CUBA TROPICAL STORMS EARLY WARNING SYSTEM

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NATIONAL DISASTER COORDINATORS AND METEOROLOGISTS DIALOGUE: ADVANCING MULTI-HAZARD EARLY WARNING SYSTEMS IN THE CARIBBEAN

5th Caribbean Conference on Comprehensive Disaster Management

Montego Bay, Jamaica
Monday, 6th December, 2010

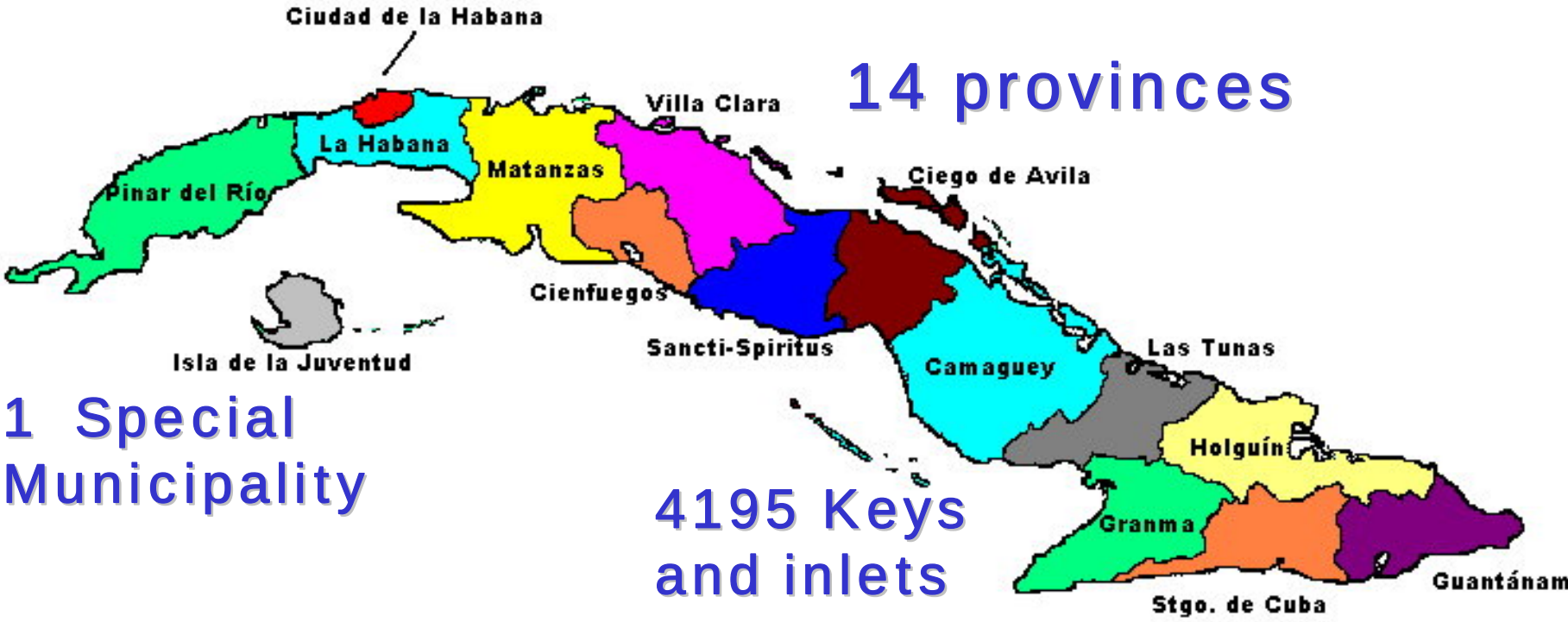
"Hazards should not be watched upon when they are already over us, but when they could be avoided"

" To place Science in everybody's language, that is a goodness than only a few people do".

José Martí
National Hero of Cuba

(1853 – 1895)

Overview on Cuba



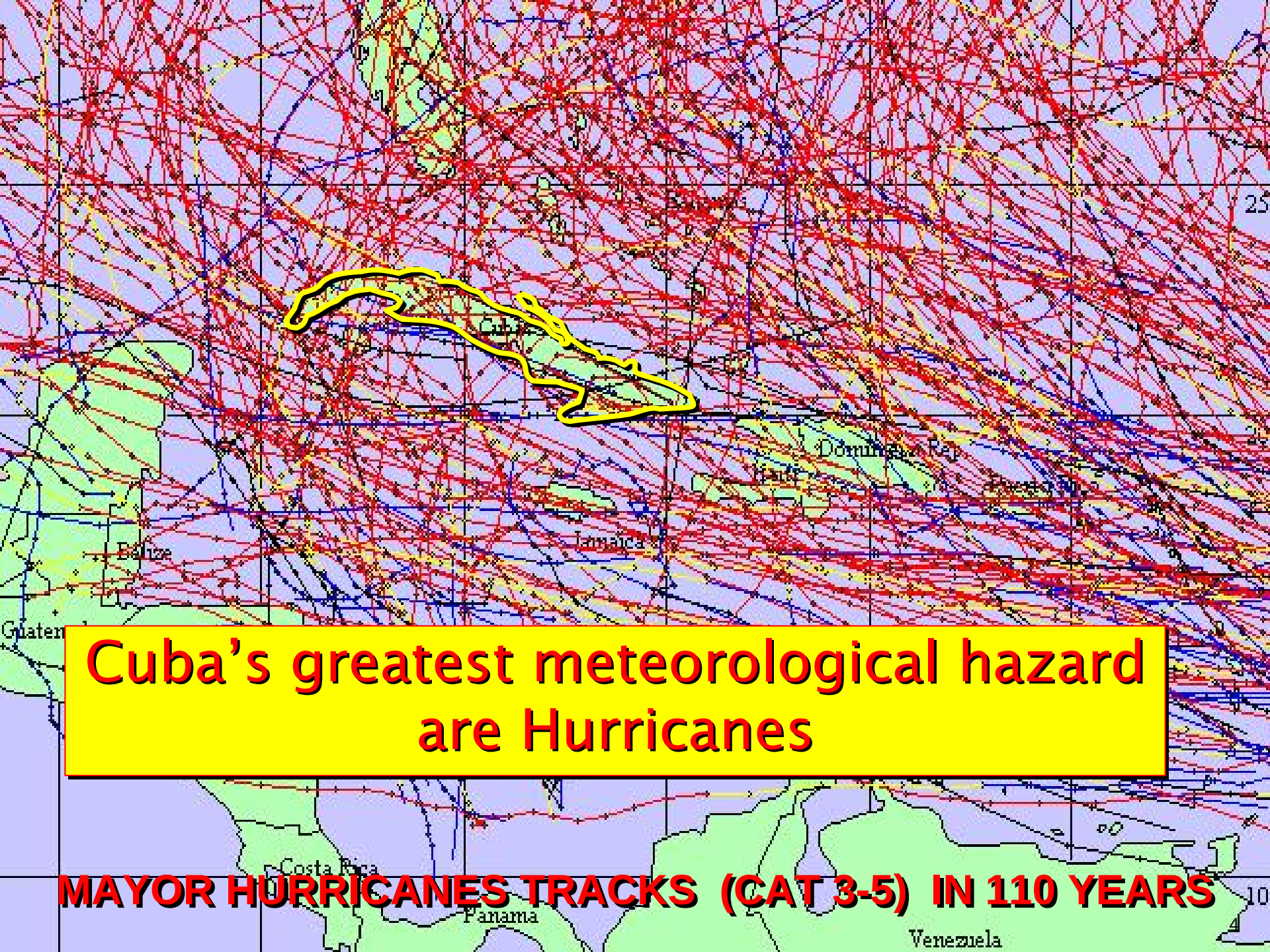
14 provinces

1 Special Municipality

4195 Keys and inlets

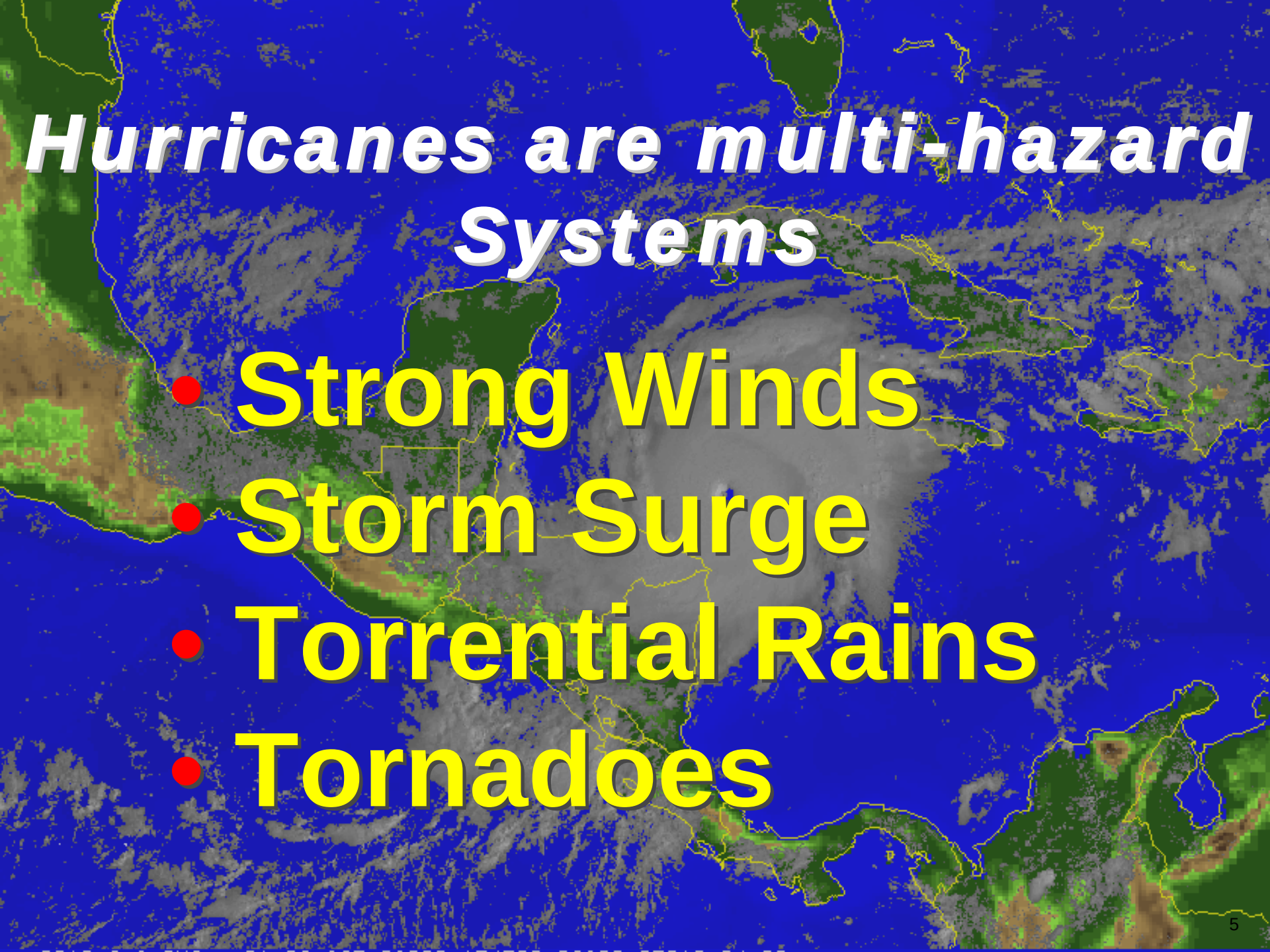
Area : 110 922 km² Coastline: 5 746 km

Population: 11 millon



Cuba's greatest meteorological hazard are Hurricanes

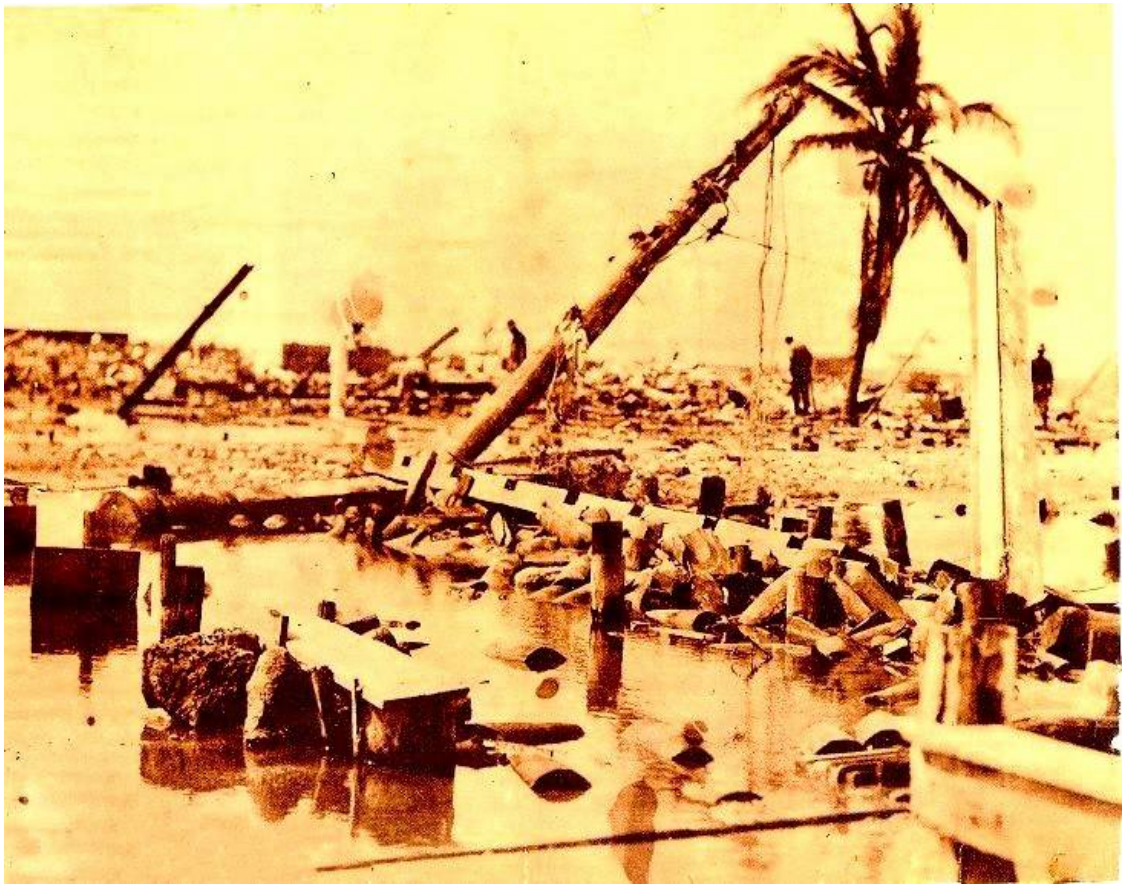
MAYOR HURRICANES TRACKS (CAT 3-5) IN 110 YEARS



