1.2

THE GREAT UK WEATHER WATCH

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1. INTRODUCTION

The Great UK Weather Watch (UKWW) took place on Wednesday 17 March 2004 during the third week of *MetLinkInternational 2004*, the Royal Meteorological Society's annual online weather project for schools and individuals (www.metlink.org). All who took part were asked to observe the weather at least twice during the day (every three hours from 09:00 to 18:00 GMT, if possible) and to enter their observations in the *MetLink* database: http://metlink.org/data/observe.php.
In the database, provision is made for the following observations to be entered: current, maximum and minimum temperature, relative humidity, barometric pressure, wind speed and direction, precipitation amount, precipitation type, precipitation intensity, cloud amount and cloud type. A box for comments is also provided.

Brief reviews of the weather across Europe were published on the *MetLink* website during the morning and afternoon of 17 March (see: http://www.metlink.org/data/reviews.php).
The present report contains an analysis of the weather across the British Isles in greater detail than in those reviews. It also considers the observations made by Weather Watch participants and the lessons learned from the Watch. Volunteers assisted with the preparation of the report, which focuses upon the following:

- Local variations of weather in relation to topography, urban influences, etc.
- Observations in relation to climatic norms for the time of year.
- Comparisons of the observations made by Weather Watch participants with those made at official weather stations.
- Comparisons of the clouds reported by Weather Watch participants with the clouds indicated by weather satellite images.

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As part of the UKWW project, a weather forecast competition was held. All taking part in the project were invited to submit, by 17:00 GMT on Monday 15 March, a forecast for 17 March for their region of the UK. Each person who entered was required to provide a brief justification of his/her prediction.

All *MetLink* participants in the United Kingdom, Ireland and Belgium were encouraged to take part in the Great UK Weather Watch and efforts were made to recruit observers who would take part in just the Weather Watch itself. The UKWW was publicised by the Royal Meteorological Society (in *Society News*, on the Society's website and on the *MetLink* homepage), and members of the Climatological Observers' Link (COL) were invited to take part.

The number of observations entered in the *MetLink* database on 17 March by observers in the UK was 223. In addition, a school in Belgium entered two observations. No observations were received from the Republic of Ireland, which was disappointing but probably partly explained by the fact that 17 March is St Patrick's Day!

2. THE WEATHER OVER EUROPE ON 17 MARCH

Synoptic charts for 00:00, 06:00, 12:00 and 18:00 GMT on 17 March are shown in Figure 1 (next page). They show the following:

- A complex area of low pressure north and west of the British Isles.
- An isobaric pattern consistent with a west- to south-westerly flow over the British Isles.
- A cold front over the North Sea and southern parts of the British Isles.
- Various fronts over Scandinavia and eastern Europe.
- High pressure over central and southern Europe and a ridge of high pressure extending north-eastwards towards the Iberian Peninsula from an anticyclone in mid-Atlantic.

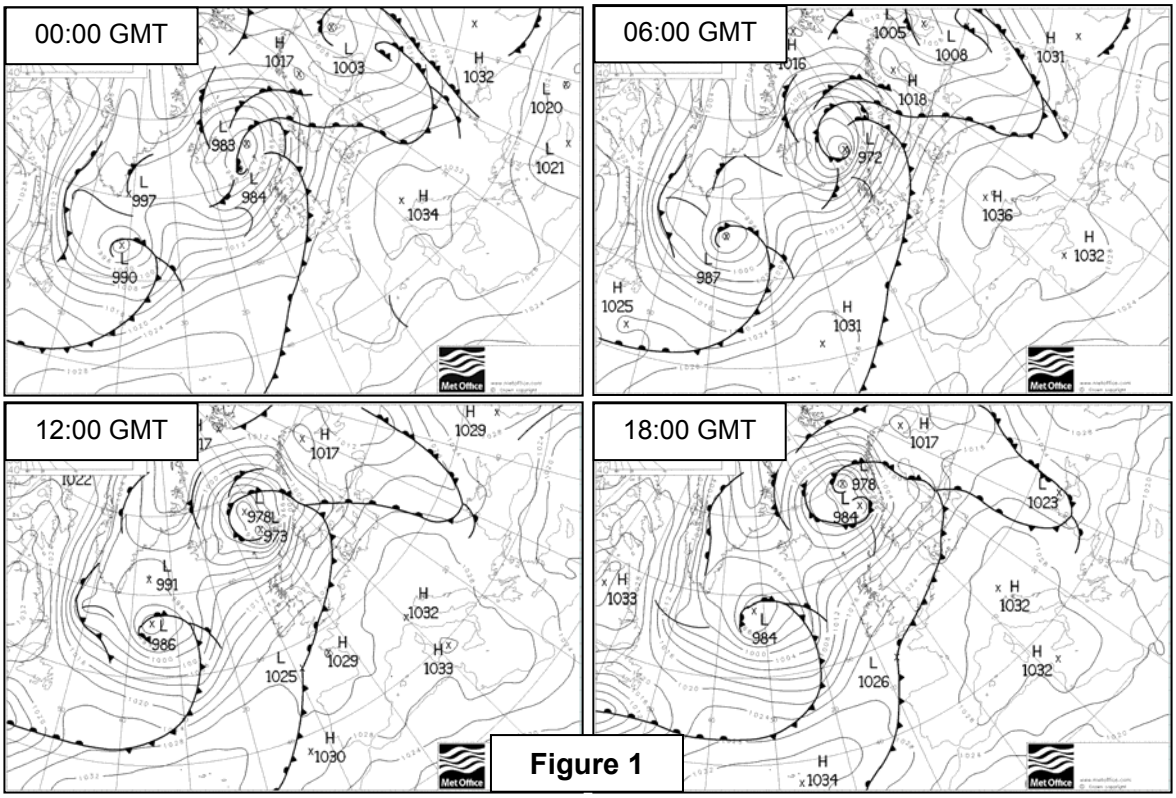


Figure 1

The large, slow-moving anticyclone which covered central and southern Europe was accompanied by widespread clear skies and light winds. Where night-time temperatures fell to near freezing, mist and fog formed by dawn (see Figure 2), but this soon cleared during the morning to give a sunny, warm day with temperatures across Europe reaching 20 to 25°C. An exception was Spain and Portugal, where patchy cloud at various heights resulted in a less than perfect day.

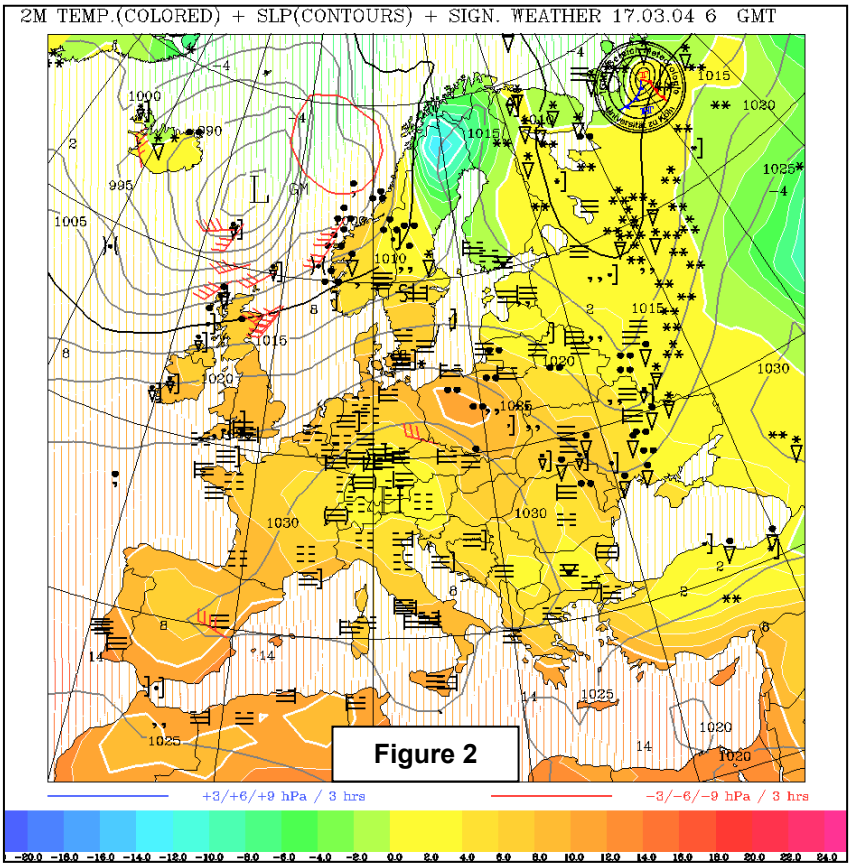


Figure 2

The deep, occluding, frontal depression to the north of the British Isles moved north-eastwards during the day and brought strong south-westerly winds on its southern flanks (Figure 2). Speeds exceeded 20 knots (37km/h) from north-western Ireland across Scotland to Norway, and even reached 50 knots (92km/h) along the Norwegian coast, where the mountains probably caused channelling and acceleration. These south-westerly winds were mild compared with the near-freezing air over much of Sweden and Finland ahead of the warm and occluded fronts. Frontal rain occurred to the north of Scotland and over Scandinavia, where the rain turned to snow when it reached northern Sweden.

The cold front which was associated with the depression to the north of the British Isles moved south-eastwards during the day, followed by showers of rain over Ireland, Scotland and western Norway. The front slowed down and weakened as it moved south-eastwards across England, becoming almost stationary near the south coast by the end of the day. This resulted in a cloudy day for much of southern England with a little patchy light rain or drizzle. However, many places enjoyed quite sunny weather, with temperatures up to 13°C in central England and 15°C in East Anglia by early afternoon. The 11:05 GMT visible and infra-red images from the NOAA-17 polar-orbiting satellite show the cold front clearly (see Figure 3). The images shown in Figure 3 are reproduced by kind permission of the Dundee University Satellite Receiving Station.

