A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.7 Environmental Statement – Appendix 14.1 Vulnerability to Climate Change Baseline

Part A

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

June 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

The A1 in Northumberland: Morpeth to Ellingham
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Environmental Statement - Appendix

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Rev 0	June 2020	Application Issue

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14 VULNERABILITY TO CLIMATE CHANGE BASELINE

14.1.1. This Appendix provides a description of the climate baseline (current and projected (future) baseline data) for the Study Area, as referred to in the **Chapter 14: Climate**, **Volume 2** of this Environmental Statement (ES) (**Application Document Reference: TR010041/APP/6.2**).

14.1.2. UK Climate Projections (2018) (UKCP18) (**Ref 14-1.1**) have been used to infer future changes in a range of climate variables that may affect the vulnerability of Part A: Morpeth to Felton (Part A) of the Scheme to climate change. At the time of writing, these represent the most up-to-date representation of future climate in the UK. However, the UKCP18 data currently available does not provide data for extreme precipitation, drought, snow and ice, extreme temperature, solar radiation, wind or relative humidity. Data for these aspects has been taken from UK Climate Projections (2009) (UKCP09) (**Ref 14-1.2**).

14.2 OVERVIEW OF CLIMATE FOR THE NORTH EAST OF ENGLAND REGION

14.2.1. The climate of the northeast of England is temperate, although rainfall is significant, even in the driest month (typically February in Tynemouth, which is the nearest meteorological station to Morpeth).

14.2.2. The sections that follow describe historical trends and future projections in climate variables for the Representative Concentration Pathway 8.5[1].

PRECIPITATION

14.2.3. Rainfall in the UK tends to be associated with Atlantic depressions or with convection. The Atlantic lows are more vigorous in autumn and winter and bring most of the rain that falls in these seasons. In summer, convection caused by solar surface heating can form shower clouds and a large proportion of rain falls from showers and thunderstorms in the region during this time (**Ref 14-1.3**).

14.2.4. Altitude also greatly affects rainfall in the northeast of England region. The average annual rainfall exceeds 1,500 mm in the higher parts of the Pennines. There is a decrease as the land falls eastwards, such that the east coast is one of the driest parts of the UK with less than 600 mm in places such as Teesside and the Northumbrian coast. These values can be

[1] To model and predict future climate it is necessary to make assumptions about the economic, social and physical changes to our environment that will influence climate change. Representative Concentration Pathways (RCPs) are a method for capturing those assumptions within a set of scenarios. Each pathway results in a different range of global mean temperature increases over the 21st century. RCP8.5 represents a high emissions scenario.

compared with annual totals around 500 mm in parts of eastern England and over 4,000 mm in the western Scottish Highlands.

14.2.5. At the Tynemouth meteorological station (located approximately 15 miles south-east of Morpeth), an average of 597.2 mm of rain fell annually from 1981-2010. The driest month is February and the wettest month is November. **Table 14-1** shows total mean monthly rainfall at Tynemouth.

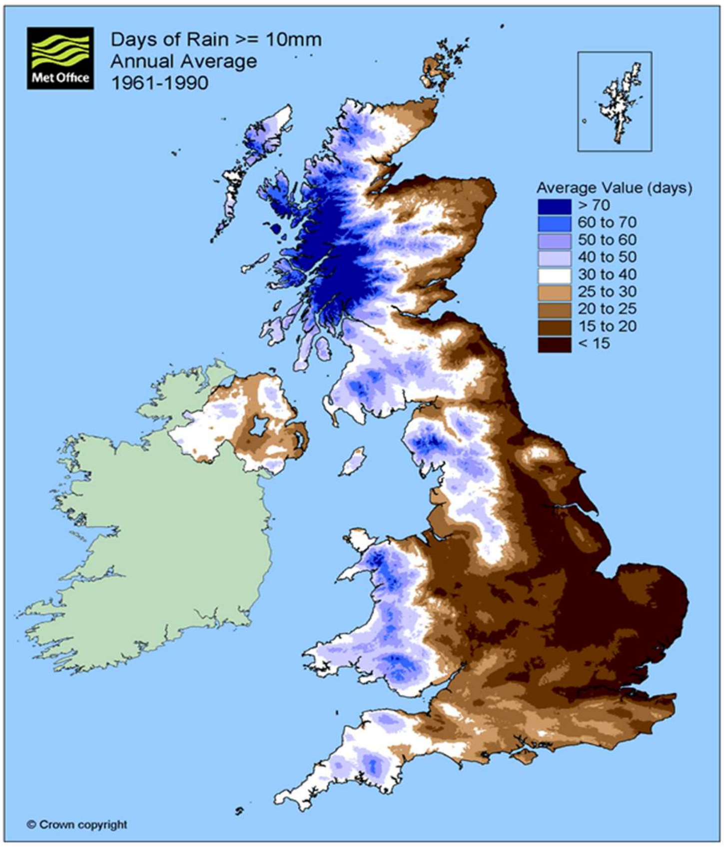
Table 14-1 – Total Monthly Mean Rainfall at the Tynemouth Station (1981-2010)

Precip (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	45.5	37.8	43.9	45.4	43.2	51.9	47.6	59.6	53.0	53.6	62.8	52.9

14.2.6. Over much of the north-east region, the number of days with rainfall totals of 1 mm or more ('wet days') tends to follow a pattern similar to the monthly rainfall totals. In the higher parts in winter (December-February), 45-50 days is the norm but this decreases to about 35 days in summer (June-August). In the drier areas closer to the coast, about 30 days in winter and about 25 days in summer are typical (**Ref 14.1.3**). Periods of prolonged rainfall are often associated with easterly or north easterly winds on the northern flank of depressions passing to the south of the area.

14.2.7. **Figure 14-1** shows annual average days of heavy rainfall (≥ 10 mm). In summary, the Study Area experiences a higher number of 'wet days' in winter than in summer.

Figure 14-1 – Days of Rain >= 10 mm (1961-1990)



14.2.8. Thunderstorms are most likely to occur from May to September, reaching their peak in July and August, but are less frequent than in areas further south, and the north of the region can expect only 5 to 8 days with thunder each year. The heaviest falls of rain in the UK are often associated with these summer thunderstorms (**Ref 14.1-3**).

14.2.9. With regard to future projections, UKCP18 suggests that climate change is projected to lead to wetter winters and drier summers, with more extreme rainfall events.

