Argyll and Bute Climate Trends Analysis

September 2024

Sniffer, Edinburgh Climate Change Institute, High School Yards, Infirmary Street, Edinburgh EH1 1LZ, Scotland, UK,
T: 0131 651 4674 **E:** info@sniffer.org.uk **W:** www.sniffer.org.uk **:** @SnifferScotland

Introduction

This report sets out the approach to, and key findings from, analysis of climate observations and trends from the Argyll and Bute region.

The data used came from several sources. The main source of climate trends and projections data came from the 2018 UK Climate Projections (UKCP18) User Interface data download site. These data were supplemented with information from the Met Office Local Authority Climate Explorer[1]. The analysis within this report was supported by using information from the Dynamic Coasts platform[2] and the Climate Central websites Coastal Risk Screening Tool that provides maps of land below 1m above the current high tide line[3].

Given current emission pathways and the challenges in implementing the Paris agreement, the RCP8.5 scenario was used in this analysis, representing a high-emissions scenario. This approach is consistent with the emerging methodology of the 4th UK Climate Change.

Projection data was analysed out to 2080, with sea level rise looked at to 2100.

The analysis looked at Argyll and Bute at several spatial scales, including regionally (the river basin region), the local authority boundary, and sixteen key settlements across the area.

Methodology

The approach taken to the data analysis for the climate trends and projections from Argyll and Bute follows analysis undertaken by other Place-Based adaptation partnerships in Scotland such as Climate Ready Clyde and Climate Ready South East Scotland. The overarching aim is to understand the key observed climate trends in recent history in the area, and what the latest climate models project as being experience between 2023 and 2080.

The approach was adapted to suit the Argyll and Bute region and the following section sets out the detailed methodology used and explains the reasoning behind the options selected for scenarios, scale, metrics and variables.

Data variables

Spatial scales

Climate projections were looked at for three main spatial scales:

- The Argyll river basin region
- The Argyll and Bute Local Authority area
- Settlements – sixteen key settlements across the region identified by the Climate Change subgroup of the Argyll and Bute Community Planning Partnership.

[1] https://themetoffice.maps.arcgis.com/apps/dashboards/506ff7d53c884badb0d8fd36d6280a91

[2] https://www.dynamiccoast.com/

[3] https://coastal.climatecentral.org/map/15/-4.9542/55.988/?theme=water_level&map_type=water_level_above_mhhw&basemap=roadmap&contiguous=true&elevation_model=best_available&refresh=true&water_level=1.0&water_unit=m

The UKCP data interface allows you to generate maps, plots and download the raw data for various climate variables, RCP scenarios, geographical and temporal scales. However, not everything is available at all scales, and whilst it is possible to generate maps for the full Argyll and Bute region, the data can only be downloaded at either a "West Scotland" Administrative Boundary scale, or at the Argyll river basin scale. The River basin omits a small part of the region at the eastern side, but the data at this scale was more representative of Argyll and Bute than the whole of West Scotland which also includes all of Ayrshire, D&G, Greater Glasgow and Falkirk.

Most data are available at a 2.2km scale, meaning that it is accessible for the settlements used to generate graphs of trends. However, the maps generated by the UKCP user interface use the regional level data and therefore do not show any more detail for the settlements than the regional maps. Therefore, maps for the settlements have not been created.

In addition to this, the data is not available for individual local authorities, and the maps again show the same outputs as the regional maps, therefore trends and projections for the Argyll and Bute local authority boundary have been generated using the Met Office Local Authority Climate Explorer.

Emissions scenarios

The analysis used the RCP8.5 projections. This is a high emissions scenario and meets the recommendations of the CCRA UK Climate Change Risk Assessment to assess the risks for a 4°C warming.

RCPs, or Representative Concentration Pathways, are scenarios for the future concentrations of greenhouse gases in our atmosphere (not emissions at that point in time) and cover a range of assumptions around future population, economic development and impacts of actions to mitigate greenhouse gas emissions towards international targets.

Each pathway drives a different range of simulated global mean temperature increases over the 21st century and are used to model possible future climatic conditions. They range from a low emissions scenario (RCP2.6) which models the future if global warming is limited to 1.6°C, to a high emissions scenario (RCP8.5) which models the future climate if global warming reaches 4.3°C compared to the 1850-1900 baseline.

The information from the Met Office Local Authority Climate Explorer, however, uses Global Warming Levels (GWLs) rather than RCPs, with data provided for three future GWLs (1.5, 2, 4°C). Whilst not exactly comparable, GWL4°C is an approximation of a lower level RCP8.5 scenario, reaching a 3.5°C temperature increase by the 2080s. Therefore, information for GWL4°C has been used for the local authority level analysis.

Climate variables

Three key climate variables were looked at for all three spatial scales. They are:

- Annual mean air temperature (°C)
- Precipitation rate (mm/day)
- Sea level rise (only applicable to the settlements with a coastline.)

In addition to this, seasonal data was looked at for the whole region, but not individual settlements, due to the timescales involved in downloading and processing this data:

- Summer mean air temperature
- Winter mean air temperature
- Summer precipitation rate
- Winter precipitation rate

Temporal scales
All data were downloaded to 2080. Sea Level data were downloaded to 2100.

Climate Change type
Regional data is also available in either absolute values or anomaly values. Absolute values project the temperatures and precipitation rates that we are likely to see, whilst the anomaly values show the percentage change from a chosen baseline.

Absolute values were used for the majority of the analysis, as the observed trends from 1960 could be combined with the projections with ease, and it was felt that the graphs produced from absolute values would be easier to understand for the audience of the adaptation strategy. However, anomaly values were used also used to calculate the projected change in temperature and precipitation rate in 2100 from 1961.

Observational data
To assist with analysing the projections in a context of experienced climate trends for the region, observed data for mean air temperature and precipitation rate from 1961 – 2022 were downloaded and incorporated into the projection data.

Again, due to the timescales involved in downloading and processing the data, observation data was only included for the annual mean air temperature and precipitation rate analysis for the Argyll River basin region and the individual settlements. It was not looked at seasonally, though that data is available should it be of interest at a later date.

Outputs
Outputs are in the form of graphs, maps, and tables from the automatically generated reports for the local authorities from the Met Office Local Authority Climate Explorer.

Graphs showing the observed climate trends and projections against time have been produced for the regional data and individual settlements. These have been produced either by data manipulation in Excel, or automatically generated by the UKCP User Interface.

Processing the data

Data downloaded from the UKCP were processed in excel, with graphs of the climate trends and projections produced for analysis. Observational data was incorporated into these graphs.

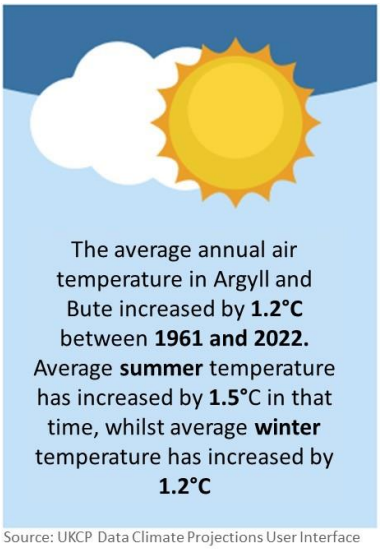
The Met Office Local Authority Climate Explorer was accessed for the local authority specific data, which can be viewed and explored using a web-based dashboard and automatically generated reports downloaded with a summary of the information contained within.

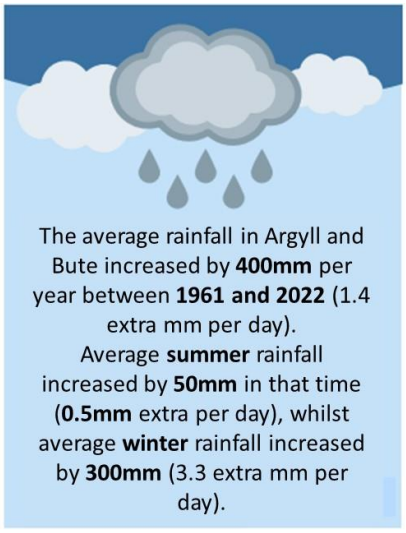
For areas not considered coastal by either of the data sources above, the Dynamic Coasts website was used to suggest likely sea level rise by 2100 under the RCP8.5 scenario.

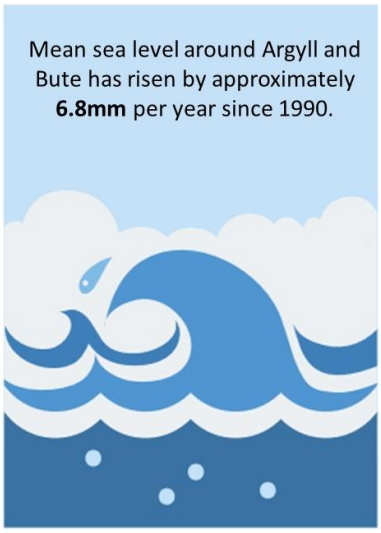
Key Findings

The analysis of current climate trends (1960 – 2022) in Argyll and Bute show that the average annual air temperature has increased by 1.2°C during that time. Average summer temperature has increased by 1.5°C with average winter temperature increasing by 1.2°C. Average annual rainfall has increased by 400mm per year in that time, equating to an average extra 1.4mm per day across the year. Summer rainfall has increased by 50mm per year since 1960, with winter rainfall increasing by 300mm per year. Mean sea level around Argyll and Bute has risen by approximately 6.8mm per year since 1990.

The key findings of the climate projection is that the Argyll and Bute region will experience an increase in average annual temperature of around 3.5°C and an increase in precipitation rate of around 10% from the 1981-2000 baseline by 2080. Sea level is expected to rise by between 0.4 and 0.7m by the 2080s.







Source: UKCP Data Climate Projections User Interface

There is a small amount of variation in these figures across the region, with individual settlements providing a picture of those variations.

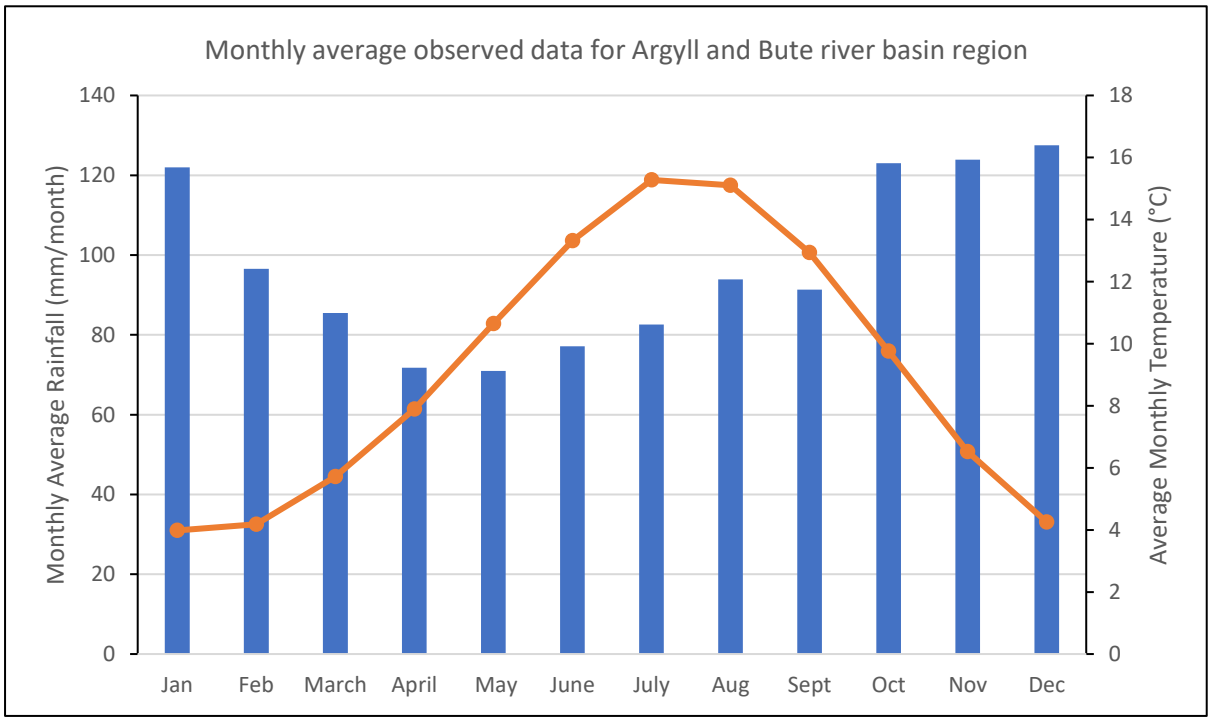
Seasonal variation is also important to consider, as whilst the annual precipitation rate shows only small amounts of change, the seasonal analysis shows a significant decrease in summer precipitation with an increase in winter precipitation which almost balance each other out over the course of a year. This seasonal variability is likely to have more of an impact on the region as the annual changes given its geography, economics and infrastructure.

Regional Findings

Current observations

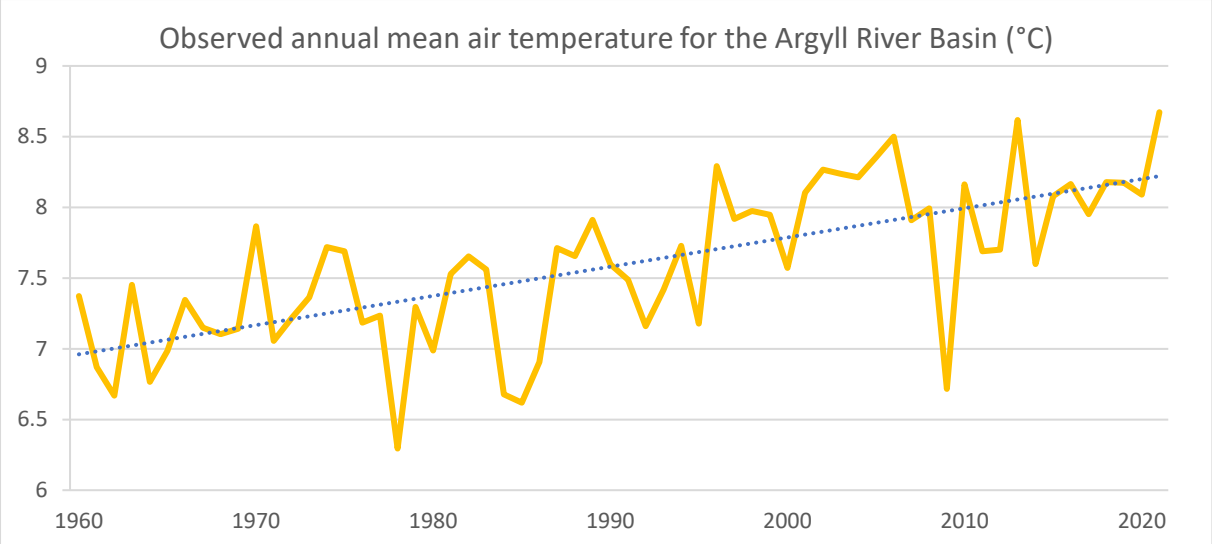
Monthly temperature and precipitation data from 1990 - 2022 were first analysed for Argyll and Bute, to provide a context for the projected changes, particularly seasonally. This has been plotted on the graph below. Perhaps unsurprisingly, the data confirms that temperatures are warmer, and precipitation is less in the summer months than in the winter months.

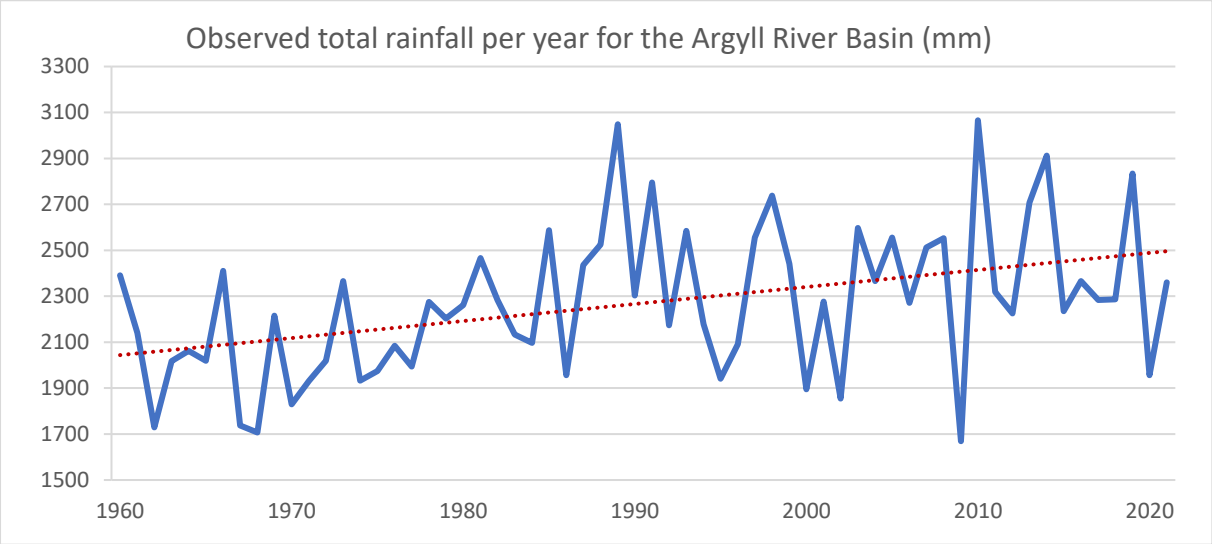
However, it also indicates that, generally, the driest months in Argyll and Bute are actually in Spring – April and May. The largest change in precipitation is seen between September and October, where on average, there is an increase of around 30mm.

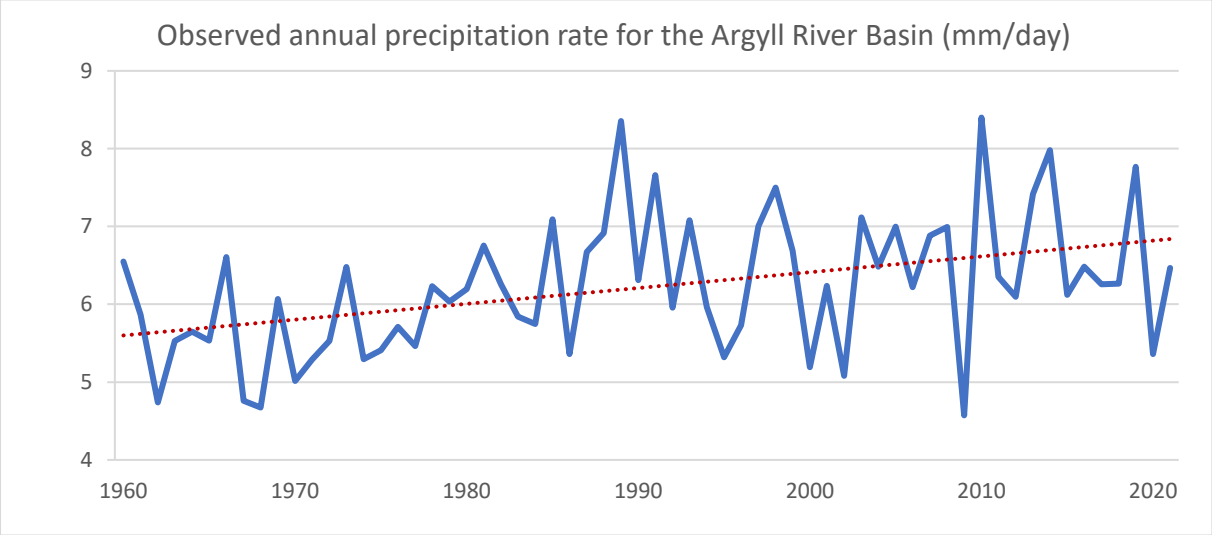


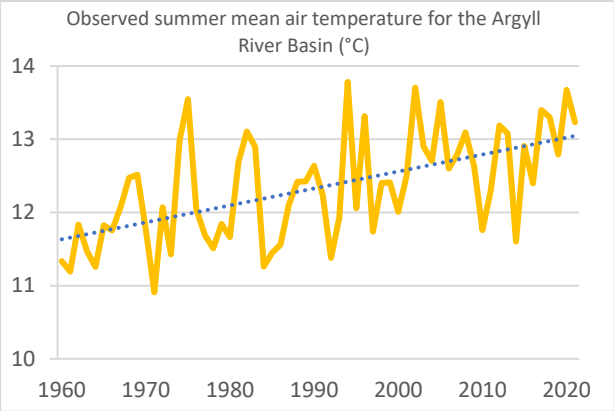
Average annual temperature and precipitation observations from 1960 – 2022 were also plotted, along with seasonal (summer and winter) observations. Observed annual data shows that the region has already experienced an average temperature increase of around 1.2°C and an increase in precipitation rate of just over 1mm/day since 1960.

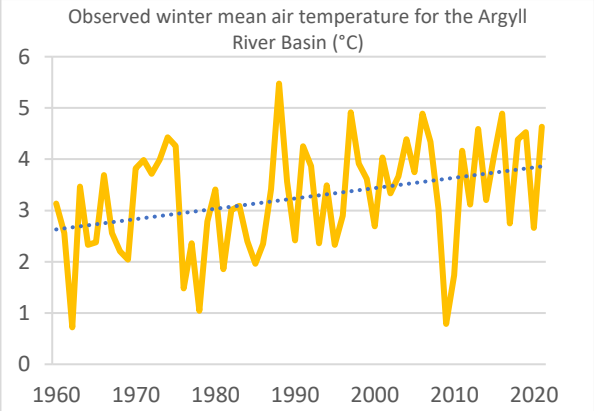
Observed seasonal data shows that the region has already experienced an average temperature increase in summer of around 1.3°C and an average temperature increase in winter of around 1.4°C. The region has also already experienced an average increase in winter precipitation rate of over 3mm/day and a slight increase in summer precipitation rate of just under 1mm/day since 1960.

