WHAT ARE THE IMPACTS OF OUR WORK?

Lt. Gerardo Macedo – DHN (online)
Cmdr. Carlos Zúñiga – SHOA

HOW ARE WE ASSESSING THE TSUNAMI THREAT?

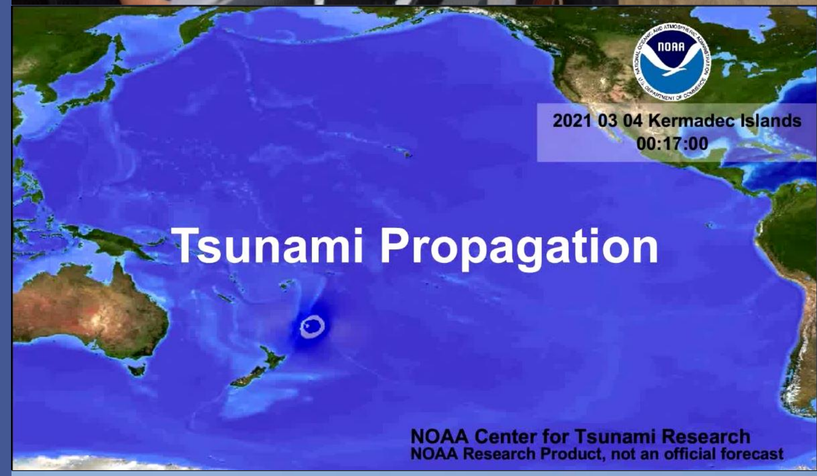
SNAM Chile

National Tsunami Warning System

National Tsunami Warning System

- Supreme Decret No 26, January 11, 1966.
- Mission: Tsunami hazard assessment within the national responsibility area.

- Advanced technology systems, with national scientific contribution.
- High level of professionalism and training.
- Redundancy in monitoring, command/control and communications systems.
- High cost of maintenance and renovation.
- Operation under national and international protocols.



SHOA

SHOA

Main Ops Room

Alternative I Ops Room

APN

Alternative II Ops Room

Viña del Mar

Playa Ancha

Valparaíso

International cooperation

Southeast Pacific Regional Cooperation

National Tidal Network

SENAPRED
Ministerio del Interior y Seguridad Pública
Gobierno de Chile

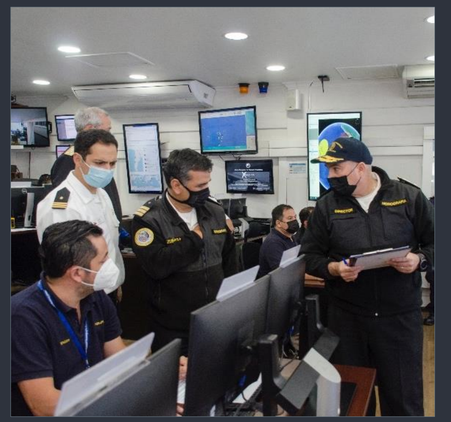
National Disaster Management Office

Maritime Field

Navy Field

Emergency Evacuation Actions

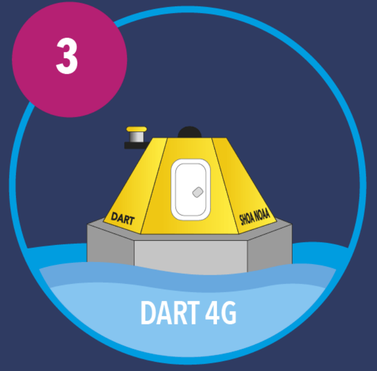
Type of tsunami	Expected amplitude	EVACUATION AREAS	Threat Status
Instrumental	< 0.3m	No action required	INFORMATIVE
Minor	0.3 to 1m	Evacuation of the population outside the Precautionary zone, which includes areas of beaches, rocky shores, wetlands, estuaries, river mouths, coastal walks (pedestrians), marinas, waterfronts (vehicular), coves, ports and docks.	WATCH
Intermediate	1 to 3m	Evacuation of the population towards the Security Area (or Safe Zone), established at a height greater than 30 meters or as provided by local authorities.	ADVISORY
Major	≥ 3.0m		WARNING



SNAM Chile
Sistema Nacional de Alarma de Maremotos

Monitoring Network

DART BUOYS – SEA LEVEL STATIONS



ENM

Isla de Pascua

Arica
Pisagua
Iquique
Patache
DART Iquique
Triaxys Iquique
Tocopilla
Mejillones
DART Mejillones
Antofagasta
Paposo
Taltal
Chañaral
San Félix
Caldera
DART Caldera
Huasco
Punta de Choros
Coquimbo
Puerto Aldea
Pichidangui
Quintero
DART Pichidangui
Watchkeeper Valparaíso
Valparaíso
Juan Fernández
San Antonio
Boyeruca
Constitución
DART Constitución
Watchkeeper Talcahuano
Coliumo
Isla Quiriquina
Talcahuano
Coronel
Lebu
Villarrica
Nehuentue
Queule
Corral
Bahía Mansa
Ancud
Puerto Montt
Castro
Puerto Melinka
Watchkeeper Melinka
Puerto Aguirre
Puerto Chacabuco
Puerto Edén
Caleta Meteoro
Triaxys Punta Arenas
Bahía Gregorio
Punta Arenas
Puerto Williams
Base Prat
Base O'Higgins

N
W
E
S

LEYENDA:

Red Nacional de Monitoreo de Nivel del Mar

- Estaciones de Nivel del Mar
- Estación de Monitoreo en Lagos
- Boya DART II
- Boya DART 4G
- Boya Triaxys
- Boya Watchkeeper
- Límites Administrativos

