13. Air Masses affecting the UK

13.1 The basic forecasting rules

A simple way to identify the air mass affecting an area could be to consider the wind direction.

If an area is covered by straight isobars, i.e. not experiencing weather generated by a synoptic system (such as a high or a low-pressure system) a generalisation of the likely weather to be experienced in a particular area may be made by considering the air mass and the time of year.

A place to start is to consider the basic forecasting rules that were introduced in previous Lesson 1.12.

(1) Warm air is capable of holding more moisture than cold air.

(2) In winter the land is relatively cold and the sea relatively warm.

(3) In summer the land is relatively warm and the sea is relatively cold.

Cold air moving over a relatively warm surface

- Air is heated at the surface by contact.
- The warmed (less dense) air rises (convection).
- The greater the temperature difference between the air mass and the underlying surface, the more vigorous the convection.
- As the air rises it cools adiabatically causing the relative humidity (RH) increase.
- If the rising air is cooled beyond its *dew point* temperature, condensation will take place and *cumuliform* clouds will develop.
- This situation is described as being *unstable* since the air has risen spontaneously.
- These unstable conditions are associated with:
  Cumulus type clouds;
  Very good visibility;
  Showers.

Warm air moving over a relatively cold surface

- Air is cooled at the surface by contact making it denser.
- The now colder (more dense air) tends to resist upward movement and the atmosphere is said to be *stable*.

- Surface roughness/friction causes turbulence and will cause the cooled air to rise.

- As the air rises it cools adiabatically causing the relative humidity (RH) increase.

- If the rising air is cooled beyond its *dew point* temperature, condensation will take place and *stratus* (layer) type clouds will develop.

- A s*table* atmosphere is associated with: *Stratus (layer) type clouds;*
  Poor visibility;
  Rain/drizzle and/or fog.

13.2 The air masses affecting the UK

The weather can change on an almost daily basis around the UK because the Polar Front is always close by except when an intervening high-pressure system develops at the end of a family of depressions.

It is often stated that we 'can experience all four seasons in one day' with the weather being so changeable in the UK!

The principal air masses that affect the UK are identified in the figure below. They arise as a result of the relative positions of high and low-pressure systems and associated direction of the isobars which are clearly indicated on any synoptic chart.