The 06:00, 12:00 and 18:00 GMT Meteosat images, which can all be viewed on the MetLink website, show, *inter alia*, the following (for the 12:00 GMT visible and infra-red images, see Figure 4):

- Clouds associated with the depression which was centred north of the British Isles, including the aforementioned cold front running south-westwards across the North Sea and eastern Atlantic.
- The progressive weakening of this cold front over the North Sea and southern parts of the British Isles during the day and the development of a wave on this front south-west of Land's End.
- Frontal clouds associated with the depression which was centred south-south-east of Greenland.
- Frontal clouds over Scandinavia and eastern Europe.
- Skies largely cloud-free over a wide area of western, central and southern Europe.
- An extensive area of low cloud over the western Mediterranean Sea.
- An area of low cloud over the Mediterranean Sea south and south-west of Malta.
- Patches of cloud, mostly in the lower and middle troposphere, over the Iberian Peninsula.
- Cumulonimbus activity over the Atlantic Ocean to the west of Ireland and Scotland.

The snow-covered Alps and Pyrenees can be seen clearly on the Figure 4 visible image. The snow-covered mountains east of the Adriatic Sea (the Dinaric Alps and Pindus Mountains) can also be seen on this image.

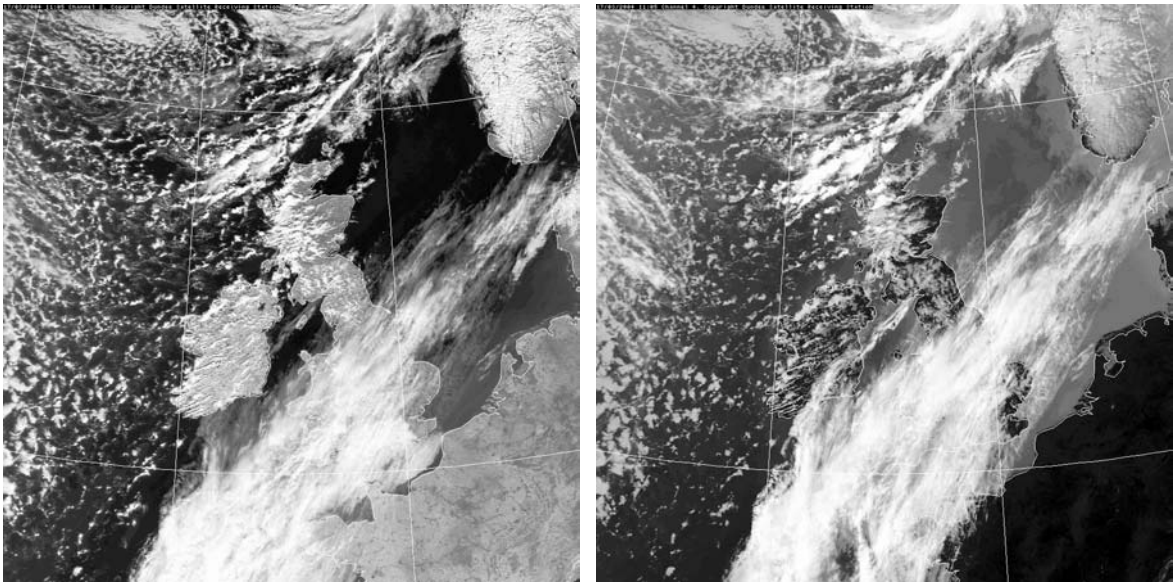


Figure 3
Images from the NOAA-17 polar-orbiting satellite: 11:05 GMT, 17 March 2004
Left: visible image Right: infra-red image

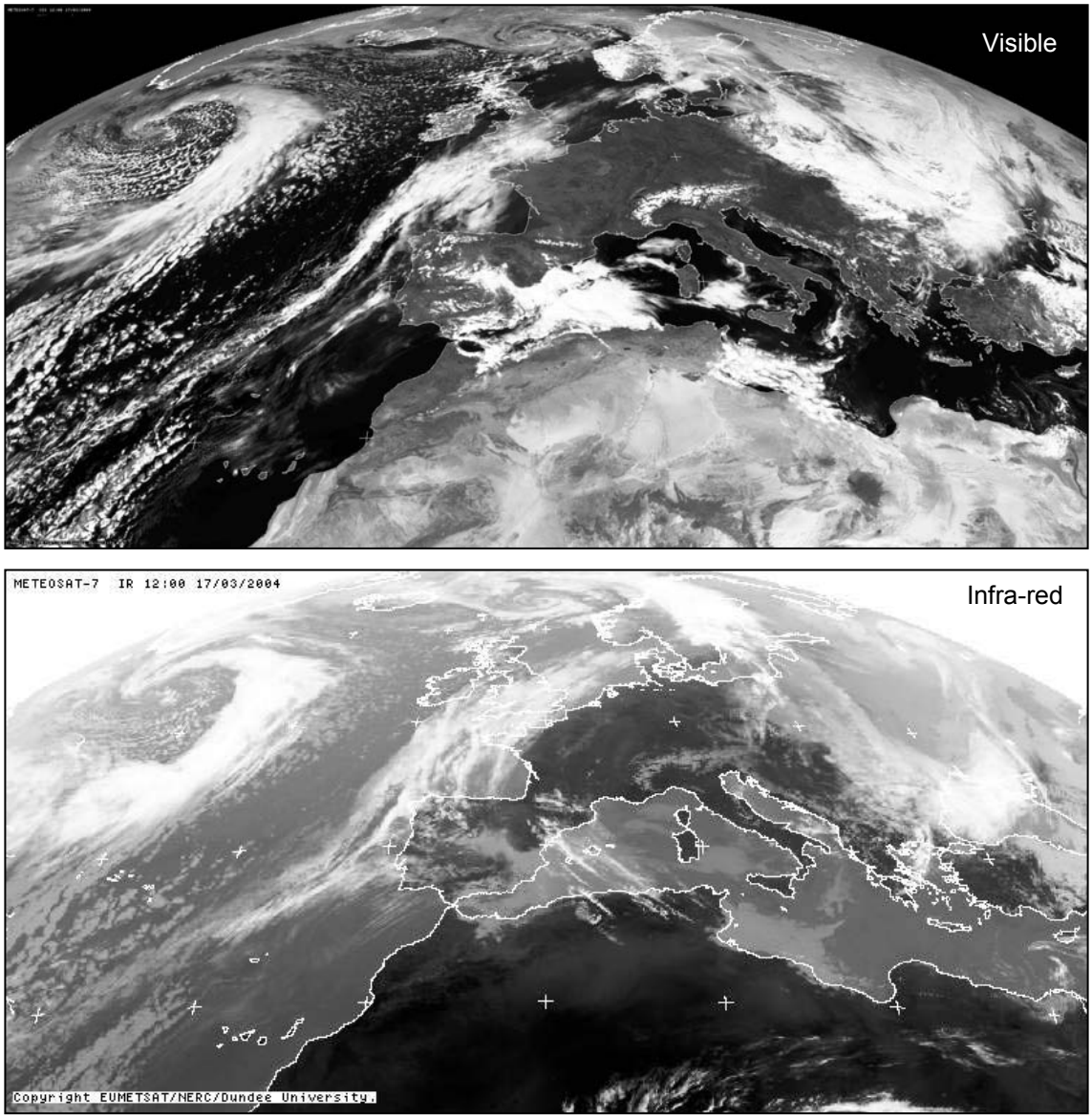


Figure 4
Metosat visible and infra-red images: 12:00 GMT, 17 March 2004

3. THE WEATHER OVER THE BRITISH ISLES ON 17 MARCH

The weakness of the cold front can be seen from the sequence of radar images shown in Figure 5. Over land, the front brought light precipitation to a few places in England and Wales during the morning, and it brought a little rain to Devon and Cornwall during the afternoon. But most places in England and Wales which were under the front enjoyed a dry, though cloudy, day. To the north and west of the front, particularly over Ireland and Scotland, showers occurred, being of snow or sleet above about 600 metres, rain at lower levels. The radar images show that shower activity decreased markedly during the afternoon with the approach of a weak ridge of high pressure from the west.

