Shifting nitrogen pathways in response to changing agricultural practices

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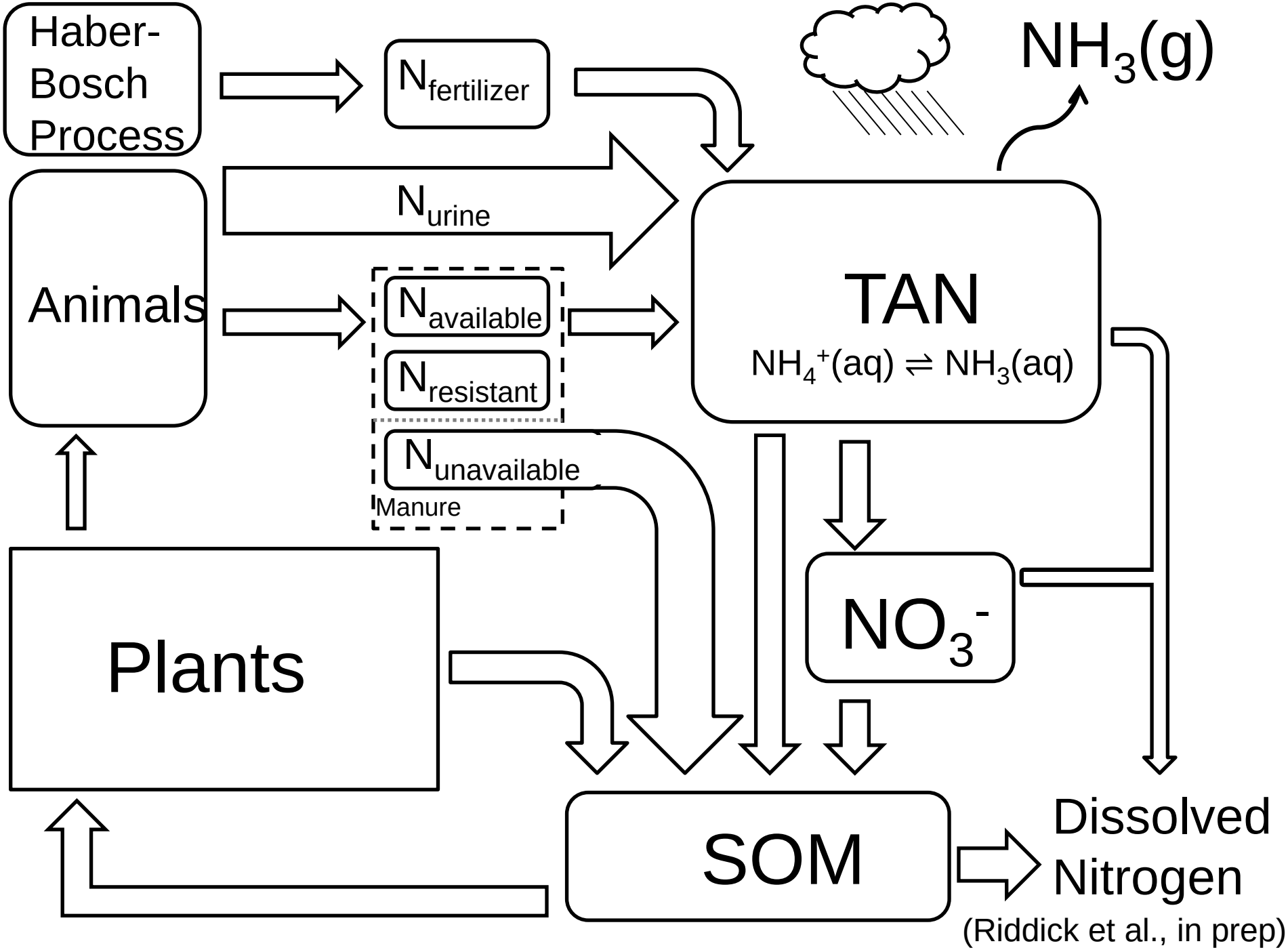
Aim – Create a 0^{th} order model to quantify the size of N_r pathways

Rationale - Environmentally important when trying to understand the current impact of fertilizer and manure


