US National Cancer Institute in Bethesda, Maryland. "It's a real problem."

IL-2 is a protein made by the body to spur the development of T cells in response to threats such as pathogens or cancer. Most cancer immunotherapies are designed to fire up T cells, but the effects can sometimes be deadly. Patients must be closely monitored while receiving high-dose IL-2 treatment, because it can cause skin rashes, short-term neurological disturbances and dangerous drops in blood pressure.

Given the risks and the difficulty of administering high-dose IL-2, patients and doctors often baulk at using the treatment, which is approved in the United States for use against advanced melanoma and kidney cancer. But Howard Kaufman, a tumour immunologist at Rutgers Cancer Institute of New Jersey in New Brunswick, argues that IL-2's bad reputation is outdated. Fatalities have declined as physicians have learned how to manage side effects, he says. And data from Kaufman and others suggest that more patients benefit from the drug than previously realized.

At the ASCO meeting this week, Kaufman will present an analysis of IL-2 treatment in people who received the therapy for kidney cancer between 2007 and 2012. Tumours shrank in only about 15% of patients, but they stopped growing in another 15%. Those people, said to have 'stable' cancer, lived longer than people whose cancers kept growing after treatment.

Even so, the therapy remains dangerous, warns Patrick Ott, a medical oncologist at Dana-Farber Cancer Institute in Boston, Massachusetts. "It can't be given at just any community hospital," he says. "You need a real expert team to administer this treatment."

"There are patients who are dying without ever getting a potentially curative treatment."

Ott and Kaufman are among researchers trying to make IL-2 therapy less toxic. At the meeting, they will describe their plans to test NHS-IL2, a fusion of IL-2 and an antibody that targets the DNA that is released by dying tumour cells. The antibody, developed by EMD Serono of Rockland, Massachusetts, directs IL-2 to tumour cells, helping to minimize its effects on healthy tissue. Another strategy, developed by a team led by John Frelinger, a cancer researcher at the University of Rochester Medical Center in New York, involves modifying IL-2 so that it is inactive until it encounters enzymes that are particularly abundant around tumour cells. "IL-2 was not meant to be expressed at high levels throughout the body," says Frelinger. "That's where the trouble with IL-2 therapy starts."

Others are experimenting with ways to expand the number of patients who respond to IL-2 treatment. In addition to activating cancer-fighting T cells, IL-2 stimulates regulatory T cells, which keep immune responses in check. Alkermes, a biotechnology company based in Dublin, is modifying the IL-2 protein so that it is less likely to activate regulatory T cells, and thus has the potential to generate a stronger immune response at lower doses. Because some of the toxic side effects of high-dose IL-2 seem to be independent of immune responses, it is possible that the approach will provide a more tolerable therapy.

Newer therapies, including PD-1 inhibitors, have milder side effects than IL-2. But even if those therapies are approved by the FDA, Ott thinks that IL-2 treatments of some stripe will still have a role, especially for people who do not respond to other treatments. "High-dose IL-2 has a track record of patients who have been disease free for 20 years," says Ott. "And we just don't know that yet with the new drugs." ■

OCEANOGRAPHY

US Arctic research ship ready to cast off

Long-awaited vessel Sikuliaq *joins an ageing fleet.*

BY ALEXANDRA WITZE

UAF/VAL IHDE

The latest addition to the US oceanographic research fleet will soon set off for its home port in Alaska.

A brand-new research vessel is buoying the hopes of US oceanographers. In the first week of June, the University of Alaska Fairbanks plans to take possession of the RV *Sikuliaq*, a US$200-million, 80-metre ship that is currently floating in the Great Lakes. It is the first research vessel built for the National Science Foundation (NSF) since 1981; polar scientists have been calling for a versatile ice-strengthened ship for four decades.

"People ask, 'Why should the Arctic have a special ship'? It's a special place," says Vera Alexander, a biological oceanographer at the University of Alaska who has been involved in the campaign to build an Arctic research vessel. Plans call for the *Sikuliaq* to spend much of its time examining the effects of shrinking sea ice and other climate-change impacts on northern ecosystems.

The *Sikuliaq*'s launch is particularly striking because most of the US oceanographic-research fleet faces a grim future. Many of the other 23 vessels are ageing, and there is little money available to replace them. Construction of the *Sikuliaq* was made possible only because, in 2009, then-NSF director Arden Bement chose to give the project $148 million from a government economic-stimulus package.

With its ability to navigate coastlines, ice-bound waters and the open sea, the *Sikuliaq* can explore a wide range of science questions, says Alexander. Biologists will be better able to track animal populations in places such

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as the Bering Sea, one of the world's most biologically productive marine ecosystems. Geologists will be able to map the sea floor between Alaska and Siberia to reveal details about when the land bridge between the two was exposed, letting humans cross from Asia to North America. And chemical oceanographers will be able to track the spread of pollutants through once-pristine environments.

