SPATIAL CONNECT

An activity based project

Flooding in rural Victoria

Hazards and Disasters

VCE UNIT 1

gtav

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SPATIAL CONNECT

Flooding in rural Victoria
Hazards and Disasters

Level

VCE Geography Unit 1: Hazards and disasters

Aims

1. Appropriately employ a spatial technology (GIS) in Geography.
2. Interpret data in a visual and numerical form, provided via a Geographic Information System (GIS).
3. Use a range of geographic skills, including observation, map and data interpretation and analysis, to investigate a flooding hazard and relate this to real-world examples and situations.
4. To use GIS-based flood modelling data to predict and visualise the likely impact of a 1 in 100 year (1%) flood on locations in a catchment on properties.

Lessons required

2–3 lessons

http://www.cerdi.edu.au/cb_pages/corangamite_flood_portal.php

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Curriculum Links

VCE Geography Outcomes
Area of study 1
Key knowledge
the role of human activity in initiating and/or compounding the selected hazards and how this has changed over time
factors affecting the risk level for people, places and environments and impacts of the selected hazards and hazard events on people and environments and how these factors are interconnected
the potential and realised positive and negative impacts on people and environments in the short and long term
applications of spatial technologies by agencies in identification and assessment of impacts, and management of hazards and hazard events
Key skills
analyse maps, data and other geographic information to develop descriptions and explanations
interpret and analyse maps and other geographical data and information
Area of study 2
Key knowledge
the types of responses to selected hazards and disasters, including prediction of risk and vulnerability, planning protection and mitigation, recovery and reconstruction
the role of spatial technologies in management of responses to selected hazards and disasters.
Key skills
analyse maps, data and other geographic information to develop descriptions and explanations
interpret and analyse maps and other geographical data and information
explain the usefulness of spatial technologies in developing effective prevention and mitigation measures with selected hazards and disasters

Part 1: Where will it flood?

Introduction

Flooding is one of the most common hazards that affects Victoria. Though the extent of flooding can be predicted, when they will occur and how great their impacts cannot. Local government and planners have an interest in keeping development in flood-prone areas compatible with the likelihood of flooding, and people who live or work in areas subject to flooding need to be as prepared as possible for inevitable hazard events.

The Corangamite Catchment Management Authority (CCMA), which extends from Ballarat in the north to Cape Otway in the South and east to west from the Bellarine Peninsula and Geelong to Camperdown, employs a Geographic Information System-based portal to assist with informing the public about the potential for flooding.

Aims

Students will:

- understand the nature of flooding, as an atmospheric hazard
- understand flood probability
- integrate spatial, GIS-based flood visualisation data with freely accessible media such as video and street view imagery for interpretation
- make predications about the nature and impacts of floods based on spatial data interpretation.

Preparatory knowledge

Prior to completing these activities, students should understand:

- that topography and extreme rainfall events can lead to flooding events along watercourses and in floodplains
- terminology such as floodplain, inundation, and catchment.

Resource links

- Geoscience Australia hazards resources – flooding: http://www.ga.gov.au/scientific-topics/hazards/flood/basics (includes basic information, definitions, flood causes, distribution in Australia, and images).
- Flood Victoria: http://www.floodvictoria.vic.gov.au/centric/home.jsp (mainly aimed at hazard preparedness, but the 'Learn about flooding' section includes historical Victorian flood information [only to 2007], definitions, flood types, and more).

Getting started

Load the Corangamite Flood Portal, Flood Mapping site http://www.ccmaknowledgebase.vic.gov.au/flood/cb_pages/flood_mapping.php clicking the *Agree and Continue* button for the terms and conditions.

When the map page loads, go to the layer menu visible in the top right corner of the map and turn off the *Coastal Flood Extent – 1% (1 in 100 yr) with 80cm Sea Level Rise* by un-ticking the check box.

Click on the *Riverine Flood Extent – 1% (I in 100 yr* text so that it is highlighted. This is now the *active layer* and will be indicated as such by the green text.

Ensure *Query mode* is OFF. Click the icon to the right of the *Transparency* slider in the main panel to toggle this on and off.

