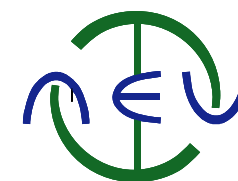


Inverse modelling of European and global CH₄ emissions

Peter Bergamaschi, Matteo Corazza, Arjo Segers

NitroEurope partners:

- ECN (Alex Vermeulen)
- UK-MET (Alistair Manning, Maria Athanassiadou)
- LSCE-CEA (Philippe Bousquet, Rona Thompson, Isabelle Pison)
- MPI (Ute Karstens)



NitroEurope IP

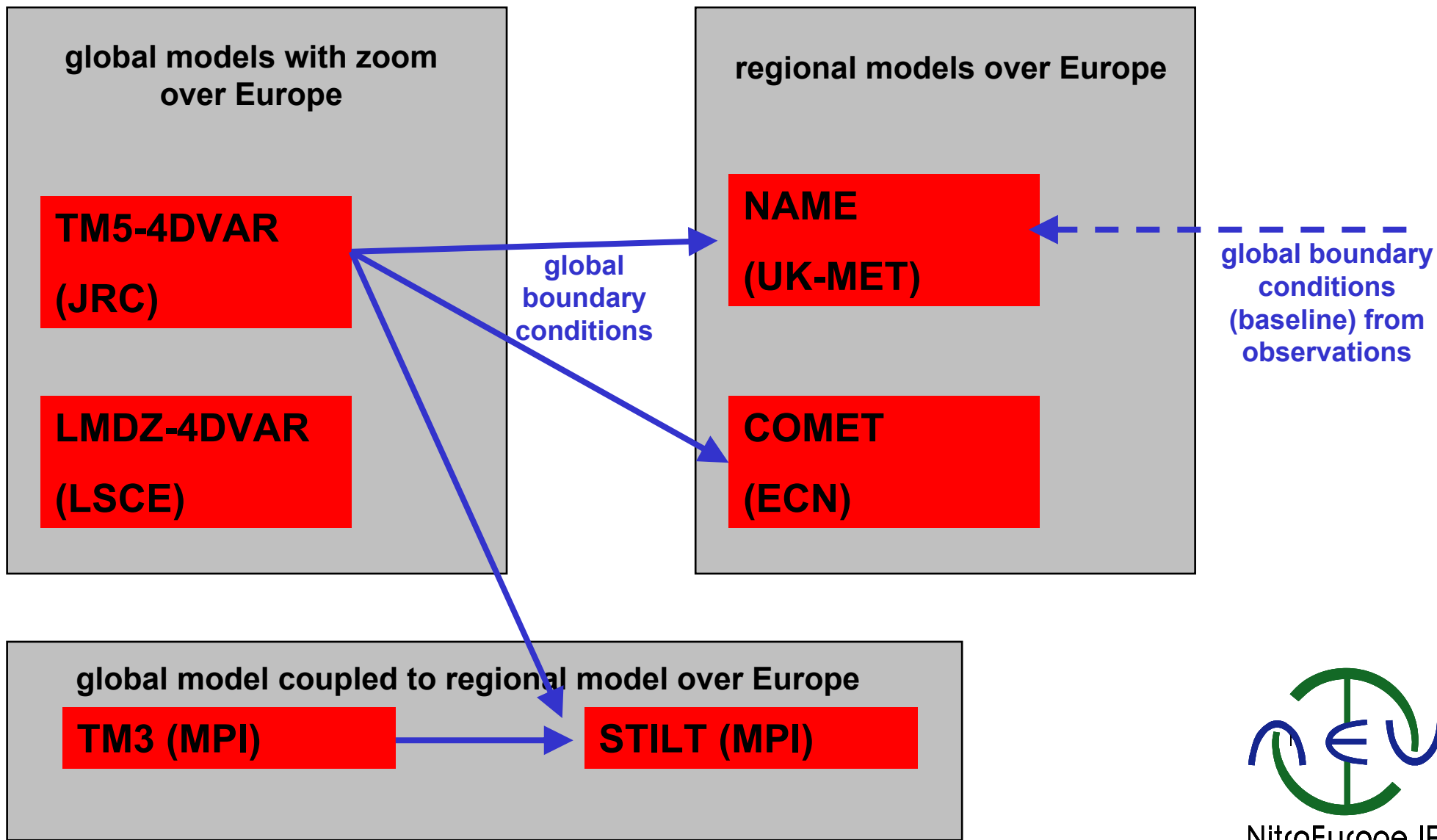
Atmospheric CH₄ observations (surface stations):

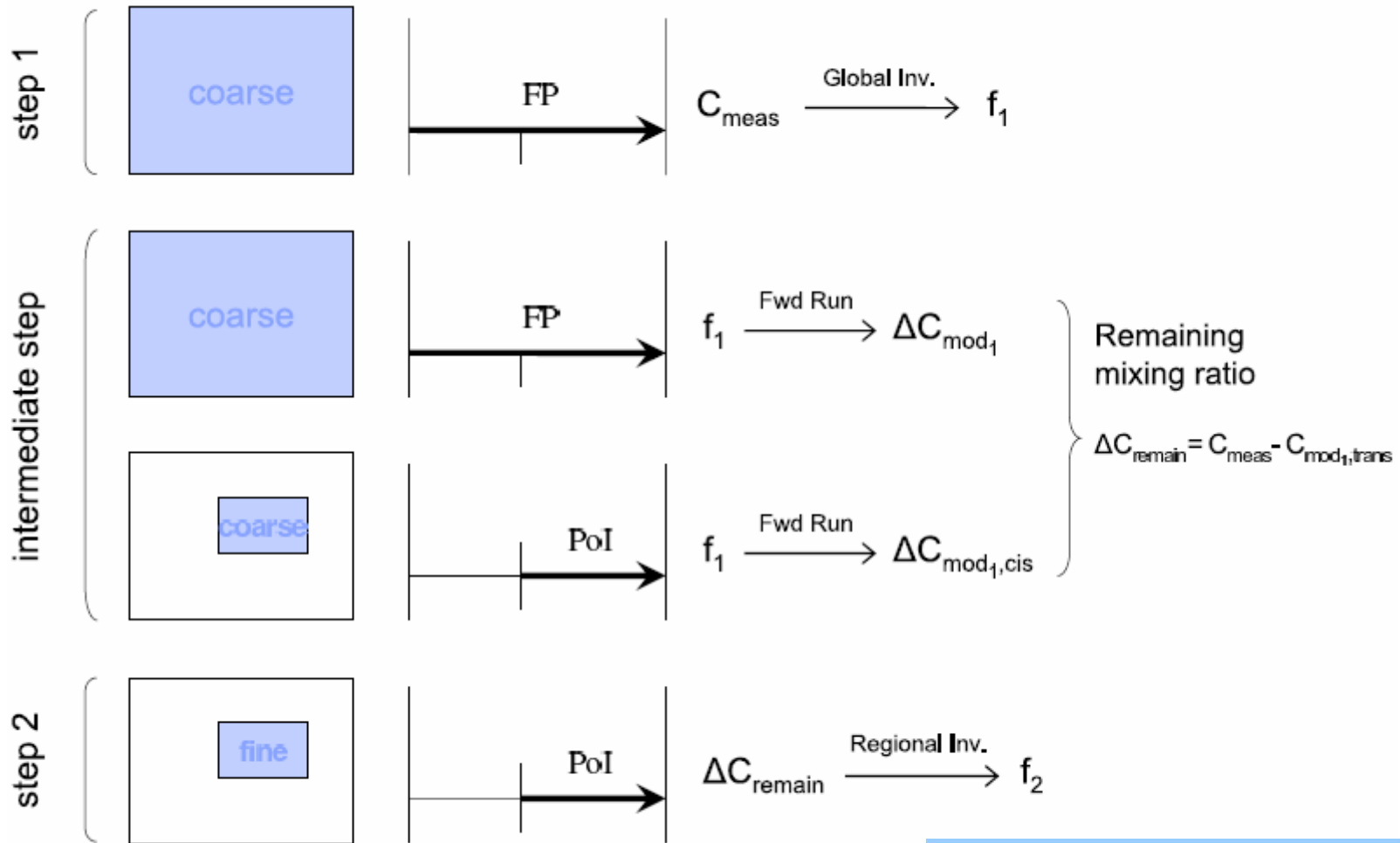
CHIOTTO, UBA(D), AGAGE, NOAA, EMPA, RHUL, ENEA

