

Verification and uncertainty of European estimates

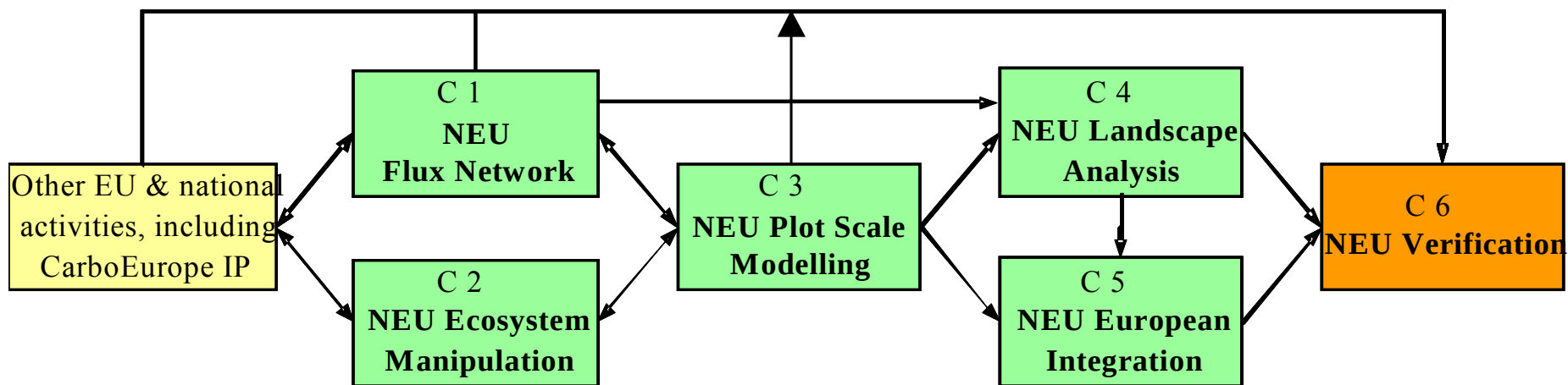
Jan Willem Erisman and Albert Bleeker



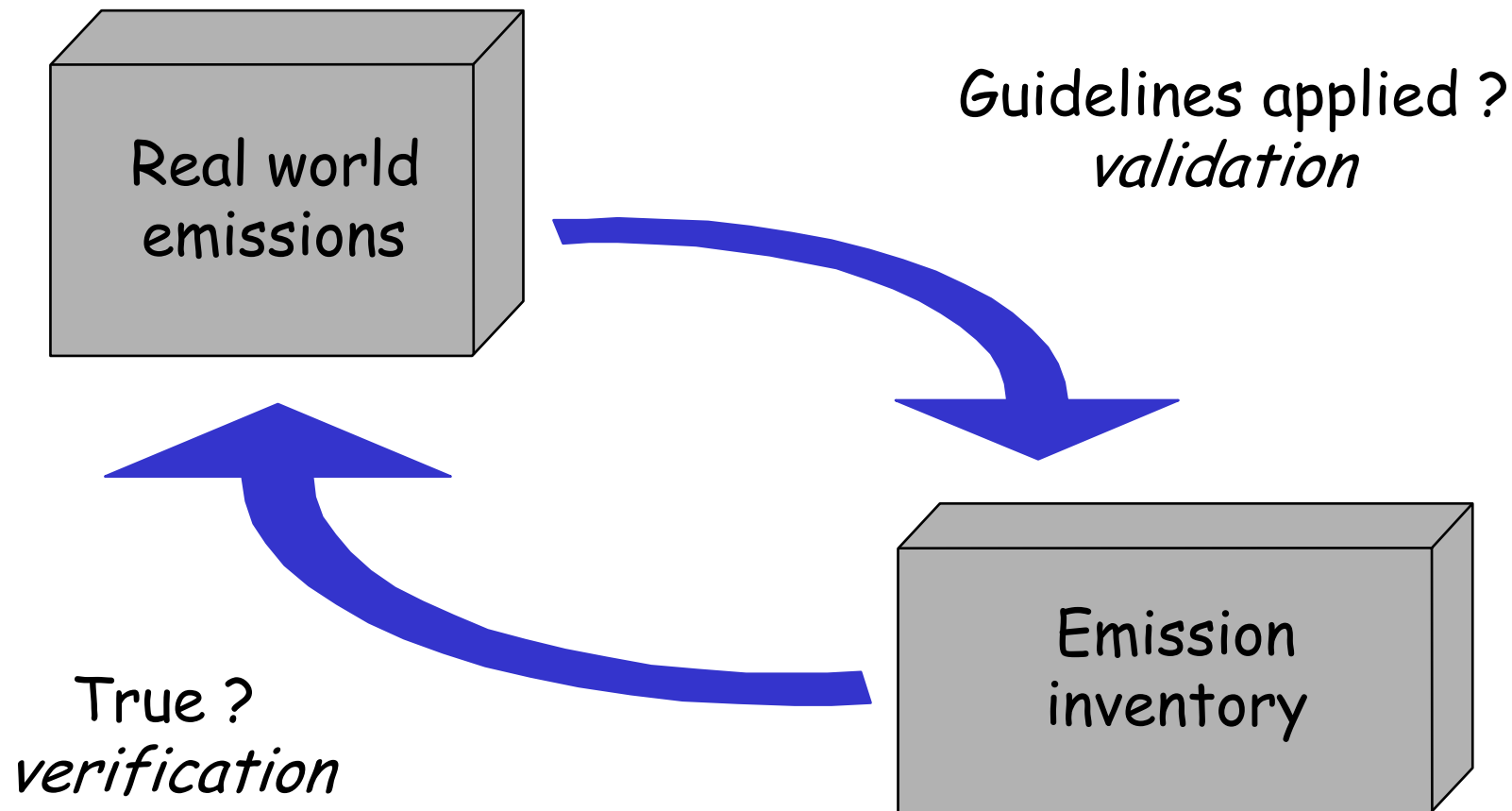
Outline

- Background
- Position Component 6 in NEU
- Work program
- Relation with other Components

WP6 Position in NEU

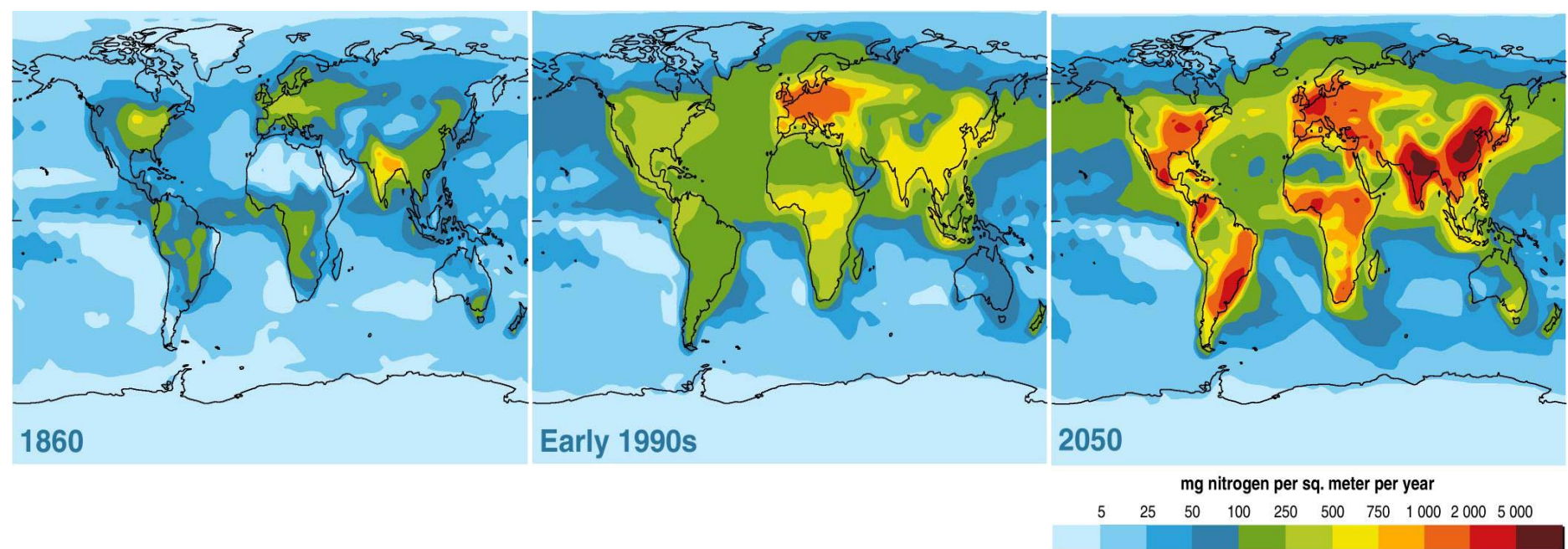


Why verification?



Atmospheric Deposition: True?

