Integrated non-CO_2 Greenhouse gas Observing System

InGOS

non-CO_2 greenhouse gas observations in Europe

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European Commission

SEVENTH FRAMEWORK PROGRAMME

ECN

InGOS overview

Improving and extending European observation capacity for non-CO_2 greenhouse gases

- **Infrastructure project: Integrating Activities**
- **Budget 11 M€, EU 8 M€**
- **34 (36) partners, 14 (15) countries, 24 (28) observing stations**
- **1 October 2011 – 1 October 2015**
- **Will improve non-CO_2 observations and integrate them in ICOS**
- **Builds on: CHIOTTO, SOGE, CarboEurope, GHGEurope, IMECC etc.**
- **Coordination: ECN, NL**
  - http://www.ingos-infrastructure.eu

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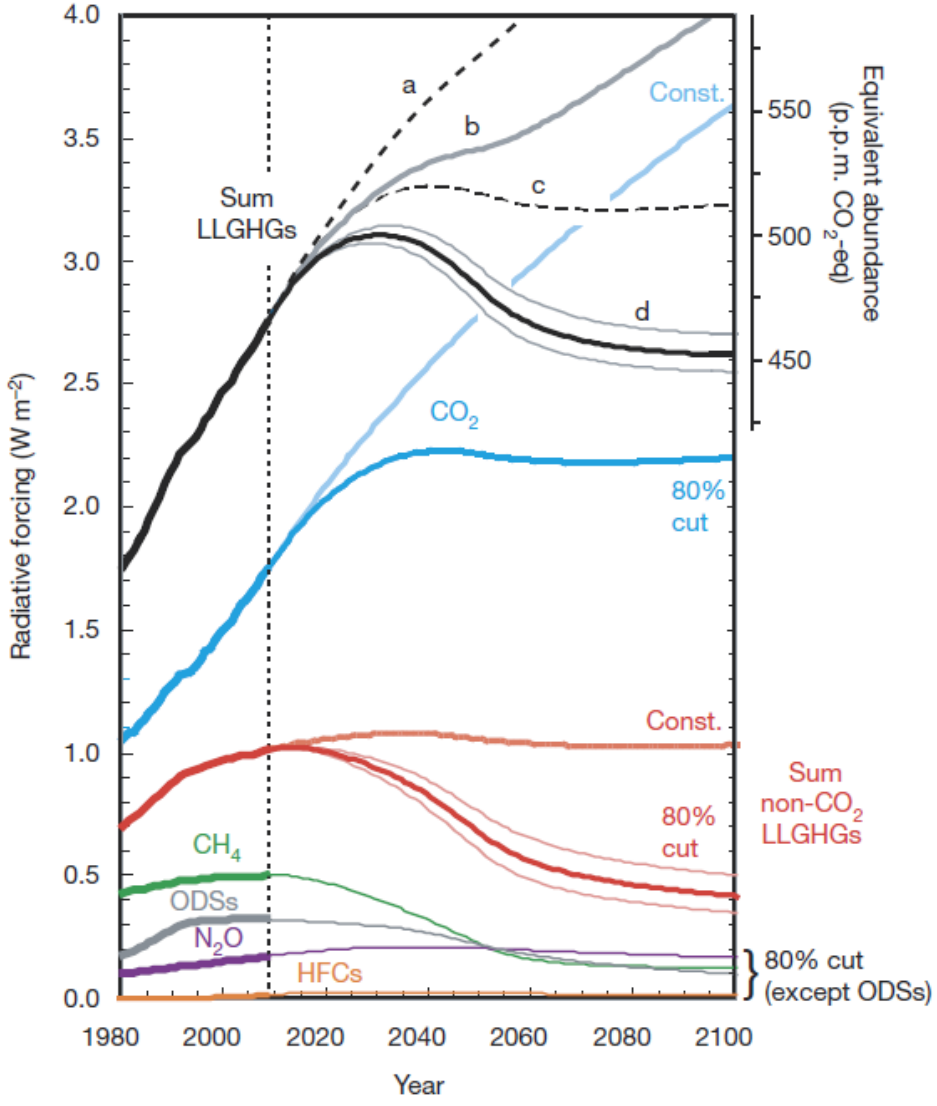
Integrated non-CO_2 Greenhouse gas Observing System

Non-CO_2 reductions will be needed (too)!



- 2 ºC limit in 2100 hard to reach
- CO_2 –eq=2 ºC -> 450 ppm

- a = 2010 (non-)CO_2 emissions
- b = 80% reduct. non-CO_2
- c = 80% reduct. CO_2
- d = 80% reduct. CO_2+non-CO_2

Montzka et al, Nature, 2011

N_2O is currently biggest ODS (Ravishankara et al, 2009)

Emission reductions >80%: verification!

