Hydrology And Remote Sensing Laboratory

In-Depth Program Review

February 21-23 2006

Hydrology And Remote Sensing Lab
Animal And Natural Resources Institute
Beltsville Agricultural Research Center
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HYDROLOGY AND REMOTE SENSING LABORATORY
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Session 9:00am to 5:00pm
Beltsville Agricultural Research Center
Bldg. 005, Rm 21

9:00 am	Executive Session I Review Team, Area Management Team, National Programs Leaders
10:00	General Session – Opening Remarks Tom Sexton, Director, Animal and Natural Resources Institute
10:05	Overview of the Hydrology and Remote Sensing Laboratory Program Walter Rawls, Research Leader
10:20	Develop measurement tools, and decision support tools for quantifying soil factors and processes influencing soil productivity. Charlie Walthall, Lead Scientist
10:35	Break
10:50	Development of models for assessing climate change on water vegetation, carbon and nutrients Greg McCarty, Lead Scientist
11:05	Using remote sensing and modeling for evaluating hydrologic fluxes, landscape states, and constituent transport processes within agricultural landscapes Wade Crow, Lead Scientist
11:20	Executive Session II Review Team and Invited Guests
12:00	Lunch
1:00 pm	Tour of Lab Facilities in Bldg. 007

INTERVIEWS WITH INDIVIDUAL SCIENTISTS
Move to Bldg. 007, Rm 006

1:30	Wade Crow
2:10	Tom Jackson
2:50	Break
3:00	Mike Cosh

3:40	Martha Anderson
4:20	Review Team Work Session

Wednesday, February 22, 2006
Session 9 am to 5:00 pm
Beltsville Agricultural Research Center
Bldg. 007, Rm 006

INTERVIEWS WITH INDIVIDUAL SCIENTISTS / STAFF Continued

9:00 am	Bill Kustas
9:40	Ali Sadeghi
10:20	Break
10:30	Jerry Ritchie
11:10	Paul Doraiswamy
11:50	Lunch
12:50	Raymond Hunt
1:30 pm	**Permanent / Temporary Support Staff** (Bakhyt Akhmedou, Krystyna Bialek, Rajat Bindish, John Bolten, Peter Downey, Wayne Dulaney, Donna Geiman, Carrie Graff, Dean Hively, Ann Hsu, Megan Lang, Fuqin Li, Lynn McKee, Swati Mookherji, Sushil Milak, Eva Mladenova, Parag Narvekar, Attila Nemes, Laura O'Hare, Rob Parry, Chris Pooley, Barry Francis, Ralph Roberts, Andy Russ, Kerry Sefton, Alan Stern, Walter Stracke, Tugrul Yilmiz, Xiwu Zhan)
2:00	Cliff Rice
2:15	Jim Starr
2:35	Charlie Walthall
3:15	Break
3:25	Tim Gish
4:05	Craig Daughtry
4:45	Adjourn

Thursday, February 23, 2006
Session 9:00 am to 2:30 pm
Beltsville Agricultural Research Center
Bldg. 007, Rm 006

9:00 am	Greg McCarty
9:40	Jim Reeves
9:55	Walter Rawls
10:30	Review Team work session

MOVE TO BLDG. 005, RM. 20

1:00 pm	Executive session III Review Team, Area Management Team, National Programs Leaders
2:00	General Session HRSL Staff, Review Team, Area Management Team, National Programs Leaders
3:00	Adjourn

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Acting - Global Change
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Mission Statement / History

MISSION: The mission of the Hydrology and Remote Sensing Laboratory is to conduct nationally orientated basic and applied research on water resources and remote sensing concerns related to the production of food and fiber and the conservation of natural resources.

HISTORY: In the fall of 2000 the Beltsville Agricultural Research Center under went a major reorganization. The Natural Resources Institute was abolished and most of the natural resources research was moved into the newly formed Animal and Natural Resources Institute (ANRI). Prior to the reorganization this unit was the Hydrology Laboratory composed of 7 scientists conducting research on remote sensing and process modeling related to hydrology and water quality. The research was divided into two projects (CRIS projects) which contributed to the ARS National Programs NP 201 Water Quality and Management; NP 202 Soil Resource Management and NP 204 Global Change. As a result of the reorganization 5 scientists conducting remote sensing research in the Remote Sensing and Modeling Laboratory were moved into the lab and it was renamed the Hydrology and Remote Sensing Laboratory. The research that was added to the laboratory was encompassed in two projects which contributed to the ARS programs NP 207 Integrated Agricultural Systems, NP 201 Water Quality and Management; NP 202 Soil Resource Management. Because of commonality the projects were merged into three projects which contributed to the ARS programs NP 201 Water Quality and Management; NP 202 Soil Resource Management and NP 204 Global Change. In fall of 2005 a minor reorganization of the Natural Resource projects in ANRI was conduced and parts of 5 scientist's time representing a total of three SY years were added to the lab with two projects which contributed to ARS programs NP 201 Water Quality and Management; NP 202 Soil Resource Management and NP 206 Manure and Byproduct Utilization. At present the lab's research projects are being consolidated into three projects which contribute to the ARS national programs NP 201 Water Quality and Management; NP 202; Soil Resource Management and NP 204 Global Change.

Since 2000 we have had three scientists retire and they have been replaced by scientists working in the remote sensing of soil moisture, evapotranspiration, modeling and data assimilation areas.

New project in OSQR review:

National Program 202: Soil Resources and Management

Title: Quantifying Landscape Factors Influencing Soil Productivity and the Environment

Investigators	**FTE**
Charles Walthall, Lead Scientist	1.0
Walter Rawls (RL)	1.0
Craig Daughtry	0.8
Timothy Gish	0.8
Raymond Hunt	0.2

Scientific Staff Years: 3.80

Planned Duration: 60 months (April 2006 to March 2011)

Objective 1: Develop measurement tools, and decision support tools for quantifying soil factors and processes influencing soil productivity.

Sub Objective 1.1: Spatially variable soil, subsurface, and landscape features can be quantified to characterize hydrologic characteristics affecting soil productivity.

Sub Objective: 1.2 Soil nutrient status is available via direct measurement or via surrogate measurement of condition and character of plant response.

Approach: Sustained soil productivity and watershed conservation requires information for decision-making on the status of factors and processes affecting soil productivity and environmental quality. Production fields are now perceived as mosaics of homogeneous patches of variable crop response to soil factors (i.e. response zones) and landscape position. Thus, scale-appropriate quantification of spatial and temporal variability is now urgently needed. New approaches for acquiring and analyzing remote sensing data, scalable *in situ* measurements, and models offer potential solutions to the need for characterizing the variability of soil properties. Research will be conducted to develop technologies for quantifying the variability of soil hydrologic factors, and soil and plant nutrient status factors at scales that are appropriate for within-field management of heterogeneity. Surrogate indicators of soil hydrologic properties and landscape position will be assessed using analysis of yield data and remote sensing imagery. A new approach to pedotransfer functions will be pursued. Remote sensing of crop residue cover and nutrient stats will be investigated using image spectral reflectance signature analysis. Nutrient status and other indicators of crop response to soil productivity will be investigated via investigation of remote sensing image spatial/texture analysis of the patterns and spacing of groups of pixels. The research will result in new tools with a supporting knowledge base that will enable improved day-to-day land use management actions for nutrient management, conservation, and soil water management decisions and for decisions affecting development, implementation and enforcement of policy.

New project in OSQR review

National Program 204: Global Climate Change

Title: Assessing Climate, Soil and Landscape Processes Affecting Agricultural Ecosystems

Investigators	**FTE**
Gregory McCarty, Lead Scientist…….	0.6
Martha Anderson……..	0.3
Wade Crow……	0.2
Craig Daughtry……..	0.2
Paul Doraiswamy……..	0.5
Raymond Hunt ……...……..	0.3
Thomas Jackson……	0.3
James Reeves (Located in EBUL in ANRI) ……	0.2
Jerry Ritchie……..	0.4

Scientific Staff Years: 3.0

Planned Duration: 48 months (April, 2006 to March, 2010)

Overall Objective: Develop new methods and models to assess the movement and fate of soil carbon and water in agricultural ecosystems at multiple scales.

Objective 1: Develop methods to measure and characterize crop residues and soil carbon under different management systems.

Objective 2: Assessing carbon sequestration and trace gas emissions under conservation practices at the landscape scales in the Mid-Atlantic region as part of the GRACEnet CLR (cross-location) project.

Objective 3: Assessing impacts of soil redistribution on carbon dynamics by use of a biogeochemical model that includes landscape processes and scale measurements

Objective 4: Modeling soil carbon sequestration and carbon fluxes at local, regional scales.

Objective 5: Integrate global soil moisture mapping from satellites into the land surface component of atmospheric prediction models.

Approach: The terrestrial carbon (C) and hydrologic cycles are closely linked and have influence on, and in turn, are influenced by changes in global climate. This project will develop improved methodologies for utilizing sample, flux and remote sensing data in the spatial characterization of key components of land-surface C and water cycles. Quantifying soil and crop residue C by spectroscopic characterization will provide cost-

effective methods for monitoring or model validation. In support of the GRACE net Cross Location Project, trace gas emissions from winter cover crops will be monitored to assess overall global warming potential of prospective best management practices for C sequestration. The C fluxes associated with soil erosion and subsequent C redistribution over a field or landscape is poorly known, so Cesium-137 will be used as a tracer to estimate the magnitude and impact on redistribution patterns at field and watershed scales. Tower flux measurements will be used to validate spatial estimates of CO_2 assimilation primarily through the parameter, light use efficiency. Combined crop growth/biogeochemical models use land cover, leaf area index, and soil and residue C for spatial model inputs and light use efficiency for spatial model validation. These models can simulate the impacts of various management practices on the C and hydrologic cycles under current and changed climate. Because CO_2 assimilation by vegetation cover is in turn linked to plant availability of soil water, improved technologies and models developed within this project for assessing soil moisture status will enhance global climate models for climate change predictions.

***New project proposed for OSQR review*:**

National Program 201: Water Quality and Management

Title: Using remote sensing and modeling for evaluating hydrologic fluxes, landscape states, and constituent transport processes within agricultural landscapes.

Investigators	**FTE**
Wade Crow, Lead Scientist ……..	0.8
Martha Anderson……...	0.7
Michael Cosh .....……	1.0
Paul Doraiswamy ……	0.5
Timothy Gish ……..……	0.2
Raymond Hunt …….....	0.5
Thomas Jackson…….	0.7
William Kustas……..	1.0
Gregory McCarthy…….	0.4
Jerry Ritchie……...	0.6
Clifford Rice (Located in EBUL in ANRI) ……..	0.3
Ali Sadeghi	0.7

Scientific Staff Years: 7.4

Planned Duration: 60 months (June 2006 to May 2011)

Objective #1: Development of models and methods for evaluating environmental impacts of conservation practices at watershed scales.

Objective #2: Development of remote sensing tools and techniques for assessing variability in landscape and hydrologic states.

Objective #3: Development of remote sensing and ground techniques for improved hydrologic and crop yield modeling and drought monitoring and detection.

Approach: A better understanding of the complex hydrologic pathways operating within agricultural landscapes is critical for efforts to minimize the water quality impacts of agricultural production systems, maximize water agricultural use efficiency, and predict the impact of hydrologic extremes on agricultural productivity. Existing shortcomings in process-level hydrologic understanding, modeling tools, and observational resources currently limit our ability to effectively manage many agricultural landscapes. In this project, research will be conducted to develop modeling and decision support tools to quantify and mitigate the impact of agricultural production on water quality. The effectiveness of current major USDA water quality conservation programs, both now and under climate change scenarios, will be evaluated. Our understanding of factors governing the temporal and spatial patterns in soil moisture and surface energy fluxes within agricultural watersheds will be enhanced, and remote-sensing tools for the large-scale measurement of these variables will be improved. Landscape and remote sensing

research will be linked through the development of effective spatial scaling tools capable of linking the vastly different spatial supports of ground-based (0.01 to 100 m) and space-borne (> 500 m) observations of land surface variables (e.g. evapotranspiration and soil moisture). In aggregate, these improvements should manifest themselves in an enhanced ability to manage agricultural systems for conservation goals and monitor vital hydrologic variables. In particular, novel remote sensing, modeling, and data assimilation tools will be developed that enhance our ability to detect drought, monitor root-zone soil moisture and forecast crop yields.

Expiring Projects with Significant Accomplishments and Technology Transfer

1265-12130-001-00D: Fate & Transport of Nutrients in Agricultural Systems as Affected By Soil & Nutrients Management

Scientists:

FTE	Scientist
.60	Gregory McCarty – Lead Scientist
.50	James Starr
.20	James Reeves (Located in EBUL in ANRI)

Total FTE: 1.3

Total Funding: $764,634.00

Objectives:

Quantify basic nutrient transformation and transport processes and their controlling factors in agricultural systems. Assess the influence of soil resource management strategies on C and nutrient cycles in agricultural ecosystems. Develop nutrient management practices, specifically the P-index, to improve nutrient efficiency and protect environmental quality. Develop feather fiber/quill separation technologies and uses for keratin containing quill.

Approach:

Studies of basic soil processes will utilize real-time soil moisture capacitance measurements to investigate soil water dynamics as affected by soil and crop management factors which affect water infiltration, retention, and impact on nutrient fate. Basic chemistry studies will utilize nuclear magnetic resonance spectroscopy to precisely measure the forms and transformations of phosphorus (P) and nitrogen (N) in soils and wastes. New chemical methods will also be developed for quantifying and characterizing soil C. Field research will utilize 4-ha sub-watersheds and an adjoining riparian area and stream to evaluate the environmental benefits of site-specific nutrient management. These investigations will study the pre-sidedress N test, P-index, and soil C loss and sequestration in wetlands. Nutrient budgets for each management strategy will be constructed to quantify nutrient recoveries, losses, and loss pathways. Field buffer-strips will be studied for reducing P surface runoff losses. Examine chemistries of feather fiber and quill.

Selected Major Accomplishments:

INFLUENCE OF RIPARIAN BUFFER VEGETATION ON FATE OF AGRICULTURAL NUTRIENTS: Excess nutrients in agricultural effluent may be retained by nearby riparian buffer vegetation, but these nutrients may negatively impact the ecosystem's species diversity, which is an important measure of ecosystem health. Herbaceous and woody plants were surveyed and harvested for nitrogen and phosphorus analysis in a wetland receiving agricultural runoff for over 50 years and in a wetland not impacted by agriculture. In the agriculturally-influenced wetland, the species diversity was lower, the nutrient concentrations in the vegetation were higher, and species that

were better able to cope with disturbance were dominant. Determining the long-term impact of agricultural runoff on wetland ecosystems will lead to better management practices and to a greater understanding of the role of vegetation in nutrient retention within agricultural watersheds.

SOIL REDISTRIBUTION AND THE CARBON CYCLE IN AGRICULTURAL ECOSYSTEMS: Erosion/deposition processes are poorly understood, but they are important for understanding the landscape distribution of soil organic carbon. Patterns of soil erosion/deposition patterns were measured by use of Cs tracer at study sites in Iowa, Ohio, and Maryland and were compared to landscape distributions of soil carbon. Although carbon and soil redistribution patterns were complex but correlated to varying degrees at each of the sites, the results indicated that agricultural fields contain both sites of erosion and deposition. This work will provide data for development of improved landscape models because most current numerical erosion and carbon models cannot simulate deposition, and such capability must be incorporated into models if they are to be used to predict carbon inventory accurately. Assessing impact of wetland sedimentation on carbon dynamics is important in the overall assessment of carbon storage within agricultural ecosystems. Evaluation of 210Pb as a chronological marker of sedimentation and carbon deposition can provide new tools for assessment of ecosystem carbon dynamics. The results showed remarkable correspondence between 210Pb activity and carbon content in sediment deposits. Sedimentation event dating and carbon dynamics assessment associated with wetland sedimentation provide a powerful new approach to assess the impact of agricultural activities on carbon storage in wetlands within agricultural ecosystems.

FORMS OF PHOSPHORUS IN AGRICULTURAL ECOSYSTEMS.

Soil management treatments to decrease excess nutrients from manures use metal salts, such as those containing ferric ions, to complex inorganic P, forming a water-insoluble precipitate, but the same treatment effect on organic P from manures is uncertain. Enzymatic release of inorganic P was investigated in the presence of ferric and ferrous ions and aspergillus ficcum from the major form of organic P in manures (phytate). Increasing the amount of ferric ions decreased the rate of dephosphoralation of phytate; the treatment thus will result in phytate P remaining organic longer in the soils to which manure has been applied. Since organic P is a major reservoir from poultry and dairy manures (solids), the release of inorganic P into the environment cannot be adequately explained without understanding how quickly this reservoir fills up and how slowly it empties.

Technology Transfer

Scientists facilitated bilateral U.S.-Brazil information exchange on Global Change through the LABEX program. Visiting Brazilian laboratories in April 2005.A long-term collaboration of ARS scientists with scientists from NRC (Nuclear Regulatory Commission) has led to new methodologies to be used in the NRC disposal facilities. NRC will use these new monitoring and analytical procedures to better quantify and understand technical issues involving ground-water recharge estimates at nuclear facilities.

Expiring Projects with Significant Accomplishments and Technology Transfer

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality

Scientists:

FTE	Scientist
.80	Craig Daughtry, Lead Scientist
.50	Charles Walthall
.40	Raymond Hunt
.50	Martha Anderson
.20	Walter Rawls
.20	Timothy Gish

Total FTE: 2.6

Total Funding: $1,032,019.00

Objectives:
Our overall objective is to extract quantitative information about vegetation and soil from remotely sensed data. Specific objectives are to: 1) develop methods for quantifying nutrients and constructing nutrient budgets for crops at the leaf, field, watershed, and regional scales; 2) develop methods for measuring crop residue cover and soil organic carbon; 3) develop methods for mapping crop and soil management zones; and 4) develop advanced methods to detect weeds and narcotic plants.

Approach:
The research approach employs a combination of measurements and simulation models. Reflectance, transmittance, and emissions of crops and soils will be measured and combined with models to develop insights to the basic physical and physiological processes. Special attention will be paid to the spatial variability of these processes in pant canopies. Within the Beltsville Agricultural Research Center (BARC), several intensive and extensive test sites have been identified and comprehensive databases are being developed. Crop and soil management inputs, meteorological data, crop yields, and multispectral images will be recorded in a geographic information system (GIS) and combined with crop models to assess and manage the spatial variability of soils and crops. Ground-based, airborne, and satellite imagery will be acquired to assess the spatial variability of crops and soils. Additional sites with known management histories at other ARS and/or collaborator locations will be included as appropriate.

Selected Major Accomplishments:
SUBSURFACE FLOW PATHWAYS CONFIRMED WITH VEGETATIVE INDICES: Identifying locations for monitoring subsurface flow of water and chemicals is especially difficult because conventional sampling methods are inadequate for measuring this highly variable, yet critical process. Analysis of remotely sensed imagery over several years confirmed the existence and extent of the subsurface water flow network in agricultural fields and quantified the impact of hydrologically-active zones on

corn yields. Remotely sensed imagery is useful in locating these subsurface flow pathways when ground-penetrating radar data are either unavailable or ineffective. Knowledge of subsurface hydrology dramatically improved nitrogen management. Effective nitrogen (N) management depends on identifying soil and hydrologic parameters that governs crop growth and yield. At the Beltsville Agricultural Research Center a protocol was developed that for the past four years has reduced N inputs on a 4.2 ha field by nearly 50% relative to an adjacent 3.6 ha field under split N-management with no reduction in yields. This technique holds promise as a tool for managing the spatial variability of N in crops so as to minimize detrimental environmental impacts while maintaining crop production.

LEAF CHLORPHYLLI CAN PROVIDE GUIDANCE FOR NITROGRN APPLICATION: Maps of the within-field spatial variability of leaf chlorophyll concentration can provide guidance for applying the appropriate amounts of N fertilizer to optimize crop growth and yield while minimizing excess fertilizer loss to the environment. The USDA-ARS Hydrology and Remote Sensing Lab at Beltsville, MD acquired reflectance spectra of soils, corn leaves, and corn canopies along with measurements of corn leaf chlorophyll and developed remote sensing methods for measuring N status under varying soil and crop conditions. This approach holds promise as N management decision aid as crop N status can be accurately mapped in the presence of other factors affecting crop reflectance such as soil brightness and foliage density.

FLUORESCENCE CAN BE USE TO ASSESS PLANT PHYSIOLOGICAL TRAITS: Natural fluorescence emissions of corn canopies in sunlight were good predictors of vegetation health and carbon fixation. Remote measurement of photosynthetic capacity of plant canopies will provide a new tool for monitoring agricultural and natural vegetation ecosystems. Imagery from small radio-controlled aircraft also provided a tool to monitor crop conditions. These images had higher spatial resolution, shorter delivery time, and lower cost than current satellite or airborne imagery for monitoring fields throughout the growing season. Areas with low rates of applied N fertilizer and areas with weed infestations were identified in the imagery. Alternative remote sensing systems provide opportunities for effective site-specific crop management.

Technology Transfer

The remote sensing techniques developed for small radio-controlled model airplanes have been transferred to Intellitech Microsystems, Inc. (Bowie, MD), our CRADA partner, to develop unmanned aerial vehicles (UAV) for crop consultants. These UAV can quickly provide customers with high spatial resolution remotely sensed images for site-specific crop management.

Research identifying and evaluating different models and sources of data that can be used to generate maps for precision agriculture-based crop management has been transferred to Geosys Inc., the CRADA partner. This research has been especially beneficial to Geosys as off-the-shelf software appears suitable and thus, no significant software development appears warranted for Geosys to employ these techniques.

Research characterizing the effectiveness of remote sensing for marijuana detection has been transferred to the DEA and the National Guard Bureau Counter Drug Program and training has benn conducted for various law enforcement agencies.

Expiring Projects with Significant Accomplishments and Technology Transfer

1265-13660-009-00D: **Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes**

FTE Scientists:
.80 Timothy Gish, Lead Scientist
.80 Walter Rawls
.50 Jerry Ritchie
.50 Charles Walthall
.20 Craig Daughtry
Total FTE: 2.8

Total Funding: $792,018.00

Objectives:
The primary objectives of this proposal are to: 1) develop and evaluate methods for accurately quantifying water and chemical behavior at field, watershed, and regional scales; and 2) to identify water and chemical source areas within a watershed so that management practices and recommendations can be developed for mitigating environmental degradation.

Approach:
Atmospheric, surface, and subsurface flow pathways will be identified in four small watersheds, each about 4 ha. Instrumentation for monitoring real-time vapor, surface and subsurface fluxes will be developed and evaluated as a function of climate, management practice, landscape position, and hydrological setting. Because preferential flow has been identified as a significant contributor to groundwater contamination, both matrix and preferential flow processes is the subsurface will be evaluated.

Selected Major Accomplishments
DEVELOPPED PROCEDURE TO LOCATE SUBSURFACE PATHWAYS:
Subsurface hydrologic processes are by far the dominant pathways whereby water and chemical exit agricultural land. Although these subsurface flow pathways are stationary they are also temporally dynamic with regard to water movement, and so are difficult to quantify. The ARS Hydrology and Remote Sensing Lab., in collaboration with the University of Wisconsin, Madison, WI developed a procedure where ground-penetrating radar (GPR) and digital elevation maps were linked to hydrologic programs in a GIS framework to identify subsurface hydrology on small watersheds. These subsurface flow pathways where found to respond to preferential flow (funnel flow) which govern the subsurface transport of agricultural chemicals off-site to neighboring ecosystems. With the capacity to accurately determine the location of these subsurface pathways, protocols for monitoring water and chemical fluxes on a watershed-scale can be developed which will improve water quality models and government policy germane to production agriculture.
FACTORS INFLUENCING PESTICIDE VOLATILIZATION DETERMINED:
Although the scope and magnitude of detrimental environmental impacts from

agricultural activities is a function of how chemicals are partitioned between atmospheric, surface and subsurface loss pathways, surface volatilization processes at the small watershed scale are still poorly understood. The ARS Hydrology and Remote Sensing Laboratory, in collaboration with the ARS Laboratory in Ames, IA monitored metolachlor and atrazine vapor fluxes over a five-year period. Pesticide behavior was evaluated while soil properties, agricultural management practice, and pesticide chemistry were held constant across the 22 ha corn production site. Metolachlor atmospheric losses were 7% of that applied when soils were dry and cool. On the other extreme, 25% of the applied metolachlor was lost to the atmosphere when soils temperatures and surface soil water contents were high. The dramatic range in pesticide atmospheric losses demonstrates the critical impact climate has on field and watershed scale chemical behavior and the importance of quantifying pesticide volatilization in environmental investigations. This unique data set will allow scientists to improve pesticide volatilization models and will encourage producers to use methods which will reduce atmospheric losses.

WATER SOIL WATER STORAGE AND RELEASE ALGOTHRITHMS DEVELOPED: Soil properties are critical to describing how water is stored and released from the soils at the regional scale. Consequently, the ARS Hydrology and Remote Sensing Laboratory at Beltsville, MD in collaboration with NASA determined the most important soil survey information for estimating soil water retention and conductivity properties. Procedures incorporating soil survey profile information used for predicting soil water retention and conductivity properties were developed. The procedure developed allows soil water retention and conductivity properties to be predicted for the thousands of soil survey descriptions available in the United States.

CARBON SEQUESTRATION LINKED TO SOIL REDISTRIBUTION: To accurately determine the impact of agriculture and neighboring wetlands on carbon sequestration, soil characteristics and landscape position influences must be quantified. Research was conducted to quantify soil carbon patterns by evaluating the role of soil redistribution on carbon sequestration using radioactive Cesium-137. These carbon studies demonstrated a high spatial correlation between the concentration of radioactive fallout Cesium-137 and concentration of soil organic carbon. Furthermore, soil carbon patterns of upland soil were found to be significantly correlated, suggesting that Cs-137 patterns may be used to help understand soil carbon dynamics throughout the agricultural landscape. This information will allow a better prediction/estimate of the spatial patterns of carbon in the soil will improve estimates of soil carbon budgets.

Technology Transfer

ARS scientists determined the data requirements and models that are needed to quantify water and chemical transport at NRC waste disposal facilities which will allow NRC to develop strategies that will preserve groundwater quality below NRC waste disposal facilities.

Software was developed and given to NRCS for quantifying soil water hydraulic characteristics based on readily available NRCS soil survey information.

