

PROTECTING SINGAPORE FROM CLIMATE CHANGE

Climate change is set to change our lives and environment. Find out how Singapore is preparing for the potential impacts of climate change.

HOW WILL CLIMATE CHANGE IMPACT US?



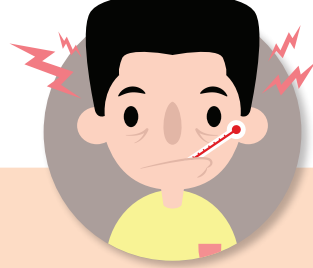
RISE IN SEA LEVELS AND COASTAL EROSION
Those living along the coast may be affected as sea levels rise.



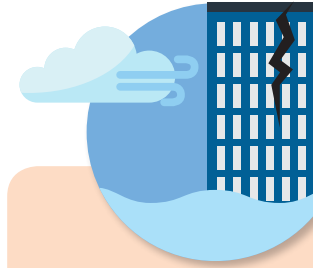
THREATENED WATER SUPPLY
Prolonged dry spells or droughts will put a strain on our water supply.



MORE INTENSE AND FREQUENT RAINFALL
The threat of floods will be more serious as we see more intense storms, coupled with rising sea levels.



WARMER TEMPERATURES
With warmer days, we could experience more discomfort and heat-induced illnesses such as heat stroke and rashes.



SAFETY AND RELIABILITY OF INFRASTRUCTURE
Our transport network, telecommunication, power stations and buildings could be affected by floods, rising temperatures and stronger winds.



DISRUPTION OF FOOD SUPPLY
Singapore imports more than 90% of our food supply. Crop failure and low crop yields worldwide will affect us. Prices of food may also become unstable.



BIODIVERSITY AND GREENERY UNDER THREAT
Trees may be uprooted in storms and forests threatened by bushfires.



INCREASED RISK OF DISEASE OUTBREAKS
Changes in the weather pattern, such as temperature increase, could create prime conditions for mosquitoes to breed and viruses to replicate faster, increasing the risk of diseases such as dengue.

WHAT SINGAPORE IS DOING

- Over 70% of Singapore's coastline is protected with structures such as seawalls and rock slopes.
- Selected roads located around coastal areas are raised in height.
- New land being reclaimed must be at least four metres above mean sea level.
- Geo-bag walls are built. Geo-bags are large sand-filled bags, laid into the ground to be level with low tide. They help to reduce sand erosion.

Diversify Singapore's water sources to include reclaimed water (NEWater) and desalinated water – sources that are less dependent on rainfall.

- Drainage improvement works are implemented to alleviate flood risks.
- Developers implement on-site detention measures to slow down peak runoff into public drains.
- Developers implement flood protection measures to prevent floodwaters from entering buildings.

Workplace safety and health guidelines are developed to help Singaporeans manage heat stress.

- Flood protection measures are implemented at critical infrastructure, such as raised platform levels at Changi Airport and entrances to underground MRT stations.
- Inspections are carried out to ensure that defects in structures are discovered and rectified.

- Import food from more regions to reduce the impact of potential disruption of supply.
- The government is helping local farmers to prepare for climate change, and to increase their production.

- Trees vulnerable to storms are replaced with hardier species.
- Mangrove restoration projects are carried out.
- Patrols at hot spot areas are stepped up to reduce the risk of bushfires.

Nation-wide programme to suppress mosquito population and monitor the spread of vector-borne diseases such as dengue.

HOW DO WE PROTECT OURSELVES AGAINST THE IMPACTS OF CLIMATE CHANGE?

Deduce the answers in the blanks and find them in the grid.

- We need to build a climate- R _____ T Singapore.
- What we need to do in warmer days to prevent heat stroke: _____ K more water
- A feature that developers can include in new buildings to reduce flood risks: R _____ N _____
- On hot days, we can prevent heat injury if we wear light-coloured _____ IN _____
- When we support local F _____, we do our part to improve our food security.
- We can help prevent the spread of dengue if we stop _____ Q _____ breeding.