MACC partners (satellite retrievals / IFS assimilation):

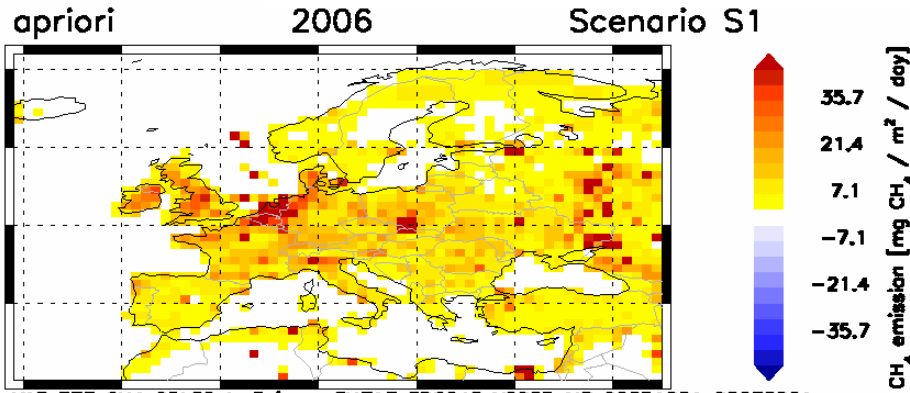
- SRON (A. Gloudemans, C. Frankenberg)
- ECMWF (R. Engelen)



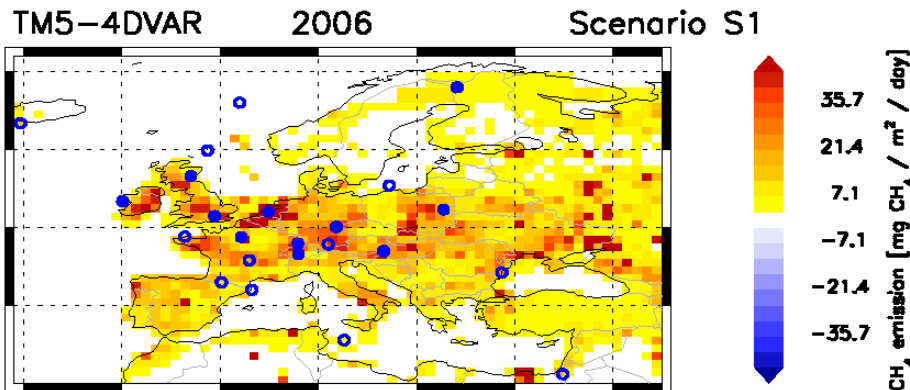




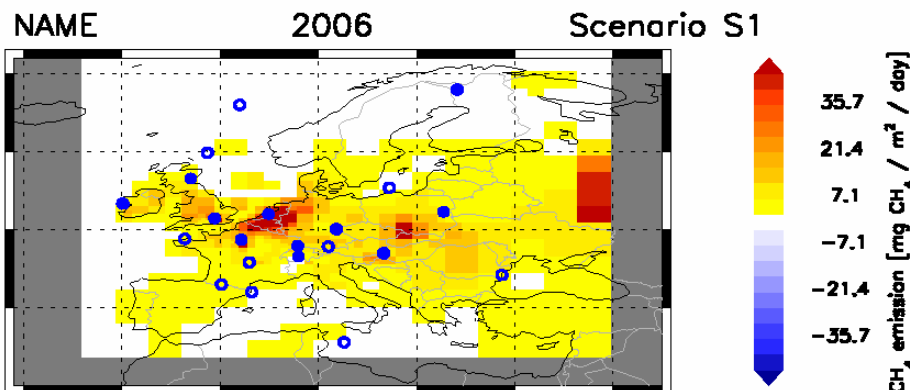
[Roedenbeck et al., ACP, 2009]



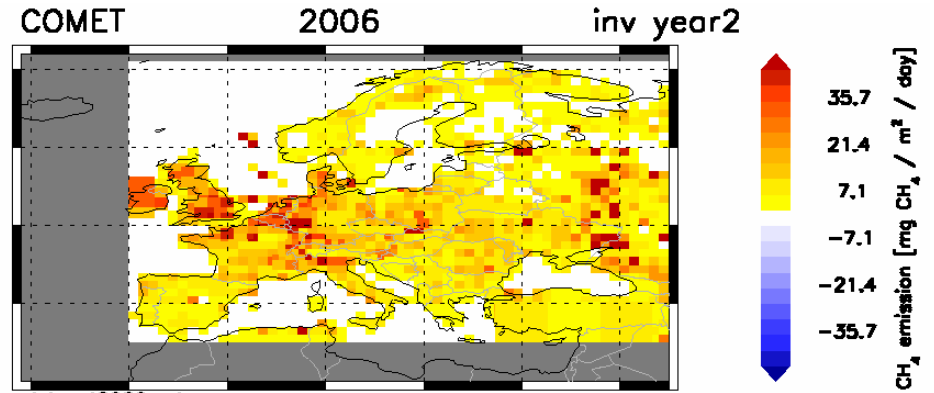
VAR_T33_CH4_25L60_1m5ei_eur_EU313_EDG040_V0205_MS_20051201_20070201



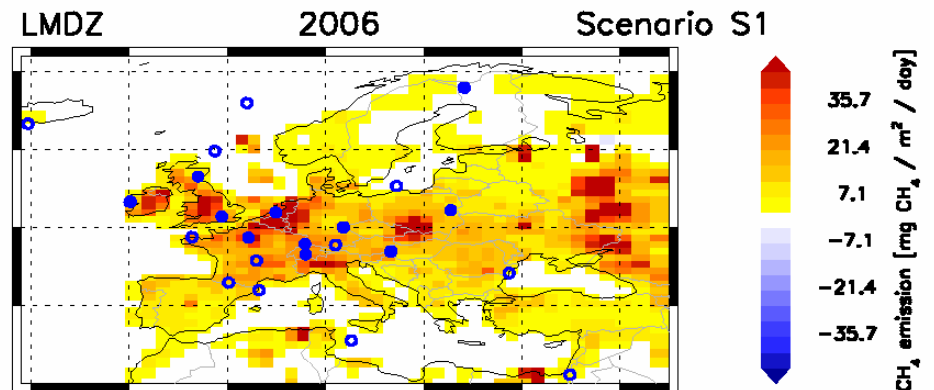
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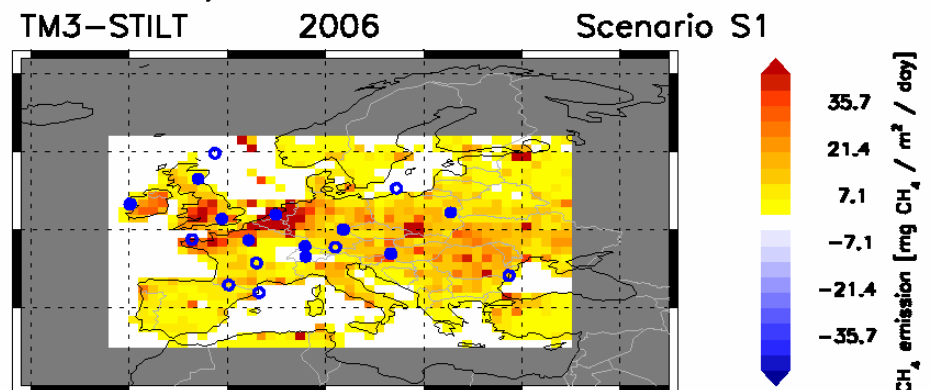
CH4Y2b_2006_APriori_mean



