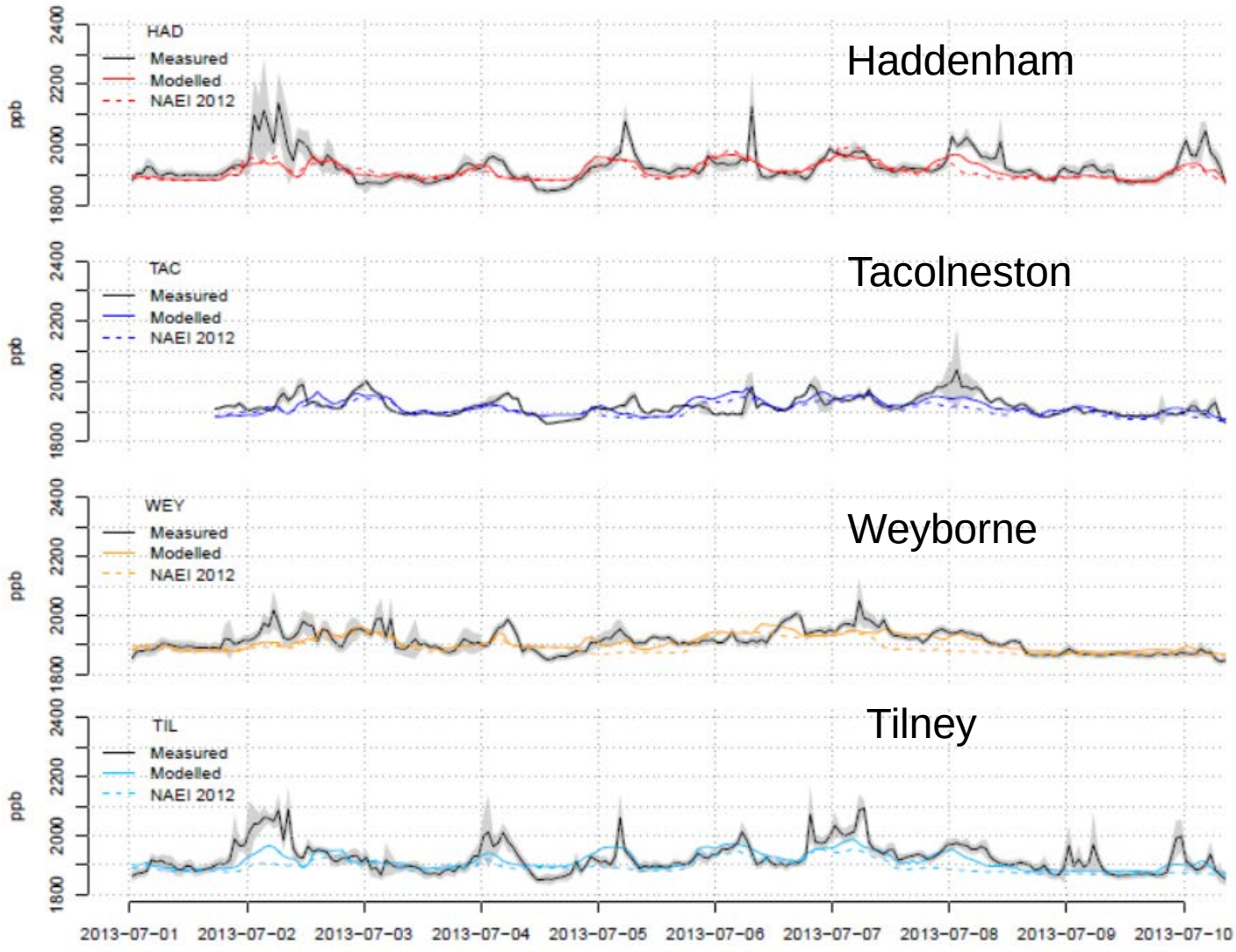
InTEM uses information content to decide whether to split each box in half

Met Office analyses: 1.5 km horizontal; hourly averages.

