Met Office Balloon Challenge

Teacher's notes

We hope that the Met Office balloon challenge will be fun and educational for your pupils. The chosen activities can be carried out at any time and are based on December 2001, 0900 hrs surface wind speed and direction from a total of seven stations. All the activities have been provided in this pack — please photocopy as required for use in the classroom. Ideally, ICT skills can be developed using these activities, from the basic entry of data to manipulation and visual presentation of information, which can be enhanced with real-time data, extracted from the internet.

By providing information from seven stations, you will be able to:

1. choose that most relevant to your area;
2. divide the number of activities between groups of pupils;
3. spread the activities over several lessons.

Suggestions on how to use the data provided are as follows.

- Plot wind roses of surface winds from a selection of stations for December 2001. (Template and results provided.)
- Compare the findings with the seasonal average based on 10 years of data. (Annual wind roses provided.)
- Discuss who would be interested in receiving wind information in this format.

Additional ICT use of the data sheets

- Enter the information provided into a spreadsheet and manipulate the data
- Create a direction range that covers a 16-point compass, e.g. north, north-west, east, north-east, etc.
- Create charts to give visual representation of the findings; note the importance of correct labelling

Important notes

Environmentally friendly latex balloons and labels have been provided. Please help us to care for the environment by following the guidelines and code of conduct for balloon releases, which can be found at **www.nabas.co.uk**

We have been alerted to the fact that, in a very small number of cases, those suffering from nut allergies can experience a reaction to latex.

Contents

Prediction instructions and map

Information sheets on wind speed and direction — test your knowledge quiz

December 2001, 0900 hrs surface wind data sheets for:

- Aberporth
- Cardiff
- Eskdalemuir
- Heathrow
- Kinloss
- Manchester
- St Mawgan

Annual wind rose summaries for:

- Aberporth
- Cardiff
- Eskdalemuir
- Heathrow
- Kinloss
- Manchester
- St Mawgan

Wind data activity sheets

Wind rose template

Wind data activity sheets: Answers

Wind rose: Answers

Met Office Balloon Challenge

Completing the prediction sheet

Prior to the launch

- Observe the wind — how fast are the clouds moving; are they all moving in the same direction?
- Ensure the pupils understand the position of north, south, east and west.
- Print out a copy of the prediction sheet **www.metoffice.com/education/balloon** and copy as required — scale must not be altered. Give each student a prediction sheet or hold an open debate with one overall prediction being agreed upon.
- Identify your school or your starting point on the map — please label this point 'Start'.
- Complete the labels and attach to the balloons (no string required). Please follow the guidelines and code of practice for the balloon launch, these are available at **www.nabas.co.uk**
- Release one balloon as a test (optional).
- Release the balloons (as close to 1.30 p.m. on the launch day as possible).
- Collect as much information as you need to make your prediction. Forecast weather charts will be available at **www.metoffice.com/education/balloon** during the period covering the balloon challenge.
- Predict the final destination of the balloon(s) on the map — please label this point 'Finish'.
- Send your prediction sheet(s) to:

  Met Office
  Balloon Challenge
  Scott Building
  Eastern Road
  Bracknell
  Berkshire
  RG12 2PW

Entries will not be accepted after 29 March 2002.

Assumptions

- All balloons have been inflated to the same size and pressure.
- The buoyancy of the balloon will take it to a starting height of 1.5 kilometres.
- The balloons will be released on or close to 1.30 p.m. on the day of the challenge (model run 1330 hrs).
- The final destination of the balloons will be reached within 12 hours of the start time.

What determines a balloon's path?

The path (also called a *trajectory*) of a helium balloon is influenced by many factors. You might like to consider the following points before making your predictions.

Because the balloons are filled with helium, which is a lighter gas than air, they will naturally rise upwards and, as they rise, will be blown along by winds in the atmosphere. So, to forecast the path of a balloon, we need to have an idea of how high it will rise and what the pattern of winds will be at the time. We also need to know for how long the balloon will remain airborne.

First, consider how high the balloon can rise. This is largely determined by the type of balloon and the amount of helium inflating it. Inflating the balloon to a high pressure causes it to rise faster and to a greater altitude, but this is not without its risks. If you fill the balloon with too much helium, it can burst as it rises through the atmosphere.

The pressure exerted on the balloon by the surrounding air falls as the balloon rises upward (atmospheric pressure decreases with height). This causes the balloon to expand and become colder. The balloon has two possible fates: either it continues to rise and expands until it bursts, or it safely reaches a level where it stops rising and then gradually drifts downward again as the helium leaks out of the balloon.

So what height can it reach? Some balloons have been observed rising to an altitude of four or five kilometres (and greater heights are probably possible!).

However, other factors also need to be considered when predicting the height that your balloon will reach. Is it raining? Will the balloon rise through low cloud?

If the surface of the balloon becomes wet, the extra weight of the water will reduce its buoyancy. There will be an even greater impact if the balloon rises through moisture when its surface temperature is below 0° C — ice will freeze onto the balloon. Heavy icing could cause the balloon to fall dramatically or even burst.

Are there any showers forecast? Strong air currents in shower clouds could lift the balloon upwards or suddenly drop it downwards.

Can you think of any other effects that the weather might have here?

As your balloon rises through the air to its predicted altitude, it will be blown along by the motion of the atmosphere. You can estimate the balloon's trajectory by using the Met Office's weather forecast charts. But remember that, in the northern hemisphere, winds blow along the isobars (almost!), with low pressure on the left. You should also consider that the wind pattern changes with height. Have you ever watched clouds moving in different directions at different heights? Taking account of upper-air observations might be useful here.

How long will your balloon remain airborne? The helium gas will gradually leak away from the balloon and, as it loses its buoyancy, it will fall back to the ground. This depends on the type of balloon — metal foil balloons remain buoyant for a long time, but latex party balloons lose helium at a much faster rate. In a previous balloon release, we estimated that the balloons would remain airborne for 6–12 hours; although longer flight times might be possible.

So now you should be able to put together your prediction.

Good luck!

Where will my balloon go? — Forecasting the wind today

What you will need

- A surface weather chart for midnight last night (analysed chart) and midnight tonight (forecast chart) from our web site at **www.metoffice.com/education/balloon/index.html**
- A pen or pencil
- A ruler
- A protractor
- A calculator
- The prediction sheet

1. Look at the analysed chart for 0000 UTC on 8 March 2002 (or 20 March 2002) (midnight last night) and compare it with the forecast chart for 0000 UTC on 9 March (or 21 March) (midnight tonight). How do the charts differ over the UK? Are the isobars closer together or further apart? Are the isobars going in a different direction? What effects will these changes have on the wind throughout the day?

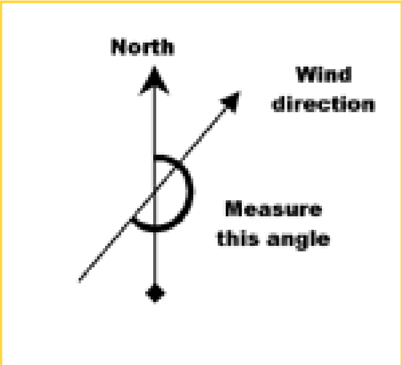
2. Look at the analysed chart and, roughly where your school is, draw an arrow on the chart parallel to the isobars using a pencil and ruler. Draw the head of the arrow so it is pointing in the direction where the low pressure is to the left. This is the direction the wind will be blowing.

3. Measure the angle from north around to the tail of the arrow as in the diagram (right).

The direction of the wind over my school today is:

.... degrees or

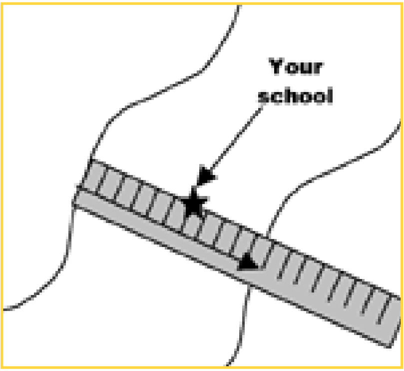
........................’ly.



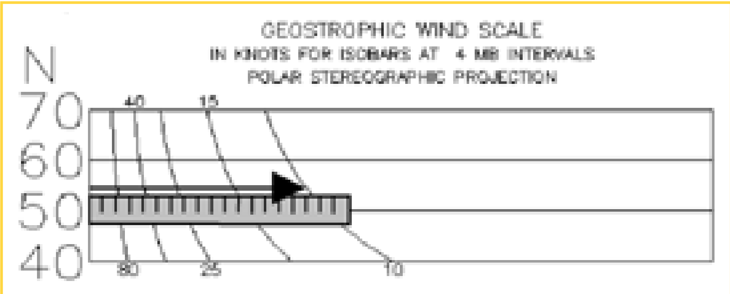
4. Look at the analysed chart again and, roughly where your school is, use a ruler to measure the distance between the isobars. Make sure that your ruler is at right angles to the isobars when you make your measurement, as in the picture (right).

The distance between the isobars over my school today is:

.... cm



5. At the top of the analysed chart is a wind-speed scale like the one in the picture below. Take the distance measured between the isobars and place it along the scale from the left-hand side. Mark this distance with a line. Use the middle of the scale so that you are at the correct latitude of around 55 degrees north.



6. Read the wind speed from the curved lines on the scale. If your point is between two of the curved lines, then estimate the wind speed (for example, if your line is half-way between the 15 knot and 25 knot line, then your wind speed will be 20 knots). In the example above, the wind speed will be 10 knots.

The wind speed across my school today will be

.... knots.

The wind speed you have calculated will not be the same as the speed you feel at ground level because the trees and buildings on the Earth's surface slow down the wind as a result of friction. However, it will be the wind speed that your balloon will experience after you have launched it.

7. Your balloon will hopefully stay in the air for around 12 hours before it bursts and falls to the ground. So how far will your balloon travel in that time?

Speed	X	Time	=	Distance travelled
.... Knots	X	12 hours	=	.... nautical miles (n mile)

My balloon will travel .... n mile in 12 hours.

8. Using the map provided on the prediction sheet, mark a small dot where your school is. Using a protractor, measure the direction of the wind that you calculated earlier. Remember though, this angle gives the direction the wind is coming from. Your balloon will travel in the opposite direction.

9. Now you will need to convert the distance you have calculated in nautical miles into centimetres from the scale on the prediction sheet map. The scale of the map means that 1 cm is equal to 75 nautical miles.

Distance in n mile	÷	75 n mile	=	Distance in cm on map
.... n mile	÷	75 n mile	=	.... cm

10. Plot the distance (in cm) that you have just calculated from your school in the direction that you expect your balloon to travel. (Remember that this is in the opposite direction to the angle you calculated earlier.) Mark the final destination that you have forecast for your balloon with a cross on the map.

