



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



Schweizerischer Erdbebedienst
Service Sismologique Suisse
Servizio Sismico Svizzero
Swiss Seismological Service

ETH zürich



3.8 Central American Tsunami Advisory Center (CATAAC) established at INETER, Nicaragua

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<http://catac.ineter.gob.ni>

CATAC Web site <http://catac.ineter.gob.ni>

Results

- - Earthquake Viewer
- - Seismic Re-Locator
- - Seismic station viewer
- - Seismogram viewer
- - Shakemaps
- - Tide stations
- - Earthquake Map
- - Seismological Communiqué

Tools

- - GAPS - Seismological processing
- - GDS - Messenger
- - FDSNWS - fdsnws Graphic Terminal
- - FDSNWS - fdsns web services, metadata
- - QuakeLink - Seismic Event Service
- - Capacitation

Docs

- Project with JICA
- プロジェクト概要
- CATAC User Guide
- Tsunami Threat Central America
- INETER Publications
- CA-19 Drill (19 Aug 2019)
- CA-20 Drill (11 Nov 2020)
- Software documentation

Instituto Nicaragüense de Estudios Territoriales (INETER), Managua, Nicaragua, en cooperación con JICA, UNESCO, and INETER.

Centro de Asesoramiento de Tsunami para América Central - CATAC -

El CATAC, establecido en INETER/Nicaragua, fue desarrollado en 2016-2019 por INETER en cooperación con JICA/Japón, CODUNESCO y los países centroamericanos. CATAC entró en funcionamiento experimental en agosto de 2019. Envía en tiempo real mensajes de información sobre terremotos y tsunamis a las instituciones científicas y de Protección Civil en América Central.

Recomendaciones del PTWS (23/04/2020) - Tsunami y Coronavirus:
"Una Orden de Evacuación de Tsunami como prioridad sobre una orden de permanencia en casa de COVID-19."

Resultados

- Visor de sismos
- Re-Localizador de sismos
- Visor de estaciones sísmicas
- Visor de sismogramas
- Shakemaps
- Estaciones mareográficas
- Mapa de Sismos
- Comunicado Sismológico

Herramientas

- GAPS - Procesamiento sísmológico
- GDS - Mensajero
- FDSNWS - Terminal gráfico de fdsnws
- FDSNWS - Servicios web de fdsns, metadatos
- QuakeLink - Servicio para eventos sísmicos

Docs

- Proyecto con JICA
- プロジェクト概要
- Guía de Usuario CATAC
- Amenaza de tsunami América Central
- Publicaciones INETER
- Simulacro CA 19 (19 Ago 2019)
- Simulacro CA 20 (11 Nov 2020)
- Documentación software

CATAC - Áreas de servicio en el Pacífico y el Caribe
Los países de los países de América Central y Caribe.

CATAC - Áreas de Monitoreo (AM)

Servicios de Tsunami para América Central (SUMAMI-CA-19)
Iniciado el 19 de agosto de 2019. Se envían en tiempo real mensajes de información a los países de Centroamérica (Guatemala, El Salvador, Honduras y Nicaragua).

Tsunami para una zona Terremoto

Disastrous tsunami at the Pacific Coast of Nicaragua



1 sep 1992, 7:15pm Magnitude 7.8

Slow Earthquake, weak seismic shaking.

No destructins due to seismic impact

8:00pm Tsunami max 10 m run-up.

170 dead o disappeared

Extensive destruction along all the coast.

No warning.

No seismic network.

No communications system.

No scientific knowledge.

No conciousness about the risk.



Tsunami Advisory Center for Central America (CATAAC)

created 2016, pilot operation from 2019, interim operation from Dec 2021

- 400 seismic stations in Central America (+ 200 global via IRIS)
- 24x7 Two watchstanders (group of 16)
- Seismological processing (SeisComP PRO)
- Tsunami Evaluation (SeisComP TOAST)
- Earthquake Early Warning (EEW) products used in Nicaragua
- Initial Seismological info message in 2 minutes
- Tsunami parameter message including graphical products in less than 10 minutes

Addressees

In Spanish

- 11 monitoring/scientific institutions, 9 civil protection agencies
- 1 regional coordinating body (CEPREDENAC)

In English

- PTWC (US), NWPTAC (Japan)

How CATAC emerged

1992 Disastrous tsunami in Nicaragua, 10 m, 170 killed

1993 Nicaragua begins active cooperation with ICG/PTWS

1996 NTWC established in Nicaragua, first in Central America

2003 CEPREDENAC Decision on the Development of a Regional Tsunami Warning System

2003 ICG/PTWS-WG-CA training to support this process

Images of destructive tsunamis shock the world:

2004 South Asia - 2010 Chile - 2011 Japan

2009/2011/2014 WG-CA meetings.... Nicaragua offers to establish CATAC

2015 CEPREDENAC country representatives "recognize within CEPREDENAC's priorities the development of the Central American Tsunami Warning Center (CATAC) and the creation of a Regional Seismic Network to be established in the Republic of Nicaragua and elevate it to SICA".

2015 Creation of CATAC accepted by ICG/PTWS, Caribbean EWS and IOC Assembly

How CATAAC developed

2016 Nicaragua creates CATAAC at INETER

2016 Nicaragua requests support from Japan for the development of CATAAC

2016 CATAAC Strengthening Project Begins

Training, procurement of software and equipment, installation, installation

2016-2019 other projects support CATAAC (UNESCO, EWARNICA)

2019 Completion of CATAAC reinforcement project with Japan

2019 ICG/PTWS and ICG/Caribbean EWS accept experimental CATAAC operation

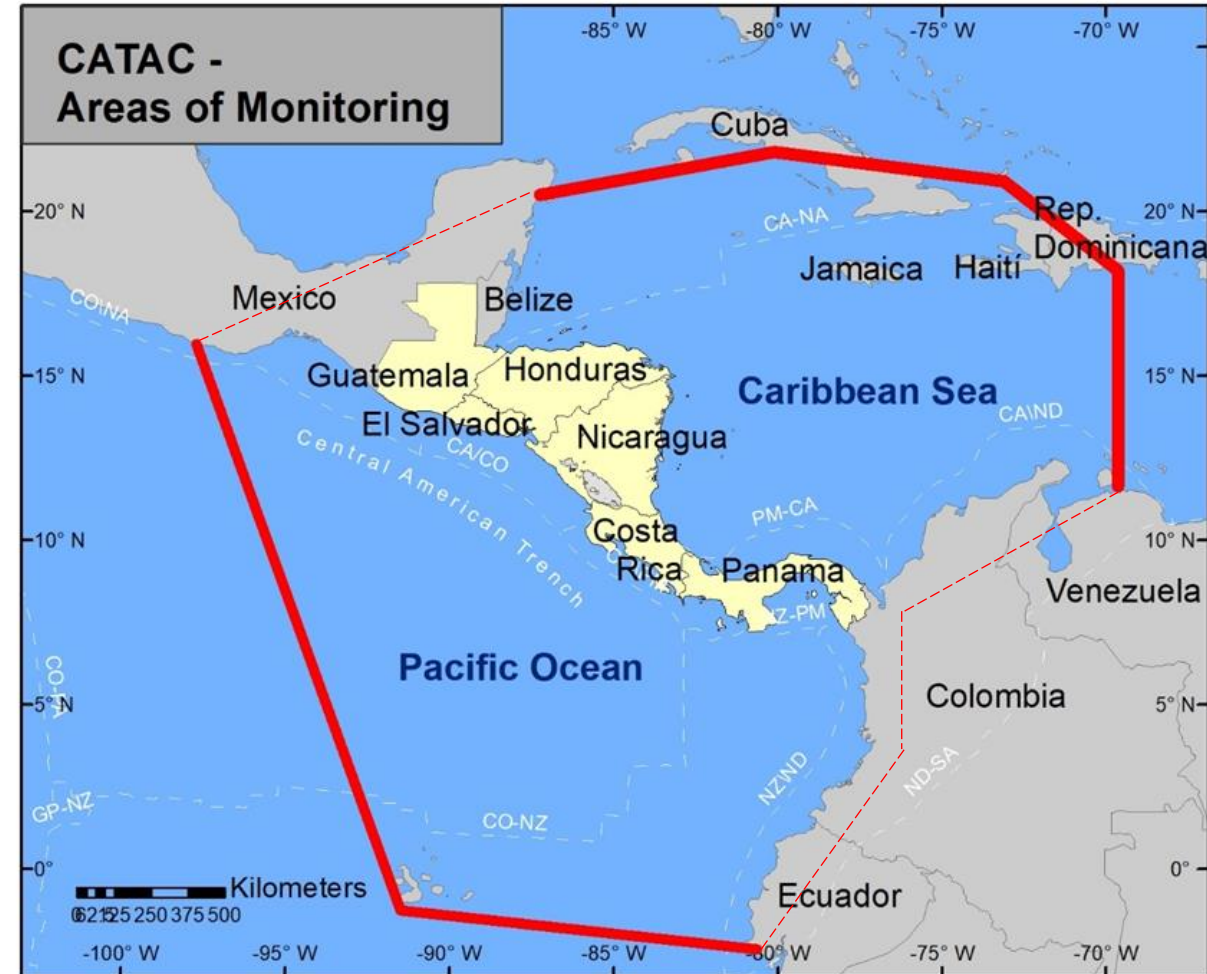
2021/Dec ICG/PTWS accepts full operation of CATAAC in interim mode

2023/Apr ICG/CARIBE EWS accepts full operation of CATAAC in interim mode

2023/Sep ICG/PTWS supports full operation of CATAAC in routine mode

2024/May ICG/Caribe is asked to support full operation of CATAAC in routine mode

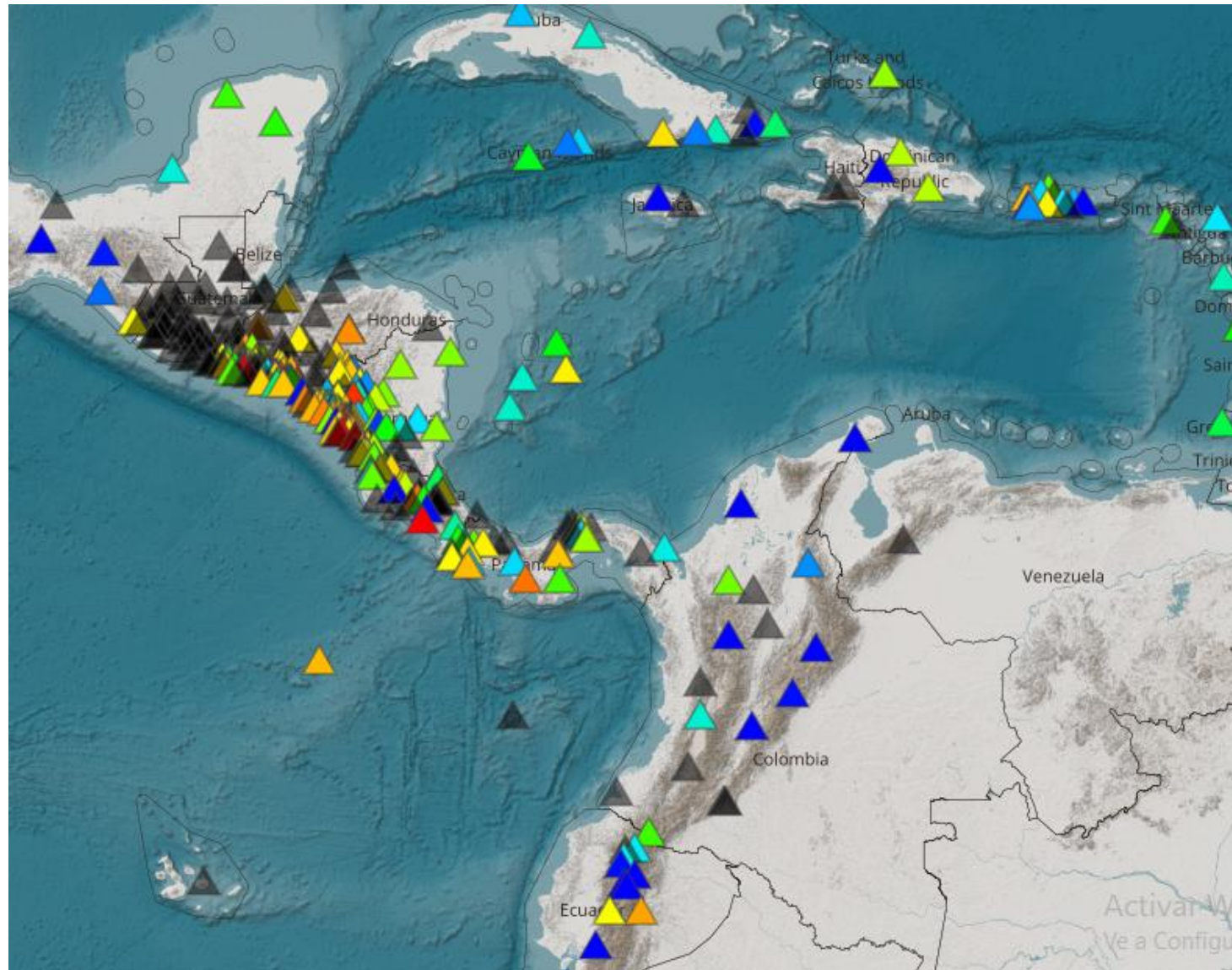
CATAC 2024 - service areas and monitoring zones



