Montana Association of Geographic Information Professionals (MAGIP)

2019 Big Sky GeoCon

April 1-4, 2019 | Clarion Inn Copper King | Butte, Montana

Workshops, Presentations, Posters, and Web Applications

2019 Big Sky GeoCon

| **A** Awards | **C** Census | **F** Coffee Break | **E** Emergency Services | **H** Hosted Lunch & Keynote | **L** Lidar |

A Awards   **C** Census   **F** Coffee Break   **E** Emergency Services   **H** Hosted Lunch & Keynote   **L** Lidar

G Local Government   **1** Lunch   **M** Meeting   **N** Natural Resources   **S** Social   **O** Socio-Economic

P Special Session   **R** Survey   **T** Technology/Mapping   **U** UAS Applications Block   **2** UAS General

B UAS Private Sector Block   **K** UAS Public Block   **I** Utilities   **V** Vendor Track   **W** Web & Mobile App

3 Workshop

APRIL 1 • MONDAY

| 08:00 – 12:00 | **3 Building Python Modules** | Copper Room 2 |

08:00 – 12:00   **3 Building Python Modules**   Copper Room 2

Speakers: John Hogland

Workshop Format: bring your own computer: There are numerous coding libraries available that allow us to automate many tasks within our workflow. However, there are often times in which we cannot easily address questions or tasks by using existing libraries or modules. In those circumstances it can be useful to develop our own python modules that can be automated. In this workshop we will discuss development techniques used to create modules that support aspects of data creation, spatial modeling, and decision making. Through multiple interactive examples we will develop a series of routines and spatial modeling tools that will be used describe varying characteristics of spatial data and help to inform decision making. Workshop requirements: ArcGIS and python, your favorite interactive development environment (I will be using MS Visual Studio 2015), and SciPy

| 08:00 – 17:00 | 3 **R and ArcGIS (two day course)** | Copper Room 1 |

Speakers: Eric Pimpler

Workshop Format: bring your own computer: Each computer will need to have RStudio (free version) installed along with the tidyverse package. I will be sending the students instructions on how to get these installed and configured when we get closer to the conference. There is also an optional section of the course that we do at the end that shows how to build custom R script tools for ArcGIS Pro, so ArcGIS Pro is an optional install. Below is a description you can use:

Chapter 1: Introduction to R and RStudio
Chapter 2: The Basics of Data Exploration
Chapter 3: Loading Data into R
Chapter 4: Transforming Data
Chapter 5: Creating Tidy Data
Chapter 6: Basic Data Exploration Techniques
Chapter 7: Basic Data Visualization Techniques
Chapter 8: Visualizing Geographic Data with ggmap
Chapter 9: R Markdown
Chapter 10: Case Study – Wildfire Activity in the Western United States
Chapter 11: Case Study – Single Family Residential Home and Rental Values
Chapter 12: Integration with ArcGIS Pro

Today, data science is an indispensable tool for any organization, allowing for the analysis and optimization of decisions and strategy. R has become the preferred software for data science, thanks to its open source nature, simplicity, applicability to data analysis, and the abundance of libraries for any type of algorithm.

This book will allow the student to learn, in detail, the fundamentals of the R language and additionally master some of the most efficient libraries for data visualization in chart, graph, and map formats. The reader will learn the language and applications through examples and practice. No prior programming skills are required.

We begin with the installation and configuration of the R environment through RStudio. As you progress through the exercises in this hands-on class you'll become thoroughly acquainted with R's features and the popular tidyverse package. With this class, you will learn about the basic concepts of R programming, work efficiently with graphs, charts, and maps, and create publication-ready documents using real world data. The detailed step-by-step instructions will enable you to get a clean set of data, produce engaging visualizations, and create reports for the results.

| 12:00 – 13:00 | 1 **Lunch on your own** | |

| 13:00 – 17:00 | 3 **Batch Processing** | Copper Room 2 |

Speakers: John Hogland

Workshop Format: bring your own computer

The RMRS Raster Utility (Hogland and Anderson 2017) is a spatial, statistical, and machine learning library that can be used to address various management and scientific questions in an extremely efficient manner. Some examples of how this library has been recently used include mapping forest species using remotely sensed imagery (Hogland et al. 2018), quantifying delivered costs (Hogland et al. 2018), producing land cover maps (St. Peter et al. 2018), prioritizing needs (Hogland et al. 2017), and comparing different sources of remotely sensed data (Ahl et al. 2019). Many access the routines and procedures of the RMRS Raster Utility library through a graphical interface within an ArcGIS addin called the RMRS Raster Utility toolbar (website). In addition to the toolbar, we have developed a command line syntax executable (batch executable) that can be used to automate a wide array of procedures. In this workshop we will explore some of the capabilities of this library and work through a series of spatially explicit examples designed to highlight the utility of batch processing. Workshop requirements: ArcGIS 10x.

| 13:00 – 17:00 | 3 **Fundamentals of Census Geography** | Copper Room 3 |

Speakers: Jim Castagneri & Lacey Loftin

Workshop Format: lecture style, bring your own computer if desired

The MAF/TIGER system is the foundation for the decennial census and for the American Community Survey (ACS) among others. Created through a cooperative program with the United States Geological Survey (USGS) in the 1980's, TIGER and census demographic data are now a critical part of the planning landscape. This workshop will explore the details of census geography and TIGER topology. We will answer questions such as; What happens to census blocks when a city submits a new annexation? And; Why did my CDP change shape in-between censuses? Bring your tough questions about TIGER and Census geography for an answer packed session designed to help you make the most out of TIGER data!

| 13:00 – 17:00 | 3 **Survey123** | Copper Room 5 |

Speakers: Curtis DeVault

Workshop Format: bring your own computer

Survey123 is a simple to design and use form oriented data gathering and analysis solution. It also very customizable, allowing users to create forms that allow data to be gathered with tight control while remaining very simple for the user perspective. During this workshop we will go through the simple form creation tool, and the advanced option using XLSForms, then sharing your survey, and analyzing your survey data.

| 13:00 – 17:00 | 3 **UAS Contemporary Applications** | Copper Room 4 |

Speakers: Jackson Beighle, Michael Clancy, Jeremy Crowley, Jesse Bunker, Stephen Frazer

Workshop Format: lecture style

Part 1: UAS Data Acquisition & Deliverables

Speaker: Jackson Beighle of Frontier Precision

In Part 1, broaden your knowledge of unmanned aircraft systems (UAS) for rapidly collecting geospatial data. Learn about drones, sensors, UAS deliverables and acquiring ground control points.

Part 2: UAS data collection for Surveying and Ecological Mapping

Speaker: Michael Clancy of EcoPoint

In Part 2, see an applied example of flight parameters, sensor calibration and processing routines to derive quality products in a variety of terrain types. Gain knowledge about lessons learned on sharing data with reclamation professionals and surveyors.

Part 3: Thermal UAS

Speakers: Jeremy Crowley and Jesse Bunker of Montana Bureau of Mines and Geology

In part 3 we will focus specifically on the equipment requirements and potential applications for thermal UAV projects. This part of the workshop will cover the basics of thermal UAV equipment, thermal images, applications, flight planning, calibration, software, and processing of large thermal datasets.

Part 4: Fixed-Wing UAS

Speaker: Stephen Frazer of Water and Environmental Technologies (WET)

Part 4 of the workshop will focus specifically on equipment, flight planning, data collection, and data processing for fixed-wing UAS. Fixed-wing UAS have the advantage of higher flight speeds and larger project area coverage compared to multi-rotor platforms. This portion of the workshop will explore advantages/disadvantages of fixed-wing platforms, tips and tricks for flight planning large and complex missions, ground control, and QA tips for data processing.

| 17:30 – 20:30 | S **Monday Night Meet Up** | Butte Brewing Company |

Meet Up and Network! Butte Brewing Company - Trolly transportation provided

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APRIL 2 • TUESDAY

| 08:00 – 12:00 | 3 **Disaster Preparedness** | Copper Room 4 |

Speakers: Shane Clarke

This half day workshop will focus on Esri solutions to prepare for and respond to disasters. We will discuss how to use ArcGIS online in preparation for supporting a large and coordinated response to a natural disaster. ArcGIS online provides a platform that is scalable and agile for rapid response, however some early forethought and preparations are required to be prepared for these types of events. We will use this time to show various approaches and lessons learned from the devastating fires in California in 2017 and 2018.

| 08:00 – 12:00 | 3 **Integrating Census Data into GIS** | Copper Room 5 |

Speakers: Jim Castagneri & Lacey Loftin

Workshop Format: lecture style, bring your own computer if desired

Have you ever struggled to integrate data from the Census Bureau's website into your GIS? This session will cover everything you need to know. From understanding and selecting the proper census data, to formatting the data in ArcGIS. We'll cover the various types of Census geography, data sources and programs, data retrieval from American Factfinder, basics of the Census API, and data considerations in ArcGIS.

| 08:00 – 12:00 | 3 **R and ArcGIS (cont.)** | Copper Room 1 |

Speakers: Eric Pimpler

| 08:00 – 12:00 | 3 **UAS Data Processing (all day course)** | Copper Room 2 |

Speakers: Greg Crutsinger

Workshop Format: bring your own computer with minimum Pix4D trial version

In this hands-on workshop you will focus on understanding UAS data processing. This includes a review of cloud processing options in Atlas, Pix4D, Airing and Agribotix, best practices for upload, what the results look like, and how to optimize those results. The workshop will also provide a more in depth look at Pix4D; which license to buy for which needs, how to best upload data and workflows and parameters to get the best results.

| 12:00 – 13:00 | 1 **Lunch on your own** | |

| 13:00 – 17:00 | M **MLIAC Meeting** | Copper Room 3 |

Speakers: Erin Fashoway

| 13:00 – 17:00 | 3 **Intro to ArcGIS Online** | Copper Room 4 |

Speakers: Brian Anderson

Workshop Format: Laptops will be provided

This workshop is designed for people who want an introduction to the basic concepts of ArcGIS Online. The workshop provides an overview of what users can do in ArcGIS Online such as quickly turning data into valuable information by creating intelligent interactive web maps and sharing them privately or publicly. ArcGIS Online provides a platform that enables users to make spatial data available through an interactive web map, a web app, story map and a mobile app without the need for programming. This means it is accessible to users any time on any operating system. You will learn some of the uses of ArcGIS Online including: using an interactive map, creating an interactive map, adding your own data, configuring the map display and creating an app. By the end of this workshop you will be able to create your own interactive map and app and share it with others.

