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CYCLONES

GEOGRAPHY

GRADE 12

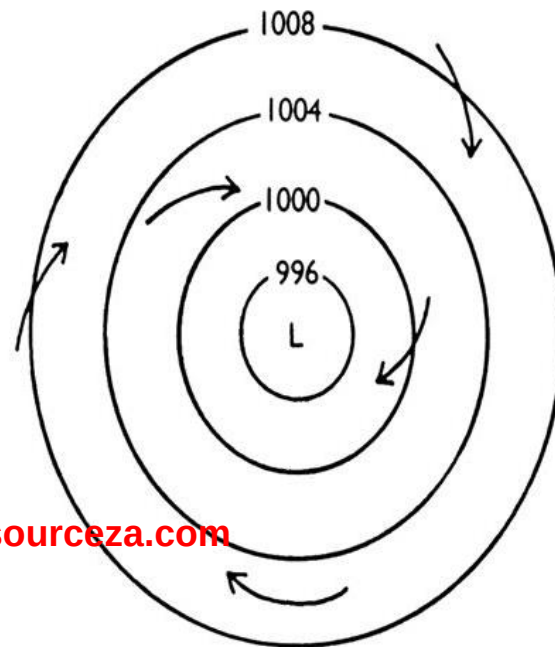
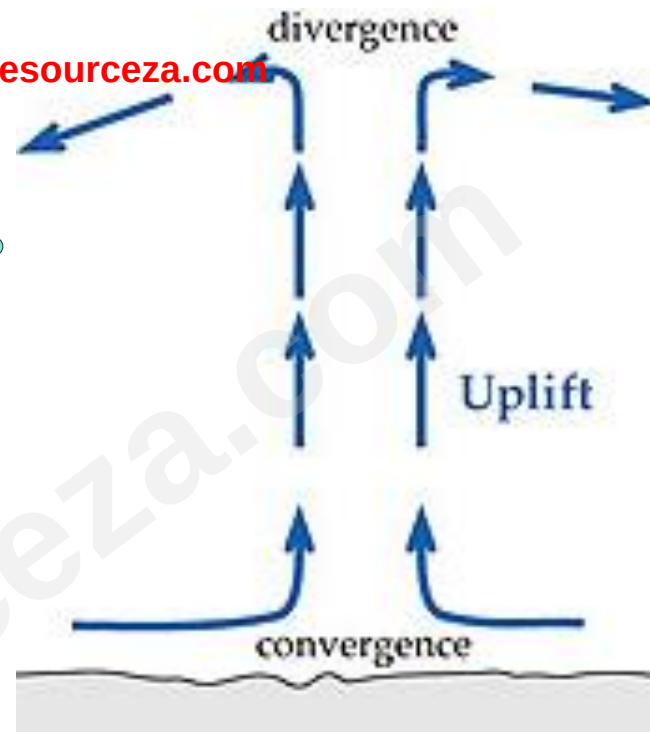
F. LAHER



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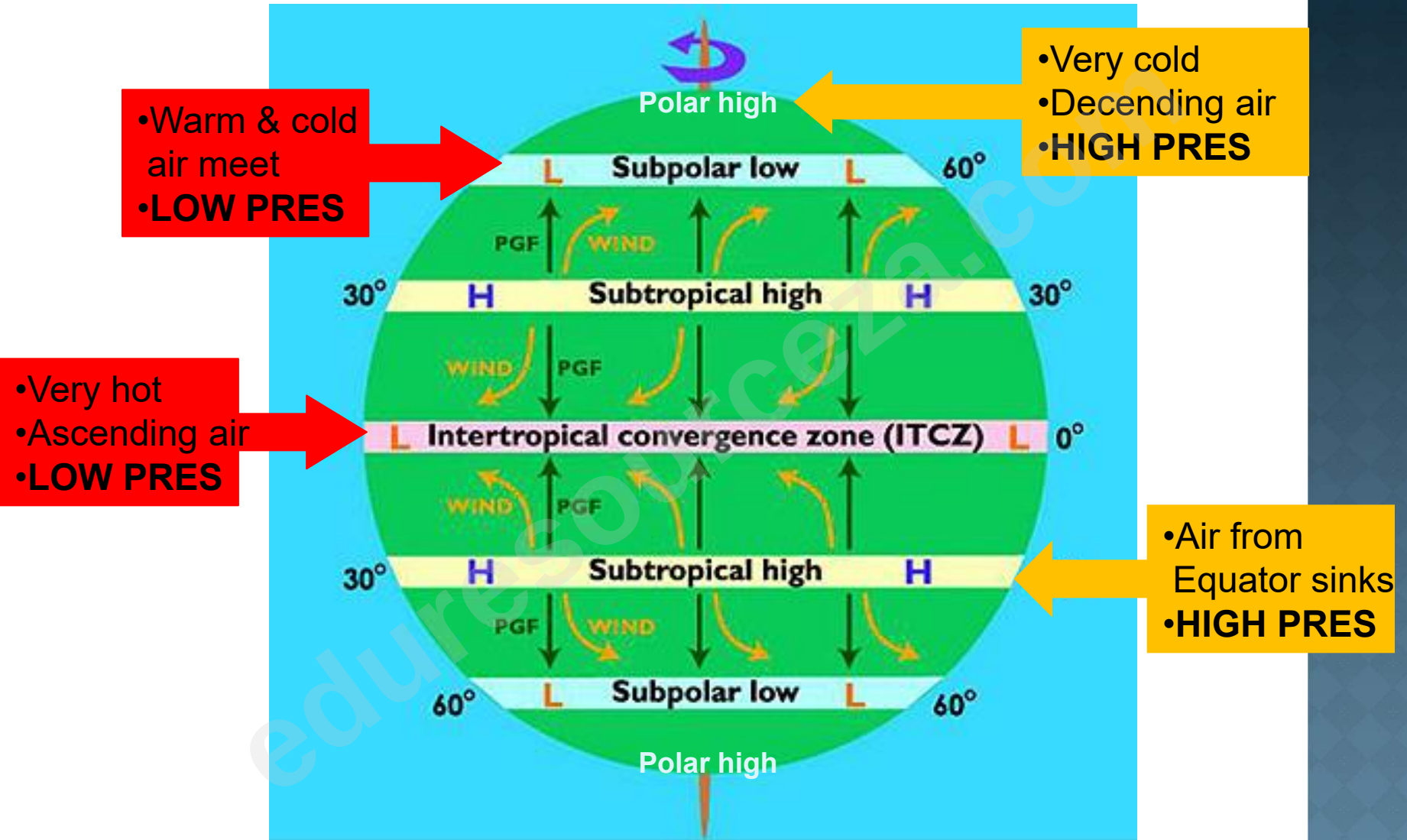
GRADE 11 RECAP....

- ⦿ A cyclone is another name for a low pressure cell...
- ⦿ Characteristics of a low pressure cell:
 - Air rises
 - Surface convergence and upper air divergence
 - Rising air cools, condenses and causes rain
 - Winds blow from a HP into a LP in a clockwise direction in the SH
 - Due to the Coriolis force



GRADE 11 RECAP....

- ⦿ Primary Air circulation
 - Tri-cellular model- Hadley, Ferrel and polar cells
- ⦿ Secondary air circulation
 - Mid-Latitude cyclones
 - Tropical cyclones
- ⦿ Tertiary air circulation
 - Valley climates
 - Urban climates
 - Berg winds
 - Land and sea breeze
 - Anabatic and Katabatic winds



Winds deflect to the RIGHT in NH and to the LEFT in SH

GLOBAL AIR CIRCULATION

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GLOBAL AIR CIRCULATION

World pressure belts:

1. Thermal belts

- Equatorial Low (Equator)

- Polar High

2. Dynamic belts

- Sub-tropical high (Horse latitudes)

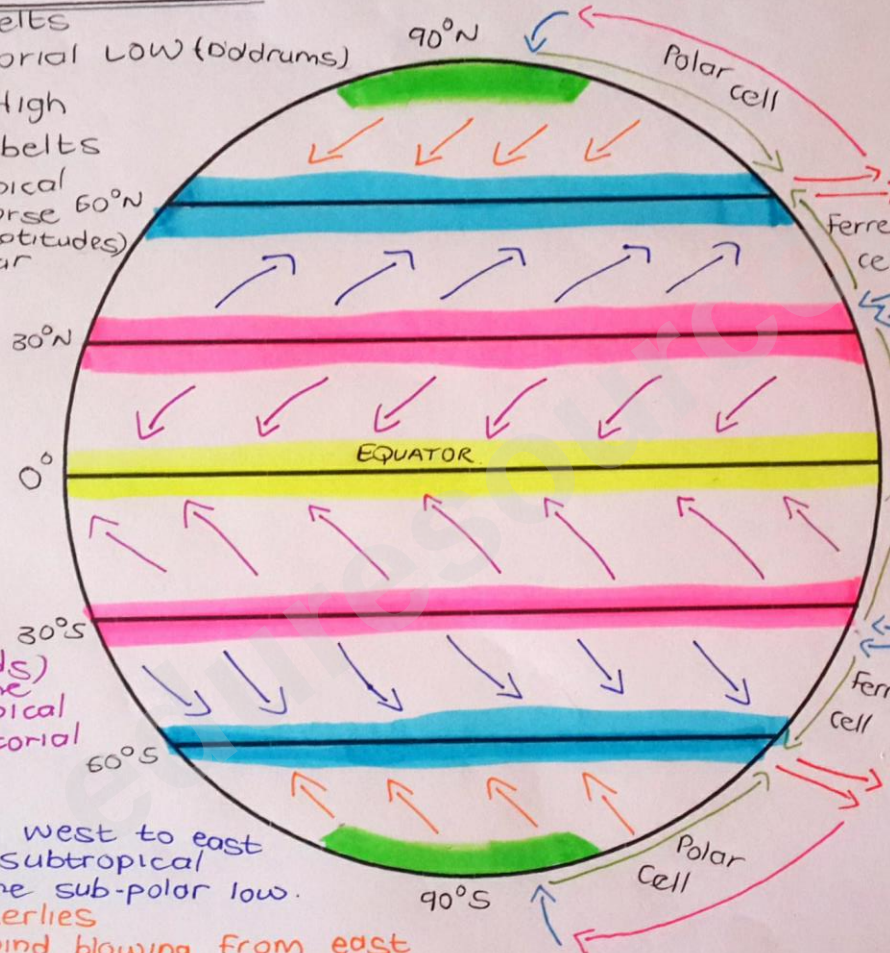
- Sub-polar Low

Planetary winds

→ Tropical Easterlies (trade winds) blow from the east - Sub-tropical high to equatorial low.

→ Westerlies - blow from west to east - From the sub-tropical high to the sub-polar low.

→ Polar Easterlies - Cold dry wind blowing from east to west - Blow from polar high to sub-polar low



Tri-cellular model

→ Hadley cell

- Air blowing in the tropical easterlies **converge** at the ITCZ.

- warm air **risers**

- Rising air cools and **diverges** in the upper atmosphere.

- cold air **sinks** at about 30°N and S.

→ Ferrel cell

- Air **sinks** at 30°N and S. - As it **sinks** it warms and **diverges** at the surface.

- At about 60°N and S the warm air meets cold air moving from the poles to the equator.

- **Convergence** causes warm air to **rise** above cold air.

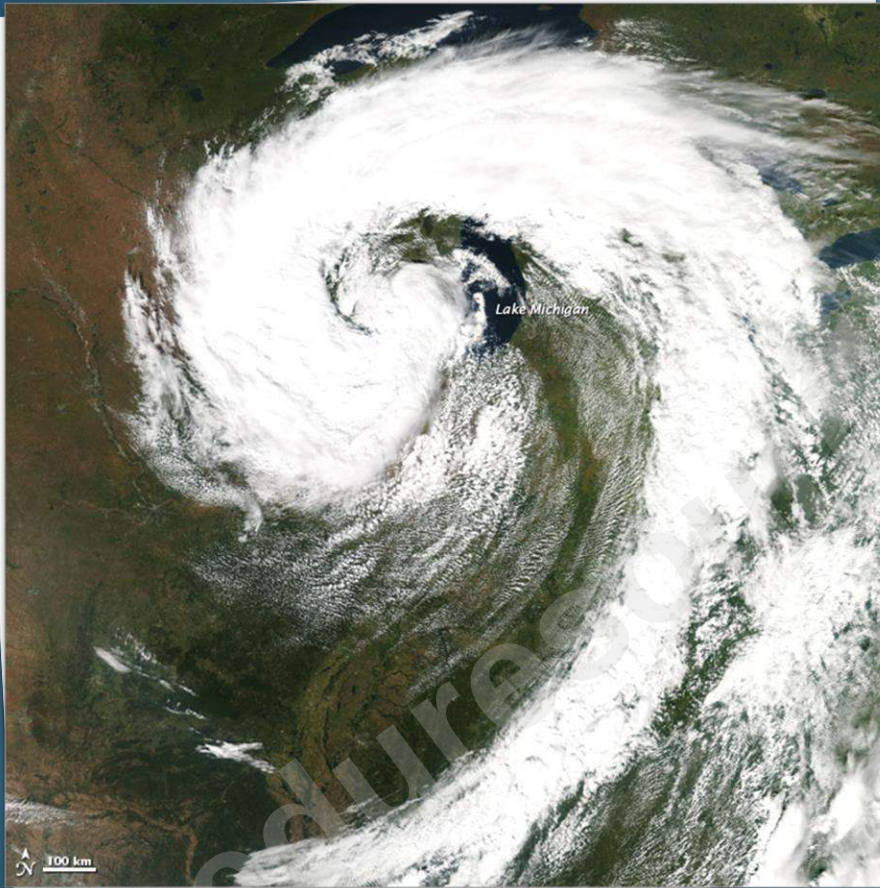
- Rising air **diverges** in upper atmosphere.

→ Polar cell

- cold air **sinks** at the poles - meets warmer air from 60°N/S **convergence** causes warm air to **rise**

- Air **diverges** back to the poles

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MID LATITUDE CYCLONES



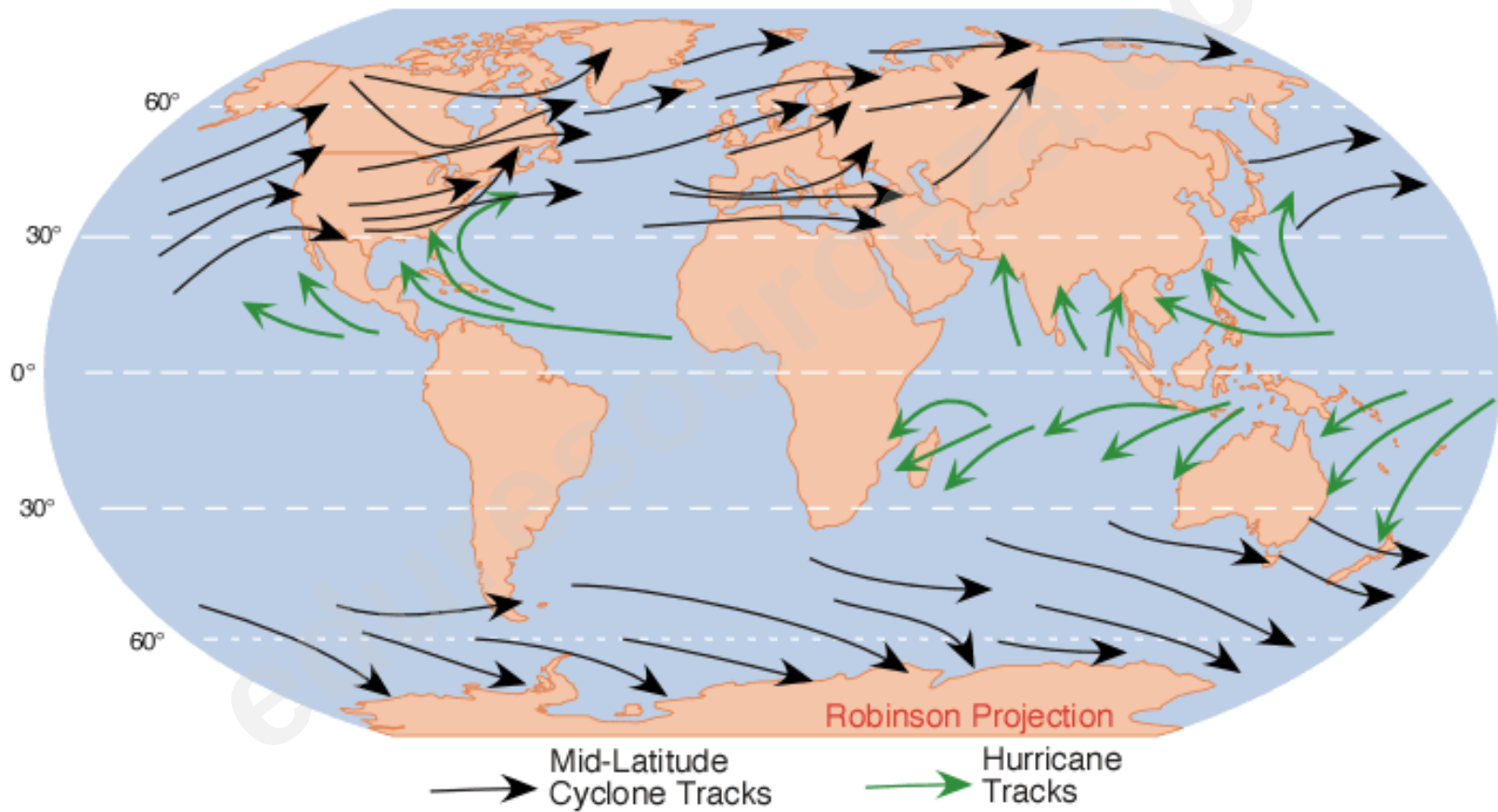
GENERAL CHARACTERISTICS

- ◉ Cells of low pressure that bring cold windy wet weather
- ◉ Winds blow into the LP in a clockwise direction
 - Surface convergence and upper air divergence
- ◉ They develop 40°-60° North and South
 - Ferrel cell and are affected by the westerlies
- ◉ Form because cold polar air meets warm subtropical air creating the polar front
 - Warm front and a cold front
- ◉ They occur in families
- ◉ 1500-3000km in diameter
- ◉ Lasts for +/- 4-14 days and can travel 1200km a day
- ◉ Isobars closed and oval in shape