14.2.10. Using data from UKCP18, **Figure 14-2** shows projections (RCP8.5 emission scenarios only) of mean summer precipitation across three timeslices, namely: 2020s, 2050s and 2080s. The changes projected by UKCP18 are calculated against the baseline from HadUK-Grid Climate Observations on a 60 km grid from 1961-1990.

Table 14-2 - Baseline Total Seasonal Rainfall Data from 1961-1990

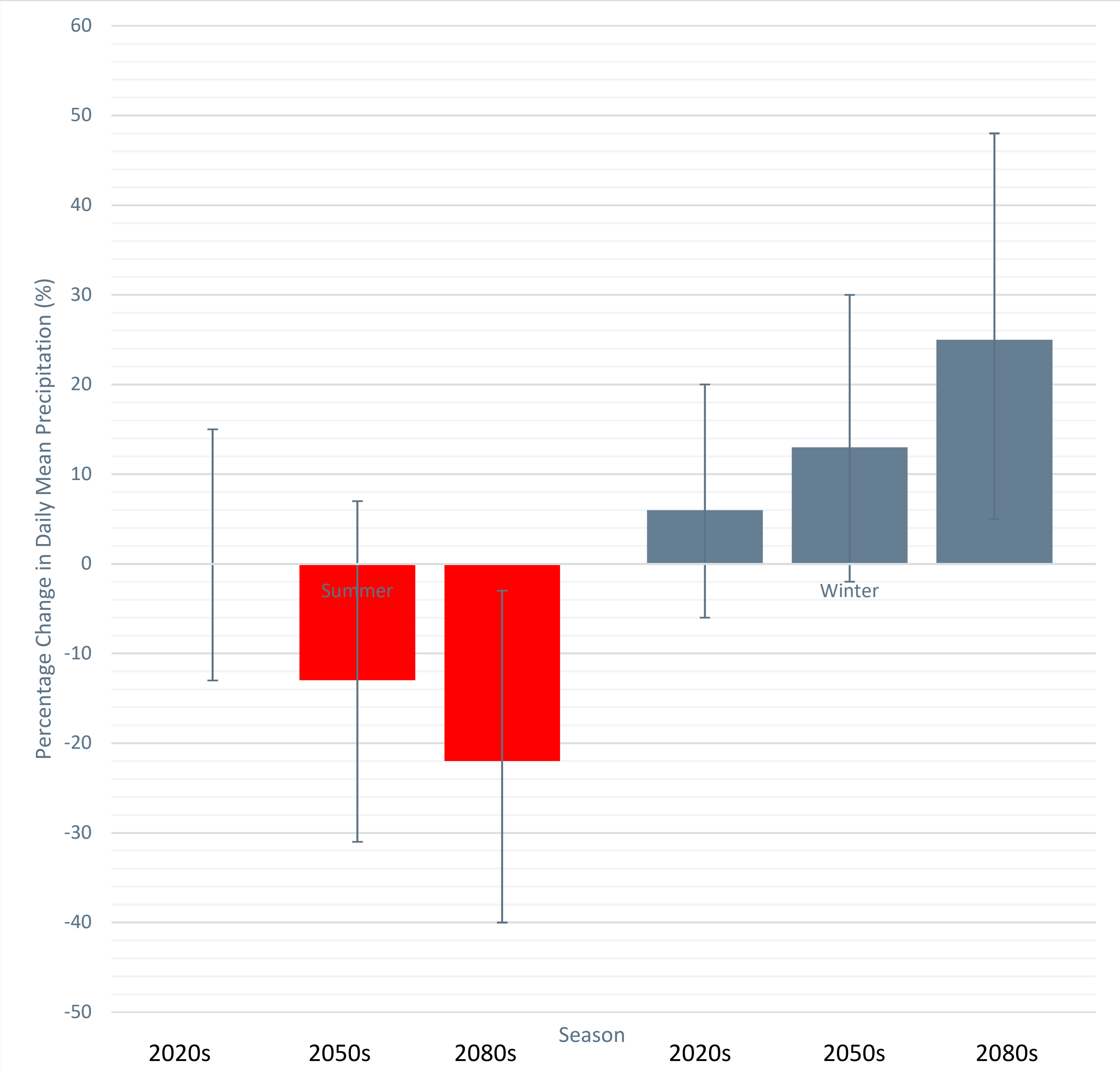
Variable	Winter	Summer
Total Rainfall (mm)	249.05	228.64

14.2.11. By the 2020s, mean summer precipitation is expected to have 0% change (50th percentile), with the range of estimates from a 13% decrease to a 15% increase (represented by the 10th and 90th percentile respectively). By the 2050s, the central estimate (50th percentile) for mean summer precipitation rate is a 13% decrease and the 10th and 90th percentile projections range from 31% decrease and 7% increase. By the 2080s, this decreases further to 22% (50th percentile), with the 10th percentile at 40% decrease and the 90th percentile at 3% decrease.

14.2.12. **Figure 14-2** also shows projections (RCP8.5 only) of mean winter precipitation across the same timeslices. By the 2020s, this is expected to be a 6% increase (50th percentile), with the range from 6% decrease at the 10th percentile to 20% increase at the 90th percentile. By the 2050s, the central estimate (50th percentile) is projected to increase by 13%, with the 10th and 90th percentile projections ranging from 2% decrease and 30% increase respectively; and by the 2080s, this is increased to 25% (50th percentile), with the range from 5% increase to 48% increase (represented by the 10th and the 90th percentile) under RCP8.5.

14.2.13. **Figure 14-2** summarises mean winter and summer precipitation for the 2020s, 2050s and 2080s under RCP8.5.

