Department of Geography and the Environment

Senior Projects Day

Tuesday, 9 December 2014
2:30 – 3:30 p.m.

Mendel Science Center
Villanova University
Department of Geography and the Environment
Villanova University

Projects Day Program: Fall 2014

- Department Faculty / Staff

Francis A. Galgano, Ph.D.
Associate Professor and Department Chair

J. Harold Leaman, Ph.D.
Associate Professor, Geography

Bangbo Hu, Ph.D.
Associate Professor, Geography

Keith G. Henderson, Ph.D.
Associate Professor, Geography

Lisa J. Rodrigues, Ph.D.
Associate Professor, Environmental Science

Nathaniel B. Weston, Ph.D.
Associate Professor, Environmental Science

Bonnie M. Henderson, Ph.D.
Assistant Professor, Geography

Steven T. Goldsmith, Ph.D.
Assistant Professor, Environmental Science

Melanie A. Vile, Ph.D.
Assistant Professor, Environmental Science

Stephen Levas, Ph.D.
Env.Sc. Post-Doctoral Teaching Fellow

Lori Sutter, Ph.D.
MSE Post-Doctoral Teaching Fellow

John L. Kelley
Adjunct Faculty, Geography

Ross Lee, Ph.D.
Adjunct Faculty, Environmental Science

Eric J. Wagner
GIS Laboratory Technician

Angelina Fondaco
Administrative Assistant

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Erin Grady

The Influence of Weather Conditions on the Abundance, Size, and Composition of Marine Debris on Long Sands Beach, ME.

Accumulation of marine debris is a major issue currently facing our world’s oceans. Marine debris poses a serious threat to the ocean environment by destroying habitats, endangering marine species, decreasing biodiversity, and spreading invasive species. It also decreases beach aesthetics and creates issues with boating navigation. Past studies have looked at the abundance of marine debris in different locations, but little research has been done on seasonality and the effects of weather on marine debris. This study was conducted on Long Sands Beach in York Beach, Maine to observe patterns in the abundance, composition, size, and source of marine debris during July and August 2014. Debris was collected along a standard walking path and sorted by size, composition, and probable source. Abundance was compared with temperature, precipitation, and wind data from Portland, ME. Debris on average was small, land-based plastics. When compared with abundance, days with temperatures above 75°F and little to no rain (considered fair weather conditions) typically had more debris while colder, rainier days (considered poor weather conditions) typically. This association needs to be studied over a longer period of time to observe multiple storm events and confirm this pattern. All though these results are specific to this location, this method can be used over a longer period of time at any location to determine the influence of weather conditions on the abundance, size, and composition of marine debris.

Advisor: Dr. Lisa Rodrigues

Jason Labrie

Remediation: The Next Step in Philadelphia’s Coal History

After years of receiving coal mining debris associated with the powering of the U.S. industrial revolution, the Schuylkill River was finally dredged of its coal waste in 1947 as an effort to clean up the water. This dredged coal sediment was piled into 23 retention basins along the river, including one in Valley Forge National Park where there are visible signs of reduced plant growth compared to the surrounding areas. Previous research has shown high levels of Fe, Zn, Pb, and Co at the surface of the Valley Forge Retention Basin (VFRB) that could lead to metal toxicity and poor plant growth. However, it is unclear as to whether this limited growth could also be a function of nutrient limitation. Therefore, this study focused on applying a series of soil amendments to the coal sediment and measuring the corresponding growth of bean
plants. Bean plants were planted in extracted samples of the sediment with the following four treatments: deionized water, KNO$_3$, KH$_2$PO$_4$, and KNO$_3$ + KH$_2$PO$_4$. The results showed that the plants grew well in DI water and KH$_2$PO$_4$, while the KNO$_3$ + KH$_2$PO$_4$ plants had 1.3% longer stalks and more visibly robust leaves. This indicates that the soil is likely phosphorus limited as opposed to nitrogen limited. These results suggest that vegetative recovery in the retention basins would benefit from the application of a phosphate fertilizer.

