What most affects a seaman's (and your) life?

The Weather….?

Never go to sea without a weather forecast

On land

- TV
- National radio
- Local radio
- Newspaper
- Teletext
- Web
- Mobile phone
- Barometer

At sea

- Barometer/barograph
- BBC radio
- Coastguard VHF
- Metfax to PC
- Navtex
- Observation
- Mobile phone

The Shipping Forecast

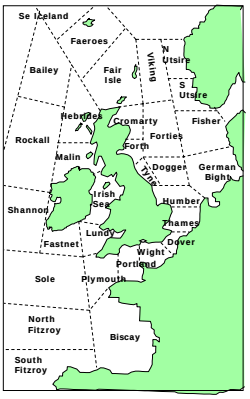
(0048, 0535, 1201, 1754 BBC LW)

1. Gale warning summary
2. General synopsis at time of issue
3. Sea-area forecasts:

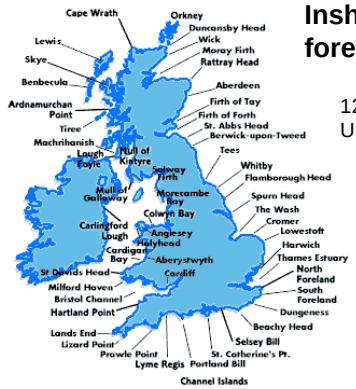
- Wind direction and speed
- Wind later (after 12 hours)
- Sea state
- Weather (ie rain, showers)
- Visibility

Reports from Coastal stations

Gale warnings are broadcast at the first available programme break



http://www.metoffice.gov.uk/education/teachers/in-depth/understanding



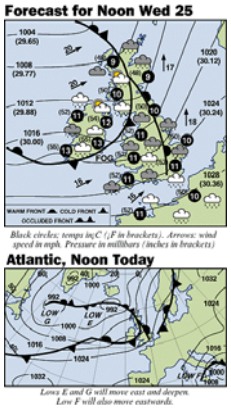
Inshore waters forecast:

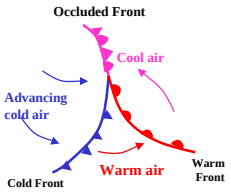
12 miles offshore of the UK coast

- Includes sea state
- + 24 hour outlook

Shipping forecast

- The shipping forecast issued by the Met Office, on behalf of the Maritime and Coastguard Agency, on Monday 04 February 2008 at 1130
- There are warnings of gales in Viking, North Utsire, South Utsire, Forties, Cromarty, Tyne, Dogger, Fisher, German Bight, Humber, Thames, Dover, Wight, Portland, Plymouth, Biscay, FitzRoy, Sole, Lundy, Fastnet, Irish Sea, Shannon, Rockall, Malin, Hebrides, Bailey, Fair Isle, Faeroes
- **The General synopsis at 0600**
  Complex low Rockall 965 expected Faeroes 972 by 0600 tomorrow. Atlantic low moving rapidly northeast expected Ireland 977 by same time
  The area forecasts for the next 24 hours
  Viking, North Utsire, South Utsire, East Forties
  Southeasterly 6 to gale 8, occasionally severe gale 9 except east Forties. Very rough or high becoming rough. Rain or showers. Moderate or good
  West Forties, Cromarty, Forth
  Southerly 6 or 7, occasionally gale 8 except Forth, becoming cyclonic 5 or 6 later. Moderate or rough. Showers, rain later. Good becoming moderate
  Tyne, Dogger
  Southwest backing south 5 to 7, perhaps gale 8 later. Moderate or rough. Showers, rain later. Good becoming moderate
  Fisher
  Southeast veering south 6 to gale 8. Rough or very rough. Rain or showers. Moderate or good
  German Bight, Humber, Thames, Dover
  South or southwest 5 or 6, increasing 7 or perhaps gale 8 later. Moderate or rough, occasionally very rough later. Showers, rain later. Moderate or good
  Wight, Portland, Plymouth
  Southwesterly 5 or 6 increasing 7 or gale 8. Moderate or rough, becoming very rough or high in Portland and Plymouth. Showers, rain for a time. Good, becoming moderate or poor





An **occluded front** is formed when the faster moving cold front overtakes and merges with the warm front. Typical weather is cloudy, with light rain and poor visibility

BUYS-BALLOTS LAW

Christoph Buys-Ballot was a 19th century Dutch meteorologist. His Law says that in the Northern Hemisphere, if you stand with your back to the wind, the area of low pressure is to your left and the high to the right.

This is useful because lows bring bad weather - cloud, rain and snow - and highs usually bring sun shine and clear skies.

It results from the Earth's rotation, which deflects to the right air moving from areas of high pressure to areas of low in the Northern Hemisphere, due to the Coriolis effect. In the Southern Hemisphere, the effect is reversed.

