Using Curated Datasets

Met Office Weather Observations Website

Royal Geographical Society with IBG
Advancing geography and geographical learning

https://wow.metoffice.gov.uk/

Met Office Weather Observations Website (WOW)

The WOW site is a collection of meteorological records taken from over 10,000 weather stations run by both the Met Office and by members of the public. While many of the records are made through Automatic Weather Stations (AWS) that upload data through an internet connection, there remains a strong element of citizen science in the running of the site as it relies on a large community of weather watchers to inform and keep the site updated. WOW covers almost all of the UK as well as large sections of Europe and the USA.

How do I access the data?

The homepage of the WOW site shows a map of the UK with the most recent temperature readings displayed by default. In this overview mode one can change the nature of the data displayed (named on the site as a **Layer**) to enable one to look at the overall weather picture for the UK. It is important to recognise that not all weather stations will display the same level of detail as others. You might not wish to use some weather station data if you question the accuracy of citizen science or wish to have a smaller sample size that consistently measures the same aspects of weather and climate. The **Filters** menu shows you the four different sources of weather station sites available: **WOW Observations**, **Official Observations**, **Climate Sites** and **Registered Sites**. It is also worth noting that outside the UK, some countries show greater or lesser representation of weather station observations according to which source of data you choose.

From the home screen, you can select the data from a weather station to view using a locational identifier such as longitude, latitude or a location name. Alternatively, you can scroll through the map and select a weather station manually. Once you have selected a particular weather station this brings up the current readings for that site in a separate panel and a five day forecast is also provided. Clicking **View Full Observation** takes you to that weather station's site. Here, you can see a more detailed map of the location as well as information about who runs the station and why. Selecting the **Table** tab gives you an option to choose what time period of data you wish to view by choosing **Start and End Dates**. In the **Observation Options** tab you can also choose the nature of the data being displayed as well as various **Weather Impact Options**. Once the right filters have been applied, selecting **Update Table** will renew the table at the bottom of the page and populate it with the appropriate data. You can then **Export** the data to an Excel file from where one can manipulate the data and analyse it.

The **Graph** tab also allows you to filter data by time period and observation and will then draw a graph of the results - a useful tool if one selects more than one observation so these can be directly compared with one another.

Layers of data held on WOW

- Temperature
- Dew point temperature
- Rainfall rate
- Wind speed and direction
- Humidity
- Pressure
- Snowfall
- Soil moisture
- Magnetometer readings
- Present weather (using standard weather map descriptors)
- Weather impacts (reported disruptions and damage)
- Photographs
- Webcam views

This project was funded by the Nuffield Foundation, but the views expressed are those of the authors and not necessarily those of the Foundation.

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How can I use this in my teaching?

Weather and Climate is an appropriate topic at every key stage. Though the mechanics of weather have fallen away from curriculum focus in recent years, weather and climate data still has enormous relevance through their link to climate change and global systems. The sheer volume of weather stations covered by the WOW site makes it a really valuable tool for students regardless of the location of their study site, as well as the different layers and observation options available to them. Of great use is the link the WOW site makes between weather and weather impacts, such as through reported damage and disruption records. These help students to realise the close connection there is between weather and their own lives. Climate data can also be linked to any study of ecosystems and habitats which can be found in a chosen study area.

For those schools and departments that have the means, the purchasing of a simple AWS, which will allow students to feed their own data into the WOW site is a great way to ignite interest in weather data and how it is collected, as well as create avenues for direct use in the classroom. The nature of the WOW data recording and collation system also highlights to students the value of citizen science and the possible problems it may have with regards to accuracy and reliability.

Curriculum Links

This curated dataset links to a number of parts of the National Curriculum and is relevant to GCSE and A Level Specifications.

Key Stage Three: An understanding of geographical similarities differences and links between places through the study of physical geography.

An understanding, through the use of place-based examples, of the key processes in physical geography relating to weather and climate.

An understanding of how human and physical processes interact to influence and change the climate.

GCSE: A knowledge and understanding of the UK's geography including its physical landscapes.

A knowledge of the causes and consequences of extreme weather conditions and natural weather hazards.