Background based on wind direction

Regional Emissions in the UK

Model – measurement match



7 days

General features OK

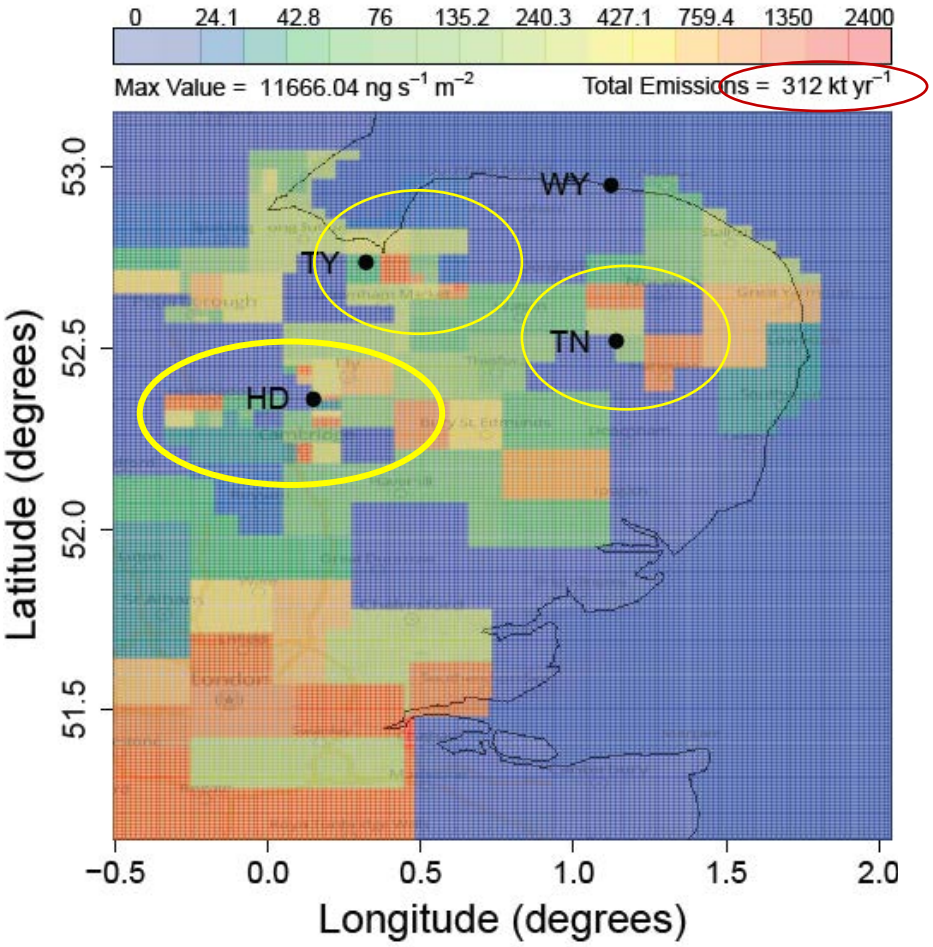
Peaks not done well

Large vs small scale transport / local emissions

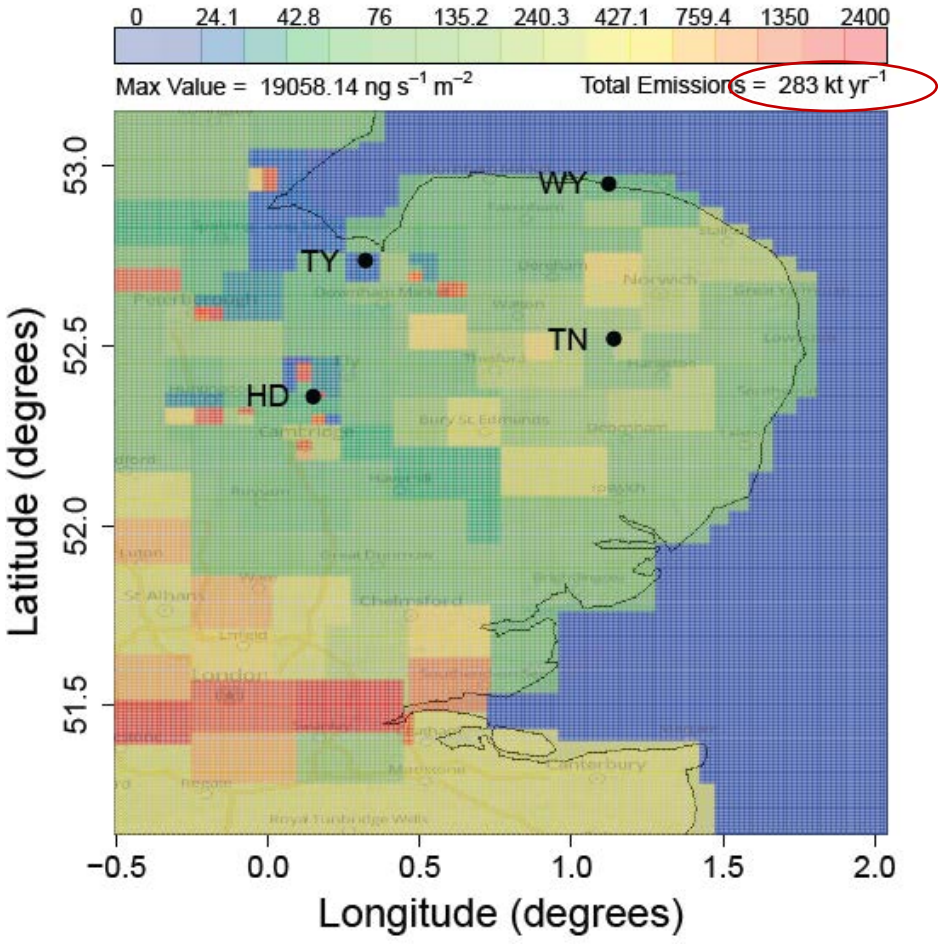
Connors et al., in prep.