Escala: 1:27.000.000

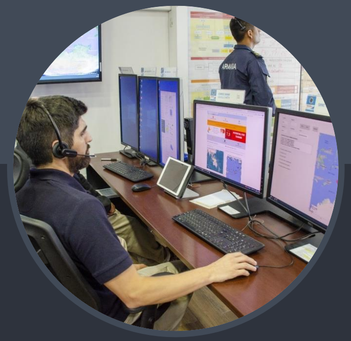
250 125 0 250 500

Millas Náuticas

Sistema de Coordenadas:
GCS WGS 84







SNAM OPERATION

Activation

- PTWC , CSN, USGS, NTWC, GFZ

Reception of Information

00:00

Assessment

It is disseminated to:
- SENAPRED
- MARITIME FIELD
- NAVY FIELD

Dissemination

00:05

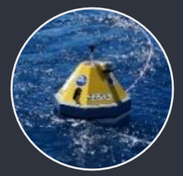
Monitoring

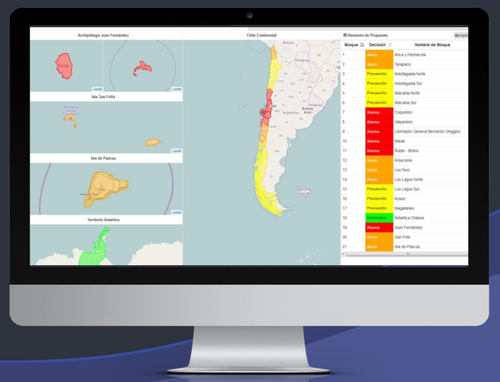
Forms of dissemination:
- VHF ONEMI / MARITIME / CSN
- DATAMAR2 SYSTEM
- SNAM Fax
- Fixed and satellite telephones
- E-mails

Cancellation

>06:00

- Amplitude records
- Flood model comparison
- Field observers



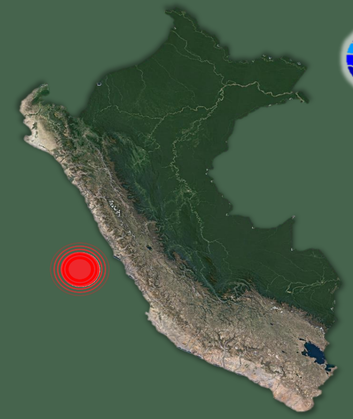


MARINA DE GUERRA DEL PERÚ

CENTRO NACIONAL DE ALERTA DE TSUNAMIS

CNAT

Member of the National Tsunami Warning System



IGP

DIHIDRONAV

Seismic Parameters

< 8 minutes

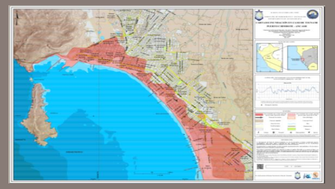
Alert/alarm bulletin

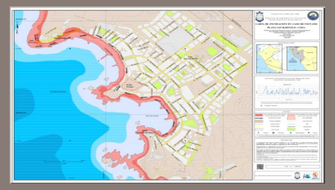
< 8 minutes

Dissemination and action plans.

< 8 minutes

Tsunami Inundation Maps





Proyected: 225 CITs

Planning

Field work

Publication

Post proccess

MARINA DE GUERRA DEL PERÚ
CENTRO NACIONAL DE ALERTA DE TSUNAMIS
CNAT

NATIONAL TSUNAMI WARNING CENTER

Working Group – Tsunami Warning for the Southeast Pacific

DIMAR

INOCAR

DIHIDRONAV

SHOA

Hydrographic technical standards

Dissemination and awareness campaigns

Awareness talks

App, broadcast media

REGIONAL / DISTANT

LOCAL

OBSERVATORIO DE HONOLULU HAWAI (PTWC)

INSTITUTO GEOFÍSICO DEL PERÚ (IGP)

AFTN/AHMS-C-T-S

C-T-RDSI-S

DIRECCIÓN DE HIDROGRAFÍA Y NAVEGACIÓN DE LA MARINA (DIHIDRONAV)

CN-C-T-R-S

C-T-R-RDSI-S

INDICATIVO COLECTIVO TSUNAMIS

INSTITUTO NACIONAL DE DEFENSA CIVIL (INDECI)

