CASE STUDY

eBee vs. the tide: Using a drone to help shore up an English beach

When the U.K. Environment Agency needed a partner to calculate beach volumes, it turned to UAV experts ATEC-3D to carry out a volume survey with its eBee before the tide came in

As part of the U.K. Environment Agency's sea defence and beach management remit, the shingle of the beaches it manages must be replenished every few years.

This replenishment is a crucial anti-erosion measure, necessary to prevent tides gradually shifting the shingle along the coast, leaving shores exposed and placing local low-lying neighbourhoods at risk of flooding.

One such beach sits between the villages of Littlestone and St. Mary's Bay in Kent, a county in the south east of England. It was here that UAV service provider ATEC-3D was employed by the Environment Agency to survey half a square kilometer (0.2 mi^2) of beach with its eBee mapping drone.

"We talked to the agency about the kind of service we provide and they were impressed by the data we showed them. This led to us being employed as the survey contractor for the Littlestone replenishment. We were required to survey the beach and calculate the volume difference between its current profile and the agency's target profile," explains ATEC-3D's director, Chris Slee.

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For profile analysis work such as this, beaches are typically split into sections called chainages (horizontal distances between two points). The Environment Agency divided the Littlestone beach into 29.5 chainages, each 100 metres long; a total shoreline of just under three kilometres.

"Within each chainage, our task was to calculate the amount of shingle needed to bring the level of the beach back up to the desired profile. This data would then be passed to the agency's contractor, which would use a dredging ship to spray additional shingle onto the beach as needed—a bit like using a big water cannon—before smoothing out the beach with special machinery," Slee says.

The beach replenishment project took place between the villages of Littlestone and St Mary's Bay on England's southern coast.

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A ship similar to that used by the Environment Agency's replenishment contractor. Its role was to spray shingle onto different 'chainages' (sections of beach) in line with ATEC-3D's volume findings. (Image: Boskalis Westminster.)

Race against the tide

The project presented an interesting challenge: how to complete all the survey's flights within a tight time window.

"As we were calculating volumes of shingle on the beach, our flights needed to be conducted during low tide," says Slee. "We also wanted to complete all the flights on the same day, since flying under the same light conditions helps us ensure we get back highly consistent data, and similar weather and wind conditions also give us more consistent flight timings, which helps with our planning."

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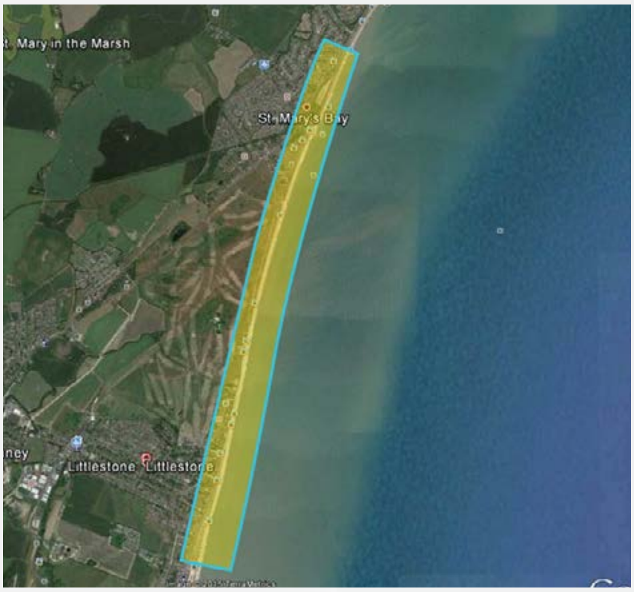
To maximise the number of hours staff could spend on the beach, the team decided to target a spring low tide. Such tides result in lower than average water levels, meaning more beach time, however these tides only occur only once every two weeks. Plus, Slee had to ensure that the tide in question fell during daylight hours. With such limited timings, the team needed to carefully plan its approach.

"We visited the site prior to the spring tide, to identify ground control point locations and to confirm landing locations for our eBee. We chose the widest sections of beach to be safe. By doing this planning in advance, on the day of the survey we could just turn up and crack on with setting GCPs and flying," Slee explains.



In order to cover the project's 0.5 km² at the 2.8 cm/pixel ground resolution required, ATEC-3D's team programmed four 30-minute eBee flights.

Extended line of sight

ATEC-3D chose to use an eBee for the project due to the firm having received Civil Aviation Authority permission to use this system for extended visual line of sight (EVLOS) missions.