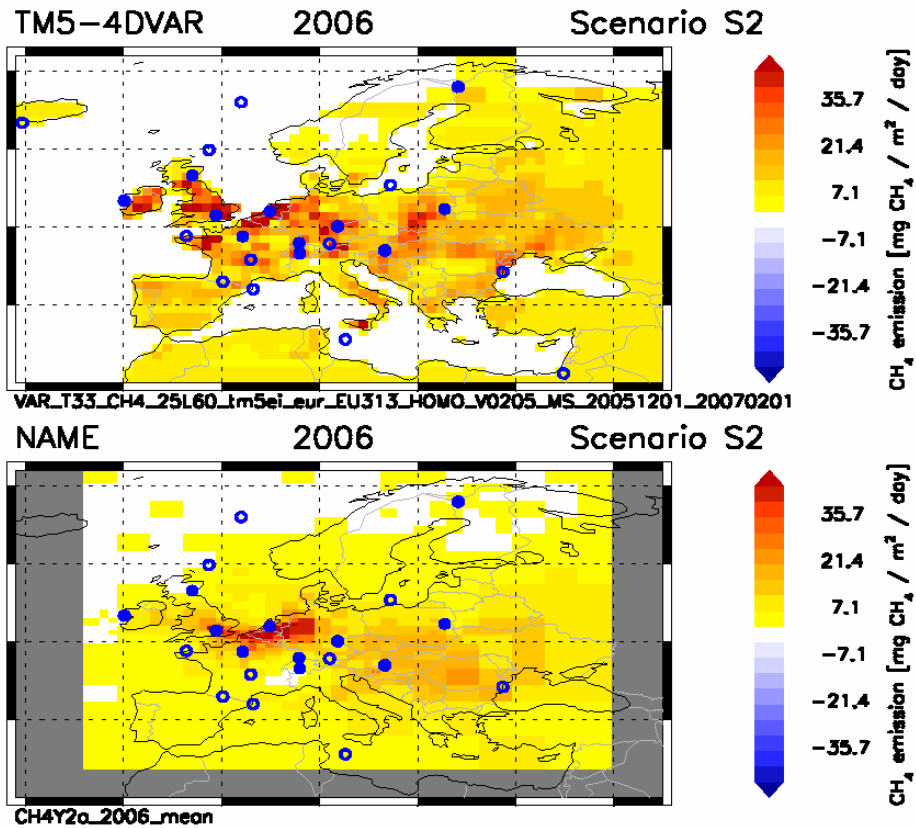
ch4post2006cmt.asc



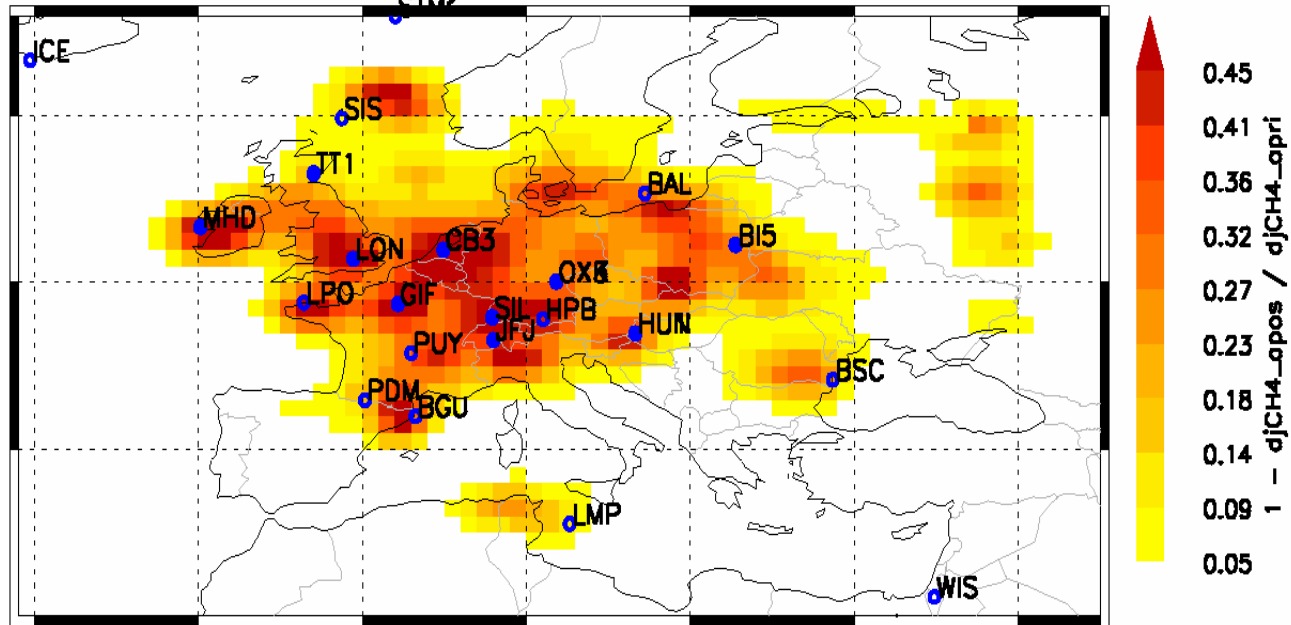
LSCE4DVAR_monthly_emissions_CH4.nc

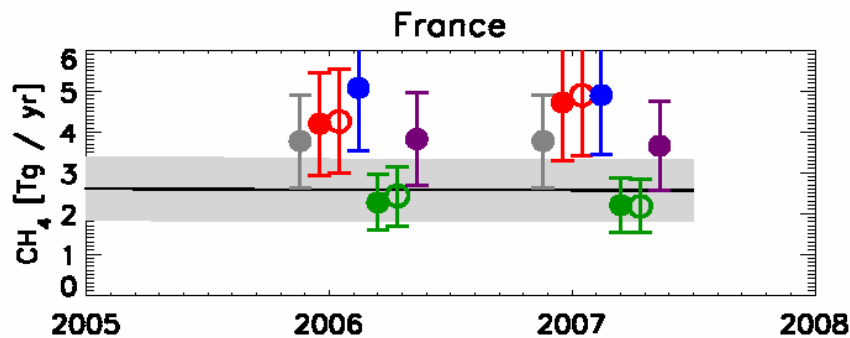
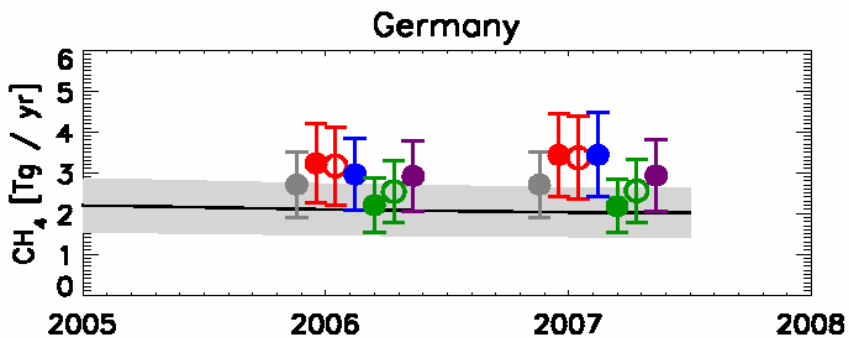


