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## Interpreting weather charts

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### Introduction

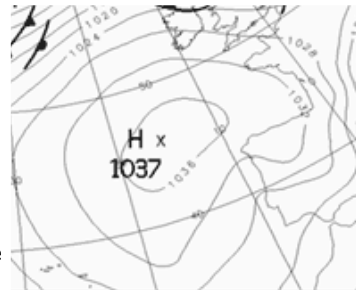
Weather charts consist of curved lines drawn on a geographical map in such a way as to indicate weather features. These features are best shown by charts of atmospheric pressure, which consist of isobars (lines of equal pressure) drawn around depressions (or lows) and anticyclones (or highs). Other features on a weather chart are fronts and troughs. These are drawn to highlight the areas of most significant weather, but that does not mean that there is nothing of significance elsewhere on the chart.

### Weather systems

#### High pressure or anticyclones

Anticyclones are areas of high pressure, whose centres are often less well defined than depressions, and are associated with quiet, settled weather. Winds blow in a clockwise direction around anticyclones in the northern hemisphere, this is reversed in the southern hemisphere.

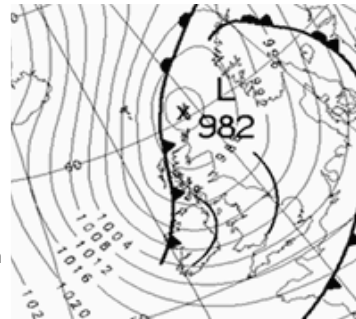
Fig 1: An anticyclone



#### Low pressure or depressions

Depressions are areas of low pressure, usually with a well-defined centre, and are associated with unsettled weather. Winds blow in an anticlockwise direction around depressions in the northern hemisphere, this is reversed in the southern hemisphere.

Fig 2: A depression



### Fronts

Early weather charts consisted simply of station plots and isobars, with the weather being written as comments, like 'Rain, heavy at times'. During the 1920's, a group of Scandinavian meteorologists, known collectively as the Bergen School, developed the concept of representing the atmosphere in terms of air masses. Since the air masses could be considered as being in conflict with each other, the term 'front' was used to describe the boundary between them. Three types of front were identified which depend on the relative movement of the air masses.

#### Cold Front

A cold front marks the leading edge of an advancing cold air mass. On a synoptic chart a cold front appear as a blue line with triangles. The direction in which the triangles point is the direction in which the front is moving.



### Warm Front

A warm front marks the leading edge of an advancing warm air mass. On a synoptic chart a warm front appears as a red line with semi-circles. The direction in which the semi-circles point is the direction in which the front is moving.



### Occlusion (or occluded front)

Occlusions form when the cold front of a depression catches up with the warm front, lifting the warm air between the fronts into a narrow wedge above the surface. On a synoptic chart an occluded front appears as a purple line with a combination of triangles and semi-circles. The direction in which the symbols point is the direction in which the front is moving.

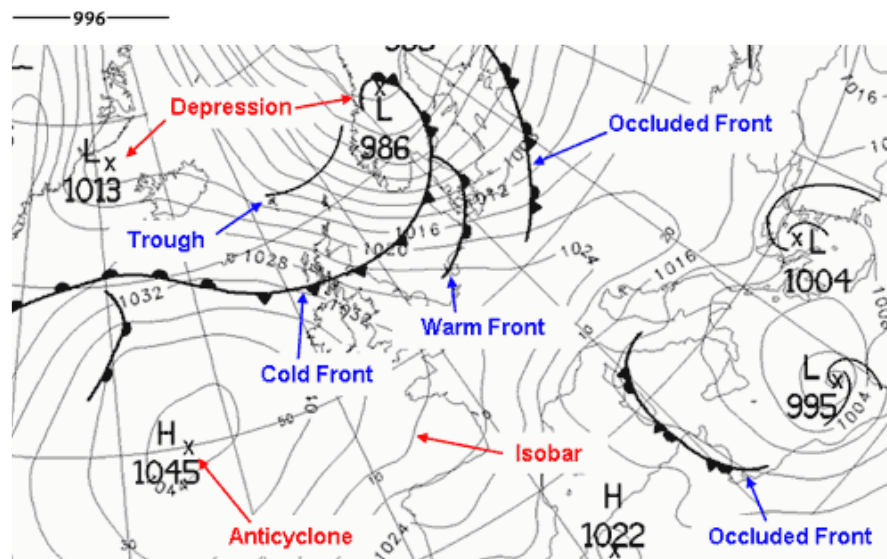


### Troughs

Fronts describe thermal characteristics. They also happen to be where there is significant precipitation. However, precipitation is not confined to fronts. Drizzle in warm sectors or showers in cold air occur fairly randomly, but occasionally, lines of more organized precipitation can develop. These are called troughs.

