03

WIND

The Mediterranean and its coastline education programme

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Fundación "la Caixa"

SOCIB Balearic Islands Coastal Observing and Forecasting System

03

WIND

Since ancient times sailors have used sails to harness wind power and travel faster.

Although the wind is important for propelling ships, it is also related to other atmospheric phenomena and it is the main generator of waves.

You have probably seen how the wind blowing over the sea produces waves, but

do you know how the wind is produced?

3.1 WHAT IS WIND?

We call the horizontal movement of the air over the surface of the land wind.

The wind can blow in any direction at different speeds, it can be anything from a light breeze to a severe hurricane.

WHERE DOES IT COME FROM?

Solar radiation heats the atmosphere and the earth's surface, but not in a homogeneous way, so there are areas which are warmer than others. This uneven heating of the different surfaces of the Earth generates differences in atmospheric pressure, which is the force the air exerts on the surface of the Earth.

The warmer, less dense air masses tend to rise (**A**), creating an area of low pressure called a depression. Their place is taken by masses of surrounding air which is cooler, and therefore denser, (**B**) and of a higher pressure, called an anticyclone. You have probably seen the weather forecast many times on television and you will have heard about these air masses because depressions are usually accompanied by rain and storms, whilst anticyclones offer more stability and fair weather.

When there are two areas of different atmospheric pressure, air flows from the area of higher pressure towards the area of lower pressure to balance the difference between the two, producing air currents.

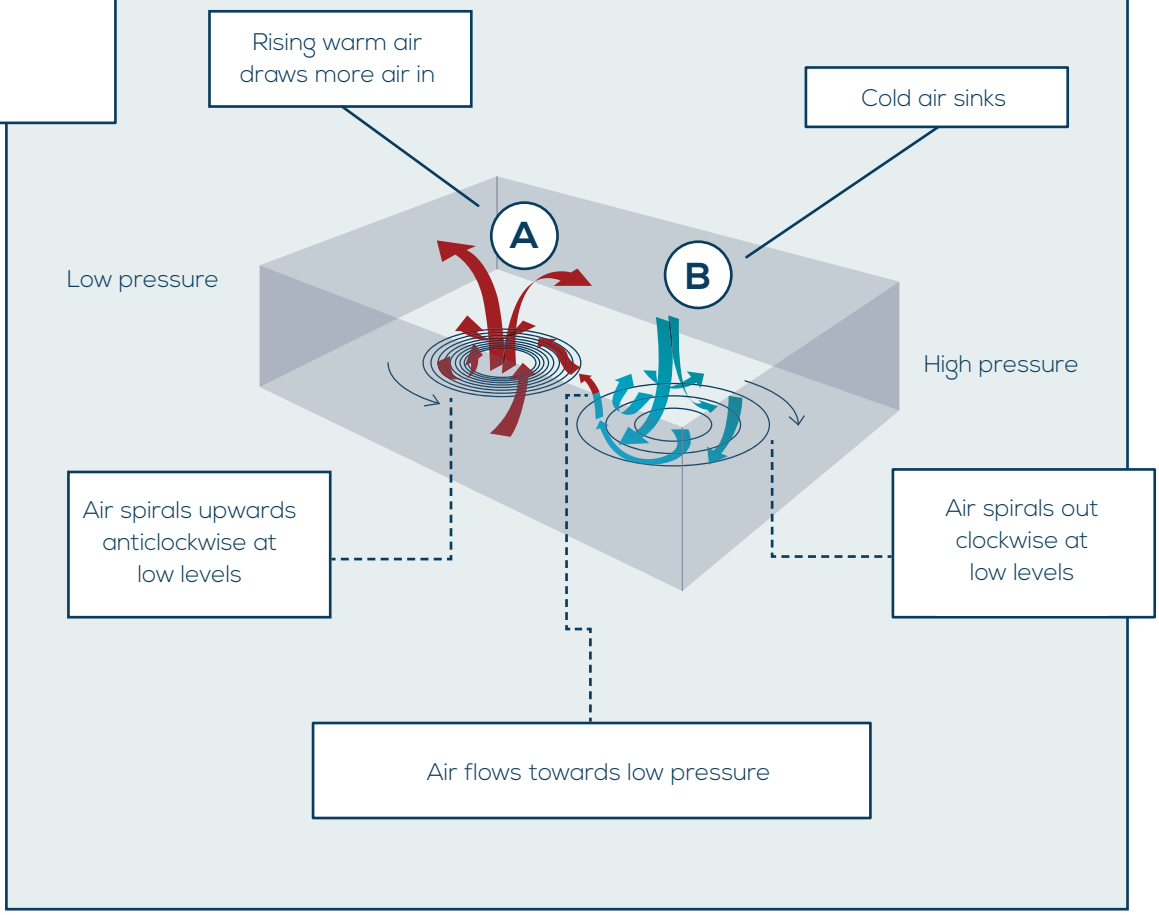
Have a look at the air masses graphic on the next page (Fig. 3.1)

