HSBC

HKUST 環境研究所 INSTITUTE FOR THE ENVIRONMENT

ENVR Division of Environment and Sustainability





# Advice on Climate Change from the Intergovernmental Panel on Climate Change and the Hong Kong Observatory

## 18 October 2019

## Event Report

Supported by

BUSINESS ENVIRONMENT COUNCIL 商界環保協會

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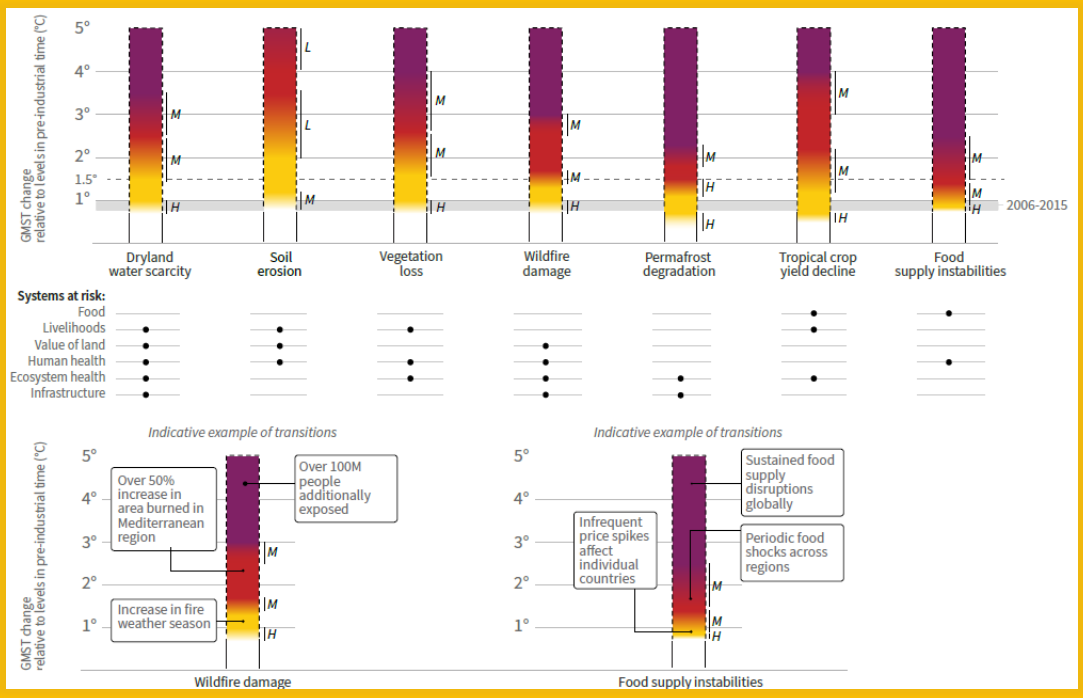
# EXTRACT FROM THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE SPECIAL REPORT ON GLOBAL WARMING OF 1.5°C

## Reasons for Concern

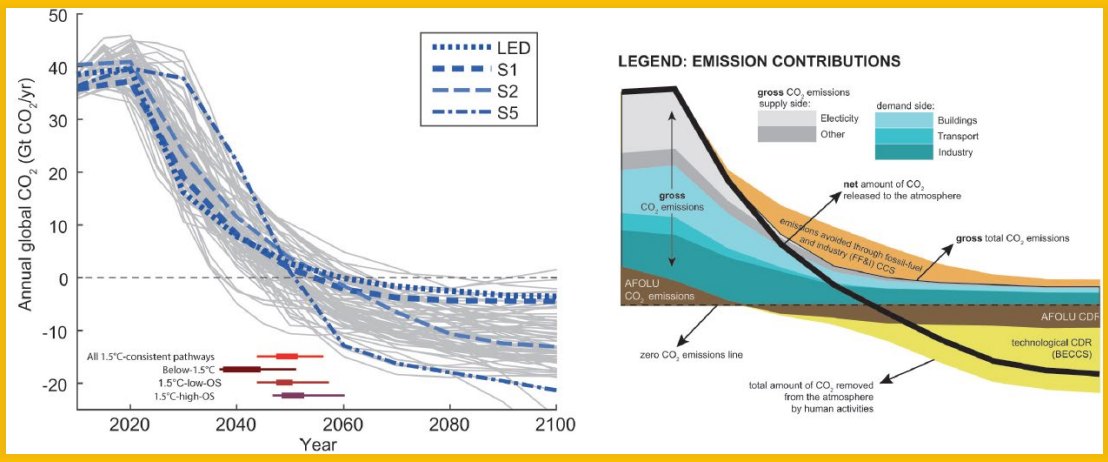
**Risks to humans and ecosystems from changes in land-based processes as a result of climate change**




*IPCC Special Report on Climate Change and Land. Summary for Policy makers page 13*

## Action Needed

**Left: Pathways which keep temperature increase to 1.5°C**
**Right: The components of example pathway**




*Special Report Global Warming of 1.5°C (page 113)*

# EVENT BACKGROUND

The Intergovernmental Panel on Climate Change (IPCC) was set up in 1988 by the World Meteorological Organization and United Nations Environment Programme to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

This seminar heard from two of the leaders of the IPCC about the three IPCC Special Reports it has issued in the last year:

- Global Warming of 1.5 °C (published October 2018 www.ipcc.ch/sr15/)
- Climate Change and Land. This covers the impact of climate change on desertification, land degradation, sustainable land management and food security, and greenhouse gas fluxes in terrestrial ecosystems (published August 2019 www.ipcc.ch/report/srccl/)
- The Ocean and Cryosphere in a Changing Climate. This covers the impact of climate change on the world's oceans and on the Greenland and Antarctic Ice-caps. (September 2019 www.ipcc.ch/report/srocc/)

In addition, Mr. C M Shun Director of the Hong Kong Observatory and Mr. P W Chan its Assistant Director covering climate change advised on how Climate change is affecting Hong Kong.

# EVENT PROGRAM

| TIME | ITEMS | SPEAKERS |
|---|---|---|
| 09:00 | Opening Remarks | **Mr. Mukhtar Hussain**, Group General Manager, HSBC |
| **Session I: Science basics, where are we now and possible pathways forwards** (Moderated by **Mr. J Robert Gibson**, HKUST & Civic Exchange) | | |
| 09:10 | Projections on how climate is changing, the impacts these changes and reductions in carbon emissions required to avoid severe impacts | **Prof. Panmao Zhai**, IPCC<br>**Prof. Hans-Otto Pörtner**, IPCC |
| | Mitigation of Greenhouse Gas Emissions | **Mr. J Robert Gibson,** HKUST & Civic Exchange |
| | Panel Discussion | **Prof. Panmao Zhai**, IPCC<br>**Prof. Hans-Otto Pörtner**, IPCC<br>**Mr. Shun Chi-ming**, Director, HK Observatory |
| 10:20 | Coffee/tea break | |
| **Session II: Adapting to the expected impacts, actions required to avoid catastrophe and business implications** (Moderated by **Mr. Jonathan Drew**, HSBC) | | |
| 10:50 | Global perspectives | **Prof. Hans-Otto Pörtner,** IPCC |
| | Hong Kong's perspectives & action | **Mr. Pak-Wai Chan**, Assistant Director, HK Observatory |
| | Panel Discussion | **Prof. Hans-Otto Pörtner**, IPCC<br>**Prof. Panmao Zhai**, IPCC<br>**Mr. Shun Chi-ming**, Director, HK Observatory |

# EVENT SUMMARY

## SESSION I: Science basics, where are we now and possible pathways forwards

### Opening remarks

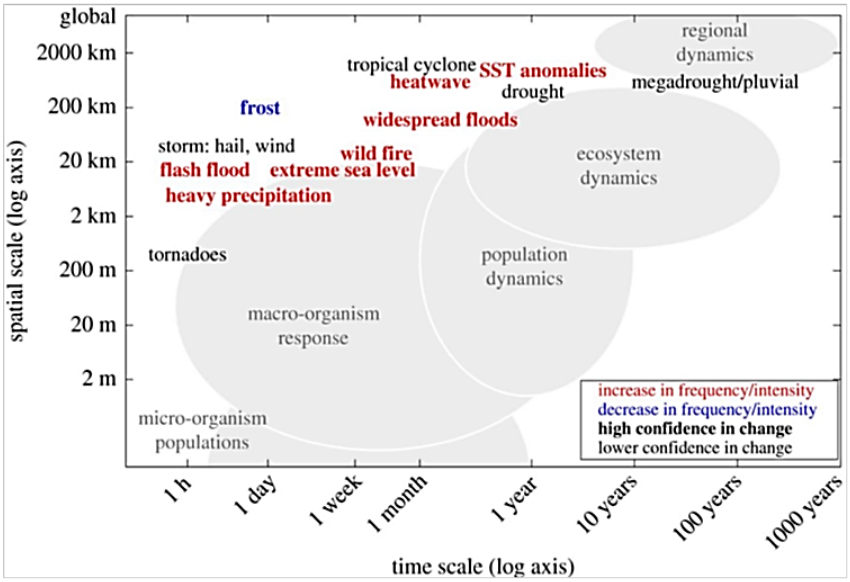
**Mr. Mukhtar Hussain,** HSBC's Group General Manager, Head of Belt and Road Initiative and Business Corridors, with responsibilities for sustainable finance, welcomed the speakers and noted we are here to test the hypothesis, or confirm the reality, that climate change poses the biggest single threat to our existence. We need to do more than understand the threat. We need to mobilise action.

