GIS @ University of Maryland

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College Park, MD

GIS @ University of Maryland

- Overview
- GIS Education
  - Master of Science in Geospatial Information Sciences (MSGIS) Program
    - Partnership with NOAA CAT-B Program
- GIS Research
  - Center for Geospatial Information Science (CGIS)
- GIS Practice
  - Enterprise GIS at UMD

GIS @ University of Maryland

- Overview
  - Clarification: GIS = Geospatial Information Sciences
    - Geographic Information Systems (GIS)
    - Remote Sensing (RS)
    - Computer Science (CS)
    - Data Science (DS)

GIS @ University of Maryland

- Overview
  - Main GIS groups at UMD
    - Dept. of Geographical Sciences
    - Dept. of Facilities Management
    - National Consortium for the Study of Terrorism and Responses to Terrorism (START)
    - Dept. of Transportation
    - UMD Police Department (UMDP)
    - Other academic units

GIS @ University of Maryland

- GIS Education
  - MSGIS Program
    - Since 2008
    - To provide advanced GIS education and training
    - To help students become GIS developers (instead of GIS users)
      - Curriculum is designed to be technical and practical
      - Increasingly emphasized on computing skills
      - Focused on enterprise GIS
    - An Esri Development Center (EDC)

GIS @ University of Maryland

- GIS Education
  - MSGIS Program
    - Two tracks to choose from:
      - MS degree in GIScience
      - Graduate Certificate in GIScience

GIS @ University of Maryland

- GIS Education
  - MSGIS Program
    - Curriculum

Mobile GIS	Web GIS	Drones and Data Collection
Spatial Analysis	Open Source GIS	Digital Image Processing & Analysis
Spatial Statistics	Big Data Analytics	Programming and Scripting for GIS
Web Programming	Spatial Databases	Advanced Remote Sensing with Lidar
GIS Modeling	Capstone Project	Fundamentals of Geospatial Intelligence

GIS @ University of Maryland

- GIS Education
  - MSGIS Program
    - All classes are scheduled in the evenings (5:30-7:30pm)
    - Real lectures in real time
    - Lectures are taught in classrooms and at the same time broadcast online
    - All lectures and lab sessions are video archived
    - All classes have final projects (individually completed) in addition to the capstone project (equivalent to MS thesis research)

GIS @ University of Maryland

- GIS Education
  - NOAA CAT-B Program (MSGIS as a partner)
    - Since 2017
    - MSGIS offers four classes:
      - Spatial Analysis
      - Spatial Databases
      - GIS Modeling
      - Advanced Remote Sensing with Lidar
    - These four classes are taught at NOAA Headquarter.

GIS @ University of Maryland

- GIS Education
  - NOAA CAT-B Program (MSGIS as a partner)
    - Any NOAA employees with background in GIS may apply.
      - If no background in GIS, need to complete prerequisite courses before official enrollment.
    - Participants have the option to continue and complete more classes
      - MSGIS degree

GIS @ University of Maryland

- GIS Education
  - NOAA CAT-B Program (MSGIS as a partner)
    - Examples of NOAA students' class projects

Analyzing Priority Areas for Future Seafloor Research and Exploration off the California Coast

Jennifer Kraus, NOAA

GEOG653/Spatial Analysis/Spring 2019

Dr. Jiangao Ma

Introduction

Spatial information about the seafloor is critical for decision-making by marine research and management organizations. It is important for these agencies to convey where their data interests lie to better understand their individual objectives, mandates, and missions (Battista & O'Brien 2015). In order to effectively analyze data interests, a spatial framework and web-based tool was used to identify common spatial priorities among different organizations. Users are able to allocate a certain number of coins per cell and select a justification and product to associate with the input (Battista et al, 2017).

Objectives

For this project, I will analyze the prioritization data collected off the coast of California to answer the following:

1) Where are the most coins allocated? Where are the top justifications and products located?
2) How do the higher concentrations of cells change when considering total coins, top justification, and product? This will be done using a Kernel Density Analysis
3) What areas of the (combined) hotspots have not been previously surveyed?

Study Area

This project will focus on the data collected off the coast of California, ranging out to the 200 nautical mile Exclusive Economic Zone (EEZ). The figure to the right shows the extent of the prioritization, the sections of northern, central and southern California (merged together for this project), and the grid cells used for the analysis (10 x 10 minute grid).

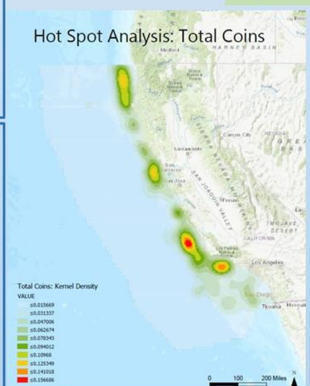
Data

Most of the data used were produced in-house by NOAA's NCCOS Biogeography team. The prioritization grid and online tool was created by NCCOS using a GIS Web-based interface and digital atlas (Kendall et al, 2018). Results from the prioritization were provided as a data table with coin values for each grid cell (including 0-no input). These values corresponded with input from users on total coin number, coins per justification (ie exploration, fishing, cultural) and number of coins per product (ie habitat maps, sediment samples).

Dataset Name	Source	File Type
California Prioritization AOI	NOAA/NCCOS	Shapefile
Grid 10x10 minute	NOAA/NCCOS	Shapefile
Prioritization Results	NOAA/NCCOS	Table
Hydrography Map Footprint	NOAA/NCEI	Shapefile

Objective 1: Spatial allocation of total coins, top justification and product

Objective 2: Hot Spot Analysis using Kernel Density



Results and Discussion

- The most coins were allocated in the nearshore areas, primarily within 200km offshore.
- There about 4 hot spots that were similar among total coins, the top justification (exploration) and desired product (habitat map).
- When previously surveyed areas are removed from the combined hot spot results, there is a total of 19,155 km^2 of high priority areas that have not yet been surveyed.
- The results of this study can provide agencies with insight as to where to focus their data collection and research, in order to better allocate limited resources (ie ship time and scientist availability) where data needs are highest.
- Published results will also encourage collaboration across (and within) organizations where data needs overlap.

References

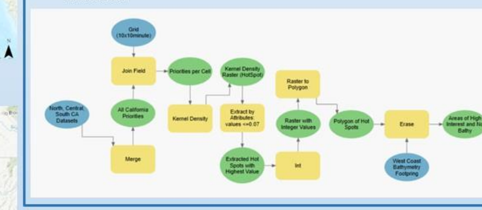
Battista, T.; O'Brien, K. Spatially Prioritizing Seafloor Mapping for Coastal and Marine Planning, *Coastal Management* **2015**, 43:1, 35-51.
https://www.tandfonline.com/doi/pdf/10.1080/08920753.2014.985177

Battista, T.; Buja, K.; Christensen, J.; Hennessey, J.; Lassiter, K. Prioritizing Seafloor Mapping for Washington's Pacific Coast. *Sensors* **2017**, *17*, 701.
https://www.mdpi.com/1424-8220/17/4/701/htm

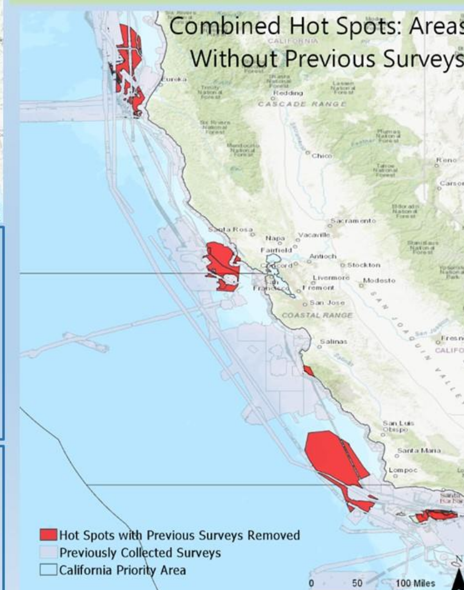
Kendall, M.S.; Buja, K.; Menza, C.; Battista, T. (2018) Where, What, When, and Why Is Bottom Mapping Needed? An On-Line Application to Set Priorities Using Expert Opinion. *Geosciences* **2018**, *8*, 379.
https://www.mdpi.com/2076-3263/8/10/379

Data Analysis Methods

1) Tables for north, central, and south California were combined to get all of the prioritization input for California
2) Graduated symbols used to display total coins, top justification, and top product fields.
3) Table join: grid and coin data to get values per grid. Calculated top 5% and 10% (in excel) and displayed these as colored grids.
4) Kernel Density to calculate magnitude per unit area
5) Extract by Attribute values < or + 0.07 to extract hot spots
6) Int tool to convert floating point raster to integer
7) Raster to polygon: convert hotspot raster to polygon
8) Erase: remove bathy footprint from hotspot polygons
9) Final polygon: combined hotspots with previous surveys removed



Objective 3: Areas of high priority (combined hotspots) that have not been previously surveyed.



