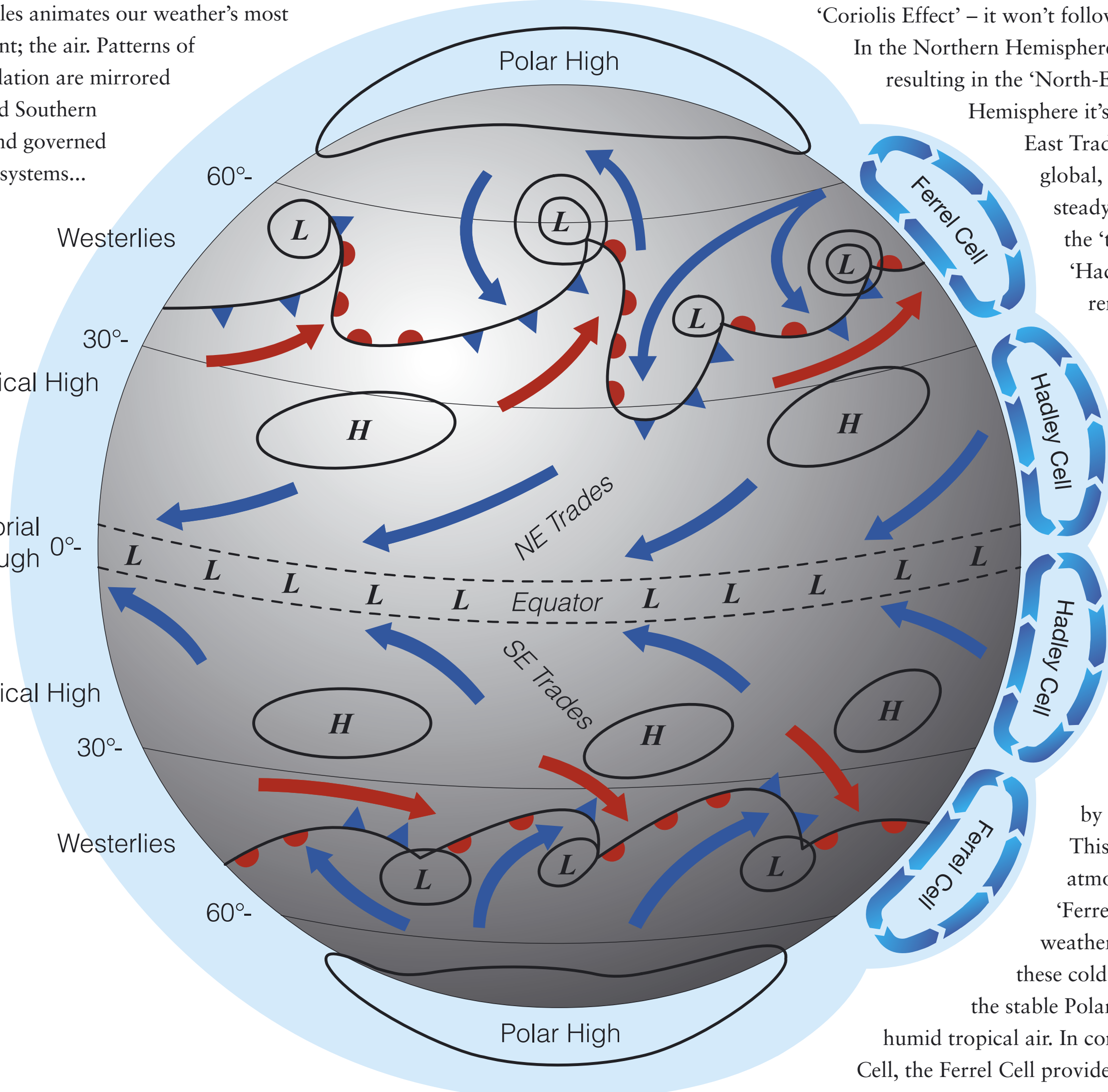
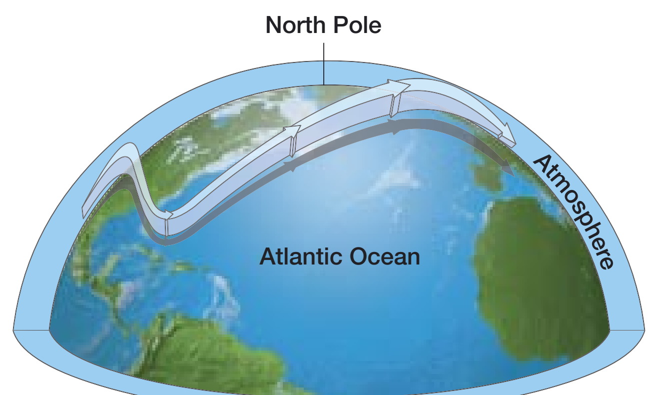
II. The Formation of Wind

