INMS Component 3
Demonstration and verification at regional/national/local levels

Mark Sutton, Cargele Masso
& the Demo Co-Leads

INMS-3
Edinburgh
16 April 2018

INMS Regions & Partners

- **Country clusters: Major N sources, N flows, opportunities, NUE, barriers, sharing successes in country clusters**

  South Asia: India, Sri Lanka, Bangladesh, Nepal, Maldives
  - *N. Raghuram, Tapan Adhya & INI South Asia*

  East Asia: China, Japan (South Korea, Phillipines)
  - *Xiaoyuang Yan & Kentaro Hyashi, & Xiaotang Ju INI East Asia*

  Lake Victoria Basin: Kenya, Uganda, Tanzania, Rwanda, Burundi
  - *Cargele Masso & INI Africa*

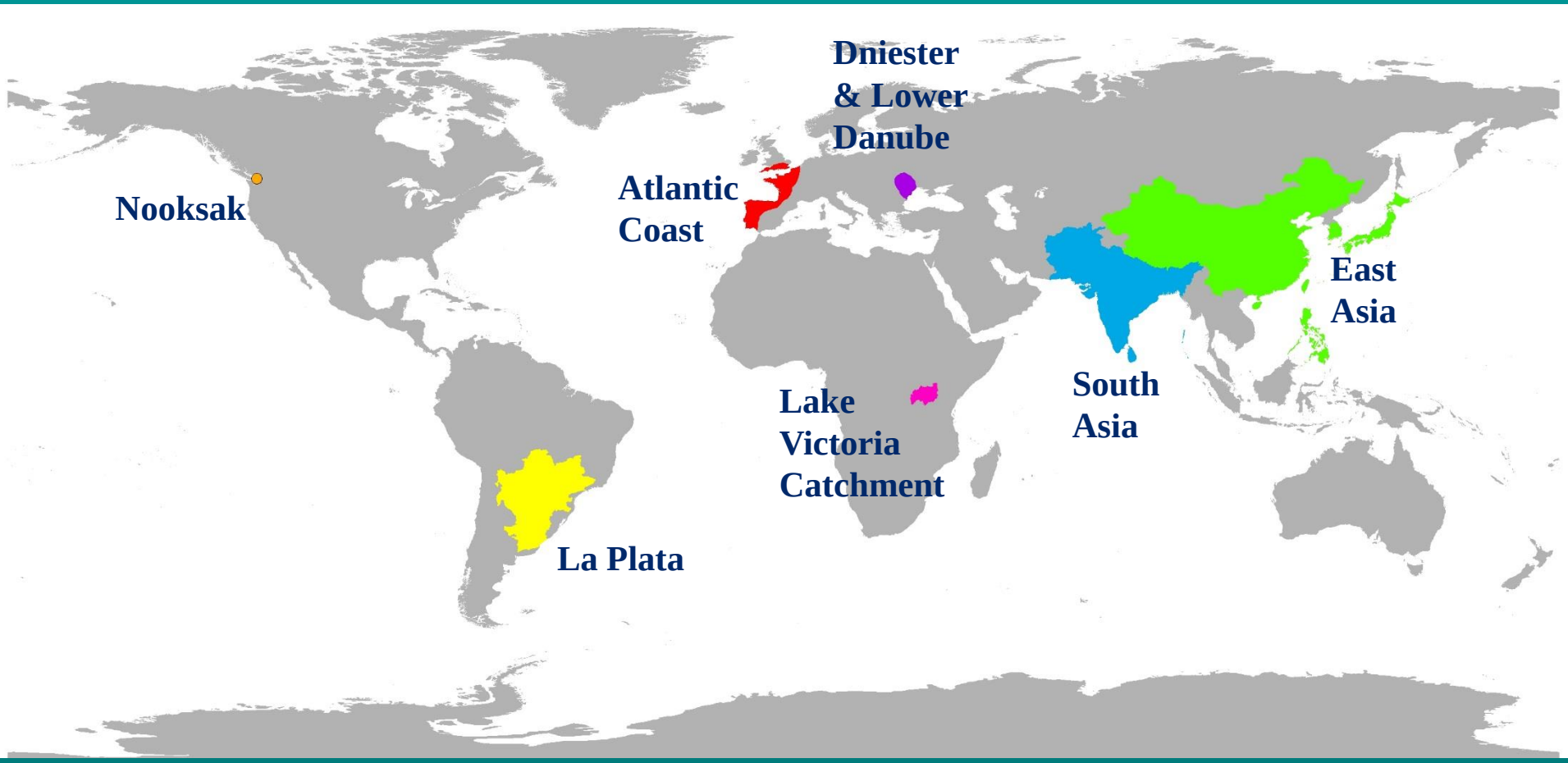
  Latin America (La Plata): Brazil, Paraguay, Uruguay, Argentina, Bolivia
  - *Jean Ometto & INI Latin America*

  Black Sea: Diester, Prut & Lower Danube
  - *Lidiya Molychuk & Serge Medinets, EPN-EECCA & INI Europe*

  North America: Nooksak and Lower Fraser Valley, USA, Canada
  - *Jana Compton, Shabtai Bitman, Jill Baron*

  West Europe: Atlantic Coastal catchments (FR, ES, PT, UK, IE, BE, DE)
  - *Josette Garnier, Gilles Billen, Alberto Sanz and others.*

INMS Component 3
Regional Demonstrations



INMS
Regional Demonstrations

Towards the INMS
International Nitrogen Management System
www.inms.international

Activity 3.1
Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.

Output 3.1
Four demonstration cases deliver conclusions refining approaches to regional assessments and improving understanding of regional N cycle :
Case 1: Developing areas with excess N_r.
(*South Asia, East Asia, Latin America)*
Case 2: Developing areas with insufficient N_r.
(*East Africa)*
Case 3: Regions with transition economies.
(*East Europe)*
Case 4: Developed areas with excess N_r.
(West Europe) [by regional co-finance]

Tasks	Task Outputs
Tasks 3.1.1 & 3.1.2 Examination of **N flows by sector & pathway**; inc improving access to data	Task Outputs 3.1.1 & 3.1.2 Main N flows quantified by source sector & pathway; better data access & understanding
Task 3.1.3 Identifying & quantifying **major uncertainties** and means to improve	Task Output 3.1.3 Quantification of major N source sectors with estimated uncertainties
Tasks 3.1.4 & 3.1.5 Agreeing key **threat/benefit priorities** with policy stakeholders, supported by CBA	Task Outputs 3.1.4 & 3.1.5 Key N benefits/threats quantified & regional priorities identified with policymakers & others
Task 3.1.6 Relation to **N performance indicators**, in co-operation with global analysis	Task Output 3.1.6 Basis to compare regions in relation to agreed performance indicators
Task 3.1.7 Review of available **options for mitigation**/ better N management, co-benefits/trade-offs	Task Output 3.1.7 Document on N mitign/mangnt options identifying win-wins & regional priority list of options
Task 3.1.8 Profiling **success stories, barriers to change**, & demonstration of N joined up approach	Task Output 3.1.8 Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers
Task 3.1.9 **Contribution to scenarios** development in cooperation with global analysis	Task Output 3.1.9 Global N scenarios informed by evidence from the regional demonstrations

Key Points for the INMS Demonstrations

- Consider the sequence of the demo stages
  - Which sources, which impacts, which measures, which barriers, which opportunities?
- Agree on the system boundaries
  - Which geographic scope?
  - Which time scales considered?
- Outputs expected
  - Demonstration Reports
  - Chapter in the International Nitrogen Assessment
  - Feed in to other INMS activities (e.g. indicators, scenarios, successes/barriers)