Science will help us define the problem, understand the issues and accelerate some of the solutions for dealing with the challenges. Business must commercialise and deliver solutions that are sustainable. The capitalist economic system relies on outcomes, incentives and people wanting to do the right thing. We would like to see the right outcome to prevail on a more consistent basis.

### A new understanding of climate change science

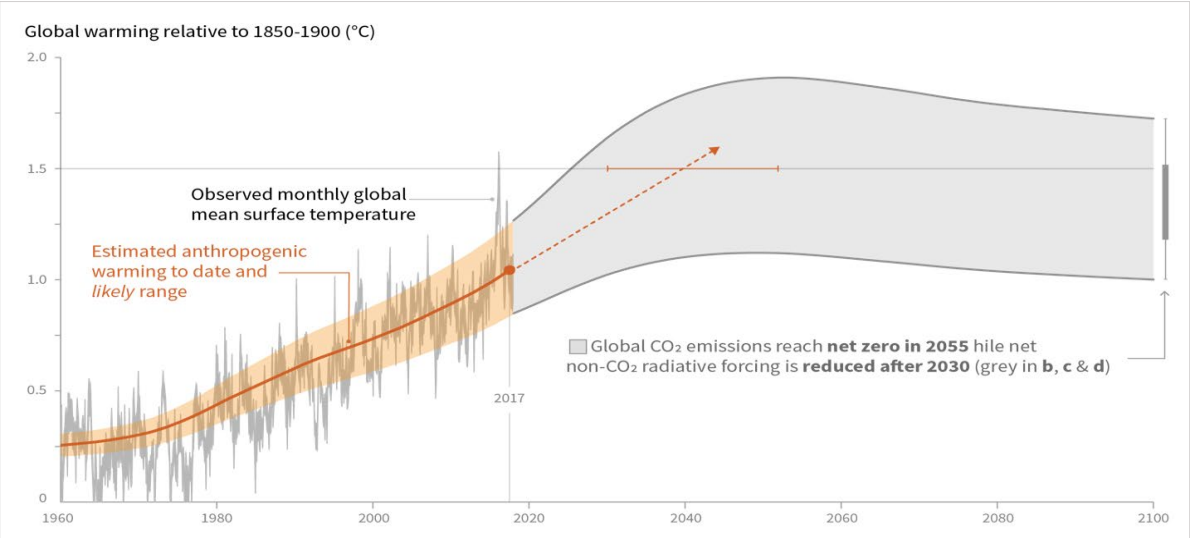

**Prof. Panmao Zhai,** Co-Chair of Working Group I IPCC (Climate Science) noted:

- Global mean surface temperature (GMST) has increased by about 1.0°C from pre-industrial levels. The great majority of the increase is due to humanities emissions of greenhouse gases. Variations in solar radiation and volcanoes have an impact but it is small over the long-term.
- GMST is the average of the air temperatures at the surface of land and the oceans. Comparing 2006-15 with 1850-1900 it has increased by about 0.87°C while the increase in land temperature alone is about 1.53°C
- Extreme weather events on land have increased:



- Over 90% of the extra energy the Earth is absorbing due to greenhouse gases and changes in albedo goes into the oceans. This causes thermal expansion rising sea-levels. Sea-level is also rising due to the melting of ice on land. The rate has increased in recent decades due to accelerating loss of ice from Greenland and Antarctica.
- The sea-level rise coupled with storm surge from strong tropical cyclones is leading to more extreme sea-level events.
- Future projections have been done for both 'Business as Usual' (RCP8.5) and low greenhouse gas emissions scenario (RCP2.6). By 2300 the increase may be 3 meters on the 'Business as Usual scenario and slightly over 1 meter on the low emissions scenario.
- Other impacts are ocean acidification and loss of oxygen; melting of permafrost releasing methane into the atmosphere and thus accelerating climate change.
- The difference between a 1.5°C and a 2.0°C increase in GMST is very significant. In some land areas a 0.5°C increase in GMST causes an increase of more than 2.0°C in local temperatures. In South-East Asia the increase in heatwaves will have substantial health impacts. Heavy precipitation and more extreme sea-level events will also increase.
- Our current trajectory gets us to 1.5°C about 2040. Very rapid reduction in $CO_2$ emissions are required to avoid this.
- The chance of keeping to 1.5°C is substantially increased by action is to reduce non-$CO_2$ greenhouse gases.

**Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways**



## The impacts of climate change and how avoiding severe impacts should guide ambition in adaptation and in mitigation (reducing Greenhouse Gas emissions)

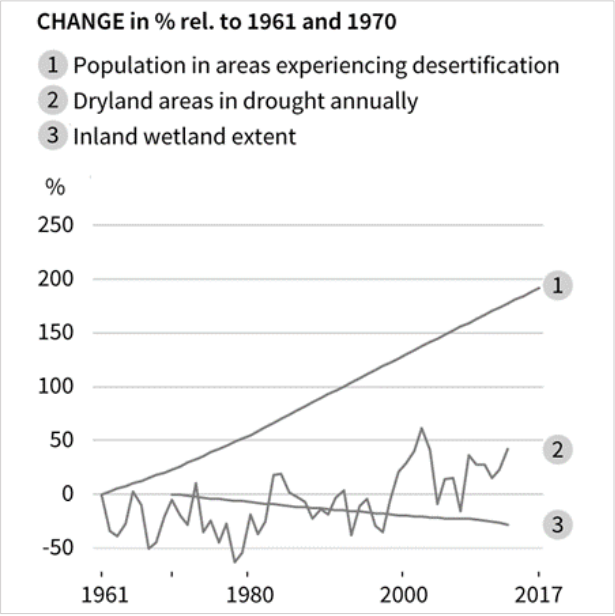
**Prof. Hans-Otto Pörtner,** Co-Chair of Working Group 2 of IPCC (Impacts of Climate Change) noted:

As Prof. Zhai has said, the IPCC's Special Report on Global Warming of 1.5°C advised:

- Human activities have caused approximately 1.0°C increase in Global Mean Surface Temperature (GMST) over the pre-industrial level.
- This is already having consequences for people, nature and livelihoods.
- At current rate of greenhouse gas emissions GMST could reach 1.5°C between 2030 and 2052.
- Past emissions alone do not commit the world to 1.5°C

The Special Report on Climate Change in Land notes:

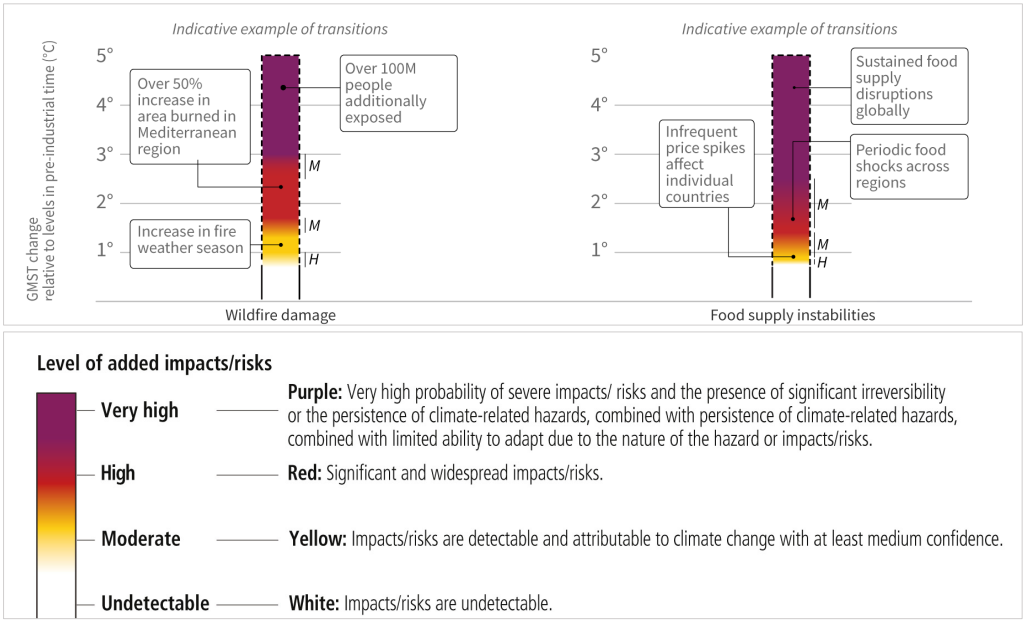
- Land is a critical resource. We rely on it for food, water, health and wellbeing.
- The current use of land and loss of biodiversity are unprecedented in human history and are non-sustainable. For example, the drylands which cover 46% of the world's surface and are home to 3 billion people. Land-use change with a growing population in drylands has contributed to desertification and land degradation:




SRCCL PM Figure 1 – F

- As Prof. Zhai has said warming over land has occurred at a faster rate than the global mean.
- Restricting warming to "well below 2°C" would greatly reduce the negative impacts of climate change on land but some mitigation options, such as bioenergy carbon capture and storage would increase competition for land, resulting in societal challenges