The Beaufort Scale of Wind Force

	Wind Speed	Description	Waves
1	1 - 3	Light airs	Ripples.
2	4 - 6	Light breeze	Small wavelets
3	7 - 10	Gentle breeze	Occasional crests.
4	11- 16	Moderate breeze	Frequent white horses
5	17- 21	Fresh breeze	Moderate waves, many white crests.
6	22 - 27	Strong breeze	Large waves, white foam crests.
7	28 - 33	Near gale	4m waves. Sea heaps up, spray, breaking waves, foam blows in streaks.
8	34 - 40	Gale	Moderately high waves (5.5m), breaking crests. Foam blown in streaks.
9	41 - 47	Severe gale	High waves (7m), spray affects visibility. Dense streaks of foam along the direction of wind; crests of waves begin to topple and roll over.
10	48 - 55	Storm	Very high waves (9m) long breaking crests
11	55 - 63	Violent Storm	11m waves Sea covered in foam. Visibility affected.
12	64 +	Hurricane	11m+ waves The air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected

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Shipping Forecast Terms

Gale Warnings - Timing
Imminent = within 6 hours of issue
Soon = within 6 - 12 hours
Later = after 12 hours

Wind
Veering - changing direction clockwise
Backing - changing direction anticlockwise
Cyclonic - rapid changes in direction
Direction - where the wind comes from

Pressure Tendency
Steady: < 0.1 mb in 3 hrs
Slowly: 0.1 to 1.5 mb in 3 hrs
Rising/Falling: 1.6 to 3.5 mb in 3 hrs
Quickly: 3.6 - 6.0 mb in 3 hrs
Very Rapidly: > 6.0 mb in 3 hrs = Gale

Pressure System - speed of movement
Slowly - up to 15 kn
Steadily - 15 - 25 kn
Rather quickly – 25 - 35 kn
Rapidly – 35 - 45 kn

Fair = No precipitation

Visibility
Very poor = < 1000 metres
Poor = < 2 Miles
Moderate = 2 - 5 Miles
Good = > 5 Miles

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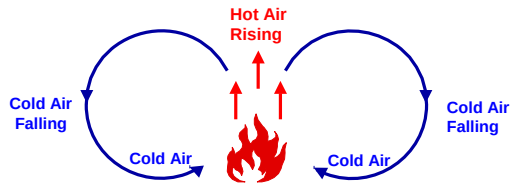
Fundamental Cause Of 'Weather'



Good overview here: http://www.metoffice.gov.uk/education/teachers/in-depth/understanding

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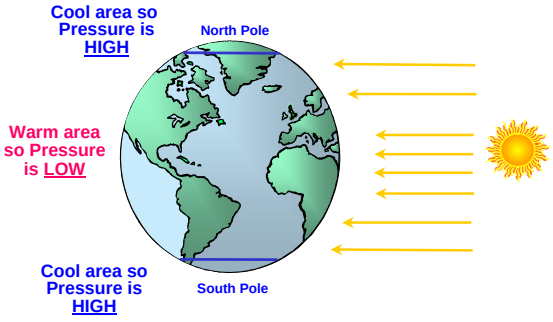
WORLD WIDE EFFECTS



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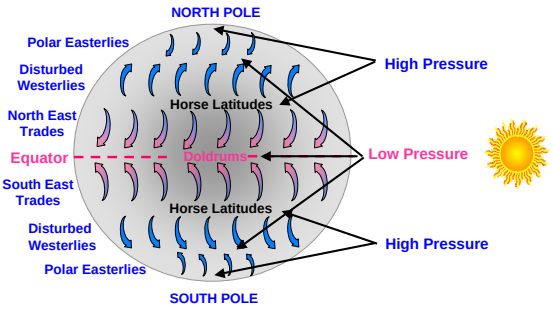
Wind Origins



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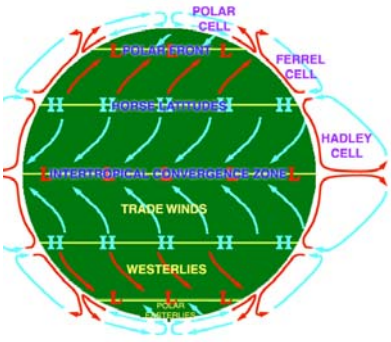
Global Convection systems



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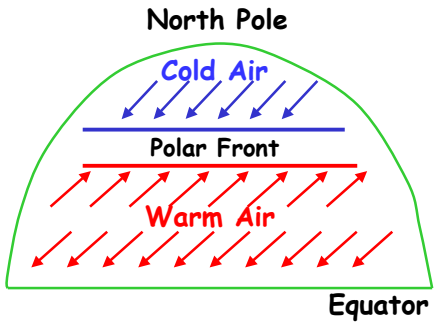
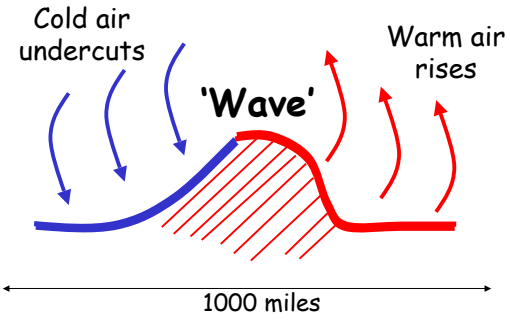
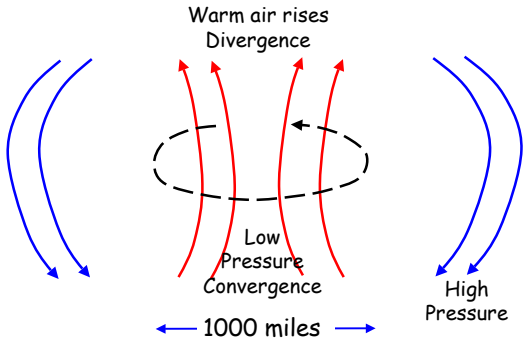
How a Depression Forms - 1



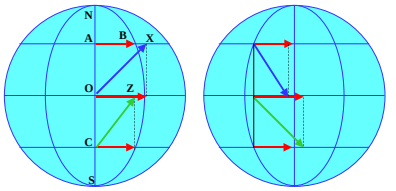
How a Depression Forms - 2

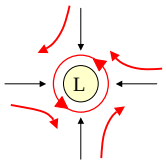


How a Depression Forms - 2



Coriolis Effect *(G-G Coriolis, French scientist, 1835)*





Wind attempts to blow towards the low pressure but is diverted to the right. (N Hemisphere)

The earth makes one rotation per day, but the linear speed of a stationary object on the surface at the Equator is approximately 900 knots, while closer to the poles the speed of an object on the surface approaches zero.