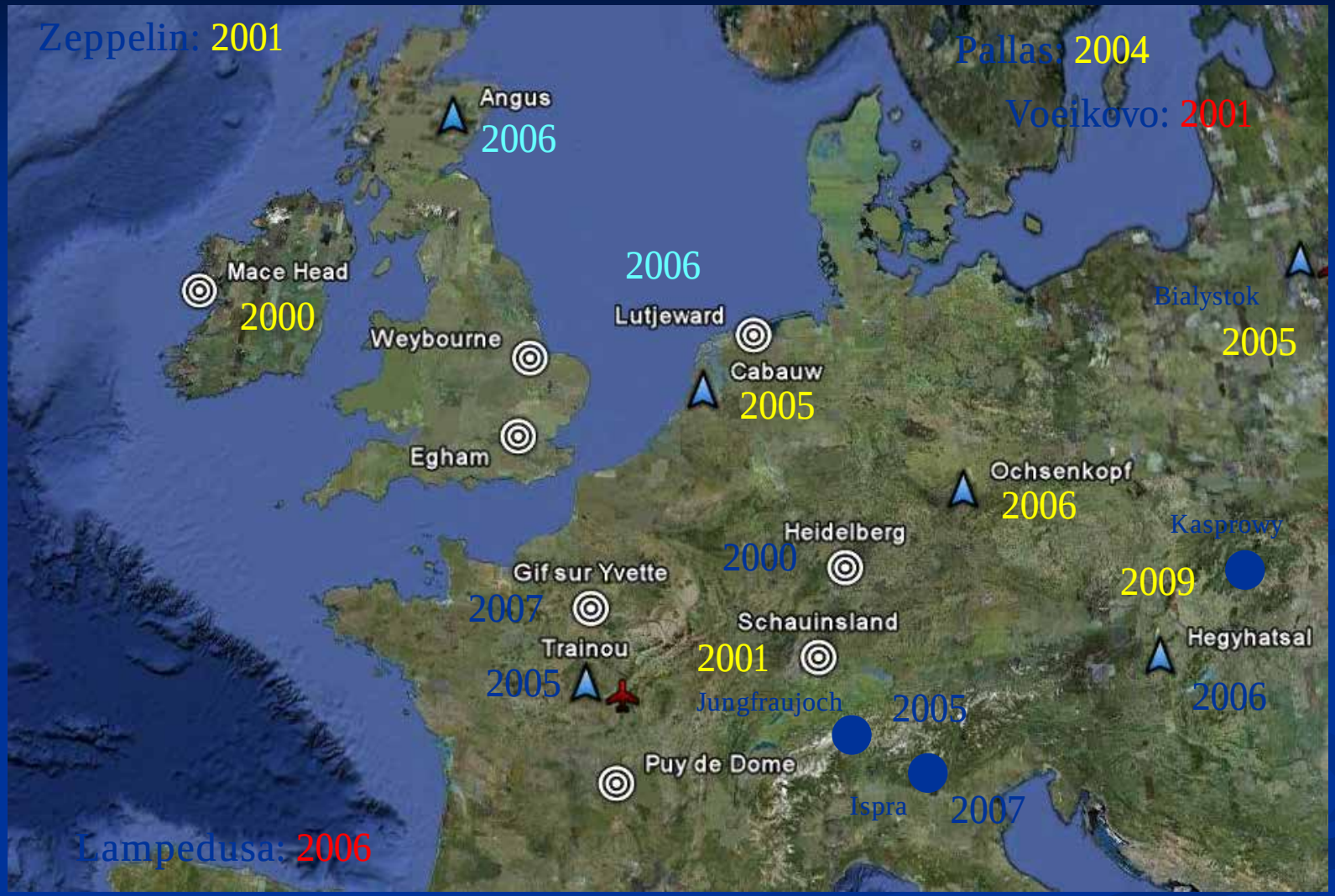
non-CO_2 GHG emissions uncertain

- Global antrop. emissions from network badly constrained
- Anthropogenis emissions bottom-up on country basis:
  - CO_2 emission annually per country -> 10% or more different (EEA, 2012)
  - CH_4: 30%
  - N_2O: 50 .. 200%
  - SF_6: 50%
  - Halocarbons: 50%
- Verification by more and better observations is needed
- Needs development of inverse transport models
- We can't go back later to measure todays baseline
- Capture surprise emissions (natural (CC) or human)

InGOS activities

- Networking activities:
  - Improve historic datasets CH_4, N_2O, SF_6, H_2, CO
  - Good practice development for all gas, isotope and flux observations
  - Near real-time provision of tracer data
  - Provide QA'ed new observational data
- Trans National Access:
  - 18 stations
  - Providing:
    - lab calibration standards
    - Gases for comparisons
- Service activities: databases (linked/shared with ICOS/AGAGE/WMO etc)
- Research activities
  - Testing and (co-)developing new sensors/instruments/methods
  - Integration of measurements and (inverse) modelling, network optimisation.
  - Link with remote sensing (TCCON)
  - Development of new observations (halocarbons, isotopes)
  - Integration of flux and concentration measurements at tall tower sites

Historical data: CH_4



no data

no uncertainty estimates

no uncertainty in data base

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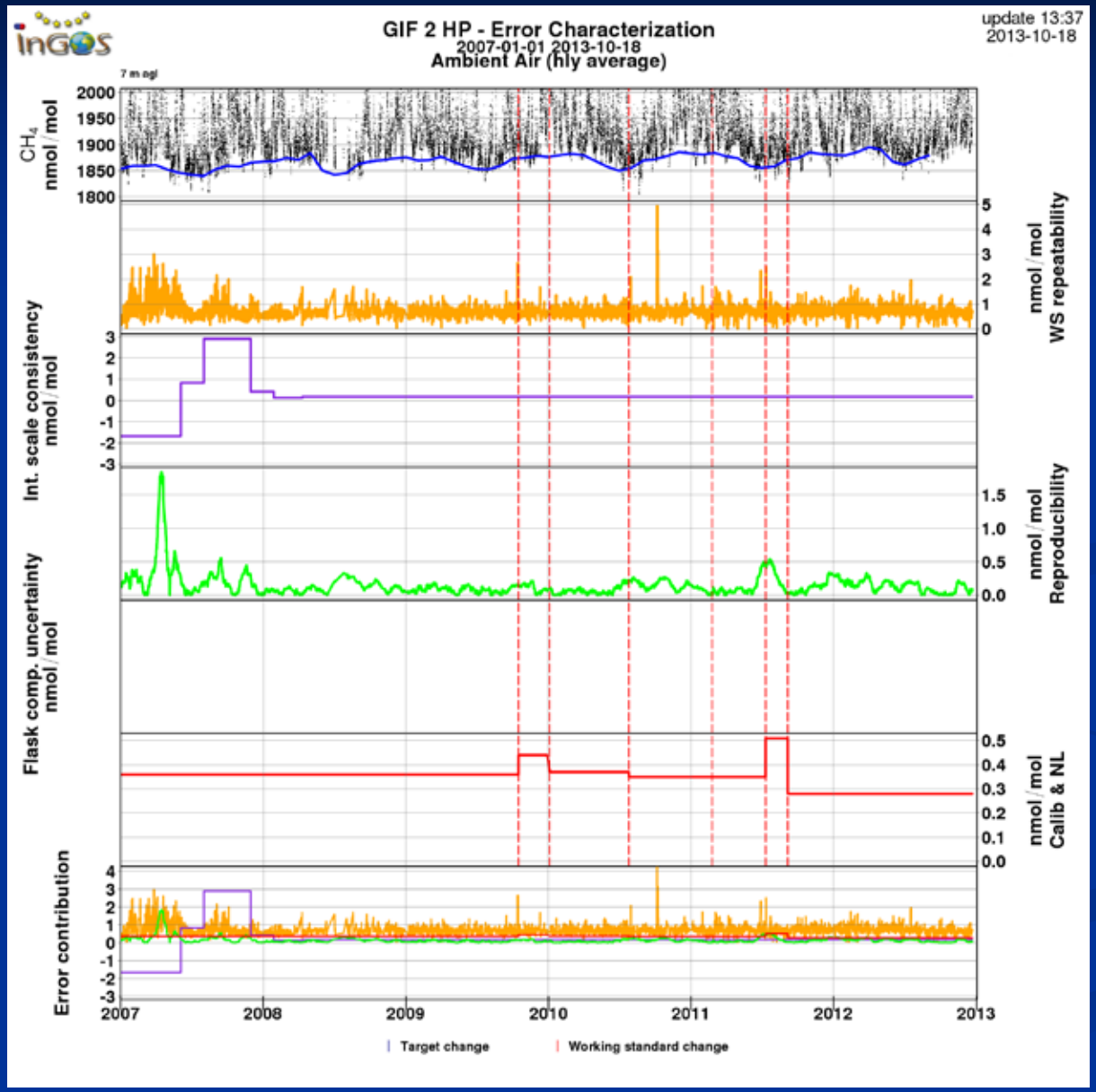
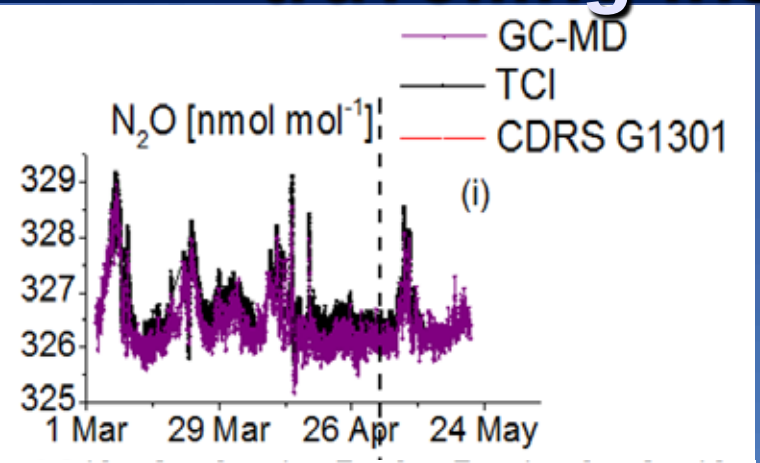
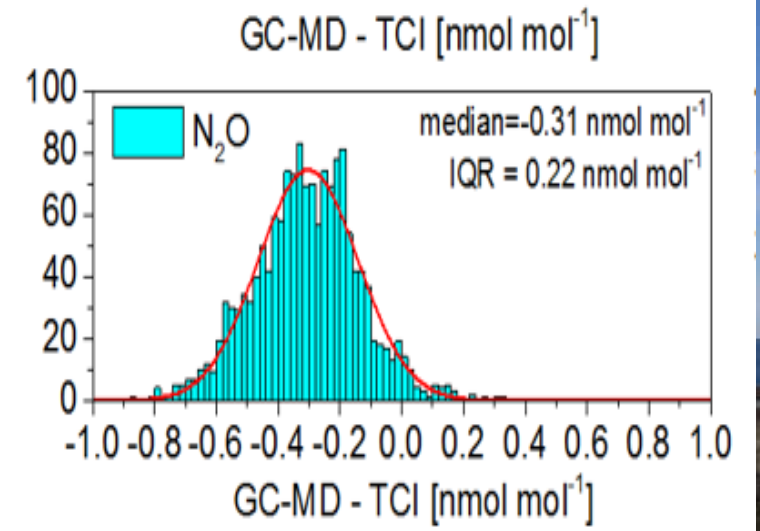
Output for quality assessment