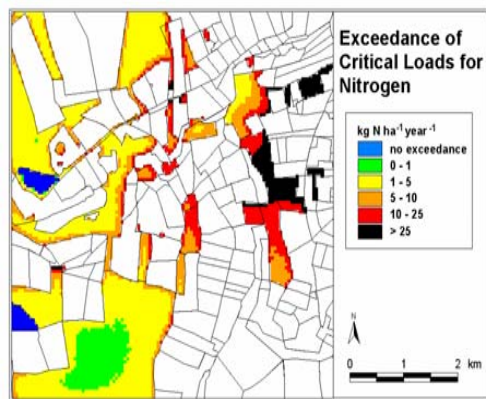
Past and Present $\text{mg N m}^{-2} \text{yr}^{-1}$



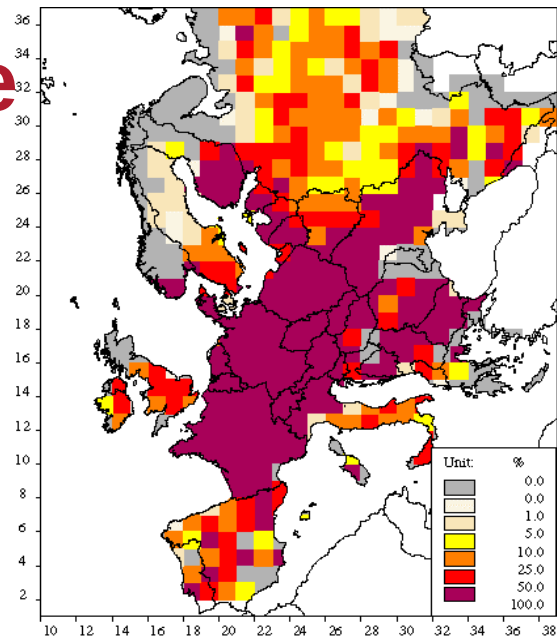
Source: Galloway et al. 2004

Millennium assessment

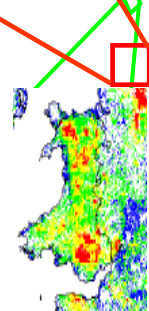
Dealing with spatial scale



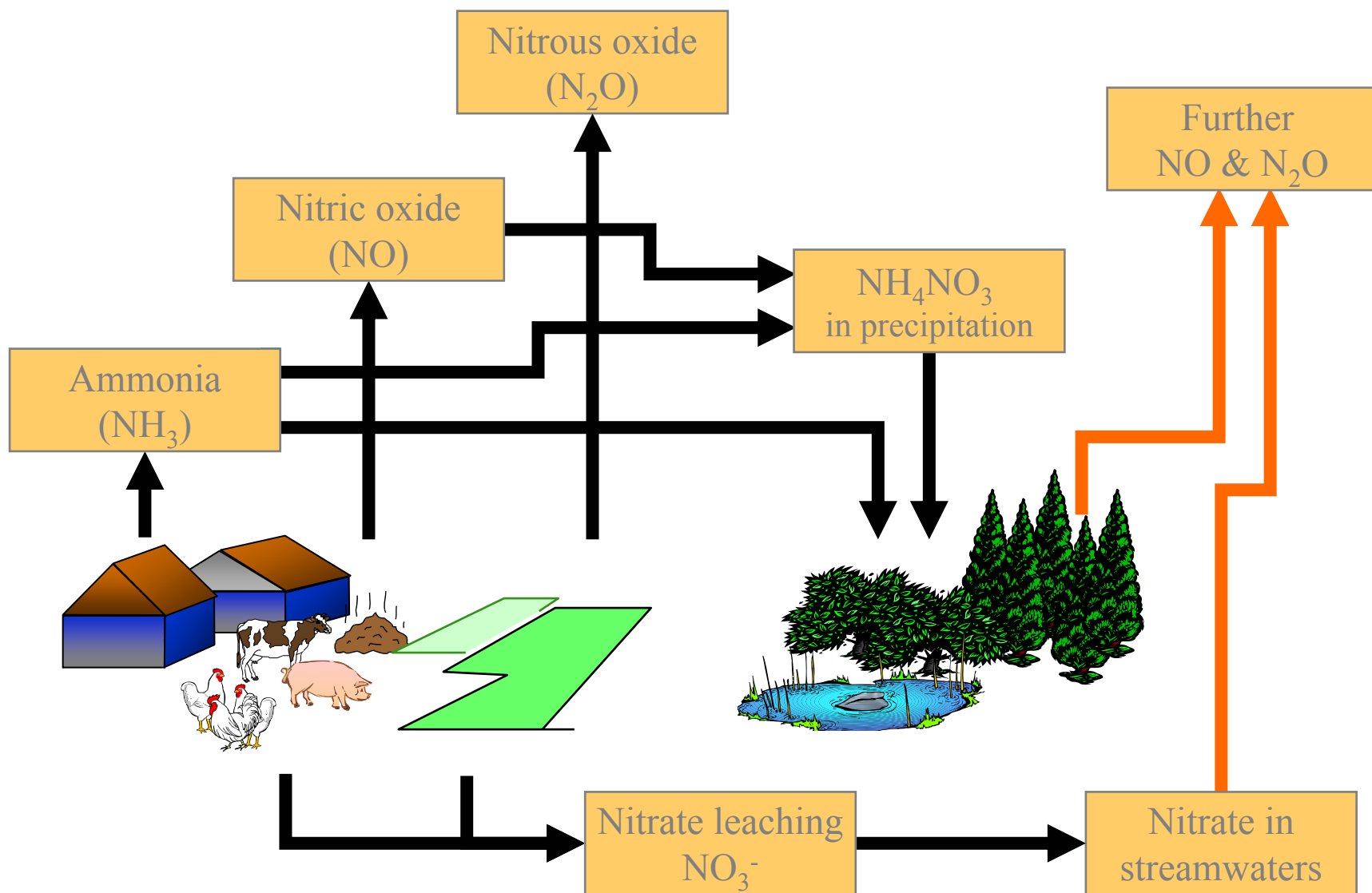
Ecosystem protection



European emissions,
deposition and
critical load
exceedances



National targets
and policy

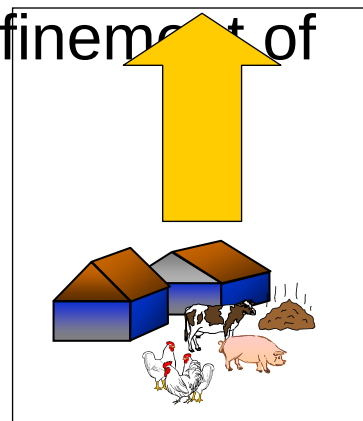


Objective

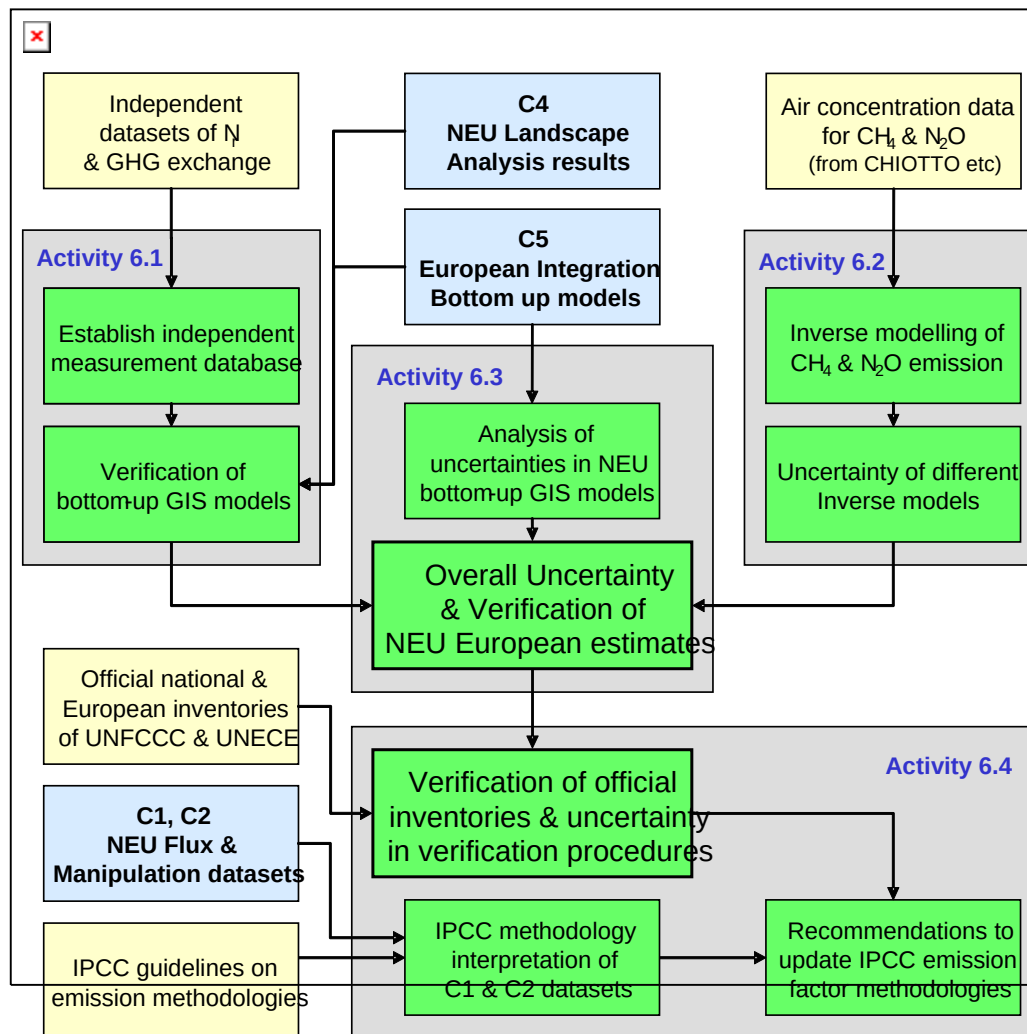
- ▶ The overall goal of NEU C6 is to assess uncertainties in the European model results and use these together with independent measurement/inverse-modelling approaches for verification of European nitrogen budgets, N_2O and CH_4 inventories and refinement of IPCC approaches.