Haber-Bosch Process
$N_{fertilizer}$
$NH_3(g)$
N_{urine}
Animals
$N_{available}$
$N_{resistant}$
TAN
$NH_4^+(aq) \rightleftharpoons NH_3(aq)$
$N_{unavailable}$
Manure
NO_3^-
Plants
SOM
Dissolved Nitrogen
(Riddick et al., in prep)

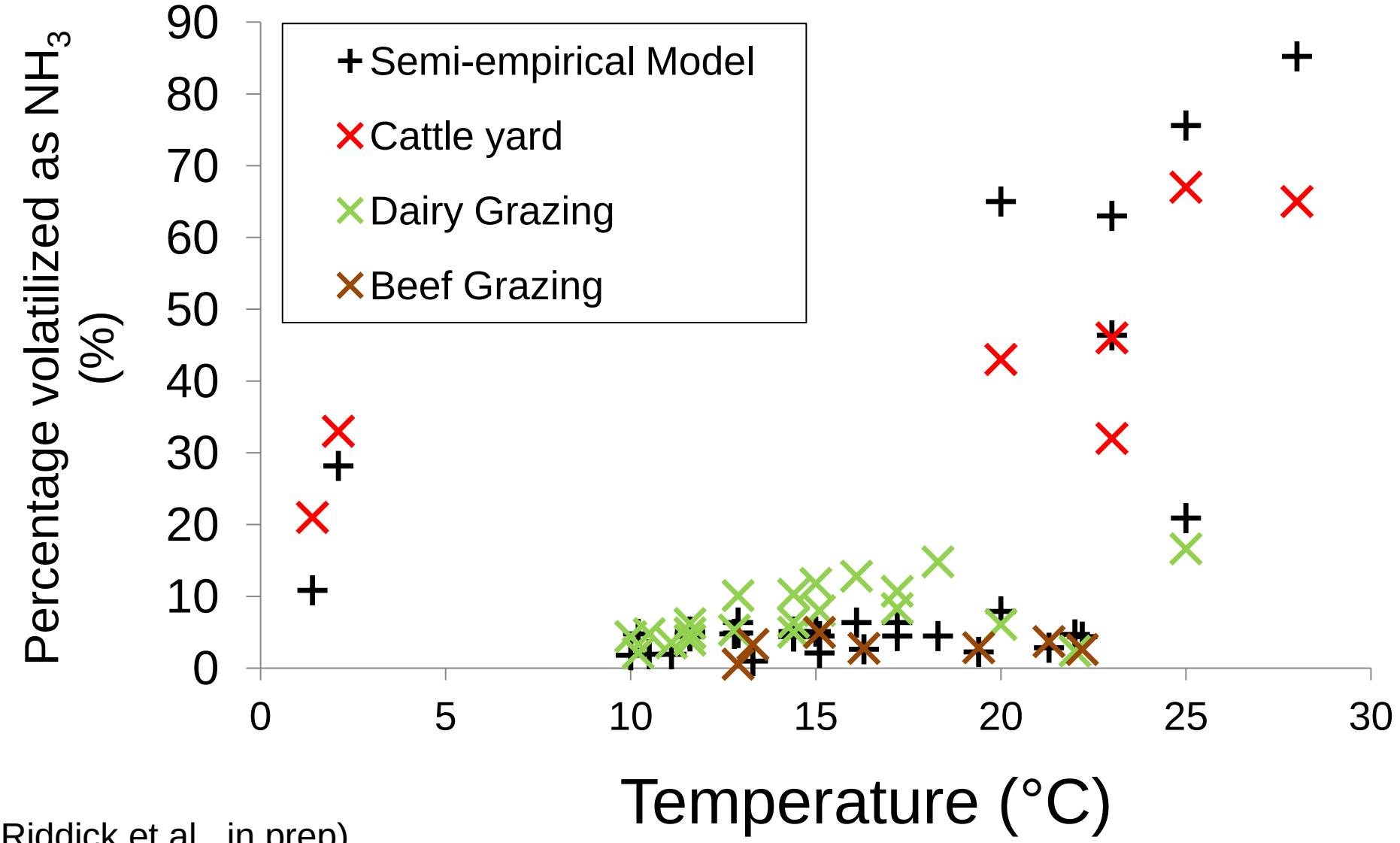
Major Assumptions

- Animals graze on short semi-natural grassland
- All artificial fertilizer is urea fertilizer
- Nitrogen is uniformly spread over the grid cell
- Fertilizer is applied once in spring
- Does not account of agricultural practices

