Role of IMD
For Weather Information, Forecasts, Early Warning System and Criteria for Flood & Cyclone in AP

S. Stella
Director
IMD
The Process of Weather Forecasting/Early Warning

@

Meteorological Centre

Hyderabad

(Govt of India, Ministry of Earth Sciences, India Meteorological Department)
Step 1A: Weather Observation - Surface

- Weather Observation
  - Rain Gauge
  - Antenna
  - Solar Panel
  - Radiation Shield
  - Enclosure

- Locations of Surface Weather Observatories in AP and Telangana

- Automatic Weather Station

- Manual Observatory

- Plus Ships, Bouys

10/11/2012
Step 1B: Weather Observation - Upper Air

- Upper Air: Pilot Balloon, Radiosonde, Rocket Sonde, Drop Sonde, etc.
- Remote Sensing: Radar, Satellite
Step 2a: Weather Analysis - Synoptic

- Isobaric, Isotach, Isothermal, Streamlines etc

- Identification of Surface level Weather Systems, Patterns, Disturbances like Low Pressures, High Pressures, Troughs, Ridges, Waves, Confluences, Subsidences, Convergences,

- Identification Upper Air systems like Circulations, Convergence, Divergence, Troughs, Ridges, Jet Streams, Frontal systems etc

Step 2b: Weather Analysis – Numerical Weather Prediction Models
Step 2C: Analysed Isobaric Chart - Surface

- Surface Weather Data Assimilated into NWP (Numerical Weather Prediction Models)
- Low Pressure Area
- High Pressure Area
- Monsoon Trough
Step 2C: Analysed Chart – Upper Air (Low Level)

- Weather Data Assimilated into NWP (Numerical Weather Prediction Models)
- Upper Air Cyclonic Circulation
Step 2C: Analysed Chart – Upper Air (High Level)

- Upper Air Ridge
- Upper Air Anti-Cyclonic Circulation
Step 3: Weather Forecasting
(Subjective and NWP maps)

- **Weather Forecasts**: Estimation of likely hood of future weather in terms of rainfall, heat conditions, etc with different Spatial and Temporal Scales

- **Range of Forecasts**: Nowcasts (upto 3 hours)
  - Short range (upto 48 hours)
  - Medium Range (3 – 10 days)
  - Extended Range (up to 1 month)
Step 4: Dissemination of Forecasts/Warnings

1. Web sites  
   (a) imdhyderabad.gov.in  
   (b) imd.gov.in

2. Emails to designated users

3. Fax Messages to designated users

4. SMS of Warnings

5. Group messages in WhatsApp  
   ✥ (Electronic & Print Media/GHMC/State Govt etc)

6. Telephonic Alert to higher officials in case of high impact extreme weather warnings

7. Media Briefs, Interviews to Media, Phone Ins etc as requested by Media

8. Also on Facebook and Twitter

9. Other: Awareness Workshops, Seminars etc
Step 5: Verification, Diagnostics, Reports, Climatology

1. The forecasts/warnings issued by IMD are verified against available ground truths.
2. Diagnostic Bulletins published
3. Daily/Weekly/Monthly/Seasonal/Annual Reports published
4. Climatology of stations/states/country prepared
5. Impact assessments done
6. Etc
7. Feedback/ground truth information from Public/Govt help us in better verification and improvement of forecasts.
8. Feedback/suggestions/ground truth information from Public/Govt are welcome.
Important Tools for Weather Forecasting

1. Analysed Weather Charts
2. Doppler Weather Radar Images/data
3. Meteorological Satellite images/profiles
4. Numerical Weather Prediction Model forecast maps
5. Climatological/Statistical Information
DISASTROUS WEATHER PHENOMENA

1. Heat Waves
2. Thunderstorms
3. Hail Storms
4. Lightning
5. Tornado
6. Heavy Rainfall
7. Floods & Inundation
8. Squall/Gale Winds
9. Cold Waves
1. Heat Waves

1. Occur in Summer season (March to May)
2. More Severe in May/June
   - or + 5 °C above Normal
4. 5. Severe Heat Wave: When Day Maximum Temperature > 47°C
   - or + 7 °C above Normal
6. Generally cause casualities due to sun-stroke
7. Sufficient precautions can save life and improve comfort of living
2. Thunderstorms

- Occur MOSTLY in Summer season (March to May), Less in other seasons
- Due to Cumulo-Nimbus (Cb) clouds that develop locally when instability in atmosphere prevails with sufficient levels of temperature and humidity
- Vertical growth due to updrafts (strong upward moving winds)
- Vertical growth of cloud up to Tropopause (~16 Km ht)
- Cause Lightning, Thunder (Sound produced by the violent expansion of the air. Can be heard usually up to 8 to 16 kms), Thunderbolt (Cloud to Ground Lightning), Heavy Spell of Rainfall in short duration, Gusty/Squally winds of the order of up to 150 Kmph
- Downdrafts (downward winds) cause gusty winds.
- More tall, more severity.
- Generally happen in groups, series and last for an hour or two
- Cause uprooting of trees, damage to, Kutch houses and to life.
- **Supercell thunderstorms** are much larger, more powerful, and last for several hours. More tall, more severity.
- Dry Thunderstorms (Thunder without rain) also happen.
3. Hail Storms

- A case of severe thunderstorm
- Due to Cumulo-Nimbus (Cb) clouds that develop beyond 10 Km vertically
- Similar characteristics as Thunderstorms except that SOLID Precipitation occurs
- When Depth of cloud above Freezing level (~5Km above ground) is more.
- Hail size is proportional to height of cloud
- Non-Severe for < 9Km AGL; 0.75-1.00 inch Hail for 9 – 11 Km AGL; 1.25-2.00 inch Hail for > 11Km AGL
Radar Image of Thunderstorm Cloud
(Maximum Reflectivity Image)

- Patancheruvu
  (Lat 17.51 N 78.25 E)

- Thunderstorm clouds
Radar Image of Thunderstorm Clouds, Squall Line (Maximum Reflectivity Image)
Radar Images of Thunderstorms:

Cb in Cyclonic Storm

File: 2006102912035138.caz
Type: MAX(Z)
Range: 250.0 km

29.10.2006
12:03:51

dBZ
62.0 - 65.0+
59.0 - 62.0
56.0 - 59.0
53.0 - 56.0
50.0 - 53.0
47.0 - 50.0
44.0 - 47.0
41.0 - 44.0
38.0 - 41.0
35.0 - 38.0
32.0 - 35.0
29.0 - 32.0
26.0 - 29.0
23.0 - 26.0
20.0 - 23.0

