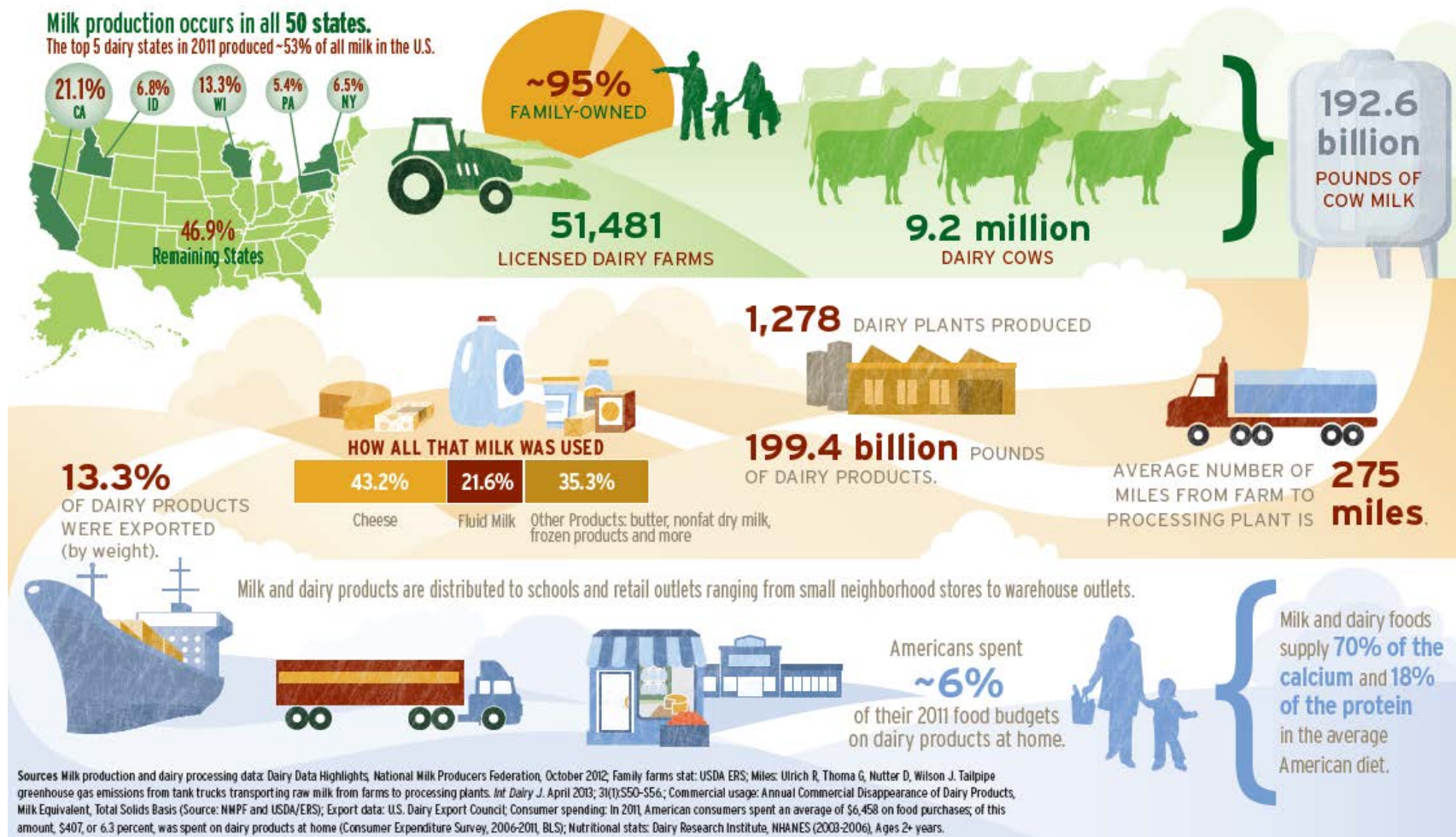

Modeling Ammonia Emissions from Dairy Production Systems in the United States

Jia Deng, Ying Wang, Changsheng Li
Earth Systems Research Center, EOS, UNH
Innovation Center for U.S. Dairy
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Contents

- Introduction
- NAMES & Manure-DNDC
- Model validation
- Alternative scenarios to mitigate NH₃ emissions
- Conclusions and next

