

Case Study “Environmental change and management of the coastal environment”

Activity Sheet 3 “The impacts of climate change on the coastal environment”

Introduction

The impacts associated with climate change are a growing concern for the coastal environment. As noted in the report “Australia: State of the Environment – Coasts 2016 “ when discussing the pressures to the coast “the increased frequency of severe weather events, including strong tropical cyclones, heat waves, droughts and floods are predicted to have a very high impact on the coastal environment”. In recent years the impacts of rising ocean temperatures have been clearly evident with the episodes of coral bleaching on the Great Barrier Reef. If no action is taken it is also predicted that the associated rising sea levels in the future will impact heavily on the coast.

This has the potential to be quite a large topic - Activity Sheet 3’s focus is to introduce students to these pressures and the associated impacts to the coastal and marine environment. Opportunity exists for you to go into more detail about some of these specific pressures.

The content of this activity sheet relates to the following Geographic Concepts and Skills and Geographic Knowledge.

Geographic Concepts and Skills

Place, space and interconnection

- Identify, analyse and explain significant spatial distributions and patterns and identify and evaluate their implications over time and at different scales.

Data and Information

- Collect and record relevant geographical data and information, using ethical protocols, from reliable and useful primary and secondary sources.
- Analyse and evaluate data, maps and other geographical information using digital and spatial technologies and Geographical Information Systems as appropriate, to develop identifications, descriptions, explanations and conclusions that use geographical terminology.

Geographic Knowledge

- Environmental, economic and technological factors that influence environmental change and human responses to its management
- Causes and consequences of environmental change, comparing examples from Australia and at least one other country.

Assumed Knowledge

- An understanding of what constitutes climate change.
- The natural and human causes of climate change.
- Evidence of climate change

If you need to spend time revising these concepts some useful sites and short clips to assist you are listed below.

Websites

- What is climate change? - Met Office
<https://www.metoffice.gov.uk/climate-guide/climate-change>
- Climate Change - Definition from ecolife.com
<http://www.ecolife.com/define/climate-change.html>
- What Is Climate Change? | NASA
<https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html>

Short clips

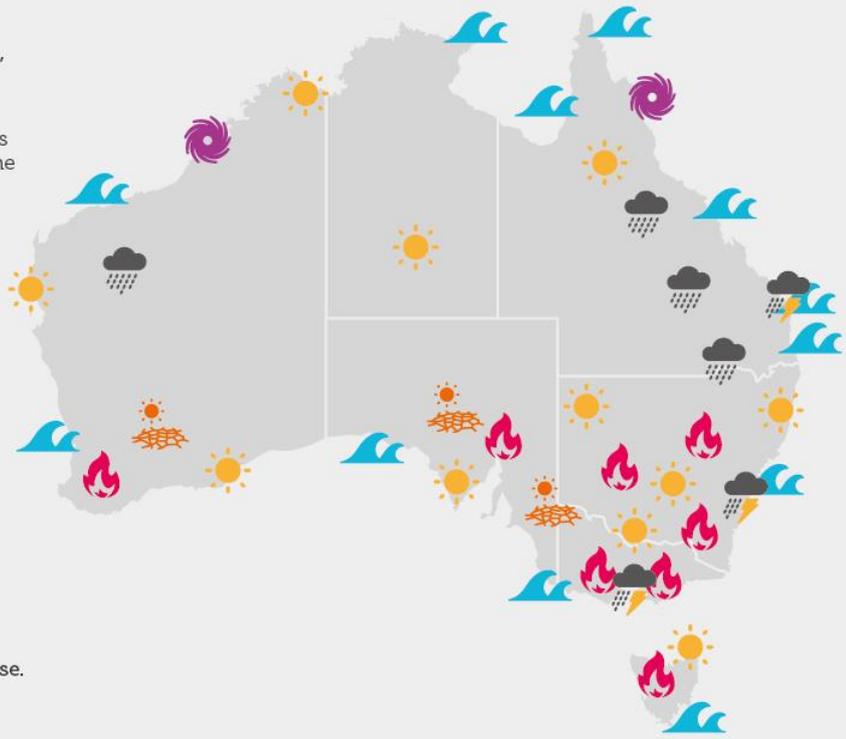
- <http://theconversation.com/melting-arctic-sends-a-message-climate-change-is-here-in-a-big-way-95573>
- The three-minute story of 800,000 years of climate change with a sting ...
<https://theconversation.com/the-three-minute-story-of-800-000-years-of-climate-change-with-a-sting-in-the-tail-73368>

An Overview

The report “Australia: State of the Environment – Coasts 2016’ in regard to climate change states that “it is expected to become increasingly prevalent and unlike most other pressures affect the entire coast. Since 2011 climate change has manifested as increased frequencies of marine heatwaves and storms, such as Ningaloo heatwave, tropical cyclone Yasi of 2011 and the 2016 marine heatwave that caused severe bleaching of the northern Great Barrier Reef. Sea level rise is a key pressure that Australia is only just beginning to experience and one that will have increasingly conspicuous impacts in the future decades. If green house gas production is not rapidly reduced, the rate of sea level rise is predicted to reach 12mm per year or higher by 2100.