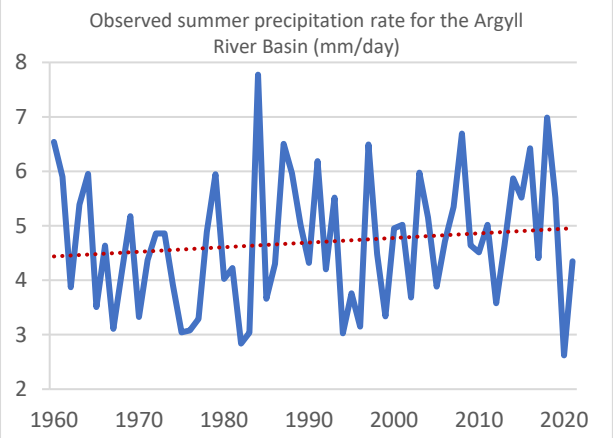

Observed annual mean air temperature for the Argyll River Basin (°C)
9
8.5
8
7.5
7
6.5
6
1960
1970
1980
1990
2000
2010
2020

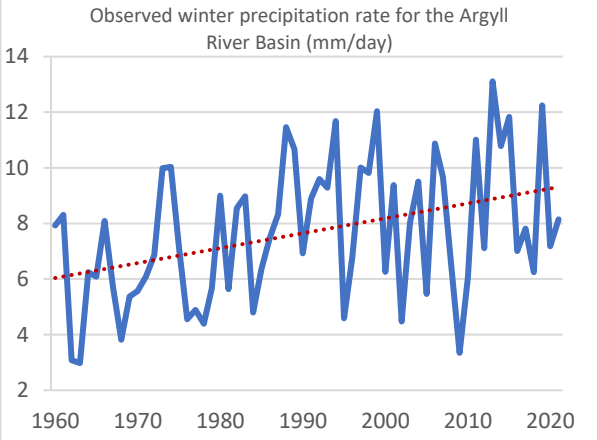

Observed total rainfall per year for the Argyll River Basin (mm)
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1960
1970
1980
1990
2000
2010
2020


Observed annual precipitation rate for the Argyll River Basin (mm/day)
9
8
7
6
5
4
1960
1970
1980
1990
2000
2010
2020









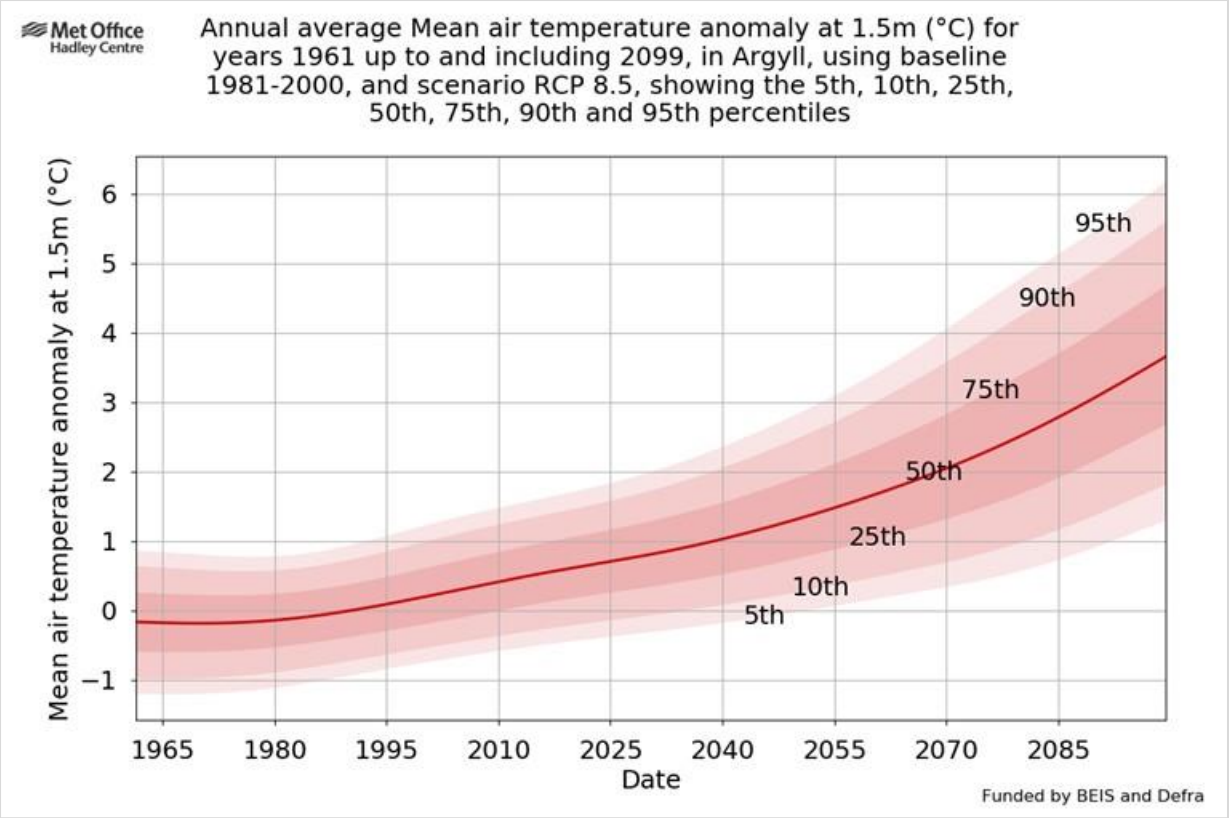
Another important note in the observed data, is the variability between years, as discussed in the key findings summary above. Whilst both the observed data, and projections give an indication of overall trends, the variability of both temperature and rainfall experienced in any given year is very hard to predict and could have a bigger impact on the Argyll region than the annual trends.

Projected air temperature and precipitation rates

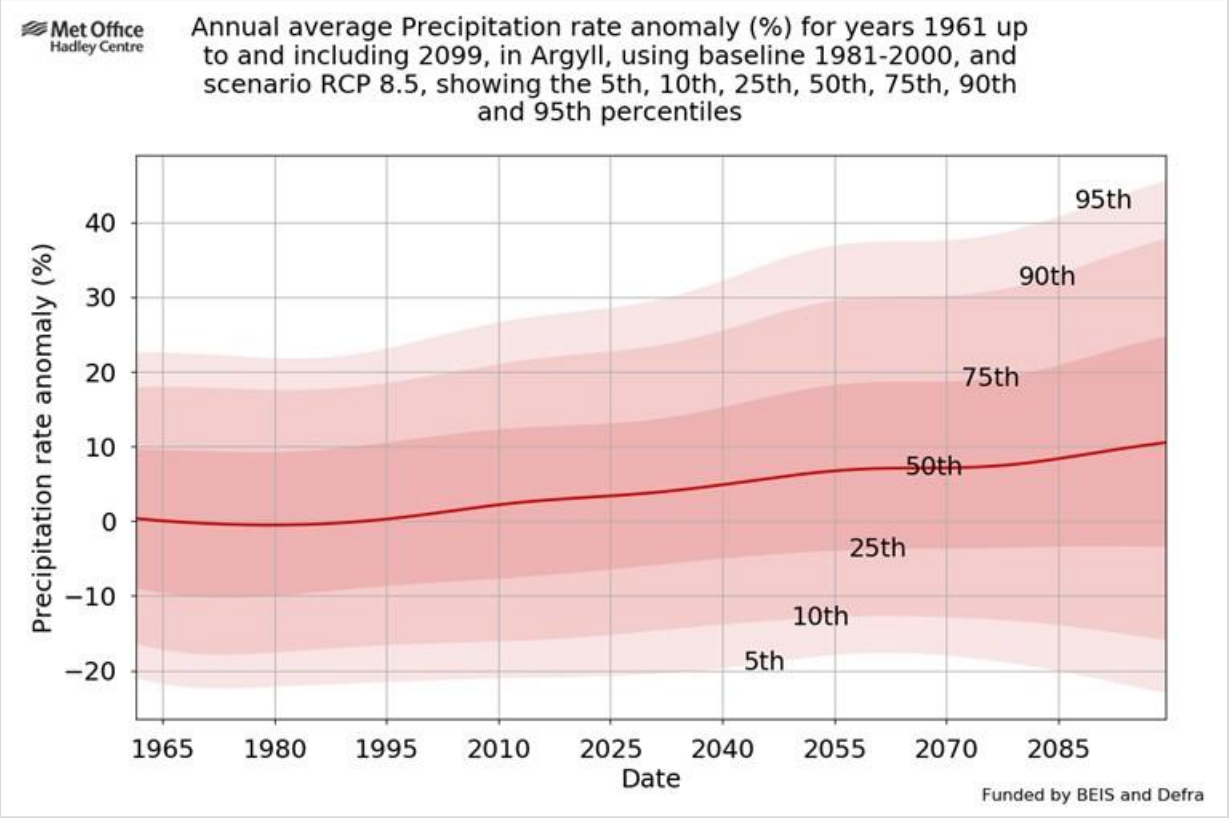
Anomaly values (change from baseline):
The below graphs were generated using anomaly values directly in the UKCP User Interface. This data shows change from a baseline of 1961 for the Argyll river basin up to the end of the century. The bold line shows the central project of the 50th percentile i.e. as likely as not in the current scenario. The shaded areas show the other relative percentiles of probability – from 5, 10, 25th, 75th, 90th and 95th.

The graphs generated by the UKCP User Interface automatically uses an end date of 2099, where as the data for absolute values (see section below) is only projected to 2080. Therefore, in order to avoid confusion and compare the data, the interpretation of graphs for the anomaly values below have looked at the 2080 date point.

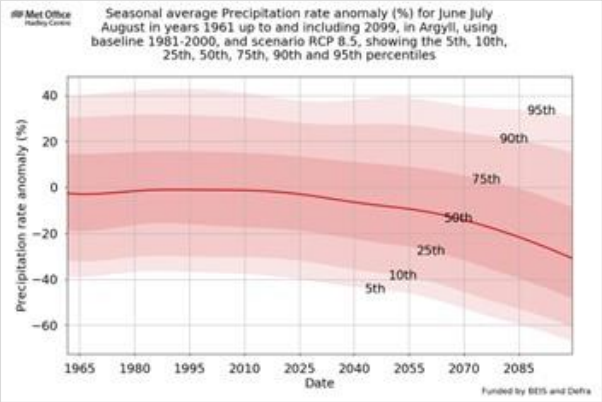
The first graph shows the annual average air temperature anomaly – the projected annual temperature increase, indicating a probable increase of around 2.8°C by 2080 under a high emissions scenario.

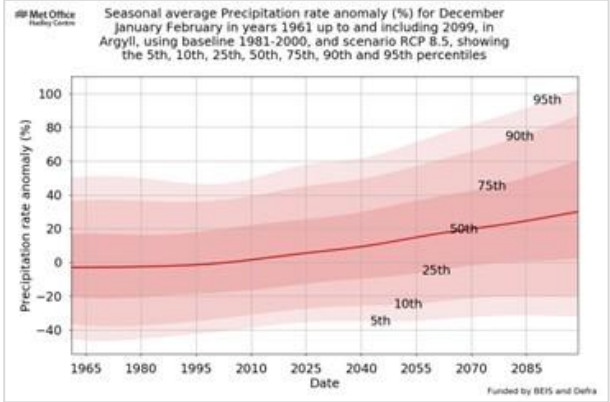


The second graph shows the annual average precipitation rate anomaly – the projected annual change in precipitation, indicating a probable increase of around 9%C by 2080 under a high emissions scenario.



As discussed above, precipitation is usefully looked at across the seasons. Therefore, the following two graphs show the summer and winter average precipitation rate anomaly. These graphs indicate a likely summer decrease in precipitation rate of around 20% by 2080 and a winter increase in precipitation rate of 20% by 2080 under a high emissions scenario. These appear to cancel each other out, so it can be anticipated that the projected annual increase in precipitation rate will mean that spring and autumn will become wetter.



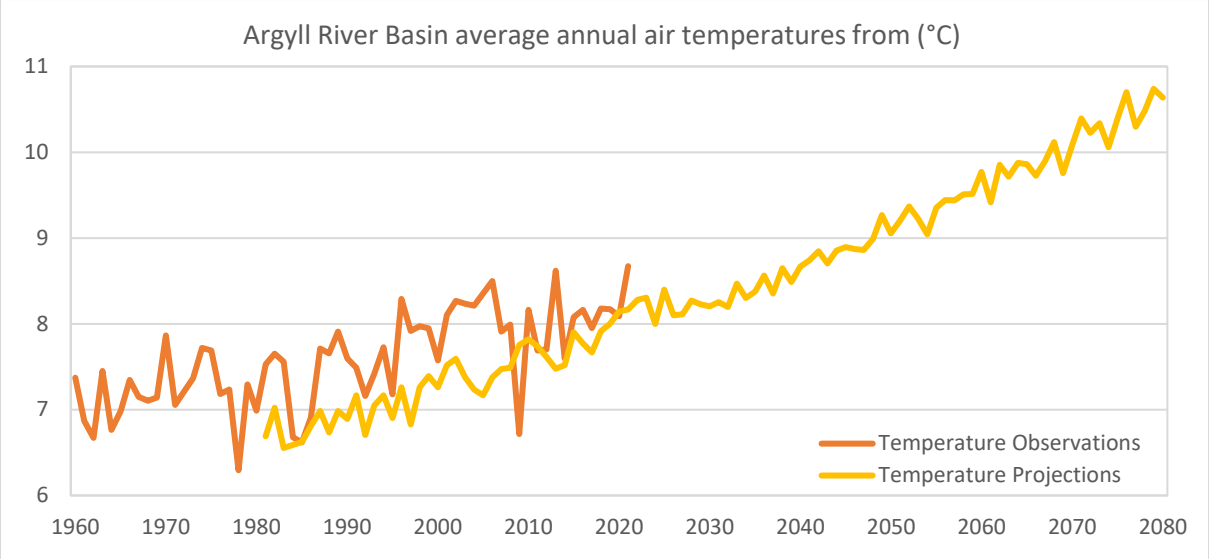


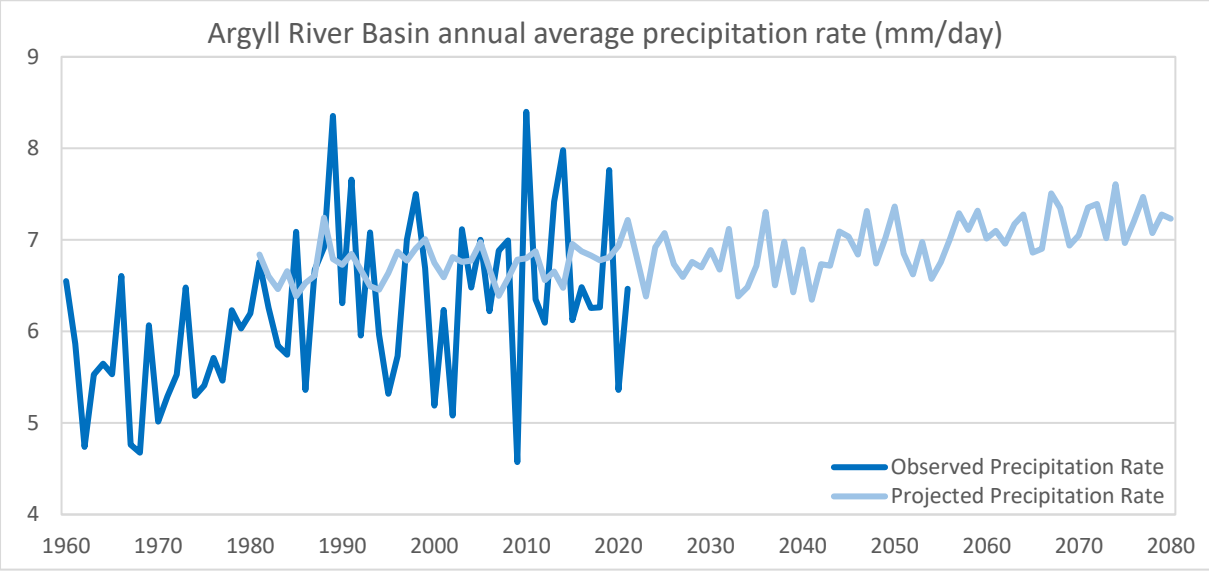
Considering the current observed monthly precipitation shown in the graph in the Observed Data section, an increase in autumn precipitation could have significant impacts given the already high precipitation amounts from October onwards, and this would compound the impacts of the increase in winter precipitation as the ground will already be saturated. An increase in spring precipitation, may on the face of it have less of an impact, however, coming on the back of an increase in winter rainfall (not snowfall, as the temperature increase will mean precipitation falls mainly as rain) could have just as severe an impact on again, already saturated ground.

Absolute values:
Absolute values for both observation and projection data for average annual air temperature and annual precipitation rates were plotted on the same graphs to compare the current trends in climate since 1960 and what the climate models predicted would happen, along with the future projections.

Since 1960, the Argyll and Bute region has experienced an increase in average annual temperatures of around 1.4°C, but with high levels of variability from year to year, as seen in the graph below and above. Projections indicate that this increase will continue steadily on reaching close to 11°C by 2080.

The graphs also show that the projections fall slightly below the observed temperature from 1960 – 2022, and whilst some of this is down to the way the data is manipulated to get the averages from the 12 different climate models, there is the suggestion that the projections have previously underplayed the amount of warming currently being experienced.

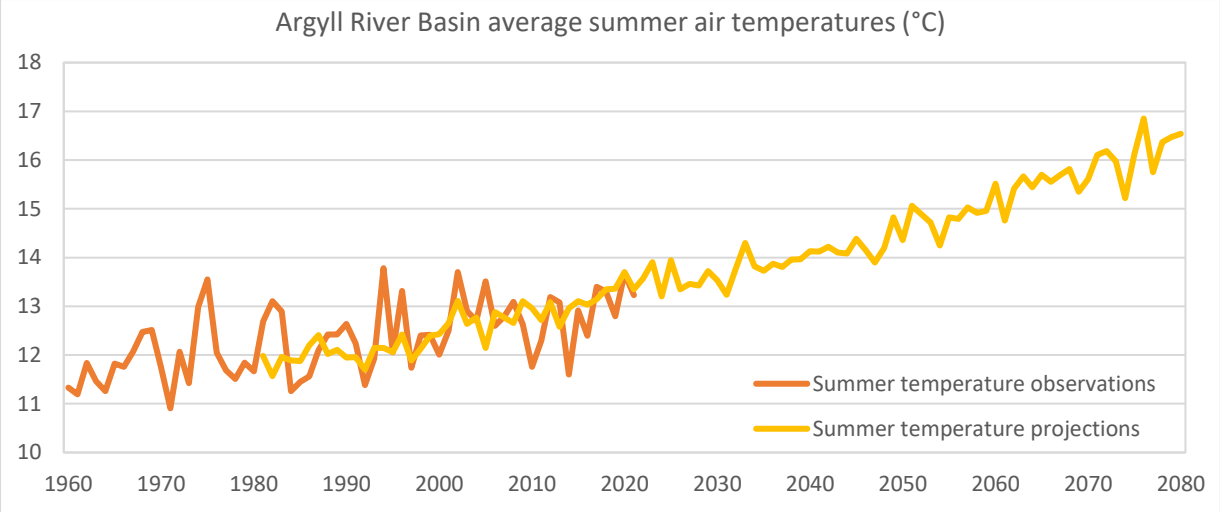


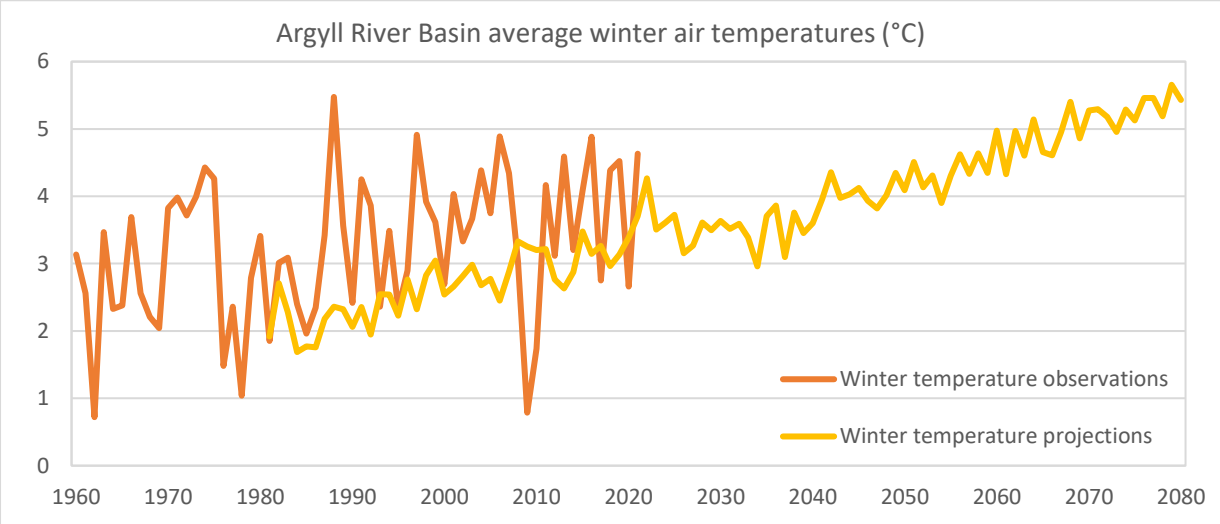


The graph above shows that the Argyll region has experienced a slight increase in annual precipitation rate since 1960, but perhaps more importantly that there is a significant degree of variability between years. The projections indicate that this increase will continue, though perhaps slowly, reaching a little over 7mm/day by 2080.