WHAT ARE ITS MAIN FEATURES?

Two measurements are used to define wind-direction and velocity. The direction of the wind indicates where it comes from, so when we say a wind is blowing from the north, it means it goes from north to south. The wind speed depends on the difference in atmospheric pressure between two points. The greater the difference, the greater the strength of the wind.

WHERE DOES THE WIND COME FROM?

Fig. 3.1

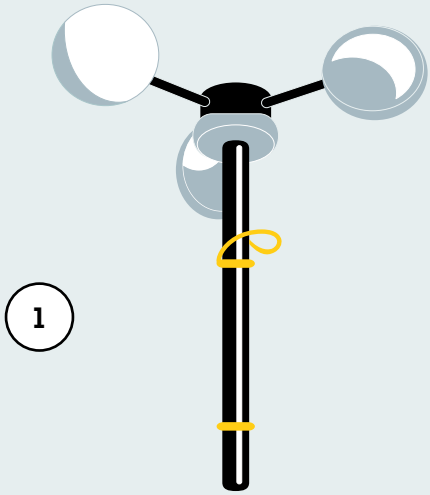


3.1 MEASURING WIND

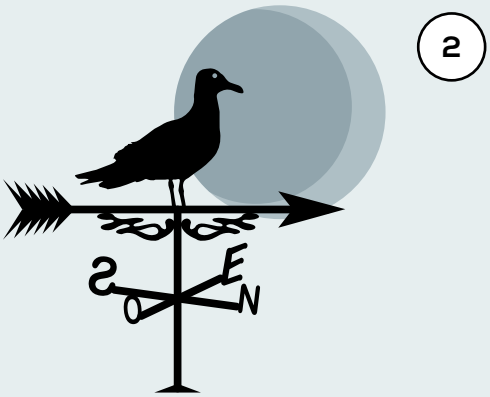
Knowing the direction and wind speed is important in many areas, for example, in weather forecasting, in planning agricultural work, in maritime or air navigation, in industry and in the energy sector, as well as for studying different areas of science.

A specific measuring system is necessary to calculate the direction and force of the wind:

Fig. 3.2 Anemometer (**1**), weather vane (**2**), anemoscope (**3**) and radiosondes (**4**).