Towards the INMS
International Nitrogen Management System
www.inms.international

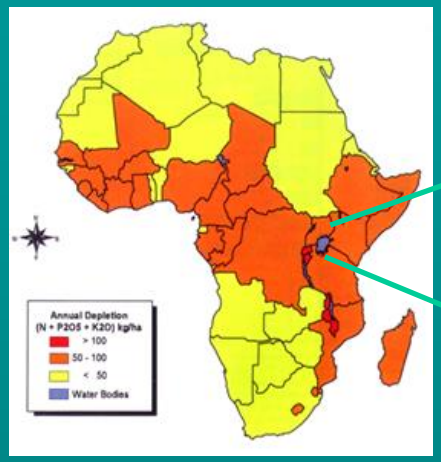
Challenges and Questions for East Africa Demonstration

- *"Challenges and opportunities for developing areas with **insufficient** reactive nitrogen"*
- *"Challenges and opportunities for developing areas with **excess** reactive nitrogen*
- Limited access to quality data to accurately quantify N flows, benefits, and threats

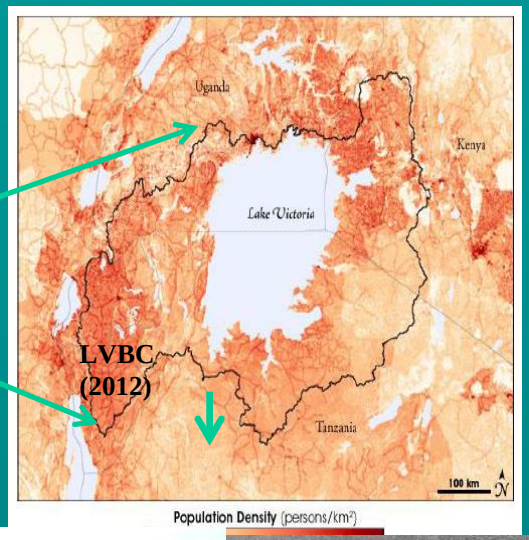
Key Questions

- Can nitrogen inputs be increased in the region without exacerbating nitrogen pollution threats?
- How do the different sources of N input fit together most effectively?

East Africa Demonstration Region



Henao & Banante



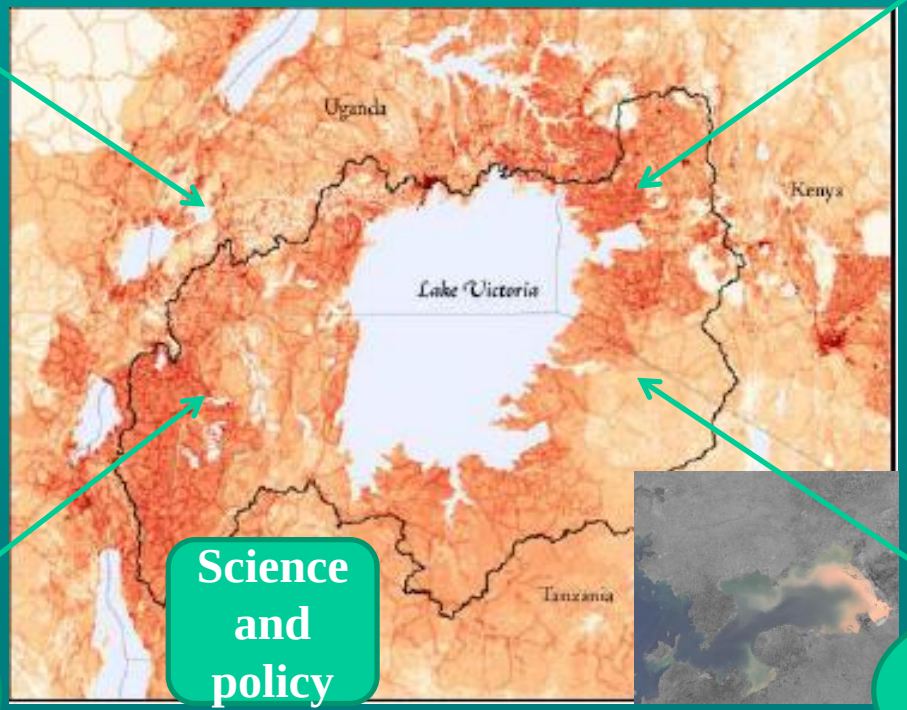
Butterbach-Bahl et al. (2014)

Countries, issues, partnerships

Action areas

Industrial and municipal Sewage

Farming systems



Science and policy

Atmospheric deposition

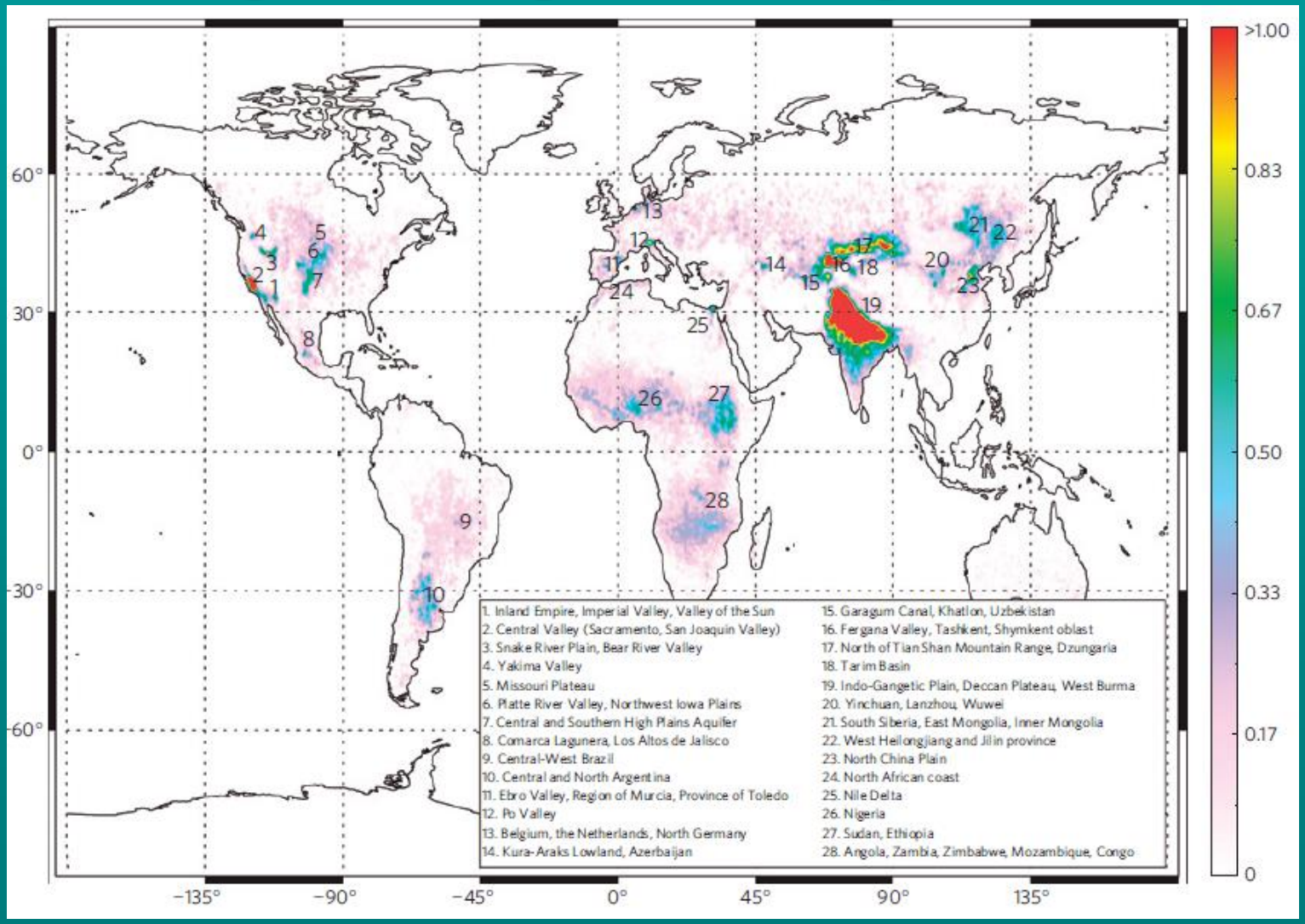
NRM

Big questions for South Asia

- Have key effects been missed – impacts on terrestrial biodiversity?
- Is there really no impact on eutrophication in the Bay of Bengal?
- How much does nitrogen pollution exacerbate loss of Coral Reefs?
- What policy lessons are offered by the comparison between countries?

