

# Climate of Guam

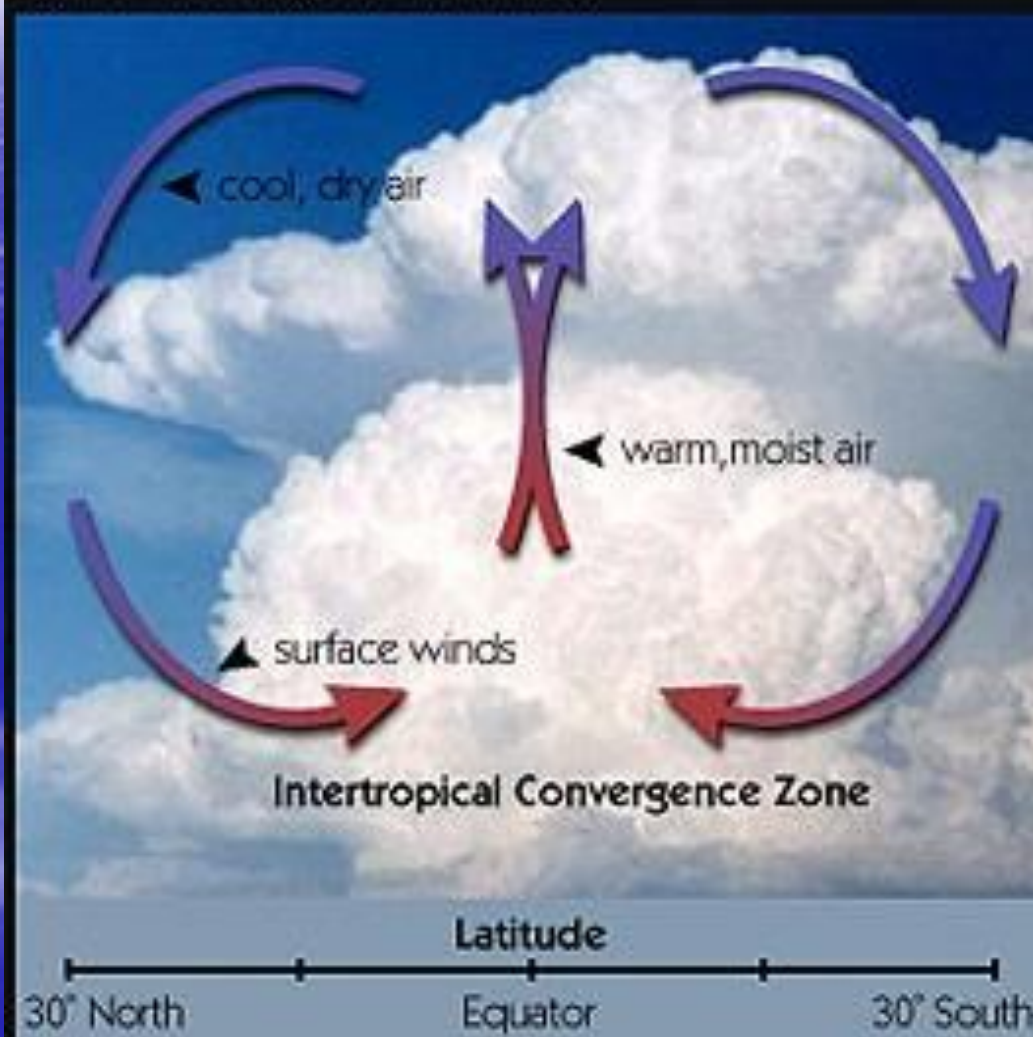
BI 201 Natural History of Guam  
Class Presentation 20

