Towards joined-up nitrogen guidance for air, water and climate co-benefits.

Theme 3: Field application of organic and inorganic fertilizers

Tom Misselbrook, Shabtai Bittman, Claudia Cordovil, Bob Rees, Roger Sylvester-Bradley, Jørgen Olesen, Antonio Vallejo

N amendments to land

- **Mineral N fertilizers**
  - Ammonium, nitrate and urea
  - Straights, compounds, blends [anhydrous ammonia]
  - Urea (incl. UAN) accounted for 17% of N applied in EU28 in 2014
- **Livestock manure**
  - Predominantly cattle, pig and poultry
  - Slurry, FYM, solid manure, litter
  - Total N content, mineral N, C:N ratio
- **Other organic amendments**
  - Sewage sludge, green waste composts, food and industry by-products

N amendments to land

- **Crop residues**
  - Above- and below-ground
  - Cover crops
  - N content; C:N ratio
- **Grazing returns**
  - Cattle, sheep [outdoor pig and poultry]
  - Urine, dung; spatial distribution
- **Biological N fixation**
  - Legume protein crops; clover in grasslands
  - Future increases?

Have we missed anything?

How robust are our estimates?

How robust are our N loss estimates?

Global default 'emission factors'

↓

Regional-specific 'emission factors'