Why South Asia?

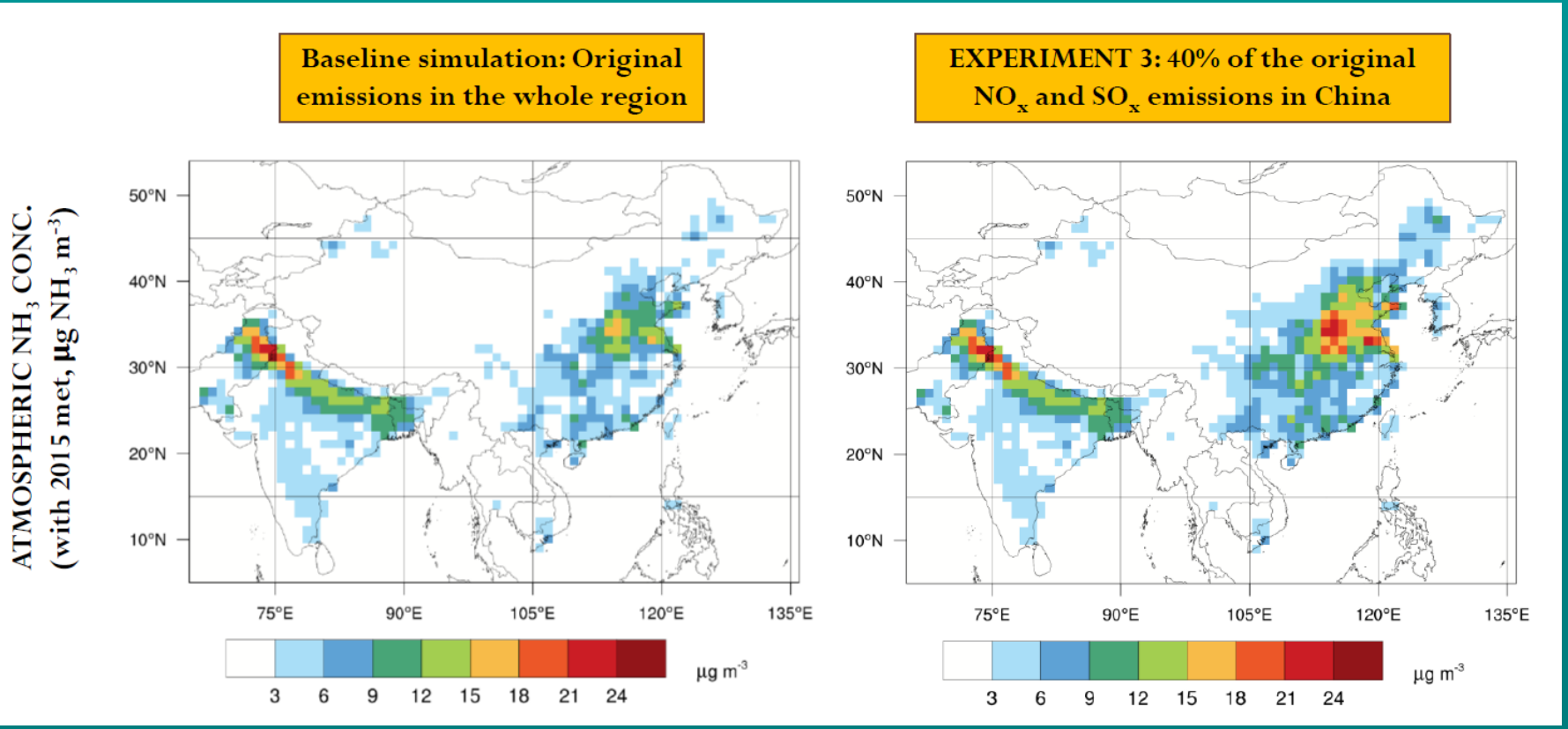
A global hotspot for nitrogen losses



Global ammonia column (mg m^{-2}) from IASI satellite

Clarisse et al., *Nature Geoscience*

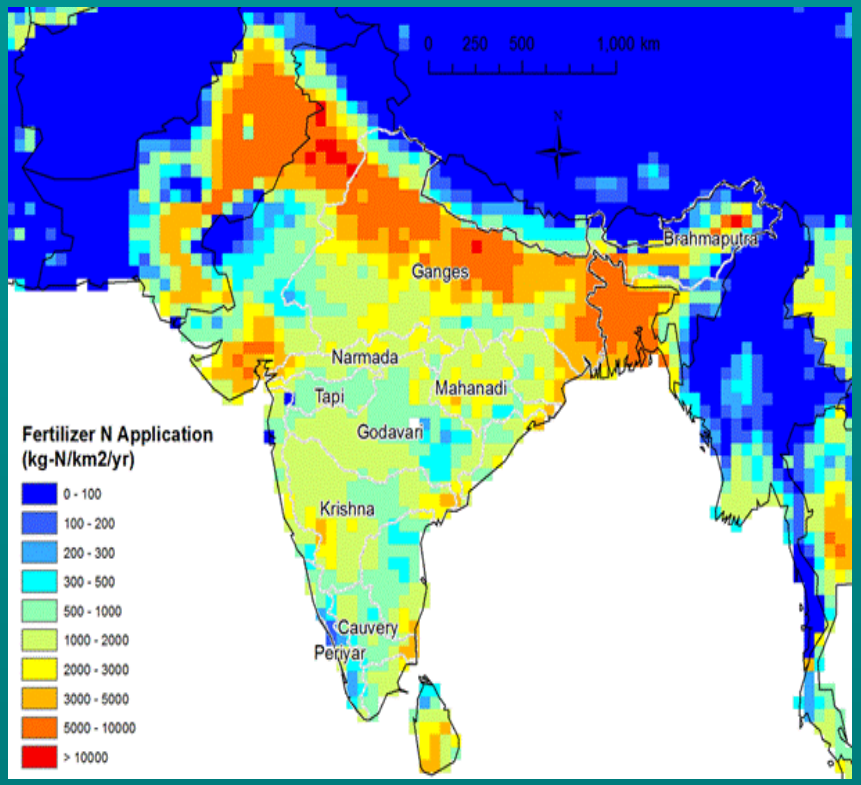
What is driving the atmospheric NH_3 differences between South and East Asia?



