

Department of Geography & Environmental Engineering



*COL Eugene J. Palka
Professor and Head,
Department of Geography & Environmental Engineering*

Department Research Overview (2009 – 2010)

The research philosophy of the Department of Geography & Environmental Engineering 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, some research should complement 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 department's outreach effort is focused through the Center for Environmental and Geographic Sciences (CEGS). The CEGS works 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 21st 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, we are represented by COL Steven D. Fleming as a member of the Academy's Academic Research Council (ARC). COL Fleming has served on the ARC since 2005 and was selected to serve as the ARC Chair during AY10-11.

Research Project Summaries

Modern Military Geography

Dr. Francis A. Galgano – Villanova University
COL Eugene J. Palka – U.S. Military Academy

Although geographic factors have had a compelling influence on battles and campaigns throughout history, geography and military affairs have gained heightened attention during the past two decades, and military geography is the subdiscipline best suited to explain the interactions between the two. Hence, the premise of our continuing research is founded on the principle that geographic knowledge of space, place, people, and scale provide essential insights into contemporary security issues and promotes the idea that such insights are critical to understanding and managing significant military problems at local, regional, and global scales. Within the context of *Modern Military Geography*, we strive to connect contemporary topics in military geography to the roots of the subdiscipline. Our framework, which includes introducing military geography, historical and operational military geography, and applied military geography—provides a comprehensive approach to addressing salient issues in the subdiscipline.

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.

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.

Characterization of Extreme Environments for US Army Materiel and Human Performance Testing

Dr. Russell S. Harmon – Army Research Office
BG (R) Wendell C. King - USACGSC
COL Eugene J. Palka – U.S. Military Academy
Dr. William W. Doe – Colorado State University

Sponsor: YPG (Yuma Proving Ground)

For the United States Army to successfully operate on a global scale, today's soldiers and their equipment must be capable of accomplishing any mission in all possible environments; cold or hot, wet or dry, with every possible combination of terrain and vegetation. This requirement challenges the Army's testing programs, which must define the threats to operations posed by natural conditions and then identify where these conditions are found globally. This can be done by defining and characterizing different Military Operating Environments and then applying science, coupled with operational experience, to identify the specific challenges each of these environmental settings pose for military operations. Given that the U.S. Army will continue to be operationally involved in extreme environments (desert, wet-tropics, and cold regions) for the foreseeable future, it is imperative that military equipment is designed and tested so that soldiers can accomplish their missions under the special conditions presented by these distinct military operating environments.

America's Military Footprint: Landscapes and Built Environments within the Continental U.S.

Dr. William W. Doe – Colorado State University
COL Eugene J. Palka – U.S. Military Academy

Megaprojects are huge in scale and cost and can have significant economic, social and environmental impacts, both positive and negative, on the surrounding landscape and communities. The U.S. military landscape is one of the largest, most expensive, and most enduring of the megaprojects within the country. Indeed, America's current military footprint has been evolving for more than 230 years and today includes more than 30 million acres within the nation's states (Doe 2008). Military lands comprise a unique component of the federal land management system in the U.S. These lands reflect the country's development and history, beginning as coastal defenses and outposts on the frontier, to becoming major military installations that are self-contained municipalities. Controlled by the four Armed Services, military lands include all land within the "fenceline" of a military installation, including two primary areas: 1) the cantonment – the built up component or "city" that houses and supports military personnel and their families, and 2) the range and training complex – consisting of live-fire ranges, bombing ranges and maneuver areas for training and testing of personnel, units and equipment. Irrespective of base realignments and closings, the military landscape within the U.S. is destined to continue as the federal government's largest, most expensive, and most enduring megaproject.

