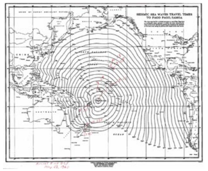
The Tsunami Programme & GLOSS

unesco

Intergovernmental Oceanographic Commission

We have gone a long way…

1948 the **Honolulu Magnetic Observatory**, under the US Coast and Geodetic Survey (USCGS)established



ITSU
IOC/IV-6, International Aspects of the Tsunami Warning System in the Pacific, Paris, November 1965

ITSU development

1965

The Honolulu Observatory renamed Pacific Tsunami Warning Center PTWC

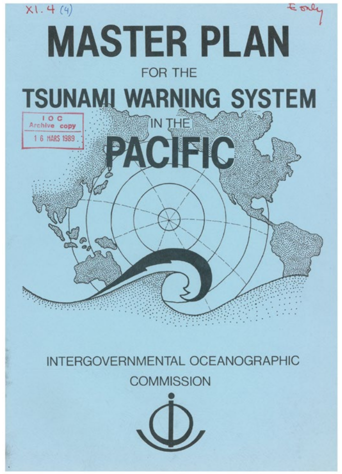
1977

1952. The Japan Meteorological Agency started its national tsunami warning center

1965 - IOC Working Group on the International Aspects of the Tsunami Warning System in the Pacific, organized by the USCGS on behalf of the IOC, Honolulu, 27-30 April 1965

1989

First Master Plan



The tragedy brings world attention to the dangers of tsunamis in every nation and initiates the development of warning and mitigation systems in the Indian Ocean

Indian Ocean Tsunami

2004

ITSU renamed

September 2005, Vina del Mar, Chile

The 20th Session of the ICG/PTWS-XX decides to change its name to the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System

2005

3 ICGs established

Indian Ocean (ICG/IOTWS), Caribbean and Adjacent Seas (ICG/CARIBE-EWS), Mediterranean and North Eastern Atlantic (ICG/NEAMTWS) (IOC/XXIII-11, 12, 13, **June 2005**)

nature

6 January 2005 Volume 433 Issue no 7021

A divided world

The lack of preparation for last month's tsunami illustrates shocking disparities in how science is applied in different regions of the world. The global response to the disaster offers a glimmer of hope that these disparities will be addressed.

As the full horror of the Asian tsunami sinks in, the reactions of scientists echo those of the population as a whole. These range from a sense of hopelessness in the face of nature's power to concern for the victims and a determination that their suffering should be addressed.

The Indian Ocean tsunami of 26 December 2004 occurred at about 01:00 GMT, when the Indian tectonic plate moved underneath the neighbouring Burma microplate, raising it by about 10 metres along a length of more than 1,000 km and sending a wave propagating through the full depth of the overlying ocean at high speed. With wavelengths much larger than the depth of the ocean, such waves propagate across the great distances of the open sea without much surface perturbation and with very little energy loss, until shallower coastal shelves slow the wave and increase its amplitude — resulting, in this case, in a calamity of biblical proportions.

Such disasters have always been with us, but this particular event (see News, pages 3–5) had some characteristics that cry out for a global response that is more emphatic and sustained than a brief outburst of charity.

The most distinctive of these characteristics is the uneasy feeling, prompted by the delayed action of the tsunami, that a great deal of the suffering could have been avoided. Much of the damage, after all, occurred in Sri Lanka and on India's eastern coast about two hours after an earthquake had triggered the tsunami in the ocean. Monitoring stations in Japan and the United States, for example, had been able to observe the event in real time and yet apparently could do nothing — despite the ubiquity of modern telecommunications — to warn victims of the impending risk.

It turns out, on closer examination, that not all of this is true. The size of the earthquake wasn't apparent at first glance: early estimates put it at magnitude 8, which is not exceptional for submarine quakes and is an order of magnitude smaller than the eventual value of 9 that made this the world's largest seismic event for 40 years. And, in the absence of an ocean-based monitoring system, remote seismologists did not know that the quake had triggered a tsunami. Many researchers who were alerted to the event in the United States on their Christmas night, for example, went to bed quite oblivious to the carnage that was unfolding as they slept.

