

Understanding weather and the weather forecast

Week 25

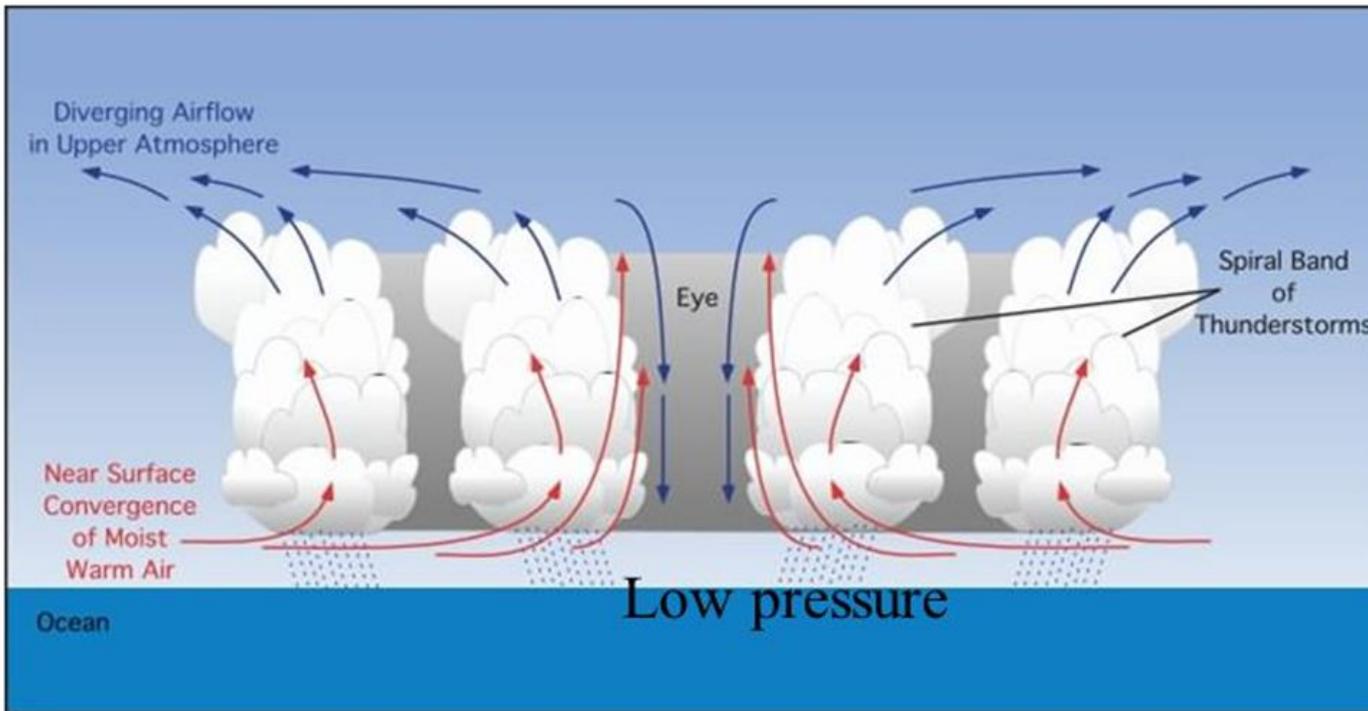
Tropical Cyclones
El Niño/La Niña

Terry Hart

Tropical Cyclones

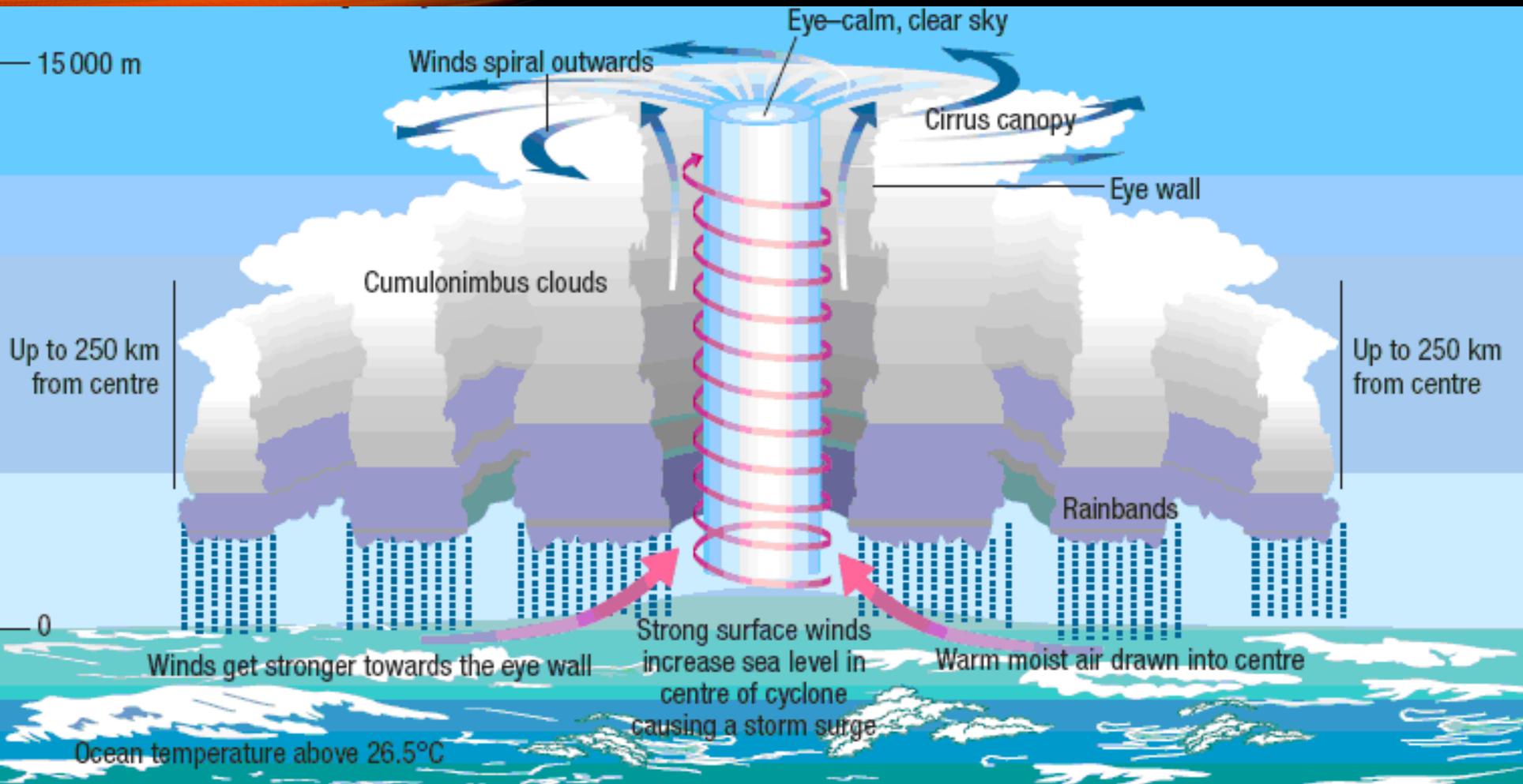
- Form from an active thunderstorm area in a weak low pressure area
- Under favourable circumstances these narrow towers can mutually reinforce and combine into a large cyclone
- The wind accelerates into the centre of the weak low and spin faster due to conservation of angular momentum (Coriolis Effect).
- Convergence produces even more lifting - leading to more thunderstorms and rainfall
- Pressure continues to fall – so a feedback cycle is set up.

High relative humidity required: one of the most important ingredients to form hurricanes is the release of latent heat to the atmosphere



○ Latent heat released due to condensation warms the atmosphere and cause the decrease of pressure at surface

○ As sea level pressure decreases, more air converges at the center of the storm, more latent heat is released and the storm becomes stronger and more powerful, with increasing winds



