



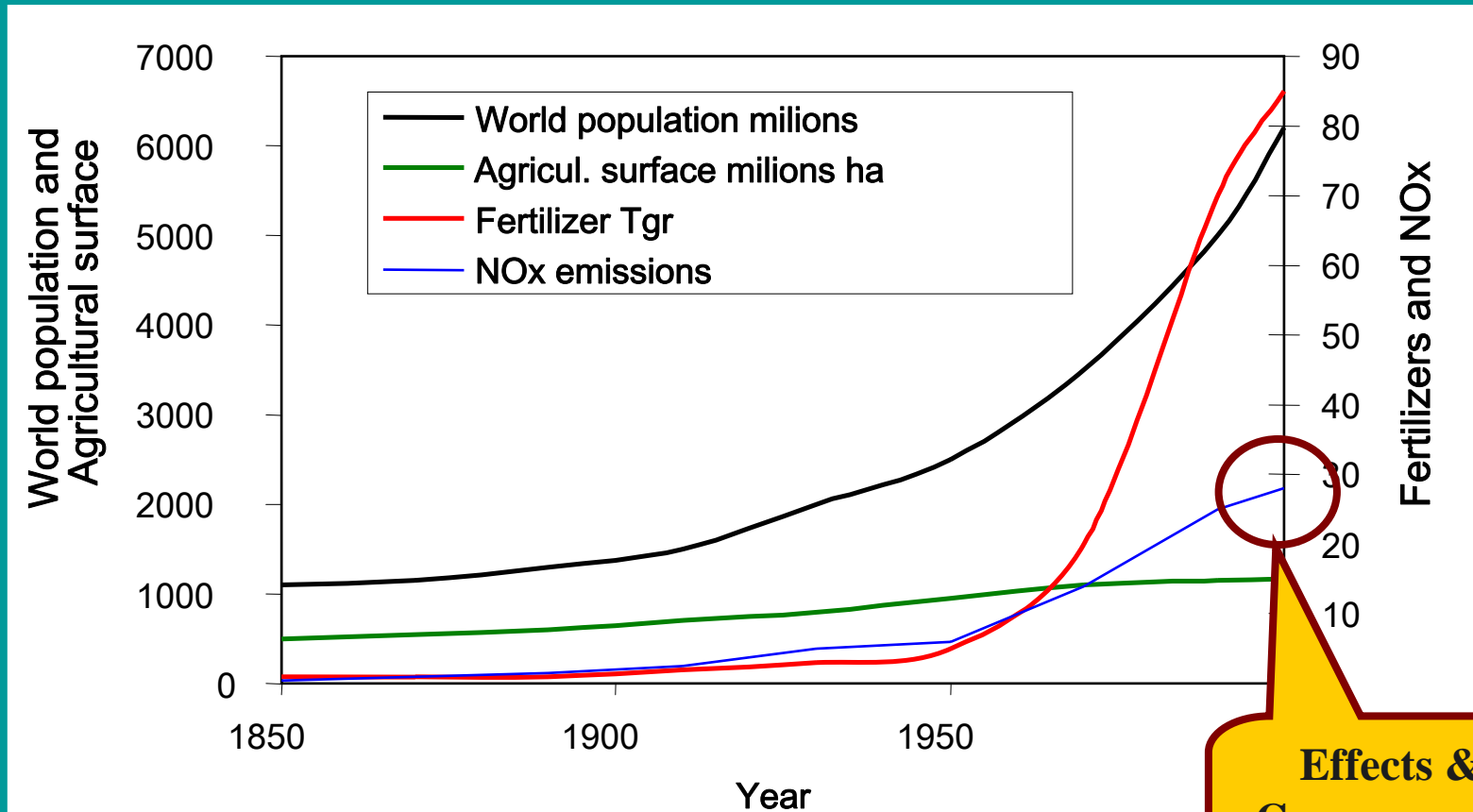
NitroEurope IP

Nitrogen and the European GHG balance

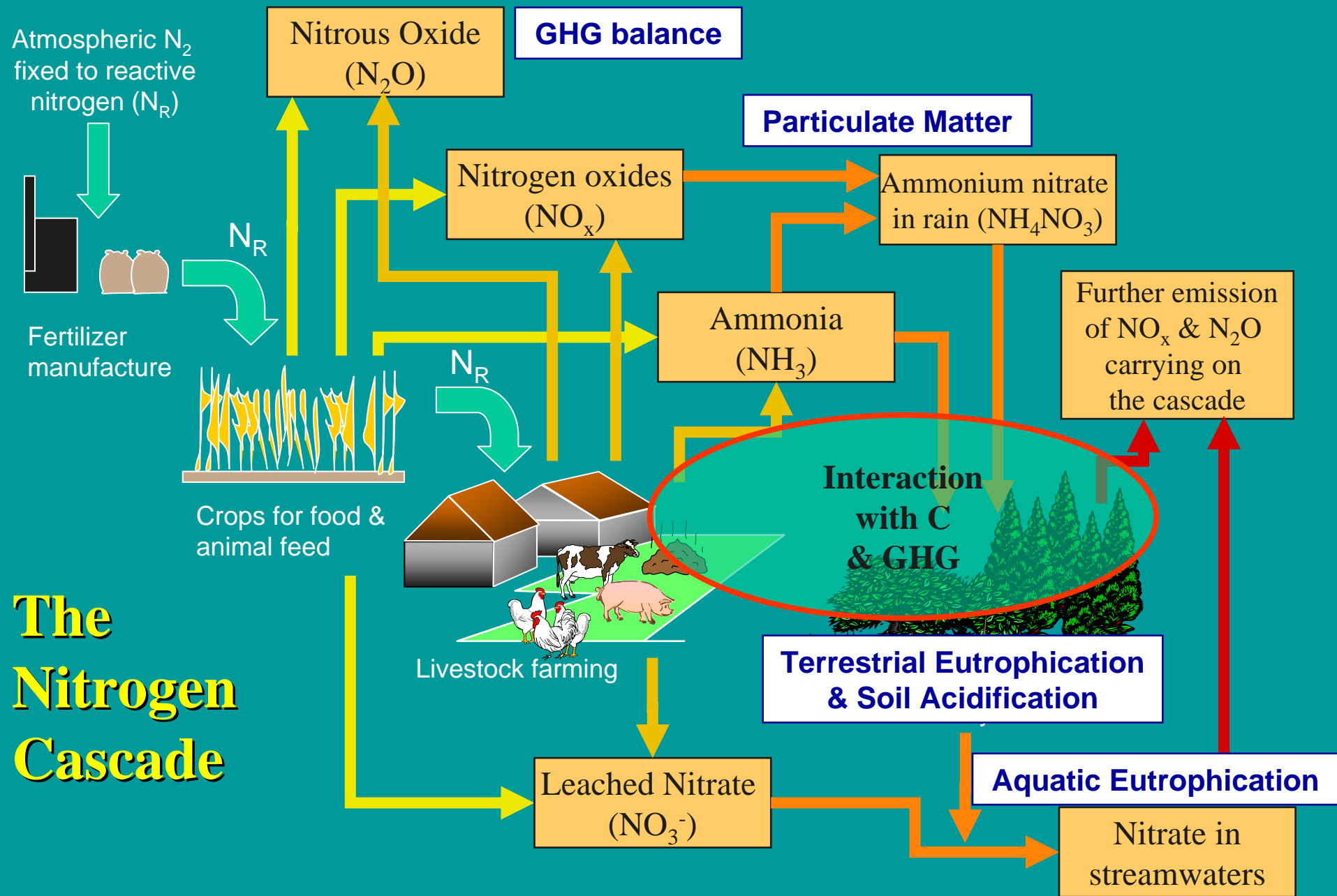
Sutton, Mark A., Jan Willem Erisman, Klaus Butterbach-Bahl, **Claus Beier**, Wim de Vries, Pierre Cellier, Francesca Cotrufo, Eiko Nemitz, Ute Skiba, Mark Theobald, Ulrike Dragosits, Claire Campbell, Marcel van Oijen, Bridget Emmett, Lucy Sheppard, David Fowler, Albert Bleeker, Alex Vermeulen, Nicolas Bruggeman, Kim Pilegaard, Oene Oenema, Hans Kros, Jean-François Soussana, Günther Seufert, Adrian Leip, Peter Bergamaschi, Albrecht Neftel, Juerg Fuhrer, Jan K. Schjoerring, Per Gundersen, Annette Freibauer, Vincenzo Magliulo, Sophie Zechmeister-Boltenstern, Timo Vesala, Jørgen E. Olesen, Bob Rees, Pete Smith, Jo Smith, Michael Obersteiner, Andre van Amstel, Bogdan Chojnicki, Tuomas Laurila, László Horváth, Lars R. Hole, Jan Duyzer, John Moncrieff, Keith Smith, Riccardo Valentini, Volodymyr Medinets, Leif Klemetsson, Franco Miglietta, Zoltán Tuba, Oswald Van Cleemput, Michael Sommer, Per-Erik Jansson, Lech Ryszkowski, Lutz Breuer, Alistair Manning, Ulrich Dämmgen, Josep Peñuelas, Peringe Grennfelt, Filip Moldan, Albert Tietema, Torben R. Christensen, Antonio Vallejo, Patrick Schleppi, Eva Boegh, Jari Liski and Zoltán Bozóki

and quite a few others....

Why care about nitrogen?



Effects & Consequences ??