These impacts are reflected by the image below.

HOW WILL CLIMATE CHANGE AFFECT AUSTRALIA?



-  Cyclones are likely to become **more intense**, but less frequent.
-  Extreme rainfall events are expected to become **more intense**.
-  **Hotter and drier** conditions will lead to harsher bushfire weather.
-  Heatwaves will become even **longer and hotter**.
-  Higher sea levels will **increase flooding** in coastal cities and towns.
-  Potential severe thunderstorm days are expected to **increase**.
-  Droughts are likely to happen **even more often**.

 CLIMATECOUNCIL.ORG.AU

crowd-funded science information

To go into more detail about the above content go to “Australia state of the environment 2016: coasts” <https://soe.environment.gov.au/sites/g/files/net806/f/soe2016-coasts-launch-17feb.pdf?v=1488793015>

Once on this site go to the section on “Pressures affecting the coastal environment” then “Climate and weather” (page17 of the PDF version). Using the information contained here answer the following questions.

1. List the ways that changes in climate and weather could affect the coast.
2. Provide recent examples of the above impacts.

An article and a short clip which also summarises the impacts of climate change on the coast can be found at

Climate Change Affects Coastal Communities and Beyond - VOA News
<https://www.voanews.com/a/climate-change-coastal-communities/4091023.html>

Sea Level Rise

1. As an introduction watch the clip “Catalyst: Sea Level Rise - ABC TV Science
<http://www.abc.net.au/catalyst/stories/4045476.htm>

A longer clip that provides a good overview of this issue can be found at
<https://www.marineinsight.com/environment/effects-of-rising-sea-levels/>

2. Read over the information found at
<https://climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Sea-level-and-coasts>.

<http://www.abc.net.au/news/science/2018-02-13/25-years-of-satellite-data-confirms-global-sea-level-rise-rate/9416570>

With reference to the above content answer the following questions.

- a. How much are sea levels rising by? What evidence is there that sea levels are rising?
 - b. Explain the current causes of rising sea levels.
 - c. List the potential impacts of rising sea levels to the coastal environment (this will be covered in more detail in later questions)
3. Watch the clip <https://www.space.com/30379-nasa-sea-level-rise-model-video.html>
 - a. Note down the regions of the world that are experiencing rising sea levels. There are also global maps that you can also download to identify regions that are susceptible to rising sea levels. Please check the accuracy of these.

- b. Read over and discuss the article <https://www.theguardian.com/cities/ng-interactive/2017/nov/03/three-degree-world-cities-drowned-global-warming>

Summarise the content found in this article by completing a table similar to that below. The content of this table will also provide a useful introduction to other tasks that follow.

Location	Potential impacts of rising sea levels	Current or planned actions to limit the impact of rising sea levels.

- c. Go to “Australia state of the environment 2016: coasts”
<https://soe.environment.gov.au/sites/g/files/net806/f/soe2016-coasts-launch-17feb.pdf?v=1488793015>

Once on this site go to the section on “Pressures affecting the coastal environment” then “Sea level rise”.

Refer to Figure COA6 showing Sea Level Trends (page 22 of the PDF version).

Describe the pattern shown. (Before undertaking this task it is recommended that this map is described and discussed. To make this task easier it may be useful to categorise the rises in sea levels as high, medium and low.)

4. Using the content from the above tasks as a guide, conduct further research into the impacts of rising sea levels to the coastal environment. Share and discuss these impacts in class.

To extend this activity categorise these impacts. For example, broad categories such as the impacts on the built and physical environment could be used. If you wish these two broad categories could in turn be further broken down.

Using this content, complete one of the activities below.

Option A.

Go to “Australia state of the environment 2016: coasts”
<https://soe.environment.gov.au/sites/g/files/net806/f/soe2016-coasts-launch-17feb.pdf?v=1488793015>

Once on this site go to the section on “Pressures affecting the coastal environment” then “Sea level rise”. Refer to Figure COA7 showing the “Regional distributions of sea level change 4 emission scenarios” (page 23 of the PDF version).