### Isobars

Isobars are lines joining places with equal mean sea-level pressures (MSLP).



**Fig 3:** Identification of weather systems, isobars and front

[Weather systems and fronts](#)

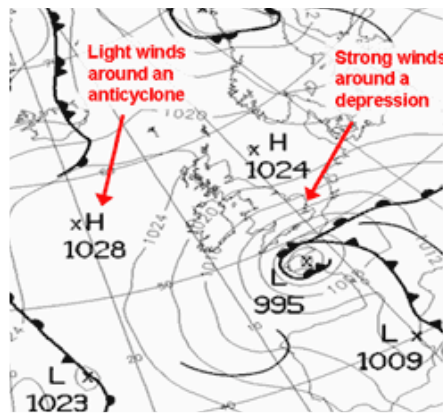
### Relationship between isobars and wind

Wind is a significant feature of the weather (see Figure 4). A fine, sunny day with light winds can be very pleasant.

Stronger winds can become inconvenient and, in extreme cases, winds can be powerful enough to cause widespread destruction. The wind can easily be assessed when looking at a weather map by remembering that:

- closer isobars mean stronger winds;
- the wind blows almost parallel to the isobars;
- in the northern hemisphere, the wind blows round a depression in an anticlockwise direction and around an anticyclone in a clockwise direction. In the southern hemisphere, the opposite is true;
- winds around anticyclones can sometimes be even stronger than indicated by the isobars;

- in warm air, the wind is relatively steady and tends to blow at about two-thirds the speed that the chart would suggest, though there are exceptions to this ;
- in cold air, the wind is usually as strong as indicated by the isobars and can be very gusty.



**Fig 4:** Relationship between isobars and wind speed

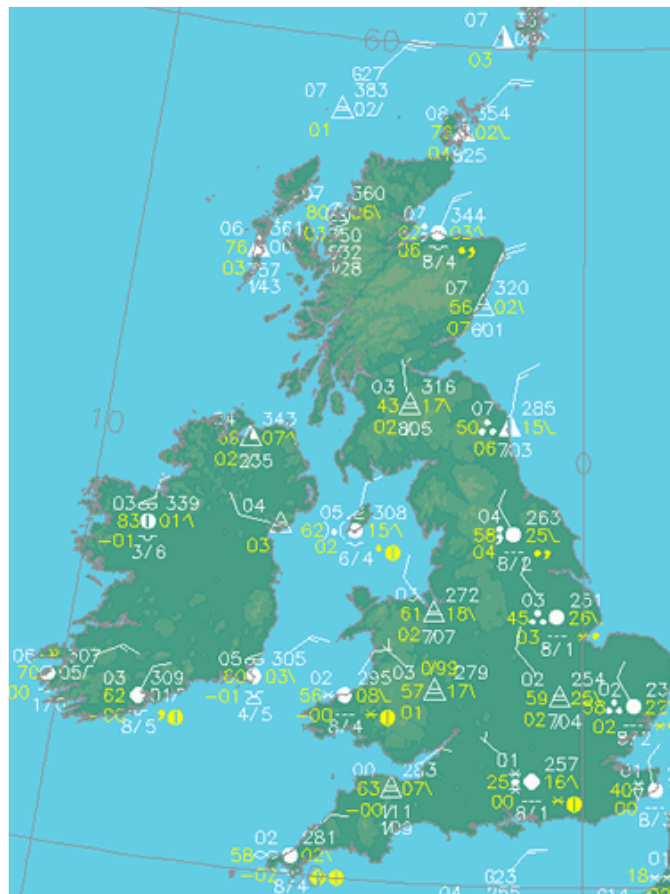
### Understanding station plots on a weather map

Good quality observations are one of the basic 'tools of the trade' for a weather forecaster.