(Riddick et al., in prep)

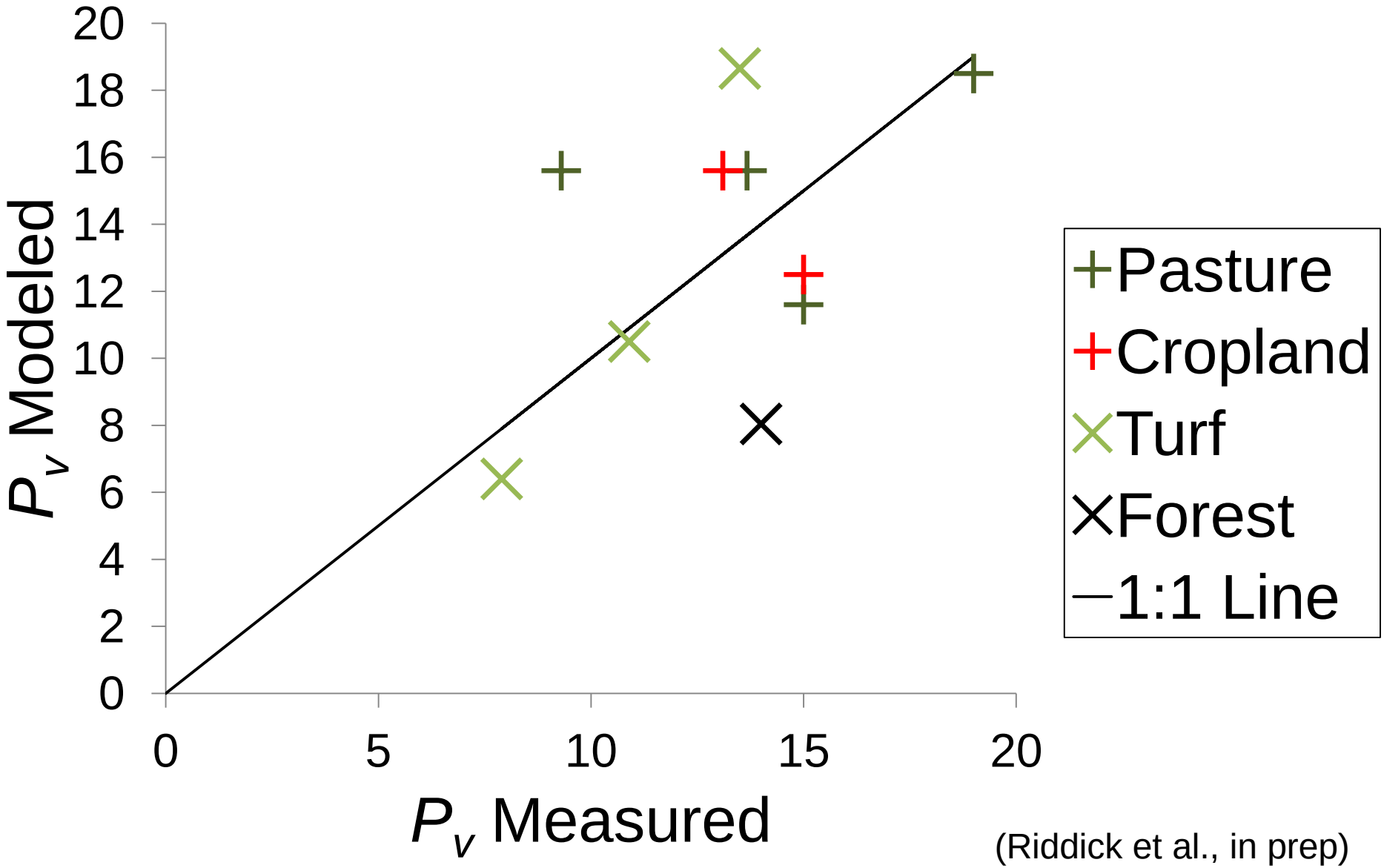
MODEL OUTPUT

Validating NH_3 emissions from manure at the local scale



(Riddick et al., in prep)

