NATIONAL REPORT
Submitted by NICARAGUA

BASIC INFORMATION

1. ICG/PTWS Tsunami National Contact (TNC)
   The person designated by a Member State to an Intergovernmental Coordination Group (ICG) to represent his/her country in the coordination of international tsunami warning and mitigation activities. The person is part of the main stakeholders of the national tsunami warning and mitigation system. The person may be the Tsunami Warning Focal Point, from the national disaster management organization, from a technical or scientific institution, or from another agency with tsunami warning and mitigation responsibilities.

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   Title: Director of the Geological and Geophysical Department of INETER
   Organization: Instituto Nicaraguense de Estudios Territoriales (INETER)
   Postal Address: Frente a Hospital Solidaridad. Apdo. Postal 2110 Managua, NICARAGUA
   E-mail Address: angelica.munioz@gf.ineter.gob.ni
   Telephone Number: +505-22492761 ext 122

2. ICG/PTWS Tsunami Warning Focal Point (TWFP)
   A 24 x 7 point of contact (office, operational unit or position, not a person) officially designated by the NTWC or the government to receive and disseminate tsunami information from an ICG Tsunami Service Provider according to established National Standard Operating Procedures. The TWFP may or not be the NTWC.

   TWFP Agency name: Instituto Nicaraguense de Estudios Territoriales (INETER)
   Name: Instituto Nicaraguense de Estudios Territoriales (INETER)
   Position: Sismología
   Telephone Number: +505-22492761 ext 122
   Email Address: sismologia@gf.ineter.gob.ni
   Postal Address:

   TWFP 24x7 point of contact (office, operational unit or position, not a person):

   Name of office, operational unit or position:
   E-mail Address:
   Telephone Number:
   Cellular phone number:
   Fax:

National Tsunami Warning Centre (if different from the above)
A centre officially designated by the government to monitor and issue tsunami warnings and other related statements within their country according to established National Standard Operating Procedures
3. Tsunami Advisor(s), if applicable

(Person, Committee or Agency managing Tsunami Mitigation in country)

Name:
Title:
Postal Address:
E-mail Address:
Emergency Telephone Number:
Emergency Fax Number:
Emergency Cellular Telephone Number:

4. Tsunami Standard Operating Procedures for a Local Tsunami

(when a local tsunami hazard exists)

- What organization identifies and characterizes tsunamigenic events?

The Instituto Nicaraguense de Estudios Territoriales (INETER, gubernamental institution, largest geosciences institution in Central America) identifies tsunamigenic events. The seismic activity is monitored by the seismic datacenter at INETER (27x7, 2 watch persons) using online data from 88 stations in Nicaragua, around 100 stations from other countries in Central America and around other 200 stations worldwide. Data processing is carried out by a number of SeisComP3 systems. The Operation Center of Civil Defense and SINAPRED has a graphical client of INETER’s SeisComP3 which presents in real time the graphical (Epicentral Map) and alphanumeric information of the occurring seismic events. First seismic event characterizations should be available within 1 minute for events in Nicaragua. Tsunami warning should be declared within 5 minutes.

- What is the threshold or criteria for declaring a potential tsunami emergency?

INETER recommends a tsunami alert for the Pacific coast when an earthquake is detected below or near the Pacific Ocean of Nicaragua or Central America with a magnitude above 6.8 and a depth below 70 km. As soon information from the PTWC becomes available INETER reconsiders its recommendation and adapts the tsunami alert recommendation in a conservative manner for the population.

- What organization acts on the information provided by the agency responsible for characterizing the potential tsunami threat?

INETER communicates the tsunami information to
1) The Presidency of Nicaragua,
2) The National System of Disaster Prevention (SINAPRED),
3) Center of Operations of the Civil Defense of Nicaragua.