Additionally, as the awful scale of the disaster slowly emerged from remote regions of western Indonesia, it has become clear that most of the death and destruction had occurred in a region that was too close to the epicentre of the event for warnings to have made much difference.

Neglect

Nonetheless, an effective warning system, allied to a public education campaign of the sort that has already taken place around the Pacific Ocean, could have reduced the scale of the disaster.

It is clear, with the benefit of hindsight, that the arcane international bodies that manage tsunami protection have been neglected and underfunded for many years. Most of them have focused on the Pacific Ocean, and occasional attempts to widen their brief to the Indian Ocean have been rebuffed.

A master plan prepared in 1999 by ITSU, one of the international organizations that plans for the monitoring of tsunamis, stated: "Tsunami hazards exist on both sides of the Atlantic Ocean, in the eastern Indian Ocean, and in the Mediterranean, Caribbean, and Black Seas. Efforts to establish warning centers in those areas should be encouraged."

An important reason for the previous confinement of monitoring systems to the Pacific has been the occurrence of two tsunamis in the Pacific quite recently, in 1960 and 1964. The last tsunami produced by an earthquake in the Indian Ocean is thought to have occurred back in 1833.

However, the most important differentiating factor has been the readiness of 'Pacific rim' nations such as Japan, Australia and the United States to support a cheap but potentially effective system for monitoring and for educating the public about an infrequent risk. India, Indonesia and the other nations on the Indian Ocean's rim are relatively poor countries with needs that seemed more pressing than that of planning against the remote — but nonetheless inevitable — prospect of a tsunami.

Pushing for change

A great amount could have been done at relatively little expense to plan for a tsunami, however. The most important component of such preparation is public education, so that local inhabitants are aware, for example, of the fact that a dramatic recession of the ocean is in itself a warning of an impending event. The next most important component is the construction of a simple network that will quickly convey warning information from the seismological stations to some central point (such as the Pacific Tsunami Warning Center in Hawaii) and back out again to local radio and television channels, perhaps using siren systems in regions that can afford them.

Some of this will doubtless now take place — and so it must. As earthquake-mitigation programmes in Japan and California have shown, we can avoid vast carnage in the face of major natural disruptions. Scientists have a role to play in this. Biomedical researchers have taken global initiatives to address preventable deaths from tropical diseases that might otherwise be ignored. In the same spirit, Earth scientists around the world must now press even harder for resources in rich countries to be brought to bear to confront the risks of natural disasters in poor countries.

The same communications technologies that could have helped to mitigate this disaster have, instead, brought it home relentlessly to our living rooms. The science behind the event has been busily and prominently displayed for all to see — alongside the consequences of inaction in the face of well-established risks.

Is it too much to expect that people in rich countries, when confronted with evidence on such a scale, will ask that their governments start to pay modest respect to the value of human life amongst the poor, and adjust their budgetary priorities accordingly? Scientists, at least, should argue for a strengthening of research priorities that reflect the needs not of well-protected interest groups in their own nations, but of humanity itself. ■

The New York Times https://www.nytimes.com/2004/12/31/world/worldspecial4/how-scientists-and-victims-watched-helplessly.html

ASIA'S DEADLY WAVES: GAUGING DISASTER

How Scientists and Victims Watched Helplessly

By Andrew C. Revkin

Dec. 31, 2004

Correction Appended

It was 7 p.m. Seattle time on Dec. 25 when Vasily V. Titov raced to his office, sat down at his computer and prepared to simulate an earthquake and tsunami that was already sweeping across the Indian Ocean.

He started from a blank screen and with the muted hope that just maybe he could warn officials across the globe about the magnitude of what was unfolding. But the obstacles were numerous.

Two hours had already passed since the quake, and there was no established model of what a tsunami might do in the Indian Ocean. Ninety percent of tsunamis occur in the Pacific, and that was where most research had been done.

Dr. Titov, a mathematician who works for a government marine laboratory, began to assemble his digital tools on his computer's hard drive: a three-dimensional map of the Indian Ocean seafloor and the seismic data showing the force, breadth and direction of the earthquake's punch to the sea.

