M2 Junction 5 Improvements
Environmental Statement
Volume 2 - Appendix K Climate
June 2019

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Document control

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Appendix K (Climate)

Appendix K. Climate

K.1 Carbon Tool

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2018 Oct - Bulk Materials

Mark page as complete

Add new row:

Total CO2e	19,571.436	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

Material / Product								Assign % of total quantity to categories						Transport				Forecast
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver-sion Factor	This Return tCO2e	Not Allocated %	Fencing %	Drainage %	Road Pavements %	Civils Structures %	Waste %	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e	Next Return Quantity Forecast
Ready mix concrete	C40/50	m3	2118.0	0.151	tCO2e/t	2.400	767.563	0.00%				100.00%		HGV	200.0	0.0001095	222.546	
Reinforcement steel	Steel bar and rod	tonnes	493.0	1.400	tCO2e/t	1.000	690.200	0.00%			18.00%	82.00%		HGV	200.0	0.0001095	21.584	
Fill and aggregate	Recycled imported fill/aggregate	tonnes	151.0	0.003	tCO2e/t	1.000	0.453	0.00%				100.00%		HGV	200.0	0.0001095	6.611	
Fill and aggregate	General fill/aggregate	tonnes	16200.0	0.005	tCO2e/t	1.000	84.240	0.00%		86.00%	14.00%			HGV	200.0	0.0001095	709.248	
Ready mix concrete	C8/10 (Gen 1, ST 2)	m3	30500.0	0.082	tCO2e/t	2.400	6002.400	0.00%			100.00%			HGV	200.0	0.0001095	3204.749	
Ready mix concrete	C32/40	m3	1600.0	0.132	tCO2e/t	2.400	506.880	0.00%			100.00%			HGV	200.0	0.0001095	168.118	

Asphalt	General Asphalt	tonnes	60000.0	0.076	tCO2e/t	1.000	4560.000	0.00%			100.00%			HGV	200.0	0.0001095	2626.844	
								100.00%										

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2018 Oct - Earthworks

☒ Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	616.109	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

Material / Product								Transport			
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver -sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Geotextiles	Polypropylene geotextile / matting	m2	187484.0	3.430	tCO2e/t	0.001	608.344	HGV	200.0	0.0001095	7.765

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2018 Oct - Fencing, Barriers & Road Restraint Systems

Converter:

Miles	=	km
1.00	=	1.61

(excluding bulk materials)

Total CO2e	831.374	Tonnes

☒ Mark page as complete

Add new row:

Material / Product								Transport			
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver-sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Fence	Steel/wire/chain fence (includes posts)	metres	2250.0	3.020	tCO2e/t	0.004	25.957	HGV	200.0	0.0001095	0.376
Noise Barriers	Steel barrier 2m	metres	200.0	1.460	tCO2e/t	0.100	29.200	HGV	200.0	0.0001095	0.876
Road Restraint System/ Safety Barrier	Steel RRS barrier single sided	metres	4816.0	1.540	tCO2e/t	0.022	165.317	HGV	200.0	0.0001095	4.700

Road Restraint System/ Safety Barrier	Steel RRS barrier double sided	metres	365.0	1.540	tCO2e/t	0.036	19.977	HGV	200.0	0.0001095	0.568
Road Restraint System/ Safety Barrier	Pre-cast concrete step barrier	metres	2091.0	0.199	tCO2e/t	1.150	479.127	HGV	200.0	0.0001095	105.277

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2018 Oct - Drainage

Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	847.436	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

	Material / Product								Transport			
	Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver-sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Bulk Materials	Fill and aggregate	General fill/aggregate	tonnes	13932.0	0.005	tCO2e/t	1.000	72.446	HGV	200.0	0.0001095	609.953
	Plastic pipework (HDPE)	150mm diameter	metres	758.0	2.520	tCO2e/t	0.002	4.511	HGV	200.0	0.0001095	0.078
	Plastic pipework (HDPE)	225mm diameter	metres	2000.0	2.520	tCO2e/t	0.004	21.287	HGV	200.0	0.0001095	0.370

Plastic pipework (HDPE)	300mm diameter	metres	4000.0	2.520	tCO2e/t	0.008	75.687
Plastic pipework (HDPE)	450mm diameter	metres	7500.0	2.520	tCO2e/t	0.011	211.027
Plastic pipework (HDPE)	600mm diameter	metres	300.0	2.520	tCO2e/t	0.020	15.484
Precast concrete circular pipework	900mm diameter	metres	200.0	0.180	tCO2e/t	0.888	31.968
Precast concrete manholes	1800mm diameter, up to 3m depth	no.	180.0	0.208	tCO2e/t	6.620	247.853
Precast concrete manholes	2400mm diameter, up to 3m depth	no.	4.0	0.197	tCO2e/t	10.730	8.455

HGV	200.0	0.0001095	1.315
HGV	200.0	0.0001095	3.666
HGV	200.0	0.0001095	0.269
HGV	200.0	0.0001095	7.775
HGV	200.0	0.0001095	52.169
HGV	200.0	0.0001095	1.879

Precast concrete inspection chambers	600mm diameter, up to 1.2m depth	no.	60.0	0.282	tCO2e/t	0.364	6.151	HGV	200.0	0.0001095	0.956
Plastic inspection chambers	600mm diameter, 1.2m - 3m depth	no.	7.0	3.960	tCO2e/t	0.326	9.028	HGV	200.0	0.0001095	0.100
Gullies	Plastic gully pots - PVC	no.	185.0	2.103	tCO2e/t	0.021	8.248	HGV	200.0	0.0001095	0.172
Channel & slot drains	Precast concrete channel (heavy duty)	metres	4000.0	0.180	tCO2e/t	0.150	108.000	HGV	200.0	0.0001095	26.268
Headwalls	In-situ reinforced concrete										
Damp proof course and impermeable membrane	Polyethylene membrane	m2	1922.0	2.540	tCO2e/t	0.001	4.638	HGV	200.0	0.0001095	0.080