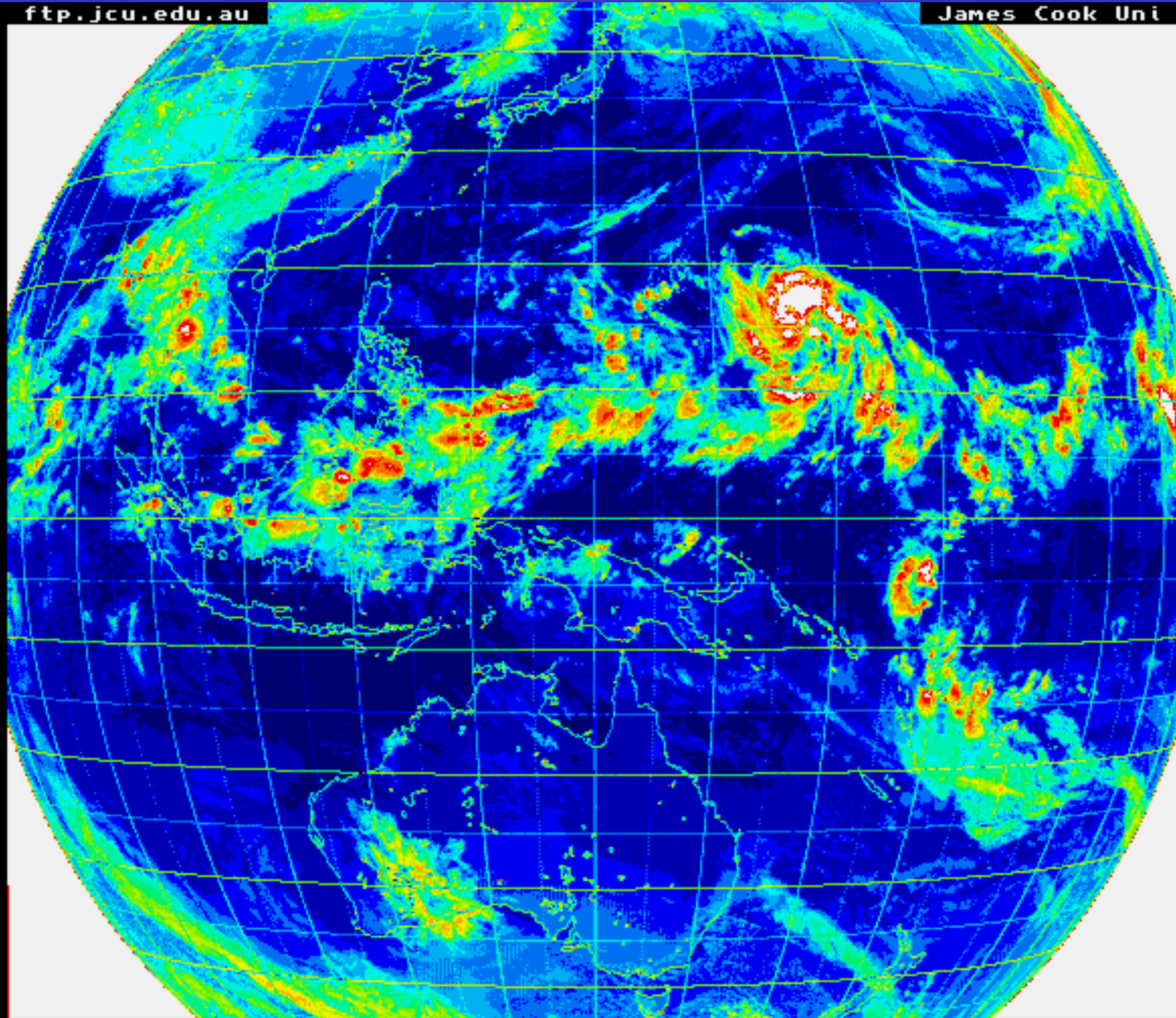
- What is the difference between **weather** and **climate**?
  - Weather is the state of the atmospheric conditions (temperature, wind, rain, etc.) at any given time
    - Weather varies throughout the day and night
    - The driving force of weather is solar radiation
  - Climate is the average weather conditions for a given area over a long period time, usually more than 30 yr

