ASSOCIATION OF CANADIAN MAP LIBRARIES AND ARCHIVES
BULLETIN

Drones in Libraries: The Development of an Interdisciplinary Research Service Using Drones and 3D Modeling Technologies at Ryerson University Library

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Introduction

At Ryerson University Library, we collaborate with researchers across a variety of disciplines that require capturing and modeling the real world in 3 dimensions (3D). To do so, several 3D reconstruction technologies have been applied, varying in cost and ease of use. Some applications require capturing large areas for which a Remotely Piloted Aircraft System (RPAS) or "drone" presents a cost effective option for data acquisition.

On June 1, 2019, new rules for flying a RPAS in Canada came into effect, requiring drone pilot certification to operate any drone between 250 g and 25 kg. In response to new regulations and the needs of our researchers, the Library has initiated the development of a research service dedicated to supporting the use of drones and 3D modelling technologies. This service is well positioned in a central research hub that minimizes researchers' need to acquire expertise and licensing given the new RPAS regulations. In addition to data collection via flights, the library provides consultations supporting 3D reconstruction technologies.

Before cancellation due to the Covid-19 pandemic, the joint CAG/CCA/CARTO-ACMLA conference - CAG 2020: Resilience on a Dynamic Planet - provided a national venue to showcase our progress to date. A 1.5 hour workshop was to be conducted both as a conference presentation and live demonstration of drone technology. The agenda included an introduction to drone licensing in Canada, a showcase of our missions and resulting deliverables to date, and a demonstration of the imagery acquisition process through conducting a live autonomous flight. Another goal was to connect with like-minded researchers in the field and explore the potential for future collaboration. This report will summarize our workshop content and outline existing collaborations and future directions for our research and service.

Regulations and Legal Requirements for flying RPAS in Canada

On June 1, 2019, drone pilot certification became a requirement to legally operate RPAS between 250 g and 25 kg. Along with acquiring the pilot certificate, the pilot must register the RPAS with Transport Canada and mark the drone with the registration number. A drone that is less than 250g does not require registration or a drone pilot certificate. (Flying your drone safely and legally,

2020). A complete list of regulations and requirements is outlined by Transport Canada on their *Drone Safety* webpage.

Category of Drone Operation

Two categories for drone operation exist in Canada which follow specific rules related to any flight. These main categories are **Basic** and **Advanced** operations which both require that the operator and/or crew maintain a Visual-Line-of-Sight (VLOS) with the RPAS at all times.

Basic Operations: Three main conditions exist for operating a drone with a Basic drone pilot certificate. The operator must conduct flight in uncontrolled airspace. Transport Canada defines uncontrolled airspace as areas with no air traffic control, at least 1.8 km away from a heliport and 5.6 km away from airports. The drone must be flown a minimum of 30 metres (100 feet) horizontally from bystanders and may never be flown over bystanders. To acquire the pilot certificate for Basic Operations, the operator must pass an online examination and may be asked to show proof that the related knowledge is retained over time (Find your category of drone operation, 2020).

Advanced Operations: If any of the conditions outlined under Basic operations are not met, the operator must acquire a pilot certificate for Advanced Operations. Under Advanced operations, a drone pilot may request air space approval from NAV CANADA to conduct a flight in controlled airspace, may fly within 30 metres (100 feet) horizontally from bystanders, and may apply for a Special Flight Operations Certificate (SFOC) to fly over bystanders. To acquire the pilot certificate for Advanced Operations, two knowledge requirements exist. The operator must first pass an online examination and then schedule an in person flight review with a reviewer that is associated with a drone flight school (Find your category of drone operation, 2020).

Development of an Interdisciplinary Research Service

Our research consultation service related to drones has grown based on a partnership initiated between the Ryerson University Library Collaboratory and the Geospatial Map and Data Centre (GMDC). The Ryerson University Library Collaboratory is an interdisciplinary research hub that provides Ryerson faculty and graduate students with physical space, technology and access to consultation services to facilitate research. The GMDC houses and provides access to a geospatial data inventory, hardware, software and consultation services supporting the effective uses of GIS and related technologies. Although our geospatial inventory is extensive, specific demand for imagery and digital elevation data including point cloud data in the .las file format has been steadily growing over time. This demand, the changes to regulations for flying drones in Canada, and complementary knowledge bases ignited a collaboration between Jimmy Tran (Research Technology Officer in the Collaboratory) and Dan Jakubek (GIS and Map Librarian) to develop this service.

Since acquiring pilot certificates for Advanced Operations in June 2019, the Library has worked to establish a research community at Ryerson University related to this technology. Outreach with faculty from related disciplines led to a preliminary event in the Library Collaboratory to help guide the scope of our service and to stimulate collaboration. As a result, we have identified various needs of our research community ranging from guidance related to the drone licensing process, assistance with flight planning and imagery capture in diverse environments, processing and creation of data products with specialized software, and support related to visualization and analysis. A selection of these collaborations will be highlighted in this article.

Overview of Library Collaboratory Drones and Technology

Over the past year, the Library has experimented with various drones in the imagery acquisition process. To date we have worked exclusively with DJI drones (the current industry leader in drone development). The majority of our flights have been conducted with the DJI Mavic Pro. Although this drone is the original design in the Mavic Series, it has proven to be a reliable and cost effective solution in both manual and autonomous flights. The DJI Spark (now out of production) is a smaller drone which was acquired to be flown in dense/urban environments which the Mavic Pro could not easily navigate. In response to the new Canadian regulations requiring a license to fly drones in Canada weighing above 250 g, DJI replaced the DJI Spark with the Mavic Mini (this drone features similar specifications when compared to the Spark and a total weight of 249 g with memory card). Given its weight, the Mavic Mini does not require a drone pilot certificate to be flown in Canada and provides an excellent option for flight training or activity in controlled airspace where requests for airspace approval are not possible.

The DJI Mavic Pro, Spark, and Mavic Mini all provide the ability to acquire imagery given their built-in cameras on gimbals; however, they do not have the capacity to handle significant payloads required to mount specialized cameras and/or sensors. Based on consultations with our research community and data requests via the GMDC, datasets acquired via LiDAR (Light Detection and Ranging) technology e.g. 3D Point Cloud and Digital Elevation Models (DEMs) are a priority. LiDAR is a laser based technology that produces 3D representations of terrestrial or airborne features (LIDAR 101, 2020) and requires an enterprise drone solution given the payload required for data acquisition. In response to this demand, the Collaboratory acquired a Velodyne LiDAR Puck Lite and a DJI Matrice 600 Pro. We are currently in the process of developing a workflow for data creation using LiDAR technology (stitching and processing) and have initiated test flights with the Matrice 600 Pro.

Processing Review and 3D Reconstruction

The majority of our processing and 3D reconstruction activity to date has been based on aerial photogrammetry. “Photogrammetry is the art, science, and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting photographic images and patterns of recorded radiant electromagnetic

energy and other phenomena (Wolf & Dewitt, 2000; McGlone, 2004 in Aber et al., 2010, p. 23)." Aerial photogrammetry requires a combination of flight planning (at a predetermined altitude and applying the optimal image overlap and camera angle), imagery acquisition and processing workflows for the creation of data products. We use a mobile application called Pix4DCapture to plan flight missions. The software also has the capability to interact directly with the drone and execute autonomous flights to capture data which provides consistency in the imagery acquisition far beyond the capability of manual human controlled flights. Post-flight, the data is processed with the desktop application, Pix4D Mapper.

Flight Planning: A variety of flight planning applications exist that offer different mission planning options. Our preliminary autonomous flights were conducted using the DroneDeploy application; however, we now exclusively use the Pix4DCapture application based on the available flight planning options and reliability to date. Our general guidelines for image acquisition intended for 3D reconstruction are:

1 - Employ a Double Grid flight path to ensure optimal overlap

2 - Conduct flights at the most appropriate altitude possible, prioritizing safety given existing obstructions in the flight path

3 - Set camera angle to 80 degrees

4 - Set Front and Side Overlap for image acquisition to a minimum of 80%

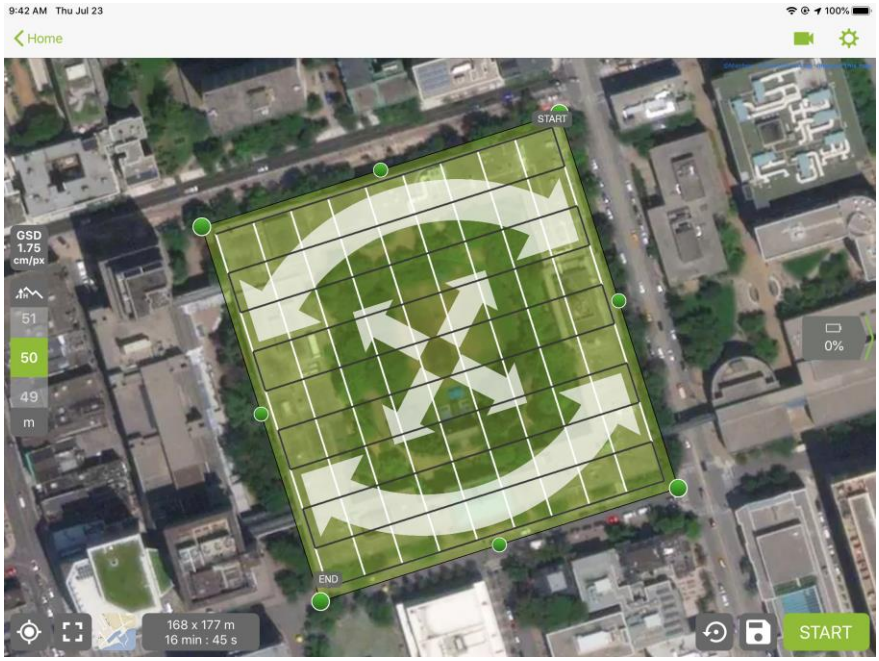

Figure 1: Flight Planning Example with the Pix4DCapture mobile application on the Ryerson University Campus

Processing: Using Pix4D software, we are able to create the following data products using the aerial photogrammetry process: Orthomosaics, Digital Elevation Models (DEMs), 3D Point Cloud datasets (.las file format), and 3D Textured Meshes. While processing with Pix4D software, an environmental scan of related processing technologies was conducted which led us to ESRI's Drone2Map software. This software is based on Pix4D technology and produces comparable outputs. In addition, the resulting datasets are ArcGIS ready for users who choose to conduct analysis using the ArcGIS suite of software. Drone2Map is also a cost effective option for those institutions that have existing ESRI site licenses. We are in the process of comparing processing results between Pix4D and Drone2Map to ensure the production of best quality data products.

Library Collaboration and Mission Highlights

East and West Chinatown Heritage Project

Professor Linda Zhang is a faculty member in the Ryerson School of Interior design. She began to look into a project that focused on preserving the heritage of Toronto's East and West Chinatowns. After becoming a member of the Collaboratory, she worked with Jimmy Tran to explore various methods to create digital 3D models of architectural structures of the Chinatowns in Toronto. Through this work, the use of drone technology was identified as an extremely effective method for systematic image acquisition enabling aerial photogrammetry utilizing software such as Pix4D Mapper to build 3D models. Professor Zhang was able to further process these data to enable 3D printing in the design of a Build Your Own Chinatown board game. Although photogrammetry was successful in Chinatown East, Chinatown West posed some challenges as there were many large trees blocking buildings. One work around was to collect data during leaf-off periods in early spring but continual development of LiDaR stitching would be the optimal solution. *Figures 2* and *3* demonstrate a 3D model of the "Chinese Arch" in Chinatown East.

