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About 10,000 years ago, sea levels in Singapore were at least 20m lower than what they are today.

With the Ice Age coming to an end, melting land ice fuelled the oceans and sea levels rose over the next three millennia.

Eventually, rising waters flooded and killed a mangrove forest along Singapore's southern coast, according to a study by climate scientists at the Nanyang Technological University (NTU).

The results were published in the scientific journal *The Holocene*.

They offer insight into how present rising sea levels could impact the country in the years to come – especially when the accelerating rate due to human activity is taken into consideration.

Researchers found that from 10,000 to 5,000 years ago, sea levels were rising at rates as high as 10mm to 15mm a year. Sea-level data for the subsequent two millennia is patchy and NTU researchers are looking to fill the gaps.

Preliminary data, however, indicates that modern sea levels were reached about 3,000 years ago and remained relatively con-

Scientists dig deep to gauge Singapore's rising sea levels

Better understanding of fluctuations will yield more accurate predictions on future changes

stant until the start of the Industrial Revolution in the 18th century.

In the 20th century, a warming planet due to human emissions caused sea levels to rise 1mm to 2mm a year as water expands when heated.

Today, the rate is between 3mm and 4mm a year – thermal expansion is still happening but land ice is also melting faster.

The study's lead author Stephen Chua, who did the research as part of his doctoral work at NTU's Earth Observatory of Singapore and the Asian School of the Environment, said understanding how sea levels have changed in Singapore could lead to more robust local projection of sea-level rise.

A better understanding of the fluctuations will help scientists to come up with models that can more accurately predict sea-



Global warming is causing sea levels to rise much more quickly than before. TNP FILE PHOTO

level rise in this part of the world.

To figure out what sea levels were like all those years ago, the researchers had to dig deep into the earth.

They looked through thousands of available borehole logs – records of holes that have been drilled into the ground for infrastructure projects – to find an area with deposits such as

marine mud and mangrove peats.

Such deposits accrete, or accumulate, layer by layer and contain pollen and microfossils of foraminifera – tiny organisms found in marine environments.

Their presence can help researchers determine how sea levels have fluctuated in Singapore.

The climate scientists at NTU discovered abundant mangrove pollen 20m below the current sea level, indicating that a mangrove shoreline existed in southern Singapore almost 10,000 years ago.

Because the complex root systems of mangrove trees can trap sediment from the tides as they ebb and flow, they can, to an extent, keep pace with sea-level rise and are considered a natural defence against rising waters.

Despite mangroves' adaptability and effectiveness as a coastal defence, the study highlights their limitations in the event of rapid sea-level rise, said the NTU researchers in a statement.

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