Machilipatnam
Scan R: 250 km
Scan Res: 0.50 km
Disp R: 250 km
Disp Res: 1.250 km
PW: Short
PPR: 600 / 450
AS: 8.50 deg/s
TS: 48
PS: 2
CC: 10
SQI: 0.20
CSR: 10.0 dB
LOG: 2.0 dB
H: 15.00 km
LS: 0.10 km

CDR, MACHILIPATNAM

India Meteorological Department
Satellite Images of Thunderstorms:

- Cb in Cyclonic Storm

3D-View of Radar/Satellite Image
Satellite Images of Thunderstorms

Overshooting tops

GOES-8 IMAGER - VISIBLE (0.65 UM) - 22:32 UTC 21 JAN 1999  CIMSS
4. Lightning

- Due to Cumulo-Nimbus (Cb) clouds that develop beyond 17 Km vertically
- Happens simultaneously with Thunderstorm/Hailstorm
- Discharge of static electricity. Static electricity develops due to friction between ice particles in up-draft
- A lightning flash is an enormous spark.
- The discharge may take place either between a cloud and the ground or within a two parts of a cloud or between two clouds.
About 100 strikes Earth's surface every single second.

Strike can cause cardiac arrest and severe burns. Survivors suffer from a variety of lasting symptoms, including memory loss, dizziness, weakness, and life-altering ailments.

An average lightning carries an electric current of 30,000 amperes (30 kA) and contain up to one billion volts of electricity.
5. TORNADO

- Also called "twisters", The most violent weather phenomena known on the earth
- They are an off shoot of some of the very severe thunderstorms.
- It is usually visible as a funnel shape cloud with a broad base in the cumulonimbus and a narrow tubular extension tapering downward to the ground, few tens of metres.
- The pressure within the centre of funnel cloud is very low, resulting in the production of very violent winds exceeding 200 kts around the centre.
- Complete destruction when a tornado moves over a built up area.
- Rare in India.
- When tornado occurs over the sea, it is known as a water spout.
6. HEAVY RAINFALL

- Daily (24 Hr) rainfall > 6 cm
- Very Heavy: 11 to 20 cm; Extremely Heavy: >20 cm
- Caused due to Low Pressure systems, Upper Air Cyclonic circulations, Thunderstorms/Hail storms

- Spells Intensity or Rain rate:
  - Heavy Spell: 4–16 mm/hour
  - Very Heavy spell: 16 – 50 mm/hour
  - Extremely Heavy spell: 50 – 100 mm/hour
7. Floods and Inundation

- An affect of heavy rainfall

- More of Hydrological condition than Meteorological

- Intensity depends on terrain, soil characteristics, available drainage system

- Worsened by continuing rainfall
8. Squall / Gale winds

- Strong horizontal surface winds
- Squall: A sudden increase of wind speed by at least 3 stages on the Beaufort Scale, the speed rising to force 6 or more, and lasting for at least one minute is called a squall.
- Gale: A very strong wind (63 to 88 kmph). Also called cyclonic wind.
- Gust: A rapid increase in the strength of the wind relative to the mean strength at the time.
- Happen in Thunder/Hail storms and cyclonic storms.
9. Cold Wave

- When Minimum temperature of a day is below 10 °C and below normal by less than 5 °C
- Severe when it is below normal by less than 7 °C
- Rare in Telangana but occasional in Northern districts
- Could happen in December/January
- When chilly winds blow from North side
IMD’s Services

- Provides the real time data and weather prediction
- Issues warnings for:
  - Maximum temperature, Minimum Temperature
  - Heat-wave warning Heat-alert,
  - Thunderstorm/hailstorm Warnings with Gusty Winds, Lightning
  - Heavy Rainfall
  - Cold Wave
  - Nowcast (upto 3 hours) for TS/HS/Squall/Lightning
- For the Districts/cities
- Seasonal forecast/outlook
- Real-time forecast and warnings for 5 days
- Prevalence reports
- On the panel of Advisors to State Govt for Policy making/Action Plans for Disaster Mitigation, Weather monitoring, Instruments Procurement etc

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT
### Temperature Forecast: Specific Range, Time duration and area

- **Now casting:** (Lead time/validity of 3 to 6 hours)
- **Short range:** (Lead time/validity of 1 to 3 days)
- **Medium range:** (Lead time/validity of 4 to 10 days)
- **Long/Extended range:** (Lead beyond 10 days)
- **Local range:** (Its intensity, frequency and time of occurrence is indicated)

### 3.3 Identification of Color Signals for Heat Alert:

<table>
<thead>
<tr>
<th>Color Alert</th>
<th>Description</th>
<th>Normal Maximum Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Alert (Severe Condition)</td>
<td>Extreme Heat Alert for the Day</td>
<td>Increase 6° C to more</td>
</tr>
<tr>
<td>Orange Alert (Moderate Condition)</td>
<td>Heat Alert Day</td>
<td>Increase 4° C to 5° C</td>
</tr>
<tr>
<td>Yellow Alert (Heat-wave Warning)</td>
<td>Hot Day</td>
<td>Nearby Normal Maximum Temp.</td>
</tr>
<tr>
<td>White (Normal)</td>
<td>Normal Day</td>
<td>Below Normal Maximum Temp.</td>
</tr>
</tbody>
</table>
Heatwave Awareness

DO’s

'http://www.india.gov.in'

- Try to stay in cold places
- Use umbrella during hot days
- Wear thin, loose cotton garments, preferably of white colour
- Wear a hat of cotton or a turban
- Avoid outdoor physical activity from 12-3 P.M. If unavoidable, attend to only light physical activity under the hot sun
- Take ample water along with salted butter milk or glucose water
- Take measures to reduce the room temperature like watering, using window shades, fanning, and cross ventilation
- Shift the person with heat stroke symptoms to cool dwelling
- The person suffering with heat stroke should have minimum clothing
- The person suffering with heat stroke has to be sponged with cold water, indirect application of ice-packs
- The person suffering with heat stroke should be kept in between ice-blocks
- If the person affected with heat stroke is not showing any improvement, he should be shifted to a hospital immediately preferably with cooling facility

Don’ts

- Expose to direct sunlight or hot breeze
- Move under hot sun without umbrella
- Use of black and synthetic, thick clothes during summer season
- Move under the hot sun without a hat or turban
- Attend to strenuous physical activity under the hot sun
- Allow direct hot air into the living room
- Delay in shifting the person suffering with heat stroke to a cool place
- The person suffering with heat stroke to have thick clothing
- The person suffering with heat stroke to be sponged with hot water and to be exposed to hot air
- The person suffering with heat stroke to be sponged with hot water and to be exposed to hot air
Heatwave Awareness Video
Lightning Awareness

❖ Do’s and Don’ts of Lightning Safety

❖ If you are outside with a thunderstorm approaching, seek shelter inside a building as soon as possible—ideally in a structure with a lightning protection system.

