Meteorology: Atmosphere and Environment
Hand-in Assignment 2018

Posted on Learn: Wednesday 10 October
Hand-in deadline: Wednesday 24 October, 12 noon
Hand in electronically via Learn. If you encounter problems handing in electronically, take a hard copy to Grant Teaching Office, Grant 332 by the deadline. Complete the 'Own Work Declaration' on Learn/at Grant 332.

There are penalties for late submission of work: a reduction in the maximum possible mark by 5% per day for submissions up to 5 days late, and zero marks for submissions more than 5 days late. Extensions will only be granted for special circumstances; you should contact your Personal Tutor if you need to request an extension, and also let the course organiser/secretary know that your work will be late.

This assignment will be marked out of 100, and contributes 1/3 of your coursework marks and 10% of your overall mark for the course. If you do not hand it in, your maximum possible coursework mark will be 66%; a coursework mark of at least 40% is required to pass the course.

Please produce this assignment on a computer, and hand in the electronic copy via Learn. You may have hand-written work – if so, please scan this and also hand in this electronically. For several of the questions, the answers are best presented as a table. I am expecting about 3-4 pages to be handed in – if you have much more than this you are probably waffling too much, and are liable to lose marks.

The Excel workbook Obs2018.xlsx (also Obs2018b.xls – earlier version of Excel) in the Learn Assignment folder contains a spreadsheet of observations recorded in the second week of lab sessions, with each set of observations identified by an observer number (this is part of your submitted data, with a few minor edits by me; NB there are three 'sheets' in the Excel file: one for Monday, Tuesday and Thursday).

At the end of this document there are four figures:

Figure 1: Air temperature (°C) measured by the JCMB Automatic Weather Station, 0905 (BST) Monday 01/10/18 to 1600 (BST) Friday 05/10/18.

Figure 2: As Figure 1, but Pressure (on the roof of JCMB) (hPa).

Figure 3: As Figure 1, but relative humidity (%)

Figure 4: Surface pressure, winds and 500-1000 hPa thickness (red dashes) for 1200 UTC (1300 BST) on Thursday 4 October 2018.

Contact David Stevenson (dstevens@staffmail.ed.ac.uk) if you have any questions.

Please answer the following five questions.

Question 1

With thousands of weather observations being made around the world every hour, it is very important for the Met Office to be able to identify erroneous measurements and reject them before assimilating observations into a numerical weather forecast. Two simple ways of doing this are to compare observations with expected ranges of the variable being measured, and to "buddy check" measured variables at a station with the same variables measured at nearby stations, looking for suspiciously large differences. By comparing the observations made by observers in each lab group, identify measurements that are clearly wrong. Make a list giving the observer number, the name and value of the variable, and the likely cause of the error (e.g., measurement error, calculation error, or data in incorrect units, etc.) in each case. (You should find the total number of clear errors to be somewhere between 15 and 40; there are some more borderline erroneous data too – you will need to use your judgement to decide what is definitely wrong and what are true variations.)

[25 marks]

Question 2

(a) After removing any measurements that you believe to be erroneous, calculate the average and standard deviation of the air temperature, maximum temperature, minimum temperature, wet-bulb temperature, dew-point temperature, relative humidity, and sea-level pressure measurements for each lab group (if you don't know what the standard deviation is, look it up on Wikipedia or the Excel help; an example calculation of average and standard deviation values is highlighted in red in the Excel sheet with the lab data). Report values to one decimal place for temperatures and pressures, and to zero decimal places for humidity.

[15 marks]

(b) You will find a spread of values for each quantity (the standard deviation is one useful quantitative measure of this spread). Which factors contribute to this spread in values for each quantity in each lab group? Why is the spread larger for some quantities compared to others?

[10 marks]

Question 3

(a) Figures 1-3 (below) show air temperature, relative humidity, and pressure from the JCMB AWS. What ranges of air temperature, relative humidity, and pressure were measured by the automatic weather station during the Monday, Tuesday and Thursday labs? (Assume the Monday and Thursday labs started at 2pm, and the Tuesday lab started at 10am, and that measurements were all taken in the 1st hour.)

[15 marks]

(b) Compare the range of AWS measurements found in 3a with the lab measurements of air temperature, relative humidity and pressure found in 2a. Suggest reasons for any differences.

