Progress on Activity 1.4
Approaches for N threat-benefit valuation

July 2020

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INMS-5 Meeting

Progress on Activity 1.4

July 2020

Use of Economic Valuation

- Awareness raising - signal function
- Environmental liability - polluter pays
- Decision support - money speaks louder than words
- Internalize externalities & change behavior
- Sustainable financing

Prof Roy Brouwer, Univ Waterloo 2018

Assess relative importance ("societal weight") of incompatible issues

Essence of Activity 1.4

- Develop global valuation functions for major N-impacts
  - Relevance across contrasting economies
- Provide scientific support; status report
- Apply for base year (2010) and scenarios (2050)
  - Using A2.1 model output

“Big five” N issues for INMS Societal benefits and costs

1. N fertilizer use and crop production and regional food security-sufficiency (benefit),
2. NH_3 and NOx emission to air and human health loss,
3. N runoff and marine eutrophication/HABs,
4. N deposition and terrestrial biodiversity loss,
5. N deposition and C-sequestration (climate benefit) / wood production (economic benefit).

- *Optionally simple approaches for other impacts*

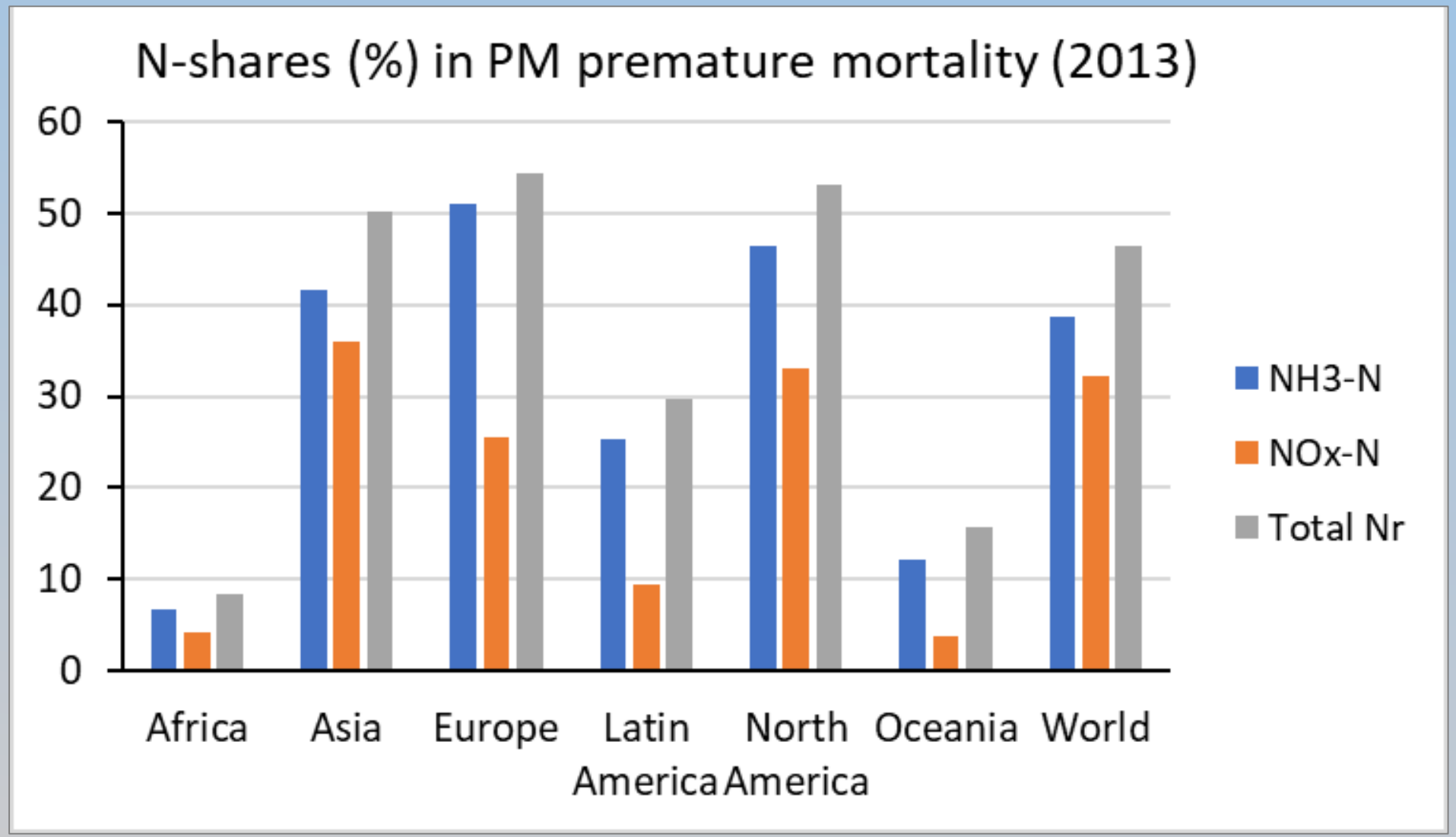
Approach

- Derive or update state of the art global Value Functions for the Big Five
  - Functions use N flows and N-impacts from INMS A2.1 global models
  - Concept of N-share; contribution N to total impact
  - We left lumped Unit Damage Cost approach (ENA)
  - Requires more research time than anticipated

