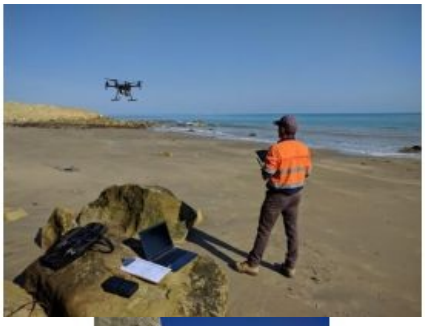
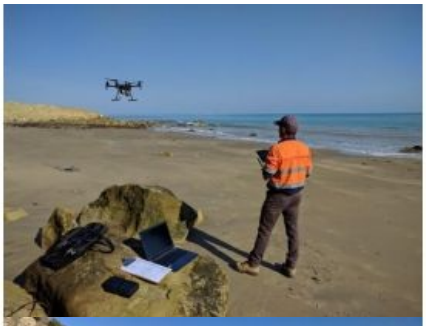
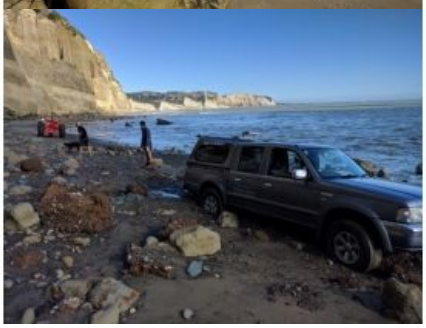
UAV Maps New Zealand Beach to Create Detailed 3D Model







A landslide on Clifton Beach, New Zealand, earlier this year injured two Korean tourists when they were washed out to sea. Following this event, the beach was closed while Hastings District Council undertook a risk assessment. The Surveying Company was contracted to provide data collected by an unmanned aerial vehicle (UAV or 'drone') to assist the council in making public safety decisions regarding access to the Cape. To map the cliff faces they used a combination of RTK GPS and a PPK GPS unit mounted to their UAV.

Initially the surveyors concentrated on assessing the main rockfall where the tourists were injured, then proceeded with mapping the whole coastline from the Clifton Motor Camp to the Gannet Colony at the tip of the Cape to inform a Quantitative Risk Assessment being undertaken by the Council and the Department of Conservation. The reason for mapping the entire beach was to have a highly accurate 3D model to use as a baseline for future monitoring and rockfall event analysis. This data was necessary in order to determine whether the beach would be safe to access again.

Combining RTK GPS and PPK GPS

The surveyors decided to choose to work with a combination of RTK GPS and a PPK GPS unit mounted to their UAV. The Surveying Company team connected each UAV survey to the existing survey network by locating and measuring survey marks in the local area. The GPS base station was then set to log raw GPS data for the duration of each UAV flight.

Access to the beach needed to be pre-planned as the beach is only accessible via 4WD during low tide, giving us a window of about three hours. Neap tides severely shortened the amount of time the team could spend on the beach, and there were a few hairy moments when returning from the job on one occasion! The position of the sun also had to be right to provide good quality photography.

The Matrice 200 coming in for a battery change.

No Line of Sight

Before each flight, check points and control points were marked on the beach and measured with RTK GPS. These helped verify the data once it had been processed. The marks were temporary (non-toxic spray paint) and disappeared with the next high tide. The surveyors could not leave permanent marks on the beach. Having a high accuracy on-board PPK GPS system was a must as there was no access to the cliffs above the beach, and line of sight to the base station was not possible, eliminating the use of RTK GPS on the UAV.

The beach was split into 1km sectors in order to make the mapping process easier. Each sector had a series of flights manually designed in the office that conformed to the natural topography. Relatively constant offset from the ground and cliff faces was maintained to provide high resolution imagery over the entire project. While the UAV was in the air it recorded images at regular intervals while ensuring a high overlap of imagery to give a complete dataset at the end.

The UAV flew each planned flight flawlessly and despite the cliffs shading half the satellites, especially at low flying altitudes, the PPK GPS system gave a fixed solution for each photo location.

(text continues after the photo)

Cliffs up to 140m tall posed potential multipath and satellite shading issues â€“ especially at low altitudes.

Back at the Office

Back at the office, the data was downloaded and survey measurements were reduced. Each photo taken was given a coordinate accurate to +/-30mm.

The imagery, photo coordinates and camera calibration parameters were fed into Pix4d for processing. Pix4d generates keypoints for each image, then matches neighbouring images to each other with the end result being all images stitched together into one block.

The control points the crew marked on the beach were then found in the photos, and measured coordinates were compared to the calculated coordinates to verify accuracy. When the surveyors were happy with the accuracy, they proceeded to generating a point cloud (up to 25million points per kilometre of beach), a 3D model, orthoplane and orthophoto imagery. Again, this process was repeated for each sector.

Below is a short video of how the processing works, using the main rockfall as an example.

To get the final result, as seen in this video, all 9 projects were merged together and a 3D model was generated. The amount of data collected was huge and the PC spent 4 weeks continuously working to put it all together. The result though, was worth it.

The surveying crew only got bogged once while mapping Clifton Beach.

Project stats:

- Over 12,500 photos, each positioned to +/- 30mm

- More than 155km of UAV flights

- Just over 9.5km of beach mapped

- Cliff faces were up to 140m+

- 2D accuracy was under 15mm

- 3D accuracy was under 22mm

- Average GSD / resolution for the entire job was approximately 2.38cm/pixel

Equipment:

- DJI Matrice 200 with X4S camera

- Klau PPK GPS system

- Leica GS16/GS18 RTK GPS

- Pix4D to process data

Acknowledgement
Thanks for The Surveying Company for sharing this story with GIM International.