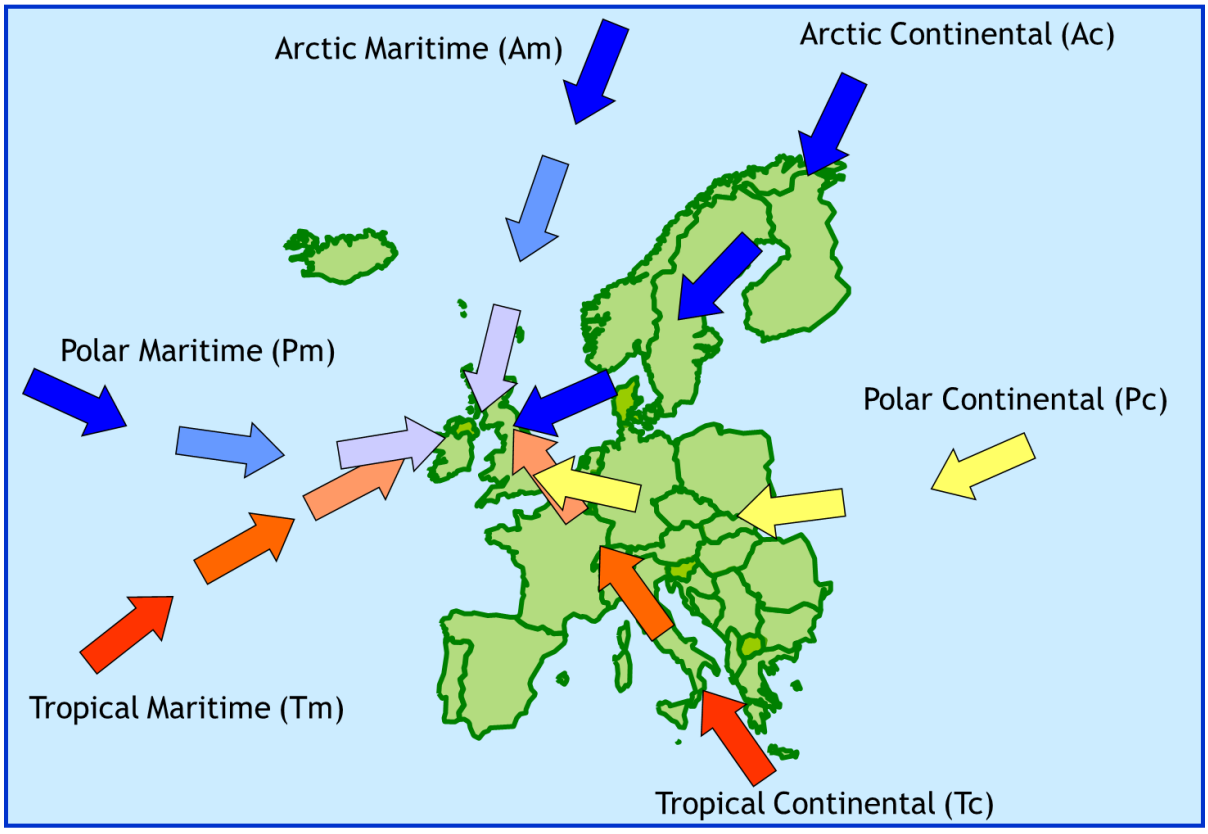

Fig. 13.1 – The principal air masses affecting the UK.

