OCEAN RACING CLUB OF VICTORIA

WEATHER FOR SAILORS

MODULE 2 - COASTAL SAILING (KNOWLEDGE)

ORCV OCEAN TRAINING

Weather for Sailors Module 2 – Coastal Sailing

Definitions

Anabatic winds: Upflow winds flowing on rising lands.

Baroclinic instability: in meteorology an imbalance in the levels of pressure and density in a fluid that is one of the mechanisms determining the behaviour of the earth's atmosphere. Eg the instability that causes these particular disturbances is called a baroclinic instability which occurs when the latitudinal temperature differences become too large.

Relating to a state of a fluid (atmosphere) in which surfaces of constant pressure intersect those of constant density

Barotropic: having surfaces of constant pressure which co-incide and do not intersect with those of constant density (jet sstreams?)

Extratropic: Mid latitude poleward of the tropics

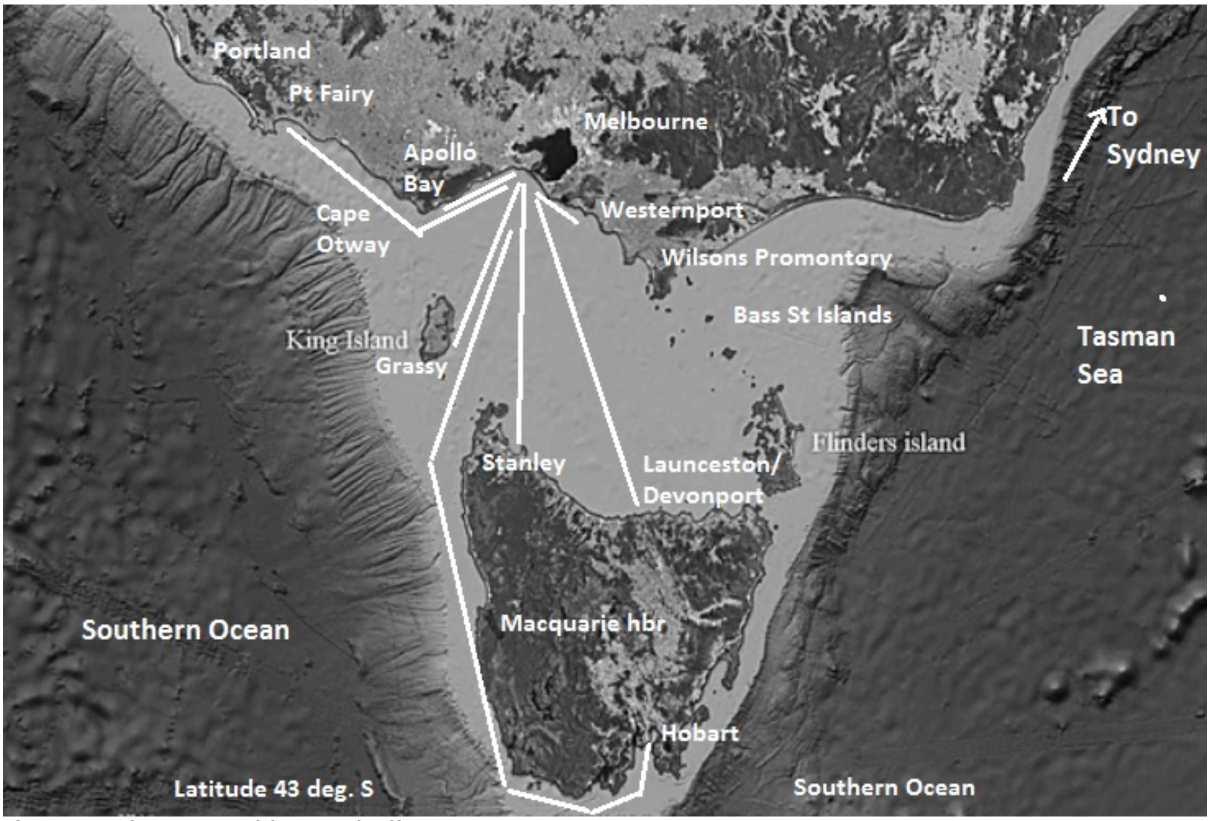
Rossby waves

Tidal Gate: An area of relatively strong tides such that a boat passing through with a favourable tide obtains a distinct advantage over a boat which traverses after the tide has turned and thereby encounters an unfavourable tide. For example between King Island and NW Tasmania, Banks St NE Tasmania, when rounding Cape Otway or Wilsons Promontory.

Tropics Latitudes between the tropics of cancer and Capricorn

Offshore Voyages of 3-4 days

The ORCV conducts offshore events along the Victorian coast and in the Bass Strait area including to the Island state of Tasmania's northern coast and the state capital of Hobart. These areas are popular cruising grounds and contain unspoiled natural features unavailable to non-sailors. Melbourne Apollo Bay, Melbourne Port Fairy and Melbourne Portland are entirely coastal, Melbourne Launceston/Devonport, Melbourne King Island, Melbourne Stanley are across open water and Melbourne Hobart as open water plus coastal including the exposed western coast and Southern Ocean. Worth remembering is that all offshore races aim to finish in a safe harbor. What constitutes a safe harbor? You might ask.



Answer: An area with no wind!

As with most Australian boating conditions one still requires good weather knowledge and understanding of the excellent forecasting information available. Perhaps the best onboard investment to be made in this era of communication is internet capability although more facility for mobile phones is progressing with attendant data use. Sat phones are nowadays available for monthly hire at reasonable rates and several data options available. Part of this course module will be discussing such systems.

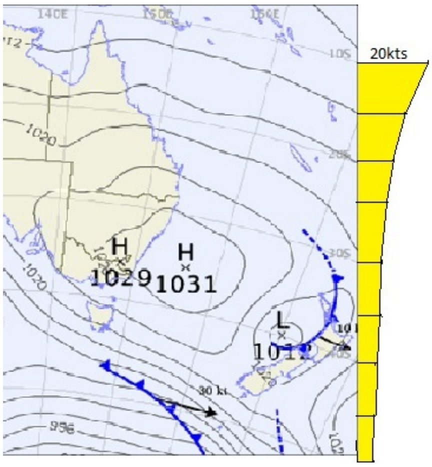
There are many delightful cruising locations within easy reach from Melbourne or the regional populations near marinas within several coastal towns. Most offshore races and cruising is conducted from mid spring to later autumn with the longest race being Melbourne-Hobart during the Xmas break. Several yachts journey to Sydney for the Sydney to Hobart race and to the Queensland coastal events during the Victorian winter. These winter migrations north are usually accomplished in about three day steps stopping at the several secure refuges along the way up the Australian East coast, and weather-wise traverse the horse latitudes (where the winter Sub Tropical Ridge band of highs are) before reaching the South Eastern tradewind regions where regattas are organised. The Melbourne to Hobart race takes some 3-4 days and the northern Tasmania coast generally one and a half to two days. From all these destinations excellent cruising grounds in natural mostly unspoilt areas await the return voyage whereas much of the cruising expeditions are undertaken during late February to April. Wilsons Promontory and Refuge Cove, Deal Island , Flinders Island, Northern Tasmania ports to King Island thence Apollo Bay constitute the Bass Strait triangle. There are always challenges occurring with boating and experience best gained carefully.

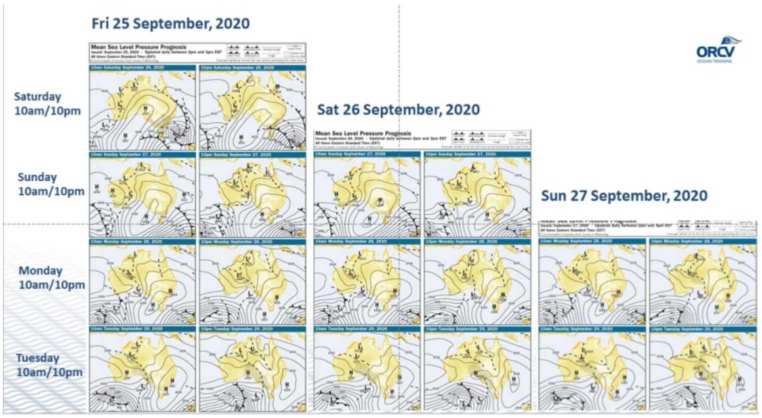
The East Australian Current flows Southwards along the coast and can reach up to 3-4 knots in some places. The current speed is very much influenced by large eddies comprised within the general flow. The Bureau of Meteorology has excellent mapping of the current and eddies which will also be visited in this course. Strong Southerly winds against the current can make uncomfortable conditions with dangerous seas and to avoid the adverse current usually requires remaining close to the land when voyaging Northwards. The trade winds can be light or fresh according to a number of factors such as the El Nino-La Nina circulations and visiting mariners often cruise in the Whitsunday Islands until the lessening of the season about October/November before returning Southwards riding the favourable current.

Especially for longer distance sailing with watch-keeping, a semi state of fatigue can easily arise similar to jet-lag. Mal de Mer or the precursor can be especially limiting. It is therefore ideal to pre-plan as much as possible and in such a way that can be easily accessed and

understood. Even when extra information can be acquired, there is a balance with the time demanded to obtain it and with ensuring the boat is performing well. Forecasts now are very reliable for the next 3 days, a little less so in spring but even then changes are not great. Along the coast there are internet available areas which allow update on board. The following is an example of one way to prepare by copying internet diagrams and pasting as a series for ready reference when onboard facilities are not available.

Copy/paste the 4-day weather map (this example looks interesting). West Australian state wind map has been selected and is copy/pasted at 12 hr intervals, in this example for three





days. The wind diagrams come in 3 hr intervals using this chart but for a demonstration 12 hrs is okay. If the maps are made fairly small, it is an easy matter to make a notation or handwritten accompaniment. It is nearly always possible to find a place onshore who will provide a similar facility. If you have a laptop there is always MacDonalds? The 4 day maps are very reliable for 3 days which is enough to reach the next port.

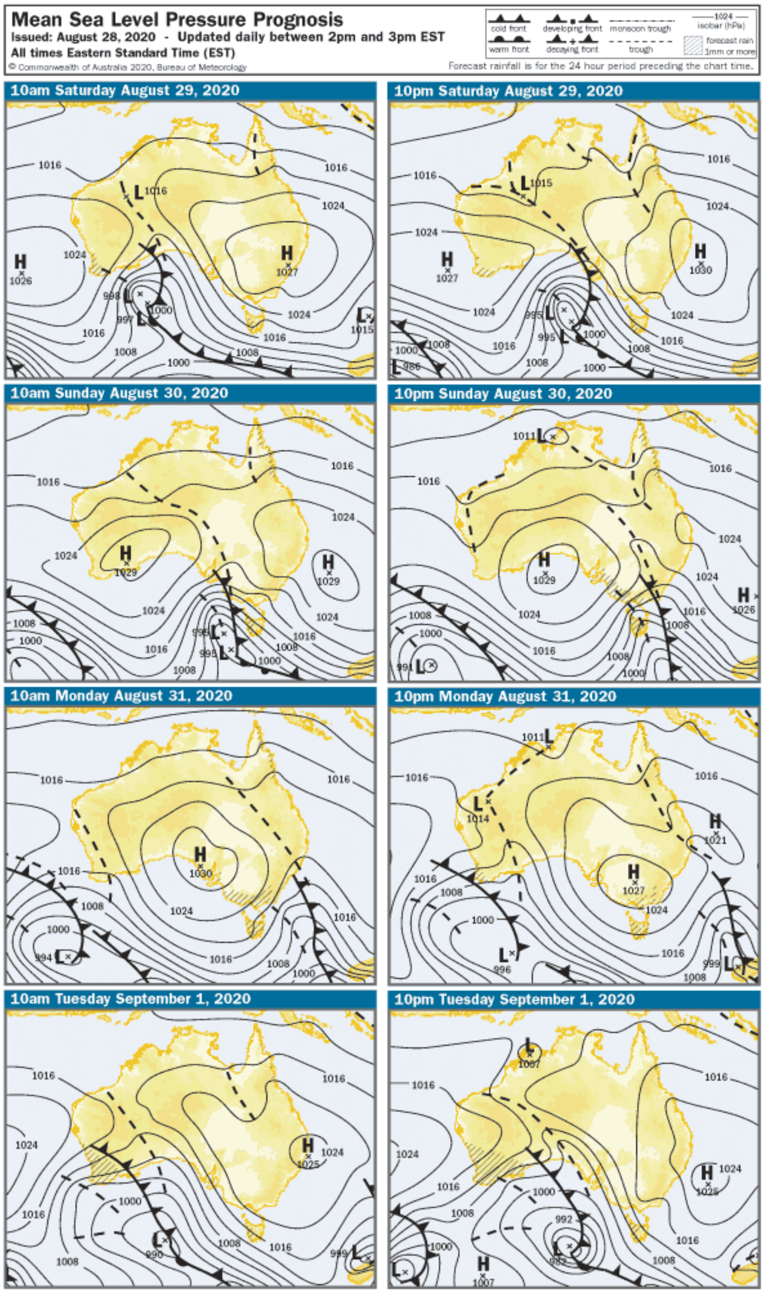
In conjunction with the increased number of VHF repeater stations now installed on most coasts, reliable radio bulletins are frequently also available. That is one way to operate on the basic or in emergency. An easy way to check forecast reliability is to down load 4 day maps each day before planning a voyage start.