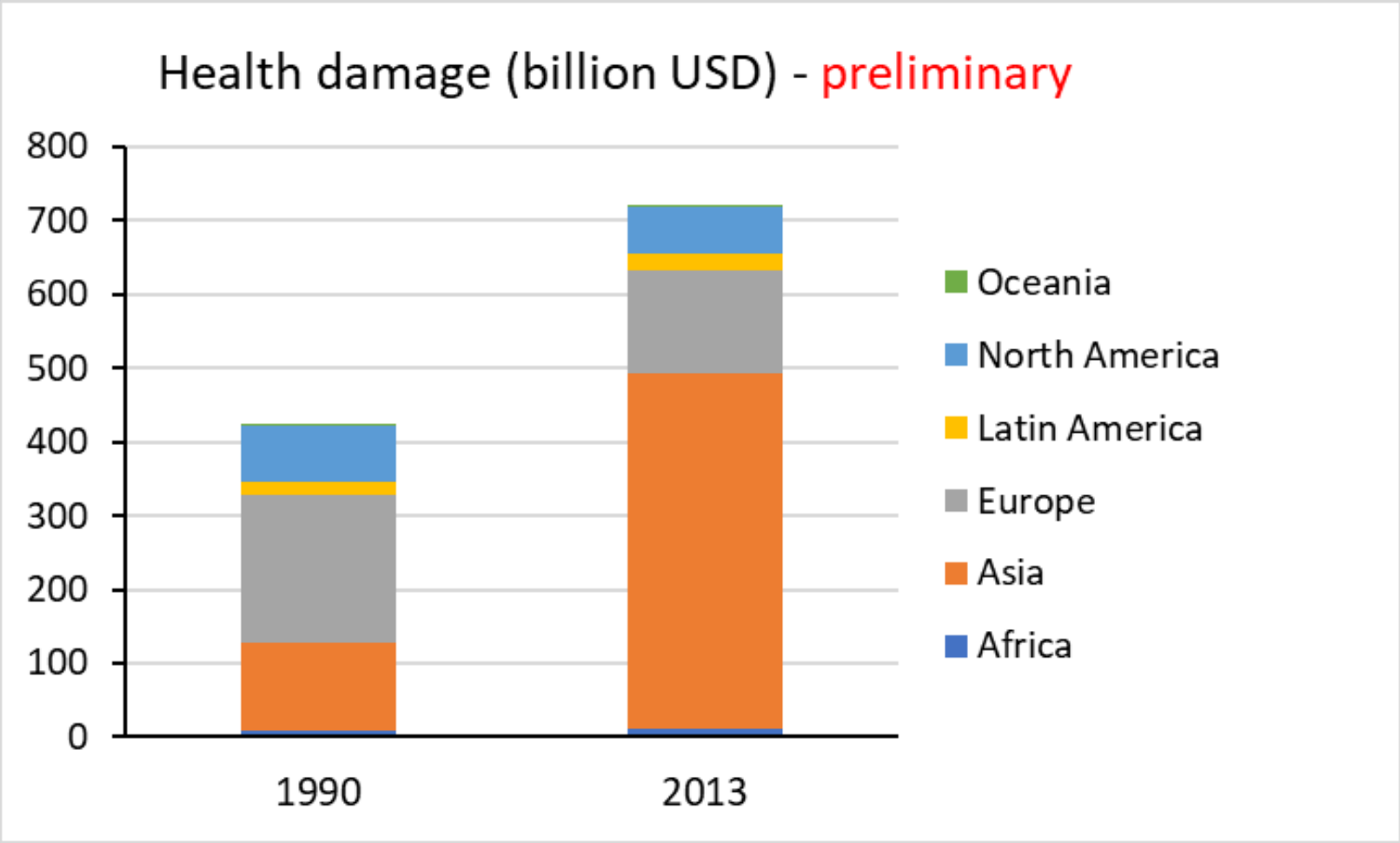
N-shares in mortality by ambient air pollution

- TM5-FASST, EMEP4-earth, GEOchem
- N-shares in PM, ozone and mortality from model perturbation
- World Bank (2016) method for valuation of mortality
  - GDP elasticity for VOLY