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2018 Oct - Road Pavements

Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	0.000	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

	Material / Product								Transport			
	Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver-sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Bulk Materials	Asphalt	General Asphalt	tonnes	60000.0	0.076	tCO2e/t	1.000	4560.000	HGV	200.0	0.0001095	2626.844
Bulk Materials	Fill and aggregate	General fill/aggregate	tonnes	2268.0	0.005	tCO2e/t	1.000	11.794	HGV	200.0	0.0001095	99.295
Bulk Materials	Ready mix concrete	C32/40	m3	1600.0	0.132	tCO2e/t	2.400	506.880	HGV	200.0	0.0001095	168.118

Bulk Materials	Ready mix concrete	C8/10 (Gen 1, ST 2)	m3	30500.0	0.082	tCO2e/t	2.400	6002.400		HGV	200.0	0.0001095	3204.749
Bulk Materials	Reinforcement steel	Steel bar and rod	tonnes	88.7	1.400	tCO2e/t	1.000	124.236		HGV	200.0	0.0001095	3.885

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2018 Oct - Street Furniture & Electrical Equipment

Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	44.548	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

Material / Product								Transport			
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver-sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Road lighting and columns	LED light	no.	68.0	9.160	tCO2e/t	0.012	7.475	HGV	200.0	0.0001095	0.036
Road lighting and columns	Steel columns 8m	no.	10.0	1.540	tCO2e/t	0.132	2.033	HGV	200.0	0.0001095	0.058
Road lighting and columns	Steel columns 10m	no.	52.0	1.540	tCO2e/t	0.189	15.135	HGV	200.0	0.0001095	0.430

Road lighting and columns	Steel columns 12m	no.	2.0	1.540	tCO2e/t	0.288	0.887	HGV	200.0	0.0001095	0.025
Cable	Armoured cable / Power cable	metres	9500.0	2.493	tCO2e/t	0.001	17.528	HGV	200.0	0.0001095	0.308
Cabinets	Any type	no.	2.0	1.540	tCO2e/t	0.200	0.616	HGV	200.0	0.0001095	0.018

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2018 Oct - Civils Structures & Retaining Walls

Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	280.761	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

	Material / Product								Transport			
	Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver -sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Bulk Materials	Fill and aggregate	Recycled imported fill/aggregate	tonnes	151.0	0.003	tCO2e/t	1.000	0.453	HGV	200.0	0.0001095	6.611
Bulk Materials	Ready mix concrete	C40/50	m3	2118.0	0.151	tCO2e/t	2.400	767.563	HGV	200.0	0.0001095	222.546
Bulk Materials	Reinforcement steel	Steel bar and rod	tonnes	404.3	1.400	tCO2e/t	1.000	565.964	HGV	200.0	0.0001095	17.699

Bulk Materials

Formwork / Shuttering	Plywood	m3	34.0	1.100	tCO2e/t	0.540	20.196	HGV	200.0	0.0001095	0.804
Formwork / Shuttering	Plastic formwork (disposable)	tonnes	53.0	2.520	tCO2e/t	1.000	133.560	HGV	200.0	0.0001095	2.320
Piling	Pre-cast concrete piles	tonnes	1.0	0.180	tCO2e/t	1.000	0.180	HGV	200.0	0.0001095	0.044
Pre-cast Concrete	General concrete	tonnes	0.1	0.143	tCO2e/t	1.000	0.014	HGV	200.0	0.0001095	0.004
Bricks and blockwork	Concrete blocks (includes mortar)	no.	57827.0	0.091	tCO2e/t	0.016	83.546	HGV	200.0	0.0001095	40.092

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2018 Oct - Fuel, Energy & Water

☒ Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	16,125.116	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

Material / Product								Transport			
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver-sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Site offices, site vehicles and plant energy	Electricity	kWh	68500.0	0.494	kgCO2e/kWh	0.001	33.857				
Water	Mains	Litres	7500000.0	0.000	kgCO2e/l	0.001	2.581				
Site offices, site vehicles and plant energy	Diesel	Litres	5000000.0	3.802	kgCO2e/kg	0.001	15905.500	HGV	200.0	0.0001095	183.179

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2018 Oct - Business and Employee Transport

Converter:

Miles	=	km
1.00	=	1.61

(excluding bulk materials)

Total CO2e	710.124	Tonnes

☒ Mark page as complete

Add new row:

Material / Product								Transport			
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver -sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Employee commuting	Private vehicle (any type)	km	3744000.0	0.190	kgCO2e/km	0.001	710.124				

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2018 Oct - Waste

Mark page as complete

Add new row:

(excluding bulk materials)

Total CO2e	5,459.809	Tonnes

Converter:

Miles	=	km
1.00	=	1.61

Material / Product								Transport			
Item	Type	Unit	This Return Quantity	Carbon Factor Value	Carbon Factor Unit	Conver -sion Factor	This Return tCO2e	Transport mode	Transport distance value (km)	Carbon Factor ($tCO_2e/t.km$)	This Return tCO2e
Aggregate and soil exported off-site	Landfill	tonnes	413950.2	0.002	tCO2e/t	1.000	827.900	HGV	50.0	0.0001095	4530.760
Concrete, brick, tiles and ceramics	Landfill	tonnes	4207.0	0.002	tCO2e/t	1.000	8.414	HGV	50.0	0.0001095	46.046
Bituminous mixtures	Landfill	tonnes	3540.0	0.002	tCO2e/t	1.000	7.080	HGV	50.0	0.0001095	38.746
Mixed metals	Landfill	tonnes	27.0	0.021	tCO2e/t	1.000	0.567	HGV	50.0	0.0001095	0.296

K.2 Baseline Climate – Vulnerability of the Scheme to Climate Change

Temperature

K.2.1 Kent's climate is one of relatively mild winters and warm summers. To provide some climatological context for the study region, long-term average monthly weather data for the period 1981 to 2010 has been sourced from the Met Office. The South-East England administrative region was compared to the mean long-term average of all other administrative regions in the UK as well as the minimum and maximum.