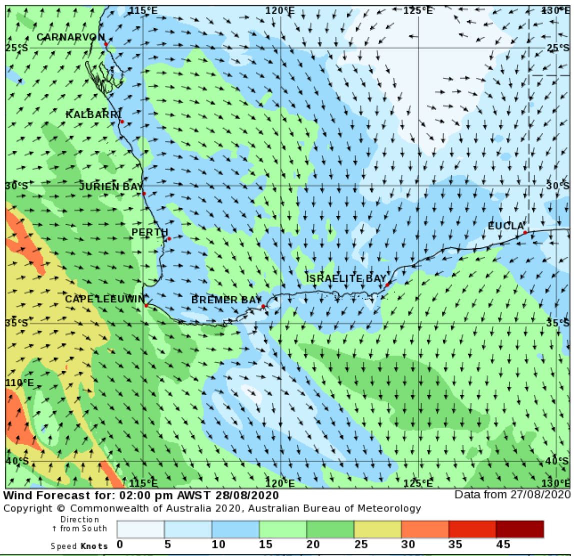
Compare the day two map from 3 days previous to the day one on the 4 days previous map?. Are they the same? Then the day 3 map from 4 days before to the day 1 before. Same? If there is not much difference then the atmosphere is stable and forecasts reliable. If there are differences then the degree of difference is a measure of reliability. Atmosphere chaotic?

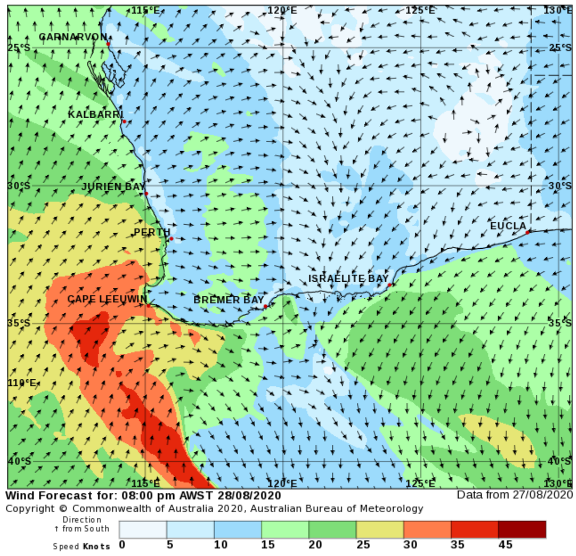
In addition, checking radio forecasts on a daily basis is advised as there can be extraordinary events which will be outlined further in this course. On board forecasting and keeping an easy to read, well set out log is best also practiced. Simply put, in lieu of technology, the most important instrument is the Mk1 eyeball. Changes of any kind? Sky?, Sea? Next would be the barometer, amount of change in a rolling three hour period. Record it hourly! In the Bass Strait region of 38-40° S, 148° E, a 3 hr change of 3 mb indicates a 30 kt change whether the barometer has moved up or down.

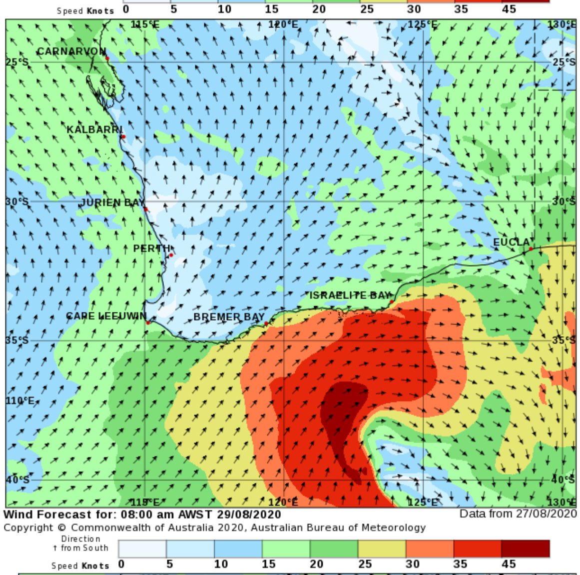
In lower latitudes the pressure changes in 3 hr for a similar wind change become progressively smaller and the further south, the larger in accordance to the weather map scaled isobar spacing diagram. Repeating earlier description in module one- for a particular latitude, the horizontal width on the 20 kt scale corresponds to the perpendicular distance between isobars adjacent to that horizontal 20 kt width. If the isobar spacing is, say, one half that of the 20 kt scale then the wind will be twice the 20 kts and if double the spacing then half the 20 kts. For a guide other proportioning is applicable. Again, the scale is only applicable to the latitude adjacent and note also the latitude parallels on the weather chart are curved.

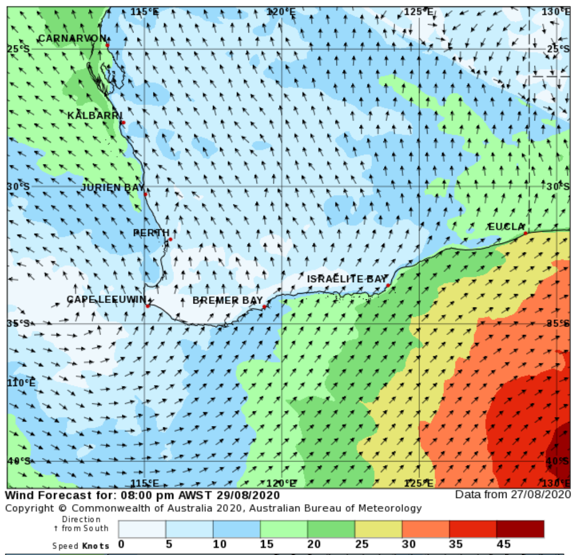
We will be studying three different weather providers in this course. BOM Australia, Windy.com and Predict Wind. BOM uses it's ACCESS & METEYE models, Windy uses ECMF & GFS, Predict Wind uses ECMF & GFS plus its proprietary modified versions.

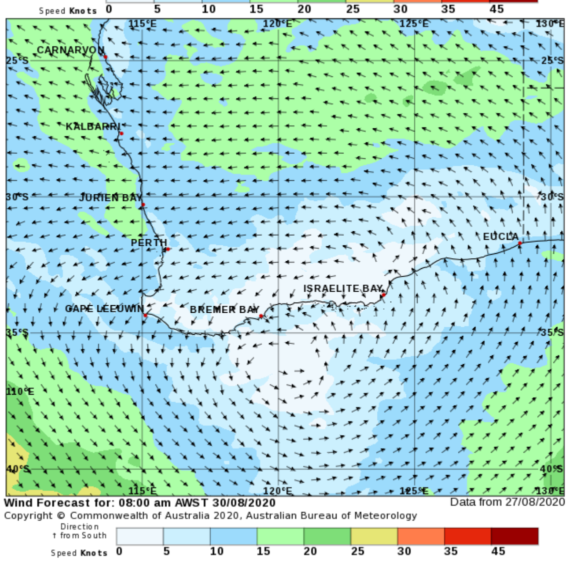


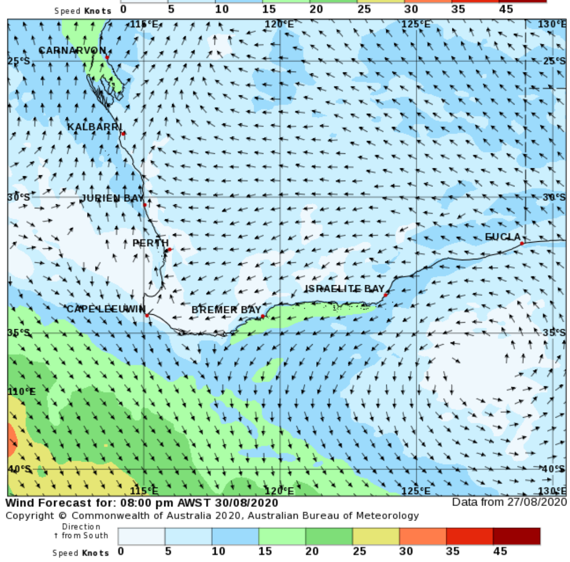






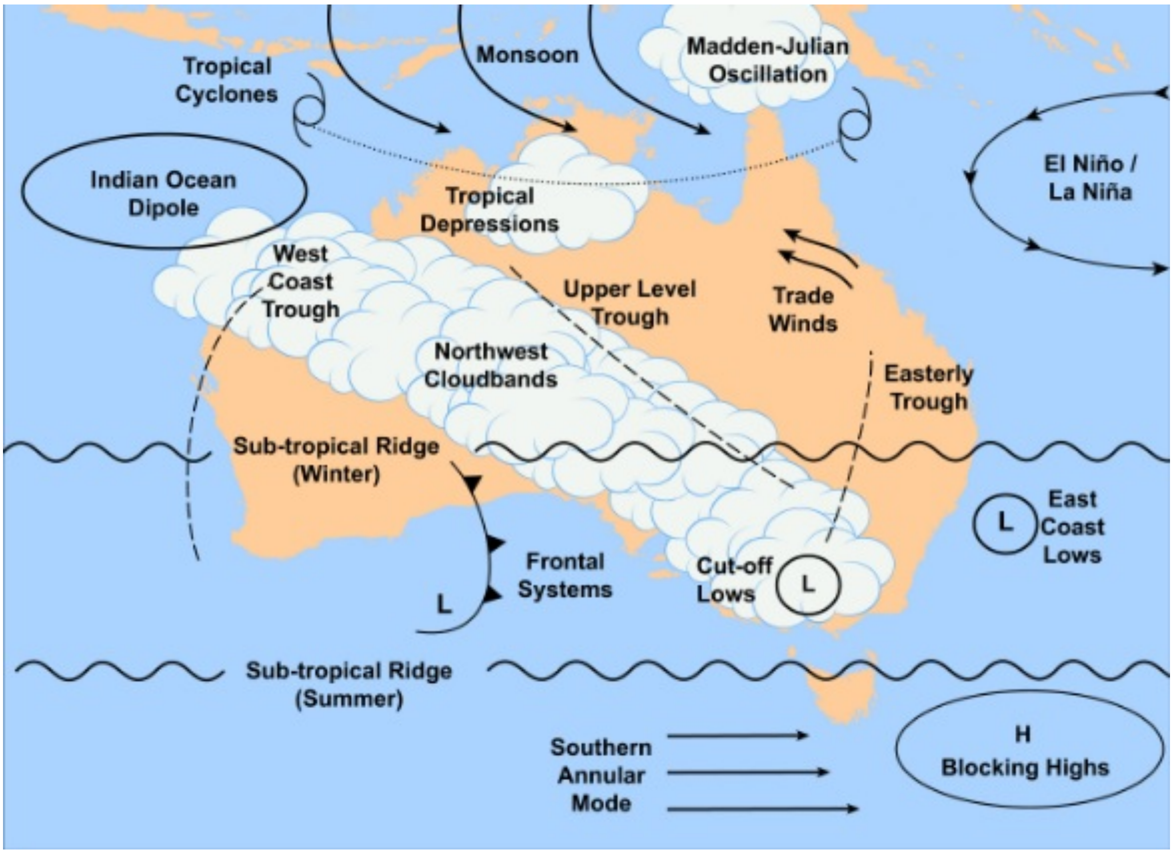




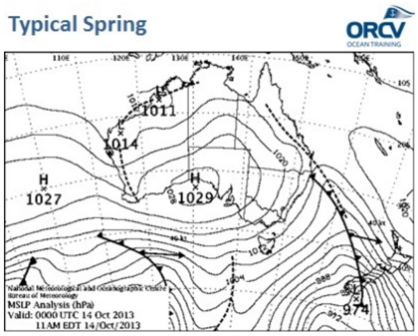


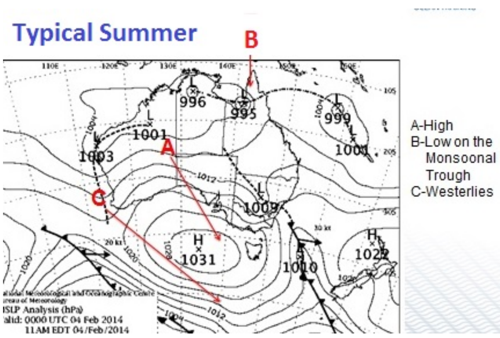
Much of the BOM pages were presented in Module 1-Enclosed waters. The additional material helpful for coastal voyages will be examined and also pages not immediately necessary.

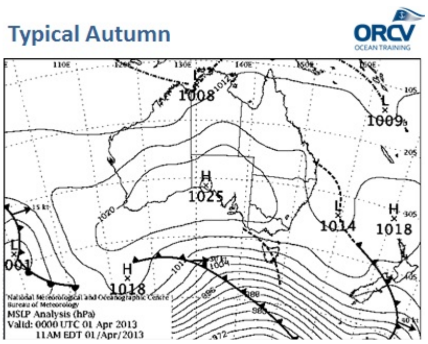
The aspects of weather around Australia are conveniently summarised in a BOM diagram following and during the course we will examine the areas outlined for boating application.