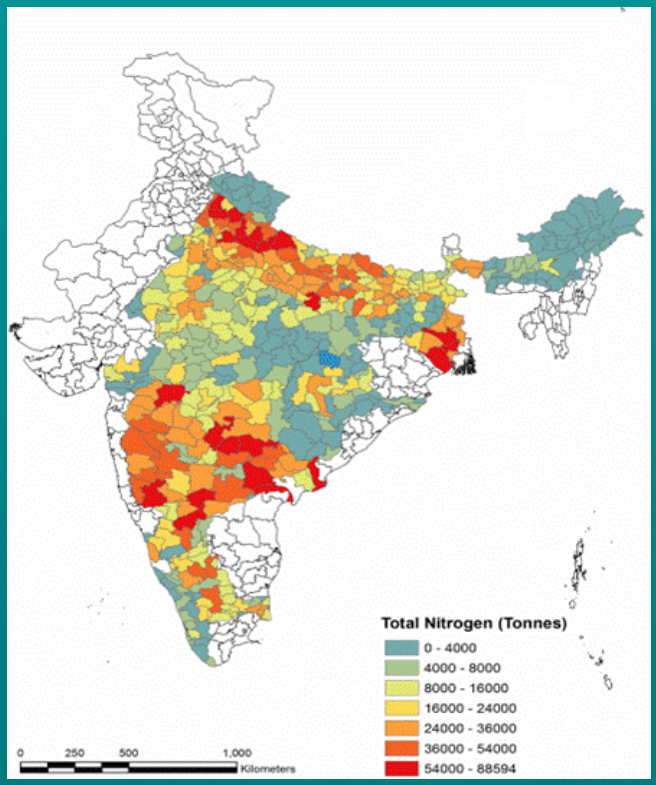
Andi Moring, Massimo Vieno et al.

Where is the fertilizer?

Modelled fertilizer application

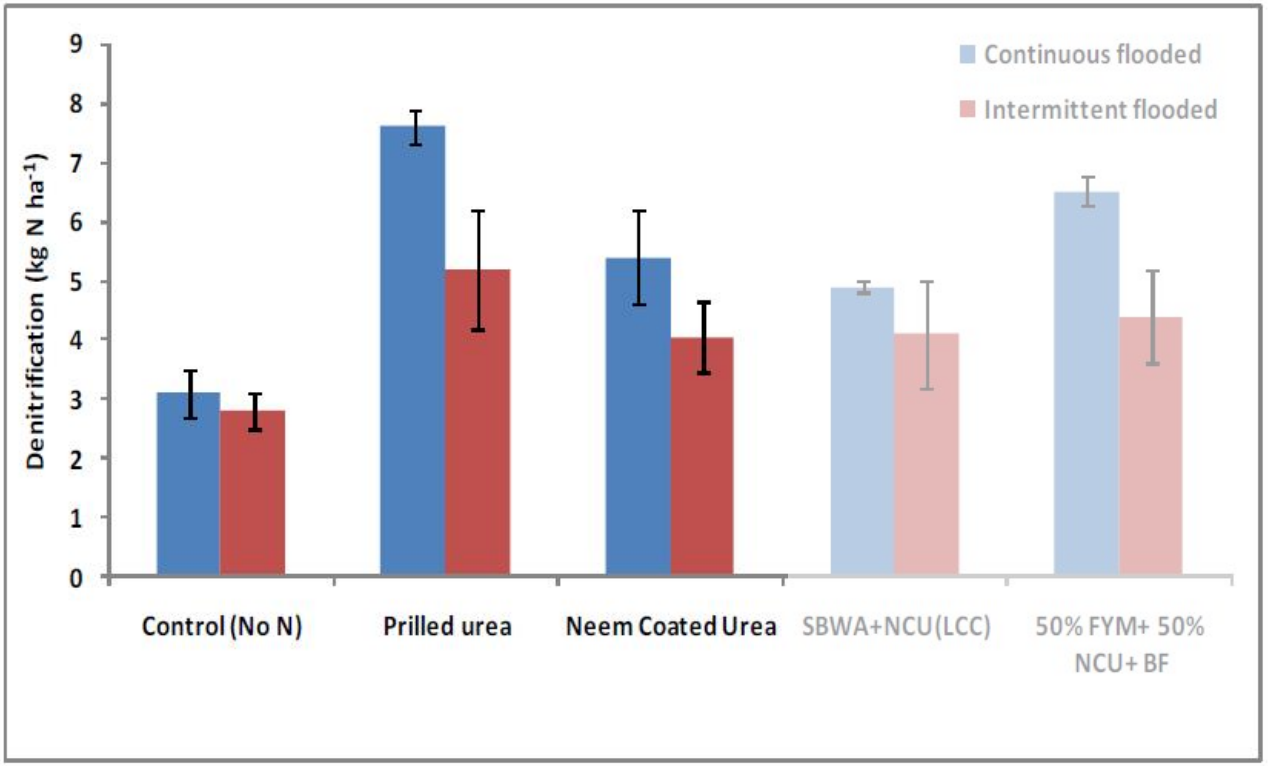


Statistics on fertilizer use



⇒Improved methods for spatial distribution are needed

Denitrification (as N_2O)