Regional Emissions in the UK

June 2013 to May 2014 InTEM inversion



regridded 2012 NAEI



Connors et al., in prep.

Regional Emissions

Measurements

- 4 sites in East Anglia

Separate inversion

- baseline found from upwind measurements
- county-level emissions derived (~40 km)
- consistent with NAEI
- hotspots / main emitting regions dominate

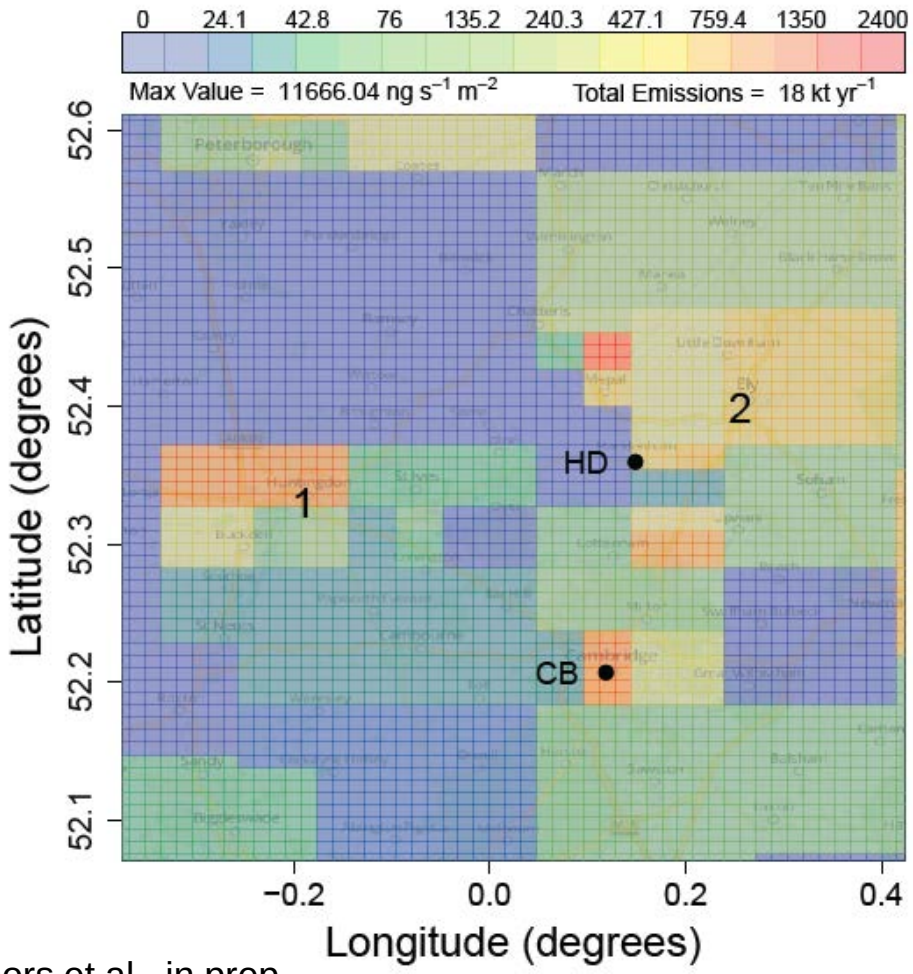
Outstanding issues

- better baseline method
- full uncertainty analysis needed
- is higher resolution possible?