13.2.1 Tropical maritime (Tm)

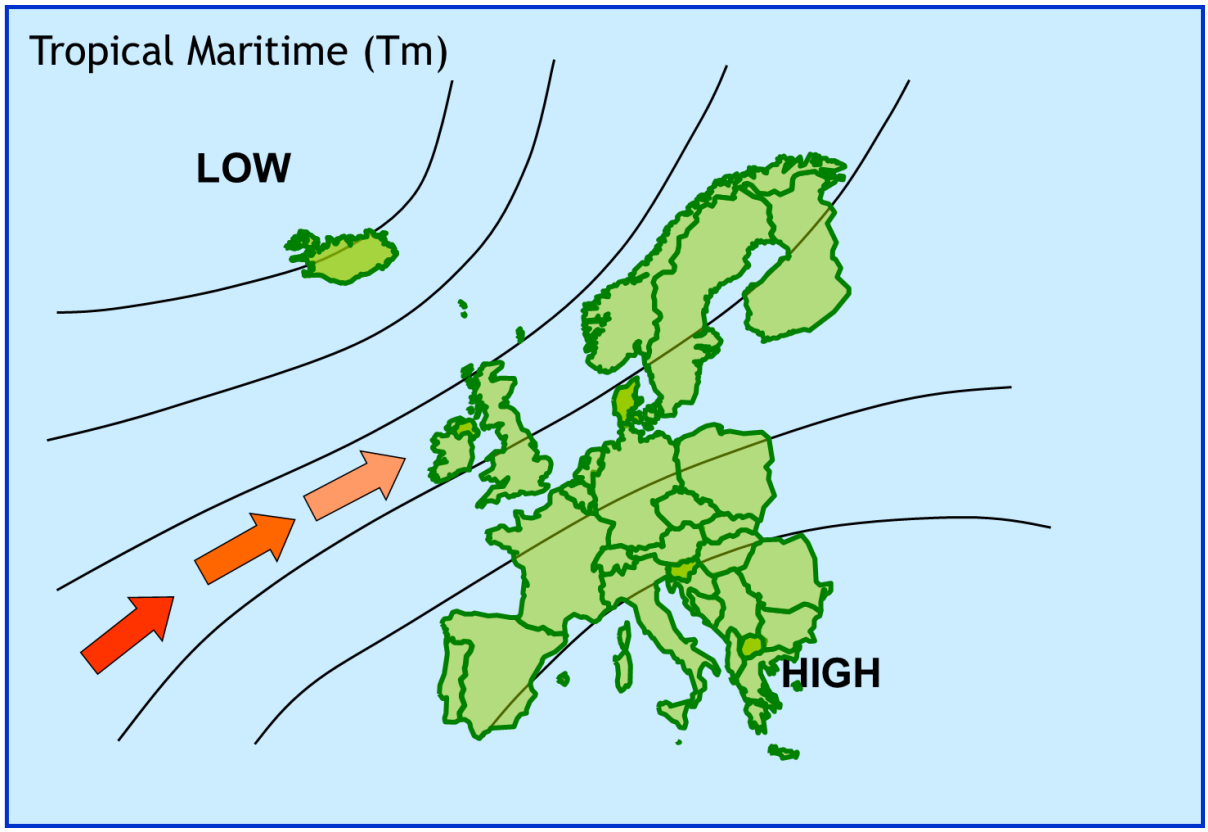

Fig. 13.2 - Tropical maritime air mass.

- The source region for this air mass is the warm waters of the Atlantic Ocean between the Azores and Bermuda.
- The predominant wind direction across the British Isles, in a tropical maritime air mass, is south-westerly.
- Tropical maritime air is warm and moist in its lowest layers and although unstable over its source region, during its passage over cooler waters becomes stable and the air becomes saturated.
- When a tropical maritime air mass reaches the British Isles, it brings low stratiform cloud and drizzle, perhaps also fog around windward coasts and across hills.
- To the lee of high ground though, the cloud my break up and here the weather, particularly in the summer months, can be fine and sunny.
- Foehn effect often experienced in the lee of the Scottish Highlands.
- This is a mild air stream and during the winter months in particular can raise the air temperature several degrees above the average.

- Visibility is poor to moderate. Mists and fog inland in winter and at night when sky clears and winds are light.

- Fog in the English Channel and western approaches in spring and early summer.

