

## Department of Geography & Environmental Engineering



*COL Steven Fleming  
Director, Center for Environmental and Geographic Sciences*

### **Center Research Overview (2010 – 2011)**

The research philosophy of the Center for Environmental and Geographic Sciences emphasizes conducting research that expands scientific understanding in our disciplines, while providing the United States Army with solutions to multifaceted technical and policy issues. Further, much of research that is done within the center complements the primary mission of the academic program at the United States Military Academy, educating and inspiring cadets to become life-long learners. Our research supports our academic mission by providing real-world teaching examples, professional development for the faculty, and opportunities for cadet independent academic development projects.

The center's outreach effort is focused on work with the Army, other governmental agencies, and community partners to provide a resource for research in military geography, environmental security, environmental science and engineering, and the field of geospatial information science. We have laboratory facilities for environmental science and engineering, geology, and the geosciences. Our Geosciences Laboratory provides state-of-the-art hardware and software for all areas related to geographic information systems, remote sensing, cartography, photogrammetry and surveying. The scope of effort by the Department also includes active participation in solving problems related to the Army's vision of being a national leader in environmental stewardship for the 21<sup>st</sup> century. Our goal is to capitalize on the talents and initiatives of our outstanding faculty as the foundation for building a national-class research program that benefits the Army, the Hudson Valley, and the U.S. Military Academy.

Institutionally, the center is led by COL Steven D. Fleming. In this capacity, he also serves as a member of West Point's Academy Research Council (ARC). COL Fleming has served on the ARC since 2005 and was selected to serve as the ARC Chair during AY10-11 and AY11-12.

## **Research Project Summaries**

### **Climate Change and Potential Effects of Future U.S. Military Operations**

COL Eugene J. Palka – U.S. Military Academy

Observed increases in global average air and ocean temperatures, widespread melting of ice and snow, and rising global average sea level provide unquestionable evidence of global climate change (IPCC, 2007). Many anticipate that climate change may have a particularly negative impact on regions where people struggle to subsist on marginal lands. These are already volatile places as groups compete for scarce resources. Additionally, the continual decrease in the extent of sea ice in the Arctic could create tensions among countries that have sovereign claims or economic interests in the far north. When U.S. interests are at stake, the U.S. government normally considers a range of diplomatic, informational, and economic options to effectively address the problem. When these measures fail, U.S. military forces may be employed to diffuse the situation. Consequently, the U.S. Military must be postured to deploy to regions where climate change contributes to deteriorating environmental conditions and escalating violence or threatens national interests. Although the individual service components operate jointly during major operations and campaigns, each service would be impacted differently by climate change and rising sea level, given their differing missions, organization, and equipment.

### **Technical Analysis and Characterization of Southern Cayo, Belize for Tropical Testing and Evaluation of Foliage Penetration Remote Sensing Systems**

Colonel Steve Fleming, PhD, Panel Chair - U.S. Military Academy

Dr. Marguerite Madden, PhD, CRMS – University of Georgia

Dr. David Leigh, PhD, University of Georgia

Mrs. Phyllis Jackson, CRMS – University of Georgia

MAJ Dustin Menhart, CRMS – University of Georgia

Mr. Rodney Peralta – USSOUTHCOM – Science, Technology and Experimentation

*Sponsor – US SOUTHCOM*

Over the last decade, seven separate reports were issued by the tropical test study panel, reporting the results of work conducted at 24 sites. The evolution of tropical testing to the suite of sites approach were compiled and integrated into a single document, which compared and contrasted all of the sites examined to date. This report, A Technical Analysis of Locations for Tropical Testing of Army Materiel and Opportunities for Tropical Training of Army Personnel (February 2009), summarized the environmental characteristics of the sites found to have testing value and made a comparative analysis between the twelve sites. It was intended to help the testing community select the best locations for each test and provide summary environmental data for test design. The original work remains important because each of those reports contains environmental details that are critical to the testing community when they are selecting where to test. Referencing this work, a concatenated study of a new, test site in Western Belize was deemed necessary for work being done there by USSOUTHCOM during

2010. A team of scientists was rapidly assembled to evaluate vegetation and geomorphology of a site at Southern Cayo, Belize, primarily in support of tropical testing and evaluation of foliage penetration remote sensing systems. This report represents those findings. Further work at the site may be necessary in order to support future testing of other equipment.

## **Evaluation of Digital Elevation Models Generated From Lidar Data and Digital Aerial Photography**

Dr. John Brockhaus - U.S. Military Academy

*Sponsor – National Geospatial Intelligence Agency (NGA)*

This research has been focused on the generation, comparison, and determination of the accuracy of high resolution digital elevation model data derived from Lidar and digital aerial photography. New image processing and analytical photogrammetric methodologies have been used to produce high resolution digital elevation models from the data generated from these systems. Two elevation data sets have been generated, one from the processing of high resolution Lidar imagery and another from the photogrammetric analysis of high resolution digital aerial imagery acquired from a digital aerial mapping camera. The two data sets will be compared in terms of: 1) the cost to acquire the imagery; 2) the length of time required to extract the elevation models from the imagery; and, 3) the accuracy of the elevation data generated.