About the Dairy Industry

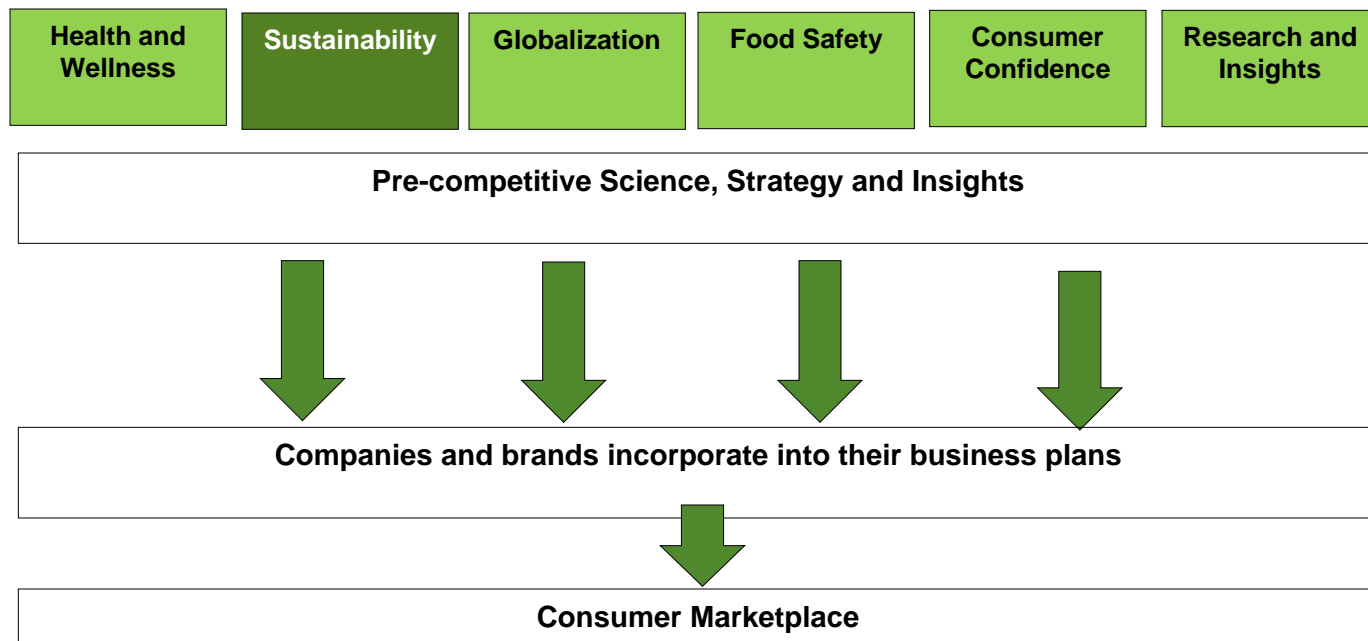


Innovation Center for U.S Dairy



34 CEOs and Chairmen of leading dairy companies and cooperatives

+800 professionals from dairy industry and beyond



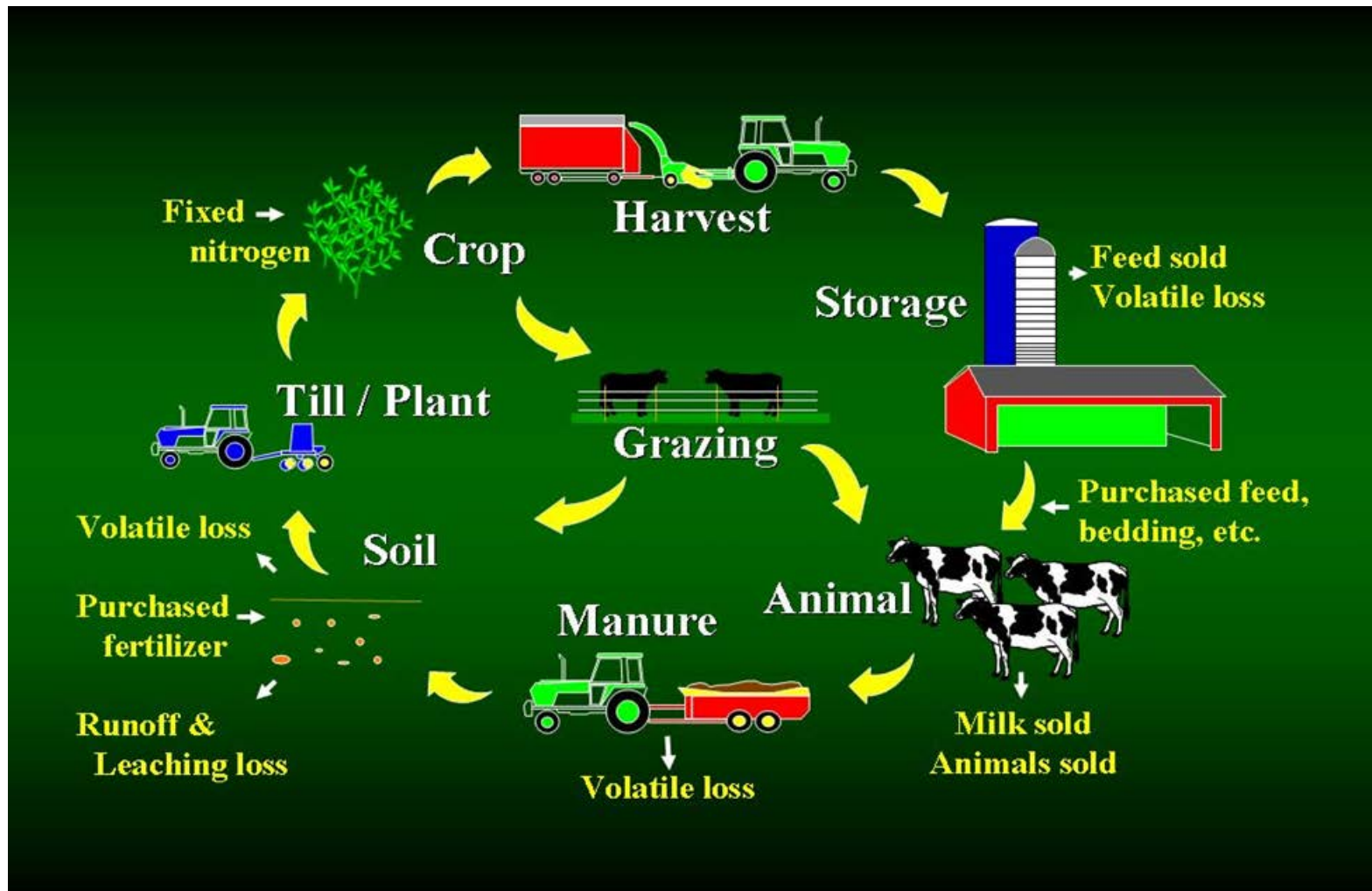


Alliance Dairies
 Clauss Dairy Farms
 Fair Oaks Farms
 Fiscalini Farms
 Foster Brothers Farm
 Gar-Lin Dairy Farm
 Graywood Farm
