Emissions of Ammonia, Methane, and Nitrous Oxide from Dairy Production Systems in a Semi-Arid Climate

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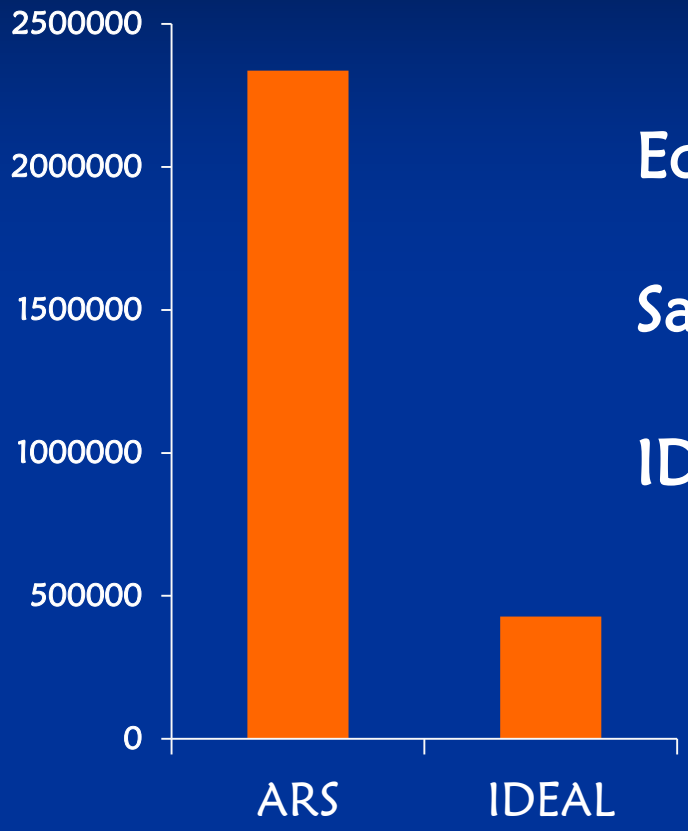
The Cost of Doing Emissions Work



Equipment: $536,000

Salaries & Supplies: $1,800,000

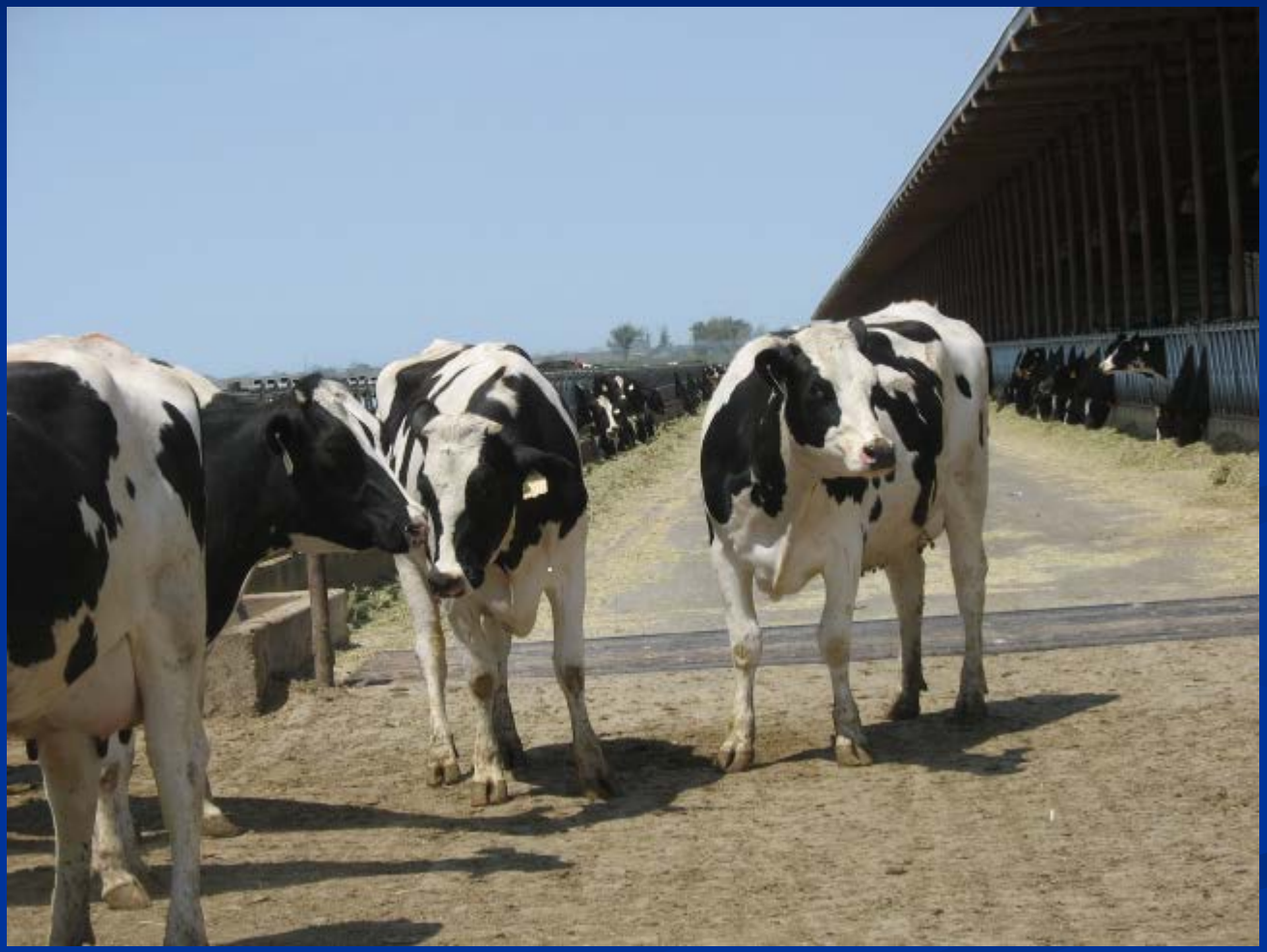
IDEAL Funding: $427,959

Farm 1. 700 Milking Cow Production Facility (780 total cows with ~60 m^2 cow^{-1})

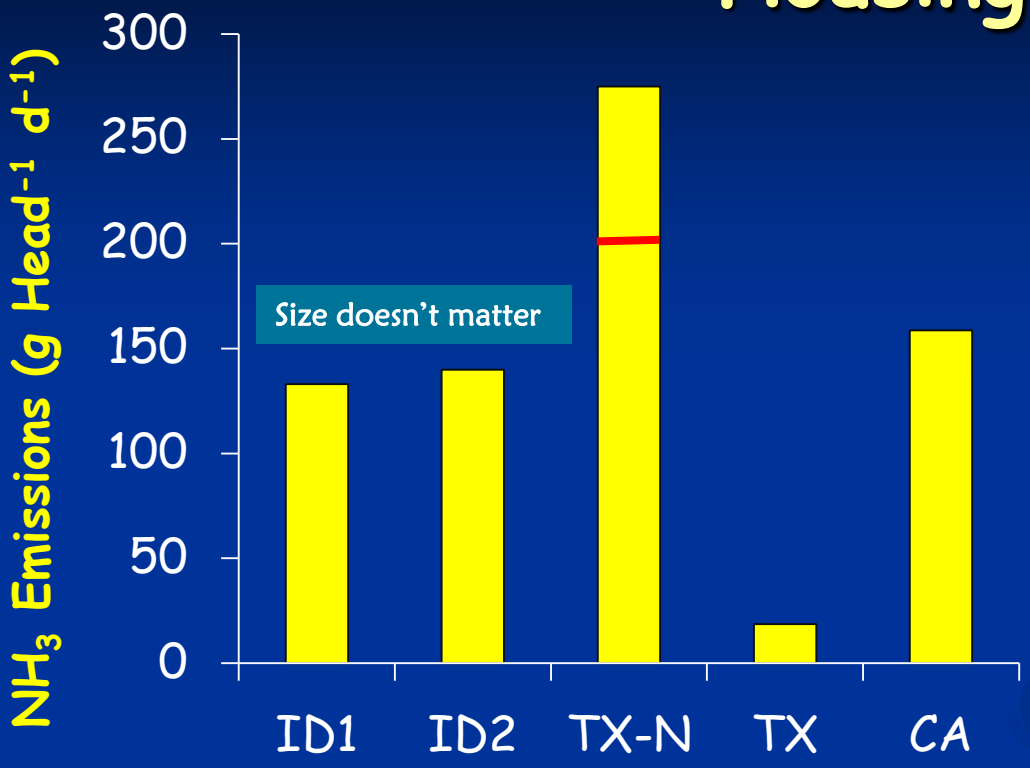
Farm 2. 10,000 Milking Cow Production Facility (10,800 total cows with ~55m^2 cow^{-1})

Farm 3. 10,000 Milking Cow Production Facility (10,000 total cows with ~27m^2 cow^{-1})

Emissions from Housing



Ammonia Emissions from Open Lot Dairy Housing



Difference in Methods?