Figure 2: Photograph of the "Chinese Arch" in Chinatown East, Toronto

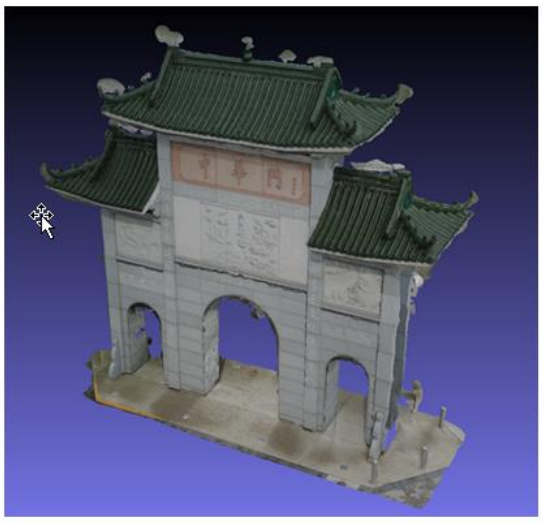

Figure 3: 3D model of the "Chinese Arch" in Chinatown East, Toronto

Ryerson University Campus Core Revitalization Project

A component of Ryerson's Public Realm Plan focusing on the redevelopment of Gould Street and Victoria Lane commenced in 2019. In order to document the phases of development, periodic flights have been conducted to capture these changes to the campus over time. Data products created include Orthomosaics, 3D Textured Meshes and 3D Point Clouds. The intention is to document and preserve this piece of Ryerson's history and to make these datasets openly available to the research community. *Figure 4* demonstrates a 3D Textured Mesh created using the photogrammetry process.

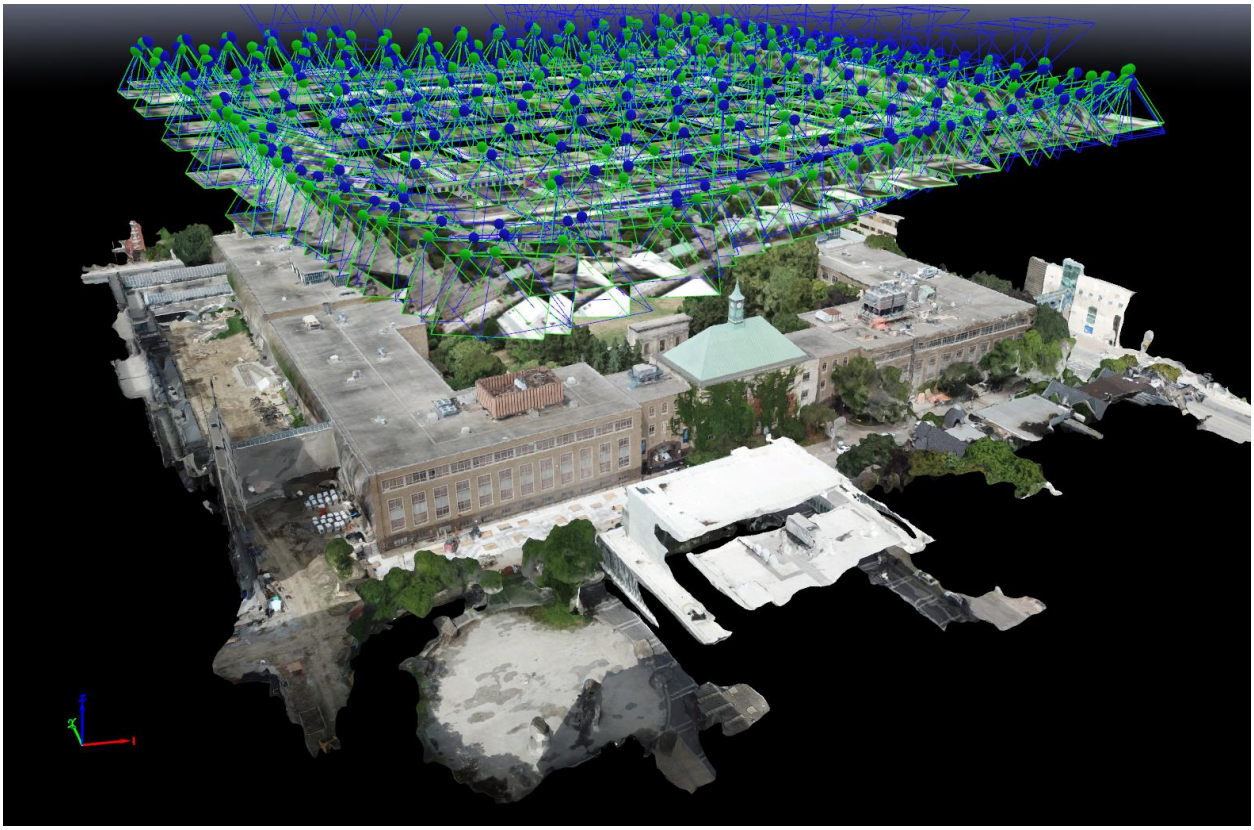

Figure 4: 3D Model of the Ryerson University Kerr Hall Building created in Pix4D Mapper using photogrammetry

3D Reconstruction of the Urban Forest - Glen Stewart Ravine and Allan Gardens, Toronto

In collaboration with Dr. Andrew Millward (Department of Geography and Environmental Studies, Ryerson University), we have been exploring whether aerial photogrammetry is a viable approach for creating 3D representations of the Urban Tree Canopy. To date we have conducted flights in both the Glen Stewart Ravine and Allan Gardens in Toronto. We have experimented flying at various altitudes and applying different camera angles to assess whether aerial photogrammetry is capable of producing accurate results. Based on our observations, we have

determined that LiDAR technology will be required to produce the desired 3D Point Cloud datasets.

Course Curriculum Enhancement - GEO 542: Introduction to Remote Sensing

In collaboration with Dr. Wayne Forsythe (Department of Geography and Environmental Studies, Ryerson University), we delivered a session introducing students in *GEO 542 - Introduction to Remote Sensing* to drone technology. The session included a live demonstration of drone functionality, including both manual and autonomous flights. The demonstration was followed by a lecture in the Collaboratory which focused on the regulations and legal requirements for flying Remotely Piloted Aircraft Systems (RPAS) in Canada and showcased selected data outputs resulting from aerial photogrammetry. Following our session, a participant designed a project involving the use of drones in agriculture and was recently awarded a Creators Grant via the Library's Digital Media Experience Lab.

Visualization

Virtual Reality (VR) Environment

The recent progress made in VR technology has provided exciting options to visualize data. The Ryerson Library Collaboratory developed an immersive VR experience where users/players are able to walk around East Chinatown in Toronto as if they were actually there. This was done using the Unity Game Engine on the HTC Vive VR platform. The 3D models from the Chinatown Heritage project created by Pix4D Mapper were created from images captured by drones. This project was initiated as a proof of concept to show that powerful visualization can be created with relative ease using simple tools available to our researchers.

Figure 5: 3D model of Chinatown East at Gerrard Street East and Broadview Avenue

Immersive 360 Degree Projection Environment

Ryerson University Library is in the planning stages of building an Immersion Studio. Based on the Igloo Immersion 360 degree Projection System, the Library's Immersion Studio is going to develop extensible models and programs for the development and dissemination of digital research and scholarship in a large-scale and immersive visualization environment. This technology infrastructure will provide faculty opportunities for pedagogical innovation and enrich students' learning experience. With the Immersion Studio, the Library's capacity to support teaching, learning and research will be expanded to a new level. We are in the process of working with 360 degree cameras and related technologies, and will pilot content for the Immersion Studio based on our drone imagery acquisition and processing outputs to date.

Future Directions

3D Reconstruction using LiDAR Sensor

Aside from photogrammetry, the other method for 3D reconstruction is to use a LiDAR sensor to scan the environment. A LiDAR sensor uses a spinning laser to measure points in 3D space and produces 3D point clouds that are more accurate than those created using photogrammetry. Algorithms such as Iterative Closest Points (Besl & McKay, 1992) serve as a basis for a general technique called Simultaneous Localization and Mapping (SLAM) (Nuchter et al., 2005) to align each individual scan together to produce a large 3D model. In outdoor environments where the sensor is visible to Global Positioning System (GPS) satellites, industrial grade GPS receivers can be used to create a geo-located Point Cloud.

Up until a few years ago, LiDAR technology has been prohibitively expensive, requiring significant financial investment to employ the technology. As a result, activity was typically limited to large corporations or institutions given the high cost (above $100,000). Given the recent progress in robotics and accelerated development of autonomous vehicles (self driving cars), the cost of LiDAR technology has decreased significantly to a few thousand dollars (Puck LITE, 2020). Albeit, more affordable now, LiDAR is still much more expensive than photogrammetry and a complete turn-key solution for LiDAR scanning and 3D model generation still requires an investment in the tens of thousands of dollars. The Ryerson Library Collaboratory is in the process of developing a cost effective way for researchers to have access to this technology by developing software using open source research projects.

Library Drone Lending Vs. Learning Program

As drone technology has become more affordable in recent years, it is becoming a more prominent component of the research process. Before pilot certification became a requirement to legally operate drones in Canada, Ryerson Library investigated the potential for a library drone lending program. In this scenario, the library would loan the hardware to researchers who could demonstrate competence with operation of the RPAS. Since June 1, 2019, licensing requirements

have complicated the potential for this initiative. In addition to required pilot certification, drones must be marked and registered to licensed operators, further complicating the loan process. Furthermore, the potential for accidents and/or aircraft malfunction is greater with novice operators, thus introducing financial risk related to drone repair and/or replacement. Finally, any library loaning drones must ensure that drones owned and operated by the university in compliance with Canadian Aviation Regulations are covered under the institutions' General Liability policy in addition to assessing the deductibles associated with property damage policies. These challenges have redirected our vision from Library Drone Lending to the development of a Library Drone Learning program.

The scope for our Library Drone Learning Program includes guidance for patrons interested in acquiring a Drone Pilot Certificate for Basic Operations. When demand exists, consultation services also extend to Advanced Operations once the basic certification has been obtained. Beyond licensing, the Mavic Mini provides an excellent opportunity for flight training given that no RPAS certification is required to operate this model. We are currently supporting curriculum in undergraduate and graduate programs and collaborating with faculty and students across disciplines. As the service grows we will assess sustainability which may introduce a cost recovery model for our time that can support further development or the acquisition of new hardware.

Closing Remarks

Our work to date has uncovered many challenges related to the development of a research service employing drones and 3D modeling technologies. Support for such a service requires a specialized knowledge base and significant time commitment to obtain the necessary certification to operate drones. That said, the Library is very well positioned to provide this expertise given the interdisciplinary nature of its support services. Our local community of researchers interested in the application of drones continues to grow based on diverse research agendas and we hope to expand this community externally as we continue to grow our knowledge base.