The huge temperature difference between the equator and Poles animates our weather's most excitable element; the air. Patterns of global air circulation are mirrored in Northern and Southern Hemispheres and governed by three broad systems...



Happily, it's a whole different story between these becalmed waters. Half of the air descending from the Subtropical High feeds back to the Equatorial Low. Because of deflection due to the Earth's rotation – the 'Coriolis Effect' – it won't follow a direct north-south route. In the Northern Hemisphere it is deflected to the right, resulting in the 'North-East Trades' (in the Southern Hemisphere it's spun left, meaning 'South-East Trades'). Trade winds are global, highly dependable, and steady – they ably demonstrate the 'tropical convection cell', or 'Hadley Cell', in action. The remainder of the descending air-mass at 30°N heads towards the North Pole. Again it's deflected to the right, resulting in westerly winds at mid-latitudes. At about 60°N the 'Sub-Polar Low' forms, recirculating air skyward and south to descend again at 30°N. The prevailing winds between 40 and 60°N – logically dubbed the 'Westerly Wind Zone' – are further reinforced by the Jetstream overhead. This process describes another atmospheric convection cell; the 'Ferrel Cell'. Strong winds and weather patterns are created when these cold and dry air-masses from the stable Polar High meet the warm and humid tropical air. In contrast to the steady Hadley Cell, the Ferrel Cell provides the very unsettled and diverse weather familiar to Europeans.

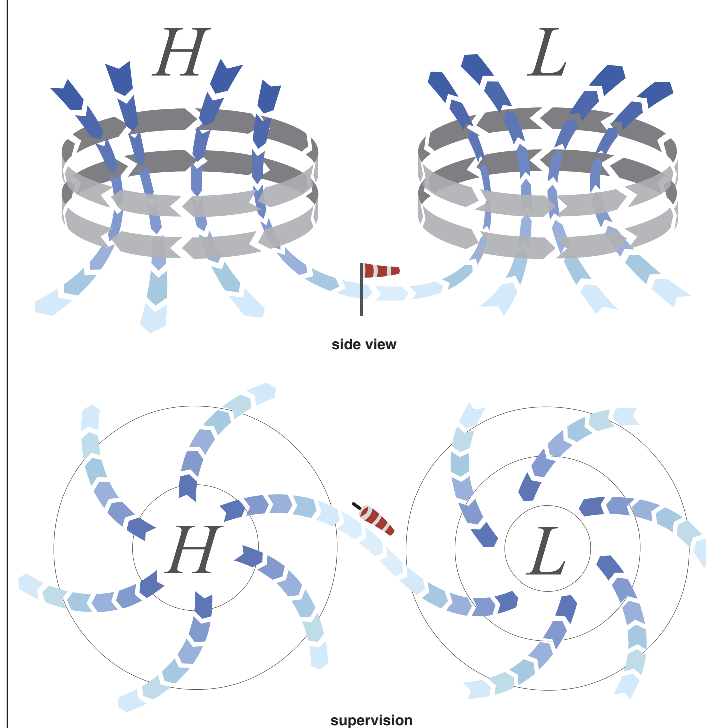
Intensive solar radiation at the equator heats local air-masses. In common with any gas, fewer of the heated molecules can occupy the same volume so the air expands. This warm, light air rises to a higher altitude in the atmosphere building a belt of low-pressure – the 'Equatorial Trough' – around the equator. Having reached an altitude of about 15-20km, these tropical air-masses follow the Troposphere (lower atmosphere) north and south, just as hot air from a convection heater would move along a room's ceiling. Slowly the air cools and it finally falls back down at latitudes of about 30°. These regions of descending air form the 'Subtropical Highs'. In contrast to the equatorial regions (where cloud formation and tropical rains allow the warm rising air to slowly cool and lose its humidity) subtropical air-masses warm up during their descent, making them extremely dry. This is responsible for the world's arid zones such as the Sahara, Kalahari, and Australian deserts. Only at the ocean's surface can the air gain humidity again. As with the Equatorial Lows (also known as 'The Doldrums') the vertical motion of the air-masses in the Subtropical Highs doesn't cause surface (ie; horizontal) winds. Sailors of old, driven half-mad by the lack of breeze and forced to eat their horses through hunger, called these regions the "*Horse Latitudes*". Whatever you call them, for kiters and windsurfers they're a definite no-go!



