FIRE & ICE

How the poles affect tropical climates

S'pore could feel impact of sea-level rise, earth absorbing more heat and changes in global weather patterns

Audrey Tan
Environment Correspondent

Tropical Singapore is poles apart from the Arctic in distance and climate. But the icy realms of the world could affect the tropics in far more ways than many think, said scientists at a conference on arctic issues in Tromso, Norway, last month.

As the world warms, melting ice is causing sea levels to rise. Ice loss is also causing the planet to absorb more of the sun's heat, as a result of the disappearance of its icy reflective "shield". These point to the vulnerability of the region and the implications that the changes would have on the world.

Citing a recent report by the Intergovernmental Panel on Climate Change (IPCC), Norwegian Minister of Climate and Environment Ola Elvestuen said at the conference that a warming of 1.5 deg C will risk an ice-free Arctic in the summer every 100 years. "That is serious and disturbing enough. With a 2 deg C warming, we risk it every 10th year," he added.

The IPCC report, released last October, highlighted the differences in the impact of a 1.5 deg C global warming scenario versus a 2 deg C one, with the latter having catastrophic effects on earth systems, human livelihoods and biodiversity.

The urgency in limiting global warming to 1.5 deg C is clear. If this is achieved, the risk of reaching critical tipping points in the global climate system will be much lower, said Mr Elvestuen.

SCIENTIFIC EVIDENCE

Recent scientific reports on various aspects of global warming underscore the importance of the discussions at the Tromso conference.

Last month, an article in scientific journal Science noted that the oceans were heating up 40 per cent faster on average than what scientists estimated five years ago, reported The New York Times.

Two separate papers published in December and last month also documented the accelerating rates of ice melt at the Greenland and antarctica ice sheets.

The science clearly points to human activity as driving these global changes. But what is the impact on Singapore?

Professor Benjamin Horton, principal investigator at the Nanyang Technological University's (NTU) Earth Observatory of Singapore, said: "The large-scale changes that take place in the arctic climate system exert a strong influence on the global climate system."

Their impact on Singapore, said Prof Horton, who is also one of the review editors of the upcoming Sixth Assessment Report by the IPCC, can broadly be classified into three main categories: sea-level rise, heat gain due to the loss of a planetary icy "shield", and changes in global circulation patterns.

Already, Singapore is feeling the impact of global warming.

It is experiencing a long-term trend of warming, with last year being the Republic's eighth-warmest year on record, said the Meteorological Service Singapore.

SEA-LEVEL RISE

Singapore's Second National Climate Change Study has shown that the mean sea level is estimated to rise by up to 1m by 2100.

There are a few ways global warming could cause this. The first is the thermal expansion of water, which expands when heated. This has been the biggest contributor to sea-level rise so far, said Prof Horton.

And, in view of recent findings on ocean warming, this effect is expected to continue to contribute up to 50 per cent of the rise in sea levels in years to come, he added.

And just as how adding ice cubes to a glass of water raises water levels, melting land ice would also substantially contribute to sea-level rise. Most of this water is now locked in the world's ice sheets in Greenland and Antarctica. If they were both to melt completely, sea levels would go up by about 65m, said the IPCC.

Scientists say this would take thousands of years at the current rates of warming. But the impact on Singapore in this doomsday scenario would be worse than the global average, said Prof Horton.

S'PORE'S STRATEGIES continued on B3

STRONG IMPACT

The large-scale changes that take place in the arctic climate system exert a strong influence on the global climate system.

PROFESSOR BENJAMIN HORTON, principal investigator at the Nanyang Technological University's Earth Observatory of Singapore. The impact on Singapore can broadly be classified into three main categories:

- Sea-level rise;
- Heat gain due to the loss of a planetary icy "shield";
- Changes in global circulation patterns.

