SWOOP2010 - One Mission: 3 Planes + 5 Weeks + 12 People = 45,000 Sq Kms or 72,000 Photos @ 16 cms.

HOW SOUTHWESTERN ONTARIO WAS COMPLETELY PHOTOGRAPHED FOR THE FIRST TIME IN ONLY ONE SNOW FREE SEASON.

By Alex Giannelia

Introduction:

In the spring of 2010, The Airborne Sensing Corporation (ASC), an aerial survey company based at the Billy Bishop Toronto Airport, completed one of the largest and most time constrained projects of its 30-year history. Considering that a large number of private and public partners participated in this project as purchasers of the data and because part of the aerial orthophotography mapping takes place in the aircraft, it was felt that describing how this was accomplished would benefit the survey community whether they are on the receiving or the supply side.

Background:

ASC was asked by a number of mapping companies for prices to provide airborne data collection, processing and verification services for the South Western Ontario Orthophotography Project 2010 (SWOOP2010) as co-ordinated by the Ontario Ministry of Natural Resources Land Information Ontario Office (OMNR/LIO). As the technology that ASC uses has already been described in a previous Ontario Professional Surveyor article (Surveyors DO WHAT?? - Summer 2008) penned by Paul Francis, the President of one of our clients, Northway Photomap Inc., it will not be repeated here.

ASC owns and operates 3 modified photo survey aircraft, 2 large format digital cameras, 3 large format film cameras, 7 GNSS base stations and 3 APPLANIX POS units, all necessary to derive the precise exterior orientation parameters for each image which accelerates the processes of aerial triangulation and subsequent photo-orthorectification.

Based on its 30-year experience working in Ontario, ASC determined that while the project could be flown in the required time period with only 2 aircraft/camera combinations, a 3rd camera would give additional "headroom" in terms of capacity, and therefore, made this a key point in its strategy.

Key Success Factors:

In addition to capacity, the key success factors in this project included experience with ground conditions, ability to "pounce" on the project immediately, rotation of crews to ensure freshness and avoidance of missed opportunities

One of ASC's Aircraft the "Christina G" – Pemberton B.C.

(clear sunny days are usually in the minority here), and rapid feedback with respect to any image quality issues which came up.

Flight Plan:

Since the advent of the orthophoto, there has been an enhanced demand for image contiguity within a project area. As this can only be accomplished in small areas and because 45,000 square kms cannot be flown in a day, a flight plan needs to be created which offers contiguity and is practical to fly. ASC decided at the bidding stage to break down the SWOOP area into municipal blocks, reducing the flying time for each area down to less than 3 flying days. Added advantages to this approach were:

1) Ground Control and Aerial Triangulation Blocks followed logical municipal boundaries.
2) Flight Line Length adhered to best practices with respect to GNSS/IMU data collection by remaining less than 1/2 hour each.
3) Radiometric changes based on Solar Altitude Azimuth changes were reduced within each block.
4) Ground Condition changes, which are dramatic in the spring, were reduced within each block.

Thus each municipal partner could look forward to a mosaic which represented a very small time slice in its

history and as a result, looked consistent.

Base Station Plan

Along with the block plan was the need to adhere to ASC's best practices based on its 18-year experience in airborne GPS data collection. Most municipal blocks had airports within them, or nearby, so it was relatively straightforward to organize the requisite base station data collection.

Meteorological Concerns

Digital aerial imagery does not require clear sunny skies with sun angles in excess of 30 degrees, but clients' expectations of best cosmetic effect and consistency of imagery throughout do. Fortunately, the SWOOP area has a history of between 50-80 hours of clear sunshine with sun angles greater than 30 degrees during the snow free, leaf free period, thus the limiting factor is capacity.

As it was, the time budget for the project was around 205 hours of "time over target" which represented about 67 hours per aircraft. The actual time spent ended up being a total of 175 hours or about 58 hours per plane.

Airspace Concerns

Even if economically feasible in a price competitive proposal response, unlimited flying capacity is further limited by access to the airspace in the SWOOP area, which is further complicated by the fact that 3 air traffic control (ATC) units in 2 countries are involved in granting access. Effective communications with all ATC units was an essential factor in gaining access when necessary. Furthermore, the Meaford Training area is restricted most days due to military activity that includes ordnance which could down any aircraft flying too close. Once again, communication is important.

Vegetation Concerns

Not only is the mythical "snow free, leaf free" period frightfully short, the progression to "leaf out" is not geographically consistent throughout the SWOOP area. The transition from snow free to leaf out is based on varying factors, such as latitude, altitude, tree species, soil moisture, and ambient atmospheric temperature and moisture. Generally, the ideal period is estimated to last about 3-4 weeks in any one area and the total window over the SWOOP area is 5-6 weeks.

Running Image Quality Control

Since it can happen that by the time the images are viewed, reflight conditions no longer exist, it was necessary to create as close to a "real time feedback loop" as possible to ensure that if any areas were missed due to weather or equipment issues, they could be recovered before the ground conditions changed much. With digital technology, this was possible, but it involved both error avoidance and extra effort on the part of the flight crews and image processing centre to ensure that all images were reviewed within 48 hours of flight, if not in the aircraft between camera off and landing. As of the writing of this article, no missing areas have been found.

Running GNSS/IMU Quality Control

Because the product is more than a pretty picture, it is equally important to be cognizant of the effect that good quality GNSS/IMU data has on the resultant map product and the ease with which it is created. Inflight data, such as number of satellites and PDOP values, had to be monitored continuously as well as all raw data needed to be archived every night and a QC process run daily to keep up with the flying.

Lessons Learned

Start Early: SWOOP II, as it was known, was openly discussed as far back as January 2009.

Get the Administration Onside: Due to concerns unknown to us, the award date was perilously close to being too late for a contiguous campaign in one season.

Buy Local: While the public procurement process enjoys using the World Wide Web for worldwide procurement on the basis of "level playing field policies", this doesn't work in aerial surveying. There is no coincidence with the fact that the 2 previous large area campaigns in southern Ontario were not completed on time and the vendors had a large extra-provincial content even though those vendors had much larger organizations behind them. Local knowledge is a key component to optimizing flight decisions and cannot be replaced.

Use Proven Technology: Digital systems are emerging from their infancy into childhood and are still nowhere near as functionally reliable as their film-based (analogue) predecessors. Thus, the use of the "latest" sensor technology, which may be seductive for the procuring agency to demand, can and will expose projects of this size to the risk of failure. This is why we had the extra camera on line, so the inevitable sunny day breakdowns would not have as serious an impact and we also had uniform sensor types and systems and aircraft platforms working.

Single Command Structure: Often projects of this size attract consortia, which if it wasn't for the ATC concerns may have worked here, but the need to dispatch aircraft while the sun is rising at 1800+ kms/hr demands short, simple and effective chains of command. If these lessons aren't applied, look to Snoopy's attempt at SWOOPING for guidance. As Snoopy tries to fly (swoop) from a tree in a 1968 Peanuts comic strip and hits the ground, Charlie Brown remarks, "If you'll pardon my saying so, your 'swooping' leaves much to be desired".

Alex Giannelia is the founder and president of THE AIRBORNE SENSING CORPORATION. Since founding his company in 1980, Mr. Giannelia has introduced a number of air survey technologies to the Ontario marketplace while offering them in the wider space in which ASC operates; colour photofinishing, the use of airborne KGPS in reducing ground control, the use of GPS/IMU systems to reduce the time spent in aerial triangulation, and both scanned from film and direct digital aerial imaging. He can be reached by email at **ag@airsensing.com.**