

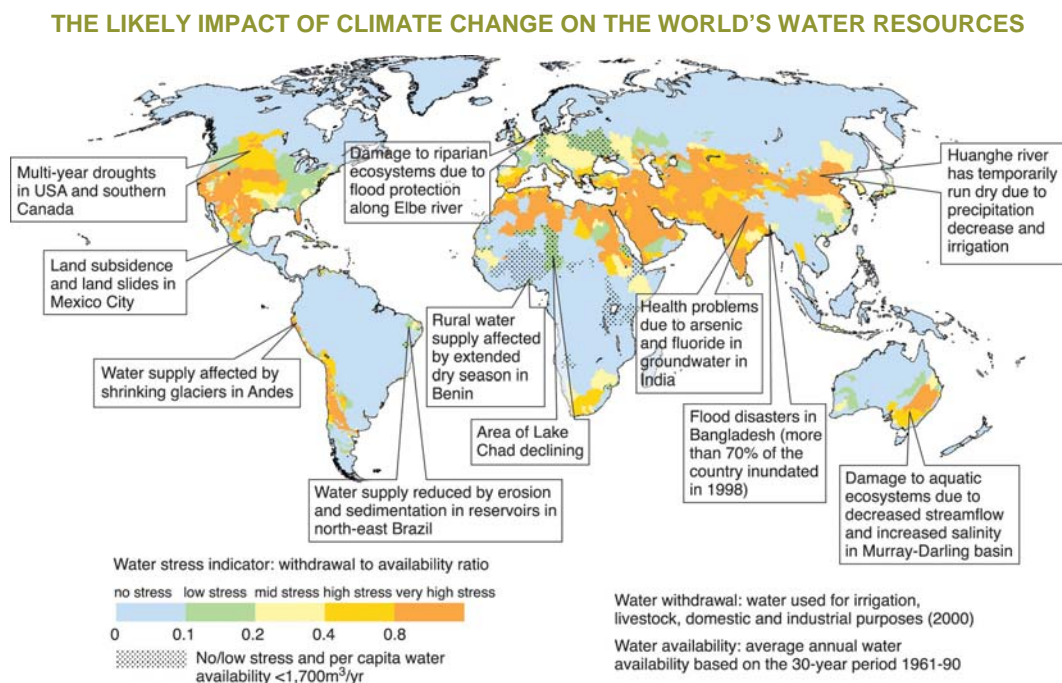
MODULE 4: HOW DO WE PREDICT THE FUTURE?

STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

Climate varies from region to region. This variation is driven by the uneven distribution of solar heating, the individual responses of the atmosphere, oceans and land surface, the interactions between these, and the physical characteristics of the regions. Some human-induced factors that affect climate are global in nature, while others differ from one region to another. For example, carbon dioxide, which causes warming, is distributed evenly around the globe, regardless of where the emissions originate, whereas sulphate aerosols (small particles) that offset some of the warming tend to be regional in their distribution. As a result, the projected changes in climate will vary from region to region. For example, temperatures over land are expected to increase about twice as rapidly as temperatures over the ocean and warming will be greatest at higher latitudes. Similarly some areas will get wetter, whereas other areas will get drier.

ACTIVITY NINE

Climate change will affect every aspect of our lives. The graphics below show some of these impacts in more detail.

