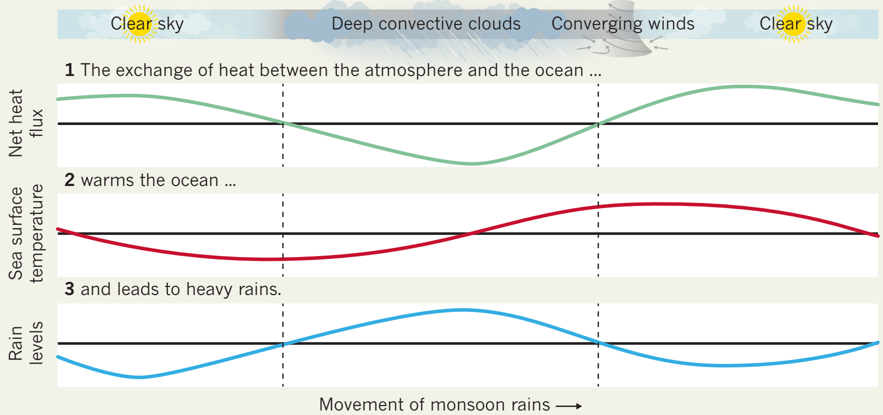
STORMY SKIES

Each summer, the monsoon brings alternating periods of rain and clear skies to the Indian subcontinent. Researchers are trying to understand the factors that drive these wet and dry periods, to better predict and prepare for future monsoons.



SOURCE: HARINDRA FERNANDO

▸ of Bengal, and sometimes veer towards the Indian subcontinent — where they can cause serious damage. In 2017, a powerful MISO brought torrential rain and landslides to Sri Lanka, killing more than 200 people.

Weather and climate models have not been able to accurately predict MISOs[1]. Strong and frequent interactions between the atmosphere and the ocean seem to help get them started[2], as warm ocean waters feed energy into the air above (see 'Stormy skies'). A study published this year suggests that certain ocean processes, such as a type of wave that helps warm the topmost waters, could play a big part in kicking off many MISOs[3]. Having direct measurements from within a MISO will help modellers to pinpoint the exact conditions that drive them, says lead author Jason West, an atmospheric scientist at the University of Colorado Boulder.

The Bay of Bengal project aims to measure the microphysics of energy flows between the ocean and the atmosphere once MISOs are under way. It builds on a long history of international field campaigns to understand the intricacies of the Indian Ocean monsoon, so that neighbouring countries can better prepare for it[4]. Funders of the five-year study include the Indian Ministry of Earth Sciences and the US Office of Naval Research, working with institutions such as Sri Lanka's National Aquatic Resources Research and Development Agency (NARA).

MISO-BOB's aerial component started on 15 June from an air base in Colombo, Sri Lanka. Scientists have been flying aboard the US Air Force's hurricane-hunter C-130 plane, which carries equipment to measure the properties of clouds and the atmosphere. It is releasing instrument packages called dropsondes that measure temperature, pressure and wind speed as they plummet towards the sea.

The *Thompson*, meanwhile, left Chennai, India, on 4 June for the first of two research legs to gather data on ocean conditions. Scientists on board — mostly students and early-career researchers — have deployed a variety of instruments to measure temperature, salinity, currents and other factors at different depths and locations across the Bay of Bengal. They have also released radiosondes, which are instrument packages carried upward by weather balloons to gather meteorological data.

"We want to observe the conditions across the air–sea interface cleanly, which is a challenging thing to do," says Emily Shroyer, an oceanographer at Oregon State University in Corvallis, who led the first leg. The second leg will take another group of scientists on board and will wrap up by 22 July. This team will travel farther to the south, and an associated group will take measurements near Sri Lanka with the NARA research vessel *Samudrika*, says NARA oceanographer Priyantha Jinadasa.

