2018 GIS and Remote Sensing Research Symposium

April 20, 2018 | 12:00 – 4:30 pm
Virginia Tech, Newman Library Multipurpose Room (first floor behind the coffee shop)

Poster Abstracts

Heather Abernathy
Department of Fish and Wildlife Conservation
Virginia Tech
Acknowledgements: Micheal Cherry, Elina Garrison, Richard Chandler, Mike Conner, U.S. Fish and Wildlife Service, National Parks Service, and Florida Fish and Wildlife Conservation Commission
Title: *Is the Grass Really Greener: Examining the Trade-offs Between High-quality Parturition Sites and Depredation Risk in White-tailed Deer*

Many ungulate species limit space use to a small proportion of their home range during fawn-rearing. Selection of and within these subsets can impact the quality of concealment cover for fawns and forage availability during early lactation, which is the peak of maternal investment. Further, selection of fawn rearing areas are thought to be based upon the trade-offs of depredation risk and the energetic demands of lactation. Resource procurement by foraging ungulates can be reduced under high depredation risk because of increased vigilance, or selection for safer but lower quality habitat patches. Therefore, fawn-rearing habitat selection has potential to link anti-predator behaviors to population-level processes such as neonate growth, survival, and recruitment.

It has been shown that in predator dominated systems white-tailed deer (Odocoileus virginianus, hereafter deer) select for habitat type that has the most concealment cover at the cost of high-quality forage. In south Florida, the endangered Florida panther (Puma concolor coryi, hereafter panther) is the primary predator of adult deer, but in addition to panther, fawns are also susceptible to depredation by bobcat (Lynx rufusname) and black bear (Ursus americanus). We aim to compare the energetic demands of lactation with the benefit of concealment cover for female deer in south Florida; specifically, our research objective is to compare concealment cover selection to habitat quality (i.e. productivity) of parturition sites.

In order to quantify habitat selection and habitat productivity within parturition sites, we estimated home ranges (first-order selection) and fawning home ranges (second-order selection) for does, and quantified mean distance ratio to habitat types and photosynthetic activity in each home range, respectively. We used Florida natural areas inventory data to quantify cover types and Normalized Difference Vegetation Index and Enhanced Vegetation Index to quantify productivity. This is part of a larger study that aims to examine the trade-offs for female deer between high-quality habitat selection and depredation risk in south Florida.

Sanam Aksha
Department of Geography
Virginia Tech
Acknowledgements: Lynn M. Resler, Bill Carstensen, Luke Juran
Title: *Application of Logistic Regression Model for Landslide Susceptibility Mapping using GIS and Remote Sensing Data*

Landslide susceptibility mapping is a primary tool to understand the basic characteristics of slopes that are prone to landslides. The aim of this study is to evaluate the hazard of landslides at Dharan city, Nepal using a geographic information system (GIS) and remote sensing, and logistic regression modeling in R. In this study, landslide locations were identified and mapped from the interpretation of high-resolution satellite images, google earth images, and field surveys. In total, 71 landslide locations were mapped using ArcGIS 10.3, and the locations were randomly divided into two groups: training (70%) and validating (30%) respectively. Ten layers of landslide-conditioning factors were prepared including slope angle, slope aspect, curvature, distance from faults, distance from streams, elevation, land use, lithology, normalized difference vegetation index (NDVI), and topographic wetness index (TWI). After performing logistic regression in R, elevation, land use (water), TWI, and distance from stream were obtained as significant predictors to model presence and absence of the landslides in the study area. The receiver operating characteristics (ROC), including the area under the curve (AUC), was used to assess the accuracy of the models. The success (training data) and prediction (validation data) rate curves were calculated. The result show that the AUC for success rate is 0.739 (73.9%) and the prediction rate is 0.837 (83.7%). The outcome map would be useful for local officers and planners for sustainable development planning as well as in devising better disaster risk reduction programs and policies.

Abby August
Department of Geography
Virginia Tech
Acknowledgements: Abigail August, Dept. of Geography; Stewart Scales, Department of Geography; Emily Satterwhite, Appalachian Studies, Dept of Religion & Culture.
Title: *Mapping Appalachia*

There have been attempts to define Appalachia's boundaries for over 100 years. The definitions differ in their criteria, (eg. physiographic, geologic, political) and are dependent on the perspective of the scholar defining the region.

The historic and modern definitions of Appalachia are not only useful for educators, but have real life impacts such as the distribution of Federal funding and public policy. The research we have completed comes in two parts - an article (soon to be) published in the Journal of Appalachian Studies, and an online mapping component hosted by Virginia Tech and ESRI. The article presents a historical overview of major scholarly and political delineations from 1895 to the present. The online component is a website that houses dynamic reconstructions of Appalachian regional maps created in ArcGIS, hosts the published article, and contains scans of original maps. While other online resources for historic maps of this region exist, there has yet

to be a single digital resource that compiles many of the regional definitions, which can be used as to compare and contrast all prior and current versions of Appalachia's boundaries.

This digital archive offers the possibility of combining many previous studies to define the Appalachian region in a different way, in a single paper. The purpose of the article and the map series is to make available a mapping tool for education and activism, facilitate discussion regarding the meaning of places, and to urge for the most useful and inclusive definition of Appalachia.