↓

Simple empirical models

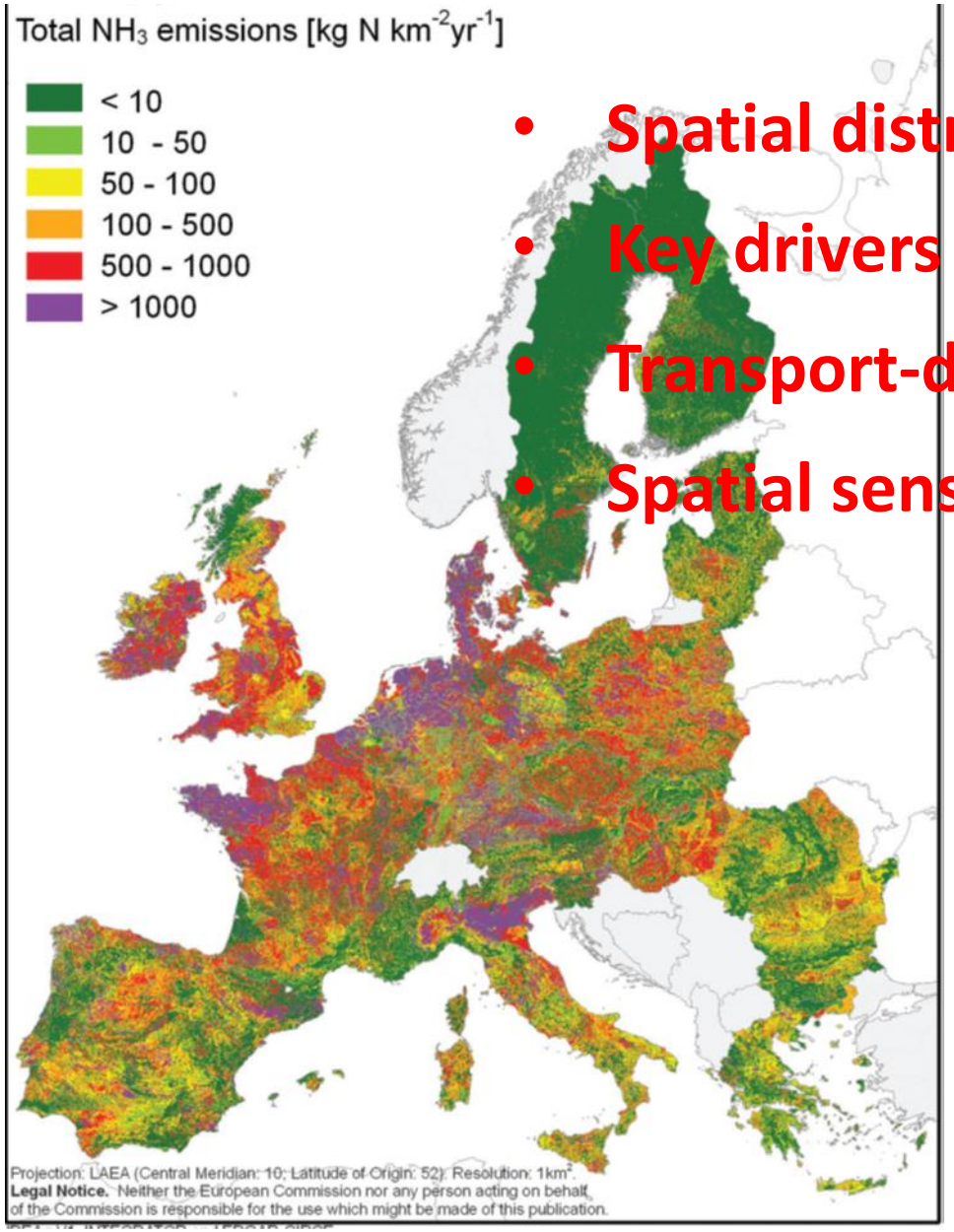
↓

Highly mechanistic models

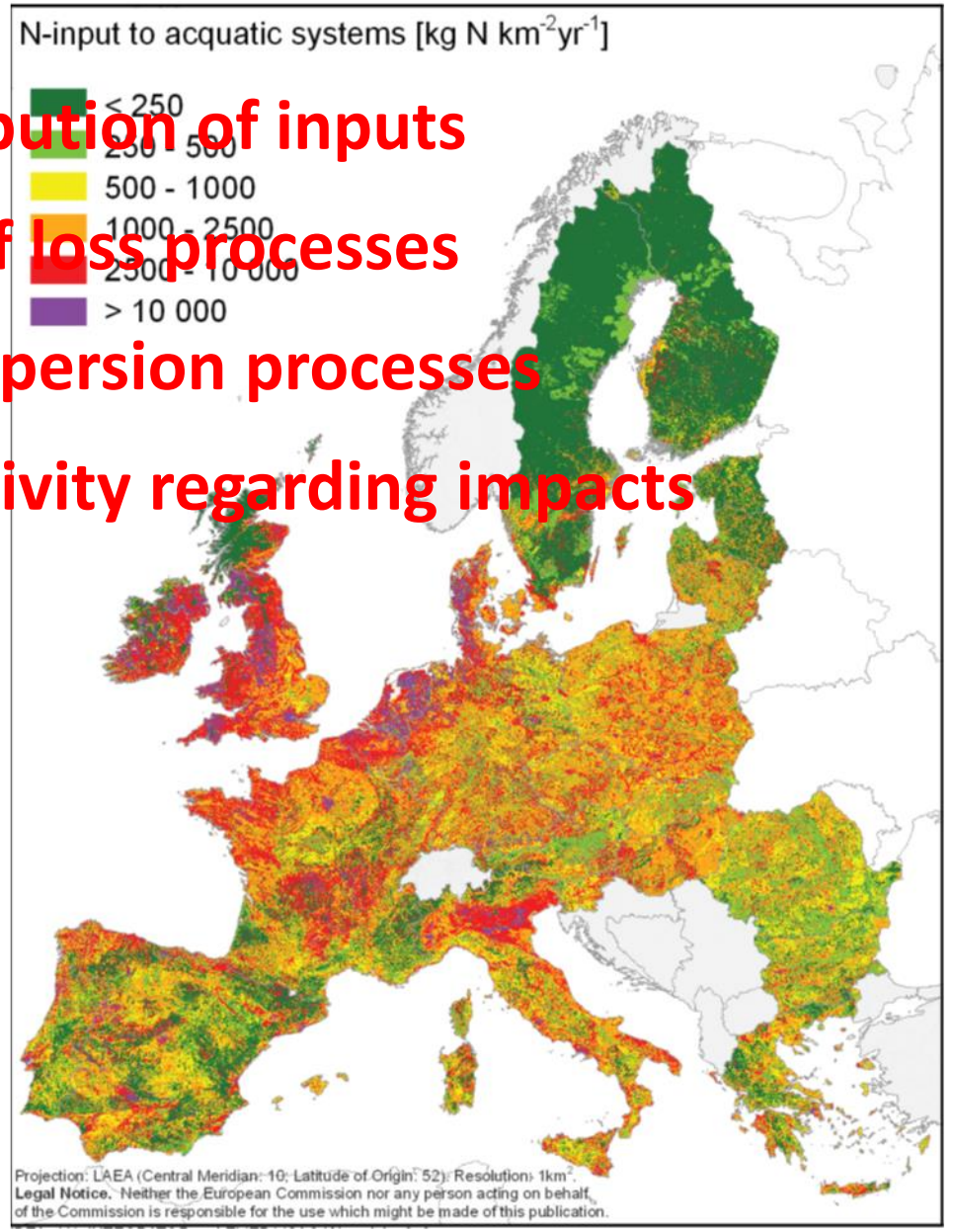
- Underlying science and understanding
- Parameterisation and activity data
- Verification, validation
- Extrapolation

Where are the greatest uncertainties?