Validating NH_3 emissions from fertilizer at the local scale



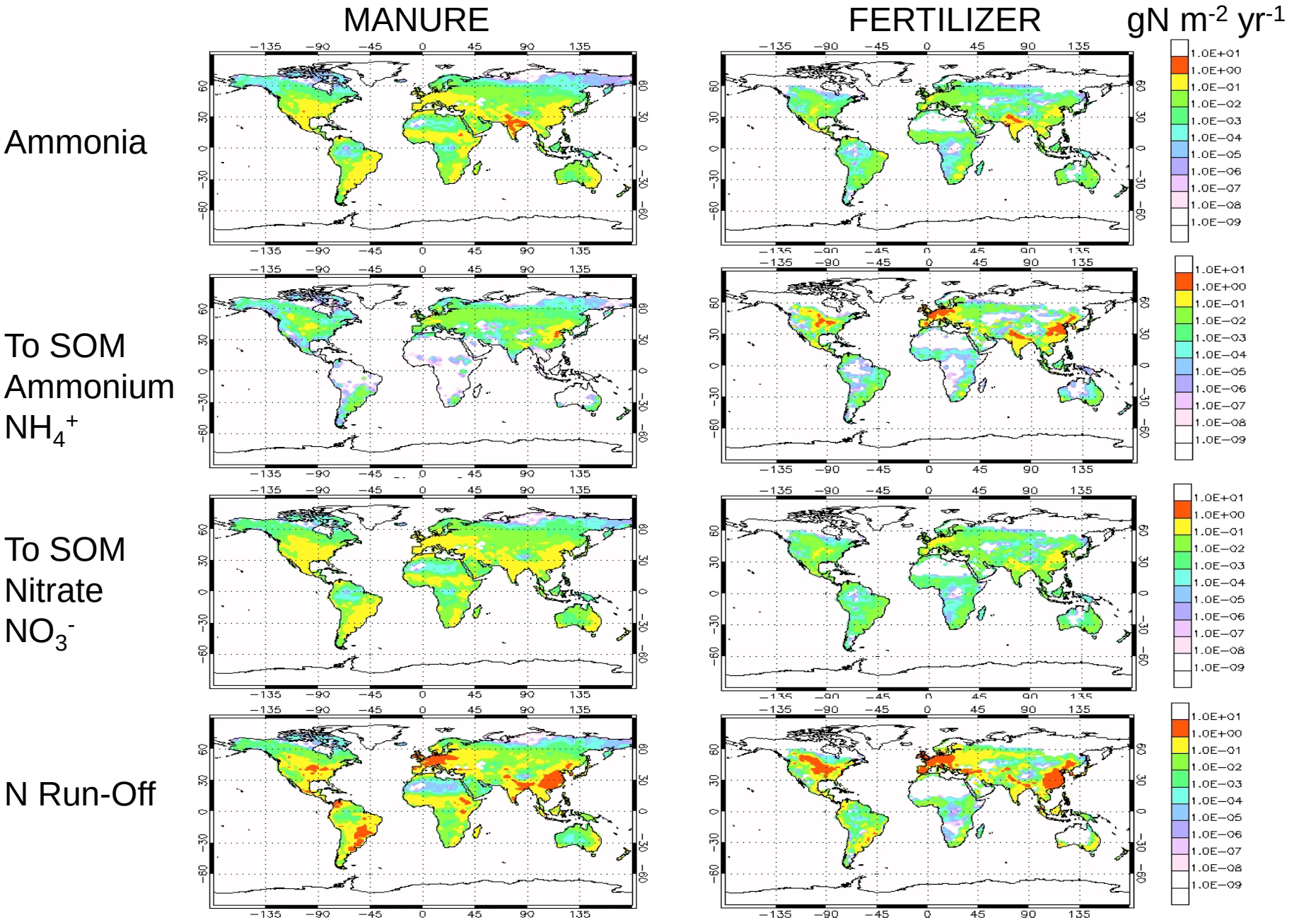
(Riddick et al., in prep)