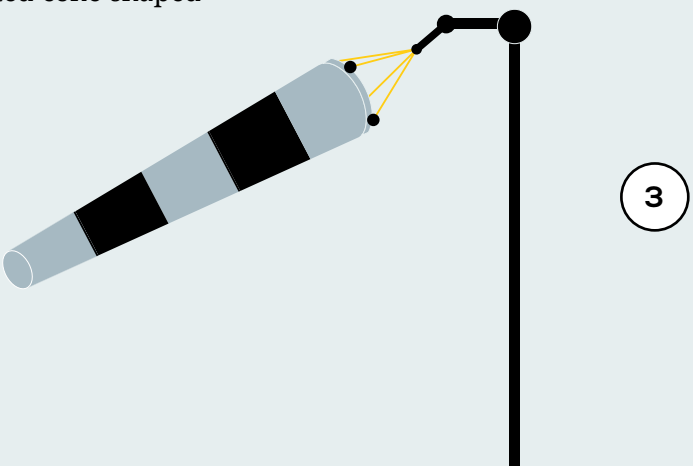


Wind speed is measured using an **anemometer** (1), which gives the velocity in metres per second, or in knots (nautical miles/hour). An anemometer is an instrument which consists of three or four cups mounted on a vertical axle, spinning at the speed the wind blows. The anemometer detects the revolutions it spins at and provides a speed reading.



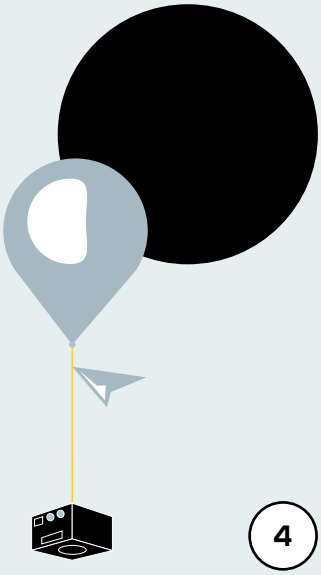
To measure the direction of the wind a **weather vane** (2) is used, this device turns to point to the direction the wind is blowing from. Normally it has an arrow shape pointer which indicates the direction, so if it is pointing to the west, it means the wind is coming from the west.

A **windsock** or **anemoscope** (3) is used to indicate the direction and strength of the wind relative to the horizontal ground, that is to say, the intensity of the crosswind. It is a truncated cone-shaped



tube and it usually has red and white stripes along its length. The end with the larger diameter is mounted on a support fixed to a vertical mast, which allows it to rotate freely (360º) around the vertical axis. Windsocks are mainly used at airports, high altitude viaducts and along roads in places with strong crosswinds which may be hazardous for driving.

The wind varies according to the height at which it is measured, which is why meteorologists have systems for measuring winds at different heights such as **radiosondes tied to weather balloons** (4). This device ascends at a constant speed. From the monitoring station it is possible to identify the balloon's position and check the data from the radiosonde. These probes can measure other variables as well as wind speed and direction, such as pressure, temperature or relative humidity.



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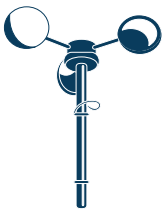
Did you know...

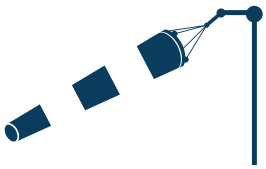
This sign warns of the danger of strong crosswinds.

A.3.1.

MEASURING THE WIND

Identify each instrument and describe what it is used for in each case:





a *Windsock or anemoscope:*

b *Anemometer:*

c *Weather vane:*

d *Radiosonde:*

A.3.2.

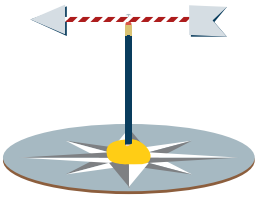
ROUND AND ROUND GOES OUR WEATHER VANE

Build your own weather vane:

YOU WILL NEED...

- A drinking straw
- A pencil with a rubber on the end
- A ball of plasticine
- A cardboard disc with a wind rose
- A pin
- Glue
- Scissors and cardboard
- Compass

MAKE IT TURN!



1. First we cut an arrow head about 5 cm long, and an arrow tail about 8 cm long.
2. Then take the drinking straw and make two cuts, one about 1 cm long where we will insert the arrow head, and the other about 2 cm long to place the arrow tail. The final result will be an arrow.
3. Measure the straw. At exactly the centre point insert a pin and fix it to the rubber on the end of the pencil.
4. The cardboard disk with the wind rose is the weather vane base, place the ball of plasticine in centre. Stick the pencil in to the plasticine ball so it is held it upright.
5. Now all that is left is to do is align the north of the wind rose with North on the compass and observe where the wind is coming from.

