



DOCUMENT
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DOCUMENT TITLE
METEOROLOGY FOR AUSTRALIA

CHAPTER 17 – TROPICAL METEOROLOGY

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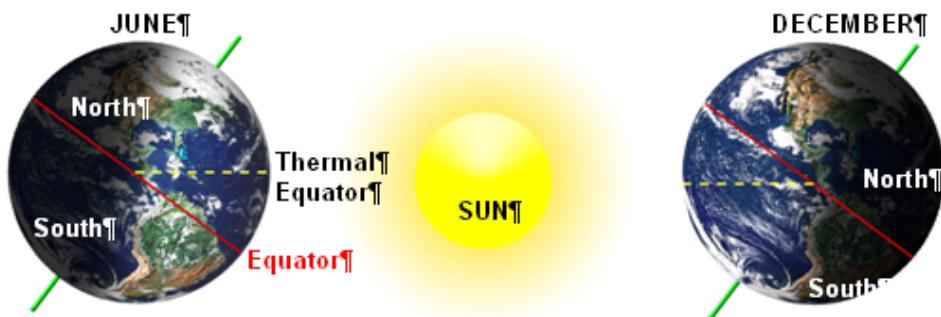
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WORLD PRESSURE SYSTEM DISTRIBUTION

The Earth's surface which has the sun directly overhead receives the greatest amount of heat. This point is called the Thermal (or Meteorological) Equator.

Relative to the Earth, the sun "migrates" north and south due to the Earth's revolution around the sun, and the tilt of the Earth's axis.



The sun's "migration" with the seasons.

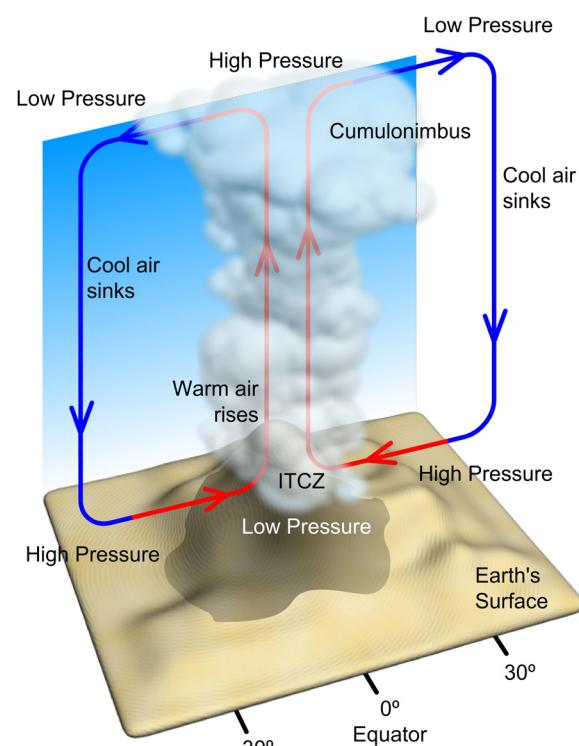
The sun "migrates" as far north as 23½°N in June and as far south as 23½°S in December. The thermal equator "follows" the sun so the hottest part of the Earth also migrates. Air touching the warm ground heats and rises, giving a low surface pressure. Therefore corresponding to the sun's position over the Earth, there is a constant low pressure area. This constant low pressure area may be referred to as:

- Equatorial trough
- Doldrums
- ITCZ (Inter-Tropical Convergence Zone)
- Equatorial Low

In this region there is a convergence zone where strong ascent of air occurs. This is the necessary trigger action for convective instability resulting in vast amounts of Cu and Cb cloud.

