ARS NP212 CLIMATE CHANGE, SOILS AND EMISSIONS PROGRAM UPDATE

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Food Animal Environmental Systems Research Unit
Bowling Green, Kentucky
* ARS NP212 CLIMATE CHANGE, SOILS AND EMISSIONS PROGRAM UPDATE

* REAP/GRACENET DATABASE PROGRESS REPORT

* SAMPLE RESEARCH FROM KENTUCKY
ARS NP212 CLIMATE CHANGE, SOILS AND EMISSIONS PROGRAM UPDATE

- ARS NP212 Retrospective Review - end of 5 year research cycle
  - Stakeholder webinar workshop conducted Dec. 3, 2014
  - Draft of Action Plan for next five years for NP 212 was put together using stakeholders', NP 212 scientists', NP 214 scientists' and other customers' input
  - Program Direction and Resource Allocation Memo (PDRAM) process starts soon and Program Review Panel at a later date
ARS NP212 CLIMATE CHANGE, SOILS AND EMISSIONS PROGRAM UPDATE

- Natural Resources & Sustainable Agriculture Programs Reorganization
  - Due to changing priorities and for better project alignments, NP 214 (Agricultural and Industrial Byproducts) and NP 212 (Climate Change, Soils, & Emissions) were merged.
  - For better alignment, some projects from NP212 were transferred to NP 216 - Agricultural System Competitiveness and Sustainability that will now have a new research program component (Genetics x Environment x Management (GxExM) interactions).
  - More cross-disciplinary research projects
  - These projects moving to GxExM will also go through Program Review Panel at a later date
  - Charlie Walthall moving to NP216
  - Position for National Program Leader for NP 212 is currently being advertised
ARS NP212 CLIMATE CHANGE, SOILS AND EMISSIONS PROGRAM UPDATE

• NP212: Soils & Air
  • Soils research
  • Air quality research – Air Quality Researchers Working Group
    • Including Animal systems, manure
  • GRACEnet & Livestock GRACEnet
  • REAP – will focus on soil health/sustainability
    • Renewable Economic Agricultural Practices

• Future Activities
  • USDA-EPA Ammonia Research Group
  • New Soil biology working group
  • Soil Health partnership with NRCS
  • Rangeland Wind Erosion working group
  • Data stewardship: ARS-wide (“Big Data”)
    • Internet-2 lines
    • More computing power
GRACEnet Locations

Evaluate soil C status & change
Determine net GHG emission (CO$_2$, CH$_4$ and N$_2$O)
Determine environmental effects (water, air and soil quality)
Currently, users can query IPCC Tier 1 predictions for N$_2$O emissions (1% of N additions) at the site and treatment levels.

County level maps of N$_2$O emissions generated by DayCent simulations reported in the US National GHG Inventories are also available.

Future: Implement ability to conduct DayCent, and other process based model simulations, for particular site/treatment combinations “on the fly”
Pre-release data – as of 10/24/2014

- 22 locations provided additional data

  - 15 unique site ID (compared to 10 in public)

  - 34 unique site IDs (compared to 15 in public version), update of public in January.
Progress Highlights

- The ARS Data Portal (GRACEnet, REAP, STEWARDS) now offers:
  - Use of higher visibility keywords and search engines to better locate the portal on the web
  - Improved transmission speed and failover capabilities (10G) due to cluster-based servers
  - Additional GIS capabilities

http://nrrc.ars.usda.gov/arsdataportal/#/Home
http://nrrc.ars.usda.gov/dpasa/#/Home
Progress Highlights

- The ARS Data Portal (GRACEnet, REAP, STEWARDS) Current Endeavors:
  - Data team/data contributors in the process of evaluating and testing new applications
  - Working with CSU to facilitate data download for modeling purposes
  - Partnership with Justin Demer (ARS-RRRU) to tie into remotely sensed LTAR data
  - Possible data mining collaboration with private industry
* EXAMPLE RESEARCH FROM FAES (KENTUCKY)

FAES=FOOD ANIMAL ENVIRONMENTAL SYSTEMS RESEARCH UNIT

- N₂O LOSS FROM SOIL N TREATMENTS

- AIR QUALITY TRAILER FOR ONLINE NH₃/VOC/PM MEASUREMENTS
**Site:** Warren County, Kentucky

**Soil:** Crider Silt Loam, 3% sand, 65% silt, and 32% clay; SOM of 2.5% and pH 5.8.

**Crop:** No-till Corn

**N sources:**
1. Polymer-coated urea (ESN ®), 44% N
2. UAN, 28 % N
3. NH₄NO₃, 34 % N
4. Urea, 46% N
5. Super U ®, 46% N
6. UAN + AgrotainPlus, 28 % N
7. Poultry litter, 3% N
8. Poultry litter + AgrotainPlus, 3 % N
9. Control (no N applied)