1. Click on the blue 'i' button after the green active layer text. When was this data updated – how current is it?
2. What do you think the word "riverine" means? Look the word up to check your understanding.
3. The thick red line on the map is the Corangamite Catchment Management Authority boundary and the flood data is only available within this region.
   a) While looking at the map, move the *Transparency* slider all the way to the left and then to the right several times. What water features do the blue areas (in two shades) appear to match with? You may like to zoom into the map to see this in more detail.
   b) The two shades of blue show how much flood data is available for an area. According to the legend in the main panel, what do they each represent? For which kind of data is there more coverage?

Navigating the map

Information panel: To provide more map space, the *Flood information* panel on the left side can be closed by clicking the X, and re-opened by clicking the > button. This panel can also be opened by selecting the *Flood information* button on the tool bar.

Zooming: The map can be zoomed using the plus and minus side on the left side top corner of the map (or the wheel on your mouse).

Moving around: To move around the map, click on it so that a four-way arrow appears, and drag in any direction.

Map views: The default view is *Map* view with roads, population centres, major physical features and, when zoomed in close enough, property boundaries. Using the selector to the left of the main control panel, *Imagery* will provide satellite image data, and *Hybrid* will combine map and satellite data.

Address search: A street address within the catchment can be found by typing it into the search window in the toolbar.

Scale and location: Note that the scale as a ratio and a scale bar are provided in the bar to the lower right of the map. The latitude and longitude change with the cursor position.

4. Hide the *Flood information* panel and use the map navigation controls to zoom into Colac. Make sure the *Transparency* slider is at the middle point. Explore and observe the Colac township and surrounds.
   a) What kind of data is available for the area of Lake Colac and near its shoreline?
   b) What kind of data is available for the creeks flowing north, through Colac township, into Lake Colac?
   c) Using map evidence, what is the name of the creek to the south-east side of Colac that floods?
   d) Why might the Catchment Management Authority (CMA) have invested in one kind of data for the town area, and another for the area around the lakes? Use the 'Imagery' or 'Hybrid' views to visit the lake shore areas to assist you.

Understanding property flood data

Expand the *Flood information* panel.

In the *Advanced selection modes* drop down menu, select *Property selection mode*. Further instructions are provided in the grey box. Note the status of the map and turn on the *Property summary* option (it will fade in colour when off). Now use the cursor to click and select properties on the map that have experienced flooding.

Flood data table explained

Property Flood Information Summary

Please note that inundation levels may not be consistent over the whole property.

1% AEP Riverine Flooding	Max	Min
Flood Depth (metres)		
Velocity (m/s)		
Flood Level (mAHD)		

1% AEP Riverine Flooding: The probability of a river flood happening in any given year. This means the largest expected flood in a century – 1 in 100 year flood, the term used in the main panel legend – has a 1% chance of happening in any year. It is, however, possible for such floods to occur more often, and is also not an indication that this is the largest possible flood (PMF – Probably Maximum Flood).

Flood Depth: For the 1 in 100 year flood, the maximum and minimum flood depths are given, which would be the height the water surface reaches (in metres) above ground level for the property, noting that not all properties consist of level ground. A minimum of 0.00m would indicate part of the property would remain free of flood water during a flood.

Velocity: This is the speed at which the flood waters would likely be moving, in metres per second (m/s). The CCMA would prefer that properties not be built in areas where velocity is likely to be over 1.5m/s.

Flood Level: Is the height of the flooding above sea level, not the ground level at that location. It is given in metres, based on the Australian Height Datum (AHD).

5. Refer to the Colac key map, and navigate to the area to the west of Lake Colac near Rossmoyne and Sheehans Roads.

   a) Click on the point indicated by the number 1 on the key map. The property boundary will appear on the map and information for it will appear in the *Flood information panel*. What is the street address for the property?

   b) The property at point 1 is located in the light blue flood area which means there is "limited flood study data" within its boundary. What flood data does the information panel tell you is available?