STATISTIC ANALYSIS TO IDENTIFY HOW MUCH SOLAR PHOTOVOLTAIC POTENTIAL THERE IS ON ROOFTOPS IN A SMALL TOWNHOUSE COMMUNITY, NORTH BETHESDA, MARYLAND

Patrick Chauvet GEOG 653 – CAT B – February 2019

Introduction

Our society and our economy are very dependent on energy. As our demand in electricity increases every day and our supply in fossil fuel decreases, with concern about carbon dioxide emissions contributing to possible global warming, there is an increase of interest in clean and renewable energy around the world. The sun rises from east to west but the way the sun moves across the sky favors the south. However if the solar panels face east, they will receive direct sunlight in the morning, and if they face west, they will receive direct sunlight as the sun sets, in the late afternoon and early evening, rather when the sun is at his peak. The lost of energy output is about 20% compare to south-facing systems. The price of solar panels has become affordable and more homeowners have opted to invest in an emission free electricity by having solar panels installed on their roof. Solar panels or photovoltaic modules use light from the sun to generate electricity. In some states, the energy produced and not used can be sent into the grid and can be used when needed, especially during cloudy and snowy days. As of 2017, the state of Maryland has a target for renewable energy to be 20% by 2020, including 2% from solar power.

Objectives

1. To Identify how much solar photovoltaic potential energy exist on rooftops.
2. Which houses are south-facing that will provide the most direct sunlight.
3. Can this residential area be totally off the grid.

Study Area

The aspect and the total annual solar radiation show that all of the houses have their roofs in an angle well oriented to have solar panels. This neighborhood does not have gas and is entirely dependent on electricity. The house selected on this study area, which I am the owner, has solar panels and according to the point solar distribution the mean solar energy on the entire roof is 1258 kWh/m²/year. The total surface of the roof is 80 m² that sums to an estimated potential production of 100,640 kWh/year. Not the entire roof can be cover with photovoltaic solar panels. Photovoltaic panels do not convert 100% of solar radiation into electricity. The panels on this house have a sunlight to electricity conversion efficiency of over 19.4%, amongst the highest in the industry. It is a system with an estimated yearly production of 11,700 kWh. In 2018, the entire electricity consumed was 11,719 kWh. This house generates 100% of its electricity with solar energy. I have solar panels installed in April 2018 and started production in May 2018. The entire consumption of my 2018 energy is calculated using electric bills and a yearly report of solar energy production.

Methods

Image: Montgomery county, Rockville area, elevation Lidar 1 meter resolution.

Slope: identifies the steepest downhill slope for a location on a surface. The result polygon represents a range of slope values in degrees.

Aspect: identifies the steepest down slope direction at a location on a surface. There are degrees measured clockwise from North.

Using Aspect, I did a first query to select areas that are between 112.5° to 247.5° (southeast to southwest) which shows that approximately 80% of the houses have roofs with good south coverage. The second query was to select areas between 67.5° to 292.5° (east to west) that shows 100 % of houses have roofs are suitable to have solar panels installed.

Solar Radiation Tool: calculates the amount of insolation received across the landscape of a specific location and time. The tool allows to choose specific years, month and time.

Raster to Point: solar radiation raster was converted to vector point in order to use it with the digitized rooftops polygon layer.

Clip: the rooftops polygon feature class was used to isolate the solar radiation points falling specially on each house and eliminate the rest of the area.

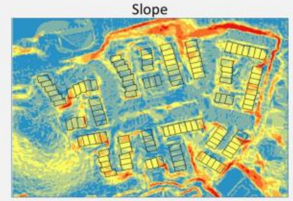
Study Area

North Bethesda, Maryland

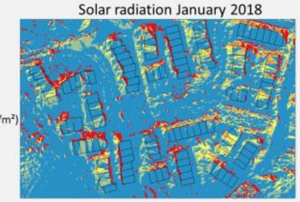
Conclusion

This study does not take in consideration the vegetation, the weather and the fact that the roofs have two sides with slopes facing opposite direction. If 11% of the yearly estimated solar production is enough to generate 100 % of electricity, using solar radiation points, we can estimate the total potential solar energy production for each house. It is possible that most of the houses can potentially generate 100% of their electricity using solar energy and be off the grid.

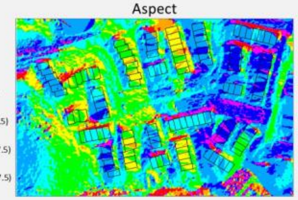
Slope



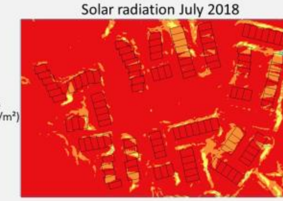
Solar radiation January 2018



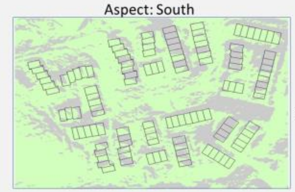
Aspect



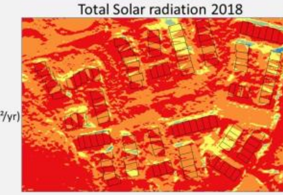
Solar radiation July 2018



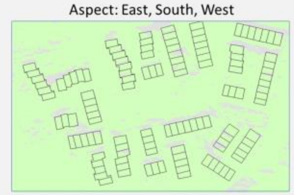
Aspect: South



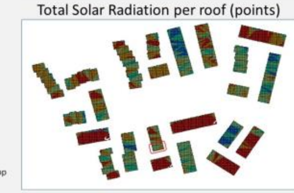
Total Solar radiation 2018



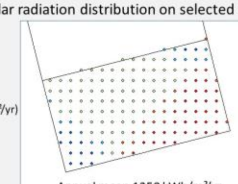
Aspect: East, South, West



Total Solar Radiation per roof (points)



Solar radiation distribution on selected rooftop



Annual mean 1258 kWh/m²/yr

References

World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Info: www.en.wikipedia.org/wiki/Solar_power_in_Maryland

Data: https://datagateway.nrcs.usda.gov/

Aspect of solar radiation analysis using ArcGIS https://www.researchgate.net/publication/311740728_Aspects_of_Solar_Radiation_Analysis_using_ArcGis

Carl, Caroline. *Calculating Solar Photovoltaic Potential on Residential Rooftops in Kailua Kona, Hawaii*. University of Southern California, 2014.