CH_4 and N_2O comparison of InGOS travelling instrument at Mace Head





- Good agreement for CH_4
- N_2O difference explained by scale difference between NOAA & AGAGE

Vardag et al., in prep

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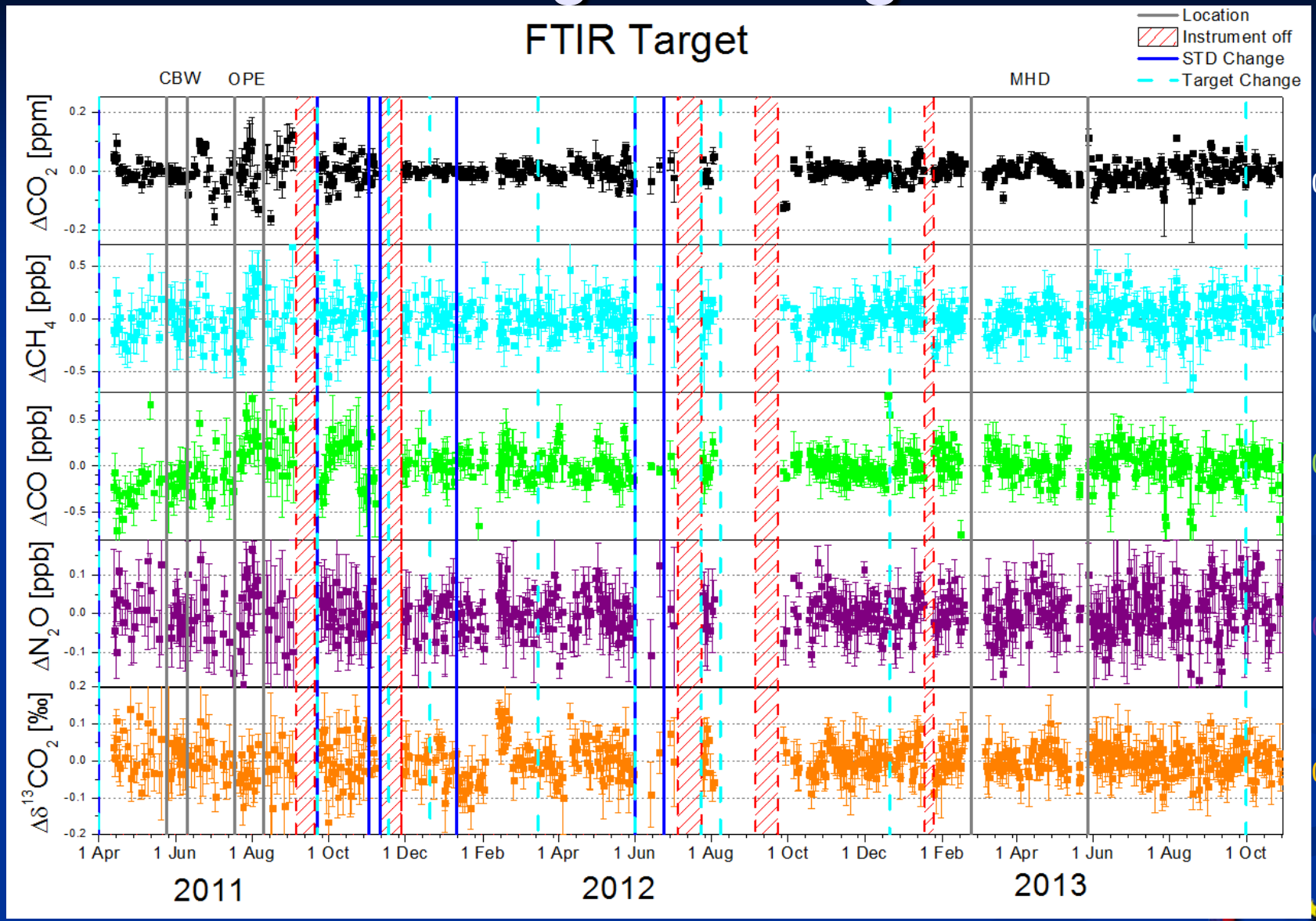
N_2O instrument testing