Spatial importance of N inputs, losses and impacts



- Spatial distribution of inputs
- Key drivers of loss processes
- Transport-dispersion processes
- Spatial sensitivity regarding impacts



Leip et al., 2011

Existing guidance

TFRN Ammonia Abatement Guidance Document

HELCOM Baltic Sea Action Plan

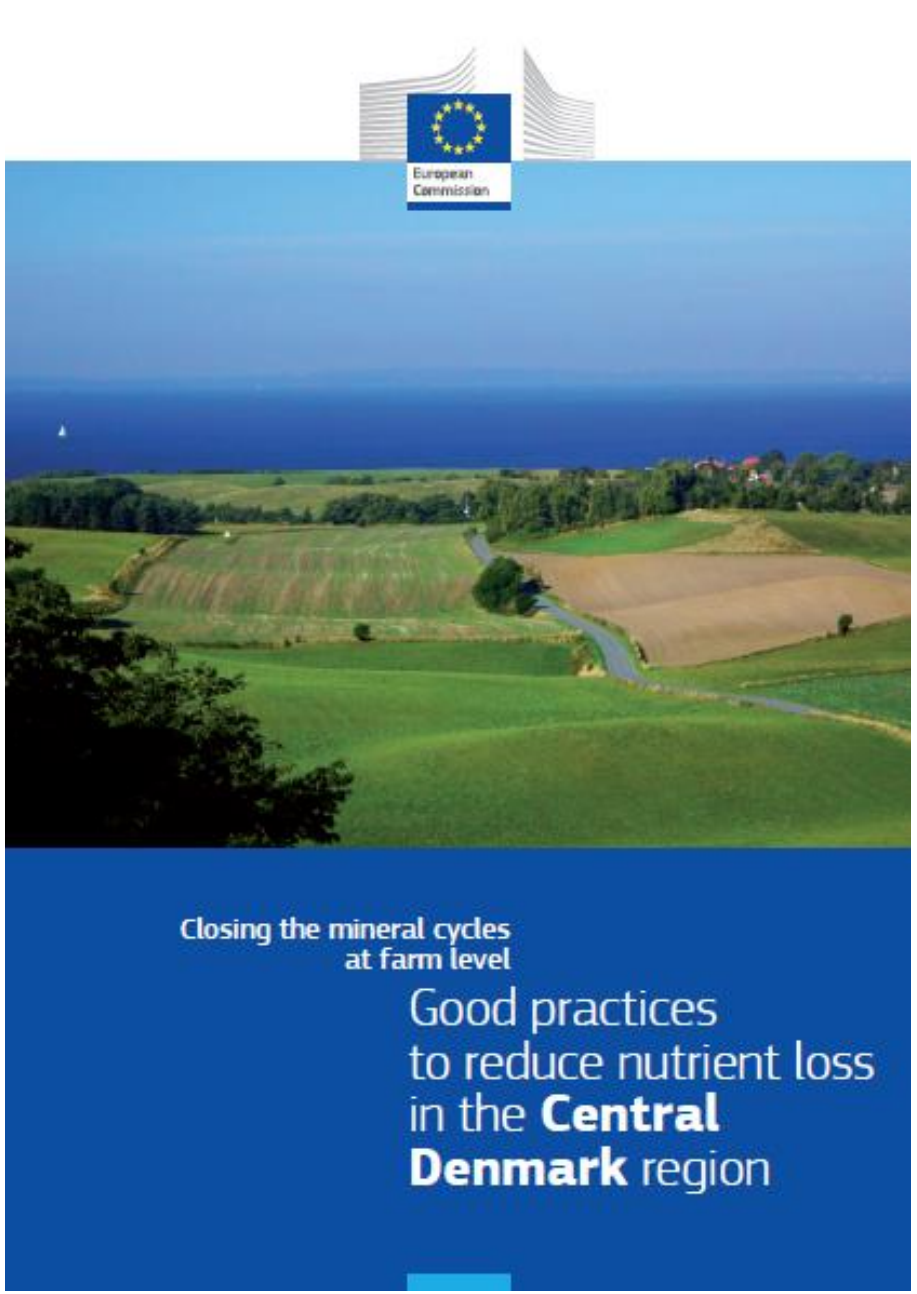
EC Project report – Closing Mineral Loops