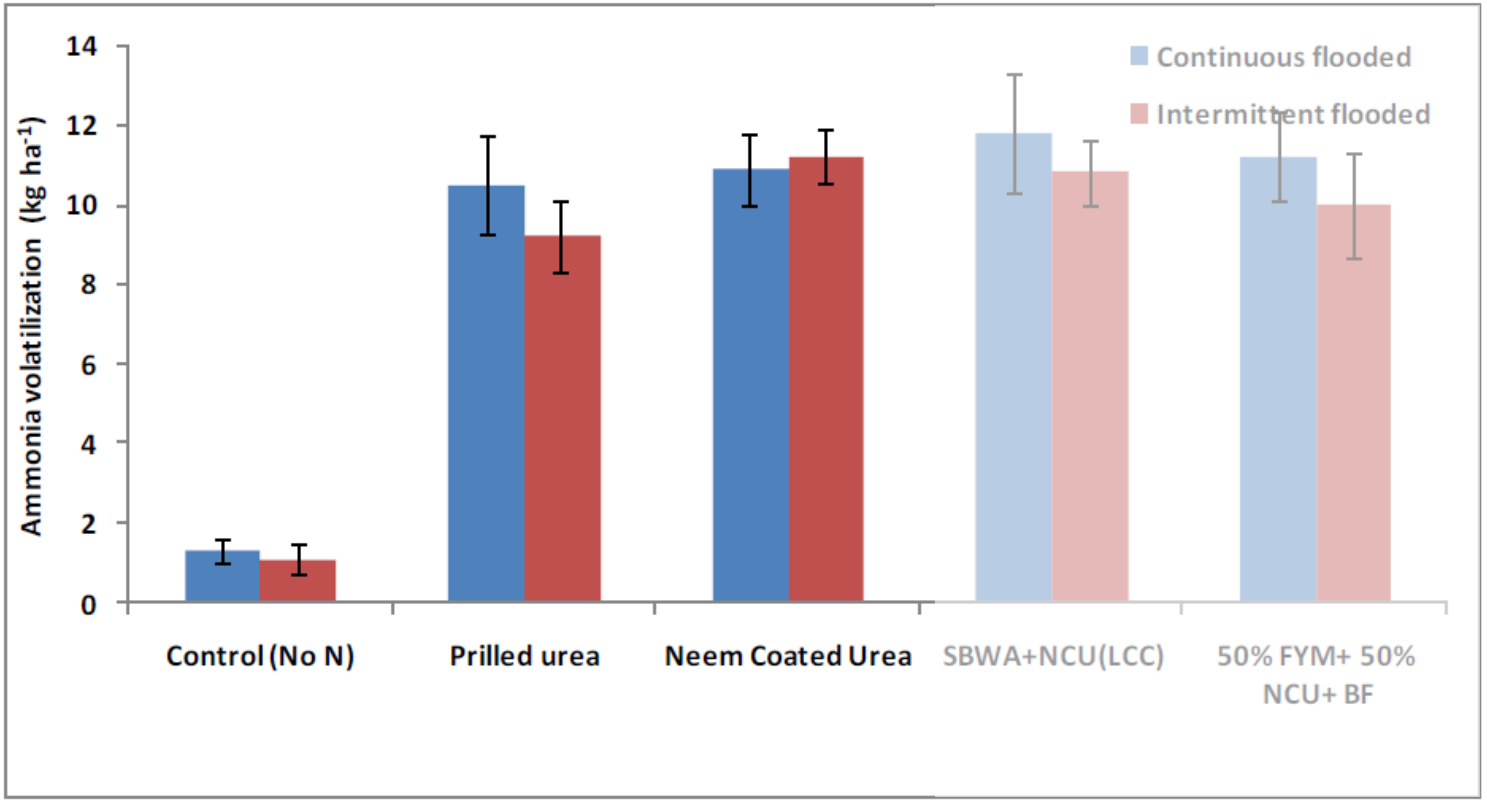


Denitrification was higher in continuous flooded rice as compared to the intermittent flooding

Arti Bhatia, Niveta Jain, Renu Singh et al.

SBWA + NCU = sensor based water application + neem coated urea; BF = biofertilizer

Ammonia volatilization



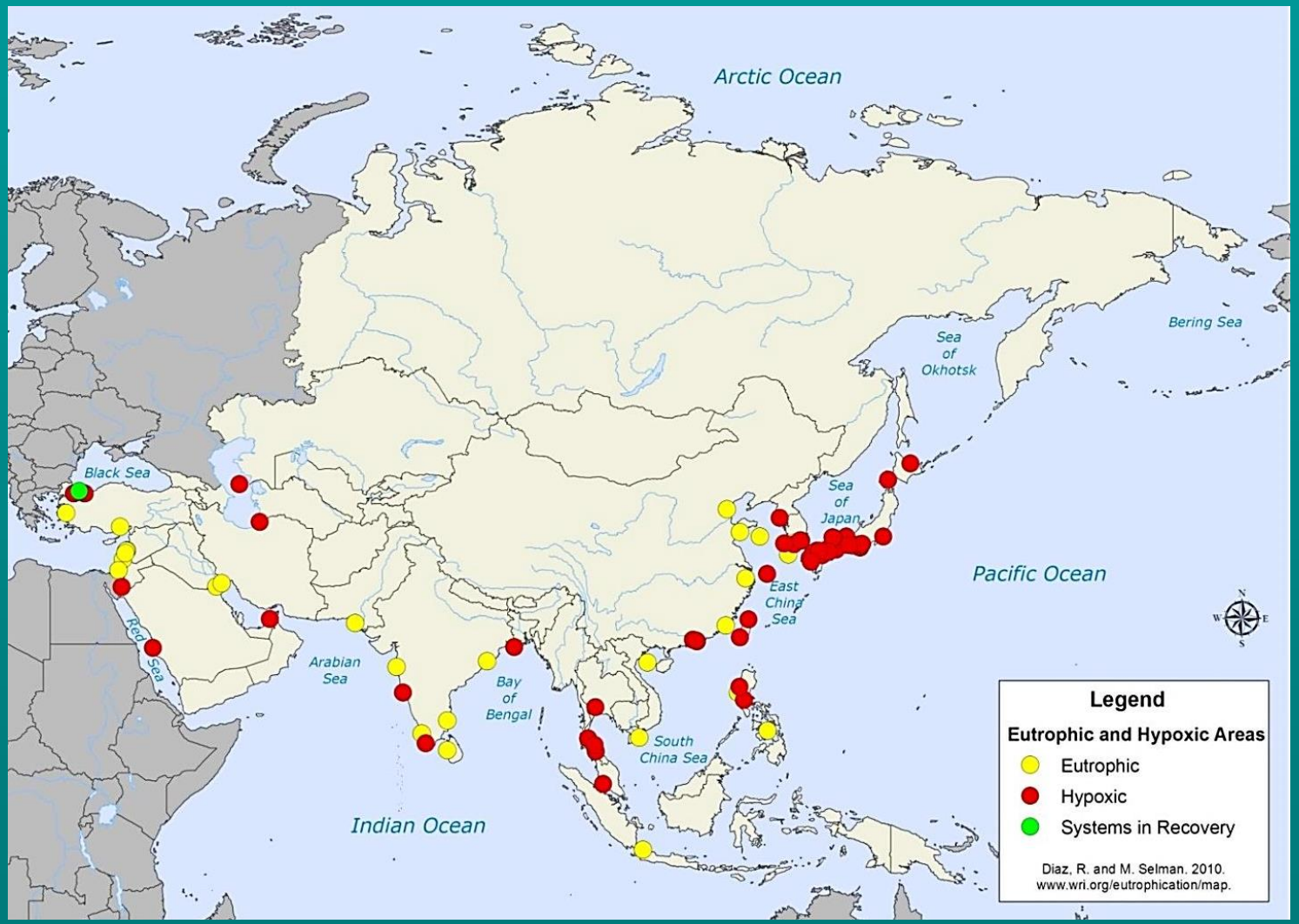
- LCC based Neem coated urea emitted highest NH_3
- 9.8 to 11.3 % of applied N was lost as ammonia

Arti Bhatia, Niveta Jain, Renu Singh et al.

Big questions for East Asia

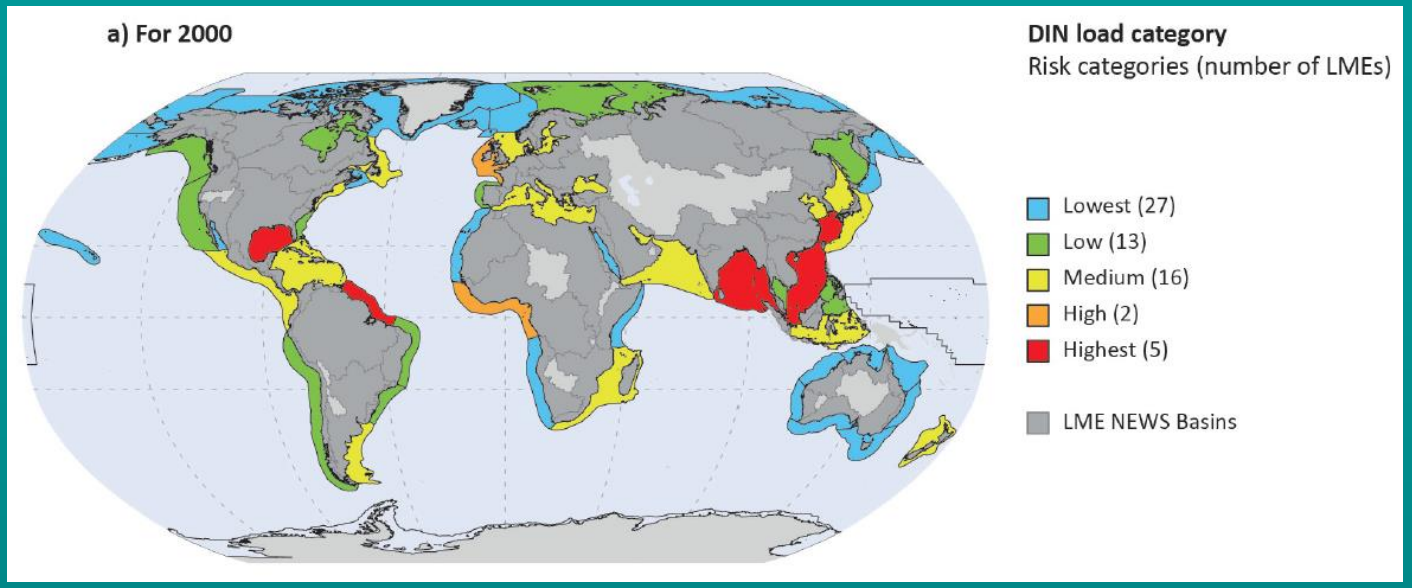
- Global Nitrogen Hotspot: What is the scale of the major adverse impacts?
- Is there evidence of open ocean eutrophication from the atmosphere?
- Are some areas still pristine?
- What is the economic opportunity and lessons to be learned between countries? (China, Japan, S. Korea, Philippines)