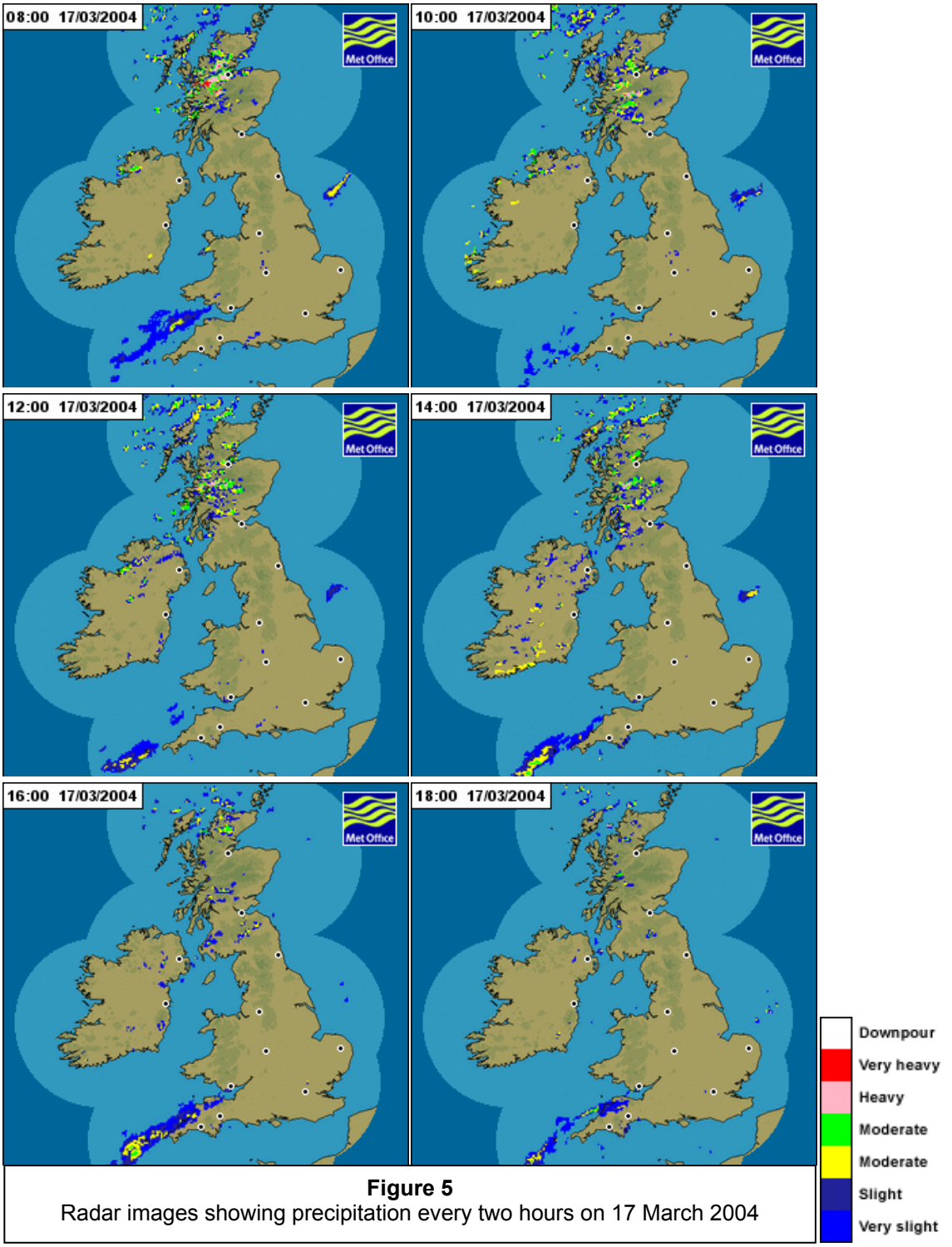


Figure 5
Radar images showing precipitation every two hours on 17 March 2004

Surface observations made at official meteorological stations at 06:00, 12:00 and 18:00 GMT on 17 March are shown in Figures 6(a), (b) and (c). The mild south-westerly flow which was mentioned earlier can be seen, with wind speeds strongest over northern Scotland, lightest over southern England. Barometric pressure increased during the day at all stations except, during the afternoon, those in the south and west of Ireland, the west of Wales and the south-west of England. The weather remained misty and overcast all day in southernmost parts of England but clouds were broken during the day almost everywhere else in the British Isles (and cloud amounts small in some places).

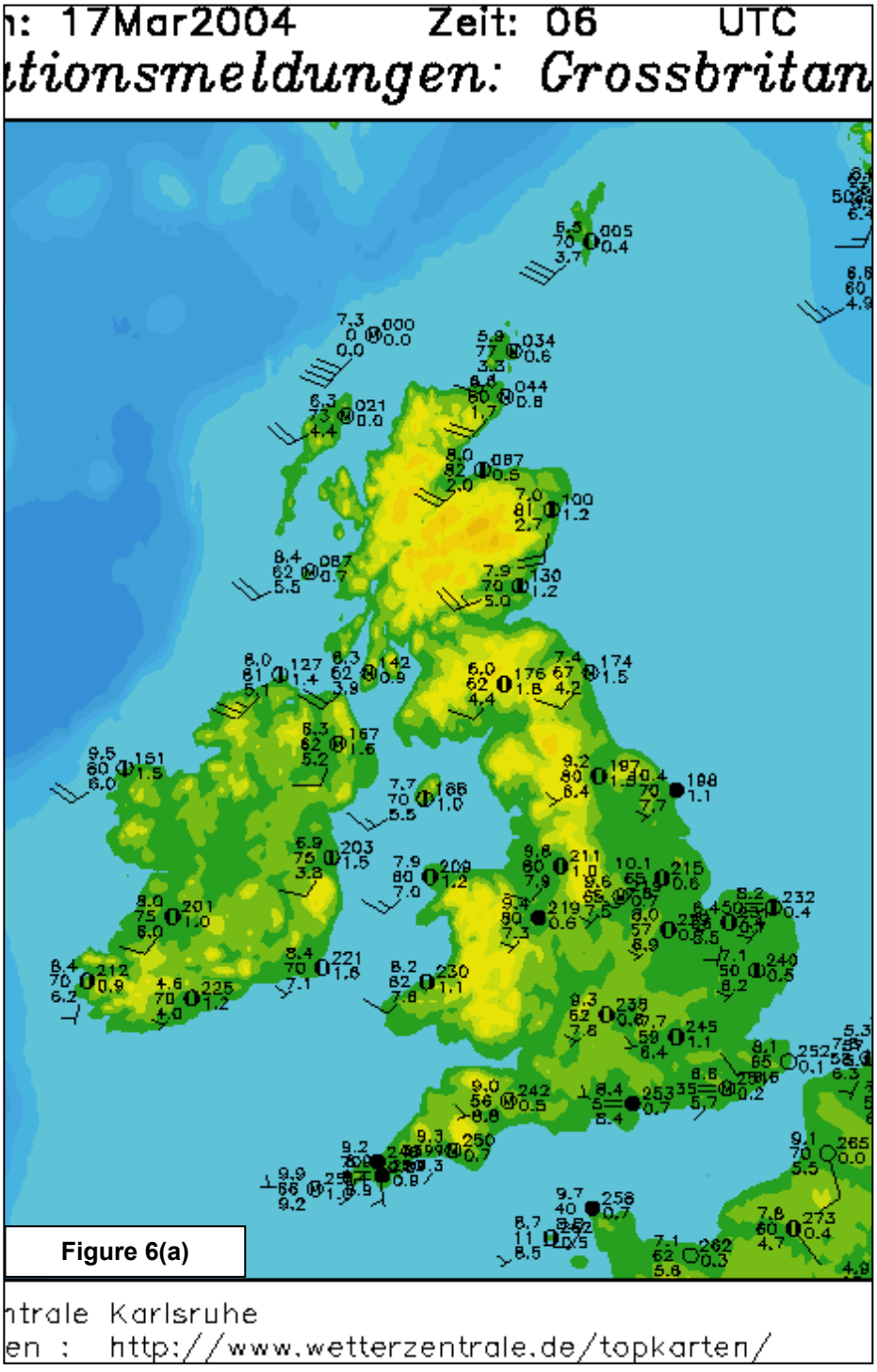
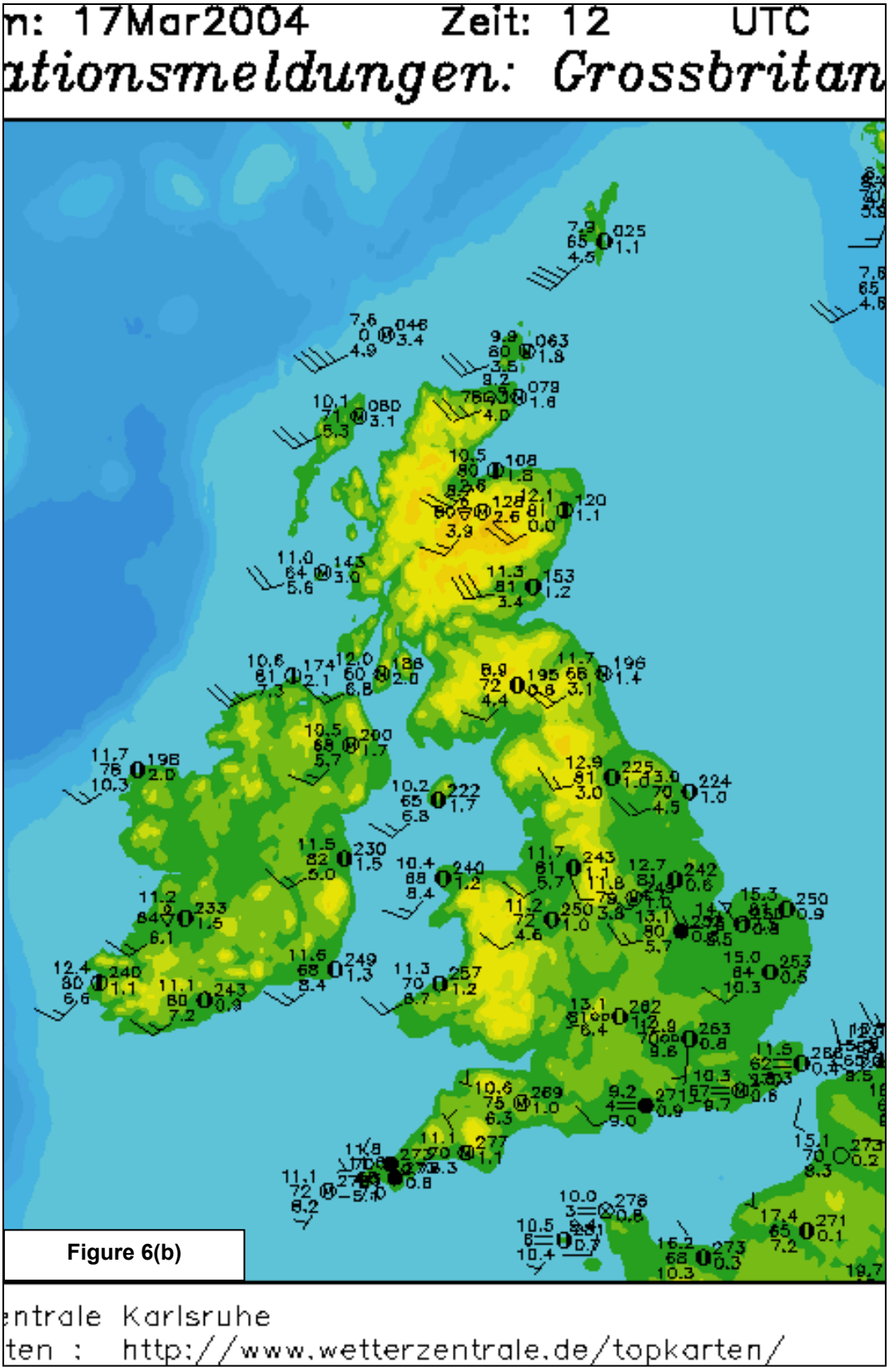


Figure 6(a)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ationsmeldungen: Grossbritan
ntrale Karlsruhe
ten : http://www.wetterzentrale.de/topkarten/

Figure 6(b)