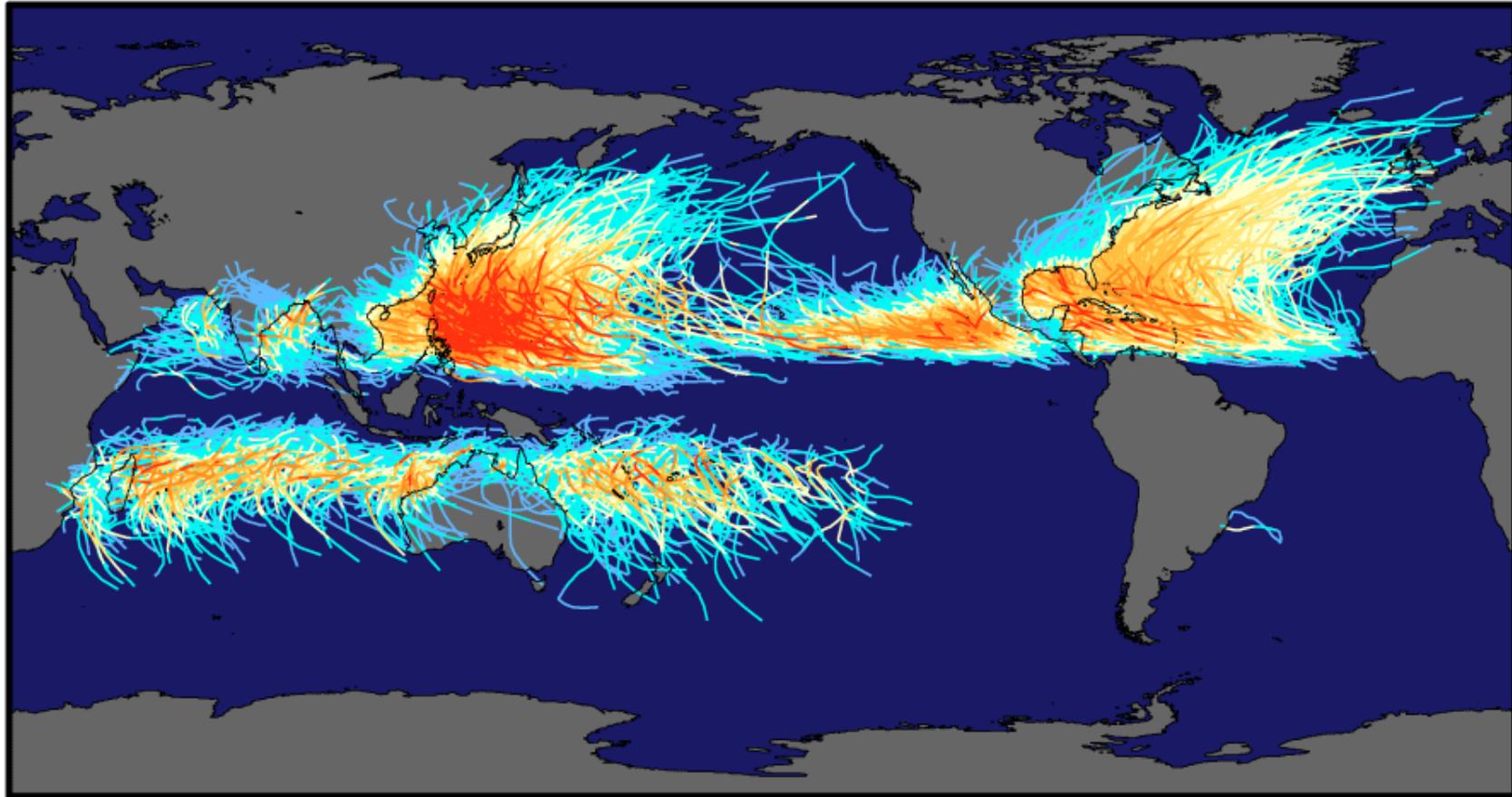
Conditions for tropical cyclones to form:

- Sea Surface Temperature greater than 26.5 degrees
- Moist unstable atmosphere
- Light winds at surface that do not increase much with altitude (strong wind shear can blow the system apart)
- Far enough from Equator for Coriolis effect:
5-10 degrees North and South.

Decay of Cyclones:

- Move into area of strong upper winds
- Move over colder waters
- Move over land – friction and fuel source (water vapour) are cut off.

Tracks and Intensity of All Tropical Storms



Saffir-Simpson Hurricane Intensity Scale

https://eoimages.gsfc.nasa.gov/images/imagerecords/7000/7079/tropical_cyclone_map_lrg.gif

(up to 2006)



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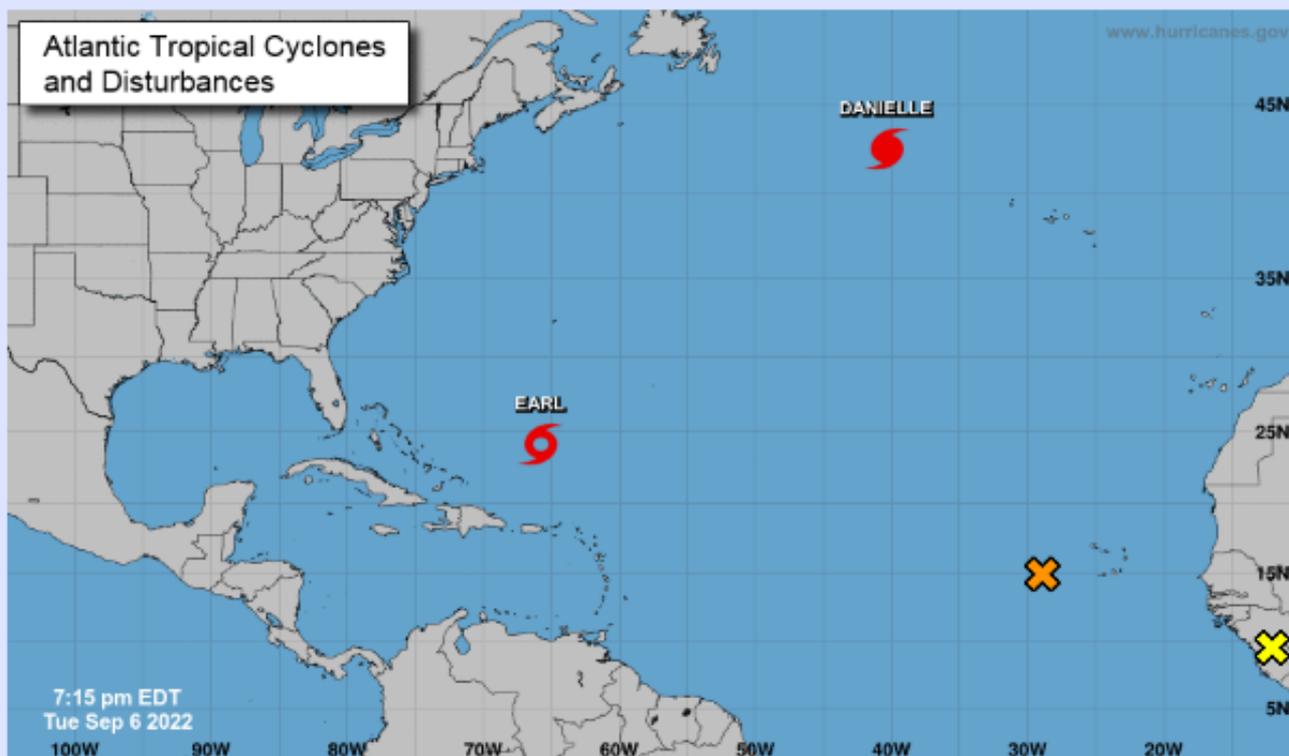
Last update Tue, 6 Sep 2022 23:42:52 UTC