Can hot-spots be identified?

Looking more closely at Haddenham/Cambridge area - *how real is this?*

June 2013 to May 2014 InTEM inversion



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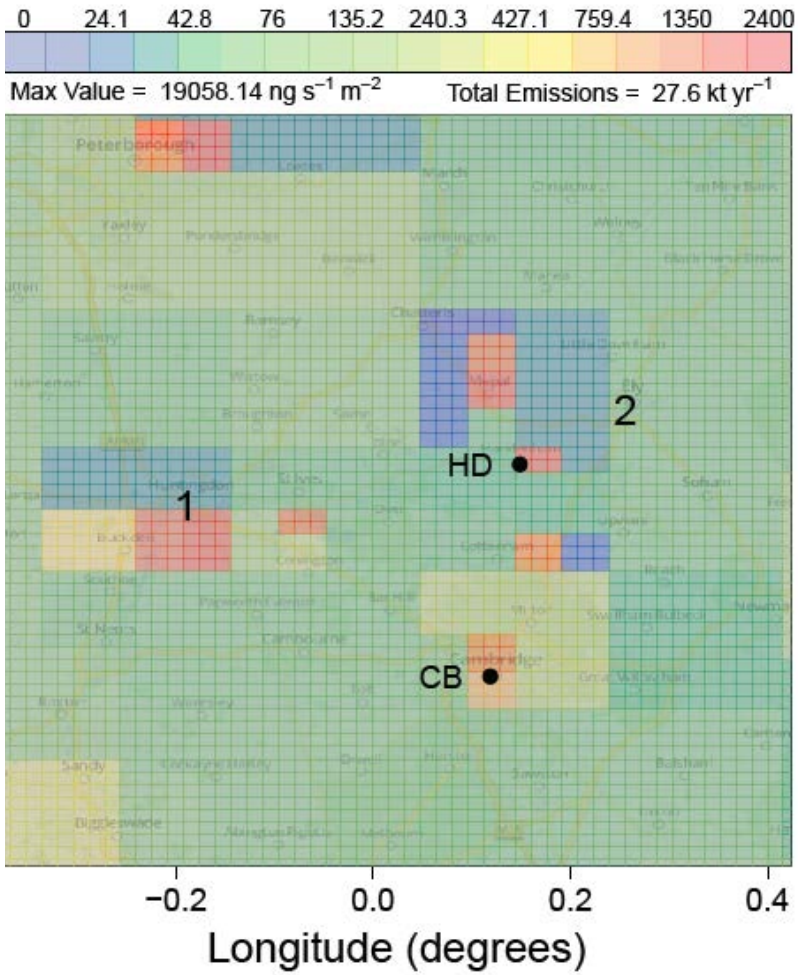