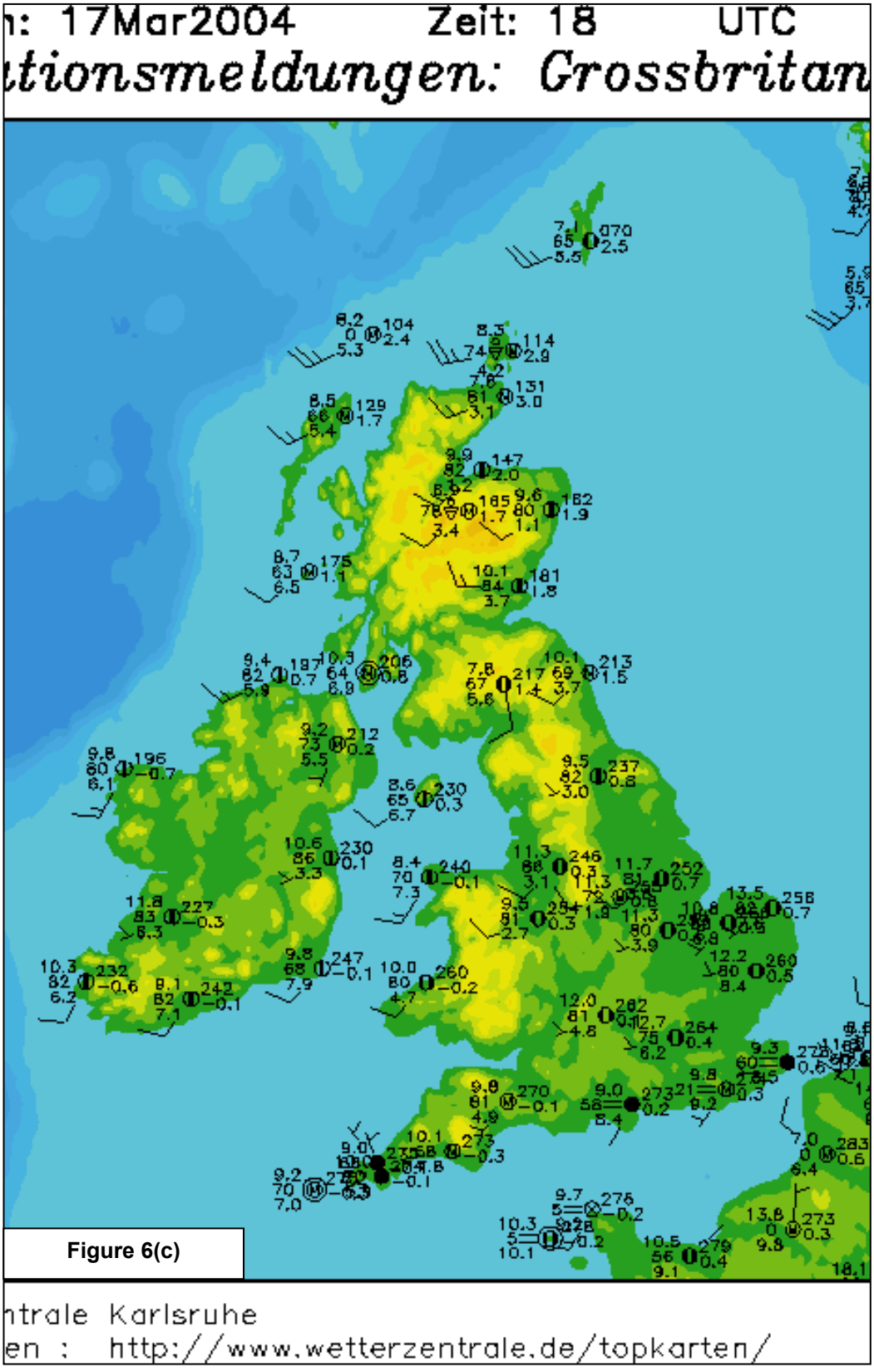

n: 17Mar2004 Zeit: 18 UTC
ationsmeldungen: Grossbritan
ntrale Karlsruhe
en : http://www.wetterzentrale.de/topkarten/

Figure 6(c)

Upper-air ascents made at 12:00 GMT on 17 March at a number of stations in the British Isles are shown in Figures 7(a), (b) and (c) in the form of skew-T / log-p diagrams.

The stations are:
Albemarle (55°01'N 01°52'W) – Figure 7(a)
Nottingham (53°00'N 01°15'W) – Figure 7(b)
Camborne (50°13'N 05°19'W) – Figure 7(b)
Herstmonceux (50°54'N 00°19'E) – Figure 7(c)
Lerwick (60°08'N 01°11'W) – Figure 7(c)

At all stations, winds were south-westerly throughout the troposphere and strong near the tropopause (100 knots at 250 mb – 10 km height – over Albemarle).

At Nottingham and Camborne, places close to the cold front, the air in the middle and upper troposphere was moist and the air in the lower troposphere comparatively dry.

At Herstmonceux, just to the south of the cold front, the air in the lower troposphere was warmer and drier than at Camborne or Nottingham, and drier, too, in the middle troposphere.

At Albemarle, which was north of the cold front, the air was very dry in the middle troposphere, moist in the upper troposphere.

A feature of the ascent made at Lerwick was the low tropopause (only 6 km height). The day was showery at Lerwick and this is consistent with the upper-air ascent, which shows (a) that the lapse rate in the lower troposphere was close to the dry adiabatic and (b) that saturated ascent was possible to around 500 mb. At all stations other than Lerwick, the upper troposphere was moist, which is not surprising, given that cirrus cloud was present at the time over these stations (see Figure 3).

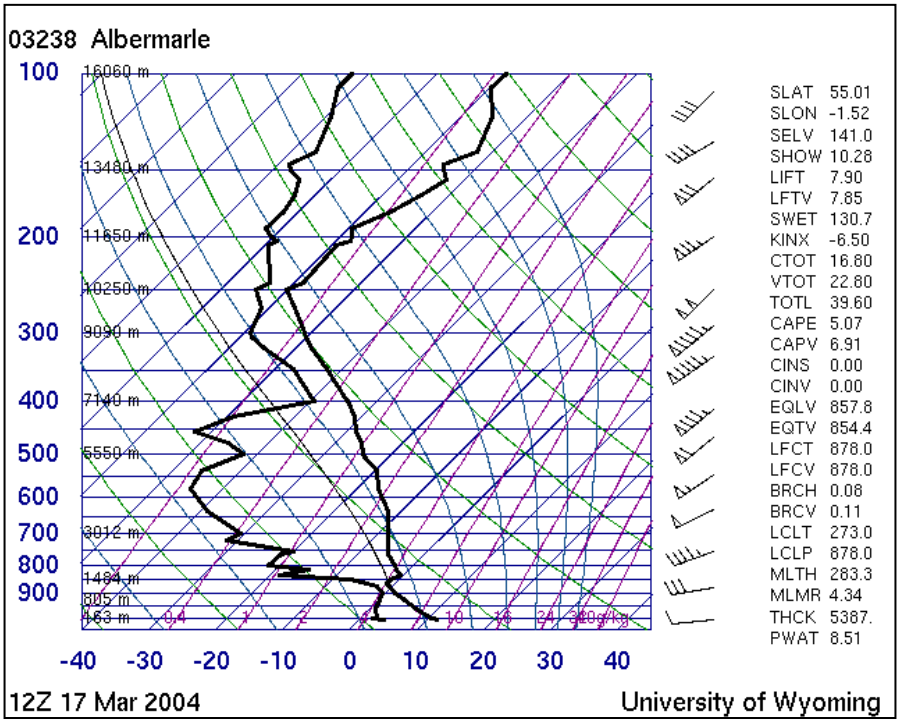
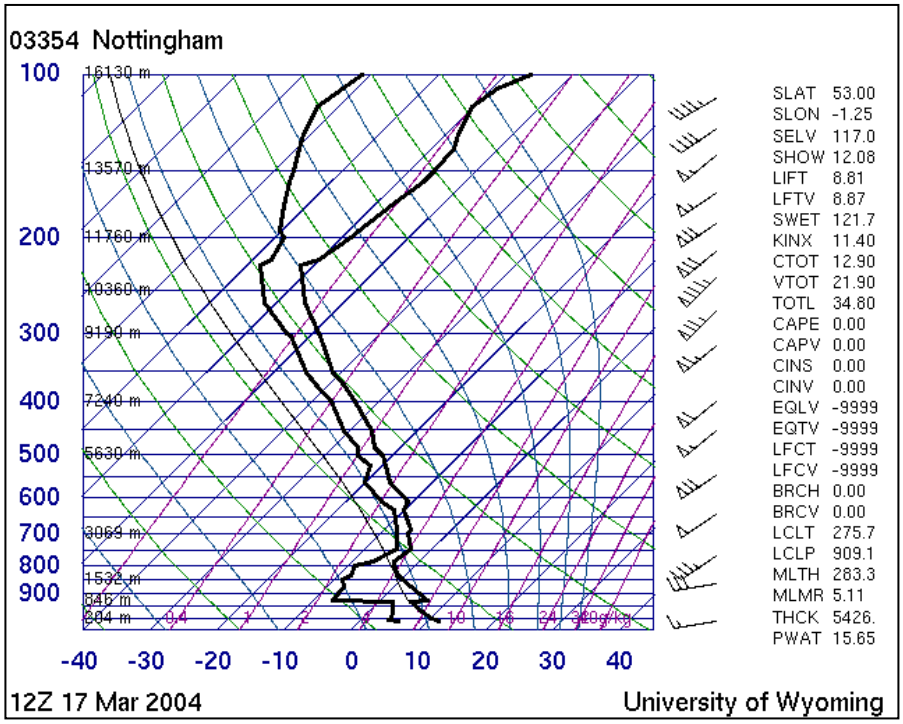
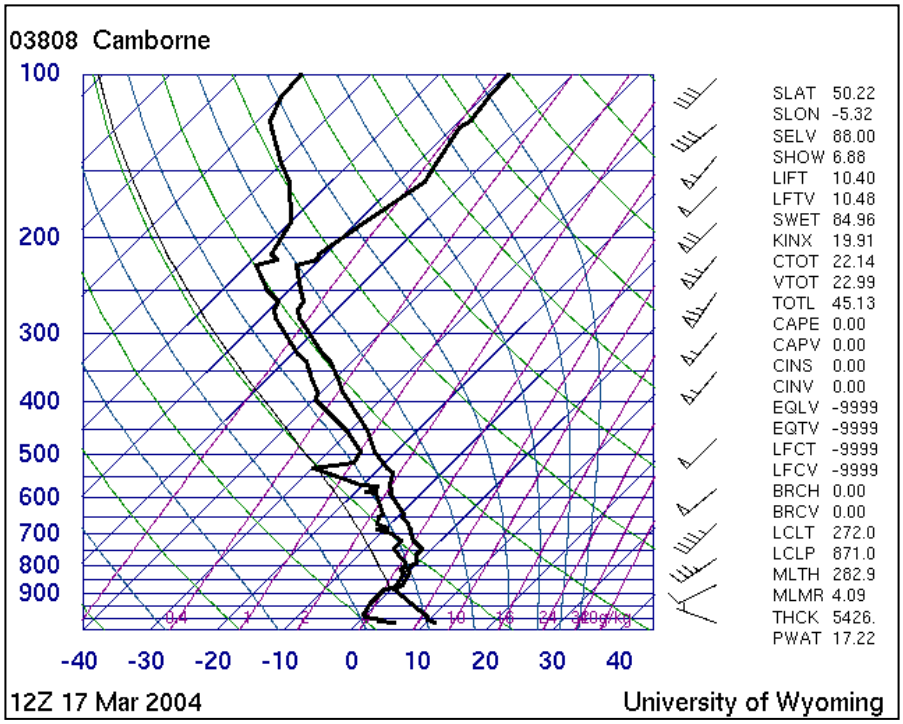