## **Object Oriented Delineation of Roofing Materials**

Dr. John Brockhaus - U.S. Military Academy

Determination of roofing materials used in the construction of homes was conducted using high resolution multi-spectral satellite imagery, lidar data and object oriented feature extraction software. Two subdivisions located in southeastern Colorado Springs, Colorado were used as the study site for this research. A wall to wall survey of the roofing materials for every structure within these two subdivisions was conducted for use in evaluating the results of the delineation of materials as derived from the satellite imagery. Post-classification results demonstrated that 95.6% of the materials used to roof the structures within the two subdivisions were correctly determined using the satellite imagery and the object oriented feature extraction software.

## **A Technical Analysis of Locations for Tropical Testing of Army Material and Opportunities for Tropical Training of Army Personnel**

BG (R) Wendell C. King - USACGSC  
COL Eugene J. Palka – U.S Military Academy  
Dr. James Juvik – University of Hawaii, Hilo  
Dr. Russell S. Harmon – Army Research Office  
Dr. Jan Hendrickx – New Mexico Tech  
COL Steven D. Fleming – U.S. Military Academy

Dr. William W. Doe – Colorado State University

*Sponsor - YPG (Yuma Proving Ground)*

There have now been 7 separate reports issued by the tropical test study panel, reporting the results of work conducted at 24 sites. The evolution of tropical testing to the suite of sites approach now requires that individual reports be compiled and integrated into a single document, which compares and contrasts all of the sites examined to date. This continuing research summarizes the environmental characteristics of the sites found to have testing value and makes a comparative analysis between these 12 sites. It is intended to help the testing community select the best locations for each test and provide summary environmental data for test design. The original work remains important because each of those reports contains environmental details that are critical to the testing community when they are selecting where to test, but the continuing work is designed to compile a summary document to enhance the utility of the panel's work.

### **Geovisualization of Land Navigation Routes with Pen Based and GPS Technology**

COL Michael D. Hendricks - U.S. Military Academy  
CDT John Puryear - U.S. Military Academy  
CDT Justin Smith - U.S. Military Academy  
LTC James Merlo - U.S. Military Academy

Training individuals in land navigation is a challenging endeavor. One of the difficulties with this task is providing effective after action review feedback to individuals. The current method asks the navigator to draw their planned and executed route on a map. With this information the trainer provides feedback to the individual on route selection and overall success. This process is flawed in many ways. The individual often does not know where they traveled, or worse they may confidently believe they traveled along a route which is in fact not true.

GPS data loggers can be employed to provide the navigator feedback on their actual traveled route. Trainers can view this route information and provide quick and effective feedback related to their executed route. This technique is employed to great success with the United States Military Academy's Orienteering Team and many other individuals.

Feedback on a navigator's executed route, though critical, is only part of a robust land navigation training program. It is also important to provide feedback on both the navigator's planned route and perceived executed route. Analyzing differences between these three routes, planned, perceived, and executed, allows trainers to provide truly effective feedback. The use of geospatially referenced pen based graphic input devices allows trainers to quickly obtain both the navigator's planned route and their perceived route. These devices now allow individuals to draw their routes along with key decision points on a paper map and have these routes automatically georeferenced. With this new technique trainers now immediately provide feedback to navigators on all three routes overlaid on high resolution imagery and map data in an interactive 3D environment.

## **Yuma Proving Ground Test Site Characterization, Mapping and Imaging**

COL Steven Fleming - U.S. Military Academy  
LTC Curtis Edson - U.S. Military Academy  
MAJ Travis Rayfield - U.S. Military Academy  
MAJ Hannon Didier - U.S. Military Academy  
CDT Benton Beltramo - U.S. Military Academy  
CDT Cody Peterson - U.S. Military Academy  
CDT Charles Smigen - U.S. Military Academy

*Sponsors - Yuma Proving Ground (YPG) and Desert Research Institute (DRI)*

The Department of Geography and Environmental Engineering (D/GEEnE) from the United States Military Academy (USMA) at West Point has supported Yuma Proving Ground (YPG) for over a decade with test site evaluations, characterizations and data collection. During the summers of 2010 and 2011, D/GEEnE completed two missions in support of YPG. These missions included: (1) terrestrial imagery and soil data collection at Aberdeen Proving Ground; and (2) terrestrial imagery and soil data collection at Fort A.P. Hill.