Expiring Projects with Significant Accomplishments and Technology Transfer

1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools

FTE Scientists:
.70 Ali Sadeghi, Lead Scientist
.40 Gregory McCarty
.30 Clifford Rice (Located in EBUL in ANRI)
.30 James Starr
Total FTE: 1.7

Total Funding: $659,211.00

Objectives:
Ascertain basic hydrologic, chemical, and biological processes influencing quality of water exiting agricultural production systems. Assess riparian buffer and vegetative filter effectiveness to mitigate agricultural pollution in surface and subsurface waters at field and landscape scales. Evaluate and modify current models/modules for the development of risk assessment and decision support tools.

Approach:
Examine basic and interactive hydrologic, chemical, and biological processes that influence the rate and magnitude of contaminant transport by determining the functional relationships between selected agronomic practices and critical environmental parameters, such as topography, vegetative filters, and rainfall/irrigation. Critical source areas contributing to the potential pollutant loss will be delineated at field and watershed scales. Important transport parameters and selected soil physical properties will be superimposed and coupled with management strategies to identify areas within the watersheds that present the most risk to water quality degradation. Knowledge of these basic processes will form the basis for evaluation and development of risk assessment and decision support tools. Management strategies designed to minimize Total Maximum Daily Loads (TMDL) for agrochemicals, nutrients, sediments and pathogens from agricultural lands and to improve water quality will be evaluated using several ARS and U.S. EPA models.

Selected Major Accomplishments:
NITROGEN LOADS ARE GREATER FROM RIPARIAN AREAS IN WET YEARS: Stream Nitrate fluxes within riparian systems can be highly variable, but real-time continuous monitoring is rarely attempted, making accurate determination of contributions from small stream sources difficult to assess. We have established multiple monitoring stations, allowing continuous record of stream flows within a small first-order stream channel within riparian ecosystems. Results revealed that stream nitrate flux is highly dependent on rainfall and total annual N load exported via stream flow was fives times greater in a wet year than a dry year which impacts the overall function of riparian ecosystems. These findings will aid the quantification of the relationships between nutrient variability and rainfall characteristics within the riparian ecosystems.

QUANTIFICATION OF WETLAND NUTRIENT DYNAMICS TO IMPROVE RIPARIAN MODELS: Better understanding of the nutrient dynamics and distributions is needed to improve models predicting flux of nutrients through riparian ecosystems. Extensive monitoring instrumentations have been established within riparian ecosystem vegetations to identify nutrient dynamic pathways, in terms of composition and released availability. We are continually evaluating surveys of vegetation within the ecosystem and measured nutrient contents in the plant tissue. Results indicated that the herbaceous vegetation at the agriculturally influenced site within the riparian system had higher concentrations of phosphorus and nitrogen than the vegetation at the non-agriculturally influenced site, but that the carbon concentrations were similar. These findings will improve the capability of riparian models for predicting nutrient fate and movement in riparian ecosystems.

IMPROVE METHODS FOR VEGETABLE PRODUCTION SYSTEMS TO REDUCE ENVIRONMENTAL IMPACTS: Vegetable producers frequently use plastic mulch to increase soil temperature, plant earlier, and decrease weeds, however, runoff from plastic into adjacent surface waters can have adverse effects on non-target organisms as a result of increased turbidity and degraded water quality. Field studies showed that runoff from vegetable production utilizing plastic mulch may contain up to 35% of the applied copper (a widely used fungicide/bactericide) because it is primarily transported with suspended particulates from the furrows. Replacing the bare-soil furrows with furrows planted in cereal rye significantly reduced the soil loss and copper loads yet crop yields were unaffected. Thus, replacing the bare-soil furrows with vegetative furrows greatly reduced the potential negative impacts of the conventional plastic mulch systems and allows growers to have an acceptable economic return.

IMPROVED SOIL & WATER ASSESSMENT TOOL (SWAT) TO ASSESS PATHOGEN FATE: A new microbial component was incorporated into watershed-scale model SWAT. The model is being successfully tested at watershed levels in two locations, by scientists at FAPRI (Food and Agricultural Policy Research) in Columbia, Missouri), and by Scientists at the University of Guelph in Canada). This model improvement is being carried out, primarily, through a collaborative effort with ARS scientists at Temple, TX (SWAT model developers) and Environmental Microbial Safety Laboratory (EMSL) at Beltsville, MD. Nearly 50% of the Environmental Quality Incentive Program (EQIP) budget has been devoted to reducing the environmental impacts of animal unit operations. Consequently, a model is needed for the USDA's agencies such as NRCS and FSA that are required by law to perform risk analysis for their major conservation programs. This modeling tool supports the integrated assessment of pathogen release and loadings into water resources along with nutrient and sediment evaluations. The U.S. EPA has considered the use of SWAT/Pathogen model for their states and national TMDL assessments.

Technology Transfer

A pathogen sub-model had been incorporated into the SWAT model. the U.S.EPA has recently recommended the SWAT/Pathogen Sub-Model as the future model for the States to use in TMDL assessments.

Expiring Projects with Significant Accomplishments and Technology Transfer

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

FTE	Scientists:
1.00	William Kustas, Lead Scientist
1.00	Paul Doraiswamy
.60	Raymond Hunt
1.00	Thomas Jackson
.50	Martha Anderson
1.00	Michael Cosh
1.00	Wade Crow
.50	Jerry Ritchie

Total FTE: 6.7

Total Funding: $1,705,128.00

Objectives:

The main objectives for this research project is to develop process-based land surface algorithms and models using remote sensing technology and evaluate their utility for mapping surface states (e.g. soil moisture, surface temperature, vegetation cover) crop yields and water, energy carbon fluxes from field and farm to watershed, and regional scales. This necessitates research into scaling of land surface states and understanding feedbacks of landscape heterogeneity on surface-air state coupling.

Approach:

To address these objectives field data covering a range of scales from point to field to watershed and regional scales commensurate with remotely sensed observations are being collected and processed. In addition, models evaluating exchange rates or fluxes of water, energy and carbon across the land-atmosphere interface will be developed. An array of such physically-based remote sensing models will be implemented for testing remote sensing algorithms and scaling techniques, while Large Eddy Simulation model simulating atmospheric turbulent processes will be linked to remotely sensed boundary conditions for evaluating the feedbacks between surface states and the atmosphere. For quantifying regional scale carbon budgets from daily to seasonal time scales, the utility of simple schemes will be explored. That will involve intergrading measurements of carbon exchange into regional models of ecosystem processes, driven by remotely sensed vegetation indices.

Selected Major Accomplishments:

GLOBAL SOIL MOISTURE MONITORING SYSTEM: Analyses of microwave aircraft and satellite data from large scale field experiments (Monsoon90, SGP97, SGP99, SMEX02, SMEX03 and SMEX04) covering a wide variety of landscapes demonstrated the potential for large area soil moisture assessment, and are now being implemented with the new generations of satellites (AMSR and ADEOS-II). The impact

of this research is the development of a global soil moisture monitoring system for improved weather and hydrologic forecasts.

MULTI-SCALE SOIL VEGETATION ENERGY WATER BALANCE MODEL: A multi-scale soil-vegetation-energy-water balance regional modeling framework has been developed which can use remotely sensed surface temperature from operational weather satellite to predict vegetation and soil water use and stress without the need of air temperature observations and that minimizes measurement errors. In addition, this regional output can be disaggregated to field scale with high-resolution satellite remote sensing data. This framework is being implemented in a climate forecasting model and being integrated as part of NASA's Earth Observing System EOS-Terra/Aqua satellite data products. This research will improve weather forecasts and crop yield predictions critical to maintaining agricultural competitiveness.

SURFACE ROUGHNESS FROM AIRBOURNE LASER ALTIMETERS: Airborne laser altimeters have been shown to provide measurements of landscape roughness over large areas quickly and easily that will improve our ability to manage natural and agricultural landscapes. The algorithms are now available for operational implementation by private and government agencies. The result will be the production of more reliable roughness maps over different landscapes for improved modeling of ecosystem health.

DATA ASSIMULATION EXAMINED OVER A RANGE OF COVERS: The performance of data assimilation techniques was examined over a range of land covers within the south-central United States to assess their robustness and value relative to existing approaches. Data assimilation approaches are powerful mathematical tools being used in climate modeling for more accurate weather forecasts. They are now being utilized in hydrologic models for improving predictions and have recently been developed to utilize remotely sensed surface temperature observations to solve the surface energy balance and predict surface energy fluxes. The impact of this research is more accurate forecast models.

REMOTE SENSING DATA INTEGRATED INTO EDDY SIMULATION MODEL: The Large Eddy Simulation (LES) model was used for investigating the effect of land surface heterogeneity on land surface-atmosphere coupling. An understanding of the coupling between land surface and atmosphere is essential for understanding the degree to which vegetation changes affect local and regional climate and weather. A suite of LES simulations over surface fields obtained from recent field experiments have begun. Preliminary analyses from the simulations indicate the strength of surface contrasts has a significant affect on surface-air coupling resulting in potentially large errors in flux computations that assume uniform atmospheric forcing. This research enables a greater understanding of the effects of land cover heterogeneity on regional scale land-atmosphere flux interactions.

EVALUATED MODELS FOR SIMULATING ORGANIC CARBON IN SOILS: Evaluated the potential use of the EPIC- Century biogeochemical model for simulating the accumulation of organic carbon in the soil under various soil and crop management practices. Estimation of regional carbon storage in the soil is critical assessing agricultural impact on the global carbon budget and potential consequences on global climate change. A database was set up to run the EPIC-Century model in central Iowa and south western Mali. Preliminary runs have been completed and the database is being populated with additional detailed soil and land cover information required for model simulations. The impact of this research is that it could be set up to predict the rate of

changes in soil carbon with different tillage and residue management practices at regional scales.

Technology Transfer:

Algorithms developed for the translation of remotely sensed data to hydrologic variables have been adopted as operational tools by NOAA and others will be implemented in future satellite programs for monitoring evapotranspiration by NASA and Japan.

A prototype soil moisture retrieval algorithm for use with satellite sensors launched in 2002 was provided to NASA and the Japanese space agency to produce daily soil moisture products for public distribution.

Transferred a spring wheat yield model to PECAD-FAS for operational assessment of crop yields in northern Kazakhstan.

Airborne lidar technology is now widely available in the commercial arena for a wide variety of applications, allowing the landscape roughness algorithm to be implemented operationally.

Relationship between Current & Proposed CRIS Projects

Expiring CRIS Projects	*Proposed New CRIS Projects*
1265-12130-001-00D: Fate & Transport of Nutrients in Agricultural Systems as Affected By Soil & Nutrients Management **FTE Scientist** .60 Gregory McCarty – Lead Scientist .50 James Starr .20 James Reeves **Total FTE: 1.3**	**Quantifying Landscape Factors Influencing Soil Productivity and the Environment.** **FTE Scientist** 1.0 Charles Walthall, Lead Scientist 1.0 Walter Rawls (RL) 0.8 Craig Daughtry 0.8 Timothy Gish 0.2 Earle Raymond Hunt Jr **Total FTE: 3.80**
1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality **FTE Scientist** .80 Craig Daughtry, Lead Scientist .50 Charles Walthall .40 Earle R. Hunt, Jr. .50 Martha C. Anderson .20 Walter J. Rawls .20 Timothy J. Gish **Total FTE – 2.6**	**Using remote sensing and modeling for evaluating hydrologic fluxes, landscape states, and constituent transport processes within agricultural landscapes.** **FTE Scientist** 0.8 Wade Crow, Lead Scientist. 0.7 Martha Anderson 1.0 Michael Cosh 0.5 Paul Doriaswamy 0.2 Timothy Gish 0.5 Earle Raymond Hunt Jr 0.7 Thomas Jackson 1.0 William Kustas 0.4 Gregory McCarthy 0.6 Jerry Ritchie 0.3 Clifford Rice 0.7 Ali Sadeghi **Total FTE - 7.4**
1265-13660-009-00D: **Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes** **FTE Scientists:** .80 Timothy Gish, Lead Scientist .80 Walter Rawls .50 Jerry Ritchie .50 Charles Walthall .20 Craig Daughtry **Total FTE; 2.8**	**Assessing Climate, Soil and Landscape Processes Affecting Agricultural Ecosystems** **FTE Scientist** 0.6 Gregory McCarty, Lead Scientist 0.3 Martha Anderson 0.2 Wade Crow 0.2 Craig Daughtry 0.5 Paul Doraiswamy 0.3 Raymond Hunt 0.3 Thomas Jackson 0.2 James Reeves 0.4 Jerry Ritchie **Total FTE: 3.0**
1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools **FTE Scientists:** .70 Ali Sadeghi .40 Gregory McCarty .30 Clifford Rice .30 James Starr **Total FTE: 1.7**	
1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles **FTE Scientists** 1.00 William Kustas, Lead Scientist 1.00 Paul Doraiswamy .60 Earle R. Hunt 1.00 Thomas Jackson . 50 Martha Anderson 1.00 Michael Cosh 1.00 Wade Crow .50 Jerry Ritchie **Total FTE: 6.6**	

SPECIFIC COOPERATIVE AGREEMENTS

1265-13660-009-06T- University of California, Riverside
Identification of Critical Source Areas of Flow and Contaminants in Agricultural Watershed
Investigator: Timothy Gish
Funding to University of California: $148,824.00
Start Date: 05/01/2003
Term Date: 12/31/2005

1265-13610-026-01S – Duke University
Combining Large Eddy Simulation with Remote Evapotranspiration
Investigator: William Kustas
Funding to Duke University: $35,000.00
Start Date: 02/01/2002
Term Date: 01/31/2007

1265-13610-026-06S – Utah State University
Combining Remote Sensing and Energy Flux Measurements for Evaluating the Influence of Land Surface Heterogeneity on Evapotranspiration
Investigator: William Kustas
Funding to Utah State University: $53,896.00
Start Date: 08/01/2002
Term Date: 07/31/2007

1265-13610-026-20S – University of Massachusetts
Synthetic Aperture Radiometry Measurements for Soil Moisture
Investigator: Thomas Jackson
Funding to University of Massachusetts: $25,000.00
Start Date: 09/01/2001
Term Date: 08/31/2006

1265-13610-026-21S – University of South Carolina
Field Modeling Validation of Aircrafted Satellite Based Soil Moisture Products
Investigator: Thomas Jackson
Funding to University of South Carolina: $49,500.00
Start Date: 09/01/2001
Term Date: 09/01/2006

1265-13610-026-24S – University of Wisconsin, Madison
Quantifying Field Scale Evapotranspiration Using a Disaggregation Approach to Remote Sensing
Investigator: William Kustas
Funding to University of Wisconsin, Madison: $79,500.00
Start Date: 09/01/2001
Term Date: 08/31/2006

1265-13610-019-02G – T-Systems International, San Diego
Monitoring and Evaluation of Irrigation Practices in the Mid-Atlantic Region
Investigator: James Starr
Funding to T-Systems International, San Diego: $ 35,000
Start Date: 07/01/2002
Term Date: 12/31/2005

1265-13610-019-03N – Sentek, Pty. Ltd
Assessing TRISCAN for Simultaneously Measuring Soil Water and Salinity Under Humid and Intermittent Rainfall Conditions
Investigator: James Starr
Funding to Sentek, Pty. Ltd: $ 15,000
Start Date: 04/12/2004
Term Date: 12/31/2005

1265-13610-019-05S – Horn Point Laboratory
Evaluation of Conservation Practice Effectiveness in Water Quality Protection in the Choptank River Watershed
Investigator: Gregory McCarty
Funding to Horn Point Laboratory, Cambridge, MD: $148,229.00
Start Date: 12/01/2004
Term Date: 11/30/2009

1265-13610-019-06S – Smithsonian Environmental Research Center
Utilizing Nitrogen and Oxygen Isotopes as Tracers for Manure Nutrient Fate in the Chesapeake Bay Watershed
Investigator: Gregory McCarty
Funding to Smithsonian Environmental Research Center: $5,060.00
Start Date: 07/01/2005
Term Date: 06/30/2009

1265-13610-026-27S – University of Oklahoma
Validation of Satellite Estimates of Soil Moisture in the Southern Great Plains
Investigator: Thomas Jackson
Funding to University of Oklahoma: $41,510.00
Start Date: 02/01/2003
Term Date: 01/31/2008

1265-13610-026-32S – University of Maryland
Integration of Remotely Sensed Snow Coverage Extent Measurements with a Snowmelt Runoff Model
Investigator: Wade Crow
Funding to University of Maryland: $30,000.00
Start Date: 07/31/2003
Term Date: 07/30/2008

1265-13610-026-38N – Japan Aerospace Exploration Agency
Integrating Remote Sensing, Climate and Hydrology for Evaluating Water, Energy and Carbon Cycles
Investigator: Thomas J. Jackson
Funding to Japan Aerospace Exploration Agency : $0.00
Start Date: 04/01/2004
Term Date: 03/31/2007

1265-13610-026-41S – Duke University
Effects of Land Surface Heterogeneity on Regional Flux Estimation Using Large Eddy Simulation Model with Remote Sensing
Investigator: William Kustas
Funding to Duke University:
Total: $324,263.00
Start Date: 12/01/2004
Term Date: 11/30/2009

EXTRAMURAL PROJECTS

1265-13610-026-03R – NASA Impact
Impact of Field-Scale Heterogeneity in Surface Moisture and Vegetation Cover on Regional-Scale Fluxes: From Land Atmosphere Modeling and Remote Sensing Perspectives
Investigator: William Kustas
Funding: $143,528.00
Start Date: 04/01/2001
Term Date: 03/31/2006

1265-13610-026-08R – JAPAN JAXA
Soil Moisture Algorithm Application and Validation Using AMSR
Investigator: Thomas Jackson
Funding: $74,000.00
Start Date: 08/01/2002
Term Date: 03/31/2005 – Expecting additional funding and extension of period of performance

1265-13610-026-30R – NASA SMEX03
Soil Moisture Experiment 2003
Investigator: Thomas Jackson
Funding: $210,000.00
Start Date: 04/01/2003
Term Date: 03/05/2006

1265-13610-026-33R – NASA ESE
Integrating NASA Earth Sciences Enterprise Data Into Global Agricultural Decision Support Systems
Investigator: Paul Doraiswamy
Funding: $298,000.00
Start Date: 12/18/2003
Term Date: 12/31/2005 – Extension coming

1265-13610-026-34R – NASA AQUA
Improving Flood Forecasts Through the Integration of ACQUA Satellite Products with a Macro-Scale Hydrologic Model
Investigator: Wade Crow
Funding: $294,000.00
Start Date: 05/01/2004
Term Date: 04/30/2007

1265-13610-026-35R – NASA IDS
Accounting for Effects of Subpixel Surface Variability on Regional Flux Estimation Using Large Eddy Simulation with Terra and Aqua Sensors
Investigator: William Kustas
Funding: $680,000.00
Start Date: 04/01/2004
Term Date: 03/31/2007

1265-13610-026-36R – AMS
Chief Editor for AMS Journal of Hydrometeorology
Investigator: William Kustas
Funding: $72,500.00
Start Date: 03/01/2004
Term Date: 03/01/2007

1265-13610-026-39R – NASA NAME
Soil Moisture Experiment 2004 and the North American Monsoon Experiment
Investigator: Thomas Jackson
Funding: $361,000.00
Start Date: 05/01/2004
Term Date: 04/30/2006 (Extension Requested to 10/31/2006)

1265-13610-026-40R – NASA LeVine
Soil Moisture Retrieval Using Two Dimensional Synthetic Aperture Radiometer
Investigator: Thomas Jackson
Funding: $34,000.00
Start Date: 08/25/2004
Term Date: 09/30/2006

1265-13610-026-42R- NASA Carbon
Decision Support Systems for C Management Across the U.S. Corn Belt Using NASA Remote Sensing Data Products
Investigator: Paul Doraiswamy
Funding: $852,869.00
Start Date: 02/08/2005
Term Date: 08/31/2007

1265-13610-026-43R- NASA Jet Propulsion Laboratory - Hydros
HYDROS: The Hydrosphere State Mission Project
Investigator: Thomas Jackson
Funding: $46,000.00
Start Date: 07/12/2004
Term Date: 04/30/2006

1265-13610-026-46T- World Bank, Ministry of Environmental Protection of Republic of Kazakhstan
Dryland Management Project
Investigator: Paul Doraiswamy
Funding: $325,000.00
Start Date: 07/01/2005
Term Date: 06/30/2008

1265-13610-026-47R- University of California, Davis
Global Estimation of Canopy Water Content
Investigator: Raymond Hunt
Funding: $283,851.00
Start Date: 01/01/2005
Term Date: 12/31/2007

1265-13610-026-48R- Naval Research Laboratory
SMEX05 Ground Data Collection and Analysis
Investigator: Thomas Jackson
Funding: $30,000.00
Start Date: 07/01/2005
Term Date: 12/31/2005

1265-13610-026-49R- NASA
Multi-Scale Remote Assessment of Land-Surface Hydrological Response to Natural and Anthropogenic Stressors: A Case Study in the Florida Everglades
Investigator: Martha Anderson
Funding: $328,995.00
Start Date: 10/01/2005
Term Date: 05/31/2007

1265-13610-026-50R – National Agricultural Statistics Service
A Method for Disaggregating NASS State Yield Estimates to County and Agriculture Statistics District Yields Using MODIS Imagery
Investigator: Paul Doraiswamy
Funding: $80,000.00
Start Date: 10/01/2005
Term Date: 09/30/2006

1265-13610-026-51R – Japan Aerospace Exploration Agency (JAXA)
Algorithm Development and Calibration and Validation for the Advanced Earth Observing Satellite II
Investigator: Thomas Jackson
Funding: $60,000.00
Start Date: 11/10/2005
Term Date: 03/31/2008

Under 25K-Intellitech Microsystems, Inc.
Developing the Use of UAV's in Precision Agriculture
Investigator: Raymond Hunt
Funding: $23,320.00
Start Date: 04/01/2005
Term Date: 03/31/2007

1265-13610-019-04R – Natural Resources Conservation Service (NRCS)
Assessment of Natural Resource Conservation Practice Effectiveness Within the Choptank River Watershed
Investigator: Greg McCarty
Funding: $299,707.00
Start Date: 06/15/2004
Term Date: 06/14/2009

Under 25K – FILTREXX
Compare Effectiveness of Erosion Control Materials on Soil and Nutrient Loss
Investigator: Ali Sadeghi
Funding: $10,000
Start Date: 06/01/2005
Term Date: 04/30/2007

1265-12630-003-03R – Nuclear Regulatory Commission
Application of Model Abstraction Techniques to Simulate Contaminant Transport in Soils
Investigators: Co PI's Yakov Pachepsky and Timothy Gish
Funding: $ 360,000.00
Start Date: 08/01/2005
Term Date: 09/30/2008

Proposed Future Unfunded Research Projects

Since all our projects are in the review stage, we have incorporated what we and the National Program Staff consider to be the highest priority research which we can accomplish with our existing funding. With additional funding we think the following high priority areas of research should be conducted.

1**. Development of a drought monitoring/detection system using thermal-infrared and microwave remote sensing and data assimilation**. A lack of information on the spatial and temporal variability of soil moisture significantly hampers drought forecasting, detection and monitoring. Two near future satellites could significantly affect our ability to monitor global soil moisture. The Japanese Aerospace Development Agency (JAXA) will launch a L band radar satellite in 2006 and the European Space Agency (ESA) will launch the Soil Moisture Ocean Salinity satellite (SMOS) during 2007. SMOS will be the first satellite to incorporate synthetic aperture radiometry and L band microwave sensing concepts that were pioneered by the Hydrology and Remote Sensing Lab. These satellites will provide global coverage and support the development of soil moisture products that could be implemented into data assimilation and directly into applications by FAS and other USDA agencies. Both ESA and JAXA will provide the data to cooperating groups. There is no formal support from NASA or other outside agencies, therefore, it falls on the ARS to conduct the research necessary to retrieve soil moisture, validate the products, and implement these in applications. This will support refining/improving existing thermal based drought monitoring systems using NOAA's Geostationary Operational Environmental Satellite (GOES) to work with future U.S. operational satellites in the next decade including NOAA's National Polar-Orbiting Operational Environmental Satellite System (NPOESS). This research would help achieve USDA goals for improving weather and hydrologic forecasting models for drought monitoring/detection and forecasting.

2. Landscape modeling. Landscape position plays an important role in the movement of soil nutrients, surface runoff, groundwater leaching, soil erosion and soil carbon sequestration. High temporal and spatial variability of states of soil and hydrologic processes within agricultural landscapes provide formidable barriers to accurate assessment of carbon and nutrient fate within the ecosystem. Strong interactions between soil processes and landscape effects often drive the observed variability. Prior field data collection efforts have focused on including the influence of landscape position on long-term changes of soil physical and chemical properties. However, modeling of soil and hydrologic processes to account for elevation and landscape position are not well developed. Advanced data collection strategies and landscape models that account for landscape spatial and temporal variability are needed to implement site specific management strategies for agricultural landscapes that improve soil and water quality.

3. Modeling soil carbon sequestration across the landscape. Extensive research on changes in soil carbon sequestration through changes in management such as minimum tillage, crop rotation and cover crop practices has been conducted. The area and location of tillage intensity by soil and crop types are needed to understand spatially relative to hydrologically active areas within watersheds. The identification of soil tillage practices relative within watersheds will highlight areas requiring site-specific conservation

practices, such as planting cover crops, establishing buffer strips, and using minimum-till planting, to reduce loss of soil and agricultural contaminants from fields. A critical gap in this research is the incorporation of spatial information in biogeochemical models for regional assessment of soil carbon sequestration under various management scenarios. Also, the impact of this new information is needed for evaluating selected physically-based, distributed parameter water quality models that simulate the effects of various crop and soil management practices on sediment and nutrient delivery to streams.

4. Parameterization of water quality models using remote sensing. Land use/land cover, land management, soil characteristics, landscape position and structure are factors affecting water quality. Simulation models are used to evaluate the effects of these factors on water quality. Incorporation of parameters detailing the variability of these factors through time and space is needed for the models to adequately represent states and processes influencing water quality for a given location across a range of scales from local to national. Current methods for parameterizing water quality models rely on the interpolation between discrete point samples of these factors, and on assumptions associated with specific land covers. Improved parameterization of the factors affecting water quality is believed possible with the use of remotely sensed data and selected surface-based measurements. Research is needed to develop methods to derive information from remote sensing visible, near infrared, short-wave infrared, thermal, microwave, and radar imagery that can be used to capture the spatial and temporal variability of factors affecting water quality. Improved, more representative parameterization of the states and processes of factors affecting water quality will lead to more accurate water quality assessments and improved management and policy decisions affecting water quality.

