Recommended Units and Supporting Data for Standardized Reporting of Air Emissions from Animal Agriculture

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Purpose

to provide guidance for presentation of emission data from on-farm evaluations so that comparisons among animal farms and mitigation strategies can be universally compared.

Specifically:

1. Recommended units for reporting emissions to best represent an end use for the information; and
2. Outlines collection of raw data related to physical, biological and operational characteristics of the enterprise that are needed for the development of the emissions in the recommended units.

There is a need for Standardized Reporting as emission unit expressions vary widely, often do not note the uncertainty in the measurements, and typically do not fully characterize the conditions under which the data were collected.

Emissions Units Uses

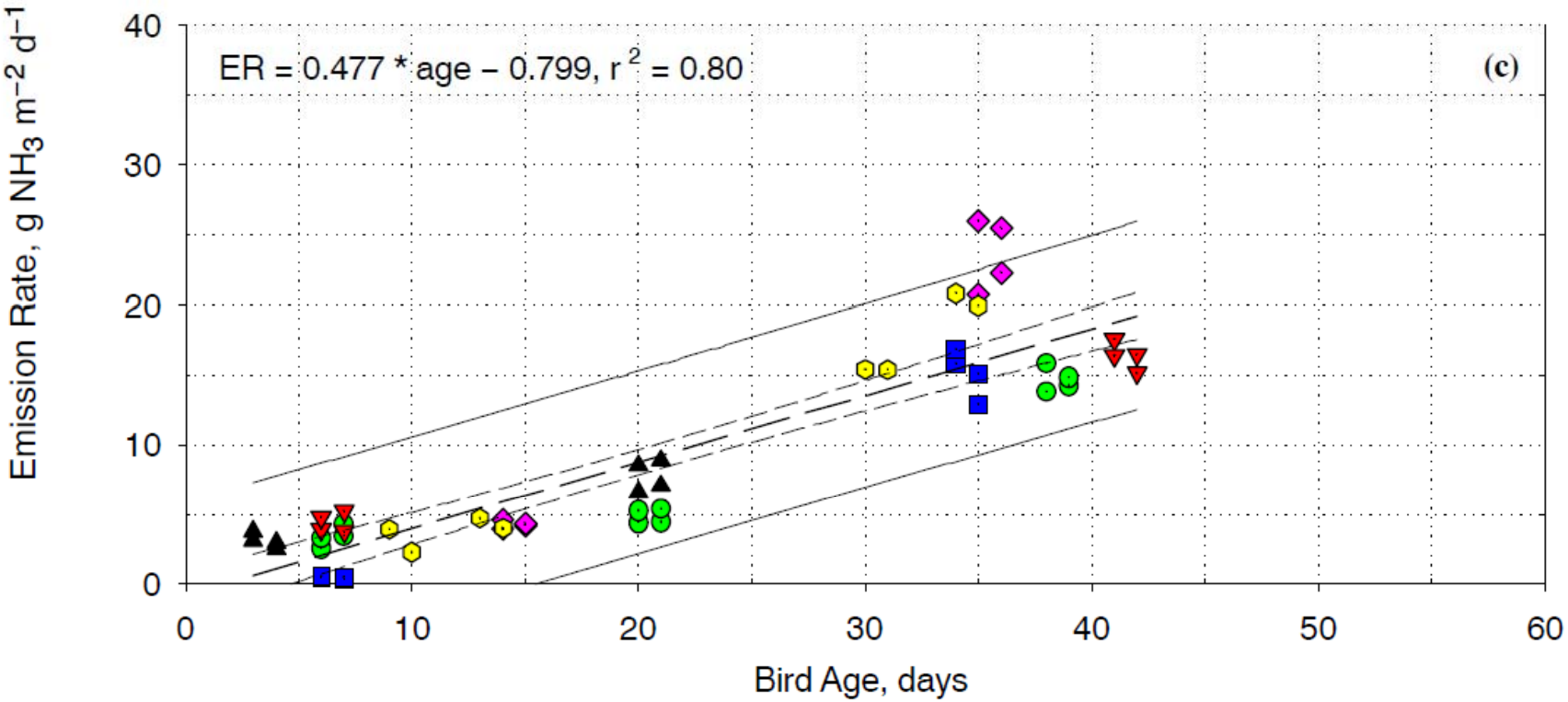
A. Regulations: air pollution
B. Modeling: process-based and dispersion
C. Life Cycle Analysis and efficiency: carbon credits; carbon taxation; “greenest” production methods
D. Public Information