❖ If a building is not available take shelter in car with a metal roof and keep doors and windows closed. It is the metal frame of the car that protects you from lightning and not the rubber tires.

❖ If there is no building or car in which to take shelter, minimize your risk by going to an area of lower elevation and staying away from bodies of water and trees. Stay away from trees! Trees are a dangerous place to be in a thunderstorm.

❖ If someone has been struck by lightning, provide first-aid immediately, begin CPR and Ambulance. It is perfectly safe to touch someone who has been struck by lightning—you will not get an electrical shock.

❖ Invest in a lightning protection system for your home and or business.
# TROPICAL CYCLONES

<table>
<thead>
<tr>
<th>PART OF THE WORLD</th>
<th>FAMILIAR AS</th>
<th>ORIGIN OF THE WORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATLANTIC &amp; EASTERN PACIFIC</td>
<td>HURRICANES</td>
<td>Derived from ‘HURACON’ - God of Evil</td>
</tr>
<tr>
<td>WESTERN PACIFIC</td>
<td>TYPHOONS</td>
<td></td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>WILLY-WILLIES</td>
<td></td>
</tr>
<tr>
<td>MEXICO</td>
<td>CORDONAZO</td>
<td></td>
</tr>
<tr>
<td>PHILIPPINES</td>
<td>BAGIOUS</td>
<td>Named after a city ‘BAGUIO’ which experienced a rain fall of 116.8 cm in 24 hrs in July, 1911</td>
</tr>
<tr>
<td>INDIAN SEAS</td>
<td>CYCLONIES</td>
<td>Derived from Greek word ‘CYCLOS’ – Coil of a Snake</td>
</tr>
</tbody>
</table>
Favorable conditions for a Cyclonic Storm

- Pre existing area of disturbed weather
- Sea surface temperatures greater than 26.5° Centigrade
- Warm ocean water must be at least 200 feet deep (waves can’t bring up cold water)
- Absence of wind shear
- Not closer than 5° latitude from Equator

CYCLONE SEASONS
(For Indian Seas)

Pre-Monsoon Cyclone Season : March to May
Post Monsoon Cyclone Season : October to December
## STAGES OF DEVELOPMENT OF A CYCLONIC STORM

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>Pressure deficit in hpa</th>
<th>Associated Wind Speed in knots (kmph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low pressure area</td>
<td>1.0</td>
<td>&lt; 17 (&lt;32)</td>
</tr>
<tr>
<td>Depression</td>
<td>1.0 – 3.0</td>
<td>17-27 (32–50)</td>
</tr>
<tr>
<td>Deep Depression</td>
<td>3.0 – 4.5</td>
<td>28-33 (51–59)</td>
</tr>
<tr>
<td>Cyclonic Storm T2.0/T2.5</td>
<td>4.5-8.5</td>
<td>34-47 (60-90)</td>
</tr>
<tr>
<td>Severe Cyclonic Storm (SCS) T3.0/T3.5</td>
<td>8.5-15.5</td>
<td>48-63 (90-119)</td>
</tr>
<tr>
<td>Very Severe Cyclonic Storm (VSCS) T4.0/T6.0</td>
<td>15.5-65.6</td>
<td>64-119 (119-220)</td>
</tr>
<tr>
<td>Super Cyclonic Storm &gt;T6.0</td>
<td>&gt;65.6</td>
<td>&gt;119 (&gt;220)</td>
</tr>
</tbody>
</table>
A CYCLONIC STORM AS SEEN FROM A LOW LEVEL (POLAR ORBITING) SATELLITE
# Dimensions of Tropical Cyclones

<table>
<thead>
<tr>
<th>Size</th>
<th>Speed of Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (700-1000km dia)</td>
<td>10-14 kmph (Slow)</td>
</tr>
<tr>
<td>Medium (300-700km dia)</td>
<td>15-25 kmph (Moderate)</td>
</tr>
<tr>
<td>Small (&lt;300km dia)</td>
<td>&gt;25 kmph (Fast)</td>
</tr>
</tbody>
</table>
SOME FACTS ABOUT CYCLONES CYCLONES OF NORTH INDIAN SEAS

- Minimum No. of cyclones in a year - One (1949)
- Maximum No. of cyclones in a year - Ten (1893, 1926, 1930, 1976)
- Out of total disturbances - 35% intensify to Cyclones
  16% intensify to SCS
  7% intensify to VSCS

- Peak activity – November followed by May
- Out of 80 global annual number - four form over Bay of Bengal – two / three intensify to severe ones
- About 4 to 6 cyclones in Bay of Bengal and Arabian Sea every year
- Ratio of TCS between Bay of Bengal and Arabian Sea – 4:1
- Year to year variation - Quite large, No trend or periodicity
MONITORING OF CYCLONES BY IMD

• One of the most important functions of IMD

• A constant watch is kept on the Arabian Sea and the Bay of Bengal for the likely genesis of tropical cyclones with the help of satellite imagery.

• Data from ships and ocean buoys is also very valuable.

• When the systems come nearer to the Indian coastline, their subsequent development and movement is monitored by a chain of Cyclone Detection Radars.

• The likely movement of the storms is predicted with the help of track prediction models (Computer Programs) and by reference to past climatology which has been built up using 140 years of cyclone data.
Potential Impact upon Landfall of a Tropical Cyclone

- Effect of local Tides
- Effect of local Coastal Configuration
- Low Atmospheric Pressure in the Centre
- Storm Surge
- Wind
- Rain
- Flooding

- Loss of Human Life: Injuries
- Flooding of Low-Lying Coastal Areas
- Erosion of Beaches
- Damage to onshore & offshore installations
- Damage to Shipping & Fishing Facilities
- Urban Bushfire
- Loss of Communications & Power
- Loss of Soil Fertility from Saline Intrusion
- Land Subsidence
- Contamination of Domestic Water Supply
- Destruction of Vegetation, Crops, Livestock
- Loss of Soil Fertility from Saline Intrusion
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- Flooding of Low-Lying Coastal Areas
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- Loss of Soil Fertility from Saline Intrusion
- Land Subsidence
- Contamination of Domestic Water Supply
- Destruction of Vegetation, Crops, Livestock
A Storm Surge is an abnormal rise of sea level caused by a cyclone moving over a continental shelf.
Abnormal rise of Sea level caused by a cyclone due to interaction of air, sea and land.