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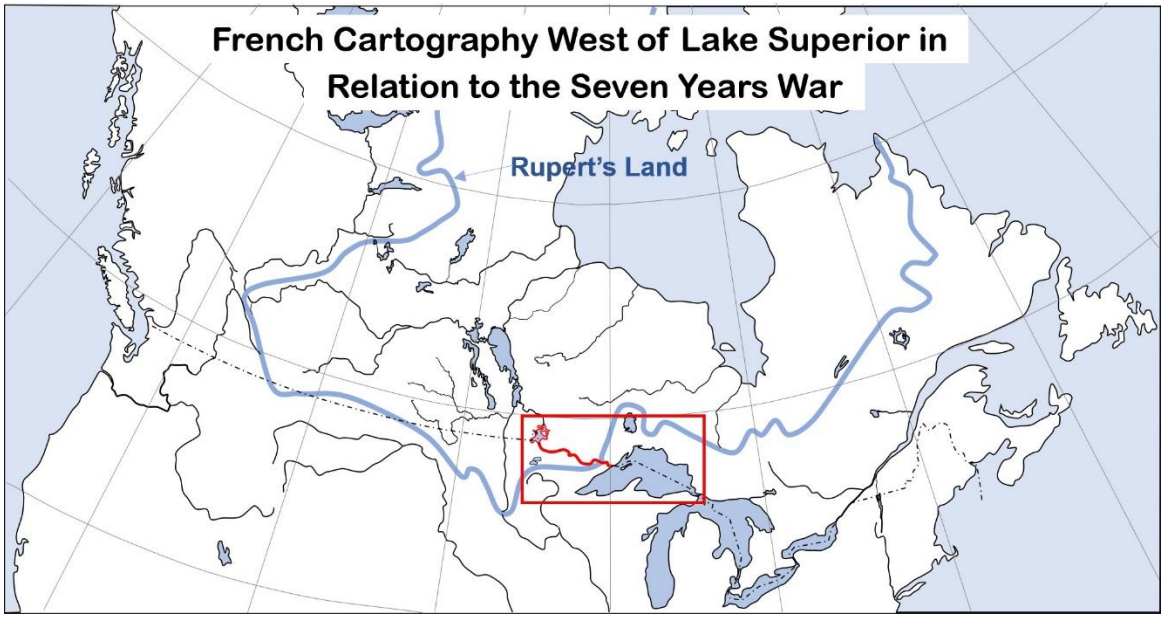
French Cartography West of Lake Superior in Relation to the Seven Years War

CARTO ACMLA VIRTUAL CONFERENCE PAPER
June 10th, 2020

David Malaher



French cartography up to 1756

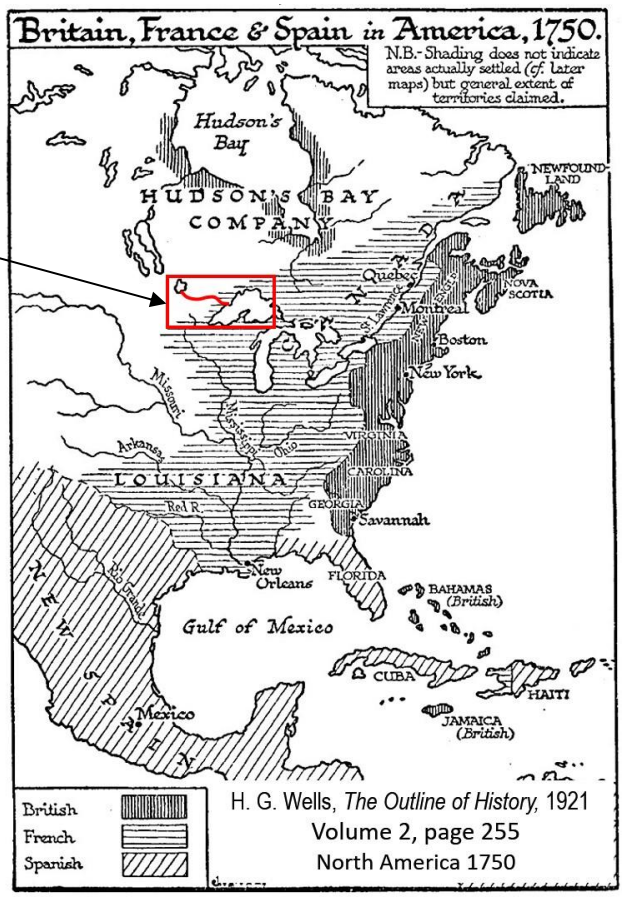
No accurate information was available to European cartographers about the territory west of Lake Superior until sometime after 1730 when Pierre de la Verendrye provided his sketch maps of Lake of the Woods and a map by Auchagah, his Cree guide, showing the 570 km route.

French westward exploration was stalled along the western shore of Lake Superior, roughly from Lake Nipigon to the Falls of St. Anthony on the Mississippi River. Since Sieur Duluth picked up Jesuit Father Hennepin near Mille Lacs (Minnesota) in 1680, the only French to pass west of the 600 km line were illegal, illiterate coureurs de bois**.** La Verendrye arrived in 1731 with approval to search for a route to the western sea.

While this French exploration hiatus was in effect, competition with the English for living space brought frontier skirmishes. By the time La Verendrye was building his first large trading post on Lake of the Woods in 1732, a war with maps was underway. Claims for western land were made with maps, whether the geography was really known or not. French maps were in circulation long before the English had theirs to offer.

Although the territory west of Lake Superior is very large, the zone adjacent to the Lake is small when viewed on a map of Canada. The small zone makes up a geological and ecological margin between the western Canadian Shield and the eastern edge of the great plains prairie. Three maps from 1729, 1743 and 1746 will illustrate the French knowledge of the west up to the declaration of war in 1756.

Territory west of Lake Superior which remained un-explored by the French and other Europeans from 1680 to 1730.



Some independent French fur traders made notable attempts to go west of Lake Superior to find new territory for fresh grounds for their business. These are three examples**:**

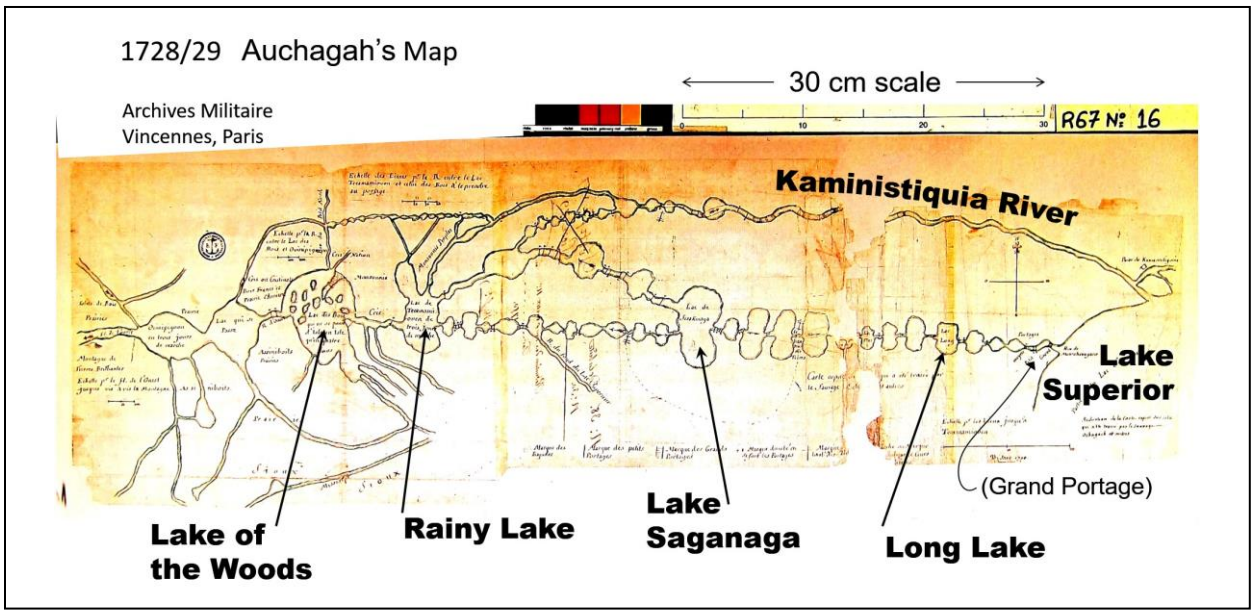
The first recorded person to go west was Jacques de Noyon in 1688, possibly accompanied by others. His effort was not licensed and his turn-around point is uncertain, possibly Rainy Lake.

Zacharie Robutel de La Noue was a licensed trader sent by the government in 1717. He stayed at Lake Superior without going further west until 1721 before returning to Montreal.

Jean Pachot is said to be the first French trader to use the Grand Portage in 1722. (see p.13)

Joseph La France was an unlicensed trader in 1739 who followed the routes taken by La Verendrye in 1731 and 1732. La France issued a map but it was an error-filled copy.

1729 Auchagah's Map



Auchagah's depiction of the 570 km route to Lake of the Woods was simplified but still showing the essential features. According to La Verendrye the map was drawn for him over the winter of 1728/29 by Auchagah with input from other Cree chiefs who lived in the region.

Starting from Lake Superior, the map shows two principal routes to Rainy Lake and one route from there to Lake of the Woods. Auchagah recommended the route through Long Lake and Lake Saganagah which he interpreted as having 25 lakes but later travelers report 37 lakes and 32 portages. These details show the deep know-ledge of the people who lived in the region and the importance for first-time explorers to seek help from knowledgeable local guides.

Auchagah's map and mutual goodwill with the party of fifty fur traders led by La Verendrye opened the way for France to begin exploring west of Lake Superior.

The map shown here is kept in the Archives Militaire at Vincennes, near Paris. The original by Auchagah is said to have been drawn with charcoal on birchbark. As the scale indicates, the map is large, roughly 1 m in length. This archive copy could have been made in Quebec or in Paris. Other copies have been made in various sizes, often with less detail. A test for authenticity of the Auchagah map is that "Long Lake" is marked on the chain of lakes exactly as it is in this copy.

The name Grand Portage for the 8 ½ mile trail between Lake Superior and the Pigeon River is derived from Gichi Onigamiing or the great carrying place as it was known to the Indigenous people who frequented the site since the first millennium CE. The Kaministiquia River, 65 km to the north, was an alternative link to the western country. As mentioned above, Jean Pachot is said, by the Ontario Heritage Trust, to be the first French trader to use the Grand Portage in 1722.