### **Climate Change & Health**

Dr. Adam Kalkstein, U.S. Military Academy

This research focuses on how climate change and weather events affect public health.

### **Climatology / Geomorphology**

Dr. Adam Kalkstein, U.S. Military Academy

Moodna Creek, located entirely within Orange County, NY, has been associated with numerous flooding events in the past. Recently, scientists have used a Thornthwaite water budget model to estimate stream flow using meteorological data collected in close proximity to the creek. Among other things, the model has been used to predict future stream flow under various climate change scenarios. Unfortunately, the meteorological data from this location only span ten years, and as a result, no study has attempted to create a historical stream flow record. Thus, the goal of this study is to examine numerous meteorological stations from across the Hudson Valley to determine which station or stations best mimic the day-to-day weather conditions found within the Moodna Creek watershed. Using these proxy data, a historical record of estimated stream flow will be calculated for Moodna Creek. It is our hope that this historical record can be used to increase preparedness for future flooding events, as well as for supporting information towards climate change adaptation.

## **Energy**

MAJ Margaret McGunegle, U.S. Military Academy

Privately owned subsurface mineral rights underlie 93% of the Allegheny National Forest (ANF) and create challenges for forest management. The construction of well pads and road networks for the oil and gas industry fragments the forest landscape and dissects wildlife habitat. This study examined how the expansion of the oil and gas industry in the ANF contributes to forest fragmentation.

## **Energy**

MAJ Steve McGunegle, U.S. Military Academy

Rapid expansion of ethanol production in the United States is reshaping the industry. From 1999–2006, production increases averaged 29% annually. According to the Renewable Fuels Association, ethanol production will double again between 2008 and 2013. Corn is currently the primary feedstock for ethanol production in the United States. In the past, the Midwestern location of corn production dictated the co-location of ethanol plants. Expansion of ethanol production is now occurring in corn-deficient regions, like Pennsylvania. The beginnings of an ethanol industry in Pennsylvania emerged in 2008 as BioEnergy LLC began to construct the first plant, which was located in Clearfield, PA. Understanding the market forces leading to the expansion and evaluating the location decision requires answers to two basic questions (1) “why here”; and (2) “can this location be competitive?” In this thesis, I conducted a critical case study and applied industrial location theory to answer these questions.

## **Environmental Security**

Dr. Amy Richmond Krakowka - U.S. Military Academy

Many conflicts are enabled by environmental instability. This has been especially problematical in sub-Saharan Africa where non-sustainable practices and environmental change have combined with the proliferation of failing governments, enabling long-standing ethnic and religious antagonisms to erupt into violent conflicts. History has demonstrated that environmental stress can result in conflict, frequently along ethnic lines. Thus, the concept of environmental security has emerged as one basis for understanding conflict. To that end, this paper examines the nexus between the environment and conflict.

## **Geopolitics**

Dr. Peter Siska, U.S. Military Academy  
Viliam Lauko, Komensky University

*Sponsor - INSTITUTE OF NATIONAL SECURITY STUDIES (INSS)*

After the downfall of Iron Curtain Central Europe became a new region that joined NATO. The United States planned to put in this regional Mid-Course Missile System as part of larger missile shield against potential missile attack from Iran and North Korea. This missile system was strongly opposed by Russia. The purpose of this research was to determine political and social climate in Central Europe with respect to this missile deployment. The questionnaires were developed at the Department of Geography and translated into Polish and Slovak. The questionnaires were distributed with the help of Komensky University in Poland, Czech Republic and Slovakia. Besides these questionnaires the responses from home media were also studied as well as the results from professional surveys in these countries. The results from this research were useful for international diplomacy.

### **Modeling Pollen and Vegetation patterns in Columbia Basin using Geostatistics and Factor Analysis**

Dr. Peter Siska, U.S. Military Academy  
Dr. Vaughn Bryant, Texas A&M University  
Dr. Stefan Polacik, Slovak Academy of Sciences

*Sponsor - ARMY RESEARCH LABORATORY (ARL)*

The pollen grains are regional variables. The angiosperm pollen is transferred by the air and sinks on the ground at certain distances from parent plants. Distribution of pollen on the ground is determined using samples that area analyzed in laboratory and provided with latitude and longitude coordinates for geostatistical and GIS mapping and analyses, The relationships between the parent plants and pollen distribution patterns is studied for three purposes: 1) first of all to determine genetic transfer from plant to plant that is necessary for maintaining healthy vegetation, 2) to determine past climatic changes (using fossil pollen data) 3) to identify or reconstruct crime scenes for forensic analysis. In this project we selected Columbia Basin due to its dry environment. Currently we constructed several pollen maps and apply also factor analysis which determines underlying spatial factors that control distribution of pollen in the studied area and also correlations between all variables.