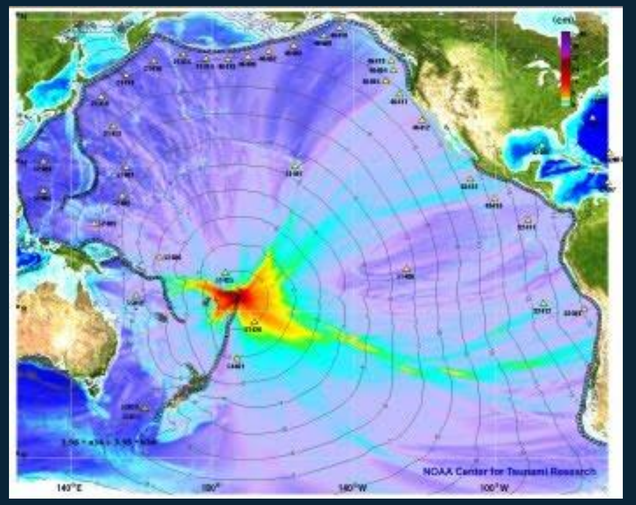
C-T-R-S

AUTORIDADES Y COMITÉS REGIONALES

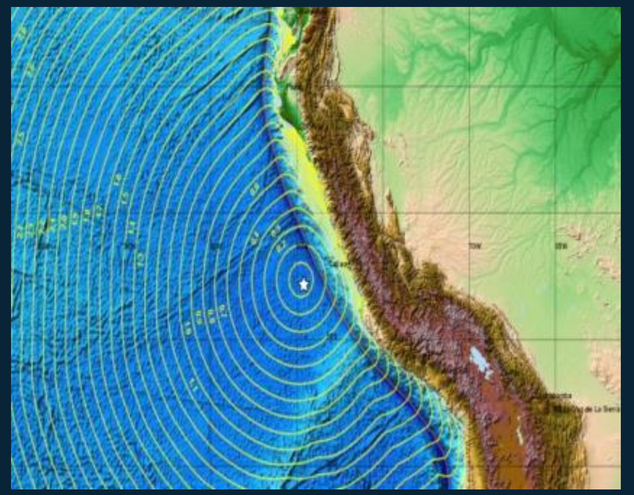
LEGEND

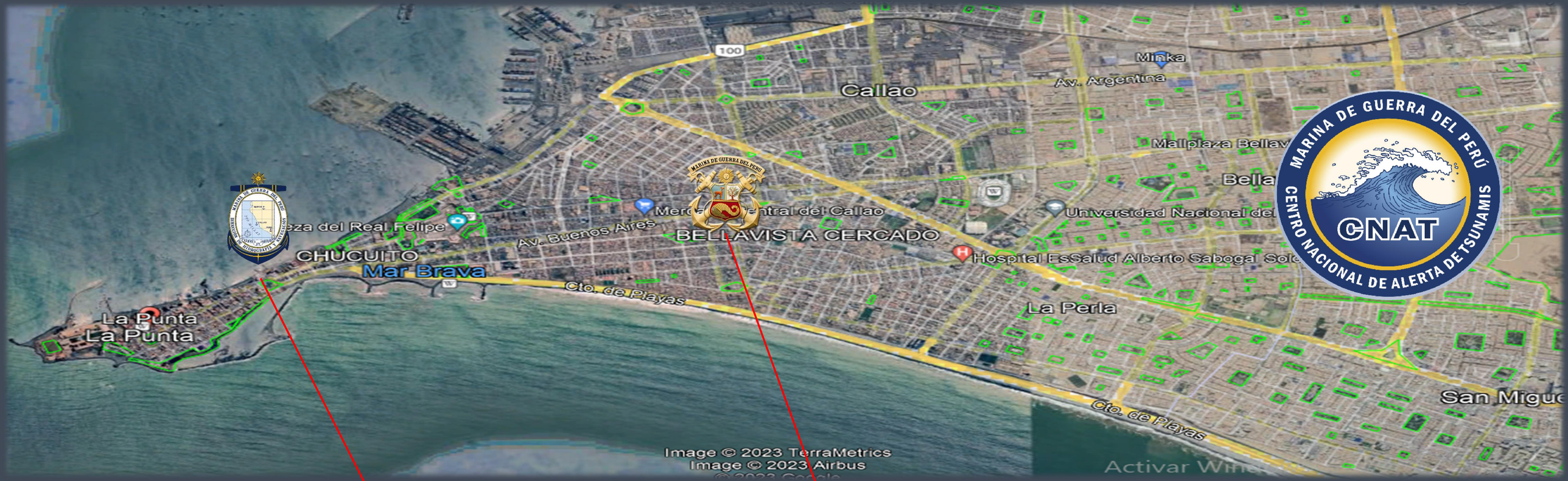
CN: NAVAL COMMUNICATIONS
C: EMAIL
T: PHONE
RDSI: DIGITAL DEDICATED NETWORK
R: RADIO
S: SAT PHONE
AFTN/AHMS: AERONAUTICAL FIXED TELECOMUNICATION NETWORK