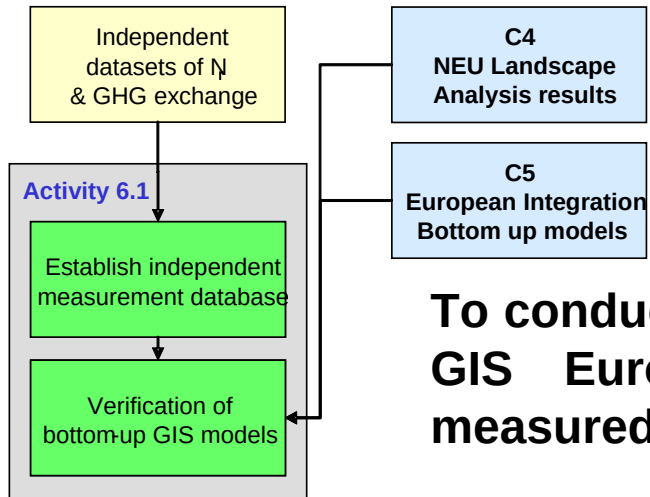


or



C6 activities and their relations





6.1 10

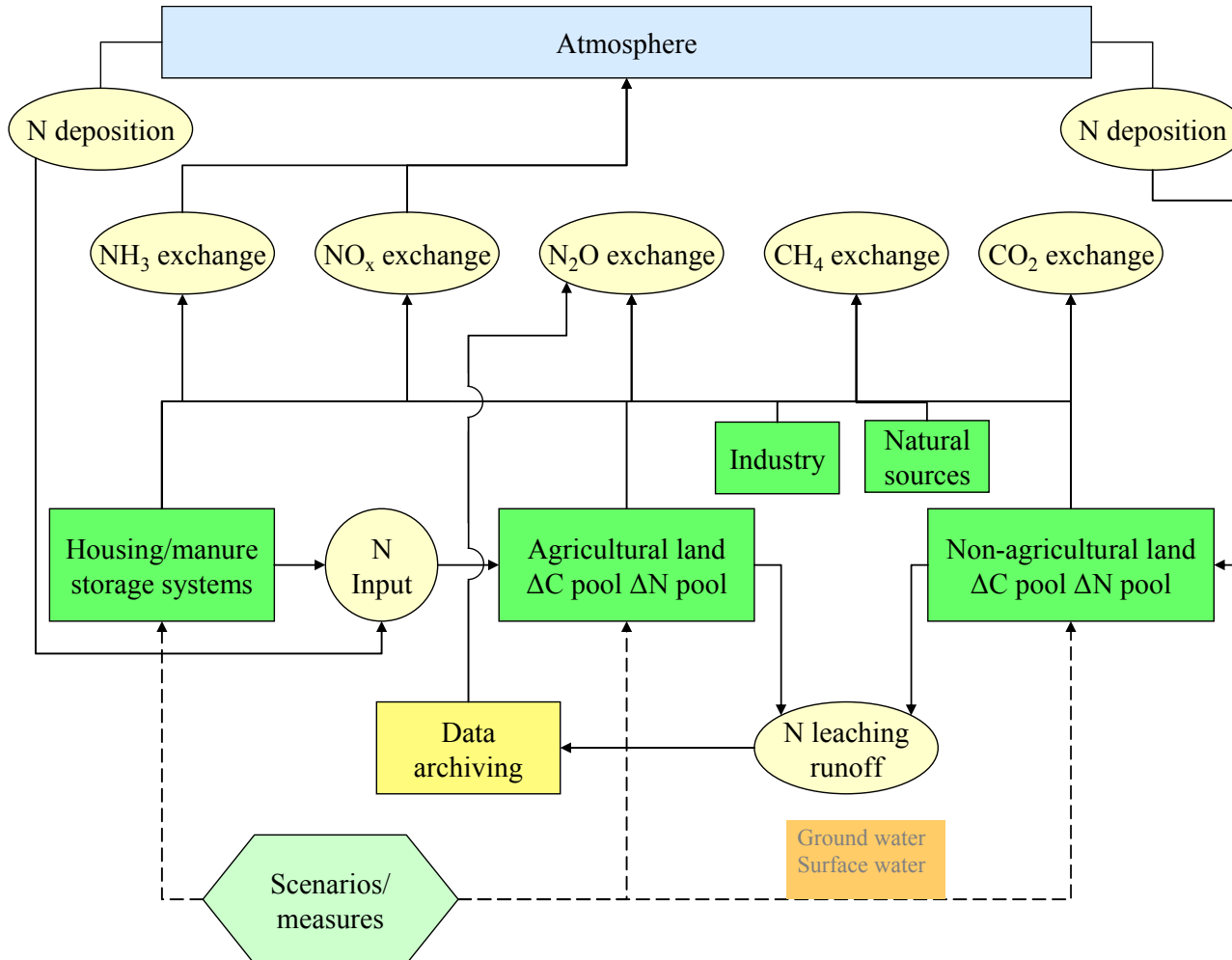
Technical Objective

To conduct a verification assessment of the NEU bottom-up GIS European models by reference to independent measured datasets not used in the model development (C6),

Means to achieve this objective:

- Proposal on database structure (A6.1)
- Database with independent datasets from which N budgets and GHG emissions can be derived (A6.1)
- Report on inferential methodology for upscaling measurements for fine scales to national and continental (annual) scales (A6.1)
- Report on importance of regional input data uncertainties (A6.1)
- NEU bottom-up GIS European models evaluated by means of a verification assessment (A6.1)

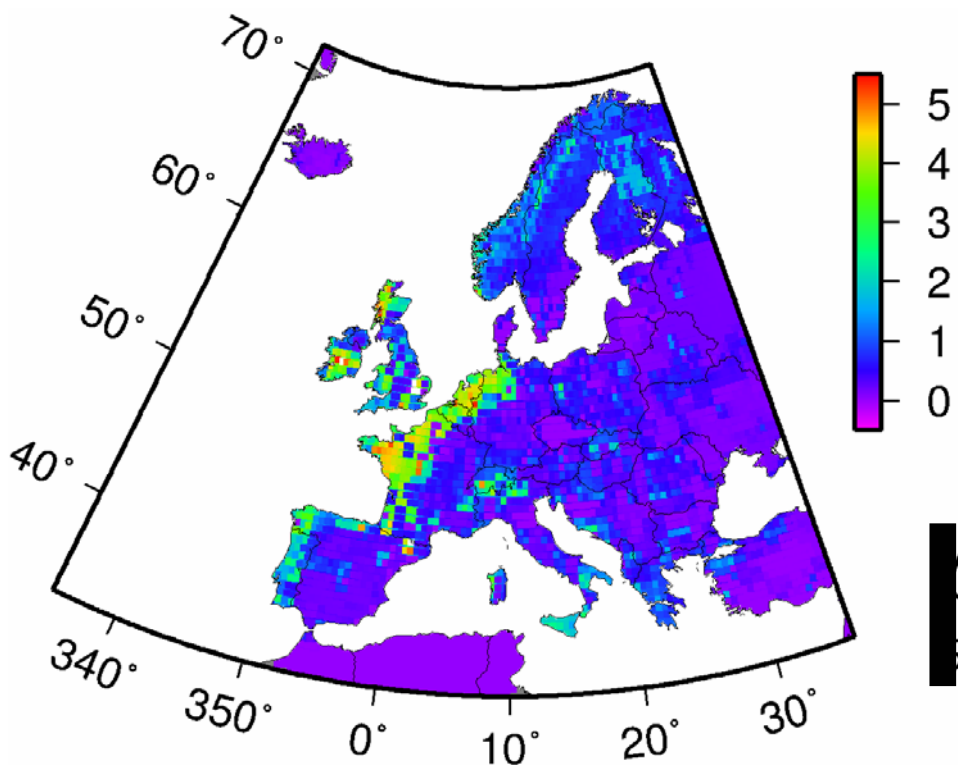
Scaling up N fluxes to Europe (NEU C5)



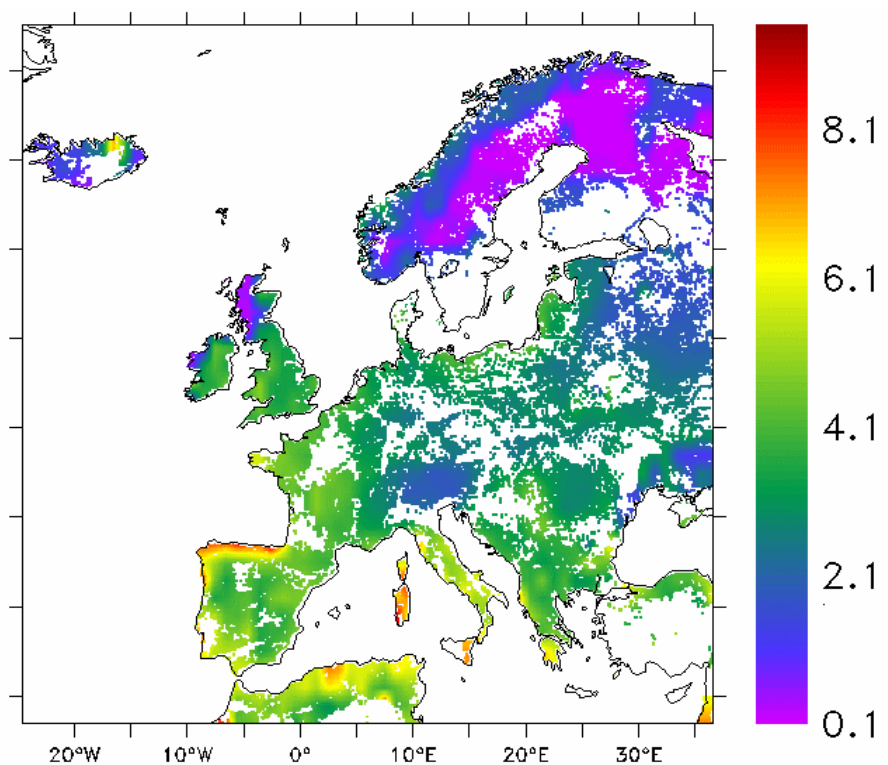
N₂O emission from European Grassland

DNDC (with grass management typology)

