Gatwick Airport Northern Runway Project

Environmental Statement
Appendix 15.5.1: Sensitivity Analysis – Climate Extremes

Book 5

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Table of Contents

Tables

Figures

1 Introduction

1.1 General

1.1.1 This document forms Appendix 15.5.1 of the Environmental Statement (ES) prepared on behalf of Gatwick Airport Limited (GAL) for the proposal to make best use of Gatwick Airport's existing runways and infrastructure (referred to within this report as 'the Project').

1.1.2 This document provides the sensitivity analysis of climate change data, looking at climate extremes, for the Project. The core climate change data and assessment are contained in Section 5 of **ES Chapter 15: Climate Change** (Doc Ref. 5.1). This sensitivity analysis uses newer climate (not weather) extremes from the latest climate extremes data from the UK Met Office, testing the sensitivity of seasonal climate extreme maximum temperature, 1-day and 5-day precipitation rates; examining the projected extreme values of a 1 in 100-year event for each variable respectively.

2 Baseline Conditions

2.1.1 The Probabilistic Projections of Climate Extremes (PPCE) (Murphy et al., 2020) provide information on temperature and precipitation extremes across the UK for the twenty-first century for a range of return periods. PPCE projections for current climate extremes have been obtained from the UK Climate Projections 2018 (UKCP18) (Met Office). The data is provided at a 25 km x 25 km grid resolution and was used to obtain observed projections for three climate variables, daily maximum air temperature at 1.5 m, daily maximum precipitation and 5-day accumulated precipitation. Projections were also developed for the lowest (driest) maximum daily maximum precipitation and 5-day accumulated precipitation, to act as an indicative assessment of trends in dry conditions. The grid cell selected to collect the baseline climate data is presented in **ES Figure 15.5.2** (Doc Ref. 5.2).

2.1.2 Seasonal climate extreme averages across a 20-year climatic period for Gatwick Airport are presented in Table 2.1.1. The values represent the return level for an extreme event of a 1 in 100-year return period and provide actual values. The 95th percentile and 5th percentile have been chosen to represent the uncertainty range for the maximum and lowest maximum intensity of an event expected once within the 1 in 100-year return period, respectively.

2.1.3 For the baseline period (1981-2010) for the 95th percentile of the 1 in 100-year event the daily maximum air temperature at 1.5m during the summer months at Gatwick Airport is 35.8℃. For autumn, spring, and winter maximum air temperatures at 1.5m are 30.1 °C, 29.5 °C and 18.1 °C respectively.

2.1.4 Current daily maximum precipitation and driest maximum precipitation is highest during autumn (88.1 mm and 48.0 mm) and lowest in the spring (56.6 mm and 31.5 mm). The five-day maximum accumulated precipitation is 165.1mm during autumn and 91.0 mm in the spring, whereas the lowest 5-day maximum accumulated precipitation is 110.3 mm in autumn and 63.3 mm in spring.

2.1.5 These extreme values present the observed modelled seasonal averages across a 30-year climatic period of the 1981-2010 baseline, not the wettest or driest it could get on one day in a certain month in a set year. Individual extreme weather events could be higher or lower than the seasonal climatic average values given here.

Table 2.1.1: Baseline (1981-2010) seasonal average PPCE data

Parameter	Baseline 1981-2010
Daily maximum air temperature at 1.5m (°C) (95th Percentile)	
Autumn	30.1
Winter	18.1
Spring	29.5
Summer	35.8
1-day maximum precipitation (mm) (95th Percentile)	
Autumn	88.1
Winter	69.8
Spring	56.6
Summer	71.2
Driest 1-day maximum precipitation (mm) (5th percentile)	
Autumn	48.0
Winter	40.3
Spring	31.5
Summer	41.4
5-day maximum precipitation (mm) (95th percentile)	
Autumn	165.1
Winter	92.8
Spring	91.0
Summer	94.0
Driest 5-day maximum precipitation (mm) (5th Percentile)	
Autumn	110.3
Winter	81.1
Spring	63.3
Summer	71.0

3 Future Conditions

3.1.1 Information for future climate has been obtained from the UKCP18 PPCE projections (Murphy et al., 2020). The emissions scenario Representative Concentration Pathway (RCP) 8.5 for a 1 in 100-year return period was selected to represent a worst-case scenario allowing us to consider the future trend of climate extremes.