Nebraska Wind Turbine Suitability Models

Max Andersen, MPSGIS Student

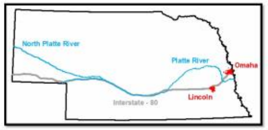
UNIVERSITY OF MARYLAND

Introduction and Objective

Nebraska has the fourth highest wind capacity in the United States (1). In actual wind energy production, however, it lags far behind the neighboring states of Iowa, Kansas, South Dakota, and Colorado. This is primarily because the power utility companies in Nebraska are publically owned and therefore can't take advantage of the same tax benefits as private companies in other states. In recent years, however, as wind energy technology has improved and become less costly, it has begun to make economic sense for public utility companies to sign contracts with private turbine owners. These private owners, in turn, sign leases to build the turbines on land owned by rural farmers, ranchers, and other community members (2).

In order to effectively develop wind energy production, it will be important to examine the state as a whole and identify areas that hold the greatest potential value. To accomplish this, two suitability maps were produced from a variety of input factors that help determine the best locations for wind turbines. To develop the models, work completed by Janke, Van Hoesen and Letandre, and Miller and Li in Colorado, Vermont, and two individual counties in Nebraska was consulted (3) (4) (5). The pre- and post-processed data are shown to the right, specific processing steps are described below, and the final models and conclusions are discussed at the bottom.

Study Area Overview



A majority of the residents of Nebraska live in the eastern part of the state near Omaha and Lincoln, which are the only cities with a population over 60,000. The central part of the state is dominated by row-crop agriculture, while the western portion (Sandhills) has a greater percentage of pasture and grassland. Small towns and infrastructure have typically developed following the Platte River or Interstate-80, as seen in the data to the right.

Processing Steps

1) *Fishnet*: First, the "Create Fishnet" tool was used in ArcMap to generate a polygon grid across the entire state. A cell size of 750 meters was chosen based on trial and error of the author's PC processing capabilities. The fishnet was used as a 'container' to store input variable values. All input data were projected to NSRS 2007 Nebraska State Plane (FIPS 2600 – meters) and snapped to the fishnet so that cells were properly aligned.

2) *Categorical Data*: Wind Capacity data was provided as a polygon with 200 m resolution. Each cell was ranked as 1-7, with 7 being the highest capacity areas. This file was converted using the "Polygon to Raster" tool, changed to a 750 m resolution using the "Resample" tool (with Nearest Neighbor setting), converted again using the "Raster to Point" tool, and stored in the fishnet file using the "Spatial Join" tool. Land Cover data was provided as a 30 m resolution raster with 15 different categories. The resolution was changed using the "Resample" tool, converted using "Raster to Point", and stored in the fishnet using "Spatial Join".

3) *Distance Data*: Major Power Transmission Lines, Major Roads, and City Boundary data were retrieved as line and polygon shapefiles. They were converted to raster format by using the "Euclidean Distance" tool with 750 m cell size settings. The distance value for each cell was converted using the "Raster to Point" tool and stored in the fishnet by using the "Spatial Join" tool.

4) *Data Masks*: Federally-owned lands (such as National Parks and military bases), Native American land, and endangered species critical habitat areas were provided in shapefiles. They were used as masks to denote areas where wind turbine development could not take place. First, the files were combined using the "Merge" tool, converted using the "Polygon to Raster" tool with 750 m cell settings, converted to a binomial raster using the "Raster Calculator" tool so that cells that represented federal lands were given a value of 0, and cells with no data were given a value of 1, converted with the "Raster to Point" tool, and stored in the fishnet with the "Spatial Join" tool.

5) *Normalization*: The Land Cover categories were normalized by manually redefining the categories based on their suitability for turbine development. Areas such as 'Open Water' were converted to 0, 'High Intensity Development' and 'Forested' areas to 0.33, 'Low Intensity Development' and 'Wetlands' to 0.66, and 'Barren land', 'Herbaceous', 'Pasture', etc. to 1 by using the "Select by Attribute" and "Create New Field" tools. Wind Capacity, Transmission Line Distance, and Road Distance were normalized by using the formula $x = \frac{x}{x_{max}}$. Road Distance was normalized by using the formula $x = \frac{x_{max} - x}{x_{max}}$. Mask data did not need to be normalized.

6) *Model Creation*: The simple model was produced by creating a new field in the fishnet attribute table and using "Field Calculator" to multiply each of the normalized variables with each other. This model was then converted using the "Polygon to Raster" tool. The weighted model was produced by converting each normalized variable to a raster first, and then using the "Weighted Sum" tool. The Wind Capacity variable was assigned a value of 3 and the Distance to Transmission Lines variable was assigned a value of 2. This identified the areas of "lowest hanging fruit", or areas with the highest capacity that would be the easiest to incorporate into the grid.

Pre-Processed Data | Model Input Data

Wind Capacity Rankings

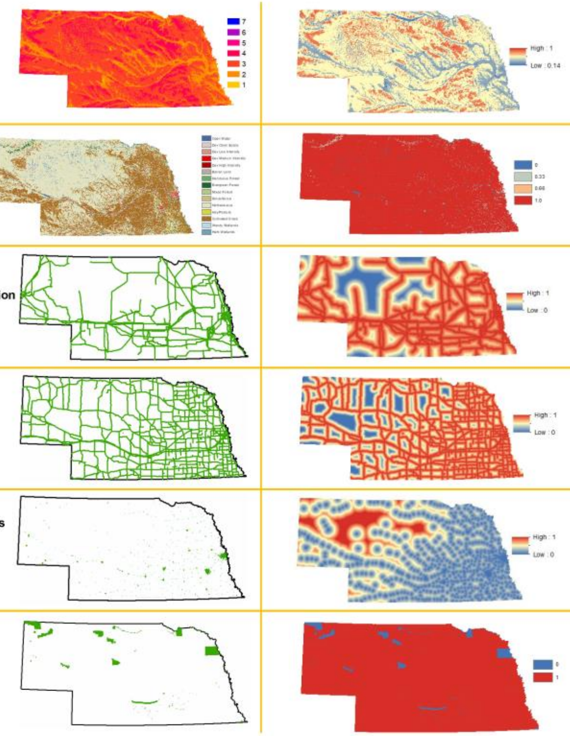
Land Cover

Electric Power Transmission Lines

Major Roads

Municipal Boundaries

Land Masks



References and Sources

(1) https://www.omaha.com/money/new-developments-help-nebraska-take-advantage-of-its-capacity-for/article_74db577f-005b-5c98-94fa-7f20622255b2.html

(2) https://www.omaha.com/money/turning-to-turbines-as-commodity-prices-remain-low-wind-energy/article_2814e2cf-83a3-547d-a09e-f039e935f399.html

(3) Janke, Jason R. "Multicriteria GIS modeling of wind and solar farms in Colorado." *Renewable Energy* 35.10 (2010): 2228-2234.

(4) Van Hoesen, John, and Steven Letendre. "Evaluating potential renewable energy resources in Poultney, Vermont: A GIS-based approach to supporting rural community energy planning." *Renewable energy* 35.9 (2010): 2114-2122.

(5) Miller, Adam, and Ruopu Li. "A geospatial approach for prioritizing wind farm development in Northeast Nebraska, USA." *ISPRS International Journal of Geo-Information* 3.3 (2014): 968-979.

Wind Capacity Ranking Data:
https://www.nrel.gov/gis/data-wind.html

Land Cover Data:
https://datagateway.nrcs.usda.gov/GDGOrder.aspx

Electrical Power Transmission Line Data:
https://hifld-geoplatform.opendata.arcgis.com/datasets/electric-power-transmission-lines?geometry=-123.72%2C32.488%2C-68.217%2C44.478

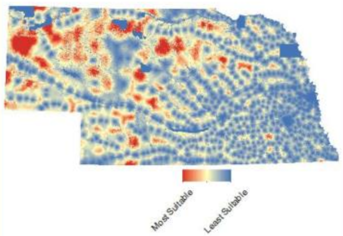
Municipal Boundary and Road Data:
https://www.census.gov/geo/maps-data/data/tiger-geodatabases.html

Endangered Species Critical Habitat Data:
https://data-outdoornebraska.opendata.arcgis.com/datasets/endangered-and-threatened-species-ranges/data?page=2

Federally-owned and Native American Lands Data:
https://viewer.nationalmap.gov/basic/#productSearch

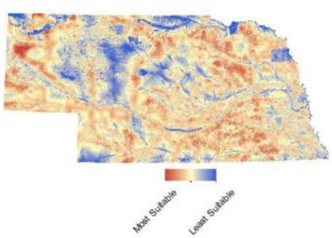
Model Results

Simple Model



W.C.R. * L.C. * E.P.T.L * M.R. * M.B. * L.M.