- Guam lies within the **Intertropical Convergence Zone (ITCZ)**
  - The ITCZ is an area of low pressure that forms where the Northeast Trade Winds meet the Southeast Trade Winds near Earth's equator

- As these winds converge, the warmed, moist air is forced upward and cooler air moves in beneath it, forming a Hadley cell
- This causes water vapor to condense, or be "squeezed" out, as the air cools and rises, resulting in a band of heavy precipitation around the globe

Figure 2: Hadley Cell Circulation





- This band moves seasonally, always being drawn toward the area of most intense solar heating, or warmest surface temperatures
- It moves toward the Northern Hemisphere from June through November and reverses direction in preparation for the Southern Hemisphere Summer that occurs from December through May

- Variation in the location of the ITCZ drastically affects rainfall in many equatorial nations, resulting in the wet and dry seasons of the tropics rather than the cold and warm seasons of higher latitudes
- Longer term changes in the ITCZ can result in severe droughts or flooding in nearby areas



## ■ **General characteristics of Guam's climate**

– Guam's climate is generally described as warm-tropical and humid, with little seasonal variation

### – Temperature conditions

- Temperatures are rather uniform temp year-round, averaging 76–86 °F throughout the year
- There is little diurnal variation, averaging only 10 °F, and there is little change with elevation

- The mean temperature in Guam is 81 °F
  - The monthly mean temperature ranges from 80 – 82 °F
- The mean high temperature is 86 °F
  - The monthly mean high temperature ranges from 85 – 87 °F
  - The maximum temperature recorded is 96 °F (April 1971)
- The mean low temperature is 76 °F
  - The monthly mean low temperature ranges from 75 – 77 °F
  - The minimum recorded temperature is 60 °F (February 1995)

- The coolest period is January – February, and the warmest period is May – Jun
  - However, the temperature range between these periods, based on average monthly temperatures, is  $<3^{\circ}\text{F}$
- The diurnal temp range averages at least  $10^{\circ}\text{F}$  in all months
- For coastal areas ( $<80$  ft. elevation), the warmest daytime temperature ranges from  $83 - 88^{\circ}\text{F}$ , and the coolest part of the night (i.e., just before dawn) ranges from  $73 - 77^{\circ}\text{F}$

- Regional differences are minor
  - On the northern plateau, the maximum and minimum temperatures are about 2 °F lower than for coastal regions
  - During the dry season, when trade winds are blowing, east coast areas are 2 – 3 °F cooler than west coast areas

## – Humidity

- The humidity is high in Guam, averaging 71–86 % throughout the year, because very humid air from the equatorial Pacific passes over the island
- The relative humidity commonly exceeds 84% at night throughout the year
  - The mean monthly maximum humidity ranges from 83 – 89% relative humidity
- During the warmest part of the day, the average humidity is at least 66% every month
  - The mean monthly minimum ranges from 66 – 75% relative humidity

- Variation in humidity from season to season is slight, with the dry season slightly less humid during the day
  - The humidity is below 60% only about 1.4% of the time in Guam
  - The humidity is 90 – 100% for about 14.4% of the time
  - Humidity below 40% has not been recorded in Guam

## – Wind conditions

- Trade winds are dominant in Guam, especially during the dry season
- Winds are from the northeast clockwise through east southeast more than 90% of the time
- Even during the rainy season, trade winds are dominant

## – Rainfall

- The annual mean rainfall in Guam varies from about 86 inches in coastal areas to more than 110 inches in mountainous regions
  - The maximum rainfall recorded in one month is 38.49 inches (August 1997) and in one year, 131.74 inches (1997)
  - The minimum rainfall recorded in one month is 0.31 inches (February 1961) and in one year, 27.0 inches (1976)
- Two seasons, based on rainfall, are recognized
  - The dry season extends from January to May, when the monthly average rainfall is  $\leq 5.5$  inches
  - The rainy season extends from July to November, when the monthly average rainfall is  $\geq 5.6$  inches
  - June and December are transitional months with characteristics of both rainy and dry seasons



