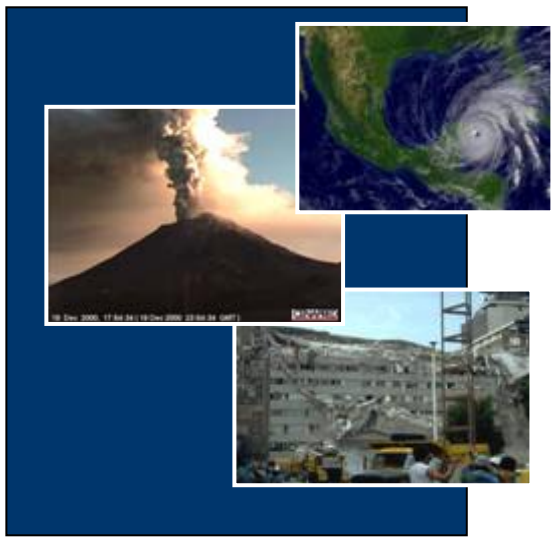

Monitoring and Warning Systems for Natural Phenomena The Mexican Experience

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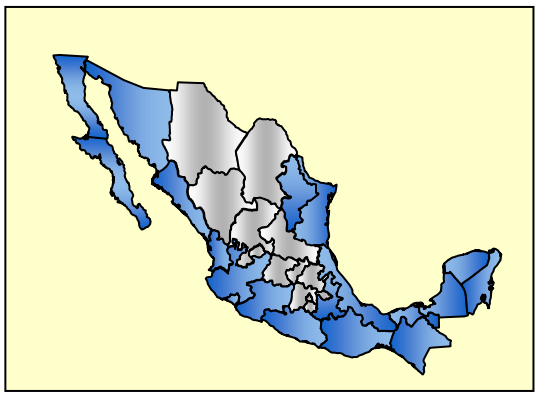
EWC III
Third International Conference on Early Warning
From concept to action

March, 2006

Mexico Hazard Profile

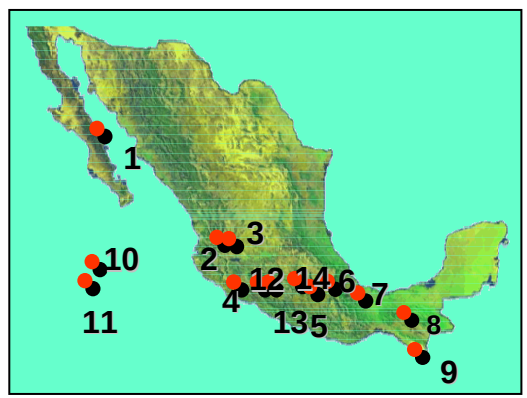
Phenomena	Area (Km2)	% del Nal territoy.	Inhabitants (millons)
Storms, hurricanes, floods	815’353	41%	31.3
Earthquakes	540’067	27%	31.0
Droughts	573’300	29%	21.2
Fires	747’574	37%	28.4



States exposed to the impact of hurricanes

2005, impact of hurricane Stan in Chiapas, Mex

Seismic Hazard



Active volcanoes in Mexico City

Mexico Disaster Profile

From 1900-1999 in Mexico occurred 101 great disasters(*):

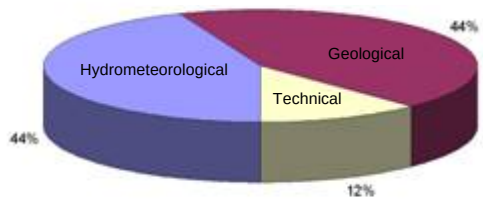
✓Hydrometeorological	59%
✓Geological	20%
✓Technological	19%
✓Sanitary	2%

1985 Earthquake (M=8.1) Impact in Mexico City

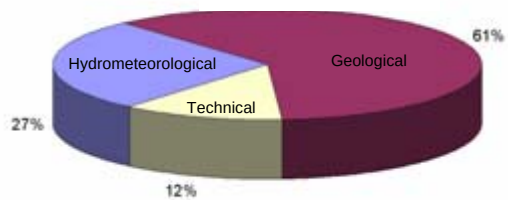
(**)