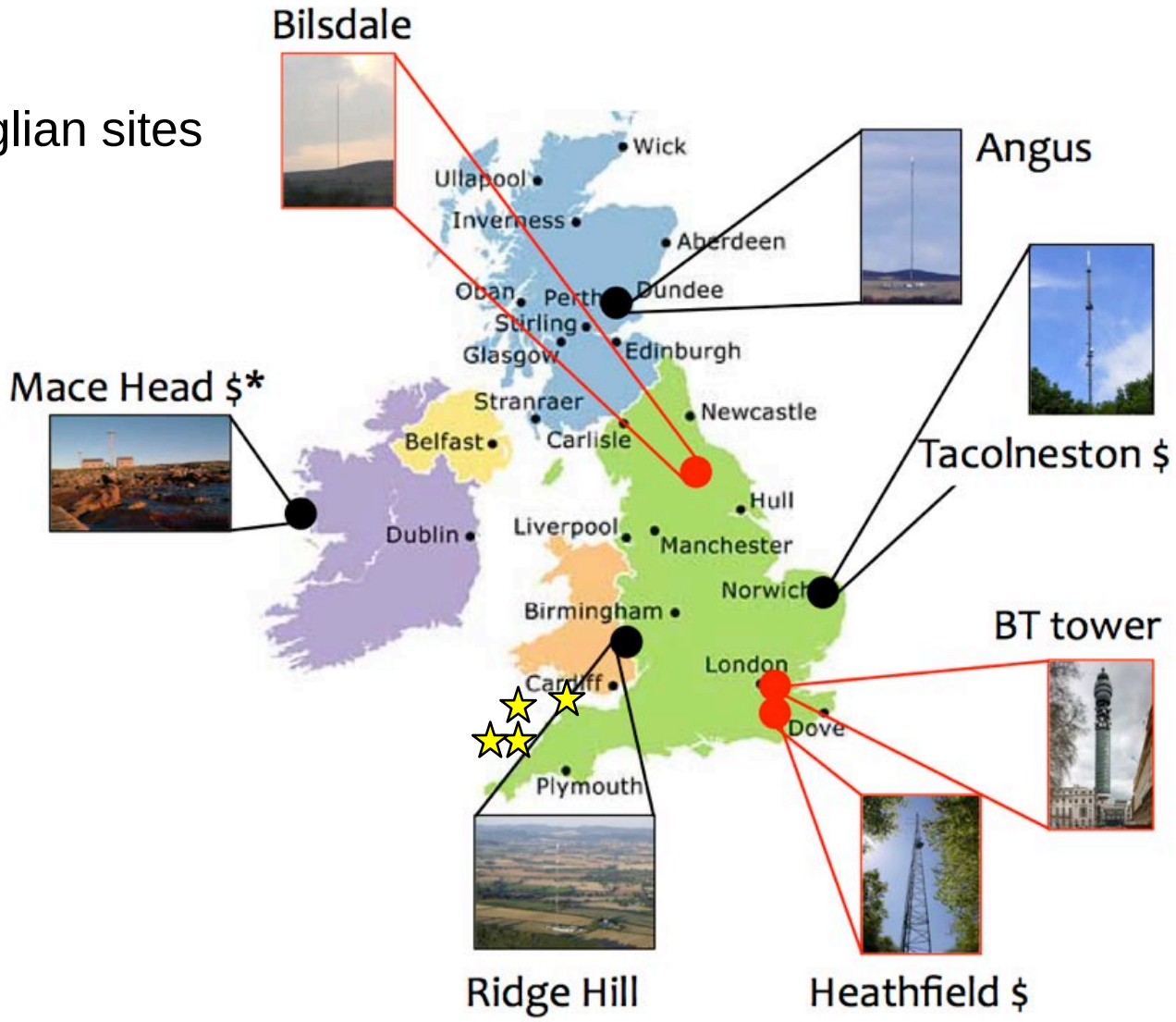
Connors et al., in prep.

Point Source Emissions - landfills

- ~18% of global anthropogenic CH_4 emissions
- Large uncertainty in UK inventory (NAEI)
- Experiment at Haddenham identified spikes as from nearby landfill
- Agreement between near, medium and far-field approaches, though with large uncertainties