Sum-weighted Model



Wind Capacity Weight = 3

Power Line Distance Weight = 2

Discussion and Conclusions

* Both models predict a highly-suitable area near the western border of the state just north of the North Platte River. This is a low population area, but has infrastructure in place near it and a high wind capacity. This could be the most cost-effective area to target for wind turbine production.
* Small town municipal boundaries appear to play an exaggerated role in the simple model. It may be useful to normalize their impact by population density in future analysis.
* The sum-weighted model places a higher priority on wind-capacity rankings, so the majority of south-central Nebraska is ranked as very suitable, while only small pockets of it receive high rankings in the simple model.
* The models may suffer from multi-collinearity, as municipal boundaries, major roads, and electrical power transmission lines appear to be correlated. Further testing would be needed to verify this.
* Future analysis could include different weighting systems for the input variables and the inclusion of new variables, such as population density and line-of-sight analysis.

GIS @ University of Maryland

- GIS Research
  - Research Centers at the Dept. of Geographical Sciences
    - **Center for Geospatial Information Science (CGIS)**
    - **Center of Excellence in Remote Sensing**
    - **Joint Center for Carbon Cycle Science**
    - **Center for Global Agricultural Monitoring Research**
    - **The Global Land Cover Facility**

GIS @ University of Maryland

- GIS Research
  - [Center for Geospatial Information Science (CGIS)]()

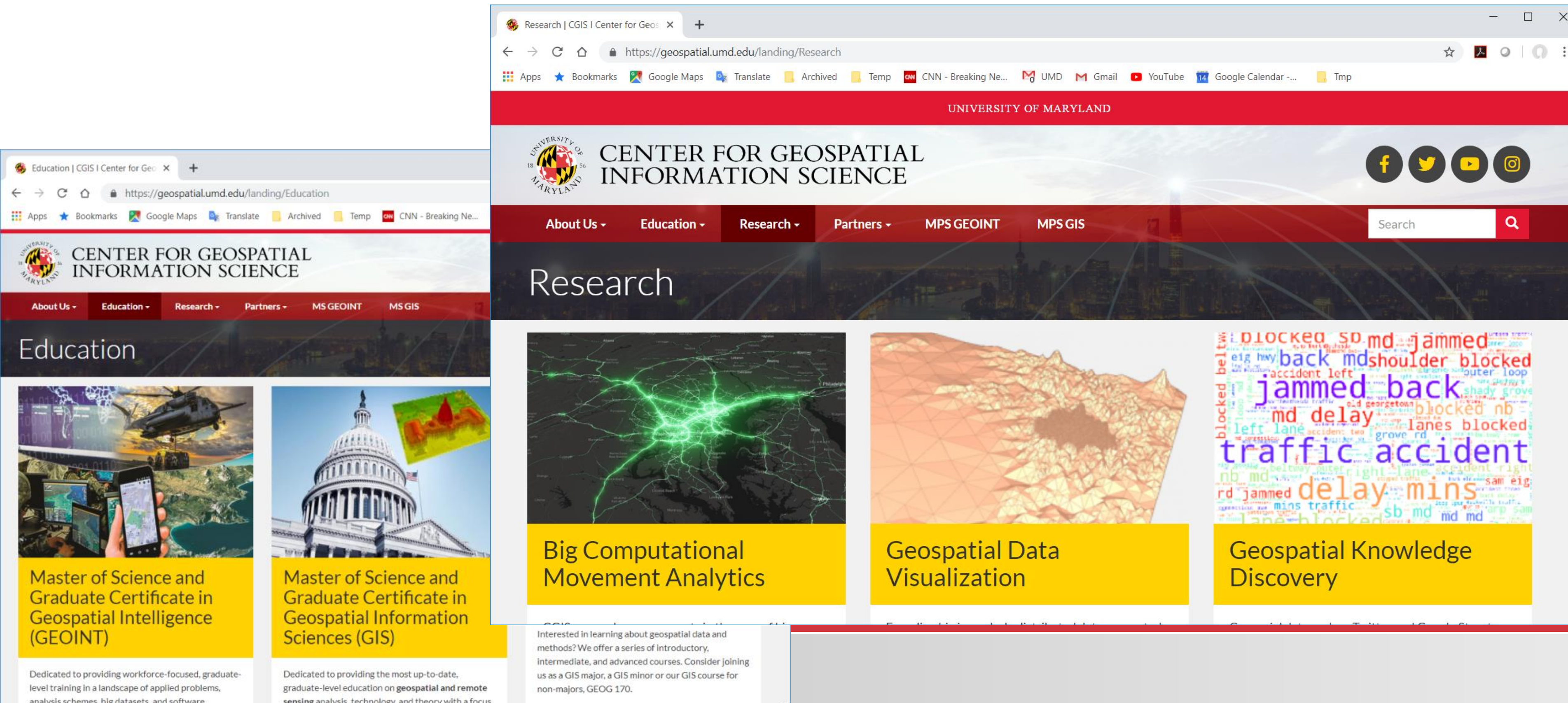
Center for Geospatial Information Science is *part of the Department of Geographical Sciences*
University of Maryland
College Park, MD, USA
www.geospatial.umd.edu

GIS @ University of Maryland

- GIS Research
  - [Center for Geospatial Information Science (CGIS)]
    - Research areas:
      - Big geospatial data
      - Spatial data science
      - 3D geovisualization
      - Mobility and spatial trajectory analytics
      - Geostatistical analytics
      - Network analysis
      - Geospatial social media analytics
      - Geospatial semantic modeling, among other topics

GIS @ University of Maryland

- GIS Research
  - [Center for Geospatial Information Science (CGIS)](#)



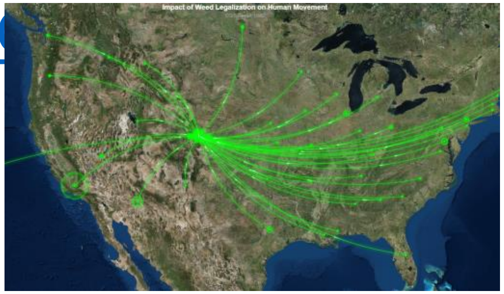
Vehicles shown here, but our research could also be applied to ships, tracking vessel movements, harbor analytics

GIS @ University of Maryland

- GIS Research
  - [Center for Geospatial Information Science (CGIS)]()
    - Research examples:

GIS @ University of Maryland

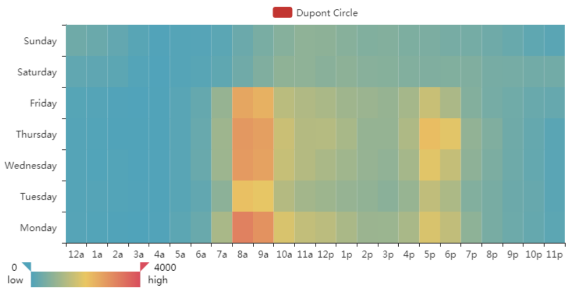
- GIS Research
  - [Center for Geospatial Information Science (C](#)
    - Research examples: tracking movement and mobil



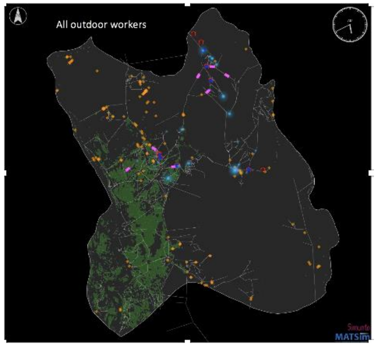
Has travel to Colorado changed over time since marijuana legalization in this state?