As he set to work, Sumatra's shores were already a soup of human flotsam. Thailand to the east was awash. The pulse of energy transferred from seabed to water, traveling at jetliner speed, was already most of the way across the Bay of Bengal and approaching unsuspecting villagers and tourists, fishermen and bathers, from the eight-foot-high coral strands of the Maldives to the teeming shores of Sri Lanka and eastern India.

In the end, Dr. Titov could not get ahead of that wave with his numbers. He could not help avert the wreckage and death. But alone in his office, following his computer model of the real tsunami, he began to understand, as few others in the world did at that moment, that this was no local disaster.

With an eerie time lag, his data would reveal the dimensions of the catastrophe that was unfolding across eight brutal hours on Sunday, one that stole tens of thousands of lives and remade the coasts of the Asian subcontinent.

above.

The energy unleashed in a 9.0 quake, as this one would ultimately come to measure, is roughly the amount that would be unleashed if it were possible to create a bomb made of 32 billion tons of TNT and set it off.

As the news media calls began flooding in, Dr. Sieh began to recount the mechanism he knew so well. It would be two days and nights before he would have time to turn on a television and witness the consequences of the upheaval. It was likely that a fresh distortion would be etched in the corals. It was certain that a region and people he had grown to love had been ripped asunder.

Australia: International Inertia

The possibility of tsunamis arising in the Indian Ocean had not completely escaped international attention. During the 1990's, an obscure United Nations group, the International Coordination Group for the Tsunami Warning System in the Pacific, periodically considered the extension of tsunami alert systems to parts of the globe outside the Pacific, including the Caribbean and Indian Ocean.

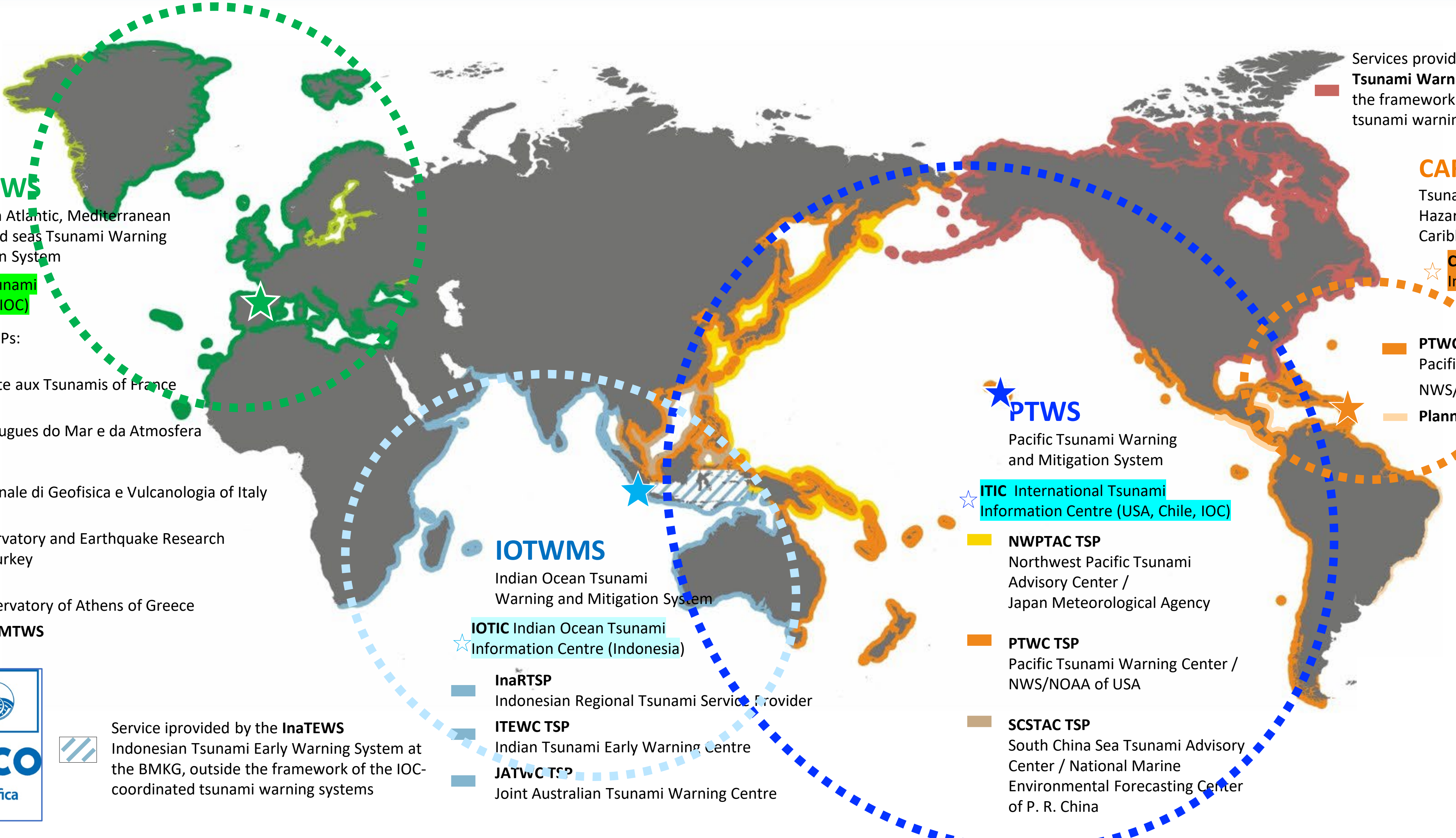
At a meeting of the group in Lima, Peru, in September 1997, for example, its members had considered proposals to expand the network to the Indian Ocean, particularly because of Indonesia's tectonic activity. Nothing concrete happened.