GENERAL CHARACTERISTICS

- ◉ Pressure at the centre is about 992hPa
- ◉ Also called frontal depressions, temperate depressions, temperate cyclones, extratropical cyclones
- ◉ They travel west to east often affecting the western side of continents
 - Causes the Western Cape to receive rainfall in winter
- ◉ Mid-latitude cyclones occur all year but shift when pressure cells shift with the ITCZ
 - Affect South Africa in WINTER

AREAS WHERE THEY FORM



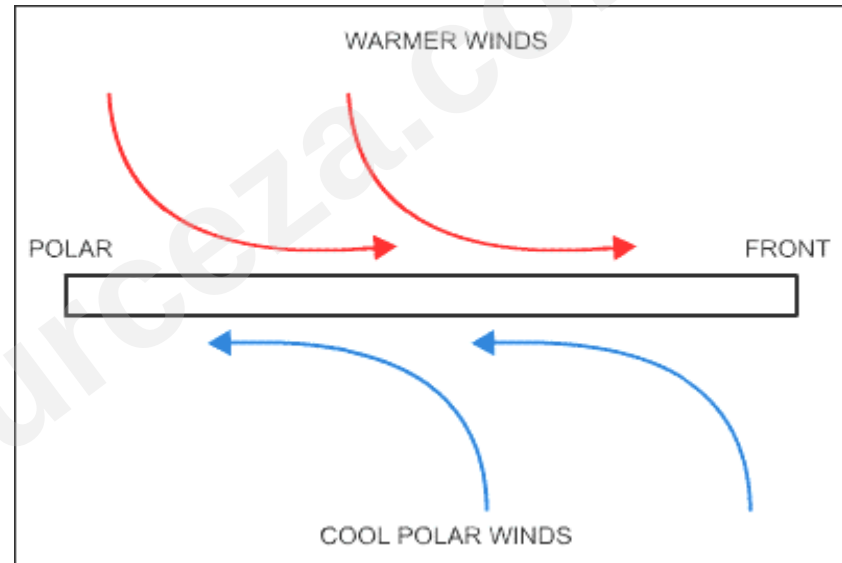
CONDITIONS NECESSARY FOR FORMATION

- ◉ Warm moist air needs to meet cold dry air to set up a front
 - A front is the boundary between 2 different air masses
- ◉ Upper air divergence to ensure continued ascend of air
- ◉ A trigger to develop the low pressure
 - Disturbances in the jet streams
 - Disturbances by a mountain range

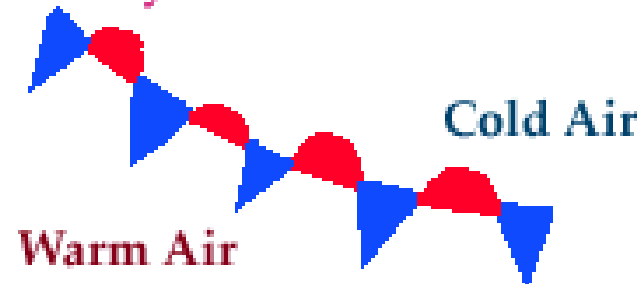
STAGES OF DEVELOPMENT

◉ Stage 1- the initial stage

- There is no movement of air across line of separation (front)
- The air masses are parallel to each other and blow in opposite directions
- the initial stage is characterized by a stationary front.



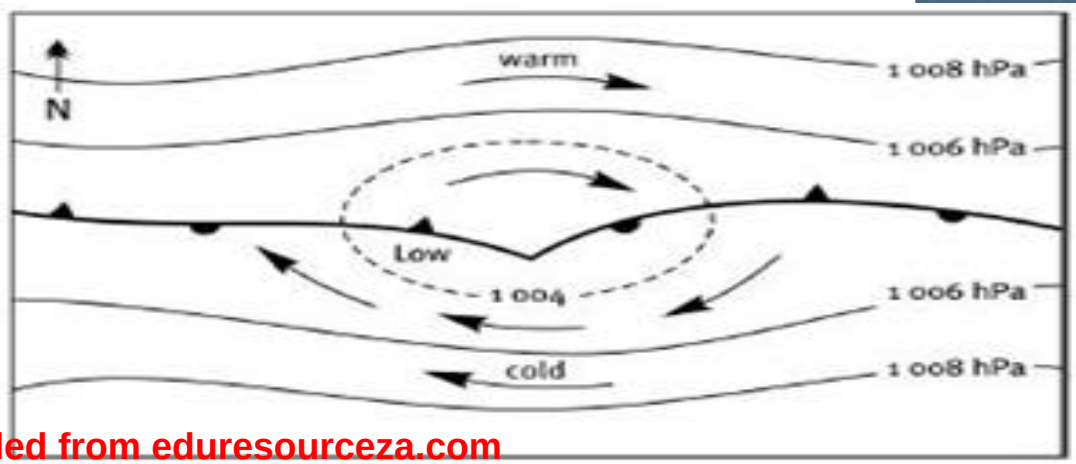
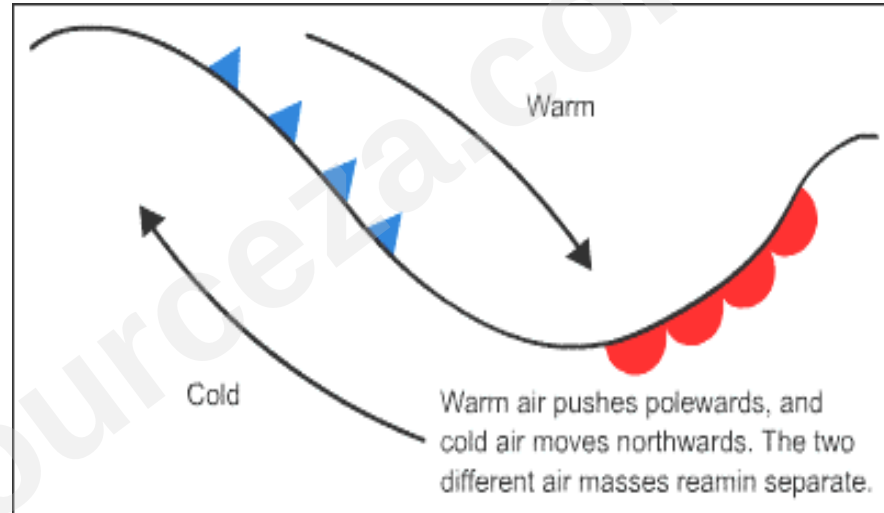
Stationary Front



STAGES OF DEVELOPMENT

◉ Stage 2- The developing stage

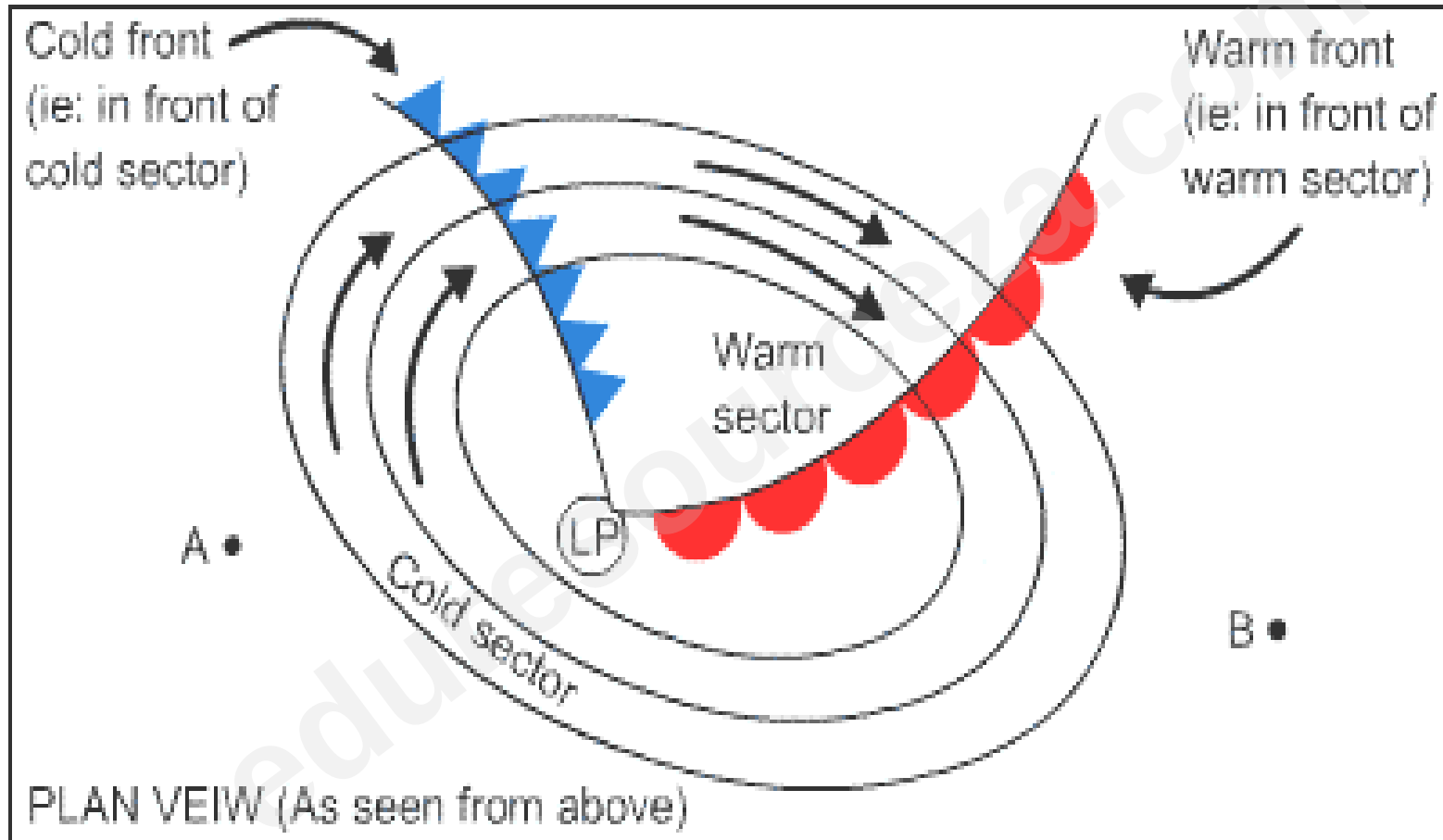
- A disturbance is formed along the polar front caused by friction
- The warm air mass is less stable than the cold one and rises causing the low pressure to decrease
- This will cause a rotary air movement and begin to produce a wave-like pattern

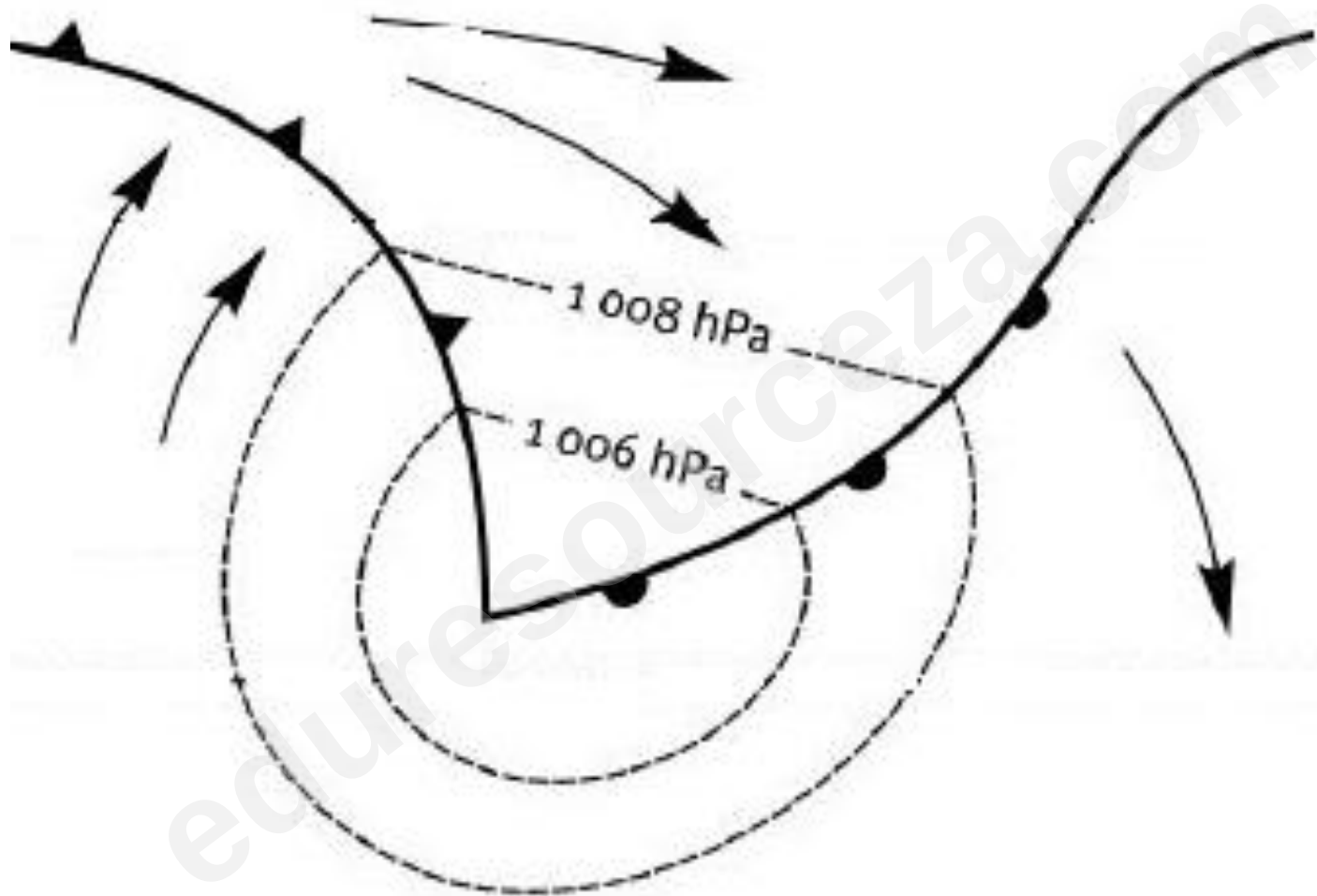


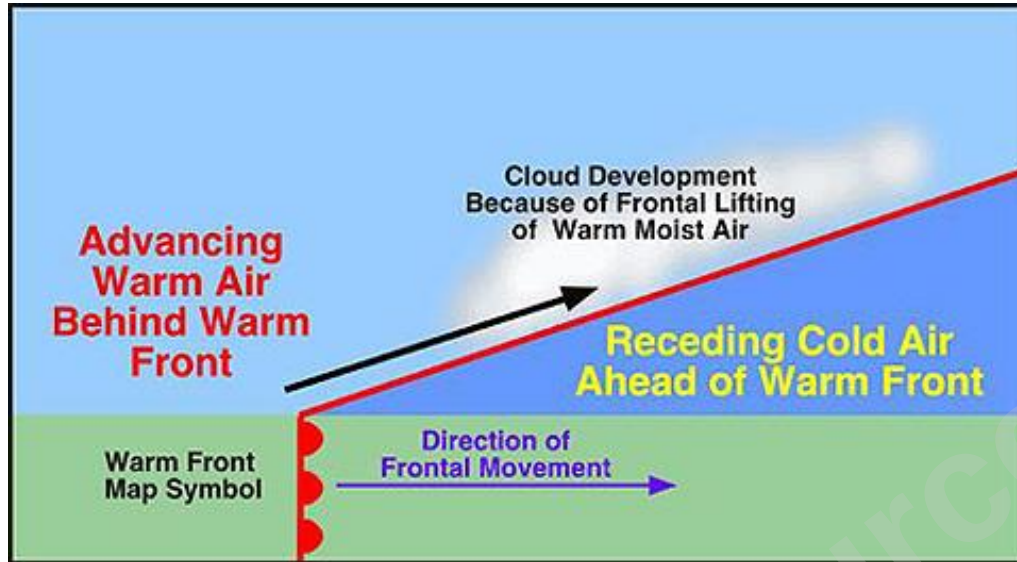
STAGES OF DEVELOPMENT

◉ Stage 3- The mature stage

- Well formed warm and cold fronts have developed.
- Each front marks the boundary and takes the name of the temperature of the air mass behind it
 - ◉ Warm front is the leading edge of warm air and the cold front is the leading edge of the cold air
- Wind directions vary within the system
 - ◉ Winds are from the NW in the warm sector
 - ◉ Winds are from the NE ahead of the warm front
 - ◉ Winds are SW in the cold sector behind the cold front
- Air rises along the warm front
- Air rises along the cold front (warm sector) as colder air from behind the cold front wedges under