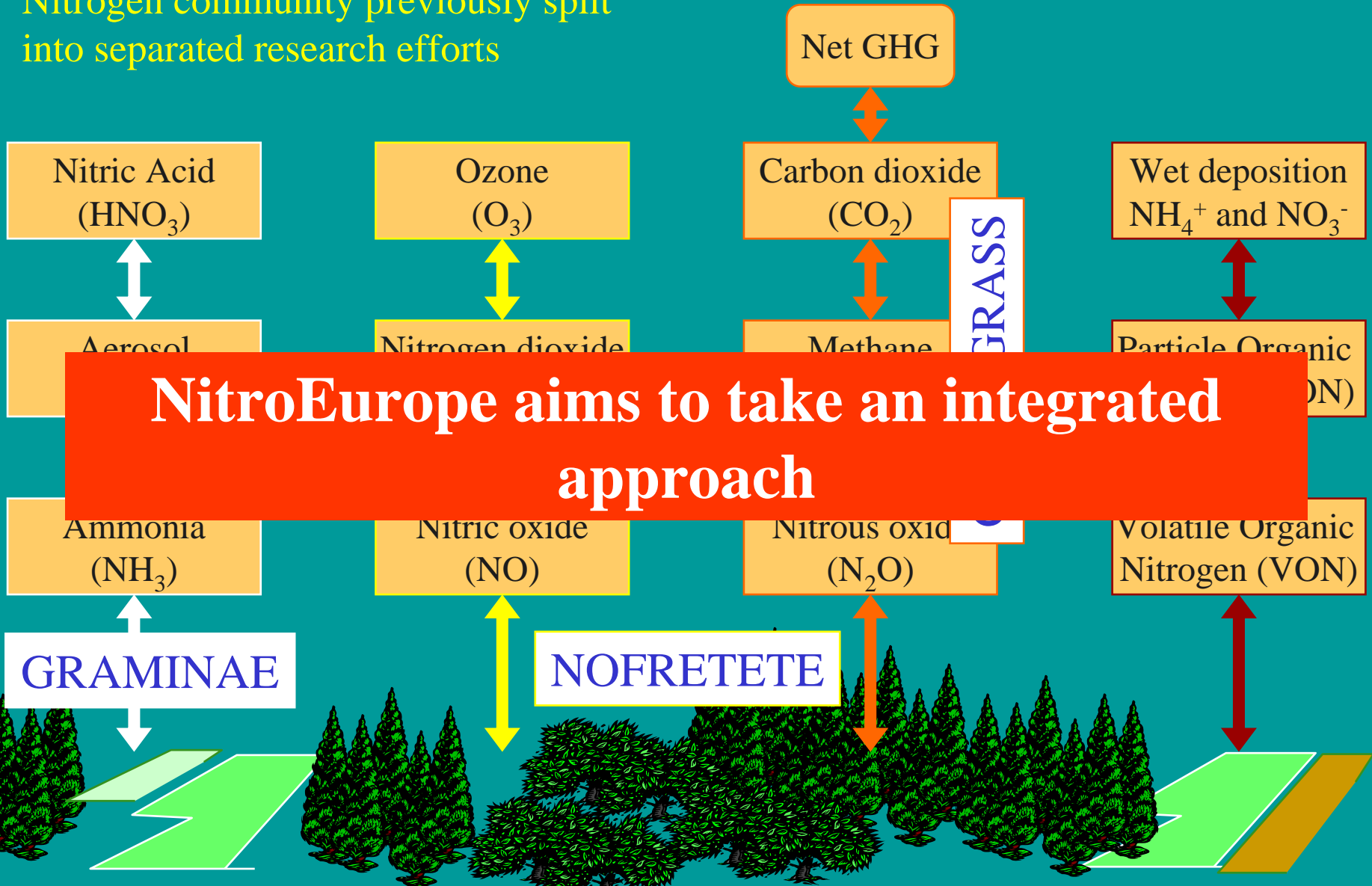
The Nitrogen Challenge

- **Multi-source**
agriculture, fossil fuel, natural
- **Multi-pollutant**
 N_2O , NO_x , NH_3 , aquatic NO_3^- , aerosol etc
- **Multi-problem**
GHG balance, biodiversity, water quality, human health
- **Multi-receptor**
Forests & other terrest. ecosystems, agriculture, rivers, stratosphere, urban, coastal & marine, humans

Land-atmosphere exchange of nitrogen

- and past focus areas

Nitrogen community previously split into separated research efforts



NitroEurope IP



What is the effect of reactive nitrogen supply on the direction and magnitude of net greenhouse gas budgets for Europe?

– interaction with the C cycle

Effect of N on the GHG balance – What do we know??:

↑ GHG	?	↓ GHG
N₂O (+2' from NH ₃ , NO ₃ ⁻)	Cattle CH₄	C uptake by plants
CH₄ from wetlands	SOM decomposition	Nitrogen aerosol
NO_x → O₃ → less primary production		

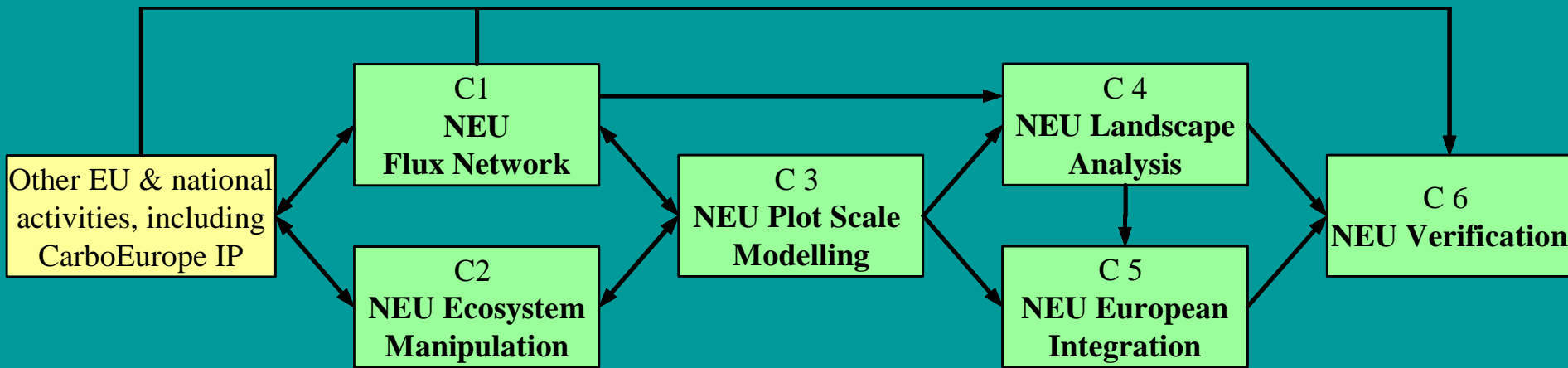
Future changes and interactions with drivers (climate, N-dep, carbon, Land Use Change, management etc.)

