



Integrated non-CO<sub>2</sub> Greenhouse gas Observing System



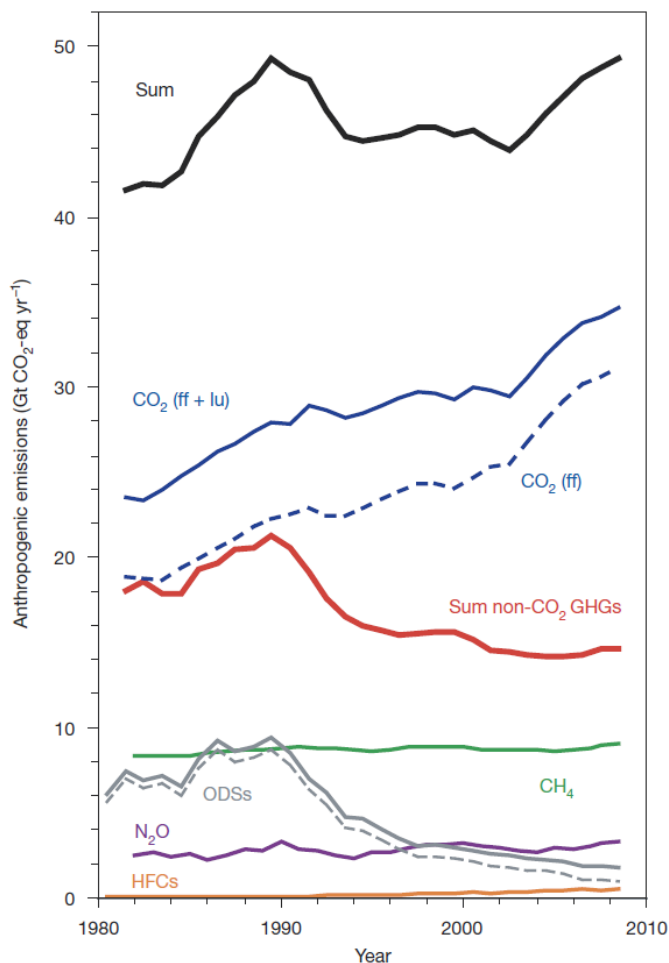
Energieonderzoek  
Centrum  
Nederland

# InGOS objective & means

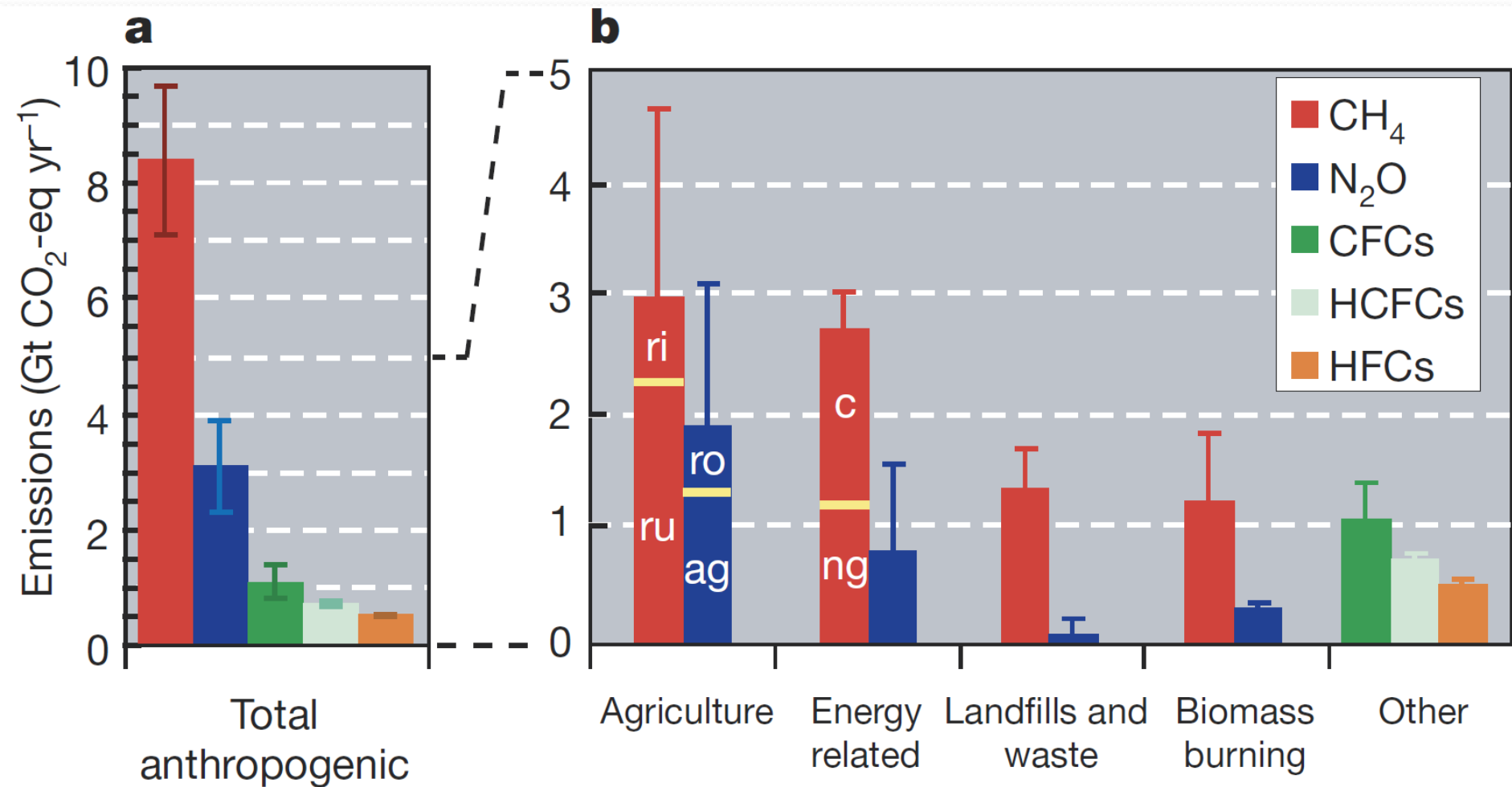
## Improving and extending the European observation capacity for non-CO<sub>2</sub> greenhouse gases