Among the scientists who kept up a restrained but insistent pressure was Dr. Phil Cummins, a seismologist with Australia's geosciences agency. He continued to gather and present evidence that an Indian Ocean tsunami was inevitable, although unpredictable in terms of timing, and posed a grave threat to many countries. He met with no ill will, but with considerable inertia, he said.

GLOBAL TSUNAMI WARNING AND MITIGATION SYSTEM

Intergovernmental Oceanographic Commission of UNESCO

2025 www.ioc-tsunami.org



Services provided by the **US National Tsunami Warning Center** are outside the framework of the IOC-coordinated tsunami warning systems

NEAMTWS

North Eastern Atlantic, Mediterranean and connected seas Tsunami Warning and Mitigation System

☆ **NEAMTIC** NEAM Tsunami Information Centre (IOC)

Accredited TSPs:

- **CENALT**
  Centre d'Alerte aux Tsunamis of France
- **IPMA**
  Instituto Portugues do Mar e da Atmosfera of Portugal
- **INGV**
  Istituto Nazionale di Geofisica e Vulcanologia of Italy
- **KOERI**
  Kandilli Observatory and Earthquake Research Institute of Turkey
- **NOA**
  National Observatory of Athens of Greece
- **Planned NEAMTWS**

IOTWMS

Indian Ocean Tsunami Warning and Mitigation System

☆ **IOTIC** Indian Ocean Tsunami Information Centre (Indonesia)

- **InaRTSP**
  Indonesian Regional Tsunami Service Provider
- **ITEWC TSP**
  Indian Tsunami Early Warning Centre
- **JATWC TSP**
  Joint Australian Tsunami Warning Centre

Service iprovided by the **InaTEWS** Indonesian Tsunami Early Warning System at the BMKG, outside the framework of the IOC-coordinated tsunami warning systems

PTWS

Pacific Tsunami Warning and Mitigation System

☆ **ITIC** International Tsunami Information Centre (USA, Chile, IOC)

- **NWPTAC TSP**
  Northwest Pacific Tsunami Advisory Center / Japan Meteorological Agency
- **PTWC TSP**
  Pacific Tsunami Warning Center / NWS/NOAA of USA
- **SCSTAC TSP**
  South China Sea Tsunami Advisory Center / National Marine Environmental Forecasting Center of P. R. China

CARIBE-EWS

Tsunamis and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions

☆ **CTIC** Caribbean Tsunami Information Centre (Barbado

- **PTWC TSP**
  Pacific Tsunami Warning Center /
  NWS/NOAA of USA
- **Planned TSP PTWS, CARIBE-EWS**

unesco

Comisión Oceanográfica Intergubernamental

Photo 1. Damaged sea level station the day after the 27 February 2010 tsunami, Talcahuano, Chile
Photo by Rodrigo Núñez Gundlach

Minamisoma, Fukushima prefecture, Japan. 2011 March 11, Mw 9.0, Honshu, Japan earthquake and tsunami. (Credit: AFP/AFP/Getty Images.)