PASIM (with “Intelligent Farm

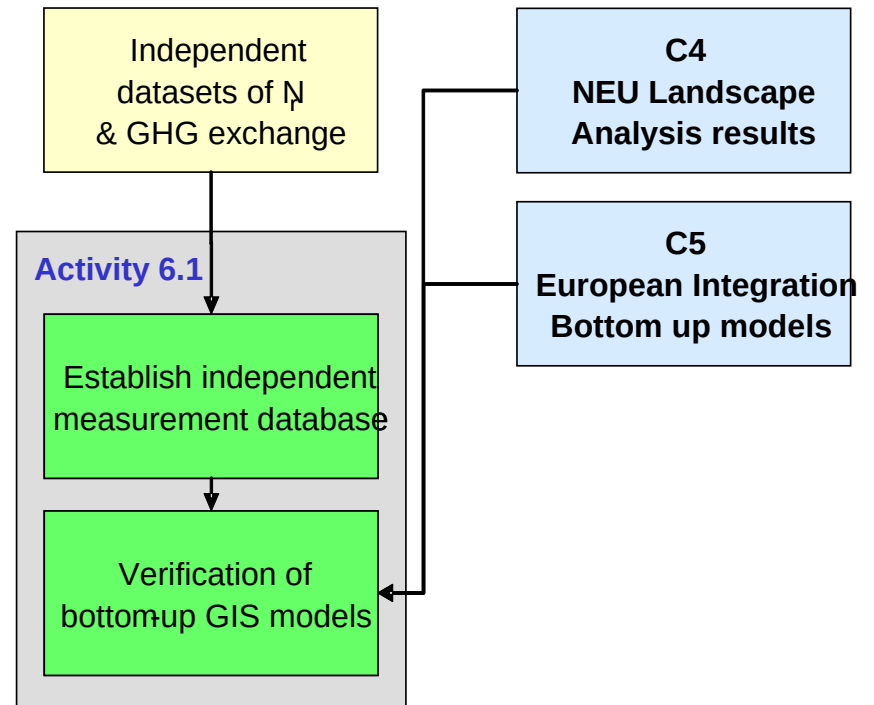


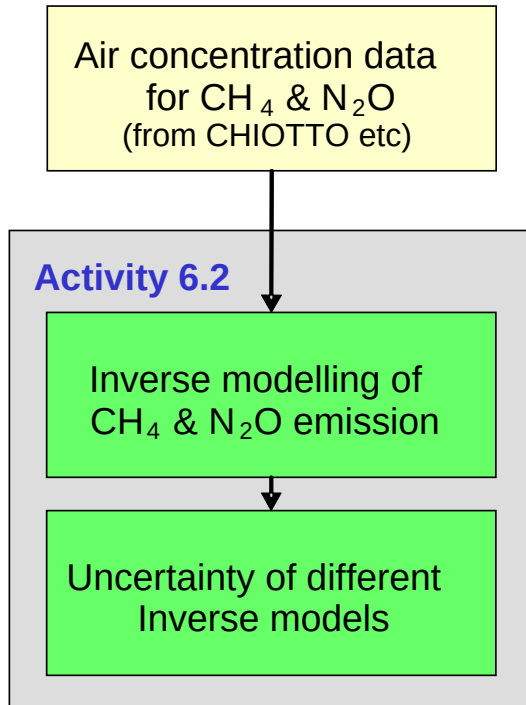
N₂O emission kg N ha⁻¹ year⁻¹



Activity 6.1 - partners

- ECN – Netherlands
 - NERC – UK
 - Alterra – Netherlands
 - FZK – Germany
 - UNIABDN – UK
 - SYKE – Finland
 - IVL – Sweden
-
- Activity leader: A. Bleeker (ECN)





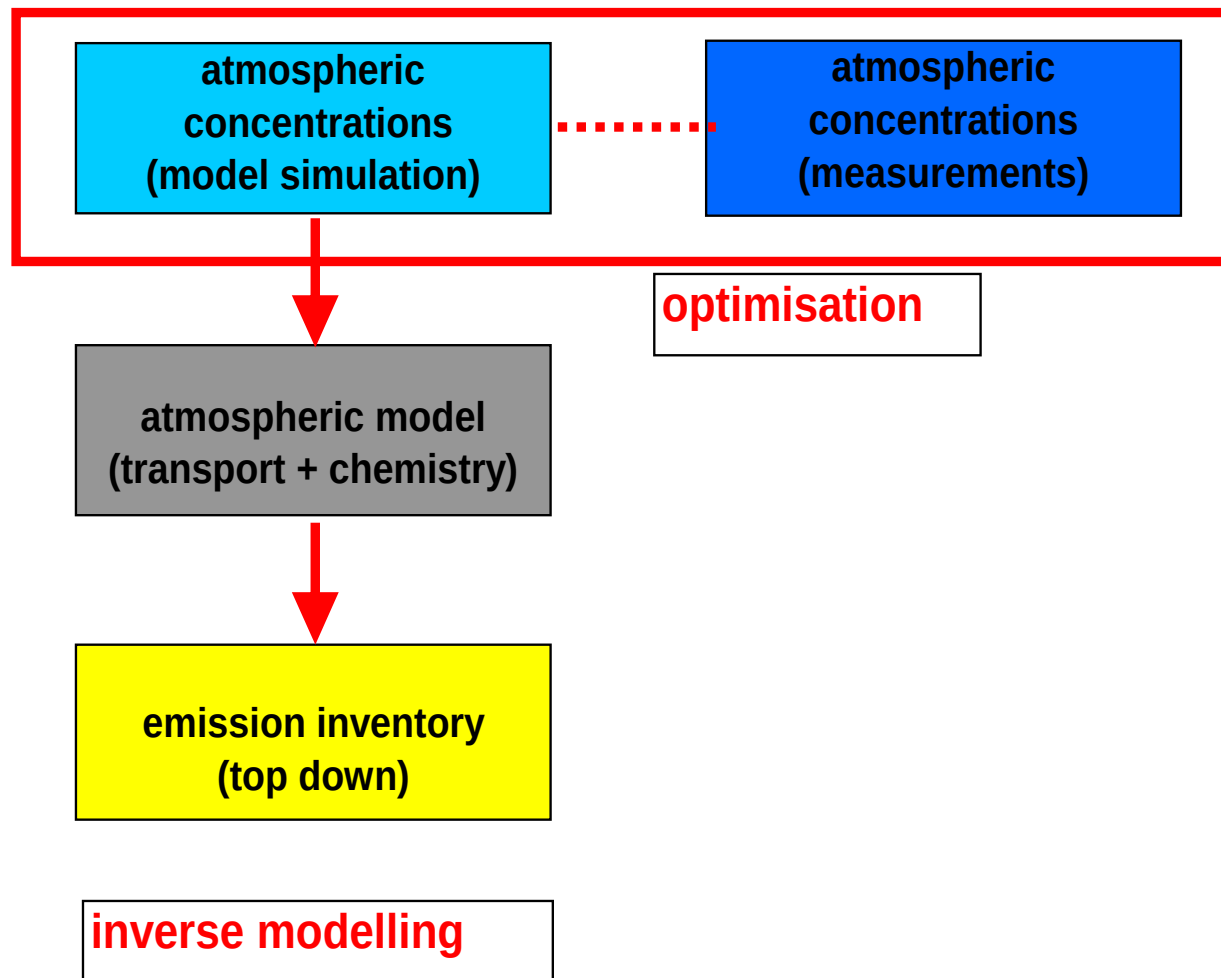
6.2 Technical Objective 11

To apply a suite of European-scale Lagrangian and Eulerian inverse model approaches to derive independent estimates of European N₂O and CH₄ emissions (C6),

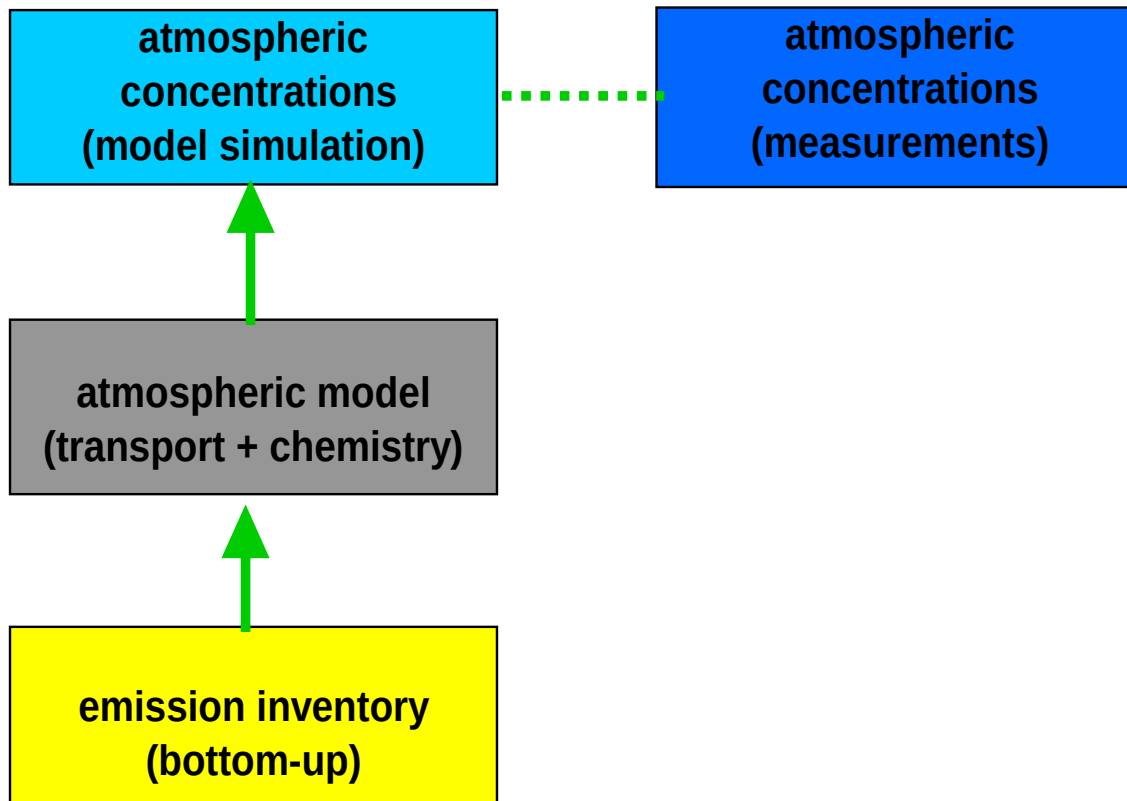
Means to achieve this objective:

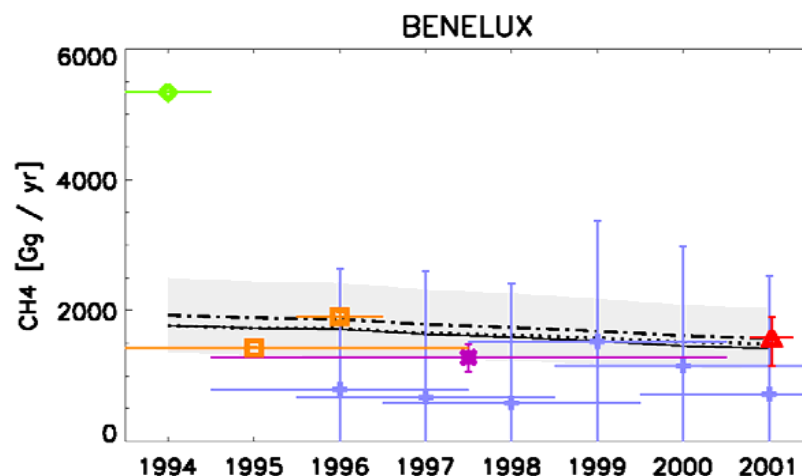
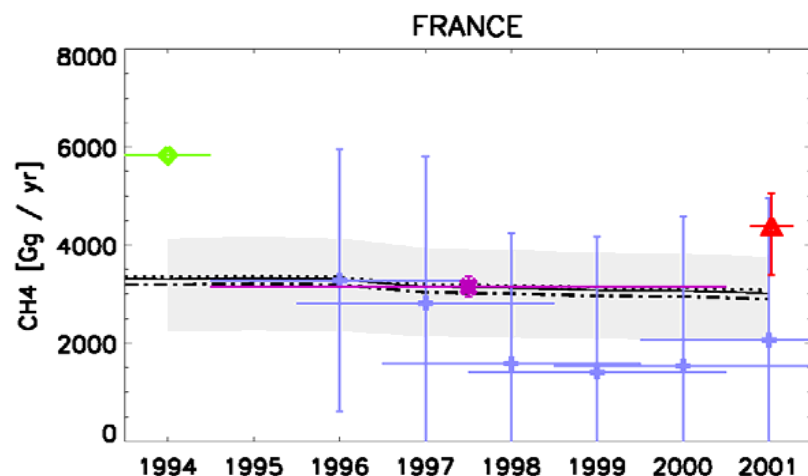
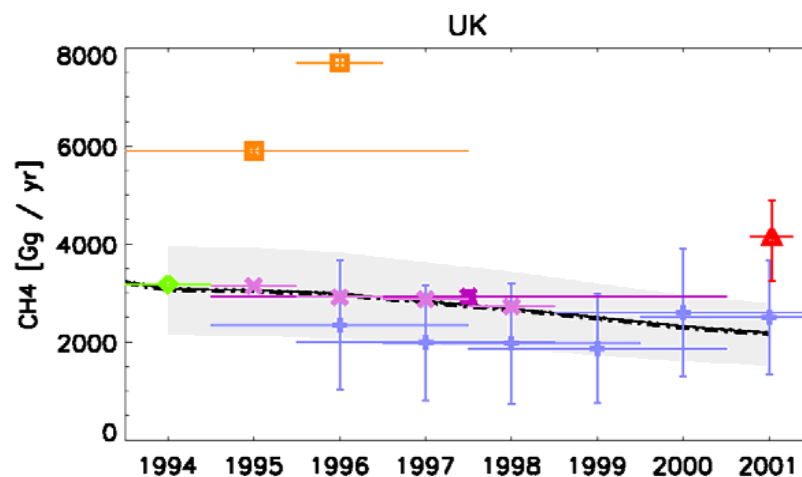
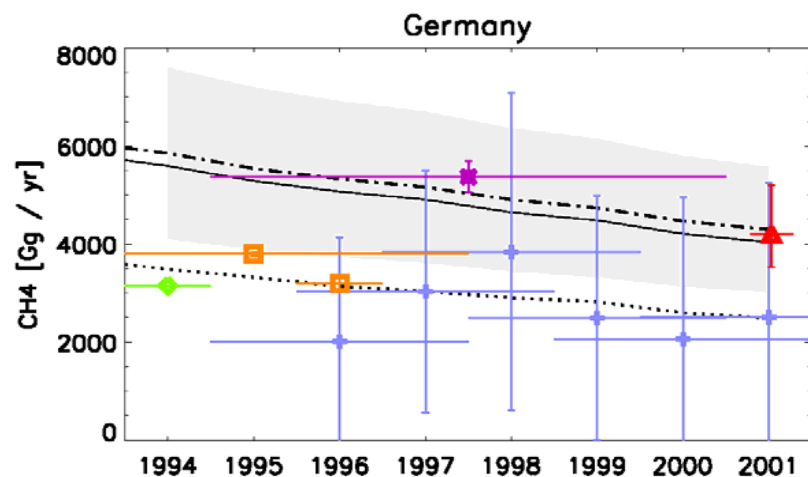
- Database for biogeochemical module of inverse models complete (A6.2)
- Report on CHIOTTO and other network measurements (A6.2)
- Preliminary European N₂O and CH₄ emissions derived by means of inverse models (A6.2)
- European N₂O and CH₄ emissions derived by means of inverse models (A6.2)

basic principle: inverse modelling



basic principle: forward modelling



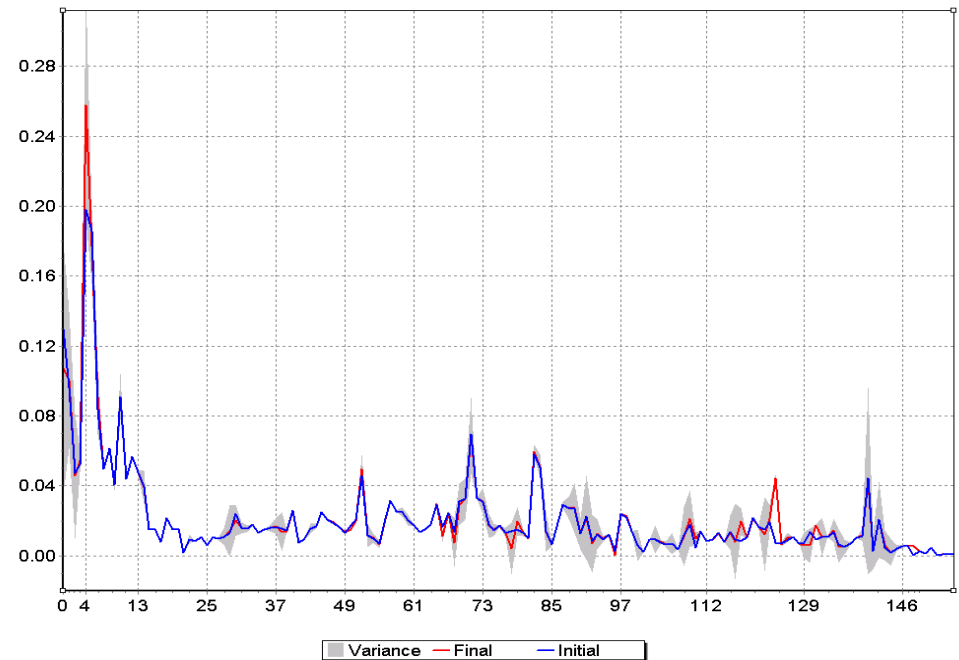
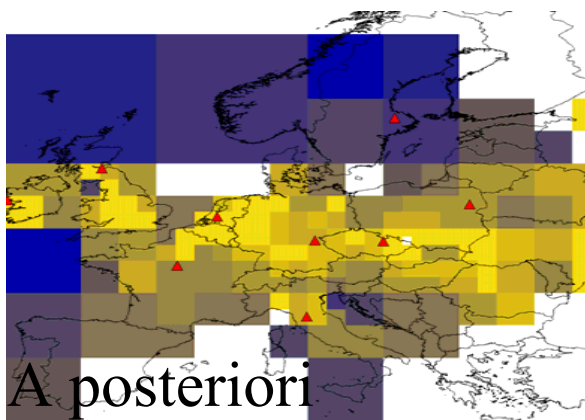
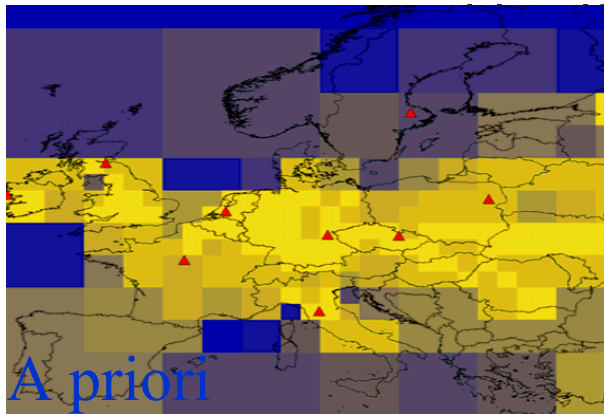


----- UNFCCC [EEA, 2004] + natural sources / sinks
 ——— UNFCCC [EEA, 2004]
 UNFCCC [EEA, 2003]

▲ [this study]
 + [Manning et al, 2004]
 ■ [Manning et al, 2003]
 × [Ryall et al., 2001]
 ◇ [Roemer et al., 2000]
 □ [Vermeulen et al., 2004]

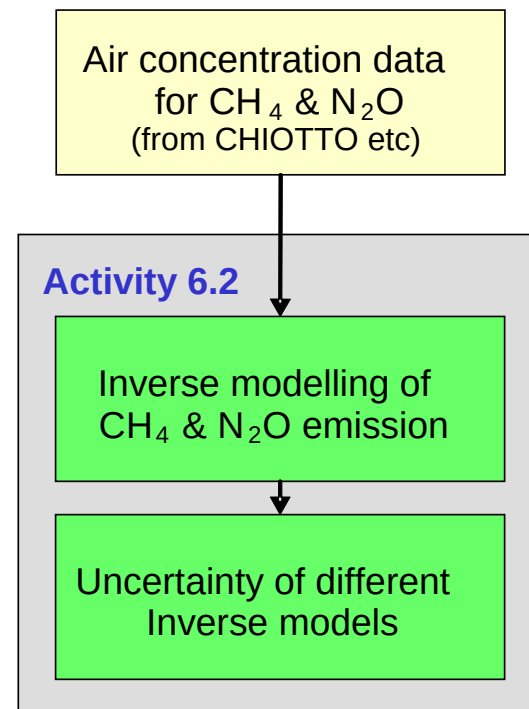
Multiple station synthetic inversion (2002, 8 CHIOTTO stations)