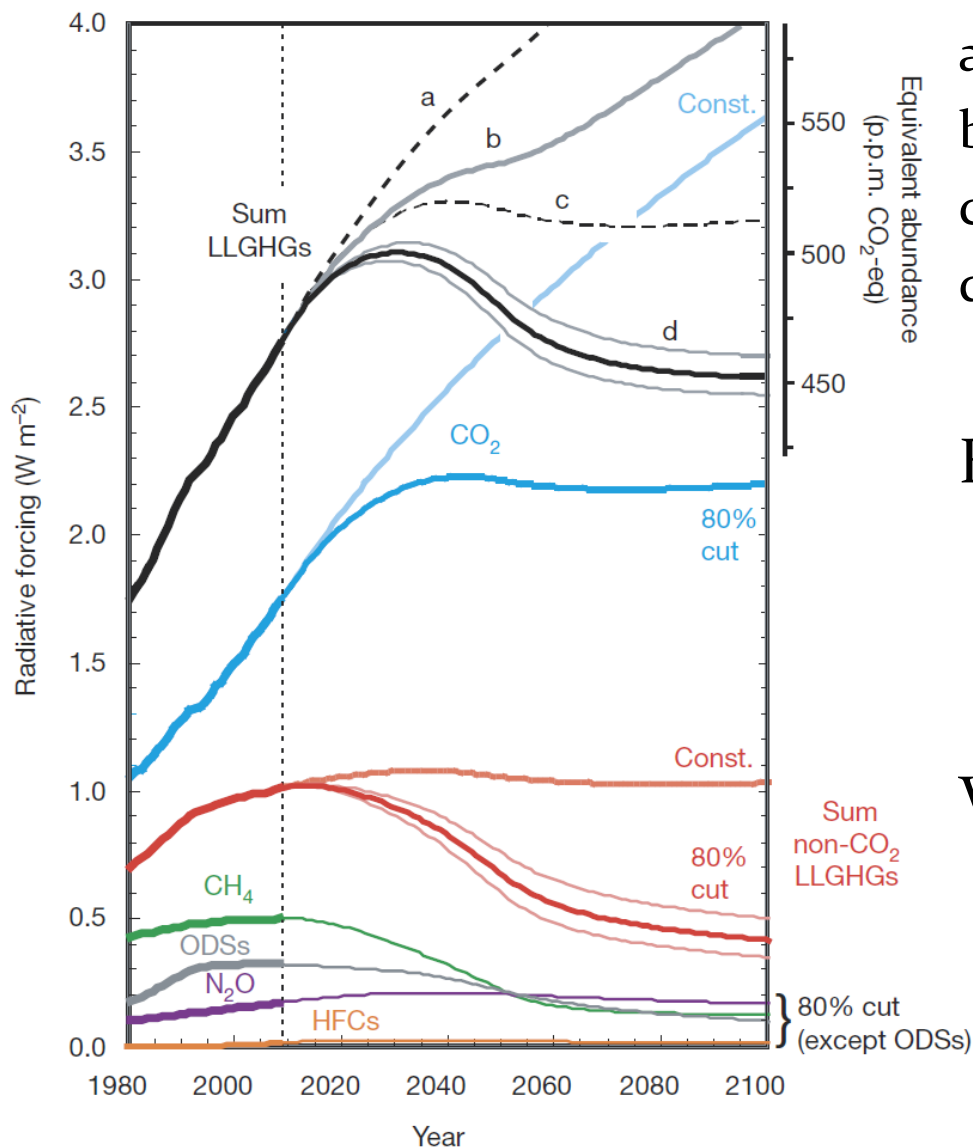
- Infrastructure project: Integrating Activities
- Budget 10 M€, EU 8 M€
- 34 partners, 14 countries, 24 observing stations
- 1 October 2011 – 1 October 2015
- Will integrate the non-CO<sub>2</sub> observations in ICOS infrastructure
- Builds on: CHIOTTO, SOGE, CarboEurope, GHGEurope, IMECC etc.
- Coordination: ECN, NL

# Non-CO<sub>2</sub> gases and climate



- Forcing=57% CO<sub>2,ff</sub>
- Montreal protocol succesful (ODS)
- Non-ODS emissions still increase
- N<sub>2</sub>O now most important ODS
- Emissions very uncertain
- Big emission reduction potential





- a = continued 2008 emissions
- b = -80% longlived non-CO<sub>2</sub> 2050
- c = -80% CO<sub>2</sub> 2050
- d = -80% all GHG 2050

Beware of the possible feedbacks (lifetime, natural emissions)!

Verification of reductions and monitoring of natural sources will be important!

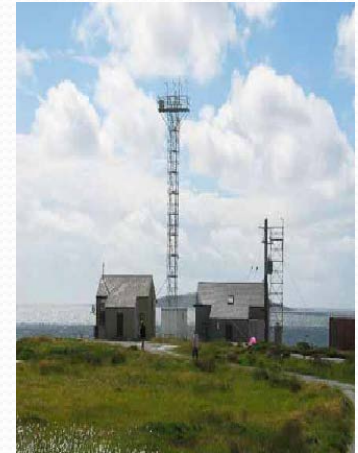


# General features of NCGHG mixing ratios; InGOS targets

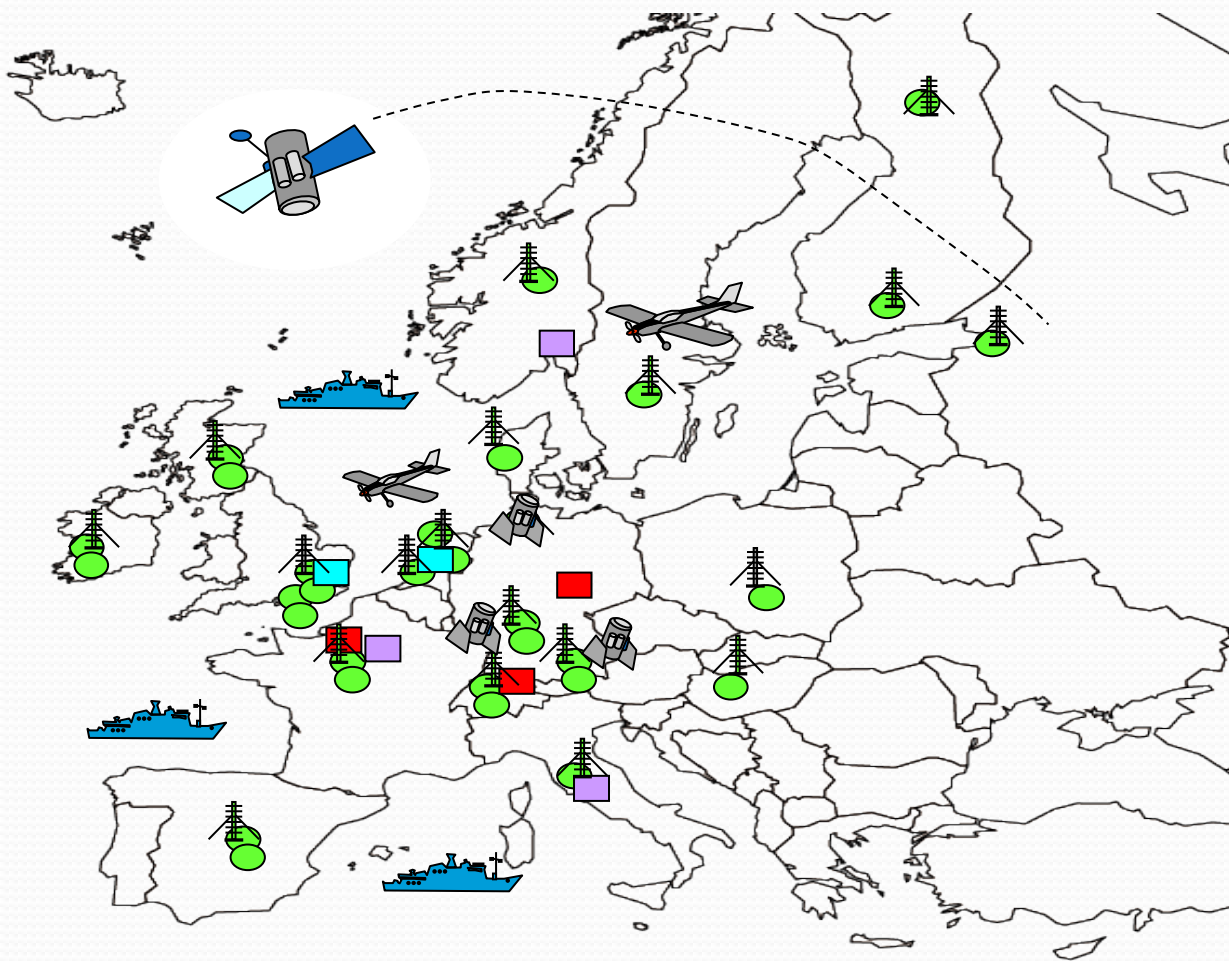
- Low abundances
- Small signal to baseline ratio
- High demands for precision and accuracy
  