HRSL FY 06 Budget

ARS Base Funds	4,792,900
TemporaryMoney to support 2 Post Doc's	160,000
Katrina Assessment (1.0%) Temporary recession	-47,900
Indirect research cost (IRC)	-1,002,000
Shared Research Costs (SRC)	-1,500
Net to the lab	3,901,500
Salaries	
Category 1 Research Scientist	2,021,200
Category 2 Non Perm Research Scientist	153,700
Category 3 Support Scientists	303,700
Category 4 Service Scientist	149,900
Category 6 Specialist	682,700
Category 7 Technicians	171,400
Category 9 Administrative Support	89,700
Step Increases/ Awards	64,000
Total Salaries	3,636,300
Operating Funds	266,200
Office administration	70,000
Scientist discretionary funds	196,200
Discretionary Funds per SY	13,000

HRSL Position Staffing Chart

Employee Name	Position Category [1]	Position Title	Pay Plan &Grade	Status[2]	Full Time Equivalent (FTE)	NOTES
Rawls, Walter	1	Research Leader / Hydrologist	GM-15	PFT	1.00	Research Leader
Geiman, Donna	9	Support Services Asst.	GS-7	PFT	1.00	
Nemes, Atilla		Visiting Scientist			1.00	Funded on soft Funds
O'Hare, Laura	9	Program Support Tech.	GS-6	PPT	.50	
Parry, Robert	6	Computer Specialist	GS-13	PFT	1.00	
Pooley, Chris	6	Computer Specialist	GS-12	PFT	.50	Supervised in Soybean Genomics & Improvement Lab
Anderson, Martha	1	Research Physical Scientist	GS-14	PFT	1.00	
Cosh, Michael	1	Research Hydrologist	GS-12	PFT	1.00	
Crow, Wade	1	Physical Scientist	GS-13	PFT	1.00	
Daughtry, Craig	1	Research Agronomist	GS-15	PFT	1.00	
Michael Bayless	0	Research Assistant	GS-2	TPT	.30	
Russ, Andrew	7	Biological Science Lab Tech	GS-9	PFT	1.00	
Vacant	2		GS-11	TFT	1.00	Post Doc funded by headquarters
Doraiswamy, Paul	4	Meteorologist	GS-15	PFT	1.00	
Akhmedou, Bakhyt		Remote Sensing Specialist			1.00	Contractor funded on soft funds
Milak, Sushil		Remote Sensing Specialist			1.00	Contractor funded on soft funds
Stern, Alan	6	Remote Sensing Specialist	GS-12	PFT	1.00	
Gish, Timothy	1	Soil Scientist	GS-15	PFT	1.00	
McKee, Lynn	3	Soil Scientist	GS-12	PFT	1.00	
Hunt, Raymond	1	Research Physical Scientist	GS-14	PFT	1.00	
Johnson, Mark	0	Research Assistant	GS-2	TPT	.30	Student funded on soft funds
Roberts, Ralph	6	Computer Scientist	GS-13	PFT	1.00	
Jackson, Thomas	1	Hydrologist	ST-0	PFT	1.00	
Bindish, Rajat		Remote Sensing Specialist			1.00	Contractor funded on soft funds
Bolten, John	2	Research Associate	GS-11	TFT	1.00	Post Doc funded on soft funds
Kimes, Laura	0	Physical Science Technician	GS-04	TPT	.50	Student funded on soft funds
Mladenova, Eva		Visiting Scientist			1.00	Funded on soft funds
Narvekar, Parag		Visiting scientist			1.00	Funded on soft funds
White, William	0	Physical Science Technician	GS-04	TPT	.50	Student funded on soft funds
Yilmaz, Tugrul		Visiting Scientist			1.00	Funded on soft funds
Zhan, Xiwu	6	Remote Sensing Specialist	GS-13	PFT	1.00	
Kustas, William	1	Hydrologist	GS-15	PFT	1.00	
Agam, Nurit		Visiting Scientist			1.00	Funded by BARD
Li, Fuqin	2	Research Physical Scientist	GS-12	TFT	1.00	Research Associate funded on soft funds
Hsu, Ann	6	Remote Sensing Specialist	GS-13	PFT	1.00	
McCarty, Greg	1	Research Soil Scientist	GS-14	PFT	1.00	
Hively, W. Dean	2	Soil Scientist	GS-12	TFT	1.00	Post Doc funded by headquarters
Mookherji, Swati	3	Soil Scientist	GS-11	PFT	1.00	
Stracke, Walter	7	Physical Science Technician	GS-7	PFT	1.00	
Waterworth, Sarah	0			TPT	.50	Student funded on soft funds

HRSL Position Staffing Chart Continued

Employee Name	**Position Category**[1]	Position Title	**Pay Plan &Grade**	**Status**[2]	**Full Time Equivalent (FTE)**	**NOTES**
Reeves, James	1	Research Chemist	GS-15	PFT	.20	Supervised in the Environmental Management &By-Product Utilization Lab
Francis, Barry	3	Chemist	GS-11	PFT	.20	Supervised in the Environmental Management &By-Product Utilization Lab
Rice, Cliff	1	Research Chemist	GS-15	PFT	.30	Supervised in the Environmental Management &By-Product Utilization Lab
Bialek, Krystyna	3	Chemist	GS-11	PFT	.30	Supervised in the Environmental Management &By-Product Utilization Lab
Ritchie, Jerry	1	Soil Scientist	GS-15	PFT	1.00	
Sadeghi, Ali	1	Research Soil Scientist	GS-14	PFT	.70	0.30 FTE in the Environmental Microbial Safety Lab
Graff, Carrie	2	Research Associate	GS-11	TFT	1.00	Post Doc funded on soft funds
Sefton, Kerry	7	Biologist	GS-11	PFT	.50	0.50 FTE in the Environmental Microbial Safety Lab
Starr, James	1	Research Soil Scientist	GS-15	PFT	.80	0.20 FTE in the Environmental Microbial Safety Lab
Downey, Peter	3	Agronomist	GS-9	PFT	1.00	
Walthall, Charles	1	Physical Scientist	GS-15	PFT	1.00	
Lang, Megan	2	Research Associate	GS-11	TFT	1.00	Post Doc funded by headquarters
Dulaney, Wayne	6	Remote Sensing GIS Specialist	GS-12	PFT	1.00	

Notes:

Footnote 1: Definitions of Position Categories

An ARS system of administrative designations for groups of positions having generally similar characteristics, primarily for personnel and budgetary tracking purposes. Category has no legal or administrative significance outside of ARS. Some positions may perform duties from more than one category. ARS categories established for all positions are as follows:

Position Category Codes

Category 1 (Research Scientist). Permanent positions in which the highest level of work, for a major portion of time, involves personal conduct or conduct and leadership of theoretical and experimental investigations primarily of a basic or applied nature such as: determining the nature, magnitude, and interrelationships of physical, biological, and psychological phenomena and processes; creating or developing principles, criteria, methods, and a body of knowledge generally applicable for use by others. Such positions meet all or most of the criteria enumerated in the RGEG. Category 1 positions are SY positions.

Category 2 (Nonpermanent Research/Service Scientist). Professional scientific positions which are established on a nonpermanent basis, are filled through temporary or term appointments, and entail research and/or service science work. Examples are Research Associate, Research Affiliate, Visiting Scientist, and individuals reemployed in ARS after having retired from Category 1 or Category 4 positions. (Except those appointed as Collaborators -- see Code 0.)

Category 3 (Support Scientist). Professional scientist positions which function to provide direct support or service to one or more Category 1 or 4 positions. The work of such positions is characterized by responsible involvement in one or more, but not all, phases of research (particularly not the problem selection and definition phases); responsible participation in analysis and preliminary interpretation of data (but not including responsibility for final interpretation and conclusion which relate the results to the field of research involved). Examples include but are not limited to: (1) conducting literature searches; (2) selecting procedures and conducting experiments; (3) collecting and analyzing data or specimens; or (4) preparing technical reports.

Category 4 (Service Scientist). Permanent positions whose incumbents either primarily or exclusively serve as project or program leaders over or personally perform, work assigned to ARS involving professional scientific services to the public or other governmental agencies, such as: identification of animals, plants, or insects; diagnosis of diseases; mass production of plants, animals, or insects, collection, introduction, and maintenance of germplasm or specimens; vaccine production; education, extension, or technology transfer activities; or nutrient data and food intake surveys. Category 4 positions are SY positions.

Category 5 (Technician/Aid/Assistant (Non-engineering and Non-scientific). Includes all technicians, aids, and assistants in non-engineering and non-scientific single-interval occupational series (except those within the GS-0300 Group). Examples include: Safety Technician, Personnel Assistant, Accounting Technician, Purchasing Agent, Procurement Assistant, Library Technician, Supply Clerk, Personnel Clerk, Photographer, Guard, Firefighter.

Category 6 (Specialist). “Specialist” positions which perform scientific program management, administration and/or analytical duties and therefore require professional education and training. Examples are: Area Director, Center Director, Agricultural Administrator, National Program Leader, Human Resources Specialist, Information Technology Specialist, Administrative Officer, Budget Officer, and Librarian.

Category 7 (Technician/Aid/Assistant positions (Engineering and Scientific Support). Identify technician, aid, and assistant positions in one-grade interval series within the GS-400, 600, 700, 800, 1300, and/or 1500 groups. Examples include: Biological Science Technician/Aid, Electronics Technician, Hydrologic Technician, Statistical Assistant/Clerk, Physical Science Technician.

Category 8 (Trade and Craft Occupations). Positions having trade or craft knowledge as the paramount qualifications requirement. Examples: Boiler Plant Operator Foreman, Animal Caretaker Leader, Laborer, Farmer, Tractor Operator.

Category 9 (Administrative Support Occupations Clerical/Secretarial/Other). General occupations involved in structured work in support of office operations within one-grade interval series in the GS-300 occupational group. Examples: Secretary, Office Automation Clerk/Assistant, Computer Operator, Administrative Technician/Clerk, Management Assistant/Clerk.

Category 0 (Zero). Includes all positions that do not fit any of the above codes, including all positions incumbered by students. Examples: Student Trainees (STEP, SCEP); Expert and Consultant positions; Collaborators; and Volunteers.

Category G (Intergovernmental Personnel Act (IPA). Employees serving a temporary assignment between ARS and States, local governments, institutions of higher education, Indian Tribal governments, or other organizations under Title IV of the Intergovernmental Personnel Act of 1978 (PL 95-454).

Note 2: Status

PFT – Permanent Full Time
PPT – Permanent Part Time
TFT – Temporary Full Time
TPT – Temporary Part Time

Martha Anderson - Research Physical Scientist

Education:

1993 University of Minnesota; Astrophysics; Ph.D.
1987 Carleton College; Physics; B.A.

Experience:

1995 - 1997	Postgraduate Researcher, Soil Science Dept., University of Wisconsin-Madison
1997 - 1999	Associate Researcher, Soil Science Dept., University of Wisconsin-Madison
1999 – 2005	Assistant Scientist, Soil Science Dept., University of Wisconsin-Madison
2003 – 2005	Assistant Scientist, Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison
Apr 2005 – present	Research Physical Scientist USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD

Current CRIS Projects:

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments:

- Developed a remote-sensing-based algorithm that predicts partitioning in the regional-scale surface energy budget (including evapotranspiration; ET) based on time-changes in surface temperature. This model is currently being applied daily over the continental U.S. using GOES satellite thermal imagery.
- Developed an ancillary technique for robustly disaggregating regional-scale (10-km resolution) flux predictions down to smaller scales (10-100m) for detailed analyses over heterogeneous landscaped and for validation with respect to ground- and aircraft-based micrometeorological observations.
- Developed a methodology for integrating thermal-based ET estimates into continental-scale evaluations of evaporative stress and sub-surface soil moisture content. Currently testing the utility of these evaluations in terms of operational drought assessment and in assimilation into regional meteorological and hydrologic forecasts.
- Developed a simple analytical model of canopy-scale stomatal resistance based on light-use efficiency, and implemented this technique within a remote-sensing framework for large area carbon flux mapping. These mapping techniques are being used to upscale distributed point-based carbon flux measurements obtained with the AmeriFlux tower network to estimates of regional- and continental-scale carbon assimilation.
- Used high-resolution surface flux mapping techniques to evaluate differences in source-area footprint associated with turbulent fluxes of sensible and latent heating and net carbon exchange as measured by tower and airborne eddy covariance systems.
- Developed and implemented operational agricultural forecasting products based on remote sensing and a simple soil-plant-atmosphere model, disseminated to

growers via the Internet. Products included spatially distributed predictions of potential ET, cranberry frost, potato blight, and gypsy moth phenology.

Selected Publications (2001 to 2005):

Anderson, M.C., W.L. Bland, J.M. Norman, G.R. Diak, Canopy wetness and humidity prediction using satellite and synoptic-scale meteorological observations, Plant Disease, 85, 1018-1025. 2001.

J.M. Jacobs, D.A. Meyers, **M.C. Anderson**, and G.R. Diak, GOES surface insolation to estimate wetlands evapotranspiration, J. of Hydrology, 266, 53-65. 2002.

W.P. Kustas, J.M. Norman, **M.C. Anderson**, A.N. French, Estimating subpixel surface temperature and energy fluxes from the vegetation index-radiometric temperature relationship, *Remote Sens. Environ*. 85, 429-440. 2003.

G.R. Diak, J.R. Mecikalski, **M.C. Anderson**, J.M. Norman, W.P. Kustas, R.D. Torn, R.L. DeWolf, Estimating land-surface energy budgets from space: Review and current efforts at the University of Wisconsin-Madison and USDA-ARS, *Bull. Amer. Meteorol. Soc*. 85, 65-68. 2003.

A.N. French, J.M. Norman, **M.C. Anderson**, Simplified correction of GOES thermal infrared observations, *Remote Sens. Environ*., 87, 326-333. 2003.

J.M. Norman, **M.C. Anderson**, W.P. Kustas, A.N. French, J.R. Mecikalski, R.D. Torn, G.R. Diak, T.J. Schmugge, B.C.W. Tanner, Remote sensing of surface energy fluxes at 10^1-m pixel resolutions, *Water Resourc. Res*., 39, Art. No. 1221. 2003.

Anderson, M.C., W.P. Kustas, J.M. Norman, Upscaling and downscaling – a regional view of the soil-plant-atmosphere continuum, *Agron. J.* 95, 1408-1423. 2003.

J.M. Norman, and **M.C. Anderson**, The Soil-Plant-Atmosphere Continuum, in Encyclopedia of Soils in the Environment (Ed. D. Hillel; in press). 2004.

W.P. Kustas, J.M. Norman, T.J. Schmugge, **M.C. Anderson**, Mapping surface energy fluxes with radiometric temperature, in Thermal Remote Sensing in Land Surface Processes (Eds. D.A. Quattrochi, J.C. Luvall). 2004.

Anderson, M.C., J.M. Norman, J.R. Mecikalski, R.D. Torn, W.P. Kustas, J.B. Basara, A multi-scale remote sensing model for disaggregating regional fluxes to micrometeorological scales, *J. Hydrometeor*., 5, 343-363. 2004.

J.M. Jacobs, **M.C. Anderson**, L.C. Friess, G.R. Diak, Solar radiation, longwave radiation, and emergent wetland evapotranspiration estimates from satellite data in Florida, USA, *Hydro. Sci. J*. 49, 461-476. 2004.

T.J. Jackson, D. Chen, M. Cosh, F. Li, **M. Anderson**, C. Walthall, P. Doraiswamy, and E.R. Hunt, Vegetation water content mapping using Landsat data derived normalized difference water index for corn and soybeans, *Remote Sens. Environ.*, 92, 475-482. 2004.

C. Walthall, W. Dulaney, **M. Anderson**, J. Norman, H. Fang, and S. Liang, A comparison of empirical and neural network approaches for estimating corn and soybean leaf area index from Landsat ETM+ imagery, *Remote Sens. Environ.*, 92, 465-474. 2004.

Anderson, M.C., C.M.U. Neale, F. Li, J.M. Norman, W.P. Kustas, H. Jayanthi, J.Chavez, Upscaling ground observations of vegetation water content, canopy height, and leaf area index during SMEX02 using aircraft and Landsat imagery, *Remote Sens. Environ.*, 92, 447-464. 2004.

J.A. Otkin, **M.C. Anderson**, J.R. Mecikalski, and G.R. Diak, Validation of GOES-based insolation estimates using data from the U.S. Climate Reference Network, *J. Hydromet.* 6, 460-475. 2005.

Anderson, M.C., J.M. Norman, W.P. Kustas, F. Li, J.H. Prueger, J.R. Mecikalski, Effects of vegetation clumping on two-source model predictions of surface energy fluxes from an agricultural landscape during SMEX02, *in press J. Hydromet.* 2005.

A.N. French, F.F. Jacob, **M.C. Anderson**, W.P. Kustas, W. Timmermans, and A. Gieske, Z. Su, B. Su, M.F. McCabe, F. Li, J. Prueger, N. Brunsell, Surface energy fluxes with the Advanced Spaceborne Thermal Emission and Reflection radiometer (ASTER) at the Iowa 2002 SMACEX site (USA), *in press Remote Sens. Environ.* 2005.

W.P. Kustas, **M.C. Anderson**, A.N. French, and D. Vickers, Using a remote sensing field experiment to investigate flux-footprint relations and flux sampling distributions for tower and aircraft-based observations, *in press Adv. Water Res.* 2005.

Anderson, M.C., W.P. Kustas, J.M. Norman, Upscaling tower and aircraft fluxes from local to continental scales using thermal remote sensing, *accepted Agron. J.* 2005.

Cooperator	***Affiliation***	***Location***
Dr. John Norman	University of WI-Madison	Madison, WI
Dr. John Mecikalski	University of AL-Huntsville	Huntsville, AL
Dr. Jennifer Jacobs	University of New Hampshire	Manchester, NH
Dr. Andrew French	USDA-ARS	Tucson, AZ
Dr. Tilden Meyers	NOAA-ATDD	Oak Ridge, TN
Dr. Ronald Dobosy	NOAA-ATDD	Oak Ridge, TN
Dr. Derek Williamson	University of AL	Tuscaloosa, AL
Dr. Christopher Neale	Utah State University	Logan, UT
Dr. John Albertson	Duke University	Durham, NC
Dr. John Prueger	USDA-NSTL	Ames, IA
Dr. Dan Cooper	Los Alamos Natl. Laboratory	Los Alamos, NM

Michael Cosh.- Research Hydrologist

Education:

2002 Cornell University; Civil and Environmental Engineering, Ph.D.
1998 Cornell University; Civil and Environmental Engineering, M.S.
1996 Pennsylvania State University; Civil and Environmental Engineering, B.S.
1995 Saint Francis College; Engineering, B.A.

Experience:

2005-present Research Hydrologist, USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD
2002-2005 Post-Doctoral Researcher, USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD
1998-2002 Graduate Research Assistant, Cornell University, Ithaca, NY

Current CRIS Projects

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments:

- Assembled a database for satellite soil moisture product calibration and validation efforts. This database includes hourly surface soil moisture for four ARS Watersheds and has historical data from early 2002 to present.
- Completed temporal stability analysis of three soil moisture networks, establishing applicability for future satellite validation projects.
- Coordinated the data archiving and organization of the AMSR-E Soil Moisture Calibration and Validation data products, including the Soil Moisture Experiments (SMEX) for the National Snow and Ice Data Center.

Selected Publications (2001 to 2005)

Starks, P.J., G.C. Heathman, T.J. Jackson, and **M.H. Cosh**, Temporal stability of profile soil moisture during the SGP97 and SMEX03 remote sensing experiments, *Journal of Hydrology*, in press, 2006.

Cosh, M.H., T.J. Jackson, P. Starks, and G. Heathman, Temporal stability of surface soil moisture in the Little Washita River watershed and its applications in satellite soil moisture product validation, *Journal of Hydrology*, in press, 2006.

Jackson, T.J, R. Hurkmans, A. Hsu, and **M.H. Cosh**, Soil moisture algorithm validation using data from the Advanced Microwave Scanning Radiometer (AMSR-E) in Mongolia, *Italian Journal of Remote Sensing*, 30(31):23-32, 2005.

Cosh, M.H., T.J. Jackson, R. Bindlish, J.S. Famiglietti, and D. Ryu, A Comparison of Soil Moisture Impedance Probe Calibration Techniques, *Journal of Hydrology*, 31(1-4), 49-58, 2005.

Cosh, M.H., T.J. Jackson, R. Bindlish, and J. Prueger, Watershed scale temporal persistence of soil moisture and its role in validating satellite estimates, *Remote Sensing of Environment*, 92(4), 427-435, 2004.

Jackson, T.J., D. Chen, **M.H. Cosh**, F. Li, M. Anderson, C. Walthall, P. Doraiswamy and E. Ray Hunt, Vegetation water content mapping using Landsat data derived

normalized difference water index for corn and soybeans, *Remote Sensing of Environment*, 92(4), 475-482, 2004.

Cosh, M.H., J.R. Stedinger, and W. Brutsaert, Variability of Surface Soil Moisture at the Watershed Scale, *Water Resources Research*, 40, W12513, doi:10.1029/2004WR003487, 2004.

Li, F., Jackson, T.J., Kustas, W. P., Schmugge, T. J., French, A., **Cosh, M. H.**, and Bindlish, R., Deriving land surface temperature from Landsat 5 and 7 during SMEX02/SMACEX, *Remote Sensing of Environment*, 92(4), 521-534, 2004.

Guha, A., J.M. Jacobs, T.J. Jackson, **M.H. Cosh**, E.-C. Hsu, and J. Judge, Soil moisture mapping using ESTAR under dry conditions from the Southern Great Plains Experiment (SGP99), *Transactions in Geoscience and Remote Sensing*, 41, 10, 2392-2397, 2003.

Cosh, M.H., and W. Brutsaert, Microscale structural aspects of vegetation density variability, *Journal of Hydrology*, 276 (1-4), 128-136, 2003.

Cosh, M.H., J. Stedinger, and W. Brutsaert, Time changes in spatial structure of surface variability in the Southern Great Plains, *Advances in Water Resources*, 26, 407-415, 2003.

Ou, S.C., K.N. Liou, Y. Chen, **M.H. Cosh**, and W. Brutsaert, Satellite Remote Sensing of Land Surface Temperatures: Application of the Atmospheric Correction Method and Split-Window Technique to Data of ARM-SGP Site, *International Journal of Remote Sensing*, 23, 24, 5177-5192, 2002.

Rawls, W., **M.H. Cosh**, T.J. Jackson, and A. Nemes, Use of remotely sensed soil moisture to determine soil hydraulic properties, *Proceedings of IGARSS*, [CD-ROM], 2004

Cosh, M.H., T.J. Jackson, R. Bindlish, and J.H. Prueger, Estimation of watershed scale soil moisture from point measurements during SMEX02, *Interagency Conference on Research in the Watersheds Proceedings*, 205-211, 2003.

Chen, D., T.J. Jackson, F. Li, **M.H. Cosh**, C. Walthall, and M. Anderson, Estimation of vegetation water content for corn and soybeans with a Normalized Difference Water Index (NDWI) using Landsat Thematic Mapper data, *Proceedings of IGARSS*, [CD-ROM], 2003.

Jackson, T.J., R. Bindlish, **M. Cosh**, A. Gasiewski, B. Stankov, M. Klein, B. Weber, and V. Zavorotny, Soil Moisture Experiments 2004 (SMEX04) Polarimetric Scanning Radiometer, AMSR-E, and Heterogeneous Landscapes, *Proceedings of IGARSS*, [CD-ROM], 2005.

Cooperators	***Affiliation***	***Location***
Dr. Wilfriend Brutsaert	Cornell University	Ithaca, NY
Dr. Jery Stedinger	Cornell University	Ithaca, NY
Dr. John Prueger	USDA-ARS	Ames, IA
Dr. Jay Famiglietti	UC-Irvine	Irvine, CA
Dr. Pat Starks	USDA-ARS	El Reno, OK
Dr. Gary Heathman	USDA-ARS	West Lafayette, IN
Dr. Jennifer Jacobs	U. New Hampshire	Durham, NH
Dr. Daoyi Chen	U. Manchester	Manchester, England

Wade Crow - *Research Physical Scientist*

Education:

2001 Princeton University, Civil and Environmental Engineering, Ph.D.
1998 Princeton University, Civil and Environmental Engineering, M.S.E.
1995 Carleton College, Physics, B.A.

Experience:

1995 - 2001	Research Assistant, Princeton University, Princeton, New Jersey
2001 – 2002	Post-doctoral Research Assistant, Princeton University
2002 – present	Research Physical Scientist, USDA ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD

Current CRIS Projects

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments (2001 to 2005):

- Applied a number of recently developed data assimilation techniques to optimally merge remote sensing retrievals with a land surface hydrology model. In multiple publications, results have demonstrated that the application of such systems improves the ability of the land surface model to predict root-zone soil moisture, evapotranspiration, and surface runoff. Received two competitive research grants from NASA to continue this work.
- Completed an Observing System Simulation Experiment that validated key aspects of NASA's planned Hydrosphere State (Hydros) mission. Dr. Crow was asked to join the science team of the mission in 2002.
- Developed a novel spatial scaling technique to correct land surface model evapotranspiration predictions for the impact of (non-resolved) sub-footprint-scale surface soil moisture heterogeneity.
- Demonstrated the feasibility of using a spatially distributed land surface model to upscale field-scale soil moisture observations (obtainable from ground-based observations) up to the spaceborne footprint-scale. Results suggest a potential role for land surface modeling in the validation of spaceborne soil moisture retrievals.

Selected Publications (2001 to 2005):

Crow, W.T., M. Drusch, E.F. Wood, An observation system simulation experiment for the impact of land surface heterogeneity on AMSR-E soil moisture retrieval, *IEEE Transactions on Geoscience and Remote Sensing*, 39(8): 1622-1632, 2001.

Crow, W.T., and E.F. Wood, Impact of soil moisture aggregation on surface energy flux prediction during SGP'97, *Geophysical Research Letters*, 29(1): 2001GL013796, 2002.

Crow, W.T., and E.F. Wood, The value of coarse-scale soil moisture observations for regional surface energy balance modeling, *Journal of Hydrometeorology*, 3: 467-482, 2002.

Crow, W.T., and E.F. Wood, The assimilation of remotely sensed soil brightness temperature imagery into a land-surface model using ensemble Kalman filtering: A case study based on ESTAR measurements during SGP97, *Advances in Water Resources*., 26: 137-149, 2003.

Crow, W.T., Correcting land surface model predictions for the impact of temporally sparse rainfall rate measurements using an Ensemble Kalman filter and surface brightness temperature observations, *Journal of Hydrometeorology*, 4(5): 960-973, 2003.

Crow, W.T., E.F. Wood, and M. Pan, Multiobjective calibration of land surface model evapotranspiration predictions using streamflow observations and spaceborne surface radiometric temperature retrievals, *Journal of Geophysical Research - Atmospheres*, 108(D23) doi: 10.1029/2002JD003292, 2003.

