

Background: Limitations of Print Map Indexes for Aerial Photograph Collections

The University of Ottawa Library has more than a quarter of a million aerial photographs in its National Air Photo collection. This is a subset of the comprehensive collection of National Air Photos housed by the National Air Photo Library (NAPL). Aerial photography is significant because it records natural and constructed features on the surface of the earth. Urban planners, cartographers, historians, and developers all make use of the kinds of information captured in such photographs taken from the air.

Photos at the University of Ottawa Library are stored vertically in metal boxes on floor-to-ceiling shelves, separate from the rest of the library collection. The numbering and shelving system does not lend itself to being “browsable” on the shelf. Up until this past year, clients and staff used paper map indexes and a card catalogue to identify and locate photos in our collection.

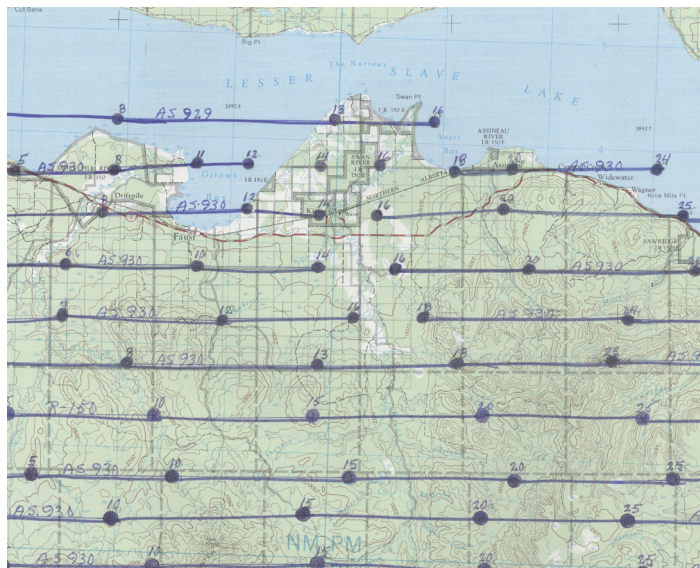


Figure 1 A typical paper air photo map index with hand-drawn flight line and photo locations is shown here for the Lesser Slave Lake area in Alberta, Canada.

GOOGLE MAPS FOR INDEXING AERIAL PHOTOS

To organize collections of recently captured photographs, paper air photo indexes are created by the flight crew at the end of each photo acquisition mission. As seen in Figure 1, indexes are created by drawing the flight path of the aircraft (which is represented by a line and a dot for every fifth photo) over top of a pre-existing map of the area. Each time a new roll of film is loaded into the camera a new unique roll number, which is registered with the NAPL series of roll numbers, is assigned. Subsequently, each film exposure which is shot in sequence on that roll is assigned its own photo number. A card catalogue is also maintained and may provide additional metadata, such as altitude, year, lens, and scale. With these two tools a client can find an air photo two ways: by air photo index (if location is known) or by card catalogue (if photo and roll number are known).

The shortcomings of this system stem from the fact that all of the air photos are marked by hand on multiple map indexes, since every time a mission is flown for a given area a new index map is created. As a result, a client may need to sort through numerous air photo map indexes until he or she finds one that covers the desired location. The geographic region which the client is looking for may extend beyond the boundaries of more than one map sheet, further complicating the search process. As well, our paper indexes are falling apart

because they are not printed on acid-free paper and the ink used to draw the flight lines has begun to fade.

The air photos in our collection are valuable and will become increasingly so for historical aspects of geographic information systems (GIS) technology-based research, especially when photos are georeferenced (latitude and longitude are identified on the corners and in the centre). Eva Dodsworth points out in her article “Historical Air Photo Digitization Project University of Waterloo Map Library” (*Partnership*, 2008): “A georeferenced image has the benefit of situating the location of the photo accurately on the earth’s surface. A user can compare, for example, the past and the present with very close precision” (www.criticalimprov.com/index.php/perj/article/view/836/1360) Libraries need to make it easier for researchers to explore and access such items in our respective collections. A pending renovation, a need for more space, and a concern for preserving the usability of our air photo collection were the combining circumstances which drove us to create an online index. We anticipate such a look-up tool will help maintain and enhance searchability and discovery of the air photos in the short and long term.

Conversion to an Online Index (2007-2009)

Over a six-month period, student employees systematically worked through the paper card catalogue of our holdings to create lists of photo and roll numbers in Excel spreadsheets. As we progressed, batches of this inventory were sent to NAPL. NAPL matched the data by the unique combination of photo and roll number and provided us with additional metadata they have for each photo. NAPL sent back embellished Excel files detailing altitude, scale, film, lens, and dates for our photos. Most crucially, the metadata included longitude (value x) and latitude (value y) of the centre point and the four corners for each photo. This is the essential data which will eventually make it possible to plot a digital representation of each photograph in our collection using Google Map markers. (A “marker” acts like a virtual thumbtack to pinpoint a location on the map.)