- **NHC issuing advisories for the Atlantic on TS Earl and Hurricane Danielle**
- **NHC issuing advisories for the Eastern Pacific on Hurricane Kay**
- **Marine warnings are in effect for the Atlantic, Caribbean/SW Atlantic and Eastern Pacific**
- Key Messages regarding Hurricane Kay
- Hurricane Andrew at 30: Where science has taken us
- The National Hurricane Center Storm Surge Unit has released Version 3 of the Storm Surge Risk Maps

Central Pacific

Eastern Pacific

Atlantic



Current Disturbances and Two-Day Cyclone Formation Chance: < 40% 40-60% > 60%

Tropical or Sub-Tropical Cyclone: Depression Storm Hurricane

Post-Tropical Cyclone or Remnants



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Last update Tue, 6 Sep 2022 23:45:21 UTC

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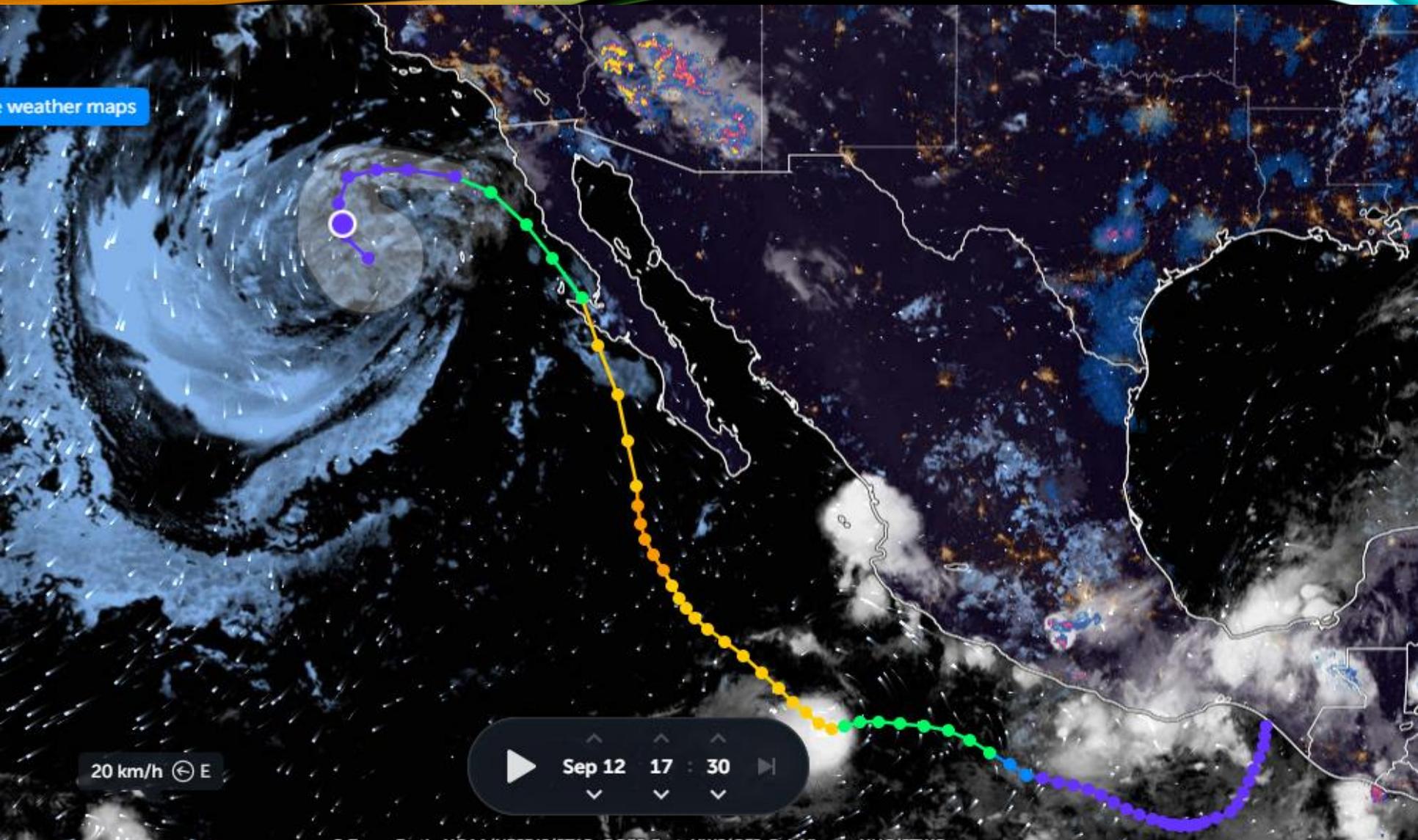
8 Ways The 2022 Atlantic Hurricane Season Has Been Weird