Service coasts: both coast of Central America & Islands

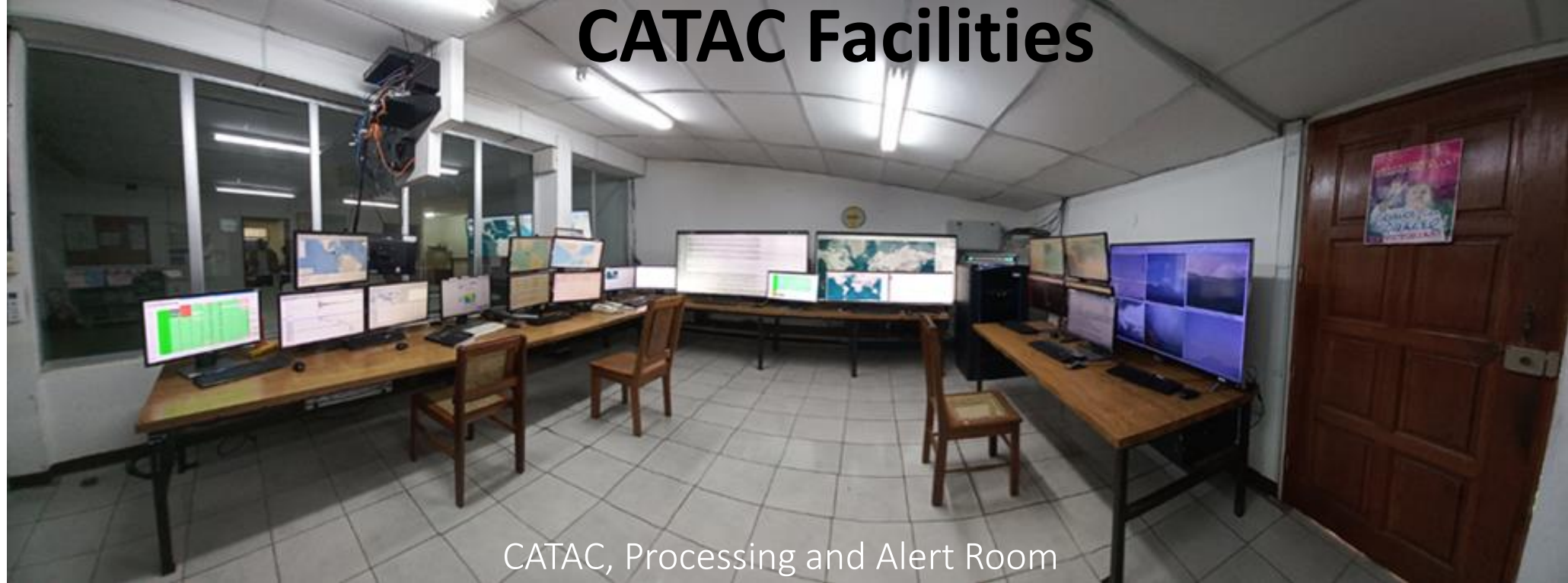
Monitoring zones:
about 1 hour or less tsunami travel time to Central America

Location of seismic stations in and around Central American countries used by CATAAC, 2024

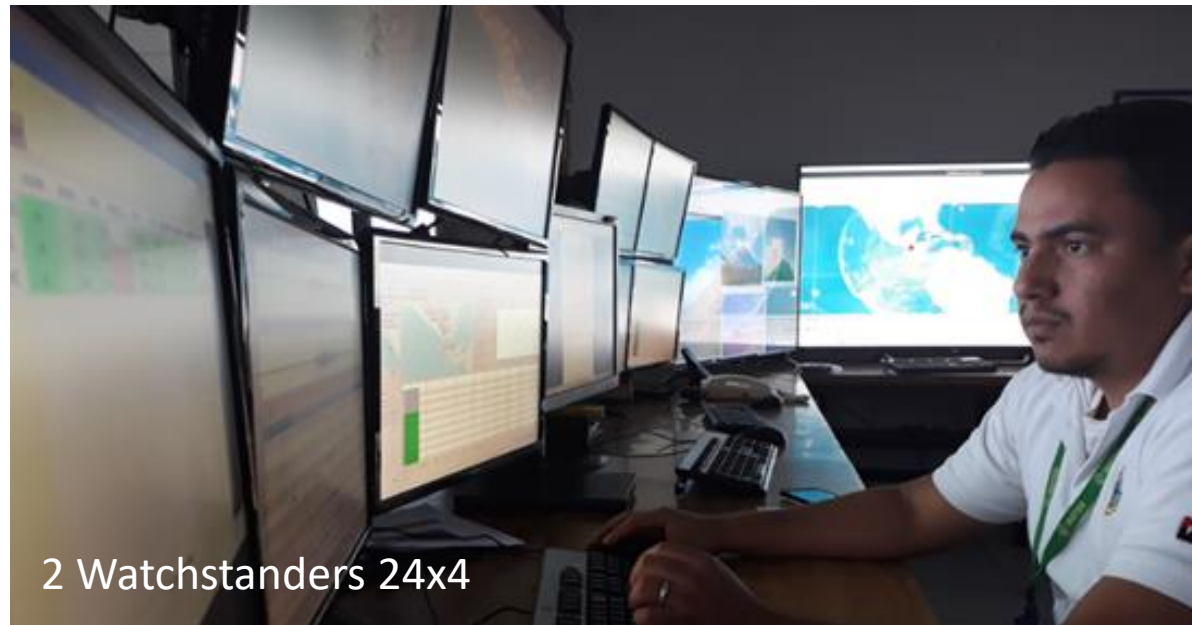


Additionally stations from the global seismic network are used

CATAC Facilities



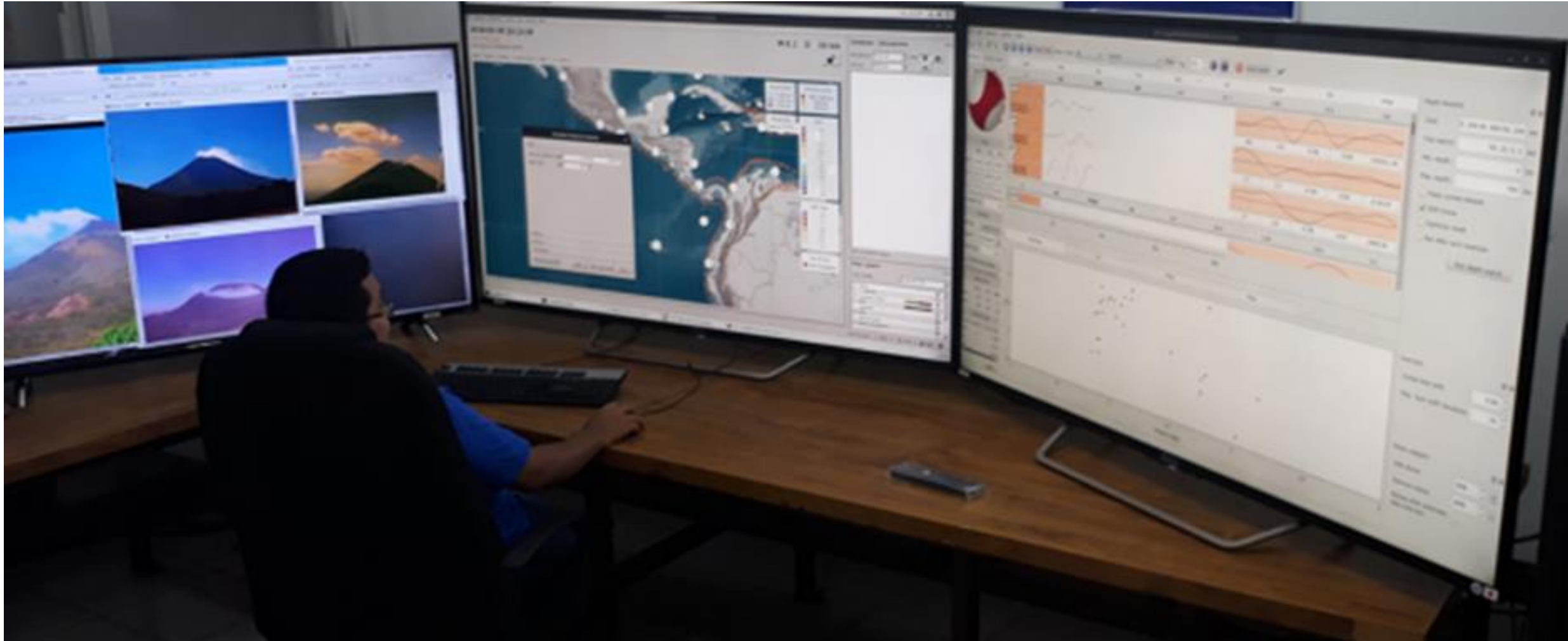
CATAC, Processing and Alert Room



2 Watchstanders 24x4



Moment Tensor and Tsunami Simulation

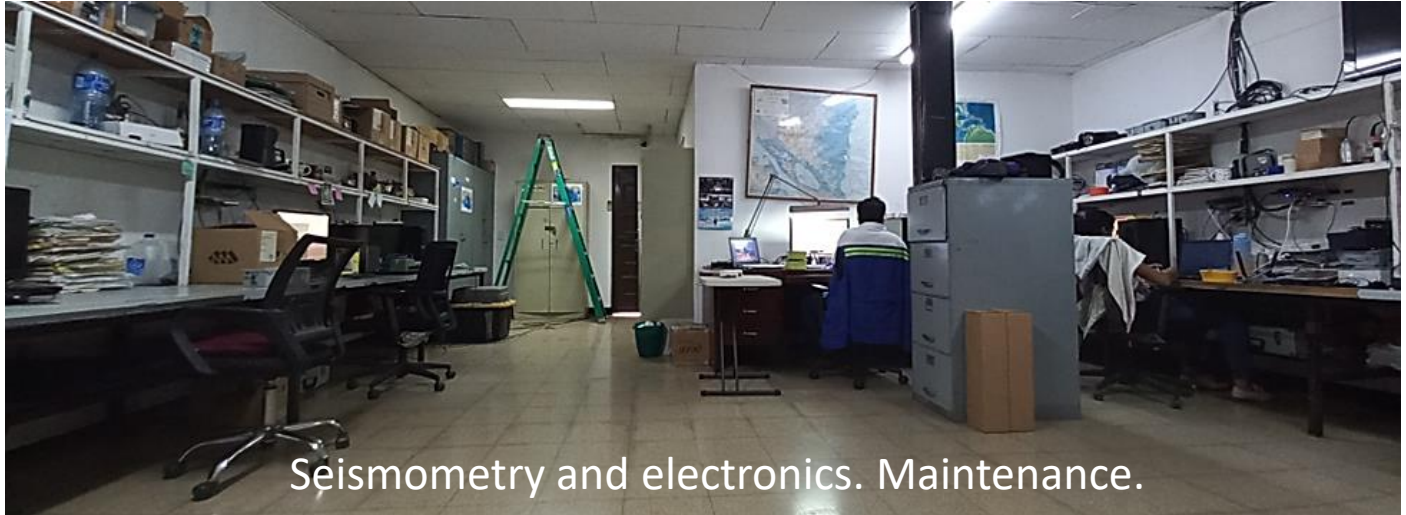




Situation and meeting room. Capacitation.



Concrete bunker for IT, Servers, web seismometers



Seismometry and electronics. Maintenance.



Battery backup 20kWh



Seismic/GPS stations



Sea gauges

Main Software Systems for CATAC operations



- **SeisComP seismological software package**
 - Automatic & Interactive seismological processing
 - Calculation of the Moment Tensor from which the Magnitude M_w is derived
 - Sending seismological and tsunami messages (on seismological basis)

- **TOAST – part of SeisComP PRO suite**
 - Numerical tsunami simulation (on the fly)
 - Sending of simulation product messages, arrival times and amplitudes
 - Processing of tide gauge records

Note: Tsunami database with pre-calculated solutions
is not longer used as bugs were detected and real time solutions are 20 times faster now than 2019

CATAC Performance Indicators and the values to be achieved in its initial/experimental operation phase and in the fully implemented phase.