REGIONAL / DISTANT TSUNAMI



LOCAL TSUNAMI



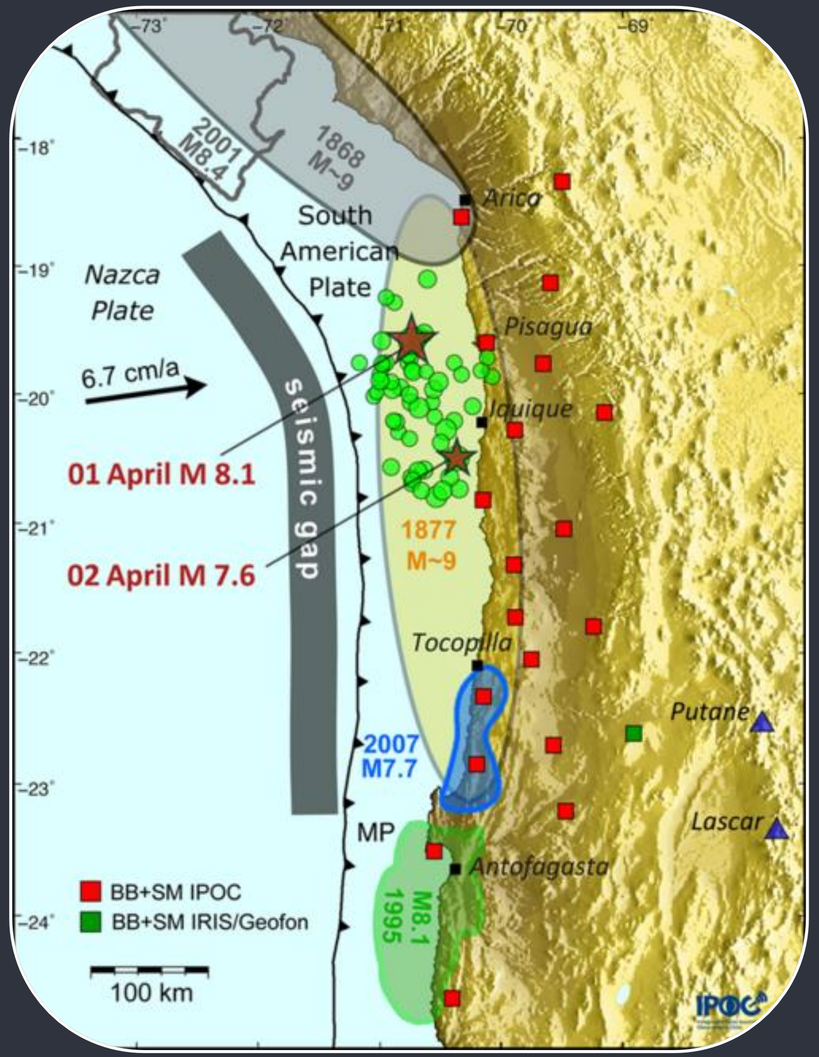


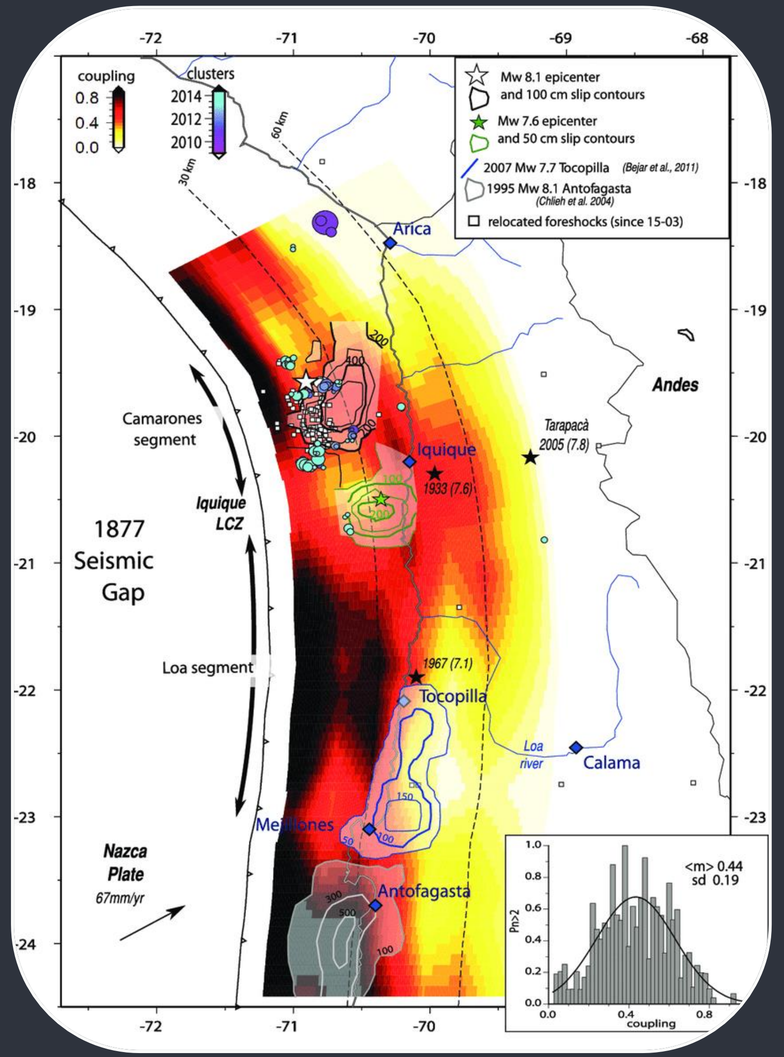
PRINCIPAL

ALTERNATIVE

WHERE ARE
OUR CHALLENGES?

Seismic Gap

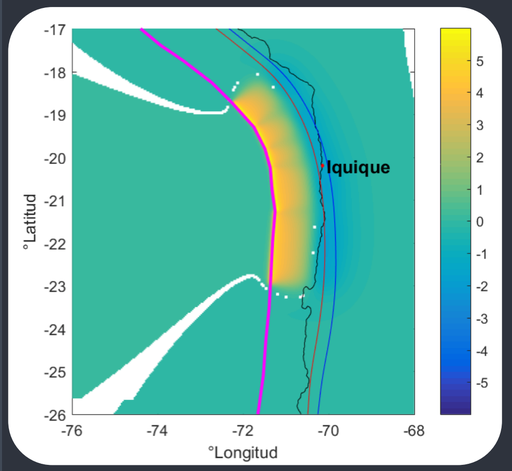


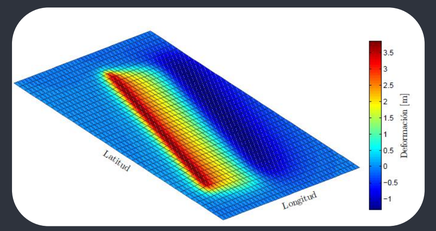


- Studies point to the existence of a large seismic gap extending across northern Chile that could trigger a megathrust earthquake of Mw 8.8 - 9.0.
- Some models indicate that the 2014 Pisagua earthquake ruptured the middle segment of the fault from a depth of 30 to 55 km along the dip.
- The northern and southern segments are still intact, so there is still a large area that could generate an earthquake of Mw >8.5 with the consequent generation of a more significant tsunami.