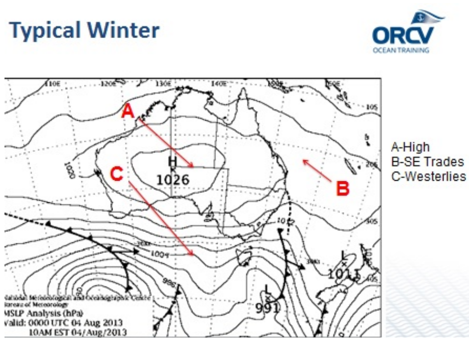


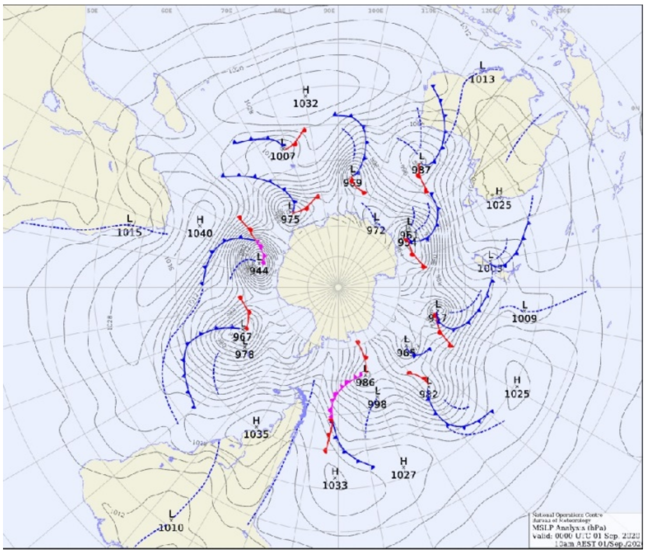
Our main boating activity area lies between the Sub-tropical Ridge (Winter) and the Sub-Tropical Ridge (Summer). The sub-tropical ridge represents the band of highs which move with the seasons as in the following typical weather maps. Of course, weather is rarely typical











Looking at a Southern Hemisphere MSLP Analysis map from BOM Weather Maps/Southern Hemisphere, the band of highs or Sub-tropical ridge can clearly be seen within the latitude rings encircling the South Pole. The entire weather systems circle around clockwise (SH) from west to east. Very often cold fronts extend in between the separate highs arising from lows embedded in the westerlies region. Also evident on the polar map are lows, some very close to the polar Antarctic circle with fronts heralding a blast of arctic air should they reach into Victoria's winter longitudes. On the southern edge of the highs the winds expelled from the systems blow West to East contributing to the Westerlies and in our mainly maritime climate is subject to the SAM. The Southern Annular Mode.

SAM is a climate driving effect concerning the latitudinal position of the westerly wind belt commonly known as the 'Roaring Forties' and 'Furious Fifties'. In a negative SAM event, other climate drivers have an influence on the SAM in some seasons. The Pacific Ocean Walker Circulation ENSO event of La Nina tends to favour a positive SAM during the spring to summer. El Nino favours a negative SAM in the spring to summer months.

A negative SAM means the westerlies are closer to Australia and in a positive SAM they move further than usual towards Antarctica.

SAM in autumn and spring (from BOM)

Climatologically, winter sees the belt of westerly winds at its northernmost position, while summer sees the belt at its southernmost position. In the other two seasons, autumn and spring, the belt of westerly winds is located somewhere in between summer and winter. In autumn, Australia's climate typically sees very little effect from SAM, while in spring, the effect on rainfall resembles a weak summer pattern.

Autumn and spring also tend to be the times of the year when SAM has greatest influence on extreme heat. In autumn and winter, northern and central Australia have double the chance of extreme temperatures occurring during a negative phase of SAM, while in spring, southern Australia has double the chance of extreme temperatures occurring during a negative phase of SAM.

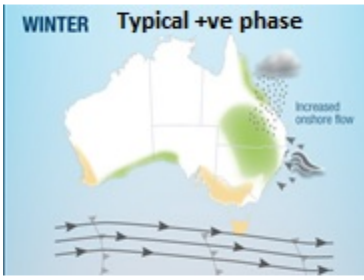
(Example report) The Southern Annular Mode (SAM) is negative, and is expected to become neutral for the remainder of September. At this time of year negative SAM is typically associated with above-average rainfall across far southern parts of the country, and decreased rainfall further north. (From BOM weekly climate report). BOM has an excellent video with explanations.

https://www.youtube.com/watch?v=KrhWsXCB3u8

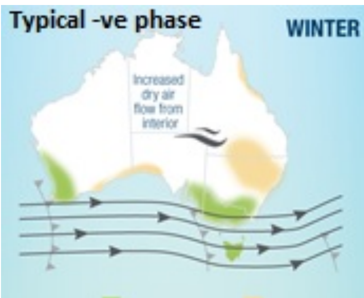
‘Understanding the Southern Annular Mode’

The Southern Annular Mode in winter

In winter, the usual position of the belt of westerly winds is close to Australia. Southern parts of the country typically get rainfall from cold fronts and troughs which pass over the southern reaches of Australia.



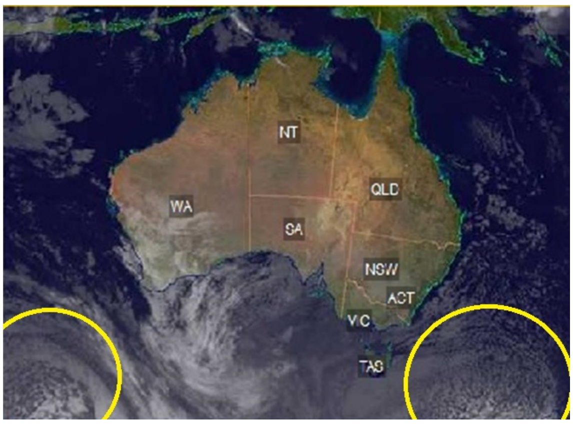
In a positive SAM phase, the belt of westerly winds contracts towards Antarctica. This results in weaker than normal westerly winds and higher pressures over southern Australia, restricting the passage of cold fronts inland. Generally, this means that there are fewer rain events in winter for southern Australia. However, in eastern Australia, the southward movement of the westerly winds means more easterly onshore flow is experienced. This wind is moist as it has just flowed from the Tasman and Coral seas and therefore typically brings more rainfall to the east.

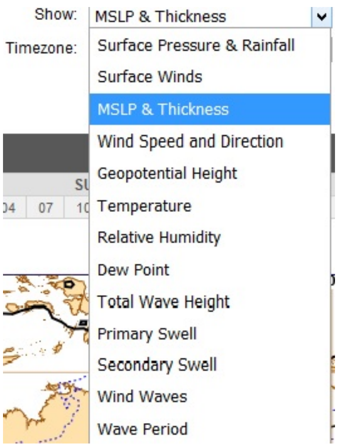


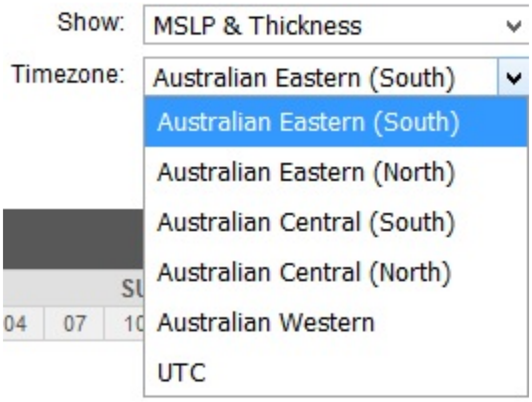
In a negative SAM phase, the belt of westerly winds expands and is positioned more northwards (towards the equator and Australia) . This results in stronger than normal westerly winds, lower atmospheric pressure, more cold fronts and more storm systems over southern Australia. Typically this means that there are more rain events in winter for southern Australia. However, in eastern Australia, the northward displacement of the westerly winds means less moist onshore flow from the east, and thus decreases rainfall for eastern Australia.

Satellite Pictures on BOM face page

At the BOM website, the first page shows a sat pic of Australia and surrounding areas. Of particular note for the mid-latitudes are the cloud formations of a cold front and the cold air pool behind it with a ‘speckled’ appearance. In this file picture cropped from a screenshot of a BOM internet weather page are two cold fronts with cloud bands over them and the ‘speckled’ cold air pools behind them. The position of the cold air pool and front depends on season, SAM and the low associated. Each of these ‘speckles’ is a storm with gusty winds, rain, possibly hail, and may endure from 2-3 hours to a day. Their intensity gradually decreases as the weather systems progress from west to East. Remember a system in vicinity of Perth WA takes roughly 3½ days to reach Melbourne so at a glance one can get an idea from a sat pic what’s coming. It is also evident that behind the front is a ‘push’ mostly from south west in this example.

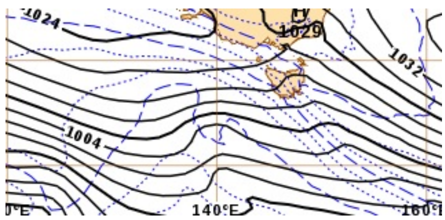


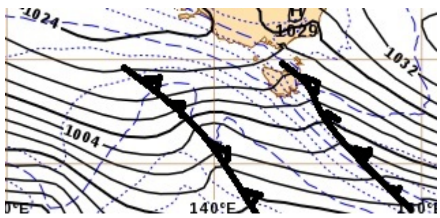


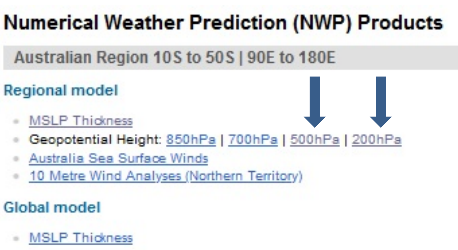


For voyaging offshore in Australia the 4 day map and the wind maps are very useful. If more information is desired, the BOM internet page and 'Weather maps' button will lead to the selection page as explained in Module 1 session 2. Items of interest here are particularly Satellite Images (current only) and 'Weather Maps' which opens to 'Numerical Weather and Ocean Products'/Numerical Weather Prediction (NWP) Products. From here we can select MSLP thickness and later Geopotential Height. The MSLP (Mean Surface Level Pressure) thickness map requires some selections. It is a 7 day prediction map but has a 3 day option with every chance the 3 day option comes up first. There are three applicable settings. In the centre top 'Show MSLP and thickness', and 'Time zone', and on the right 'Area and Period'. MSLP gives a computer produced 7 day map which, depending on your requirements is for 3 days, 3 hourly or 7 days, 6 hourly or combined with both. With any selection remember to press 'Refresh View' .

The MSLP & Thickness map has two displays, MSLP is in black and gives the latest forecast, thickness is in dashed blue and represents the height where pressure is 500 hpa. Thus the higher the thickness layer is, the warmer the air is. (Warmer = less density= higher level to be 500 hpa). Viewing the latest map and looking further to the west gives you 7 days and a guess as to what is coming from further west over the amount of mapped Indian Ocean. (10 days?). Fronts are not drawn in on a computer model. Fronts are usually where isobars are kinked.

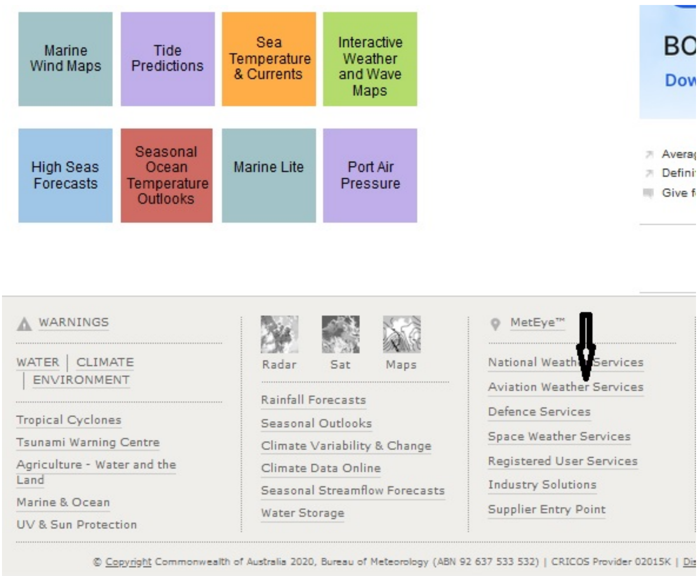




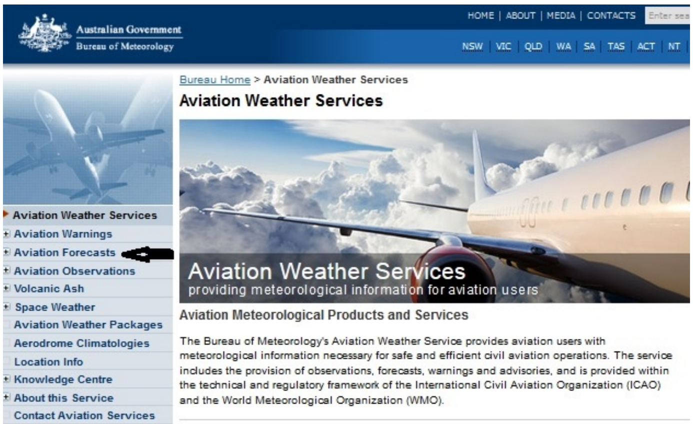


To check what is happening in the upper atmosphere further, if desired, return to the selection for 'Geopotential Height', and select the appropriate height pressure level required. For example to examine for features such as jet streams, East Coast lows, Blocking highs, Upper level Convergence and Divergence suggested levels would be 500hpa and 200hpa wherein most of these events can be discerned. A jet stream can either be the cause of, or accentuate a low pressure system. It is a fast moving current of air resembling a flattened tube moving generally from west to east and can reach speeds up to 200 mph. Jets are subject to divergence and convergence, slowing and similar effects as on the surface. A divergence can cause a pressure drop which if it happens over a low pressure system (ascending air) increases the rate of ascending air effectively deepening the low and intensifying surrounding winds. Colour coding identifies jet speeds and as a rule above 80 kts is considered a jet. They can meander both horizontally and vertically.

When forecasts and weather warnings mention 'developing low, deepening low, or intensifying low' there is a possibility of jet stream influence and severe weather.