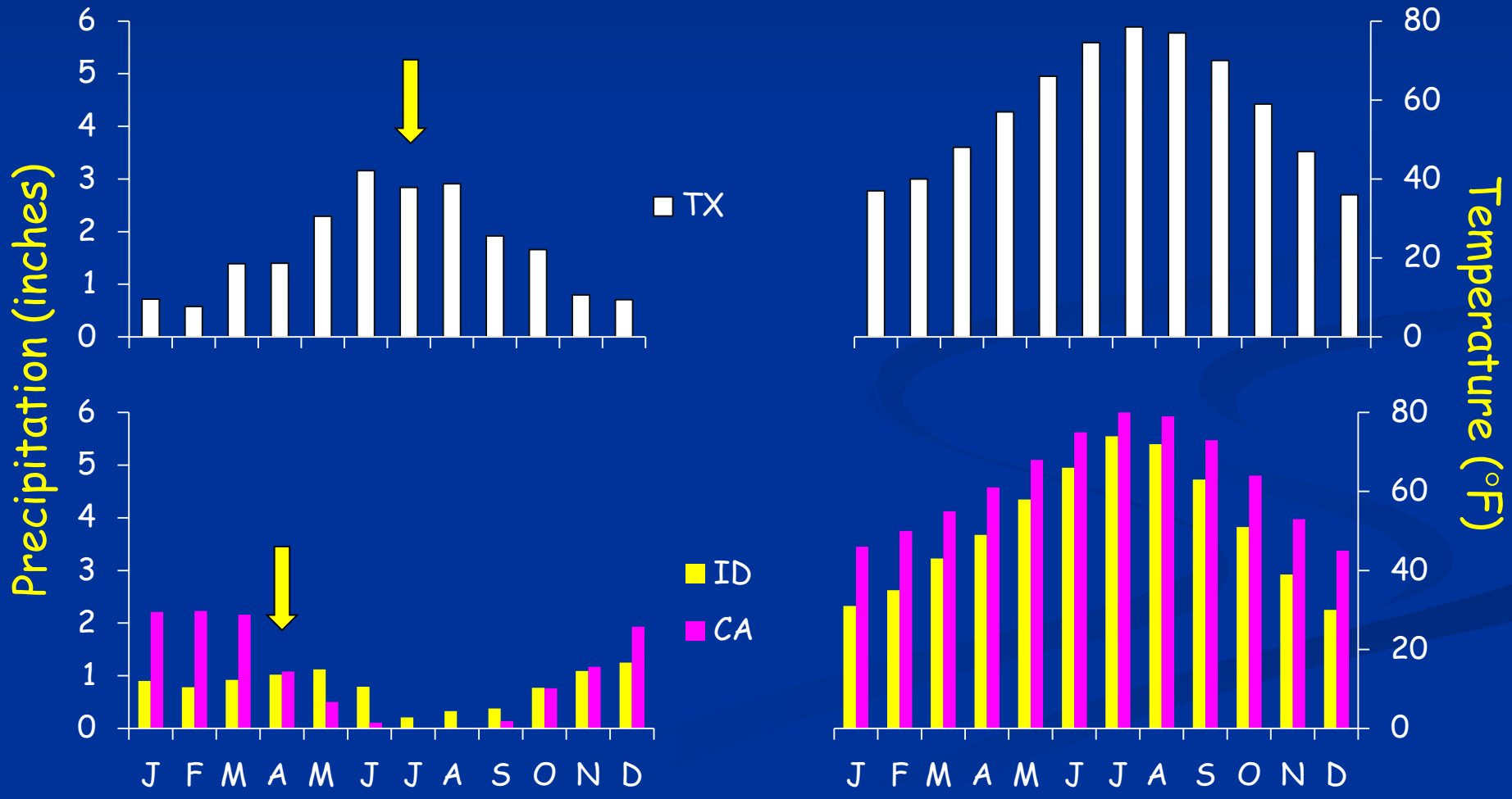
- ID1, ID2, TX-N, CA used a non-interference method (inverse dispersion modeling)
- TX used a chamber method

Changes in Feeding and Influence of Lot Management?

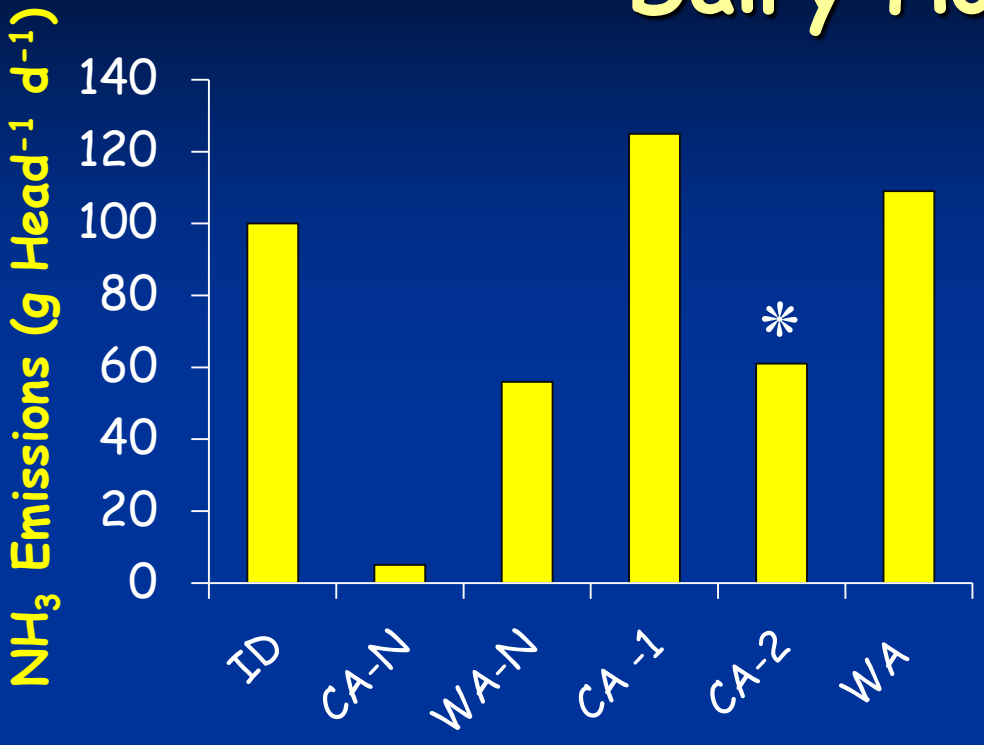
- Manure samples were taken from the TX-N site during each sampling month. Manure ammonia increased from 0.02% during three of the seasons to 0.04% during the summer sampling event
- Also during this time they were harrowing the lots and hauling out manure