Performance indicators	Values achieved during preliminary operations until 2019	Values to be achieved after final implementation As of 2024
Time elapsed from earthquake to emission of initial tsunami products with preliminary earthquake parameters 2.	5 minutes	2 minutes
2. Probability of detection of earthquakes with magnitude $M_w \geq 6.0$.	100%	100%
3. Accuracy of preliminary earthquake parameters in: hypocenter location/magnitude/depth.	0.3degree/0.3/<30km	0.2degree/0.2/<20km
5. Accuracy of Estimated Time of Arrival in the event of a tsunami	10% of travel time travel time	10% of travel time travel time
6. Percentage of Member States receiving products shipped by CATAC	100%	100%
7. Percentage of time that CATAC is operating and able to respond to a tsunami event.	100%	100%
8. Frequency of regular communication tests	Twice a year	Four times a year



Tsunami Genic Potential adopted by CATAAC based on preliminary seismological parameters

Magnitude (M_w)	Tsunami Potential Description
$6.5 \leq M_w \leq 7.0$	There is no tsunami threat from this earthquake.
$7.1 \leq M_w \leq 7.5$ and under the sea; and depth less than 100km	Possibility of a destructive local tsunami confined to distances of 100-300 km from the epicenter.
$M \geq 7.6_w$ and under the sea; and depth less than 100km	Possibility of a destructive tsunami all along the coast

Criteria adopted by CATAC

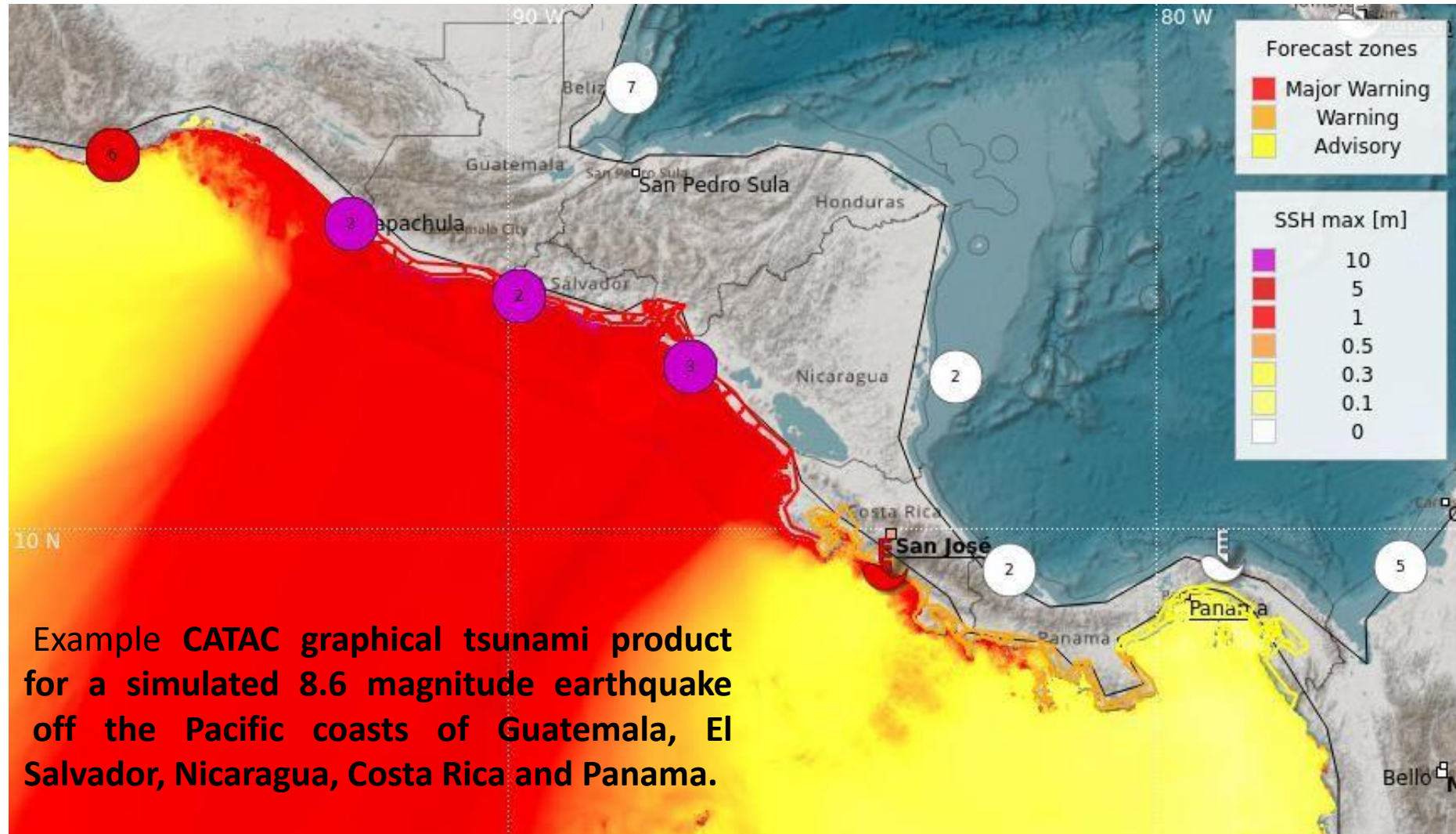


Type of Newsletter	Message	Criteria	Content	Time
Seismological information	Earthquake Early Warning	ML 4.5 and above	Location, depth and magnitude Predicted intensities	Less than 0.5 min
	Seismological message	ML 4.5 and above	Location, depth and magnitude, Observed intensities	1-2 min
Tsunami Information	Only one bulletin	ML 6.0-6.4; or underground; o depth≥100km	Earthquake parameters and declaration No tsunami hazard	1-2 min
	Only one bulletin if no minor reportable waves observed	MW 6.5-6.9	Earthquake parameters (Magnitude Mw) and 'No Tsunami Hazard' statement	5-10 min
Tsunami Threat Message	Bulletin with quantitative prediction	Mw 7.0 and above	Earthquake parameters and quantitative prediction of hazard level and estimated time of arrival (ETA).	5-10 min
Additional Tsunami Hazard Message	Supplementary with comments	Complex earthquakes, Mega earthquake, Tsunamis for which amplitudes are predicted to increase after several hours.	Earthquake parameters, quantitative prediction and tide gauge observations	When there is a revision of the earthquake or tsunami prediction, or of observations

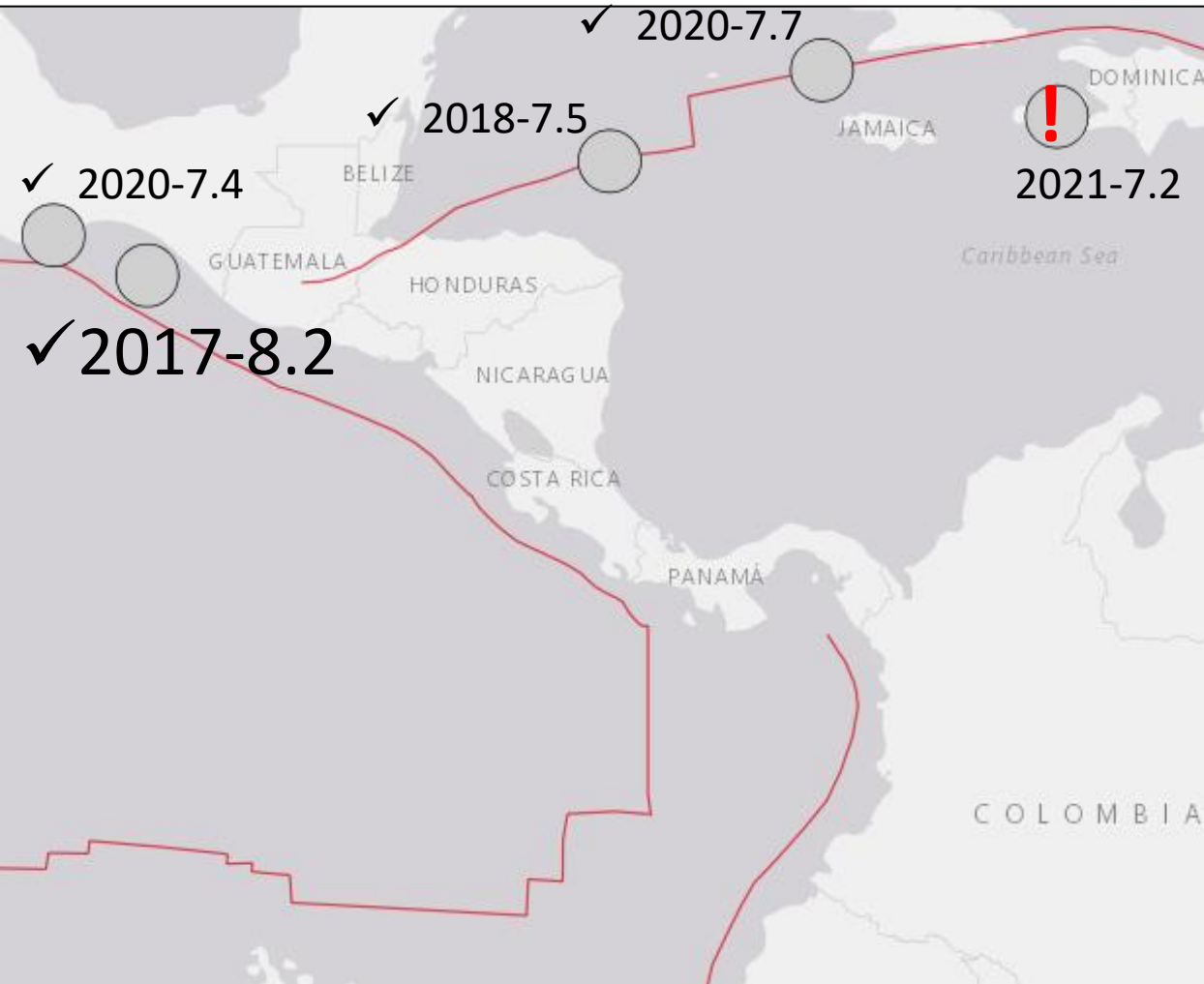
Tsunami Hazard evaluation based on numerical simulation;

Alfanumérico and graphical products:

1. Tsunami arrival; 2. Tsunami amplitudes; 3. radiated energy



Experience with the processing of earthquakes larger than M7



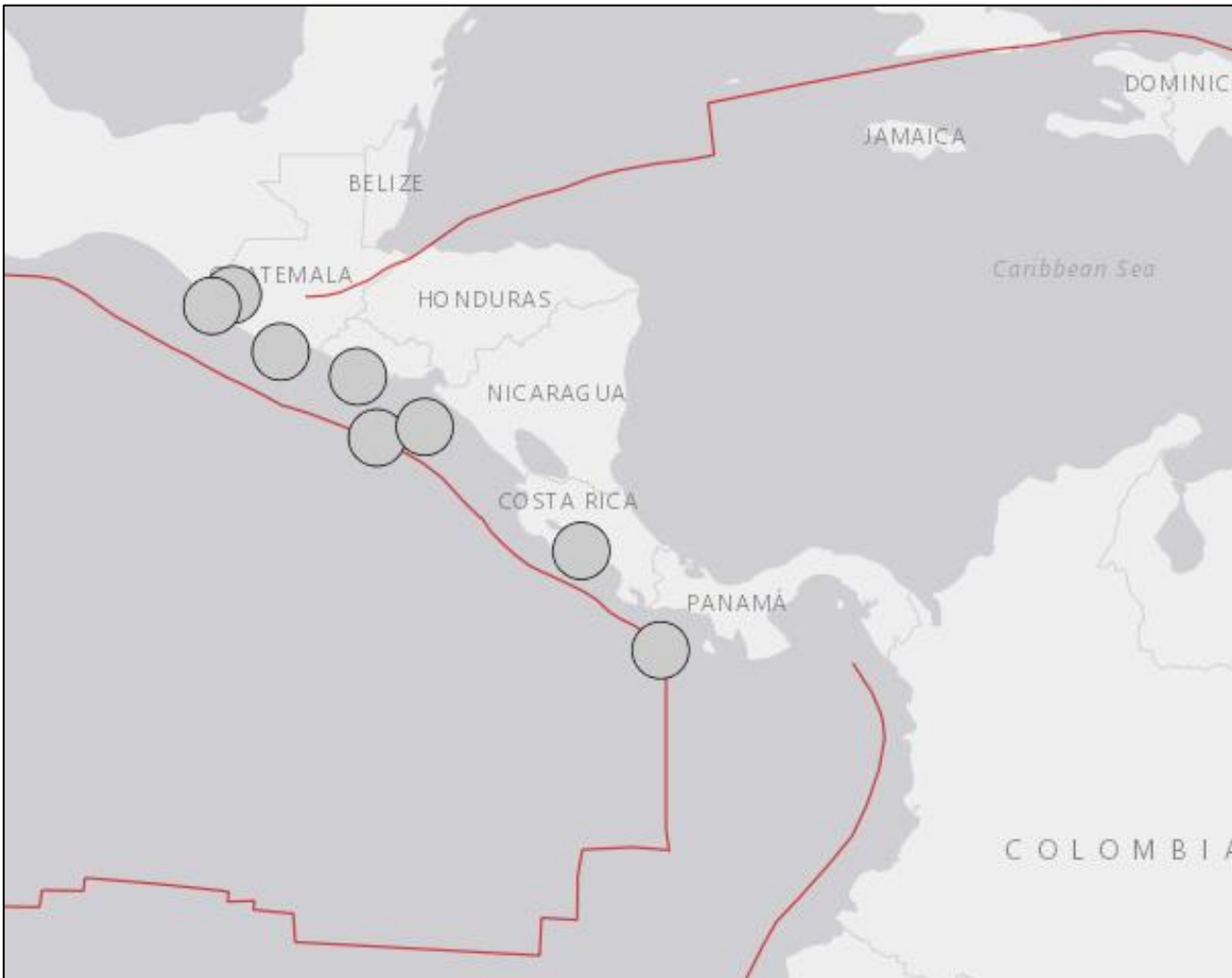
These seismic events were processed and CATAC products were sent to the recipients in an informal manner. By Whatsapp and email.