Regional Emissions within National Inversion

Towers plus 4 East Anglian sites

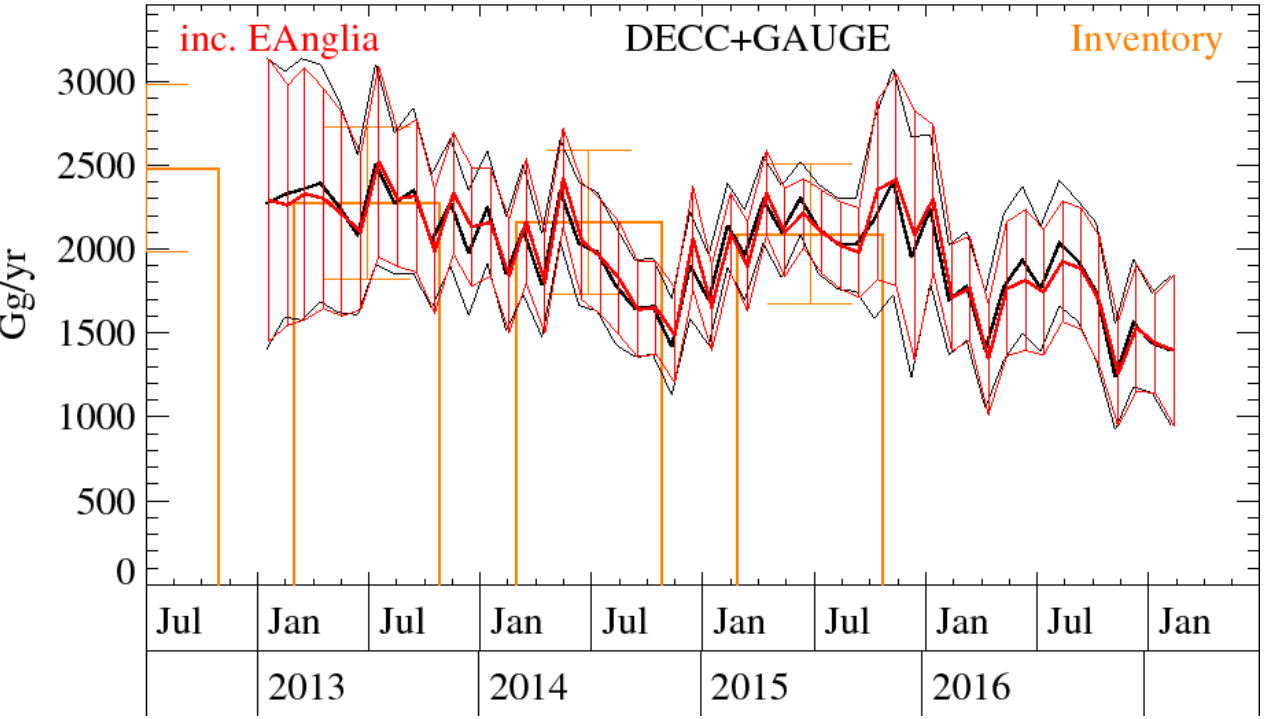


Regional Emissions within National Inversion

Use East Anglian network measurements in addition to tall towers + Mace Head

(i) check effect on UK CH_4 emission total — No – which is good news

(ii) see if credible, extra detail emerges in emissions map



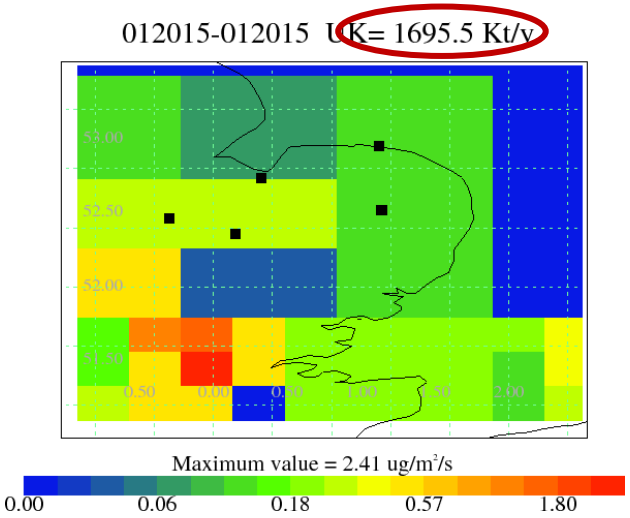
Mace Head + tall towers

Mace Head + tall towers + East Anglian stations

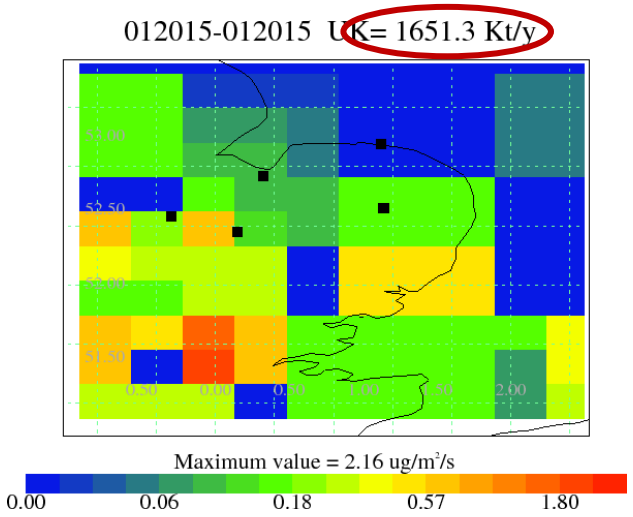
Blocs in orange: inventory compared to UNFCCC (2017 submission)

