

by Lucy Prentice

INTERPRETING SYNOPTIC CHARTS AND SATELLITE IMAGES IN THE UK CONTEXT

METEOROLOGY is the science of forecasting the weather. Predicting what weather the atmosphere is going to produce, where and when, is very complex. The Met Office is the main source of weather forecasts for the UK. Forecasters use both traditional surface-based instruments and satellite imagery to measure, monitor and forecast the weather.

What is a synoptic chart?

A synoptic chart shows the atmospheric conditions of an area at a particular time. The chart shows lines called **isobars** which join points of equal atmospheric surface pressure. Surface weather conditions may also be shown using information gathered from land- and sea-based weather stations. The Met Office uses a network of both manned and automatic weather stations to gather together detailed data on weather conditions. Figure 1 shows the official weather symbols used by weather forecasters to represent weather conditions. The chart also shows symbols for weather fronts, which separate large uniform areas of air called **air masses**. Fronts are generally characterised by bands of cloud and rain. Air masses have their origin in Tropical, Arctic, Polar, Maritime and Continental areas, each being recognised by their different temperatures, weather and humidity.

What do isobars show?

- Isobars show areas of low pressure or cyclonic conditions as closely spaced

Cloud	Weather	Wind speed	Temperature																																																												
	<table border="0"> <tr> <th>Symbol</th> <th>Weather</th> </tr> <tr> <td>≡</td> <td>mist</td> </tr> <tr> <td>≡≡</td> <td>fog</td> </tr> <tr> <td>•</td> <td>drizzle</td> </tr> <tr> <td>••</td> <td>rain and drizzle</td> </tr> <tr> <td>•••</td> <td>rain</td> </tr> <tr> <td>••••</td> <td>rain and snow</td> </tr> <tr> <td>*</td> <td>snow</td> </tr> <tr> <td>••••</td> <td>rain shower</td> </tr> <tr> <td>*••••</td> <td>snow shower</td> </tr> <tr> <td>••••</td> <td>hail shower</td> </tr> <tr> <td>••••</td> <td>thunderstorm</td> </tr> </table>	Symbol	Weather	≡	mist	≡≡	fog	•	drizzle	••	rain and drizzle	•••	rain	••••	rain and snow	*	snow	••••	rain shower	*••••	snow shower	••••	hail shower	••••	thunderstorm	<table border="0"> <tr> <th>Symbol</th> <th>Speed (knots)</th> <th>Force</th> </tr> <tr> <td>☉</td> <td>calm</td> <td>0</td> </tr> <tr> <td></td> <td>1-2</td> <td>1</td> </tr> <tr> <td></td> <td>3-7</td> <td>2</td> </tr> <tr> <td></td> <td>8-12</td> <td>3</td> </tr> <tr> <td></td> <td>13-17</td> <td>4</td> </tr> <tr> <td colspan="3">For each additional half-feather add 5 knots or add an extra force up to</td> </tr> <tr> <td></td> <td>48-52</td> <td>11</td> </tr> </table> <p>Wind direction Indicates a north-westerly wind direction</p>	Symbol	Speed (knots)	Force	☉	calm	0		1-2	1		3-7	2		8-12	3		13-17	4	For each additional half-feather add 5 knots or add an extra force up to				48-52	11	<table border="0"> <tr> <td>☉</td> <td>3° Celsius</td> </tr> <tr> <td colspan="2">Pressure</td> </tr> <tr> <td colspan="2">Pressure is shown by isobars and is measured in millibars</td> </tr> <tr> <td colspan="2">— 1012 — mean sea-level pressure</td> </tr> <tr> <td>L</td> <td>= centre of an area of low pressure</td> </tr> <tr> <td>H</td> <td>= centre of an area of high pressure</td> </tr> </table>	☉	3° Celsius	Pressure		Pressure is shown by isobars and is measured in millibars		— 1012 — mean sea-level pressure		L	= centre of an area of low pressure	H	= centre of an area of high pressure
Symbol	Weather																																																														
≡	mist																																																														
≡≡	fog																																																														
•	drizzle																																																														
••	rain and drizzle																																																														
•••	rain																																																														
••••	rain and snow																																																														
*	snow																																																														
••••	rain shower																																																														
*••••	snow shower																																																														
••••	hail shower																																																														
••••	thunderstorm																																																														
Symbol	Speed (knots)	Force																																																													
☉	calm	0																																																													
	1-2	1																																																													
	3-7	2																																																													
	8-12	3																																																													
	13-17	4																																																													
For each additional half-feather add 5 knots or add an extra force up to																																																															
	48-52	11																																																													
☉	3° Celsius																																																														
Pressure																																																															
Pressure is shown by isobars and is measured in millibars																																																															
— 1012 — mean sea-level pressure																																																															
L	= centre of an area of low pressure																																																														
H	= centre of an area of high pressure																																																														
<p>Fronts</p>	<p>Model</p>	<p>Example</p>																																																													