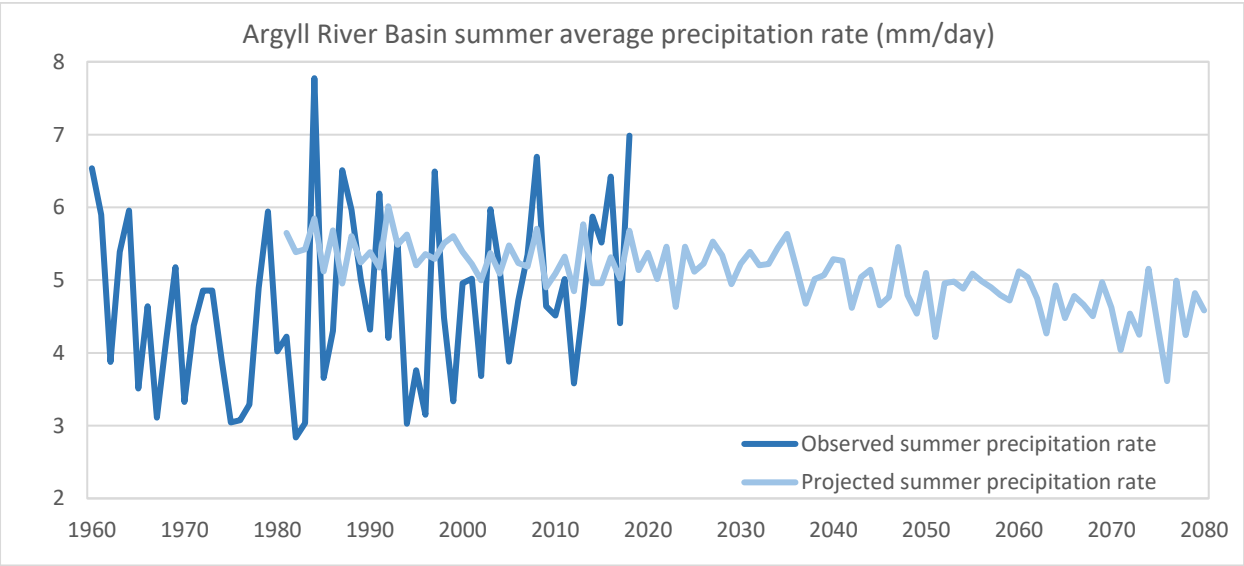
As with the observed data, and anomaly data, precipitation rate projections were looked at seasonally (summer and winter). The below graphs show the observed and projected temperature and precipitation rates in summer (June, July and August) and winter (December, January and February) from 1960 – 2080.

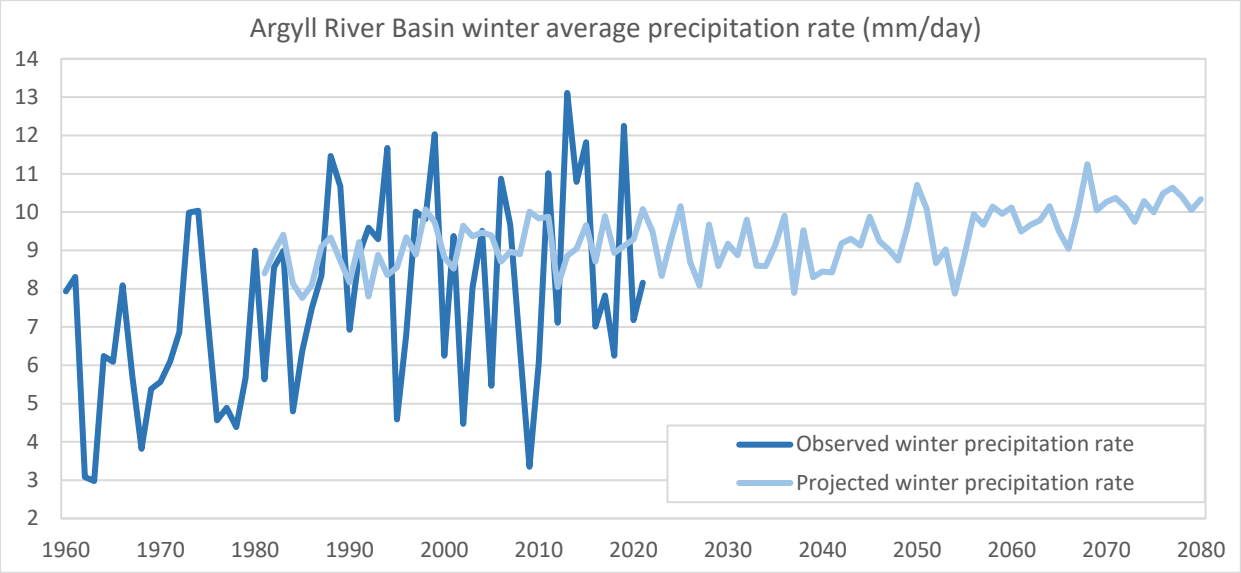
Seasonal temperature also shows an observed increasing trend across both summer and winter, which carries on into the projections to 2080. Observed data shows a higher variability in the winter temperatures which the projections do not, which is worth bearing in mind when considering the impacts of the climate trends.





Seasonal precipitation rates, however, show a different pattern between summer and winter, with a steady decrease in summer and an increase in winter. The observational data again shows a high degree of variability from year to year in precipitation rates, making patterns of overall increases and decreases difficult to ascertain.





Sea Level

Sea Level data is not available at the regional scale, it is projected at either specific tidal gauge locations or 2km coastal locations. Sea level change will be covered in the local authority section and where relevant in the settlement analysis below. However, looking at the RCP8.5 sea level predictions for around the region, there is the projection that sea levels will arise around the region on average between 0.30 and 0.71m by 2080, taking into account isostatic rebound (gradual rise in land level formerly covered by ice sheets during the Ice Ages), and potentially up to 1m by 2100 in some locations (not factoring in isostatic rebound).

The available data only looks at sea level rise in isolation and does not include storm surges or storminess. It is not currently possible to model and project changes in storm surges or storminess with any accuracy, though they are predicted to increase due to the changes in weather patterns expected in a changing climate. The data presented here could be interpreted as a baseline which storm surges would be added to. The Climate Central website Coastal Risk Screening Tool referred to in the introduction provides maps of land below 1m above the current high tide line, which can be used to infer the location of the mean high water line in 2100, though there are caveat around topography of surrounding land and existing and future sea defences that will influence the exact level of sea rise in specific locations.

The Atlantic Meridional Overturning Circulation (AMOC) is a large system of ocean currents in the North Atlantic Ocean that bring warm water from the tropics up to the west coastline of northern Europe, often called The Gulf Stream. It is a key reason why Scotland doesn't see the same temperatures as the Baltic Nations and Russia in winter. The AMOC varies from year to year and though there hasn't been enough monitoring to pick up long terms trends, climate models suggest that the AMOC will weaken as greenhouse gases increase, which could have a significant impact on the UK Climate as less warmer water is brought northwards. There is a large amount of uncertainty of both the affect of a weaker AMOC and at present it hasn't been included in the UK Climate Projections due to a lack of robust data surrounding it. However, this is being worked on by the Met Office and future Projections will hopefully include it.

Local Authority level Findings

As mentioned in the methodology section, the High global Warming Levels used in the Met Office Local Authority Climate Explorer roughly coincide with the RCP8.5 to 2080.

The report for Argyll and Bute suggests an annual average temperature increase of 2.4 - 3.2°C over the 1981-2000 baseline under the high emissions GWL, with the summer average at 4.7°C higher and the winter average 2.5°C higher. These projections also project a summer maximum temperature of 4.7°C above and a winter minimum temperature of 5.3°C above the 1981-2000 baseline.

Summer precipitation rate is projected to be around 15% lower with winter precipitation predicted to be around 10% above the 1981-2000 baseline.

In addition to temperature and precipitation rate, the Met Officer Local Authority Climate Explorer reports include other climate indicators. The report for Argyll and Bute predicts the following median annual values, for the 4°C GWL:

Indicator	**Baseline (1981-2000)**	**4°C GWL Median**
Summer Days[1] – daily maximum temperature >25°C	1	10
Hot Summer Days – daily maximum temperature >30°C	0	1
Extreme Summer Days – daily maximum temperature >35°C	0	0
Tropical Nights – daily minimum temperature >20°C	0	0
Frost Days – daily minimum temperature <0°C	52	7
Icing Days – daily maximum temperature <0°C	2	0
Growing Degree[2] Days – daily mean temperature >5.5°C	1,249	2,005
Heating Degree Days – daily mean temperature <15.5°C	2,772	1,916
Cooling Degree Days – daily mean temperature <22°C	3	20

For areas with a coastline, the Met Office Local Authority Climate Explorer also provides projections on sea level. The report for Argyll and Bute projects a sea level rise of between 0.30 and 0.72m above the 1990 mean high tide line by the 2080s.

[1] Summer days above the stated temperature thresholds can occur at any time of year.

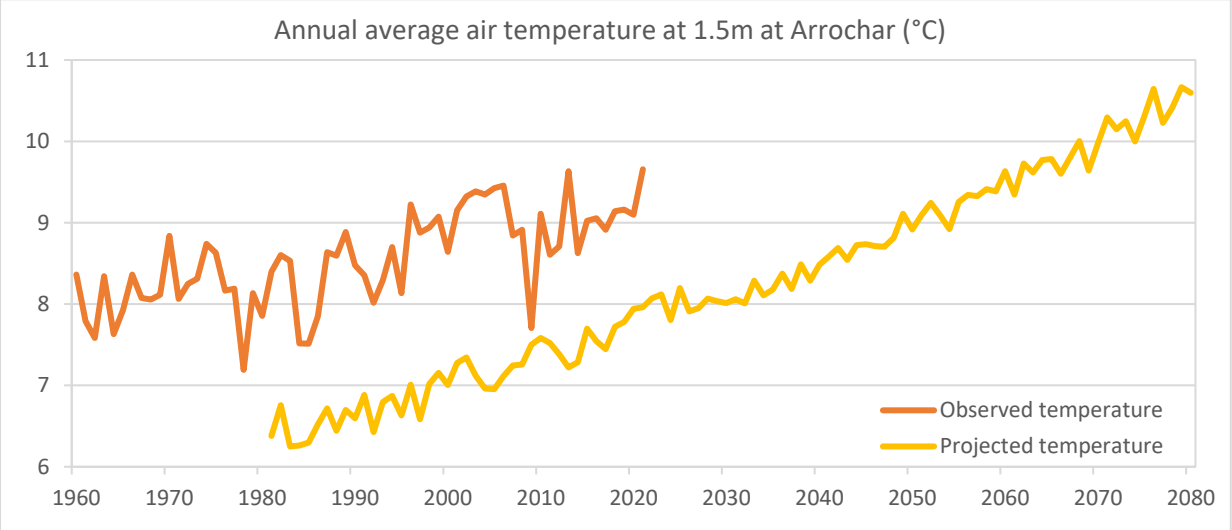
[2] Degree days are not a number of days, but the number of degrees the daily average temperature exceeds the threshold each day, added up over a year.

Settlement Findings

Argyll and Bute is a large area, with a diverse geography, topography and coastline. Sixteen key settlements were identified by the CPP to allow the analysis of climate trends across the region. There is a mixture of large and small urban centres, coastal, inland and island settlements, landscape types and topographies:

Arrochar

Air temperature

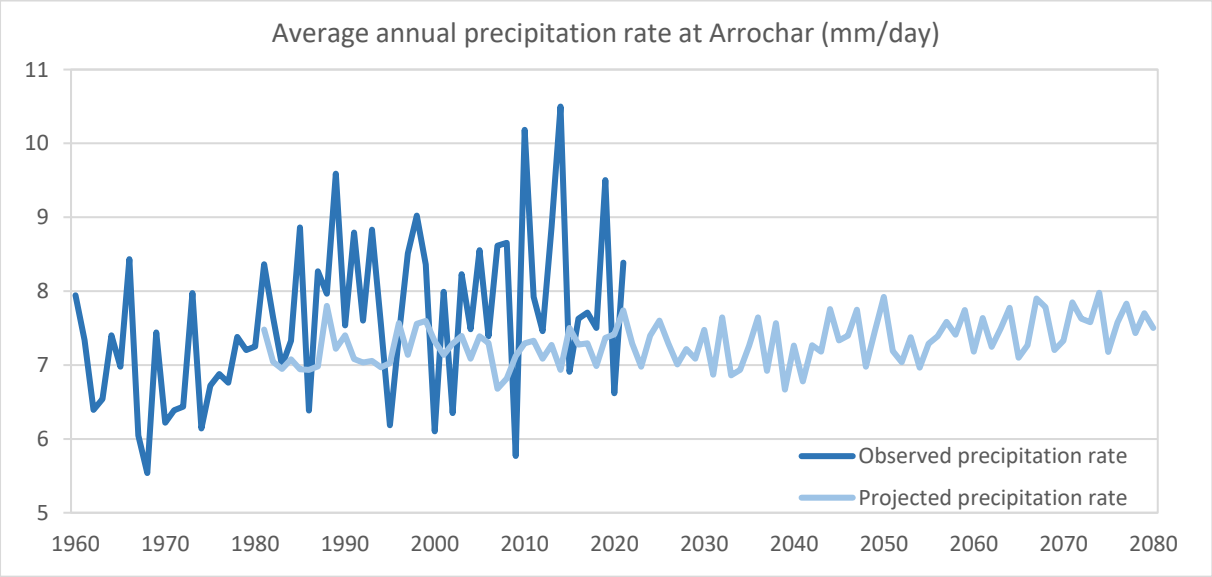


Average annual air temperature at Arrochar is predicted to increase over the coming decades, reaching to approximately 10.5°C by 2080. This is in line with the UKCP anomaly projections showing a 2.8°C increase in annual average temperature for the Arrochar area.

Precipitation rate

Average annual precipitation rate in Arrochar is predicated to broadly stay steady compared to the baseline, which compares to the UKCP anomaly projections suggesting a 5% increase in precipitation rate for the Arrochar area.

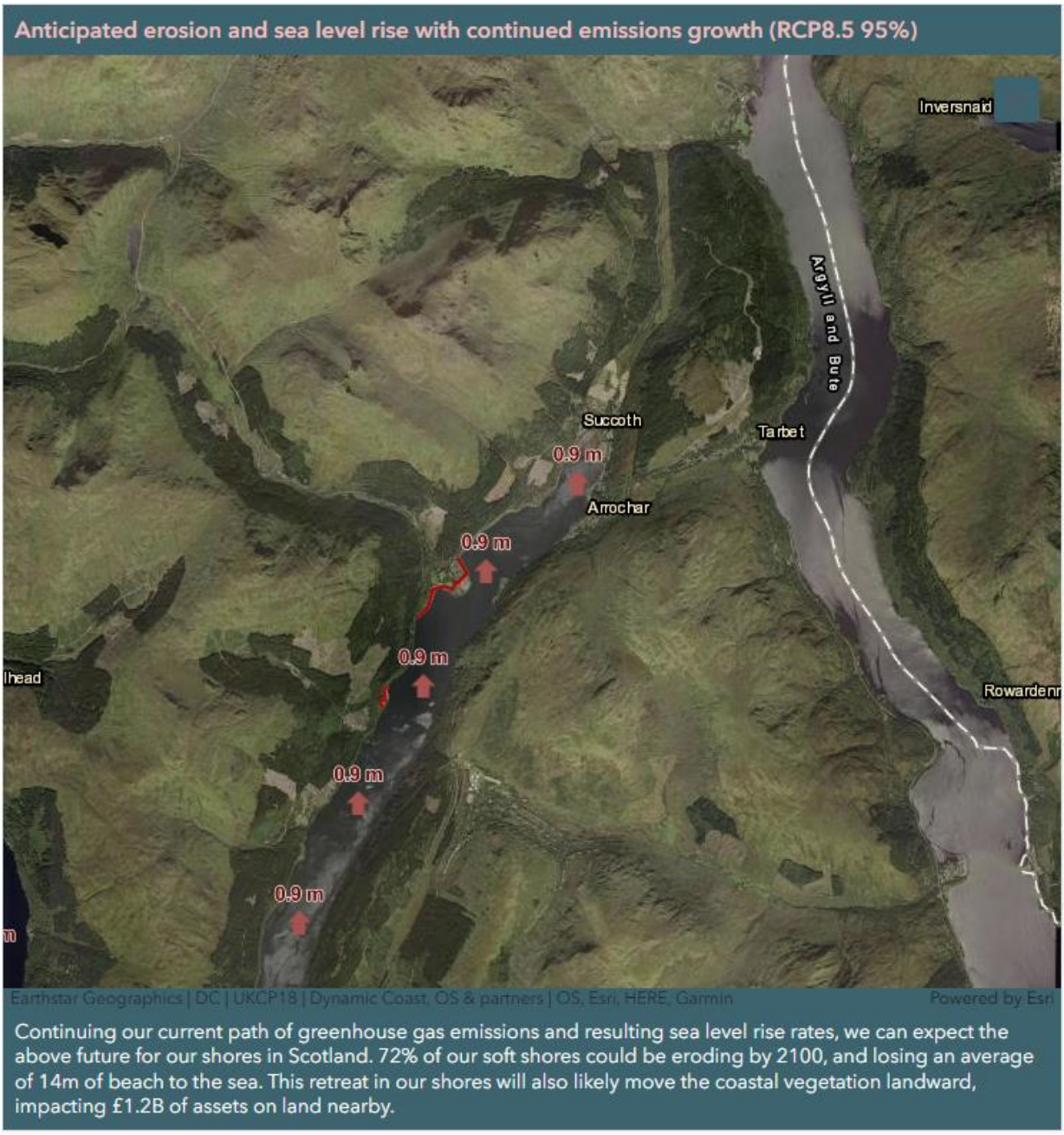
However, as noted in the regional section above, the variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place. The observational data below shows a high level of variability in precipitation rate between years from 1960 – 2023.



Sea Level Rise

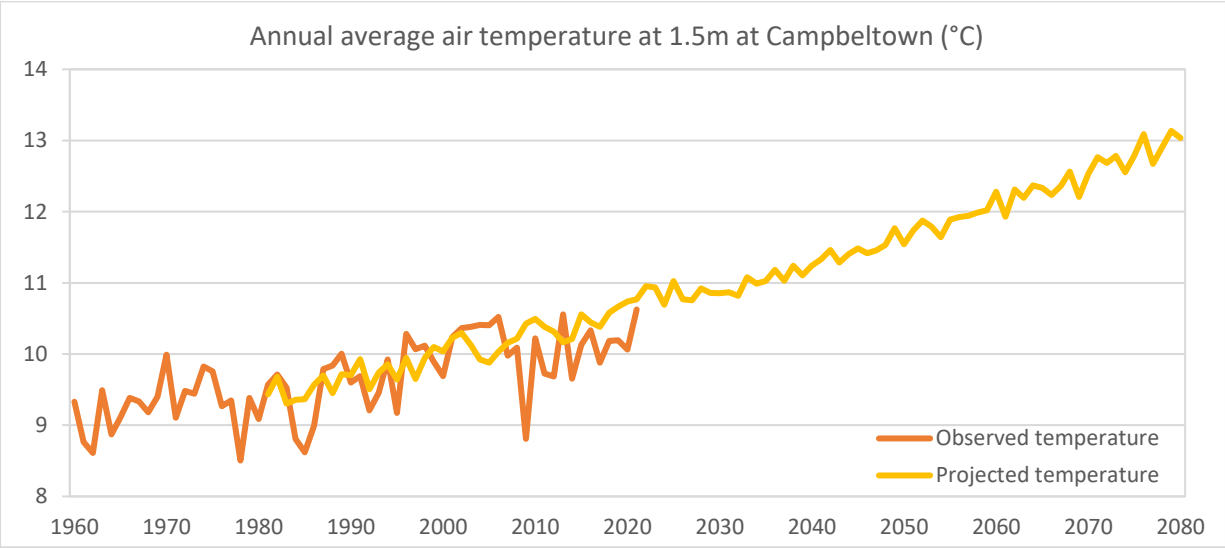
Despite being at the head of a sea loch, Arrochar is not considered as a coastal location by the UCKP marine projections and therefore, sea level change data is not available. According to the Dynamic Coasts High Emissions dashboard, however, a 0.9m sea level rise is anticipated at the 95% of the high emissions pathway RCP8.5:

https://www.arcgis.com/apps/dashboards/defe901982154099b6ceb19db8aa41a4 (Note: it is necessary to pan and zoom to the desired location after following the link, as below)



Campbeltown

Air temperature

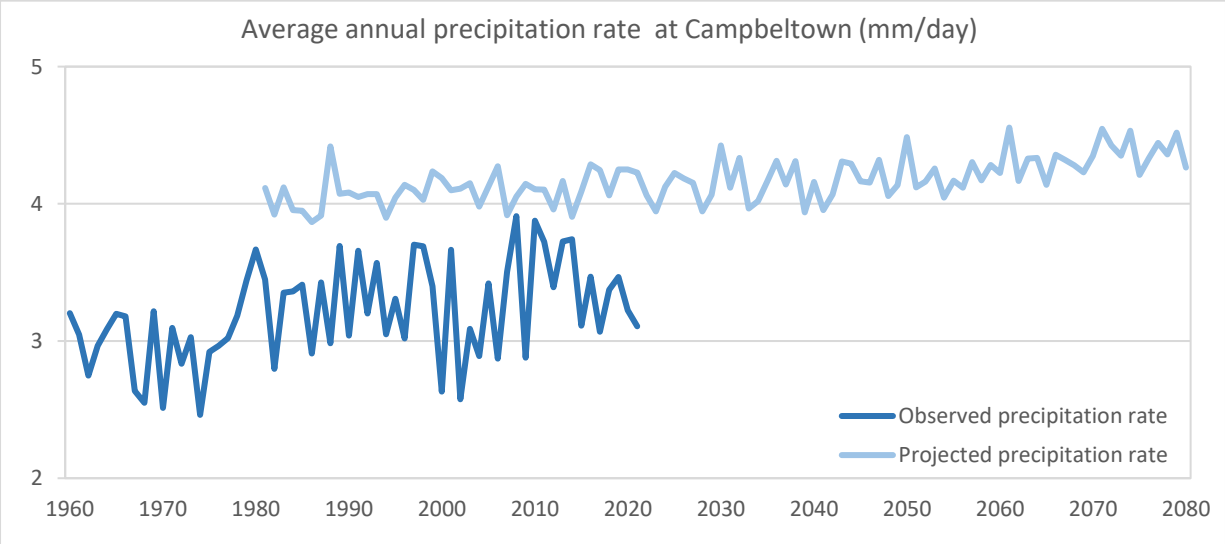


Average annual air temperature at Campbeltown is predicted to increase over the coming decades, in line with the projections, reaching to approximately 13°C by 2080 This is in line with the UKCP anomaly projections showing a 2.8°C increase in annual average temperature for the Campbeltown area.

