COVER CROPS AND CROPS WITH HIGH NITROGEN CONTENT

AARHUS UNIVERSITY
DEPARTMENT OF AGROECOLOGY

PLANTEKONGRES 2025
9 JANUARY 2025

DIEGO ABALOS
SENIOR RESEARCHER

SOLIDUM PETIT IN PROFUNDIS · UNIVERSITAS ARHUSIENSIS ·

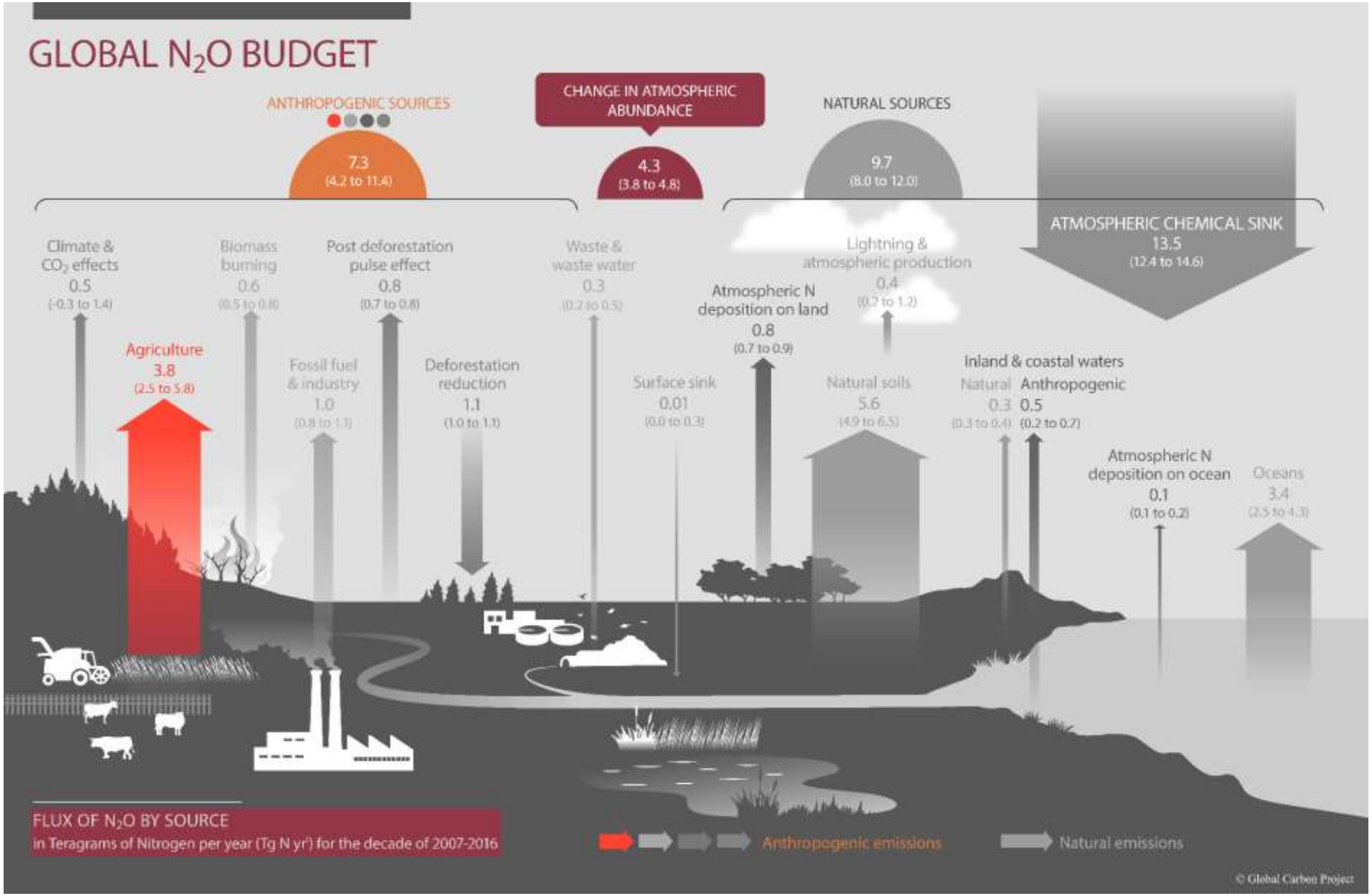
Nitrous Oxide (N_2O)

Per unit of mass, N_2O is considered 298 times as effective as a GHG as CO_2 (over 100-years).