### **Regional Geography / Security / Pakistan**

COL Laurel Hummel, U.S. Military Academy  
Dr. Rick Wolfel, U.S. Military Academy  
CDT Christopher Gaulin, U.S. Military Academy  
Lt Col Luis Rios, U.S. Military Academy  
COL Wiley Thompson, U.S. Military Academy  
MAJ Chris Fuhrman, U.S. Military Academy

*Sponsor - CENTER FOR STRATEGIC LEADERSHIP, US Army War College, Carlisle, PA*

This research addressed the complexity and importance of modern Pakistan as both a positive and negative influence on stability in South and Central Asia. The research included analyses from cultural, political, historical, and economic perspectives.

## **Using Microbial Fuel Cells for Side Stream Nitrogen Removal**

LTC Tom Timmes, U.S. Military Academy  
CDT Matthew Burke, U.S. Military Academy  
CDT Josh Karper, U.S. Military Academy

*Sponsor - DECOM/ARO/Penn State University*

This research was performed under the U.S. Military Academy's Advanced Individual Academic Development (AIAD) program with funding from RDECOM. Work Performed at the Penn State Kappe Environmental Engineering Labs. Microbial fuel cells (MFC's) are a fairly new technology with possible applications for military base camps. Our experimentation focused on the nitrogen removal from side-stream wastewater. We created four MFC's (two control and two test cells) to monitor the nitrogen removal with an ammonia nitrifying bacteria. The MFC's were constructed with air cathodes. The test group was coated with a platinum layer to see if this would further aid in the electrical output and ability of the MFC's.

## **Iron Electrocoagulation Experiments with Surface Water and Wastewater**

LTC Tom Timmes, U.S. Military Academy  
CDT Matthew Periola, U.S. Military Academy  
CDT Andrew Billisits, U.S. Military Academy

*Sponsor - RDECOM/ARO/Penn State University*

This research was performed under the U.S. Military Academy's Advanced Individual Academic Development (AIAD) program with funding from RDECOM. Work Performed at the Penn State Kappe Environmental Engineering Labs. This research used iron electrocoagulation (EC) to treat two water sources (surface water collected from Alumni Memorial Pond, and treated wastewater effluent from the State College Wastewater Treatment Plant). The results demonstrate the total iron dosage and voltage trends observed over short term (min-hrs) and during extended EC operations (24 continuous hours). This research continues the doctoral work by LTC Thomas C. Timmes, supported by the Army Research Office (W911NF-07-1-0436).

## **Selection of Type I and Type II methanotrophic proteobacteria in a fluidized bed reactor under non-sterile conditions**

MAJ Andrew Pfluger, MS, Eng - U.S Military Academy  
Dr. Weimin Wu, PhD - Stanford University  
Dr. Allison Peija, PhD - Stanford University  
Ms. Katherine Rotkowski, MS - Stanford University  
Mr. Jonathan Wan, MS - Stanford University  
Dr. Craig Criddle, PhD - Stanford University

*Sponsor - California EPA*

Only Type II methanotrophs are capable of producing polyhydroxybutyrate (PHB). A laboratory fluidized bed reactor (FBR) was tested the selection of types of methanotrophs. The initial inoculation was an Methylocystis -like dominated culture (Type II). Influent dissolved oxygen (DO) of 9 mg/L and pH 6.2-6.5 with nitrate as the N-source resulted in Methylobacter -like Type I methanotroph dominated biofilms, which did not produce PHB. Shift to PHB-producing biofilms comprising both Type I and Type II methanotrophs was achieved by re-inoculation with an Methylosinus culture (Type II) with dissolved N<sub>2</sub> as primary N-source at low influent DO (2.0 mg/L). Batch tests indicated that the enrichments of the biofilm sample with N<sub>2</sub> were predominated by Type II methanotrophs and capable of PHB accumulation, while enrichments with nitrate or ammonium were dominated by Type I methanotrophs and lost PHB production capability. The key selection factors for Type II were N<sub>2</sub> as N-source and low DO.

### **Oxygen Sensitivity in Type II methanotrophic proteobacteria**

Ms. Katerine Rotkowski, MS - Stanford University  
MAJ Andrew Pfluger, MS, Eng - U.S. Military Academy  
Dr. Craig Criddle, PhD - Stanford University