NitroEurope

Overall Science Structure



Measurements **Modelling** **Upscaling**



Plus four supporting components:

C7. Standards and Data Management

C8. NEU Management

C9: NEU Training

C10: NEU Dissemination

Linking Tasks and Delivery in NEU



C1 Flux Networks

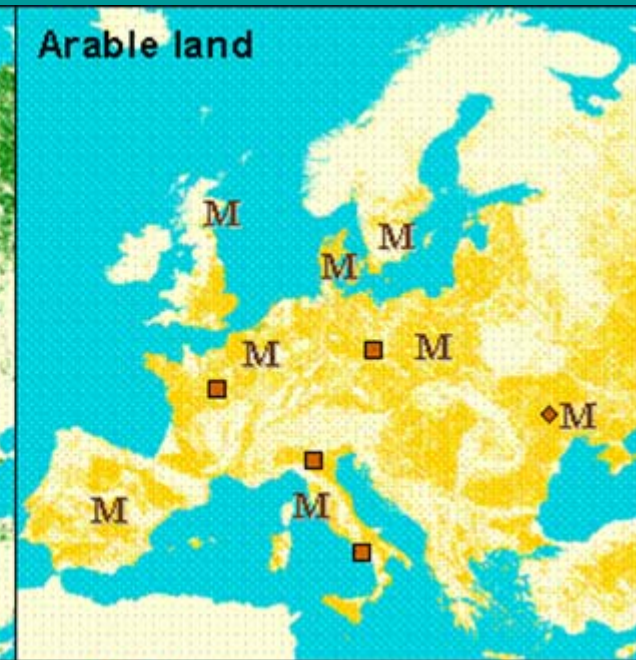
- Methods development
- Integrated air, plant and soil data
- Process understanding
- 95% N budget



C2 Manipulation

- Process testing
- System responses to perturbation
- Interactions between drivers
- Relative change important

NitroEurope: Flux network (C1) & Manipulation network (C2)