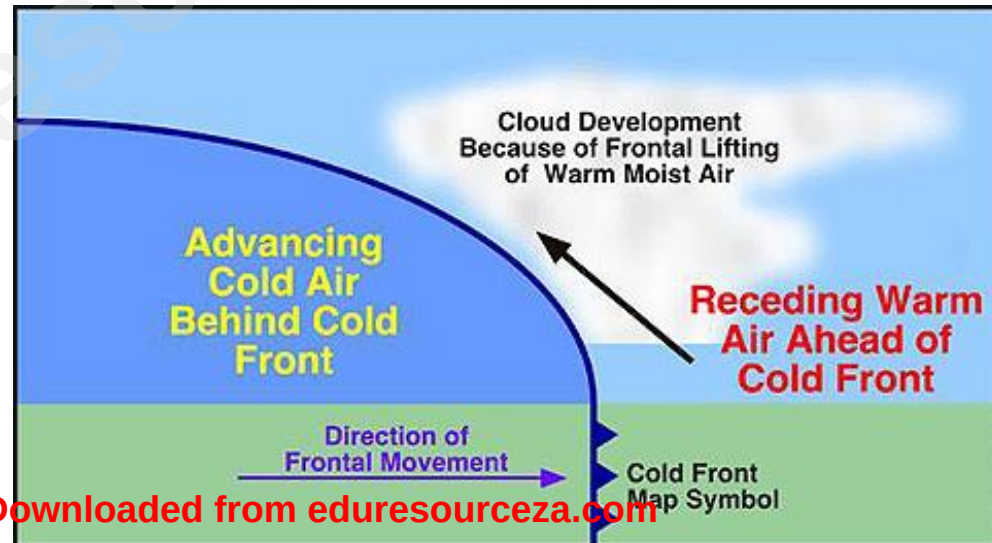






WARM FRONT

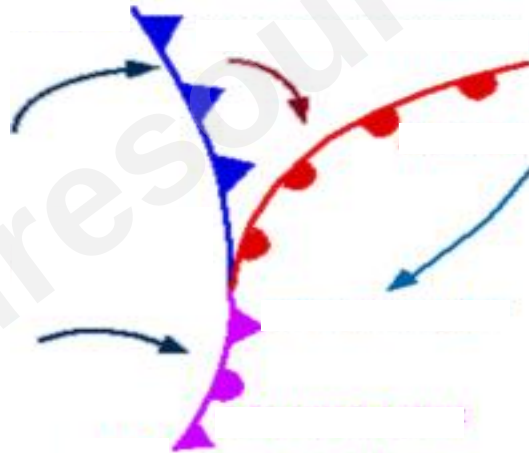
COLD FRONT



STAGES OF DEVELOPMENT

◉ Stage 4- The occluded stage

- The cold air behind the cold front travels faster than the warm air. As a result the cold front catches up to the warm front and creates an occluded front



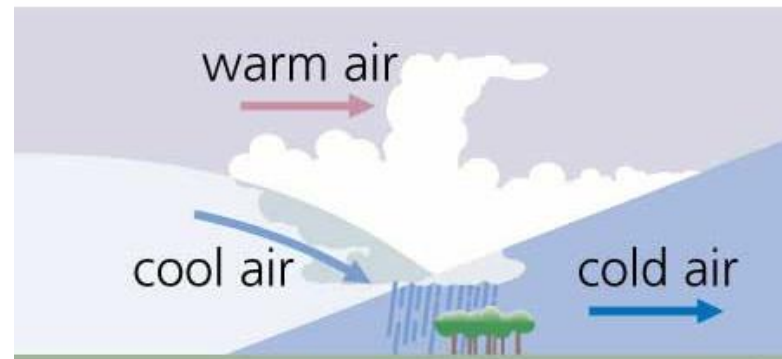
- The warm air is forced to rise above the cold air bringing heavy rainfall

- The cold front remains in contact with the ground and lifts the warm front



COLD FRONT OCCLUSION

- The warm front remains in contact with the ground and lifts the cold front



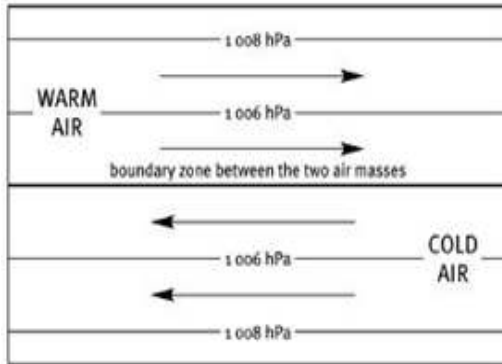
WARM FRONT OCCLUSION

STAGES OF DEVELOPMENT

◉ Stage 5- the dissipated stage

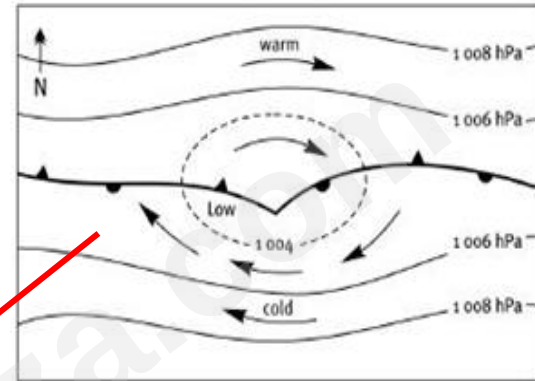
- The entire warm sector is above ground and no warm air remains on the ground
- There are no fronts as there is no distinction between air masses
- Isobars have returned to normal

STAGE 1

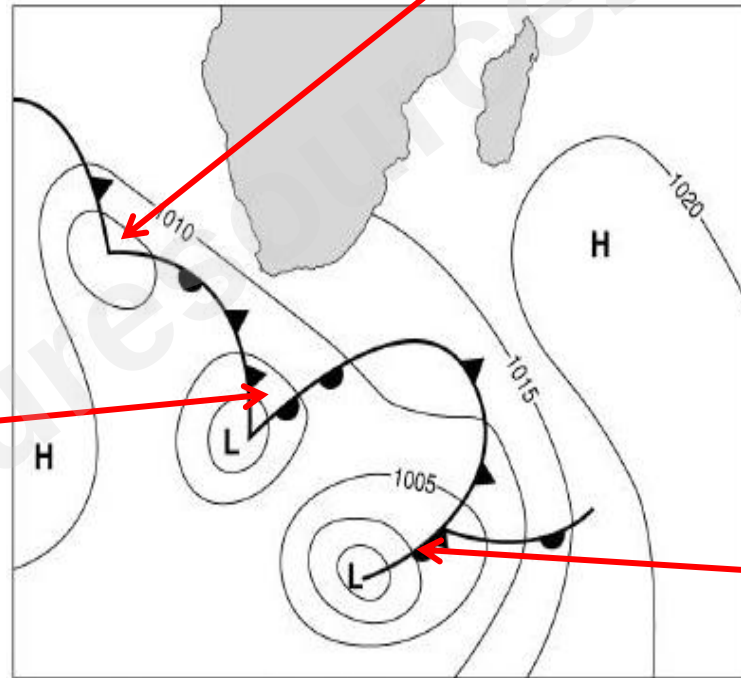
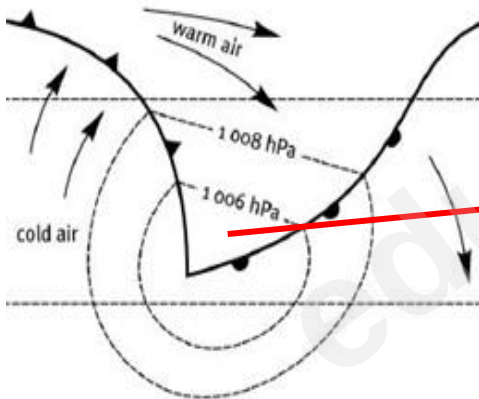


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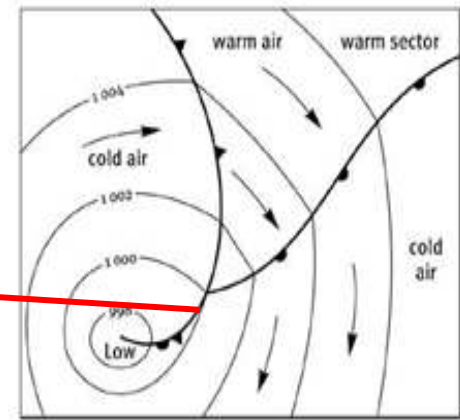
STAGE 2



STAGE 3

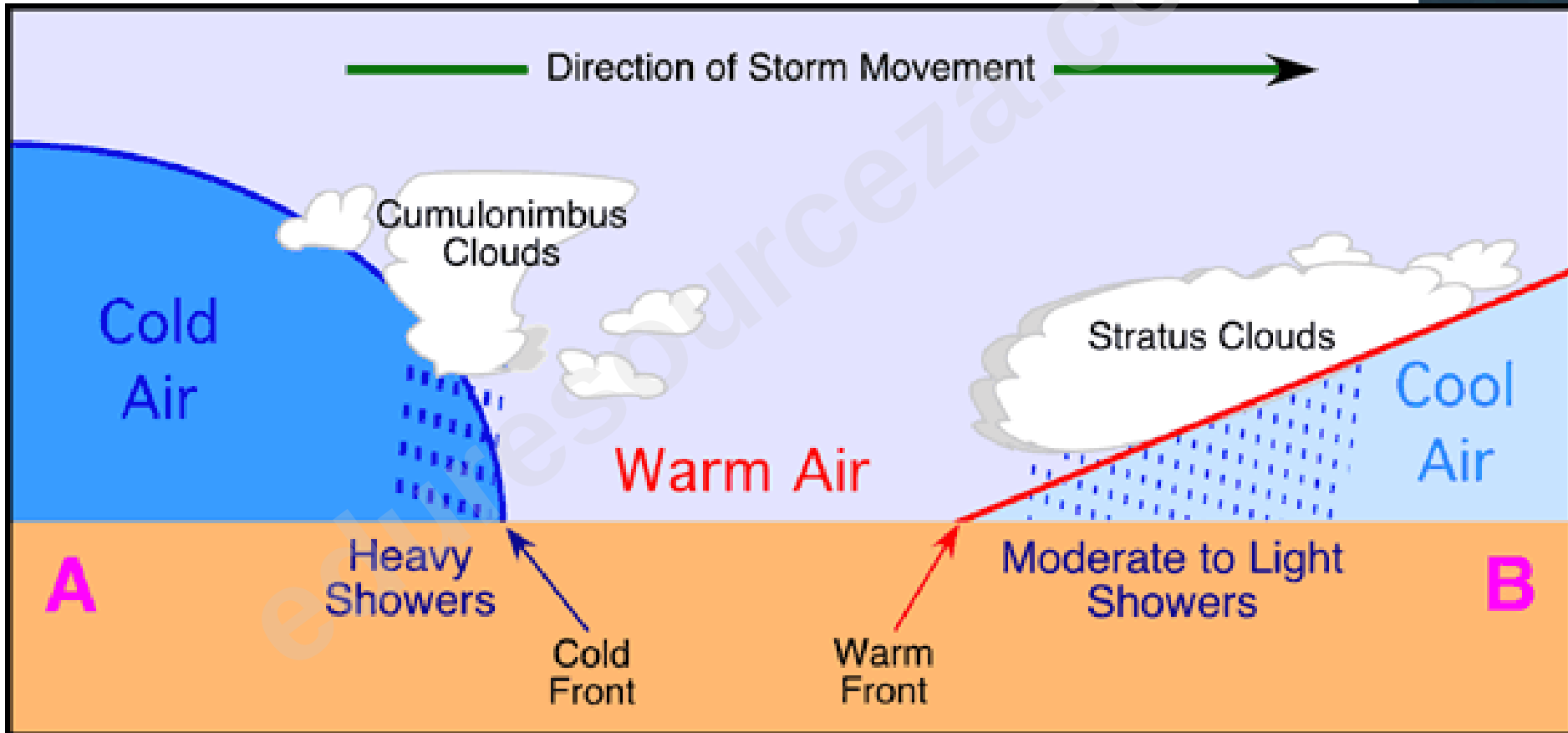


STAGE 4



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CROSS-SECTION THROUGH A MID-LATITUDE CYCLONE



ASSOCIATED WEATHER

⦿ Cold front

- Covers a smaller area
- Uplift is rapid
- Tall cumulonimbus clouds
- Heavy rain
- Thunderstorms
- Most rain is behind the front
- Temperature decreases
- Pressure increases
- Humidity decreases
- Wind direction shifts
 - SH- backing → NW to SW
 - NH- Veering → SE to SW

● Cold front

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	Before Passing	While Passing	After Passing
Winds	South-southwest	Gusty; shifting	West-northwest
Temperature	Warm	Sudden drop	Steadily dropping
Pressure	Falling steadily	Minimum, then sharp rise	Rising steadily
Clouds	Increasing: Cirrus, Cirrostratus, Cumulonimbus	Cumulonimbus	Cumulus
Precipitation	Short periods of showers	Heavy rains, sometimes with hail, thunder, lightning	Showers, then clearing
Visibility	Fair to poor in haze	Poor, followed by improving	Good, except in showers
Dew Point	High; remains steady	Sharp drop	lowering

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ASSOCIATED WEATHER

◉ Warm front

- Covers a wide area
- Uplift is more gentle
- Hot air rises forming clouds
 - ◉ Cirrus, altostratus, nimbostratus
- Soft rain, mostly ahead of the front
- Temperature increases
- Pressure decreases
- Humidity increases
- Wind direction shifts
 - ◉ SH- backing → NW to SW
 - ◉ NH- Veering → SE to SW