Singapore is already feeling the impact of global warming. It is experiencing a long-term trend of warming, with last year being the Republic's eighth-warmest year on record, says the Meteorological Service Singapore. Furthermore, Singapore's Second National Climate Change Study has shown that the mean sea level is estimated to rise by up to 1m by 2100. ST FILE PHOTO

Running into obstacles, rivalry from e-scooters

FROM B1

The unwillingness of commuters to pay higher fees for shared bikes is a challenge, said Dr Elliot Fishman from the Institute For Sensible Transport in Australia. "With all the competition among bike-sharing firms, no commuter wants to pay a lot of money for shared bikes."

Former operators such as oBike and ShareBikeSG have cited regulation as another obstacle here.

The LTA has stepped in with its licensing regime to tackle the problem of rampant indiscriminate parking of shared bikes, which were estimated to number more than 100,000 at one point.

LTA requires operators to comply with a set of rules. Those with a full licence have to pay a $30 annual fee and a $30 refundable security deposit per bike. Smaller players can apply for a sandbox licence, which has a fee of $12 per bike.

Mr R.J. Seet, strategy manager of Anywheel, which has a sandbox licence to operate 1,000 bikes, said the new regulations could potentially deter customers, who have to take an additional step to end their ride at a designated parking area.

SG Bike, which has a full licence to operate 3,000 bikes, said it translated into higher operation costs.

An LTA spokesman acknowledged operators will incur some costs, but said the new rules are necessary for the "sustainable and responsible growth" of the industry.

Shared-bike operators are also set to face additional competition, in the form of shared e-scooters.

Some companies believe such devices would be more popular than bicycles. That is why Grab has pivoted from bikes to e-scooters, which it said have "a stronger fit in Singapore due to the humid weather and limited land space".

Still, local start-ups SG Bike and Anywheel remain optimistic.

SG Bike has seen consistent growth in the usage of its bikes in the past few months, according to its marketing director Benjamin Oh. He declined to give specific figures, for competitive reasons.

He added that the Government's push for a car-lite society and ongoing infrastructure improvements, such as building more bicycle paths, mean bicycles could become a more popular mode of transport.

Anywheel believes that the current supply of shared bicycles does not meet the demand. It thus plans to apply for a full licence and expand its fleet to 10,000.

But Dr Theseira said the road ahead may not be as smooth as some hope. "Everybody agrees that it might be useful to have some kind of shared short-range transport system, but that is different from the question of whether you can get people to pay for it," he said.

"If you can solve the financing problem, then okay, fine. But right now, nobody has cracked that yet."

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Six hurt as car hits tree; driver arrested

Six people were taken to hospital after a car accident in Punggol yesterday morning.

The police said they were alerted to the accident involving three pedestrians in Punggol Central, towards Sumang Lane, at 8.48am.

The driver and two passengers were among the six, aged between 29 and 65, taken to Khoo Teck Puat Hospital. The 63-year-old driver was later arrested for causing hurt by a negligent act, the police said.

Engineer Koh Chek Kian told The Straits Times that he saw the car breach the kerb and hit a tree at high speed. "It then swerved 90 degrees, and its tail hit three people on the road island who were waiting to cross the road," he said.

Passers-by and churchgoers from the nearby Church of the Transfiguration ran over to help.

One injured woman was trapped under the car and had to be rescued by Singapore Civil Defence Force officers using hydraulic tools.

Mr Koh, 48, said the woman's leg was trapped under a wheel of the car and bleeding profusely. He said some passers-by used some of their clothing to help stem the bleeding.

The driver and his two passengers were bleeding from cuts and abrasions on their arms, Mr Koh said.

He added that one of the passengers was an elderly woman crying out in pain. "She was slumped over in the centre part of the car. I had to help her out... She said she was very dizzy and her right leg felt numb."

Videos provided by Mr Koh show several people at the site, with the car on the road divider.