Global Nitrogen Pathways

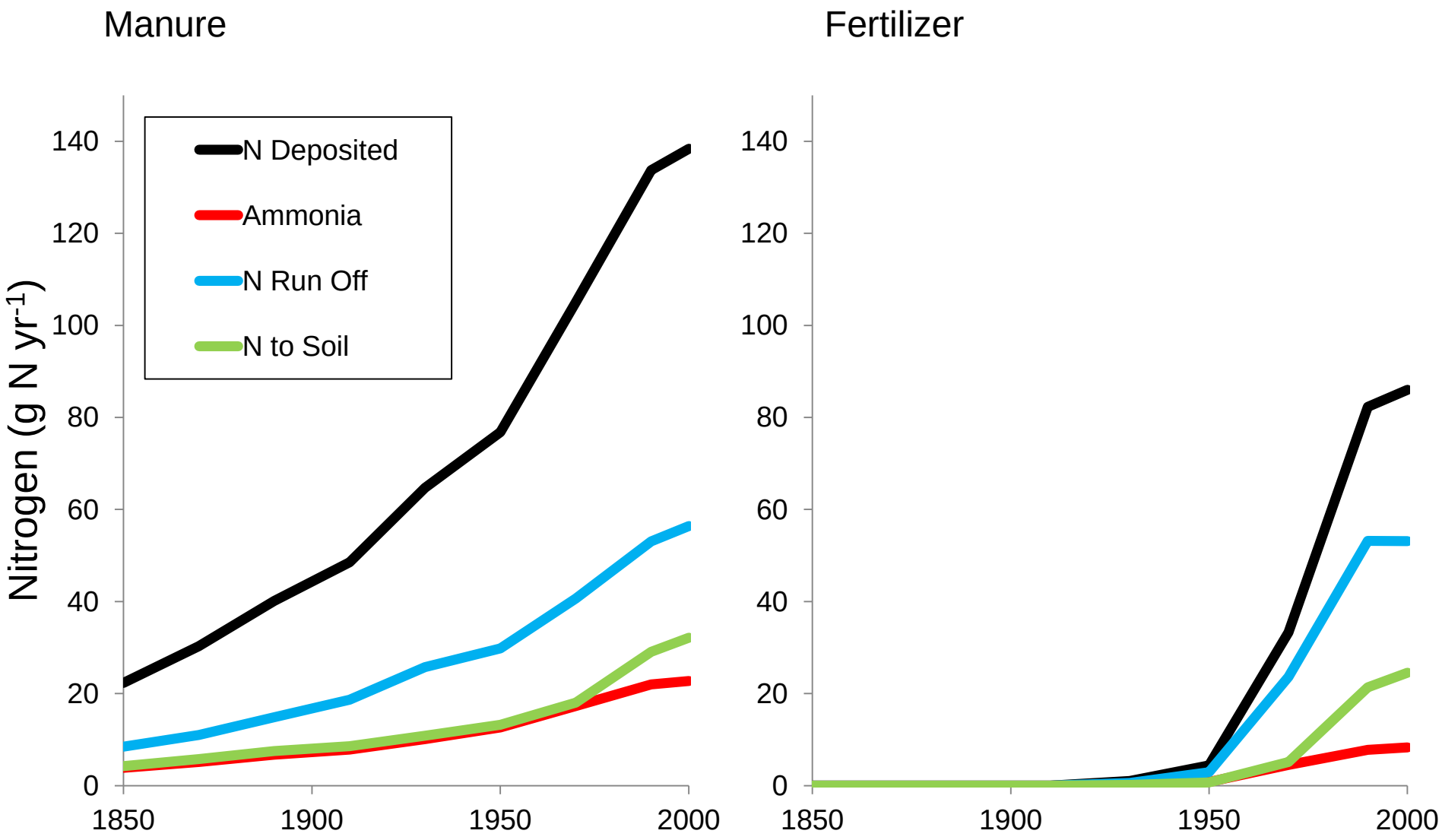
Data Source	Source	N Input (Tg)	NH_3 (Tg)	Dissolved N (Tg)	SOM (Tg)	Remains in N pools (Tg)
Semi-Empirical	Manure	138	22	56	29	31
Galloway (2004)	Manure		24			
EDGAR	Manure		16			
Semi-Empirical	Fertilizer	86	8	51	26	0
Galloway (2004)	Fertilizer		10			
EDGAR	Fertilizer		20			

(Riddick et al., in prep)