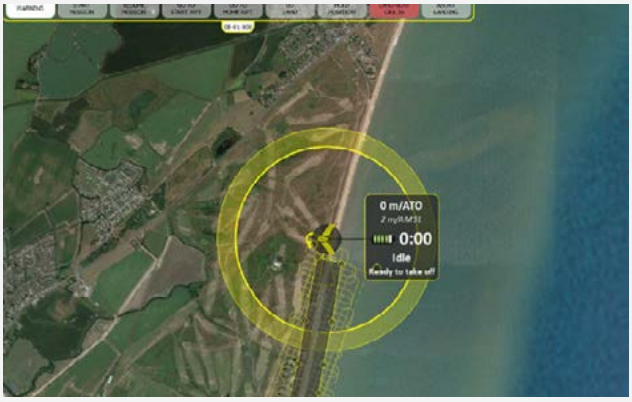
"We're one of only a few U.K. companies authorised to operate a UAV like this," Slee states. "By using two additional ground observers, situated 500 metres apart, we are licensed to fly our eBee up to 1,500 metres away from its operator. These observers maintain direct line of site with the drone as it is overhead, and report back via radio should any emergency actions need to be taken. For this project we used one observer, meaning we could fly up to 1,000 metres away from the operator, which saved us additional time."

This type of operation did however require an additional planning step be taken prior to take-off. "When flying over extended distances, we are required to notify the local air traffic control room of our activity so that a Notice to Airmen, or NOTAM, can be created to make other airspace users aware of our activity. However, even using the eBee under normal line of sight conditions, since the beach's location sits just outside Lydd Air Traffic Zone this NOTAM would still have made sense. We then maintained constant contact with the control room throughout the day," Slee explains.

An additional benefit of using the eBee, Slee adds, is that when planning its flights his team was able to work out, almost exactly, how long staff would need to be on-site. "This was particularly important when working against the tide times. Plus, we know the eBee also operates well in breezy conditions, and since the width of our landing area was limited we also appreciated its accuracy," he says.

Planning parameters

When planning the drone's flights, Slee specified a ground resolution of 2.6 cm/pixel in the drone's eMotion software. "We chose this figure to give us the most accurate volume calculations possible, while minimising blurring effects and data gaps due to standing water," he says. This resolution led the drone's eMotion software to calculate a flight altitude of 84.5 metres.



One of the project's four flight plans, created using the eBee's eMotion software.

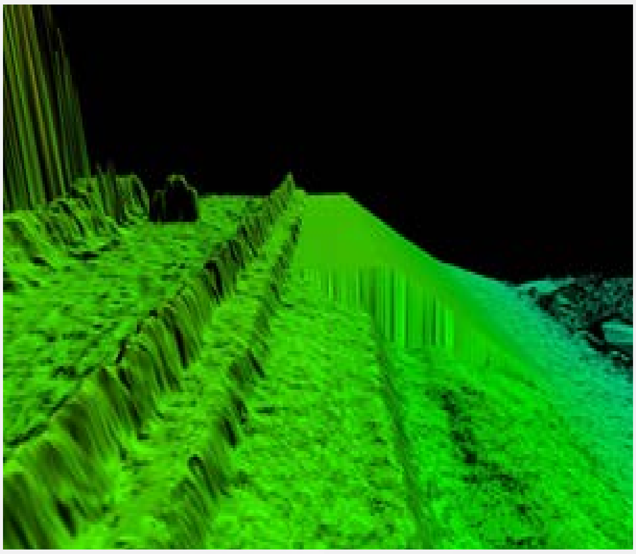
Slee then set each flight's lateral and forward image overlap to 72%. "There were no trees or foliage, obviously, so this percentage gave us good coverage without dramatically increasing the number of flights needed," he explains.

The result of these various parameters? Four 30-minute UAV flights were needed to survey the entire 0.5 km^2 site.

On the day of the survey itself, two staff first traversed the beach to set and record 30 GCPs with a GPS base station, placing square markers on top of both the sea wall and selected groynes (low walls that jut out into the sea).

"The GCP team was just finishing up on the final section of beach when our drone team starting flying the first of its four flights," Slee says. "We arrived on site around eight in the morning and in the end we were on the beach for just three and a half hours. The tide was already starting to come in though, so another couple of hours and we might've missed our window."

Chris Slee of ATEC-3D prepares to launch the eBee on one of the survey's four flights.



One of ATEC-3D's 3D models, showing one chainage's target profile (background) and its current profile (foreground), the sea wall running up from the bottom-left corner.

Each 30-minute flight captured between 306 and 376 images for a total of 1,411 high-resolution aerial shots.

Back in the office, two staff then used the drone's Postflight Terra 3D software to process the images—importing and geo-tagging these shots, then generating and geo-rectifying each flight's orthomosaic—before performing the required volume calculations using Global Mapper GIS software.

