Module 1: Introduction to weather & climate

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In this first module we're going to look at some of the basic concepts around weather and climate. Module 2 will then go into these concepts in more detail.

Key messages in Module 1

- The climate is changing
  - Humans are a major source of the greenhouse gas emissions that drive climate change.
- The resulting changing weather patterns can affect human health trends & projections in climate.
- The health sector has a role nationally & internationally in preparing for, preventing, & coping with the health risks of climate change.

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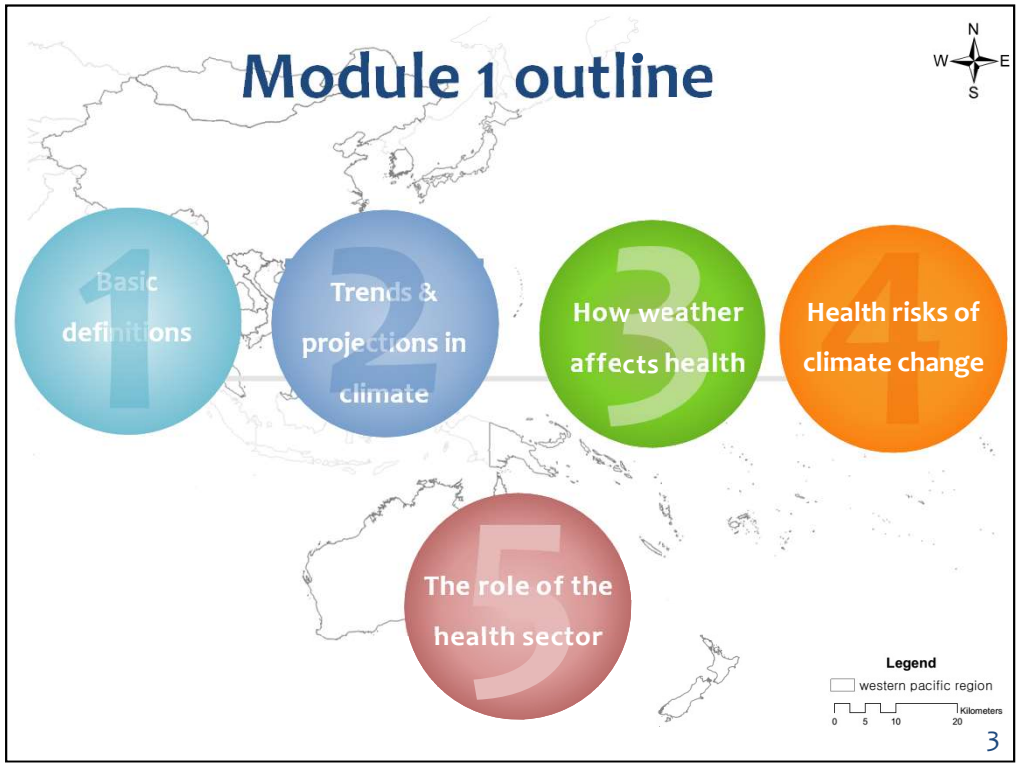
The intention of this module to provide a broad overview on climate variability and change and their associated health risk, and the role of the health sector in climate change in international and national efforts to manage climate change.

Here are the key take aways from Module 1.

Read through each of the bullets



This is what we'll cover in Module 1. Remember each of these topics will be covered in more detail in subsequent modules, so this is a first introduction.

1. Basic definitions
2. Trends and projections in climate
3. The framework by which changing weather patterns can affect human health
4. The health risks of climate variability and change
5. The role of the health sector nationally and internationally in preparing for, preventing, and coping with the health risks of climate change

Let's start off by looking at some definitions of common words used in the climate change field, so we have a good understanding of these.

First, it's really important to understand the difference between weather and climate. Climate is what you expect, but weather is what you actually get on a day to day basis. Weather and climate are part of a continuum.

The World Meteorological Organization designates particular weather stations for collecting data on a range of weather variables for determining the "climate normal" or the 30-year average of weather variables in a particular location. Projecting what could happen over 30-year time periods is, in some ways, less challenging that forecasting what will happen tomorrow or next week. Weather, then, is the day to day variability in climate that we experience.

Climate definitions

- **Climate variability**
  - Short-term fluctuations around the average weather
  - Includes ENSO (El Nino - Southern Oscillation)
- **Climate change**
  - Operates over decades or longer
  - General Circulation Models (GCMs) / Earth System Models (ESMs)
    - Not predictions – based on scenarios
    - Downscaling / spatial issues