Dery, S.T., **W.T. Crow**, M. Stieglitz, and E.F. Wood, Modeling snowcover heterogeneity over complex terrain for regional and global climate models, *Journal of Hydrometeorology*, 5(1): 33-48, 2004.

Gao, H., E.F Wood, M. Drusch, **W.T. Crow**, T.J. Jackson, Using a microwave emission model to estimate soil moisture from ESTAR observations during SGP99, *Journal of Hydrometeorology*, 5(1): 49-63, 2004.

Entekhabi D., et al. The Hydrosphere State (HYDROS) mission concept: An earth system pathfinder for global mapping of soil moisture and land freeze/thaw, *IEEE Transactions on Geoscience and Remote Sensing*, 42(10): 2184-2195, 2004.

Crow, W.T., T. Chen, D. Entekhabi, P. Houser, A. Hsu, T. Jackson, E. Njoku, P. O'Neill, J. Shi, and X. Zhan, An observing system simulation experiment for Hydros radiometer-only soil moisture products, *IEEE Transactions on Geoscience and Remote Sensing*, 43(6): 1289-1303, 2005.

Crow, W.T., D. Ryu, and J.S. Famiglietti, Upscaling of field-scale soil moisture measurements using distributed land surface modeling, *Advances in Water Resources*, 28(1): 1-14, 2005.

Crow, W.T., and W.P. Kustas, Utility of assimilating surface radiometric temperature observations for evaporative fraction and heat transfer coefficient retrieval, *Boundary-Layer Meteorology*, 115: 105-130, 2005.

Crow, W.T., R. Bindlish and T.J. Jackson, The added value of assimilating spaceborne passive microwave soil moisture retrievals for forecasting rainfall-runoff partitioning, *Geophysical Research Letters*, 32, L18401, doi: 10.1029/2005GL023543, 2005.

Crow, W.T., R.D. Koster, R.H. Reichle, and H. Sharif, Relevance of time-varying and time-invariant retrieval error sources on the utility of spaceborne soil moisture products, in press, *Geophysical Research Letters*.

Crow, W.T., F. Li, and W.P. Kustas, Intercomparison of spatially distributed models for predicting surface energy flux patterns during SMACEX, in press, *Journal of Hydrometeorology*.

Crow, W.T., and E. Van Loon, The impact of incorrect model error assumptions on the assimilation of remotely sensed surface soil moisture, in press, *Journal of Hydrometeorology*.

Zhan, X., P.R. Houser, J.P. Walker, and **W.T. Crow**, A method of retrieving high resolution soil moisture from Hydros L-Band radiometer and radar observations, in press, *IEEE Transactions on Geoscience and Remote Sensing*.

Cooperator	***Affiliation***	***Location***
Dr. Susan Moran	USDA ARS	Tucson, AZ
Prof. Dara Entekhabi	MIT	Cambridge, MA
Prof. Jay Famglietti	UC-Irvine	Irvine, CA
Dr. Eni Njoku	CIT/NASA JPL	Pasadena, CA
Dr. Rolf Reichle	NASA GMAO/UMBC GEST	Greenbelt, MD
Dr. Randal Koster	NASA GMAO	Greenbelt, MD
Prof. Emiel Van Loon	University of Amsterdam	Amsterdam, Netherlands
Prof. Eric Wood	Princeton University	Princeton, NJ
Prof. Paul Houser	CREW/GMU	Calvert, MD
Dr. Hatim Scharif	UT-San Antonio	San Antonio, TX
Dr. Peggy O'Neill	NASA GSFC	Greenbelt, MD
Dr. J.C. Shi	UCSB	Santa Barbara, CA
Dr. Matthias Drusch	ECMWF	Reading, UK
Dr. Stephen Dery	Princeton University	Princeton, NJ
Prof. Marc Stieglitz	Georgia Tech	Atlanta, GA
Prof. Kaye Brubaker	UM-College Park	College Park, MD
Prof. Jeffery Walker	University of Melbourne	Melbourne, Australia

Craig S. T. Daughtry - *Research Agronomist*

Education:

1976 Purdue University, Agronomy (crop physiology), Ph.D.
1974 University of Georgia, Agronomy, M.S.
1972 University of Georgia, Agronomy, B.S.

Experience:

1976-1987 Senior Research Agronomist, Agronomy Department and Laboratory for Applications of Remote Sensing (LARS), Purdue University, West Lafayette, IN
1987-present Research Agronomist, USDA-ARS Hydrology & Remote Sensing Laboratory, Beltsville, MD

Current CRIS Projects

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality
1265-13660-009-00D: Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes

Accomplishments:

- Established that crop residues fluoresce when illuminated with ultraviolet radiation, while most soils do not fluoresce. This innovative application of a fluorescence technique led to a U.S. patent for measuring crop residue cover. Identified optimal fluorescence excitation and emission wavelengths for detecting plant stresses and crop residues. Fluorescence and reflectance images are complementary diagnostic tools and provide independent sources of information.
- Developed robust reflectance methods to assess crop residue cover and soil tillage intensity based on a broad absorption feature near 2100 nm associated with cellulose and lignin in plant residues. The cellulose absorption index (CAI) was linearly related to crop residue cover and was minimally affected by soil color, residue type, and residue age.
- Identified key spectral bands for discriminating marijuana from other vegetation. Determined that the unique blue-green reflectance of marijuana, frequently observed by aerial spotters, is associated with microscopic leaf surface structures that preferentially scatter blue skylight. Co-hosted the only marijuana detection program in the U. S. where federal, state, and local law enforcement officers can train with legally grown marijuana plants.
- Measured and modeled spatial variability of soil properties and crop growth and yields at multiple scales. Demonstrated conclusively that crop growth and yield models can be enhanced with remotely sensed estimates of LAI and the fraction of absorbed photosynthetically-active radiation (fAPAR). Developed a dynamic technique to extract information about leaf chlorophyll concentrations from leaf reflectance spectra and hyperspectral images of crops. The innovative analysis technique minimized the variations in soil brightness and plant growth that have confounded previous remote sensing approaches.

Selected Publications (2001 to 2005)

Daughtry, C. S. T. Discriminating crop residues from soil by shortwave infrared reflectance. Agronomy Journal 93:125-131. 2001.

Kim, M. S., McMurtrey, J. E., Mulchi, C. L., **Daughtry, C. S. T.**, Chappelle, E. W., and Chen, Y. R. Steady-state multispectral fluorescence imaging for plant leaves. Applied Optics 40:157-166. 2001.

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Walthall, C. L., Gish, T. J., **Daughtry, C. S. T.**, Dulaney, W. P., Kung, K.-J. S., McCarty, G. W., Timlin, D. Angier, J. T., Buss, P., and Houser, P. R. An innovative approach for locating and evaluating subsurface pathways for nitrogen loss. The Scientific World 1:(S2), 223-229. 2001.

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Liang S., Fang, H., Morisette, J. T., Chen, M., Walthall, C. L., **Daughtry, C. S. T**., and Shuey, C. J. Atmospheric correction of Landsat ETM+ land surface imagery: II. Validation and applications. IEEE Trans. Geoscience Remote Sensing. 40:2736-2746. 2002.

Pinter, P. J., Hatfield, J. L., Schepers, J. S., Barnes, E. M., Moran, M. S., **Daughtry, C. S. T.**, and Upchurch, D. R. Remote sensing for crop management. Photogrammetric Engineering and Remote Sensing 69:647-664. 2003.

Barnes, E. M., Sudduth, K. A., Hummel, J. W., Lesch, S. M., Corwin, D. L., Yang, C., **Daughtry, C. S. T.**, and Bausch, W. C. Remote- and ground-based sensor techniques to map soil properties. Photogrammetric Engineering and Remote Sensing 69:619-630. 2003.

Moran, M. S., Fitzgerald, G., Rango, A., Walthall, C., Barnes, E., Bausch, W., Clarke, T., **Daughtry, C.**, Everitt, J., Hatfield, J., Havstad, K., Jackson, T., Kitchen, N., Kustas, W., McGuire, M., Pinter, P., Sudduth, K., Schepers, P., Schmugge, T., Starks, P., and Upchurch, D. Sensor development and radiometric correction for agricultural applications. Photogrammetric Engineering and Remote Sensing. 69:705-718. 2003.

Liang, S. Fang, H., Kaul, M., Van Niel, T. G. McVicar, T. R., Pearlman, J., Walthall, C. L., **Daughtry, C. S. T.**, and Huemmrich, F. Estimation and validation of land surface broadband albedos and leaf area index from EO-1 ALI data. IEEE Trans. Geoscience Remote Sensing 41:1260-1267. 2003.

Gish, T. J., Dulaney, W. P., Kung, K.-J. S., **Daughtry, C. S. T**., Doolittle, J. A., and Miller, P. T. Evaluating use of ground-penetrating radar for identifying subsurface flow pathways. Soil Science Soc. America J. 66:1620-1629. 2002.

Nagler, P. L., Inoue, Y., Glenn, E. P., Russ, A. L, **Daughtry, C. S. T**. Cellulose absorption index (CAI) to quantify mixed soil-plant litter scenes. Remote Sensing of Environment 87:310-325. 2003

Chinkuyu, A. J., Meixner, T., Gish, T. J., and **Daughtry, C. S. T.** The importance of seepage zones in predicting soil moisture content and surface runoff from watersheds with GLEAMS and RZWQM. Transactions ASAE 47:427-438. 2004.

Daughtry, C. S. T., Hunt Jr., E. R., and McMurtrey III, J. E. Assessing crop residue cover using shortwave infrared reflectance. Remote Sensing of Environment 90:126-134. 2004.

Gish T. J., **Daughtry, C. S. T.**, Walthall, C. L. and Kung, K-J. S. Quantifying impact of hydrology on corn grain yield using ground-penetrating radar. Subsurface Sensing Technologies and Applications Journal 2:493-496. 2004.

Daughtry, C. S. T., Hunt Jr., E. R., Doraiswamy, P. C., and McMurtrey III, J. E. Remote sensing the spatial distribution of crop residues. Agronomy J. 97:864-871. 2005.

Gish, T. J., Walthall, C. L., **Daughtry, C. S. T.**, and Kung, K-J. S. Using soil moisture and spatial yield patterns to identify subsurface flow pathways. J. Environmental Quality 34:274-286. 2005.

McMurtrey, J. E., **Daughtry C. S. T.**, Devine, T. E., and Corp, L. A. Detection of crop residues in conventional and large biomass soybeans using a cellulose absorption index. Agronomy for Sustainable Development 25:25-34. 2005.

Pachepsky, L. Kaul, M. Walthall, C., Lydon, J., Hong, H., and **Daughtry, C. S. T**. Soybean growth and development visualized with L-systems simulations: effect of temperature. Int. J. Biotronics 33:31-48. 2005.

Hunt, E. R., Baker, J. A., Cavigelli, M. A., **Daughtry, C. S. T.**, McMurtrey, J. E., and Walthall, C. L. Evaluation of aerial photography from model aircraft for remote sensing crop biomass and nitrogen status. Precision Agriculture 6:359-378. 2005.

Daughtry, C. S. T., Doraiswamy, P. C., Hunt, E. R., Stern, A. J., McMurtrey, J. E., and Prueger, J. H. Remote sensing crop residue cover and soil tillage intensity. Soil and Tillage Research. (in press) 2006.

Cooperator	***Affiliation***	***Location***
Fredric Baret	INRA	Avignon, France
Emmett W. Chappelle (retired)	NASA-Goddard	Greenbelt, MD
Lawrence A. Corp	SSAI	Beltsville, MD
Jerry L. Hatfield	USDA-ARS	Ames, IA
Melinda Higgins	Georgia Tech Research Inst.	Atlanta, GA
Shunlin Liang	University of Maryland	College Park, MD
John Lydon	USDA-ARS	Beltsville, MD
Wayne Maresch	USDA-NRCS	Beltsville, MD
James E. McMurtrey (retired)	USDA-ARS	Beltsville, MD
Elizabeth Middleton	NASA-Goddard	Greenbelt, MD
Pamela L. Nagler	University of Arizona	Tucson, AZ
John H. Prueger	USDA-ARS	Ames, IA
James S. Schepers	USDA-ARS	Lincoln, NE
Vern C. Vanderbilt	NASA-Ames	Moffett Field, CA
Tony J. Vyn	Purdue University	West Lafayette, IN

Paul C. Doraiswamy – *Physical Scientist*

Education:

1977 University of Washington, Forest Meteorology; Ph.D.
1971 University of Nebraska, Agricultural Meteorology; M.S.
1967 Madras University, Physics; B.S.

Experience:

1969 - 1971	Research Assistant, University of Nebraska, Lincoln, NE
1971 – 1975	Research Assistant, University of Washington, Seattle, WA
1975 – 1979	Research Associate, Texas A & M University, College Station, TX
1979 – 1982	Principal Scientist, Lockheed Engineering, JSC, Houston, TX
1982 – 1988	Technical Advisor, Ministry of Agriculture, USGS and USDA, Riyadh, Saudi Arabia
1988 - Present	USDA-ARS, Hydrology and Remote Sensing Lab, Beltsville, MD. (Previously the USDA – ARS, Remote Sensing Lab)

Current CRIS Projects

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality
1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools Detrimental Chemical Fluxes

Accomplishments:

- Conducted field studies for validation of spring wheat yield models in southern Siberia, which is one the largest spring wheat regions in the world. Crop yield prediction in this region is important for USDA's foreign crop production assessment. Two new satellite sensors were used to develop crop classification and retrieve crop physiological parameters used in the simulation model for regional assessment of crop yields. The validated model was delivered to the foreign Agricultural Service for operational application.
- Developed methods for retrieval of crop condition and physiological parameters from the new Terra MODIS sensor. Global products such as crop classification and leaf area index developed by NASA investigators were validated from field experiments we conducted in the U.S. Corn Belt. Our evaluation showed that these NASA products were not directly usable for regional crop yield assessment by USDA (NASS, FAS). Alternate methods investigated in this research provided similar products that were suitable for USDA operational agencies.
- Developed an operational procedure for crop yield assessment for corn and soybean crops in the U.S. Corn Belt. The NASS Research and Development Division is a collaborator and end user of new methods developed in this research. The data and information from the new methods will supplement the need for spatial assessment for NASS's operational crop yield forecast.
- Soil carbon sequestration is an important area of research investigated for the benefits to improving soil quality, crop productivity and the environment. The EPIC-CENTURY model was evaluated in Central Iowa for predicting the potential for soil carbon sequestration under various soil management and cropping practices. Developed methods for scaling up changes in soil carbon

sequestration from local to regional scales. The NRCS (NRI) is a partners in this research and will be the end user of a Web-based decision support system developed for carbon management.

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SELECTED Publications (2001 to 2005):

Doraiswamy, P.C. S. Hollinger, T.R. Sinclair, A. Stern, B. Akhmedov and J. Pruger Application of MODIS derived parameters for regional yield assessment. Proc. Remote Sensing for Agriculture, Ecosystems, and Hydrology III, 17-21 September 2001, Toulouse, France. CD-ROM 4542-1: 1-8. 2001.

McMurtrey, J., **P. Doraiswamy**, L. Corp, A. Stern, J. Schepers. Index for Detecting Nitrogen Level Needs for Site Specific Management in Field Corn. Proceedings of Third International Conference for Geospatial Information in Agriculture and Forestry, Denver, Colorado, November, 2001.

Stern, A.J., **P.C. Doraiswamy**, and P.W. Cook. Spring Wheat Classification in an AVHRR Image by Signature Extension from a Landsat TM Classified Image. Photogrammetric Engineering & Remote Sensing, 67:207–211. 2001.

Doraiswamy, P., P. Zara,., A. Stern. Satellite remotely sensed data application in estimating crop condition and yield. Remote Sensing Applications, Ch 24, pp. 229-240. Edited by M.S. Srinivas: Narosa Publishing House, New Delhi, 2001.

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Daughtry, C. S. T., E.R. Hunt, **P.C. Doraiswamy.** Assessing carbon dynamics in agriculture using remote sensing. International Symposium on Evaluation of Terrestrial Carbon Storage and Dynamics by In-situ and Remote Sensing Measurements, pp.28-35, CD-ROM. 2002.

Yost, R., **Doraiswamy, P.C.**, Doubia, M. Defining the Contract Area: Using Spatial Variation in Land, Cropping Systems and Soil Organic Carbon . Defining the contract area: using spatial variation in land, cropping systems and soil organic carbon, A Soil Carbon Accounting and Management System for Emissions Trading. Soil Management and Collaborative Research Support Program. Special Publication, SM CRSP 2002-4, University of Hawaii. Honolulu, Hawaii, p. 13-40. 2003.

Daughtry, C.S., Hunt, E.R., **Doraiswamy, P.C.**, Mcmurtrey, J.E., Russ, A.L. Remote Sensing Of Crop Residue Cover And Soil Tillage Intensity. In: Proceedings Of 2003 International Geoscience And Remote Sensing Symposium, July 21-25, 2003, Toulouse, France.(CD-ROM) 2003.

Yost, R., **Doraiswamy, P.C.**, Doubia, M. 2003. Defining The Contract Area: Using Spatial Variation In Land, Cropping Systems And Soil Organic Carbon, A Soil Carbon Accounting And Management System For Emissions Trading. Soil Management And

Collaborative Research Support Program. Special Publication, SM Crsp 2002-4, University Of Hawaii. Honolulu, Hawaii, P. 13-40. 2003.

Doraiswamy, P.C., S. Moulin, P.W. Cook, and A. Stern. Crop yield assessment from remote sensing, Photogrammetric Engineering and Remote Sensing, 69, 665– 674. 2003.

Doraiswamy, P.C., J.L. Hatfield, T.J. Jackson, J.H., B. Akhmedov, and A.J. Stern. Crop condition and yield simulations using Landsat and MODIS imagery, Remote Sensing of Environment, 92: 548– 559. 2004.

Doraiswamy, P.C., Diagne, G.B., Moussa, L., Shaha, S.K., Virchenko, O. User requirements for Satellite and Other Remote Sensing Information in the field of Agricultural Meteorology. Commission for Agricultural Meteorology, CAgM Report No..95, WMO/TD, No. 1230. 2004.

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Doraiswamy, P.C., T.R. Sinclair, S. Hollinger, B. Akhmedov, A. Stern, and J. Prueger. Application of MODIS derived parameters for regional yield assessment, Remote Sensing of Environment. 97(2), 192-202. 2005.

Zheng, D., E.R. Hunt, **P.C. Doraiswamy**, G.W. McCarty, S.R. Ryu. Using models and remote sensing approaches to understand the ecology of landscapes. Linking Ecology to Landscape Hierarchies (Editors: Jiquan Chen, Sari C. Saunders, Kimberly D. Brosofske and Thomas R. Crow). In Press. 2005

Daughtry, C.S.T., **Doraiswamy, P.C.**, Hunt, E.R., Stern, A.J., McMurtrey, J.E., Prueger, J.H. Remote sensing crop residue cover and soil tillage intensity. Soil and Tillage Research. (*Accepted*). 2005.

Doraiswamy, P.C., G. W. McCarty, E.R. Hunt, R. Yost, M. Doumbia., and Franzluebbers, A.J. Modeling of Soil Carbon Sequestration in Agricultural Lands of Mali, Agricultural Systems. *(Accepted)*. 2005.

Cooperator	***Affilation***	***Location***
Mr. George Hanuschak	USDA-NASS	Fairfax, VA
Dr. Jerry Hatfield	USDA-ARS	Ames, IA
Dr. John Prueger	USDA-ARS	Ames, IA
Mr. Wayne Maresch	USDA-NRCS	Beltsville, MD
Dr. Patrick Starks	USDA-ARS	El Reno, OK
Dr. Thomas Sinclair	University of Florida	Gainesville, FL

Timothy J. Gish – *Soil Scientist*

Education:

1981 University of California Riverside, Riverside California, PhD
1975 Brigham Young University, BS

Experience:

1981-present USDA-ARS Hydrology and Remote Sensing Lab., Beltsville MD
1981 Post doctoral position, University of California Riverside, Riverside CA

Current CRIS Projects

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality
1265-13660-009-00D: Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes

Accomplishments:

- Spatial and temporal dynamics of chemical transport were quantified at various scales, i.e. from laboratory soil columns to field observations. Research demonstrated that contrary to existing concepts preferential flow was common and often the major process controlling deep leaching. Recent water quality models are incorporating some aspects of preferential flow.
- Although not frequently measured, pesticide volatilization losses can be very significant loss pathway with 5 to 25% of the surface applied pesticide being lost to the atmosphere each year. Greenhouse, field chambers, and vapor flux tower measurements were conducted that revealed the importance of soil moisture and climate are critical factors governing pesticide volatilization losses.
- Knowledge of preferential fluid mechanics was linked with pesticide and polymer chemistry in developing and evaluating controlled-release herbicide formulations with the potential to reduce detrimental environmental fate. Laboratory and field experiments showed that, under humid East-coast conditions, the controlled-release formulations gave improved weed control, essentially eliminated transport through soil by preferential flow, and reduced volatilization losses by 50% relative to commercial formulations.
- A unique field-scale design was developed which allowed matrix and preferential flow processes to be monitored and theoretically characterized. Field flux experiments in New York, Indiana, Maryland, and Wisconsin demonstrated that preferential flow is the dominant flow mechanism in soils at irrigation rates as low as 3 mm/hour however at less than 1 mm/hour matrix flow was the dominate transport mechanism.
- Subsurface flow channels were located using primarily ground-penetrating radar (GPR) and digital elevation maps in a GIS framework. Analysis of multiple years of corn grain yield, real time soil moisture monitoring, and remotely sensed imagery confirmed the GPR-identified flow pathway locations. These subsurface flow pathways respond to preferential flow processes and appear to govern subsurface transport of agricultural chemicals off-site to neighboring ecosystems and corn grain yields during average and drought weather conditions.

Selected Publications (2001 to 2005):

Angier, J. T., G. W. McCarty, **T. J. Gish**, and C. S. T. Daughtry. 2001. Impact of a First-Order Riparian Zone on Nitrogen Removal and Export From an Agricultural Ecosystem. In Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection: Proceedings of the 2nd International Nitrogen Conference on Science and Policy. TheScientificWorld 1:642-651. 2001. http://www.thescientificworld.com/publications/NitrogenToC.asp

Daughtry, C. S. T., **T. J. Gish**, W. P. Dulaney. C. L. Walthall, K.-J. S. Kung, G. W. McCarty, J. T. Angier, and P. Buss. Surface and subsurface nitrate flow pathways on a watershed scale. In Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection: Proceedings of the 2nd International Nitrogen Conference on Science and Policy. TheScientificWorld 1:155-162. 2001.http://www.thescientificworld.com/publications/NitrogenToC.asp

Walthall, C.L., **T.J. Gish**, C.S.T. Daughtry, W.P. Dulaney, K-J.S. Kung, G. McCarty, D. Timlin, J.T. Angier, P. Buss and P.R.Houser, 2001. An innovative approach for locating and evaluating subsurface pathways for nitrogen loss. In Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection: Proceedings of the 2nd International Nitrogen Conference on Science and Policy. TheScientificWorld 1:223-229. 2001. http://www.thescientificworld.com/publications/NitrogenToC.asp

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Gish, T. J., C. L. Walthall, C. S. T. Daughtry, G. W. McCarty, and W. P. Dulaney. 2003. Watershed-scale sensing of subsurface flow pathways at the OPE3 site. Proceedings of the 1st Interagency Conference on watershed Research, Bensen Arizona, Oct 27-30, 2003. (Proceedings)

Chinkuyu, A.J., Mexiner, T.**, Gish, T. J.**, Daughtry, C.S. Sensitivity analysis of gleams model using multi-objective sensitivity analysis procedure. American Society of Agricultural Engineers Meeting. Paper number 032109. Las Vegas Nevada, July 28-31, 2003. (Proceedings)

O'Neill, P.E., A. Joseph., G. De Lannoy, R. Lang, R., C. Utku, E. Kim, P. Houser, and **T. J. Gish**. Soil Moisture Retrieval Through Changing Corn Using Active/Passive Microwave Remote Sensing, International Geoscience and Remote Sensing Symposium Proceedings (CD-ROM). Toulouse, France, July 21-25, 2003. (Proceedings)

Gish, T. J., K.-J. S. Kung. J. Posener, G. Bubenzer, C. S. Helling, E. J. Kladivko, and T. S. Steenhuis. Impact of preferential flow at varying irrigation rates by quantifying mass fluxes. J. Environ. Qual. 33:1033-1040. 2004.

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Venteris, E.R., McCarty, G.W., Ritchie, J.C. and **Gish, T. J.** Soil organic carbon and soil redistribution: Influence of site history and site variables. Soil Science 169(11):787-795. 2004.

Gish, T. J., C. L. Walthall, C.S.T. Daughtry, and K.-J. S. Kung. Using soil moisture, remote sensing and yield to confirm small-watershed subsurface flow pathways. J. Environ. Qual. 34:274-286. 2005.

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Prueger, J. H., **Gish, T. J.**, McConnell, L.L., McKee, L.G, , Hatfield, J.L., and Kustas, W.P. Solar Radiation, Relative Humidity, and Soil Water Effects on Metolachlor Volatilization. Environ. Sci and Tech. Environ. Sci and Tech.39(14):5219-5226. 2005.

Kung, K.-J.S., M. Hanke, C. S. Helling, E. J. Kladivko, **T. J. Gish**, T.S. Steenhuis, and D. B. Jaynes, Quantifying pore-size spectrum of macropore-type preferential pathways, Soil Sci. Soc. Am. J. 69:1196-1208, 2005.

