

For our Environment

Umwelt 
Bundesamt

International Nitrogen Initiative 2016 conference (INI2016).

Quantification of the German nitrogen cycle

Markus Geupel

Section II 4.3

Air Quality and Terrestrial Ecosystems

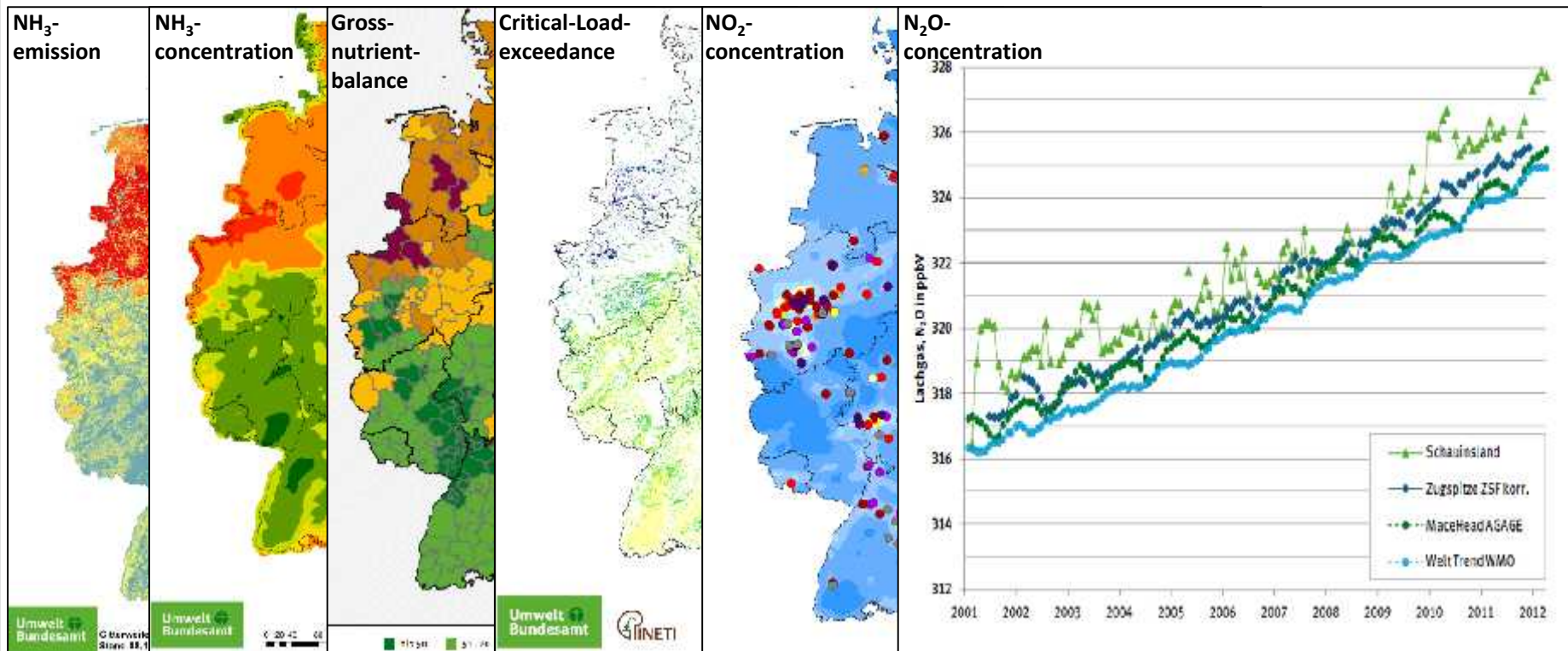
Quantification of the German nitrogen cycle

Background - environmental targets to be reached:

- National emission ceilings (ammonia, nitrogen oxide)
- Critical loads for eutrophication
- Gross nutrient balance in agriculture as a national goal/indicator
- Nitrogen input to Baltic Sea and into the North Sea
- Quality standards for nitrate in groundwater bodies
- Nitrogen dioxide (NO₂) concentration limits