- The dry season is characterized by mostly light showers of short duration
- The rainy season is characterized by frequent showers, with about 33% of the showers characterized as “steady rain” of longer duration
- During the rainy season, there is a greater probability of showers between 3 – 6 p.m.
- Drought is a normal feature of Guam’s climate, usually occurring seasonally between February and April

## – Storms

- There are two principal kinds of storms affecting Guam: small-scale storms and large-scale storms
- Small-scale storms form quickly and vanish quickly
  - They may dominate an area of 10 – 20 mi<sup>2</sup> with winds up to 33 knots

## – Dry season squalls

- These storms are 1 – 3 miles in diameter and embedded in the trade winds
- They move from east to west
- Over water, dry season squalls produce intense showers for few minutes, with winds up to 25 mph
- However, wind speed decreases when the squall moves onto land
- It is not unusual to have a few scattered squalls within an 8 – 10 mile radius of Guam on any given day

## – Rainy season squalls

- In these squalls, winds range 15 – 20 mph
- These squalls are much more numerous than during dry season; several squalls are often visible from Guam at any given time
- Rainy season squalls may be so numerous that they produce frequent showers over wide areas of Guam



## – Thunderstorms

- Thunderstorms are more frequent during the rainy season
- They are most common in July, occurring on average about 1.4% of days