- Initially >250 aggregated source regions
- After SVD and optimization >150 source regions

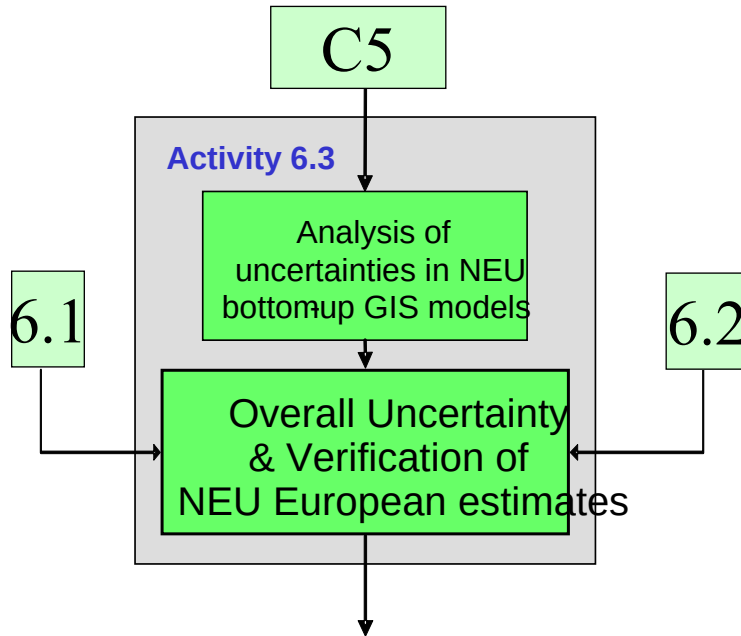


Activity 6.2 - partners

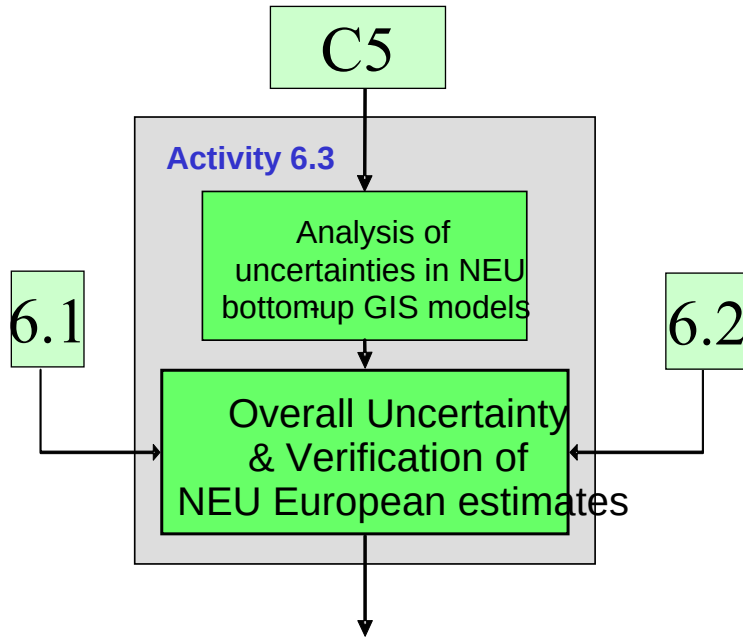
- JRC – Italy
- ECN – Netherlands
- MPI – Germany
- CEA – Italy
- MET - UK
- FZK – Germany
- RIVM - Netherlands
- LSCE-CEA - France
- Activity leader: P.Bergamaschi (JRC)



6.3 Technical Objective 12



To assess the uncertainties within and between the different approaches to estimate N and GHG emissions at the European scale (bottom up GIS models, top-down inverse-models, independent measurement-based estimates), supported by data on the reliability of the underlying input datasets (C6)



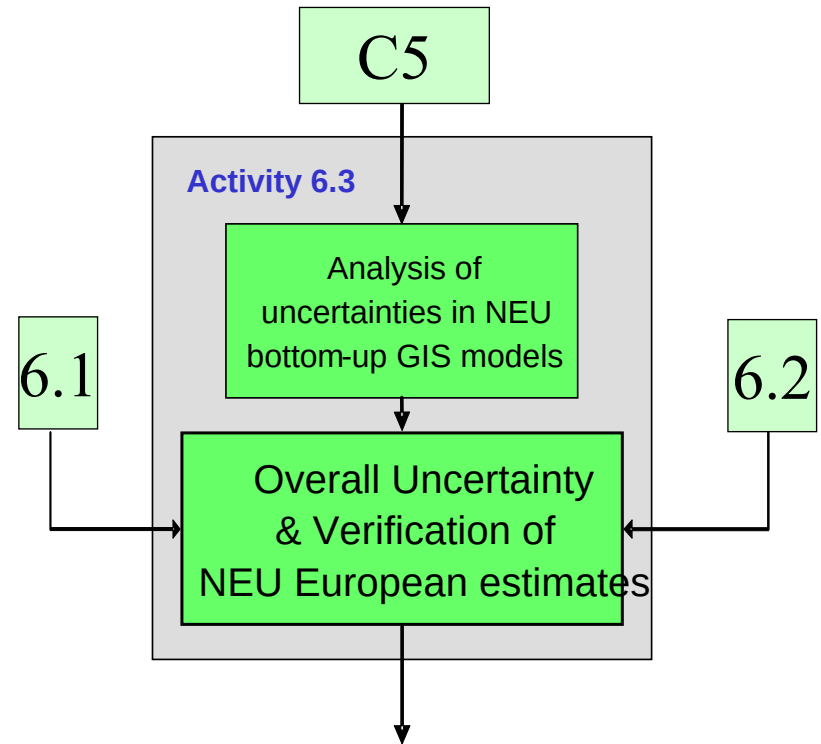
6.3 Technical Objective 12

Means to achieve this objective:

- Protocol for quantification of uncertainty at regional scales (A6.1, A6.3)
- Uncertainties in different emission estimation approaches quantified and analysed (A6.3)
- Differences between NEU GIS models, inverse models and independent datasets and national/European inventories of N and GHG emissions quantified and analysed (A6.3)

Activity 6.3 - partners

- NERC – UK
 - ECN – Netherlands
 - Alterra – Netherlands
 - MET.NO – Norway
 - FZK – Germany
 - UNIABDN - UK
-
- Activity leader: M. van Oijen (UK)