Cooperator	***Affiliation***	***Location***
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Tim Green	USDA-ARS- GPSR	Fort Collins, CO
Andrey Gruber	USDA-ARSEMSL	Beltsville, MD
K.-J. S. Kung	Soil Dept., Univ. Wisconsin	Madison, WI
Thomas Nicholson	Nuclear Regulatory Commission	Washington DC
Peggy O'Neill	NASA Goddard Space Flight Center	Greenbelt, MD
Yakov Pachepsky	USDA-ARS-EMSL	Beltsville, MD
John Prueger	ARS National Soil Tilth Laboratory	Ames IA
Adam Schwartzman	Nuclear Regulatory Commission	Washington DC
Adel Shirmohammadi	University of Maryland	College Park, MD

E. Raymond Hunt, Jr. – *Research Physical Scientist*

Education:

1984 University of Michigan, Botany, PhD
1981 University of Michigan, Botany, MS
1978 Ohio University, Botany, BS

Experience:

1999-present Research Physical Scientist, USDA-ARS Hydrology and Remote Sensing Laboratory, Beltsville, MD (formerly USDA-ARS Remote Sensing and Modeling Laboratory)
1995-1999 Assistant Professor, University of Wyoming, Department of Botany, Laramie, WY
1989-1995 Research Assistant Professor, University of Montana, School of Forestry, Missoula, MT
1986-1989 Member of the Technical Staff and Postdoctoral Research Associate, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA
1984-1986 Postdoctoral Research Associate, University of California at Los Angeles, Laboratory of Biomedical and Environmental Sciences, Los Angeles, CA
1978-1984 Research and Teaching Assistant, University of Michigan, Division of Biological Sciences and Biological Station, Ann Arbor, MI

Current CRIS Projects:

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality
1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments:

- Remotely sensed leafy spurge, a noxious invasive weed species. Applied advanced hyperspectral techniques for detection of leafy spurge presence and estimation of leafy spurge cover. Developed method to use leaf and flower reflectance data from spectral libraries to assess potential to detect leafy spurge by remote sensing platforms. Used remote sensing to test distribution models of leafy spurge to estimate spread of invasive species. Maps of invasive weed distribution will help prioritize areas for management.
- Developed alternative remote-sensing platforms for low-cost, high-resolution imagery using radio-controlled unmanned airborne vehicles (UAV's). With IntelliTech Microsystems Inc., developed multispectral digital photography system for unmanned airborne vehicles. This research will help farmers by providing low-cost, high-resolution imagery in a timely manner during the early growing season for precision agriculture.
- Created geospatial model of stocking rates in rangelands based on the remote sensing of productivity from satellite imagery. Resulting maps of stocking rates will help rangeland managers better utilize the rangeland resource for multiple objectives.
- Discovered that the relationship between daily eddy-flux correlation data and absorbed photosynthetically active radiation (PAR) can be used to estimate

vegetation radiation use efficiency. Absorbed PAR is estimated over large areas using remote sensing, so integration of flux network data with remote sensing would allow better estimates of regional vegetation productivity for rangelands and agriculture.

- Developed the Moisture Stress Index based on shortwave-infrared reflectances to estimate the amount of water in leaves. Using this index, vegetation water content can be estimated from operational satellite sensors and integrated with microwave remote sensing to obtain better estimates of soil water content to quantify impacts of drought.

Selected Publications (2001 to 2005):

Winslow, J. C., **Hunt, E. R., Jr.**, and Piper, S. C., A globally applicable model of daily solar irradiance estimated from air temperature and precipitation data, Ecological Modelling 143:227-243, 2001.

Slaton, M. R., **Hunt, E. R., Jr.**, and Smith, W. K., Estimating near-infrared leaf reflectances from leaf structural characteristics, American Journal of Botany 88:278-284, 2001.

Kelly, R. D., **Hunt, E. R., Jr.**, Reiners, W. A., Smith, W. K., and Welker, J. M., Relationships between daytime carbon dioxide uptake and absorbed photosynthetically active radiation for three different mountain/plains ecosystems, Journal of Geophysical Research - Atmospheres 107(D14):19.1-19.8, (DOI 10.1029/2001JD001181), 2002.

Parker-Williams, A., and **Hunt, E. R., Jr.**, Estimation of leafy spurge cover from hyperspectral imagery using mixture tuned matched filtering, Remote Sensing of Environment 82:446-456, 2002.

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Smith, W. K., Kelly, R. D., Welker, J. M., Fahnestock, J. T., Reiners, W. A., and **Hunt, E. R., Jr.**, Leaf-to-aircraft measurements of net CO_2 exchange in a sagebrush steppe ecosystem, Journal of Geophysical Research Atmospheres, 108(D3):9.1-9.9 (DOI: 10.1029/2002JD002512), 2003.

Winslow, J. C., **Hunt, E. R., Jr.**, and Piper, S. C., A phenological model of the global C_3 and C_4 grass distribution with application to the United States Great Plains under a VEMAP climatic change scenario, Ecological Modelling, 163:153-173, 2003.

Daughtry, C. S. T., **Hunt, E. R., Jr.**, and McMurtrey, J. E., III., Assessing crop residue cover using shortwave infrared reflectance, Remote Sensing of Environment 90:126-134, 2004.

Parker-Williams, A., and **Hunt, E. R. Jr.**, Accuracy assessment of leafy spurge detection with hyperspectral remote sensing, Journal of Range Management, 56:106-112, 2004.

Gillham, J. H., Hild, A. L., Johnson, J., **Hunt, E. R., Jr.**, and Whitson, T. H., WISP: weed invasion susceptibility prediction model for rangeland geographic information systems, Arid Lands Research and Management, 18:1-12, 2004.

Hunt, E. R. Jr., Kelly, R. D., Smith, W. K., Fahnestock, J. T., Welker, J. M., Reiners, W. A., Carbon sequestration in two rangeland ecosystems from remote sensing and net ecosystem exchange. Journal of Environmental Management, 33: S342-S441, 2004.

Jackson, T. J., Chen, D., Cosh, M., Li, F., Anderson, M., Walthall, C., Doraiswamy, P., and **Hunt, E. R.**, Vegetation water content mapping using Landsat data derived normalized difference water index for corn and soybeans, Remote Sensing of Environment 92:475-482, 2004.

Hunt, E. R., Jr., McMurtrey, J. E., III, Parker-Williams, A., and Corp, L. A., Spectral characteristics of leafy spurge leaves and flower bracts, Weed Science 52:492-497, 2004.

Daughtry, C. S. T., **Hunt, E. R., Jr.**, Doraiswamy, P. C., and McMurtrey, J. E., III., Remote sensing the spatial distribution of crop residues. Agronomy Journal 97:864-871, 2005.

Hunt, E. R., Jr., Cavigelli, M., Daughtry, C. S. T., McMurtrey, J. E., III, and Walthall, C. L., Evaluation of digital photography from model aircraft for remote sensing of crop biomass and nitrogen status. Precision Agriculture 6:359-378, 2005.

Hunt, E. R. Jr., and Miyake, B. A., Comparison of stocking rates from remote sensing and geospatial data. Rangeland Ecology & Management, in press.

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Doraiswamy, P.C., McCarty, G.W., **Hunt, E. R.**, Yost, R.S., Doumbia, M. Franzluebbers, A.J., Modeling soil carbon sequestration in agricultural lands of Mali. Journal of Agricultural Systems, in press.

Daughtry, C.S.T., Doraiswamy, P.C., **Hunt, E. R.**, Stern, A.J., McMurtrey, J.E., Prueger, J.H., Assessing crop residue cover and soil tilliage intensity. Soil and Tilliage Research, in press.

Cooperator	***Affiliation***	***Location***
Michel Cavigelli	USDA-ARS	Beltsville, MD
Susan Ustin	University of California	Davis, CA
Vern Vanderbilt	NASA Ames Research Center	Moffet Field, CA
Stephen Fujikawa	IntelliTech Microsystems	Bowie, MD

Thomas J. Jackson -. Research Hydrologist

Education:

1976 University of Maryland, Civil Engineering; Ph.D.
1973 University of Maryland, Civil Engineering; M.S.
1971 University of Maryland, Fire Protection Engineering; B.S.

Experience:

1977-present, Hydrologist, USDA, ARS, Beltsville, MD
1976-1977, Assistant Professor, University of Kentucky, Lexington, Kentucky

CRIIS Project.

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments:

- Efforts to utilize operational satellite data have been hindered by the lack of a practical approach to accounting for the numerous factors influencing the data interpretation. Dr. Jackson developed an original approach to solving this problem that was only dependent on data, which should be available. This work was founded on extensive investigations of the effects of vegetation on microwave emission of soils. Since the launch of the Aqua and ADEOS-II satellites he has contributed to the implementation and validation of soil moisture retrieval algorithms through both the U.S. (NASA) and Japanese space agencies.
- One of the most perplexing issues in passive microwave remote sensing is achieving a useful spatial resolution from satellite altitudes. Dr. Jackson identified an innovative solution to this problem using an emerging antenna technology. His work in this area contributed to the selection of this approach by the European Space Agency for a Soil Moisture Ocean Salinity satellite mission being developed for launch in 2007.
- Passive microwave Earth observing systems can provide information but at a coarser spatial resolution than hydrologists and soil physicists typically view the Earth. A recurring question is how does microwave brightness temperature scale from relatively small ground and aircraft footprints (1 – 1000 m) that we are able to control and verify to the coarse resolution expected from satellite missions (10 – 50 km)? Dr. Jackson was the first to demonstrate that surface soil moisture retrieval algorithms based on remotely sensed microwave observations, developed and verified at high spatial resolution, can be applied at coarser resolutions over large regions. This was accomplished within a broad experiment, the Southern Great Plains 1997 Hydrology Experiment (SGP97). This experiment was designed to understand land-atmosphere interactions using remotely sensed data. Using previous investigations as a base, experiments were conducted to extend the algorithm to coarser resolutions, larger regions with more diverse conditions, and longer time periods. The scope of the research program expanded significantly over time and involves a large team that must be coordinated and managed for an extended period. SGP97 successfully demonstrated the ability to map and monitor soil moisture using low frequency microwave radiometers. Conclusions supported a satellite-based implementation. These results elevated

the importance of soil moisture measurement within NASA's Earth Science Program. As a result NASA selected a soil moisture mission (Hydros) as part of its Earth System Science Pathfinder satellite program, which is scheduled for launch later this decade.

Selected Publications (2001 to 2005)

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Jackson, T. J., Hsu, A. Y., Shutko, A. M., Tishchenko, Y., Petrenko, B., Kutuza, B., and Armand, N. Priroda microwave radiometer observations in the SGP97 hydrology experiment. International Journal of Remote Sensing, 23:231-248. 2002.

Jackson, T. J. and Hsu, A. Y. Soil moisture and TRMM microwave imager relationships in the Southern Great Plains 1999 (SGP99) experiment, IEEE Trans. Geoscience and Remote Sensing, 39:1632-1642. 2001.

Jackson, T. J. Remote sensing, soil moisture and implications for groundwater recharge. Hydrogeology Journal, 10:40-51. 2002.

Jackson, T., Hsu, A., O'Neill, P. Surface soil moisture retrieval and mapping using high frequency microwave satellite observation in the Southern Great Plains, J. Hydrometeorology, 3:688-699. 2002.

Jackson, T., Gasiewski, A., Oldak, A., Klein, M., Njoku, E., Yevgrafov, A., Christiani, S., and Bindlish, R. Soil moisture retrieval using the C-Band polarimetric scanning radiometer during the Southern Great Plains 1999 experiment. IEEE Trans. Geoscience and Remote Sensing, 40:2151-2161. 2002.

Njoku, E., **Jackson, T.**, Lakshmi, V., Chan, T., and Nghiem, S. Soil moisture retrieval from AMSR-E. IEEE Trans. Geoscience and Remote Sensing, 41:215-229. 2003.

Bindlish, R., **Jackson, T. J.**, Wood, E., Gao, H., Starks, P., Bosch, D. and Lakshmi, V. Soil moisture estimates from TRMM Microwave Imager observations over the southern United States. Remote Sensing of Environment, 85:507-15. 2003.

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Entekhabi, D., Njoku, E., Houser, P., Spencer, M., Doiron, T., Belair, S., Crow, W., **Jackson, T**., Kerr, Y., Kimball, J., Koster, R., McDonald, K., O'Neill, P., Pultz, T., Running, S., Shi, J.C., Wood, E., and van Zyl, J. The hydrosphere State (Hydros) mission concept: An earth system pathfinder for global mapping of soil moisture and land freeze/thaw, IEEE Trans. Geoscience and Remote Sensing, 42:2184-2195. 2004.

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and Hunt, E.R. Vegetation water content mapping using Landsat data derived normalized difference water index (NDWI) for corn and soybean, Remote Sensing of Environment, 92: 475-482. 2004.

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Cosh, M.H., **Jackson, T. J.**, Bindlish, R., and Prueger, J.H. Watershed scale temporal persistence of soil moisture and its role in validation satellite estimates, Remote Sensing of Environment, 92:427-435. 2004.

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Jackson, T .J. Remote Sensing Soil Moisture. In Encyclopedia of Soils in the Environment. Ed. D. Hillel, Elsevier, Ltd., Oxford, UK, vol. 3:392-398. 2005.

Jackson, T. Passive microwave remote sensing of soil moisture and regional drought monitoring, Chapter V:89-104. in Boken, V. (ed.) Monitoring and Predicting Agricultural Drought. Oxford Univ. Press. 2005.

Jackson, T. J., Bindlish, R., Gasiewski, A.J., Stankov, B., Klein, M., Njoku, E.G., Bosch, D., Coleman, T.L., Laymon, C., and Starks, P. Polarimetric Scanning Radiometer C and X band microwave observations during SMEX03. IEEE Trans. Geoscience and Remote Sensing, 43:2418-2430. 2005.

Cooperator	***Affilation***	***Location***
Prof. Dara Entekhabi	MIT	Cambridge, MA
Dr. Eni Njoku	NASA JPL	Pasadena, CA
Peggy O'Neill	NASA Goddard	Greenbelt, MD
Prof. Venkat Lakshmi	U. South Carolina	Columbia, SC
David Bosch	ARS	Tifton, GA
Mark Seyfried	ARS	Boise, ID
David Goodrich	ARS	Tucson, AZ
Pat Starks	ARS	El Reno, OK
Li Li	Naval Research Lab	Washington, DC
David Le Vine	NASA Goddard	Greenbelt, MD
Jun Wen	Chinese Academy of Science	Xian, China
Paul Houser	George Mason Univ.	Calverton, MD

William Kustas - Hydrologist

Education:

1986 Cornell University, School of Civil and Environmental Engineering; Ph.D.
1983 Cornell University, School of Civil and Environmental Engineering; M.S.
1981 State University of New York College of Environmental Science & Forestry; B.S.

Experience:

1982 - 1986	Research Assistant, School of Civil and Environmental Engineering, Cornell University
1986 –	Hydrologist, USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD. (Previously the USDA - ARS Hydrology Laboratory)
1991-1993	Visiting Research Scholar, College of Marine Studies, Center for Remote Sensing, University of Delaware
1999-2000	Visiting Research Fellow, College of Environmental Sciences, University of Virginia

Current CRIS Projects:

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments:

- Led a team of university scientists in developing a relatively simple yet robust energy balance-remote sensing model quantifying soil and vegetation water and energy fluxes. This robust scheme has been implemented in an operational evapotranspiration monitoring/weather forecasting model.
- First to develop and test synergistic techniques that combined optical and microwave remote sensing with a simplified soil-vegetation-atmosphere model for computing spatially distributed energy fluxes. This modeling framework will permit implementation of a robust surface energy balance monitoring system using current and future (Hydros) satellite platforms.
- First to couple a land surface scheme employing remotely sensed boundary conditions with a Large Eddy Simulation (LES) model for evaluating the effects of landscape heterogeneity defined by remotely sensed fields on surface-atmosphere dynamics. This will allow the development of methods to account for the impact of real landscape heterogeneity on lower atmospheric properties. This will ultimately improve hydrologic and weather forecasting models where surface-air interaction and feedbacks are often neglected.
- As principle investigator (PI)/Co-PI, Dr. Kustas designed and coordinated large scale interdisciplinary remote sensing field experiments supported by NASA in Arizona (Monsoon 90), Oklahoma (Washita 92 Washita 94, SGP 97 and SGP 99), and Iowa (SMACEX/SMEX02). The original research contributions and field data from these experiments have been adopted and used by national and international researchers, leading to significant advances in land surface-atmosphere algorithm development and basin and regional scale hydrologic modeling.

Selected Publications (2001 to 2005)

Zhan, X., and **Kustas, W. P.** A coupled model of land surface CO2 and energy fluxes using remote sensing data. Agric. For. Meteorol. 107:131-152. 2001.

Kustas, W. P., Diak, G. R., and Norman, J. M. Time difference methods for monitoring regional scale heat fluxes with remote sensing. In: Observations and Modeling of the Land Surface Hydrological Processes. AGU Water Science and Applications Series. (V. Lakshmi, J. Albertson and J. Schaake, Editors) Vol. 3:15-29. 2001.

Kustas, W. P., Jackson, T. J. , French, A. N., and MacPherson, J. I. Verification of patch and regional scale energy balance estimates derived from microwave and optical remote sensing during SGP97. J. Hydromet. 2(3):254-273. 2001.

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Albertson, J. D., **Kustas, W. P.**, and Scanlon, T. M. Large eddy simulation over heterogeneous terrain with remotely sensed land surface conditions. Water Resour. Res. 37(7):1939-1953. 2001.

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French, A. N., Schmugge, T. J., and **Kustas, W. P.** Estimating Evapotranspiration over El Reno Oklahoma with ASTER. Agronomie 22:105-106. 2002.

Schmugge, T. J., **Kustas, W. P.**, Ritchie, J. R., Jackson, T. J., and Rango. A. Remote sensing of hydrology. Adv. Water Resour. 25:1367-1385. 2002.

Kustas, W. P., Moran, M. S., and Norman. J. M. Spatial distribution of evaporation. Chapter 26 In: Handbook of Weather, Climate and Water, Atmospheric Chemistry, Hydrology, and Societal Impacts (T.D. Potter and B.R. Coleman, Editors) John Wiley & Sons pp. 461-492. 2003.

Kustas W. P., Bindlish, R., French, A. N., and Schmugge, T. J. Comparison of energy balance modeling schemes using microwave-derived soil moisture and radiometric surface temperature. Water Resour. Res. 30:1039-1049. 2003.

Kustas, W. P., and Albertson, J.D. Effects of surface temperature contrast on land-atmosphere exchange: A case study from Monsoon 90. Water Resour. Res. 39(6), 1159. DOI:10.1029/2001WR001226. 2003.

Kustas, W. P., Anderson, M.C. , Norman, J.N., and French, A.N. Estimating subpixel surface temperatures and energy fluxes from the vegetation index-radiometric temperature relationship. Remote Sen. Environ. 85:429-440. 2003.

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Norman, J.M., Anderson, M.C. , **Kustas, W. P.**, French, A.N., Mecikalski, J.R., Torn, R.D., Diak, G.R., Schmugge, T.J., and Tanner, B.C.W. Remote sensing of surface energy fluxes at 10^1-m pixel resolutions. Water Resour. Res. 39(8),1221, doi: 10.1029/2002WR001775. 2003.

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Crow, W.T., **Kustas, W.P.** Utility of assimilating surface radiometric temperature observations for evaporative fraction and heat transfer coefficient retrieval. Bound-Layer Meteorol. 115: 105-130. 2005.

Cooperator	***Affiliation***	***Location***
Dr. John Prueger	USDA-ARS	Ames, IA
Dr. Jerry Hatfield	USDA-ARS	Ames, IA
Dr. John Norman	Univ. of Wisconsin	Madison, WI
Dr. Mark Friedl	Boston Univ.	Boston, MA
Dr. Andrew French	USDA-ARS	Phoenix, AZ
Dr. Christopher Neale	Utah State Univ.	Logan, UT
Dr. John Albertson	Duke Univ.	Raleigh, NC
Dr. John Mecilkalski	Univ. Alabama	Huntsville, AL

Gregory McCarty - Soil Scientist

Education:

(1978-1982) Agronomy, Department of Agronomy, Iowa State University, B.S.
(1982-1985) Soil Fertility, Department of Agronomy, Iowa State University, M.S.
(1985-1989) Soil Microbiology, Department of Agronomy, Iowa State University, Ph.D.

Experience:

1982 - 1985, Research Assistant, Dept. of Agronomy, Iowa State University
1985 - 1990, USDA Fellow, Dept. of Agronomy, Iowa State University
1990 - 1992, Postdoctoral Research Associate, Dept. of Agronomy, Iowa State University
1992 - 2000, Soil Scientist, Environmental Chemistry Laboratory, USDA, ARS, Beltsville, MD
2000 - 2005, Soil Scientist, Environmental Quality Laboratory, USDA, ARS, Beltsville, MD
2005 to present Soil Scientist, Hydrology & Remote Sensing Laboratory, USDA, ARS, Beltsville, MD

Current CRIS Projects

1265-12130-001-00D: Fate & Transport of Nutrients in Agricultural Systems as Affected By Soil & Nutrients Management
1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools Detrimental Chemical Fluxes

Accomplishments:

- Improved ability to measure carbon sequestration in agricultural ecosystems and to gain better understanding of the impact of soil movement on carbon dynamics within agricultural landscapes.
- Quantified changes in soil carbon storage under plow tillage and no tillage management and assessing emissions of greenhouse gases under these management systems.
- Helped develop infrared methods for rapid analysis of soils for carbon as well as other characteristics which will enable inclusion of soil carbon stocks in a market-based system for regulating emissions of greenhouse gases.
- Assessed the effectiveness of forested riparian buffer ecosystems for removal of agricultural pollutants of surface and ground water. His research deals primarily with fate of nutrients, and he collaborates on studies of pesticide fate within riparian buffers.
- Involved in several international projects for developing carbon market trading capability on small farms in West Africa (USAID/NASA) and in the steplands of Kazakhstan (World Bank). He has active collaborations with scientists in Poland and Brazil examining carbon processes and soil and water quality issues.

Selected Publications (2001 to 2005)

McCarty, G. W. and Reeves III, J. B. Development of rapid instrumental methods for measuring soil organic carbon. Adv. Soil Sci. pp. 371-380. 2001.

Rosecrance R., **McCarty, G. W.**, Shelton, D. R. and Teasdale, J. Denitrification and N mineralization in cover crop production systems. Plant Soil 227:283-290. 2000.

McCarty, G.W. and Angier J. Impact of preferential flow pathways on ability of riparian wetlands to mitigate agricultural pollution. Proceedings of Second International Symposium on Preferential Flow pp. 53-56. 2000.

Daughtry, C.S.T., Gish, T.J., Dulany, W.P., Walthall, C.L., Kung, K,-J.S., **McCarty, G.W.**, J.T. Angier, and P. Buss. Surface and subsurface nitrate flow pathways on a watershed scale. Scientific World 1:155-162. 2001.

Reeves, J.B. III, **McCarty, G.W.** and Mimmo, T. The potential of diffuse reflectance spectroscopy for the determination of carbon inventories in soils. J. Environ. Pollut. 116:277-284. 2002.

McCarty, G.W. and Ritchie, J.C. Impact of soil movement on carbon sequestration in agricultural ecosystems. J. Environ. Pollut. 116:423-430. 2002.

McCarty, G.W., Reeves, J.B. III, Reeves, V.B., Follett, R.F., and Kimble, J.M. Mid-infrared and near-infrared diffuse reflectance spectroscopy for measurement of carbon in soils. Soil Sci. Soc. Am. J. 66:640-646. 2002.

Angier, J.T., **McCarty, G.W.**, Rice, C.P., and Bialek, K. Influence of a riparian wetland on nitrate and herbicides exported from a field applied with agrochemicals. J. Agric. Food Chem. 50:4424-4429. 2002.

Mookherji, S., **McCarty, G.W.**, and Angier, J.T. Dissolved gas analysis for assessing the fate of nitrate in wetlands. J. Am. Wat. Resour. 39:381-387. 2003.

Stuczynski T., **McCarty, G.W.**, and Siebielic, G. Response of soil microbial activities to Cd, Pb, and Zn salt amendments. J. Environ. Qual. 32:1346-1355. 2003.

Kristensen, H.L., Debosz, K., and **McCarty, G.W.** Short-term effects of tillage on mineralization of N and C in soil. Soil Biol. Biochem. 35:979-986. 2003.

Ritchie, J.C., and **McCarty, G.W.** Using 137 Caesium to understand soil carbon redistribution on agricultural watersheds. Soil and Till. Res. 69:45-51. 2003.

Siebielic, G., **McCarty, G.W.**, Stuczynski, T., and Reeves, J.B., 2003. Use of near- and mid-infrared diffuse reflectance spectroscopy for measuring metal content in soil. J. Environ. Qual. 33:2056-69. 2004.

Calderon, F.J., **McCarty, G.W.**, Van Kessel, J.A. and Reeves, J.B. Carbon and nitrogen dynamics during incubation of manured soil. Soil Sci. Soc. Am. J. 68:1592-1599. 2004.

Venteris, E.R., **McCarty, G.W.**, Ritchie, J.C. and Gish, T. Influence of management history and landscape variables on soil organic carbon and soil redistribution. Soil Science 169:787-795. 2004.

Angier, J., **McCarty, G.,** and Prestegaard, K. Hydrology of a first-order riparian zone and stream, Mid Atlantic Coastal Plain, Maryland. Journal of Hydrology. 309:149-166. 2005.

Calderon, F.J., **McCarty, G.W.**, and Reeves, J.B. Analysis of manure and soil nitrogen mineralization during incubation. Biology and Fertility of Soils 41:328-336. 2005.

Calderon, F.J., **McCarty, G.W.**, and Reeves, J.B. Nitrapyrin delays denitrification on manured soils. Soil Science 170:350-359. 2005.

Madari, B.E., Reeves III, J.B. Coelho, M.R. Machado, P.L.O.A., De-Polli, H., Benites, V.M. Souza, L.F., and **McCarty, G.W.** Mid and near infrared spectroscopic determination of carbon in diverse set of soil from the Brazilian National Soil Collection. Spectroscopic Letters 38:721-740. 2005.

Cavigelli, MA, Lengnick, L.L., Buyer, J.S., Fravel, D.R., Handoo, Z.A., **McCarty, G.W.**, Milner, P.D., Sikora, L.J., Wright, S.E., Vinyard, B.T., and Rabenhorst, M. Landscape level variation in soil resources and microbial properties in a no-till corn field. Applied Soil Ecology 29:99-123. 2005.

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Capuco, A.C., Rice, C.P., Baldwin, R.L., IV Bannerman, D.D., Paape, M.J., Kauf, A.C.W., **McCarty, G.W.**, Hapeman, C.J., Sadeghi, A.M., Starr, J.L., McConnell, L.L., and Van Tassel, C.P. Fate of dietary perchlorate in lactating dairy cows. Proceedings of the National Academy of Sciences. 102:16152-16157 2005.

Schumacher J.A. T.C. Kaspar, T.C., Ritchie, J.C., Schumacher, T.E., Karlen, D.L., Venteris, E.R., **McCarty, G.W.**, Colvin, T.S., Jaynes, D.B., Lindstrom, M.J., and Fenton T.E. Identifying spatial patterns of erosion for use in precision conservation. Journal of Soil and Water Conservation. 60:355-362 2005.