1743 Jacques Nicolas Bellin

1743 Jacques Nicolas Bellin (1703 – 1772)

Library and Archives Canada
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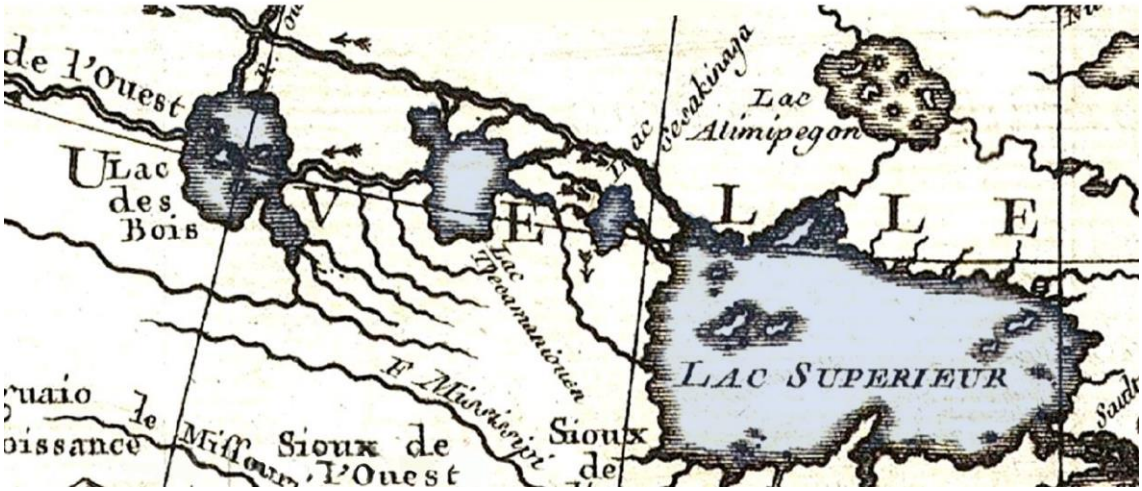


By 1743 the routes from Auchagah's map were incorporated into a map by Jacques-Nicolas Bellin at the French Navy cartographic office - Le Dépôt des Cartes et Plans de la Marine, in Paris. The most important features picked up from Auchagah's map are: the first three large lakes west of Lake Superior, the choice of rivers to reach the three lakes, and the arrows showing the direction of water flow. Bellin also further simplified Auchagah's map by leaving out several small lakes. Thereafter, these routes or portions of them were being reproduced on maps by other cartographers in France and elsewhere in Europe. At the same time, La Verendrye was able to move around on the prairie both by water and overland which opened the way for him to extend the scope of his maps, and so to increase French knowledge of the west over the next ten years.

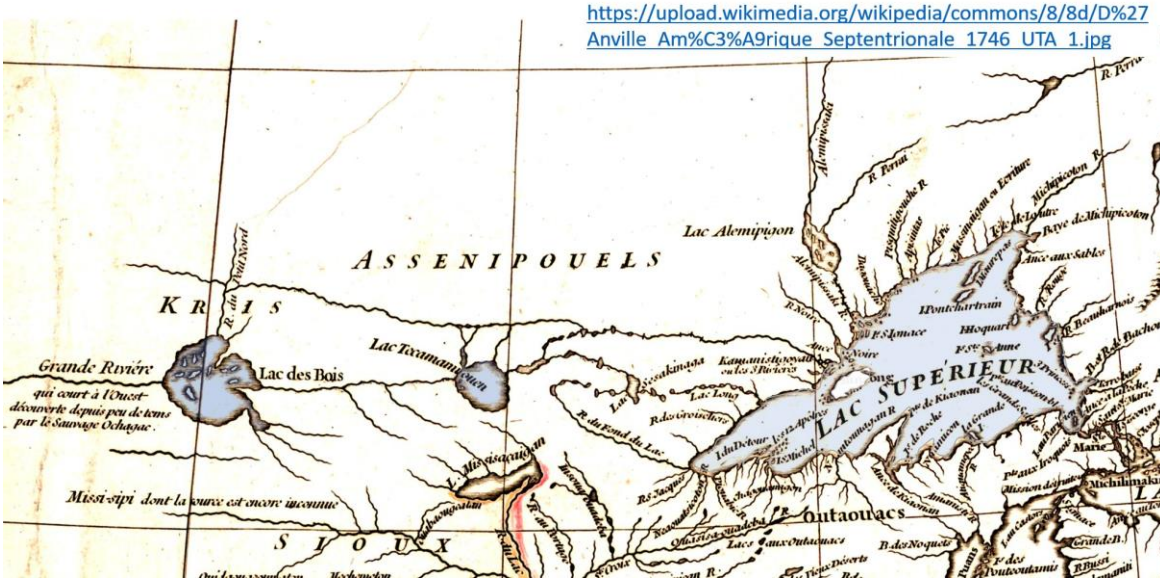
This timing is in line with French diplomatic activity to assert its claims to sovereignty over North American territory from New Orleans in the Gulf of Mexico, up the Mississippi, Ohio and Missouri Rivers as far as places where Duluth, Hennepin, Charlevoix and several other Jesuit, military and fur trade explorers had travelled, including the Great Lakes.

Under Bellin, as the chief cartographer at Le Dépôt, a particular style was established for North America which was mostly distinguished by the shapes of the five Great Lakes. However, too much simplification by Le Dépôt of details submitted by La Verendrye depreciated the value of his exploration. New maps of western Canada created at Le Dépôt were all from one source, La Verendrye. For the French side, the map war called for more surveys of new western territory to produce new maps, not simplified old maps.

1746 Jean-Baptiste D'Anville

1746 Jean-Baptiste d'Anville (1697 – 1782

https://upload.wikimedia.org/wikipedia/commons/8/8d/D%27Anville_Am%C3%A9rique_Septentrionale_1746_UTA_1.jpg



Diplomacy between France and England was faltering over land claims issues in Acadia and the lower St. Lawrence River while new quarrels came up in the "high country" with rivers flowing down into the Great Lakes. There was suspicion that maps in general use were faulty and were the cause of geographical disputes, in which there was some validity.

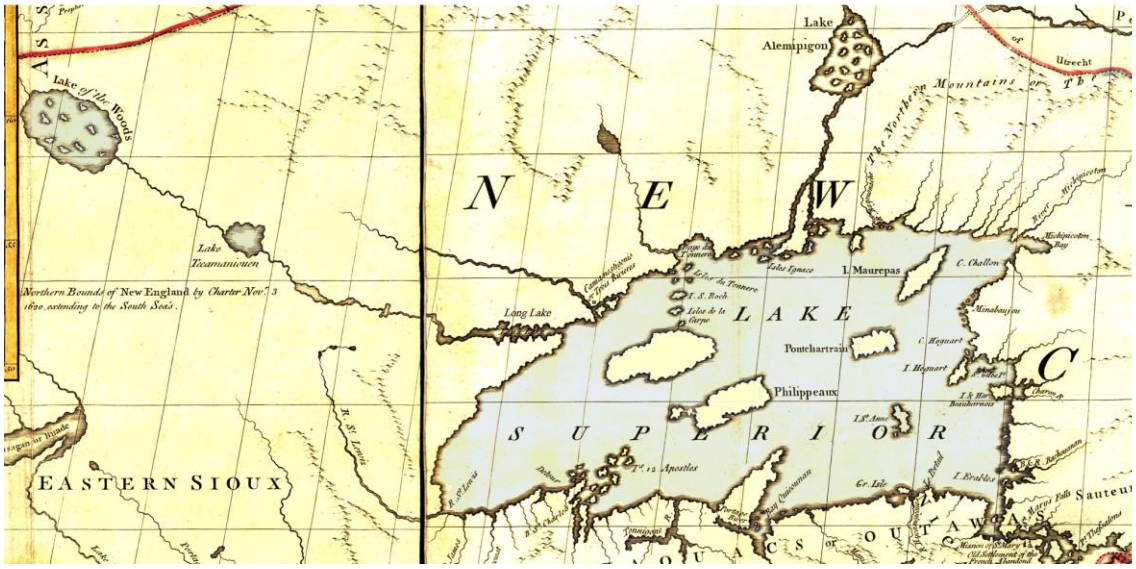
D'Anville, who was older than the other cartographers in Le Dépôt and established as a leading theorist on world geography, took a turn at creating a definitive map of North America. By waiting three years, more sketch maps by La Verendrye had been received at Le Dépôt from which D'Anville copied certain new features. His map released in 1746 made use of essentially the same information that Bellin and others were using but west of Lake Superior the end result differed in several details. True to his principles, D'Anville ended his western details at Lake of the Woods where his exploration information ran out.

Auchagah's route from Lake Superior to Lake of the Woods was simplified by removing most of the minor alternative segments. Also, D'Anville applied a more correct smaller size for the three key lakes west of Lake Superior. He seems to have had information about the course of Riviere du Fond du Lac (now the St. Louis River) which subsequently influenced John Mitchell.

There were then two base-maps with noticeable differences, by Bellin and by D'Anville, two highly respected cartographers. In the map war, the English were starting to take notice of the latest French cartography.

1755 John Mitchell

1755 John Mitchell (1711 –1768) LC G3300 1755 .M51

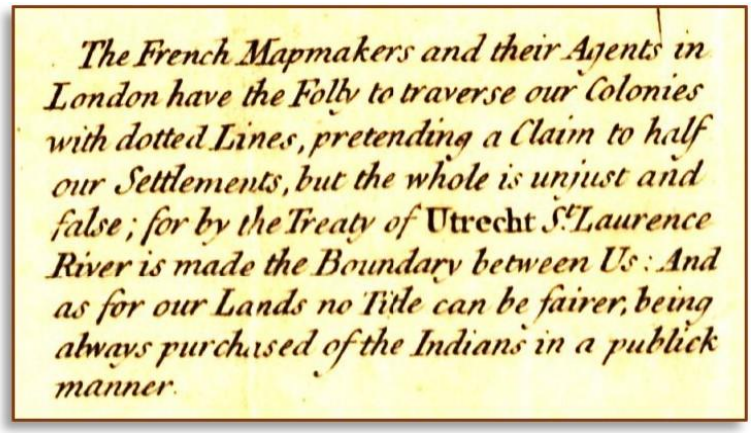


Through the 1740s and into the 1750s the rival land claims between France and Britain grew more intense. Acadia and the Atlantic sea coast received most attention because it was the closest region to Europe and the place where towns and people were most numerous. Population of the British Colonies was already ten times that of New France. Nevertheless, the loss of frontier land to a smaller French colony was possible because the British Colonies were each constituted independently while the situation required their joint action. The British Board of Trade and Plantations had no program for creating maps of the thirteen colonies comparable to the work done by Le Dépôt des Cartes et Plans de la Marine in Paris for the colony in New France.

John Mitchell, however, saw the picture very clearly**;** as a citizen of Virginia, well educated in Edinburgh and later taking up residence in London. There he soon found members of the Board of Trade and Plantations receptive to his warning that France could likely overtake a large part of North America. Mitchell proposed that a map showing British land claims should be drawn up for serious negotiations with France and the Board supported his scheme by giving him full access to the available British cartography on North America.

Mitchell could use the best of world maps of North America as sources as well as his personal knowledge of the north east colonies. In February 1755, in London, he unveiled a remarkable, large map in trapezoidal projection 54 x 78 inches covering the continent from the Atlantic coast to 500 miles west of the Mississippi River and from New Orleans to Hudson Bay. All over it were 250 notes exclaiming in imaginatively different ways that such and such "an Englishman had been there a long time ago", or words to that effect.

Around the time when Mitchell's map was issued, other British mapping entrepreneurs such as Henry Overton produced look-alikes with provocative comments about the French mapmakers.



Overton placed this note on a map that was labelled as a copy of one made earlier by D'Anville.

LC G3300 1760 .O8

Mitchell's map was too late to prevent war between France and Britain which started with action in the British colonies in 1754 and officially broke out world-wide in 1756. His depiction of Auchagah's 570 km route to Lake of the Woods was simplified, more similar to D'Anville than to Bellin, but still showing the essential features. In the overall route of 37 lakes in which Auchagah and La Verendrye had singled out Lac Long, Mitchell presented the whole eastern string of 9 lakes flowing east into Lake Superior as a single Long Lake. By simple comparison it looks possible that Mitchell copied Bellin's Great Lakes layout for his core inland feature and used D'Anville's simplified version of the route to Lake of the Woods.