Characterizing Cold Regions for Army Materiel and Human Performance Testing

Dr. Russell S. Harmon – Army Research Office
COL Eugene J. Palka – U.S. Military Academy

Sponsor: ARO (Army Research Office)

A detailed terrain study of the Army test area at Fort Greely, Alaska was undertaken over a half-century ago by W.H. Holmes and W. S. Benninghoff of the Military Geology Branch of the U.S. Geological Survey for the U.S. Army Corps of Engineer Waterways Experiment Station as a contribution to a larger project on 'Military Evaluation of Geographic Areas' (Holmes and Benninghoff, 1957). It is interesting to note that the purpose of this work was....."the development of techniques of evaluating, comparing, and mapping actual and potential areas of military operation in terms of environmental effects" and that a subtask of that effort was to..... "collect in the field environmental data on existing research and development sites to provide a basis for evaluating the extent to which these test sites are representative of world-wide climatic-physiographic regions." Other studies from the 1950s examined analogs of Alaskan climate, terrain, and landscapes in other parts of the world (e.g. Falowski, 1957; Hastings, 1959) and developed techniques for identifying in quantitative terms those properties related to cold regions terrain that affect military materiel, personnel, and operational procedures (Stoertz, 1959, 1961). In effect, this study is a continuation of these early studies that utilizes more modern approaches but has the same objectives.

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.

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

COL Steve Fleming - U.S. Military Academy
Dr. Marguerite Madden - CRMS @ University of Georgia
Dr. David Leigh - 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: USSOUTHCOM (United States Southern Command)

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.

TRTC and YTC Test Site Characterization, Mapping and Imaging

COL Steven Fleming - U.S. Military Academy
MAJ Ian Irmischer - U.S. Military Academy
MAJ David Roux - U.S. Military Academy
CDT Brandon Boxler - U.S. Military Academy
CDT Ahmed Moomin - U.S. Military Academy
CDT Augustin Paulo - U.S. Military Academy
CDT Michael Seese - U.S. Military Academy
CDT Lee Summerlin - U.S. Military Academy
CDT Samuel Vaughn - U.S. Military Academy

Sponsors:

Yuma Proving Ground (YPG)
Yuma Test Center (YTC)
Tropic Regions Test Center (TRTC)

The Department of Geography and Environmental Engineering (D/GENE) 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 2007 and 2008, D/GENE completed eight missions in support of YPG. These missions included: (1) map data collection at Fort Greely, Alaska (with Cold Regions Test Center [CRTC]); (2) map data collection in Panama (with Tropic Regions Test Center [TRTC]); (3) site characterization of Llano Carti, Panama; (4) site characterization of Mocerón, Honduras; (5) re-assessment and update of the YPG Enterprise GIS; (6) cold regions test site descriptions and analog assessments; (7) terrestrial image data collection in Panama (with TRTC); and (8) terrestrial imagery and soil data collection in Alaska (with CRTC). In the winter of 2008/2009, YPG requested support for Summer 2009 missions, including work in Panama with TRTC and at Yuma, Arizona with Yuma Test Center (YTC).

CRTC Test Site Characterization, Mapping and Imaging

COL Steven Fleming - U.S. Military Academy
MAJ William Wright - U.S. Military Academy
CDT Jennifer Gerschultz - U.S. Military Academy
CDT Marie Hokenson - U.S. Military Academy
CDT Catherine Pottorff - U.S. Military Academy
CDT Derek Whitehouse - U.S. Military Academy

Sponsors:

Yuma Proving Ground (YPG)
Cold Regions Test Center (CRTC)

The Department of Geography and Environmental Engineering (D/GENE) 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 2007 and 2008, D/GENE completed eight missions in support of YPG. These missions included: (1) map data collection at Fort Greely, Alaska (with Cold Regions Test Center [CRTC]); (2) map data collection in Panama (with Tropic Regions Test Center [TRTC]); (3) site characterization of Llano Carti, Panama; (4) site characterization of Mocoron, Honduras; (5) re-assessment and update of the YPG Enterprise GIS; (6) cold regions test site descriptions and analog assessments; (7) terrestrial image data collection in Panama (with TRTC); and (8) terrestrial imagery and soil data collection in Alaska (with CRTC). In the winter of 2008/2009, YPG requested support for Summer 2009 missions, including the work done in Alaska.