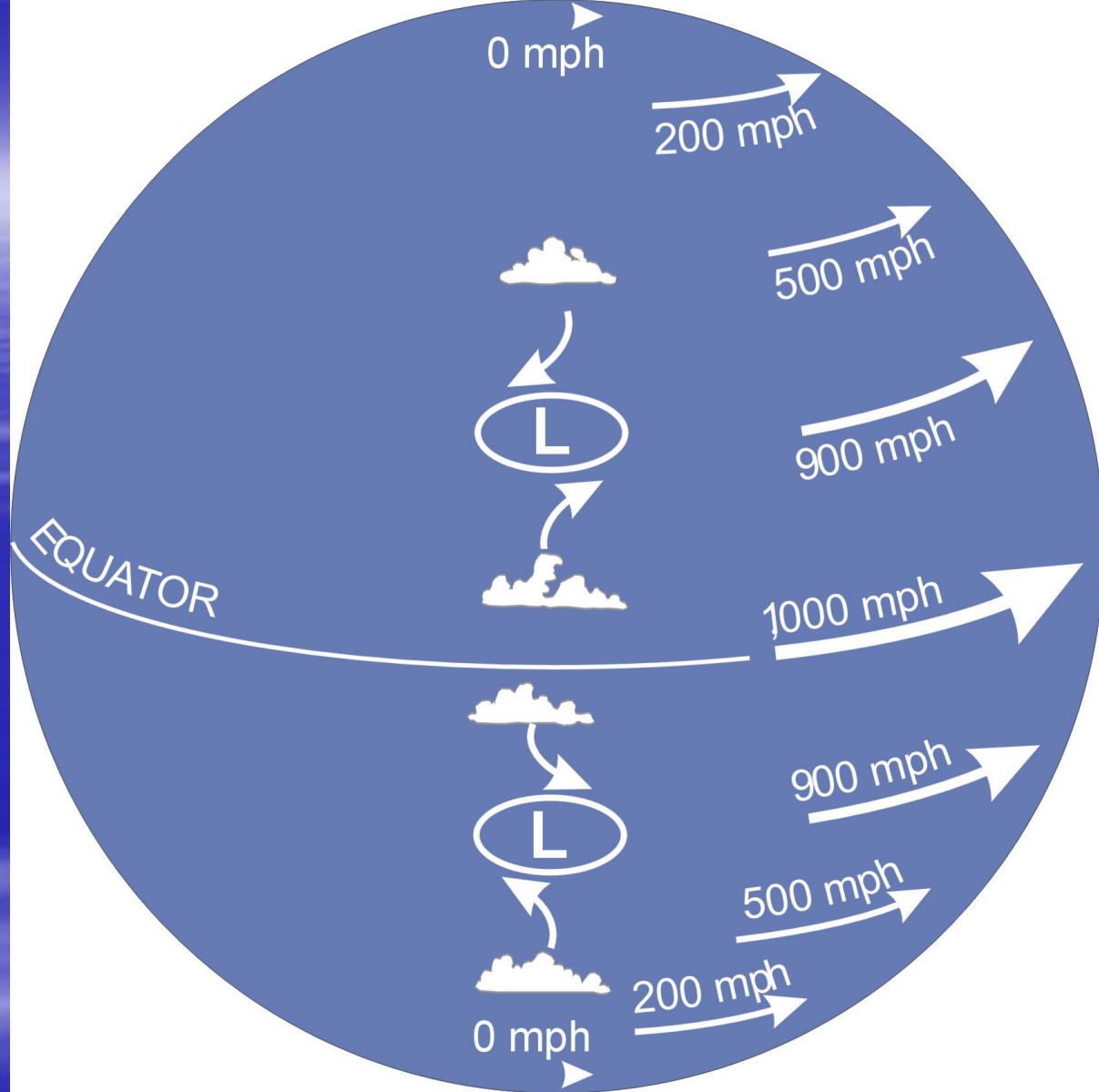
## – Pressure waves

- Pressure waves produce winds just a few mph above normal, but they do not produce a closed low-pressure system
- Pressure waves produce moderate to heavy rainfall over larger area than squalls

## – Tropical depressions

- A tropical depression is a closed storm system without high winds, but associated with heavy rainfall (2" – 4")
- Sustained winds in a tropical depression are <33 knots (38 mph)

- Large-scale storms persist for many days, even as long as two weeks
  - They may dominate weather over an area of 100,000 mi<sup>2</sup>; with winds exceeding 33 knots
  - **Tropical storms**
    - Tropical storms are closed pressure systems with sustained wind speeds of 33 – 65 kt (38 – 74.9 mph)
    - In the Northern Hemisphere, the air circulates counterclockwise
    - Tropical storms are accompanied by heavy to intense rainfall (3" – 5")