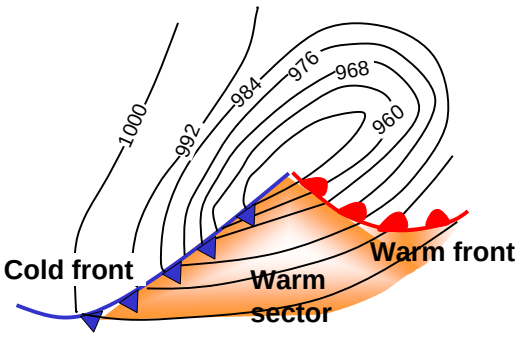
If an object is propelled northwards from the equator, it is still also travelling east at 900 knots. It arrives at point X before a stationary object starting at A travelling east at a slower speed. It thus appears to be diverted to the RIGHT compared to A-B. This why an air mass which starts as a south wind will become a south west wind, and depressions rotate anticlockwise.

In the southern hemisphere, the north bound object starting at C arrives at Z after a stationary object starting at O. It thus appears to be diverted to the LEFT. Thus depressions in the S hemisphere rotate clockwise.

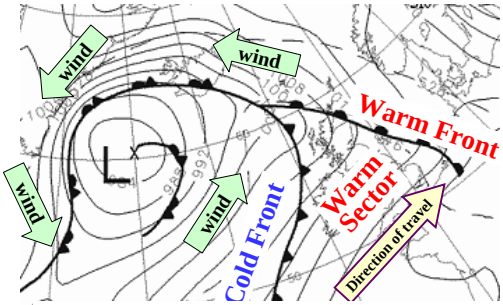
The right hand diagram shows a similar effect for objects travelling south.

Coriolis affects wind and tides; a north bound current will be deflected to the right in the N hemisphere.

Bird's eye view of a Depression



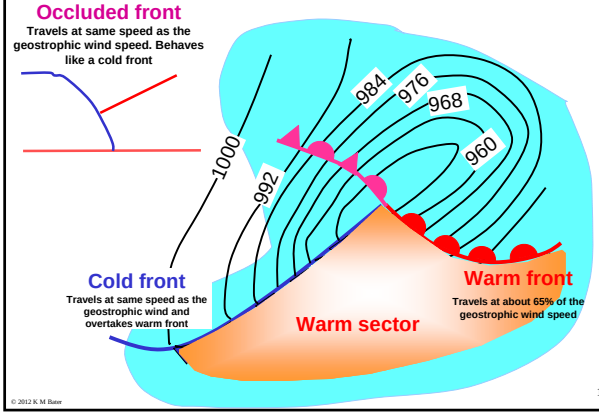
An Atlantic Depression



Direction of travel of the depression is roughly parallel to isobars in the warm sector
The wind direction is roughly parallel to the isobars around the depression, but skewed inwards due to friction of the sea or land surface on the wind.

Occluded Front

Occluded front
Travels at same speed as the geostrophic wind speed. Behaves like a cold front



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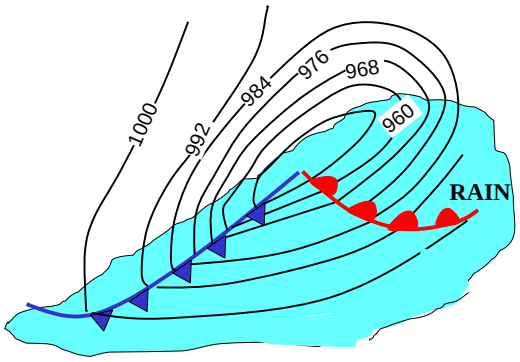
Bird's eye view of a Depression



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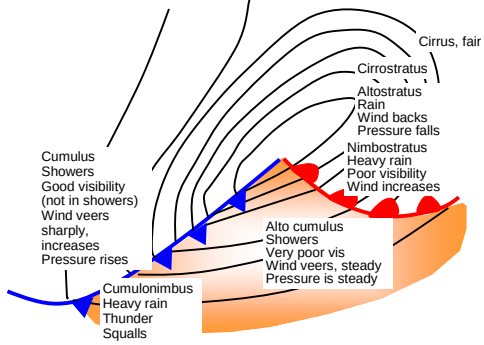
Bird's eye view of a Depression



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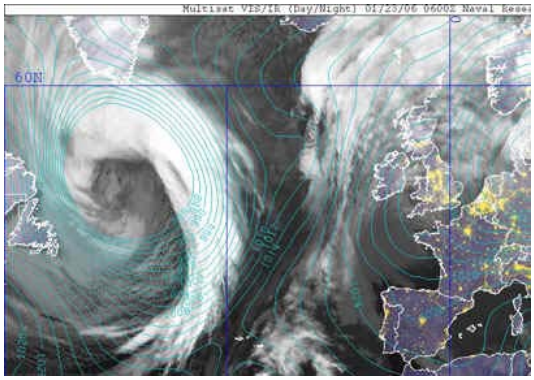
Satellite Photograph