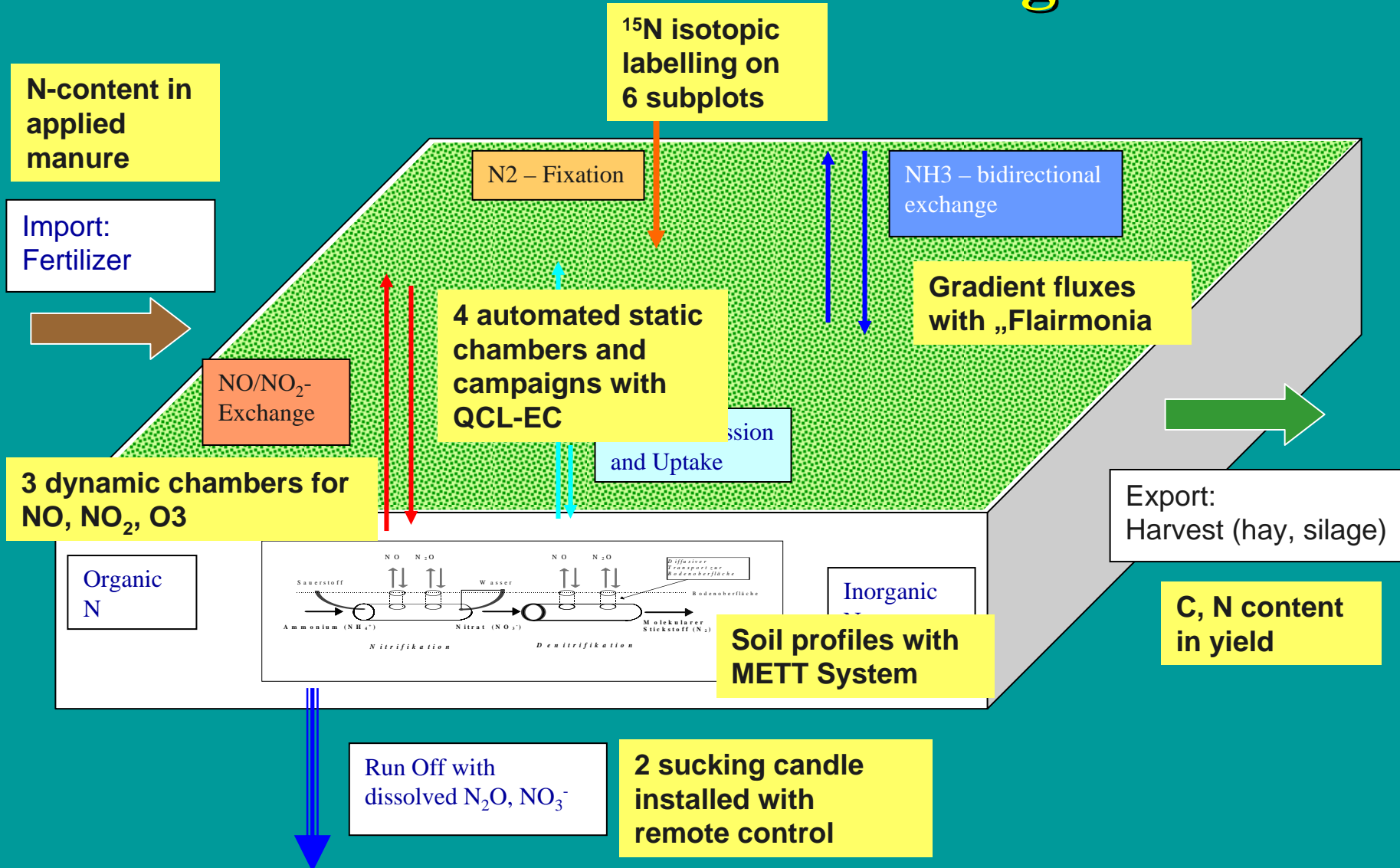


13 Super Sites
9 Regional Sites
50 Inferential Sites

22 Core Manipulation Sites
14 Assoc. Manipulation Sites

Component 1

NEU Level 3 site Oensingen





C1 – Flux network

Chambers



Leaf level

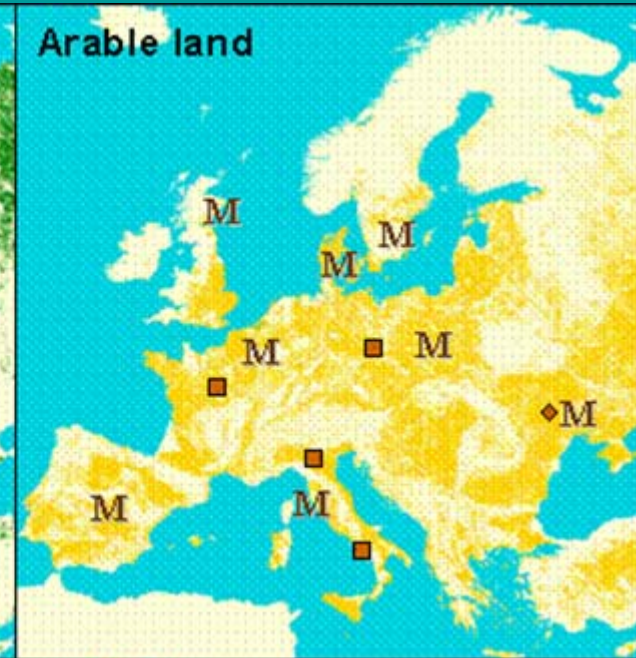