Precipitation rate

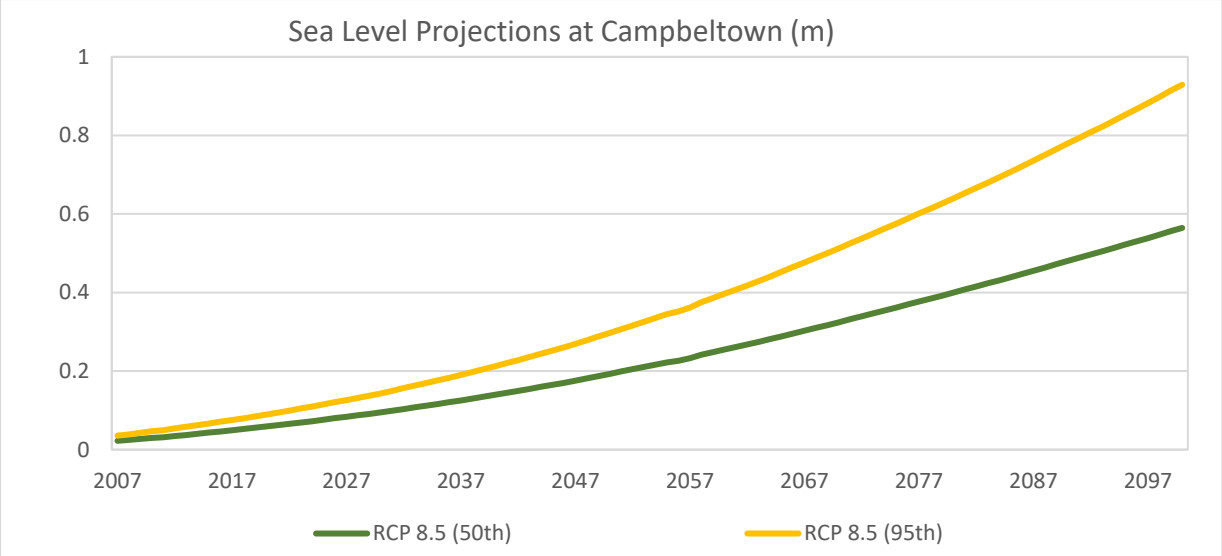
Average annual precipitation rate in Campbeltown is predicated to broadly stay steady compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest a 10% increase in precipitation rate for the southern Kintyre peninsula, the variation between that and the absolute values for Campbeltown could be due to the eastern location of the town.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



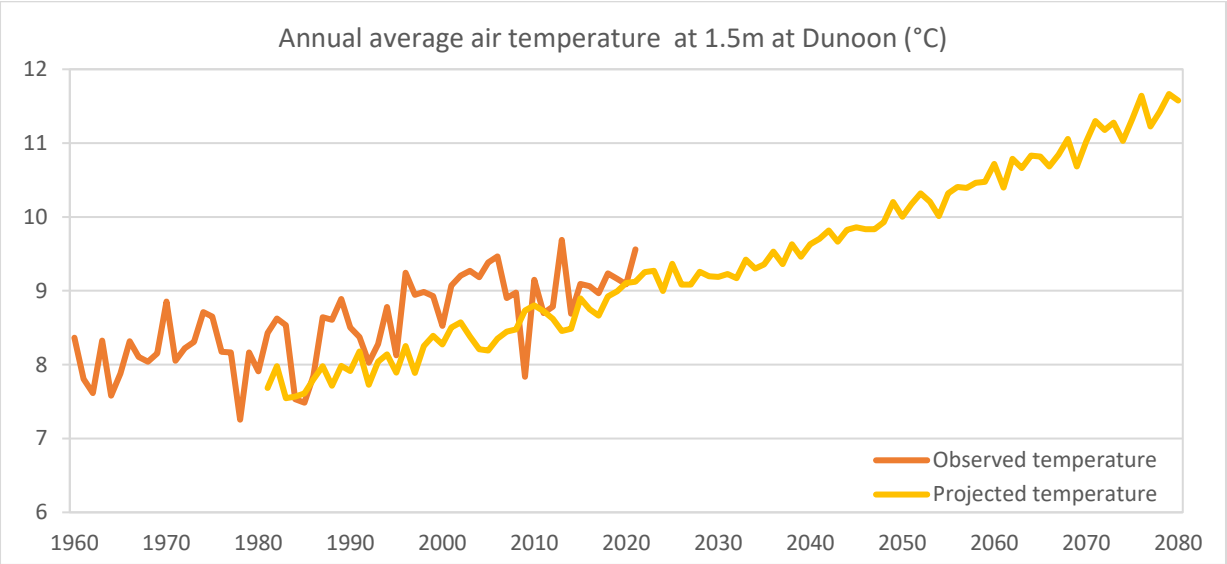
Sea Level Rise

Sea Level at Campbeltown is projected to rise by between 0.58m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Dunoon

Air temperature

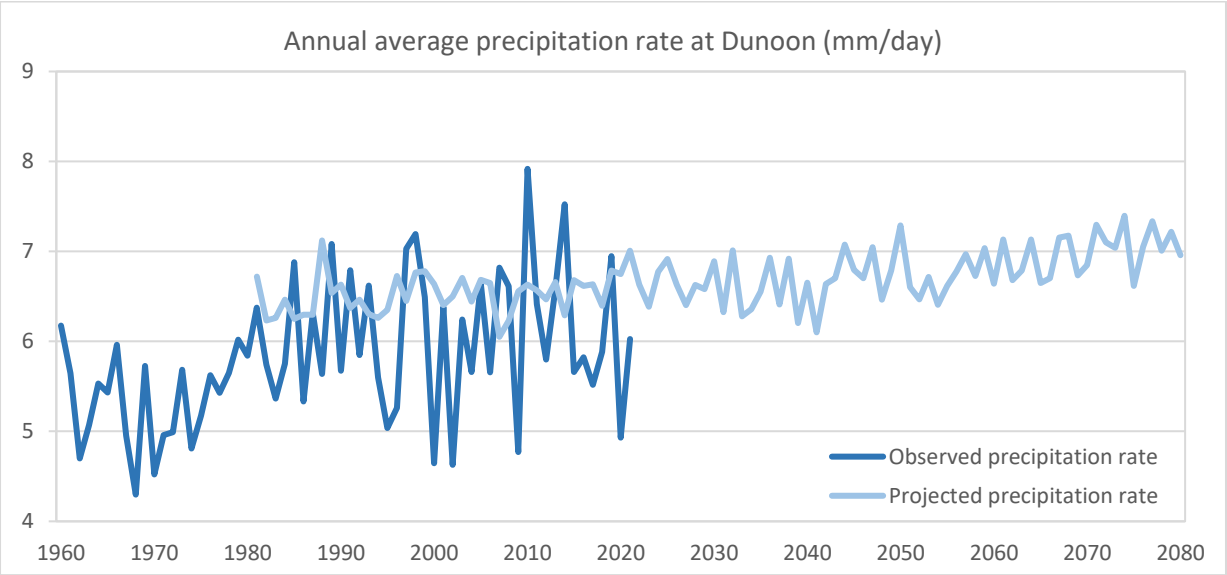


Average annual air temperature at Dunoon is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 3°C increase in annual average temperature for the Dunoon area.

Precipitation rate

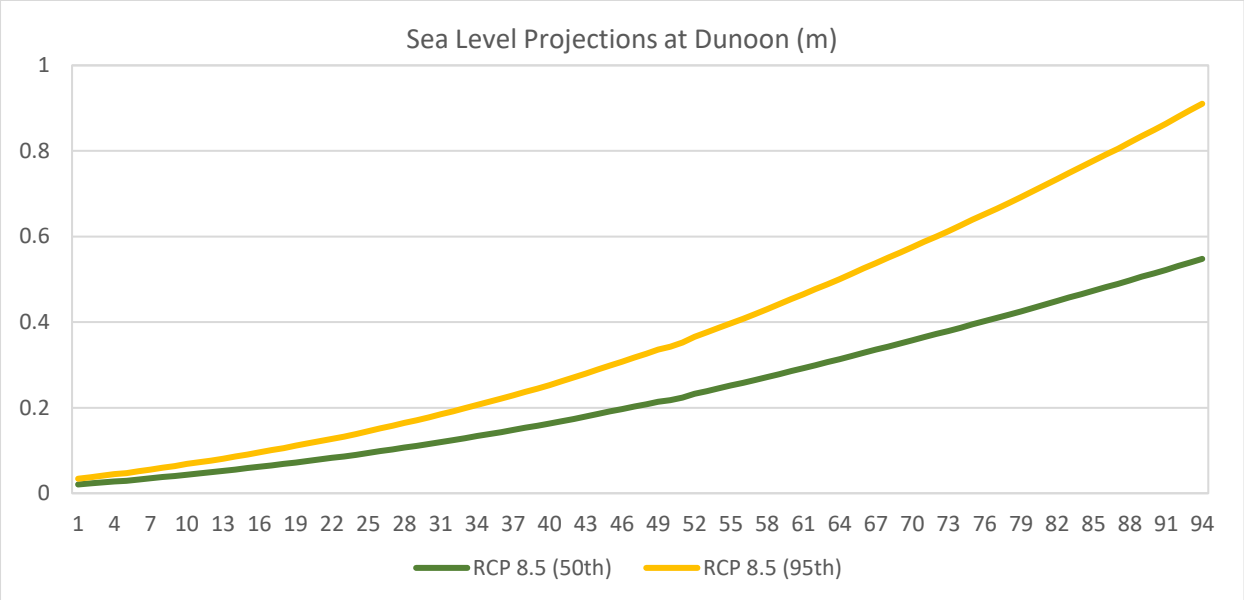
Average annual precipitation rate in Dunoon is predicated to slightly increase compared to the baseline. The UKCP anomaly projections suggest a 9% increase in precipitation rate for the Dunoon area.

The variability of precipitation rate over the year and between years, however, will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



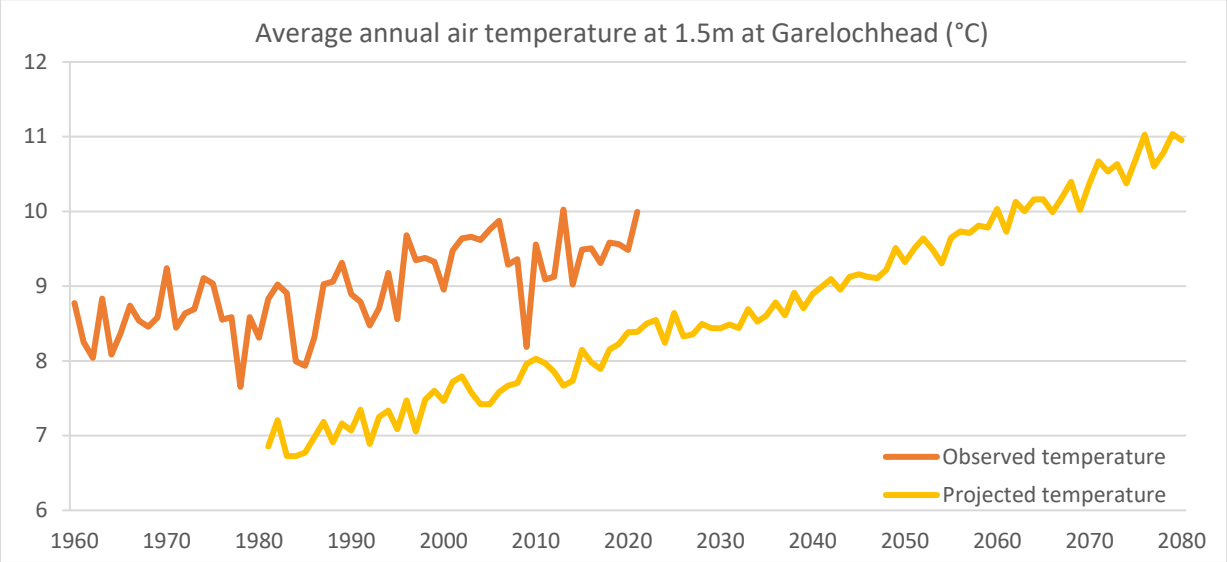
Sea Level Rise

Sea Level at Dunoon is projected to rise by between 0.55m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Garelochhead

Air temperature

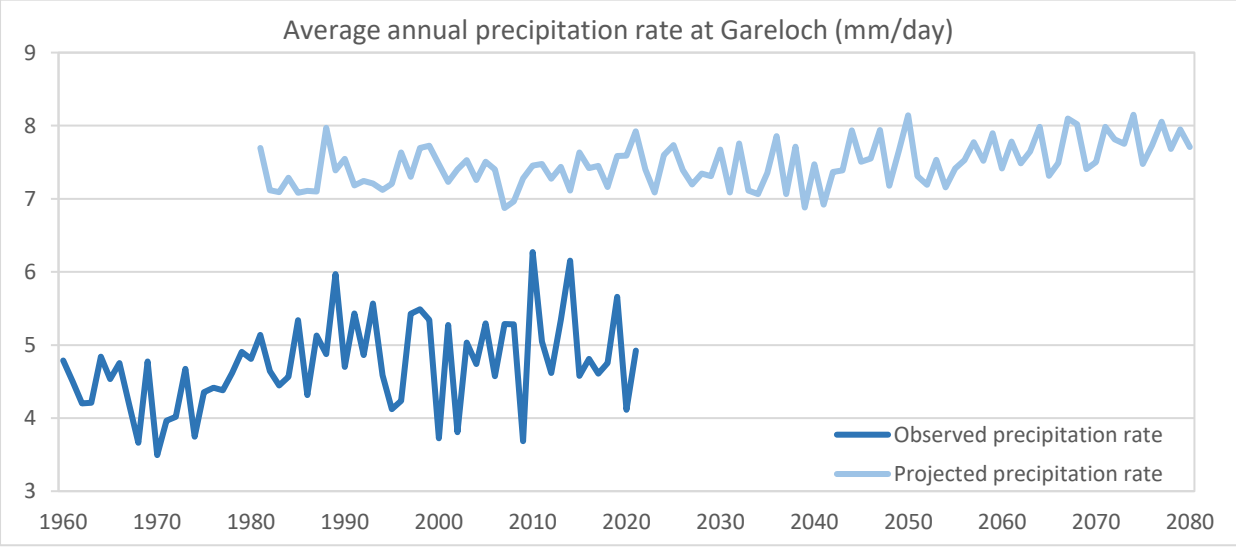


Average annual air temperature at Garelochhead is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11°C by 2080. This is in line with the UKCP anomaly projections showing a 3°C increase in annual average temperature for the area.

Precipitation rate

Average annual precipitation rate in Garelochhead is predicated to broadly stay steady compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest a 9% increase in precipitation rate for the Garelochhead area, which could be accounted for in the higher projections than observations.

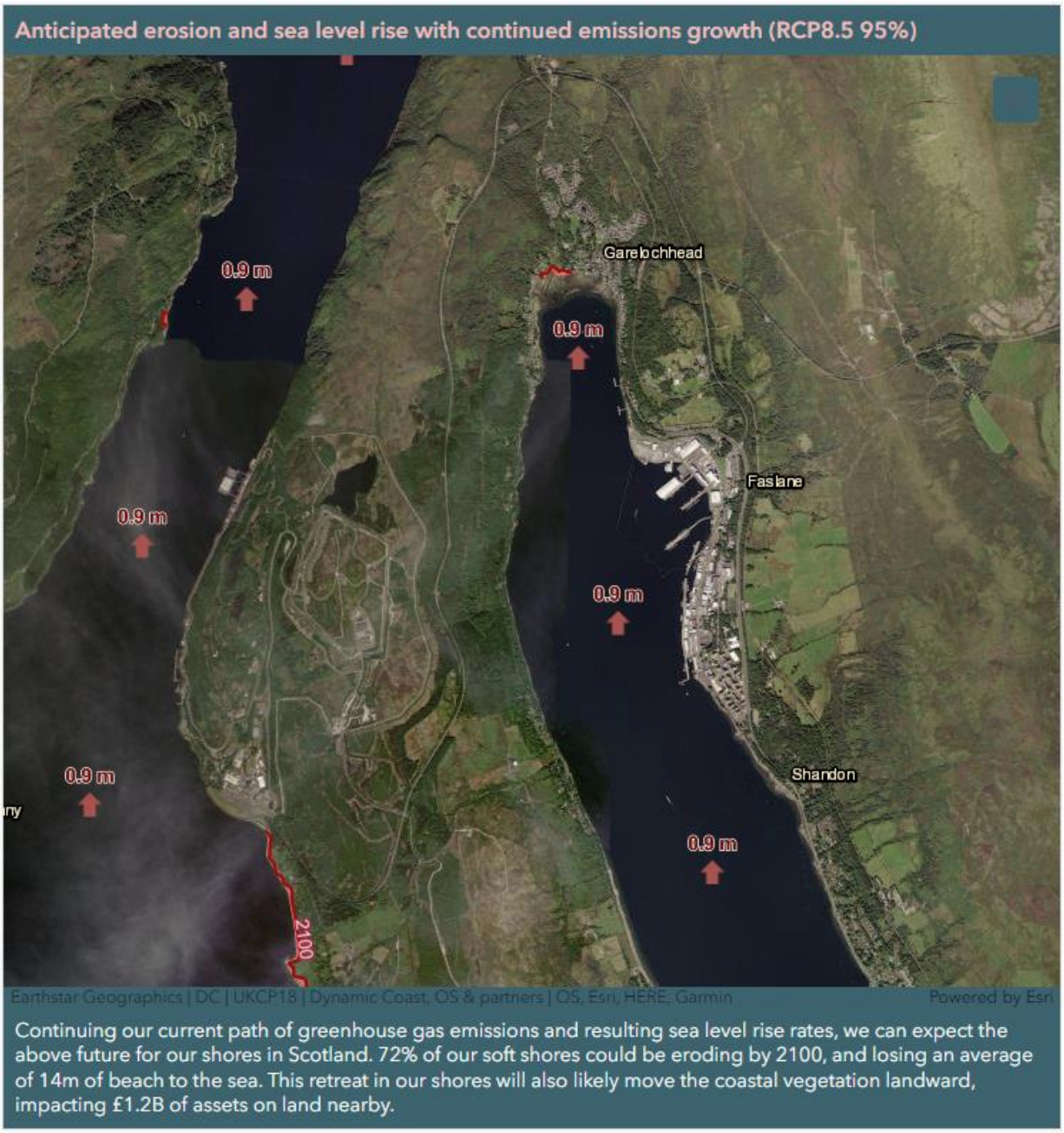
The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



Sea Level Rise

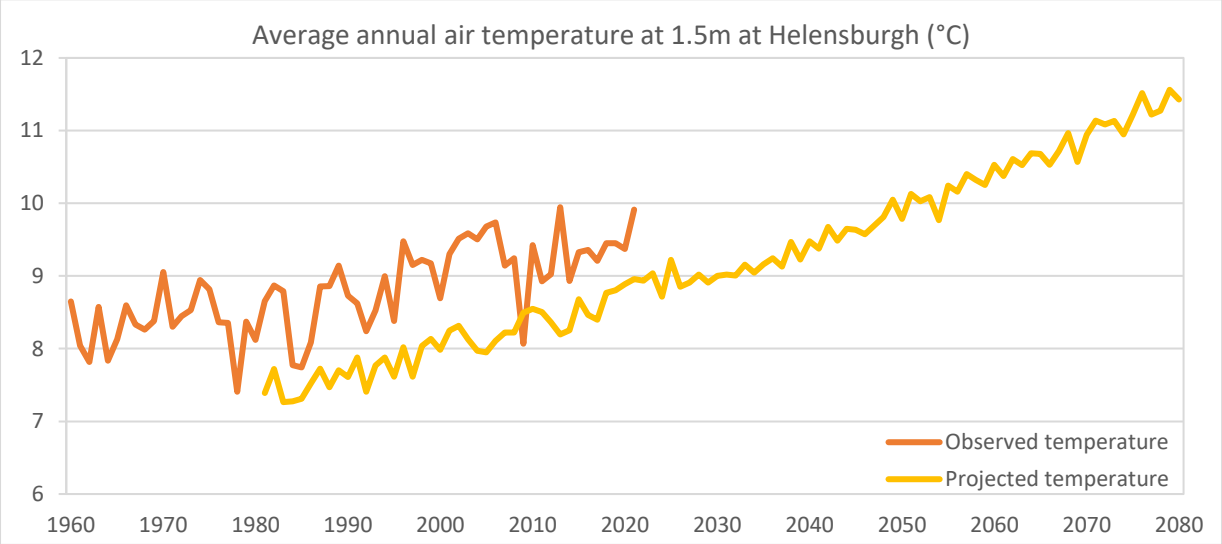
Garelochhead is not considered as a coastal location by the UCKP marine projections and therefore, sea level change data is not available. According to the Dynamic Coasts High Emissions dashboard, however, a 0.9m sea level rise is anticipated at the 95% of the high emissions pathway RCP8.5:

https://www.arcgis.com/apps/dashboards/defe901982154099b6ceb19db8aa41a4 (Note: it is necessary to pan and zoom to the desired location after following the link, as below)



Helensburgh

Air temperature

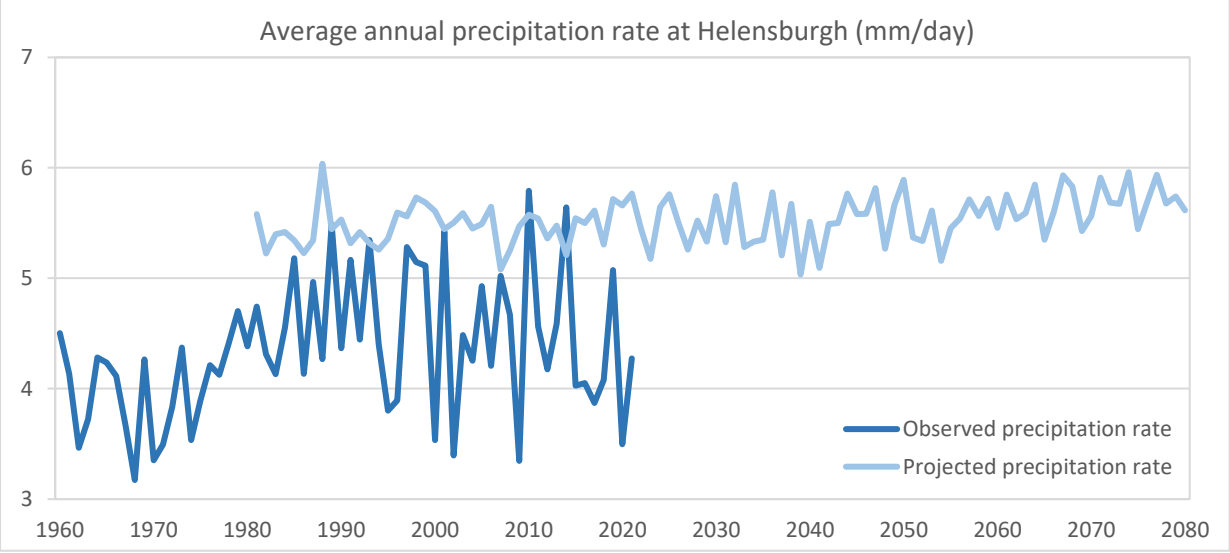


Average annual air temperature at Helensburgh is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 3°C increase in annual average temperature for the Helensburgh area.