| 13:00 – 17:00 | 3 **Lidar and ArcGIS Pro** | Copper Room 5 |

Speakers: TJ Abbenhaus

Workshop Format: Half-day, lecture style

This half day workshop will show you how Esri can help you extract value from your imagery and lidar data. Lidar (light detection and ranging) is a relatively new remote sensing technology allowing us to collect very dense point samples of features in 3D. Lidar technology has evolved to become a common source of geographic data in GIS. ArcGIS Pro supports data visualization, advanced analysis and authoritative data maintenance in both 2D and 3D. ArcGIS Pro is tightly coupled with the ArcGIS platform supporting data sharing across ArcGIS Online and ArcGIS Enterprise through Web GIS. Please join us for a workshop where we will discuss and explore using ArcGIS Pro to quickly view lidar data in 2D and 3D, manage huge volumes of lidar data holdings, update lidar class codes, and explore and create a web scene.

| 13:00 – 17:00 | 3 **R and ArcGIS (cont.)** | Copper Room 1 |

Speakers: Eric Pimpler

| 13:00 – 17:00 | 3 **UAS Data Processing (cont.)** | Copper Room 2 |

Speakers: Greg Crutsinger

| 18:00 – 21:00 | S **Public Vendor Night** | King Ballroom |

Public Night/Map Poster Gallery

Interactive Exhibits, Vendor Booths, Appetizers, No--Host Bar

A	Awards	C	Census	F	Coffee Break	E	Emergency Services	H	Hosted Lunch & Keynote	L	Lidar
G	Local Government	1	Lunch	M	Meeting	N	Natural Resources	S	Social	O	Socio-Economic
P	Special Session	R	Survey	T	Technology/Mapping	U	UAS Applications Block	2	UAS General		
B	UAS Private Sector Block	K	UAS Public Block	I	Utilities	V	Vendor Track	W	Web & Mobile App		
3	Workshop										

APRIL 3 • WEDNESDAY

08:00 – 08:30	G **Using GIS to Identify Community Health Care Resources on the Blackfeet Indian Reservation**

Speakers: Joe Donohoe & Mary Erickson   Copper Room 2

Mountain-Pacific Quality Health (Mountain-Pacific) collaborated with the Blackfeet Community Hospital, Blackfeet Tribal Health Department and Blackfeet Community Health Representatives to develop Blackfeet Connections (www.blackfeet.mpqhf.org), an online map and guide to the community resources serving the Blackfeet Reservation. Because many buildings do not have addresses and resources are not well known in the community, the parties collectively identified the need to create a map that shows and lists the locations of community resources and events in an easy-to-use format.

Blackfeet Connections focuses on health and wellness resources. The website is used by community members and health care providers to identify resources that might not otherwise be known to the Blackfeet community. Blackfeet Connections also displays a map and calendar of upcoming community events. A key design consideration of the website was the ability for non-technical end users to easily add community resources and upcoming events. The website was also designed so the general maintenance of the map and calendar avoids advanced geographic information system (GIS) or programming expertise.

Mountain-Pacific used Google's free suite of office products to collect resource and event data, and a free Google Maps API plug-in to geocode addresses and create the maps. Users click a button on the map to add their new community resource or event through a Google Form, which then automatically populates a Google Sheet. The Awesome-Table plug-in (www. Awesome-table.com) uses Google Maps API to geocode the submitted addresses and display the results on an interactive Google Map. The design of the workflow allows an experienced spreadsheet user, but non-GIS analyst, to maintain the maps by simply manipulating the underlying Google Sheet. The workflow is still customizable by more technical users because Awesome-Table allows HTML, CSS and JavaScript code in the Google Sheet to pass to the Google Maps API to dictate the final map's display and behavior. This presentation will provide a walkthrough of the system and a brief overview of how it was created.

08:00 – 08:30	I **Utilities, from little or nothing, into a GIS System** Copper Room 1

Speakers: Steven Lowman

This presentation will cover how to get Utility information from multiple sources into a GIS. This session will deal with water, waste water, and storm sewer systems and typical sources for data. Typically dealing with historic utility plans, CAD data, and human knowledge and how you get from all of this to something inside a GIS system. We will discuss going from paper to GIS using heads up digitizing. Exporting/importing from CAD to GIS and some of the issues dealing with coordinate systems. Using GPS and how that can help enhance the GIS data. Human knowledge and what do you do with it in a GIS system. Simple GIS attributes and what to consider down the road. Working with departments and what is their end goal and will include example of some past and present experience.

| 08:00 – 09:00 | R **State Plane Coordinate System 2022, Real Time Networks, and More** | Copper Room 5 |

Speakers: Pam Fromhertz

Do you work with geospatial data? Would 2 or 4 feet change affect your work? If so, come hear the latest developments from the National Geodetic Survey Modernization efforts of the National Spatial Reference System. Changes will be around 4 foot horizontally and -2 feet vertically in Montana. NGS is developing State Plane Coordinates for 2022.

| 08:00 – 09:00 | K **Emerging Directions Within the Commercial Drone Industry: Notes From Inside** | Copper Room 4 |

Speakers: Gregory Crutsinger

| 08:00 – 17:00 | V **Vendor Presentation Track** | Copper Room 3 |

| 08:40 – 09:10 | G **Missoula Area Mapping Project – Community engaged land use planning** | Copper Room 2 |

Speakers: Andrew Hagemeier & Andrew Stickney

Missoula County's land use map, a long range planning tool, was first adopted in 1975 and, after 40+ years, it no longer fully represents our community vision or values. Updating the land use map has giving the county's residents an opportunity to re-envision our community; allowing us to focus on the issues we face today by proactively planning for the future. Throughout the mapping update process, county staff have used a combination of online mapping engagement strategies to inform the public of the project, identify values and ideas on growth and development, get feedback on draft maps, and calculate build-out potential of housing units. In this session, you will learn about the online engagement tool Social Pinpoint, how to incorporate story maps into a project framework to inform citizens, and the process of using future land use designations to perform a build out analysis.

| 08:40 – 09:10 | I **Outage Mapping using ArcGIS Online and Microsoft Azure** | Copper Room 1 |

Speakers: Michael Krueger

The electric grid is undergoing one of the most radical transformations in its history. Critical power delivery facilities across the nation are aging and in the not so distant future will require massive upgrades. One such innovation is the implementation of smart infrastructure to help monitor load growth, alert organizations of outages in real time, manage voltage levels to conserve energy, streamline organizational operations at multiple levels, and so much more. A challenge that arises with all this smart data is how to visualize and disseminate in a timely fashion. While very intuitive and useful in its native form, smart infrastructure platforms can sometimes be difficult to integrate in day to day business operations. Through the use of ArcGIS Online, Microsoft Azure, and Python a utility can cost effectively surface smart infrastructure data in one platform, in real time. Pulling data from various sources and analyzing in manners that best suit the utility's needs. And, what better venue to share data within your organization other than GIS! This presentation will cover a workflow that was implemented for such a need going through the process from start to finish. Working through smart meter platform integration with ArcGIS Online using Microsoft Azure and Python to tie it all together.

| 09:10 – 09:40 | F **Coffee Break** | King Ballroom |

| 09:40 – 10:10 | G **Visualizing a community's past, the digitization of Butte Montana's cultural legacy** | Copper Room 2 |

Speakers: Ellen Crain

Since 1981 the Butte-Silver Bow Public Archives has housed the city and county's historical records, preserving the physical documents and written stories of the community's past. In an effort to provide greater access to these resources, the translation of printed material to digital formats enriches the relationship between citizens and students with their predecessors. Digitization not only helps to reach a wider audience, the visualization of experiences fosters an enhanced connection to history through associated imagery and photographs. Finally spatial context and the mapping of places provide a tangible and tactile relationship between the past and present. This presentation outlines the processes performed and stories realized in the transition from written records to digital interpretation.

| 09:40 – 10:10 | **N A comparison of modeled stream network feature lengths and sinuosity using multiple resolutions of digital elevation model data** |
| | *Speakers: Rob Ahl* |

Copper Room 5

This work is an exploration of how stream features modeled from LiDAR-based bare earth models compares to those derived from data with larger pixel sizes. In summary, linear and ordered stream features were derived from 1, 5, 10, and 30 meter digital elevation model (DEM) data, over a range of contributing area thresholds. Results were compared across DEM resolutions, and also to features available from the National Hydrography Dataset (NHD). Modeled stream feature outputs based on 5 and 10 meter elevation data were remarkably similar. When compared across the board, 5, 10, and 30 meter results were more similar to each other than to features produced from 1 meter elevation data. The biggest differences in feature lengths were observed in the first order features, but overall there was approximately 15% more sinuosity in the 1 meter-derived features than all others. Also, 1 meter features were more representative of the stream channel than NHD, but NHD provided a closer fit to the observed stream channel than features modeled from 5, 10, or 30 meter digital elevation data.

| 09:40 – 10:10 | **U A Comparison of UAV Systems with Enhanced Navigation for Geotechnical Investigations using LiDAR and Photogrammetry** |
| | *Speakers: Rachel Becker* |

Copper Room 4

Autonomous vehicles are increasingly being used in underground mining as a way to improve the safety of mine personnel. In comparison to traditional data collection tools, unmanned aerial vehicles (UAVs) have the potential to collect versatile data in inaccessible areas of a mine using technologies such as photogrammetry and LiDAR. Spatially accurate 3D point clouds can then be built that provide important geotechnical information for interpretation including the ability to measure discontinuity orientation, inspect rock properties, and record the geometry in an area. Due to the difficulty of flying UAVs in the underground environment, the focus of this investigation was on UAVs with enhanced navigation and obstacle avoidance capabilities. Four teams individually participated in a series of underground flight demonstrations at Barrick's Golden Sunlight Mine to test the abilities of their enhanced systems in challenging environments. The flight demonstrations semi-autonomous flights in drifts, stopes, and ventilation raises both within and beyond line-of-sight. Many of the UAVs carried a LiDAR scanner that was used for Simultaneous Localization and Mapping (SLAM), which allows a vehicle to create a map of its surroundings while also locating itself within that map. Throughout the demonstrations, the data collected included video footage that was used to build photogrammetric point clouds, as well as LiDAR point clouds from the flight. The accuracy of the photogrammetry point clouds were quantitatively and qualitatively compared to the LiDAR point clouds to assess the potential applications for the data sets that were collected.

| 09:40 – 10:10 | **W Conservation Cartography:Putting Maps to Work for Endangered Species** | Copper Room 1 |
| | *Speakers: Kevin McManigal* |

Fifty percent of the world's protected lands remain unmapped. The most endangered species, including tigers, lions, and snow leopards, call these lands home and are threatened by continued habitat loss, but more urgently, by increased poaching pressure. The Laboratory for Conservation Cartography at the University of Montana is actively engaging with NGO's working to defend these animals. For some protection goals, the right strategy has been the creation of 1:25,000 topographic maps for use by patrol rangers. However, the production barriers of time and cost have led to new models for quickly implementing the right geospatial technology. This allows rangers to participate in the building of their maps, analyze field data in real-time, and drive decision making for their missions on the ground. The presentation will outline the solutions being implemented to give conservation staff access to satellite imagery and topography data on digital devices, in an unconnected, cell and Wi-Fi free environment. It will also cover the developing efforts to integrate ranger observations, GPS collar tracks and camera trap data to predict the movements of both animals and poachers. Maps are making a difference, and the closing success stories prove we can preserve the last of these iconic species.

| 10:20 – 10:50 | N **Floodplain Connectivity Analysis in GIS: A Tool for Ecological Restoration** | Copper Room 5 |

Speakers: Selita Ammondt

Stream to floodplain connectivity is an important indicator of ecosystem health in many riparian environments. Disconnection of floodplains can occur with human alterations to riparian habitat, including from agriculture, grazing, and mining practices. Stream restoration and floodplain reactivation can restore natural floodplain functions and ecosystem benefits to these degraded habitats.