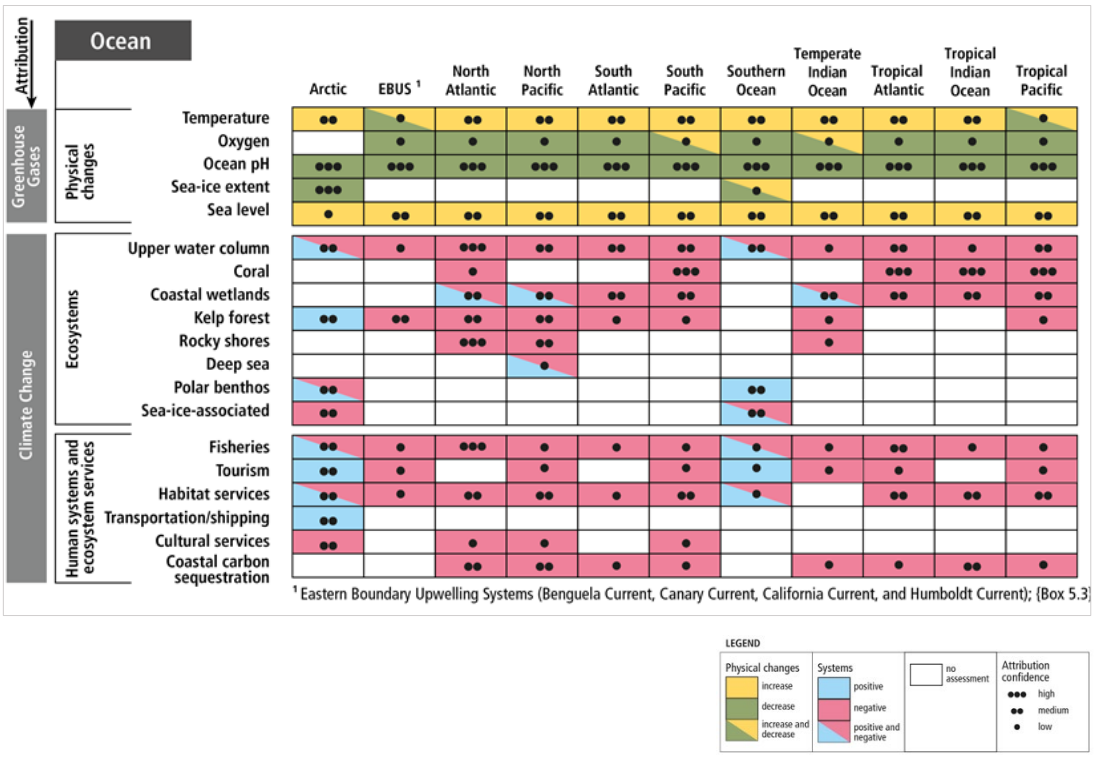
- Scientists do risk assessments and present them for negotiators at the UN Climate Summits using the following type of chart:



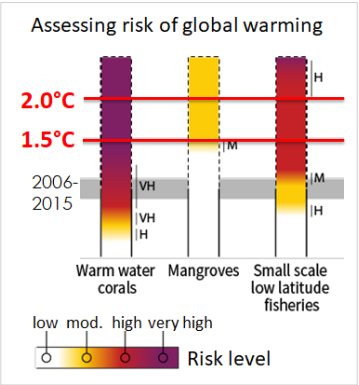

SRCCL SPM Figure 2 – A2

The Special Report on the Ocean and Cryosphere in a Changing Climate notes:

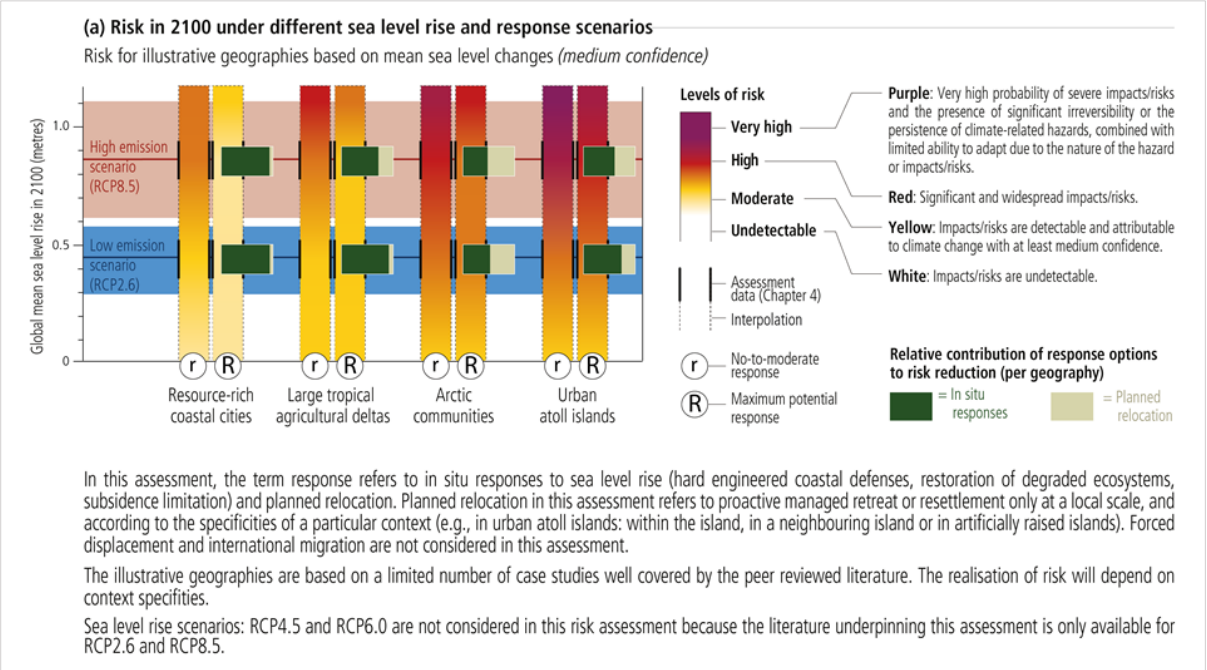
- The world's ocean and cryosphere have been 'taking the heat' from climate change for decades. Consequences for nature and humanity are sweeping and severe. (Refer Prof. Zhai's talk.) The chart below summarises physical and system impacts of the changes to oceans and cryosphere. Virtually all ocean regions are impacted by climate change and mostly negatively.



One type of ecosystem which is particularly sensitive is warm water corals. Even in a 1.5°C warmer world there is a high risk of losing 70% to 90% of coral reefs and their services to humankind. See chart on the right.



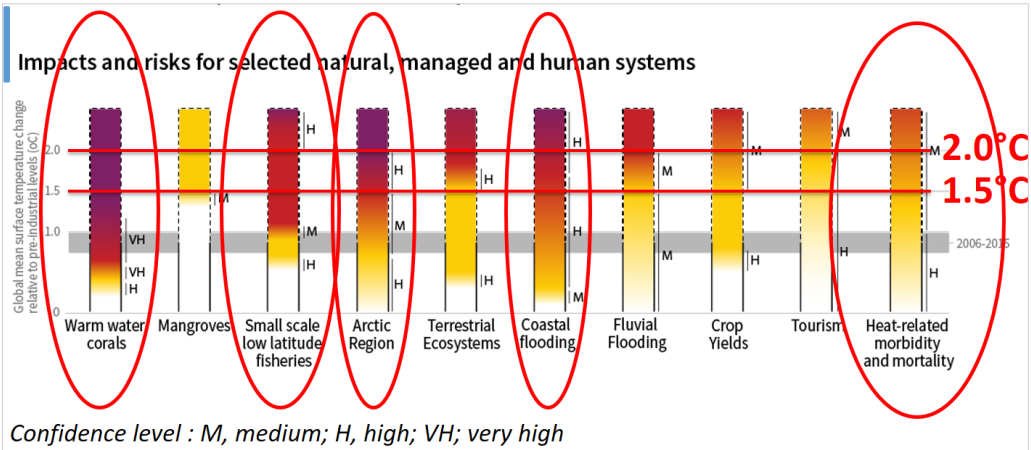

Sea level rise coupled with storm surge is likely to lead to 'one-in-a-century' events becoming one per decade or even annual. The following chart shows the risk assessment for different land-use types.




Note that risk development (increase) may not be fully stopped by adaptation.

- The horizontal Green/Beige bars showing the extent to which adaptation can be 'in situ' – e.g. building seawalls and the extent to which will be necessary to relocate.
- Resources-rich coastal cities can protect themselves with expenditure on infrastructure.
- It is very difficult to protect large tropical agricultural deltas and many Arctic communities and Urban atolls.