Figure 14-2 – Change in Seasonal Mean Precipitation (mm/day) for the 2020s, 2050s and 2080s in the 25 km^2 grid square (412500.00, 587500.00), under RCP8.5

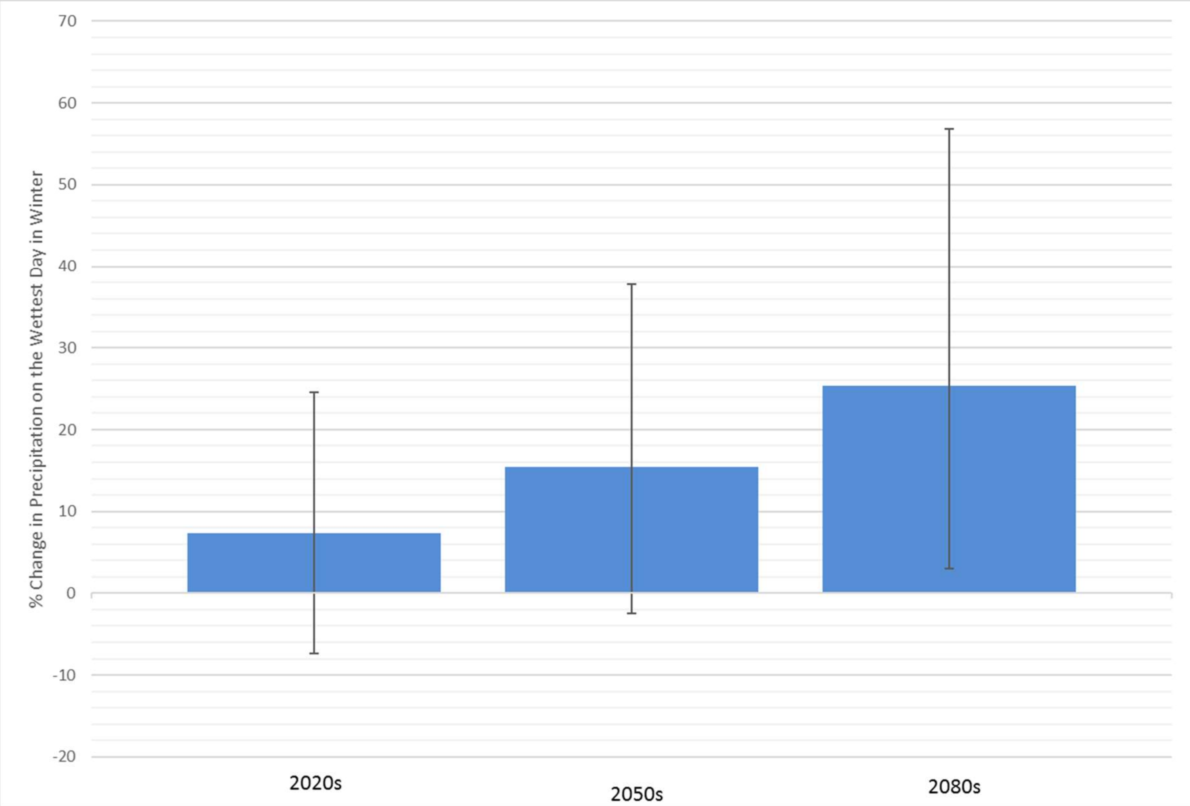


14.2.14. The central estimate projections for RCP8.5 for mean daily precipitation as shown in **Figure 14-2** suggest that winter precipitation will increase, and summer precipitation will decrease over the 21st Century.

14.2.15. **Figure 14-3** shows the UKCP09 projections for changes in extreme precipitation in winter in the Morpeth 25 km grid square (ID 965) in the 2020s, 2050s and 2080s under RCP8.5. By the 2020s, precipitation on the wettest day in winter is expected to increase by approximately 7.3%. However, there is considerable uncertainty around this central estimate, which ranges from approximately -7.4% to 24.5% (represented by the 10th and 90th percentile). By the 2050s, the central estimate projects an increase of 15.4%, with large uncertainty (ranging from -2.5%, 10th percentile, to 37.8%, 90th percentile). By the

2080s, an increase in precipitation on the wettest day of approximately 25.3% is predicted by the central estimate, with the 10th percentile at 3.0% and the 90th percentile at 56.8%.

Figure 14-3 - Percentage Change in Precipitation on the Wettest Day in Winter in the 965-grid square for the 2020s, 2050s and 2080s under the High Emissions Scenario