13.2.2 Polar maritime (Pm)

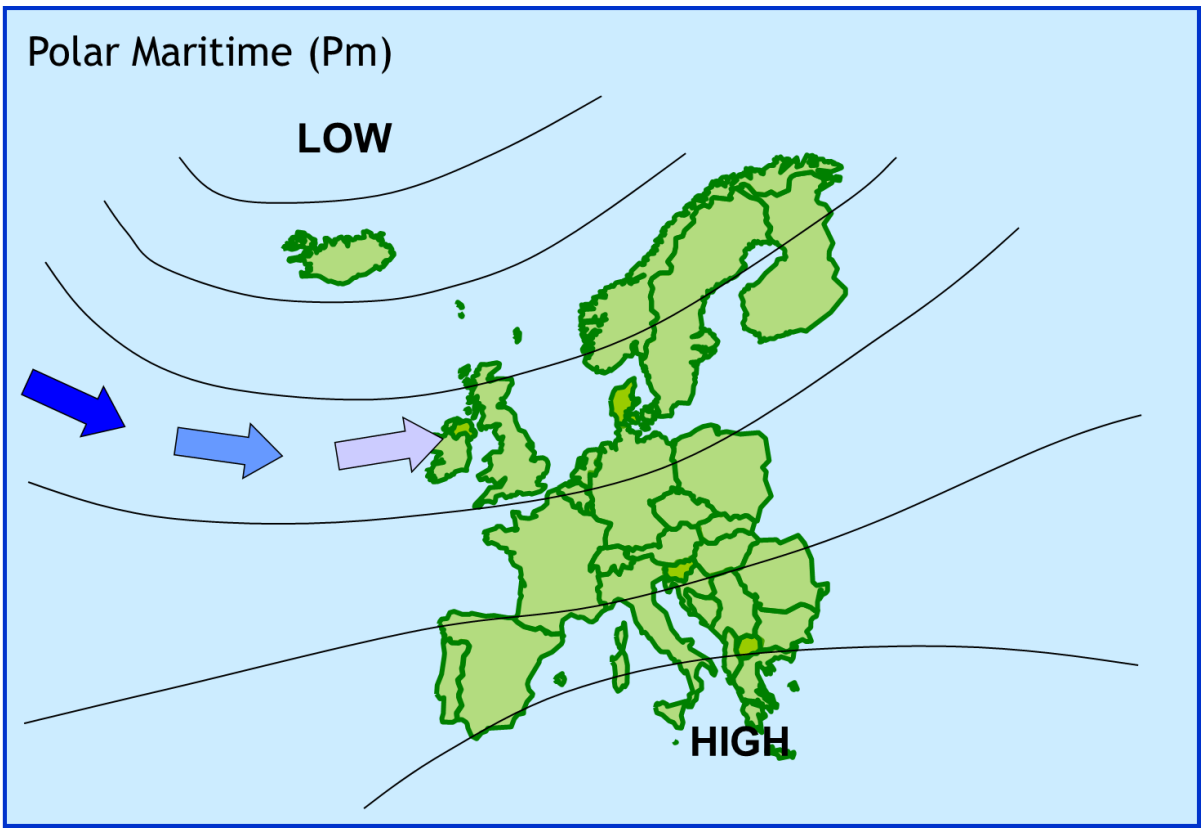

Fig. 13.3 – Polar maritime air mass.

- Source region is over northern Canada and Greenland and reaches the British Isles in a north-westerly air stream.

- Polar maritime is the most common air mass to affect the British Isles.

- This air mass starts very cold and dry but during its long passage over the relatively warm waters of the North Atlantic its temperature rises rapidly and it becomes unstable to a great depth giving cumuliform clouds.

- This air mass is characterised by frequent showers at any time of the year.

- In the winter months when instability (convection) is most vigorous over the sea, hail and thunder are common across much of the western and northern side of the British Isles. However, eastern Britain may see fewer showers as here the surface heating is reduced.

- In winter may bring snow if the air has travelled quickly over the ocean

- During the summer land temperatures are higher than sea temperatures and the heaviest showers occur over eastern England, possibility of thunderstorms.

- Visibility very good except in showers.

- Commonly occurs behind cold and occluded fronts.

Note
Returning polar maritime is another version of polar maritime, but this time with a longer sea track which takes the air first southwards over the North Atlantic and then the north-eastwards across the British Isles.

During its passage south, the air becomes unstable and moist but on moving north-east it passes over cooler water making it stable in its lowest layers.

Although the weather across the British Isles in this air mass is largely dry, there can be extensive low level stratiform clouds.