- Complex equipment
- High running costs

InGOS will improve:

- Cost of operation
- Quality of measurements
- Coherence of the network
- Number of sites and frequency of observations



# InGOS infrastructure



 (Flux) sites

 Tall towers

 Ocean observations

 Airborne measurements

 Total column (up)

 Satellite data (down)

 Data centre

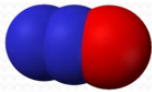
 Isotope Lab

 Cal gas Lab

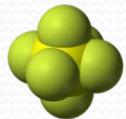
# The InGOS gases



Methane (CH<sub>4</sub>)



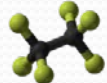
Nitrous Oxide (N<sub>2</sub>O)



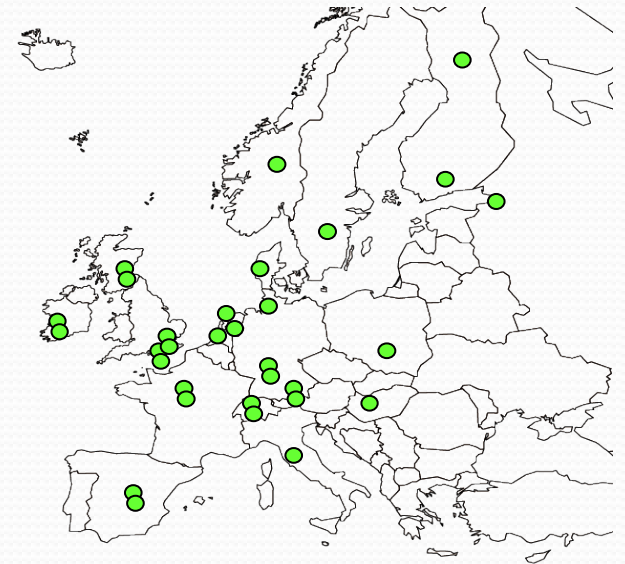
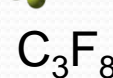
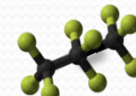
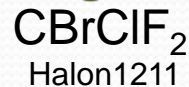
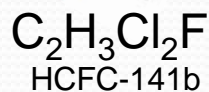
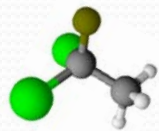
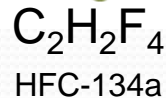
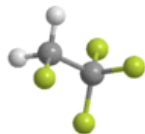
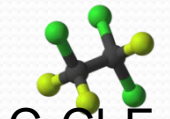
Sulphur Hexafluoride (SF<sub>6</sub>)



Hydrogen(H<sub>2</sub>)

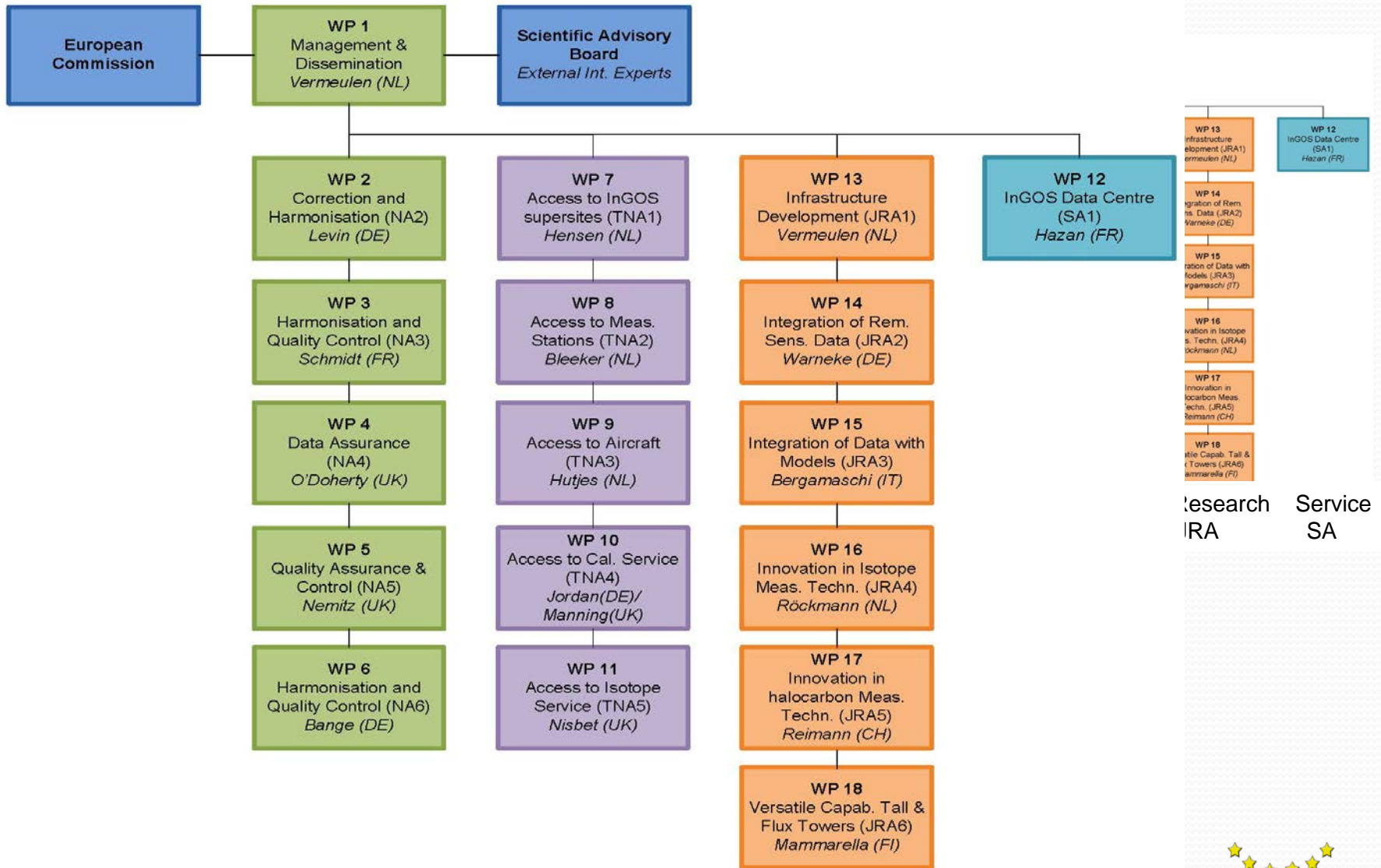


Halocarbons (many different species)



