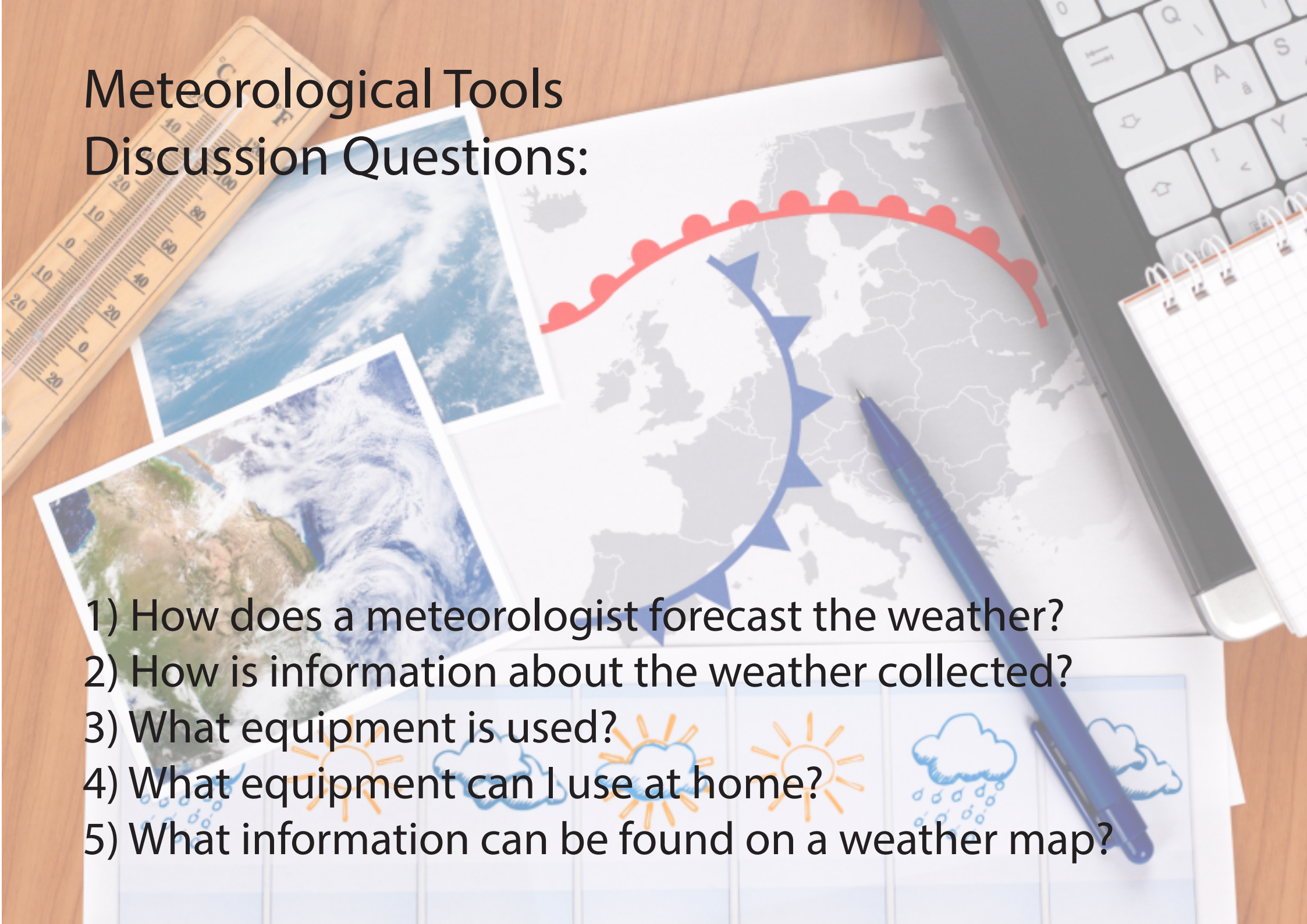
Meteorological Tools
Discussion Questions:



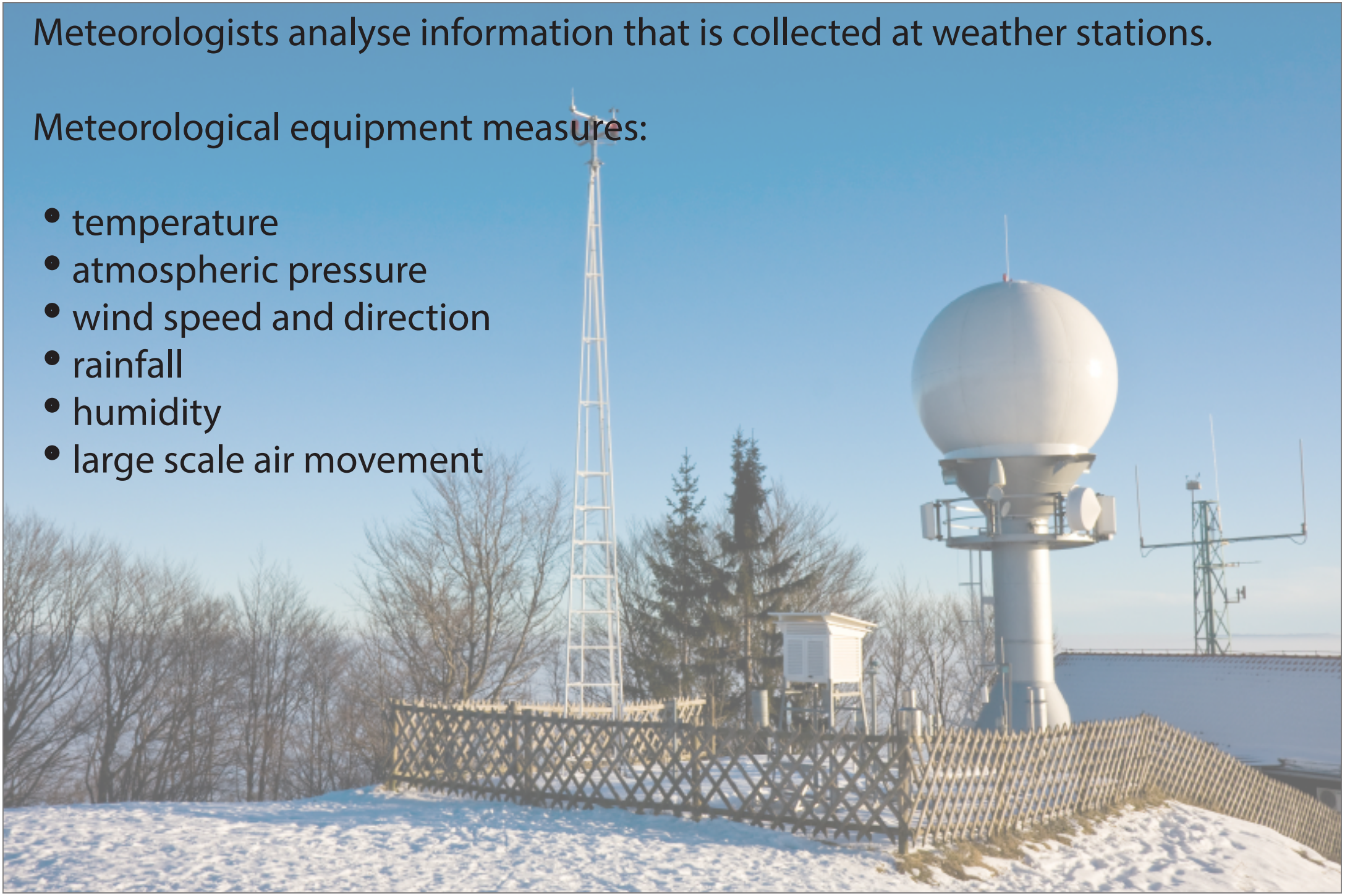
1) How does a meteorologist forecast the weather?
2) How is information about the weather collected?
3) What equipment is used?
4) What equipment can I use at home?
5) What information can be found on a weather map?