STILT_ch4_apost_flux.mo.nc



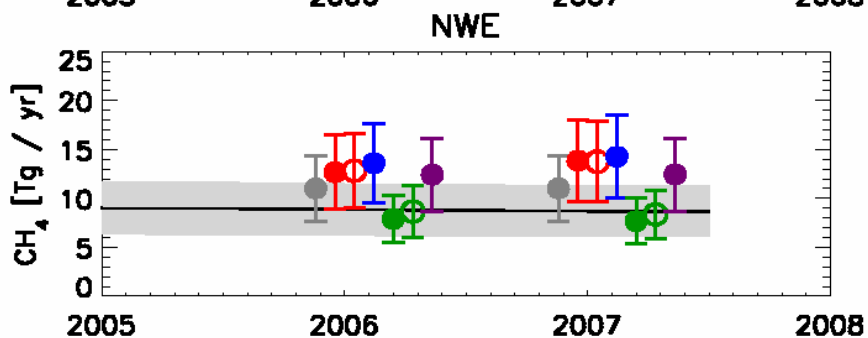
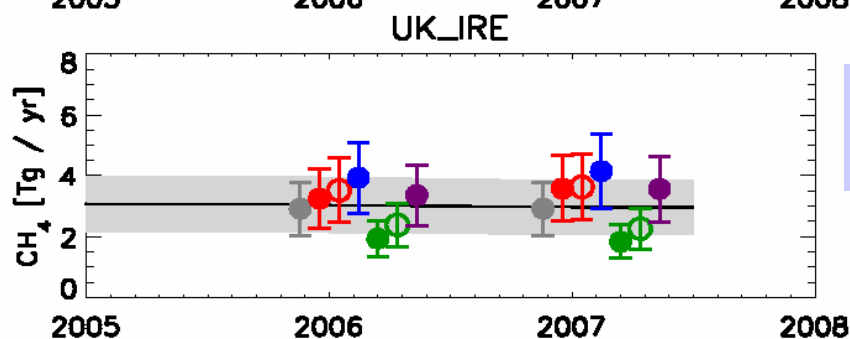
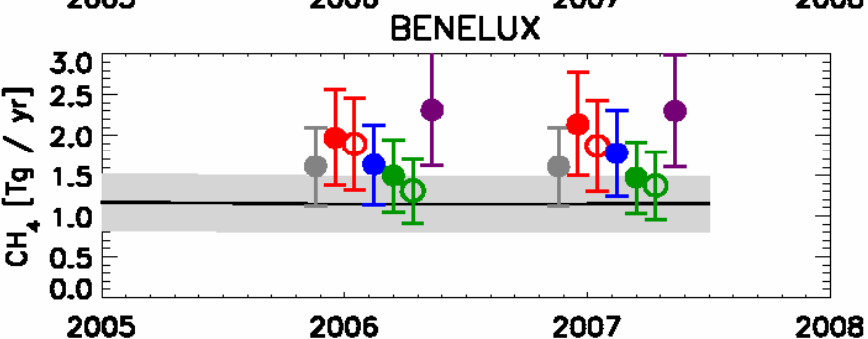
relative uncertainty reduction





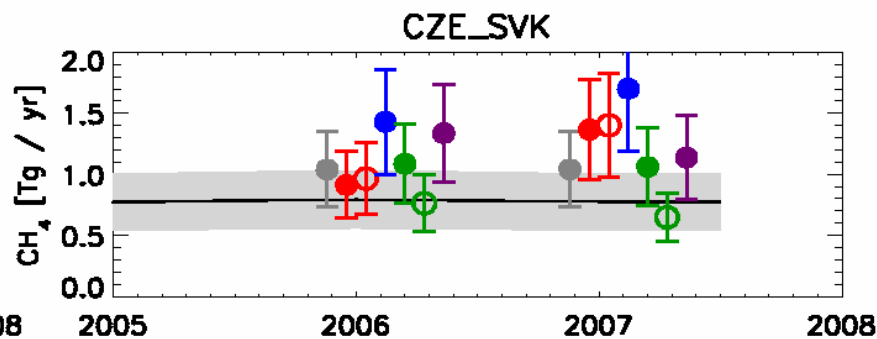
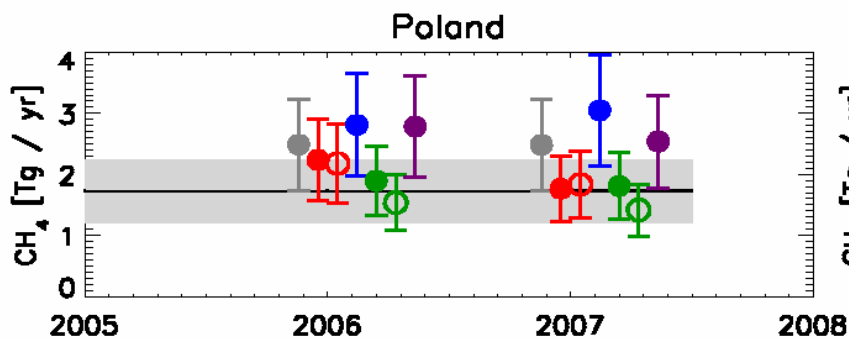
apriori
■ TM5-4DVAR
■ LMDZ
■ NAME
■ TM3-STILT

● scenario S1
○ scenario S2



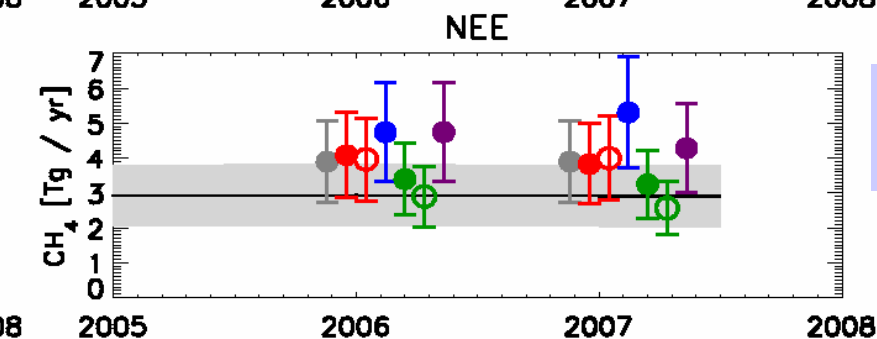
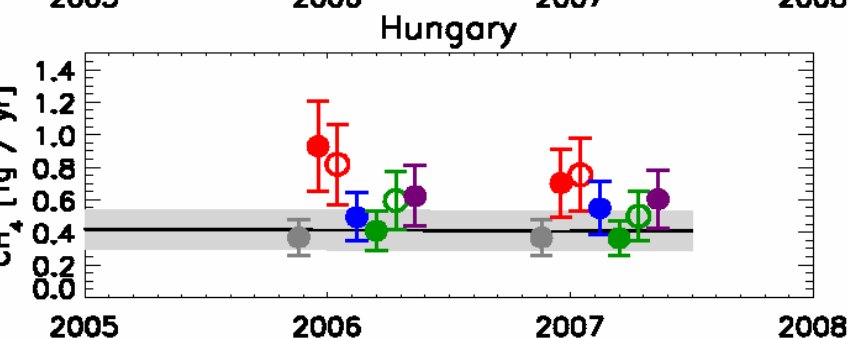
— UNFCCC 2009