[10 marks]

Question 4

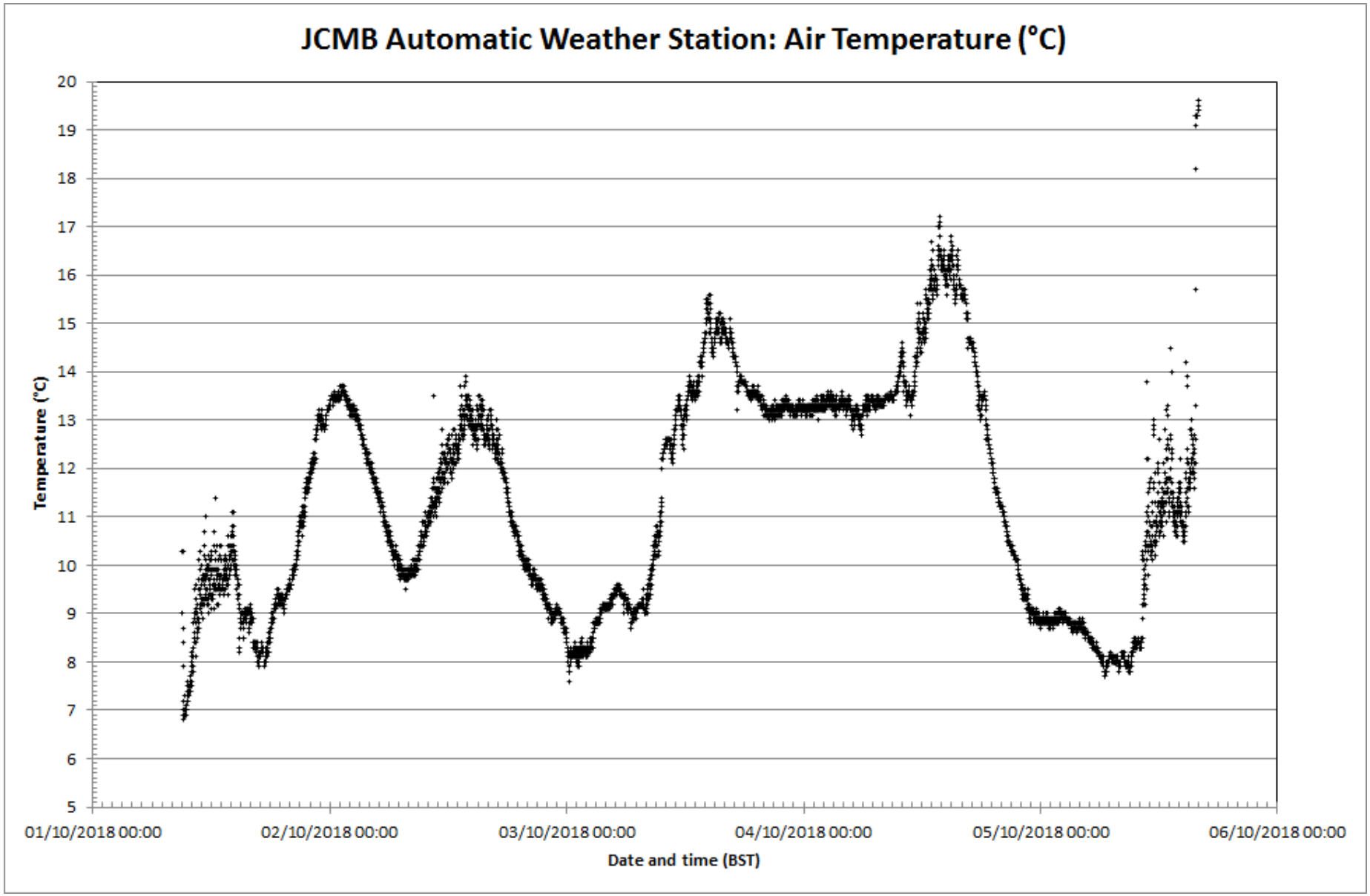
The maximum and minimum thermometers at JCMB are reset once a week (around 0900 on Friday) – this is not the standard procedure at official sites. At official sites, maximum and minimum thermometers are reset daily at 0900 (local time). Using the automatic weather station data, calculate the maximum and minimum temperatures that would have been read at JCMB during the three labs (assume the reading takes place at 3pm on Monday/Thursday and 11am Tuesday) if the maximum and minimum thermometers had been reset daily at 0900 (BST). (Clearly show where your answers come from).