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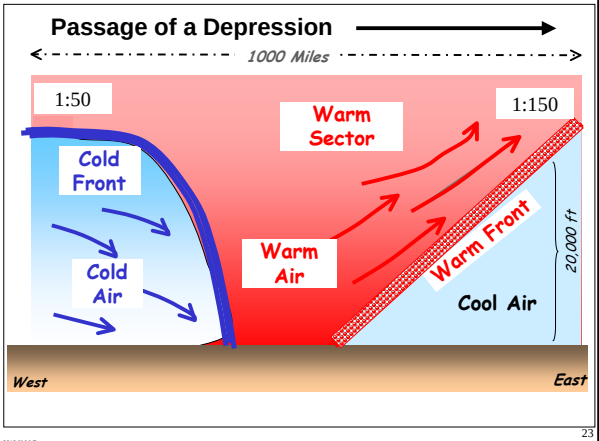
Passage of a Depression



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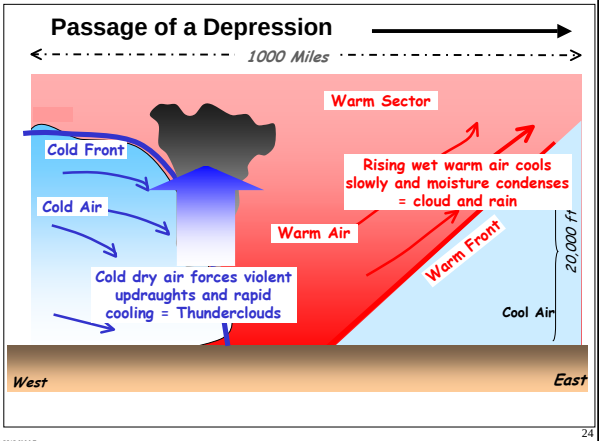
Passage of a Depression



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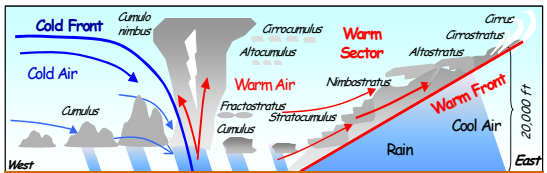
PASSAGE OF A DEPRESSION



WIND	Strong gusts	Veering sharply Squalls	Steady	Veering	Backing & increasing	WIND
PRESSURE	Rising, then steady	Rising quickly	Steady	Steady	Falling	PRESSURE
RAIN	Sunny, squally showers	Heavy rain, thunder, hail	Light rain	Drizzle	Becoming heavier and prolonged	RAIN
VISIBILITY	Good except in showers	Poor in rain	Poor, Fog	Poor	Deteriorating	VISIBILITY
TEMP	Cold	Falls	Warm	Warm	Rising	TEMP

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Clouds and Rain

- Air temperature decreases with height - at about 0.5°C per 100 meters.
- This known as the Adiabatic 'Lapse Rate'.
- An **Adiabatic Process** is any process occurring without gain or loss of heat within a system
- When air near sea level becomes warmer than the air above it, it tends to rise. As a 'bubble' of air rises, it moves into reducing pressure, so it expands.
- As it expands, it gets cooler, at a rate of about 1 °C per 100 metres, until it reaches a level where it is the same temperature as the ambient air around it.
- If the temperature of the surrounding air is reducing more quickly than the bubble temperature, the bubble of air will continue to rise: this produces conditions described as '**unstable**' - Cumulus cloud
- If the temperature of the surrounding air is reducing more slowly than usual, the bubble of air will not be able to rise as far or as quickly: this produces '**stable**' conditions - Stratus cloud.

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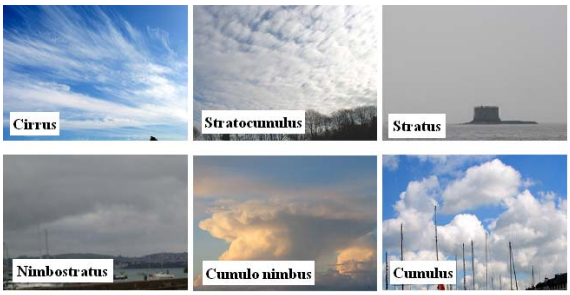
Clouds



Cirrus	Curl
Stratus	Layer
Cumulus	Heaped
Alto	High (and medium level)
Nimbus	Rain bearing

http://www.metoffice.gov.uk/education/teachers/in-depth/understanding

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Clouds

Low-level clouds (base 0 - 2 km high)

Stratus (S) - extensive, featureless, shallow cloud sheet, can yield drizzle or light rain

Stratocumulus (Sc) - shallow cloud sheet, broken into roughly recurring masses of cumulus. Only light / moderate winds

Cumulus (Cu) - separate, hill-shaped puffy clouds, with level bases. Usually fair, but may bring showers after a cold front.

Cumulonimbus (Cb) - very large, high (up to10km) cumulus, with dark bases and anvil shaped top. Can bring thunder, lightning, squalls and heavy rain

Medium-level clouds (base 2 - 4 km high)

Altocumulus (Ac) - shallow cloud sheet with roughly regular patches or ripples of small rounded clouds. Usually fair weather

Altostratus (As) - featureless, thin, translucent cloud sheet. Usually fair weather.

Nimbus (Ns) - extensive, very dark cloud sheet, usually yielding precipitation

High clouds (base 5 -15 km high)

Cirrus (Ci) - streaky, white, feather-like cloud. Indicates an approaching depression

Cirrocumulus (Cc) - shallow, more or less regular patches or ripples of cloud. Fair weather.