Derive and analyze **human activity spaces** from **socially-sensed data (e.g., Twitter)**

Integrate **spatial**, **temporal** and **travel network** aspects to track and visualize individual movement trajectories and activity spaces



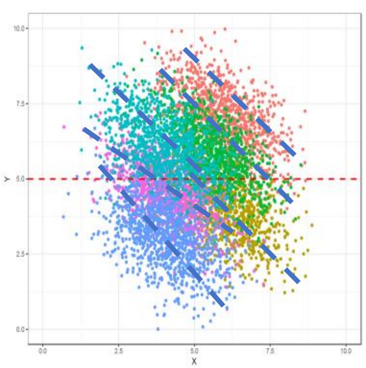
Cell phone data for Dupont Circle, Washington, D.C. shows activity patterns



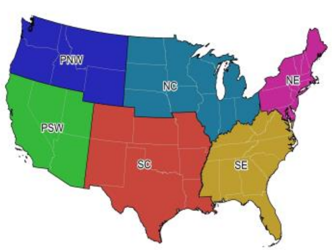
Analyzing local population movement to determine risk of malaria infection

GIS @ University of Maryland

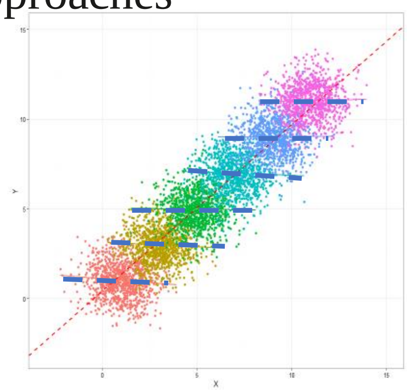
- GIS Research
  - Center for Geospatial Information Science (CGIS)
    - Research examples: spatial analysis
      - **geographically weighted regression** (GWR) for multivariate local modeling
      - **Scaling algorithms** to handle millions of observations (locations of interest) with lower computation times over other approaches



Negative relationships



Local relationships from spatial subsets



Positive relationships

GIS @ University of Maryland

- GIS Research
  - [Center for Geospatial Information Science (CGIS)]
    - Research examples: geospatial data visualization

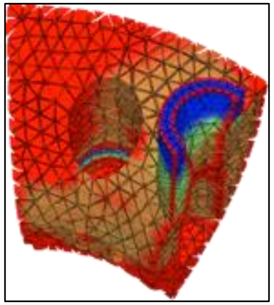
Research problem: encoding **big** irregularly distributed data connected through **unstructured meshes**

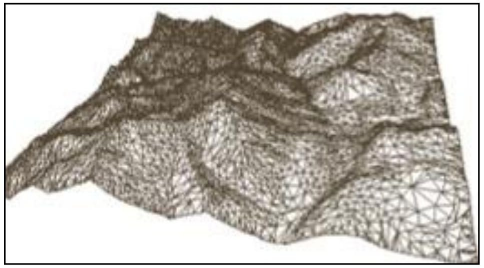
- terrain and urban models
- models of scattered scalar or vector data distributed in complex domains

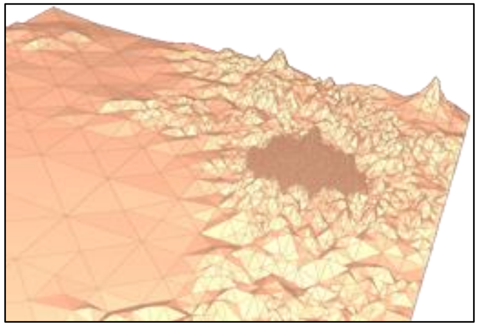
Multiresolution

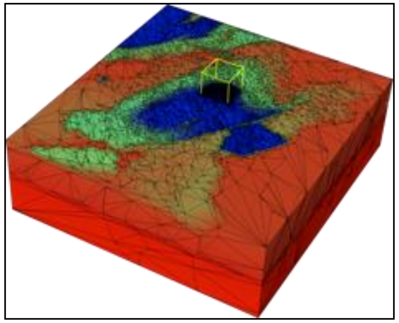
Distributed data structures

Topology-based visual analytics









GIS @ University of Maryland

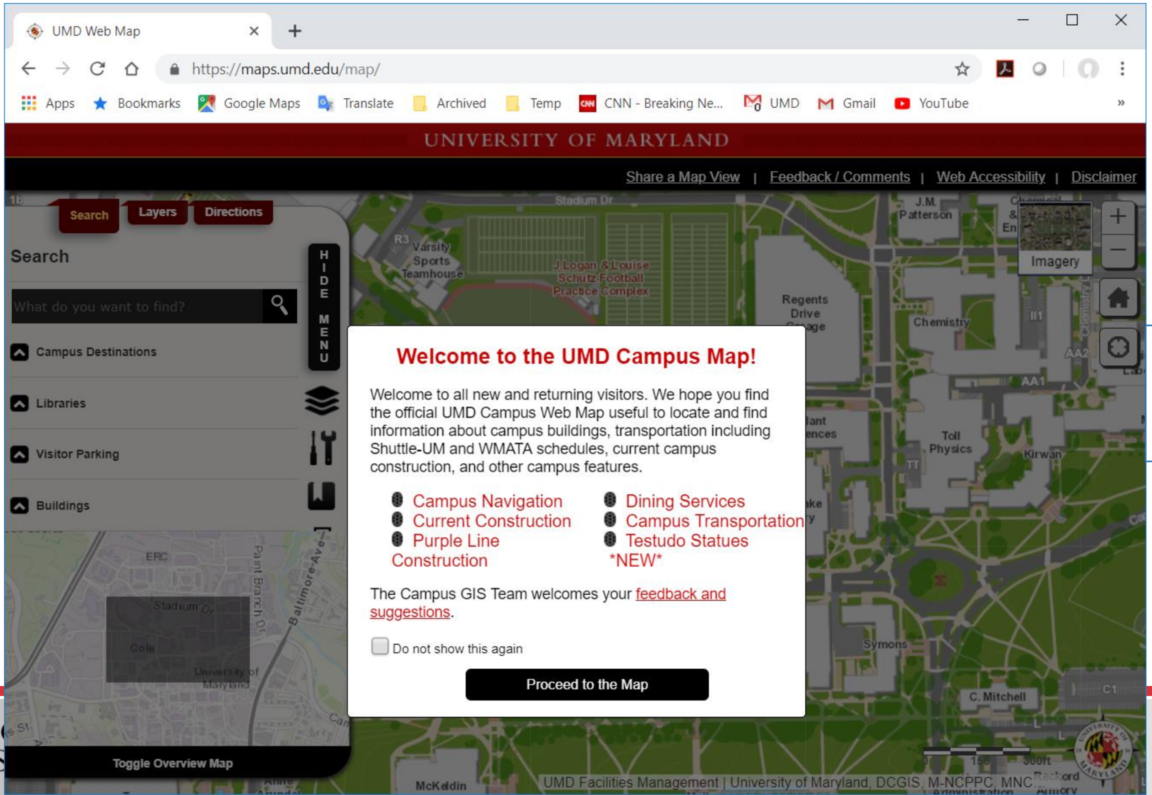
- GIS Practice
  - UMD is big and complex.
    - Academic staff: 4,610 (Fall 2016)
    - Administrative staff: 5,481 (Fall 2016)
    - Students: 41,200 (Fall 2018)
    - 1,339 acres
    - 441 Buildings
    - ~20 miles of Roads
    - ~66 miles of Sidewalks
  - **Enterprise GIS is needed at UMD for management efficiency and quality.**

GIS @ University of Maryland

- GIS Practice
  - Enterprise GIS makes big difference at UMD.
  - Data services to students, visitors, transportation, utility, facilities management, police, etc.
  - A collaborative effort to create a centralized campus information management platform
  - More timely access to more accurate information
  - Better decision making tools for administrators
  - Enhancements to existing information management and dissemination systems.
  - Dept. of Facilities Management (UMD FM) is the major developer of GIS apps on campus.