Litter was applied at 303 kg N ha⁻¹ (271 lb N/A); other treatments at 168 kg N ha⁻¹ (150 lb N/A).
Effects of N sources on corn grain yield and cumulative N$_2$O emissions under continuous corn in no-till production system.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain Yield Bu/acre</th>
<th>N$_2$O Emissions kg ha$^{-1}$</th>
<th>N$_2$O Emissions kg N$_2$O-N ha$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>113</td>
<td>7130 b</td>
<td>1.3 e</td>
</tr>
<tr>
<td>ESN</td>
<td>144</td>
<td>9077 a</td>
<td>5.7 ab</td>
</tr>
<tr>
<td>UAN</td>
<td>164</td>
<td>10291 a</td>
<td>3.9 b</td>
</tr>
<tr>
<td>NH$_4$NO$_3$</td>
<td>164</td>
<td>10335 a</td>
<td>6.0 ab</td>
</tr>
<tr>
<td>Urea</td>
<td>169</td>
<td>10650 a</td>
<td>3.3 c</td>
</tr>
<tr>
<td>Super U</td>
<td>180</td>
<td>11322 a</td>
<td>2.8 cd</td>
</tr>
<tr>
<td>UAN + AgrotainPlus</td>
<td>166</td>
<td>10440 a</td>
<td>3.9 b</td>
</tr>
<tr>
<td>Poultry litter</td>
<td>169</td>
<td>10631 a</td>
<td>5.8 ab</td>
</tr>
<tr>
<td>Poultry litter+AgrotainPlus</td>
<td>167</td>
<td>10522 a</td>
<td>6.8 a</td>
</tr>
</tbody>
</table>

Means followed by the same letters are not significantly different $\alpha=0.05$
Developing the Capacity for Continuous/Online/Real-time Measurements of Relevant Agricultural Compounds
Gas Emissions and Particulate Matter

- Increasingly clear that the interactions between gas phase emissions and particulate formation “Secondary Aerosol” is an issue
  - $\text{NH}_3 /	ext{VOC} \rightarrow \text{PM}$ but also reactions between “urban” and “rural” sources

- What do we need to get a handle on this?
  - Partitioning between the two phases $(g) \leftrightarrow (s, l)$ = Need data on BOTH
  - Chemistry, meteorology can be rapid = Need real-time/online data
  - Low concentrations = Sensitive Instrumentation

- In support of future field studies, we have put together an air quality trailer equipped with instrumentation providing faster temporal data
## FAES Air Quality Trailer

<table>
<thead>
<tr>
<th>Instrumentation</th>
<th>Analytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Ion Monitor (ion chromatography)</td>
<td>Gas and particulate ions ($\text{NH}_4^+$, $\text{NO}_3^-$, $\text{SO}_4^{2-}$, amines, carboxylic acids), 30 minutes</td>
</tr>
<tr>
<td>TrsMedor (GC)</td>
<td>$\text{H}_2\text{S}$, thiols, disulfides, 10 minutes</td>
</tr>
<tr>
<td>Scanning Mobility Particle Sizer (SMPS)</td>
<td>Particle size distribution and concentration (10-500 nm) 3 minutes</td>
</tr>
<tr>
<td>Aerodynamic Particle Sizer (APS)</td>
<td>Particle size distribution and concentration (0.3-20 $\mu$m) 20 seconds</td>
</tr>
<tr>
<td>Optical Particle Counter</td>
<td>Particle concentration (0.3-10 $\mu$m)</td>
</tr>
<tr>
<td>LiCor</td>
<td>$\text{CO}_2$ and water</td>
</tr>
<tr>
<td>Photoacoustic</td>
<td>$\text{NH}_3$ and greenhouse gases</td>
</tr>
<tr>
<td>Weather station</td>
<td>Temp., RH, wind speed and direction, radiation</td>
</tr>
<tr>
<td>Sonic anemometers</td>
<td>3D wind speed</td>
</tr>
</tbody>
</table>
PM Ammonium Comparison at National Park

- AIM Ammonium
- IMPROVE Ammonium

Date and Time:
- 3/21/2012
- 3/23/2012
- 3/25/2012
- 3/27/2012
- 3/29/2012
- 3/31/2012
- 4/2/2012

μg m⁻³:
PM Sulfate Comparison at National Park

- AIM sulfate
- IMPROVE Sulfate

Date and Time:
- 3/21/2012
- 3/24/2012
- 3/27/2012
- 3/30/2012
- 4/2/2012

μg m⁻³
Particulate Trimethylamine

1-hour particulate trimethylamine at a dairy in California

Date and Time

12:00 PM 1/9/2012
12:00 AM 1/10/2012
12:00 PM
12:00 AM 1/11/2012
12:00 PM
12:00 AM 1/12/2012
12:00 PM
12:00 AM 1/13/2012

μg m⁻³
Sulfur Emissions Swine Facility

10 minute reduced sulfur compounds

Compost Turning

Living Area
- H₂S
- DMS
- MeSH
- DMDS

Date and Time

ppb

ppb DMDS
Special Symposium on Agriculture and Aerosols/Particulate Matter

• American Association for Aerosol Research (AAAR)
  – October 12-16, 2015 Minneapolis
    • Abstracts due this Friday (but probably be extended a week...)
  – All aspects of agriculture and aerosols:
    • Dust
    • Bioaerosols
    • Secondary formation from NH$_3$, VOCs, etc.

• Measurements, Fate, Remediation, Effects