Project workflow

01 Identify site & carry out familiarisation:
- Identify take-off areas
- Identify landing areas
- Identify GCP locations

02 Lay GCPs & fly site

03 Process data same day (office)

04 Complete volume calculations

05 Deliver data & results to Environment Agency

06 Volume calculations to contractor for shingle distribution

07 Re-survey beach to verify new profile (not yet completed)

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Results

As a result of the team's careful planning and stress-free drone operation, ATEC-3D completed the survey well within its self-imposed one-day deadline, turning around the entire project—from flight planning to product delivery—in just 10 days.

"Performing a traditional ground survey would have been a lot more time-consuming," Slee notes. "The client also estimates that they more than halved their survey costs by using us, compared to using a traditional surveying provider."

The team's average positional accuracy across the four flights was 0.01 metres for the X and Y, and 0.03 metres for the Z. "The Environment Agency told us this was similar to the accuracy of the ground surveys completed in the past, only our approach was much quicker," Slee concludes.

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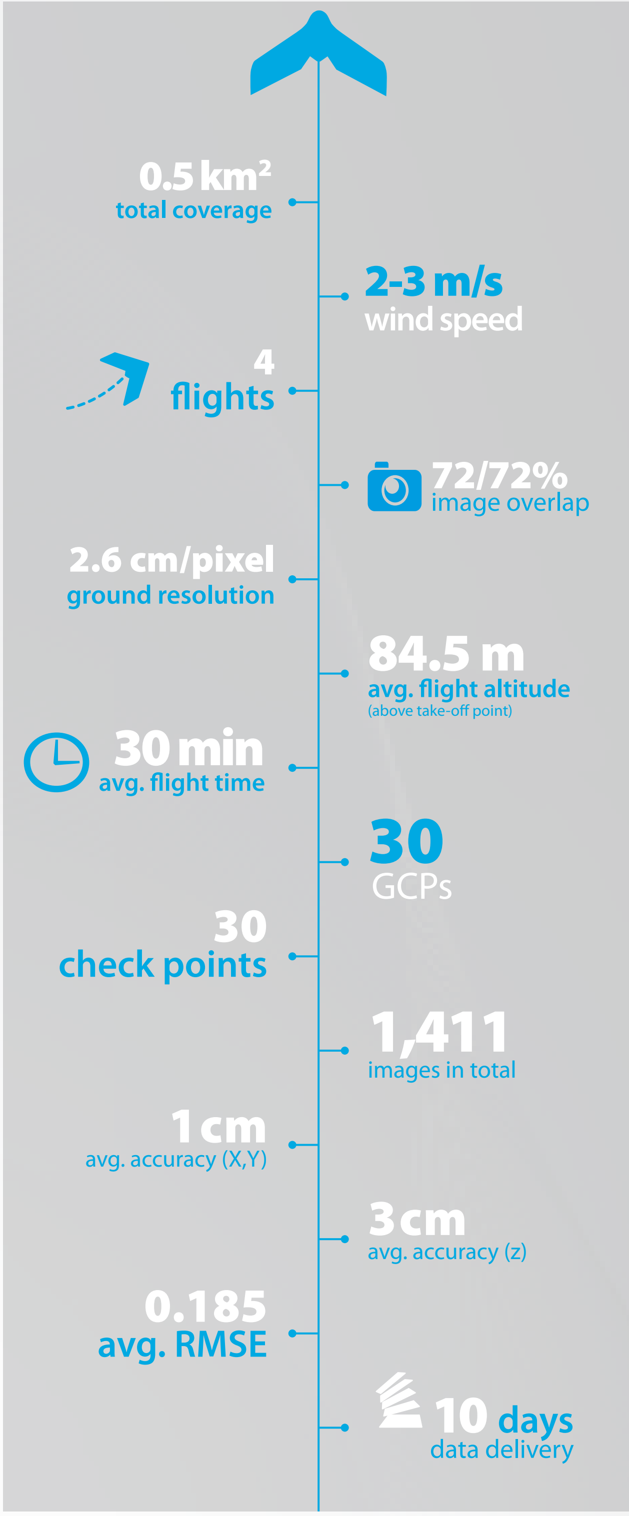
One of the project's final orthophotos, showing the southern section of the beach.

A screenshot taken from the project's final densified point cloud.

About ATEC-3D

ATEC-3D (www. atec-3d.com) is a specialist UAV service provider based in Kent, England. The company employs fixed-wing and multi-rotor drones to provide cost-effective and reliable aerial services across a wide variety of applications such as aerial photography, surveying and monitoring, operating worldwide and across a variety of different industries. All ATEC-3D UAV operators are authorised by the UK's Civil Aviation Authority (CAA) and fully insured.

PROJECT STATISTICS



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