Development of an improved soil amendment for control of lead on firing ranges

Dr. Michael Butkus - U.S. Military Academy
CDT Mark Lennox - U.S. Military Academy
CDT Taylor Pearce - U.S. Military Academy
Mr. Anand Shetty - U.S. Military Academy

Sponsor: Army Research Laboratory (ARL)

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. Column experiments were used to evaluate the effectiveness of Polonite to retard the transport of lead in groundwater. Preliminary data reveal that Polonite and Polonite amended with phosphate significantly reduced the transport of lead at circumneutral pH values.

Selective Growth of Methanotrophic Bacteria in Biological Fluidized Bed Reactor

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

Sponsor: California Environmental Protection Agency

Type II methanotrophs produce polyhydroxybutyrate (PHB) when grown under unbalanced growth conditions, but Type I methanotrophs do not. To identify selection conditions that favor Type II methanotrophs over Type I methanotrophs, we operated a laboratory-scale fluidized bed reactor (FBR) with granular activated carbon (GAC) over a 255-day period under various conditions. The FBR was initially inoculated with an enrichment dominated by Type II *Methylocystis* species. Influent dissolved oxygen (DO) was maintained at 9 mg/L, pH was maintained at 6.2-6.5, and nitrate was provided as the N-source. A *Methylobacter* spp.-like Type I methanotroph dominated the resulting biofilm. Growth of the Type I methanotrophic biofilms was only temporarily inhibited by a decrease in influent DO to < 7 mg/L and pH to < 5.5. Shift to biofilms comprising both Type I and Type II methanotrophs was eventually achieved by: (1) removal of most existing biomass from the reactor, (2) re-inoculation with a Type II methanotrophic culture dominated by *Methylosinus* species, (3) use of dissolved N₂ as sole N-source, and (4) operation at low influent DO (2.0 mg/L). Batch tests with the mixed methanotrophic biomass to characterize growth and PHB production indicate that samples grown with N₂ as the sole N-source were dominated by Type II methanotrophs and were capable of PHB accumulation, while samples grown with nitrate or ammonium were dominated by Type I methanotrophs and did not accumulate PHB.

Metabolic Kinetics of Methanotrophic Bacteria: A Classroom Laboratory Experiment

MAJ Andrew Pfluger - U.S. Military Academy
Dr. Weimin Wu, PhD - Stanford University

Sponsor: California Environmental Protection Agency

With the field of biotechnology rapidly expanding, it is increasingly important to provide relevant, hands-on education to environmental engineering students in the area of microbial growth and metabolic kinetics. Students enrolled in introductory microbiology courses can have difficulty visualizing the physical growth of bacteria, the stoichiometric ratios of substrate consumption, and the results of metabolic processes that produce end products. Methanotrophic bacteria can be used as a model, allowing students in an experimental laboratory class to understand microbiological fundamentals. Methanotrophs possess a relatively simple and easily understandable metabolic pathway, consuming methane (electron donor) and oxygen (electron acceptor) as their primary substrates, and producing carbon dioxide and water as end products. The objective of this study was to develop a simple experiment that clearly shows students the concepts of microbial growth, and the stoichiometry

associated with substrate consumption, using simple techniques with a readily available source of bacteria, i.e., methanotrophs. Typical results clearly depict the different rates of substrate consumption for oxygen and methane, and the rate of carbon dioxide production. This unique approach allows students to see firsthand the stoichiometry of the chemical reactions associated with the metabolism of methanotrophs. The results also clearly depict the microbial growth concepts of lag, exponential growth, and, if the experiment is continued long enough, microbial death. This experiment has been successfully conducted with several different genera of methanotrophic bacteria including *Methylobacter*, *Methylonsinus*, and *Methylocystis*, indicating that any genus of the methanotroph family can be successfully grown under these conditions.

Promoting human security in the developing world by adaptive reuse of commonly discarded materials to build solar cookers

Dr. Marie Johnson - U.S. Military Academy
MAJ Andrew Pfluger - U.S. Military Academy
CDT Dan Thueneman - U.S. Military Academy

This project focuses on designing and building an effective prototype solar cooker, created from commonly discarded materials, such as car parts, that are readily available in LDCs. The target population is the urban poor, who have access to scrapped materials, but do not have consistent access to firewood or the ability to afford cooking fuel. While solar cookers are not a new idea, our concept for designing and building them from junk, such as car parts, is unique. We do not envision building solar cookers en masse and then marketing or giving the cookers to people in need. Instead, we want to develop a solar cooker design that is flexible enough to be built from any type of available junk. Thus, local people with knowledge of the important design constraints could develop their own designs specific to their unique situation. This approach involves treating the local population as partners and not victims.

