CLIMATE AND WEATHER

MAIN TOPICS

A

MID-LATITUDE CYCLONES

B

TROPICAL CYCLONES

C

SUBTROPICAL ANTICYCLONES

D

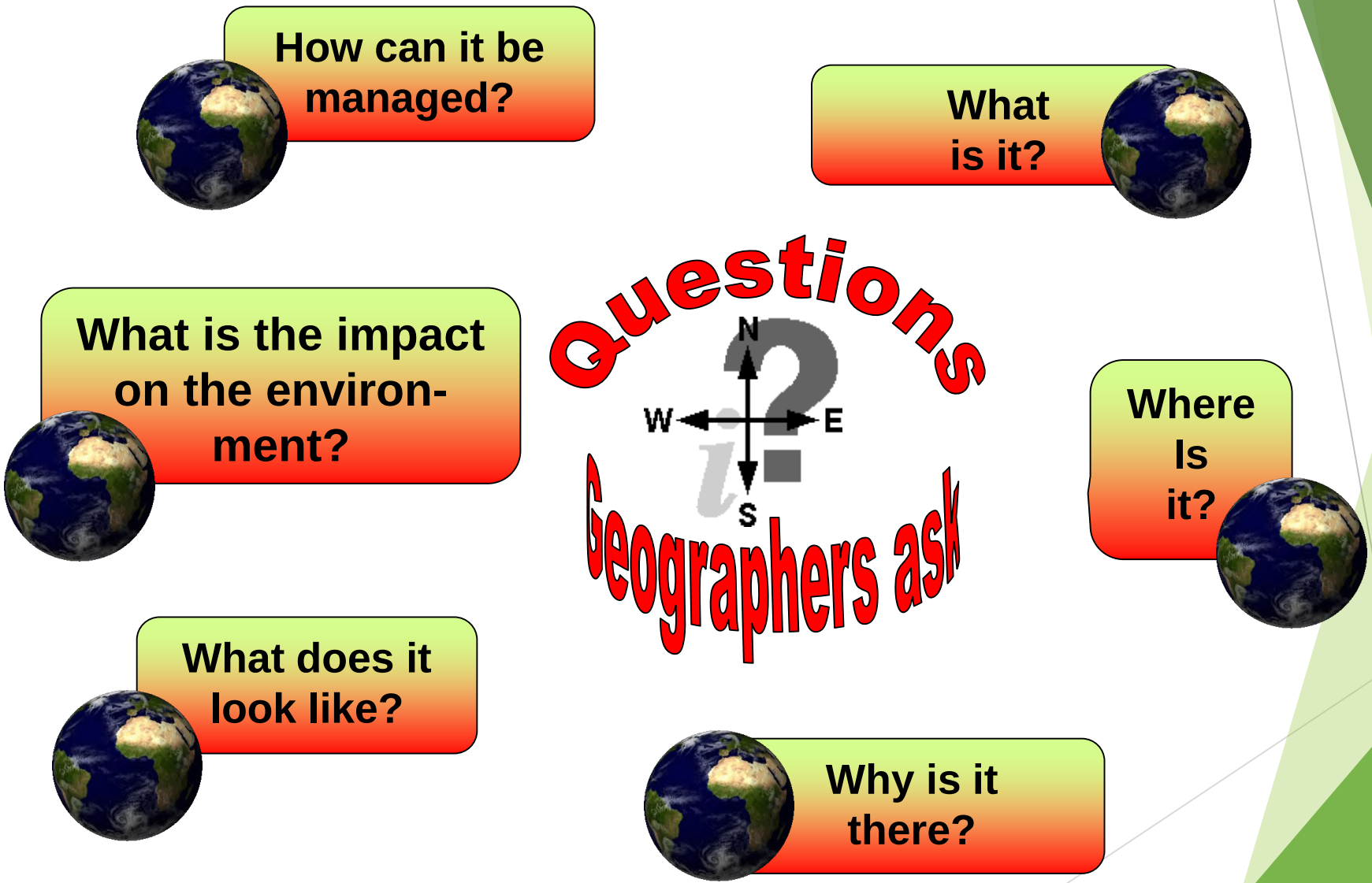
VALLEY CLIMATES

E

URBAN CLIMATES

SYNOPTIC WEATHER MAPS

DATA RESPONSE QUESTIONS



MID-LATITUDE CYCLONES
What you must know

1

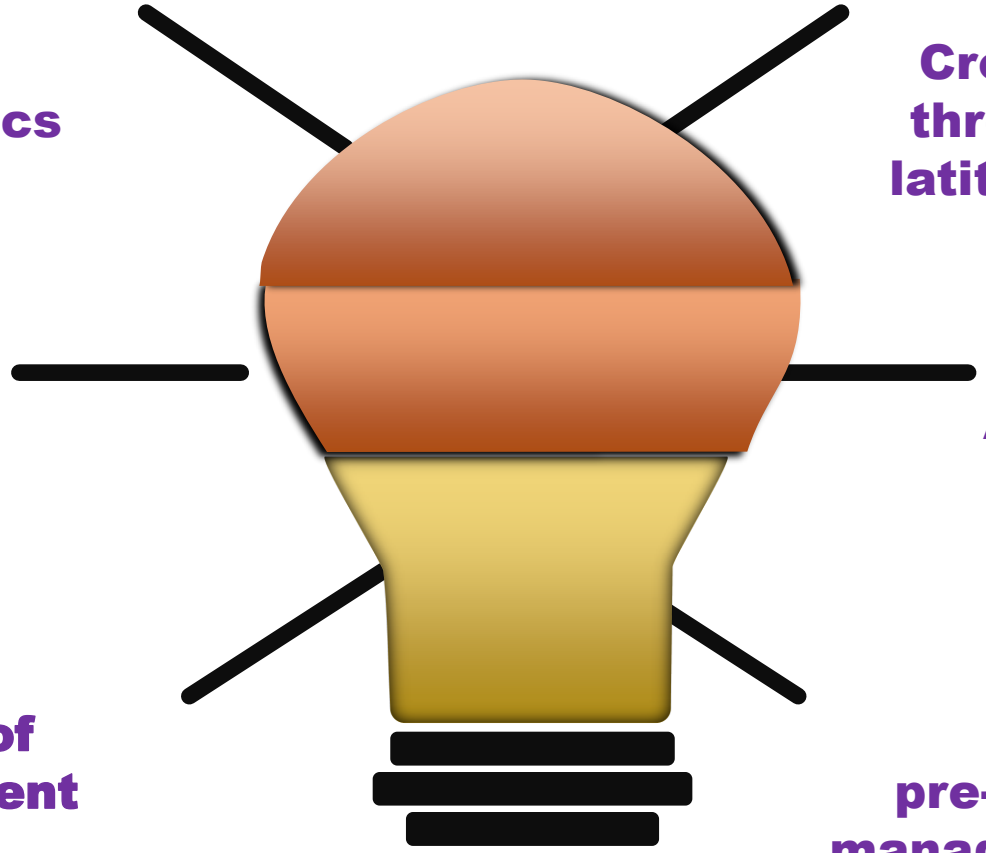
General characteristics

2

conditions necessary for formation

3

Stages of development



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Cross-section through a mid-latitude cyclone

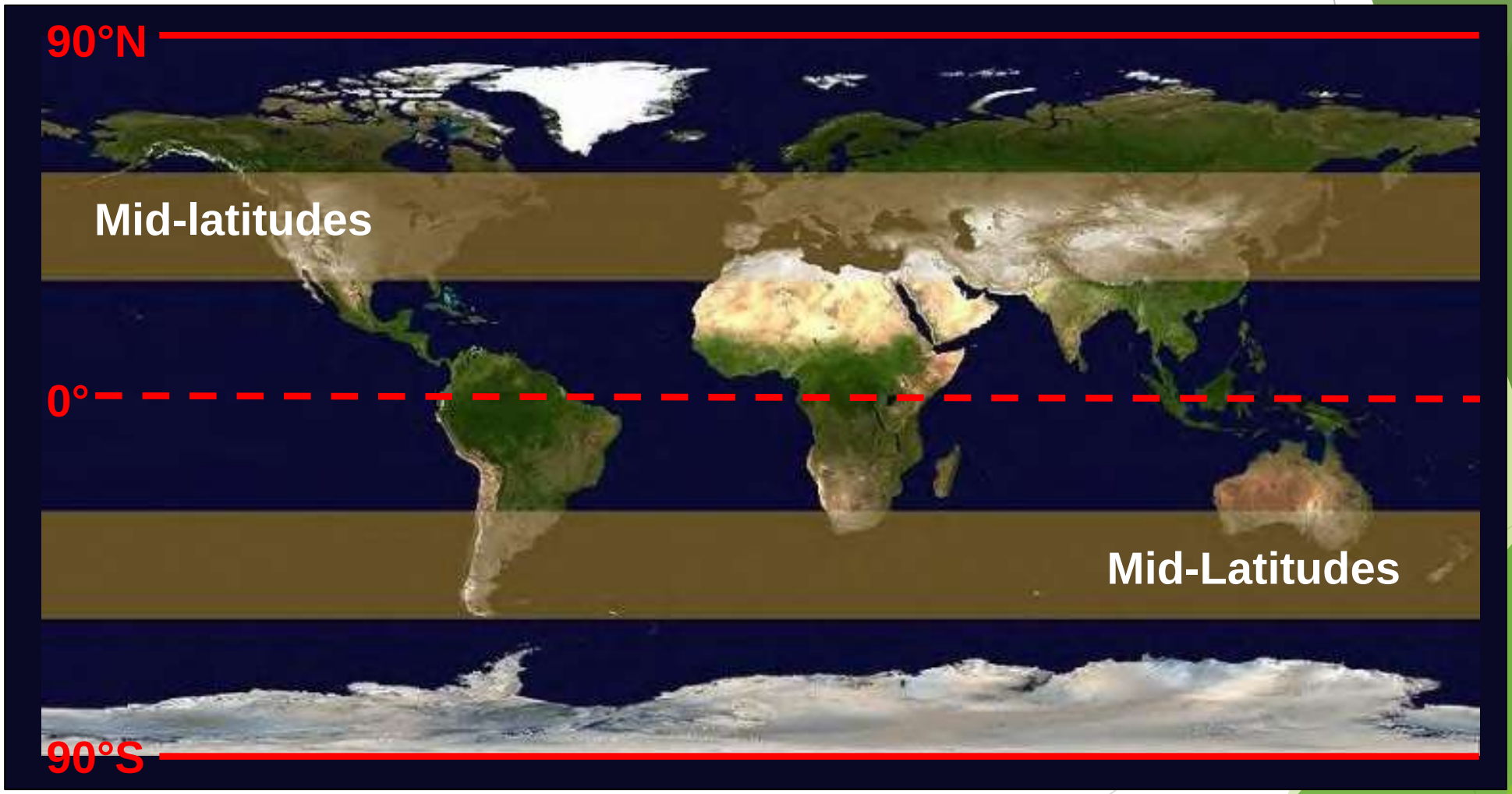
5

Associated weather patterns

6

Impact, pre-cautionary and management strategies

Where do mid-latitude cyclones form?

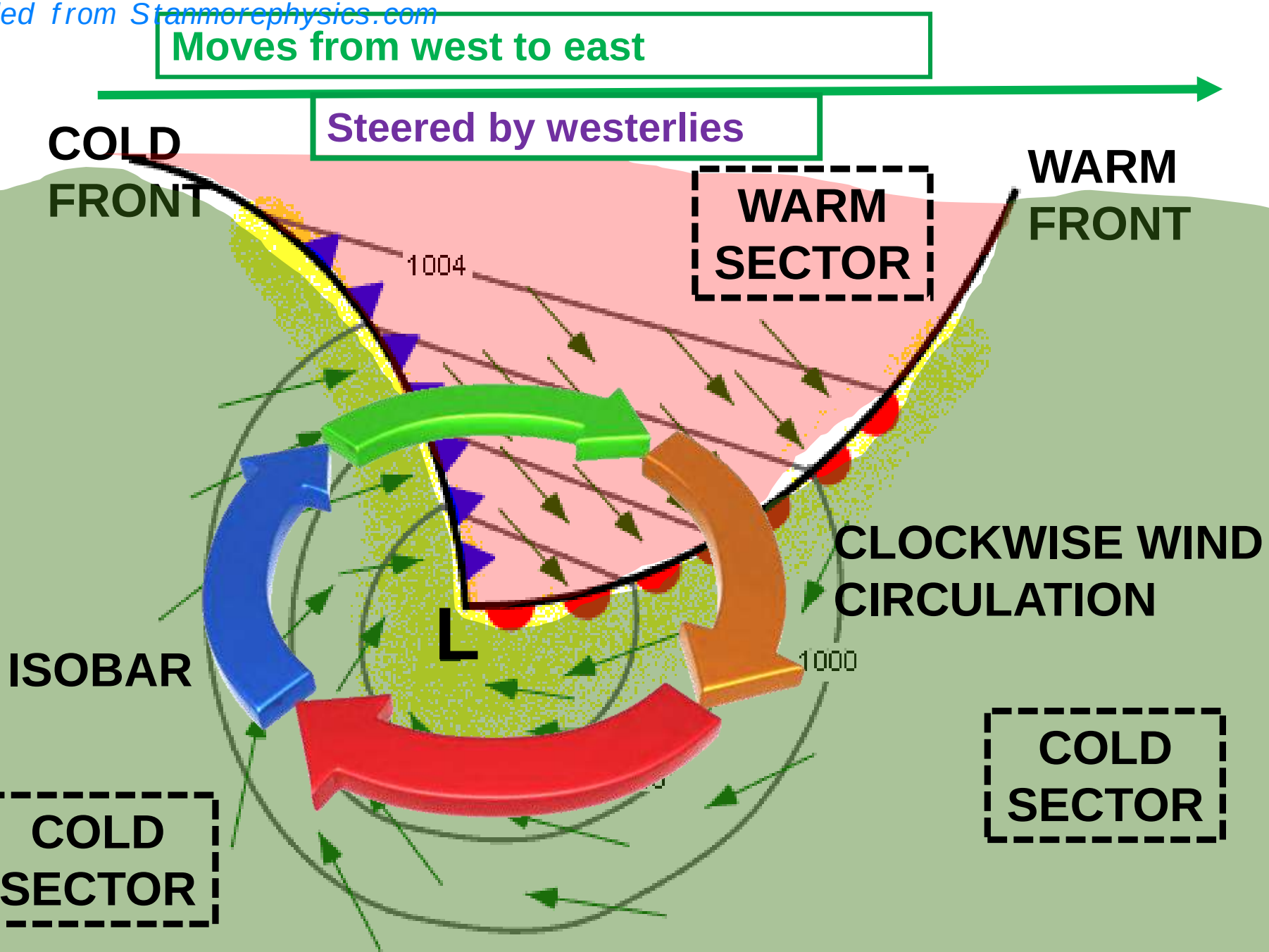


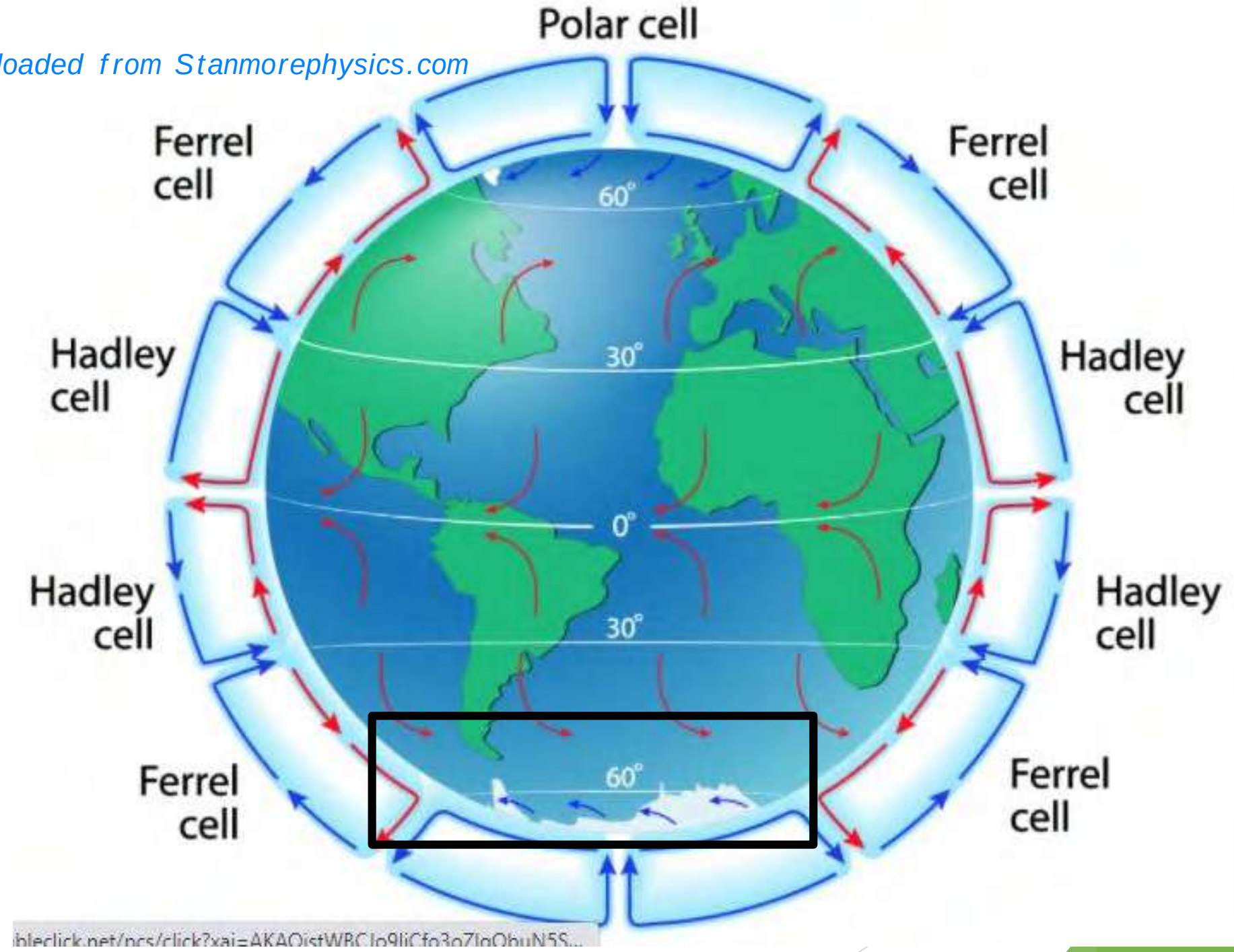
Mid-latitude cyclones

CHARACTERISTICS

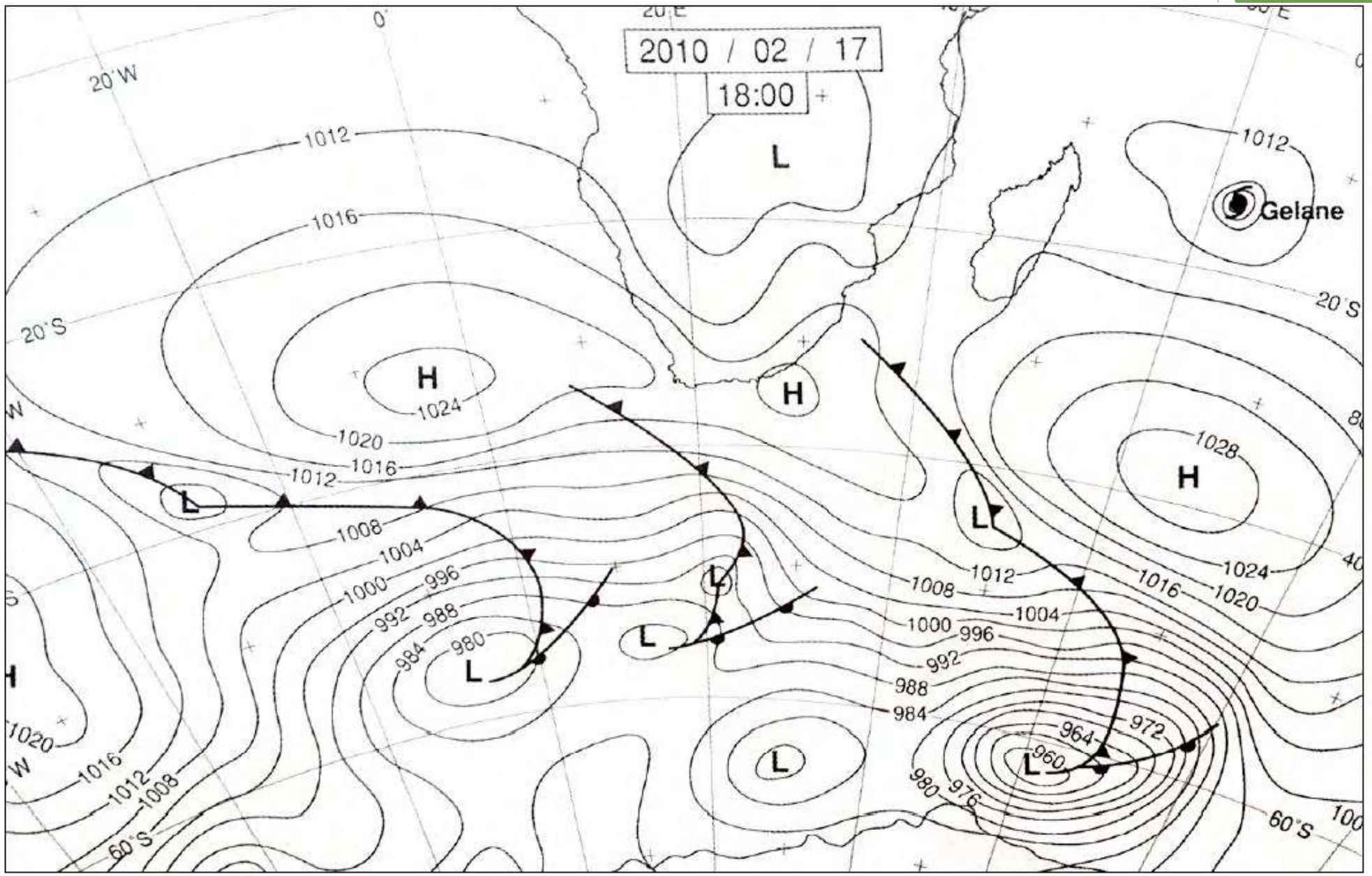
- They occur 30^0 and 60^0 latitude.
- Move from west to east.
- Steered by westerlies in the westerly wind belt.
- It consists of cold and warm fronts.
- The size is about 1000km
- They last from 2 to 14 days.
- They rotate anticlockwise.
- Affects south Africa only in winter.

Mid-latitude cyclones: Characteristics

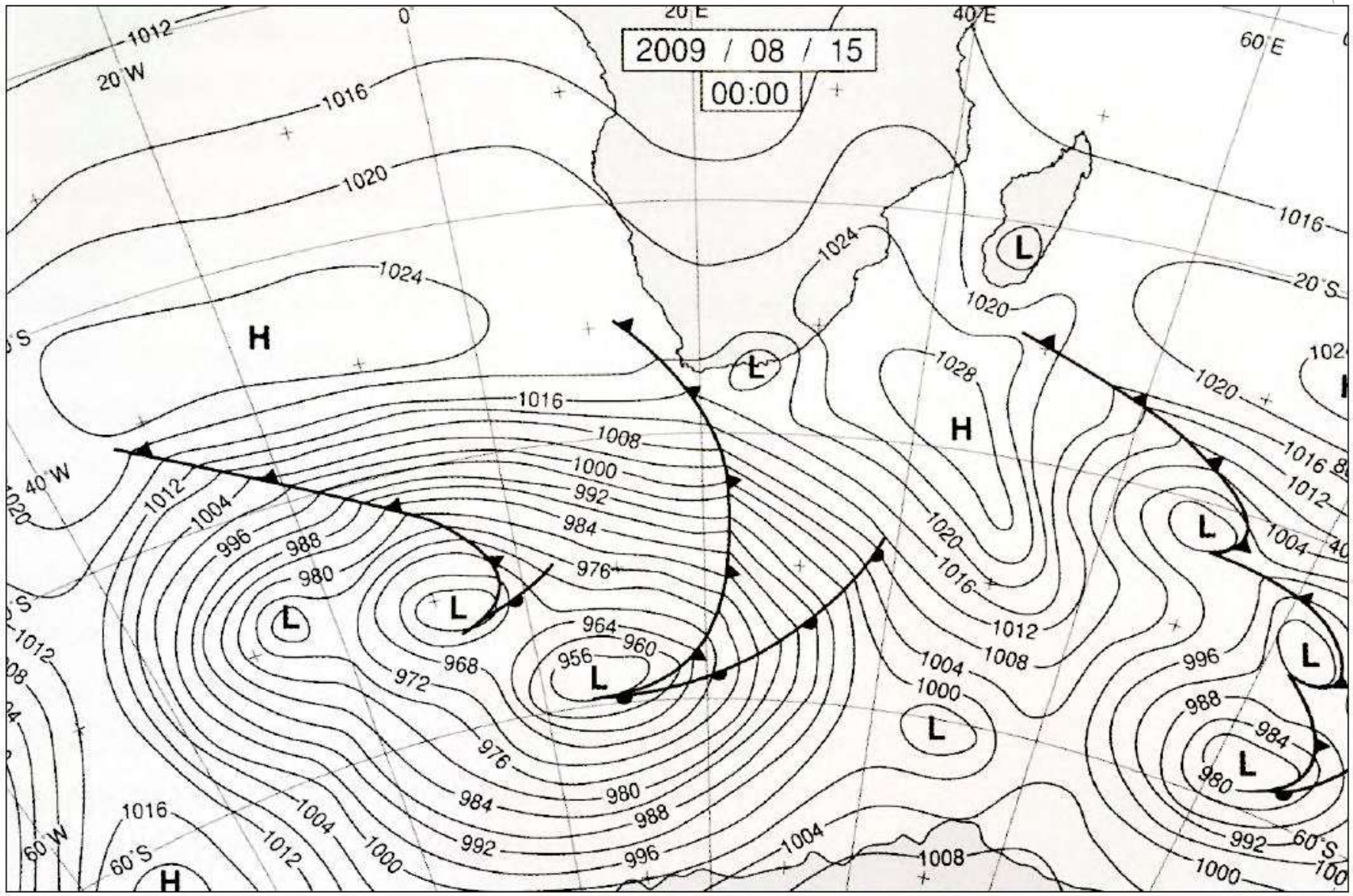


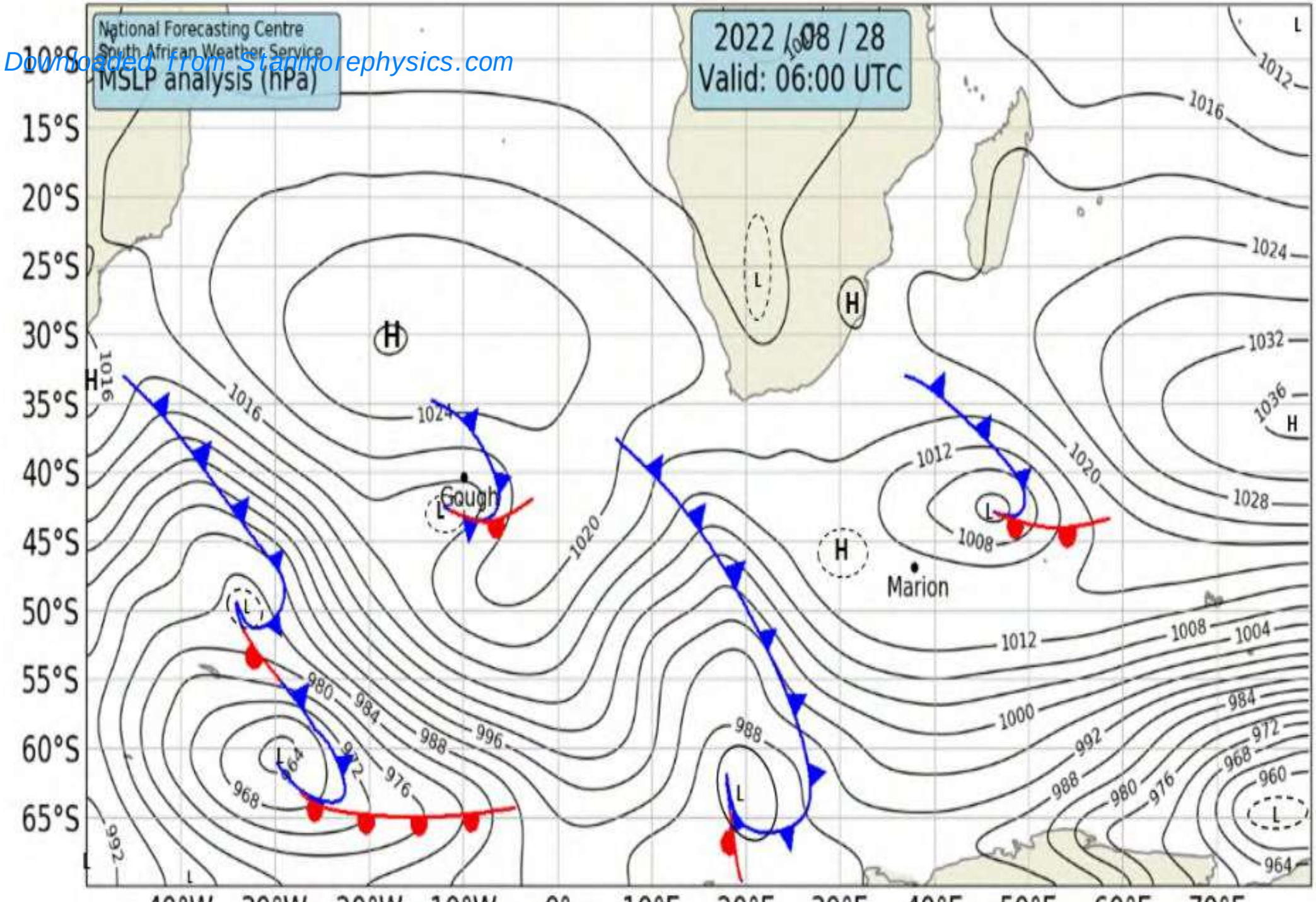


Summer synoptic weather map



WINTER SYNOPTIC WEATHER MAP

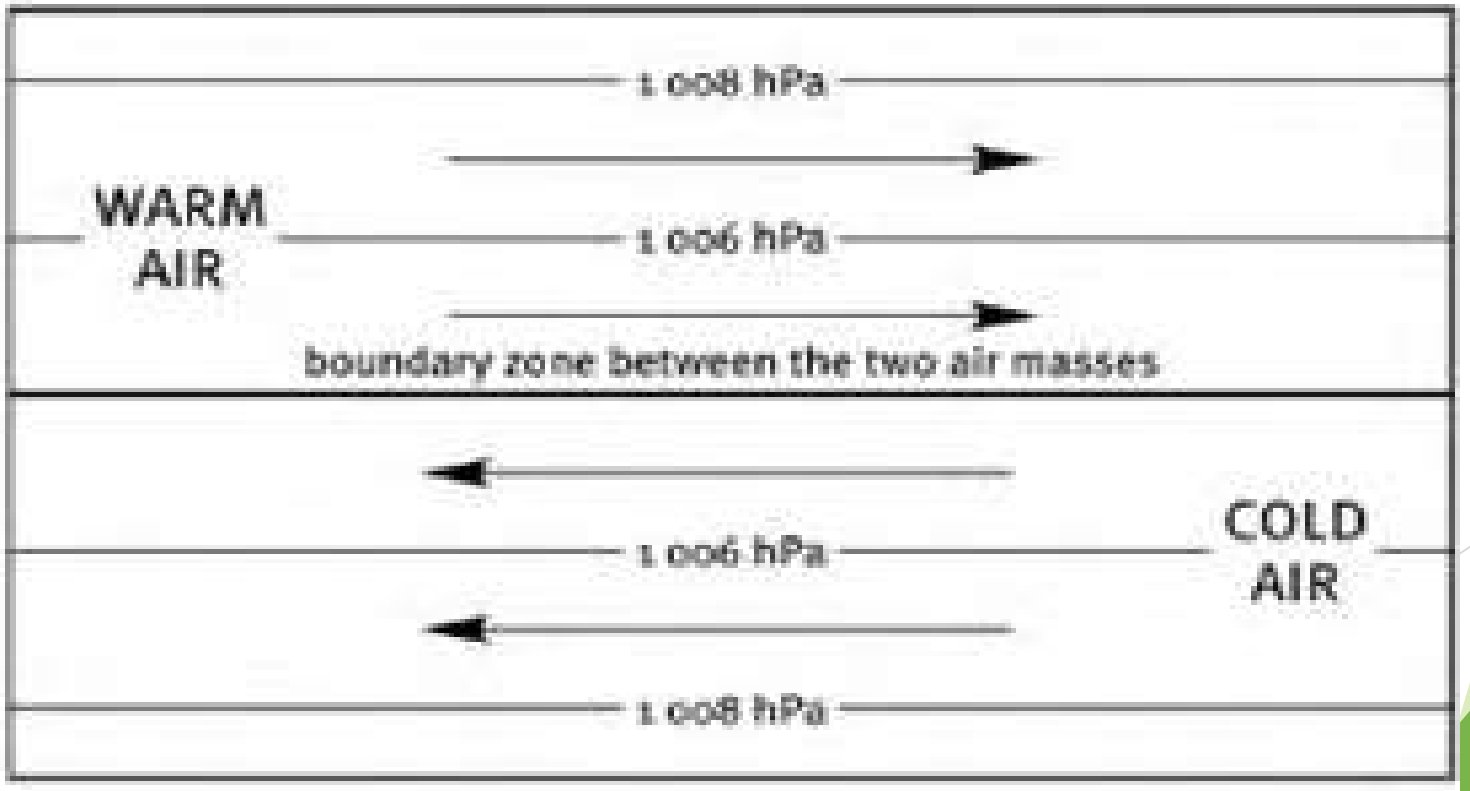




CONDITIONS NECESSARY FOR FORMATION

Warm air mass (from 30^0N/S)meets with the cold air mass (from 90^0N/S) at the polar front.