N-shares mortality ambient air pollution



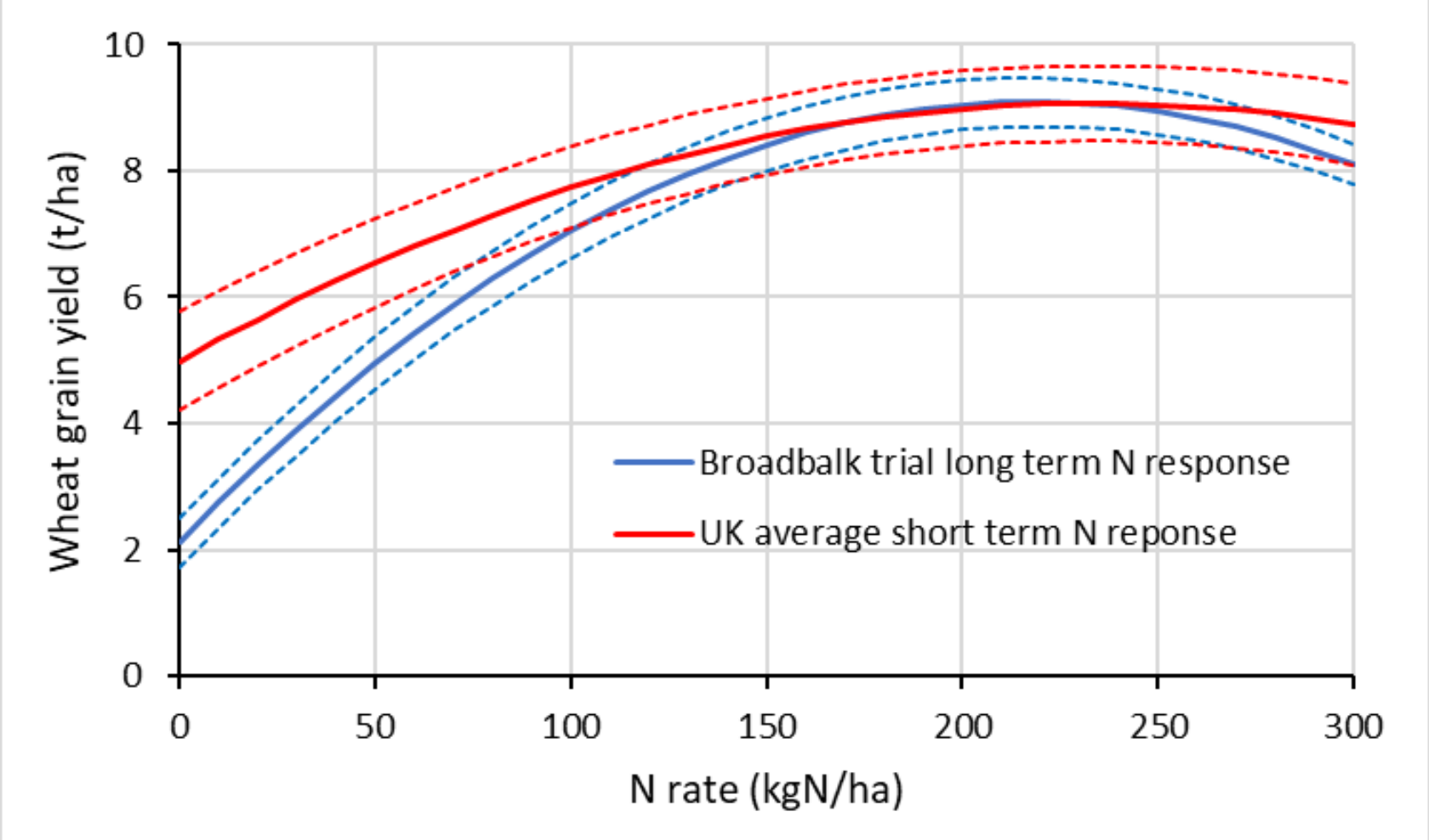
Mortality cost ambient air pollution: increase 70% since 1990, two third in Asia