The President of Nicaragua decides about the declaration of the emergency. SINAPRED informs all related parts of the national disaster prevention system about the emergency and coordinates their efforts to mitigate the impact to the population and infrastructure. Civil Defense activates the 60 automatic sirens on the Pacific Coast, communicates the emergency to the Army of Nicaragua and coordinates the efforts for the evacuation of the population under risk. Civil Defense monitors via INTERNET the results of PTWC, NEIC, seismic data centers in Central America. If the communication to INETER and/or Presidency fails (e.g. due to the impact of the earthquake) and they became aware about a possible tsunami thread they would emit tsunami warning to the population by their own decision observing the thresholds defined in the national tsunami protocols.
• *How is the tsunami information (warning, public safety action, etc) disseminated within country?  Who is it disseminated to?*

Tsunami information is disseminated by means of
- 60 automatic sirens to alarm the population on the coast line.
- Radio communication to local authorities and natural leaders on the coast
- Electronic mail and SMS to national, regional and local authorities.
- National mass media as radio and television

• *How is the emergency situation terminated?*

The emergency situation is terminated by the recommendation of INETER,
1) When no tsunami is detected within the predicted arrival time plus 3 hours;
2) When, after a tsunami was detected, the tsunami amplitudes remains below 30 cm during 3 hours.

5. *Tsunami Standard Operating Procedures for a Distant Tsunami (when a distant tsunami hazard exists)*

INETER identifies also distant tsunamigenic events. The seismic activity is monitored by the seismic datacenter at INETER (27x7, 2 watch persons. First seismic event characterizations should be available within 5-15 minute for remote events in the Pacific Ocean. Information about a possible Tsunami emergency should be declared within 5 minutes after knowing of the tsunami generic event.

• *What is the threshold or criteria for declaring a potential tsunami emergency?*

INETER recommends a tsunami alert for the Pacific coast when an earthquake is detected below or near the Pacific Ocean with a magnitude above 7.0. As soon information from the PTWC becomes available INETER will consider its recommendation and adapt the tsunami alert recommendation in a conservative manner for the population.

• *What organization acts on the information provided by the agency responsible for characterizing the potential tsunami threat?*

INETER communicates the tsunami information to
1) The Presidency of Nicaragua
2) The National System of Disaster Prevention (SINAPRED)
3) The Civil Defense of Nicaragua

The President of Nicaragua decides formally about the declaration of the emergency.
SINAPRED informs all related parts of the national disaster prevention system about the emergency and coordinates their efforts to mitigate the impact to the population and infrastructure.
Civil Defense activates the 60 automatic sirens on the Pacific Coast, communicates the emergency to the Army of Nicaragua and coordinates the efforts for the evacuation of the population under risk.
Civil Defense monitors via INTERNET the results of PTWC, NEIC, seismic data centers in Central America. If the communication to INETER and/or Presidency fails (e.g. due to the impact of the earthquake) and they became aware about a possible tsunami threat they would emit tsunami warning to the population by their own decision observing the thresholds defined in the national tsunami protocols.

• *How is the tsunami information (warning, public safety action, etc) disseminated within country?  Who is it disseminated to?*

Tsunami information is disseminated by means of
- 60 automatic sirens to alarm the population on the coast line.
- Radio communication to local authorities and natural leaders on the coast
- Electronic mail and SMS to national, regional and local authorities.
- National mass media as radio and television

• *How is the emergency situation terminated?*
The emergency situation is terminated by the recommendation of INETER based on the recommendation of PTWC.

6. **National Sea Level Network**

*Please include a table with position and description of stations/sensors, and a map.*