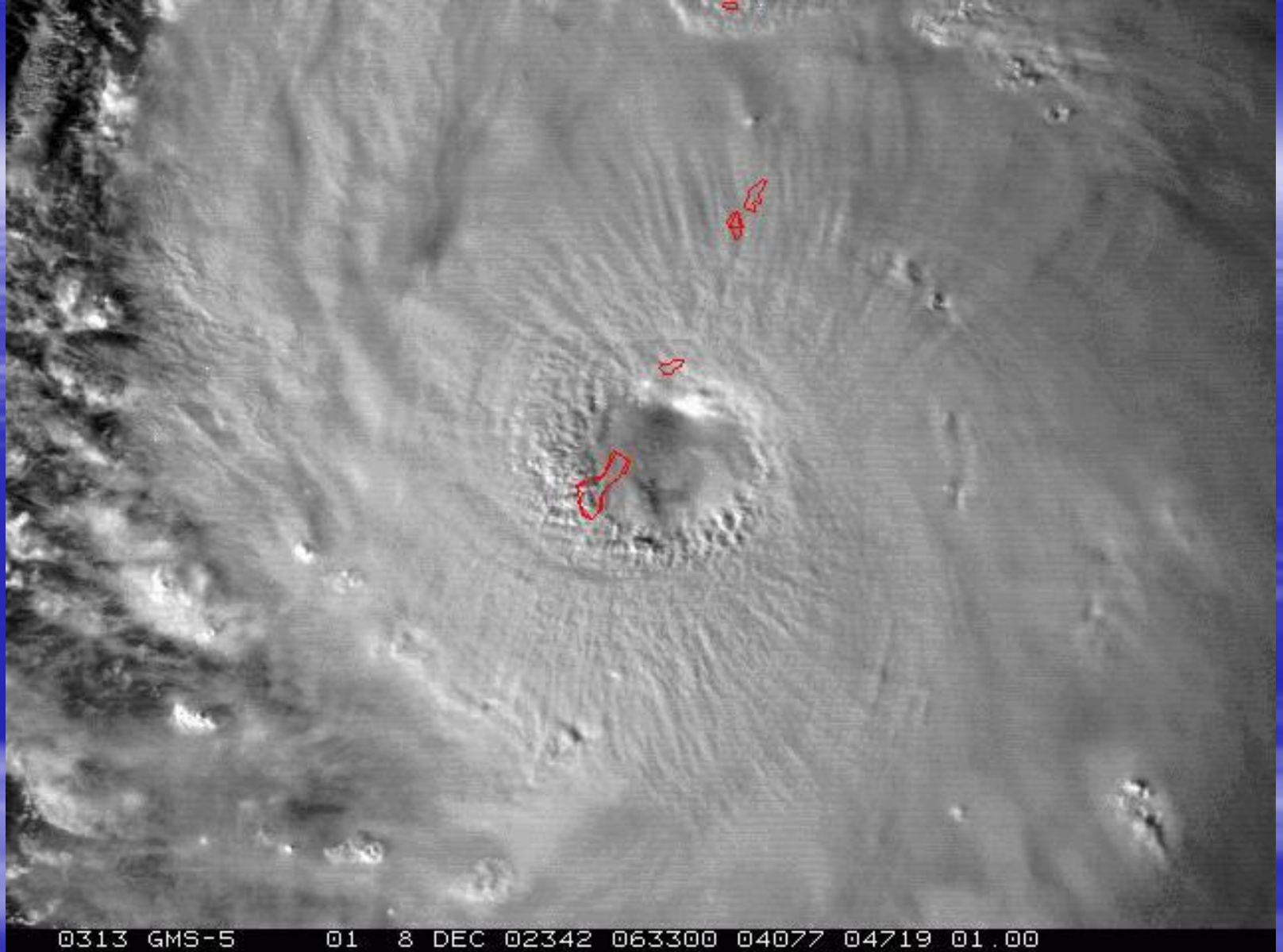


Air near the Equator is warmed by solar radiation and rises. Air from higher latitudes rushes in over the Earth's surface to replace the rising air, creating wind. These winds, the tradewinds, are deflected by the Coriolis force and approach the Equator at an angle of about 45°.



## – Typhoons

- Typhoons are closed pressure systems similar to tropical storms, but more intense
- Typhoons have sustained winds of >65 kt (>75 mph)
- They are usually accompanied by heavy to intense rainfall
- About 60% of the typhoons in the western Pacific pass within 120 mi of Guam
- The likelihood of typhoons passing over Guam is greatest during July through September
- The least likelihood of a typhoon passing over Guam is from January through April; however, a typhoon may hit the island during any month



**Satellite image of Supertyphoon Pongsona**

## – Barometric pressure

- At sea level in Guam, the barometric pressure ranges from 1011.4 millibars to 1014.2 millibars
- At Tiyan (245 ft elevation), the barometric pressure ranges from 1002.8 to 1005.2 millibar

## – Illumination

- Daylight occurs from sunrise to sunset
  - Daylight is 12 hr 56 min at the summer solstice (June 21)
  - At the winter solstice (Dec. 22 or 23), daylight is 11 hr 19 min at
  - Twilight is constant year round, ranging from 22 – 24 minutes in duration