*Sponsor - California EPA*

Methanotrophs are the major terrestrial sink for methane and a subset of the methylotrophs, bacteria that metabolize one-carbon compounds (Hanson and Hanson 1996; Murrell 2010; Lidstrom 2006). As early as 1970, researchers discovered that some methanotrophs could produce polyhydroxybutyrate (PHB), a bioplastic, under nutrient limiting conditions (Whittenbury et al. 1970a). The subset of methanotrophs capable of producing PHB are known as the "Type II methanotroph" (Pieja et al. 2011a) and they produce the PHB homopolymer (Wendlandt et al. 2001; Helm et al. 2008; Choi and Lee 1999; Wendlandt et al. 2005). When diverse Type II methanotrophs were screened for PHB production, levels ranged from 9 to 44% by dry mass (Pieja et al. 2011a). Under optimized conditions, others have reported levels of 51% (Wendlandt et al. 1998, 2001) and 52 % (Wendlandt et al. 2010). Optimizing growth and PHB production for type II methanotrophs is of commercial interest. This study identifies the optimal partial pressure of oxygen for growth and subsequent PHB production of several type II methanotrophs, comparing the use of nitrate (NO<sub>3</sub><sup>-</sup>) and nitrogen gas (N<sub>2</sub>) as the sole nitrogen sources.

### **Building solar cookers from discarded materials**

Dr. Marie Johnson, PhD - U.S. Military Academy  
MAJ Andrew Pfluger, MS, Eng - U.S. Military Academy

This study explored the adaptive reuse of discarded materials for the purpose of constructing solar cookers capable of achieving the temperature required for water pasteurization. Results of five different configurations of solar cookers constructed from junk car parts indicate that the most important design parameters include maximizing container surface area exposed to the sun, transparent (not tinted) glass, and the presence of black absorbent material inside the solar cooker box. The optimal configuration, which consisted of a car tire whose wheel rim was

lined with black insulating material and covered by a side door window, heated water to 69 °C in partly sunny conditions in August in New York. These results demonstrate that with very minor modifications, a field expedient, zero cost solar cooker capable of heating water to pasteurization (65 °C) can be assembled from discarded material. Translating these key design parameters, rather than the design itself, to people in developing countries via relief organizations, such as Engineers Without Borders, could help improve drinking water quality, reduce respiratory distress from indoor biomass burning, and potentially reduce the time and household income devoted to acquiring traditional biomass fuels. Other organizations, such as the military or the American Red Cross, that operate in austere conditions or regions where recent disasters have occurred and safe drinking water may be unavailable may also benefit from knowing these design principles.

### **Risk Based Screening Criteria for Beneficial Use of Dredged Material: Proposed Development Methodology**

MAJ Andrew Pfluger, MS, Eng - U.S Military Academy  
Mrs. Susan Bailey - ERDC  
Mr. Daniel Averett - ERDC  
Dr. Paul Schroeder, PhD - ERDC

*Sponsor - ERDC, Environmental Engineering Division*

The beneficial use (BU) of dredged material is critical to sustainable dredged material management. Although dredged material reuse is gradually being recognized as a resource and a green technology, employment of BU practices are still limited by a lack of consistent criteria for environmental protection. Determining appropriate criteria (or the approach to criteria selection and development) is a challenge due to the wide range of BU applications, each of which has differing potential for exposure, human health impacts, and environmental effects. Currently, criteria for BU vary greatly among regulatory agencies. In many instances there is either a lack of criteria applicable to dredged material BU or overly-prohibitive criteria established based on the "precautionary principle". This lack of consistency can debilitate planning efforts and lead to missed opportunities to appropriately utilize dredged material, which can further lead to increased costs. A scientifically-based method for determining the suitability of dredged material for BU applications is needed. A risk based screening criteria can be adapted to effectively determine if dredged materials can be used for different beneficial uses.

### **Water and Sanitation: Decisive Effects in Modern Operations**

MAJ Dennis Sugrue, MS, Eng - U.S. Military Academy  
MAJ Andrew Pfluger, MS, Eng - U.S. Military Academy

Defense organizations, particularly the Army, need to prepare for and train to implement water and sanitation projects in developing countries. Many developing countries face a critical shortage of adequate water and sanitation facilities, which places an unnecessary burden on already over-stressed health care services and supporting government entities. Progress in

stabilizing the developing world is slow and requires continued efforts to meet basic human needs. Establishing basic services and health care are key components in successfully conducting stability operations and, according to President Obama's 2010 National Security Strategy, fundamental to our national security strategy. To be successful however, projects need to be sustainable. With careful consideration of social, political, and environmental factors, government and non-governmental organizations can develop sustainable solutions that are acceptable and suitable to target communities. The Army plays an important role in water and sanitation development because its units commonly deploy to austere environments with people in desperate need of services and who are often separated from municipal areas receiving benefit from centralized services. To achieve our nation's strategic goals, Army units need to adopt new and appropriate measures of effectiveness concerning water and sanitation projects in stability operations. Additionally, home station training needs to prepare junior leaders to be successful in community partnership and understanding the planning and development of water and sanitation projects.