*(Includes stations on the Pacific and Caribbean coasts)*

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Station Name (Station Code)</th>
<th>Coordinates</th>
<th>Sampling Rate</th>
<th>Transmission Interval</th>
<th>Means for Data Collection</th>
<th>Power</th>
<th>Observation Components</th>
<th>Responsible Institution</th>
<th>Inspection Interval</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>Puerto Corinto (cori)</td>
<td>12° 29'00&quot; 87° 10' 03&quot;</td>
<td>10 Min</td>
<td>1 Hour</td>
<td>Satellite transmission</td>
<td>Solar</td>
<td>Sea level (m)</td>
<td>INETER/DGRH</td>
<td>6 Months</td>
<td>Under Operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Water Temperature</td>
<td>INETER/DGRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Wind speed &amp; direction</td>
<td>INETER/DGRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Precipitation</td>
<td>INETER/DGRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>Puerto Corinto</td>
<td>12° 29'00&quot; 87° 10' 03&quot;</td>
<td>10 Min</td>
<td>5 Min</td>
<td>Satellite transmission</td>
<td>Solar</td>
<td>Sea level (m)</td>
<td>INETER/DGGG</td>
<td>6 Months</td>
<td>Start from 2003 Currently Interrupted</td>
</tr>
<tr>
<td>Pressure</td>
<td>Puerto San Juan del Sur (sjds)</td>
<td>11° 15' 04&quot; 85° 52' 30&quot;</td>
<td>10 Min</td>
<td>1 Hour</td>
<td>Satellite transmission</td>
<td>Solar</td>
<td>Sea level (m)</td>
<td>INETER/DGRH</td>
<td>6 Months</td>
<td>Currently Interrupted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Water Temperature</td>
<td>INETER/DGRH</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>10 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Wind speed &amp; direction</td>
<td>INETER/DGRH</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>10 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Precipitation</td>
<td>INETER/DGRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>Puerto Sandino (psdn)</td>
<td>12° 12' 38&quot; 86° 45' 52&quot;</td>
<td>10 Min</td>
<td>1 Hour</td>
<td>Satellite transmission</td>
<td>Solar</td>
<td>Sea level (m)</td>
<td>INETER/DGRH</td>
<td>6 Months</td>
<td>Under Operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Water Temperature</td>
<td>INETER/DGRH</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>10 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Wind speed &amp; direction</td>
<td>INETER/DGRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>Corn Island (cois)</td>
<td>12° 19' 38&quot; 83° 04' 04&quot;</td>
<td>10 Min</td>
<td>1 Hour</td>
<td>Satellite transmission</td>
<td>Solar</td>
<td>Sea level (m)</td>
<td>INETER/DGRH</td>
<td>6 Months</td>
<td>Under Operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 Min</td>
<td>1 Hour</td>
<td></td>
<td></td>
<td>Water Temperature</td>
<td>INETER/DGRH</td>
<td></td>
<td></td>
</tr>
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<td>Pressure</td>
<td>Masachapa</td>
<td>Located between Puerto Sandino and Puerto San Juan del Sur</td>
<td>1 Min</td>
<td>1 Min</td>
<td>WIFI</td>
<td>Solar</td>
<td>Sea level (m)</td>
<td>INETER/DGGG</td>
<td>6 Months</td>
<td>Start 2007 Currently Interrupted</td>
</tr>
</tbody>
</table>

DGGG – maintained by INETER/Dirección de Geología y Geofísica (Geology and Geophysics Department)
DGRH – maintained by INETER/Dirección de Recursos Hídricos (Hydrological Resources Department)
7. **Information on Tsunami occurrences**  
*Please include sea level observations, pictures, wave arrival descriptions, public, media, or other responses to warnings, lessons learned, etc.*

The known strongest tsunami which affected the Pacific coast of Nicaragua occurred on September 1, 1992, and was caused by a magnitude 7.7 earthquake. It was a slow earthquake with very low seismic intensities. 170 persons were killed and there was extended destructions of infrastructure along all the coast. Maximum run-up heights were nearly 10 meters. In general, all the Pacific coast had run-up heights of around 3 to 4 meters.