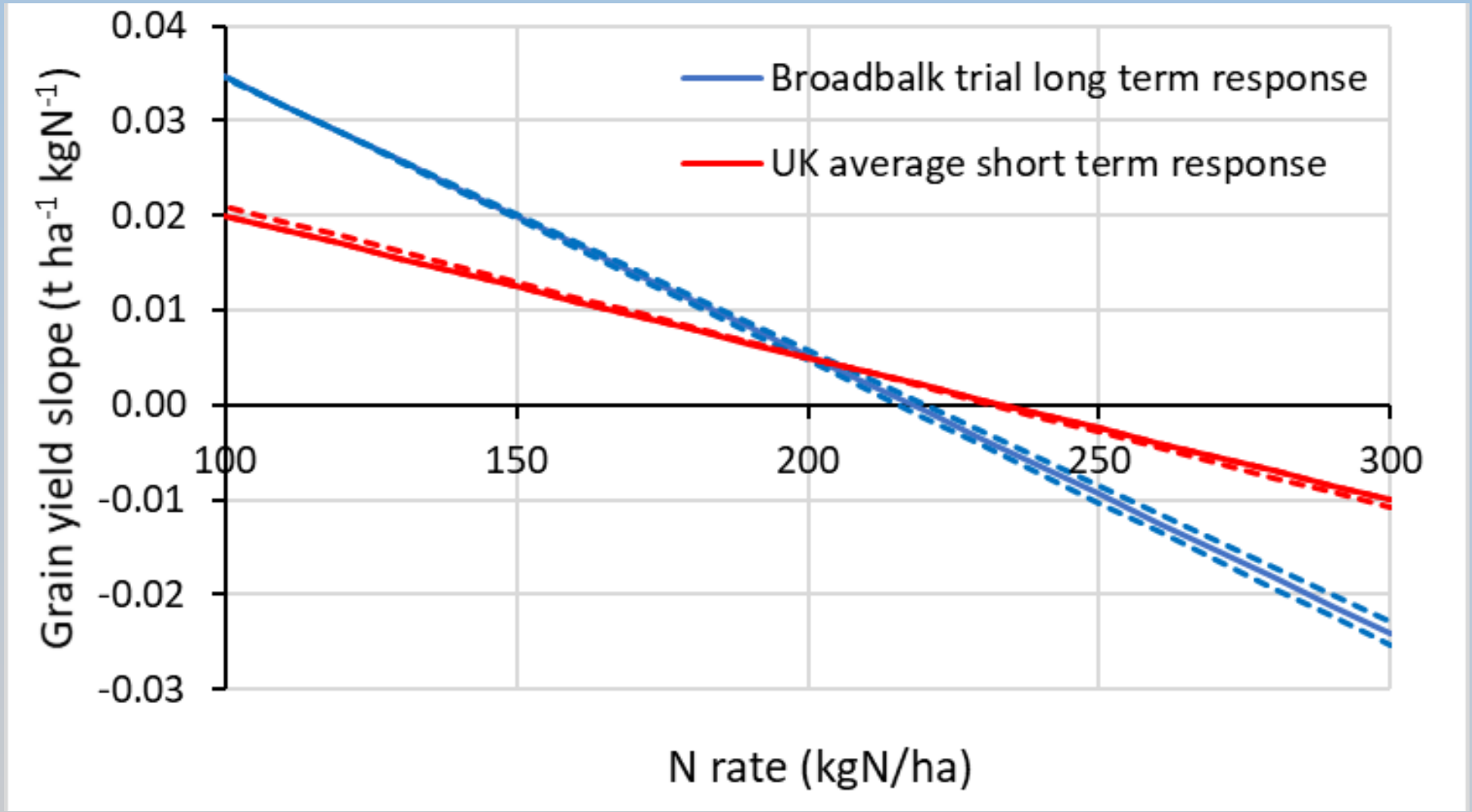
Valuation benefit of N fertilization for crops

- Cereals: wheat, maize, rice and barley
  - 50% global crop land and N fertilizer use
- Developed new globally applicable long-term N response relationships
- Marginal benefit of N fertilizer based on
  - Current prices of cereals and fertilizer (FAOstat)
  - Current N fertilizer rates (IFA, Fertilizers Europe)
  - Non fertilizer inputs (IMAGE-GNM, GRAFS)

