AERIAL SURVEY IN CANADA

Photography from coast to coast to coast

By Blair Watson

Aircraft with hi-tech remote sensing equipment are used for environment management, monitoring seismic activity, and even detecting unexploded ordnance.
(Photo Courtesy of Fugro Airborne Surveys, copyright Harquail Photography 2003)

The online digital maps and printed navigation charts that we use in our professional and personal lives would not exist had it not been for creative thinkers and risk-takers who lived more than a century ago. Sometime in the autumn of 1858, on the outskirts of Paris, Gaspard-Felix Tournachon loaded his camera into the basket of a hot air balloon, climbed in, and ascended into the sky. From an unknown altitude he took the first aerial photo – of three houses and a delivery cart in the village of Petit Bicetre.

Aerial photography has come a long way since Tournachon captured a place for himself in the history books. Often referred to as aerial survey, and part of the broader field of remote sensing, air photography has played an important role in transforming our world. In Canada, the history of aerial photo began in 1883, when the first image was taken 1,450 feet above the Halifax Citadel. The camera, which was attached to a balloon tethered to a portable windlass, was operated from the ground by Capt Henry Esdale, Royal Engineers.

The first aerial photograph taken from a fixed-wing airplane was captured in 1908 over Le Mans, France, involving pilot Wilbur Wright and photographer L.P. Bonvillian. Not only were aircraft and balloons used as aerial photo platforms nearly a century ago, rockets and even pigeons were too, prompting a leading Parisian magazine to remark in 1909, "It is quite natural to see birds becoming photographers at a time when men are beginning to become birds."

During World War I, the requirements for better intelligence about the enemy resulted in air photography developments in cameras, film, and processing. Less than two months after the war began, Britain's Royal Flying Corps conducted regular photo reconnaissance missions over enemy lines. Vertical and oblique photos were taken, and the developed film sometimes revealed preparations for new offensives such as trench and railway extensions.

Wartime aerial photo reconnaissance was hazardous, with aircraft being shot at from the ground and by enemy airplanes. Pilots would push the limits and fly missions even in inclement weather. A crew member/photographer had to lean over the side of the airplane with a large camera, enduring the blast of the slipstream in his face, to take photographs. Later in the war, fuselage camera mounts were designed and used.

Because of Canada's contribution during the war, in 1919 Britain gifted surplus military aircraft and aerial photography equipment to this country. Relatively little of Canada had been surveyed because of the nation's enormous size and wilderness regions. The same year, the federal government established an aerial survey committee, and in 1920 a number of survey projects using aircraft were undertaken, starting with experimental photo flights over Dartmouth, Ottawa, and some other cities.

It was soon recognized that surveying, which had previously been done by men on the ground over weeks and months, could be completed in hours or days using photos taken from airplanes. Aerial photography would prove to be particularly beneficial in surveying Canada's vast hinterland and coastal areas. In 1919, there were a number of Canadian aerial survey firsts, including the use of air photos by Imperial Oil geologists and an entomologist from BC who photographed swampy sections of the Slave River from the air to identify mosquito breeding areas. By November 1920, more than 1,200 aerial survey photos had been taken, at altitudes up to 10,000 feet.

The following year, air photographs of London, Ont. were taken, and the prints arranged to create a photo mosaic of the city. Aerial mosaics, which involve joining photos together to form a single, non-rectified image, are still used today. Other aerial surveys done in the 1920s and 1930s helped greatly in the engineering of the St. Lawrence Seaway, the massive construction project completed in 1959

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that allowed oceangoing ships to travel as far west as Chicago.

In 1921, the Air Board, which was established by the federal government to oversee civil aviation development in Canada, concluded that air photography should be used for surveying and mapping, town planning, geodetic triangulation, location of sites for water power development, crop monitoring and other purposes. More than eight decades later, aerial survey is flown for those reasons and many others, including forestry management, quarry inventories, tracking ice flows, and monitoring populations of animal species such as the beluga whale and caribou.

The Terraquest Ltd. Piper PA-31 Navajo was modified for magnetic survey and can also be equipped with spectrometer and hyperspectral imaging systems.