Risk based screening for beneficial use of dredged material: proposed development methodology

MAJ Andrew Pfluger - U.S. Military Academy
Mrs. Susan Bailey – ERDC
Mr. Daniel Averett – ERDC
Dr. Paul Schroeder – ERDC

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, Sanitation, and Hygiene development in rural Afghanistan

MAJ Dennis Sugrue - U.S. Military Academy

Sponsor: Center for Nation Reconstruction and Capacity Development

Afghanistan suffers from a lack of development in water and sanitation infrastructure. International groups have invested considerable time and money to the development of municipal services in Afghan cities, but 80% of Afghans live in rural areas. This research is developing activities that ISAF troops can engage in to better our counterinsurgency practices and simultaneously address the critical humanitarian need in that country. The project will additionally consider how these practices could be applied in any theater of operation.

Sustainability

Dr. Marie Johnson - U.S. Military Academy

LTC Mark Smith - U.S. Military Academy

This research program has the objective to evaluate the sustainability based approach toward educating future military officers on aspects of energy and environmental security. In particular, great savings can be achieved by applying sustainable principles and practices throughout military installations, systems, and operations. These sustainability practices can reduce risks to military war fighters by reducing the logistic burden of transporting fuel and water, and by minimizing the overall logistics footprint at base camps. Cadets can become the catalyst for the enhancement of military sustainable communities through an application of green technologies and human capacity building. Cadets, following their commissioning as officers, can play a vital role in driving new innovation and technologies critical to the military's future success in achieving energy and environmental security.

Greening Initiative West Point

LTC Mark Smith - U.S. Military Academy

COL Russell Lachance - U.S. Military Academy

Dr. Paul Simihtis - U.S. Military Academy

Dr. Gunnar Tamm - U.S. Military Academy

This research program has the objective to create an energy efficient and environmentally friendly campus through joint academic, West Point installation, and Army Ventures. In developing these "green" initiatives, we intend to follow a Systems Engineering thought process and methodology. Each proposed "green" project will be evaluated not only on the basis of its

individual merit and cost effectiveness, but also on the basis of how well each project's capability complements (or detracts from) the entire system, to include reduced energy cost and consumption, cadet education and leader development, and our overall technical, academic, and outreach objectives. This holistic approach encourages projects to be selected based on their positive effect on both monetary and nonmonetary criteria of value, and how the project may complement and support other potential projects, instead of being viewed in isolation. Results from this initiative will contribute toward making West Point a Net Zero Energy Installation by 2020.

America's Military Footprint: Landscapes and Built Environments within the Continental U.S.

Dr. William W. Doe - Colorado State University
COL Eugene J. Palka - U.S. Military Academy

Megaprojects are huge in scale and cost and can have significant economic, social and environmental impacts, both positive and negative, on the surrounding landscape and communities. The U.S. military landscape is by far the largest, most expensive, and most enduring of the megaprojects addressed in this book. Indeed, America's current military footprint has been evolving for more than 230 years and today includes more than 30 million acres within the nation's states (Doe 2008). Military lands comprise a unique component of the federal land management system in the U.S. These lands reflect the country's development and history, beginning as coastal defenses and outposts on the frontier, to becoming major military installations that are self-contained municipalities. Controlled by the four Armed Services (Army, Navy, Air Force, and Marine Corps), military lands include all land within the "fenceline" of a military installation, including two primary areas: 1) the cantonment – the built up component or "city" that houses and supports military personnel and their families, and 2) the range and training complex – consisting of live-fire ranges, bombing ranges and maneuver areas for training and testing of personnel, units and equipment. Irrespective of base realignments and closings, the military landscape within the U.S. is destined to continue as the federal government's largest, most expensive, and most enduring megaproject.