**”State of the art” techniques
– coordinated with CarboEurope**

**Micrometeorological
methods**



NitroEurope: Flux network (C1) & Manipulation network (C2)

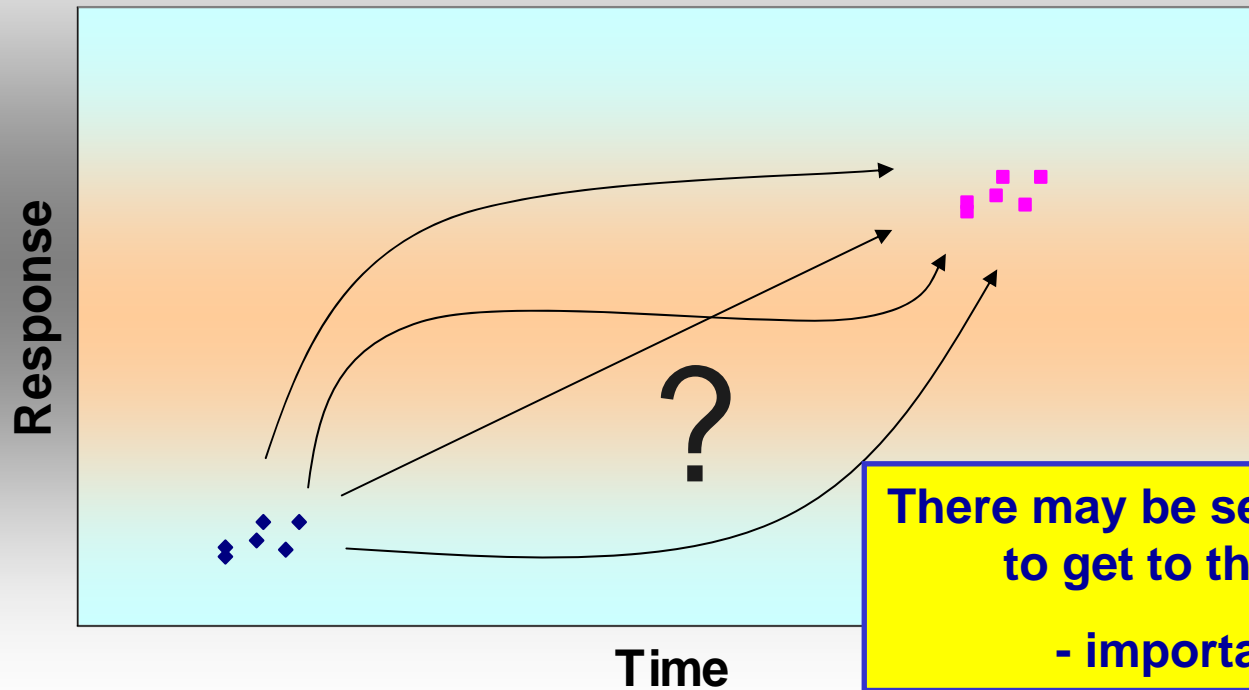


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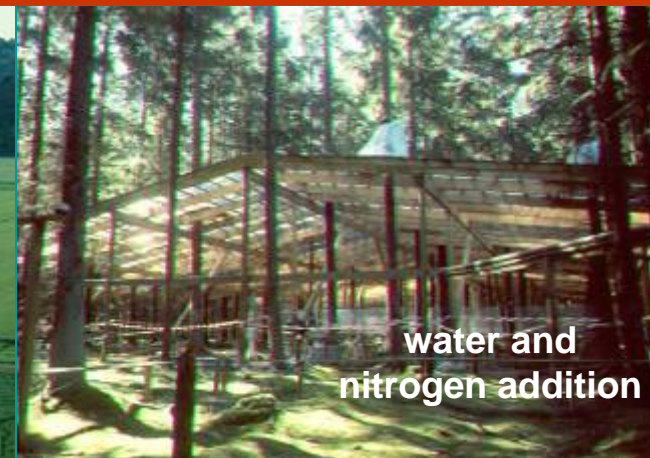
C2 - Why experiments