D'Anville had also marked the eastern string of 9 lakes as a single Long Lake on his map in 1746. An innocent coincidence of an obscure feature such as this is unlikely and it is fair to assume that Mitchell copied the Long Lake grouping directly from D'Anville's map, or someone's copy of it. This cartographical error in locating Long Lake was ignored in New France but after the American Revolution the true location of Long Lake became very important when Mitchell's map was used in defining the new international boundary.

1755 Jacques-Nicolas Bellin

1755 Jacques Nicolas Bellin (1703 – 1772)

LAC, NMC 20157

Bellin's 1755 map was comparable to Mitchell's map in scope. In the northwest, Bellin showed corrected hydrography related to Auchagah's route as well as the latest mapping of Lake of the Woods. La Verendrye must have sent a sketch to Le Dépôt showing an extensive survey around Lake of the Woods in which the large central peninsula was a primary subject. Now known as the Aulneau Peninsula, the promontory created an outline resembling a large lobster claw, which continued to appear on French and British maps for more than a century.

Red Lake, or Lac Rouge, was marked accurately due south of Lake of the Woods. Most interesting is the label indicating, very roughly, where La Verendrye's son Jean-Baptiste and others were ambushed by the Sioux.

Having worked with the Auchagah information for nearly 20 years it could be noted that Bellin had grown so familiar with it that he took short cuts with its details. Long Lake, for example, was not marked. Whether Bellin's or Mitchell's map came out first in 1755 is immaterial in terms of the influence of their maps for preventing war. Mitchell could offer no special knowledge of the geography in the northwest. At the same time, policy at Le Dépôt was weak in proving that France had a long history of occupying the region west of Lake Superior. The latest French maps were simply spreading the old Auchagah information across the west in order to fill the space.

Like Mitchell's 1755 map, this was Bellin's last map for the purpose of justifying French claims to territory west of the English Colonies.

1780 Rigobert Bonne (1727-1794)

1780 Rigobert Bonne (1727-1794)

Bartele Gallery, Sneek, NL Stock# 31929
https://maps-prints.com/antique-maps-north-america/3669-partie-occidentale-du-canada-bonne-c1780.html
G3400 1780 .B61 map 21 x 32 cm.

Bonne succeeded J. N. Bellin as Royal Cartographer at the Dépôt de la Marine in 1773, a decade after France had been defeated and had to give up its colony in North America. By 1780 France was supporting the American Revolution and Bonne was updating the Dépôt's maps of its lost colonial territory. For this new map, Bonne used the outline of Lake Superior that D'Anville had developed in 1746. However, Bonne also added the half-dozen fictitious islands in Lake Superior which Bellin was ordered to create earlier as tributes to his political patrons.

In his reprise of the French colonial cartography era in North America, Bonne did not understand Auchagah's sketch of the route to the west and made a bad portrayal of it. He labelled Lake Winnipeg as Lac des Bois and the actual Lac des Bois as Rainy Lake. In the mix-up he inadvertently omitted Rainy Lake altogether.

Closing Remarks

French cartography west of Lake Superior played little or no part in starting or ending the Seven Years War. The most significant map arising from the region west of Lake Superior in relation to the Seven Years War was produced by Auchagah and his Cree compatriots by 1730, 25 years before the War. The influence of western French exploration and cartography hardly went beyond Auchagah's map.

ACMLA NEWS

CARTO (ACMLA/ACACC) 2019/2020 (Outgoing) President's Report

What a 2020 so far!

To begin, a huge thank you to the CARTO (ACMLA/ACACC) Executive that stepped up to serve at the June2019 AGM in Hamilton and shortly thereafter. Martin Chandler (McGill) volunteered to be Secretary and Rosa Orlandini, (York) volunteered to be VP Communications & Outreach.

Dan Jakubek continues on, or is stuck with being, Treasurer for his 3-three year tenure; thank you Dan! Marcel Fortin was the voice of experience and wisdom as Past-President. Alex Guindon (Concordia) volunteered to be the new webmaster; Merci Alex!

In March 2019, danielBM attended WDCAG and was approached by CAG if CARTO (ACMLA/ACACC) would like to co-host and participate in CAG2020 to be held in Victoria in late spring 2020. After discussion with CARTO Executive, we decided to participate.

During many planning meetings at UVic beginning in the fall of 2019 with the Local Organizing Committee (LOC), in conjunction with the Canadian Association of Geographers-CAG, it became clear that the 2020 conference was not really going to be a joint meeting but a CAG conference with CARTO (and Canadian Cartographic Association-CAA) as participants. The CAG whale easily outsized the CARTO minnow but it was decided by the CARTO executive that this was ok.

Needless to say, in light of COVID-19 and the growing number of cases in Canada and throughout the world, the decision to cancel the CAG/CARTO/CCA 2020 conference was made in early March 2020.

After discussions at the 2019 AGM, the CARTO executive decided to offer a $1000 bursary for early-career librarians, archivists or MLIS/MAS students, who are new to geospatial and map librarianship, to apply for the bursary to attend the above mentioned conference. The bursary/scholarship was to be a stipend of $1000 CAD towards costs related to the conference (conference registration, lodging, travel), and a one-year membership in ACMLA/CARTO. The successful applicant would have had their response to the question about what interests them regarding GIS and map librarianship published in the ACMLA *Bulletin*. Sadly, this bursary was also cancelled.

In March and April 2020 Marcel Fortin put out two calls for volunteers for the Executive Nomination Committee and no one responded. Again, as in 2019, it appears our organization is currently much less formal. However, Martin Chandler volunteered to be the incoming President; Thank you Martin!

Rosa Orlandini will continue as VP Communications & Outreach. Francine Berish volunteered to be secretary; Thank you Francine! I, daniel, will move over to Past-President

At the virtual 2020 AGM, Marcel Fortin announced and we honoured Cheryl Woods with an Honorary Membership Award and Gord Beck with a Honours Award; congratulations to both!

Also at the AGM, members stated the CARTO-ACMLA executive should explore options to perhaps fund professional development courses/workshops for those new to geospatial and map librarianship if we cannot offer a travel and accommodation bursary in 2021 because of COVID-19.

Finally, in April 2020, it came to light that Natural Resources Canada had hired a consultant, BDO Group, to survey users regarding the *Atlas of Canada*, digital and print resources including geospatial data. As we in the library committee are massive users of the *Atlas of Canada* resources, I tried to extend the deadline for the BDO report but to no avail. Nonetheless, I put together a report for BDO and the consultant responded:

"I thoroughly appreciate that you have shared these insights, as some of them are unique and have not been identified by other stakeholders."

With respect, thanks for having me as President, daniel Brendle-Moczuk

CARTO (ACMLA/ACACC) Incoming President's Message

Dear Colleagues,

It is with surprise, delight, and some uncertainty that I step into the role of president of CARTO-ACMLA. When the call for executive was repeated at last year's AGM, I decided it would be wise to take a more active role in the organization and volunteered, assuming some years at least would be prudent, to see if I would be qualified to be elected into a leadership role. In what, I think, is a sign of the times, we cannot know where we are until we're there.

These are strange and strained times for all of us; our lives individually, institutionally, and as an association have undergone rapid shifts recently, but things were changing long before COVID-19. As librarians, archivists, and map and geospatial information professionals, we have much work to do to ensure that the value of our work is seen and championed. Coupled with this, we must evaluate the state of the association and ensure that it is not only open, but actively inclusive. How can we ensure new information professionals know about our association, and add their talents as we offer ours to them? How do we reach out and encourage new geospatial workers to benefit from CARTO-ACMLA? What can we anticipate for our work in the future? There is much to consider.

This work will not overwhelm us. We can meet the challenges as they come, while preparing ourselves for the next thing. All of which to say, I'm looking forward to working with all of you in the coming year as we continue to figure out where we came from, where we are, and where we are going.

Martin Chandler

CARTO (ACMLA/ACACC) AGM 2020 Annual (Online) General Meeting

Present:

Rosa Orlandini	Andrew Nicholson	Lorraine Dubreuil
Daniel Brendle-Moczuk	Dan Jakubek	Sherri Sunstrum
Barbara Znamirowski	Christine Homuth	Lori Martin
Martin Chandler	Francine Berish	Stefano Biondo
Kara Handren	Rebecca Bartlett	Leanne Trimble
Marcel Fortin	Jason Brodeur	Gordon Beck
Siobhan Hanratty	Cheryl Woods	Meg Miller
Alex Guindon	Erika Reinhardt	Rene Duplain
Pierre	Rhys Stevens	Wenonah van Heyst
David Malaher		

Welcome

Approval of Agenda

Siobhan Hanratty - moves
Seconded – Martin

Francine added diversity fund to agenda
Approved

Approval of 2019 AGM Minutes

One change – Barb Z had volunteered to talk to Leslie Weir about the accessibility of digital maps on the LAC website, and to make as much open as possible.

Rebecca B moved
David Jones seconded

Approved

President's Report

Past President's Report

Honourary Endowments

Cheryl Woods was awarded an Honourary Lifetime Membership.

Gord Beck was awarded the Honours Award.

Vice-President Outreach Report

Work was made to develop and promote the conference bursary. There were 6 applicants, however due to the pandemic causing the cancellation of the conference, no conference bursary could be awarded this year.

Treasurer's Report

3 reports were presented showing the final financial state of the association at the end of 2019, Jan-June of 2020, and projections to the end of 2020.

Payment for membership and other items was moved from Paypal to Bambora, which has the same fees but is a Canadian company with better service. Some cost and work savings will be achieved by switching the membership system from Membee to Wild Apricot.

A request from NRCAN to purchase some maps was received, and as they could not accept the maps for free, daniel agreed to a payment of $50 for those.

Siobhan Hanratty moves
Francine Berish seconds

All approved, no opposed, 1 abstention

Any additional items / discussion

There was discussion of starting a bursary to promote diversity among the membership, as this is something already offered by WAML. Questions of the sustainability of such a bursary were raised, given declining membership. It was also suggested that professional development opportunities could be supported, depending on whether a conference would happen or not.

There was discussion, as well, about next year's CARTO-ACMLA conference. Preliminary suggestions were for University of Victoria to host in 2021 and Memorial University of Newfoundland in 2022, or, if University of Victoria was no longer able to host, then Memorial in 2021.

Next years' executive was announced:

President: Martin Chandler

Past President: daniel Brendle-Moczuk

VP Outreach and Communication: Rosa Orlandini

Secretary: Francine Berish

Treasurer: Dan Jakubek

Adjourn:

Rebecca Bartlett moved

Cheryl Woods seconded

Association of Canadian Map Libraries and Archives Awards

ACMLA Honourary Membership Award: Cheryl Woods

ACMLA/CARTO bestows an honorary life-membership to a member who has, as described in the by-laws, "made a distinguished contribution to their profession and whom the Association chooses to honour." This award is presented on an irregular basis and is voted upon by the Association membership. Honorary members receive a lifetime membership at no charge and have the right to vote. This year, **Cheryl Woods** of Western University was nominated for the honorary member award and presented with the award at the Annual CARTO AGM (online).