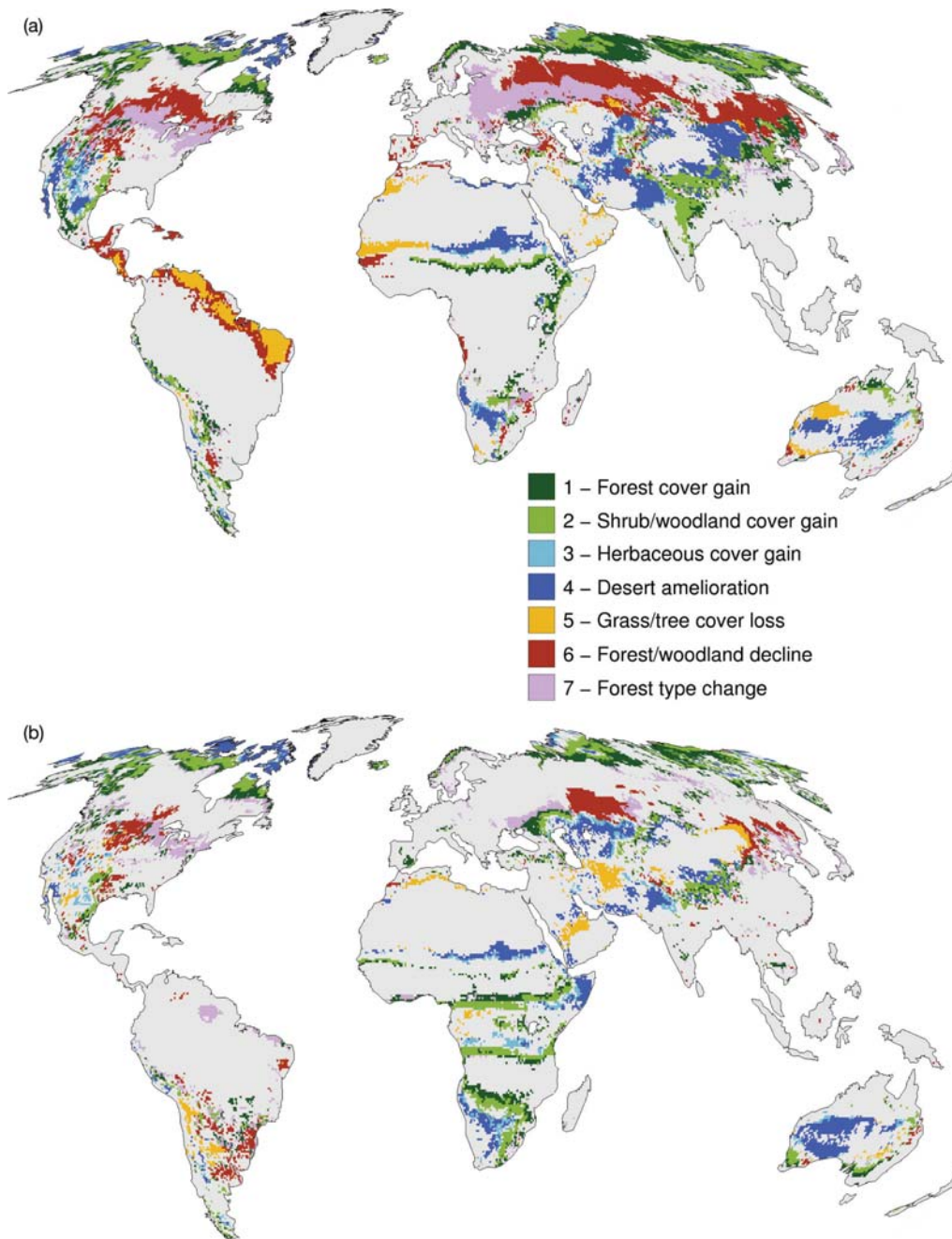


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- This is a water stress map. It shows how climate change is affecting freshwater resources.
- Dark orange shades show areas of high water stress. Here, water is used for irrigation, farming and industry, making less available for other uses.
- By 2050, annual average water availability will increase by 10-40% at high latitudes and in some wet tropical areas. Heavy rainfall and flooding are likely to increase.
- By 2050, annual average water availability will decrease by 10-30% over some dry regions, in mid-latitudes and the dry tropics, some of which are already water stressed. Drought areas will increase.
- Water stored in glaciers and snow cover will decline affecting over one-sixth of the world's population who use melt water from mountains.

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

THE LIKELY IMPACT OF CLIMATE CHANGE ON THE WORLD'S ECOSYSTEMS

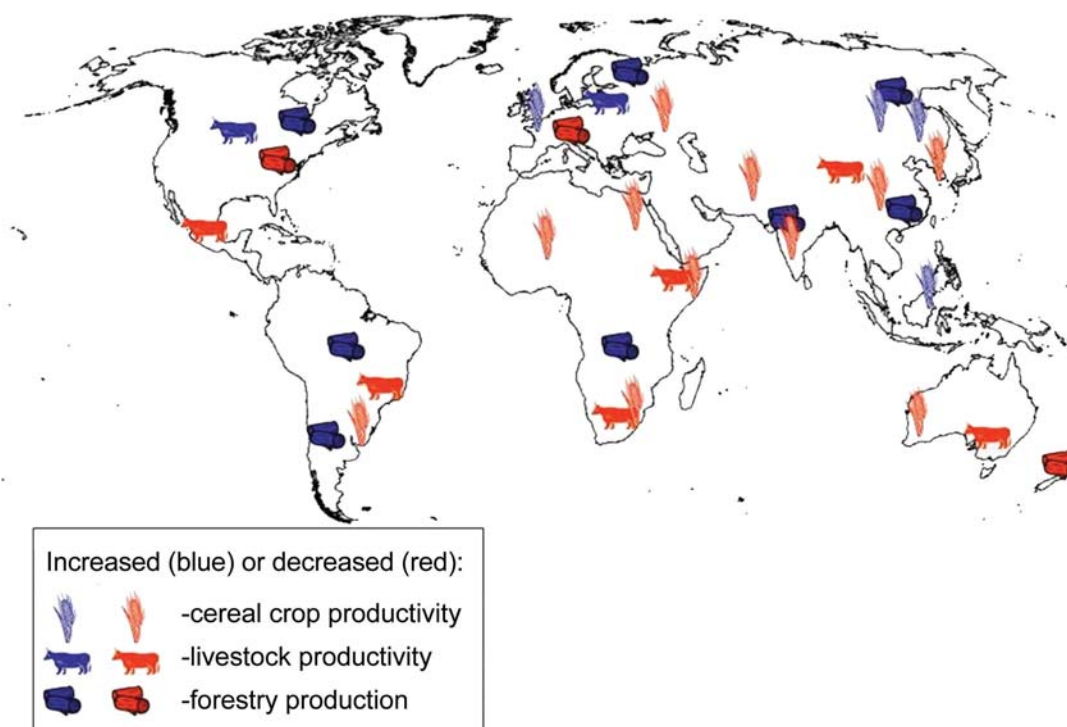


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- These maps show projected changes in ecosystems (plants, animals and other living organisms) by 2100
- Map A. shows a high carbon world, based on a medium-high emissions scenario (A2). See Learning Module 8 for details
- Map B. shows a low carbon world, based on a low emissions scenario (B1). See Learning Module 8 for details
- Many ecosystems are likely to be damaged this century by flooding, drought, wildfire and ocean acidification.
- Coral reefs, marine shell organisms, tundra, boreal forests, mountain and Mediterranean regions are very vulnerable.

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

- Around 20-30% of plant and animal species could face extinction if the average global temperature rises above 1.5 to 2.5°C.
- Spring events, like blossom and appearance of leaves, bird migration and egg-laying are likely to happen earlier than usual.
- Changes in algal, plankton and fish abundance in high latitudes are likely.

THE LIKELY IMPACT OF CLIMATE CHANGE ON THE WORLD'S FOOD SUPPLY


SOURCE: INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007) IPCC FOURTH ASSESSMENT REPORT. CLIMATE CHANGE. [ACCESSED JUNE 2009] AVAILABLE FROM WORLD WIDE WEB: [HTTP://WWW.IPCC.CH/GRAPHICS/GRAPHICS/AR4-WG2/JPG/FIG-4-3.JPG](http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/fig-4-3.jpg)

- This map shows how climate change is likely to affect some types of farming and forestry by 2050.
- Blue shapes highlight more production and red shapes, less production.
- In mid to high latitudes there will be temperature increases of 1-3°C, increasing crop productivity.
- In the Tropics, crop productivity will decrease even with small temperature increases.
- Increases in the frequency of droughts and floods will decrease crop and livestock production, especially at low latitudes.
- Globally, timber productivity is expected to rise.

As a result of these likely changes each of the following may be affected:

- Coastal systems
- Water resources
- Ecosystems
- Food supplies
- Health
- Industry and society

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

Here are some of the ways in which climate change could impact on our lives, categorise them according to the aspects listed above.