Only 20 years later, on August 26, 2012 occurred again a slow earthquake with a magnitude of 7.3 off shore of the Gulf of Fonseca, between Nicaragua and El Salvador. It caused waves which affected with run-up heights of around 5 meters very locally an area in the northern part of the Nicaraguan coast Pacific coast and also an area on the coast of El Salvador. Both areas are very sparsely populated. People were affected but not harmed. The low seismic intensities and the low magnitudes originally computed by INETER and NEIC caused some confusion. As soon PTWC transmitted a corrected magnitude based on distant seismic stations a tsunami warning was emitted, but with an internal procedure transmitting the messages only to military and local administration officials on the coast, the population was not informed. If there had been detected a wave occurrence in a larger settlement a full warning would have been emitted.

Tsunami warnings were transmitted to the public on September 5, 2012 due to a magnitude 7.4 earthquake on the Nicoya Peninsula, Costa Rica and a 7.3 earthquake on the Pacific coast of Guatemala.

On October 13, 2014 a magnitude 7.2 earthquake which led to the emission of a tsunami warning for the Nicaragua Pacific coast.

8. **Web sites (URLs) of national tsunami-related web sites**

http://www.ineter.gob.ni/

9. **Summary plans of future tsunami warning and mitigation system improvements.** *This information will be used to aid the development of the PTWS Medium Term Strategy and the PTWS Implementation Plan.*

**NATIONAL PROGRAMMES AND ACTIVITIES INFORMATION**

The Nicaraguan government has initiated a process to improve the work of INETER related to the seismic and tsunami monitoring and the general warning system on geologic hazards in Nicaragua and to promote a corresponding activities in Central America. These improvements respond to the problems and necessities identified in the last years during seismic and tsunami emergencies especially in the large seismic events in Central America in 2012, the tsunami of 26 of August, 2012, in El Salvador and Nicaragua, the magnitude 7.2 earthquake on October 13, 2014, and the destructive earthquakes near Managua in April, 2014. Also the lessons learned from the destructive tsunamis in Chile 2010 and Japan, 2011, were taken into account.

**INETE Seismic Network**

In June, 2014, 25 new accelerometer stations were installed around Managua and in larger cities near the Pacific coast of Nicaragua.

The seismic network counts now WITH 88 seismic stations. All stations are digital and are transmitted in real time to the data center.

In 2015, the installation of least 20 new seismic stations is planned.
Integration of seismic stations from the Central American region and from the global network

The number of stations data of which are received in real time from the other Central American countries was considerable increased: 10 from Guatemala, 10 from Honduras, 15 from El Salvador, 50 from Costa Rica, 3 from Panama.

GPS network

INETER has acquired 30 high precision GPS and is planning to use them as permanent GPS stations for volcano and tsunami warning. Some GPS will be used as mobile equipment for a large number of geodetic sites for tectonic and volcanic monitoring.

INETER seismic datacenter

Considerable upgrades of the seismic data acquisition and processing system were carried out in 2014 and 2015. The automatic SeisComP3 system was extended to guarantee redundancy of data processing. The software is now running on new servers.

Personnel working 24x7

The number of staff being present in the 24x7 shift was increased to 2 persons. There is a total number of 13 persons working 24x7. In case of an emergency additional staff rushes to the center to help with data processing and communication.

Formal capacitation of personnel

INETER together with the National University UNAN is carrying out, since November 2014, an extensive program to capacitate scientific personnel in seismology. A number of 30 young geophysicists and electronics/informatics engineers from INETER’s existing permanent staff, from other institutions, and from a group of temporary contracted young scientists are trained in a postgraduate course on the UNAN. The duration of the course is 9 months occupying 2 days the week. The professors of the course are doctors in seismology from Nicaragua and Cuba. It is pretended to integrate some the best students of the course in the monitoring and early warning system of INETER.

An INETER scientist is studying 2014-15 in Japan for a Master’s degree on tsunami mitigation.

For the period 2015-2016 another two young scientist from INETER will study on seismology and tsunami mitigation in Japan.

Ineter personnel participated in capacitation courses of the PTWS and CTWS on tsunami warning, and the new warning products in Hawaii and Mexico.