11. Write your name, school and school address in the space provided on the prediction sheet and hand it in to your teacher so that they can send it back to the Met Office to see who has won.

12. Fill in the details on the balloon tag and attach it to your helium-filled balloon.

13. Finally, go outside with your classmates and launch your balloons together.

Good luck!

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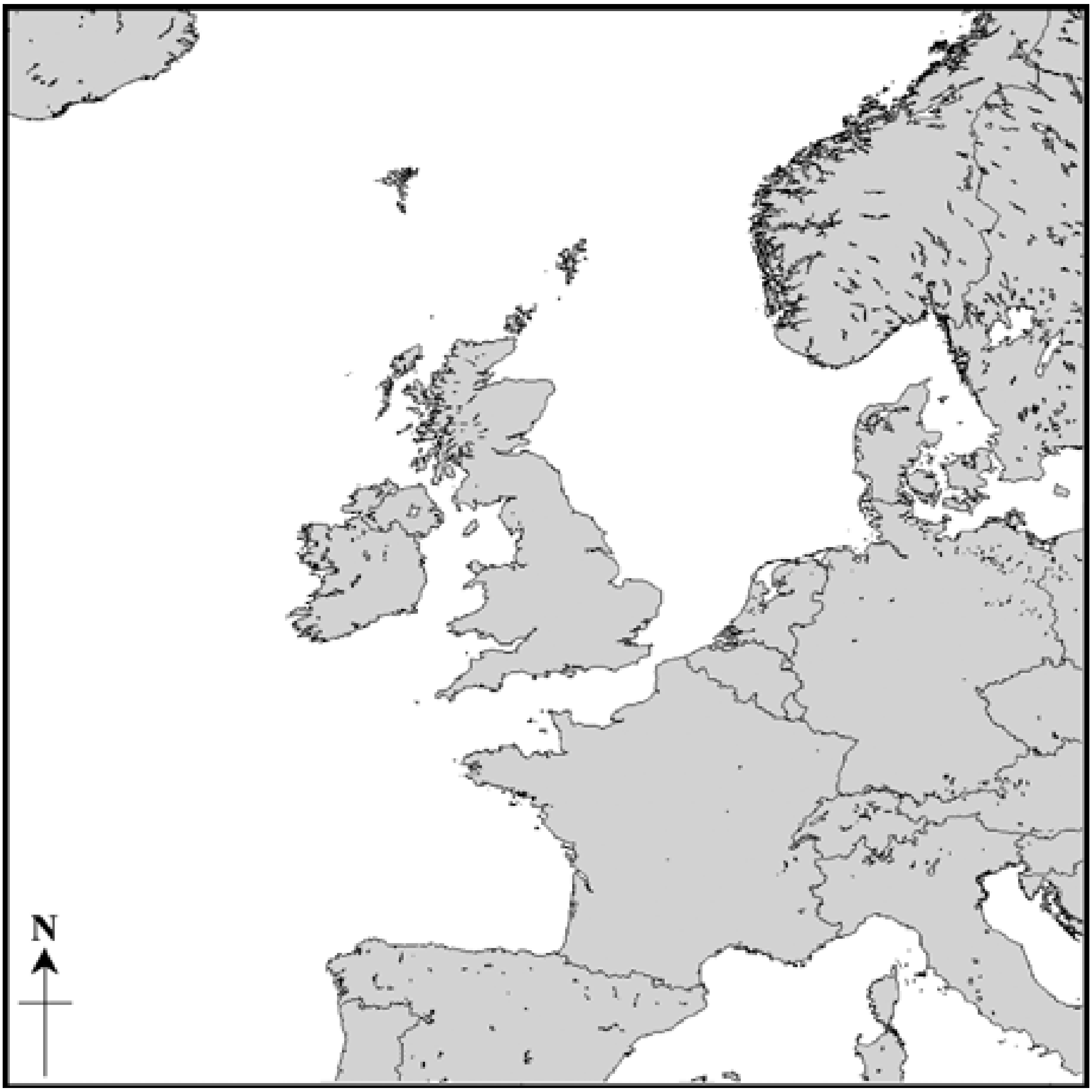
Prediction sheet

On the map below, mark a small dot (labelled 'Start') where your school is and a cross (labelled 'Finish') to show where you think your balloon will end up. Now fill in the details below and hand this sheet in to your teacher so that they can post it back to the Met Office.

Name

School

School address



nautical miles

0 100 200 300

1 cm = 75 nautical miles

Do NOT resize this map if you photocopy it.

Met Office Balloon Challenge

Wind information

What is the wind? Why does the wind blow? How do we measure the wind? Why is the wind so important? These are all questions that are worth answering before we start looking at the ways in which we forecast wind speed and direction. This information will then help you work out where your balloons may end up after you have released them from your school.

So let's start at the beginning...

What is the wind?

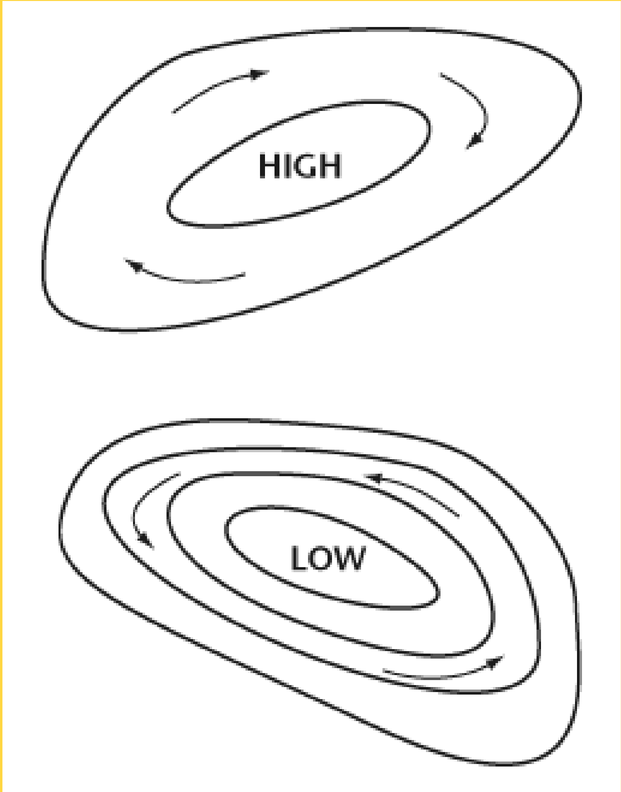
We all feel and see the wind every day. It can make us feel cold, it makes trees sway and moves fallen leaves and rubbish across the ground. But what is the wind? In very simple terms, wind is **the movement of air from one place to another** and is dependent on what the weather is like. Usually, if it is wet, the winds tend to be stronger and more blustery, moving the air around much more quickly. If it is fine and sunny, the winds tend to be lighter, or even calm.

Why does the wind blow?

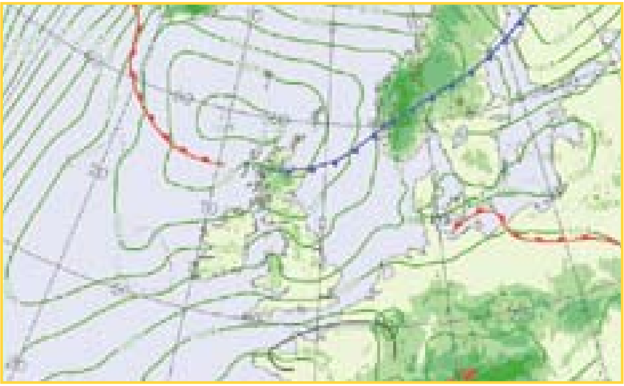
If there was no wind, our weather would be very boring. Nothing would change at all. It is the wind that brings us our varied weather. We may complain about it but, if it didn't change, we probably wouldn't be very impressed. Just think, if the wind stopped today we would have the weather we have at the moment forever. Perhaps it would never rain where you are, and then nothing would grow and we would go hungry. Perhaps it would never stop raining and we would all have to move around in boats!

So why does the wind blow? The answer is that it blows because of **differences in pressure or temperature at different places across the Earth's surface**. If you release the valve on a bicycle tyre, the air immediately rushes out because of the pressure difference. In the atmosphere, the same thing happens but on a much larger scale. The Earth is always trying to even out the pressure across the world, so air moves from areas of high pressure, or **anticyclones**, where there is more air at the surface, to areas of low pressure, or **cyclones**, where there is less air at the surface. This movement of air, however, does not follow the quickest straight-line path. This is because the Earth is spinning beneath the air. In fact, the air moving from high to low pressure follows a spiralling route, outwards from high pressure and inwards towards low pressure.

Consequently, in the northern hemisphere, air blows **anticlockwise around a low-pressure system** and **clockwise around a high-pressure system**, as shown in the diagram to the right. Or, in other words, if you stand with your back to the wind, low pressure will be on your left.



If we have a weather map with isobars (lines of equal pressure) drawn on it, like the one below, we can interpret which direction the wind will come from.



But why do winds blow at different speeds? Well, we have already said that the air always tries to move from areas of high pressure to areas of low pressure to even out the differences. The speed at which the air moves, or wind blows, will depend on the **difference in the pressure between the high and the low areas and how close they are together**. Take our bicycle or car tyre again. When we release the valve, at first, when the pressure difference between the inside of the tyre and the outside air is the greatest, the air rushes out quickly. However, as the pressure inside the tyre becomes closer to that of the air outside, the air is released more slowly. This is shown on weather maps by the distance between the isobars. The closer these are together, the stronger the winds will be.

There are three important relationships between isobars and winds.

- **The direction of the wind is such that if you stand with your back to the wind in the northern hemisphere, the pressure is lower on the left than on the right.**
- **The wind blows almost parallel to the isobars.**
- **The closer the isobars, the stronger the wind.**

These three facts make it possible to deduce wind speed and direction from the isobars.

How do we measure the wind?

There are two parts to the wind that are important to us. How fast it is going and where it is coming from, or its **speed** and its **direction**. The two parts are measured separately from each other.

The wind direction is measured using a **wind vane**. Wind vanes are usually situated on top of church steeples or towers and are often in the shape of a cockerel standing on a big arrow, as in the picture on the right. The force of the wind turns the arrow to line up with the direction the wind is coming from. We can then determine the direction by using compass points, such as north or south, or measure it in degrees. The direction shows where the wind has come from, so a south-westerly wind will have come from the south-west.