K.2.2 As shown in Figure K.1 to K.3 the temperatures in the South-East England administrative region are higher than the UK average.

Figure K.1: Long-term average monthly mean temperature (1981-2010)

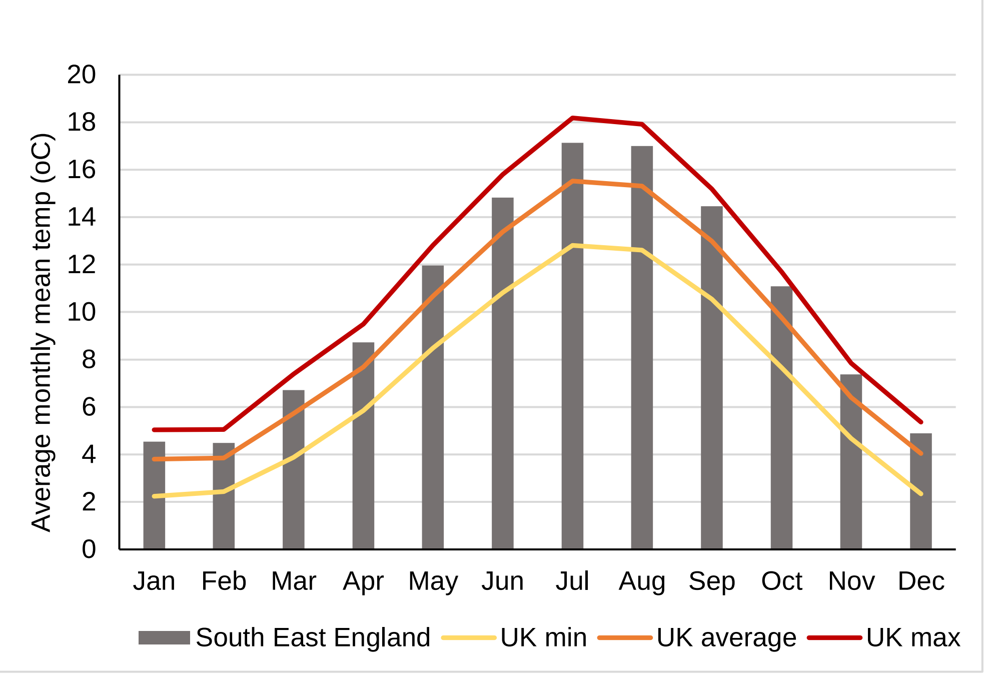


Figure K.2: Long-term average monthly maximum temperature (1981-2010)

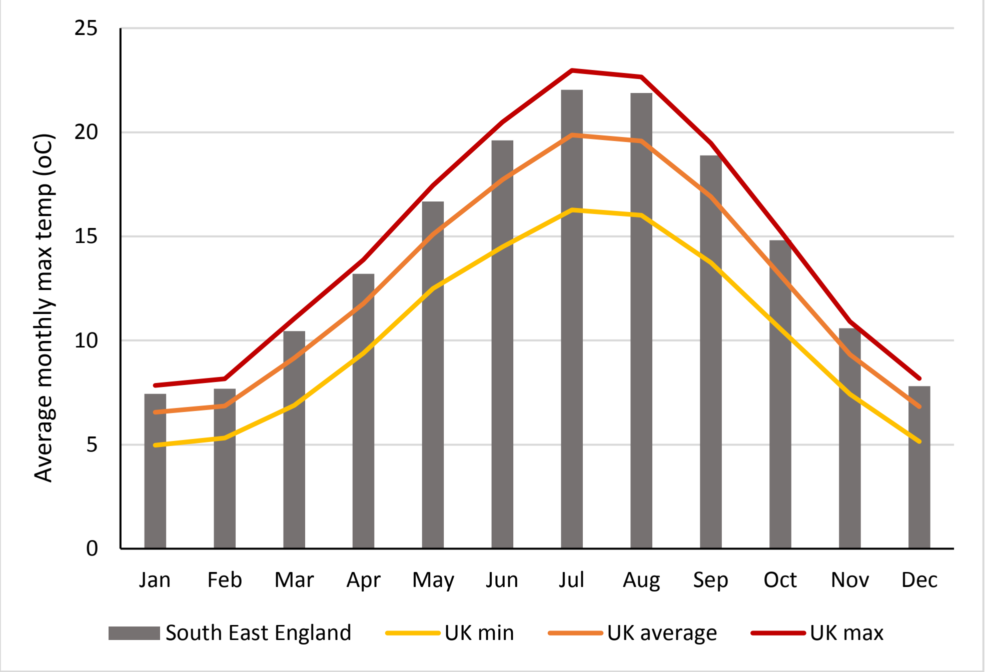
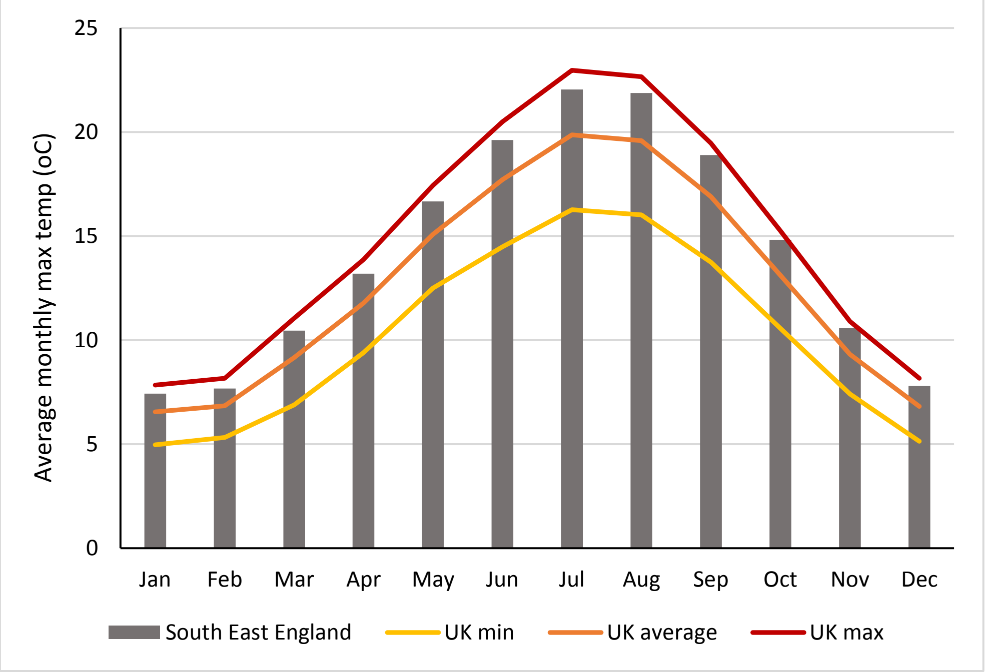