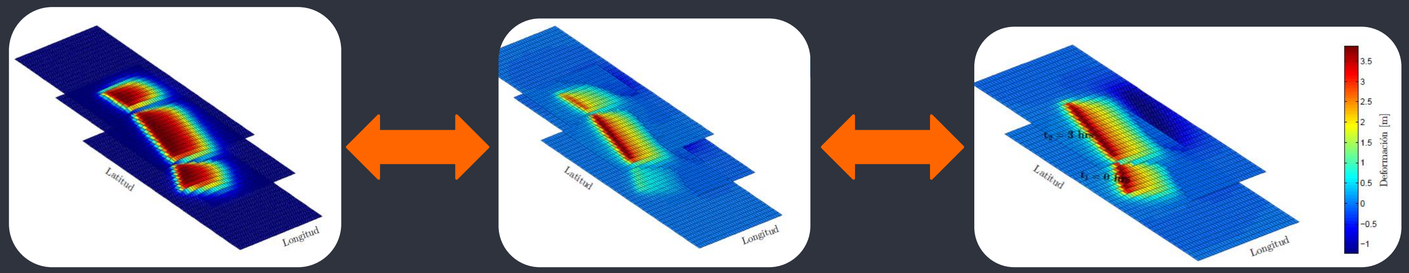
Importance of rupture model

Uniform Fault





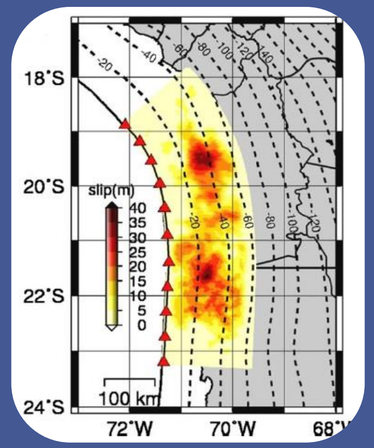
Multifault (Uniform slip each segment)

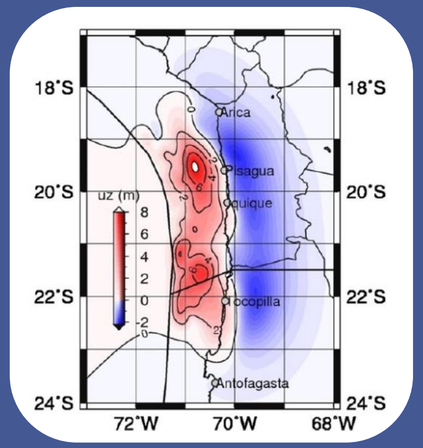


Models with slip distribution:

- Historical scenarios.
- Stochastic scenarios.

New challenges
Models with slip distribution





Source: Ruiz et al., 2015

- Studies point to the existence of a large seismic gap extending across northern Chile that could trigger a megathrust earthquake of Mw 8.8 - 9.0.
- Some models indicate that the 2014 Pisagua earthquake ruptured the middle segment of the fault from a depth of 30 to 55 km along the dip.
- The northern and southern segments are still intact, so there is still a large area that could generate an earthquake of Mw >8.5 with the consequent generation of a more significant tsunami.

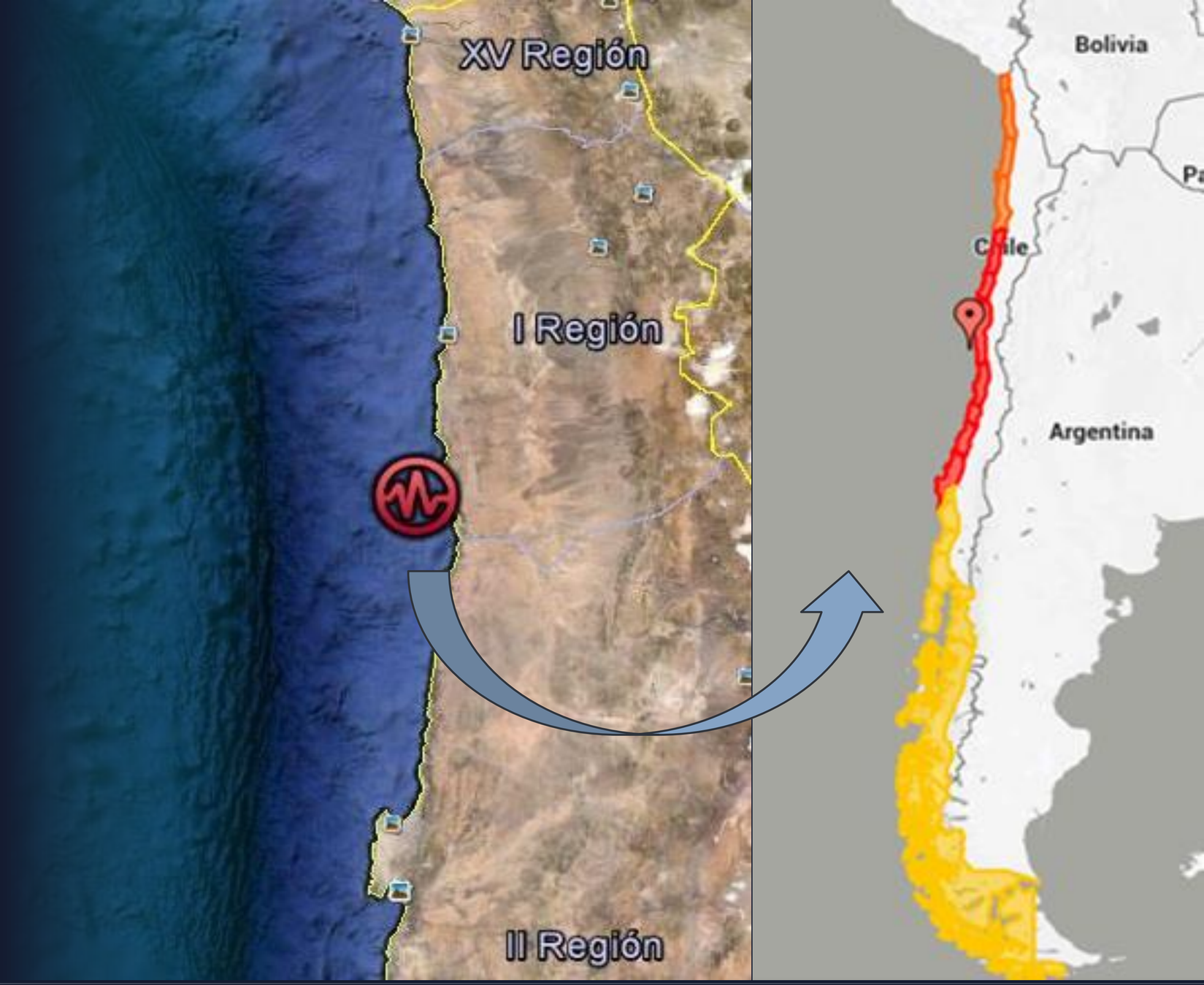
WHERE WILL IMPACT OUR RESULTS?