Cirrostratus (Cs) - shallow sheet of largely translucent cloud. Fair weather.

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Types of Cloud

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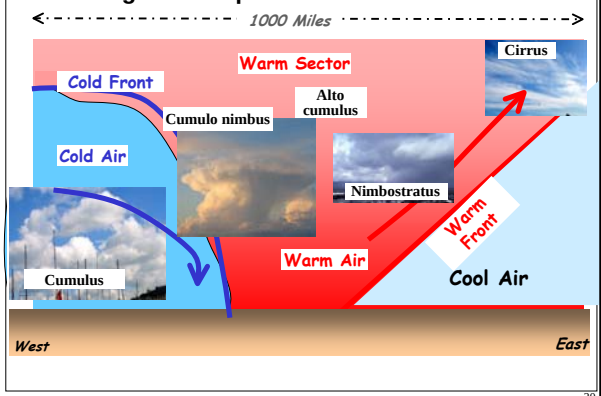
Passage of a Depression



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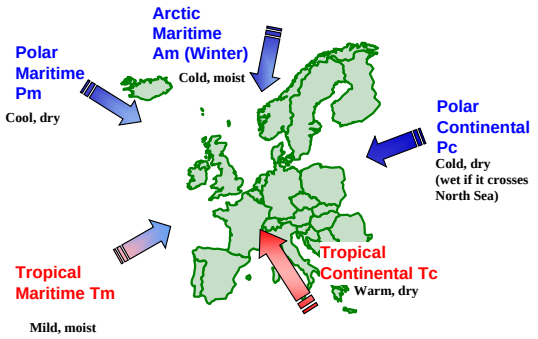
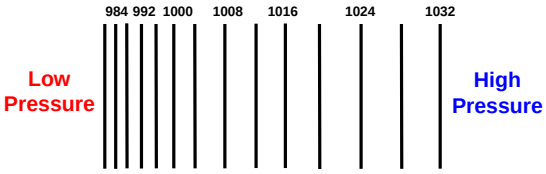
Wind – Air Mass Effects on UK Weather



ISOBARS



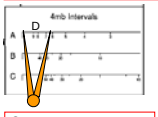
ISOBARS CLOSE TOGETHER
Steep pressure gradient
Strong winds, rain

ISOBARS FAR APART
Gentle pressure gradient
Light winds, little cloud

Estimating wind speed

Geostrophic wind is the undisturbed wind at 1000 metres altitude

Geostrophic scales at 2 and 4mb intervals
Scale A = Beaufort force
Scale B = Warm front speed
Scale C = Cold front and Occlusion speed



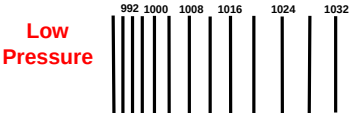
Or:
Wind speed =
1176 / (D x Sin Latitude)

1. Measure the distance D across the isobars, then apply the dividers to Scale A for wind force (reading from the left of the scale).

Similarly if you measure the isobars along a front you can find the speed of the front.

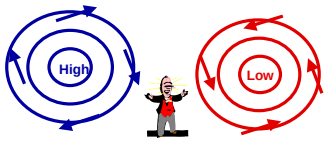
On most synoptic charts, the wind scale is a curve for various latitudes because the wind speed varies with latitude.

Buys Ballot's Law



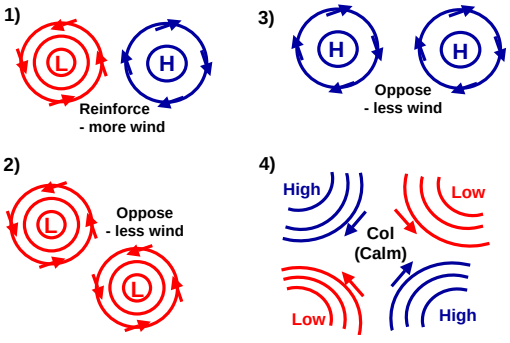
Buys Ballot's Law

In the Northern Hemisphere, if you stand with your back to the wind, the LOW PRESSURE area is to your left

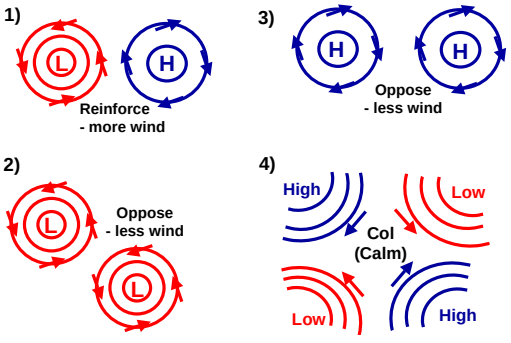


In the Southern Hemisphere, this is reversed

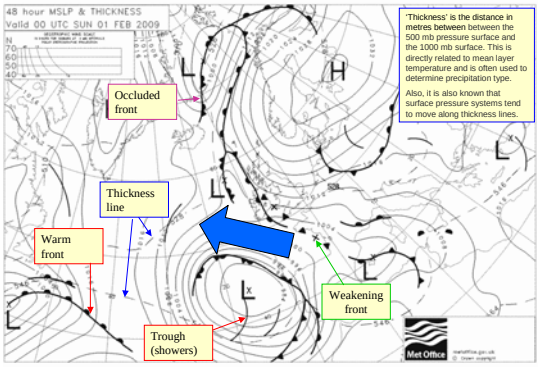
Effect Of Multiple Systems



Effect Of Multiple Systems



Effect Of Multiple Systems

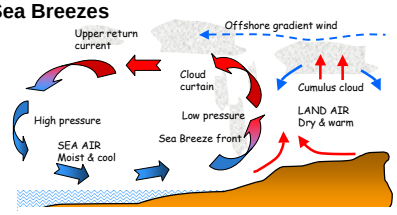


www.metoffice.gov.uk/weather/uk/guide/key.html

What affects Wave Height?

