2023 Virginia Tech Office for GIS and Remote Sensing Research Symposium
Student Poster and Web Map App Showcase Abstracts
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Author: Muna Khatiwada
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Title: Precipitation Trends in the Ganges-Brahmaputra-Meghna River Basin, South Asia: Inconsistency in Satellite-Based Products
Abstract: The Ganges-Brahmaputra-Meghna (GBM) river basin is the world's third largest river basin covering Nepal and Bhutan and certain parts of China, India, and Bangladesh. Literature show that changes in precipitation have a significant impact on climate, agriculture, and the environment in the GBM. Two satellite-based precipitation products, Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks-Climate Data Record (PERSIANN-CDR) and Multi-Source Weighted-Ensemble Precipitation (MSWEP), were used to analyze and compare precipitation trends over the GBM as a whole and within 34 pre-defined hydrological sub-basins separately for the period 1983-2019. A non-parametric Modified Mann-Kendall test was applied to determine significant trends in monsoon (June-September) and pre-monsoon (March-May) precipitation. The results show an inconsistency between the two precipitation products. However, both products strongly indicate that precipitation has recently declined in the pre-monsoon and monsoon seasons in the eastern and southern regions of the GBM river basin, agreeing with several previous studies.

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Title: Using Remote Sensing Data to Predict Habitat Occupancy of Bachman's Sparrow, an Early Successional Bird Species, in Georgia
Abstract: Ecological and anthropogenic shifts in disturbance regimes have caused a decline in early successional habitat, leading to profound biological impacts on many avian species. Managing the habitat of impacted species is challenging due to the ephemeral nature of their habitat requirements. Satellite remote sensing data provide a potential tool which can be used to aid the management of early successional species. Specifically, these data provide an instantaneous snapshot of habitat quality at a high resolution and across a large geographic area, often making its use more efficient than traditional surveying. In this study, we sought to evaluate the use of satellite remote sensing data to inform the management of early successional species. To meet this objective, we created predictive models of occurrence for Bachman's sparrow (Peucaea aestivalis; BACS), using three years of BACS survey data and environmental data extracted from Sentinel-2 satellite imagery. We then evaluated the success of our model predictions via an additional breeding season survey, which ultimately showed that our model performed moderately in predicting BACS occurrence (AUC = .69).

Author: Chloe Maclean
Affiliation: Virginia Tech / School of Visual Arts -- Graphic Design
Category: Poster
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Title: Wrong Side of the Tracks | Map Exploration
Abstract: Focusing on the Roanoke Valley Area, this project highlights poverty and education trends within targeted areas in Roanoke, specifically the city in the North West areas. By using public archives of information, such as the US Census and Arc GIS, maps were created using QGIS to gain an understanding of trends within the counties. As the user scrolls through the website they are able to watch the map transform as it highlights important information about poverty and education, as well as their evolution over 5 years. The story boxes on the side aim to provide a story and background for the user to engage with, as well as house vital information such as keys and legends. All maps were created using QGIS and public archive information, all data was sourced by hand.

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Coauthors and other acknowledgements: Grace Coleman, Computational Modeling and Data Analytics; David Carter, Virginia Tech, Dept. of FREC; Adam Coates, Dept. of FREC
Title: Forest Complexity and Fuel Structure Influence the Applicability of Terrestrial Laser Scanning for Fuel Quantification in the Central Appalachians
Abstract: Prescribed fire has been proposed as a restoration tool for central Appalachian forests, especially in systems where changes in fire regime have contributed to the replacement of fire-adapted pine-oak stands with fire-intolerant species (e.g. red maple). Conventional field-based methods for assessing fuel structure and predicting prescribed fire behavior are typically time-consuming and vulnerable to observer error. Terrestrial laser scanning (TLS) has been successfully utilized to estimate fuels and fire effects in coastal plain pine systems in the eastern United States, but its efficacy in more topographically and structurally diverse pine-hardwood systems is not yet clear. To assess the applicability of TLS for fuel estimation in the central Appalachians, we present preliminary results from a comparison of field-based fuel data to LiDAR metrics across a gradient of structural diversity . Our findings support our hypotheses that 1) TLS-based fuels assessment methodology is most appropriate in stands with reduced understory and topographical complexity, and 2) TLS can effectively model large coarse woody fuels (diameter > 7.6 cm) but is less effective for litter and fine fuels.