- no correction for natural sources
- no offshore emissions



apriori
 TM5-4DVAR
 LMDZ
 NAME
 TM3-STILT

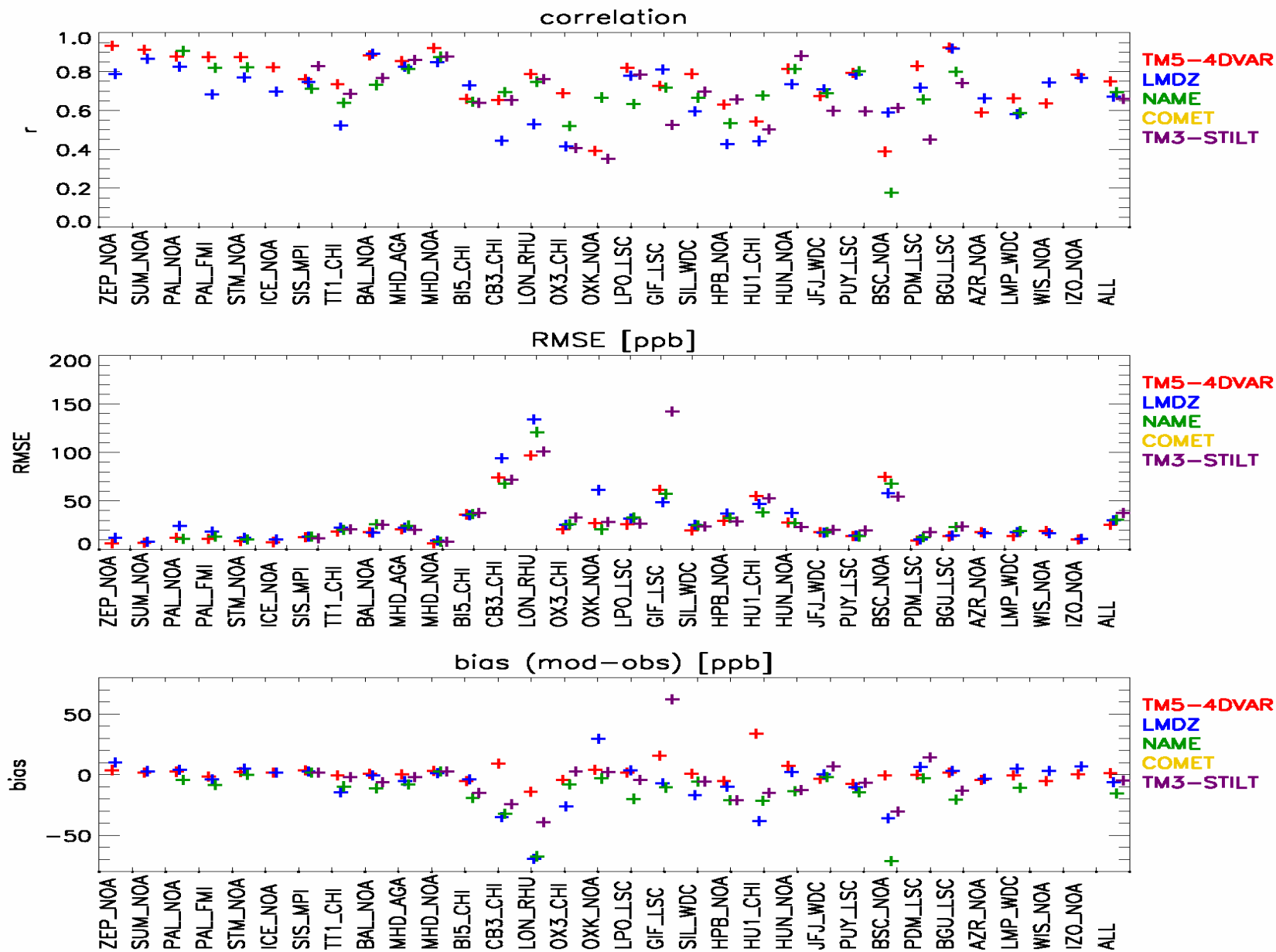
● scenario S1
 ○ scenario S2



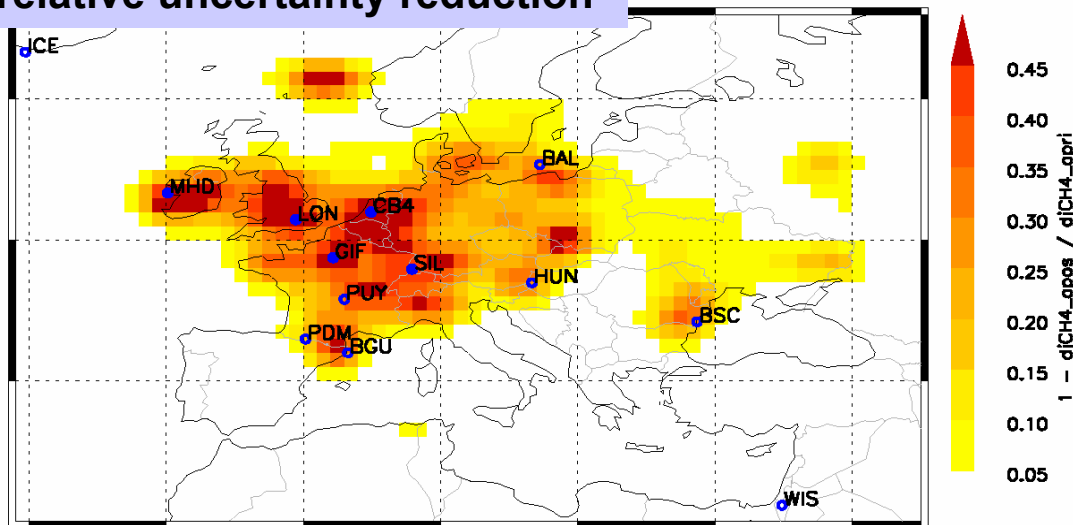
— UNFCCC 2009

- no correction for natural sources
 - no offshore emissions

CH₄ stations - statistics 2006 (S1)