SHOA

SIPAT

Technology platform for Tsunami hazard forecast based on numerical modeling (pre-modeled scenarios).

Given a seismic event, it allows to obtain a quick and sectorized forecast (21 blocks) of the different threat levels for Chile.



SHOA

SIPAT

Technology platform for Tsunami hazard forecast based on numerical modeling (pre-modeled scenarios).

Given a seismic event, it allows to obtain a quick and sectorized forecast (21 blocks) of the different threat levels for Chile.

CHILE DIVIDED IN

21 Blocks

According to Tsunami propagation and political division of Chile.

SHOA

SIPAT

Technology platform for Tsunami hazard forecast based on numerical modeling (pre-modeled scenarios).

Given a seismic event, it allows to obtain a quick and sectorized forecast (21 blocks) of the different threat levels for Chile.

+9.000
ESCENARIOS

Seismic parameters

DATABASE

Possible Scenarios

Selected Scenario

XV Región

I Región

II Región

Scenario

Real event

SHOA

SIPAT

Technology platform for Tsunami hazard forecast based on numerical modeling (pre-modeled scenarios).

Given a seismic event, it allows to obtain a quick and sectorized forecast (21 blocks) of the different threat levels for Chile.

Coquimbo 2015	
Magnitude	8.4 (Mw)
Date and Time	16/SEP/2015 19:54 Local Time
Location	31.553°S; 71.864° W
Depth	11,1 km
Geografic Reference	42 km al W de Canela Baja
Source	National Seismology Center (CSN)

ALARMA

ALERTA

PRECAUCIÓN

INFORMATIVO

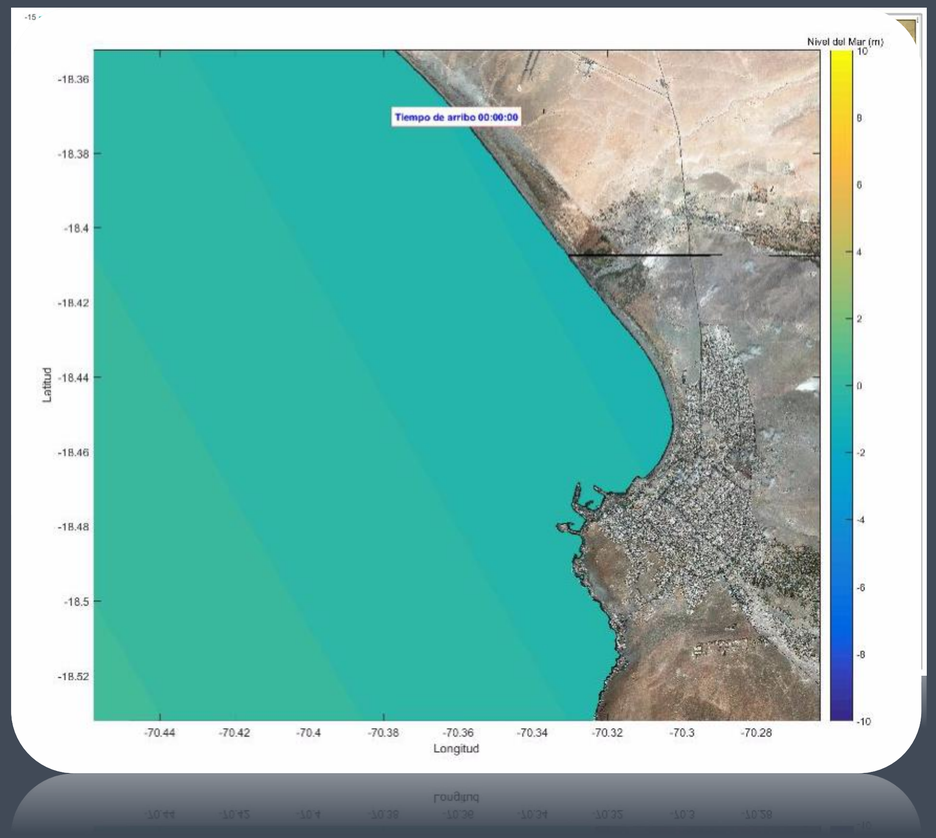
Before SIPAT

After SIPAT

SHOA

CITSU

Tsunami Flood Charts



Threat maps, which includes areas that could be flooded and their depth, in the event of a Tsunami.