Both air masses move in opposite direction



CONDITIONS NECESSARY FOR FORMATION

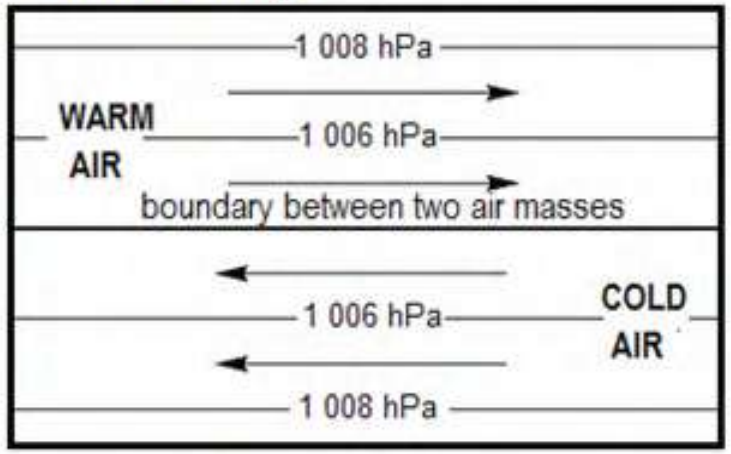
The air masses interact because of the frictional drag.

Why does frictional drag occur?

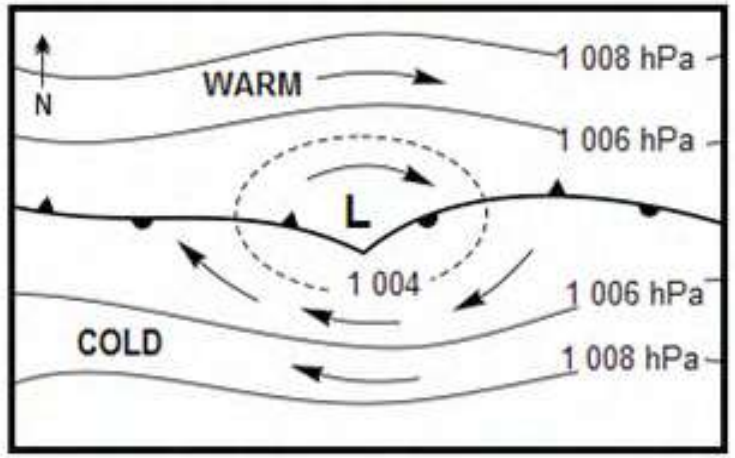
1) **Difference in speed between the air masses.**
2) **Uneven surface over which they move.**
3) **Temperature differences between the land and the sea**

STAGES OF DEVELOPMENT

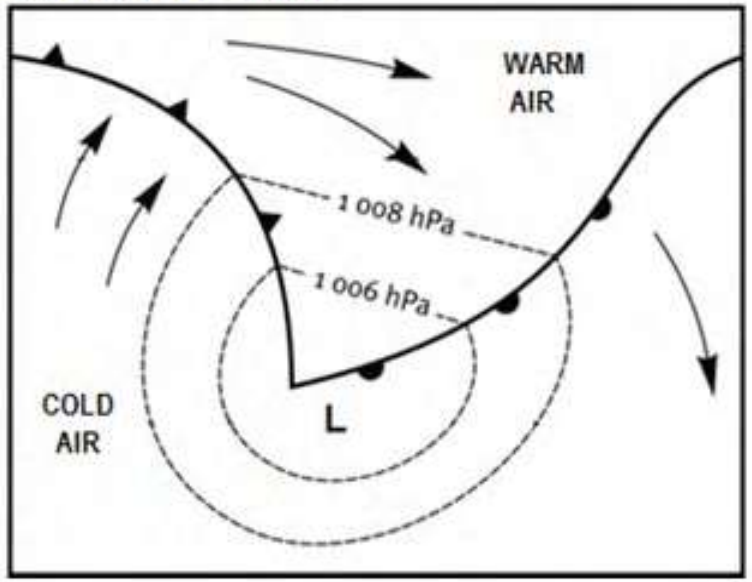
1. Initial stage



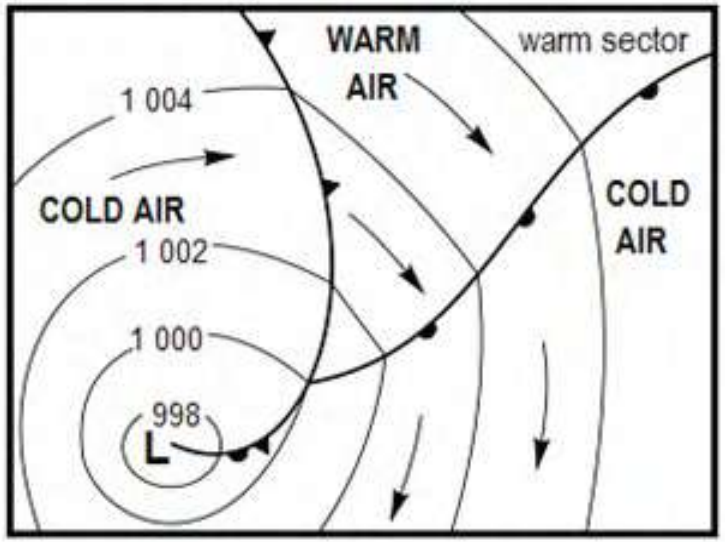
2. Development stage



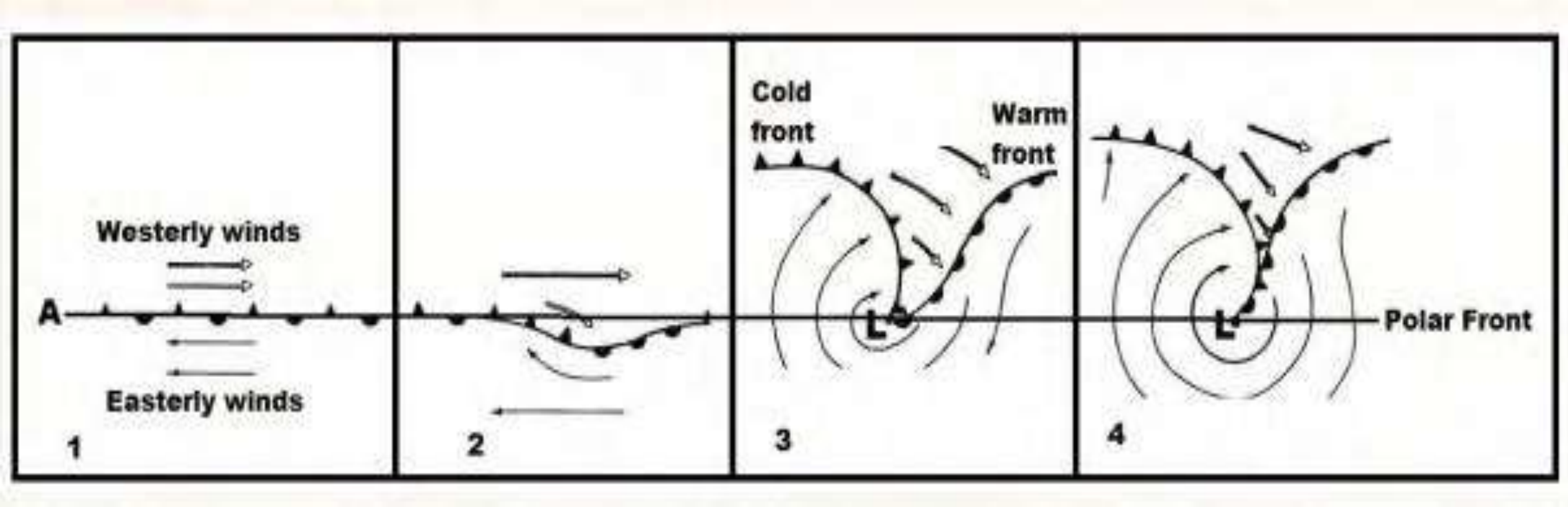
3. Mature stage



4. Occluded stage

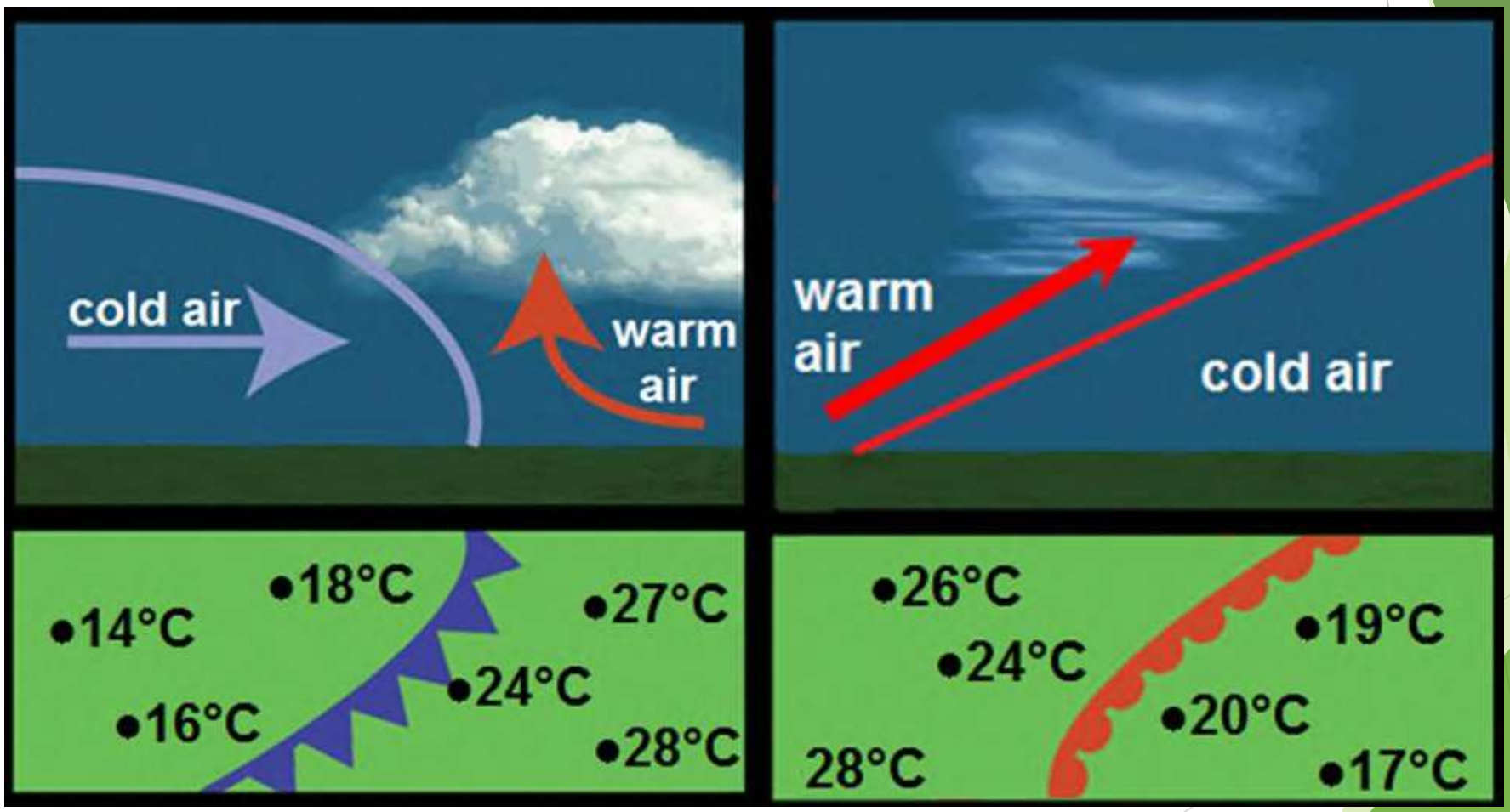


STAGES OF DEVELOPMENT



What are warm and cold fronts?

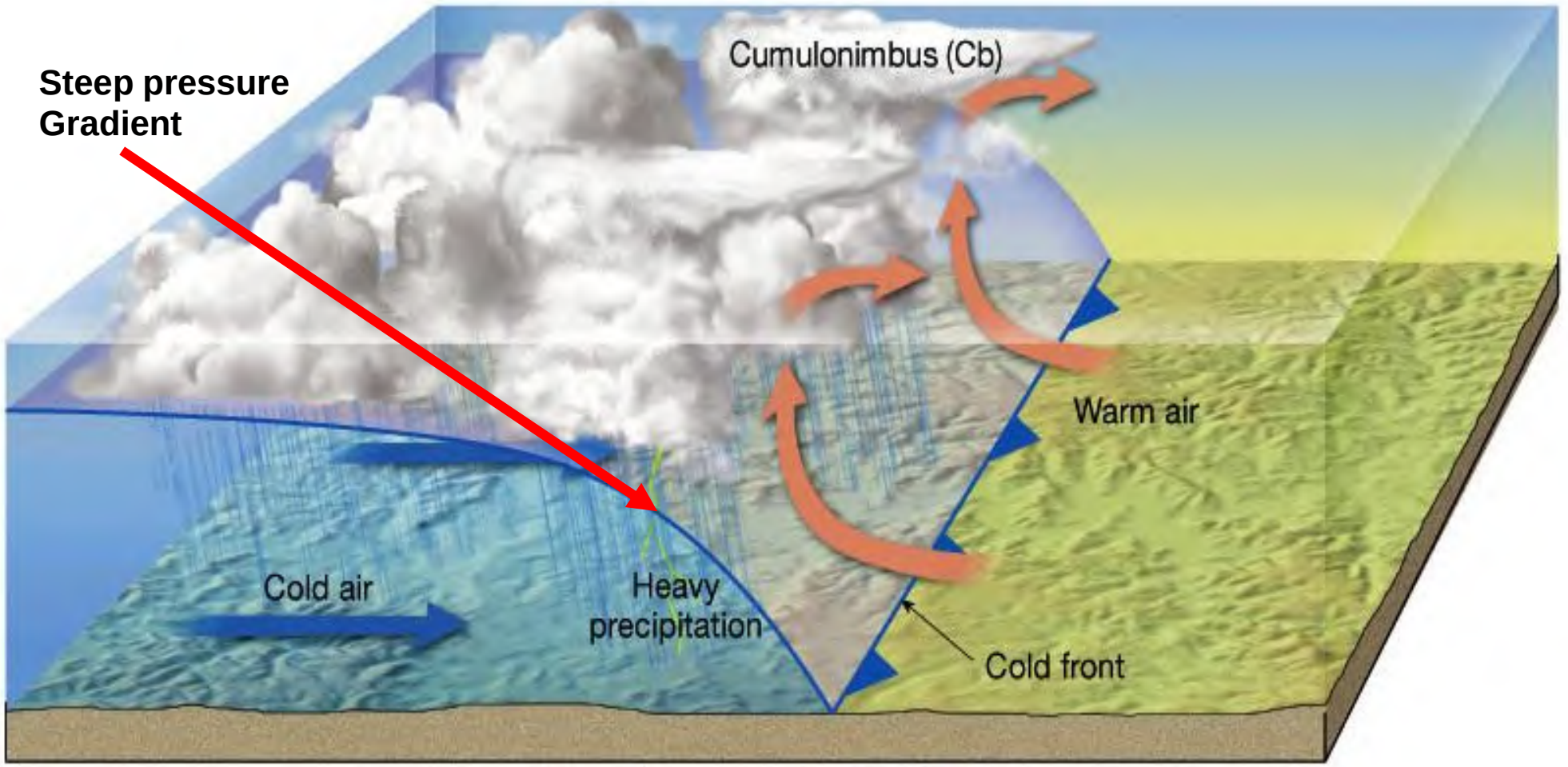
Why is is fast



Cold air behind cold front

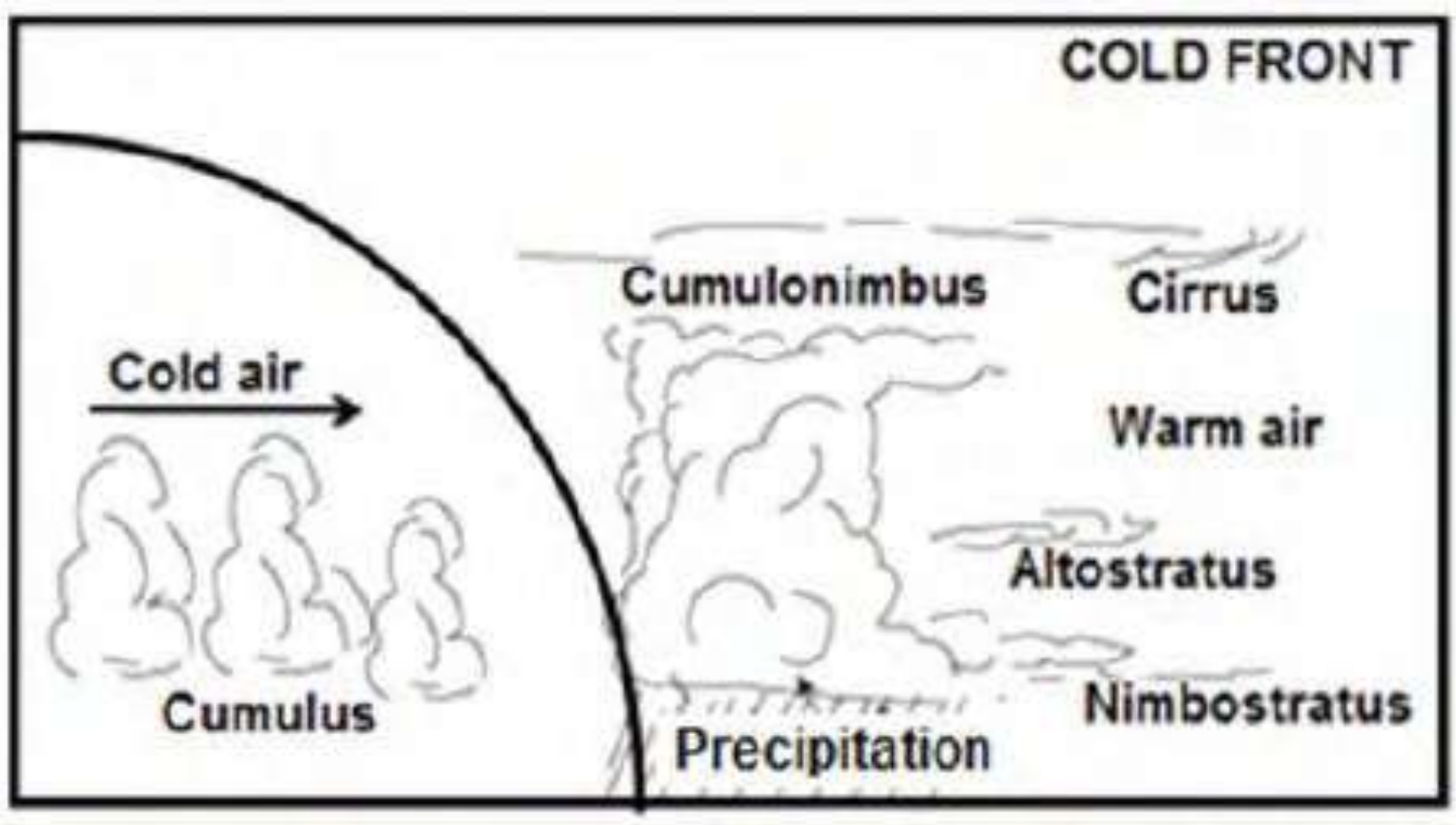
Warm air behind warm front

COLD FRONT CROSS SECTION

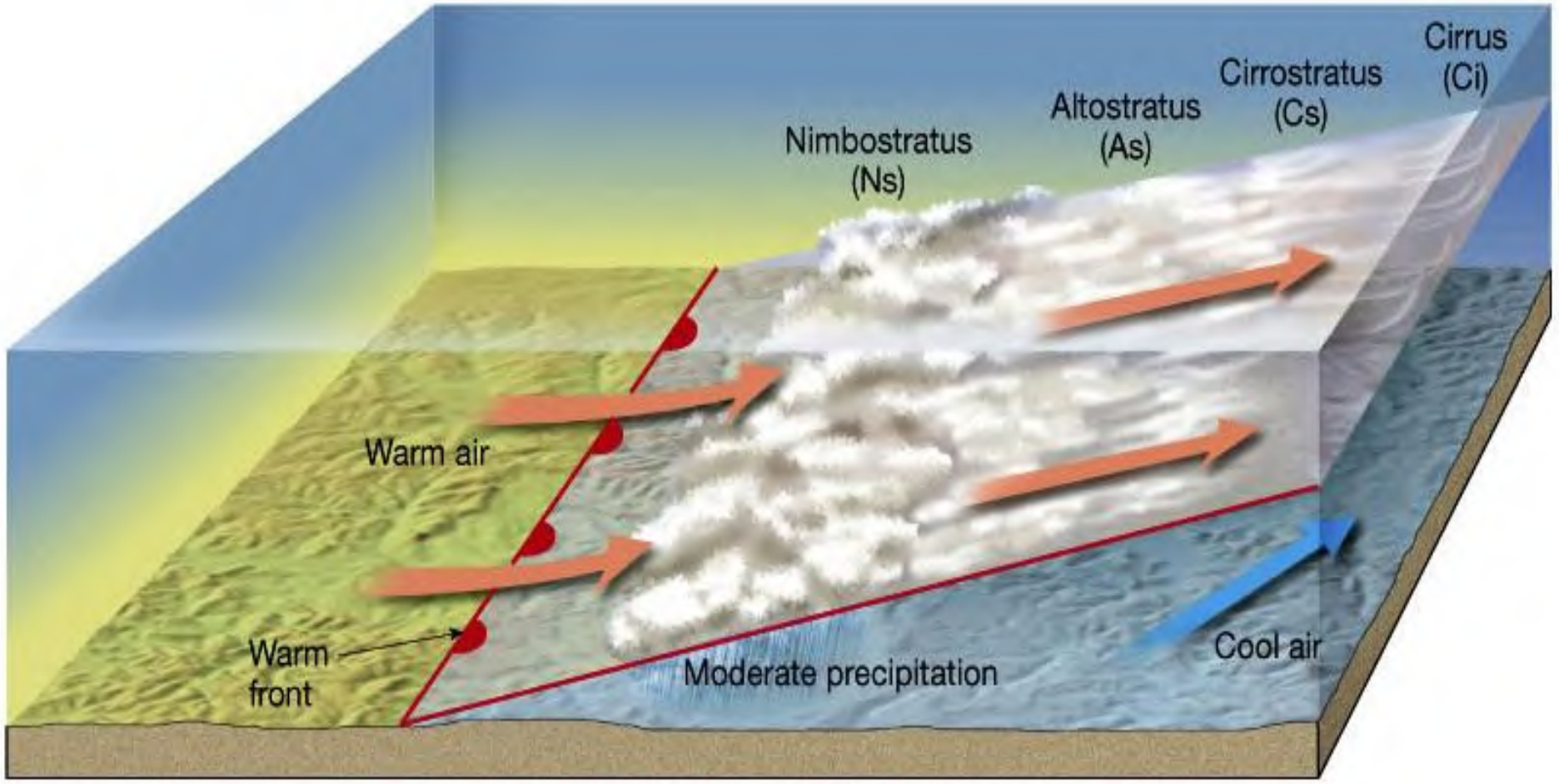


Schematic cross-section of a cold front.

COLD FRONT CROSS SECTION - diagram

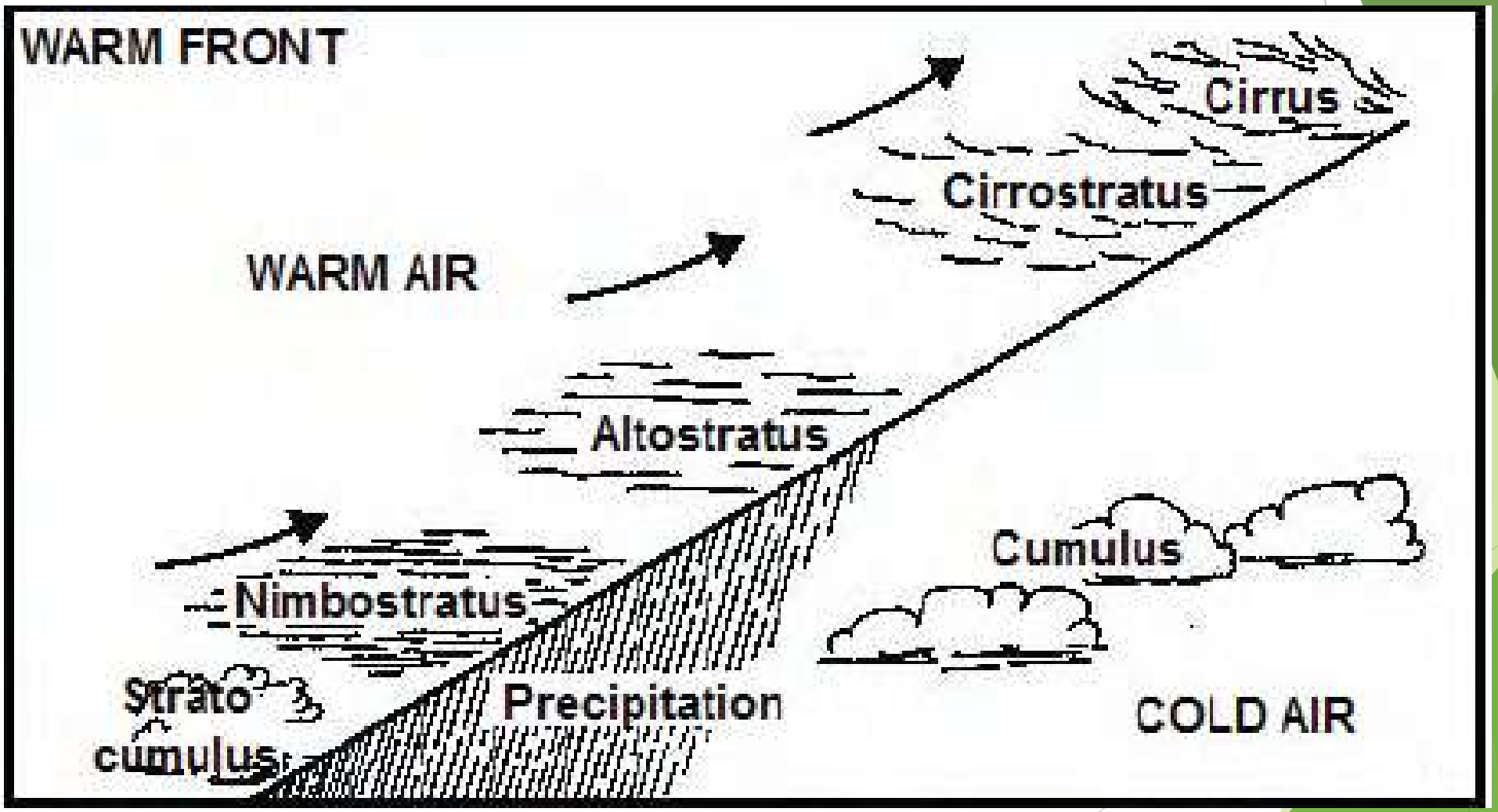


WARM FRONT



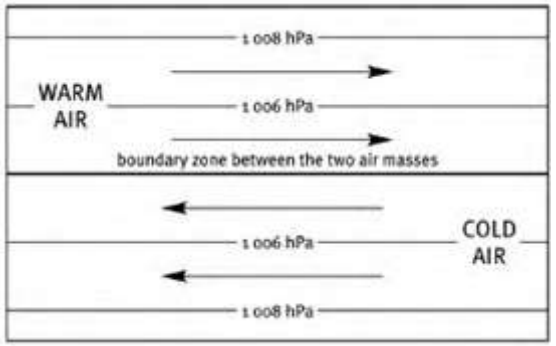
Schematic cross-section of a warm front.

