

► other, be it for SKA or something else,” says Eric Torr, a former resident of the province who owns a local aviation company.

Expropriation would be a last resort, say SKA South Africa officials. “It’s not in the best interests of the SKA to do that because we have to live in this community,” says Alice Pienaar-Marais, who is in charge of the land-acquisition process. She is confident that SKA

South Africa will acquire the 36 farms by the end of next year, in time for SKA1 construction in 2018.

SKA Australia, meanwhile, “could be doing more” with respect to community engagement, project director David Luchetti told *Nature*.

The Australian SKA Pathfinder telescope, which is currently being commissioned, is to be built on an area that traditionally belongs

to the Wajarri Yamatji tribe. Following the 2009 Indigenous Land Use Agreement, which was negotiated between the government and the indigenous group, the tribe has received benefits worth more than Aus\$18.1 million (US\$13.5 million) in exchange for the use of the land for radioastronomy.

But the agreement needs to be renegotiated for the SKA before construction starts. ■



An earthquake-triggered tsunami is thought to have drowned this Pacific Northwest forest 2,000 years ago.

SEISMOLOGY

Canada builds quake warning system

Undersea instruments will monitor the Cascadia fault zone.

BY NICOLA JONES

On 15 June, Canada broke ground on an offshore earthquake early-warning system. Sea-floor sensors will monitor the Cascadia subduction zone off British Columbia to provide crucial seconds of warning if the ‘big one’ hits. Putting sensors so close to the fault should give the Canadian system an edge over a more developed sister project in the United States.

To produce early warnings of quakes,

scientists rely on a network of seismometers and accelerometers to detect the tremor’s first, non-destructive primary (P) waves. Those waves travel faster than the destructive secondary (S) waves, and so hit cities seconds to minutes earlier. The closer that detectors are to the source of an earthquake, the more warning they can provide. That time can be used to stop high-speed trains, shut down nuclear reactors and tell the general population to brace for shaking. But with offshore faults, getting close to the action means putting sensors

under water, which is very expensive.

Japan pioneered earthquake early warnings. The country has had a system to stop bullet trains since the 1960s, and public warnings have been issued since 2007. During the magnitude-9 Tohoku earthquake of March 2011, residents of Sendai, the major city nearest to the epicentre, got 15 seconds of warning; Tokyo got more than a minute. Japan added data from an array of undersea seismometers to its earthquake early-warning system in August 2011, and a second phase of that project was completed in March, more than doubling the number of offshore detectors to 50. Now, the country is working on an ambitious 150-station network called S-net. Connected by 5,700 kilometres of cable, it could provide up to an extra 30 seconds of warning for a large offshore quake.

The United States and Canada have lagged far behind Japan, despite the fact that the Cascadia subduction zone off North America’s west coast is expected to one day produce a catastrophic ‘megathrust’ quake similar to the Tohoku one.

By the end of June, the research non-profit group Ocean Networks Canada (ONC) in Victoria plans to have installed three accelerometers on its NEPTUNE sea-floor observatory, which consists of more than 840 kilometres of ocean-bottom cable looped out past the Cascadia fault (see ‘Quake watch’). “I took this job and asked, ‘Why aren’t we doing earthquake early warning?’” says ONC president Kate Moran, who joined the organization in 2011 as director of NEPTUNE.

The network already has a handful of seismometers, but these send data back in packets instead of instantaneously, and the information is subject to censorship by the navy. As such, Moran says, they are ill-suited for an early-warning system. The new accelerometers, which have a simpler data stream designed to circumvent these issues, were made possible by a Can\$5-million (US\$3.9-million) grant from the British Columbia government in February.

The team is also hoping to install a tiltmeter down a 300-metre borehole, to detect slow, almost imperceptible movement of the tectonic plates at the fault. Clusters of such slow-slip events occurred before the 2011 Japan quake, and detecting them might help seismologists to track the strain that is building on the fault.

Moran anticipates that within 5 years, the ONC will have 40 accelerometers on- and

JOHN STANMEYER/NGC

SOURCE: ONC



offshore to produce public early warnings. The instruments will be positioned specifically to detect an earthquake resulting from a subduction-zone tremor. Spotting quakes from other faults, which would be smaller but potentially much closer to cities, would require a significantly denser network of accelerometers.

On the US west coast, a network of onshore accelerometers can already alert a select group of users — such as the Bay Area Rapid Transit system in northern California — to the early rumbles of earthquakes. That prototype programme, called ShakeAlert, is hoping to get its information to a wider audience soon. “I think we’re really now, finally, at the beginning of rolling out a public system, after years of trying to get funding,” says ShakeAlert lead Richard Allen, a seismologist at the University of California, Berkeley, who anticipates issuing public alerts within five years. ShakeAlert got its first congressional funding in December 2014, and now has about half the funds it needs for a full system, says Allen. To reliably detect quakes from multiple fault lines, Allen reckons that the network needs about 1,100 detectors just in California, where it currently has about 500.