From	Deaths	Total losses (Millon USD)	Average death toll pear year	Average total losses per year (Mill USD)
1980-1999	10,114	14,547	500	700
2000-2004	1,304	2, 149	261	430

Economic Losses



Deaths



(*) Source: Diagnóstico de Peligros e Identificación de Riesgos,CENAPRED, 2000

(**) Source: D. Bitrán B.,Características del impacto socioeconómico de los principales desastres ocurridos en México, 2001

Strategy

To reduce these unacceptable figures, Mexico has established new initiatives to promote prevention and disaster risk reduction:

- It has been established in the **National Development Plan**, a policy to change from a reactive strategy to a preventive one (privilege prevention and disaster risk reduction, without distracting emergency management)
- The integration of a **National Risk Atlas**
- Funds for emergency management (FONDEN) and funds for **disaster prevention** (FOPREDEN, FIPREDEN)
- We recognize that Early Warning Systems are key elements in preventing and reducing the impact of disasters. Systems for three natural phenomena are discussed in this presentation:

✓ **Early Warning System for Tropical Storms** (coordinated by National Civil Protection authorities, close collaboration with Meteorological Service and National Center for Disaster Prevention, CENAPRED)

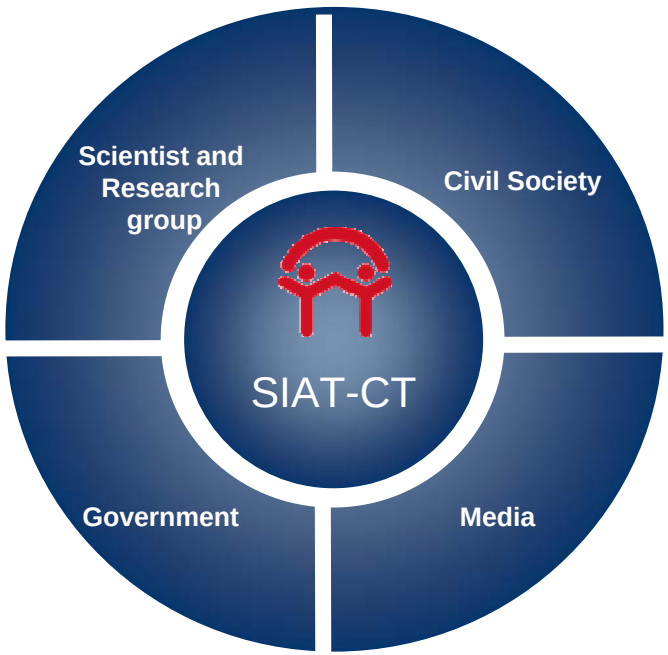
✓ **Warning System for an active volcano** (coordinated by Civil Protection and operated by CENAPRED, with participation of the National University of Mexico, and USGS)

✓ **Earthquake Alarm System** for Mexico City (operated by a civil association)

I will breafly describe the monitoring techniques, some forecast process and dissemination mechanisms.

EW for tropical cyclones (SIAT-CT)

Timely and adquate warning → **Communication mechanisms** → **Response**



PROGRAMS

PLANS

PROCEDURES

AGREEMENTS.

In the year 2000, SIAT was established by National Civil Protection Authorities and involves a close coordination and collaboration between different institution at federal, state and municipality levels, to timely alert people and the corresponding actions and procedures .