Shreejana Bhattarai
Department of Geography
Virginia Tech
Acknowledgement: Korine Kolivras, Dept. of Geography
Title: *Understanding Land Use and Land Cover in Nepal*

Land use and land cover are changing constantly all over the world, mostly due to human activities. This study aims to understand the patterns of land use and land cover in Nepal from 1990 to 2010 and then predict the future land cover for 2020 using Markov Chain Transition Model with the help of ArcGIS. The most common land cover types in Nepal are forest, shrubland, grassland, agriculture land, barren area, water bodies, snow/glacier and built-up areas. Forest, grassland and water bodies decreased in Nepal by 6.99%, 10.85% and -3.25% respectively between 1990 and 2010 whereas, shrubland, agriculture area, barren area, snow/glacier and built-up area increased by 4.47%, 7.57%, 25.15%, 7.54% and 65.14% respectively. While other land cover showed mix of increase and decrease between 1990-2000 and 2000-2010, built-up area increased in both of the periods with the rate of 28.51% in each period and a cumulative of 65.14% between 1990 and 2010. This shows that there is high rate of urbanization in Nepal.

The predicted land cover for 2010 was compared with the actual land cover of 2010 and it showed that there was high prediction accuracy for forest, shrubland, grassland, agriculture, water bodies and built-up area, the prediction accuracy ranging from 90.71% for agriculture to 96.39% for shrubland. However, the prediction accuracy was lower for barren area (68.68%) and snow/glacier (72.05%). Prediction of LULC for 2020 based on 2010 data shows that forest, water, snow/glacier and built-up area are going to increase while shrubland, grassland, agriculture land and barren area are predicted to decrease. These results may be helpful to decision makers to monitor urbanization and other land cover changes and plan development works that is beneficial to public instead of randomly constructing any infrastructure.

Michael Bittner
Department of Public Health
Virginia Tech
Acknowledgements: River Pugsley, VDH; Andrea Bertke, Dept. of Public Health
Title: *The Changing Prevalence of Gonorrhea in Virginia*

Gonorrhea has become an increasing health issue for residents of the U.S. In 2013, there were 270,000 reported cases of gonorrhea while in 2017 it is predicted that we will have 820,000 cases (1). This increase is seen in Virginia as well, where in 2017 there were 4,099 cases reported by June 2017 while in 2012 there were 5,752 for the whole year. Cases occur all over the state, higher numbers showing up in the Central and Eastern regions. However, there are specific areas where large numbers of cases have been reported consistently over the past several years. These areas have been slowly growing broader with new cases springing up close to key focal points.

After looking at the data, it was found that each of these distinct areas are usually cities, often having a major college affiliated with them. This makes it likely that reported cases are most likely coming from teens and young adults (17-25). Other notable places experiencing high trends of cases are naval and army bases. This can be explained by considering that 18 year olds can join, making it possible for them to be the source of the outbreak within these facilities. Actions need to be taken to reduce the spread of gonorrhea further which could come in the form of education or providing free prevention measures to the at risk population. Preventative measures need to be taken so that the recent increasing trend in reported cases does not continue going forward.

Amy Blood
Department of Forest Resources and Environmental Conservation
Virginia Tech
Acknowledgement: Susan Day, Dept. of FREC
Title: *An Ecohydrological Urban Forest Typology*

Urban forests mitigate stormwater runoff, yet the contribution of particular trees depends partly upon form, structure, and configuration (location in the landscape relative to immediate surroundings). Additionally, these factors may be associated with ecohydrological landscape characteristics (ELCs) such as species, leaf area, and ground covers that also mediate ecohydrological processes. It is logistically challenging to assess individual attributes of every urban tree and their interactions with neighboring landscape features, but also difficult to link these individual attributes with policy or management.
In this study, we asked can we meaningfully classify urban forest types and include their ecohydrological differences and interactions?

We hypothesize that this can be achieved through development of an ecohydrological typology.

Our objective is to define common groupings of urban forest characteristics that influence ecohydrology. We extracted ELCs from urban forest plots in Atlanta, GA. Using hierarchical cluster analysis we derived distinct ELC groupings to define distinct urban forest types.

Kyle Brasier
Department of Crop, Soil, & Environmental Science
Virginia Tech
Acknowledgements: Joseph Oakes, Dept. of PPWS; Maria Balota, Dept. of PPWS; Sam Winter, Dept. of CEE; Wade Thomason, Dept. of CSES; & Carl Griffey, Dept. of CSES
Title: *Remote Sensing as a Tool to Enhance Conventional Plant Breeding*

Mid-Atlantic wheat production requires nitrogen (N) fertilizers to meet plant demands and ensure grower profits. However, N lost from the plant-soil system can contribute to the degradation of aquatic and terrestrial ecosystems. Wheat breeders have responded by developing cultivars that are capable of taking up and utilizing applied N for grain yield and biomass production. Conventional approaches for measuring biomass and N-uptake are costly and labor intensive. Unmanned aerial vehicle (UAV) mounted sensors provide an opportunity to complement traditional plant breeding with high-throughput and cost-efficient plant phenotyping. This study was conducted to develop predictive models using 13 UAV-collected indices at six developmental stages for grain yield, above-ground biomass, and N uptake in a panel of 14 winter wheat varieties grown under standard and reduced N rates.