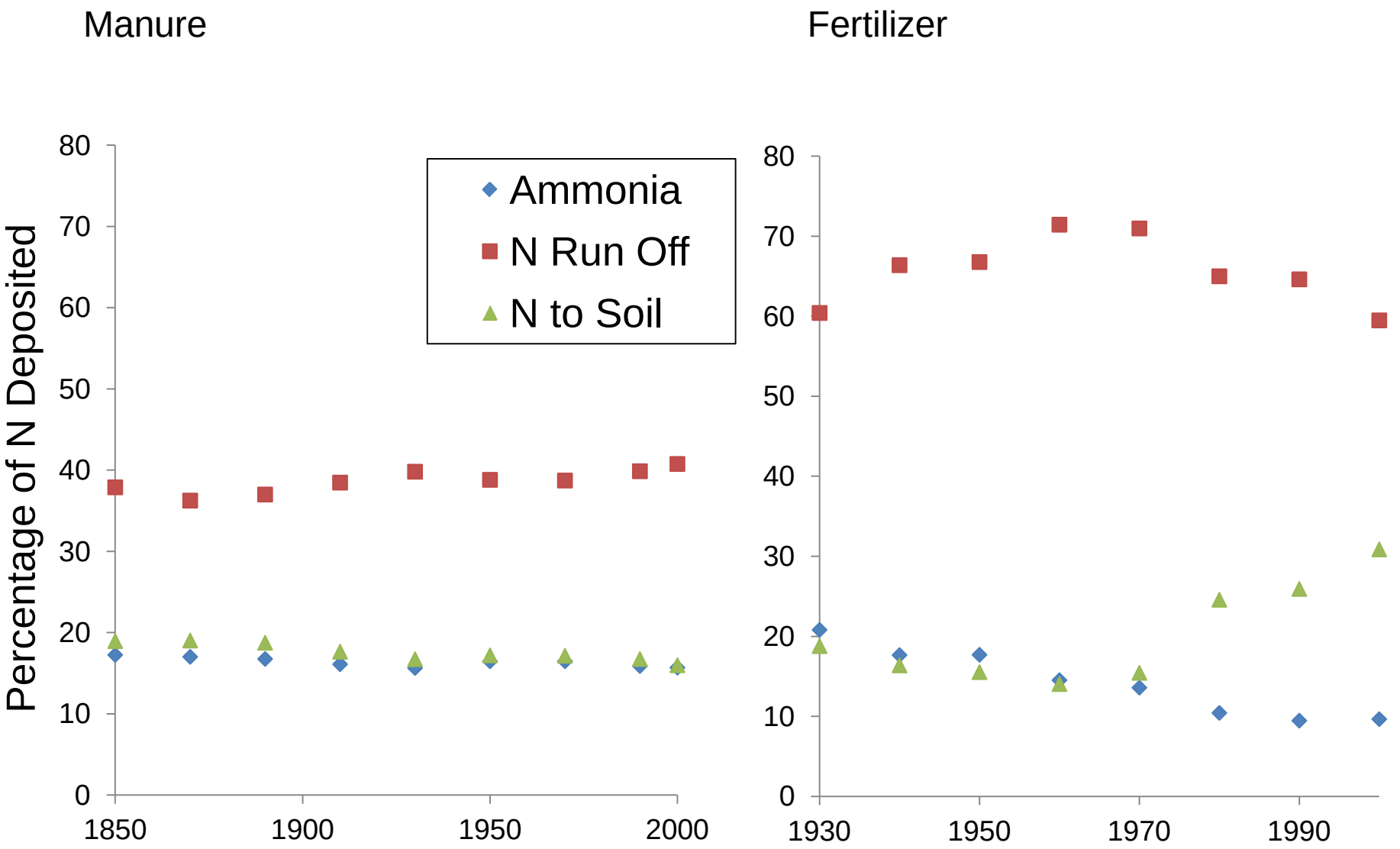
Global Heterogeneity in Nitrogen Pathways 2000