The weather conditions at each individual station can be represented on a surface chart by means of station plot.

This means that information which would take up a lot of space if written on to a chart can be displayed in a quick easy to understand format.

Figure 5 shows an example of a plotted chart.



**Fig 5:** An example of a plotted chart

The land station plot can represent all the elements reported from that station, these typically include:

- |  |                   |
|--|-------------------|
| ■ Air temperature                              | ■ Cloud amounts   |
| ■ Dewpoint temperature                         | ■ Cloud types     |
| ■ Wind speed                                   | ■ Cloud heights   |
| ■ Wind direction                               | ■ Present weather |
| ■ Visibility                                   | ■ Past weather    |
| ■ Atmospheric pressure and three-hour tendency |                   |

Traditionally station plots for manned observing sites were based around a central station circle. However increasingly, automatic weather observations are replacing these and being plotted on weather charts. To differentiate between the two, automatic observations are

plotted around a station triangle. Each element of the observation, with the exception of wind, is plotted in a fixed position around the station circle or triangle so that individual elements can be easily identified.

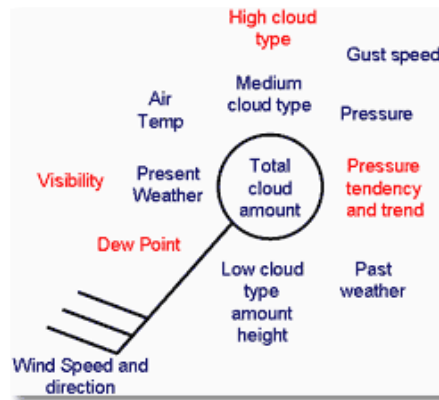


Fig 6: Plotting positions on a station circle

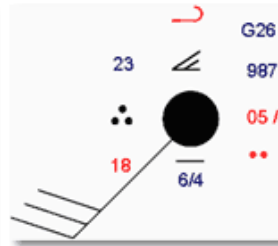


Fig 7: A typical coded manual observation

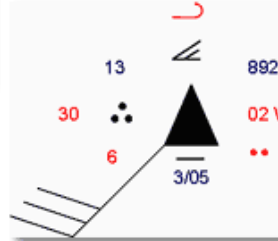


Fig 8: A typical coded automatic observation

### Plotting a station plot

#### Total cloud amount

The total amount of the sky covered by cloud is expressed in oktas (eighths) and is plotted within the station circle for manned observations or station triangle for automatic stations, by the amount of shading.

The symbols used for both manual and automatic observations are shown below.



























Fig 9: Symbols for manual cloud cover



Fig 10: Symbols for automatic cloud cover

#### Wind speed and direction

The surface wind direction is indicated on the station plot by an arrow flying with the wind. Direction is measured in degrees from true North. Therefore a wind direction of 180 is blowing from the south. The wind speed is given by the number of 'feathers' on the arrow. Half feathers represent 5 knots whilst whole feathers indicate 10 knots. A wind speed of 50 knots is indicated by a triangle. Combinations of these can be used to report wind speed to the nearest 5 knots. The symbols used are as follows.

	Calm		53 – 57 knots
	1 - 2 knots		58 - 62 knots
	3 - 7 knots		63 - 67 knots
	8 - 12 knots		68 - 72 knots
	13 - 17 knots		73 - 77 knots
	18 - 22 knots		78 - 82 knots
	23 - 27 knots		83 - 87 knots
	28 - 32 knots		88 - 92 knots
	33 - 37 knots		93 – 97 knots
	38 - 42 knots		98 – 102 knots
	43 - 47 knots		Wind direction variable
	48 – 52 knots		Wind direction given but wind speed missing

**Fig 11:** Symbols for wind speed

#### **Air temperature**

Air temperature is plotted to the nearest whole degree Celsius, i.e. 23 would indicate 23 degrees Celsius.

#### **Dew point temperature**

Dew point temperature is plotted to the nearest whole degree Celsius, i.e. 18 would indicate a dew point of 18 degrees Celsius.

