PAKISTAN METEOROLOGICAL DEPARTMENT

Presented by

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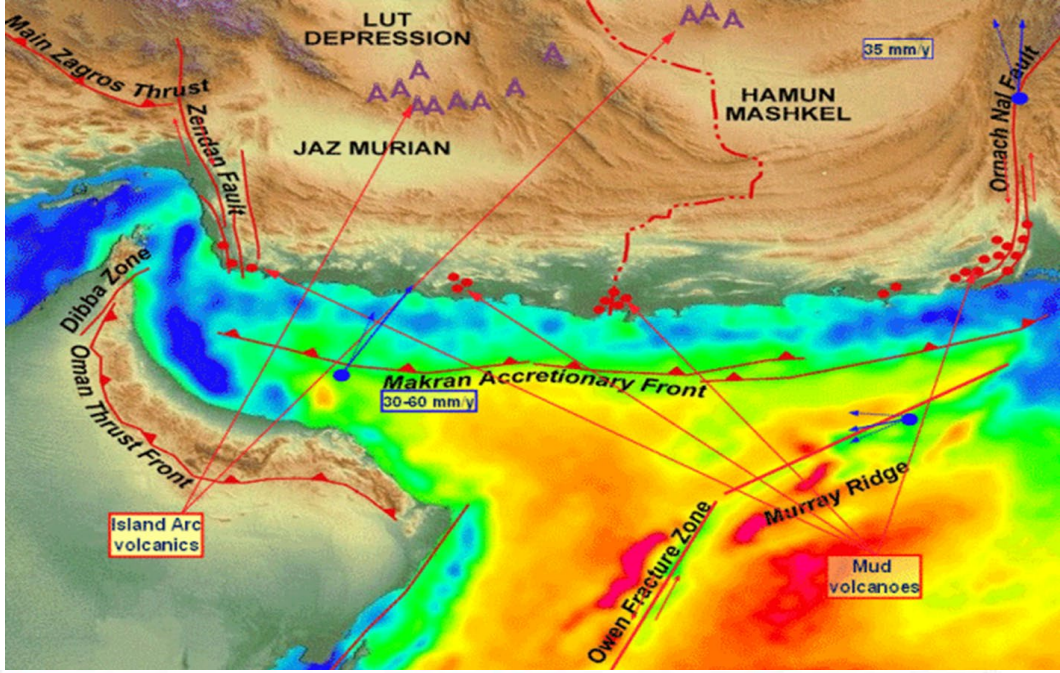
Director