Ecological response to change in drivers over time



**There may be several ways
to get to the goal
- important!!**

C2 - Manipulation Experiments

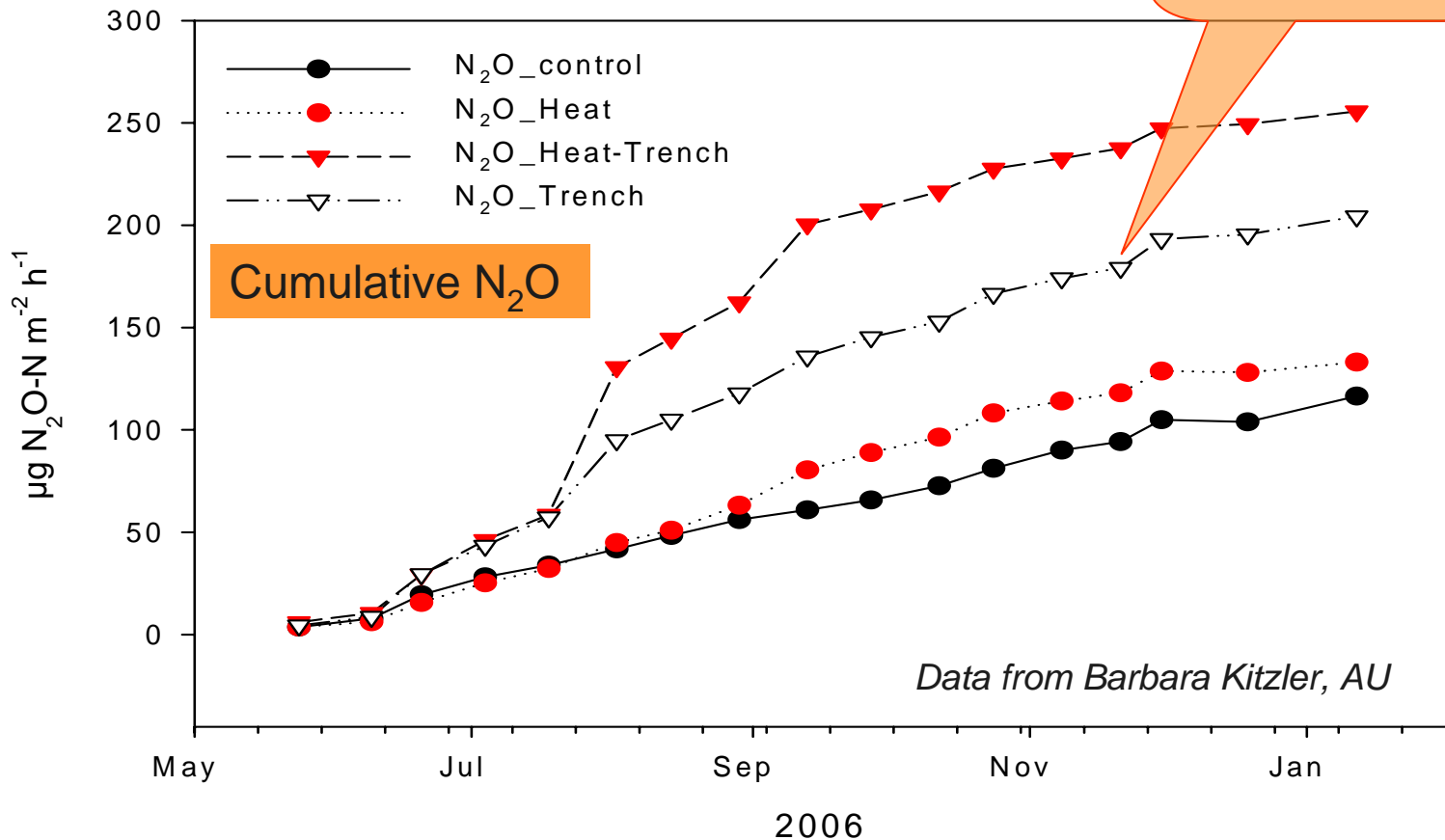


Ecosystem manipulation to understand N interactions with global change drivers

C2- Impact of climate

Warming (+3°C), Achenkirchen, Austria

