Meteorological Hazards Affecting Trinidad and Tobago

Disaster Risk Reduction

Table of Contents

Meteorological Hazards affecting Trinidad and Tobago

Meteorology is the study of the atmosphere and its phenomena.

Weather is the condition of the atmosphere at any particular time and place, like a picture.

Climate is the condition of the atmosphere over a given period of time.

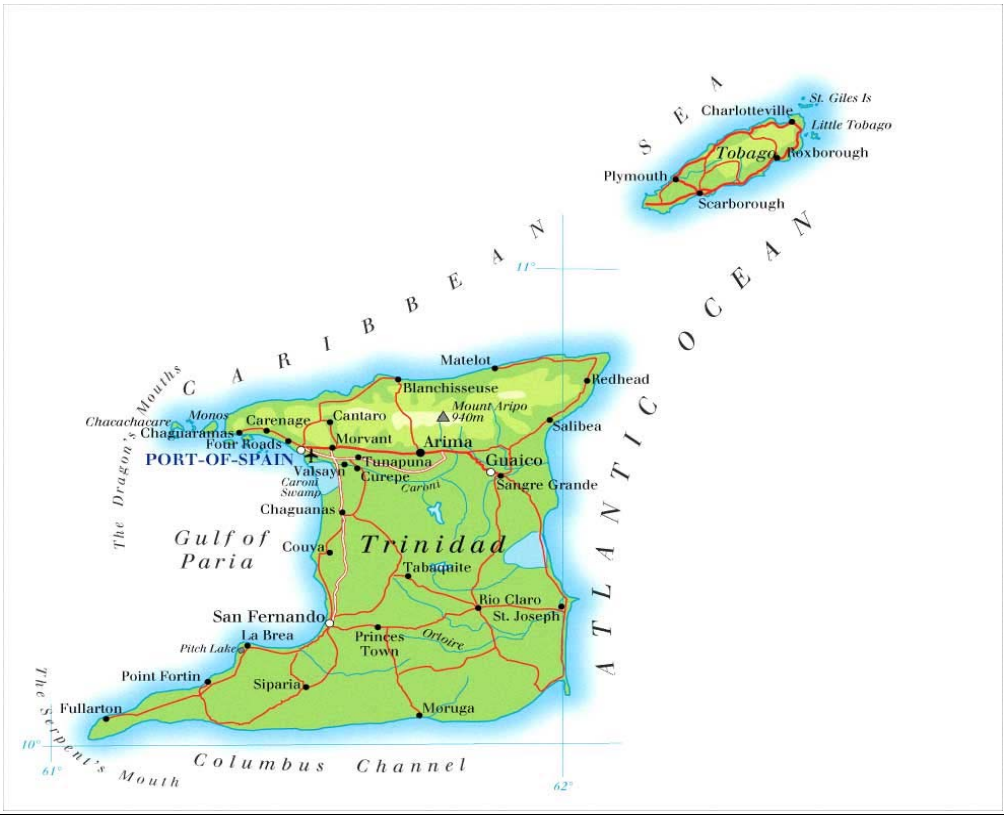
Meteorological (Weather) Parameters:

Wind, clouds, temperature, humidity, precipitation, atmospheric pressure, visibility, weather, sunlight.

Meteorological Hazards are attributed to:

- Wind – gusts, shear, downburst/ micro-bursts, tornado/waterspouts
- Precipitation – intense rainfall, hail
- Visibility – fog, intense rainfall
- Clouds – cumulonimbus – lightning, micro-burst

Trinidad and Tobago



Climatology of Trinidad and Tobago

Trinidad and Tobago are located at (Trinidad) 10°30N, 61°W and (Tobago) 11°N, 60°W. We observe two seasons - **dry** season, from January to May and **wet** season, from June to December. The hurricane season is observed between June 1st and November 30th. The wind usually blows from the east over our islands.