Cheryl has retired in the spring of 2020 after a brilliant career in Map Librarianship at Western University where she started work under Map Librarianship pioneer Serge Sauer, and eventually came to manage one of the most important and largest map collections in North America. She has also built and curated an impressive and beautiful collection of Globes at Western University, that is not rivalled anywhere in Canada.

Cheryl has been a member of the ACMLA for over thirty years and has served in several roles on the executive and in several association committees. She was ACMLA President in 1989-1990, 1st Vice President in 1987-1988 and secretary prior to that. Cheryl has also been the long-time editor of the New Cartographic Resources: Maps, Atlases and Books for the ACMLA *Bulletin*.

Cheryl has contributed and led to many important map projects at the provincial and national levels, including the ACMLA Historical Map Facsimile Program and the Historical Topographic Maps Digitization Project. She has also been a long time co-lead and contributor to the Ontario Historical County Maps Project with Marcel Fortin and Lorraine Dubreuil. She, along with Lorraine Dubreuil published, through the ACMLA, the canonical book containing the Fire Insurance Plan holdings of most post-secondary institutions in Canada. The publication is one of the most important books about Canadian map collections in 2002, and continues to be used in Map Libraries and Special Collections across the country.

Throughout her career, Cheryl has been dedicated to map communities at the local, provincial and national levels. Cheryl has been an important mentor to many Map and GIS Librarians and technicians now active in the GIS and Map Library world. Cheryl has an irreplaceable store of knowledge of maps that will be missed by colleagues across Canada and has acted as a "go to" reference source for map advice. Her willingness to share her wisdom and knowledge has known no bounds.

Cheryl Woods -- selected bibliography

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ACMLA Executive

ACMLA Honours Award: Gord Beck

The Association of Canadian Map Libraries and Archives (ACMLA) recognizes individuals who have made significant contributions to map librarianship at the local, regional, national, and international levels through their granting of the Honours Award for Outstanding Achievement. Gord Beck is one such individual who has made significant contributions to map librarianship, curatorship, and archiveship at the local, regional, national, and international levels, and is a recognized expert in the field of WWI trench maps and aerial photos. Gord has appeared frequently in the media and as a guest speaker on that topic. He has completed two projects with Canadian Geographic involving the creation of a 'Giant Floor Map of Vimy Ridge,' and a documentary about mapping and aerial photography in WWI narrated by Dan Aykroyd and entitled, 'Drawn to Victory.' And most recently, a map of France, from the Lloyd Reeds Map Collection at McMaster University, from the First World War was featured in the Oscar-nominated film "1917", starring Colin Firth. Digitized maps from the Collection will soon be used in another Colin Firth war epic, as his production company has asked permission to use 20 maps in the upcoming film "Operation Mincemeat".

Gord's McMaster Library career began with a Library Assistant's position in the H.G. Thode Library in 1985. He transitioned to a Map Assistant's position in the Lloyd Reeds Map Collection in 1997 and since that time has been promoted to his current position of Map Specialist. He developed his expertise in military cartography over his 20+ year period working in the Lloyd Reeds Map Collection. Due to Gord's extensive knowledge of maps and mapping (and specifically its advancement during World War I), requests are often made for him to give talks to undergraduate classes, as well as local and national groups. Despite the requirements on his own time, Gord always accepts these talks in a gracious and selfless manner. Highlighted among these engagements is a talk given in October of 2014 for the National Gallery of Canada exhibition in Ottawa: "The Great War: The Persuasive Power of Photography", and a McMaster Lager Lecture public talk entitled: "Cartographic Connections: The role of science in the history of mapping".

In 2014, Gord (and Margaret Rutten, Map Metadata Specialist) received the McMaster President's Award for Outstanding Service. That award recognizes employees who have made an outstanding contribution beyond that normally expected for their position to the mission of McMaster University. In addition to their continuing commitment to traditional service, Gord and Margaret played an instrumental and leading role in the Library's expanding focus on developing digital resources for research and teaching. Specifically, Gord and Margaret were key contributors to the development of the Geospatial Literacy blended learning modules that were created in partnership between McMaster Institute for Innovation and Excellence in Teaching and Learning (MIIETL) and the Library. These online modules have been integrated into coursework in three different Faculties, helping students to develop their geographic skills and succeed in their learning. These

modules were among the first of their kind in Ontario and Canada, and have been highly regarded and requested by various Geography departments across the country. The team's success with the geospatial literacy modules has been equaled or surpassed by their work to digitize and provide online access to tens of thousands of historical and rare maps in the Library's collections through McMaster's Digital Archive.

In 2018, he was the curator of the Robert Clifford Map Exhibit, in the McMaster Museum of Art. Maps in that exhibit were generated for Napoleon's campaigns, and some were of enormous proportions. Bacler d'Albe, Napoleon's chief cartographer, devised a method of mounting the maps on linen backing, dissecting them into sections, and folding them for ease of transport. One such map in the Clifford collection measures in excess of 9 x 12 feet when fully assembled. The exhibit marked the first time that it was available for public viewing in its entirety since the acquisition of the Clifford collection by McMaster in 1969.

Selection of recent media stories:

• http://dailynews.mcmaster.ca/article/mcmaster-maps-and-archives-help-shed-light-on-pivotal-point-in-hamiltons-history/

• https://museum.mcmaster.ca/about/news/clifford/

• https://dailynews.mcmaster.ca/events/lager-lecture-cartographic-connections-the-role-of-science-in-the-history-of-mapping/

• https://toronto.ctvnews.ca/canadian-connection-to-first-world-war-map-featured-in-oscar-nominated-film-1917-1.4803399

• https://dailynews.mcmaster.ca/events/lager-lecture-cartographic-connections-the-role-of-science-in-the-history-of-mapping/

ACMLA Executive

ASSOCIATION OF CANADIAN MAP LIBRARIES AND ARCHIVES
BULLETIN

Regional News

Compiled by Martin Chandler

British Columbia

David Malaher
Reflections on the Mapping from Home half-day virtual event

I enjoyed the whole affair, all 4 hours of it. There are certainly some very clever people out there and I feel humbled by what they can do. Dan Cole's Keynote presentation used about 25 historical maps, and a similar number of modern ones. My 6 maps were all historical. The other six presenters used computer aided compositions/cartography. The present practice of cartography is a hybrid skill of statistics and graphical arts where geographical and political features are combined.

There was some nostalgia revealed in the Q & A session when seven people expressed their appreciation of seeing "old maps" as the centre of attention.

My specialty is the history of the Canada-USA boundary, from coast to coast. Today's presentation used only 300 miles of the boundary west of Lake Superior. This is strong fur-trade country since around 1660 and the historic Grand Portage component remains relatively unchanged. Except that the canoes no longer use birchbark; think carbon fiber and Kevlar. The boundary and the fur trade are close companions.

Ontario

Toronto Reference Library
Kathleen Wyman

As of July 31, 2020, I will be retiring from my position as a Map/Urban Affairs Librarian after 35 years of service.

I started my map career at York University in 1985. I obtained a position at the Toronto Reference Library in 1989 in the Urban Affairs Library and selected urban books until 2011. My career came full circle back to maps in 2012 when I was given the responsibility for map collection. These final years have kept me busy in procuring maps, atlases and urban books. A perfect ending to a great career for an undergraduate geography major who took courses that included urban planning and cartography!

When I started my map career in 1985 I became involved with ACMLA. I was secretary of ACMLA from 1987 to 1989 and assisted with various committees.

I have enjoyed all the time I spent with the ACMLA organization. During the time I was in the Urban Affairs Library, I missed working with my ACMLA colleagues and maps. I've always said that map people are the best people in the world.

I wish ACMLA and its members all the best in the future.

Library and Archives Canada
Erika Reinhardt

The cartographic community of librarians and archivists at Library and Archives Canada (LAC) are pleased to share news of the work done with our cartographic holdings.

In early 2020, LAC completed the acquisition of the records of Environment and Climate Change Canada's (ECCC) Canadian Glacier Inventory (CGI) by having approximately 400 original glacier maps showing flight lines for glacier photographs transferred to its permanent holdings. These cartographic records represent the final transfer of key records of the CGI, with previous transfers including 6.8 meters of glacial datasheets, 4,149 photographs of glaciers included in the Inventory, 544 field books compiled by surveyors and scientists documenting all glaciers in Canada, along with reference material related to the CGI. LAC is currently in the process of making this significant historical collection available to climate scientists, students and other members of the researching public through digitization initiatives and partnerships with ECCC.

Archivists in LAC's Military portfolio also recently acquired more than 2,300 plans of Royal Canadian Navy ships and warship class drawings dating from 1906 until the late 1980s from the Directorate of Supply Chain Operations. This important collection updates earlier naval ship plans held by LAC that are known today as the "ship modelers' collection." A team of students began work to process the material and to verify the finding aid in late 2019.

Canadian Geographic magazine highlighted several maps from LAC's collection as part of an on-going collaboration with the Royal Canadian Geographic Society to provide historical content for the Discovery section of the serial publication. Maps featured since January 2020 include, a manuscript map from the Avro Arrow project showing DEW line support for the Arrow; the first French language map of Quebec following Confederation; a 1758 Plan of the Fortress of Louisbourg; and A.L. Russell's 1871 Map of the Province of Manitoba. Digital copies of these maps are available in LAC's Collections Search database.

The We Are Here: Sharing Stories team continues to digitize records as part of an initiative to digitize and describe Indigenous-related collection items in LAC's holdings. Recently digitized cartographic material include George Back's field notes and sketchbooks of maps and drawings created during John Franklin's 1819-1822 overland expedition up the Coppermine River to reach the Arctic Ocean and 75 maps relating to the career of Robert Bell, geologist with the Geological Survey of Canada. LAC also digitized 63 maps of Indian agencies and reserves in British Columbia

and over 150 maps of Canada's Polar Regions from the Verner Coolie collection. A list of digitized and described indigenous content is available online on LAC's website.

Special thanks to Roderick McFall, Alexander Comber, Thora Gustafsson, and Erika Reinhardt and the We Are Here: Sharing Stories project team for their hard work.

McMaster University

Gord Beck and Christine Homuth

Digitization

When digitization operations ceased in mid-March due to the COVID-19 lockdown, we had just completed several projects, with others only awaiting the creation of metadata before upload to our digital archives. They are as follows:

Apollo Missions and Planetary Mapping

https://library.mcmaster.ca/apollo-missions-and-planetary-mapping

This collection of charts consists of the original mapping prepared by NASA, the USGS, and the USAF Aeronautical Chart and Information Center for the Apollo missions (1962-1976), including "landing site" and "pre-mission maps." Our Mars and other planetary mapping are still in process.

WWII (digitization partnerships)

https://library.mcmaster.ca/wwii-topographic-map-series

- Two hundred of approximately nine hundred maps at a scale of 1:100,000 from the *University of Alberta*, depicting the western portion of the Soviet Union and Finland from Russian, German, British, and U.S. sources. All required translation, which was accomplished by our student assistants who can read and write in Cyrillic. Many maps include the names of individual Soviet Red Army officers responsible for their production. This project is ongoing.
- Aeronautical charts from the collection of the *Canadian Warplane Heritage Museum*. This project is also ongoing.

Cold War

https://library.mcmaster.ca/cold-war-1945-1989

- A collection of U.S. Navy Air Navigation Charts produced for the new "jet-age" in the years 1946-47, at the very beginning of the Cold War, immediately following the end of World War II. These charts are oversized, measuring approximately six feet in length, reflecting the need to show a greater geographic area when travelling at accelerated speed. The maps have been scanned but are awaiting metadata and upload.