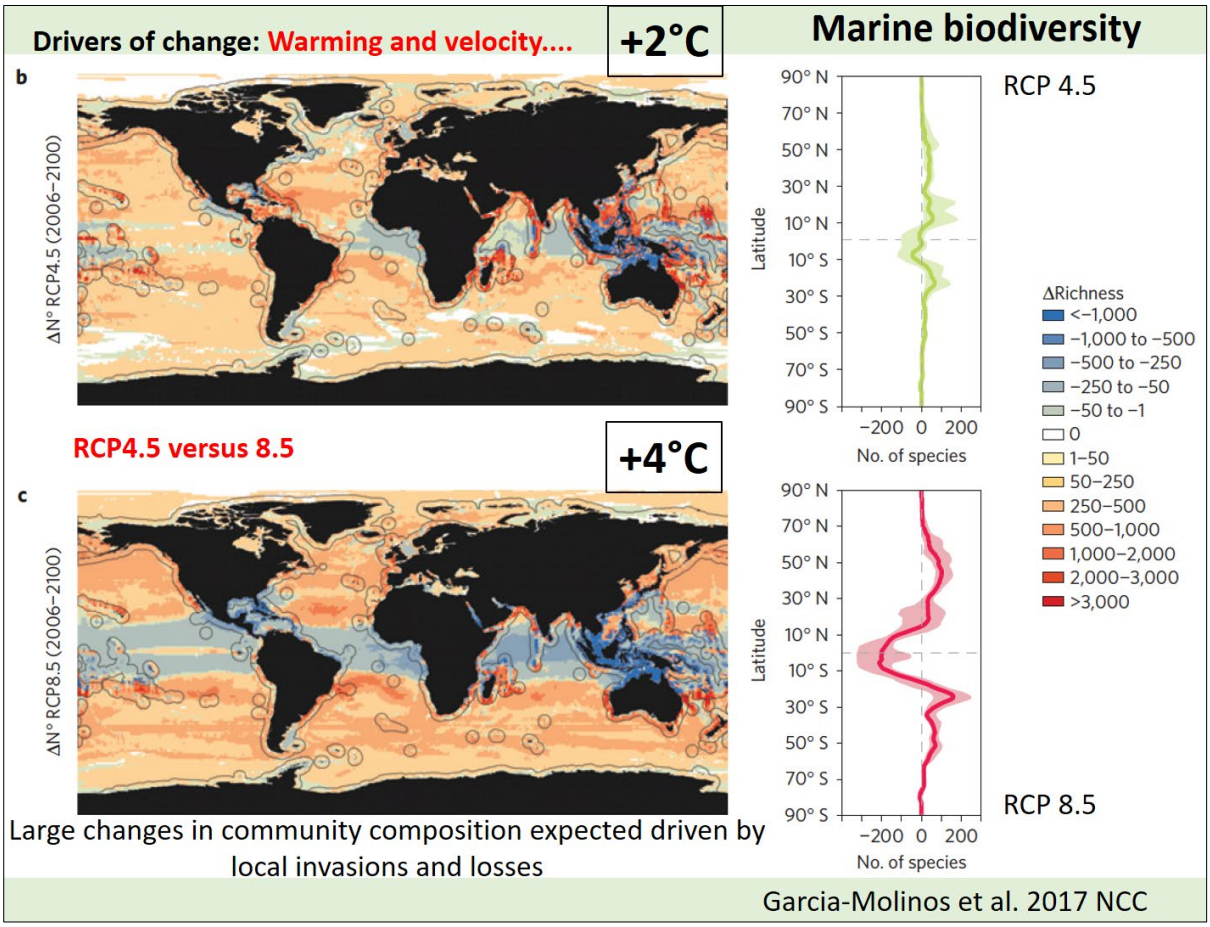
Looking at the impacts and risk for other systems. As the chart below records, every half a degree matters, every bit of warming matters. This is for ecosystems, biodiversity and humankind.



Coastal flooding risks may be understated as sea level projections may be conservative if we pass tipping points which increase loss of ice from the Antarctica ice sheet and from ice-sheets on land in the Arctic.

Also particularly note 'Heat related morbidity and mortality'. Humans are not able to survive for long at high temperatures. So we are losing habitat for humans.

Rising temperatures will have a great impact on biodiversity. The blue-grey areas near the equator on the chart below shows the extent to which we will essentially be clearing the lower lattitudes [in the oceans] of biodiversity. These are developments which over time can only be compared to mass extinctions which happened in the Earth's history. Already biologists are talking about humans pushing the planet into a Sixth Mass Extinction event due to a combination of many influences.




So for fisheries:

- There will be loss of fisheries at low latitudes and some gain at high latitudes as changes in the oceans cause shifts in fish populations. Net there will be a reduction the global catch potential.
- Communities that depend highly on seafood may face risks to nutritional health and food security.
- Reducing other pressures such as pollution will help marine life deal with changes in their environment.
- Policy frameworks for fisheries management and marine protected areas offer opportunities for people to adapt.

In summary:

- At 1.5°C and even more so at 2°C, there is disproportionately high risk for Arctic, dryland regions, small island developing states and least developed countries

- 1.5°C has lower risks than 2°C for health, livelihoods, food security, water supply, human security and economic growth
- A wide range of adaptation options can reduce climate risks. Less adaptation is needed at 1.5°C than 2°C.
- It is essential to get to Net Zero Carbon emissions by 2050 to curtail increase in global temperatures. Further, given current trends, it is likely that we will need to Carbon Dioxide Removal (CDR) from the atmosphere after 2050 meet the temperature targets. The sooner we start on the reduction in emissions the less damage there will be and the less need there will be for CDR.

## Mitigation – How might, as an example, Hong Kong reduce its greenhouse gas emissions?


**Mr. Robert Gibson** noted IPCC Working Group III covers mitigating (i.e. reducing) Greenhouse Gas Emissions. We do not have a representative of this Working Group with us. We already fortunate to have Co-Chairs from IPCC Working Groups I and II. Instead he covered the topic briefly using Hong Kong as an example.

Hong Kong's Council for Sustainable Development has recently completed a collecting public views on what Hong Kong's Long-term Decarbonisation target should be. The engagement discusses whether Hong Kong should be 60% reduction, 80% reduction or go to Net Zero by 2050 and notes that Net Zero will be need by 2100. You've heard the strong argument from the scientists that the globe as a whole should go to Net Zero by 2050. So let's look at how Hong Kong might get there[1]:

- For electricity the low carbon options are:
    - Renewable energy: Let's have as much solar and wind generated electricity as we sensibly can have in Hong Kong. Let's also import from Mainland China where there are areas with better solar insolation and better wind.
    - Nuclear: In 2010 the Hong Kong Government proposed a second deal like the Daiya Bay Power Station to increase nuclear's share of our energy from 25% to 50%. That would be a big step in moving towards net zero.
    - Finally, burning natural gas: We are currently reducing emissions by switching from coal to gas. Gas, however, still emits about 0.4 Kg $CO_2$ to the atmosphere per kilowatt hour produced. So one for net zero it will be necessary to follow IPCC advice to use using Carbon Capture and Storage (CCS). That is to collect the $CO_2$ from the power station exhaust and pump it into the rocks under the South China Sea. About 100 kilometres offshore there are big saline aquifers suitable. But it will cost money to do that.
- In addition to obtaining low carbon electricity there is the big question of how to balance the grid. If all your electricity comes from nuclear which runs full-steam all the time and from renewables which produce when the sun shines and the wind blows, how do you balance our demand for electricity with the supply.

[1] The comments on decarbonising Hong Kong are based on the response to the Public Engagement provided by the 'Hongkong 2050 is Now' Study which Civic Exchange and WRI are undertaking.

- One solution is electricity storage. Already CLP has a pumped storage in the Mainland which helps balance supply and demand relating to the Daya Bay nuclear station. Maybe more pumped storage can be added. Another possibility is hydrogen. We have surplus electricity we can use it to manufacture hydrogen and when there is a shortage we burn the hydrogen to generate electricity.
- A second solution is demand management including the timing when electric cars are charged and arrangements for Power Suppliers to turn off user's appliances when there is a shortage. For example, Southern California Edison offers consumers of an annual payment in return for having the right to turn off their air-conditioners when it has a shortage of power.

- Towngas: How do we get our distributed gas to be carbon neutral? One option is electrification. Another option is hydrogen. Towngas is already 50% hydrogen. It could have hydrogen as its only fuel content and mix this with an inert gas for a safe mixture. Other countries are looking at this solution.

- Energy efficiency in buildings: One thing is to reduce the carbon intensity of electricity. The other is to use less. Buildings consume more than 50% of the electricity we use so their efficiency is important.

- Mobility: Carbon emissions from transport can be reduced by three types of action. In order of importance they are:
  - **Avoid:** Examples – (1) Children walking to school. (2) Reducing Stamp Duty on flats so that Owner-Occupiers are more willing to move home to be near work.
  - **Shift:** Examples – (1) Change from Cars/Taxies to Buses; (2) Change from Buses to the MTR. This would be helped by controlling the number of private cars and Electronic Road Pricing. NB: One of the reasons our buses burn so much fuel is their being slowed down by traffic congestion.
  - **Improve:** For example, moving from petrol to electric or hydrogen powered vehicles. Note:
    - Electric may be good for cars but if you want to make a Heavy Duty Vehicle such a cement lorry zero carbon then every kilogram of batteries added is a kilogram less of cement carried. Hydrogen fuel cell systems are a much lighter solution which other countries such as Japan are considering.
    - Prioritize taxis and minibuses rather than private cars. The average taxi may do 20 times the mileage of the average private car.

- Lifestyle:
  - While our carbon footprint from our direct emissions is not very high by world standards this is due to using stuff made abroad. For example, our government puts up graphs showing our emissions per person are less than Singapore but part of the reason for this is the petrol and diesel we use is refined in Singapore with the emissions being counted against Singapore not us.
  - If the world is going to Net Zero we need to think about the carbon emissions required to create the food, clothing, other manufactured goods and international transport which we use, set reduction targets. and educate people so we move towards these targets

## Panel discussion

**Prof. Panmao Zhai and Prof. Hans-Otto Pörtner of the IPCC together with Mr. C M Shun, Director of the Hong Kong Observatory. Moderated by Mr. Robert Gibson**


Mr. C M Shun noted that Hong Kong has experienced two super typhoons in the last two years. It is a matter of concern that sea level rise will not stop at the end of this century but will continue to, perhaps, more than 3.00 meters by 2300. It is also concerning that the IPCC's has raised its estimate of the likely increase by 2100 by 10 cm (or 14%) from previous assessment. The implication is that Hong Kong could be affected by a Mangkhut size storm surge almost every year by the end of the century. Mr. C M Shun asked for the IPCC's advice on this matter.