Explain the maps to the class and discuss their meaning/repercussions.

With reference to class discussion and the research into the impacts of rising sea levels, students are to write a report outlining the potential repercussions for the “business as usual scenario” and recommended actions that could be undertaken to avoid this scenario. If you wish to extend this task you could ask students to comment on the impacts for each of the scenarios shown.

Choose whether you would like this task to be done individually or in a group work scenario.

In their report students could cover the following key points

- Areas impacted by the rise in sea levels.
- The impacts to the built and physical environments as a result of rising sea levels.
- Existing strategies that have been implemented to reduce the impacts of rising sea levels and an evaluation of their effectiveness.
- Recommendations of other strategies (you may wish to place a number on the amount of suggested strategies) that could be implemented to reduce the impacts of rising sea levels. If you wish to extend this task students could complete a SWOT analysis for their proposals.

To assist students in developing a set of recommendations on ways to minimise the impacts of rising sea levels, refer back to the previous work completed. A range of articles, such as those listed below are also available.

- <https://www.foreground.com.au/planning/design-sea-level-rise/>
- <https://helpsavenature.com/sea-level-rise-causes-effects-potential-solutions>
- <https://mashable.com/2014/07/16/cities-rising-sea-levels>
- <https://www.quora.com/What-can-stop-the-sea-levels-from-rising>
- <http://theconversation.com/sea-level-rise-is-real-which-is-why-we-need-to-retreat-from-unrealistic-advice-51051>

Some useful clips are

- <https://www.lifegate.com/people/news/protecting-cities-from-sea-level-rise>
- <https://www.unenvironment.org/news-and-stories/video/adaptation-sea-level-rise>
- <http://www.unenvironment.org/news-and-stories/story/rising-sea-levels-how-stop-city-sinking>

Option B.

Go to <https://www.melbournewater.com.au/sites/default/files/Planning-for-sea-levels.pdf>.

Refer to the map titled “2100 tidal inundation areas in Port Phillip and Westernport Regions”.

With reference to class discussion and the research into the impacts of rising sea levels, students are to write a report outlining the potential repercussions for Port Phillip Bay as a result of a 0.8 metre rise in sea level and recommended actions that could be undertaken to avoid this scenario.

In their report students could cover the following key points

- Areas impacted by the rise in sea levels.
- The impacts to the built and physical environments as a result of rising sea levels.
- Existing strategies that have been implemented to reduce the impacts of rising sea levels and an evaluation of their effectiveness.
- Recommendations of other strategies (you may wish to place a number on the amount of suggested strategies) that could be implemented to reduce the impacts of rising sea levels. If you wish to extend this task students could complete a SWOT analysis for their proposals.

Articles, such as those listed below, discuss the specific impact of a sea level rise on Port Phillip Bay.

- <https://www.theage.com.au/national/victoria/how-a-possible-twometre-sea-level-rise-would-flood-thousands-of-melbourne-homes-20170522-gwagl1.html>
- <http://mojonews.com.au/rising-sea-level-threatens-port-phillip-homes/>
- <https://www.heraldsun.com.au/news/victoria/st-kilda-docklands-among-suburbs-under-risk-from-rising-sea-levels-website-claims/news-story/148c534503911cbadc96ccb1fc969469>
- https://www.lean.net.au/sea_level

Refer to the list of resources in Option A regarding strategies to minimise the impacts of rising sea levels.

Extreme Weather Events

In regards to extreme weather events the report “Australia: State of the Environment – Coasts 2016’ states “Coastal Australia has experienced many extreme weather events in the past 5 years consistent with predicted effects of climate change”.

The major effects of severe weather activities on the coast include

- The direct effect of bushfire frequency and intensity on coastal habitats and the resultant erosion and rise in sediments that enter the waterways when bushfires are followed by rains.
- Flooding of low lying areas during storm activities (likely to be exacerbated by rising sea levels). This may also result in an increase in the amounts of nutrients and chemicals entering waterways and oceans.
- Erosion of foreshore areas during storm activity and the damage done to property and infrastructure (likely to be exacerbated by rising sea levels)
- Damage to the physical and built environment from cyclones/hurricanes.
- The rising ocean temperatures and reduced river flows associated with drought/heat waves. This will be covered as a separate topic later in this activity sheet.

To show the impacts of the above events complete the following activities.

1. Quickly brainstorm categories of extreme weather activities such as those shown in the table below.
2. Place these categories in the table below. For each of the different categories get students to research recent examples of these severe weather events (you may choose to do this on a global scale or just for Australia).