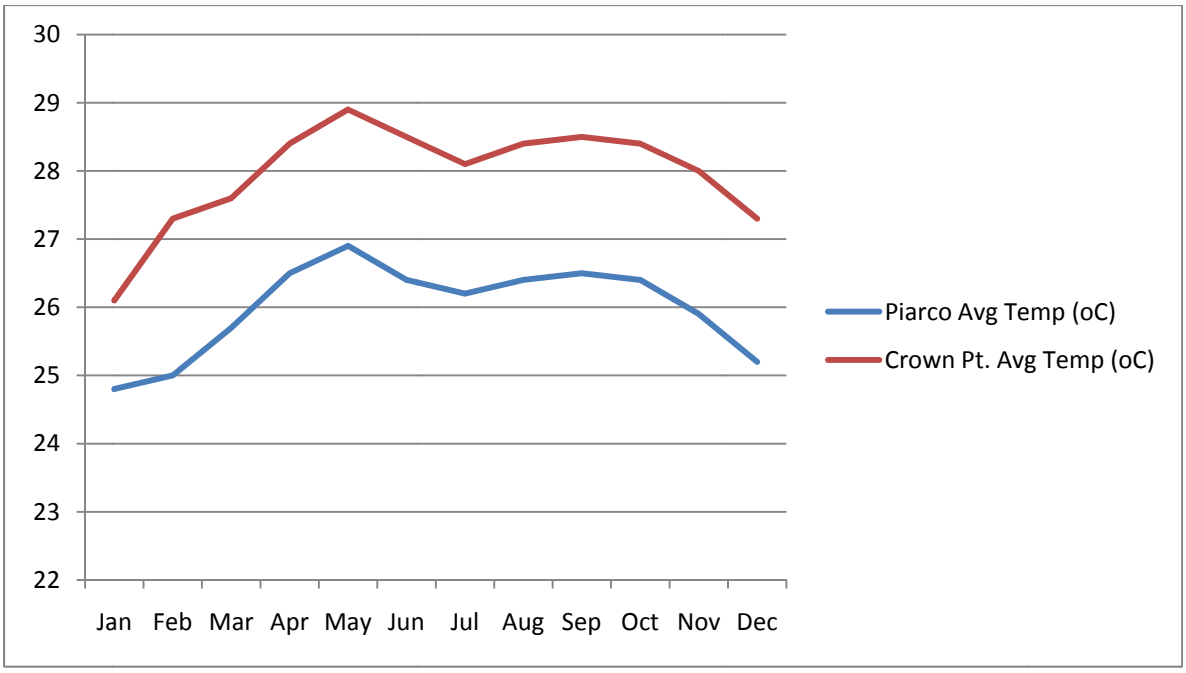
During the wet season, rainfall is usually associated with

- The passage of a Tropical Wave
- The Inter-Tropical Convergence Zone (ITCZ)

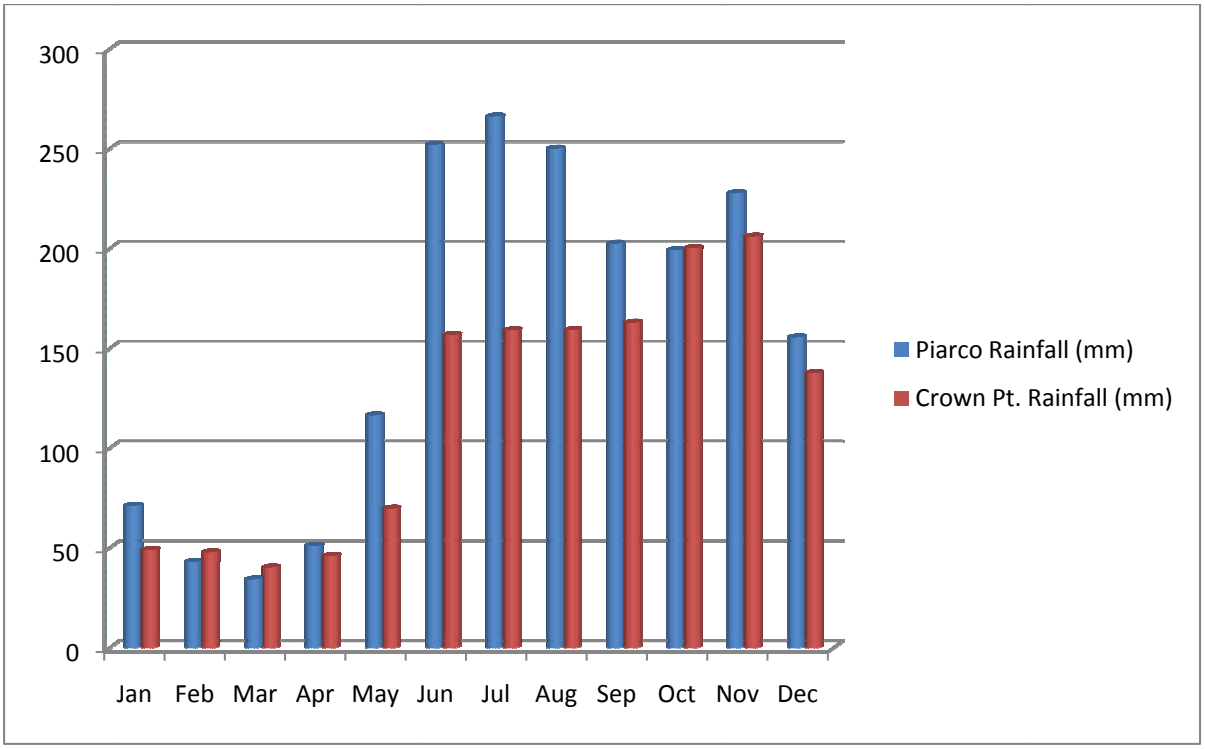
The following table contain statistics on actual meteorological parameters for Trinidad and Tobago.