- Prof. Zhai noted sea level rise in South East Asia, including in Hong Kong is greater than the global average. That said the IPCC focuses on global rather than local trends so Hong Kong will need to do its own studies on its local circumstances. It is fortunate that it has leading scientists who have contributed to the global understanding of tropical cyclones.
- Prof. Pörtner noted the importance of both early warning systems and coastal defenses. Policy makers and practitioners having an adequate understanding of risks is key to getting risk mitigation in place. It is important to plan adaptation measures for the highest projection scenarios.
- Prof. Pörtner also noted that there remains uncertainty on future sea level rise projections. The next IPCC assessment may well come up with even higher projections.

**Audience question:** What is the Earth systems response to human induced global warming? We are told there some are mechanism which amplify the warming are their also ones which dampen it?

- Prof. Pörtner advised there is some inertia in the Earth's response to increased greenhouses gases in the atmosphere but the key determinant of long-term temperatures is the level of these gases. A step to stabilizing temperatures is to move to an economy which does $CO_2$ recycling rather than putting more $CO_2$ into the atmosphere.

**Audience question:** Hong Kong's emissions are 6.6 tonnes $CO_2$/person on a production basis. When considering how to get to Net Zero shouldn't we also consider our consumption based emissions which some estimate put at 30 tonnes $CO_2$/person?

- Mr. Robert Gibson noted that the experts on the panel covered the science and impacts of climate change rather than mitigation. Also that the world going to 'Net Zero Emissions' would impact carbon emissions which we import items such as beef. We should be thinking about this as we will have to change as a result of changes elsewhere in the world. One view is that we should set targets for reducing our consumption of carbon intense items and then devise policies which will move us towards these targets.

**Audience question:** Is it true that even if we stop emissions immediately we will still have a substantial increase in temperatures?

- Prof. Zhai advised that the 'committed' change based on the current level of past emissions is less 1.5°C. If, however, we continue to emit and go past the 2.0°C level then positive feedbacks in the system may further increase temperatures. To avoid this we need quick, deep reductions in emissions. If we do not reduce quickly enough we will need to take $CO_2$ out of the atmosphere.
- Prof. Pörtner noted that if we cut emissions rapidly the Oceans will help keep temperatures down as they will continue to absorb CO2 and heat. Also the ice sheets will continue to melt.

**Audience question:** Is it true that there are high emissions in the manufacture of nuclear power stations?

- Mr. Robert Gibson advised we cannot answer this question now but if we receive a written question we would be pleased to arrange a response.

**Question from Edwin Lau of the Green Earth:** I worry that our Government has a low awareness of climate change risks. In HK's recent Policy Address there was no mention of polices for making Hong Kong carbon neutral. Yet many countries have done this. Further the recent Public Engagement on long-term decarbonisation does not set a clear requirement for getting to Net Zero by 2050 or even earlier.

- Mr. Robert Gibson responded that the IPCC recommendations is that the whole of humanity is at Net Zero emissions by 2050. If Hong Kong does not achieve this then maybe it will need to pay another party to suck its net emissions out of the atmosphere. Today we pay Saudi Arabia for oil. In 100 years' time maybe we will be paying them to do CO2 removal with concentrated solar power and putting it in the holes the oil came from.
- Mr. C M Shun noted that the Government's Steering Committee on Climate Change was carrying forward studies on how to adapt to stronger typhoons and their higher storm surges, waves and winds.

# SESSION II: Adapting to the expected impacts, actions required to avoid catastrophe and business implications

## Global perspectives on impacts of adaptation and mitigation measures guiding choices

**Prof. Hans-Otto Pörtner from IPCC** noted:
When looking at the impacts of climate changes we also need to consider the impacts of the adaptation and mitigation measures we take. Studies repeatedly shows that mitigation, done in time, produces a better result than adaption. Mitigation has co-benefits of

- Lower hazards to human health,
- Less competition for land for BECCS (bioenergy carbon capture and storage).
- Better food security
- biodiversity conservation

We should take action to stop degrading land. That is achieving 'Land Degradation Neutrality'. Achieving land degradation neutrality depends on the integration of multiple responses across local, regional and national scales. Also considering multiple sectors including agriculture, pasture, forest and water. This needs adoption of sustainable land management, and reversing degradation through rehabilitation and restoration of degraded land. It also needs measures that promote land degradation neutrality in rangelands, croplands and forests. This can help to eradicate poverty and ensure food security, as well as contribute to climate change adaptation and mitigation. Better land and ocean management combined with ambitious mitigation supports biodiversity conservation and food security.

One conclusion of the report on Global Warming of 1.5°C is that limiting temperature increase to this level helps reach the Sustainable Development Goals (SDGs).

While the Paris Agreement and the SDGs provide good targets but our implementation is poor. The report on Oceans and Cryosphere identifies the following societal challenges:

- People with the highest exposure and vulnerability are often those with lowest capacity to respond (*high confidence*) (C1) These people need to be helped.
- Climate change impacts and their societal consequences occur on time horizons which are longer than those of governance arrangements (e.g., planning cycles, public and corporate decision making cycles, and financial instruments) (C1.1). They are thus difficult for governments and business to consider.
- Governance arrangements (e.g., marine protected areas, spatial plans and water management systems) are too fragmented across administrative boundaries and sectors. We need cooperation across boundaries to provide integrated responses to the increasing and cascading risks from climate-related changes (*high confidence*) (C1.2).
- The capacity of governance systems in polar and ocean regions to respond to climate change impacts has been strengthened recently, but is still not sufficiently rapid or robust to adequately address the scale of increasing projected risks (*high confidence*) (C1.2). This is probably also true for land areas and for cities.

So it is important to find solutions for four pillars: (1) climate change, (2) biodiversity conservation, (3) sustainable land management and (4) sustainable ocean management. Actions we can take:

- For both oceans and land, networks of protected areas help maintain ecosystem services, including carbon uptake and storage, and enable future ecosystem-based adaptation options by facilitating the poleward movements of species, populations, and ecosystems (*medium confidence*) (C2.1).
- We need both marine and terrestrial habitat restoration. Ecosystem management tools, such as assisted species relocation and coral gardening, can be locally effective in enhancing ecosystem-based adaptation (high confidence). BUT coral reef restoration options may be ineffective if global warming exceeds 1.5°C, because corals are already at high risk (*very high confidence*). (C2.2) Life on this planet is dependant on keeping to certain temperature ranges.
- Strengthening precautionary approaches, such as rebuilding overexploited or depleted fisheries, and responsiveness of existing fisheries management strategies reduces negative climate change impacts on fisheries, with benefits for regional economies and livelihoods (*medium confidence*) (C2.3).

But everyone, at some time, prefers to ignore what is coming. We are like the people in this picture. We need to overcome this inertia and avoid focusing only on the short-term. This brings us to the question: "What is it feasible to do?"

- Can we keep warming to 1.5°C according to the laws of chemistry and physics? **Yes**
- Do we have technologies to support mitigation and adaptation measures? **Yes**
- Could we redirect financial flows to stop fossil fuel subsidies? **Yes**
- Do we have necessary institutions? **Yes**
- Do we have informed policy leading and directing societal transformation? **Maybe?**

So the challenge is to implement informed policy leading and directing societal transformation. On this the response to the IPCC's 1.5°C report gives cause for hope.

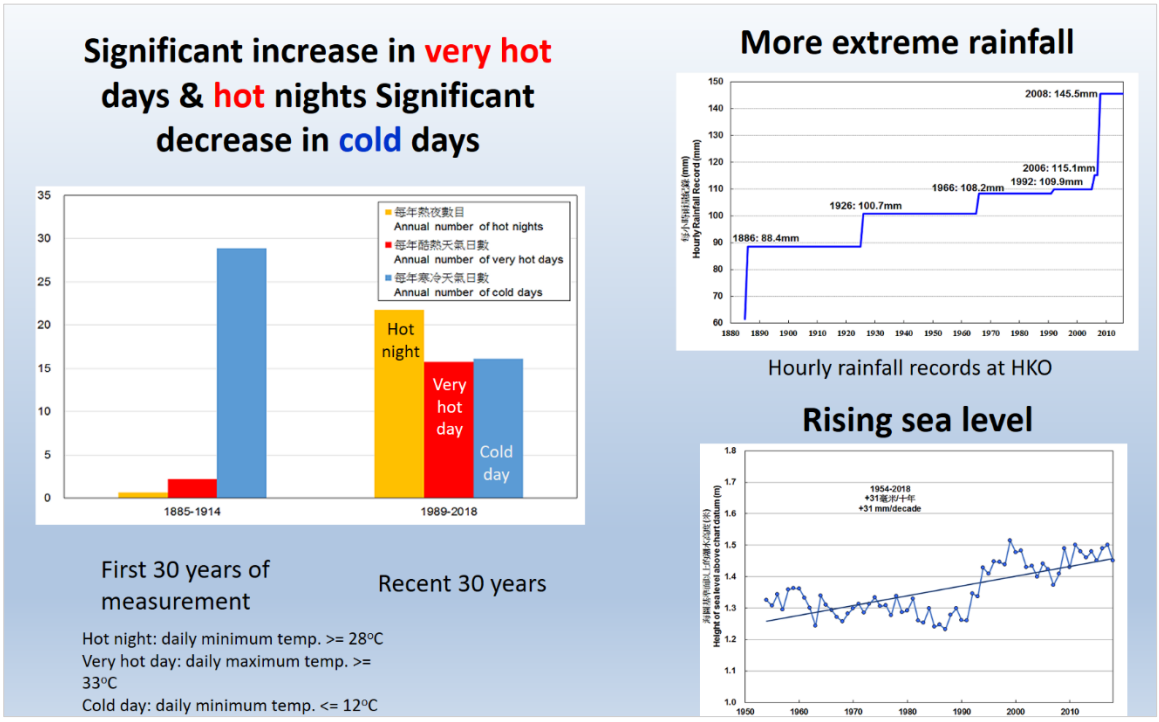
**For minimizing impacts and associated risks….**

- *Every bit of warming matters.*
- *Each year matters.*
- *Each choice matters.*
- *Political and societal will matters.*

The more decisively and earlier we act, the better able we will be to address unavoidable changes, manage risks, improve our lives and achieve sustainability for ecosystems and people around the world – today and in the future.

