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Research Project: [Emission and Dispersion of Air Quality Constituents from Agricultural Systems](#)
Location: [Air Quality of Agricultural Systems Research](#)
2007 Annual Report**1a.Objectives (from AD-416)**

Evaluate emission and dispersion patterns to the boundary layer as a function of complex terrain and structural obstructions; Quantify the effectiveness of agricultural management to reduce ammonia and nitrous oxide emissions into the atmosphere; Identify and quantify volatile organic compounds (VOC) attached to particulates emitted from animal feeding operations and manure application on to fields. Identify and quantify amounts of endotoxins and pathogens emitted and dispersed from animal feeding operations and manure application sites.

1b.Approach (from AD-416)

Utilize a wind tunnel to conduct a series of wind flow simulations over model scale terrain and structures to determine the wind flow patterns over complex agricultural sites that include buildings. Conduct lidar measurements of particulates and water vapor coupled with turbulence measurements obtained from sonic anemometers to characterize the turbulence regime in limited fetch environments. Evaluate the potential of using open path FTIR measurements to compliment the lidar measurements in the development of improved emission and dispersion models. Conduct studies on ammonia and nitrous oxide emission from controlled laboratory studies using soil columns and various manure application practices coupled with field studies to ascertain the impact of different soil and cropping management practices on these emissions. Collect particulate samples using samplers located at various positions from different livestock production facilities to determine the variation of particulate concentration and the VOC compounds attached to the particulates.

3.Progress Report

Refinement and development of improved protocols in the use of the AgLite Light Detection and Ranging (LiDAR) have increased the ability to characterize the plume shape and density concentration of the dust emissions

Project Team

- [Prueger, John](#)
- [Sauer, Thomas](#)
- [Parkin, Timothy - Tim](#)
- [Hatfield, Jerry](#)
- [Pfeiffer, Richard - Dick](#)

Project Annual Reports

- [FY 2008](#)
- [FY 2007](#)
- [FY 2006](#)

Publications

- [Publications](#)

Related National Programs

- [Manure and Byproduct Utilization](#) (206)
- [Air Quality](#) (203)

Related Projects

- [Development of Farming Systems for Environmental Credits and Production Efficiency](#)
- [Development of Instruments for Measurement of Particulates and Gases from Agricultural Operations](#)

during the harvest operations of an almond orchard. Spectral analysis of the high frequency sonic anemometer profile data (above and within the orchard) have shown unique diurnal signatures in the transport of momentum over an almond canopy. This has significant implications toward understanding the transport of dust emissions during a harvest operation. Extensive analysis is ongoing.

Growth chamber experiments were conducted to assess the impact of a rye cover crop on the fate of swine manure-nitrogen (N) applied to soil. Retention of manure-N in the soil system was enhanced in the presence of the rye cover crop, due to plant uptake. Resulting nitrate (NO₃) leaching losses and gaseous N losses (N₂O and NH₃) were also lower in the rye cover crop treatment. A field experiment was established to investigate cover crop effects on N₂O emissions from swine manure-N. Nitrous oxide emissions were measured every week from April through September, and at monthly or bi-monthly intervals from November through March. These data are currently being analyzed.

An open-path Fast Fourier Transform Infrared Spectrometer (FTIR) unit for gas concentration measurement will be deployed and evaluated for sensitivity of ammonia and other gases around a swine facility in late summer and early Fall 2007. An evaluation of hydrogen sulfide sensors for their accuracy and reliability was evaluated as part of the ongoing cooperative effort between USDA-ARS and Battelle Laboratories as part of the Environmental Testing and Evaluation (ETV) program.

4. Accomplishments

A 2-D particulate LiDAR was developed by the Space Dynamics Laboratory (Logan, Utah) and field tested in the late summer of 2005 at confined animal feeding operation (CAFO) facility in central Iowa. Particulate plume emission and dispersion were measured, Light Detection and Ranging (LiDAR) sensitivity and calibrations were conducted, and 2-D image of plume dispersion were measured and evaluated. High frequency turbulence was measured in the approach, within building complex and recovery space surrounding the CAFO. A first year data set has been acquired where LiDAR measurements of particulate dispersion can be correlated with high frequency turbulence data that will enable the possibility to evaluate particulate and gas dispersion with local meteorological conditions. Particulate characterizations are critical to understanding the movement of odoriferous compounds from animal confinement operations. The determination and quantification of these compounds will aid in developing technologies to reduce the emissions. The Fast Fourier Transform Infrared Spectrometer (FTIR) is providing data and insight on the vapor phase concentrations of these compounds. The extension of the micrometeorological and Lidar techniques demonstrates the utility and flexibility to apply these method to include different agricultural sectors as pertaining to monitoring and predicting impacts to air quality.

This research contributes to the Nutrient Management and Atmospheric Emissions components of the ARS Manure and Byproduct Utilization National Program (NP206) and the Particulate Emissions, Ammonia and Ammonium Emissions and Pesticides and Other Synthetic Organic Compounds components of the ARS Air Quality National Program (NP203).

5. Significant Activities that Support Special Target Populations

Continued efforts have been directed toward characterizing the air quality variations around a typical almond operation in the Sacramento valley.

Review Publications

[Prueger, J.H., Hatfield, J.L., Kustas, W.P., Hipps, L.E., Macpherson, J.I., Neale, C., Eichinger, W.E., Cooper, D.I., Parkin, T.B. 2005. Tower and aircraft eddy covariance measurements of water vapor, energy and carbon dioxide fluxes during SMACEX. *Journal of Hydrometeorology*. 6:954-960.](#)

[Meek, D.W., Prueger, J.H., Kustas, W.P., Hatfield, J.L. 2005. Determining meaningful differences for SMACEX eddy covariance measurements. *Journal of Hydrometeorology*. 6\(6\):805-811.](#)

[Becer, J.M., Parkin, T.B., Nakastu, C.H., Wilbur, J., Konopka, A. 2006. Bacterial activity, community structure, and degree of spatial heterogeneity on the small scale at a long-term contaminated site. *Microbial Ecology*. 51\(2\):220-231.](#)

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