WARM FRONT

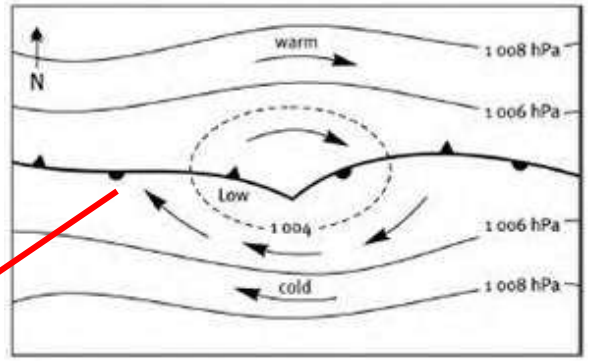


MIDLATTITUDE CYCLONE: DEVELOPMENT

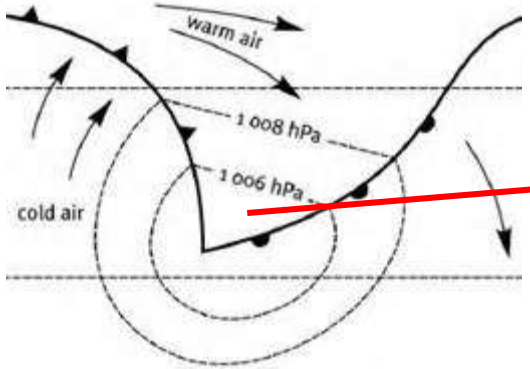
1 INITIAL STAGE

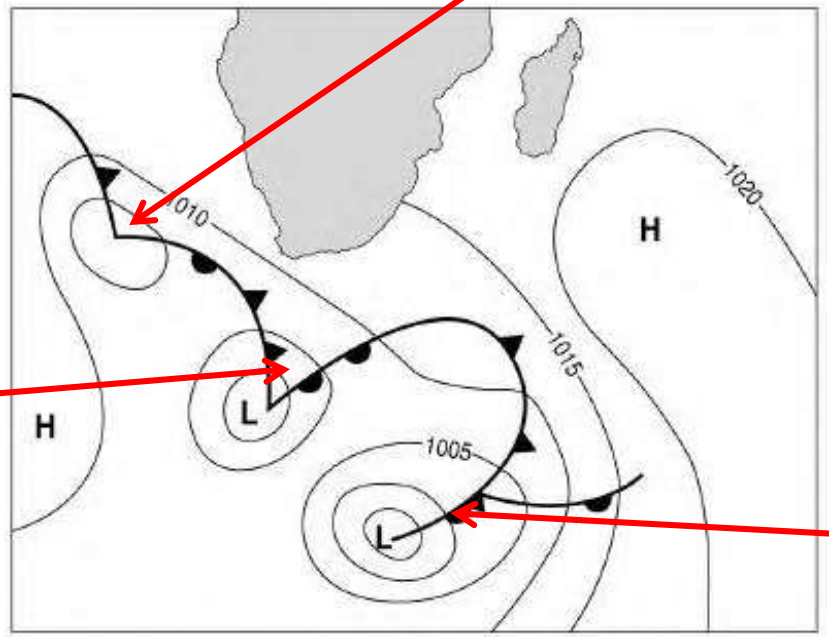


2 DEVELOPMENT STAGE

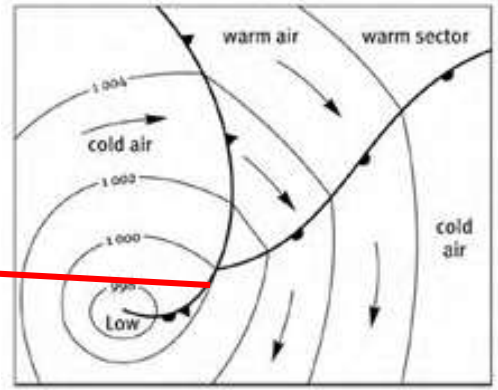


3 MATURE STAGE





4 OCCLUSION



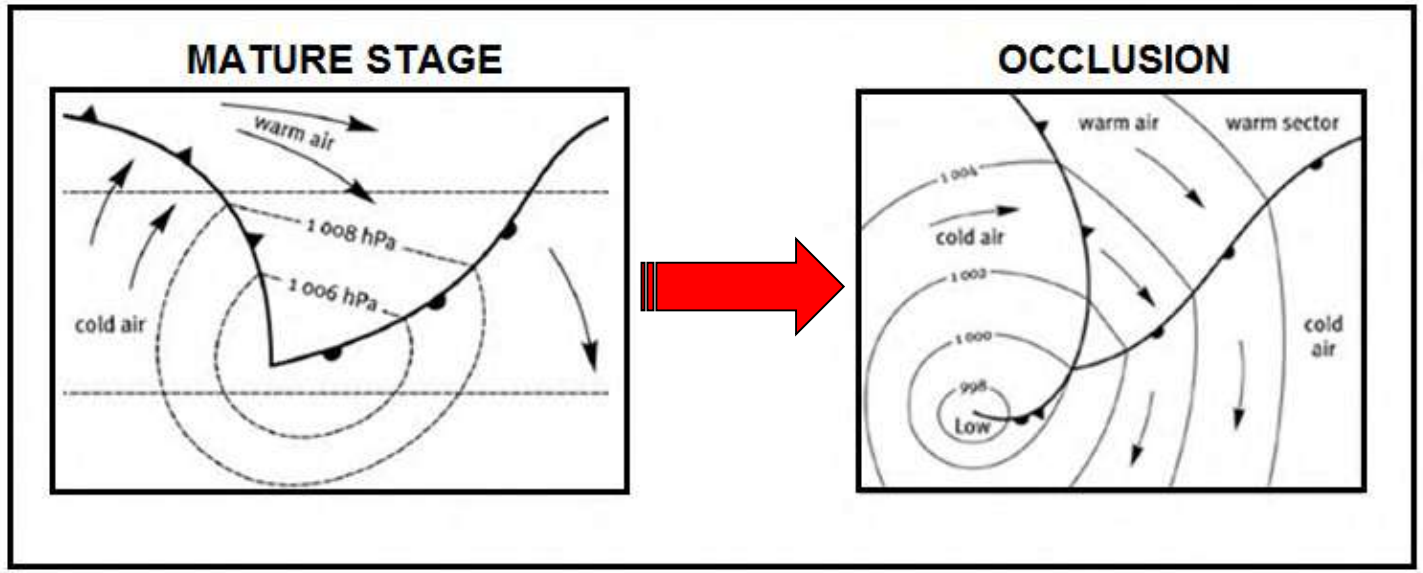
FAMILY OF CYCLONES

MID- LATITUDE CYCLONE

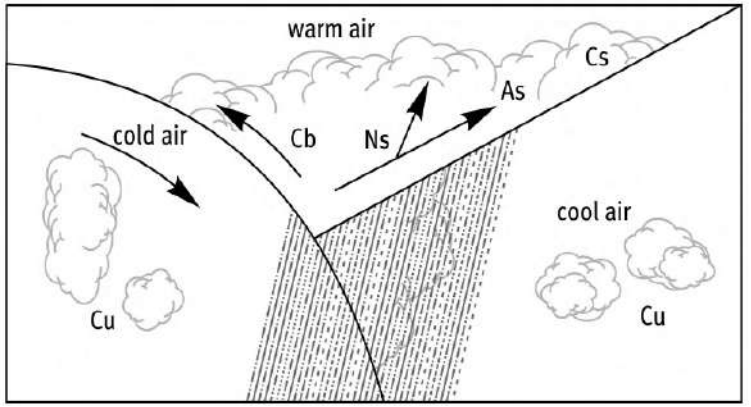
Associated weather patterns:

- Cold front conditions
- Warm front conditions
- Occluded front conditions
- Impact on human activities (social and economic) and the environment
- Possible pre-cautionary and management strategies

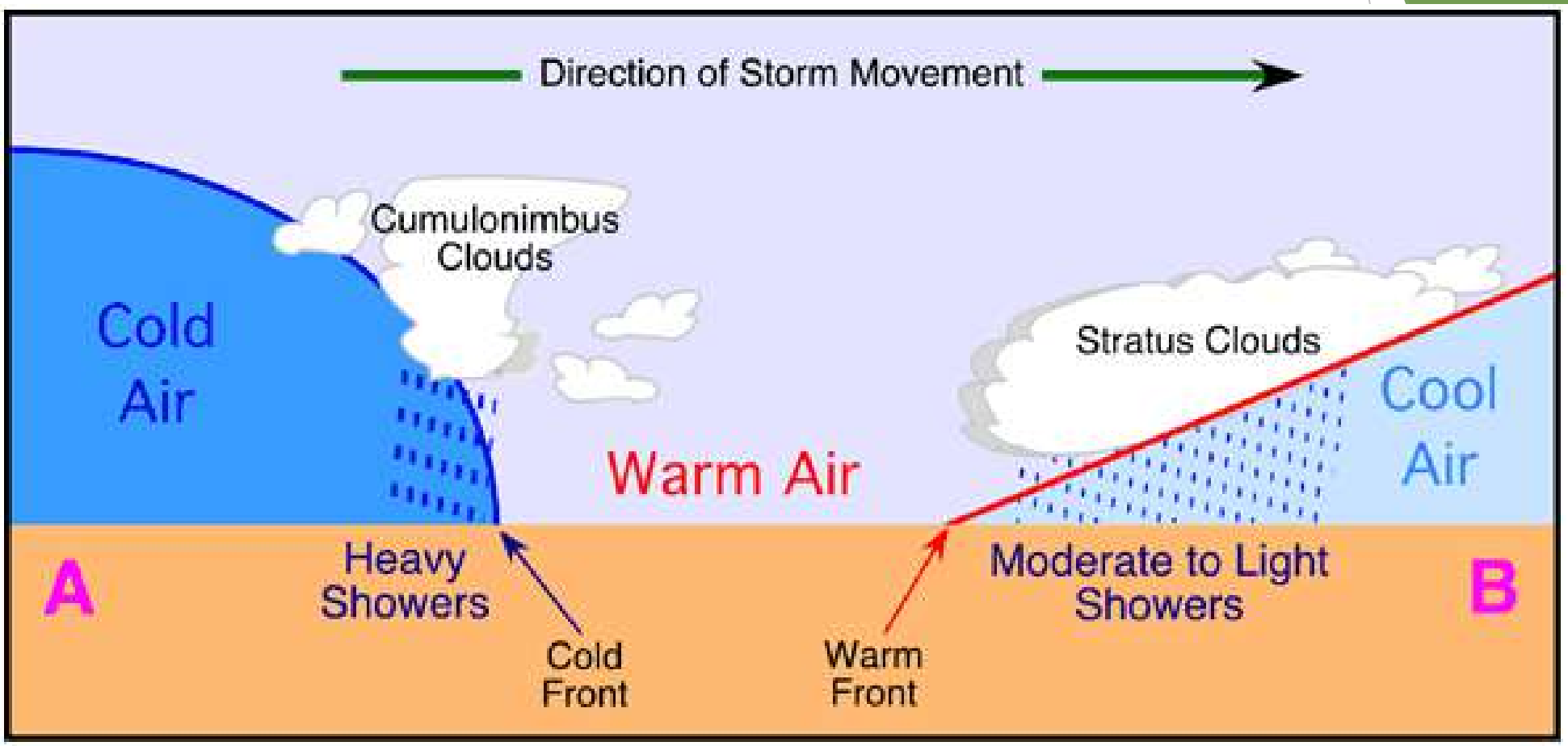
Write a paragraph in which you explain the development of a cold front occlusion.



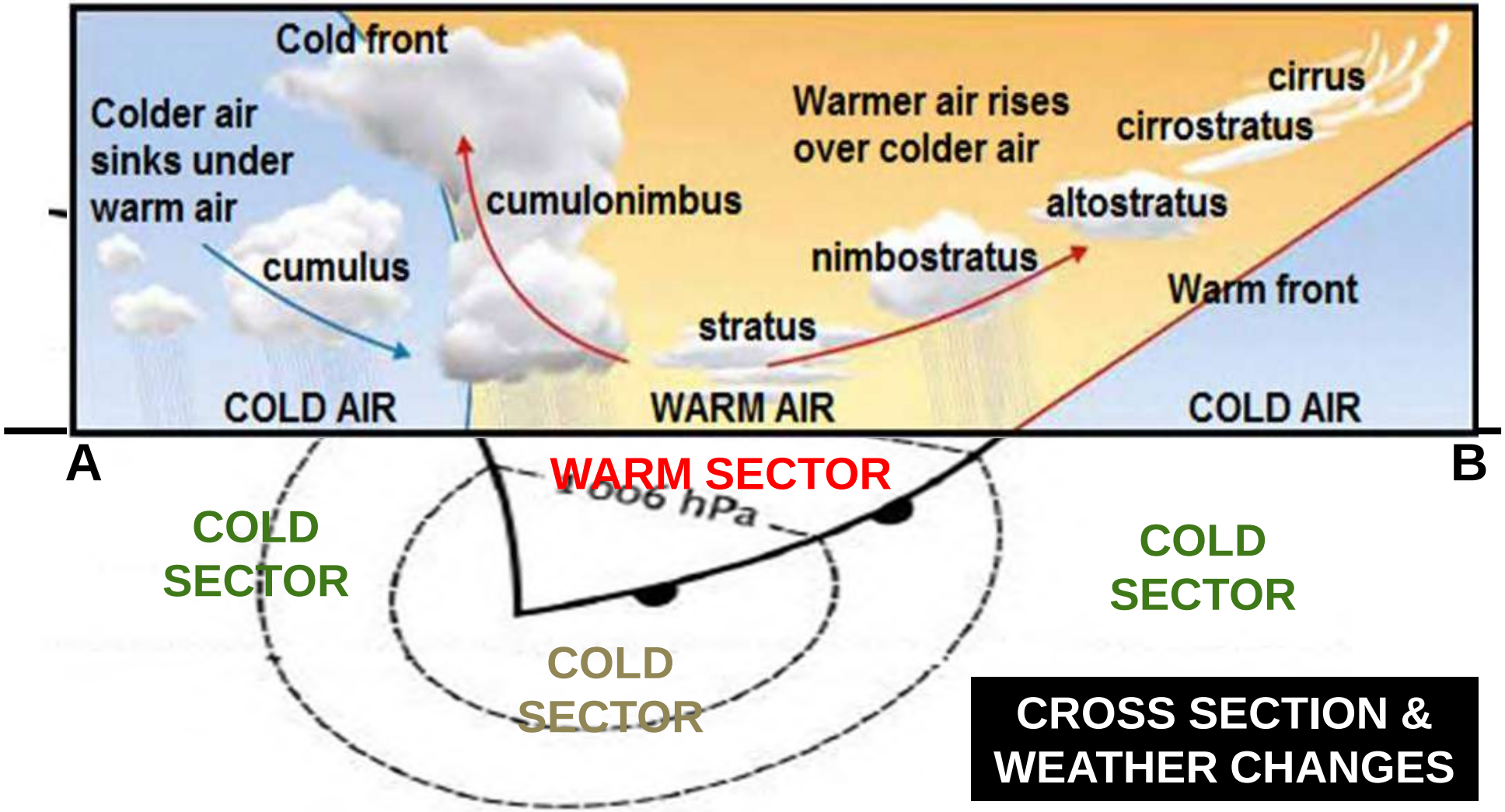
- Air behind cold front is cold
- Cold air moves faster than warm air
- Catches up with warm front
- Cold front undercuts the warm front
- Warm sector is lifted off the surface



Mid- latitude cyclone cross section

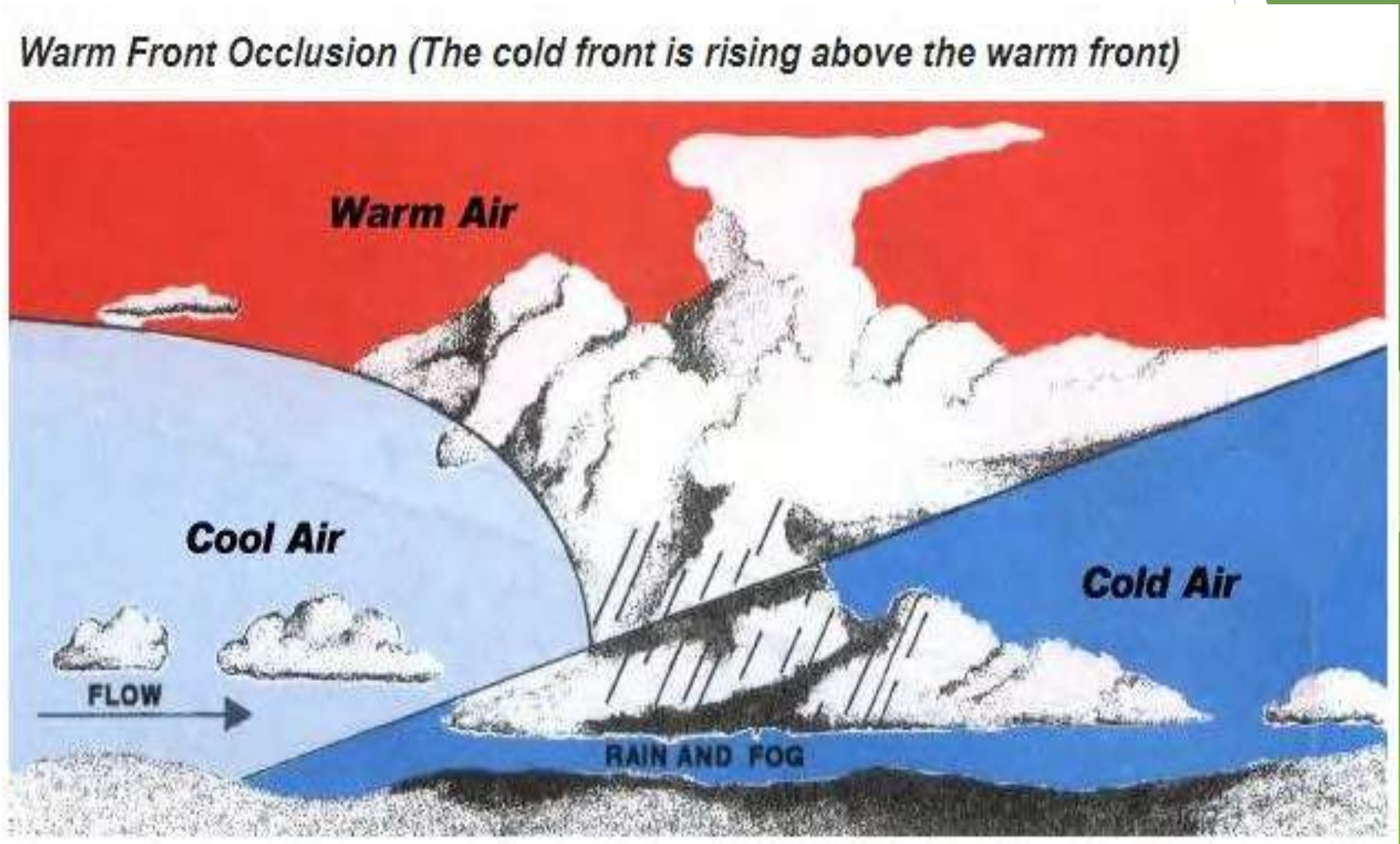


• Temp: sudden decrease • Air pressure increases • Wind changes to SW • Thick cloud cover • Heavy rainfall	• Temp reaches maximum • Air pressure: at lowest • Wind direction: N-NW • Cloud cover decreases • Rainfall stops	• Temp: sudden rise • Air pressure drops • Wind direction: NE • Cloud cover increases • Rainfall: steady



CROSS SECTION & WEATHER CHANGES

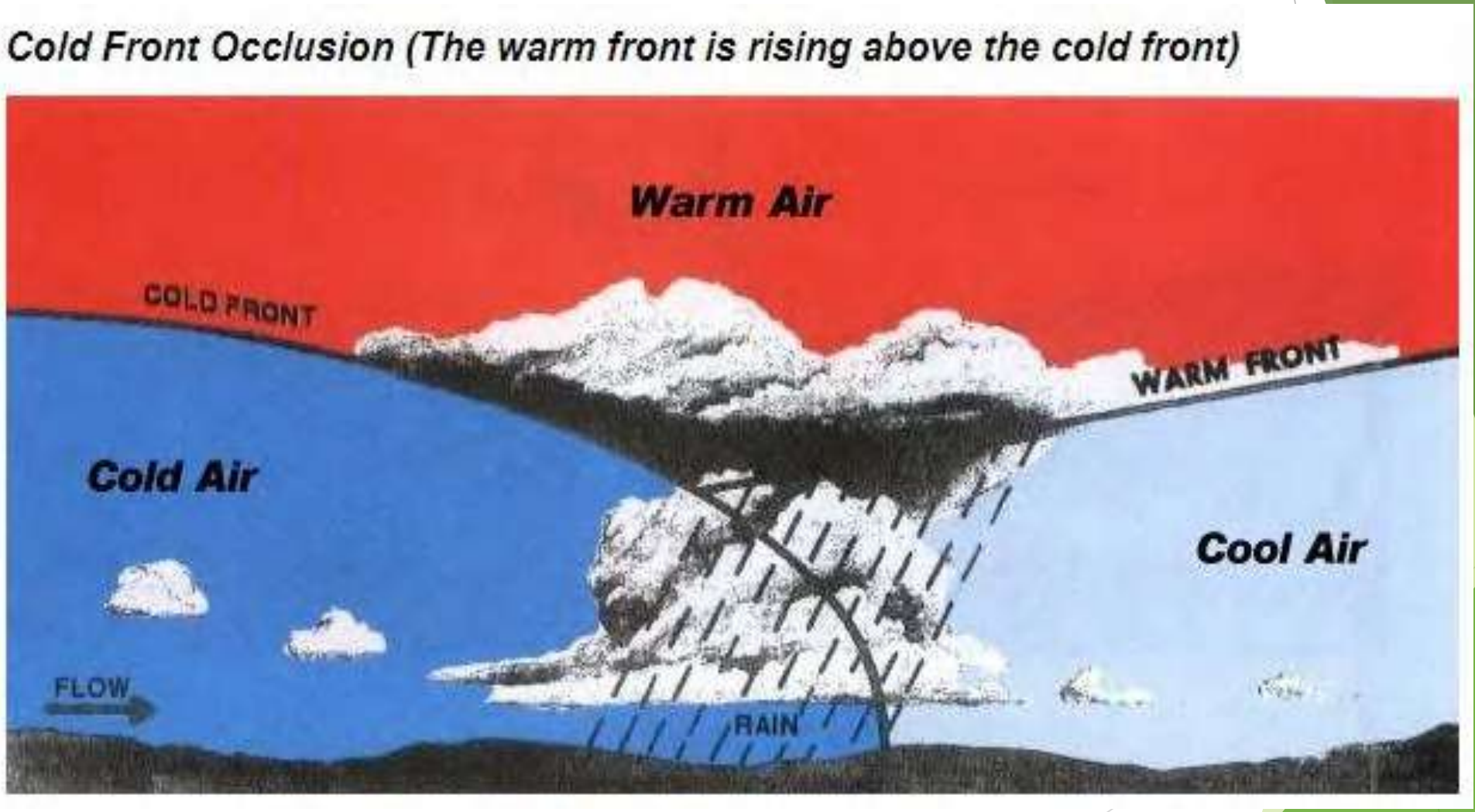
Warm front occlusion



WARM FRONT OCCLUSION:

- Air ahead of the cold front is colder than the air behind the cold front.
- This results in the air behind the cold front and the warm air in warm sector, rising over the cold air in the front.
- Rising air cools, condensation takes place and forms nimbostratus clouds.
- This results in rain.

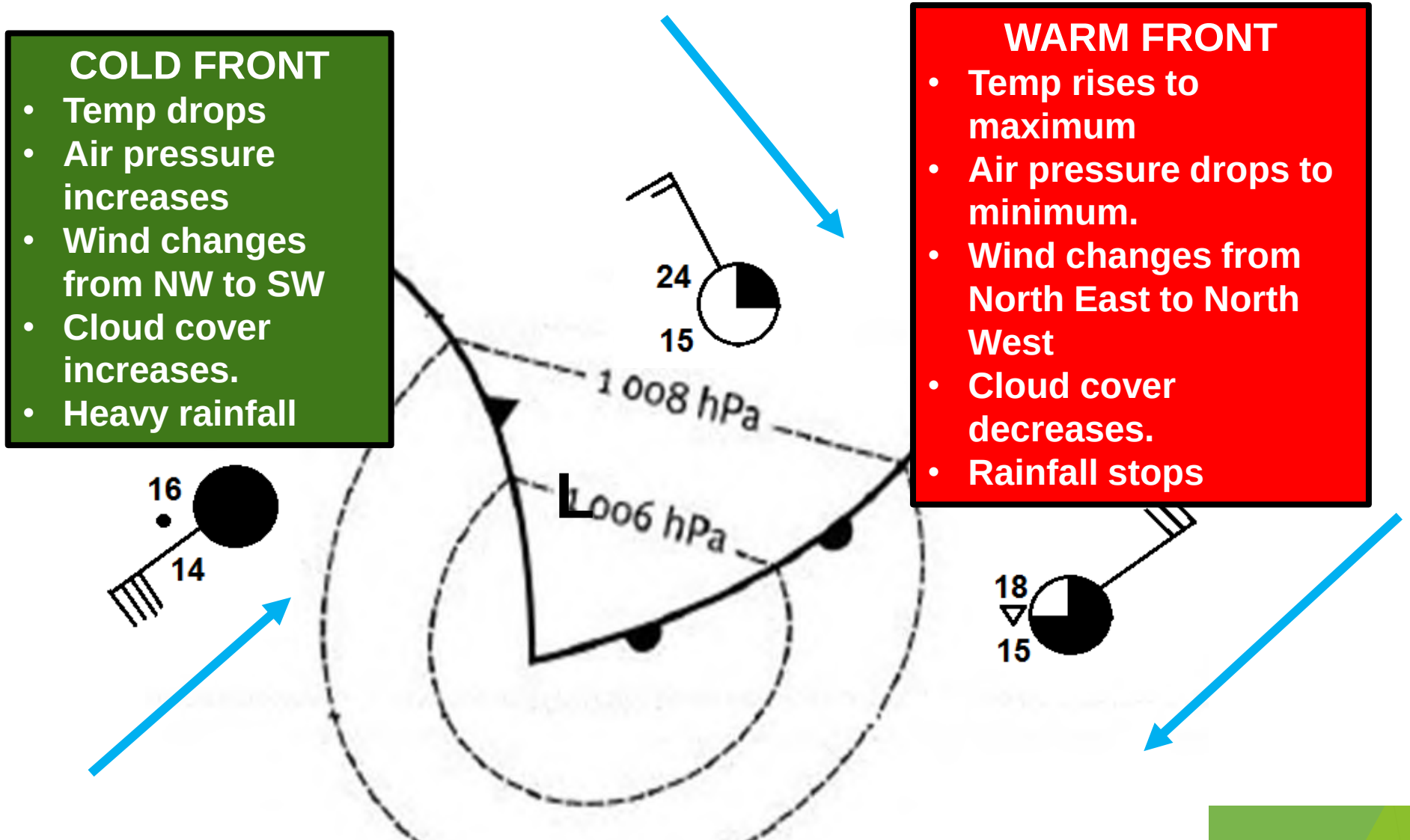
Cold front occlusion



COLD FRONT OCCLUSION:

- Air ahead of the cold front is slightly warmer than the air behind the cold front.
- This causes the warm air in front to be uplifted along the cold front.
- Rising air cools, condensation takes place and forms nimbostratus clouds.
- This results in rain.

Describe the weather changes associated with the passing of a warm/cold front.



Effects of mid-latitude cyclones on human activities.

- **EFFECT ON THE ENVIRONMENT:**
- ✓ The rainwater raises the water table and make periodic rivers flow.
- ✓ May cause flooding which may result in soil erosion.

SOCIAL EFFECTS:

- ✓ People's houses in low-lying areas may be flooded.
- ✓ People may be affected by waterborne diseases due to contaminated water.
- ✓ People may be forced to cancel outdoor activities due to bad weather.

Effects of mid-latitude cyclones on human activities.

- **ECONOMIC EFFECT:**

- ✓ It brings winter rainfall in the South Western Cape which is used for irrigation of crops. (**Positive**)
- ✓ The approach of a cold front may cause snow that can attract tourists to the area and generate revenue to the South Western Cape. (**Positive**).
- ✓ Snowfall may damage crops and kill livestock.(**Negative**)
- ✓ Hiking in the table mountain is limited as the place becomes inaccessible. (**Negative**)
- ✓ Frontal storm, strong winds and high seas pose a hazard(danger) to fisherman in the South Western Cape. (**Negative**)

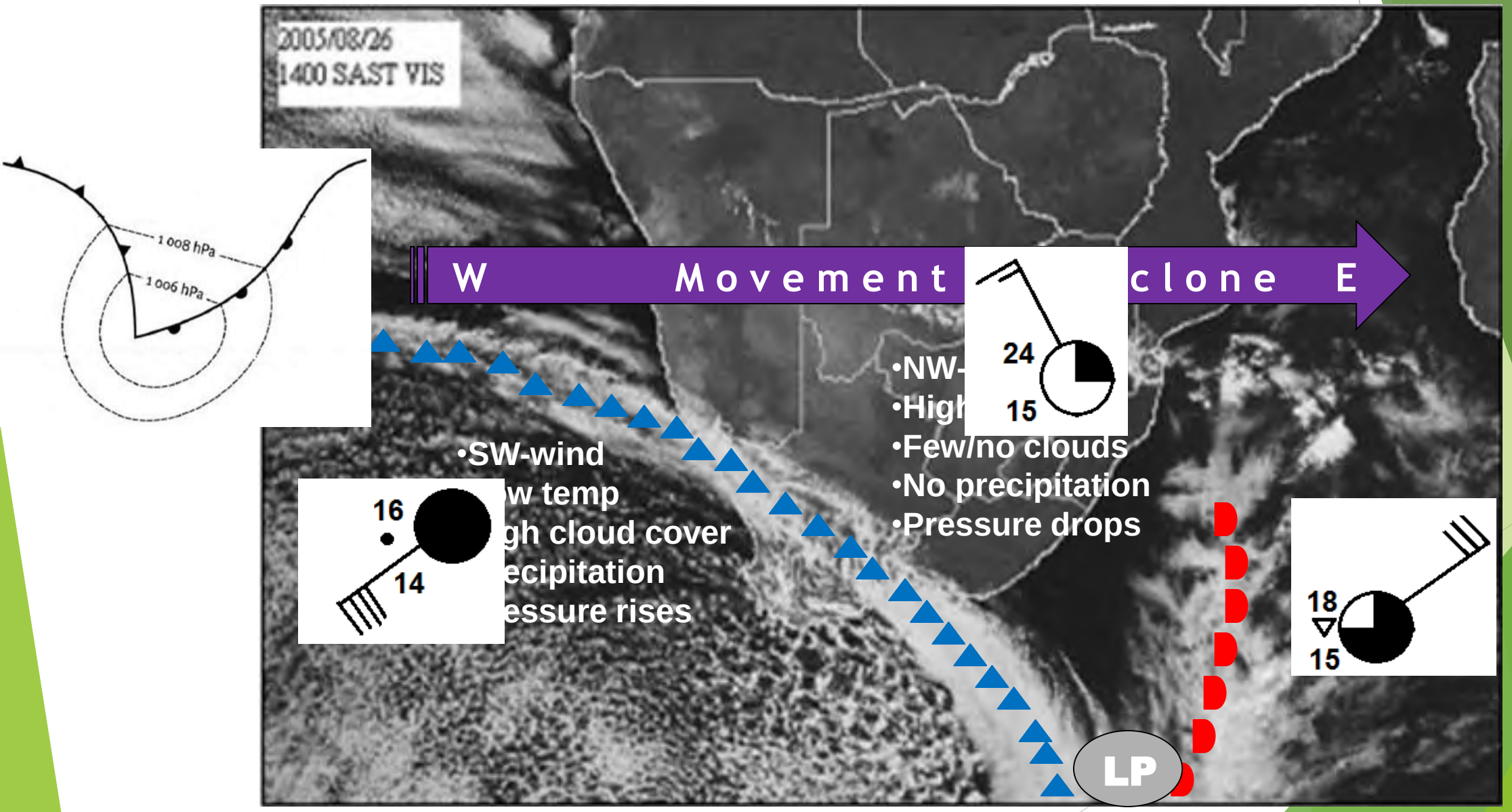
Precautions

- Avoid construction of houses in low-lying areas to prevent the risk of flooding.
- Municipalities must have effective drainage systems to reduce flooding.
- Livestock must be kept in enclosed area to prevent losses during snowfall.
- Farmers must have sufficient grain and fodder to minimize loss of livestock.
- People must get a weather update before engaging in outdoor activities.
- Fishermen must not venture into the sea during frontal weather.