E	M	E	F	I	M	Q	T	I	C	K	N	I	A	M	O	T
S	O	O	I	A	C	N	T	T	E	W	A	T	S	G	U	T
N	E	G	S	O	U	E	T	A	E	T	N	I	U	W	F	N
E	B	E	T	Q	C	T	W	Q	B	W	R	T	E	R	O	E
D	A	L	I	K	U	O	N	O	G	O	T	S	G	H	T	I
R	R	I	A	P	S	I	U	R	Q	W	A	T	G	S	I	L
A	Y	H	G	C	L	O	T	H	I	N	G	S	R	I	C	I
G	E	R	F	H	S	M	U	O	W	A	V	E	A	A	F	S
N	C	F	K	U	N	K	C	E	G	P	M	A	R	M	R	E
I	L	M	A	T	E	E	L	R	G	R	B	R	E	G	U	R
A	W	K	N	I	R	D	I	R	A	T	E	E	T	Q	T	S
R	E	S	U	C	E	N	G	F	A	V	S	F	I	U	P	E

Answers: 1. resilient 2. drink 3. rain gardens 4. clothing 5. farmers 6. mosquito

HEAR IT FROM A CLIMATE SCIENTIST!

Dr Muhammad Eeqmal Hassim, 34, is a senior research scientist at the Centre for Climate Research Singapore (CCRS). He joined CCRS in 2014 and works on climate modelling and prediction.

What do you do in a day's work?

It varies day-to-day because the CCRS is involved in many interesting projects and side-studies. In climate science, we handle huge volumes of complex data. We need to perform sophisticated analysis and visualisation in order to gain true understanding of what is happening.

People sometimes think that climate scientists only work on future projections of climate, but this is not the case. As part of my work, I also monitor current regional weather conditions using satellite imagery and other data sources to look for unusual large-scale patterns which are related

to the El Niño or the monsoon and other phenomena.

What is the most interesting aspect of your work?

I find communicating climate information in a simple, engaging way to be the most interesting yet challenging aspect of my work. With a topic as rich and complex as climate change, our findings can be overwhelming even to an educated audience. If we simplify it too much, we risk introducing misleading statements; if we present information in a very technical way, we risk losing the audience completely.

How was the 2nd National Climate Change Study for Singapore conducted?

The 2nd National Climate Change Study for Singapore comprised two phases. Phase One involved projecting our climate to the year 2100 in detail. We also performed experiments to look at climate up to the year 2300, with fewer

details. This work was undertaken by scientists from CCRS in collaboration with colleagues from the world-renowned UK Met Office Hadley Centre.

A state-of-the-art regional model was employed to run multiple simulations of the future climate derived from the latest available global climate models. The simulations were run on high-performance computing systems both in CCRS and the UK, crunching the data 24/7, for a year. You can imagine how huge the resulting datasets were.

What was groundbreaking was that the regional model was at a very high spatial resolution. The average "pixel-size" of most global climate models is about ~100 - 200km. That's just a blur over Singapore! In our study, the regional simulations conducted were at a much higher spatial resolution (12 km grid spacing). Furthermore, we designed the simulations



such that they produce meteorological variables of relevance to Singapore – to answer specific questions such as, "What will the wind speed in Northeast Monsoon conditions be like a few decades from now?", "Will rainfall become more intense?", "What's the number of very hot days can we expect, on average?". And some of the answers are quite sobering.

Projections from these future climate simulations are now being used as part of Phase Two by various government agencies, to conduct climate change impact studies on critical infrastructure and ecological biodiversity.

And Coming Up ...

- A coastal adaptation study is underway to identify how we can better protect our coasts over the longer term.
- Two new desalination plants and a fifth NEWater plant are being built. A fifth desalination plant will be built on Jurong Island. By 2030, we aim to meet up to 80% of Singapore's water demand through NEWater and desalination.
- A heat stress information system is being developed to help us plan and manage our outdoor activities.

- Research and development into technology to help increase the productivity of our local farmers.
- The impact of climate change on our buildings and infrastructure is now under study.
A review of the resilience of our power stations, transport and telecommunications infrastructure is underway.
- A Fire Probability Index is being developed so that we can monitor bush fires more effectively.
- Innovative vector control measures are being explored, such as using *Wolbachia*-carrying *Aedes aegypti* mosquitoes to suppress the mosquito population. When male mosquitoes carrying the *Wolbachia* bacteria breed with non-infected female mosquitoes, the females produce eggs that do not hatch.

Read more about Singapore's Climate Action Plan at www.nccs.gov.sg