Emission Units

- mass/area/time
- mass/animal/time
- mass/animal mass/time
- mass/animal unit/time
- mass/mass N fed/time
- mass/mass VS excreted/time

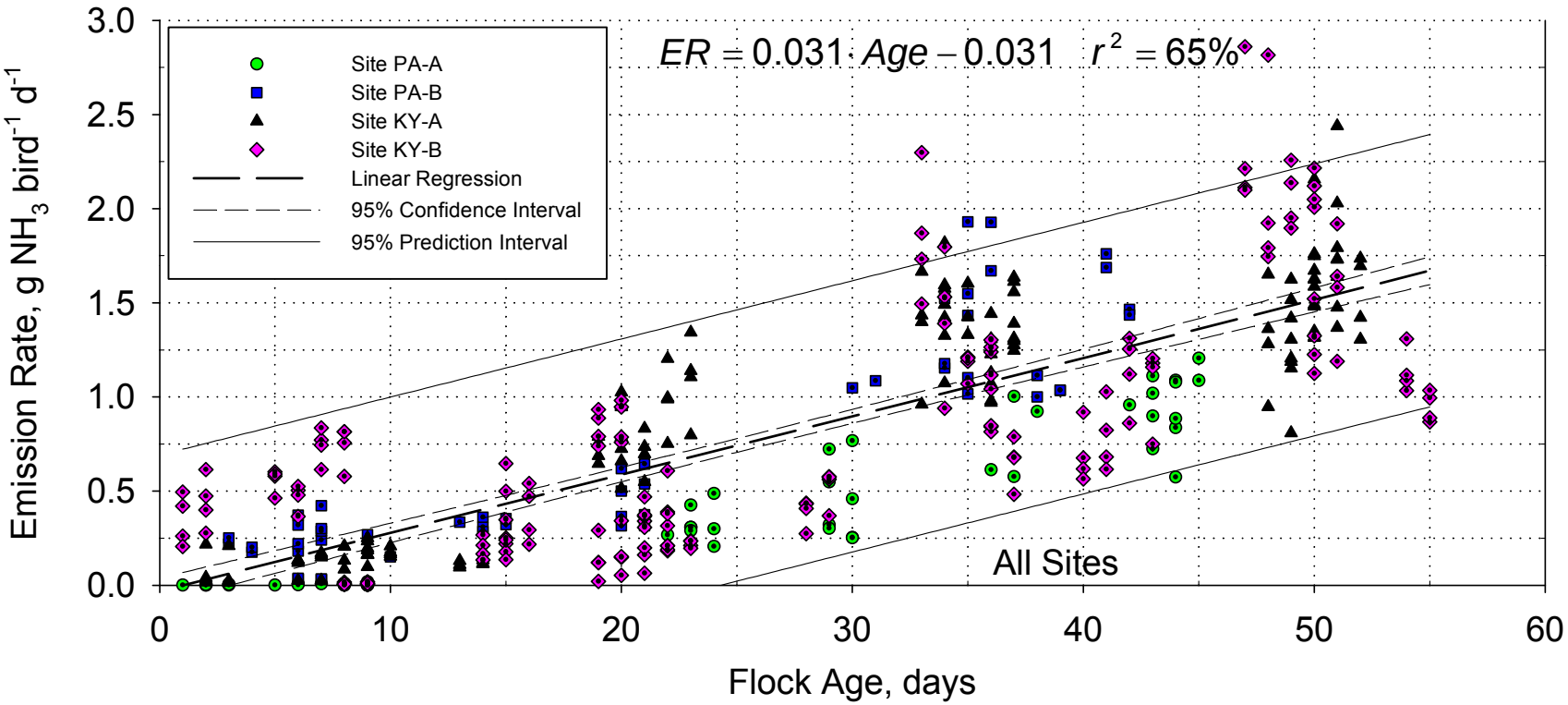
Emission Units

- mass/area/time
  - What area
    - Emitting and non emitting areas
    - Areas emitting at different rates