Cooperator	***Affiliation***	***Location***
Jerry Ritchie	USDA-ARS HRSL	Beltsville, MD
Paul Doraiswamy	USDA-ARS HRSL	Beltsville, MD
Tom Kasper	USDA NSTL	Ames, IA
Kevin Sellner	Chesapeake Research Consortium	Edgewater, MD
Tomasz Stuczyncki	Polish Inst. Plant & Soil Sci.	Poland
Helvecio De-Polli	Labex/EMBRABA	Brazil
Patrick Kangas	University of Maryland	College Park, MD
Andrew Baldwin	University of Maryland	College Park, MD

Walter Rawls- Research Leader / Hydrologist

Education:

1976 Georgia Institute of Technology; Hydrology and Water Resources; Ph.D.
1968 Virginia Polytechnic Institute of Technology; Civil Engineering; M.S.
1966 Virginia Polytechnic Institute of Technology; Civil Engineering; B.S.

Experience:

1966 - 1967	Research Assistant, Virginia Polytechnic Institute, Blacksburg, VA
1971 – 1974	Hydrologist, USDA-ARS, Northwest Watershed Research Center, Boise, ID
1975 – 1976	Staff Specialist Hydrologist, USDA-ARS, National Program Staff, Beltsville, MD
1976 – 1993	Hydrologist, USDA-ARS, Hydrology Laboratory, Beltsville, MD
1993 – present	Research Leader / Hydrologist USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD. (Previously the USDA - ARS Hydrology Laboratory)

Current CRIS Projects

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality
1265-13660-009-00D: Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes

Accomplishments:

- Assembled the first comprehensive national data base (encompassing 32 states and over 10,000 soils) of these properties and developed a hierarchy of procedures for estimating how water is stored and released from the soil based on available soil survey information such as particle size distribution, bulk density, organic matter, and one or more moisture release values.
- Methods for incorporating the cover effects into infiltration parameters were developed from extensive field experiments conducted on a broad range of soils and vegetative cover conditions. This procedure has allowed process based infiltration technology to be used operationally.
- Utilizing new scaling techniques such as fractal analysis, methods were developed to describe the composition of pores and to predict how the composition of pores affects how water flows through the soil. Also, methods were developed to predict the parameters based on soil survey information.
- Using new data mining analysis procedures methods for estimating water retention and hydraulic conductivity from soil profile descriptions were developed. The procedures enable the mass of soil profile descriptions to be used to predict soil hydraulic properties, thus enabling NRCS to populate their soil survey data base with water retention and hydraulic conductivity parameters.

Selected Publications (2001 to 2005)

Pachepsky, Y. A., **W. J. Rawls**. and D. J. Timlin. A one parameter relationship between unsaturated hydraulic conductivity and water retention. Soil science 165:942-951. 2001.

Pachepsky, Y. A., Timlin, D. J. and **W. J. Rawls**. .Soil water retention as related to topographic variables. Soil Science Society of America Journal 65(6):1787-1795. 2001.

Pachepsky, Y. A., **W. J. Rawls**, and D. Gimenez. Comparison soil water retention at field and laboratory scales. Soil Science Society of America Journal 65(2):460-462. 2001.

Oldak, A., Y. A. Pachepsky, T. J. Jackson, and **W. J. Rawls**. Statistical properties of soil moisture revisited. Journal of Hydrology 255:12-24. 2002.

Rawls, W. J. Infiltration properties. In Encyclopedia of Soil Science Rattan Lal, Ed. Marcel Decker pp. 689-692. 2002. (Book Chapter).

Pachepsky, Y. A., J. Crawford, and **W. J. Rawls**. Scaling effects. In Encyclopedia of Soil Science Rattan Lal, Ed. Marcel Decker pp.1175-1179. 2002. (Book Chapter).

Rawls, W. J., Y. A. Pachepsky and M. H. Shen. Testing soil water retention estimation with MUUF pedotransfer functions for the Southern United States. Journal of Hydrology 251:177-185. 2001.

Wosten, J. H. M., Y. A. Pachepsky, and **W. J. Rawls**. Pedotransfer functions bridging the gap between available basic soil data and missing soil hydraulic data: their development, uncertainity and practical use in modeling. Journal of Hydrology 251: 123-150. 2002.

Rawls, W. J., and Y. A. Pachepsky. Using field topographic descriptors to estimate soil water retention. Soil Science. 167(:6.): 423-435. 2002.

Pachepsky, Y. A., D. J. Timlin, and **W. J. Rawls**. Generalized Richards equation to simulate water transport in soils. Journal of Hydrology. 272:3-13. 2002.

Rawls, W. J., J. C. Ritchie, Y. A. Pachepsky, T. M. Sobecki, and H. Bloodwort, Effect of Soil Organic Carbon on Soil Water Retention. Geoderma, 116:61-76. 2003.

Tomasella, J, Y. A. Pachepsky, S. Crestana, and **W. J. Rawls**. Comparison of two approximation techniques to develop pedotransfer functions of water retention of Brazilian soils. Soil Science Society of America J. 67:1085-1092. 2003.

Guber, A. K., **W. J. Rawls**, E. V. Shein, and Y. A. Pachepsky. Effect of soil aggregate size distribution on water retention. Soil Science, 168:223 - 233. 2003.

Rawls, W. J., W. P. Kustas, T. J. Schmugge, J. C. Ritchie, T. J. Jackson, A. Rango, P. Doraiswamy. Remote Sensing in watershed scale hydrology. Proceedings of The First Interagency Conference on Research in the Watersheds 2003. (Proceedings).

Rawls, W. J., A Nemes, and Y. A. Pachepsky. Effect of soil organic carbon on soil hydraulic properties Chapter 6 in Development of pedotransfer functions in soil hydrology, Ed Y. A. Pachepsky and W. J. Rawls. Development in Soil science, Elsevier.

30 : 95-114. 2004.

Nemes, A. and **W. J. Rawls**. Soil texture and particle-size distribution as input to the estimation of soil hydraulic properties. Chapter 4 in Development of pedotransfer functions in soil hydrology, Ed Y. A. Pachepsky and W. J. Rawls. Development in Soil science, Elsevier. 30: 47-70. 2004.

Rawls, W. J. Pedotransfer functions for the United States. . Chapter 23 in Development of pedotransfer functions in soil hydrology, Ed Y. A. Pachepsky and W. J. Rawls. Development in Soil science, Elsevier. 30: 437-448. 2004.

Pachepsky, Y. A. and **W. J. Rawls**, ED. Development of pedotransfer functions in soil hydrology. Development in soil science, Elsevier. 30: 497. 2004.

Cooperator	***Affiliation***	***Location***
Dr. Yakov Pachepsky	USDA-ARS	Beltsville, MD
Dr. Attila Nemes	Univ. California	Riverside, CA
Dr. Laj Ahuja	USDA-ARS	Fort Collins, CO
Dr. Rein Van Genuchten	USDA-ARS	Riverside, CA

James B. Reeves, III – Research Chemist

Education:

1976 University of Maryland; Biochemistry; Ph.D.
1984 University College, University of Maryland; Computer Science; B.S.
1970 University of Maryland, Chemistry; B.S.

Experience:

1975-1975	Prepared a literature search on tuberculin production for Ormont Drug and Chemical, Hackensack, NJ
1975-1976	Research Associate, University of Maryland. Worked at USDA Consumer Food Economics Institute, Hyattsville, MD
1976-1978	Research Chemist , Consumer Food Economics Institute, Hyattsville, MD
1978-1983	Research Chemist, Feed Energy Conservation and Ruminant Nutrition Laboratories, Beltsville, MD
1983-2000	Research Chemist, Ruminant Nutrition Lab and Nutrient Conservation and Metabolism Lab, Beltsville, MD
2000-present	Research Chemist, Animal Manure and By-Products Lab (Acting Research Leader AMBL, May 2003 to [illegible]. 12, 2005)

Current CRIS Projects

1265-12130-001-00D: Fate & Transport of Nutrients in Agricultural Systems as Affected By Soil & Nutrients Management

Accomplishments:

- Demonstrated that mid-infrared reflectance spectroscopy could be used with non-KBr diluted samples for the quantitative analysis of forages with results as good as obtained using near-infrared spectroscopy.
- Demonstrated that a simple, home-made sample transport device improved results obtained using mid-infrared spectroscopy for quantitative analysis of forages.
- Demonstrated that mid-infrared reflectance spectroscopy is almost always superior to near-infrared spectroscopy for the quantitative determination of carbon in ground soils.
- Demonstrated that mid-infrared reflectance spectroscopy can accurately predict the differences in C-13 values in soil sample based on differences in C composition.

Selected Publications (2001 to 2005, Soil C Related Only Shown)

Reeves, III, J. B. and McCarty, G. W. Quantitative Analysis of Agricultural Soils Using Near-Infrared Reflectance Spectroscopy and Fiber-Optic Probe. J. Near Infrared Spectrosc. 9:25-34. 2001.

Reeves, III, J. B., McCarty, G. W. and Reeves, V. B. Mid-infrared diffuse reflectance spectroscopy for the quantitative analysis of agricultural soils. J. Agic. Food. Chem. 49:766-772. 2001.

Reeves, III, J. B., McCarty, G. W. and *Mimmo, T. V.* The potential of diffuse reflectance spectroscopy for the determination of carbon inventories in soils. J. Environmental Pollution. 116(1001):S277-S284. 2002.

McCarty, G. W., **Reeves, III**, **J. B. ,** Reeves, V. B., Follett, R. F. and Kimble, J. M. Mid-infrared and near-infrared diffuse reflectance spectroscopy for soil carbon measurement. Soil Science Society of America J. 66:640-646. 2002.

Mimmo, T., **Reeves, III**, **J. B. ,** McCarty, G. W. and Galletti, G. C. Determination of biological measures by mid-infrared diffuse reflectance spectroscopy in soils within a landscape. Soil Science. 167:281-287. 2002.

Reeves, III, J. B. and Reeves, V. B. Effects of instrument variations, as reflected by the frequency of obtaining background spectra and instrument functions such as type of apodization on mid-infrared calibrations for feed composition. Spectroscopy Letters. 35:663-680. 2002.

Reeves, III, J. B. and Delwiche, S. R. SAS partial least squares regression for analysis of spectroscopic data. J. Near Infrared Spectrosc. 11:415-431.2003.

Delwiche, S. R. and **Reeves, III, J. B.** The effect of spectral pretreatments on the PLS modeling of agricultural products. J. Near Infrared Spectrosc. 12:177-182. 2004

Reeves, III, J. B., Francis, B.A. and Hamilton, S.K. Specular reflection and diffuse reflectance spectroscopy of soils. Applied Spectrosc. 59:39-46. 2005.

Reeves, III, J. B. Effect of water and physical state on near- and mid-infrared partial least squares (PLS) calibrations for multi-component carbohydrate mixtures. J. Near Infrared Spectrosc. 12:241-250. 2004.

Siebielec, G. W., McCarty, G. W., Stuczynski, T. I. and **Reeves, III, J. B.** Near- and mid-infrared diffuse reflectance spectroscopy for measuring soil metal content. J. Envir. Quality. 33:2056-2069. 2004.

Reeves, III, J. B., Follett, R. F., McCarthy, G. W. and Kimble, J. M. Can near- or mid-infrared diffuse reflectance spectroscopy be used to determine soil carbon pools. J. Soil Plant Analysis. Accepted.

Madari, B. E., **Reeves, III, J. B.**, Machado, P. L. O. A., Torres, E., Guimaraes, G. M. and McCarty, G. W. Mid- and near-infrared spectroscopic determination of soil compositional parameters and structural indices in two ferralsols. Spectroscopy Letters: Accepted.

McCarty, G. W. **and Reeves, III., J. B.** Comparison of Near Infrared and Mid Infrared Diffuse Reflectance Spectroscopy for Field Scale Measurement of Soil Fertility Parameters. J Soil Plant Analysis. Accepted.

Cooperator ***Affiliation*** ***Location***

Abudul-Baki, Aref	SASL	Beltsville, MD
Andersen, Richard	U. of NH	Durham, NH
Comberford, Nick	D. of Soil and Water Sci. U. of FL	Gainesville, FL
Delwiche, Stephen	ISL	Beltsville, MD
De-Polli, Helvecio	LABEX, EMBRAPA,	Brazil
Follet, Ronald	SPNR	Fort Collins CO
Galletti, Guido	Dept. of Chemistry, U. of Bologna	Bologna, Italy
Hamilton, Steve	Hamilton Lab., Kell. Biol. Station	Hickory Corners, MI
Harper, Lowry	SPCR	Watkinsville, GA
Jackson, Louise	Dept. of Vegetable Crops, U. of Calif.	Davis, CA
Kimble, John	NRCS-NSSC	Lincoln, NE
Krizek, Donald	SASL	Beltsville, MD
Machado, Pedro	Empraba Soils	Rio de Janeiro, Brazil
Madari, Beata	Empraba Soils	Rio de Janeiro, Brazil
Malone, Bud	Dept. of Poultry Sci., U. of DE	Georgetown, DE
Martens, Dean	SWR	Tucson, AZ
McClure, William	Consultant, U. of NC (Retired)	Raleigh, NC
Mimmo, Tanja	Dept. of Agriculture, U. of Bologna	Bologna, Italy
Oliveira Sa, Sandra M.	CENA/USP	Piracicaba-SP, Brazil
Pachepsky, Yakov	USDA-ARS-AWPL	Beltsville, MD
Reeves, Valerie	CVA, FDA	Rockville, MD
Roberts, Craig	Dept. of Agronomy, U. of Missouri	Columbia, MO
Shalini, J.	Nav. Res. Lab.	Washington, D.C.
Siebielec, Grzegorz	Inst. of Soil Sci. & Plant Cultivation	Pulawy, Poland
Stuczynski, Thomas	Inst. of Soil Sci. & Plant Cultivation	Pulawy, Poland
Van Kessel, Jo Ann	EMSL	Beltsville, MD
Workman, Jerome J.	Thermo-Nicolet	Madison, WI
Yang, Chih C.	Mitsuba International	Raleigh, NC
Zapf, Charles M.	McCormick & Company	Hunt Valley, MD
Ziska, Louis	ACSL	Beltsville, MD

Clifford Rice - *Research Chemist*

Education:

1958 – 1962 B.S. College of Agriculture, Washington State University, Pullman
1962 - 1963 Department of Botany, University of Würzburg , Germany
1966 – 1971 Ph.D. Department of Entomology, Cornell University, Ithaca, NY

Experience:

1963 - 1964 1st Lieutenant, US Army
1964 - 1969 Teaching Assistant, Cornell University, Ithaca, NY
1971 - 1974 Research Associate, Syracuse Research Corporation, Syracuse, NY
1974 - 1977 Instructor/Research Associate, University of Rhode Island, Kingston, RI
1978 - 1985 Associate Research Scientist, University of Michigan, Ann Arbor, MI
1986 Research Scientist, US EPA, Grosse Ile, MI
1986 - 1992 Chemist & Research Chemist, Patuxent Wildlife, Research Center Laurel, MD
1992 - 2005 Research Chemist, USDA/ARS/ANRI, Environ. Quality Lab Beltsville, MD
2005-present Research Chemist, USDA/ARS/ANRI Hydrology and Remote Sensing Lab and Environmental Management and Byproduct Utilization Lab, Beltsville, MD

Current CRIS Projects

1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools Detrimental Chemical Fluxes

Accomplishments:

- From a study of herbicide transport into and through a forested riparian wetland it was discovered that two metabolites of metolachlor, metolachlor ethane sulfonic acid and metolachlor oxanilic acid, are virtually unretained as groundwater exfiltrates upward from subsurface flow. The parent materials, metolachlor and atrazine, are abated during upward movement of the groundwater as are also the degradates of atrazine.
- From a study of river transport of alkylphenol ethoxylates in the Cuyahoga River in Ohio it was discovered that enhanced discharge occurs downstream of the Akron Waste Water Treatment Plant. This caused increased concentration in fish collected just downstream of the outfall of this plant.

Selected Publications (2001 to 2005)

Walter F. Schmidt, Susanna Bilboulian, Cathleen J. Hapeman, Laura L. McConnell, **Clifford P. Rice**, Susanna Bilboulian and James C. Fettinger. 2001. Thermodynamic, Spectroscopic, and Computational Evidence for the Irreversible Conversion of ß- to ∀-Endosulfan. *J. Agric. Food Chem*. 49(11):5372-5376.

Fries, G.F., Feil, V.J., Zaylksie, R.G., Bialek, K.M., **Rice, C.P.** 2002. Treated wood in livestock facilities: Relationships among residues of pentachlorophenol, dioxins, and furans in wood and beef. *Environmental Pollution.* Vol 116/2, pp 301-307.

Datta, S. Loyo-Rosales, J.E., **Rice, C.P.** (2002) A Simple Method for the Determination of Trace Levels of Alkylphenolic Compounds in Fish Tissue Using Pressurized Fluid Extraction, Solid Phase Clean-up and High-Performance Liquid Chromatography Fluorescence Detection. *J. Agric. and Food Chem.* 50:1350-1354.

Angier, J., McCarty, G., **Rice, C.**, Bialek, K. 2002. Influence of a Riparian Wetland on Nitrate and Herbicides Exported from an Agricultural Field. *J. Agric. and Food Chem.* 50: 4424-4429.

Rice, C., Nochetto, C., Zara, P. 2002. Volatilization of trifluralin, atrazine, metolachlor, chlorpyrifos, ∀-endosulfan and ∃-endosulfan from freshly tilled soil. *J. Agric. and Food Chem.* 50: 4009-4017.

Rice, C., Chernyak, S., Begnoche, L., Quintal, R., Hickey, J. 2002. Comparisons of PBDE Composition and Concentration in Fish collected from the Detroit River, MI and Des Plaines River, IL. *Chemosphere*. 49: 731-737.

Mazanti, L., **Rice, C.**, Bialek, K., Sparling, D., Stevenson, C., Johnson, W.E., Kangas, P., Rheinstein, J. (2003). Aqueous-Phase Disappearance of Atrazine, Metolachlor, and Chlorpyrifos inLaboratory Aquaria and Outdoor Macrocosms. *Archives of Environ. Toxicol. and Chem.* 44:67-76.

Loyo-Rosales, J.E., I. Schmitz-Afonso, **C. P. Rice**, A. Torrents (2003). Analysis of octyl- and nonylphenol and their ethoxylates in water and sediments by liquid chromatography-tandem mass spectrometry. *Anal. Chem.* 75:4811-4817.

Schmitz-Afonso, I., J. E. Loyo-Rosales, M. de la Paz Avilés, B. A. Rattner and **C. P. Rice** (2003) Determination of alkylphenol and alkylphneol ethoxylates in biota by liquid chromatography with detection by tandem mass spectrometry and fluorescence spectroscopy. *J. Chromat. A*. 1010: 25-35.

Rice, C.P., Schmitz-Afonso, I. Loyo-Rosales, J.E., Link, E., Thoma, R., Fay, L., Altfater, D., Camp, M.J. (2003). Alkylphenol and alkylphenol-ethoxylates in carp, water, and sediment from the Cuyahoga River, Ohio. *Environ. Sci. Technol.* 37:3747-3754.

Loyo-Rosales, J.E., Rosales-Rivera, G.C., Lynch, A.M., **Rice, C.P.,** Torrents, A. (2004) Migration of nonylphenol from plastic containers to water and a milk surrogate. *J. Agric. Food Chem*. 52:2016-2020.

Rattner, B.A., McGowan, P.C., Golden, N.H., Hatfield, J.S., Toschik, P.C., Lukei, R.F., Hale, R.C., Schmitz-Afonso, I., **Rice. C.P.** (2004) Contaminant Exposure and Reproductive Success of Ospreys (Pandion haliaetus) Nesting in Chesapeake Bay Regions of Concern. *Arch. Environ. Contam. Toxicol*. 47:126-140.

Angier, J., McCarty, G., **Rice, C.**, Bialek, K. (2004) Improving riparian zone function by identifying critical areas with limited mitigation capacity. *Riparian ecosystems and buffers: Muli-scale structure, function, and management- Conference Proceedings June 28-30, 2004.* Am. Water Research Assoc. Olympic Valley, CA. pp 6.

Capuco, A.V., **Rice, C.P.**, R. L. Baldwin VI, D. D. Bannerman, M. J. Paape, W. R. Hare, A. C. W. Kauf, G. W. McCarty, C. J. Hapeman, A. M. Sadeghi, J. L. Starr, L. L. McConnell, and C. P. Van Tassell. (2005) Fate of dietary perchlorate in lactating dairy cows: Relevance to animal health and levels in the milk supply. *Proc. Nat. Acad. Sci.*

Chernyak, S. M., **Rice, C.**, Quintal, R.T., Begnoche, L.J., Hickey, J.P., Vinyard, B.T. (2005) Time trends (1983-1999) for organochlorines and polybrominated diphenyl ethers in rainbow smelt (Osmerus mordax) from Lakes Michigan, Huron, and Superior, USA. *Environ. Toxicol. Chem*. 24: 1632-1641.

Rice, C.P., Park, Y.B., Adam, F., Abdul-Baki, A.A., Teasdale, J.R. (2005) Hydroxamic acid content and toxicity of rye at selected growth stages. *J. Chem. Ecol.* 31:1887-1905.

Zasada, I. A., Meyer, S. L. F., Halbrendt, J. M., and **C. Rice**. 2005. Activity of hydroxamic acids from *Secale cereale* against the plant-parasitic nematodes *Meloidogyne incognita* and *Xiphinema americanum. Phytopathology* 95:1116-1121.

Harman-Fetcho, J.A., Hapeman, C.J., McConnell, L.L., Potter, T.L., **Rice, C.P.**, Sadeghi, A.M., Smith, R.D., Bialek, K., Sefton, K.A., Shaffer, B.A., Curry, R. (2005) Pesticide occurrence in selected South Florida and Biscayne Bay during high agricultural activity. *J. Agric. Food Chem*. 53:6040-6048.

Baker, C.J., Mock, N.M., Whitaker, B.D., Roberts, D.P., **Rice, C.**, Deahl, K.L., Averyanov, A.A. 2005. Involvement of Acetosyringone in plant/pathogen recognition. *Biochemical and Biophysical Research Communications*. 328:130-136

Loyo-Rosales, J.E., Rosales-Rivera, G.C., **Rice, C.P.**, Torrents, A. (in press) Linking laboratory experiences to "The real world": The extraction of octylphenoxyacetic acid from water. *J. Chem. Educ*.

Cooperator	***Affiliation***	***Location***
Dr. Alba Torrents	Univ. of MD	College Park, MD
Dr. Bruce Whitaker	USDA-ARS	Beltsville, MD
Dr. Inga Zasada	USDA-ARS	Beltsville, MD
Dr. John Teasdale	USDA-ARS	Beltsville, MD
Dr. Barnett Rattner	USGS-BRD	Laurel, MD
Dr. Anthony Capuco	USDA-ARS	Beltsville, MD
Dr. Sergei Chernyak	Univ. of MI	Ann Arbor, MI
Dr. Douglas Bannerman	USDA-ARS	Beltsville, MD
Dr. Tony Pait	NOAA-NOS	Silver Springs, MD
Stephen Smith	USGS-NAWQA	Reston, VA

Jerry C. Ritchie - *Soil Scientist*

Education:

1960	B.A. in Biology/Education	Pfeiffer University, Misenheimer, NC
1962	M.S. in Botany/Soils	University of Tennessee, Knoxville, TN
1967	Ph.D. in Botany (Ecology)	University of Georgia, Athens, GA

Experience:

1967-1968	Post-Doctoral Fellow in Plant and Soil Sciences, USDA-ARS, Southeast Watershed Research Center and the U. Georgia, ARS Hydrologic Study Team, Tifton, GA
1968-1978	Botanist/Soil Scientist, Sedimentation Lab., USDA-ARS, Oxford, MS
1978-1983	Staff Scientist, National Program Staff, USDA-ARS, Beltsville, MD
1983-Present	Soil Scientist, Hydrology and Remote Sensing Laboratory, USDA-ARS, Beltsville, MD

Current CRIS Projects

1265-13660-009-00D: Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes

1265-13610-026-00D: Integrating Remote Sensing, Climate and Hydrology and Evaluating Water, Energy and Carbon Cycles

Accomplishments:

- Developed a technique to measure soil erosion and redeposition patterns using the redistribution patterns of radioactive fallout ^{137}Cesium. This technique is the only method available that allows soil erosion and, probably more importantly, redeposition within a field to be measured from a single site visit.
- Developed a method to measure sediment deposition rates using the distribution of radioactive fallout ^{137}Cesium in sediment profiles. This technique is used extensively to determine rates of sediment accumulation in any depositional environments (i.e., lakes, reservoirs, flood plains, estuaries).
- Demonstrated that the measurement of the quality and quantity of solar radiation reflected from water surfaces could be used to provide quantitative estimates of suspended sediments in surface water giving a synoptic view of the surface distribution of suspended sediments in water bodies across the landscape that is not possible with *in situ* techniques.
- Showed that airborne laser altimeters can provide unique measurements of the physical properties of the landscape surface roughness for measuring channel morphology, gully degradation and aggradation, canopy height, canopy cover, canopy density, canopy distribution, aerodynamic roughness, and vegetation type can be measured. These studies demonstrate that airborne laser technology can be used to measure vegetation and landscape roughness properties and patterns of large areas quickly and quantitatively.
- Showed that agricultural systems have the potential to sequester significant quantities of carbon the sediments of small agricultural reservoirs and riparian systems. Recent research has shown a significant redistribution of soil carbon within agricultural fields; however, much of this redistribution remains in the same field showing the potential for carbon sequestration within agricultural

fields.

- Showed that hedges of stiff grasses planted on elevation contours could effectively reduce soil loss from areas of concentrated flow erosion by keeping the soil in the field. Research with eastern gamagrass showed that this native, perennial, warm-season bunch grass is good for hedges, grows well in soil with marginal agricultural value, and has good forage quality.

Selected Publications (2001 to 2005)

Ritchie, J.C. Cesium-137 for measuring soil erosion and redeposition: Application for understanding soil carbon, pp. 403-415. In: Lal, R., Kimble, J.M., Follett, R.F. and Stewart, B.A. (Eds.), Assessment Methods for Soil Carbon, Lewis Publishers, Boca Raton, FL, 2001.

Ritchie, J.C., Seyfried, M.S., Chopping, M.J. and Pachepsky, Y. Airborne laser technology for measuring rangeland conditions. Journal of Range Management 54(2):8-21, 2001.

Ritchie, J.C. and Cooper, C.M. Remote sensing techniques for determining water quality: Application to TMDLs, pp. 367-374. In: TMDL Science Issues Conference, Water Environment Federation, Alexandria, VA, 2001.