2011 Tōhoku earthquake and tsunami

2018

December 18, 2018 **December 30, 2018**

Volcano generated tsunami

2010 Chile

2011

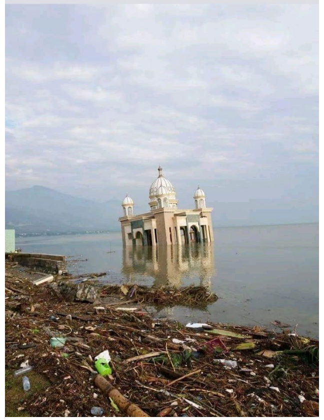
Palu, Indonesia

Sunda strait, Indonesia

Tonga

Inter-ICG Task Team on Hazard Assessment Related to Highest Potential Tsunami Source Areas

Landslide generated tsunami



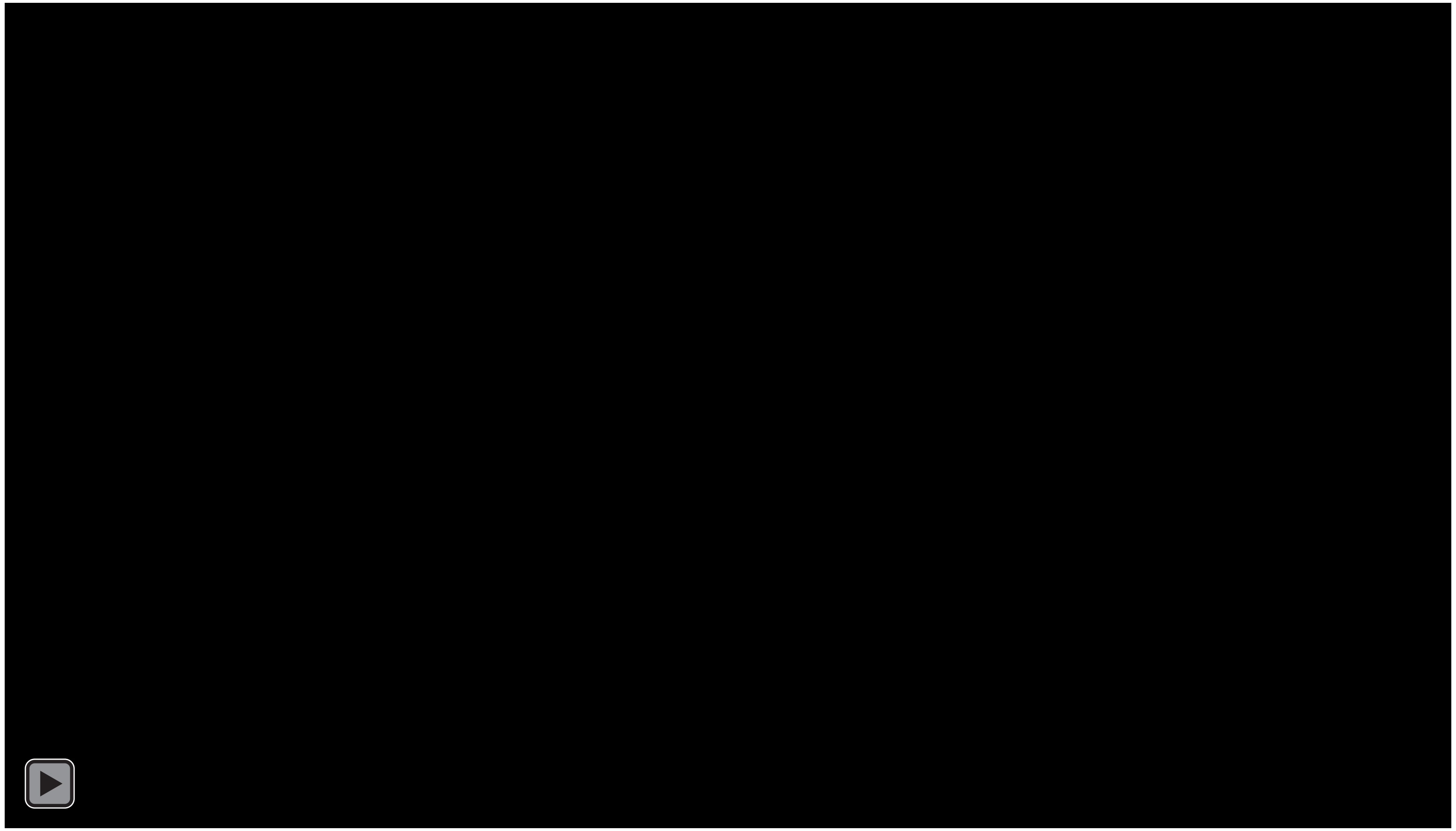
2018

2022

The Group decided to establish a specific Ad Hoc Team on Meteo-tsunamis &Ad Hoc Team on Tsunamis Generated by Volcanoes

2016 ->Recent case studies demonstrated complexity and variability, as well as importance of other types of tsunami sources and that earthquake generated Tsunamis can happen in any subduction zones.

Despite the progress we still have work to do



GLOSS Implementation Programme and Tsunami

Restricted distribution

IOC/INF-663 rev.
Paris, 30 October 1986
English only

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of Unesco)

12 JAN. 1987

GLOBAL SEA-LEVEL OBSERVING SYSTEM IMPLEMENTATION PLAN
1985-1990

The first Draft of this Document (IOC/INF-663) was prepared by the IOC Task Team on Global Sea-Level Observing System, upon the request of the Thirteenth Session of the IOC Assembly (Resolution XIII-7), and submitted to the Nineteenth Session of the IOC Executive Council in March 1986. In accordance with the Resolution EC-XIX.6, it has been further updated upon receipt of inputs and comments from Member States. This Plan will be submitted to the Second Session of the IOC Programme Group on Ocean Processes and Climate (10-13 March 1987) and to the Fourteenth Session of the IOC Assembly (17 March - 1 April 1987).

TABLE OF CONTENTS

GLOSS Implementation Programme and Tsunami

Intergovernmental Oceanographic Commission
technical series

50

Global Sea Level Observing System (GLOSS) Implementation Plan - 1997

UNESCO 1997

TABLE OF CONTENTS

GLOSS Implementation Programme and Tsunami

TABLE OF CONTENTS

5.4 STORM SURGES AND TSUNAMIS