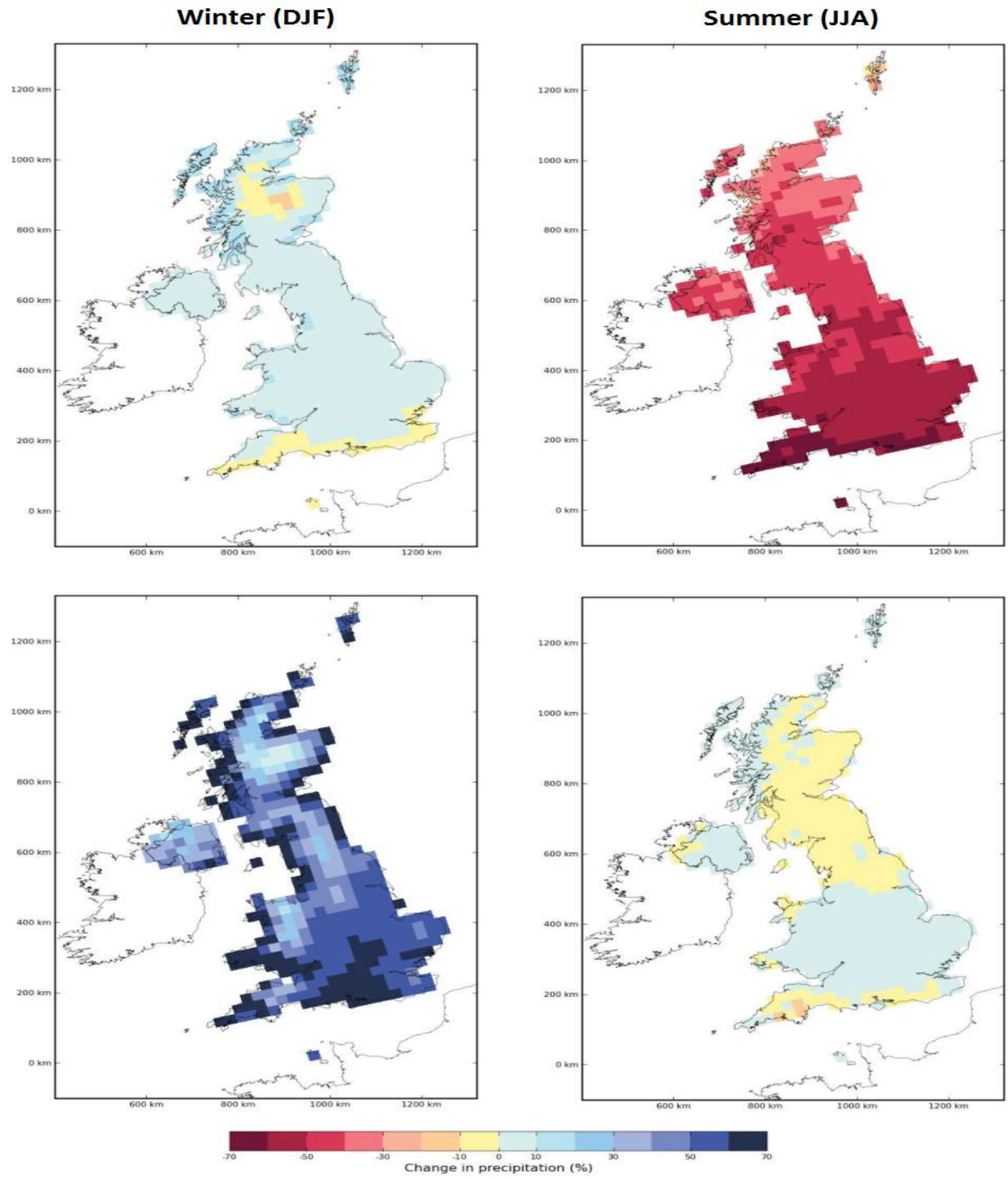
Drought

14.2.16. A combination of higher summer temperatures and reduced summer rainfall could see increases in the risk of drought in the UK. UKCP09 is not suitable for the analysis of multi-year droughts, however, it does contain some information on changes at the seasonal timescale.

14.2.17. **Figure 14-4** shows projected changes in winter (left panels) and summer (right panels) precipitation totals expected by 2070-2099 under the UKCP09 High emissions scenario. The upper panels represent changes at the 10% probability (i.e. driest) level of the probabilistic range. The lower panels represent changes at the 90% probability (i.e. wettest) level.

14.2.18. The overall pattern is a move toward wetter winters and drier summers suggesting that short-term summer droughts may increase in frequency. The range of the projected changes varies considerably across the probability ranges from almost no change through to shifts of greater than 70% of the 30-year average value, therefore there is large uncertainty in the magnitude of change although the direction is agreed (droughts are likely to become more frequent). Other studies, including the recent UK Climate Change Risk Assessment (CCRA) Evidence Report **(Ref 14-1. 4)** suggest that the north-east region, including the Study Area, is expected to experience a water surplus, of between >100 to ≤ 1,000 Ml/day by the 2080s under a High emissions scenario. Therefore, risk from drought is likely to be lower than other parts of the country but may still pose a threat, particularly in the summer months.

Figure 14-4 - Projected Changes in Winter (left) and Summer (right) Total Precipitation by 2080s



Snow and ice

14.2.19. Snowfall is closely linked with temperature, with falls rarely occurring if the temperature is higher than 4 °C. For snow to lie for any length of time, the temperature normally must be lower than this. Over most of the north-east of England region, snowfall is normally confined to the months from November to April, but upland areas can often have falls in October and May. Snow rarely lies on low ground outside the period from November to March but over higher ground lying snow can also occur in October and as late as May.

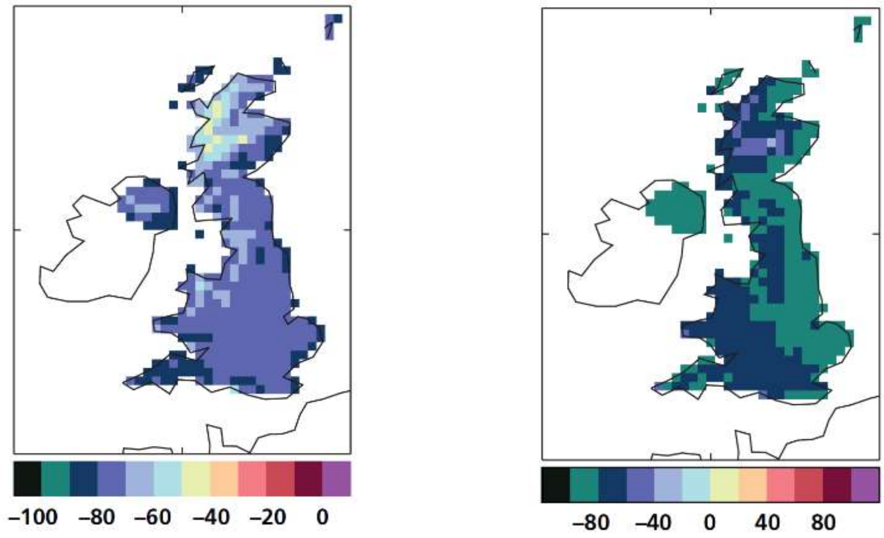
14.2.20. An average increase of about five days of snow falling per year for every 100 m increase in altitude has been found to be typical (**Ref 14-1.5**). The number of days with snow lying is also mainly dependent upon altitude but partly upon proximity to the sea. The number therefore varies from about 10 days per year near the east coast and in low lying areas of south Yorkshire to over 40 days in the higher Pennines. These averages can be compared with parts of the Scottish Highlands, which have about 60 days with snow lying on average and with the coasts of SW England, with less than three days per year. In most places, January is the month with most days of both snow lying and snow falling.

14.2.21. With regards to future changes, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. UKCP09 projects a reduction of mean snowfall, the number of days when snow falls and heavy snow events by the end of the 21st century (**Ref 14-1.6**). UKCP09 does not provide projections for the nearer-term for snow. While there is less certainty in the magnitude of projected change, there is confidence that snow fall is generally expected to decrease compared with the baseline (**Ref 14-1.7**). Projections indicate substantial reductions in snowfall days for all regions in winter and this is expected to be the case in the Study Area (**Ref 14-1.6 and Ref 14-1.8**).

14.2.22. Reductions of 70 to 80 % are projected for the majority of England in winter (refer to **Figure 14-5**, left pane), and similar magnitude changes are also projected for spring (not shown). Ensemble projections for the 2080s suggest that for most of the UK, the intensity of winter and spring 'heavy' snow events (the 90th percentiles of snowfall rate) could decrease by over 80 percent (**Ref 14-1.6**). Reductions are greatest in eastern and north-eastern areas of England (refer to **Figure 14-5**, right pane) and therefore the Study Area and Part A is likely to experience a reduction in snowfall and heavy snow days.

14.2.23. **Figure 14-5** shows the ensemble mean of the 11 individual RCM projections.

Figure 14-5 - Changes in the Number of Winter Days with Snow Falling (%) (left) and Percentage Changes in the 90th Percentile of Snow Fall Rate for Winter (right) for 2070-99 Relative to 1960-1991 Baseline



Temperature

14.2.24. Mean annual temperatures depend strongly on altitude, with a decrease of about 0.5°C for each 100 m increase in altitude, and, to some extent, proximity to coast (**Ref 14-1.5**). The coldest waters around the UK are found off north-east England. This, coupled with extensive areas of upland, means that temperatures in the Study Area, relative to elsewhere in England, are generally cool throughout the year.