Figure 7(a)


03354 Nottingham
100
200
300
400
500
600
700
800
900
16130 m
13570 m
11760 m
10360 m
9190 m
7240 m
5630 m
3069 m
1532 m
846 m
304 m
-40 -30 -20 -10 0 10 20 30 40
SLAT 53.00
SLON -1.25
SELV 117.0
SHOW 12.08
LIFT 8.81
LFTV 8.87
SWET 121.7
KINX 11.40
CTOT 12.90
VTOT 21.90
TOTL 34.80
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
LFCV -9999
BRCH 0.00
BRCV 0.00
LCLT 275.7
LCLP 909.1
MLTH 283.3
MLMR 5.11
THCK 5426.
PWAT 15.65
12Z 17 Mar 2004
University of Wyoming


03808 Camborne
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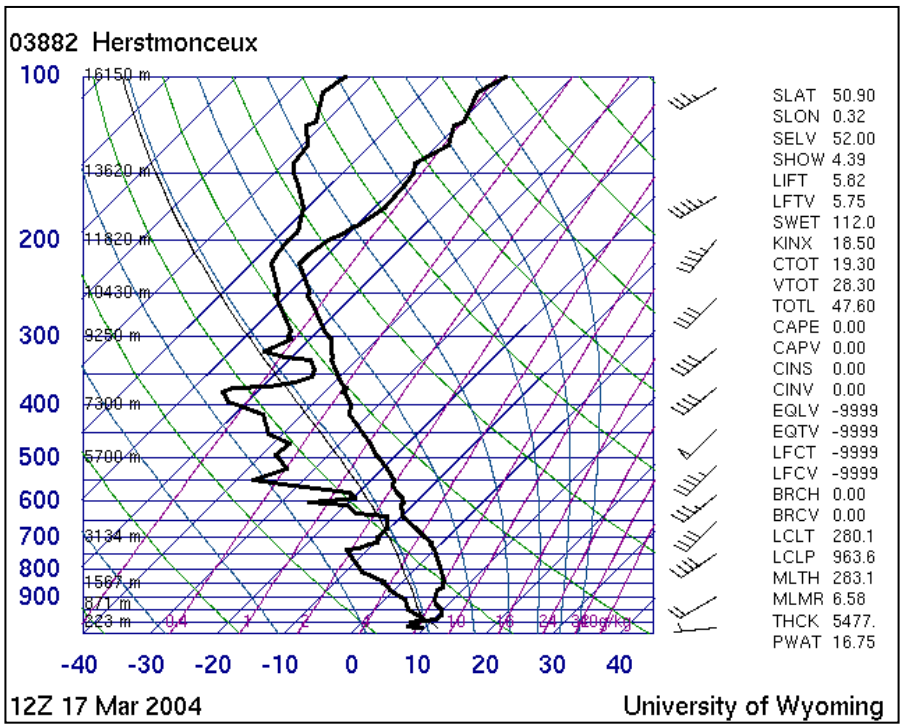
-40 -30 -20 -10 0 10 20 30 40
SLAT 50.22
SLON -5.32
SELV 88.00
SHOW 6.88
LIFT 10.40
LFTV 10.48
SWET 84.96
KINX 19.91
CTOT 22.14
VTOT 22.99
TOTL 45.13
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
LFCV -9999
BRCH 0.00
BRCV 0.00
LCLT 272.0
LCLP 871.0
MLTH 282.9
MLMR 4.09
THCK 5426.
PWAT 17.22
12Z 17 Mar 2004
University of Wyoming

Figure 7(b)


03882 Herstmonceux
100
200
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400
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800
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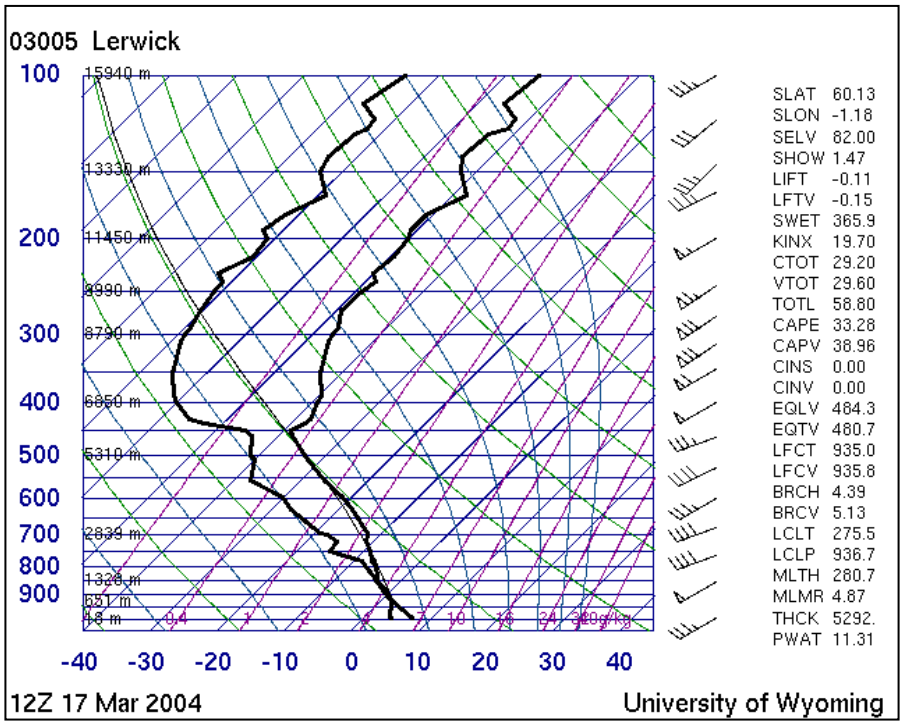
16150 m
13620 m
11820 m
10430 m
9250 m
7300 m
5700 m
3134 m
1567 m
871 m
223 m
0.4
1
2
4
10
16
24
32g/kg
-40 -30 -20 -10 0 10 20 30 40
SLAT 50.90
SLON 0.32
SELV 52.00
SHOW 4.39
LIFT 5.82
LFTV 5.75
SWET 112.0
KINX 18.50
CTOT 19.30
VTOT 28.30
TOTL 47.60
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
LFCV -9999
BRCH 0.00
BRCV 0.00
LCLT 280.1
LCLP 963.6
MLTH 283.1
MLMR 6.58
THCK 5477.
PWAT 16.75
12Z 17 Mar 2004
University of Wyoming


03005 Lerwick
100
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600
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800
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15940 m
13330 m
11450 m
9990 m
8790 m
6850 m
5310 m
2839 m
1329 m
651 m
48 m
0.4
1
2
4
10
16
24
32g/kg
-40 -30 -20 -10 0 10 20 30 40
SLAT 60.13
SLON -1.18
SELV 82.00
SHOW 1.47
LIFT -0.11
LFTV -0.15
SWET 365.9
KINX 19.70
CTOT 29.20
VTOT 29.60
TOTL 58.80
CAPE 33.28
CAPV 38.96
CINS 0.00
CINV 0.00
EQLV 484.3
EQTV 480.7
LFCT 935.0
LFCV 935.8
BRCH 4.39
BRCV 5.13
LCLT 275.5
LCLP 936.7
MLTH 280.7
MLMR 4.87
THCK 5292.
PWAT 11.31
12Z 17 Mar 2004
University of Wyoming

Figure 7(c)

4. A CLOSER LOOK AT CLOUDS AND SATELLITE IMAGERY

The 11:05 GMT visible and infra-red images from the NOAA-17 polar-orbiting satellite show a basic two-way split in the cloud pattern over the UK and Ireland on 17 March (see Figure 3 – reproduced below and on page 3). On the visible image, which shows reflected solar radiation, the whiter an area of cloud appears, the thicker or deeper the cloud is. On the infra-red image, which provides a thermal map of the various surfaces, cold surfaces appear white and hot surfaces black.

amounts of cloud in the middle and/or lower troposphere are large, cirrus clouds may not be observed. This was the case on 17 March, when observers at many places affected by the cold front reported large amounts of low or medium cloud. Observers under the northern edge of the front, however, and observers in East Anglia reported clouds of the cirrus family. The observer at Greenmount (Bury, Lancashire), for example, reported at 12:00 GMT that high cloud was receding to the south-east, with clear skies to the north-west. He also reported: "cumulus below high cloud giving hazy sun at times".

