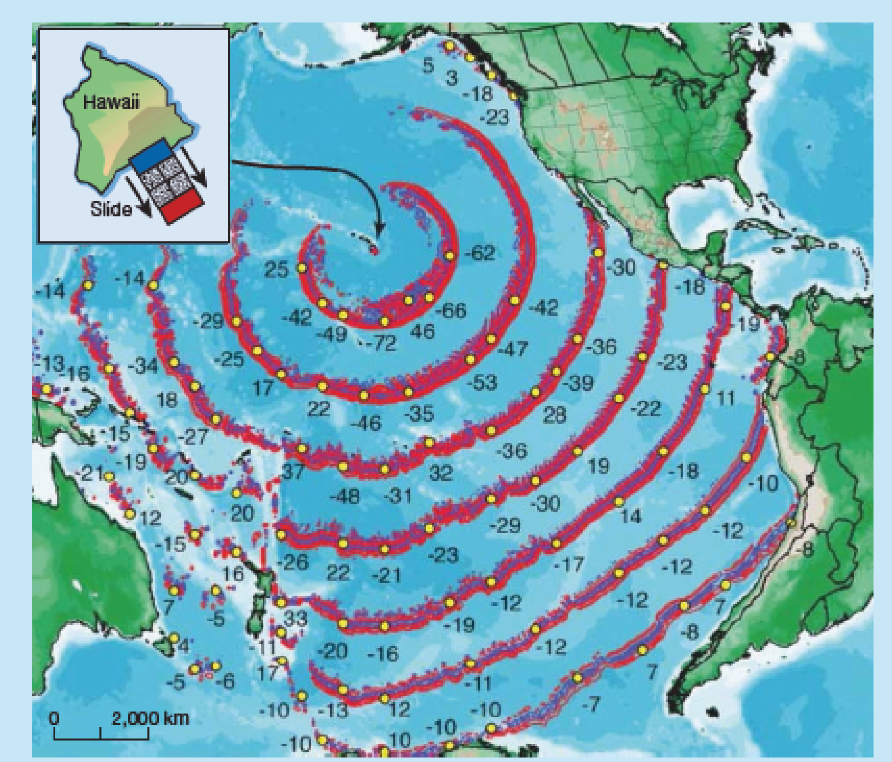

Figure 1 **Computer simulation[7] of the tsunami waves that might be set off in a collapse of Kilauea's southeast flank. The simulation assumes that a block 40 km long, 20 km wide and 2,000 m thick (blue, inset) slides for 60 km at 70 m s^{-1}. The tsunami wave fronts are pictured at two-hour intervals from 2 to 14 hours. Red and blue contours are wave elevations and depressions, respectively, and the numbers are sample wave heights in metres. Tsunamis from this collapse would have 1.72 10^{19} J of energy (equivalent to about 4,100 megatons of TNT), and focus slightly towards the southeast. The waves span 280° of arc, sparing only locations to Hawaii's north and west. Tsunamis from volcanic flank collapses can dwarf those generated by earthquakes of any plausible magnitude. The model predicts potentially devastating 30-m waves beaching on the west coast of North America. These decay to 10 m in height by the time of their arrival at the tip of South America.**

might provide the extra nudge, especially if the detachment fault is also lubricated by the injection of high-pressure groundwater.

Last year, Simon Day and I published an article[6] on the tsunami waves that might be generated by the collapse of another oceanic island volcano, Cumbre Vieja on La Palma in the Canary Islands. Our computer simulations predicted that a tsunami stirred by a 500-km^3 landslide there could span the entire Atlantic basin, keeping amplitudes of 10–20 metres. Based on these calculations, if a 2,000-km^3 piece of Kilauea ever does push into the sea, it could, under certain conditions, parent a tsunami that will strike much of the Pacific Rim (Fig. 1). Historical time has not seen a tsunami of this scale, but many researchers argue that geological deposits and landform shapes preserve the signature of older ones.

The implication that volcanic island collapses could raise extensive tsunamis grips both one's imagination and concern. Could potential collapses be monitored and perhaps forecast? Cervelli *et al.* demonstrate that current GPS technology deployed in networks at 5-km intervals can provide real-time detection of even seismically silent shifts in volcanic edifices: small, silent shifts that may presage a fully fledged flank failure. The world's oceanic volcanoes are stages best not left unwatched. In a few years, dedicated radar satellites may take up volcano guard duty. For now, GPS provides one of the sharpest views.

People should not lose sleep over large but rare natural hazards. They should not run blind either, particularly when a useful eye exists. Until the next volcanic island does collapse we will never know how nature's great landslides play out, but for me, Cervelli and colleagues' article supports the case that seeing is believing. ■

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Daedalus

Support for neutrons

Nuclear matter, the stuff that neutron stars are made of, is essentially a mass of neutrons packed together. It weighs millions of tons per cubic millimetre; even a microscopic quantity would be hard to keep at the Earth's surface. Last week Daedalus argued that neutron-rich material would be stable, as neutron stars are. He is now working out how to hold it against gravity.

He planned to make it by persuading the electrons of an atom to dive into the nucleus. If not all of them did this, the result would still be normal atoms, with electrons orbiting the space outside each nucleus. Each atom would be superheavy, its dense nucleus stabilized by a vast excess of neutrons. The resulting solid would be a hundred times as dense as water, and very strong. The jewel in the crown of such materials, and the strongest of them all, would be superheavy diamond.

Daedalus recalls the Eiffel Tower, which has a sharply diverging base that supports its top load. He is designing a tiny 'Eiffel Pyramid', topped with a microscopic sliver of pure nuclear matter. The wider layers beneath are dense, strong, intermediate matter; under these are wider layers of less dense matter; the broad base of the Pyramid is less dense still, the strongest normal matter. The Eiffel Pyramid could test Daedalus's bold prediction that nuclear matter should absorb neutrinos.

Normal matter is mainly empty space, so neutrinos go straight through it; indeed, billions of neutrinos a second penetrate all normal matter in every direction. Even the Sun, from which neutrinos escape so easily, has such a low density that it would float in strong potassium carbonate solution. But nuclear matter is over 10^{15} times denser. It should absorb the neutrino background. Indeed, black holes and neutron stars could be the only neutrino sinks known.

Daedalus would love to exploit our own neutrino background in this way. He will be alert for warming at the top of his Eiffel Pyramid of nuclear matter — a sign that neutrinos are being absorbed. How splendid it would be to capture neutrinos, the ultimate waste product of the Universe, and use their energy for our own needs. The neutrino flux would be useful even as background heating; if it generates temperatures above 100 °C it could be used to raise steam and power. Compared with the vast sums expended on the magnetic fusion reactor ITER, and the ever-receding dream of fusion power, the idea of exploiting free solar or cosmic neutrinos looks quite attractive. **David Jones**