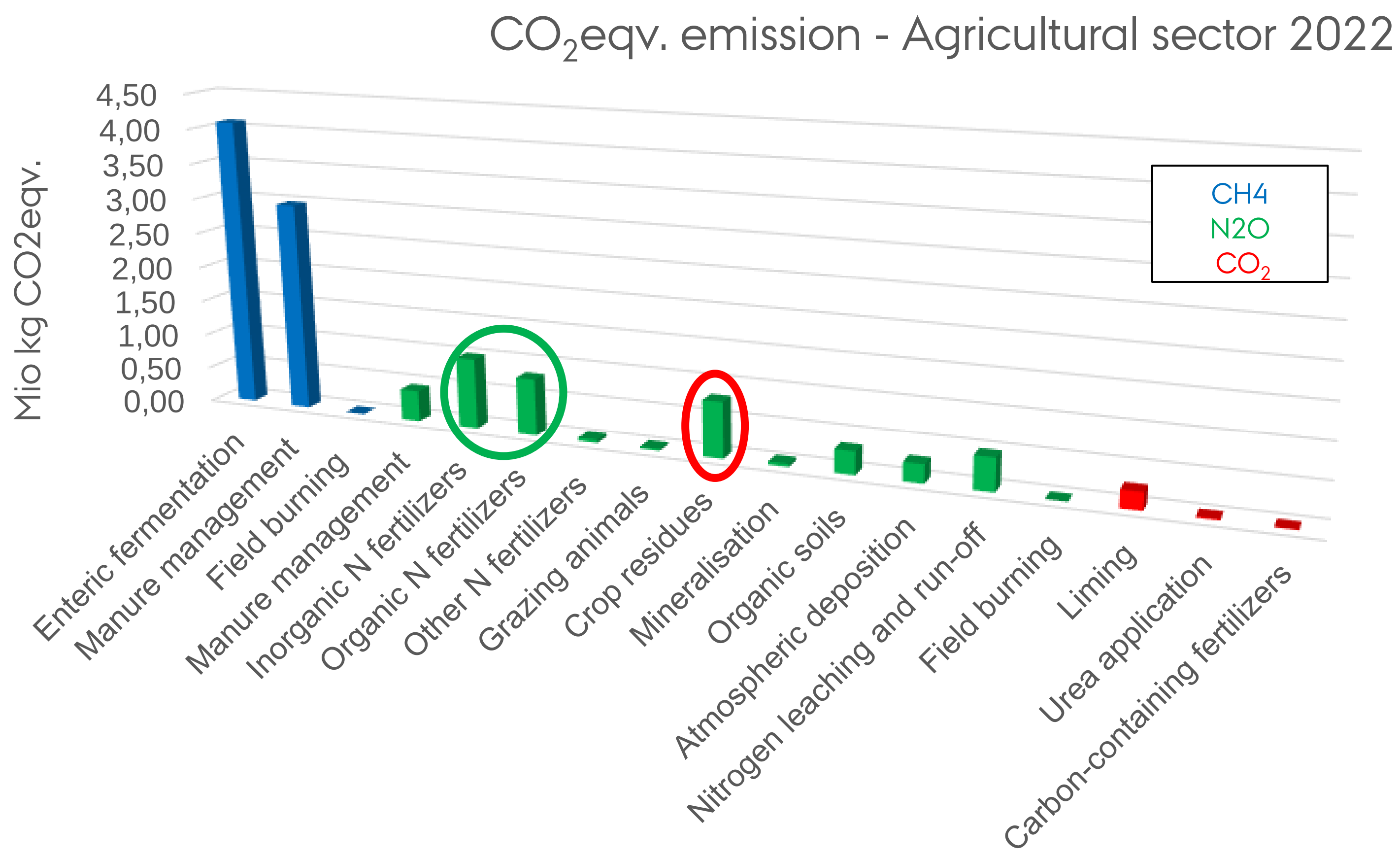
Third most important anthropogenic greenhouse gas (6.5% of the climate change).

Largest stratospheric ozone depleting substance.

Agriculture: 52-66% of total anthropogenic emissions



Emissions sources – the agricultural sector in DK



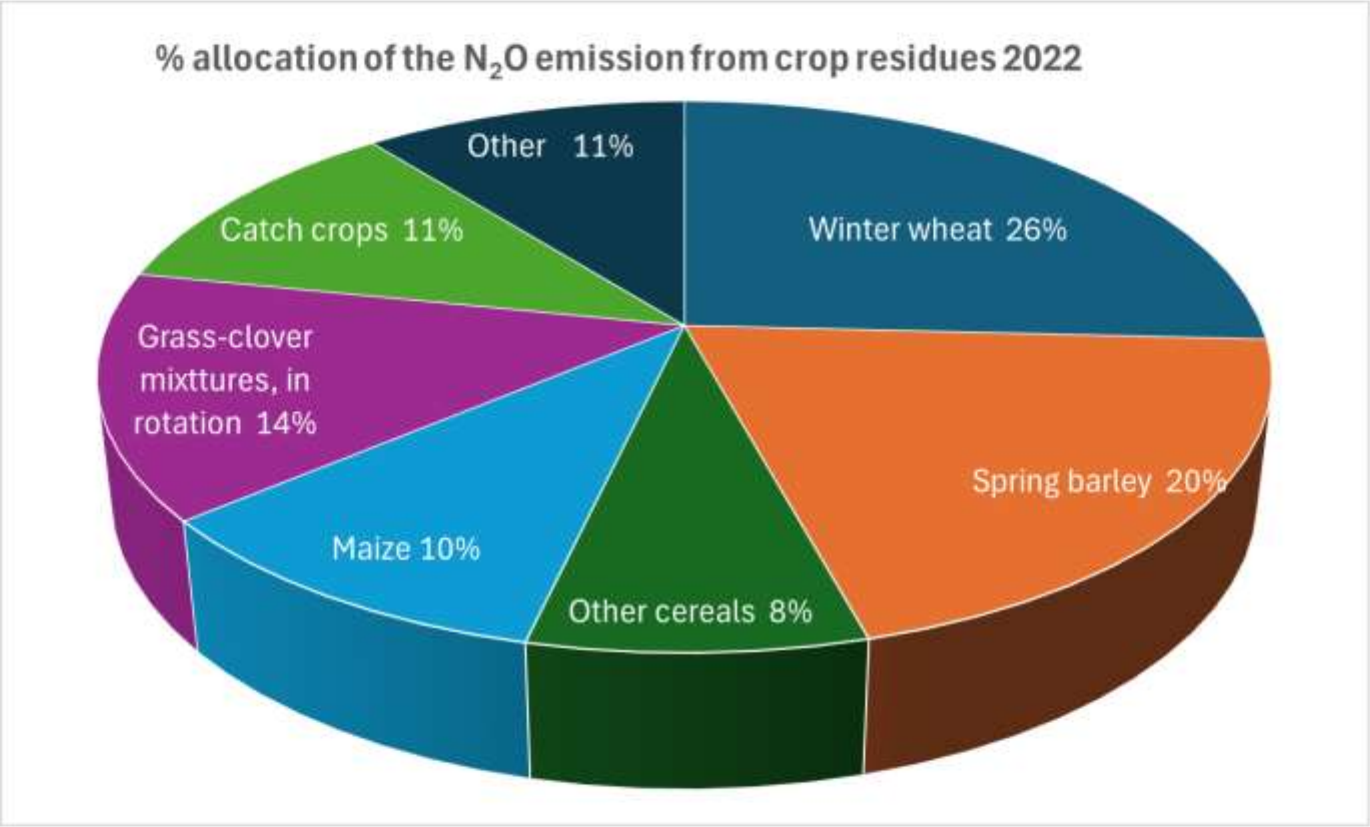
CH_4 emission = 61%
N_2O emission = 36%
CO_2 emission = 2%