In the next step of preparation, leading to the Google Maps API mash-up, the Excel files were mapped using the x

and y centre point values in Esri ArcGIS software and then aggregated to a single file. In the ArcGIS environment it was straightforward to check anomalies once the photos were mapped by their geographic coordinates. In the initial ArcGIS import, eight photos stood out erroneously in the Southern Hemisphere (well outside the scope of our collection). The photos were identified and their geo-coordinates were corrected, in consultation with NAPL.

In order to make information available over the web, all records were exported from a local ArcEditor desktop client into our web server’s MySQL database. Data was transferred in eight slices of subsets that were small enough for importing into MySQL with few problems. The size of the collection (a quarter of a million air photos) poses challenges for Google Map rendering. If we were to generate all the photos, 250,000 markers all at once, the map would appear as a splotchy outline of Canada.

By **Erin** Forward and **Cameron** Metcalf

PHOTOGRAPH COLLECTIONS

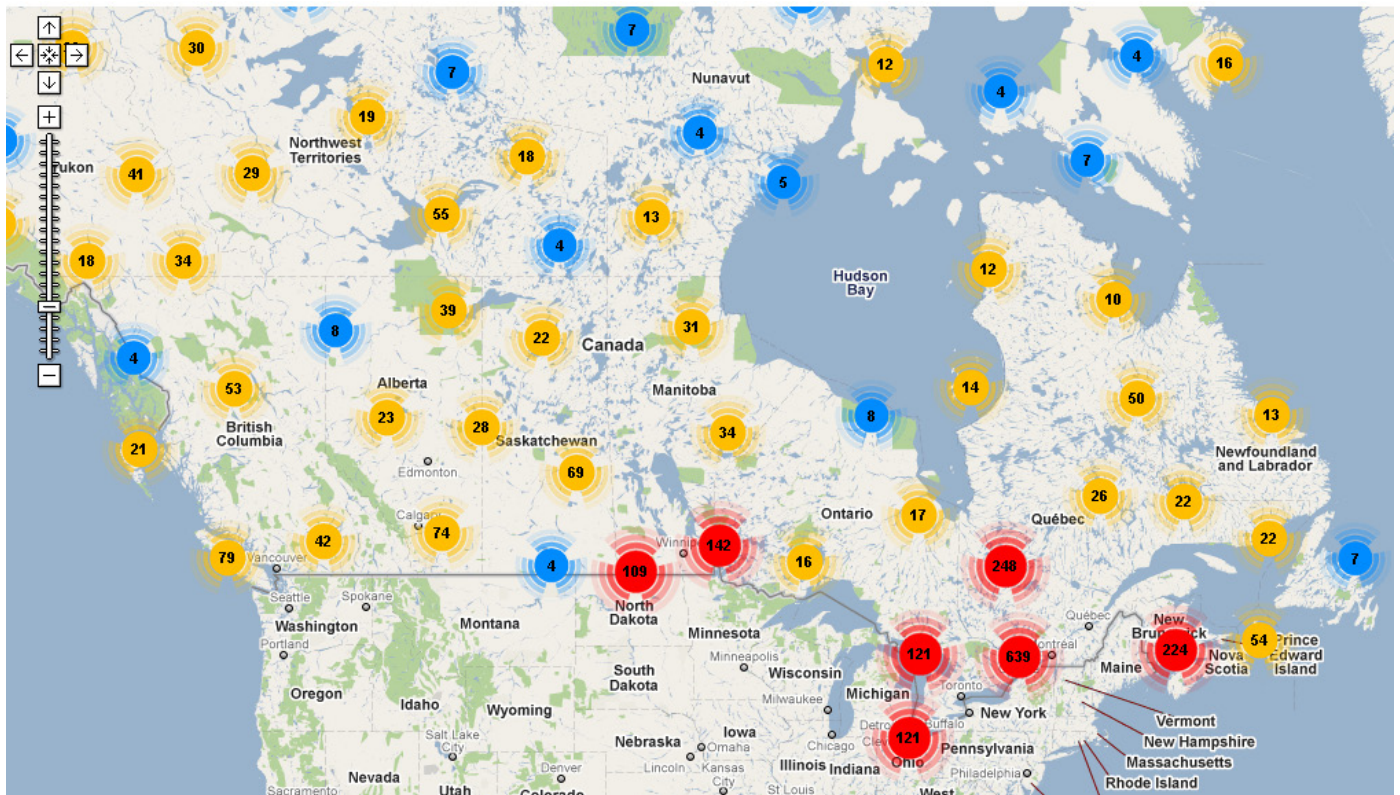


Figure 2 Screenshot of an early mash-up attempt using MarkerClusterer for our collection. Note that the numbers represent a count of total flight lines, by roll number for that area (not a tally of individual photos).

