Breakout Group Discussion Questions
ARS Session: Organizing Research Efforts and Approaches
Thursday May 15, 2008

Component 1: Emissions (non-GHG)

Problem:

Global economic pressures have led to consolidation of the agricultural industry for both crop and animal production. With this change has come an increased awareness of the atmospheric emissions from agriculture. These emissions include particulate matter (PM), inorganic compounds, greenhouse gases (GHGs), and volatile organic compounds (VOCs) and semi-volatile compounds. Some of these emissions can contribute to smog and ground-level ozone pollution while other emissions can contribute to global climate change or global warming. Still others can be harnessed for energy production. Furthermore, as human population continues to grow the demand for food will also grow. Meeting increased demand for meat and dairy products will also require an increase in feed crops. The tremendous growth of biofuel production places even more pressures on the natural resource base.

As agricultural production demands rise and as populations move to less urban environments, the potential for conflict between communities will grow. In addition, lands that have traditionally been dedicated to agricultural activities are being developed for residential communities. This has led to rising regulatory pressure to address risks to both public and environmental health. Esthetic issues from nuisance odors, for example, have also contributed to the tension between agriculture and residential communities.

Traditionally, water quality has been used as an indicator of environmental health and to some extent public health. More recently, air quality and the interactions of the atmosphere with soil and water have been recognized as contributing to public, worker and environmental health. However, the emission, fate, and transport of the air pollutants particularly for agricultural sources are not well described resulting in control measures that need to be improved. Producers will require innovative solutions to maintain economic stability while remaining sustainable from a natural resource perspective.

Research Needs:

Scientific discoveries are required to understand the nature and the magnitude of emissions as a function of agricultural practices, i.e., crop and animal production and post harvest processing. Creative approaches, multiple-input predictive models, and new systems-thinking will be required to use this new knowledge for developing effective control strategies. A critical research need is to examine emissions as mixtures, not only PM or odors or ammonia and to understand how changes in production practices or control measures will impact emissions of various chemical classes or elicit changes in the character or magnitude of particulates released. Strong collaborative ties are required between research teams, producer groups, cooperative extension, environmental organizations, and the regulatory community in order to obtain feedback and to efficiently relay the most important research developments.

Volatile Organic Compounds. VOCs are generally considered industrial chemicals like petroleum products or solvents. However, VOCs are any organic chemical with a high vapor pressure under normal temperature and pressure conditions. Some VOCs are released naturally from plants and trees. VOCs are also emitted from manures, waste treatment systems, feed storage/mixing areas, and from the breath and bodies of production animals. Fumigants are also generally considered VOCs and a large fraction of many pesticide formulations may consist of organic solvents.

Reactive VOCs also known as reactive organic gases (ROGs) can contribute to ground-level ozone production in combination with nitrous oxides (NOx) and sunlight. New national ambient air quality standards for ground-level ozone have been issued by the US EPA. The new primary standard is 0.075 ppm. State governments are required to develop state implementation plans (SIPs) for areas which have been designated as nonattainment to achieve reductions in ozone levels. California, for example, has included reductions in VOC emissions from agriculture as part of their SIP. The atmospheric lifetime of an organic pollutant is critical in determining the potential of that chemical to persist in the environment. VOC emissions from agriculture are highly variable between facilities and also depend on meteorological conditions. Some of these emissions may contain reactive organic gases, contributing to ground-level ozone production, while others may persist and become an odor issue in downwind areas.

While some VOCs are odorless, many are perceived by humans as odors which may range from floral or fruity in nature to medicinal or rancid. The human detection thresholds for chemicals, despite the nature of the odor, vary by several orders of magnitude. When chemicals are released as mixtures, odor does not necessarily increase linearly. Masking or enhancement effects may occur. Odorants may also undergo oxidation reactions or other chemical transformations during transport, thereby changing the composition of the odorant plume. The complexity of the VOC mixtures released from agricultural operations present challenges for the development of sample collection and analysis methods which address all major compound classes a detection limits of relevance to human detection thresholds. In addition, ground level sample collection does not adequately allow for analysis of the fate and transport of an odorant plume. Regions with multiple VOC sources can also distort research results.