The wind speed is measured using an **anemometer**, which comprises three spinning cups mounted horizontally on a spindle. When the wind blows, it pushes the cups around. The faster the wind blows, the faster the cups will spin, the speed of which can then be measured.

Measurements of wind strength are made at 10 metres above the ground. A specified height has to be used because the wind speed decreases towards the ground. In this country, winds are measured in knots (nautical miles per hour). However, forecast winds are often given in miles per hour (where 1 knot is equivalent to 1.15 m.p.h.) or in terms of the Beaufort Scale. The Beaufort Scale of wind strengths is shown in the table below.

Force	Description	Specification for use over land	Mean speed in knots
0	Calm	Smoke rises vertically	Below 1
1	Light air	Direction of wind shown by smoke, but not by wind vane	1 to 3
2	Light breeze	Wind felt on face; leaves rustle; wind vane turns in wind	4 to 6
3	Gentle breeze	Leaves and small twigs in motion; wind lifts small flags	7 to 10
4	Moderate breeze	Raises dust and loose paper; small branches move	11 to 16
5	Fresh breeze	Small trees begin to sway; crested wavelets form on inland water	17 to 21
6	Strong breeze	Large branches in motion; umbrellas become difficult to use	22 to 27
7	Near gale	Whole trees in motion; inconvenience felt when walking against wind	28 to 33
8	Gale	Twigs break off trees; generally impedes walking progress	34 to 40
9	Severe gale	Slight structural damage occurs (chimneys and slates removed)	41 to 47
10	Storm	Trees uprooted; considerable structural damage	48 to 55
11	Violent storm	Widespread damage	56 to 63
12	Hurricane force	Devastation and loss of life	Above 63

What have we learnt?

Let's quickly summarise what we have learnt so far.

- The wind is the movement of air from one place to another
- The wind is important as it brings us our weather
- The wind blows because of differences in pressure or temperature across the Earth's surface
- Air tries to move from high pressure (anticyclones) to low pressure (cyclones)
- The air cannot move in a straight line because the Earth is spinning beneath it
- The wind blows anticlockwise around a low-pressure system and clockwise around a high-pressure system (in the northern hemisphere)
- The speed of the wind depends on the pressure difference between areas of high and low pressure and how far apart they are
- Wind direction is measured using a wind vane
- Wind speed is measured using an anemometer
- If you stand with your back to the wind, low pressure will be on your left (in the northern hemisphere)
- The wind blows almost parallel to the isobars
- The closer the isobars, the stronger the wind

Quiz

Fill in the blanks with the words at the bottom of the page. Each word is used only once.

1. The wind is the .... of air from one place to another.
2. The wind blows because of differences in .... or .... across the Earth's surface.
3. An area of high pressure is called an .... while an area of low pressure is also called a ....
4. Air blows from areas of .... to areas of ....
5. Air does not follow a straight-line path but takes a .... path.
6. The wind blows .... around an area of low pressure.
7. The .... of the wind depends on the .... in pressure between low- and high-pressure areas and how close they are to each other.
8. Lines of equal pressure on a weather map are called ....
9. The wind blows almost .... to the isobars.
10. The .... the isobars, the stronger the ....
11. If you stand with your back to the wind, low pressure will be on your ....
12. Wind direction is measured using a ....
13. Wind speed is measured using an ....
14. A south-westerly wind will blow from the ....
15. Wind speeds are measured in .... in the UK, which is equivalent to 1.15 m.p.h.

anemometer	anticlockwise	anticyclone	closer
cyclone	difference	high pressure	isobars
left	low pressure	movement	parallel
pressure	south-west	speed	spiralling
temperature	wind vane	wind	knots

Wind data sheet — Aberporth

Aberporth
NGR = 2241E 2521N
Altitude = 133 metres amsl
Latitude = 52° 14′ N Longitude = 04° 57′ W

Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC (kn)
01/12/2001	240	13
02/12/2001	160	15
03/12/2001	170	17
04/12/2001	290	24
05/12/2001	240	34
06/12/2001	150	14
07/12/2001	170	17
08/12/2001	160	19
09/12/2001	140	9
10/12/2001	150	15
11/12/2001	130	7
12/12/2001	050	7
13/12/2001	100	13
14/12/2001	110	9
15/12/2001	090	7
16/12/2001	070	11
17/12/2001	100	4
18/12/2001	070	7
19/12/2001	310	5
20/12/2001	090	5
21/12/2001	290	23
22/12/2001	010	17
23/12/2001	200	8
24/12/2001	280	21
25/12/2001	350	29
26/12/2001	300	21
27/12/2001	280	25
28/12/2001	310	25
29/12/2001	330	21
30/12/2001	300	21
31/12/2001	140	4

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind data sheet — Cardiff

Cardiff
NGR = 2998E 1683N
Altitude = 49 metres amsl
Latitude = 51° 40′ N Longitude = 03° 44′ W

Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC (kn)
01/12/2001	250	8
02/12/2001	070	6
03/12/2001	120	10
04/12/2001	290	14
05/12/2001	250	15
06/12/2001	090	8
07/12/2001	130	7
08/12/2001	070	8
09/12/2001	070	11
10/12/2001	070	13
11/12/2001	070	10
12/12/2001	100	8
13/12/2001	080	14
14/12/2001	080	13
15/12/2001	050	11
16/12/2001	070	13
17/12/2001	080	7
18/12/2001	040	5
19/12/2001	330	5
20/12/2001	050	7
21/12/2001	290	14
22/12/2001	330	6
23/12/2001	330	7
24/12/2001	290	17
25/12/2001	290	13
26/12/2001	310	8
27/12/2001	280	17
28/12/2001	300	16
29/12/2001	320	7
30/12/2001	310	11
31/12/2001	350	4

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind data sheet — Eskdalemuir

Eskdalemuir
NGR = 3235E 6026N
Altitude = 242 metres amsl
Latitude = 55° 31′ N Longitude = 03° 20′ W

Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC (kn)
01/12/2001	260	12
02/12/2001	130	1
03/12/2001	200	4
04/12/2001	240	8
05/12/2001	060	10
06/12/2001	330	1
07/12/2001	160	5
08/12/2001	210	9
09/12/2001	360	2
10/12/2001	330	2
11/12/2001	330	3
12/12/2001	330	4
13/12/2001	360	5
14/12/2001	060	4
15/12/2001	330	2
16/12/2001	350	2
17/12/2001	350	4
18/12/2001	360	3
19/12/2001	280	8
20/12/2001	150	2
21/12/2001	290	15
22/12/2001	350	15
23/12/2001	230	5
24/12/2001	270	11
25/12/2001	320	9
26/12/2001	300	6
27/12/2001	140	4
28/12/2001	300	26
29/12/2001	310	10
30/12/2001	340	6
31/12/2001	190	1

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind data sheet — Heathrow

Heathrow
NGR = 5077E 1767N
Altitude = 25 metres amsl
Latitude = 51° 48′ N Longitude = 00° 45′ W

Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC (kn)
01/12/2001	190	10
02/12/2001	010	2
03/12/2001	060	5
04/12/2001	250	10
05/12/2001	170	14
06/12/2001	000	0
07/12/2001	130	4
08/12/2001	010	2
09/12/2001	020	3
10/12/2001	030	2
11/12/2001	020	4
12/12/2001	350	6
13/12/2001	030	7
14/12/2001	030	4
15/12/2001	020	4
16/12/2001	360	8
17/12/2001	350	4
18/12/2001	350	5
19/12/2001	280	3
20/12/2001	260	2
21/12/2001	250	10
22/12/2001	270	5
23/12/2001	280	2
24/12/2001	250	9
25/12/2001	280	4
26/12/2001	260	6
27/12/2001	230	12
28/12/2001	290	17
29/12/2001	240	3
30/12/2001	270	7
31/12/2001	320	3

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind data sheet — Kinloss

Kinloss
NGR = 3067E 8627N
Altitude = 5 metres amsl
Latitude = 57° 65′ N Longitude = 03° 56′ W

Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC(kn)
01/12/2001	080	5
02/12/2001	180	9
03/12/2001	170	16
04/12/2001	240	10
05/12/2001	140	1
06/12/2001	230	6
07/12/2001	190	7
08/12/2001	140	3
09/12/2001	240	2
10/12/2001	230	5
11/12/2001	200	2
12/12/2001	240	4
13/12/2001	120	2
14/12/2001	150	5
15/12/2001	260	4
16/12/2001	230	2
17/12/2001	240	6
18/12/2001	220	4
19/12/2001	290	17
20/12/2001	250	15
21/12/2001	340	16
22/12/2001	340	17
23/12/2001	250	21
24/12/2001	260	19
25/12/2001	340	21
26/12/2001	240	11
27/12/2001	110	5
28/12/2001	360	29
29/12/2001	240	11
30/12/2001	330	4
31/12/2001	240	9

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind data sheet — Manchester

Manchester
NGR = 3814E 3844N
Altitude = 69 metres amsl
Latitude = 53° 36′ N Longitude = 02° 27′ W

Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC (kn)
01/12/2001	250	9
02/12/2001	130	7
03/12/2001	150	10
04/12/2001	260	12
05/12/2001	170	18
06/12/2001	110	2
07/12/2001	150	8
08/12/2001	150	6
09/12/2001	210	5
10/12/2001	200	1
11/12/2001	290	1
12/12/2001	270	2
13/12/2001	060	6
14/12/2001	110	3
15/12/2001	310	2
16/12/2001	030	5
17/12/2001	180	1
18/12/2001	290	2
19/12/2001	260	2
20/12/2001	260	3
21/12/2001	280	13
22/12/2001	330	8
23/12/2001	200	3
24/12/2001	270	11
25/12/2001	270	4
26/12/2001	180	3
27/12/2001	260	12
28/12/2001	270	18
29/12/2001	340	4
30/12/2001	260	3
31/12/2001	150	2

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind data sheet — St Mawgan

St Mawgan
NGR = 1872E 641N
Altitude = 103 metres amsl
Latitude = 50° 43′ N Longitude = 05° 00′ W