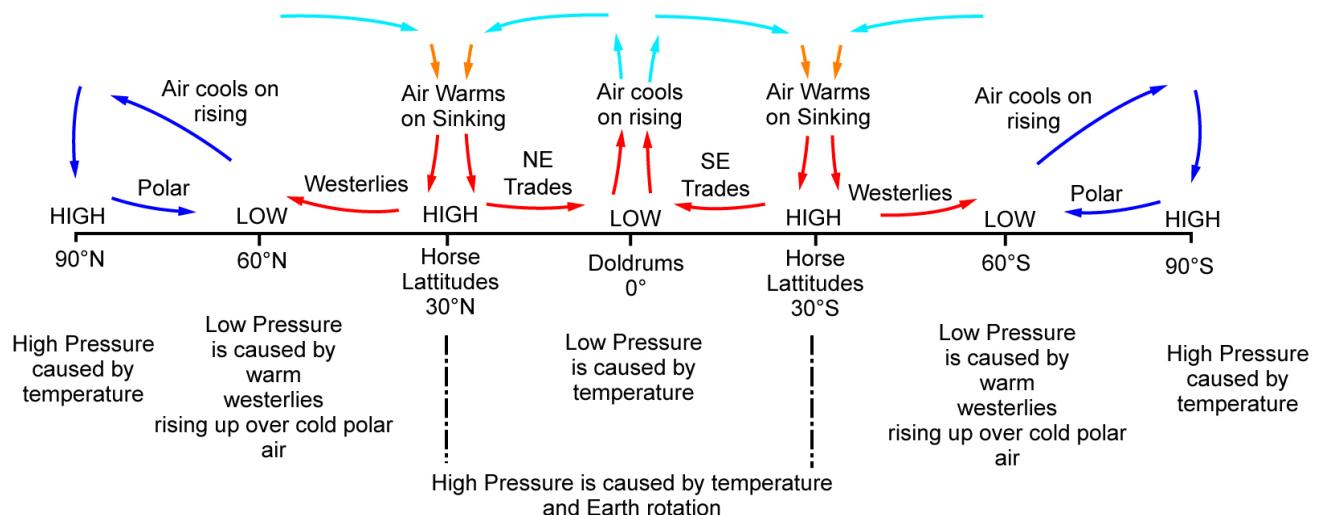
A circulation of air is established with rising air at the equator and descending air at about 30°N or 30°S. This descending air warms, and is stable and dry creating surface high pressure areas which correspond to the world's desert regions. They are known as:

- Horse latitudes
- Sub-Tropical H.P. belt
- Sub-Tropical H.P. ridge.

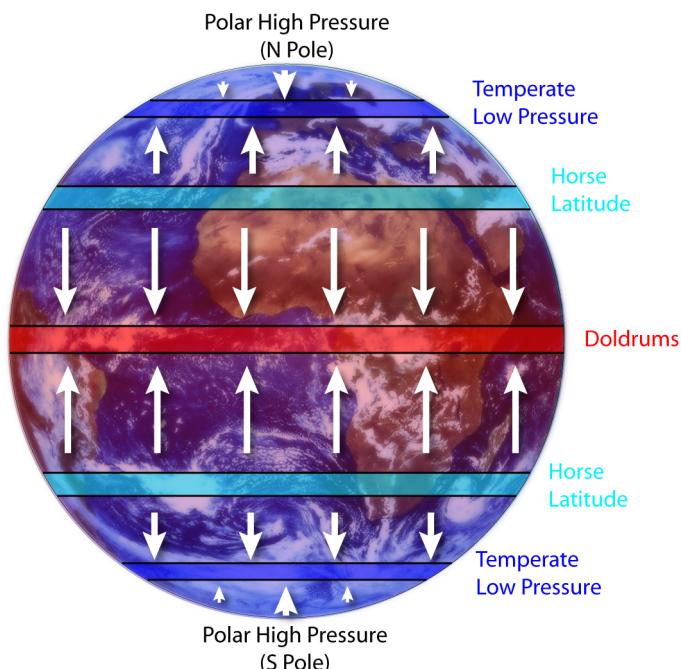


At the poles, cold dense air forms high pressure areas. These high pressure areas are called the Polar Highs. Cold air moving from the poles meets warm air moving from the equator. The warm air rises over the more dense cold air and a series of frontal systems result. At about 45°N and 45°S regions of low pressures form, known as the:

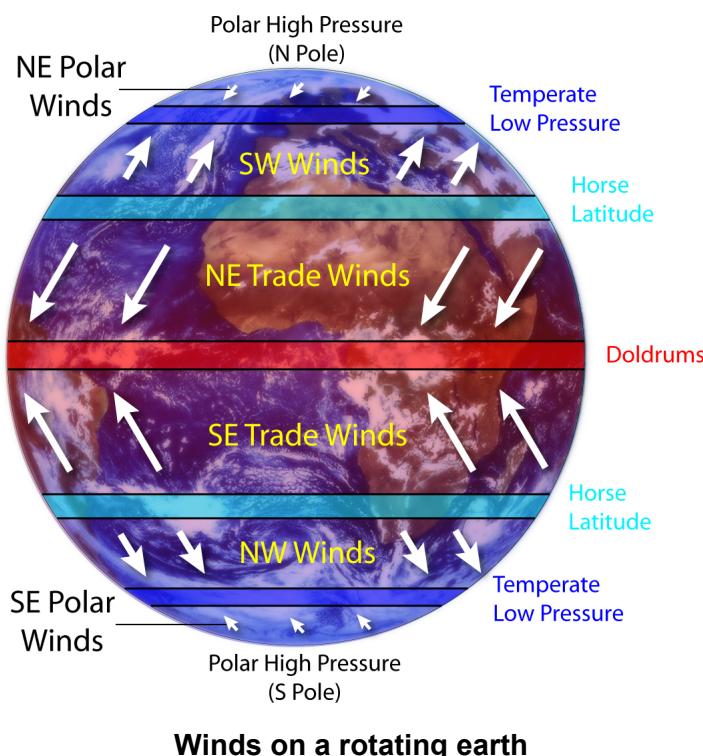
- Mid-latitude low pressure area
- Circumpolar lows
- Sub-polar lows



