Getting ready for rainy days

To adapt to climate change, one must plan for impending episodes of heavy rainfall that will be more severe than ever

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While weather is traditionally unpredictable, days when there is extreme rainfall seem no longer to be events that are rare. And the general belief is that with global warming they will start coming more often.

Angeline G Pendergrass of National Center for Atmospheric Research, Boulder, Colorado and Reto Knutti, Institute for Atmospheric and Climate Science, ETH?Zurich, Zurich, report in *Geophysical Research Letters* that while the total rainfall will only slightly increase, the severity of extreme events will worsen. This would sharpen the existing lopsidedness, where the best part of the rain that falls through the year comes down in just a few days of heavy downpour, they say.

Pendergrass and Knutti use extensive rainfall data, and models, to analyse the asymmetry, or the unevenness of the timing of rainfall, as it exists and as it would change with the effects of global warming. As it is, they say, one half of the annual rainfall, worldwide, falls during just the 12 wettest days of the year, with comparatively negligible rain during the rest of the year. If the emission of greenhouse gases continues without significant check, they say,the asymmetry would increase, with as much as a fifth of the annual rain within just the two wettest days, half the annual rain, which now takes 12 days, in just six days, and 70 per cent in the wettest two weeks!

The unevenness of rainfall has been increasing over the last century, the paper says. One way of measuring unevenness has been by the percentage of the annual rainfall in the 95th percentile, or the top five per cent of the rainy days. This percentage has been increasing during the 20th century, the paper says. Another measure of inequality, which is often used to describe how income is distributed in a population, is the Gini coefficient. The coefficient can takes values from 0 to 1. Coefficient 0 would mean no inequality, or everybody earns the same, and coefficient 1 would mean total inequality, with one person bagging all the income. The coefficient does not indicate the total or the average income, only the distribution. Thus, Turkey and the US are said to have had the same Gini index, about 0.4, in 2014, although the GDP per person in Turkey is less than half of what it is in the US (India is around 0.35).

We can see that in the context of rainfall, Gini =0 would mean the same rainfall throughout the year and Gini=1 would mean all the rain fell in a single day. The paper alludes to studies that have shown that the Gini index of rainfall has risen right through the 20th century, and other studies that showed the rise was linked to man-made emissions. The percentile or the Gini index as measures of changes in rainfall patterns have the merit of being numerical, but they are not quite intuitive, to be easily understood by a broad audience, the paper says.

Researchers have rather looked at how two aspects of rainfall respond, separately, to climate change. One is the mean rainfall. This is expected to rise by a modest two per cent for every °C rise in temperature. The severity of extreme events would increase faster, about six per cent for every °C rise in temperature, depending on what we consider to be an extreme. The difference can be understood, of course. The mean rainfall, over the course of a year, depends on the energy the earth receives from the sun, evaporation and winds. If a lot of the vapour in the atmosphere comes down in a short period, there is less for the rest of the time, and the average is not affected. Extremes, on the other hand, depend on different factors, increasing moisture, humidity, temperature, terrain and their interplay. Here, it is seen that the effect of warming is more or less marked according to our definition of the extreme. The 99th percentile, for instance, is the most affected, the 95th percentile to a lesser degree and the 90th percentile starts behaving like the mean.

The present study takes a fresh look at the data to find a measure that brings out the element of changing unevenness more distinctly. As the main feature is that a large fraction of rainfall comes down in a small number of days, changes in the way a given fraction of rain falls within a fixed number of the rainiest days appears to capture how the unevenness is progressing. They note that 'three quarters of precipitation falls on the wettest 30 days each year, over 1/8 falls on the wettest two days and 1/12 on the wettest day'. Hence, the number of days each year during which half of annual precipitation falls, they say, would serve as a 'summary metric' and they note that half of total precipitation falls on the wettest 12 days each year.

They then analyse how this measure would change in the future, according to different levels of greenhouse gas build-up, depending on how the industry and populations respond to containing warming. The main conclusion they reach is that while the mean rainfall would respond gradually, the change in the severity of extreme events would also average out, but there would be dramatic increases in the precipitation during the wettest periods. Over half the increase, they say, would take place on the wettest 8.6 days each year, and beyond the 98.2 percentile.