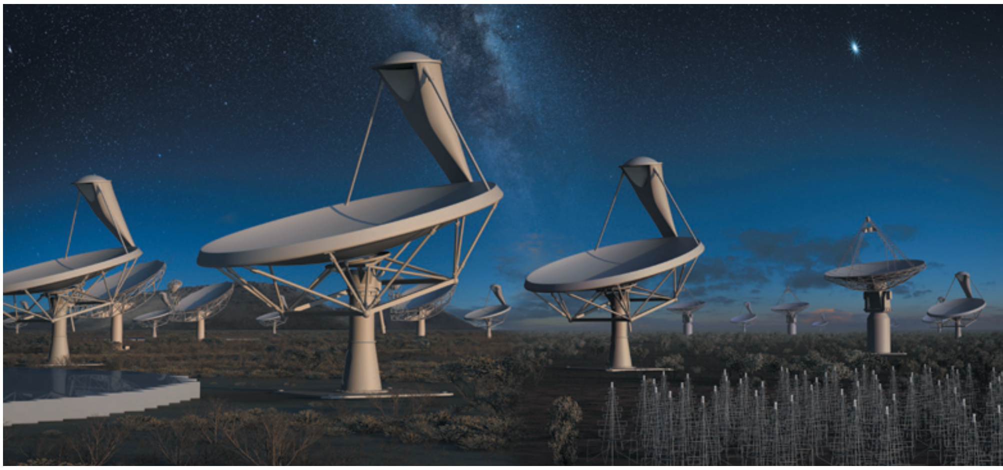
The *Sikuliaq* carries the latest oceanographic bells and whistles, including a high-tech boom that can be lowered over the side to deploy instruments such as sonar and oceanographic sensors. Unlike its predecessor, the now-retired *Alpha Helix*, the *Sikuliaq* has the ability to yank sediment cores up from the sea floor. A huge expanse of open deck space towards the stern will allow researchers to bring on board custom equipment, including autonomous underwater vehicles. "It's pretty amazing," says Michael Castellini, dean of the school of fisheries and ocean sciences at the University of Alaska.

The ship also has advanced navigation technology to improve manoeuvres through sea ice. That is important, because although its reinforced double hull allows it to plough through floating ice up to a metre thick and a year old, it cannot handle thicker, multi-year ice. (In line with the vessel's capabilities, *sikuliaq* is an Inupiaq word that means 'first-year sea ice that is safe enough to walk on'.)

Although construction delays have put it roughly a year behind schedule, "they didn't significantly alter when we wanted the first science to start", says Castellini. Plans call for the *Sikuliaq* to be at sea for some 270 days a year. One advantage to having a dedicated science vessel is that it will not be diverted for other purposes; research ships such as the US Coast Guard icebreaker *Healy* are occasionally called away to attend to emergencies such as delivering fuel to the icebound city of Nome, Alaska.

"People ask, 'Why should the Arctic have a special ship?' It's a special place."

Before it can do any science, the ship must pass final tests and be transferred from its builder, Marinette Marine of Wisconsin. After the University of Alaska team takes charge, the *Sikuliaq* will head out of the Great Lakes through the Saint Lawrence Seaway and then proceed southward along the US east coast. The ship will be based in Woods Hole, Massachusetts, for about a month while it undergoes shakedown tests at sea, and will then continue on, through the Panama Canal. It will do its first research in the deep waters of the tropical Pacific Ocean before heading north to reach its home port of Seward, Alaska, by February 2015. ■



SKA ORGANISATION

Data from the planned Square Kilometre Array of radio telescopes will require vast computing resources.

TECHNOLOGY

Cloud computing beckons scientists

Price and flexibility appeal as data sets grow.

BY NADIA DRAKE

Sometime in the next decade, the Square Kilometre Array (SKA) will open its compound eyes — roughly 2,000 radio dishes divided between sites in South Africa and Australia. The radio telescope will then begin staring into supermassive black holes, searching for the origin of cosmic magnetic fields and seeking clues about the young Universe.

Meanwhile, the telescope's engineers are struggling to plan for the imminent data deluge. The photons that will stream into the array's receivers are expected to produce up to 1 exabyte (10^{18} bytes) of data per day, roughly the amount handled by the entire Internet in 2000. Electricity costs for an on-site computing cluster big enough to process those data could total millions of dollars each year. So the engineers are investigating an increasingly common choice for researchers wrestling with big data: to outsource their computing to the cloud.

"No one's ever built anything this big before, and we really don't understand the ins and outs of operating it," explains SKA architect Tim Cornwell of the Jodrell Bank Observatory near Manchester, UK. He says that cloud systems — which provide on-demand, 'elastic' access to shared, remote computing resources — would provide an amount of flexibility for the project that buying dedicated hardware might not.

Such elasticity can also benefit projects that involve massively parallel data analyses, such as processing and aligning billions of DNA base pairs, or combing through hundreds of photos to identify specific zebras from their stripe patterns. It is also a boon to scientists who require bursts of computing power rather than sustained usage, as do researchers looking at seismic data in the aftermath of an earthquake.

"The rest of the year, when there are no earthquakes happening, they're just paying for storage," says David Lifka, director of the Cornell University Center for Advanced Computing in Ithaca, New York, which runs a computing-platform service called Red Cloud.

But the economics of cloud computing can be complex. An ongoing price war between major providers such as Google, Microsoft and Amazon Web Services has cut costs overall, but in many cases, sending data to the cloud, or retrieving them, remains much more expensive than storing them. Amazon's Elastic Cloud Compute S3 service charges US customers as much as US$0.12 per gigabyte for transfer from its servers, but no more than $0.03 per month to store the same amount of data.

This comes as a surprise to many researchers, according to a 2013 US National Science Foundation survey of 80 science projects that rely on the cloud (see 'Room to grow'). "Some cloud billing mechanisms are really opaque," says Daniel Perry, director of product and marketing for Janet, a private, UK-government-funded group near Oxford that is working to link British educational facilities to a shared data centre. "Unless you know what you're doing, you may find that you've run ▶

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