Hurricane season tracks as of early afternoon on Sept. 7, 2022. The black segments indicate when each system was known as a "potential tropical cyclone", in other words, not yet a tropical depression or storm. This included "Potential Tropical Cyclone Four" in the western Gulf of Mexico in August.

<https://weather.com/storms/hurricane/news/2022-09-06-2022-atlantic-hurricane-season-weird>

weather maps



Hurricane Kay

Kay unleashes nearly year's worth of rain, flash flooding in SoCal

After bringing deadly impacts to Mexico as a hurricane, the storm lost wind intensity while pounding the Golden State — and it came close enough as a Pacific tropical storm to make the history books.

By Allison Finch, AccuWeather staff writer

Published Sep 11, 2022 9:59 AM AEST | Updated Sep 12, 2022 7:56 AM AEST

- . the closest approach to Southern California from the Pacific in the last 50 years.
- . tropical storms typically don't reach California, but San Diego State University Professor Dr. Pat Abbott said that the extended heat wave in Southern California allowed Kay to move closer than usual, as the ocean waters were warmer.
- . On Friday, Mt. Laguna, located about 55 miles east of San Diego and about 6,000 feet above sea level, measured 5.60 inches of rain on the mountain's Piñon Point. As the rain came down on the arid landscape, including areas scarred by wildfire burns, there were violent flash floods, but the rain helped suppress wild-fires.

<https://www.accuweather.com/en/hurricane/tropical-storm-kay-unleashes-nearly-years-worth-of-rain-flash-flooding-in-socal/1245242>