No roots
= more
available N





C2 - Manipulation Experiments

Climaite – multifactor climate change experiments

CO₂, water & Temperature

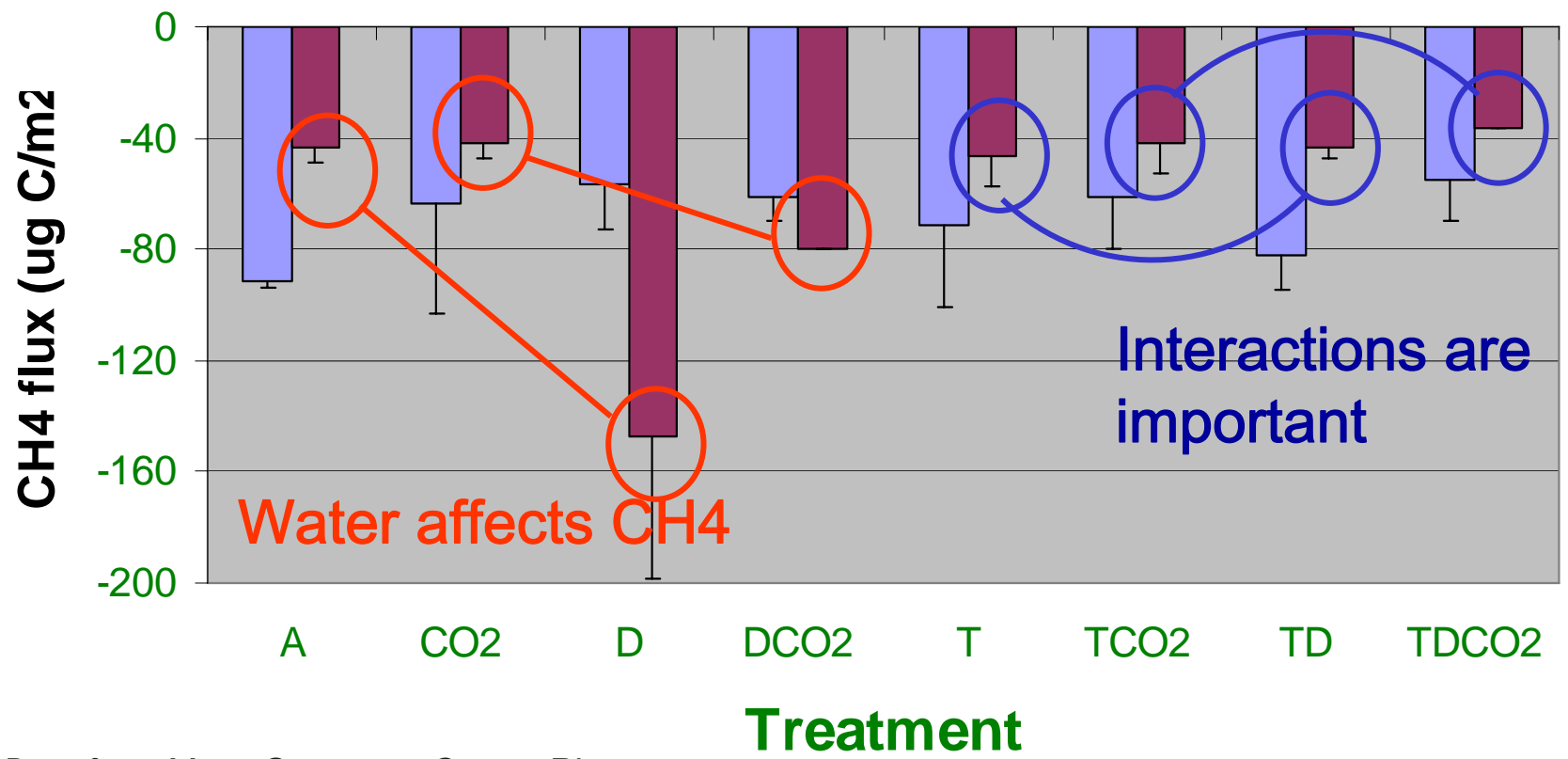


Clima!te

C2- Impact of climate

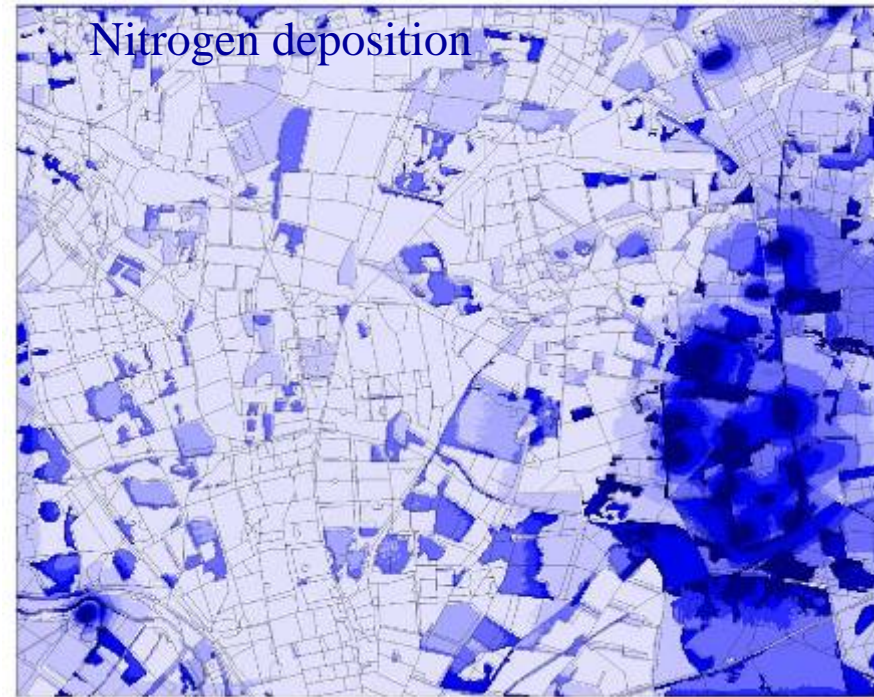
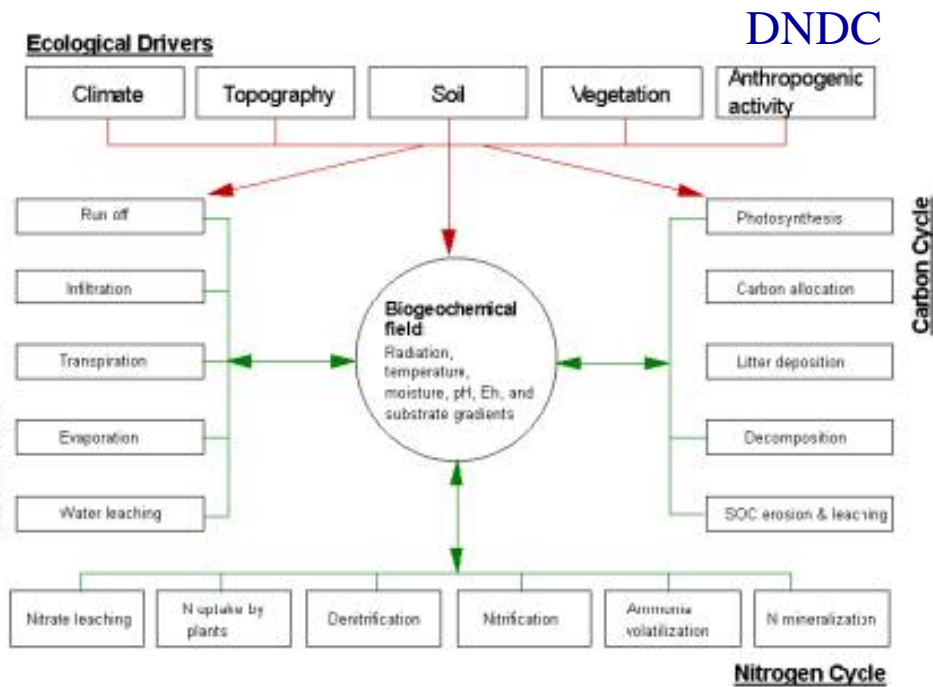
CH₄ fluxes before and during drought