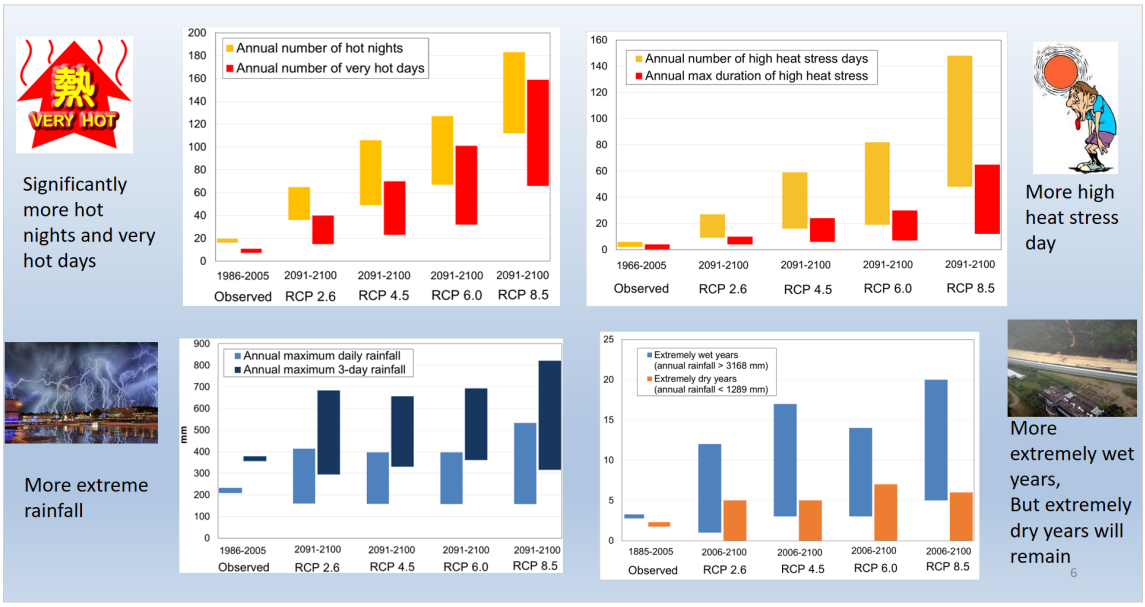
## Hong Kong in a Warming World

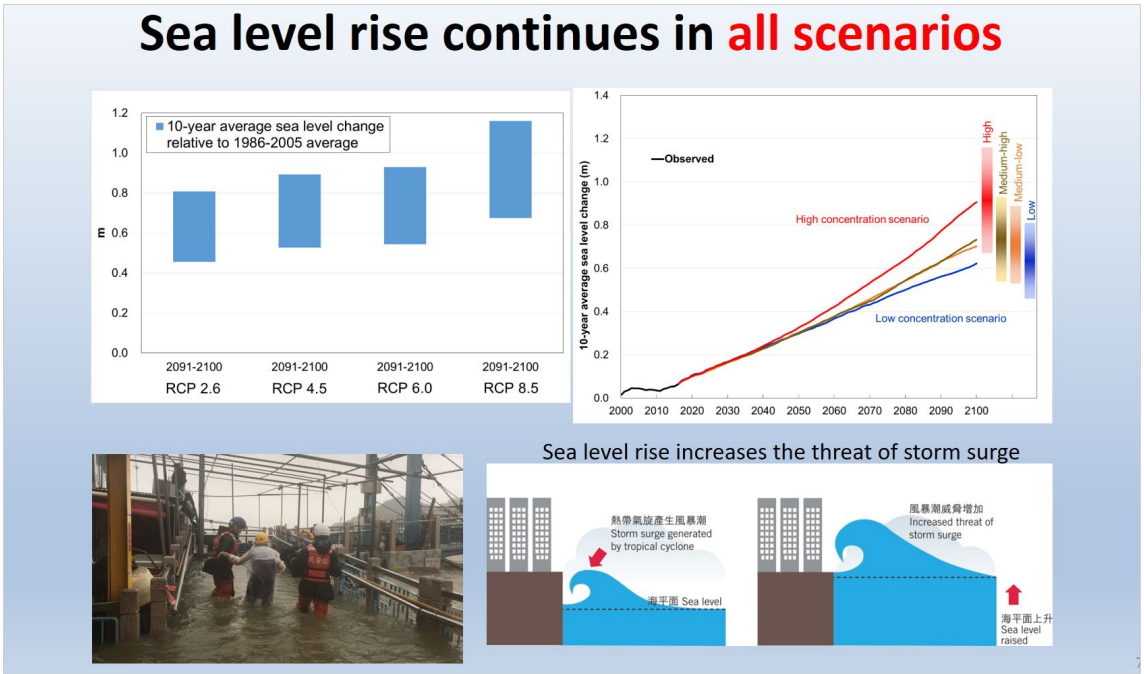
**Mr. Pak-Wai Chan**, Assistant Director, Hong Kong Observatory noted:
Hong Kong is already seeing the effects of climate change. It is experiencing more hot days, fewer cold days, more extreme rainfall and sea level rising:




Extreme sea level events such as Mangkhut's storm surge are becoming more frequent and may become close to annual occurrences by 2100.

The Hong Kong Observatory's projections of future weather extremes under different IPCC scenarios. Note that RCP2.6 is for rapid reduction in greenhouse gas emissions while RCP8.5 is a continuation of 'business as usual'.



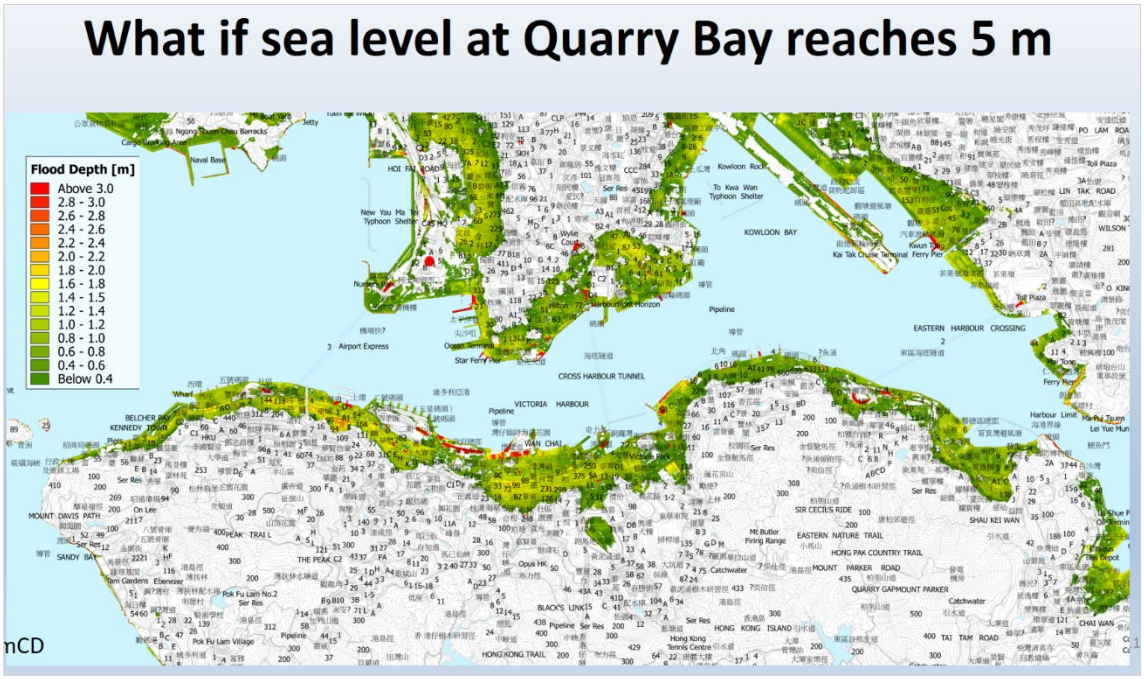




Typhoons are forecast to reduce in frequency in certain ocean basins but become more intense with heavier rainfall.