	Instr. 1	Instr. 2	Instr. 3	Instr. 4	Instr .5	FTIR
Precision -sec (ppb)	0.09	0.07	0.17	0.67	**0.02**	
Precision 1-min (ppb)	0.04	0.03	0.05	0.13	**0.01**	0.15
30 hour Drift (ppb/hr)	-0.008	0.004 (?)	**-0.001**	-0.004	0.006	0.004
Repeatability (ppb)	**0.02**	**0.02**	0.03	0.17		
Reproducibility (ppb)	0.34	0.2	**0.06**	0.29	0.04*	0.09
Temperature dependence	--	--	-	+	NA	-
H2O correction	-	--	NA	--	++	NA

-- to ++: poor to good (qualitative)
NA: not applicable
* Two hourly calibrated

M. Schmidt, unpublished

Heidelberg FTIR target record



1σ

0.05ppm

0.26ppb

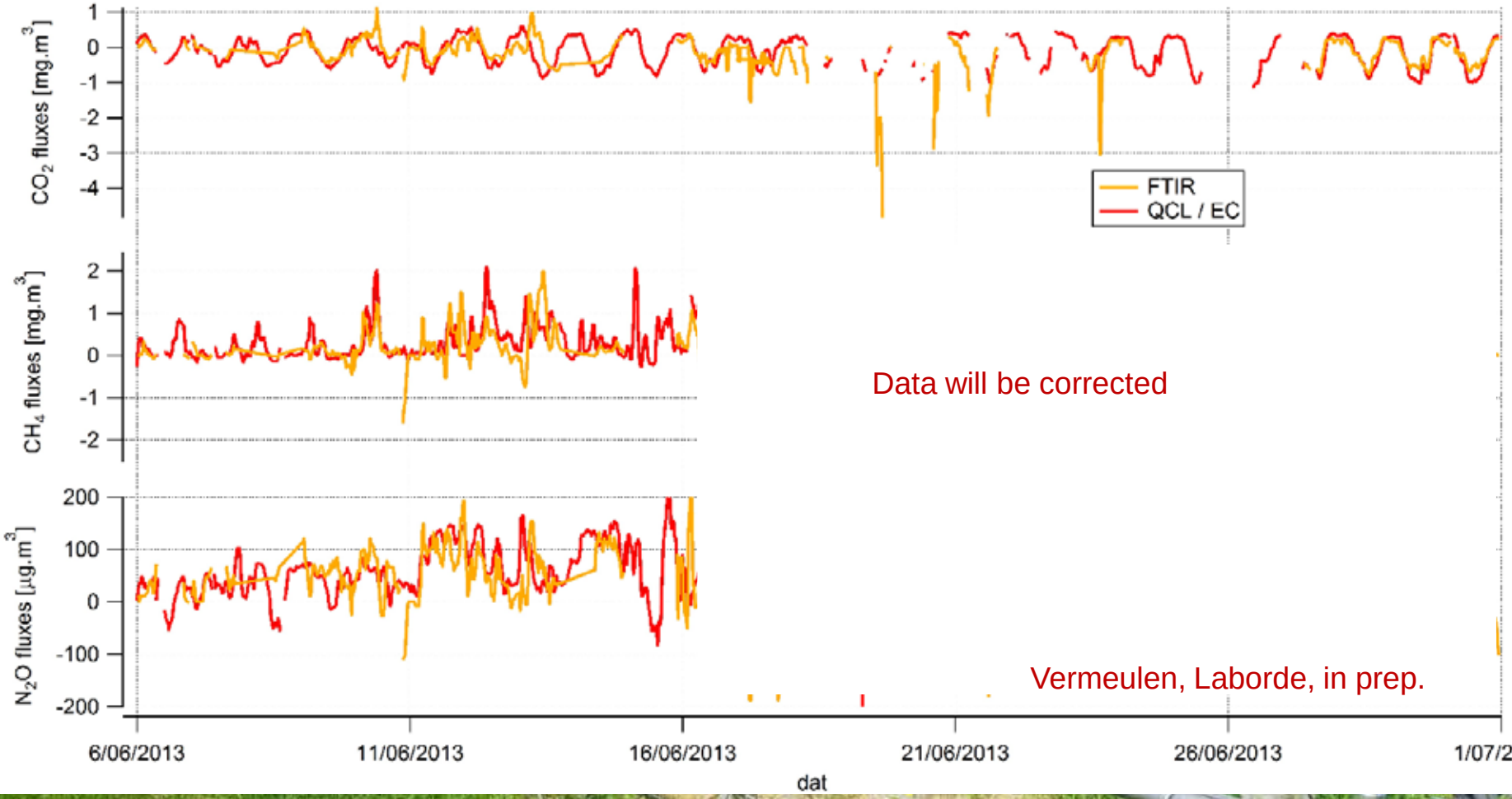
0.40ppb

0.09ppb

0.06‰

S. Hammer, unpublished

N_2O flux measurement campaign Edinburgh July 2013



Data will be corrected

Vermeulen, Laborde, in prep.

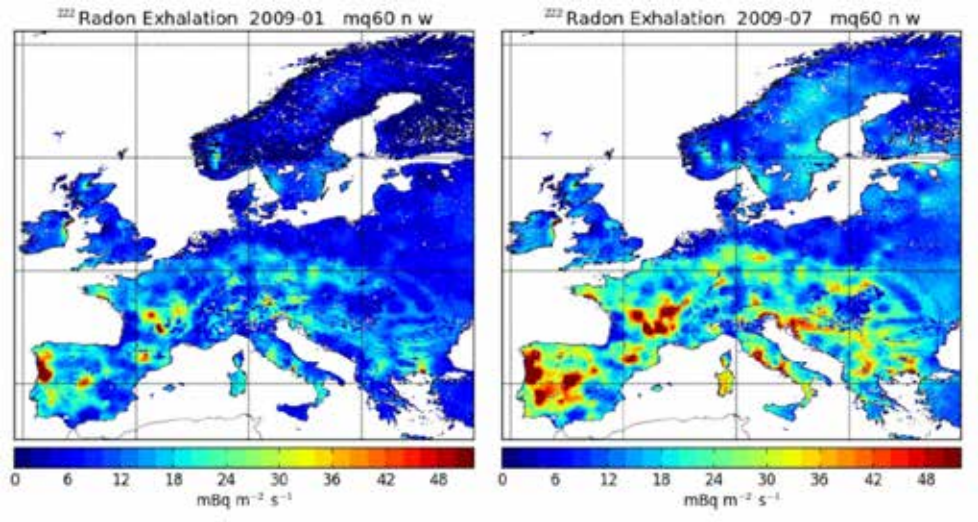
InGOS integration of models and observations