Figure 1: Weather symbols

- concentric rings, with the lowest pressure in the middle.
- Winds blow across the isobars towards the centre of a low pressure area in an anticlockwise direction in the northern hemisphere.
- Isobars that are closely packed together indicate high winds and are found in low pressure areas.
- High pressure areas or anticyclones have more widely spaced isobars, with the highest pressure at the centre.
- In a high pressure area winds blow out from the centre across the isobars in a clockwise direction in the northern hemisphere.

What do the weather symbols show?

The central circle or triangle of a weather station symbol shows whether the data was collected by human observation or by an automatic weather station. The circle/triangle is then shaded according to how many eighths

of the sky, or oktas, are obscured. The wind feather shows the direction from which the wind is blowing and how strong the wind is (in knots). The current temperature and other weather features are also shown. The Met Office may add more data, such as past weather and cloud type.

What is a satellite image?

Satellite imagery has revolutionised how the weather is forecast by showing frequent images of weather systems moving around the globe. A scanner called a **radiometer** on the satellite sweeps the Earth's surface and collects readings on how much light is being reflected from the area directly beneath the scanner – sea, land or clouds. The scanner divides the Earth's surface into strips and each strip is then divided into squares or pixels, just like a digital image or photograph on a computer. The data is

stored on the satellite and then transmitted to a receiving station on the Earth's surface. The pixels are reassembled by the computer to make an image.

The scanner can pick up visible, infrared and thermal infrared light. Visible images can only be collected in daylight because they rely on reflected sunlight but infrared images can be collected day and night. Infrared energy is emitted from surfaces; higher readings show that the surface is warm, lower readings that it is cold. This is useful, as high cloud tops are cold and show bright white, while lower, thinner clouds appear grey, and hot land surfaces black.

Types of satellite

Polar orbiting satellites:

- orbit over the Earth's poles as the Earth spins beneath
- have an orbit time of 102 minutes, altitude 830 km
- scan a strip/swathe 2,600 km wide
- have a resolution of 1.1 km
- names: NOAA, Metop, EOS, MODIS.

Geostationary satellites:

- move in a synchronised orbit above the same spot on the Earth above the equator

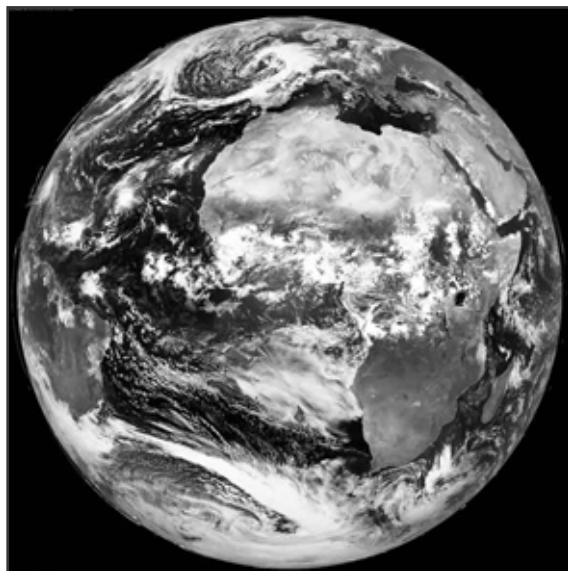


Figure 2: A visible Meteosat image of the Earth's disc for 5 September 2008

Source: EUMETSAT/NEODAAS/University of Dundee

- cover the full Earth's disc every 30 minutes
- are positioned at a height of 36,000 km
- have a resolution of 1 km
- names: Meteosat (Europe), GOES East/West (USA)

Figure 2 is a Meteosat image showing an intense depression over the British Isles.