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Title: Developing Expressed Site Indices for Young Douglas Fir Growth Through LiDAR Using Individual Tree Detection Algorithms
Abstract: While site index is the most commonly used method for defining site quality it is rarely utilized in young stands due to the vast manual effort required to capture the wide variety of height growths in early-term growth. In order to capture the wide variation in growth patterns of young stands we utilized LiDAR data, industry management histories, and SSURGO data across ~8000 acres and 170 sites of 3-7-year-old Douglas-fir in the western Washington region to develop site quality metrics. Our study shows significant evidence that large-scale soil factors such as soil texture and order have a significant

effect on increasing young Douglas-fir growth. Moreover, it showed that these better site qualities for young growth do not necessarily strongly correlate with higher-ranked site indexes for growth later in life. This demonstrates the importance of having site quality indices for young stands to provide accurate information for land manager decision-making during the most crucial management period.

Author: Mohammad Khorrami
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Title: Sentinel-1 Satellite Monitoring of Disappearing Water Sources (Lake Urmia, Iran)
Abstract: Lake Urmia, Iran, is one of the largest hypersaline lakes in the world. This lake has shrunk dramatically over the last two decades because of a variety of climate and mismanagement reasons. Lake Urmia lost almost 85 percent of its volume causing more than 1.6 million $US of loss to ecotourism and outdoor recreation in 2019. Here, we use Synthetic Aperture Radar data acquired by Sentinel-1A/B satellites to investigate the lake area variations from 2017-2022. We apply a Bayesian approach to generate probabilistic water area maps, which contain each pixel its probability to be water rather than binary information. Using lake water level change from 1965-2022, we estimated the lake's water volume change and further evaluated the in-situ data such as precipitation, drought index variations, and anthropogenic data in the region to understand the link between climate change and anthropogenic with the shrinkage of this lake. The outputs of this study can be used to improve our understanding of the current situation of this lake to revise the water resources management strategies in the area.

Author: Brandy Ayesu-Danso
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Category: Graduate student / Poster
Coauthors and other acknowledgements: Santosh Rijal, Virginia Tech, Dept. of GEOG.
Title: Thresholding And Digitizing the Coastlines of Ghana to Assess the Change in the Last Three Decades Using Geospatial Analysis.
Abstract: About thirty-seven percent of the coastal land of Ghana had been lost to erosion and flooding between 2005 and 2017 alone. Though sea-level rise is partly the cause of erosion and flooding on the coast of Ghana, human activities played major roles in exacerbating the situation. Currently, there's little research on the physical evolution of the coastal zone of Ghana using geospatial information technology, which creates a research gap that needs to be addressed. This poster aimed to investigate physical shoreline changes in the coastal zone of Ghana within the period of 1990 and 2020. The poster achieves this aim through the objective to assess the physical evolution of Ghana's coastal zone. Satellite images and shapefiles of the coastal zone of Ghana are downloaded and created via Earth Explorer, Rstudio, and ArcGIS Pro. The images are then analyzed and further worked on using GIS geoprocessing approaches and geospatial analysis techniques. The results of the poster will inform local stakeholders, local assemblies, and the government of Ghana of physical changes that have occurred in Ghana's coastal zone as well as can be the baseline for another research.

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Title: [No title given]
Abstract: NAIP imagery provides a unique opportunity to detect individual tree crowns routinely across the United States with sub-meter resolution. In this study, we will use NAIP imagery from 2021 with a U-Net-ID instance segmentation model to identify and create a shapefile for individual crowns over Virginia, USA. We will use the methodology and results from a preliminary analysis completed in the Lake Tahoe Basin of California, USA, to adapt the crown segmentation model to the Commonwealth of Virginia and compare sample areas of forest cover to lidar-detected crowns. Identified trees in the sample area will be validated using equivalence tests on the number of crowns identified and calculated total crown area. We anticipate some adjustments to the original crown segmentation model so that a crown delineation map of the sample area can be produced to estimate crown area with an accuracy greater than or equal to 85%.