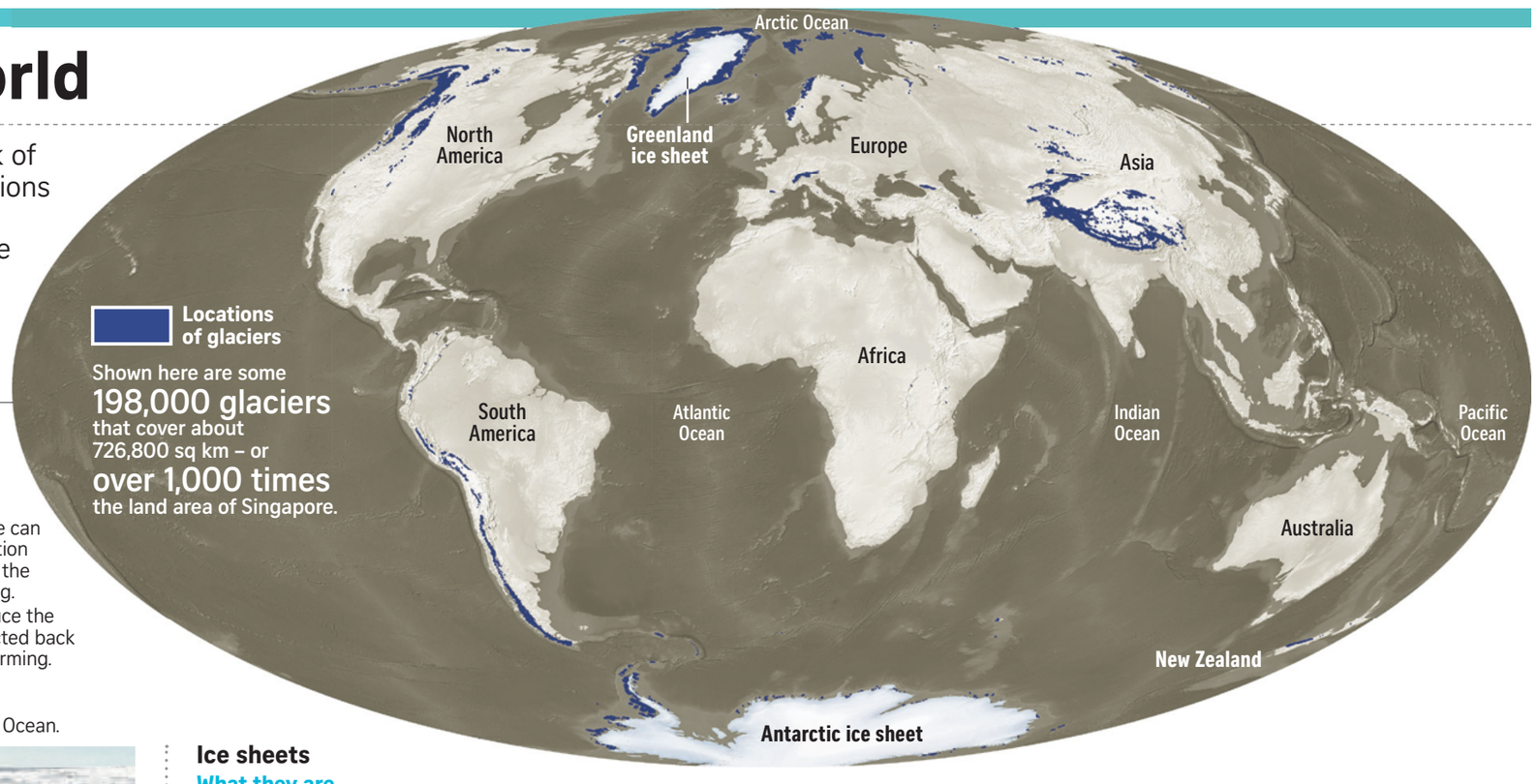
A photo taken by Chinese-language daily Lianhe Wanbao shows the car's front and hood severely damaged and bent out of shape from its impact with the tree. The police are investigating the incident.