How does a meteorologist forecast the weather?

Meteorologists analyse information that is collected at weather stations.

Meteorological equipment measures:

- temperature
- atmospheric pressure
- wind speed and direction
- rainfall
- humidity
- large scale air movement



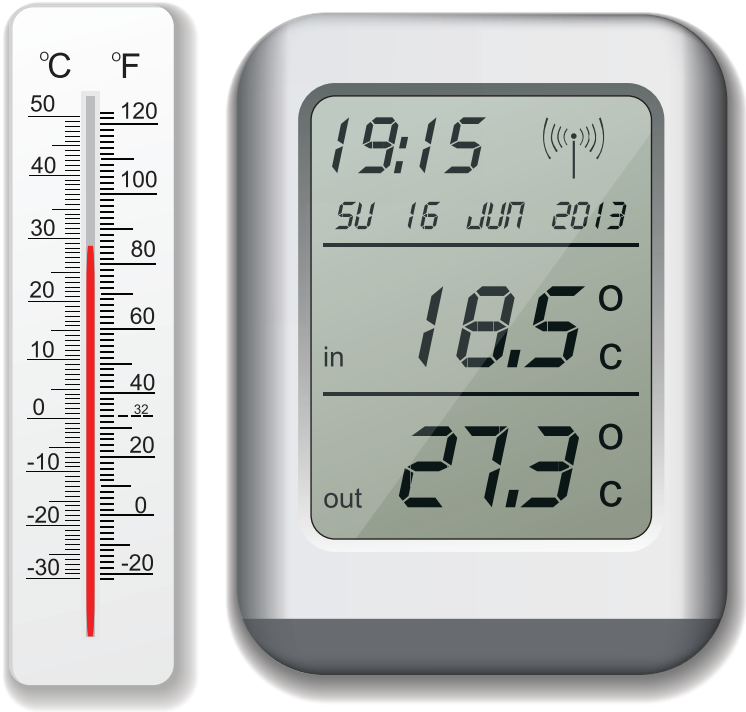
Measuring Temperature

A ***thermometer*** is used to measure temperature. Temperature is measured in degrees Celsius. In some parts of the world degrees Farenheit is used.

A standard mercury filled thermometer has a reservoir of liquid which expands when it is heated up and contracts when it cools down. This results in liquid rising up the tube in warmer weather and going down the tube in cooler weather. The scale next to the tube gives us the temperature reading.

Electronic thermometers have a digital display.

Weather stations generally use electronic sensors to measure temperature. They are housed inside a vented box to protect them from the direct rays of the sun, to ensure an accurate reading.