☉ Warm front

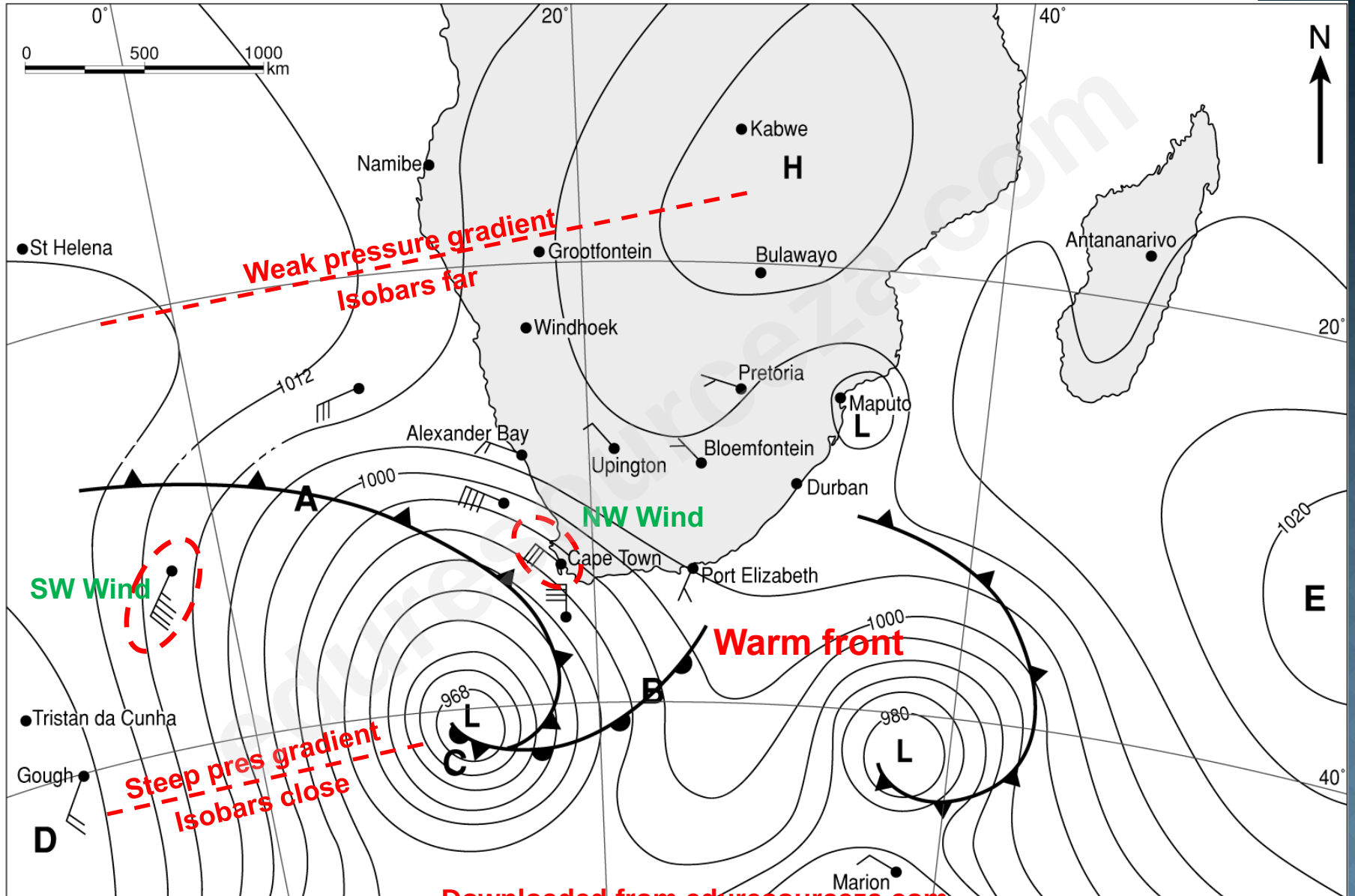
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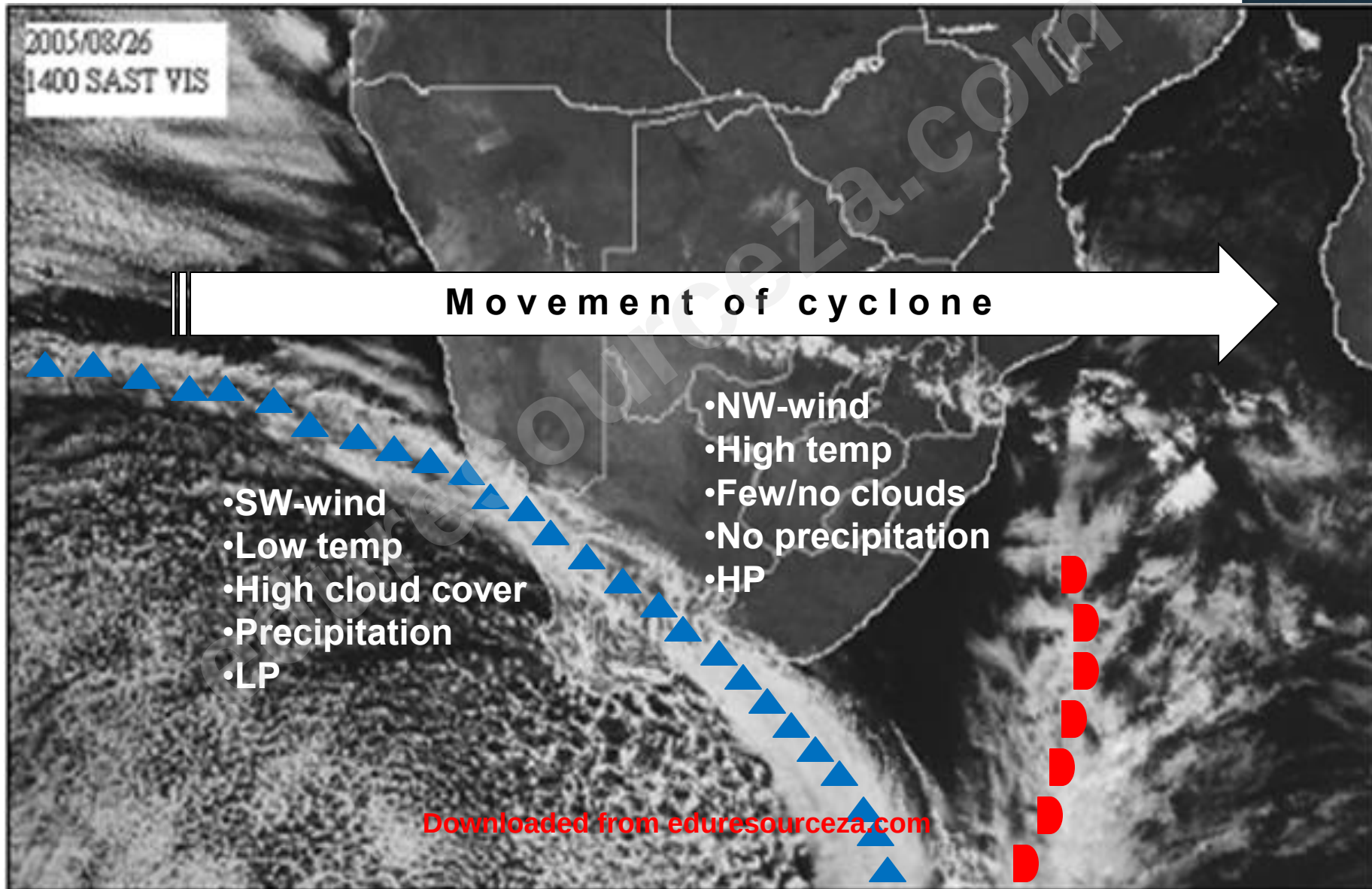
	Before Passing	While Passing	After Passing
Winds	South-southeast	Variable	South-southwest
Temperature	Cool-cold, slowly warming	Steady rise	Warmer, then steady
Pressure	Usually falling	Leveling off	Slight rise, followed by fall
Clouds	Cirrus, Cirrostratus, Nimbostratus	Stratus-type	Clearing with scattered Stratocumulus
Precipitation	Light to moderate rain, snow, sleet or drizzle	Drizzle or none	Usually none, sometimes light rain in showers
Visibility	Poor	Poor, but improving	Fair in haze
Dew Point	Steady rise	Steady	Rise, then steady

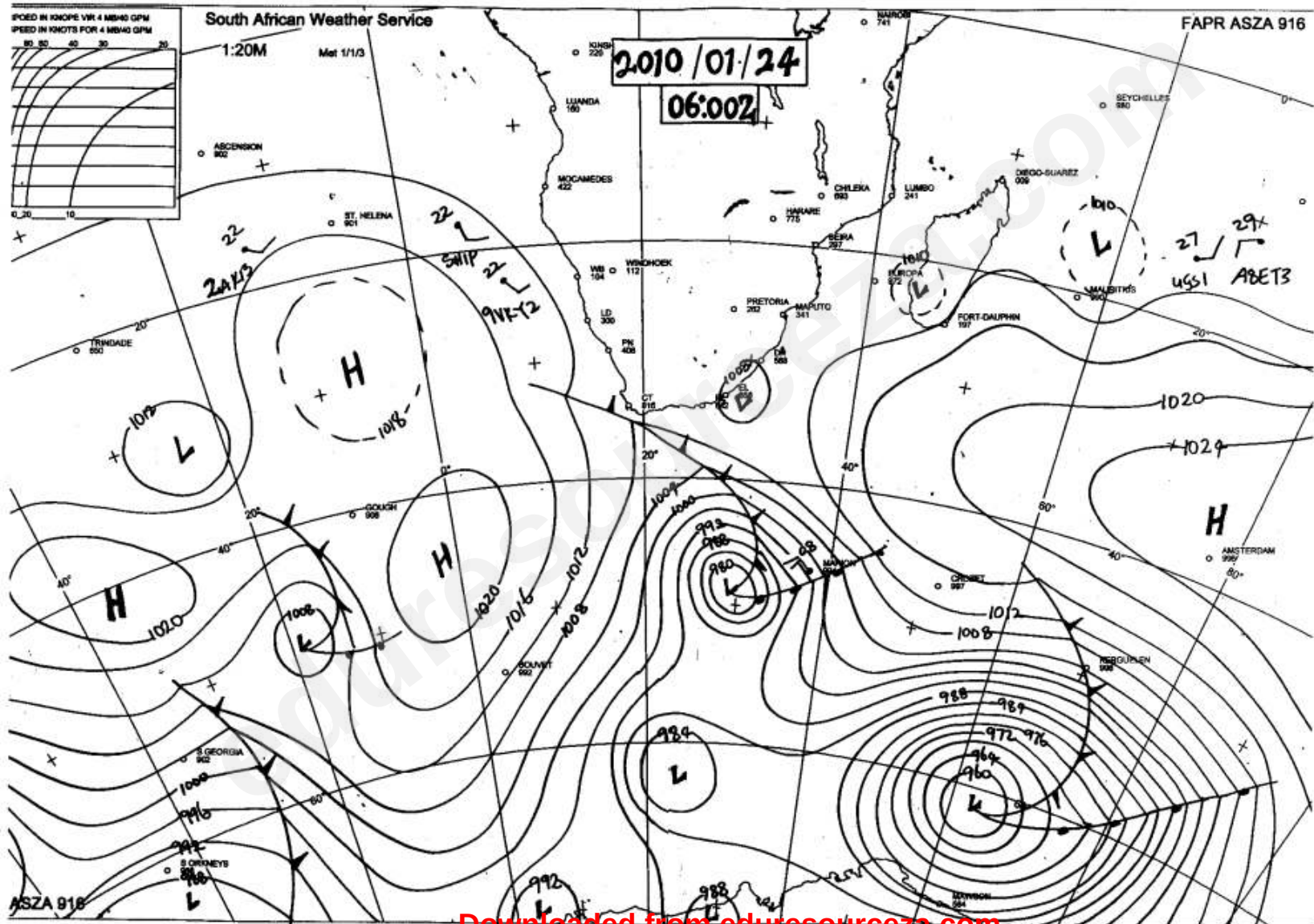
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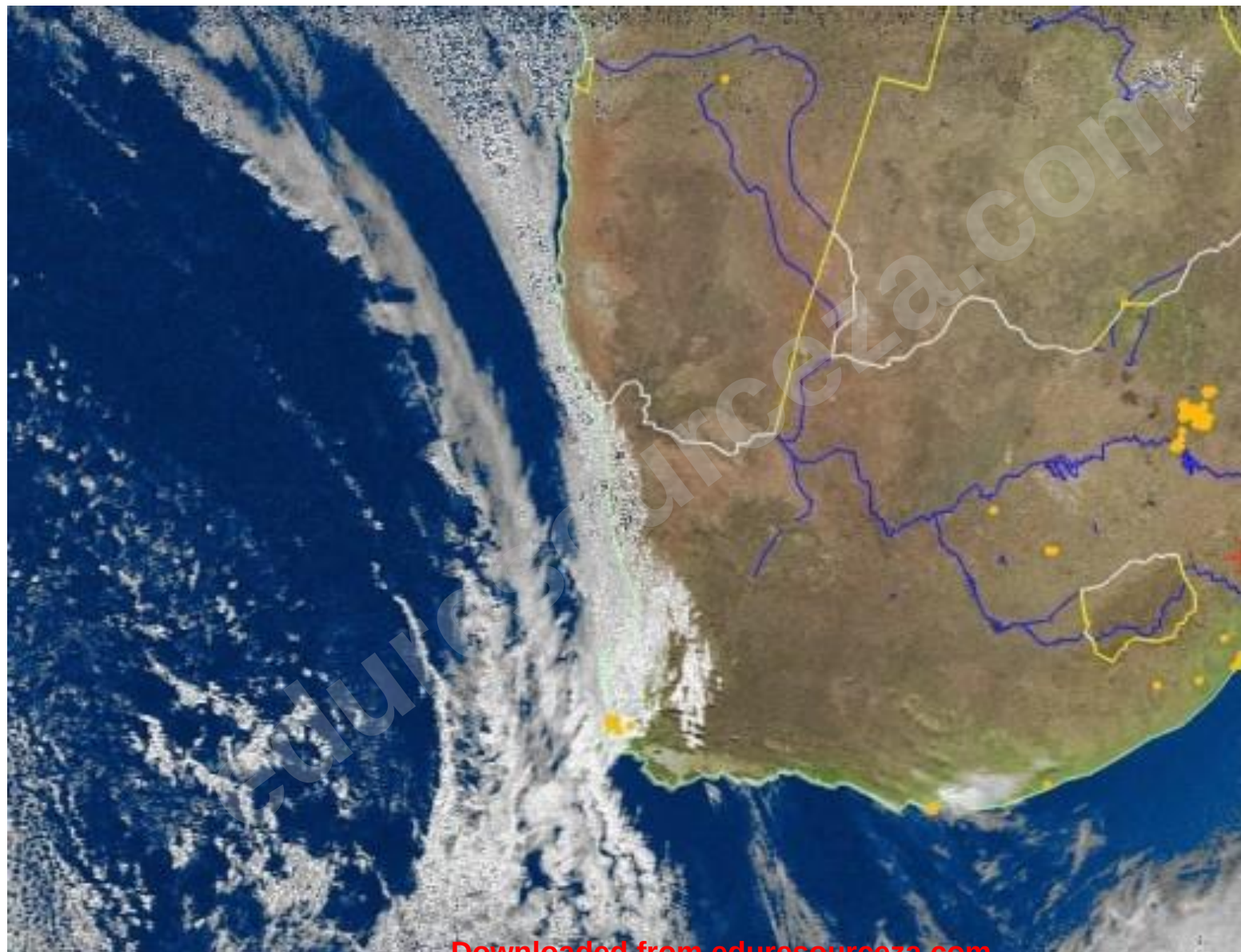
IMPACTS