Significant vegetative indices and routinely collected morpho-physiological traits will be combined to develop, validate, and compare multi-variable parametric and non-parametric models for plant N response. Simple linear regression failed to adequately predict grain yield within an environment (R2 = 0.52) using normalized difference vegetation index during mid-grain fill. The study will utilize ridge and random forest regression models with conserved variables to improve selection of major N-related traits in winter wheat.

Jill Derwin
Dept. Forest Resources and Environmental Conservation / Remote Sensing IGEP
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Acknowledgements: Valerie Thomas, Randolph Wynne, Evan B. Brooks, Christine E. Blinn, Department of Forest Resources and Environmental Conservation, Virginia Tech; Greg Liknes, John Coulston, Mark Finco, Kevin Megown, Gretchen Moisen, Chris Toney, K. Schelleweis, USDA Forest Service; Robert Benton, Bonnie Ruefenacht, UDSA Forest Service Remote Sensing Applications Center
Title: *Modeling of Percent Tree Canopy Cover from Multi-temporal Landsat Data: The Performance of Phenological Curve Characteristics*

Tree canopy cover (TCC) is the measure of proportionate area covered by the vertical components of tree crowns (Jennings, Brown, & Sheil, 1999). This measure of density influences a broad range of processes, applicable to forest ecology and management including fire,

hydrology, nutrient cycling, and local and global climate.

The goal of this study is to determine whether including information characterizing the annual phenology from three years preceding our target date can improve estimates of percent TCC.

Time-series analysis yields information describing trends in repeated measurements through time. These data could provide insight into phenological characteristics at the pixel-level, which may impact TCC in that location. In recent years the capacity to analyze time-series of remotely sensed imagery across large areas has increased drastically due to improvements in high performance and cloud-based servers, as well as the open publication of the Landsat archive and other satellite imagery.

For this research, we compare the performance of spatial models of percent Tree Canopy using Landsat Median Composite imagery and digital elevation data to those using variables derived from Landsat time-series, and those combining both types of variables. For time-series variables, we include harmonic regression coefficients which describe the amplitude and period of fluctuations in reflectance over time for each pixel, using multi-temporal stacks of NDVI, SWIR 1 and SWIR 2 imagery from Landsat.

We demonstrate, that time-series variables, describing the recent phenologic cycle within a pixel, can be very informative in predicting percent Tree Canopy Cover, and improve overall model performance. Models generated from our time series variables perform better than those generated from comparable single-date variables (NDVI, SWIR1 and SWIR 2 from Landsat Median Composites), matching or improving R2 values by up to 10%, and full models combining a full suite of single-date variables including digital elevation data are improved by up to 12% when time-series variables are also considered. Overall model performance for the full model predicts TCC with an R2 of between 0.676 and 0.704 with an RMSE ranging from 15.80 to 20.64.

Samantha Fried
Department of Science, Technology, and Society
Virginia Tech
Title: *Knit the World*

In this project, I will create Fair Isle knitting patterns from Landsat imagery. Fair Isle is a type of knitting that typically involves anywhere from two to five different colors of yarn, knitting and purling (the two most basic stitches), and a variety of techniques for carrying yarns that are not presenting in the pattern in a given stitch or row over (this is called "catching floats"). However, for this project, I am attempting Fair Isle patterns of Landsat imagery that involve ten or more different yarn colors. The purpose of this project is to use this knit Landsat imagery to (1) create tactile art projects that can teach public audiences about remotely sensed images of earth; (2) bring the language and techniques of fiber art into the field of remote sensing in new and interesting ways; (3) re-situate the history of the digital image -- and the coding techniques that make such an image possible -- within the history of fiber art broadly, and within the history of the Jacquard Loom specifically.

Michael Graham
Geospatial and Environmental Analysis
Virginia Tech
Acknowledgements: Craig Daughtry (USDA-ARS, Hydrology and Remote Sensing Laboratory); Baojuan Zheng; James Campbell, (Dept. of Geography);, Megan O'Rourke (Dept. of Horticulture); Quinn Thomas (Dept. of FREC)
Title: *Detecting Differences in Tillage Practices with Remote* Sensing

New moderate-resolution satellites, such as Landsat 8 and Sentinel-2A & -2B, are expected to substantially enhance capacity to collect high-quality remote sensing data for many Earth science applications, including agricultural land use change (LUC), and assessment of tillage status. Landsat 8, and the two Sentinel-2 systems, provide similar spectral and spatial resolution, and, together, greatly improve revisit capabilities (at least five days), thereby enhancing opportunities to acquire the sequential cloud-free imagery necessary for monitoring LUC. However, few studies have compared or combined Landsat 8 and Sentinel imagery to assess LUC over broad areas.

Broad-scale satellite imagery has been shown to provide an effective means of assessing uses of varied tillage practices. Alternative tillage practices, particularly conservation tillage, have been shown to improve ecosystem services on agricultural lands, thereby supporting assessment of impacts of tillage upon water quality, soil erosion, and soil carbon status.