Ritchie, J.C. Comparing erosion and redeposition rates and patterns upslope of a grass hedge determined using ^{137}Cesium and field survey techniques, p. 1039-1043. In: Stott, D.E., Mohtar, R.H. and Steinhardt, G.C. (Eds.), Sustaining the Global Farm, Selected papers from the 10th International Soil Conservation Organization Meeting, International Soil Conservation Organization, West Lafayette, Indiana USA. 2001.

Schmugge, T., French, A., **Ritchie, J.C.**, Rango, A. and Pelgrum, H. Temperature and emissivity separation from multispectral thermal infrared observations. Remote Sensing of Environment 79(1/2):189-198, 2002.

Van Pelt, R.S., Zobeck, T.M., **Ritchie, J.C.** and Gill, T.E. Partitioning of ^{137}Cesium (^{137}Cs) in wind eroded sediments: Implications for estimating soil loss. Proceedings of the 17th World Congress of Soil Science 59(835):1-10, 2002.

Schmugge, T.J., Kustas, W.P., **Ritchie, J.C.**, Jackson, T.J. and Rango, A. Remote sensing in hydrology. Advances in Water Resources 25:1367-1385, 2002.

Krizek, D.T., **Ritchie, J.C.**, Sadeghi, A.M., Foy, C.D., Rhoden, E.G., Davis, J.R. and Camp, M.J. A four-year study of yields of eastern gamagrass grown on an acid, compact soil. Communications in Soil Science and Plant Analysis 34(3/4):457-480, 2003.

Ritchie, J.C. and McCarty, G.W. Using ^{137}Cesium to understand soil carbon redistribution on agricultural watersheds. Soil and Tillage Research 69(1-2):45-51, 2003.

De Vries, A.C., Kustas, W.P., **Ritchie, J.C.**, Klaassen, W., Menenti, M., Rango, A. and Prueger, J.H. Effective aerodynamic roughness estimated from airborne laser altimeter

measurements of surface features. International Journal of Remote Sensing 24(7):1545-1558, 2003.

Hunt, Jr., E.R., Everitt, J.H., **Ritchie, J.C.**, Moran, M.S., Booth, D.T. and Anderson, G.L. Applications and research using remote sensing for rangeland management. Photogrammetric Engineering and Remote Sensing 69(6):675-693, 2003.

Ritchie, J.C., Zimba, P.V. and Everitt, J.H. Remote sensing techniques to assess water quality. Photogrammetric Engineering and Remote Sensing 69(6):695-704, 2003.

Ritchie, J.C., Herrick, J.E. and Ritchie, C.A. Measuring in semiarid grass and shrub communities using ^{137}Cesium. In: Servat, E., Najem, W., Leduc, C. and Shakeel, A. (Eds.), Hydrology of Mediterranean and Semiarid Regions. IAHS Publication no. 278: 4 pp. (Montpellier 2003-CD Rom), 2003.

Ritchie, J.C., Herrick, J.E. and Ritchie, C.A. Variability in soil redistribution in the northern Chihuahuan desert based on ^{137}Cesium measurements. Journal of Arid Environments 55(4):737-746, 2003.

Ritchie, J.C., Finney, V.L., Oster, K.J. and Ritchie, C.A. Sediment deposition in the flood plain of Stemple Creek watershed, northern California. Geomorphology 61: 347-360, 2004.

Ritchie, J.C., Gitz III, D.C., Krizek, D.T. and Reddy, V.R. Temperature and CO_2 effects on eastern gamagrass: Growth and yield, pp. 211-217. In: Randle, J. and Burns, J.C. (Eds.), Proceeding of the 3nd Eastern Native Grass Symposium, Chapel Hill, NC, Oct. 1-3, 2002, Omnipress, Madison WI, 2004.

Ritchie, J.C., Nearing, M., Nichols, M. and Ritchie, C.A. Patterns of soil movement on Lucky Hills Watershed, Walnut Gulch Arizona. Catena 61(2-3):122-130, 2005.

Ritchie, J.C. and Zimba, P.V. Hydrological application of remote sensing water quality: Suspended sediment and algae, pp. 939-949. In: Anderson, M.G., Encyclopedia of Hydrological Sciences, John Wiley and Sons, London, UK., 2005.

Schumacher, J.A., Kaspar, T.C., **Ritchie, J.C.**, Schumacher, T.E., Karlen, D.L., Venteris, E.R., McCarty, G.M., Colvin, T.S., Jaynes, D.B., Lindstrom, M.J., and Fenton, T.E. Identifying spatial patterns of erosion for use in precision conservation. Journal of Soil and Water Conservation 60(6):355-361, 2005.

Cooperator	***Affiliation***	***Location***
Dr. Mark Nearing	ARS SWWRC	Tucson, AZ
Dr. Allen Gellis	USGS	Baltimore, MD
Dr. Albert Rango	ARS Jornada Expt. Range	Las Cruces, NM
Dr. Thomas Schmugge	New Mexico State University	Las Cruces, NM
Dr. Paul Pedone	NRCS	Portland, OR
Dr. Vern Finney	NRCS	Sacramento, CA

Ali Sadeghi – Soil Scientist

Education:

1984 University of Arkansas; Soil Physics; Ph.D.
1979 University of Arkansas; Agricultural Engineering, Soil & Water; M.S.
1972 Pahlavi University (Iran); Agricultural Engineering; Irrigation & Drainage; B.S.

Experience:

1985 - 1987	Research Associate, Kansas State University, Manhattan, KS
1988 - 1993	Soil Scientist, USDA-ARS, Pesticide Degradation Laboratory, Beltsville, MD
1994 - 1998	Soil Scientist, USDA-ARS, Environmental Chemistry Laboratory, Beltsville, MD
1998 – 2005	Soil Scientist, USDA-ARS, Environmental Quality Laboratory, Beltsville, MD
2005 – present	Soil Scientist, USDA-ARS, Hydrology and Remote Sensing Laboratory, Beltsville, MD

Current CRIS Projects:

1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools
1265-12630-003-00D: Fate and Transport of Manure-Borne Pathogenic Microorganisms

Accomplishments:

- The Soil & Water Assessment Tool (SWAT), a watershed model was modified to include a pathogen component. The model originally contained nutrients and sediment processes, but did not have a pathogen component. The new SWAT/Pathogen Sub-Model is the first watershed model that can be used by regulatory agencies, as a new management tool, to evaluate risks associated with excess nutrients, sediment, and pathogens at watershed scale, simultaneously.

- Performed validation and testing of Pesticide RootZone Model (PRZM), used by USEPA for pesticide registration purposes, using observation from large scale field studies. Results demonstrated that the model does not account for the preferential transport of herbicides in soil, especially under conservation practices, and consequently underestimates the movement of herbicides into the lower soil profile. Findings from this work provided fundamental advances concerning the importance of preferential flow and the role of management practices on herbicide loss in crop production systems.

- Design and implementation of a series of laboratory and field studies have contributed to a better understanding and modeling of agricultural pollutants in runoff and erosion processes under different management practices. Results from the specially designed laboratory and large-scale pesticide runoff studies have allowed USEPA to set standards and to make more realistic time-zero estimation values for herbicide application in environmental fate models which influences the overall decision-making process for pesticide registration.

- Developed innovative experimental and modeling methodologies that allowed rapid estimation of nitrate fate and transport parameters that are the necessary input components of nitrogen fate models. This involved a specially designed *in-situ* field-chamber in conjunction with HYDRUS-2D computer model that allowed accurate estimates of nitrate fate and transformation as well as the rates/extent of N mineralization and denitrification within wetland/riparian zone systems.

Selected Publications (2001 to 2005)

Sadeghi, A.M., A.R. Isensee. Impact of hairy vetch cover crop on herbicide transport under field and laboratory conditions. Chemosphere. 44:109-118. 2001.

Rice, P.J., L.L. McConnell, L.P. Heighton, **A.M. Sadeghi**, A.R. Isensee, J.R. Teasdale, A. Abdel-Baki, J.A. Harman-Fetcho, C.J. Hapeman. Runoff loss pf pesticides and soil: a comparison between vegetative mulch and plastic mulch in vegetable production systems. J. of Environ. Quality. 30:1808-1821. 2001.

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Graff, C.D., **A.M. Sadeghi**, R.R. Lowrance, R.G. Williams. Quantifying the sensitivity of the riparian ecosystem management model (REMM) to changes in climate and buffer characteristics common to conservation practices. Transactions of the ASAE, vol. 48(4): 1377-1387. 2005.

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Cooperator	***Affiliation***	***Location***
Linda Abbott	USDA-Office of Risk Assessment	Washington, DC
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David Bosch	USDA-ARS	Tifton, GA
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Cathleen Hapeman	USDA-ARS	Beltsville, MD
Tom Jordan	Horn Point Laboratory	Cambridge, MD
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James L Starr - Soil Scientist

Education:

1961 Michigan State University; Agricultural Education; B.S.
1966 Eastern Baptist Theological Seminary; M.A
1970 Michigan State University; Soil Fertility; M.S
1973 University of California, Davis; Soil Physics; Ph.D

Experience:

1972-1974 Research Associate, University of California, Davis, CA
1974-1978 Assistant/Associate Scientist, Connecticut Agriculture Experiment Station, New Haven, CT
1979-1999 Soil Scientist, USDA, ARS, Soil and Environmental Chemistry Laboratory, Beltsville, MD
1999-2005 Soil Scientist, USDA, ARS, Environmental Quality Laboratory, Beltsville, MD
2005-present Soil Scientist, USDA, ARS, Hydrology Remote Sensing Laboratory, Beltsville, MD

Current CRIS Projects

1265-12130-001-00D: Fate & Transport of Nutrients in Agricultural Systems as Affected By Soil & Nutrients Management Chemical Fluxes
1265-13610-019-00D: Evaluating Water Quality Processes for Development of Risk Assessment and Decision Support Tools Detrimental Chemical Fluxes

Accomplishments:

- Discovered large seasonal changes in infiltration and co-developed a systematic basis for choosing the best infiltration model to characterize infiltration parameters. This research showed that seasonal changes in water infiltration into soil are directly affected by soil management practices and directly impact water availability to crops and movement of nutrients to groundwater. The model comparison work is now being used by scientists to design infiltration experiments and choose the most appropriate model(s) to characterize the experimental results.
- Developed the means to measure in situ denitrification rates and nitrate transport in riparian shallow groundwater. This data was then used to characterize lateral transport components needed to quantitatively assess the fate and transport of nutrients and the functionality of riparian/wetland systems. The knowledge and techniques developed provide valuable tools to scientist for assessing the efficacy of old and newly established riparian buffer zones.
- Provided the first peer-reviewed research using newly developed technology for near-continuous soil water measurement over large areas. This research has not only led to greater understanding of the relationship between soil and crop management systems water and infiltration, water retention, and crop water use, but has provided impetus for a wide range of scientific studies.
- Demonstrated that near-continuous and real-time soil water content measurements can provide crucial information to efficiently manage water and nutrients in cropping systems while minimizing groundwater contamination. Impact: These

research findings on temporal and spatial real-time soil water dynamics are being used by industry, government agencies, and scientists to improve irrigation management practices under humid and intermittent rainfall conditions. This on-going research is providing important information as to the impact of irrigation management practices in relation to Chesapeake Bay restoration, and the database needed to develop new irrigation guidelines suited specifically to the mid-Atlantic region.

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Cooperator	***Affiliation***	***Location***
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Dr. Dennis Timlin	USDA-ARS	Beltsville, MD

Charles L. Walthall - Physical Scientist

Education:

1988 University of Nebraska, Agricultural Meteorology & Climatology; PhD
1982 Texas A&M University, Forest Science; MS
1977 University of Maryland, Geography; BS

Experience:

1977-1979 Systems Analyst, Computer Sciences Corporation, NASA, Greenbelt, MD
1978-1981 Graduate Research Assistant, Remote Sensing Center, Texas A&M University, College Station, TX
1981-1983 Graduate Research Assistant, Remote Sensing Center, University of Nebraska, Lincoln, NE
1983-1986 NASA Graduate Research Fellow, Center for Agricultural Meteorology and Climatology, University of Nebraska, Lincoln, NE
1987-1988 Assistant Research Scholar, Dept. Geography, University of Maryland, College Park, MD and Research Associate, NASA, Greenbelt, MD
1988-1992 Associate Research Scholar, Dept. Geography, University of Maryland, College Park, MD and Research Associate, NASA, GSFC, Greenbelt, MD
1992-1994 Associate Research Scientist, Dept. Geography, University of Maryland, College Park, MD and Research Associate, NASA, GSFC, Greenbelt, MD
1994-present Physical Scientist, Hydrology & Remote Sensing Lab, Beltsville, MD (Previously with Remote Sensing & Modeling Lab, Remote Sensing Lab)

Current CRIS Projects:

1265-12660-005-00D: Spectral and Spatial Measurements and Modeling to Improve Nutrient Management and Environmental Quality
1265-13660-009-00D: Quantifying Environmental Hydrology to Mitigate Detrimental Chemical Fluxes

Accomplishments:

- A foliage density mapping method using image spectral and spatial information was developed; LAI mapping was shown to improve with decreasing spatial resolution (from 1 m to 8 m). Reasonable maps of foliage density were shown to be possible from imagery without ground-based calibration measurements.
- Inference of soil characteristics from vegetation patterns was demonstrated by modeling foliage density with soil water holding capacity, limited crop and soil information, and weather data. An artificial neural network worked with publicly available data, whereas a plant growth model required research-grade data. Vegetation patterns captured with imagery from multiple years, and especially drought years, were shown to contain soil hydrology information.
- High spatial resolution image texture was found to contain information on plant species and plant canopy architecture, thus offering a new approach to image analysis for agriculture. Spatial resolution and information content were modeled.
- Leaf reflectance showed greater variance than canopy reflectance for visible wavelengths. The unique blue-green appearance of marijuana plants was explained by a combination of diffuse, internal green reflectance from chlorophyll, and specular reflectance of blue skylight from leaf surface structures.

- A small, calibrated, airborne hyperspectral imager for acquiring imagery suitable for agricultural applications was developed with NASA and Finnish engineers, and a US commercial firm. A web site for novice airborne remote sensing imagery providers and imagery users was developed (http://hydrolab.arsusda.gov/rsbasics/).

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applications. Photogrammetric Engineering and Remote Sensing, 69(6): 705-718, 2003.

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Walthall, C.L., Y. Pachepsky, W.P. Dulaney, D.J. Timlin and C.S.T. Daughtry. Using spatial variance information from remotely sensed imagery to map crop foliage density. Proc. Third International Conference on Geospatial Information in Agriculture and Forestry, Denver, CO. CDROM, 2001.

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Walthall, C.L. and C.S.T. Daughtry. Detecting marijuana using optical wavelength remote sensing. Proc. 2001 ONDCP International Technology Symposium. June 25-28, San Diego, CA. pp. 648-656, 2001.

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Dr. Dennis Timlin	USDA-ARS	Beltsville, MD
Dr. Vern Vanderbilt	NASA	Moffett Field, CA

COMMONLY USED ACRONYMS
OF
USDA, REE, AND ARS

AA	Associate Administrator
AAD	Associate Area Director
AAO	Area Administrative Officer
ABFO	Area Budget and Fiscal Officer
AC	Administrator's Council
AC	Accounting Code
ACS	Area Computer Specialist
AD	Area Director
ADA	Associate Deputy Administrator
ADAAM	Associate Deputy Administrator, Administrative Management
ADO	Authorized Departmental Officer
ADP	Automated Data Processing
ADODR	Authorized Departmental Officer's Designated Representative
A-E	Architect - Engineer
AES	Agricultural Experiment Station
AFM	Administrative and Financial Management
AGPMR	Agriculture Property Management Regulation
AHERA	Asbestos Hazard Emergency Response Act
AL	Annual Leave
ALOC	Acceptable Level of Competence
AM	Administrative Management
AO	Administrative Officer
AOD	Administrative Operations Division
APHIS	Animal and Plant Health Inspection Service
APMO	Area Property Management Officer
APO	Accountable Property Officer
ARD	Automatic Release Date
ARMP	Annual Resource Management Plan
ARMPS	Annual Resource Management Planning System
ARMS	ARS Resource Management System
ARS	Agricultural Research Service
ARS-CMU	ARS Correspondence Management Unit
ARS-LS	ARS Legislative Staff
ARS-OA	ARS Office of Administrator
ARSITS	Agricultural Research Service Invention Tracking System
ASB	Accounting Services Branch
ASHM	Area Safety and Health Manager
ATR	Agriculture Travel Regulations
AUO	Area Utilization Officer
AWOL	Absent Without Leave
BA	Beltsville Area
BARC	Beltsville Agricultural Research Center

BCA	Board of Contract Appeals
B&F	Budget and Fiscal
BFSB	Budget and Fiscal Services Branch, FMD
BLM	Bureau of Land Management
BOC	Budget Object Class
BPMS	Budget & Program Management Staff
BRM	Business Reply Mail
BSO	Biological Safety Officer
CAA	Clean Air Act
CAD	Contracting and Assistance Division
CD	Center Director
CDL	Commercial Drivers License
CDSD	Communications and Data Services Division
CDSO	Collateral Duty Safety Officer
CEP	Career Enhancement Program
CEPS	Cluster Environmental Protection Specialist
CERCLA Act	Comprehensive Environmental Response, Compensation, and Liability
CFC	Combined Federal Campaign
CFPDC	Consolidated Forms and Publications Distribution Center
CFR	Code of Federal Regulations
CG	Comptroller General
CMCO	Classified Material Control Officer
COLA	Cost of Living Allowance
CONUS	Continental United States
COP	Continuation of Pay
COR	Contracting Officer's Representative
CR	Civil Rights
CRAS	CRIS Resource Allocation Schedule
CRIS	Current Research Information System
CS	Contract Specialist
CSRA	Civil Service Reform Act
CSREES	Cooperative State Research, Education and Extension Service
CSRS	Civil Service Retirement System
CWA	Clean Water Act
DA	Deputy Administrator
DAAM	Deputy Administrator, Administrative Management
DAEA	Designated Area Ethics Advisor
DDES	Demonstration and Delegated Examining Section, NSB, PD
DEMO	USDA Demonstration Project
DEPPC	Departmental Excess Personal Property Coordinator
DEU	Delegated Examining Unit
DLA	Defense Logistics Agency, Department of Defense
DM	Department Manual
DMM	Domestic Mail Manual
DOD	Department of Defense
DOJ	Department of Justice
DPM	Department Personnel Manual

DR	Department Regulation
EAD	Extramural Agreements Division
EAP	Employee Assistance Program
EAS	Employee Appeals Staff
EC&R	Executive Correspondence and Records Unit, Office of Operations
EEO	Equal Employment Opportunity
EEOC	Equal Employment Opportunity Counselor
EEOO	Equal Employment Opportunity Officer
EO	Executive Order
EOD	Enter on Duty
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERC	Equipment Review Committee
ERRC	Eastern Regional Research Center
ERS	Economic Research Service
ESB	Extramural Services Branch, Contracting and Assistance Division
FAA	Foreign Agricultural Affairs, FAS
FAO	Food and Agricultural Organization
FARC	Federal Archives and Records Center
FAS	Foreign Agricultural Service
FBI	Federal Bureau of Investigation
FCMD	Facilities Construction Management Division
FD	Facilities Division
FDC	Financial Data Code
FECA	Federal Employees Compensation Act
FEHB	Federal Employees Health Benefits
FEORP	Federal Equal Opportunity Recruitment Program
FEPA	Federal Employee Pay Act
FEPCA	Federal Employees Pay Comparability Act of 1990
FERS	Federal Employees Retirement System
FES	Factor Evaluation System
FLSA	Fair Labor Standards Act
FMD	Financial Management Division
FOIA	Freedom of Information Act
FOMC	Facilities Operation Maintenance Contract
FPL	Full Performance Level
FPM	Federal Personnel Manual
FPMR	Federal Property Management Regulations
FPR	Federal Procurement Regulations
FPRS	Federal Property Resource Services, GSA
FR	Federal Register
FRC	Federal Records Center
FSC	Federal Supply Classification
FSS	Federal Supply Schedule
FT	Full Time Tour of Duty
FTCA	Federal Tort Claims Act
FTD	Federal Travel Directory
FTE	Full Time Equivalent

FTIS	Foreign Travel Information System
FTR	Federal Travel Regulations
FTS	Federal Telecommunications System
FTTA	Federal Technology Transfer Act
FTU	Foreign Travel Unit, FAS
FWS	Federal Wage System
FY	Fiscal Year
GAMS	Grants and Agreements Management Staff, CAD
GAO	General Accounting Office
GM	GS Employees in the Performance Management and Recognition System
GNA	Guide Not Applicable (decision)
GOV	Government Owned Vehicle
GPO	Government Printing Office
GTR	Government Transportation Request
GS	General Schedule
GSA	General Services Administration
GSD	General Services Division
HPRL	High Priority Requirement List
HQS	Headquarters
HRD	Human Resources Division, AFM
HWC	Hazardous Waste Cleanup
IDO	Informal Deciding Official
IDP	Individual Development Plan
IDR	Indepth Review or Reviewer
IFB	Insufficient Factual Basis (decision)
IH	Industrial Hygiene/Hygienist
IPSC	Indirect Program Support Cost
IR	Invention Report
IRS	Internal Revenue Service
IS	Information Staff
ISTD	Information Systems and Technology Division
ITP	Individual Training Plan
KSA	Knowledge, Skill and Ability
L/A	Letter of Authorization
LAO/LAT	Location Administrative Officer/Technician
LASER	Lincoln Advanced Science Engineering Reinforcement Program
LC	Location Coordinator
LD	Laboratory Director
LL	Location Leader
LERB	Labor Employee Relations Branch
LOC	Locations
LOTS	Location Obligation Tracking System
LS	Lead Scientist
LWOP	Leave Without Pay
M&IE	Meals and Incidental Expenses
MM	Mail Manager
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding

MRMD	Mail and Reproduction Management Division, Office of Operations
MSA	Mid South Area
MSPB	Merit Systems Protection Board
MU	Management Unit
MWA	Midwest Area
NAA	North Atlantic Area
NADC	National Animal Disease Center
NAL	National Agricultural Library
NARA	National Archives and Records Administration
NARS	National Archives and Records Service
NASS	National Agricultural Statistics Service
NCAUR	National Center for Agricultural Utilization Research
NEPA	National Environmental Policy Act
NFC	National Finance Center
NPA	Northern Plains Area
NPL	National Program Leader
NPS	National Program Staff
NRRC	Northern Regional Research Center
NSB	National Services Branch, PD
NTTC	National Technology Transfer Coordinator
NTE	Not to Exceed
NTIS	National Technology Information Service
OA	Office of the Administrator
OBPA	Office of Budget and Program Analysis, USDA
OCI	Office of Cooperative Interactions
ODS	Official Duty Station
O&F	Office of Operations and Finance
OGC	Office of General Counsel
OGE	Office of Government Ethics
OHMP	Occupational Health Maintenance Program
OICD	Office of International Cooperation and Development
OIG	Office of Inspector General
OMB	Office of Management and Budget
OO	Office of Operations
OP	Office of Personnel
OPF	Official Personnel Folder
OPM	U.S. Office of Personnel Management
OSEC	Office of Secretary
OSC	Office of Special Counsel
OSHA	Occupational Safety and Health Act/Administration
OSQR	Office of Scientific Quality Review
OTT	Office of Technology Transfer
OWCP	Office of Worker's Compensation
PA	Privacy Act
PA	Patent Advisor
PA	Program Analyst
PAA	Program Analyst Assistant
PAIS	Property Accounting Information System

PAO	Procurement Assistance Officer
PB	Publications Branch
PCB	Polychlorinated Biphenyls
PCMI	President's Council on Management Improvement
PCS	Permanent Change of Station
PC-TARE	Personnel Computer-Time and Attendance Remote Entry
PD	Personnel Division
pd	Position Description
PDS	Permanent Duty Station
PFT	Permanent Full Time
PIADC	Plum Island Animal Disease Center
PIP	Performance Improvement Plan
PL	Public Law
PM	Program Management
PMAR	Precious Metals Recovery Representative, Defense Logistics Agency, DOD
PMB	Property Management Branch
PMO	Property Management Officer
PMRS	Performance Management Recognition System
POB	Personnel Operations Branch, PD
POD	Post of Duty
POV	Privately Owned Vehicle
P&P	Policies and Procedures
PPPM	Payroll/Personnel Processing Manual
PPMS	Personal Property Management Section
PPSB	Personnel Policy and Systems Branch, PD
PRB	Performance Review Board
PRC	People's Republic of China
PSP	Position Staffing Plan
PT	Part Time Tour of Duty
PTO	Patent and Trademark Office
PVPA	Plant Variety Protection Act
PVPC	Plant Variety Protection Certificate
PWA	Pacific West Area
RA	Research Associate
RAP	Research Apprenticeship Program
RCRA	Resource Conservation and Recovery Act
REE	Research, Education and Economics
RG	Records Group
RGEG	Research Grade Evaluation Guide
RIF	Reduction in Force
RL	Research Leader
R&M	Repair & Maintenance
RMIS	Research Management Information System
RMO	Records Management Officer
RPEC	Research Personnel Evaluation Committee
RPES	Research Position Evaluation System
RSA	Research Support Agreement

RS#4	Reporting Section #4
RSS	Radiological Safety Staff
SAA	South Atlantic Area
SARA	Superfund Amendments and Reauthorization Act
SBG	Scored Below Grade
SES	Senior Executive Service
SEU	Special Examining Unit
SF	Standard Form
SGEG	Supervisory Grade-Evaluation Guide
SHEM	Safety, Health, and Environmental Management
SHEMB	Safety, Health, and Environmental Management Branch
SL	Senior Level
SL	Sick Leave
SOW	Statement of Work
SPA	Southern Plains Area
SPO	Servicing Personnel Office
SPS	Servicing Personnel Specialist
SR	Standard Regulations
SRRC	Southern Regional Research Center
ST	Scientific and Professional Pay Plan
SY	Scientist Year (Category 1 or 4 positions)
T&A	Time and Attendance
TAC	HQ and/or Area Time and Attendance Coordinator
TASSB	Technology Assessment and Support Services Branch
TC	Transaction Code (NFC T&A designation)
TCR	Tort Claims Representative
TDY	Temporary Duty
TEKTRAN	Technology Transfer Automated Retrieval System
TEP	Technical Evaluation Panel
TFT	Temporary Full Time
TMC	Travel Management Center
TPS	Target Percent in Salaries
TRAI	Training Information System
TSCA	Toxic Substance Control Act
TSP	Thrift Savings Plan
TT	Technology Transfer
TY	Travel Year
UPS	United Parcel Service
U.S.C.	United States Code
USDA	United States Department of Agriculture
USPS	United States Postal Service
USSR	Union of Soviet Socialist Republics
VRA	Veterans Readjustment Act
WG	Wage Grade
WGI	Within-Grade Increase
WNRC	Washington National Records Center
WOPFP	Without Postage and Fees Paid
WPFP	With Postage and Fees Paid