3.1.2 Changes in future seasonal values for three climate variables; daily maximum temperature at 1.5m, daily maximum precipitation and 5-day accumulated precipitation were obtained from the Probabilistic Projections of Climate Extremes (PPCE) data set on a 25 km x 25 km grid. The nearest grid cell to Gatwick was selected and is shown in **ES Figure 15.5.2** (Doc Ref. 5.2).

3.1.3 Table 3.1.1 shows the future values for seasonal averages of daily maximum temperature, daily maximum precipitation, and 5-day accumulated precipitation under a high emissions scenario (RCP8.5) for the end of the century (2050-2079). The data reflects the 95th percentile and 5th percentile for the 1 in 100-year return period.

3.1.4 The daily maximum air temperature at 1.5m for the 1 in 100-year return period at Gatwick Airport will increase in all seasons with the greatest increase in temperature from the baseline (1981-

2010) to the end of the century (2050-2079) occurring during the summer with an increase of 7.6 °C resulting in an increase in the 1 in 100-year daily maximum temperature of 43.4 °C.

3.1.5 Under the worst-case scenario (RCP8.5) for a 1 in 100-year return period (95th percentile) daily maximum precipitation at Gatwick Airport will increase in all seasons with the largest increase occurring in the autumn with a total of 106.6 mm of rainfall projected to fall during a single day. Summer and winter see smaller increases in daily maximum precipitation of 80.1 mm and 79.8 mm respectively, whilst spring is projected to receive the lowest amount of daily precipitation at 67.0 mm. The driest daily maximum precipitation event for a 1 in 100-year return period increases in precipitation across autumn, winter, and spring, with autumn experiencing the largest increase in rainfall, rising to 54.3 mm. In summer, the maximum precipitation event for a 1 in 100-year return period with the least rainfall is projected to become drier, decreasing to 33.8 mm of rainfall.

3.1.6 By the 2060s (2050-2079) the 5-day accumulated precipitation is projected to increase in all seasons. Climate projections for 5-day accumulated precipitation also shows the largest increase (26.6 mm increase between the baseline and future time periods) in precipitation under a worst-case scenario (RCP8.5) for a 1 in 100-year return period (95th percentile) will occur in the autumn. The 5-day accumulated precipitation would be 191.7 mm. Summer (106.8 mm) will see the smallest increases in 5-day accumulated precipitation when compared with the baseline (94 mm, 1981-2010). The driest maximum 5-day accumulated precipitation event for a 1 in 100-year return period is projected to increase in rainfall across all seasons besides summer. Of these seasons, the largest increase is projected to be in autumn, rising to 114.2 mm of rainfall. Summer is unique in being the only season where this event is projected to become drier, with precipitation falling from 71.0 mm to 62.1 mm.

3.1.7 These extreme values present the observed modelled seasonal averages across a 30-year climatic period of the future 2060s time period, not the wettest or driest it could get on one day in a certain month in a set year. Individual extreme weather events could be higher or lower than the seasonal climatic average values given here.