14.2.25. At the Tynemouth meteorological station (**Ref 14.1-3**) (located approximately 15 miles south-east of Morpeth), the minimum annual average temperatures from 1981-2010 was 6.7°C whilst the maximum annual average temperature was 12.1°C. **Table 14-3** shows minimum and maximum mean monthly temperatures at Tynemouth.

Table 14-3 - Minimum and Maximum Monthly Mean Temperatures at the Tynemouth Station (1981-2010)

Temp. (°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	2.2	2.2	3.3	4.8	7.2	10.0	12.3	12.3	10.4	7.7	4.9	2.5
Max	7.2	7.3	9.0	10.3	12.7	15.6	18.1	18.1	16.1	13.2	9.7	7.4

14.2.26. From 1961-2006 the north-east region experienced an increase in mean annual temperature of 1.46°C. **Table 14-4** summarises changes in daily mean annual temperature in each season for the period 1961-2006.

Table 14-4 - Change in Daily Mean Temperature (°C) from 1961 to 2006 by Season in the North-East Region

Spring	Summer	Autumn	Winter	Annual
1.43°C	1.57°C	1.13°C	1.86°C	1.46°C

14.2.27. With regard to future projections, climate change is projected to lead to hotter summers and warmer winters, with more extreme high temperature events.

14.2.28. The following baseline from HadUK-Grid Climate Observations on a 60 km grid from 1961-1990 was used to show the projected changes by UKCP18.

Table 14-5 - Baseline Temperature Data from 1961-1990

Variable	Winter	Summer
Mean air temperature (ºC)	2.21	12.75
Daily minimum temperature (ºC)	-0.41	8.62
Daily maximum temperature (ºC)	4.82	16.95

14.2.29. As shown in **Figure 14-6**, by the 2020s, mean air temperature in the 25 km^2 grid square (412500.00, 587500.00) in the summer is projected increase by 1.2ºC at the central estimate (50th percentile). The 10th and 90th percentile projections (represented by the error bars in Figure 14-6) represent the uncertainty around the central estimate and range from 0.4°C to 2.0°C.

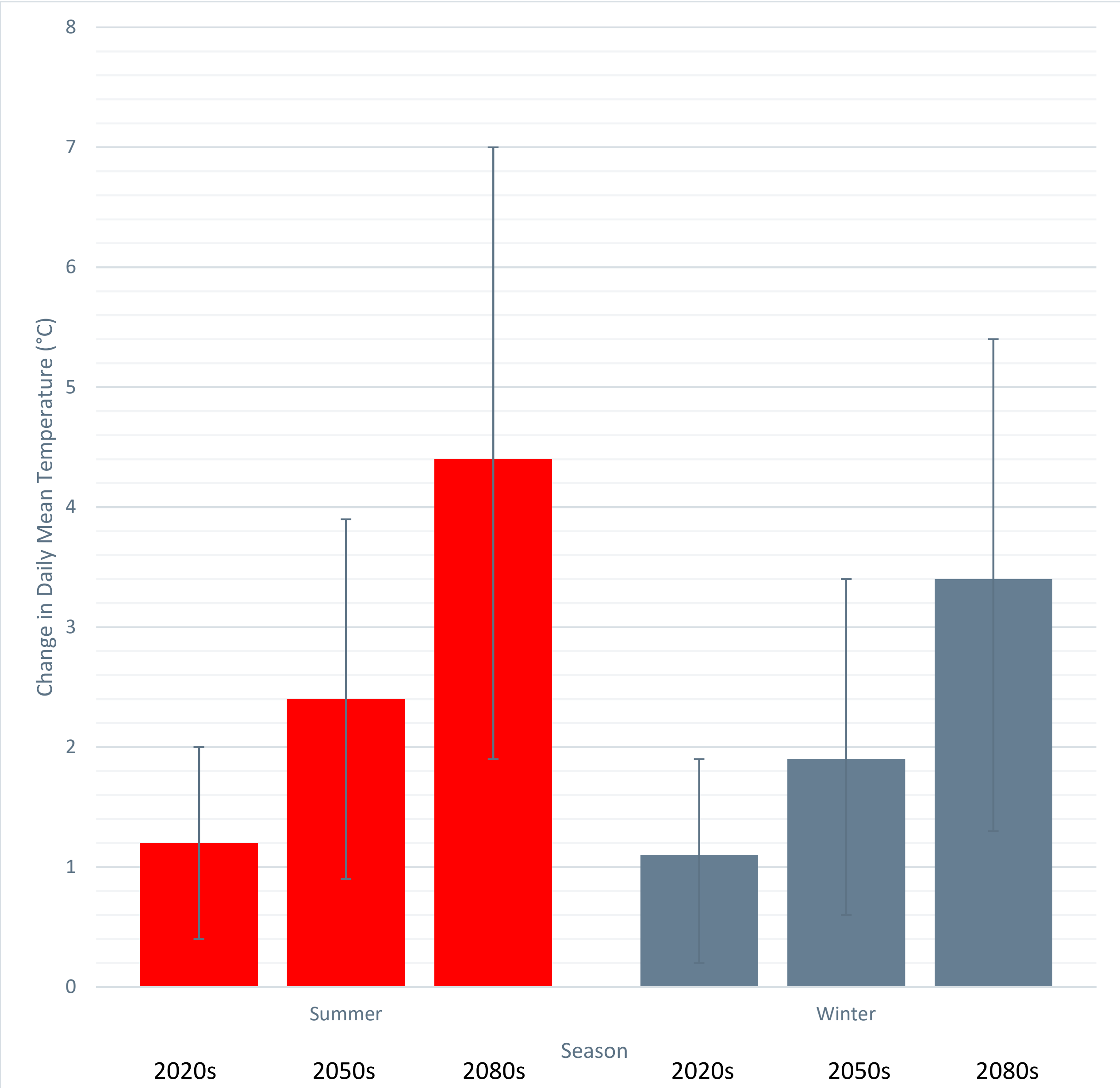
14.2.30. The UKCP18 projections for change in mean temperature rise are even higher for the 2050s and 2080s respectively. Under RCP8.5, by the 2050s, mean air temperature in the summer is projected to increase by 2.4°C at the central estimate (50th percentile). The 10th and 90th percentile range from 0.9°C and 3.9°C respectively.