 Haubenschild Farms Inc.
 Kooistra Farms
 Maddox Dairy
 Medeiros & Sons Dairy
 Nobis Dairy
 Prairieland Dairy
 Rovey Dairy
 Simonson Dairy
 Spruce Haven Farm
 Stauffacher Highway Dairy
 Werkhoven Dairy

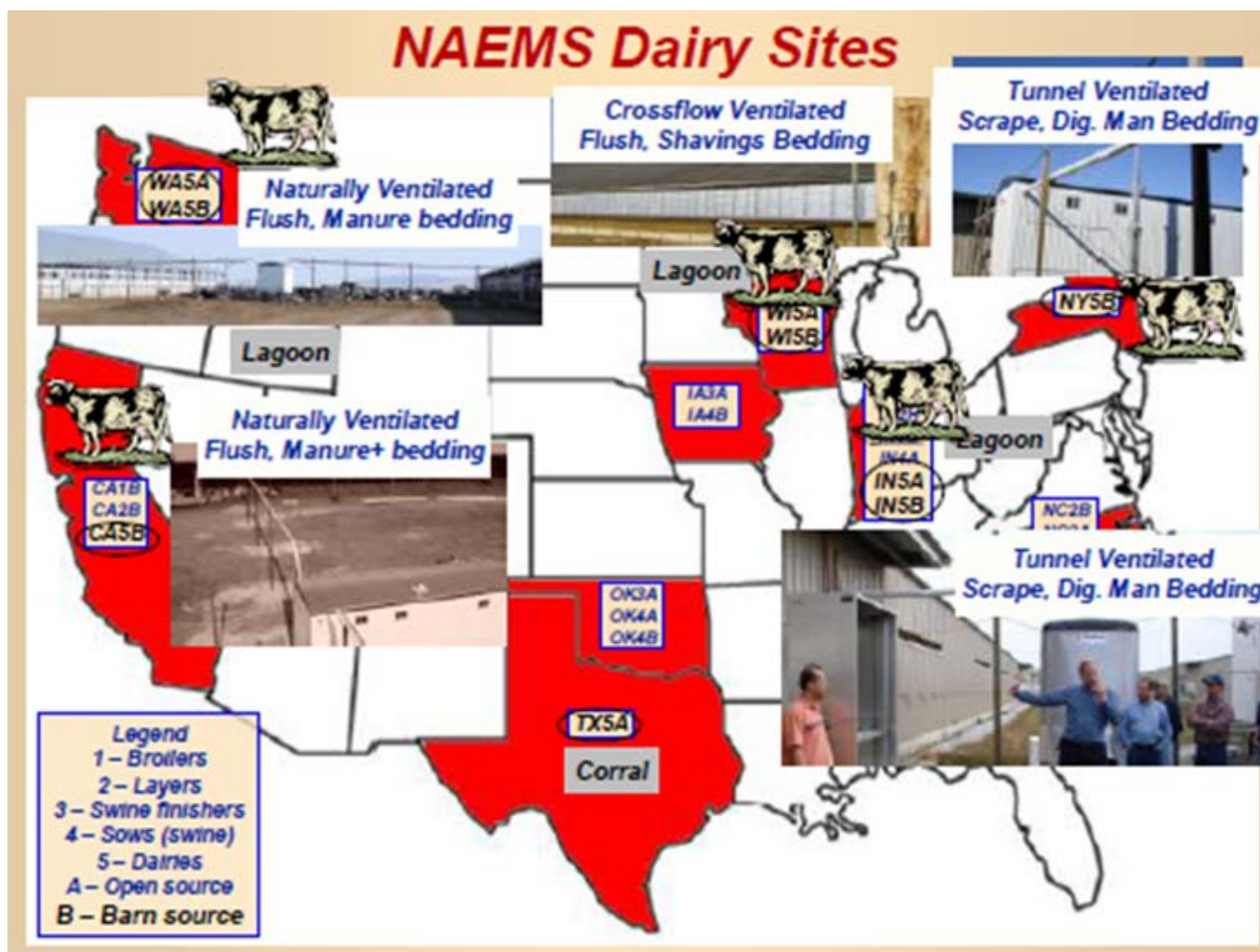


92 companies & 131 professionals in the Sustainability Council
 Leading 11 project teams with over 800 industry members contributing over \$6M