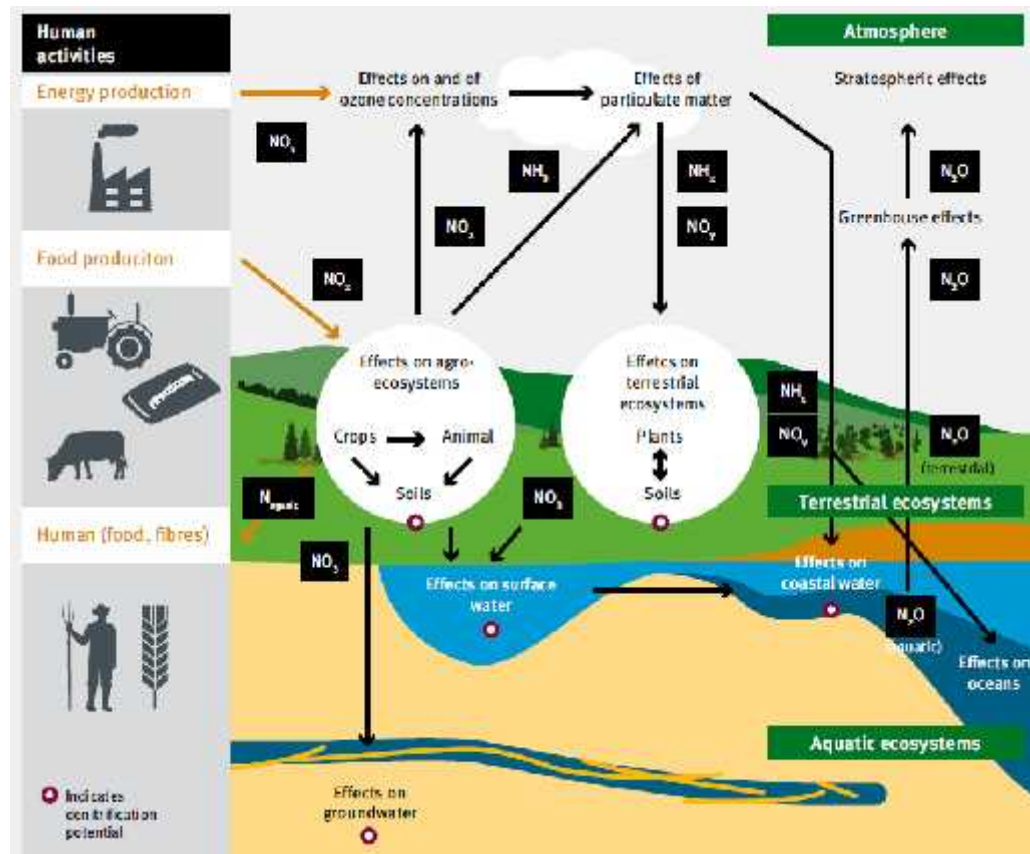
Quantification of the German nitrogen cycle

Background - environmental targets to be reached:



Quantification of the German nitrogen cycle

Objective: Quantification of the nitrogen cycle



after Galloway et al., 2003

Objective: Quantification of the nitrogen cycle

- Policy support
 - Where are the main flows?
 - Who are the main polluters?
 - Where are the most promising intervention points?
- Part of our agency's recommendations to go for an integrated approach.
- First quantification in 2009 (data from 2000-2004)
- Second quantification in 2015 (data from 2005-2010)
- Application of a national method
- No application of Guidelines of the Expert Panel Nitrogen Budgets (EPNB)
- Exchange of experiences with EPNB

Methods and system boundaries

- Review work – basically no own calculations

- **Pools, entities that store, release or receive nitrogen**

Industry and Energy	Transport	Agriculture	Natural and semi-natural ecosystems
Waste and wastewater	Atmosphere	Hydrosphere	Urban system

- Focus on **fluxes** between pools
- Pooled nitrogen has not been quantified
- Values $> 1 \text{ Gg N yr}^{-1}$ rounded to values of 5 Gg N yr^{-1}
- Relevant period 2005 – 2010, if available average values for 2008 - 2010