13.2.3 Arctic maritime (Am)

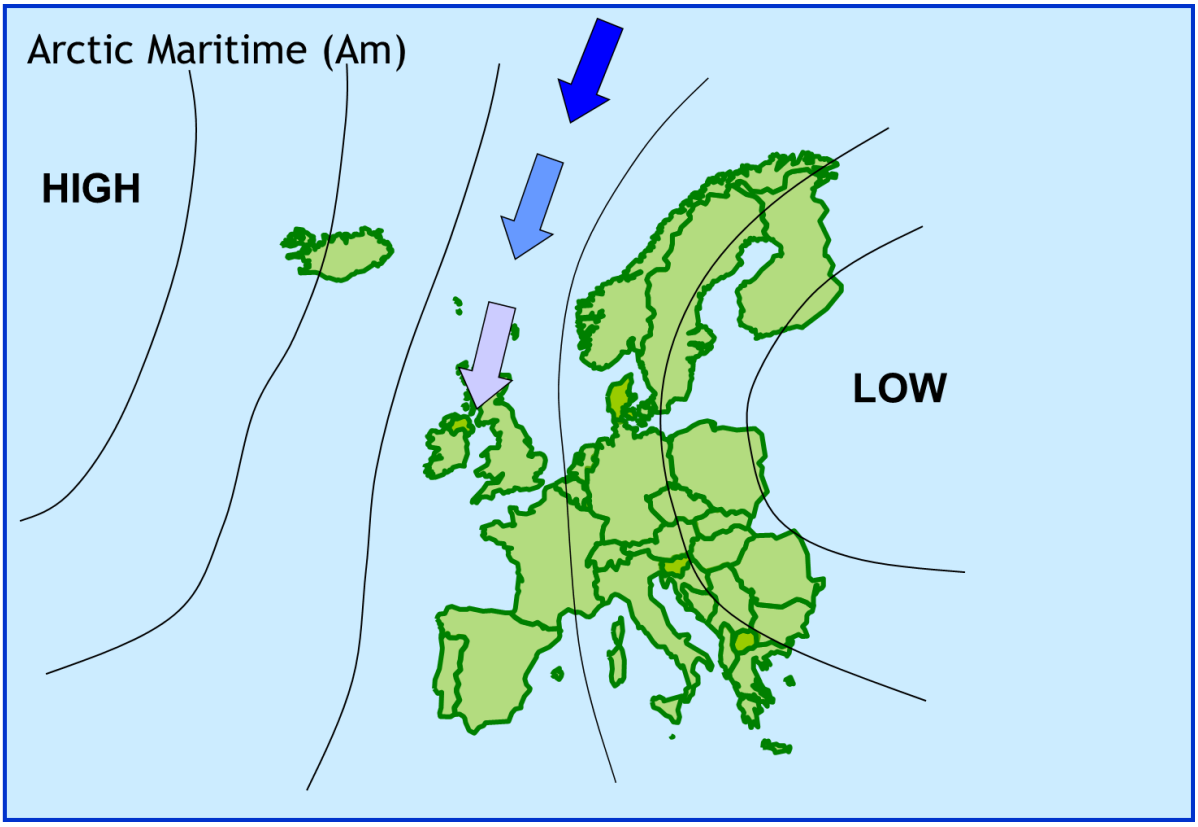

Fig. 13.4 - Arctic maritime air mass.

- Source region is the North Pole and the Arctic Ocean.

- An arctic maritime air mass has similar characteristics to a polar maritime air mass, but because of the shorter sea track the air is colder and less moist.
- Unstable and very cold, low absolute humidity but high relative humidity.
- Arctic air is uncommon during the summer, but when it does occur it may bring heavy showers or thunderstorms and unseasonably low temperatures.
- The air mass can bring very damaging late frosts.
- In winter night frosts can be severe and may last all day.
- Between October and May the air is cold enough to produce hail showers or snow and these are most frequent over Scotland and along the coasts exposed to northerly winds.

Note
Polar low-pressure systems forming in this air mass can sometimes lead to widespread and heavy snowfall, but otherwise inland areas remain free of cloud in the winter months. In northern Scotland, arctic maritime is usually the coldest air mass, but over the rest of Britain, this air mass is not as cold as polar continental.