relative uncertainty reduction

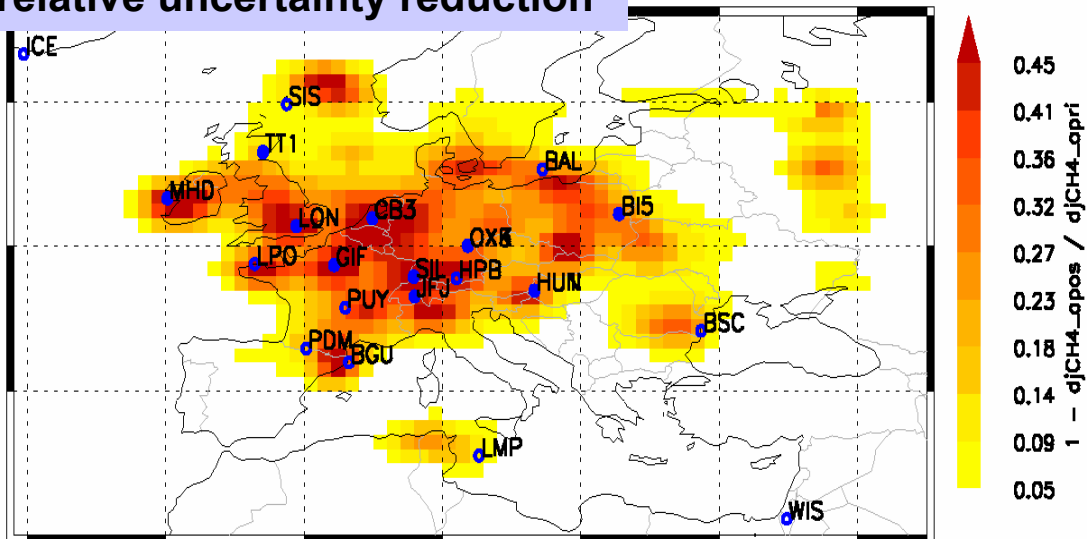


[Bergamaschi et al, JGR, 2010]

11 European stations (5 CM, 6 FM)

2001-2006

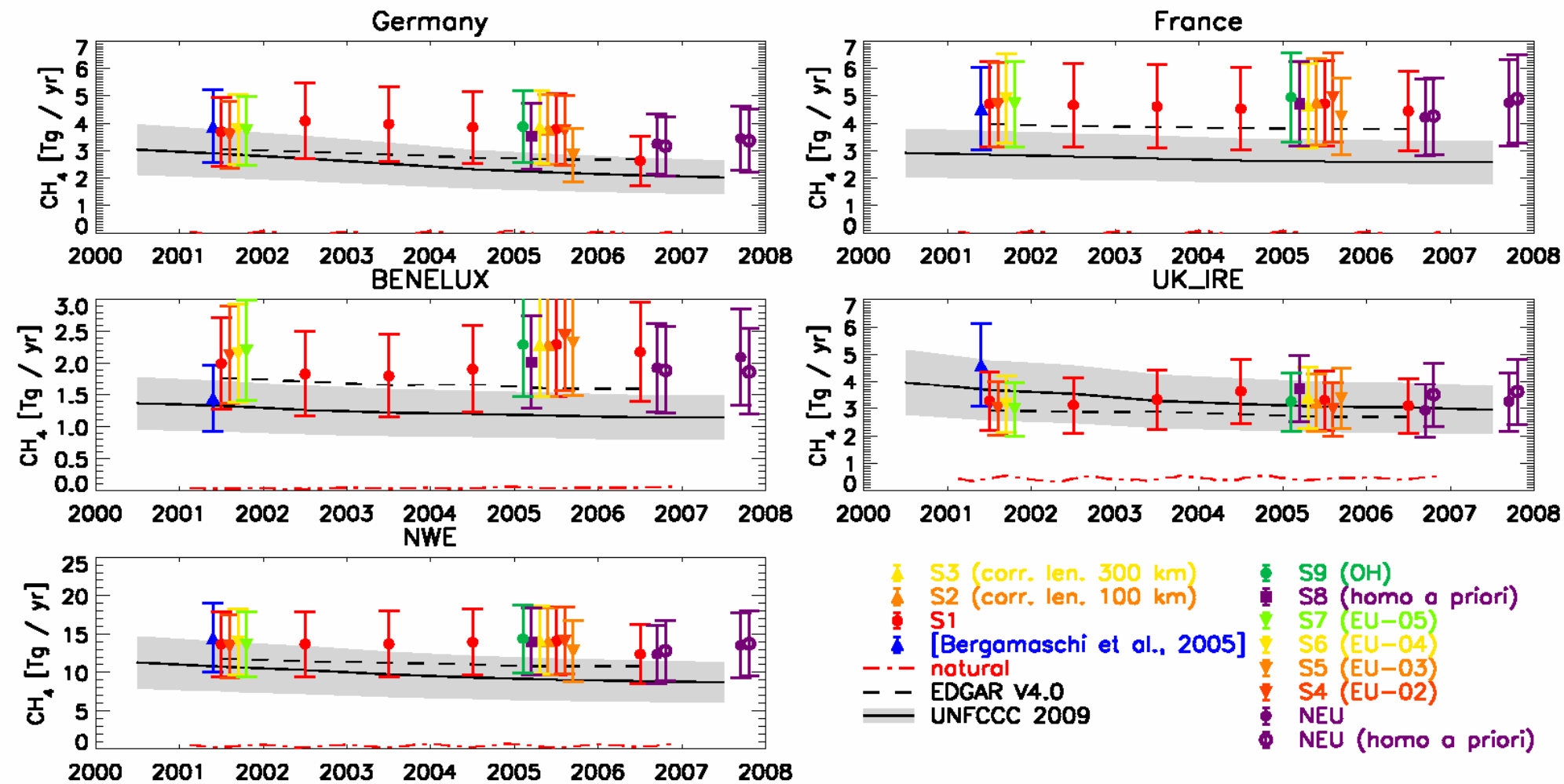
relative uncertainty reduction



NEU

19 European stations (9 CM, 10 FM)

2006-2007



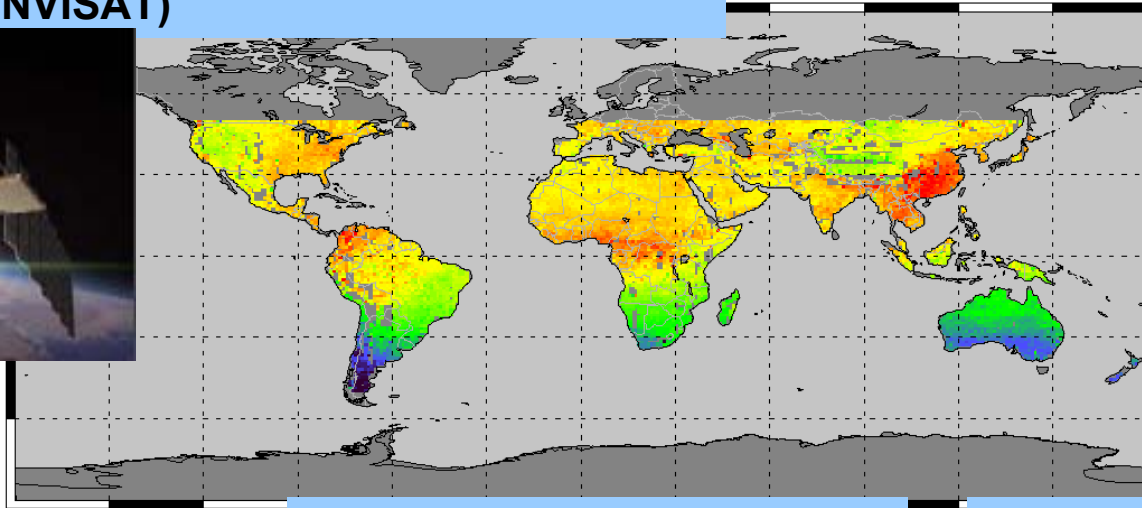
MACC GHG subproject

CH₄ inversions

- > Setup of pre-operational processing chain
- > Improve CH₄ inversion system
- > Delayed mode inversion (every 6 months, ~5 month behind real time)
- > MACC reanalysis (2003-2010)