Understanding Pakistan: A geographic approach

COL Laurel Hummel - U.S. Military Academy
Dr. Richard Wolfel - U.S. Military Academy

Sponsor: US Army War College

This work is intended for an audience of operational to strategic level US military and government policymakers and planners dealing with the complex issues of Pakistan - a critical and troubled Muslim ally, and a nuclear state. It should also be valuable to students of Pakistan who wish to learn from cross-cutting and reinforcing thematic perspectives, and for all who realize its increasing geo-political importance to regional security vis-à-vis its relationships with perennial foe India to the east and Afghanistan to the west. With the realization by the United States Government (USG) and more specifically the Departments of Defense (DOD) and State

(DOS) that Pakistan will figure prominently in Asian and Middle East security relationships, we believe the need for timely, scholarly, and relevant geographically-based information is increasing. We envision the book to contain fifteen chapters, each focused on a different aspect of Pakistan's human, political, historical, physical or environmental geography. Chapters will give a larger-scale view of a system or process as it affects the state, while containing place-based case studies where appropriate. These thematic chapters will not provide a comprehensive examination of all the ways geography helps us understand Pakistan, but we believe they will reinforce one another synergistically and help the reader toward a multifaceted understanding of Pakistan and its issues. To further diversify the book's perspective and enrich its potential readership, we offer a foreword by Washington Post Deputy Foreign Editor Pamela Constable and an epilogue by travel writer Ethan Casey.

Project Ramani: Human Terrain Mapping in the Democratic Republic of Congo

Dr. Richard Wolfel - U.S. Military Academy

Sponsor: AFRICOM (United States Africa Command)

This project focused on the collection of geographic, social, political and cultural data for AFRICOM. The researchers reviewed open source materials in the United States, related to contemporary conflicts in the Democratic Republic of Congo and the ethnic geography of Kisangani, DRC. Next, we traveled to AFRICOM headquarters to meet with the social science research team and collect more data and guidance from them. Then, we traveled to Belgium for interviews with NGOs and research in major research libraries and the Congo museum in Brussels. Finally, we spent 2 weeks in the Democratic Republic of Congo conducting primary research in the academic libraries on site and field work interviewing key individuals and conducting analyses of landscape features.

The Tyranny of the Map and Modern Instability: The Ramifications of Incongruent Political and Ethnic Boundaries on Modern Africa

Dr. Richard Wolfel - U.S. Military Academy

Sponsor: US Army War College

One of the major issues hindering political and economic development in modern Africa is the incongruence of political and ethnic boundaries. Starting with the Berlin Conference, 1884-85, the boundaries of Africa were drawn out of convenience for the European powers with little regard to the ethnic boundaries of Africa. The result of this decision is an extended era of tribal and ethnic conflict. Most of the modern ethnic conflicts can be tied to the creation of multi-nation states, incorporating ethnic and tribal groups with a long history of animosity. This chapter will explore the evolution of political and ethnic boundaries in Africa as an important influence on modern conflict in Africa. The grouping of ethnic and tribal groups with long histories of conflict has created not only humanitarian crises as seen in Rwanda, Nigeria and Sudan, but also has facilitated authoritarian rule in various regions of the continent. In order to

successfully understand the nature of ethnic conflict in Africa, one must begin with a discussion of colonization and the division of Africa as started in Berlin.

Forging the New Pakistan: The Nationalistic and Geopolitical Movement of the Pakistani Capital to Islamabad