Use of the minimum Normalized Difference Tillage Index (minNDTI) have been established as an approach for accurately estimating field-level crop residue cover (CRC) and tillage status based on multi-temporal Landsat imagery acquired early in the growing season, as new crops are planted. Yet, utility of the minNDTI method has previously been limited, even when two Landsat systems were active, by cloud cover during the narrow window available for observing tillage status. The recent launch of Landsat 8, and two Sentinel-2 satellites, however, offers the opportunity to overcome these constraints and improve effectiveness of the minNDTI approach for monitoring tillage practices. Therefore, objectives of this research are to compare performance of the minNDTI method using sequential imagery from: 1) Landsat 8 Operational Land Imager (OLI), 2) the Sentinel-2A & Sentinel-2B MultiSpectral Instruments (MSI), and 3) combined data from Landsat 8 OLI and Sentinel-2 MSIs.

Results indicate that for measured versus minNDTI predicted CRC, coefficient of determination (R2=0.66) and RMSE (12.13) were lower for Landsat 8 in 2016, compared to Sentinel-2 (R2=0.70, RMSE=11.47%). Combining Landsat 8 and Sentinel-2 data resulted in a higher (R2=0.79) and lower RMSE (9.43) in 2016 compared to either Landsat 8 or Sentinel-2 separately. In 2016, overall accuracy for Landsat 8 was 55%, 70% for Sentinel-2, and 80% for combined Landsat 8 and Sentinel-2 data. In 2017, measured versus minNDTI predicted CRC for Landsat 8 had R2 of 0.84 and RMSE of 8.83%. Sentinel-2 had higher R2=0.86 and lower RMSE (8.03%). Since minNDTI values for all points for combined data were derived from Landsat 8 in 2017, the combined Landsat 8 and Sentinel-2 results for 2017 are identical to those of Landsat 8. Sentinel-2 had lower overall accuracy (78%) relative to Landsat 8 (83%) and combined data

(83%). These results corroborate the potential for combining next generation satellites to obtain accurate information on tillage practices and CRC at broad spatial scales.

Brittany Grutter
Online Master of Natural Resources
Virginia Tech
Acknowledgements: Cully Hession, Dept. of BSE; Laura Lehmann, Dept. of BSE
Title: *Small Unmanned Aircraft use in LiDAR Data Collection*

Small unmanned aerial vehicles (UAVs) are becoming less expensive and more available for use in agricultural management and environmental assessment. We will be using a new Light Detection and Ranging (LiDAR) system mounted on our Vapor35 UAV for highâ€resolution mapping of agricultural and environmental activities. The ability to deploy LiDAR on smaller UAVs is new, and in need of method development and testing to evaluate capabilities for mapping for farm management and environmental assessment/management. We will present results of mapping in distinctly different environments (cropland, pasture, silvopasture, streams, and floodplains) and discuss the potential of UAVâ€borne LiDAR systems.

Sara Harrell
Landscape Architecture Program
Virginia Tech
Acknowledgement: Mintai Kim, LAR Program
Title: *Analysis of Blacksburg, VA's Challenges and Opportunities to Local Ecology and Urban Development*

The discipline of landscape architecture approaches understanding the world through a lens considering the cultural, physical, and biotic factors driving the landscape ecology of a particular place. The town of Blacksburg, located within the Valley and Ridge physiographic province, is situated in the headwaters of two watersheds: the Chesapeake Bay and the Mississippi River. The two named creeks that drain away all of the town's stormwater runoff are vulnerable to the impacts from excess nutrient, sediments, bacteria, and physical degradation due to accelerated runoff over impervious surfaces.

Virginia Tech's 2047 Beyond Boundaries vision for the future and complementing campus master plan will no doubt have implications for landscape and upland disturbance remediation both on campus and across town. Increased enrollment and expansion at the university will drive market demand for housing and support services, which will require new development in both the town and county. Understanding the challenges and opportunities within the impacted watersheds would help planners and decision-makers with their directive of developing the town to accommodate the needs of the growing university population while also being cognizant of potential environmental impacts. Virginia Tech's conceptual master plan, the town of Blacksburg's existing and future land use zoning, U.S. Census data, and other spatial data will be analyzed together to tell a story about what the future might look like for ecology and ecosystems for the watersheds directly impacted.

Austin Hayes
Department of Crop and Soil Environmental Sciences
Virginia Tech
Acknowledgements: David T. Reed, Dept. of CSES; David McCall, Dept. of PPWS; & Pat Donovan, Dept. of CSES
Title: *Aerial Observation of Flue-Cured Tobacco*

While aerial imagery has been used in other crops as a means to estimate various plant qualities, less is known about its usefulness in tobacco research and production. Given the high value per acre of tobacco, as well as the importance of leaf quality in determining this value, tobacco growers and researchers stand to benefit from aerial imagery that can be used for predicting those factors effecting the crops quality and yield. Therefore, an experiment was designed to investigate whether these factors can be observed using UAV-acquired broadband NDVI imagery.