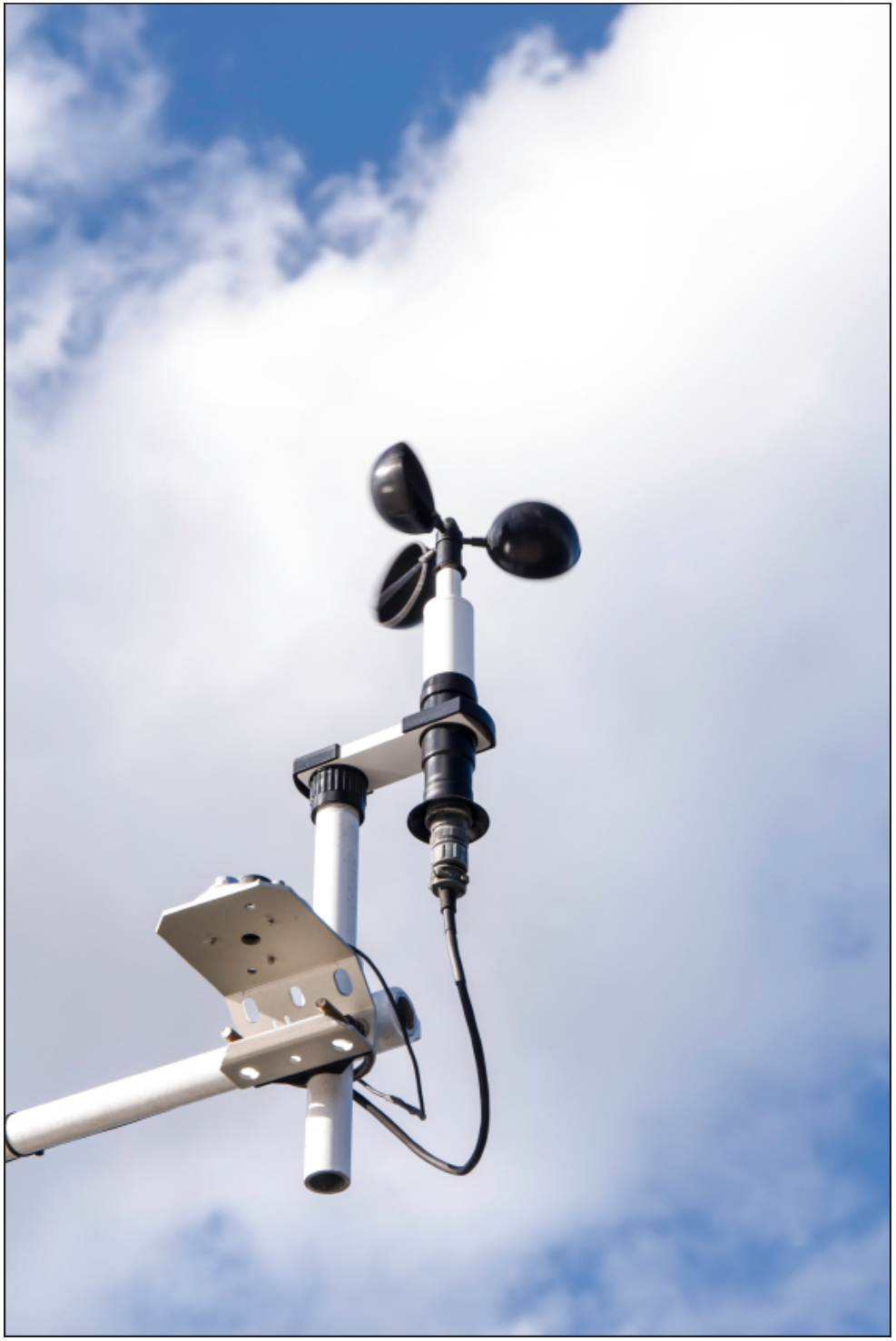
Measuring Wind Speed

Wind speed is measured by an ***anemometer***. An anemometer usually has cups that spin around in the wind. (Some anemometers have propellors instead of cups.)

The spinning device of some anemometers is connected to a small electrical generator that measures electrical current. The stronger the wind, the faster the rotation, the greater the current generated, the higher the wind speed measured.

Some anemometers are connected to a magnetic counter that measures the number of spins per second. Wind speed is determined by the number of rotations the anemometer makes.

Wind speed is expressed as km per hour or miles per hour, depending on what part of the world you live in.



Measuring Wind Direction

Wind direction is measured by a ***wind vane***.

A wind vane has an arrow and a tail end with a larger surface area. Both sides of the vane weigh the same so the device can swivel easily on its base.

The wind moves the larger surface area of the vane until it is in line with the direction that the wind is blowing. The arrow end is then pointing in the direction that the wind is coming from.

A southerly wind, therefore, blows from the south toward the north.

Wind vanes have been around since Roman times. Many people have beautifully decorated wind vanes on their roof. The ones used for weather forecasting are not so fancy!

Measuring Humidity

Humidity is the amount of moisture in the air. You can't see it but water vapour is present in the air. Some places in the world have a higher amount of water vapour in the air than others. For example, tropical regions near the equator are much more humid than regions nearer to the poles.