A GIS-based approach was used to analyze and compare surfaces generated from Light Detection and Ranging (LiDAR) data and stream bankfull indicators, on multiple project sites throughout western Montana and north-central Idaho. This stream to floodplain connectivity analysis effectively identified ecological restoration opportunities and constraints on Flint Creek, Spotted Dog Creek and Ninemile Creek in Montana, and Dan Lee and Jim Brown Creeks in Idaho.

We found that for floodplain vegetation, which is a proxy for riparian health and function, floodplain elevation relative to stream bankfull stage is a practical predictor of potential plant community composition. In addition, for systems impaired by channelization and irrigation withdrawals, floodplain connectivity analysis can identify historical channel locations that have the potential to be reactivated during restoration. Overall, this spatial analysis approach in GIS provides a foundation for understanding the structure and function of diverse floodplains, and identifies opportunities for reconnecting historical floodplain surfaces and channel oxbows.

| 10:20 – 10:50 | U **NDVI Drones and Lessons Learned** | Copper Room 4 |

Speakers: Bart Bauer

This project utilized drones, multispectral sensors, and automated flight controls to gather high-resolution data, for NDVI analysis, over time. This project was conducted between July-August of 2018, utilizing a DJI Inspire drone, a Micasense RedEdge multispectral sensor, DJI Ground Station Pro and Pix4d to capture high resolution (8cm/pixel) multiband imagery, for computing weekly NDVIs of the study sites. Deer Lodge Prison served as the location for all study sites, ranging from ~50 acres and smaller. Techniques, procedures, environmental conditions and altitudes were tested and evaluated to determine feasibility and workflows. Data and procedures were evaluated to determine best practices, limitations, and resources needed, for future projects. This was a proof of concept project, funded by the Montana Space Grant Consortium, in collaboration with the Autonomous Aerial Systems Office, to determine best practices, workflows, and limitations, of sensors and drone capabilities.

| 10:20 – 10:50 | W **Operation Dashboard: Creating Dashboards with Configurable Apps** | Copper Room 1 |

Speakers: TJ Abbenhaus

Operations Dashboard for ArcGIS is a configurable web app that provides location-aware data visualization and analytics for a real-time operational view of people, services, assets, and events. In this session we will introduce the key features of dashboards, walk through examples of the many different types of dashboards and finally demonstrate the configuration and deployment of an Operations Dashboard. We will get the most out of the Dashboards that you create by learning best practices and discovering essential tips and tricks that will help you build effective dashboards within your organization. This session will cover design tips and advanced strategies to configure visualizations so that you provide the right information for your users. Finally, we will provide you with techniques for sharing and embedding dashboards on websites and in Story Maps so you can deploy your Dashboards in the most effective way.

| 10:20 – 11:20 | G **Following Up Your NG 911 GIS Assessment, What's Next?** | Copper Room 2 |

Speakers: Ken Wall

Now that you have received your NG 911 assessment from Digital Data Techologies, Inc, we will present best practices in interpreting the results and getting your data ready for deployment. The presentation will use several examples from Montana counties well underway in preparing their NG9-1-1 data themselves. We will demonstrate the options for leveraging the DDTi results and efficient processing, saving time and avoiding duplication. We will also discuss how to provision the NG9-1-1 data model, options for maintaining it in real-time and key steps to work with your neighbors to ensure your data fits within the Montana MSDI framework. The last 20 minutes will be Q&A, bring your questions.

| 11:00 – 11:30 | N **A Simple Methodology for Producing an Accurate Irrigated Land Cover Dataset** | Copper Room 5 |

Speakers: Andrew Nemecek

Methods for classifying irrigated land cover are often complex and not quickly

reproducible. Further, moderate resolution time-series datasets have been consistently

utilized to produce irrigated land cover products. Creation of geospatial irrigated land cover products with higher resolution datasets could improve their reliability. This is a summary of a simple methodology using 30-meter resolution Landsat NDVI data for classifying irrigated land cover in semi-arid western Montana. The availability of machine learning classifiers for GIS software programs was leveraged, and Random Forest results were compared with Decision Tree results. Both models yielded high accuracy, but the Random Forest model was determined the best model for classifying irrigated land cover, thus validating its recent use for classifying irrigation in other studies. Further, the NDVI dataset provided adequate spatial and temporal resolution for time-series irrigated land cover classification at the basin and growing season scales via climatology interpolation of cloud and cloud shadow pixels. The dataset provides a viable alternative to coarse resolution NDVI products. However, field-verified training samples were generated within a roads buffer, thus land-cover classes inaccessible by roads were underrepresented in the training sample. The model mistakenly classified a subset of land-cover classes on the edges of the analysis area where road density was low, and sampling was infrequent. Classification error was likely due to the lack of sampling on analysis area edges and spectral similarity of classes on analysis area edges with the irrigated class. Masking classes the model could not distinguish from irrigated could provide a solution, but further experimentation with training point sampling techniques (e.g., random sampling), the number of training classes and the degree of masking is necessary to produce the best product. Finally, other explanatory variables (e.g., evapotranspiration, land-surface temperature, etc.) should be explored.

| 11:00 – 11:30 | U **UAV Mounted Low Cost Trace Gas Senor for Volcanic Plume and Emission Characterization and Long Range Video Transmission** | Copper Room 4 |

Speakers: William Pardis & Tristan Gray

Volcanic gas emissions act as a large source to the atmosphere for poisonous and greenhouse gases. An estimated 9% of the world's population lives within 100km of a volcano [1]. This makes it important to identify the potential effects of the geophysics of the volcanic systems whether it is by active eruption or continuous gas emission. Conventional volcanic gas flux measurement is difficult given the inaccessibility of some of the areas in question and the high cost of instrumentation to analyze them. We are developing a low cost ($500) sensor system for identification of carbon dioxide, hydrogen sulfide and sulfur dioxide concentration as well as other physical parameters. Its low power and small size allows for it to be mounted on an Unmanned Arial Vehicle (UAV) for unmanned and spatial analysis of the poisonous plume's features. Further, the implementation of sensory feedback to the UAV's navigation would allow for sophisticated and autonomous deployments of the sensor. These autonomous implementations allows for low maintenance and long term high temporal and spatial frequency data of these systems and therefore the ability to better characterize these systems and potentially forewarn life threatening eruption events.

[1] Longo, B. M. (2013). Adverse Health Effects Associated with Increased Activity at Kīlauea Volcano: A Repeated Population-Based Survey. ISRN Public Health, 2013, 1-10. doi:10.1155/2013/475962

| 11:00 – 11:30 | W **Mobile GIS Workflows using Collector, Workforce, Survey 123, Navigator and Dashboards** | Copper Room 1 |

Speakers: TJ Abbenhaus

ArcGIS field apps help you use the power of location to improve coordination and achieve operational efficiencies in field workforce activities. Reduce or even replace your reliance on paper. Ensure that everyone, in the field and the office, uses the same authoritative data so you can reduce errors, boost productivity, and save money. See five of these apps in a set of demonstrations and discussions to get you started.

| 11:30 – 13:00 | H **Hosted Lunch & Keynote Presentation** | Copper King Ballroom |

Hosted Lunch and Keynote Presentation featuring Courtney McKee from Headframe Spirits

| 13:00 – 13:30 | G **Geo-Enabled Elections** | Copper Room 2 |

Speakers: Erin Fashoway

"In the fall of 2017, the National States Geographic Information Council (NSGIC) launched an effort

to identify best practices for the use of GIS in supporting election systems management and citizen engagement. At the onset of this project, GIS technology, in most cases, was relatively new to state elections implementations. This project brings together GIS leaders in state government, local elections officials and state elections offices, national GIS and elections organizations, and federal partners to identify opportunities to integrate GIS into elections systems across the country. The GIS model is expected to significantly enhance accuracy, transparency, and efficiency of representative government. NSGIC's Geo-Enabled Elections (GEE) project is underwritten in part through a foundation grant by the Democracy Fund Voice, a nonpartisan organization that advocates for and supports work that strengthens and sustains American democracy." GEE State Representatives

Baseline Survey Report

Come to learn more about how things are progressing with the project and what is happening at the national level and how this can apply at the local level.

| 13:00 – 13:30 | N **Using Big Data to Prioritize Restoration Outreach** | Copper Room 5 |

Speakers: Joseph St. Peter & Conor Phelan

This two part presentation features a method for producing large scale fine resolution land cover datasets, followed by a presentation on using those types of geospatial datasets along with consumer financial data to prioritize land owner outreach. Land cover classification is a widely used process of assigning land cover classes to pixels in remotely sensed images. The new technique presented produces a series of raster surfaces depicting the probability of a given class at the pixel level, using a soft max neural network. We applied our probabilistic method to an ecological significant area in northern Florida of approximately 28,000 square miles. Using function modelling and parallel processing, we efficiently produced a 13 band raster surface that estimates the probability that each cell is one of the 13 visually identified classes. This method, and the publicly available software we developed, allows practitioners to create accurate probabilistic land cover classification with minor investments in time and resources.

