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SATURDAY

LOUNGE



That sinking feeling

CLIMATE CHANGE IS NO LONGER A SPECTRE. LOUNGE LOOKS AT THE UN'S NEW REPORT ON RISING OCEANS AND MELTING CRYOSPHERE TO SEE HOW THE WORLD, AND ESPECIALLY INDIA, IS BEING AFFECTED



That sinking feel

Climate change is no longer a spectre, it is something that we are living through. Lounge looks at the UN's new report on rising oceans and melting cryosphere to see how the world, and especially India, is being affected

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All over the world, mean temperatures rose by a few degrees each year. The majority of tropical areas rapidly became uninhabitable, entire populations migrating north or south from temperatures of a hundred and thirty and a hundred and forty degrees. Once-temperate areas became tropical, Europe and North America sweltered under continuous heat waves, temperatures rarely falling below a hundred degrees. Under the direction of the United Nations, the colonisation began of the Antarctic plateau, and of the northern borders of the Canadian and Russian continents."

Science fiction? Yes it is, a passage from J.G. Ballard's eerie novel from 1962, *The Drowned World*. Of course, this was before we had any inkling of climate change, so Ballard's fictional vision was realized by him imagining the sudden appearance of violent solar storms which lasted several years and burnt away the earth's ionosphere. Writing as he was just a decade on from the birth of a geological epoch that many scientists call the Anthropocene, when human actions and activities started changing the world like never before, Ballard wouldn't have known about runaway carbon emissions playing havoc with the climate.

And yet, on 25 September, when the UN's Intergovernmental Panel on Climate Change (IPCC) published an almost 1,200-page dossier, the *IPCC Special Report On The Ocean And Cryosphere In A Changing Climate (SROCC)*, the revelations did read like science fiction, because it spoke of future life on our planet, a planet that seemed unrecognizable from the one we live in. It spoke of a world of multi-metre sea-level rise, vanished Himalayan glaciers, a Greenland denuded of permafrost and the collapse of the Antarctic ice sheet. It was a world of dead zones in the oceans, of category 5 cyclones hitting multiple times a year, and coastal cities and populations devastated by extreme weather events. These are alarming revelations, couched in the careful, analytical voice of science (see box, *IPCC SROCC in numbers*)

A survey and summary of current available scientific knowledge about the effects of anthropogenic (man-made) greenhouse gas emissions, the *SROCC* is the third and final special report to appear as part of IPCC's Assessment Review 6 (AR6). The first of



People wading through a flooded street in Kurla, Mumbai, in September.

this was the ground-breaking one from last October, which detailed the planetary effects of a failure to limit global warming to a rise of 1.5 degrees Celsius above mean temperatures from the time of the Industrial Revolution. A second report, on the effects of climate change on land, followed this August, and now this report on the oceans and the cryosphere. Already, scientists from around the world are working on the AR6 Synthesis Report, which will be presented in 2022.

WHAT THE REPORT SAYS

The world's oceans have, since the baseline year of 1970, absorbed 90% of the excess heat generated by greenhouse gas emissions. Between 1993-2017, the rate of ocean warming has doubled, as compared to 1969-93. Marine heat waves have doubled since 1982, and they have also become more long-lasting,