Eutrophic & Hypoxic Coastal Areas of India

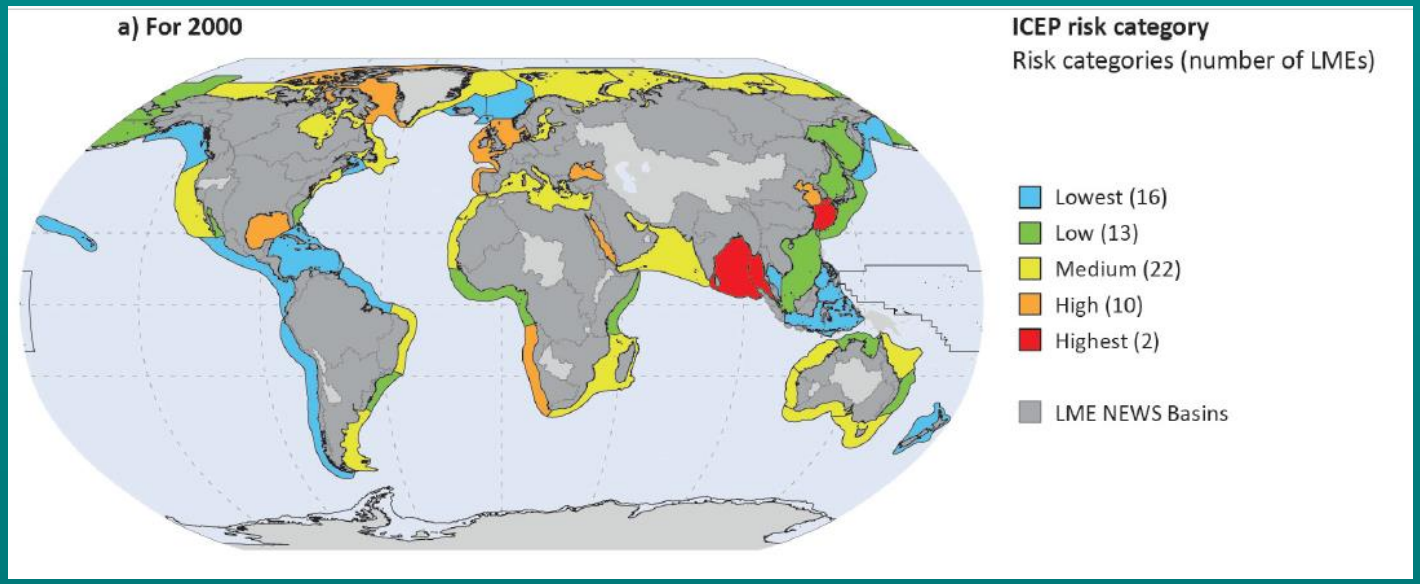


Risk categories for Large Marine Ecosystem (LMEs)

Dissolved Inorganic Nitrogen



Index of Coastal Eutrophication Potential



April 30, 2017, Beijing: China contribution

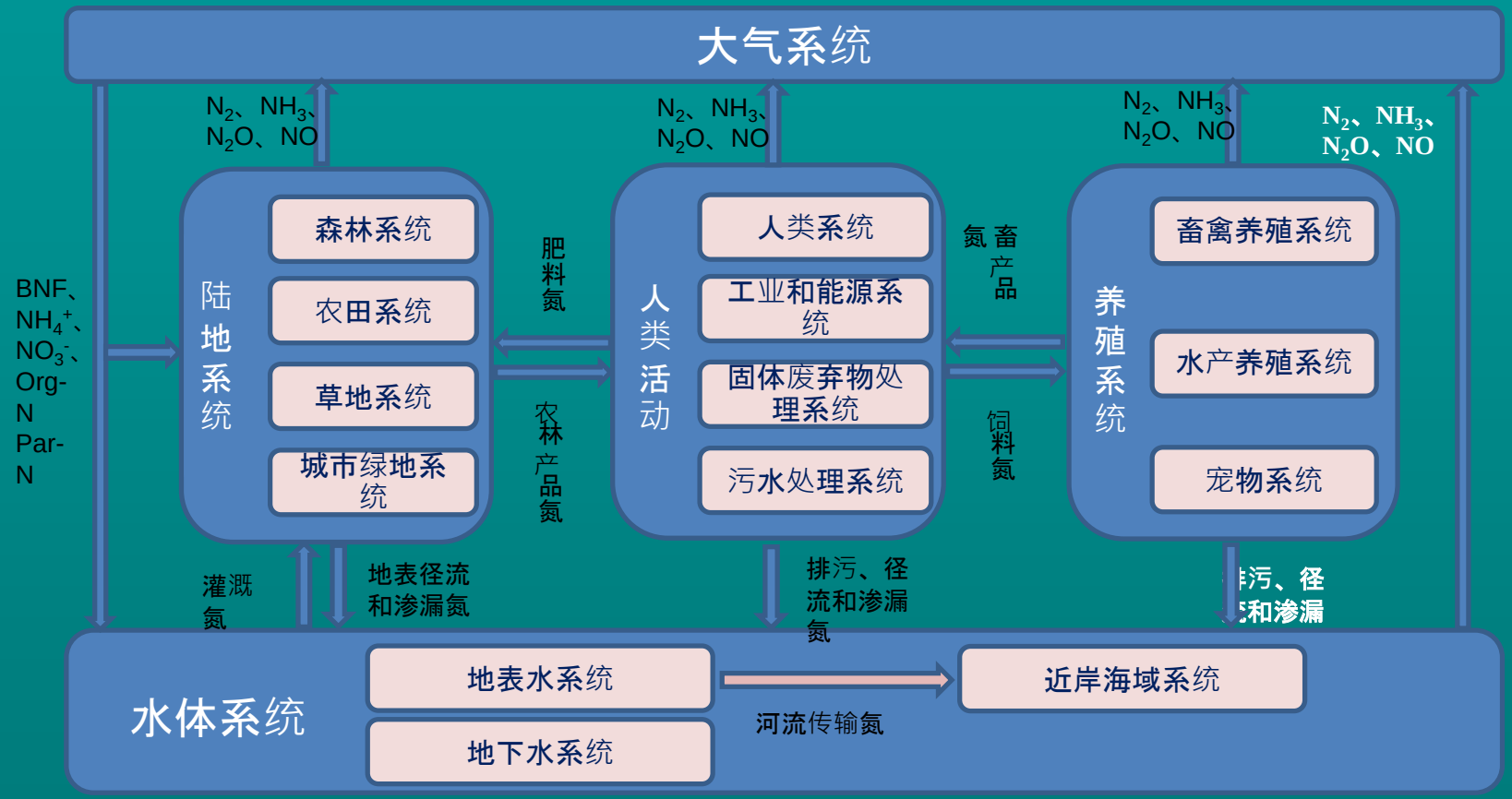
Activity	Person
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	Authors of book: Guidelines for Nitrogen flow Analysis in China
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	Authors of book: *Guidelines for Nitrogen flow Analysis in China*, uncertainty analysis by Feng Zhou and Yongqiu xia
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	Baojing Gu
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	Xiaotang Ju
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	Lin Ma and Xuejun Liu
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	Xiaoyuan Yan
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	Feng Zhou