ER = 0.477 * age – 0.799, r 2 = 0.80
(c)
Emission Rate, g NH3 m−2 d−1
Bird Age, days
0
10
20
30
40
50
60

Emission Units

- mass/animal/time
  - All animals are not the same
    - Different weight/age ranges
    - Growing vs breeding
    - Different diets & rations fed

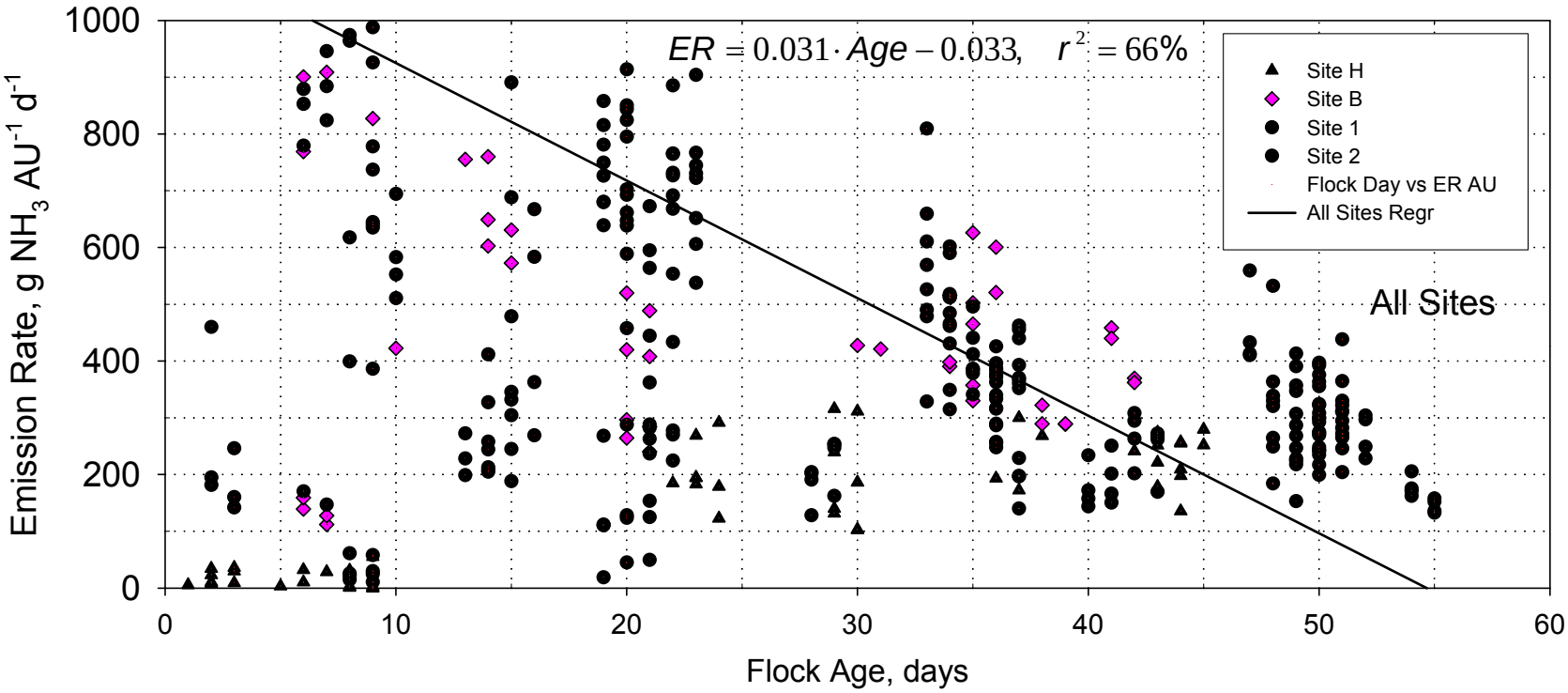

Site PA-A
Site PA-B
Site KY-A
Site KY-B
Linear Regression
95% Confidence Interval
95% Prediction Interval
ER = 0.031 Age – 0.031 r² = 65%
All Sites
Emission Rate, g NH3 bird-1 d-1
Flock Age, days
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
10
20
30
40
50
60