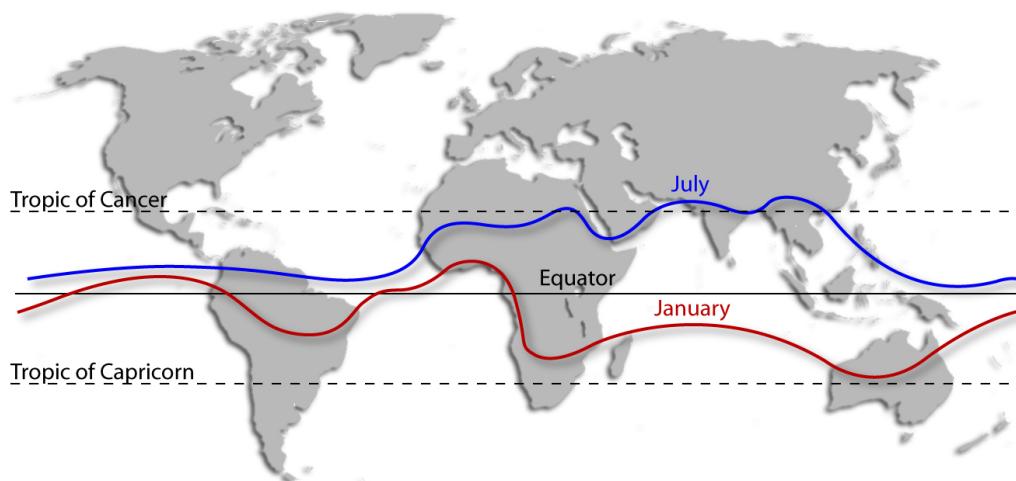
World Pressure and Circulation



Winds on a non-rotating earth



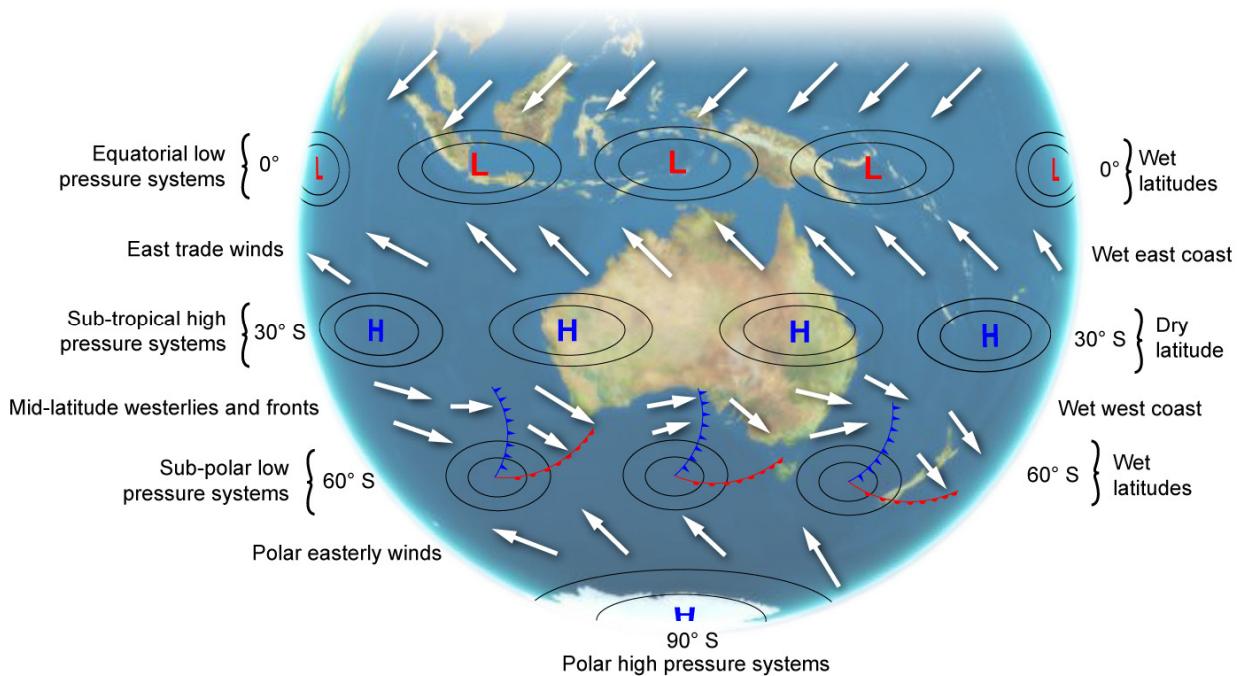
As the sun migrates north and south, the pressure systems also migrate north and south.