Dr. Richard Wolfel - U.S. Military Academy

Sponsor: US Army War College

This work examines the nationalistic and geopolitical motives for the 1960 move of the Pakistani capital from Karachi to Islamabad. The partition of the Indian subcontinent in 1947 created a series of boundary disputes; one of the most notable was in the Kashmir region. The Kashmir region was a predominately Muslim region, but lacked a large population base and a developed economic infrastructure. When the ruler of Kashmir refused to join Pakistan, in 1947, war erupted. First, Pakistan launched a campaign. This was followed up by the Indian Army which drove Pakistan from the region. The result of these conflicts in 1947 and 1948 was a region that was predominately controlled by India. This left Pakistan without a claim on the region. As a result, the Pakistanis built a forward capital near Kashmir in an effort to focus attention on Kashmir. From a nationalistic perspective, this move has two ramifications. First, the movement of the capital acts as a motivating force for Pakistanis to move to the northern regions of the country. Second, the movement of the capital can be explained using Foucault's (1980) theory of the prison. Foucault emphasized that prisons are designed in an effort to promote maximum surveillance of the prisoners. An interesting parallel exists in Pakistan. The Pakistani government and president Ayub Khan may have moved the capital near the Kashmir region in an effort to "watch" the Indian state and make a geopolitical claim on the disputed Kashmir region.

Language and Intercultural Competence: The Pathway to Intercultural Effectiveness?

Dr. Richard Wolfel - U.S. Military Academy

LTC Jesus Aguirre - U.S. Military Academy

Dr. Jeff Watson - U.S. Military Academy

Sponsor: OSD: Language Transformation Initiative

Increased intercultural competence and language proficiency have become important goals for education and training in the US Army. Empathy and flexibility have been identified as important characteristics of intercultural competence through the academic literature and along with general cultural knowledge, have become the foundation of the Center for Languages, Cultures and Regional Studies' (CLCRS) position on interculturally competent leaders. Also central to the foundation of CLCRS is the belief that increased language proficiency and the development of skills that helps individuals learn additional languages in the future are important career building skills for not only Army officers, but most college graduates. Given the

increased expenditure on language and culture training, there has been an increased emphasis on assessment of the study abroad experience. In the area of intercultural competence, CLCRS is currently employing the IDI as our primary assessment tool. As for the language assessment, initially, the Defense Language Proficiency Test (DLPT) was seen as the primary assessment tool. Concerns developed very quickly that the DLPT was not effective in assessing language achievement and proficiency at the lowest levels of competence. The basic level at which most cadets will operate after a year of course work and/or a short term study abroad opportunity. As a result of this concern, CLCRS has developed a "Prochievement" test to assess language proficiency and achievement at the basic level. Another issue that was quickly identified by CLCRS was a need to assess the interplay between language proficiency and cross cultural competence. There has been great debate in the academic literature over the connection between language proficiency and cross cultural competence. The goal of this project is to examine the interplay between language proficiency and intercultural competence. It is hypothesized that individuals with higher language proficiency scores should have a more developed position on the Developmental Model of Intercultural Sensitivity (DMIS) than people with lower scores. This is because language is a labor intensive skill and requires a large level of commitment. Individuals in more developed stages of the DMIS see the value of language skills and work to achieve greater language proficiency. Therefore, we expect a positive correlation between language proficiency (as measured on the in house prochievement test and also on final exams) and cross cultural competence (as measured by the IDI). The results of this study will allow CLCRS to emphasize the interrelationship between language and culture education and forge greater interdisciplinary links as the core curriculum at the academy is assessed for the quality and quantity of its culture education and training program. This is important beyond just the military and resonates in academic and business environments as all educators and trainers struggle with finding the correct balance between language and intercultural competence training and education.

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: OSD: 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 pollenmaps 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.

Strategic Missile Deployment: A Geographic Perspective

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 was useful for international diplomacy.

Predicting Karst Hazards Using Indicator Geostatistics

Dr. Peter Siska - U.S. Military Academy
Dr. Phillip Kemmerly - Austin Peay State University

Sponsor: FACULTY DEVELOPMENT RESEARCH FUND (FDRF)

The karst geomorphology is prone to natural hazards. The purpose of this project was to use GIS data from Austin Peay State University and develop methodology for mapping and predicting hazards associated with collapsing sinkholes. These maps would be then valuable for city planners, construction work, pipelines, flood prevention and other institutions that work in the karst area. The research was conducted in Clarksville, Tennessee area.

