Background Information for Teachers

The data used in this exercise was obtained via the Met Office's WOW website (wow.metoffice.gov.uk). The weather station chosen – Lowood House, is to the north west of Edinburgh, on the east coast of Scotland.

Rainfall can be convective due to a polar source or air mass (and enhanced by orographic uplift) and/ or due to frontal rainfall. In each case, the rainfall comes from rising air – either because the air is being warmed from underneath (polar air mass), pushed up by the land surface (orographic) or because warmer air is pushed up when it meets colder air (frontal). As the air rises, it cools to the point where condensation exceeds evaporation and cloud droplets form.

When there are westerly winds:

- The air mass is polar maritime.
- Most of the rain will be on the west coast – by the time the air gets to the east coast, most of the rain will have already fallen.

When there are easterly winds:

- The air mass is polar continental.
- Although it's continental, it'll have picked up enough moisture crossing the North Sea to give rainfall on the east coast. By the time the air gets to the west coast, most of the rain will have already fallen.

When there is a **front**, there can be rainfall anywhere on the front. Because the air moves around a depression in an anticlockwise direction, the direction of air motion on a front is almost always westerly.

This means that:

In the west of Scotland

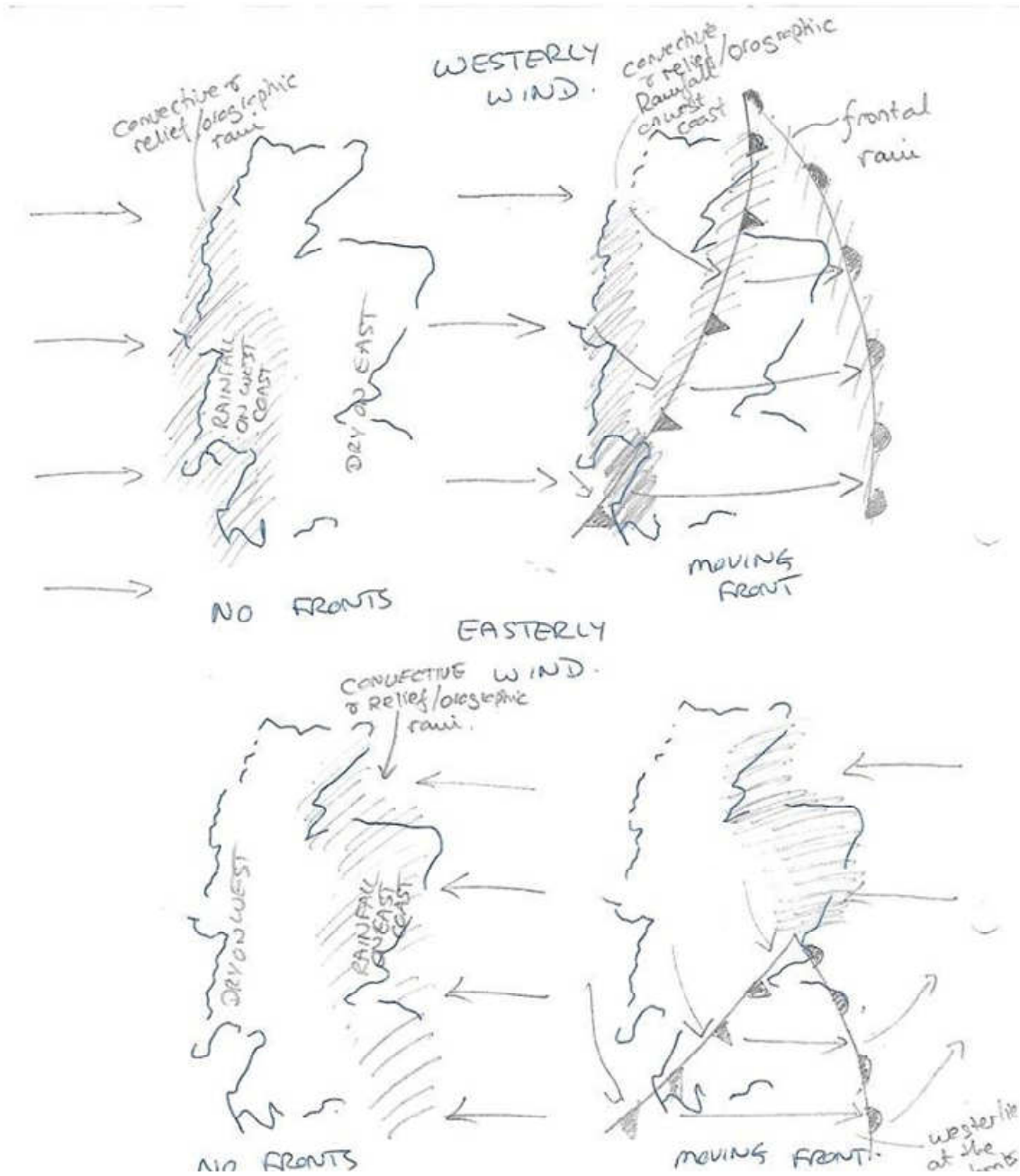
- With a westerly, rainfall can be frontal or because of the air mass (convective).
- With an easterly, rainfall is unlikely.