Tide gauges provide the longest records available for studies of historic storm surges. Tide gauge data also are being used operationally for storm surge monitoring and modeling [Flather, 2000; Alvarez Fanjul et al., 2000; Pérez et al., 2012]. The examination of storm surge signals requires high-frequency data, with a real-time reporting capability if operational activities are being supported. Dense regional networks are required in regions of intense tropical (e.g., Bay of Bengal) and extratropical (e.g., Western Europe) storm activity.

The devastating tsunamis originating in Sumatra (2004) and Japan (2011) have highlighted the value of tide gauge data for regional tsunami warning. **Most tide gauges remained operational during both tsunamis despite turbulent water conditions and strong wave-driven forces (Figure 5). The use of solar and battery powered water level stations that transmit data without reliance on the local power grid has proven to be an effective approach for a low-cost, distributed tsunami warning system**. For this purpose, high-frequency tide gauge data must be available in near-real time (e.g., 5-15 minutes) as the data are collected. A basin-wide distribution of stations is needed, with additional stations positioned in earthquake zones where tsunamis are generated. Near tsunamigenic zones such as Japan or Indonesia, or in smaller basins such as the Mediterranean, shorter data latencies (1-2 minutes) are preferable.

GLOSS cannot maintain complete (or high density) storm surge and tsunami water level systems, these are best handled at the national and regional levels, but GLOSS Core stations can be configured to support storm surge and tsunami warning, thereby contributing to regional infrastructure and serving as best practice stations. **For storm surge and tsunami research, a valuable contribution** from the GLOSS programme would be the assembly and serving in delayed mode of as many high frequency time series that are affected by surge and tsunami events.