The CITSUs are based on a **probable extreme event**, considering the scientific background and available technologies

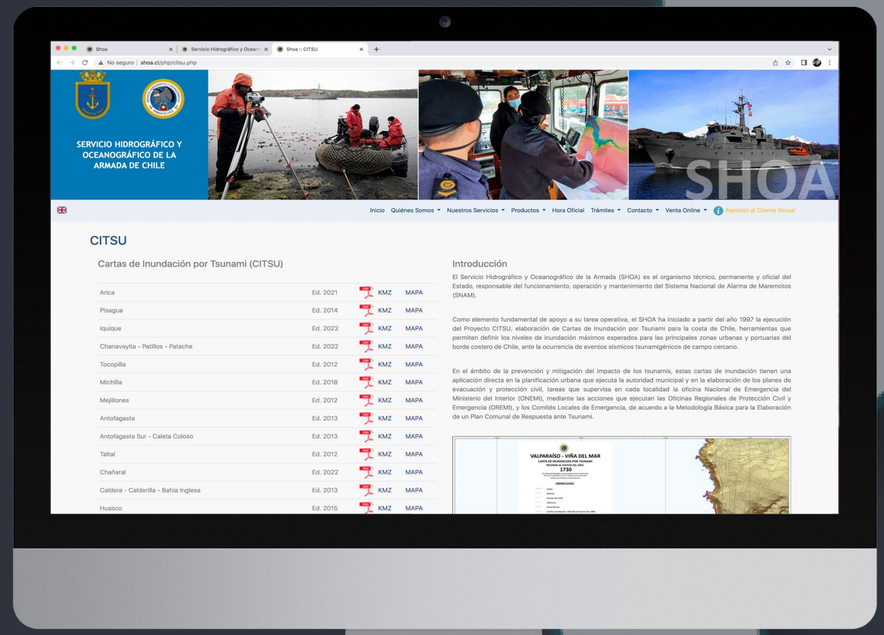
With the new SINAPRED Law, the CITSUs become Disaster Risk Management Instruments, which are necessary for territorial planning.

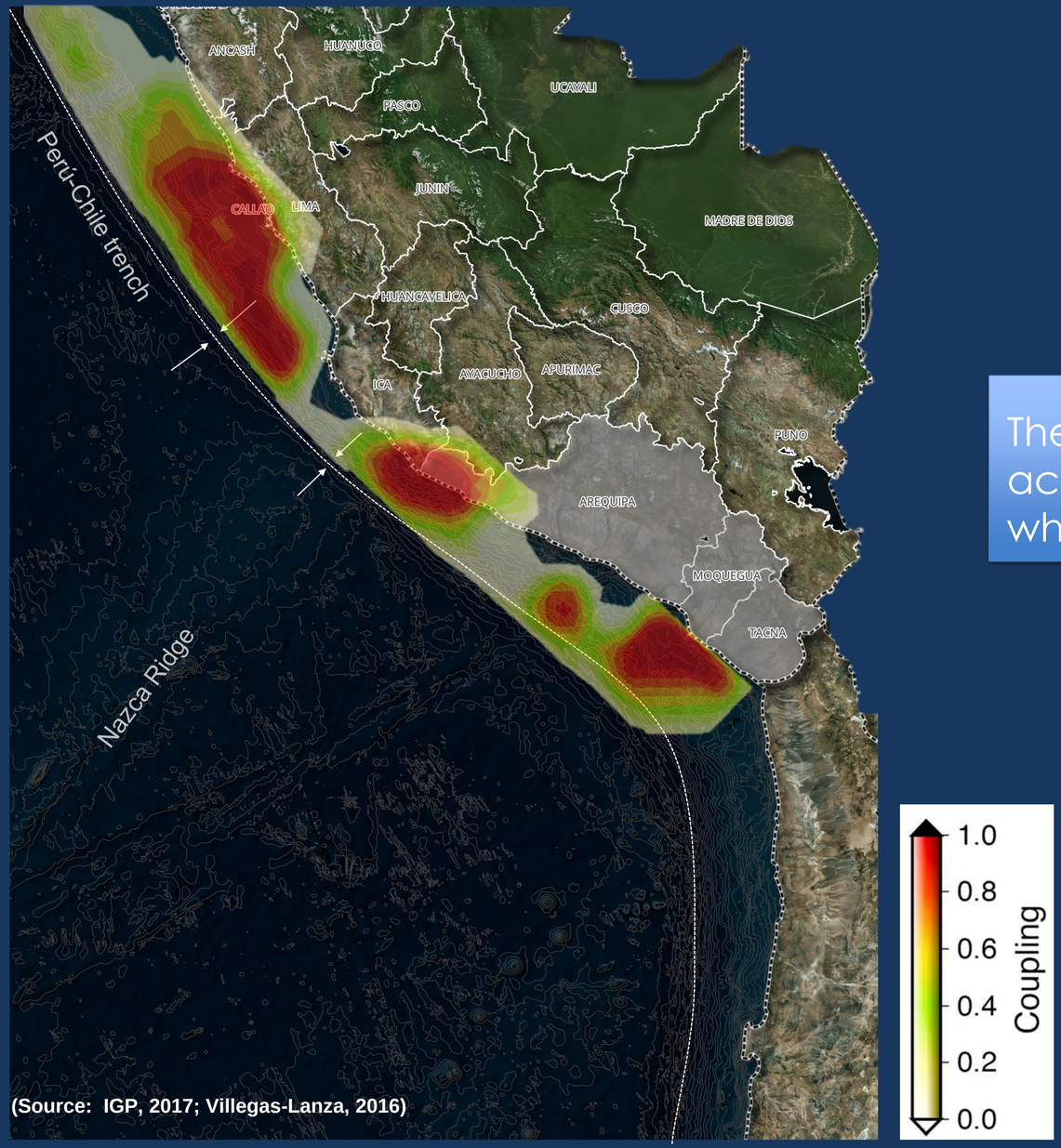
CITSUS IN FORCE

70

Between Arica and Puerto Williams
Available on Web Site

www.shoa.cl





(Source: IGP, 2017; Villegas-Lanza, 2016)