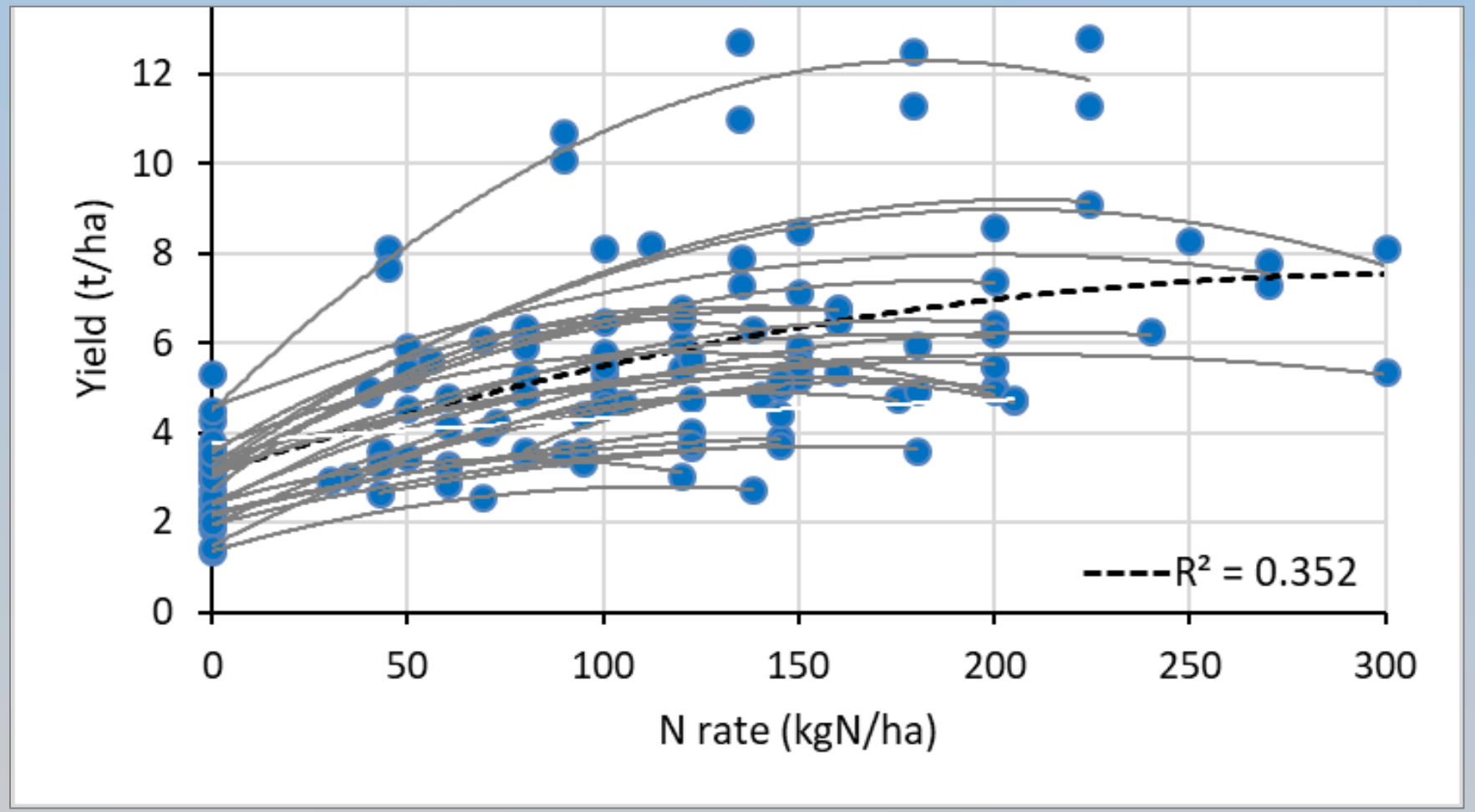
Long-term versus short-term N response



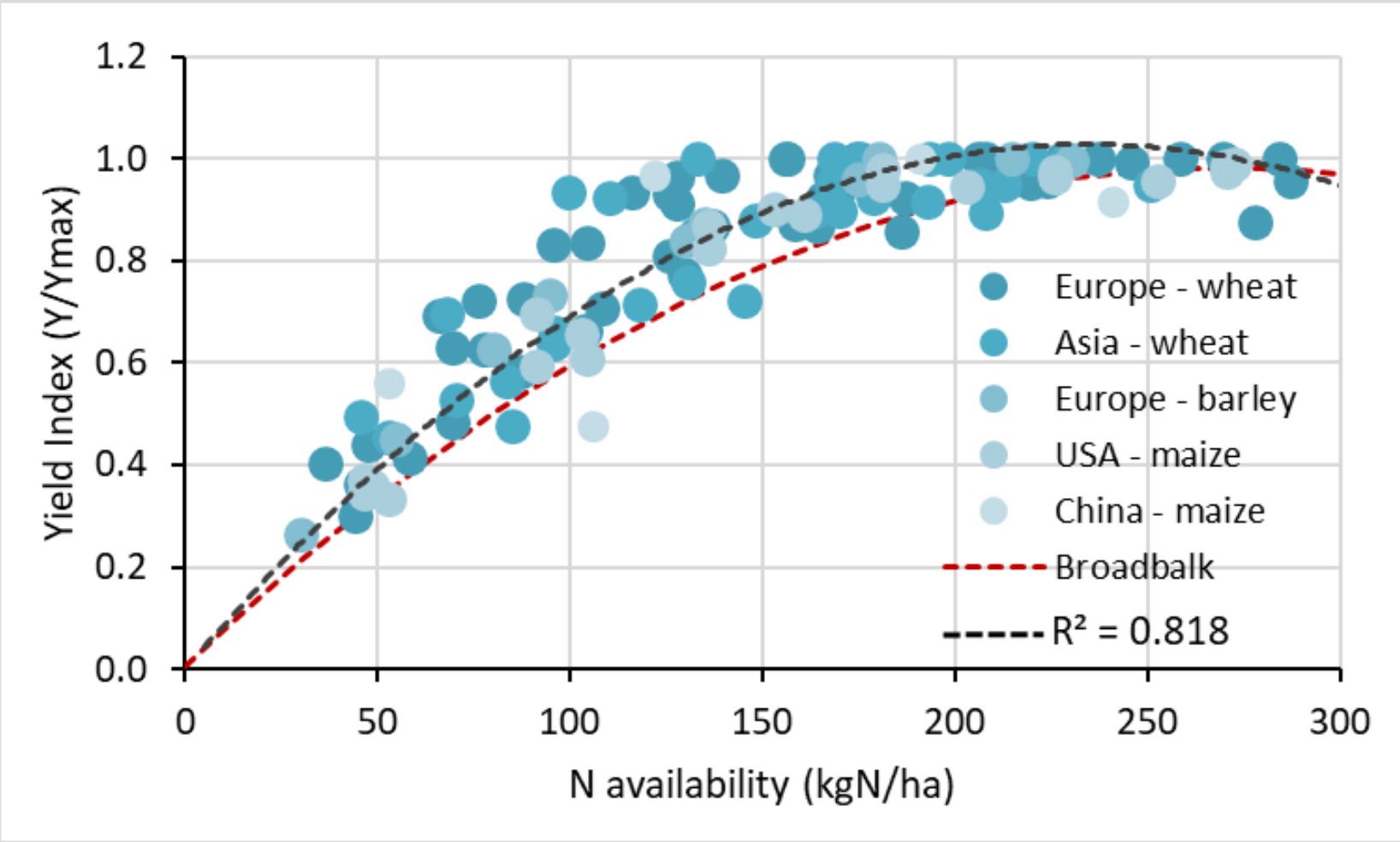
Large implications for marginal N benefits