The Jetstream snakes and undulates around the globe. Its compression results in high atmospheric pressure, which forms a high-pressure centre at ground level. Air will spiral anti-cyclonically (clockwise in the Northern Hemisphere) away from the centre of a high, creating clear and dry weather. Conversely, where the Jetstream expands the barometric pressure drops. Air then spirals anti-clockwise (cyclonically) into the low-pressure region at ground level and rises, resulting in cloud formation and the development of a mid-latitude low. The faster the Jetstream is, the more violent the storms it produces and carries north-eastward will be.

Dynamic High & Low Pressure Systems

High barometric pressure represents a relatively dense air-mass within the atmosphere. Imagine the atmosphere in simple terms as a balloon: It would bulge where the pressure was high, whereas low-pressure (a deficit in air density) would cause a dent. Air naturally moves from high to low pressure zones in an attempt to restore equilibrium.



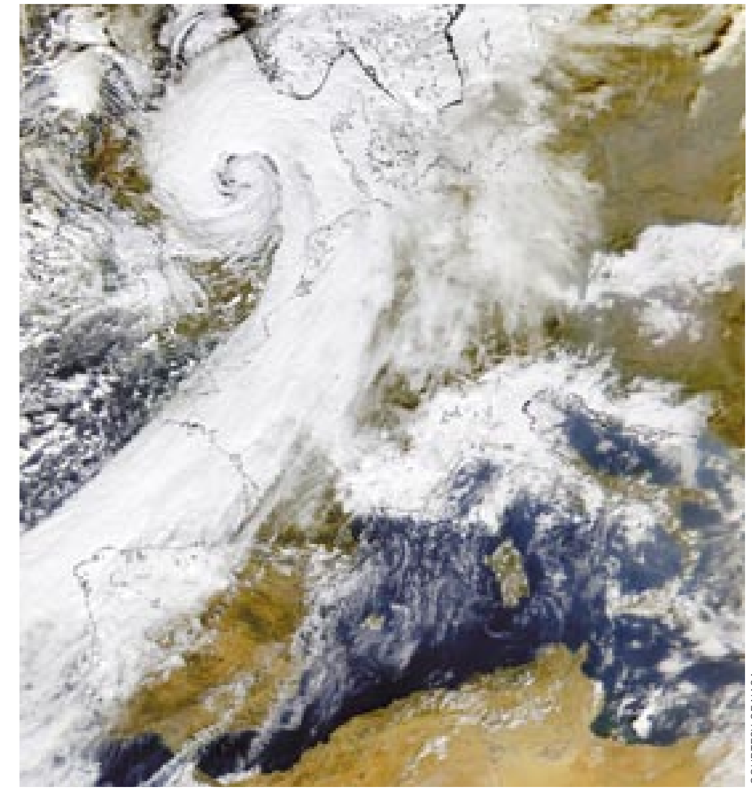
High Pressure System / Anti-Cyclone:
As air exits a high-pressure area, the Coriolis Force (an apparent effect of the Earth's rotation) immediately deflects it. In the Northern Hemisphere, the airflow swerves to the right and thus spirals around the core of the high pressure cell. Seen from above – ie; on a weather chart – this rotation is clockwise. A high strengthens (barometric pressure rises) as long as more air flows in than exits near the ground. In contrast, barometric pressure will fall if the exhaust is faster than the resupply from above. As a result, the high weakens and the associated air-masses rotate more slowly until the difference in pressure eventually disappears.