Australian tropical cyclone categories

<http://www.bom.gov.au/cyclone/about/intensity.shtml>

<https://youtu.be/qTV8Qft6Nco>

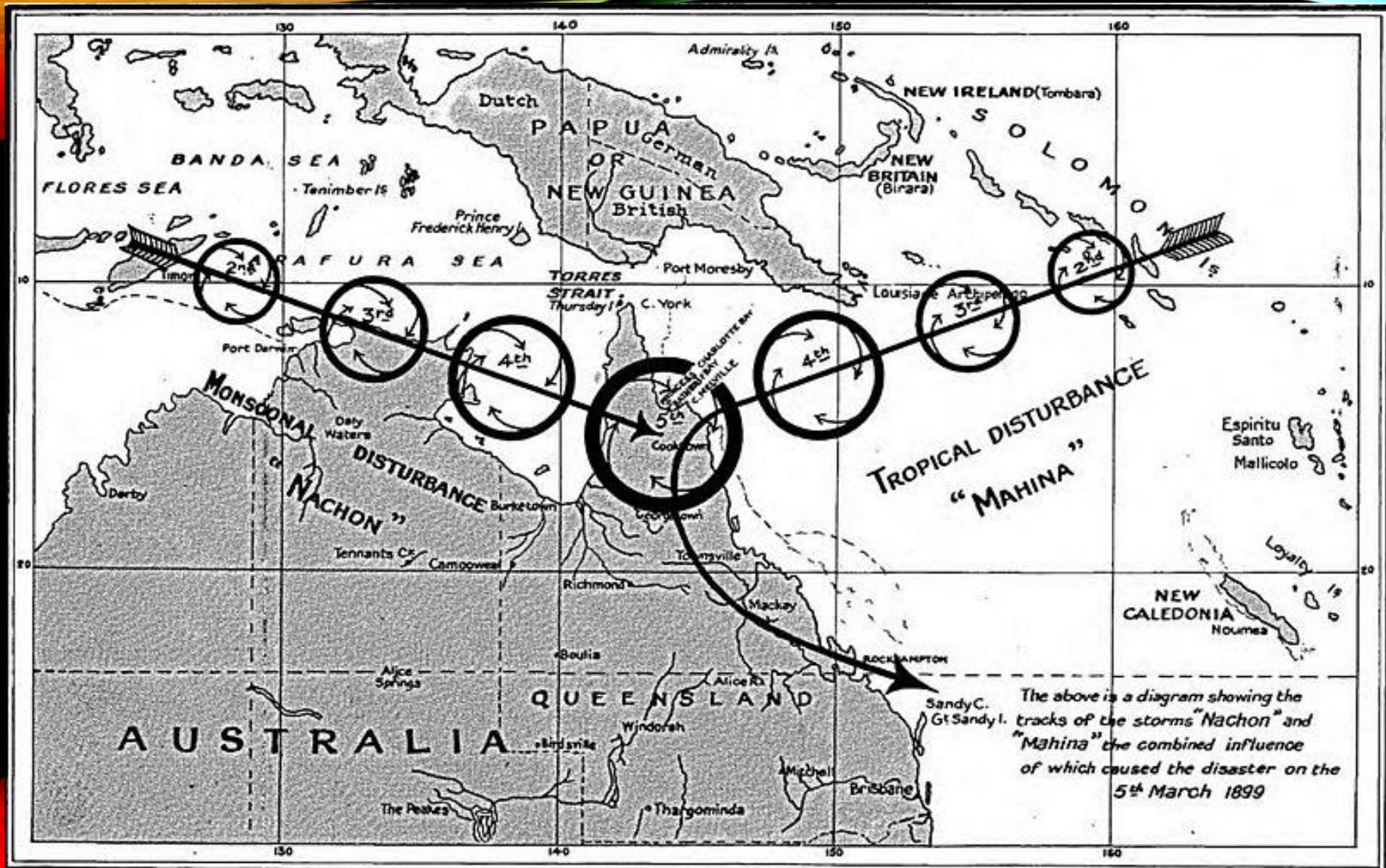
Storm surges associated with tropical cyclones

<http://www.bom.gov.au/cyclone/tropical-cyclone-knowledge-centre/understanding/storm-surge/>

<https://youtu.be/an5uDI2ftb8>

A *storm surge* is generated by weather systems forcing water onshore over a generally limited stretch of coastline. It will normally build up over a time frame of a few hours, as the cyclone or similar weather system approaches. Normally wind-waves on top of the surge will contribute to its effect.

A *Tsunami* is generated by earthquakes, undersea landslides, volcanic eruptions, explosions or meteorites. They travel great distances, sometimes across entire oceans affecting vast lengths of coastal land.