Hurricanes are multi-hazard Systems

- **Strong Winds**
- **Storm Surge**
- **Torrential Rains**
- **Tornadoes**


Factor that lead to the establishment of EWS in Cuba



SANTA CRUZ DEL SUR NOVEMBER 1932

Mayor Catastrophe in Cuban History

Storm Surge in a Major Hurricane.

Casualties: 3033

The whole city dissapeared under the 6.5 meters high Storm Surge

HURRICANE FLORA
OCTOBER 1963

Casualties: 1200

Great Material Losses,

US $300 000 000
(1963 value)

Total amount of rain:
1 800 mm in 72 hours
over mountainous terrain
where the largest Cuban
river cross lowlands

ORIGIN OF THE EARLY WARNING SYSTEM IN CUBA

- Triumph of Cuban Revolution in 1959.
- The Great Disaster in Hurricane “Flora” (1963).
- The specific need for organization and preparedness to face the threat of disasters.

LEAD TO:

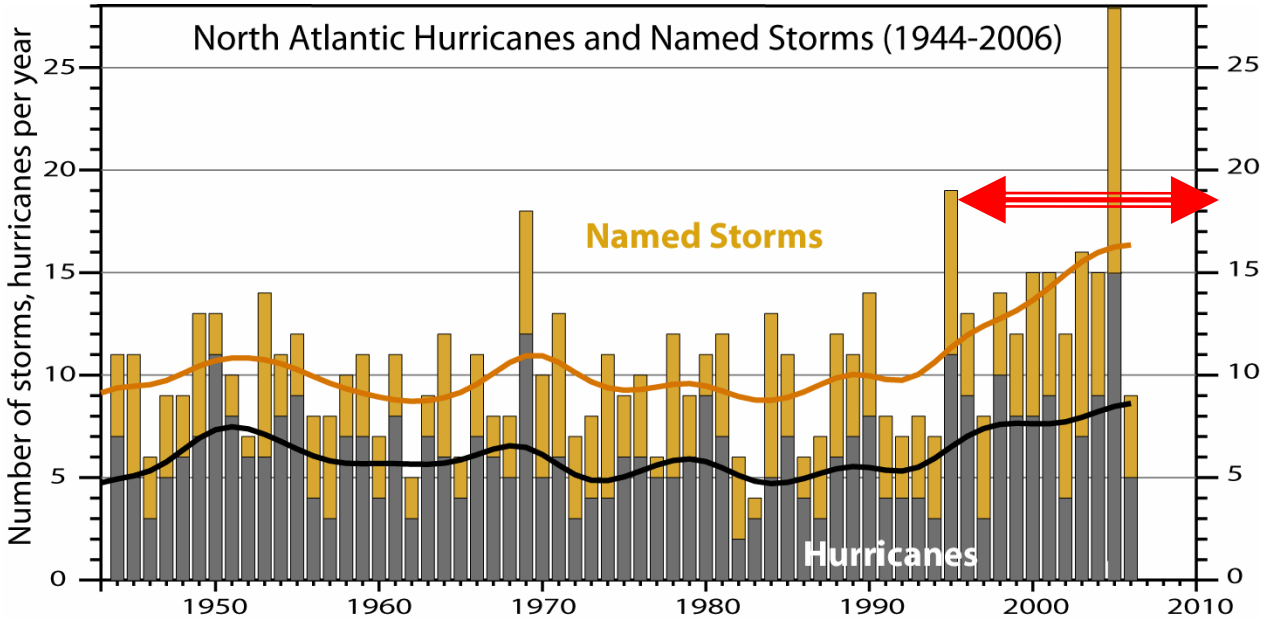
✓THE MODERNIZATION OF THE CIVIL DEFENSE (CREATED IN 1962)

✓THE METEOROLOGICAL SERVICE (FOUNDED IN 1856, BUT ALMOST WITH NO CHANGE UNTIL 1963),

✓THE BUILDING OF A SYSTEM OF DAMS TO PREVENT LARGE FLOODINGS.

OTHER BACKGROUND ISSUES FOR THE ESTABLISHMENT OF EWS

An active Tropical Cyclone period began in 1995 Cuban National Meteorological Service foresaw the need to have an early alert on tropical cyclones



The first Early Warning Message was issued on October 14, 1996, several days before hurricane "Lili" crossed over the central provinces of Cuba

PRINCIPLES OF THE EARLY WARNING SYSTEM IN CUBA

- ✓ NATIONAL AND INSTITUTIONAL REACH
- ✓ DIRECTION OF THE SYSTEM AT HIGHEST LEVEL
- ✓ OVERALL PROTECTION
- ✓ DIFFERENTIAL WAY OF PLANNING AND ORGANIZING PROTECTION.
- ✓ EFFECTIVE COOPERATION WITH THE METEOROLOGICAL SERVICE, THE MEDIA, THE ARMED FORCES AND THE MINISTRY OF THE INTERIOR, AS WELL AS OTHER SPECIALIZED FORCES, FOR THEIR SUPPORT IN CASE OF NATURAL DISASTER SITUATIONS.

A wide legal basis regulating the functioning of EWS

- Law No. 75 of National Defense
- Decree-law No. 170 on the Civil Defense system
- Guideline No. 1 of the Vice President of the National Defense Council
- Law No. 81 / 97 on the Environment
- Resolution 106 /99 of the Ministry of Science, Technology and Environment
- Ordinance Law No. 279 of 2007 "On General Principles, Organization, Preparation and Provisions of the Hydrometeorological System of Cuba for Exceptional Situations

DIRECTION AT THE HIGHEST LEVEL

THE PRESIDENT OF THE STATE COUNCIL IS THE HEAD OF THE CIVIL DEFENSE

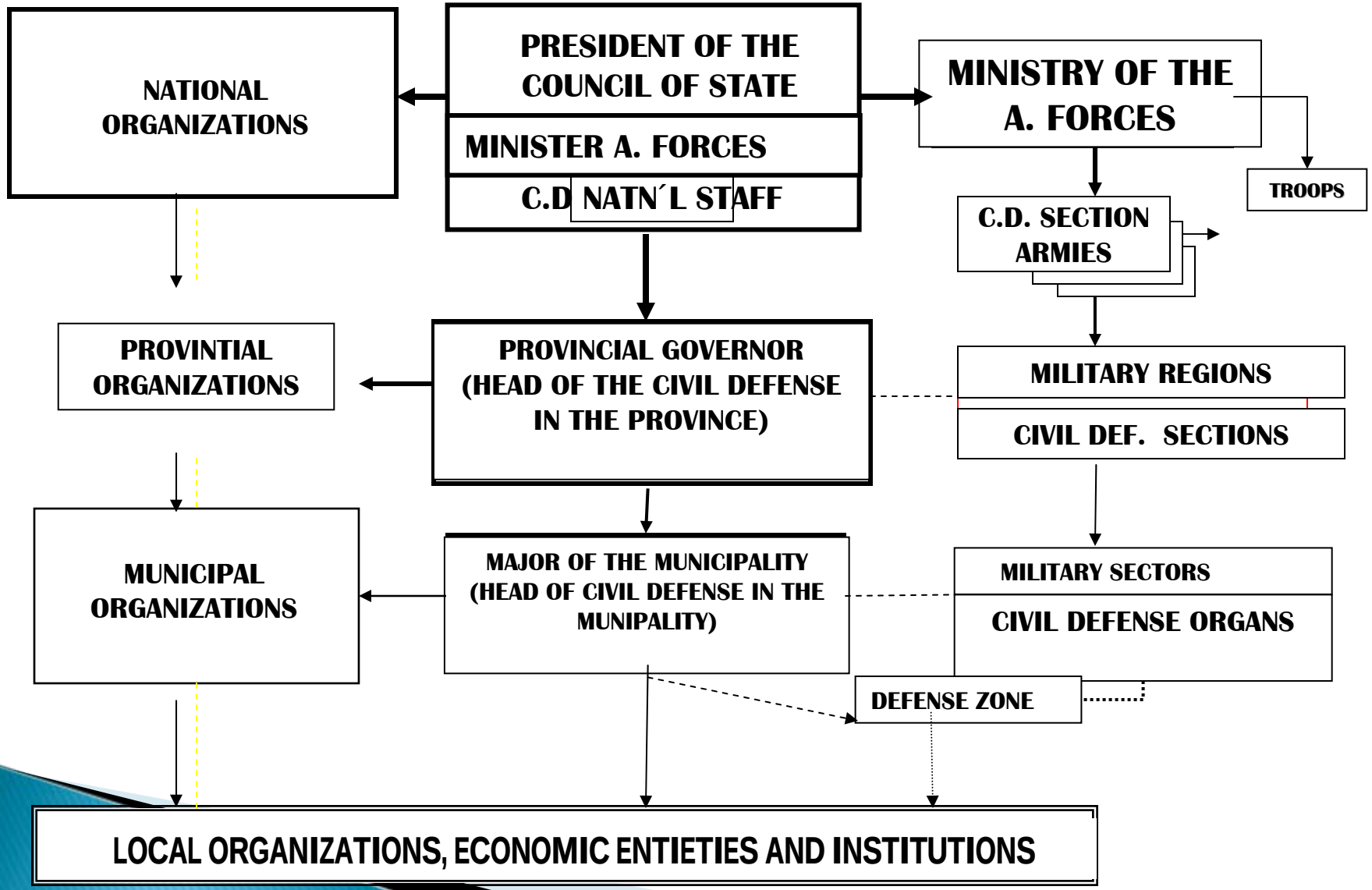
THE MINISTER OF THE ARMED FORCES HAS:

THE CIVIL DEFENSE NATIONAL STAFF

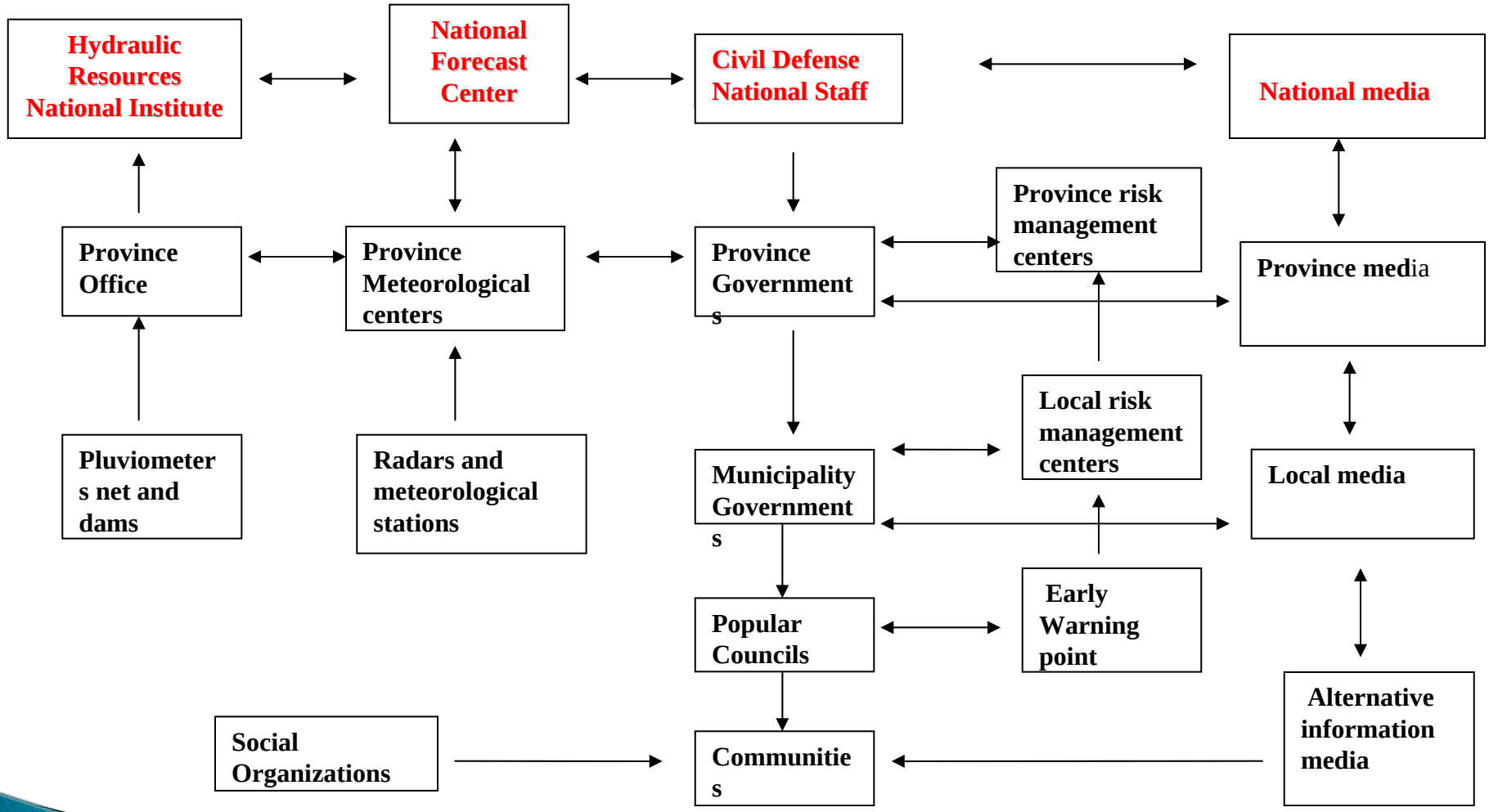
THE GOVERNORS AND MAYORS IN PROVINCES AND MUNICIPALITIES ARE THE HEADS OF THE CIVIL DEFENSE IN THEIR TERRITORIES

THE DIRECTORS OF STATE ORGANIZATIONS, AND THE ONES OF ECONOMICAL ENTIETIES AND SOCIAL INSTITUTIONS ARE AT THE SAME TIME THE HEADS OF THE CIVIL DEFENSE AND ARE RESPONSIBLE FOR THE CIVIL DEFENSE SYSTEM IN THEIR AREAS OF INTEREST.

ORGANIZATION OF THE CUBAN CIVIL DEFENSE SYSTEM



FUNCTIONAL STRUCTURE OF EARLY WARNING SYSTEM FOR TROPICAL CYCLONE IN CUBA



GENERAL STEPS IN THE EARLY WARNING PROCESS

- PREVENTION
- PREPAREDNESS
- RESPONSE: PHASES, ACTIONS AND MEASURES
- RECUPERATION, REHABILITATION AND RECONSTRUCTION

Training Program for officials, workers and all people includes:

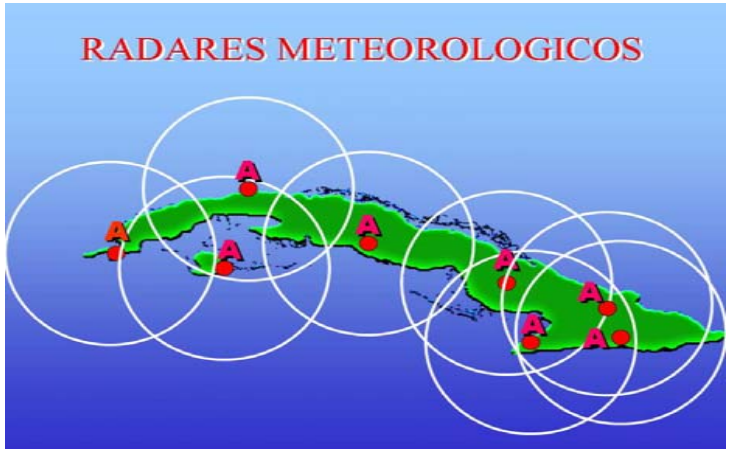
Talks and Conference,
Radio and TV programs,
Short Courses through the Educational TV Channels,
School Curriculae in Primary, Secondary and University levels.

Main elements of the EWS for TC

- The central surveillance entities in charge of monitoring the hazards and their territorial branches.
- Authorities at the different levels, entrusted implementing the relevant protection measures, advised by officials and experts of the Civil Defense.
- The media and mass and social organizations at the local level, which help disseminate information.
- The people, who are well organized and prepared.

Elements including in EWS for tropical cyclones

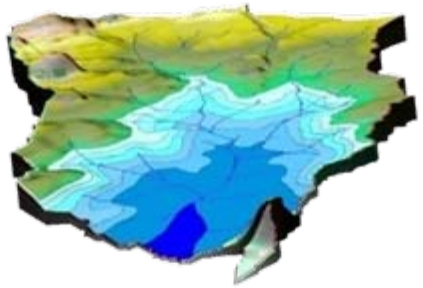
- An effective meteorological and hydrologic surveillance and communication systems between these services and Civil Defense institutions, both at the national and local levels.
- An effective network for transmitting information
- The use of all the mass media for spreading warning messages.
- Plans designed for different situations



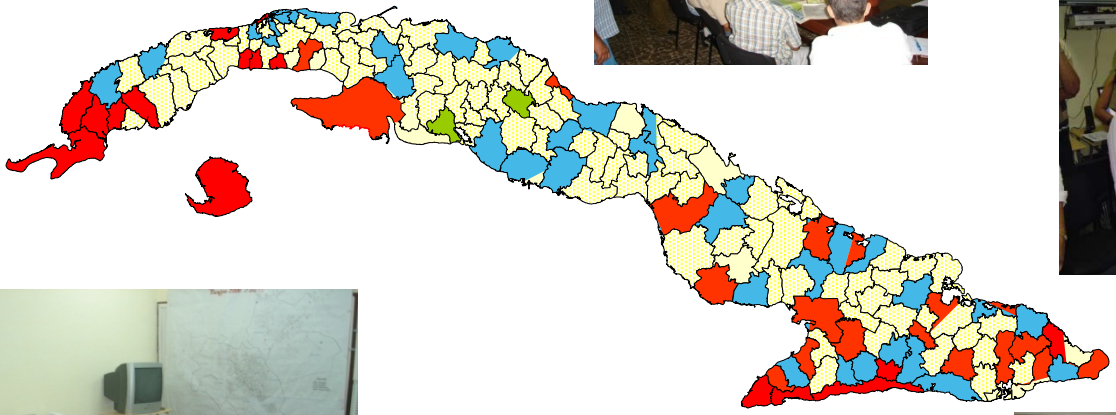
Utilization of risk information in emergency planning and warnings

- The Environment Agency of the Ministry of Science, Technology and the Environment was assigned the responsibility, to organize, lead and conduct disaster risk studies.

- There is a group of specialists that elaborated a methodology to assess the risk from national to local level



- Databases of risk for are properly stored at the risk management centers of each municipality
- Plans are updated every year based on risk estimation
- The results of the upgrade are informed to the provincial and national levels.

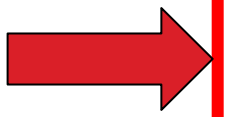


Role of the NMHS in the EWS

- To constantly monitor weather
- To issue timely Early Warnings to the Government, the Civil Defense, and the people on any hazardous weather system that could affect any part of the Country.
- To transmit Early Warnings and warnings through the Media, mainly TV and radio, updating the information.
- To participate in awareness and educational activities

Hazard monitoring, forecasting, and mandates for warning development

The National Meteorological Service has the sole mandate for issuing meteorological warnings on thunderstorm, tropical cyclone, flash flood, strong winds, landslide, tornado, coastal flooding and storm surge



National Staff of the Civil Defense issues a warning note

threatened areas

A true partnership as part of a sole National System in which all efforts are put into action for the protection of life and material resources as well

Cuban Meteorological Service has the organizational responsibility for monitoring, forecasting and developing the hazard warning and communicating it to the public from the scientific and operational point of view

National Civil Defense is responsible for the development of the warning in terms of the mobilization of all national and local resources, including all logistics for protective measures and evacuations