## – Cloud cover

- Average cloud cover in Guam, in tenths of the total sky-dome, varies from a minimum of 6.8 tenths during January to March to a maximum of 8.0 tenths during July to September

Climate summary for Guam International Airport for the period 1945-1997

Tropical cyclone data from NOCC/JTWC 1945-1997

Marine winds from combined ocean-atmosphere data set 1850-1979

	TEMPERATURE						MEAN RELATIVE HUMIDITY (%)		
	AVERAGE		MONTHLY AVG	MAXIMUM RECORDED			7 A.M.	1 P.M.	
	MAX	MIN		HI	YEAR	LO			YEAR
JAN	85	75	80	94	1989	63	1995	83	71
FEB	85	74	80	93	1946	60	1995	83	68
MAR	86	75	81	93	1964	66	1965	83	67
APR	87	76	82	96	1971	68	1965	83	67
MAY	87	77	82	94	1971	70	1951	84	70
JUN	88	77	83	95	1969	69	1994	85	71
JUL	87	77	82	95	1969	70	1949	88	76
AUG	87	76	82	93	1986	70	1986	89	75
SEP	87	76	82	93	1987	69	1972	89	77
OCT	87	76	82	93	1984	65	1994	88	76
NOV	87	77	82	92	1970	68	1967	86	75
DEC	87	76	81	91	1988	68	1962	85	73
YEAR									
	87	76	81	96	1971	60	1995	86	72

	PRECIPITATION (INCHES)						
	MONTHLY AVG	MAXIMUM		MINIMUM		24-HOUR MAXIMUM	
		YEAR	YEAR	YEAR	YEAR	YEAR	
JAN	4.66	18.09	1976	0.95	1983	7.43	1990
FEB	3.24	13.57	1980	0.31	1960	8.58	1980
MAR	2.53	9.27	1974	0.40	1978	2.21	1976
APR	3.54	15.28	1963	0.51	1966	5.83	1963
MAY	5.14	24.07	1976	0.40	1987	27.00*	1976
JUN	5.70	13.33	1985	0.83	1983	3.85	1982
JUL	9.84	17.69	1962	4.46	1954	6.77	1986
AUG	13.91	38.49	1997	3.91	1965	5.91	1997
SEP	13.39	24.34	1982	3.91	1951	9.28	1950
OCT	12.50	26.47	1953	4.27	1976	15.48	1953
NOV	8.55	16.15	1978	2.60	1945	4.10	1992
DEC	5.62	23.48	1997	1.57	1992	20.60	1997
YEAR							
	88.72	131.74	1997	59.14	1973	27.00	1976

WIND				TROPICAL CYCLONES IN THE VICINITY OF GUAM **	
PREVAILING DIRECTION	AVG SPEED (KNOTS)	THUNDERSTORM DAYS	TROPICAL STORMS	TYPHOONS	
JAN	ENE	9	#	1 in 15	1 in 15
FEB	ENE	9	#	1 in 46	1 in 46
MAR	ENE	9	#	1 in 46	1 in 46
APR	E	10	#	1 in 23	1 in 12
MAY	E	9	#	1 in 23	1 in 9
JUN	E	8	1	1 in 8	1 in 46
JUL	E	7	4	1 in 4	1 in 23
AUG	E	6	5	1 in 3	1 in 23
SEP	E	6	4	1 in 2	1 in 8
OCT	E	7	3	1 in 2	1 in 6
NOV	E	9	1	1 in 2	1 in 7
DEC	ENE	9	#	1 in 7	1 in 8
YEAR	E	8	18	3 in 1	1 in 1

NOTES:

# = number of days is less than 1

\* Estimated maximum during Typhoon Pamela (1976)

\*\* Odds of a tropical storm or a typhoon passing within 180 miles of Guam, based on data from 1945-1991. For example, 1 in 7 means 1 tropical storm or 1 typhoon will pass within 180 miles of Guam every 7 years.

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