Low Pressure System / Cyclone:
The barometric pressure in a low is less than that of the surrounding area. Air streams towards it from all sides to nullify the pressure difference, but again doesn't travel in a straight line because the Coriolis Effect deflects it to the right. So as air is finally vacuumed in towards the high-altitude low-pressure core it thus spirals anti-clockwise and upward towards it's centre. The stronger the low, the faster the inflowing air-masses will be. Wind, as we feel it, is the movement of air from a high to a low at ground level.

In Europe, the anti-clockwise rotation of air flowing into a low results in a defined sequence of wind directions as it moves (typically from west to east) over a region: South then south-westerly winds form at its front, the wind direction then changes to westerly and finally north-westerly while the low passes over. (You would experience easterly winds if the low passed south of you.)

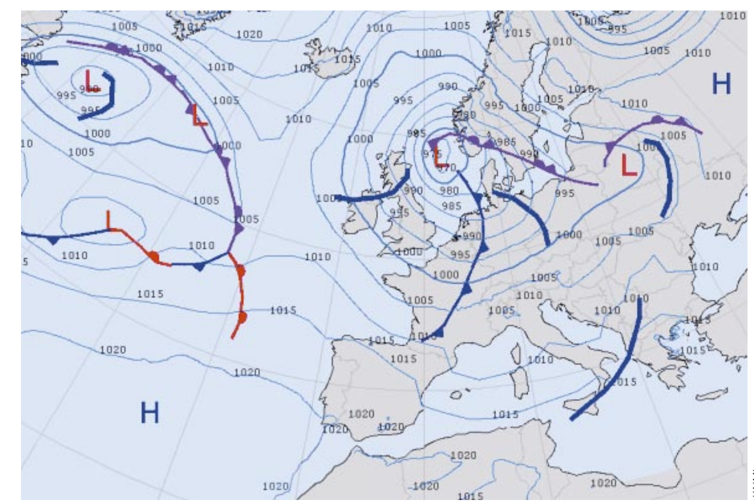
But unfortunately things are a little more complex than simple convection currents. Aside from of the differences in heat content (high-pressure = cold & heavy; low-pressure = warm and light), weather events are influenced by interactions between dynamic high and low pressure systems. In reality, fluid high and low pressure systems are constantly formed to nullify regional differences in atmospheric pressure. Plus, the direction and force of all this wind is dynamically influenced by centrifugal force, friction and the Coriolis Effect...

Thanks to the Jetstream, regional atmospheric differences spawn dynamic high and low pressure systems. Compression or expansion of the Jetstream dictates barometric pressure in the underlying air too. For example, decompression of air at high altitude will decrease barometric pressure in the lower atmosphere, causing air-masses to corkscrew into the low-pressure core – a *dynamic low*. The meandering Jetstream supplies the Northern



Cyclonic storm Oratia above northern Europe.

Hemisphere with plenty of dynamic lows, especially in the North Atlantic Ocean. Warm subtropical air meeting cold Polar air between 40 and 60°N further aids the formation of powerful low-pressure systems. These warm and cold fronts also rotate around – and are drawn towards – a low-pressure core. Within a few days of orbiting the core, the fast cold air catches up with the sluggish warm air, hence their combined rotatory energies climb and so does the windspeed. This low will hitch a ride across the Atlantic as the Jetstream drags it towards Europe. Often the Jetstream decompresses the low even further, the barometric pressure drops, and the low strengthens. If this low also accelerates in the same direction as the Jetstream, the windspeed will increase yet more as our dynamic low becomes a cyclonic storm.



Isobars
The unit of barometric pressure is a millibar (abbreviated mb). Just as contour lines join equal altitudes on a map, so areas of the same barometric pressure on a weather chart are connected with lines called *isobars*. The closer the adjacent isobars, the steeper the pressure gradient ... and hence the windier it is. Simple!

Though do take care when interpreting weather charts: Great Britain and other English-speaking countries tend to draw isobars at 4mb increments whereas 5mb increments are standard in mainland Europe. So expect tighter isobars on a British weather map than a Continental depiction of exactly the same windstrength.