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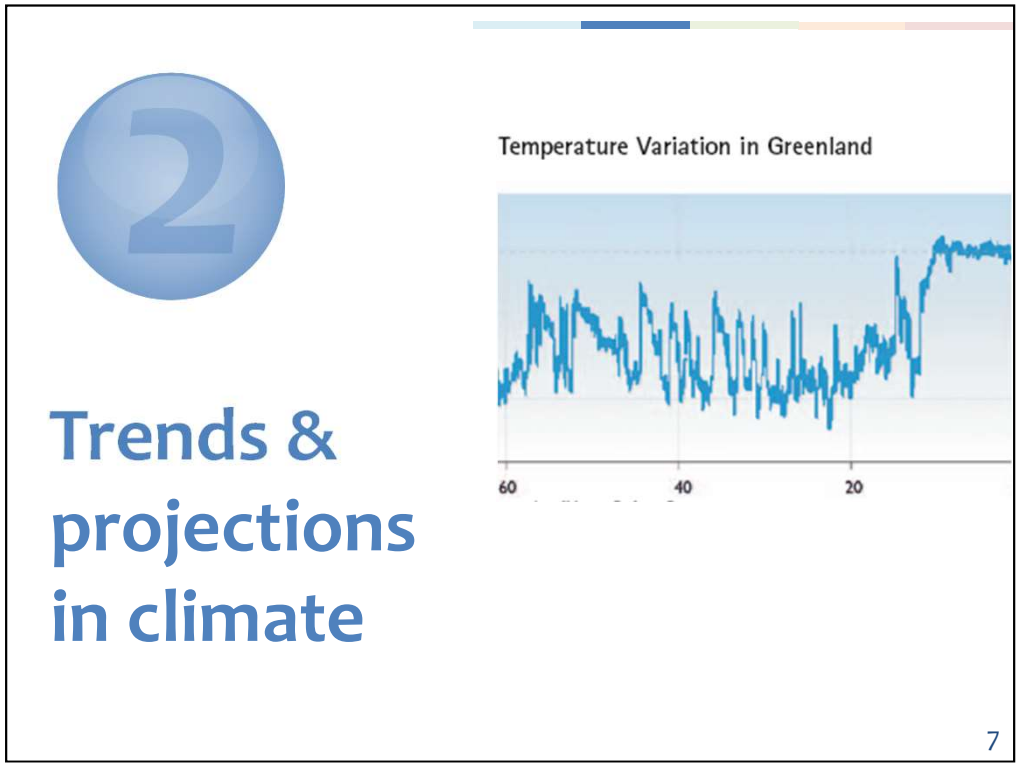
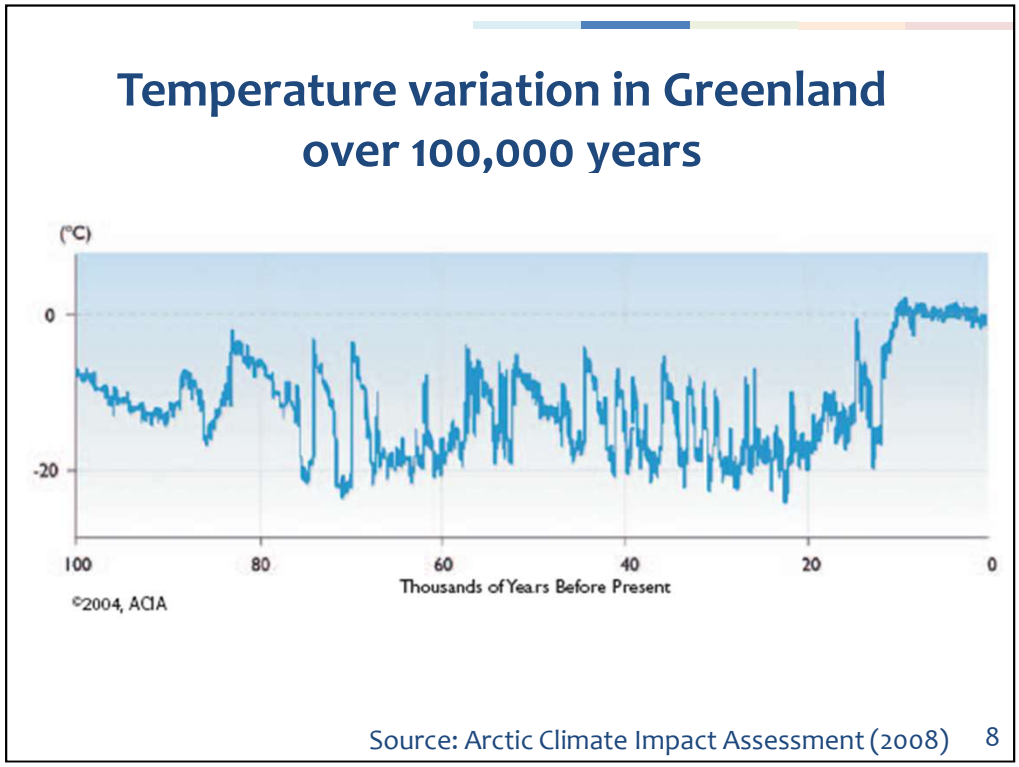
Climate variability is the term used to describe short-term variations around average weather. El Nino-Southern Oscillation events are particularly important expressions of climate variability for human health. As you will hear in other modules, ENSO events are associated with adverse health outcomes in many regions. For example, in some regions of Asia and the Pacific, ENSO events are associated with drought. In other regions, ENSO events are associated with flooding. Both extreme events can cause direct and indirect health impacts.

Climate change operates over decades or longer. Future climate change is projected using GCMs or ESMs, where ESMs are more complex models than GCMs by including additional factors and interactions associated with climate. The future is inherently uncertain, so projections are not "predictions". Climate projections are based on scenarios of drivers of greenhouse gas emissions, including, at a minimum, demographic change (including patterns of change), economic development, and technological development. Scenarios have typically been developed at relatively

course geographic scales (world regions or very large countries). While the resolution of GCMs have increased significantly over recent decades, there still are limits to the scale at which models have skill for projecting changes in temperature, precipitation, and other weather variables. There is considerable research ongoing to (1) project climate change at finer scales within GCMs; and (2) to downscale from GCMs using several techniques to project at finer spatial scales. There often remains a mismatch between the desired spatial resolution for health models of the risks of climate change and the scale at which GCMs project.



Now that we understand the difference between weather and climate, and the difference between climate variability and climate change, let's now look at some of the changes in climate that have occurred over human history.



The slide shows the temperature variation in Greenland over 100,000 years, determined by data from ice core sample. First a note on how climatologists analyze historic trends. Because climate is always changing, there is no natural baseline against which to compare. Therefore, trend analyses are not appropriate for determining long-term trends. Instead, analyses start by choosing a baseline period. The baseline for many climate studies is 1961-90 (a climate normal). The weather data are normalized to that baseline and plotted to show deviations (anomalies) over time.