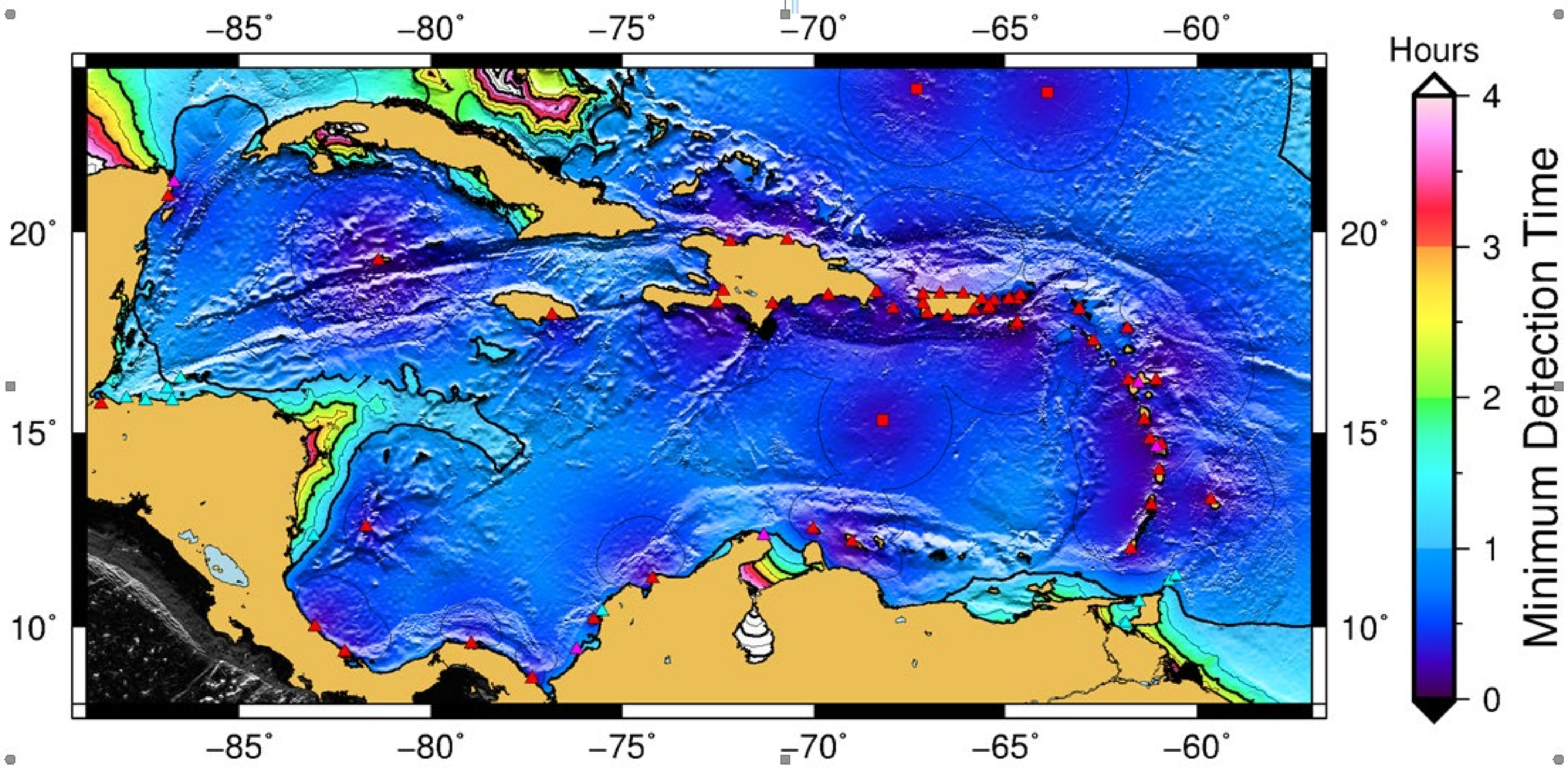


Figure 9b : Tide Gauge Network Capability Map computed using the SLS contributing in March 2017. Color indicates the time necessary for the tsunami to reach the first tide gauges, the thick line represents the one hour boundary. We can appreciate the improvement on Yucatan peninsula South coast, Jamaïca region and Costa-Rica/Panama/Colombia region. Some gaps still remain.