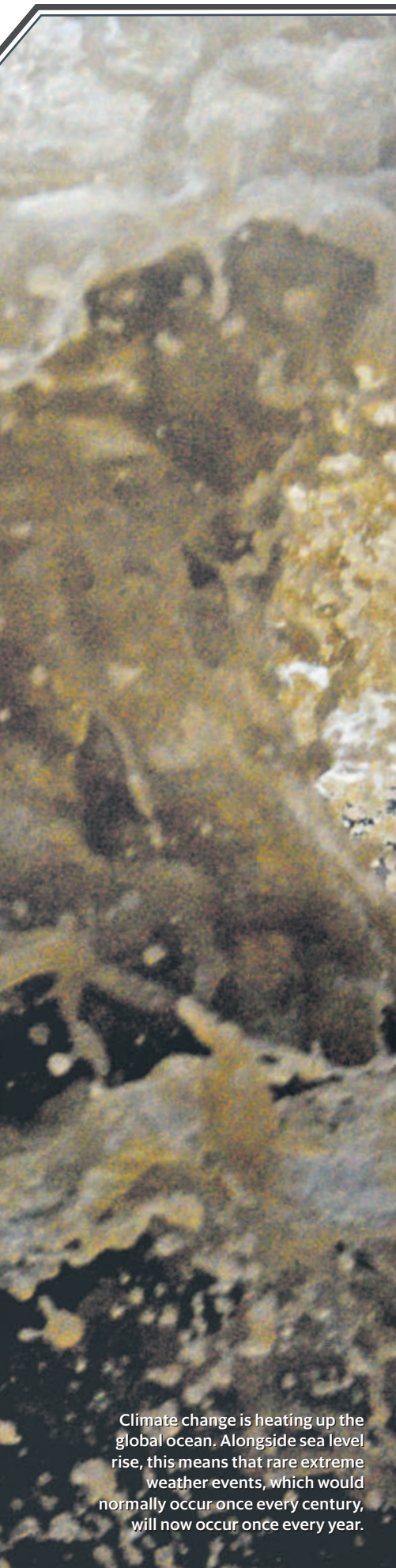
“Most of the coal is in some of the poorest parts of the country, while renewables are coming in the richest parts of the country; this is a huge equity issue.”

CHANDRA BHUSHAN
Environmentalist

more intense and more extensive. And because the ocean has absorbed 20-30% of anthropogenic CO₂, it has undergone increased acidification, with a loss of oxygen from the surface down to a depth of 1,000m in many areas (see box, *Effects Of Climate Change On Oceans*).

These changes have already triggered a host of consequences. A warmer ocean means a rise in extreme weather events, like devastating storm surges in coastal areas and the increased likelihood of category 4 and 5 tropical cyclones making landfall. Marine heat waves are the biggest threat to coral reefs, while increased ocean acidification has the potential to devastate fish stocks worldwide.

“So far, we have been bothered about extremes over land, so now this report has brought to light the extremes happening over the ocean, which have an impact on life over land,” says Roxy Mathew Koll, a



GETTY IMAGES



GETTY IMAGES

A view of the bleached Society Islands coral reef in Morea, French Polynesia. As marine heatwaves triggered by climate change rise in frequency, intensity and extent, coral reefs may not be able to recover from bleaching events and die out globally by 2100.

AHMED RAZA KHAN/MINT

LIVING WITH CLIMATE CHANGE

IPCC SROCC* in numbers

104

Scientists

(coordinating lead authors, lead authors and review editors)

36

Countries represented by scientists

6,981

Publications referenced by SROCC

31,176

Comments from reviewers and governments of 80 countries

Different warming scenarios

The report uses different representative concentration pathways (RCPs). These are scenarios that combine projected greenhouse gas (GHG) emissions and climate change mitigation policies to arrive at different levels of global warming from the present to 2100.

RCP 2.6

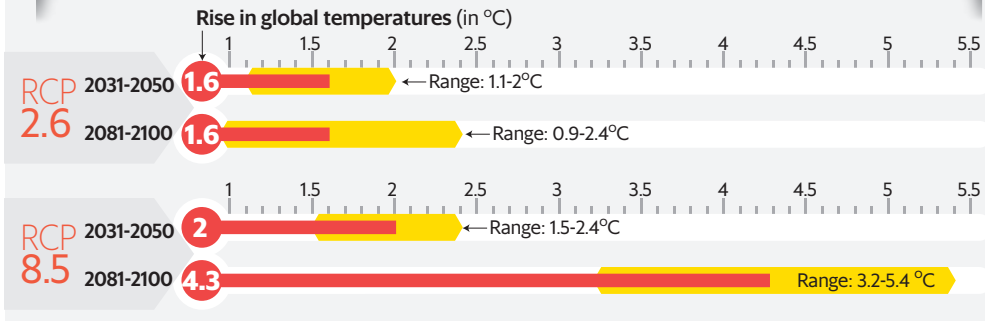
Low GHG emissions + high climate change mitigation policies