### **Development of an Improved Soil Amendment for Control of Lead on Firing Ranges**

Prof. Michael Butkus - US Military Academy  
LTC William Pearman - US Military Academy  
Dr. Dawn Riegner - US Military Academy

*Sponsor - ARL (AY11)*

Phosphate has become an accepted remediation strategy to immobilize lead on firing ranges. In some cases, however, phosphate treatment has been reported to increase lead concentrations in field water leaching tests. The purpose of this work was to develop an improved sorbent and source of phosphate for control of lead on firing ranges. Polonite, a mineral based sorbent that has been developed to remove phosphate from wastewater, was capable of removing high quantities of lead and phosphate from solution in isotherm adsorption experiments. Preliminary data (presented at the ARL Conf in 2010) reveal that Polonite and Polonite amended with phosphate significantly reduced the transport of lead at circumneutral pH values. Spectroscopic studies are being conducted to identify the species of lead on the Polonite surface

### **Modeling munitions constituent (MC) movement in the artillery impact area (used by Range 2 and 13)**

Prof. Michael Butkus - US Military Academy  
Dr. Dave Smith - ERDC  
MAJ Andrew Pfluger - US Military Academy  
Mr. Anand Shetty - US Military Academy

*Sponsor - ERDC*

MC modeling will make use of GIS data provided by USAG-West Point and surface water samples collected at two locations (Normandy and Mine Torne Road). The surface water samples will measure the amount of MC after being transported from the impact area. This

information will be compared against model estimates so that model accuracy and precision can be evaluated.

### **Using High-Density Microarrays to Analyze the Microbial Community Present During Nitrification**

LTC Jeffrey Starke, PhD, - U.S Military Academy  
Dr. L. Safak Yilmaz, PhD, – University of Wisconsin - Madison  
Dr. Daniel Noguera, PhD, University of Wisconsin - Madison  
Dr. Gregory Harrington, PhD, University of Wisconsin - Madison

*Sponsor - Water Research Foundation*

Drinking water utilities that have a high ammonia content or use chloramination as a disinfectant strategy can witness periodic episodes of microbially-mediated conversion of the ammonia to nitrite and nitrate - a phenomenon known as nitrification. Nitrification events are problematic in drinking water as they degrade the residual disinfectant and produce regulated compounds that can result in deleterious health impacts such as methemoglobinemia. High-density microarrays were designed using a thermodynamically based model to analyze the diversity of known bacteria and archaea that are capable of ammonia oxidation. The microarray detects the presence of PCR amplified DNA and thus is able to understand the microbial composition present in drinking water distribution system that use chloramination prior-to and during a nitrification event.

### **Biogas Opportunities in Wisconsin**

LTC Jeffrey Starke, PhD, - U.S Military Academy  
Aleia McCord, – University of Wisconsin - Madison  
Sarah Stefanos, University of Wisconsin - Madison  
Steven Plachinski, University of Wisconsin - Madison  
Gary Radloff, University of Wisconsin – Madison

*Sponsor - NSF (CHANGE-IGERT grant) UW-Madison Nelson Institute for Environmental Studies, UW-Madison Wisconsin Bioenergy, Initiative Great Plains Institute*

Germany is the international leader in on-farm biogas production with over 4000 systems whereas Wisconsin is the national leader with approximately 32 systems. A multi-disciplinary team was assembled to evaluate the technical engineering, social, political, and economic aspects of Germany's success. A 7 day tour of biogas plants in southern Germany was conducted to understand the impacts of this growth in terms of energy production and impact upon the agriculture industry. Lessons learned were then applied to the Midwestern United States agricultural industry - specifically Wisconsin.

## **Promoting a Sustainability Ethic in Future Army Leaders at West Point**

Dr. Marie Johnson, PhD - U.S. Military Academy  
LTC Mark Smith, PhD - U.S. Military Academy

*Sponsor - Army War College*

This work focuses on the state of sustainability education at West Point and the importance of infusing the Army's young officer corps with a sustainability ethic.

## Publications

### **BOOK CHAPTERS:**

Doe, William W. and Palka, Eugene J. 2010. America's Military Footprint: Landscapes and Built Environments within the Continental U.S. In *Engineering Earth*. Stanley D. Brunn, ed. Dordrecht, Heidelberg, London, and New York: Springer, pp. 1683-1699.

Harmon, RS, King, WC, Palka EJ, and Doe, WW. 2011. Characterization of Extreme Environments for US Army Materiel and Human Performance Testing. In *International Handbook of Military Geography* (H. Häusler, editor), Truppendienst Taschenbuch, pp. 242-249. (NOTE: This work began in 2009.)

Palka, Eugene J. 2011. Climate Change and Potential Effects on Future U.S. Military Operations. In *International Handbook of Military Geography* (H. Häusler, editor), Truppendienst Taschenbuch, pp. 381-392. (NOTE: This work began in 2009.)