#### **Pressure**







Pressure is recorded in millibars and tenths and the last three digits are plotted. Therefore 1003.1 would be plotted as 031 and 987.1 would be plotted as 871.

#### **Present weather**

In total the Met Office has 100 codes for recording the current weather at the time of the observation. Different types of weather are represented using different weather symbols, a key to which can be found below.

Symbol	Code Figure	Description
<b>WW - 00 to 19 - No precipitation, fog (except for 11 and 12), duststorm, sandstorm, drifting or blowing snow at the station at the time of observation or, except for 09 and 17 during the preceding hour.</b>		
	00	Cloud development not observed or observable
	01	Clouds dissolving or becoming less developed
	02	State of sky on the whole unchanged
	03	Clouds generally forming or developing
	04	Visibility reduced by smoke haze
	05	Haze
	06	Widespread dust in suspension in the air, not raised by wind at or near station at the time of observation
	07	Dust or sand raised by the wind at or near the station at the time of observation, but not well-developed dust whirl(s), and no sandstorm seen: or, in the case of ships, blowing spray at the station
	08	Well developed dust whirl(s) or sand whirl(s) seen at or near the station during the preceding hour or at the time of observation, but no duststorm or sandstorm
	09	Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour
	10	Mist
	11	Patches of shallow fog or ice fog
	12	More or less continuous shallow fog or ice fog less than 2m on land or 10m at sea
	13	Lightning seen, no thunder heard
	14	Precipitation within sight, not reaching the ground or surface of the sea
	15	Precipitation within sight, reaching the ground or the surface of the sea, but distant, i.e. estimated to be more than 5km from the station
	16	Precipitation within sight, reaching the ground or the surface of the sea, near to, but not at the station
	17	Thunderstorm, but no precipitation at the time of observation
	18	Squalls at or within sight of the station during the preceding hour or at the time of observation
	19	Funnel cloud(s) at or within sight of the station during the preceding hour or at the time of observation

**Fig 12:** Symbols for present weather

Symbol	Code Figure	Definition
<b>WW - 20 to 29 - Precipitation, fog, ice fog or thunderstorm at the station during the preceding hour but not at the time of observation.</b>		
	20	Drizzle (not freezing) or snow grains, not falling as showers
	21	Rain (not freezing), not falling as showers
	22	Snow, not falling as showers
	23	Rain and snow or ice pellets, not falling as showers
	24	Freezing drizzle or freezing rain, not falling as showers
	25	Shower(s) of rain
	26	Shower(s) of snow, or of rain and snow
	27	Shower(s) of hail, or of rain and hail
	28	Fog or ice fog
	29	Thunderstorm (with or without precipitation)
<b>WW - 30 to 39 - Duststorm, sandstorm, drifting or blowing snow</b>		
	30	Slight or moderate duststorm or sandstorm, has decreased during the preceding hour
	31	Slight or moderate duststorm or sandstorm. No appreciable change during the preceding hour
	32	Slight or moderate duststorm or sandstorm, has begun or increased during the preceding hour
	33	Severe duststorm or sandstorm, has decreased during the preceding hour
	34	Severe duststorm or sandstorm. No appreciable change during the preceding hour
	35	Severe duststorm or sandstorm, has begun or increased during the preceding hour
	36	Slight or moderate drifting snow, generally low (below eye level)
	37	Heavy drifting snow, generally low (below eye level)
	38	Slight or moderate drifting snow, generally high (above eye level)
	39	Heavy drifting snow, generally high (above eye level)