Tee Zhuo

The car's front and hood were severely damaged and bent out of shape after the vehicle breached the kerb and crashed into the tree in Punggol yesterday. PHOTO: LIANHE ZAOBAO

What cools the world

As the world warms, the earth faces the risk of losing its ice. This could have many implications for Singapore. **The Straits Times** speaks to Ms Margaret Lindeman, a doctoral candidate studying glacier-ocean interactions at the Scripps Institution of Oceanography, to learn more about the cryosphere, and the role of ice in the climate system.



MAIN TYPES OF ICE

Sea ice

What it is

- Formed when air cools the ocean below its freezing point.
- Just as how the water level in a glass of frozen water does not change when the water melts, melting sea ice does not have an impact on sea-level rise.
- But it still plays a crucial role in the climate system due to its reflective capabilities. Called the ice-albedo feedback, sea ice can reflect incoming solar radiation back into space, preventing the earth's surface from warming.
- Melting sea ice could reduce the amount of heat being reflected back into space, exacerbating warming.

Where it can be found

In places such as the Arctic Ocean.

Arctic sea ice as seen from a South Korean icebreaker in August last year.

Ice sheets

What they are

Ice sheets, according to the National Snow and Ice Data Centre, are land ice that are at least 50,000 sq km.

Where they can be found

- There are only two ice sheets in the world – the Greenland ice sheet, formed about three million years ago, and the Antarctica ice sheet at about 34 million years old.
- Scientists estimate that if both ice sheets were to melt completely, global sea levels will go up by about 65m.

Hiawatha impact crater covered by the Greenland ice sheet.

Glaciers

What they are

Glaciers are also land ice that, like ice sheets, are formed through the compaction of snow.

Where they can be found

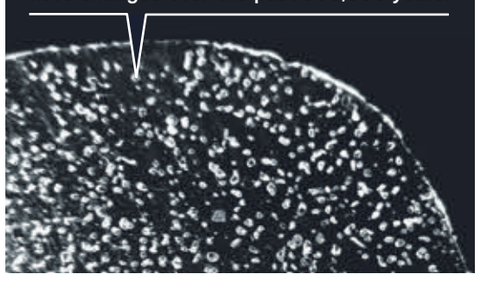
- In many places around the world, including in northern Asia.
- Surprisingly, the key season that determines the formation of glaciers is summer, not winter. If the rate of ice melt in summer is lower than snow fall in winter, glaciers are likely to form.
- This condition means glaciers usually form in the polar regions or in mountainous areas.

Franz Josef Glacier on New Zealand's South Island dwarfs visitors.

Ice cores

As snow accumulates on land and gets compacted into ice, it holds within its layers clues to earth's climate in the past.

Ancient air, trapped in bubbles in the ice, allows scientists to measure how carbon dioxide concentrations in the atmosphere have changed over the past 800,000 years.



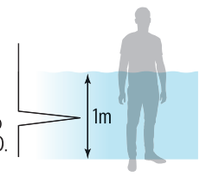
IMPLICATIONS FOR SINGAPORE

Shipping hub status

Melting sea ice in the Arctic could threaten Singapore's position as a global shipping hub if the Northern Sea Route is opened all year round, shaving 30 per cent off travel time via the conventional Suez Canal-Malacca Strait route.

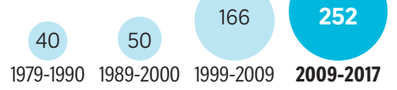
Sea-level rise

- The melting of glaciers and ice sheets has the potential to cause sea-level rise.
- Singapore's Second National Climate Change Study has projected mean sea level in the Republic to go up by about 1m by 2100.



Antarctic ice loss has raised global sea levels 1.4cm since 1979

Antarctic ice loss per year (billion tonnes)



Sources: MARGARET LINDEMAN, NATIONAL SNOW AND ICE DATA CENTRE, NATIONAL SCIENCE FOUNDATION ICE CORE FACILITY, ST FILE
PHOTOS: NASA EARTH OBSERVATORY, TOURISM NEW ZEALAND, AFP, COURTESY OF JACOB MORGAN STRAITS TIMES GRAPHICS

Impact of warming on earth's icy shield, weather patterns

FROM B2

Ice sheets are large blocks of ice that extend at least 50,000 sq km, as defined by the National Snow and Ice Data Centre. Their large masses allow them to attract ocean waters towards them, raising surrounding sea levels.