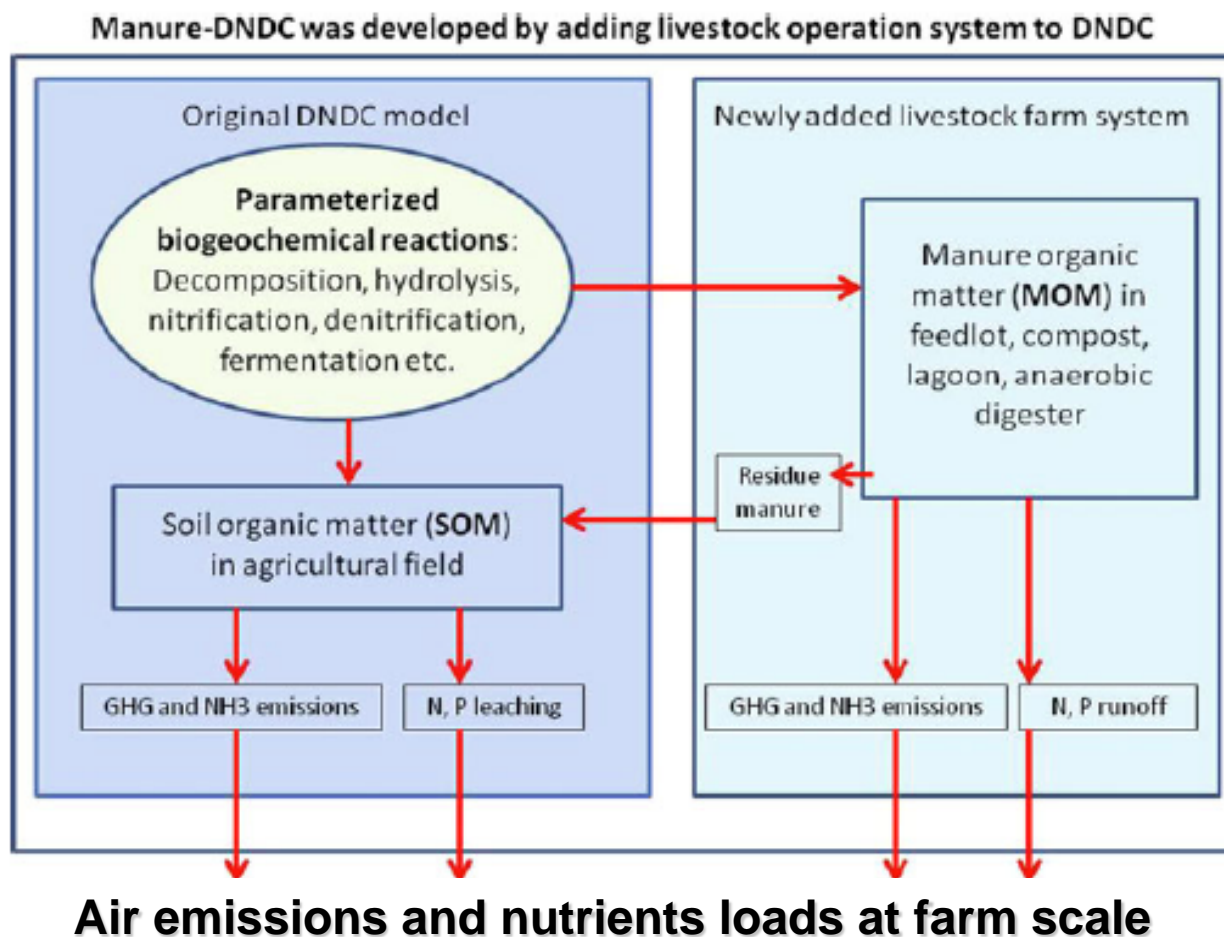
Environmental impact of dairy



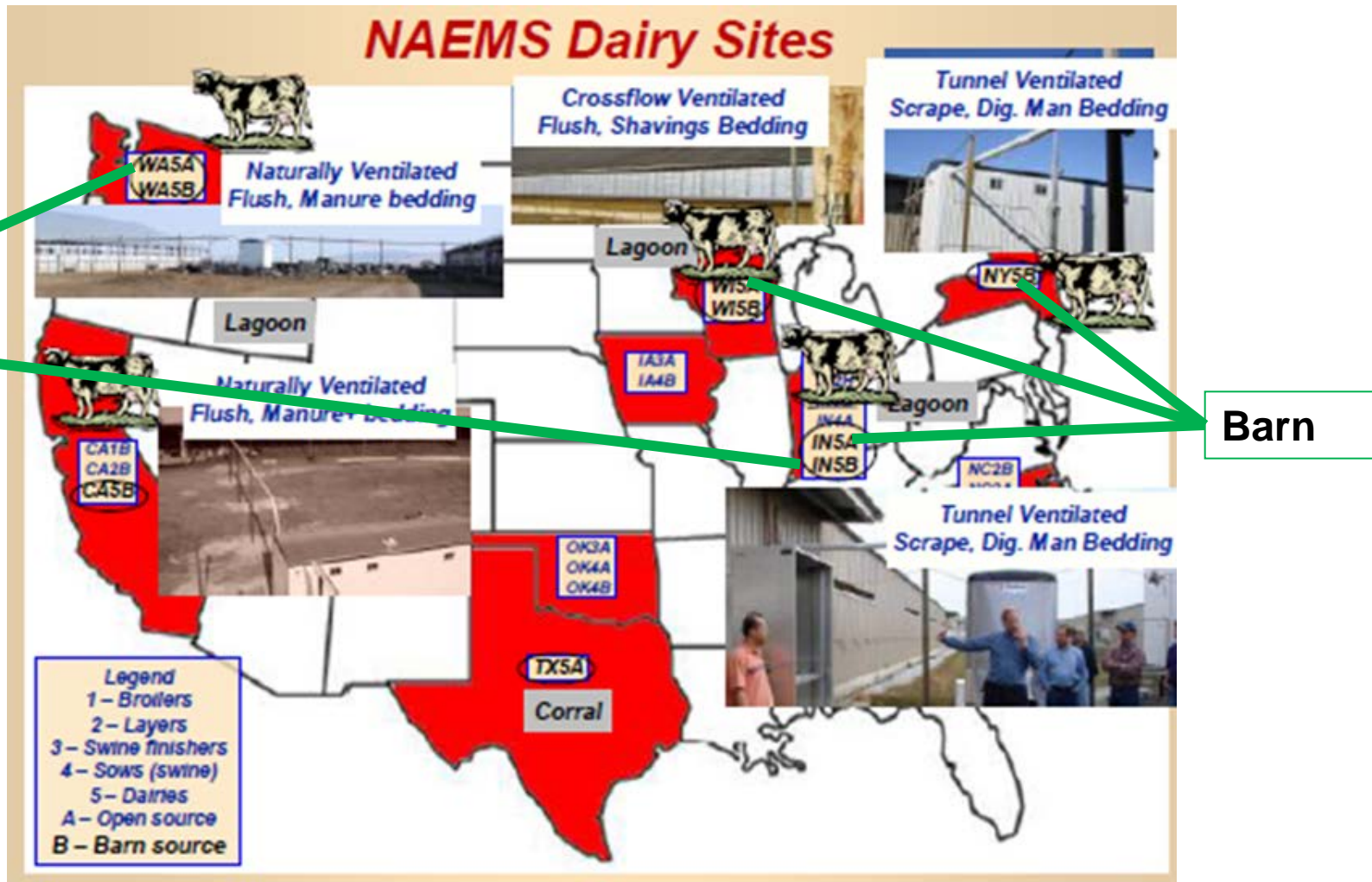
NAEMS (National Air Emissions Monitoring Study)



