Principle #4. Consistency in Reporting AFO Air Emissions Mitigation Practices

Hosted by: USDA-agricultural Air Quality Task Force

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TEAM . . . THINK TANK . . . THINK BASIN

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ORIGINAL TASK

- Discuss key components of mitigation practices including
  - System efficiency
  - Mitigating mechanism
  - Mitigation efficiency
  - Efficacy of emission reduction
  - Cost effectiveness
  - Limitations of application

Paper Outline

- Describe the need for reporting consistency
- Example “Standardized Reporting Framework”
- Resources required to finalize such a Framework

Need for Standardization

- There is a recognized need to reduce air emissions to meet federal or state standards and public demands
- To meet this need there has been a significant amount of effort in the private and public sector to develop mitigation technologies or strategies
- Regulators, farmers and the public need assurances that the anticipated emission reductions from these technologies are achieved in the field

Mitigation Methods

- Pre-generation
  - Building design changes (e.g. mechanical ventilation)
  - Building ventilation system changes (e.g. evaporative cooling)
  - Integrated manure treatment systems (e.g. belt systems)
  - Diet manipulation (e.g. phase feeding)
  - Management techniques (e.g. litter management)
- Post-generation
  - Manure storage covers
  - Physical, chemical or biological filtration systems
- Progression from “mitigation technique” to standard practice such as phase feeding in swine production

Quantification of Mitigation

- Comparison to Baseline
  - What is baseline?

GATES ET AL. (2008)

Reference	Growth Period (d)	Stocking Density	Flocks	Litter	Mean ER(g/b/d)	Location
1	52	12.7	3	New	0.49	KY
1	52	12.2	9	Built-up	0.62	
2	42	14.7	10	New	0.47	KY, PA
2	42	14.7	12	Built-up	0.65	
2	49	13.4	24	Built-up	0.76	
2	63	10.8	20	Built-up	0.98	
3	42	16.1	9	Built-up	0.92	TN,
4	49	13.5	12	Built-up	0.63	TX
5	42	20	1	Built-up	1.18	DE

1) Burns et al 2007
2) Wheeler et al 2006
3) Burns et al 2003
4) Lacey et al 2003
5) Siefert et al 2004

Quantification of Mitigation

- Comparison to Baseline
  - What is baseline?
  - Burns 2007,
    - Average ammonia emission range of 0.49 to 1.18 grams/bird/day with each building having its own diurnal, seasonal and flock cycle variation
    - What should be the baseline?
- Comparison to Control
  - Within Farm Variation
    - Diurnal
    - Seasonal
    - Management
  - Between Farm Variation

WHICH FARM SHOULD YOU USE FOR CONTROL?