A.3.3

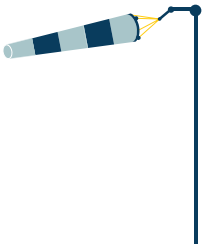
DANGEROUS CROSSWINDS

Horizontal wind above certain speeds can be dangerous for driving on motorways or roads.

Indicate the approximate wind speed depending on the degree of inflation and angle of the windsock:

Vertical cone

Cone at 45º



Horizontal cone

Beaufort scale

Sailors and meteorologists use the **Beaufort scale** to describe the strength of the wind. This scale was created by Sir Francis Beaufort, an Irish naval officer and hydrographer, who established a set of sea conditions and numbered them from 1 to 12 according to their intensity and navigation difficulty. With the improvement of instruments that measure the actual velocity of wind, the original scale was modified to become the table used today.

CALM

FORCE: 0

SPEED: 0 to 1 Km/hr

KNOTS: < 1 nautical miles/hr

SEA : Like a mirror.

LAND : Calm, smoke rises vertically.

LIGHT AIR

FORCE: 1

SPEED: 2 to 5 Km/hr

KNOTS: 1 to 3 nautical miles/hr

SEA : Ripples, with no foam crests.

LAND : Smoke indicates wind direction.

SLIGHT (LIGHT BREEZE)

FORCE: 2

SPEED: 6 to 11 Km/hr

KNOTS: 4 to 6 nautical miles/hr

SEA : Crested waves that do not break.

LAND : Leaves fall from the trees and windmills begin to move.

LIGHT (GENTLE BREEZE)

FORCE: 3

SPEED: 12 to 19 Km/hr

KNOTS: 7 to 10 nautical miles/hr

SEA : Small waves, crests breaking.

LAND : Leaves constantly moving, flags extended.

FAIR (MODERATE BREEZE)

FORCE: 4

SPEED: 20 to 28 Km/hr

KNOTS: 10 to 16 nautical miles/hr

SEA : Frequent white caps, larger waves.

LAND : Dust and papers raised, treetops moving.

FRESH (FRESH BREEZE)

FORCE: 5

SPEED: 29 to 38 Km/hr

KNOTS: 17 to 21 nautical miles/hr

SEA : Moderate waves with some length, many whitecaps.

LAND : Trees begin to sway, lake surfaces are choppy.

FRESH (STRONG BREEZE)

FORCE: 6

SPEED: 33 to 49 Km/hr

KNOTS: 22 to 27 nautical miles/hr

SEA : Large waves begin to form, breaking crests, foam.

LAND : Tree branches move, it is difficult to keep an umbrella up.

VERY FRESH (HIGH WIND)

FORCE: 7

SPEED: 50 to 61 Km/hr

KNOTS: 28 to 33 nautical miles/hr

SEA : High sea with foam blown in wind direction.

LAND : Large trees move, difficult to walk against the wind.

STORM (GALE)

FORCE: 8

SPEED: 62 to 74 Km/hr

KNOTS: 34 to 40 nautical miles/hr

SEA : High waves breaking, streaks of foam.

LAND : Treetops break, very difficult to walk.

STRONG STORM (SEVERE GALE)

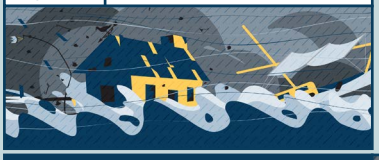
FORCE: 9

SPEED: 75 to 88 Km/hr

KNOTS: 41 to 47 nautical miles/hr

SEA : Very high, breaking waves. Reduced visibility.

LAND : Damage to trees, impossible to walk against the wind.



HEAVY STORM (WHOLE GALE)

FORCE: 10

SPEED: 89 to 102 Km/hr

KNOTS: 48 to 55 nautical miles/hr

SEA : Very high waves with overhanging crests. The sea's surface is white.

LAND : Trees uprooted, structural damage to buildings.