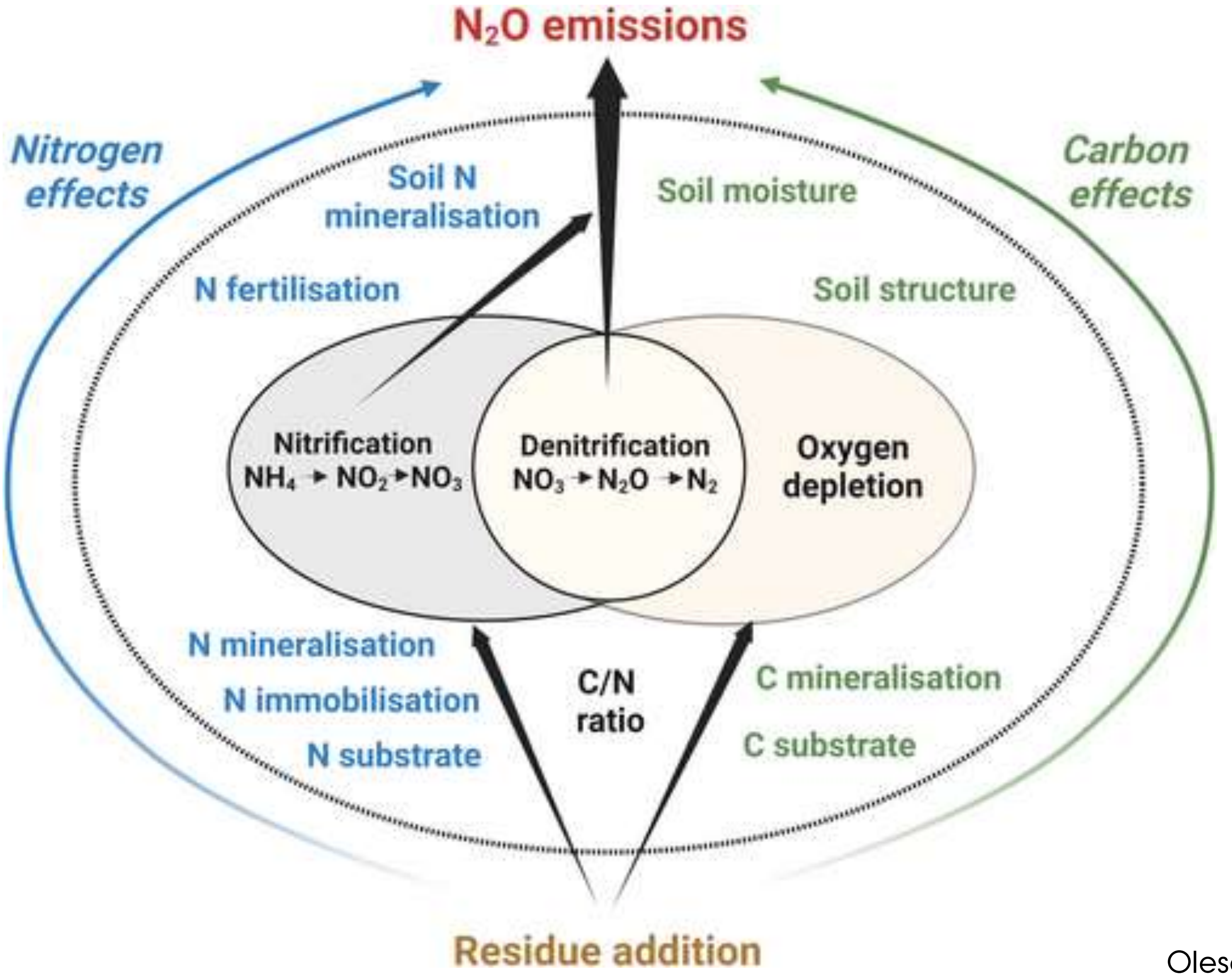
N_2O from crop residues in national inventory