WORLD TROPICAL CYCLONE SYSTEM

WMO WORLD WEATHER WATCH

Global Observations --- Global Telecommunications

WORLD METEOROLOGICAL SPECIALIZED CENTERS

Global Numerical Models

WMO REGIONAL & TC SPECIALIZED CENTERS

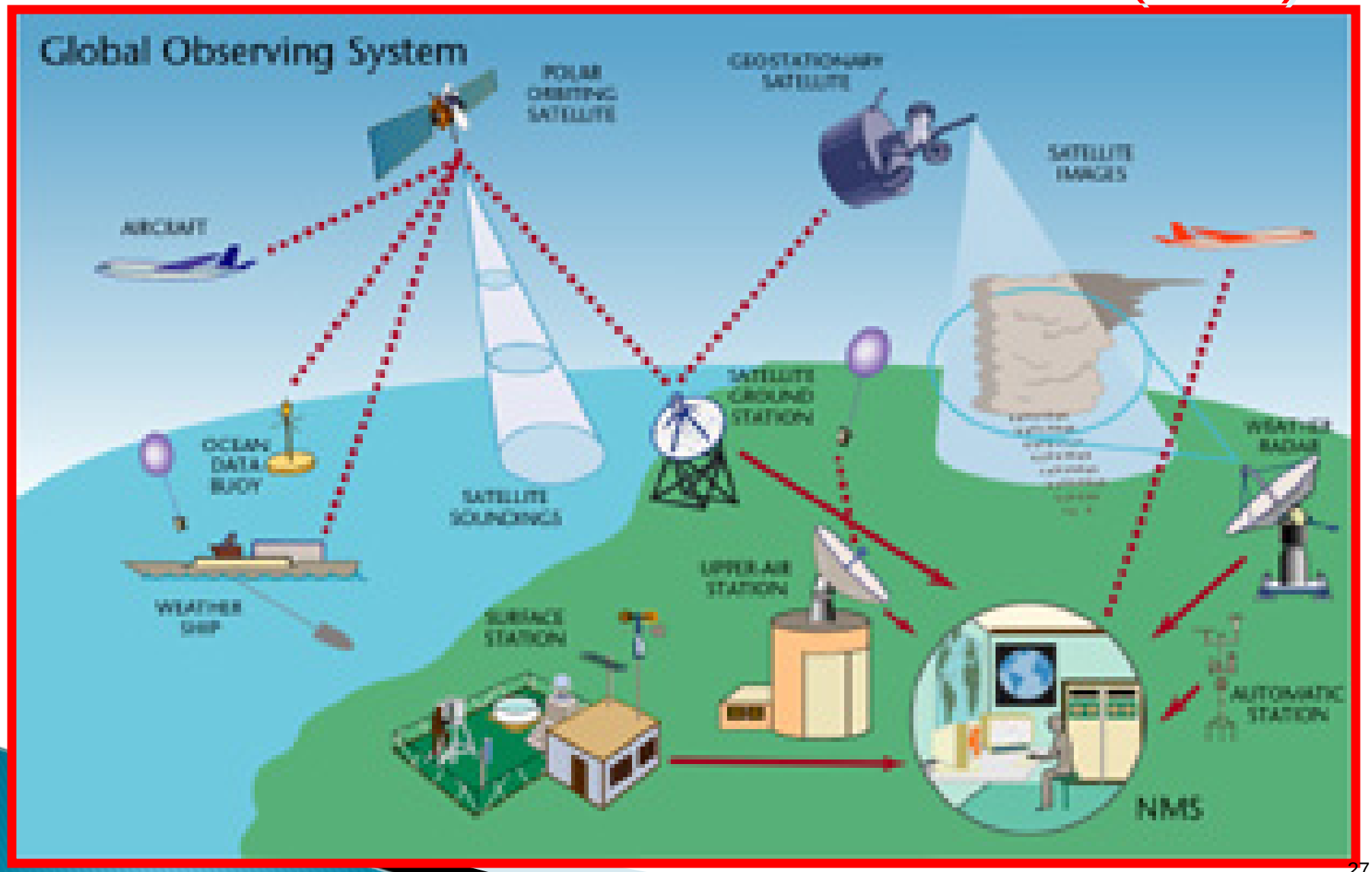
Regional Models and TC Models

NATIONAL METEOROLOGICAL CENTERS

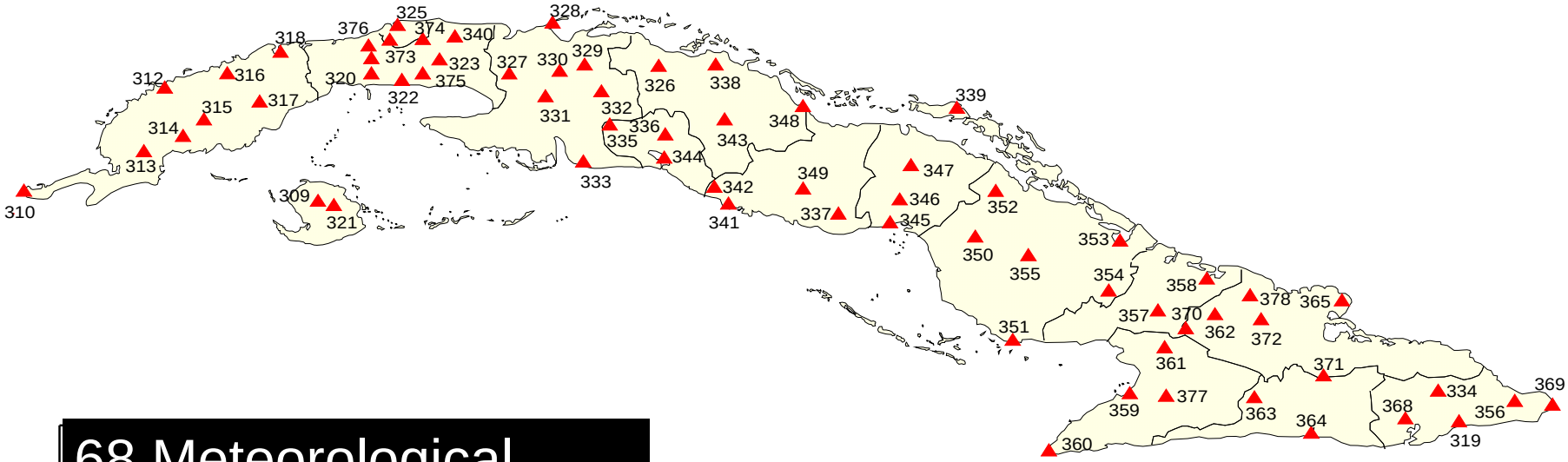
National Weather Watch, Forecasts & Warnings for the Country

PUBLIC | GOVERNMENT | CIVIL DEFENSE | MEDIA

WMO GLOBAL OBSERVING SYSTEM (GOS)

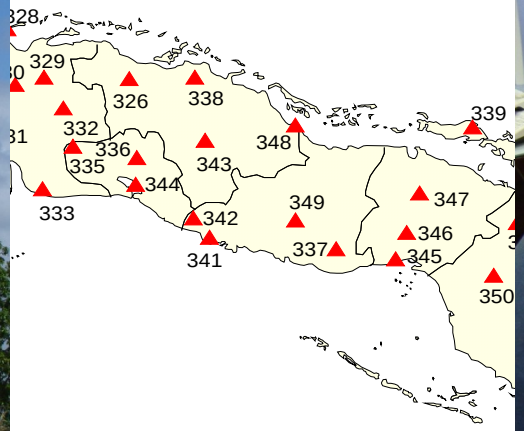


NATIONAL METEOROLOGICAL OBSERVING SYSTEM IN CUBA



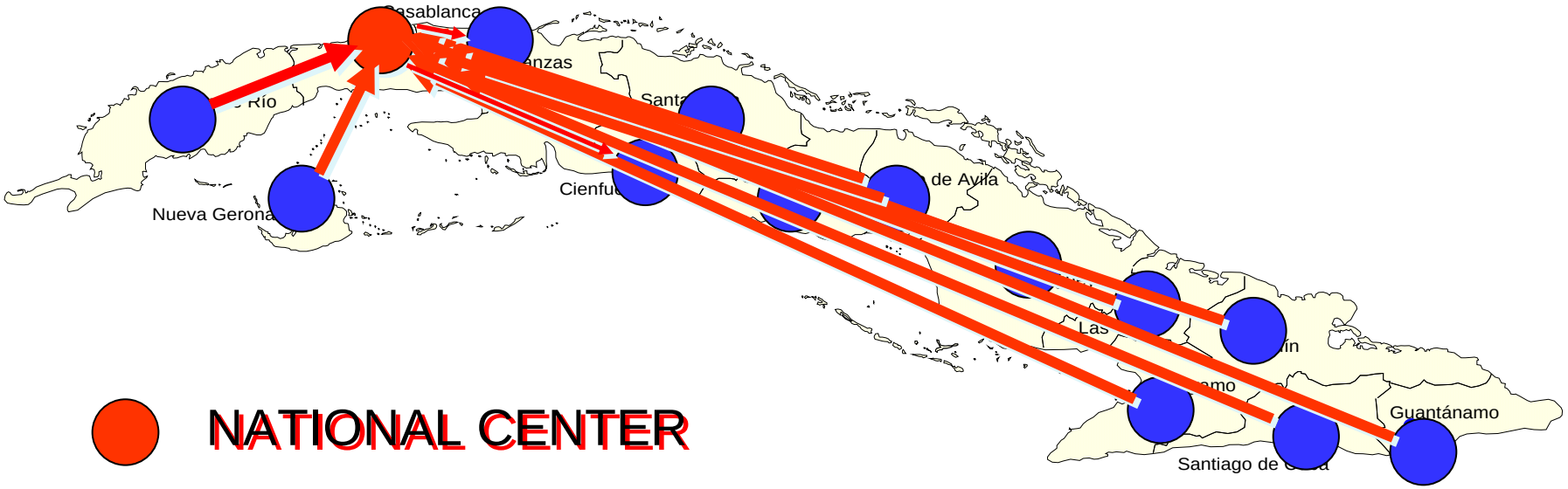
68 Meteorological Stations
1 Upper Air Sounding Station
2 Satellite Earth Station

NATIONAL METEOROLOGICAL OBSERVING SYSTEM IN CUBA



68 Meteorological Stations
1 Upper Air Sounding Station
2 Satellite Earth Station

NATIONAL METEOROLOGICAL TELECOMMUNICATION NETWORK IN CUBA



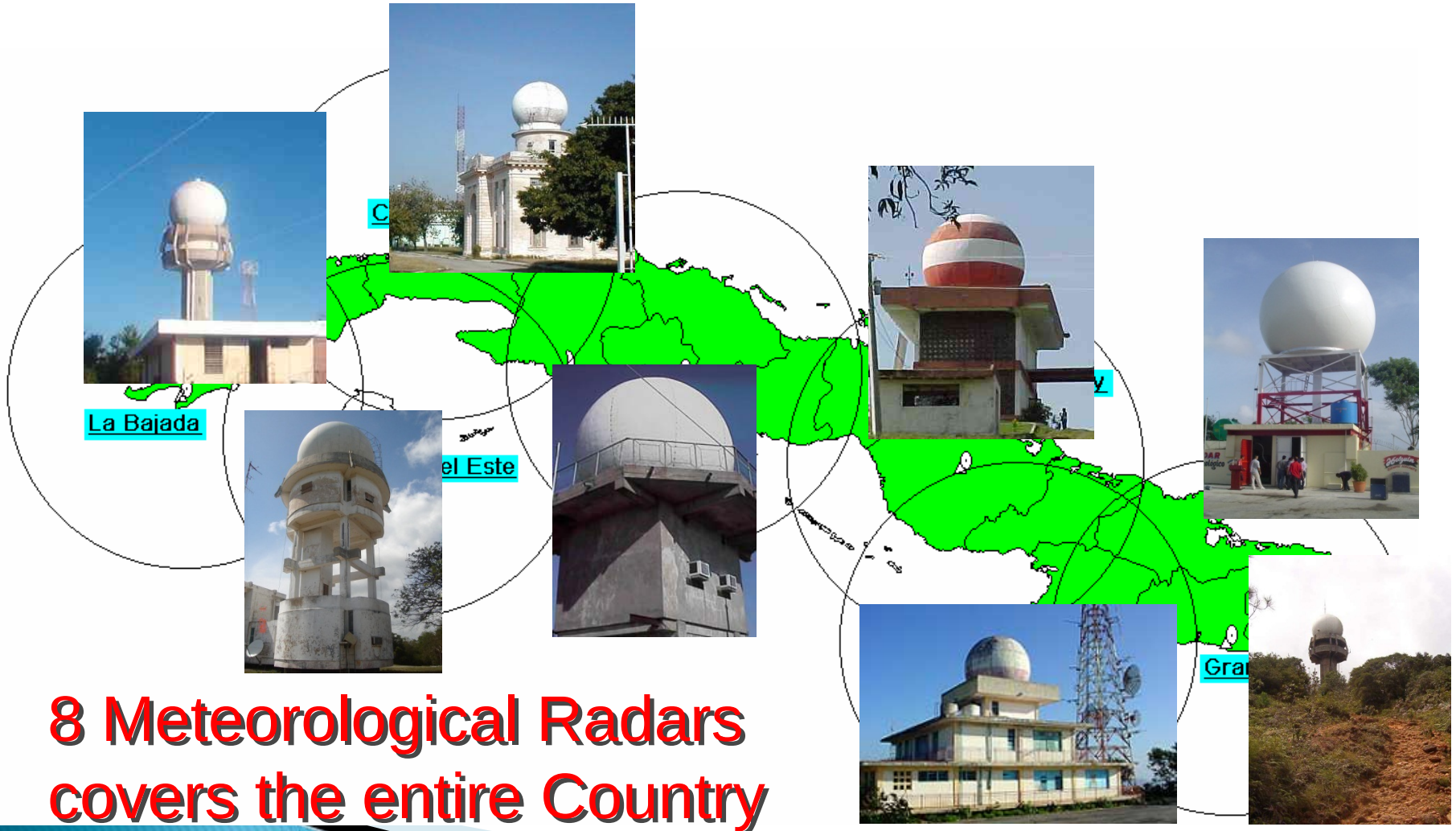
NATIONAL CENTER

PROVINCIAL CENTER

TCP / IP LINK

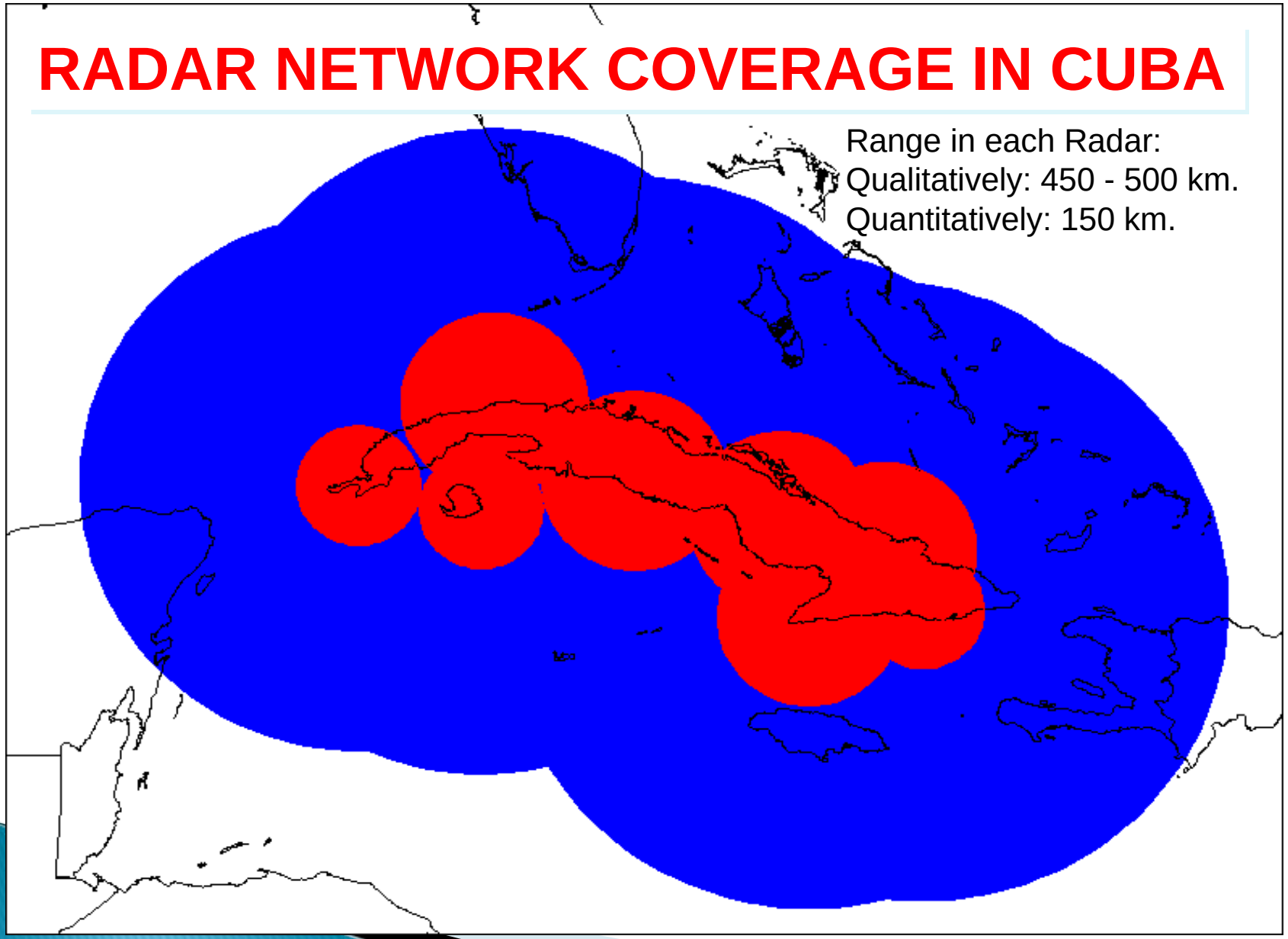
NMTN digitally provides all relevant exchange of meteorological information in the Country