June
July



Data from Mette Sustmann Carter, Risø

Linking Tasks and Delivery in NEU



C3 Plot-scale modelling

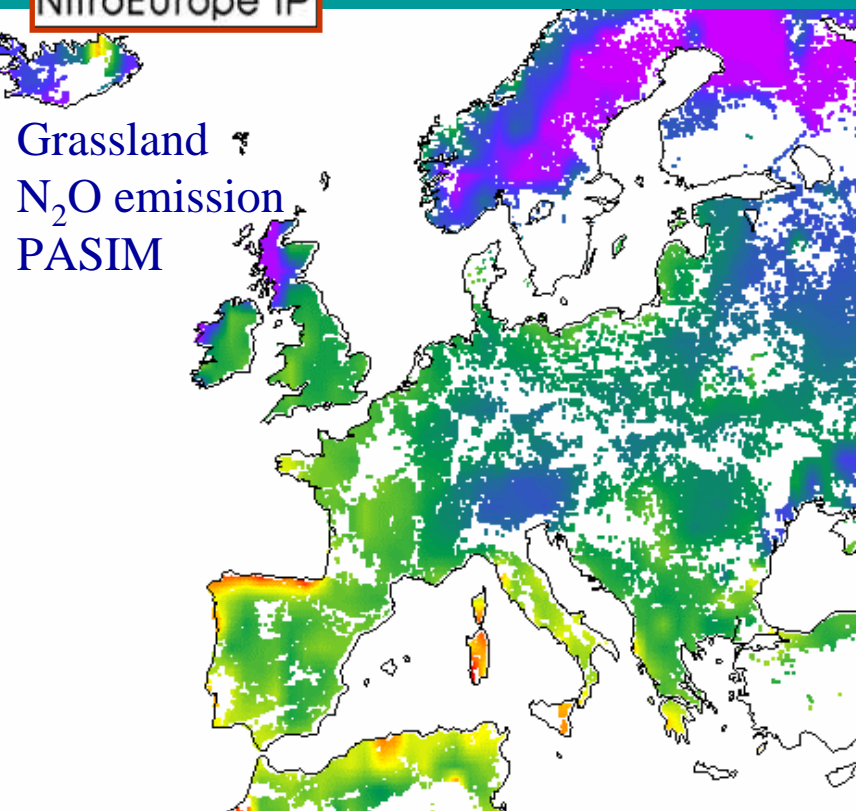
- Reconstruction of observations
- Explanation of interactions
- Prediction of future responses

C4 Landscape analysis

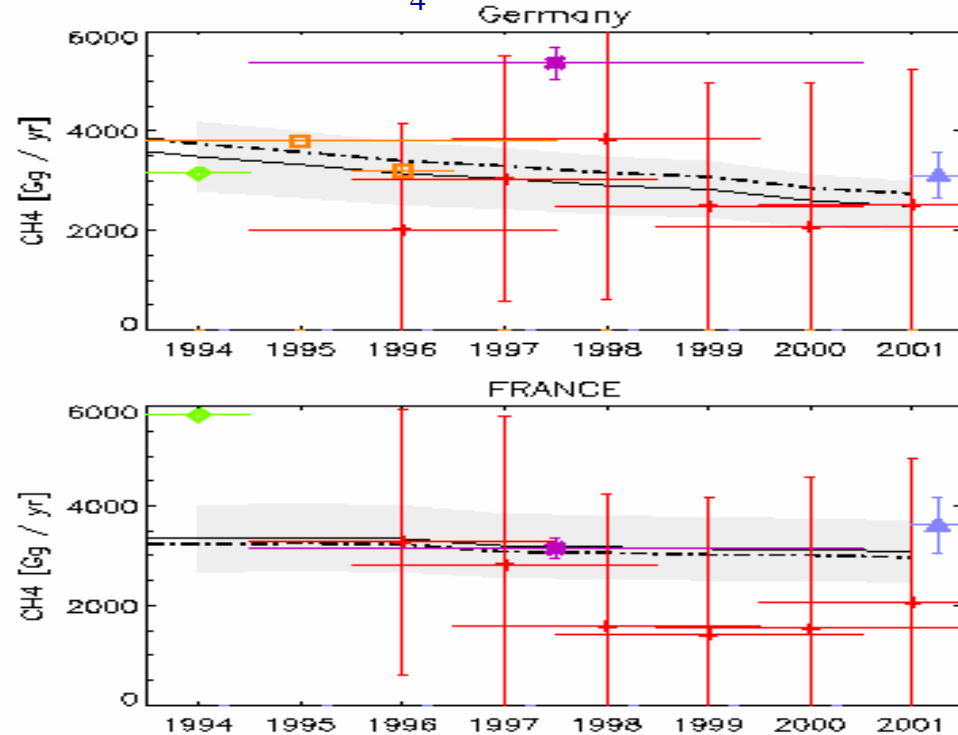
- Spatial interactions
- Complexity
- Management interactions
- Abatement strategies



Linking Tasks and Delivery in NEU



Inverse model CH₄ emission estimates



C5 European Integration

- Upscaling
- Improving input datasets
- Ecosystem vs multi-sector models
- Past changes and future scenarios

C6: Verification

- Independent data check
- Uncertainty assessment
- Protocol compliance
- Revision of IPPC/UNECE values



Summary – key topics

Large scale – Cross European project (gradient)

“State of the art” measurement techniques

Experiments to look at drivers

Interactions (C-N – and climate, management, N input etc.)

Modelling (Plot scale – region – landscape)

Invitation

**Nitro Europe - associated partners from outside
Europe**

<http://www.nitroeuropa.eu>