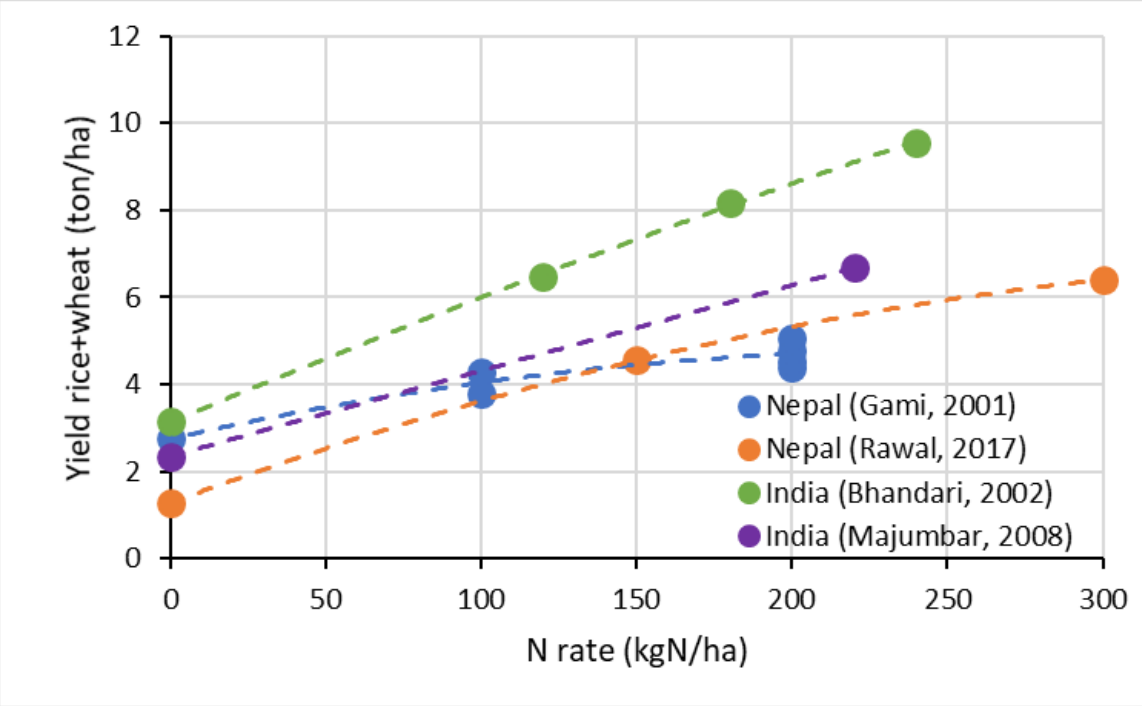
Long-term generic nitrogen response for global cereals