Mean positions of the Equatorial Trough, January and July

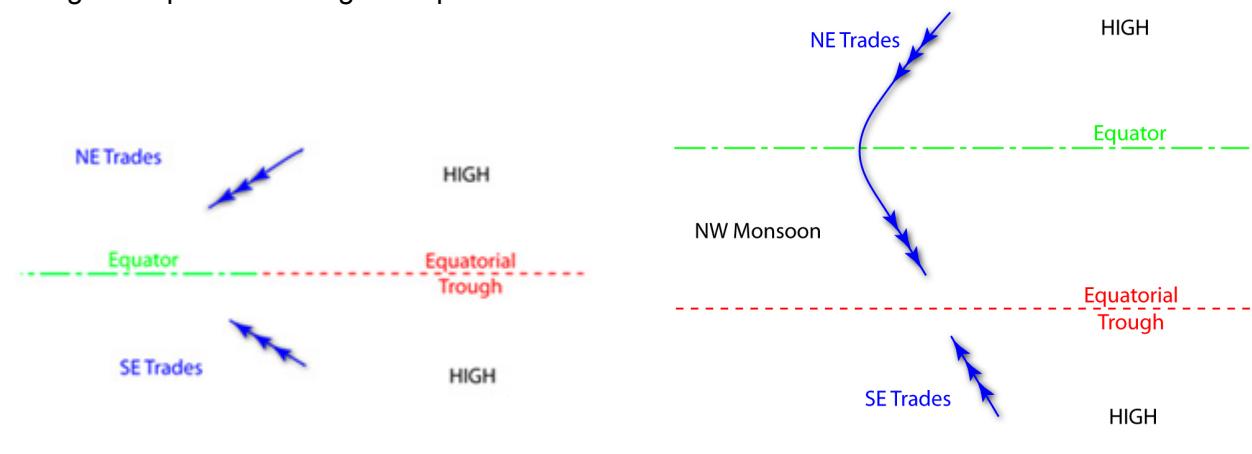
Note:

- Greater migration over land than the sea
- Small movement over Pacific
- No movement south of Equator on West African and West South American coastlines



Pressure Distribution and Surface Winds in the Southern Hemisphere

The winds flowing from the Sub-Tropical H.P. to the Equatorial L.P. change direction when crossing the equator due to geostrophic force.



Surface Winds at the Equatorial Trough

Surface winds after Crossing Equator

MONSOONS

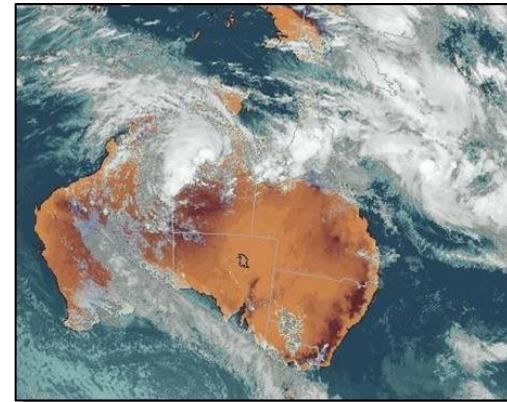
In **December** the sun has migrated south. Northern Australia is affected by the **NW Monsoons**, which bring the Tm air masses.

In **July** the sun has migrated north and SE Asia is affected by **SW Monsoons** bringing the Tm air masses.