Alistair Manning; 25 km

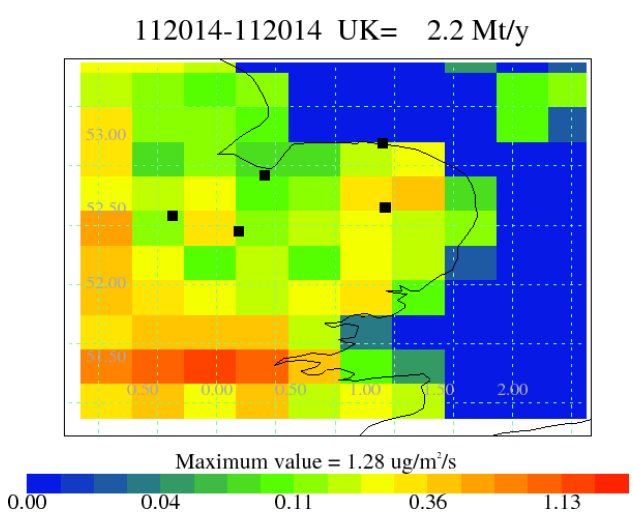
Regional Emissions with National Inversion



Mace Head + tall towers



Mace Head + tall towers + EA sites



NAEI emissions 2013 on 25 km

Map for one month – January 2015

General spatial features similar

Some features sharpened up – limit how much with grid used.

Next - increase resolution of inversion grid and include point sources – use some of the peaks

Alistair Manning

Regional Emissions – where next?

Regional emission inversions work

monthly, regional results possible

where best? cities, specific processes (e.g. fracking)?

benefit from link to larger scale networks

Important to build way of including point source emissions

local effects important on any measurement

-> need way to disentangle w/out losing information content

Improved vertical information needed, esp. in BL

preferably GHG info

ancillary information useful if it can constrain model transport

important to look at over longer periods

Thank you for listening and to:

Universities

Bristol, Cambridge, Cranfield, East Anglia, Edinburgh, Leicester, Manchester, Royal Holloway, Southampton

Meteorological Office

BEIS (DECC)

Diocese of Ely

NERC and other funding agencies (DEFRA, Royal Soc)

and, on a personal level, Andrew Robinson

As always Boulder is inspiring, full of surprises and self-deprecating?

Free WEEKEND 5.19.2017

Colorado DAILY

Conflicted 'Covenant'

6th installment in 'Alien' franchise at odds with itself [11]

An edition of the Daily Camera

Celebrating more than 100 years in publishing

Massive dump

Up to 2 feet of snow in the mountains [4]

Wife Your daily allotment of odd

FLORIDA WOMAN FINDS IGUANA IN TOILET BOWL, CALLS 911

MIAMI — What did a South Florida woman do when she lifted the lid on her toilet and found an iguana inside?

She closed it again and called 911.

Lt. Scott Mullin of Miami-Dade Fire Rescue's Venom One unit tells the Miami Herald it's the first time he's found an iguana in a toilet.

Mullin says when the call came in Tuesday night, he asked the dispatcher to make sure it was an iguana and not a snake.

He says the woman, her daughter and grandchildren were waiting when he arrived at their home in West Kendall, south of Miami. Mullin says the lizard likely came up through the pipes.

Mullin used gloves to lift the iguana from the bowl, put it in a box and drove it to a wildlife rescue center.

Point Source Emissions - landfills

B. Waterbeach Waste Management Park, near Cambridge

Month	Case Study		Annual Estimate	
	WindTrax	Gaussian Plume	Gaussian Plume	InTEM
	(kg hr^{-1})	(kg hr^{-1})	(kg hr^{-1})	
January			1370	
February			2160	
March			1580	
April			1120	
May			830	
June			1070	
July	450 ± 20%	640 ± 23%	620	
August			1100	
September			1480	
October			1350	
November			1210	
December			2040	
		Total Emission (Gg yr^{-1})	11.6 ± 32%	13.7 ± 91%

1. Fair agreement

2. Seasonal variation

Landfill T?