Volatile Inorganic Componds. Some inorganic gases are also odorants. Ammonia and hydrogen sulfide, for example, are commonly emitted from animal production facilities. Hydrogen sulfide is classified by the US EPA as a hazardous air pollutant.

Greenhouse Gases. GHGs are gases present in the atmosphere which reduce the loss of heat from the earth through the greenhouse effect. Carbon dioxide, methane and nitrous oxide are three GHGs emitted from cropping and animal production facilities. Opportunities exist in agriculture to serve as a carbon sink or to sequester carbon.

Science & regulatory challenges for PM… Isotope tracers…

Science & regulatory challenges for semi-volatiles… pesticides and pbdes

<u>Problem Statement 1A:</u> Understand, predict, and manage emissions from cropping systems
<u>Problem Statement 1B:</u> Understand, predict, and manage emissions from animal production systems
<u>Problem Statement 1C:</u> Understand, predict, and manage emissions from process and post harvest systems
<u>Problem Statement 1D:</u> Understand, predict, and manage emissions from bioenergy production and use systems

Research Needs

- Need for better understanding of factors influencing the emission, fate and transport of ag pollutants
- Conduct studies to fill in information gaps concerning…
- Develop experimental protocols to characterize total emissions
- Development/modification/evaluation instrumentation
- Development of emission factors
- Development/modification/evaluation of models
- Development and evaluation of protocols for measuring methods
- Development of abatement technologies
- Determining the impact of emissions on local and regional air quality
- Determine the impact of emissions on off-site receptors
- Determine the interactions of ag and urban emissions and the effects on air quality
- Development of approaches and technologies for source identification
- Development of efficient technologies to produce energy from ag biomass….
- Determine the impacts of emissions for the production and use of bioenergy
- Determine the temporal and spatial variability of ag emissions
- Coordination of research activities of scientists examining ag emissions
- Discover technologies to capture emissions for beneficial use

Anticipated Products

- Scientific peer-reviewed manuscripts
- Factsheet/whitepaper/blogs/newsletters for stakeholders
- Educational materials for producer training and trainers
- Fundamental baseline knowledge of processes and mechanisms controlling emissions
- Lifecycle analysis of emissions
- Improved emission and transport models
- Peer-reviewed data sets related to emissions for stakeholders including emission factors
- Guidelines (factsheet/whitepaper) for controlling emissions
- Abatement and mitigation technologies and practices (BMPs)
- Recommended scientifically-sound protocols for measuring emissions
- ARS Air Quality Emissions Research Workgroup

Potential Benefits

- Regulations based on best available science

- More sustainable ag production systems
- Ag and urban communities will exist more harmoniously

Cropping Systems	Animal Production	Post Harvest	Bioenergy
Cathleen Hapeman - EMBUL	Cathleen Hapeman - EMBUL	Cathleen Hapeman - EMBUL	Cathleen Hapeman - EMBUL
Scott Yates – USSL (gases/modeling)	Al Rotz – PSWMRU (gases/modeling)	Mike Buser – CPGRU PM	Mike Buser - CPGRU
Mike Buser - CPGRU	Mark Powell - DFRC	Ed Hughes - SWCGRL	Ed Hughes - SWCGRL
Ed Hughes - SWCGRL	Mike Buser - CPGRU	Jerry Hatfield - NSTL	Ted Zobeck - WEWCRU
Tom Potter - SEWRL	Ed Hughes - SWCGRL	Laura McConnell – EMBUL (gases)	John Tatarko - WERU
Laura McConnell - EMBUL	Laura McConnell - EMBUL		Matt Smith - EMBUL
Al Rotz - PSWMRU	Steve Trabue – SOU (odors)		Al Rotz – PSWMRU?
Brenton Sharratt - LMRU	Jack Meisinger - EMBUL		
Ted Zobeck - WEWCRU	Jerry Hatfield – NSTL (micromet)		
Jack Meisinger - EMBUL	Larry Wagner - WERU		
Jerry Hatfield - NSTL	Pat Millner - EMSL		
Larry Wagner – WERU (PM/modeling)	Dan Shelton - EMSL?		
Dennis Flanagan – NSERL?	Dan Miller - Lincoln		
Heping Zhu - Wooster	Rick Todd - Bushland		
Tim Gish - HRSL	Karamat Sistani – Bowling Green?		
John Baker – StPaul (micromet)			