1. **Wind speed and duration**
2. **Tide speed and direction**
   wind against tide causes higher waves
3. **Depth of water - waves break in shallows**
4. **Fetch - the distance over which the wind blows**
5. **Swell - the wave pattern before the current weather**

Sea Breezes



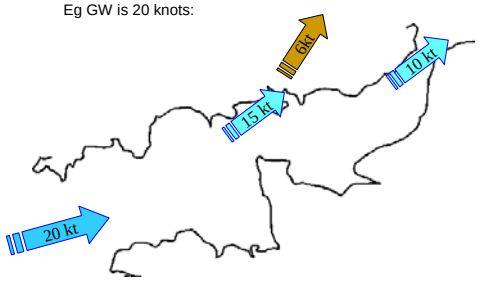
Sea breezes are caused by unequal heating and cooling of adjacent land and sea surfaces. A sea breeze blows from the sea to the land as a result of this unequal heating. During the day, especially in summer, solar radiation causes the land surface to become warmer than the sea surface. The difference between land and sea surface temperatures rises during the day to a maximum around mid-afternoon.

The warmed air rises over the land surface and cool air from the sea is drawn in over the land. The ascending air returns towards the sea. As the sun's heating effect increases, the sea breeze gains in strength, and may reach 15 knots (Force 4). A sea breeze in early summer may extend 10 M inland during the afternoon, and under favourable circumstances the sea breeze may penetrate as much as 30M inland. The sea breeze has maritime characteristics such lower temperature and higher humidity.

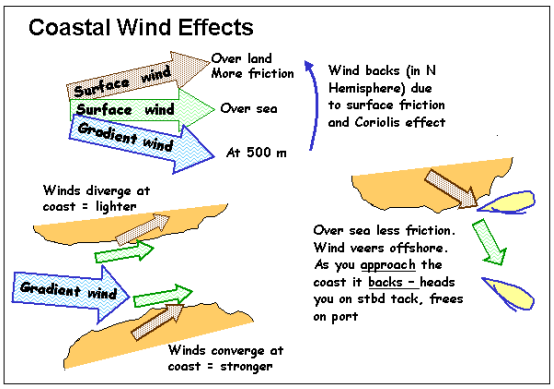
A land breeze develops at night as the land cools relative to the sea and an opposite circulation is set up. The temperature difference is much less than during the day and the breeze strength is much less.

Adjusting wind speed

Find the Geostrophic Wind GW = straight line, no friction
Over land, speed is 33% of GW
Over sea, with enough fetch, speed is 66% of GW
Eg GW is 20 knots:



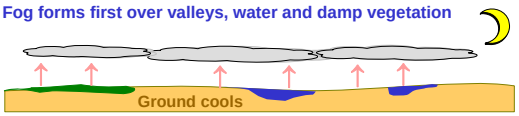
Coastal Wind Effects



Fog

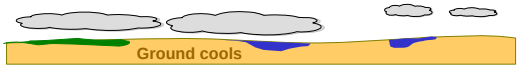
Land (Radiation) Fog — **Clear nights with little wind**

Damp warm air radiates off as the ground cools at night
Condensation takes place
Fog forms first over valleys, water and damp vegetation



Thickest around dawn when air temperature is at its lowest

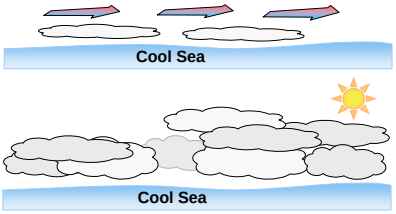
Heat from sun usually disperses this type of fog



FOG

Sea (Advection) Fog

Tropical Maritime - warm moist wind blowing over cold sea
Air cools and water vapour condenses to form fog

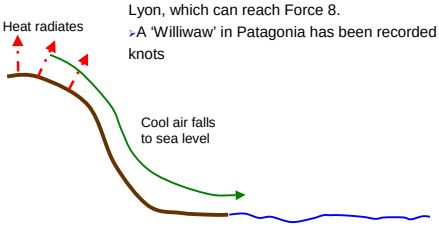


Force 5/6 winds will lift the fog to form low stratus cloud

Sun tends to thicken the fog by warming the air further so it holds more moisture

Katabatic Winds

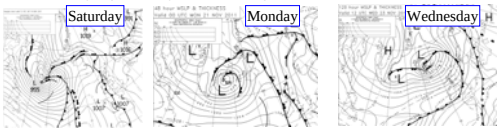
- A katabatic wind (Greek 'katabatikos', going downhill) is caused by air cooling by radiation on top of a hill, mountain or glacier.
- Cool air is dense, so flows downhill under gravity, and warms as it descends.
- A typical example is the Mistral off the Alps to the Gulf of Lyon, which can reach Force 8.
- A 'Williwaw' in Patagonia has been recorded at 200 knots



Weather Forecasts 1

A possible approach:

1. Use the synoptic 6 day charts for a general overview

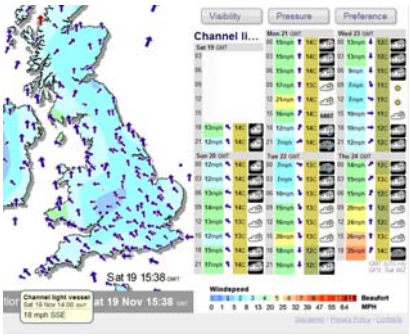


http://www.weathercharts.org/ukmomslp.htm

2. Use www.GRIB.us for a 'raw' view of the forecast winds – 3 days ahead, 3 hour steps

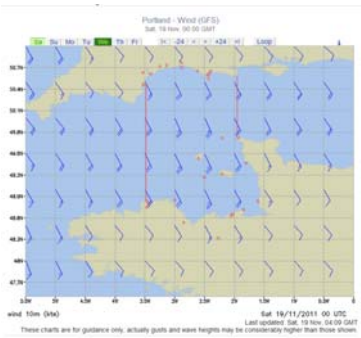
Weather Forecasts 2

3. Use your preferred display for more pictorial views: www.xcweather.co.uk/



Weather Forecasts 3

3. Use your preferred display for more pictorial views: www.weatheronline.co.uk



Weather Forecasts 4

Caution:

Many sites use the GFS model - Global Forecasting System. They display the same forecast in different formats. Other good models are NAE (Met Office North Atlantic Europe) and ECWMF (European Centre for Medium Range Forecasting).

Other good sites:

Windguru

Weatherweb (Simon Keeling). He will also send regular video updates and good information including a weekend forecast

Météo France (own model)

Weatheronline.co.uk

Etc etc

Weather Forecasts 5

www.globalmarinenet.com/grib.htm

www.mailasail.com/Main/Weather

There is a free FTP service from www.grib.us and web browser services from www.passageweather.com/ and www.windfinder.com , these give wind arrows on a regular grid. Again, using a browser, there are wind arrows at specific locations derived by simple interpolation from www.xcweather.co.uk

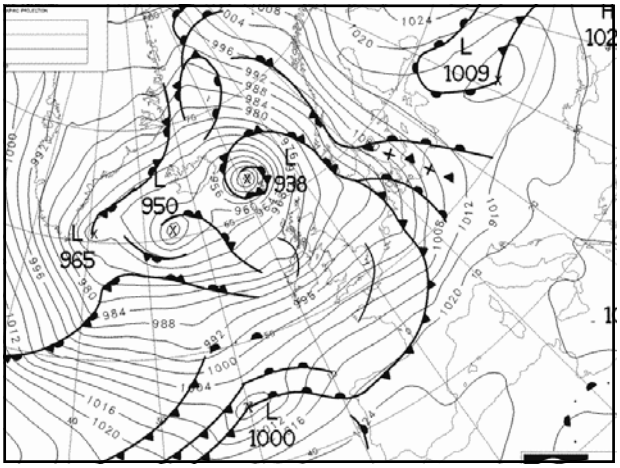
www.buoyweather.com pay site
www.windguru.com/int

There is an FTP service, on prepayment www.movingweather.com , which gives wind arrows on a chart, "zooming in" by simple interpolation from the GFS.

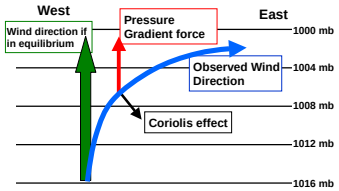
Weather Forecasts 5

Frank Singleton: My experience, as a user, is that a 24 hour synoptic chart or GRIB forecast will be pretty good, but never be precisely correct in all detail.

- A 48 hour forecast will have more errors.
- At 5 days, there will be appreciable skill but significant errors in places.
- By 7 days, skill will be too small for our use.
- By 15 days there will be no skill whatsoever.
- Consider the lifetime of small weather features:
  - A gust lasts seconds
  - a small cumulus cloud lasts about 30 minutes
  - a thunderstorm has a life span of about 6 hours
  - a group of storms perhaps 36 to 48 hours
  - a frontal depression can have a life span of a few days. These facts determine how long ahead it is worthwhile using a meso-scale forecast. Anything up to 36 hours is my suggestion and no more.



