

Wrath of the sea

Rising sea level exacerbates the fury of cyclones



Goa, Maharashtra and Gujarat are limping back after Cyclone *Tauktye*. Estimates of the cost of the damage and restoration are yet to come. And then, there is Cyclone *Yaas*, striking the eastern states of Bengal and Odisha. In the same month of May, last year, Cyclone *Amphan*, had struck Odisha and Bengal (and Bangladesh) and caused damage priced at \$ (US) 14 billion. There is no telling what it would be this time, but a study published in the journal, *Nature Communications*, says the damage resulting from extreme climate events increases with the rise in sea level.

There is ample documentation to show that there has been an 18 cm (over seven inches) rise in the average sea level since 1900. With the globe warming much faster in the last few decades, we can expect an even greater rise within a much shorter time. Warming itself has been linked to more frequent and intense weather events. That sea level rise would multiply the damage caused by the events is ominous.

Benjamin H Strauss, Philip M Orton, Klaus Bittermann, Maya K Buchanan, Daniel M Gilford, Robert E Kopp, Scott Kulp, Chris Massey, Hans de Moel and Sergey Vinogradov, from Climate Central, a group of scientists in Princeton, Stevens Institute of Technology and Rutgers University in New Jersey, Tufts University, Boston, Vrije Universiteit Amsterdam, Potsdam Institute for Climate Impact Research, Germany, United States Army Corps of Engineers, Washington, DC and Binera, Inc. in Maryland look into the role of human activity in Hurricane *Sandy*, which struck the East Coast of the U S in 2012. The cost of the damage was \$ 60 billion. The group writing in *Nature Communications* used simulation with different sea levels and found that 13.5 per cent of the damage was a result of sea level rise due to human activity.

Hurricane *Sandy*, which wreaked havoc all along the east coast of the U S, caused 300-year record high flood levels in the New York Metropolitan Area, "flooding streets, tunnels and subway lines and cutting power in and around the city." The *Nature Communications* paper concedes that the hurricane was worsened by having struck right when it was high tide and again by having come in at almost right angles with respect to the New Jersey coastline. Despite these factors, the paper says, the mean sea level had a direct connection with the flood levels experienced. And modelling establishes the extent of damage due to sea level rise arising from human activity.

The factual basis of the simulation is the observation that sea level is rising, and rising faster, with the ice sheet and glacier melt being the major contributors. Data from tide gauges and satellite ranging shows that the sea level rose by 1.4 mm each year, between 1900 and 1990, but by 2.1 mm a year between 1970 and 2015, by 3.2 mm a year between 1993 and 2015 and by 3.6 mm a year between 2006 and 2016. We can see that the rate of rise has increased by 150 per cent since 1970.

And then, in the context of 95 per cent of global temperature rise, which leads to ice sheet melting, being due to human activity, the team assesses the contribution of human activity to sea level rise, globally and in the New York region. The method of assessment was to con-

struct a table where the sea level rise, over a period, was correlated with the change in the mean temperature during the period. There is a fraction of sea level rise that is due to other reasons. This is factored out and the contribution of human activity is calculated.

Accordingly, the sea level rise was computed, based on (a) the elements that contribute to the rise and (b) empirical data relating sea level rise with temperature rise. For the first computation, referred to as a "budget-based" estimate, the main contributors were seen to be the melting of land-bound ice sheets and glaciers, the rise due to expansion of seawater with rising temperature, and changes in water stored in inland reservoirs (like dams). And these are affected by the changes in the shape of the Earth itself, mainly due to changes in the ice-loading at the poles. And from this analysis, the team works out that 9.8 cm out of the 18 cm rise in sea level from 1900 to 2012 was on account of the warming that arose from human activity.

The second approach was to estimate the sea level, over the centuries, based on different geological sources, and records, like tide-gauge readings kept for mercantile shipping, the world over. The record shows that the sea level rose a tenth of a millimetre every year for the first eight centuries CE and fell by two tenths of a millimetre during the 2°C cooling of the mini ice age in the 11th to the 15th centuries. But it picked up during the 19th and 20th centuries, faster than anything during the previous 27 centuries. Modelling sea level rise shows that but for human activity, the sea level rise in the 20th century would have been

less than 51 per cent of what is seen.

Damage due to sea level rise

Having thus found that at least 49 per cent of the rise in the sea level is on account of human activity, the paper looks at what part of the damage caused by Hurricane *Sandy* should be pinned on human activity. With only small damage due to winds, 98 per cent of the damage and loss came from coastal flooding, the paper says.

This exercise was carried out using a procedure for modelling the near shore hydrodynamics of events like storms, developed by the U S Army Corps of Engineers. The topography and water depth data, and the wind and atmospheric pressure during Hurricane *Sandy* were used to develop the model, and the flood levels in the simulation were found to match the actual flooding. The model was then applied to discover flooding with lower levels of the mean sea surface. With the help of a "damage model" based on the actual flooding, it was then possible to work out what the damage would have been with lower mean sea levels, to start with.