Note that Trinidad's average is a 30 year mean from 1961-1990 and Tobago's average is a 30 year mean from 1971- 2000.

	Average Temp. (°C)	Avg. Max. Temp. with extremes (°C)	Avg. Min. Temp. with extremes (°C)	Avg. Rainfall (mm)
Trinidad	26	31 (36.5)	22 (15.6)	1869.8
Tobago	28	31 (37.5)	24 (18.9)	1435.3



Average Temperature measured at Piarco and Crown Point



Rainfall measured for Piarco and Crown Point.

Systems providing weather to Trinidad and Tobago during the Rainy season

Tropical Wave

A Tropical Wave is a perturbation in the wind field forming an area of low pressure that is usually oriented north to south and moves from east to west across the tropics carried by the prevailing easterly winds. We usually experience areas of cloudiness and thunderstorms when they traverse our region. A Tropical Wave provides an atmospheric disturbance, one of the many parameters needed in the formation of tropical cyclones in the North Atlantic.

ITCZ

The Inter-Tropical Convergence Zone (ITCZ) is a low pressure zone that on average resides at about 5°N and 5°S latitude where the northeast trade winds and southeast trade winds converge. The ITCZ can be seen as far north as 15°N during the Northern Hemisphere summer.

Tropical Cyclones

A Cyclone is an organized storm system having an anticlockwise (cyclonic) spin in the Northern Hemisphere around and into a low pressure centre.

The eye or centre of the cyclone has the lowest surface pressures, the sky is clear and the wind is relatively light. Usually it is 20-50 km in diameter. The eye-wall around the centre of the cyclone has the highest cumulonimbus clouds, the strongest winds and most intense rainfall.

Categories of Cyclones

Tropical Depression: An atmospheric circulation in which the sustained winds at the earth's surface are equal to or less than 37-62km/h (20 and 34 knots or 23-39 mph)