GIS @ University of Maryland

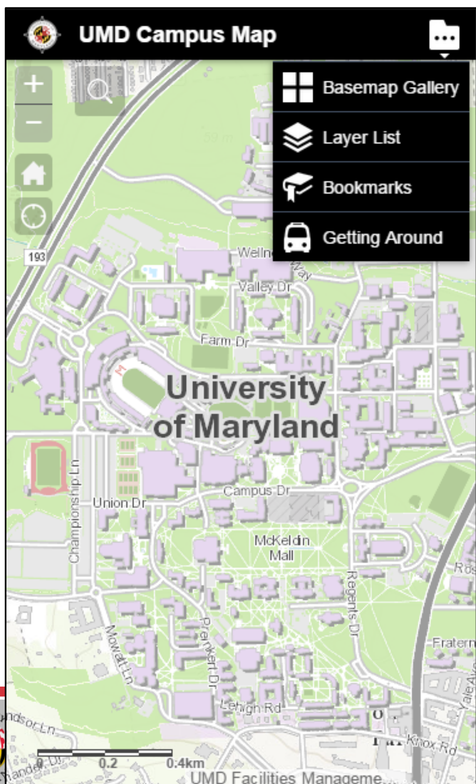
- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 2D Navigation ([interactive campus map](https://maps.umd.edu/map/))

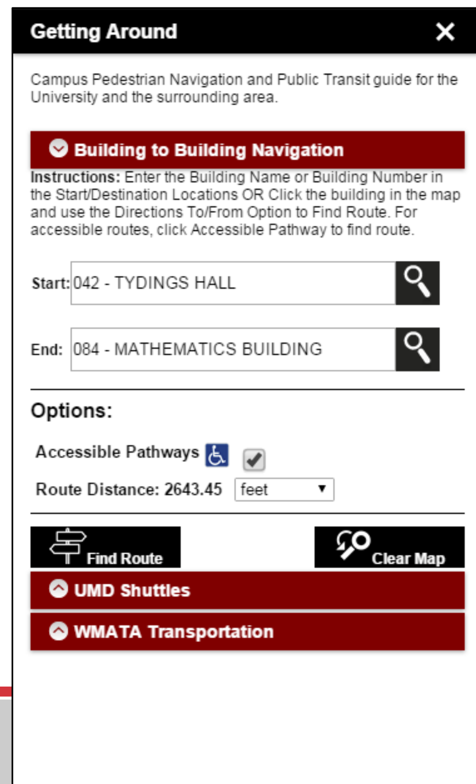


UMD FM

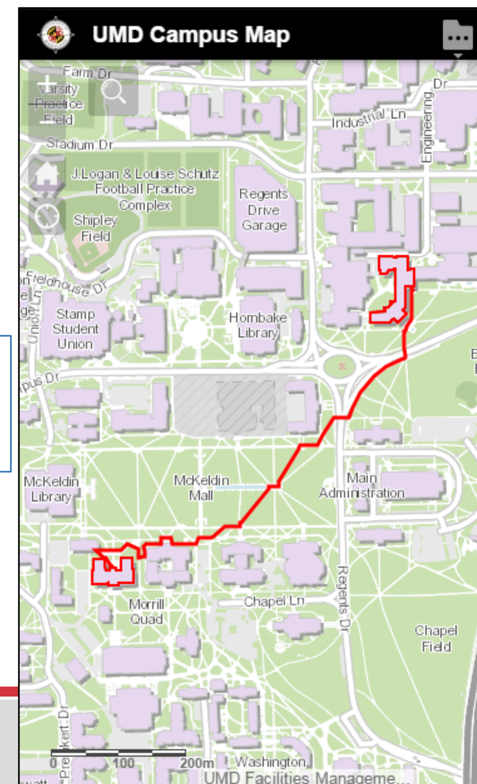
GIS @ University of Maryland

- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 2D Navigation (mobile version)