In 1937, colour film was first used in aerial survey and 70 years later, it is still employed for commercial and scientific purposes. During the spring and summer of 1939, Australian Sidney Cotton made flights over Nazi Germany in a Lockheed 12A fitted with hidden cameras. So revealing were the photos taken on his trips as a 'playboy' that the Royal Air Force recruited Cotton to oversee the fledgling Photographic Development Unit. The unit later became the RAF's 1 Photographic Reconnaissance Unit, which flew thousands of sorties during World War II in support of military operations. Photo recon aircraft included the Spitfire, which had its armour and armaments removed so it could fly faster and higher (30,000+ feet) and the 360-knot de Havilland Mosquito, of which 1,134 were built in Canada.

Many Canadians involved in wartime photo reconnaissance applied their skills in aerial survey back home after hostilities ended. The equipment and techniques associated with high-altitude and high-speed stereoscopic photography developed during the war transformed air photography in Canada (and other countries) after 1945. Aircraft used by the US in the war such as the P-38 Lightning and B-17 Flying Fortress were employed postwar in aerial survey in this country.

Canada has been photographed from the air from coast to coast to coast, and most areas have been captured on film several times during the past 80+ years. Over six million aerial photographs, archived at the National Air Photo Library in Ottawa, are available to the public. The Library's Web site is at http://airphotos.-nrcan.gc.ca.

There have been many aerial survey advances in the past six decades, including the development of infrared film and thermal imaging sensors, digital cameras, multi-spectral and LIDAR (Laser Imaging Detection and Ranging) systems, and magnetic gradiometers (used in natural resource exploration). GPS allows for precise survey line navigation and position determination. Aircraft with hi-tech remote sensing equipment are used for environment management, monitoring seismic activity, and even detecting unexploded ordnance.

Fixed-wing airplanes used in aerial survey range from single-engine, piston Cessnas to large, multi-engine, turbine airplanes like the Dash 7. Jet aircraft such as the Citation II and Learjet 35 have been equipped with cameras and other remote sensing gear. Canadian survey aircraft and crews have flown on every continent, at altitudes as low as a few hundred feet to 35,000+ feet.

Aerial survey requires prolonged concentration on the part of the aircrew and precise flying (to within one degree of heading). Flight lines can be in excess of 100 nm and survey areas made up of several lines. Crews, which often comprise a single pilot and a survey equipment operator, are typically away from home base for several weeks each year, sometimes in Third World nations. Aircraft maintenance is done by a company AME or a local maintenance provider.

What does the future hold for aerial survey? Creating new technologies and combining them with cost-effective airborne platforms such as Unmanned Aerial Vehicles is a development that will grow in the years ahead. UAVs employed in survey work are capable of flying for 12+ hours and at very low altitudes where it would be dangerous for a crewed airplane. Geophysical data and aircraft performance information is continuously transmitted to the Ground Control Station, and in case of in-flight difficulties or transmission problems, UAVs are 'smart' enough to return to base on their own. Thanks to the advanced technology, a single operator can remotely fly more than one survey UAV simultaneously.

Since the early 1960s, the final frontier for remote sensing has been space. On Sept. 29, 1962, the first scientific research satellite was launched from the Pacific Missile Range, and put in a 1,000-km orbit. The satellite, the Alouette-1, was conceived by scientists at Canada's Defence and Research Telecommunications Establishment and used to study the ionosphere. Its design life was one year, but because it was well built and its design included then-new technologies such as transistors and solar cells, the Alouette-1 was in operation for a decade, producing more than one million images of the ionosphere.

Today, Canada has a number of remote sensing satellites, such as RADARSAT-1, this nation's first commercial Earth observation satellite. Orbiting at 798 km since November 1995, RADARSAT-1 has provided images for use in agriculture, cartography, hydrology, forestry, oceanography, geology, ice and ocean monitoring, Arctic surveillance, and oil slick detection. The satellite covers the Arctic daily and most of Canada every 72 hours, depending on where its instruments are pointed. RADARSAT-2, which will have a resolution up to 3m and positional accuracy to 100m, was scheduled to launch in March 2007.