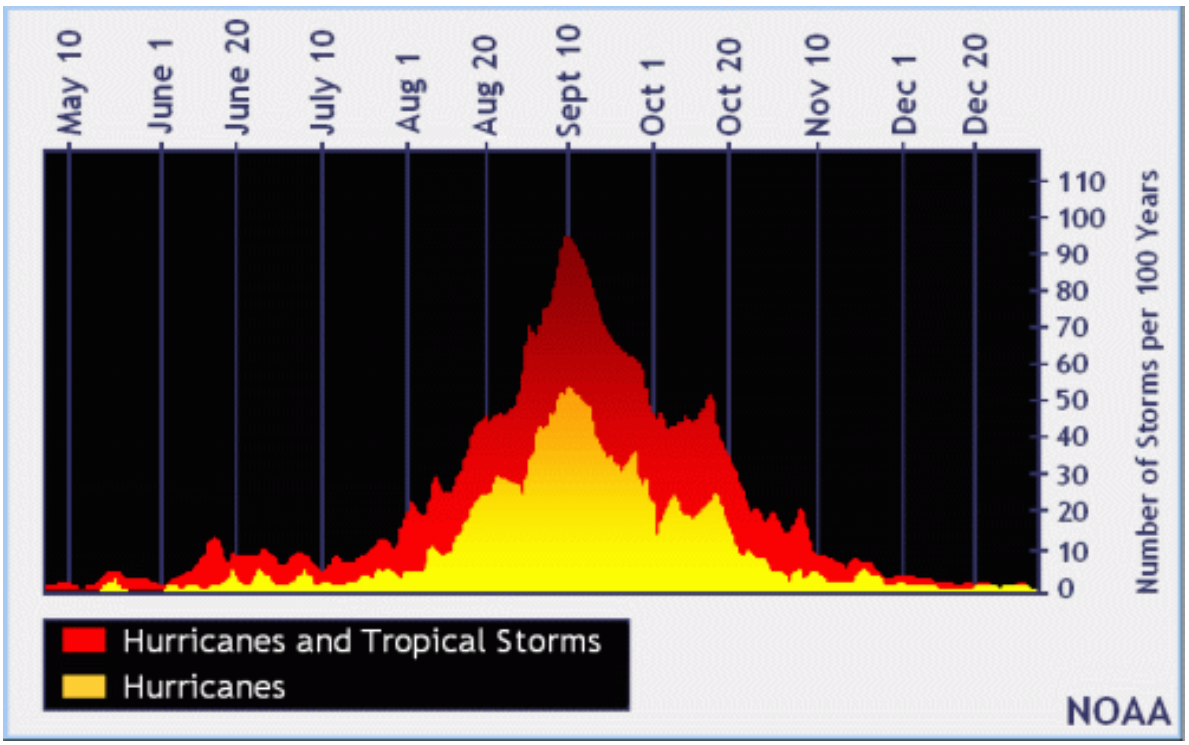
Tropical Storm: An atmospheric circulation in which the sustained winds at the earth's surface are in the range of 63 km/h to 118 km/h (35-64 knots or 39-73 mph).

Hurricane: An atmospheric circulation in which the sustained winds at earth's surface are greater than 118 km/h (64 knots or 74 mph).

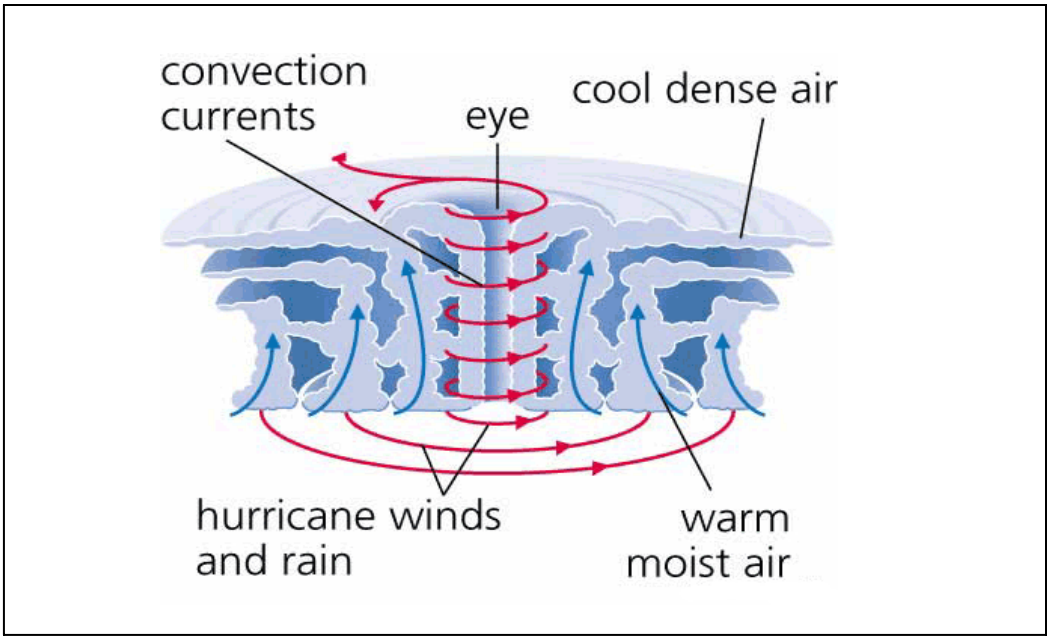
Hurricanes are categorized using the Saffir-Simpson Scale