$N\text{-total}_{crop\ residues} = N\text{-above ground}_{crop\ residue} + N\text{-below ground}_{crop\ residue}$

Based on:
- national data for harvest yield and dry matter content
- IPCC conversion factor (1% of total N lost as N_2O)

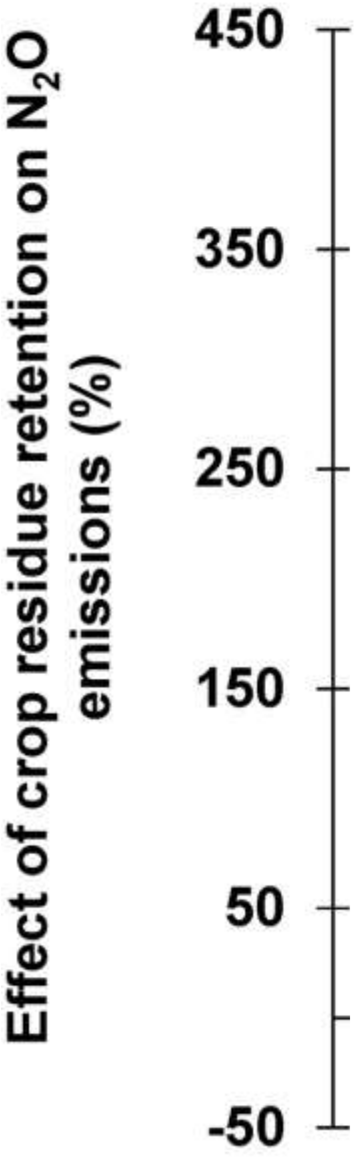
Mette Hjorth Mikkelsen





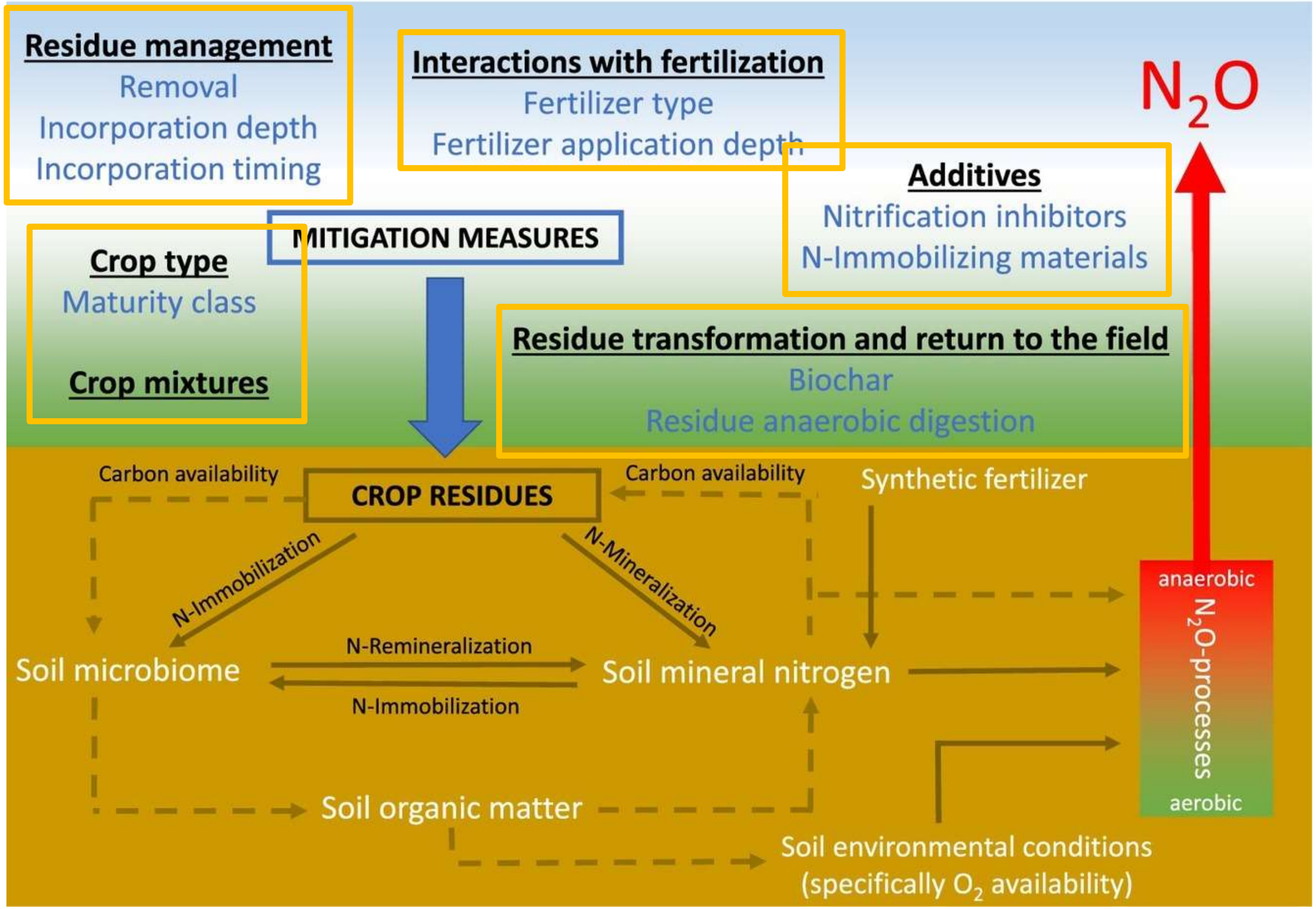
Olesen et al. (2023) GCB

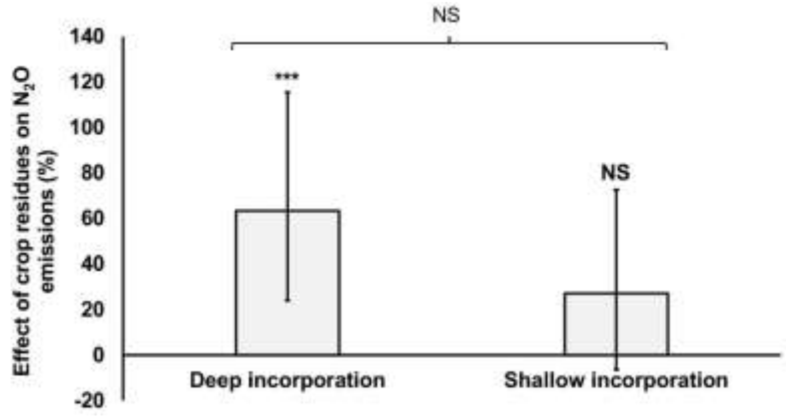
Abalos et al. (2023a) STOTEN

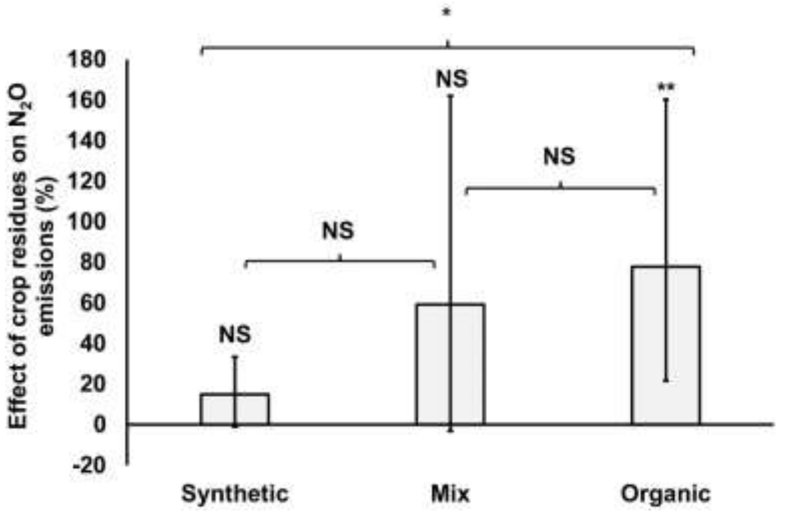


Predicting field N_2O emissions from crop residues based on their biochemical composition: A meta-analytical approach