13.2.4 Tropical continental (Tc)

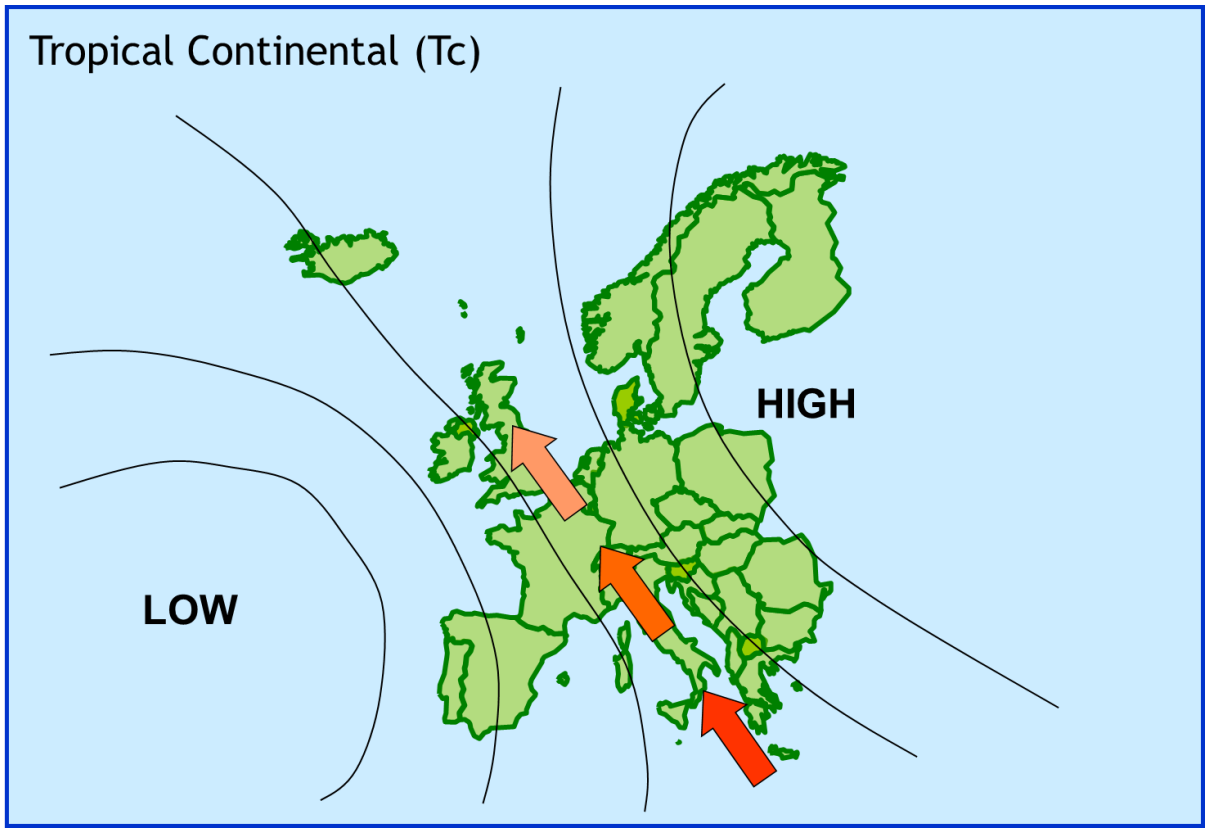

Fig. 13.5 – Tropical continental air mass.

- This air mass originates over North Africa and the Sahara.
- It is most common during the summer months June, July and August, although it can occur at other times of the year.
- Dry and stable but may become unstable due to heating of ground causing limited cumulus cloud development but generally little cloud because of low absolute humidity.
- Highest UK temperatures usually occur under the influence of tropical continental air (over 30 °C by day and around 15 to 20 °C at night).
- Visibility is usually moderate or poor due to the air picking up pollutants during its passage over Europe and from sand particles blown into the air from Saharan dust storms. Occasionally, the Saharan dust is washed out in showers producing coloured rain and leaving cars covered in a thin layer of orange dust.