Figure 1: Colac key map

c) Click on point 2 in the key map. What is the street address for the property?

d) During a time of flood, will all of the two properties be under water? How do you know this?

e) Turn on the *Hybrid* map option and zoom into the area of property 2. Would a 1% flood impact any buildings?

f) The property at point 2 includes the darker blue indicating that there is *detailed flood data* available, which will be obvious in the information panel on the left of the screen. Looking at this information, you can see that *Regional Flood Mapping* was carried out in 2016, naming the two creeks involved. You identified one creek in 4(c), above. What is the name of the creek flowing into Lake Colac at the western end of the town, where you are now investigating?

g) The minimum 1 in 100 year flood depth in the table is 0.00m. What would this mean?

h) What is the maximum flood depth predicted for property 2 in centimetres? Use your ruler to determine where the water would come up to on your leg if you were standing in water this deep.

i) The average adult human normally walks at around 1.4 metres per second (m/s), with a fast walk being 2.4 m/s, and a jog at 3.6m/s. Use this information to describe the impact of water moving at this speed in this area?

j) Click the *Tools* button on the toolbar and select the *Measure distance* tool (). Click on the area behind the property's buildings, move to the closest part of the indicated flooding, and double-click. The measured distance will appear in the tools window. Approximately how far from the property's buildings would flood waters reach in a 1% flood?

k) Close the map tools panel, and return to *Map* view.

Integrating Natural Resource Management Planning Portal

This portal contains many layers of interest for other work in the region, including data on bioregions, endangered species, for example. There is a 1 in 100 year flood layer, but this is not as detailed as the one in the Flood Portal.

Load the NRMPP site for Corangamite: http://www.ccmaknowledgebase.vic.gov.au/nrmpp/ clicking the map image to open, then click the 'Agree and Continue' button for the terms and conditions.

Using the main panel, turn off (de-select) the *CCMA Landscape Zones (2014*)

Again in the main panel, expand the *Regional priorities* > *Waterways and wetlands* categories using the + sign, then activate the *CWS reaches (CCMA 2014)* map layer. CWS stands for Corangamite Waterway Strategy. Information about Lake Colac.

6. Lake Colac is its own catchment with the two main watercourses flowing through the Colac township itself from the south, rising on the northern slopes of the Otway Ranges. Follow the steps for *Integrating Natural Resource Management Planning Portal* and zoom in on the Colac region. The two streams will be outlined as a blue line.

   a) Using your navigation skills and the distance measure tool found in this portal (the same steps as in 5j), determine an approximate length of the eastern-most of the two watercourses. You will not be able to follow every bend in the stream but be as accurate as you can.

   b) The actual length of this stream is about 13km. Your measured length was probably less than this. Why is this the case?

   c) Repeat the measurement exercise for the creek to the west. How long have you estimated it is?

   d) How would you be able to more accurately measure the lengths of these watercourses using the tool?

Property flood reports

Return to the Corangamite Flood Portal page

Report download: To download a copy of the detailed flood report in PDF form, click the green *Flood Information Property Report* button. This will likely open in your browser and can then be saved to a drive.

Report contents:

- Property address, zoning, planning considerations
- Property flood map and data table
- How council decides about various aspects of flooding and planning
- Definitions of terms.

7. Enter 24 Wallace Street Colac 3250 into the address search at the top left of the screen and press the *Enter* key. When the address is returned as a hyperlink in the menu, click on it and it will be shown on the map. From the flood information panel, download the full flood report for the property.

   a) Who is likely to want such a report?

   b) How is this property zoned for development? Are there any other planning conditions (or overlays) noted for the property?

   c) Looking at the map and/or the map extract in the report document, what is the most important thing to notice about which part of this property is subject to flooding?

   d) Enter 24 Wallace Street Colac 3250 in either Google Maps or Google Earth and use Street View to "stand outside" the property, using the zoom to enlarge the view of the house. A standard house door is about 2m high. Carefully, on your screen, use a piece of paper and pen to mark the top and bottom of the door. Using the maximum flood depth data, use a third mark to represent the height of the flood using that 2m scale. Next, place the door-bottom mark at ground level against the side of the house on the left side near the driveway. Estimate how far above the door level (in centimetres) the water would reach using your flood level mark.