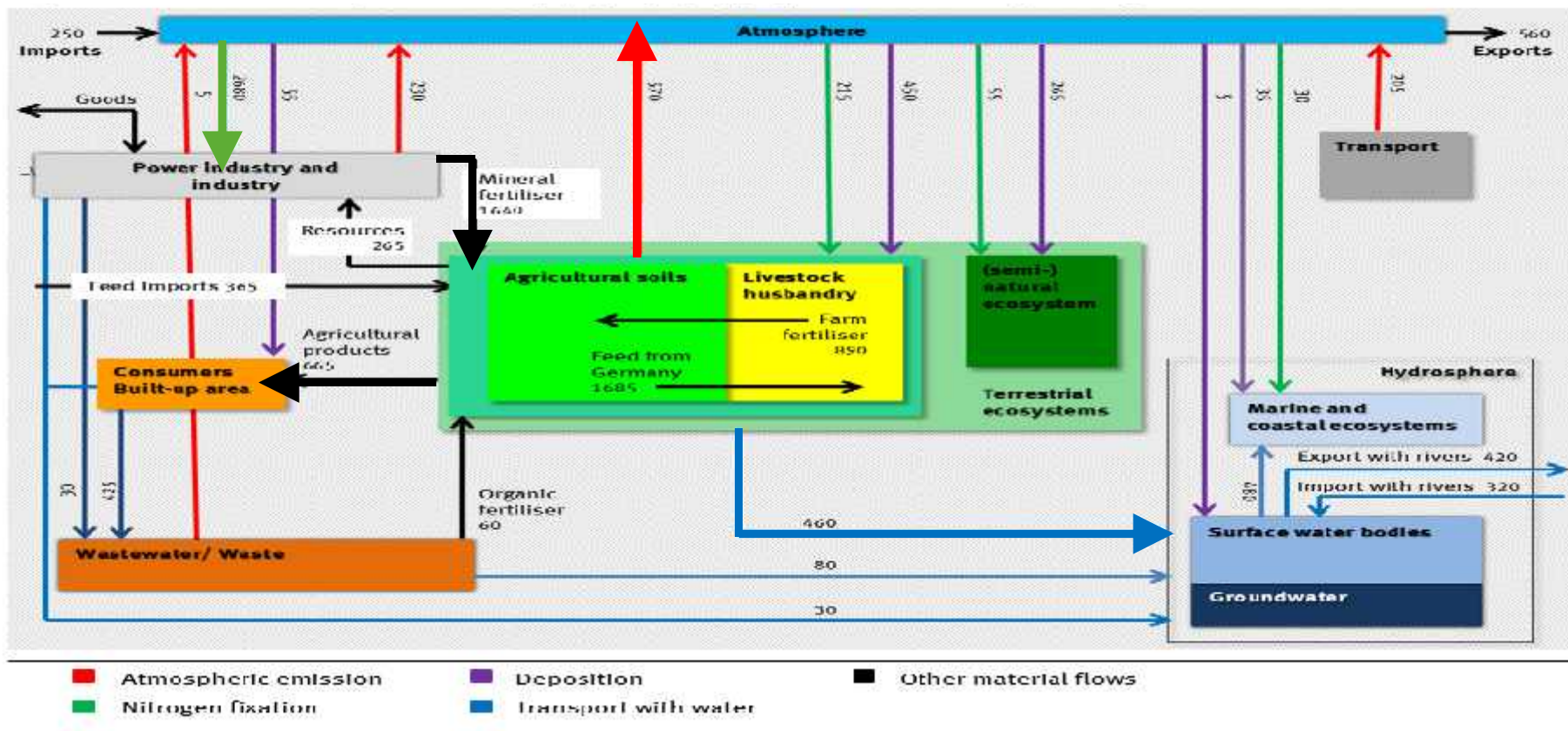
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Data collection