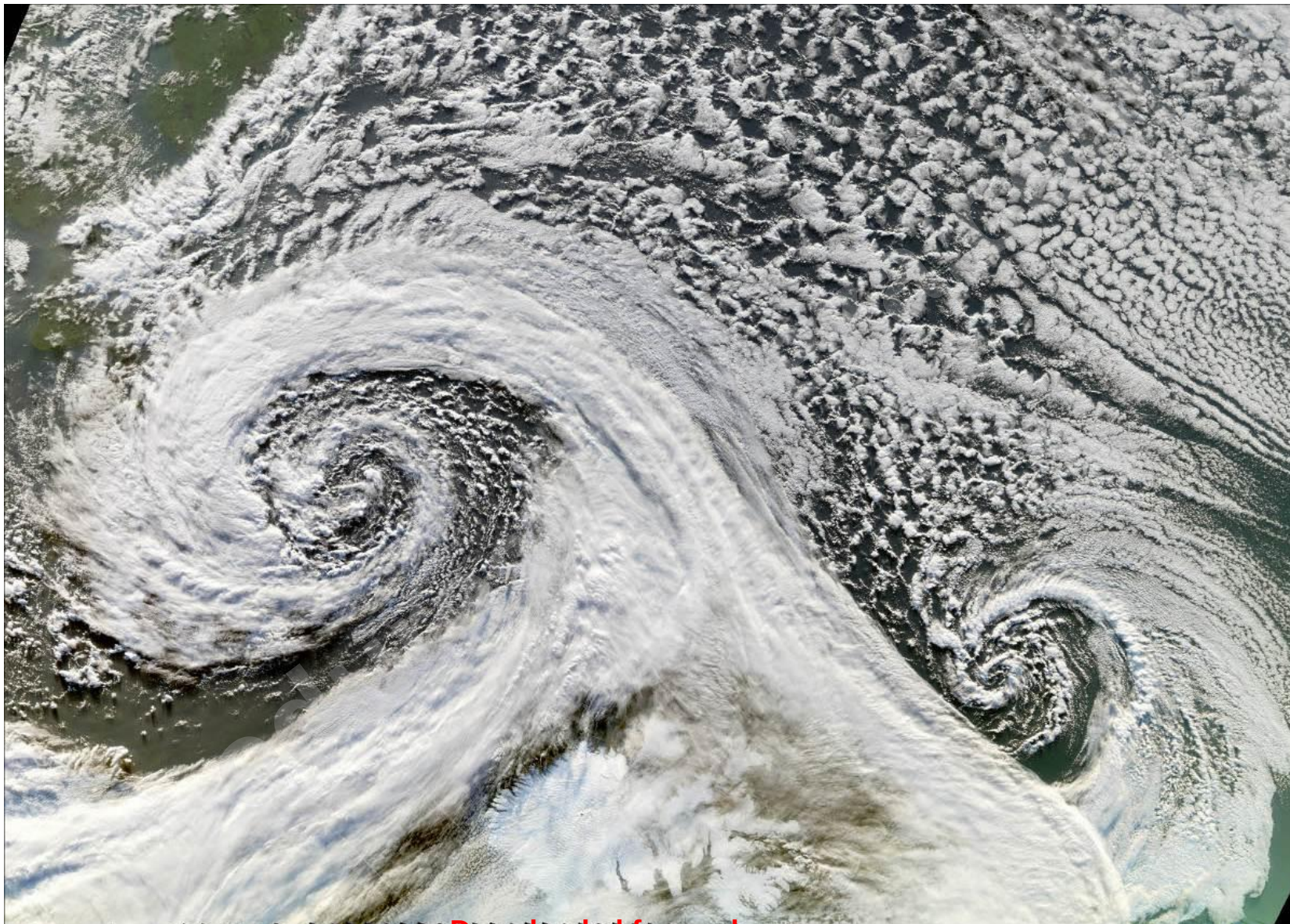
- ⦿ Thunderstorms
- ⦿ Gale force winds
- ⦿ Death of livestock
- ⦿ Damage to crops
- ⦿ Damage to infrastructure
- ⦿ Berg winds













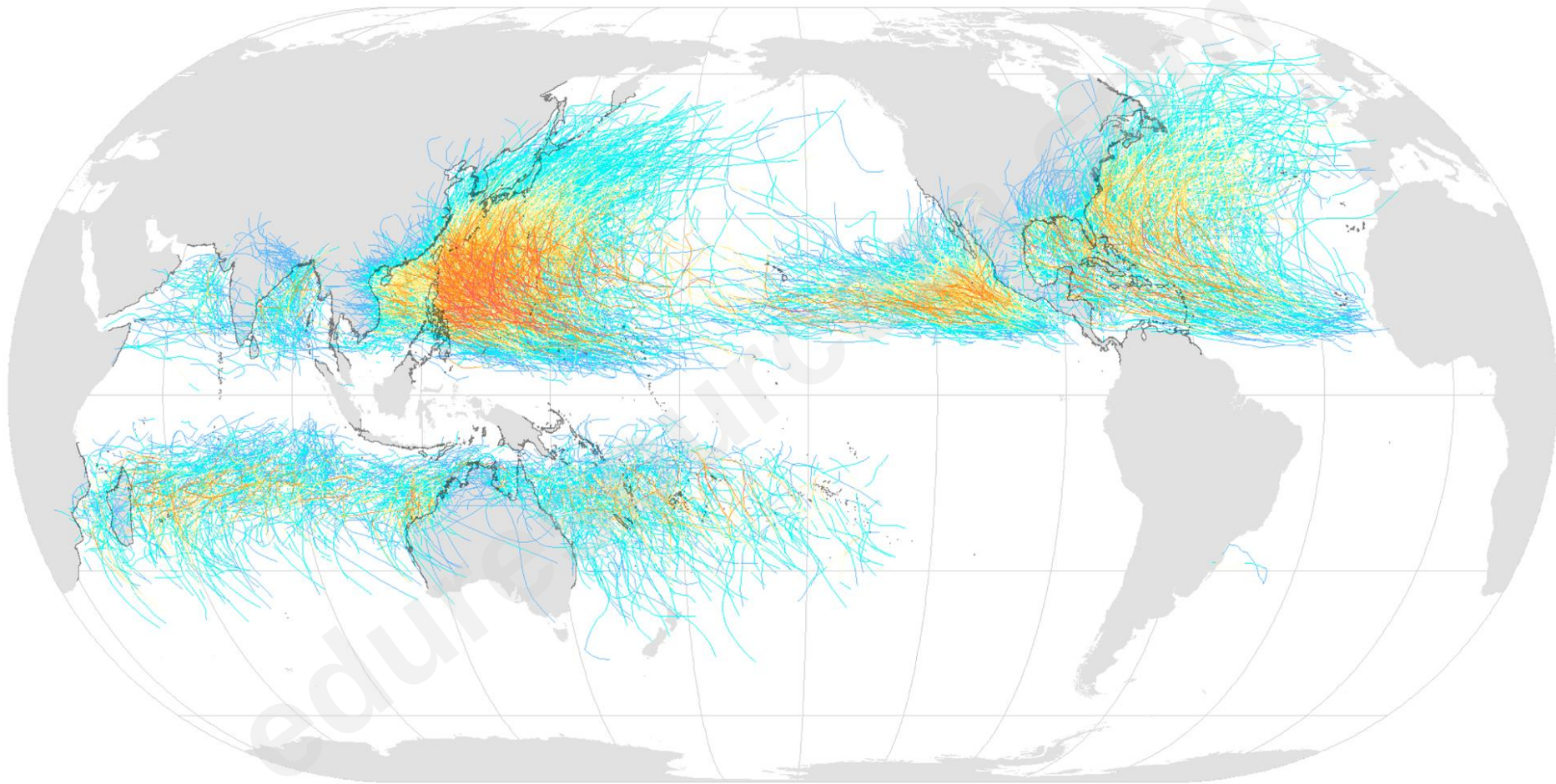


TROPICAL CYCLONES

WHAT IS A TROPICAL CYCLONE?

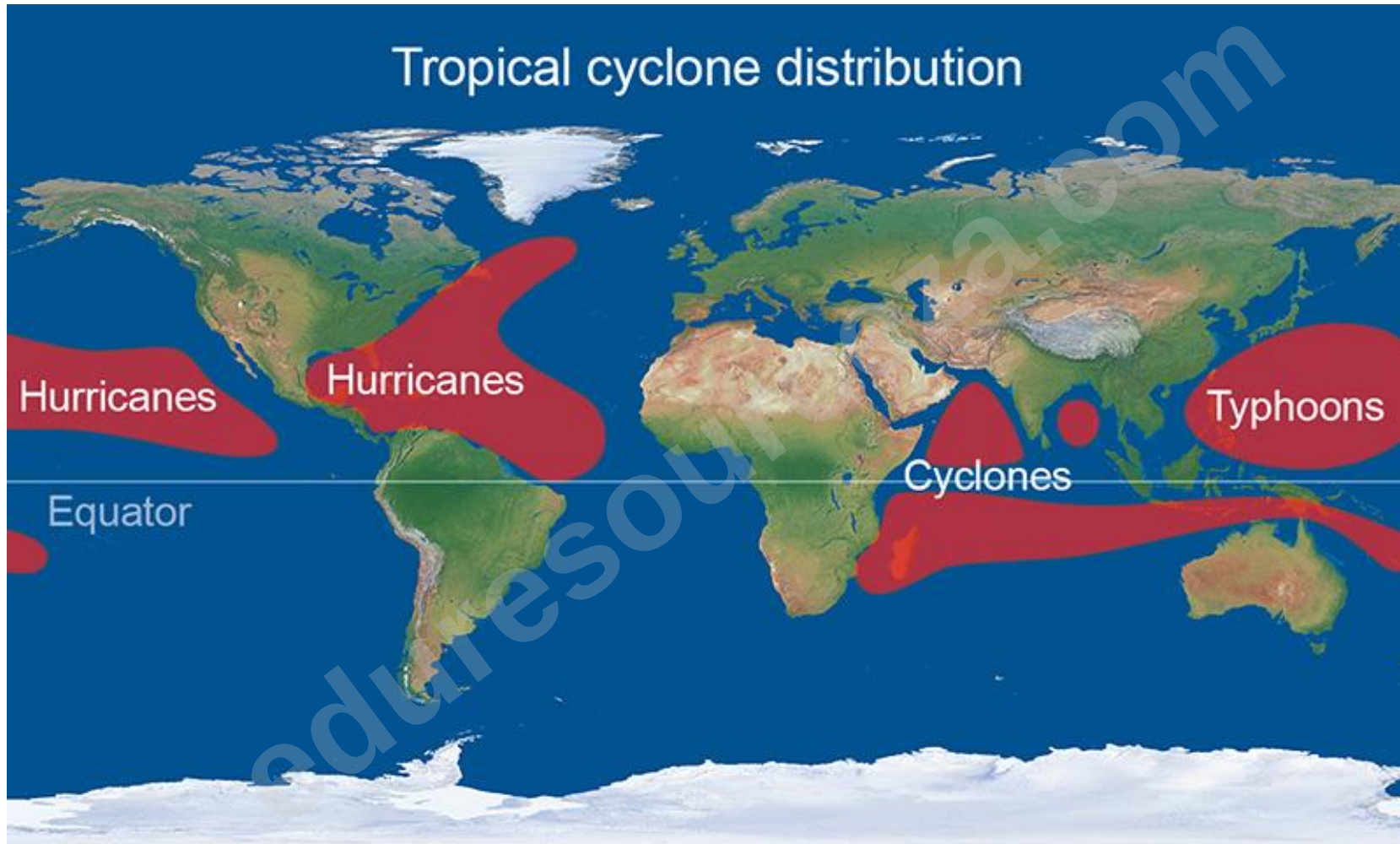
- ⦿ A localized, very intense low-pressure wind system, forming over tropical oceans and with winds of hurricane force.
- ⦿ They cause intense rainfall and can have devastating effects

Tropical Cyclones, 1945–2006



Saffir-Simpson Hurricane Scale:



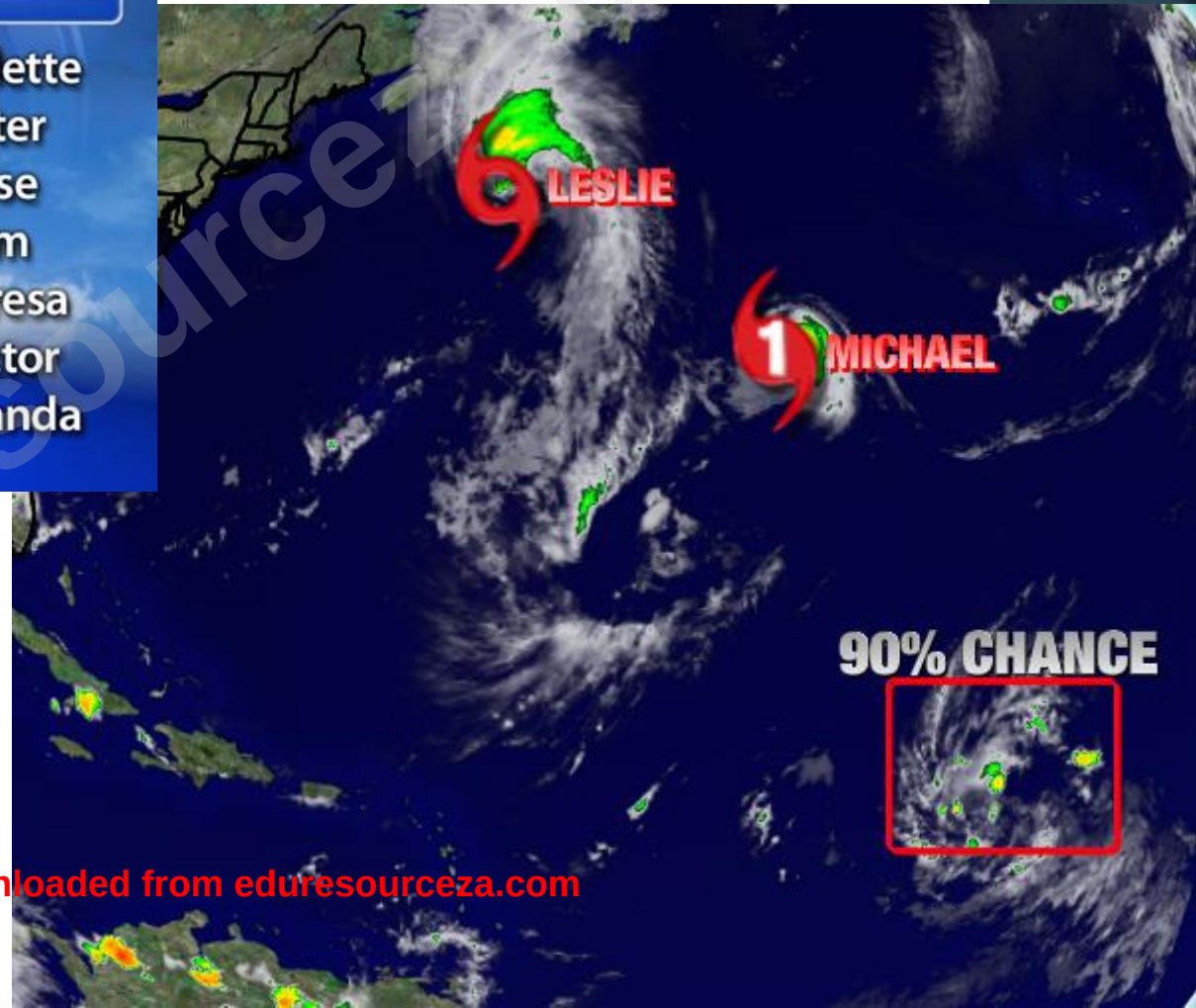




NAMES

2015 Hurricane Names

Ana	Henri	Odette
Bill	Ida	Peter
Claudette	Joaquin	Rose
Danny	Kate	Sam
Erika	Larry	Teresa
Fred	Mindy	Victor
Grace	Nicholas	Wanda



CHARACTERISTICS

- ◉ They originate over tropical oceans
 - Except the South western Atlantic as it never becomes warm enough
- ◉ Occur usually in late summer/ early autumn
- ◉ They develop between 5° and 30° north and south of the equator
 - They do not occur at the equator because there is no coriolis force
 - Hadley cell, the equatorial low pressure belt and are affected by the tropical easterlies
- ◉ They are centered around a cell of extremely low pressure
 - 996hPa
 - Surface convergence and upper air divergence

CHARACTERISTICS

- ⦿ Their rotation is clockwise once formed (SH)
- ⦿ Accompanied by heavy rain and showers
- ⦿ Cause a great deal of damage as result of floods, strong winds and high rainfall
- ⦿ Source of energy is the large amount of latent heat liberated as moist tropical air condenses
- ⦿ Rising of moist air in centre contributes to liberation of latent heat.
 - Rising air cools, condenses and releases latent heat
 - Latent heat is the heat given off when condensation takes place