A monsoon is a large scale wind blowing from the sub tropical high pressure belt to the equatorial low pressure area.

These winds bring Tm air masses and:

- Are moisture laden
- Have a steep lapse rate
- Produce Cu and Cb clouds
- Produce heavy persistent rain
- Thunderstorms occur daily with accompanying violent squalls.



TROPICAL CYCLONES (HURRICANES, TYPHOONS)

A tropical cyclone is an intense Low Pressure with vast quantities of cloud (Cb, Ns, TCu, Ac). Heavy continuous rain persists with strong winds. These winds may be greater than 100 kts. The pressure may fall to below 950 hPa and high seas accompany the storm.

Requirements for Cyclones

- A pre-existing low pressure system.
- Warm oceans (approximately 27°C). At greater than 15° of latitude the water is usually too cold.
- Vast quantities of moisture (over the sea). It is the latent heat released during condensation that gives a cyclone its tremendous energy.
- At least 5° to 15° N or S of latitude. Geostrophic force is required to induce circulation.
- At less than 5° there is little geostrophic force.
- A trigger to get the air rising e.g Equatorial Trough.

Life Cycle of a Tropical Cyclone

Formative Stage

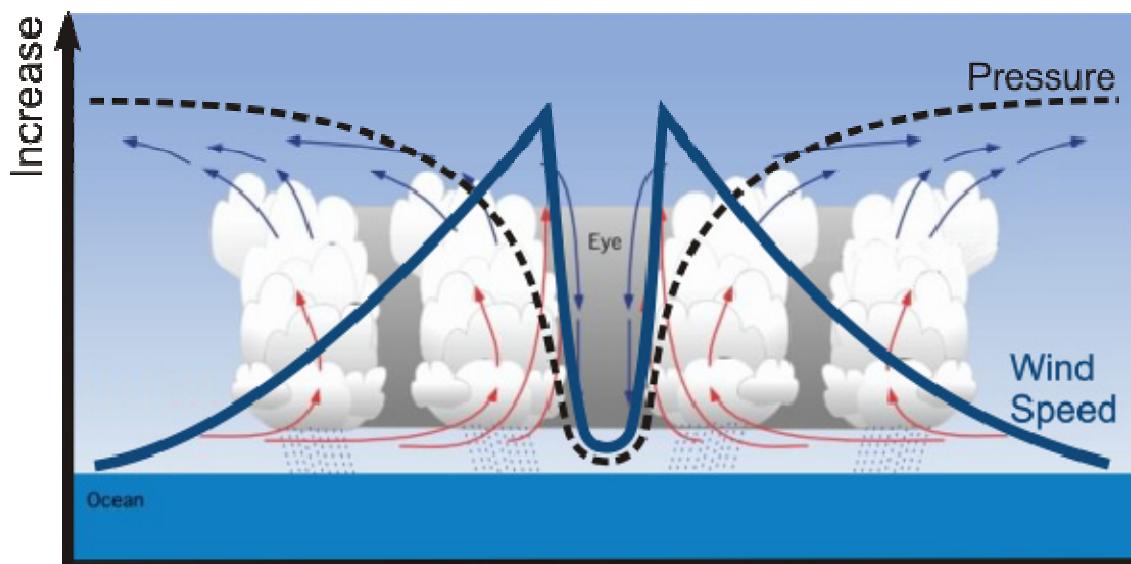
The pressure in a pre-existing low continues to fall and the winds develop to gale force. Nearby areas have warnings such as a heavy sea swell, increasing wind strength and a falling pressure. An “eye” in the pressure system begins to form.

Immature Stage

The pressure falls below 1000 hPa and continues to fall; the winds reach gale force (≥ 34 kts) and a spiral band of cloud begins to form. Continued development can result in pressure falling below 970 hPa and winds increasing to a speed greater than 63 knots.