Figure K.3: Long-term average monthly minimum temperature (1981-2010)



Precipitation

K.2.3 Figure K.4 shows that long-term average monthly rainfall (1981-2010) in the South-East England administrative region is lower than the UK average.

K.2.4 Figure K.5 shows the long-term average number of days that had rainfall over 10 mm. If we consider this as a proxy for heavy monthly rainfall it suggests that the region experiences fewer heavy rainfall days than most other administrative regions of the UK.

Figure K.4: Long-term average monthly rainfall (1981-2010)

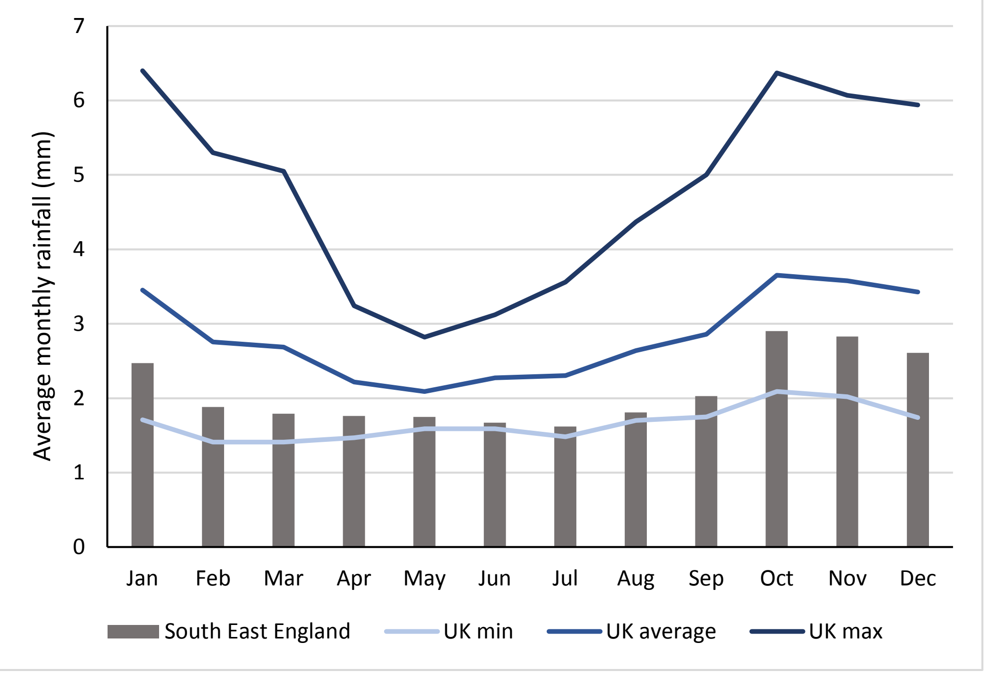
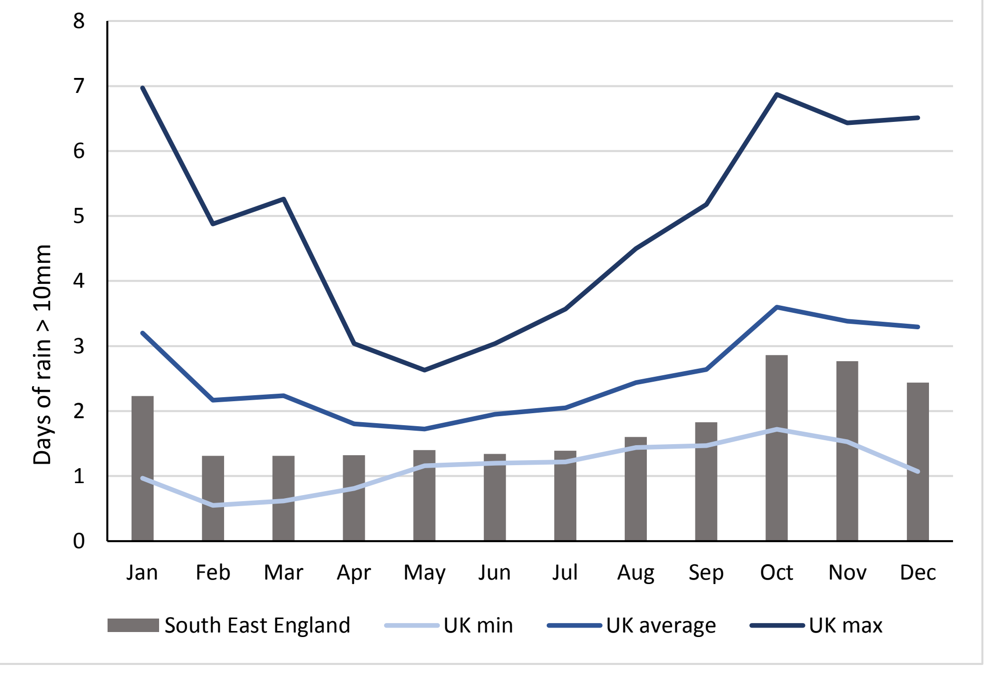
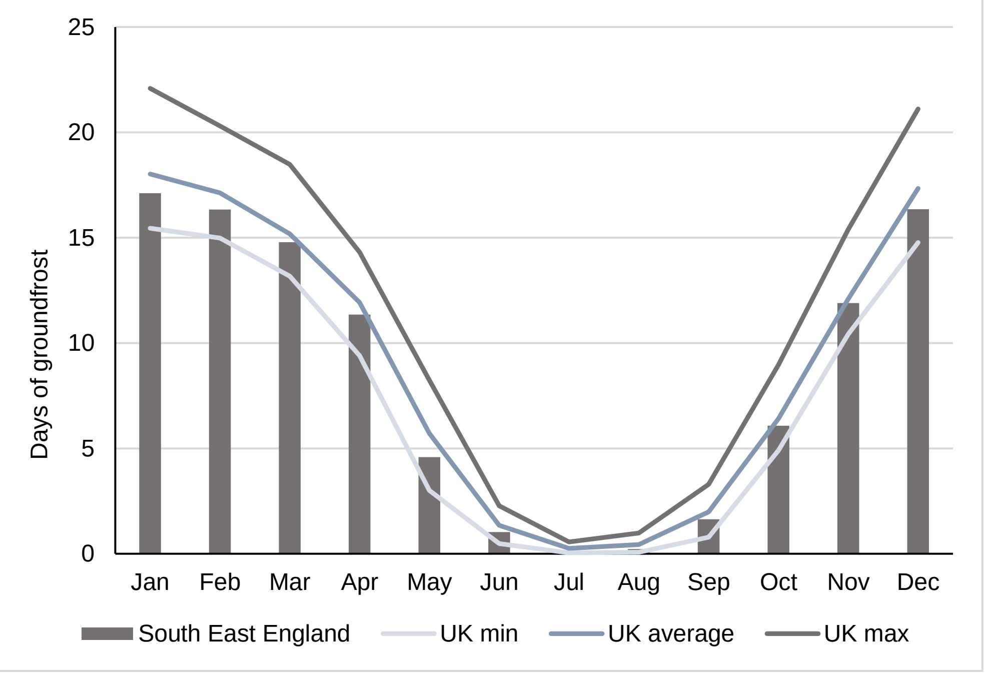


Figure K.5: Long-term average days with rainfall above 10mm (1981-2010)