Table 3.1.1: Future (2050-2079) seasonal average PPCE data

Parameter	2050-2079 (RCP 8.5)
Daily maximum air temperature at 1.5 m (°C) (95th Percentile)	
Autumn	36.6
Winter	21.6
Spring	36.0
Summer	43.4
1-day maximum precipitation (mm) (95th Percentile)	
Autumn	106.6
Winter	79.8
Spring	67.0
Summer	80.1
Driest 1-day maximum precipitation (mm) (5th percentile)	
Autumn	54.3
Winter	43.6
Spring	32.8
Summer	38.8
5-day maximum precipitation (mm) (95th percentile)	
Autumn	191.7
Winter	109.4
Spring	110.2
Summer	106.8
Driest 5-day maximum precipitation (mm) (5th Percentile)	
Autumn	114.2
Winter	83.7
Spring	65.2
Summer	62.1

3.1.8 The PPCE projections of seasonal daily maximum temperature and precipitation values and the 5-day accumulated precipitation values pose an increased risk to Gatwick Airport in terms of flooding and overheating risk.

3.1.9 The results of the PPCE projections for climate extremes largely substantiate the trends that were projected for seasonal climate averages and average extreme weather events. In doing so, they also provide greater granularity on the seasonal differences within the broader climatic trends. The results of both analyses indicate that air temperatures will increase through to the end of this century. This is consistent across winter and summer mean temperature and mean daily maximum temperatures, as projected in the climatic analysis, as well as the daily maximum temperature for events with 1 in 100-year return period for all seasons, as modelled in the PPCE projections. The increase in numbers of hot days and the heatwaves projected within RCP 8.5 scenario of the climatic analysis also supports these findings.

3.1.10 The increase in winter precipitation through to the 2060s found in the median percentile of the UKCP18 average climatic projections is substantiated by the increase in both 1-day and 5-day maximum winter precipitation events, as modelled through the PPCE projections towards the 2070s. In respect to the decrease in summer precipitation reflected in the average climatic projections, this is supported by the decrease in summer precipitation modelled for 5-day maximum precipitation events as well as driest 1-day and 5-day maximum precipitation events from the PPCE projections. The only aberration here is that summer 1-day maximum precipitation events become wetter through to the 2070s, as modelled through the PPCE projections.

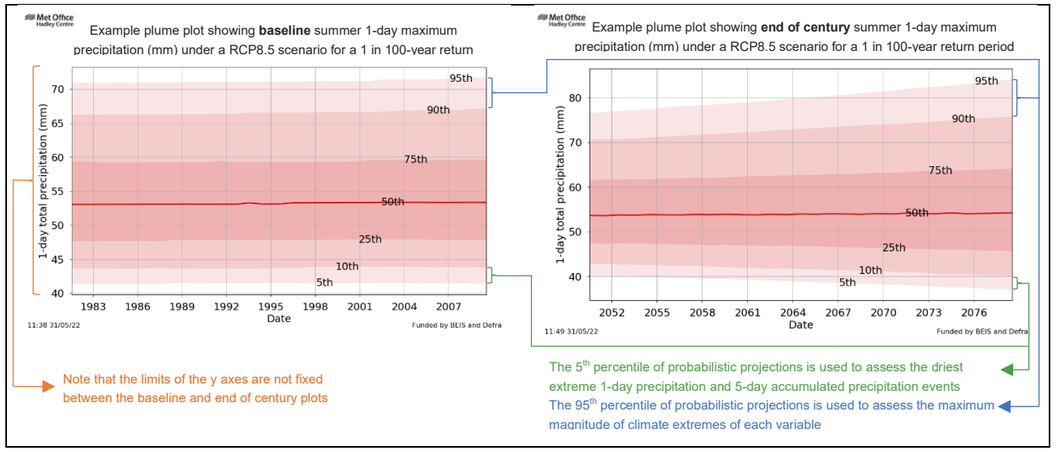
4 Plume plots

4.1.1 Plume plots of the seasonal time series of PPCE baseline (1981-2010) and end-of-century (2050-2079) projections for the intensity of an event are expected once within the 1 in 100-year return period under a high emissions scenario (RCP 8.5), for air temperature at 1.5 m (℃), daily maximum precipitation (mm), and 5-day accumulated precipitation (mm). The plumes display the 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles of the chosen projection. These percentiles represent the uncertainty range for the intensity of an event expected once in 100 years.