Climate Variability

Need to look at temperature AND precipitation patterns



Ammonia Emissions from Open-Freestall Dairy Housing



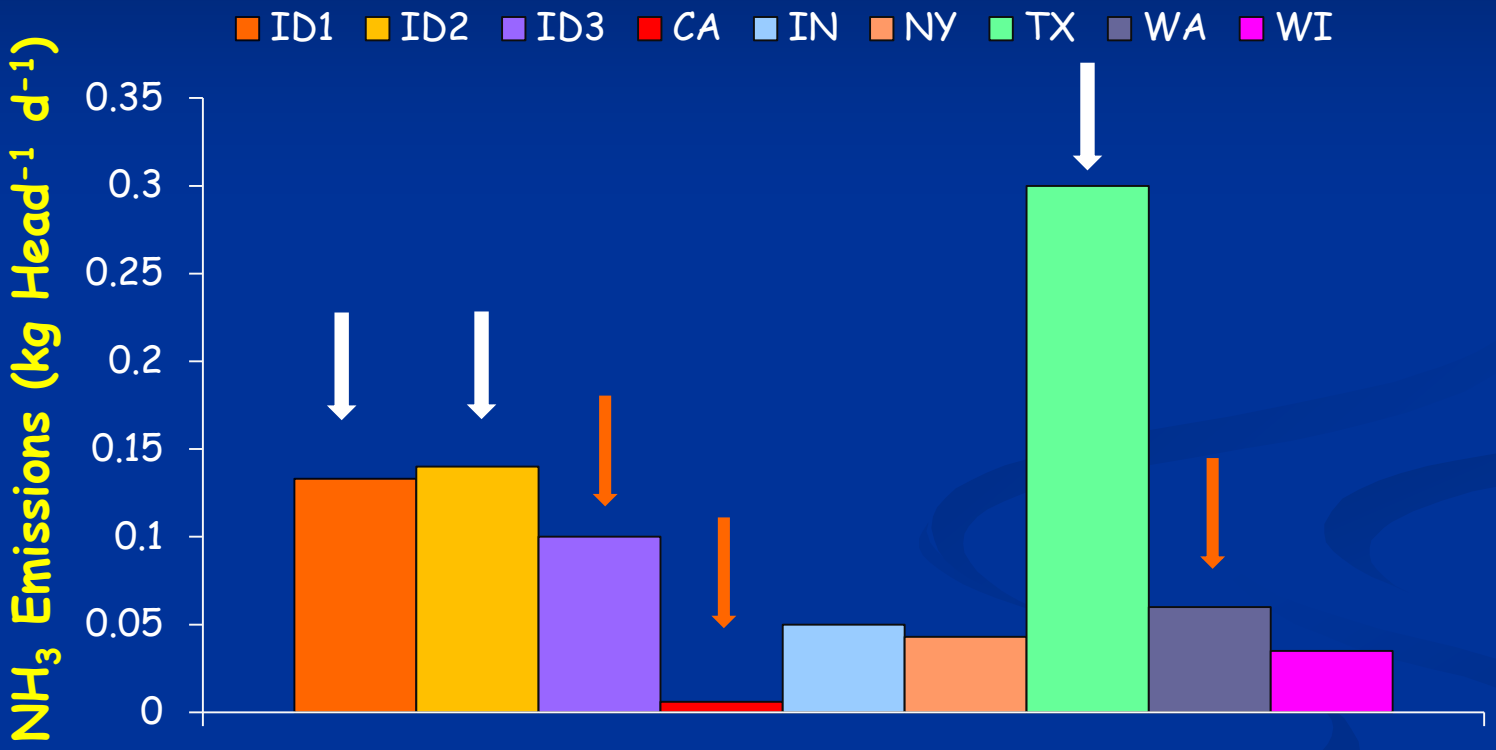
Difference in Methods?

- ID, CA, WA used non-interference methods (inverse dispersion modeling, micromet). CA-2 measurements were during low emissions time periods and in Feb.
- CA-N and WA-N estimated emissions from wind velocities in barn and concentration measurements

Biologically Reasonable?

- With non-interference methods NH_3 losses range from 15 to 17% of N intake or 21 to 24% of excreted N. (does not account for losses in manure storage)
- NH_3 losses from CA-N dairy would be 0.7% of N intake or 1% of N excreted

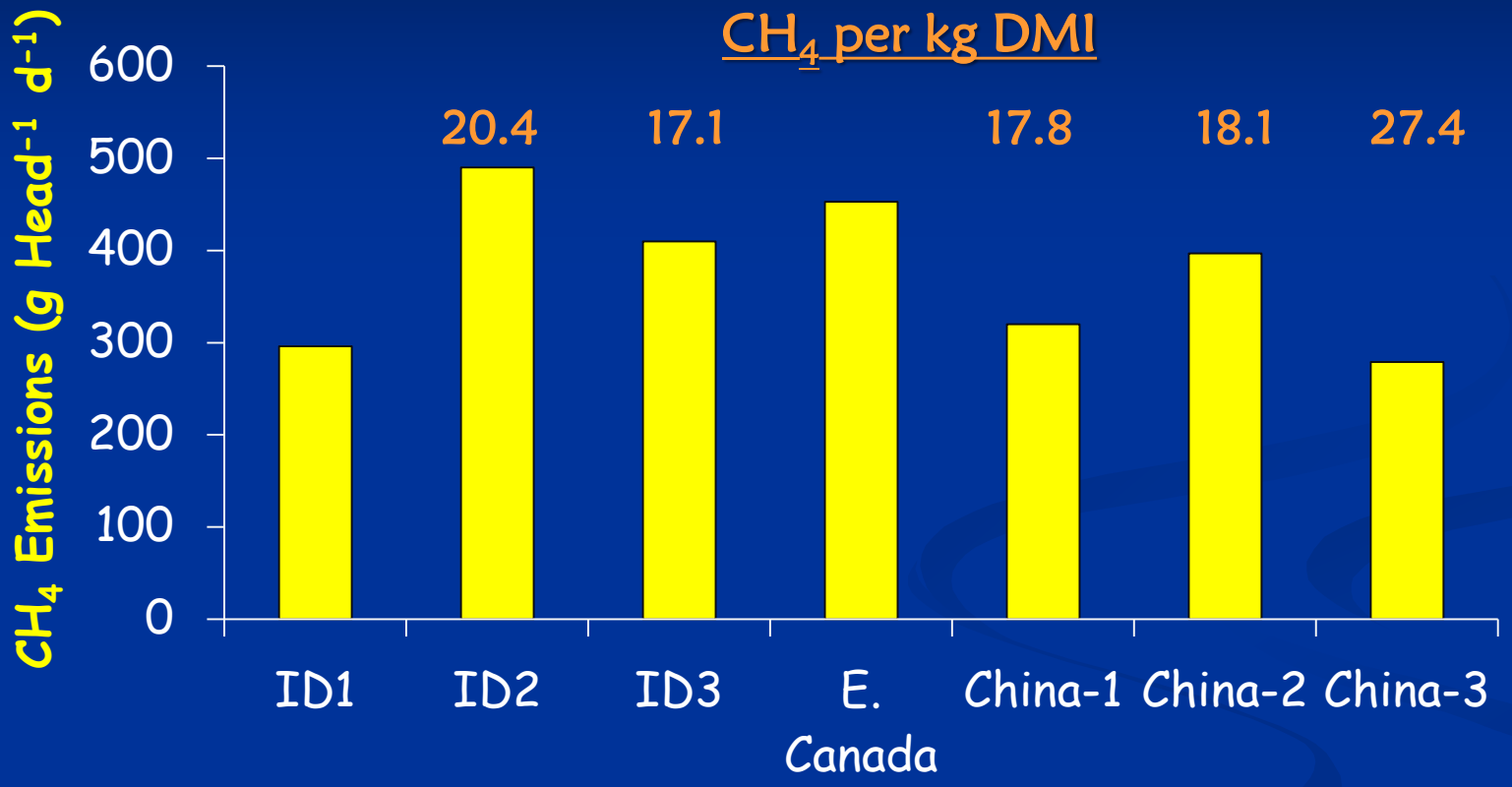
Comparison of Average Ammonia Emissions From Housing with NAEMS Data