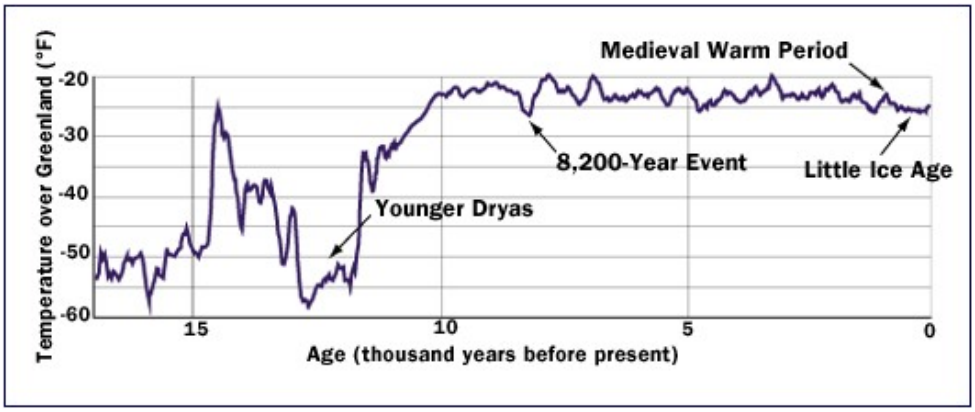
Several points should be clear from the figure. Climate is always changing, with often very large swings in temperature over relatively short time periods (on a geologic scale). One can imagine the impacts on societies if temperature patterns returned to that degree of variability.

Another point is that the last 10,000 years are unique in the climate record: they

have been relatively stable. The earth is coming out of this period of stability.

Source: Arctic Climate Impact Assessment 2008 <<http://www.acia.uaf.edu/>>

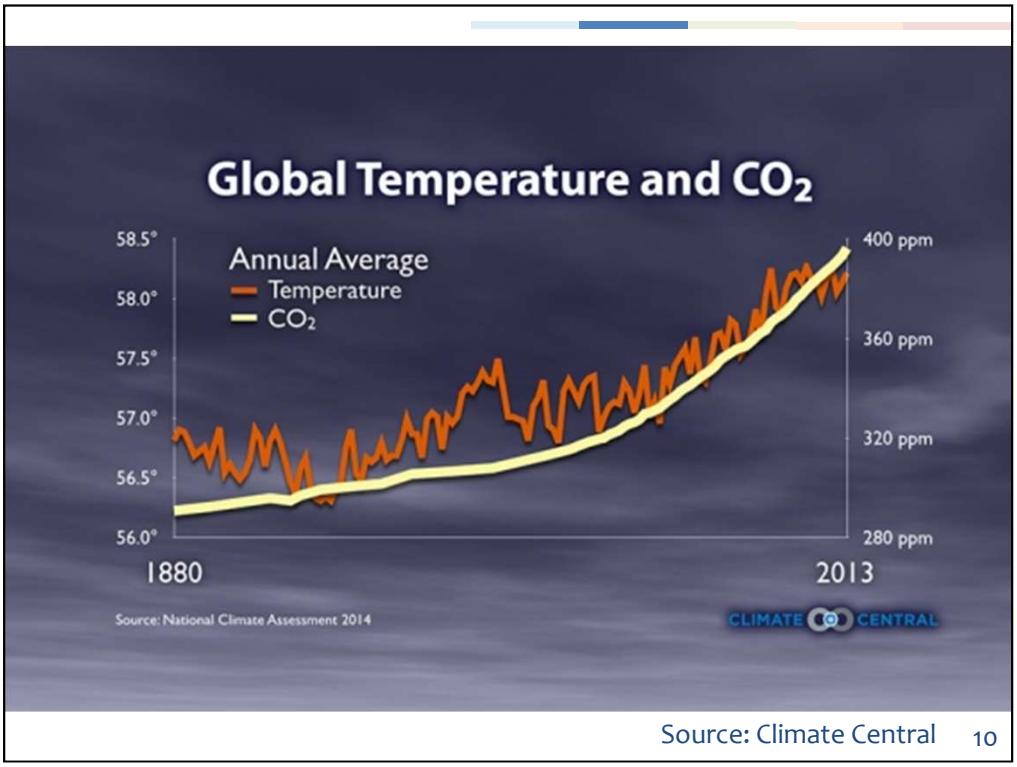
Temperature over Greenland over past 17,000 years



Source: Alley (2000) 9

This figure shows the last 17,000 years. The earth started warming out of the last ice age about 15,000 years ago. After warming considerably, temperature fell during a period called the Younger Dryas. After several thousand years, the earth starting warming again and continued to warm until about 10,000 years ago, when temperatures over Greenland (and for the rest of the world), became relatively stable. The Medieval Warm Period and Little Ice Age are marked. Although the Little Ice Age was quite small compared with the rest of the climate history, it had significant direct and indirect impacts on human health, including from reductions in crop yields leading to food insecurity.