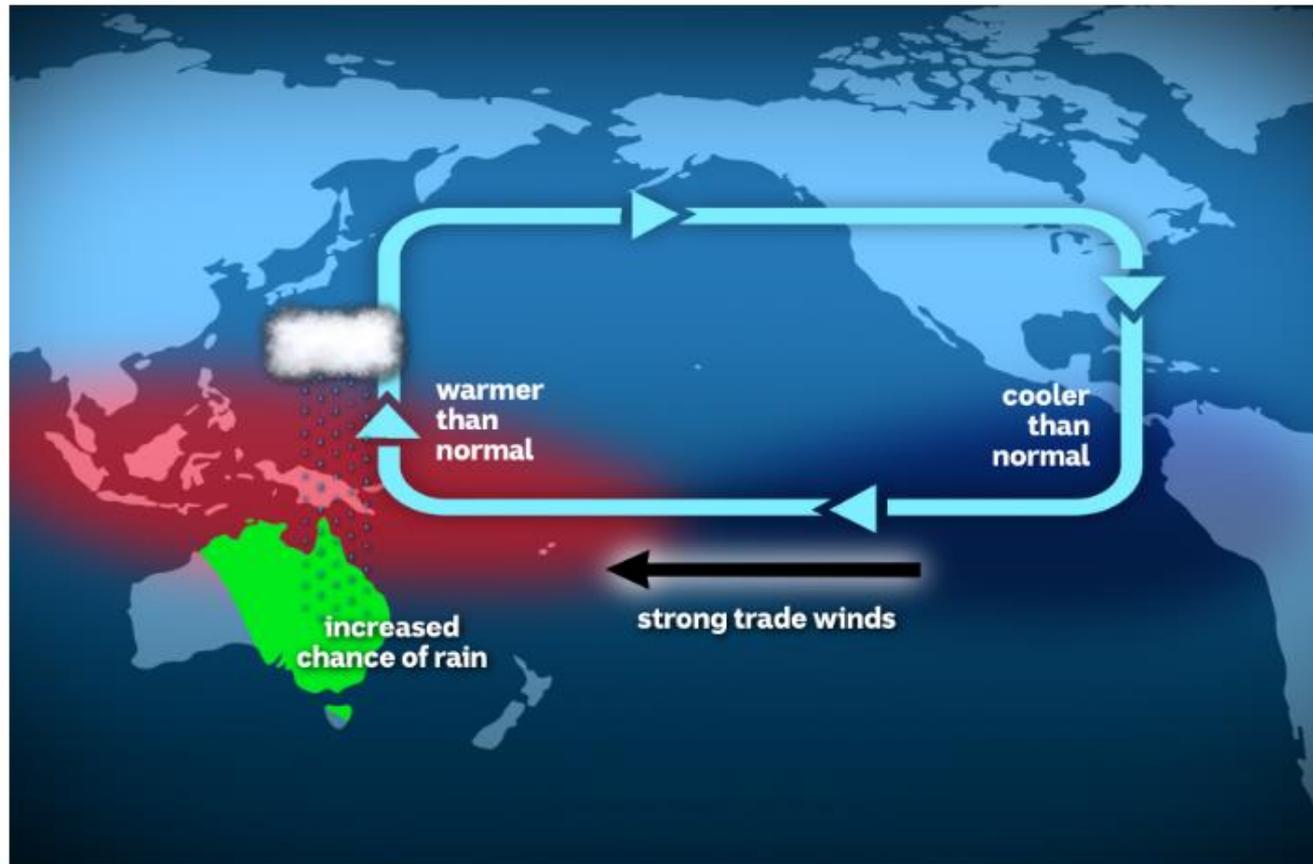
1899 "Mahina" Pearlning fleet – 152 ships, 307 sailors killed ; aborigines not counted
 Presumed to be category 5 with central pressure below 914 hPa

Tropical Cyclone *Tracy* 25 December 1974

- 65 lives, at least
- the destruction of most of Darwin
- profoundly affecting the Australian perspective of the tropical cyclone threat.
- Small but intense tropical cyclone at landfall, the radius of gale force winds being only about 50 km.
- The anemometer at Darwin Airport recorded a gust of 217 km/h before the instrument was destroyed.

<http://www.bom.gov.au/cyclone/history/tracy.shtml>

BOM declares La Niña, increasing flood risk for third year in a row



During a La Niña the atmospheric set-up encourages rainfall for much of eastern and northern Australia. (ABC News)

<https://www.abc.net.au/news/2022-09-13/bom-declares-third-la-nina-summer-weather-flood-risk/101424100>



Australian Government
Bureau of Meteorology

CLIMATE DRIVER UPDATE

Issued 13 September 2022

The latest [Climate Driver Update](#) and [Climate Model Summary](#) are now available on the Bureau's website.

La Niña under way in the tropical Pacific

The Bureau's [ENSO Outlook](#) has been raised to LA NIÑA.

Key atmospheric and oceanic indicators of the El Niño–Southern Oscillation (ENSO) show an established La Niña. Tropical Pacific sea surface temperatures have been cooling since June and are now at La Niña thresholds. Atmospheric indicators including the Southern Oscillation Index (SOI), trade wind strength, and equatorial cloudiness are also displaying patterns typical of a La Niña event.

ENSO Outlook

Our [ENSO Outlook](#) provides up-to-date information on the likelihood of an El Niño or La Niña developing.



Current status: LA NIÑA



8 September 2022

Welcome to the Very Fast Break seasonal climate update video clips.

Play 
Victoria

Play 
SA

Play 
SNSW

If you have comments, questions or feedback address them to Dale Grey at the.break@agriculture.vic.gov.au

<https://www.youtube.com/watch?v=gC6476hvjJk>

Seasonal Climate Drivers

Changes in the ocean temperatures can also lead to large scale changes in pressure with high impact for climate.

Climate kelpie – rounding up climate tools for Australian farmers

<http://www.climatekelpie.com.au/index.php/climatedogs/>

El Niño/Southern Oscillation (ENSO)

Indian Ocean Dipole

El Niño – Southern Oscillation - ENSO

Charles Todd (meteorology and telegraphs - South Australia).

1888 - suggested droughts in India and Australia tended together.

Sir Gilbert Walker (1868-1958)

1904 - Sir Gilbert Walker, a British mathematician entered the British Colonial Service as Director General of the Indian Meteorological Observatory, with the goal of predicting Asian monsoon fluctuations, after failure of the monsoon and disastrous droughts in 1877 and 1899.