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Coauthors and other acknowledgements: Maaz Gardezi, Virginia Tech, Dept. of Sociology; Sarah Misyak, Virginia Tech, Dept. of Human Nutrition, Foods, and Exercise
Title: Access to Online Purchasing of Fresh Produce as a Digital Equity Consideration for SNAP participants in Virginia
Abstract: The Supplemental Nutrition Assistance Program (SNAP) launched online purchasing through select retailers in 2019 and continues to expand authorizations, with 17 retailer systems currently authorized in Virginia. Access to fresh produce is often disproportionately low for SNAP customers and broadband connection may expand shopping options and influence nutrition equity. This project determined the overlap of broadband connection and pickup sites for fresh produce ordered online with SNAP benefits within Virginia and presented the results in a map. The availability of pickup locations was concentrated in Virginia's metro areas. Some grocery locations offered online SNAP purchases but did not offer curbside pickup. Rural areas were not equitably served by online produce ordering and pickup capability or broadband connection. An expansion of broadband connection may encourage retailers to increase coverage of their online ordering systems into currently underserved areas. The results have implications for digital infrastructure and nutrition policies. Future GIS research should explore delivery coverage of online SNAP purchases.

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Title: Effects of Drone Lidar DEM Resolution and Flow Area Resolution on Hydrodynamic Modeling Results
Abstract: As drones become cheaper, and sensors become lighter, lidar acquisition is more accessible to researchers and industry. This increase in accessibility requires decisions to be made about resolution of subsequent data products. Our study focuses on analyzing how lidar digital elevation model (DEM) and flow area resolutions affect hydrodynamic model results. Lidar data were collected for about 5ha along 1.5km of Stroubles Creek at the Virginia Tech StREAM Lab in Blacksburg, VA. Ground points were identified using the simple morphological filter, DEMs were created at several resolutions (0.1m, 0.25m, 0.5m, 1m, 2m), and were inputted into a 2D hydrodynamic model with two flow area resolutions (1m,

2m). Model results of depth, water surface elevation and velocity were assessed for spatial differences between each model simulation. Greater differences between simulations were found at shallower water depths near the flood extent boundary and along the channel-floodplain interface. We found that simulations from larger resolutions had lower velocity maximum values. The results of this study can be utilized to inform selections of DEM and flow area resolutions for 2D hydrodynamic modeling.

Author: Tyler Mochizuki
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Title: Urban Food Deserts: Analyzing Food Insecurity in Roanoke, VA
Abstract: The issue of food insecurity is one that is frequently overlooked in national discourse despite its prevalence and severity in many parts of the country. Nearly 1.2 million or 14.83 percent of Virginians live in food deserts' a rate higher than the national average. Food deserts are census tracts that meet both low income and low food access thresholds and are used to spatially analyze the severity of food insecurity. In this study, quantitative variables including poverty rates, food stamp usage, vehicle ownership rates, and racial demographics were found to be the most highly correlated with census tracts formally classified as food deserts by the USDA. Mapping these variables enabled the ability to locate specific census tracts with the highest food insecurity rates along with those trending toward potential vulnerability to food insecurity. Roanoke, VA is used as a case study because of its location in Appalachia' a region less frequently studied and documented than other regions in the country.

Author: Luke Jones
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Title: Planting for climate resilience: Using heat mapping to assess climate vulnerability and the need for future greenspace and urban tree cover in Salem, VA
Abstract: Urban areas are subject to higher levels of heating due to changes in the local energy balance. These urban heat islands (UHI) can result in a greater need for energy consumption for cooling in the summer as well as negatively impact public health. These impacts are often not equitably distributed and can have the greatest impact on historically underserved communities. Heat mapping data was collected in Salem, Virginia as part of a statewide Virginia Heat Watch campaign, coordinated by the Virginia Foundation of Independent Colleges in partnership with CAPA Strategies. Route data collected by Roanoke College faculty, students, and citizen volunteers were converted to heat maps. The greatest heating was associated with major roadways, commercial districts, and industrial areas due to lower tree cover and higher coverage by low albedo hardscape. Higher UHI was also associated with neighborhoods that had been subjected to historic redlining practices and still retain low levels of greenspace and tree cover. GIS was then used to rank potential locations for future tree plantings based on climate vulnerability, current land cover, and public ownership.

Author: Ellen Holt
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Category: Undergraduate student / Poster
Coauthors and other acknowledgements: N/A
Title: Historic Heat: Redlining & the Urban Heat Island in Atlanta, GA

Abstract: The Urban Heat Island Effect (UHI) is the phenomenon where urban areas retain more heat than suburban and rural areas and release it throughout the day. As a Southern city, Atlanta already faces higher average temperatures than other cities in the United States. Despite being banned in the 1960s, redlining practices by the Home Owners' Loan Corporation (HOLC) sowed the seeds of generational poverty in southern Atlanta. This set up residents to be disproportionately negatively affected by things largely out of their control. This project examines interrelated variables in the heart of Atlanta such as racial division, income disparity, building density, greenspace, and daily temperature. It can be seen that living in or near Atlanta's historically redlined districts means residents are more likely to experience hotter temperatures as a result of the UHI. Understanding where and who is affected most allows us to plan strategies to mitigate the UHI and protect those who are vulnerable.