   e) Read this article about the flooding of 16 September 2016: http://www.colacherald.com.au/2016/09/huge-sandbagging-effort/. It mentions several Colac roads where sandbagging protected homes. Wallace Street was not listed; why not?

   f) Based on what you can see of the 24 Wallace Street house, would sandbagging the doors likely be effective in keeping out flood water?

   g) On the left of the screen, click on the green *Flood Information Property Report (PDF)* button, and read the section of the full flood report section on "decision guidelines". The second paragraph points out that local councils – in this case the Shire of Colac Otway – must consider potential flooding with approving land development. The Corangamite CMA is responsible for such assessments in this region. With this in mind, in your own words, summarise the five points the CMA considers when assessing developments.

   h) In the following section of the decision guidelines, point number 3 talks about a building's minimum floor height. Why would floor height matter? The house at number 24 Wallace Street is nearly 100 years old – why would its floor level be below the flood level?

When it floods

On 16 September 2016, Victoria experienced major flooding after high rainfall in many regions. This flood event provides an opportunity to compare the actual flooding with that predicted in the Corangamite Flood Portal.

8. Watch the video found at http://youtu.be/6ii2BVrhGDo?t=22, though to the 2:48 minute mark. This was filmed during the Barwon River flood of 16 September 2016 at Breakwater, a suburb of Geelong.

a) The children's crossing sign (visible at 1:27 and 1:54 in the video) is approximately 2.5m tall, and the road edge markers, about 1m in height. Using these as a reference, estimate how deep the flood water appears to be at this point on Gundog Lane.

b) Based on the video, how would you characterise the flow velocity of the flood waters? Would it be safe to cross in a vehicle?

c) In the Corangamite Flood Portal, use the *Tools* button and enter the latitude **-38.182195** and the longitude **144.365268** in the *Go to location* boxes and click *go*. A green marker will be located at this point on the map. Using the distance measuring tool (see 5(j)), how far is it from the green location marker to the edge of the predicted 1 in 100 year flood level, to the east along Gundog Lane?

d) Zooming out, and using the measuring tool once again, measure approximately how far it is from the edge of the flood zone from Breakwater Road in the west, to Gundog Lane in the east, keeping in line with the road. Using the flood depth you recorded near the edge of the flood area in 8(a), how likely is it that the water is deeper along other parts of these roads?

e) Briefly turn off the flood layer in the main panel so there are no boxes now ticked. Switch to the *Imagery* view. Use the measuring tool to measure the width of the Baron River (the Gundog Lane road bridge is a good guide). How long is it?

f) Using your measurements from 8(d) and (e), how many times wider would the Barwon River become in a 1% flood?

g) Switch the riverine flood layer back on. Why might the railway line not shaded in blue?

9. Using the latitude and longitude in 8(c), open Google Earth and add a placemark () using these coordinates. Zoom into the untitled placemark on the map (it is in Geelong).

a) Use Street View to position yourself on the placemark and face west along Gundog Lane bridge looking west. Find the children crossing sign and road edge markers in the view. Why might the bridge have no railings on the sides (look at the video again to help you answer)?

b) What do you notice runs along each side of the roadway where the first edge markers are situated? What would this be for?

c) Turn your view to look east along Gundog Lane. Using this view and the Flood Portal flood line. Why is it obvious from the shape of the land that the 1% flood would stop here?

d) Go back to the vertical aerial view in the Flood Portal. Make sure you are on *Imagery* view. You can also move the transparency slide to see both layers of information. What is the main land use of the flood area along the line of Gundog Lane and Breakwater Road? What other land uses are less, but still affected?

e) Zoom out and use the transparency tool to look at the larger flood area. What do you notice about the land use in the flood area?

Flood planning – will my house flood?

Using the Corangamite Flood Portal, this is an exercise investigating a real residential development and the likely impacts that a flood might have.

Ensure that *Query mode* for the 1 in 100 year flood layer is *On*. If this mode does not function the first time, switch between the modes try clicking on the map again. A pop-up will appear that provides the modelled flood data for that specific point.