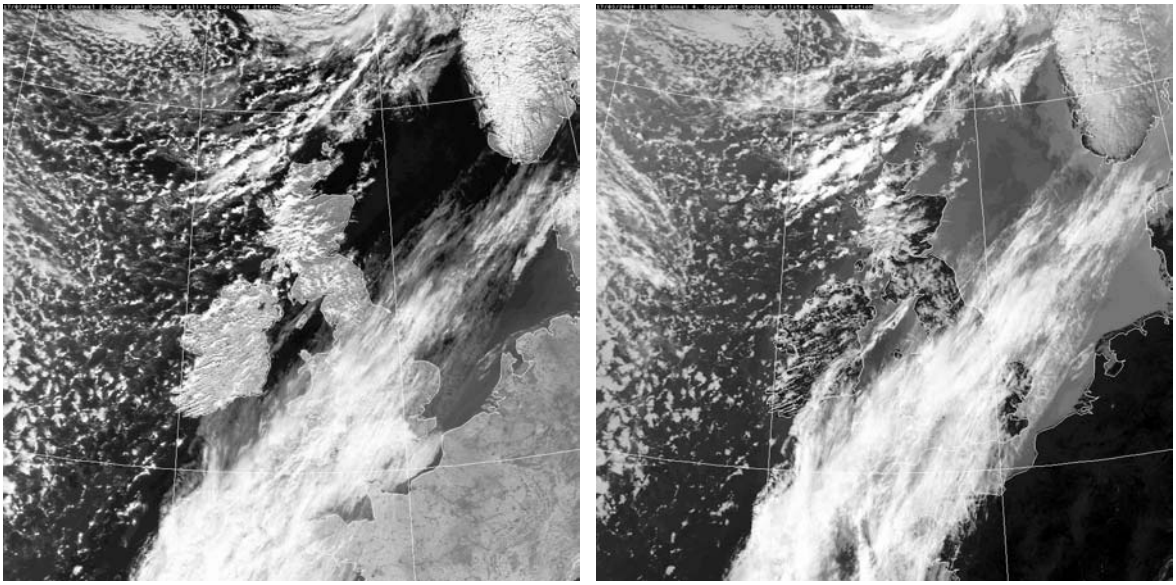

Figure 3 (see also page 3)
Images from the NOAA-17 polar-orbiting satellite: 11:05 GMT, 17 March 2004
Left: visible image Right: infra-red image

Figure 3 shows a broad swathe of cloud (shown white on both images) stretching north-eastwards from the west of Brittany across Wales and much of England to the North Sea.

In the band of cloud over southern parts of the British Isles on 17 March, there was some variation in cloud thickness, but in many places, especially on the northern flanks of the band and over East Anglia, the cloud was thin enough for land and sea to be seen through it.

The cloud associated with the cold front appeared white on the NOAA-17 satellite image and was therefore in the upper troposphere, where temperatures were low (below -40°C above 8 km height at Nottingham and Camborne). It was cloud of the cirrus family (mostly cirrostratus).

It is worth remembering that a satellite views clouds from above, whereas observers on the ground see clouds from below. If, therefore,

Three hours earlier, this observer had reported a "layer of altostratus thinning to cirrostratus in the west". High cloud was reported from Llansadwrn on Ynys Môn (Anglesey), too, the 12:00 GMT observation reading as follows: "Mainly sunny through thin cirrostratus. Halo seen at noon." Other observers under the northern edge of the cold front who reported cirrus cloud were the children of St Francis de Sales Junior School in Liverpool and Woodchurch Road Primary School on the Wirral. In East Anglia, Great Finborough Primary School at Stowmarket and the Royal Hospital School at Ipswich reported cirrus cloud; and St Pieterscollege at Blankenberge in Belgium reported three oktas of cirrus at 15:00 Local Time (14:00 GMT).

North of the cold front, conditions were more pleasant, with a good deal of sunshine and scattered cloud in the cooler polar air. Over Ireland and western Scotland, there were narrow lines or 'streets' of cumulus cloud running

parallel to the wind. These can be seen most clearly on high-resolution versions of the NOAA-17 images (which can be viewed on the MetLink website). These high-resolution images also show, mainly over northern England and southern Scotland, narrow rib-like cloud bands aligned at right angles to the low-level wind. These are lee-wave clouds, resulting from the passage of air over hills such as the Pennines.

The relatively large patches of cloud over northern and western Scotland and northern parts of Ireland are quite bright on both visible and infra-red NOAA-17 images. Thus, the images seem to show quite thick clouds reaching the middle to upper troposphere. There were, indeed, in these areas cumulonimbus clouds producing showers (see Figure 5).

Like the 11:05 GMT images, the 15:26 GMT visible and infra-red images from the NOAA-12 polar-orbiting satellite (not pictured) show a two-way split in the cloud pattern over the British Isles. The swathe of cloud associated with the cold front still covered essentially the same region as at 11:05 GMT. However, both images indicate more breaks in the cloud sheet than in the late morning, and quite a number of observers in areas affected by the cold front reported cirrus or cirrostratus in their 15:00 GMT reports.

To the north of the cold front, the situation at 15:26 GMT was much the same as at 11:05 GMT, with scattered cumulus cloud and sunshine over Ireland, North Wales, northern England and much of Scotland. Cloud streets persisted over western Ireland, and lee waves were still in evidence in some places (east of the Lake District, for example). There was still some shower activity over northern and western Scotland.

5. SOME COMMENTS ON THE WEATHER WATCH DAY FROM THE PERSPECTIVE OF A METEOROLOGIST TRYING TO USE THE UKWW OBSERVATIONS TO PRODUCE PLOTTED CHARTS

by Roger Brugge

5.1. Methodology

I began with A4-size three-hourly Met Office charts of station plots (00:00 GMT, 03:00 GMT, 06:00 GMT, etc.) for the 17th, enlarged these to A3 and then attempted to plot UKWW observations on top. For a nominal chart time of hh:00 GMT, data for the period 90 minutes either side of hh were added to the chart.

In many cases, there were too many observations to plot easily on the charts (e.g. in the Thames Valley where, in addition to the official reports from the original chart, there might be several UKWW reports at the same time). In these cases, the observations were plotted below the chart to enable a quick comparison with other reports.

The observations plotted for the purpose of this exercise were temperature, relative humidity, current weather (from the *MetLink* drop-down menu only), cloud cover, wind direction, wind speed and barometric pressure.

The first difficulty encountered was that of station location. Although the *Metlink* project enables the user to locate most of its reporting stations by means of a map of a substantial area of Britain with the station location superimposed, it does become quite tedious to repeat this for all the UKWW reports. In addition, not all the sites can be located in this way, as some stations did not feature on the maps.

Suggestion: Provide a listing of all sites with UK counties and latitude-longitude coordinates.

Suggestion: Ensure that all station names come with a place name. Some consisted only of a person's name.

Suggestion: Provide a single map with all stations for UKWW located on it – with place names attached. This option is available for all *Metlink* sites in the UK, but without place names.

5.2. The observations

5.2.1 General

The distribution of observations in the UKWW database with time was as follows:

00:00-01:30 GMT – 1	01:31-04:30 GMT – 1
04:31-07:30 GMT – 6	07:31-10:30 GMT – 62
10:31-13:30 GMT – 62	13:31-16:30 GMT – 50
16:31-19:30 GMT – 23	19:31-22:30 GMT – 20

Total number of observations: 225
NB: One UK observation in the database for 17 March was from HMS *Endurance* at 39.8°S 038.6°W!

The distribution clearly reflects the duration of the school day, with individual observers making additional observations earlier in the morning and in the evening.

Observations were made primarily in the United Kingdom (with one station in Northern Ireland); and two UKWW reports were received from Belgium. Observations ranged in latitude from Cornwall to the north coast of mainland Scotland.

5.2.2 Current temperature

This was the most widely reported of all the weather elements. When plotting temperatures, no obvious errors came to light, although by 10:00 GMT a school just to the north of London was reporting 15°C, which is a little on the high side. A school in Yorkshire was reporting 17°C at this time also. At both of these stations, the sky was almost or totally clouded over, suggesting that the instruments were misreading on the high side through design, rather than through exposure.

Observations on the 09:00 GMT chart showed a general increase in temperature southwards, with Farr High School in northern Scotland reporting 5.5°C at 09:00 GMT.

By 12:00 GMT, 19°C was reported under 3 oktas of cloud at a station in south-east England, while 20°C was measured at another station in south-east England at 13:15 GMT. Both of these are also a little on the high side, although the highest temperature reported in the 18:00 GMT national climat message to the Met Office was 18°C at Margate, in the same general area as the aforementioned two stations.

However, with these few exceptions, it is difficult to infer much about the accuracy, or otherwise, of the current temperature measurements, as rather cloudy skies in the south and windy conditions farther north would have resulted in little opportunity for extreme temperature reports to occur, except through reading error.

5.2.3 Maximum and minimum temperature

The majority of stations made reports of temperature extremes. The lowest temperature reported was minus 4°C at a place in Greater London, with 0°C at a station in Kent. Both of these are rather on the low side for the day, and this highlights an inherent weakness in the recording of extremes – to what time/period of the day do they refer? At both places, the minimum temperature around dawn on the 17th should have been closer to 8°C, suggesting that the minima may have been carried over from early on the 16th.

Suggestion: In a study such as this one, omit references to minimum temperature, unless it is clearly stated which day they refer to. For example, ask participants to reset their observing equipment to 15:00 GMT on the previous day in order to get the minima applying to around dawn on the day in question.

Maximum temperatures reported during the day ranged from 9°C to 23°C, with 22°C at two places in south-east England. Both of these were on the edge of a cloudy zone whose boundary ran through the Kent-London borders around midday, suggesting that these high temperatures were the result of exposure to direct sunshine. The diurnal temperature range reported by one school is remarkable! Without knowing the nature of the instrumentation, this author can only note that (as his own experience has shown) some of the cheaper automatic observing equipment does not provide sufficiently reliable exposure when compared to a standard Stevenson screen. However, while this makes comparison with nearby sites difficult, such equipment can still be used to investigate the diurnal development of the weather.

Suggestion: Issue guidelines to observing schools on instrument exposure. How do you take temperature observations with a thermometer but no Stevenson screen? Where should an automatic weather station be sited?

From the observations provided, it is clear that at some stations the maximum and minimum temperatures were reset at every observation time, while at other sites this resetting was done once or twice a day. Presumably these differences are in accord with the normal observing practice of the stations – note that some observers were individuals who report at regular times to the Met Office and/or the Climatological Observers Link (COL).

5.2.4 Relative humidity

Most, but by no means all, observations included relative humidity reports. The data from Met Office stations contain dew-point readings and suggest that, broadly-speaking, there was little variation in the dew point across the British Isles due to fronts. This suggests that the relative humidity would vary largely as a result of variations in surface temperature, with slightly higher values in the colder air to the north.

Arranging all the relative humidity data by magnitude reveals one or two interesting things. Of 129 values reported during the day, there were eight reports of values under 50%. Of these, seven were below 49% and were (in order) 0, 1, 1, 9, 10, 38 and 41%. These latter two are possible values, but the other five are clearly wrong. I suspect that '0' was entered as a 'no available data' report, while the two entries of '1' were made at the same time by the same site.