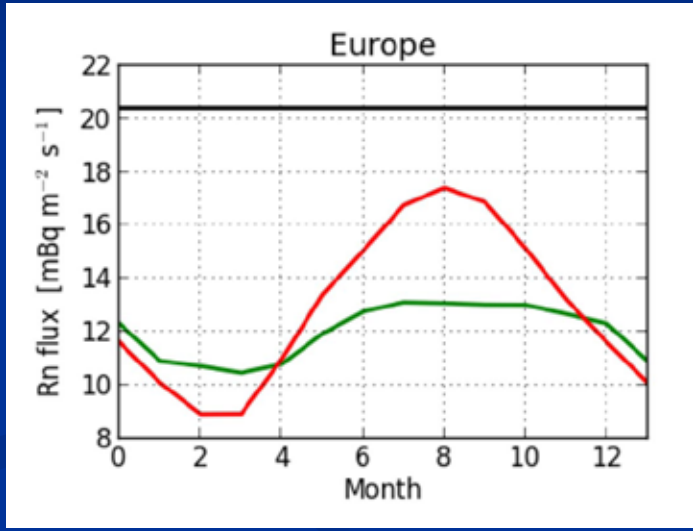
- High resolution ^{222}Rn emission maps for model validation (connects with Transcom-BLH)
- Forward and inverse modelling by 7 independent global and/or regional models
- CH_4+N_2O:
  - Network sensitivity for
    - current network (22)
    - ICOS (34),
    - ICOS future (50)
  - Special EDGAR 4.2FT for prior emission estimates
- $^{13}CH_4$ tracer modelling
- Halocarbon inversions

Model validation

^{222}Rn tracer for atmospheric transport (especially vertical mixing)

new ^{222}Rn emission map
parameterized by soil type, porosity, moisture and water table





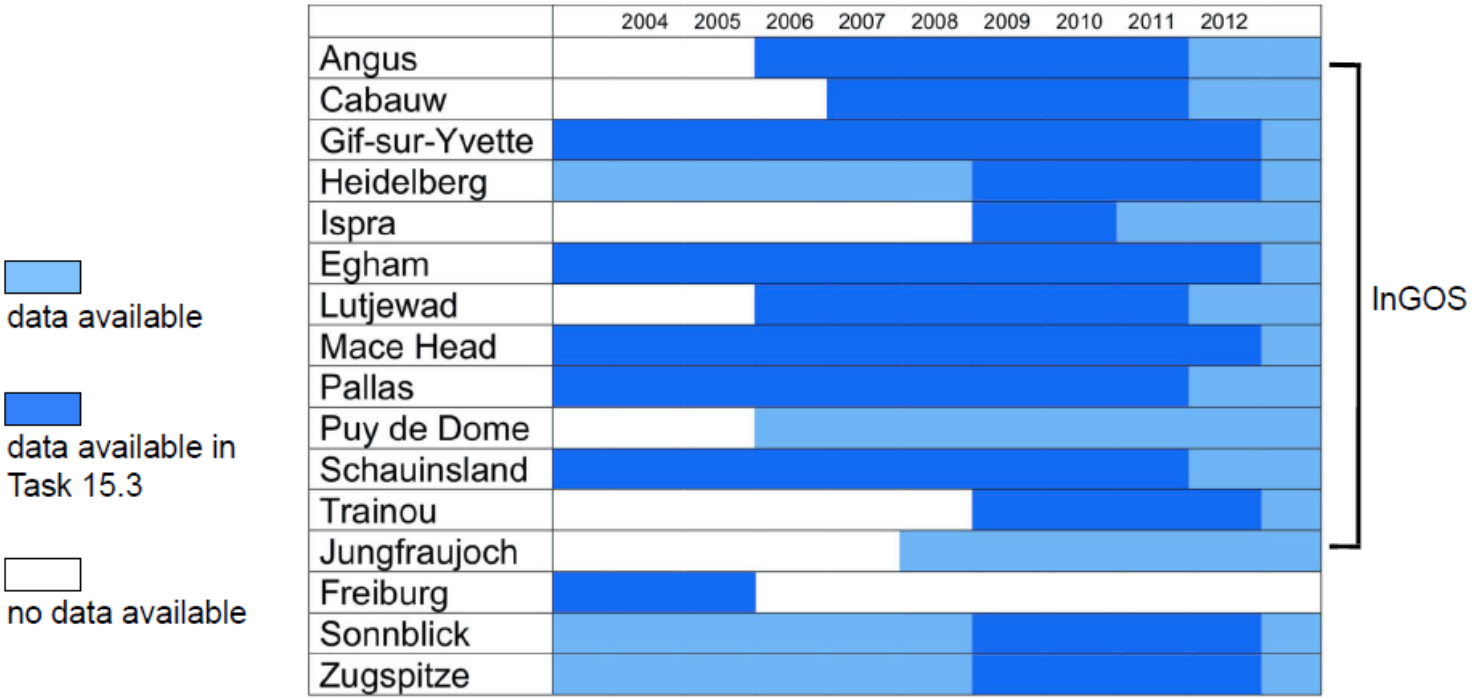
simulations with new ^{222}Rn emission map:
better agreement with observations (especially regarding seasonal variation)

comparison of model boundary layer height with observations
- LIDAR BLH measurements
- Integrated Global Radiosonde Archive (IGRA)