In summary the social impacts of climate change are:

- More heat-related illness due to more heat extremes
- More energy consumption for cooling (→ more carbon emissions)
- Increased risks of flooding and landslides due to more extreme rainfall
- Increased threat of storm surge due to higher sea level + stronger tropical cyclones
- More infrastructural damages due to stronger tropical cyclones

By 2100 with a sea level rise of about 1 metre, the same storm surge brought by Mangkhut may well cause sea level to reach 5 meters above chart datum (CD) in the Victoria Harbour with this impact:




Other hazards from severe typhoons and very heavy rainfall events.

The Hong Kong Observatory has collaborated with Insurance Companies to produce the following estimates of economic loss of the two recent typhoons:

## Economic loss due to Hato & Mangkhut (Greater Bay Area)

| Direct Economic Loss | Hato (2017) | Mangkhut (2018) |
|---|---|---|
| HK (in billion HKD) | 1.20 | 4.60 |
| Macao (in billion MOP) | 9.05[a] | 0.69[a] |
| Guangdong (in billion RMB) | 27.36[b] | 8.29[c] |
| Total (in billion HKD) | 40.35 | 14.47 |

The total direct economic loss in GBA resulted from Hato was estimated to be about 3 times of that of Mangkhut.

Exchange Rate: 1 MOP = 0.97 HKD, 1 RMB = 1.11 HKD
[a]Statistics and Census Service in Macao
[b]2017年廣東省防災減災年鑒
[c]2018年廣東省氣候公報

So how to tackle climate change? Hong Kong is working on:

1. **Mitigation:** increasing renewable energy supply, improving energy efficiency and lifestyle changes.
2. **Adaptation:** improved slope safety, improved drainage and reducing 'urban heat island' effects. It is currently studying how to strengthen coastal defenses.
3. **Stronger resilience**. Improving public education and other measures.

# Panel Discussion

**Prof. Hans-Otto Pörtner, IPCC; Prof. Panmao Zhai, IPCC; and, Mr. Shun Chi-ming, Director, HK Observatory. Moderated by Mr. Jonathan Drew**

**Moderator question:** What reasons, besides human activity, are there for the 1.0°C increase in Global Mean Surface Temperature which has occurred since the start of the Industrial revolution?


Prof. Zhai: The answer depends on the timescale and the spatial scale one looks at. On a small spatial scale there are many factors influencing climate but on a global scale the only non-human impacts are:

- Volcanos can have an impact but only for a few years.
- Solar radiation: Firstly this varies on a decadal scale but by less than 1%. Secondly, if one looks over thousands of years there are big impacts from changes in the Earth's orbit.
- Heat transfer between oceans and the atmosphere with El Nino / La Nina phenomena can have a significant impact but these variations cancel out over a few years.

In summary the 1.0°C temperature increase is almost entirely due to human impacts. This conclusion is supported by observations and by running computer models with and without the changes to the atmosphere caused by humans.

**Moderator question:** What happens if humanity has Net Zero greenhouse gas emissions from today? Is it correct that the time-lags in the system will lead to temperature increasing to 1.1°C or 1.2°C and then stabilizing?

Prof. Zhai: Yes: Part of the reason for this result is the extent to which plants and oceans will absorb some of the $CO_2$ which is currently in the atmosphere after humanity reaches Net Zero.

**Moderator question:** Human emissions are still increasing. If we manage to keep them at current level rather than have them grow how soon will global mean surface temperature increase to 2.0°C?

Prof. Zhai: For 1.5°C the year is 2050. For 2.0°C perhaps 2070.

Mr. C M Shun: Based on current commitments by governments 3.0°C is likely by 2100.

**Moderator question:** We are currently at 408 ppm $CO_2$ today. What level of $CO_2$ equates to stabilizing temperature at 2.0°C?

Prof. Pörtner: About 450 ppm but there is uncertainty. There is little value in speculating about a scenario where we keep emissions constant as the current economic growth is leading to emissions growing. Yes, there is some decoupling of economic growth from emissions but it is not sufficient to see us reaching a peak. Even the current 'Nationally Determined Contributions' have insufficient emissions reduction leading to, as Mr Shun says, 3.0°C likely by 2100.

There is a range of uncertainty and the climate physics in some of the CMIP-6 models indicate climate sensitivity to greenhouse gas levels is underestimated and hence forecast temperatures are also underestimated.

**Moderator question:** Prof. Pörtner you talked about a +4.0°C world with a great swathe of the planet near the equator becoming uninhabitable. How many people might have to migrate if we got to those extremes?

Prof. Pörtner: According to projections under the scenarios of RCP 2.6, RCP4.5, RCP6.0 and RCP8.5, areas no longer amenable to human life without air-conditioning will be expanding. Areas impacted will include the Persian Gulf, Amazon and South-East Asia. There is no animal life on land beyond 45°C body temperature. It is difficult for humans to live at greater than 40°C. For plant life the temperature limits are a little higher.

**Moderator question:** Is it fair to say that a world with 4.0°C will have so much loss of eco-systems that there is little point in modelling its economics?

Prof. Pörtner: Before getting to 4.0°C the cost of damage will be far greater than the cost of mitigation. It is just not an option for consideration.

**Moderator question:** If, as presented by PW Chan, a Typhoon Mangkhut level storm surge scenario becomes the 'every year' expectation then what would a 1 in 100-year storm surge look like?

Mr. C M Shun: Looking at the historical record there were very severe typhoons with severe storm surges in 1874, 1906 and 1937 which brought great casualties. If we take the estimated 5.0-metre (above chart datum) storm tide for Victoria Harbour for the 1874 typhoon and add 1.0 meter of sea level rise (under the high emission scenario), we would have a 6.0-meter impact flooding low-lying areas around the Harbour. A 7.0-meter impact is also conceivable for certain areas in Hong Kong.

Prof. Pörtner: If we burnt all known fossil fuels and melted all the ice on the planet we would get 65 meters of sea level rise. This is unrealistic but the scale of this number warns us of the uncertainty in our current projections of sea level rise. We do not know the tipping points at which the melting of large ice-sheets will start accelerating.

What we do know is that during the last interglacial 120,000 years ago sea levels were 6 to 7 meters higher than today with our current temperatures. OK, the Earth's orbital position was different so this position is not fully comparable. But also note that the last time the planet had 400ppm $CO_2$ in the atmosphere, 3 to 5 million years ago, sea levels were over 7 meters higher. This is something we are heading for and is a warning signal which should encourage us to use a precautionary approach and not trigger the climate system more than we need to.

**Moderator question:** What do these future climate projections mean for businesses? What about future wind-speeds in typhoons?


Mr. C M Shun: The current building code is based on worst recorded typhoons including the 1937 typhoon and Typhoon Wanda in 1962. The Government has appointed consultants to study possible future wind speeds and whether the building code should be revised. Answers should be available in about a year.

Even though the government has already made substantial investments in infrastructure to

divert storm water and in drainage, we are also looking at planning for increases in the intensity of heavy rain with 900mm in 24 hours recently experienced in Japan being conceivable.

Beside flooding, heavy rains can also cause landslides. A great deal of work has been done by the government on artificial slopes. With the likely heavier rainfall rates more attention needs to be paid to natural slopes. For example, numerous landslides during a Black Rainstorm event in 2008 on natural slopes over Lantau blocked the highway to the airport, where the length of one of the landslides (a debris flow) reached almost 2 kilometres. – Viz Mr. P W Chan's presentation.

**Moderator question:** Reviewing what has been said, is it fair to say the RCP8.5 'Business as Usual' scenario is so bad that we shouldn't think of it as an option?

Prof. Zhai: Past $CO_2$ emissions have been generated by industrialization. Future $CO_2$ emissions will be driven by socio-economic development, that is by the lifestyle people will have. The IPCC's past Assessment Reports focused on Representative Concentration Pathway (RCP) scenarios defined by the increase in radiative forcing in $W/m^2$ caused. The current Special Reports and forthcoming Assessment Report 6 add the concept of Shared Socio-economic Pathway (SSP) scenarios. These link our lifestyles to the level of future greenhouse gas emissions.

The current reports also introduce a RCP1.9 scenario for the level needed to stabilize temperatures at a 1.5°C increase. This requires a 45% reduction in emissions by 2030.

**Moderator question:** What is the relative contribution between the forcing from $CO_2$ and from Methane?

Prof. Zhai: New work is being done on Methane and other non-$CO_2$ drivers. These non-$CO_2$ drivers include aerosols which are harmful to health.

**Audience question:** Today's presentation of climate change problems may cause people to despair. When will HSBC run a session about engineering and business initiatives which will solve the problem?

Mr. Jonathan Drew suggested the priority was to focus on listening to the scientists in today's session and there have been and will be future sessions on possible business solutions.

**Audience question:** How does water vapour impact global warming and what can we do about its level in the atmosphere?

Prof. Zhai: Water vapour is the greenhouse gas with the largest effect in the atmosphere. Without it the average temperature on Earth will be about minus 18C. Water vapour is a short-lived gas so human activity does not directly affect the level. However, there is an internal feedback effect: when the climate is warmer there is more water vapour in the atmosphere and hence it has a larger greenhouse gas affect.

**Audience question:** Do the 5 m or possibly 7 m sea levels, above chart datum, caused by storm surge included the tide?

Mr. C M Shun: Yes, these figures are made with reference to the chart datum and so have already included the tide.