The consumer data presentation will describe work that uses fine resolution geospatial data, private landowner parcel data, and big consumer data to "microtarget" landowners that are most likely to respond to specific land conservation outreach efforts. This case study focused on filling riparian buffer gaps using fine scale geospatial data to identify streamside areas lacking critical vegetative buffers. By overlaying spatial landownership data (parcels), we were able to identify the landowners with the largest amount of stream buffer gaps on their land. Finally, consumer data, and past outreach participation was used to model the consumer profile of likely participants in future conservation outreach projects. Combining these datasets allows practitioners to prioritize outreach efforts to landowners who are most likely to respond, and have the greatest conservation need on their property.

| 13:00 – 13:30 | B **Using UAS to perform an emergency survey of Willow Creek Dam** | Copper Room 4 |

Speakers: Craig Threlkeld

DJ&A was called on to perform an emergency survey of the Willow Creek Dam emergency Survey during heavy flooding last spring. We were able to perform the survey and deliver data within a week.

| 13:00 – 13:30 | W **Operations Dashboard and MDT Planned Projects** | Copper Room 1 |

Speakers: Brian Klapstein

Until now, the best tool MDT has for exposing the public to their planned projects is the Tentative Construction Projects map: a once-a-year update to a basic ArcGIS Online web map. Through a multi-Division effort, the dream of having a robust, dynamically updated map is nearly a reality. Learn how MDT has utilized Operations Dashboard, and other ArcGIS Online elements, to create the MDT Planned Projects App. There will be an introduction to the basics of creating and tying together Operations Dashboard elements including: maps, filters, lists, charts, graphs, and more. Discover the pros and cons of some of the other options available in ArcGIS Online. Observe how all the components come together for the final app and, in the process, inspire new ideas for your own organization.

| 13:40 – 14:10 | G **How Does GIS Work in the Next Generation 911 Center, the NENA i3 Standard Demistifyed** | |

Speakers: Ken Wall — Copper Room 2

The NENA i3 Standard is a highly technical, 500+ page standard, developed for the successful implementation of Next Generation 9-1-1. This talk will focus on where GIS fits into the standard, how and why it is critical to the process. We will provide references to the key parts of the i3 Standard that are important to GIS professionals. It is easy to get lost in the acronyms, we will explain and demystify the i3 components and explain how GIS works in the Next Generation 911 Center.

| 13:40 – 14:10 | N **Spatial Analysis Lab Introductions** | Copper Room 5 |

Speakers: Jessica Mitchell

A look at the Spatial Analysis Lab of the Montana Natural Heritage Program. The talk provides background on the lab and cover topics such as the Land Cover layer in the Montana State Library Spatial Data Infrastructure (MSDI) system, past and current projects, research initiatives, staff expertise, future directions, and upcoming opportunities. Project highlights that will be discussed include biodiversity mapping, invasive species detection, and early adaptation of imagery from new NASA missions such as ECOSTRESS and ICESat-2.

| 13:40 – 14:10 | B **UAS Applications and Drone Technology in Enigeering and GIS** | Copper Room 4 |

Speakers: Jackson Beighle

The Unmanned Aerial Systems (UAS) industry is changing rapidly with new drone technology coming online every week. UAS is a way to reduce project costs, share up-to-date and accurate information, and keep field workers safe. Lower cost drones and more user-friendly software are enabling professionals in engineering, GIS, surveying and construction to rapidly create geospatial data. Applications are wide spread including GIS mapping, cut/fill measurements, site monitoring and 3D modeling. Learn how you can take advantage of this exciting technology to produce high-accuracy data in a fraction of the time.

After this presentation, participants will have a better understanding of drone technology and the common applications for UAS in engineering and GIS. Including how ground control and photogrammetry software are used to generate high quality UAS outputs.

| 13:40 – 14:10 | W **Mapping, Managing, and Maintaining Moble GIS data** | Copper Room 1 |

Speakers: Jeff LeProwse

WET has developed custom application for the City/County of Butte-Silver Bow to map, manage, and maintain existing Superfund source areas and remedial storm water infrastructure. This application leverages ESRI's ArcGIS online and Survey123 applications as well as a Microsoft Access front end database for querying and reporting capabilities. Using ESRI's Survey123, field crews can generate categorized inspections and record county-wide Operation and Maintenance (O&M) activities. Managers can use ArcGIS Online web maps to view inspection details and O&M activities, view high priority sites, and complete work assignments. All activities are synced with a Microsoft Access to efficiently query data, report on infrastructure conditions, and generate status reports and O&M activities. By utilizing ArcGIS Online, ESRI's Survey123 and custom JSON feeds this application and saves the county hundreds of hours per year in labor, allowing them to instantaneously view Superfund storm water inspection and maintenance activities and meet reporting and data management requirements.

| 14:10 – 14:30 | F **Coffee Break** | King Ballroom |

| 14:30 – 15:00 | C **Census Business Builder** | Copper Room 2 |

Speakers: Lacey Loftin

Are you looking for data to help you start or grow a business or understand the business landscape for a region? The Census Business Builder (CBB) is a suite of services that provide selected demographic and economic data from the Census Bureau tailored to specific types of users in a simple to access and use format

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| 14:30 – 15:00 | B **UAS Data, how are you using it?** | Copper Room 4 |

Speakers: Andrew Coleman

Discuss various projects I've worked on. Discuss Hardware and software options. Engage the audience to help us grow the UAS industry.

| 14:30 – 15:30 | N **New GIS data, maps, and apps from the USDA NRCS–Montana State Library Partnership** |

Speakers: Troy Blandford, Catherine Maynard, Meghan Burns, Maya Daurio   Copper Room 5

The USDA Montana Natural Resources and Conservation Service (NRCS) and the Montana State Library have partnered to develop a wide variety of statewide GIS data, maps, and applications readily available online. This presentation will highlight recently developed products to support natural resources inventories, ecological site mapping, conservation planning, and environmental assessments. We will provide an overview of elevation, soils, LiDAR, and snow and water supply products recently made available. Additionally, we will demonstrate: 1. the Ecological Site Reviewer, a web application for quickly exploring locations of interest and assessing ecological attributes, and 2. HUC Environment Geodatabases, a suite of environmental data clipped by 8-digit Hydrologic Unit and packaged with ready symbology and a template Map Document.

| 15:10 – 15:40 | C **2020 Census New Construction Program** | Copper Room 2 |

Speakers: Jim Castagneri & Lacey Loftin

The New Construction Program will help ensure that the U.S. Census Bureau's address list is as complete and accurate as possible. We will discuss the opportunity for local governments to submit city-style mailing addresses for new units where construction began during or after March 1, 2018 and the address was not submitted to the Census Bureau as part of any previous effort

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| 15:10 – 15:40 | K **Waivers vs Certificates of Authorization For Unmanned Aircraft Systems; Are the Props Spinning?** |

Copper Room 4

Speakers: Jen Fowler

This presentation will cover Unmanned Aircraft System FAA regulations. How did we get to the current regulatory structure? What are the consequences of the current regulations? How do we remain flexible to operate in various research and commercial operations? An overview will be provided of the differences between commercial and public operations and pros and cons of using certificates of authorization versus waivers. Additionally University of Montana experiences working under differing regulations will be shared.

| 15:10 – 15:40 | W **Modern Tree Inventory: Building a system that works for you** | Copper Room 1 |

Speakers: Alex Norquist

A robust tree inventory is a critical tool for modern tree care. Learn about the evolution of Bozeman's system used to manage park and boulevard trees. This presentation will discuss and compare methods for collecting data, inventory maintenance, and management implications.

| 15:50 – 16:20 | C **Overview of Census 2020** | Copper Room 2 |

Speakers: Jim Castagneri & Lacey Loftin

The 2020 Census is less than one year away. How does the Census Bureau get the job done? This presentation will cover the staffing, processes, and field operations for the largest peacetime mobilization in the country!

| 15:50 – 16:20 | N **Grizzly Bear Range Expansion and Population Connectivity in Montana: Planning for Shared Landscapes** |

Copper Room 5

Speakers: Celicy Costello

This presentation will provide the latest on grizzly bear core habitat and connectivity in Montana, highlighting a recent study that used GPS bear locations and models to map potential connectivity between the GYE and NCDE. We will highlight key areas and discuss how communities can reduce human-wildlife conflicts.

| 15:50 – 16:20 | K | **Using UAS Technology/Orthoimagery to Assess Pre- and Post-Construction Conditions on a Landslide Re-Contouring Project on the NZ-CLW Forest** |

Copper Room 4

Speakers: Teresa Morales

The intent of this presentation is to demonstrate how to use Drone Technology, Ortho-imagery, and CADD to conduct pre- and post-construction surveys of complex construction projects as well as assisting in long term monitoring. The ortho-imagery was processed using Pix4D. A point cloud was generated using Pix4D and then exported to CADD to create a surface model of the existing conditions. The original grading plan for the project was based on data collected from a conventional survey crew. Pre-construction site conditions were flown a month prior to commencement of work. Once construction was completed the site was flown again to generate a surface model of the post-construction conditions. A point cloud of the ortho-imagery was generated using PointCloud. This data was then exported to AutoCAD. Vegetation in and around the area of interest were removed in order to better approximate 'bare-earth' conditions for both the pre- and post-construction imagery. This process was done by simply generating profiles of the area of interest and then manually removing vegetation from the surface of the slope.

A comparison of the two surface models in CADD was used to calculate total volume of material moved using the Volumes Dashboard feature in CAD (which compares surface models). The Volume Report generated by CAD was then used to support payment to the Contractor.

| 15:50 – 16:50 | P | **GISP Dr. Office** |

Copper Room 1

Speakers: Curtis DeVault & Michael Krueger

| 16:30 – 17:00 | C | **MSDI Administrative Boundary Update** |

Copper Room 2

Speakers: Meghan Burns

The Montana State Library is the steward of the Montana Spatial Data Infrastructure (MSDI) Administrative Boundaries which is comprised of: Incorporated Cities and Towns, Reservations, School Districts, County Boundaries, Tax Increment Financing Districts, Weed Management Districts, and the State Boundary. This presentation will provide an update on the U. S. Census Boundaries and Annexation Survey (BAS) and School District Review Program (SDRP) as well as database schema changes and web service updates. This presentation will also touch on CadNSDI and cadastal updates and the Census LUCA program.

| 16:30 – 17:00 | N **Geospatial Research & Education in Glacier National Park with partial funding from MAGIP Scholarships & Grants** | Copper Room 5 |

Speakers: Morgan Voss

Snow avalanches are the common form of mass wasting in the high mountain environments of Glacier National Park (GNP), Montana. These natural disturbances play important roles in mountain ecosystems by regularly disturbing montane systems, providing critical habitat for some species, transporting debris, and influencing vegetation and fire dynamics. Since the 1900s, natural avalanche-related activity recorded along important transportation corridors within the park has frequently disrupted transportation. While many of the steep slopes of GNP are susceptible to avalanching, formal inventories exist only for small, critical portions of the park and they vary substantially from one another. GNP's protected status does not allow for avalanche mitigation, allowing this area to serve as a natural mountain environment for studying these processes. Because of a lacking inventory, a current, high-resolution inventory of avalanche locations in the park is needed for the entirety of the Park. Imagery and digital elevation models (DEMs) were used to map the distinct biogeographic and topographic patterns left by avalanching using machine learning methods. Mosaics of National Agricultural Imagery Program (NAIP) aerial photographs acquired in 2013 were segmented to map avalanche tracks. Principal components from the imagery and derivatives of the DEM were used as input to a Random Forests algorithm which mapped the most likely class for each segment using a probabilistic approach. Avalanche paths were found to comprise approximately 5-12% of the park, along predominantly south and southeasterly facing slopes between 20° to 40°. While this estimate is similar to previous studies, this work did not map starting or runout zones which would have increased the total area. The paths predicted provide a comprehensive inventory that can be used to monitor shifts in vegetation and climate dynamics within the disturbance regime. Changes were clearly seen in the contraction and expansion of trim lines of some avalanche paths in recent imagery. Future research could use this work as a baseline for time-series analysis.