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Title: Plant Successional Patterns at Sperry Glacier Foreland, Glacier National Park, MT, USA
Abstract: Plant successional trends on terrain exposed by deglaciation gives insight into factors influencing alpine ecosystem change and recovery. Understanding these patterns is vital for conservating alpine landscapes as glaciers recede. This study investigates how biophysical factors influence vegetative trends in the dynamic alpine environment of Sperry Glacier, a mid-latitude glacier in Glacier National Park, MT. Using field data and geostatistical analysis, we assessed: (1.) vegetative trends (species richness, cover, and composition) over a 170-year chronosequence, and (2.) vegetative trends over field and GIS-derived site conditions (e.g., rock fragments, concavity, and solar radiation). Sixty-one plots (8 square meters) were collected using stratified random sampling by terrain age. Species richness, cover, and composition were recorded for each plot. Trends across terrain age were assessed using a Dunn's Test, showing significant increases in species richness and cover with terrain age ($p=0.0013$ and 0.0033, respectively). Generalized linear models and classification and regression trees accessed vegetative trends across site conditions, providing insight into influential factors.

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Title: Scenario-based projections of relative sea level rise through ensemble analysis of TWS change-driven VLM
Abstract: References to sea level rise (SLR) commonly describe only the global mean sea level (GMSL), which is nowhere near specific enough to inform policies and mitigation actions. In reality, sea level is changing at highly differing rates and is strongly dependent on location. Therefore, relative sea level (RSL) rise is much more informative for realistic plans and action. Multiple processes impact RSL rise, with the most impactful being vertical land motion (VLM). Changes in terrestrial water storage (TWS) can induce vertical land motion, as increases in TWS induce subsidence and decreases induce uplift. This, in turn, impacts RSL when near the coast. We calculate the CLM resulting from changes in TWS through a geophysical disk load function (Bevis et al., 2016) in MATLAB. For the input, or load (TWS), we gather a multi-model ensemble of TWS projections, similar to that in Pokhrel et al. (2021). To improve the

projections, we calibrate the models with remotely sensed data from the GRACE/GRACE-FO satellites. With the calibrated models, we will calculate VLM and resulting RSL projections through the rest of the century.

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Title: Examining the role of agro-environmental conditions in vulnerability to poverty in Niger
Abstract: Droughts can pose existential challenges to rainfed agricultural regions. In response, many programs have emerged that seek to break the link between adverse conditions & welfare crises among vulnerable households. However, identifying who is weather-sensitive typically relies on data about relevant on-the-ground outcomes and assumptions about what constitutes abnormal conditions. Using new welfare estimates from the World Bank, we study how different ways of characterizing abnormal weather impact vulnerability estimates by varying indicators of adverse conditions, the timeframe used to establish historical normals, & the degree of spatial aggregation. Analyzing data from ~6000 Nigerien rural households, we find that vegetation & precipitation indicators identify similar net numbers of vulnerable households but only overlap spatially in 11% of cases. Estimates remain consistent for reference periods of 5-28 years due to stationarity in that reference period; however, coarser resolution appears to overstate vulnerability as compared with finer one. These findings suggest that examining what indicator is used, how, and where can influence what households are classified as vulnerable

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Title: Assessing age height relationship of loblolly pines using ICESat-2 heights and Landsat derived time series
Abstract: This study investigates differences in pine height by active forest management intensity in the Southeastern U.S. using ICESat-2, ATL08-derived height data, and maps derived from the Landsat time series. We intersected ICESat-2 ground tracks with locations of pine plantations and the Land Change Monitoring System (LCMS) fast-change product to identify previously clear-cut pine plantations. We subtracted the LCMS fast loss year from the date of the ICESat-2 acquisition to identify plantation age at the time of the height measurement. Natural pines or planted pines that have not been clear-cut during the satellite record, were assigned an age of >40 years. We stratified the data according to management intensity, where stands that experience both thinning and harvesting were most intensively managed. The goal is to develop age-height relationships across the region to better characterize the impact of management on productivity and site index.