13.2.5 Polar continental (Pc)

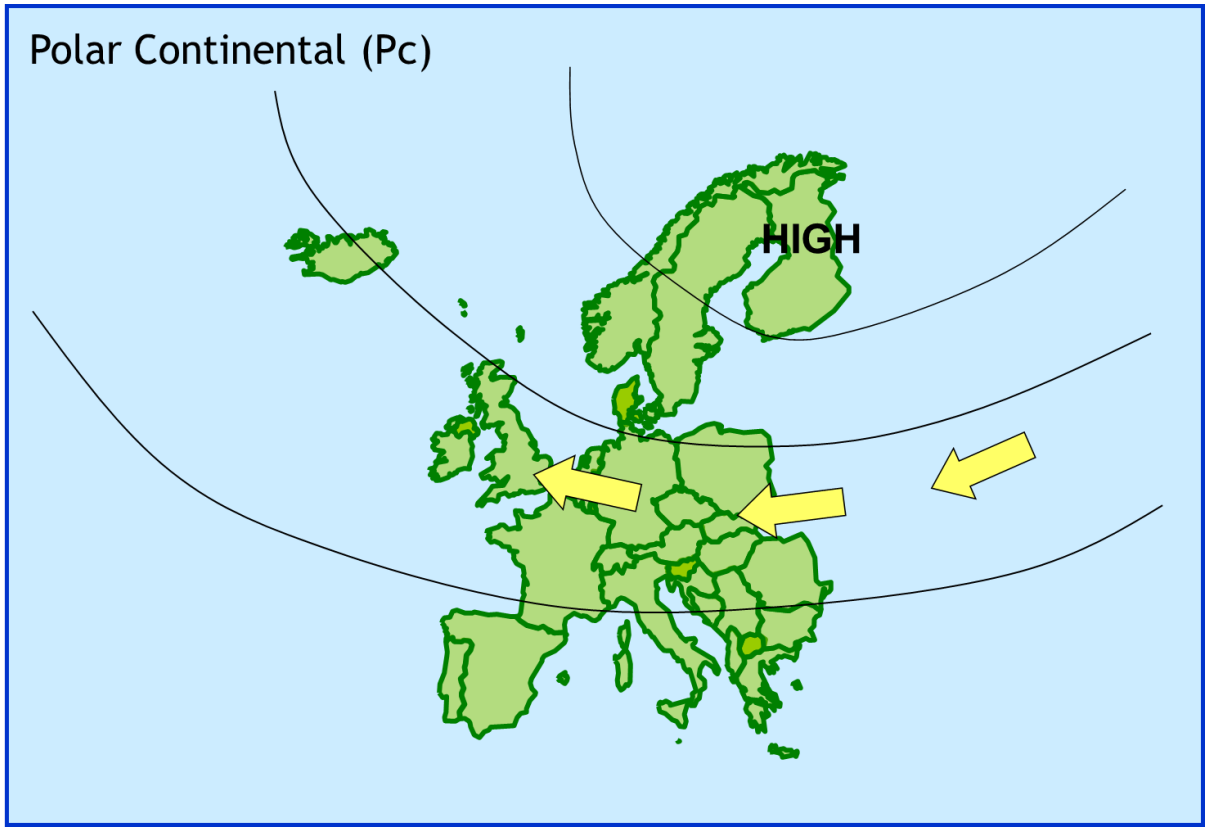

Fig. 13.6 - Polar continental air mass.

- Air mass has its origins over the snow fields of Eastern Europe and Russia.
- Air is very cold and dry.
- Is only considered a winter (November to April) phenomena.
- During the summer with the land mass considerably warmer, this air mass would be classed as a tropical continental.
- Weather characteristics depend on the length of the sea track during its passage from Europe to the British Isles:

  - if it reaches southern Britain with a short sea track over the English Channel the weather is characterised by clear skies and severe frosts.

  - with a longer sea track over the North Sea the air becomes unstable and moisture is added giving rise to showers of rain or snow, especially near the east coast of Britain.

- The lowest temperatures across all the British Isles usually occur in this air mass, lower than -10 °C at night and sometimes remaining below freezing all day.