**Fig 13:** Symbols for present weather



Symbol	Code Figure	Definition
<b>WW = 40 to 49 – Fog or ice fog at the time of observation</b>		
	40	Fog or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer
	41	Fog or ice fog in patches
	42	Fog or ice fog, sky visible, has become thinner during the preceding hour
	43	Fog or ice fog, sky obscured, has become thinner during the preceding hour
	44	Fog or ice fog, sky visible, no appreciable change during the preceding hour
	45	Fog or ice fog, sky obscured, no appreciable change during the preceding hour
	46	Fog or ice fog, sky visible, has begun or has become thicker during the preceding hour
	47	Fog or ice fog, sky obscured, has begun or has become thicker during the preceding hour
	48	Fog or ice fog, sky visible
	49	Fog or ice fog, sky obscured
<b>WW = 50 to 59 - Drizzle</b>		
	50	Drizzle, not freezing, intermittent – slight at the time of observation
	51	Drizzle, not freezing, continuous – slight at the time of observation
	52	Drizzle, not freezing, intermittent – moderate at the time of observation
	53	Drizzle, not freezing, continuous – moderate at the time of observation
	54	Drizzle, not freezing, intermittent – heavy (dense) at the time of observation
	55	Drizzle, not freezing, continuous – heavy (dense) at the time of observation
	56	Drizzle, freezing, slight
	57	Drizzle, freezing, moderate or heavy (dense)
	58	Drizzle and rain, slight
	59	Drizzle and rain, moderate or heavy

**Fig 14:** Symbols for present weather



<u>Symbol</u>	<u>Code</u> <u>Figure</u>	<u>Definition</u>
<b>WW – 60 to 69 - Rain</b>		
•	60	Rain, not freezing, intermittent – slight at the time of observation
••	61	Rain, not freezing, continuous – slight at the time of observation
⋮	62	Rain, not freezing, intermittent – moderate at the time of observation
⋮⋮	63	Rain, not freezing, continuous – moderate at the time of observation
⋮⋮⋮	64	Rain, not freezing, intermittent – heavy at the time of observation
⋮⋮⋮⋮	65	Rain, not freezing, continuous – heavy at the time of observation
⤿	66	Rain, freezing, slight
⤿⤿	67	Rain, freezing, moderate or heavy
⋆	68	Rain or drizzle and snow, slight
⋆⋆	69	Rain or drizzle and snow, moderate or heavy
<b>WW – 70 to 79 – Solid precipitation not in showers</b>		
⋆	70	Intermittent fall of snowflakes – slight at the time of observation
⋆⋆	71	Continuous fall of snowflakes – slight at the time of observation
⋆⋆	72	Intermittent fall of snowflakes – moderate at the time of observation
⋆⋆⋆	73	Continuous fall of snowflakes – moderate at the time of observation
⋆⋆⋆	74	Intermittent fall of snowflakes – heavy at the time of observation
⋆⋆⋆⋆	75	Continuous fall of snowflakes – heavy at the time of observation
↔	76	Diamond dust (With or without fog)
△	77	Snow grains (With or without fog)
⊗	78	Isolated star-like snow crystals (With or without fog)
△	79	Ice pellets

**Fig 15:** Symbols for present weather

Symbol	Code Figure	Definition
<b>WW – 80 to 89 – Showery precipitation, or precipitation with current or recent thunderstorm</b>		
	80	Rain shower(s), slight
	81	Rain shower(s), moderate or heavy
	82	Rain shower(s), violent
	83	Shower(s) of rain and snow mixed, slight
	84	Shower(s) of rain and snow mixed, moderate or heavy
	85	Snow shower(s), slight
	86	Snow shower(s), moderate or heavy
	87	Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed, slight
	88	Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed, moderate or heavy
	89	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder, slight
<b>WW – 90 to 94 – thunderstorm during the preceding hour but not at the time of observation</b>		
	90	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder, moderate or heavy
	91	Slight rain at the time of observation
	92	Moderate or heavy rain at the time of observation
	93	Slight snow, or rain and snow mixed, or hail at the time of observation
	94	Moderate or heavy snow, or rain and snow mixed, or hail at the time of observation
<b>WW – 95 to 99 – thunderstorm at the time of observation</b>		
	95	Thunderstorm, slight or moderate, without hail but with rain and/or snow at the time of observation
	96	Thunderstorm, slight or moderate, with hail at the time of observation
	97	Thunderstorm, heavy, without hail but with rain and/or snow at the time of observation
	98	Thunderstorm, combined with duststorm or sandstorm at the time of observation
	99	Thunderstorm, heavy, with hail at the time of observation

**Fig 16:** Symbols for present weather

**Past weather**

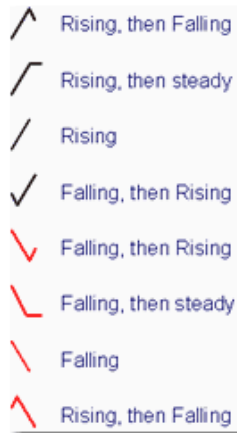
A simplified version of the present weather plots is used to indicate past weather.