A knowledge of the spatial and temporal characteristics of climate change.

A knowledge of the distribution and characteristics of global ecosystems.

A Level: A knowledge and understanding of the distribution and size of stores of water in the atmosphere and the factors driving changes in the size of these stores.

A knowledge and understanding of the pathways which control the cycling of water between land, ocean, atmosphere and cryosphere.

The following specifications make particular reference to weather and climate:

GCSE:			**A Level:**	
AQA	Cambridge IGCSE		AQA	CIE
Edexcel A	Edexcel B	Eduqas A	Eduqas A	
Eduqas B	OCR A	OCR B		

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An example data walk-through

A student wishes to investigate how conditions varied across the UK during an extreme weather event. The event they are interested in is the 2017 heat wave which is widely reported to have seen record temperatures in a number of different locations. The student wants to see if there was a distinct temperature difference between inland and coastal areas when one compares data during the heatwave and during normal conditions.

First, the student selects the two weather stations to be considered from the home page map. The student wishes to be able to view as many sites as possible to allow for a logical locational choice to be made, so chooses to **Filter** the map and only view **WOW observations** and **Official Observations**. Then the student chooses, simply by eye, one as close to the centre of the UK as possible (**Church Lawford** in Warwickshire) and another in a coastal location that sits on roughly the same latitude (**Gorleston** in Norfolk) to allow as close a comparison to be made as possible. The student believed that during a heat wave the differences between inland and coastal air temperatures would be greater than during 'normal' conditions as the air temperature would rise so much quicker during the day and take far longer to drop off as the sun went down.

21st June 2017	6am	12pm	6pm
Church Lawford	14.6°C	28°C	28.5°C
Gorleston	16.5°C	19.2°C	19.7°C

21st June 2018	6am	12pm	6pm
Church Lawford	10.5°C	17.1°C	16.2°C
Gorleston	13.1°C	14.3°C	15.2°C

For each site they view the **Full Observation** to get to the **Table** tab from where they select and record data from two dates: 21st June 2017, when it was known to be a record breaking day and the same day one year later which the student considered to be more normal conditions. This data was then **Exported** to an Excel spreadsheet and further data was extracted. It was decided that three time periods should be considered to enable temperature progression and regression throughout the day to be noted. Data was extracted for three time periods - **6am**, **12pm** and **6pm** (see above) and the temperature differences between the inland and coastal site for each time period was calculated (see below).

Temperature differences between inland and coastal sites	6am	12pm	6pm
21st June 2017 (during heatwave)	1.9°C	8.8°C	8.8°C
21st June 2018 ('normal' conditions)	2.6°C	2.8°C	1°C

The data from the WOW site shows that in these very particular circumstances there was indeed a greater temperature range between inland and coastal locations in a period considered a heatwave than in those conditions considered 'normal', with the exception being in the initial hours of the morning when the greater difference was in the later year. However, when considering the limitations of the data and how it was collected, the student noted the very small sample size, the considerable arbitrary nature of the locations chosen and the highly specific nature of the data itself. Further locations could be chosen and a greater range of 'normal' years be considered to allow for more meaningful conclusions to be made.

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Suggested delivery activities

Future climates

Weather and climate data can be used to look at long term trends for particular locations. For example, precipitation data can be graphed over time and students can look for signs of increasing frequency and intensity of rain events. Students can calculate the probability of rain happening in a particular month based on past data.

Once graphed, students can also look to extrapolate trend lines and predict how the nature of rain events may change in the future. Students should think about the scale of the data they have used and the effect this might have on the accuracy, reliability and workability of the future predictions they are able to create. This can relate further to a discussion about sample size and its effect.

Climate flipbooks

Students can investigate how the climate of the UK changes as one moves across it. They can draw a transect line across a map of the UK where they predict that climate will be different at each end (for example from the South West to the North East) The line should run through, or be close to running through at least ten monitoring sites.

Using monthly averages data, students can draw a climate graph for each location on pre-determined scaled axes so that when stacked on top of each other, can create a climate flipbook, and each climate graph is directly comparable with the next. Before the flipbook is flipped, students might like to predict what pattern the flipbooks will show along their transect.