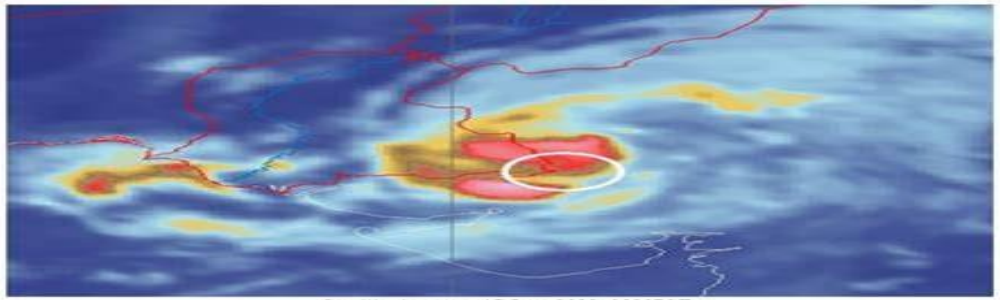
National Tsunami Center Karachi

INTRODUCTION

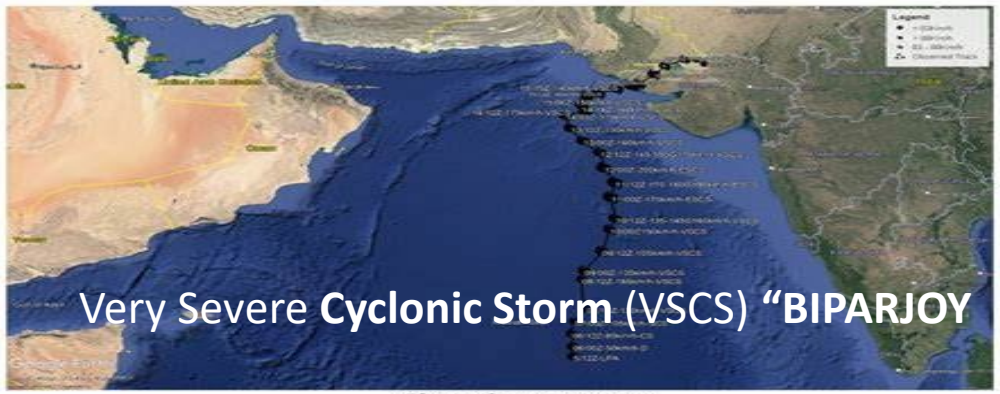
Pakistan coastline bordering Iran in the west and India in the east is prone to multiple coastal hazards like Tsunami, Tropical Cyclones, Storm Surges and Mud Volcanoes .



On the eastern part of Pakistan coastline, the frequent phenomena are Tropical Cyclone for example recent cyclone: "BIPARJOY"



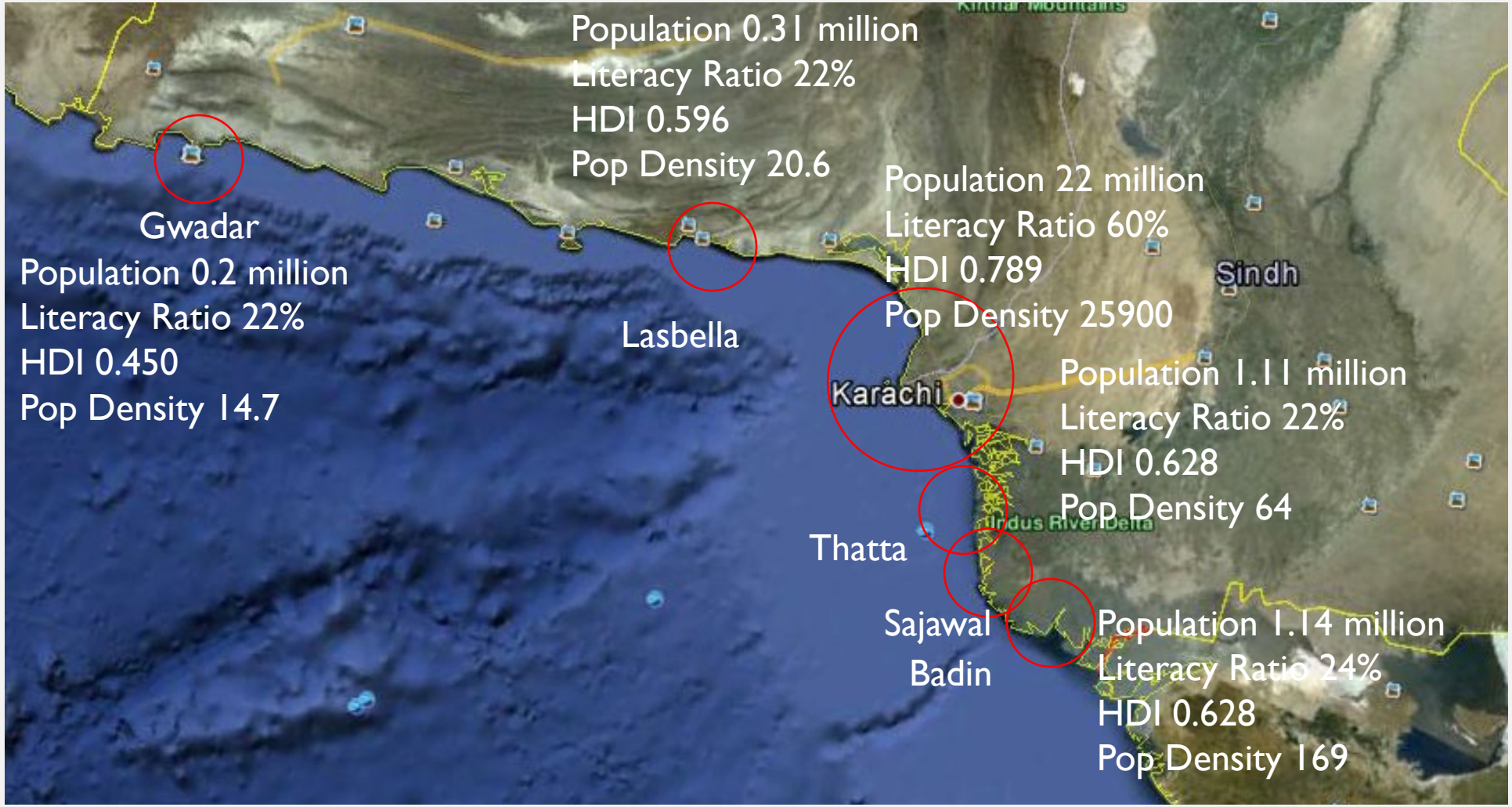
Satellite imagery: 17 June 2023, 0800PST