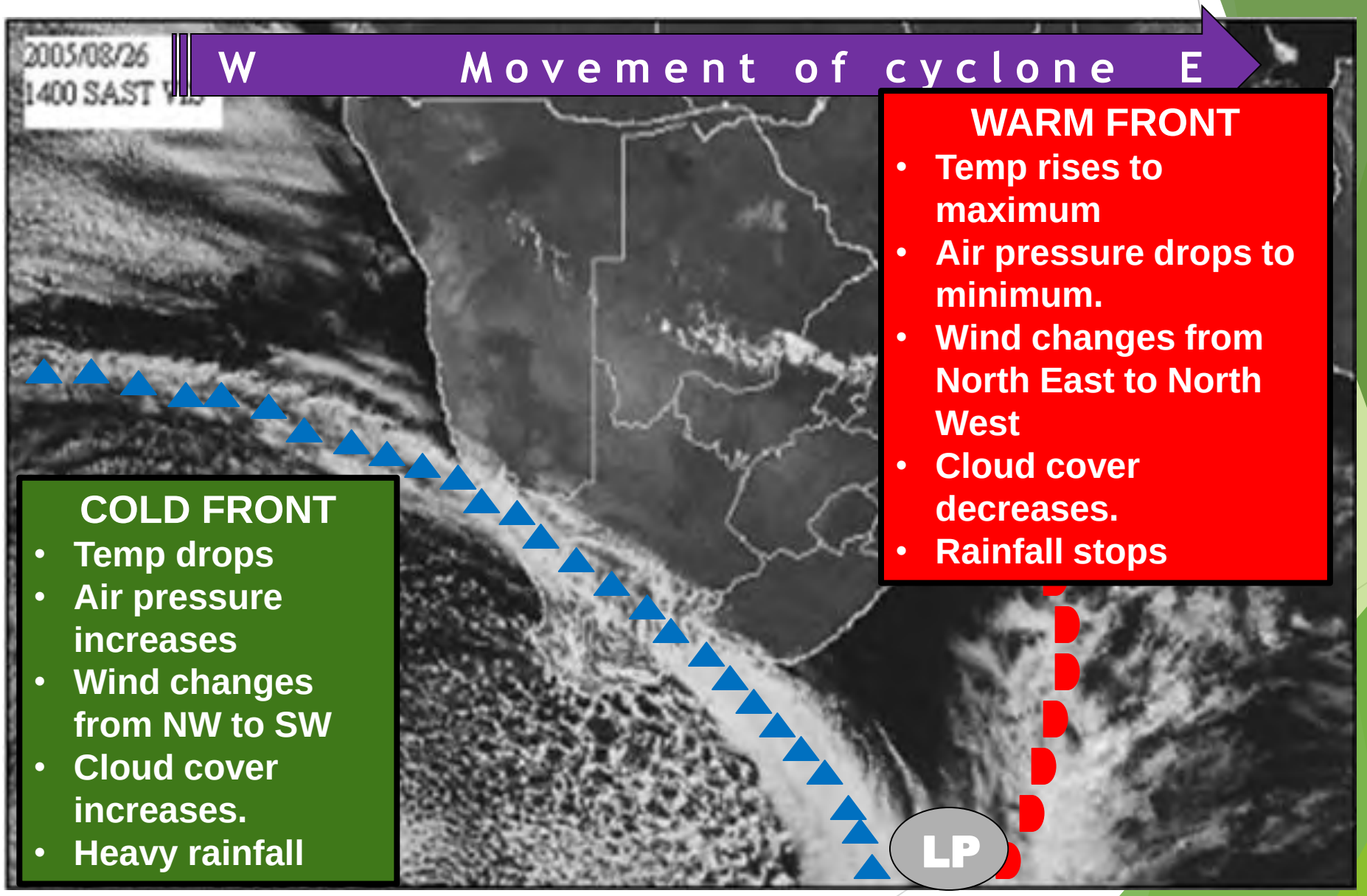
Precautions - continued

- People must minimize driving because of poor visibility.
- Stock up essential supplies such as batteries, food and medication as power outage is expected and shorter trading hours.

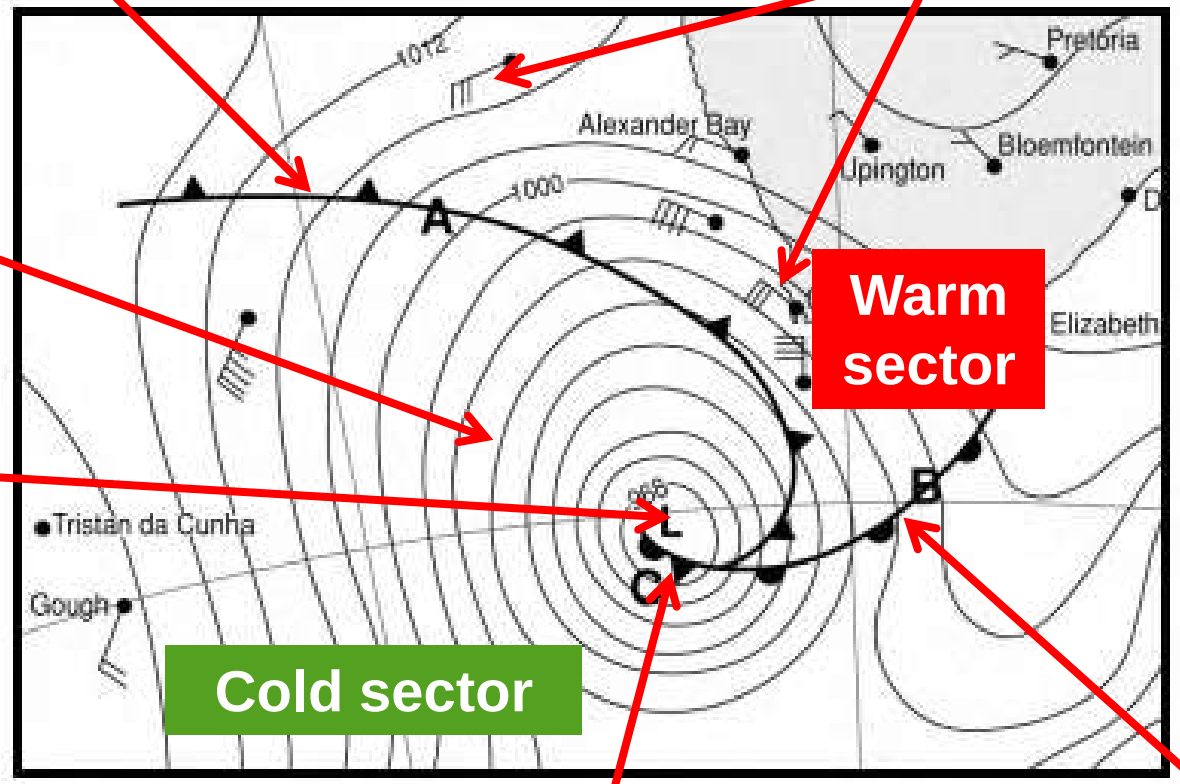
WEATHER CHANGES: COLD FRONT



WEATHER CHANGES: COLD FRONT



Mid latitude cyclones – Synoptic Weather map



Tropical cyclones

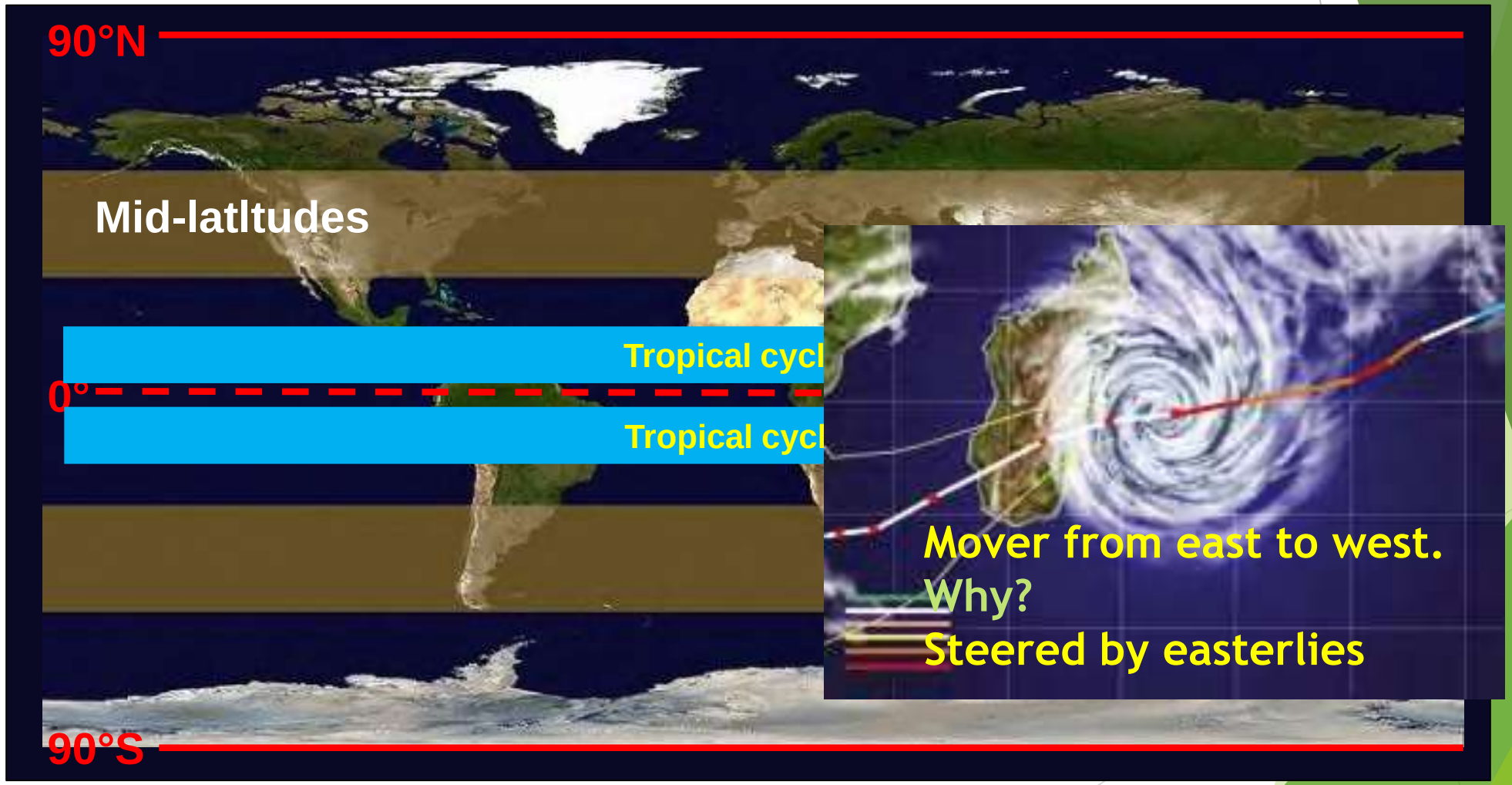
1. Favourable conditions
2. Characteristics
3. Location
4. Weather patterns
5. Development stages
6. How managed

Adapted from Glen Samaai WC

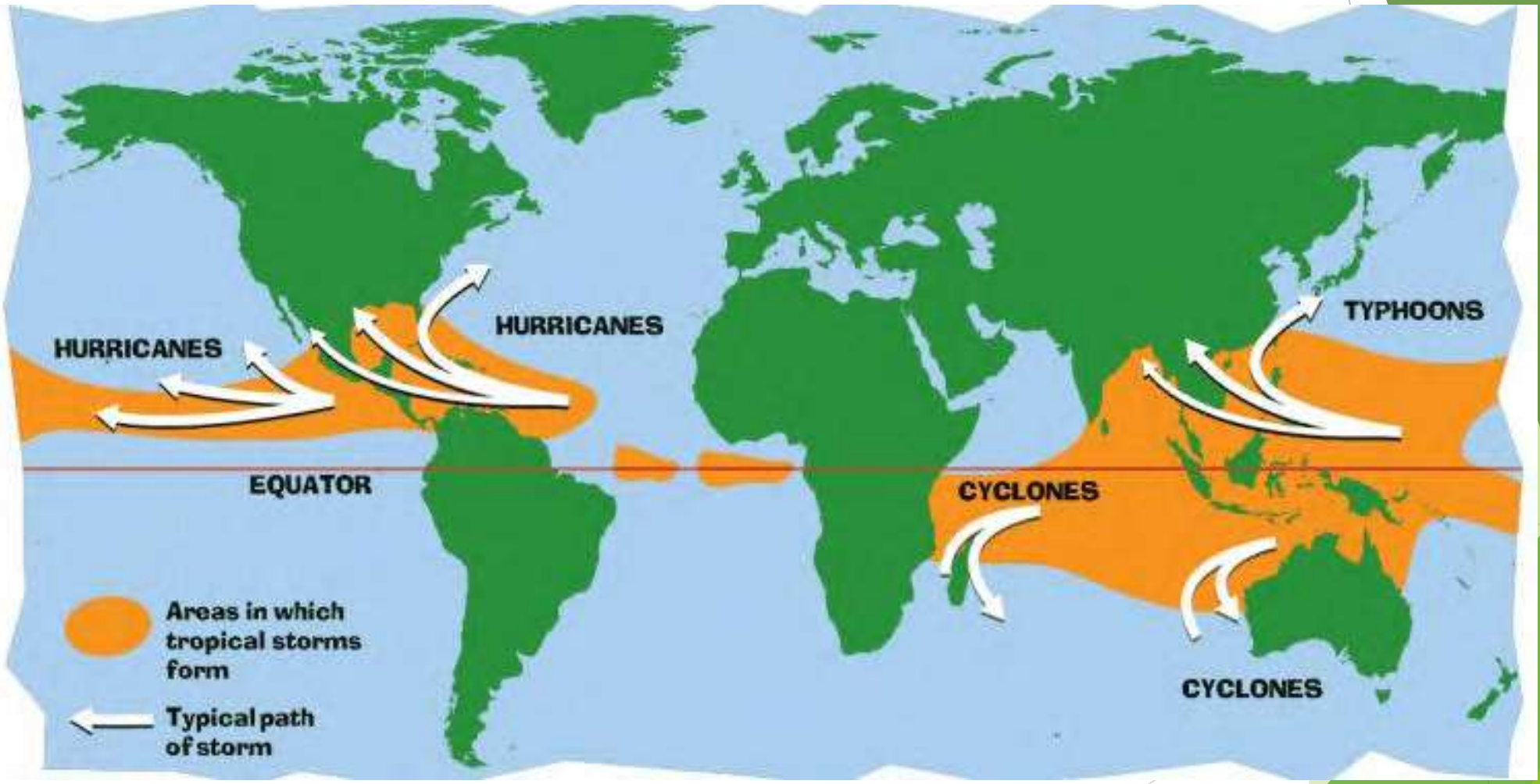
General characteristics

- Represented by enclosed isobars.
- Originate over tropical oceans between 5^0 N/S and 25 ^{0} N/S
- The temperature over the ocean must be over 27^0C to develop the intense low pressure.
- They develop in the easterly wind belt region.
- They rotate clockwise in the southern hemisphere.
- They follow and erratic path. WHY?
- Because of temperature differences over the ocean.

Where do tropical cyclones form?



Where do tropical cyclones form?



Conditions for formation of TC

- Surface sea temperature of 27^0 C to develop **low pressure** and **convection** (rising of air)
- **High surface temperature** of the **sea promotes high evaporation rate.**
- There is **less friction** over the ocean which assists the **rising of air**.
- There is **high water vapour content** over the ocean and it has **latent heat** and it **triggers** the development of the cyclone.

Conditions for formation of TC ...cont

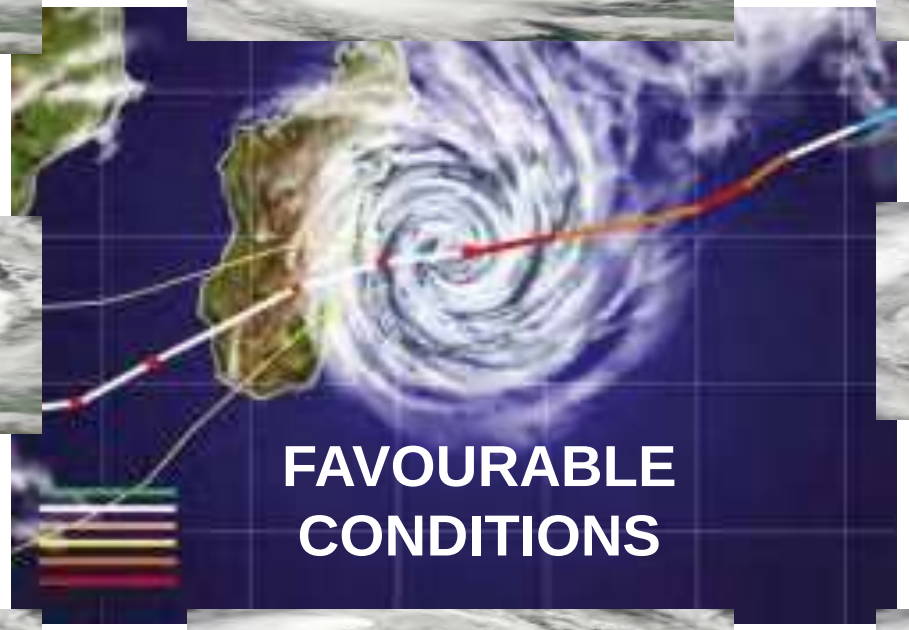
- Unstable atmospheric conditions are necessary for convection and the release of latent heat as the air rises.
- **Calm conditions** are needed for the **convergence** of air and the **formation of cumulonimbus clouds.**
- Upper air convergence is needed to maintain a low pressure on the surface and promotes surface convergence

CONDITIONS FOR TROPICAL CYCLONES TO FORM

Divergence in upper air levels

Sea temperature at least 26º C

High humidity



Air pressure below 950hPa

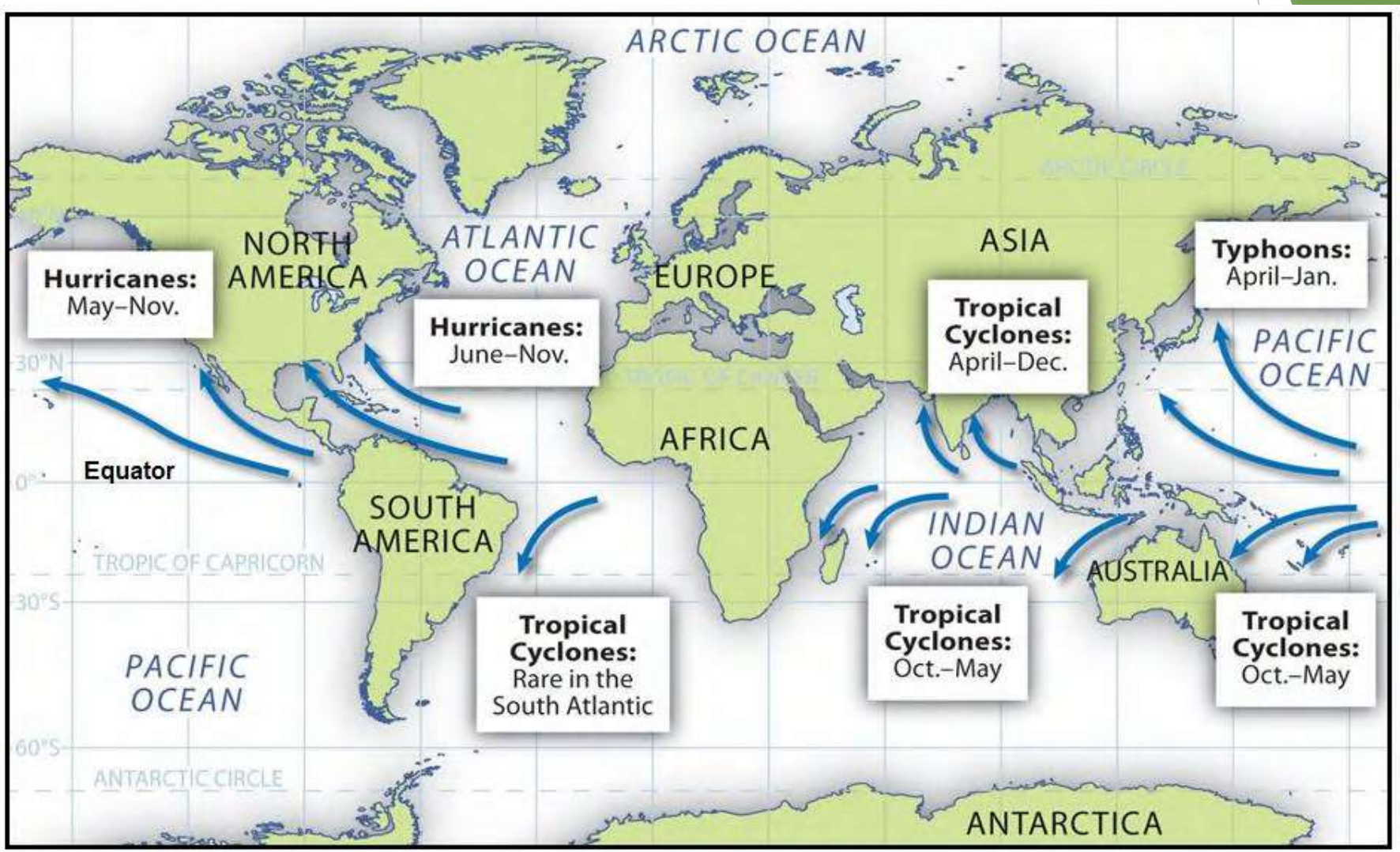
Coriolus force

Light variable winds

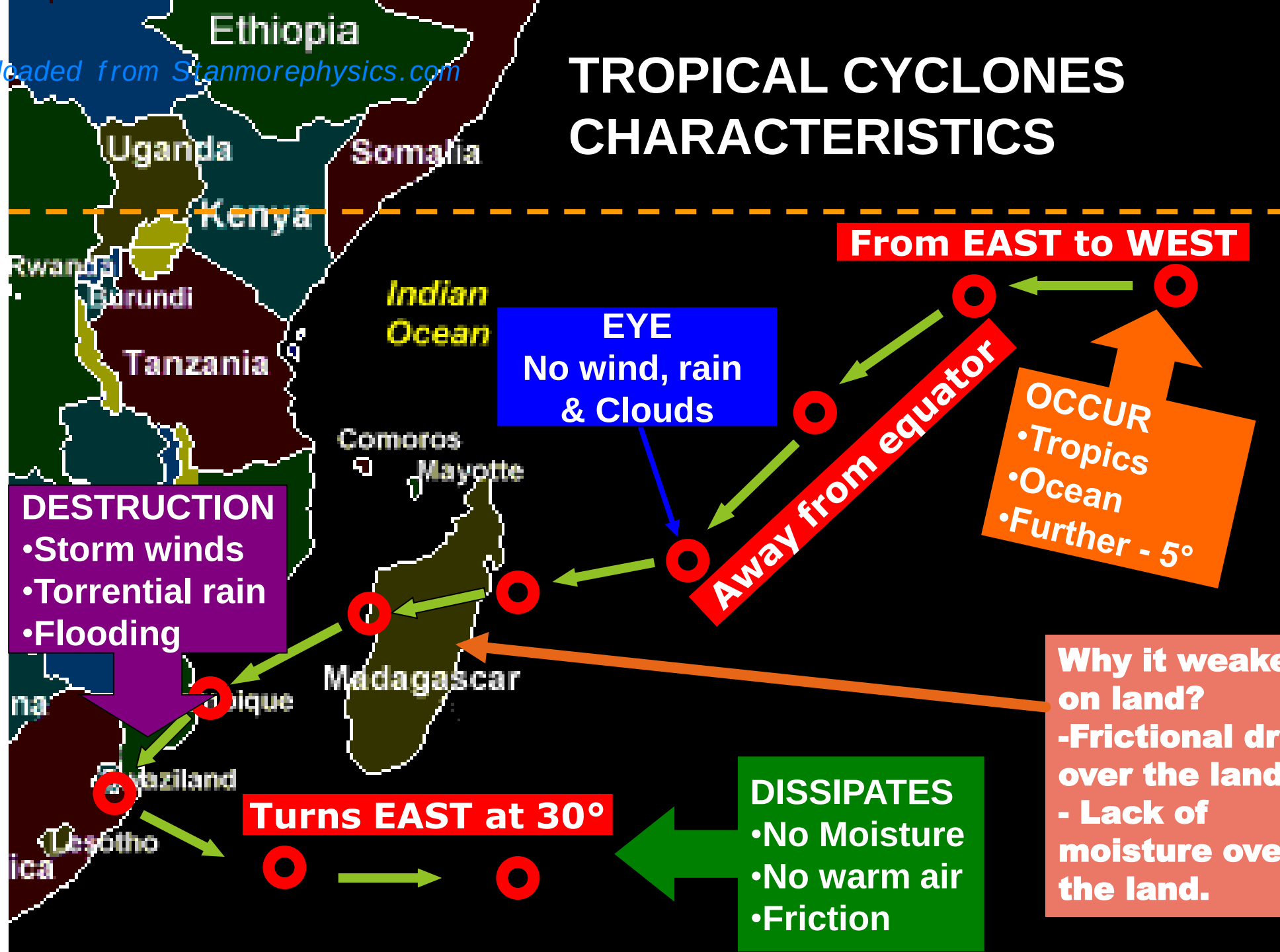
Little surface friction

Unstable air

TC occurrences.



TROPICAL CYCLONES CHARACTERISTICS



TROPICAL CYCLONE: DEVELOPMENT

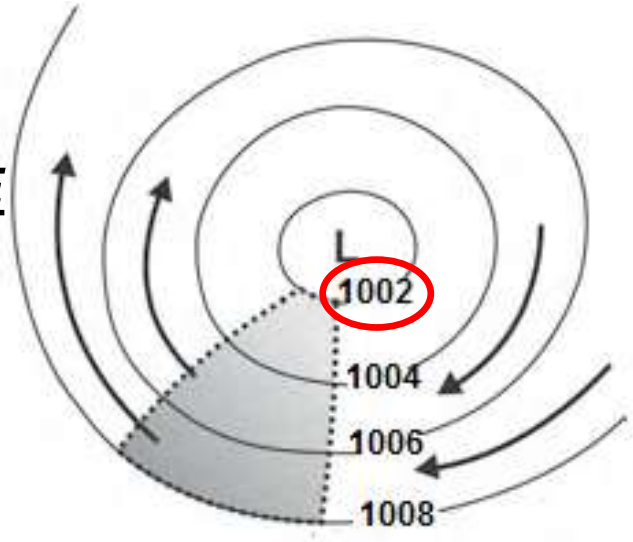
1

FORMATIVE

Pressure

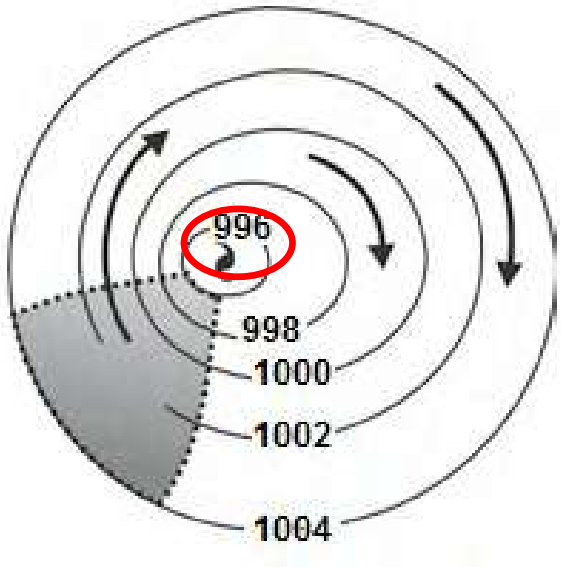
ABOVE

1000 hPa



The atmospheric pressure is still above 1000hp.
Isobars are far apart.
Eye begins to form as warm air converges.
Cirrus and cumulus clouds produce light rain.

