

3D Printing the Weather

Lesson Activity Ideas

Overview

Modelling the Central England Temperature Record

These resources will allow your students to make tactile, engaging models of the Central England Temperature record. The models in turn can be used to look at past weather and climate, and at how the climate of the UK has been changing over time.

What is the Central England Temperature (CET) Record?

The CET dataset is the longest instrumental record of temperature in the world.

The data represents the temperature in a roughly triangular area of the United Kingdom enclosed by Lancashire, London and Bristol.

The sources of the data include records kept by individuals around the country, all carefully combined and corrected for factors such as changing instruments over time etc. The precision of the data published for each year reflects the number, accuracy, reliability and geographical spread of the temperature records that were available for that year – so early in the record, the data may only have a precision of 1°C or 0.5°C, whereas more recent data has a precision of 0.1°C.

The mean monthly temperature record starts in 1659 (with daily data being available from 1772 and maximum and minimum daily and monthly data beginning in 1878).

The full dataset and references can be found at www.metoffice.gov.uk/hadobs/hadcet

What is the data we have supplied you with?

In the spreadsheet called [CET_3DModellingDataSet.xls](#) you will see data which looks something like

Central England Temperatures offset by 4 degrees													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1659	7	8	10	11	15	17	20	20	17	14	9	6	
1660	4	8	10	13	15	18	19	20	17	14	10	9	
1661	9	9	10	12	15	18	19	19	17	15	12	10	
1662	9	10	10	12	15	19	19	19	17	15	10	7	
1663	5	5	9	11	14	18	19	19	17	14	11	9	

Each row represents one year and each column the month within the year. So, for example, the highlighted square shows May 1659. The number in the square is the mean temperature in that month *offset by 4°C*. We have done this because it is not possible for you to print negative values. So, the mean temperature in May 1659 is 15°C-4°C=11°C.

To illustrate this in your models, we suggest that you use one colour (maybe blue?) to print values up to 4.0, and another colour (maybe red?) to print everything greater than that.

So, for example, for this selection of years

1737	10.2	8.2	10.1	12.8	16.5	19.9	21.4	17.8	18.2	12.9	10.1	8.9
1738	8.6	8.6	9.5	13.9	15.4	18.2	20.4	20	16.5	14.2	10.3	10.1
1739	8	10.8	9.8	10.7	15.6	19.2	20	18.7	17.1	13.6	7.7	7.2
1740	1.2	2.4	7.9	10.4	12.6	16.8	19.3	18.7	18	9.3	7.3	6.2
1741	5.7	8.4	8.2	11.1	13.3	19.2	19.6	20.7	18.7	15	11.8	7.9
1742	5.9	7.6	8.1	10.6	14.6	19	19.8	19.8	16.7	13.7	8.4	5.1

You can see that January and February 1740 were extremely cold, with the average temperature in January being 1.2-4 = -2.2°C

In addition, at the bottom of the spreadsheet, you can see a row labelled climate:

2015	8.4	8	10.4	13	14.8	18	19.9	19.9	16.6	15	13.5	13.7
2016	9.4	8.9	9.8	11.5	16.5	19.2	20.9	21	20	14.9	9.6	10
2017	8	10.1	12.7	12.9	17.2	20	20.8	19.6	17.5	16.4	10.8	8.8
2018	9.3	6.9	8.9	13.8	17.2	20.1	23.1	20.6	17.7	14.6	12.3	10.9
climate:	8.4	8.4	10.6	12.5	15.7	18.5	20.7	20.4	18.0	14.7	11.1	8.6

This data shows the average 1981-2010 temperature – this is the period which is currently being used as our reference climate. So, in January, you would currently expect a temperature of 4.4°C. In August you would expect 16.4°C. Over the 1981-2010 period, half of the years will be warmer, and half colder than this reference climate. You can compare each year's weather with this reference climate – was that month warmer or colder than our current 'normal'? Has the frequency of warmer or colder years changed over time?

How can the Models be Used in Geography, PSHE and other lessons?

There are many ways the models can be used, but we've supplied you with some specific ideas and resources:

1. The difference between climate and weather
2. The current climate of the UK
3. The changing climate of the UK
4. Looking at past extreme weather events and researching their impacts on people in the UK

Resource 1: The difference between climate and weather

Climate is the average weather for a certain place. We usually define climate as being the 30-year average.

“Climate is what you expect; weather is what you get”

What to print

Between them, the students should print a 30 year period from the 1659-2018 record in the supplied spreadsheet. For this activity, they may like to choose a period which is different to now – i.e. not the last 30 years or 1981-2010.

Questions

First of all, familiarise yourself with the model. Practise finding different months and different years.

Is the average temperature for a particular month the same in each year – for example look at all the January temperatures, are they the same?

Complete this table:

Month	Year when the temperature was coldest	Year when the temperature was warmest
January		
February		
March		
April		
...		

Find the warmest November in your model. Is the October and December temperature for that year also higher than most of the others in your model? Now find the coldest February – were the January and March temperatures relatively cold too?

- Is the weather in one month related to the weather in the months either side of it?

Now find the coldest January in your model. Are the Januarys in the years each side of the coldest January also relatively cold? Look at the warmest August too – are the Augusts on each side of it also relatively warm?

- Is the weather in one year related to the weather in the years on either side of it?

Can you find some examples of when the temperature didn't change in the way that you would expect – for example maybe it got colder between March and April when you

would expect it to get warmer? Maybe it got warmer between November and December when you would expect it to get colder?

In your own words, explain why we use a 30-year period to define the climate of a particular place.

You may like to finish by watching this film:

<https://youtu.be/e0vj-0imOLw>

Resource 2: The current climate of the UK

Climate is the average weather for a certain place. We usually define climate as being the 30-year average.