Advisor: Dr. Steven Goldsmith

• Patricia Lloveras

Impacts of Hurricanes, Tropical Storms, and Sea Level Rise on Florida Coastline

This study attempts to relate and predict future effects of global warming, and tropical storm intensity and frequency on Miami-Dade County, Florida. The continuous increase in Earth’s mean temperature causes ocean warming potentially providing additional energy for developing tropical storms. At the same time, global warming is responsible for the partial melting of glaciers, ice caps, and the Greenland and Antarctica ice sheets causing a rise in sea levels. The combination of sea level rise and increased hurricane intensity creates a scenario that most strongly affects low-lying coastal communities such as Miami, FL. In order to predict future tropical storm intensity and frequency I examined past hurricane trends on Florida’s coastline, specifically Miami-Dade County, from 1950 until 2014. Then, I factored in time, geography, storm intensity projections, and sea level rise, in order to create scenarios of coastal damages for the years 2040, 2060, and 2080. Southern Florida has a high probability of experiencing destructive effects like the loss of coastal communities, ecosystems, and vegetation. Major hurricanes along with increasing sea level rise can cause studied geomorphic changes within coastal zones. It would be beneficial to better understand the trends of tropical storms at or near cities of interest to better cope and plan for such impacts.

Advisor: Dr. Keith Henderson

• Francis Polignano

Where is the Fertilizer Going? Using GPS and LIDAR derived Digital Elevation Models to Determine Flow Path of Nutrient Runoff

Nutrient pollution is a growing problem. With fertilizer use rising for the past 50 years, monitoring fertilizer runoff has never been more important. Excess nutrients from fertilizer runoff end up in local water bodies where they stimulate plant growth causing eutrophication. Villanova University uses fertilizers to keep their athletic fields and highly visible areas looking presentable. It is crucial for Villanova to understand where this fertilizer runoff is going. In this project, the potential paths of fertilizer runoff were
determined by constructing multiple digital elevation models (DEM’s) of Villanova’s Campus. Campus was broken up into 3 separate areas, Main, West and South. Roughly a 100,000 point elevation and positon dataset was constructed using a GPS. Data were logged in 1s intervals as campus was covered on foot. Using ArcGIS, the dataset was used to create 3 DEM’s which were then used to determine flow path. A second set of DEM’s were created using a LIDAR dataset in an attempt to compare the accuracy of the two methods. Both models found the highest single point elevation value of all 3 study areas to be on Main campus (520.3/469.83 ft.). The lowest single point elevation value was found on South (387.23/394.92 ft.) and the highest average was found on West (451.08/445.76 ft.). Both models predicted water on Main campus to flow from Mendel Field to Lancaster Ave. towards Pike Lot, West campus to flow away from the center in both directions and South campus from Lancaster Ave. towards Good Counsel.

Advisor: Dr. Keith Henderson

- Alma Provencio

**Can shifts in energy balance resulting from Pinyon tree die-off in New Mexico influence weather patterns?**

Large-scale tree mortality due to drought, higher temperature, and other pests is emerging as a global phenomenon. In this research we hypothesized that tree die-off might also have adverse effects on local energy balance and subsequent climate. We measured near-ground air temperature, near-ground relative humidity with small data logging weather stations, and net radiation with a two component net radiometer in three experimental plots near Albuquerque, New Mexico. These plots included trees that died recently of natural causes, trees that were girdled (i.e. killed by removing bark from around the tree base), and trees that remain alive. Our preliminary results suggest that near-ground temperature and relative humidity are different across these three experimental plots. Girdled and dead tree plots had higher minimum and maximum temperatures than live tree plots, but the live tree plots had a higher percentage of relative humidity than the other 2 plots. More importantly, our results also suggest similar trends in energy balance across these plots. All three plots are emitting and in-taking about the same levels of energy, with the girdled plot in-taking a slightly lower amount of solar radiation and live tree plots emitting a little less energy than the other two plots. These findings suggest that near-ground microclimate can be affected by changes in tree density and spatial patterns and such changes can lead to alterations in the balance of energy. Although this study is small in scale and focuses on Pinyon pine woodlands in New Mexico we believe that large scale tree die-off, predicted to occur as climate warms, could cause adverse effects on forests in other parts of the world such as the Amazon rain forests of Brazil.