Observed Track of Cyclone

CHALLENGES

The challenges faced by coastal communities in enhancing their resilience and response capabilities to effectively mitigate the impact of these devastating oceanic disasters.


Population 0.31 million
Literacy Ratio 22%
HDI 0.596
Pop Density 20.6
Gwadar
Population 0.2 million
Literacy Ratio 22%
HDI 0.450
Pop Density 14.7
Lasbella
Population 22 million
Literacy Ratio 60%
HDI 0.789
Pop Density 25900
Sindh
Karachi
Population 1.11 million
Literacy Ratio 22%
HDI 0.628
Pop Density 64
Thatta
Sajawal
Badin
Population 1.14 million
Literacy Ratio 24%
HDI 0.628
Pop Density 169

Lessons from 2005 Kashmir earthquake

Economic Impact Apart from the terrible loss of life and infrastructure, the earthquake also left a significant economic impact. Property losses were estimated at **around 4 billion US dollars**, including damage to homes, businesses, and vital infrastructure.

Source :kashmirreader.com/2023/11/02/lessons-from-2005-kashmir-earthquake/

- Aftermath of Indian Ocean Tsunami of 26th December, 2004 and unique Kashmir Earthquake of 8th October, 2005 and keeping in view the potential risk of any tsunami along Pakistan coast;

- Pakistan Meteorological Department (PMD) has established a state-of-the art Seismic Monitoring network and Tsunami Early Warning Centre at PMD Complex, Karachi

- The centre has been operational since 28th November, 2008 on 24/7 basis.

- NTWC uses National and Global Seismic station networks data on real-time basis to monitor seismic activity in order to locate potential tsunami-genic earthquakes.