Diego Abalos [a,*,1], Tatiana F. Rittl [b,1], Sylvie Recous [c], Pascal Thiébeau [c], Cairistiona F.E. Topp [d], Kees Jan van Groenigen [e], Klaus Butterbach-Bahl [f], Rachel E. Thorman [g], Kate E. Smith [g], Ishita Ahuja [b,h], Jørgen E. Olesen [a], Marina A. Bleken [i], Robert M. Rees [d], Sissel Hansen [b]



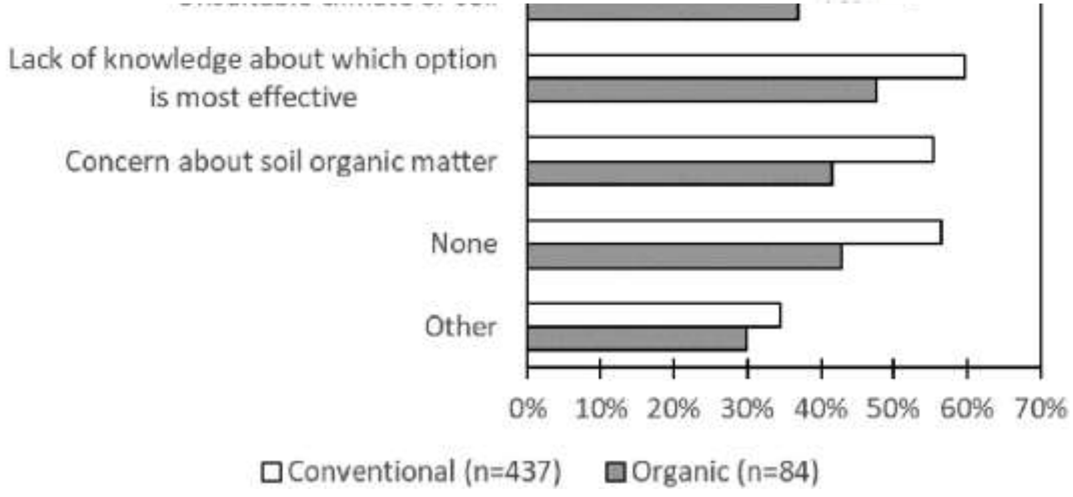




Abalos et al. (2023b) STOTEN

Barriers to the adoption of alternative strategies of residues management, for conventional and organic farmers.