WRRC	Western Regional Research Center
YW	Pay Plan for Stay-in-School Students

ABBREVIATIONS OF USDA AGENCIES

Agency Abbreviation	Agency
ACS	Agricultural Cooperative Service
AMS	Agricultural Marketing Service
APHIS	Animal and Plant Health Inspection Service
ARS	Agricultural Research Service
ASCS	Agricultural Stabilization and Conservation Service
BA	Beltsville Area, Agricultural Research Service
BCA	Board of Contract Appeals
CCC	Commodity Credit Corporation
CSREES	Cooperative State Research, Education, and Extension Service
EAS	Economic Analysis Staff
EMS	Economics Management Staff
ERS	Economic Research Service
ES	Extension Service
FAO	Food and Agricultural Organization
FAS	Foreign Agricultural Service
FmHA	Farmers Home Administration
FCIC	Federal Crop Insurance Corporation
FGIS	Federal Grain Inspection Service
FNS	Food and Nutrition Service
FS	Forest Service
FSIS	Food Safety and Inspection Service
GAO	General Accounting Office
GIPSA	Grain Inspection and Packers and Stockyards Administration
GS	Graduate School (USDA)
HNIS	Human Nutrition Information Service
JO	Judicial Officer
NAL	National Agricultural Library
NARDAC	National Regional Data Automation Center
NASS	National Agricultural Statistics Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
OAE	Office of Advocacy and Enterprise
OALJ	Office of Administrative Law Judges
OBPA	Office of Budget and Program Analysis
OCA	Office of the Consumer Advisor
OCE	Office of Chief Economist
OE	Office of Energy
OFM	Office of Finance and Management
OGC	Office of the General Counsel
OHR	Office of Human Resources
OICD	Office of International Cooperation and Development
OIG	Office of the Inspector General

OIRM	Office of Information Resources Management
OO	Office of Operations
OP	Office of Personnel
OPA	Office of Public Affairs
OT	Office of Transportation
PSA	Packers and Stockyards Administration
REA	Rural Electrification Administration
RTB	Rural Telephone Bank
SCS	Soil Conservation Service
SEC	Office of the Secretary
WAOB	World Agricultural Outlook Board

DEFINITION OF RPES

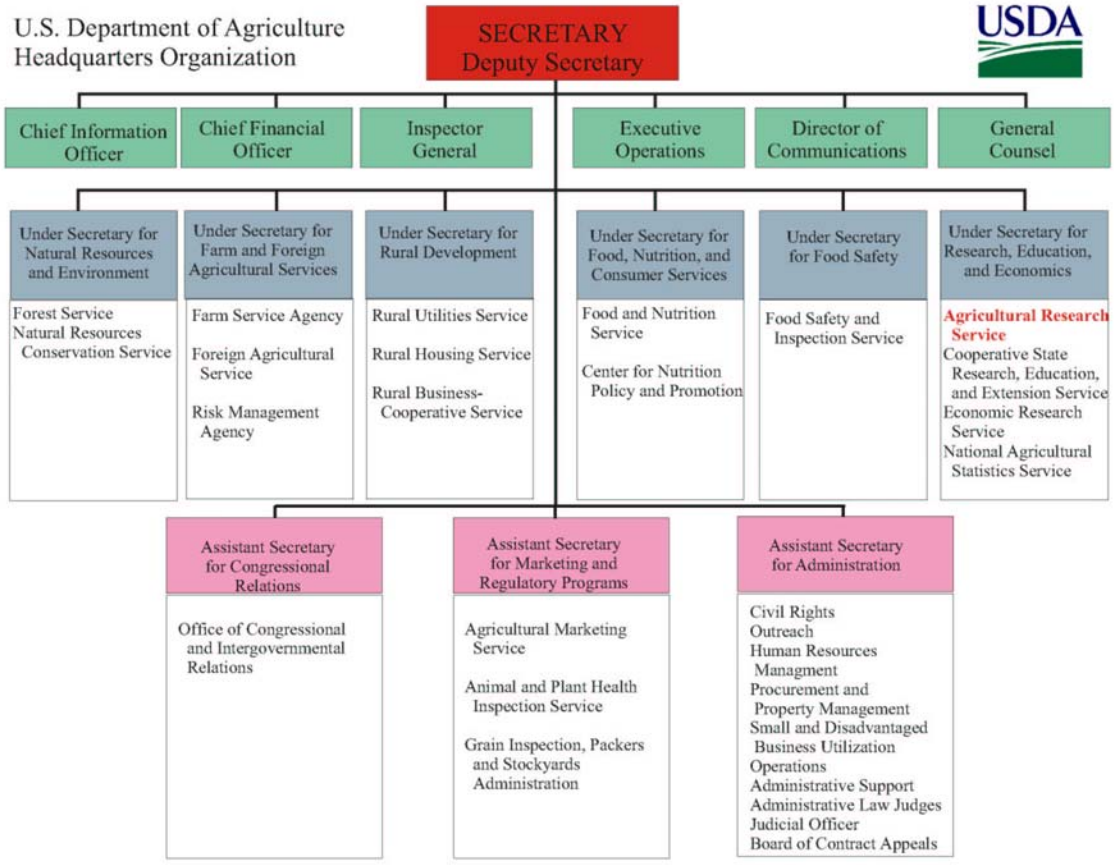
The Research Position Evaluation System (RPES) provides for review of ARS Category 1 positions on a cyclical basis to assure classification accuracy.

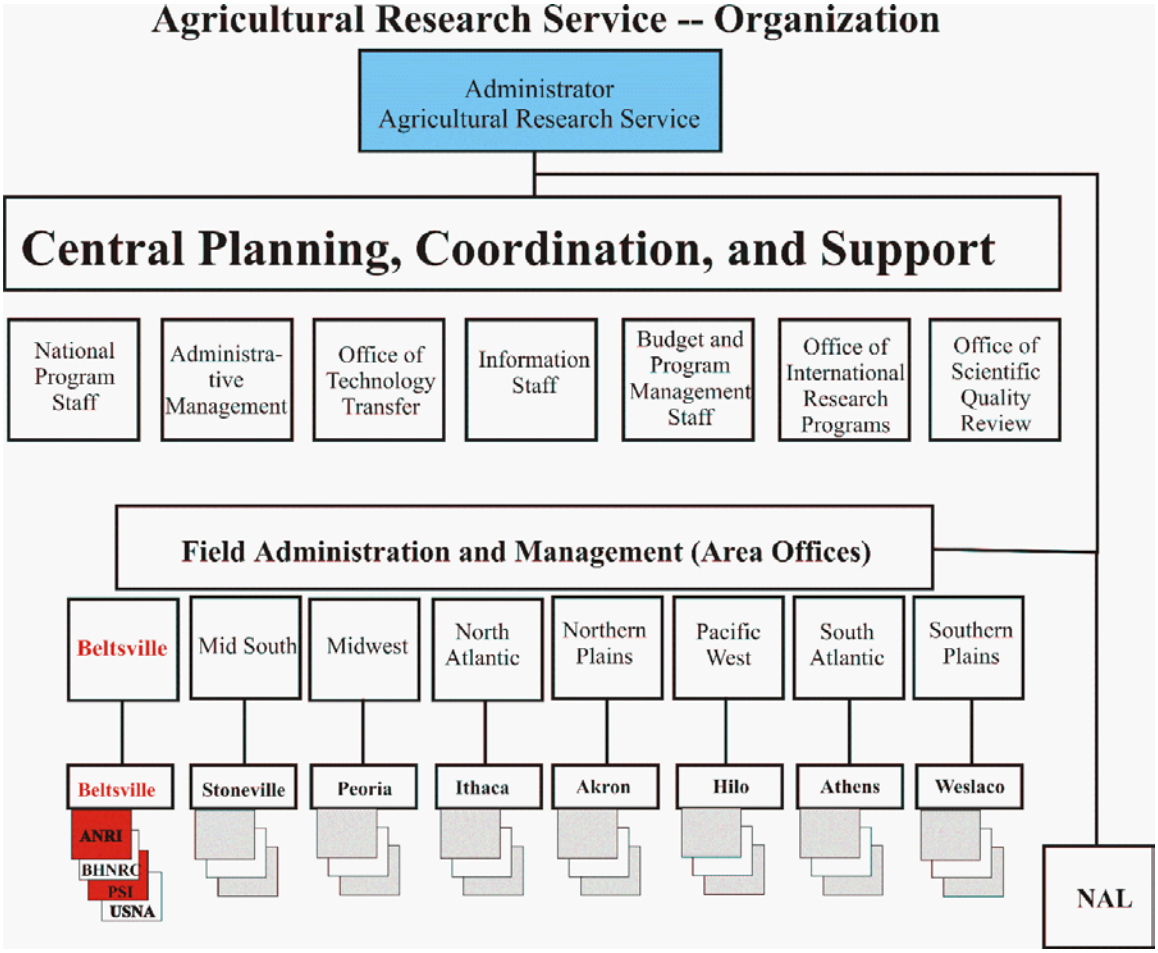
The RPES is based on the "person-in-the-job" concept. Under this concept, research scientists have open-ended promotion potential based on their personal research and leadership accomplishments, which can change the complexity and responsibility of their positions.

The RPES applies **only** to ARS Category 1 research positions. Other professional scientific positions are evaluated by application of appropriate U.S. Office of Personnel Management (OPM) classification standards.

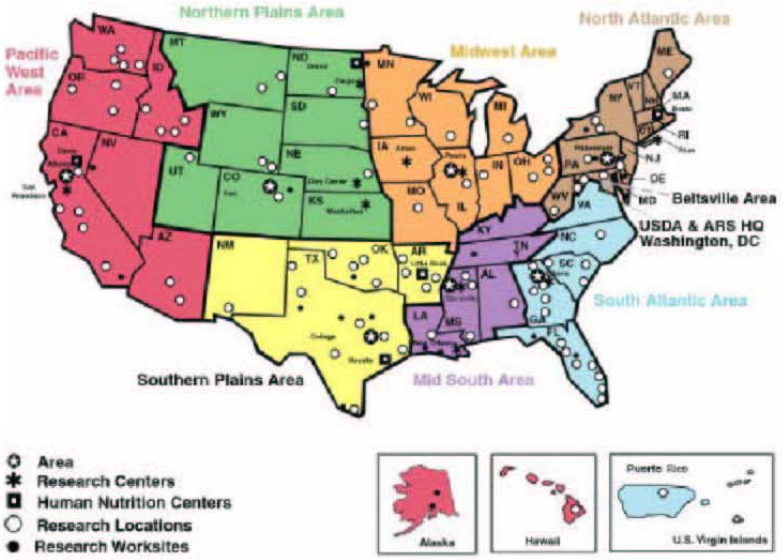
DEFINITION OF OSQR

The Peer Review process conducted by the OSQR involves independent and expert scientific peer review of ARS project plans. This is a critical component of research planning. In this way, OSQR contributes to the National Programs focus on quality of ARS research.


U.S. Department of Agriculture
Headquarters Organization
SECRETARY
Deputy Secretary
USDA
Chief Information Officer
Chief Financial Officer
Inspector General
Executive Operations
Director of Communications
General Counsel
Under Secretary for Natural Resources and Environment
Forest Service
Natural Resources Conservation Service
Under Secretary for Farm and Foreign Agricultural Services
Farm Service Agency
Foreign Agricultural Service
Risk Management Agency
Under Secretary for Rural Development
Rural Utilities Service
Rural Housing Service
Rural Business-Cooperative Service
Under Secretary for Food, Nutrition, and Consumer Services
Food and Nutrition Service
Center for Nutrition Policy and Promotion
Under Secretary for Food Safety
Food Safety and Inspection Service
Under Secretary for Research, Education, and Economics
Agricultural Research Service
Cooperative State Research, Education, and Extension Service
Economic Research Service
National Agricultural Statistics Service
Assistant Secretary for Congressional Relations
Office of Congressional and Intergovernmental Relations
Assistant Secretary for Marketing and Regulatory Programs
Agricultural Marketing Service
Animal and Plant Health Inspection Service
Grain Inspection, Packers and Stockyards Administration
Assistant Secretary for Administration
Civil Rights
Outreach
Human Resources Managment
Procurement and Property Management
Small and Disadvantaged Business Utilization
Operations
Administrative Support
Administrative Law Judges
Judicial Officer
Board of Contract Appeals


Agricultural Research Service -- Organization
Administrator
Agricultural Research Service
Central Planning, Coordination, and Support
National Program Staff
Administra-tive Management
Office of Technology Transfer
Information Staff
Budget and Program Management Staff
Office of International Research Programs
Office of Scientific Quality Review
Field Administration and Management (Area Offices)
Beltsville
Mid South
Midwest
North Atlantic
Northern Plains
Pacific West
South Atlantic
Southern Plains
Beltsville
Stoneville
Peoria
Ithaca
Akron
Hilo
Athens
Weslaco
ANRI
BHNRC
PSI
USNA
NAL

ARS Research Locations



- **Beltsville Area**

  Beltsville, MD & Washington, DC
- **Mid South Area**

  Alabama, Kentucky, Mississippi, Louisiana, Tennessee
- **Midwest Area**

  Iowa, Illinois, Indiana, Michigan, Minnesota, Missouri, Ohio, Wisconsin
- **North Atlantic Area**

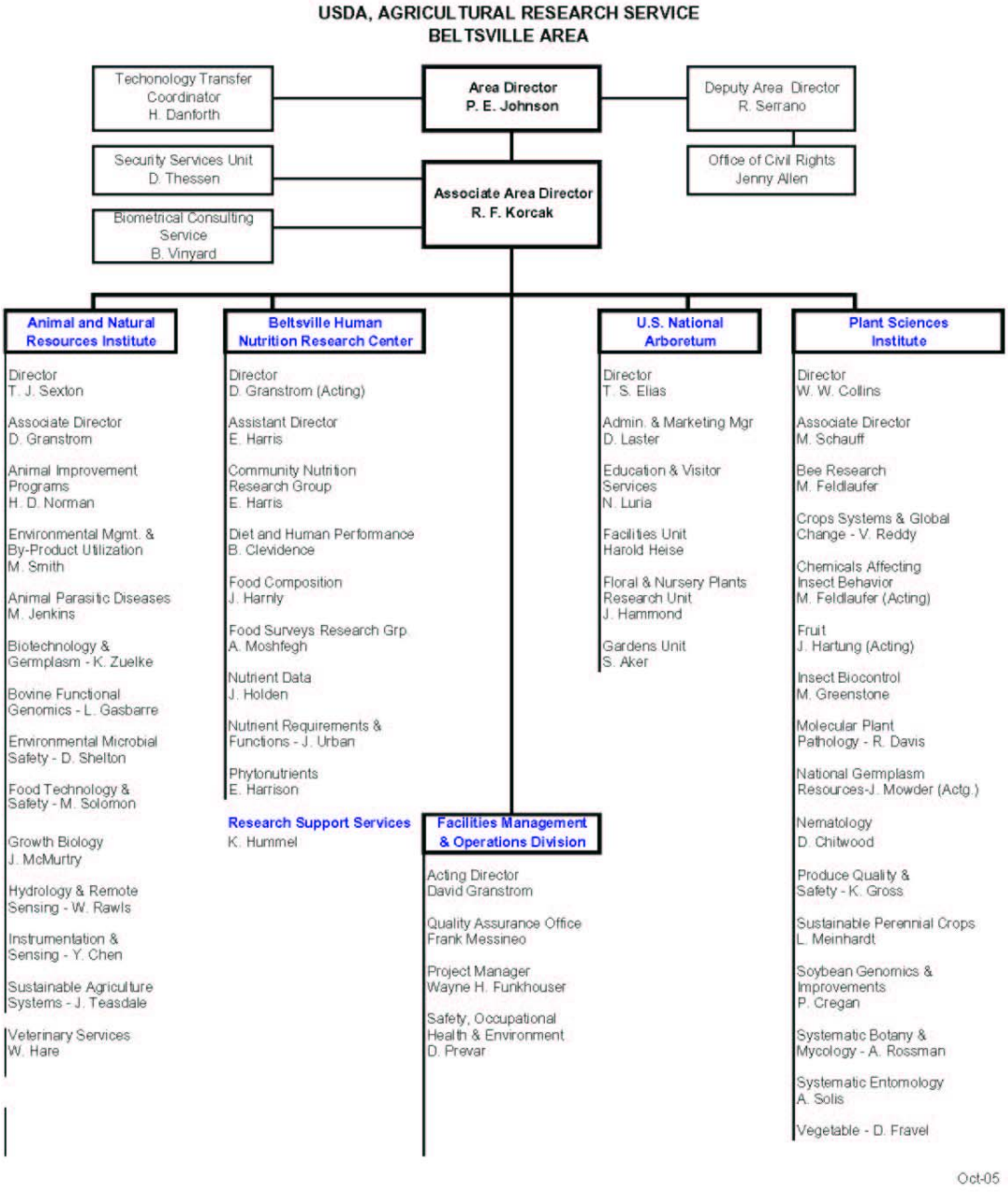
  Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia
- **Northern Plains Area**

  Colorado, Kansas, Montana, North Dakota, Nebraska, South Dakota, Utah, Wyoming
- **Pacific West Area**

  Arizona, California, Hawaii, Idaho, Nevada, Oregon, Washington
- **South Atlantic Area**

  Florida, Georgia, North Carolina, Puerto Rico, South Carolina, Virginia, Virgin Islands
- **Southern Plains Area**

  Arkansas, New Mexico, Oklahoma, Texas, Panama
- **International Locations**


USDA, AGRICULTURAL RESEARCH SERVICE
BELTSVILLE AREA
Techonology Transfer Coordinator H. Danforth
Area Director P. E. Johnson
Deputy Area Director R. Serrano
Security Services Unit D. Thessen
Office of Civil Rights Jenny Allen
Biometrical Consulting Service B. Vinyard
Associate Area Director R. F. Korcak
Animal and Natural Resources Institute
Director T. J. Sexton
Associate Director D. Granstrom
Animal Improvement Programs H. D. Norman
Environmental Mgmt. & By-Product Utilization M. Smith
Animal Parasitic Diseases M. Jenkins
Biotechnology & Germplasm - K. Zuelke
Bovine Functional Genomics - L. Gasbarre
Environmental Microbial Safety - D. Shelton
Food Technology & Safety - M. Solomon
Growth Biology J. McMurtry
Hydrology & Remote Sensing - W. Rawls
Instrumentation & Sensing - Y. Chen
Sustainable Agriculture Systems - J. Teasdale
Veterinary Services W. Hare
Beltsville Human Nutrition Research Center
Director D. Granstrom (Acting)
Assistant Director E. Harris
Community Nutrition Research Group E. Harris
Diet and Human Performance B. Clevidence
Food Composition J. Harnly
Food Surveys Research Grp A. Moshfegh
Nutrient Data J. Holden
Nutrient Requirements & Functions - J. Urban
Phytonutrients E. Harrison
Research Support Services
K. Hummel
Facilities Management & Operations Division
Acting Director David Granstrom
Quality Assurance Office Frank Messineo
Project Manager Wayne H. Funkhouser
Safety, Occupational Health & Environment D. Prevar
U.S. National Arboretum
Director T. S. Elias
Admin. & Marketing Mgr D. Laster
Education & Visitor Services N. Luria
Facilities Unit Harold Heise
Floral & Nursery Plants Research Unit J. Hammond
Gardens Unit S. Aker
Plant Sciences Institute
Director W. W. Collins
Associate Director M. Schauff
Bee Research M. Feldlaufer
Crops Systems & Global Change - V. Reddy
Chemicals Affecting Insect Behavior M. Feldlaufer (Acting)
Fruit J. Hartung (Acting)
Insect Biocontrol M. Greenstone
Molecular Plant Pathology - R. Davis
National Germplasm Resources-J. Mowder (Actg.)
Nematology D. Chitwood
Produce Quality & Safety - K. Gross
Sustainable Perennial Crops L. Meinhardt
Soybean Genomics & Improvements P. Cregan
Systematic Botany & Mycology - A. Rossman
Systematic Entomology A. Solis
Vegetable - D. Fravel
Oct-05

BARC "CORE" Research FACILITIES

(03/31/05)

Bioinformatics

8-processor Linux server that provides a number of services, including campus access to GCG, 32-processor Linux cluster running accelerated Blast algorithms and Sun Grid Engine for general computing, and a Timelogic Decypher server for hardware accelerated genomics comparison algorithms including Blast, Smith-Waterman, and Hidden Markov Models.

> Contact: Curt Van Tassell, ANRI, Animal Improvement Programs Laboratory and Bovine Functional Genomics Laboratory, Bldg 200, BARC-E, Tel (301) 504-6501 curtvt@aipl.arsusda.gov

DNA sequencing and fragment analysis

The Bovine Functional Genomics Laboratory (Building 200, Rm 2) houses an automated 96-capillary DNA analyzer (ABI-3730). Researchers in the BA can access use of this instrument for either DNA sequence or fragment analysis (STS and AFLP marker). A minimum of 96 samples most be submitted, and access to GeneMapper analysis software is provided for determining marker genotypes.

> Contact: Tad Sonstegard, ANRI, Bovine Functional Genomics Laboratory, Bldg 200, BARC-E, (301) 504-8416 tads@anri.barc.usda.gov

Electron Microscopy Unit

Hitachi S-4100 Scanning Electron Microscope with Oxford CT-1500 Cryostage, Hitachi S-4700 Scanning Electron Microscope with Polaron (Quorum) Polarprep 2000T Cryopreparation Chamber and Cold Stage and Hitachi H-7000 Transmission Electron Microscope with AMT 2K X 2K Digital Image Acquisition System and STEM capabilities. In addition specimen preparation equipment, including American Optical-Reichart Ultracut-Ultramicrotomes, Denton DV-502 Vacuum Evaporators, and Tousimis Samdri 780A Critical Point Dryer, RMC MF 7500 Ultrafreeze Freeze Substitution Devise, Ted Pella 345 Laboratory Microwave Fixation Devise, consultation and collaborative support is available.

> Contact: Eric Erbe, PSI, Soybean Genomics and Improvement Laboratory, Bldg 465, BARC-E, Tel (301) 504-8046 erbee@ba.ars.usda.gov

Microarrays and bioinformatics

Cartesian Technology PixSys 5500 pin microarray printer, GSI Lumonics ScanArray 4000 chip reader, BioDiscovery ImaGene software, microarray hybridizing chamber, and SPOT™ software available on a collaboration basis. Bioinformatics support is provided with microarray fabrication and data collection.

Contact: Benjamin F. Matthews, PSI, Soybean Genomics and Improvement Laboratory, Bldg 006, BARC-W, Tel (301) 504-5730 matthewb@ba.ars.usda.gov

Proteomics

Thermo Finnigan Deca ion trap mass spectrometer coupled with a Surveyor quaternary pump and an Applied Biosystems Voyager-DE STR MALDI-TOF mass spectrometer and a 7 processor Dell server with Mascot software for processing data.

Contact: Kurt Zuelke, ANRI, Biotechnology and Germplasm Laboratory, Bldg 200, BARC_E, (301) 504- 8545 at ANRI kzuelke@anri.barc.usda.gov

Ciphergen PS2B ProteinChip Reader (a SELDI-TOF mass spectrometer) for protein profiling and biomarker discovery.

Contact: Thomas Linke, BHNRC, Phytonutrients Laboratory, Bldg 307C, BARC-E, (301) 504-8270 linke@bhnrc.arsusda.gov.

Nuclear Magnetic Resonance Spectroscopy

10. Bruker QE 300 NMR 5mm dual ^{1}H-^{13}C probe used extensively for solving structural elucidation problems, run on very user friendly Aquerius software. Single pulse and multi-plus 1D experiment including APT and DEPT and multi-pulse 2D experiments including COSY, NOESY, and HETCOR. Technical support is available as needed. Bruker DMX 400 NMR, ^{31}P 20mm solutions probe, ^{1}H 5mm proton solution probe, 10 mm multi-nuclear solution probe, and 7mm multi-nuclear solids probe: its operation requires specialist expertise. A nominal fee is charged per hour of NMR time, used to cover the cost of Helium and Nitrogen cryogens and maintenance.

    Contact: Ute Klingebiel, or Walter F. Schmidt, ANRI, Environmental Quality Laboratory, Bldg 012, Room 1-6. BARC-W, (301) 504-5030 KlingebU@ba.ars.usda.gov

Polymer and Polymer Composite Processing and Characterization

Brabender Prep-Center with internal mixing head and 25:1, ¾" single screw extruder. Slit and capillary dies and automated pelletizing capability for mixing, compounding, and extruding polymers. Carver Press Autofour/30 Model 4394 compression molder for molding polymers. Misonix Sonicator 3000 for mixing polymer solutions. Retsch ZM 1000 centrifugal grinder and Retsch PM400 planetary ball mill for grinding fillers. TA Instruments DSC910s for thermal characterization of polymers. Com-Ten Industries 95 RC Test System with compression and tensile fixtures for mechanical property characterization. Affiliated with NMR facility (QE 300 MHz and Bruker 400 MHz with solids capability) and FT-IR laboratory (Thermo Nicolet Avatar 370) for advanced characterization of polymers and composites.

Contact: Justin Barone, ANRI, Environmental Quality Laboratory, Bldg. 012, Rm. 1-3, BARC-W, Tel (301) 504-5905, baronej@ba.ars.usda.gov

Confocal Microscopes

Zeiss LSM-410

Zeiss Axiovert 135M microscope with 10x, 25x, 40x, and 100x objective lens. Equipped with a helium-neon laser for excitation at 633nm,an argon/krypton laser for excitation at 488, 568, 647 nm, and a UV argon laser for excitation at 351 and 364 nm. The user is responsible for operating the microscope and must be trained in its use. Because of the costs required to maintain and operate the equipment, a pro-rated fee will be charged based upon its relative use compared to the other users.

Contact: Rob Griesbach, Bldg. 010A, 301-504-6574.

(awaiting info on second confocal in ANRI)

Digital Imaging Systems
Systematic Entomology Laboratory houses 3 high-end digital imaging stations. Two automontage image compositing systems with high res. camera and compound and dissecting microscopes (1 in bldg. 005 and 1 at National Museum). Also a Microptics, Inc. Digital Lab XLT imaging microscope with camera and specialized lighting (at National Museum).

Contact: In 005, Dr. Gary Miller (gmiller@sel.barc.usda.gov, 504-6896). At U.S. National Museum of Natural History, Dr. Michael Pogue (mpogue@sel.barc.usda.gov, 202-382-1786).