Radon (<sup>222</sup>Rn)





Network Activities

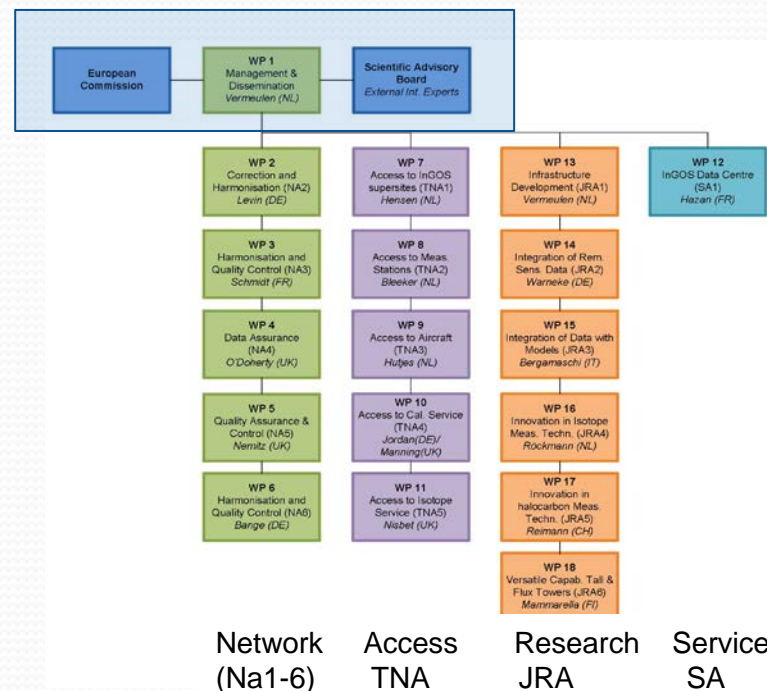
Transnational Access Activities

Joint Research Activities

Service Activities

Research Service  
IRA SA

# InGOS Structure



NA1: Running the project & reporting to EU



# InGOS Structure

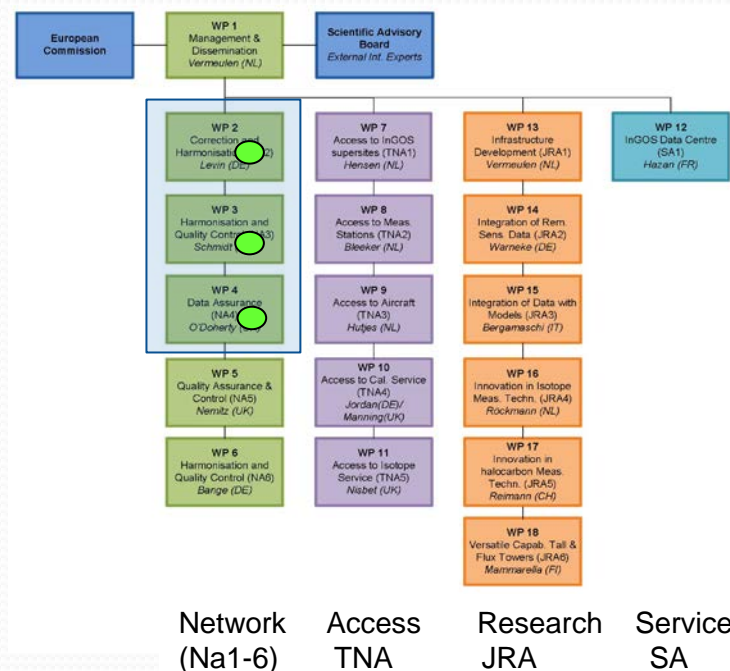
## NA 2,3,4: Harmonisation



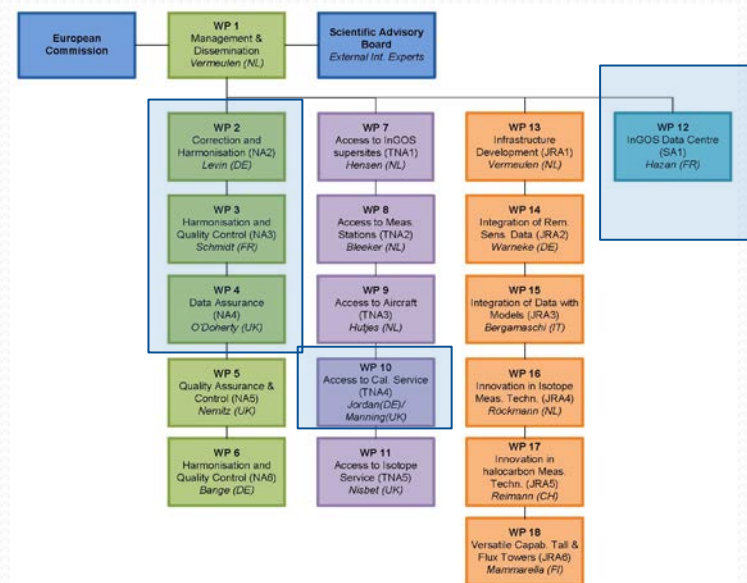
**NA2 WP 2**  
Correction and  
Harmonisation (NA2)  
*Levin (DE)*

**NA3 WP 3**  
Harmonisation and  
Quality Control (NA3)  
*Schmidt (FR)*

**NA4 WP 4**  
Data Assurance  
(NA4)  
*O'Doherty (UK)*

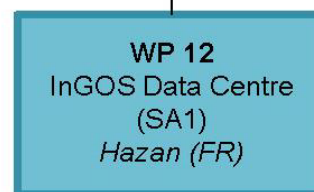
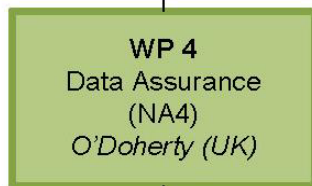
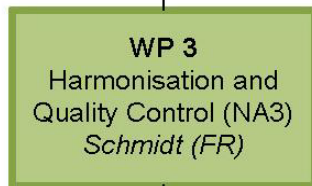
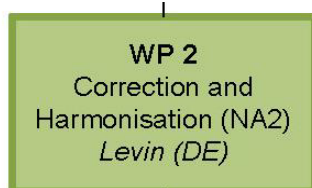