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Department of Conservation and Recreation; Karen Powers, Radford University; W. Mark Ford, U.S. Geological Survey
Title: Hibernation Phenology of the Endangered Northern Long-eared Bat in Western Virginia
Abstract: Recent population declines of the northern long-eared bat (Myotis septentrionalis) have resulted in an endangered species designation. To examine weekly probable and total relative activity, we acoustically monitored 13 hibernacula in western Virginia during 2020-2022. During the fall, relative activity peaked around September 1, but was sustained between July 26 and October 28. Emergence occurred between February 23 and May 17, but peaked near April 13. Relative activity increased with temperature, canopy height, and distance from forest interiors but decreased with increasing precipitation. Probable weekly activity was highest during spring, and despite low relative activity during hibernation, we detected no difference in probable weekly activity between fall and winter. Additionally, probable activity increased with the number of cover types present but decreased with distance from forest interiors. Our results highlight important phenological variations during hibernation in western Virginia. Heterogeneous habitats proximal to hibernacula, particularly those associated with mature forest patches, may benefit remaining northern long-eared bat populations during hibernation.

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Title: To Rotate or Not to Rotate? Rotational Bale Grazing: A Feasible Alternative Winter Hay-Feeding System for Beef Cows
Abstract: Producers in the Northern Great Plains and Canada have begun to reap the benefits of rotational bale grazing as an alternative winter hay feeding system for beef cows. Traditional winter hay feeding systems result in substantial daily labor, machinery use, fuel cost, uneven distribution of nutrients, soil compaction, and reduced forage production the subsequent year. This study was conducted to determine if beef producers can adopt bale grazing as an alternative winter hay feeding system in the Southeastern region of the U.S. Emlid Reach Receivers were utilized to complete soil grid sampling before winter hay feeding began and Mehlich 1 soil nutrients were measured. Hay bales were placed in areas of lowest Mehlich 1 phosphorus and strip grazing was utilized allowing cattle access to the bales at a controlled rate. After winter hay feeding, 3 drone flights accompanied by ground sampling were completed to measure forage spring recovery in a traditional sacrifice paddock system compared to the rotational bale grazing system. We will discuss the influence of rotational bale grazing on the spatial distribution of nutrients as well as forage spring recovery.

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Title: [No title given]
Abstract: Using machine learning to develop an algorithm capable of classifying lakes and rivers globally using specific inputs necessary (color, size, shape, elongation, proximity to the ocean, etc.).

Author: Cole Bristow
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Coauthors and other acknowledgements: Lisa M. Kennedy, Virginia Tech, Dept. of Geography; Santosh Rijal, Virginia Tech, Dept. of Geography; and James A. Parkhurst, Virginia Tech, Dept. of Fisheries and Wildlife
Title: Effects of Road Characteristics, Landscape, and Population Density on Roadkill Distribution in Southwest Virginia
Abstract: Wildlife-vehicle collisions (WVCs) pose a significant safety issue for drivers and wildlife alike in the United States. To examine the frequency, patterns, and causes of WVCs locally, this project tallied roadkill across a yearlong study period and examined relationships between frequent roadkill hotspots and several landscape and road variables in a study area within Montgomery and Giles Counties in southwest Virginia. We collected field data on the location and species of carcasses found on predetermined routes that include 2- and 4-lane roads and varying speed limits, road infrastructure, and adjacent land cover. We used government-provided data sets, imagery, and field verification to characterize our study routes. A zero-inflated Poisson generalized linear model tested the relationship between roadkill location data and possible driving factors such as land cover type and traffic speed. Our results showed that higher traffic speeds and higher road classifications were associated with higher rates of roadkill, while adjacent urban land cover was associated with a decrease in roadkill.

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Title: Navigating the Indoor Frontier: Uncovering Movement Patterns with Terrestrial Lidar
Abstract: Indoor spaces have traditionally been difficult to map using conventional GIS and remote sensing-based methods: indoor spaces are not directly sensible with satellites and drones, and camera-based 3D reconstructions are of poor quality indoors. We investigate how terrestrial lidar can be used to analyze movement activity in the lobby of the Creativity and Innovation District (CID) Building at VT, focusing primarily on the methodological aspects of collecting, visualizing, and analyzing the data. We aggregate lidar data from 11 sensors into a single point cloud every second using a defined Building Reference Coordinate System, which we record as point clouds and orthographic images. We further process the orthographic images into animations and NetCDFs for spatiotemporal analysis. Additionally, using Percept, an object-tracking lidar perception software, we create line-based vectors containing both spatial and attribute data (including positional velocity, direction, and size). Future work will apply these methods to answer research questions about how people use and move in the space, and how these patterns change in response to disturbance and affordances of resources.