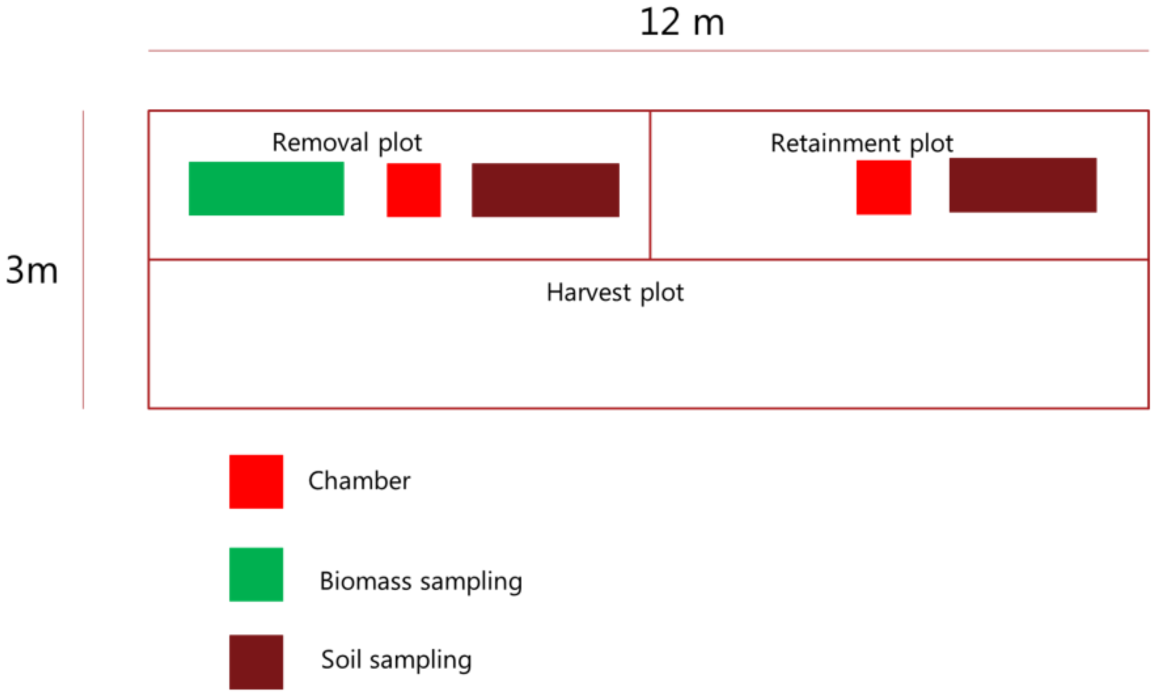
	Method	Type of residue	Yes	No	Already	Maybe
Conventional	Removal	Straw (n = 352)	45%	33%	18%	3%
		Vegetable (n = 98)	15%	69%	7%	8%
		Cover crop (n = 282)	19%	68%	7%	5%
	Even surface spreading	Straw (n = 360)	44%	10%	41%	5%
		Vegetable (n = 104)	51%	16%	26%	7%
		Cover crop (n = 328)	45%	5%	47%	3%
	Direct seeding	Grassland renewal (n = 229)	38%	47%	6%	10%
	Deep incorporation	Straw (n = 320)	47%	23%	25%	5%
		Vegetable (n = 101)	43%	30%	15%	13%
		Cover crop (n = 308)	51%	17%	27%	5%
		Grassland termination (n = 256)	56%	13%	27%	5%
	Nitrification inhibitors (n = 301)		39%	39%	3%	20%



De Notaris et al. (2023) STOTEN

BUP PROJECT – N2ORESIDUE (JØRGEN E. OLESEN: AU, KU, SEGES, ICØL)

Field trial (Foulum & Taastrup)



Measure N_2O from plots with retained vs. removed residues to estimate contribution from the (shoot) residues

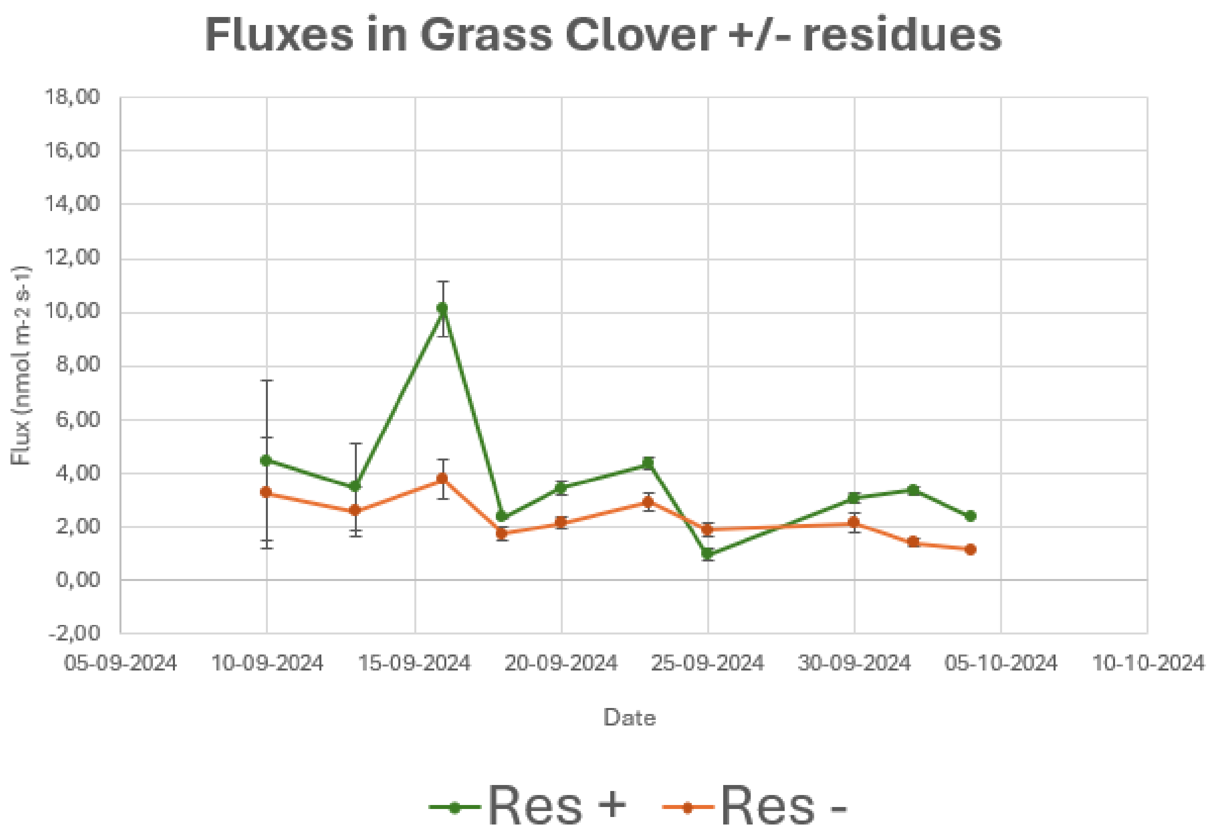
Done with different crop types at different incorporation times