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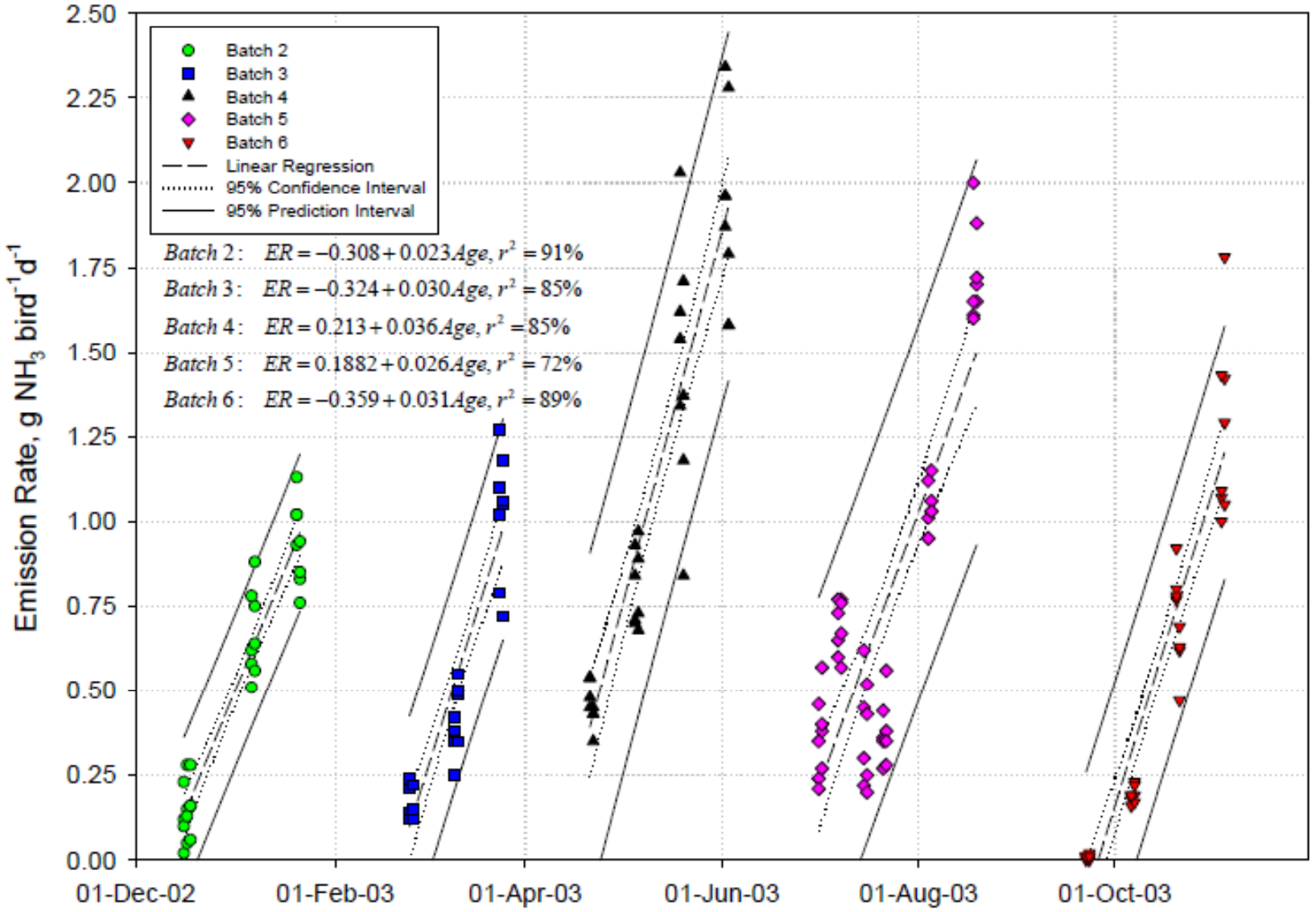
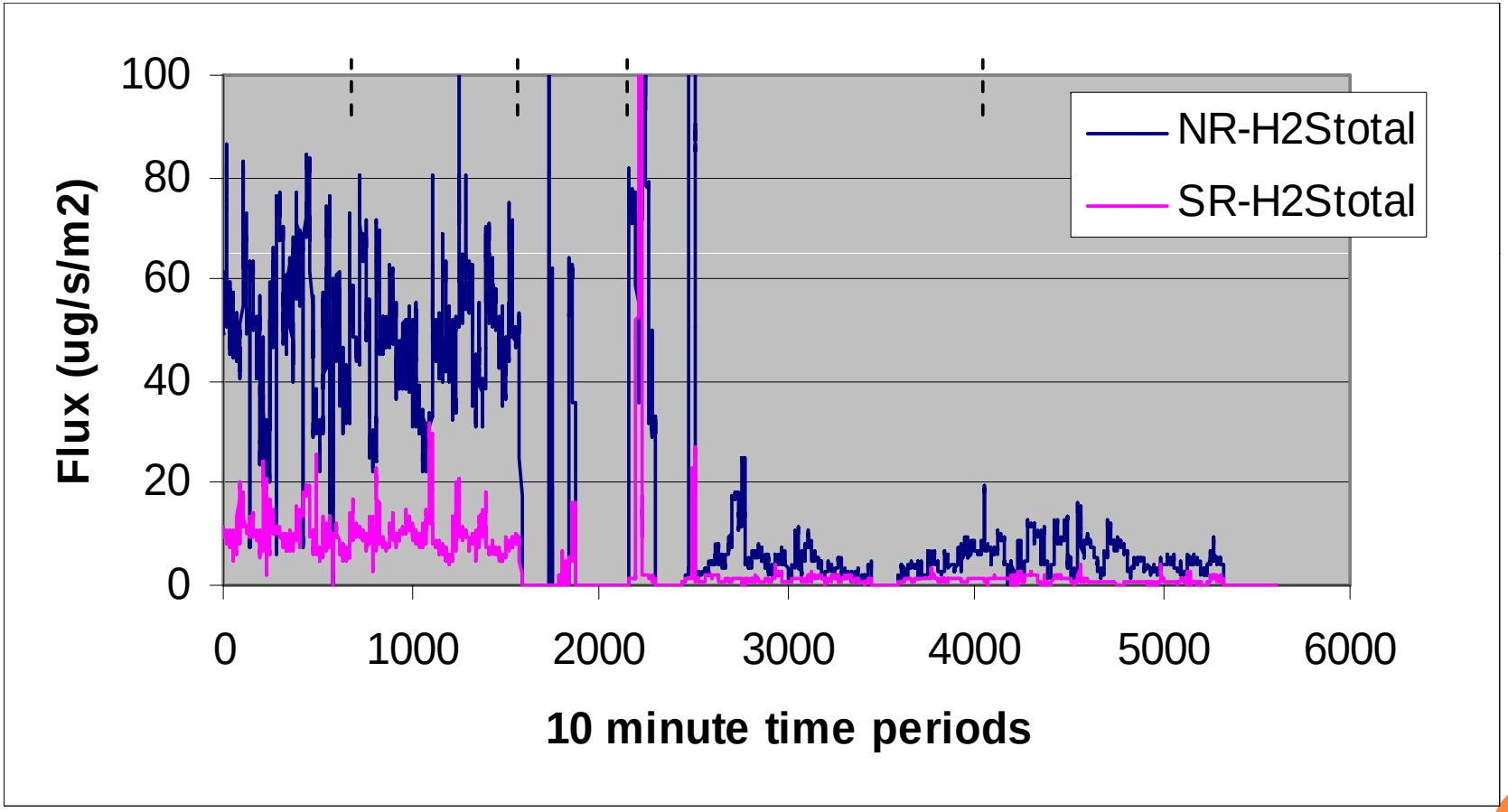
Figure S2A_2. 2003 NH_3 Emission Rates - Site 2, Batch 2, 3, 4, 5 & 6



Deep Pitted Finishing Barn H2S Flux



MN data Jacobson et al.

