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Snapshots From Space

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New software from Caltech zeroes in on natural catastrophes

By Steve Coulter

You might as well admit it, because we've all done it. There you are, right in the middle of the workday with a big deadline looming, when you are suddenly struck by an uncontrollable urge.

The next thing you know, you're flying around the earth at breakneck speed, like Christopher Reeve in the movie "Superman." The only difference is he was circling the globe in order to turn back time and save the woman he loved, whereas you are probably just looking at 3-D views of your ex-girlfriend's apartment building.

You've landed on Google Earth, a virtual globe program which combines satellite images and aerial photographs to form a detailed, bird's-eye view of the world. Although Google Earth is not the only virtual globe software available, it is undoubtedly one of the most popular and has given birth to a worldwide subculture of virtual globetrotters.

As a testament to the software's pop cultural gravity, there are several videos on YouTube dedicated to it. Perhaps the best known of these montages is "Secret Images of Google Earth," a two-minute clip that exposes some of the planet's most peculiar geological and man-made formations as pictured from space. Posted in December 2006, it has so far been viewed more than 1.5 million times.

There is no doubt that Google Earth is a true cultural phenomenon, but that sort of technology has a lot more to offer than mind-blowing cubicle excursions. Sebastien Leprince, a graduate student in electrical engineering at Caltech, recently developed similar software under the guidance of geology professor Jean-Philippe Avouac. He designed it for geoscientists monitoring natural disasters.

"[Our software] uses optical satellite images to monitor Earth's surface displacements with high accuracy," Leprince said. "Optical images are acquired using optical sensors. You can think of it as taking a picture through a telescope. They are the same kind of images that are used in Google Earth."

The software that Leprince wrote is called Co-registration of Optically Sensed Images and Correlation (COSI-Corr), and it accurately tracks some of the biggest changes on Earth's surface, including earthquake ruptures, "slow" landslides and fast-moving glaciers. To put it another way, when nature strikes, Leprince's software is able to collect measurements geoscientists can use to predict where similar phenomena might occur and what the consequences could be.

Using the 7.6 magnitude earthquake that struck Pakistan in 2005 as an example, Leprince explained that a lot of needed information from that particular disaster could not be collected through a traditional field survey, because a great deal of the damage occurred at high elevations and in extreme weather conditions.

"Imagine sending teams of geologists for months to map fault ruptures that can run for hundreds of kilometers," he said. "You arrive after the event and try to measure on the ground where the land was before it moved. For all these reasons, the measurements we provide are extremely valuable."

One of COSI-Corr's greatest strengths is that it doesn't replace the existing radar-based imaging technique known as InSAR but complements it. Leprince believes that InSAR and his optical image correlation software will continue to work in unison, with COSI-Corr taking the lead in measuring larger events.

As for the future, Leprince said that validating the technique and releasing a free version of the software is only the first step. His hope is that geoscientists will begin to discover more applications for COSI-Corr and that optical correlation will become standard.

“We could think of having dedicated computers processing satellite images in real time to monitor large-scale disasters and direct rescue teams in the field,” Leprince said. “From a more technical point of view, we’re also studying how future satellites should be improved to provide images that can be better exploited for scientific purposes.”

I wonder what websites Leprince looks at when he wants to goof off at work.