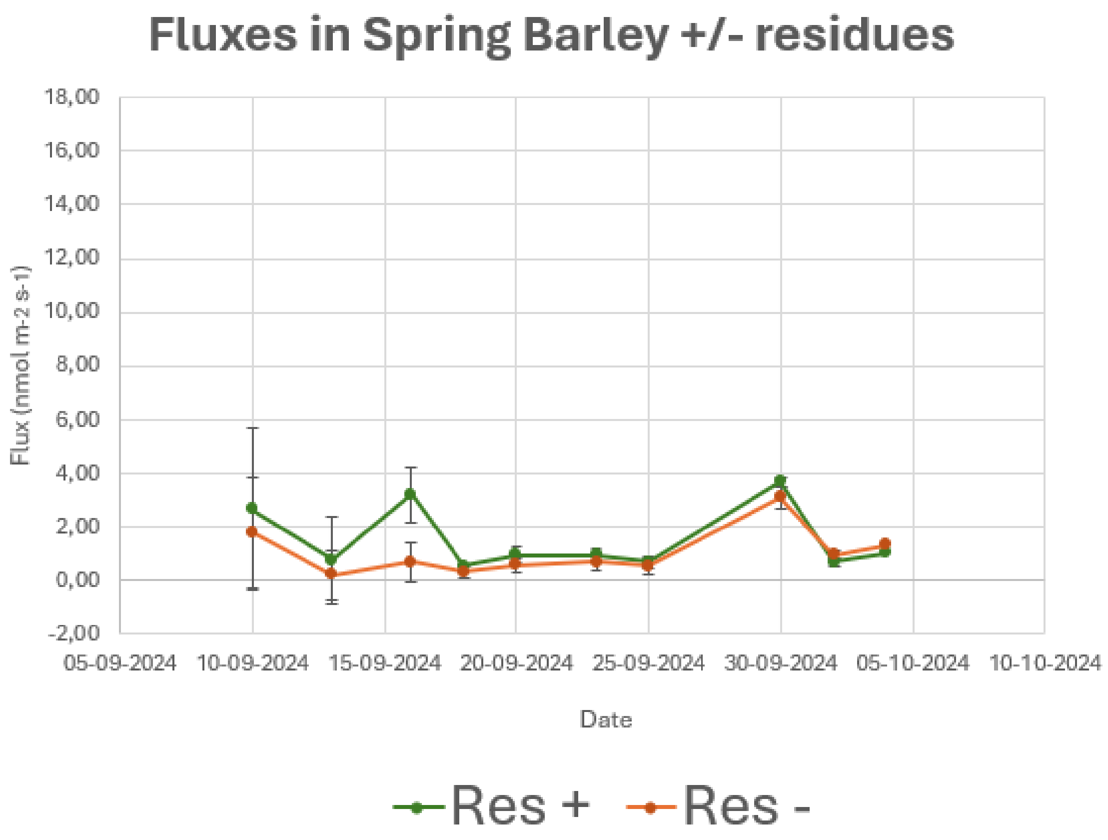
Autumn: ploughing start September (followed by winter wheat) 24 plots
T1. Spring Barley (Prospect)
T2. Faba Beans
T3. Grass-clover (50% ryegrass + 50% tetraploid redclover)