Some starter links to assist with question 10(g):

- https://www.floodvictoria.vic.gov.au/prepare-prevent/risks
- http://www.empiredesigns.com.au/tips-for-building-or-rebuilding-in-flood-zones/
- http://www.australiangeographic.com.au/news/2013/03/aussies-refuse-to-flood-proof-homes-report
- http://theconversation.com/living-with-water-four-buildings-that-will-withstand-flooding-23536

10. Images A-E are taken in the township of Buninyong, on the Geelong side of Ballarat. They show various views of De Soza Park that has the Union Jack Creek flowing through it. This creek, which is a small tributary of the Yarrowee and Barwon Rivers, is prone to flooding.

a) Using images A and B looking west, describe the shape of the land to the north (right) of Union Jack Creek, compared with the south (left side) as you look downstream from this location. Image C gives the perspective looking south across the creek. What can you observe about the residences on the south compared with the north? (You might like to label N, S, E and W on the photo/s to help).

Union Jack Creek, Buninyong (4 and 5 Gum Tree Court properties and De Soza Park)

Image A: Union Jack Creek looking downstream (west)

Image B: Panorama of the Union Jack Creek, De Soza Park. Major directions are indicated on the image.

Image C: 3, 4 and 5 Gumtree Court viewed from De Soza Park, looking south over the creek.

b) Enter the Flood Portal, and using Tools > *Go to location* and the coordinates **-37.64871** and **143.88159** to add a place marker to the map. This is the point from which the panorama (Image B) was taken. Ensuring *Query mode* is set to *ON*, click at the marker (zoom in a little and click on the very tip of the green marker). From the pop-up, what is the maximum flood height (in metres) and velocity (in m/s)?

c) Now enter the street address 4 Gumtree Ct Buninyong 3357 into the address search window. The property boundary will appear on the map. Using the images, what is the property being used for? The houses on either side are constructed and under construction.

d) Using the query mode, click in each corner of the property boundary; northwest, northeast, southeast and southwest on the court (see key map). What are the flood depths given for each point?

e) Image D shows the fence on the rear boundary of numbers 4 and 5 Gumtree Court, on De Soza Park. The full height of the fence is 1.17m and the red line marked is 0.9m above the ground level. Given your results from 10(d), what can you say about the potential height of 1% flood water in relation to the fence in the corner where the tree is?

Image D: The red line marks the 0.9m mark above ground level.

f) Using the data from 10(d), describe the situation for the house at number 4 (Image E) in a 1% flood. What does it mean for the house pictured at number 5?

Image E: 4 Gumtree Court, Buninyong; ready to build.

g) Imagine that you are the owner of the block at number 4 and wished to build a house. Do some research about building houses in flood prone areas and list three things that you could do to protect your home, once built.

h) Images F, G and H compare views of Union Jack Creek during the 2011 flood and the same views without flooding. For reference, the bridge can be seen in the image B panorama, and is higher than the surrounding ground level. Given this evidence, what is your conclusion about the water level compared with the residential blocks? Where might the level of this flood reach on the fence in image D?

i) Image G was taken at the approximate location **-37.64860** latitude and **143.88163** longitude looking downstream. Use the *go to location* feature of the Google Earth to find this location and orientate yourself. Using the *hybrid* view, determined what change seems to have occurred in the area of the Gumtree Court development with regard to vegetation. This can be confirmed by using the Google Earth *historical imagery* feature ( ).

j) Compare image F (a smaller flood than a 1% flood) with image C (without flooding). Look at the Flood Portal map in 'hybrid' view to see the possible extent of a 1% flood (which would be much higher than the 2011 flood). Keeping this in mind, in your opinion, should the local council have allowed this residential development to go ahead? Justify your answer.

k) Just because a 1 in 100 year flood has not happened in living memory, does it mean it will never happen? Is it possible for more than one 1 in 100 year floods to occur in the same century, or even in the same year?

Image F: 2011 Union Jack Creek flood (left – courtesy of Robyn Barnett) and normal conditions (right).

Image G: A view during the 2011 Union Jack Creek flood looking downstream to the west (flood photo courtesy of Robyn Barnett) and the same view without floodwater (lower). For reference, identify the larger, leaning tree in the 2011 image (to the left of the person walking in the lower image).