From this research and collaboration with the Glacier National Park, a variety of GIS lessons for students across the Flathead Valley were developed. The unique physiographic features of GNP provide a natural classroom for students across the Flathead region. In addition to an existing lesson plan about aquatic invasive species, we developed two lesson plans to help high school students engage in GIS in the classroom and to apply GIS methods to investigate potential effects from climate change and other natural resource issues in an environment close and relevant to the students.

One lesson details the possible changes in sensitive bull trout habitat from warming streams due to climate change, while the other lesson plan details the importance of avalanches, terrain features, debris transport, and the relationship to disturbance ecology/debris transport in the park. Working with park staff, this curriculum was distributed to Flathead Valley High Schools. Training and materials were also provided to interested area teachers so they could use the lessons and adapt materials for other natural resources questions.

| 16:30 – 17:00 | K **State Agency UADeveloping UAS Policy for Organizations** | Copper Room 4 |

Speakers: Kreh Germaine

As the DNRC started to develop its UAS program, it became quickly apparent that there was a need to develop policies to handle both operational efficiency and concerns regarding data & privacy to avoid any legal encumbrances. This presentation will inform attendees of the current activities of a multi-organizational UAS workgroup focused around developing consistent standards for UAS program development.

| 17:30 – 20:30 | A **No-host Cocktail Social and Banquet** | King Ballroom |

Join us for a no-host cocktail and the opportunity to network with your peers. Followed by a hosted banquet .

A	Awards	C	Census	F	Coffee Break	E	Emergency Services	H	Hosted Lunch & Keynote	L	Lidar
G	Local Government	1	Lunch	M	Meeting	N	Natural Resources	S	Social	O	Socio-Economic
P	Special Session	R	Survey	T	Technology/Mapping	U	UAS Applications Block	2	UAS General		
B	UAS Private Sector Block	K	UAS Public Block	I	Utilities	V	Vendor Track	W	Web & Mobile App		
3	Workshop										

APRIL 4 • THURSDAY

08:00 – 09:00	E **Emergency Services Plenary (Panel Presentation)**	King Ballroom

Speakers: Jesse Best, Chris Cruz, Chad Sperry

09:30 – 10:00	E **The Montana NG9-1-1 GIS Data Assessment Project**	Copper Room 1

Speakers: Michael Fashoway

The Montana State Library recently finished coordinating a Next Generation 9-1-1 (NG9-1-1) GIS data assessment project for every Public Safety Answering Point (PSAP) in Montana. This presentation will go over what the assessment project did (and didn't) do, as well as provide some advice for how local governments and 9-1-1 GIS data providers can use the assessment results to improve their GIS data for NG9-1-1.

09:30 – 10:00	L **Lidar and Natural Hazards**	Copper Room 5

Speakers: Mike Stickney

09:30 – 10:00	O **Visualizing Crime Patterns with GWR Model**	Copper Room 2

Speakers: Yu Zhou

GWR (Geographically Weighted Regression) is a method of spatial statistical analysis used to explore geographic differences in the effect of one or more predictor variables upon a response variable. In the past, GWR model has been used in analyzing spatial patterns of socio-economic as well as natural phenomena. In this study, GWR is used to study violent crimes of South Bend, Indiana, a city with a significantly higher crime rate than nearby similar-sized Midwestern cities. Previous researches on violent crime indicate that socio-demographic factors create variations of crime concentration. Neighborhoods with great poverty rate, high population density, and inadequate informal social network, for example, generate a consistent concentration of violent crime over time. It is very important, therefore, to identify the characteristics of neighborhoods in order to have an effective control of violent crime. With GWR, the crime pattern, in relation to neighborhood socio-demographic characteristics is analyzed and mapped.

09:30 – 10:00	2 **UAVs in Aerial Cinematography**	Copper Room 4

Speakers: Steve White

Get a sense of what is happening in the UAV industry regarding the cinematography, including the equipment being used. As in every UAV industry sector, the FAA regulations play a big part. This seminar will cover those important topics, and include some of the equipment that play critical roles in producing quality outcomes.

10:10 – 10:40	L **The Montana Statewide Lidar Plan**	Copper Room 5

Speakers: Troy Blandford

| 10:10 – 11:10 | E **How to Get to a Standardized Seamless Statewide NG9-1-1 Data Set in Montana?** | Copper Room 1 |

Moderators: Erin Fashoway

Speakers: Ken Wall, Michael Fashoway, Jason Horning, Phil Peterschnick, Joe Sewash

How to Get to a Standardized Seamless Statewide NG9-1-1 Data Set in Montana – Panel Discussion

This panel will discuss best practices for Montana local governments to follow in preparing their Next Generation 9-1-1 required GIS layers and collaborating with neighboring PSAPs to facilitate rolling up their road centerline, structures and emergency service polygons to create seamless statewide, and nationwide NG9-1-1 layers. State GIS specialists from North Dakota and Virginia will share their approaches and experiences with us. They have been through this process, and have extensive experience with statewide 911 coordination.

| 10:10 – 11:10 | O **The Long Streets Project** | Copper Room 2 |

Speakers: Eric Dietrich

The Long Streets Project is an ongoing journalistic effort that uses human-scale reporting and digital storytelling to understand and explain economic challenges across Montana. Project stories, which have included looks at employment geography, housing and airport access, are published through the nonprofit Montana Free Press and republished by newspapers across the state. Work has been funded in part with support from the Greater Montana Foundation. Stories have included graphics developed with public data and open-source tools including D3.js, QGIS and ai2html.

| 10:10 – 11:10 | 2 **UAS Technology Use in the World of Public Land Management & Emergency Response** | |
| | | Copper Room 4 |

Speakers: Chris Cruz

This presentation will focus on the initial training, different use cases in the field of public land management. We will explore the use of Drones in the Incident Command System (ICS). Use of scenarios in training emergency response personnel. Training examples will be provided for teams involved in emergency response. Finally, changes in regulations new use cases will be discussed.

| 10:50 – 11:20 | L **Finding the Value in Lidar Mapping** | Copper Room 5 |

Speakers: Jason Caldwell

This presentation will focus on the full life cycle of large lidar program development including planning, data acquisition, feature extraction, data dissemination and systematic updates. Focus will be placed on how to increase buy-in from partners at all stages of a programs life-cycle. Identifying use cases, derivative products, and stakeholders provides the foundation for program planning. Understanding the many variables that effect use cases, schedule, and cost allows for data acquisition that meet the greater community needs. Once data is acquired, developing derivative products adds considerable value for stakeholders. Recognizing the cost/benefit ratio associated with derivative products and if the derivative products need to be specified prior or after acquisition allows for an educated streamlined approach while still adding value for the customer base. Data discovery and dissemination for lidar data sources is an important aspect for all programs. A strong data discovery and distribution solution ensures program adoption by new users as well, and provides the framework to consider true stakeholder engagement. At this stage it is also important to provide end users with the ability to analyze the data without significant delays. The greater the engagement the higher the potential for ongoing program support. The final step in the program life-cycle includes ongoing data maintenance. Over time the geography will change which means the data value will decrease. Recognizing change and updating the data to ensure usability is an important aspect of any geospatial program. We will discuss a work flow that allows users to see before and after and to highlight changes over time as a way to ensure strong value proposition is maintained throughout the life-cycle.

| 11:30 – 12:00 | E **Beyond the 98: The NG9-1-1 GIS Data Puzzle** | Copper Room 1 |

Speakers: Jason Isherwood

Is your GIS data ready for Next Generation 9-1-1 (NG9-1-1)? NG9-1-1 fully embraces our data driven world and aims to upgrade emergency response systems so they remain current with ever-evolving mobile communications and technology. Leveraging an internet protocol based system, NG9-1-1 allows digital information and location coordinates to be transmitted through the 9-1-1 network like never before. This change in opens the door of spatial possibilities and data responsibilities. But, the migration to geospatial call routing requires local GIS data to be maintained at a higher level of precision than ever before and the responsibility to build and maintain these spatial features lies at the local level. Synchronizing GIS data with MSAG and ALI tables to 98% is a good start but it is important to go beyond this metric to ensure for GIS data is truly ready to support NG9-1-1.

| 11:30 – 12:00 | L **3DEP Overview** | Copper Room 5 |

Speakers: Steve Shivers

The U.S. Geological Survey (USGS) National Geospatial Program's 3D Elevation Program (3DEP) was established to respond to growing needs for high-quality topographic data and for a wide range of other three-dimensional (3D) representations of the Nation's natural and constructed features. The primary goal of 3DEP is to systematically collect 3D elevation data over the United States over an 8-year period. This presentation will provide an overview of the program including a status update on the effort to collect statewide lidar in Montana.

| 11:30 – 12:00 | K **Using Unmanned Aerial Vehicle (UAV) high resolution multi-spectral imaging to identify noxious weeds** | Copper Room 4 |

Speakers: Jay Slocum

Whitetop Classification

Image analysis to identify and classify the occurrence of Cardaria draba (whitetop or hoary cress) was conducted on Anaconda-Deer Lodge County (ADLC) Parcels containing five (5) vegetation monitoring areas requiring Long Term Inspection and Maintenance (LTIM). The purpose of this analysis was to assess the efficiencies of using an Unmanned Aerial Vehicle (UAV) with high resolution multi-spectral imaging to identify and classify whitetop patches.

Image analysis was conducted via supervised classifications of UAV aerial photos containing Red-Green-Blue (true color) and near-infrared (NIR) color spectrums. To aid in the image analysis and supervised classification, ground data was collected to provide training data for the classification algorithm

Spatial Analyst Extension contained in ArcGIS software was utilized to perform a supervised classification of the imagery. The training data was incorporated into the classification to obtain specific spectral signatures which assigned each pixel a unique vegetative cover value. After classified thematic maps were developed by the applied maximum likelihood algorithm, model accuracies were tested, and the classifications were edited to correct for known inaccuracies in the classification. Following data interpretation and editing of the classified model, post-classification image processing methods were performed.