The Google API works very well on the client-side approach to coding, by delivering results fairly quickly: between five to ten seconds in most browsers, when working with fewer than 1,500 markers at a time. We experimented with marker clustering solutions to show fewer photograph results at a time. Individual markers appear as the user zooms into the map at higher levels of detail.

Working with the MarkerClusterer tool involved parsing search results, with PHP, into .xml or .json (mark-up which is a little lighter than XML) (see googlegeodevelopers.blogspot.com/2009/04/markerclusterer-solution-to-too-many.html). This was straightforward to code and it produced an aesthetically attractive solution. See Figure 2. However, there were access issues for the end user. If a geographic region happened to contain 20,000 photos (well above the 1,500-marker ceiling), the rendering took too long (40 seconds or more) or the website would crash altogether.

These issues could be avoided by bundling pre-queries for specific areas of Canada, but this involved too much speculation and second-guessing of our researchers' requirements. We resumed development by focusing on the fundamental advantage of having our coordinates housed in a database. We now allow the user to select any spot on the map, rather than pre-limiting results by geographic area or by date.

In our current iteration, results are limited by two constraints: allowing no more than 1,500 results to be returned within a maximum radius of 30 km. Clicking on the map returns a pop-up form with the geographic coordinates for that point on the map. See Figure 3. Clicking "Go" submits a query to MySQL searching for photos which are geographically closest. It then finds the next available photos and as the search progresses the circular perimeter expands until it reaches a 30-km radius or a maximum of 1,500 photos. See Figure 4. From these results, users can click individual markers to read the photo metadata and further filter results by flight line or by year. See Figure 5.

Next Steps and Future Development

While this new look-up tool in Google Maps has enabled users to browse our collection of national air photos, many opportunities remain to expand its features and scope. We intend to resume investigation of marker clustering by re-coding a server-side solution. This would reduce the "clunkiness" of our application and allow users to simply scroll and zoom a map (without clicking a submit button) to navigate our collection holdings. We also plan to provide more information about each photo from the individual marker pop-up windows. In the next version, clicking the map marker will allow the user to clearly visualize the geographical coverage for each photo by projecting a rectangular polygon shape over the map and may ultimately offer a thumbnail image of the air photo itself in an .html pop-up window.

We also still need to integrate provincial collections and photos from the US Navy. We intend to develop inventories

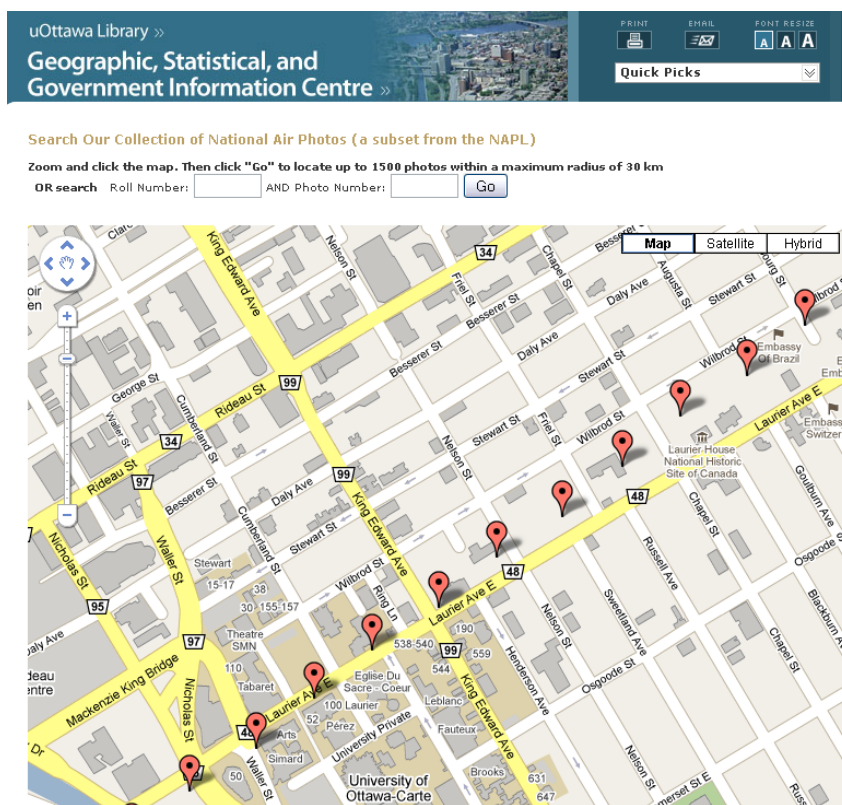


Figure 3 Screenshot of MySQL query: a location is clicked on the map to show the geographic coordinates and then the database is queried ("Go") to see if air photos exist covering the University of Ottawa Campus.