Variations in climate, feed and housing type

Ammonia not lost in housing is likely lost somewhere else

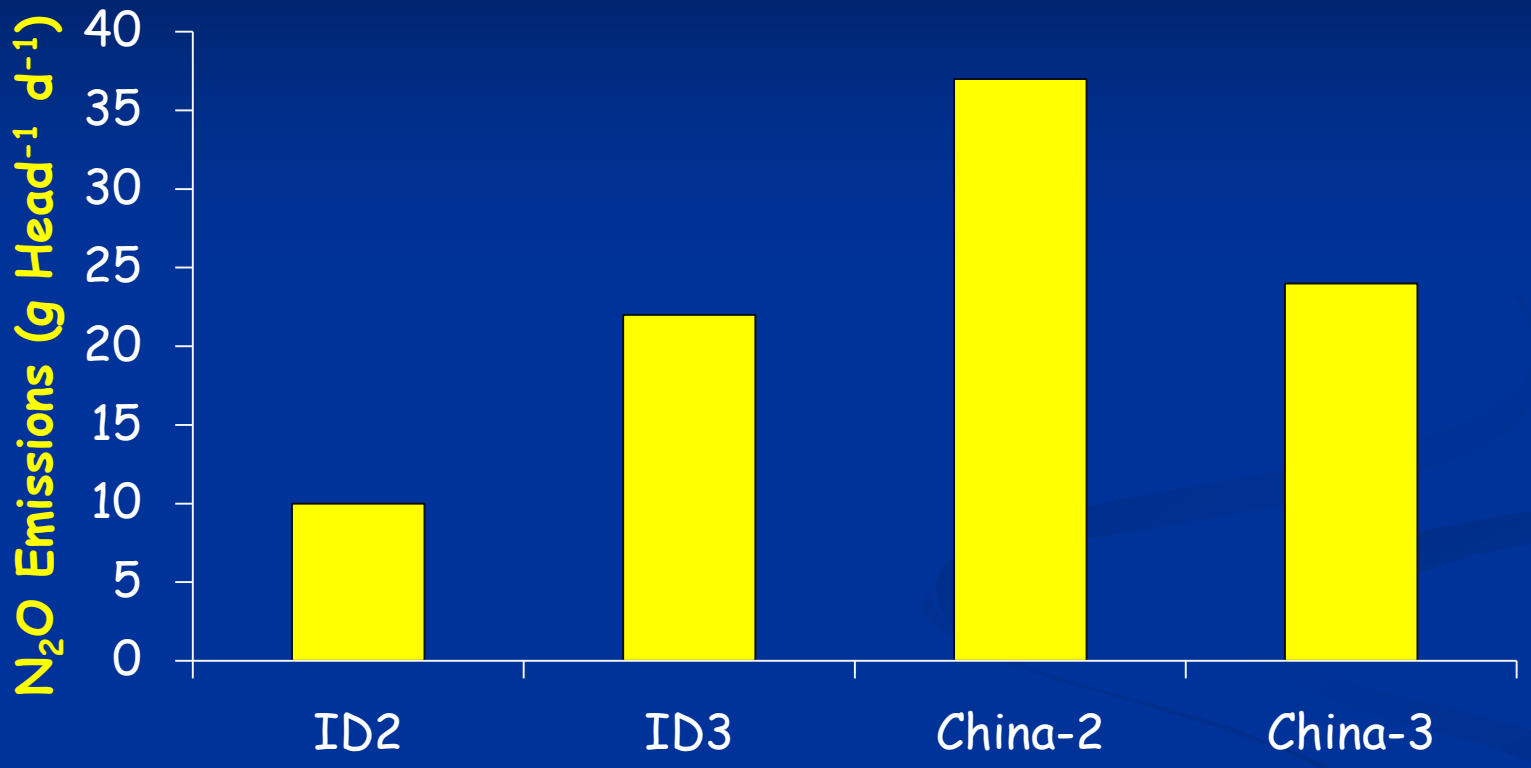
Methane Emissions from Open Lot & Open-Freestall Dairy Housing



Differences in Animal Populations and Feed Efficiencies

- E. Canada site had dry cows and heifers on open-lot
- China-3 had heifers

Nitrous Oxide Emissions from Open Lot & Open-Freestall Dairy Housing



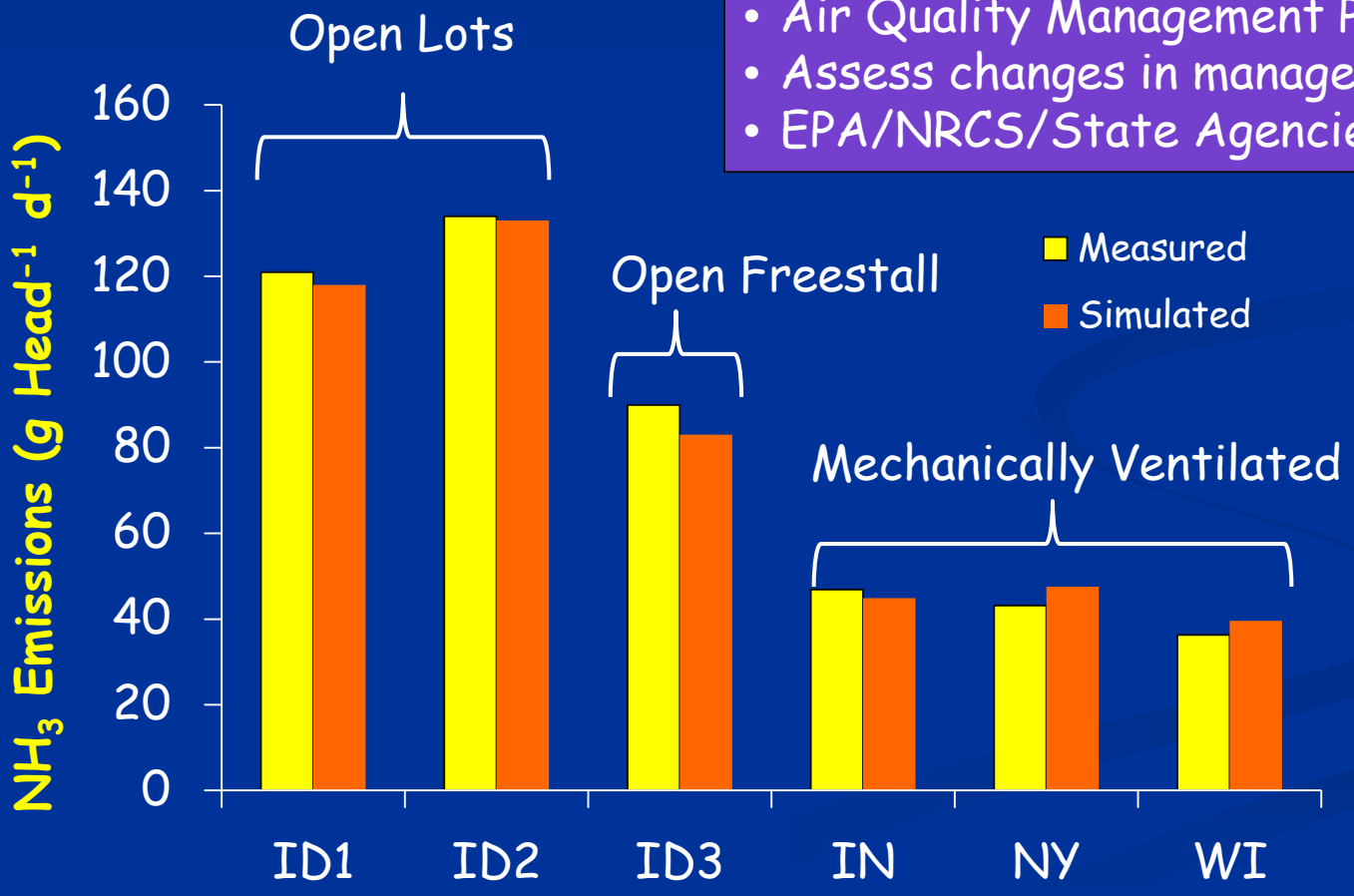
Differences in Animal Populations and feed efficiencies