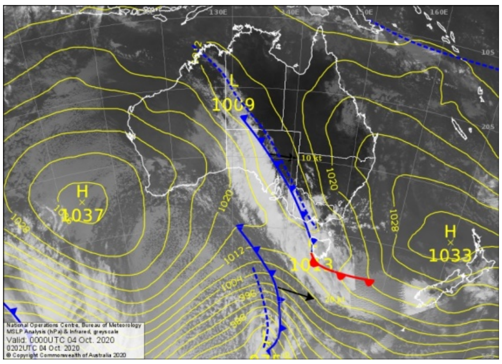
A much easier but less precise way to check is to use an aircraft SIGWX map. From the lower part of the BOM face page and 'Marine and Ocean button selection' is 'Aviation Weather Services' which when selected requires to accept a disclaimer and then a selection for 'Aviation Services' . Then select Aviation forecasts followed by SIGWX and then 'High Level SIGWX (FL250-FL630) with 4 time intervals. FL**** is flight level and requires 2 zeros after it to become altitude ie FL170 is altitude 17,000 ft.



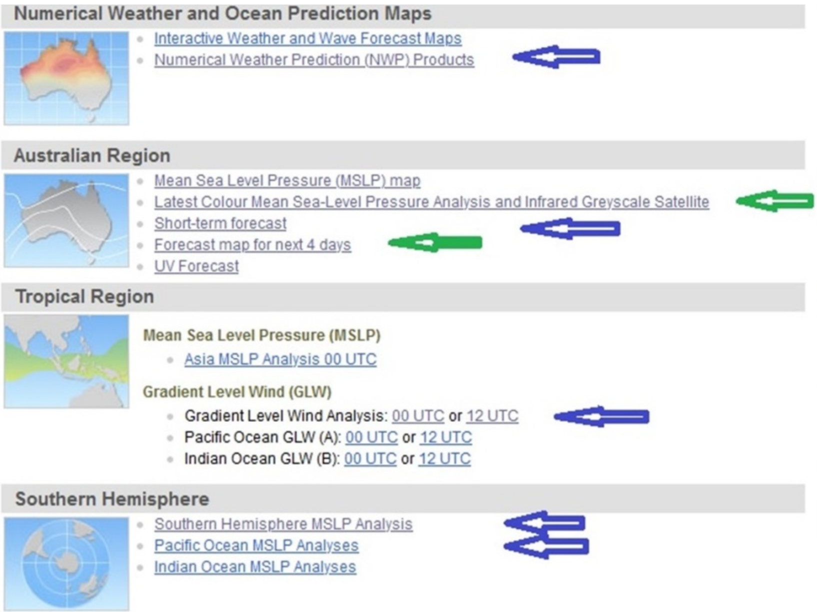
There is not the continuity of forecasts ahead as aircraft travel in much shorter time periods but if you are stuck in a harbour somewhere wondering what is happening and how long before you can move, every bit of information helps. Selecting the map area above the sigwx FL time choices allows to inspect everywhere around the world which is very useful route monitoring for distant voyagers.

Returning to the index page for Weather Maps

After clicking the 'weather maps' button on the face page of the BOM site, the index page has been marked with green indicator arrows for map products of shorter term interest and blue indicator arrows for products adaptible for longer outlooks. Latest colour Mean Sea-Level Pressure Anaysis and Infrared Greyscale Satellite



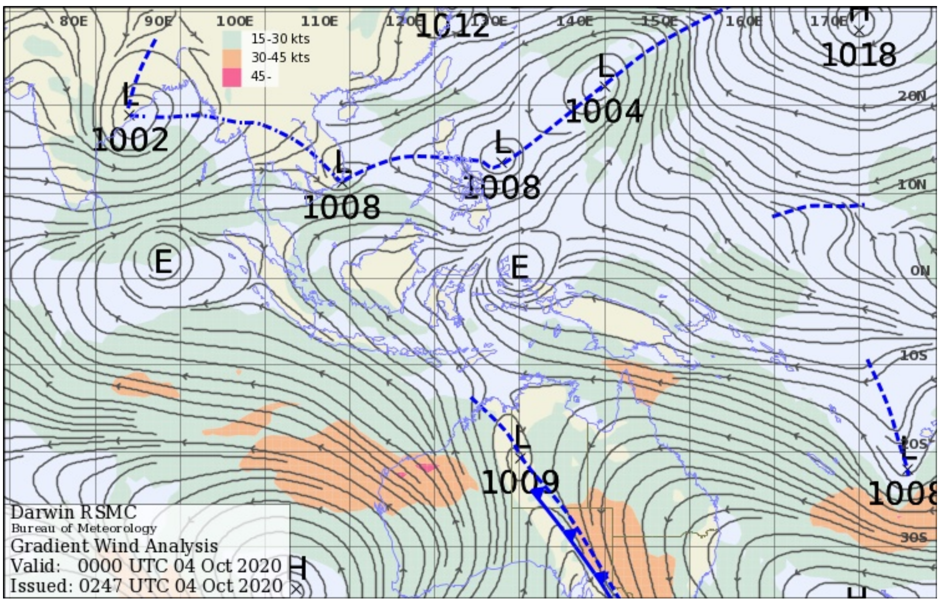
This map and picture has isobars and clouds shown along with the sat-pic which enables 'at a glance' information, but as there is no prognosis involved some experience of the west-east movement is helpful or in conjunction with other products. The following article 'Interpreting the Gradient Wind Analysis' is largely adapted and reprinted from one of the excellent Bureau Of Meteorology explanatory papers on many subjects and available through their website.



The ‘Gradient level Wind Analysis is best used for the tropics and especially so for the northern Australian coastlines where the very small pressure differences render conventional weather maps of little use. Adjustment is required to reduce wind strength for friction 20% over sea and 40% over land. Wind deflections for highs and lows also must be factored in for direction varying from 10% near the equator and more further away.

The Gradient Level Wind Analysis is a snapshot of the airflow near the surface of the earth. The arrowed lines are called streamlines and represent the direction of the wind. The dashed lines are called isotachs, and connect points of equal wind speed. The standard isotach intervals are 15 and 30 knots (28 km/h and 56 km/h) - knots is the preferred unit for these charts as they complement the Bureau's marine services. Adjustment is required for windspeed friction loss at surface and deflection resulting-read below.

Current Gradient Level Wind Analysis, twice daily, 00 UTC and 1200 UTC



Asian Region Gradient Level Wind

Black and white half domain charts are also available. See below.

Asian Region Gradient Level Wind - Region A (Indian Ocean) west of roughly 123ºE

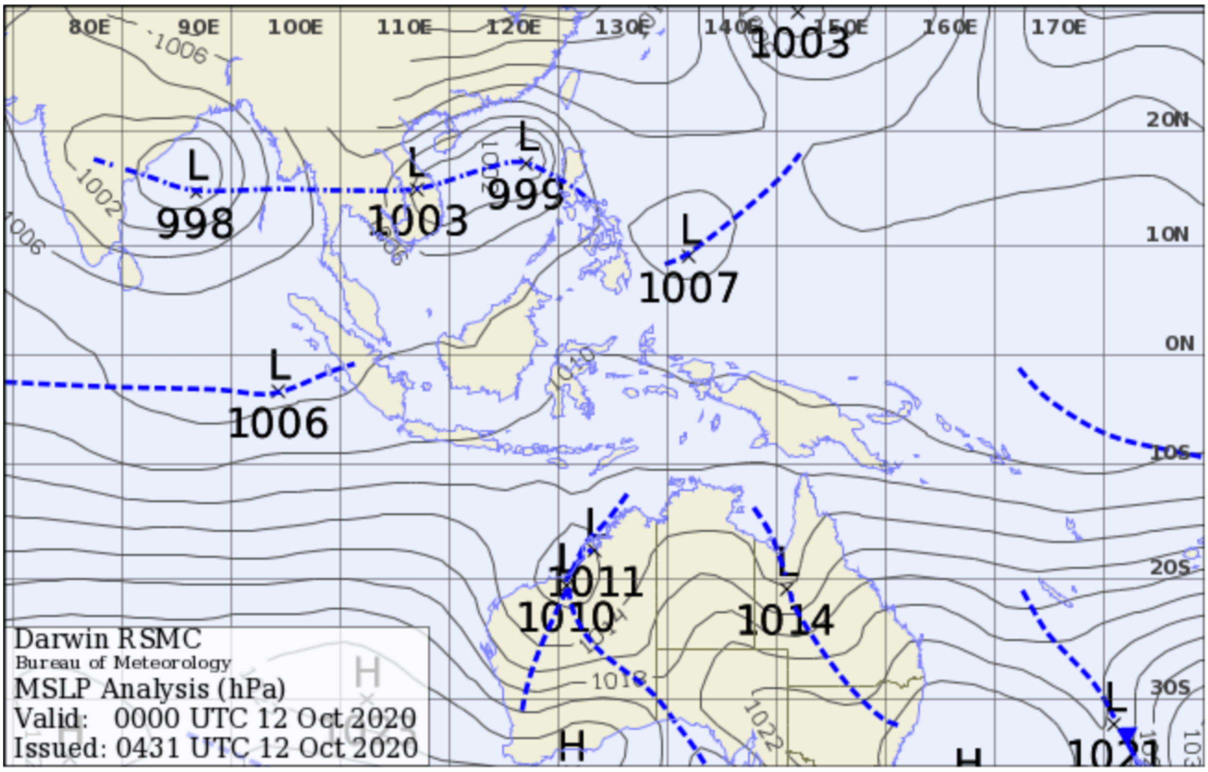
Asian Region Gradient Level Wind - Region B (Pacific Ocean) east of roughly 123ºE

Current MSLP

Asian Region MSLP

The gradient level lies about 1000 metres above the earth's surface, and is the level most representative of the air flow in the lower atmosphere immediately above the layer affected by surface friction. This level is free of local wind and topographic effects (such as sea breezes, downslope winds as katabatics etc) as these are significant for sailing.

Streamline charts are much more useful than isobaric pressure (Mean Surface Level Pressure MSLP) charts for showing the weather patterns over tropical areas. While MSLP charts are good for estimating wind direction and strength over mid and high latitudes, in the tropics pressure gradients are weak and often don't give a good indication of the prevailing winds. Meteorologists overcome this difficulty by drawing charts of the actual wind flow. The surface wind may be estimated by decreasing the gradient level wind speed by approximately 20% over the ocean, 40% over land and assuming a direction deviation of about 10-30 degrees. If looking along the direction of the wind, the deviation is to the right if low pressure is on your right (or if high pressure is on your left).



On streamline charts, low pressure systems (including tropical cyclones) appear as inflowing circulations - clockwise in the southern hemisphere and anticlockwise in the northern hemisphere. High pressure systems appear as outflowing circulations, with direction of rotation opposite to that of the lows. Near the equator, when the wind changes direction as it flows from one hemisphere into the other, closed eddies may appear; these are indicated by an "E" and are not associated with high or low pressure (and are often associated with clear weather).

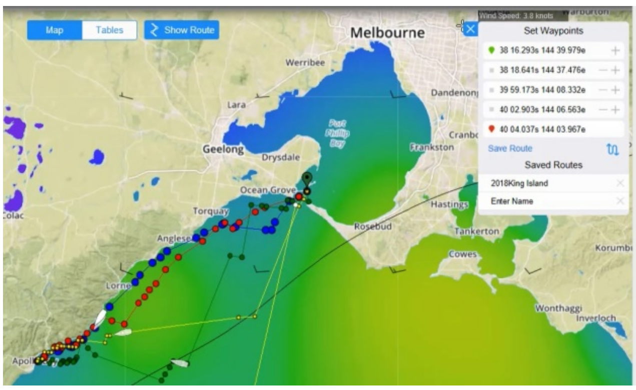
Lows are indicated by an L symbol, highs by H , accompanied with the value of central pressure in hectoPascals. Tropical cyclones are particularly intense low pressure systems, identified by the cyclone symbol, together with information on the name, maximum wind speed (knots) , central pressure (hPa) and current direction of movement (speed in knots). In the northwest Pacific, tropical cyclones are called Tropical Storms, and the more intense systems are called Typhoons. In Australia, these systems are called Tropical Cyclones and Severe Tropical Cyclones.

The broad streams of air flowing toward the equator from the mid-latitude highs are called the trade winds: southeast winds in the southern hemisphere and northeast winds in the north; these wind streams tend to be strongest in the winter hemisphere when high pressure systems are more intense.

In the summer hemisphere, persistent winds tend to flow into the near-equatorial area from the opposite hemisphere, and are frequently associated with widespread cloudiness and heavy rain. These winds are referred to as the northwest monsoon in the southern hemisphere (December-March) and the southwest monsoon in the northern hemisphere (June-September). The monsoon flow is on the equatorward side of an area of low pressure called the monsoon trough, and tropical cyclones often develop from lows located in this trough.

Weather Routing

The process involves two critical pieces of information: accurate weather forecasts, which come in the form of Gridded Binary (GRIB) files, and the vessel's performance characteristics, which come in the form of polars. Polars are developed by the manufacturer for each particular standard vessel, and predict a sailboat's speed through the water at various wind speeds and angles. Any deviation from the standard vessel will affect the supplied polars, particularly loaded displacement and rig. With Predictwind software, a range of vessels polars are supplied and a close fitting alternative can be selected. While private weather-forecasting and weather-routing services use GRIB files, the raw data for these files is typically collected by government organizations such as the National Oceanic and Atmospheric Association, which builds its free Global Forecast System, or GFS files, every six hours. The European Union's European Centre for Medium-Range Weather Forecasts (ECMWF) releases fee-based GRIBs twice daily. If racing, grib files need to be watched carefully and especially near mountainous coasts as the grid parameters used can skip detailed features which may have a bearing.