Karstens et al, in prep

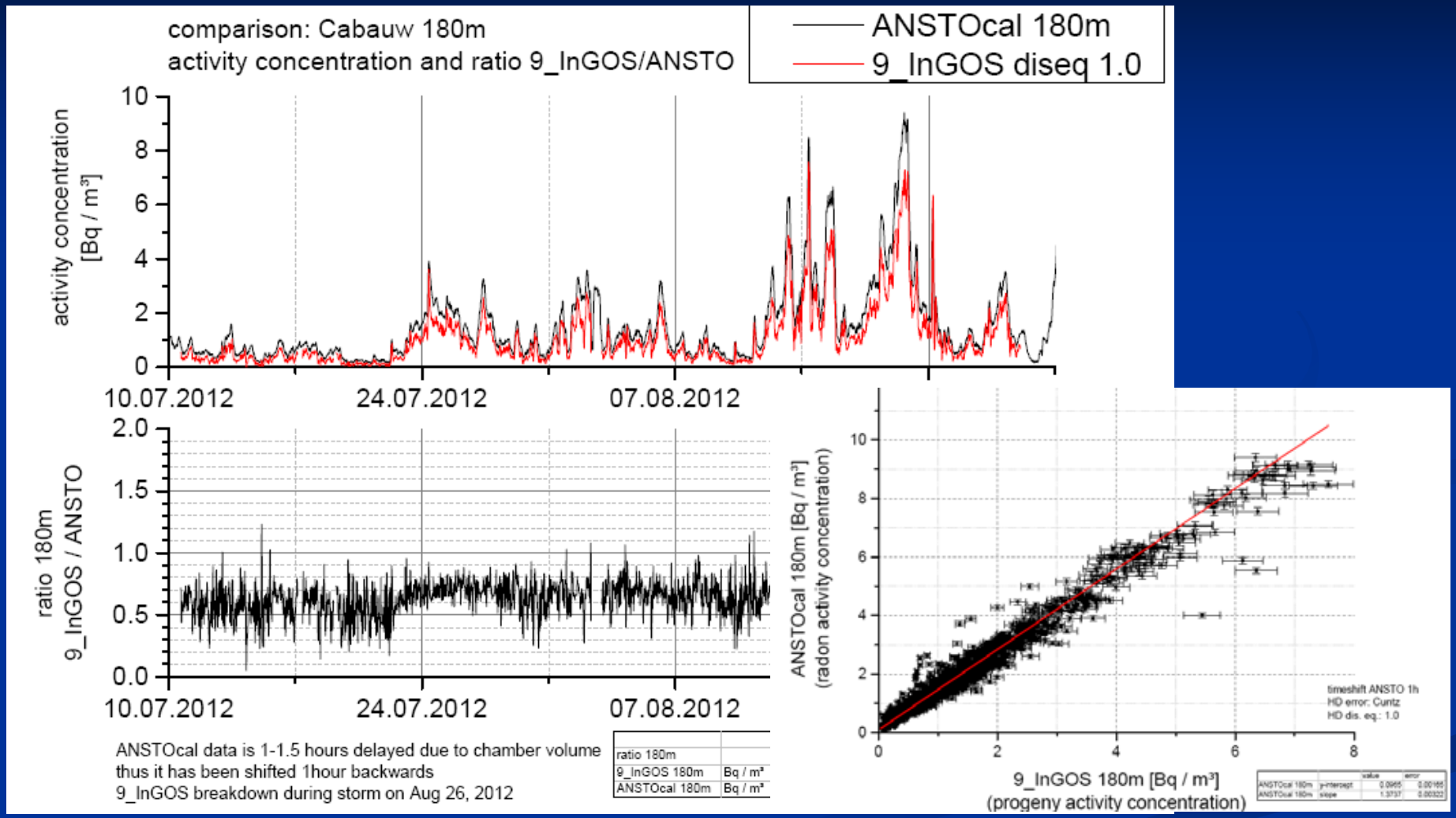
Availability of atmospheric ^{222}Radon data

^{222}Rn measurements available from WP2 (NA2)



Data need some harmonization for the comparison

^{222}Radon intercomparison: Cabauw



Schmithüsen et al, in prep

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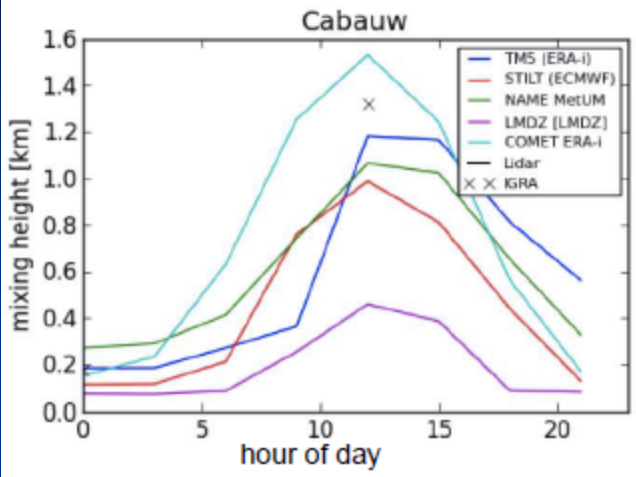
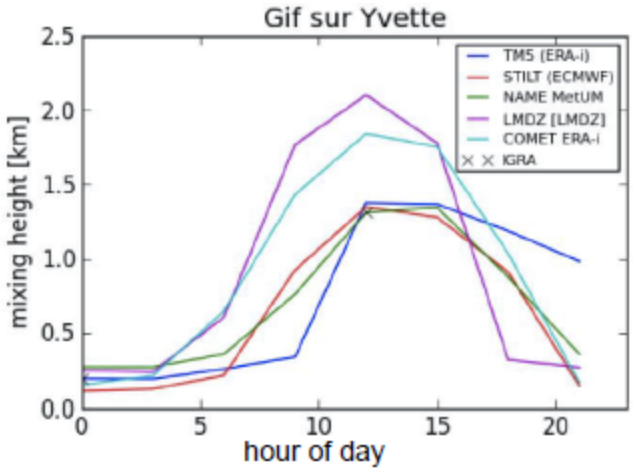
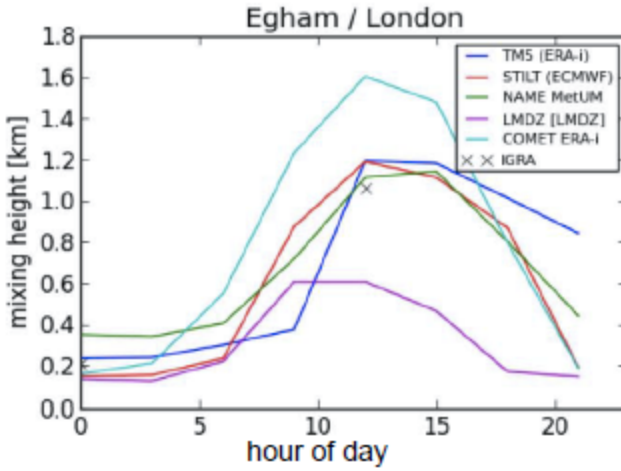
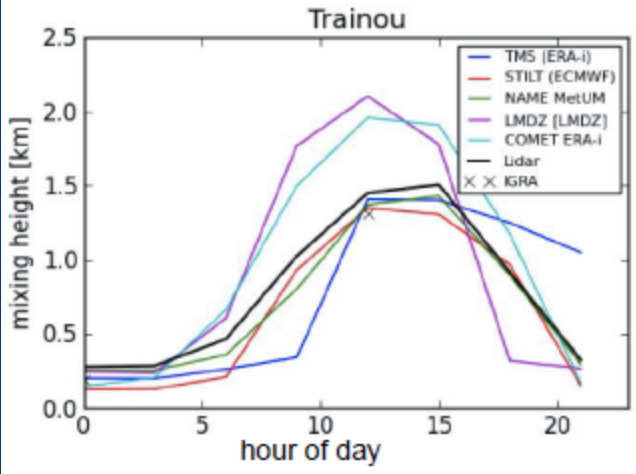
Mixing Height: Diurnal Cycle