- Through the 21st century, glaciers and snow cover will decline, reducing water availability in regions supplied by melt water from major mountain ranges.
- Coasts will be exposed to increasing risks, including erosion and sea level rise. These effects will increase in densely populated areas.
- The spatial distribution of some infectious diseases will change. For example, malaria will become a problem in more parts of Africa and Asia.
- Approximately 20-30% of plant and animal species are likely to face extinction if global average temperature increases exceed 1.5 to 2.5°C.
- Increases in the frequency of droughts and floods will have a negative effect on crop and livestock production, especially at low latitudes.
- Poor communities will be especially vulnerable, especially those in high-risk areas. They tend to have fewer resources to adapt to the changing weather and are more dependent on climate-sensitive resources such as local water and food supplies.
- Globally, timber productivity is expected to rise.
- Coral reefs are vulnerable to increased temperatures. This can lead to coral bleaching, causing widespread disease.
- There will be increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts.
- Many millions more people will be flooded every year due to sea level rise by the 2080s. Densely populated and low lying areas which face other challenges such as tropical storms or local coastal subsidence are especially at risk.
- The most vulnerable industries and settlements are those in coastal and river flood plains, in areas prone to extreme weather events, and where rapid urbanisation is occurring.
- More people are expected to suffer from cardio-respiratory diseases due to higher concentrations of ground-level ozone related to climate change.

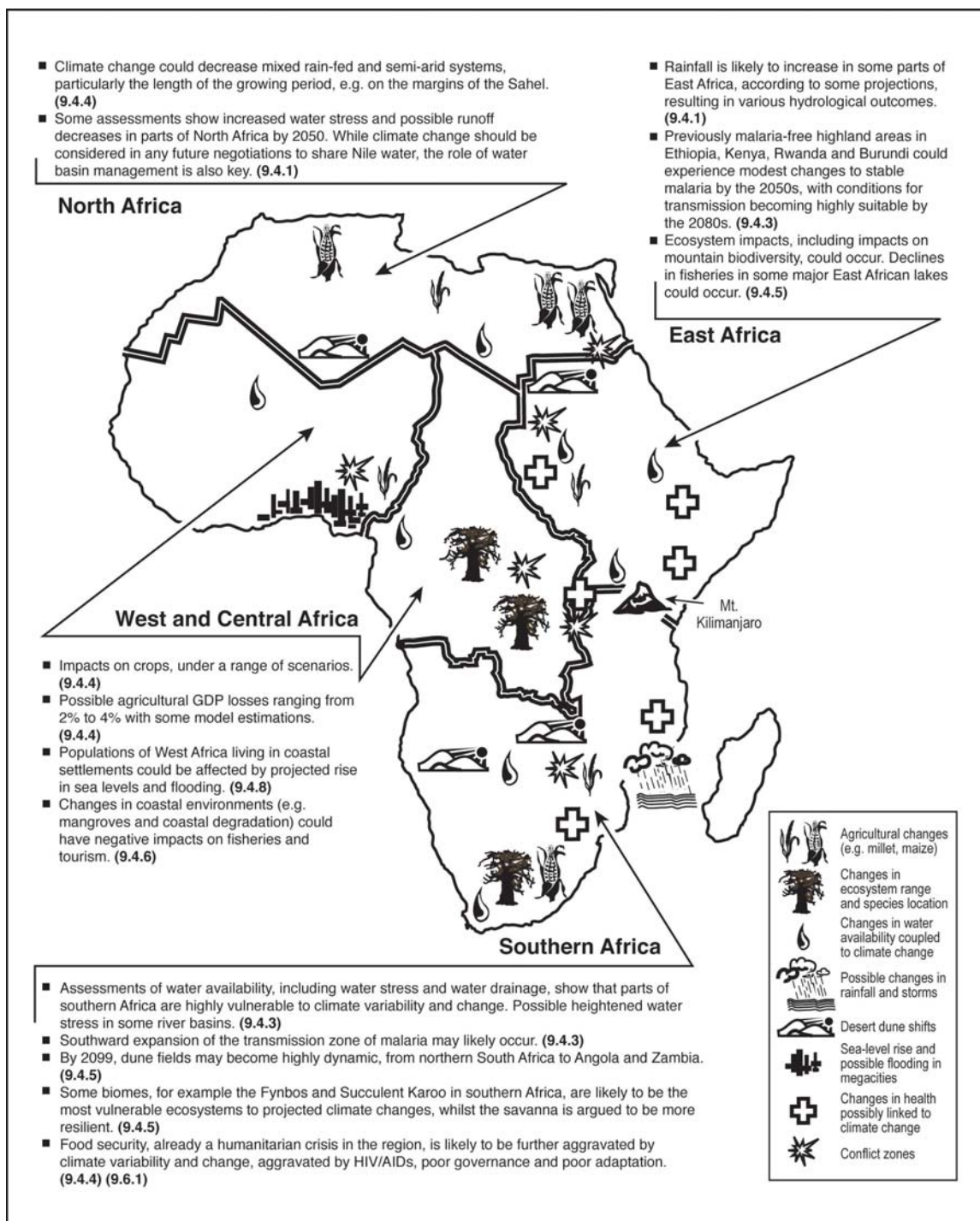
Some of this information is linked, for example the increase in flooding at low altitudes will affect food production and may destroy industries.

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

ACTIVITY TEN

Different parts of the world will be affected by climate change in different ways. In some regions water supply or health might be the most important aspects affected. In other regions it might be more economically important aspects which are affected.

The graphic below shows how Africa will be affected by climate change.



SOURCE: INTER GOVERNMENTAL PANEL ON CLIMATE CHANGE (2007) IPCC FOURTH ASSESSMENT REPORT. CLIMATE CHANGE. [ACCESSED JUNE 2009] AVAILABLE FROM WORLD WIDE WEB: [HTTP://WWW.IPCC.CH/GRAPHICS/GRAPHICS/AR4-WG2/JPG/FIG-9-5.JPG](http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/fig-9-5.jpg)

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

This map shows why Africa is one of the most vulnerable continents to climate change.