Urban Heat Islands and GIS

Using the latitude and longitude coordinates for different monitoring sites and their temperature data, students can create GIS maps that compare the degree of urban/rural land use (through an index which can be designed by the students, with the maximum and minimum temperatures found there, or indeed the temperature range found there. This may allow them to see if the idea of urban heat islands is played out in the UK and the scale to which it occurs. A digital map provider such as ArcGIS will allow students to see if there is any correlation between the locations that are considered most urban and those that experience the highest temperatures. It also provides the means for students to critique and evaluate whether the scale and frequency of monitoring stations is able to give them accurate results.

Spearman's Rank Correlation Coefficient

Students can use a statistical test such as Spearman's Rank to see if there is any meaningful relationship between two sets of weather data. Spearman's Rank takes pairs of data (for example data covering two variables that was recorded at a single location) and shows the extent of any correlation between them. For example, students may have learnt about the theoretical connection between air pressure and humidity—that air at low pressure might have the ability to hold more moisture. Using a stats test can tell students the nature of any correlation (if it is positive or negative) between them and the strength of that correlation, as well as if the results came about by chance or if they were significant. A guide to Spearman's Rank Correlation Coefficient appears on the next page.

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A Guide to calculating Spearman's Rank Correlation Coefficient using data from weather stations

Spearman's Rank Correlation Coefficient (SRCC) is a simple statistical test which allows researchers to calculate the degree to which two sets of data are meaningfully correlated and the strength of that correlation. The two sets of data cover two variables taken at multiple locations or at different times. A minimum of fifteen pairs of data is advisable to make SRCC work.

The final result is given as a value between –1 (a perfect negative correlation) and +1 (a perfect positive correlation). Geographers use SRCC to find correlations in data which they already believe (perhaps through their understanding of geographical theory) should have a meaningful relationship.

Using the data from the WOW site, a student might wish to see if there is a significant correlation between air pressure and humidity with records from fifteen different locations at the same time on the same day.

Worked example:

The relevant data was extracted and downloaded from the WOW site (for 30th January 2020 at 12pm) and placed into a table:

Location	Air pressure (MSLP)	Rank 1 (R_1)	Humidity (%)	Rank 2 (R_2)	R_1 - R_2 (d)	d^2
Benson	1002	12	97.3	9	3	9
Bingley	996	6	96.6	11	-5	25
Bournemouth Airport	1002	12	98.6	3	9	81
Bridlington	996	6	89.6	14	-8	64
Cambourne	1003	14.5	98.0	5	9.5	90.25
Capel Curig	996	6	96.0	12	-6	36
Church Lawford	1000	8.5	97.4	8	0.5	0.25
Coningsby	1000	8.5	93.5	13	-4.5	20.25
Eskdalemuir	992	3	99.3	1.5	1.5	2.25
Inverbervie	985	2	97.9	7	-5	25
Loch Glascarnoch	978	1	85.0	15	-14	196
Manston	1003	14.5	96.7	10	4.5	20.25
Mumbles Head	1001	10	98.0	5	5	25
St Bees Head	994	4	98.0	5	-1	1
Wattisham	1002	12	99.3	1.5	10.5	110.25

Each set of data was then ranked. Those ranks were subtracted from one another (the difference or d) and the result squared to remove any negative numbers. The sum of these d^2 values was calculated (in this case, it was 705.5). The following equation was then used to calculate the coefficient (r_s). n is the number of paired sets of data .

$$r_s = 1 - \frac{6 \Sigma d^2}{n^3 - n} \qquad r_s = 1 - \frac{6 \times 705.5}{3375 - 15} \qquad r_s = 1 - \frac{4233}{3360} \qquad r_s = 1 - 1.260$$

The r_s calculated value is –0.26. This indicates a very weak negative correlation between air pressure and humidity. As it is the result can be dismissed as too weak to draw conclusions from but in other circumstances, the calculated result should be compared to a critical value derived from a SRCC significance table to determine if the result is statistically significant of not.

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