	Cloud cover ½ or less of the sky throughout the appropriate period
	Cloud cover ½ or less for part of the appropriate period and more than ½ sky for part of the period
	Cloud cover more than ½ of the sky throughout the appropriate period
	Duststorm, sand storm or blowing snow – Visibility less than 1000 metres
	Fog or thick haze – Visibility less than 1000 metres
	Drizzle
	Rain
	Snow or rain and snow mixed
	Shower(s)
	Thunder, with or without precipitation

**Fig 17:** Symbols for past weather

**Pressure Tendency**

Pressure trend shows how the pressure has changed during the past three hours i.e rising or falling, and pressure tendency shows by how much it has changed. The tendency is given in tenths of a millibar, therefore '20' would indicate a change of two millibars in the last three hours. Pressure tendency is indicated by the following symbols:



**Fig 18:** Symbols for pressure tendency

**Visibility**

Visibility, which is how far we can see, is given in coded format, in either meters or kilometres. Visibilities below five kilometres are recorded to the nearest 100 metres, whilst those above five kilometres are given to the nearest kilometre.

For visibilities equal to and less than five km:

**Table 1: Codes for visibilities of less than five km**

Code	Distance in km	Code	Distance in km	Code	Distance in km
00	<0.0	19	1.9	38	3.8
01	0.1	20	2.0	39	3.9
02	0.2	21	2.1	40	4.0
03	0.3	22	2.2	41	4.1
04	0.4	23	2.3	42	4.2
05	0.5	24	2.4	43	4.3
06	0.6	25	2.5	44	4.4
07	0.7	26	2.6	45	4.5
08	0.8	27	2.7	46	4.6
09	0.9	28	2.8	47	4.7
10	1.0	29	2.9	48	4.8
11	1.1	30	3.0	49	4.9
12	1.2	31	3.1	50	5.0
13	1.3	32	3.2	51	Not Used
14	1.4	33	3.3	52	Not Used
15	1.5	34	3.4	53	Not Used
16	1.6	35	3.5	54	Not Used
17	1.7	36	3.6		
18	1.8	37	3.7		

For visibilities greater than five km:










**Table 2: Codes for visibilities of more than five km**

Code	Distance in km	Code	Distance in km
56	6	73	23
57	7	74	24
58	8	75	25

<b>59</b>	9	<b>76</b>	26
<b>60</b>	10	<b>77</b>	27
<b>61</b>	11	<b>78</b>	28
<b>62</b>	12	<b>79</b>	29
<b>63</b>	13	<b>80</b>	30
<b>64</b>	14	<b>81</b>	35
<b>65</b>	15	<b>82</b>	40
<b>66</b>	16	<b>83</b>	45
<b>67</b>	17	<b>84</b>	50
<b>68</b>	18	<b>85</b>	55
<b>69</b>	19	<b>86</b>	60
<b>70</b>	20	<b>87</b>	65
<b>71</b>	21	<b>88</b>	70
<b>72</b>	22	<b>89</b>	>70

### Low cloud type














The type of low cloud present is provided in coded format, using the symbols below.

	Cumulus with little vertical extent
	Cumulus of moderate or strong vertical extent,
	Cumulonimbus without fibrous or anvil top
	Stratocumulus formed by the spreading out of cumulus
	Stratocumulus not resulting from the spreading out of cumulus
	Stratus in a more or less continuous sheet or layer,.
	Stratus fractus of bad weather
	Cumulus and stratocumulus at a different levels
	Cumulonimbus, fibrous or anvil top