Category	Wind				Pressure	Storm Surge		Damage
	mph	m/s	km/hr	kt	mb	ft	m	
1	74-95	33-42	118-152	64-82	>980	3 to 5	1 to 1.7	minimal
2	96-110	43-49	153-176	83-95	979-965	6 to 8	1.8 to 2.6	moderate
3	111-130	50-58	177-209	96-113	964-945	9 to 12	2.7 to 3.8	extensive
4	131-155	59-69	210-250	114-135	944-920	13 to 18	3.9 to 5.6	extreme
5	156+	70+	250+	136+	<920	19+	5.7+	catastrophic

Most active time of the Hurricane season is observed to be in the month of September.



The Anatomy of a Cyclone



- The eye or centre of the cyclone has:
  - lowest surface pressures,
  - clear sky,
  - relatively light wind
  - Usually 20-50 km in diameter.
- The eye-wall around the centre of the cyclone has:
  - the highest cumulonimbus clouds,
  - the strongest winds,
  - most intense rainfall

Basically, a cyclone comprises of

- ✓ Numerous thunderstorms – lots of thunder and lightning
- ✓ Intense rainfall – flooding
- ✓ Strong winds and gusts, tornadic activity
- ✓ High surf/ storm surge

Risk Reduction: 1. Conservation 2. Right Practices 3. Plan

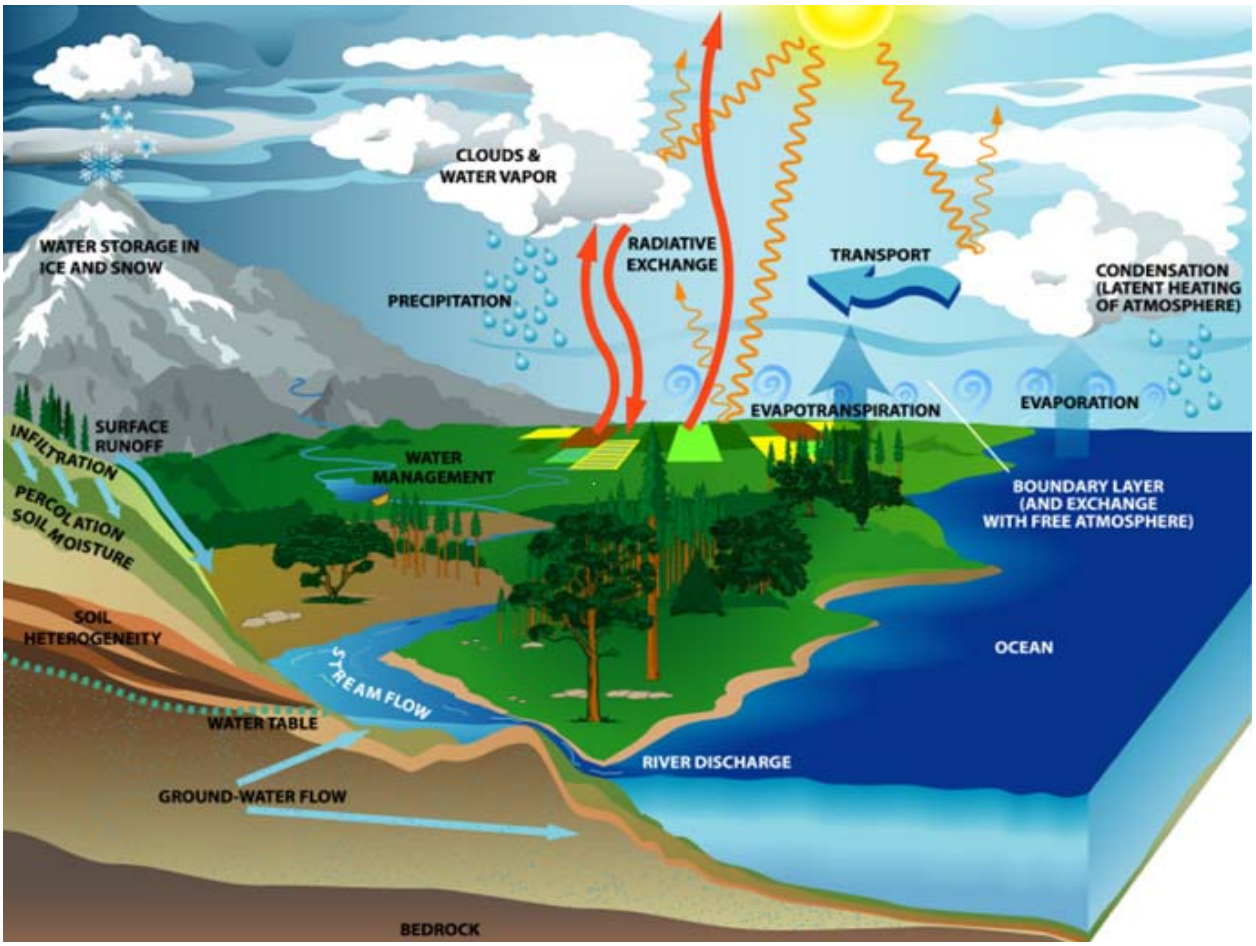
Lightning

- *An estimated two thousand thunderstorms are going on in the world at any one time.*
- Lightning is electricity.
- Electrical charges build up in large cumulonimbus clouds and when the potential difference is big enough, the electricity flows….seen as lightning.
- Lightning discharges within a cloud, between clouds, or between the cloud and the ground.
- Lightning strikes can disable persons and even kill them.

Lightning Protection

- ✓ Get indoors during a thunderstorm.
- ✓ Avoid using the telephone or electrical appliances.
- ✓ Put computers and other electrical devices on surge protectors.
- ✓ If trapped outdoors, do not stand near tall objects, isolated trees or metal fences.
- ✓ Avoid open spaces (football fields), beach, swimming-pool.
- ✓ If you feel your hairs standing on end, squat with your head between your knees, do not lie flat.
- ✓ If in a car, stay in the car with the windows rolled up.

The Water Cycle



The Water Cycle gives the natural cycle of the water that exists on the Earth. Changes to the natural environment distort the cycle.