Mature Stage

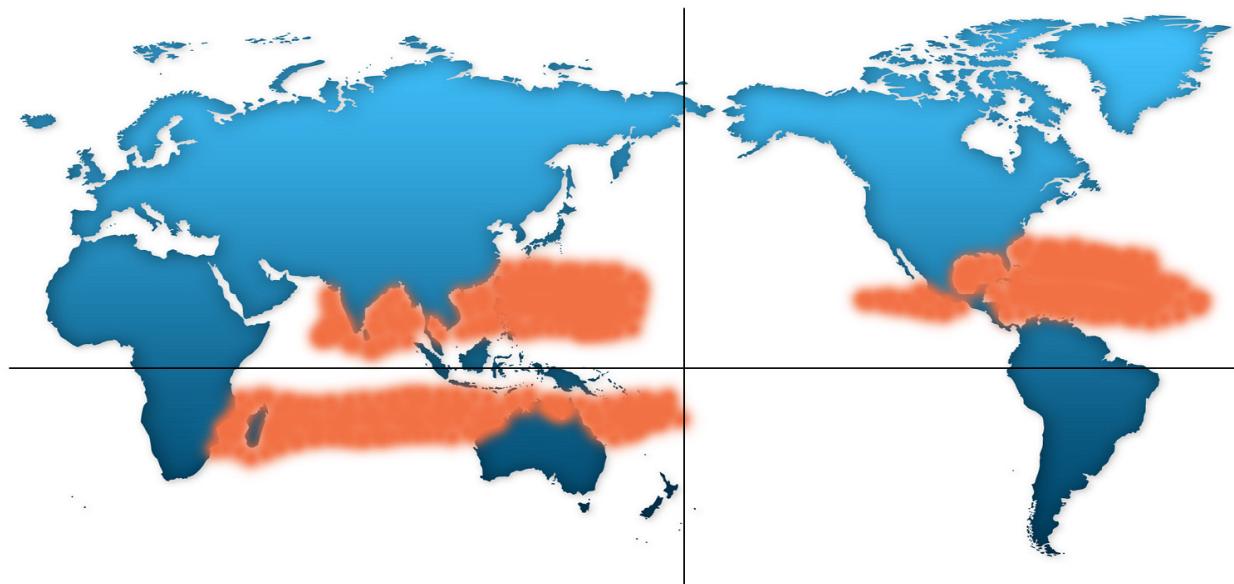
The pressure falls to about 950 hPa and winds reach up to 100+ kts. The area expands up to 400 nm in diameter. The cyclone travels at about 10 to 15 kts and the worst conditions occur in the **left forward quadrant** in the **southern hemisphere** and in the **right forward quadrant** in the **northern hemisphere**.



Cross Section of a Tropical Cyclone

- Decaying Stage

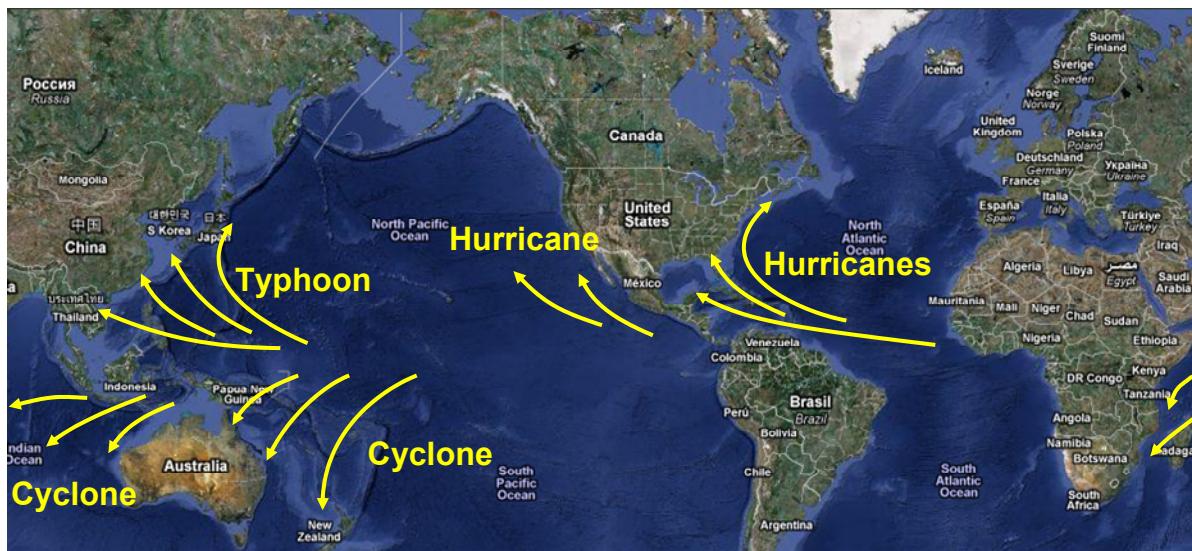
Once a cyclone crosses the coast and moves over land, its supply of moisture is cut off. With no evaporation, there will be no condensation and latent heat release. The central pressure begins to rise and the winds ease off. The cyclone dissipates into a rain depression.