Human Terrain Analysis Concepts Course Curriculum

LTC Andrew D. Lohman - U.S. Military Academy
LTC Wiley C. Thompson - U.S. Military Academy

Sponsor: National Geospatial Intelligence Agency (NGA)

The National Geospatial Intelligence Agency has recently directed that a Human Terrain Analysis Concepts course be developed in order to support NGA analyst training. The desired outcome is that analysts, be able to effectively integrate HTA into the GEOINT tradecraft as a key tool so that they are able to assist commanders, strategic decision makers, and civilian leaders in understanding the factors that influence human behavior around the globe.

Seasonal variability in heat-related mortality across the United States

Dr. Scott Sheridan - Kent State University
Dr. Adam J. Kalkstein – U.S. Military Academy

Examined when humans are most susceptible to heat-related illness throughout the year.

Climate-suicide relationships: A research problem in need of geographic methods and cross-disciplinary perspectives

Dr. Grady Dixon - Mississippi State University
Dr. Adam J. Kalkstein – U.S. Military Academy

Evaluated the importance of geography and climatology in weather-suicide research.

The Use of Historic Aerial Photography for Land Use and Land Cover Change Studies

MAJ Margaret L. McGunegle - U.S. Military Academy

One of the challenges of land use and land cover change studies is acquiring data over a long enough time scale to produce significant results. Some areas such as those on the edge of urban development may change considerably over the course of just a few years. However, studies concerning less dynamic landscapes such as established forests or small rural towns may take decades to show meaningful change. One method to acquire information about changes to an area's land use and/or land cover is through the use of historic aerial photography. In the 1940s, the Farm Service Agency started photographing agricultural lands to accurately calculate farm acreage. With the application of today's geospatial technology, these historic images can be orthorectified, classified, and analyzed to generate landscape metrics going back up to 70 years.

Environmental Security

Dr. Amy Richmond Krakowka - U.S. Military Academy
Lt Col Lou Rios - U.S. Military Academy

Many areas of the world struggle on a daily basis with a multitude of environmental stressors ranging from day-to-day inconveniences to outright disasters threatening life and livelihood. The field of environmental security attempts to understand how the interrelationships between human and natural processes destabilize the environment and undermine human security. Indeed the cyclical relationship between resource depletion, poverty, and conflict has the ability to push societies to the brink of disaster. Environmental security is one component of human security, defined by the United Nations in 1994 as the intersection of economic, food, health, environmental, personal, community and political needs (Nyong 2005).

Environmental Security

Dr. Amy Richmond Krakowka - U.S. Military Academy
COL Laurel J. Hummel - U.S. Military Academy

The Department of Defense's Unified Command Plan divides the world into regions that are the responsibility of several Combatant Commands. The 2005 revision of the Unified Command Plan displays the 21st century's new geopolitical realities. In particular the changing situation of the African continent in the world system. The focus of this research/chapter is to better understand and critically interpret Africa's new geopolitical importance, and why a new Combatant Command, termed "African Command" (AFRICOM), is necessary in today's security environment when it was not necessary during and immediately following the "Cold War's" geopolitical and geo-economic environments.

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.

Environmental Security

Dr. Amy Richmond Krakowka - U.S. Military Academy
Dr. Frank Galgano - Villanova University

Sponsor: INSTITUTE OF NATIONAL SECURITY STUDIES (INSS)

The relationships between food, population growth, climate, resources, and environmental stress are evident in many developing states (Homer-Dixon 1999). This Malthusian paradigm generates much disagreement among researchers. However, both factions have to agree on an undeniable outcome that was manifest in Rwanda: population growth and environmental stress, superimposed over latent ethnic and political divisions will, in the end, be solved one-way or another. History and events suggest that their resolution can be violent (Diamond 2005). Thus, we propose a framework for conflict analysis that identifies sources of environmental stress and linkages to political, cultural, economic, and ethnic dimensions. Our framework is developed after the work of Butts (1994), Percival and Homer-Dixon (1995), Homer-Dixon (1999), and Diamond (2005). The framework is not intended to be predictive or proscriptive, only an analytical tool to account for dynamic and complex factors that contribute to environmentally enabled conflict.