In case of the 2021 Haiti earthquake, there was a problem in immediate processing due to lack of nearby non-saturated stations....

The earthquake was re-processed -see results in a separate presentation.

2016-2022 Experience with M6.5 - M7 (NEIC) earthquake processing.

Seisms were processed and seismological products were sent to the recipients.



M6.9 156 km SSW of Puerto El Triunfo, El Salvador

2016-11-24 18:43:47 (UTC) 10.0 km

M6.9 2 km SSW of San Pablo, Guatemala

2017-06-14 07:29:04 (UTC) 93.0 km

M6.8 28 km SW of Puerto San José, Guatemala

2017-06-22 12:31:03 (UTC) 38.1 km

M6.5 18 km W of Parrita, Costa Rica

2017-11-13 02:28:23 (UTC) 19.4 km

M6.7 5 km SW of Puerto Madero, Mexico

2019-02-01 16:14:12 (UTC) 66.0 km

M6.6 32 km S of La Libertad, El Salvador

2019-05-30 09:03:32 (UTC) 57.9 km

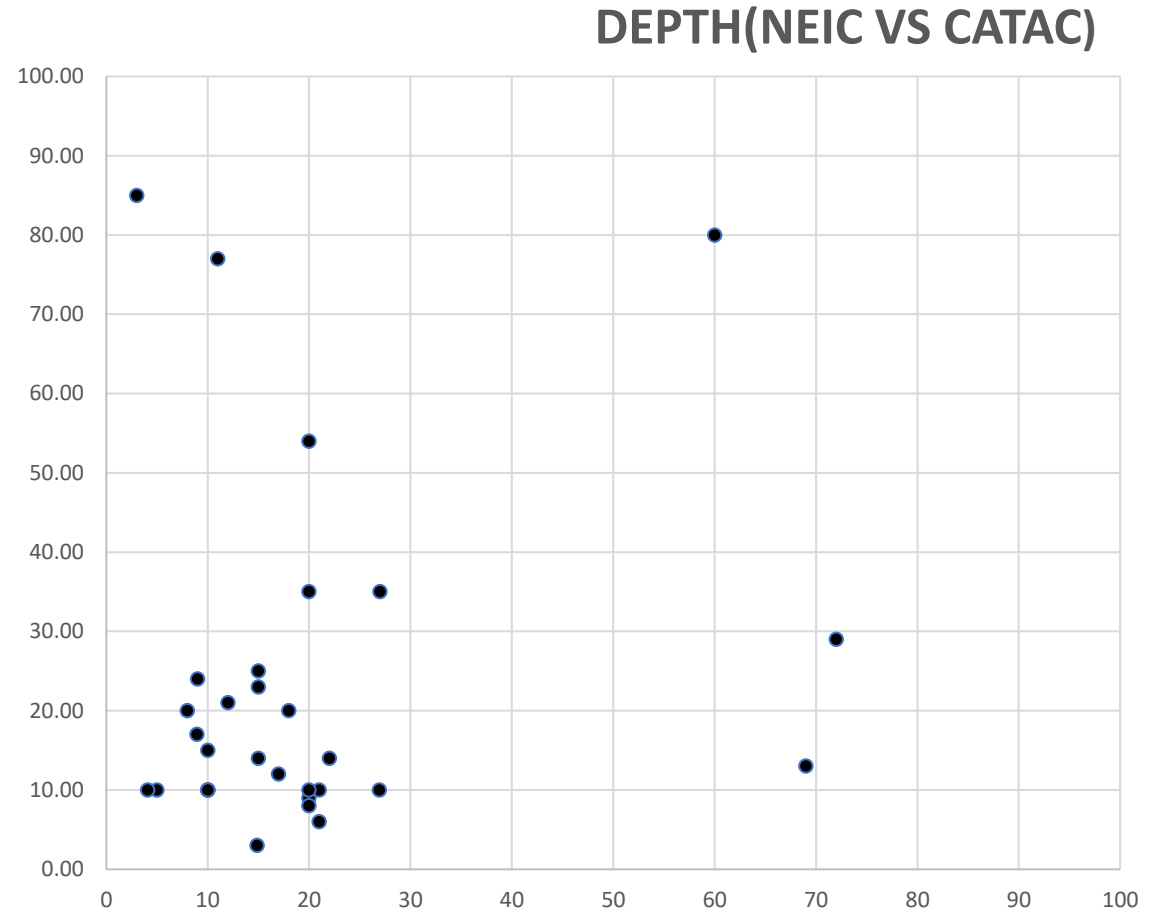
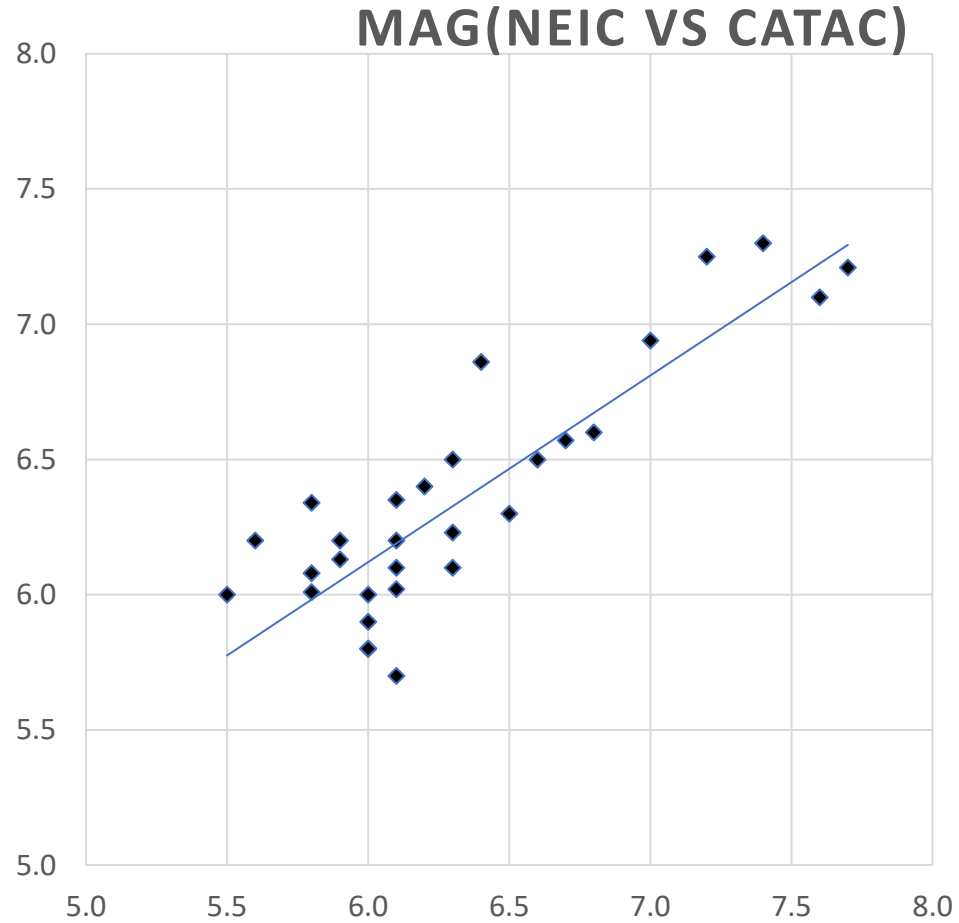
M6.7 71 km S of Burica, Panama

2021-07-21 21:15:12 (UTC) 10.0 km

M6.5 80 km SW of Jiquilillo, Nicaragua

2021-09-22 09:57:07 (UTC) 21.0 km

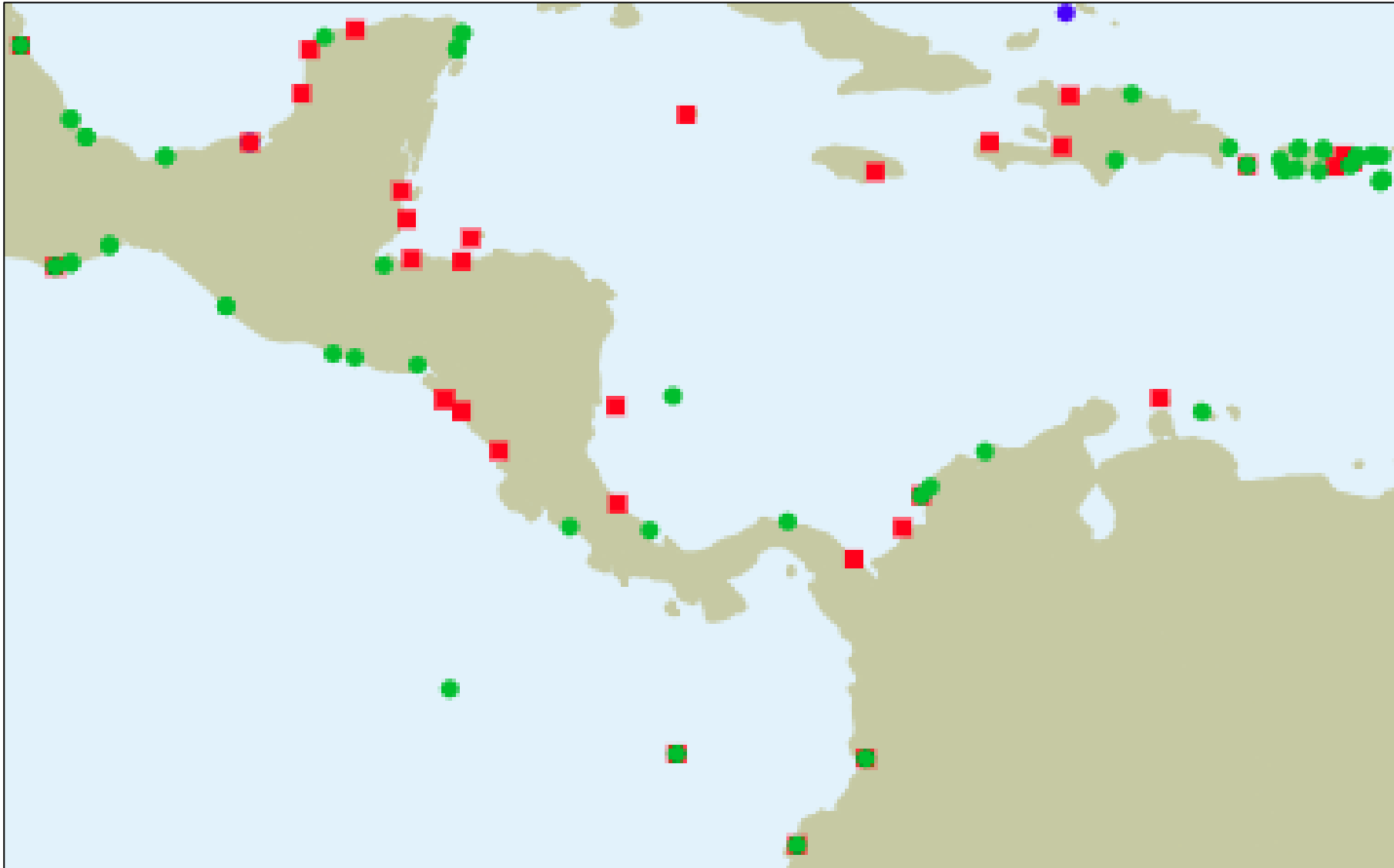
CATAC: processed events bigger than M6, 11/2019 - 12/2022



- **Advice** o the CA countries not only in emergencies
- Information about CATAC Products
- Analysis of weaknesses in the countries
- Cooperation with the institutions in CA countries to improve their capacities

Problems

Tide stations used by CATAC



- Tide stations are the weakest point of the tsunami warning system for Central America.
- The number is very low and many do not function properly.

Occurrence of slow earthquakes in Central America

In Central America there are **2 known occurrences of slow earthquakes**:

- 1992 disastrous tsunami (10 m) from Nicaragua and
- 2012 tsunami affecting El Salvador and Nicaragua (5m)

Slow earthquakes have **very weak seismic shaking** and the magnitudes calculated with conventional methods are 1 to 2 magnitude units lower than what would correspond to their potential tsunami generation.

Thus, seismology and tsunami warning agencies may at least initially err in assigning the hazard to an earthquake.

The possibility of slow tsunamis imposes on CATAC the need to use very fast methods to determine the true Mw magnitude. For this purpose, the SCMTV module is used interactively and SCAUTOMT automatically. **It is possible to obtain Mw within 5 to 7 minutes. The epicentral distance of the stations is limited to 1000 km and accelerographic stations are allowed to be used for the calculation.**

The second CATAC exercise was dedicated to slow earthquakes in order to raise awareness of this issue in Central American countries.