K.2.5 Figure K.6 shows a count of days with ground frost from the long-term data (1981-2010) in the South-East England administrative region are low compared to recorded UK average.

Figure K.6: Long-term average days with ground frost 10mm (1981-2010)



Projected climate changes and extreme weather

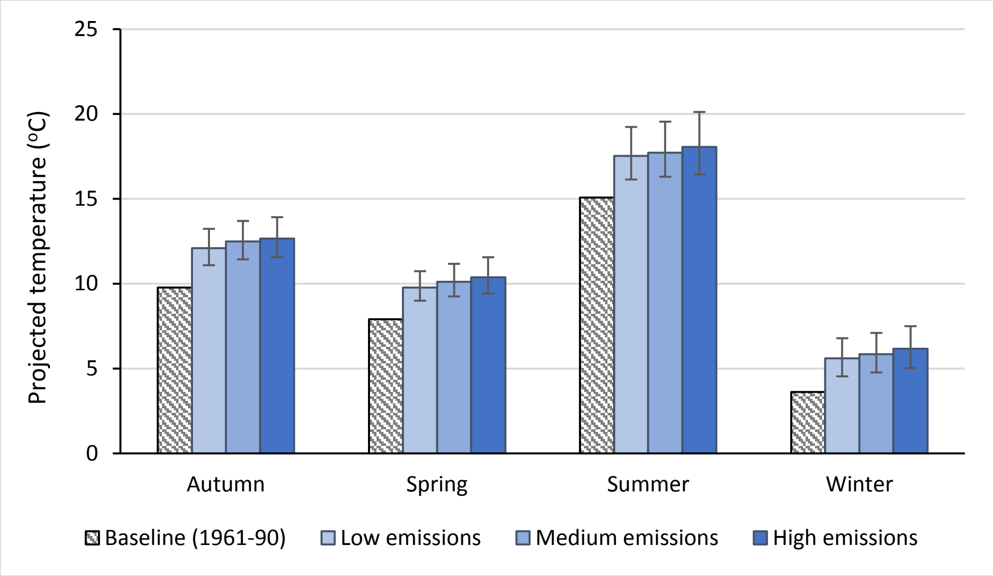
K.2.6 There is considerable uncertainty in climate modelling, particularly around extreme/severe events. The level of uncertainty is dependent on the climate variable. For example, there is greater confidence around changes in temperature than there is in wind. However, recent and continued warming of the Earth's climate system is likely to have an impact on the frequency and severity of extreme weather events[1]. Therefore, to inform adaptation decisions, a summary of the likely projected changes in relevant average and extreme weather variables is presented below.