In the east of Scotland

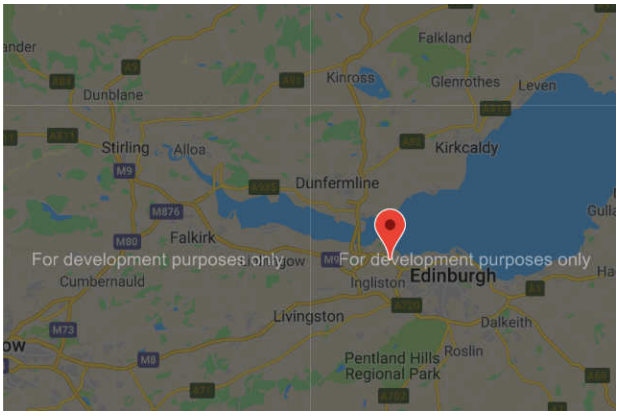
- With a westerly, rainfall can only be frontal
- With an easterly, rainfall is usually because of the air mass

So, if we want a situation where rainfall is linked to pressure, we'd better look at a location in the east of Scotland where any rainfall is likely to be on a front, and therefore linked to a depression.

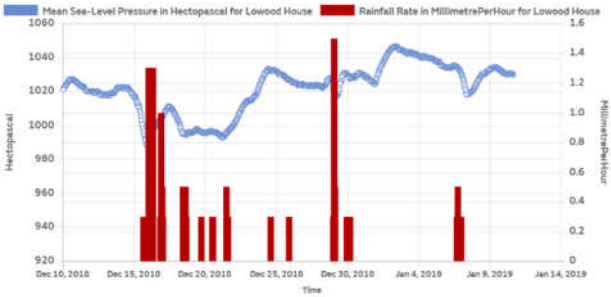
I've tried to illustrate this in the diagrams below:



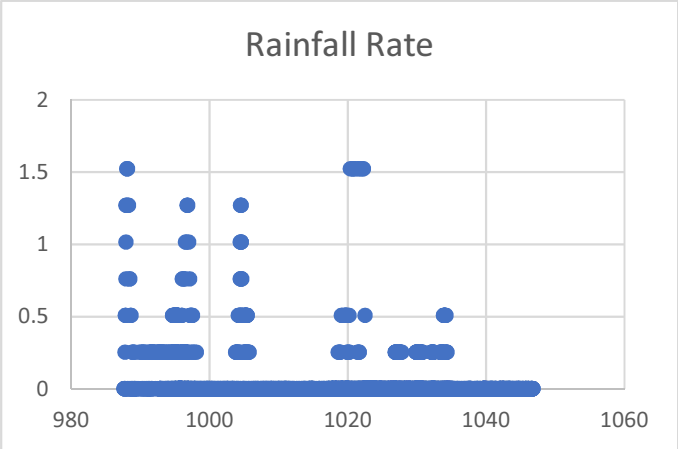
The location of Lowood House weather station:



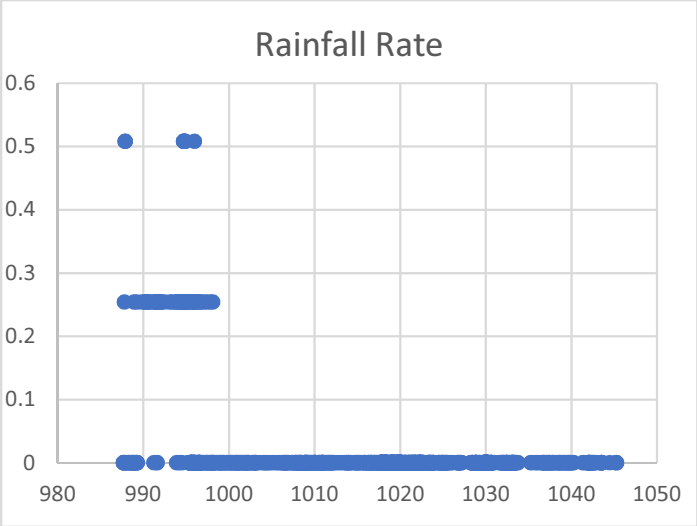
Here is a graph showing rainfall and pressure – it is promising, there is clearly rainfall whenever the pressure is low:



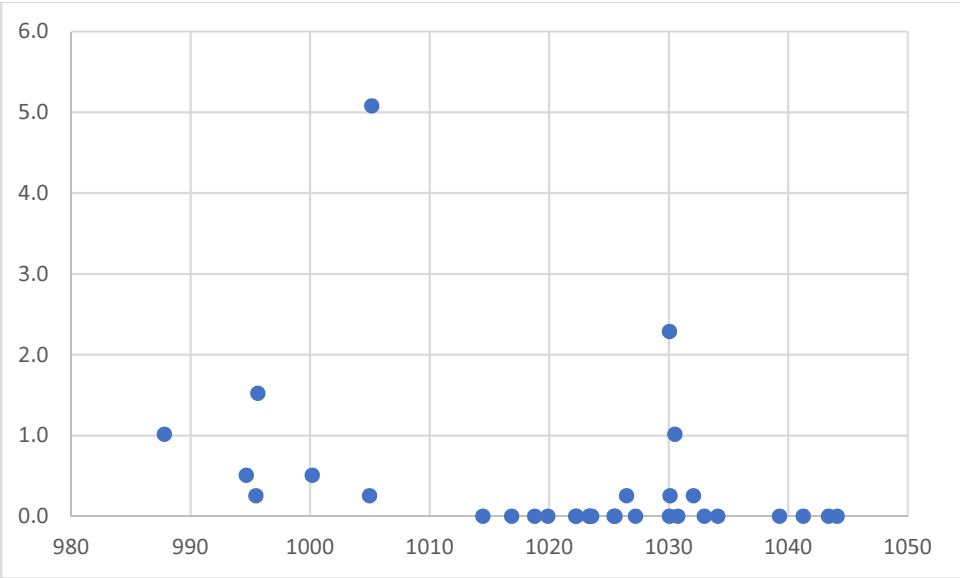
However, if we look at a scattergraph of pressure against rainfall, it clearly shows that it doesn't just rain when the pressure is low:



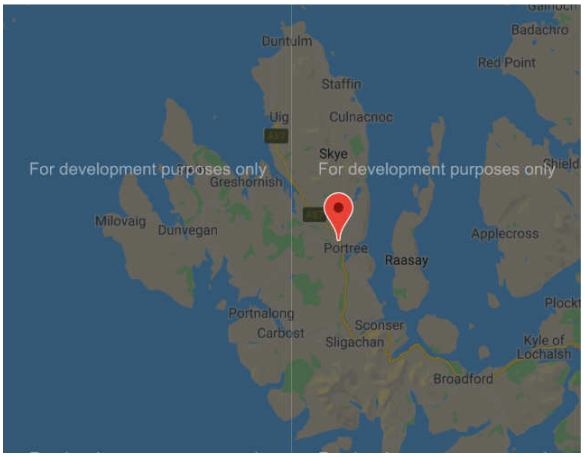
However, if we do the same thing again selecting only those times when the wind is from the west (and any polar maritime airmass related rainfall is likely to have been rained out over the west coast) we get a much clearer relationship:



In the simplified data given to the students, we have used daily total rainfall and mean pressure so that there are fewer data points and have included all wind directions. Their scatter plots should look like:



For reference, let's repeat the exercise for Portree, a weather station on the Isle of Skye:



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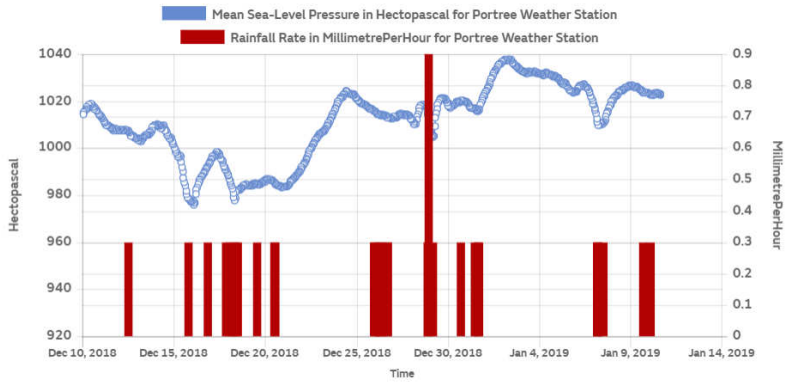
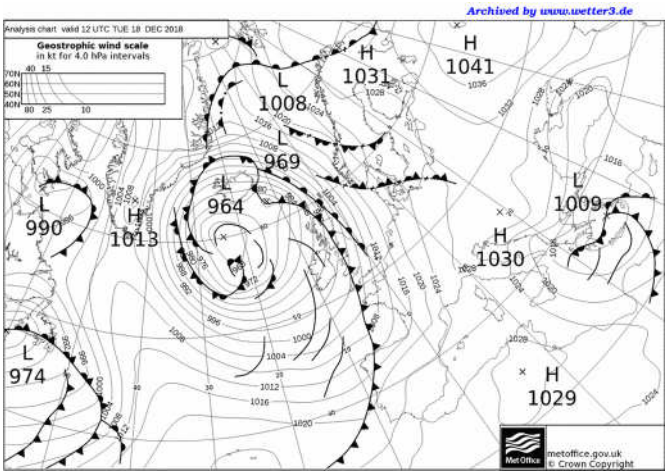
The graph below suggests a less clear relationship between pressure and rainfall, because, as we explained above, it is much harder to separate polar maritime related precipitation from frontal rainfall:



The extension exercise gives the students the weather maps for 4 of the days when it rained: the first 3 show when the pressure was low and the 4th shows when the pressure was high and it rained. In each of the maps, a front has passed through Edinburgh giving the rainfall – unusually for the 4th case, this occurs when the pressure is relatively High (but still lower than the High over Spain/ France – this was a front associated with a depression, it's just that the pressure values in the depression were all relatively high). Students should recognise that all types of front (cold, warm, occluded) give rainfall.