CATAC investigation 2023:

Identification of coastal areas with a **reduced time** of possible first impact by local tsunamis

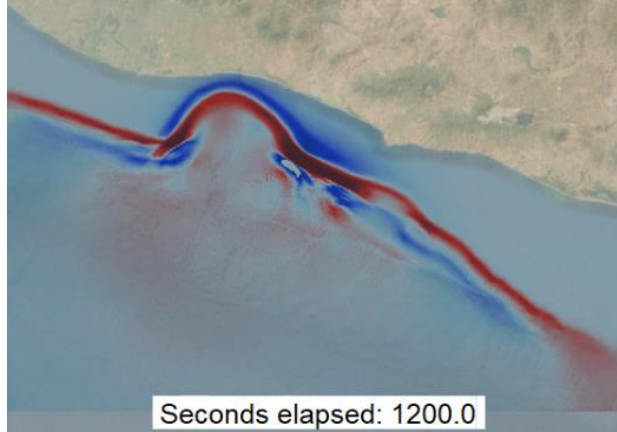
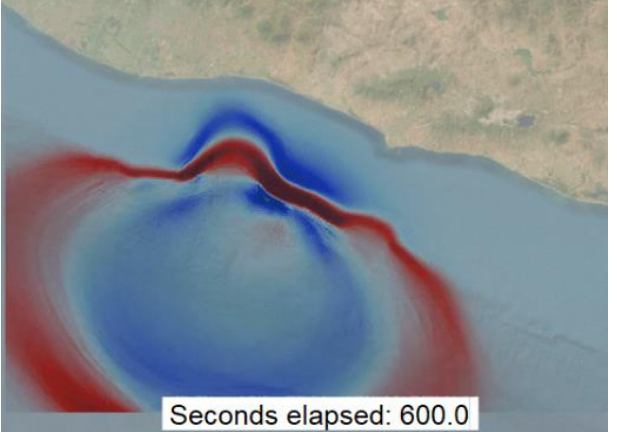
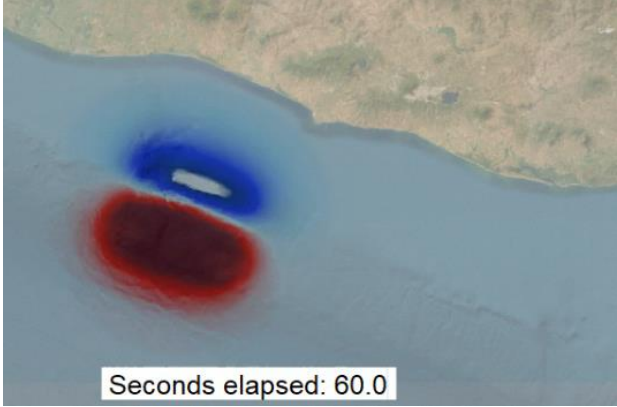


Causes:

- 1) The source is very close to the coast (Islands to the N of Honduras; San Juan del Norte in Nicaragua, El Limon in Costa Rica, Panama Canal).
- 2) Between the coast and the source zone there are very deep waters (Gulf of Chiriqui in Panama).
- 4) A deep sea channel that connects the source with the coast (South of Guatemala).
- 5)

The existence of these zones imposes on CATAC and Civil Protection agencies the **urgency to work very fast**. Therefore, CATAC uses earthquake early warning methods and delivers first solutions within 2 minutes.

Example: Pacific/Guatemala-El Salvador



Example: Immediate tsunami impact, M7.3, N Honduras, 28/05/2009

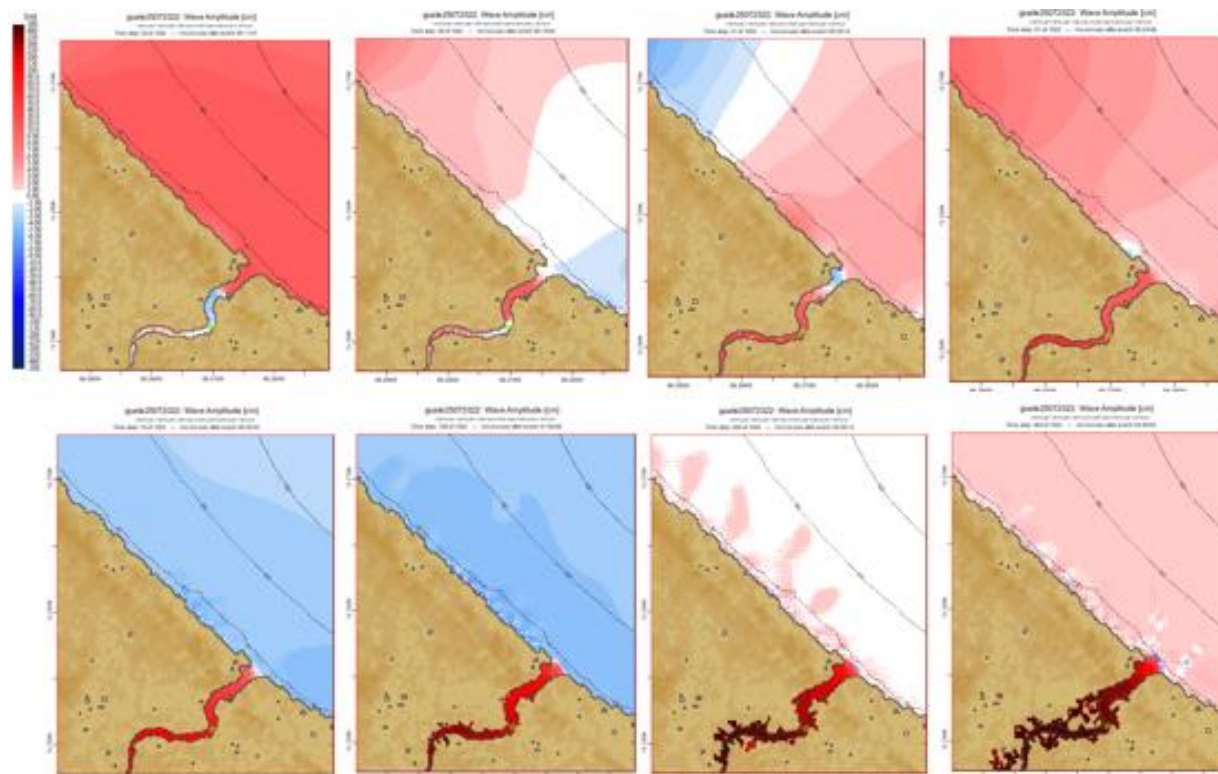
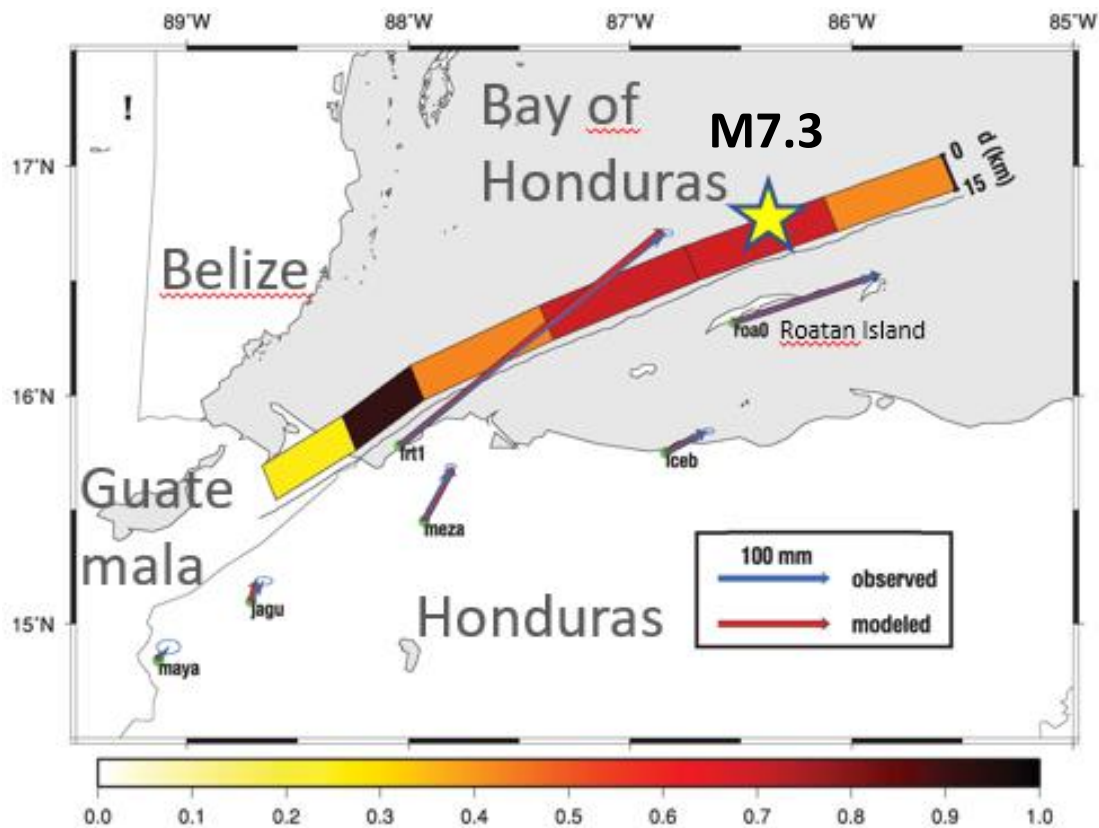
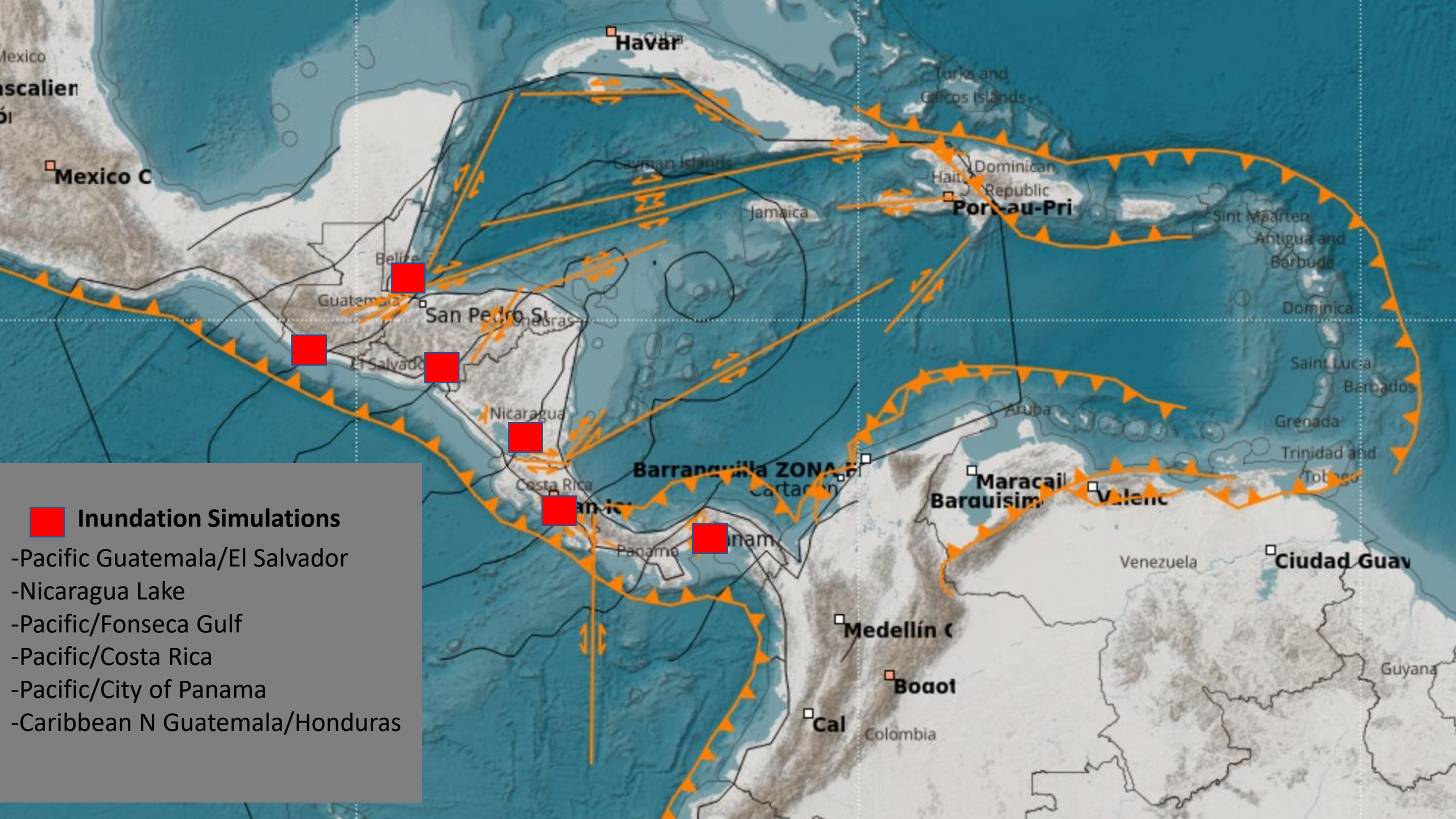


Figure 1. Slip distribution along the fault, yellow star denotes NEIC epicenter. Adapted from Graham et al. 2012. Arrows are GPS vectors post earthquake.