Advisor: Dr. Keith Henderson
The Effects of Instream Natural Gas Pipeline Construction on Discharge and Turbidity Concentrations in the East Branch of the Brandywine Creek

The high growth rate of natural gas as an energy source in the United States (approximately 7.5% per year for the past five years) has led to a surge in the construction of pipelines to facilitate its transport. Pipelines are generally considered to be safe, efficient, and cost-effective once construction is complete. However, with over 300,000 miles of natural gas pipelines in the continental United States, it is inevitable that some pipelines will intersect waterways, which could negatively affect the associated stream quality during construction. The focus of this study was to examine the effects of pipeline construction on the East Branch of the Brandywine Creek in Downingtown, PA by examining data for stream discharge and turbidity. Data were downloaded from USGS monitoring stations for locations above stream and below stream of construction activities and then analyzed to determine trends in discharge and turbidity over the construction time-period. The results of this experiment supported the claims made by previous studies that instream construction results in short-term turbidity spikes. In particular, seven spikes in downstream turbidity concentrations that were unrelated to rain events were observed over the 13-week construction period with an average duration of 1.3 hours. While effects of instream construction can be reduced through proper techniques, there is a still a concern because even short-term turbidity increases can negatively impact drinking water quality and aquatic habitats.

Advisor: Dr. Steven Goldsmith

Environmental Security Index of East Asia

The intersection of geopolitical boundaries, population pressures, and abundant natural resources creates the potential for environmental security risks in East and Southeast Asia. These countries are important within the context of twenty-first century climate change as emerging economies with large populations and complex environmental challenges. Most significantly, China controls the headwaters of nearly all of the major rivers in East Asia, and is likely to experience tension with its neighbors as it seeks to secure resources for its own people. Further, many of these countries also struggle with high dependency on the land, deforestation, and soil degradation, all of which combine to form environmental security risks. This research seeks to quantify and spatially represent the risk of conflict among China and its neighboring countries based on environmental security variables.

Advisor: Dr. Frank Galgano
Kate Wister

Evaluating a Link Between Groundwater Chemistry and Human Perception of Fracking

Recent advances in shale gas extraction practices (i.e., hydraulic fracturing) have allowed for a rapid expansion of U.S. natural gas production. However, concerns remain with regards to potential impacts to shallow groundwater quality and resulting effects on human health. Here we conduct a joint geochemical study and citizen survey to evaluate a potential link between shale gas hydraulic fracturing and impacts to groundwater quality and human health. As part of this study, approximately 25 private shallow drinking water wells in Bradford and Susquehanna Counties in Pennsylvania were sampled and analyzed for methane, total conductivity, nutrients and select elemental constituents. These same residents also took a survey documenting their perceived changes in water quality and resident health since commencement of drilling activities as well as their opinions on shale gas hydraulic fracturing. The analytical results revealed detectable methane concentrations in over 70% of the wells. In addition, we found a positive correlation between methane concentrations and total conductivity. This correlation could indicate a link between residential groundwater chemistry and the chemistry of the Marcellus shale salt brine, which would suggest that flowback fluid from hydraulic fracturing is migrating to the underground aquifer. However, isotopic analysis of the methane is needed in order to confirm this result. The survey revealed a statistically significant decrease in residents’ opinions of their water quality before and after drilling commenced in their immediate area, however no statistical correlation was observed between resident’s ratings of their water and groundwater levels of methane and conductivity. Finally, while the majority of residents interviewed supported hydraulic fracturing because of the economic benefits, most of these residents did not drink their water. These preliminary results indicate the need for increased sampling efforts evaluating the groundwater and human health impacts associated with shale gas extraction.

Advisor: Dr. Steven Goldsmith