Image H: 2011 flood water (upper – courtesy of Roby Barnett) compared with numbers 4 and 5 Gumtree Court at present (lower). Note the situation of the two trees on the left in both images.

Extension tasks

1. If your school or house is located within the Corangamite CMA area, determine which areas nearby are subject to flooding and find out what data is available.
2. Use the Corangamite Flood Portal to determine a location for fieldwork, supporting the available flood data with visits to corresponding locations and field data collection.

Summary

Describe how spatial technologies (GIS maps) are useful in helping manage flooding in this area? How can authorities use this tool to plan for a flood hazard?

Part 2: Will sea level rise make floods worse?

Introduction

In Australia, 85 per cent of the population lives in the coastal zone. With the progress of climate change, sea levels are expected to rise which will flood many coastal areas. Sea level rise will worsen the impacts of flooding that occurs from rainfall events.

This activity investigates how the combination of sea level rise and flooding from high rainfall will affect coastal areas, and investigate some ways that the impacts can be reduced.

Aims

Students will:

1. understand that sea level rise will exacerbate the impacts of flooding in the future
2. visualise how coastal settlements may be affected by flooding enhanced by sea level rise
3. consider how different strategies could mitigate flooding with sea level rise
4. undertake basic mathematical operations to manipulate data, to make predictions and draw conclusions.

Lessons required

1–2 lessons

Preparatory knowledge

Prior to completing these activities, students should understand:

- the difference between riverine (activity 1) and coastal flooding (arising from the combinations of extreme tides, storms, onshore winds and sea level rise) and riverine flooding.
- that extreme rainfall events, combined with sea level rise, will bring about higher, more frequent floods in low-lying coastal areas.

Procedure

Open the Corangamite Flood Portal, Flood Mapping site http://www.ccmaknowledgebase.vic.gov.au/flood/cb_pages/flood_mapping.php clicking the 'agree and continue' button for the terms and conditions.

Turn on the *Coastal Flood Extent - 1% (1 in 100 yr) with 80cm Sea Level Rise* layer and turn of all the other layers.

1. In the map view, zoom in to the Bellarine Peninsula, including Geelong, Portarlington, Queenscliff, Ocean Grove and Barwon Heads (Scale = ~1 : 289K). Toggle the *Coastal Flood Extent - 1% (1 in 100 yr) with 80cm Sea Level Rise* layer on and off. Describe which places would be affected by sea level rise of 80cm plus flooding caused by rainfall.
2. What are some likely impacts of this scale of sea level rise?

Go to http://www.ozcoasts.gov.au/climate/sd_visual.jsp and examine the table on the right side showing

3. The Flood Portal combines the 1% (1 in 100 year) flood with a sea level rise of 80cm (0.8m). The CSIRO has modelled different sea level rise scenarios; 'low', 'medium' and 'high' scenarios (which can be considered projections or predictions).

   a) Using the table on OzCoasts, from which year is the sea level rise calculated? Starting from a fixed date is known as relative change.

   b) In which scenario is a 0.8m rise found?