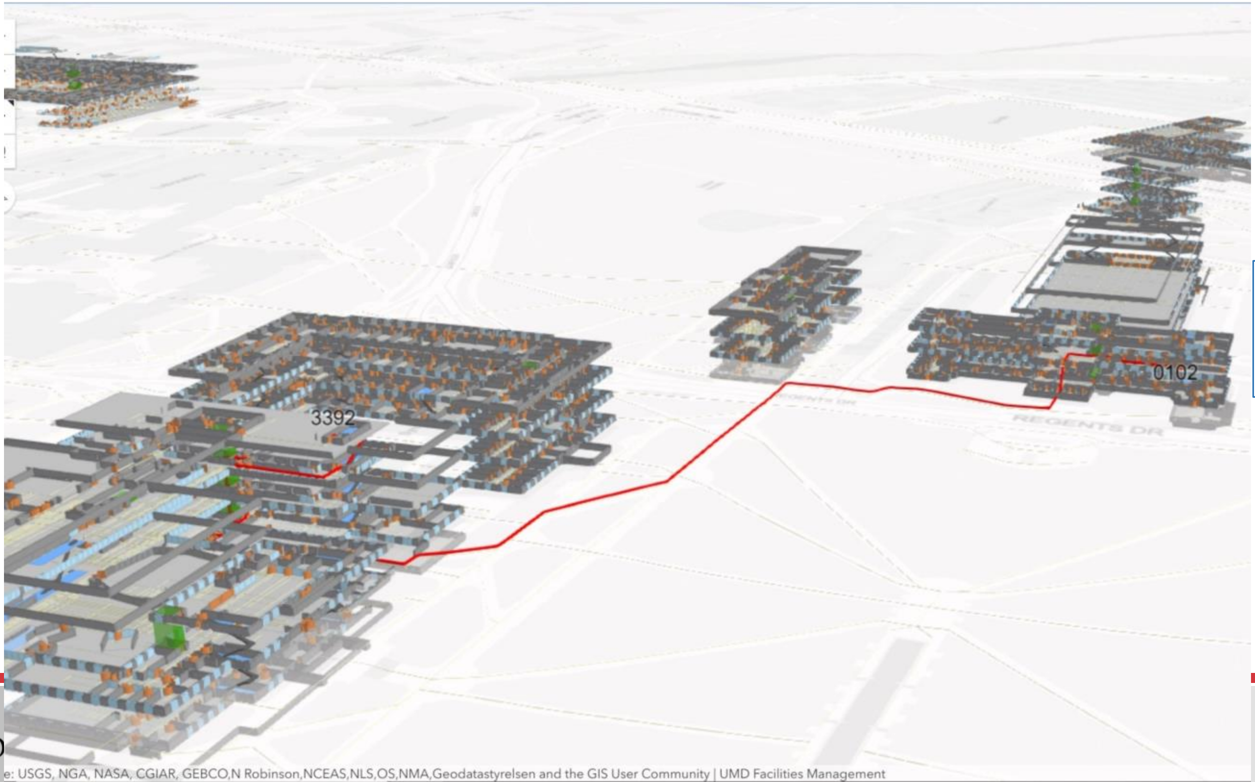


UMD FM



GIS @ University of Maryland

- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 3D Interior Navigation



UMD FM

GIS @ University of Maryland

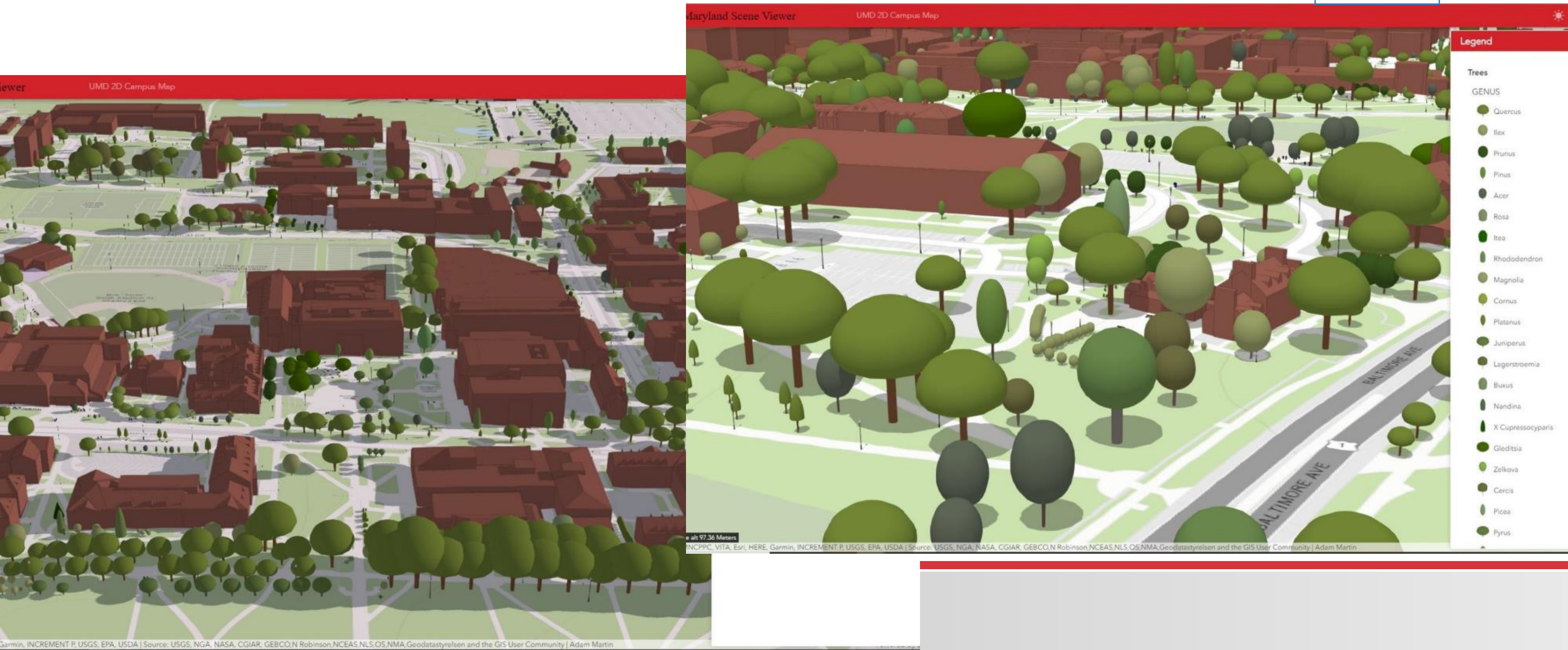
- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 3D Interior Navigation

UMD FM

GIS @ University of Maryland

- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 3D Campus Viewer

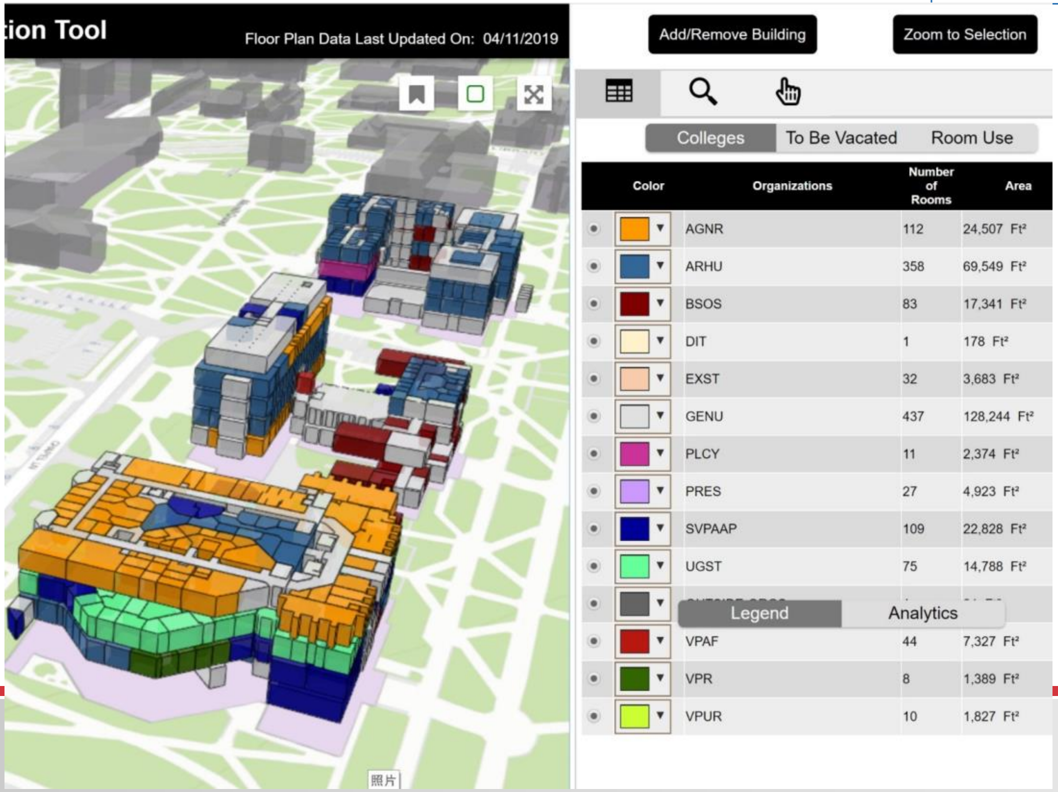
UMD FM



GIS @ University of Maryland

- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 3D Campus Space Planning and Visualization