If the trees that slow down the run-off are removed from the hillsides, and replaced by concrete/ hard surfaces, then there would be faster and a greater volume of surface run-off, thus causing low-lying areas to be flooded in a shorter period of time.

Risk Reduction: 1. Conservation 2. Right Practices 3. Plan

Flooding

- Slower moving storms (less than 10 mph) generate more rainfall.
- 78% of children killed by tropical cyclones drowned in floods or raging rivers.

Find out how development would change the area around you.

- Eg. Cutting trees reduce the interception of water by the trees and percolation into the soil – soil erosion and more runoff into drains
- Eg. Paving a road or the yard reduces percolation of water into the ground – more runoff into the drains
- Eg. Developers filling up a natural flood plain or natural (dry) water course – sudden flooding when there is a heavy downpour.

Have a plan

- Clear gutters and drains.
- Make sure important items are in waterproof containers and in a high place.
- In highly flood-prone areas, get to higher ground. If you are able to wait out a flood at home, get your vehicles to higher ground. Keep materials on hand like sandbags, plywood, plastic sheeting, plastic garbage bags, lumber, shovels, work boots and gloves,
- Be aware of streams, drainage channels and areas known to flood, so you or your evacuation routes are not cut off.

Be cautious

- Desist from going into flood waters. Restrict children from playing in flooded areas.
- Avoid driving into water of unknown depth. Moving water can quickly sweep your vehicle away.
- Sanitize water
    - For a litre (1 quart) of water, add 2 drops of bleach, mix well and leave for 30 minutes - for a gallon, use 8 drops of bleach.
- Do not use fresh food (fruits and vegetables) that has come in contact with floodwaters. Wash fresh food thoroughly.
- Wash canned goods that come in contact with floodwaters with soap and hot water.

- Stay away from downed power lines.
- If flood water covers electrical outlets, do not step into water…it may be charged and electrocution can occur. Cut off main electrical supply.
- Be on the look out for displaced animals and reptiles.

