



Protesters during a climate strike rally on 20 September in Dhaka, Bangladesh.

DENVER, COLORADO

In Denver, Colorado, climate strikers turned out under sunny skies to march from the city's main train station to the state capitol building.

Kirsten Blagg, a graduate student in physics at the Colorado School of Mines in nearby Golden came to her first climate march to support the students who have been organizing the global strikes, and to help send a message to politicians that many people care about

climate change. "It's pretty frustrating when scientists with real knowledge don't get listened to," she said. "I just wanted to put another body on the street."

Rhea Esposito, an ecologist at the National Ecological Observatory Network in Boulder, also said she was marching to keep public and political attention on the issue. "The climate crisis is the number-one issue that we are facing as a species."

NEW YORK CITY

Climate activists filled downtown New York City as they marched to the tip of Manhattan island, where Thunberg was set to speak.

Corey Lesk, a climate scientist studying for a doctoral degree, joined other protesters from Columbia University's Lamont-Doherty Earth Observatory in Palisades, New York.

Lesk says the world should have acted aggressively on climate change decades ago, and he is sceptical that the global climate rallies will change the political dynamic. That's one reason he decided to study climate adaptation, focusing on the future of food and agriculture. Nonetheless, Lesk helped to organize Lamont's contingent and came with three signs. "Keep it in the ground," one read. "That's the safest place for carbon," Lesk says.

LONDON

Thousands of protesters descended on Westminster to demand action on climate change. Chants of "What do we want? Climate justice! When do we want it? Now!" rang out as people navigated the packed streets.

"I'm striking for the same reason that I research climate change," says Neil Grant, a PhD student at the Grantham Institute for Climate Change and the Environment at Imperial College London. "It is a huge societal problem we need to face. My research is aimed at helping to find solutions. But I can't just engage with climate change intellectually, I need to engage practically." ■

POLAR RESEARCH

Epic Arctic mission will lock research ship in ice

Year-long voyage will give scientists detailed look at the changes gripping the polar north.

BY QUIRIN SCHIERMEIER

Warming temperatures are changing the Arctic in unprecedented ways — but for the next 12 months, there will be a regular fixture on the polar horizon.

In an extraordinary expedition that set off on 20 September, scientists will freeze Germany's biggest research vessel, *Polarstern*, into Arctic sea ice, where it will stay trapped for the next year. The ship will host a rotating crew of some 300 scientists from 17 countries and serve as a drifting polar-research laboratory — one that will give researchers their closest-ever look at how the polar climate, and its fragile ecosystems, are changing.

The €140-million (US\$154-million) research

project, called MOSAiC (Multidisciplinary Drifting Observatory for the Study of Arctic Climate), is one of the biggest research missions ever to go to the Arctic and has been years in the planning. Led by the Alfred Wegener Institute (AWI) for Polar and Marine Research in Bremerhaven, Germany, the expedition commemorates Norwegian polar explorer Fridtjof Nansen's legendary but ill-fated attempt in 1893 to reach the North Pole in a three-masted wooden schooner trapped in drifting sea ice. But unlike Nansen and his men, whose strenuous journey on the *Fram* lasted three years, the MOSAiC team will rely on a superbly equipped research ship and on logistical support by Russian, Swedish and Chinese icebreakers.

After a first leg in which *Polarstern* will sail

polewards in the open ocean, the vessel will freeze into the sea ice at a latitude of about 85 degrees north, probably in October. The team will then set up a network of camps on the thick ice surrounding the ship. Nearby research stations will be accessible at any time. Those farther away — up to 50 kilometres — will be served by helicopters that will transport crew and equipment. Where *Polarstern* will end up in 12 months' time is uncertain. Statistical calculations of sea-ice drift suggest possible end points near the North Pole or in the Fram Strait between Greenland and Svalbard. "We will go and do science wherever the ice might carry us," says chief scientist Markus Rex, an atmospheric scientist at the AWI.