Severe Weather Event	Australian Example	Global Example
Bushfire	Wye River Fire 2015	
Floods	Brisbane Floods	
Cyclone/Hurricanes	Cyclone Marcia (2015) Cyclone Yasi (2011)	Hurricane Harvey (2017) Hurricane Katrina (2005)
Storms	Melbourne 2017	
Droughts/reduced river flow	The Millennium Drought and the impact on the Coorong	Capetown

3. From the list of extreme weather events created above, highlight those that are likely to have the largest impact on the coastal environment and that will also have information readily available.

Either, allow students to select their own event or allocate an event to research and to prepare a short presentation. This presentation could include the following

- Map showing the location of the event and a description of the events relative location.
- Date and duration of the event.
- A short explanation of the factors causing the event. This should be supported by diagrams or clips.
- The impact of this event to the physical environment of the coast. This should be supported by statistics and images.
- The impact to the built environment of the coast. This should be supported by statistics and images.
- Optional – a description of how this event was managed and the effectiveness of management strategies.

Alternatively you may select one example from the above and complete the activity as a class or simply show a clip of a well known event and record the content in a table similar to that below.

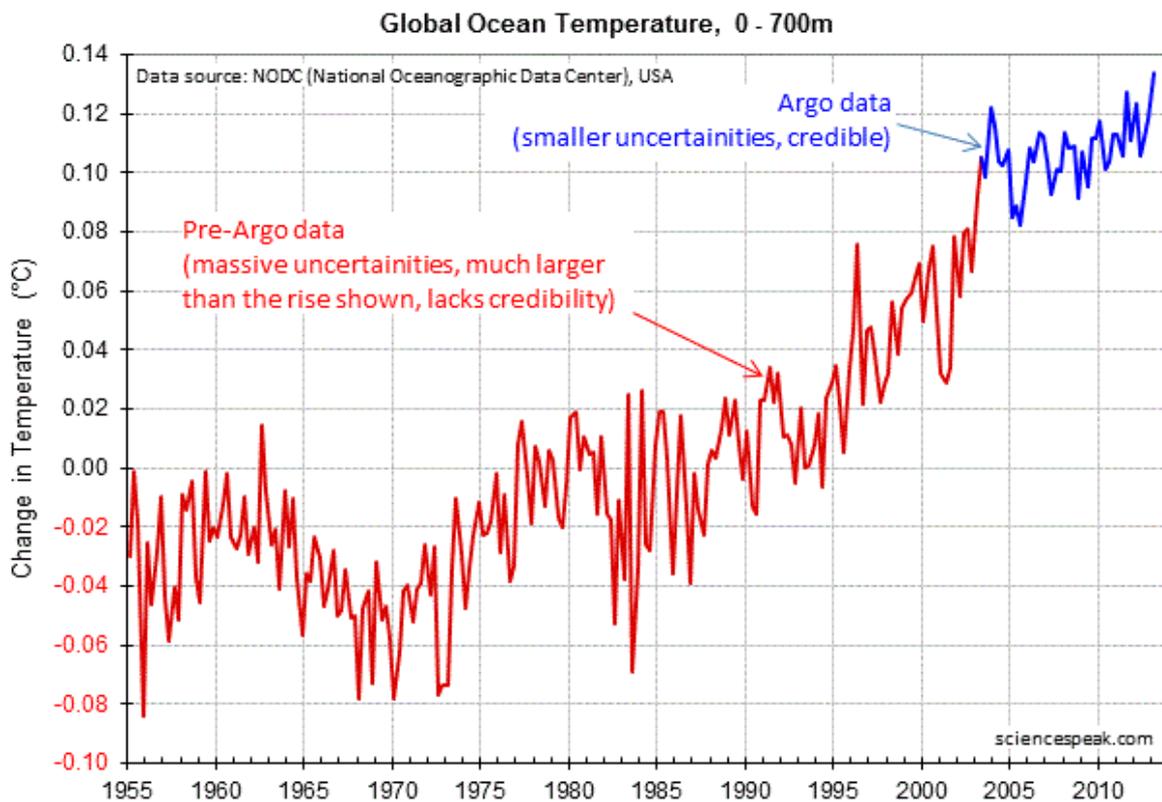
Name of Event : _____

Date of Event : _____

Duration	
Causes of the event	
Impact to the physical environment of the coast	
Impact to the built environment of the coast	
Strategies implemented to repair damage/to minimise the risk of further damage.	