EW for tropical cyclones (SIAT-CT)

The system considers different stages of warning to different areas, depending on the characteristics of the cyclone

Promedio de Escalas	detección o más de 72	72 a 60 horas	60 a 48 horas	48 a 36 horas	36 a 24 horas	24 a 18 horas	18 a 12 horas	12 a 6 horas	menos de 6 horas
0 a 0.99									
1 a 1.99									
2 a 2.99									
3 a 3.99									
4 a 4.99									
5									

Approach Table / Front part of the cyclone

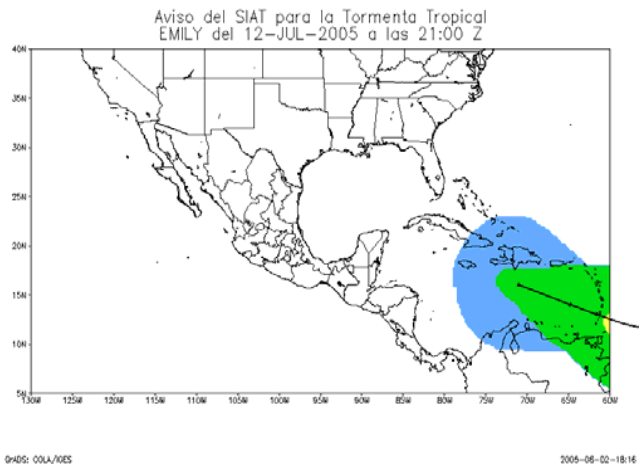
Promedio de Escalas	0 a 100 km	100 a 150 km	150 a 200 km	200 a 250 km	250 a 300 km	300 a 350 km	350 a 400 km	400 a 500 km	500 a 750 km	mayor a 750 km
0 a 0.99										
1 a 1.99										
2 a 2.99										
3 a 3.99										
4 a 4.99										
5										

Withdrawal Table / Back part of the cyclone

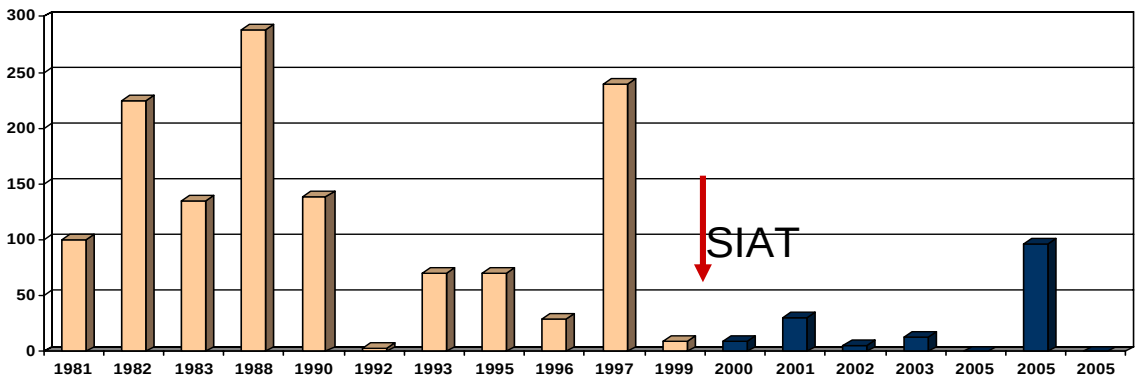
Scale based on:

E=0.5 (I + 0.0377R)

- Saffir-Simpson Scale
- Circulation Scale
- Transferring velocity
- Distance (34 knots wind line)