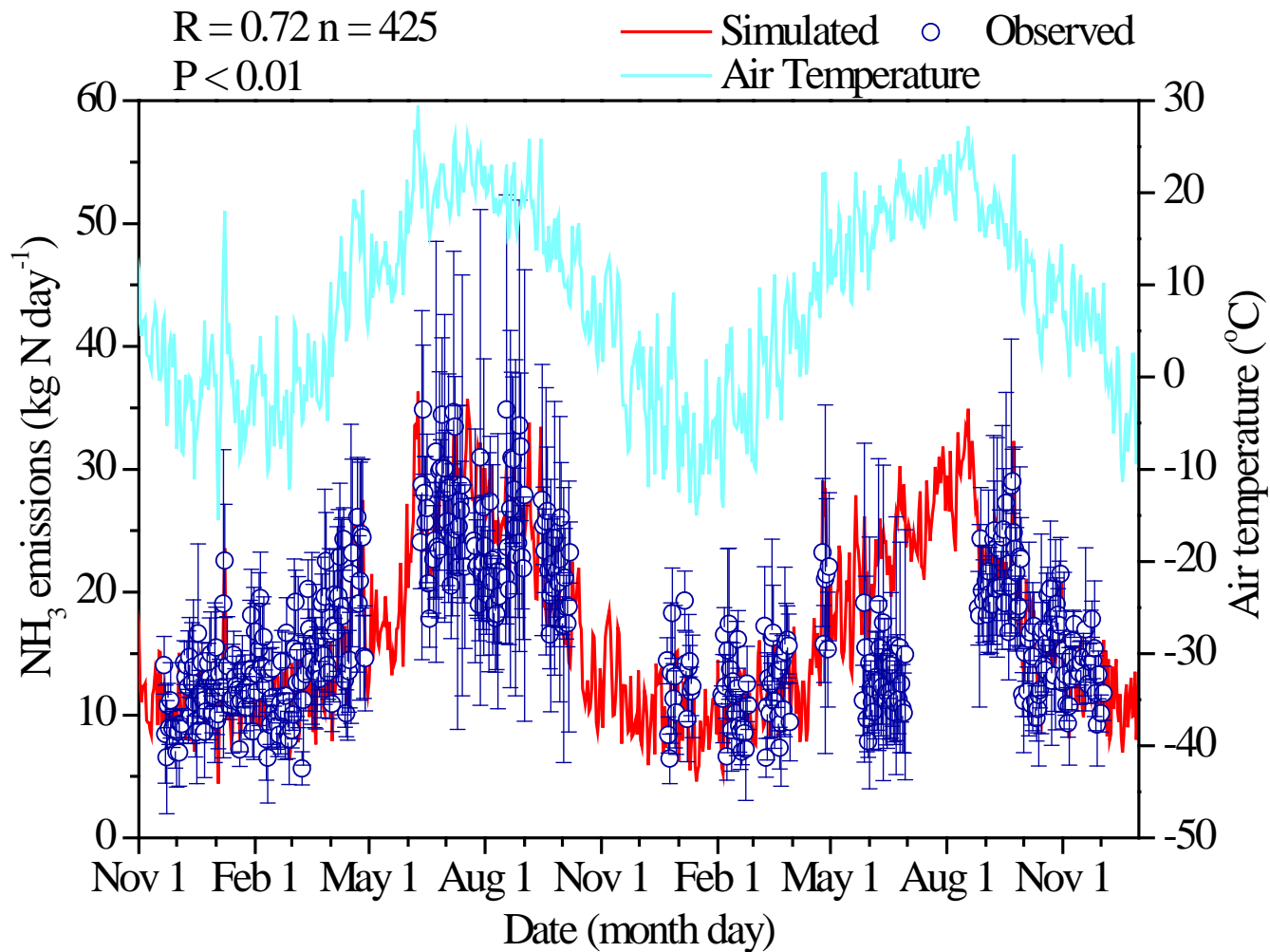
Manure - DNDC



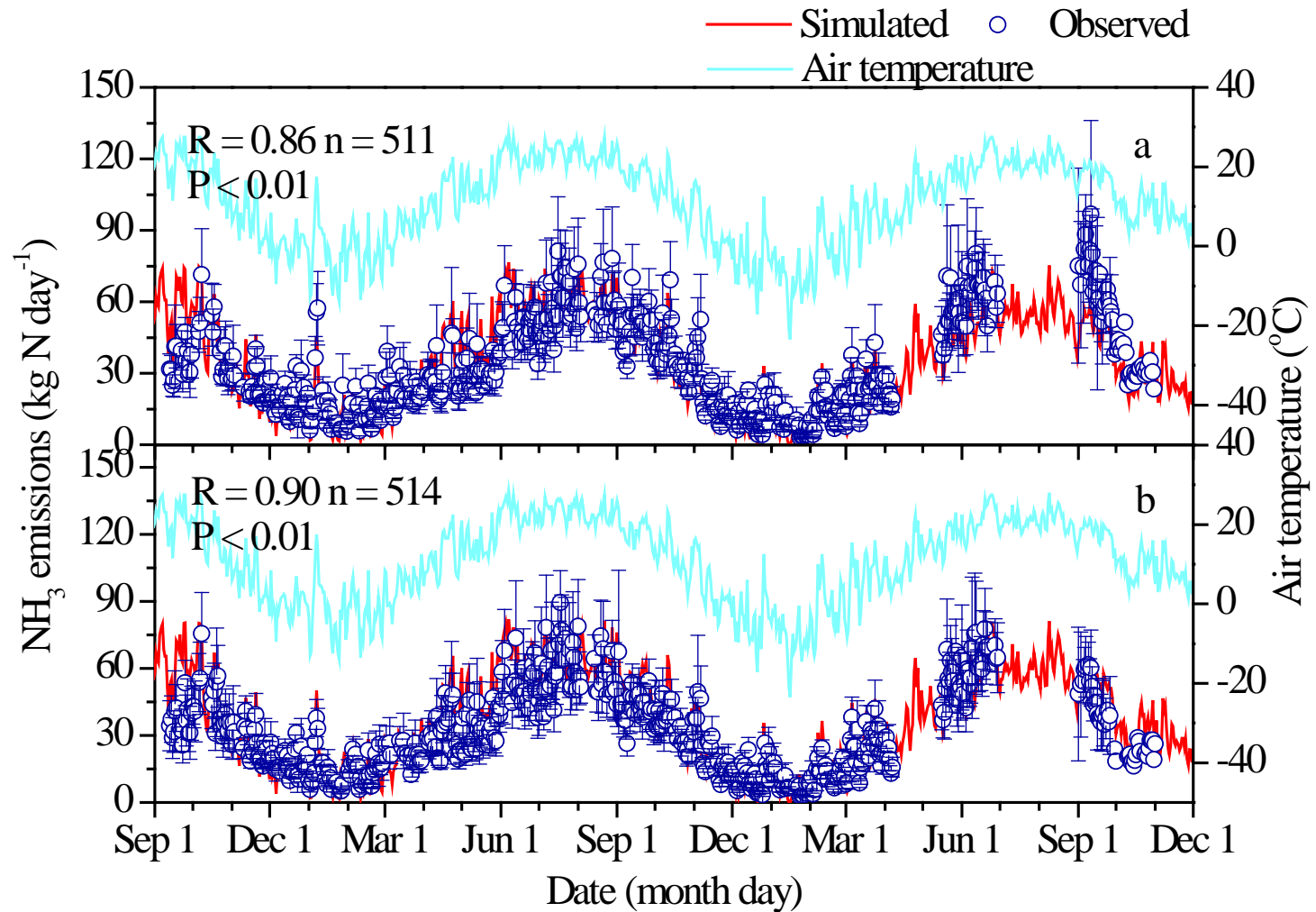
NH3 validation using NAEMS data



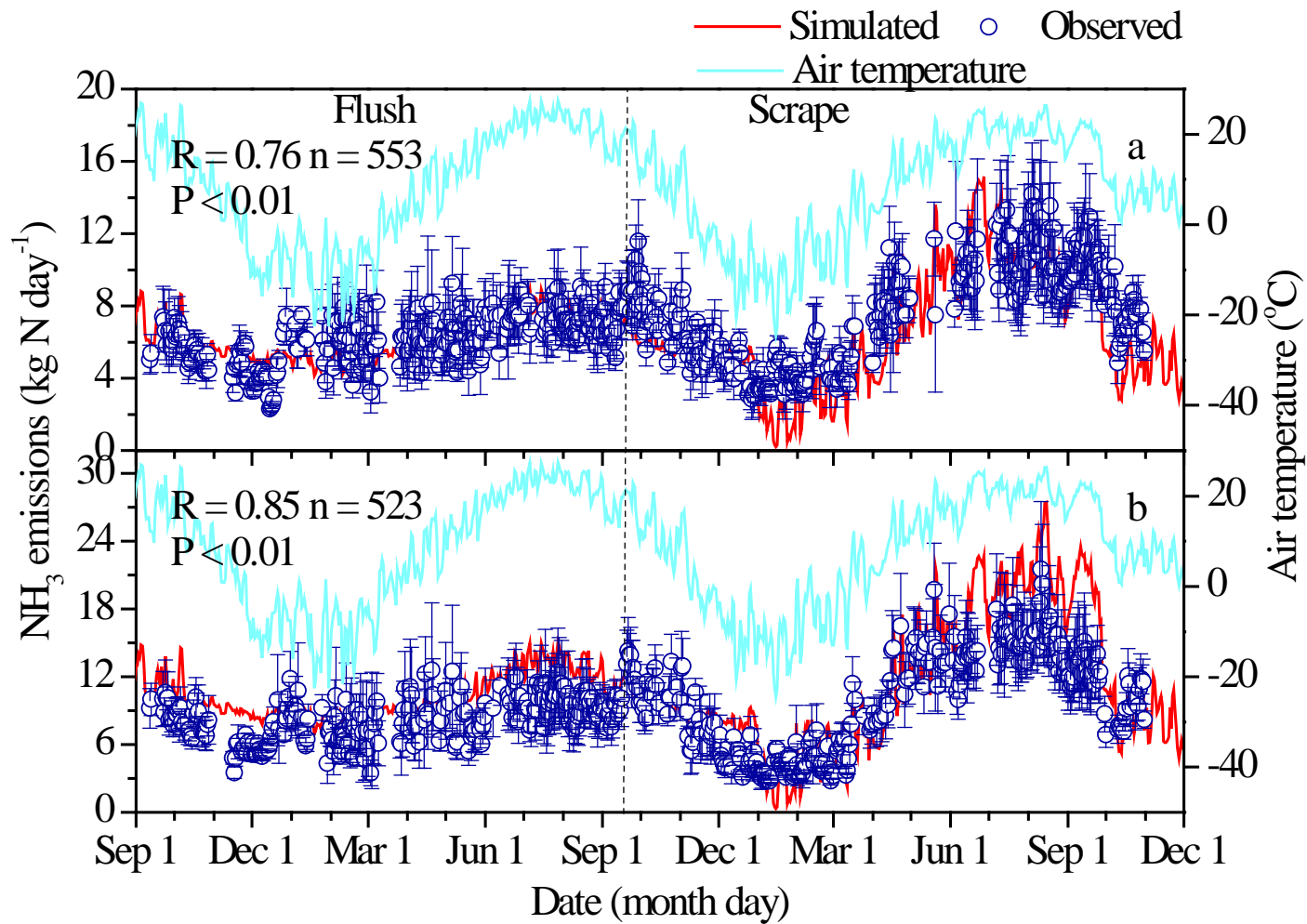
Model validation



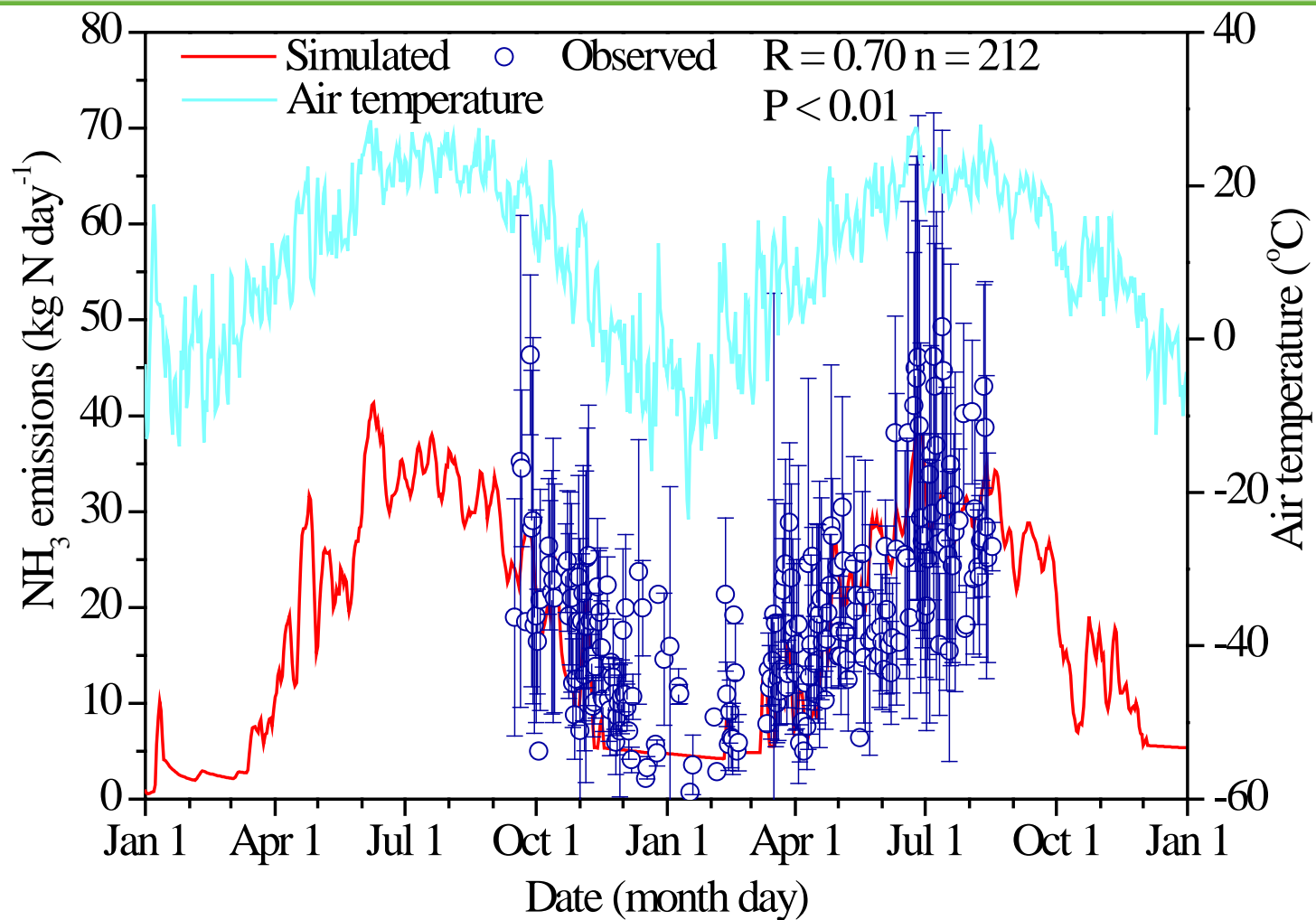
Model validation



Model validation



Model validation



Model validation

- Controlling factor of annual total NH₃ emissions: animal inventory.
- Other factors: climate, feed practices, manure removal method.
- Agreements between simulations and observations for all barns and the lagoon IN (RMSE: 4-21%).

NH₃ mitigation – mitigation potential of alternative management practices