WEATHER RADAR NETWORK COVERAGE IN CUBA



8 Meteorological Radars covers the entire Country

RADAR NETWORK COVERAGE IN CUBA



DATA INPUT

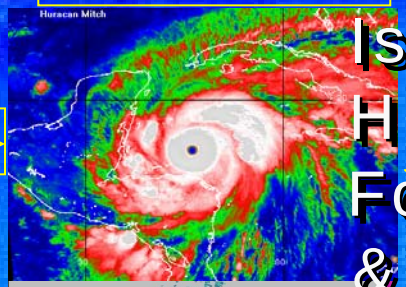
ANALYSIS AND NUMERICAL MODELS

DIFUSSION OF WARNINGS

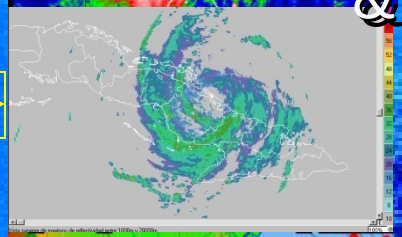
RESPONSE ACTIONS

GOVERNMENT,CIVIL DEFENSE, RESIDENTS

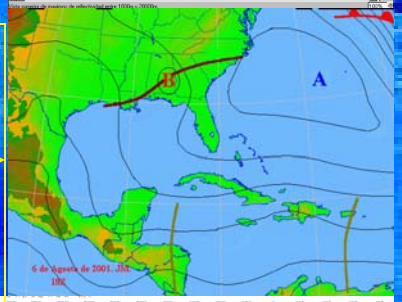
SATELLITES



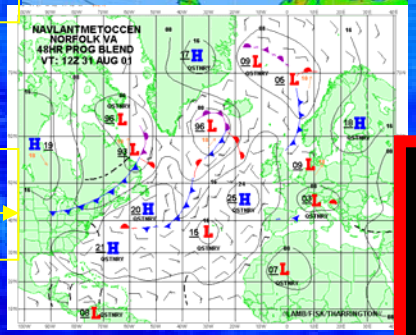
RADARS



WEATHER STATIONS
UA SOUNDINGS
SHIPS
BUOYS
AIRCRAFTS

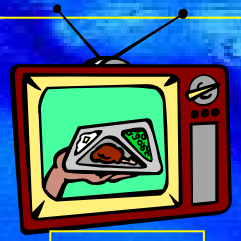


NUMERICAL MODELS



Issues Official Hurricane Forecasts & Warnings

FORECASTERS



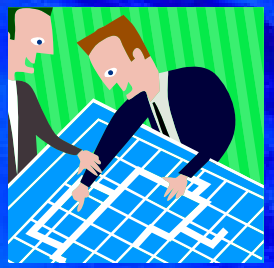
TV

RADIO

PHONE - FAX

INTERNET

NATIONAL FORECASTING CENTER



OPTIONS TO REDUCE FORECAST UNCERTAINTY?

More accurate and numerous observations with greater coverage.

Improved analysis (data assimilation) methods.

Faster computers and more complex models.

Probabilistic forecasting with ENSAMBLES and a CONSENSUS FORECAST

THE CHALLENGE OF AN EARLY WARNING IN HURRICANES

MEAN 5-DAY TRACK FORECAST ERRORS FOR THE ATLANTIC BASIN

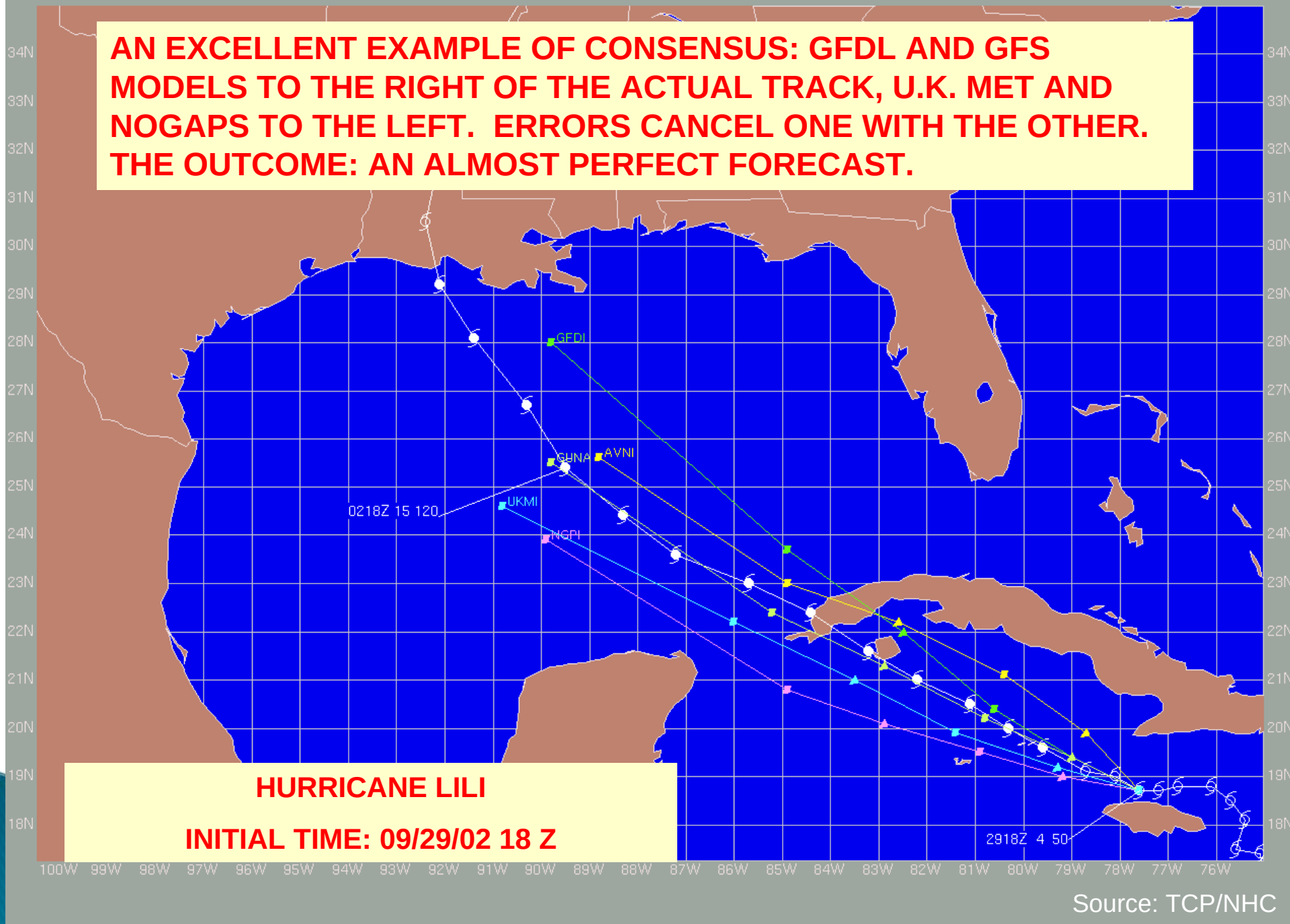
24 HR….147 km

48 HR….257 km

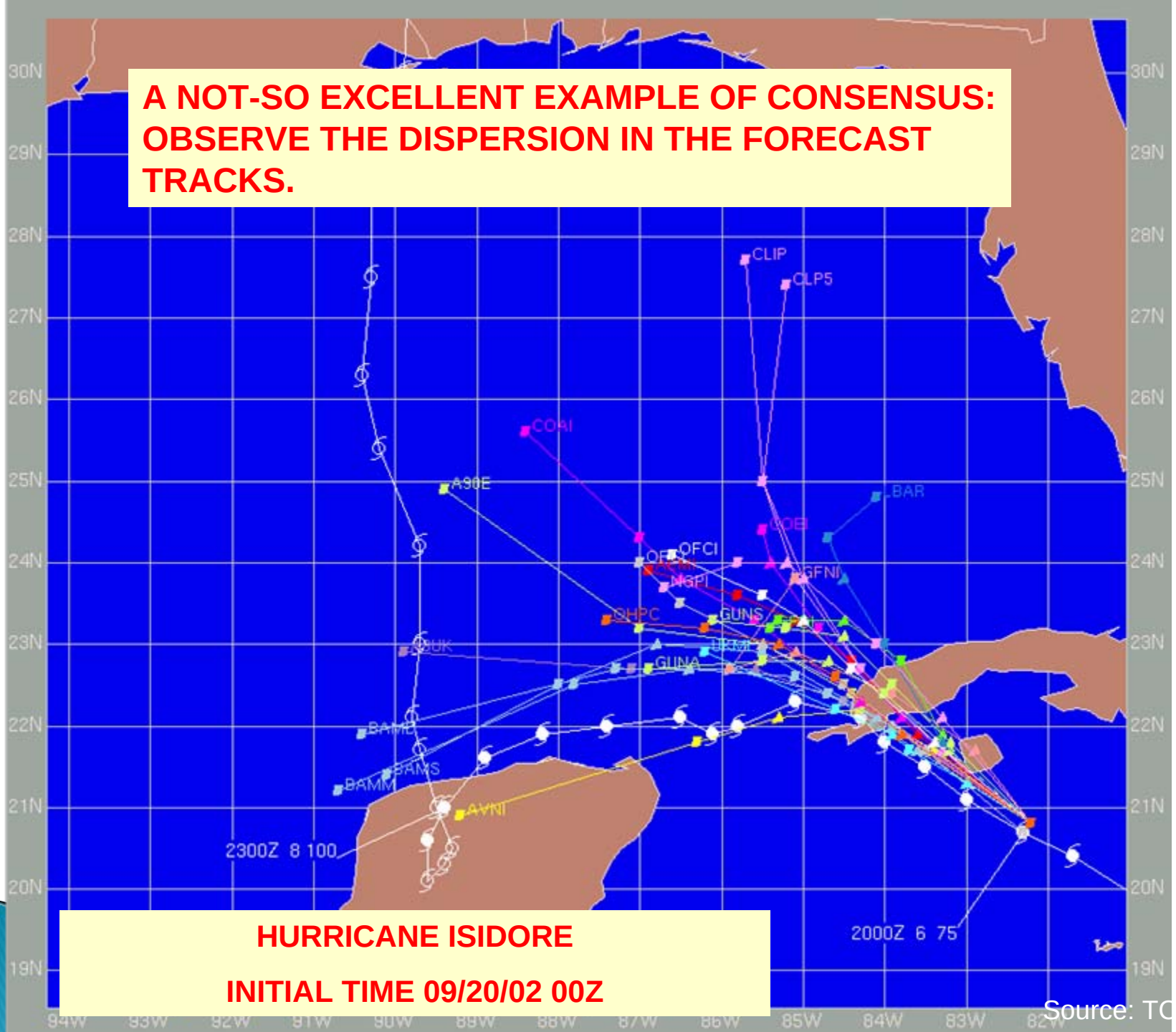
72 HR….388 km

96 HR….505 km

120 HR…688 km



Source: TCP/NHC


A NOT-SO EXCELLENT EXAMPLE OF CONSENSUS: OBSERVE THE DISPERSION IN THE FORECAST TRACKS.
CLIP
CLP5
CONI
A90E
BAR
OFCI
GFNI
NGPI
GHPC
GUNS
UKMI
GUNA
UKM
BAMD
BAMS
BAMM
AVNI
2300Z 8 100
2000Z 6 75
HURRICANE ISIDORE
INITIAL TIME 09/20/02 00Z
Source: TC

"*WARNING*" AND "*EARLY WARNING*" HAS DIFFERENT MEANINGS WHEN DEALING WITH TROPICAL CYCLONES

WARNIN

- Usually means that inmediate actions have to be taken to protect lives and properties, generally in a 24 hr time frame.