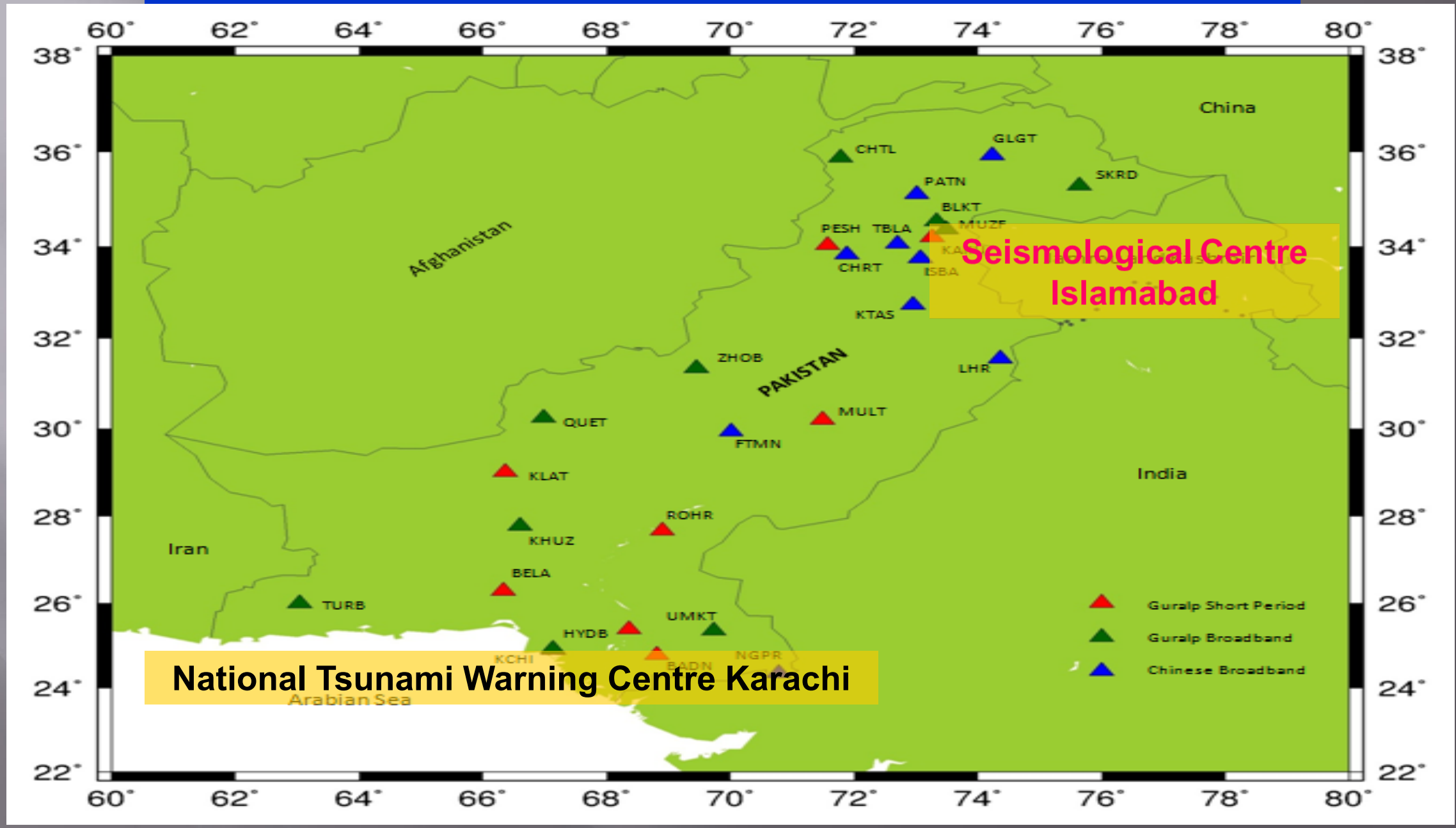
- **Seiscompro earthquake analysis software & Tsunami Modeling Software Toast are used to analyses the earthquakes.**

- Earthquake Data is being saved as catalog. This data is provided to Public and private companies involved in infrastructure development, educational institutions and students on the request.