Series of water levels on the N Guatemalan coast and River Motagua, obtained in the simulation

The epicenter is at a distance of about 200 km from the fault segment with the maximum displacement and from the tsunami and river inundation occurrence.



■ Inundation Simulations

- Pacific Guatemala/El Salvador
- Nicaragua Lake
- Pacific/Fonseca Gulf
- Pacific/Costa Rica
- Pacific/City of Panama
- Caribbean N Guatemala/Honduras

We need to be faster:

Acceleration of Processing

1. Acceleration of automatic and manual Moment Tensor calculation

-Use of data from near accelerograph stations.

-Limiting the distance of stations to be used for the first message.

First solutions in less than 10 mins

Acceleration of Processing, cont.

2. Optimization of the configuration of tsunami simulations in the SeisComP module TOAST. GPU based calculations in several steps

Execution time in seconds for simulation with TOAST (easywave).
original GPU at CATAC (2018, 4000 Cuda cores)

	Hours of tsunami propagation			
Bathymetry in arcsec	1	2	4	8
15	29	92	716	1753
30	14	32	63	140
90	7	23	46	143

3. Faster GPU's: RTX 4090 (bought by JICA, INETER)

(17000 Cuda Cores & higher frequency & memory)

considerably reduced of simulation time (by about 20)

Use of Earthquake Early Warning (EEW) Products for Tsunami Warning

EWARNICA/ATTAC project, with Switzerland and CA countries.
Phase 3 2022-2024



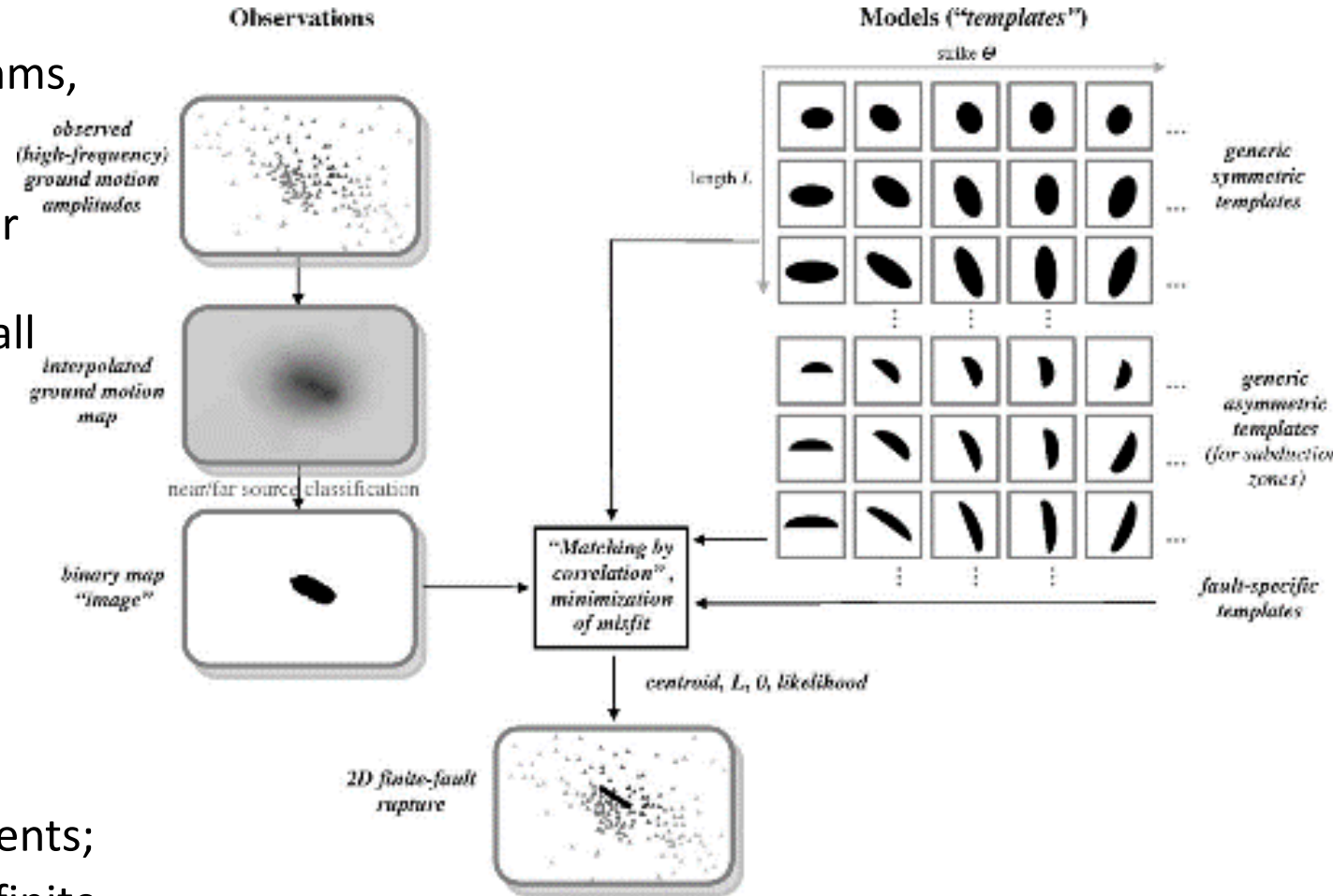
- Products that benefit CATAC and tsunami warning in the countries of the region.
- Upgrading of the accelerometer stations installed in 2021 will benefit CATAC and the countries of the region.
- Establishment of earthquake early warning in Nicaragua, El Salvador, Costa Rica (Honduras, Panama) will benefit the tsunami warning by CATAC and the countries.
- Method of earthquake source estimation with the **FINDER** module would benefit the tsunami warning by CATAC and the countries.
- Development of methods to transmit warning messages massively to the general population. Can also be used for tsunami warning.

Use of EEW Algorithm - FINDER

Finite-Fault Rupture Detector, Cooperation (ETHZ, USGS, CalTech)




- Compared to other more traditional EEW algorithms, FinDer has a number of interesting features. (see Böse et al. (2018) for more details):
- Characterization of seismic ground motions rather than earthquake sources;
- Consistent models and uncertainties for both small and large earthquakes;
- There is no magnitude saturation in large earthquakes;
- Applicable to complex seismic sequences;
- There are no station averages, but true network solutions;
- Independent of traditional phase selection and screening partners;
- It is unlikely to be activated during teleseismic events;
- It allows the realization of seismic-geodetic joint finite fault models in real time (e.g. for tsunami warning);
- It can resolve fault plane ambiguities, including those of small earthquakes.



Böse et al. 2018:

<https://core.ac.uk/download/pdf/211369985.pdf>

Expansion of seismic networks for earthquake and tsunami warning

 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

 Schweizerischer Erdbebendienst
Service Sismologique Suisse
Servizio Sismico Svizzero
Swiss Seismological Service

ETH zürich

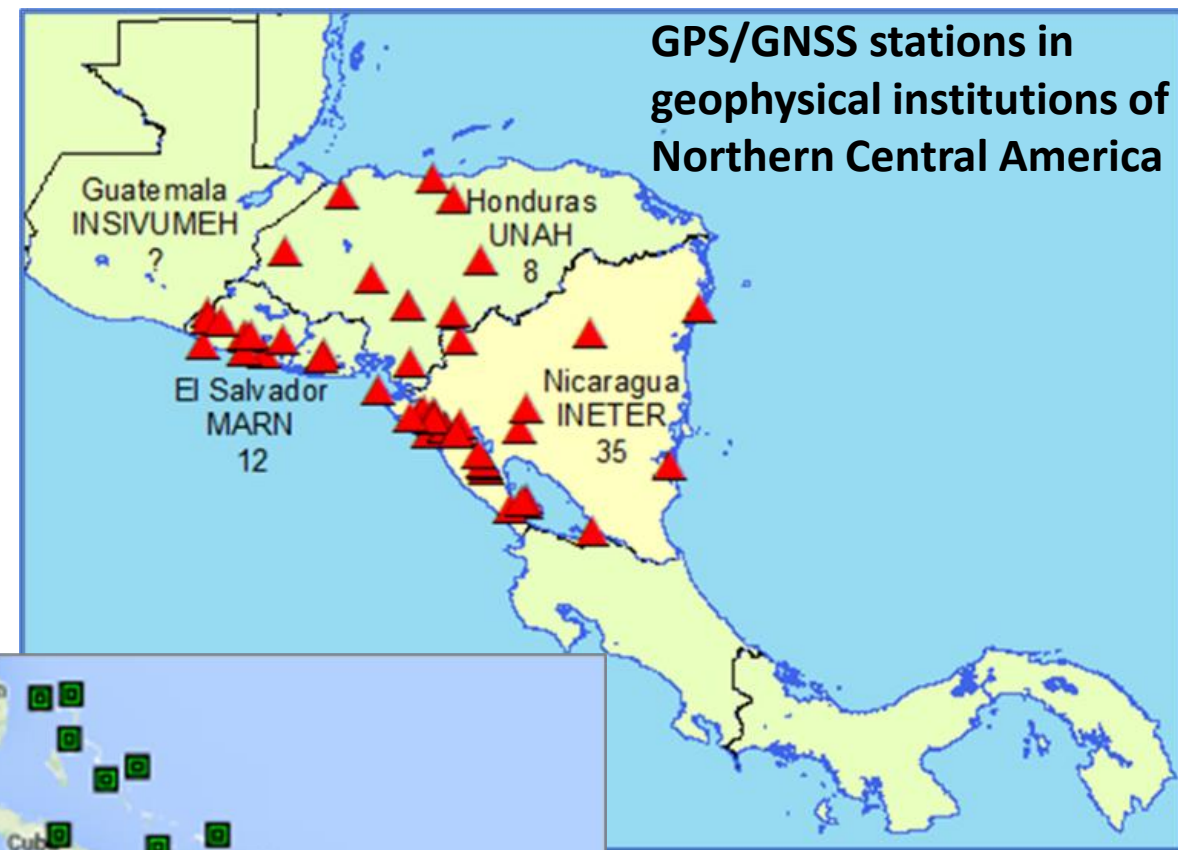
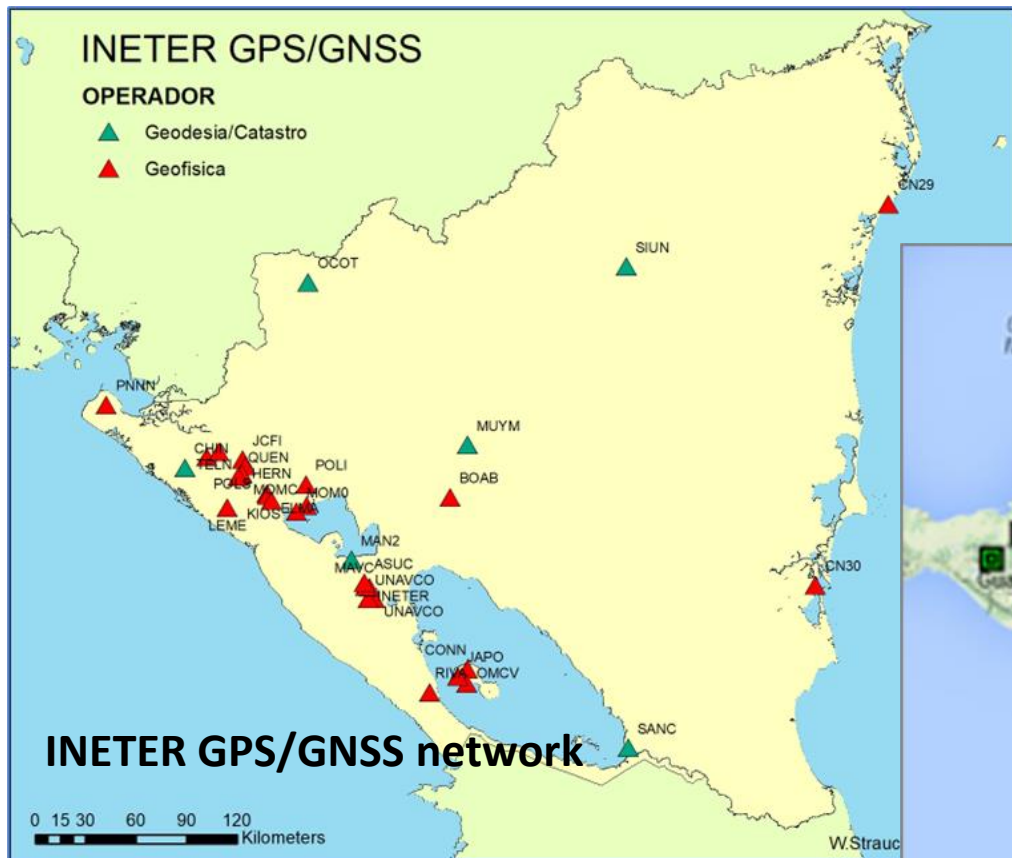
New accelerographs
digital Fortimus installed, in cooperation with:

- Nicaragua (25)
 - El Salvador (25),
 - Guatemala (17),
 - Costa Rica (4)
-
- **Reduction of the detection and localization time of earthquakes,**
 - Improved quality of results,
 - Possibility to calculate very fast Moment Tensor (and magnitude M_w) of strong earthquakes with local stations (not saturated).
 - Creation of Shakemaps (Shakemaps)
 - Seismic impact recording in major installations



Use GPS/GNSS to reduce time for EQ evaluation & Tsunami warning.