Type of flow in N-cycle	N-amount (Gg yr ⁻¹)	Ref. period	Source of data	Type of flow in N-cycle	N-amount (Gg yr ⁻¹)	Ref. period	Source of data
Industry and Energy <ul style="list-style-type: none"> ➤ Industrial statistics ➤ Emission inventories (CLRTAP, IPCC) 				Natural and semi-natural ecosystems <ul style="list-style-type: none"> ➤ Research data 			
Transport <ul style="list-style-type: none"> ➤ Emission inventories (CLRTAP, IPCC) 				Wastewater <ul style="list-style-type: none"> ➤ Research data, Wastewater statistics 			
Agriculture <ul style="list-style-type: none"> ➤ Agricultural statistics ➤ Emission inventories (CLRTAP, IPCC) 				Atmosphere <ul style="list-style-type: none"> ➤ EMEP-data ➤ National deposition data 			
				Hydrosphere <ul style="list-style-type: none"> ➤ Research data 			

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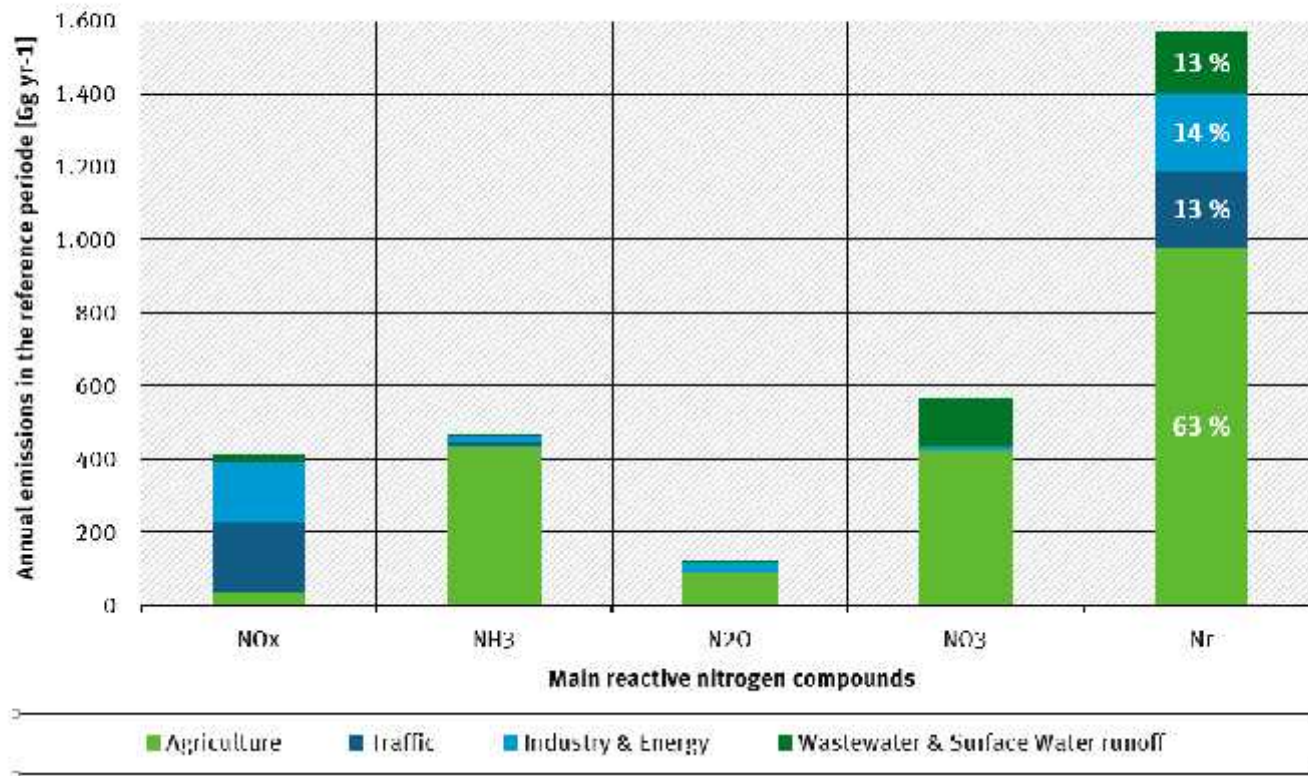
Nitrogen cycle - Key flows of reactive nitrogen