- China-3 had heifers

Comparison of Annual Measured and Simulated (IFSM) Ammonia Emissions from Dairy Housing

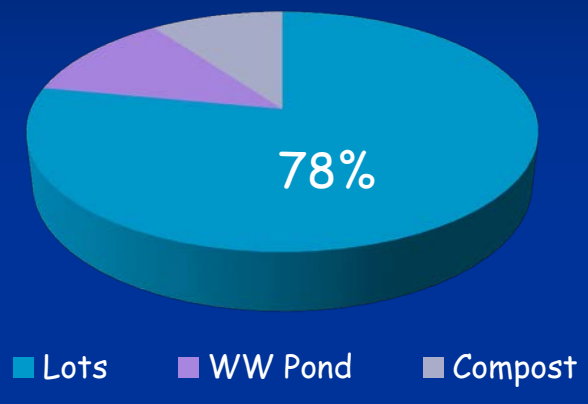
If we have a model that is easy to use, then we can generate emission factors that could be used for:

- Air Quality Management Plans
- Assess changes in management practices
- EPA/NRCS/State Agencies

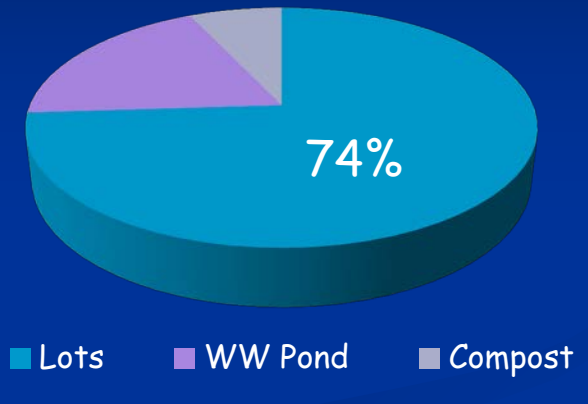


Contribution of Different Production Sectors on Emissions at Open Lot Dairy