4.2 Example plots

4.2.1 The following example diagram displays both a baseline and end of century plume plot for 1-day maximum precipitation events with a 1 in 100-year return period. Annotations have been added to assist with the interpretation of the plots.

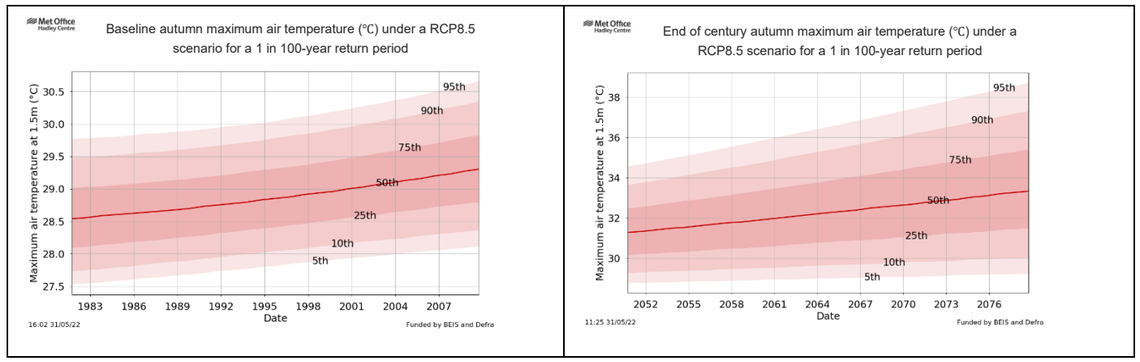
Figure 4.2.1: Example baseline (1981-2010) and end of century (2050-2079) plume plots for 1-day maximum precipitation event with a 1 in 100-year return period



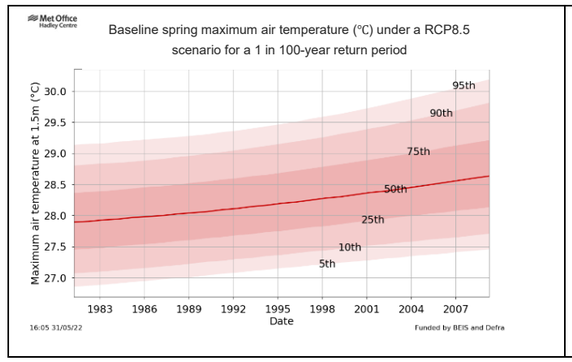
4.3 Maximum Air temperature at 1.5 m (℃)

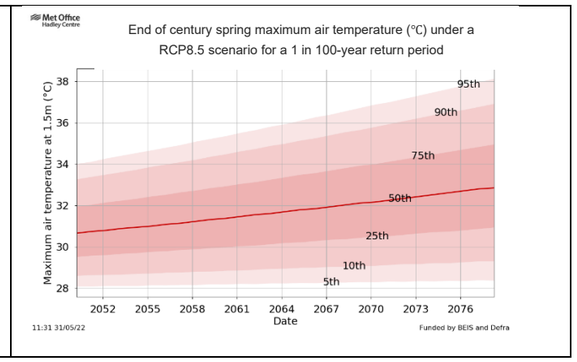
Figure 4.3.1: Seasonal baseline (1981-2010) and end of century (2050-2079) plume plots for maximum air temperature at 1.5 m (℃) events with a 1 in 100-year return period