CHARACTERISTICS

- ◉ Move from east to west at between 40 - 200 km a day then curve back in easterly direction
 - They affect the Eastern sides of continents
 - Dissipate as they reach cooler latitudes or due to friction (by land)
- ◉ Concentration of potential energy causes storms to develop
- ◉ 600-1000km storm diameter
- ◉ Storms begin small and gradually grow depending on the amount of energy it has
 - Tropical depression → tropical storm → category 1 → category 2 → category 3 → category 4 → category 5
 - Not all storms become a tropical cyclone

FACTORS NECESSARY FOR FORMATION

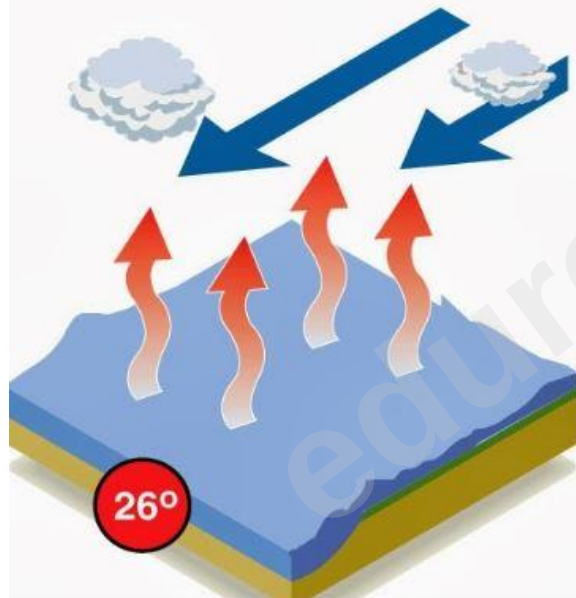
- ⦿ A sea temperature of more than 27°C
 - Water evaporates and the latent heat provides energy for the storm
- ⦿ High Humidity and unstable air
 - Hot moist air converge due to tropical easterlies
- ⦿ LP area must be pole ward of 5°N , 5°S which ensures a coriolis force
 - Coriolis force causes winds to spiral into the LP to such an extent that a calm cloud free funnel called the eye develops
 - Pressure in the eye is so low that some air is sucked down and warmed adiabatically
- ⦿ Little surface friction
- ⦿ Intense low Pressure for upper air divergence

These conditions should last for a period of time

How tropical storms are formed

High humidity and ocean temperatures of over 26°C are major contributing factors

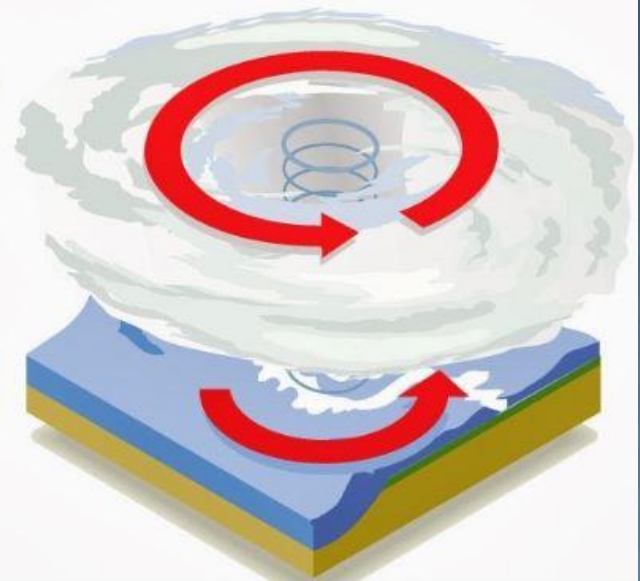
Water evaporates from the ocean surface and comes into contact with a **mass of cold air**, forming **clouds**



A **column of low pressure** develops at the centre. **Winds form** around the column

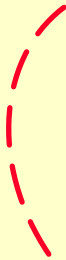


As pressure in the central column (the eye) weakens, the **speed of the wind around it increases**



STAGES OF DEVELOPMENT

1. Formative stage



3. Tropical Storm



2. Tropical Depression



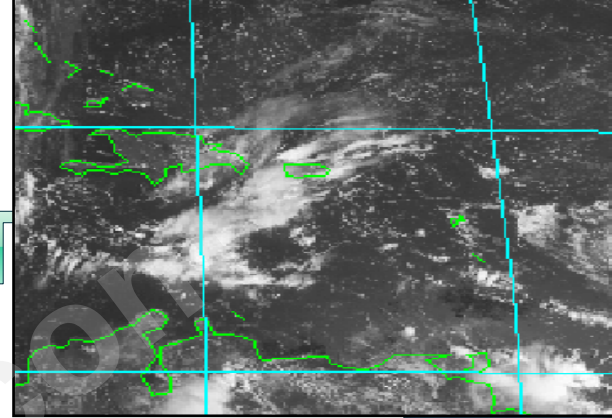
4. Mature Stage



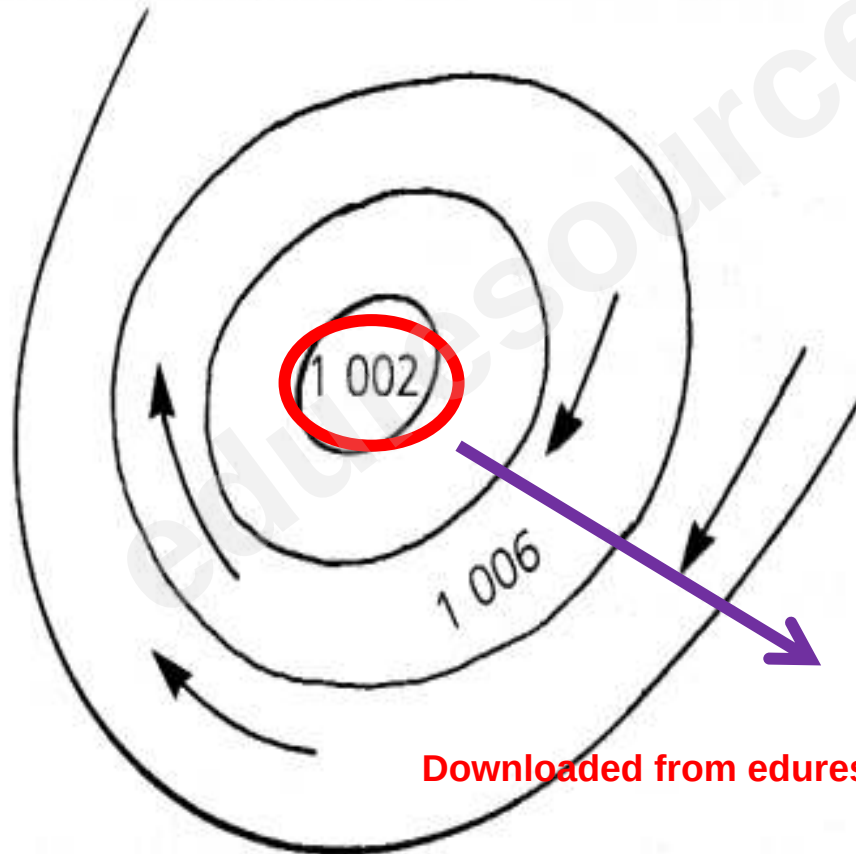


STAGES OF DEVELOPMENT

● Formative stage- tropical depression



Southern hemisphere



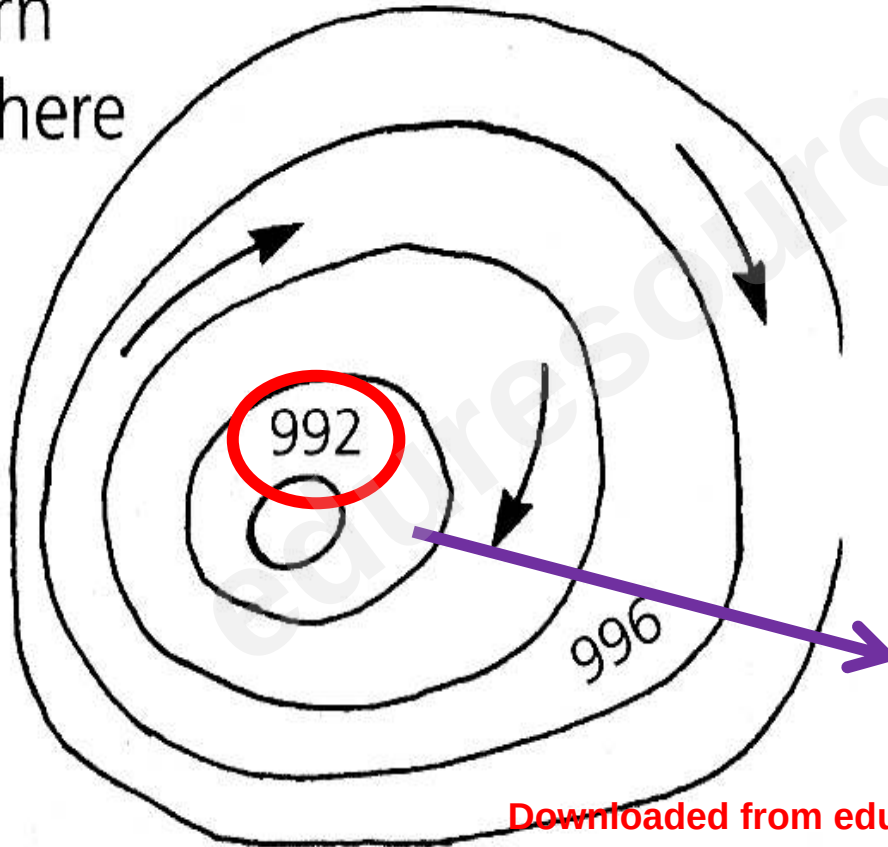
- Pressure **ABOVE** 1000 hPa
- Cumulonimbus clouds surround the centre

Gale force winds 50km from the eye

STAGES OF DEVELOPMENT

● Immature stage- tropical storm

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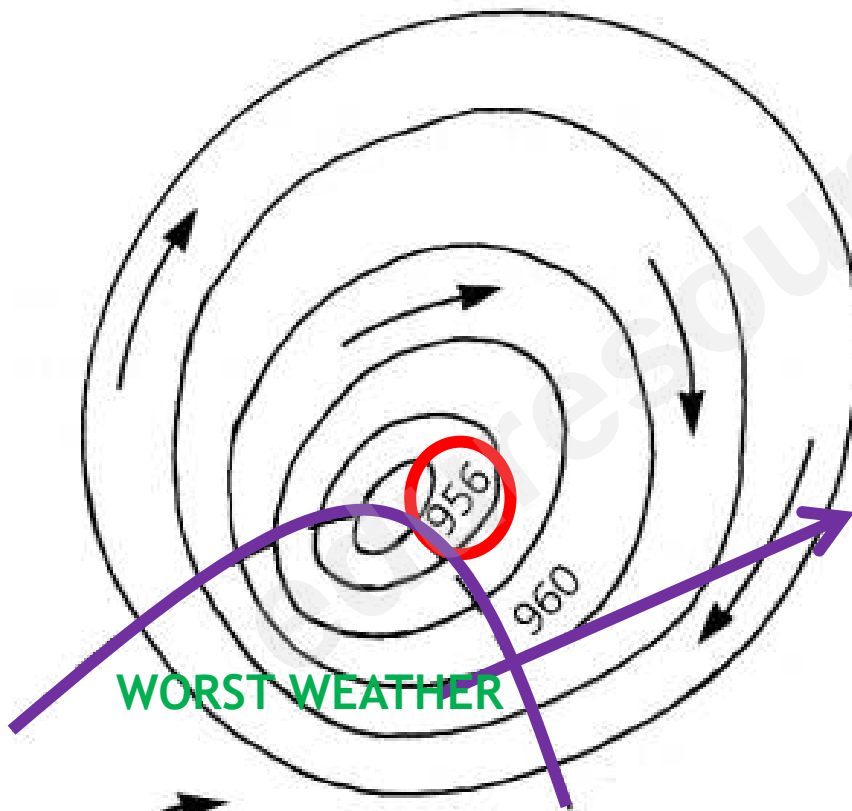
- Pressure drops **BELOW** 1000 hPa
- Isobars are almost circular
- A wall of cumulonimbus clouds surround the eye
EYE - central, calm, clear, cloudless
- Wind speeds increase

Hurricane speed winds
50km from the eye



STAGES OF DEVELOPMENT

● Mature stage- tropical cyclone



➤ Pressure is
WELL BELOW
1000 hPa

➤ Cyclone is given a name
➤ The eye is clearly visible

Air subsides in the eye and is
heated **ADIABATICALLY**

ACTIVE QUADRANT
Direction of wind in the
cyclone is the same as the
direction of movement
SH - SW
NH - NE