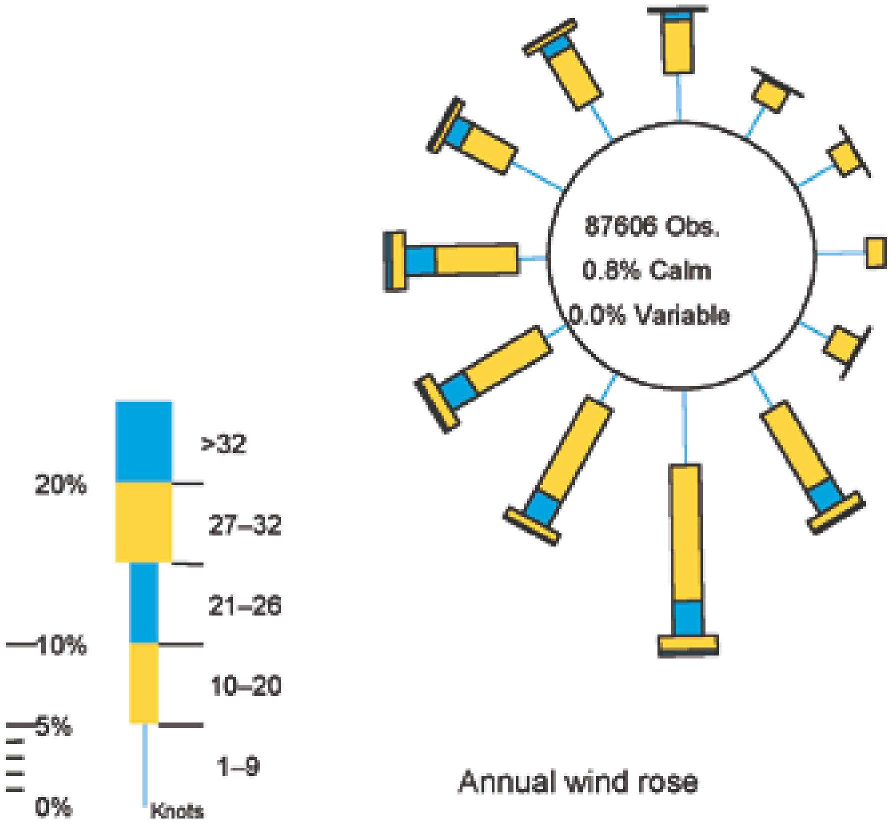
Date	Wind — Mean direction at 0900 UTC	Wind — Mean speed at 0900 UTC (kn)
01/12/2001	260	14
02/12/2001	090	8
03/12/2001	170	9
04/12/2001	290	18
05/12/2001	240	23
06/12/2001	120	10
07/12/2001	140	7
08/12/2001	110	14
09/12/2001	090	8
10/12/2001	090	15
11/12/2001	090	10
12/12/2001	080	5
13/12/2001	080	9
14/12/2001	080	9
15/12/2001	090	10
16/12/2001	050	10
17/12/2001	070	8
18/12/2001	060	7
19/12/2001	080	6
20/12/2001	070	6
21/12/2001	300	16
22/12/2001	060	1
23/12/2001	110	4
24/12/2001	280	16
25/12/2001	310	19
26/12/2001	320	13
27/12/2001	280	20
28/12/2001	280	17
29/12/2001	080	4
30/12/2001	320	9
31/12/2001	080	6

Direction range	Number of occasions
340-020	
030-060	
070-110	
120-150	
160-200	
210-240	
250-290	
300-330	
CALM	