13.2.6 Arctic continental (Ac)

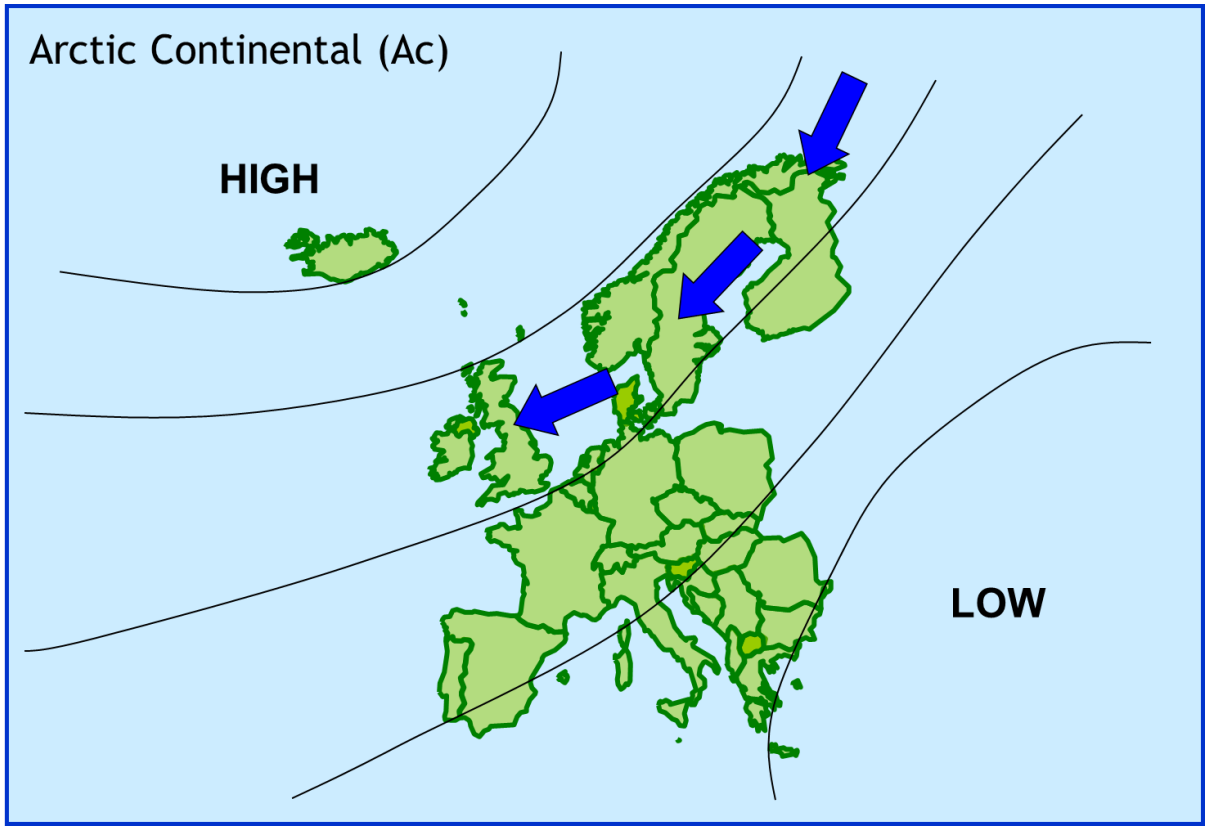

Fig. 13.7 – Arctic continental air mass.

See polar continental (Pc); this is not described by the Met Office.

Note
The Met Office identifies SIX air masses as detailed below; this may differ from what is quoted in some meteorology syllabi.

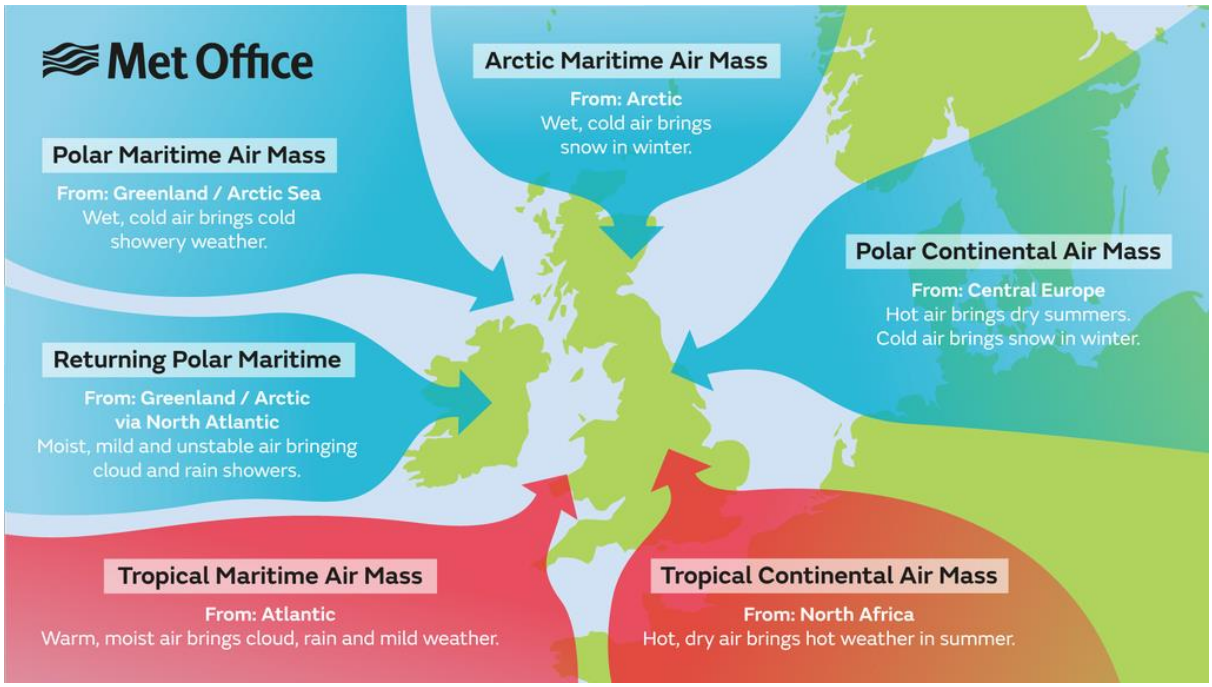

Fig. 13.8 – The SIX air masses identified by the Met Office.
https://www.metoffice.gov.uk/learning/atmosphere/air-masses/types