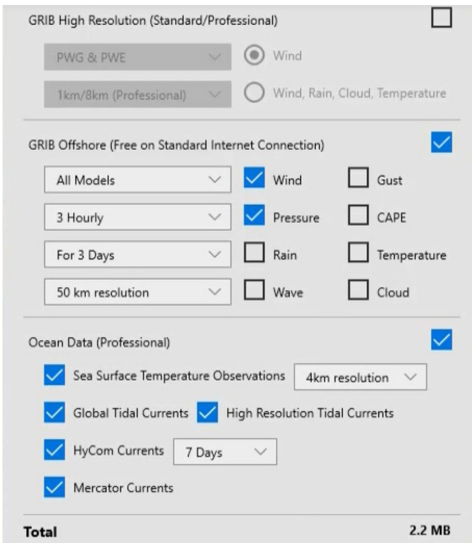
Weather routing takes into account the weather forecasts for the intended journey and plots where it thinks you'll be relative to the predicted weather because it knows your boat's predicted speeds in different conditions. Additionally, weather-routing software can help users determine the optimal departure time and routing based on user-specified parameters. These parameters can include maximum acceptable wind speeds or wave heights, as well as the percentage of time that the boat will be on a particular point of sail. While long-range GRIB files (sometimes extending out to 16 days) are available, all navigators worth their salt understand that newer forecasts always outshine old information. Also, given the size of some GRIB files and the potential data costs and downloading times involved, navigators are cautioned to only download the forecasts that they need, rather than files for an entire region.

Predict Wind

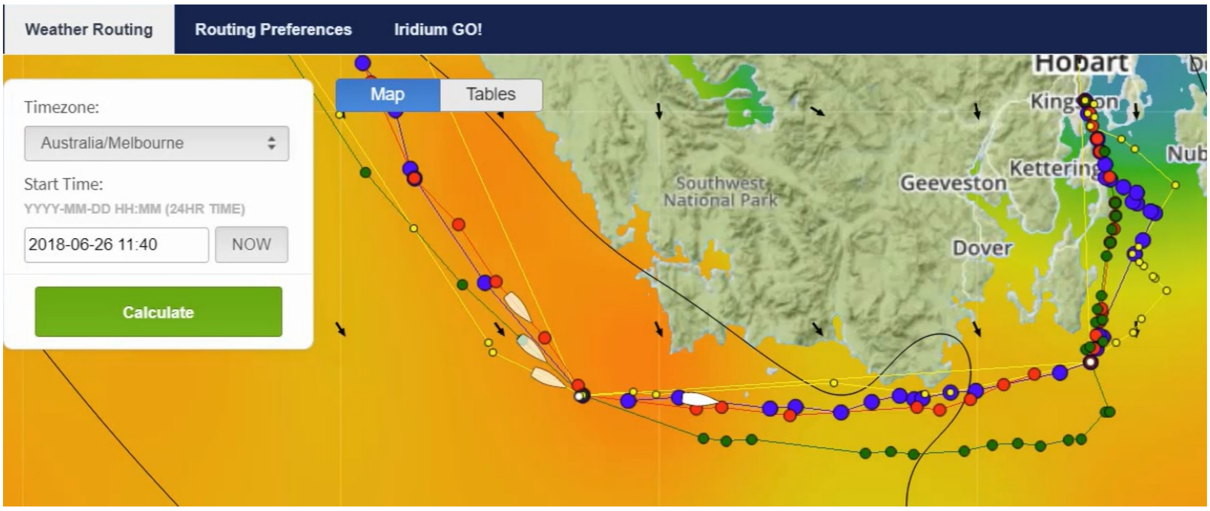
Predict Wind Weather and Maps

Four weather models are available with any two displayed side by side for comparison and evaluation. These are the American Global Forecast System (GFS) and the ECMWF System (European Centre for Medium-Range Weather Forecasts). Predict wind makes available both of these models as adjusted by their own meteorologists and then labelled as PWG and PWE. Initially select region and time and then in the selection menu are Forecast tables, Graphs, Wind maps, Gust maps, Cape maps, Wave maps, Rain maps, Clouds, Air temperature and Sea temperature. The maps can be played as animations and paused or reversed as required. CAPE is an acronym for Convective Available Potential Energy. Its value is useful for determining the severe weather potential at a given place and time. Eg. Thunderstorms, lightning etc.

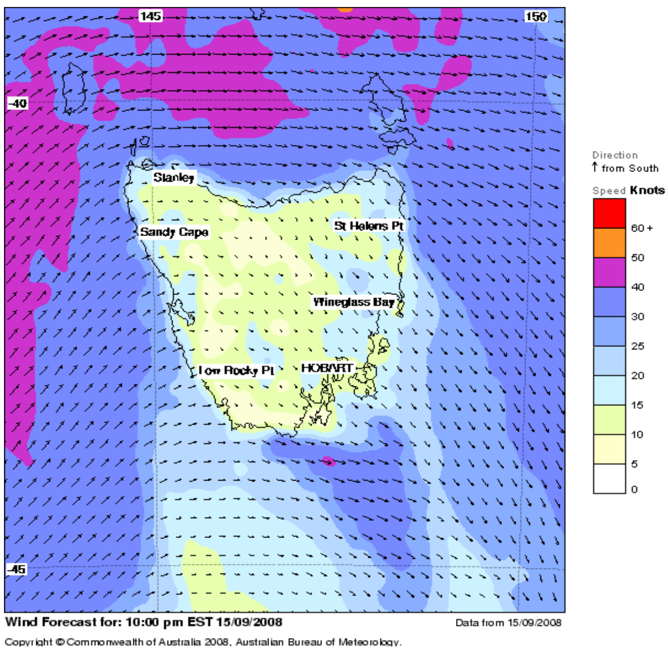
Predict Wind Offshore App .



This is a sample menu for selecting and downloading a choice of grib files to program the application. Importantly it provides the file sizes of the choices as the use if required of sat-phones can be very slow to download and extremely expensive. Therefore advice is to carefully download at your residence initially and update at sea only when necessary. The menu pic shown here illustrates the selection choices as:-Grib High res, Grib Offshore, Ocean Grib, Weather Routing, Spot Forecast, GMDSS, Satellite Imagery, Next available forecast timeslot. A selection is also available to use Iridium Go satellite system if fitted. The system is too vast to describe in these notes but generally is described in preceding articles inc weather routing. The Predict wind program along with 'Expedition' has been used extensively by many top-flight racers and world-wide cruisers very successfully for many years now (2020). With weather routing, the capabilities to plan your voyage are very powerful and enable selections not just for racing but also for comfortable cruising with chosen parameters such as maximum wave height, wind strength, time on the wind and similar. Other options include departure planning and a useful feature with tables and graphs for planning and analysis.



Topography and Mountainous Coasts



Coastal Voyages and races are influenced to a very large extent by adjacent topography and tides. In trans Ocean voyages the emphasis is on strategy with wind directions and currents. Melbourne Launceston, Melbourne King Island, Melbourne Stanley as across open water and Melbourne Hobart as open water plus coastal whereas Melbourne Apollo Bay, Melbourne Port Fairy, and Melbourne Portland, Melbourne to Port Lincoln S.A, and Australia East coast voyages would be entirely coastal. In all these events the start and finish destination at least is influenced by the land in some way and the coastal topography is a major influence on the weather conditions to be encountered. When sailing near a coast, a careful study of the land topography can identify where winds might be bent, stopped or accelerated. Areas where sea breeze, land breeze or katabatics are possible etc. Examining these and other possibilities further can assist greatly.

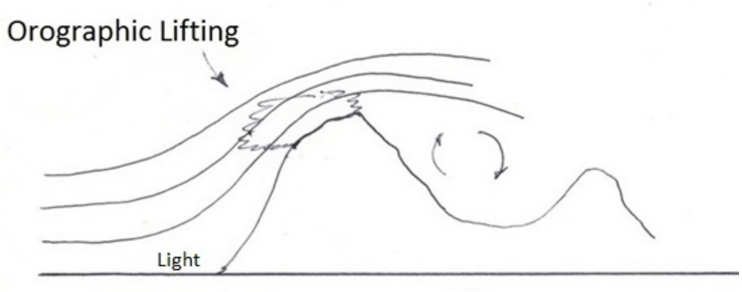
This pic shows acceleration around Tasmania with funneling in Bass St. and the effect of wind with an obstruction of high mountains. Centre of low pressure system a little further south and lee side wind shadow. Rather than lift over the Tasmanian highlands the wind accelerates around for an easier path with system wind flow. It then has to squeeze through King and Flinders Islands as well as Cape Otway and Wilsons Promontory resulting in storm force winds.Mountainous coasts eg Cape Otway

Steep cliffs and high hills affect winds over the sea in similar ways but depending on direction and the stability of the atmospheric conditions. The principles involved apply to any coast but are well illustrated by the Port Fairy race usually held in Autumn when more stable conditions can be expected.

Autumn background- Considering summer when maximum solar radiation is received, the earth acts like a giant heatbank. Although radiating heat out at night the loss is less than received during the day and heat accumulation occurs. By the autumn solstice the radiation out and received equalize and as the days shorten, gradually more radiates out than received. In these circumstances the 'heat bank earth' begins to radiate out heat according to the differential. The huge volumes of water surrounding Australia assist with this effect. Thus autumn weather is more moderate and at the same time in our latitude, the band of highs is usually centered overhead with high pressure systems weather more common. Water in particular, has a high specific heat index and is a much greater influence than land in moderating temperature.

With cooler nights and less cloud, stable morning conditions with light winds are very likely and downward temperature inversions more prevalent.

By the winter solstice the radiation received begins to improve but radiation out is in excess of that in so the 'heat bank earth' is still decreasing until minimum late July. It then again starts to increase such that by the September equinox radiation out and in equalize although 'heat



Stable conditions Laminar Airflow -Possible Inversion

bank earth' requires a further month before accumulating excess. Contrasting spring is that the water is only gradually heating and at a much slower rate than the shallow land with therefore greater daily differences. The greater the temperature differences the more difference in weather.

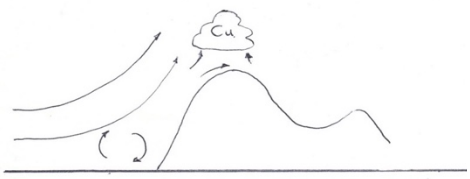
In stable conditions, orographic lifting on a high coast can force air above saturation level forming cap cloud or very often lenticular clouds which often last only a short while forming a lens shaped cap but are an important indicator. Lenticular, and wave cloud particularly, are developed when relatively stable faster moving air is forced up over a barrier creating a gravity wave downwind. If sufficient moisture is present at that height the up wave crest expands and cools reaching dew point while the downwave warms below dew point. The cloud does not move with the air but appears constant as new air is forced upwards. It is the cap cloud shape that indicates laminar flow and wave clouds indicating somewhat faster air aloft.

Laminar flow can still exist with no cloud. It has been known for two yachts sailing in the same direction some distance apart and on opposite tacks. They were therefore one on a rotor, the other in gradient wind. Wind strengths can vary depending on where one is in the system. This diagram can be reversed to apply South Easterly or Northerly at C Otway. As the day progresses and the land warms, the presence of cumulus cloud firstly on the peak indicates stability breaking down and unstable conditions developing. Instability changes sailing conditions as thermals provide turbulence and mixing. Sail settings alter to suit less twist and stronger breezes.

CCSL-Cirrocumulus standing lenticular

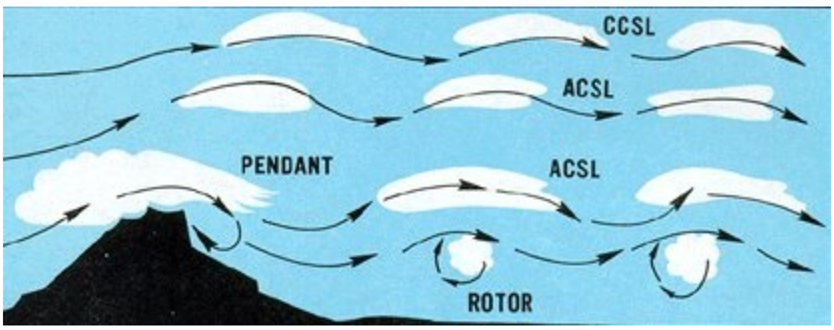
ACSL-Altocumulus standing lenticular

They are most often seen in the winter or spring when winds aloft are typically the strongest.



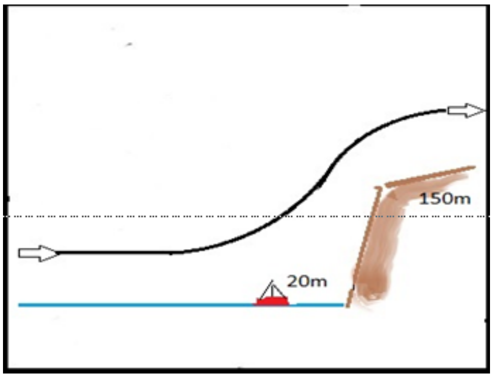
Convection breaks laminar flow -Rotors form seaward

If Cumulus cloud is observed as distinct from lenticular and wave, then the atmosphere has become unstable and sailing positioning will be more in line with sea or tidal current. Bullets occur in hilly areas such as the Whitsundays, or locally as an example, Bass Strait Erith Island in strong North-Westerlies. Here the wind is obstructed and piles up more vertically due to wind momentum until gravity forces the wind to break somewhat like a wave. Think of water flowing in a channel against an obstruction to visualize.