VIOLENT STORM

FORCE: 11

SPEED: 103 to 117 Km/hr

KNOTS: 56 to 63 nautical miles/hr

SEA : Exceptionally high waves, completely white sea, severely reduced visibility.

LAND : Cars, trees, houses, roofs and people are blown away. It causes damage everywhere.

HURRICANE FORCE (HURRICANE)

FORCE: 12

SPEED: +118 Km/hr

KNOTS: +64 nautical miles/hr

SEA : Huge waves, white sea, zero visibility.

LAND : Cars, trees, houses, roofs and people are blown away. May cause a hurricane or typhoon.

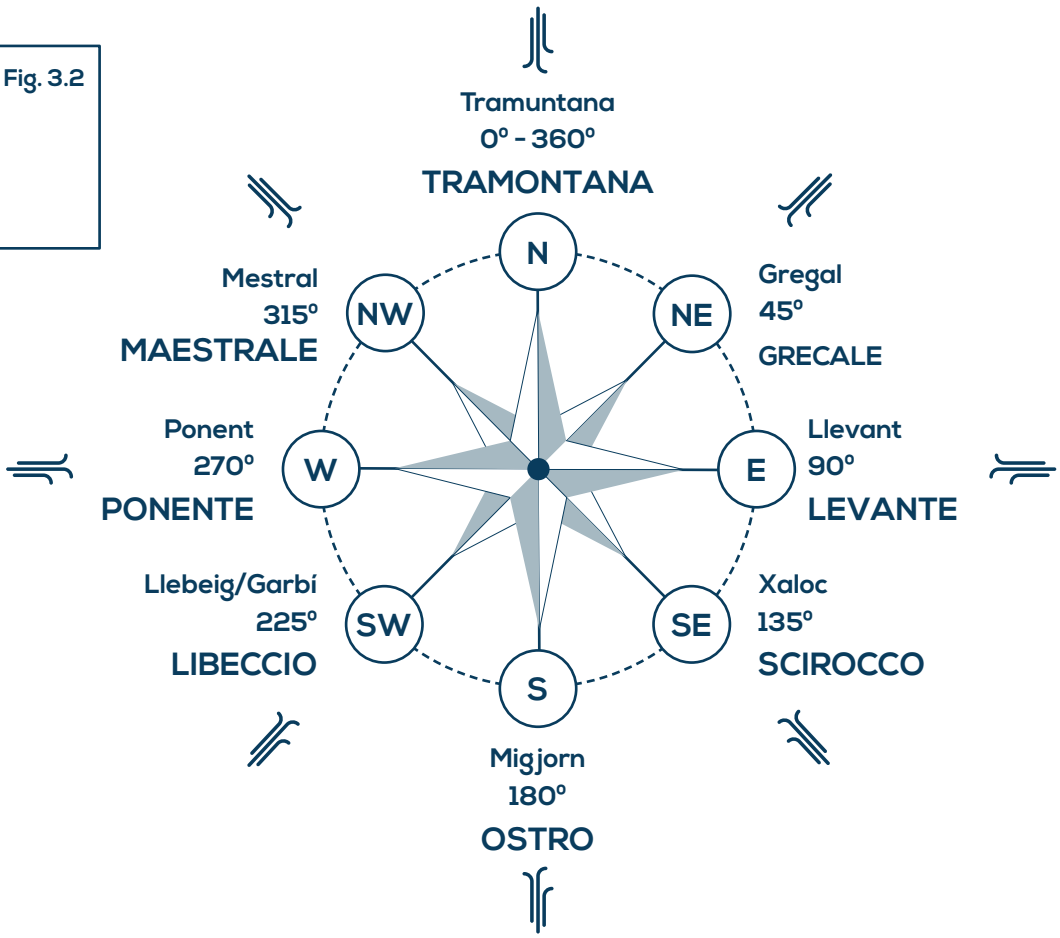
3.2 WIND NAMES

When we talk about the wind direction we are referring to the coordinates from which it blows, not the ones it is heading to. To find out the coordinates the wind is blowing from we use a wind rose. A wind rose is a diagram which depicts the cardinal points, North, South, East and West.