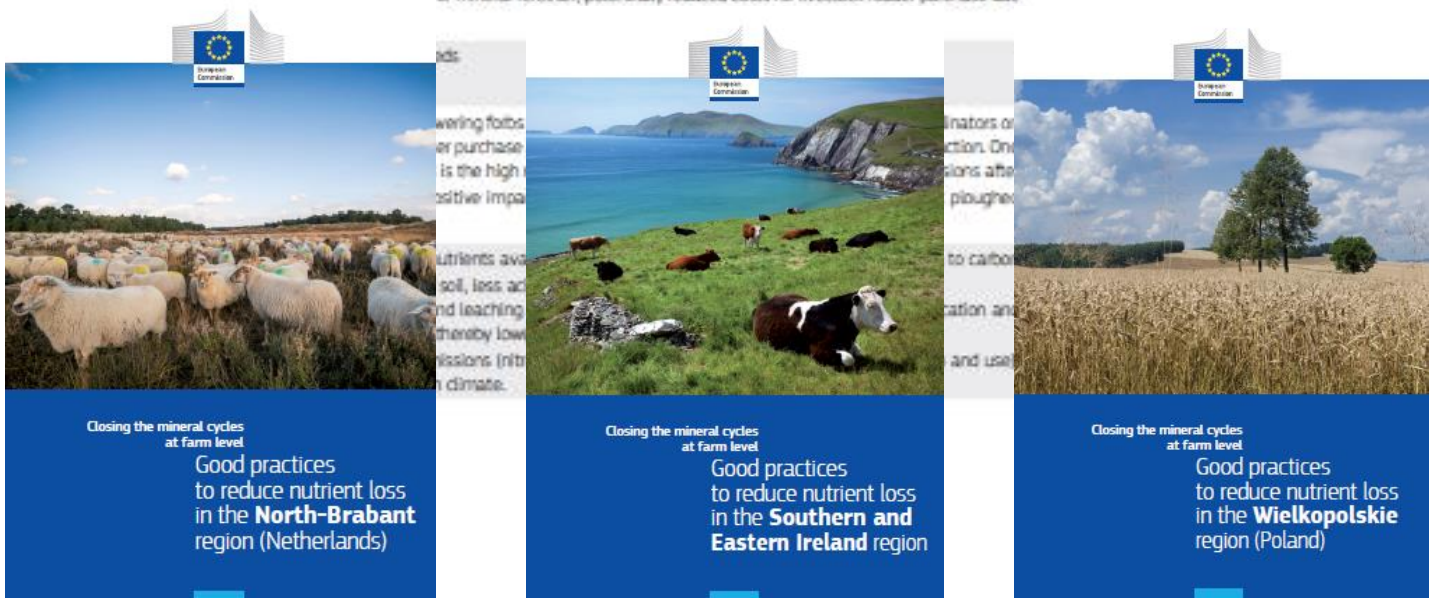
EC Report – Mainstreaming climate change into RDP

National fertilizer guidance document

National codes of good agricultural practice

Regional guidance – closing the mineral cycles at farm level





Management/mitigation practices

Practice	Leaching/runoff	Ammonia volatilization	Nitrous oxide	Notes
Livestock manures				
Integrated N management plan	↓	↓	↓	
Apply slurries by band spreading/trailing shoe	~↑	↓	~↑	
Apply slurries by injection	~↑	↓	~↑	Shallow injection can create runoff channels
Slurry dilution for fertigation	~↑	↓	~↑	
Slurry acidification	~↑	↓	~↑	
Use nitrification inhibitors	↓	~↑	↓	
Rapid incorporation of manures after application	~↑	↓	~↑	
Anaerobic digestion	~↑	~↑	~↑	Depends on management of facility and subsequent digestate

Guidance Document structure

- Types/quantities of material being applied to land and potential N loss pathways
- Regional/spatial considerations – in terms of practices and soil-climatic influences
- Guidance on measures/practices:
  - grouped according to N input category;
  - N loss pathways; yield effect; other pollutants; key influencing drivers; costs; scope for implementation; barriers; confidence in current knowledge; ease of monitoring/verification