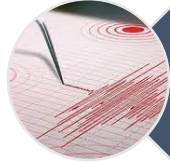
- In work



GPS/GNSS stations received at the Coconet mirror at INETER

Analysis of weak points

Hypothesis



Earthquake magnitude 7.5 at a depth of 10 km, in Panama City with epicenter located in the Pedro Miguel fault, (8°58'N 79°33'W).



Damage to human settlement buildings and basic living infrastructure



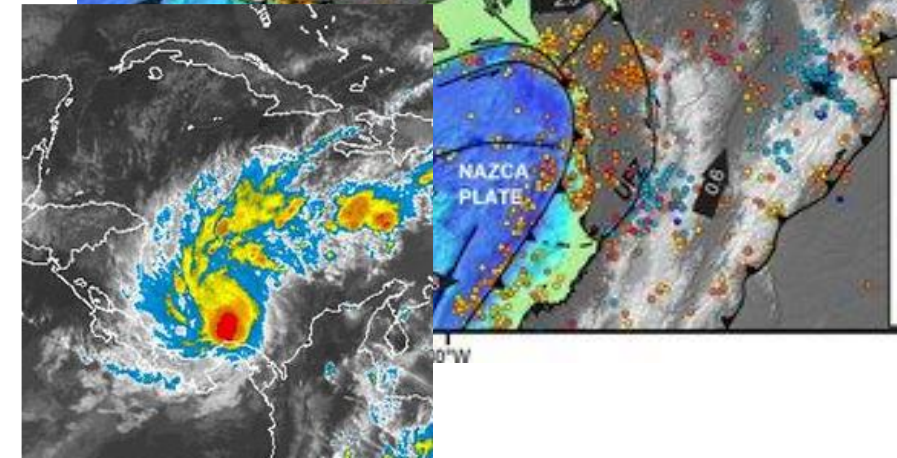
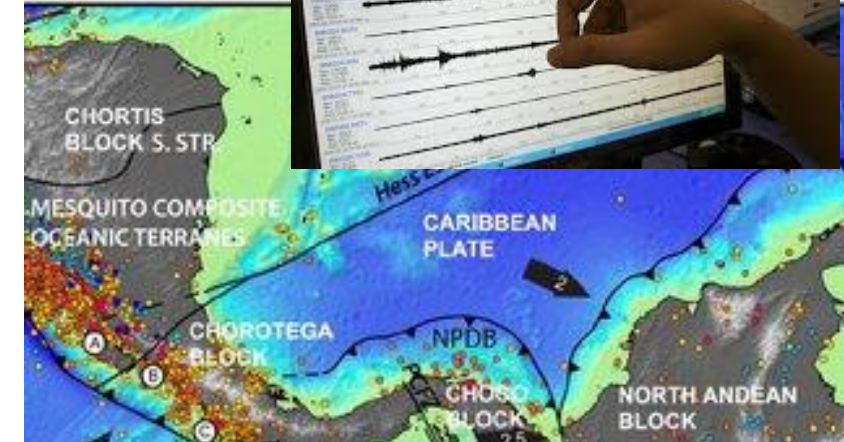
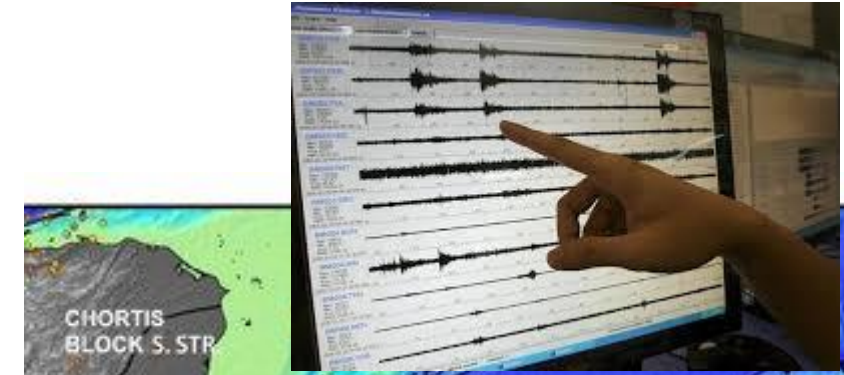
trapped and missing persons, structural fires and hazardous material spills.



Passage of Tropical Wave #10 causes rivers to overflow in the provinces of Chiriqui, Bocas del Toro, Cocolé and Colon causing major flooding.



Threat of Biological contamination by monkeypox





CEPREDENAC
CENTRO DE COORDINACIÓN PARA LA PREVENCIÓN DE LOS DESASTRES
EN AMÉRICA CENTRAL Y REPÚBLICA DOMINICANA



SICA
Sistema de la Integración
Centroamericana



Webinar on the use of CATAAC products, Feb-Mar 2023

prepared with **CEPREDENAC**, JICA
In support of 3rd regional disaster simulation, **CEPREDENAC**, Jun2 2023 in Panamá
15 Webinars – done.
1 final Webinars with CEPREDENAC to be organized

Included Belize and Dominican Republik on request of CEPREDENAC.

#	Fecha y Hora	País	Institución	Tipo institución	Modalidad	Horas
1	20/2/2023 10:00	Nicaragua	SINAPRED	Protección civil	Presencial	2
2	20/2/2023 14:00		Defensa Civil	Protección civil	Presencial	2
3	21/2/2023 10:00	El Salvador	MARN	Científica	Virtual	2
4	21/2/2023 14:00		Protección Civil	Protección Civil	Virtual	2
5	22/2/2023 10:00	Guatemala	INSIVUMEH	Científica	Virtual	2
6	22/2/2023 14:00		CONRED	Protección Civil	Virtual	2
7	23/2/2023 10:00	Honduras	UNAH	Científica	Virtual	2
8	23/2/2023 14:00		COPECO	Protección Civil	Virtual	2
9	14/3/2023 10:00	Costa Rica	SINAMOT-UNA	Científica	Virtual	2
10	14/3/2023 14:00		CNE	Protección Civil	Virtual	2
11	15/3/2023 10:00	Panamá	IG-UPA	Científica	Virtual	2
12	15/3/2023 14:00		SINAPROC	Protección Civil	Virtual	2
13	16/3/2023 10:00	República Dominicana	Sis-USAG	Científica	Virtual	2
14	16/3/2023 14:00		Defensa Civil	Protección Civil	Virtual	2
15	17/3/2023 10:00	Belice	Servicio Meteo.	Científica	Virtual	2
16	17/3/2023 14:00		Protección Civil	Protección Civil	Virtual	2
17	21/3/2023 10:00		CEPREDENAC	Protección Civil	Virtual	2

During the simulation, in June 2023, meetings to be organized with Panamanian institutions to advise Panama on CATAAC's performance in rapid earthquake and tsunami processing, CATAAC's products and how Panama can benefit from its services.

Webinar topics

- Tsunami Hazard country specific
- Minimum dangerous tsunami height
- Zones with small impact times
- CATAC procedures
- Tsunami simulation
- Warning products
- Warning messages
- Warning methods (social networks)
- Recipients of messages
- Country protocols
- Proposals



Webinar with Insivumeh/Guatemala



Norwin Acosta, CATAC, explains minimum dangerous tsunami height

Updating the contact list of CATAAC (PTWC)

National Tsunami Warning Center (NTWC), Tsunami National Contacts (TNC) and Tsunami Warning Focal Points (TWFP), according IOC webpage

- Often not updated
- Often only one institution is represented (scientific)
- Few contacts

In the discussion the interest was expressed to include more persons and more institutions

Preliminary results of Webinar

- **Update contact list** of CATAC (and PTWC) messages
- **More contacts** in the countries
- **Use of social networks** for distribution of messages
- **Revision of SOP** in the countries to make adequate use of CATAC products

Advisory on the improvements of the SOP's



New Project developed for Regional Capacitation 2023-26 about the use of CATAAC products (SOPs)

Support by JICA

Each November:

- **Zoom capacitation (5 days, 2 hours)**
- **In person capacitation (5 days, 6 hours)** at INETER/Managua with CATAAC users

During the years:

- **Several Zoom** meetings with user institutions
- **Visits** to the institutions in the countries

Furthermore

- Funding of **software licences** SeisComP 5
- Funding of **equipment for capacitation**

Actions 2023

Apr Start of new JICA project

May - Start of follow up of the Webinar, revision of protocols

May - Adaptation of CATAC Procedures according discussions at Webinar and WG-CA

May - Correction of Message formats

Jun - 12-18, in Panamá: Regional Disaster Exercise; M7.EW in Panama city

Aug – working on draft User's Guide CATAC

Sep - ICG/PTWS-XXX - presentation of new Users Guide

Nov - Capacitation – Zoom and in person, at CATAC/Managua,
for all countries receiving our product

Exercises

1. March 2023 CARIBEWAVE

2. June 2023 Regional EQ 7.5 exercise in Panama organized by CEPREDENAC

3. Sep-Nov 2023 PACWAVE 2023

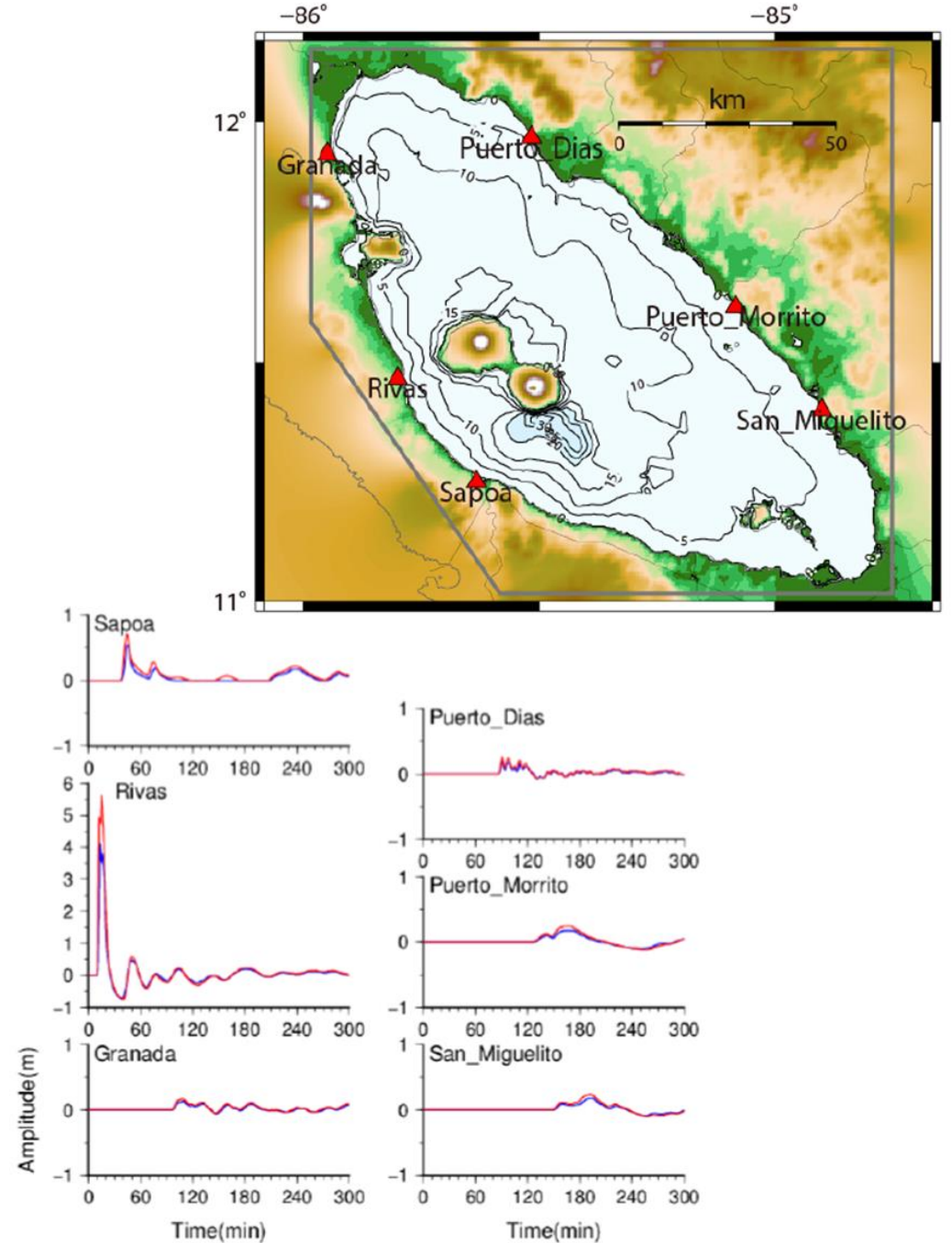
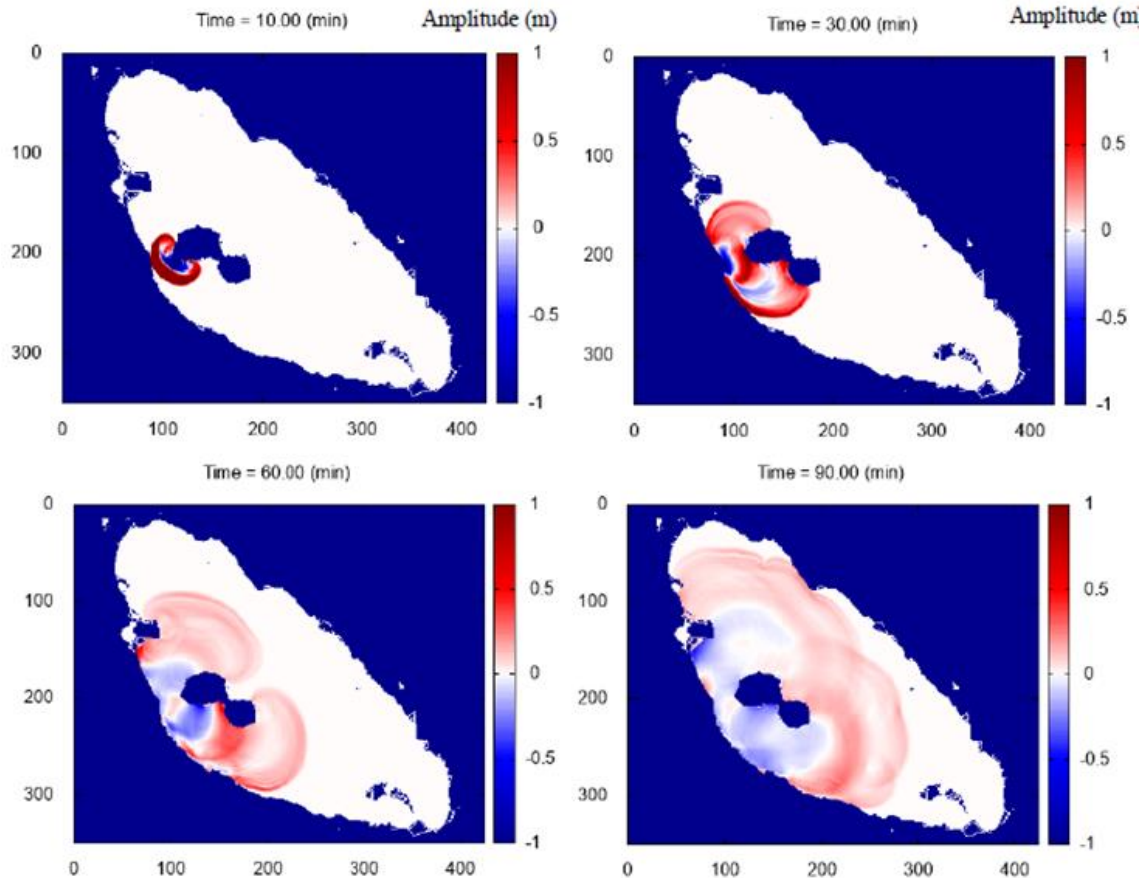
4. Mar, Jun, Sep, Dec – National Disaster simulations in Nicaragua, including tsunami