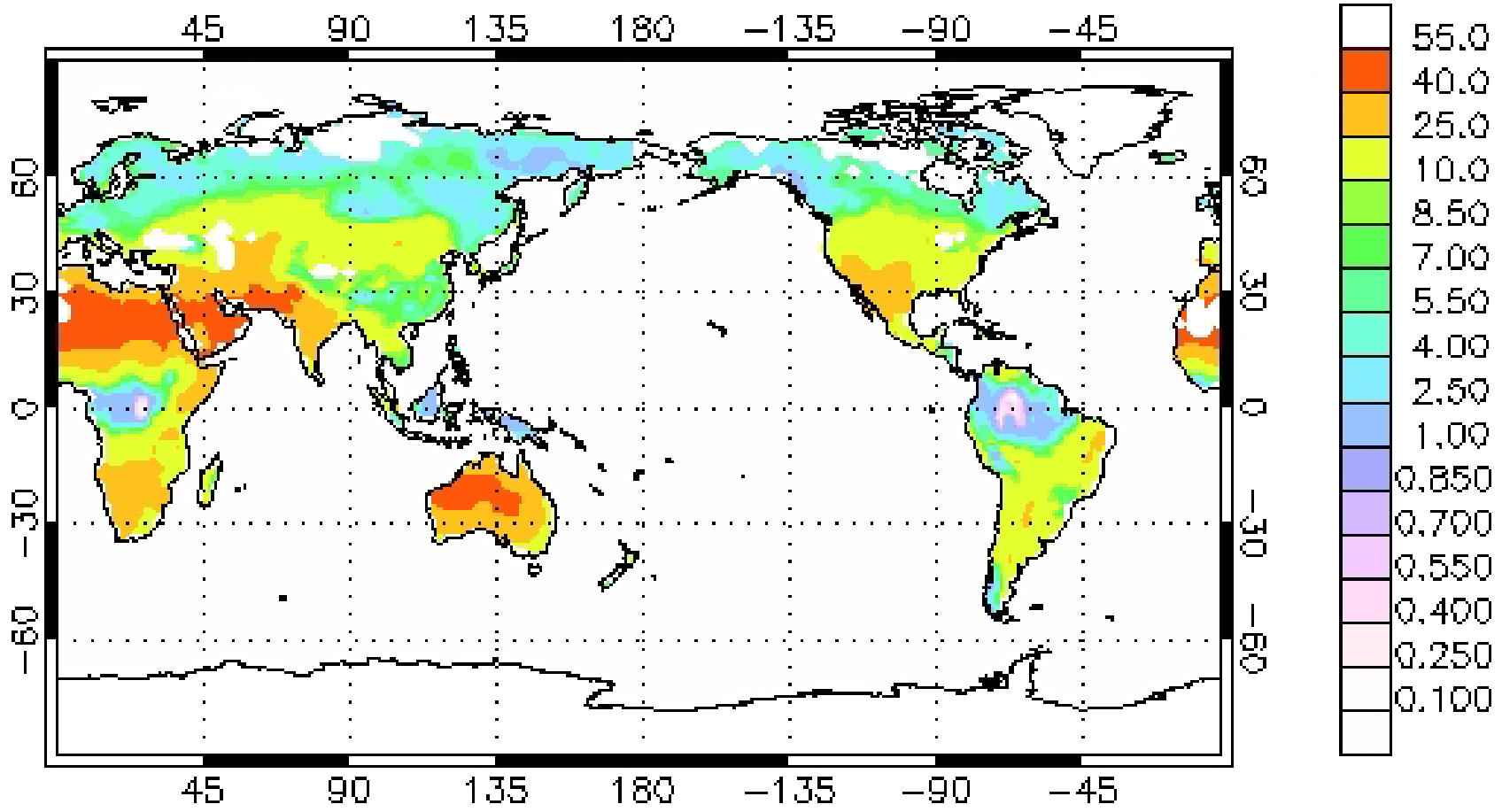
Hind-casting nitrogen pathways 1850 - present



Partitioning of nitrogen pathways 1850 - present



Global variation in annual P_v of NH_3 from manure calculated by the CESM



(Riddick et al., in prep)

Conclusions

- N pathways from fertilizer & manure have increased from pre-industrial
- From manure in 2000:
  - 21.7 Tg N year^{-1} NH_3 emission
  - 56.4 Tg N year^{-1} run-off
- From fertilizer in 2000:
  - 8.4 Tg N year^{-1} NH_3 emission
  - 51.1 Tg N year^{-1} run-off
- Range of deposited manure N that volatilizes as NH_3 is:
  - Maximum 49.8 % (Iran)
  - Minimum 0.16 % (Venezuela)
  - Average 15.7 %
- Fertilizer N partitioning of is dependent on at amount of nitrogen applied to the surface.

(Riddick et al., in prep)