Alternative Scenarios

Scenarios	Farming management practices
Baseline	Feeding rate: 24.2 kg head ⁻¹ day ⁻¹ ; CP: 16%; MRM: scraping; open lagoon; slurries in lagoon were removed one time annually; manure application: surface application.
AS1	Baseline + CP: 13%.
AS2	AS1 + flushing barns with recycled liquid urine to remove manure.
AS3	AS2 + covered lagoon.
AS4	AS3 + slurries in lagoon were removed two times annually.
AS5	AS4 + manure was incorporated into farm lands

CP: the concentration of crude protein in forage; MRM: manure removal method.

Baseline: a dairy farm located in the Indiana

Dairy cows: 3400

Barns: 2; floor: concrete with surface area of 3850 m²; manure removal : scraper on daily basis.

NH3 mitigation

	Baseline ^a	AS1	AS2	AS3	AS4	AS5
Cow number	3400	3400	3400	3400	3400	3400
CP (%) ^b	16	13	13	13	13	13
N intake rate (kg N cow ⁻¹ yr ⁻¹)	226	184	184	184	184	184
N excretion rate (kg N cow ⁻¹ yr ⁻¹)	156	127	127	127	127	127
NH ₃ losses form barns (kg N cow ⁻¹ yr ⁻¹)	15.7	12.8	10.8	10.8	10.8	10.8
N imported into lagoon (kg N cow ⁻¹ yr ⁻¹)	140	114	116	116	116	116
NH ₃ losses form lagoon (kg N cow ⁻¹ yr ⁻¹)	12.4	11.3	7.9	1.6	1.5	1.5
N applied into crop fields (kg N ha ⁻¹ yr ⁻¹)	159	127	135	143	144	144
NH ₃ losses form crop fields (kg N ha ⁻¹ yr ⁻¹)	38.4	29.5	32.3	35.6	30.3	21.6
NH ₃ losses from whole farm (kg N cow ⁻¹ yr ⁻¹)	58.6	47.5	44.3	40.6	36.3	29.5
NH ₃ emissions from farm / Manure-N (%)	38%	37%	35%	32%	29%	23%

NH3 mitigation

- All alternative management practices mitigated NH3 losses.
- Intervening management practices may simultaneously regulate NH3 emissions from several components.
- Up to 50% reduction of NH3 emissions.

Conclusions and next

- Model validation: consistency and uncertainty
- NH₃ mitigation: other ecosystem factors
- Database and regional analysis



Thank you !