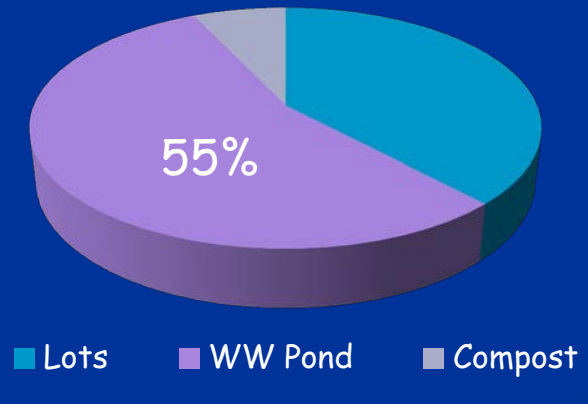
Ammonia



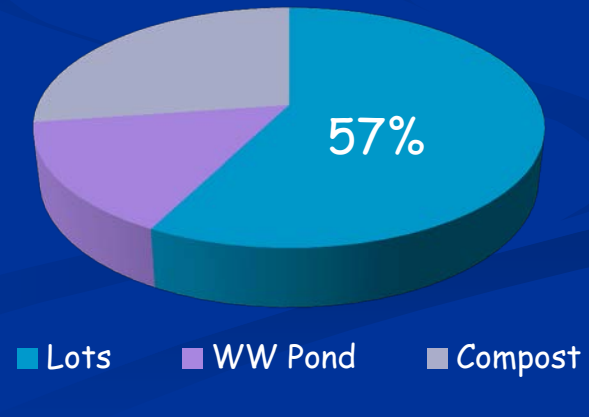
Methane Spring



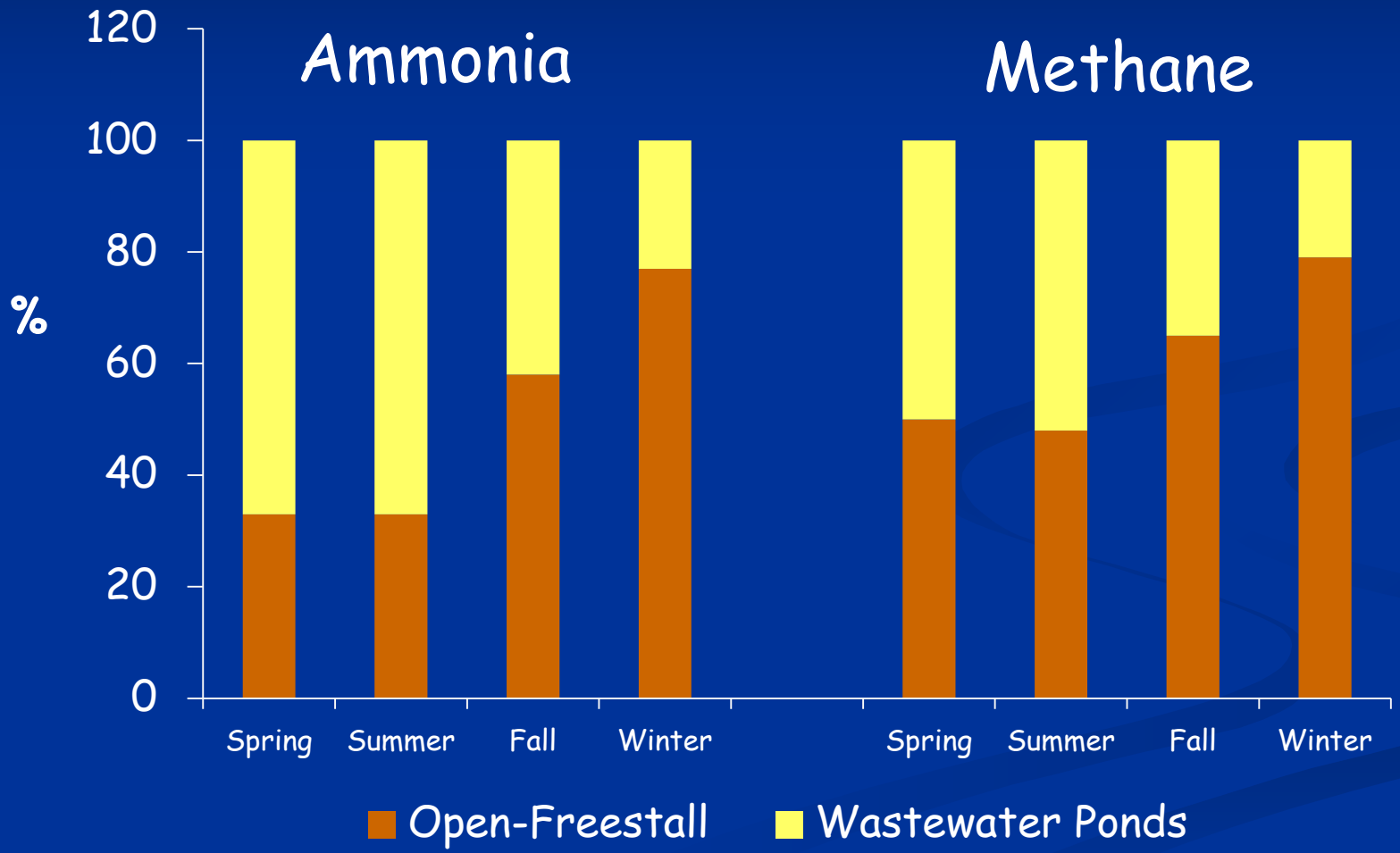
Methane Summer



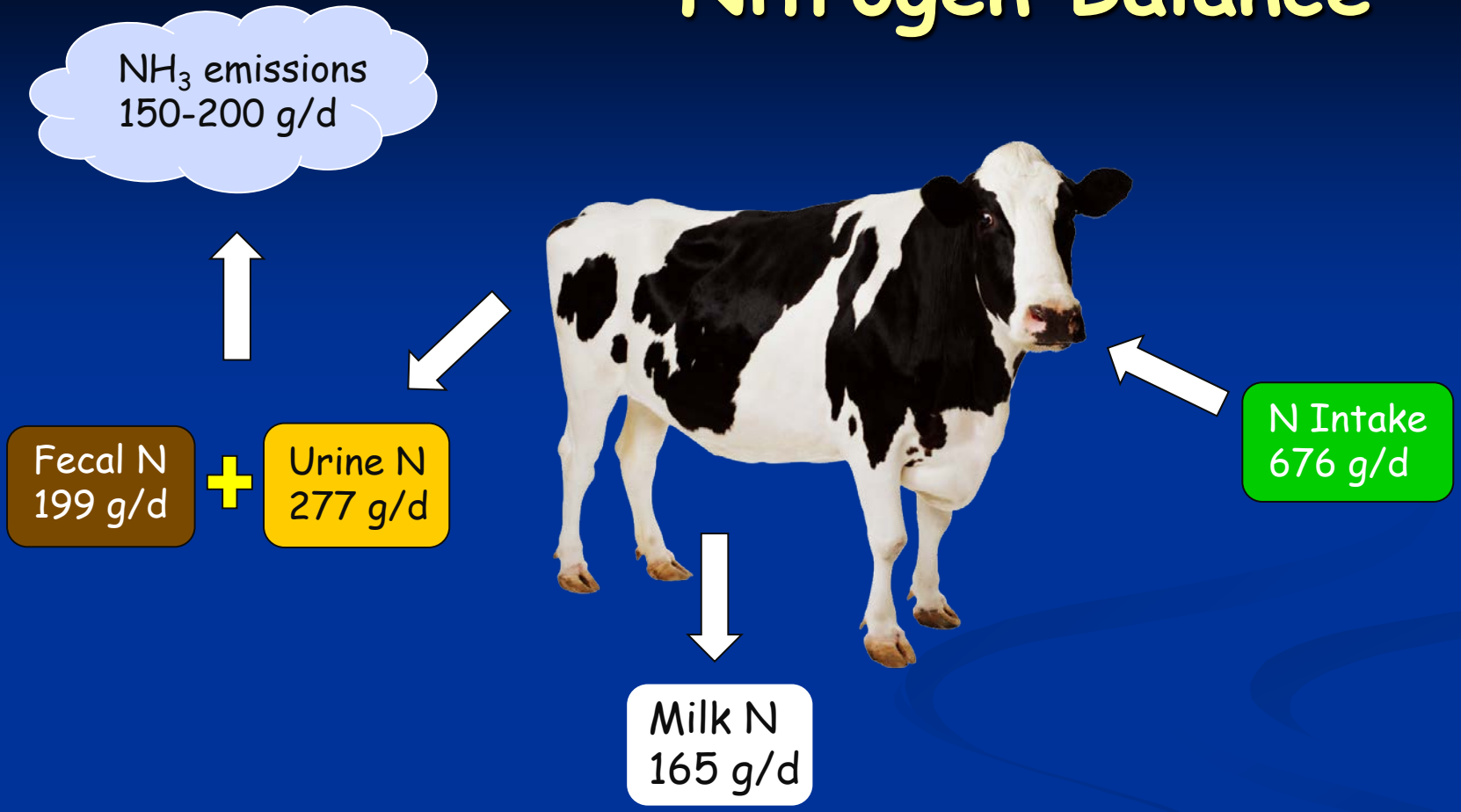
Nitrous Oxide



Contribution of Different Production Sectors on Emissions at OFS Dairy



Nitrogen Balance



Based on a calculated N balance:

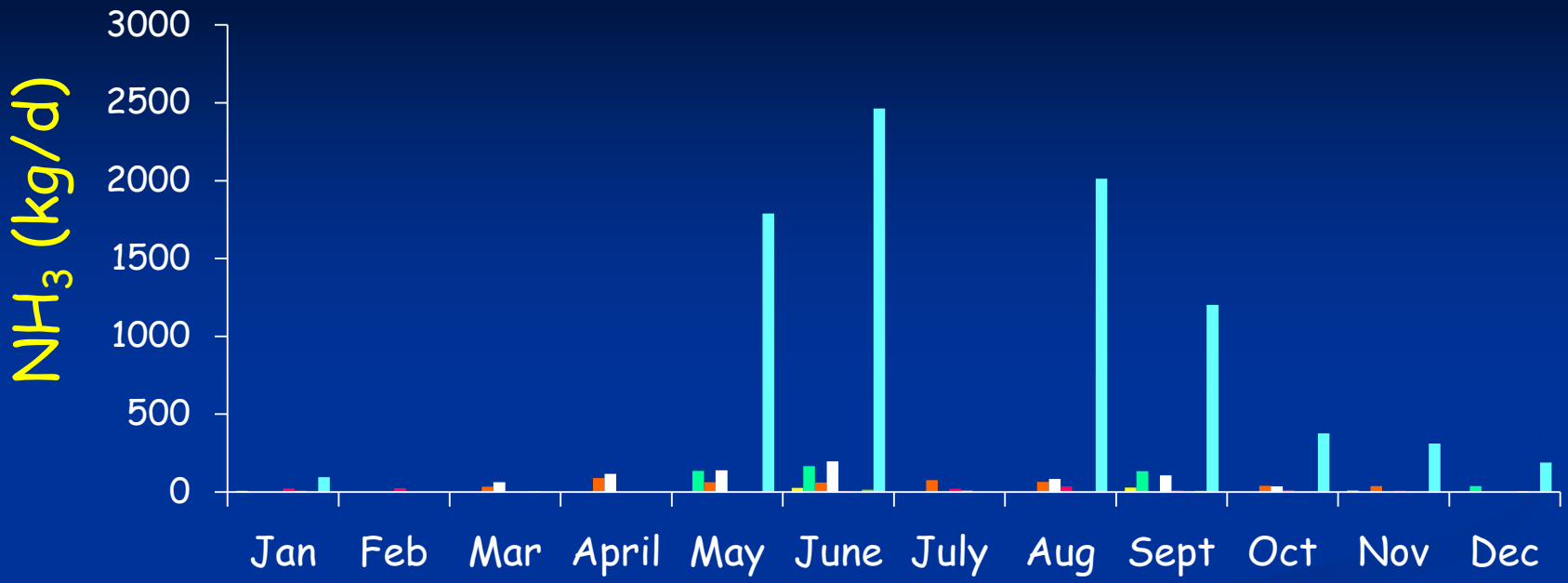
22-30% of total N ingested was lost as NH_3