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Title: Seeing Heat in 3D: Multisensor Integration for Comprehensive 3D Thermal Mapping and Modeling

Abstract: Thermal imagery has previously been focused on improving 2D visualizations of heat in urban areas to better communicate how land cover impacts heat emissions. To better understand the impacts of building façades on heat emissions, we developed 3D fully interactive thermal models. During this project, we compared the outputs of three different camera types and resolutions, the FLIR One, FLIR Duo Pro R, and FLIR Vue Pro R to understand what quality of camera is required to effectively model the thermal façade of buildings. Additionally, we experimented with using different sources for the physical models of buildings, including terrestrial and drone Structure from Motion, and the use of secondary sources such as aerial lidar. Flights used Real Time Kinematic GPS positioning for Ground Control Points, and Pix4D software was used to reconstruct the 3D environment from the images. These 3D models will form the basis for a future user study in which they will be assessed for how well they improve users' learning about the thermal properties of a location compared to more traditional thermal orthoimagery.

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Title: Virtual Reality for Accurate and Efficient Classification of Point Clouds
Abstract: Both lidar and Structure from Motion (SfM) photogrammetry produce point clouds. Points in a point cloud can include attribute information such as color or intensity but not always semantic information about what that point is. The usefulness of point clouds is limited without high-quality semantic information. We present work completed over the past year in the development of a virtual reality, immersive point cloud classification system. The system is deployed via a web-browser similar to Potree, and is built on open WebXR (i.e., augmented and virtual reality) components. It features the ability to load user point clouds in the common LAZ format, render them by classification color or RGB value, change classification, and save the modified point cloud. Future work will improve the user interface, add the ability to bring in additional geospatial layers to provide context, include support for the new COPC format, and conduct user testing. This represents an important advance for QA/QC in point cloud classification workflows, but more importantly provides a mechanism to generate a large volume of 'ground truth' data to facilitate point cloud classification algorithm development.

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Title: Geoheritage Inventory of the Baraboo District, Wisconsin, USA
Abstract: UNESCO Global Geoparks (GGs) harbor sites of internationally significant geological diversity by prioritizing a delicate balance of conservation, education, and economic activity. Of the nearly 200 extant GGs, USA hosts zero(!) This study will build a full inventory of geologically, biologically, or bio- and geo-culturally significant sites. Step 1 is to conduct a geoheritage inventory of southern Wisconsin's Baraboo District. The Baraboo Range intersects the Ice Age National Scenic Trail straddling landforms of both the aptly-named Wisconsin Ice Age and those of the unglaciated Driftless Zone. We conducted fieldwork in June 2022, scouting ~100 Sites featuring notable geologic or relevant bio-cultural heritage. Our would-be GG is bounded by a mashup of natural/administrative boundaries that contains the innermost 65 sites, all known outcrops of the basement Precambrian quartzite syncline, and the grounds of a defunct ammunition plant recently returned to the Ho-Chunk Nation. Next steps will involve

follow-up fieldwork to build our inventory of sites and data, and to quantitatively score each site with respect to science, education, tourism, and risk of degradation.

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Coauthors and other acknowledgements: Mark Salvatore, Northern Arizona University, Dept. of Astronomy and Planetary Science; & John Barrett, Virginia Tech, Dept. of Biological Sciences
Title: Modeling habitat suitability for soil biocrusts in an Antarctic desert
Abstract: Climate change is anticipated to alter Antarctic soil ecosystems. Biocrusts are critical to the productivity of the McMurdo Dry Valleys ecosystem because the organisms comprising them (cyanobacteria) are the base of the food web. Thus, understanding controls over biocrust distribution is an essential first step in understanding the impacts of climate change on these soil ecosystems. We surveyed 64 sites covering a range of moisture levels and biocrust abundance, collecting samples for biological and chemical analysis of the biocrust and underlying soil. We assess habitat suitability of biocrusts by modeling their distribution using reflectance measurements predictive of biocrust occurrence and incorporating physical, chemical, and climate drivers derived from satellite data, geospatial products, field surveys, and in-situ sampling data to determine the main predictors of biocrust presence. This work brings us closer in our efforts to understand controls over the distribution and activity of these critical soil communities using remote sensing, an ideal technology for measuring ecosystem dynamics in Antarctic systems which are particularly climate-sensitive and difficult to access.

