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Satellites could fill in where sinkhole studies fall through

Earth orbiting satellites are now able to determine areas prone to land subsidence, the sinking of ground above abandoned mines.

26 Feb 2014 13:14 Sarah Wild

Age lies heavily on the abandoned mine shaft, its stale air thick and leaden in the darkness. Decades ago, it was a bustle of activity, with hunched men digging coal out of the blackened walls and carrying it to the surface about 10 metres above their heads.

Today, it sits empty and hollow as the supporting pillars begin to sag with each year. Tufts of grass have begun to grow above it, and many have forgotten that there was once a mine there, until one day the roof of the mine collapses and sucks the surface into its belly.

"Surface deformation due to underground mining poses risks to health and safety as well as infrastructure and the environment," explained Dr Jeanine Engelbrecht this week. She recently completed her PhD at the University of Cape Town in techniques to detect mining-related land subsidence. "Sometimes mining companies are aware [of potential subsidence], but when they don't expect surface subsidence, it can cause serious damage to infrastructure and roads."

Meanwhile, an orbiting satellite is bouncing signals off the earth's surface to detect where this will happen. Engelbrecht, now based at the Council for Scientific and Industrial Research's ICT Meraka Institute, is using these data to predict possible subsidence on South Africa's surface.

"We used earth orbiting satellites [transmitting and receiving] microwave signals to accurately measure the earth's surface," Engelbrecht said. For her PhD, she used this technique on an area that had been an underground coalmine, but cannot disclose which mine due to a confidentiality agreement. The data, captured by European, Japanese and Canadian satellites, can measure surface deformation in terms of millimetres.

'Novel' technique

Engineering geoscientist Dr Souleymane Diop, based at the Council for Geoscience, said this "novel" technique is "the X-ray you get when you go to the doctor", while the work he does is the biopsy: "We do ground geophysics and then invasive techniques, like drilling, to confirm that there is a void, with the potential of caving in."

He indicates the Witbank area, where there are many old coal mines, as a site of major land subsidence.

But traditional mining-related subsidence is only one part of what Diop's team at the council looks at: "Subsidence can happen for many reasons," he said, such as dolomitic land (where the ground comprises dolomite, a kind of rock that can be dissolved by slightly acidic water), acid mine drainage, swelling clay and illegal mining.

In some cases, old mines used timber to support the ceiling, and those supports have rotten away. In others, the long-dead miners left pillars of coal to stop the roof from caving in, but now "illegal miners go in and mine the pillars as well", Diop said.

At the Meraka Institute, Engelbrecht is developing her PhD work on these satellite techniques for earth observation to include "not just mining, but also areas prone to sinkholes and geological hazards".

Solutions

Lee Annamalai, earth observation competency manager at the institute, said Engelbrecht is "coming with the domain knowledge from a geological point of view ... I want to add steroids to the work that she's doing and turn in from research work into practical solutions for customers, [such as] mines, the environmental community interested in dune erosion, various air forces [to] monitor sinkholes on the air force's bases."

The Meraka Institute, with just over 200 staff, has a track record of innovative ICT solutions, such as its Advanced Fire Information System (AFIs) which tracks fires in real time.

But, unlike the publicly available AFIs offering, "we still haven't worked out if we'll have a publicly accessible map [for surface deformation] ... but there are interesting applications we want to investigate", Annamalai said.