Rising Sea Temperatures

1. As shown by the image below global ocean temperatures are on the rise



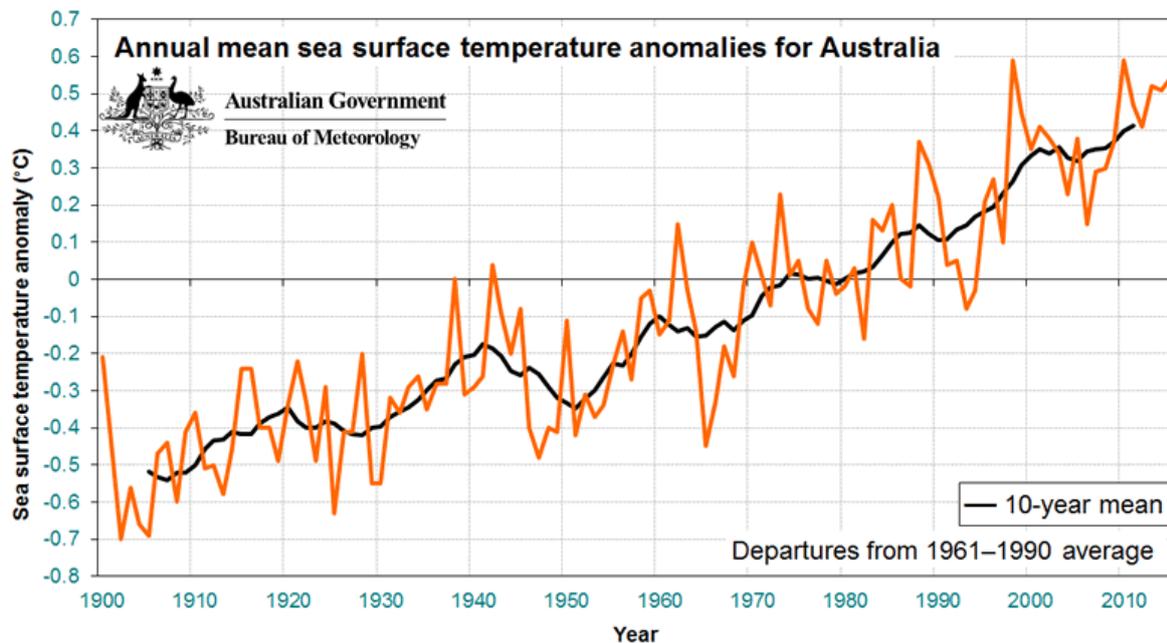
With reference to this graph

a. Describe the recent trends in global ocean temperatures. An explanation of the “argo data” is explained in an article found at <https://www.theguardian.com/environment/climate-consensus-97-per-cent/2017/jun/26/new-study-confirms-the-oceans-are-warming-rapidly>.

If you wish to get more specific and extend this task, this article also contains images of the rise in temperatures for the different oceans.

b. Estimate the average rise per annum in global ocean temperatures.

2. Since the beginning of the 20th century the temperature of Australian coastal waters have risen by 0.9 C. With reference to images such as that found below describe the recent trends for Australia.



If you wish to extend the above task articles such as

<https://theconversation.com/this-summer-s-sea-temperatures-were-the-hottest-on-record-for-australia-heres-why-56906> provide an explanation for recent rises in sea temperatures and why there is some variance as evidenced in the above graph.

3. In regards to the impacts of rising ocean temperatures the report “Australia: State of the Environment – Coasts 2016” states “rising sea temperatures are associated with shifts in the distribution of species, coral bleaching, increased risk of harmful algal bloom and impacts on fishing and aquaculture”

a. The article found at <https://www.iucn.org/news/secretariat/201609/latest-ocean-warming-review-reveals-extent-impacts-nature-and-humans> summarises the above impacts in more detail. With reference to this article describe the impacts that rising sea temperatures can have on the coastal environment.

b. Using the above as a guide undertake the necessary research to examine the impacts of rising ocean temperatures on the Great Barrier Reef. Several resources and clips, particularly in regard to coral bleaching events are available. Some of these resources are

- <https://www.coralcoe.org.au/for-managers/coral-bleaching-and-the-great-barrier-reef>

- <https://theconversation.com/how-the-2016-bleaching-altered-the-shape-of-the-northern-great-barrier-reef-95142>
- <http://www.abc.net.au/news/2017-04-10/great-barrier-reef-severe-coral-bleaching-hits-two-thirds/8429662>
- [Impacts of rising sea temperatures on the Reef - GBRMPA](#)
- [Climate change and the Great Barrier Reef - NCCARF](#)
- [The impact of climate change on the Great Barrier Reef - The Economist](#)
- [Climate change - Great Barrier Reef Foundation](#)
- [99% of Australian Green Sea Turtles Studied Turning Female From ...](#)
- [Climate change could alter ocean food chains, leading to far fewer fish ...](#)