EARLY

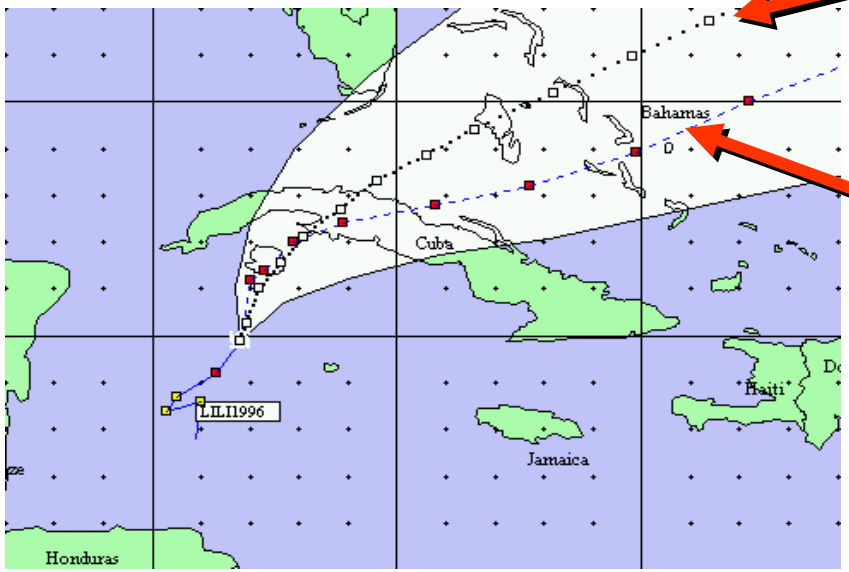
- Means that **there is some likelihood that hurricane conditions might be expected in 3, 4 or 5 days and, because of it, the level of information and awareness should be increased, without taking, for the moment, any further action.** This information is given with time enough, so that everyone could be well informed.

- Heavily depends on a previous education and preparation of the users of this information (i.e. Government, Civil Defense, the Media people, residents, etc.).

- Increases awareness on the likelihood of the hurricane threat and prepares everybody to take actions in the near future, if it becomes

ERROR CONE GRAPHICS

Forecast track + mean error = “Risk area”

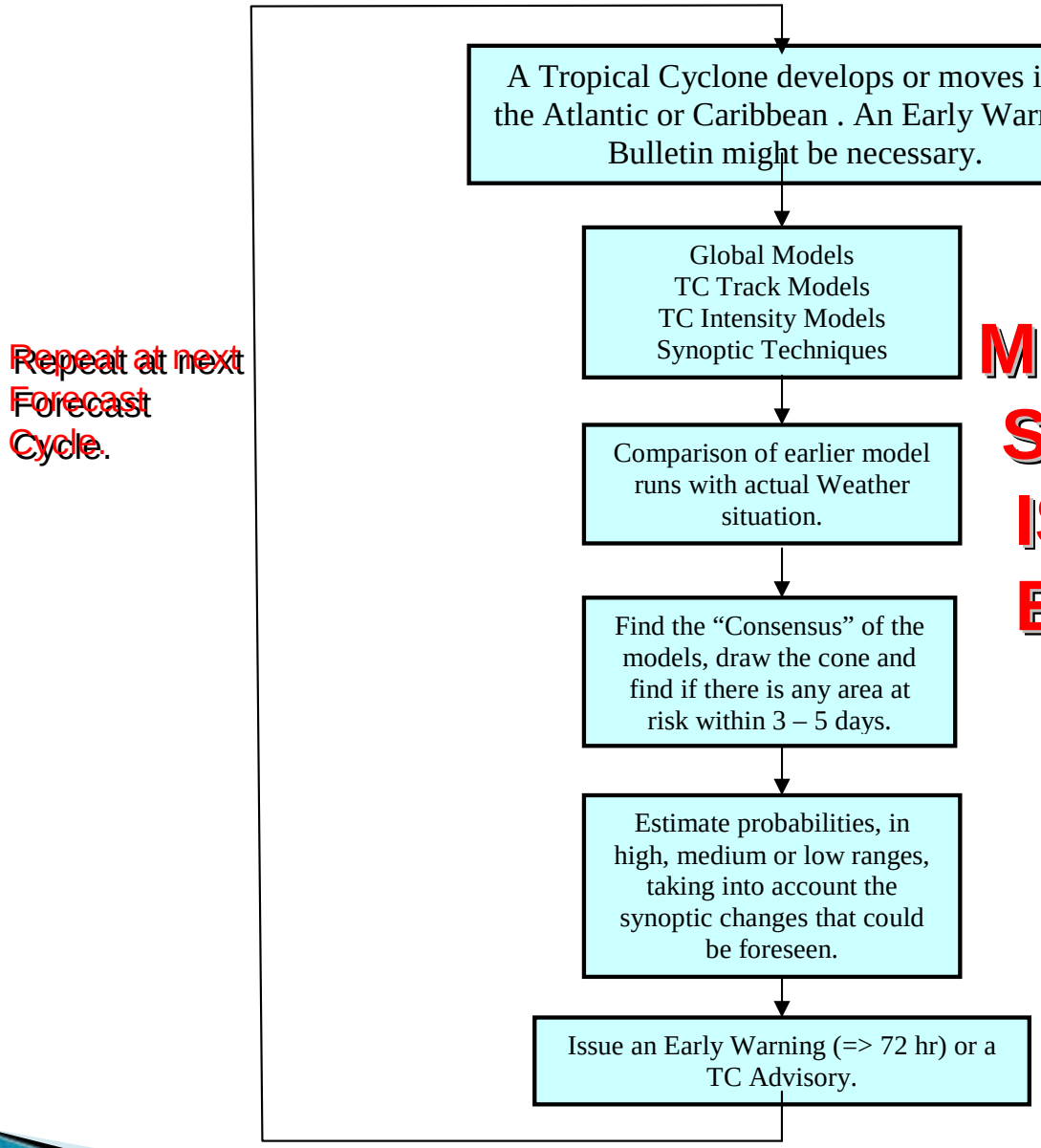


Forecasted mean track in the middle of the cone

Actual best track

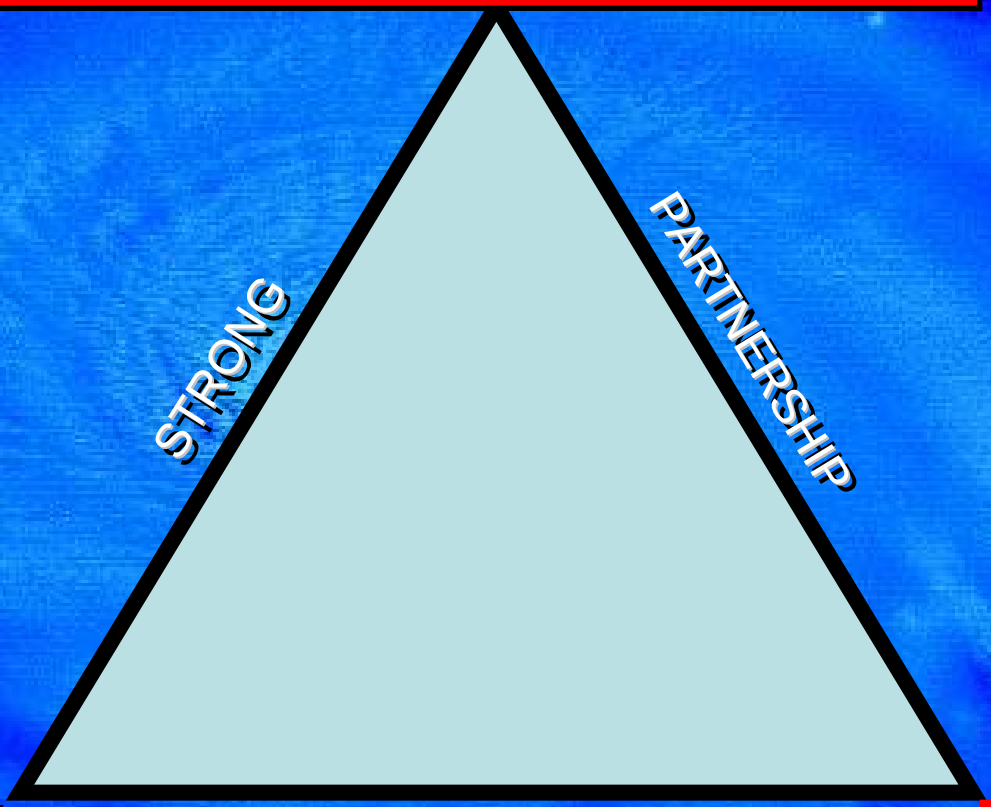
(60 to 70 % of actual tracks will be inside the cone area)

Main Application in Early Warning:
To make users aware of the uncertainty of the forecast track and to discourage users from focusing only on a single forecast track, but at the same time ASSESSING THAT THEY ARE IN AN AREA AT RISK.



METHODOLOGICAL SCHEME FOR THE ISSUANCE OF AN EARLY WARNING AT CUBAN NATIONAL FORECASTING CENTER.

National Forecast Center



The Media

Civil Defense

TO FACE THE HURRICANE HAZARD, THERE IS A STRONG PARTNERSHIP AMONG THE NFC,THE CIVIL DEFENSE AND THE MEDIA

Cuba:

RADIO & TELEVISION

Radio:
5 Natl. Networks
15 Prov. Networks
63 Municipal Radio Stations

Coverage: 99.3 % of Cuban territory

Television:
4 Natl. Networks
15 Prov.TV Stations

Coverage: 96 % of Cuban territory

NATIONAL FORECASTING CENTER (NMS)

- Cuban NMS uses an user-oriented philosophy, as emphasized by WMO PWS Program.
- Cuban NMS has a reputation of accuracy, reliability and timeliness.
- Early Warnings and Warnings are issued with a clear, concise wording, with a wide use of graphics and the introduction of probabilities to address incertitude.

CIVIL DEFENSE

The Civil Defense receive a clear message so that they can take protective measures such as evacuation, well ahead of the impact.

MEDIA

The Media is an effective link between the NMS, the Civil Defense and the community, having a strong influence in how a warning is received

PUBLIC INFORMATION

- Is more frequent as the Tropical Cyclone becomes closer.

- National Radio & TV broadcast “live” from the National Forecasting Center and the Civil Defense Headquarters from 48 – 24 hours before the storm strikes.

- Local Radio & TV stations do the same for their localities from the Provintial Forecasting Departments and Local Civil.

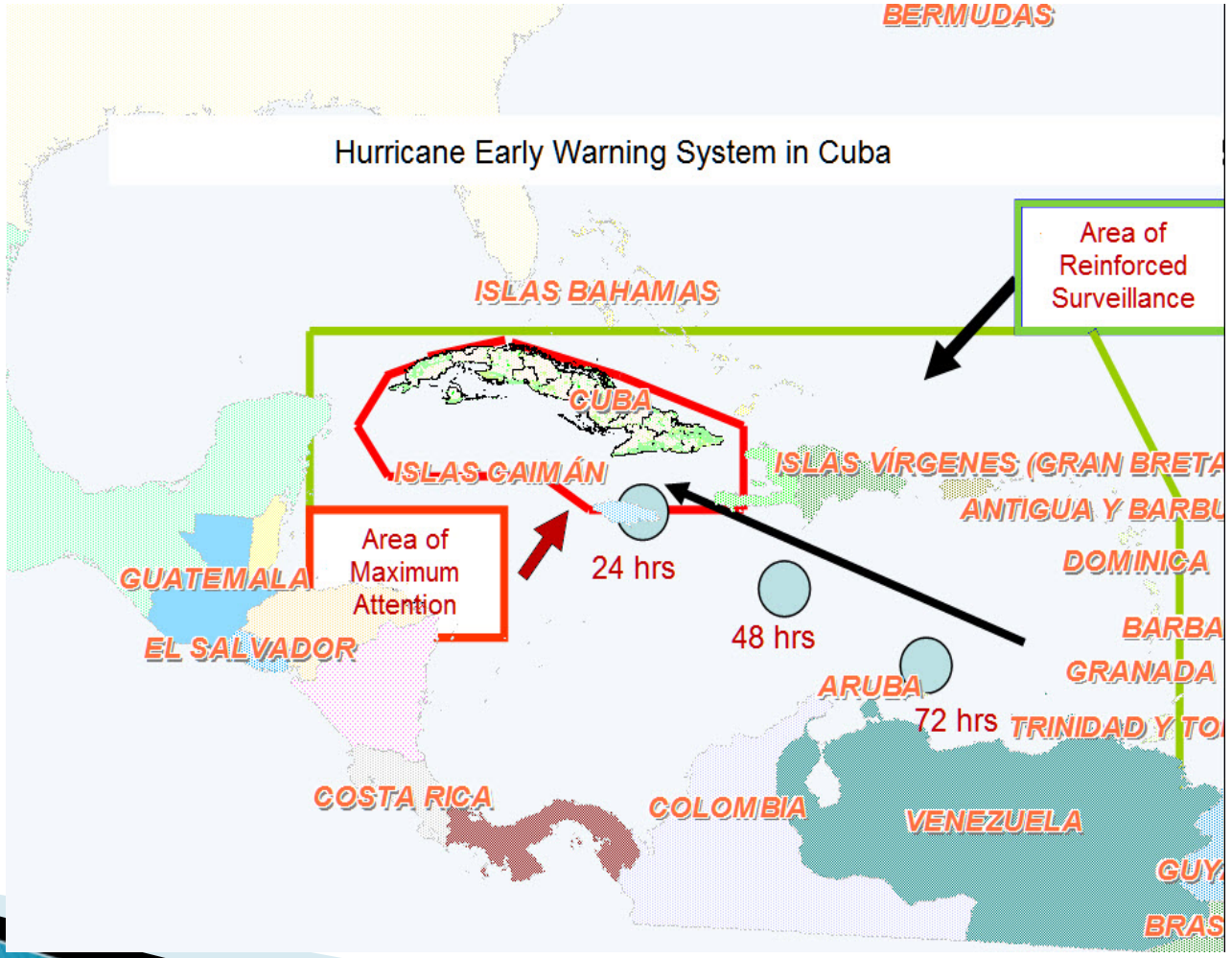
- **The Perception of Danger is gradually being created!!.**