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Title: Collect Data Optimized for Forest Productivity Investigations using FREC's Unmanned Aerial System (UAS) with Hyperspectral and LiDAR
Abstract: Ecosystem structure and function provide insight on the dynamics of the carbon cycle which contribute to the pools and fluxes of carbon in the system. Further analysis on of the interactions of forest structure and function will enhance the understanding of forest productivity to effectively inform climate models. In order to collect data optimized for forest productivity investigations from remote sensing, this research combines estimates of forest structure from LiDAR and function from hyperspectral imagery compared to in situ flux tower measurements. In August and September of 2022, Paige Williams and Daniel Cross conducted multiple Unmanned Aerial System (UAS) flight acquisitions over the forested area surrounding NEON's flux tower at Mountain Lake Biological Station in Southwest Virginia. FREC's UAS includes the SkyFish M6 drone integrated with a Headwall Nano-Hyperpsec VNIR imaging sensor and Velodyne LiDAR puck-LITE. This combination of sensors provides a rich dataset for environmental analysis by producing 3D high-resolution images of the forest.

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Title: Does spatial resolution affect the magnitude of automated weather-based insurance payouts?
Abstract: An increasing number of disaster relief programs rely on automated weather data to trigger payouts, though determining the appropriate spatial resolution for the trigger is challenging. To examine this issue, we investigate a subsidized precipitation-based insurance program in the US that began in 2007. Leveraging historical data on coarse resolution precipitation (~25 by 25km) estimates made publicly available by the program, we compare the payout distribution with a newer, finer resolution estimate (0.05 x 0.05) in the same areas from 2007-2022. In a preliminary analysis of precipitation estimates from a region in [West] Texas, we observe payout gaps among 3 (21%) of the 14 years. By the conference, we will translate these gaps into payout differences for policyholders across Texas. This analysis seeks to provide evidence on the trade-offs of using newer, finer-resolution estimates of distress and their implications for policyholders and the public.

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Title: Mapping Chesapeake Bay Marsh Communities
Abstract: The Chesapeake Bay's 166,000 km2 watershed supports North America's largest estuary and contains many large metropolitan areas and a variety of coastal environments. The Bay's coastline supports a diverse assemblage of marsh vegetation communities that serve as vital habitat for many imperiled species, in addition to the associated communities of people that utilize these areas for economic and recreational means. The Chesapeake Bay receives countless hours of surveying and research aimed at studying land conservation, pollution from nearby run-off, and other efforts vital to characterizing ongoing environmental change. We utilized field data from the Virginia Institute of Marine Science's Tidal Marsh Inventory (TMI) to perform exploratory spatial data analysis (ESDA) and to inform our future efforts in studying past distributions of marsh vegetation communities in the Chesapeake Bay. Results from our ESDA documented spatial clustering of past TMI sampling efforts at various sites in the Bay. Future work will include finding coinciding periods of data availability between TMI and various remote sensing platforms in an effort to perform a comprehensive mapping of Bay marshes.

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Title: How incentivized crop conversion influences farmers' judgements, decisions and livelihoods in the face of drought
Abstract: Droughts are becoming increasingly frequent and prolonged. This is particularly worrying for Morocco, a Mediterranean nation highly dependent on rainfed agriculture. In 2008, the Moroccan government introduced the Plan Maroc Vert (PMV)/Green Morocco Plan, a multi-billion dollar agricultural strategy that shifted production away from drought-prone cereal crops towards drought-resistant perennial crops. The goal of this research is to determine how crop conversion, particularly in favor of greater perennial crop (olive) production, (i) impacts how farmers perceive and expect drought patterns, (ii) influences farmers' employed drought coping strategies, and (iii) affects their incomes/livelihoods. Farmer-level survey data is to be collected in the Northeast of Morocco, which has been a focus of land conversion efforts since the implementation of the PMV. Remotely-sensed data will be utilized to measure drought conditions over the same region. The outcomes of this research will be

relevant in determining how large-scale agricultural investments can influence smallholder farmer outcomes.