14.2.31. By the 2080s, under RCP8.5, mean air temperature is projected to increase by 4.4°C at the central estimate (50th percentile) with the 10th and 90th percentile ranging from 1.9°C to 7.0°C. **Figure 14-6** also shows that mean air temperature in the winter is projected to increase by 1.1°C at the central estimate (50th percentile), by the 2020s. The 10th and 90th percentile projections show lower and upper estimates of 0.2°C and 1.9°C respectively.

14.2.32. The projections from UKCP18 show even higher temperature increases for the 2050s and the 2080s respectively. By the 2050s, under RCP8.5, mean air temperature in the winter is expected to be 1.9°C higher at the central estimate (50th percentile). The 10th and 90th percentile projections range from 0.6°C to 3.4°C.

14.2.33. By the 2080s, mean air temperature in the winter is projected to increase by 3.4°C at the central estimate (50th percentile), with the 10th and 90th percentile projects, representing the uncertainty, range from 1.3°C to 5.4°C.

Figure 14-6 – Change in seasonal average daily mean temperature (°C) for the 2020s, 2050s and 2080s in the 25 km^2 grid square (412500.00, 587500.00) under RCP8.5



14.2.34. Temperature shows both a seasonal and a diurnal variation. January is usually the coldest month, with mean daily minimum temperatures varying from below -0.5 °C on the highest ground to ~2 °C along the coast and in South Yorkshire. Minimum temperatures usually occur around sunrise and extreme minima have been recorded in winter, most often in January or February.

14.2.35. With regards to changes in minimum and maximum temperatures, from 1961-2006 the north-east region has experienced an increase in mean minimum temperatures of ~1.35°C. **Table 14-6** summarises the changes in mean annual minimum temperature for each season for the period 1961-2006 for the north-east region.

Table 14-6 - Change in Daily Minimum Temperature (°C) from 1961-2006 by Season in the North-East Region

Spring	Summer	Autumn	Winter	Annual
1.19°C	1.42°C	1.13°C	1.78°C	1.35°C

14.2.36. From 1961-2006, the north-east region has also experienced an increase in mean maximum temperature of 1.55°C. **Table 14-7** summarises the changes in mean annual maximum temperature for each season for the period 1961-2006 for the north-east region.

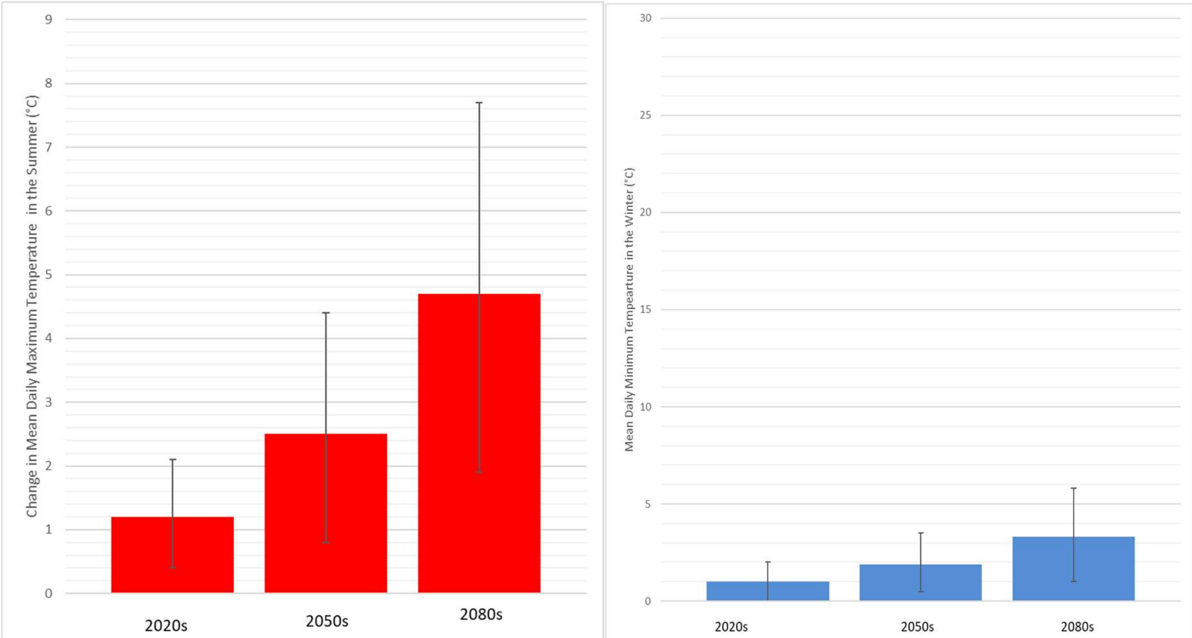
Table 14-7 - Change in Daily Maximum Temperature (°C) from 1961-2006 by Season in the North-East Region

Spring	Summer	Autumn	Winter	Annual
1.63°C	1.72°C	1.11°C	1.92°C	1.55°C

14.2.37. As shown in **Figure 14-7** by the 2020s, the central estimate (50th percentile) projections under RCP8.5 suggest that mean daily maximum temperature in the summer will increase by 1.2°C. There is large uncertainty around these central estimates (represented by the 10th and 90th percentile), ranging from 0.4°C to 2.1°C. By the 2050s, mean maximum temperature in the summer is expected to increase by 2.5°C, with the 10th and the 90th percentile ranging from 0.8°C to 4.4°C. By the 2080s, projections for daily maximum summer temperature for the 25 km^2 grid square (412500.00, 587500.00) are an increase of 4.7ºC for the central estimate (50th percentile), with uncertainty ranging from 1.9ºC (10th percentile) to 7.7ºC (90th percentile).