Component 1 Problem 1B Resources

Problem 1e: Reducing Greenhouse Gas Emissions from Agricultural Systems: Grazinglands, CRP and Buffers

Problem Statements

1. Measurement/mitigation. High uncertainty in system-specific net GHG emissions and CO_2 equivalent footprint analysis for conventional and alternative agro-ecosystems.
2. Process. Inadequate understanding of process controls over net GHG emissions.

(Lack of succinct and targeted information for customers regarding management impacts on GHG emissions and mitigation strategies.)

Research Needs:

Problem 1. Measurement/Mitigation.

- Quantification of net GHG emissions and CO_2 equivalent footprint of conventional and alternative agro-ecosystems under different climate and soil regimes.
- Additional GHG emissions data from greater variety of systems.
- Portable and inexpensive methodologies for measuring GHG fluxes.
- Standardization of methods for quantifying soil C storage and GHG emissions.
- Quantifying spatial and temporal variability contributing to uncertainty.
- Comprehensive measurement of direct and indirect GHG emissions sources.
- Quantification of the efficacy of net GHG emission mitigation strategies.
- Need for quantifiable verification of C sequestration (cap and trade).

Problem 2. Process.

- Understand spatial and temporal variability of GHG emissions.
- Understanding of process and mechanistic controls over GHG emissions, e.g. interactions among climate/soil/crop/fertilizer management.
- Understanding of process and mechanistic controls over soil C storage and sequestration.
- Understanding C, N and water cycling in relation to GHG emissions and environmental quality.
- Understanding and modeling of landscape-scale processes.
- Combine biogeochemical with hydrology/transport models.

Products:

Problem 1. Measurement/Mitigation.

- Database (e.g. GRACEnet)
- Improved models
- Baseline for verifying C credits
- New methodologies for soil C and GHG emissions measurement
- Standardized protocols for soil C and GHG emissions measurement
- Synthesis of net GHG emissions data
- Strategies and practices to reduce net GHG emissions (direct and/or indirect)

Problem 2. Process.

- Improved models

- Scientific basis for developing and standardizing methods to capture dynamics
- Basic information regarding principles and processes of C, N and water cycles.
- Synthesis of net GHG emissions data to allow development of strategies and practices to reduce net GHG emissions (direct and/or indirect)
- Better understanding of processes as basis for improved mitigation practices.

<u>Outcomes:</u>
Problem 1. Measurement/Mitigation

- Scientific bases for C trading programs, and strategies to reduce net GHG emissions and improve environmental quality.
- More accurate national and global GHG emissions inventories.
- Additional GHG emissions data from greater variety of systems.

Problem 2. Process.

- Improved mitigation practices
- Improving agriculture's role in mitigating national and global GHG emissions.
- User evaluation of economic and environmental trade-offs among mitigation practices.
- More scientifically based regulations.

<u>Current and Potential customers</u>

- Other federal, state, and international regulatory and action agencies
- Federal, state, and local policy makers
- Elected officials
- Producers and commodity groups
- Other scientists
- Carbon traders
- NGOs
- Consumers
- Consultants
- Everyone who eats, breathes or drinks

<u>Resources</u>:
Problem 1. Measurement

- See GRACEnet CLR Appendix A

<u>Leads</u>
Ron Follett
Tim Parkin
Steve Del Grosso
Jeff Smith
Jane Johnson

Jim Reeves (soil C methods)

Soils, Emissions, and Climate Change Research (SECCR)

Carbon Sequestration

Breakout Session Facilitator: John Schmidt
Laptop Recorder: Michael Abbey
Flipchart Recorder:
Breakout Session Presenter:

Discussion Component/Topic: (Adapting to Global Change)
Sub Component: **Carbon Sequestration**