Existing agricultural practices and the growth of settlements have come about over centuries of largely unchanging rainfall patterns. Increasing compression of rainfall into short periods would lead to floods. And there would be corresponding droughts because of less rainfall in other periods. This would have a large impact on agriculture and food production. The water supply and storage and drainage that are established in cities and other settlements would also be challenged. Flooding could be particularly disastrous. There are large investments, like roads, underground railways and most important, the sewage system, that has considered the available 'high flood levels' during their design.

Getting ready for flood levels that we have not encountered would be an important part of adaptation to climate change.

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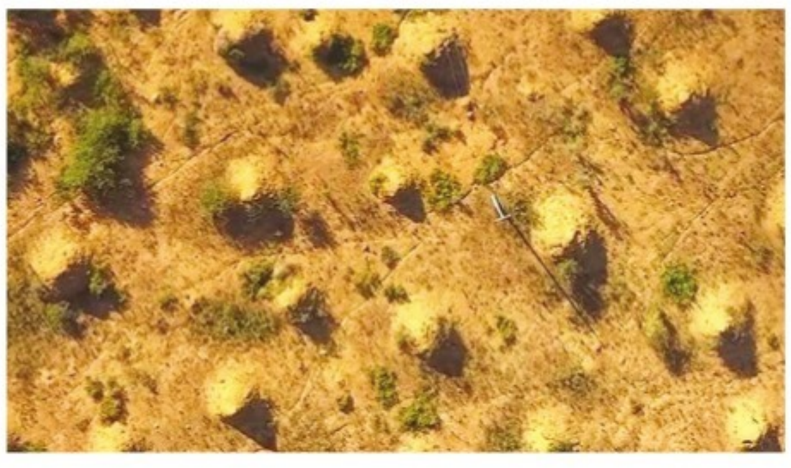
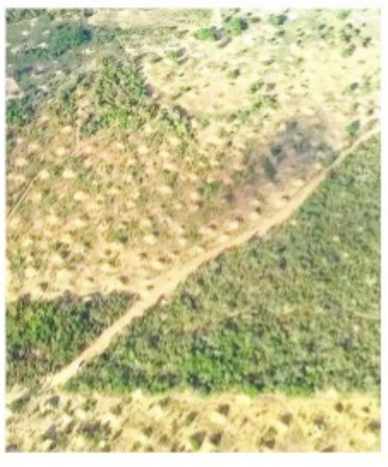
A biological wonder

Termites have been building hundreds of millions of huge mounds for 4,000 years – and now scientists know why

ALEX MATTHEWS-KING





A termite super-colony which spans an area the size of Great Britain has been under construction since the time of the pyramids in ancient Egypt, scientists have found.

Researchers studying the vast landscape of 200 million cone-shaped mounds in northeast Brazil sampled soil from 11 locations and found that some began construction around 3,820 years ago.

At around 2.5 metres tall, nine metres wide at the base, and spread across 230,000 square kilometres, it represents a vast earth-moving endeavour – but the mounds are not individual termite nests.

Instead, each one is a "waste point" where termite workers dump soil and other matter excavated in the production of a vast subterranean tunnel network which they have used to traverse the landscape in search of food for millennia.

The authors of a new study, published in the journal *Current Biology*, said the "biological wonder" was akin to those of the ancient world, but with the civilisation that built it still in residence.

"This is apparently the world's most extensive bioengineering effort by a single insect species," said Roy Funch of Universidade Estadual de Feira de Santana in Brazil, one of the authors of the report.

"Perhaps most exciting of all – the mounds are extremely old – up to 4,000 years, similar to the ages of the pyramids."

They are largely hidden from view by caatinga, an assortment of thorny, desert-like vegetation unique to Brazil, and were only revealed to international scientists a few decades ago as the land was cleared for pasture.

Now sampling from the oldest mounds has revealed the area is of comparable age to some of the oldest termite colony structures known to exist in Africa, while others began construction around 600 years ago.

They have developed in response to the drought-sculpted environment where the annual leaf fall is a boom time for harvesting food, punctuated by long periods where resources are scarcer.

"These mounds were formed by a single termite species that excavated a massive network of tunnels to allow them to access dead leaves to eat safely and directly from the forest floor," said Professor Stephen Martin, a social insect expert from the University of Salford and another of the authors.

"The amount of soil excavated is over 10 cubic kilometres, equivalent to 4,000 great pyramids of Giza, and represents one of the biggest structures built by a single insect species.