Wind rose for Aberporth

NGR = 2241E 2521N

Altitude = 133 metres amsl

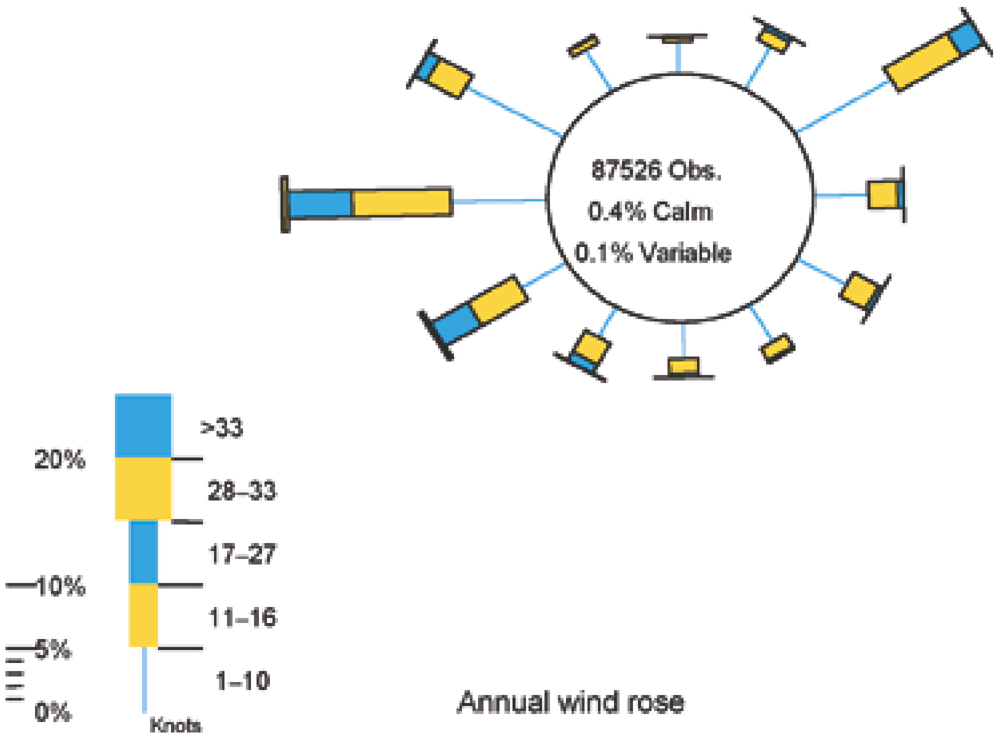


Annual wind rose

Wind rose for Cardiff Airport

NGR = 2998E 1683N

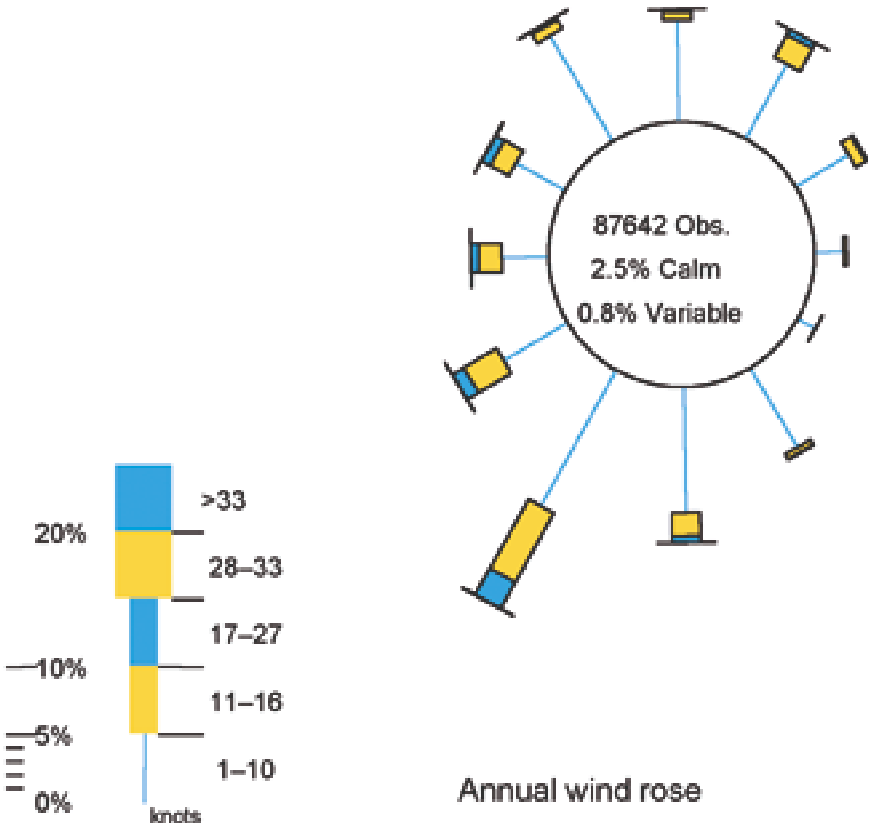
Altitude = 49 metres amsl



Wind rose for Eskdalemuir

NGR = 3235E 6026N

Altitude = 242 metres amsl

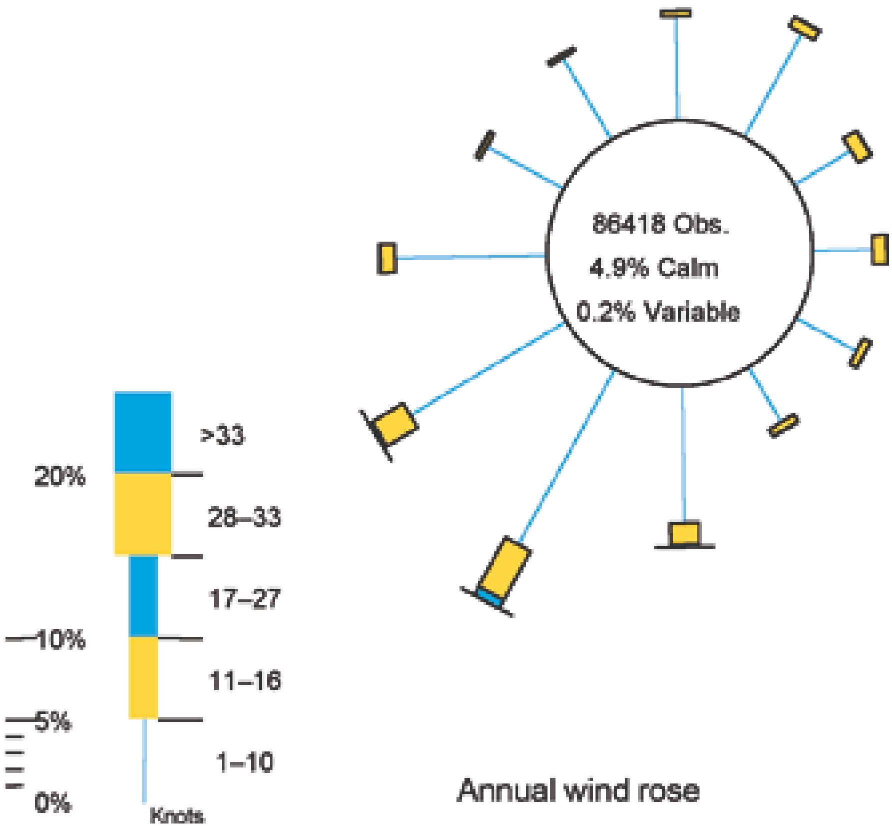


Annual wind rose

Wind rose for Heathrow

NGR = 5077E 1767N

Altitude = 25 metres amsl

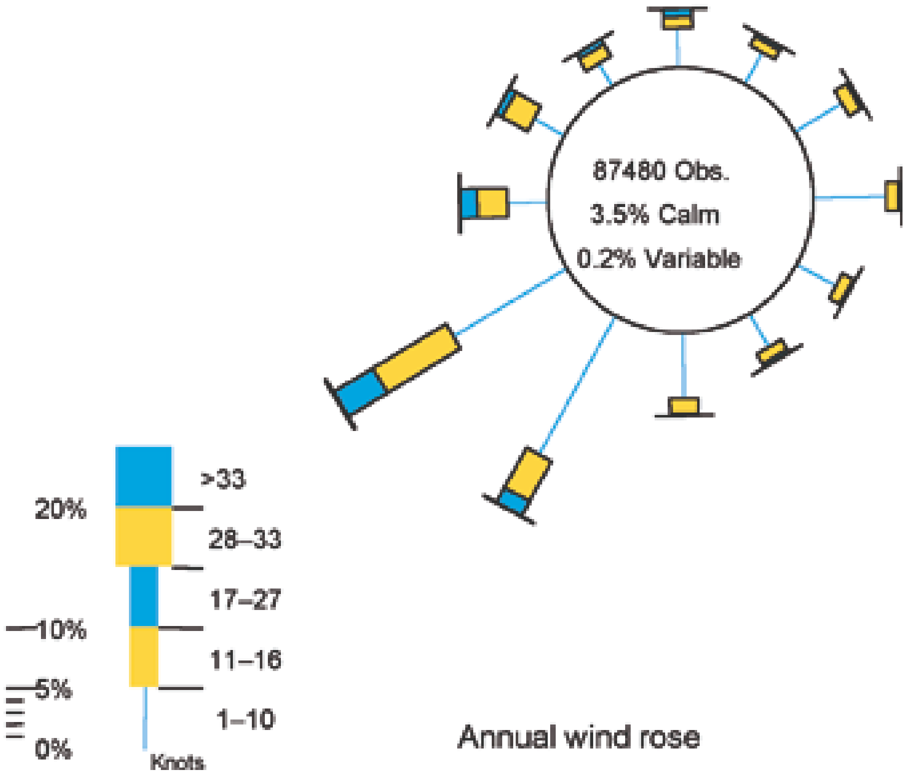


Annual wind rose

Wind rose for Kinloss

NGR = 3067E 8627N

Altitude = 5 metres amsl

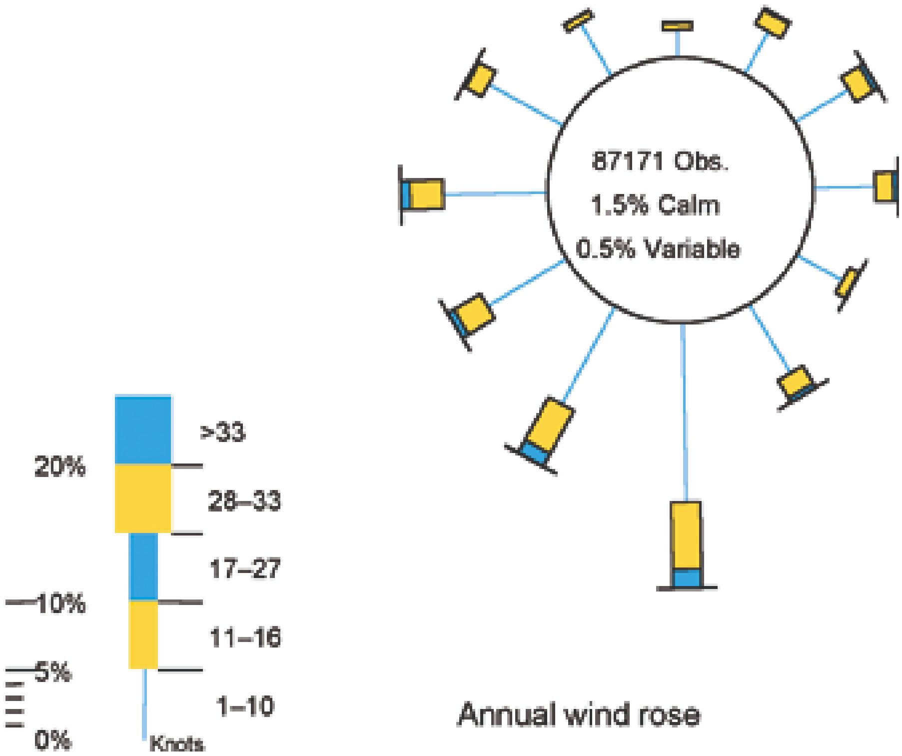


Annual wind rose

Wind rose for Manchester

NGR = 3814E 3844N

Altitude = 69 metres amsl

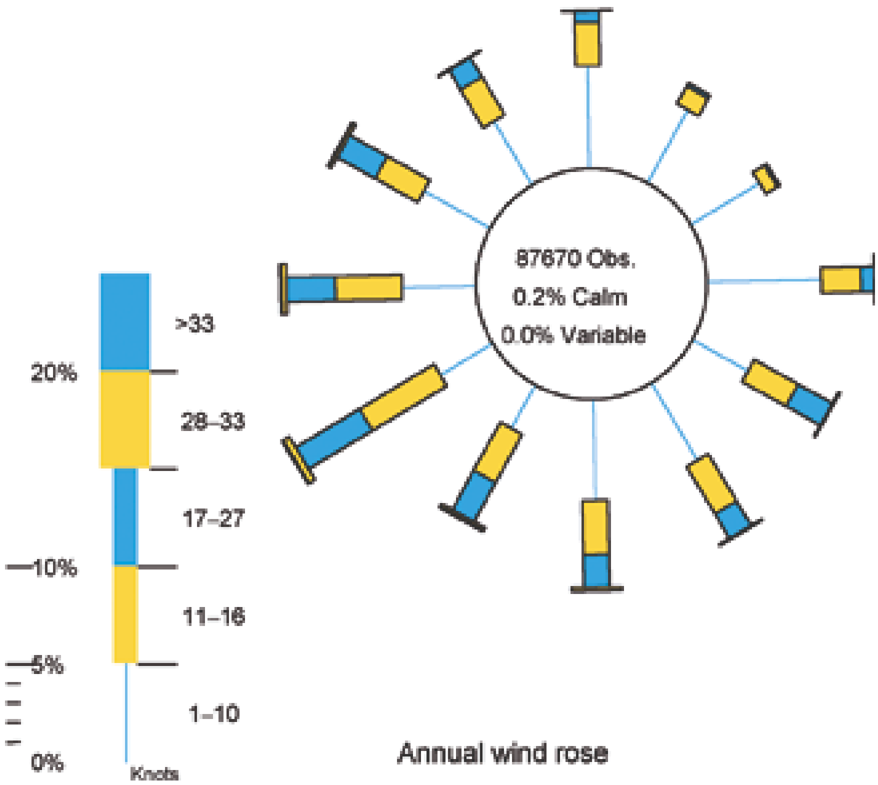


Annual wind rose

Wind rose for St Mawgan

NGR = 1872E 0641N

Altitude = 103 metres amsl



Annual wind rose

Activity

	Aberporth	Cardiff	Eskdalemuir
Strongest 0900 UTC wind speed			
Date of strongest wind speed			
Prevailing wind direction for December 2001			
Prevailing wind direction from annual long-term average wind rose			

	Heathrow	Kinloss	Manchester	St Mawgan
Strongest 0900 UTC wind speed				
Date of strongest wind speed				
Prevailing wind direction for December 2001				
Prevailing wind direction from annual long-term average wind rose				

Who would be interested in using wind data in the form of a wind rose ?

For the stations you have studied, discuss how the prevailing wind direction for December 2001 differs from the usual annual prevailing wind direction.

Aberporth

Cardiff

Eskdalemuir

Heathrow

Kinloss

Manchester

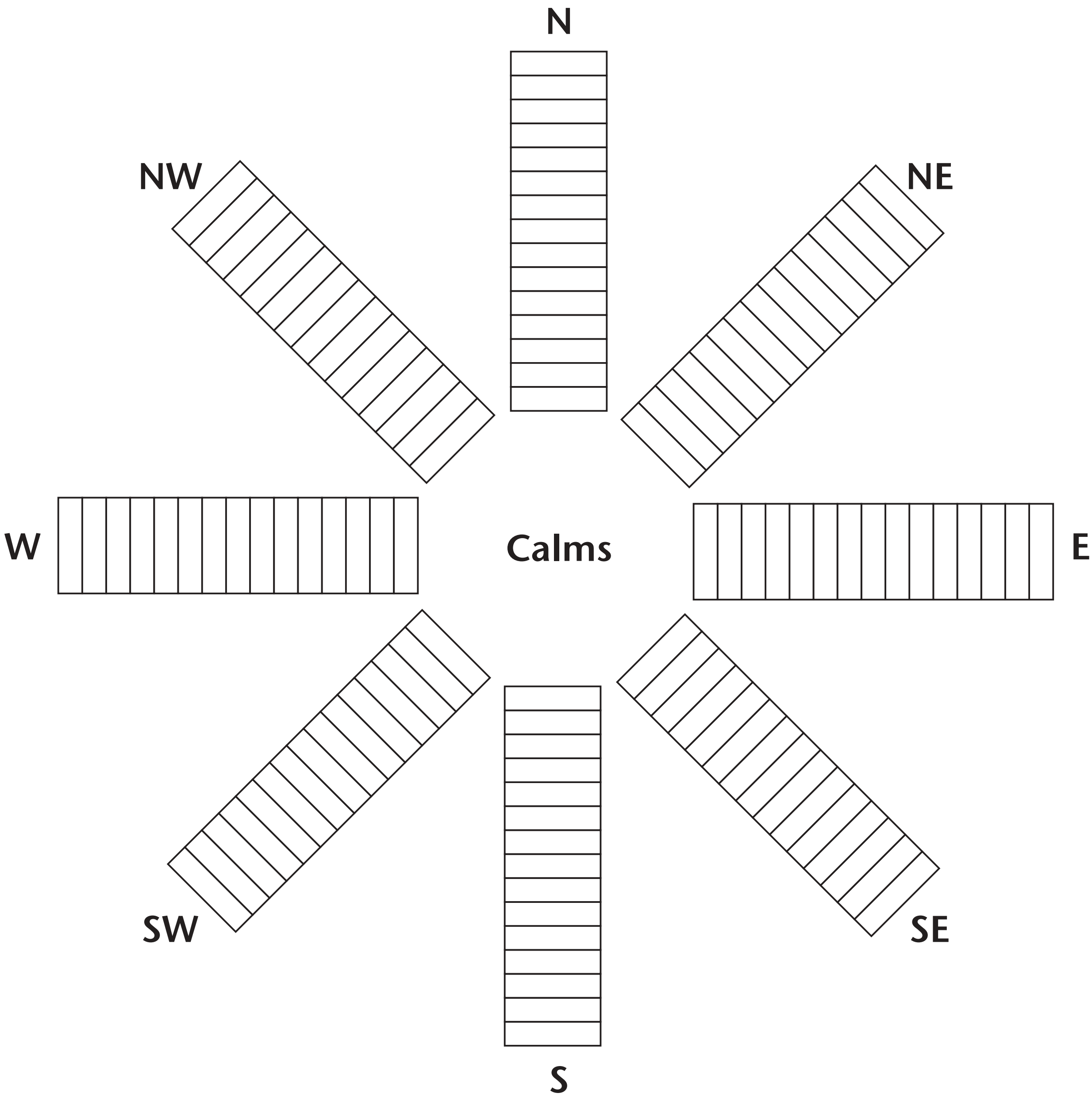
St Mawgan

Photocopy this for your template

Wind rose for

....