The observatory was founded to explore whether future famines could be prevented.

Analyzing weather data from India and lands beyond, over the next fifteen years he published the first descriptions of the **great seesaw oscillation of atmospheric pressure between the Indian and Pacific Ocean**, and its correlation to temperature and rainfall patterns across much of the Earth's tropical regions, including India. It was called the **Southern Oscillation**.

El Niño – Southern Oscillation - ENSO

Normally, **sea level pressure (SLP)** is relatively high in the south central Pacific (e.g. Tahiti) and relatively low over the Indian Ocean and Northern Australia (e.g. Darwin), with a net transport of air at low latitude from east to west (the easterly trade winds).

Every few years the SLP difference between east and west weakens, the trade winds relax and there is often drought in India and Australia.

The **Southern Oscillation Index (SOI)** is given by:

$$\text{SLP at Tahiti} - \text{SLP at Darwin.}$$

Barometric records at those stations go back to the 1880's proved to be paramount in Walker's discovery.

The concept of a **zonal circulation** along the equatorial regions became known as the **Walker Circulation**. (The Hadley circulation is a meridional circulation).

<http://www.bom.gov.au/climate/influences/timeline/>

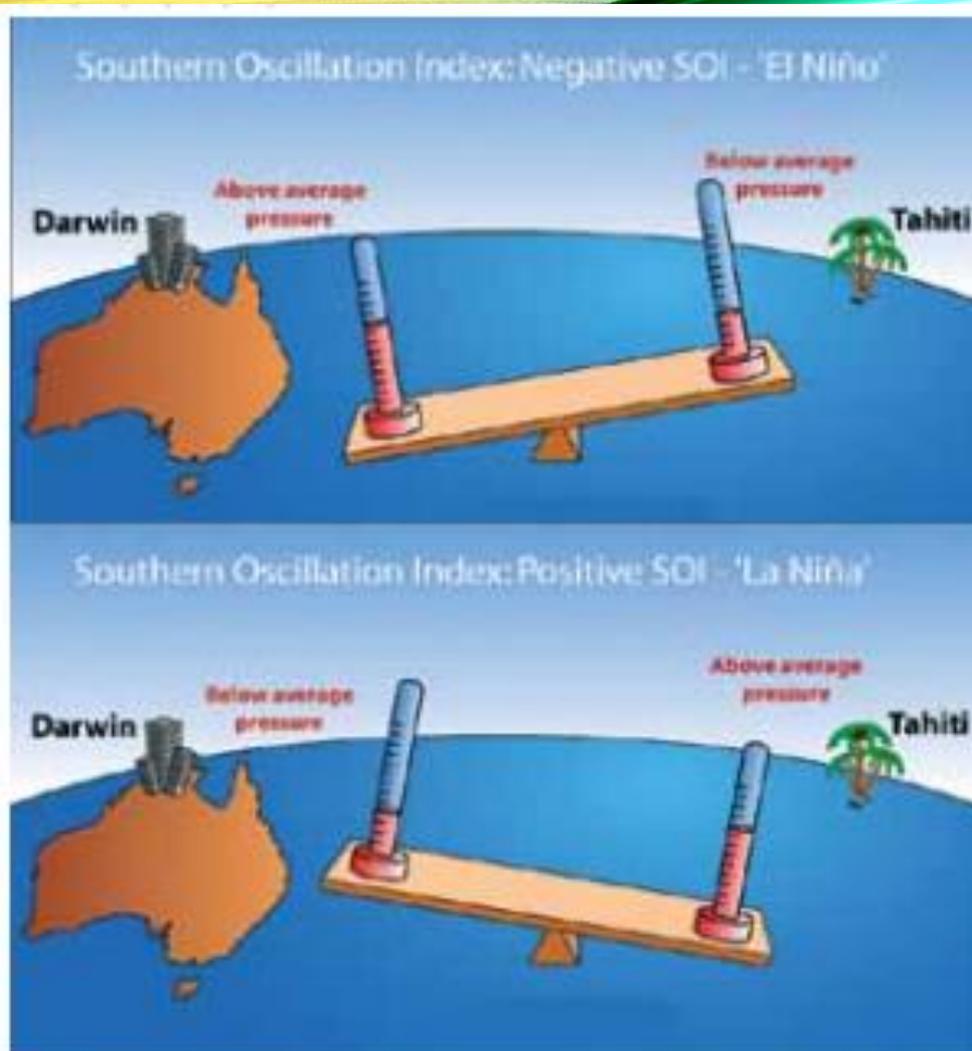


Figure 3.1. The Southern Oscillation is a see-saw of atmospheric pressure between the Indonesian region and the east equatorial Pacific.

Will it rain?

<https://www.longpaddock.qld.gov.au/about/resources/>

The East-West “Walker Circulation” in the Tropics