Flood maps were created using data of land elevation and water elevations from the model, after applying due corrections. Census data was used to assess the land, housing and population that was exposed, and damage was calculated using a system developed by the U S Federal Emergency Management Agency. The method is based on records of payments by insurance companies and even if the method is not accurate for the determination of losses, it provides reliable comparative costs of floods simulated

Preparing for the storm

Flood-proofing is the way forward for coastal settlements. Structures need to be strengthened and new structures compulsorily built to withstand floods. The machinery to evacuate people, render first aid and restore utilities must be built up and kept ticking over. The cost of not doing so is rising.

from different baseline sea levels. The method, the paper says, yields the fraction of the damage that can be attributed to sea level rise due to human action.

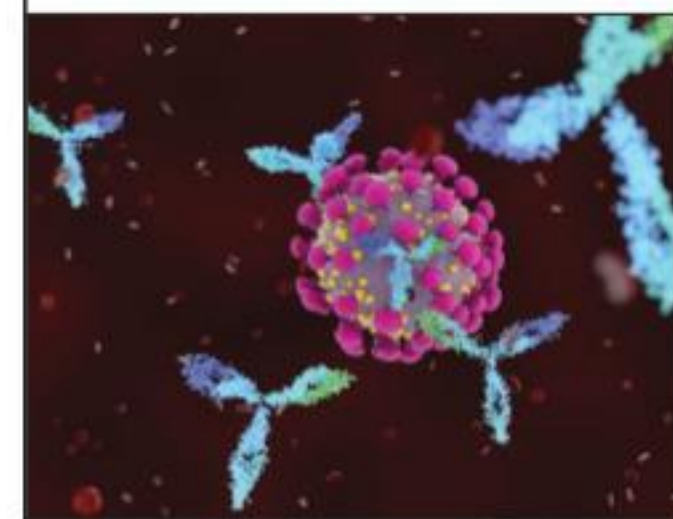
The result of the computation is that \$ 8.1 billion, or 13.5 per cent of the losses caused by Hurricane *Sandy* was driven by sea level rise associated with anthropogenic, or human-caused climate change. "The same general approach demonstrated here may be applied to other past and future coastal storms to estimate sea-level-linked anthropogenic climate damages from those events," the paper says. But the message is that with sea levels set to rise in the coming decades, the losses due to extreme climate events are also set to rise.

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This page went to press before Cyclone *Yaas* made landfall in West Bengal and Odisha.

PLUS POINTS

Covid antibodies



Antibodies against coronavirus remained in the blood of patients with Covid-19 for at least eight months after they were infected, Italian researchers said recently. They were present "regardless of the severity of the illness, the age of the patients or the presence of other pathologies," according to a statement from the San Raffaele hospital in Milan.

The researchers, working with Italy's ISS National Health Institute, studied 162 patients with symptomatic coronavirus who turned up at the emergency room during the country's first wave of infections last year.

Blood samples were taken in March and April and again at the end of November from those who survived. Some 29 patients died.

"The presence of neutralising antibodies, while reducing over time, was very persistent - eight months after diagnosis, there were only three patients who no longer showed positivity to the test," said the statement, issued jointly with the ISS.

The study, published in the *Nature Communications* scientific journal, also emphasised the importance of the development of antibodies in recovering from coronavirus. "Those who failed to produce them within the first 15 days of infection are at greater risk of developing severe forms of Covid-19," it said.

Two thirds of the patients surveyed were men, and the average age was 63. Some 57 per cent of them had a pre-existing pathology, notably hypertension and diabetes.

—THE STRAITS TIMES/AGENCIES

Booze & brain



Even moderate consumption of alcohol is associated with adverse effects on the brain, according to a new study of over 25,000 participants which calls for existing "low-risk" drinking guidelines to be revised.

While binge drinkers and individuals with high blood pressure and body mass index may be more susceptible, the study, which is yet to be peer-reviewed, found "no safe dose of alcohol for the brain." Scientists, including Anya Topiwala from the University of Oxford, assessed the health profiles of 25,378 individuals from the UK Biobank - a database designed to help researchers understand the link diseases have with genetic and environmental factors.

They assessed each participant's data, including their age, sex, BMI, blood pressure, self-reported alcohol consumption, and brain health from magnetic resonance imaging scans. The results revealed that a higher quantity of weekly alcohol consumption was associated with lower brain grey matter density even after accounting for individual differences in biological and behavioural traits among the participants.

"Alcohol consumption was linearly and negatively associated with indices of brain health across most of the brain. Additive harmful effects of alcohol volume and frequent bingeing were observed," the scientists wrote in the study, posted in the preprint platform medRxiv.