RCPs 4.5 & 6

Intermediate levels of GHG emissions

RCP 8.5

High GHG emissions + absence of policies to combat climate change



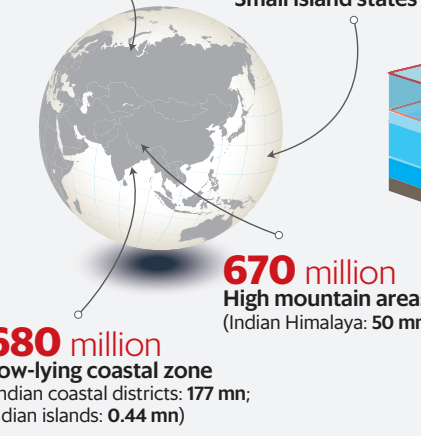
Affected human communities

4 million

Arctic zone

65 million

Small island states



Glaciers in High Mountain Asia

Most glaciers could be lost by 2100, with peak water discharge by 2050

RCP 2.6

Up to 48%

RCP 8.5

Up to 69%

Effect of climate change on

OCEANS

- Marine heatwaves
- Coral reef bleaching and death
- Marine acidification
- Loss of fish stocks
- Sea level rise
- Threats to coastal areas and coastal megacities
- Marine warming
- Stronger and more devastating cyclones
- Rising frequency of El Niño events

MOUNTAINS

- Loss of perennial springs
- Extinction threats to snow and ice-adapted plant and animal species
- Glacier lake burst floods
- Increase in slope instability

Source: *IPCC Special Report On The Ocean And Cryosphere In A Changing Climate; the International Centre for Integrated Mountain Development's (Icimod's) 'Summary Of The Hindu Kush Himalaya Assessment Report' (February 2019); Census of India 2011

tures rise globally, at high altitudes, the corresponding heating is even greater. The *SROCC* examines the evidence and comes to the sobering conclusion that mountain glaciers worldwide will exhaust most of their water by 2050. In some areas, such as the Andes and the European Alps, the glaciers have already gone past this point of peak melt, and are now just withering away. In the Himalaya, this point will be reached around 2050 (*see box, Glacier Loss In High Mountain Asia*).

One of the biggest effects will be felt downstream, with some 580 million people living in the Ganges basin alone. "The *SROCC* shows severe impacts of climate change on Himalayan glaciers and, consequently, on Himalayan rivers. This has direct consequences on water security of the entire Indo-Gangetic Basin (IGB). Livelihoods in the mountains and plains are critically mediated by

snow melt (e.g. for apple growers in Himachal) and river flow (e.g. farmers in Uttar Pradesh) and the *SROCC* findings have implications for the heavily populated IGB," says social scientist Chandni Singh of the Indian Institute for Human Settlements (IIHS), a lead author with the IPCC AR6 Working Group II, on email.

Anjal Prakash, associate professor at The Energy and Resources Institute (Teri) School of Advanced Studies and a coordinating lead author, *SROCC*, says changing weather patterns will have a bearing on mountains as well. "It is expected that there will be incessant rain in a short period of time, leading to floods and landslides, as the monsoon patterns may change," Prakash says a state like Bihar, where a majority of rivers originate in Nepal and the Tibetan plateau, will be directly impacted by flooding as glaciers melt and weather patterns change.

THE TIPPING POINTS

Melting glaciers also have other far-reaching effects on local ecology, since certain tipping points have already been reached. According to the report, no matter what our future emissions, surface temperatures in High Mountain Asia will continue to rise at .3 degrees Celsius per decade. Annual rainfall will continue to rise 5-20% through the 21st century in the Himalaya, with the Himalayan-Tibetan plateau ranges seeing a rise in the frequency and intensity of extreme rainfall events. As glaciers recede, lower elevation plant and animal species will migrate up-slope, and snow-adapted species will see a decline in abundance as well as an increase in extinction threat.

This range contraction and excessive rainfall is already a problem in Ladakh. Earlier this year, Tsewang Namgail, a Leh-based wildlife biologist and director of the Snow Leopard Conservancy—India Trust, told me: "If there's less snow, in the long run it will affect the pastures. If the pastures aren't productive enough, they won't sustain good numbers of prey species for the snow leopard. Then Ladakh is getting more rain in the summer. This doesn't help the development of pastures. Snowmelt is equally distributed and waters the plants pretty well. But if there's rain, it's not well distributed and you see flash floods."