Geography Education

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

What decisions do people in Sub-Saharan Africa make when they are hungry? How many crops do they plant? How many children do they have? These are the type of questions students are forced to think about in a game that simulates village life in Sub-Saharan Africa. This paper discusses the success and shortcomings of alternative teaching strategies conducted in an Environmental Geography class at the United States Military Academy. Several techniques are used to get students to participate in the classroom that differ from the traditional teaching methods. These include simulation games, educational trips, and blogging exercises. Empirical evidence collected over four years suggests that these nontraditional learning techniques contribute greatly to the students understanding of the subject matter. This paper explores both how to implement alternative teaching strategies and what the potential shortcomings are.

Geography Education

Dr. Peter Siska - U.S. Military Academy

Sponsor: FACULTY DEVELOPMENT RESEARCH FUND (FDRF)

The regional assessment for cadets traveling for Study Abroad Program (SAP) became of the main concerns at West Point. Though the assessment tools from foreign languages were already developed for a long period of time and culture assessment was performed using standardized IDI test, there was no assessment tool for regional studies. The six regional assessments were developed and are currently in use at West Point. The research is in process to evaluate these tools, clean them from bias and develop research that will determine the increase/decrease of cadets' regional competence after one semester studying abroad.

Geomorphology

Dr. Peter Siska - U.S. Military Academy
Dr. Phillip Kemmerly - Austin Peay State University

Sponsor: FACULTY DEVELOPMENT RESEARCH FUND (FDRF)

The karst geomorphology is prone to natural hazards. The purpose of this project was to use GIS data from Austin Peay State University and develop methodology for mapping and predicting hazards associated with collapsing sinkholes. These maps would be then valuable for city planners, construction work, pipelines, flood prevention and other institutions that work in the karst area. The research was conducted in Clarksville, Tennessee area.

Cultural Landscapes

Dr. Jon C. Malinowski - U.S. Military Academy

Cultural landscape research is a cornerstone of human geography. In celebration of the 100th anniversary of the completion of West Point's impressive gothic chapel, this research focused on the early 20th century architectural competition and subsequent redesign of the United States Military Academy grounds & buildings. The Academy's redesign was an attempt at finding common ground between the institution's self-perceptions and the grand visions of key architectural firms.

Analyzing Industrial Expansion: The Potential for Sustained Ethanol Production in Pennsylvania

MAJ Steven B. McGunegle, U.S. Military Academy

Ethanol production expanded rapidly in the United States from 2000-2008. This expansion pushed the construction of ethanol production facilities out of its traditional Corn Belt region. The expansion was fueled by surging demand due to commodity pricing combined with government regulation. This report analyzes the potential for long term profitability of production in areas that are deficient in the key resource of corn. The work aims to determine if state and county level monies invested will yield the promised long term economic and social benefits incumbent with well paying jobs from industrial production. The study shows that these facilities located outside of the traditional Corn Belt are unlikely to be profitable and will likely be subject to bankruptcy or divestment from larger corporations. The study can benefit regional development planners as well as international development agencies that pursue development through industrial expansion.

The urban heat island and its impact on heat waves in Shanghai

Dr. Jianguo Tan - Shanghai Urban Environmental Meteorology Center

Dr. Youfei Zheng - Nanjing University

Xu Tang - Shanghai Meteorological Bureau

Changyi Guo - Shanghai Municipal Center for Disease Control & Prevention

Liping Li - Medical College of Shantou University

Guixiang Song - Shanghai Municipal Center for Disease Control & Prevention

Xinrong Zhen - Shanghai Urban Environmental Meteorology Center

Dong Yuan - Shanghai Municipal Center for Disease Control & Prevention

Dr. Adam J. Kalkstein - U.S. Military Academy

Furong Li - Medical College of Shantou University

Heng Chen - Medical College of Shantou University

Studied two heat waves in Shanghai, China, and helped determine the role of the urban heat island.

The heat stress index: A new way of examining heat-related mortality

Dr. Adam J. Kalkstein – U.S. Military Academy
Dr. Laurence S. Kalkstein - University of Miami

Discussed the heat stress index, a new method of determining the how harmful a particular day will be to human health

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