This analysis provided a detailed assessment on UAV image classification capabilities for identifying and quantifying whitetop patches. The analysis identified whitetop patches that were not previously mapped, provided detailed geospatial data for use during future weed control efforts, and established baseline data for monitoring control efforts. This project suggests that UAVs may provide a more efficient and cost-effective solution to vegetation monitoring as compared to traditional ground survey methods. This project is on-going.

| 13:30 – 14:00 | E **Using GIS for Wildfire Decision Support with NASA RECOVER** | Copper Room 1 |

Speakers: Keith Weber

RECOVER is a decision support system (DSS) that brings together in a single web-based analysis environment the information necessary to support wildfire decision-making. RECOVER is the result of a close collaboration between NASA's Applied Sciences Program and Idaho State University's GIS Training and Research Center. RECOVER uses rapid resource allocation and process automation to automatically collect Earth observation data, derived decision products, and historic biophysical data so wildfire management agencies have at hand a complete and ready-to-use dataset and GIS analysis environment customized for each specific wildfire. RECOVER is transforming the information-intensive process by reducing from days to a matter of minutes the time required to assemble and deliver crucial wildfire-related data. This presentation describes the NASA RECOVER project, its numerous automation techniques, and deployments across the western US over the past five years.

| 13:30 – 14:00 | L **3DEP Lidar Proposals: Examples From Other States** | Copper Room 5 |

Speakers: Chris Chalmers

During this presentation you will hear specific success stories and strategies of states who have had multi-year 3DEP grant successes. With the 3DEP BAA grant process it is important to maximize all of the State, Regional, and Local government assets that are available.

The presentation will also give the roadmap the Federal Government has given to ensure your application is well received and has the best chance of success.

| 13:30 – 14:00 | T **Distributed Collaboration with ArcGIS Enterprise** | Copper Room 2 |

Speakers: Shane Clarke

Distributed collaboration allows you to connect your GIS with a wider network, reaching beyond departmental and geographic boundaries. Collaboration establishes a foundation of trust, allowing you to send and receive content with others as you work toward shared goals and initiatives. Hear use cases, accompanying collaboration patterns, and illustrations. Learn how to set up a collaboration network, manage your participants, and share your content across your collaboration network. Stay informed about recent enhancements and new functionality in distributed collaborations, while picking up tips and tricks to streamline administration.

| 13:30 – 14:00 | K **Using Unmanned Aerial Vehicle (UAV) high resolution multi-spectral imaging to monitor restoration progress of Mount Haggin** | Copper Room 4 |

Speakers: Jay Slocum

Mt. Haggin Vegetation Classification

WET is currently working with NRDP to perform restoration progress monitoring in the Mount Haggin Remediation and Restoration Areas near Anaconda, Montana. During 2018, WET utilized an Unmanned Aerial Vehicle (UAV) to collect Red-Green-Blue (true color) and near-infrared (NIR) imagery. This imagery was then processed and analyzed to develop detailed topography and vegetation classification models of several drainages.

The topography data was used to determine the "as-built" retention volume of hundreds of storm water control structures. In coming years, additional topography data will be collected and compared to the 2018 data. This will allow WET to determine the volume of sediment captured by the newly installed structures. Additionally, UAV usage with this project allowed the collection of a cost-effective, highly accurate topography dataset. Collecting this data using traditional ground survey methods would have been time-intensive and cost prohibitive.

Image analysis of four areas was conducted via supervised classifications of UAV aerial imagery (RGB and NIR). To aid in the classifications, training sites were generated to assess the predominant land cover types contained within the four study areas.

To extract the desired land cover classifications from the UAV imagery, the Spatial Analyst Extension contained in ArcGIS software was utilized to perform a supervised classification. The training data was incorporated into the classification to obtain specific spectral signatures which assigned each pixel a unique land cover value. After classified thematic maps were developed by the applied maximum likelihood algorithm, model accuracies were tested, and the classifications were edited to correct for known inaccuracies in the classification. Following data interpretation and editing of the classified models, post-classification image processing and final accuracy assessments were performed.

This analysis provided a detailed assessment on UAV image classification capabilities for identifying and quantifying land cover types present within the study areas. The analysis accurately classified the study areas, provided detailed geospatial data for use during future site restoration work, and established baseline data for monitoring restoration efforts. This project is on-going.

| 14:10 – 14:40 | L **What Can LIDAR Do For You?** | Copper Room 5 |

Speakers: Melissa Christie

The objective of this presentation is to present Montana Geospatial Professionals with an overview of LiDAR technology including standard LiDAR deliverables, applications and GIS. We will review how remotely sensed data leverages unparalleled efficiencies and derives cost effective solutions at all project sizes. Bare earth surface models, highest hit models and feature extraction will all be discussed in the context of Montana floodplain mapping projects. This presentation will bring an increased awareness to field scientists, GIS professionals and floodplain managers to the multiple applications that one LiDAR data set can yield. The use of USGS 3D Elevation Program (3DEP) will be discussed. Time will be available for Q&A.

| 14:10 – 15:10 | T **Cartography for GIS Users** | Copper Room 1 |

Speakers: Kris Larson

Cartographers have been making maps for thousands of years now and many people that look at maps respond almost intuitively. For example, you probably don't need to look at the map legend to figure out that the blue polygon is water. At this point in your life, you've seen it so many times that you don't even consciously realize that you process this information. Yet, in Montana, most rivers and lakes aren't blue when you're out in the landscape. As GIS becomes more readily available, many people are producing maps without a cartographic or geographic educational background, and they're not always conveying their message as easily as they might.

| 14:10 – 15:10 | T **What's new in ArcGIS 10.7** | Copper Room 2 |

Speakers: Shane Clarke

This presentation will provide an overview of recent updates in the ArcGIS Platform. This will include what's new in the ArcGIS Desktop and ArcGIS Enterprise 10.7 releases, ArcPro 2.3, ArcGIS Online, and the many apps that are part of the ArcGIS Platform. Brief mention will also be made of new products to be introduced in 2019, including ArcGIS Urban, ArcGIS Indoors, Tracker and more!

| 14:10 – 15:10 | K **UAS for Emergency Management** | Copper Room 4 |

Speakers: Chad Sperry

Unmanned Aerial Systems (UAS) have become a vital tool in emergency management and public safety. This presentation will focus on two case studies where the author used extensive UAS tools for mapping and situational awareness. The first use case will detail a response to tornado damage to over 600 homes in Taylorville, IL in December of 2018. Multiple missions were flown the day after the tornado hit to provide the incident commander with a current view of the aftermath. Captured images were processed with DroneDeploy and Drone2Map into a stitched orthomap and uploaded to ArcGIS Online where they were overlaid with damage assessment data. The second use case will detail the use of UAS in search and rescue. The author has flown UAS missions for 5 missing persons cases in the past year, providing images, videos and stitched maps for the response teams. In one case the missing subject heard the UAS and called out so nearby ground search teams were able to successfully locate her. This presentation will also touch on use of mission planning apps to capture imagery, relevant FAA regulations, and the current direction of technology.

| 14:50 – 15:20 | L **Use of High-Resolution LiDAR Data for Measurement of Arroyo Formation** | Copper Room 5 |

Speakers: Seth Mangini

Arroyo erosion is a problem throughout semi-arid parts of the world, including the western United States. The word derives from the Spanish word for "brook" and refers to the variety of erosion that causes a stream or diffuse water flow to become an incised channel that loses access to its floodplain and cuts a deep gully. Consequences include the lowering of the water table, the draining of adjacent wetlands, the loss of soil, sediment, and organic material from the riparian zone, and the loss of riparian habitat. Some factors that may trigger arroyo formation include (but are not limited to) an increase in stream power or a decrease in channel roughness. Specific triggers can include natural causes such as drought and fire, or man-made land use changes such as overgrazing, the removal of adjacent upland vegetation by logging or development, and poor road placement.

This study will use high resolution (1m) LiDAR data to study the formation of an arroyo system in the Sangre de Christo Mountains of northern New Mexico. The data will be used to (1) quantify the volume of sediment removed by erosion and reconstruct the pre-erosional valley bottom, (2) determine how erosion has modified the channel morphology (longitudinal profile and channel classification), (3) estimate how much of the area previously delineated as wetland in the National Wetland Inventory (NWI) has been converted to upland vegetation, and (4) explore topographic controls (slope, contributing area, etc.) on erosional hotspots. Quantification of the degree of degradation is a first step to understanding the processes that trigger arroyo formation, the time scale on which they operate, and the potential time required for recovery.

15:40 – 17:00　　　　　M **Montana Summit - facilitated by Michael Krueger**　　　　　King Ballroom

Join a facilitated discussion with your fellow Montana
Geospatial professionals and the MAGIP Board of Directors
and help us set some future goals and direction.

Topics of discussion will include, but are not limited to:

New Big Sky GeoCon Format
• Content Evolution
• Annual Occurrences

MAGIP Membership Benefits Review
• Meetups
• GISP Support
• Travel Grants for other conferences

MAGIP Administrative Role
MSDI Framework Theme Review
Upcoming Board Elections

Poster Title: American Prairie Reserve: Destination Map Guide
Name (Primary Author): Liz Juers
Organization or School: American Prairie Reserve
Type: Poster
Poster Class: Professional
Poster Category: Effective Cartography
Poster Size: 28.5" x 18.5"

Brief Abstract:

This map is intended to help visitors and potential visitors orient themselves to American Prairie Reserve properties and the surrounding area. Public land ownership, roads, and visitor facilities are the main focus. The map makes up one side of a pamphlet, with the reverse side containing more information on how to visit.

List of products used for creation: ArcGIS Pro

Poster Title: Powder Horn Ranch
Name (Primary Author): Steven K Lowman
Organization or School: Morrison-Maierle
Type: Poster
Poster Class: Professional
Poster Category: Information Usage
Poster Size: 36" x 48"
Key Words (3 - 5 words): Powder Horn Golf Community

Brief Abstract:

This map was created to show the Powder Horn Ranch (PHR) Golf Community and the Parcels within the community. The map was intended to be used by PHR as a marketing tool and to help the real-estate agents know which lots were platted and for sale as well as the lots that had already been sold. The PHR Golf Community is a private golf course reserved for the homeowners of the PHR development.

List of products used for creation:

ArcGIS Desktop was used extensively in this map. Using COGO to map some of the subdivisions and other locations as well. Some survey data was supplied for the location of Pathways. The Golf community had previously had some of the golf course mapped by another agency but the data was skewed and unusable as it was. ArcMAP was used to Rubber sheet the skewed data into place.
County Parcel data was used to determine ownership. Google Earth and City of Sheridan Aerial photography (2015) were used to verify location of the golf course features.