**TIDAL WAVE = STORM SURGE + ASTRONOMICAL TIDE**

Cyclones provide driving force in the form of horizontal pressure gradients and strong Surface winds. As a result, the Sea level rises and continues to rise as the cyclone moves over shallow waters and reaches a maximum on the coast near the point of land fall.

Pressure drop, Radius of Maximum winds, Vector motion of the cyclone, Bathymetry of the coast line near landfall point are the GOVERNING FACTORS for the Surge.

The Highest Storm Surge in the WORLD occurred near HUGLIE River (07.10.1737) with 40’ height.

**Storm Surges at Machilipatnam coast:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Surge Height</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.10.1779</td>
<td>15’-20’</td>
<td>20,000 drowned.</td>
</tr>
<tr>
<td>01.11.1864</td>
<td>13’</td>
<td>Swept over 80 miles of low coast reaching places as far inland as 17 miles – 30,000 perished.</td>
</tr>
<tr>
<td>19.11.1977</td>
<td>16’-18’</td>
<td>10,000 killed. 27,000 Cattle head lost.</td>
</tr>
</tbody>
</table>
Wind Distribution in a Cyclone

- Band of Maximum winds would be 20 – 50 Km from the Center.
- (Variability: 10 – 150 Km)

In this belt, Speed decreases rapidly towards eye.

But decreases slowly and in an irregular fashion outward from eye.

The highest wind will be in the northeast sector.
Rainfall Distribution in a Tropical Cyclone

- Extensive Rainfall in the Right forward sector in Recurving to East/NE
- In the left forward sector in westerly moving
- In the forward sector in north moving
- Intensive Rainfall Occurs to the left of the cyclone
- Slow moving/Big size cyclones give more rainfall whereas fast moving/small size ones give less rainfall

Intensity and Area of Rainfall depends on:
- Intensity and size of Storm
- Speed of the storm
- Orography of Land/Orientation of Coast
- Direction of movement of Storm
- Rate of ascent of air in the storm circulation
- Temperature & Lapse Rate in the System
- Continuous moisture feed even over the land into the system

RESULT: FLASH FOODS IN LOW LYING AREAS, BREACHES OF RIVERS, INUNDATION OF VILLAGES, STANDING CROPS ETC.
# Impact of Cyclonic Storms and Suggested Mitigation Actions

<table>
<thead>
<tr>
<th>Category / T.No. / Wind Speed</th>
<th>Structures</th>
<th>Communication &amp; power</th>
<th>Road/Rail</th>
<th>Agriculture</th>
<th>Marine Interests</th>
<th>Coastal Zone</th>
<th>Overall Damage Category</th>
<th>Suggested Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deep Depression T2.0</strong></td>
<td>Minor damage to loose/unsecured structures</td>
<td>Minor</td>
<td>Some breaches in Kutcha road due to flooding</td>
<td>Minor damage to Banana trees and near coastal agriculture due to salt spray. Damage to ripe paddy crops</td>
<td>Very rough seas. Sea waves about 4-6 m high.</td>
<td>Minor damage to Kutcha embankments</td>
<td>Minor</td>
<td>Fishermen advised not to venture into sea.</td>
</tr>
<tr>
<td><strong>Cyclonic Storm T2.5-T3.0</strong></td>
<td>Damage to thatched huts.</td>
<td>Minor damage to power and communication lines due to breaking of tree branches.</td>
<td>Major damage to Kutcha and minor damage to Pucca roads.</td>
<td>Some damage to paddy crops, Banana, Papaya trees and orchards.</td>
<td>High to very high sea waves about 6-9 m high.</td>
<td>Sea water inundation in low lying areas after erosion of Kutcha embankments</td>
<td>Minor to Moderate</td>
<td>Fishermen advised not to venture into sea.</td>
</tr>
</tbody>
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<th>Suggested Actions</th>
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<tr>
<td><strong>Severe Cyclonic Storm</strong></td>
<td>Major damage to thatched houses / huts. Roof tops may blow off. Unattached metal sheets may fly.</td>
<td>Minor damage to power and communication lines.</td>
<td>Major damage to Kutcha and some damage to Pucca roads. Flooding of escape routes.</td>
<td>Breaking of tree branches, uprooting of large avenue trees. Moderate damage to Banana and Papaya trees. Large dead limbs blown from trees.</td>
<td>Phenomenal seas with wave height 9-14 m. Movement in motor boats unsafe.</td>
<td>Major damage to coastal crops. Storm surge up to 1.5m (area specific) causing damage to embankments/salt pans. Inundation up to 5 Km in specific areas.</td>
<td>Moderate</td>
<td>Fishermen advised not to venture into sea. Coastal hutment dwellers advised to move to safer places. Other people in the affected areas to remain indoors.</td>
</tr>
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<tbody>
<tr>
<td><strong>(a) Very Severe Cyclonic Storm</strong> T4.0-T4.5 64-90 Knots 118-167 Kmph</td>
<td>Total destruction of thatched houses/ extensive damage to Kutch houses. Some damage to Pucca houses. Potential threat from flying objects.</td>
<td>Bending/ uprooting of power and communication poles.</td>
<td>Major damage to Kutcha and Pucca roads. Flooding of escape routes. Minor disruption of railways, overhead power lines and signaling systems.</td>
<td>Widespread damage to standing crops plantations, orchards, falling of green coconuts and tearing of palm fronds Blowing down bushy trees like mango.</td>
<td>Phenomenal seas with wave heights more than 14m. Visibility severely affected. Movement in motor boats and small ships unsafe.</td>
<td>Storm surge up to 2 m, Inundation up to 10 Km in specific areas. Small boats, country crafts may get detached from moorings.</td>
<td>Large Fishermen not to venture into sea. Evacuation from coastal areas needs to be mobilized. People advised to remain indoors. Judicious regulation of rail and road traffic needed.</td>
<td></td>
</tr>
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<th>Overall Damage Category</th>
<th>Suggested Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b) Very Severe Cyclonic Storm</td>
<td>Extensive damage to all types Kutcha houses, some damage to old badly managed Pucca structures. Potential threat from flying objects.</td>
<td>Extensive uprooting of power and communication poles.</td>
<td>Disruption of rail / road link at several places.</td>
<td>Extensive damage to standing crops plantations, orchards. Blowing down of Palm and Coconut trees. Uprooting of large bushy trees.</td>
<td>Phenomenal seas with wave heights more than 14m. Movement in motor boats and small ships not advisable.</td>
<td>Storm surge up to 2 – 5 m, Inundation may extend up to 10-15 Km over specific areas. Large boats and ships may get torn from their moorings, country crafts may get detached from moorings.</td>
<td>Extensive</td>
<td>Fishermen not to venture into sea. Evacuation from coastal areas essential. Diversion / suspension of rail traffic may be required.</td>
</tr>
</tbody>
</table>
## Impact of Cyclonic Storms and Suggested Mitigation Actions