How is the global ocean faring? According to the report, marine heat waves are leading to large-scale coral bleaching events. A coral reef takes more than 15 years to recover from one event, but the increase in heat wave frequency gives them no chance to revive, or even survive.

And the loss has massive ramifications. Koll says that though reefs occupy less than .01% of the global ocean, they support 25% of the global ocean ecosystem. "This kind of heat wave is happening in the Indian Ocean and also in the coral triangle, that is between the east Indian Ocean and the west Pacific region. There's a lot of marine diversity there," he says.

The Indian monsoon officially ends on 30 September. This time, the India Meteorological Department (IMD) said, there had been 10% excess rain overall, which is not good news for agricultural yield. What's interesting is that despite massive floods in both Kerala and Bihar, both were declared normal rainfall states. Oceanic warming, in tandem with land-use patterns, could account for it. "There were back-to-back floods in Kerala, but India has recently seen back-to-back droughts as well," says Koll. Most of the droughts have been over central and north India. "Larger monsoon circulation shows a weakening over time, with total rainfall gradually decreasing along with large fluctuations in the monsoon winds, so occasionally you are getting episodes of heavy rainfall because that is bringing a lot of moisture from the Arabian Sea and dumping it over the mainland. Generally, that means you have longer dry periods intermittent with heavy rainfall events," he says.

Another factor that affects monsoon rainfall variability is an El Niño event. This occurs when sea surface temperatures in the tropical Pacific Ocean rise to above-normal levels for an extended period of time. According to the report, events such as El Niño will only increase in frequency as the oceans heat up. Mat Collins is the joint Met office chair in climate change at the University of Exeter, UK. A coordinating lead author on the *SROCC*, he explains what this means. "What generally happens in an El Niño event is that you have droughts and floods in many different regions. So, for example, over India, you would expect to see dry conditions during an El Niño event and so if there's an increase in the frequency of these El Niño events, you can expect to see an increase in the frequency of dry conditions during the monsoon season, despite the increase in average monsoon rains due to increasing greenhouse gases," he says. In such a scenario, then, there could be an increase in both flood and drought events in India during the monsoon.

ADAPTING TO THE NEW NORMAL

When Cyclone Fani made landfall on the Odisha coast near Puri in May, there were wind gusts of 170-200 kmph. It directly affected 16 million people and set back the state's economy by ₹12,000 crore. But before making landfall, the cyclone had spent 11 days over the Bay of Bengal, gathering strength. It dawdled for so long that the IMD had to revise its forecast nine times. It was also only the second cyclone in 128 years to have made landfall in India in the pre-monsoon season.

According to the *SROCC*, such once-in-a-century weather events are set to become as frequent as once a year in tropical regions, in all future emission scenarios. "India has the seventh longest coastline in the Asian region, to the tune of 7,500km. A warmer ocean feeds into the cyclone events. This will lead to a lot of devastation in the future as it is predicted that the frequency and severity of the cyclones will be much more in the future," says Prakash of Teri.

In such a scenario, apart from limiting climate

change by drastically reducing our dependence on carbon, adaptation is key—and it's something the report puts a lot of stress on. But, as Prakash points out, giving the example of the Odisha government, this costs money. "The Odisha government has a very impressive and huge programme for cyclone management. But this has a massive cost to the exchequer of the Odisha government. Envision if the cyclones keep occurring and their frequency increases to twice or thrice in a year, imagine the cost that the Odisha government will have to incur," he says. According to Prakash, all developmental programmes will need to go through a climate-proofing process, which means that infrastructure has to be climate-resilient. This would entail an additional cost to state exchequers.

To combat sea level rise, Collins says, people will have to think about sea defences. "The thing that can be done is to invest in forecasting systems," he says, "so you know better when extreme events are going to happen. That means you can act in terms of moving people or making emergency disaster plans." Koll too believes that early warning systems, based on inter-departmental data sharing, are imperative. "It is not so much about forecasting how much rainfall there will be. A better forecasting model should be connected to a hydrological model that is also linked to an infrastructure condition. These kinds of things require multi-department cooperation," he says.