It also gives the intermediate points: northeast, southeast, southwest and northeast. They are sometimes found on maps to indicate their orientation. A wind rose marks the direction of the winds, which are named according to their direction.

Depending on where a wind blows from it receives a specific name, which may vary according to the region. In the Balearic Isles winds are differentiated by the following names:

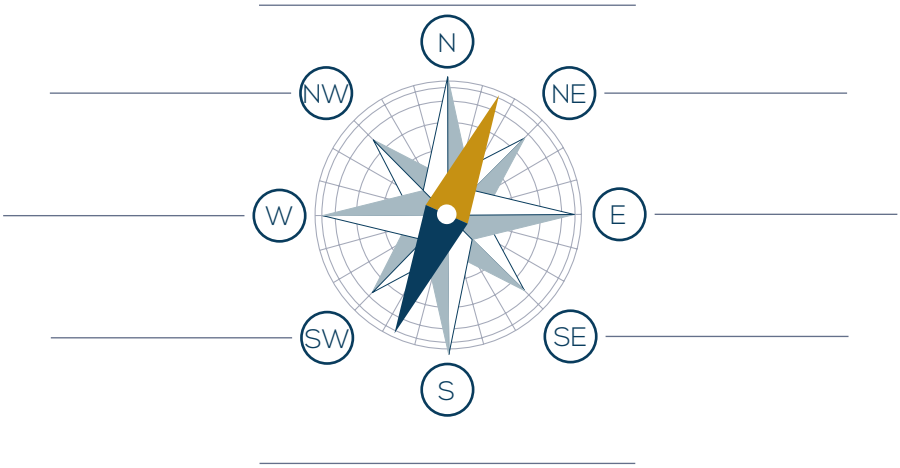
Fig. 3.2



A.3.4.

THE WIND ROSE

Write the names on the wind rose:



3.3 THE WIND IN THE BALEARIC ISLANDS

SOCIB has various weather stations spread out along the coast of the Balearic Islands so that it has information about the weather conditions at different points in the Balearic sea. These data are important when it comes to understanding swells and currents in coastal areas.

Prevailing winds are those which blow most frequently in a particular area, even if they are not the strongest winds. On the Mediterranean coast the wind may vary depending on the location or the time of year because, just as the temperatures vary over the year, so do the winds. In the case of the Balearic Islands, the Tramontana is the prevailing wind, although depending on the time of year the wind is stronger or lighter.

For example, during the summer months in the coastal areas of the Balearics thermal winds are produced, such as the sea breeze known locally as “Embat”. These winds are generated by the differences in temperature between the seawater and the land.

A.3.5.

LET'S INVESTIGATE

Look at the SOCIB panel with the data from the weather station and answer:

1- *Which direction is the wind blowing from? What is the name of the wind that blows from this direction?*

2- *¿What number on the Beaufort scale does this speed correspond to?*

A.3.6.

YOU CAN DO IT

Go into the SOCIB application/Fixed infrastructures:

http://socib.es/?seccion=observingFacilities&facility=mooring&language=en_GB

where you can see the real-time data from different marine and coastal monitoring stations around the Balearic Isles.

1- **Select units as km/hr.**

2- **Choose whichever station you like. Would you be able to identify what the wind speed is at each station and what number it corresponds to on the Beaufort scale?**

GLOSSARY:

Waves:

A succession of ripples or waves on the water surface which are caused by the wind transferring energy to the water surface, so that it moves until it reaches land.

Wind rose:

Shows the cardinal directions into which the circumference of the horizon is divided.

Wind:

Air in motion relative to the surface of the earth.

All aspects of this unit have shown the Mediterranean to be a physically confined space, with characteristics which make it unique: its waters, its climate, its biological wealth and its historical legacy. The future of the Mediterranean sea depends on our knowledge of it, and on how much love and care we invest in it from now onwards..