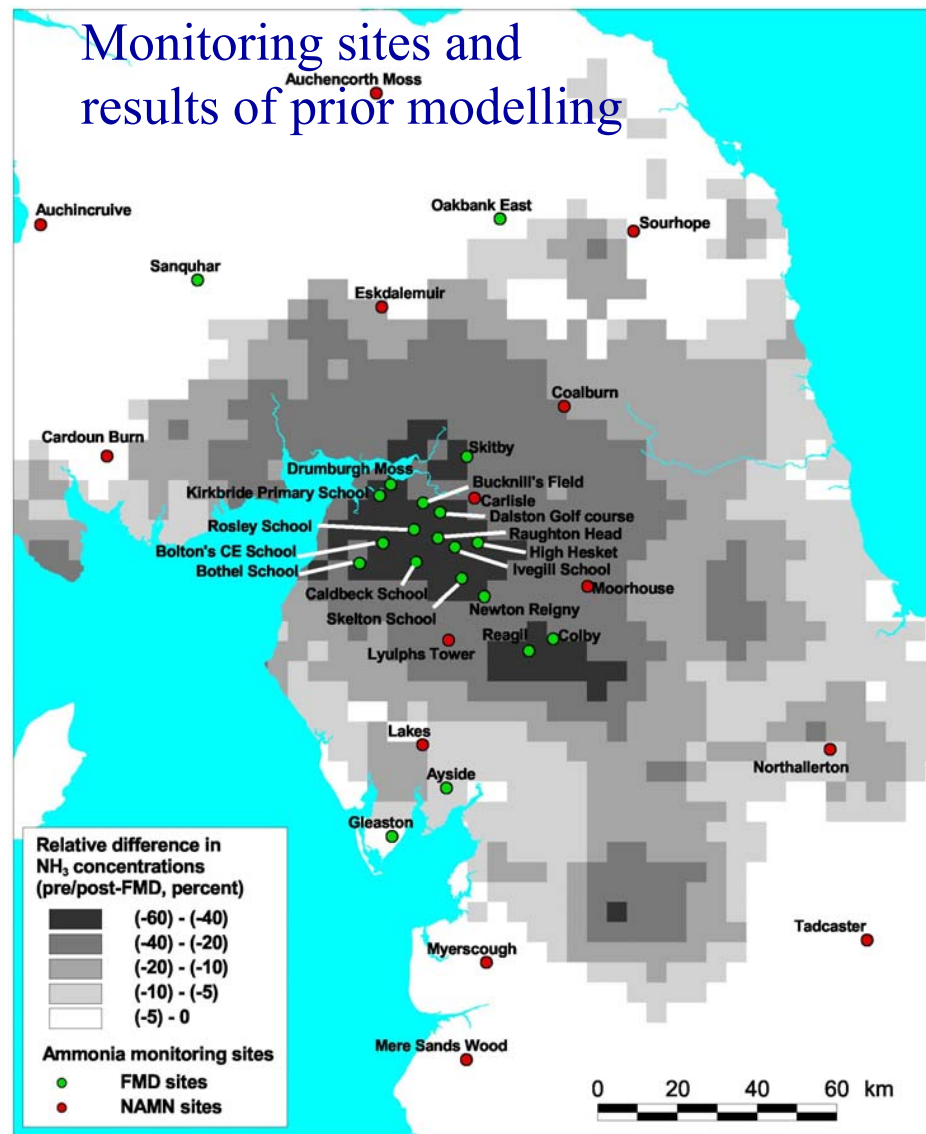


VERIFICATION

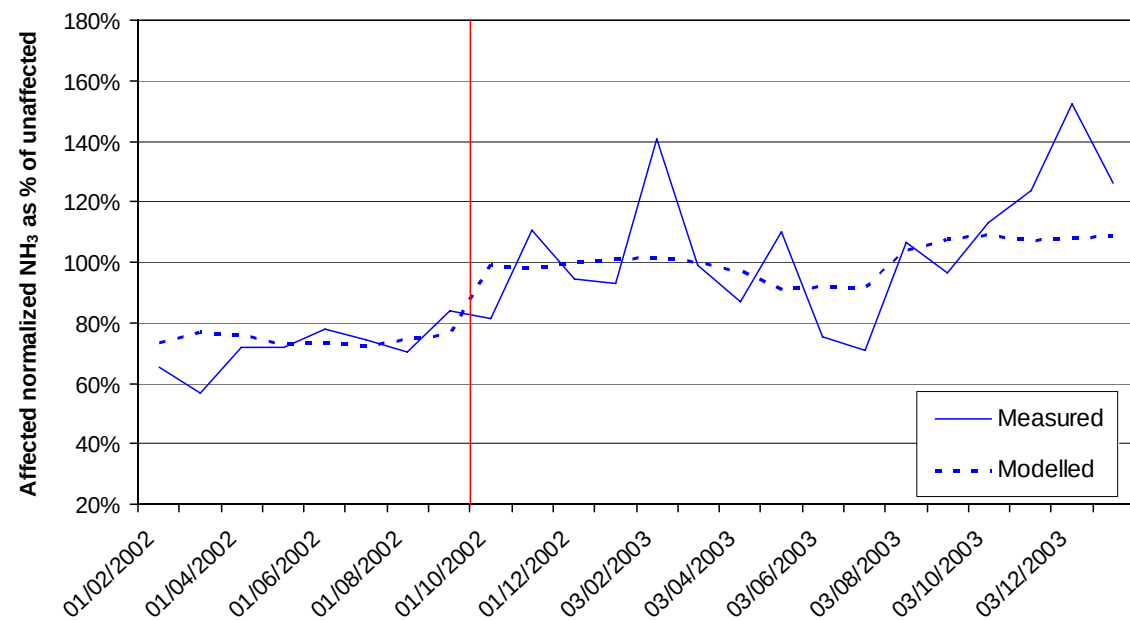
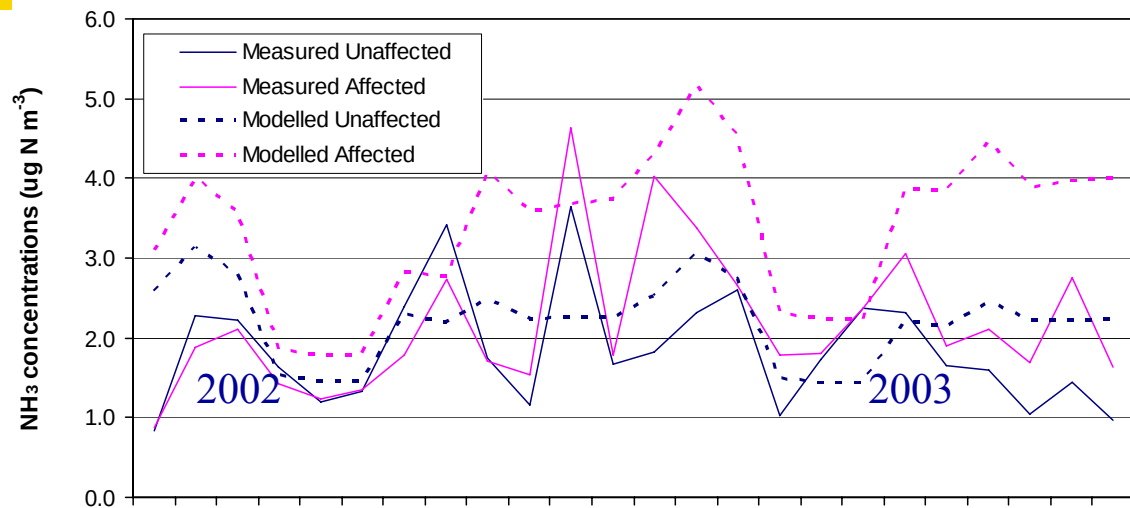
Can NH_3 emission changes be detected after the outbreak of foot & mouth disease?

Study motivated by Dutch & E. European experience of difficulty to see trends following emission reductions

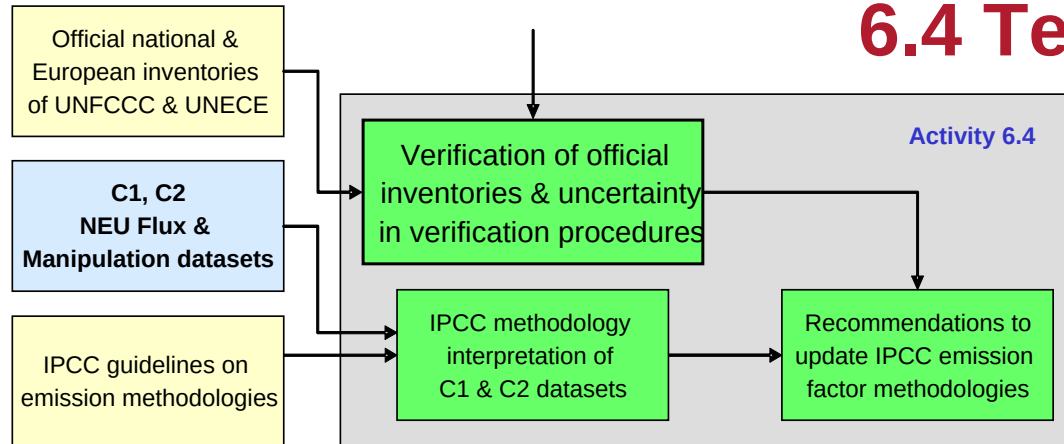
Air sampling
at ~20 targeted locations



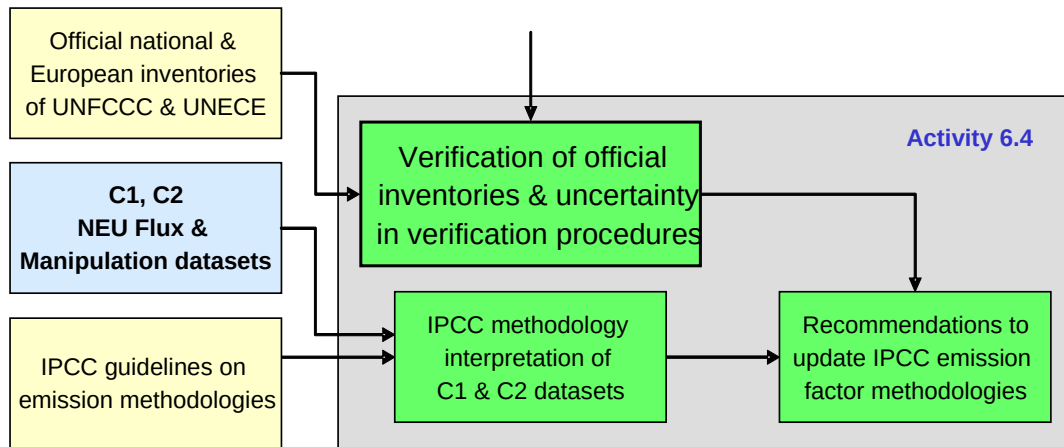
Comparison of affected & unaffected areas around Cumbria



6.4 Technical Objective 13



To assess the extent to which the NEU GIS models, inverse models and independent datasets verify national/European inventories of N and GHG emissions officially submitted to the UNFCCC and UNECE-CLRTAP (C6), and, based on the results of this (plus C1 datasets) to recommend revisions to the IPCC methodology for calculating N and GHG emission inventories.

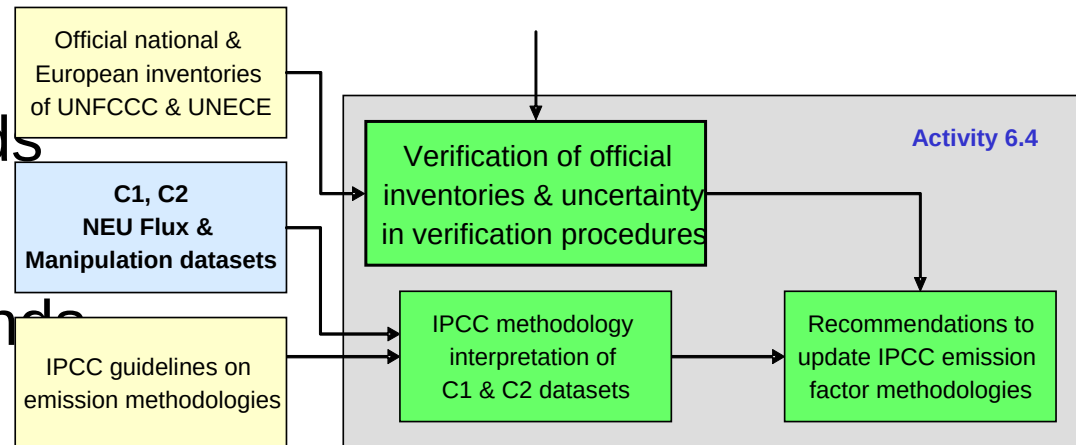


Means to achieve this objective:

- Concept report on official verification and uncertainty to stakeholders (A6.3, A6.4)
- Report on preliminary comparison of official inventories, NEU tools and independent estimates for selected test regions (A6.3, A6.4)
- Preliminary comparison of IPCC approach with flux dataset (A6.4)
- Updated comparison of IPCC approach with NEU flux measurements, NEU model predictions and independent estimates (A6.4)
- Recommendations issued with respect to the IPCC methodology, based on the results of the European verification assessment and the NEU site-based flux datasets (A6.4)