Source: **Alley, RB. The Two Mile Time Machine 2000**

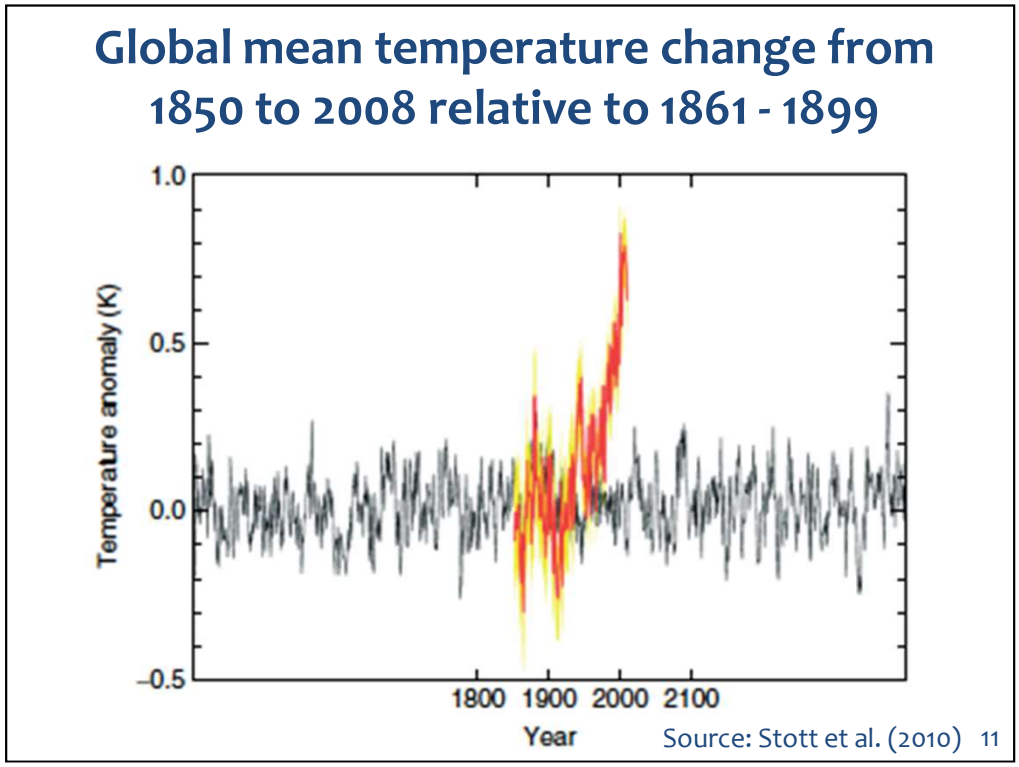


Source: Climate Central 10

This figure shows global mean surface temperature since shortly after measurements began in about the 1860s, and the atmospheric concentration of carbon dioxide. The considerable increase in both temperature and concentrations of carbon dioxide is obvious, as is the close correlation between these two.

Note the temperatures are in degrees Fahrenheit. In Celsius, the scale is 13.3 to 14.7.

Source: http://www.climatecentral.org/



The figure provides a better sense to the magnitude of the change since the start of the Industrial Revolution. The black line shows a 1000 year segment of global mean temperatures from control simulations of a coupled ocean–atmosphere climate model over many centuries, with no changes in the external drivers of climate such as increases in greenhouse gas concentrations or in solar output.

On top of this are plotted observed global mean temperature changes from 1850 to 2008 (in red) from a climate model run by the Hadley Centre in the UK. Uncertainties (yellow band) are expressed as anomalies relative to the mean temperature over the 1861–1899 period.

Source: Stott PA et al. 2010. Detection and attribution of climate change: a regional perspective. WIREs Climate Change;1:192-211.

What does this mean?

- The climate is always changing
- Since the industrial revolution, atmospheric concentrations of carbon dioxide & ambient temperature have increased significantly.

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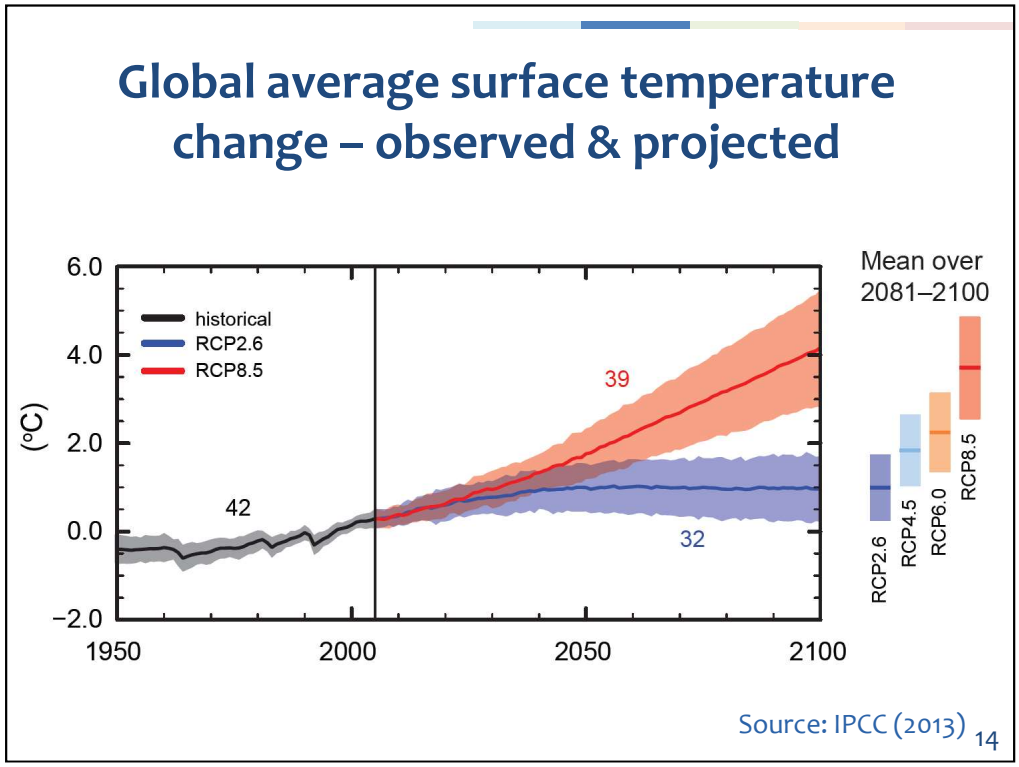
So what do the previous slides show, in terms of trends and predictions in climate?

In summary… (read)

The 10 warmest years on record globally all occurred since 1998, as this figure from Climate Central shows.

Q: Do you know what the warmest year was in your own country? *Facilitate responses. Lead a short discussion of how local and international temperatures can differ.*

Source: http://www.climatecentral.org/



The figure from the Summary for Policy Makers for the IPCC Working Group I report shows global average surface temperature change from 1950 to the present (black line) along with projections to 2100 under different assumptions of greenhouse gas emissions. The numbers on the figure show the number of climate models. Under high emissions, the global average surface temperature could increase by as much as 6° C; this is about the same difference in global average surface temperature between now and the last ice age. The mean and associated uncertainties averaged over 2081−2100 are given for all RCP scenarios as coloured vertical bars.