<table>
<thead>
<tr>
<th>Category / T.No. / Wind Speed</th>
<th>Structures</th>
<th>Communication &amp; power</th>
<th>Road/Rail</th>
<th>Agriculture</th>
<th>Marine Interests</th>
<th>Coastal Zone</th>
<th>Overall Damage Category</th>
<th>Suggested Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Super Cyclonic Storm</strong> T6.5 and above 120 Knots and above 222 Kmph</td>
<td>Extensive damage to non concrete residential and industrial building. Structural damage to concrete structures. Air full of large projectiles.</td>
<td>Uprooting of power and communication poles. Total disruption of communication and power supply.</td>
<td>Extensive damage to Kutcha roads and some damage to poorly repaired pucca roads. Large scale submerging of coastal roads due to flooding and sea water inundation. Total disruption of railway and road traffic due to major damages to bridges, signals and railway tracks. Washing away of rail / road links at several places.</td>
<td>Total destruction of standing crops / orchards, uprooting of large trees and blowing away of palm and coconut crowns, stripping of tree barks.</td>
<td>Phenomenal seas with wave heights more than 14m. All shipping activity unsafe.</td>
<td>Extensive damage to port installations. Storm surge more than 5m, Inundation up to 40 Km in specific areas and extensive beach erosion. All ships torn from their moorings. Flooding of escape routes.</td>
<td><strong>Catastrophic</strong></td>
<td>Fishermen not to venture into sea. Large scale evacuations needed. Total stoppage of rail and road traffic needed in vulnerable areas.</td>
</tr>
</tbody>
</table>
TROPICAL CYCLONE FORECASTING

Of Movement: Various Techniques are available for Track Prediction of the storm.

i) * Methods based on climatology
ii) * Methods based on Persistence & Climatology
iii) * Synoptic Techniques – Empirical Techniques
iv) * Satellite Techniques
v) * Statistical Techniques using climatology, persistence and Synoptic
vi) * Analogue Techniques and
vii) Dynamical Techniques
viii) NWP guidance (Hurricane WRF etc)
* Used in Operational Mode.

Of Intensity and Associated Weather: No reliable objective techniques. Subjective techniques like Climatology, Synoptic and Satellite are used. Good Techniques are available for Storm Surge predictions. But accuracy depends on the accuracy of input data.
CYCLONE WARNING

FOUR STAGES:

I Stage - PRE-CYCLONE WATCH: 72 Hrs in Advance

Early warning about development of a cyclone, its likely intensification, coastal belt likely to be affected etc.

Issued by DGM himself and addressed to Cabinet Secy of GOI and Chief Secy of concerned State Govts

II Stage – Cyclone Alert:

At least 48 Hours in advance of adverse weather by concerned ACWCs/CWCs

Contains location of storm, direction of movement, intensification, coastal districts likely to be affected, adv to fishermen
III Stage – Cyclone Warning:

At least 24 hrs in advance by ACWCs/CWCs at 3 hrly

Contains latest position of cyclone, its intensity, maximum sustained surface wind speed, forecast of landfall point, time of landfall, impact of strong winds, heavy rain and advice to fishermen and general public.

IV Stage – Post Landfall Outlook:

Issued 12 hrs in advance of expected time of landfall

Issued by concerned ACWC

Contains likely direction of movement after landfall, adverse weather likely to be experienced in the areas away from coast
1. Four Stage Cyclone Warnings
2. Fisheries warnings
3. Weather and Sea bulletins
4. Port Warnings (Storm Warning Signals)
5. Coastal bulletins (upto 75 Kms from the coast line)
6. Aviation Warnings
7. Bulletins for Indian Navy “Fleet Forecast”.
9. Bulletins for AIR/DD
10. Bulletins for Press
11. Album page Warnings- to important govt/pvt agencies
PORT WARNINGS

- IMD maintains a port warnings service by which the Port officers are warned about disturbed weather likely to affect their Ports.
- On receipt of warnings, Port officials hoist appropriate visual signals so that they are visible from a distance.
- Ports are warned 5 to 6 times a day during period of cyclonic storm.
- Warning contains information about location, intensity, expected direction, expected land fall point and type of signal the Port should hoist.
### PORT WARNINGS

#### A Uniform System of Storm Warning Signals for all Ports

<table>
<thead>
<tr>
<th>Signal/Flag No.</th>
<th>Name</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DISTANT BAD WEATHER</td>
<td>DC1</td>
<td>Depression far at sea. Port NOT affected.</td>
</tr>
<tr>
<td>2</td>
<td>DW2</td>
<td></td>
<td>Cyclone far at sea. Warning for vessels leaving port.</td>
</tr>
<tr>
<td>3</td>
<td>LOCAL BAD WEATHER</td>
<td>LC3</td>
<td>Port Threatened by local bad weather like squally winds.</td>
</tr>
<tr>
<td>4</td>
<td>LW4</td>
<td></td>
<td>Cyclone at sea. Likely to affect the port later.</td>
</tr>
<tr>
<td>5</td>
<td>DANGER</td>
<td>D5</td>
<td>Cyclone likely to cross coast keeping port to its left.</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>D6</td>
<td>Cyclone likely to cross coast keeping port to its right.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>D7</td>
<td>Cyclone likely to cross coast over/near to the port.</td>
</tr>
</tbody>
</table>

**LEGEND:**

- = WHITE LIGHT
- = RED LIGHT

Cont’d…2nd page
### PORT WARNINGS (Cont’d)

