How we used drones to monitor coastal erosion in Ghana

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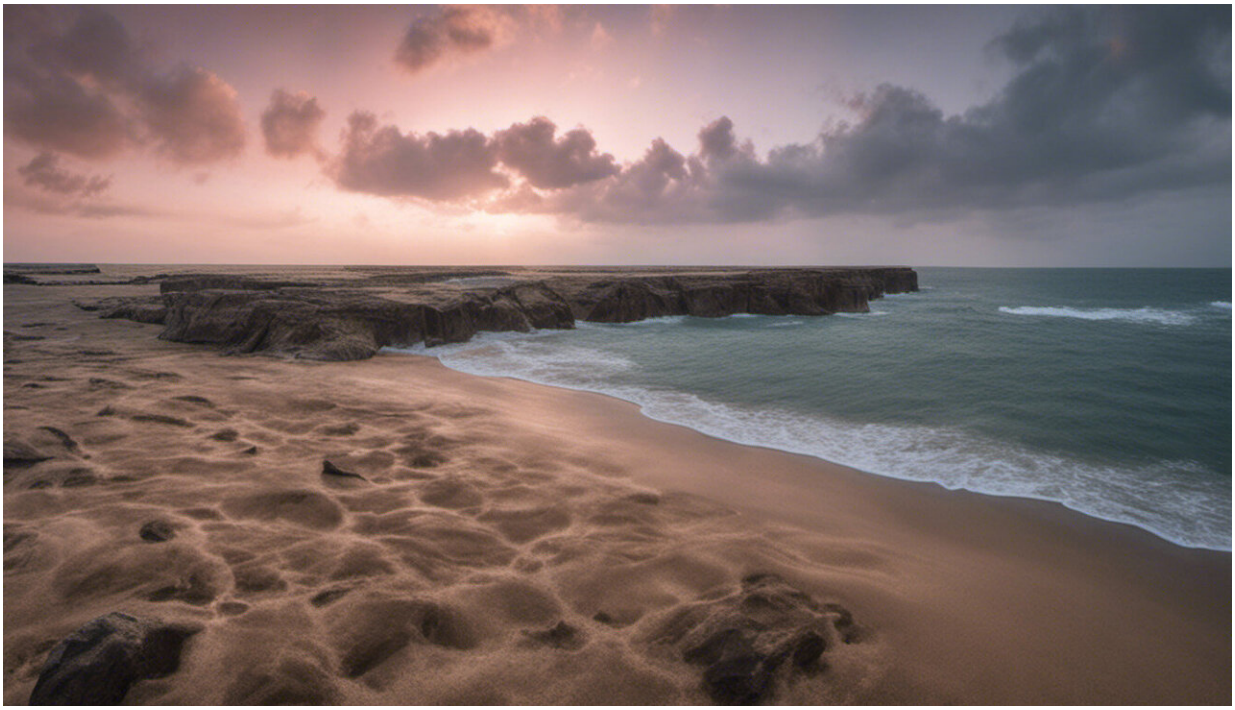

Credit: AI-generated image (disclaimer)

Delta environments are low-lying and highly vulnerable to flooding and erosion by ocean waves. And these hazards are likely to increase as the world's climate changes and sea levels rise. Monitoring these hazards, and their impacts, is very important to develop strategies and protect communities living close to deltas.

Drones can be a key tool for this work. My colleagues and I used drones to monitor flooding in Fuvemeh, a vulnerable coastal community in Ghana's Volta delta. The Volta delta, located along the eastern coast of Ghana, is a hot spot for erosion and flooding.

Even though the frequency and intensity of floods and erosion has increased in recent years, there's a lack of early warning systems and effective monitoring which doesn't allow vulnerable communities to be prepared.

One reason for this are the traditional methods of flood monitoring, like aerial photos and ground surveying, which can be very expensive and need specialised training. Drones, on the other hand, are low cost and easy to operate. They give quality, high resolution outputs, and can be deployed fast and often.

Erosion impact

Drones are unmanned aircraft that can be controlled remotely or fly automatically at a defined altitude. They also usually capture and record data. We used a DJI Phantom 3 drone – equipped with a high definition camera – to take aerial videos and images from the sky. These were recorded between August 2016 and June 2017.

We wanted to detect and measure short-term changes in the shoreline position, and assess the impact of flooding in the community. We then analysed these drone images alongside satellite images from 2014 and photographic maps from 2005.

The drone images revealed that flooding and erosion have had a severe impact on the Volta delta and the Fuvemeh community who live there. Over 12 years, out of a total area of about 375,229 m^2, 37% – about 138,118.239 m^2 – of the coastal land has been lost to erosion. In some

areas the shoreline had moved several meters inland; in others it had moved more than 100 m.

About 77 houses were destroyed. That's 42% of the total houses in the Fuvemeh community. Erosion also destroyed the only school in the community and wrecked people's livelihoods. Farmlands and plantations were obliterated and local fishing businesses lost their fish landing sites, closing down their operations and rendering people jobless.

Based on interviews with the community, about 300 people have been displaced because of these environmental shifts.

Using drones

Drones can help to accurately monitor these situations. Because they can go out without a person, are quick and very manoeuvrable, they are effective in monitoring the coast's environmental disaster as it unfolds.

For instance, we can see when waves are larger than other waves in the area. We can also see the high tides which, because the land is just two metres above sea level, would flood the Fuvemeh community. This information can then be quickly disseminated to the community.

Drones are also an effective long-term monitoring tool in coastal studies. Particularly studies that; examine the rise and fall of sea levels, look at how far up waves go up onto a beach and look at changes in shoreline positions. This is because they seem to be more effective than older methods.

Physical surveying, for instance, generates maps with the position of physical features and how they are influenced by flooding. These maps provide accurate information for change detection as there is a surveyor physically present during the data collection period. But they are time

consuming, expensive and can have human errors that affect reliability.

Aerial photographs are the most commonly used data source in coastal environment monitoring. They provide good spatial coverage but aren't timely and are very site specific, which means they're not good for monitoring.

Satellite imagery covers large areas and provides detailed, high resolution information. But these images are affected by cloud coverage, dust, pixel resolution and operational costs.

When calculating the accuracy, cost and duration of these various approaches, drones offer a good solution. They cost relatively little to operate, allow for frequent missions, have huge spatial coverage, can be rapidly deployed and the data they produce is high quality.

The information produced by the drone can offer short-term and long-term benefits to those directly affected by coastal erosion. But communities also need action on the ground. A sustainable adaptation approach is needed that increases' inhabitants' resilience – through building defensive sea structures for example, or replacing sand lost through erosion with other material.

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