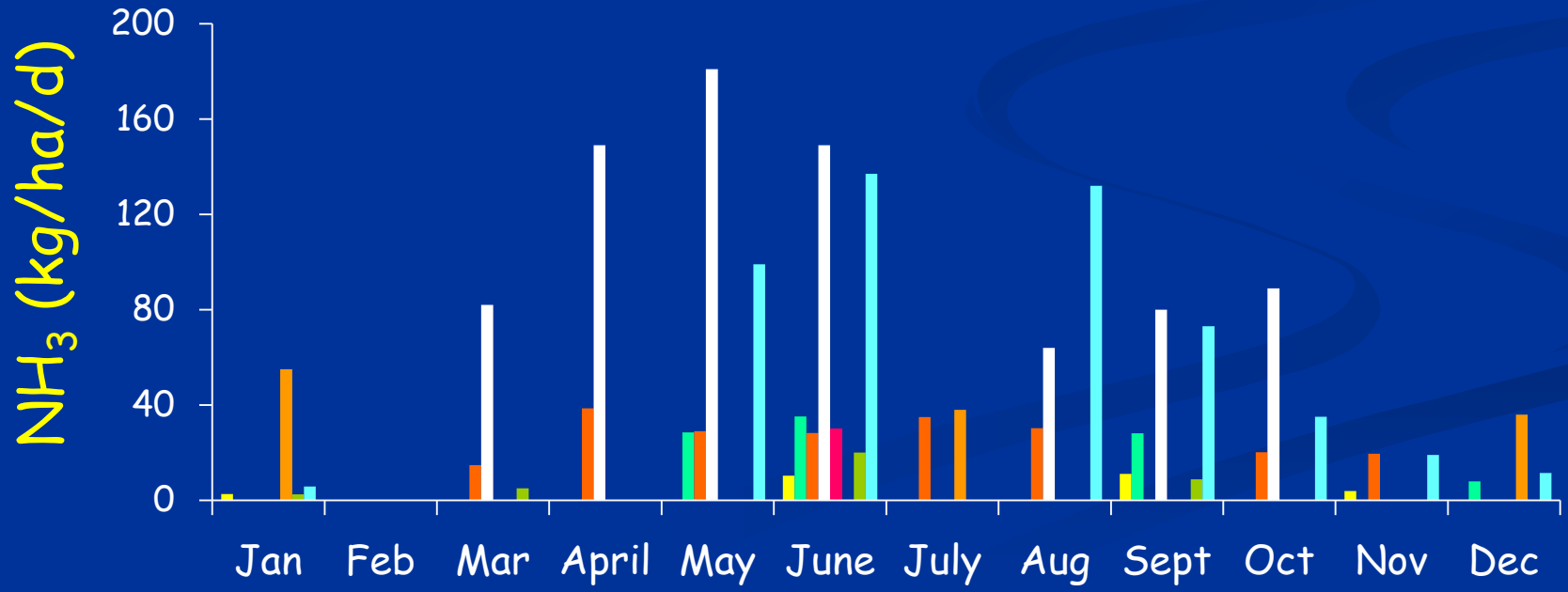
32-42% of total N excreted was lost as NH_3

54-72% of urinary N excreted was lost as NH_3

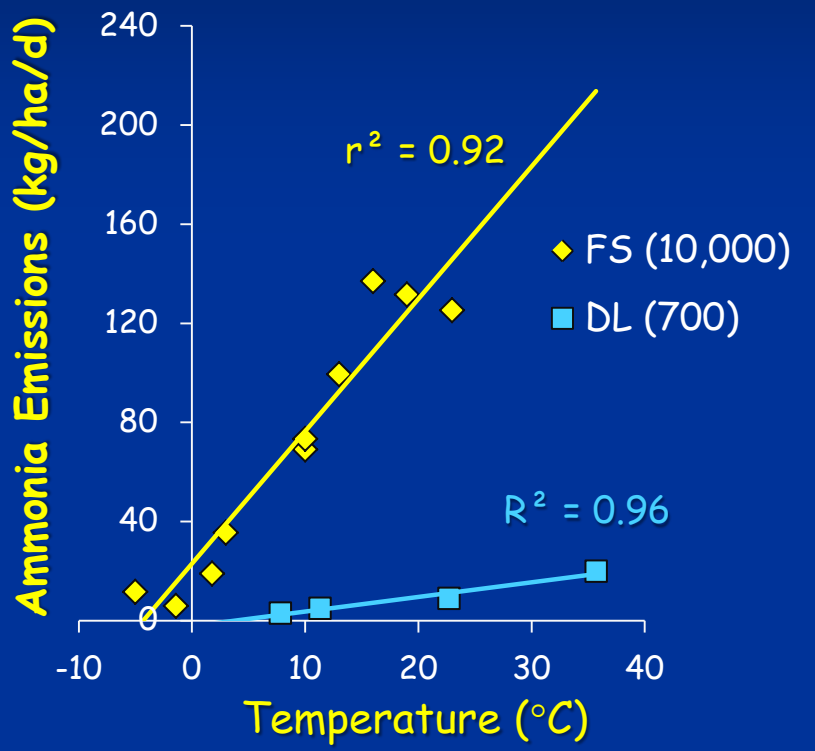
Measuring Ammonia and Greenhouse Gas Emissions from Dairy Wastewater Ponds