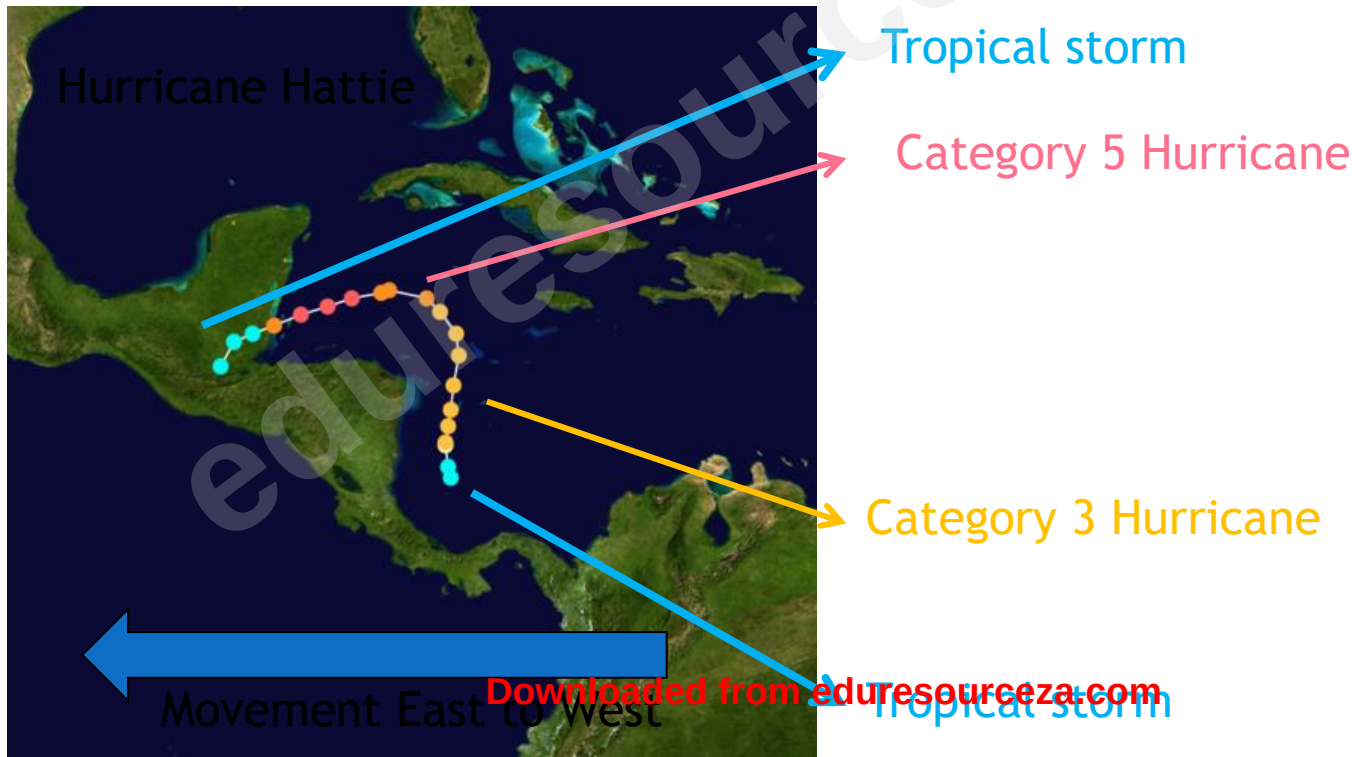


STAGES OF DEVELOPMENT

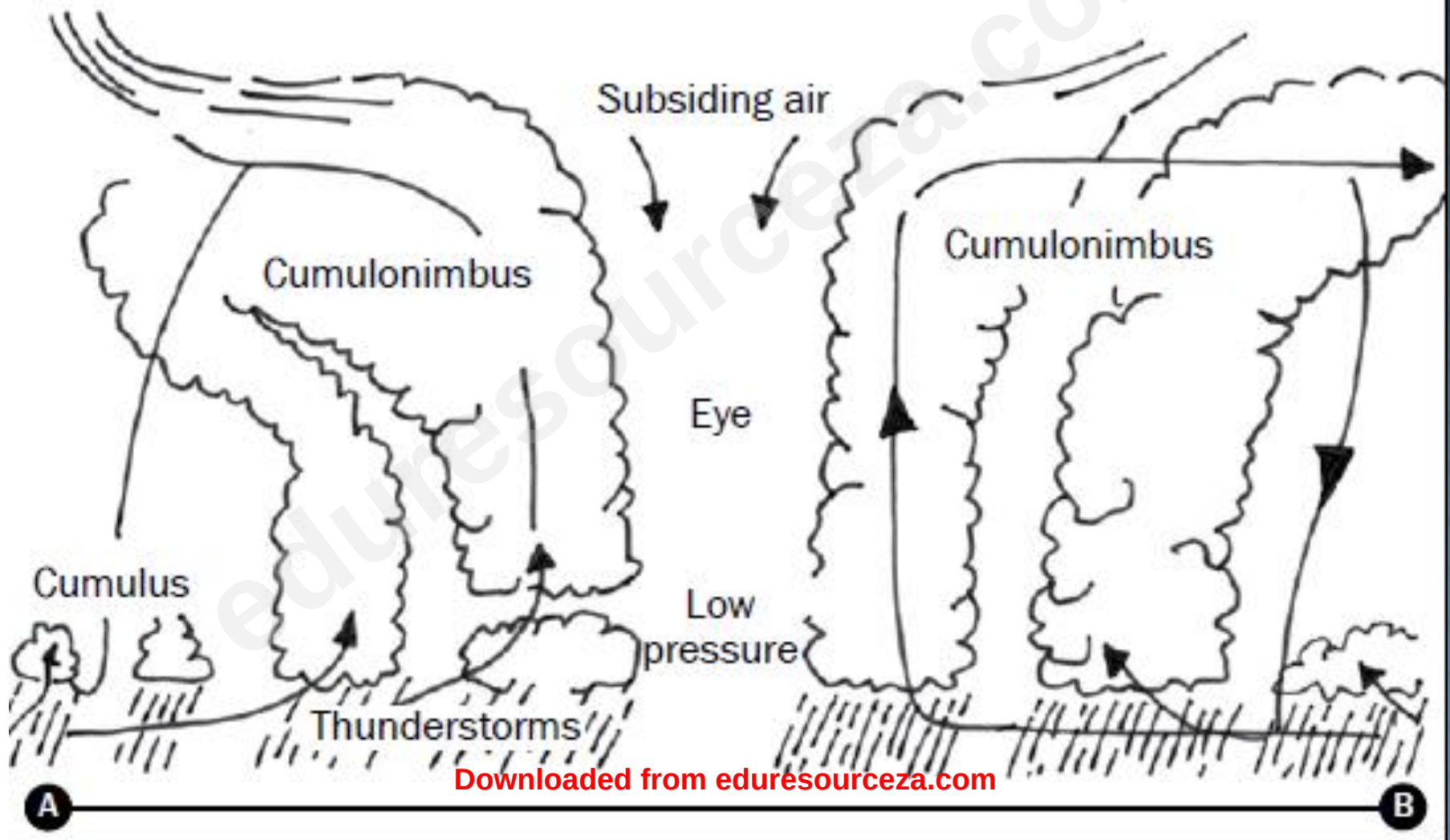
- ◉ Degenerating stage- decaying/ dissipating
- ◉ Causes:
 - Pressure increases
 - Surface area of cyclone decreases
 - Clouds begin to break up
 - Cyclone moves towards higher latitudes
- ◉ Reasons:
 - Cyclone reaches land therefore no evaporation and no latent heat to feed the system
 - Friction with the land slows it down
 - Cooler water means less evaporation

STAGES OF DEVELOPMENT

- Tropical cyclones can regenerate if it moves back over warm water
 - Will gain more energy by latent heat



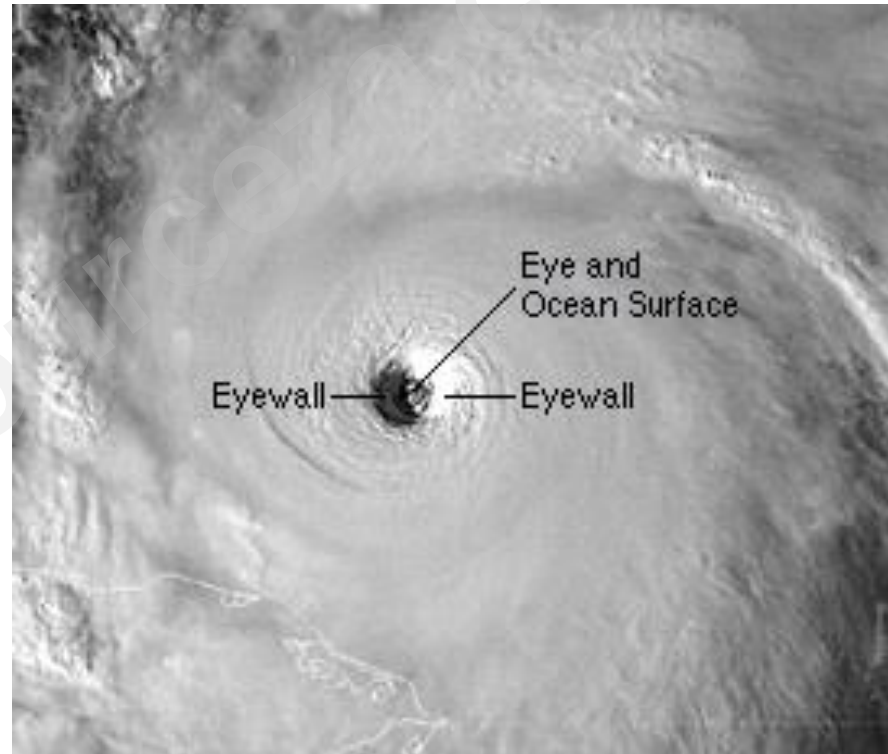
CROSS SECTION



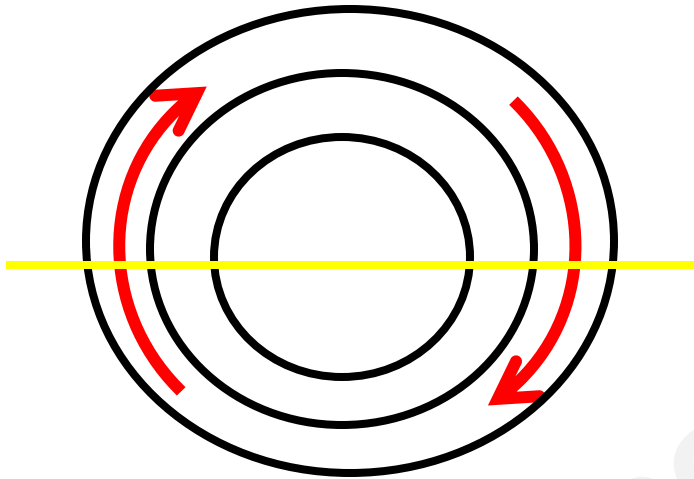
As cyclone appears 1 st vortex	As eye passes over	As cyclone moves away 2 nd vortex
Temp and humidity are high	Temperature increases slightly	Pressure increases
Pressure decreases	Pressure is at its lowest point	Winds reach hurricane force
Cirrus clouds appear and thicken into cumulonimbus clouds	Scattered clouds	Reversal of wind direction
Wind strengthens	Conditions prevail for up to 2 hours	
Torrential rain and hail	Diameter 25km	
Temperature decreases	Downloaded from eduresourceza.com	

THE EYE

- ◉ Rain is heaviest in the wall
 - Extends 15km vertically
 - 25km diameter
 - Cirrus clouds extend away
- ◉ Wind direction is different on either side of the wall.