**A Uniform System of storm warning signals for all Ports**

<table>
<thead>
<tr>
<th>Signal/Flag No.</th>
<th>NAME</th>
<th>Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td><strong>GREAT DANGER</strong></td>
<td>GD8</td>
<td><img src="image" alt="Day Symbol" /> <img src="image" alt="Night Symbol" /></td>
</tr>
<tr>
<td>9.</td>
<td>GD9</td>
<td></td>
<td><img src="image" alt="Day Symbol" /> <img src="image" alt="Night Symbol" /></td>
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<tr>
<td>10.</td>
<td>GD10</td>
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<td><img src="image" alt="Day Symbol" /> <img src="image" alt="Night Symbol" /></td>
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<tr>
<td>11.</td>
<td>XI</td>
<td></td>
<td><img src="image" alt="Day Symbol" /> <img src="image" alt="Night Symbol" /></td>
</tr>
</tbody>
</table>

**LEGEND:**
- ○ = WHITE LIGHT
- ● = RED LIGHT
FISHERIES WARNINGS

Criteria

1. Strong off-shore and on-shore winds (or with appropriate direction), speed exceeding 45 kmph
2. SQUALLY Weather – Frequent Squalls with rain; or persistent type of strong gusty winds (>20kts; 36kmph) accompanied by rain.
3. Gales
4. State of sea very rough or above.

Information

1. Through ports
2. XXW landline telegrams to fisheries officials and
3. AIR broadcast daily three / four times in local language.

Bulletin contains information about

1. Synoptic situation
2. Signals hoisted and
3. Advice not to go out in to the sea.
DISSEMINATION OF CYCLONE WARNINGS

• Radio, television, print media, telephones, fax, telex, telegrams, police wireless network. SMS started.

• Cyclone Warning Dissemination System

• Warnings are issued for general public, fishermen, farmers and different categories of users such as central and state government officials responsible for disaster mitigation and relief, industrial and other establishments located in the coastal areas, railways, aviation, communications and power authorities.

• Tropical cyclone advisories are issued by RSMC, New Delhi to the panel member countries (Thailand, Myanmar, Bangladesh, Pakistan, Sri Lanka, Maldives and Oman) during the tropical cyclones

• Issued four to eight times a day.
CYCLONE REPAREDNESS
BEFORE CYCLONE (WHEN EXPECTED)

1. Check doors, windows, bolts etc., Fix glass windows if loose.
2. Check defects in tiled/sheets roof.
3. Clean loose metal tins/sheets around house.
4. Shift from very old/damaged house.
5. Keep radio with batteries to hear cyclone warnings.
6. Store Kerosene, keep ready lamps, candles, match sticks, battery lights etc.
7. Store drinking water and provisions for a week. Ready to eat/easy to cook foods will further help in such situations.
8. Move to cyclone shelters if necessary. Move cattle to safety, secure boats & nets.
10. Give adequate weightage for Cyclone Warnings even if no wind or rain is present. Some cyclones move fast and cause great damages.
DURING CYCLONE

1. Don’t be afraid. Hear to Cyclone Warnings. Don’t spread rumors.
2. Don’t move around outside. Don’t leave cyclone shelters till told to do so.
3. Don’t open doors and windows. If required open windows which are not facing the wind
4. When cyclone passes over your place it will be calm and clear during the cyclone eye. Keep waiting for another spell of bad weather.
After Cyclone Crossed

1. Move out of cyclone shelters after consulting concerned officers.
2. Don’t touch electric wires on the way / road. Inform APSEB officials.
4. Take vaccines and cholera injections.
5. Drink water after adding chlorine tablets.
SOME FACTS ABOUT CYCLONES (Cont’d)

- Most vulnerable coast in the West Coast - South Gujarat coast.
- Most vulnerable coast in the East Coast - 24 paraganas of West Bengal followed by Krishna & Nellore districts of AP.
- No cyclones struck in the past 100 years - West Godavari district & Kanyakumari district.
- Life period of a Tropical Cyclone is 5-6 days. It will have hurricane intensity for 2-4 days as against 6 days of global average.
- Life period of the longest lived Tropical Cyclone in Indian seas is 14 days (2-15th Nov, 1886 & 16-29th Nov, 1964).
- Life period of the longest lived Hurricane Ginger over Atlantic is 31 days during 1972.
NUMBER OF CYCLONES & SEVERE CYCLONES THAT CROSSED ANDHRA COAST (1877-2005)
DECADAL FREQUENCY OF CYCLONIC STORMS & SEVERE CYCLONIC STORMS CROSSING EAST COAST

<table>
<thead>
<tr>
<th>DECADE YEARS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1890-1900</td>
<td>35</td>
</tr>
<tr>
<td>1900-1910</td>
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<td>1910-1920</td>
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<tr>
<td>1920-1930</td>
<td>15</td>
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<td>1930-1940</td>
<td>10</td>
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<tr>
<td>1940-1950</td>
<td>5</td>
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<td>1950-1960</td>
<td>5</td>
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<tr>
<td>1960-1970</td>
<td>25</td>
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<tr>
<td>1970-1980</td>
<td>30</td>
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<tr>
<td>1980-1990</td>
<td>20</td>
</tr>
<tr>
<td>1990-2000</td>
<td>15</td>
</tr>
</tbody>
</table>
MONTHLY FREQUENCY OF CYCLONIC STORMS CROSSING 1° LAT ZONES OF ANDHRA COAST: 1877 - 2004

<table>
<thead>
<tr>
<th>Lat.</th>
<th>MAY</th>
<th>JUN</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>19° N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18° N</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4 (3)</td>
<td>5 (1)</td>
<td>1 (1)</td>
<td>-</td>
<td>14 (5)</td>
</tr>
<tr>
<td>17° N</td>
<td></td>
<td>2 (1)</td>
<td>-</td>
<td>1 (1)</td>
<td>3</td>
<td>2 (2)</td>
<td>1 (1)</td>
<td>9 (3)</td>
</tr>
<tr>
<td>16° N</td>
<td>3 (1)</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>9</td>
<td>5 (4)</td>
<td>1 (1)</td>
<td>20 (6)</td>
</tr>
<tr>
<td>15° N</td>
<td>3 (2)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>6 (2)</td>
<td>-</td>
<td>11 (4)</td>
</tr>
<tr>
<td>14° N</td>
<td>1 (1)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 (3)</td>
<td>4 (3)</td>
<td>-</td>
<td>11 (7)</td>
</tr>
<tr>
<td>13° N</td>
<td>1 (1)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2 (1)</td>
<td>6 (2)</td>
<td>2</td>
<td>11 (4)</td>
</tr>
</tbody>
</table>

NOTE: FIGURES IN BRACKETS ARE NO. OF SEVERE CYCLONIC STORMS ONLY
NO STORMS DURING JAN TO APR AND JULY
EARTH QUAKES
EARTHQUAKE MONITORING

MoES / INDIA METEOROLOGICAL DEPARTMENT

IS THE

NATIONAL AGENCY

FOR

DETECTING AND LOCATING EARTHQUAKES

AND

EVALUATION OF SEISMICITY

IN

DIFFERENT PARTS OF THE COUNTRY
CAUSES OF EARTHQUAKES

ELASTIC REBOUND THEORY OF TECTONIC EARTHQUAKES

The most common cause is tectonic activity, sudden rupture along faults or fissures because of building-up of huge stress across these zones of weakness. Release enormous energy which propagate as seismic waves and constitute the earthquake.