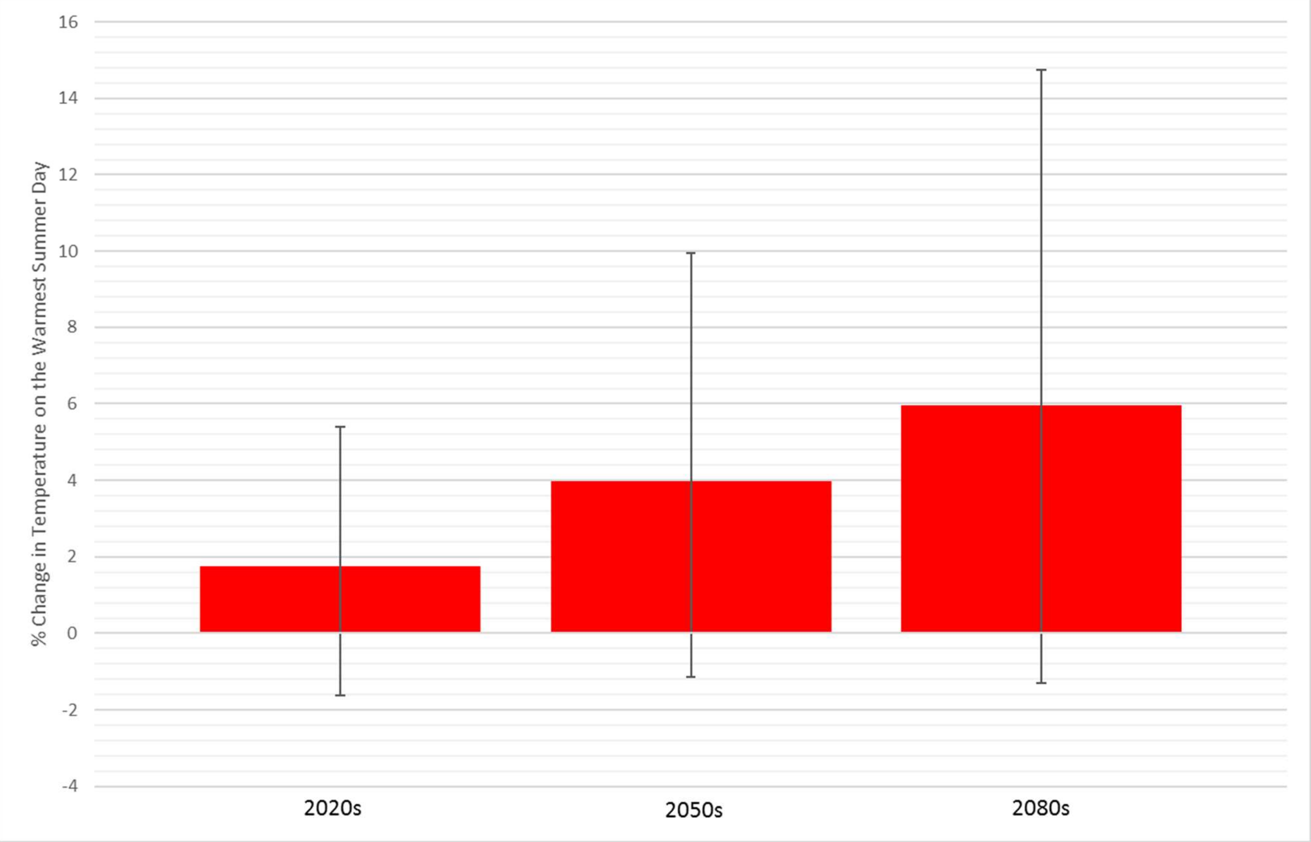
14.2.38. Mean daily minimum temperatures in the winter are projected to increase by 1.0ºC for the central estimate (50th percentile), by the 2020s. The 10th and 90th percentile projections suggest lower and upper estimates of 0.0°C and 2.0°C respectively. By the 2050s, projections for daily minimum winter temperature increase by 1.9°C for the central estimate (50th percentile) and the 10th and 90th percentile projections range from 0.5°C to 3.5°C. By the 2080s, projections show an increase of 3.3°C for the central estimate (50th percentile), with the uncertainty ranging from 1.0°C (10th percentile) and 5.8°C (90th percentile).

Figure 14-7 – Change in Seasonal Temperature Variables for the 2020s, 2050s and 2080s in the 25 km^2 grid square (412500.00, 587500.00) under RCP8.5



14.2.39. **Figure 14-9** shows the UKCP09 projections for changes in extreme temperatures in summer in the 25 km^2 grid square (ID: 965) in the 2020s, 2050s and 2080s under High emissions scenarios. By the 2020s, temperature on the warmest summer day is expected to increase by approximately 1.8%. However, the uncertainty around this central estimate ranges from approximately -1.6% to 5.4% (represented by the 10th and 90th percentile). By the 2050s, the central estimate has predicted an increase of 4.0%, with the uncertainty ranging from -1.1% (10th percentile) to 10.0% (90th percentile). By the 2080s, an increase of approximately 6.0% is predicted by the central estimate, with the 10th percentile at -1.3% and the 90th percentile at 14.8%.

Figure 14-8 - Changes in Extreme Temperature in Summer for the 2020s, 2050s and 2080s in the 25 km² 965-grid square under the High Emissions Scenario



14.2.40. With regard to heat waves, research published by the Met Office Hadley Centre suggests the European summer heat wave in 2003 could become a normal event by the 2040s. By the 2060s, such a summer would be considered cool according to some climate models (**Ref 14-1.9**). It is very likely (confidence level >90%) that human influence has at least doubled the risk of a heatwave exceeding mean summer temperatures experienced in 2003 (**Ref 14-1.10**).

Solar Radiation

14.2.41. A recent (regional) study (**Ref 14-1.11**) suggests that the North of the UK, including the north-east region and the Study Area, is likely to see an increase in annual solar radiation by the 2050s of 3.8 watts per square meter (Wm^{-2}) and by the 2080s of 4.6 Wm^{-2} under the central (50th percentile) estimate, under the High emissions scenario. **Table 14-8** outlines the changes in annual solar radiation for the 2050s and 2080s under the UKCP09 emissions scenarios.