Poster Title: Gallatin County SAR 2018 in Review
Name (Primary Author): Curtis DeVault
Organization or School: Gallatin County Search & Rescue
Type: Poster
Poster Class: Professional
Poster Category: Information Usage
Poster Size: 36" X 34"
Key Words (3 - 5 words): survey123 missions data
Secondary Authors (if applicable): Deborah McAtee

Brief Abstract:
A poster denoting Gallatin County SAR's missions for the year 2018.

List of products used for creation:
Survey123, ArcGIS Pro

Poster Title: Comparison of NAIP and Sentinel imagery as training data for predicting stand size class in Montana forests
Name (Primary Author): Ryan Rock
Organization or School: University of Montana
Type: Poster
Poster Class: Student
Poster Category: Information Usage
Poster Size: 34" x 44"

Brief Abstract:
The Montana Department of Natural Resources (DNRC) sets harvest thresholds on state-owned forest lands using field data collected   by technicians and contractors. Primarily, these thresholds rely on estimates of the size of trees (stand size class), the density of trees (total stocking density), and the dominant species (forest type). Collecting this data is expensive and time-consuming, especially when applied to all 780,000 acres of forested trust lands the DNRC manages.   Remotely sensed data and machine learning algorithms offer   an opportunity to reduce the amount of field data collected by predicting forest characteristics using spectral information. Random forest is a common machine learning algorithm that predicts outcomes based upon a set of training data. These results predict the category of class membership of a pixel and are compared to independent data to gauge the model's success. In this case, field plot data collected   in the summer of 2018 were used to train random forest algorithms to predicted forest characteristics for ~12,000 acres near the Stillwater State Forest, which was recently acquired by the state.   Predictors for the random forest can be derived from aerial imagery, so several data sources were compared to see which predicted the most accurate results. A first set were derived from NAIP 2018 4- band (R, G, B, NIR) imagery at a resolution of 1 meter. Another set were derived from the European Space Agency's Senitnel-2   satellite, which has 13 bands (3 of which are specifically designed to map vegetation) but at a coarser spatial resolution (10-20 m).
Sentinel-2 also captures images approximately every 2 weeks, in contrast to the bi-annual NAIP collection. Several spectral data from Sentinel-2 will be used to build random forest models to discover which band combinations reduces classification errors. Using random forest models to estimate forest metrics is not a new approach, but it is a new process for the DNRC. If reliable estimates of harvest thresholds can be produced with minimal field data, the agency could eliminate the need to hire contractors for data collection, reducing costs and improving profits which supply state revenue. The final product of this study will not only inform forest management on the study area but will provide the MT DNRC with the tools to apply this method statewide.

List of products used for creation:
ArcMap, RStudio, Adobe Illustrator, Google Earth Engine

Poster Title: Conservation Prioritization within Corridors: Case Study in Montana's Grizzly Bear Populations
Name (Primary Author): Joe Offer
Organization or School: University of Montana
Type: Poster
Poster Class: Student
Poster Category: Information Usage
Poster Size: 34" x 44"
Key Words (3 - 5 words): Conservation, Easements, Corridors

Brief Abstract:
Grizzly Bears within the lower 48 are split between two geographically isolated populations in the Greater Yellowstone and Northern Continental Divide Ecosystems. Long-term population stability depends upon connecting the two populations to increase genetic diversity. This project used least-cost path analyses to determine the shortest routes between the two populations over private and public lands to emphasize the areas with the greatest conservation potential.

List of products used for creation:
ArcMap, Photoshop, Illustrator

Poster Title: Identifying Discontinuities in a Rock Face Using Photogrammetry and Machine Learning
Name (Primary Author): Andrew Mullen
Organization or School: Montana State University
Type: Poster
Poster Class: Student
Poster Category: Information Usage,
Other (please specify): Research and Application of Geospatial Technology
Poster Size: 36" X 48"
Key Words (3 - 5 words): Photogrammetry, Drones, Machine Learning

Brief Abstract:
Identification of discontinuous surfaces in a rock face is vital in analyzing its stability. Recent advancements in LiDAR, drones, and computer processing power has moved this process to the digital realm. Standard methods involve manually identifying discontinuities on a 3D model or stereo-image of the outcrop, and calculating their orientations within a software such as RockScan or Virtual Reality Geologic Suite. The major drawback of these methods is that they rely completely on the geoscientist or engineer to accurately identify every discontinuous surface, and are therefore susceptible to a high degree of bias. This research examines a semi-automated methodology that removes bias from the process with a machine learning algorithm. A triangular mesh of a rock outcrop in Bozeman, MT was generated using drone photography and Structure-From-Motion photogrammetry. A k-means algorithm was run on orientation data of the triangular facets to cluster segments of the model with similar orientations. Discontinuities could then be observed in a new model that was colored based on the clusters. A heat map of facet orientations was then plotted on a stereonet along with clustering centers from the algorithm, which allowed for mean cluster orientation and cluster density to be observed. This method was found to proficiently identify discontinuous surfaces in the outcrop.

List of products used for creation:
DJI Phantom 4 Drone
Bentley Systems ContextCapture Python

Poster Title: Relative Elevation Analyses for Riparian Restoration
Name (Primary Author): Jesse Wallace
Organization or School: Geum Environmental Consulting, Inc.
Type: Poster
Poster Class: Professional
Poster Category: Information Usage
Poster Size: 36" x 48"
Key Words (3 - 5 words): LiDAR, Restoration, Wetlands, Riparian

Brief Abstract:
High-resolution elevation data and modeled hydrologic data can be combined to create relative elevation datasets and cartographic displays that provide important information for assessing the current and historical characteristics of riparian areas. These data aid in the assessment of existing site conditions and potential restoration suitability, and help identify risks and restoration constraints associated with flooding and surface water management. This poster will provide some examples of relative elevation analyses performed for riparian restoration projects in Montana and Idaho to identify habitat restoration potential and guide management of riparian areas.

List of products used for creation:
ArcGIS desktop software including Spatial Analyst extension, HEC-RAS hydrologic model outputs, bare earth LiDAR

Poster Title: Applied Geospatial Analysis for Zoning Practice in Rural County Planning
Name (Primary Author): Michael Stone
Organization or School: Cascade County Planning Division
Type:Poster
Poster Class: Professional
Poster Category: Information Usage
Poster Size: 34" x 44"
Key Words (3 - 5 words): Planning; Zoning; Rural; County; Geospatial Analysis; Land Use

Brief Abstract:
Cascade County has county-wide zoning over a vast rural area with a mix of residential, agricultural, commercial, and industrial uses.   One of the challenges of rural planning for a large and diverse area of land uses is to tailor appropriate districts that track historical land use development, trends in lot formation, and shifting economic geographies. This project demonstrates how geospatial analysis using   the Anselin Local Moran's I cluster and outlier tool provided a data-driven method for guiding a staff driven rezone proposal for Cascade County's largest zoning district, the Agricultural District. The cluster analysis, in conjunction with county zoning permit data, provided   staff with the ability to understand lot formation trends in correlation with land use trends which clearly demarcated distinct development patterns within the Agricultural District. This provided staff with a way to efficiently and effectively propose a split of the Agricultural   District into two new districts resulting in less nonconformity and accommodation for the shifting economic geographies demonstrated   by the divergent lot and land use trends. The resulting proposed zoning map demonstrates the utility of applied geospatial analysis to real-world problems in zoning practice for rural county planning.

List of products used for creation:
ESRI ArcGIS Desktop MSDI Cadastral MSDI Transportation
MSDI Administrative Boundaries
Cascade County Zoning Permits Database Cascade County Zoning Map

Poster Title: Geomorphic impacts of coarse woody debris within a recently burned mountainous hillslope
Name (Primary Author): Kailey Adams
Organization or School: Montana State University
Type: Poster
Poster Class: Student
Poster Category: Information Usage
Poster Size: 36" x 48"
Key Words (3 - 5 words): sediment yield, wildland fire, sediment storage, coarse woody debris
Secondary Authors (if applicable): Jean Dixon Dave McWethy

Brief Abstract:
Wildland fires are widely recognized to influence the geomorphology of mountainous systems. Removal of vegetation on hillslopes induces changes to sediment and flow routing, but surprisingly little is known about interactions between biotic materials that are added   by fire and soil transport dynamics. Volumes of fire-produced coarse woody debris can be equivalent to decades of input from other methods, resulting in hillslopes littered with logs. Literature suggests logs store sediment at their upslope extent, and this storage   capacity may be linked to morphologic variables such as hillslope gradient and aspect. However, limited past work has quantified the   role of logs in hillslope sediment storage, and the controlling factors are poorly understood. We use high-resolution topographic data to provide novel, quantitative insights to interactions between coarse woody debris and sediment transport dynamics at the hillslope-scale. Within a small, headwater catchment in southwester Montana, more than 6,000 logs were manually digitized from a 10-cm resolution orthophoto. Trigonometric relationships between logs and surrounding topography provide estimates of potential sediment storage.

These data are combined with morphologic variables (e.g., slope, aspect, curvature) and burn severity data to quantify controls on log orientation and, consequently, potential volume of sediment stored. This research provides an important look at the effects of fire on competing processes of soil storage and transport. Insights gained from this study will be increasingly consequential as the size and extent of wildland fires in the western U.S. continue to grow.

List of products used for creation: ArcMap CloudCompare Rstudio

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Poster Title: Highway Safety in Montana
Name (Primary Author): Mike Eidum:
Organization or School: Montana Department of Transportation
Type: Poster
Poster Class: Professional
Poster Category: Effective Cartography
Poster Size: 36" X 48"
Key Words (3 - 5 words): Highway, Safety, Fatality, Impairment, Montana

Brief Abstract:
Map detailing Montana Department of Transportation's crash data, fatality reporting analysis system data, and Montana Highway Patrol citation data.

List of products used for creation: ArcGIS, Adobe Illustrator

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Poster Title: CHISLIC: Creating Hybrid Structure from Landsat and Lidar Combination
Name (Primary Author): Chris Moran
Organization or School: National Center for Landscape Fire Analysis
Type: Poster
Poster Class: Student
Poster Category: Information Usage,
Other (please specify): Research and Application of Geospatial Technology
Poster Size: 44"x34"
Key Words (3 - 5 words): lidar, landsat, forest structure modeling
Secondary Authors (if applicable): Carl Seielstad, Matt Jolly, Birgit Peterson, Russ Parsons, Kurtis Nelson

Brief Abstract:
Accurate information about three-dimensional forest canopy structure across broad landscapes is necessary for a host of ecological and forestry applications including prediction of how wildfires will spread under various conditions. Remotely sensed data are invaluable for assessing these canopy characteristics over broad areas. Lidar data in particular are uniquely suited for quantifying three-dimensional canopy structure, but lidar is restricted to limited spatial acquisitions. Here we built an online modeling system to predict structural attributes from LANDSAT vegetation indices using lidar height variables as training data. The application allows users to upload lidar attributes in conventional raster form and identify areas of interest (AOI). The application uses gradient boosted regression trees in a distributed, parallel processing system to model and predict canopy structure for the AOI and returns predicted canopy metrics along   with model performance statistics. The application enables users with limited resources to generate actionable 3-D data with known   error estimates.