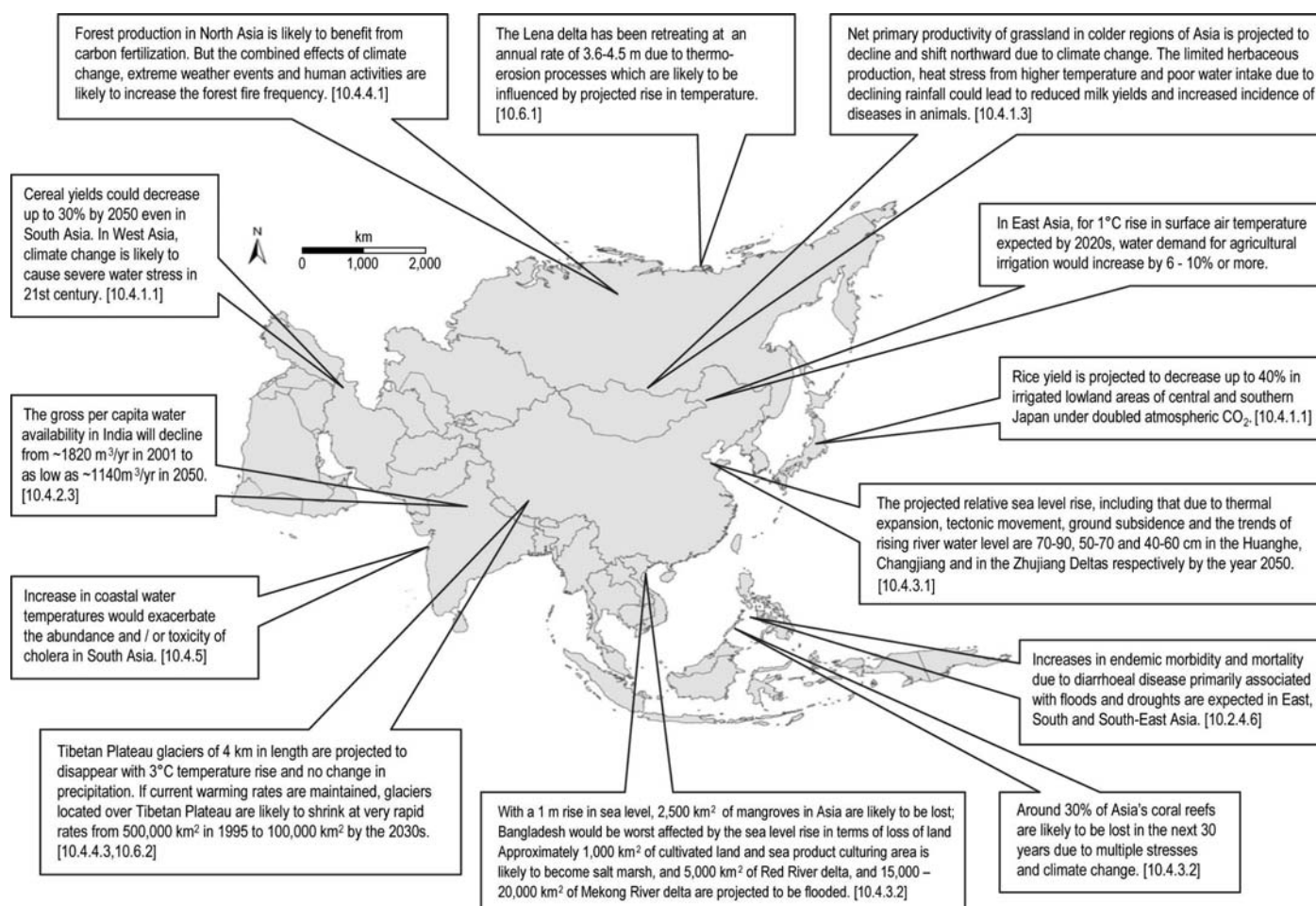
- By 2020, between 75 million and 250 million people are expected to be exposed to increased water stress.
- Food production is likely to be severely affected by a decrease in suitable farm land and decrease in the length of growing seasons.
- In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020.
- Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations.
- Mangroves and coral reefs will be degraded, causing problems for fisheries and tourism.
- Complete the following table using the map as a source of information.

REGION	NORTH AFRICA	EAST AFRICA	WEST AND CENTRAL AFRICA	SOUTHERN AFRICA
COASTAL SYSTEMS				
WATER RESOURCES				
ECOSYSTEMS				
FOOD SUPPLIES				
HEALTH				
INDUSTRY AND SOCIETY				

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

ACTIVITY ELEVEN

The graphic below shows how Asia is likely to be affected by climate change



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This map shows key climate change hot spots for Asia based on a medium emissions scenario for 2050.

- Central, South, East and South-East Asia - freshwater availability is projected to decrease affecting millions of people.
- Coastal areas will be at greatest risk due to increased flooding from the sea and, in some mega-deltas, flooding from the rivers.
- East and South-East Asia - crop yields could increase up to 20%.
- Central and South Asia - crop yields could decrease up to 30%.
- Himalayan glacier melt is projected to increase flooding, and rock avalanches, and to affect water resources within two to three decades.
- Floods and droughts are likely to increase the amount of illness and death caused by diarrheal disease.