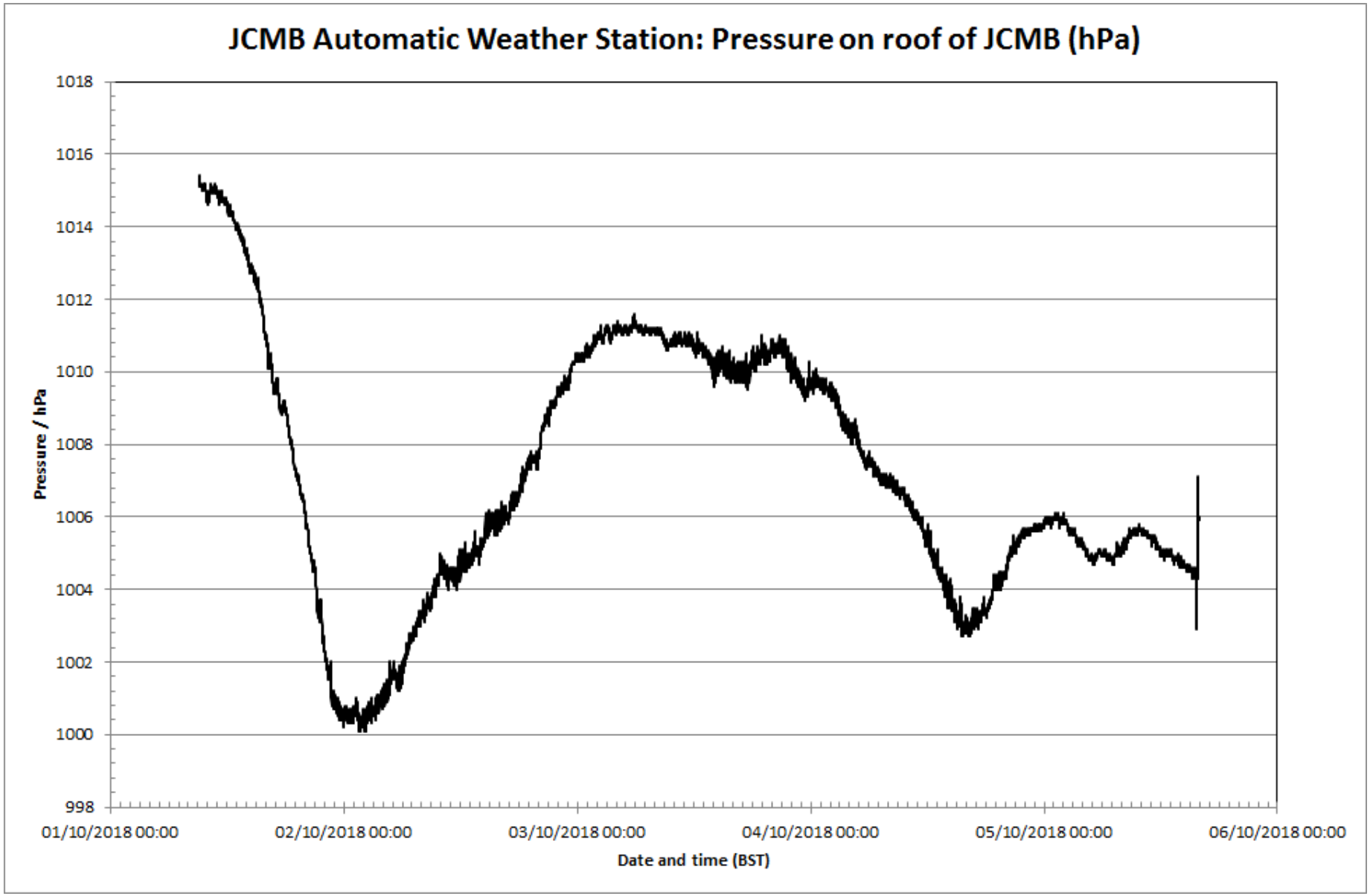
[10 marks]