Factors effecting tobacco yield and quality were separated into two levels. The first level consists of variety and N-fertilization rate, both static factors. The second includes dynamic plant factors, such as leaf nitrogen, chlorophyll, nicotine, and total alkaloids content. A flue-cured tobacco field-plot was set up in a split-plot design with N-rate as the main plots and varieties in the subplots. Treatments included 10 varieties and 3 nitrogen rates (55, 75, and 100 lbs per acre). 20 BGNIR aerial surveys were taken of the field-plot from 36 to 124 days after transplanting. ENDVI, a close relative of NDVI that is specialized for low-altitude UAS data, was applied to all surveys. Zonal statistics was then used to extract ENDVI metadata for individual plot-rows at each observation date. A seasonal pattern in ENDVI over time is present. Three growth stages can be observed: rapid plant growth (rising values), leaf expansion and dry weight accumulation (declining values), and leaf maturation and ripening (low, level values).

Removal of the terminal inflorescence appears to prompt the declining ENDVI values. For early-season observations, the effect on ENDVI due to variety and N-rate were not statistically significant (Î± = 0.05). However, starting near the end of the leaf maturation and ripening stage and through the last observation date, both effects were significant. The variety and N-rate interaction was not significant throughout. We are currently nearing the completion of gathering all data on our level two plant factors. Chlorophyll concentration was measured throughout the growing season with a handheld meter. Leaf samples were taken during harvest and they are being chemically analyzed for the other dynamic plant factors. We will investigate the correlation of these factors to ENDVI using simple linear regression.

Matthew House
Department of Forest Resources and Environmental Conservation
Virginia Tech
Title: *Landsat 8 Based Leaf Area Index Estimation in Loblolly Pine Plantations*

Leaf area index (LAI) is an important biophysical parameter used to monitor, model, and manage loblolly pine plantations across the southeastern United States. Landsat provides forest scientists and managers the ability to obtain accurate and timely LAI estimates. The primary

objective of this research was to determine how the relationship between ground-based LAI measurements and OLI-derived indices changes through the year, with a particular emphasis on peak LAI in late summer and minimum LAI in late winter. Sub-objectives were to assess the impact of image geo-registration quality, and to compare top-of-atmosphere and surface reflectance.

Permanent plots for the collection of ground LAI measurements were established at two locations near Appomattox, Virginia and Tuscaloosa, Alabama in 2013 and 2014, respectively. Each plot is thirty by thirty meters in size and is located at least thirty meters from a stand boundary. Plot LAI measurements were collected twice a year using the LI-COR LAI-2200 Plant Canopy Analyzer. Ground measurements are used as dependent variables in regressions with OLI-derived vegetation indices. We conclude that ground LAI estimates at minimum and peak LAI in loblolly pine stands can be combined and modeled with Landsat-derived vegetation indices, particularly SR and NDMI, across sites and sensors.

Cameron Houser
Department of Forest Resources and Environmental Conservation
Virginia Tech
Title: *Using LiDAR to characterize forest structure for ecosystem energy balance models*

Vegetation structure is a key ecosystem property influencing the atmosphere-land surface energy balance. The vertical structure of forest canopies can alter the movement of wind, heat, and moisture throughout the ecosystem. Forests are of particular interest as they are highly variable and complex compared to grasslands and agricultural systems. However, the variable nature of forest structure creates a challenge for incorporating structure into models focused on mapping energy fluxes across space and time.

Current atmosphere-land energy balance models that incorporate vegetation structure generally do so by using look-up table parameters that are a function of land cover classification or spectrally-derived indices (e.g. MODIS/Landsat products). Light Detection and Ranging (LiDAR) can be used to better characterize canopy properties and 3D structure in ways not possible through spectrally-based methods. To test the performance of lidar-derived vegetation parameters for evapotranspiration (ET) modeling, I integrated canopy height, fractional cover, and canopy density into the Two Source Energy Balance (TSEB) model at both a mature loblolly pine plantation forest and loblolly clearcut site in Plymouth, North Carolina.

Using a One-At-a-Time (OAT) sensitivity analysis, I characterized the variability in modeled ET as a function of parameter variability. My results show the TSEB model is not sensitive to vegetation height under the local conditions at my test site. The model run that included lidar-derived height had a lower performance than the standard model run (RMSE of 195 vs 193 watts per meter^2, respectively). However, TSEB was shown to be sensitive to fractional cover and canopy density. Inclusion of fractional cover and canopy density lead to increased model performance (RMSE of 124 vs 193 watts per meter^2). This study shows that integrating remote sensing approaches and modeling techniques can be used to better spatially

characterize surface energy fluxes such as ET. Such research will assist in helping to provide quantitative assessments of changes in canopy structure and subsequent ecosystem responses.

David Jenson
Department of Geography
Virginia Tech
Title: *Characterizing the Bering Sea Landfast Ice Annual Cycle using Synthetic Aperture Radar*

Seasonal sea ice extent and duration is declining in Arctic and Subarctic seas. Sea ice declines are important for coastal zones and inner-shelf waters, where sea ice freezes into a stationary position against coastlines and shallow seabeds. Stationary ice - termed landfast ice - is a coastal feature that mediates exchanges and interactions between land, ocean, and atmosphere. Due to its multifaceted role, changes in the landfast ice annual cycle carry wide-ranging implications for interacting human, ecological, and geophysical processes. However, incomplete spatial datasets of landfast ice limit how changing annual cycles are understood and modeled in areas of sea ice decline.