Flood

Wind Damage

Risk Reduction: 1. Conservation 2. Right Practices 3. Plan

Strong Winds

Downbursts and microburst from thunderclouds (cumulonimbus) are strong breeze (downdrafts) before and during a thundershower/storm

Tornados and waterspouts are also produced from cumulonimbus clouds. These are spinning columns of air from the cloud to the ground/ water surface.

HIGH WIND SAFETY ACTIONS - *before hurricane season*

- Build home according to building code requirements for strong winds.
- Protect all windows – shutters, or prepare with plywood.
- Reinforce weak structures, walls, etc
- Secure loose roofing. Ensure that your roof is properly fastened to the frame of the house.
- Designate a safe room in the interior of your house.
- Trim dead wood and weak/overhanging branches from all trees (the properly dispose them).

HIGH WIND SAFETY ACTIONS - *as a hurricane approaches*

- Once a hurricane warning is issued, install your window shutters or plywood panels.
- If your home is not safe, move to the designated shelter.
- When a hurricane warning is issued for your community, secure or bring inside all outside objects that could become a projectile in high winds.
- Listen carefully for safety instructions from local officials.

Storm Surge

- The most vulnerable place during a hurricane is along the coast.
- Rise of the ocean associated with a hurricane have claimed many lives along coastal communities.
    - Eg. Hurricane Katrina (2005) claimed at least 1500 persons lives directly, or indirectly, as a result of storm surge.
- Storm surges also cause damage to marinas and boats.
- There can also be salt water intrusion that endangers public health, kills vegetation, and can displace animals (snakes and alligators/caiman).
- There is beach erosion and flooding of roads near the coast. Buildings near the coast can become unstable.

Therefore: Stay away from the coast during severe weather and evacuate to higher ground.

Risk Reduction: 1. Conservation 2. Right Practices 3. Plan

Landslips and Landslides

The downward and outward mass movement of slope-forming materials including rock, soil, artificial fill, or a combination of these is called a landslide. A landslide is induced by gravity and the materials may move by falling, toppling, sliding, spreading, or flowing.

Geological causes

a. earthquake or volcanic activity
b. wave erosion and other water erosion processes
c. Vegetation removal (by fire, drought)
d. Weathering processes

Human causes

a. Excavation and Mining
b. Deforestation
c. Irrigation
d. Artificial vibration
e. Water leakage from utilities

Influence of Water

Slope saturation by water is a primary cause of landslides. This effect can occur in the form of intense rainfall, snowmelt, changes in ground-water levels, and water-level changes along coastlines, earth dams, and the banks of lakes, reservoirs, canals, and rivers.

Landslides and flooding are closely allied because both are related to precipitation, runoff, and the saturation of ground by water and these two events often occur simultaneously in the same area.

Landslides can cause flooding by forming landslide dams that block valleys and stream channels, allowing large amounts of water to back up. Also, solid landslide debris can "bulk" or add volume and density to otherwise normal stream flow or cause channel blockages and diversions creating flood conditions or localized erosion. Landslides can also cause overtopping of reservoirs and/or reduced capacity of reservoirs to store water.

Precaution and Plan

If you live in a hilly area, WATCH

1. Watch the patterns of storm-water drainage on slopes near your home, and note especially the places where runoff water converges, increasing flow over soil-covered slopes.
2. Watch the hillsides around your home for any signs of land movement, such as small landslides or debris flows or progressively tilting trees.

During severe rainfall, or storms, STAY ALERT AND STAY AWAKE. Many landslide and debris flow fatalities occur when people are sleeping.

Listen to a radio for warnings of intense rainfall. Be aware that intense short bursts of rain may be particularly dangerous, especially after longer periods of heavy rainfall and damp weather.

Listen for any unusual sounds that might indicate moving debris, such as trees cracking or boulders knocking together. A trickle of flowing or falling mud or debris may precede larger landslides.

If you are near a river, be alert for any sudden increase or decrease in water flow. Such changes may indicate landslide activity upstream, so be prepared to move quickly.

Such changes may indicate landslide activity upstream, so be prepared to move quickly.

If you live in an area susceptible to landslides and debris flows, consider leaving if it is safe to do so. If you remain at home, move to a part of the house farthest away from the source of the landslide or debris flows, such as an upper floor, but keep an escape route open should it become necessary to leave the house.