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

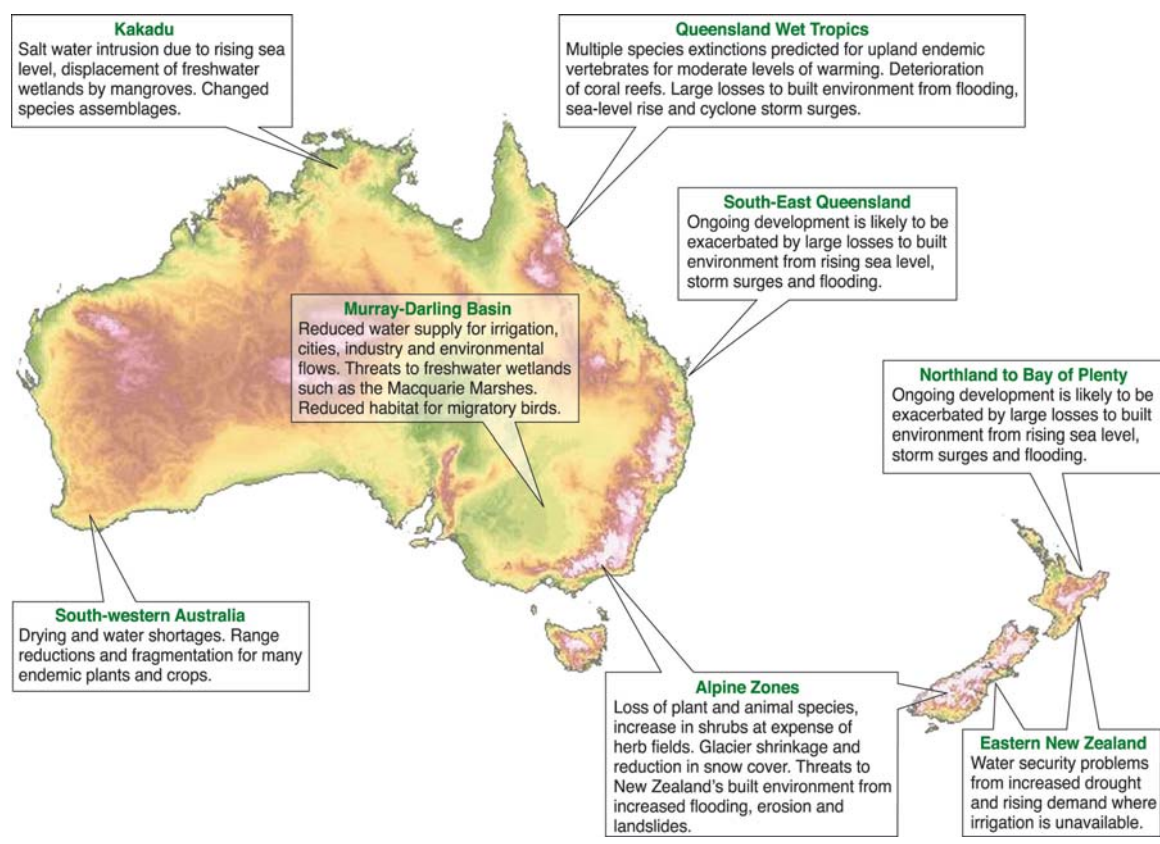
Complete the following table using the map as a source of information.

REGION	WEST ASIA	EAST ASIA	SOUTH EAST ASIA	NORTH ASIA	SOUTH ASIA
COASTAL SYSTEMS					
WATER RESOURCES					
ECOSYSTEMS					
FOOD SUPPLIES					
HEALTH					
INDUSTRY AND SOCIETY					

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

ACTIVITY TWELVE

The graphic below shows how Australia and New Zealand are likely to be affected by climate change.



Complete the following table using the map as a source of information.

REGION	SOUTH WESTERN AUSTRALIA	ALPINE ZONES	EASTERN NEW ZEALAND	NORTHLAND TO BAY OF PLENTY
COASTAL SYSTEMS				
WATER RESOURCES				
ECOSYSTEMS				
FOOD SUPPLIES				
HEALTH				
INDUSTRY AND SOCIETY				

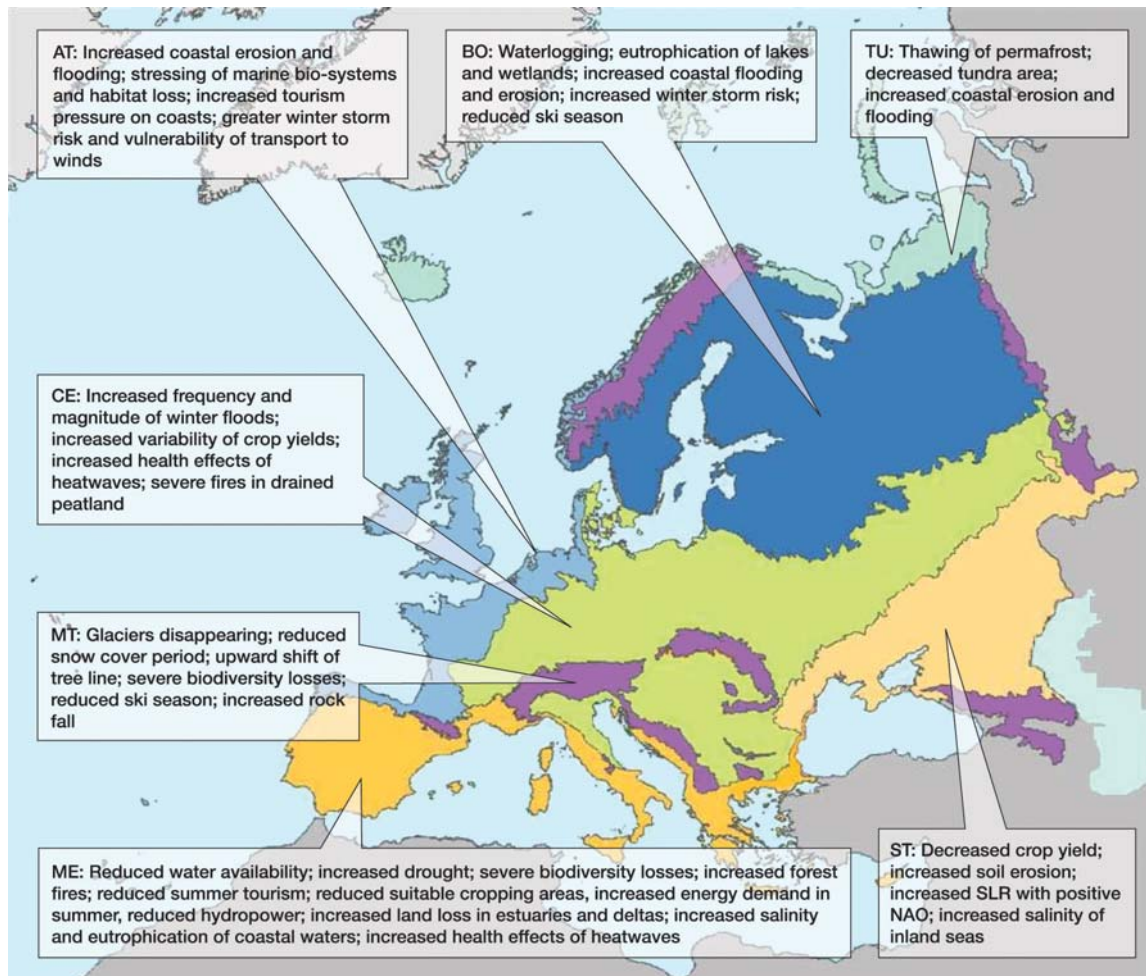
MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