Autumn

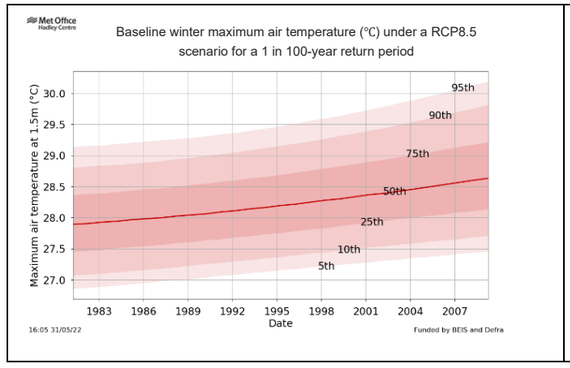


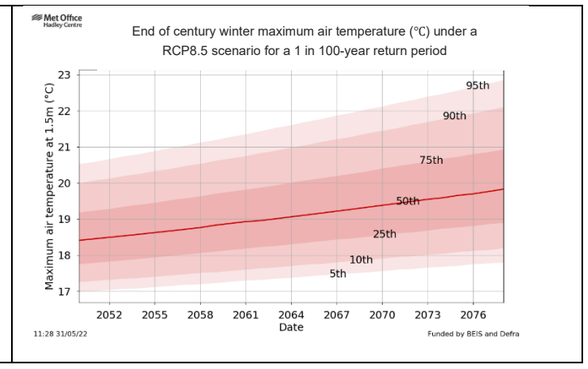
Spring



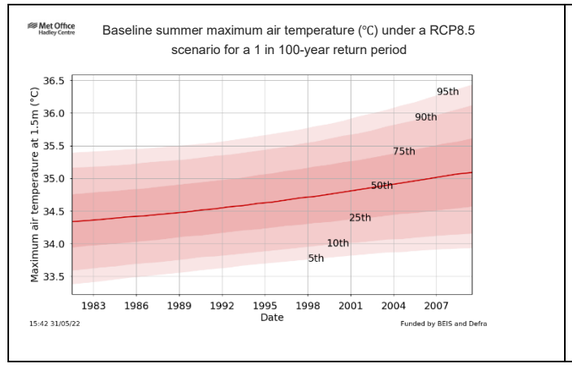


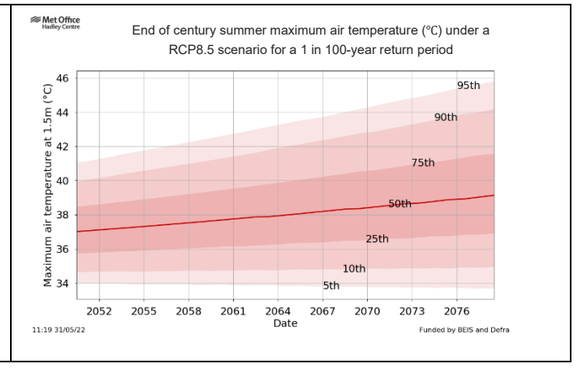
Winter





Summer

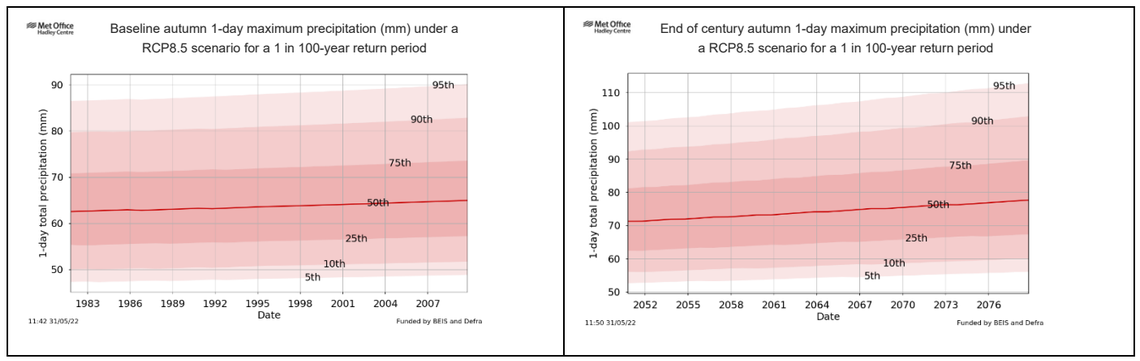




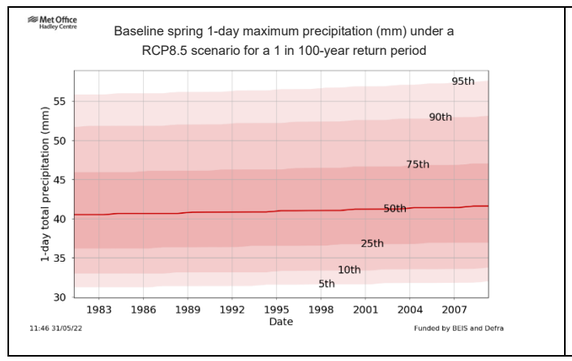
4.4 Daily maximum precipitation (mm)

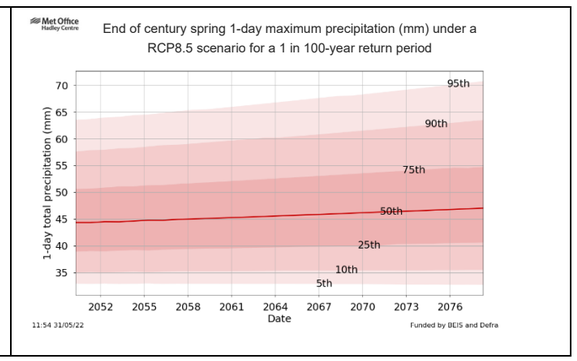
Figure 4.4.1: Seasonal baseline (1981-2010) and end of century (2050-2079) plume plots for 1-day maximum precipitation (mm) events with a 1 in 100-year return period