Warning message development cycle

The Early Warning System for tropical hurricanes is organized and works along the following sequence:

The National Forecast Center of the Institute of Meteorology permanently monitors the formation and development of tropical cyclones from their formation in the West African coast and during their traveling across the Atlantic towards the Caribbean

1



The National Staff of the Civil Defense evaluates the warning and issues a notice for the governments of the threatened provinces and for the state organizations whose resources might be affected

2

The governments of the threatened provinces, take measures based on the risk level of each community, and the assessment of the local meteorological and hydrological services

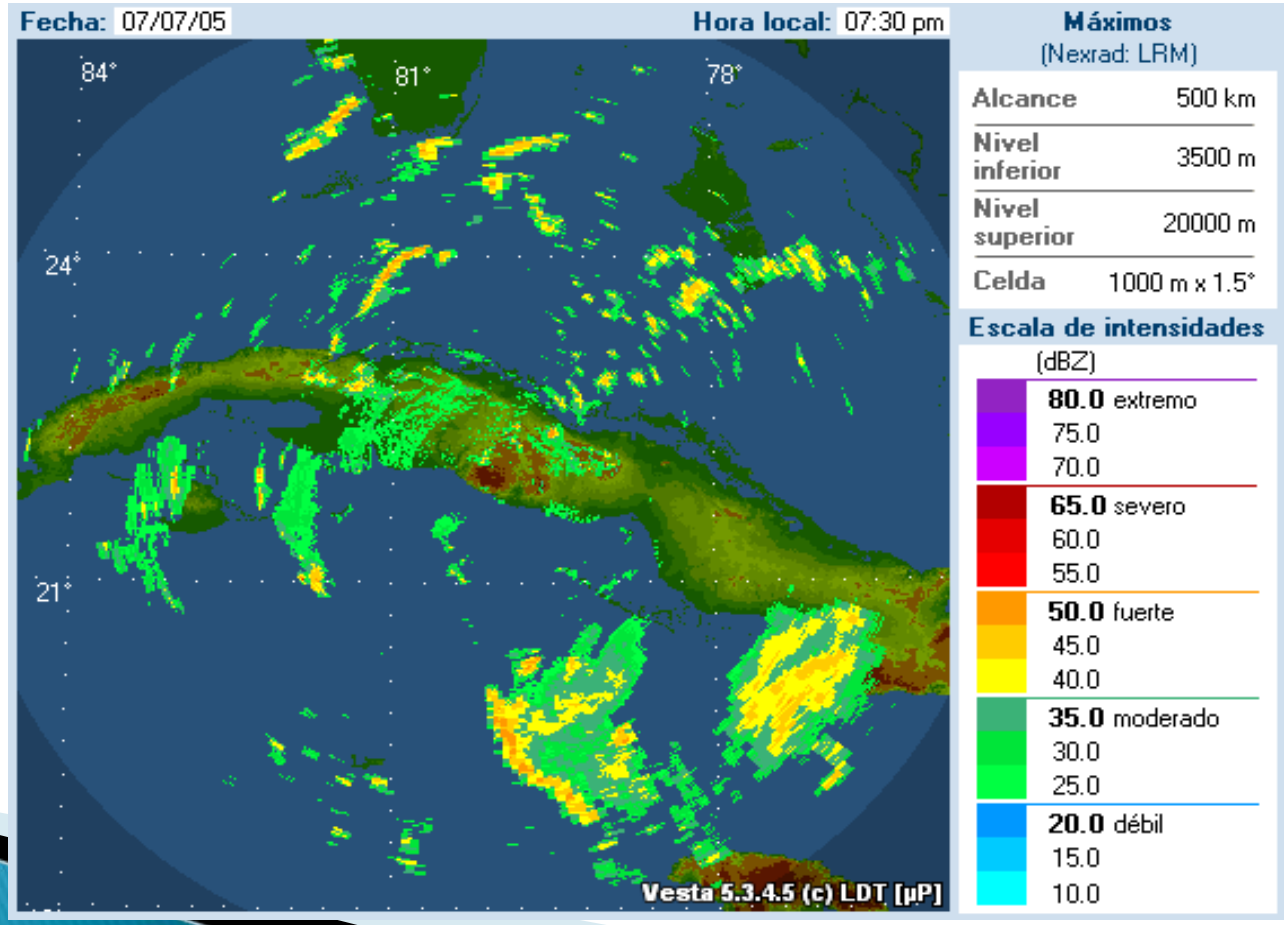
3

As the tropical cyclone continues to approach Cuba, the Meteorological Institute's Forecast Center increases the number of warnings describing in detail the future track and intensity of the hurricane, as well as the expected impact of winds, rains, storm surge and waves.

4

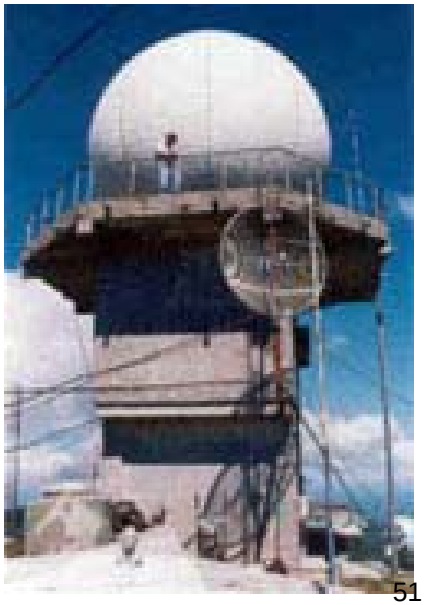
When it is estimated that the tropical cyclone could be affecting within the following 72 hours, the phases foreseen in the response stage are announced (Informative Phase (72 hours), Alert Phase (48 hours), and Alarm Phase (24hours)) by means of bulletins issued by the Civil Defense National Staff and broadcast over national and local radio and television.

5



6

The provincial meteorological centers evaluate the probable local impact of the precipitations and send the information to the hydrological service in the territory, which in turn estimates the potential for floods based on the situation of the water resources (level of water in the reservoirs, the canalization and drainage conditions, the soil saturation, and the hydrological condition of rivers.)



7

An assessment of the likely impact of winds and waves is conducted along similar lines, taking into consideration the structural vulnerabilities of housing, economic facilities and coastal settlements, which receive protection in accordance with their level of exposure and risk.

After the tropical cyclone stops being a hazard for the country, the recovery stage is declared, and the restoration of the damaged infrastructure and services begins, for which there are territorial and national plans.

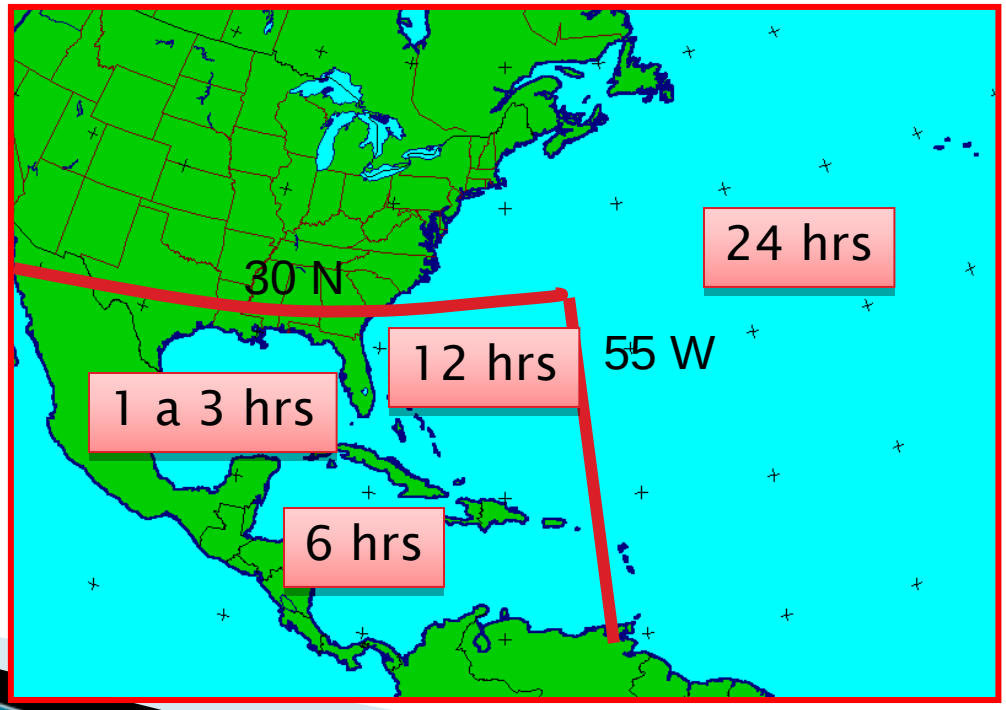
8

Warning dissemination mechanisms

•Early Warning messages begin to be issued by the National Forecast Center with 120 hours in advance of a possible impact, repeating them every 24 hours.

•When the Hurricane penetrates inside the area of surveillance of the Caribbean Sea, warnings are issued every 12 hours, and when the Hurricane ends up being a potential threat to Cuban territory in 72 hours or less, warnings begin to be issued every 6 hours.

•When the hurricane is very near the Cuban territory, warnings are issued continually every 3 hours or less.



Warning dissemination mechanisms

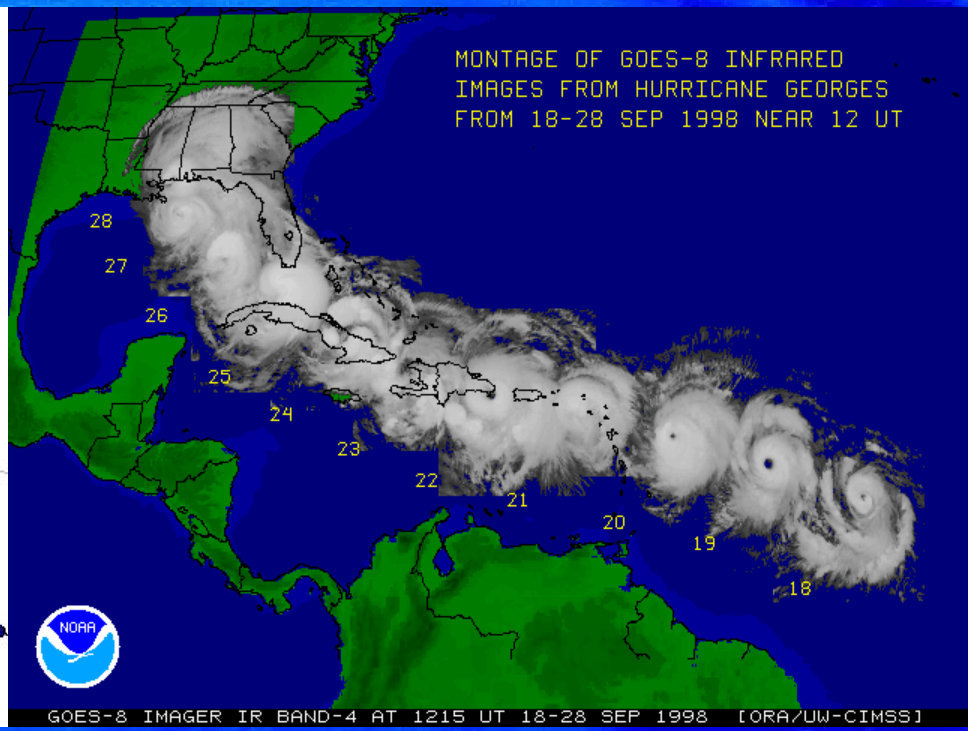
Radio, and very especially television, are very important tools for transmitting warnings.

Cuba has more than a television set for home and the TV signal arrives to 98% of the national territory, and almost to all of the population. This results in building a great awareness and interest among everybody, with frequent live direct broadcasts by meteorologists from the National Forecast Center.