Emission Units

- mass/animal mass/time
  - All animal are not the same
    - Growing vs breeding
    - Different diets & rations fed

Emission Units

- mass/animal unit/time
  - All animal are not the same
    - Growing vs breeding
    - Different diets & rations fed


$ER = 0.031 \cdot Age - 0.033, \quad r^2 = 66\%$
Site H
Site B
Site 1
Site 2
Flock Day vs ER AU
All Sites Regr
All Sites
Emission Rate, g NH_3 AU^{-1} d^{-1}
Flock Age, days
0
200
400
600
800
1000
0
10
20
30
40
50
60

Emissions Measurement

A. Appropriate measurement technique
B. Appropriate quality assurance

PRIMARY AND SUPPORTING DATA NEEDS FOR EMISSION ESTIMATES FROM ANIMAL FACILITIES.

Parameter	Regulations Air Pollution	Modeling Process-Based & Dispersion	Life Cycle Analysis & Efficiency	Public Information
PRIMARY				
Gas or particulate	☻	☻	☻	☻
Air flow	☻	☻	☻	☻
Barometric Pressure	☻	☻	☻	☻
Temperature-inside	☻	☻	☻	☻
Temperature-outside	☻	☻	☻	☻
Surface area of emission	☻	☻	☻	☻

PRIMARY AND SUPPORTING DATA NEEDS FOR EMISSION ESTIMATES FROM ANIMAL FACILITIES.

Parameter	Regulations Air Pollution	Modeling Process-Based & Dispersion	Life Cycle Analysis & Efficiency	Public Information
SECONDARY				
Environment				
Relative humidity-indoor		☻		
Relative humidity-outside		☻		
Air velocity	☻	☻		
Precipitation		☻		
Sunlight/cloud level		☻		
Weather pattern		☻		
Subsurface temperature		☻		

PRIMARY AND SUPPORTING DATA NEEDS FOR EMISSION ESTIMATES FROM ANIMAL FACILITIES.

Parameter	Regulations Air Pollution	Modeling Process-Based & Dispersion	Life Cycle Analysis & Efficiency	Public Information
SECONDARY				
Operational				
Facility size	☻	☻	☻	☻
Animal population	☻	☻	☻	☻
Animal size	☻	☻	☻	☻
Production of product	☻	☻	☻	☻
Value of product produced			☻	
Feed	☻	☻		
Feed Records	☻	☻	☻	☻
Feed storage description	☻	☻		☻
Manure	☻	☻	☻	☻
Manure management	☻	☻	☻	☻
Manure treatment	☻	☻	☻	☻
Cost of emission reduction	☻		☻	☻
Lighting program with timing		☻		
Animal activity	☻	☻		☻
Equipment (vehicular) and human activity	☻	☻		☻

PRIMARY AND SUPPORTING DATA NEEDS FOR EMISSION ESTIMATES FROM ANIMAL FACILITIES.

Parameter	Regulations Air Pollution	Modeling Process-Based & Dispersion	Life Cycle Analysis & Efficiency	Public Information
SECONDARY				
Materials Sampled				
Manure	☻	☻		
Feed	☻	☻		
Bedding		☻		
Product(s)		☻		

Summary

- Emissions of aerial contaminants from animal agriculture need to be determined in context with abundant production and management information.
- Emission in terms of contaminant mass per time per area (e.g. g PM_{10}/day/m^2) is often the primary data collection unit expression from animal housing, manure storage, and feed storage.
- Additional contextual data will allow the conversion of primary findings into other useful expressions that relate emissions to animal population (g CH_4/day/cow), product production (µg H_2S/day/case eggs), input efficiencies (tons NH_3/year/ton N-fed), and mitigation implementation cost-benefits.