With enough data and analysis, MISO forecasts could improve in perhaps five or ten years, says team member Debasis Sengupta, a monsoon expert at the Indian Institute of Science in Bangalore.

Project scientists are already planning a second, longer season of field observations for next summer. Details have not yet been finalized, but the team will continue to target how energy flows between the air and the sea during the monsoon. "There's constantly this game going on between the atmosphere and the ocean," says Amit Tandon, an oceanographer at the University of Massachusetts in Dartmouth. "It's every bit as exciting as a World Cup match between two nations." ■

1. Goswami, B. N., Rao, S. A., Sengupta, D. & Chakravorty, S. *Oceanography* **29**, 18–27 (2016).
2. Sharmila, S. *et al. Clim. Dyn.* **41**, 1651–1669 (2013).
3. West, J. B., Han, W. & Li, Y. *J. Geophys. Res. Oceans* https://doi.org/10.1019/2017JC013564 (2018).
4. Mahadevan, A. *et al. Oceanography* **29**, 14–17 (2016).

TRADE

US–China trade war rattles labs

Trump puts tariffs on Chinese technology and China retaliates with taxes on US chemicals.

BY ANDREW SILVER

Scientific research in the United States could become collateral damage in the country's escalating trade dispute with China. Both nations went head-to-head in mid-June over tariffs on a long list of goods that includes lab equipment and reagents. That is likely to increase the cost of scientific research, and the impact could be felt more keenly in US labs.

The latest skirmish in the ongoing trade war between the world's two largest economies began on 15 June, when the United States announced a 25% tax on 818 goods imported from China. The list includes equipment used by scientists, such as basic electrical parts, microscopes and geological-survey devices. President Donald Trump said the tariffs, which will start on 6 July, are intended to reduce China's dominance in industries such as robotics, new materials and information and communications technology, and will level the playing field for US firms. The Trump administration is considering tariffs on a further 284 industrial goods, including chemicals.

A day after the US announcement, China's Ministry of Commerce responded with its own set of tariffs on 545 US products imported to China, which will also start on 6 July. The government will apply taxes in the future to another 114 US imports — including basic chemicals and medical devices, such as magnetic resonance imaging (MRI) machines — although it has not announced a date.

Scientists in the United States were quick to denounce Trump's latest round of tariffs. "I am opposed to these seemingly ad hoc tariffs because it will further stretch the already anaemic scientific research budgets in this country," says Thomas Lapen, a geochemist at the University of Houston, Texas. Equipment

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and supplies are the second-largest expense for his research, after paying wages. Lapen says that his costs are likely to increase because the US tariff list includes equipment or parts his team needs, such as electrical motors that drive centrifuges.

Priscilla Cushman, a dark-matter physicist at the University of Minnesota in Minneapolis, says that research deans at US universities should be scrutinizing the list to see whether the taxes will affect their facilities.

SCIENCE SQUEEZE

The tariffs could also cause havoc for large-scale experiments, such as the ADMX dark-matter detector at the University of Washington in Seattle, which is under construction. The project's lead scientist, physicist Leslie Rosenberg, is worried that the equipment his team needs to build experiments — such as tools for power generation and distribution, and machinery that has Chinese electrical components — could be subject to the latest tariffs. "Anyone can see the tariff list, but an official must determine whether any particular procurement falls under the tariff," he says.

Rosenberg thinks that the United States' overall research capability will probably decline under the tariffs.

But other researchers aren't worried. Roberto Refinetti, a biopsychologist who studies biological clocks at Boise State University in Idaho, uses some small Chinese-manufactured equipment for his work, such as infrared motion detectors for monitoring rodents. He doesn't think that the tariffs on Chinese goods will significantly increase the cost of his research, because he purchases that type of equipment infrequently.

The White House and the Office of the United States Trade Representative did not respond to *Nature*'s request for comment on researchers' concerns.