"It's incredible that, in this day and age, you can find an 'unknown' biological wonder of this sheer size and age still existing, with the occupants still present."

The mounds are not the only entry points to the tunnel network – termites emerging at night to scavenge use dozens of smaller entrances between each waste point.

By inspecting mounts cut in half by road building projects, Professor Martin and colleagues also showed they lack the complex honeycomb of tunnels usually associated with a termite nest.

Instead each includes a single large central tunnel – measuring 10 cm across – connecting to the underground tunnel network and a series of horizontal "galleries" containing dead leaves or larvae.

"The tunnels are never left open to the environment, ruling out their use as a ventilation system," which left them puzzled as to how and why they had been created at such regular intervals.

One theory is that each mound was from a competing colony, but when they transferred termites to a rival neighbouring mound they were not swarmed and attacked.

This suggests that they intermingle underground rather than competing, and when they did the same test with termites taken from mounds 50km away the attack response was immediate.

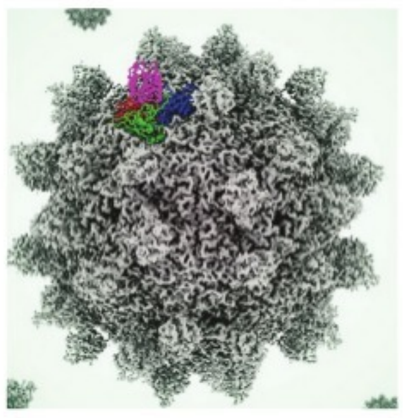
It suggests there must be shared pheromone scent cues used across the tunnel network which identify local neighbours.

Professor Martin and his colleagues suggest that these scent markers may exist at each mound point to ensure every termite uses it to remove soil and waste, leading to the equal spacing.

The independent

PLUS POINTS

Preventing recurrence



Scientists using viruses to combat cancer have found a way to prevent the disease from returning by targeting the healthy cells tumours enslave to use as camouflage and life support.

University of Oxford researchers say this is the first time they have been able to target the fibroblasts cells which have been 'tricked' into supporting the tumours without causing toxic reactions in healthy tissue. This two-pronged attack could allow doctors to directly target tumours and unmask the cancer cells.

While it still needs to be proven in human trials, it was safe and effective on mice and in-lab samples of human carcinomas - the most common group of tumours that arise in the lining of the major organs or skin.

While the technique is new, the virus, which attacks the carcinoma, is already part of human trials to test their safety and effectiveness as an immunotherapy treatment. This is a broad term for a new generation of techniques which use the immune system as part of the treatment.

The findings, published in the journal Cancer Research used a virus called enadenotucirev, which has been developed to only target cancer cells and leave healthy ones untouched. Once inside a cell, viruses replicate and burst out, rupturing their host and spreading to other cancer cells.

Dr Michelle Lockley, from Cancer Research UK, who was not part of the study, said, 'This work in human tumour samples is encouraging, but can be complicated -- one of the biggest challenges of immunotherapies is predicting how well they will work with the patient's immune system, and understanding what the side effects could be.'

The Independent

Genes decide flavour

In new research studying how genetic factors determine taste, scientists now believe they know why some humans prefer coffee while others opt for tea. A paper published this week in the journal Nature Scientific Reports found that people who are genetically predisposed to like more bitter tastes typically choose coffee due to its higher content of tart caffeine.

But, importantly for tea drinkers everywhere, that doesn't make them right. The opposite results of our study suggest coffee consumers acquire a taste or an ability to detect caffeine due to the learned positive reinforcement elicited by caffeine. In the study on more than four lakh men and women in the UK, researchers also found that people sensitive to the bitter flavours of quinine and a taste related to vegetable compounds were more likely to eschew coffee.

Although coffee-lovers are essentially defying evolution, there is another possible benefit to liking your latte. Hwang said coffee drinkers were genetically less sensitive to bitterness than tea drinkers, making them 'less likely to hate other bitter-tasting foods' such as green vegetables.

As humans evolved, we developed the capacity to detect bitterness as a natural warning system to protect the body from harmful substances. 'You'd expect that people who are particularly sensitive to the bitter taste of caffeine would drink less coffee,' said Marilyn Cornelis, assistant professor of preventative medicine at the Northwestern Feinberg School of Medicine.

The Straits Times/ANN