TROPICAL CYCLONE: DEVELOPMENT



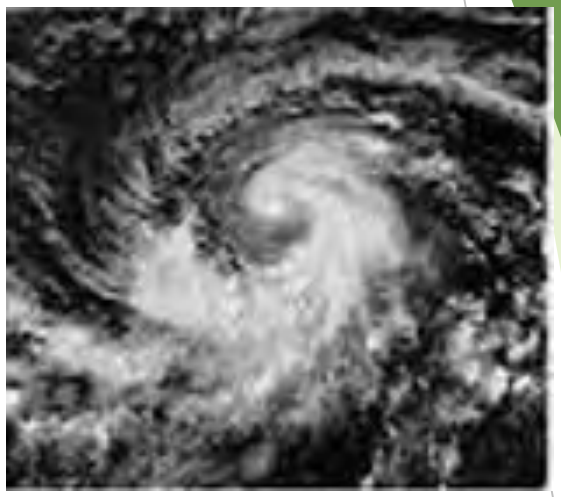
2

IMMATURE

Pressure

BELOW

1000 hPa



Pressure drops below 1000hpa
Eye intensifies as air continue to converge and rise around the center in a spiral manner.
Wind reaches hurricane strength.
Diameter is above 100km
Cumulonimbus clouds form around the eye

TROPICAL CYCLONE: DEVELOPMENT

3

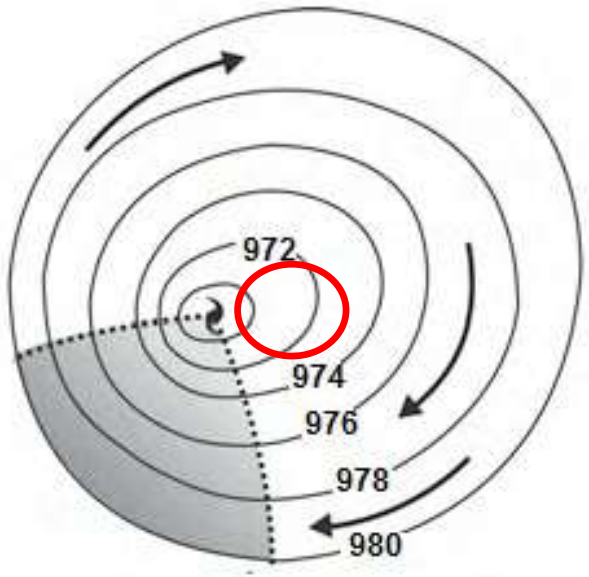
MATURE

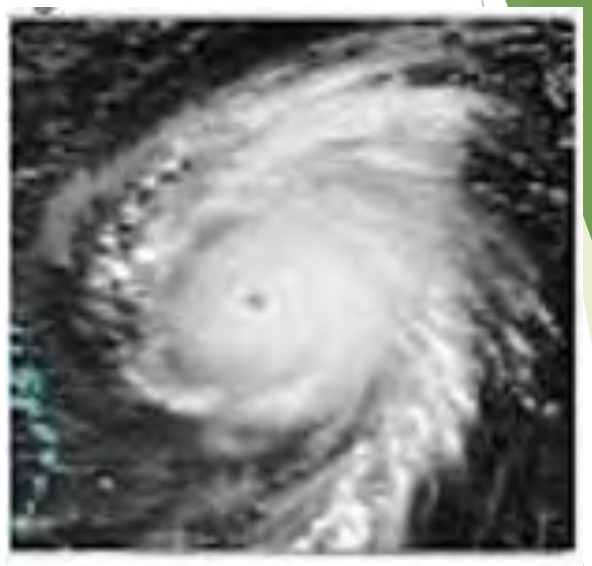
Pressure

WELL

BELOW

1000hPa





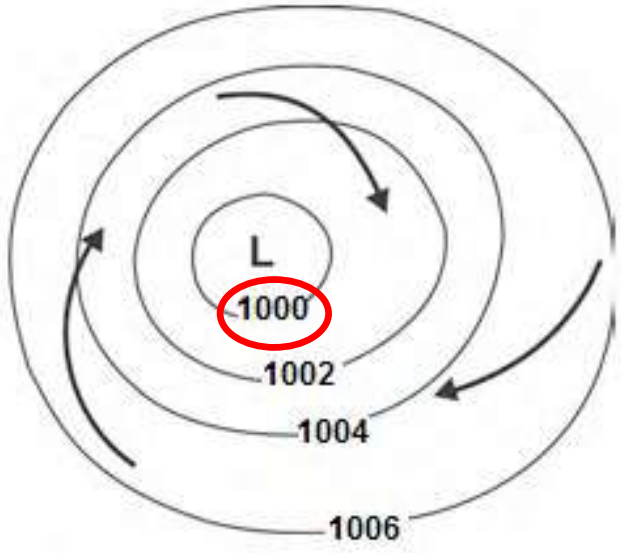
Pressure is far below 1000hpa and stops dropping.
Isobars are close together.
It is about 300km to 500km in diameter.
The dangerous semi-circle forms in the forward left hand quadrant of the cyclone.
The worst weather is in the dangerous semi circle.
Towering cumulonimbus clouds form around the eye.
Winds strength is about 120km/h

TROPICAL CYCLONE: DEVELOPMENT

4

DISSI-PATION

Pressure RISES

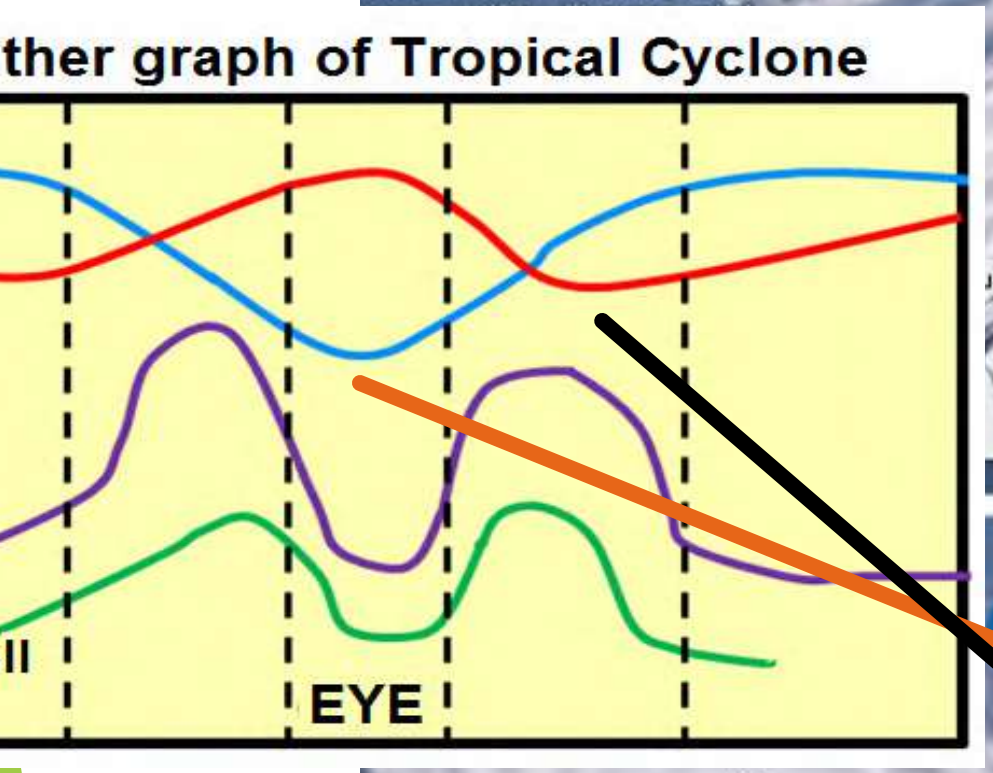


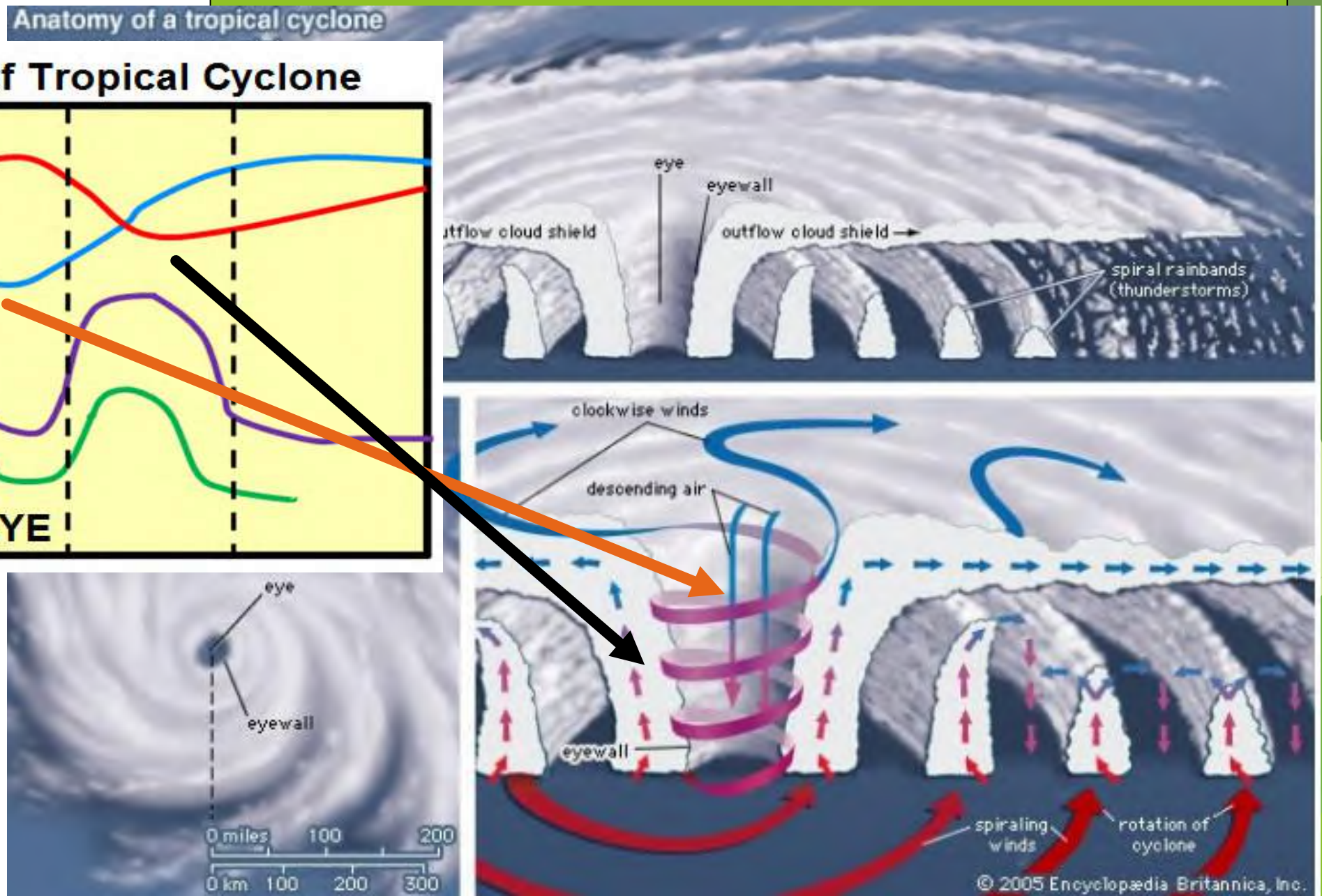
Decays/dissipates when the pressure begins to rise above 1000hpa

WHY A TROPICAL CYCLONE DISSIPATE?

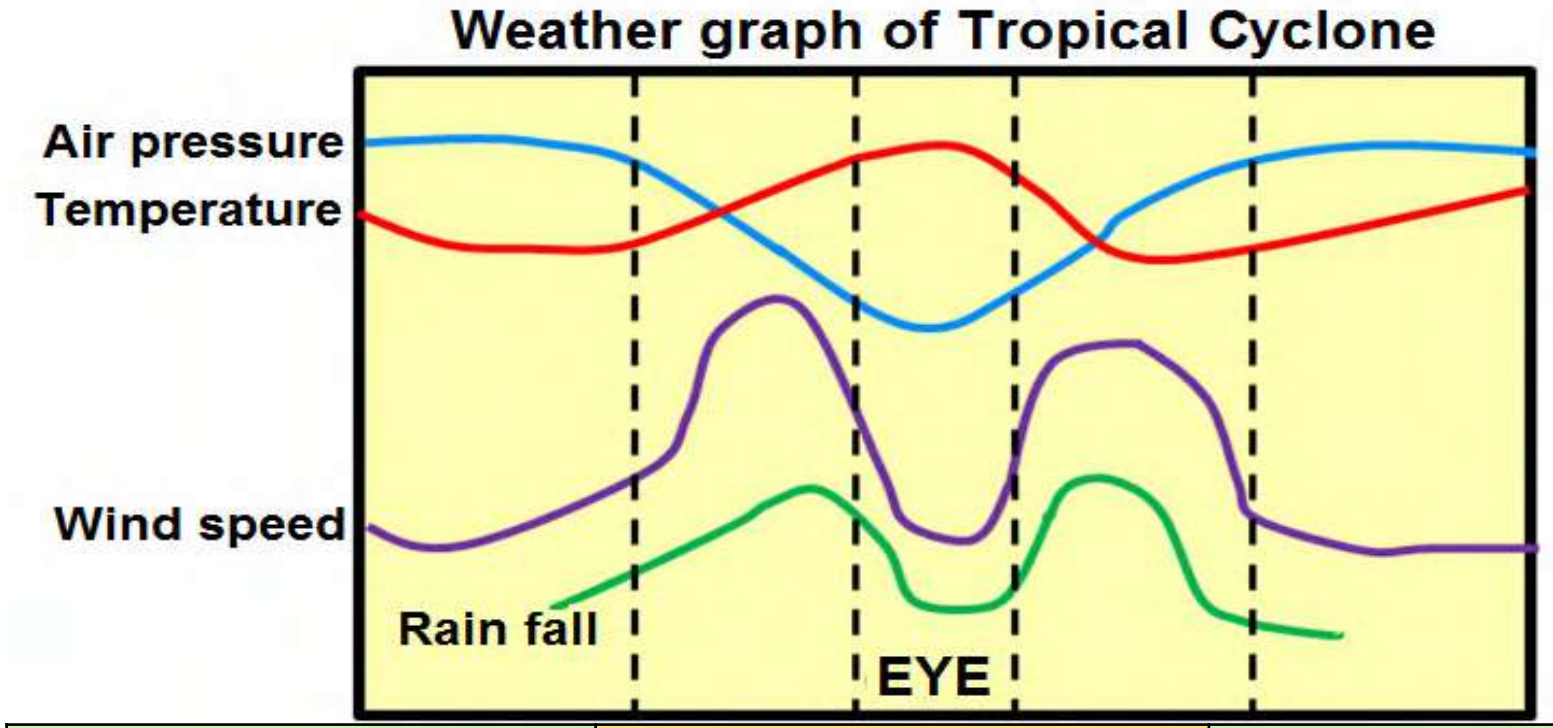
When it reaches land surface because of friction and there is less moisture.
When cold air enters the system and supply of moisture is reduced.
When it is in the path of a cold front temperature drops and pressure increases.

CROSS SECTION OF A TROPICAL CYCLONE





Tropical Cyclones: Weather patterns



BEFORE EYE (SH)	IN EYE	AFTER EYE (SH)
• Wind direction: South • Towering cumulonimbus clouds appear. • Wind: Hurricane (120km/h) • Torrential rain, lightning, thunder • Air pressure decreases • Very heavy rainfall	• No wind • No rain • No clouds • Lowest air pressure • Temp increases. • Upward spiraling of air creates artificial wall. • It prevents surface air from rising	• Wind direction: North • Wind: storm to hurricane • Air pressure increases • Heavy rainfall • Starts to dissipate

Impact of tropical cyclones.

Flooding in low-lying areas damage property and cause loss of life. Strong winds cause storm surge that cause ship wreak and flooding of coastal areas.

Impact of tropical cyclones.

Destruction of agricultural land and crops result in food shortages.
Coastal erosion has a negative impact on tourism.

Impact of tropical cyclones.

Ecosystem of is disrupted since food chains and food webs are destroyed.
Destruction of transport and communication structures like roads.
Silt is washed into dams thus reducing their water holding capacity.
Insurance companies suffer losses due to large sums of money being paid out

IMPACT ON HUMANS

- Torrential rain results in the risk of flooding.
- Strong winds damage and shatter windows and rip off
- roofs.
- Damage infrastructure. Roads and bridges washed away.
- Loss and damage of homes.
- Damaged water pipes result in lack of fresh water.
- Wind and water damage power lines.

IMPACT ON HUMANS

- Deaths and injuries of people and animals because of

  wind, floods and storm surges.
- Starvation because of lack of food.
- Outbreak of deseases e.g. cholera, typhoid etc.
- Major financial strain on families.
- Subsistence farmers lose everything.
- Swell of waves is dangerous for fisherman/humans.

IMPACT ON THE ENVIRONMENT

- Strong winds cause storm surges which can cause rapid rise insea-levels.
- Floods and salt water destroy agricultural crops.
- Flooding and rise in river levels because of rain can cause mudslides and landslides.
- Destroy ecosystems and biodiversity.
- Livestock drowns.
- Lack of clean water.
- Threatening of food security.
- Damaged sewerage pipes result in pollution.

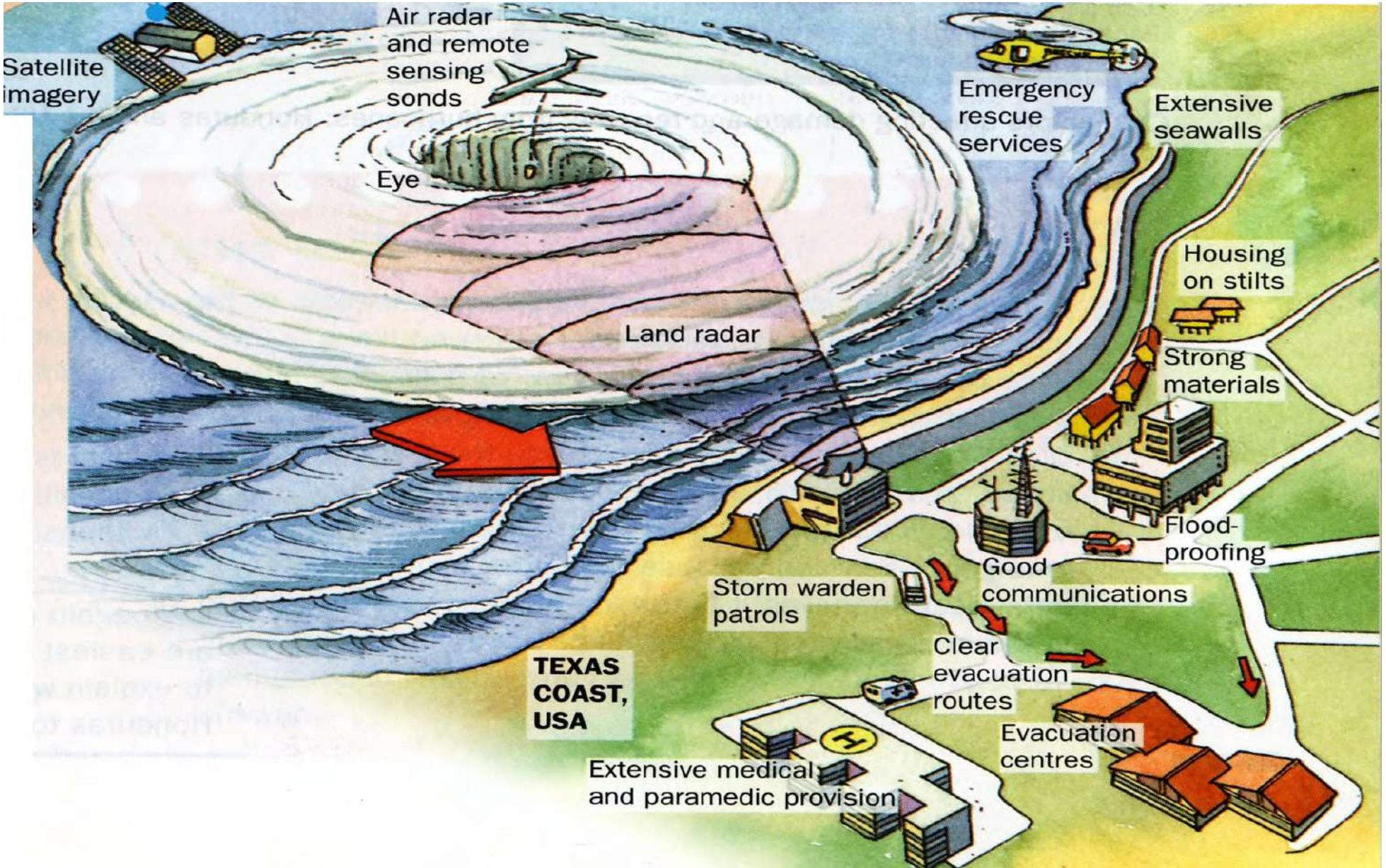
IMPACT ON THE ECONOMY

- Airports are closed.
- Damage harbor facilities.
- Businesses are closed.
- No trading is possible.
- Costly to repair damages.
- Job losses, unemployment

IMPACT ON THE ECONOMY

- High medical expenses.
- Costly insurance claims (business and personal).
- Put a strain on local civic services.
- Limits export.
- Increases imports (food and other commodities).

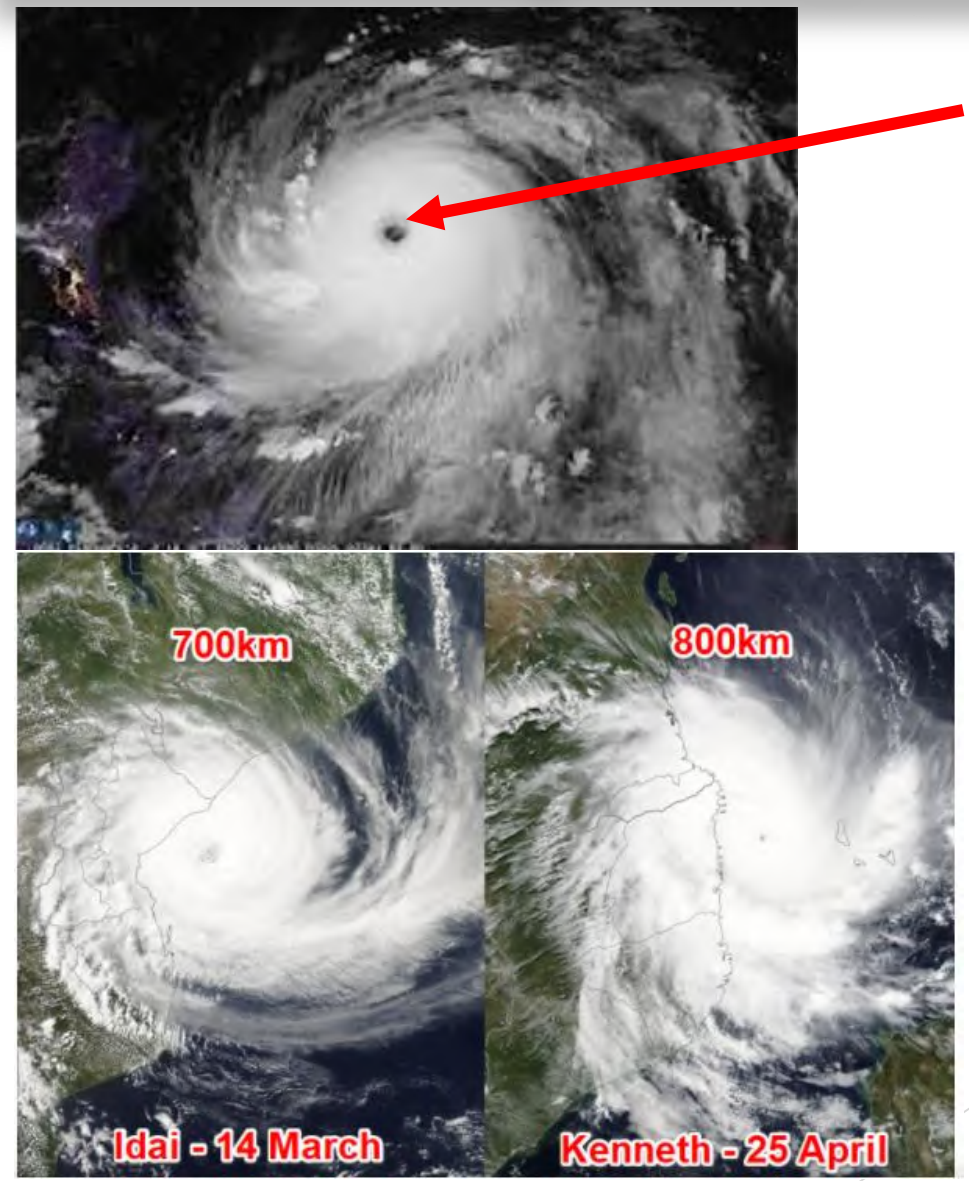
TROPICAL CYCLONE - MANAGEMENT

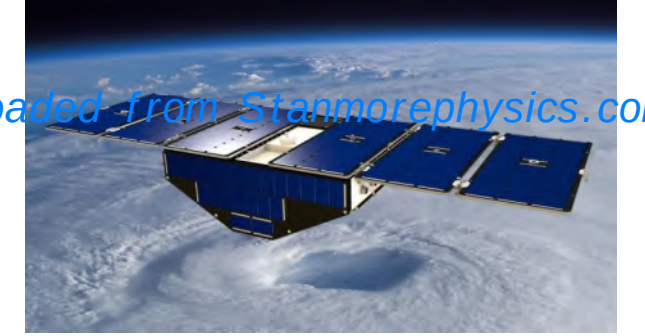


Precaution and management strategies

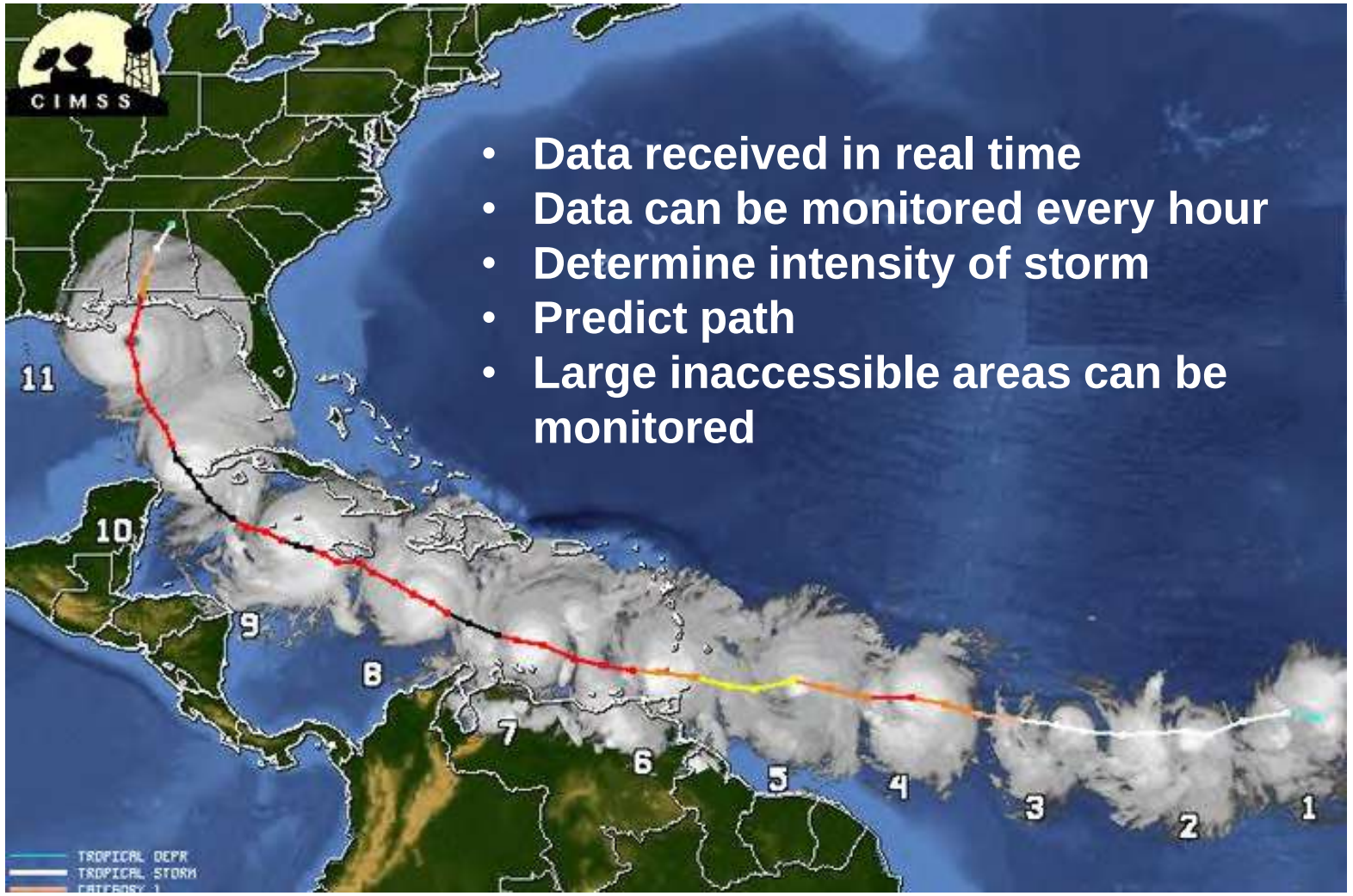
Stock up canned foods and water supplies because shops may not open.
Organize first aid kits and batteries in case of power cuts and emergency.
Move cattle and stock to higher ground.
Place sand bags along river banks and coastal areas to reduce the impact of flooding.
Set up evacuation plans for people living in low lying areas.
There must be rescue teams to rescue people from flooded areas.
There must be forecasting of weather to track and predict the path of a tropical cyclone and issue warnings.