Change in temperature

K.2.7 As shown by the long-term average mean temperature data in Figure K.7, the coldest months in South East England are the winter months (although still relatively mild). UKCP09 projects that by the 2050s, under the high emissions scenario, average mean temperatures are likely to increase throughout the year by approximately 2.6ºC in winter and 3ºC in summer.

[1] Stott, P. A., Allen, M., Christidis, N., Dole, R., Hoerling, M., Huntingford, C., Pall, P., Perlwitz, J. and Stone, D. (2013). Attribution of Weather and Climate-Related Extreme Events. Climate Science for Serving Society: Research, Modeling and Prediction Priorities, 307-337.

Figure K.7: Average mean temperatures by the 2050s



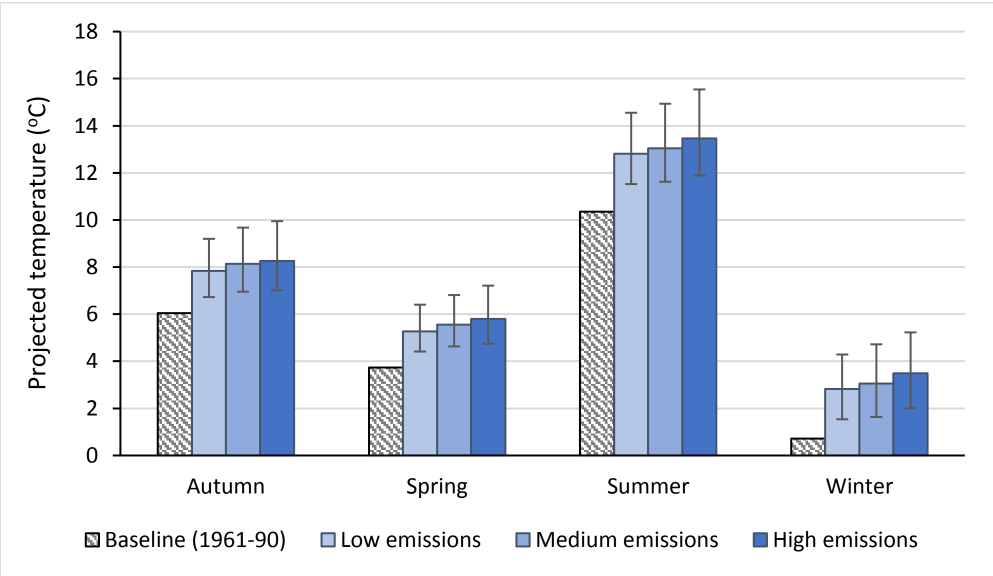
NB - error bars represent 10th to 90th percentile projections

Warmer winters

K.2.8 In winter, under the high emissions scenario, mean temperature is likely to increase by approximately 2.5ºC (central estimate). The uncertainty around this estimate ranges from ~1ºC to ~4ºC (represented by the 10th and 90th percentile respectively).

K.2.9 Figure K.8 is taken from the UKCP09 project and shows that by the 2050s, under the high emissions scenario, average minimum temperatures are likely to increase throughout the year. Under the high emissions scenario, the central estimate (50th percentile estimate) of winter minimum air temperature by 2050s is approximately 2.8ºC. This is an increase of ~2ºC. The uncertainty around this estimate ranges from ~1.3ºC to ~4.5ºC (represented by the 10th and 90th percentile respectively).