- Thanks to a donor, we have just acquired a complete set of original Soviet military topographic maps at a scale of 1:200,000 scale covering Afghanistan during the years of the Soviet occupation.

Twenty-four of our digitized WWII maps were requested by See-Saw films for their upcoming production, "Operation Mincemeat," starring Colin Firth. Another twenty maps have been requested for use in the History Channel's documentary series, "Presidents at War."

Georeferencing from home

At the start of the spring term, a number of units in the McMaster Library collaborated on an approach that allows Library staff and student assistants to georeference large amounts of digitized items from the map collection as part of their remote work. The group installed a local instance of Map Warper and populated it with hundreds of digitized maps and aerial photos from the Lloyd Reeds Map Collection. Full-time Library staff and summer student assistants were trained remotely and were able to georeference materials from the comfort and safety of their own homes. Work on this project will continue during the fall term, with plans on opening it up to the public in the future. At the time of this update, students and staff have georeferenced over 500 items from our digitized World War II map collection and local historical collection of Hamilton air photos. For more information and access - https://library.mcmaster.ca/collections/historical-rare-maps.

ASSOCIATION OF CANADIAN MAP LIBRARIES AND ARCHIVES
BULLETIN

Geospatial Data and Software Reviews

Meg Miller
University of Manitoba

Mapbox.js: an engaging open-source web mapping tool for teaching data visualization theory

Abstract
This review provides an overview of web mapping tools and discusses why and how Mapbox.js has been an effective tool in the delivery of one-shot instructional sessions on data literacy and visualization theory in an academic library context.

Tags
Web map, JavaScript, data literacy, visualization, academic library, instruction

Introduction
The following will examine the ***Mapbox.js.*** This open JavaScript API is used to make interactive online maps. The tool is very flexible with a modular flow that lends itself well to on-the-fly modification in a classroom context. In the following use case, the tool is used throughout a session to illustrate the theoretical concepts of data visualization that are being discussed in a hands-on way.

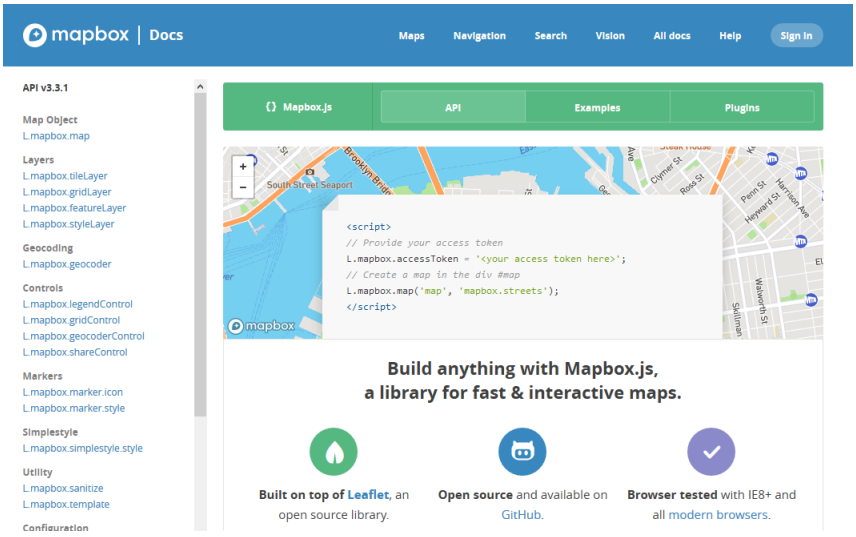


Figure 1: Mapbox API documentation landing

Background

As a response to user feedback requesting more sessions on theory and less of a focus on software instruction this style of session was developed as a way to give users an engaging look at data visualization theory. Elements such as data types, colour, line weight and type and symbology are discussed in relation to the user experience. At the beginning of the session a scenario of making a map for a particular client is introduced so that there is a central example to work from. Through the session, users make adjustments to the HTML and JavaScript code of a live web map to see how they can change its feel.

This style of session is also conducted using ESRI's ArcGIS Online for those who are new to manipulating any kind of data or GIS. Using Mapbox, Leaflet or any web mapping tool where coding exploration will take place is best suited to those who have experience with JavaScript or who are comfortable with technology and have some level of coding experience. As was previously mentioned, the purpose of the sessions are to explore data visualization theory, not learn a new tool.

Tool details

Mapbox.js is an enhanced JavaScript library built on top of Leaflet. The reason for selecting Mapbox over Leaflet or OpenLayers was its small footprint, modular, simple to understand code structure and numerous modifiable elements found in the core API. There are also many plugins to further extend projects, robust documentation and a healthy support community found on Stack Exchange.

To start out, users need to create a free Mapbox account and generate a key, this opens up the Mapbox API for the user to use and modify the available objects and classes. Major categories are listed below, with ones that lend themselves well to simple modification highlighted in italics.

Format support

Formats accepted for import are grouped into four different categories: TileLayers, GridLayers, *FeatureLayers* and *StyleLayers.* These types of layers can be embedded in the code (as lat/long pairs) or loaded from a URL as a WMS, WFS or geoJSON format.

This is a useful place to discuss data conversions, residency, field types, and the importance of planning ones project. The StyleLayer class is used to import the Mapbox hosted base maps for the project, the FeatureLayer class is used to load a geoJSON file from a local URL.

Features

Many different parameters can be set for features loaded into the map. Appropriate selection *symbology* in terms of colour, size, line weights, and symbol selection can be easily explored here. In the figure below the modular structure of the code is highlighted. A fair bit of time can be taken for exploration here.

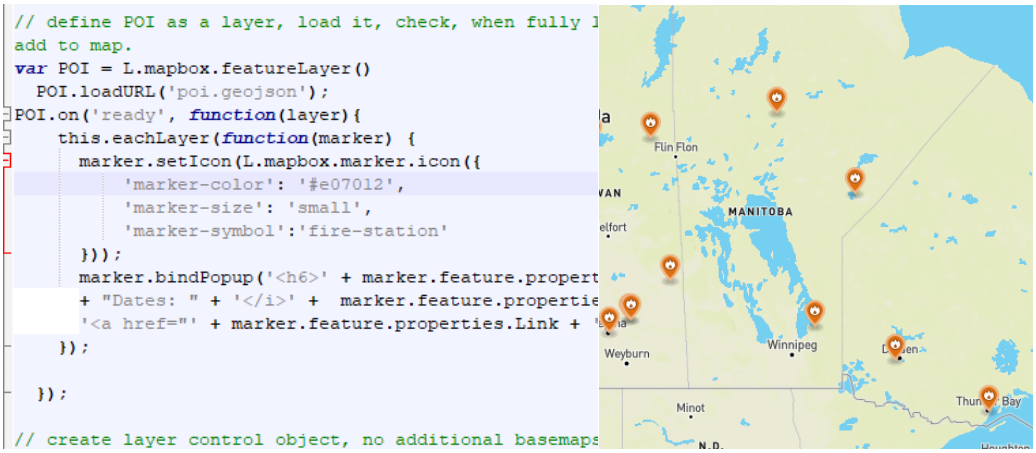


Figure 2: Left- Code block to add and symbolize POIs to a map; Right- Point symbols displayed on a map

Vector Overlays

In addition to simply displaying features on a map, base data can be imported and displayed on the fly as a choropleth, animated based on a field or clustered to improve the readability of the map. This section is discussed in terms of the purpose behind visualizing data (to clarify data's themes for the audience) and that just because all of these tools are available to the developer, it doesn't mean that they need to be used.

User Interface

This category is a catch all for everything from panning and zooming actions to pop-ups, embedded media and base-maps, legends and labels. Discussion here focuses on the purpose behind creating the visualization. Who is the audience? What will be helpful for them?

Base maps

In setting the base tiles for the map many different options are available. Depending on the purpose of the project different bases will be more appropriate than others. Radio buttons can used as a way to have multiple base map options in one map document. Different options are explored by the students from preselected links on tile sets available for low-bandwidth scenarios, imagery, topographic and artistic renderings.

Explanatory text

There are many different ways to add explanatory text in Mapbox from basic labels, to legend blocks, tool-tips and pop-ups with embedded media. Creating a hierarchy in text by modifying styles of a pop-up window allows the participants to see how small changes can make the information much clearer for the end user.

Map Actions

Pan and zoom controls are added to the map face by default are a simple way for the user to have a more intuitive experience. *Filter controls* can also easily be added to the map to keep the interface as uncluttered as possible for the user. Further controls can be added by constraining the map

window to the *bounding box* of a specific feature layer. These parameters are explored in a class setting if there is adequate time.

Plugins

Countless plugins have been developed for Mapbox by their own team and external developers. They include functions such as Heatmap, Geocode, Directions, Mini-map, Omnivore (importer for GPS tracks, KML, TopoJSON, WKT), Turf GIS and many more. In the classroom context no time is spent actively exploring these plugins, but instead discussion is centered on seeking help in discussion forums, not reinventing the wheel, and knowing when to step back.

Many examples from each of these categories are available on their site with the code heavily commented to explain what is going on. A link to the documentation can be found at https://docs.mapbox.com/mapbox.js/api/v3.3.1/.

Session workflow (1-1.5hrs)

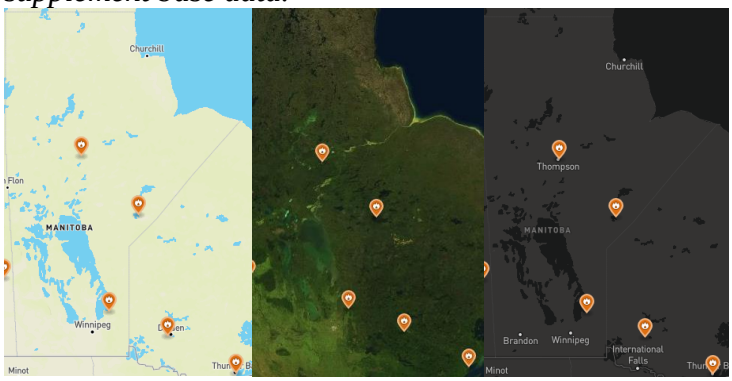
In terms of actual implementation setting up a meeting with the faculty member and their TA beforehand is important so that learning objectives can be discussed. This helps to guide the flow of the class which is based around a scenario that flows through the duration of the session.

The week before:

1. Students were instructed to create a Mapbox account and generate their API keys and have them ready;
2. Learning materials (folder with .pdf walk through, .geojson files and .html map document) are saved to the class shared space.