### **TECHNICAL REPORTS:**

Brockhaus, J., W. Wright, M. Hendricks, S. Fleming. 2010. Technical Report: Delineation of roofing material within an urban environment: Integration of WorldView-2 Imagery and Lidar Data. West Point, NY.

Fleming, S., T. Rayfield, H. Didier. 2010. Test Site Characterization, Mapping and Imaging for Yuma Proving Ground (YPG) at Aberdeen Proving Ground. Department of Geography and Environmental Engineering, United States Military Academy, West Point, New York.

Fleming, S., C. Edson, B. Beltramo, C. Peterson, C. Smigen. 2011. Test Site Characterization, Mapping and Imaging for Yuma Proving Ground (YPG) at Fort A.P. Hill. Department of Geography and Environmental Engineering, United States Military Academy, West Point, New York.

Fleming, S., M. Madden, D. Leigh, P. Jackson, D. Menhart, R. Peralta, 2011. Technical Analysis and Characterization of Southern Cayo, Belize for Tropical Testing and Evaluation of Foliage Penetration Remote Sensing Systems, Department of Geography and Environmental Engineering, United States Military Academy West Point, NY.

Siska, P. Bryant, V. Polacik, S. 2010. Technical Report on Modeling Pollen and Vegetation in Columbia Basin Using Geostatistics and Factor Analysis. West Point, NY.

Siska, P. P. 2010. Regional Expertise – the Key to Understanding Culture and Language. Center for Language, Culture and Regional Studies. Department of Foreign Languages. USMA, West Point, NY. <http://www.dean.usma.edu/centers/clcrs/papers.htm>

Timmes, Tom. 2011. Environmental Engineering Graduate Research: Using Microbial Fuel Cells for Side Stream Nitrogen Removal (AIAD #10804), West Point, NY.

Timmes, Tom. 2011. Environmental Engineering Graduate Research: Iron Electrocoagulation Experiments with Surface Water and Wastewater (AIAD #10435), West Point, NY.

### **PAPERS:**

Dixon, P.G. and Kalkstein, A.J. 2010. Teaching and Learning Guide for: Climate-suicide relationships: A research problem in need of geographic methods and cross-disciplinary perspectives. *Geography Compass*. 4: 485-489.

Johnson, MC and MA Smith. 2011. Promoting a sustainability ethic in future Army officers at West Point. Chapter in *Sustainability and National Security*, edited by Hartman, J and Butts, K. Accepted June 2011.

Kalkstein, A.J. and Goodrich, G.B. 2011. The effect of ENSO and PDO on three airborne pollutants in Phoenix, AZ. *Journal of the Arizona-Nevada Academy of Science*. In Press.

Krakowka, A.R. 2010. *Environmental Security: A Framework for Conflict Analysis*. Modern Military Geography. Ed. Francis A. Galgano and Eugene J. Palka. London: Routledge.

Krakowka, A. 2010. *Environmental Security: A Framework for Conflict Analysis*. Modern Military Geography. Ed. Francis A. Galgano and Eugene J. Palka. London: Routledge.

Pfluger, A., W. Wu, A. Peija, K. Rotkowski, J. Wan, C. Criddle. 2011. Selection of Type I and Type II methanotrophic proteobacteria in a fluidized bed reactor under non-sterile conditions, published in *Bioresource Technology*, Volume 102, Issue 21, Nov. 2011.

Pope, D., J. Brockhaus, W. Wright, M. Hendricks, S. Fleming. 2010. Mapping roofing materials: fusion of lidar & satellite imagery. In proceedings of the 2010 ESRI Users' Conference. San Diego, CA.

Pope, D., J. Brockhaus, W. Wright, M. Hendricks, S. Fleming. 2010. Mapping urban infrastructure. Poster presentation at the 2010 NGA NARP Symposium.

Sheridan, S.C. and Kalkstein, A.J. 2010. Seasonal variability in heat-related mortality across the United States. *Natural Hazards*. 55: 291-305.

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Siska, P.P. 2011. Journey to Vietnam. *West Point Magazine*, West Point, New York. Volume 1, Issue 1, Winter 2011, pp. 22-26.

## Presentations

Brockhaus, J. 2010. DEM generation, terrain visualization, and warfighter data needs. Presentation at the 2010 NGA NARP Symposium. Washington, DC.

Butkus, Michael. 2010. "Development of an Improved Soil Amendment for Control of Lead on Firing Ranges," (with Mark Lennox, Taylor Pearce, and Anand Shetty), 18th ARL/USMA Technical Symposium, Atlantic City, NJ.

Fleming, S., J. Brockhaus and M. Hendricks. 2010. *Geospatial Information Science Program and Admissions Processes at the United States Military Academy*. 2010 ESRI Educational Users Conference. San Diego, CA.

Fleming, S. 2010. *Terrestrial Imaging of Military Test Centers*. SPIE Defense, Security and Sensing National Conference, Orlando, FL.