Precipitation rate

Average annual precipitation rate in Helensburgh is predicated to broadly stay steady compared to the baseline, which compares to the UKCP anomaly projections suggesting a 5% increase in precipitation rate for the Helensburgh area. The projections do suggest a higher precipitation rate than the observed data currently shows as being experienced.

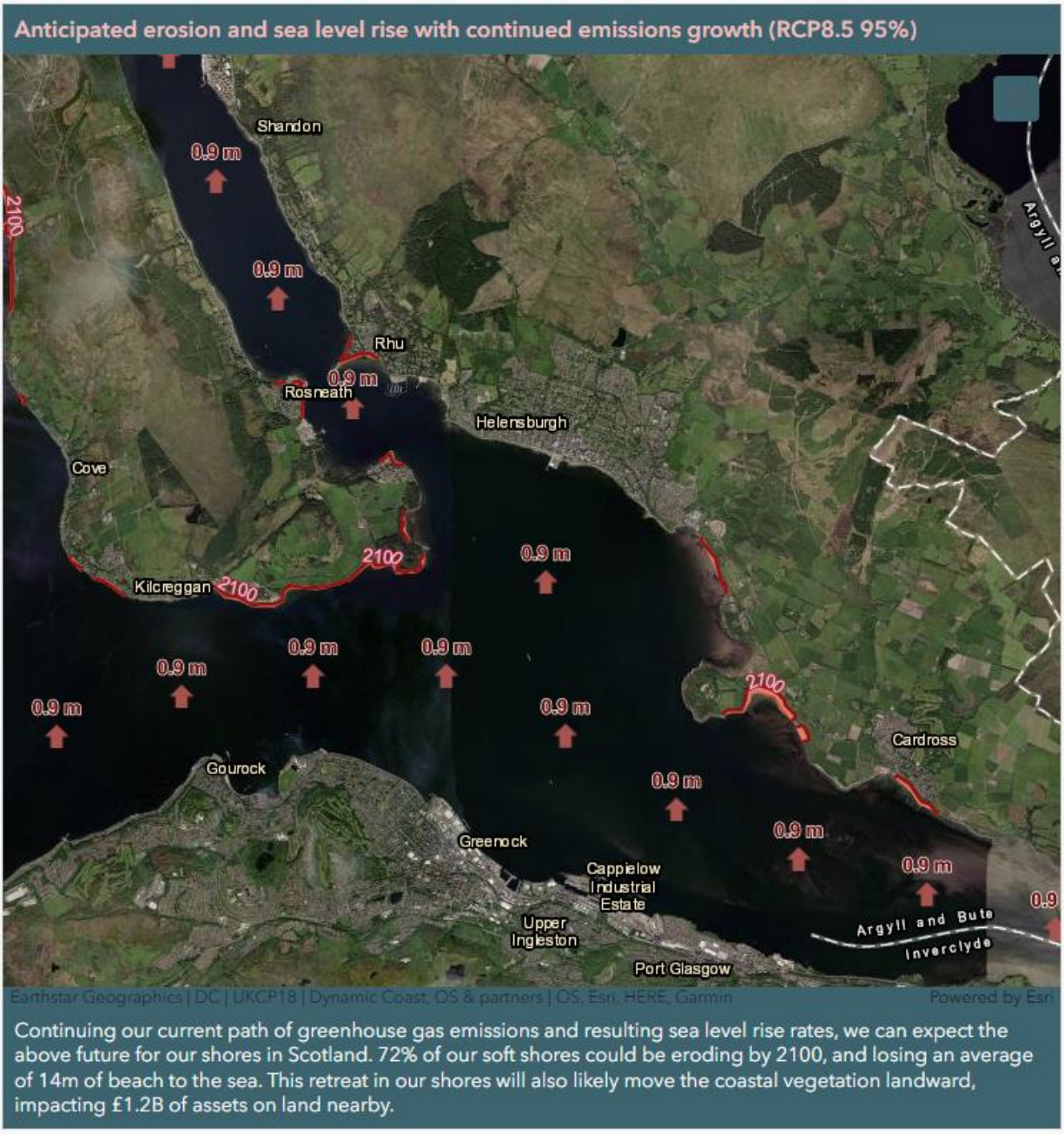
The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



Sea Level Rise

Helensburgh is not considered as a coastal location by the UCKP marine projections and therefore, sea level change data is not available. According to the Dynamic Coasts High Emissions dashboard, however, a 0.9m sea level rise is anticipated at the 95% of the high emissions pathway RCP8.5:

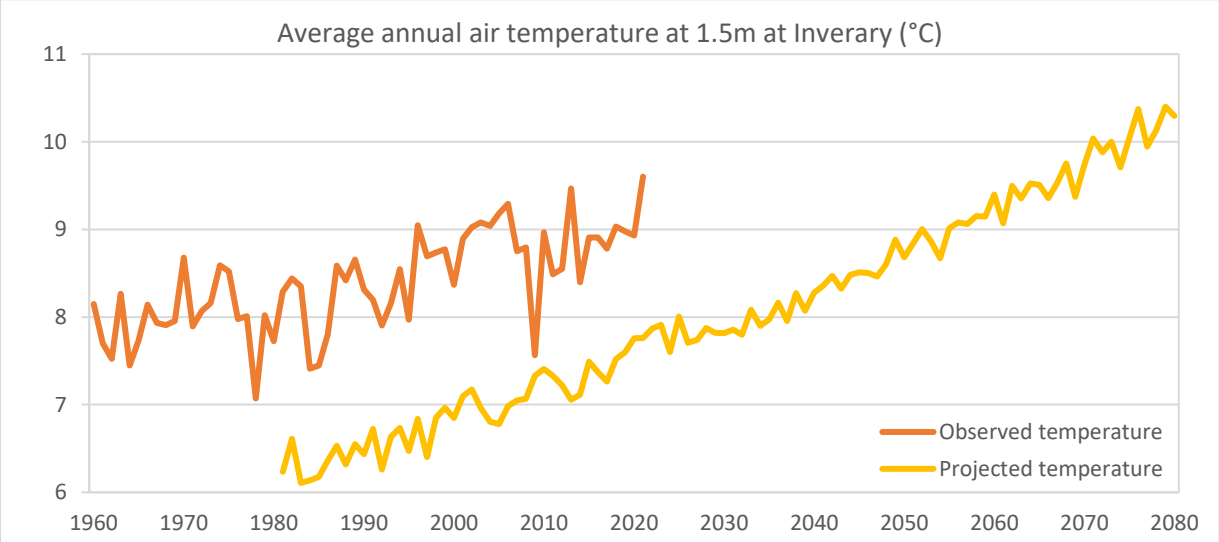
https://www.arcgis.com/apps/dashboards/defe901982154099b6ceb19db8aa41a4 (Note: it is necessary to pan and zoom to the desired location after following the link, as below)



Continuing our current path of greenhouse gas emissions and resulting sea level rise rates, we can expect the above future for our shores in Scotland. 72% of our soft shores could be eroding by 2100, and losing an average of 14m of beach to the sea. This retreat in our shores will also likely move the coastal vegetation landward, impacting £1.2B of assets on land nearby.

Inveraray

Air temperature

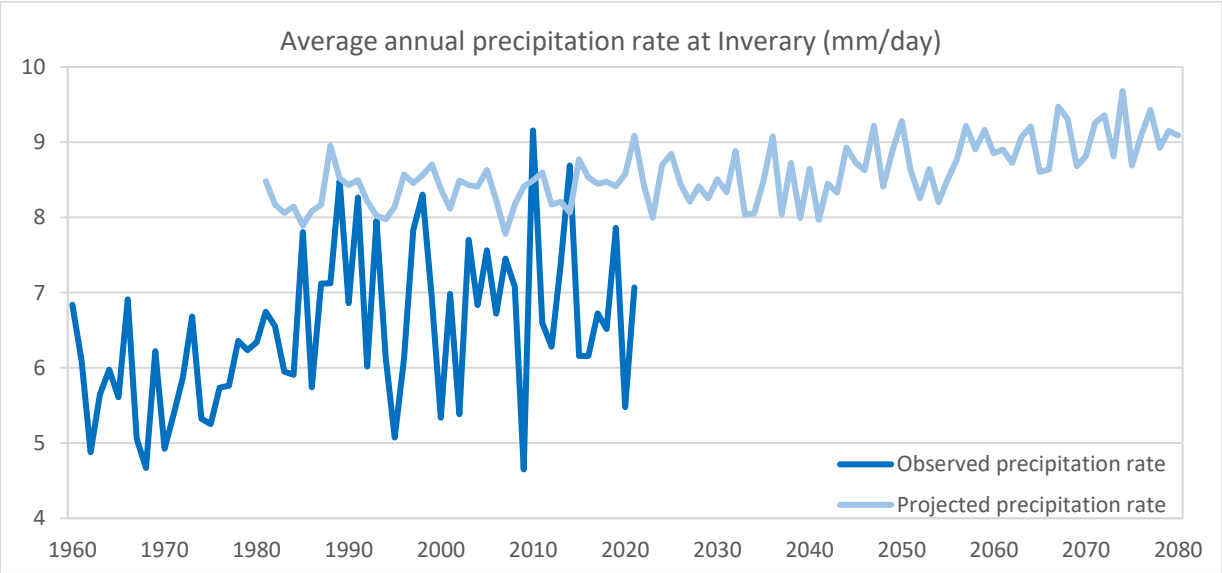


Average annual air temperature at Inverary is predicted to increase over the coming decades, in line with the projections, reaching to approximately 10.5°C by 2080. This is in line with the UKCP anomaly projections showing a 2.7°C increase in annual average temperature for the Inverary area.

Precipitation rate

Average annual precipitation rate in Inverary is predicated to slightly increase compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest an 8% increase in precipitation rate for the Inverary area, which could be accounted for in the higher projections than observations.

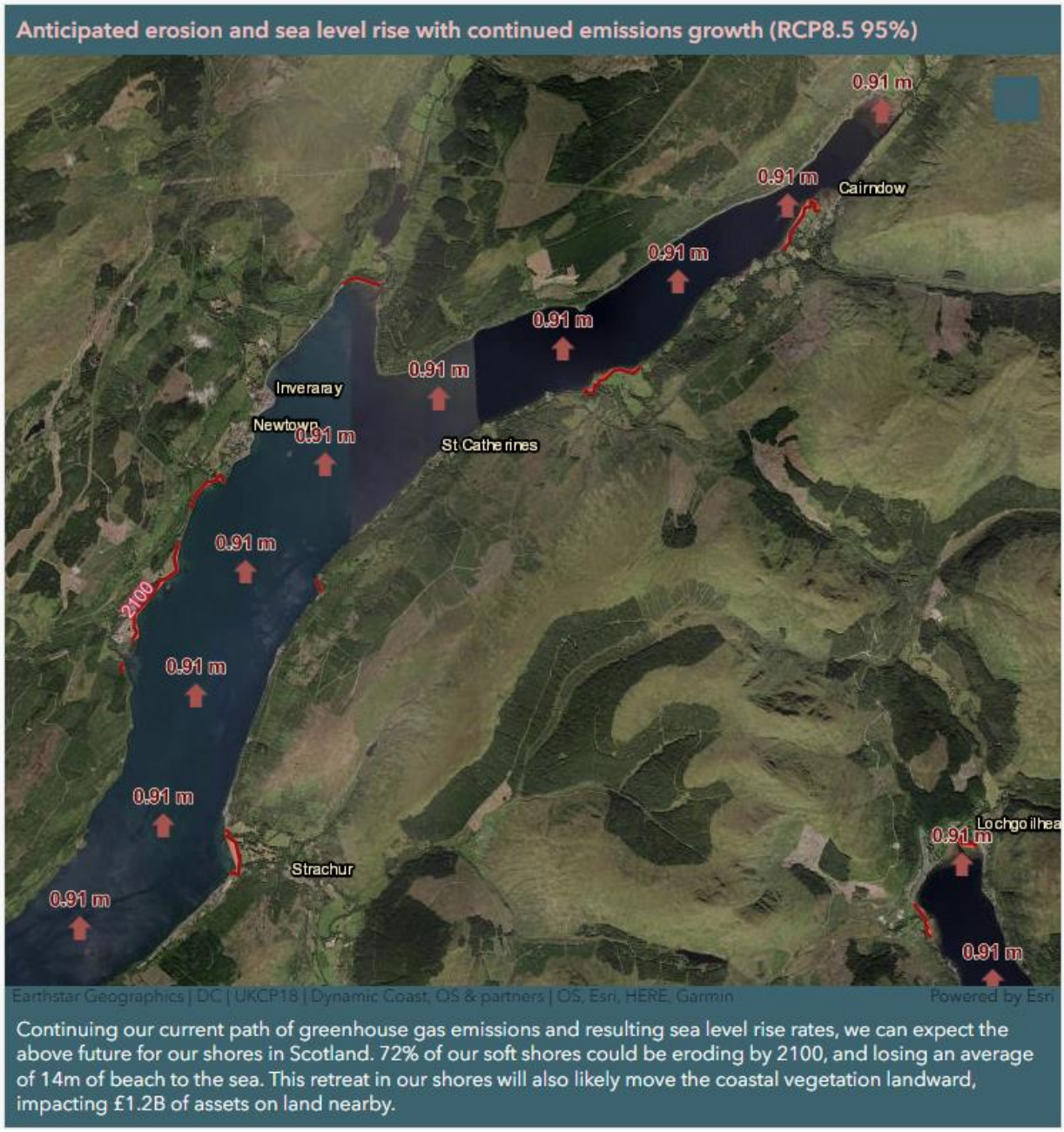
The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



Sea Level Rise

Inverary is not considered as a coastal location by the UCKP marine projections and therefore, sea level change data is not available. According to the Dynamic Coasts High Emissions dashboard, however, a 0.91m sea level rise is anticipated at the 95% of the high emissions pathway RCP8.5:

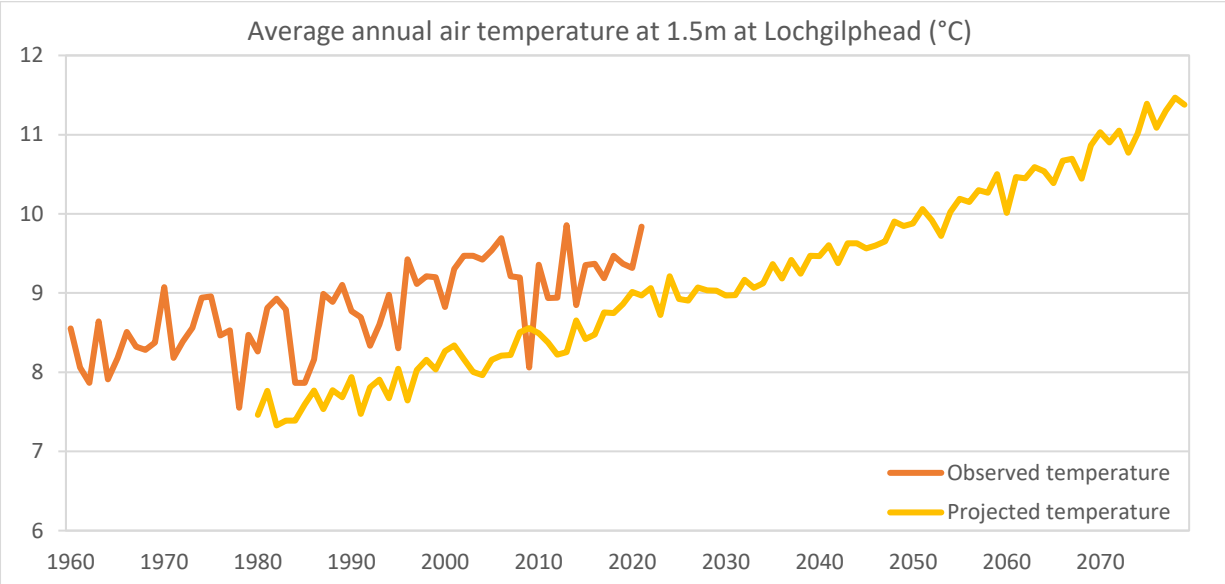
https://www.arcgis.com/apps/dashboards/defe901982154099b6ceb19db8aa41a4 (Note: it is necessary to pan and zoom to the desired location after following the link, as below)



Continuing our current path of greenhouse gas emissions and resulting sea level rise rates, we can expect the above future for our shores in Scotland. 72% of our soft shores could be eroding by 2100, and losing an average of 14m of beach to the sea. This retreat in our shores will also likely move the coastal vegetation landward, impacting £1.2B of assets on land nearby.

Lochgilphead

Air temperature

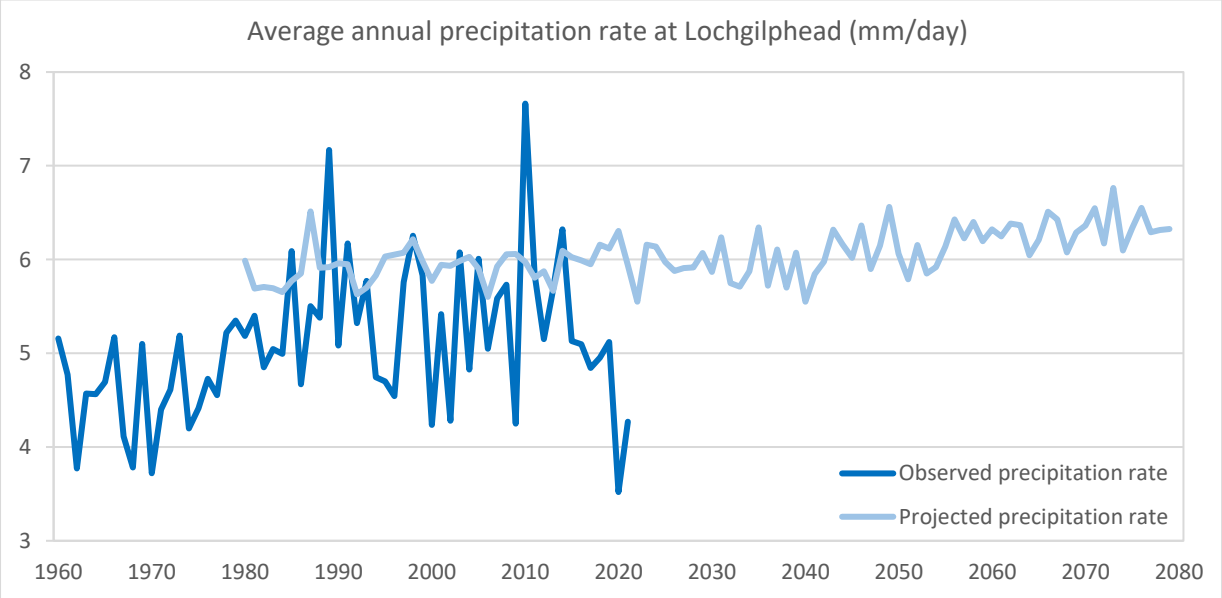


Average annual air temperature at Lochgilphead is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 3°C increase in annual average temperature for the Lochgilphead area.