Such earthquake generating process is called the elastic rebound theory of tectonic earthquakes.
NOTE: Towns falling at the boundary of zones demarcation line between two zones shall be considered in High Zone.
DAMAGES DUE TO EARTHQUAKES
MOSTLY DEPENDENT ON THE FOLLOWING FACTORS

• MAGNITUDE AND FOCAL DEPTH
• DISTANCE FROM EPICENTRE
• LOCAL GEOLOGICAL CONDITIONS
• POPULATION DENSITY
• TYPE OF CONSTRUCTION
• TYPE OF BUILDING MATERIALS USED
• TIME OF OCCURRENCE OF EARTHQUAKES
DO’S AND DONT’S

DURING AN EARTHQUAKE:

• WATCH FOR FALLING THINGS LIKE PLASTER, BRICKS, FIXTURES ETC.

• STAY AWAY FROM GLASS WINDOWS, MIRRORS, CHIMNEYS, CABINETS, etc.

• GET UNDER PROTECTIVE OBJECTS LIKE A TABLE, DESK, OR BED.

• IN CROWDED STORES, FACTORIES, TEMPLES, HALLS AND SCHOOLS, AVOID STAMPEDES

• ON ROADS AND IN OPEN SPACES, AVOID BEING NEAR HIGH BUILDINGS, WALLS, POWER POLES, TREES, etc., WHICH COULD FALL

• IF YOU ARE IN A VEHICLE, STOP IN OPEN AREAS AWAY FROM THE ROAD.
DO’S AND DONT’S

AFTER AN EARTHQUAKE:
CHECK FOR FIRES AND FIRE HAZARDS
CHECK FOR INJURIES TO YOUR FAMILY MEMBERS AND NEIGHBOURS
DO NOT USE OPEN-FLAME APPLIANCES
SHUT OFF COOKING GAS VALVES
SHUT OFF MAIN ELECTRICAL SWITCHES
DO NOT TOUCH ELECTRICAL WIRES
DO NOT SPREAD RUMOURS
TURN ON RADIO/TELEVISION TO GET THE LATEST INFORMATION/BULLETINS
BE PREPARED FOR ADDITIONAL EARTHQUAKE SHOCKS, CALLED ‘AFTERSHOCKS’, WHICH MAY OCCUR.
EARTHQUAKE PREDICTION

• NO GLOBALLY ACCEPTED AND APPLICABLE METHOD FOR EARTHQUAKE PREDICTIONS HAS YET BEEN EVOLVED

• EFFORTS ARE AFOOT TO STUDY VARIOUS PRECURSORY PHENOMENA WHICH COULD HELP IN DEVELOPING A SCHEME TOWARDS EARTHQUAKE PREDICTIONS. SOME OF THE PROMISING PRECURSORS ARE:

- EARTHQUAKE SWARMS, SEISMIC GAPS, CHANGES IN SEISMIC WAVE VELOCITY, ELECTRICAL RESISTIVITY, MAGNETIC PROPERTIES, SURFACE TOPOGRAPHY, RADON MEASUREMENT etc.
Tsunamis

A series of traveling ocean waves of extremely long length generated primarily by earthquakes, volcanic eruptions, outer-space meteorite splash or landslides occurring below or near the ocean floor.

Tsunamis are a threat to life and property for all coastal residents living near the ocean.

Although 80% of the tsunamis occur in the Pacific, they can also threaten coastlines of countries in other regions, including the Indian Ocean, Mediterranean Sea, Caribbean region, and even the Atlantic Ocean.
PROPAGATION OF TSUNAMI WAVE
ENHANCEMENT OF A TSUNAMI WAVE

<table>
<thead>
<tr>
<th>Depth (meters)</th>
<th>Velocity (km/h)</th>
<th>Wave length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7000</td>
<td>943</td>
<td>282</td>
</tr>
<tr>
<td>4000</td>
<td>713</td>
<td>213</td>
</tr>
<tr>
<td>2000</td>
<td>504</td>
<td>151</td>
</tr>
<tr>
<td>200</td>
<td>159</td>
<td>48</td>
</tr>
<tr>
<td>50</td>
<td>79</td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td>36</td>
<td>10.6</td>
</tr>
</tbody>
</table>
TERMINATION OF TSUNAMI WAVE (STRIKING THE COAST)
MORE ABOUT TSUNAMIS

• Earthquakes of intensity > 7 on Richter scale have potential for generating Tsunami
• Tsunamis travel outward in all directions from the generating area
• In the deep and open ocean, they travel at speeds of 500 to 1,000 kilometers per hour
• The distance between successive crests can be as much as 500 to 650 kilometers
• In the open ocean, the height of the waves may be no more than 30 to 60 centimeters (1 or 2 feet), and the waves pass unnoticed
• The passing waves produce only a gentle rise and fall of the sea surface.
• Upon reaching shallower water, the speed of the advancing wave diminishes, its wave length decreases, and its height may increase greatly, owing to the piling up of water
• Configuration of the coastline, shape of the ocean floor, and character of the advancing waves play an important role in the destruction wrought by tsunamis
TSUNAMI SAFETY RULES

1. All earthquakes do not cause tsunamis, but many do. When you hear that an earthquake has occurred, stand by for a tsunami emergency.
2. An earthquake in your area is a natural tsunami warning. Do not stay in low-lying coastal areas after a strong earthquake has been felt.
3. A tsunami is not a single wave, but a series of waves. Stay out of danger areas until an "all-clear" is issued by competent authority.
4. Approaching tsunamis are sometimes preceded by a noticeable rise or fall of coastal water. This is nature's tsunami warning and should be heeded.
5. Small tsunami at one point on the shore can be extremely large a few miles away. Don't let the modest size of one make you lose respect for all.
7. All tsunamis like hurricanes are potentially dangerous, even though they may not damage every coastline they strike.
8. Never go down to the shore to watch for a tsunami. When you can see the wave you are too close to escape it. Never try to surf a tsunami; tsunamis do not curl or break like surfing waves.
10. During a tsunami emergency, your local civil defense, police, and other emergency organizations will try to save your life. Give them your fullest cooperation.
TSUNAMI EARLY WARNING IN INDIA