Humidity is measured by a hygrometer. Most weather stations use electronic hygrometers. These devices work by measuring electrical current that is passed through a ceramic resistor. With higher humidity the ceramic part absorbs more moisture. This changes the amount of current that can flow through the device. These measurements are used to work out the percentage of moisture in the air.

High humidity increases the likelihood of thunderstorms.

Measuring Atmospheric Pressure

Atmospheric pressure is also known as air pressure or barometric pressure and it is measured using a ***barometer***.

Electronic barometers use electrical charges to measure changes in air pressure. Air pressure readings are taken in multiple weather stations throughout a region. These results are used to create weather charts which show areas of low and high pressure.

High pressure systems usually indicate good weather. Low pressure systems can indicate rainy and stormy weather.

Rising barometric pressure readings indicate good weather. A rapid drop in barometric pressure indicates that a storm is approaching.

Measuring Rainfall

Precipitation (rainfall) is measured each day throughout the year. The data is used to work out annual and monthly averages.

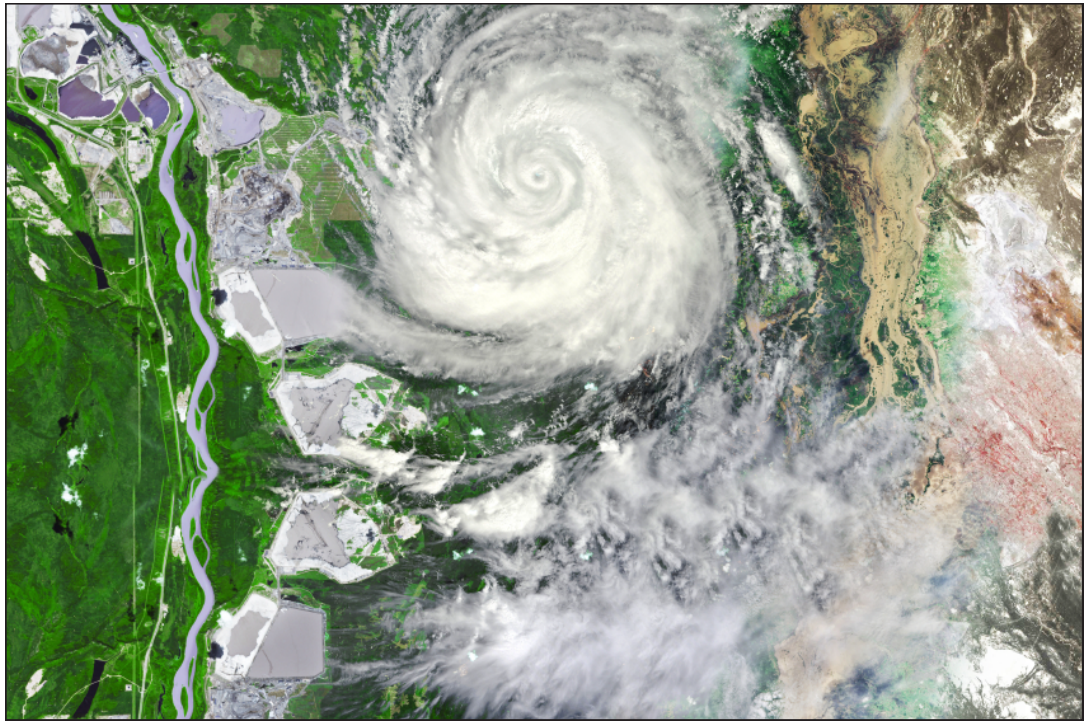
Keeping a record of precipitation over a number of years allows us to see weather patterns. For example, scientists have been able to descibe El NIno and La Nina weather patterns and predict the likelihood of weather events such as flooding.

Precipitation is collected in large flasks that are marked with measurements. The unit of measurement is millimetres or inches, depending on the country. Meteorologists check the flasks once a day. They record the measurements then drain the flasks ready for the next day.

Satellite Images

There are two types of weather satellites orbiting the earth:
1) Satellites in a polar orbit- these orbit high in the earth's atmosphere in a north south direction around the poles. As the earth rotates they can take images of the whole globe in14 days.