REGION	MURRAY DARLING BASIN	SOUTH EAST QUEENSLAND	QUEENSLAND WET TROPICS	KAKADU
COASTAL SYSTEMS				
WATER RESOURCES				
ECOSYSTEMS				
FOOD SUPPLIES				
HEALTH				
INDUSTRY AND SOCIETY				

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

ACTIVITY THIRTEEN

The graphic below shows how Europe is likely to be affected by climate change



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- This map shows how nearly all European regions are expected to be negatively affected by climate change.
- Light blue - increased risk of inland flash floods, more frequent coastal flooding and increased erosion due to storminess and sea-level rise.
- Purple - mountainous areas will face glacier retreat, reduced snow cover and winter tourism, and extensive species losses.
- Orange - in Southern Europe, high temperatures and drought will reduce water availability, hydropower potential, and crop productivity. There will be increased health risks due to heat waves and the frequency of wildfires.
- Green - in Central and Eastern Europe, summer rainfall is likely to decrease, causing higher water stress. Health risks due to heat waves are expected to increase. Forest productivity is likely to decline and the frequency of peat land fires to increase.
- Dark blue - in Northern Europe, initial benefits such as reduced demand for heating, increased crop yields and forest growth will be outweighed by more frequent winter floods and endangered ecosystems.

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

Complete the following table using the map as a source of information.

REGION	ME	ST	MT	CE
COASTAL SYSTEMS				
WATER RESOURCES				
ECOSYSTEMS				
FOOD SUPPLIES				
HEALTH				
INDUSTRY AND SOCIETY				

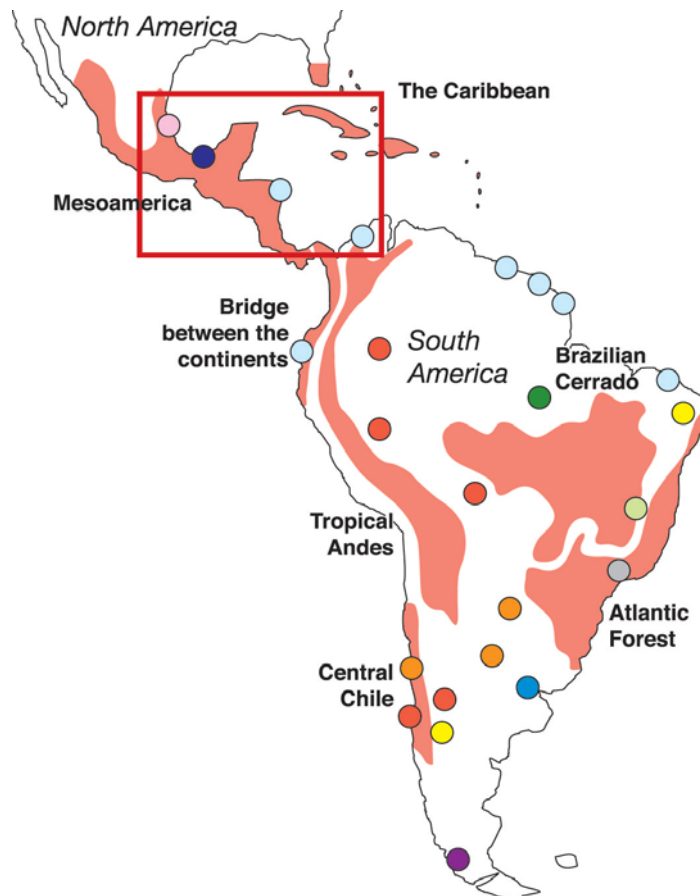
REGION	AT	BO	TU
COASTAL SYSTEMS			
WATER RESOURCES			
ECOSYSTEMS			
FOOD SUPPLIES			
HEALTH			
INDUSTRY AND SOCIETY			

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

ACTIVITY FOURTEEN

The graphic below shows how Latin America is likely to be affected by climate change.

(SST in the graphic refers to sea surface temperature)



- Coral reefs and mangroves seriously threatened with warmer SST
 - Under the worst sea-level rise scenario, mangroves are very likely to disappear from low-lying coastlines
 - Amazonia: loss of 43% of 69 tree species by the end of 21st century; savannisation of the eastern part
 - Cerrados: Losses of 24% of 138 tree species for a temperature increase of 2°C
 - Reduction of suitable lands for coffee
 - Increases in aridity and scarcity of water resources
 - Sharp increase in extinction of: mammals, birds, butterflies, frogs and reptiles by 2050
 - Water availability and hydro-electric generation seriously reduced due to reduction in glaciers
 - Ozone depletion and skin cancer
 - Severe land degradation and desertification
 - Rio de la Plata coasts threatened by increasing storm surges and sea-level rise
 - Increased vulnerability to extreme events
- Areas in red correspond to sites where biodiversity is currently severely threatened and this trend is very likely to continue in the future

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INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007) IPCC FOURTH ASSESSMENT REPORT. CLIMATE CHANGE. [ACCESSED JUNE 2009]
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Complete the following table using the map as a source of information.