December 2001



This wind rose indicates that the prevailing wind direction at .... during December 2001 was ....

Activity answers

		Aberporth	Cardiff	Eskdalemuir
Strongest 0900 UTC wind speed		34 knots	18 knots	26 knots
Date of strongest wind speed		5	5 & 28	28
Prevailing wind direction for December 2001		East	East	North-west
Prevailing wind direction from annual long-term average wind rose		South	West	South-west
	Heathrow	**Kinloss**	**Manchester**	**St Mawgan**
Strongest 0900 UTC wind speed	17 knots	29 knots	18 knots	23 knots
Date of strongest wind speed	28	28	5 & 28	5
Prevailing wind direction for December 2001	West	South-west	West	East
Prevailing wind direction from annual long-term average wind rose	South-west	South-west	South	South-west

Who would be interested in using wind data in the form of a wind rose ?

Builders and architects — for use when designing new buildings

Air quality analysts — for locating where fumes originate

Land-fill site managers — for estimating where fumes from their sites may go

Wind farm managers — for use in locating the best areas to place wind turbines

Aviators — for use in deciding the best routes to take

Scientists researching climate change and the effects of weather and climate

For the stations you have studied, discuss how the prevailing wind direction for December 2001 differs from the usual annual prevailing wind direction.

Aberporth

The prevailing wind during December was easterly compared with an annual prevailing wind from a southerly direction.

The annual wind rose shows that easterly is normally the least common direction for a prevailing wind.

Although easterly is the prevailing wind for December, there were many occasions when the wind blew from other directions.

Cardiff

The prevailing wind during December was easterly compared with an annual prevailing wind from a westerly direction.

The annual wind rose shows however that east-north-east is the second most common wind direction.

Although easterly is the prevailing wind for December, there were many occasions when the wind blew from the more common direction, e.g. westerly.

Eskdalemuir

The prevailing wind during December was north-westerly compared with an annual prevailing wind from the south-west.

The annual wind rose shows that north-westerly winds are quite uncommon, but easterly winds are even more uncommon.

Heathrow

The prevailing wind during December was westerly compared with an annual prevailing wind from a south-westerly direction.

Although westerly is the prevailing wind direction for December, there were nearly as many occasions when the wind below from the north, which is normally very rare.

The annual average wind rose for Heathrow shows that this station has the highest percentage of calm winds of all the stations. This is also highlighted during December, as Heathrow is the only station recording calm winds.

Kinloss

The prevailing wind during December was south-westerly — the same as the annual prevailing wind.

All other directions are also quite similar to their annual average, showing that December in Kinloss was a typical month.

Manchester

The prevailing wind during December was westerly compared with an annual prevailing wind from a southerly direction.

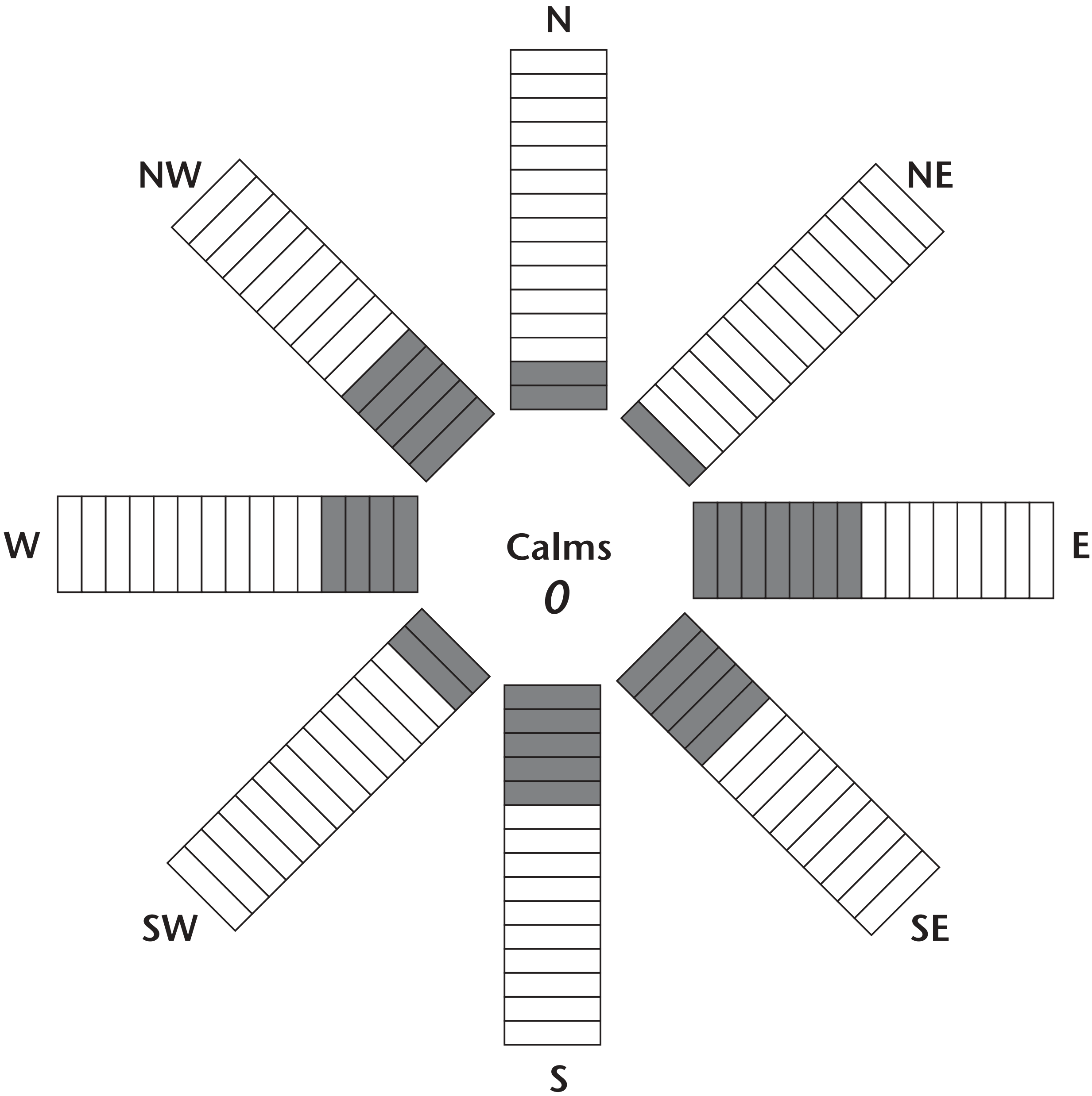
Although westerly is the prevailing wind for December, there were many occasions when the wind blew from the more common direction, e.g. southerly.

St Mawgan

The prevailing wind during December was easterly compared with an annual prevailing wind from a west-south-west direction.

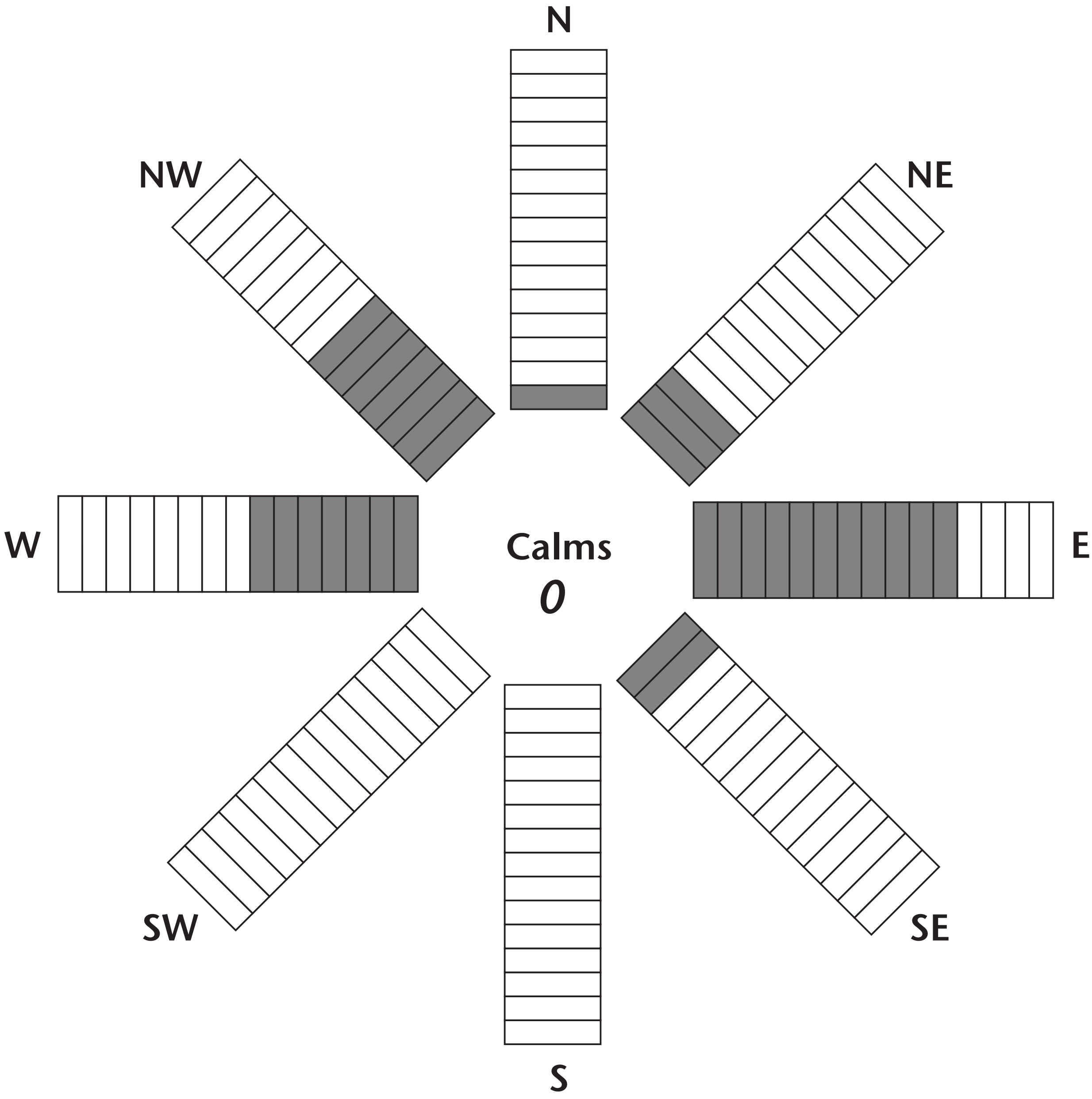
The annual wind rose shows that winds are fairly common from most directions; this is reflected in the monthly wind rose for December, which shows a couple of occasions when winds came from all directions.