Satellite image of TC



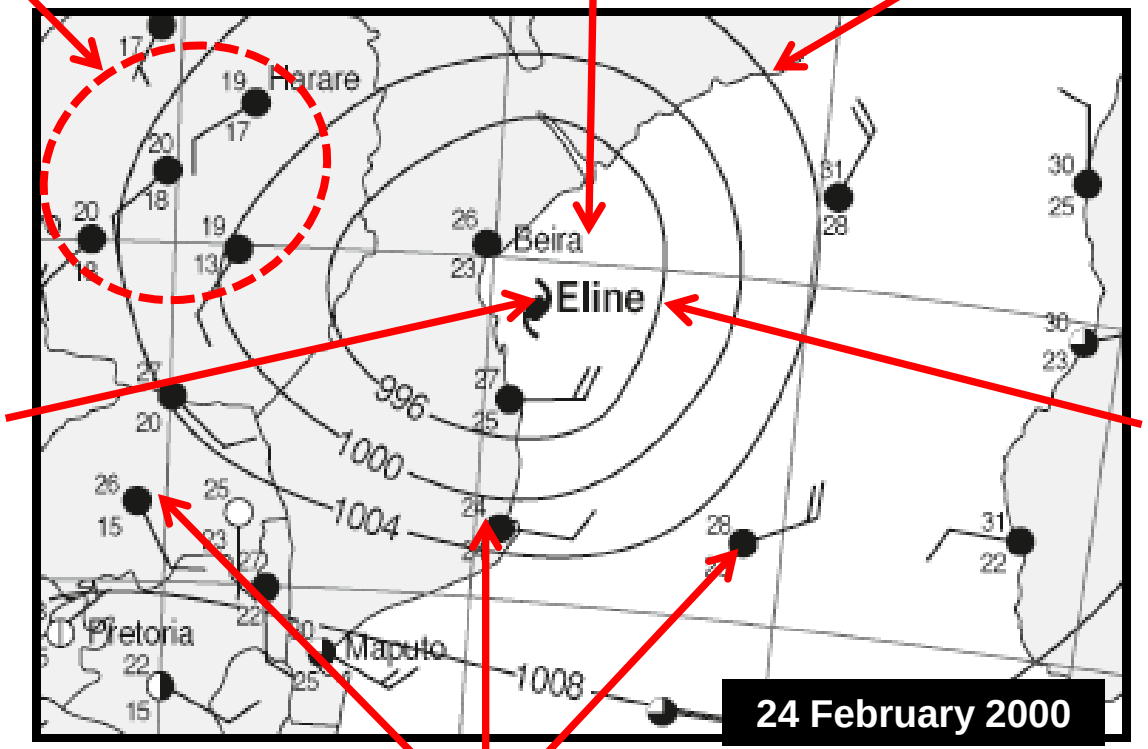


Explain why satellite images are effective for tracking cyclones



- Data received in real time
- Data can be monitored every hour
- Determine intensity of storm
- Predict path
- Large inaccessible areas can be monitored

Tropical Cyclones: Synoptic weather maps



SUBTROPICAL ANTICYCLONES AND ASSOCIATED WEATHER

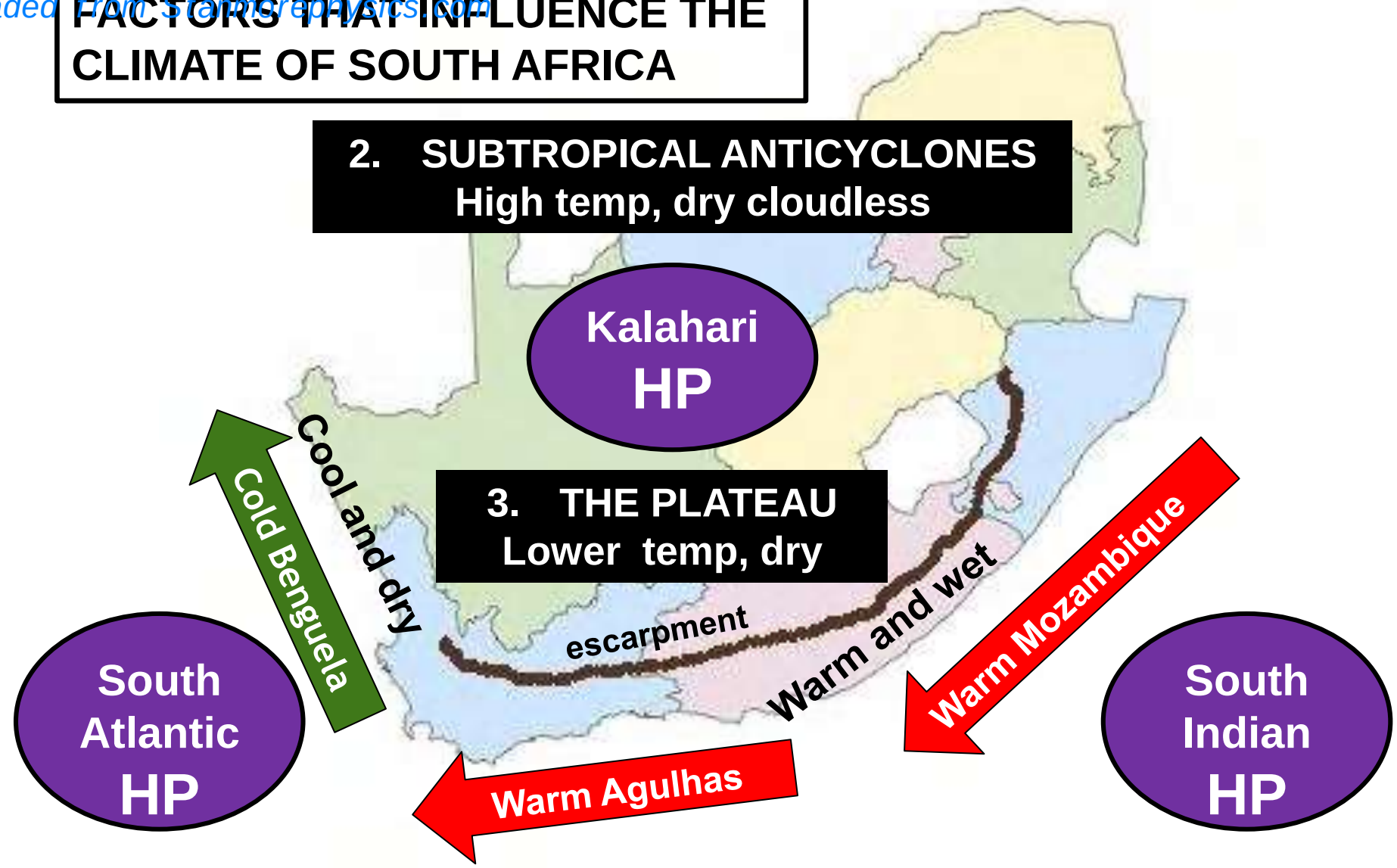
Factors influencing climate of SA

Line Thunderstorms

SA Bergwind

FACTORS THAT INFLUENCE THE CLIMATE OF SOUTH AFRICA

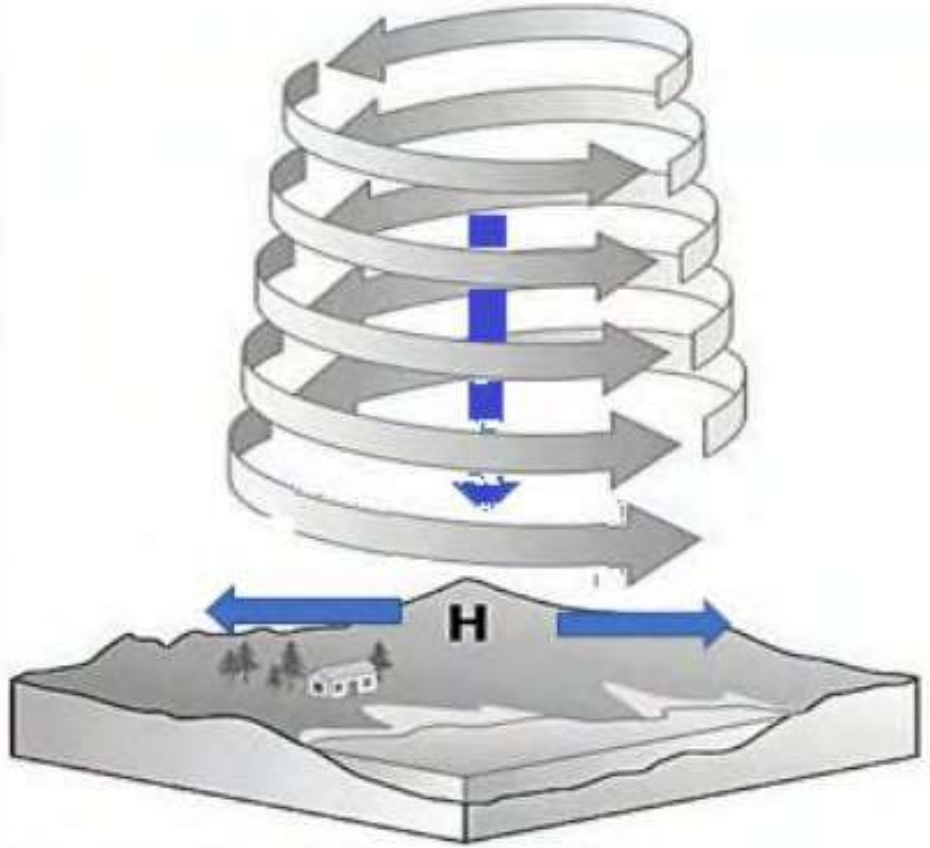
2. SUBTROPICAL ANTICYCLONES
High temp, dry cloudless



1. INFLUECE OF OCEANS

CHARACTERISTICS OF ANTICYCLONES

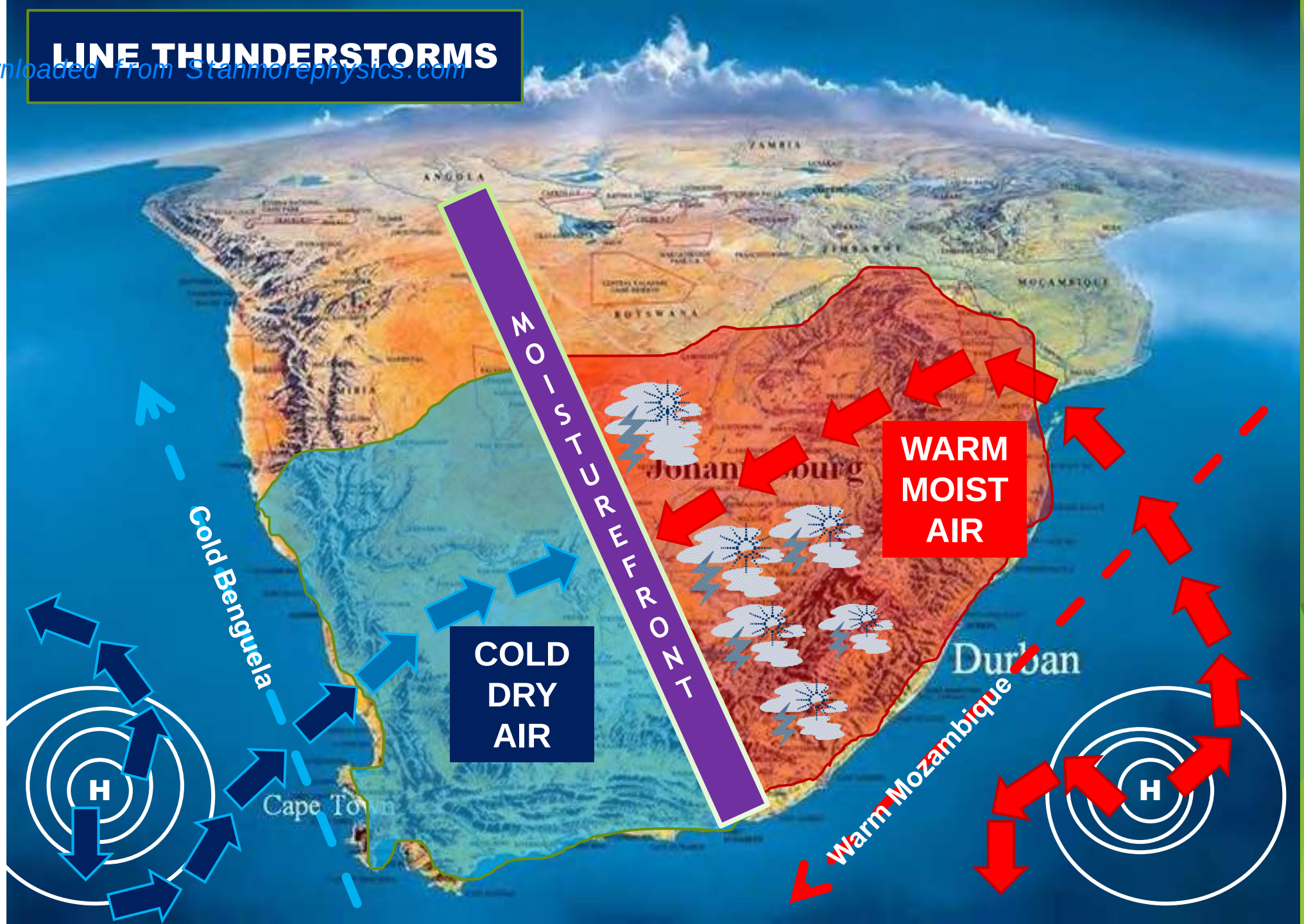
- Anticlockwise circulation.
- Air diverges at the centre
- Dry descending air results in stable atmospheric conditions and intensifies high pressure system.
- Clear skies with sunshine.
- Winds blow outwards in an anti-clockwise direction in the southern hemisphere.
- Adiabatic warming of decending air in the anticyclone.



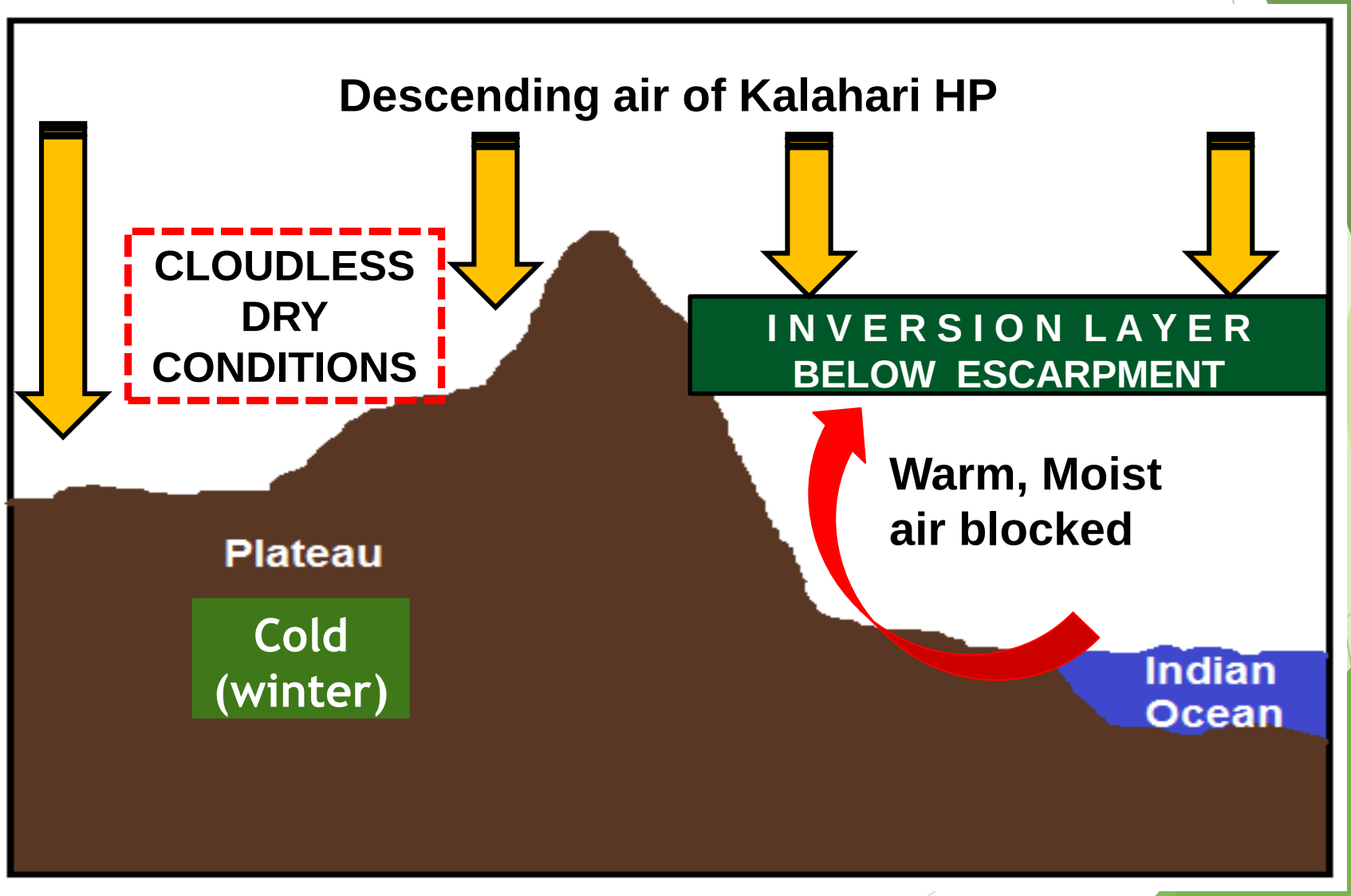
[Source: Unknown]

- Responsible for the semi-arid conditions over South Africa.
- Affect climate of South Africa because of the location at 30° South.
- More prominent in winter over South Africa because of the northward Migration of the ITCZ.

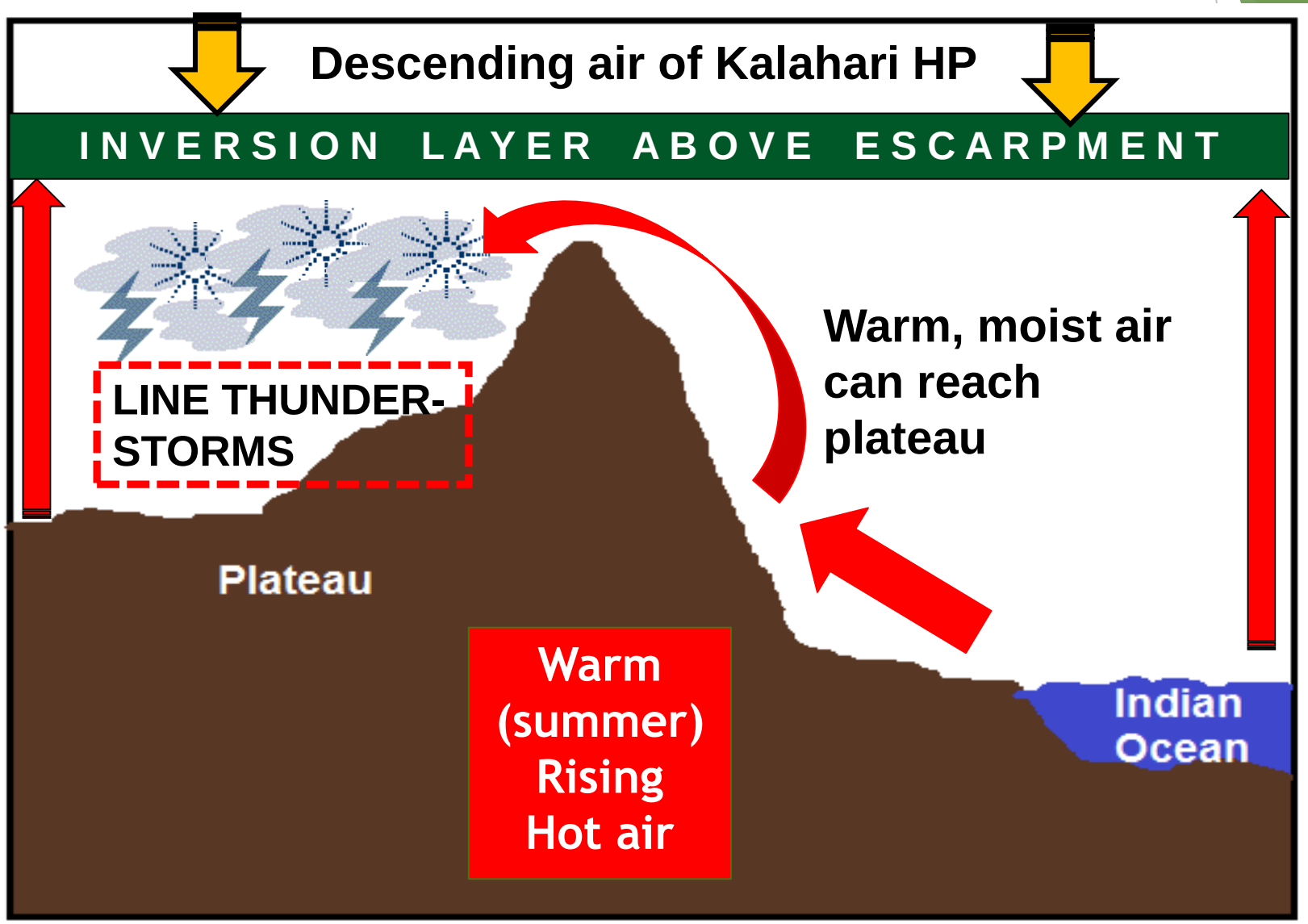
LINE THUNDERSTORMS



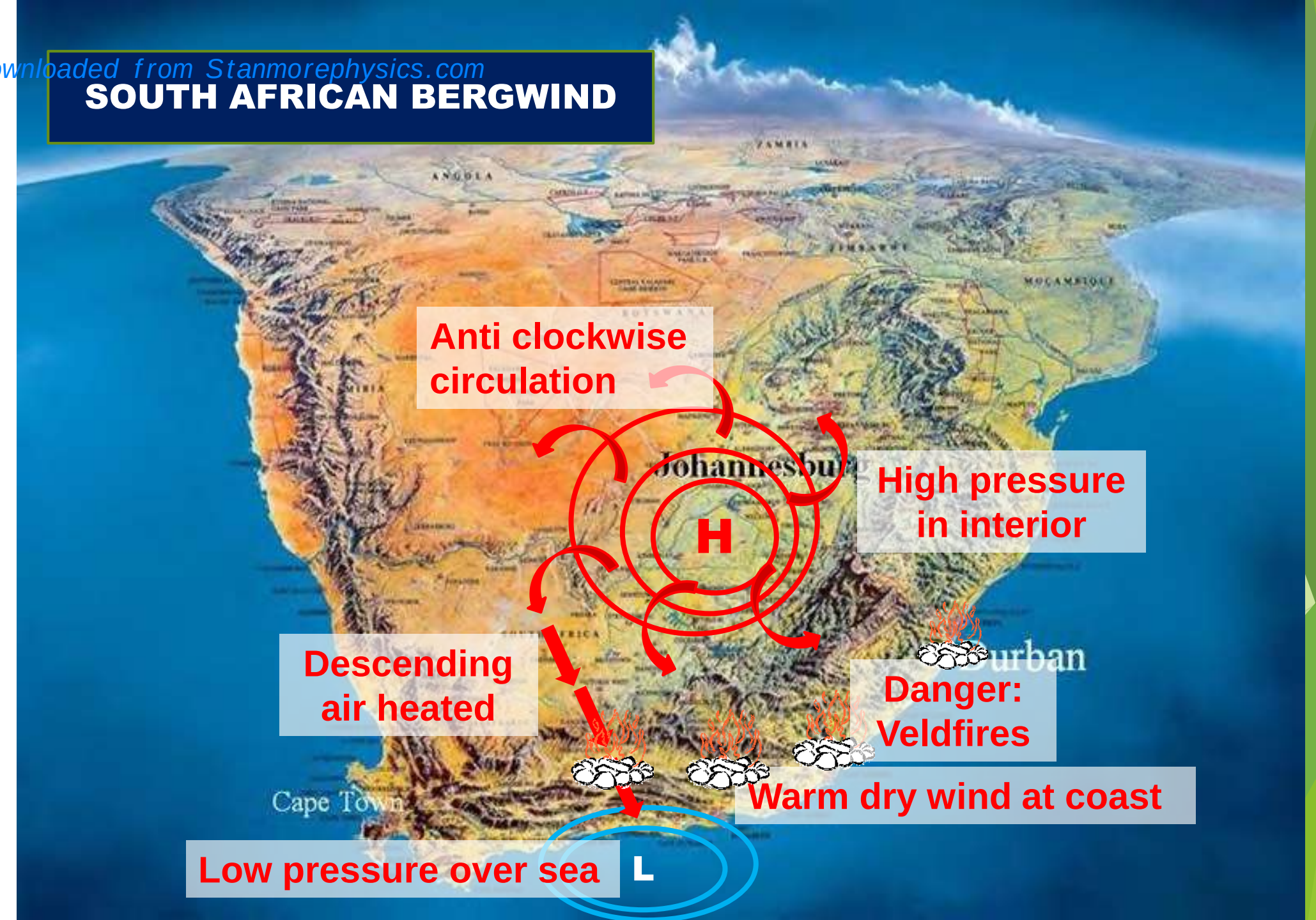
WINTER



SUMMER



SOUTH AFRICAN BERGWIND

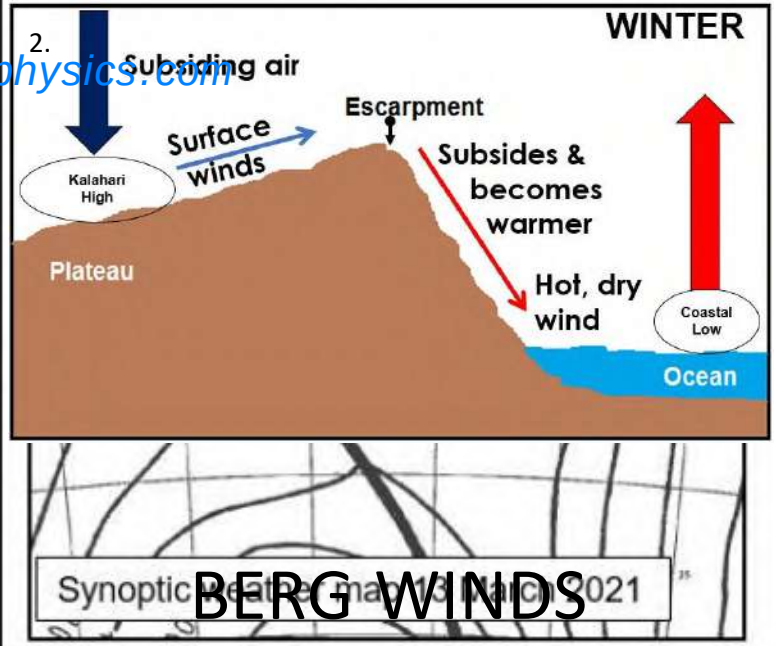


BERG WINDS

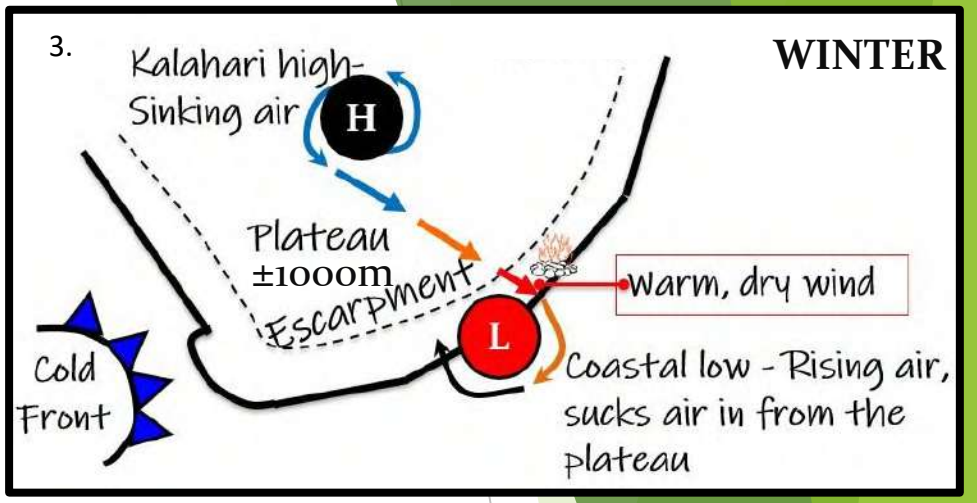
1. **Record-breaking heatwave hits East London**
Matthew Field
18 March 2021

East London residents were subject to sweltering heat last Saturday after a record-breaking heatwave resulted in a peak temperature of 43,9 °C. According to the South African Weather Service (SAWS), the heatwave was a result of berg wind conditions, when hot dry winds blow down to the coast from the country's high central plateau.

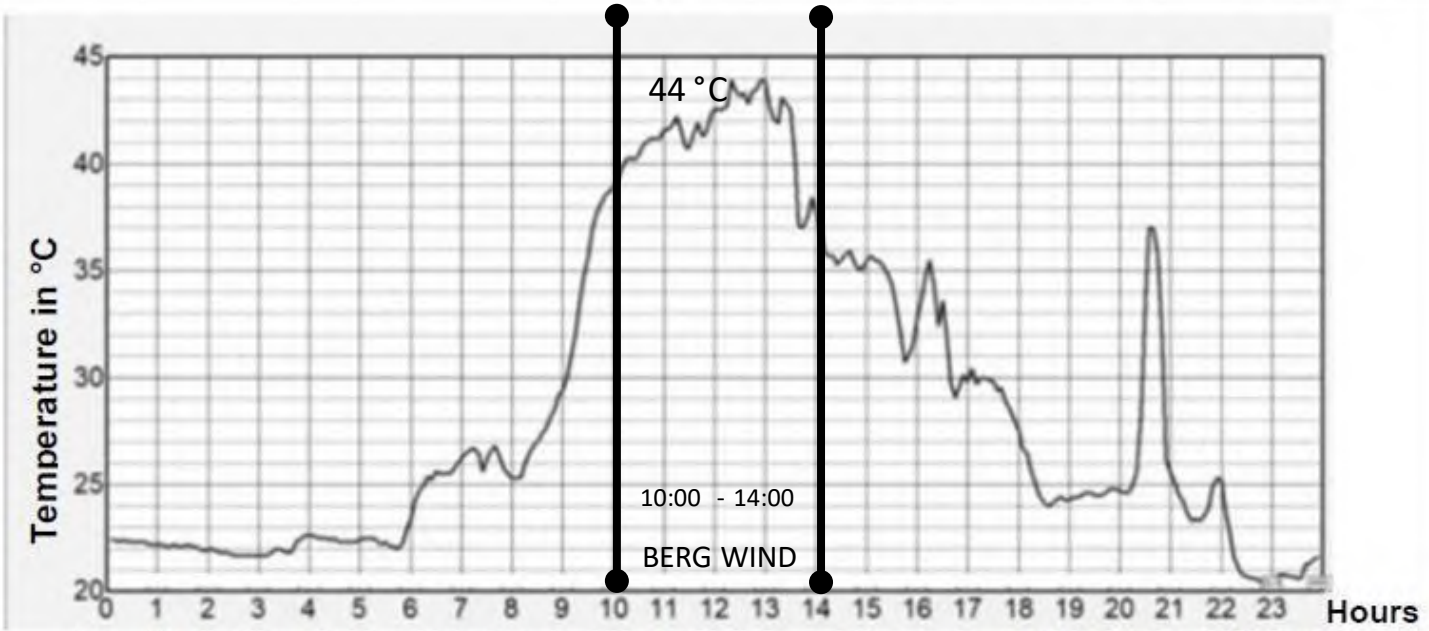
2.



3.



4.