Tsunami hazard and concept for the tsunami warning for the big lakes of Nicaragua

(concept presented at Cities on Volcanoes Congress, Antigua, Guatemala, Feb 2024)

Example:

Possible tsunamis in the big lakes of Nicaragua



Simulations from Perez, 2019

CATAC testing new messaging methods

- Emergency Warning Broadcasting System (EWBS) via Digital TV
- Computer-computer communication
 - SeisComP-SeisComP
 - other software
- Social networks: Telegram, Whatsapp, X(twitter)
- Cellphone apps

Possible direct delivery of CATAC products to CA institutions

- Close cooperation/integration of the seismological institutions in CA
- Intense data sharing, 100% with El Salvador, Guatemala and Honduras (gubernamental institutions)
- The seismological data centers en CA are compatible
- Scientists from CA institutions could work at CATAC
- CATAC wants promote acceleration of processing of earthquakes of NTWCs
- CATAC proposed to the CA NTWS to provide its products by means of the direct computer-computer interface of SeisComP
- Discussions are going on about how to establish this plan
- First, CATAC has to update its SeisComP to be 100% compatible with the other seismological datacenters in CA

SeisComP package update at CATAC

since Sep-Oct 2023

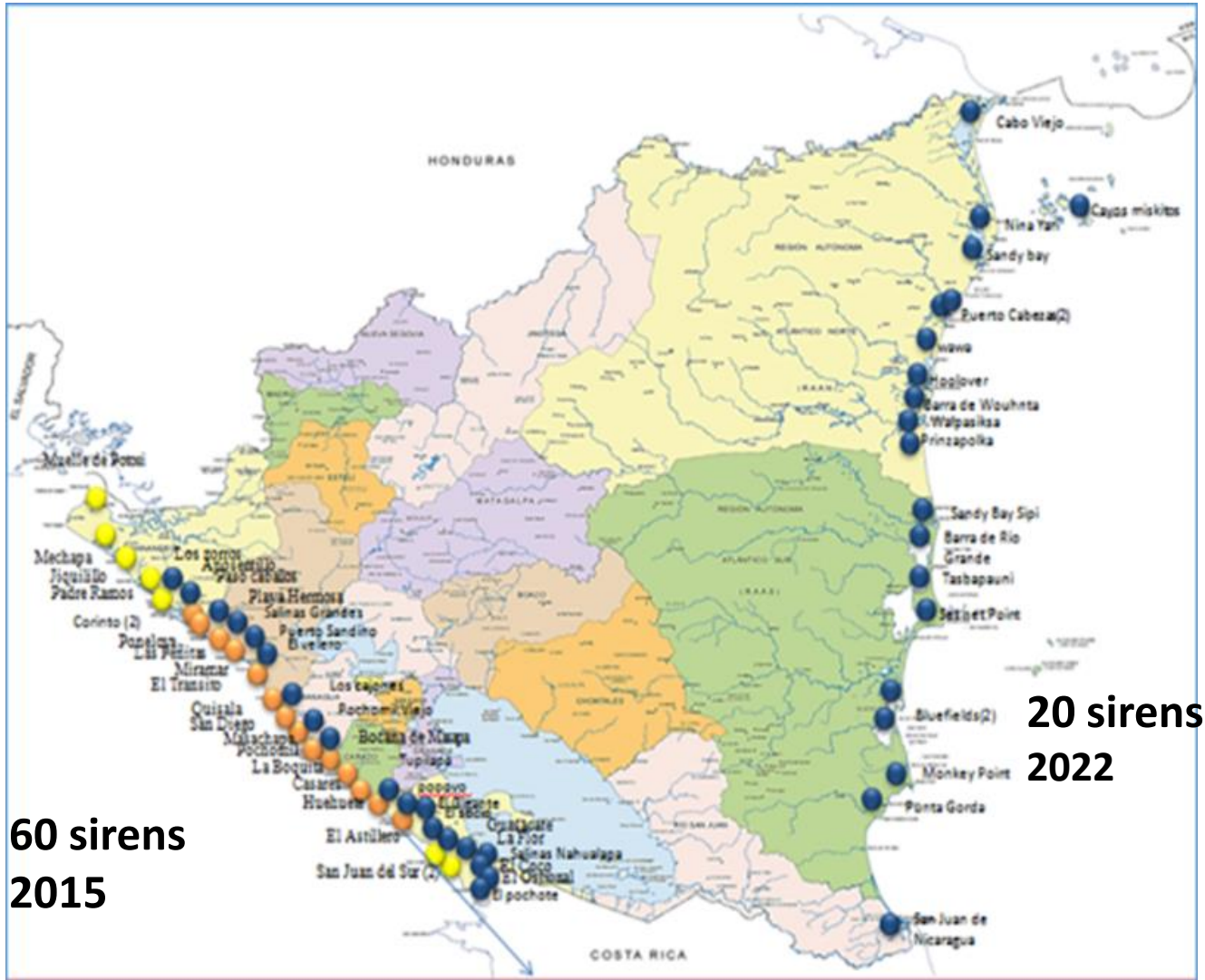
CATAC updates its SeisComP not yearly but in longer periods (less costly)

We updated SeisComP PRO vs. 3 (2020) to vs. 5 or 6

- Correction/removal of bugs
- Speedier master event locations due to GPU use (parallel processing)
- Infrasound phases for location (e.g. volcano explosi3n)
- GPS/GNSS support (improving magnitud & Moment Tensor estimation)
- Improved maps
- Easier messaging with social networks
- Enables the SeisComP-SeisComp communication with other center

2022: Extension of Nicaraguan tsunami sirens

- 20 sirens for the Caribbean coast
- New computerized control system via VHS radio



**Maintenance of Sirens by
Civil Defense of Nicaragua**

<https://www.canal4.com.ni/defensa-civil-da-mantenimiento-a-sistema-de-sirenas-de-alerta-temprana/>

Answers to requests

- **Messages in English**

(for distribution to international partners, PTWC, NWPTAC, ..)

- It's possible for automatic, standard messages
- But not practical for comments on special observations, unusual situations,.. as the mastering of English is not sufficient for most watchstanders.

(Could we could use AI ?)

For the moment we send messages to PTWC in Spanish

- **Use of WMO GTS**

for distributing messages to international partners (PTWC, NWPTAC, ..)

- INETER's Met and IT Departments are not able to provide the service
- Use of new comm methods might be more practical and faster especially for graphical products

Nicaragua: Request to ICG/CARIBE EWS XVII

CATAC progress in the pilot phase of operations from 2019 to 2023.

An experimental introductory and familiarization period of about 2 years duration, 2019-2021, was conducted. During this time, only seismological messages were routinely sent. Tsunami advisory was conducted in a less formal manner via social media communications with alert recipients in the region immediately after the earthquake.

In the experimental phase, CATAC achieved the following advances:

The **24x7 shift staff was doubled**, employing 2 people per shift. Staff was trained, especially the 8 new people on the shift that INETER additionally assigned for the 24x7 service.

The **accuracy and speed** of earthquake and tsunami processing in general was improved. Experience was gained with the processing of strong earthquakes that occurred in the region: 5 earthquakes with magnitudes greater than $M=7$; 8 earthquakes with magnitudes between 6.5 and 7, and a large number of earthquakes with M less than 6.5.

In Central America, the greatest tsunami threat comes from local and regional sources, and areas along the Central American coasts have been identified where tsunamis can impact in less than 10 minutes after the earthquake or tsunami generator. For this reason, CATAC was dedicated to accelerate the processing of earthquakes and tsunamis. To reduce the processing time and improve the reliability of the products, a series of concrete measures were taken, which are detailed in the following.

Great densification of the seismic networks in Nicaragua, El Salvador, and Guatemala was achieved through the EWARNICA project with Switzerland, while improving the accuracy of earthquake locations. With the CATAC earthquake early warning methods, CATAC obtains a first location and magnitude of the earthquakes occurring in Central America within a few seconds after the start of the event and also accelerated the calculations of the Moment Tensor and the M_w magnitude.

CATAC accelerated the tsunami simulation “on the fly” using new GPU cards, which yields tsunami parameters within a few seconds after establishing earthquake parameters.

- CATAC established its **website catac.ineter.gob.ni** and continues to develop it. This site provides information on earthquakes and tsunamis for the target audience of CATAC products as well as for the general public.
- CATAC in cooperation with ETHZ/Switzerland developed **the Shakemaps website** (<http://shakemapcam.ethz.ch/>) of strong earthquakes recorded by CATAC that shows the impact of earthquakes which is important when assessing the situation of the coastal population after an event.
- CATAC started to implement the **use of GPS/GNSS** in the process of seismological monitoring and characterization of large earthquakes. In 2021, Nicaragua started to establish real-time transmission of high frequency data sampling from 34 GPS/GNSS stations in Nicaragua to CATAC, with the aim to retransmit these data to UNAVCO and to implement software that allows the data to be used routinely.

CATAC fulfills the conditions for the routine TSP operation

Supported by

- Proposal of the ICG/PTWS-WG-CA Apr 24, 2024,
- Decisión ICG/PTWS XXIX 12/2021: Interim function for Pacific coast of CA
- Decisión ICG/Caribe EWS XV 04/2023: Interim function for Caribbean coast of CA
- Orientation of ICG/PTWS-SC 04/2023 on full functionality of CATAC
- Decisión ICG/PTWS XXX on full functionality of CATAC

Nicaragua: Proposal to ICG/CARIBE EWS XVII

- To note that CATAC elaborated a report to ICG/CARIBE EWS-VII in PPT and Text formats about its development and the progress during the experimental and interim period 2019-2022, 2022-2024
- To note that CATAC is elaborating a draft versión of its Users Guide corresponding to the new standard proposed (25 aug 2023) by ICG/PTWS Task Team of TSPs; taking into account the new processing methods, messaging formats and channels.
- To take note that CATAC will discuss the final version (English) of the new User's Guide in WG-CA, ICG/PTWS TT Task Team of TSPs, for decision, for the Caribbean coast of CA. Thereafter the the Spanish translation will be produced.
- To admit the start of CATAC's full functionality.
- To endorse the final admission of CATAC by the IOC in August of 2024.