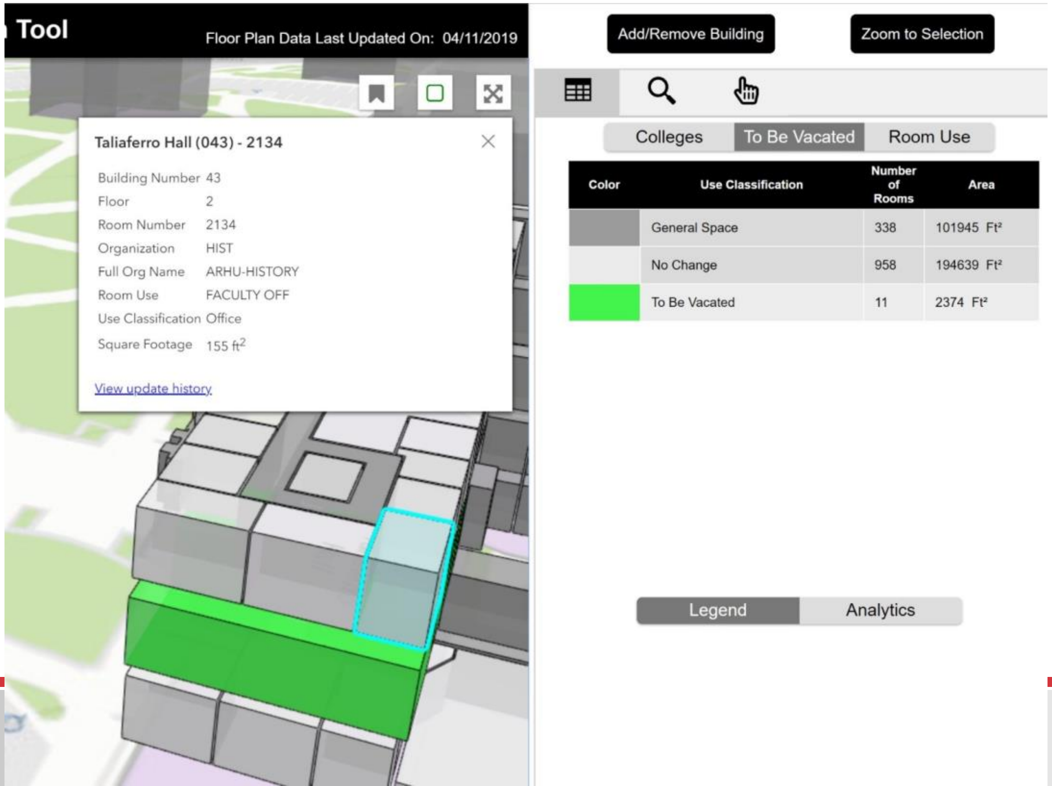
UMD FM



GIS @ University of Maryland

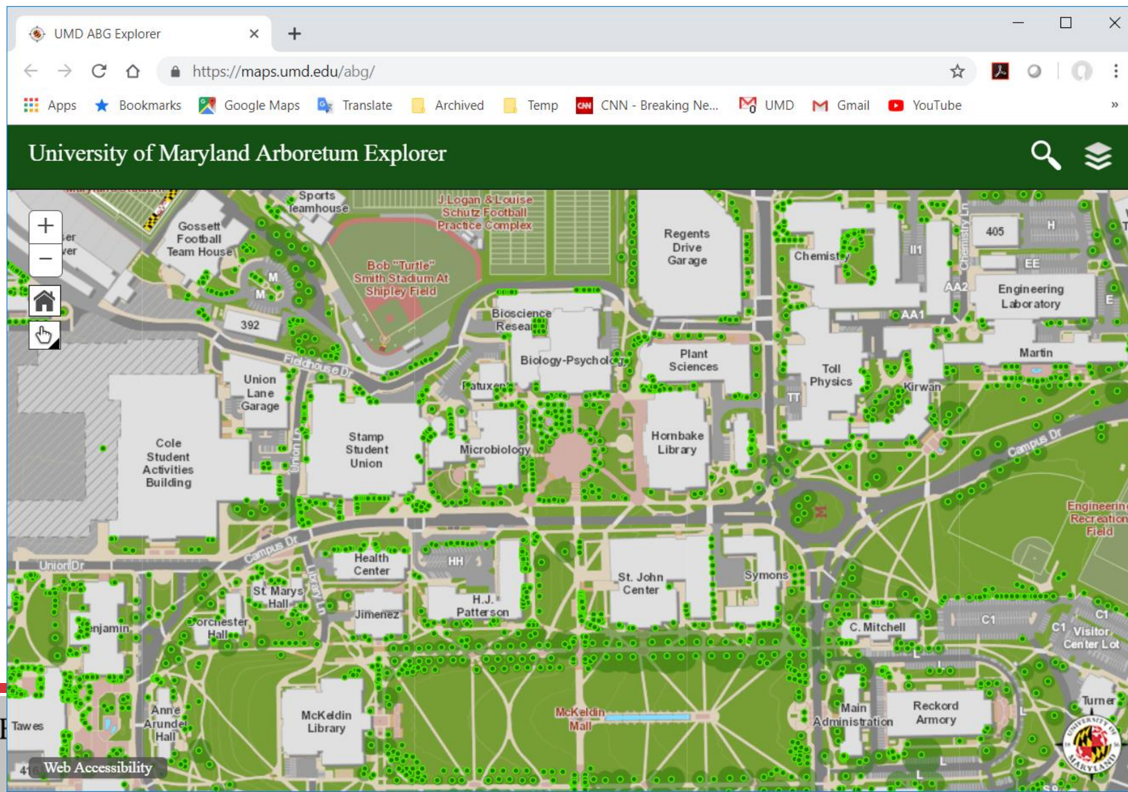
- GIS Practice
  - Enterprise GIS at UMD
    - Examples: 3D Campus Space Planning and Visualization

UMD FM



GIS @ University of Maryland

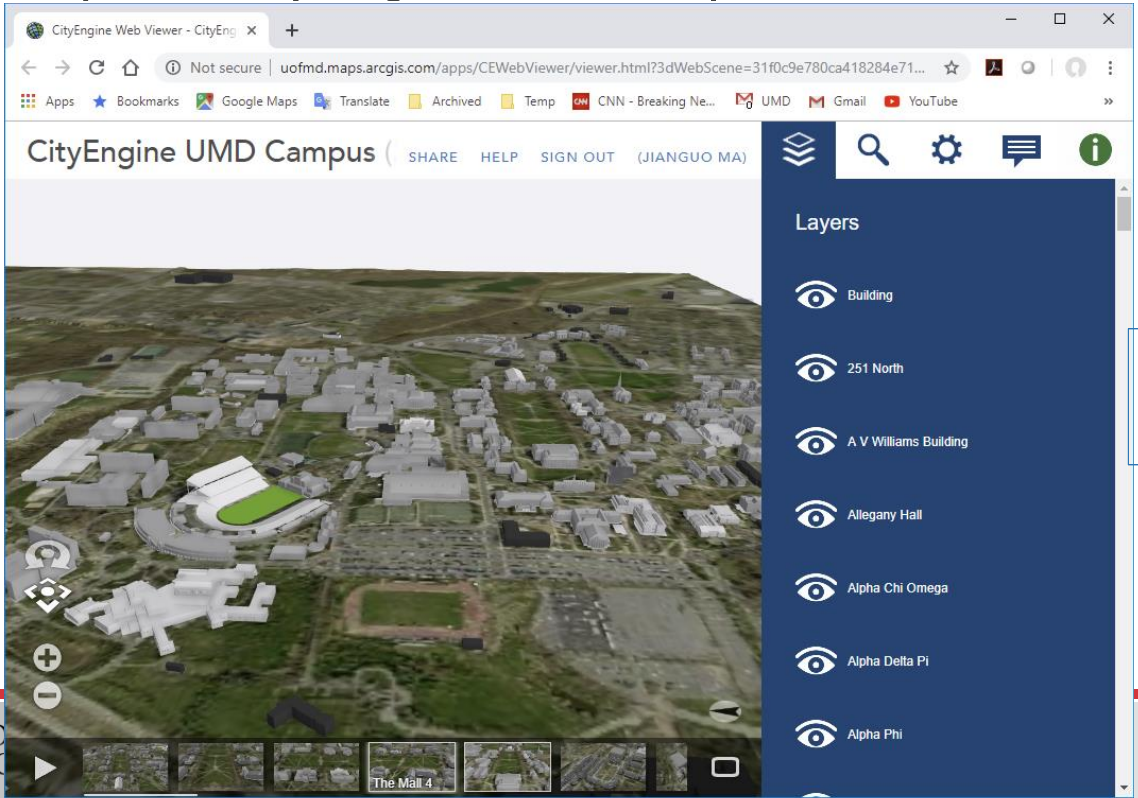
- GIS Practice
  - Enterprise GIS at UMD
    - Examples: [UMD Arboretum Explorer](https://maps.umd.edu/abg/)



UMD FM

GIS @ University of Maryland

- GIS Practice
  - Enterprise GIS at UMD
    - Examples: CityEngine 3D Campus



UMD FM

GIS @ University of Maryland

- Summary
  - Dept. of Geographical Science, particularly MSGIS program, provides a wide range of education and training in GIS, remote sensing, computing, and data science.
    - Partnership with NOAA CAT-B Program
  - Active in GIS research, especially related to data science and computing
  - Enterprise GIS has made big difference to the university management of facilities, resources, planning, etc.
  - **UMD will continue to promote GIS education, research and service on- and off-campus.**

GIS @ University of Maryland

Questions?