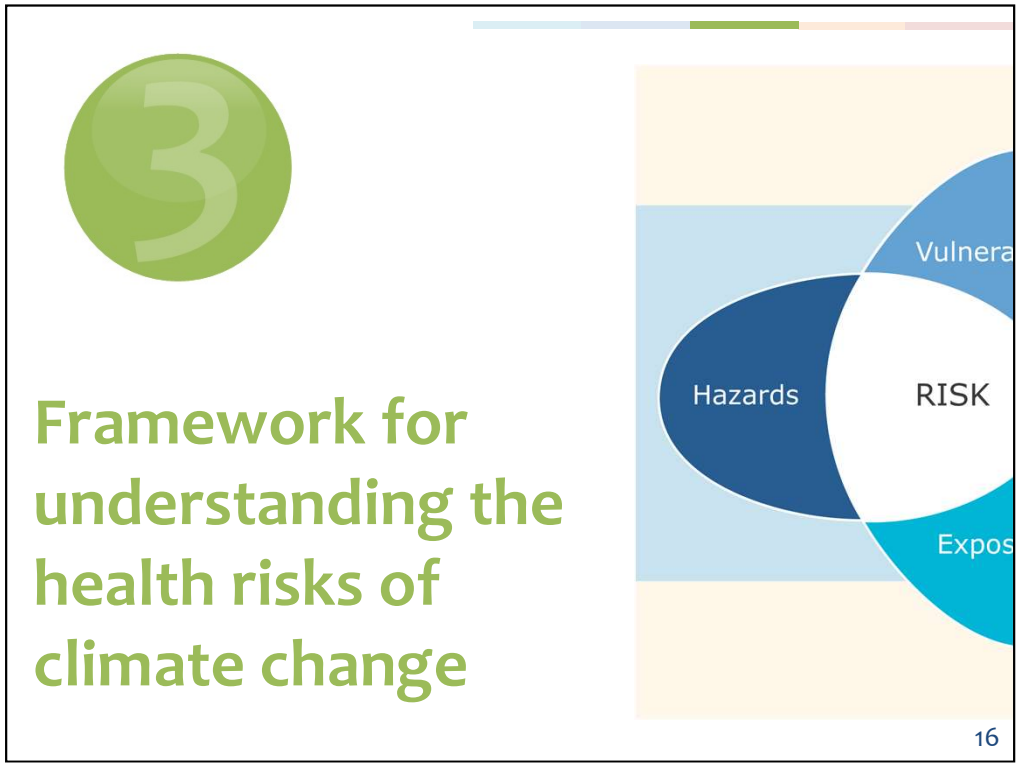
The baseline is the period 1986-2005.

Source:
http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

Some of the many consequences of temperature changes…

The trends that we've just looked at have a wide range of consequences. This image illustrates just one area of impact in the extent to which temperatures are projected to change. By the 2080s, only 6 of the 19 host cities of the winter Olympics would reliably be able to host the games again due to projected reductions in snow fall and higher temperatures.

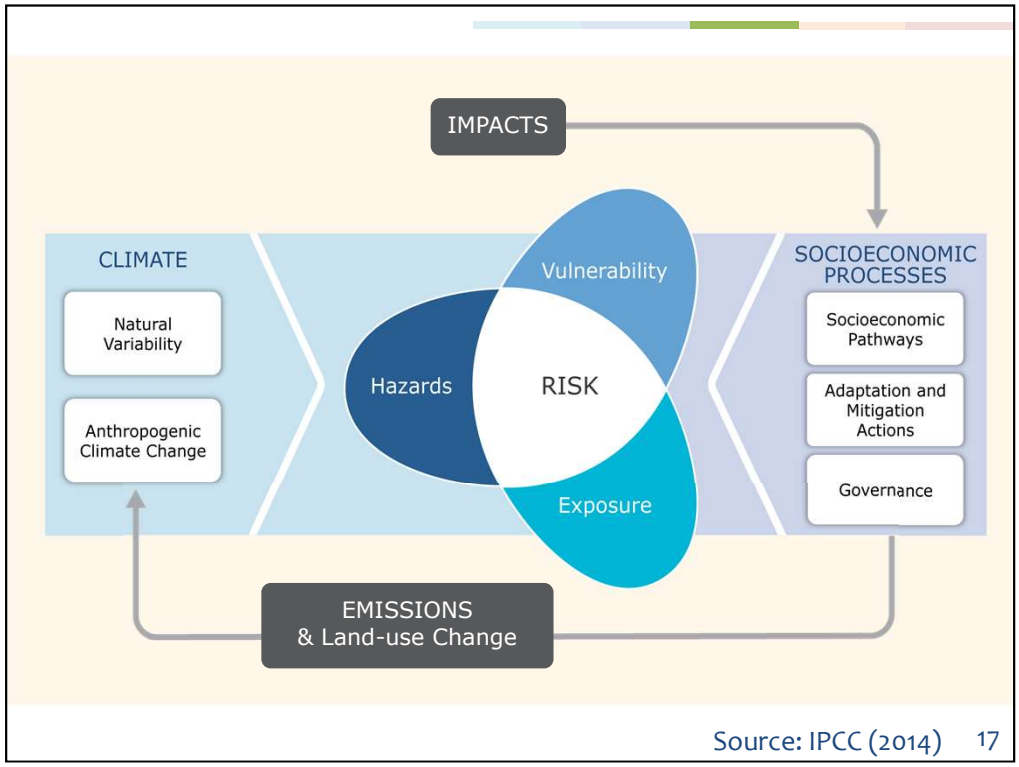
Source: http://www.climatecentral.org/



CHECK energy levels. Scan the room to see how engaged people are after a series of graphs. If people look like they're flagging, suggest a one or two minute stretch break - "Let's have a quick stretch break. Staying in the room, please stand up and find a way to move your legs, stretch your arms and take a few good breaths. … Thanks, I'll get you to take a seat again."