One major goal of MOSAiC, says Rex, ►



The *Polarstern* research vessel will carry about 300 scientists on its 12-month mission.

► is to improve strikingly uncertain climate projections for the rapidly warming Arctic, and study the effects of climate change on the region's ocean chemistry and ecosystems.

The Arctic is heating up faster than any other region on Earth. Positive feedback loops, in particular the loss of snow and ice that help to reflect sunlight, have amplified climate change in the region, which has already warmed by 2°C over the past century.

UNCERTAIN CHANGE

Climate models disagree wildly on how much more the Arctic will heat up as the concentration of greenhouse gases in the atmosphere rises and sea ice dwindles. Some models

project that the Arctic could warm by about 5°C by 2100, relative to the 1986–2005 average, under a high greenhouse-gas-emissions scenario. Others suggest that high northern latitudes might warm by more than 10°C. The region has already changed dramatically: the extent of sea ice in summer has halved since the 1970s, and the ocean around Norway's Svalbard archipelago has been largely ice-free even in winter in some recent years. Winter air temperatures there have been more than 7°C higher than normal in the past few decades.

"The Arctic has changed very much since the days when Nansen was here," says Rex. "If climate change proceeds unabated, it will turn into a completely different environment."

Scientists worldwide are eagerly awaiting the wealth of data that the MOSAiC team hopes to collect. "This is a truly wonderful opportunity for the entire climate and polar-research community," says Jens Hesselbjerg Christensen, a climate scientist at the University of Copenhagen.

Among the data will be continuous measurements of the heat exchanged between the atmosphere and the Arctic surface over the four seasons. This information will help scientists to understand why the region is warming at least twice as fast as the rest of the globe, says Mark Serreze, director of the National Snow and Ice Data Center at the University of Colorado Boulder. Current climate models don't seem to correctly capture energy fluxes and sea-ice change in the Arctic, he says. The models are also poor at representing changes in cloud cover and cloud properties, which have a substantial effect on the Arctic climate, he notes. "We don't know nearly enough about clouds; we just haven't got the data. MOSAiC will hopefully provide just that."

A number of Serreze's colleagues from the University of Colorado will be on *Polarstern*, along with scientists from countries including China, Russia and Japan. Participants will each spend about ten weeks on the ship. Scientists, food and supplies will be ferried to and from the vessel by one of four icebreakers. Life and work under extreme Arctic conditions is a special experience, physically and emotionally, says Rex, who plans to spend ten months on board.

"This will be a tremendous experience — slightly nerve-racking but monstrously beautiful," says Elise Droste, a PhD student at the University of East Anglia in Norwich, UK, who studies how sea ice affects carbon uptake by the ocean. ■

ALFRED-WEGENER-INSTITUT/STEFAN HENDRICKS

DESERTS

China's tree-planting could falter in a warming world

Researchers warn that the push to hold back deserts could strain water resources.

BY MARK ZASTROW

China has planted billions of trees over the past four decades as part of its fight against expanding deserts, mostly in its north. Each year, the country sows seedlings over an area nearly the size of Ireland. It is even sharing its desert-control methods with others as part of its Belt and Road trade initiative.

The trees have held back China's deserts. But some scientists worry that the planting could

exacerbate water scarcity. Many of the trees are not native to the regions where they have been planted, and they use a lot of water — and are being placed in areas that are experiencing reduced rainfall owing to global warming.

"The idea is nice, but it's kind of foolish to plant trees in a desert," says Troy Sternberg, a geographer at the University of Oxford, UK.

Chinese scientists say there are good reasons to plant vegetation in barren areas, but that the programme needs to take into account local

conditions. They say local and national governments are already planting more shrubs, herbs and other native vegetation that needs less water.

The Gobi Desert and similarly arid regions are expanding as processes such as overgrazing deplete vegetation on their borders, letting wind and gravity erode soil. China's largest tree-planting drive, the Three-North Shelter Forest Program, also called the Great Green Wall, is designed to halt that encroachment. The government says it has planted more than 66 billion