Fleming, S. 2011. Military Test Site Characterization - An *Integrated* Terrain Analysis Approach. International Conference on Military Geosciences, Las Vegas, NV.

Kalkstein, A.J. 2011. Separating fact from fiction in the climate change debate. Energy Strategy Workshop. United States Military Academy, West Point, NY.

Kalkstein, Adam J. and Allan Frei. 2010. Estimating Moodna Creek stream flow using meteorological stations from across the Hudson Valley. Middle States Association of American Geographers - OCT 2010, West Point, NY.

Krakovka, A.R. 2010. Alternative teaching strategies. Conference for the Association of American Geographers, Washington DC.

Krakovka, Amy. 2010. Modeling Environmental Security in Sub-Saharan Africa. AAG Annual Meeting, Seattle, WA.

McGunegle, Margaret L. 2010. The Use of Historic Aerial Photography for Land Use and Land Cover Change Studies. AAG Middle States - 22 October 2010, West Point, NY.

McGunegle, Margaret L. 2011. The Effects of Oil and Gas Development on Forest Fragmentation in the Allegheny National Forest. AAG Annual Meeting, Seattle, WA.

McGunegle, Steven. 2010. Analyzing Industrial Expansion: A Review of the Potential for Sustained Ethanol Production in Pennsylvania. Middle States Association of American Geographers - OCT 2010, West Point, NY.

McGunegle, Steven. 2010. Analyzing Industrial Expansion: A Review of the Potential for Sustained Ethanol Production in Pennsylvania. Association of American Geographers Annual Meeting, 2011. Seattle, WA.

Morrow, John. 2010. Ecotourism's Role in Positive Land-Use and Land-Cover Change in a Costa Rican Tropical Montane Cloud Forest. Middle States Association of American Geographers - OCT 2010, West Point, NY.

Palka, Eugene J. 2010. Military Operating Environments from the Military Geographer's Perspective – 7 part lecture series. Naval Post Graduate School, Monterey, CA.

Palka, Eugene J., 2010. Climate Change and Potential Regional Instability in the Arctic. West Point Center for the Rule of Law 2010 Spring Conference, West Point, NY.

Palka, Eugene J., 2010. Kurd-Arab Tensions along the Green Line: Iraq's Roadblock to Long Term Stability. Annual Convention of the Association of American Geographers. Washington, DC.

Pflugger, Andrew. 2010. "Selective Growth of Methanotrophic Bacteria in a Fluidized Bed Reactor". Annual Conference for the American Society of Microbiologists, San Diego, CA.

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Siska, P.P. 2010. "Spatial Analysis of Pollen and Forensics." Army Research Laboratory Annual Convention, Ocean City, NJ.

Siska, P.P. 2010. "New Avenues in Regional Geography." Association of American Geographers, Middle States Division Annual Conference. West Point, NY.

Siska, P. P. 2010. "Application of Kriging Techniques in Mapping Natural Resources and Environmental Hazards." Developmental Seminar. Department of Environmental, Geographic & Geologic Sciences, Lehman College, CUNY, NY

Siska P.P. 2010. Improving regional education in foreign language classes. Department of Foreign Languages, West Point, NY.

Siska, P.P. Bryant, V. M., Goovaerts, P., Hung, I. 2010. Spatial Analysis of Pollen Data and its Potential for Forensic Analysis. Joint Meeting of American Association of Stratigraphic Palynologists (AASP), Geological Association of Canada Paleontology Division (GAC) and Canadian Association of Palynologists (CAP), Dartmouth, Nova Scotia.

Siska, P.P., Bryant, V. M., Goovaerts, P. and Hung, I. 2010. Pollen distribution patterns in North-West Region: Potential for Forensic Analysis. American Association of Geographers, Conference, Washington, DC.

Siska P.P. 2011. Results from Regional Assessment for year 2009-10. Department of Foreign Languages Seminar, West Point, NY.

Starke, J. 2011. High-Density Microarrays to Analyze the Microbial Community Present During Nitrification, Association of Environmental Engineering and Science Professors (AEESP) Education and Research Conference. June 10-12, 2011. Tampa, FL.

Wolfel, Richard, Jesus Aguirre, Jeff Watson. 2010. "Language and Intercultural Competence: The Pathway to Intercultural Effectiveness?" IDI Users Conference. Minneapolis, MN.

Wolfel, Richard L. 2010. At the Crossroads: War and Remembrance in Kisangani, DR Cong. Middle States Association of American Geographers - OCT 2010, West Point, NY.

Wright, W., M. Cuvillo, S. Fleming and M. Hendricks. 2010. *Terrain Association and Land Navigation Visualization*. 2010 ESRI Educational Users Conference – Map Gallery. San Diego, CA.