Activity 6.4 - partners

- WU - Netherlands
- NERC – UK
- ECN – Netherlands
- JRC - Italy
- FZK – Germany
- Alterra - Netherlands

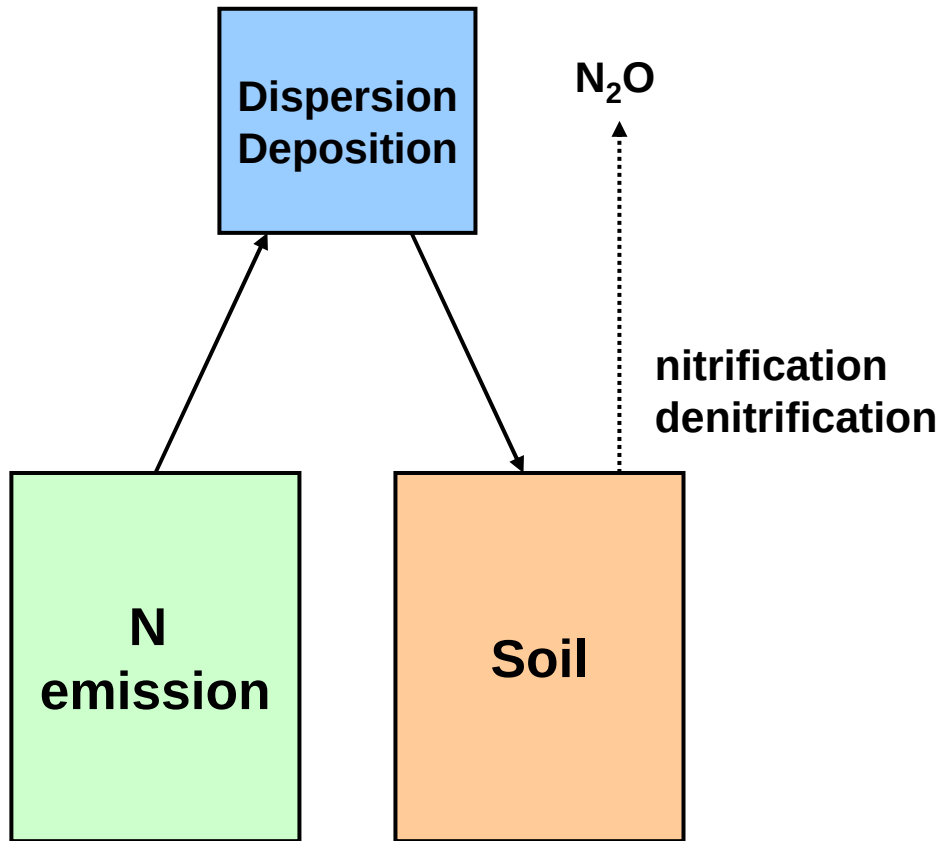


Activity leader: A. van Amstel (Netherlands)

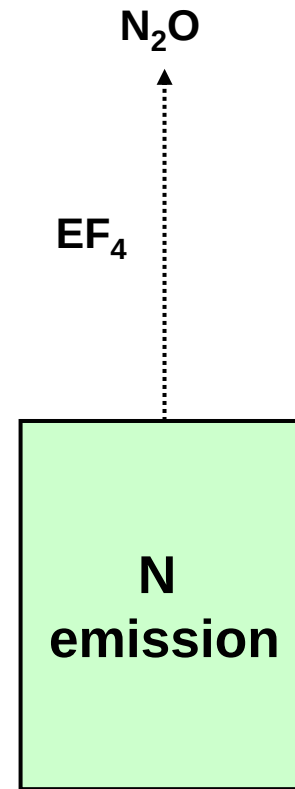
Need for IPCC (example N₂O)

- UNFCCC (United Nations Framework Convention on Climate Change) request reporting of both direct and indirect N₂O emissions
- IPCC (Intergovernmental Panel on Climate Change) treats the pathways separately and provides guidelines how to estimate both emission types
- Country-specific methodologies are possible, but they have to be transparent, properly documented and/or described in peer reviewed literature

N₂O emission calculation



Process based

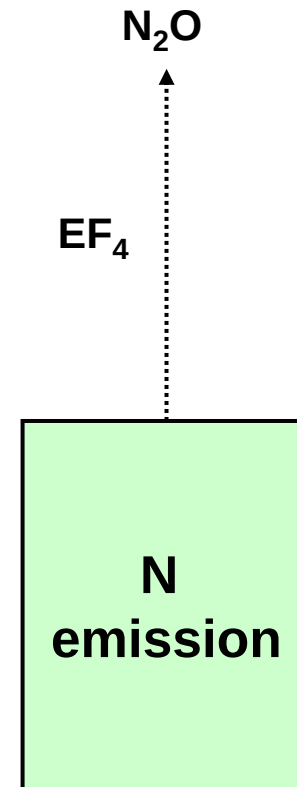


IPCC methodology

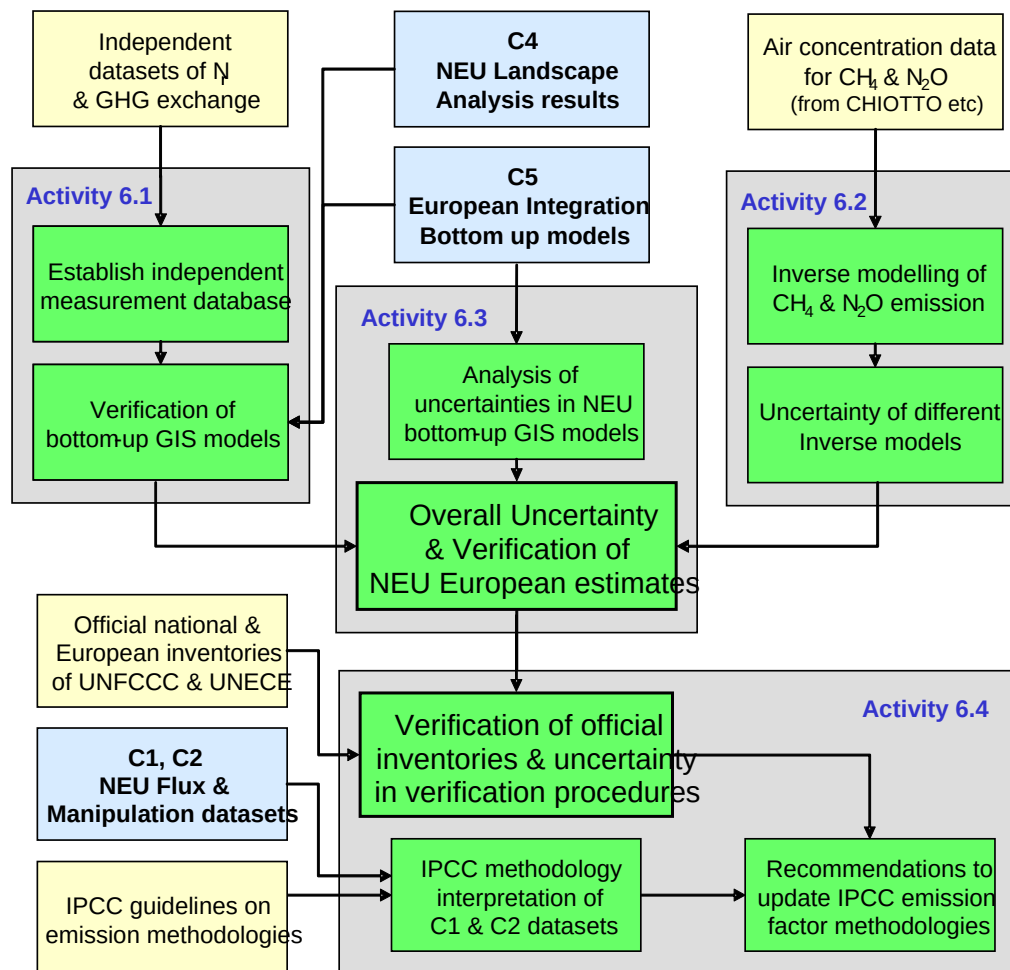
N₂O emission calculation

$$N_2O-N_{dep} = EF_4 \times [em. agr. NH_3-N + NO_x-N]$$

$$EF_4 = 0.01 \text{ kg N}_2\text{O-N/kg NH}_4\text{-N \& NO}_x\text{-N}$$



IPCC methodology



Activity Sessions during Kick-Off

- A6.1 – Tuesday (9.00-12.00)
 - Development of harmonized datasets for European modelling (Adrian Leip)
- A6.2 – Tuesday (9.00-12.00)
 - Trends in atmospheric N_2O , CH_4 and CO_2 : comparison of measurements and models (Alex Vermeulen)
- A6.2 – Tuesday (16.00-18.00)
 - Regional inverse dispersion modelling of N_2O and CH_4 (Peter Bergamaschi)
- A6.1 – Thursday (10.45-13.00)
 - Trends in atmospheric NH_x and NO_y . Comparison of measurements in relation to emissions and modelled changes (Albert Bleeker)

Specific objectives

- *O6.1 To conduct a verification assessment of the NEU bottom-up GIS European models by reference to independent measured datasets not used in the model development (A6.1, A6.3).*
- *O6.2 To apply a suite of European-scale Lagrangian and Eulerian inverse model approaches to derive independent estimates of European N₂O and CH₄ emissions (A6.2).*
- *O6.3 To assess the uncertainties within and between the different approaches to estimate N and GHG emissions at the European scale (bottom up GIS models, top-down inverse-models, independent measurement-based estimates), supported by data on the reliability of the underlying input datasets (A6.3).*
- *O6.4 To assess the extent to which the NEU GIS models, inverse models and independent datasets verify national/European inventories of N and GHG emissions officially submitted to the UNFCCC and UNECE-CLRTAP (A6.4)*
- *O6.5 To recommend revisions to the IPCC methodology for calculating N and GHG emissions inventories, based on the results of the European verification assessment and the NEU site-based flux datasets (A6.4).*

C6 activities and their relations