Parking Lots

More so in stable conditions and laminar flow, air streams can establish which pass smoothly over high and steep cliff faces and hills such that close too underneath is an almost windless area. Recognising cloud formation as key to stable or unstable conditions and topography is key to avoiding this type of situation. More so in stable conditions and laminar flow, air streams can establish which pass smoothly over high cliff faces and hills such that close too underneath is an almost windless area.



Even in unstable conditions, wind can ‘pile up’ in front of cliff or steep hill and thus be stationary =no wind. Have you seen documentary movie clips of salmon fish swimming upstream in swift rivers to spawn? The fish ‘parks’ behind an obstruction in the water current, where there is a stationary area it can rest and not have to swim against current. In reverse, wind off the land ‘skips’ over the area close-in with confused eddies or a ‘suction’. Moonlight head, some 20 miles west of Cape Otway is a notorious parking lot with many yachts having to ‘park’ up to a half day watching others sail past. The land behind rises smoothly which aids the laminar flow to establish smooth streamlines over the cliff. The coast westwards has many such cliff faces almost vertical and with similar reputations.

Sea breezes

The sea-breeze is especially important with light gradient winds and can give rise to strengths of up to around 23 knots. Of first importance is to recognize possible areas likely, and secondly the signs of formation. The tell-tale Cumulus (Cu) clouds over the land are usually first indications and can be accompanied by a small drop in barometric pressure if one is close to land. (Air expanding with less density). If wind pressure is desired and the likely sea breeze direction suitable, a key point is to remember the breeze starts close to the coast, say 2 miles. Thus one needs to do the sums of distance and time to get there in terms of reward versus where one currently is. As the sea breeze develops, the ‘sink’ will appear offshore as a cloudless area in the sky and the Cu clouds will slowly move towards it and gradually diminish next to the clear sky. In action the sea breeze has two ‘fronts’. Firstly a calm for maybe one to one and a half hours close to shore which then moves out to sea. This sea-breeze front moves out fairly rapidly depending on the heating available to become the calm under the sink. If you are further out to sea when the sea-breeze is developing, your breeze will gradually decay and the same calm will trap you for the same period as if you were near shore (it is the downwards moving air of the circulation) until the seabreeze itself reaches you. (downward

air) in front of it and depending on strength may move out some 30 miles. There is always a calm or transition for a short period before the wind is encountered. The other front (ascending air) moves out over the land bringing cooler air. The tell-tale Cu clouds move inland with the front.

The further out from the coast, the longer it takes the front to arrive (while you are in light winds, therefore important to recognize suitable conditions) and thus the later the breeze appears. Similarly, as the heat over the land diminishes towards evening, the sea-breeze will die at its' outermost and shrink back towards the land. Thus to recognize the possibilities and reach the shore to catch the beginning sea-breeze and to get back towards the shore for the last of the sea-breeze equals best sea miles. Especially in light gradient winds a predominantly clear sky will allow the land to cool rapidly favouring a land breeze formation. Again, a very light regime or calm will occur before breeze arrives. Land breeze is cool and the layer of wind usually not more than 100m vertically. It generally starts one to one and a half miles from shore about 1 am and does not move out very far but has been recorded in some European areas to 25 km.

The weather map and forecast is therefore quite important for tactics in positioning especially in light weather. Cloud identification in regard to blanket cover and heating conjoins with topography and the gradient wind to identify the most likely areas. For example sand areas, dry grasslands, and sparsely covered hills or mountains gain or lose temperature more rapidly and green forested areas more slowly.

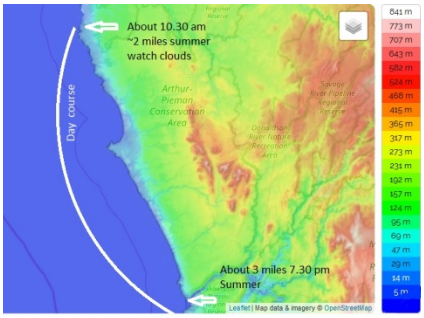
Katabatics or downslope winds.

A katabatic (downslope wind) is very similar to a land breeze but in the sailing sense is more related to downslope into a valley or river valley. In terrains that are hilly or mountainous, in a near cloudless sky, the high land radiates heat out into space, and the already cool air from elevation in contact with the high land cools more becoming more dense. This heavier air begins to slide downslope into valleys gathering heat adiabatically as it descends but losing heat overall due to continued contact with the cold ground. The cold air gathers momentum as it drains down the valley, eventually reaching the coast and spreading out seaward. Given favourable conditions, velocities to around 20 knots can be encountered sometimes reinforced by land breeze. They generally dissipate by two miles offshore. The most famous katabatics are the Mediterranean mistral, the Bora and the Antarctic wind off Mount Erabus which reaches 100 knots. A relatively smooth and long downward slope enhances strength. Gains of 30-40 miles in a night over a competitor are possible. Usually those 5-10 miles out to sea.

To take advantage of a Land breeze or katabatic.

Know the topography for presence of valleys and relatively smooth slopes from hilly terrain. It requires a preferably gentle to moderate outfall slope of at least moderate length and mainly relative smoothness. Eg heavily tree'd growth or roughness inhibits the process.

Be in the right place by 1 am to 9 am. And less than 2 miles from shore. It is very frustrating to know the right conditions will be present but not be there at the right time.

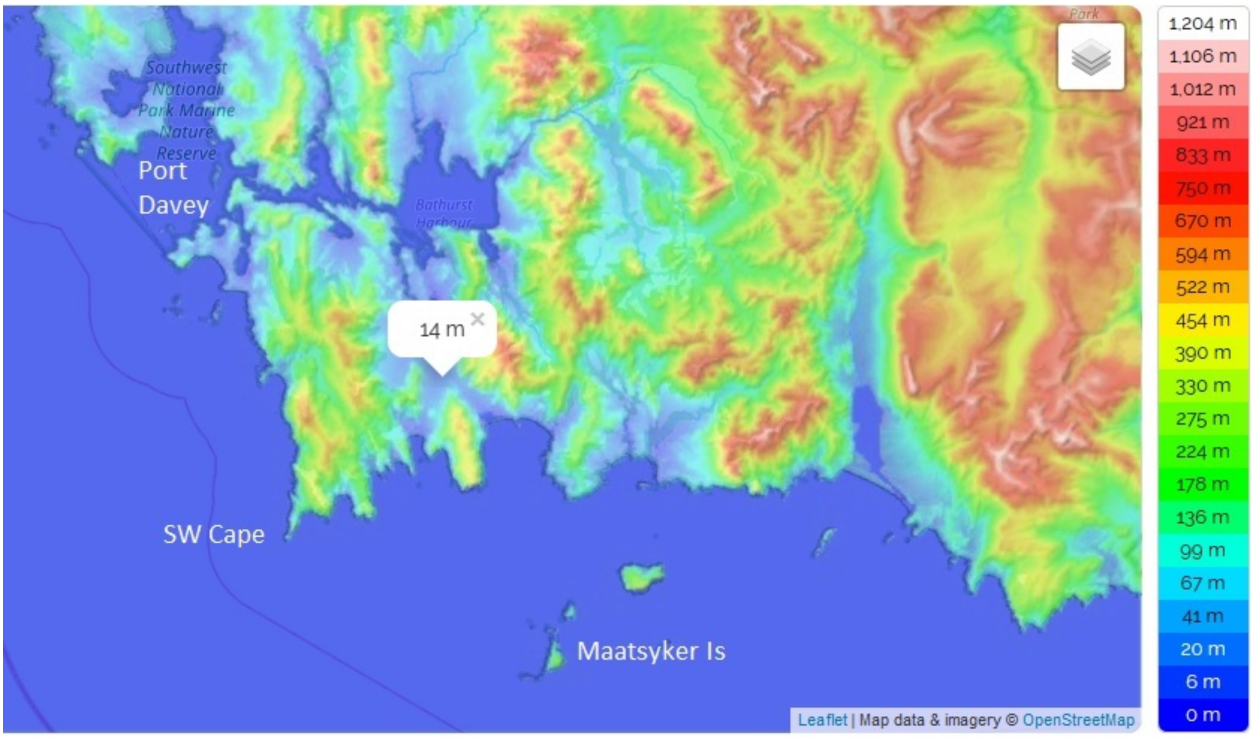


Tasmania West Coast Vicinity Sandy Cape

The sky must have been and be clear.

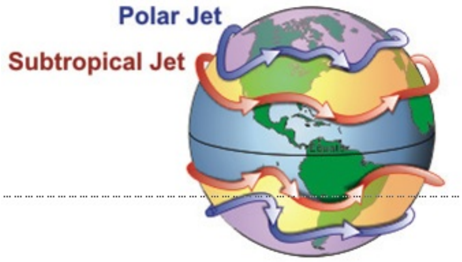
The gradient wind is preferably light.

Rivers are usually associated with a valley which is a primary indicator of where a katabatic may be found -Yarra Valley Vic., Derwent River Tas. and Tweed Heads. Queensland come to mind. The other consideration with rivers is the outflow. If the river water has a differential temperature to the sea water and depending on the sea state (turbulent mixing), there can be marked differences with currents, waves and in light winds. It can pay to check recent rainfall. Reading: Wind Strategy-D Houghton. So for a keen sailor it pays to examine the planned coastal voyage for suitable areas where sea-breezes, katabatics and land breeze might occur. Modern technology with a satellite process called ‘Altimetry’ has made this task much simpler. A combination of photography and measurements of surface heights gives almost 3-dimensional displays. In the example altimetry map, the elevations and valleys can be easily ascertained.



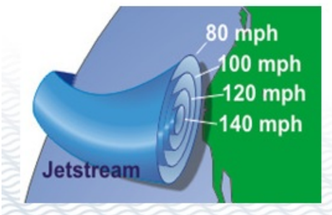
Tasmania, Australia Maatsyker Is. 43 deg 39.1' S, 146 deg 16.6'E

Deepening or intensifying lows

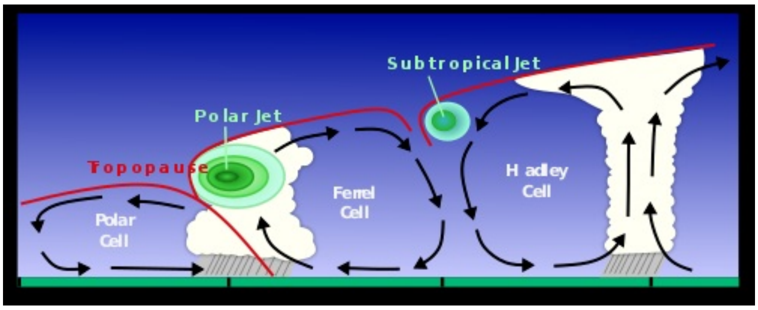


Two principal jet streams exist in each hemisphere, the polar and the subtropical jets. The location of low and high pressure systems and air temperature all affect when and where a jet stream travels. Jet streams form a border between hot and cold air. Because air temperature influences jet streams, they are more active in the winter when there are wider ranges of temperatures between the competing Antarctic and tropic air masses.

Temperature also influences the velocity of the jet stream. The greater the difference in air temperature, the faster the jet stream, which can reach speeds of up to 250 mph (402 kph) or greater, but average about 110 mph (177 kph).



They may be thought of as frontal zones separating warm and cold vertical cell boundaries. They tend to move with seasonal shifts of the cells (Hadley, Ferrel & Polar) but normally at equinox the Subtropical jet is about 20-30º latitude and the Polar jet about 50-60º latitude. The Hadley cell operates with tropical warm, less dense air which is therefore of greater altitude, the STJ is 6.2 to 9.9 miles altitude. The PJ with colder, more dense air is about 4.3 to 7.5 miles altitude. These altitudes typically correspond to the 250 hpa level in the atmosphere, maps mostly used with aviation. Jet streams can have meanders in direction. If so, the meander will have a west to east drift at considerably lesser speeds than their constituent jet wind speed. A loop in the polar jet can bring unseasonal very cold air with it and remain so for some time. Similarly a loop polewards of the STJ will bring unusually hot weather to higher latitudes it encompasses.



In this diagram note the anticlockwise loop enhancing a very strong high and the clockwise loop associated with the later depression which slammed Newcastle and drove the bulk ship PASHA BULKER ashore.

In our area of interest, their possible effect in enhancing or deepening a low is of primary interest. When a low is map observed or warned to be 'deepening, intensifying or developing' it can be well to check for a jet presence, as if so serious bad weather can result and the sailors maxim of 'AVOID, AVOID, AVOID' is best followed. As a low is an ascending air system, a divergence (spreading out) in upper levels creates 'suction' which pulls air up faster and thus reduces surface pressure levels intensifying the low. Much more upper level weather is associated with jets but for coastal purposes is not warranted. Also comparing the BOM 'Interactive weather and wave maps' 200 hpa & 500 hpa maps noting isotachs (lines of equal wind strength) 60+ is useful when considering west to east movement of features. Surface winds are roughly half of that shown on a 500 hpa map and a third of that on 200 hpa. On the positive side, the STJ prevents cyclones from continuing below 20º latitude as it tears the top of the cyclone system thus removing it's source of power.

Jet Streams and the weather edited from Wikipedia

Jets streams play a key role in determining the weather because they usually separate colder air and warmer air. Jet streams generally push air masses around, moving weather systems to new areas and even causing them to stall if they have moved too far away.

While they are typically used as one of the factors in predicting weather, jet streams don't generally follow a straight path — the patterns are called peaks and troughs — so they can shift, causing some to point at the poor forecasting skills of meteorologists.