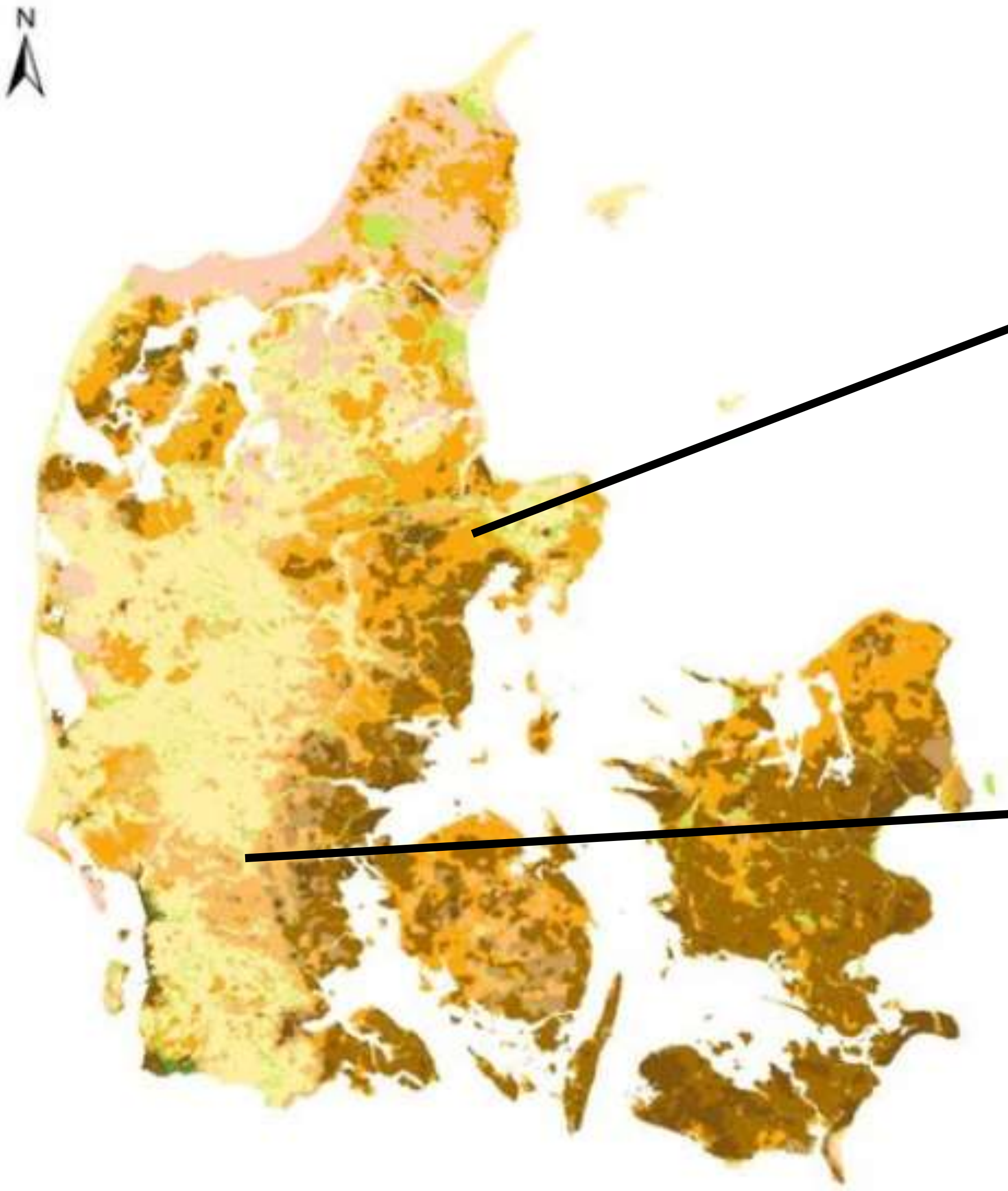
Winter: ploughing start December (followed by spring cereal) 48 plots
T4.Spring Barley
T5. Faba Beans
T6. Grass-clover
T7. Cauliflower (Zaragoza) w CC (DLF Max 25)
T8. Spring Barley w CC (DLF Max 25, mixture of hairy vetch, oilseed radish and phacelia)
T9. Spring Barley w CC (oilseed radish)

Spring: ploughing start April (followed by spring cereal) 48 plots
T10.Spring Barley
T11.Faba Beans
T12.Grass-clover
T13. Cauliflower w CC (DLF Max 25)
T14. Spring Barley w CC (DLF Max 25)
T15 Spring Barley w CC (oilseed radish)
Always N2O sampling 3 months after incorporation.

Preliminary results







Auning – Vegetables
Cauliflower
Carrot
Lettuce
Spring Barley

Askov – Long term effects (1981)
Spring barley
Straw retention: 0, 4, 8, 12 t ha^{-1}

Current inventory methodology considers N inputs by crop residues as the sole determining factor for N_2O emissions → it fails to consider other underlying factors and processes.

Compelling evidence indicates that emissions vary greatly between residues with different biochemical and physical characteristics (mineralizable N and decomposable C in the residue biomass both enhancing the soil N_2O production potential)

High concentrations of these components are associated with immature residues (e.g., cover crops, grass, legumes, and vegetables) as opposed to mature residues (e.g., straw).

A more accurate estimation of the short-term (months) effects of the crop residues on N_2O could involve distinguishing mature and immature crop residues with different emission factors.

The medium-term (years) and long-term (decades) effects relate to the effects of residue management on soil N fertility and soil physical and chemical properties → these are affected by local climatic and soil conditions as well as land use and management.

More targeted mitigation efforts for N_2O emissions are needed. This work requires to:
(1) validate N_2O emission factors for mature and immature crop residues, (2) assess emissions from belowground residues of terminated crops, (3) improve activity data on management of different residue types, and (4) evaluate long-term effects of residue addition on N_2O emissions.

AARHUS
UNIVERSITY