3. Good agreement or coincidence?

Riddick et al., ACPD

Regional Emissions with National Inversion

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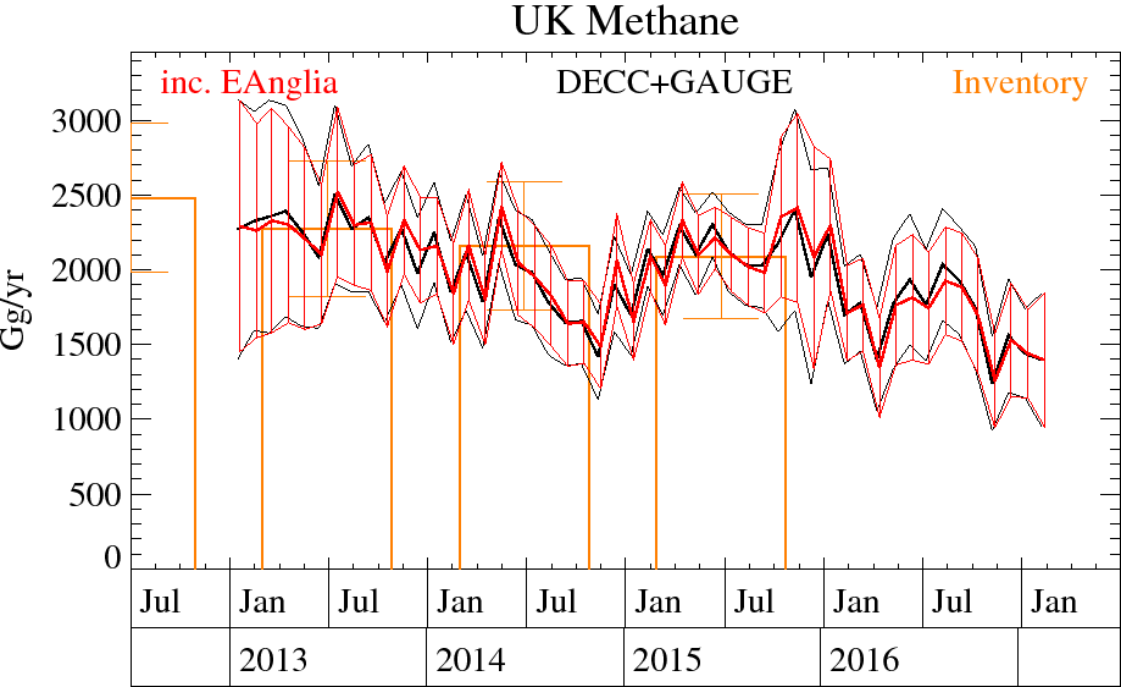

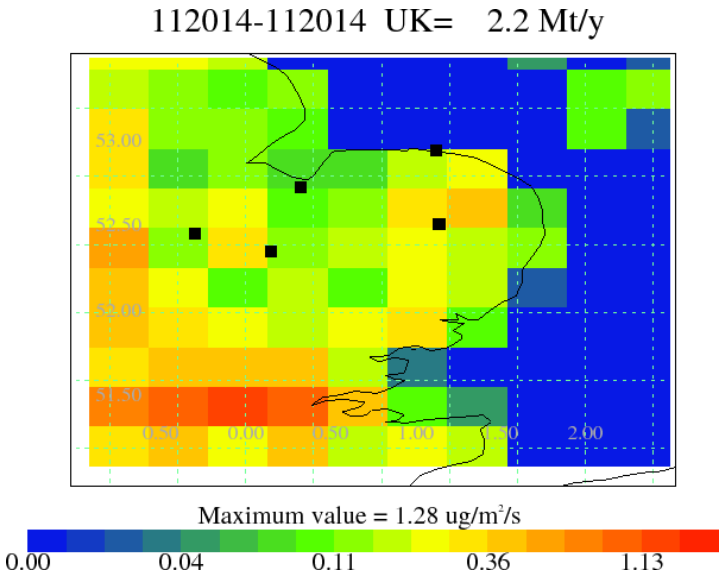

Mace Head + tall towers

Mace Head + tall towers + East Anglian stations

Inventory compared to UNFCCC (2017 submission)

NAEI 2013 emissions on 25 km grid (UK assumed 40% uncertain) used as prior for inversion

Manning

Regional Emissions in the UK

Estimated emissions

	CBG	NFK	SFK	LDN	ESX	LCS	Sea Regions		
	15	10	4	11	5	6	2	12	14
NAEI	26.5	38.9	24.1	51.2	24.5	17.6	0.0	0.1	0.3
InTEM	20.5	37.1	22.8	45.7	19.6	9.1	0.2	0.1	0.4
sd									
% difference	22.5	4.7	5.6	10.8	19.9	48.3	-1808.8[a]	14.0[a]	-23.7

	BHS	SW	Border Regions				Total[b]	NSC	Cost
	9	1	3	7	8	13			Score
NAEI	20.5	75.0	1.6	29.9	0.1	55.2	369.4	89.6	-
InTEM	30.6	124.5	116.1	240.0	53.6	294.9	310.5	80.4	12.5
sd									
% difference	-49.1	-66.1	-7153.8	-702.1	-325.0	-434.5	-11.4	10.2	

Connors et al., in prep.