NATIONAL TSUNAMI EARLY WARNING CENTER KARACHI

- Data processing
  - Data archiving from 150 seismic stations (local and Global stations)
  - Automatic/ Manual analysis.
  - Auto- epicenter location /shake-map
  - Archive catalog.
- Data management
  - Data storage
  - Data distribution service
  - Online inquire service

National Seismological Network for Pakistan



yahoo!mail | UR Undisclosed Recipients | Add keywords | Advanced

Compose

Inbox 20
Unread
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Spam
Trash

Back | Archive | Move | Delete | Spam

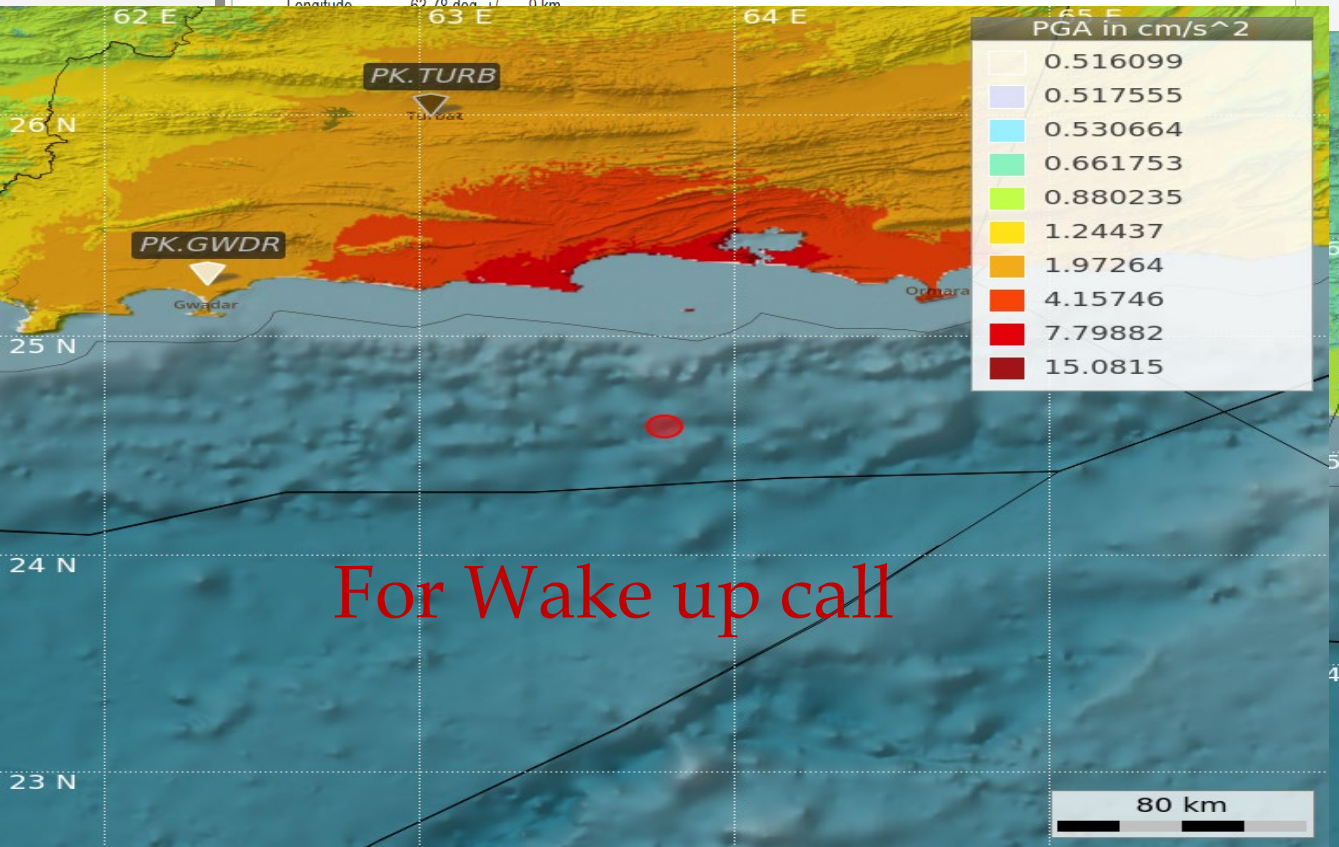
Event pmd2022owop: 5.4 (M)