Quantification of the German nitrogen cycle

Reactive Nitrogen Emissions

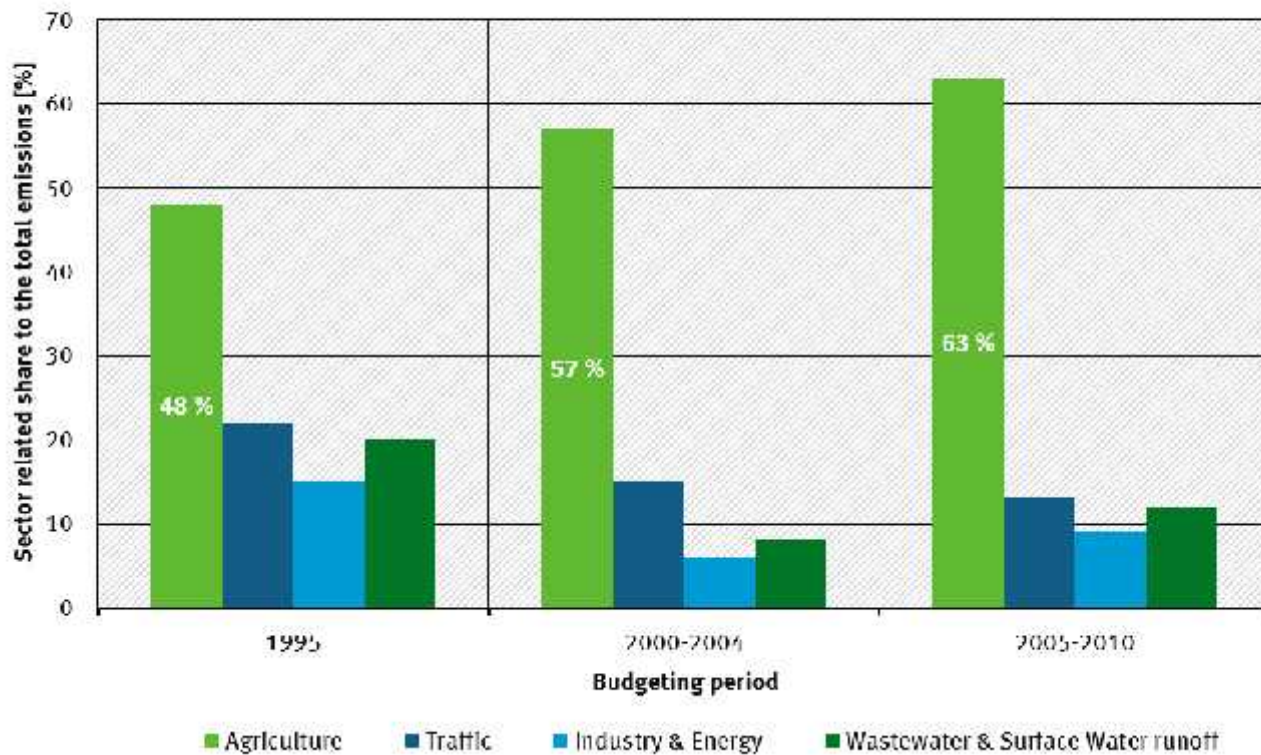
Average annual emissions of the main N-compounds by different sectors



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Contribution to the nitrogen problem in Germany