Plain language is used, and also many details are given

A call is made for everyone's past experiences with hurricanes

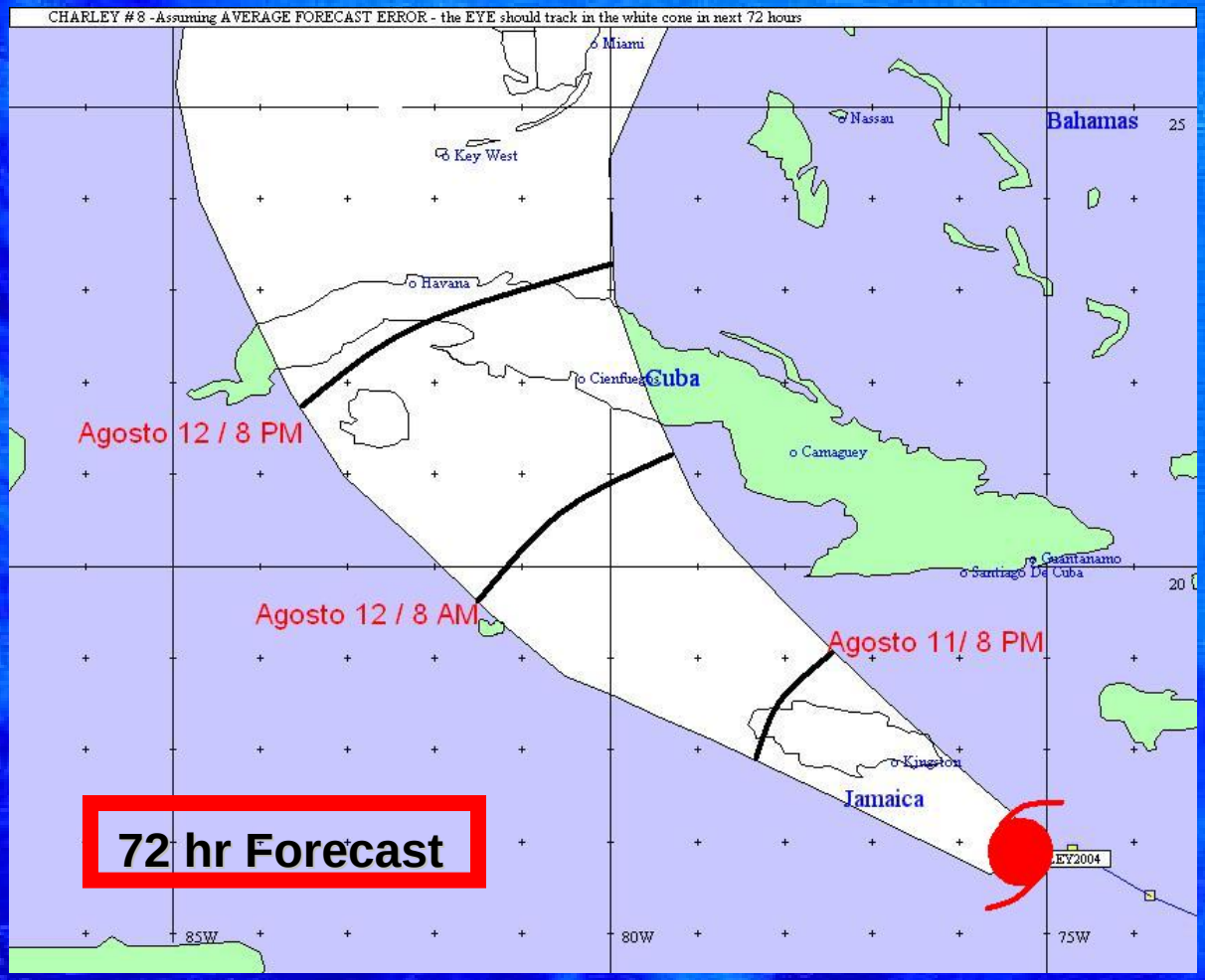
People is warned about some details that could drive to confusion, i.e. the hurricane is NOT a point.



And also that the main dangers are WINDS, FLOODINGS and STORM SURGE

The Use of Radar and Satellite Imagery in TV is very helpful to show the movement and the area covered by the Hurricane.

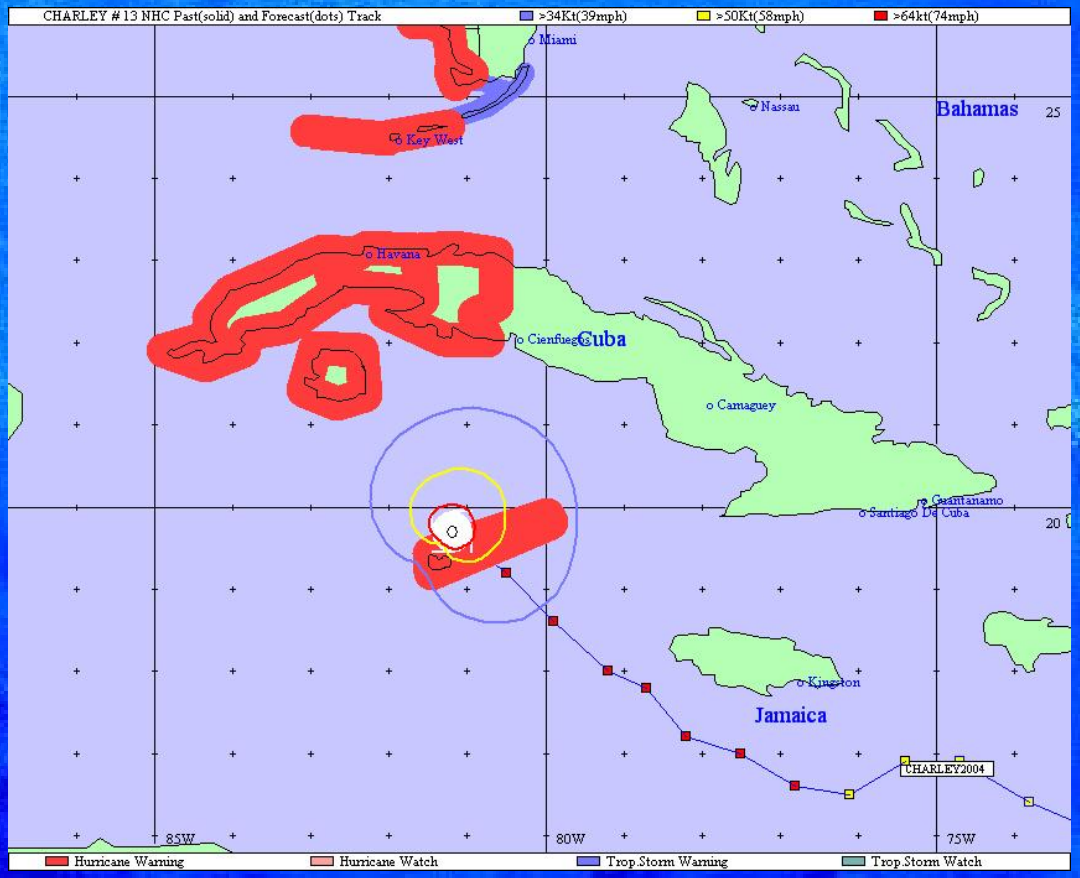
The Use of Probabilistic Cones to Address Uncertainties



Tropical Storm CHARLEY

Initial Pos.
Aug 11 / 12 noon
16.5 N 76.1 W 175 km SE Kinsgton, JAM 860 km SE Isle of Youth
Max.Sust.Winds: 110 km/h

The Areas under Warnings are clearly shown



MAIN ELEMENTS OF RESPONSE

- An adecuate apreciation of the event's main features and the level of risk for persons and the economical goods exposed
- A step by step implementation of all protective measures
- Timely protection of the population as well as their personal belongings.
- Permanent public information Información on the evolution of the hazards and the measures to take in each situation.
- A centralized System of Direction

Disasters Reduction Plans in Cuba are drafted at all levels, from the very basic People's Council to the provincial governments and from local to national economic entities and organizations, based on an assessment of the risk at each level

IMPROVEMENT OF OVERALL OPERATIONAL WORK IN EWS

- The feedback mechanisms that the NMS has been utilizing is the direct dialog with users, being these special users like the government and Civil Defense, or other users as Ministries, the Media, etc. Sometimes, written suggestions are also received. All suggestions are taken into consideration and they help to improve the forecast and warning service.

- Congratulations messages from many people and organizations, including Government, are received after each hurricane impact, for forecasts and warnings are generally successful.

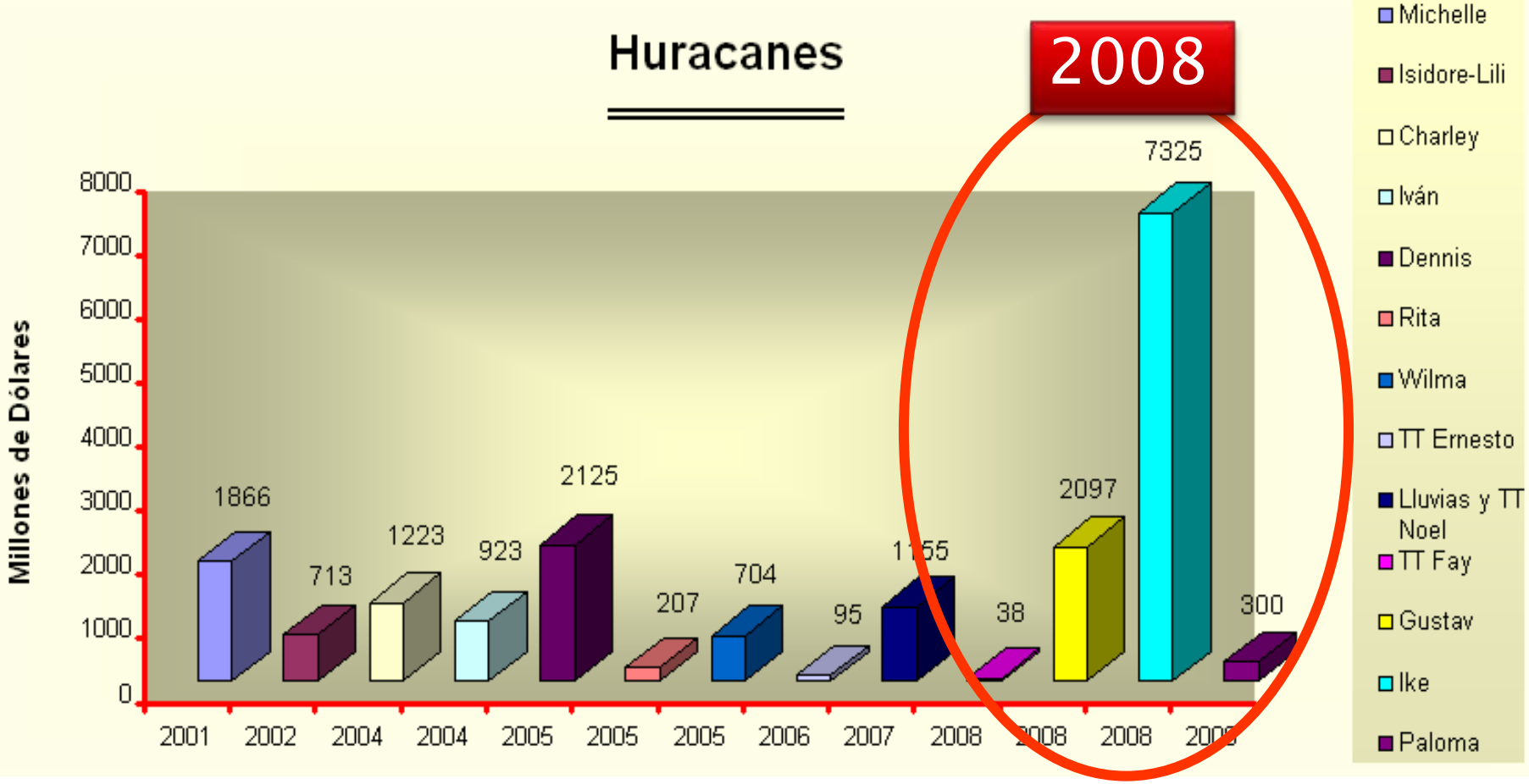
TROPICAL STORMS AND HURRICANES THAT HAVE AFFECTED CUBA SINCE 1995

NAME	YEAR	CATEGORY	DEATHS
Lili	1996	H2	0
Georges	1998	H1	6
Irene	1999	TT	2
Michelle	2001	H4	5
Isidore	2002	H1	0
Lili	2002	H2	1
Charley	2004	H3	4
Ivan	2004	H5	0
Dennis	2005	H4	16
Alberto	2006	TT	0
Ernesto	2006	TT	0
Noel	2007	TT	0

HURRICANE SEASON 2008 WAS ONE OF THE MOST ACTIVE EVER IN CUBAN HISTORY

NAME	YEAR	CATEGORY	DEATHS
Fay	2008	TT	0
Hanna (Indir.)	2008	TT	0
Gustav	2008	H4	0
Ike	2008	H3	7
Paloma	2008	H2	0

BUT ONLY 7 PEOPLE LOST THEIR LIV ES, MAINLY BECAUSE OF THE VICTIMS THEMSELVES, FOR SOME OF THEM DID NOT FOLLOW ACCORDINGLY THE ORIENTATIONS GIVEN BY THE CIVIL DEFENSE



ECONOMIC DAMAGES ARE GREAT

OVERALL LESSONS LEARNT AND FUTURE STEPS FOR IMPROVING THE SYSTEM

- The NMS needs human resources and a good infrastructure as well,
- Full coordination among the NMS, Civil Defense and the Media is needed,
- People's education is very important factor.

OVERALL LESSONS LEARNT AND FUTURE STEPS FOR IMPROVING THE SYSTEM

- Full discussion after any event leads to making things better next time,
- Increase even more people's education, mainly in aspects such as individual responsibility and discipline,
- Continue improving infrastructure of the NMS as far as economic factor permits

Thank you !

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