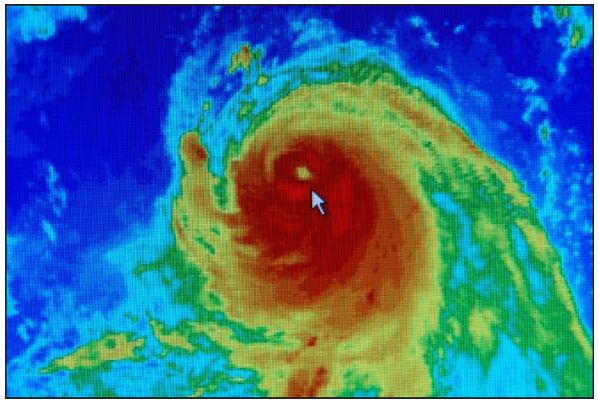
2) Satellites in a geostationary orbit- these travel at the same speed as the earth's rotation, therefore they appear to remain in the same spot. These satellites take pictures of the same area. When these are put together in sequence they can be used to track weather patterns, for example the approach of a cyclone or hurricane.

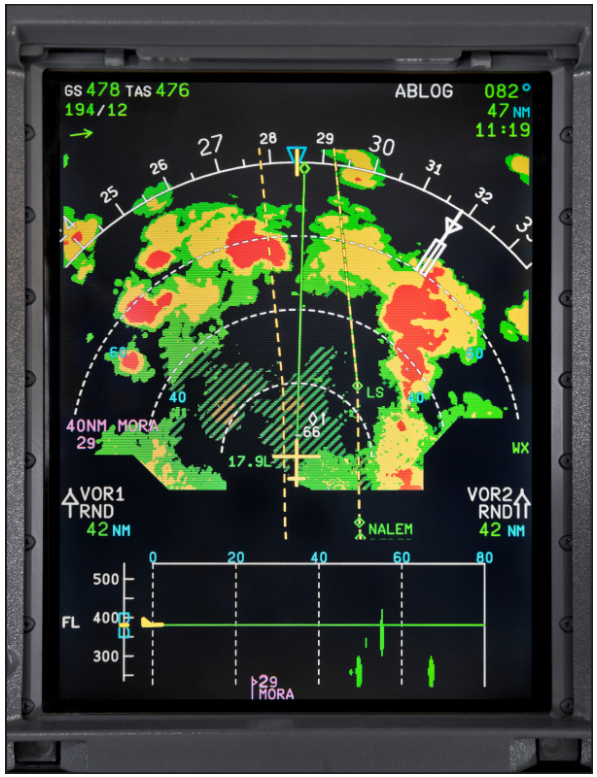


Radar Images

Radar systems work by emitting short pulses of radio waves which are pointed up at certain directions into the atmosphere. These waves travel at about the speed of light and are reflected back towards earth when they meet up with moisture in the air. The waves are reflected more strongly by heavier cloud masses and hail. The resulting radar imaging shows the amount of moisture in that area of the sky.

The red areas on the radar pictures shown here indicate areas that have the most cloud cover. The green and blue show lighter cloud cover.