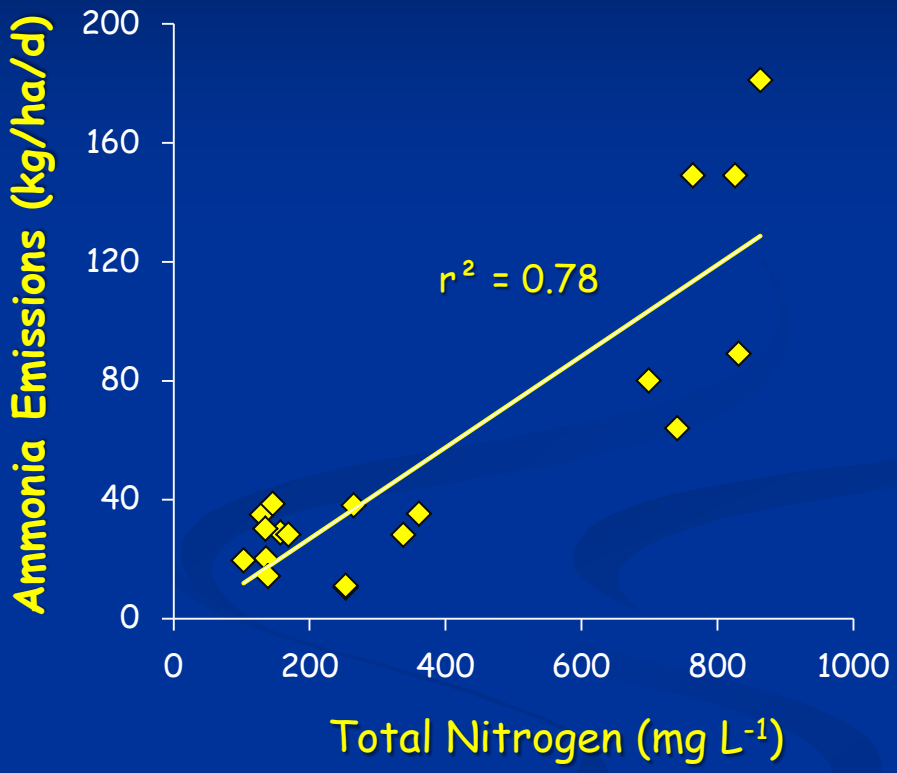
Ammonia Emissions from Wastewater Ponds





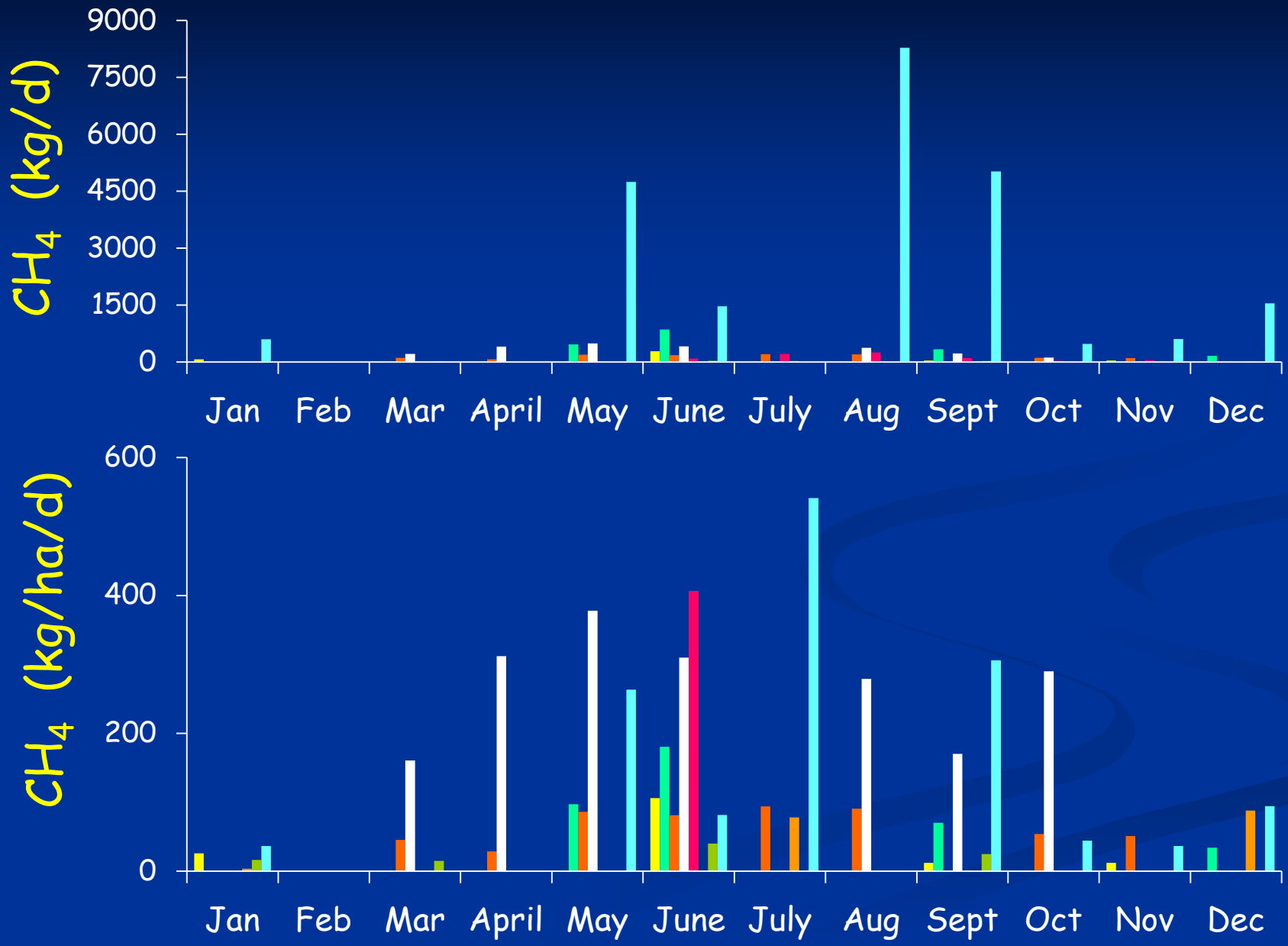
Relationship Between Wastewater Emissions Climate and Chemical Characteristics



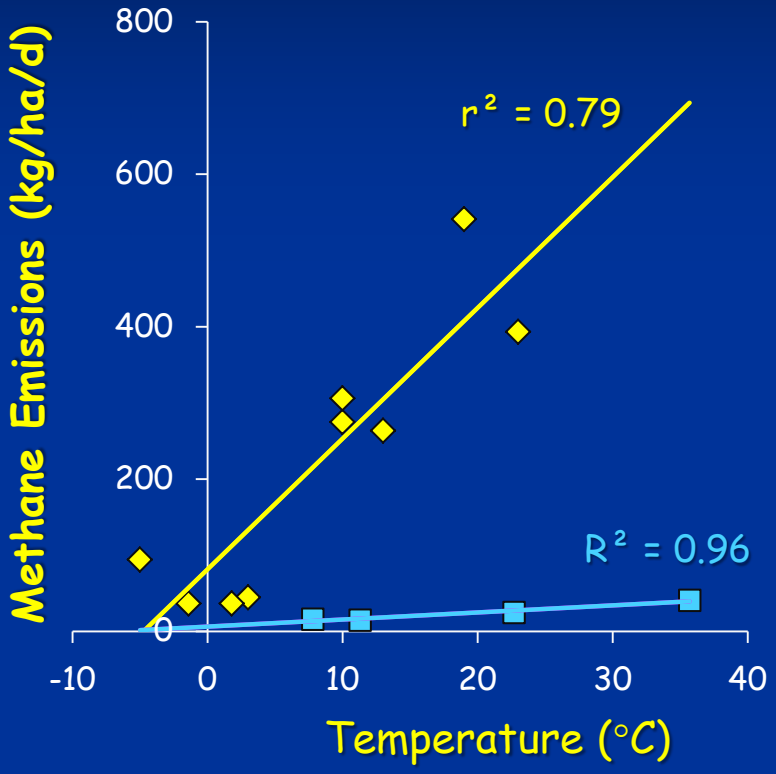


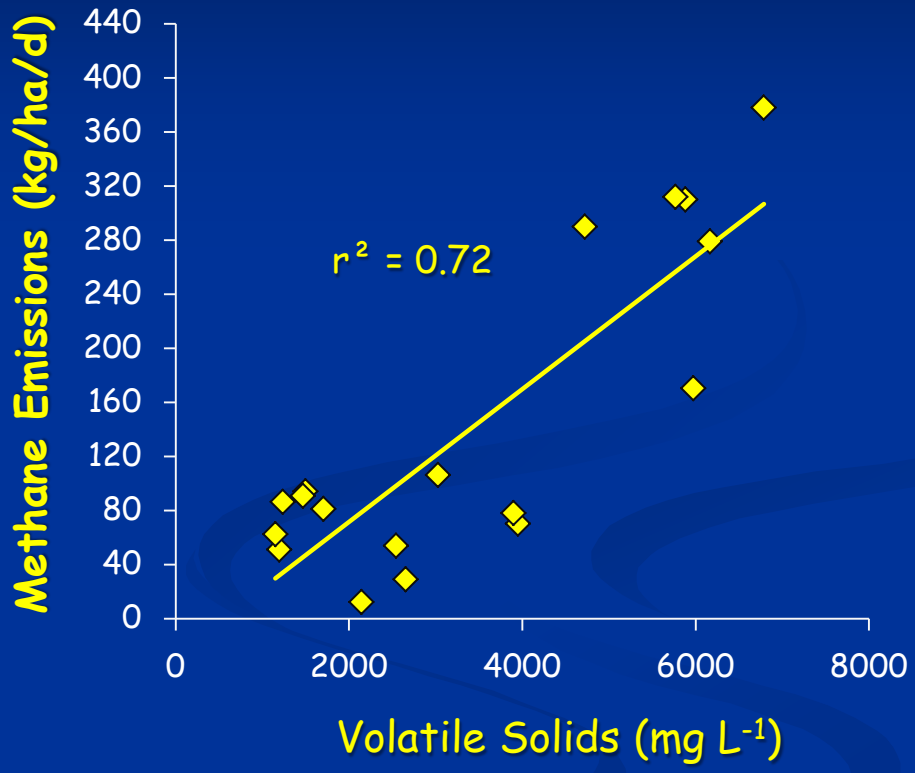
- Emissions are related to temperature only within a given dairy
- Total N and TAN have a large influence over emissions

Methane Emissions from Wastewater Ponds



Relationship Between Wastewater Emissions Climate and Chemical Characteristics





- Emissions are related to temperature only within a given dairy
- Total Solids, Volatile Solids and Chemical Oxygen Demand have a large influence over emissions

Nitrous Oxide Emissions from Wastewater Ponds

Projects in Progress

- Finishing up study looking at emissions from manure storage (lagoons and composting) and developing models to better predict lagoon emissions
- Improving process based models for estimating emissions from dairy production systems in western U.S.
- Looking at whole farm nitrogen balances and cycling
- Investigating the impacts of dietary alterations on nutrient/pathogen excretion, nutrient losses and pathogen survivability in storage and nutrient use/losses and pathogen survivability in land application of manures
- GHG emissions from land application of manure under irrigated cropping systems

Questions?

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