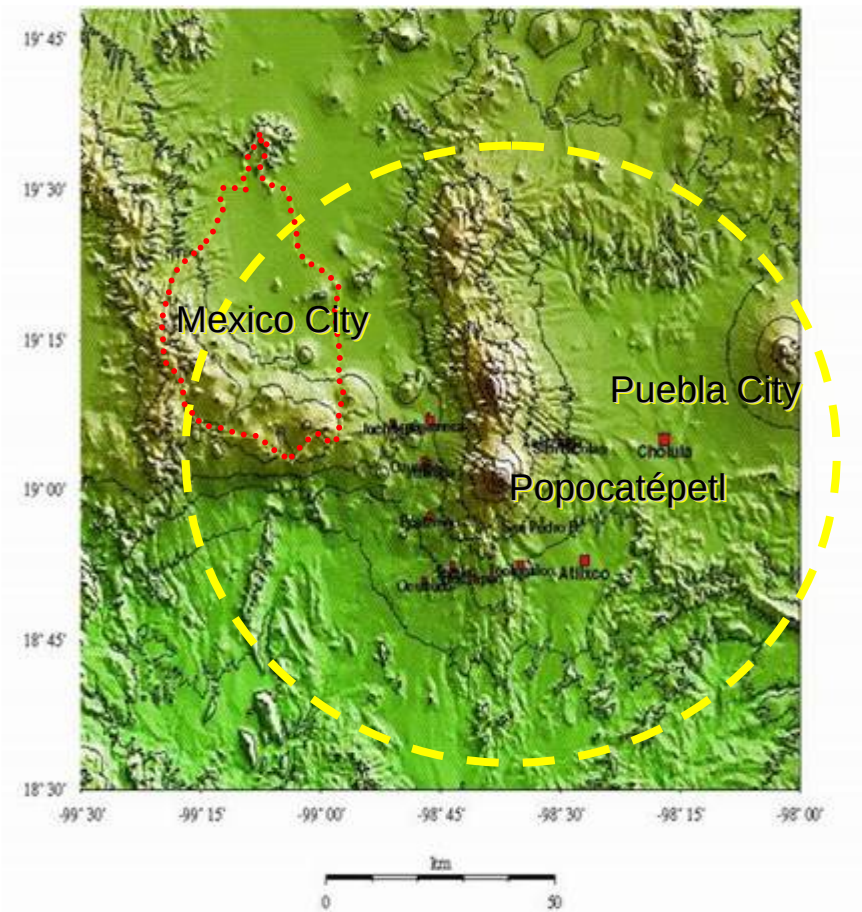


Impact of hurricanes in Mexico from 1981-2005 (deaths)*



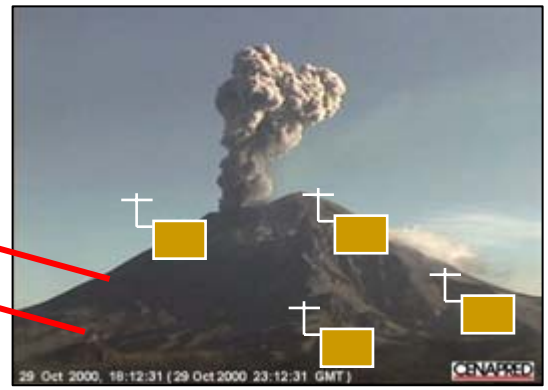
Popocatepetl monitoring and warning system

Popocatepetl (smoking mountains) is an active volcano with 13 eruptions in the last 500 years. Almost 20 million people live in a radius of 80 km around the volcano, approximately one fifth the population of Mexico.



Popocatepetl monitoring and warning system

RADIO



60 km

Central data acquisition and processing facility at CENAPRED

64 telemetry signals, 16 dedicated computers, warning and communication system

MONITORING:

- **Visual**
- **Seismic**
- **Geodesic**
- **Geochemical**

- **20 remote measurement points**

9 seismometers
4 tiltmeters
3 flow detectors
1 real-time hi-res video
1 infrared camera
1 automatic remote controlled EDM with 4 measuring points

- **Other measurements:**
  SO2 , COSPEC
  CO2 , LICOR
  Chemical analysis of ash and water springs
  Satellite images, infrasonic sensor

Popocatepetl monitoring and warning system

CENAPRED

INSTRUMENTATION AND MONITORING

CENTRAL RECORDING STATION AT CENAPRED

HAZARD MAP

SCIENTIFIC COMMITTEE

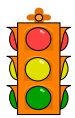
AUTHORITIES
CIVIL PROTECCION

AIR TRAFFIC CONTROLLERS

POPOTEL
(TELEPHONE MESSAGES)

POPOBIP
(PAGER MESSAGES)

INTERNET
(BULLETINS)