Units, Measurement, and Sampling Protocols

- Principles 1,2, and 3
  - Report in appropriate (and likely multiple) units
  - Report all measureable factors
  - Continuous or intermittent measurements
  - Measurement equipment
  - Quantify all variation and uncertainty
- Need to accurately verify technology claims – quickly and inexpensively – tradeoffs between accuracy and testing cost
- Additional Questions
  - What happens when all testing and reporting criteria are not met?
  - What about pilot and lab testing of a mitigation technology

BUILDING "CONSUMER" CONFIDENCE

- Certification or Standard Testing
  - Energy rating for appliances (mileage rates, etc.)
  - EPA Environmental Verification Testing Program
  - GHG emissions and carbon credits
  - Ammonia Green Label Program in Netherlands

Example of Standard Protocol (Mosquera and Ogink 2006)

- Four farms
- Grouped by design and critical management factors
- Six sampling events over 12 months
  - e.g. Jan, March, May, July, Sept, Nov
- Specific measurement equipment
  - Airflow
  - Gas Measurement
- Statistical analysis

BUILDING "CONSUMER" CONFIDENCE

- Certification or Standard Testing Energy rating for appliances
  - Other Environmental Technologies through the EPA Environmental Verification Testing Program
  - GHG emissions and carbon credits
  - Ammonia Green Label Program in Netherlands
- "Review Panels"
  - Health Risk Values
  - Environmental regulations
  - Medical procedures or treatments

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- Standardized Reporting . . .

STANDARDIZED REPORTING FRAMEWORK

- General Information
  - Make and model of equipment tested
  - Mode of action
  - Possible unintended consequences
  - Anticipated capital and operation costs reported in appropriate units
- Example: Air Treatment using Biofiltration
  - UMN Design Specs with lava rock media (~1 inch dia.)
  - Physical filtration and biological transformation
  - Potential for GHG emissions?
  - Estimated Cost: $XX per pig space, $XX per pig lb of pollutant, $XX per pound of meat produced

Standardized Reporting Framework

- Experimental Design
  - Hypothesis and test statistics
    - Note that the experimental design for testing technologies is specific to the type of technology tested
- Example
  - Pre- and Post-biofilter testing on pit fan exhaust stream from three farms in SE MN. Two biofilters per site. Tested 3 times over 12 month period for ammonia, hydrogen sulfide and odor reductions.
  - Captured gasses in tedlar bag using using a vacuum box
  - Analyzed using XYZ equipment

STANDARDIZED REPORTING FRAMEWORK

- Raw Data Reporting (Principle 2)
- Example

Date	Farm ID	Biofilter ID	In	Out	Notes

STANDARDIZED REPORTING FRAMEWORK

- Statistical Analysis (Principle 3)
- Example:
  - 75% reduction for ammonia ($p<0.01$)
  - 85% reduction in hydrogen sulfide ($p<0.01$)
  - 50% odor reduction at $p(<0.1)$
  - Reductions on pit fan ventilation air only. This would occur only during minimum ventilation periods.
  - Biofilter performance was a function of depth of manure in pit with better reductions when manure level was higher

Summary and Additional Thoughts

- There is a need to improve “consumer” confidence in mitigation technologies
- We must be quicker at moving mitigation technologies to market through quick, inexpensive, and accurate testing
- Development of a Standard Reporting Framework is one option
- Such a framework must be integrated with the information presented in Principles 1,2, and 3
- Reporting and Protocols would not be significantly different than testing for the “assigning” of an Emission Rate for a source

Summary and Additional Thoughts

- **Developing and implementing** such a framework requires
  - Leadership
  - Cooperation among stakeholders and disciplines
  - An organizational framework
    - Professional society (ASABE, AWMA)
    - USDA collaborative research groups
    - Integrated teams assembled through AFRI grants
  - Significant resources
    - Methods development research is typically not funded
    - This is not Rocket Science – it is much more complicated

Additions by Other Team Members?

THANKS!

PROVIDE SOME CONTEXT

- Federal Register Vol 75 No 155 Thursday August 12, 2010
- FAO/WHO group regarding food safety and subgroup on veterinary drug residuals in food.
  - Discussion paper on methods of analysis for residues of veterinary drugs in foods.
  - Draft priority list of veterinary drugs requiring evaluation or reevaluation
  - Factors related to the establishment of Acceptable Dietary Intake (ADI) and the process of recommending MRLs.
  - Discussion paper on sampling plan for residue control for aquatic animal products