In the Bering Sea region, data scarcity on landfast ice limits how problems associated with coastal ice reduction are studied. Here, I present on the progress of an ongoing project to characterize change in the landfast ice annual cycle in the Bering Sea region from 1996-2008, using remote sensing methods on RADARSAT-1 ScanSAR wide beam data. Preliminary results suggest significant changes to the annual cycle. Final results will be valuable for informing the study of challenges associated with sea ice decline in coastal zones.

Vasiliy Lakoba
Plant Pathology, Physiology, and Weed Science
Virginia Tech
Acknowledgement: Jacob Barney, Dept. of PPWS
Title: *Mapping Climate Envelopes to Hypothesize Ecotypic Variation of an Invasive Plant*

Invasive plants cause an estimated 35 billion dollars in damage and control costs in the United States annually (Pimentel et al., 2005). Johnsongrass (Sorghum halepense Pers., Poaceae) is a global invasive species with a prominent range in the southern half of the continental United States. Over its 190-year invasion history in the U.S., it has shown a directional transition from agricultural to non-agricultural habitats (Sezen et al., 2016). Recently, agricultural and non-agricultural lineages were found to respond divergently to climate variables (Atwater et al., 2016). By studying human land uses as drivers of ecotypic divergence, we can begin to predict invader spread and physiology in the landscape with greater sensitivity.

In this project, U.S. Johnsongrass observations from the Global Biodiversity Information Facility (GBIF) and the Early Detection and Distribution Mapping System (EDDMapS) were used to sample PRISM climate norm data for the corresponding decades. The observations were then subset based on human land uses and the resulting climate envelopes were projected on the continental United States. This method found divergent climate envelopes based on temporal,

(non)agricultural, land-use-change, and impervious surface subsetting. It also found three distinct cores within the range, which had previously been considered as largely an east-west dichotomy.

Geospatial evidence supports the connection between human land uses and Johnsongrass climate responses. These GIS analyses are a rationale for locating range cores with the highest likelihood of ecotypic variation for in-situ measurement of soil and plant community predictors of divergent adaptation.

Callie Lambert
Department of Geography
Virginia Tech
Acknowledgements: Lynn Resler, Dept. of GEOG; Yang Shao, Dept. of GEOG
Title: *Spatio-temporal Vegetation Change of Jackson Glacier Forefront, Glacier National Park, MT*

The global trend of glacier retreat is considered a clear sign of global climate change. Though work has been conducted worldwide to document the change in glaciers in response to climate change, comparatively little research has assessed associated vegetation change over time and patterns of plant colonization at glacier forefronts. The research objectives are to 1) quantify the spatial and temporal patterns of landcover change of five classes—ice, rock, tree, shrub, and herbaceous at the Jackson Glacier forefront in Glacier National Park ,and 2) determine the role of selected biophysical factors on primary succession pathways at the deglaciated area.

Landsat imagery of the study locations in 1991 and 2015 were classified and validated using ground truth points and assessed for accuracy. Overall accuracy for the 1991 image is 87.5% and the 2015 image is 82.5%. To identify biophysical correlates of change, we used a logistic regression model with a binary dependent variable, non-vegetation changed to vegetation class (code=1) or stable non-vegetation class (code=0). Results revealed that aspect, elevation, and surficial geology are statistically significant in explaining the vegetation change or no change. New case studies on vegetation change in recently deglaciated regions can deepen our knowledge about how glacier retreat at the local scales results in vegetation change and recharged ecosystem dynamics, and feedback to climate and biodiversity processes. This research will be viewed through an interdisciplinary, holistic perspective of biogeomorphology, which acknowledges the interaction between vegetation and landforms.

Wyatt McCurdy
Department of Forest Resources and Environmental Conservation
Virginia Tech
Acknowledgements: Randolph Wynne, Dept. of FREC; Valerie Thomas, Dept. of FREC, Quinn Thomas, Dept. of FREC
Title: *Continuous Estimation of Leaf Area Index using Time Series Reflectance Data and Curve-Fitting Techniques*

Leaf Area Index (LAI) is a metric which describes canopy cover over a given area, and is descriptive of canopy extent and vigor. LAI describes canopy cover, forest health, and photosynthetic capacity of a given area. This metric is therefore very useful, and may be related to a number of other measures such as biomass, disturbance/regeneration status, photosynthetic capacity, and evapotranspiration of a forest canopy. LAI is costly, though, to obtain over large areas and timeframes, and passive remote sensing is a promising way in which LAI estimates may be upscaled. Upscaling estimates of LAI is of benefit to a large number of disciplines, including land management, and the understanding of biogeochemical cycles in terrestrial environments.