Precipitation rate

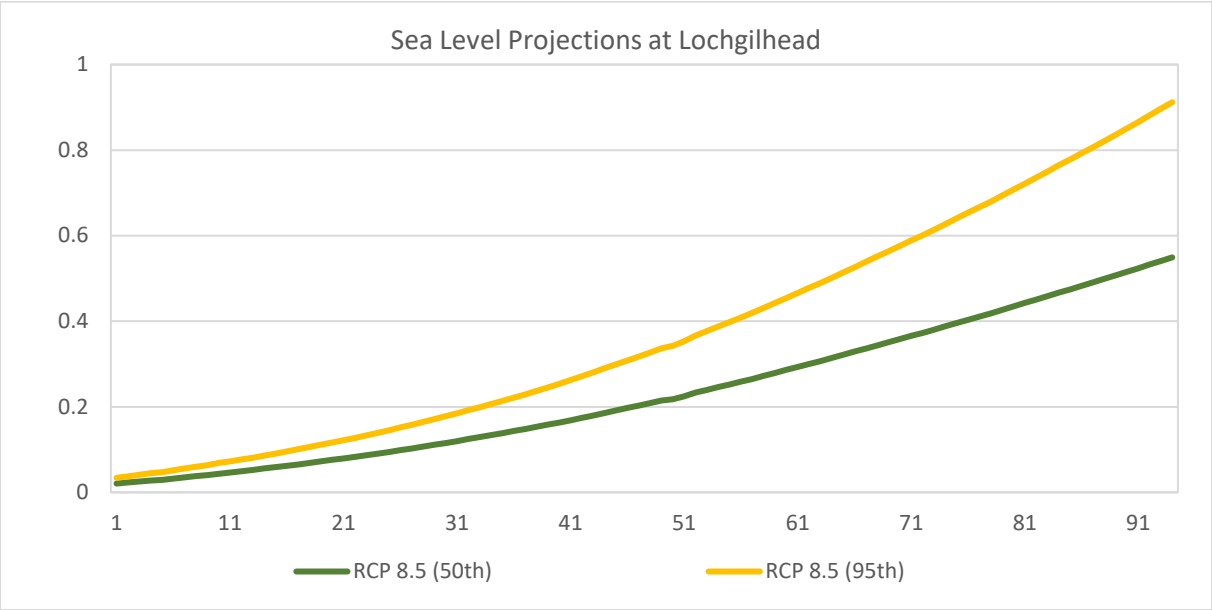
Average annual precipitation rate in Lochgilphead is predicated to broadly stay steady compared to the baseline, though with a very slight increase. The UKCP anomaly data, however, suggests that there could be an increase of up to 10%.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



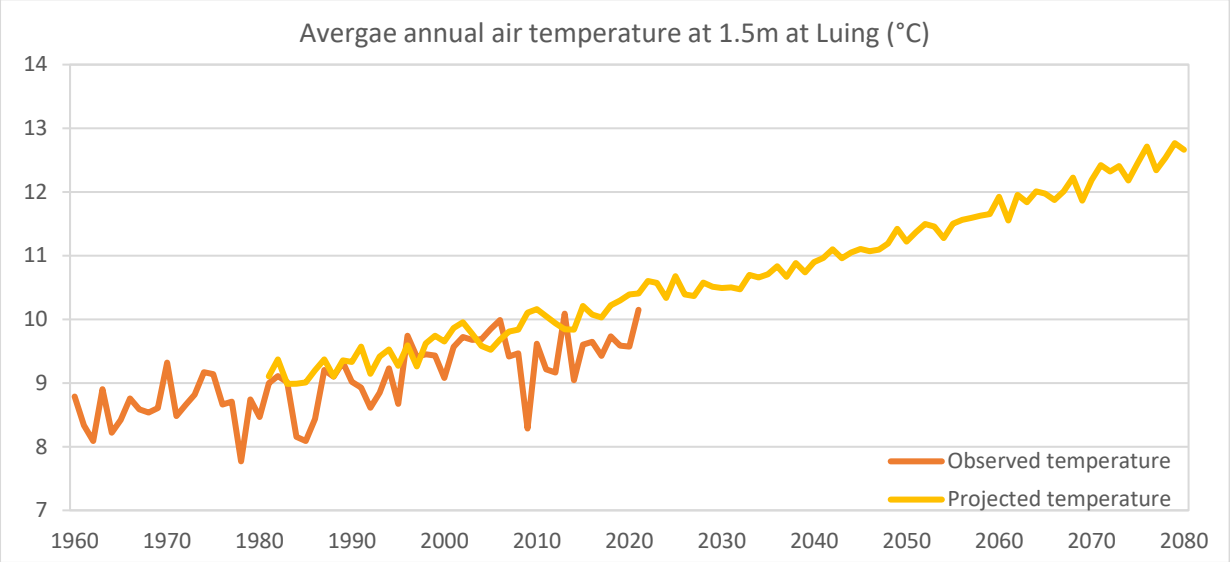
Sea Level Rise

Sea Level at Lochgilphead is projected to rise by between 0.55m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Luing

Air temperature

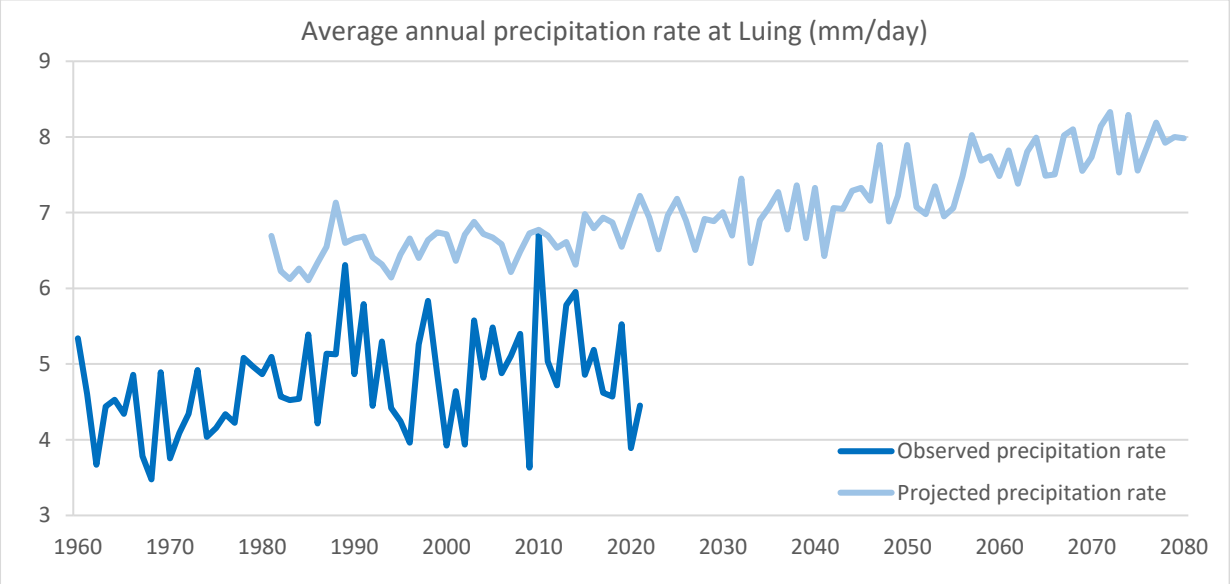


Average annual air temperature at Luing is predicted to increase over the coming decades, in line with the projections, reaching to approximately 13°C by 2080. This is in line with the UKCP anomaly projections showing a 2.5°C increase in annual average temperature for the Luing area.

Precipitation rate

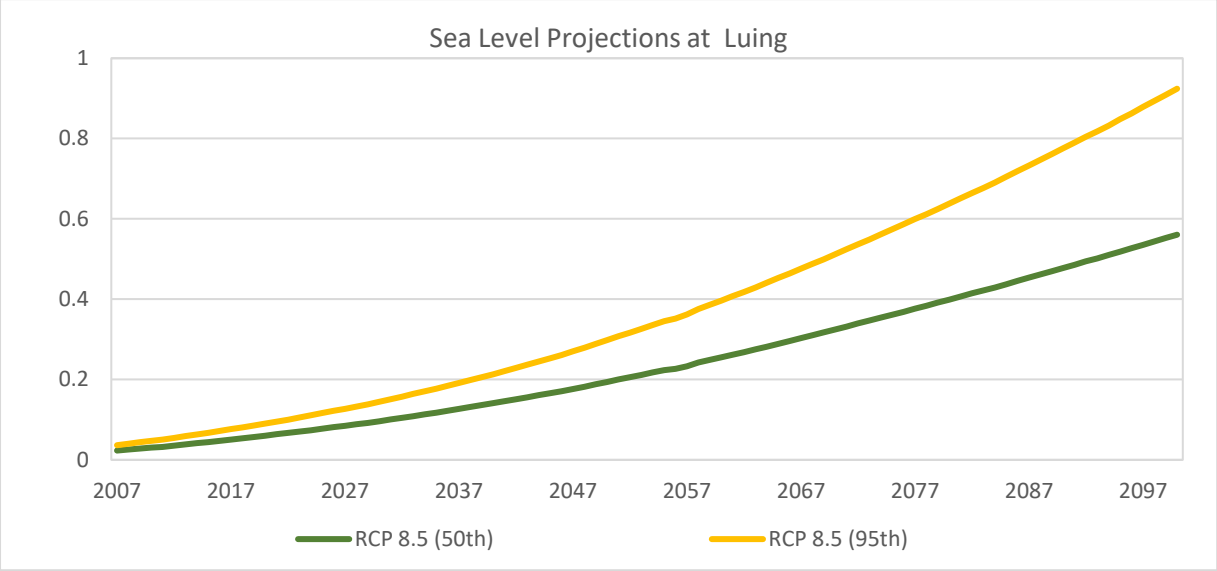
Average annual precipitation rate in Luing is predicated to increased by over 1mm/day compared to the baseline and the projections also suggest a higher precipitation rate than the observed data currently shows as being experienced. This is in line with the UKCP anomaly projections that show an anticipated increase in precipitation rate of 11%.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



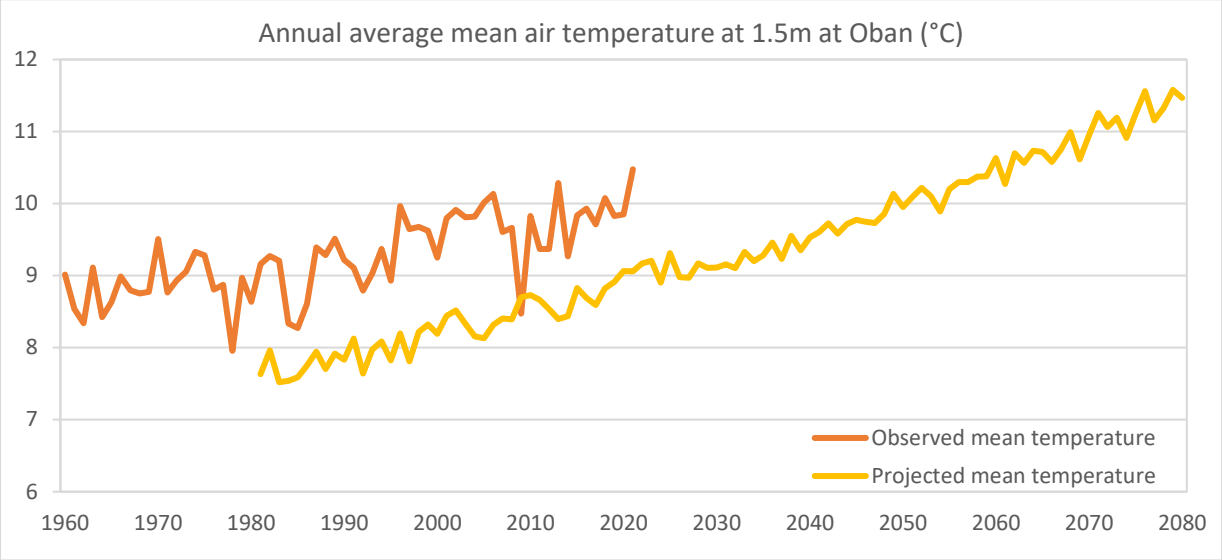
Sea Level Rise

Sea Level at Luing is projected to rise by between 0.58m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Oban

Air temperature

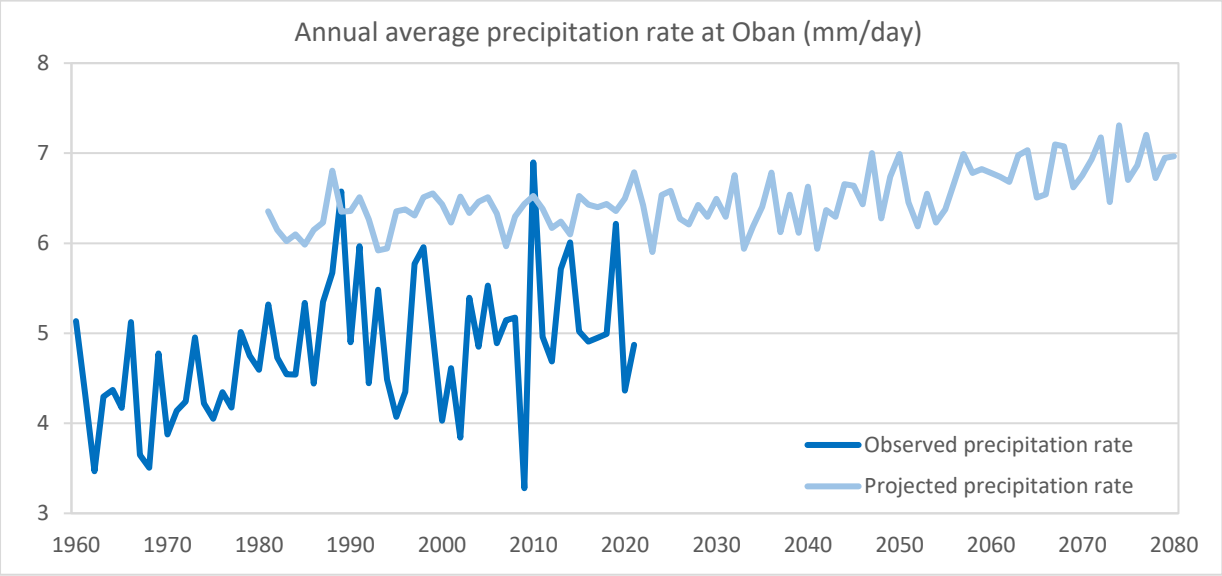


Average annual air temperature at Oban is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 2.6°C increase in annual average temperature for the Oban area.

Precipitation rate

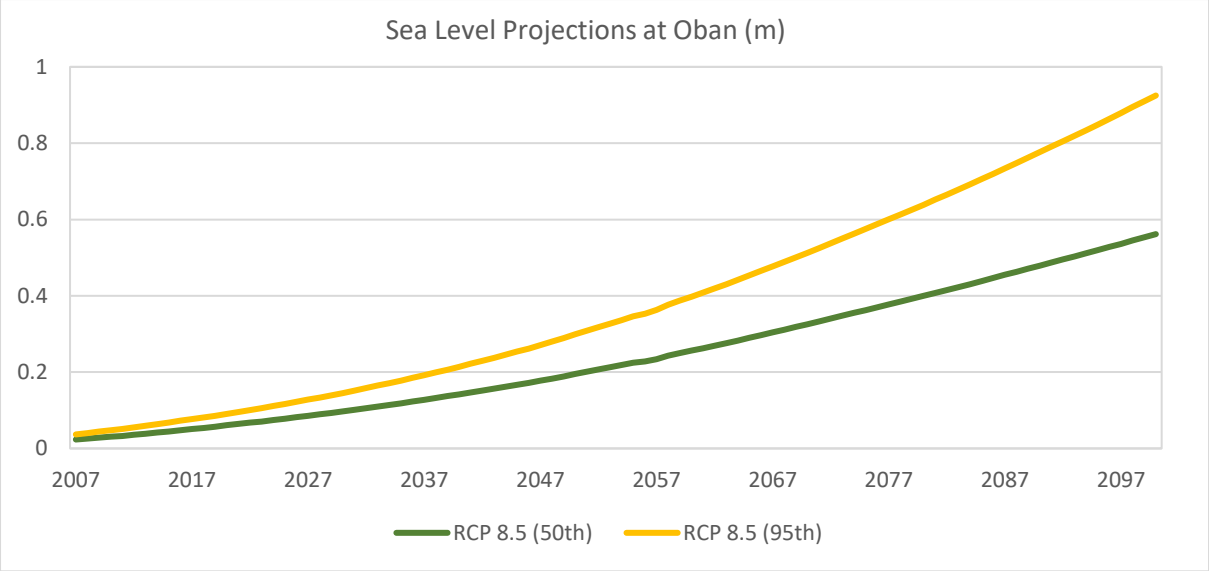
Average annual precipitation rate in Oban is predicated to slightly increase compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest a 9% increase in precipitation rate for the Oban area, which could be accounted for in the higher projections than observations.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



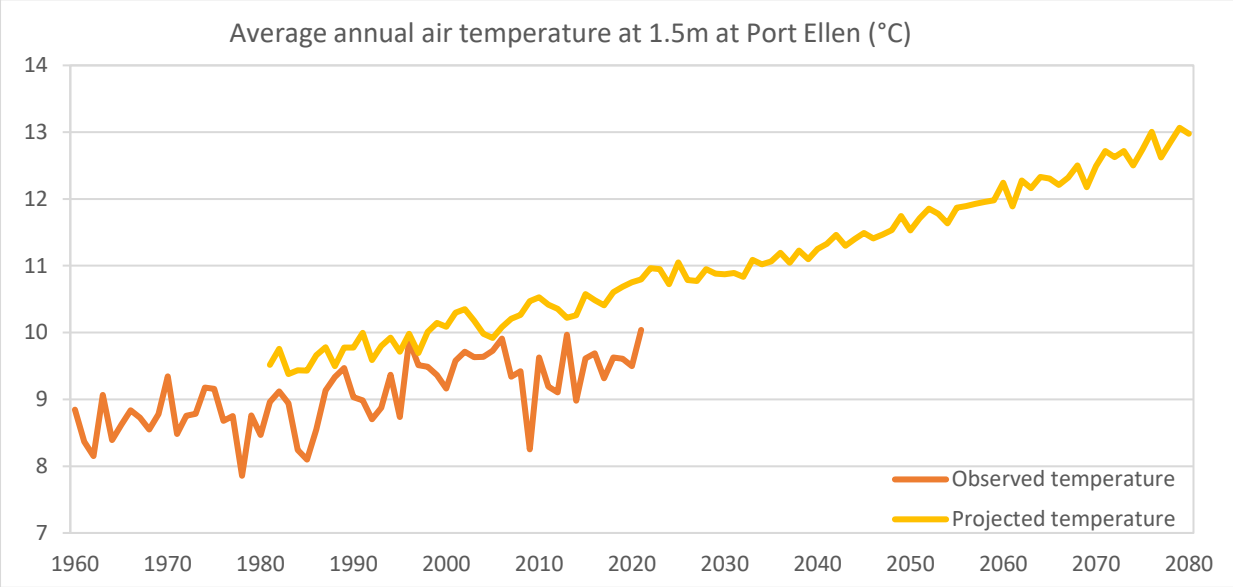
Sea Level Rise

Sea Level at Oban is projected to rise by between 0.55m and 0.92m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Port Ellen

Air temperature

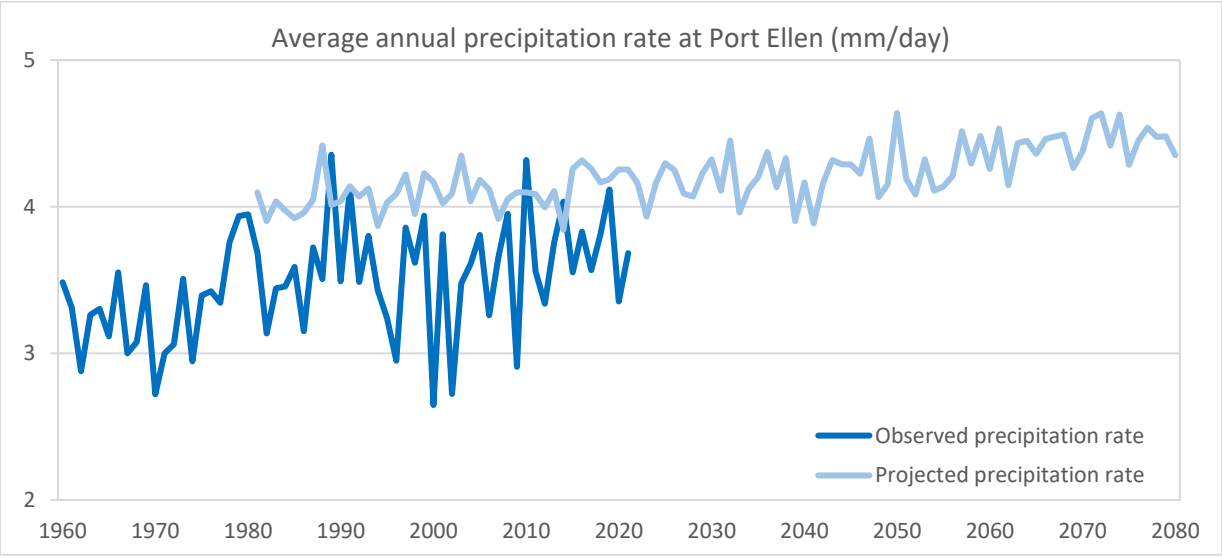


Average annual air temperature at Port Ellen is predicted to increase over the coming decades, in line with the projections, reaching to approximately 13°C by 2080. This is in line with the UKCP anomaly projections showing a 2.8°C increase in annual average temperature for Islay.