At the other end of the scale, there were ten reports of 90% or greater, with one entry of 100% being made by a reliable observer of COL. Two of the other reports were made by this same observer. The current precipitation report for all of these ten reports was 'none' – raising the question as to whether mist or fog was

prevalent at the time. Closer inspection of the reports for these ten entries reveals:

- The 100% entry was accompanied by a mention of mist; and 97% was later reported at the same site with visibility over 10km but with low cloud over nearby mountains.
- An entry of 93% was made in an area (Maidenhead) with mist and fog patches nearby; a report of 91% at Wokingham coincided with haze and 7km visibility.
- The 94% observation included mention of mist.

It was only through the 'notes' section that mention could be made of mist, fog and haze. In view of the amount of poor visibility in South Wales and southern England in the morning, which persisted until the afternoon in some coastal areas, I wonder how many other observers experienced fog or mist yet failed to report it. In fact, given the small amount of rain in most places in the south, the most interesting 'weather' in many places was the poor visibility.

Suggestion: Consider the inclusion of fog/mist/haze in a drop-down 'current weather' menu. The drawback to this might be differing definitions of fog in the meteorological and non-meteorological communities.

5.2.5 Current precipitation and precipitation intensity

Of all the reports, four mentioned rain (but with no indication of intensity) and four mentioned slight drizzle. All the rainfall observations came from Woodchurch Road Primary School (near Chester), while drizzle reports came from Farr High School (Sutherland), Kilchrennan Primary School (Argyll) and West Hill Park School (Hampshire).

Some observers did make comments about the current or past weather. These included:

Baintown – 12:00 GMT, 15:00 GMT and 17:00 GMT – past rain shower

Crowmarsh – 09:00 GMT – mist; 15:00 GMT – precipitation within sight

Ardchattan – 15:00 GMT – very heavy showers (not clear if these are 'present' or 'past')

Edenbridge – 11:45 GMT – 400m visibility and fog; 15:00 GMT – fog lifted

Kilchrenan – 14:45 GMT – past hail

West Hill Park – 11:00 GMT – a foggy morning

Wokingham – 09:00 GMT – haze

Farr High School – 09:00 GMT – hail at 8am

Greenmount – 09:00 GMT – a little nocturnal rain (0.5mm)

Velindre – (J Goodger) – 09:00 GMT – slight rain in early hours

Llansadwrn – 06:00 GMT – visibility under 1km

Thus, on a day with little precipitation, there was arguably more detail of significant weather in the 'notes' than in the precipitation menu.

Suggestion: As showers are intermittent by their very nature, include additional options in the precipitation menu so that this also contains 'recent rain', 'recent drizzle', 'recent hail', 'recent snow', 'recent sleet'. In addition, include 'thunder' and 'recent thunder'. Order all entries and ask the observer to select the uppermost one that applies (in the event of two or more being applicable).

5.2.6 Precipitation total in the last 24 hours

Precipitation totals were not plotted. At the majority of stations, no precipitation was reported. The author can think of two immediate reasons why the amount of precipitation reported might be lower than that actually occurring on the day.

1. Official sites, and the majority of individuals reporting to COL, make a single rainfall observation at 09:00 GMT or at the time of the morning observation. Thus, rainfall after this time will not be measured until the following day (the 18th in this case). It is unknown as to whether these stations followed this practice on UKWW day – the author at his Maidenhead site certainly did.
2. Some automatic weather station equipment has a rainfall totaliser that works from a specified time of day. At the school with which this observer is associated (not reporting to UKWW) the automatic rain-gauge provides 24-hour rainfall totals that are reset at 07:30 GMT each day. Thus, a report made at 12:30 GMT will still provide the rainfall total ending five hours earlier.

At the upper end of the scale, Ardchattan (near Oban) reported 11mm at 15:00 GMT; and 13.2mm was noted at the Abernethy Trust at Ardeonaig (near Loch Tay) at 10:00 GMT. Some or most of the latter total may have fallen outside UKWW day, though there were, as pointed out earlier, showers over Scotland on the day in question.

In the light of these problems, all that can be said of precipitation amounts on the 17th is that they were generally small. The national climat messages for official UK sites indicate that the wettest place in the 24 hours ending 18:00 GMT on the 17th was Loch Glascarnoch in NW Scotland (where 14mm fell). Across much of

England and Wales, the front tended to break up as it passed, and only slight rain or drizzle occurred.

5.2.7 Wind direction and wind speed

To enter information about wind direction in the *MetLink* database, a pull-down menu is provided, and the observer is asked to provide wind speeds in units of km/h. It should be noted that although these are 'natural' units for schoolchildren using the SI system of units, UK meteorologists tend to use knots or the Beaufort scale. This suggests that, since recording instruments are least likely to have displays in km/h, unit conversions are probably required by observers.

Winds blew mainly from the SW quadrant, although there was some variation as the front passed. Winds were strongest across exposed parts of Scotland and, to a lesser extent, over northern England. Winds tended to ease during the day as air pressure rose, and were weakest in the south.

Although in most cases a 0km/h wind speed was accompanied by a direction of 'calm', in a few instances a wind direction was specified and a 'nil' speed was given. These were consequently plotted as missing wind speeds. Some observers specified a wind direction but no wind speed.

Most observations did include a wind speed report – these ranged as high as 40km/h or more (eight cases) and included an erroneous 148km/h in one case. With this one exception, there are no reasons to doubt the authenticity of these reports – it was windy across Scotland and some of the highest values came from 'reputable' observers.

As a professional meteorologist, this author found the units a little strange and I wonder if using the Beaufort scale might be better in future. This should remove the need for conversions (wind speeds accurate to 0.1km/h are unusual in observations).

Suggestion: Use a pull-down Beaufort wind-scale menu in future projects to report wind speed.

5.2.8 Air pressure and tendency of pressure

Surface weather charts contain information on mean sea level (MSL) pressure and this is the one quantity on such charts that varies quite smoothly in the horizontal – as can be seen from the maps of isobars that are then drawn as a result. Thus, erroneous air pressure observations are usually easy to detect in a project like the UKWW. On the small scale, there can be localised fluctuations of the order of 1-2mb in size under conditions of frontal passage such as occurred on the 17th; and similar variations can also occur under certain heavy showers.

MSL pressure varied as follows according to official reports:

06:00 GMT: 1004.4mb at Wick to 1025.1mb at Scilly

12:00 GMT: 1007.9mb at Wick to 1027.8mb at Scilly

18:00 GMT: 1013.1mb at Wick to 1027.5mb at Scilly.

The UKWW database includes six observations of 1000mb or less, one of them as low as 960mb. These suggest that possibly some pressure recording equipment was not set to MSL, although a reading of 960mb (made at a station where the temperature extremes were also on the limits) suggests that the pressure sensor was faulty.

Suggestion: Encourage all observers to calibrate their pressure recording equipment prior to the *Metlink* projects on anticyclonic days. In future years, this might be done by having the *MetLink* organizer send out a reminder email to this effect when the UK is under a large winter anticyclone.

Suggestion: Encourage all *MetLink* participants to check their barometers against the NOAA decoded METAR website a few days before *MetLink* starts – each observer should be able to find a suitable local aerodrome on this page in order to apply any correction to their instrument.

One station in the north of England provided a reading of 1049mb, and there were several observations that were 2-3mb too high or low. However, the ease with which errors in pressure can be detected may be the reason for the identification of such erroneous values.

Suggestion: Provide a small webpage giving information about the typical range of MSL pressure that might be expected in the UK. Observers should realise that 1049mb is high and 960mb is low and that each will almost always be accompanied by distinct types of weather! Such a page could incorporate the previous two suggestions.

A brief analysis of the pressure tendencies reported during the 17th confirmed the general trend of rising pressure. There were six observations of falling pressure, 67 of rising pressure but 59 of steady pressure. Of the observations of falling pressure, three were

reported by stations whose pressure reading was far too low for the time in question, and three were observations that conflicted with reports from neighbouring stations.

5.2.9 Cloud amount

Cloud amount was provided via a drop-down menu. Quite a few observations (almost one in five) did not contain cloud-cover data. Being relatively easy to observe/estimate, I found this to be of most use in areas where the cloud bands ended and the surface network of Met Office plotted observations was sparse. Thus, at 09:00 GMT there was a progression from a rather foggy 8 oktas cover at Edenbridge (Kent) to 1 okta cover at nearby Canterbury. Both are consistent with nearby reports and help to mark the edge of the cloudsheet – and the observations also explain (at least partially) why at 09:00 GMT 10.4°C was the temperature at Edenbridge while 19C was the reading at Canterbury (which by then had 3 oktas cloud cover).

At 21:00 GMT, there were interesting observations of 1 okta cloud at Radley and Marlborough (when nearby 'official' sites were reporting 5-7 oktas cover. The author wonders if orographic effects were coming into play here – the cloud cover had been decreasing in the West Midlands but was rather more persistent in central southern England. However, at this time in March it is difficult to observe the sky unless one is away from street lighting and can see the stars. While not applicable in this case, there is always a danger of extrapolating what was seen before sunset to an observation made shortly after sunset and not taking into account sudden cloud cover changes.

5.2.10 Cloud types

These were not plotted on the outline charts. About one fifth of the observations did not include cloud type information, although at those sites where cloud details were given there was a lot of variety across Britain as a whole.

Early in the day, there was cirrus ahead of the front across south-east England, and this increased to almost total cover before low-level stratocumulus and stratus were reported under the front. Behind the front, there was cumulus and stratocumulus early in the day which deepened to deep cumulus and cumulonimbus later as convective activity developed (in the north in particular).

Interestingly, this is one observational category where the keen 'amateur' can noticeably augment the operational observing network. Increasingly nowadays, the operational network is seeing the manual station replaced by automatic weather station systems. While a few of these are able to report cloud base heights, they are unable to distinguish cloud types.

5.2.11 Additional notes

Observers were encouraged to provide additional notes about the weather, especially that during the previous three hours. These were useful in that they added detail to an otherwise constrained report (constrained by the contents of pull-down menus and pre-specified observational requirements) and highlight the difficulty of acquiring a picture of the weather using rigidly formatted/coded observations.

On a day with little significant weather, these notes did help to determine the location of precipitation by highlighting recent falls, especially in showery areas in the north. They were also useful in determining areas of poor visibility and fog/mist.

Additional notes included:

Llansadwrn – soil temperatures also reported.