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Title: Straying from the Mississippi River: A Case Study on Avulsion at Neptune Pass
Abstract: River avulsion, rapid new channel formation, can dramatically reconfigure the ecological and economic functions of surrounding landscapes. Despite the importance of avulsions, infrequent or sparse ground data collection has limited our ability to observe their dynamics. In 2016, Neptune Pass, a small channel in the lowermost Mississippi River, widened over five-fold. High resolution satellite imagery allows us to observe the avulsion, which is now over 244m wide and rerouting ~16% of one of the U.S.'s largest and most important rivers. This avulsion is not only eroding the pass but depositing sediment in the surrounding area. We conducted image thresholding on Landsat 5 and 8 surface reflectance images to binarize between water and non-water features. We then ran a sequence analysis on the binary imagery to quantify the distinct types of sequences that occurred. A preliminary analysis showed that the pass widened the most between 2019 and 2020 (0.15km2), compared with an average of >0.01km2 in all other years. Quantifying the extent of distinct sequences reveals that 2.0% represented a change from land to water and 2.2% from water to land.

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Title: Conflicting Regulatory Policies as Barriers to Emergency Intelligence Drone Usage in Flood Management
Abstract: Disaster intelligence in flood management faces challenges and opportunities with the proliferation of Unmanned Aerial Vehicles (UAVs), or drones. Drone technologies have the potential to respond to the shortfall in the current remote sensing data provisions that cannot be met with satellite or airborne imaging survey technologies. However, regulations at the federal, local, and state have resulted in a patchwork quilt of laws posed by this emerging technology. The dynamics of drone policies will be explored focusing on a recent local flooding disaster. The analysis finds evidence of conflicting regulatory policies that impact the sensorization of the environment, as well as increasing economic disparities. Policy recommendations are needed for technology-driven challenges critical to emergency flood responses.

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Title: Assessing spatio-temporal variations in $PM_{2.5}$ pollution and associated mortality in the South Asian region

Abstract: Fine particulate matter ($PM_{2.5}$) is associated with adverse impacts on ambient air quality and human mortality. The situation is extremely severe in developing countries experiencing rapid industrialization and urban development. This study assessed the spatio-temporal variations of $PM_{2.5}$ and its health impacts in the South Asian region. Both satellite and station-based data were used to monitor the variations in $PM_{2.5}$ over time. Additionally, mortality data associated with ambient particulate matter were used to depict the overall impacts of air pollution in this region. We applied the Mann-Kendall and Sen's slope trend analysis tool to investigate the trend of $PM_{2.5,}$ while clustering of backward trajectories was used for identifying the long-range air mass transport. The results revealed that the mean annual $PM_{2.5}$ mass concentration was the highest (43.2 $\mu g/m^3$) in Bangladesh among the South Asian countries during 1998-2016, exceeding the national ambient air quality standards of Bangladesh (i.e., 15 $\mu g/m^3$) and WHO (10 $\mu g/m^3$), while lower $PM_{2.5}$ was observed in the Maldives and Sri Lanka (5.3 $\mu g/m^3$ and 6.5 $\mu g/m^3$, respectively) compared with the WHO standard. The trend analysis during 1998-2016 suggested that all South Asian countries except the Maldives are experienced an increasing trend ($p<0.05$) of $PM_{2.5}$. The study showed that among the major cities, the mean annual $PM_{2.5}$ value was the highest in New Delhi (110 $\mu g/m^3$), followed by Dhaka (85 $\mu g/m^3$). In terms of seasonal variation, the highest $PM_{2.5}$ was found during the pre-monsoon season in all cities. The findings of this research would help the concerned governments of South Asian countries to take steps towards improving air quality through policy interventions or reforms. Moreover, the results would provide future research directions for studying the trend and transport of atmospheric $PM_{2.5}$ in other regions.

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Title: Investigating managed pine productivity across the southeastern United States over time using Landsat and Google earth engine, an exploratory analysis

Abstract: Managed pine in the southeastern United States can be some of the world's most intensively managed forests. While there are many plantation stands being managed to maximize harvestable yield, there are equivalent acreages of pine being extensively managed or not managed across the entire southeastern United States. This study aims to investigate differences in productivity across three forest classes: (1) intensively managed, (2) unmanaged, and (3) extensively managed. We use 5000 samples per class to determine if differences exist between the forest classes at maximum leaf area after disturbance. We will stratify by climatic zone and soil drainage class to develop a simple site index across our study area. The study area includes states between Virginia, Florida, and Texas. To accomplish this, we will use Google Earth Engine to extract vectors of point data over time from 1984 to 2023.