VOLCANIC
TRAFFIC LIGHT

- Emergency planning (coordinates actions and procedures between federal gov, 5 states, and army

- Public preparedness
- Implementation of warnings and communication of information procedures

Popocatepetl monitoring and warning system

The ***Traffic Light Alert*** translates the diagnostic of the scientific group into a scale of risk levels, expressed in terms of the most probable scenarios that may develop in a given time scale, as well as into actions to be taken by Civil Protection Authorities and the population

Decision – Making group

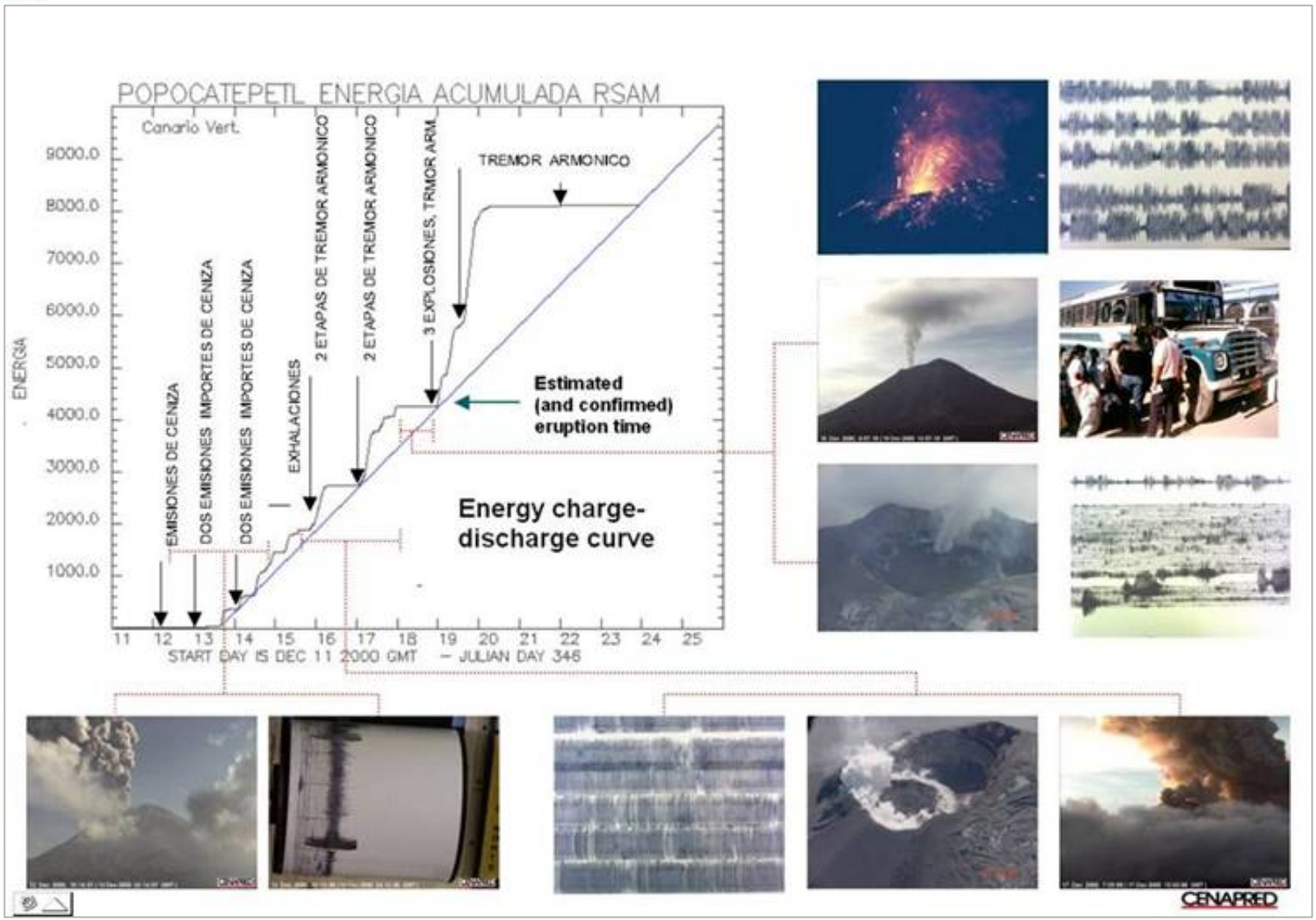
Scientists, operators and watchers at the observatory