# InGOS Structure



NA 2,3,4

Calibrations



Network (Na1-6)

Access TNA

Research JRA

Service SA

Atmosphere (CEA)

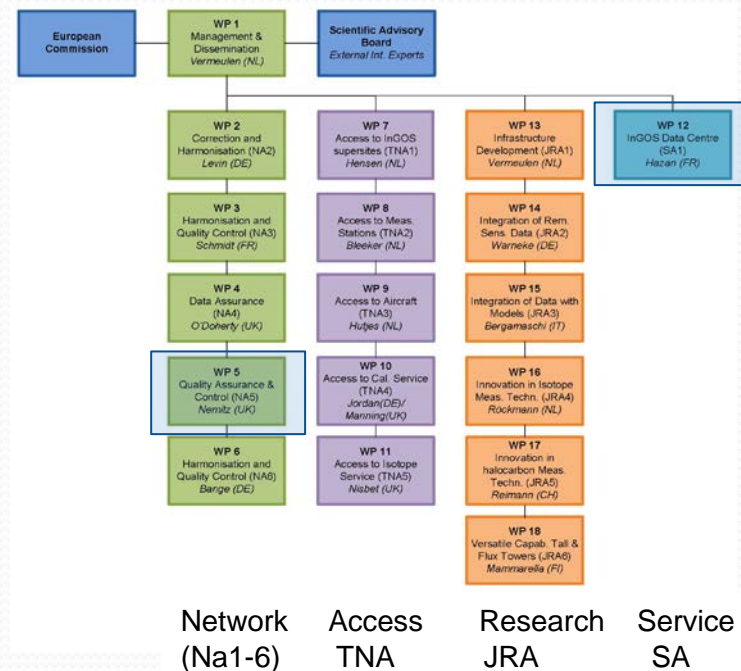
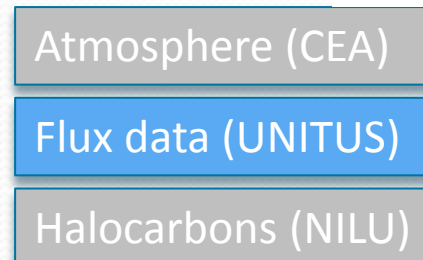
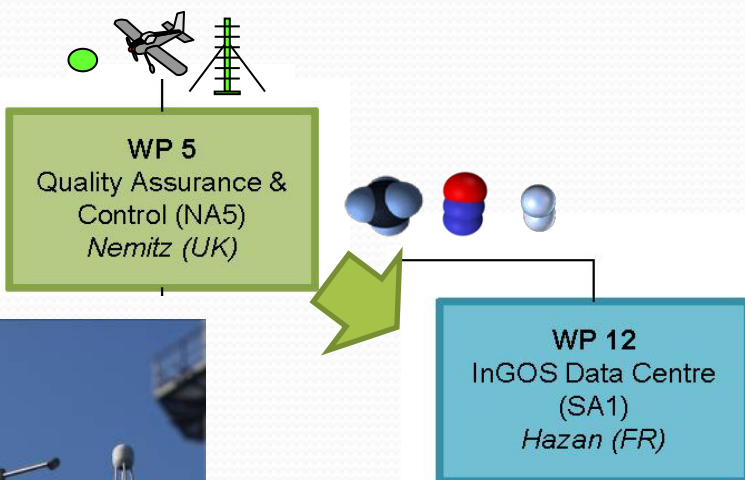
Flux data (UNITUS)

Halocarbons (NILU)



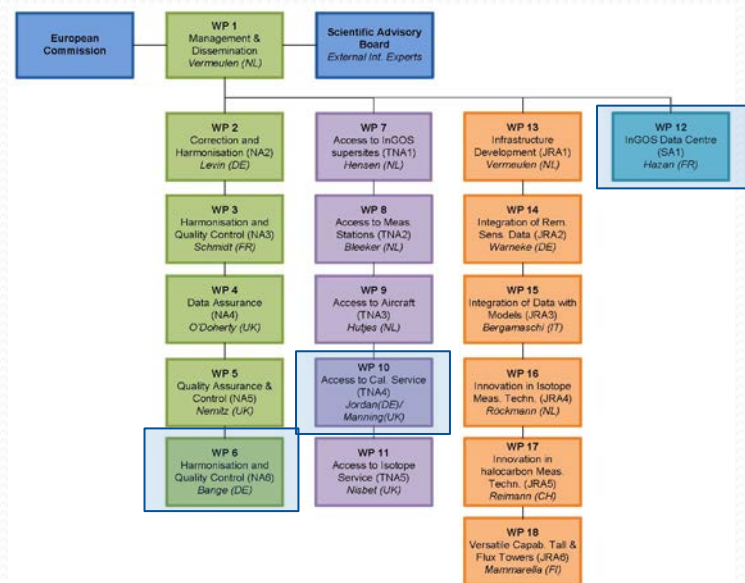
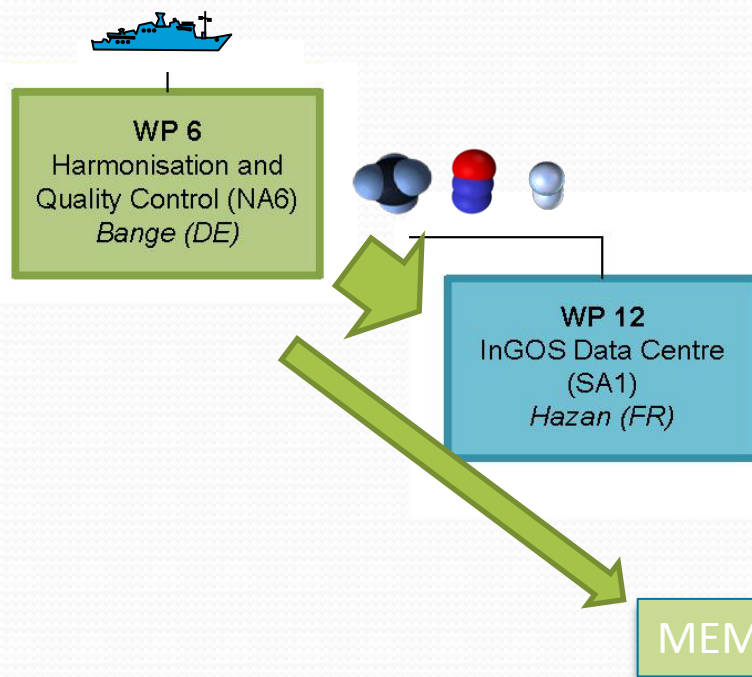
# InGOS Structure

## NA 5: Harmonisation for Flux data



# InGOS Structure

## NA 6: Ocean data



Network  
(Na1-6)