Search Our Collection of National Air Photos (a subset from the NAPL)

Zoom and click the map. Then click "Go" to locate up to 1500 photos within a maximum radius of 30 km

OR search Roll Number: AND Photo Number:

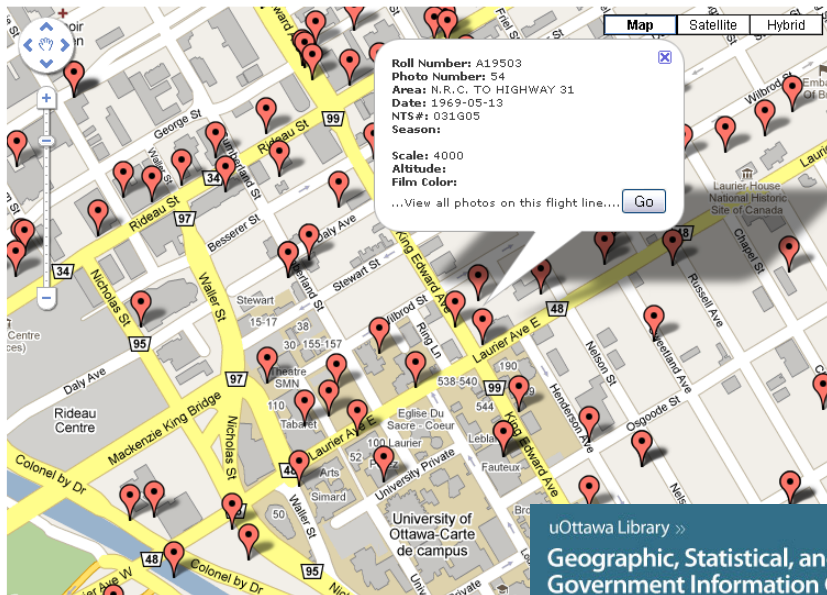


Figure 4 Screenshot search results from the previous form submission: each marker represents a different photo from various flight lines. Results may be filtered, i.e. all the photos on the 1969 flight line may be displayed by clicking "Go."

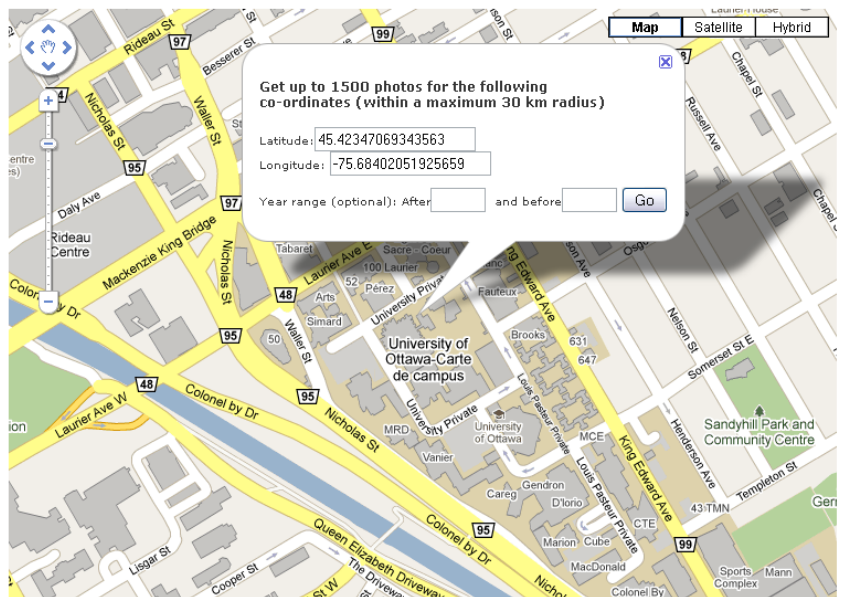
Figure 5 Screenshot of query results displaying single flight line of 1969, in the vicinity of the University of Ottawa campus based on a filter of the preceding query in Figure 2.

for these collections and expand the scope of georeferenced photos in our look-up tool. Once all of our federal, provincial, and private aerial photograph collections are amalgamated in our existing system, we will have developed a truly rich platform for the researcher to peruse the entire air photo collection held at the University of Ottawa. Researchers will have their own keys to unlock and browse through our treasured map storage room.

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