Scientific Committee

Emergency Committee (Green and Yellow Phase): Civil Protection authorities, scientists, other government officials

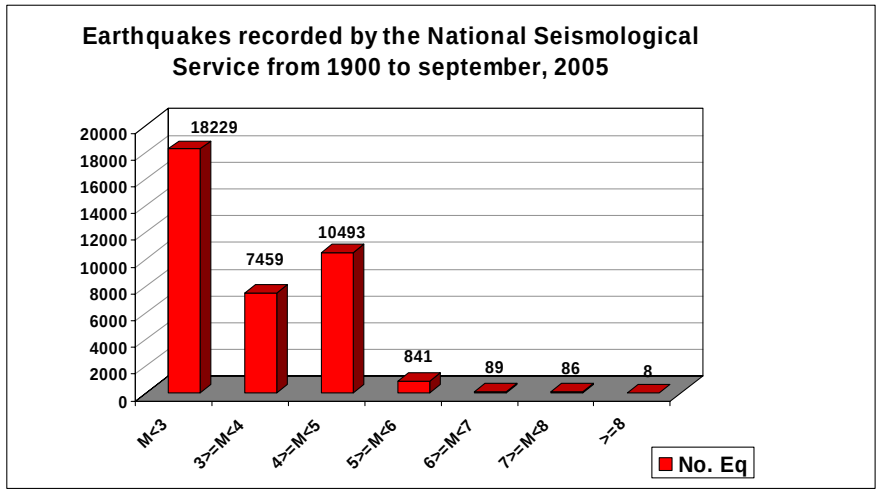
Emergency Committee (Red Phase): President, State Secretaries, State Governors, Top Civil Protection authorities, invited scientists, other high level government officials

Popocatepetl monitoring and warning system



Earthquake Alarm System

Mexico is located in a high seismic region. In average, every year an earthquake of M>6.5 occurred