Baintown – gusts to 47km/h at 09:00 GMT

Royal Hospital School (ahead of the front) – 09:00 GMT: Very nice warm morning, spring flowers open. Dew on the ground.

Greenmount (Bury, on the northern edge of the frontal cloud) – 09:00 GMT: Layer of altostratus thinning to cirrostratus to the west. Dry after a little nocturnal rain (0.5 mm). Wind light.

Farr High School (Sutherland) – 09:00 GMT: A blustery day, dry meantime, but heavy showers of hail around 8am. Not as warm as yesterday.

Llansadwrn – 09:00 GMT: Sky starting to clear, visibility now >10 km but still misty with low cloud over mountains. 12:00 GMT: Evaporation by lysimeter under grass since 09:00 GMT was 1.1 mm.

Wokingham – 09:00 GMT: 7/8 low stratus at 600 ft, visibility 7km in haze. Conditions similar at 07:00, although at that time the visibility was only 3000m in mist.

Crowmarsh – 09:00 GMT: Mist; cloudy over past 3 hours with reddish sunrise (The author wonders if this is confirming the adage about red sky in the morning, perhaps?)

Roose (Cumbria) – 09:00 GMT: noted that the cold front was clearing to the south.

West Hill Park – 11:00 GMT: A foggy morning with very poor visibility.

Stuartfield (Peterhead) – 11:30 GMT: Blue skies, sun shining brightly, quite warm with a breeze. (This was despite a temperature of just 8°C, illustrating the warming power of the sun on human flesh!)

Edenbridge – 11:45 GMT: Since 09:00hrs full low cloud (below 2000ft - no aircraft seen into Gatwick - on flightpath) and fog 400metres all am. Windchill factor reading 8°C. Feels cold and damp when out walking.

Harpbar – 12:00 GMT: Altostratus thinning. Solar halo.

St. Oswald's Sheffield – 12:00 GMT: We can see a bit of blue sky. The breeze got stronger.

Kilchrenan – 14:45 GMT: Between readings; hail, sunshine and gusting wind.

At 09:00 GMT, two observers noted that it was 'breezy' – but the mean wind speeds reported were 6km/h and 26km/h respectively. This suggests that the station notes can include quite a bit a personal interpretation.

6. WHAT CAN WE LEARN?

by David Pedgley

Here are some examples of lessons that can be learnt from a project like the UKWW, the point being that even one day can illustrate many kinds of events.

6.1 Build-up of daytime cumulus

Consider official Manchester observations (Cu = cumulus):

09:00 GMT: 1/8 small Cu – 2000 ft base – temperature 10°C

12:00 GMT: 3/8 small Cu – 2600 ft base – temperature 12°C

15:00 GMT: 2/8 large Cu – 4000 ft base – temperature 13°C

18:00 GMT: 1/8 large Cu – 4000 ft base – temperature 11°C

21:00 GMT: nil – temperature 7°C

As the sun heats the ground, convection develops and cumulus clouds begin to appear – small at first, but growing larger by midday as the depth of convection increases. At the same time, cloud base rises because the difference between temperature and dew point increases. By late afternoon, the sun's heating has almost gone, temperature has begun to fall and cloud amount is decreasing as no new clouds are forming, until they disappear altogether after sunset, when the temperature falls quickly under an almost clear sky and light winds. Cumulus development is not dramatic because the sun's heating in mid-March is weak compared with mid-summer.

6.2. Clearance of early morning low stratus cloud and fog

Take central southern England.

06:00 GMT: Much stratus/fog/local drizzle, and temperature 7-9°C.

09:00 GMT: Cloud beginning to lift and break, but also spreading to a previously clear area in light south to south-west winds, and persisting near south coast with onshore winds; temperatures 10-11°C.

12:00 GMT: Only patchy residual stratus as temperatures rise to 12-13°C (except near south coast).

15:00 GMT: Stratus all gone and replaced by small cumulus as temperatures reach 12-14°C; but stratus/fog still persisting along parts of south coast with onshore wind and temperatures 8-10°C.

6.3. Small changes in temperature with strong off-ocean winds

Compare Benbecula (small, exposed island) with Stornoway (sheltered side of larger island) – temperatures and winds (south-west)

W = mean wind speed G = Gust

	BENBECULA			STORNOWAY		
Time GMT	T°C	W (kt)	G (kt)	T°C	W (kt)	G (kt)
00:00	8	30	40	8	25	35
03:00	8	25	41	7	20	33
06:00	8	30	55	6	20	39
09:00	9	25	38	7	20	32
12:00	9	25	35	10	25	38
15:00	10	20	28	9	20	36
18:00	9	20	-	9	15	27
21:00	8	15	-	8	15	-
24:00	8	20	-	7	15	-

With such strong winds, fetch across land to the observing site at Benbecula is only a few minutes, so the air is warmed up very little, especially with the weak spring-time sun and showery weather. At Stornoway, the fetch is greater, so the daytime change is a little greater, but note the maximum is the same at both places because it is determined by the depth of convection (large in showery weather) rather than the amount of heat put in from the sun.

6.4. Origins of multi-layered clouds

Consider Birmingham.
Ci = cirrus; Sc = stratocumulus; Cu = cumulus;
Ac = altocumulus; As = altostratus;

00:00 GMT: 7/8 Ci

03:00 GMT: 8/8 Sc 3500 ft 4/8 Sc 2000 ft

06:00 GMT: 7/8 Sc 5000 ft

09:00 GMT: 8/8 Sc 6000 ft 1/8 Sc 1500 ft

12:00 GMT: 7/8 Sc 6000 ft 1/8 small Cu 2000 ft

15:00 GMT: Ci 6/8 Ac-As 10000 ft 1/8 small Cu 3000 ft

18:00 GMT: Ci 6/8 Ac-As 13000 ft 3/8 Ac-As 9000 ft

21:00 GMT: 3/8 Ac-As 16000 ft

00:00 GMT: 7/8 Ac 9000 ft

This looks like a bewildering mix of clouds! In fact, the sequence can be explained with some confidence.

The marked change from 00:00 GMT to 03:00 GMT is a result of sheets of multilayered Sc spreading across Birmingham as a cold front approached from the north-west. These persisted until 12:00 GMT. Note the main cloud sheet had a base of 5000-6000 ft, the same height as was reported by many other stations. By 12:00 GMT, despite the presence of extensive Sc, the sun's heating was able to produce a little small cumulus. By 15:00 GMT, the Sc had gone – comparison with neighbouring stations shows that it had moved away to the south-east. This clearance revealed the presence of higher level clouds (altocumulus and altostratus), which may well have been present earlier but were obscured from ground observers by the Sc. These clouds persisted for the rest of the day, being in several layers with bases from 9000 to 16000 ft, and were part of the cloud system accompanying the cold front.

7. THE WEATHER FORECAST COMPETITION

The weather forecast competition attracted seven entries, of which three did not meet the advertised condition that “each person who enters will be required to provide a brief justification for his/her prediction”. The competition was won by John Clayton of Selly Oak, Birmingham. His forecast (received at the Royal Meteorological Society at 2.24pm on Monday 15th) was as follows:

Weather Forecast for the Midlands of England, Wednesday 17th March 2004.

Forecast prepared through interpretation of Met Office synoptic charts at 14h GMT on Monday 15th March:

General situation Wednesday:

Low 998mb centred to NW of Scotland. Most of England in warm sector at first with cold front extending SW to NE from Cornwall to Teesside. The cold front will advance to lie over south east England by midday and over the northern coast of France and the Low Countries by midnight. Pressure will remain relatively high in the range of around 1020 to 1024mb.

Forecast for the Midlands of England:

Temperatures throughout Wednesday will be above average for mid March as the result of the influence of SW and W winds and Tropical Maritime air.

Tuesday/Wednesday night will be predominantly cloudy, with cloud increasing from the NW as a result of the advancing cold front, which will also bring outbreaks of rain during the latter part of the night and the morning. Night-time and early morning temperatures will be very mild (10°C) as a result of the cloud cover and the south westerly flow bringing Tm air from the Atlantic coasts of Spain and NW Africa. A moderately steep pressure gradient will result in wind speeds of 15 to 20mph (24 to 32kph).

The latter part of the morning and into the afternoon will see the rain dying out after the passage of the cold front south eastwards, to be replaced by variable cloud and some sunny intervals, which will allow temperatures to rise to a maximum of 13°C. There may be an occasional isolated shower in the moderate to fresh breeze, which will for a time become westerly following the passage of the cold front.

In the evening and night pressure will rise slightly and the pressure gradient will become slight meaning that the wind will fall to a light south westerly of around 5mph (8kph). With the rise in pressure, cloud will become more broken, and with the air behind the cold front, whilst still being Tropical Maritime, now originating from the mid Atlantic, temperatures will fall to around 5 or 6°C, which is still 3 to 4°C above average for the middle of March.

The only prediction that was significantly in error was that of the central pressure of the depression to the north of the British Isles. Mr Clayton predicted 998mb. The analyses for 00:00, 06:00, 12:00 and 18:00 GMT issued by the Met Office showed pressures much lower than this (see Figure 1, page 2). At Lerwick (Shetland), the nearest UK station to the centre of the depression, the lowest barometric pressure reported during the period 06:00 to 18:00 GMT on the UKWW day was 1001mb.

The Met Office kindly donated a prize of a Met Office umbrella signed by BBC Weather Centre radio and television weather presenters. The organizers of the UKWW wish to record their gratitude to the Met Office for their generosity.

8. CONCLUDING REMARKS

Section 5 of this report reviews the UKWW observations and contains many suggestions for improving *MetLink* and any other observational projects which the Royal Meteorological Society may organize in the future. It also highlights some of the problems of using electronic meteorological instruments and automatic weather stations. An educational point in this respect is that, in some subjects (geography in particular), the national curricula for schools in the UK require pupils to engage in field work and learn how to use instruments. Projects such as *MetLink* and the UKWW provide 'fun ways' of meeting these requirements and also draw attention to the need for attention to be paid to the calibration and correct exposure of instruments, which are fundamental aspects of science.

In both *MetLink2004* and the UKWW, the participants included individuals for whom weather is an absorbing hobby and observing the weather correctly a matter of great pride. Their involvement enhances projects such as *MetLink* and the UKWW and it may be that some of them are willing to become more involved – by linking up with local schools, for example.

9. ACKNOWLEDGEMENTS

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