"If an ice sheet melts, its gravitational attraction decreases and sea levels around it can go down," said Prof Horton. "Conversely, regions far from a melting ice sheet, such as Singapore, will see a rise in sea level greater than the global average."

But apart from ice sheets, the contribution of glaciers – smaller blocks of land ice – to sea-level rise should not be ignored, said Professor Ben Marzeion, a climate scientist at the Institute of Geography at the University of Bremen, Germany.

His research found that melted glaciers caused sea levels to rise by between 106mm and 137mm in 2015, compared with 1901 levels.

"Glaciers will contribute to future sea-level rise no matter what we do, but future warming will determine melt rates, which will decide how much time countries have to adapt," he told The Straits Times during the conference in Norway.

This, he said, is because glaciers are much smaller than ice sheets. "A large block of ice would take much longer to melt compared with a smaller piece," he said.

EARTH'S ICY SHIELD

Global warming could also cause earth's icy "shield" to melt. This results in an increase in the amount of heat absorbed by the planet, exacerbating the warming trend.

The whiteness of the snow-covered poles makes them a lot more reflective compared with earth's other surfaces, such as the ocean or forest covers.

"Snow regulates our planet's energy balance, reflecting 85 per cent of incoming solar radiation back into space," said a group of scientists from institutions such as the United States National Aeronautics and Space Administration and the Norwegian Polar Institute in a recent paper in journal Nature Climate Change.

The ability of ice to reflect heat and reduce surface warming is known as the ice-albedo feedback.

Said Prof Horton: "An ice-covered Arctic reflects solar radiation which otherwise would be absorbed by the oceans and cause the earth's surface to heat up. But when more ice and snow melt, there will be more dark surfaces. This is a self-reinforcing effect."

CIRCULATION PATTERNS

Professor Tor Eldevik, deputy director of the Bjerknes Centre for Climate Research at the University of Bergen, Norway, said melting ice could, in theory, affect the ocean's ability to transport heat around the planet.

This phenomenon is still under study, but may have the potential to cause changes in northern hemisphere weather patterns.

Under normal conditions, warm water from the tropics surges towards the Arctic, where it cools, becomes denser and sinks, before flowing back south. This is known as the Atlantic Meridional Overturning Circulation. Its warm, northbound current helps make winters in western Europe more bearable, while the cooler, south-flowing branch helps remove carbon from the atmosphere.

But in a warming world, an influx of fresh water from melting ice could reduce the density of the water in the high north, reduce the sinking, and weaken the oceanic "conveyor belt".

While there have been scientific studies showing a decline in the strength of this circulation since around 1970, Prof Eldevik said it may still be too soon to say, as there are observational studies that suggest otherwise.

"It is a big question now how climate change will affect this circulation, if it will bring warm water further into the Arctic and cause more sea ice to melt or if it will cause the arctic shelves to melt," he said.

Both melting sea ice and land ice could change the density of sea water substantially and alter the circulation.

"However, current contributions from this melting are, in my opinion, not of sufficient magnitude to cause such change," said Prof Eldevik.

Changes at the poles have the potential to cause global changes in climate, but NTU's Prof Horton said Singapore's biggest challenge would be dealing with sea-level rise.

While the process could take thousands of years, earth's rapid rates of warming could bring this forward.

Singapore is aware of this threat and is taking steps to safeguard the country, said Minister of State for Foreign Affairs Sam Tan.

In 2011, for example, the authorities here raised the minimum reclamation level to at least 4m above mean sea level, an increase of 1m.

Selected roads, such as Changi Coast Road and Nicoll Drive, have also been raised to reduce the impact of flooding. To mitigate coastal erosion, seawalls and rock slopes near the coasts have also been installed.

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