Geostrophic Wind

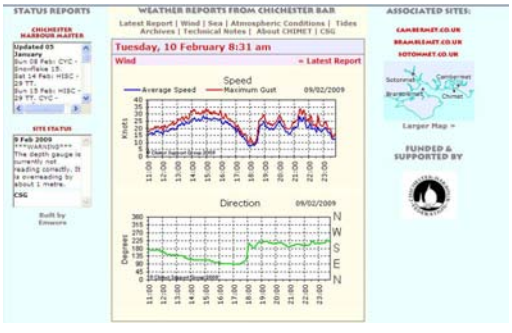


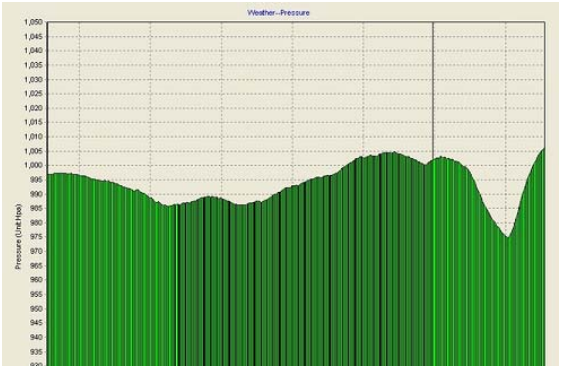
Geostrophic Wind

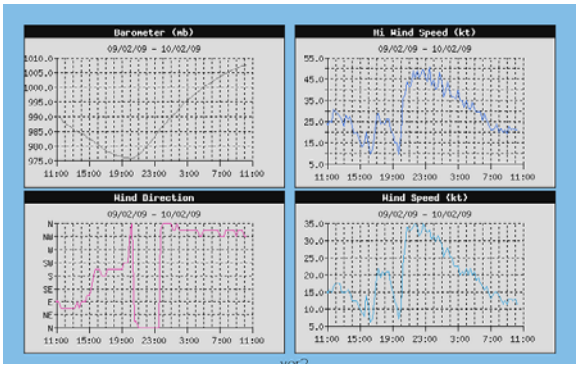
Air under the influence of both the Pressure Gradient Force and Coriolis force tends to move parallel to isobars in conditions where friction is low (1000 meters above the surface of the Earth) and isobars are straight. Winds of this type are usually called geostrophic winds. Geostrophic winds arise because Pressure Gradient Force and Coriolis force come into balance after the air begins to move

A geostrophic wind flows parallel to the isobars. In this model of wind flow in the Northern Hemisphere, wind begins as a flow of air perpendicular to the isobars (measured in millibars) under the primary influence of the pressure gradient force. As the movement begins, the Coriolis force influences the moving air causing it to deflect to the right of its path. This deflection continues until the pressure gradient force and Coriolis force are opposite and in balance with each other.

The other force acting on the wind is FRICTION. Over the sea, friction slows light winds to about 70% of the geostrophic value. Over land, it slows to 30%. The resultant wind is backed by the friction.







Subtle stuff – Wind during Day and Night

Why do wind speeds often decrease in the evening?

The wind at ground level is primarily affected by the wind higher up (geostrophic wind). It is also slowed by friction with the ground. During the day, the vertical mixing caused by the sun and convection transfers the wind at altitude to ground level, and increases it. In the evening, convection decreases and the ground wind slows down.

Subtle stuff – Easterlies on S edge of a High

Why are wind speeds increased on the southern edge of high pressure systems?

It is all to do with the balancing out of the Coriolis force (CF1), centrifugal force (CF2) and the Pressure Gradient force (PGF).

In the northern hemisphere the Coriolis force acts to balance out the combined effect of centrifugal force and pressure gradient force (i.e. CF1=CF2+PGF).

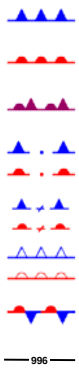
However the centrifugal force will help a parcel of air accelerate into areas of low pressure and, because the forces still need to balance, this speeds up until the Coriolis force strengthens and the flow remains in balance once again.

The effect of this is to make the anticyclonic flow on the southern side of an area of high pressure (which has a weaker Coriolis until it is forced to speed up) to be stronger than the equivalent cyclonic flow.

Is this the reason why easterlies don't drop in the evening or is there yet another reason?

Yes, as the wind inherently has more geostrophic in it, the surface layer reduction in turbulence as evening arrives is not eased as quickly and hence the wind speeds to not drop as quickly.

Simon Keeling www.weatherweb.com



Cold front
The leading edge of an advancing colder air mass. Its passage is usually marked by cloud and precipitation, followed by a drop in temperature and/or humidity.

Warm front
The leading edge of an advancing warmer air mass, the passage of which commonly brings cloud and precipitation followed by increasing temperature and/or humidity.

Occluded front (or 'occlusion')
Occlusions form when the cold front of a depression catches up with the warm front, lifting the warm air between the fronts into a narrow wedge above the surface. Occluded fronts bring cloud and precipitation

Developing cold / warm front Represents a front that is forming due to increase in temperature gradient at the surface

Weakening cold / warm front Represents a front that is losing its identity, usually due to rising pressure. Cloud and precipitation becomes fragmented.

Upper cold / warm front
Upper fronts represent the boundaries between air masses at levels above the surface. For instance, the passage of an upper warm front may bring warmer air at an altitude of 10,000 ft, without bringing a change of air mass at the surface.

Quasi-stationary front
A stationary or slow-moving boundary between two air masses. Cloud and precipitation are usually associated

Isobars
996
Contours of equal mean sea-level pressure (MSLP), measured in hectopascals (hPa). MSLP maxima (anticyclones) and minima (depressions) are marked by the letters H (High) and L (Low) on weather charts.

Thickness lines
Pressure decreases with altitude, and thickness measures the difference in height between two standard pressure levels in the atmosphere. It is proportional to the mean temperature of this layer of air, so is a useful way of describing the temperature of an airmass.
Weather charts commonly show contour lines of 1,000-500 hPa thickness, which represent the depth (in decametres, where 1 dam = 10 m) of the layer between the 1,000 hPa and 500 hPa pressure levels. Cold, polar air has low thickness, and values of 528 dam or less frequently bring snow to the UK. Conversely, warm, tropical air has high thickness, and values in excess of 564 dam across the UK often indicate a heatwave.

Trough
An elongated area of relatively low surface pressure. The troughs marked on weather charts may also represent an area of low thickness (thickness trough), or a perturbation in the upper troposphere (upper trough). All are associated with increasing cloud and risk of precipitation.

Convergence line
A slow-moving trough, which is parallel to the isobars and tends to be persistent over many hours or days. They are quite common in cold northerly outbreaks down the Irish Sea, affecting west Wales, Devon and Cornwall in particular, but can be found in other areas also. This convergence line can gives hours of persistent precipitation over very localised areas, whilst a few miles down the road it is relatively dry, leading to some heavy snowfall/rainfall. In summer the convergence lines are not as easy to forecast, but then can still occur due to sea-breeze convergence, and are over the land, whilst in winter they are over the sea.