1)


Archived by www.wetter3.de
Analysis chart valid 12 UTC TUE 18 DEC 2018
Geostrophic wind scale
in kt for 4.0 hPa intervals
H 1031
H 1041
L 1008
L 969
L 964
L 990
H 1013
L 1009
H 1030
L 974
H 1029
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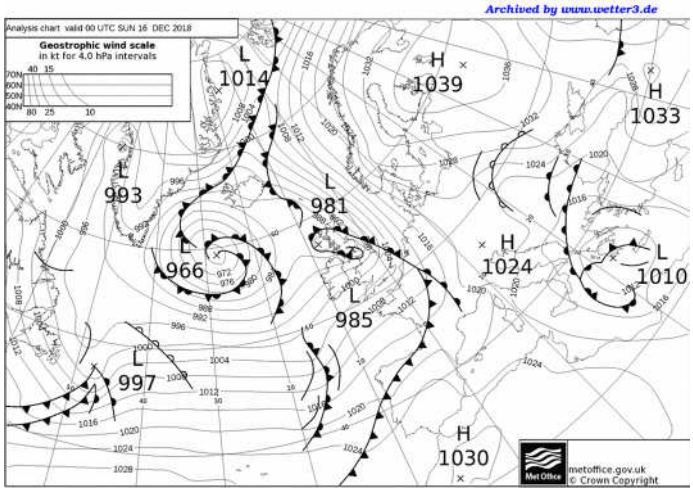
2)


Archived by www.wetter3.de
Analysis chart valid 00 UTC SUN 16 DEC 2018
Geostrophic wind scale
in kt for 4.0 hPa intervals
L 1014
H 1039
H 1033
L 993
L 981
L 966
H 1024
L 1010
L 985
L 997
H 1030
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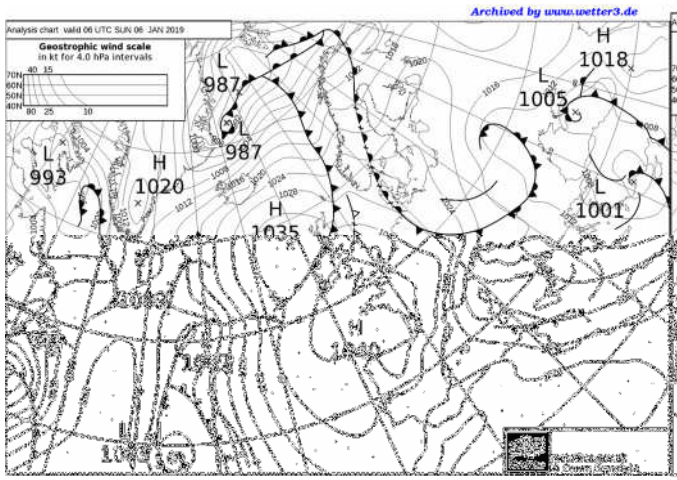
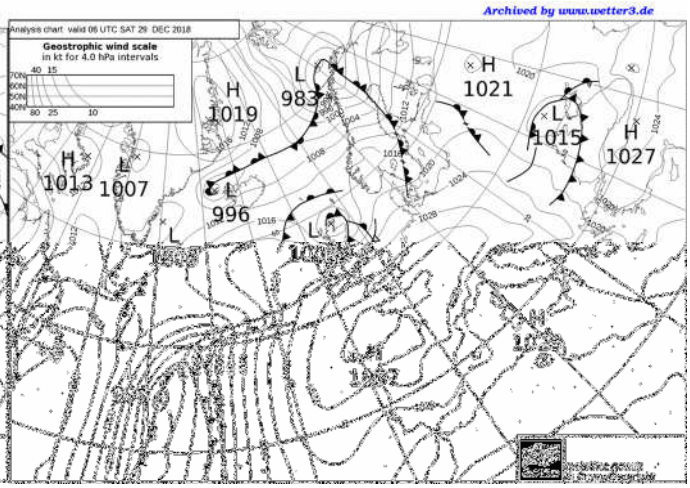
3)


Archived by www.wetter3.de
Analysis chart valid 06 UTC SUN 06 JAN 2019
Geostrophic wind scale
in kt for 4.0 hPa intervals
H 1018
L 987
L 1005
L 987
L 993
H 1020
H 1035
L 1001

4)


Archived by www.wetter3.de
Analysis chart valid 06 UTC SAT 29 DEC 2018
Geostrophic wind scale
in kt for 4.0 hPa intervals
H 1021
H 1019
L 983
L 1015
H 1027
H 1013
L 1007
L 996