Wind rose for Aberporth December 2001



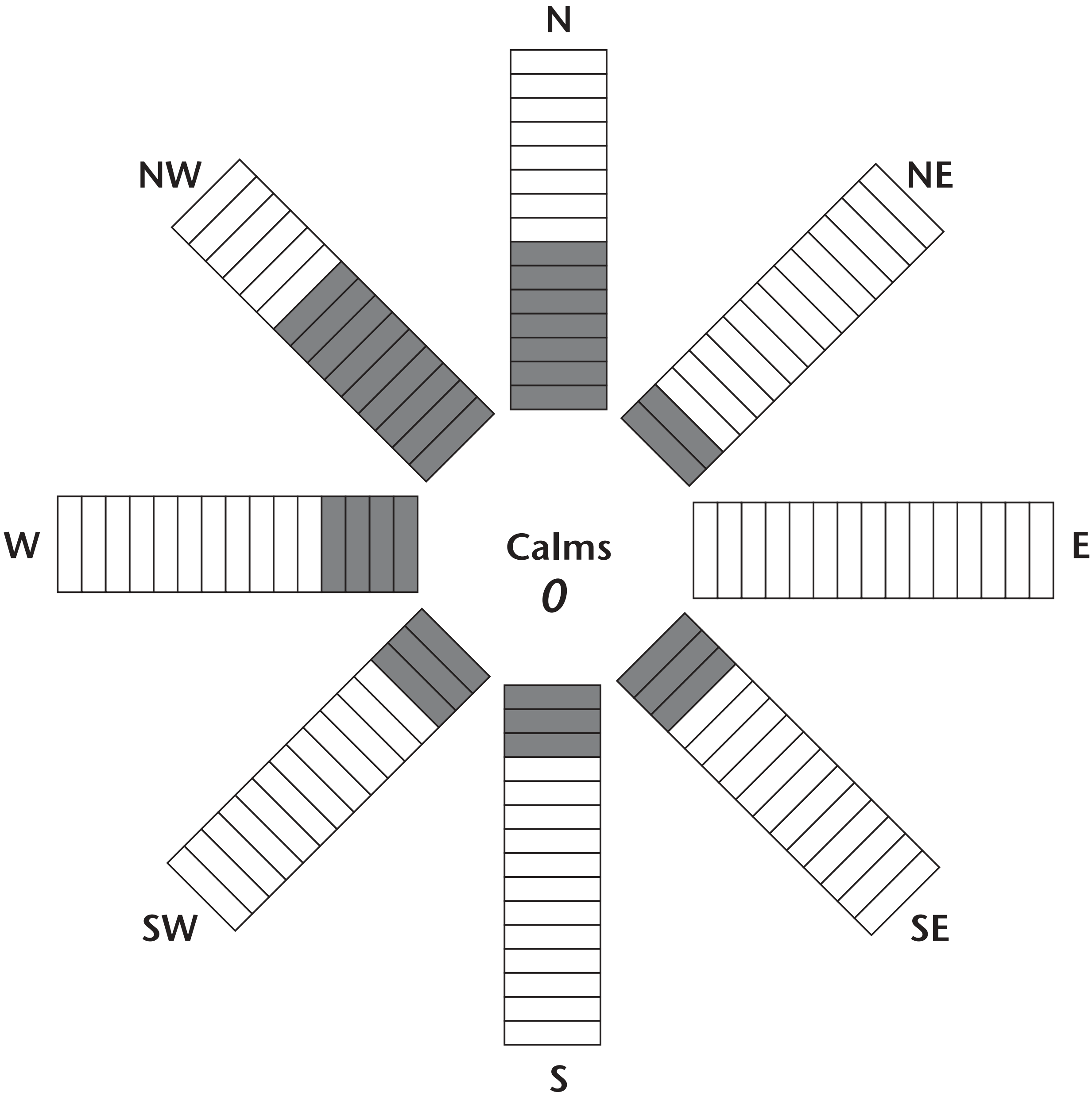
This wind rose indicates that the prevailing wind direction at Aberporth during December 2001 was easterly

Wind rose for Cardiff December 2001



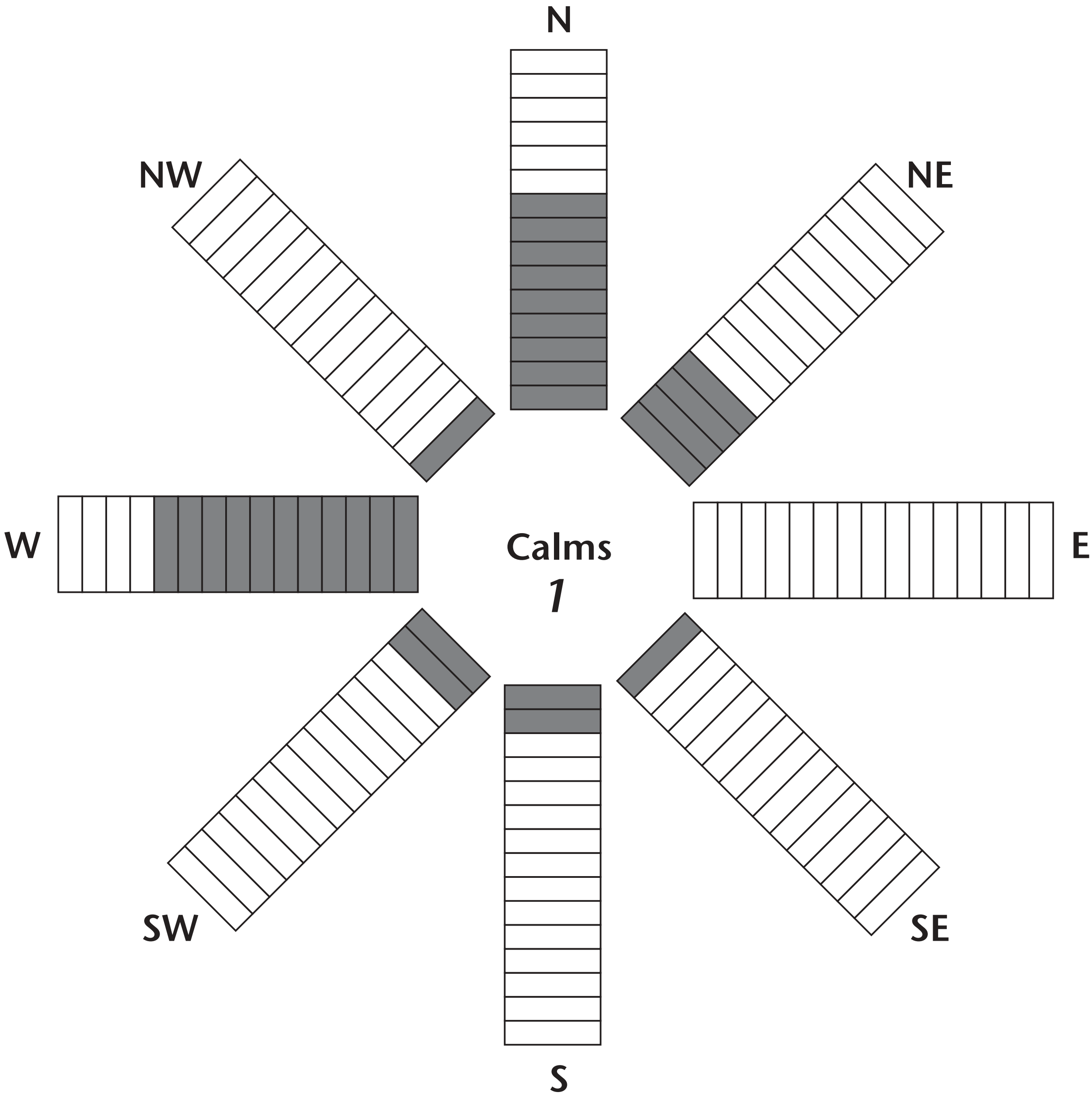
This wind rose indicates that the prevailing wind direction at Cardiff during December 2001 was easterly