Capacitation during work

INETER is actually employing a number of 15 young scientists and electronic/informatics engineers on a temporary base to train them during work with experienced staff in seismic monitoring, seismic network development/maintenance, tsunami warning, volcano monitoring and warning. A part of this group will remain at INETER to reinforce the staff working in the monitoring and early warning. Others will pass to other institutions.

Tsunami exercises

Nicaragua has participated in the tsunami warning exercise Pacific Wave 2015 organized within the frame of ICG/PTWS.

SINAPRED together with Civil Defense, INETER and other institutions on the national and local level has carried out its own tsunami warning exercises for the Pacific coast of Nicaragua. This simulations were carried out both on a national scale as well on local scale.

Public education or other measures taken to heighten awareness of the tsunami hazard and risk

SINAPRED leads a large number of activities and projects on the education on general disaster prevention topics and especially on tsunami preparation, warning and mitigation.

Each year, during the Easter week (main holiday season) information and education activities are carried out on the beaches and tourist centers. Tens of thousands of leaflets and other information material on tsunami hazard, warning and evacuation are distributed to the residents, visitors and national and international tourists.

Tsunami hazard identification

Since 1992, INETER has worked and has participated in international projects on the understanding and identification of tsunami generation mechanisms in Nicaragua and Central America. As the most dangerous tsunami source is identified the subduction zone in the Pacific Ocean. Strong earthquakes in the fault zone between Nicaragua and Costa Rica can generate tsunamis and seiches in Lake Nicaragua. Recently, indications appeared that the earthquake which destroyed Managua has generated a small tsunami in Lake Managua. Large landslides on volcanoes and collapses were identified in Lake Nicaragua which certainly have generated tsunamis several thousand years ago. Geological evidences were found on tsunami occurrence in Lake Managua caused by volcanic explosions, several thousand years ago. Volcanic explosions, Piroclastic flows, landslides and collapses in the Fonseca Bay are assumed to generate tsunamis which would affect El Salvador, Honduras and Nicaragua.

Tsunami hazard mapping

INETER has elaborated, since 1992, a number of 50 tsunami hazard maps in different scales and methods. All larger settlements on the Pacific coast of Nicaragua count with hazard and evacuation maps.

Most of the maps were elaborated with simple methods using the height above sea level as an indicator for the hazard level. The local population and local authorities participated actively in the process. The mapping projects were carried out in projects with DIPECHO, Nicaraguan Red Cross, Swiss technical cooperation, German technical Cooperation, Japanese technical cooperation. With the Japanese Technical cooperation, tsunami hazard maps based on numerical simulation were elaborated for the largest settlements on the Pacific coast as are Corinto, Puerto Sandino, Masachapa, San Juan del Sur. Within a project on the use of GIS-Technology for Disaster Mitigation with the German technical cooperation the (Federal Institute of Geosciences and Resources, BGR) and in cooperation with MARN in El Salvador and COPECO in Honduras there INETER elaborated 20 hazard and evacuation maps for towns, villages and smaller settlements on the coast of the Fonseca Gulf, a large bay of the Pacific Ocean shared by El Salvador, Honduras and Nicaragua.

The products of the mapping projects were distributed to the population, to SINAPRED, other institutions in Nicaragua and are available on INETER’s Website.

Regional cooperation

Nicaragua as the chair of the Regional Working Group for Central America (WG-CA) took the lead for the improvement of tsunami warning in all the region.

Three meetings of the WG-CA were organized with the help of IOC, PTWS. In the third meeting, in September 2014 in Managua, representatives from all central American countries of the scientific institutions responsible for tsunami warning and civil protection institutions responsible for mitigation measures decided to support the proposal of Nicaragua to establish at INETER, Nicaragua, a regional Tsunami Warning Center. Furthermore they decided to support the proposal of Nicaragua to forma a common regional seismic network to aid tsunami warning and other applications for earthquake information and early warning.
The Directorate of CEPREDENAC (Central American Center for Disaster Prevention) which consists of the directors of the Civil Protection Institutions of all Central American countries decided in its meeting of to support CATAC and Regional seismic network.