Access  
TNA

Research  
JRA

Service  
SA

Atmosphere (CEA)

Flux data (UNITUS)

Halocarbons (NILU)

MEMENTO (IFM-GEOMAR)



# Access to stations & facilities

**WP 7**  
Access to InGOS supersites (TNA1)  
*Hensen (NL)*

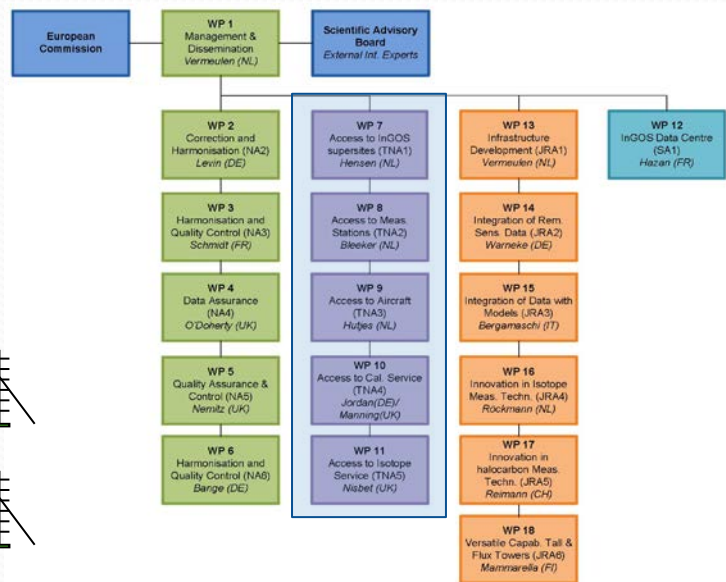
**WP 8**  
Access to Meas. Stations (TNA2)  
*Bleeker (NL)*

**WP 9**  
Access to Aircraft (TNA3)  
*Hutjes (NL)*

**WP 10**  
Access to Cal. Service (TNA4)  
*Jordan(DE)/Manning(UK)*

**WP 11**  
Access to Isotope Service (TNA5)  
*Nisbet (UK)*

- 6 'super'-sites
  - Stations where JRA campaigns are hosted
- 14 observing stations
- 2 aircraft for CH<sub>4</sub> flux variability
- Calibration service
- <sup>13</sup>CH<sub>4</sub> isotope service



Network (Na1-6)    Access TNA    Research JRA    Service SA



# Supersites

CABAUW  
200m NL (ECN)



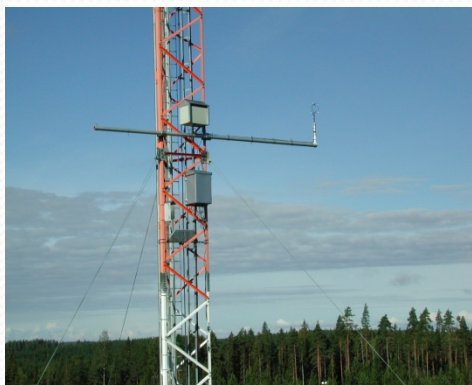
Weybourne  
UK (UEA)



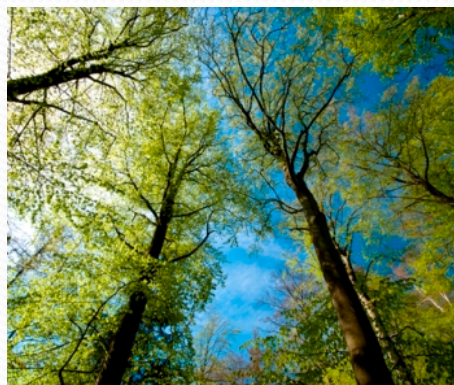
GGLES  
London UK (RHUL)



SMEAR II Hyytiala  
127m Fin (UHEL)



Willow Field & beech  
forest Dk (RISOE)



Easter Bush UK (CEH)





# Observing stations



Jungfrauoch

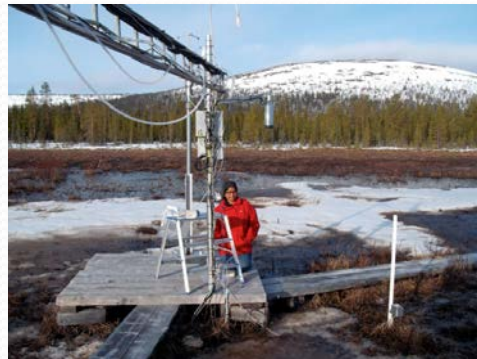
Grignon & Orleans  
Las Majadas

Mace Head  
London (GGLES)  
Angus tall tower

Kasprowy Wierch  
Hegyhátsál tall tower  
POLWET

Lutjewad  
Horstermeer

Pallas  
Norunda



# Networking objectives



- Integrate European facilities for NCGHG observations
  - Linking the different communities for CH<sub>4</sub>, N<sub>2</sub>O, H<sub>2</sub>, halocarbons, tracers, atmosphere, ecosystem flux, ocean
- Improve the quality of historical, current and future NCGHG obs. (concentrations, fluxes, atmosphere & ocean)
- Prepare expansion of the network in undersampled regions

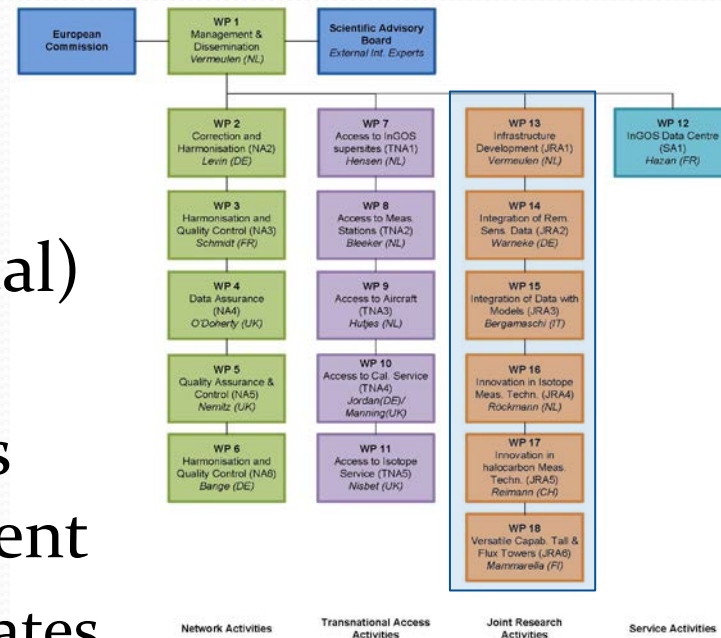
# Access and Services



- Provide access to observation sites and facilities
- Provide NRT data for CH<sub>4</sub>, N<sub>2</sub>O, SF<sub>6</sub> and H<sub>2</sub> data (building on IMECC/ICOS)
- Provide uniform databases of observational data
  - Halocarbons: NILU/Geomon -> ALE-GAGE
  - Fluxes: UNITUS/ICOS ETC -> Fluxnet
  - Atmosphere: LSCE/ICOS ATC -> GAW
  - Ocean: Memento