Climatologists say that changes in the jet streams are closely tied to global warming, especially the polar jet streams, because there is a great deal of evidence (2015) that the North and South poles are warming faster than the remainder of the planet. Also some recent research suggesting that the ITCZ (Intertropical Convegence Zone is shifting N about 0.9º Lat per decade along with the SAM (Southern Annular Mode) . When the jets streams are warmer, their ups and downs become more extreme, bringing different types of weather to areas that are not accustomed to climate variations. If the jet stream dips north, for example, it takes the colder air masses with it.

Jet streams also have an impact on air travel and are used to determine flight patterns. An airplane can travel much faster, and save fuel, by getting "sucked up" in the jet stream. That can also cause a bumpy flight, because the jet stream is sometimes unpredictable and can cause sudden movement, even when the weather looks calm and clear.

Subtropical jet

A second factor which contributes to a concentrated jet is more applicable to the subtropical jet which forms at the poleward limit of the tropical Hadley cell, and to first order this circulation is symmetric with respect to longitude. Tropical air rises to the tropopause, and moves poleward before sinking; this is the Hadley cell circulation. As it does so it tends to conserve angular momentum, since friction with the ground is slight. Air masses that begin moving poleward are deflected eastward by the Coriolis force (true for either hemisphere), which for poleward moving air implies an increased westerly component of the winds (note that deflection is leftward in the southern hemisphere). Confused? This statement is the opposite of trade winds which are moving from poleward towards the equator but is the same.

Polar front jet stream, also called polar front jet or midlatitude jet stream, a belt of powerful upper-level winds that sits atop the polar front. The winds are strongest in the tropopause, which is the upper boundary of the troposphere, and move in a generally (easterly?) direction in mid-latitudes.

Polar front jet stream, also called polar front jet or midlatitude jet stream, a belt of powerful upper-level winds that sits atop the polar front. The winds are strongest in the tropopause, which is the upper boundary of the troposphere, and move in a generally westerly direction in mid-latitudes. The vertical wind shear which extends below the core of this jet stream is associated with horizontal temperature gradients that extend to the surface. As a consequence, this jet manifests itself as a front that marks the division between colder air over a deep layer and warmer air over a deep layer. The polar front jet can be baroclinically unstable and break up into Rossby waves.

Topography-sea breezes-land breezes-katabatics-timings, clouds-temperatures-airmasses

Other land effects, headlands, indents, rivers, mountains, cliffs, islands, wind directions

Topography-sea breezes-land breezes-katabatics-timings, clouds-temperatures-airmasses

Other land effects, headlands, indents, rivers, mountains, cliffs, islands, wind directions

System awareness. Deepening Lows, East Coast Lows, Cut off Lows, Persistent Easterlies or Westerlies, Tropical Disturbances and Strong Cold fronts

The troposphere height over the warm equatorial area can reach up to 18 km, mid latitude 10-15 km and over the polar regions just 6-9 km. As the heat expanded air reaches the upper level of the tropical troposphere and cools, it begins to flow "downhill" to the lower polar region. Coriolis effect turns it into a fast moving river of air circling the globe as the sub-tropical jet. A similar process forms the polar jet. These conditions are not a uniform stream but wander up, down and sideways in meandering patterns. They can reach speeds up to 200mph, existing in cross-section as a flattened oval tube. In their travels they are subject to similar convergence, divergence and slowing as we have observed the winds on the surface. A divergence can cause a pressure drop which if it happens over a low pressure system (ascending air) increases the rate of ascending air effectively deepening the low and intensifying surrounding winds.

When forecasts and weather warnings mention 'developing low, deepening low, or intensifying low' there is a possibility of jet stream influence

Consider the options where a bad run of weather has held progress up for a while and some team members have advised they must leave the vessel for pressing matters at home. This scenario is one of the most common causes of unfortunate experiences in recreational boating. The further out the forecast, the less accuracy becomes. To receive longer outlooks than 7 days from BOM requires a subscription to enable up to 10 days.

Severe weather is potentially dangerous. It is one thing to say "The boat can handle it and the crew are experienced" but the reality is that people get fatigued and things might break or be damaged, get washed overboard and there is always a risk people might receive injuries. In the event it becomes necessary to go into "survival mode", the vessel needs to be slowed to avoid slamming damage or risk of broaching. Before running the gauntlet, every check on weather possible is advisable.

Windy.com

Windy .com -Windy is a Czech company based in Prague providing interactive weather forecasting services worldwide. Registration is free and serves to hold your preferences and settings but is not required. The site has many options and an external user has arranged a you tube video which is not only highly informative but is also educational. The portal was founded by Ivo Lukačovič in November 2014. Currently, weather forecasts are based on data from the GFS models, ECMWF, and NEMS model from the Swiss company Meteoblue.

Initially, the portal focused on wind animation, currently there are other basic meteorological parameters such as temperature, pressure, relative humidity, cloud base and additional panels with more advanced data. The wind animation is based on the open sources project of Cameron Beccario. Ivo is an airline pilot with interests in his hobbies of kite surfing and programming. The site is especially produced with visually easy to understand graphics and although perhaps lacking in detail for some academic purposes, has been engaged by many Government agencies. It operates with a staff of 18 and like most weather sites is still developing enhancements. There are smartphone apps available (iOS & Android) from the usual sites. (Windy.app: wind forecast, wind map, marine weather). Offline Mode.-You can see the forecast on the map and on favourite spots even with no internet connection - just activate the offline mode. Before going to sea (or elsewhere with no connection), open the app to download the forecasts automatically and then use them offline.

How to view the weather models like a pro using Windy

https://www.youtube.com/watch?v=gjpXKyKH9tg

Clouds

Refer ORCV Reference Material Page 64-76

Clouds can take on all sorts of shapes and sizes, ranging from thin wispy clouds (cirrus) to large, dark menacing clouds (cumulonimbus). While there are several factors that influence and affect the formation of clouds, the sun plays a major role in producing clouds.

To help understand basic cloud formation, Consider a field at sunrise. In the morning, the field is relatively cool. The sun begins to heat up the field, and throughout the day, the field becomes warmer and warmer. Certain areas of the field may begin to heat up more quickly than others due to the terrain or surrounding conditions (for example, bare soil heats up more quickly than vegetation). When this happens, a thermal (also known as an updraft) can form. A thermal can be thought of as a rising "blob" of warm air due to unequal heating of the earth's surface. When the thermal forms at the surface, it is warmer than the surrounding air. Warm air has a tendency to rise while cold air sinks, and since the thermal is warmer than the air around it, and therefore less dense, the air in the thermal will rise. As it rises, it will begin to expand and cool, and will continue to do so until its temperature is the same as the surrounding air temperature.

Although we can't see thermals with our eyes, we can feel and observe their effects. For example, many birds will use thermals to fly higher in the air. By catching a thermal, they do not have to expend as much energy to gain altitude since the rising air will carry them upwards.

The process of thermals forming in the atmosphere is a form of convection. Convection is basically the transfer of heat (in this case, through thermals) from one area to another. In our example, the heat was transferred from the surface into the atmosphere.

So how does convection help in the formation of clouds? As mentioned earlier, when a thermal rises, it begins to cool and expand. But why does it cool and expand as it rises?

Have you ever tried boiling water on a mountain? You may have noticed that the water boils faster on a mountain than as compared to boiling water at sea level. The air pressure is lighter on a mountain than at sea level, so water actually starts to boil below 100ºC! Air pressure decreases with height, and as the thermal rises, there is less pressure on it. Additionally, the internal energy inside the thermal wants to expand it. So as the pressure decreases while the thermal is rising, the thermal is able to expand more easily. However, by doing this, the thermal will begin to cool as its temperature is proportional to its internal energy.

As the parcel cools and expands, it eventually reaches the saturation point where the relative humidity is 100 percent and condensation starts to occur. When water condenses, it goes from a gas to a liquid.

The droplets that form in clouds, though, are very tiny (unlike the ones that form on the glass) and are light enough to float in the air. Once the air reaches saturation (the point at which the water vapor condenses), clouds can begin to form. Sometimes, thermals do not become fully saturated and never produce clouds. In this case, dry convection is taking place. Warmer air at the surface is being transported into the cooler air in the atmosphere, but no clouds form.

Cirriform

Cirriform category clouds generally have a wispy fibrous appearance and form at high tropospheric altitudes along the very leading edges of a frontal or low-pressure weather disturbance and often along the fringes of its other borders. They are composed of ice crystals and appear white. In general, they are non-convective but occasionally acquire a tufted or turreted appearance caused by small-scale high-altitude convection. These high clouds do not produce precipitation as such but are often accompanied or followed by lower-based clouds that do. Formation is as the tops of very high Cb blown away by strong upper level winds, hence ‘streaks’. Can be associated with:-

A low pressure system and associated cold front being an advance warning from 20-36 hours.

As first signs of an approaching warm front, especially in tropical areas.

A jet stream.

A tropical revolving storm (Cyclone in the southern hemisphere)

Indication:- When in conjunction with a regular drop in barometric pressure along with other signs such as increasing swell and followed by a typical cloud sequence heralds the arrival of a cold front in 20-36 hours. The trail points usually to the phenomena of cause.

Cirrocumulus

Cc –One finger rule-formed when Ci is subjected to upward air movement giving classic ‘Buttermilk Sky’ and as ‘Mackerel Sky’ when lifting becomes more organized developing further to definite organized ‘Ribs’ which if arranged in across streaks can be jet stream cloud. All signing to an approaching low or front. Old Sailor rhymes-Mackerel sky, dry then wet, wet then dry. And Mackerel sky, four days wet then four days dry.

Cirrostratus:

Cs Ice cloud although at a slightly lesser height than Ci, seen as a 'halo' or 'veil' with the sun or moon.

Indication:- Approaching cold front.

Cumuliform

Cumuliform clouds typically have flat bases and puffy domed tops. They are the product of localized but generally free-convective lift and can vary in vertical extent depending on the stability characteristics of the air mass where they are forming. The smallest fair weather cumuliform types occur with only minimal instability (cotton wool or cauliflower) and can therefore be considered clouds of limited convection. Incoming short-wave radiation generated by the sun is re-emitted as long-wave radiation when it reaches Earth's surface. This process warms the air closest to ground and increases air mass instability by creating a steeper temperature gradient from warm or hot at surface level to cold aloft. Moderate instability allows for the formation of cumuliform clouds of moderate size that can produce light showers if the airmass is sufficiently moist. The more the air is heated from below, the more unstable it tends to become. This may cause large towering cumuliform clouds to form in the lower half of the troposphere with tops growing into the upper levels. These buildups can cause moderate to occasionally heavy showers. They tend to be more concentrated and intense when they are associated with fast-moving unstable cold fronts.

Indication:- Small cu clouds are fine weather whereas large increasing mounds bring showers and possibly develop into thunderstorms Cb or otherwise can become the leading edge of a front.

Stratocumulus

Sc Associated with inversions either as high pressure sinking air or as gently rising air trapped by the inversion.

Indication:-Generally light to moderate winds, possible drizzle.

Cumulonimbiform

The largest free-convective cumuliform clouds occur in very unstable air and often have complex structures that include cirriform tops and multiple accessory clouds and are sometimes classified separately as cumulonimbiform. At maturity, they have very strong updrafts that can penetrate the tropopause. They can produce thunderstorms and a variety of types of lightning including cloud-to-ground that can cause wildfires. Other convective severe weather may or may not be associated with thunderstorms and include heavy rain or snow showers, hail, strong windshear, downbursts and tornadoes.

Indication:- Usually shortlived but just one of a 'family'.Strong irregular winds, gusty, heavy showers with possible hail and lightning. Tornadoes do not usually descend to ground in Australia but can happen as with waterspouts.

Mammatus

Named after ‘udder’ several uncertain descriptions of formation but generally as warning of a stronger system. Forward flank of Cn

Stratiform

In general, stratiform-category clouds have a flat sheet-like structure and form at any altitude in the troposphere where there is sufficient condensation as the result of non-convective lift of relatively stable air, especially along warm fronts, around areas of low pressure, and sometimes along stable slow moving cold fronts. In general, precipitation falls from stratiform clouds in the lower half of the troposphere. If the weather system is well-organized, the precipitation is generally steady and widespread. The intensity varies from light to heavy according to the thickness of the stratiform layer as determined by moisture content of the air and the intensity of the weather system creating the clouds and weather. Unlike free convective cumuliform and cumulonimbiform clouds that tend to grow upward, stratiform clouds achieve their greatest thickness when precipitation that forms in the middle level of the troposphere triggers downward growth of the cloud base to near surface level. Stratiform clouds can also form in precipitation below the main frontal cloud deck where the colder air is trapped under the warmer airmass being forced above by the front. Non-frontal low stratiform cloud can form when advection fog is lifted above surface level during breezy conditions.

Altostratus

As Thick layers of blue-grey or grey can sometimes have a horizontally striped or layered appearance. If the sun can be seen, has a ‘frosted’ look.

Indication:-Front due in 6-12 hours, possible thunder and rain with falling barometer and strong wind soon.

Nimbostratus

Ns The typically recognised rain cloud formed by the lowering and thickening of Altostratus.- Nimbus meaning rain bearing.

Indication:-Wind with a low pressure system becoming maximum with heavy rain and ‘scud’ low cloud expected.

Stratocumuliform

Clouds of this physical structure have both cumuliform and stratiform characteristics and generally form as a result of limited convection in slightly unstable air. They can form at any altitude in the troposphere wherever and whenever there is sufficient moisture and lift. High stratocumuliform clouds also tend to show some cirriform characteristics or form in association with cirriform clouds. If a poorly organized low-pressure weather system is present, virga or weak intermittent precipitation may fall from those stratocumuliform clouds that form mostly in the low and lower-middle height ranges of the troposphere.-(Adapted from Wikipedia)

Cirrostratus-One finger rule, Altocumulus-Three finger rule. Refers to the spacing of individual cloudlets when the hand is upstretched to the sky.