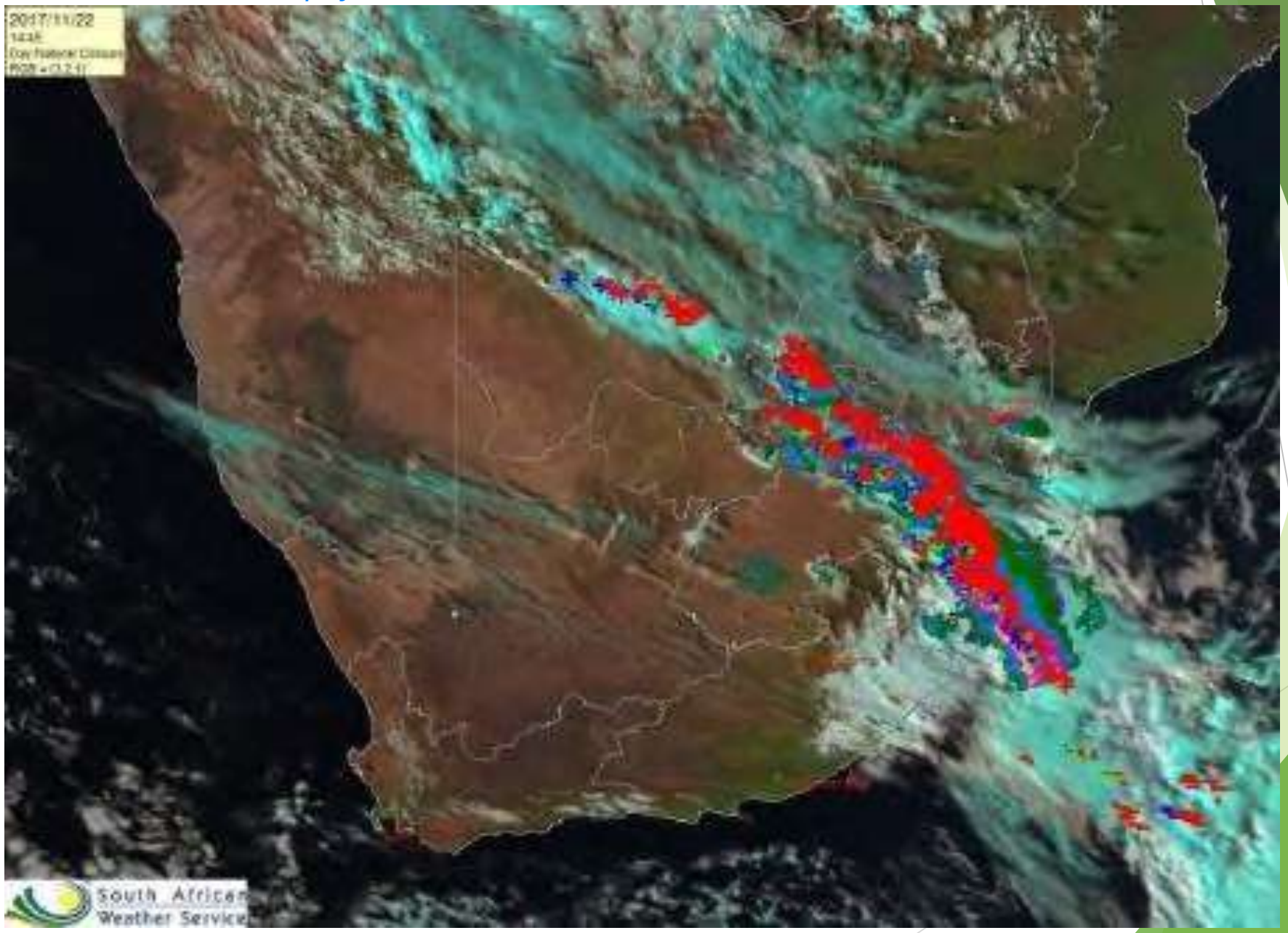


A graph tracking the temperature in East London over the course of Saturday 13 March
Picture: SA Weather Service

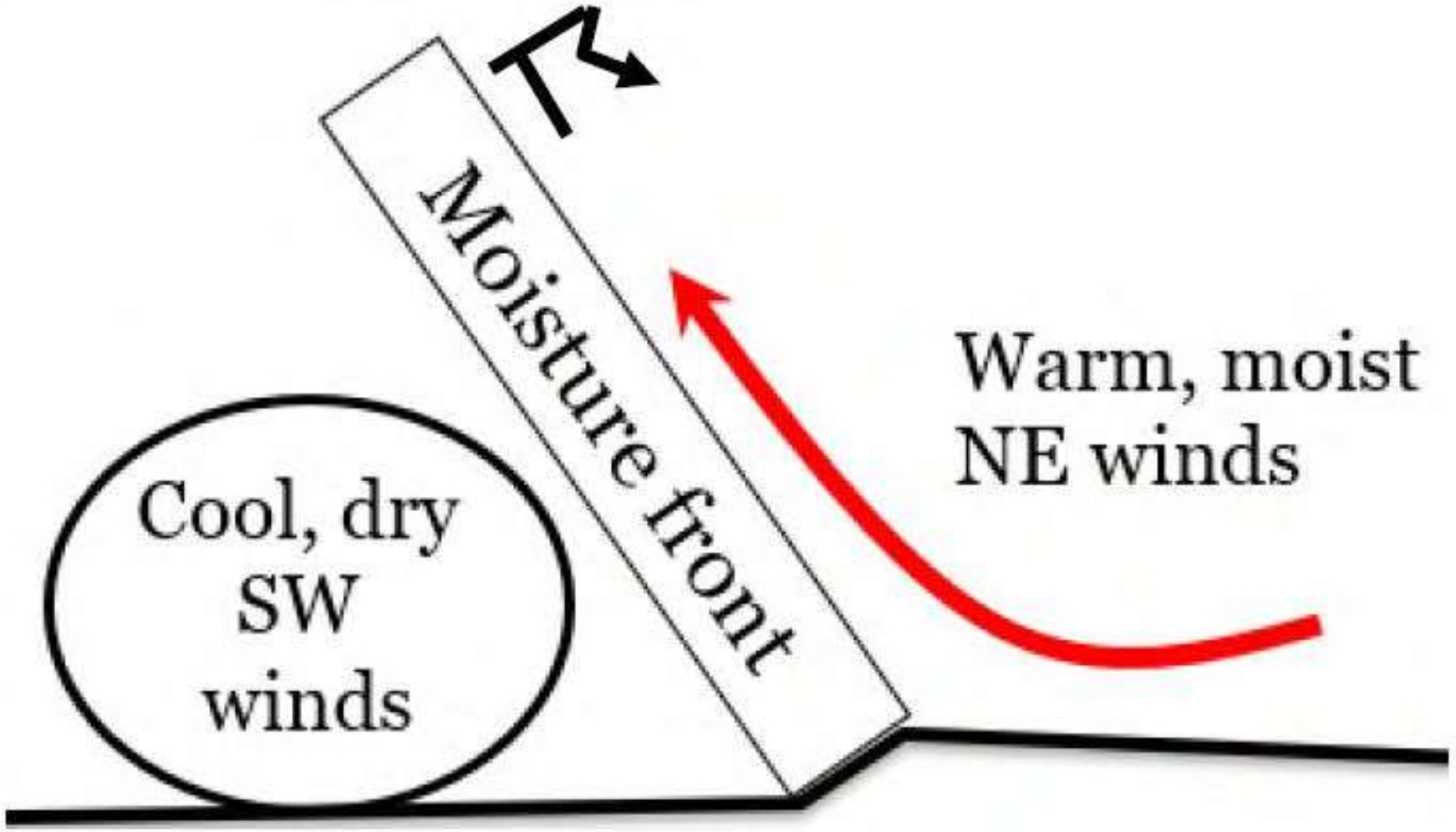
You must be able to:

- Identify and Name the 3 pressure cells that are necessary for berg winds to form/develop (source 3)
- Describe how berg winds form/develop (source 2 and 3)
- Define a berg wind (source 1)
- Explain the role of the escarpment in increasing the temperature of berg winds (source 2)
- State why berg winds occur in winter (source 3)
- Read the temperature and the time of a bergwind from a graph (source 4)
- Describe the impacts (2-4 facts) of bergwinds on the natural environment e.g., veldfires destroy natural vegetation or ash of veldfires fertilise the soil (see your class notes)
- Suggest strategies (2 -4 facts) how to reduce/manage the impact (see your class notes)

MOISTURE FRONT AND LINE THUNDERSTORM

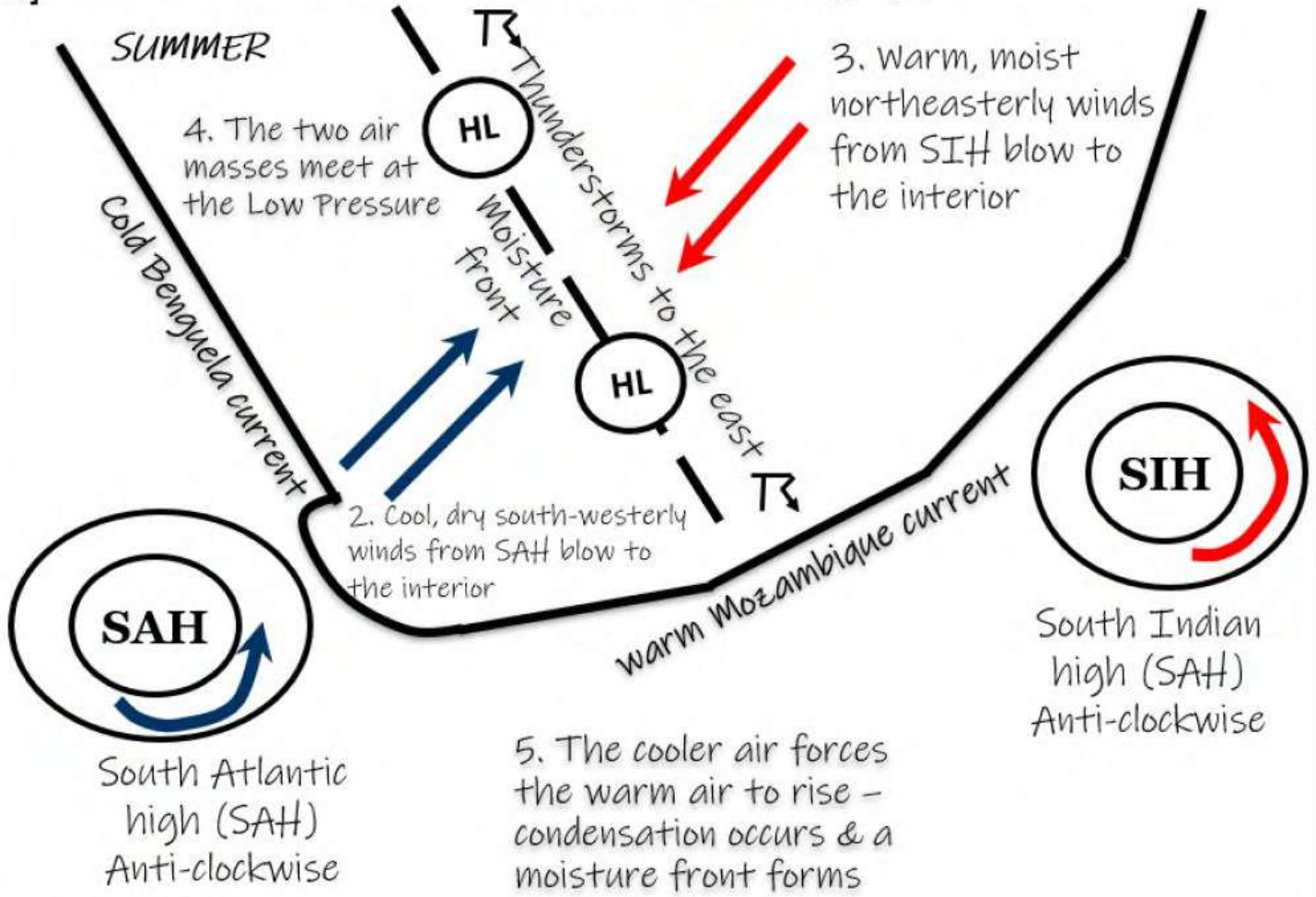


2.



Cool, dry air forces the warm, moist air to rise.

3.] 1. Warm over interior– air rises & a heat low (HL) forms



4.

Line Thunderstorm: A thunderstorm that happens in a line on the eastern side of the moisture front where the warm, moist air is forced to rise.

Moisture front: A contact zone between two air masses with different moisture content. Dry air & moist air creates a front.

5. IMPACT:

Heavy rainfall causes flooding which lead to loss of natural vegetation/habitats.
Lightning can cause fires that destroys natural vegetation/habitats.
Heavy rainfall causes widespread soil erosion/loss of fertile soil.
Hail causes damage to natural vegetation / habitats.

You must be able to:

- **Identify and Name** the season and the 3 pressure cells that are necessary for line thunderstorms to form/develop (source 3)
- **Identify** the wind directions of the 2 high pressure cells (source 3)
- **Define** a line thunderstorm and a moisture front (source 4)
- **Explain** how the moisture front is formed when air of the SAH and SIH meet over the interior (source 2 & point 5 on source 3)
- **State** why the thunderstorms form to the east of the moisture front (source 2 & point 3 on source 3)
- **State** why the air of the SAH is dry while the air of the SIH is moist (source 3)
- **State** why the air of the SAH forces the air of the SIH to rise when it meets over the interior (source 3)
- **Describe** the impacts (2-4 facts) on the natural environment (source 5)
- **Suggest** strategies (2-4 facts) how to reduce/manage the impact (see your class notes)

IMPACT:

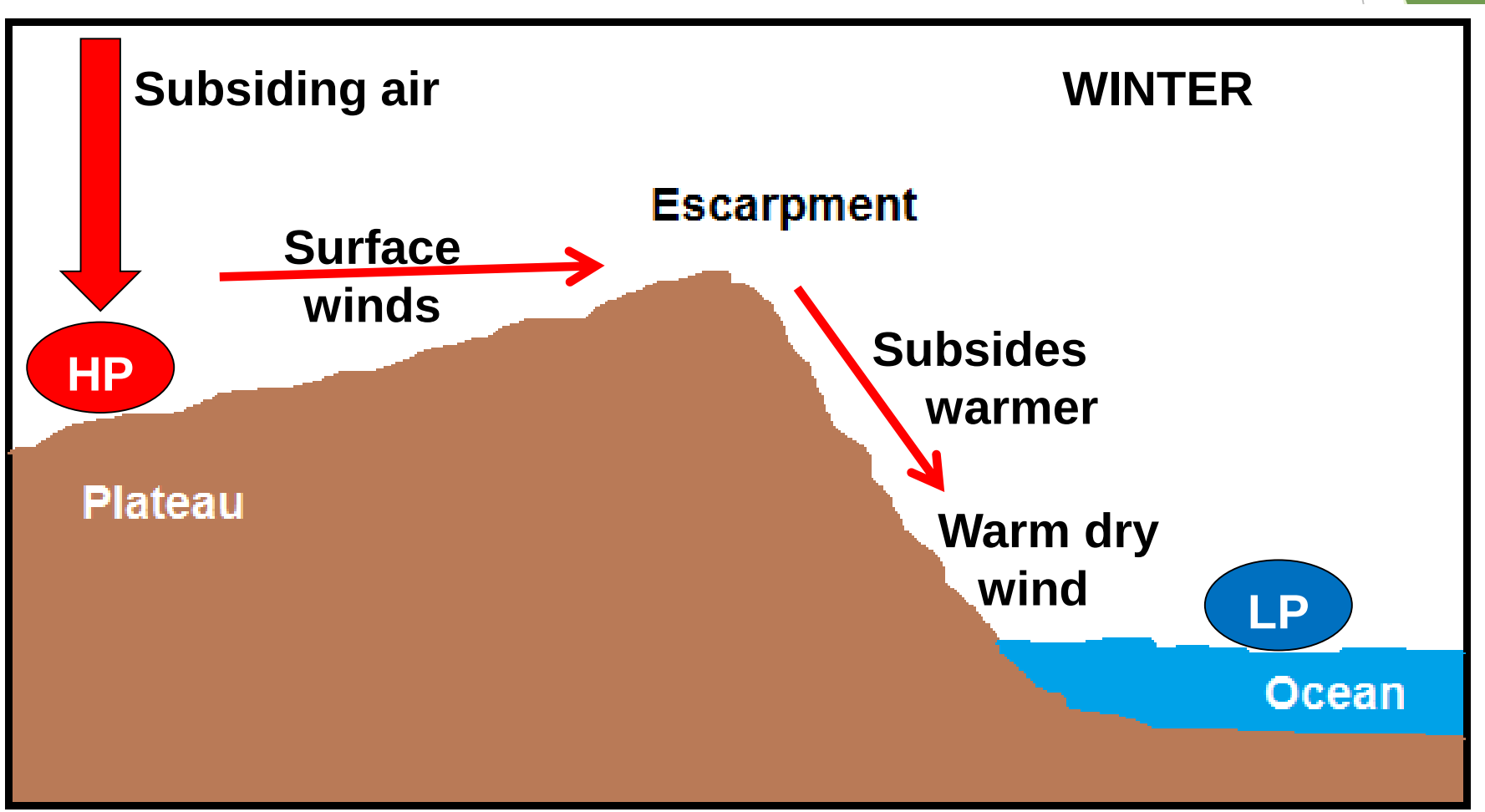
5. Heavy rainfall causes flooding which lead to loss of natural vegetation/habitats.

Lightning can cause fires that destroys natural vegetation/habitats.

Heavy rainfall causes widespread soil erosion/loss of fertile soil.

Hail causes damage to natural vegetation / habitats.

SOUTH AFRICAN BERGWIND

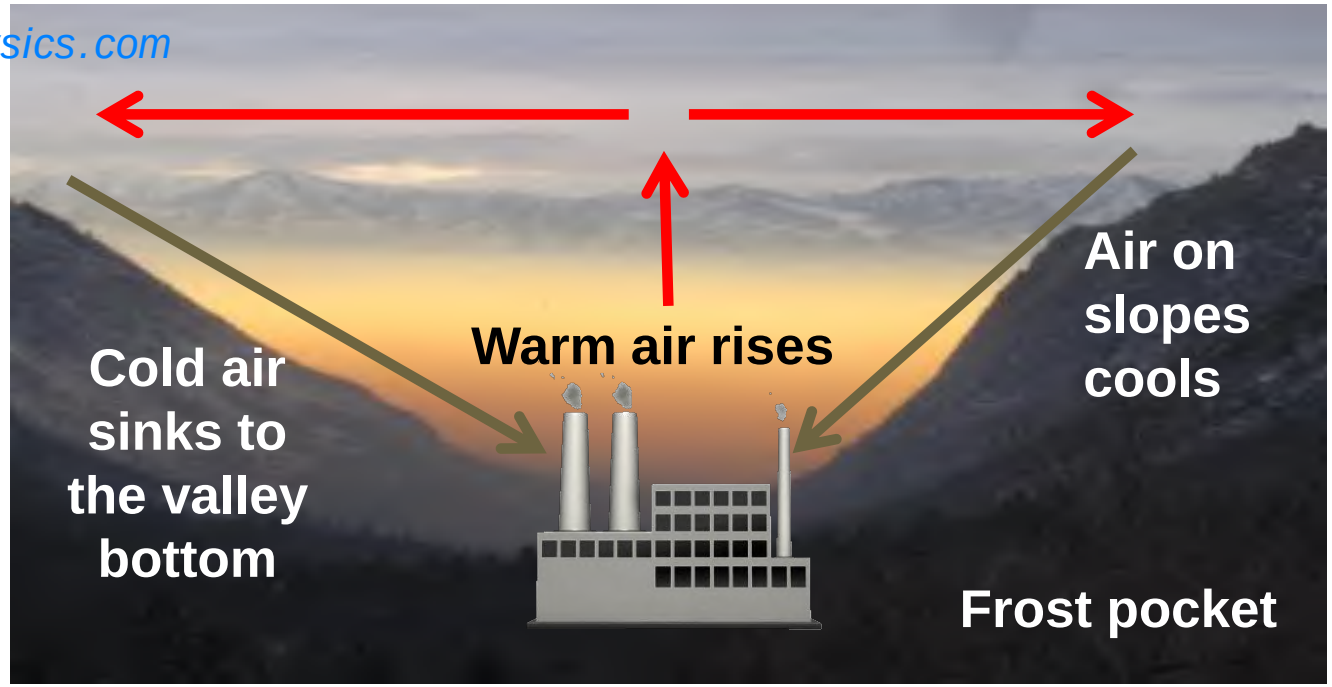


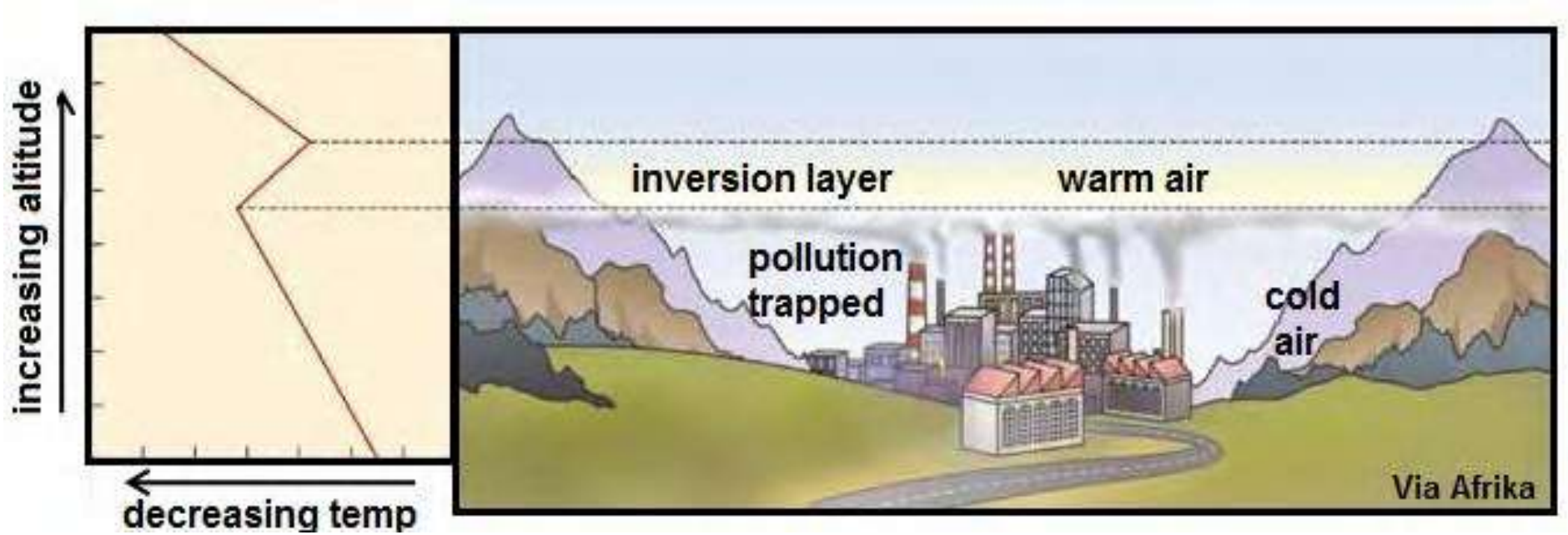
Valley Climates

1. **Effect of the slope (aspect)**
2. **Inversions**
3. **Frost pockets / Smog**

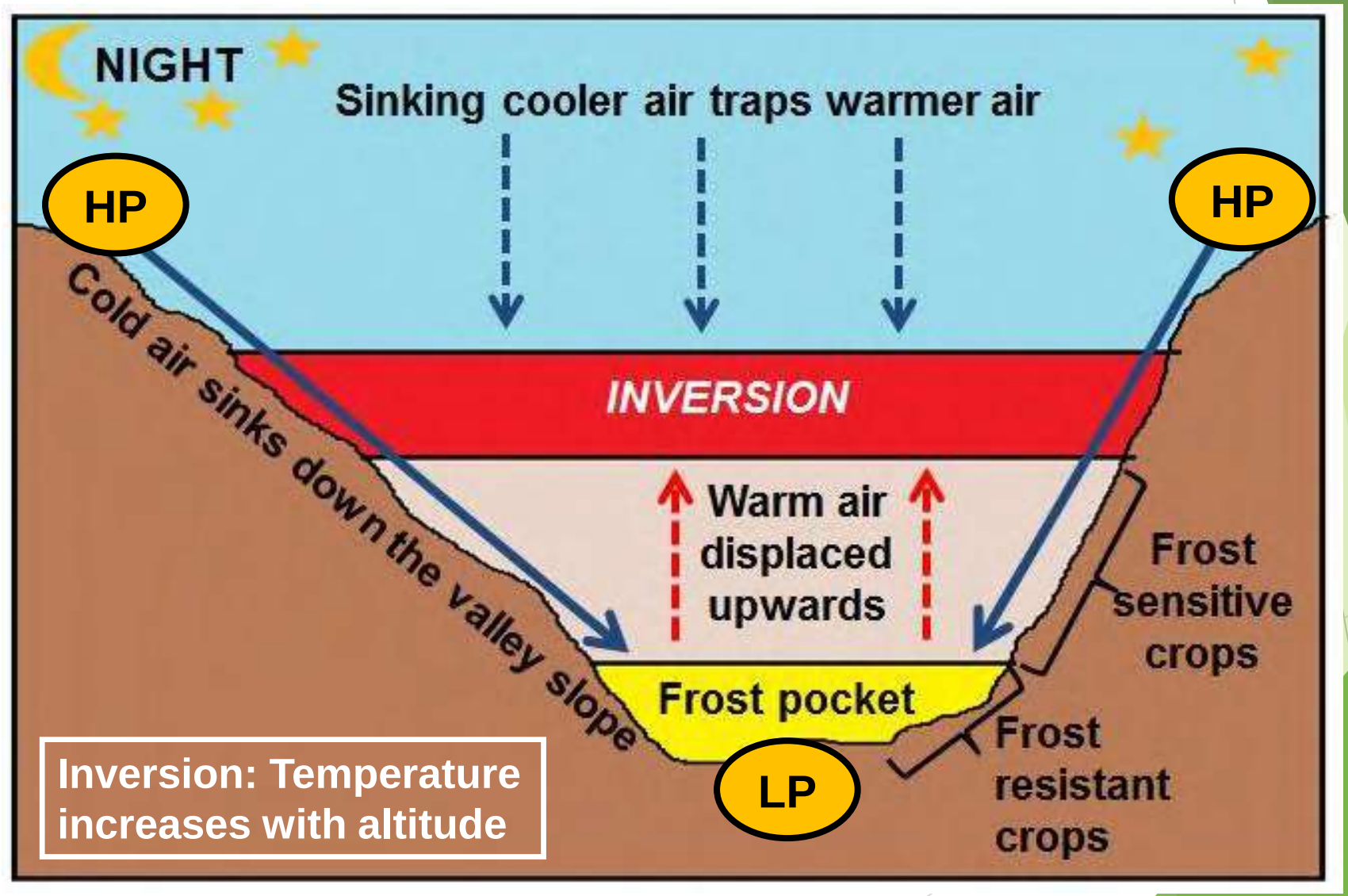
VALLEY CLIMATES ASPECT (SH)

INVERSIONS

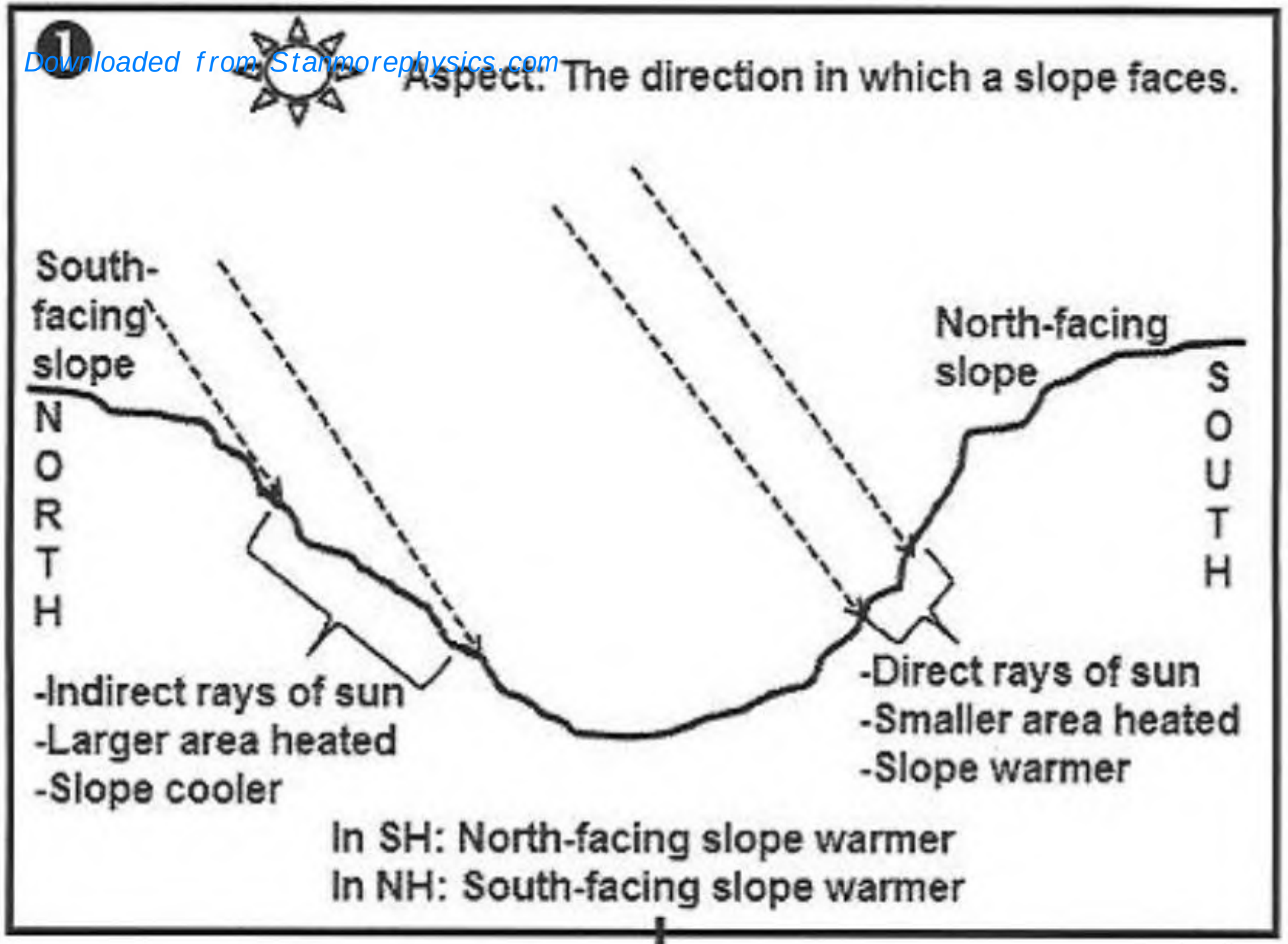




Katabatic winds and Inversions

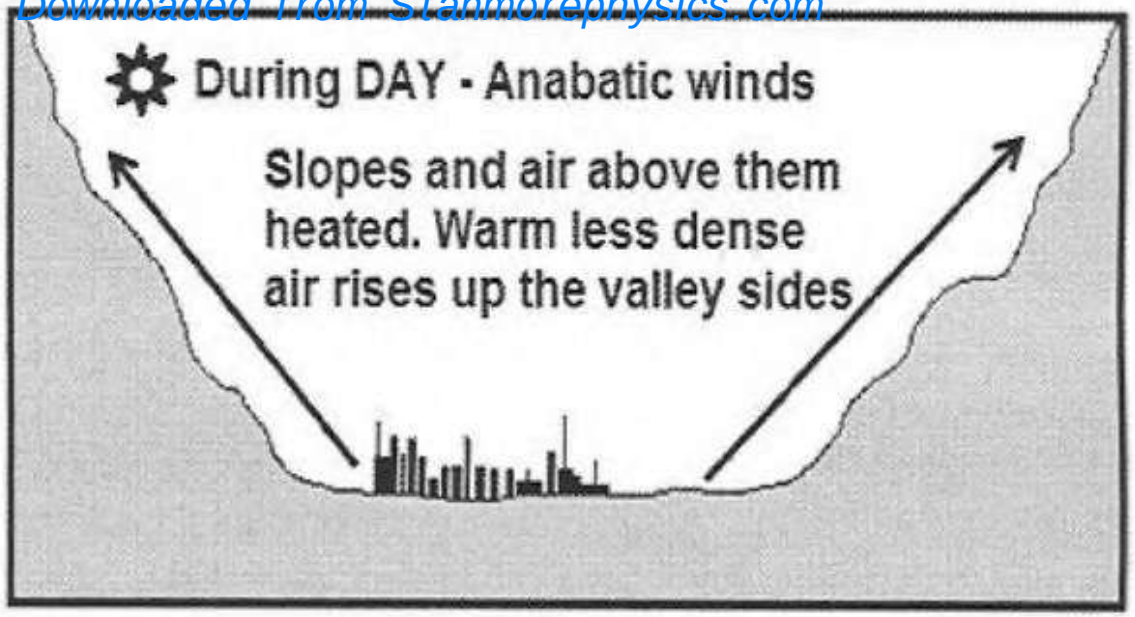


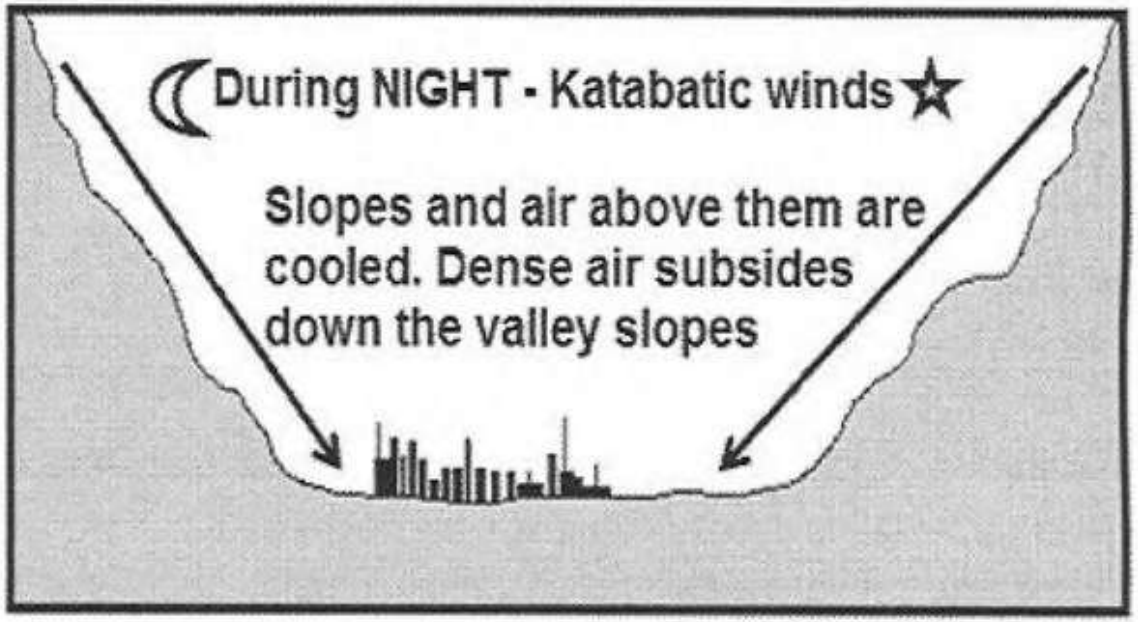
1 Aspect: The direction in which a slope faces.