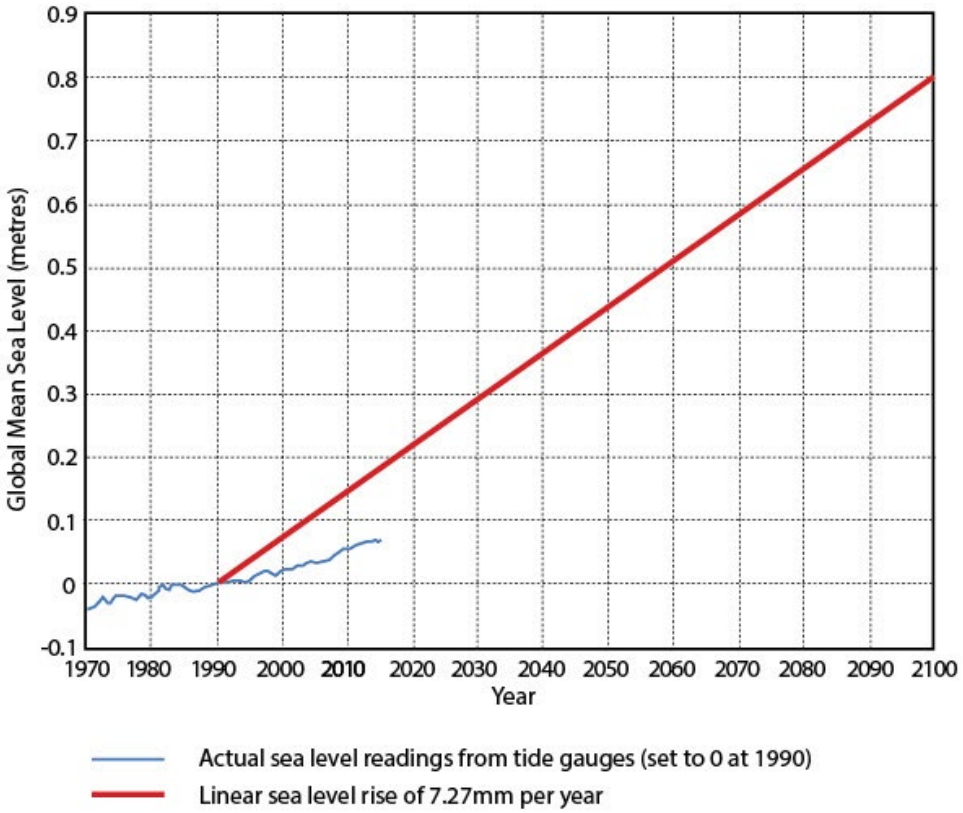
   c) Under this scenario, by what year is a 0.8m rise expected to occur? This scenario for sea level rise is the one that the world trends are generally following in reality, at the present time.

   d) How many years is it from the relative date to the predicted date for 0.8m of sea level rise?

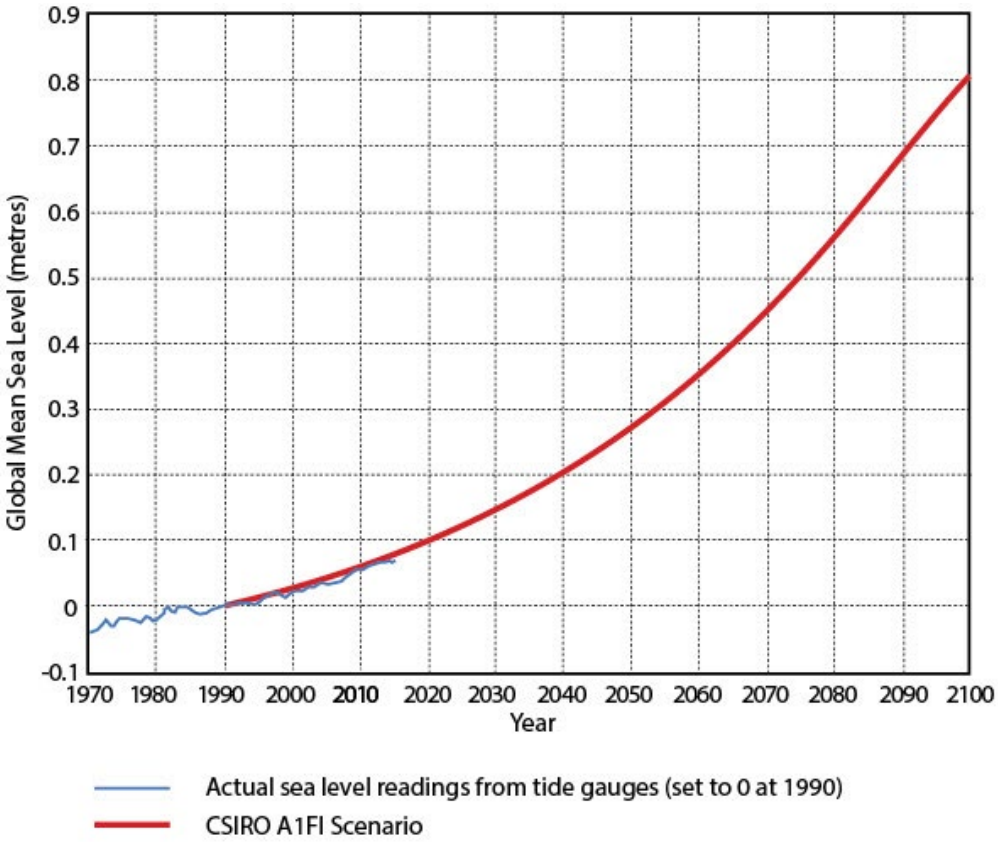
   e) Calculate how many millimetres are in 0.8m? Using the answer you found in (d), calculate how many millimetres per year, on average, the sea level must rise to reach 0.8m.