REGION	MESOAMERICA	THE CARIBBEAN	BRAZILIAN CERADO	ATLANTIC FOREST
COASTAL SYSTEMS				
WATER RESOURCES				
ECOSYSTEMS				
FOOD SUPPLIES				
HEALTH				
INDUSTRY AND SOCIETY				

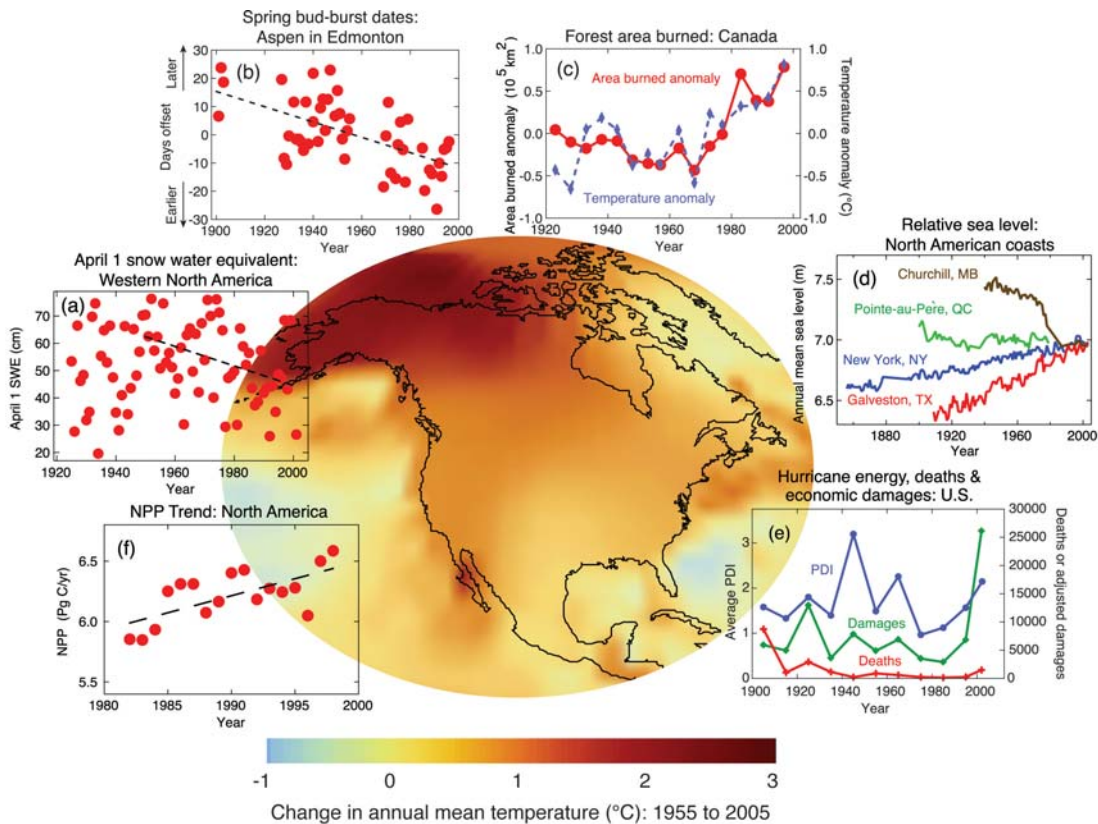
REGION	CENTRAL CHILE	TROPICAL ANDES	BRIDGE BETWEEN THE CONTINENTS
COASTAL SYSTEMS			
WATER RESOURCES			
ECOSYSTEMS			
FOOD SUPPLIES			
HEALTH			
INDUSTRY AND SOCIETY			

MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

ACTIVITY FIFTEEN

The graphic below shows how North America is likely to be affected by climate change.

(NPP is net primary production which is the rate at which all plants in an ecosystem produce net useful chemical energy)



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007) IPCC FOURTH ASSESSMENT REPORT. CLIMATE CHANGE. [ACCESSED JUNE 2009] AVAILABLE FROM WORLD WIDE WEB: [HTTP://WWW.IPCC.CH/GRAPHICS/GRAPHICS/AR4-WG2/JPG/FIG-14-1.JPG](http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/fig-14-1.jpg)

- This map highlights how predicted temperature increases are likely to affect North America in the 21st century.
- Warming in western mountains will affect water supplies by causing decreased snowpack, more winter flooding, and reduced summer flows.
- Disturbances from pests, diseases and fire will increase the risk and size of forest fires.
- There will be more intense and longer heat waves in cities, putting people's health at risk, especially the elderly.
- Coastal regions will be more vulnerable to storms.

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Complete the following table using the map as a source of information.

REGION	EDMONTON	CANADIAN FORESTS	NORTH AMERICAN COASTS	SOUTHERN STATE HURRICANES
COASTAL SYSTEMS				
WATER RESOURCES				
ECOSYSTEMS				
FOOD SUPPLIES				
HEALTH				
INDUSTRY AND SOCIETY				

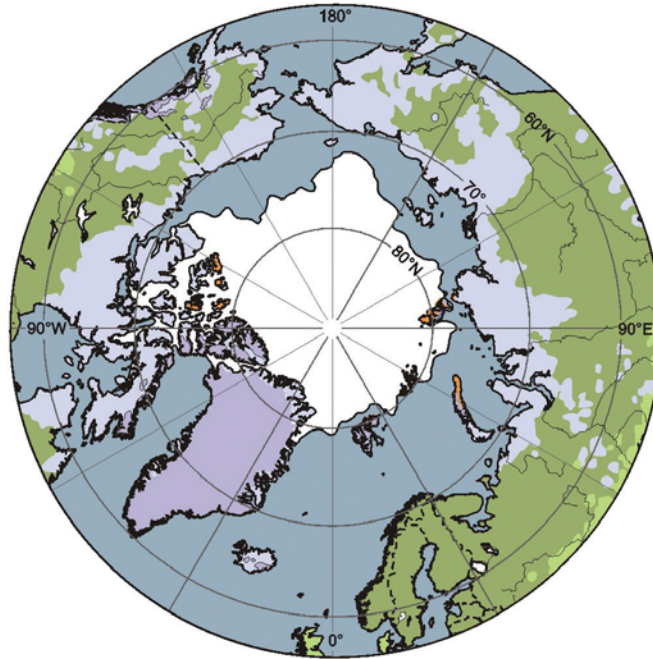
REGION	NET PRIMARY PRODUCTION	WESTERN NORTH AMERICA
COASTAL SYSTEMS		
WATER RESOURCES		
ECOSYSTEMS		
FOOD SUPPLIES		
HEALTH		
INDUSTRY AND SOCIETY		