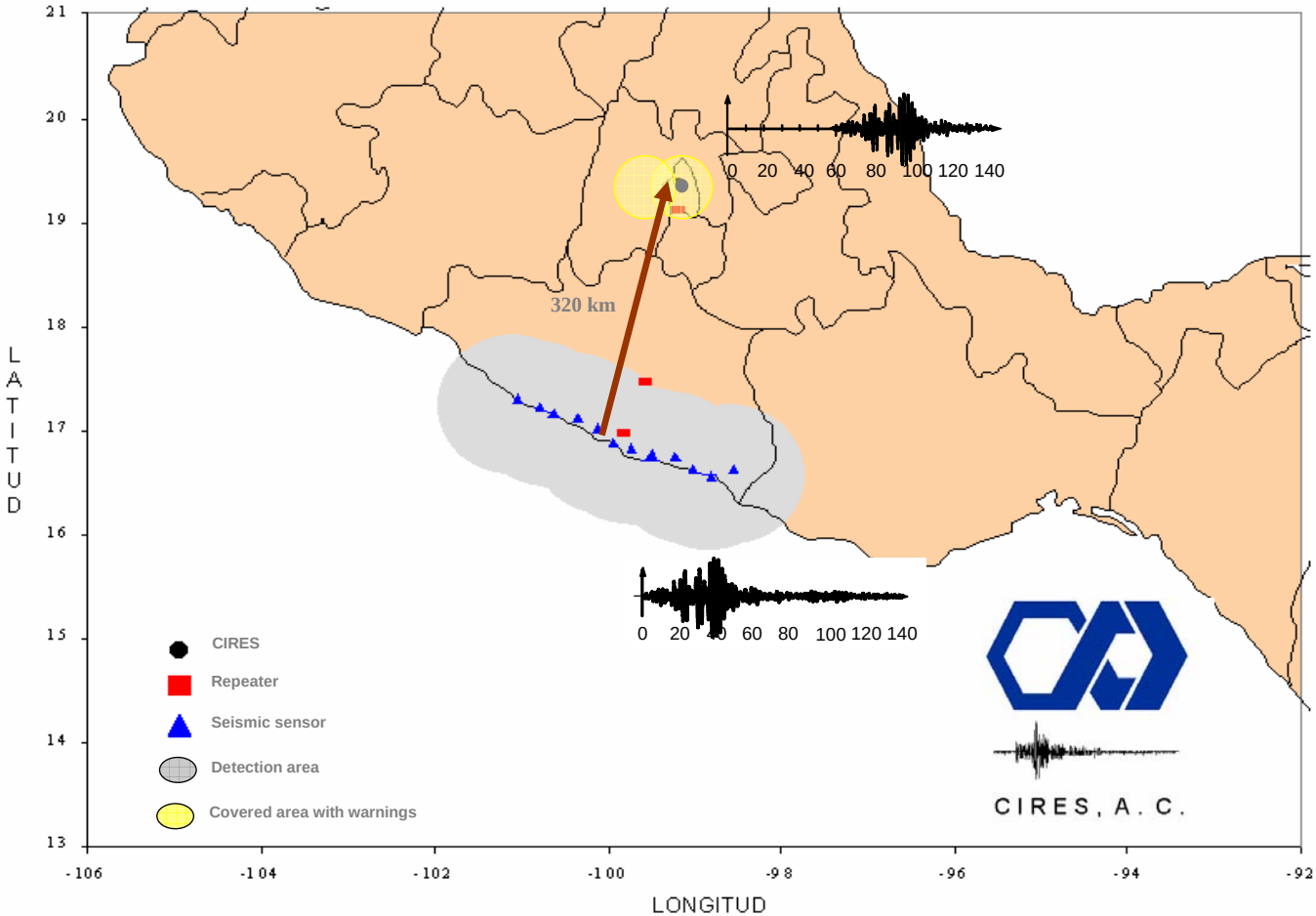


Source: National Seismological Service, UNAM

V. Kostoglodov, J. Pacheco, Instituto de Geofísica, UNAM

Mexico City is located about 300 km far from an identified seismic gap, which has a high potential to rupture in a major earthquake.

Earthquake Alarm System



Lessons learned

- Although there are different agencies and institutions involved in different hazards, it has been a good practice that National Civil Protection Authorities **coordinate** warning systems (EW for cyclones and Popocatepetl volcano)
- Coordination of national authorities with local authorities is an essential element
- It has been useful the use of a traffic light alert that translate the forecast or diagnosis of the scientific and monitoring group into a scale of risk levels, expressed in terms of the most probable scenarios that may develop in a given time scale as well as into action to be taken by Civil Protection Authorities and the population
- It has been important to test the effectiveness of the warning systems, including dissemination process and response
- The implementation of Early Warning Systems in Mexico have undoubtedly contributed to prevention. We also recognize that there are still many aspects to improve and consider.

Recommendations

- Early Warning Systems for different hazards should be, when possible, coordinated by a national authority, having a close coordination with the different actors involved (local, scientific, media, etc.)
- There should be consistency in terminology of warnings of different hazards and dissemination mechanisms
- Risk assessment for different phenomena should be clearly identified and promote consciousness and preparation among authorities, stakeholders, media and public
- The establishment of different alert levels for different hazards should be very well defined and they should correspond to specific actions and procedures to be taken by authorities and public
- National funds should be available for the implementation and maintenance of warning systems
- There is a need to test early warning dissemination mechanisms and response, improve and correct them
- Involvement of scientific and specialists of different hazards its an essential factor