Ci-Cirrus

Cs-Cirro-stratus

Cirro-cumulus

As-Alto-stratus

Ac-Alto-cumulus

Ns-Nimbo-stratus

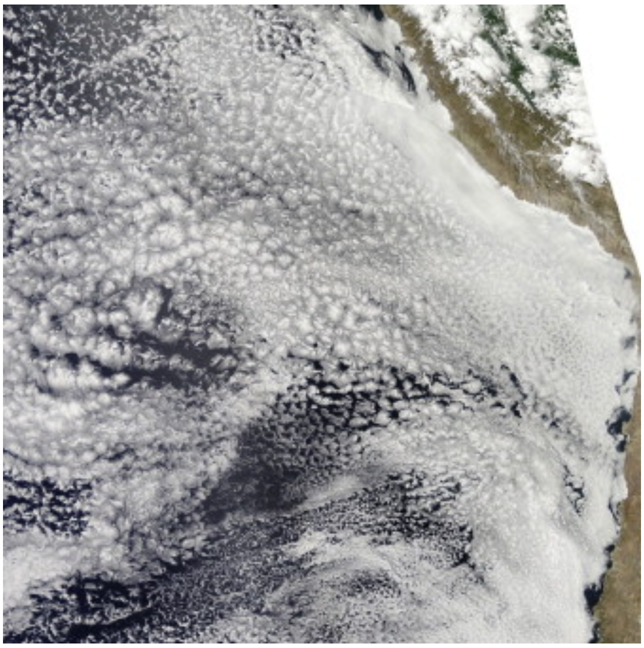
Cb-Cumulo-nimbus

Cu-Cumulus

Sc-Strato-cumulus

St-Stratus

Structure. Stratocumulus clouds are typically 200–400 m thick and usually occur at the top of the boundary layer below a thermal inversion. It is remarkable that such a thin cloud can extend practically unbroken for a thousand kilometers, but strong negative feedbacks exist to constrain cloud thickness.



Stratocumulus clouds usually form from a layer of stratus cloud breaking up. They are indicators of a change in the weather and are usually present near a warm, cold or occluded front. The definitional difference between these two is the height at which they occur. Stratocumulus are low-level clouds that will have their bases below 6500 feet whereas Altocumulus cloud bases are between 6500 and 20,000 feet making them mid-level clouds

A stratocumulus cloud, occasionally called a cumulostratus, belongs to a genus-type of clouds characterized by large dark, rounded masses, usually in groups, ...

Precipitation cloud?: Uncommon

Appearance: Much like Cumulus clouds, except ...

Altitude: 500-2,000 m; (2,000-7,000 ft)

Species: Castellanus; Floccus; Lenticularis; Str...

Appendix

Bureau of Meterology – Marine Wind Warning

Marine Wind Warnings form part of the coastal and local waters forecasts. They are broadcast on marine radio (VHF and HF), published on the Bureau's website, and available in the warnings section of the BOM Weather app. Checking for wind warnings is the most important of the Five Vital Weather Safety Checks. When a Marine Wind Warning is issued, these are the key features that you should consider.

1. When will the wind warning conditions start?

The warning indicates the period covered. Marine Wind Warnings are issued as much as 42 hours in advance and are then updated every 6 hours. However, if conditions develop rapidly, warnings can be issued and updated at any time.

Skippers already on the water should assess if they have enough time to get back to port before the wind picks up or take precautions and seek shelter.

2. What speed will the wind reach?

The wind strengths associated with the different categories of wind warnings issued by the Bureau are presented in the table below. As a skipper, you need to be aware of what wind conditions your vessel can handle, and take steps to avoid stronger winds.

Remember that the wind speeds mentioned in forecasts and warnings are averages, and that wind gusts can be 40 per cent stronger, and stronger still in the vicinity of thunderstorms and squalls.

Strong wind warning	Winds averaging from **26 knots and up to 33 knots.**
Gale warning	Winds averaging from **34 knots and up to 47 knots.**
Storm force wind warning	Winds averaging from **48 knots and up to 63 knots.**
Hurricane force wind warning	Winds averaging **64 knots or more.**

3. What area is the wind warning for?

The Marine Wind Warning Summary lists which coastal and local waters areas are affected. You should be familiar with the Bureau's coastal and local waters areas and which ones overlap with your location.

Coastal and local waters forecasts also indicate a wind warning is current for that area, and can indicate which areas may be more impacted (e.g. inshore or offshore). The Bureau's graphical forecast tool MetEye also enables you to get more detail for the area you are planning to operate in, showing three-hourly forecasts for 6km2 grids across all coastal waters areas.

4. What direction will the wind be from?

The Bureau's forecasts will indicate what direction the wind will be coming from. With passing fronts or low pressure systems, wind directions may change suddenly. If you are seeking shelter, be prepared to move your vessel when the wind direction changes for safety.

5. Is there any bad weather expected?

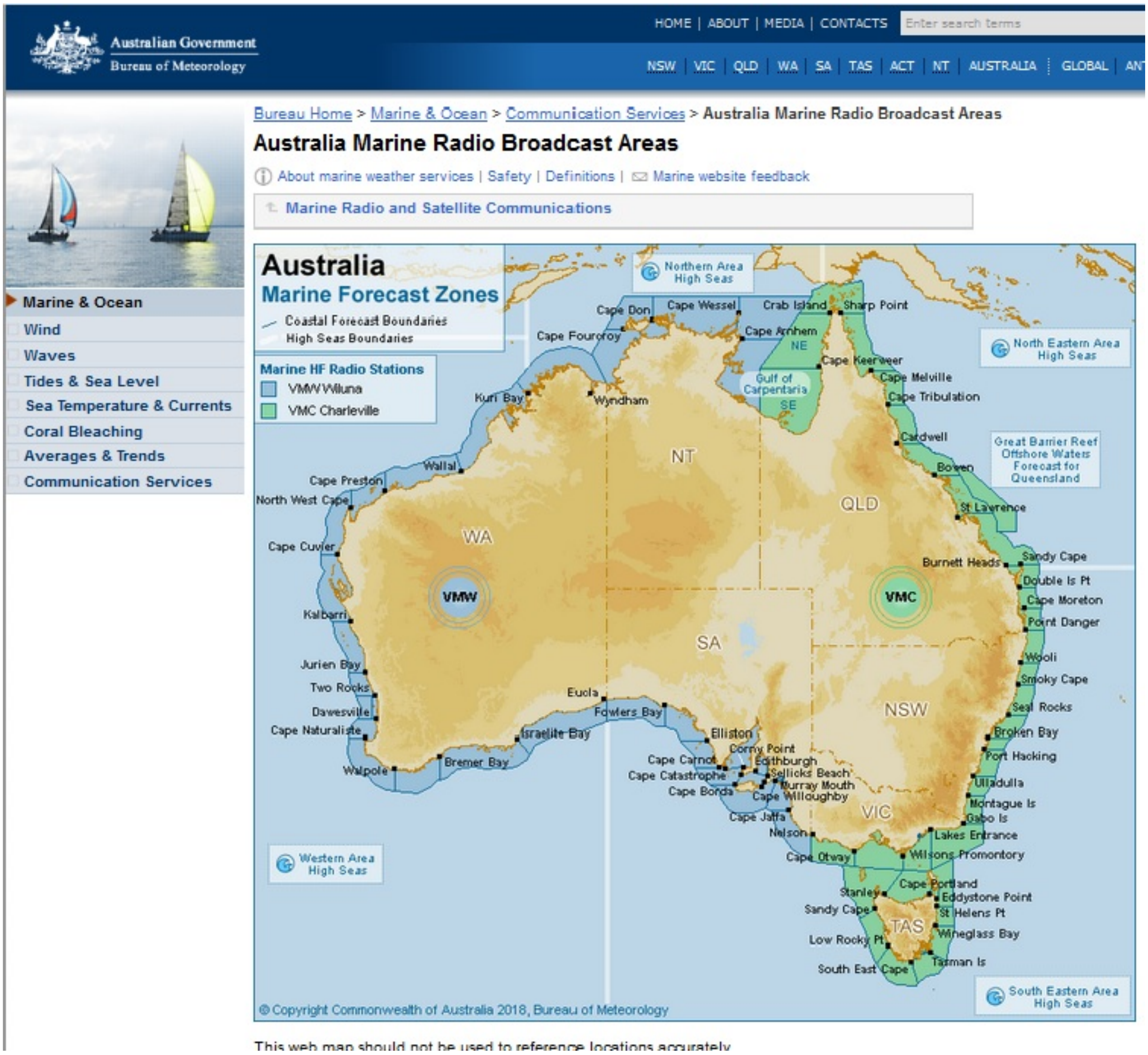
Upon hearing of a wind warning, skippers should seek further information from the Bureau's forecasts via marine radio (VHF or HF) or the Bureau's website. Coastal and local waters forecasts provide additional important information, including if bad weather is also expected. A cold front or thunderstorm may be associated with other hazards such as squalls, heavy rain, or lightning.

Skippers should always exercise additional caution for local effects and in case conditions worsen suddenly.

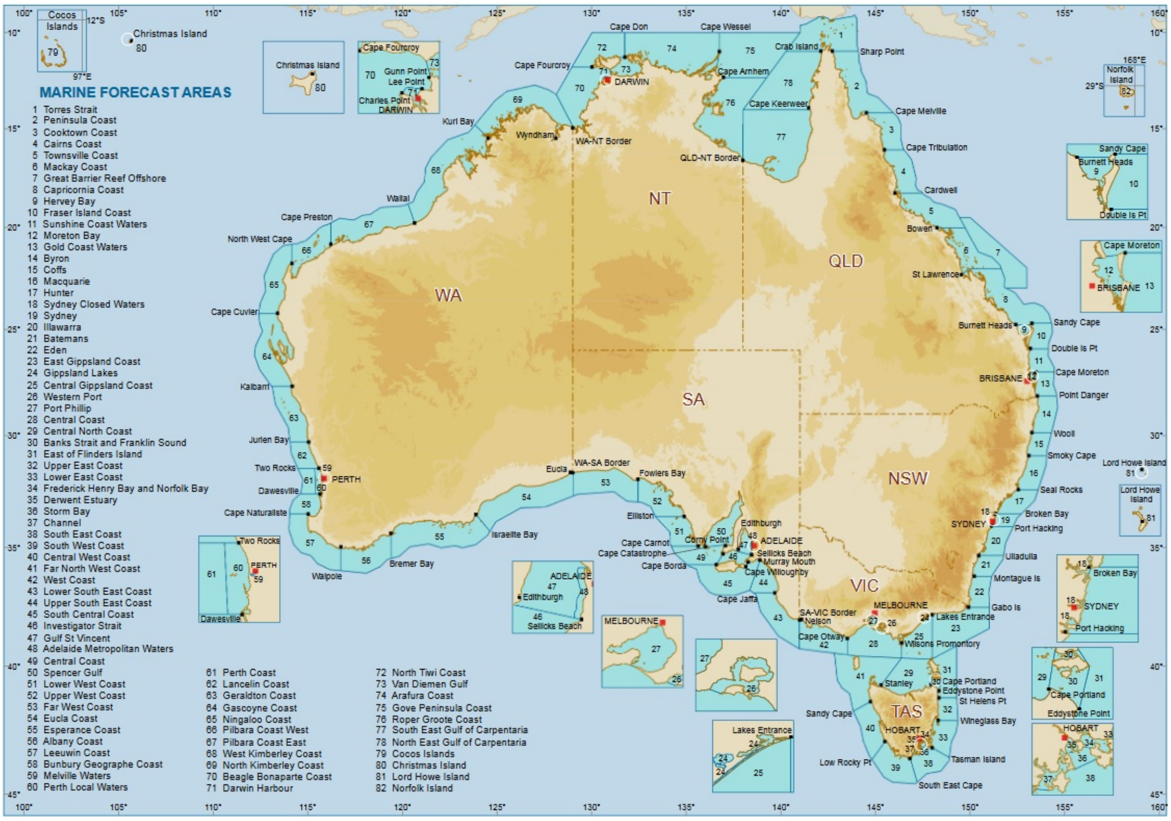
6. When will the warning conditions cease?

The wind warning and forecast indicate when winds are expected to ease, or if the warning has been cancelled. Knowing how long the wind warning may last will help skippers determine their risk management plans.

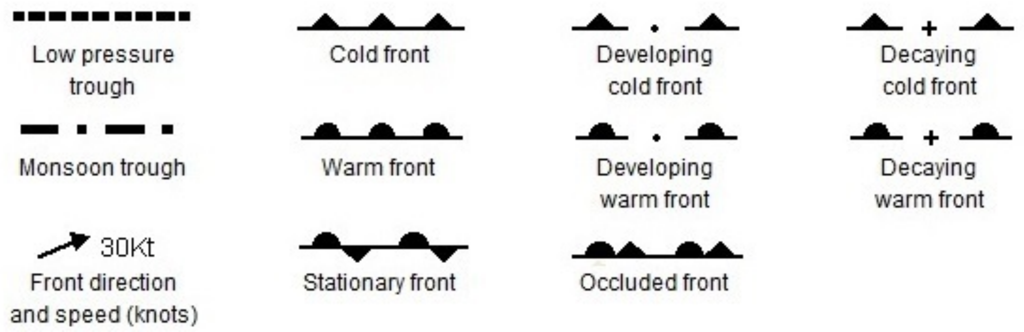
Bureau of Meterology – Australian Marine Radio Broadcast Areas



Bureau of Meterology – Marine Forecast Areas



Marine Weather Map Symbols



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