The US National Science Foundation supports a handful of wired sea-floor seismometers off the coast of Oregon as part of its Ocean Observatories Initiative. But these sensors have the same problems as the current Canadian ones, says Martin Heesemann, a marine geoscientist with the ONC. He adds that the group’s new accelerometers will be the only instruments on North America’s megathrust fault designed specifically for early warning rather than research.

The offshore Canadian system “will totally be better” than the US system, says Moran with a laugh. “It’s nice to be better than the United States.” ■

BIOMEDICAL RESEARCH

Sexes deal differently with infection

Quirks of immune system pose medical conundrum.

BY SARA REARDON

The immune systems of men and women respond very differently to infection — and scientists are taking notice. Research presented last week at a microbiology meeting in Boston, Massachusetts, suggests that the split could influence the design of vaccination programmes and lead to more targeted treatment of illness.

Hints that men and women deal with infection differently have been around for some time. In 1992, the World Health Organization hastily withdrew a new measles vaccine after it was linked to a substantial increase in deaths of infant girls in clinical trials in Senegal and Haiti. It is still not clear why boys were unaffected, but the incident was one of the first such examples to catch scientists’ attention.

Women might have evolved a particularly fast and strong immune response to protect developing fetuses and newborn babies, says Marcus Altfeld, an immunologist at the Heinrich Pette Institute in Hamburg, Germany. But it comes at a cost: the immune system can overreact and attack the body. This might explain why more women than men tend to develop autoimmune diseases such as multiple sclerosis and lupus.

Yet very few studies assess men and women separately, so any sex-specific effects are masked. And many clinical trials include only men, because menstrual cycles and pregnancies can complicate the results. “It’s sort of an inconvenient truth,” says Linde Meygaard, an immunologist at University Medical Center Utrecht in the Netherlands. “People really don’t want to know that what they study in one sex is different from the other.”

Now, scientists are beginning to tease out some precise mechanisms. At the meeting, infectious-disease researcher Katie Flanagan at the University of Tasmania in Australia reported on a tuberculosis vaccine given to Gambian infants. She found that the vaccine suppressed production of an anti-inflammatory protein in girls, but not boys. This boosted the girls’ immune responses, and may have made the vaccine more effective.

Hormones also play a part. Oestrogen can activate the cells involved in antiviral responses, and testosterone suppresses inflammation.

Treating nasal cells with oestrogen-like

compounds before exposing them to the influenza virus has revealed further clues, says Sabra Klein, an endocrinologist at Johns Hopkins University in Baltimore, Maryland. Only the cells from females responded to the hormones and fought off the virus (J. Peretz *et al. Am. J. Physiol.* <http://doi.org/bj5w>; 2016).

Genetic factors may also guide how the sexes deal with infection. Meygaard studies a protein called TLR7, which detects viruses and activates immune cells. Encoded by a gene on the X chromosome, the protein causes a stronger immune response in women than in men (G. Karnam *et al. PLoS Pathogens* <http://doi.org/bj5x>; 2012). Meygaard suspects that this is because it somehow circumvents the process whereby one of the two X chromosomes in women is shut down to avoid overexpression of proteins.

A study set to begin later this year could help to tease apart the relative influence of genes and hormones on infection. Altfeld and his colleagues will look at 40 adults

“It’s a sort of inconvenient truth.”

going through sex-change operations. If female hormones are responsible, the transgender women in the study should begin mounting stronger immune reactions to infections and develop more autoimmune problems than the transgender men.

Whether such results will lead to changes in how drugs are administered is an open question. In 2014, the US National Institutes of Health (NIH) announced that researchers must report the sex of animals used in pre-clinical research. Similar efforts are under way in Europe. But a 2015 report from the US Government Accountability Office (GAO) found that the NIH does a poor job of enforcing rules requiring that clinical trials include both sexes (see go.nature.com/28ll4nb).

According to the GAO, even if studies include both sexes, the NIH also does not routinely track whether researchers have actually evaluated any differences between them. Klein argues that gathering such data could lead to more-effective programmes — halving vaccine doses for women, for instance.

“People are tending to ignore it for as long as possible,” Flanagan says. “People will get a lot of surprises.” ■

CORRECTION

The News story 'Canada builds quake warning system' (*Nature* **534**, 446–447; 2016) incorrectly stated that the warning system being developed by Ocean Networks Canada would be the first in Canada.