So we've covered some of the basic definitions around climate change, and how climate changed over short and longer time scales, and how climate is projected to change over this century.

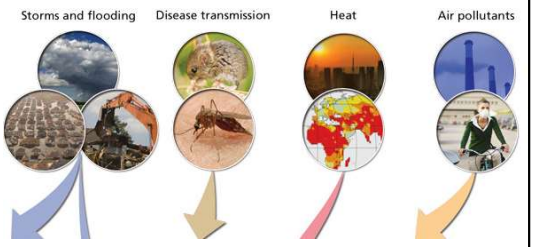
Now let's look at a framework for understanding the health risks of climate change.



This diagram shows the risk associated with a changing climate arise from the interaction of three factors: the hazards associated with a changing climate; the human and/or natural systems exposed to those hazards; and the vulnerability of these systems. Drivers of these factors include changes in climate variability and change, and socioeconomic processes, including adaptation and mitigation.

This model comes from the IPCC Working Group II 5th assessment report.

Source: http://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf



The health risks of climate variability & change

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Many health outcomes are seasonal…

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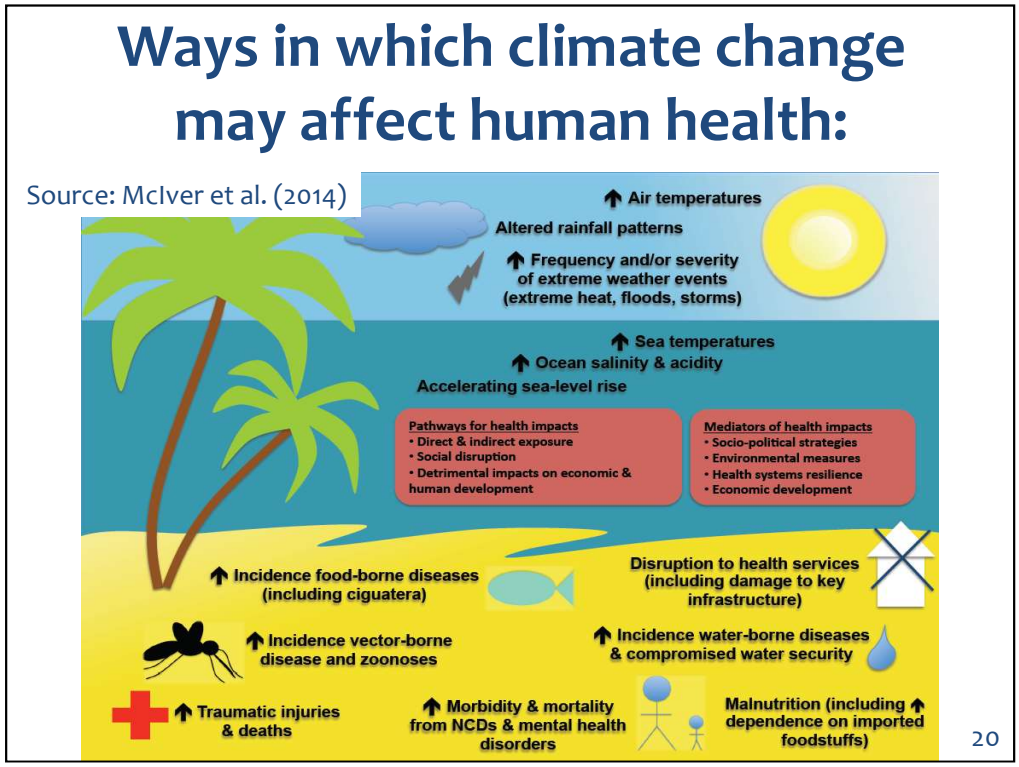
Although more than a decade old, this slide from the Ministry of Health in Guatemala is an example of the seasonality of many health outcomes. One doesn't need to understand Spanish to see the that infectious diseases typically occur only during certain months of the year. Any health outcome that is seasonal may be affected by climate change. The extent to which the incidence or geographic range of a seasonal disease could be affected by climate change will be determined by how sensitive it is to weather variables. Although not all diseases are seasonal because of temperature and precipitation patterns, most infectious diseases are.



The figure illustrate the various exposure pathways by which climate change affects health, with a particular focus on the Pacific, although the pathways are the same in other regions. Climate change can affect human health:

•directly through weather variables such as heat and storms, or from changes in ocean acidification;
•indirectly through changes in natural systems that affect disease vectors; and
•through pathways heavily mediated through human systems, such as undernutrition.

In a minute I'm going to ask you to consider which of the health outcomes listed on the slide are particular problems in your country.

Q: Any questions on this slide?