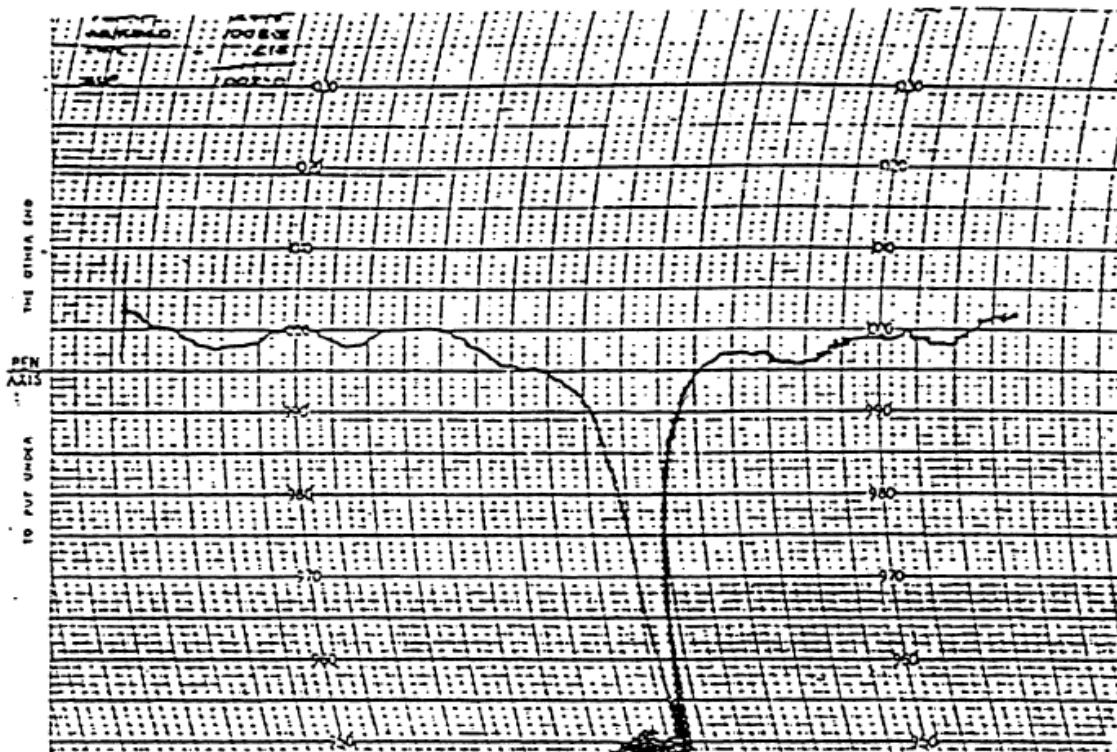
Geographical distribution of the points of origin of hurricanes in the 20 year period 1952–71. Each dot represents the first reported location of a storm which subsequently developed sustained winds in excess of 20 mps. About two thirds of these storms eventually developed winds of hurricane force. Note the area within 5° N and S of the equator.