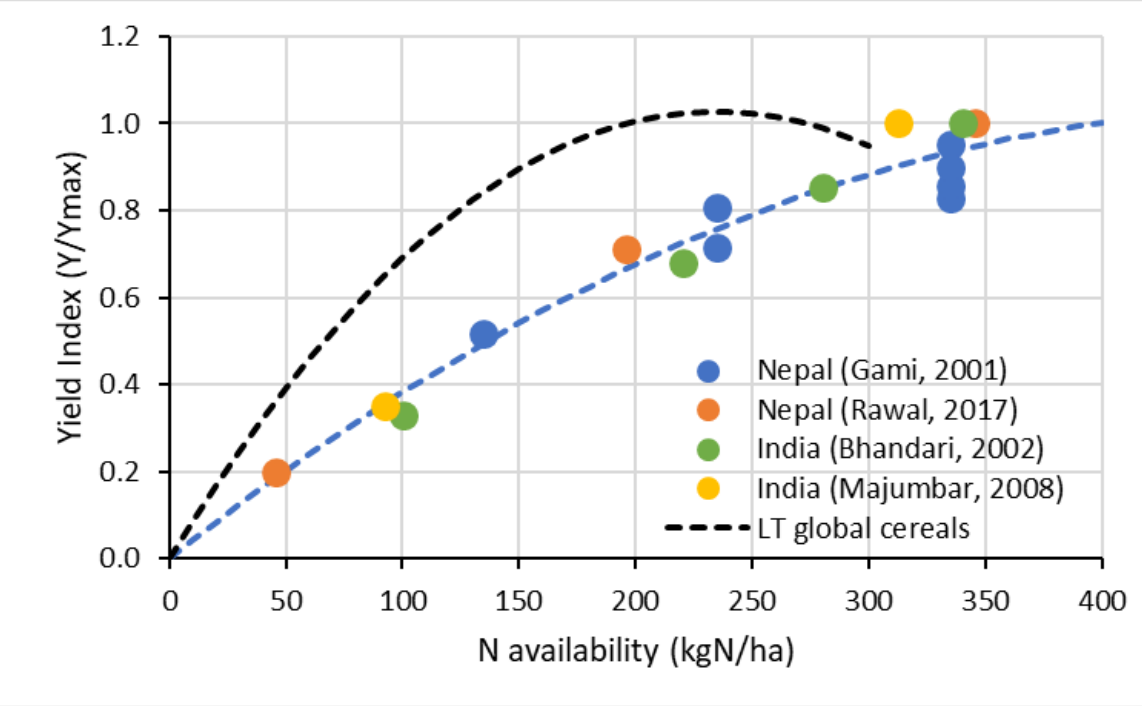


Scaling works!
Back scaling requires local Ymax and non-fertilizer N



Long-term generic N response for lowland rice- wheat systems





Valuation impacts N on biodiversity and ecosystem services

- We left Constanza approach
  - Controversial upscaling of unit values across the world; no focus on N
- Coastal and marine
  - Baltic case: 30 years of data and valuation experiments
  - Use A 2.1 IMAGE-GNM N river loads
  - Meta-analysis/Multiple regression valuation of ecosystem services
  - Challenge is global extrapolation
- Terrestrial
  - Meta-analysis/Multiple regression valuation of biodiversity
  - Use A2.1 GLOBIO Mean Species Abundance loss by N deposition

Valuation marine ES Baltic Sea

- cost and benefit of mitigation
- 47 valuation studies
  271 observations
- Wide range of N loads and GDP
- N-loads from IMAGE-GNM