Precipitation rate

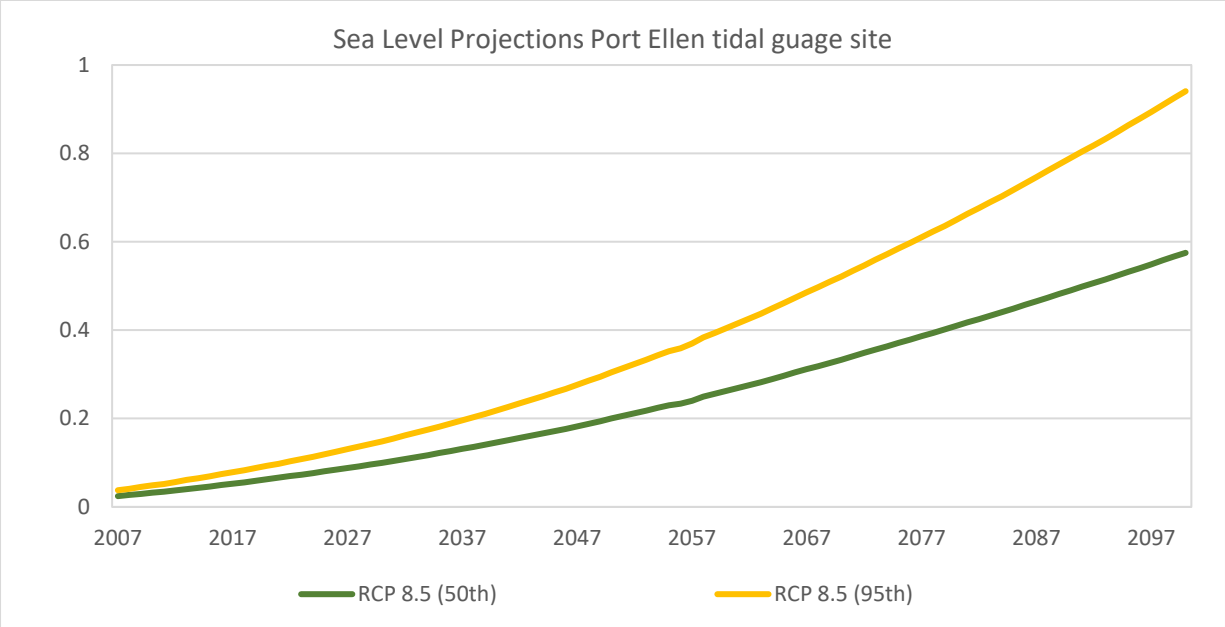
Average annual precipitation rate in Porth Ellen is predicated to slightly increase compared to the baseline, and the projections suggest a slightly higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest a 10% increase in precipitation rate for Islay, which could be accounted for in the higher projections than observations.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



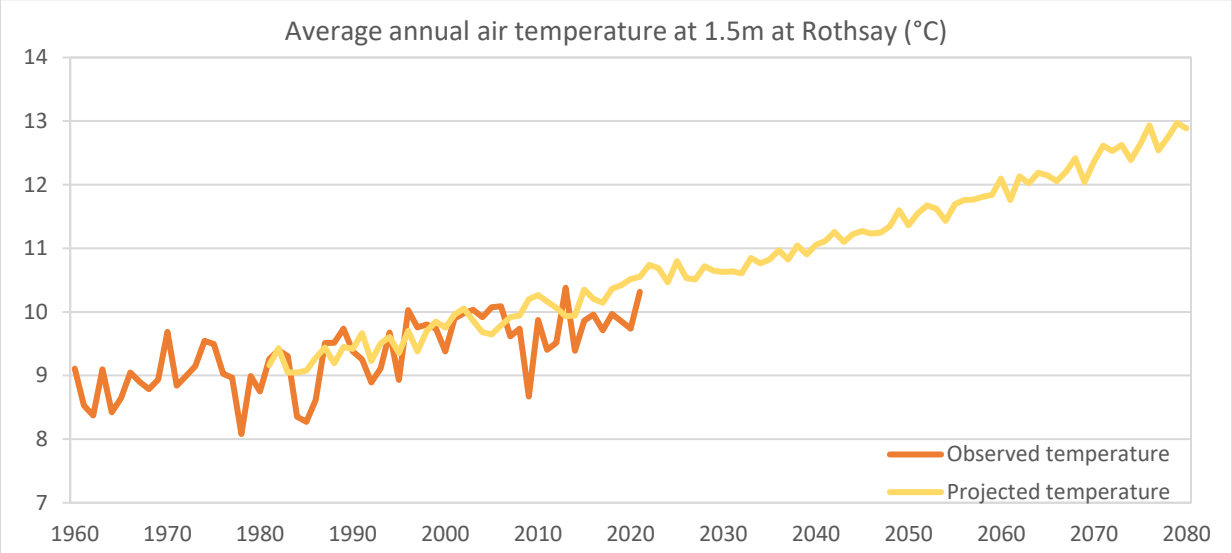
Sea Level Rise

Sea Level at the Port Ellen tidal gauge site is projected to rise by between 0.59m and 0.94m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Rothesay

Air temperature

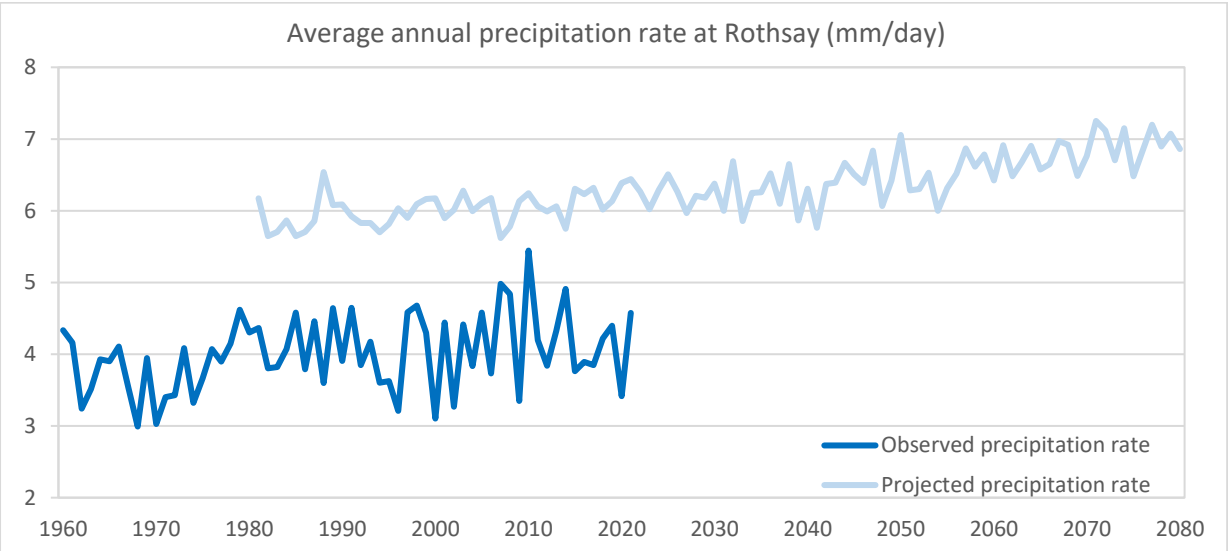


Average annual air temperature at Rothesay is predicted to increase over the coming decades, in line with the projections, reaching to approximately 13°C by 2080. This is in line with the UKCP anomaly projections showing a 3°C increase in annual average temperature for the Isle of Bute.

Precipitation rate

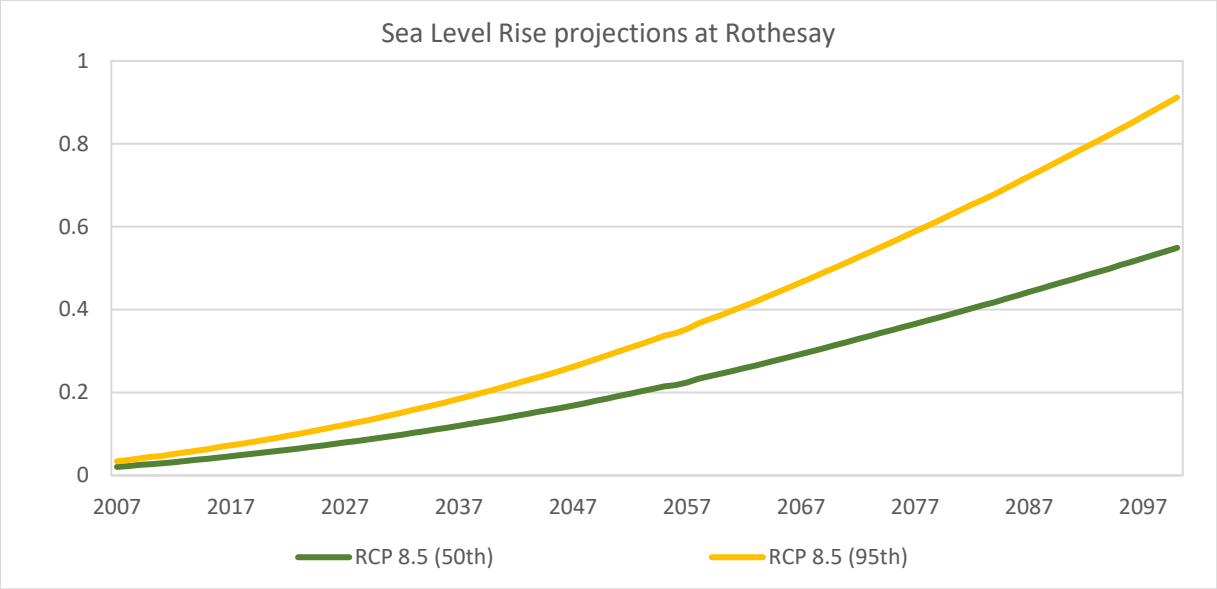
Average annual precipitation rate in Rothesay is predicated to broadly stay steady compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest a 8% increase in precipitation rate for the Isle of Bute, which could be accounted for in the higher projections than observations.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



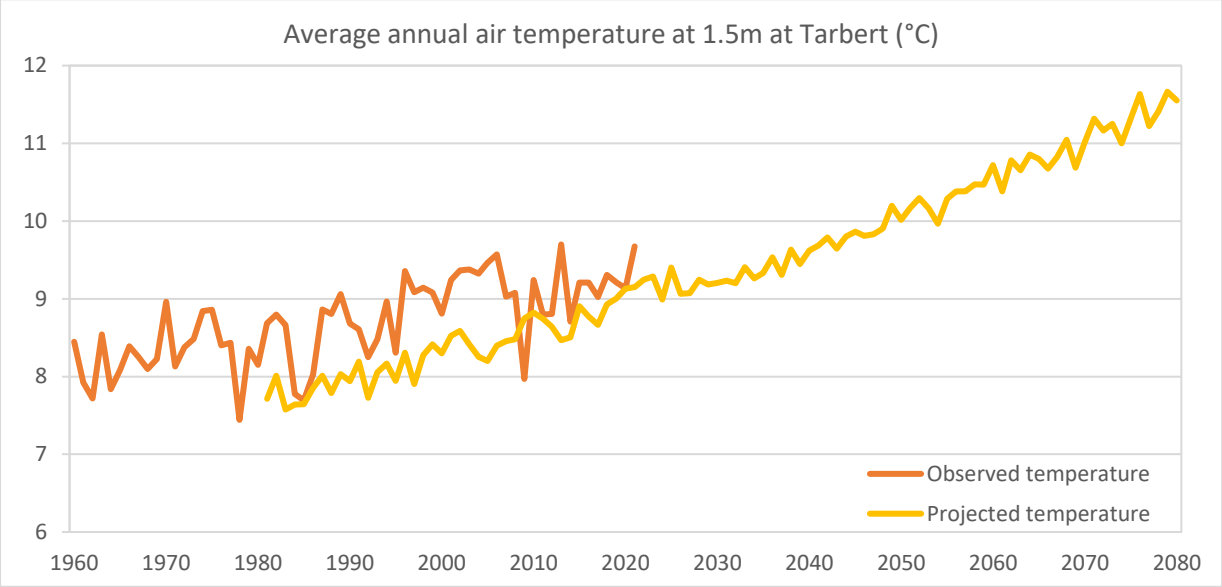
Sea Level Rise

Sea Level at Rothesay is projected to rise by between 0.55m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Tarbert, Kintyre

Air temperature

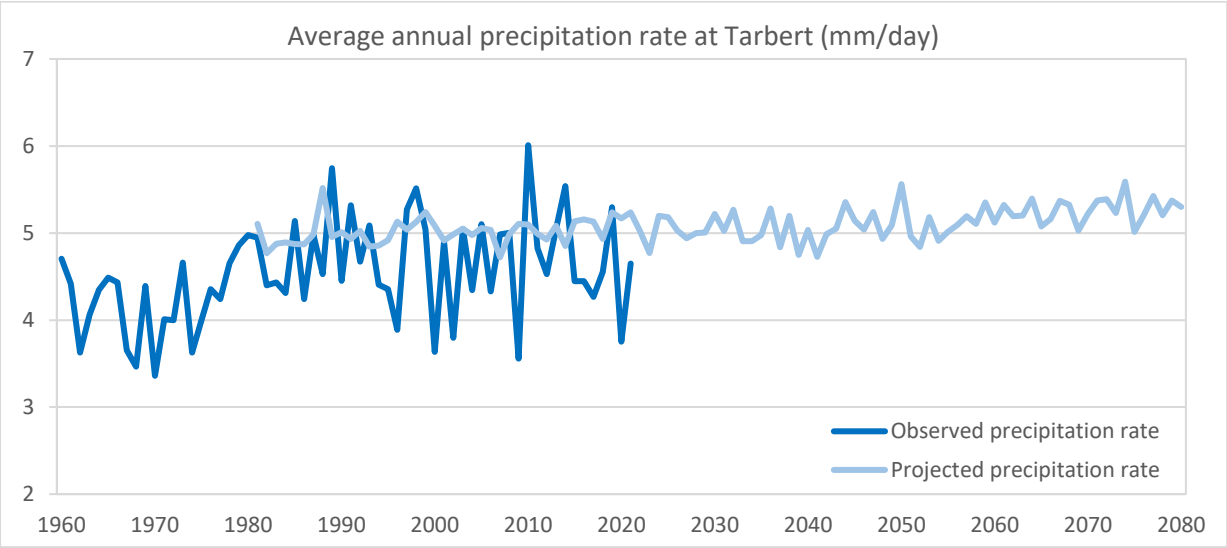


Average annual air temperature at Tarbert is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 2.9°C increase in annual average temperature for the north Kintyre peninsula.

Precipitation rate

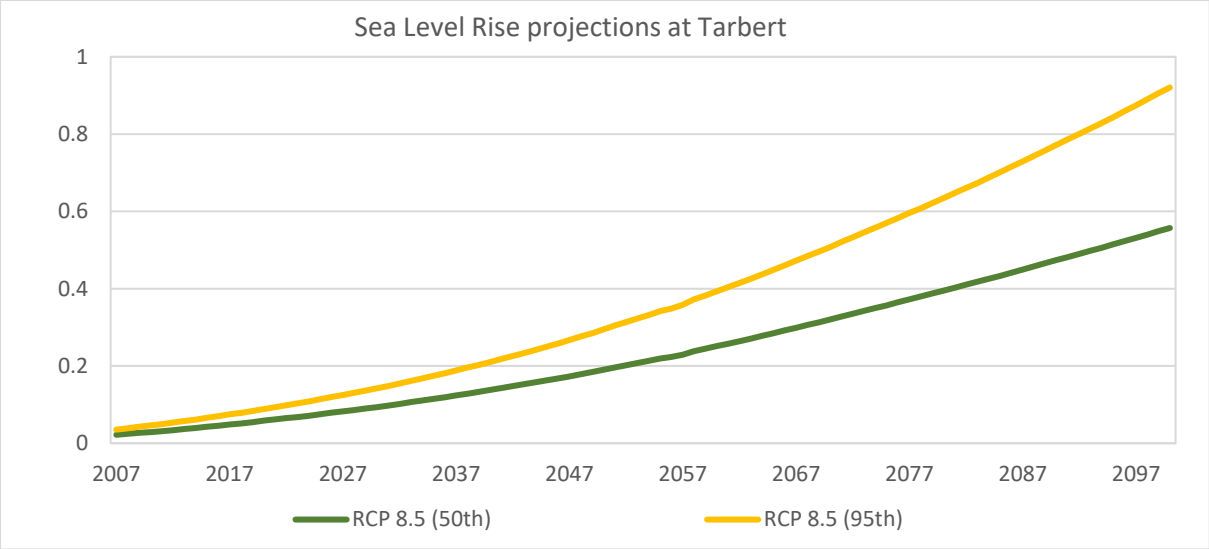
Average annual precipitation rate in Tarbert is predicated to broadly stay steady compared to the baseline. The UKCP anomaly projections suggest a 9% increase in precipitation rate for the northern Kintyre peninsula. As with Campbeltown, some of this discrepancy could be due to Tarbert's location on the eastern side of the 25km grid square used for the anomaly projections.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



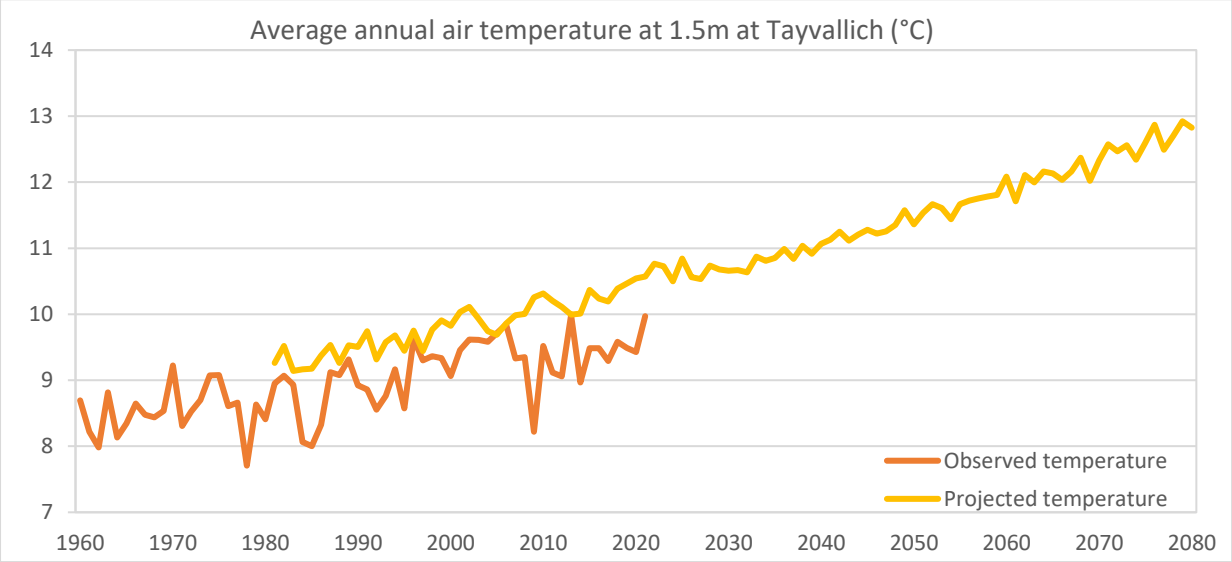
Sea Level Rise

Sea Level at Tarbert is projected to rise by between 0.55m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Tayvallich

Air temperature

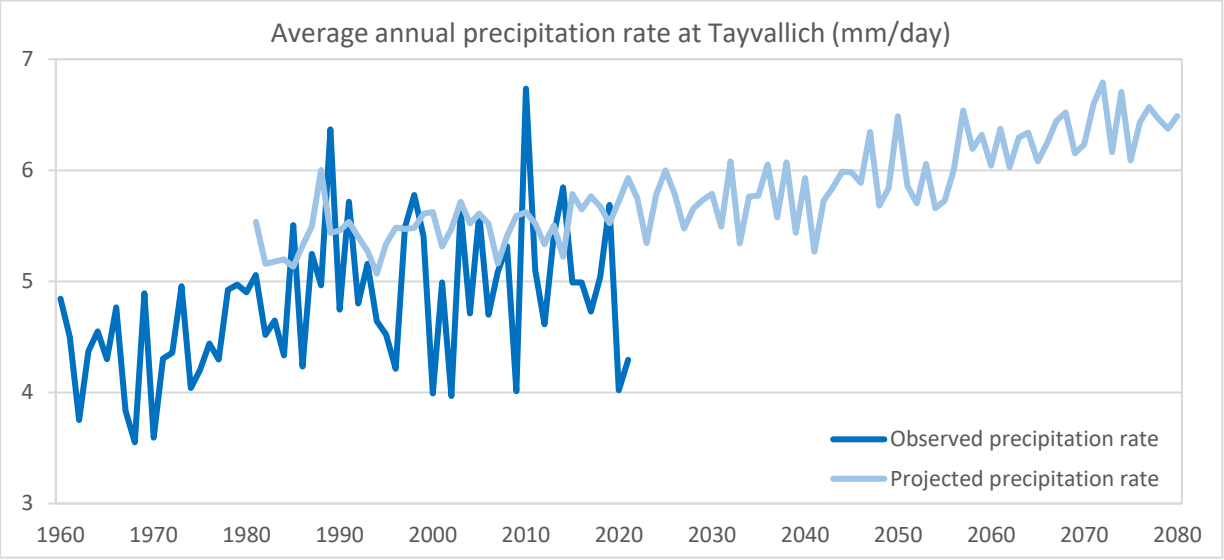


Average annual air temperature at Tayvallich is predicted to increase over the coming decades, in line with the projections, reaching to approximately 13°C by 2080. This is in line with the UKCP anomaly projections showing a 3°C increase in annual average temperature for the Tayvallich area.