SCIAMACHY (ENVISAT)

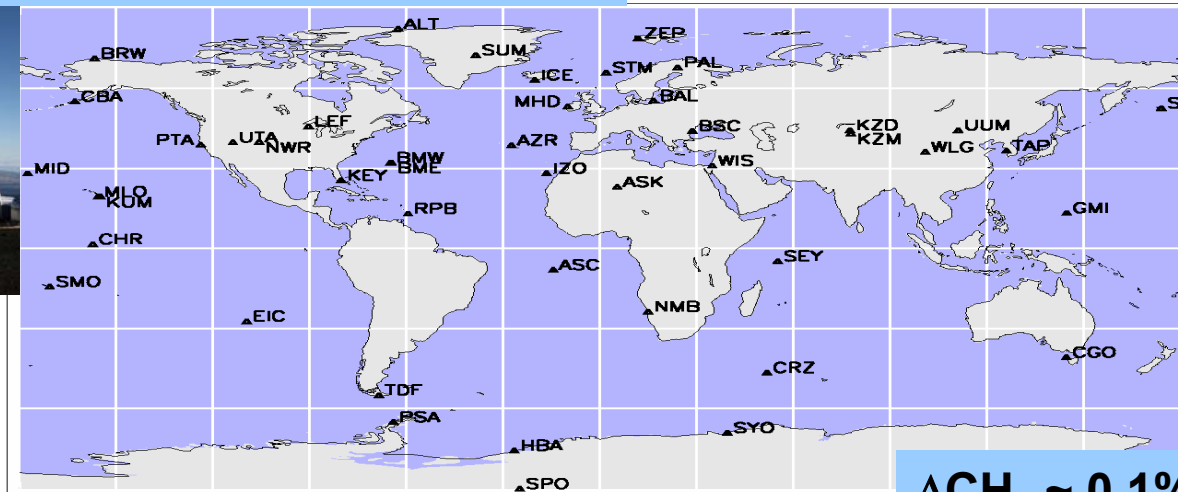


IMAP V5.5 [Frankenberg et al., 2010]

$\Delta XCH_4 \sim 1\%$

IFS

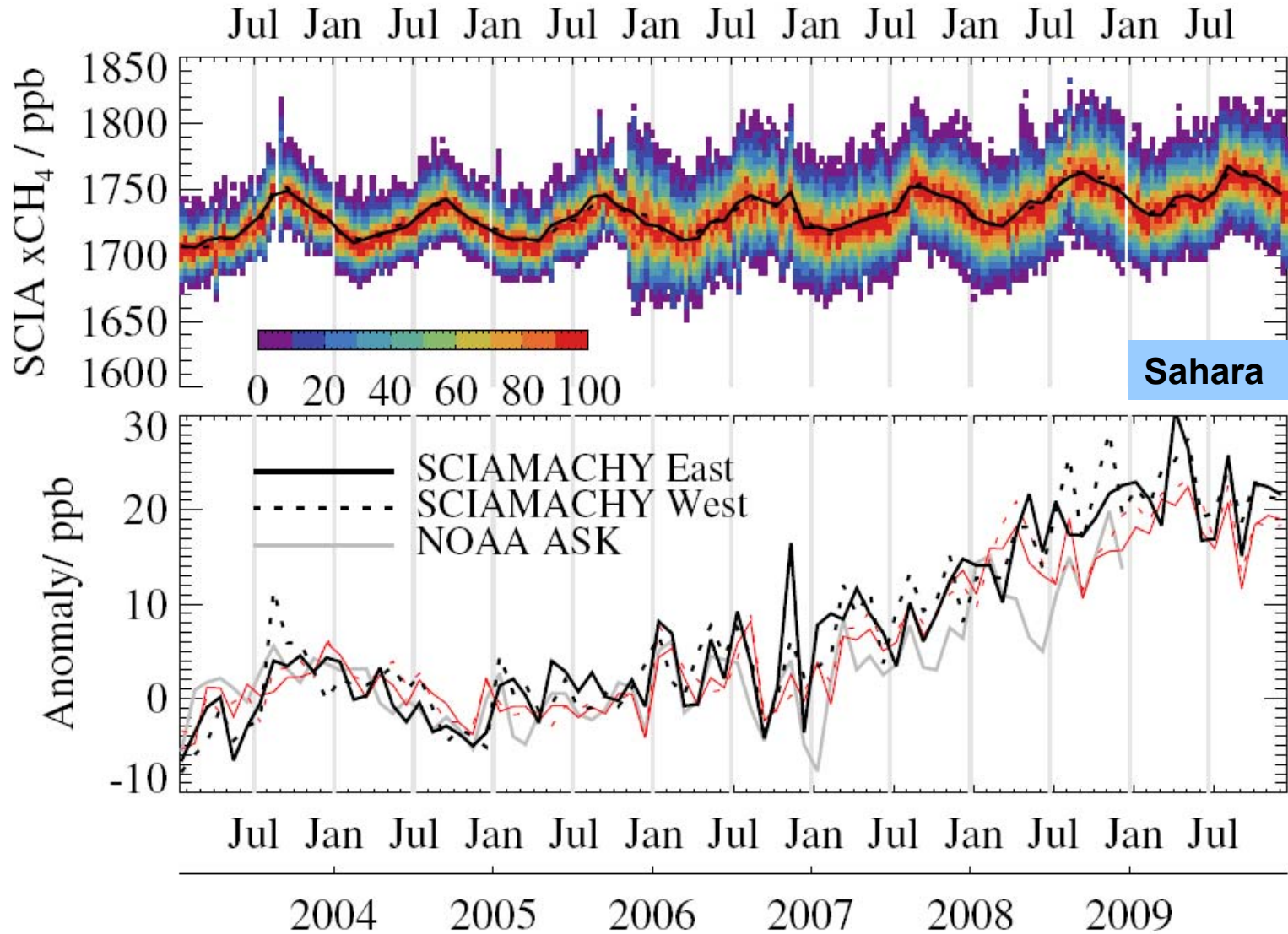
surface background monitoring sites (NOAA/ESRL)



$\Delta CH_4 \sim 0.1\%$

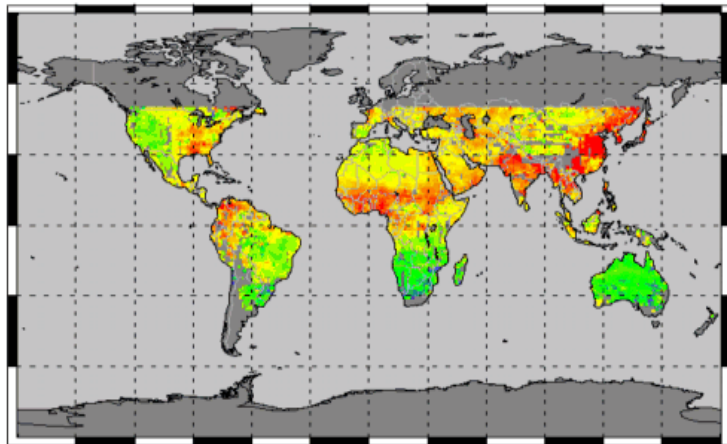
TM5-4DVAR

$$\vec{x} = \begin{bmatrix} \vec{x}_{ATM} \\ \vec{x}_{EMIS} \\ \vec{x}_{PARA} \end{bmatrix}$$