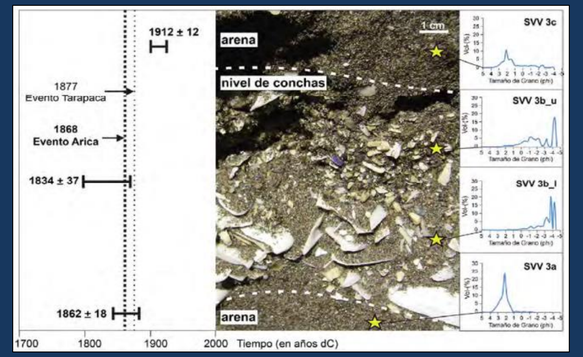
SOUTHERN PERU

The Geophysical Institute of Peru (IGP) published a deformation accumulation map (seismic coupling), these being the areas where large-magnitude earthquakes are expected to occur.

The Geological, Mining and Metallurgical Institute carried out a study of paleotsunamis in central and southern Peru. Records of two tsunami events were found: Vila Vila and Boca del Río (Tacna).

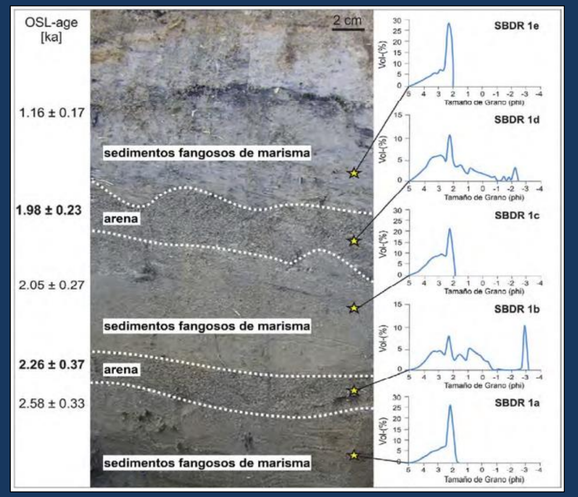
VILA VILA

Evidence of an event was found. The model could not be applied.



BOCA DEL RIO

Evidence of two events founded, estimated at 5.1 and 6.1 m wave height respectively.



(INGEMMET, 2016; Spiske et. al., 2013)

Actually, on southern coast of Peru, 21 Tsunami Inundation Maps (CIT) have been published (total 139).

AREQUIPA

Coastal population: 68 681

Coastal towns: 33

Elaborated maps: 13

MOQUEGUA

Coastal population: 66 121

Coastal towns: 3

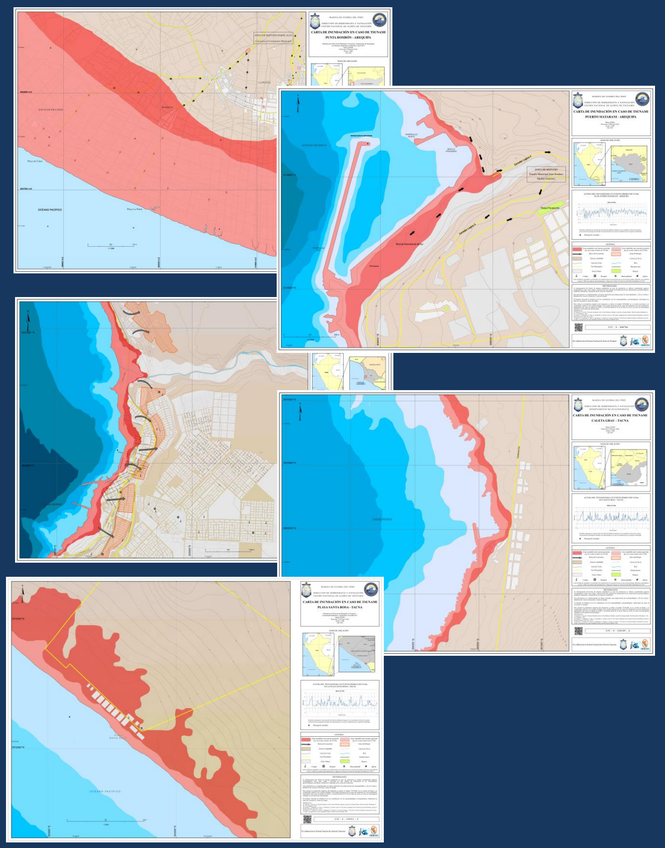
Elaborated maps: 1

TACNA

Coastal population: 1 331

Coastal towns: 12

Elaborated maps: 7



Maps available to download

MGPTSUNAMIS APP

The CITs were elaborated with the TUNAMI N2 model considering historical Arequipa 2001 and Arica 1868 seismic events.

Peru, 1942

Arequipa, 2001

South of Peru, 1604

Arica, 1868

Iquique, 2014

Tarapaca, 1877

Antofagasta, 1995

(Source: DIHIDRONAV)

(Source: The Illustrated London News)

THANK YOU