Climate change mitigation remains of paramount importance. If we reduce carbon emissions drastically and shift to, say, renewables, many of the worst scenarios may not come to pass. For a developing country like India, though, says environmentalist Chandra Bhushan, this is a complicated shift. "Right now our approach is very technocratic," he says. "We need higher gigawatts of renewable energy. Till 150 gigawatts, our grid will be able to take it. Beyond that you have to start developing the storage ecosystem, and work on grid management. Currently, there is a clear gap in developing the storage ecosystem and smart grids."

He adds that it would be difficult to move away from coal because it is a socioeconomic and political issue. "Most of the coal is in some of the poorest parts of the country, while renewables are coming in the richest parts of the country; this is a huge equity issue. The transition from coal to renewable has to be just and equitable."

While looking at adaptation, the *SROCC* insists that local and indigenous knowledge systems be taken into account by scientists and governments for the best results. "The argument is that the local people, like the high mountain population, have lived in those mountains for so long that they have developed their own ways of understanding the local environment, like indicators of snowfall, or indicators like when it is time to plant your crop," says Mukherji. She is pleased that the IPCC recognizes the fact that such systems of knowledge may not be written down, let alone peer reviewed, but that the knowledge and experience of managing the local ecosystem is important.

In India, though, issues of adaptation are closely linked to notions of justice and skewed socioeconomic power relations. Siddharth Chakravarty, a researcher with The Research Collective (which facilitates research on the theoretical aspects and practical framework of sustainable alternatives to development), stresses that the gap is often between the recommendations of reports such as the *SROCC* and their implementation by governments. "I think the report raises a lot of pertinent questions but what I see is that the implementation is still steeped in extreme power relations and implementation which continues to wrest access to resources away from smaller actors."

He gives an example. If state policy were to tell fishworkers who practise mixed farming aquaculture that growing fish with paddy isn't really aquaculture but mere subsistence, and that for higher productivity they need mono cultural export-orientated crops like shrimp, or carps, then you would not be using indigenous knowledge.

He says people are experiencing loss and displacement on a daily basis due to the dismantling of environmental protections and livelihood security through a multitude of flaws. "Suppose there was an ecosystem in which crabs used to nest on a muddy shore. Suddenly, if you replace that with a cemented wall and put up mangroves not adapted to the local place, it ends up being of no use to the people," says Chakravarty.

Chandni Singh of the IIHS echoes this when she says it is important to understand that climate change impacts are not felt evenly across societies. "Your ability to adapt is based on who you are (young, old, man, woman), where you are located (e.g. on the coast, in flood-prone low-lying areas), and what capacities you have," she says. Agriculture policies in India are currently incentivizing potential maladaptation practices in the Gangetic basin, she says, by giving diesel subsidies that encourage rapid groundwater extraction, a focus on water-intensive cash crops like sugar cane at the cost of climate-resistant millets and pulses.

Similarly, Bhushan believes Himalayan migration isn't getting the attention it deserves. "Because of a lack of economic opportunities as well as climate change stresses, like a lack of water, reduction in biodiversity and reduced ecosystem services, migrations are a reality," he says, adding that the government sees it purely as an economic problem and doesn't recognize the underlying environmental stress.

And ultimately, there's what the report calls the "limits to adaptation". You can only adapt so much. "Cryosphere is the zone which will reach the limits to adaptation fastest. I mean you can barely do anything once the glaciers are gone," says Mukherji. "No amount of adaptation is going to bring back your glacier-dependent irrigation systems."

Singh says that when people like farmers, whose access to livelihood has been exacerbated by climate change, migrate, we may see an aspect of the limits to adaptation. "In the space of migration, I believe we will see adaptation limits that are social in nature, like cities being unable to take in more migrants or paucity of jobs in places of destination."

As the report makes clear, there really is no viable alternative to nations making deeper cuts to carbon emissions. For if CO2 emissions continue to rise by 1% a year, and we carry on with our business-as-usual carbon-based lifestyles, all the frightening futures that the *SROCC* shows us will become a reality. Some already have. "I don't think we can say any more that the climate will change," says Mukherji. "We should say that the climate has changed."