**Fig 19:** Symbols for low cloud type

### Medium cloud type

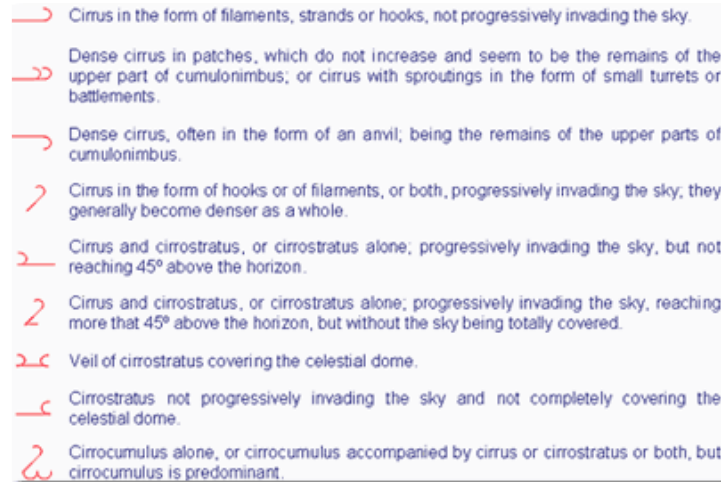
The type of medium cloud present is provided in coded format, using the symbols below.

	Altostratus through which the sun or moon may be weakly visible.
	Altostratus, dense enough to hide the sun or moon, or nimbostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.
	Altostratus.

**Fig 20:** Symbols for medium cloud type

### High cloud type

The type of high cloud present is provided in coded format, using the symbols below.



**Fig 21:** symbols for high cloud type

**Cloud height**

Cloud heights are measured in hundreds or thousands of feet. The way these are plotted varies depending on whether the station is an automatic or manned observing site.

For automatic stations, indicated by a station triangle, the following codes are used.

**Table 3: Cloud heights for automatic stations**

Code	Height in feet
00	<100
05	500
10	1000
15	1500
20	2000
...	...
50	5000
60	6000

For manned stations, indicated by a station circle, the following codes are used.

**Table 4: Cloud heights for manned stations**

Code	Height in feet
0	0-149
1	150-299
2	300 - 599
3	600 - 999
4	1,000 - 1,999
5	2,000 - 2,999
6	3,000 - 4,999
7	5,000 - 6,499
8	6,500 - 7,999
9	8,000 - or above
/	Cloud height unknown

**Gust Speed**

Gust speeds are measured in knots and preceded by the letter G. Gust speeds are normally only recorded if they exceed 25 knots and are plotted as whole knots i.e. G35 indicates a gust of 35 knots.

**Example**

The decode of this station plot is as follows:

Type of observation: Manned  
 Total cloud amount: 8 oktas  
 Wind Speed: 28-32 knots  
 Wind direction: South-westerly  
 Air temperature: 23 degrees Celsius  
 Dew point temperature: 18 degrees Celsius  
 Pressure: 1004.2 millibars  
 Present weather: Continuous moderate rain  
 Past weather: Rain  
 Pressure tendency: Falling 0.5 millibars in the past three hours  
 Visibility: 6km  
 Low cloud type: Stratus  
 Low cloud amount: 6 oktas  
 Low cloud height: 1000 feet  
 Medium cloud type: Altostratus  
 High cloud type: Cirrus  
 Gust speed: 45 knots

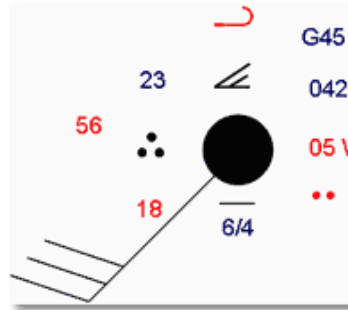
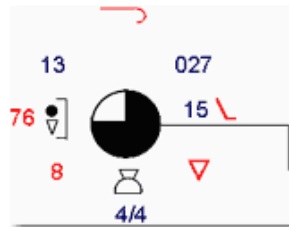


Fig 22: Example plot

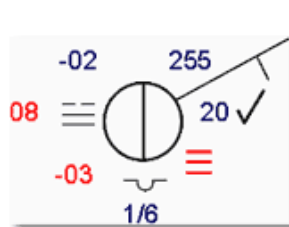
**Exercise**

Why not try decoding the following observational plots.

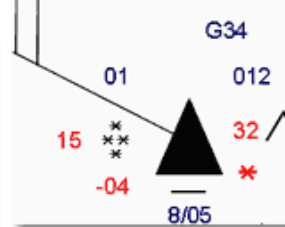
1)



2)



3)



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