The session:

Topic	***Action***
Session introduction	*Prompt to download materials to their desktop*
Define data visualization	
Introduce the example scenario:	*Participants had been hired on at a forest fire consulting firm to make a web-map depicting old fire locations for their survey crew.*
Overview of topics: 1. Data format 2. Symbology 3. Audience/ User Experience	
1. Data format • Data cleaning • File types • Metadata • Discuss importance of knowing your data	*Participants examine the contents of the data folder and open the POI.geojson file in Notepad++.*
2. Symbology • Size/ weight • Hue/Value	*Participants modify the marker code block from a generic blue dot to an orange symbol with a fire symbol in it (see red text in example below):*

• Clarity	*marker.setIcon(L.mapbox.marker.icon({* *'marker-color': **'#e07012'**,* *'marker-size': **'small'**,* *'marker-symbol':**'fire-station'***
3. Audience/ User experience • Visualization type • Explanatory Text • User Experience	*Participants modify the base-map code block to contain the layers they feel will be most useful to our audience. Additional data sources are discussed here as a way to supplement base data.*  *Figure 3: Examples of stock basemaps from mapbox.js* *If there is time they also constrain the map window to the bounding box of the POI layer on load for a better user experience for the client.*
4. Conclusion/ Plug for library services	*Questions from audience*

Future

Engineering capstone students, STEM grad students and computer science students have all left positive feedback about feeling engaged with the materials and the level of expertise required. Moving forward, there are two major changes to work through in the coming semesters: a move to an online instructional environment in response to the COVID pandemic and a major version shift by Mapbox.

Online Instruction: Up until this point, this style of session has only been conducted in person in the lab environment with code modifications being done in Notepad ++ and previewed in the default web browser. Having everyone working off the exact same set-up means less troubleshooting personal machines settings during the session for the instructor, and being able to circulate and assess where students are at comfort-wise. Two potential solutions for this are to a) shift to a Jupyter Notebook Hub model or b) to use some kind of a coding sandbox like JS Bin or Plunker.

New software version: Mapbox.js is no longer in active development and they are focusing all of their efforts on Mapbox GL JS and are marketing it as a modern alternative. The base library is still open and free, but now there are additional pay tiers of usage and support. All support forums

and documentation is being left up, so for my simplistic purposes, do I keep my teaching materials in the old version, migrate to the new one, or shift to core Leaflet?

Note: For some context I am a single person offering support for Data Visualization services, my position is new so I had no learning materials to start with. Theory on its own can be dry, so adding interactive elements helps keep people engaged. Hopefully by discussing the ways which this topic has been approached allows for an easier entry point in adopting a new resource.

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GIS Trends

Barbara Znamirowski

Esri UC2020: Reporting from the world's biggest GIS event

Abstract

In the issue of GIS Trends we review the Esri User Conference (July 13 -16, 2020) held for the first time as an all virtual event.

This year was the first opportunity for me to attend the annual Esri User Conference. I was not alone. There were 86,482 registrants from 180 countries – a sharp contrast to the 15,000 to 20,000 that normally attend this event. Did Esri or our broader GIS community see this coming? This level of participation has lessons not just about the future of conferences in a time of pandemics, but also about our global GIS community's need for engagement and learning.

This was a first opportunity for many to attend, I suspect, because many of the financial and scheduling barriers were eliminated with the move to an all-virtual, registration-free venue (for students and license holders). So, thank you, Esri, for democratizing this event. At a time when many conferences have been cancelled or scaled-down, this opportunity felt unprecedented. It was a "how-to" model to emulate for hosting large virtual conferences, giving many of us something to think about as we work to implement virtual campus engagement.

The three-part plenary introduced the conference theme "GIS - Interconnecting Our World". Led by Jack Dangermond, Esri's founder and president, the plenary talks were an opportunity to learn about the Esri vision from the top as well as hear from a wide sector of Esri staff and the broader GIS community. We got a taste of new technologies and product innovations that would be covered more deeply in conference sessions and workshops. The plenary also recognized community mapping achievements, and heard from special guests Vicki Phillips, National Geographic's Chief Education Officer and Jeffrey Sachs, the world-renowned economist, author, and President of the UN Sustainable Development Solutions Network. The plenary challenged us to consider how our work can be viewed through a lens of social responsibility, both within the immediate challenges of the pandemic and when taking a longer view regarding our roles in global efforts to achieve social, economic and environmental sustainability.

So how were the technical workshops and sessions? Hopefully, participants looked at the program in advance of the plenary, as some planning and choices were required with respect to what to take in over the course of four days. There were 118 live workshops, 114 on-demand (pre-recorded) workshops, 250 on-demand demos, 200 user videos, 39 special interest groups, 153 exhibitors, a map gallery, live polls, chat opportunities, 15 minute one-on-one networking opportunities with a wide selection of Esri staff and more. Each day we could also tune in to UC Main Stage to hear

about events of the day and engage in interesting discussions, chat and polls. UC Main Stage was co-hosted by Esri's Nick Frunzi and Dr. Rae Wynn-Grant (National Geographic Research Fellow), and featured guests. I was surprised by how effective a "Main Stage" could be for a virtual conference. It was not something I originally expected to follow, but I found myself tuning in periodically and enjoying the sense of communal engagement this forum provided.

The majority of my time was spent in technical workshops. There were many opportunities to learn about new product developments and enhancements. Here is some of what I learned:

From the "Road Ahead" workshop on ArcGIS Pro, I learned that ArcGIS Pro 2.6 is coming out at the end of July, and will be a major release. New functionalities will include "Map Graphics" which offer greater ability to create maps with custom graphics and text. Map Graphics includes a new "Add graphics layer" tool for map authoring where you can insert, update and delete map graphic elements including text. The ability to add graphics as layers has long been awaited by the mapping community. Also new to me, and significant, is the introduction of a new data type, the "Voxel" layer. Voxels enable the visualization and analysis of very large datasets of gridded, volumetric information and can include four dimensions: x, y, z, and time. Examples of visualization and exploring of 3D voxel layers were shown using atmospheric data, geological subsurface models, oceanographic data and space time cubes. Another new enhancement due to be released with ArcGIS Pro 2.6 is "Project Recovery". As most Arc users can imagine, the announcement of an auto-save functionality got a major thumbs up in an audience opinion poll. Other new highlights included: "Save Web Map", "Link Analysis", "Interactive Suitability Map", "OLEDB Connections", "Trace Networks" and more. See *Figure 1* for a slide describing development plans for Pro.

Figure 1. Source: Snapshot taken from Esri UC2020 Plenary. Available from YouTube at: Esri UC 2020 Part 3, "ArcGIS – Helping Our Users Be Successful", https://www.youtube.com/watch?v=eZV-KrA1Rjk&list=PLaPDDLTCmy4YwK56yHaEdtRgNUoPBiZTz

Figure 2 shows a schedule of release dates for Desktop software including ArcGIS Pro and ArcMap. Note that 2021 releases are due to see a systemization of version name releases for ArcGIS, bringing things under "ArcGIS 2021".

Figure 2. Source: Snapshot taken from Esri UC2020 Plenary. Available from YouTube at: Esri UC 2020 Part 3, "ArcGIS – Helping Our Users Be Successful", https://www.youtube.com/watch?v=eZV-KrA1Rjk&list=PLaPDDLTCmy4YwK56yHaEdtRgNUoPBiZTz

On the server side, a number of sessions discussed ArcGIS Enterprise. A key announcement for this product was an upcoming release of a Kubernetes version of Enterprise. This term is likely familiar to many developers and IT people, but it was new to me. I learned that Kubernetes is a portable, extensible, open-source platform for managing containerized workloads and services. It leverages the advantages of cloud and distributed computing environments and offers potential advantages for scalability as well as easier maintenance and IT integration. Developers were assured that ArcGIS Enterprise (Kubernetes) will be offered in addition to continued support and development of ArcGIS Enterprise (Windows) and ArcGIS Enterprise (Linux). Other product enhancements include bulk publishing, web hooks, sites authoring and better administration capabilities.

Many new developments were also introduced for ArcGIS Online (AOL) and related products. The next generation of Map Viewer will launch this fall and is accessible now as a beta release option. I was impressed by the Smart Mapping options offered within Viewer and the overall capacity to render large amounts of data on the fly according to user selections.

Several sessions covered developments associated to 3D technologies as well as integration of Virtual Reality (VR) and Augmented Reality (AR) solutions. I was interested to learn about greater

integration with Autodesk Revit files and the potential easing of workflows for some offices using BIM and/or CAD. A good overview of new functionalities was given in "3D in ArcGIS" and "3D on the Web with ArcGIS". I also viewed "ArcGIS Indoors: Overview and Roadmap". The product supports indoor way-finding, and enables space planning, workspace reservations, location sharing, incident reporting (for facility up-keep), indoor person tracking and more. As many might imagine, this product could be especially useful for planning COVID-19 back to work protocols and for long term indoor mapping within universities. I inquired about this product before the UC, and did learn that at that time it was not included in academic Education Site License Agreements (ESL), at least not in my region. I also had the opportunity to try out the UC Expo chat, where I receive a chat response to my question, as well as an invitation for a 15 minute meeting with Esri staff if I required further information. Thanks to Tom Hahka and colleagues for the excellent follow-up and information.

Finally, I should mention that there were many interesting workshops which introduced new mapping and data analyses techniques and provided information on how to get started with or use products more effectively. For example, I enjoyed the workshop "Map Wizardry with ArcGIS" given by John Nelson and Kenneth Field. The abstract for the session invited us to sit back and enjoy an inspiring cartographic ride … and that's exactly what it was. We looked at wonderful old classic maps such as John Snow's 1854 cholera map and new maps taken from a range of sources including twitter, and discussed best practices and techniques that can be applied in ArcGIS Pro to achieve similar cartographic effects. For example, would you like to create a point symbol that looks like a firefly? Or, did you know that you can achieve the folded and curled effect of an old map by crinkling a piece of paper, doing a bit of handy work in Photoshop, and then imposing versions of your crinkled paper as a background and an overlay in Pro? Thanks John and Kenneth for sharing these tips and tricks and for being so generous with your cartographic knowledge.

These summaries cover a small fraction of the information presented in workshops. I am infinitely grateful that these sessions are available to registrants for viewing after the conference, including chat responses taken up at the end of workshops.

Finally, I would be remiss at not mentioning some of the other fun opportunities. Instead of the 5K run normally held in San Diego, we were challenged to run or walk around the world, by collectively accumulating 40,054 km. This was also an opportunity to try out the ArcGIS Quick Capture mobile app. Individual runs and our progress can be viewed on the Esri score board. *Figure 3* is an example of the route and photos I submitted for a short walk I took.

Also on the lighter side, are you missing conference swag? If you are, you can discover the UC2020 "digital swag bag" which included the 35th Esri Map Book, downloadable coloring pages, cool screensavers, backdrops and wallpapers, a free three-month subscription to the National Geographic, and an oh-so-cute "Get up and active with Globie" poster.

Figure 3. Source: Snapshot from Esri UC Virtual Run / Walk 2020 Results Page at: https://apl.esri.com/jg/UC2020Run/index.html?globalID=a4c3c830-c898-4214-8418-5d86f73b497a. Long term Hub site: https://uc-2020-running.hub.arcgis.com/

At the first plenary Jack Dangermond mentioned that the first UC conference was 40 years ago, and consisted of 11 people. I wondered what that was like… Thank you Jack, Esri, and all GIS and GEO community members for this great conference opportunity. You've given us a lot to think about. Stay safe and take care of each other everyone. I hope we can do this again next year and I look forward to seeing you then.

GIS Trends: Note from the Editor

Submissions and Feedback

GIS Trends is a place to share ideas, observations and discoveries in the area of GIS and other spatial technologies. If you have something you would like to share please write to me. We also welcome feedback on GIS Trends articles. Proposals for articles and feedback should be sent to: bznamirowski@trentu.ca

Thanks for reading and contributing!
Barbara Znamirowski,
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