First East Asia N conference Oct. 20-22, 2017, Nanjing

INMS East Asia
China
Japan
South Korea
Philippines

Guidelines for nitrogen flow analysis in China
(中国氮素流动分析方法指南)

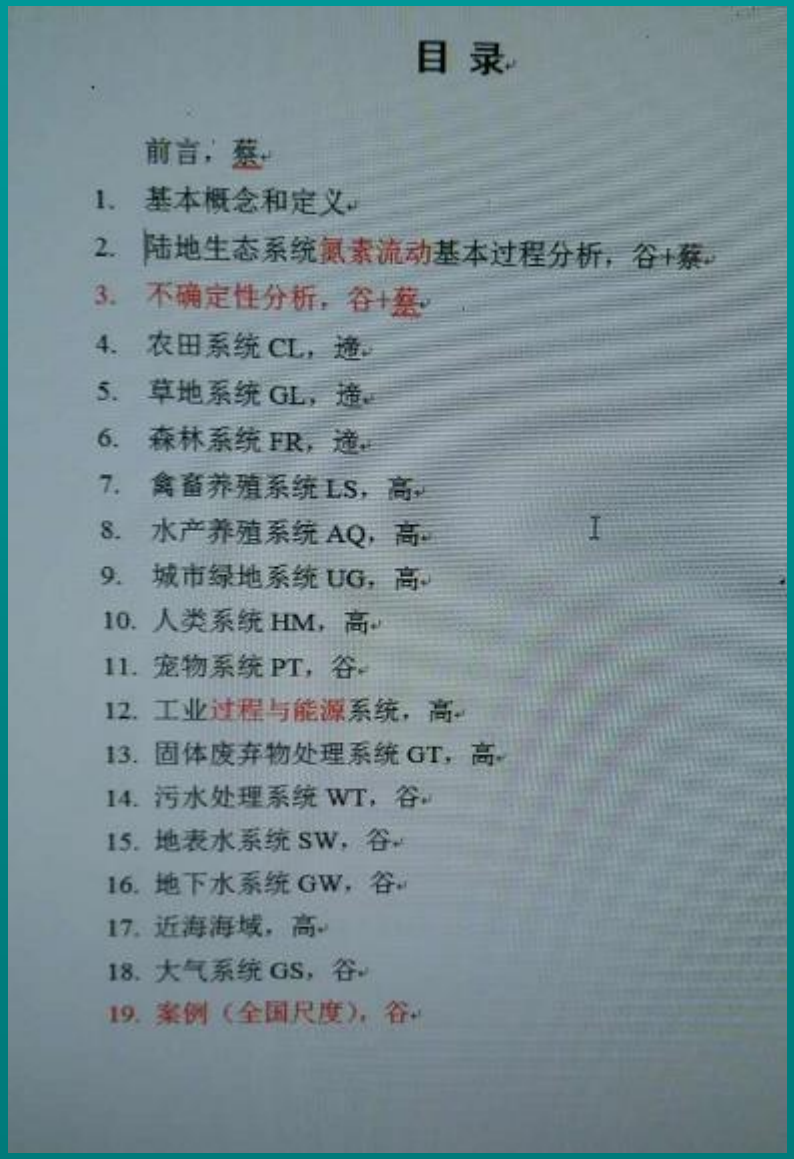
Publish by August 2018



活性氮流动图示。 BNF，生物固氮；Org-N，有机氮；Par-N,颗粒态氮。氮流动不仅存在于功能群之间，而且也存在于功能群内部不同系统之间

Chapters of book

1. Concept and definition
2. Nitrogen flow in terrestrial ecosystems
3. Uncertainty analysis
4. Croplands
5. Grasslands
6. Forest
7. Livestock
8. Aquaculture
9. Industry
10. Urban Greenland(UG)
11. Human
12. Poet
13. Solid waste treatment
14. Sewage treatment
15. Surface water
16. Underground water
17. Estuary
18. Atmosphere(GS)
19. Case study



目 录

2nd NCEIEA (East Asian N Conference)

- **NCEIEA: International Conference of Nitrogen Cycling and its Environmental Impacts in East Asia**
- **Date: 19 Mon. – 22 Thr. November 2018**
- Venue: Tsukuba, Japan (adjacent to Tokyo)

- Organizers **(under discussion)**: National Agriculture and Food Research Organization (NARO), Japanese Society of Soil Science and Plant Nutrition (JSSPN), **INI-East Asia**
- **Hosts (hope): Towards INMS, other national institutes, agencies, and academic societies of Japan**

Big questions for Europe

- What are the major uncertainties and gaps?
- Some N Emissions have decreased – do we see any evidence of recovery?
- What lessons can be learned from those countries that already took action?
- Which were the most effective measures?
- Is *dietary change* going to be needed to meet sustainable development goals?

Total NO_x emissions [kg N $km^{-2}yr^{-1}$]

Split of total NO_x emissions for EU27 [Gg N $year^{-1}$]

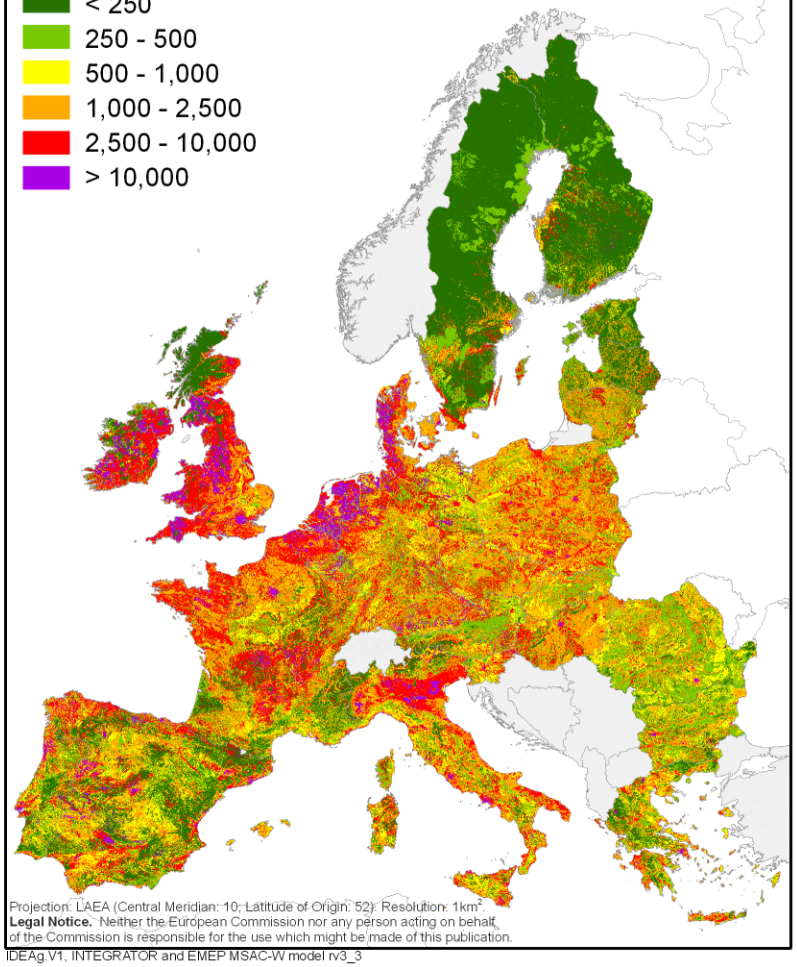
Total NH_3 emissions [kg N $km^{-2}year^{-1}$]