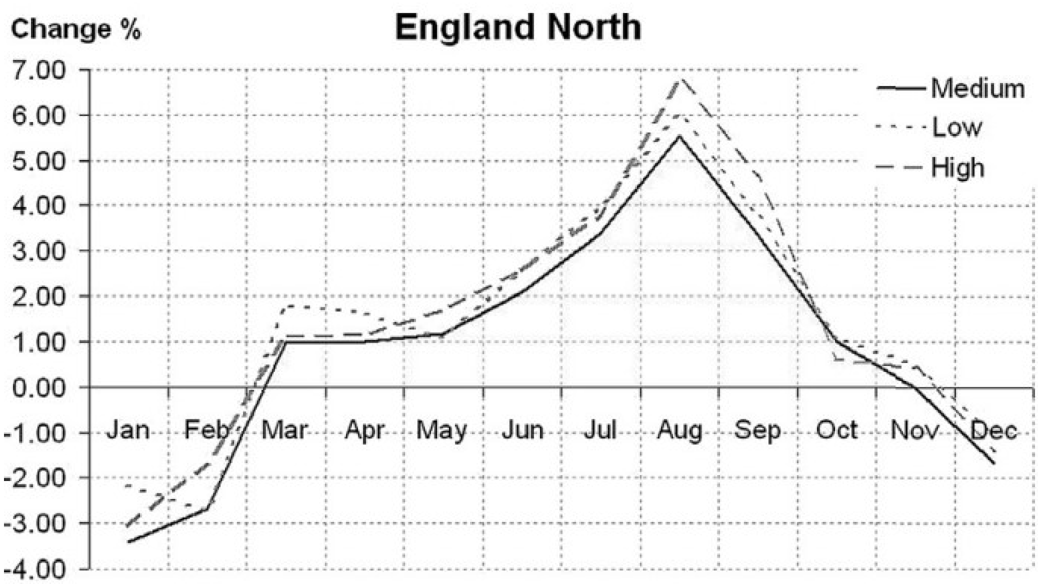
14.2.42. All regions of the UK are likely to have increased cloud cover (although there is large uncertainty around future projections of cloud cover) and therefore slightly less solar radiation during the winter.

14.2.43. **Figure 14-9** describes the change (%) in solar radiation from the baseline for the 2050s for the North of England, which includes the Study Area. The results suggest that increases in solar radiation are more likely in the spring and summer than in autumn and winter.

Table 14-8 - Changes in Annual Solar Radiation (Wm^{-2})

Period	High		
	10th	50th	90th
2050s	-0.6	3.8	8.5
2080s	-1.5	4.6	11.3

Figure 14-9 - Projected Regional Average Change (%) of Solar Radiation (2050s)



Source: Burnett *et al.*, (***Ref 14-1.11***)

Wind

14.2.44. The UKCP09 projections depict a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes much of this uncertainty (**Ref 14-1.12**). It is therefore difficult to represent regional wind extreme winds and gusts within regional climate models (**Ref 14-1.13**).

14.2.45. Central estimates of change in mean wind speed for the 2050s are small in all ensemble runs (<0.2 ms-1). A wind speed of 0.2 ms−1 (~0.4 knots) is small compared with the typical magnitude of summer mean wind speed of about 3.6–5.1 ms-1 (7–10 knots) over much of

England (Jenkins et al., 2008). Seasonal changes at individual locations across the UK lie within the range of –15% to +10%. There may be an increase in westerly flows in the north during summer and also an increase in southerly flows over the UK in winter.

14.2.46. With regards to storms, the analysis presented here is a summary of expected changes in storm patterns under a changing climate. A storm is defined by the Met Office as a wind event measuring 10 or higher on the Beaufort scale (equivalent to a wind speed of 24.5 m/s or 55 mph).

14.2.47. Thunderstorms are most likely to occur from May to September, reaching their peak in July and August, but are less frequent than in areas further south, and the north of the region can expect only five to eight days with thunder each year. The heaviest rainfall events in the UK are often associated with these summer thunderstorms.

14.2.48. With regard to future projections of storms, studies suggest that climate-driven storm changes are less distinct in the Northern than Southern hemisphere (**Ref 14-1.14**). There is some agreement of a projected poleward shift in storm tracks across the Atlantic Ocean; however, for mid-Atlantic storms, such as those that have affected the UK in early 2014, the signal is more complex (**Ref 14-1.15**). Potentially, those mid-Atlantic storms may become more intense, particularly with the long-term warming of the sub-tropical Atlantic that could increase the amount of moisture that those storms carry (**Ref 14-1.15**). However, such is the wide range of inter-model variation, robust projections of changes in storm track are not yet possible and there is low confidence in the direction of future changes in the frequency, duration or intensity of storms affecting the UK.

Relative Humidity

14.2.49. Relative Humidity is the most common measure of humidity. It measures how close the air is to being saturated. From 1961-2006 the north-east of England region has experienced a decrease in relative humidity of ~2.7%. **Table 14-9** summarises the changes in relative humidity in each season for the period 1961-2006 in the north-east region.

Table 14-9 - Change in Seasonal Mean Relative Humidity for the Period 1961 to 2006 in the North-East Region

Spring	Summer	Autumn	Winter	Annual
-2.8%	-2.8%	-2.3%	-2.6%	-2.7%

14.2.50. **Table 14-10** shows the UKCP09 projections for changes in seasonal mean relative humidity in the 25 km^2 grid square 965 in 2080 under High emissions scenarios.

Table 14-10 - Change in Seasonal Mean Relative Humidity in the 25 km^2 965-grid square in 2080 under RCP8.5

Climate variable: RCP8.5	Probability of being less than		
	10%	50%	90%
Summer mean relative humidity (%)	-8.9	-4.0	0.3
Winter mean relative humidity (%)	-1.7	0.1	1.5

Extremes (Precipitation and Temperature Events)

14.2.51. A range of 'extreme' climate change scenarios (produced by Wade *et al*., 2015 (**Ref 14-1.16**)) have also been reviewed. The H++ scenarios (high end climate change scenarios) represent the margins or beyond the 10th to 90th percentile range of the 2080s UKCP09 High emissions scenario as presented in the UKCP09 projections and reported here. These scenarios provide a high-impact, low-likelihood event to compare against more likely outcomes.

14.2.52. The H++ scenarios suggest that average summer maximum temperatures will exceed 30°C across most of the UK, with temperatures of the hottest days are also likely to exceed 40°C (**Ref 14-1.16**). The H++ scenarios for heavy daily and sub-daily rainfall suggest that, for the same period, there is a 60% to 80% increase in rainfall for summer or winter events based on a consideration of new high-resolution modelling and physical processes.

14.2.53. Wade *et al*., (2015) (**Ref 14-1.16**) recommend that a plausible H++ windstorm scenario is a 50-80% increase in the number of windstorms over the UK by 2070-2100 compared to 1975-2005. However, it is important to note that this scenario is based on the Coupled Model Intercomparison Project (CMIP5) climate model simulations (**Ref 14.1-17**), which contain biases in the position of the North Atlantic storm track and systematically under-represents the number of intense cyclones.

REFERENCES

Ref 14-1.1 Met Office (2019) UK Climate Projections User Interface http://ukclimateprojections-ui.metoffice.gov.uk

Ref 14-1.2 Met Office (2009) UK Climate Projections User Interface http://ukclimateprojections-ui.metoffice.gov.uk

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