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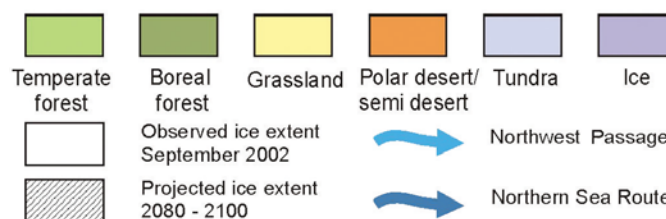
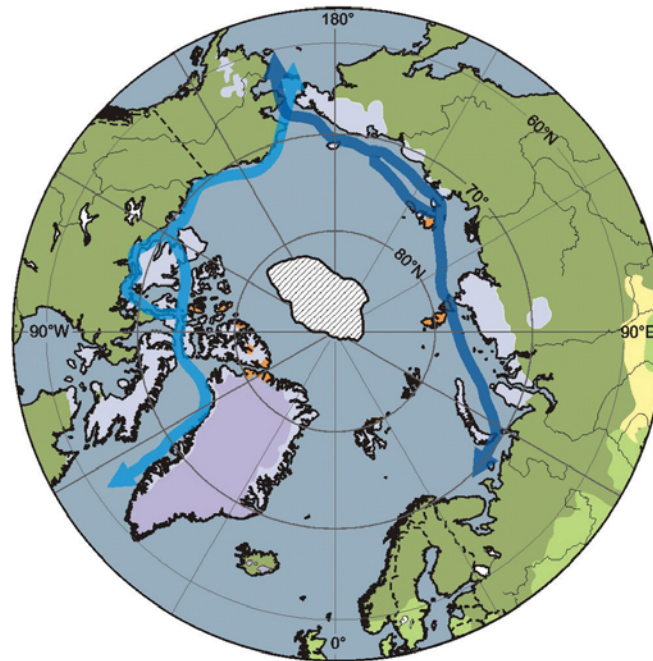
ACTIVITY SIXTEEN

The graphic below shows how the Arctic is likely to be affected by climate change.

Current Arctic Conditions



Projected Arctic Conditions



MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES

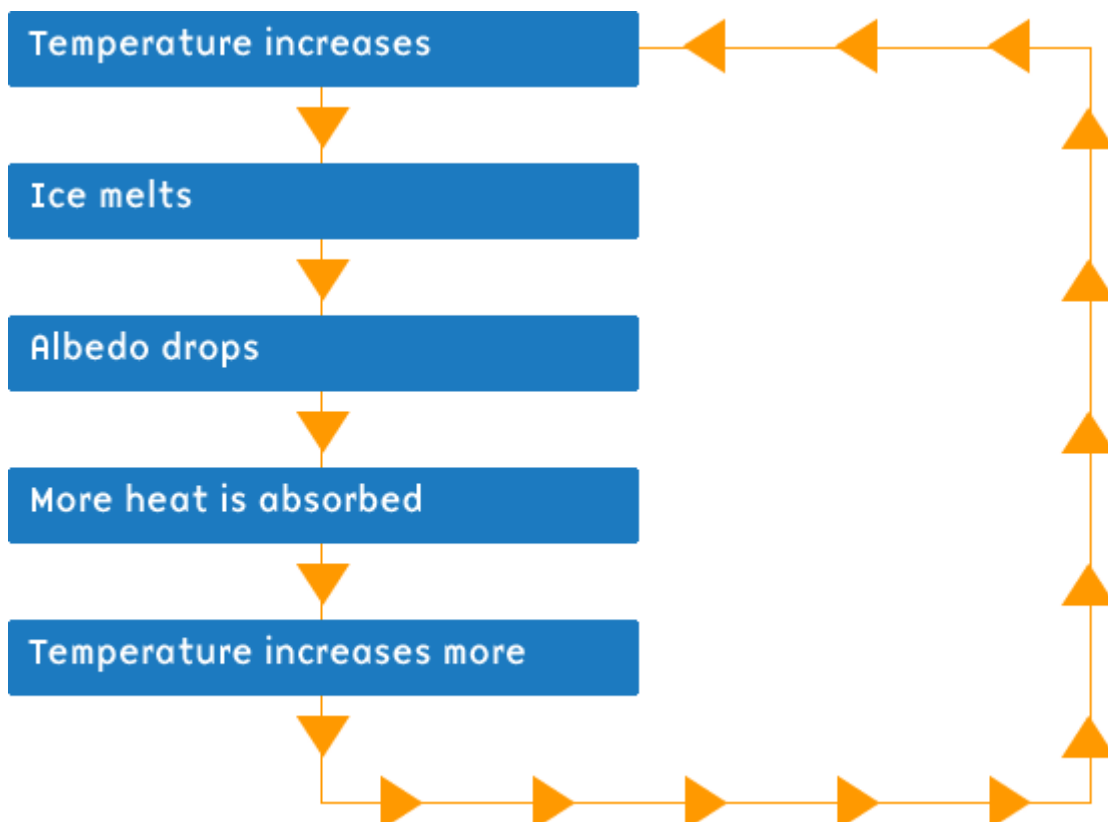
These maps show what the Arctic Circle looks like now and how it is expected to look in 2080.

Use the maps to answer the following questions.

1. What will happen to the thickness of the Polar ice?
2. What will happen to the extent of the Polar ice?
3. How will this affect migratory birds and animals?
4. What will happen to the permafrost?
5. How will this affect buildings and roads?
6. How will this affect coastal areas?
7. What will happen to the sea routes?
8. What happens to the treeline?
9. What happens to the tundra?

Feedback mechanisms respond to changes in atmospheric, ocean and surface conditions all over the world. Sometimes the feedback can increase the effects of the process (positive +), sometimes it can restore conditions to their original state (negative -)

Here's an example of a **positive** feedback loop, that is it increases the effects of the process. In this instance do you think it is positive or negative with respect to climate change processes?:



MODULE 4: HOW DO WE PREDICT THE FUTURE? | STUDENT ACTIVITY 9-17 : NATIONAL FUTURES**ACTIVITY SEVENTEEN**

Small islands are likely to be affected by climate change.

1. What will be the effect of rising sea levels on small islands?
2. Why are islands affected more by storm surges and cyclones?
3. How will the economy be affected by the erosion of coral reefs and beaches?
4. How will reduced rainfall affect islands?
5. What might happen to their ecosystems?

→ PERSONAL ACTIVITY

Complete a table like the ones in activities two to seven for the place where you live