What to print

Between them, the students should print 1981 -2010 from the 1659-2018 record in the supplied spreadsheet as well as the Climate Comparison Model File.

Questions

First of all, familiarise yourself with the model. Find the year and month that you were born in the model.

Using the full 30-year model, complete the following table

Month	Number of months below the 1981-2010 climate	Number of months above the 1981-2010 climate
January		
February		
March		
April		
...		

What can you say about the number of months below or above the climate line in your model?

How does the UK climate vary through the year? When are the warmest months, when are the coldest months?

Looking at each year in turn, do you see the same pattern of warming and cooling?

How do the extremes of climate compare to the annual range in climate? For example, is the difference between the warmest July and the coldest July actually bigger than the normal difference between July and August? Do the same for other months.

Are you surprised by anything that you have discovered?

Resource 3: The Changing Climate of the UK

Climate is the average weather for a certain place. We usually define climate as being the 30-year average.

What to print

Each student or group of students should print a ten year block chosen from the 1659-2018 record in the supplied spreadsheet as well as the Climate Comparison Model File.

To look at 20th Century Climate change, print the following blocks (if you can't print them all, print as many as you can, choosing them in the order given below – i.e. if you can only print 4, print the top 4)

2009-2018

1899-1908

1909-1918

1919-1928

1999-2008

1989-1998

1969-1978

1939-1948

1959-1968

1979-1988

1929-1938

1949-1958

Questions

For each block, complete the following table:

Month	Number of months below the 1981-2010 climate	Number of months above the 1981-2010 climate
January		
February		
March		
April		
...		

If the climate in your block was the same as our climate at the moment, you would expect there to be an equal number of months in which the weather was colder or warmer than the current climate – i.e. you would have a 5 (or maybe a 4 or 6) in both columns.

For your block, are you seeing more months which are colder or warmer than the current climate? Is there a difference through the year?

Climate is usually defined as the average of 30 years of weather data. Can you put the data in your table together with the data from students who have modelled blocks near yours so that together you have 30 years of data and can start to get a picture of the climate? Now what can you say about how the climate has changed between your period and the 1981-2010 reference period we are using?

For teachers – here is a completed table for 1899-1909

Month	Number of months below the 1981-2010 climate	Number of months above the 1981-2010 climate
January	6/7	3/4
February	6	4
March	7	3
April	8	2
May	9	1
June	7	3
July	5	5
August	8	2
September	10	0
October	8	2
November	6	4
December	8/6	2/4

To look at the Little Ice Age in the UK, print the following blocks (if you can't print them all, print as many as you can, choosing them in the order given below – i.e. if you can only print 2, print the top 2)

1700-1709

1770-1779

2000-2009

1850-1859

1660-1669

Questions

For each block, complete the following table:

Month	Number of months below the 1981-2010 climate	Number of months above the 1981-2010 climate
January		
February		
March		
April		
...		

If the climate in your block was the same as our climate at the moment, you would expect there to be an equal number of months in which the weather was colder or warmer than the current climate – i.e. you would have a 5 (or maybe a 4 or 6) in both columns.

For your block, are you seeing more months which are colder or warmer than the current climate? Is there a difference through the year?

What can you say about the weather in your 10-year period? What impact do you think this will have had on the people living then?

See what you can find out about the Little Ice Age in the UK and elsewhere in the world.

For teachers – here is a completed table for 1700 – 1709

Month	Number of months below the 1981-2010 climate	Number of months above the 1981-2010 climate
January	8	2
February	9	1
March	10	0
April	6/7	3/4
May	6	4
June	5/6	4/5
July	7/8	2/3
August	6	4
September	6/7	3/4
October	9	1
November	8	2
December	8	2

Resource 4: Looking at Past Extreme Weather Events and Researching their Impacts on People in the UK

An extreme weather event is an extended period of hot or cold (or windy or wet) weather relative to the expected conditions of the area at that time of year

What to print:

Each student or group of students should print a ten-year block chosen from the 1659-2018 record in the supplied spreadsheet. These could be chosen at random, but we would specifically suggest

2009-2018

1700-1709

1720-1729

1735-1744

1790-1799

1810-1819

1960-1969

1970-1979

Questions:

- Which years stand out in your model as being abnormally cold or warm? Be careful to look at each month separately – look for cold or warm Januarys, Februarys etc. in turn.
- What is the difference in temperature between the coldest and warmest years? Does this sound a lot, or not? Your model shows the average temperature for each month – what might this mean for the actual temperatures on a particular day or night?
- What do you think the impact of colder or warmer temperatures in the winter is? What do you think the impact of colder or warmer temperatures in the summer is?
- Use the web, or, if your model shows a period within living memory – the memories of your community, to find out about the weather in the months which you have identified as being most extremely hot or cold. What impact did that weather have on people in the UK?

Recommended sources:

<https://www.nottingham.ac.uk/geography/extreme-weather/search/>

<http://www.breadandbutter-science.com/Weather.pdf>

<http://www.pascalbonenfant.com/18c/geography/weather.html>

<http://premium.weatherweb.net/weather-in-history-1950-to-1974-ad/> (and other periods)

Copyright & Credits

This resource was brought to you by the Royal Meteorological Society and The CREATE Education Project.



© Royal Meteorological Society and Create Education Project Ltd. 2019.

These resources have been produced for educational use to support schools who wish to explore the weather and climate and/or to utilise 3D printing technology.

For more free weather and climate resources visit the Royal Meteorological Society at <https://www.metlink.org>

For learn more about 3D printing in education and to access free 3D printing classroom projects, ideas, professional development resources and much more visit www.createeducation.com



This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

To view a copy of this license visit <http://creativecommons.org/licenses/by-nc-sa/4.0>