Tropical Cyclones - Typical Tracks and Periods of Occurrence

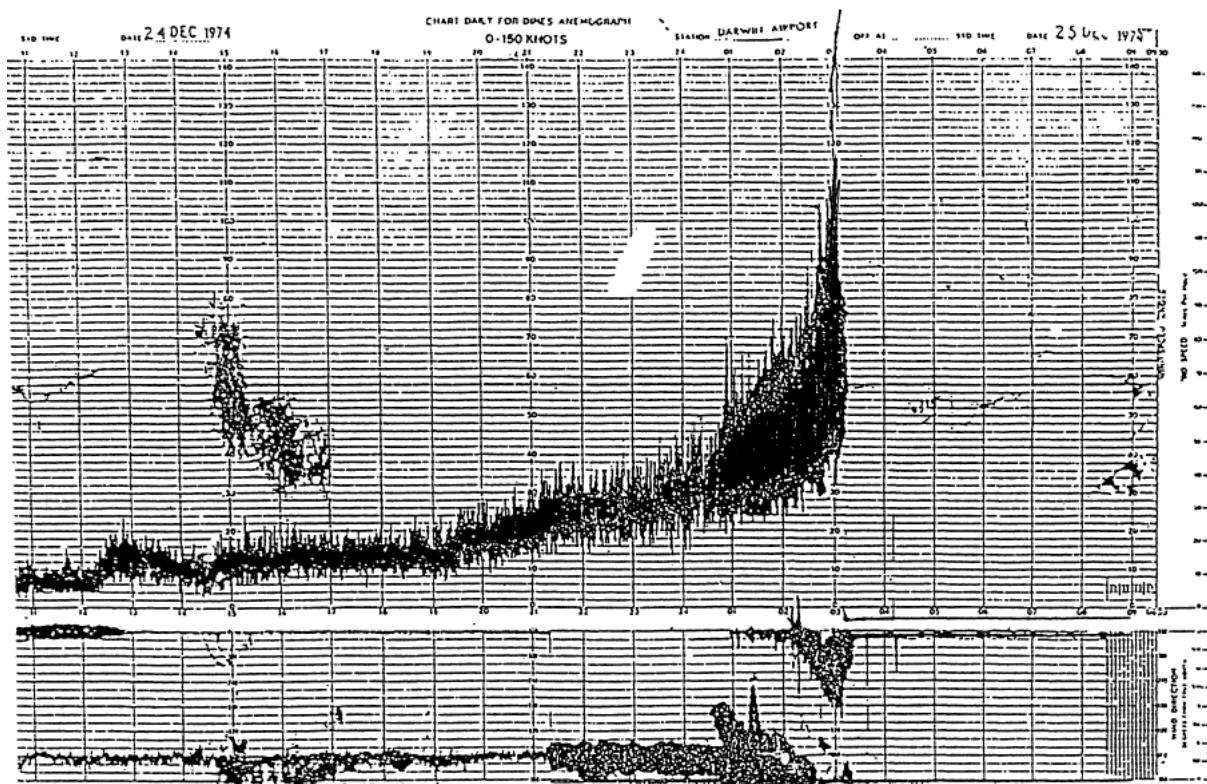


World Wide Tropical Storm Tracks



Barograph trace at Darwin City Regional Office, 23 - 26 December 1974
(Station level pressure)

In December 1974 Darwin, Australia was hit by a tropical cyclone. Note the pressure drop and rise as the tropical cyclone passes.



Dines Anemograph Trace (24 - 25 December 1974) – before the instrument was destroyed.



Hurricane "Andrew" over the Coast of Florida



The Last Word in Weather Hazards. This satellite photograph shows a super- typhoon, characterised by wind speeds exceeding 240km/hr.

Hurricane Katrina. TAF for Navy New Orleans 29 Aug. 05

Notice the Becoming 1214 when the wind is 120145G175, then it drops to VRB06 when the eye passes, then its back up to 270140G160.

KNBG 290303 04030G45KT 9000 +SHRA BR SCT010 BKN030 OVC080 QHN2940INS VCTS
BECMG 0305 03040G55KT 4800 TSRA SCT005 BKN010 OVC030 QNH2900INS
TEMPO 0509 VRB100G120KT 1600 +FC TSRA BR SCT005 OVC010CB
BECMG 0709 VRB115G130KT 0400 +TSRAGR BR SCT005 OVC010CB QNH2860INS
BECMG 0810 QNH2750INS
TEMPO 0915 +FC
BECMG 1214 120145G175KT 0100 +SHRA BR SCT005 OVC010 QNH2663INS
FM1500 VRB06KT 9999 SCT300 QNH2668INS
FM1630 270140G160KT 0100 +TSRA BR SCT005 OVC010CB QNH2672INS
BECMG 1820 270115G135KT 0600 +TSRA BR SCT005 OVC010CB QNH2680INS
BECMG 2022 270100G120KT 0800 +TSRA BR SCT010 BKN025CB OVC180 QNH2689INS
BECMG 2200 28085G100KT 1600 TSRA BR SCT010 BKN025CB QNH2692INS T24/11Z

T34/20Z

(NB 2663 INS = 901 hPa)

Forecast for QANTAS Aircraft VH-EAN Showing a Hurricane near HONOLULU

- Naming Tropical Cyclones

Clement Wragge, the Queensland government Meteorologist from 1887 to 1902 was the first meteorologist to name tropical cyclones. He initially used letters from the Greek alphabet and later names from Greek and Roman mythology. He even used the names of politicians of the day. Naming cyclones ceased until 1963. The naming of cyclones is now followed in most cyclone prone places.

In the Atlantic and Australian region the first cyclone of the season that originates in a particular area begins with the letter “a” and subsequent storms continue with the next letter of the alphabet.

In most of Asia however, although the list of names is “approved”, they are not in alphabetical order and the names of tropical storms follow the sequence of names listed. The next season’s names continue on from the previous listed name.