Previous investigations have found a strong relationship between LAI and a variety of spectral band indices such as Simple Ratio and NDVI. A key problem, though, is that many LAI data points obtained on the ground do not match temporally with available Landsat data. This complication arises because of the 16-day interval between which either Landsat 7 or Landsat 8 will take images of a given area on the Earth, as well as unpredictable cloud cover over certain areas of the globe A key challenge to the effective use of satellite imagery in tracking LAI is predicting LAI at all times of the year, using a finite amount of measurement dates. This study will take advantage of the strong relationship between LAI and several spectral band indices, in order to better understand how to accurately and precisely predict LAI values at times between capture dates of remotely-sensed data, by using multi-band reflectance data captured by Landsat, and curve-fitting techniques for continuous index prediction throughout a date-range; which have been used to great effect by past and current researchers within the Department of Forest Resources at Virginia Tech.

Snehal More & Paige Williams
Department of Forest Resources and Environmental Conservation
Virginia Tech
Acknowledgement: Randolph Wynne, FREC
Tile: *Using Remotely Sensed Data to Decipher Small Plantations versus Forest in Andhra Pradesh, India*

Our study area, the Indian state of Andhra Pradesh, has been one of the states in which overall forest cover has decreased (Forest Survey of India 2013), whilst there are apparent increases in forest plantation area, largely through conversion of degraded and existing agricultural land. Unfortunately, there are constraints in accurately mapping forest plantations using remotely-sensed data due to small size of forest plantation plots as covering few pixels in image, short rotation ages (often 3-5 years), similar spectral signatures to natural forest and neighboring

crops. Newly established plantations are very difficult to correctly identify, and the surrounding cropland is very variegated in both time and space.

We are conducting comparative analysis of satellite datasets like Landsat and Sentinel, providing variability temporality and in spatial resolution using the regeneration/harvest cycles of known plantation points. This data is collected from the International Paper Corporation, using it as training dataset by analyzing NDVI (Normalized Difference Vegetation Index) values and other spectral inquiries over time. Reflectance values for training points has been extracted from Sentinel dataset at 10m spatial resolution to run a Random Forest Model for a classification image for one date in April 2017. NDVI values from Landsat 7 Annual Greenest-Pixel TOA Reflectance Composite of Google Earth Engine from year 2005 to 2017 has been extracted for training data points, for further analysis. The analysis results will be used to distinguish plantations from natural forests using temporal, spectral and texture based classification methods and deep learning.

CJ Morrison
Department of Food Science Technology
Virginia Tech
Title: *No Oxygen... No Problem!*

Our poster made revolves around the fundamental of Fermentation and how we are exposed to fermented products daily, as well as the health benefits they provide to our bodies. Included in the poster are aspects to how fermented foods benefit health, are used in pharmaceuticals, Food and drink fermentation, sourdough fermentation, lactic acid production, and the fermentation of yeast for alcoholic beverages. We interconnected these topics around fermentation, supporting the relationships all these topics have in common.

Joshua Moser
Department of Mechanical Engineering
Virginia Tech
Acknowledgement: Dr. Scott Lowman, Chief Scientist at IALR
Title: *Use of Computer Vision to Track Thin Body Motion with the Application of Tracking Passion*

This research focuses on developing an algorithm set to track the motion of a Passiflora incarnata vine tendril's motion, commonly referred to as the passion fruit plant, for the purpose of determining the correlation between plant motion and plant health. We evaluated clustering based color segmentation with a focus on K-means, feature / texture segmentation utilizing Scale Invariant Feature Transforms (SIFT), and temporal based segmentation using Gaussian Mixture Model Background Subtraction to detect the tendril in a video sequence. Morphological image processing methods, such as erosion and connected component analysis, were used to clean up the segmentation results to estimate the vine tendril's location at each frame in the video sequence. Though successful, the results were sensitive to frames in the video sequence with high levels of noise.

Sarah Power
Department of Biological Sciences
Virginia Tech
Acknowledgement: JohnBarrett, Dept. of BIOL
Title: *Determining Terrestrial Microbial Mat Abundance and Activity Using Satellite Imagery in Taylor Valley, Antarctica*

During the austral summer in the McMurdo Dry Valleys (MDVs) of Antarctica, glacier-fed streams provide a habitat for microbial mats dominated by cyanobacteria. Since there are no vascular plants in Antarctica, these microbial mats are the main source of productivity on the continent. While there are estimates of aquatic productivity in the MDVs, currently there are no reliable estimates of terrestrial productivity.

A recent study has shown that microbial mat communities can be identified along stream margins in the MDVs using multispectral satellite imagery. Remote sensing may provide a valuable tool for investigating the distribution and productivity of microbial mats in this region. To characterize microbial mat dynamics at the landscape scale, we need high resolution ground data to quantitatively compare to the satellite imagery. In January 2018, the DigitalGlobe WorldView satellite collected images of the MDVs while we created field survey plots and collected mat samples to analyze for chlorophyll. This imagery will be processed and analyzed to determine productivity of the microbial mats. Once this tool has been validated through field and lab work, we propose to use satellite imagery to examine how the MDVs microbial mats respond to environmental variation.

Breeanna Prince
Department of Geography
Virginia Tech
Acknowledgement: Dr. Luke Juran, Dept. of Geography
Title: *An Analysis of Human-environment Waterscapes Using a Modified Water Poverty Index*

This poster presents a modified Water Poverty Index (WPI) that examines several waterscape components to better understand the characteristics and relationships among these waterscapes and the populations that use these resources. Through household survey (n= 507), water quality tests(n = 632) and qualitative methods were deployed to examine 24 villages in the districts of Nagapattinam and Karaikal. The data collected in this study was used to develop a participant – driven WPI that measures water poverty in a multi scalar fashion across five location-based indicators: quality, quantity, access, secondary water sources, and capacity. Statistical analysis revealed significant differences between the two districts and at the rural - urban scale within the districts.