Figure K.8: Average minimum temperatures by the 2050s

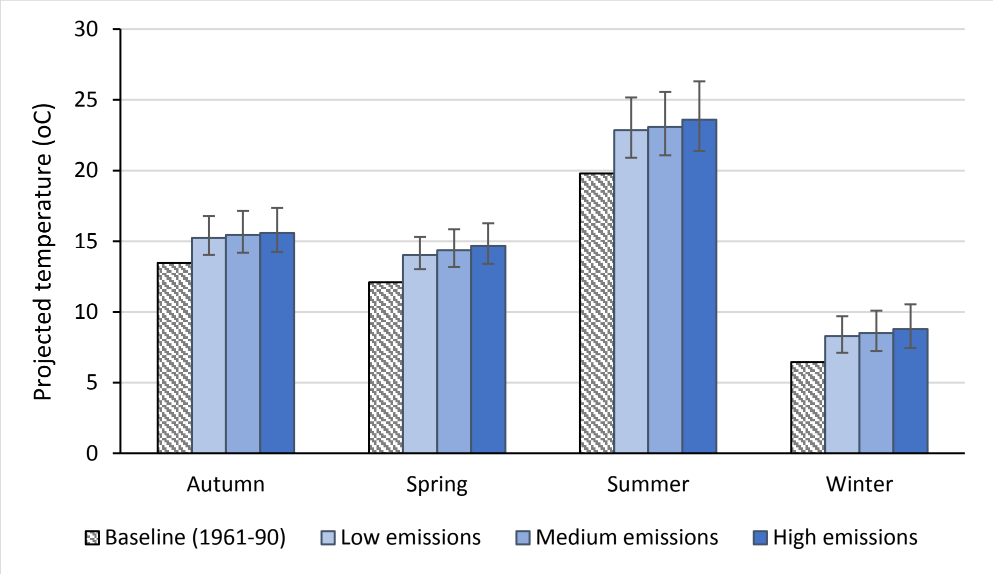


NB - error bars represent 10th to 90th percentile projections

Hotter summers

K.2.10 The UKCP09 provides probabilistic projections for mean daily maximum temperature. Mean daily maximum temperatures are derived by calculating change in the average of the warmest days in each 30-year timeslice. Therefore, it is worth noting that some days are likely to be even hotter. As shown in Figure K.9, the UKCP09 projections suggest an increase in mean daily maximum temperature by the 2050s for all seasons under all emissions scenarios. By the 2050s, summer mean daily maximum temperatures could be up to ~4ºC warmer (50th percentile estimate under high emissions).

Figure K.9: Average maximum temperatures by the 2050s



NB - error bars represent 10th to 90th percentile projections

K.2.11 Although there is no official definition of a heat wave in the UK, the World Meteorological Organization definition is "when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 5°C, the normal period being 1961-1990" . Research published by the Met Office Hadley Centre suggests that the European summer heat wave from 2003 could become a normal event by the 2040s . By the 2060s, such a summer would be considered cool according to some climate models.

K.2.12 Research has found that it is very likely (confidence level >90%) that human influence has at least doubled the risk of a heat wave exceeding mean summer temperatures experienced in 2003 .

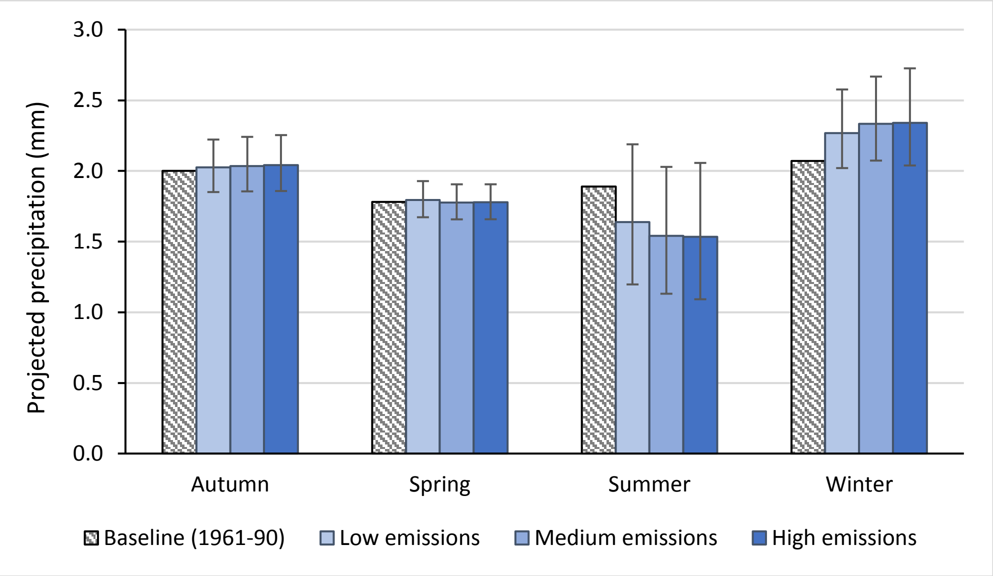
K.2.13 The H++ scenarios suggest that average summer maximum temperatures will exceed 30°C across most of the UK. Temperatures of the hottest days are likely to exceed 40°C .

Change in precipitation

Wetter Winters

K.2.14 The UKCP09 project showed that by the 2050s, under the high emissions scenario, the central estimate (50th percentile estimate) of increase in winter mean precipitation is ~13%. The uncertainty around this estimate ranges from close to no change to 29% (represented by the 10th and 90th percentile respectively). Although this percentage is sizeable, the absolute increase in winter rainfall amounts by 2050, for all emission scenarios, is <1 mm. As shown in Figure K.10, the projected winter rainfall under high emissions is relatively low (2.3 mm by 2050s at the central estimate, 50th percentile).

Figure K.10: Average precipitation by the 2050s



NB - error bars represent 10th to 90th percentile projections

Drier summers

K.2.15 As shown in Figure K.10, for summer the central estimate of change in mean precipitation, by 2050s, is approximately -18% under the high emissions scenario. The uncertainty around this estimate ranges from approximately 40% reduction in rainfall to 7% increase (represented by the 10th and 90th percentile respectively). These projections suggest that there is uncertainty in future average rainfall trends but it is expected that winter rainfall will marginally increase and summer rainfall decrease.