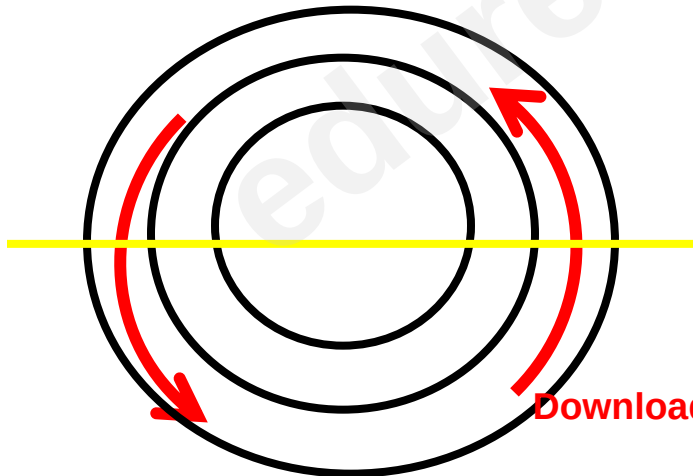
WIND DIRECTION



SOUTHERN HEMISPHERE

First Vortex - S

Second Vortex - N

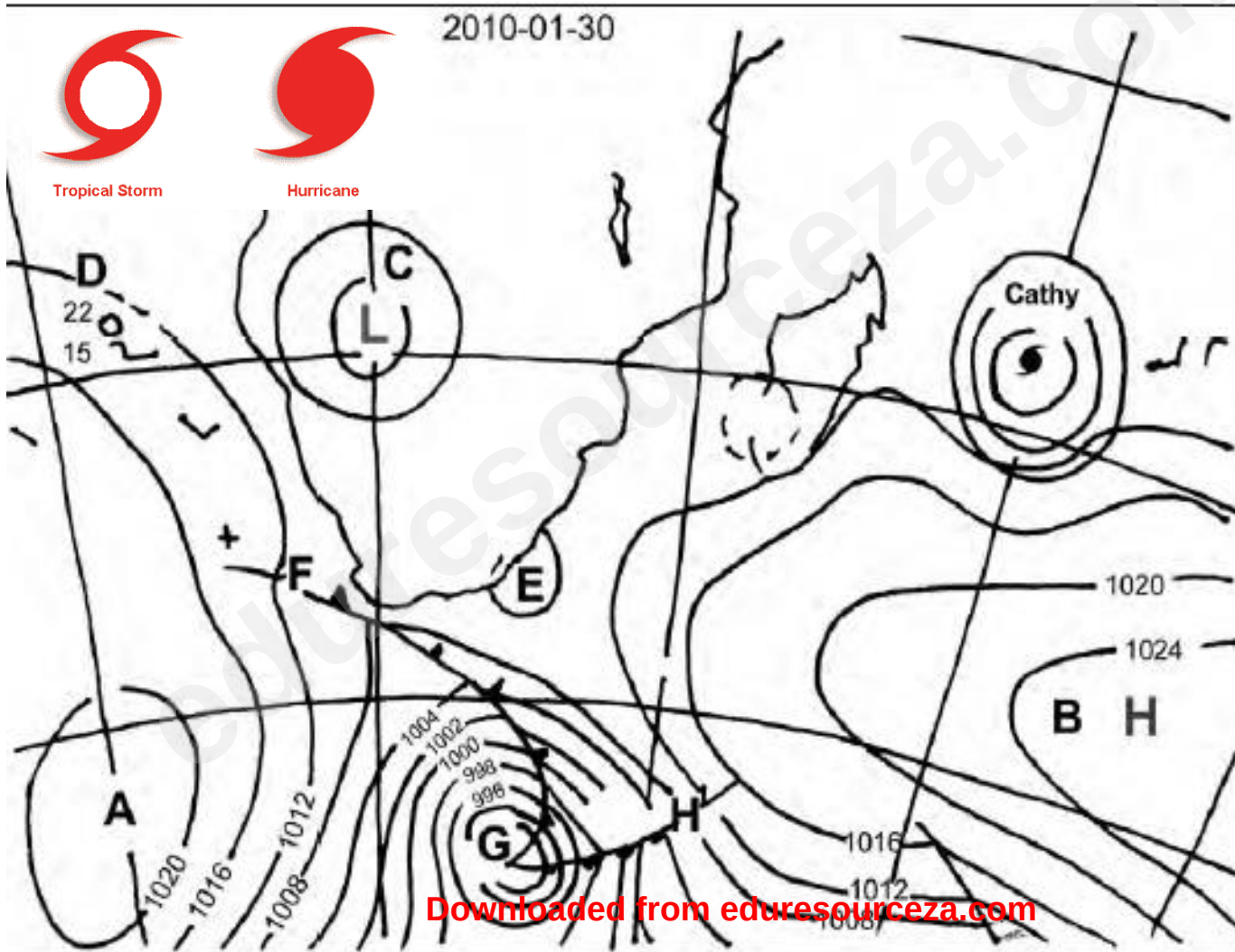


NORTHERN HEMISPHERE

First Vortex - N

Second Vortex - S

SYNOPTIC MAPS



Weather station

Temperature: 28°C

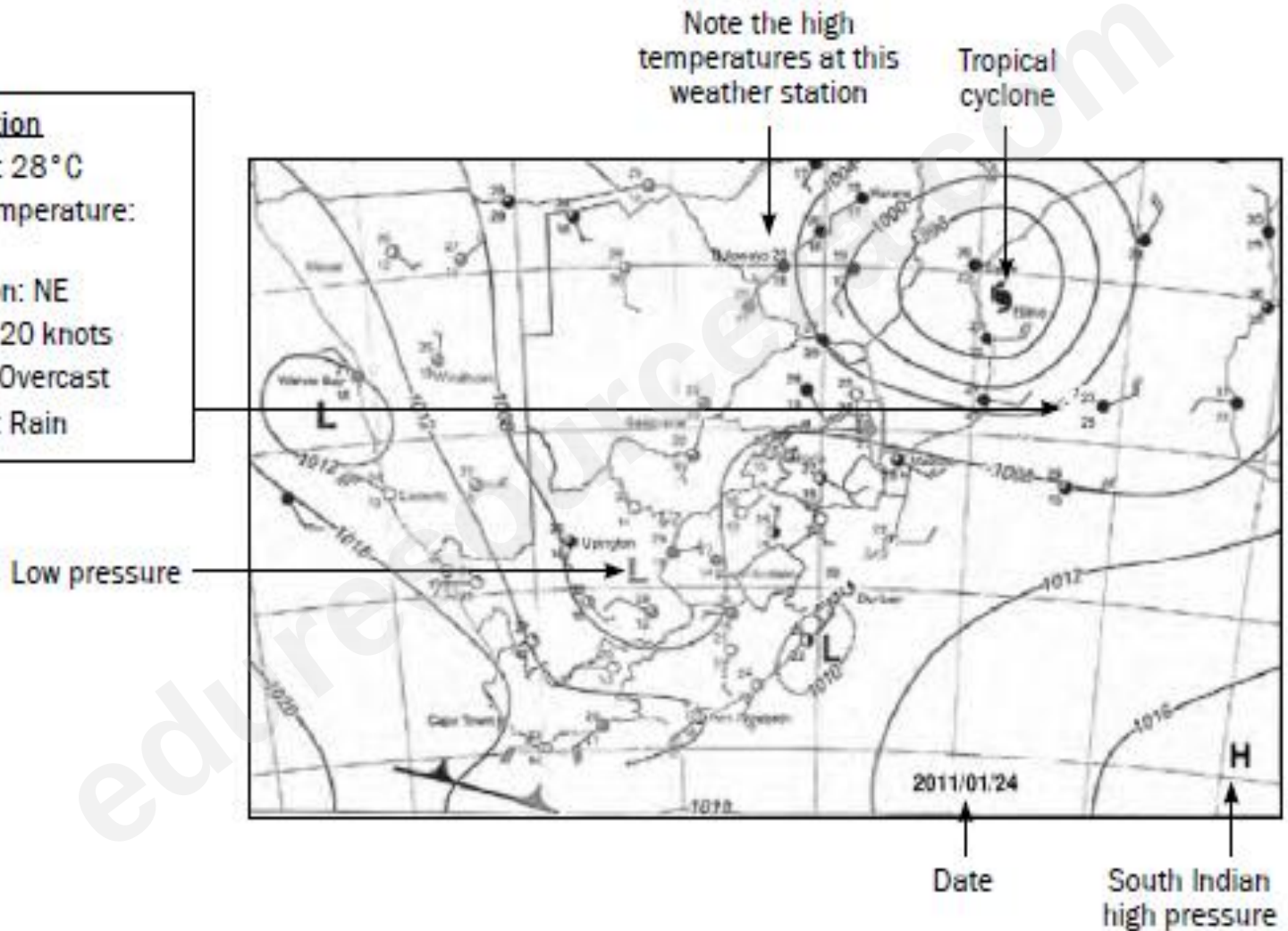
Dew point temperature:
 23°C

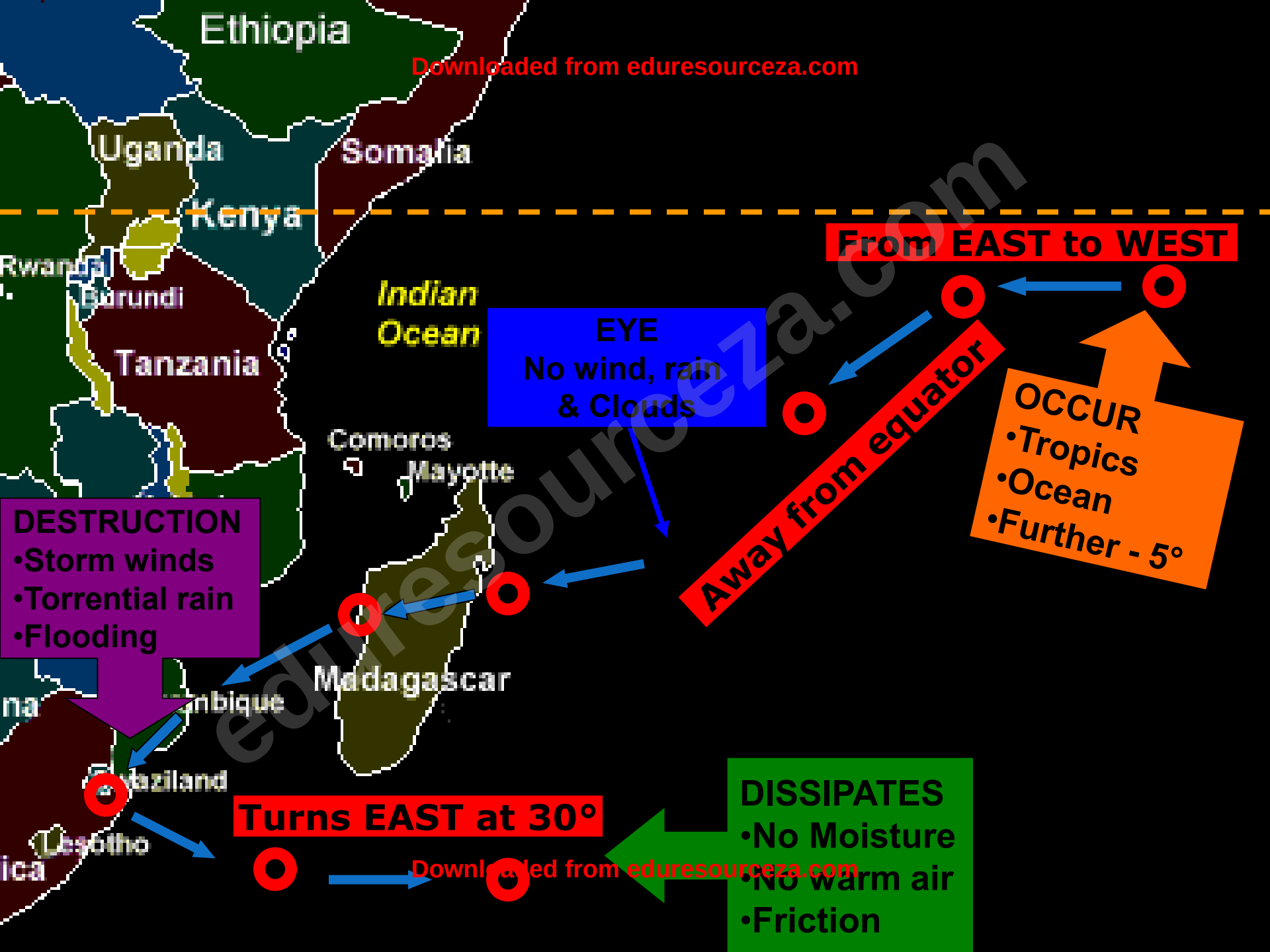
Wind direction: NE

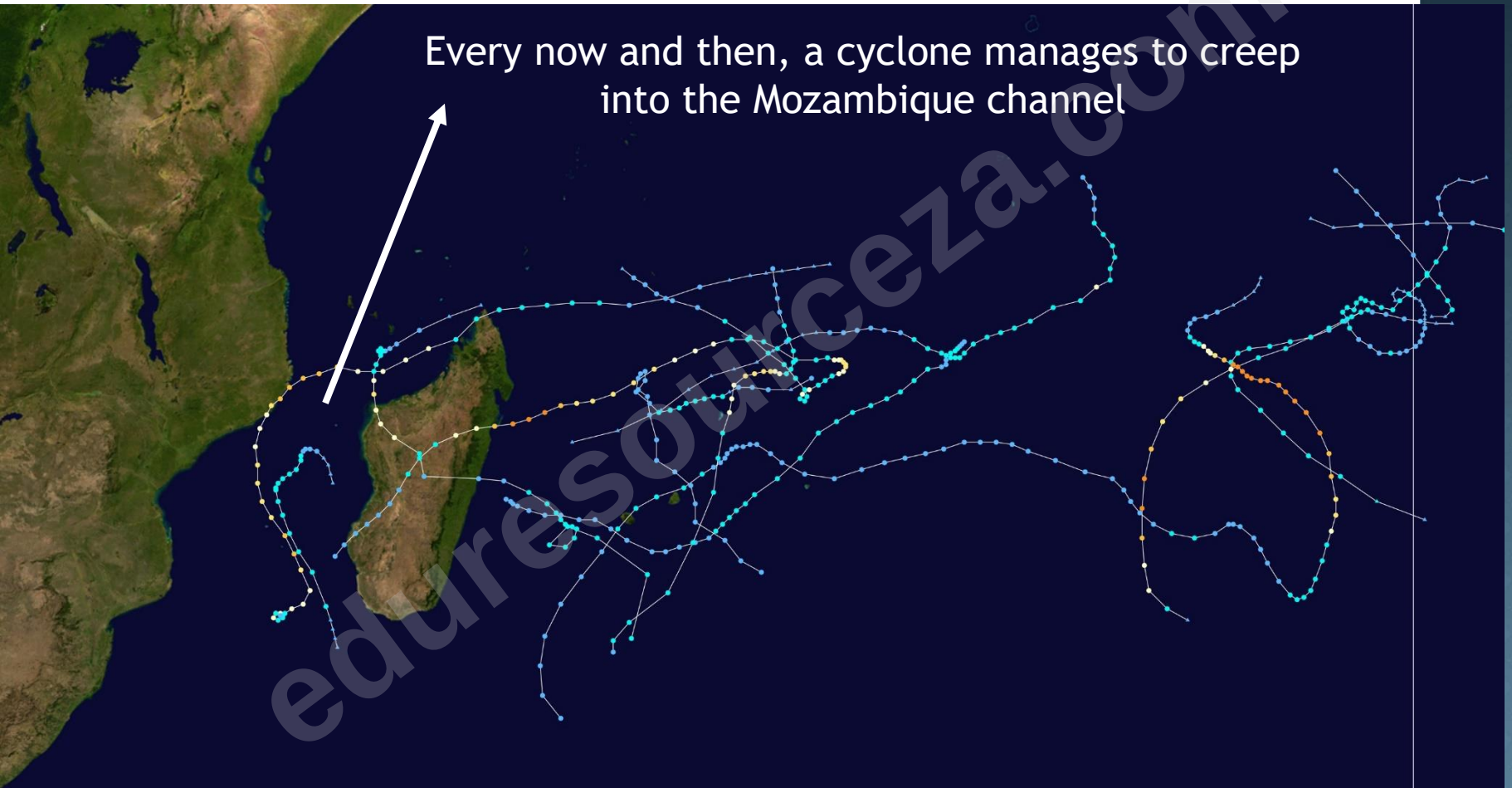
Wind speed: 20 knots

Cloud cover: Overcast

Precipitation: Rain







South Africa is SHIELDED by Madagascar

IMPACTS

ON THE ENVIRONMENT

- ⦿ Torrential rains- destroy vegetation & cause soil erosion
- ⦿ Agricultural lands and crops damaged
- ⦿ Hurricane force winds- uproot trees
- ⦿ Extremely low pressure (986hPa)

ON THE SEA

- ⦿ Swell waves up to 10 metres
- ⦿ Storm waves
- ⦿ Storm surges along the coastal areas

IMPACTS

SOCIO-ECONOMIC

- Structural damages to buildings, infrastructure
- Loss of human life
- Cost of replacement high
- Agricultural production may be affected , but insurance helps people
- Diseases break out due to lack of water and food

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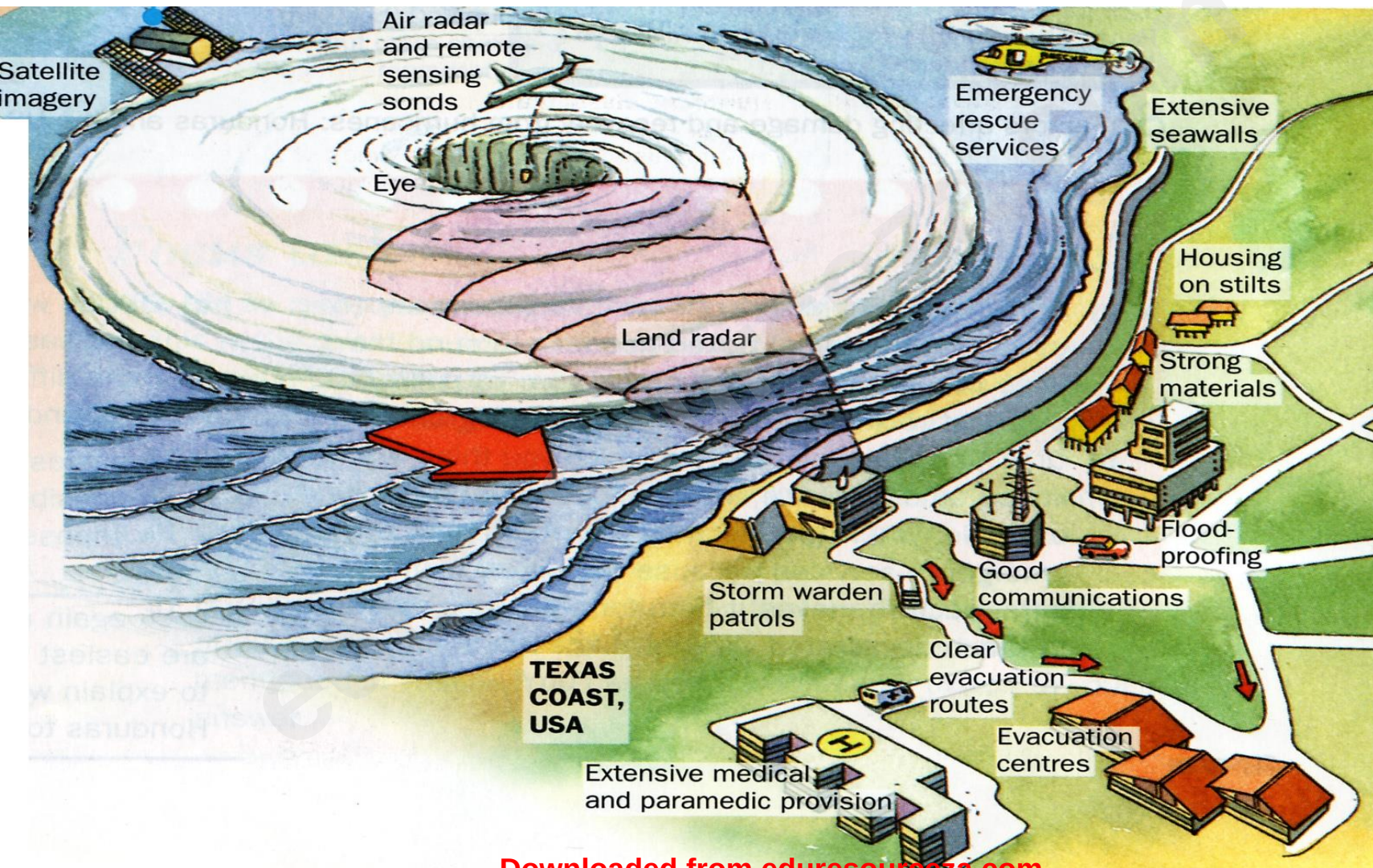
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MANAGEMENT

- ◉ Constant monitoring by weather bureaus worldwide and locally
- ◉ Weather reports , satellite images and radar
- ◉ Timely warnings made to inhabitants
- ◉ Sandbags may be placed in coastal areas to reduce flooding
- ◉ Disaster management schemes must be in operation



COMPARING CYCLONES

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	Mid-latitude cyclone	Tropical cyclone
Other names	Mid-latitude depression, temperate cyclone, extra tropical cyclone	Hurricane, typhoon, Willie-willies (named alphabetically at the beginning of each season)
Formation	40–60° N and S	± 5° N and S
Occurrence	30–60° N and S	Over tropical oceans 5–30° N and S
Movement	West to east	East to west
Season	All year round in both hemispheres; affects South Africa in winter	Mid- to late summer, early autumn
Identifying features	Warm front, warm sector, cold front, cold sector	Stormy weather in the vortex; the eye is a calm, intense low pressure area
Weather	Weather associated with a cold front: overcast, low temperatures, strong winds, heavy rain	Warm to hot, violent winds; intense thunderstorm activity
Areas affected	Western side of continents in mid-latitudes	Eastern side of continents in tropical latitudes

Synoptic representation of the cyclones on a weather map

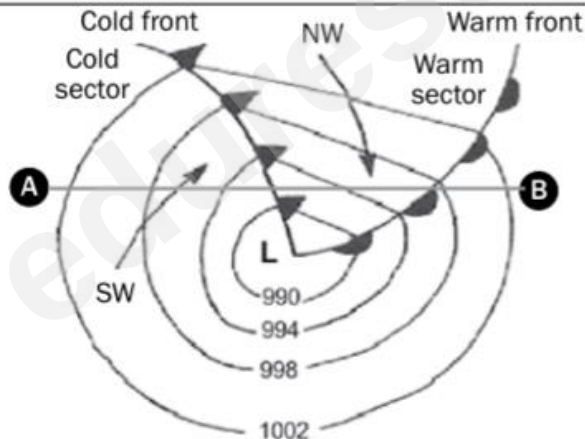


Figure 1.15: Synoptic view of mid-latitude cyclone

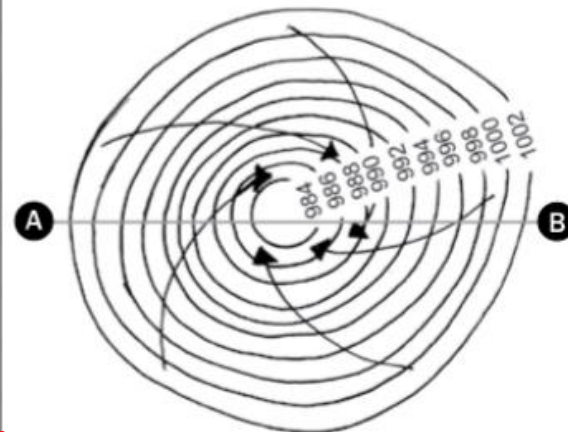


Figure 1.16: Synoptic view of tropical cyclone

Downloaded from eduresourceza.com

VIDEO REFERENCES

- ◉ https://www.youtube.com/watch?v=SSx_gisp24w
- ◉ <https://www.youtube.com/watch?v=zP4rgvu4xDE>
- ◉ <https://www.youtube.com/watch?v=5lKhb5Ggd-4>
- ◉ <https://www.youtube.com/watch?v=7qym7b-qvkE>
- ◉ <https://www.youtube.com/watch?v=HbJaMWw4-2Q>