Low pressure areas

The weather of the British Isles is dominated by weather systems that move in over the Atlantic Ocean. These weather systems, or **depressions**, are anticlockwise rotating areas of low atmospheric pressure which bring wind and rain. A low pressure area is where air is predominantly rising, and when air rises in the atmosphere, moisture in the air cools, condenses and forms clouds, ultimately producing precipitation (rain or snow).

The rain is concentrated in bands called **fronts**, of which there are three types: cold, warm and occluded. A **warm front** brings a longer period of rain but is not quite so blustery; it is followed by warm, humid air. A **cold front** brings gusty winds and intense rainfall and is followed by fresher showery weather. An **occluded front** has a distinctive

hook shape as it wraps itself around the centre of the depression, and brings a long period of rain which is slow to clear.

Low pressure area: 5/6 September 2008

On 5 September 2008 an intense depression crossed the British Isles bringing strong winds, high rainfall totals and flooding to many parts of the British Isles.

Figure 3 shows that it was located over the southern British Isles, with its centre off the

west coast of Devon. A warm front extends across northern England and a cold front from North Wales to the south coast. A characteristic hook-shaped occluded front curls around the centre of the depression in the southern Irish Sea. Weather station symbols show the surface conditions.

On Figure 4 the frontal clouds are bright white because the cloud tops are at high altitude and therefore cold. The front edge of the warm front and the back edge of the cold front are quite sharp. The mass of white cloud between them is warm humid air known as the **warm sector**. The hook of the occluded front can be seen curling through southern Ireland. Lighter grey clouds follow the depression and may indicate rain showers. The black on the image is either land or sea.

High pressure areas

Calmer weather is associated with areas of high pressure or anticyclones, which are characterised on a synoptic chart by widely spaced isobars. The system spins in a clockwise direction with air descending at the centre, enabling winds to blow out from the centre across the isobars. The weather in summer can be hot and sunny and in winter cold, frosty and foggy. High pressure areas can also produce grey blankets of cloud of which cover large areas and prevent frost from forming in winter as they trap the heat lost from the Earth's surface. A high pressure area that remains in the same general location for weeks is termed a **blocking high** as it diverts low pressure areas around it.

High pressure area: 6 June 2006

The weather station plots in Figure 5 show that the winds are very light and variable. The northern half of the UK is quite cloudy with more sun further south. In the north-west a front is trying to edge into north-west Scotland but is being blocked by the high pressure.

Activities

1 Refer to Figures 3 and 4.
 (a) Describe the general weather situation in the British Isles.
 (b) Give a more detailed description of the weather across the UK by referring to the weather station plots and the location of the weather fronts. Remember that fronts bring rain and windier conditions.

2 Refer to Figures 5 and 6.
 (a) Is this a high pressure or low pressure area?
 (b) Describe the weather that is affecting the British Isles.
 (c) How does the weather differ from that shown in Figures 3 and 4 for 5 September 2008?

3 Refer to Figures 7 and 8.
 (a) Where is the low pressure centred?
 (b) What is the lowest central pressure?
 (c) What is the weather feature extending from north-east England to Cornwall?

4 (a) Plot on a copy of Figure 8 the weather stations for the places shown in Figure 9.
 (b) Mark the following:

- low pressure centre
- high pressure centre
- the fronts: cold, warm, occluded
- area of speckled shower clouds.

(c) What makes the cold front easy to see on the satellite image?