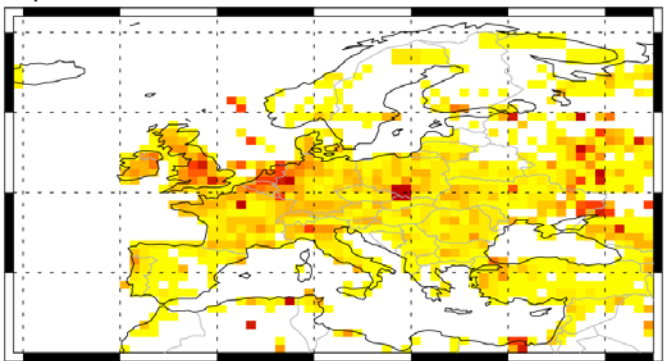
# JRA: research

- Test and further develop new (optical) sensors and observation strategies
- Modelling: analyse the observations and support the network development
  - Improved top-down emission estimates
  - Uncertainty estimates of derived emissions
  - Validation of model results
  - Evaluate  $^{13}\text{CH}_4$  observation strategy



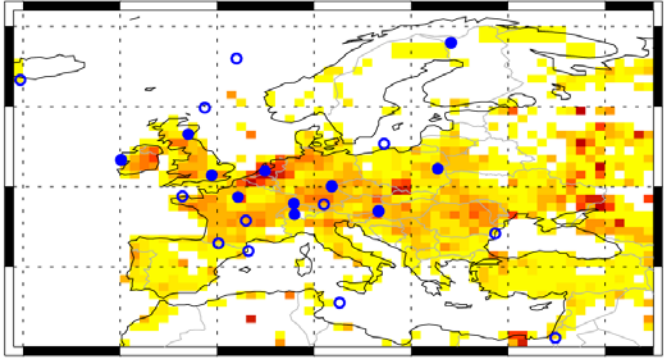
# (Inverse) Modelling

apriori 2007 Scenario S1



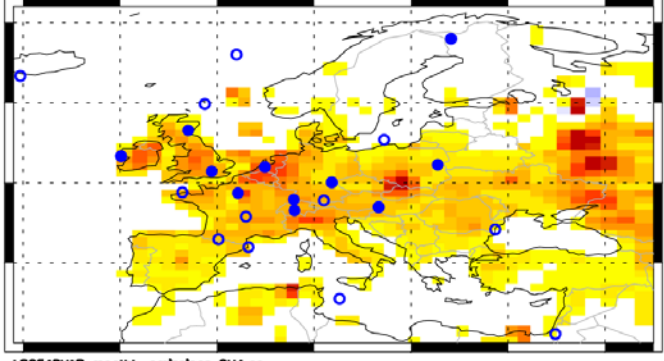
VAR\_T33\_CH4\_25L60\_lm5el\_eur\_EU313\_EDG041\_V0205\_MS\_20061201\_20080201\_J2

TM5-4DVAR 2007 Scenario S1



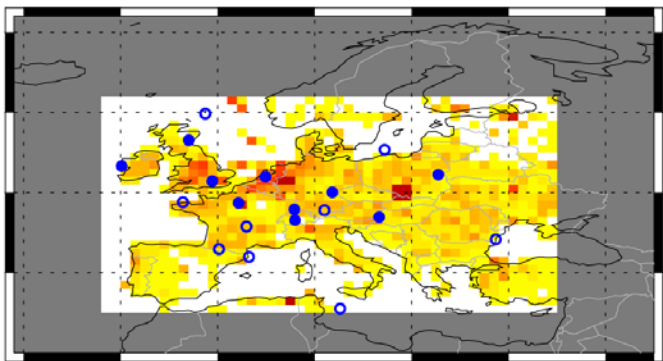
VAR\_T33\_CH4\_25L60\_lm5el\_eur\_EU313\_EDG041\_V0205\_MS\_20061201\_20080201\_J2

LMDZ-4DVAR 2007 Scenario S1



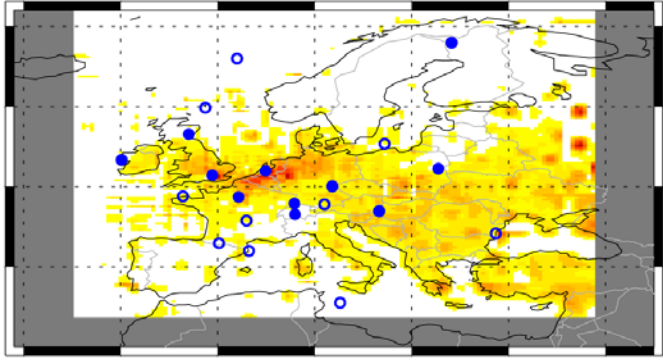
LSCE4DVAR\_monthly\_emissions\_CH4.nc

TM3-STILT 2007 Scenario S1



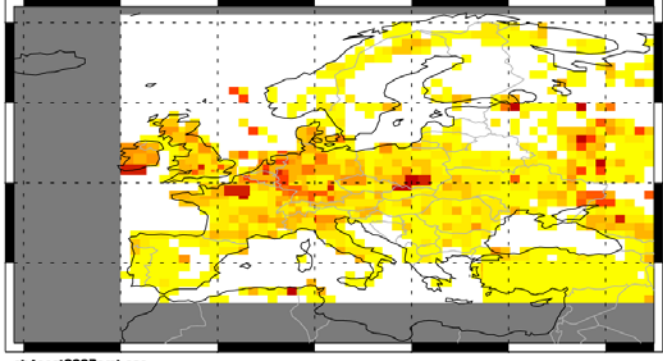
STILT\_ch4\_opost\_flux\_NEU\_update.mo.nc

NAME-INV 2007 Scenario S1



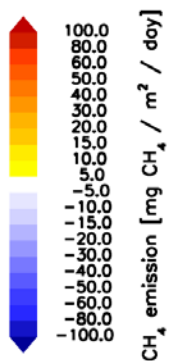
EMIS\_ch4\_Y2o\_2007

COMET 2007 inv year2

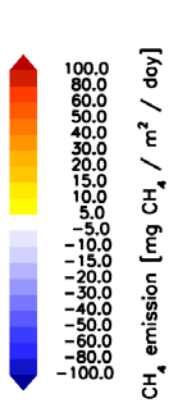


ch4post2007cml.osc

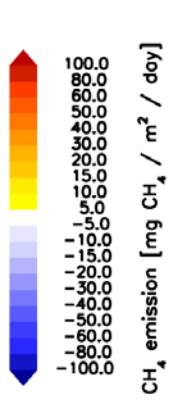
01012007-01012008



CH<sub>4</sub> emission [mg CH<sub>4</sub> / m<sup>2</sup> / day]