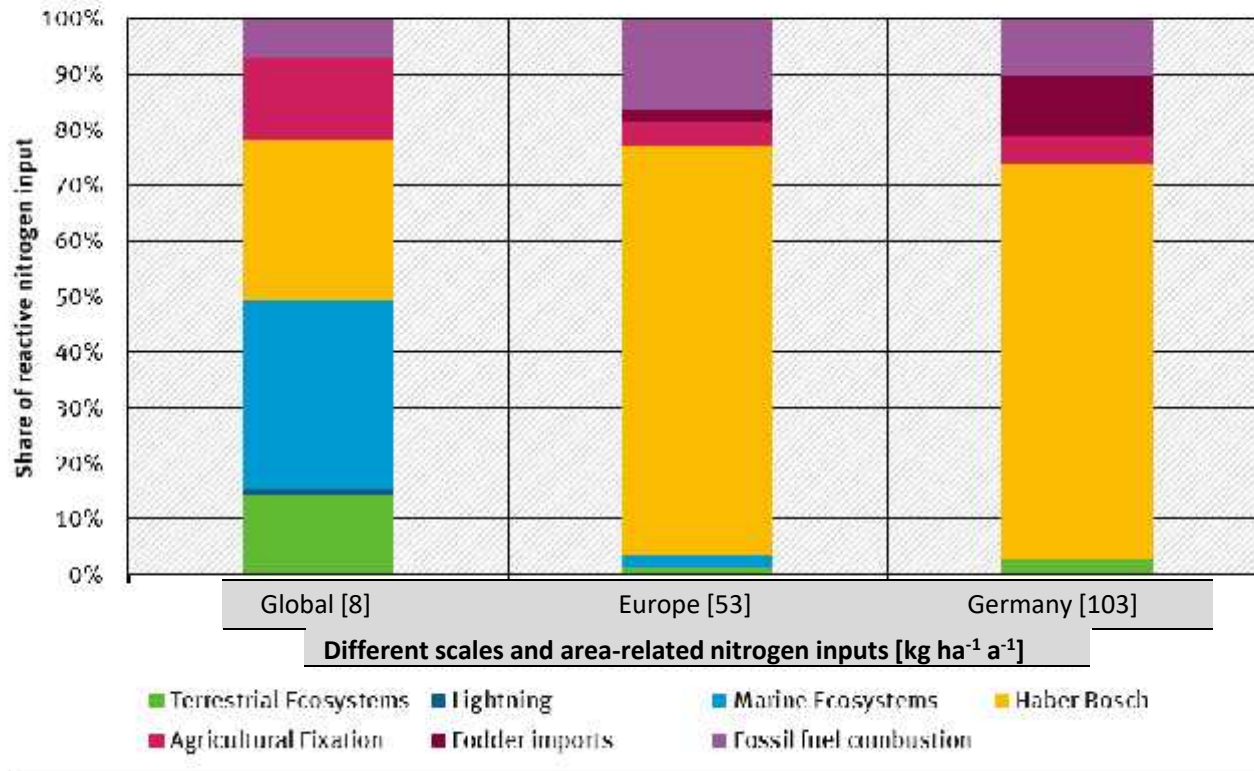
Sector related share to the total emissions over three budgeting periods



Quantification of the German nitrogen cycle

Reactive nitrogen inputs

Share of reactive nitrogen input at different scales by different natural and human activities



Total input including riverine and atmospheric imports:

4200 Gg a⁻¹

≈

50 kg person⁻¹ a⁻¹

Discussion

- Budget / balance is not closed yet
- Denitrification or retention in the aquatic and soil ecosystems had not been taken into account, yet
- This assumption is backed by the fact, that the nitrogen surplus per area amounts to a larger number than what is recorded as emission to atmosphere or the aquatic environment
- Nitrogen in industrial products had not been taken into account yet
- International exchange with products incomplete
- However very valuable information to further develop nitrogen related policies

Conclusions

- N_r induced environmental effects go along with an intensified nitrogen cycle.
- N_r is emitted to the environment in similar shares as NH_3 , NO_x and NO_3 .
- 1/3 is released to the hydrosphere, 2/3 are released to the atmosphere.
- Agriculture is the dominant polluter with nearly 2/3 of the emissions.
- All the other sectors contribute equally to the problem.
- The results underpin significantly that an integrated approach is necessary.
- However: Picking the low hanging fruits and using existing reduction potential in agriculture has the largest potential.

umweltbundesamt.de/en/publikationen/reactive-nitrogen-in-germany

Thank you for your attention!

Markus.Geupel@uba.de

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