Autumn

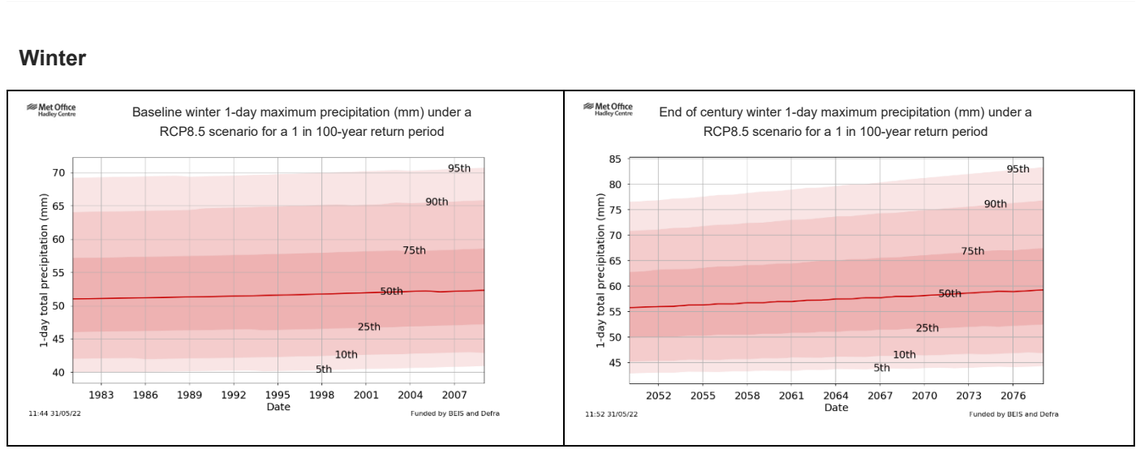


Spring

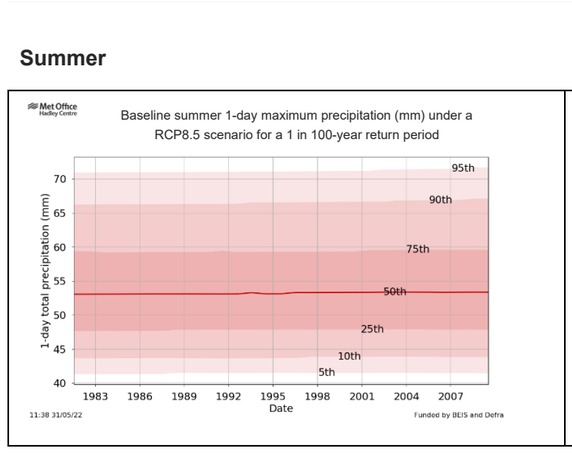


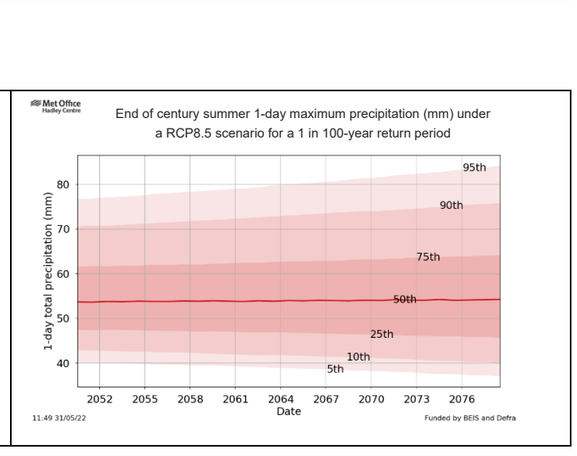


Winter



Summer

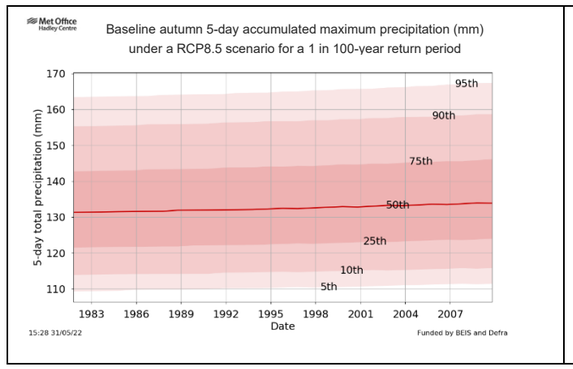


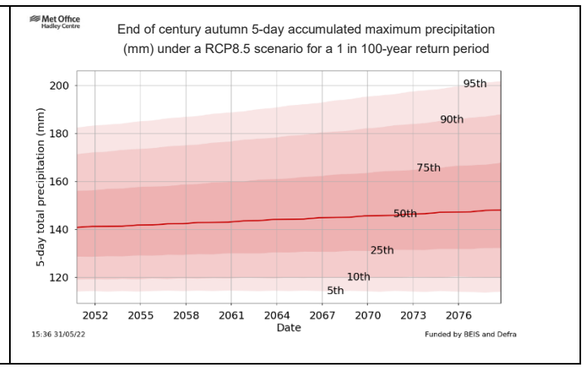


4.5 5-day accumulated precipitation (mm)

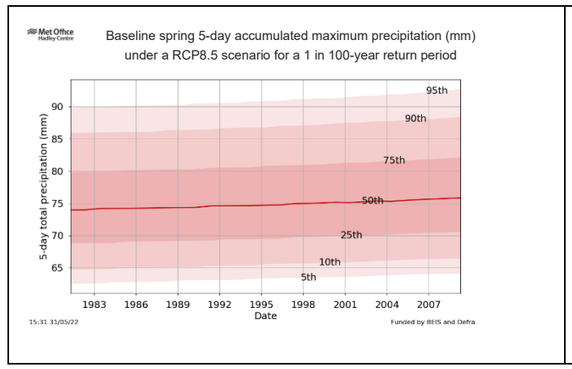
Figure 4.5.1: Seasonal baseline (1981-2010) and end of century (2050-2079) plume plots for 5-day accumulation maximum precipitation (mm) events with a 1 in 100-year return period