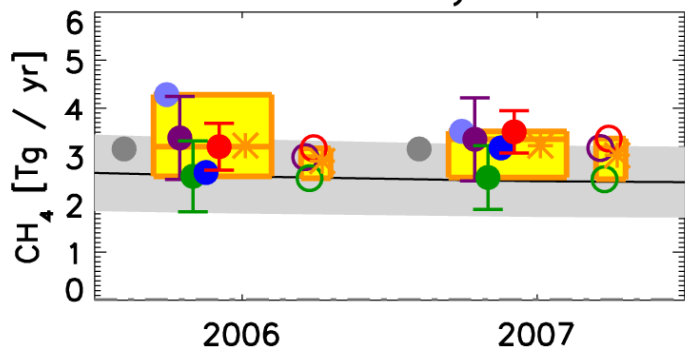
CH<sub>4</sub> emission [mg CH<sub>4</sub> / m<sup>2</sup> / day]



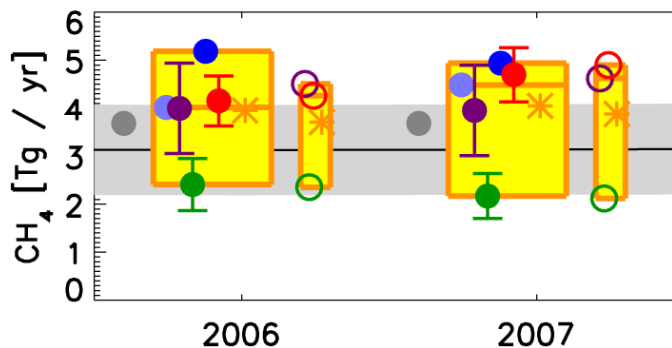
CH<sub>4</sub> emission [mg CH<sub>4</sub> / m<sup>2</sup> / day]

# Inverse modelling of European methane

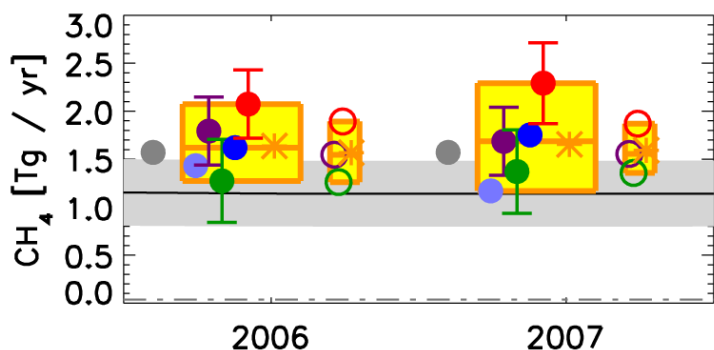
Germany



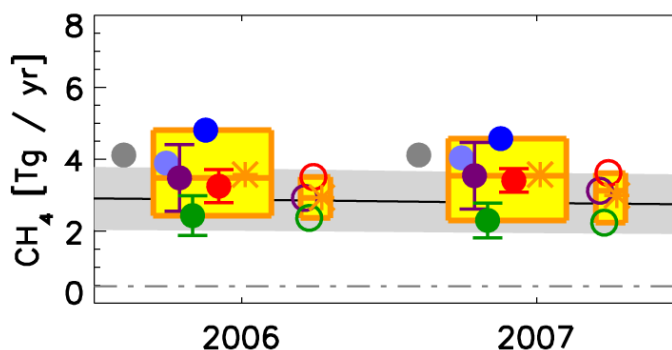
France



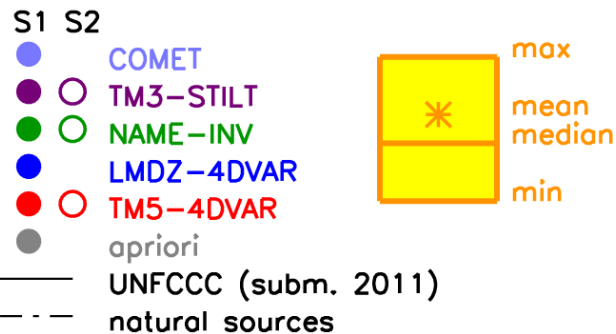
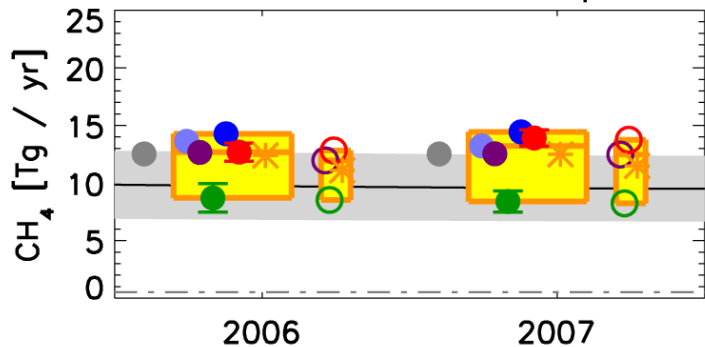
BENELUX



UK + Ireland



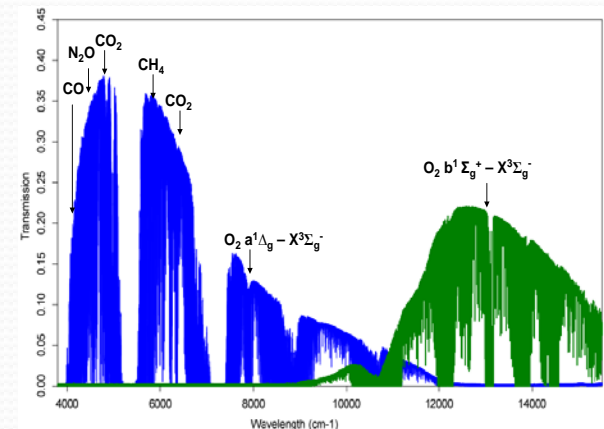
North-western Europe



Bergamaschi et al, 2011 (in prep.)

# JRA continued

- Integration of in-situ data with remote sensing -> TCCON-Europe network
- Develop continuous isotope observations for methane and maintain reference scale
- Improve the halocarbon measurement techniques
- Combine tall tower concentration obs. with flux tower observations into regional scale flux estimates



# Some products (out of 96 deliverables)

- Unified and improved historic dataset of non-CO<sub>2</sub> GHG's
- Continuation of coordinated datasets contributing to GEOSS
- Traveling FTIR and <sup>222</sup>Rn system
- Top down emission estimates for Europe
- Capacity building in undersampled regions
- Dissemination:
  - Reports, papers
  - Workshops
  - Summer schools
  - Website
  - Databases





# More info...

- DoW available on website
- Leaflets on website/request from project office

<http://www.ingos-infrastructure.eu>

Coordinator: [a.vermeulen@ecm.nl](mailto:a.vermeulen@ecm.nl)

Dissemination &

Outreach: [hensen@ecm.nl](mailto:hensen@ecm.nl) / [a.bleeker@ecm.nl](mailto:a.bleeker@ecm.nl)