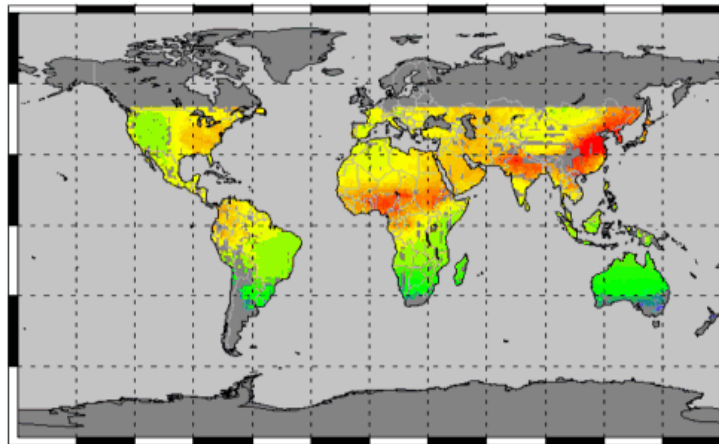


[Frankenberg et al, accepted for JGR, 2010]

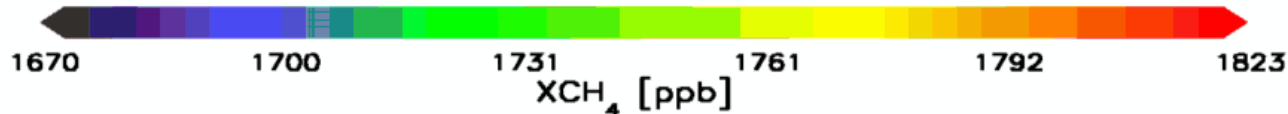
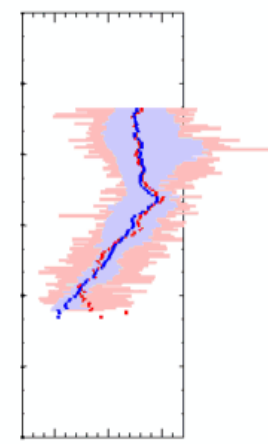
SCIAMACHY



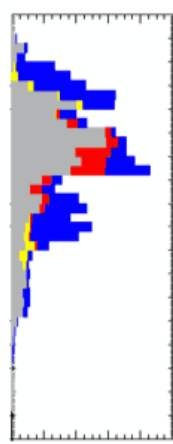
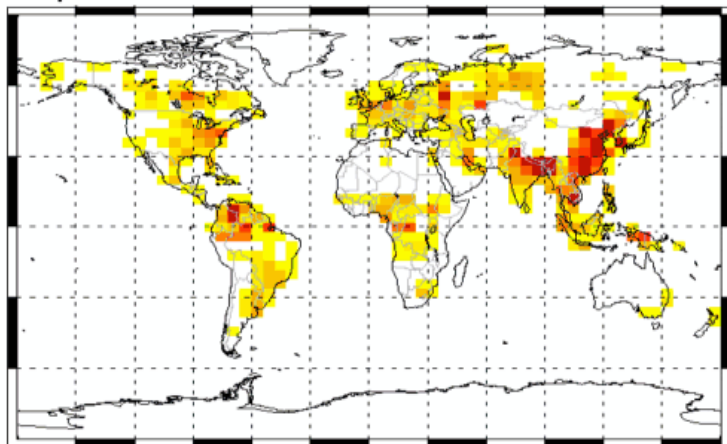
TM5-4DVAR



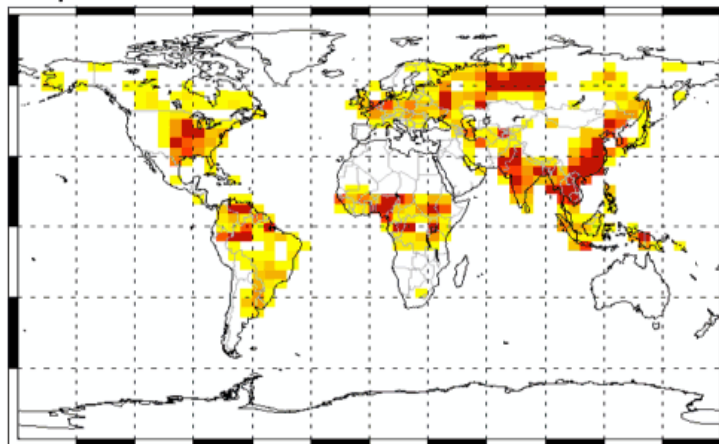
01 07 2009 – 31 07 2009



a priori

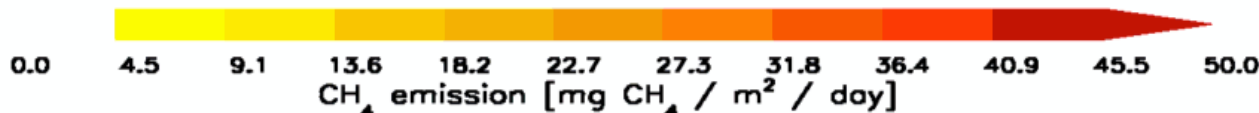


a posteriori



0 2 4 6 8 10
jCH₄ [mg/m²/day]

0 2 4 6 8 10
jCH₄ [mg/m²/day]



other
biomass-burning
rice
wetlands




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Global Atmospheric Composition

- Monitoring and Forecast... Atmospheric Composition
- Reanalysis of Global Atmospheric Composition
- Monitoring of Greenhouse Gases and Fluxes
- Global Fire Emissions
- Aerosol Record

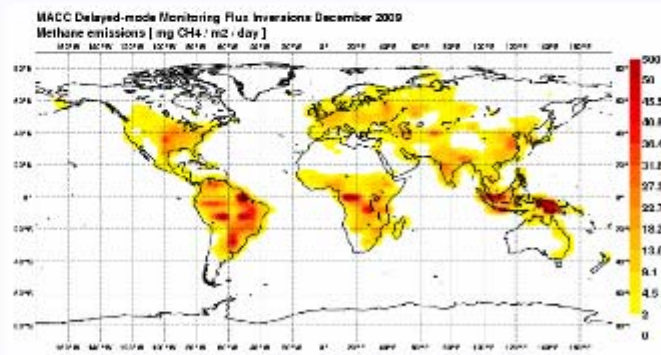
Today's Forecasts

- Reactive Gases
- Aerosols
- European Air Quality
- UV Index

Monitoring of Greenhouse Gases and Fluxes

MACC monitors greenhouse gas concentrations and their surface fluxes by assimilating satellite and in-situ observations. The assimilation runs about 6 months behind real-time to make maximum use of available observations. It was started in December 2009 for the 1st of June 2009 and plot and data products can be accessed through the links below.

Latest Results



Methane

Image that links to product page

Carbon Dioxide

Clicking on the image will lead to all current global greenhouse gas plots.

http://www.gmes-atmosphere.eu/services/gac/ghg_delayed/

- Serv
- Eurc
- Glob
- Com
- Clim
- UV,
- Str
- Serv
- Hea
- Envi
- Scie
- Citiz
- Met
- Inst
- Quic
- GEM
- PRO
- GME

- **glb6x4 -> glb3x2 (+ eur1x1 ?)**
- **OpenMP**
- **assimilate GOSAT data**
- **IASI ?**
- **OH from MACC GRG**