   f) Using your answer from (e), how many millimetres should sea levels have risen already? Using the same average annual rise, what would the sea level be in 2030?

   g) Look at the OzCoasts table again and note the predicted 2030 sea level rise for our scenario. You will notice that your answer for (f) is much greater than the figure shown in the table. Graph A shows what the sea level rise pattern is using an annual average. Graph B shows the modelled change. How does this explain the difference in your calculations?



Graph A



Graph B

h) Explain what the effect will be of 'normal' flooding caused by high rain events, when added to sea level rise of 0.8m?

i) What will have to be done to the flood models over the next few decades?

Go to the *Our Coast* portal resources: http://www.ourcoast.org.au/cb_pages/resources.php and scroll down to the videos (hosted on YouTube).

The focus will be on Barwon Heads Visualisation (http://www.youtube.com/watch?v=zcOWSK4GPWs, 2:41) and Ocean Grove Visualisation (http://www.youtube.com/watch?v=zcOWSK4GPWs, 2:41).

4. Watch the videos for Barwon Heads and Ocean Grove, but *only* the 'without adaptation' sections (to the 1:04 mark of each).

   a) For each, note at what level residential areas appear to be affected in each location.

   b) In the Flood Portal (in Hybrid view), zoom into this area. Use the transparency tool to identify the potential sea level rise impact regions of each video.

   c) Pause the Ocean Grove video at the 0:45 mark, where it shows the 0.8m rise with storm surge. Now zoom in and look at the same area in the Flood Portal. It may help you to identify the Club Grove Private Cabin Park on both. It is also useful to toggle between the two layers – the riverine flood 1% and the coastal flood with riverine flood at 1% - this shows the added impact of an 80cm sea level rise over the same area. The extent of flooding in the portal is greater? Why is this the case?

5. Now watch the remainder of the videos that includes the adaptations.
   a) For each location, what is the adaptation strategy used? Explain how they work.
   b) For Barwon Heads, pause the video and click between the 0:44 and 2:16 marks to compare before and after the adaptation with a 0.8m rise. Do the same for 0:58 and 2:33, at the 1.4m rise with surge. Do the pipes appear to do much to the inundation levels? With rainfall flooding added, what would be their likely value?
   c) For Ocean Grove, pause the video and click between the 0:45 and 2:10 marks, which show the impact of a 0.8m rise with surge, before and after adaptation. Describe the difference.
   d) Why does the adaptation in Ocean Grove have no impact at the 1.1m sea level rise and above? Compare the 0:53 and 2:16 video time marks. How might this strategy make the situation worse at that point?
6. Go to the Our Coast *Coastal impact solutions* page: http://www.ourcoast.org.au/solution_matrix.php and select Private > Buildings & Land – Residential. This provides links to information about what can be done to retreat from, adapt or accommodate, and defend against sea level rise.
   a) Will all of these strategies work for both sea level rise and flooding from storm rainfall? Why/why not?
   b) Spend some time looking into the strategies, and from each of the categories, decide which of them would be appropriate for rainfall flooding as well.
   c) What would happen to flood models, such as the Flood Portal, if land levels were raised? How might this strategy 'go wrong'?

Summary

Describe how spatial technologies (GIS maps) and scientific modelling are useful in helping manage flooding in these coastal areas? How can authorities use these tools to plan for a flood hazard?