In China, the tariff dispute could increase the cost of standard reagents used in laboratory and medical devices that scientists import from the United States. Ruibang Luo, a bioinformatician at the University of Hong Kong who collaborates with researchers on the mainland, says that if the Chinese government interprets some tariff items literally, the taxes could apply to a broad range of US-made reagents and research devices, including some DNA sequencers.

But Yu Zhou, a researcher at Vassar College in Poughkeepsie, New York, who studies science and technology development in China, says that the tariffs would not have a significant effect on research projects and experiments in China. She says that is because some universities have large enough budgets to absorb increased costs. Researchers could also share more equipment than they do now, or use goods made domestically and from countries other than the United States.

Brian Xu, a toxicologist for the scientific consulting firm ACTA in Washington DC, which works with businesses in China, agrees that China's proposal to place tariffs on US chemicals and scientific equipment is unlikely to have a major effect on Chinese research. He notes that scientists there import only a small amount of US-made chemicals, and that infrequently replaced scientific equipment from other countries, such as Japan and Germany, is of comparable quality and cost.

But the latest round of tariffs might not be the last. On 18 June, Trump threatened to impose additional tariffs on Chinese goods if the country does not rescind its tariffs and create a more balanced trade relationship with the United States. ■

SPACE

Japanese mission reaches unexplored asteroid Ryugu

Hayabusa-2 will release four landing probes before touching down to collect samples.

BY DAVIDE CASTELVECCHI

After travelling for three and a half years, the Japanese spacecraft Hayabusa-2 this week makes its final approach to the asteroid Ryugu. The probe will release landers on the space rock's surface later this year and bring a precious sample back to terrestrial labs in 2020. It is already giving planetary scientists their closest-ever view of a mysterious kind of asteroid.

The Japan Aerospace Exploration Agency (JAXA) last week released grainy pictures from a distance of around 300 kilometres away, revealing that Ryugu — an asteroid of a common but little-studied type — looks similar to a spinning top.

This week, a much more detailed picture, from 40 kilometres away, showed a surface strewn with large boulders. Hayabusa-2 will continue to inch towards the asteroid until it is about 10 kilometres away, which JAXA expects will happen around 27 June. Ryugu's orbit cuts between those of Earth and Mars.

"From a distance, Ryugu initially appeared round, then gradually turned into a square before becoming a beautiful shape similar to fluorite, known as the 'firefly stone' in Japanese," project manager Yuichi Tsuda said in a 25 June statement.

Launched in December 2014, the probe is a follow-up to — and near-clone of — Hayabusa, which explored the asteroid Itokawa starting in 2005. Hayabusa was the first mission to return an asteroid sample to Earth. Ryugu is about 1 kilometre across — around 3 times wider than Itokawa but one-quarter the size of the comet 67P/Churyumov–Gerasimenko, which the European Space Agency's Rosetta probe visited between 2014 and 2016.

> *"Ryugu initially appeared round, before becoming a beautiful shape similar to fluorite."*

Ryugu is a 'C-type' asteroid, which has a darker surface than does Itokawa. In 1997, a NASA mission called NEAR Shoemaker made a fly-by of a C-type asteroid from a distance of more than 1,000 kilometres. Hayabusa-2 is the only spacecraft to have come this close to a C-type asteroid, says Lucy McFadden, a planetary scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

"We don't know much about C-type asteroids," says McFadden. But they are expected to have a composition similar to that of the early Solar System. In particular, Hayabusa-2 will determine whether the darkness of Ryugu's surface is due to it being rich in carbon — as is often assumed — or to small, metallic particles such as magnetite.

Chemical and isotopic analyses of the rock — to be done in space by Hayabusa-2's landers and then in terrestrial labs — could help to explain the origins of Earth and, particularly, its water. Many researchers think that Earth's oceans formed from a bombardment of water-rich asteroids or comets.

Among the first measurements Hayabusa-2 made was one of Ryugu's rotational period, or time it takes to make one turn on its own ▶

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