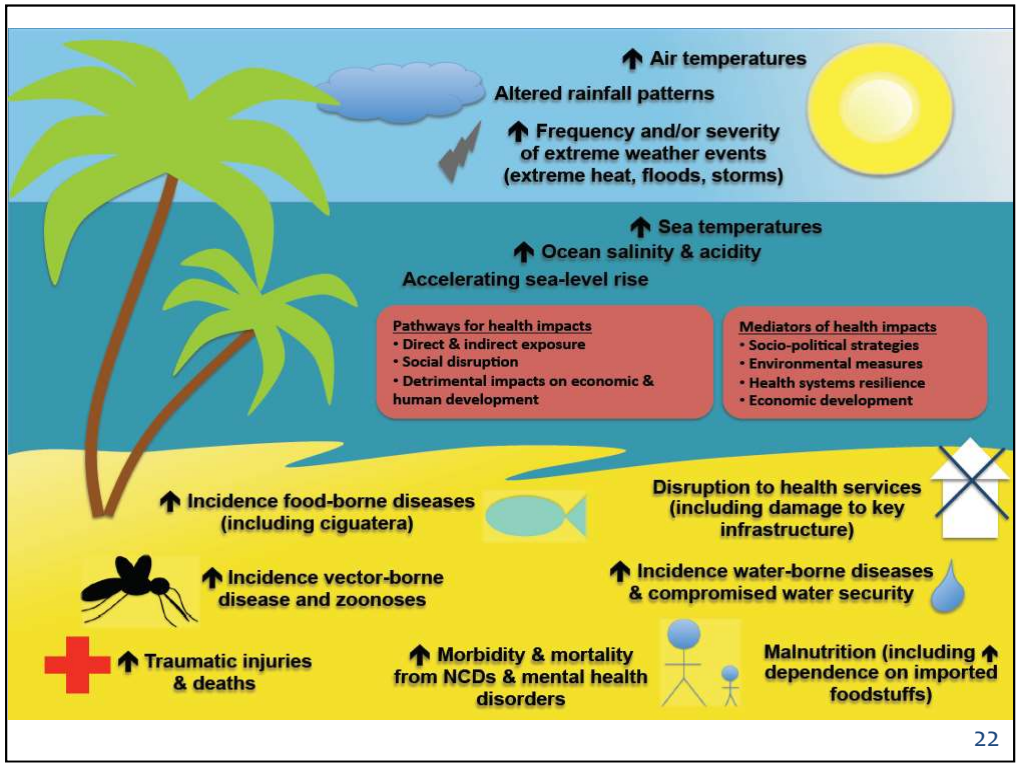
Source: McIver et al. 2014 WHO Report (being finalized)

"In a minute I'd like you to get into groups of 3 – ideally with someone from your country or region, if possible. If there aren't two others from your country, see if you can team up with someone from a nearby country.

Find yourselves a table to work at and a piece of flipchart paper and markers, and hand a marker around to each person. Introduce yourselves and then please brainstorm all the ways that climate change can affect health. These affects were listed on the previous slide, which I'll put up again in a minute. If you know the department or group that is likely to be responsible for managing this affect, please list it, using two colours if you are from different countries.

You'll have 8 minutes for this activity."

Go to next slide for full-screen image of possible health effects of climate change



Give time warnings: **4 mins** – "Ok you are half way, so you have another four minutes to work on your brainstorm. If you haven't done, have a look at the slide and make sure you've covered the range of affects that could be possible in your countries."

7 mins: "Please finish your notes over the next minute. Please make sure that your country or countries are written on your page".

8 mins: "Ok, wrap up now, thanks."

"Can I ask one volunteer from each group to take your page to the back/side wall and stick it up. Then at the end of this module we can have a look at how health in other countries is already being affected by climate change, and who is likely to be responsible or involved in managing these impacts."

The rest of you can return to where you're sitting." Wait for volunteers to return to their seats and get people's attention back by going to the next slide.

Policy responses to manage the risks of climate change

1. **Mitigation**
   - A human intervention to **reduce** the sources or enhance the sinks of greenhouse gases.
2. **Adaptation**
   - Term used by the climate change community to describe the **process of adjustment to actual or expected climate & its effects.**
   - Seeks to moderate harm or exploit beneficial opportunities
   - Basically, means **prevention** from the perspective of public health.

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In terms of managing these impacts, there are two main policy responses to managing the risks of climate change: adaptation and mitigation.

Mitigation actions reduce greenhouse gas emissions or enhance the sinks (e.g. sources that take up carbon dioxide, such as soil and rocks).

CLICK *to animate*. Adaptation is a term used in the climate change community to describe the process of adjustment of human and natural systems to actual or expected climate change. This is similar to the idea of prevention in public health.

Preventing health risks

- **Reduce exposures:**
  - Legislative policies
  - Alterations in built environment
  - Alterations in natural environment
- **Prevent onset of adverse outcomes:**
  - Early warning systems
  - Surveillance & monitoring
  - Vector control programs
  - Public education & outreach
- **Response / treatment:**
  - Medical training & awareness
  - Emergency response

Source: Ebi (2009) 24

Health systems have been managing, with various degrees of success, the health risks associated with temperature and precipitation patterns for more than 150 years. For nearly all health outcomes of concern, policies and programs are in place to prevent and reduce health burdens. This means that health systems are well placed to incorporate concerns about climate change into existing programs. This slide illustrates some of the opportunities.

Health system policies and programs are traditionally grouped into primary, secondary, and tertiary prevention. The goal of primary prevention is to reduce exposures. This slide illustrates a few of the many opportunities to reduce exposure to higher ambient temperature, changing precipitation patterns, and sea level rise. The goal of secondary prevention is to prevent the onset of adverse health outcomes once exposure has occurred. The examples listed are core programs in many ministries of health. The goal of tertiary prevention is response and/or treatment once an adverse health outcome is manifest. Most of the activities in this area fall

within health care services and emergency response.

Source: Ebi KL. Public health responses to the risks of climate variability and change in the United States. Journal of Occupational and Environmental Medicine 2009;51:4-12

Finally, let's look at the role of the health sector – you and your colleagues globally – in managing the health risks of climate change. (KT)

"I'd like to ask you to turn to two others you're sitting near. Over the next **4 minutes** please discuss between the three of you what you think the role of the health sector is in managing the risks from climate change. This includes your own role, the role of your colleagues and your organisation, as well as your country's health sector as a whole. Take some notes as you talk in the notes next to this slide.

Give one minute warning – "You have another minute to finish up your discussion" – and then a wrap up call "Ok thank you, I'll ask you to finish the last point you're discussing and turn your attention back this way"

It sounded like you came up with lots of good ideas in your discussions on the role the health sector can play in managing the risks of climate variability and climate change. It's great to see this enthusiasm and range of ideas, as the health sector does indeed have a really significant role to play. That's why we're here! ☺

Role of the health sector

- Enhance resilience & protect health from climate change
- Identify the health benefits (and potential health harms) associated with reducing greenhouse gas emissions and other climate pollutants
- Support health-promoting climate change policies

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Here is a short overview of some of the many roles we believe the health sector can play nationally and internationally around climate change.