The implementation of the three weight schemes (Equal, Survey, and Expert) produced similar outcomes but was grounded on different indicator make up. Additionally, the use of geospatial analyses, such as Global Moran's I, showed positive spatial autocorrelation (p-value < 0.001) of the indicator and WPI scores among the 24 villages. The results of the spatial autocorrelation analysis reveal that the water issues that are being measured exhibit spatial clustering, and that

the current water situations are similar across space. This information can be used by local governments to designate capital and resources more effectively.

Sayantan Sarkar
Department of Plant Pathology, Physiology, and Weed Science
Virginia Tech
Acknowledgements: Amir Sadeghpour, Dept of plant soil and agricultural system, Southern Illinois Univ; Joseph K. Oakes, Dept of PPWS, Virginia Tech; Maria Balota, Dept of PPWS, Virginia Tech
Title: *High-throughput Phenotyping of Peanut and Biomass Sorghum Using Proximal Sensing and Aerial imaging for the Mid-Atlantic U.S.*

High throughput phenotyping can be described as the use of technology for automated sensing, data acquisition, and data analysis for generation of phenotype data. It is a quick and low cost method when compared to other traditional phenotyping methods. Peanut is an important cash crop for the Mid-Atlantic U.S. which supports several food processing and value addition industries. But peanut production is limited by several biotic and abiotic stresses. Breeding approach for selection of stress tolerant genotypes are too slow and uneconomical. Biomass sorghum is a potential crop for bio-ethanol production. It has high above ground biomass and is responsive to low inputs, making it one of the most important non-food crop with low input cost for bio-fuel production. But, very less information is available on its cultural practices like seeding rate, row spacing, N requirement etc. for the Mid-Atlantic U.S. region.

Traditional methods for determining best cultural practices are slow and uneconomical. Therefore, there is a need to determine a method for predicting yield using early season physiological traits for both, peanut and biomass sorghum. Our objective is to use high-throughput phenotyping to collect early and mid season physiological data to predict yield. Also, use of computer vision and machine learning can make data collection and processing faster and more accurate. Both, the peanut and biomass sorghum studies are located in Suffolk, VA and the study was started in May 2017. Data collection includes aerial imaging using an octacopter drone and proximal canopy sensing like NDVI, canopy temperature, LAI etc. using hand held devices. Images taken by UAVs include RGB images, NIR images, and Thermal images. The images are processed and analyzed using PIX4D, ArcGIS and ImageJ. The data generated using images are NDVI, green area(GA), greener area (GGA), crop stress index, a*, u*, canopy temperature, and plant height using digital elevation models (DEM). Preliminary data suggests that early season physiological traits and growth indices are correlated to yield, and hence, can be used to predict end of the season yield. It also seems very likely that use of MATLAB and Python can make image processing faster and accurate leading to more accurate extraction of data.

Heng Wan
Department of Geography
Virginia Tech
Acknowledgement: Yang Shao, Dept. of GEOG
Title: *Updating NLCD for Monitoring Regional-Sale Land Cover Change*

In the US, National Land-cover database (NLCD) has been widely used as the baseline land-cover data for a variety of research and applications. Currently, there is a 5-year time lag between the image-capture date and the product-release date. During this time lag, some areas may have experienced substantial land cover changes, especially in urban/suburban settings. There are also land change modelling applications that require higher temporal frequency (e.g., annual) input data. This study aims at finding an effective method to update the NLCD with a high thematic accuracy. Using 2006/2011 NLCD as baseline product, we designed an image analytical approach to derive annual land cover products by integrating Landsat 7, Landsat 8, and Sentinel 2 multi-temporal imagery. Several machine learning algorithms, Random Forest, neural network (NN), and support vector machine (SVM) are applied as the classification algorithm, and different sampling methods for obtaining the training data are tested to find the best combination for image classification. Albermarle-Pamlico Estuarine System (APES) is selected as the research area due to the rich reference data available for accuracy assessment.

Elizabeth Weaver
Department of Geography
Virginia Tech
Acknowledgement: Korine Kolivras, Dept. of GEOG
Title: *Geographic Distribution of Valley Fever in the Southwestern U.S.*

Valley fever is a disease caused by inhalation of spores from the Coccidioides fungal species. The pathogen is normally soil-dwelling, but, if disturbed, can become airborne and able to infect humans and other mammals. The endemic area for this disease is not well defined or understood. Coccidioides is very difficult to isolate from the soil, therefore, little is known about its natural distribution. The goal of this study to examine the relationships between environmental variables and valley fever's spatial distribution in the southwestern U.S. Data for this study includes disease incidence rates for California, Nevada, Utah, and Arizona from 2000-2015. Climate and environmental geospatial data sets with the same spatial and temporal range were compiled from various sources to compare with valley fever incidence. Results from this study confirm linkages between environmental factors and valley fever incidence.