Wind rose for Eskdalemuir December 2001



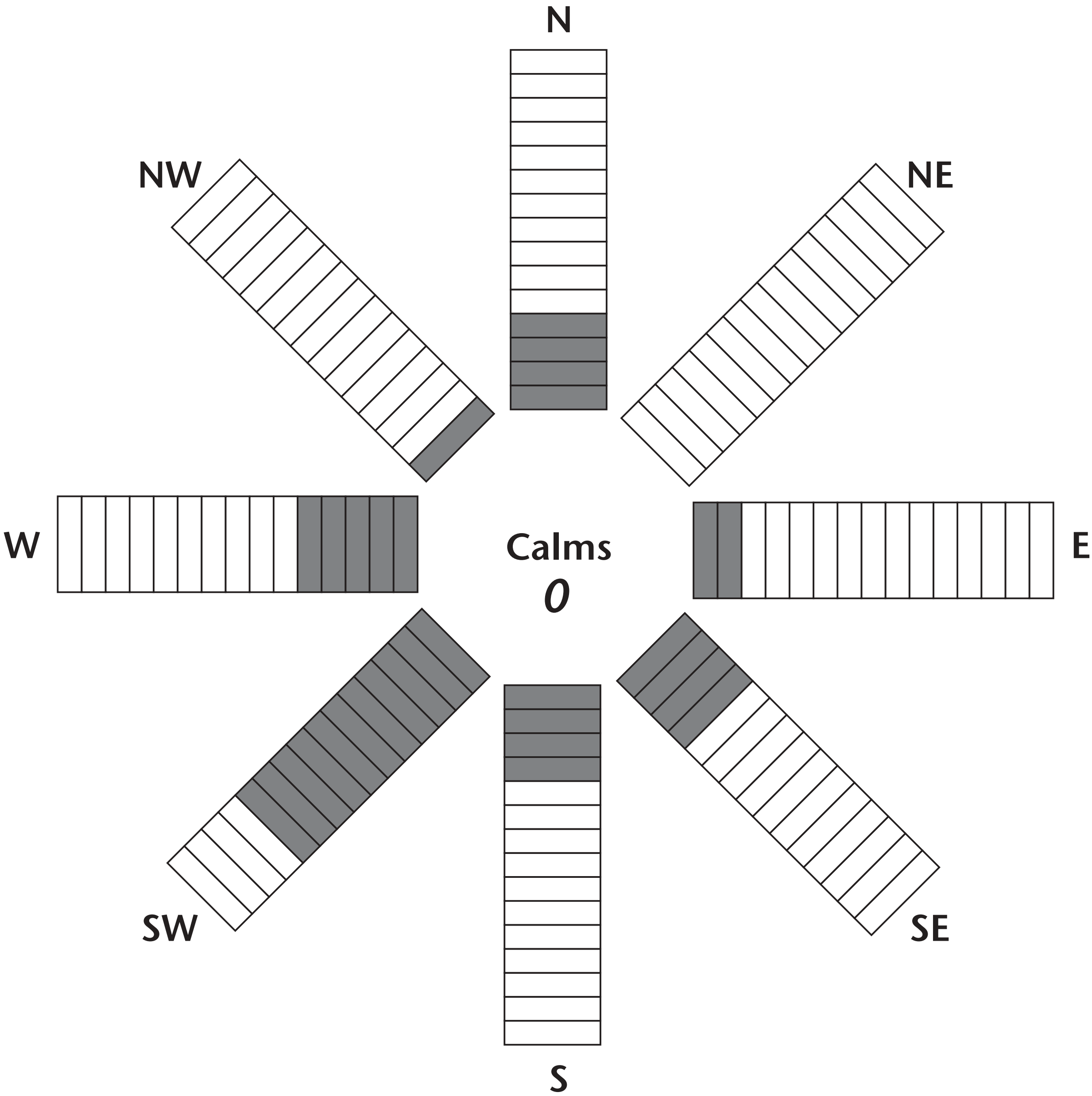
This wind rose indicates that the prevailing wind direction at Eskdalemuir during December 2001 was north-westerly

Wind rose for Heathrow December 2001



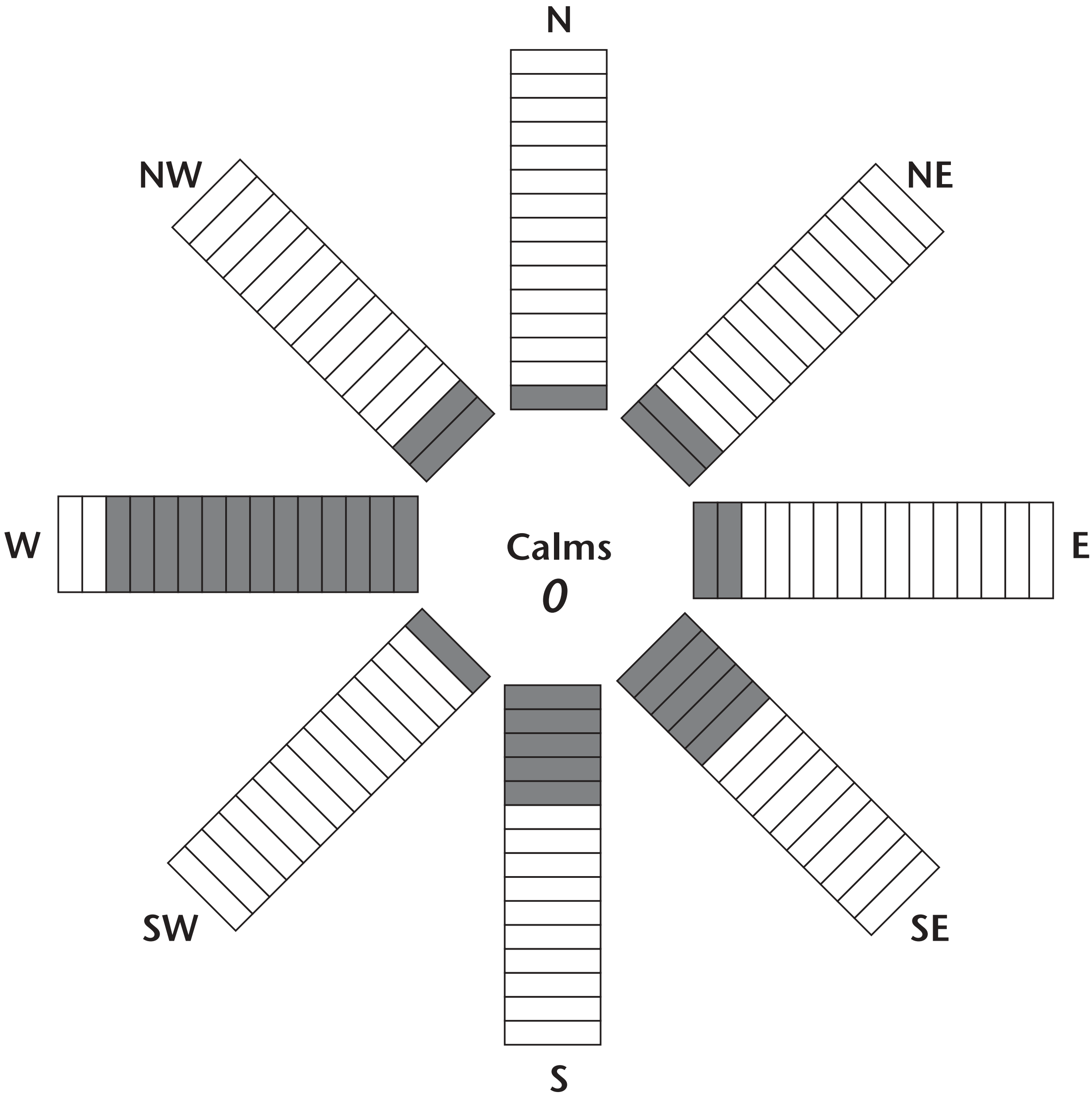
This wind rose indicates that the prevailing wind direction at Heathrow during December 2001 was westerly

Wind rose for Kinloss December 2001



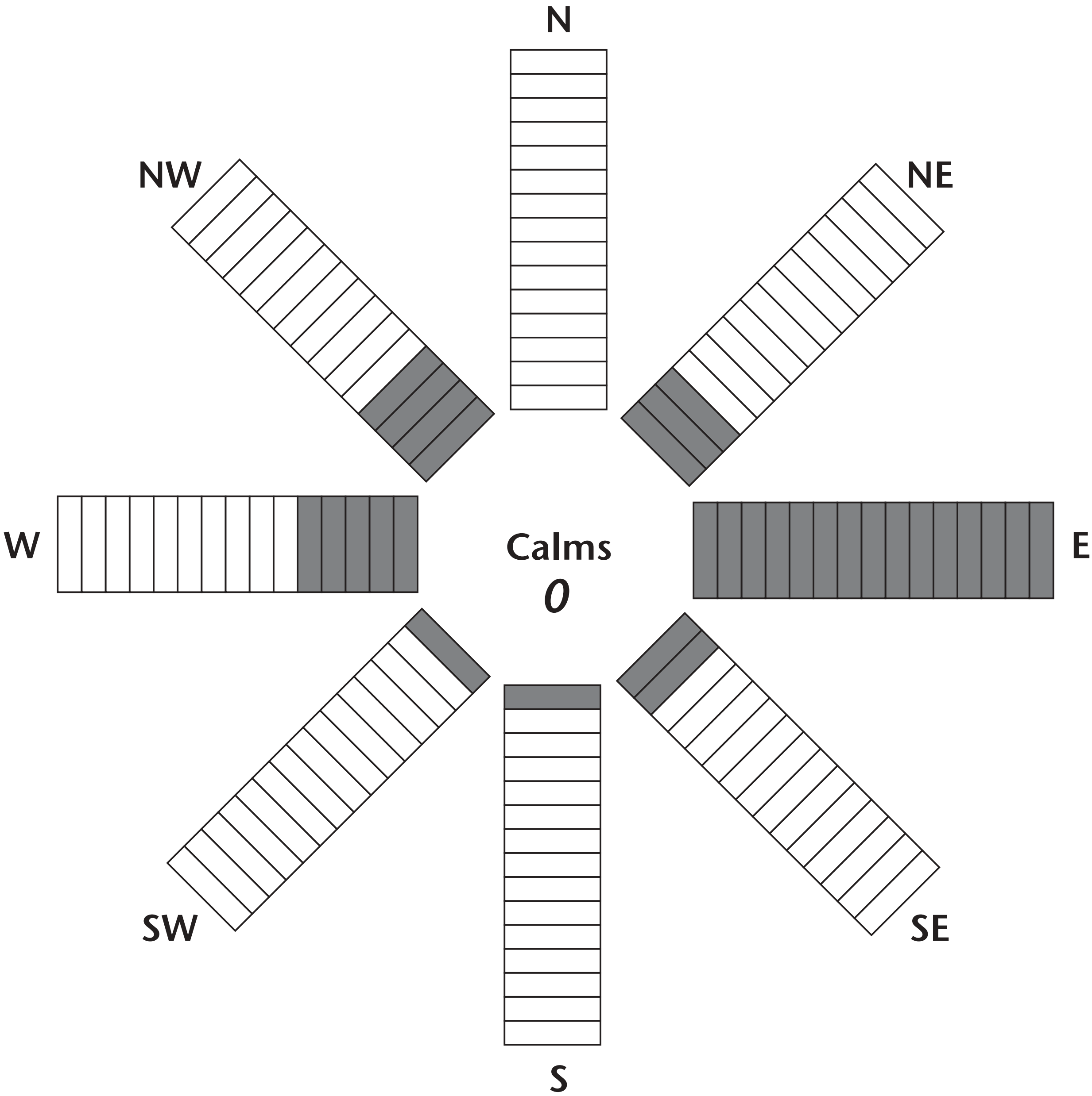
This wind rose indicates that the prevailing wind direction at Kinloss during December 2001 was south-westerly

Wind rose for Manchester December 2001



This wind rose indicates that the prevailing wind direction at Manchester during December 2001 was westerly

Wind rose for St Mawgan December 2001



This wind rose indicates that the prevailing wind direction at St Mawgan during December 2001 was easterly

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QinetiQ 1 — balloon due to launch during Summer 2002

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