Split of total NH_3 emissions for EU27 [Gg N $year^{-1}$]

Total N_2O emissions [kg N $km^{-2}year^{-1}$]

Split of total N_2O emissions for EU27 [Gg N $year^{-1}$]

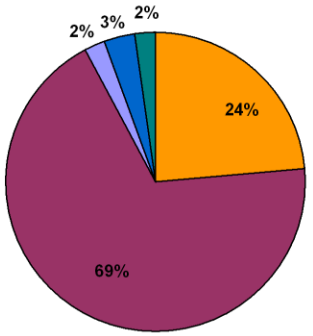
N-input to acquatic systems [kg N $km^{-2}yr^{-1}$]



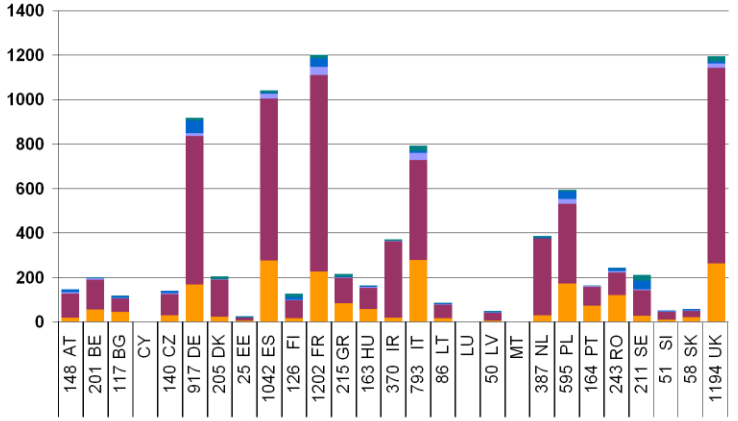
IDEAg.V1, INTEGRATOR and EMEP MSAC-W model rv3_3

Split of N-input to acquatic systems for EU27 [Gg N $year^{-1}$]

Direct sewage	2050
Diffuse agric. soils	5980
Diffuse agric. livestock	200
Diffuse - forests	290
N-deposition	190
Total	8710



Split of N-input to acquatic systems by country [Gg N $year^{-1}$]



AL/HIR, 27.07.2010. ©European Communities, 2010


2007
2017

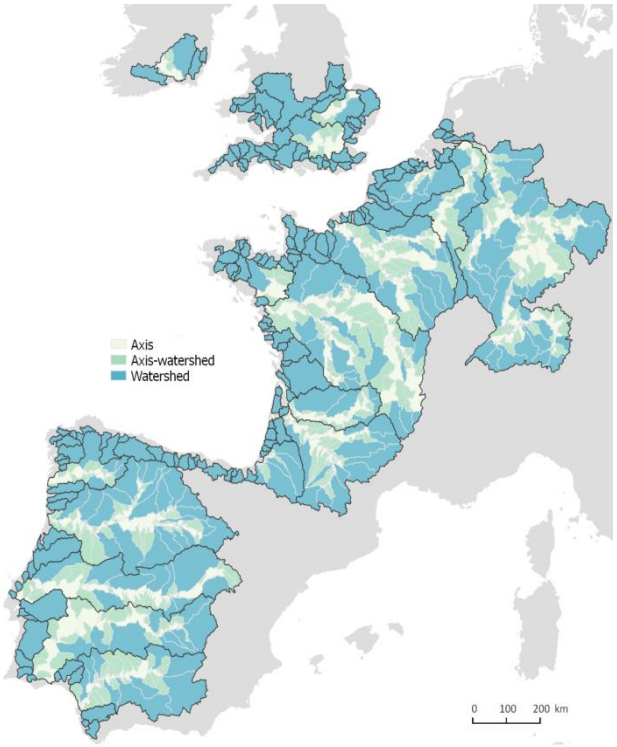
Key Objectives for Atlantic Demo

- **Describe and model the current N flows** through agricultural, atmospheric and hydrological systems of a regional territory along its land-sea continuum, and their major controlling factors
- **Establish and assess various future management** scenarios for reducing coastal eutrophication/hypoxia (nutrients excess and disequilibrium), and pollution of soils, waters, and air in the human environnement associated to reactive N (NH_3, NO_x, N_2O and NO_3^-), Si and P.
- **Elaborate prospective (not prescriptive) scenarios**, on the basis of emerging "weak signals" (organic food, circular economy, reconnection of crop/livestock, sobriety in way of life, …)

Embedded geographical scales

The European Atlantic coast from Gibraltar to the Rhine → **Large individual river basins** → **Small equipped watersheds**

Downscaling ***Downscaling***

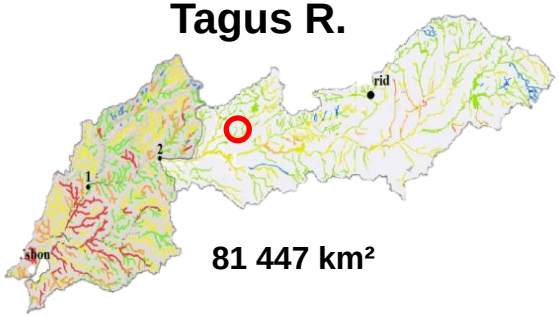


Mediterranean to temperate climate gradient

Seine R.

76 270 km²

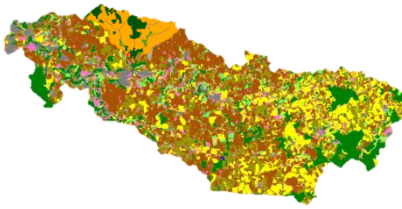
Tagus R.



81 447 km²

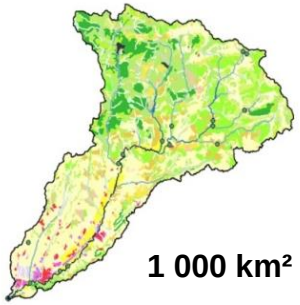
intensive measurements of processes in the N cascade (crop managmt, N losses,…)

Gd Morin>Orgeval R.



1 000 km²> 100 km²

Henares R.



1 000 km²

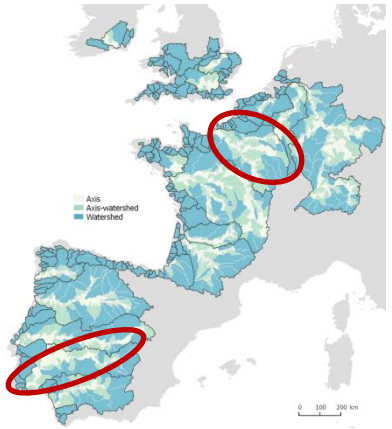
Upscaling

Adressed Issues

Critical

Potentially critical

Not critical



N management issues		Tagus	Seine
Water issues	Low water periods		
	Reservoirs		
	Point source pollution		
	N retention		
Agricultural issues	Crop mineral fertilisation		
	Livestock and Crop manure fertilization		
	Irrigation		
Atmospheric emissions & pollution	Ammonia		
	Nitrous oxide		
	Ozone		
Coastal Potential Eutrophication	N:P:Si nutrient deliveries vs. upwelling		

Learning from key global regions

- What are the stories that help the public to engage in "why care about nitrogen"?
- Have some nitrogen threats been forgotten?
- Can a joined up nitrogen approach help overcome the barriers?
- How can country clusters – working with regional intergovernmental bodies help mobilize solutions.