Scientists believe the large sample size of the study enabled a deeper exploration of the association between alcohol consumption and brain structures such as the cortex and cerebellum which was previously uncharacterised. According to the researchers, higher volume of alcohol consumption per week as well as binge drinking could have additive effects throughout the brain irrespective of the type of beverage consumed.

Citing the limitations of the study, the scientists said the invitations for participants yielded only a five per cent response rate from the UK Biobank, adding that the sample was less ethnically diverse, healthier and better educated. The researchers also added that the study was observational, and did not find any causal relationship between alcohol drinking and brain health.

While an official guideline issued by UK's department of health in 2016 urges people to not consume more than 14 units of alcohol a week - which is close to five pints of beer at five per cent alcohol by volume strength - the scientists behind the current study say this measure needs to be revised, incorporating the recent findings.

—THE INDEPENDENT



CHRIS IMPEY

When the first baby is born off-Earth, it will be a milestone as momentous as humanity's first steps out of Africa. Such a birth would mark the beginning of a multi-planet civilisation for the human species.

For the first half century of the Space Age, only governments launched satellites and people into Earth orbit. No longer. Hundreds of private space companies are building a new industry that already has \$ (U S) 300 billion in annual revenue.

I'm a professor of astronomy who has written a book and several articles about humans' future in space. Today, all activity in space is tethered to the Earth. But I predict that in around 30 years people will start living in space - and soon after, the first off-Earth baby will be born.

The players in space

Space started as a duopoly as the United States and the Soviet Union vied for supremacy

CITIZENS OF THE GALAXY

When will the first baby be born beyond the confines of Earth?

grandiose plans have sceptics but remember that these are the two richest people in the world.

Governments will continue to launch rockets, but it would be safe to say that the future of private space flight arrived in 2016 when, for the first time, commercial launches outnumbered launches by all the world's countries combined.

Living on the Moon or Mars

For a spacecraft, the trip to Mars is about 1,000 times farther than a trip to the Moon, so the Moon will be humanity's first home away from home.

China is partnering with Russia to build a long-term facility at the Moon's South Pole sometime between 2036 and 2045. Nasa plans to put "boots on the Moon" in 2024 and establish a permanent settlement called the Artemis Base Camp within another decade. As part of the Artemis mission, Nasa is also planning to launch a lunar space station in 2024 called Gateway. Nasa is teaming up with SpaceX for this and future lunar projects, and the lunar station will make it easier for SpaceX to resupply the future lunar colony.

After the Moon, comes Mars, and the collaboration between SpaceX and Nasa is accelerating the timeline for getting there. Nasa's plans are purposeful, but the organisation hasn't given a timeline. Musk, on the other hand, has loudly proclaimed that he intends to have a colony on Mars by 2050. Humanity's attempt to colonise the Moon will give us a good sense of the challenges we might face on Mars.

Sex and babies in space

For a civilisation to be free from Earth, the population needs to grow, and that means babies. Living on the Moon or Mars will be arduous and stressful, so the first inhabitants will probably spend only a few years there at a time and are unlikely to start a family.

But once people do take up permanent residency off-Earth, there are still many unknowns. First, little research has been done on the biology of pregnancy and reproductive health in a

space or low-gravity environment like the Moon or Mars. It's possible there will be unexpected hazards to the foetus or mother. Second, babies are fragile, and raising them is not easy. The infrastructure of these bases would have to be sophisticated to make some version of normal family life possible, a process that will take decades.

With these uncertainties in mind, it seems likely that the first off-Earth baby will be born much closer to home. A Dutch start-up called SpaceLife Origin wants to send a heavily pregnant woman 250 miles up just long enough to give birth. They talk a good story, but the legal, medical and ethical obstacles are formidable.

Another company, called Orbital Assembly Corporation, plans to open a luxury hotel in orbit in 2027 called the Voyager Station. Current plans show that it would hold 280 guests and 112 crew members, with its spinning-wheel design providing artificial gravity. But the breathless news reports omit any discussion of the difficulty and cost of such a project.

On 12 April this year, however, Nasa announced that it is considering allowing a reality TV show to send a civilian to the International Space Station and film them for 10 days. It's plausible that this idea could be extended, with a wealthy couple booking a long-term stay for the entire process from conception to birth in orbit.

Now, there's no evidence anyone has had sex in space. But with about 600 people having been in Earth orbit - including one Nasa couple who kept their marriage a secret - one space historian was able to gather plenty of Space Age salacious moments.

My guess is that sometime around 2040, a unique individual will be born. They may carry the citizenship of their parents, or they may be born in a facility operated by a corporation and end up stateless. But I prefer to think of this future person as the first true citizen of the galaxy.

The writer is a university distinguished professor of astronomy, University of Arizona, United States. This article first appeared on www.theconversation.com