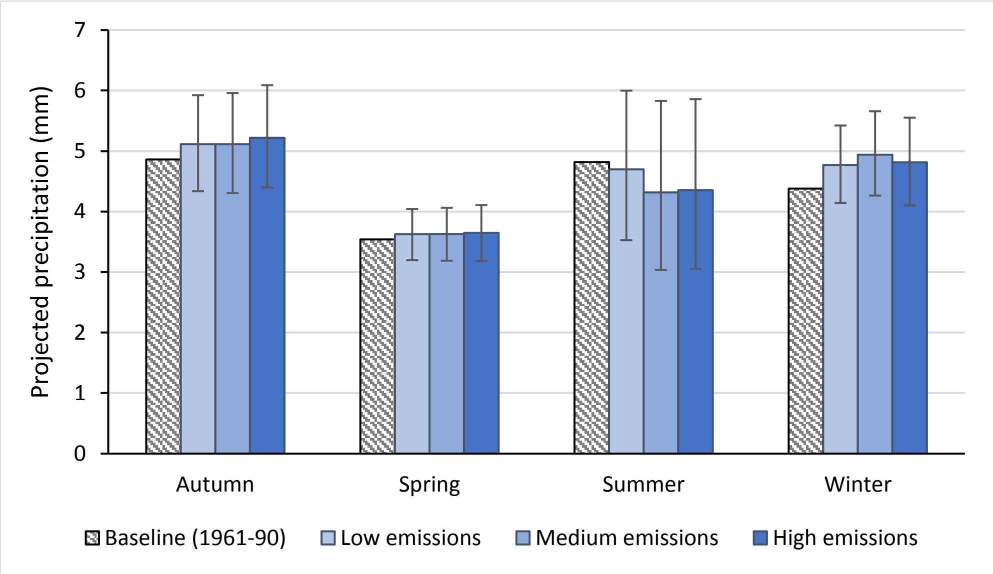
Heavy Rainfall

K.2.16 Although average rainfall conditions are important, heavy rainfall events are more likely to cause flooding and damage to roads and other infrastructure. UKCP09 does not provide specific projections for flooding but instead includes probabilistic projections for precipitation on the wettest day defined as the 99^{th} percentile of daily maximum precipitation on a seasonal basis.

K.2.17 The current climatological baseline analysis showed that the highest rainfalls in the study area are in winter months. Therefore, UKCP09 probabilistic data was sourced for projected change in rainfall on the wettest day (see Figure K.11). The figure shows that, for winter, the high emission scenario suggests a central estimate of precipitation increase on the wettest day of approximately 10% by the 2050s. The uncertainty around this estimate ranges from approximately -36% decrease to 21% increase (represented by the 10^{th} and 90^{th} percentile respectively). Although the projected percentage changes are large, London's baseline rainfall is low and therefore in absolute terms, these projections suggest that London could experience winter rainfall on the wettest day of 4.8 mm by 2050s (under high emissions) compared to 4.4 mm in the baseline.

K.2.18 Figure K.11 also demonstrates that there is great uncertainty in projections of future rainfall depending on the emission scenario or percentile.

Figure K.11: Average precipitation by the 2050s



NB - error bars represent 10th to 90th percentile projections

K.2.19 Although the 50th percentile projections for summer heavy rainfall shown in Figure K.11 suggest that summer heavy rainfall may decrease by the 2050s there is a great range of uncertainty represented by the 10th to 90th percentile projections. For example, under the high emissions scenario the 10th to 90th percentile projections range from a ~37% decrease to ~22% increase. Recent research[2] has confirmed this finding, that the UK may experience more heavy summer rainfall events in the future. Heavy summer rainfall events are predominantly caused by convective rainfall, brought about by thermal heating and evaporation. These localised convective rainfall events are currently not well replicated in climate models and, as a result, they cannot provide information directly on how their intensity and frequency might change. Therefore, the UKCP09 projections may be underestimating an increase in heavy summer rainfall as it does not include a potential increase in convective rainfall events caused by warmer summer temperatures.

K.2.20 It is expected that as summer rainfall tends to intensify with temperature, the expected increase in atmospheric temperatures will result in more intense summer rainfall events.

K.2.21 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[3].

Snow

K.2.22 Snow is precipitation that falls when the air temperature is below 2°C. In the UK, the heaviest snowfalls tend to occur when the air temperature is between zero and 2°C[4]. For snow, UKCP09 provides non-probabilistic projections based on an 11-member RCM ensemble, using a single emissions scenario (Medium). It should be noted that these do not encompass the full range of uncertainty and that projections are for the 2080s and medium emissions scenario only.

K.2.23 UKCP09 projects a reduction of mean snowfall rates, number of snow days and heavy snow events by the end of the 21st century[5][6]. While there is less certainty in the magnitude of projected change, there is confidence in the negative sign of the change[7]. The 90th percentile of snowfall rate can be used as a measure of 'heavy' snow events. Ensemble projections for the 2080s suggest that for most of the UK, the intensity of winter 'heavy' snow events could decrease by over 80%[8].

[2] See here: http://research.ncl.ac.uk/convex/ [accessed 21st February 2018]
[3] Wade SD; Sanderson M, Golding N, Lowe J, Betts R, Reynard N, Kay A, Stewart L, Prudhomme C, Shaffrey L, Lloyd-Hughes B, Harvey B. (2015). Developing H++ climate change scenarios for heat waves, droughts, floods, windstorms and cold snaps. Report prepared for the Adaptation Sub-Committee and to support the second Climate Change Risk Assessment (CCRA).
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Changes in storms and high winds

K.2.24 Future projections of storms and high winds are uncertain. 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[9]. It is therefore difficult to represent regional extreme winds and gusts within regional climate models (*ibid*). Other studies of future changes agree that confidence in future windiness is low.[10][11][12]

K.2.25 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)[13]. Studies suggest that climate-driven storm changes are less distinct in the Northern than Southern hemisphere[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[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 *(ibid).* 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.

K.2.26 Wade *et al,* (2015)[16] recommend that a plausible H++ windstorm scenario is a 50 to 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 CMIP5 climate model simulations, which contain biases in the position of the North Atlantic storm track and systematically under-represents the number of intense cyclones.

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