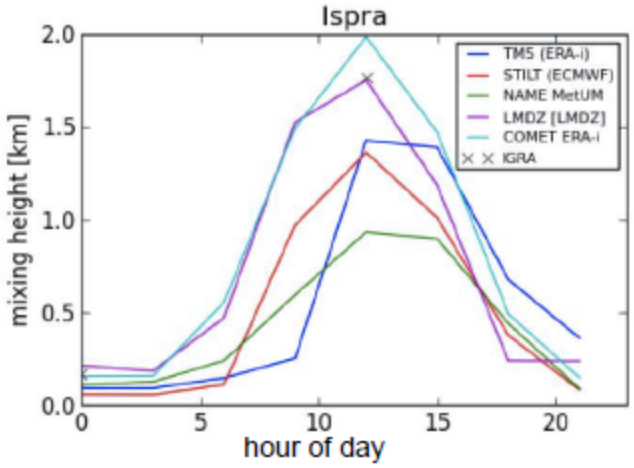
Summer

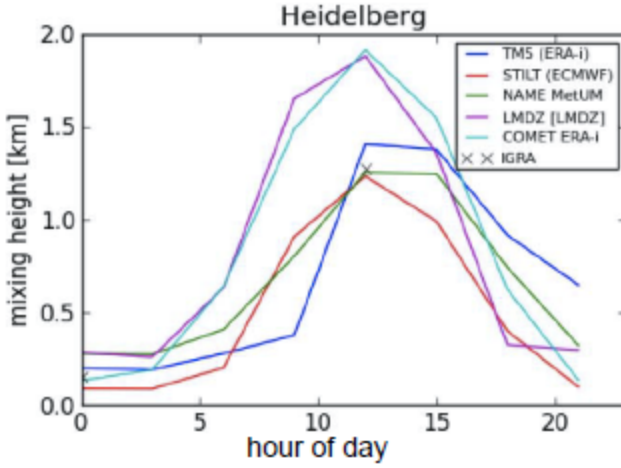




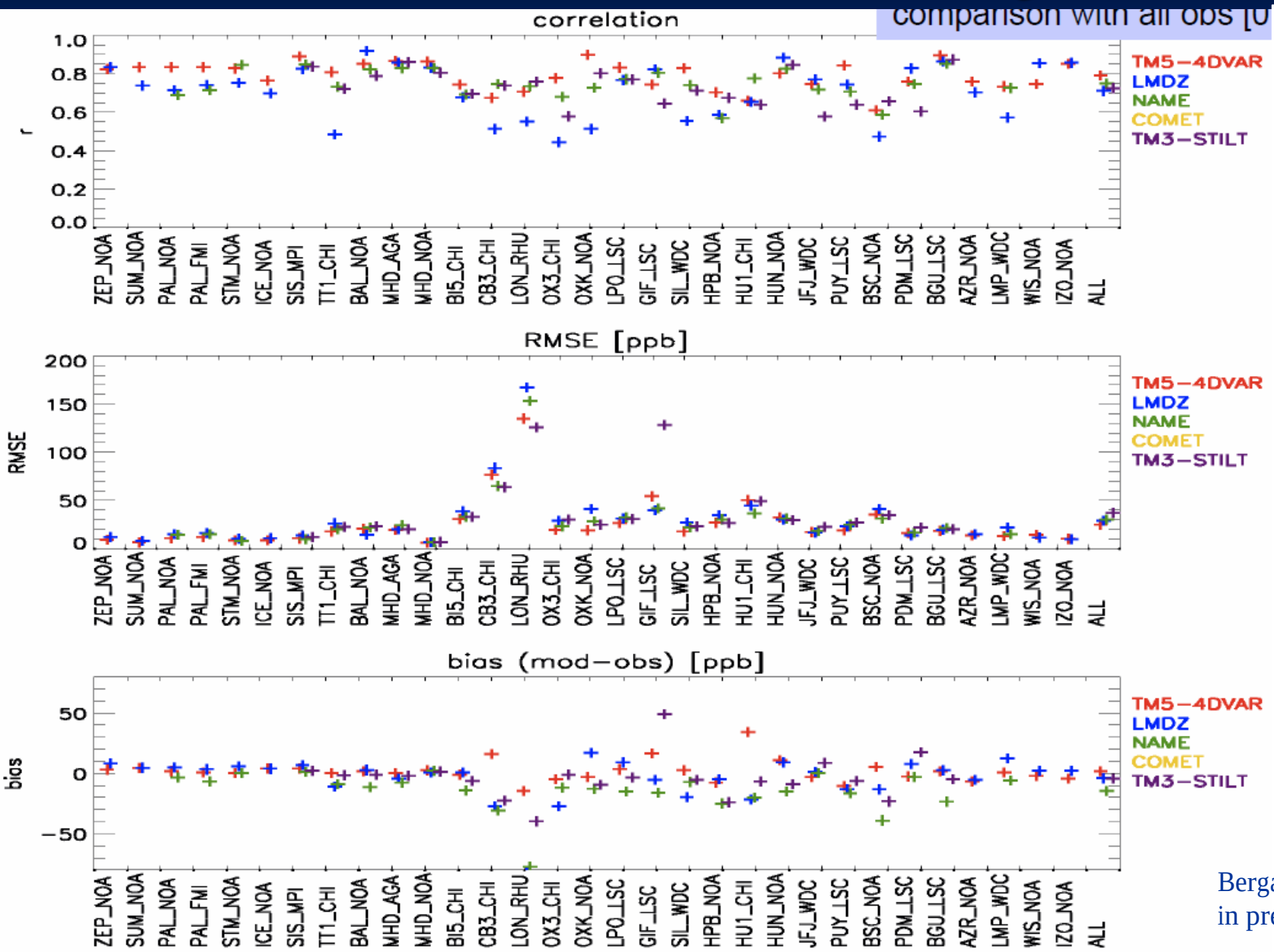




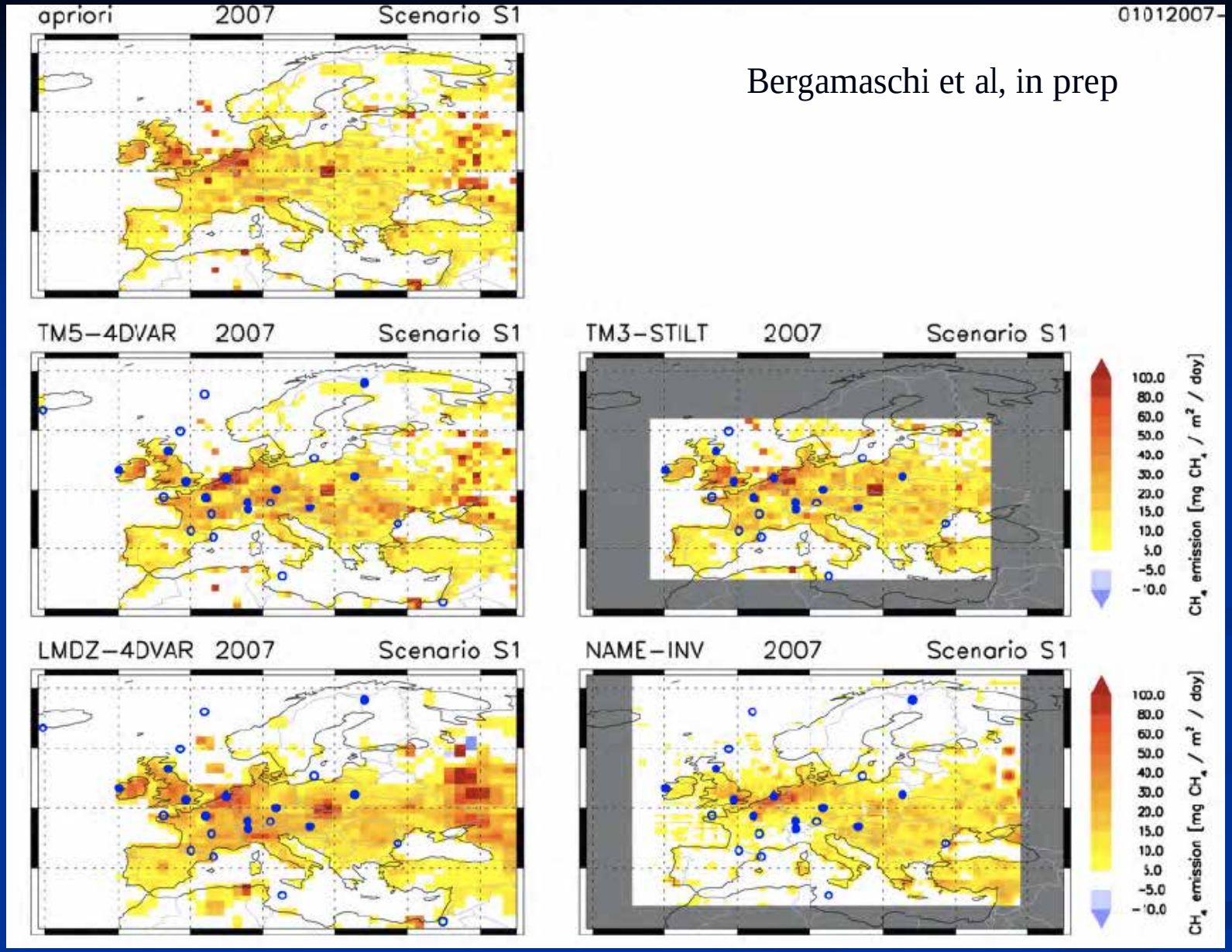




Models tested, correlations ok

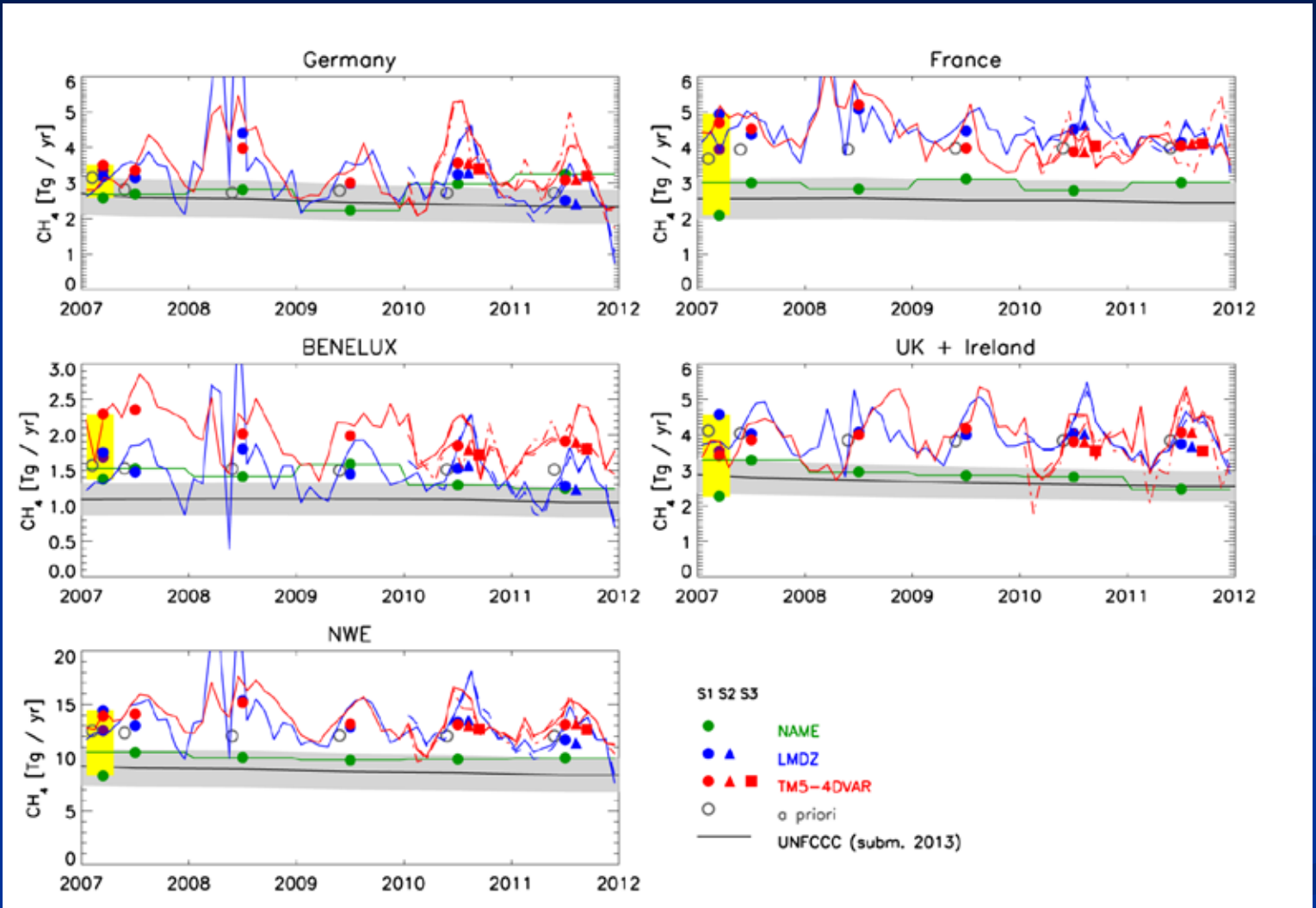


Bergamaschi et al, in prep



Bergamaschi et al, in prep

CH_4 emissions - North Western Europe



InGOS now and in the future

- InGOS now well underway (~24 months) showing good progress
- InGOS integrates different communities (surface measurements, remote sensing and modelling)
- InGOS will provide
  - Harmonized historic datasets for continuous European obs. of CH_4, N_2O, SF_6, H_2, inclusive error analysis
  - Near realtime continuous data for CH_4, N_2O, SF_6, H_2, ^{222}Rn…
  - Improved regional emission estimates (bottom up+top down)
  - Network design for non-CO_2 monitoring
  - Improved measurement techniques and methods

THANK YOU!

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