In a recent virtual meeting via Skype, the scientific institutions in Central America engaged in tsunami warning reiterated their support already given in the meeting of September 2014. They also sent supportive letters to INETER for draft recommendations about CATAC to be adopted by the ICG/PTWS meeting in Hawaii, 22-24 of April, 2015

International cooperation

Nicaragua has started a close cooperation with the Us Geological Survey on the seismic monitoring network. The aim is to improve the quality of the seismic stations, to establish new data processing techniques for data quality control (PQLX), Shake Map calculations in real time real time. Seismologists, electronic and informatics engineers of INETER engaged in seismic monitoring and tsunami warning will receive training from USGS.

INETER was established as the National data center of the CTBTO system, seismic and other data relevant for tsunami warning can be received from the CTBTO network.

At INETER there was established a mirror of the UNAVCO regional GPS network, and data could be used for tsunami warning as soon adequate methods are available.

10. EXECUTIVE SUMMARY

Brief statement of no more than one page addressing all items discussed in the National Report. Should include description of innovations or modifications to National tsunami warnings procedures or operations since last National Report, tsunami research projects, tsunami mitigation activities and best practices (especially in preparedness and emergency management), as well as public education programmes or other measures taken to heighten awareness of the tsunami hazard and risk.

Nicaragua is carrying on a process to improve considerable the seismic and tsunami monitoring and the warning system in the country and to promote a corresponding activities in Central America. These improvements respond to the problems and necessities identified in the last years during seismic and tsunami emergencies especially in the large seismic events in Central America in 2012, the tsunami of 26 of August, 2012, in El Salvador and Nicaragua, the magnitude 7.2 earthquake on October 13, 2014, and the destructive earthquakes near Managua in April, 2014. Also the lessons learned from the destructive tsunamis in Chile 2010 and Japan, 2011, were taken into account.

INETER expanded considerably the seismic and mareographic monitoring networks. Furthermore, seismic data from 100 stations in Central America and 200 stations from the global seismic network are registered in real time at INETER. INETER established also aGPS network, and installed a mirror of the UNAVCO GPS network. The seismic data processing center obtained new software and hardware for automatic and manual seismic processing and tsunami evaluation. The number of personnel working in the 24x7 system is extended, capacitation measures are going on about seismic processing and tsunami warning. A 9-months postgraduate seismology course is going on at UNAN university to prepare new specialists to work at the seismic, tsunami and volcano monitoring system. INETER personnel is trained in academnic courses in Japan and in training courses of PTWS.

Tsunami hazard investigation and mapping was carried out in cooperation with international groups. Hazard maps are available for all settlements on the Pacific coast.

INETER has started a close cooperation with the US Geological Survey on the seismic monitoring network, established as the National data center of the CTBTO system, to obtain further seismic and other data relevant for tsunami warning. Furthermore established a mirror of the UNAVCO regional GPS network at its warning center.

Nicaragua as the chair of the Regional Working Group for Central America (WG-CA) took the lead for the improvement of tsunami warning in all the region. Three meetings of the WG-CA were organized with the help of IOC, PTWS. In the third meeting, in September 2014 in Managua, representatives from all Central American countries decided to support the proposal of Nicaragua to establish at INETER,
Nicaragua, a regional Tsunami Warning Center for Central America. The aim is to improve tsunami warning for all Central American countries using the experiences of Nicaragua and to develop or strengthen the National Tsunami Warning Efforts of all countries of the region. Furthermore they decided to support the proposal of Nicaragua to form a common regional seismic network to aid tsunami warning and other applications for earthquake information and early warning. The Directorate of CEPREDENAC (Central American Center for Disaster Prevention) which consists of the directors of the Civil Protection Institutions of all Central American countries and part of the Central American Integration System (SICA) decided in its meeting of to support CATAC and Regional seismic network initiatives.

Date: 22/04/2015       Name: Wilfried Strauch