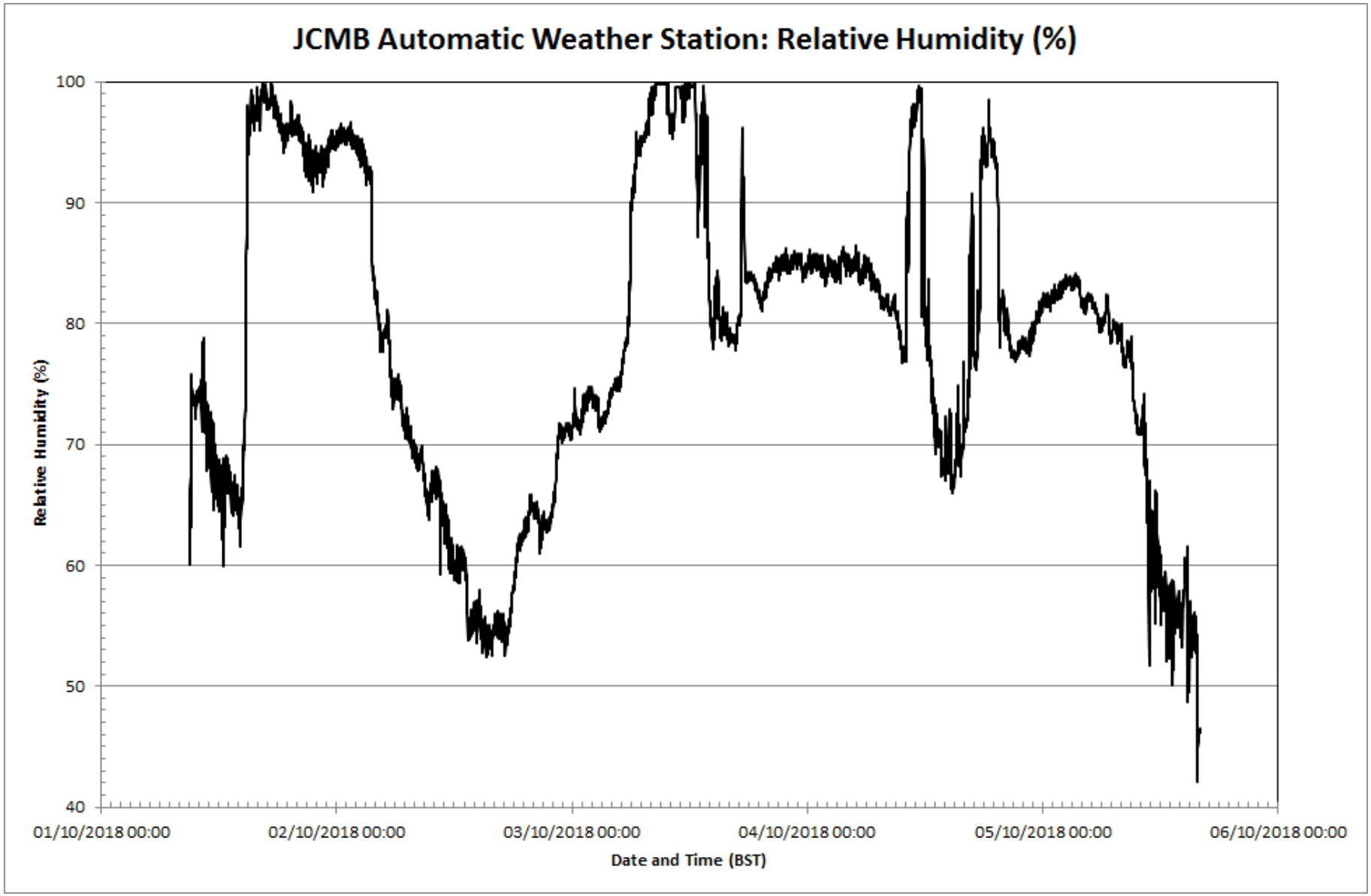
Question 5

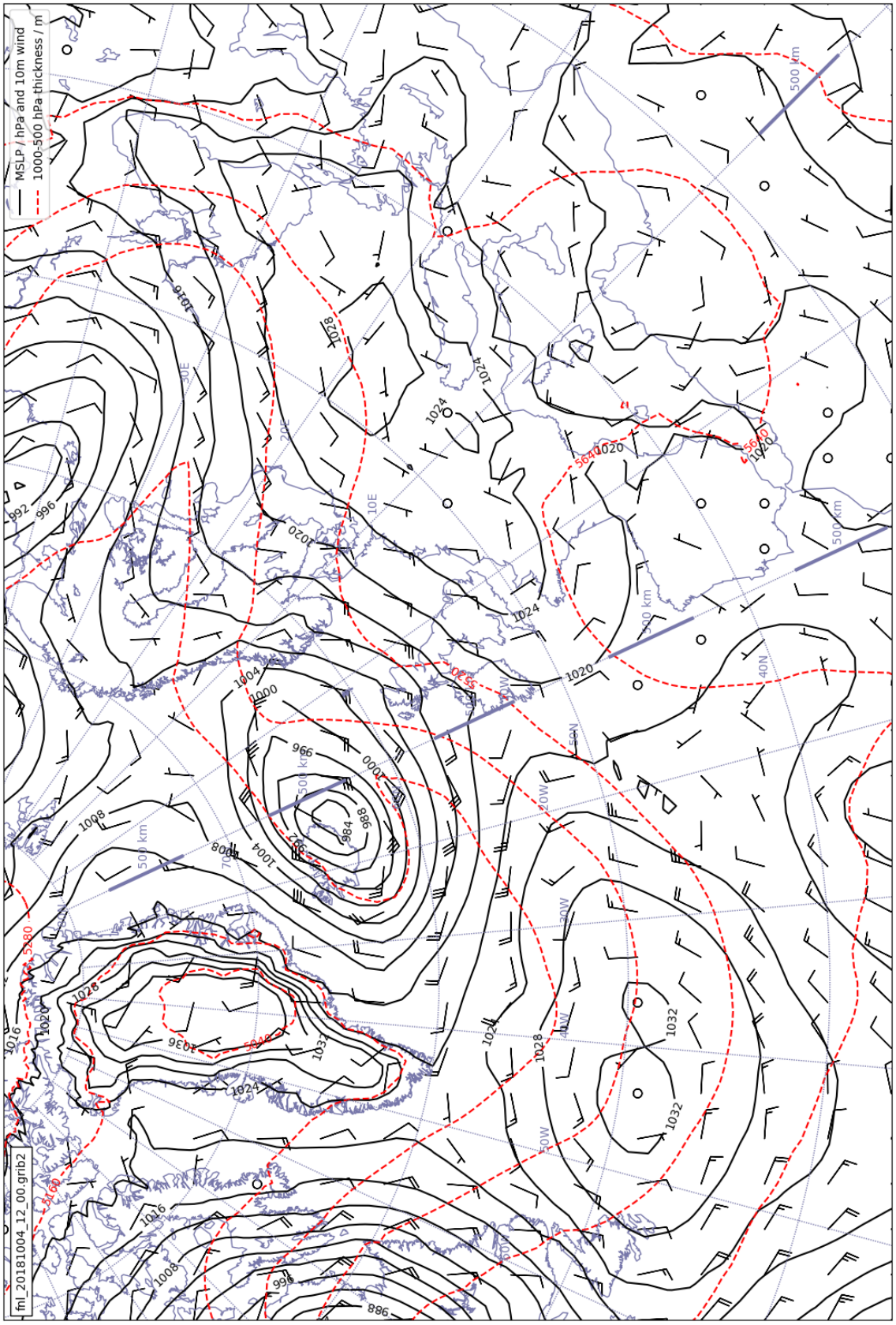
Using the above data, and the chart for 1200 GMT (1300 BST) shown in Figure 4, write a summary of the weather that occurred over Scotland early afternoon on Thursday 4 October suitable for broadcast to the public on the radio (maximum 100 words).

[15 marks]


JCMB Automatic Weather Station: Air Temperature (°C)
Temperature (°C)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
01/10/2018 00:00
02/10/2018 00:00
03/10/2018 00:00
04/10/2018 00:00
05/10/2018 00:00
06/10/2018 00:00
Date and time (BST)


JCMB Automatic Weather Station: Pressure on roof of JCMB (hPa)
Pressure / hPa
1018
1016
1014
1012
1010
1008
1006
1004
1002
1000
998
01/10/2018 00:00
02/10/2018 00:00
03/10/2018 00:00
04/10/2018 00:00
05/10/2018 00:00
06/10/2018 00:00
Date and time (BST)


JCMB Automatic Weather Station: Relative Humidity (%)
Relative Humidity (%)
100
90
80
70
60
50
40
01/10/2018 00:00
02/10/2018 00:00
03/10/2018 00:00
04/10/2018 00:00
05/10/2018 00:00
06/10/2018 00:00
Date and Time (BST)



Thursday 04/10/2018 1200