In SH: North-facing slope warmer
In NH: South-facing slope warmer

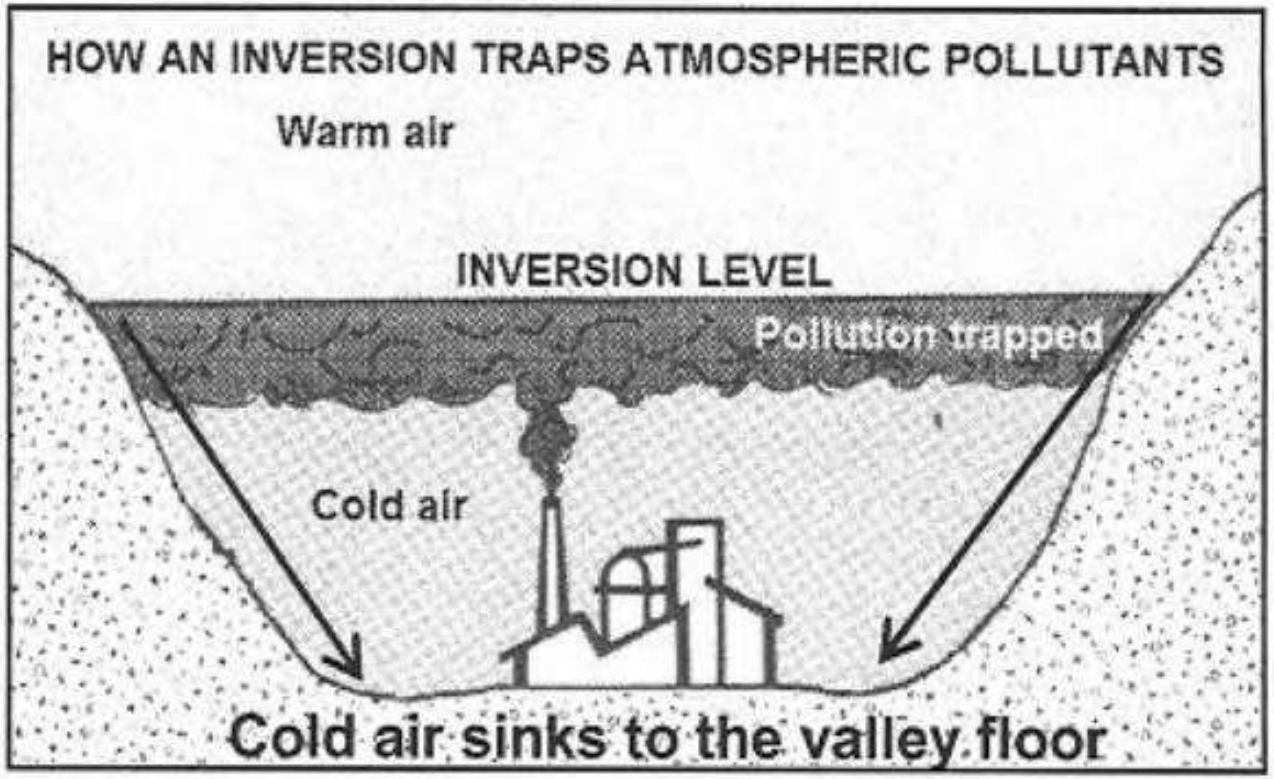
❷ Anabatic and Katabatic winds



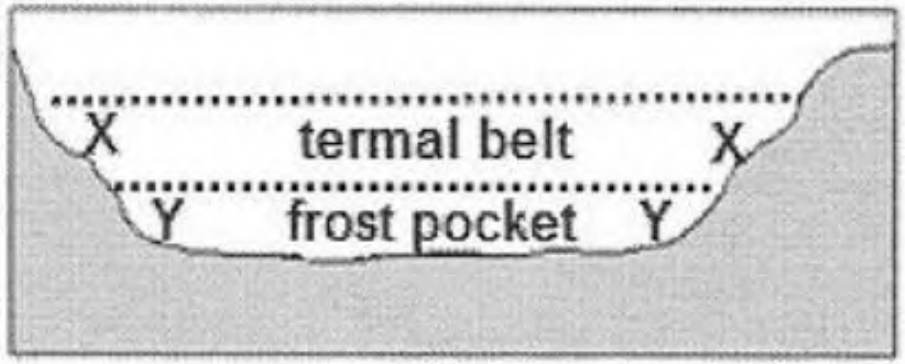


❸ Inversions

- Inversions form when the normal pattern of air temperature is reversed.
- Air closer to the ground is cooler than the air above it.
- Happens on calm cloudless winter nights.
- Upper slopes cool rapidly.
- Cold air sinks down slopes to the valley.
- The colder air is trapped under warmer air
- Temperature increases with altitude in The valley
- Polluted air gets trapped and cannot rise.



Impact on human activities



SETTLEMENT

- Develop on mid-slope (X) in thermal belt
- Night time temperatures will be higher.
- Cold air sinks to valley floor

FARMING

- In SA vineyards planted on warmer north-facing slopes.
- Frost-resistant crops planted in frost pocket (Y)
- Crops sensitive to low temperatures planted in thermal belt (X)

❺ Radiation fog

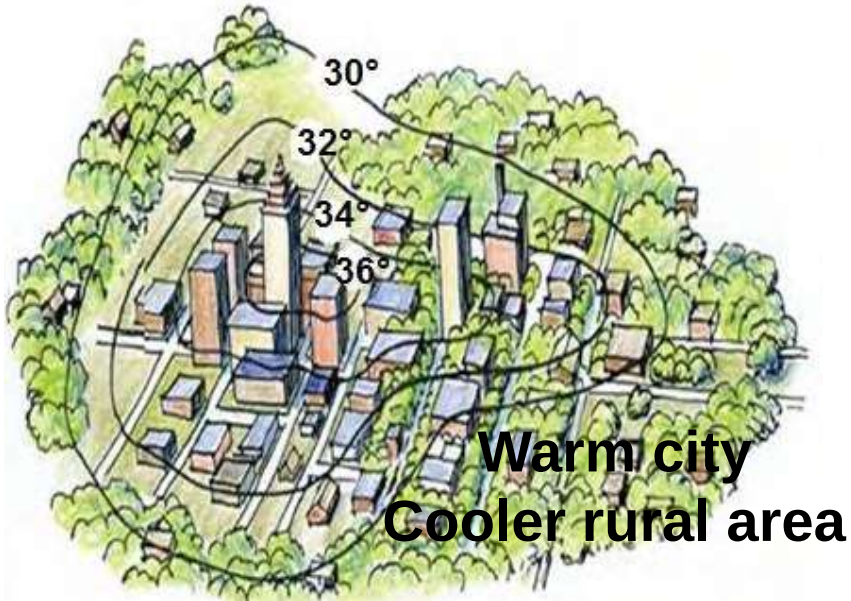
- Formed as a result of radiation from the Earth's surface.
- Formed in valleys when nights are cold, clear and cloudless.
- Earth's surface and layer of air above it cools rapidly.
- Condensation occurs tiny droplets formed
- Small droplets are suspended in the air
- Disappears after insolation starts

RADIATION FOG PHOTO

URBAN CLIMATES

1. Reasons for differences
2. Causes of heat islands
3. Pollution domes
4. Effects of heat islands

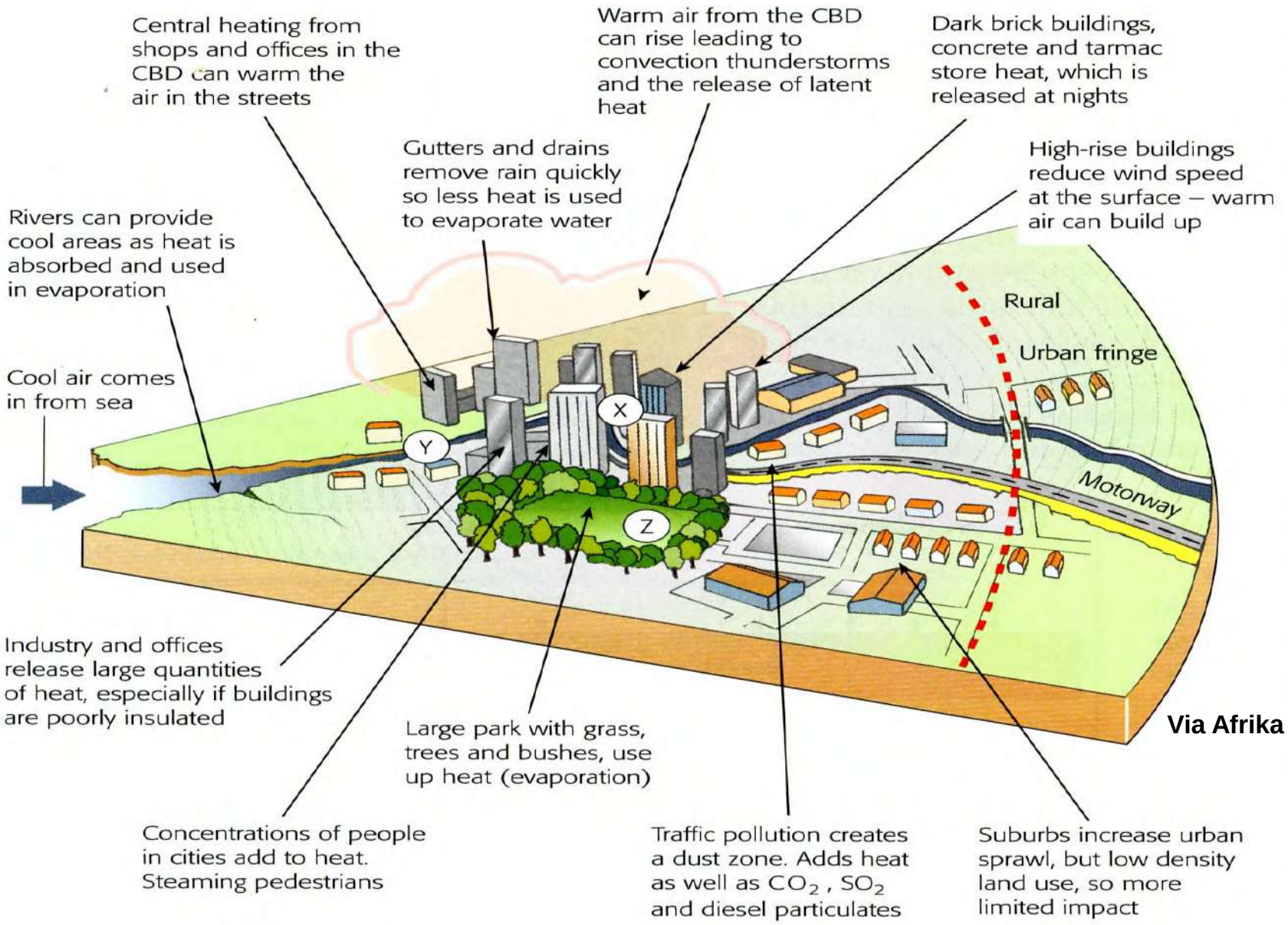
Differences between city & rural areas



Warm city
Cooler rural area

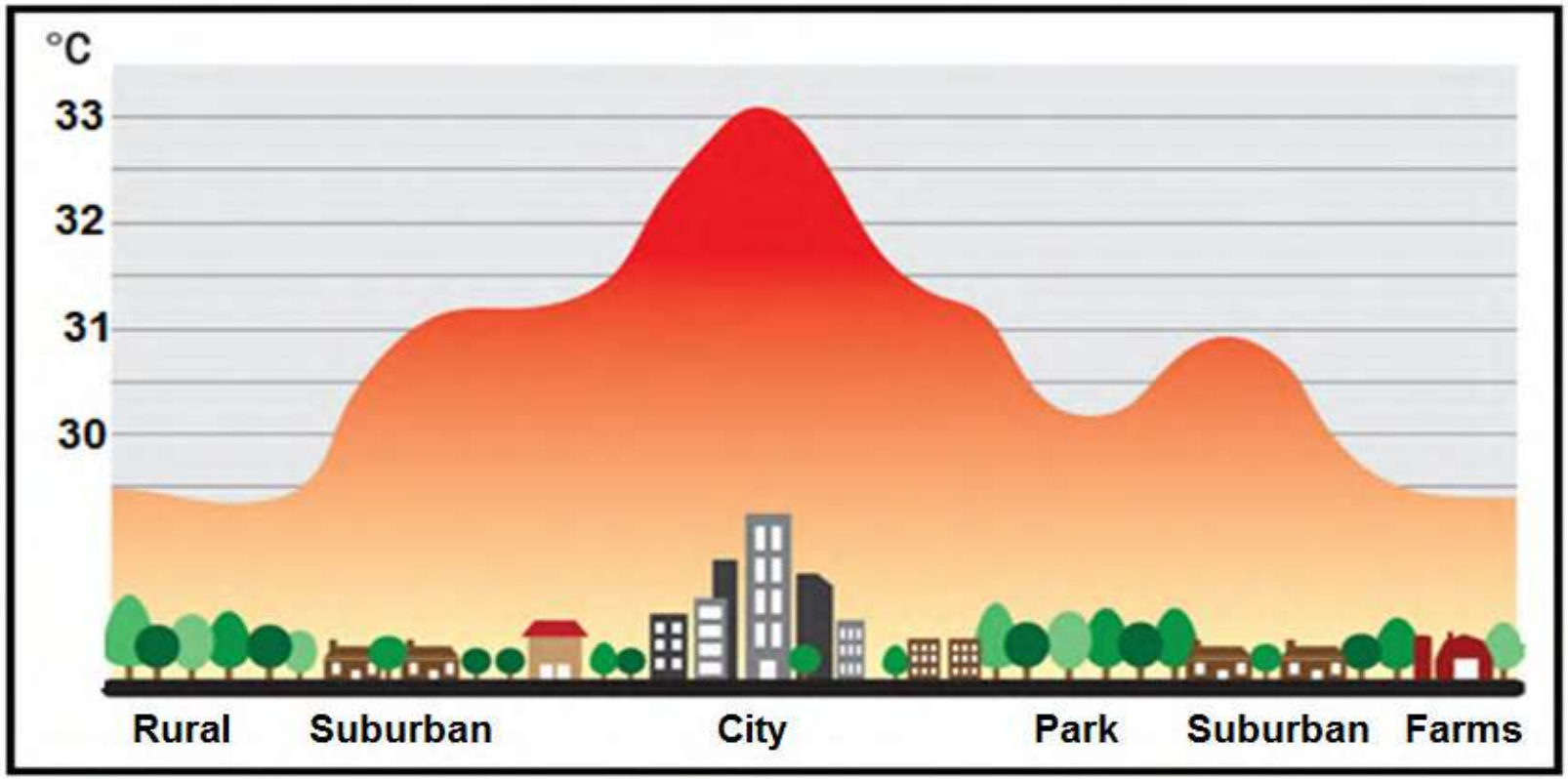
Mass of polluted air trapped by inversion layer and prevented to rise.

CAUSES OF URBAN HEAT ISLANDS



Via Afrika

EFFECTS OF URBAN HEAT ISLANDS



- Human discomfort
- Heat stroke-deaths
- Reduced visibility (smog)
- Increased energy use
- Air conditioners
- Increase in air pollution
- Increase in greenhouse gasses
- Respiratory discomfort. Asthma
- Increased precipitation
- Reduced insolation (pollution)

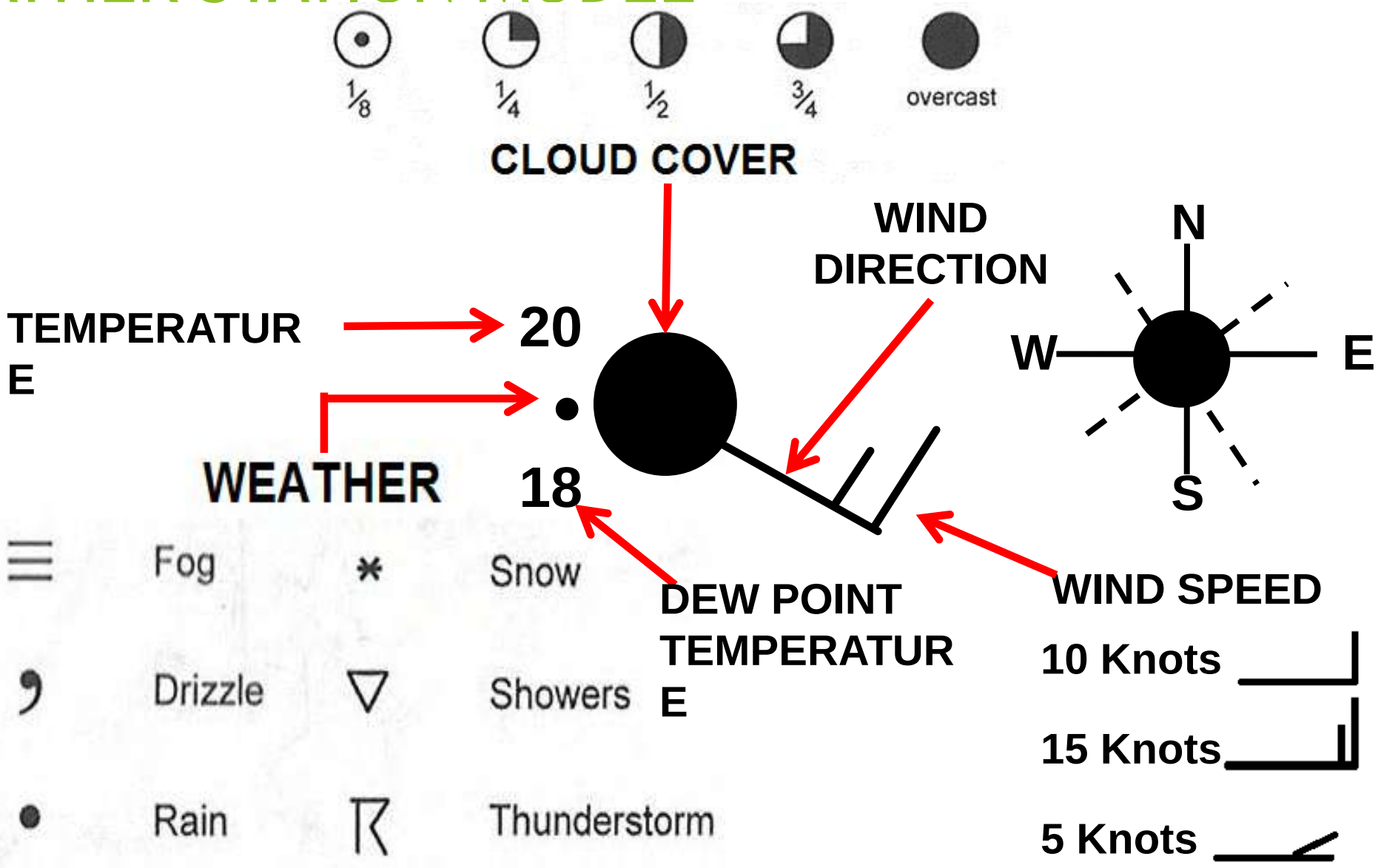
Synoptic Weather maps

Station Models

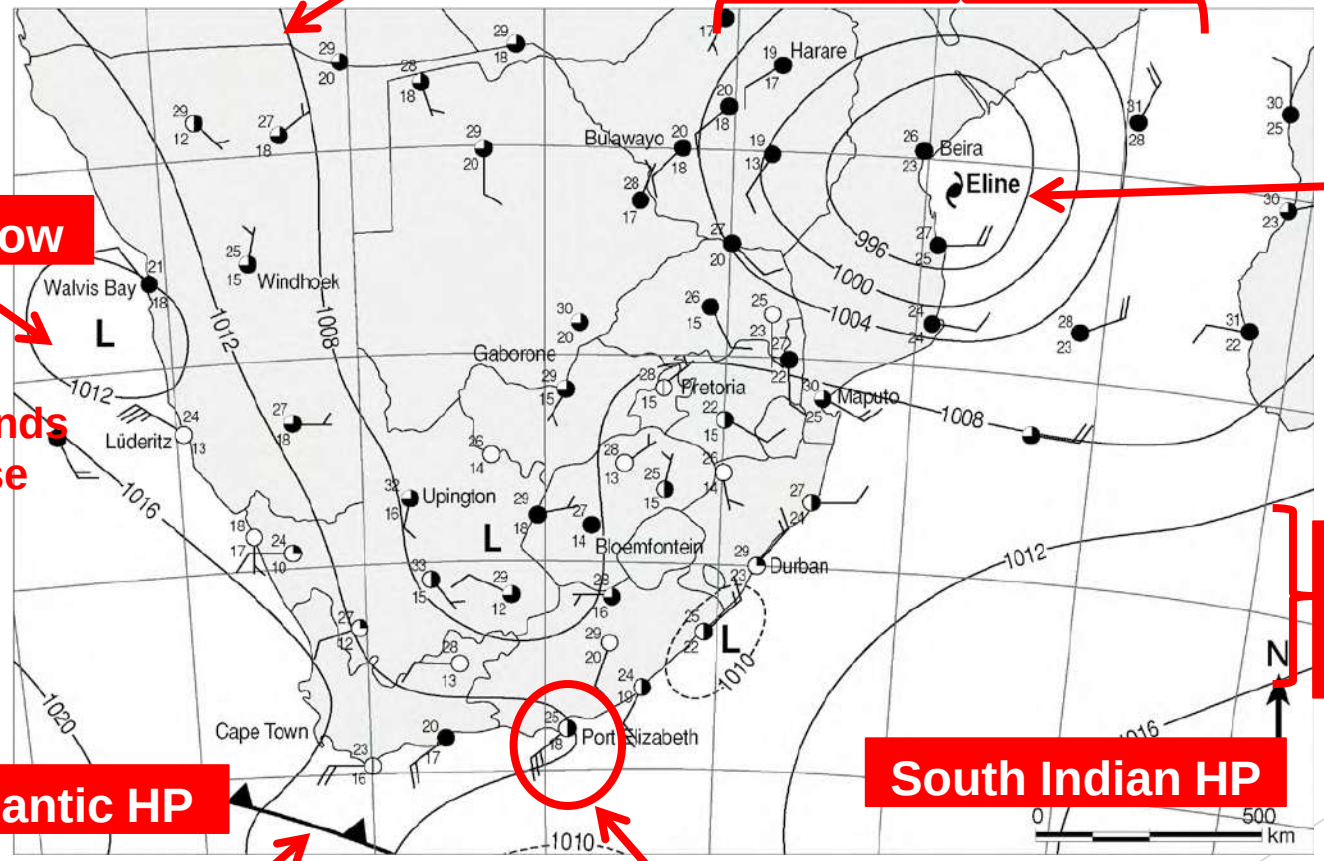
Features on SA weather maps

Satellite images

WEATHER STATION MODEL



FEATURES ON A SOUTH AFRICAN SYNOPTIC WEATHER MAP



Isobar

Clockwise movement around LP

Tropical cyclone

Coastal low

H

HP air descends anti-clockwise

L

LP air rises clockwise

Isobar interval 4hPa

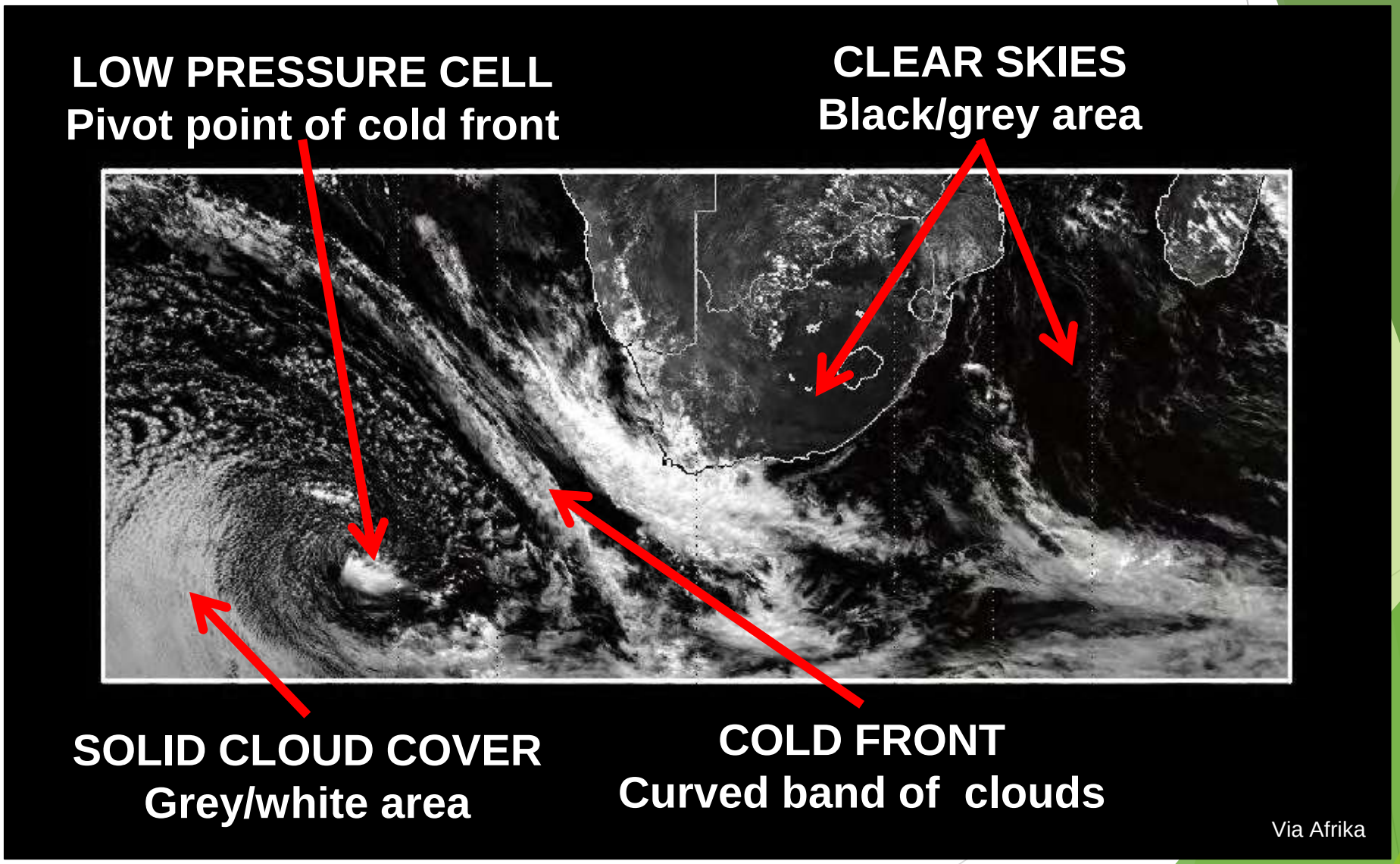
South Atlantic HP

South Indian HP

Cold front

Weather at PE

HOW TO INTERPRET A SATELLITE IMAGE



Acknowledgements:

- Glen Samaai – Western Cape
- Davechand – Gauteng Province