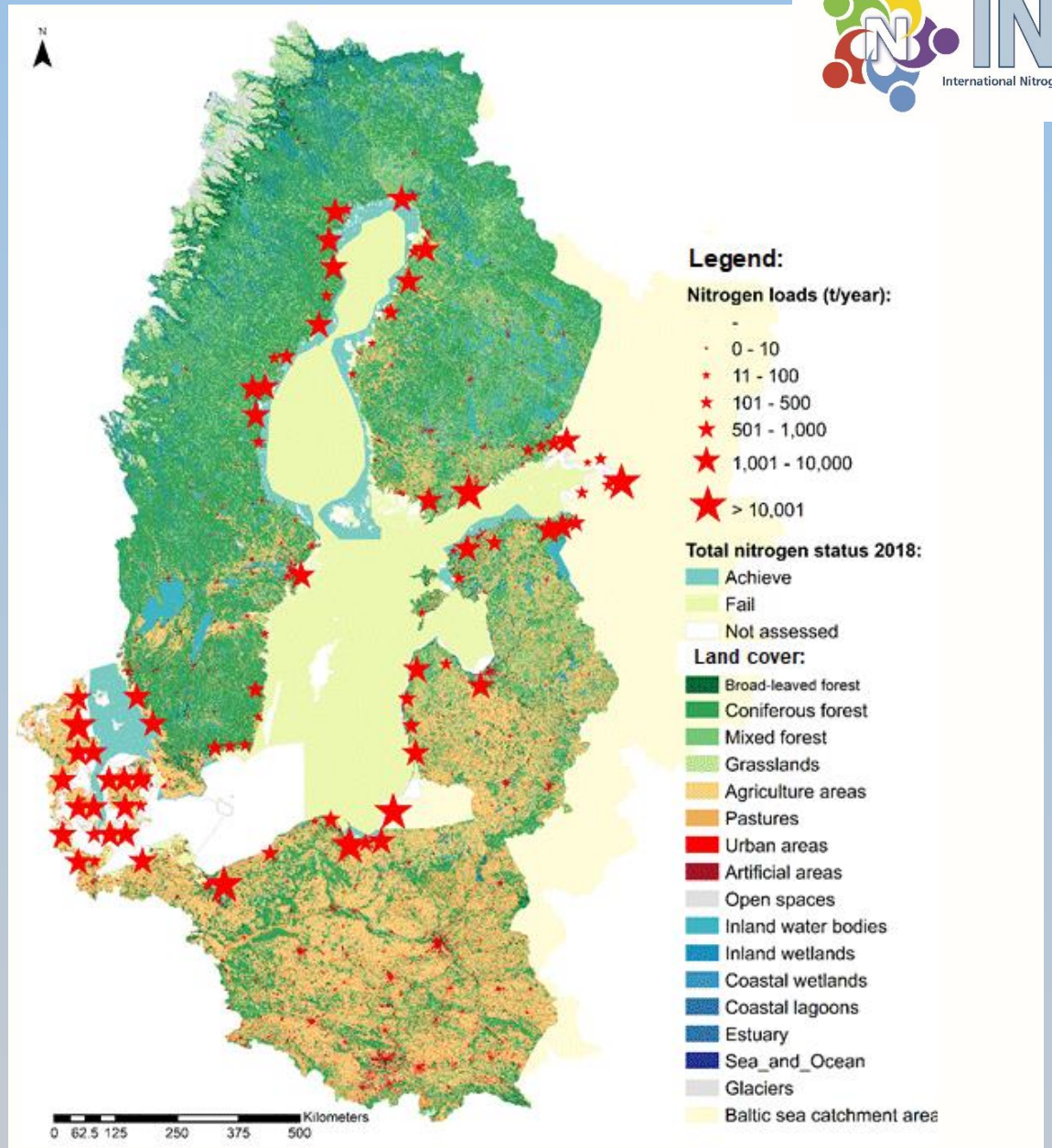


Figure 1 | Land cover and land use in the Baltic Sea catchment area

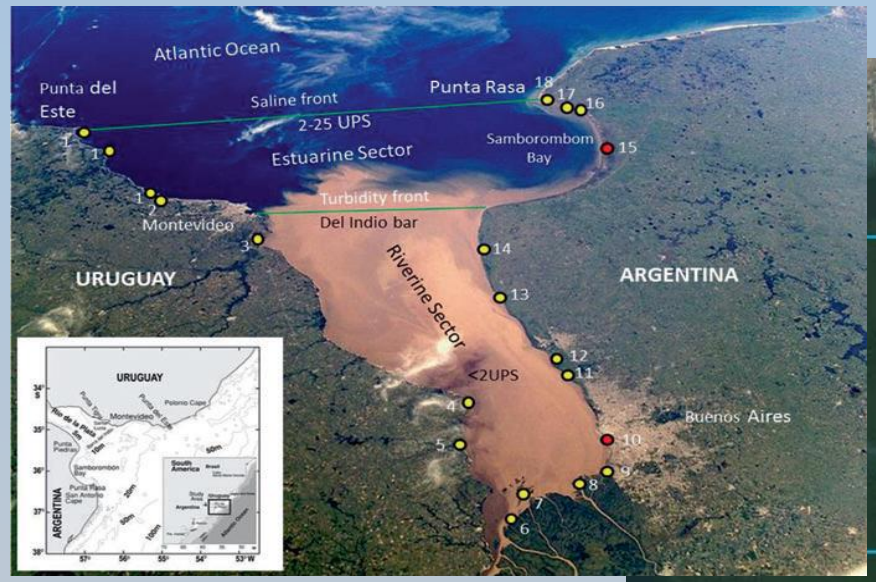
Benefit value functions Baltic Sea

Benefits are measured through public willingness to pay in US$/person/year for the ES involved:

As expected:

- **Higher benefits** are observed when:
  - N-load reductions are higher
  - The share of beaches in the area is higher
  - Tourist demand is higher
  - Income levels are higher

Test and extend applicability Baltic Sea value models for other marine systems



La Plata Estuary | Karachi mangrove coast | Gulf of Mexico | Chesapeake bay

Plans for next 4 months

- Ambition: draft results + reports ready October
- Peer review of methodology and results

Plans for next 4 months

- Air pollution: (lead: Univ. Zhejiang)
  - Finalize Global Assessment of N shares and mortalities Manuscript 50%; to be submitted

- Crop N benefits: (lead PBL)
  - Manuscript Scaled N response relationships under review:
  - Development of global tool to assess marginal N benefits and optimal N rates (Polytechnic Univ. Madrid)

Plans for next 4 months

- Marine ES (lead Univ. of Waterloo):
  - Finalize valuation Baltic case and submit manuscript in July to ERL
  - Explore and extend applicability for other marine systems (temperate and sub-tropical; use N loads IMAGE)

- Terrestrial biodiversity and ES (lead CEH, Bangor)
  - Literature review and meta-analysis just started

- Valuation of wood production and C-sequestration
  - to be planned cooperation PBL and Wim de Vries