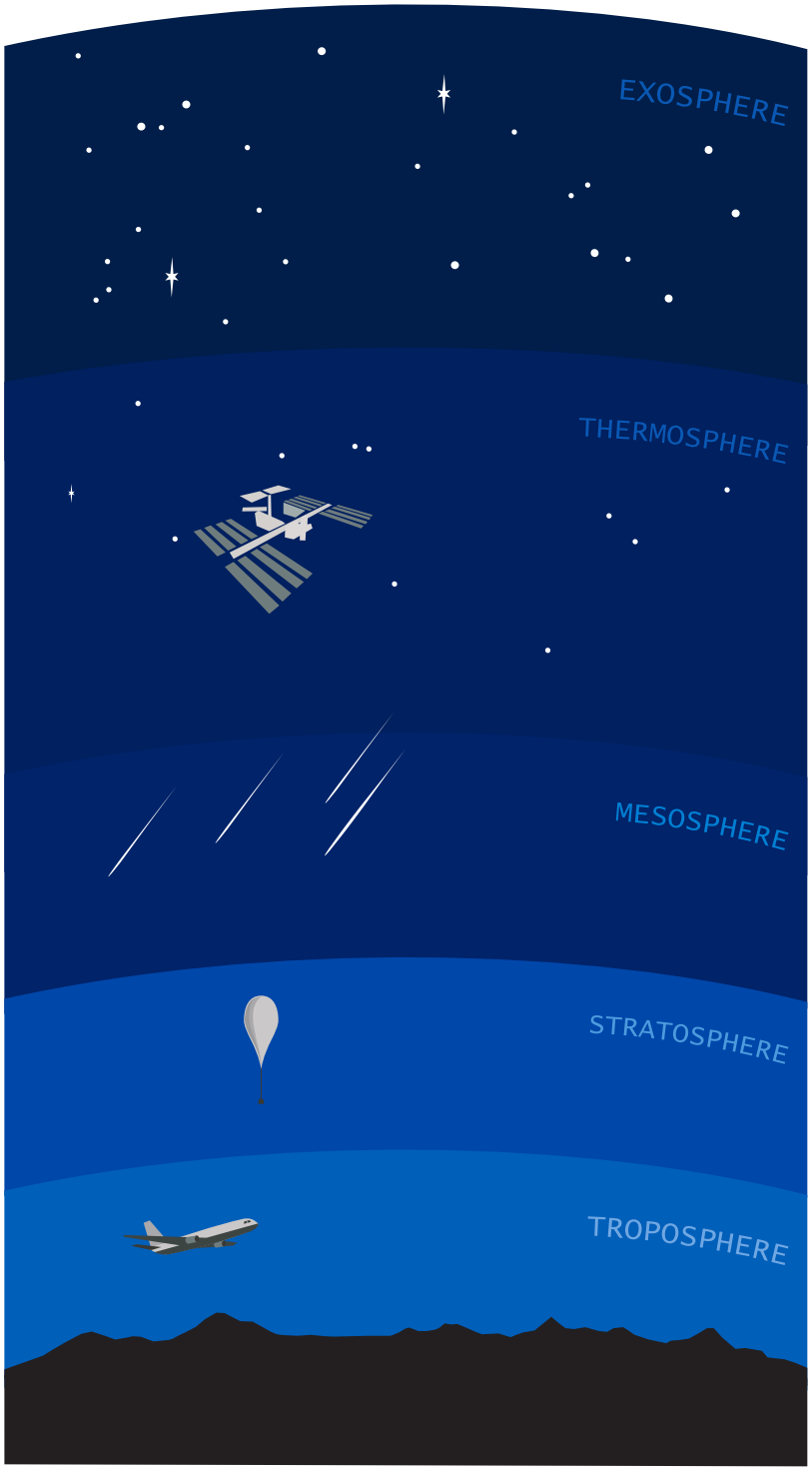




Weather Balloons

Meteorologists attach equipment to large helium filled balloons to monitor temperature, air pressure, humidity, wind speed and direction and cosmic rays in the atmosphere. Because helium is lighter than air, the balloon rises high into the atmosphere where the readings can be taken.

As the balloon travels higher it experiences less and less pressure which causes the helium inside the balloon to expand. When the balloon is stretched beyond its limit it will break, sending the monitoring equipment unit back to earth (with the aid of a parachute for a softer landing).



Weather Maps

Meteorologists use the data that is recorded in thousands of weather stations across a region to help them produce weather maps. These maps are used to monitor and predict the weather conditions.

This is a ***synoptic weather map***. These types of maps indicate the presence of low pressure systems and high pressure systems.

The black lines on the map are called ***isobars*** and they join places that have equal barometric pressure.

The coloured lines show the location of cold and warm fronts, places where warm and cool air masses meet.

The arrows indicate wind direction.

These maps were once drawn by hand. These days they are computer generated.