Problem Statement 3b:

Increasing levels of GHG in environment. Need to understand how the capacity of plants to GCC impact capacity of plants to sequester or retain carbon…***CO2 is increasing in the environment at a higher rate. Plants can provide another vehicle to sequester carbon***

Research Needs:

- Species change on C&N cycle and sequestration
- Phenology
- Understand basic processes
- Understand how P; C; N ratios of plant tissue, its impact on biomass or productivity production and species composition
- Impact on native species (sub)

Anticipated Products

- Guidelines for land use decisions, decision makers (e.g. Sustainable Site Initiative)
- Provide scientific support to policy makers and land managers, carbon trading initiatives
- Input to mechanistic models of carbon cycling
  - conceptual knowledge, numeric values and Research databases
- Inputs to National Phenological Database

Potential Benefits – other scientists, society…(Outcomes)

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Resources (scientists, locations, partners)

Abdullah J. (Morris MN)
Dana Blumenthal.
Fieke Djikstra
Wayne Polley
David Augustine
Justin Derner
Phil
Virginia Jin
Jim Kiniry

Forage Quantity and Quality (does this adequately reflect all groups involved?)

Breakout Session Facilitator: John Schmidt
Laptop Recorder: Michael Abbey
Flipchart Recorder:
Breakout Session Presenter:

Discussion Component/Topic: (Adapting to Global Change)
Sub Component:

Problem Statement 3b:

Research Needs:

- how climate change driven alter species composition and its impact on forage quality and quantity on native rangelands and pastures. (major)
- Understand how changes in carbon and nitrogen cycling affect forage quality and quantity in concentrations of nitrogen in plants (major)
- How species composition interacts with nitrogen cycling and its impact on rangeland and pastures. (sub?)
- Information on how we alter our livestock grazing management practices to adapt to species change (sub?)
- Understand how shifts in phenology may affect forage quality and quantity in grazing and pasture land (sub?)
- Impact on native species (sub)

Anticipated Products

- Guidelines for best management practices that support grazing
- Provide scientific support for rangeland regulations
- Research links to carbon trading/sequestration

Potential Benefits – other scientists, society…(Outcomes)

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Resources (scientists, locations, partners)

Wayne Polley
Dana Blumenthal
Philip Fay
David Augustine
Justin Derner
Fielka Dijkstra

Invasive Species

Breakout Session Facilitator: John Schmidt
Laptop Recorder: Michael Abbey
Flipchart Recorder:
Breakout Session Presenter:

Discussion Component/Topic: (Adapting to Global Change)

Problem Statement 3b:

Reasons to expect that types of invaders will expand ranges and become more problematic as a result of climate change

Research Needs:

- Predict changes in the locations and severity of invasive agricultural pests, weeds and diseases with current and projected changes in CO_2, temperature and water availability, and delineate management practices that will be needed to mitigate and control future infestations
  - Predict latitudinal range shifts and likely impacts of invasive species as a result of warming, changes in precipitation and CO_2 enrichment. Identify changes in management that will be required by expected range shifts
    - Herbicide management
    - Impact of invasive pests and disease on plant resistance by increased CO_2 and temperature
  - Quantify the degree to which warming, changes in precipitation and CO_2 enrichment increase the susceptibility of agro-systems to invasion
    - C_4 weeds and invasives
    - Understand whether availability of natural enemies interact with CO_2, temperature and precipitation to exacerbate invasion
    - Understand how CO_2 enrichment and warming, interact with disturbances to influence plant invasion and native ecosystem recovery

Anticipated Products

- Predictions of future invasive species ranges (statistical model)
- Prediction of changes in Best Mgmt Practices to manage invasives
- Data for State and Transition Models that account for climate change
- Rules of thumbs of types of invaders that will be more common in the future
- List of species characteristics of future invaders

Potential Benefits – other scientists, society…(Outcomes)

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Resources (scientists, locations, partners)

ARS scientists identified as leaders of Component XX include: Lew Ziska as lead?

Auburn - Brett Runion
BARC – Ray Hunt
- Allen VU