• A Network sensors being established by participating countries to share data
• A Multi Departmental setup involving IMD, DOD, DOS etc
• National Tsunami Warning Centre at INCOIS, Hyderabad
• Network if 17 Real Time Seismo Monitoring Stations being installed by IMD which transmit data to IMD and INCOIS
• 12 Nos Bottom Pressure Records being installed in BOB
• 50 Nos tide gauges being installed along east coast, 8 along AP coast
• Tsunami Modelling (N2 of Japan, MOST by US) to be used to work out quickly the wave heights, wave speed etc.
• INCOIS processes data and issued warnings to MHA at Delhi
• MHA at Delhi co-ordinates dissemination
Floods are mainly triggered by severe thunderstorms, cyclones or monsoons.

In low-lying coastal areas, storm surges, tsunamis or rivers swollen by exceptionally high tides can cause flooding.

Floods can threaten human life and property.

Flood water can become a breeding ground for mosquitoes, tsetse fly creating an increased risk of malaria, sleeping sickness, typhoid, cholera and dengue fever outbreak;
FLOOD PROBLEMS OF ANDHRA PRADESH

Andhra Pradesh has a contrasting topography with two different type of regions. Western part of the State consists of high lands and hills. While Eastern part of the state consists of vast stretches of plains extending along the entire length of the coast in the state.

There are numerous rivers as many as 35 rivers flowing in Andhra Pradesh. The large rivers are Godavari, Krishna and Pennar. These rivers have stable course and are in good regime.

Important smaller rivers are Budameru, Thammileru, Yerakalva, Yeleru, Thandava, Pampa, Varaha, Sarada, Swarnamukhi, Chippaleru and Vamsadhara.

The largest river in the state Godavari River rises as a small river in the eastern slope of the Western Ghats before it enters. The state total length of river 1465 Kms and in A.P it runs for a length of 790 Kms. The river flows in a gorge portion up to Polavaram which is 36 Kms upstream of Rajahmundry town and there is no flood problem up to Polavaram. Below Polavaram up to sea embankment for length of 535 Kms are formed on both sides to 1953 flood (28 lakhs C/s) standards and now improvements to flood banks are being made to 1986 flood (36 lakhs C/s) standards.

Krishna, the second largest river in the state rises in the western ghats at Mahabaleswar and flows through Maharastra, Karnataka and Andhra Pradesh. The total length of river 1342 Kms and in A.P it is 567 Kms. A very heavy flood was experienced in this river during 1949, 1903 of an order 11.94 Lakhs. In the recent years the maximum flood observed is 9.95 lakhs during 1964. There are embankments along the river both side for a length of 346 Kms.

The Pennar river is a relatively smaller river which originates in Chinna kesava hills in Karnataka State and floods through Karnataka and Andhra Pradesh for a length of 597 Km and in Andhra Pradesh it runs for 437 Km. This river gets flash floods lasting for a short durations only. The river is embanked on both sides for a length of 109 Kms in the plains.
IMD Hyderabad office issues daily weather bulletins for AP covering synoptic situation, realized rainfall Past 24 hours and Quantitative precipitation forecast for next 24 hours to Flood Forecasting Divisions of CWC of both Godavari and Krishna.

Flood Warning is issued by CWC
Flood control room of CWC

- Receives the following data
  - Meteorological dept
    - Rainfall
    - Monsoon position
    - Cyclone warnings
  - Central water commission
    - River flows in AP & other states
    - Rain fall correlation
  - Irrigation Department
    - River flows in AP
  - obtains status of levels, inflows, outflows and prepare a statement and Fax to all higher officials at Secretariat and other Departmental officials daily.
DISASTER MITIGATION

The best way to confront natural disasters is to:
Create a culture of safety among the communities at risk;
Enhance the capacity of the people living in vulnerable areas.

Preparedness is key in helping communities manage the inevitable disasters when they do occur.
Governments should incorporate disaster risk mitigation into national planning process
Create and share vulnerability maps
Develop early warning systems
Organisations working for disaster mitigation should establish linkages with those institutions that provide them with information about disasters
Educate the vulnerable population to be prepared to face various kinds of disasters, understand the warnings and to follow them
IMD Web sites

State
➢ http://www.imdhyderabad.gov.in/
National
➢ http://www.imd.gov.in/

Regional Meteorological Centres (RMCs)
➢ IMD Pune http://www.imdpune.gov.in/
➢ MD Delhi http://www.amssdelhi.gov.in
➢ IMD Mumbai http://www.imdmumbai.gov.in/
➢ IMD Chennai http://www.imdchennai.gov.in/
➢ IMD Kolkata http://www.imdkolkata.gov.in/
➢ IMD Guwahati http://www.imdguwahati.gov.in/
➢ IMD Nagpur http://www.imdnagpur.gov.in/
Thank You
<table>
<thead>
<tr>
<th></th>
<th>OBSERVATIONAL NETWORK IN AP &amp; TS</th>
<th>AP</th>
<th>Telangana</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IMD observatories:</td>
<td>14</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>2.</td>
<td>PTOs:</td>
<td>6</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>3.</td>
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<td>23</td>
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<td>4.</td>
<td>IMD ARG Existing</td>
<td>63</td>
<td>55</td>
<td>118</td>
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<td>5.</td>
<td>Doppler Wx Radars</td>
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<td>Radiation Observatories</td>
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<td>RSRW Observatories</td>
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<td>8.</td>
<td>Pilot Balloon Observatories</td>
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<td>9.</td>
<td>State Govt Reporting RGs: Existing:</td>
<td>262</td>
<td>223</td>
<td>485</td>
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<td>10.</td>
<td>State Govt Additional RGs Proposed:</td>
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<td>12.</td>
<td>State Govt AWS</td>
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<td>847</td>
<td>2035</td>
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<td>13.</td>
<td>Hyderabad City AWS (DISANET)</td>
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Observation System: All India

- Automatic Weather Stations (675)
- Automatic Rain gauge Stations (1289)
- Agrometeorological Observatories (264)