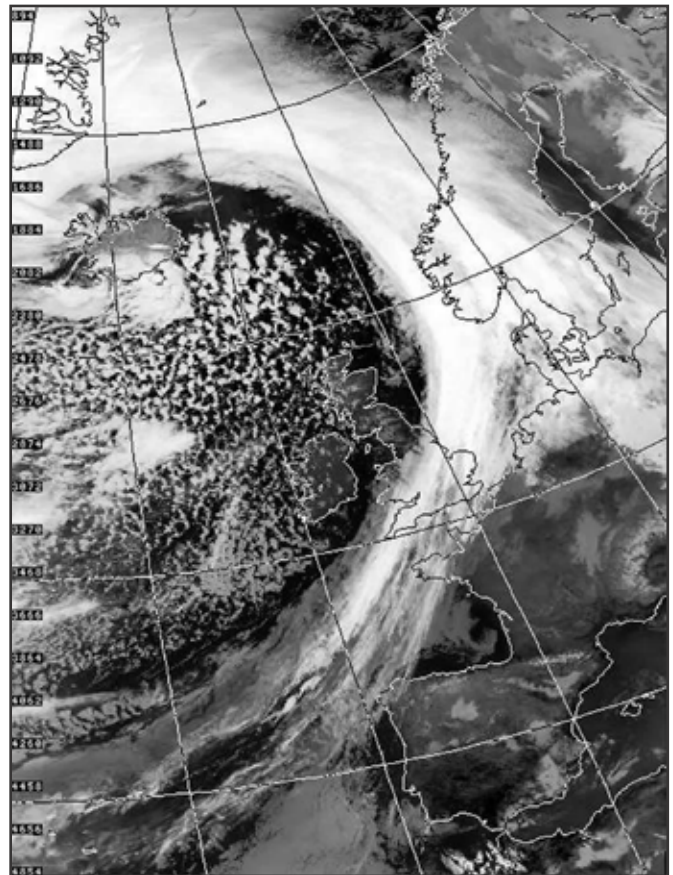


Figure 7: Infrared satellite image of a low pressure area, 12 noon, 4 January 2005
 Source: NEODAAS/University of Dundee

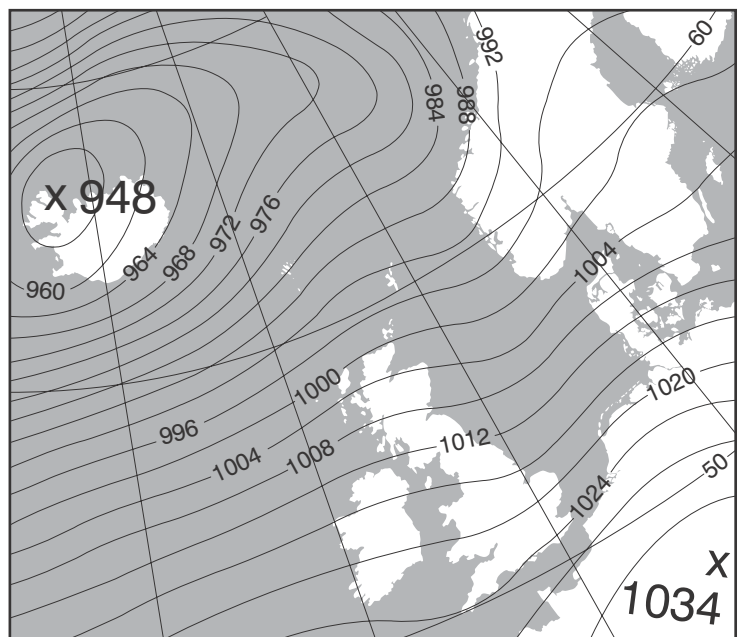


Figure 8: Basic synoptic chart for 4 January 2005

Figure 9: Weather conditions in selected places, 4 January 2005

	Edinburgh	Belfast	Marham	Heathrow Airport	Plymouth
Oktas (est.)	8	0	8	8	8
Wind speed (knots)	14	14	24	18	27
Wind direction	WSW	WSW	SW	SW	SW
Temperature (°C)	7	5.6	10	11	11
Weather	Rain	Sun/clear	Overcast	Overcast	Rain shower