**Audience question:** Are emissions from international shipping and aviation included in the scenarios?

Prof. Pörtner: These emissions are included in the modelling of future climate change. Decarbonising the sectors is a major challenge. Germany is researching using excess

renewable energy to hydrolyze water to produce the hydrogen which can then be made into synthetic fuels. The technology is there but is very costly and energy demanding.

[Post meeting note: The UNFCCC has stated that no country is responsible for international travel emissions. Instead it has asked (a) IOM (The International Maritime Organisation) to come up with a plan for reducing shipping emissions and (b) ICAO (The International Civil Aviation Organisation) to come up with a plan for reducing aviation emissions. Both are still working on the issue.]

**Audience question:** It seems to me that global governments are going to have to make draconian decisions that impact the lifestyles that developed countries have become very used to over the last 50 years. One example is beef where Hong Kong has high consumption. Another is air-travel, it is often said that Hong Kong business couldn't function if people couldn't go in and out of the airport every day. How can we combat the public aspirations [for this high carbon lifestyle] that are going to prevail unless there are some very strong global decisions?

Mr. Jonathan Drew: An important question which comes to Pörtner's comments on governance and blockers.

**Audience question:** Assuming all the measures for reducing gas emissions fail and average temperature increases by 3°C or 4°C presumably this will lead to human population decline and hence reduced $CO_2$ emissions. Will the Earth then restore itself to pre-industrial temperatures or will we have reached a point of no-return?

Prof. Zhai: We have not modeled such a scenario.

Prof. Pörtner: Certainly the biosphere has the capacity to survive. It may not include us but it will include other less complex species that are tolerant to more extreme environmental conditions.

If you think of the evolutionary history of the planet, it is a close interaction between the biosphere and the physics and the atmosphere. The composition of the atmosphere has been generated by the lifeforms on the planet. The sustainability of the life on the planet depends on stable conditions of the oceans, ocean currents and other factors. And the living conditions which we enjoy in the different regions of the planet represent the last 8,000 years of stable climates. Now, we are taking the risk to disturb that balance. Whether planet Earth will be able to come back to that balance after we left the surface of the Earth with our activities is a good question to ask. Probably it will be a somewhat different world but there will be some biosphere remaining.

**Question from Prof. Pörtner:** After all you have heard what we scientists have to say, how is the banking sector positioning itself?

Mr. Jonathan Drew responded by indicating that the banking sector and regulators are looking very closely at how climate risks may impact the stability of the banking system and what metrics may be used to measure how banks are contributing to the transition process. He asked for Prof. Pörtner's views on governance, blockers and what the business community can do.

Prof. Pörtner: There are a diversity of responses that are emerging from the business sector. Sometimes business people say they are keen to take action but need their governments to first set the right conditions. The German Government has just approved a package including a carbon price starting at EUR 10/tonne $CO_2$ which is ineffective. Economists recommend EUR 50 to 60/tonne $CO_2$. There should also be a removal of fossil fuel subsidies. Policy makers need to be courageous to implement this. Currently they hesitate to take action as there are so

many forces in society which are pushing back on any constraints. But a $CO_2$ price with societal compensation is the strongest model that is currently under discussion.

Mr. Jonathan Drew posed an open question to the panel and audience as to whether businesses should be thinking about whether their physical assets are going to become unusable, independent of government policy.

Prof. Pörtner: The research has shown that we need not just a response but a large enough response. The emission pathways that take us to 1.5°C or at least well below 2.0°C need to be understood as **hard guard rails**. This is something which it is difficult to get some people to accept. Current action is not enough. Strong governance framing is a pre-condition for things to happen fast enough.

**Mr. Jonathan Drew** concluded the session by thanking the speakers. He noted the clear message that whatever we are doing to reduce greenhouse gas emissions it is not enough. We must take action as the consequence of not doing so are dire. The organisers will hope to run sessions focused on solutions in the future.

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# SPEAKERS (in alphabetical order)

**Mr. Pak Wai Chan** is an Assistant Director of the Hong Kong Observatory. He specializes in research and development, and overseeing the climate information service including climate change studies in the Observatory. He has worked at the Observatory for over 25 years including aviation weather service with research experience on low level windshear/turbulence, meteorological instrumentation and mountain meteorology. He holds a Master of Philosophy degree on Physics in University of Hong Kong and is a Chartered Meteorologist of Royal Meteorological Society. He has published more than 180 refereed scientific papers in internationally renowned journals on meteorology.

**Prof. Hans-Otto Pörtner** is a Co-Chair of Working Group II of the IPCC for the Sixth Assessment cycle. He studied at Münster and Düsseldorf Universities where he received his PhD qualifying in Animal Physiology. As a Research and then Heisenberg Fellow of the German Research Council he worked at Dalhousie and Acadia Universities, Nova Scotia, Canada and at the Lovelace Medical Foundation, Albuquerque, USA. Currently he is Professor and Head of the Department of Integrative Ecophysiology at the Alfred Wegener Institute, Bremerhaven, Germany. He acts as an associate editor 'Physiology' for Marine Biology and as a co-editor of the Journal of Thermal Biology. He was Honorary International Associate Member of the Society for Integrative Biology, USA, between 2006 and 2013. He gave the Peter Hochachka Memorial Lecture at University of British Columbia in 2007, the Plymouth Marine Lecture in 2013, and the Bidder Lecture of the Society for Experimental Biology in Florence, 2018. During the IPCC Fourth Assessment Cycle he served as Lead Author on the Working Group III Special Report on Carbon Capture and Storage, and during AR5 as Coordinating Lead Author of Chapter 6 (Ocean Systems) of the Working Group II Report, as a member of the author teams for the Working Group II Summary for Policymakers and Technical Summary, as well as a member of the Core Writing Team for the Synthesis Report. His research interests include the effects of climate warming, ocean acidification, and hypoxia on marine animals and ecosystems with a focus on the links between ecological, physiological, biochemical and molecular mechanisms limiting tolerance and shaping biogeography and ecosystem functioning. He is a Clarivate Analytics highly cited researcher 2018.

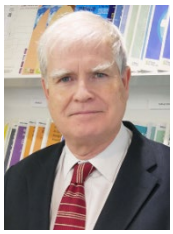
**Mr. Shun Chi-ming**, F.R.Met.S., is the Director of the Hong Kong Observatory. Mr. Shun graduated from the University of Hong Kong as Bachelor of Science in 1985. He joined the Hong Kong Observatory in 1986 as Scientific Officer. Mr. Shun specialized in aeronautical meteorology since the 1990s and introduced the most advanced droppler weather radar to detect windshear for the Hong Kong International Airport (HKIA) which opened in 1998. In the 2000's, Mr. Shun led a team of researchers to develop the world-first Light Detection And Ranging (LIDAR) Windshear Alerting System for the HKIA. The system overcame the long-standing problem of detection of windshear under rain-free conditions, winning local awards and international recognition.

Mr. Shun started taking up several international positions since the 2000's. He was President of the Commission for Aeronautical Meteorology (CAeM) of the UN World Meteorological Organization (WMO) from 2010 to 2018, the first Asian who took up this high position in WMO. Mr. Shun Chi-ming was elected a Co-Vice-President of the newly-established Commission for Weather, Climate, Water and Related Environmental Services and Applications of the WMO in June 2019.

**Prof. Panmao Zhai** is a Co-Chair of Working Group I of IPCC for the Sixth Assessment cycle. He is a well-known Chinese climatologist. He is a research professor and PhD advisor in the Chinese Academy of Meteorological Sciences, the largest multi-disciplinary and comprehensive research institution on atmospheric sciences in China. He has more than 30 years working experience in climate change and variability studies. He has published more than 100 papers in Chinese and English. He has developed the Global Climate Monitoring and Diagnostic System and established the ENSO Monitoring and Prediction System in China. Such contributions have effectively supported China National Climate Centre's operational activities and services. Currently, as a Chief Scientist, Panmao is leading a group of excellent meteorologists, studying the formation mechanism and prediction method for persistent extreme events in China.

# MODERATORS

**Mr. Jonathan Drew** is a Managing Director, Sustainable Finance in Real Assets & Structured Finance Group at HSBC. Jonathan graduated with an MA in Economics from Cambridge University in England and is also qualified as a Chartered Accountant. Jonathan started his banking career more than 20 years ago in London and after working in rapidly emerging Latin America and raising capital for large scale projects in the Middle East has been based in Hong Kong since 1997 witnessing first-hand the rapid growth of Asia and notably China. During this time he has been involved in successful transactions across a wide range of sectors including advising on and arranging finance for projects that produce and deliver energy (renewable and non-renewable) and transport people and resources from source to point of consumption as well as a wide range of infrastructure projects in social and education sectors with a focus on resource efficiency and sustainability. These transactions have involved supporting projects, corporates and institutions to approach various financial markets and structuring innovative and tailored products including green bonds and loans to meet the often large and specific needs of clients in markets with very distinct financial and regulatory characteristics. Jonathan is responsible for driving HSBC's Sustainable Finance initiative across the Asia region for the banking business and also chairs the Asia Pacific Loan Market Association Green Loan Committee..



**Mr. J. Robert Gibson** is an Adjunct Professor in the Division of Environment and Sustainability at Hong Kong University of Science and Technology, a Fellow of Civic Exchange, and a member of the Hong Kong Institute of CPA's Sustainability Committee. He focuses on mechanisms for making capitalism more sustainable and facilitating action by business to mitigate greenhouse gas emissions and adapt to climate change.