List of products used for creation: LasTools, Google Earth Engine, ArcMap, R, Spark, Adobe Illustrator

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Poster Title: Sprawl in the Northern Rocky Mountains
Name (Primary Author): Morgan Anderson
Organization or School: University of Montana
Type: Poster
Poster Class: Student
Poster Category: Information Usage
Poster Size: 34" x 44"
Key Words (3 - 5 words): Sprawl, Development, Rockies

Brief Abstract:
This focus of this project was to identify and describe sprawl in the Northern Rocky Mountains from 2001 to 2011. A landscape ecology approach was utilized to measure the fragmentation of development for functional sub-regions in Montana, Wyoming, and Idaho using NLCD data to assess the process of sprawl. Patch level analysis was also completed to more specifically identify and assess   development patterns at a smaller scale. This is useful not only for those places that are growing out, but also the areas of which growth   is heading towards.

List of products used for creation: Adobe Illustrator, ArcGIS, ArcGIS Pro, Fragstats4.1, Excel, NLCD 2001/2011, USDA Rural-Urban Commuter Area codes

Poster Title: Glacier National Park Stand Age Replacement in the Fires of 2003
Name (Primary Author): Gina Mazza
Organization or School: University of Montana
Type: Poster
Poster Class: Student
Poster Category: Information Usage
Poster Size: 36" x 32"
Key Words (3 - 5 words): Fire, Stand Age, Glacier National Park

Brief Abstract:
I created this map to fulfill a service project assignment in Kevin McManigal's Advanced Cartographic Design class at the University of Montana. I chose to build data and a map for Glacier National Park Fire Management. The map represents the 2003 fire perimeters over 100 acres. Using the 2015 NAIP imagery, I digitized areas where the fires completely replaced the forest stands. This stand age replacement data provides insight into how the fires burned. Glacier National Park plans to expand upon this project by assessing stand age replacement for fire seasons both past and present to learn about burn trends in the park.

List of products used for creation:
2015 NAIP Imagery ArcGIS
Glacier National Park provided all park base data 3DEP DEM, The National Map Viewer
Montana Major Streams and Lakes, Transportation Framework, Montana State Library

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Poster Title: Generalized Geologic Map of McCartney Mountain
Name (Primary Author): Morgan Voss
Organization or School: University of Montana
Type: Poster
Poster Class: Professional
Poster Category: Effective Cartography
Poster Size: 36" x 24"
Key Words (3 - 5 words): Geology, Dillon, McCartney Mountain

Brief Abstract:
The McCartney Mountain Stock, located outside of Dillon, Montana is one of the most complex geologic regions in the state. A seismically active area in the eastern Pioneer Mountains, McCartney Mountain is bound on the northeastern and southwestern sides by normal faults, these faults being responsible for much of the physiographic relief of the range and the deposition of thick Cenozoic   gravels and sediment. The study area possesses a unique geologic history well suited for geologic study programs. While the area has been studied extensively for countless geologic field schools, it has never been mapped at a detailed 1:24,000 scale. Field work in summer 2017 provided updated mapping units for incorporation into not only this final cartographic product, but also future studies documenting stratigraphy and associated groundwater resources. This study improved upon the existing USGS 1:250,000 geologic map from the early 1990s by documenting the surficial geology along the western, southern, and eastern flanks of McCartney Mountain. The final map provides an overview of the surficial geology, including volcanic, alluvial, and metasedimentary units.

List of products used for creation: USGS Topos, good ol' fashioned field work, NED

Poster Title: Remote Sensing of Avalanche Tracks in Glacier National Park, Montana
Name (Primary Author): Morgan Voss
Organization or School: University of Montana
Type: Poster
Poster Class: Professional
Poster Category: Information Usage
Poster Size: 36" x 48"
Key Words (3 - 5 words): remote sensing, random forests, Glacier National Park, avalanche tracks
Secondary Authors (if applicable): Anna Klene, Erich Peitzsch, Dan Fagre

Brief Abstract:
Snow avalanches are the common form of mass wasting in the high mountain environments of Glacier National Park (GNP), Montana. These natural disturbances play important roles in mountain ecosystems by regularly disturbing montane systems, providing critical habitat for some species, transporting debris, and influencing vegetation and fire dynamics. Since the 1900s, natural avalanche-related activity recorded along important transportation corridors within the park has frequently disrupted transportation.

While many of the steep slopes of GNP are susceptible to avalanching, formal inventories exist only for small, critical portions of the   park and they vary substantially from one another. GNP's protected status does not allow for avalanche mitigation, allowing this area to serve as a natural mountain environment for studying these processes.   A current, high-resolution inventory of avalanche locations in   the park is needed for the entirety of the Park.

Imagery and digital elevation models (DEMs) were used to map the distinct biogeographic and topographic patterns left by avalanching using machine learning methods. Mosaics of National Agricultural Imagery Program (NAIP) aerial photographs acquired in 2013 were segmented to map avalanche tracks. Principal components from the imagery and derivatives of the DEM were used as input to a Random Forests algorithm which mapped the most likely class for each segment using a probabilistic approach. Avalanche paths were found to comprise approximately 5-12% of the park, along predominantly south and southeasterly facing slopes between 20° to 40°. While this estimate is similar to previous studies, this work did not map starting or runout zones which would have increased the total area. The paths predicted provide a comprehensive inventory that can be used to monitor shifts in vegetation and climate dynamics within the disturbance regime. Changes were clearly seen in the contraction and expansion of trim lines of some avalanche paths in recent imagery. Future research could use this work as a baseline for time-series analysis.

List of products used for creation: NAIP, NED

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Poster Title: A Spatial Analysis of Patient Population for the North Valley Hospital Emergency Department
Name (Primary Author): Shane Foster
Organization or School: Flathead Valley Community College
Type: Poster
Poster Class: Student / In collaboration with my employers, North Valley Hospital
Poster Category: Information Usage
Poster Size: 36" x 48"
Key Words (3 - 5 words): Emergency Department Patient Population Distance
Secondary Authors (if applicable): Rick Packard, MS

Brief Abstract:
A spatial analysis of Emergency Department patient data from North Valley Hospital. The author will express spatial trends of medical facility choice for the Flathead Valley patient population in 2018.

List of products used for creation: ArcGIS, AllScripts, Medical Record Database

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Poster Title: Applied GIS and Natural Resource Education in the Flathead Valley
Name (Primary Author): Morgan Voss
Organization or School: University of Montana
Type: Poster
Poster Class: Professional
Poster Category: Information Usage
Poster Size: 36" x 24"
Key Words (3 - 5 words): GIS education, ecology, Glacier National Park
Secondary Authors (if applicable): Richard Menicke

Brief Abstract:
The unique physiographic features of Glacier National Park provide a natural classroom for students across the Flathead Valley.   Applying GIS to solve natural resource issues in places like the park is a common method in geography in addition to being relevant for many students. We developed two lesson plans to help high school students engage not only in GIS in the classroom, but also to apply GIS to investigate potential effects from climate change and other natural resource issues in the students' own back yards in Glacier National Park.

One lesson details the possible changes in sensitive bull trout habitat from warming streams due to climate change, while the other lesson plan details the importance of avalanches, terrain features, debris transport, and the relationship to disturbance ecology/debris transport in the park.

Working with park staff, this curriculum was distributed for Flathead Valley High Schools. Training and materials were also provided to interested area teachers so they can use the lessons and materials for other natural resources questions.

List of products used for creation:
USFS stream temperature data, GNP bull trout data, GNP avalanche data, GNP background data

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Poster Title: Butte Montana, August 1955 - with historical & contemporary features
Name (Primary Author): Jeremy Grotbo
Organization or School: Butte-Silver Bow
Type: Poster
Poster Class: Professional
Poster Category: Effective Cartography
Poster Size (e.g. 34" X 44"): 36" X 36"
Key Words (3 - 5 words): Butte, aerial, historic, mining, industry

Brief Abstract:
In the summer of 1955 Butte, Montana embarked on a decades long transition. Heavy metal mining would soon occur open and   exposed, lessening then ending dependence on thousands of miles of underground shafts and tunnels. Consequently, the city and   region would forever change, the landscape altered dramatically as mining operations spread outward. A moment in time and on the   cusp of transformation, August 1955 is captured from above, overlaid with the preceding generation's historic mining sites. The scene is further anchored by contemporary roadways, hydrology, and existing headframes, reminders of Butte's legacy and hallmarks of an industrial past.

List of products used for creation:
The map was created entirely within ArcMap, taking advantage of symbols and styles limited to the program. Mining shafts and headframes were located from tabular information, and reference coordinates. Roadway and hydrology refer to locally available data, as well as other sources found at the Montana State Library and within federal government. Geo-referencing of aerial images occurred   within Arcmap, and source to information shared from CDM Smith.

Web Map/Application Title: MDT Planned and Active Projects
Name (Primary Author): Brian Klapstein
Organization or School: Montana Department of Transportation
Type: Web Map/Application
Web Map/Application Web Address: https://arcg.is/0LKGer

Brief Abstract:
The MDT Planned and Active Projects web application is the successful culmination of many attempts to show the public what projects the Department is working on. Implemented primarily using ArcMap and Operations Dashboard, the app provides a map and list of statewide projects that are active and projects that are being planned. The user can utilize the available filters to narrow the list and   map down to show projects by categories such as: cost, county, type, etc.

List of products used for creation: ArcGIS Online, Operations Dashboard, Story Maps ArcGIS 10.6.1
Oracle, Microsoft Office: Word and Excel Adobe Illustrator

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Web Map/Application Title: Urban Art Tour Through Great Falls BID
Name (Primary Author): Aaron Vaughn
Organization or School: City of Great Falls
Type: Web Map/Application
Web Map/Application Web Address:
https://cogf.maps.arcgis.com/apps/webappviewer/index.html?id=c2e7e87587de4a2c927d52bc9db1d51f

Brief Abstract:
A directional tour of Great Falls Downtown's Business Improvement District traffic light box art. Art pics, artists spotlight, and details about how Great Falls is trying to beautify the downtown area.

List of products used for creation: ArcMap 10.7, ArcGISOnline, Webapp Builder for ArcGIS, MS Excel, Android Phone, Pencil and Paper

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