CLICK to animate three summary points, reading each one.

Overall, health systems need to be strengthened to ensure that communities and regions are resilient to the risks of climate variability and change, with strategies, polices, and measures explicitly incorporating climate change and with close cooperation across sectors. The health sector also needs to assess the health benefits and potential harms of policies, measures, and technologies to reduce greenhouse gas emissions and other climate pollutants. Finally, the health sector needs to support national and international negotiations to ensure agreements promote health.

"We stand to lose the most of any country in the world due to climate change & rising sea levels… we will be among the first to go under water."

Ulu of Tokelau, Mr Foua Kerisiano Toloa

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For some countries, the risks of climate change are extensive.

This quote is part of a powerful message from a representative of the government of Tokelau. Tokelau is a territory of New Zealand in the South Pacific Ocean that consists of three tropical coral atolls with a combined land area of 10 km² and a population of around 1,400. Under projected climate change scenarios, Tokelau is expected to be significantly impacted by sea level rise, cyclones, storm surges, drought and longer spells of hot weather, affecting coastal land, housing and infrastructure, water supply, coral health, and the quantity and quality of fish supply.

Source:
http://tokelau.org.nz/Tokelau+Government/Government+Departments/Department+of+Economic+Development+Natural+Resources++Environment.html

WHO Conference on Health & Climate, August 2014

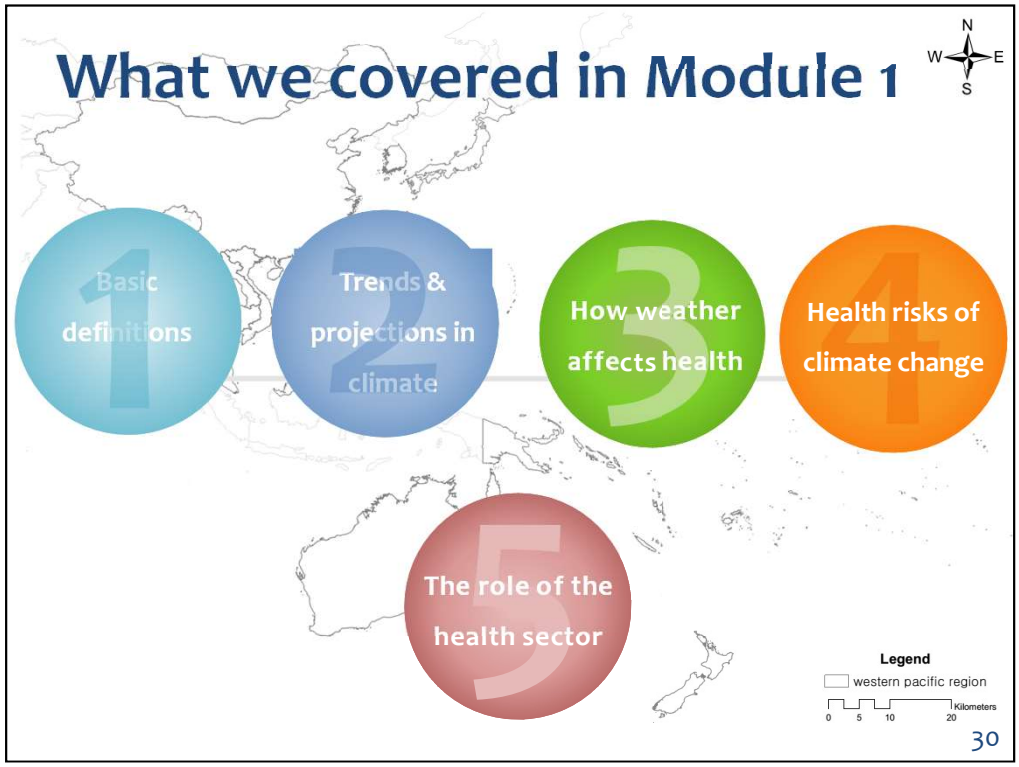
The health sector is already starting to play an important leadership role. In August 2014, WHO held its first international conference on health and climate; the photo is of some of the delegates. It was attended by 360 participants, including health and environment ministers of WHO member states, senior civil servants, technical experts, UN agencies, NGOs, chief executives from health authorities and relevant private sector entities.

The meeting discussed: the state of climate science, particularly as it relates to health; the public health response to climate change; health resilience; health benefits and health promotion while mitigating climate change; and the economics of health and climate change. Throughout the conference, participants discussed linking climate, sustainable development and health policy.

The meeting produced a draft summary that recognizes the need to strengthen health resilience to climate change and the opportunity to make gains in public

health through well-planned mitigation measures. The document also recognizes policy gaps and next steps. A final version was presented at the 2014 Climate Summit in New York in September. The conclusions are also intended to serve as input to the 21st session of the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC COP 21), the post-2015 development agenda discussions, and the 2nd Hyogo Framework for Action on Disaster Risk Reduction in 2015.

We look forward to more of you being involved in understanding and managing the health risks of climate change.



In module 1 we introduced many of the topics that will be covered in more detail in subsequent modules. We introduced and defined the terms "weather, climate, climate variability and change". Figures showed how the climate is changing. And we introduced a framework for understanding and managing the health risks associated with climate change and variability. We finished off by looking at the roles of the health sector in international and national efforts to manage climate change.

We'll go into more detail on all these topics in the next sections of the training.

Learning from Module 1

- The climate is changing
  - Humans are a major source of the greenhouse gas emissions that drive climate change.
- The resulting changing weather patterns can affect human health trends & projections in climate.
- The health sector has a role nationally & internationally in preparing for, preventing, & coping with the health risks of climate change.

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CLICK to animate each of the three key messages one by one and read.

Coming up next…

Module 2:

Weather, climate, climate variability & climate change

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