Precipitation rate

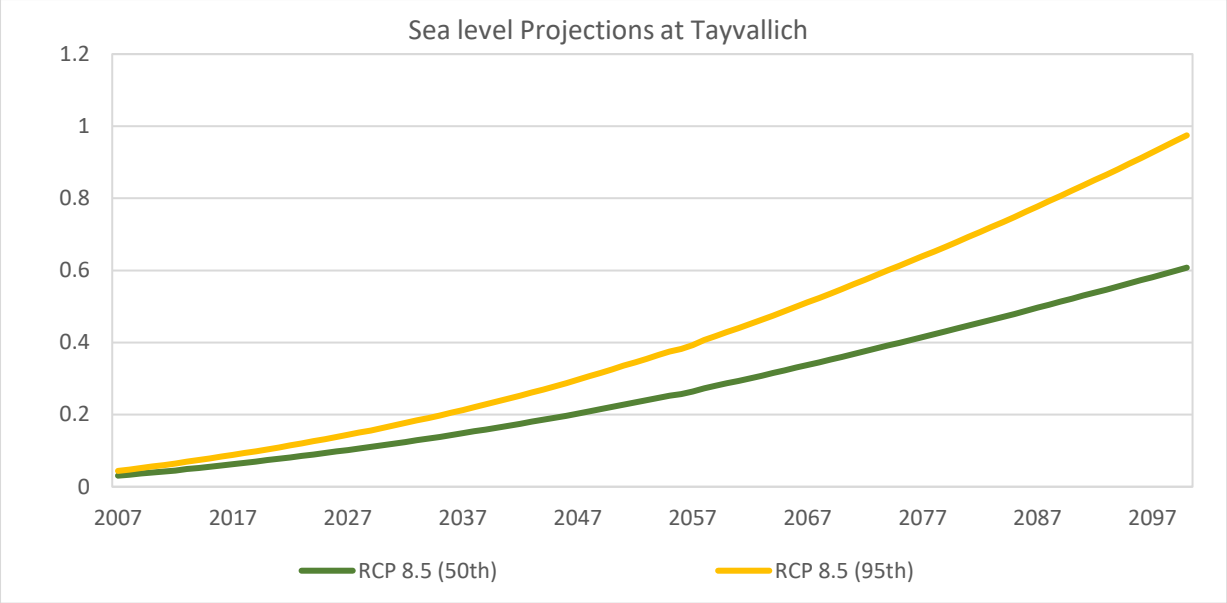
Average annual precipitation rate in Tayvallich is predicated to increase by around 1mm/day compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. This is in line with the UKCP anomaly projections that show an anticipated increase in precipitation rate of 10%.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



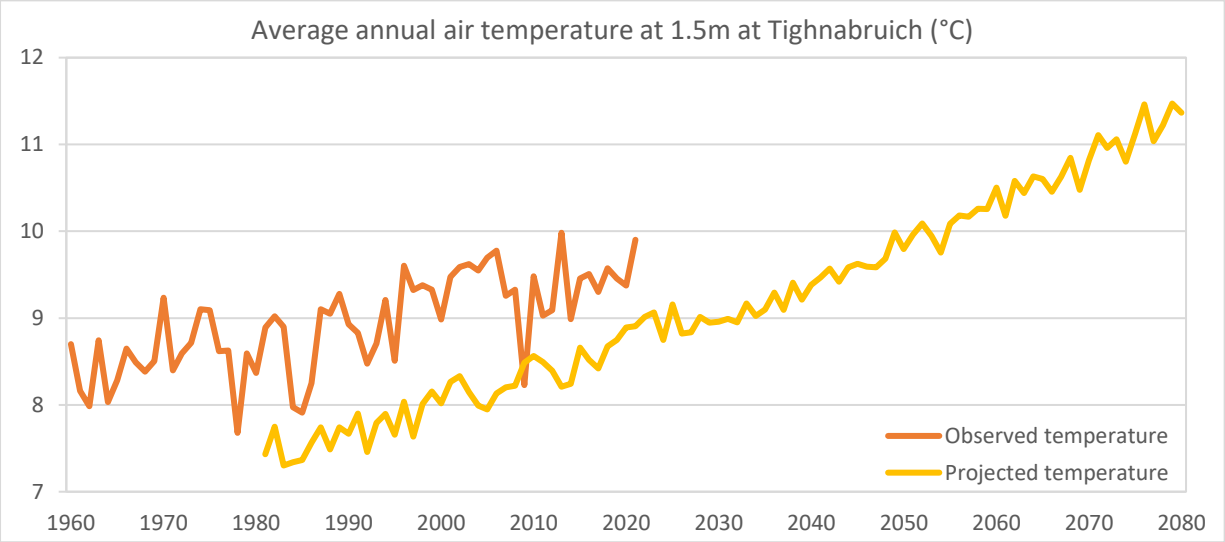
Sea Level Rise

Sea Level at Tayvallich is projected to rise by between 0.60m and 0.99m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is well above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Tighnabruaich

Air temperature

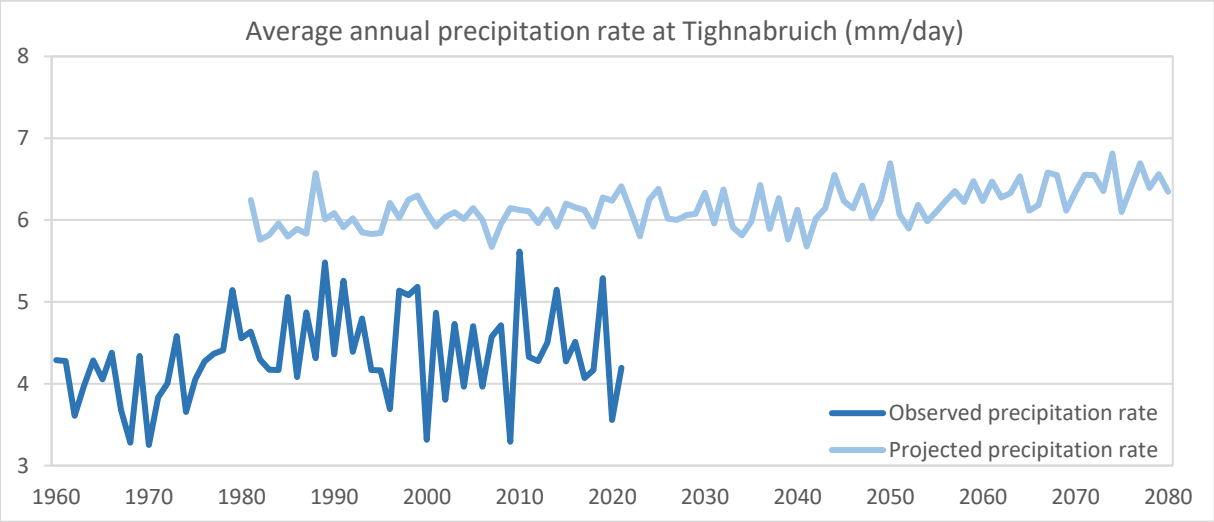


Average annual air temperature at Tighnabruich is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 2.9°C increase in annual average temperature for the Tighnabruich area.

Precipitation rate

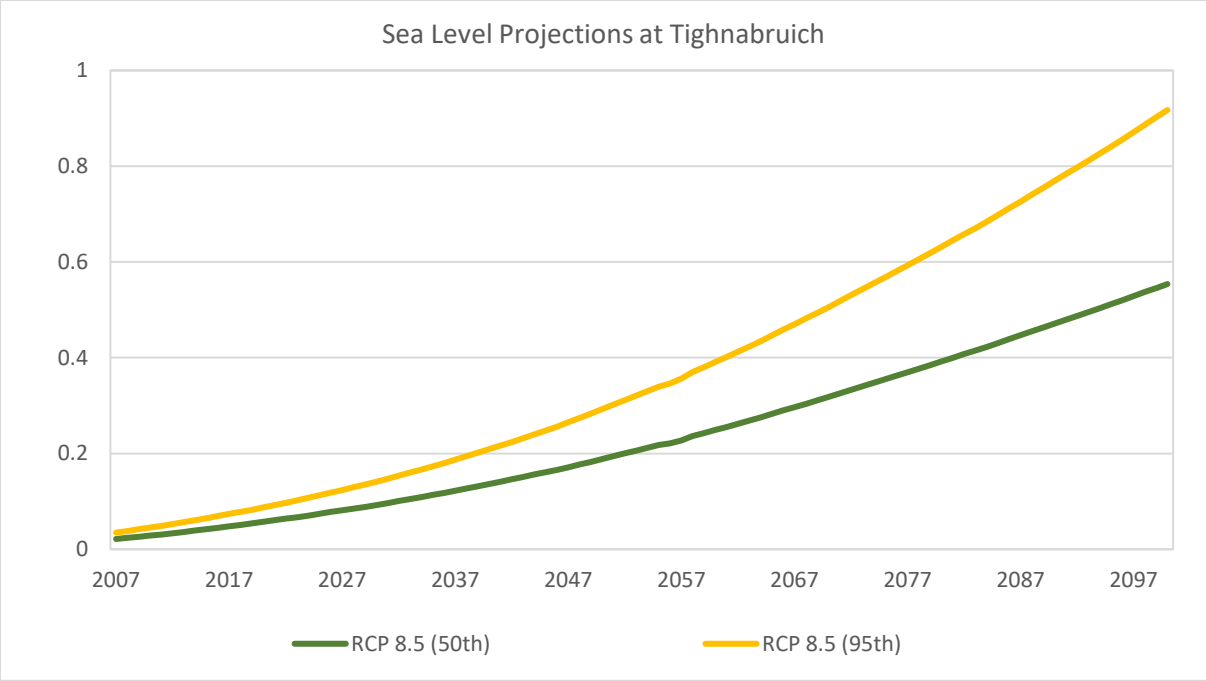
Average annual precipitation rate in Tighnabruich is predicated to slightly increase compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections suggest a 9% increase in precipitation rate for the Tighnabruich area, which could be accounted for in the higher projections than observations.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



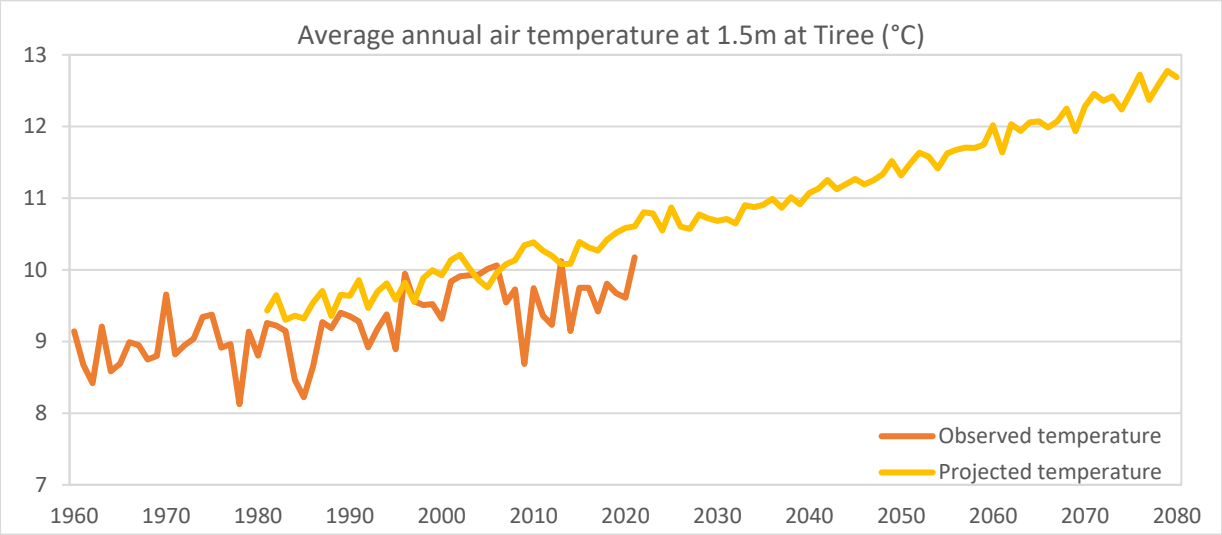
Sea Level Rise

Sea Level at Tighnabruich is projected to rise by between 0.55m and 0.91m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is slightly above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Tiree

Air temperature

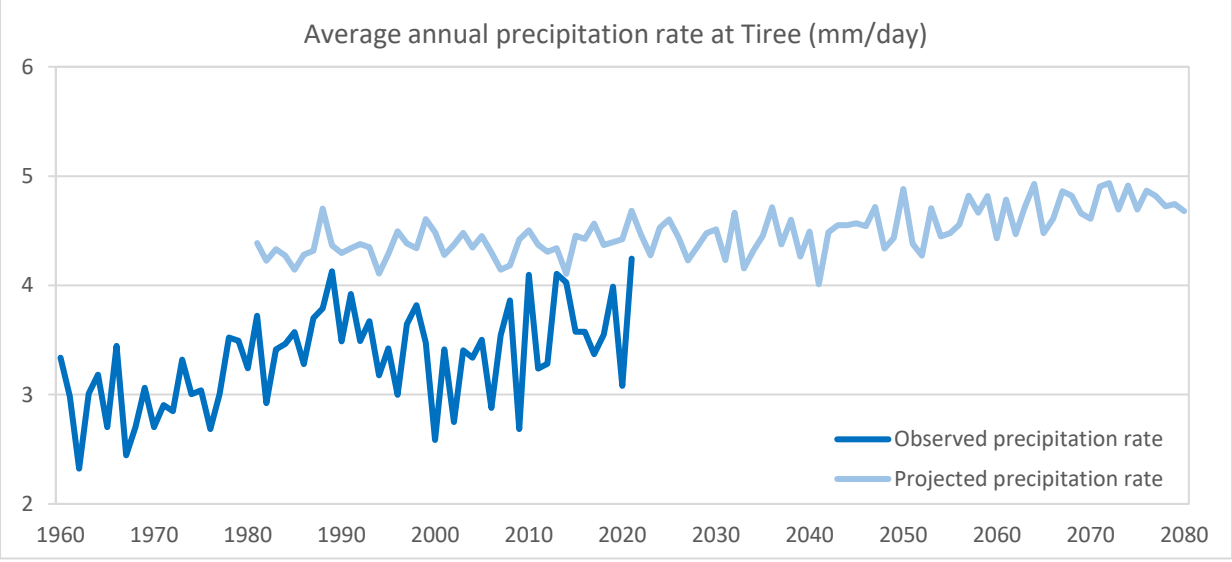


Average annual air temperature at Tiree is predicted to increase over the coming decades, in line with the projections, reaching to approximately 12.5°C by 2080. The UKCP anomaly projections do not have a 25km grid square covering Tiree, so this data is not available for comparison.

Precipitation rate

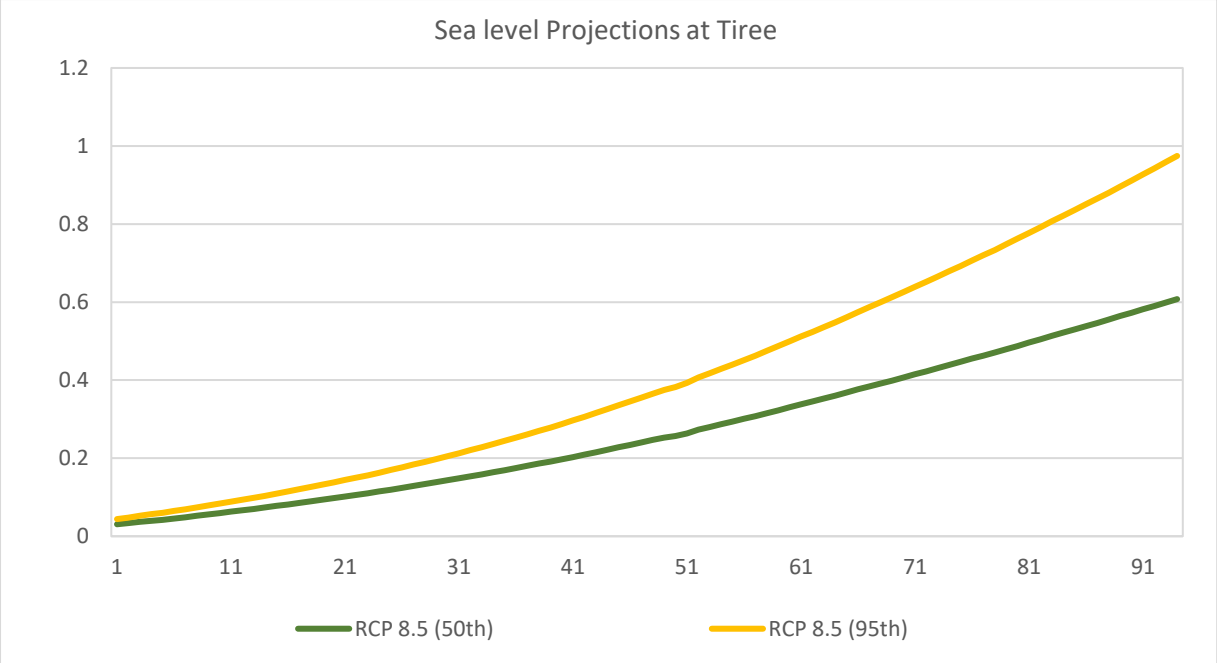
Average annual precipitation rate in Tiree is predicated to slightly increase compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly projections do not have a 25km grid square covering Tiree. so this data is not available for comparison.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



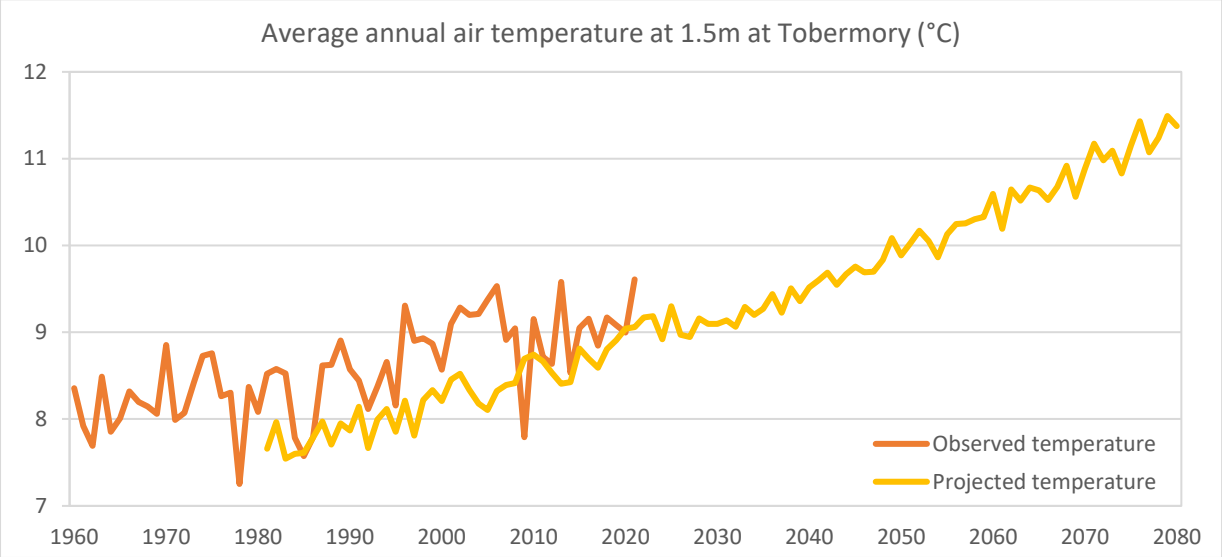
Sea Level Rise

Sea Level at Tiree is projected to rise by between 0.60m and 0.99m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is well above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.



Tobermory

Air temperature

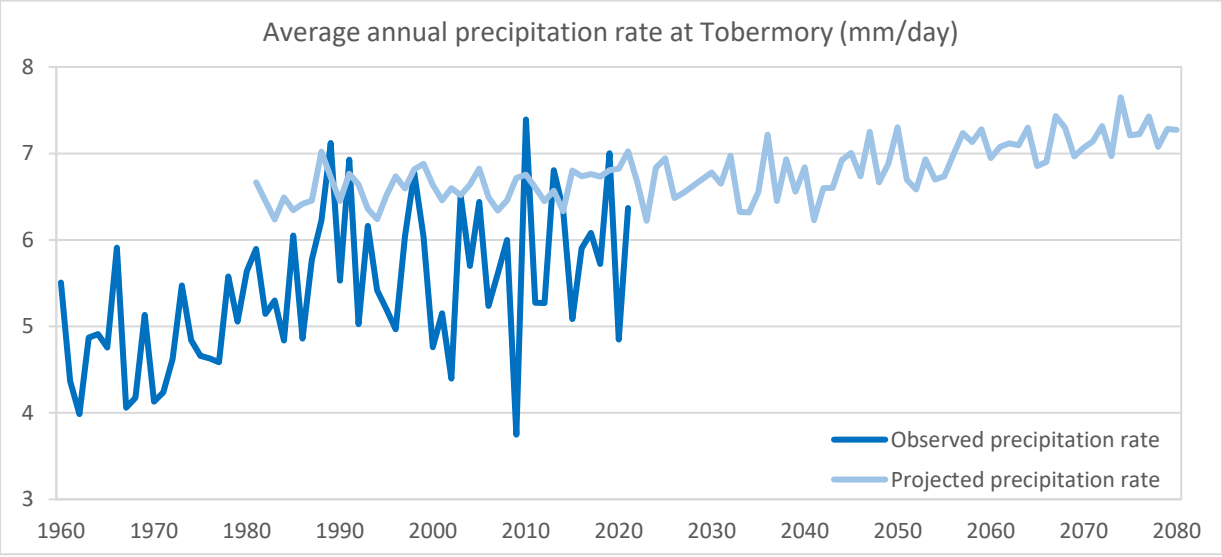


Average annual air temperature at Tobermory is predicted to increase over the coming decades, in line with the projections, reaching to approximately 11.5°C by 2080. This is in line with the UKCP anomaly projections showing a 2.5°C increase in annual average temperature for the Tobermory area.

Precipitation rate

Average annual precipitation rate in Tobermory is predicated to slightly increase compared to the baseline, though the projections suggest a higher precipitation rate than the observed data currently shows as being experienced. The UKCP anomaly data suggests an increase in precipitation rate of 11% by 2080.

The variability of precipitation rate over the year and between years will have a bigger impact on the climate risks experienced in a place, and the observational data below shows a relatively high level of variability in precipitation rate between years from 1960 – 2023.



Sea Level Rise

Sea Level at Tobermory tidal gauge site is projected to rise by between 0.6m and 0.95m from the 2007 baseline by 2100, under the RCP8.5 high emissions scenario. This is above the estimated sea level rise for the Argyll and Bute Local Authority area from the Met Office Local Authority Climate Explorer report.