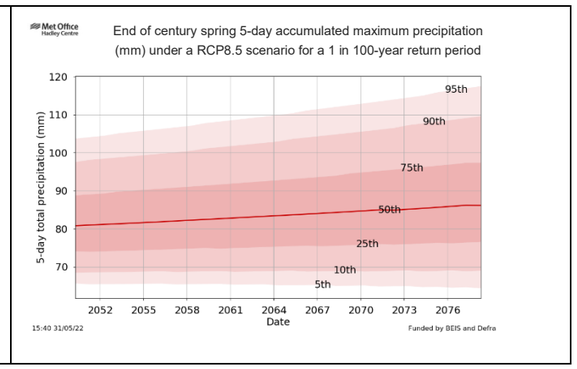
Autumn



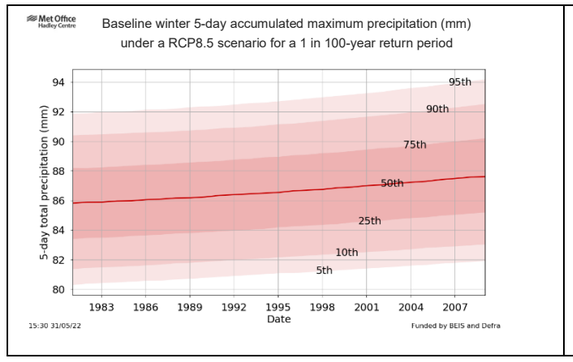


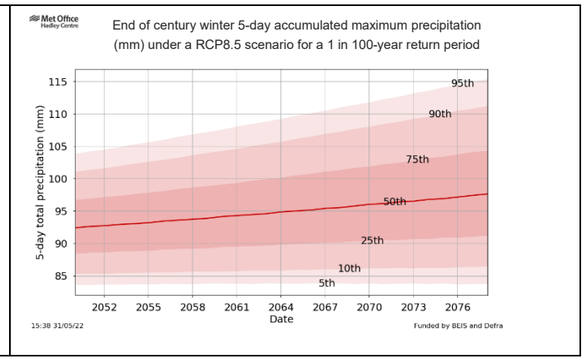
Spring



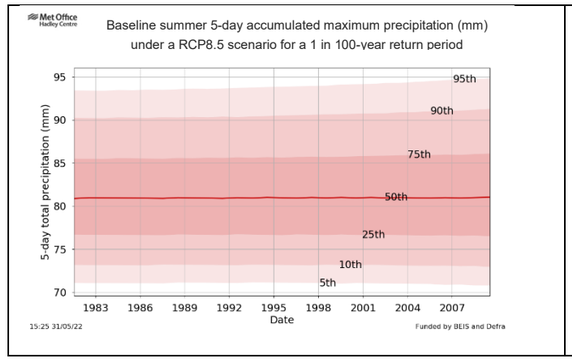


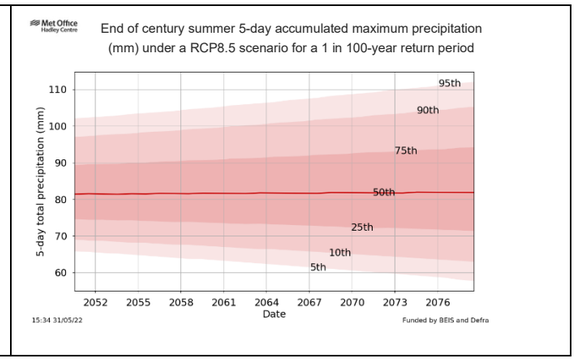
Winter





Summer





5 References

Murphy JM, Brown S and Harris G (2020). UKCP Additional Land Products: Probabilistic Projections of Climate Extremes, Met Office. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcpprobabilistic-extremes-report.pdf. OPEN ACCESS.

6 Glossary

6.1 Glossary of terms

Table 6.1.1: Glossary of Terms

Term	Description
ES	Environmental Statement
PPCE	Probabilistic Projections of Climate Extremes
RCP	Representative Concentration Pathway
UKCP18	UK Climate Projections 2018