Be alert when driving. Embankments along roadsides are particularly susceptible to landslides. Watch the road for collapsed pavement, mud, fallen rocks, and other indications of possible landslides.

To safeguard your home against landslides:

Plant ground-cover on slopes and build retaining walls.

In mudflow areas, build channels or deflection walls to direct the flow around buildings.

Learn to recognise the landslide warning signs:

Doors or windows stick or jam for the first time.

New cracks appear in plaster, tile, brick, or foundations.

Outside walls, walks, or stairs begin pulling away from the building.

Slowly developing, widening cracks appear on the ground or on paved areas such as streets or driveways.

Bulging ground appears at the base of a slope.

Fences, retaining walls, utility poles, or trees tilt or move

The ground slopes downward in one specific direction and may begin shifting in that direction under your feet.

Make evacuation plans.

Plan at least two evacuation routes since roads may become blocked or closed.

Develop an emergency communication plan. In case family members are separated from one another during a landslide or mudflow, have a plan for getting back together.

During a Landslide

If inside a building: Stay inside. Take cover under a sturdy furniture.

If outdoors:
Try and get out of the path of the landslide or mudflow.

Run to the nearest high ground in a direction away from the path.

If rocks and other debris are approaching, run for the nearest shelter such as a group of trees or a building. If escape is not possible, curl into a tight ball and protect your head.

After a Landslide

Stay away from the slide area. There may be danger of additional slides.

Check for injured and trapped persons near the slide area. Give first aid if trained.

Remember to help your neighbours who may require special assistance—infants, elderly people, and people with disabilities.

Listen to a battery-operated radio or television for the latest emergency information.

Remember that flooding may occur after a mudflow or a landslide.

Check for damaged power lines. Report any damage to the Trinidad and Tobago Electricity Commission (TTEC).

Check the building foundation and surrounding land for damage.

Replant damaged ground as soon as possible since erosion caused by loss of ground cover can lead to flash flooding.

The Plan for any emergency

- Avoid last minute running to the supermarket.
- Keep important documents safe.
- Everyone in the family should know the common meeting area.

Emergency Kit

Get a container that can be easily carried with you in an emergency and have in it items that include:

- Transistor radio with spare batteries; Flashlight with spare batteries
- Multipurpose knife, can opener, etc
- Utensils – plates, cups, spoons, etc
- Toiletries, important medication
- Water (The Red Cross recommends 1 gallon of water per person per day)
- Non-perishable food items – food that does not need to be refrigerated
- Activities to pass the time, toys for children, puzzles, etc
- Raingear, sleeping bags, and linen, clothing

Response to a Storm or Hurricane Watch or Warning

- Watch – storm conditions would affect area within 48 hours.
- Warning – storm conditions would affect area in 36 hours or less.
- Nail ply across windows.
- Secure animals.
- If your home is not your safe place, get to your safe place or shelter
- Listen for further instructions from the national emergency agencies.

Sources

- Ahrens, C. Donald, Meteorology Today
- Trinidad and Tobago Meteorological Services
- http://www.nhc.noaa.gov/pastprofile.shtml
- http://www.nhc.noaa.gov/HAW2/english/intro.shtml
- http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hurr/pub.rxml
- http://coolgeography.co.uk/GCSE/Year11/Managing%20Hazards/Tropical%20storms/tropical_storms.htm
- http://wxdude.com
- http://Wikipedia.org
- Source: edited from Newsday News, article entitles "Landslide alert", Thursday, August 19 2010 http://newsday.co.tt/features/0,126079.html
- http://www.tntisland.com/landslide.html

Compiled by Paula Wellington for

Trinidad and Tobago Meteorological Services (TTMS) and

Committee for Meteorological Enhancement in Trinidad and Tobago (COMETT)

2011

Trinidad and Tobago Meteorological Services

Rawinsonde Building, Piarco International Airport

Piarco.

Website: www.metoffice.gov.tt

Email: dirmet@tstt.net.tt

Telephone: 669-5465

Fax: 669-4009

For a presentation on

Meteorological Hazards affecting Trinidad and Tobago

Disaster Risk Reduction for Primary School Teachers

October 2010

Modified April 2011