Yahoo/Inbox

Pakistan Meteorological Department <ptws@isti.com>
To: Undisclosed Recipients

Sun, Jul 31, 2022 at 7:00 PM

Event:
Public ID pmd2022owop
Description
region name: Off Coast of Pakistan
Origin:
Date 2022-07-31
Time 13:52:13.8 +/- 1.5 s
Latitude 24.59 deg +/- 17 km



For Wake up call

yahoo!mail | UR Undisclosed Recipients | Add keywords

Compose

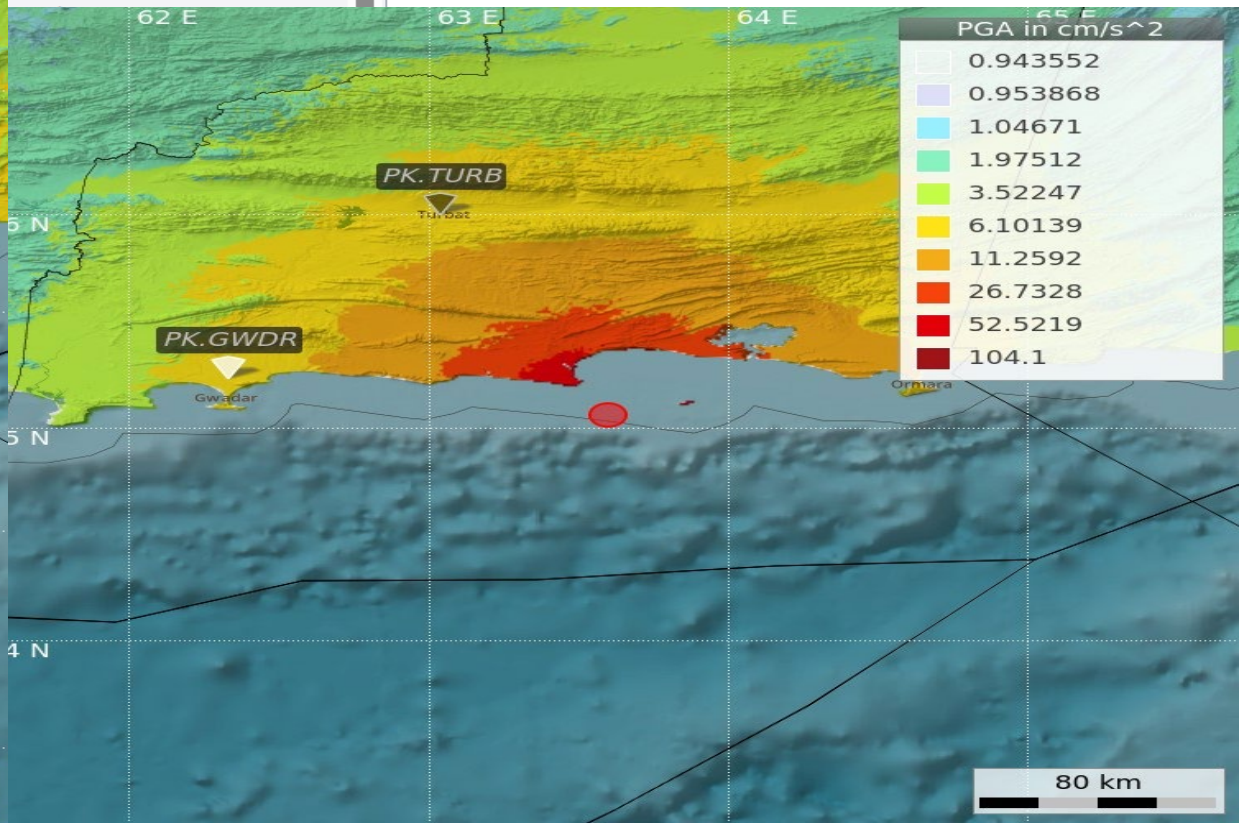
Inbox 20
Unread
Starred
Drafts
Sent
Archive
Spam

Back | Archive

Event pmd2022owoh: 5.7 (M)

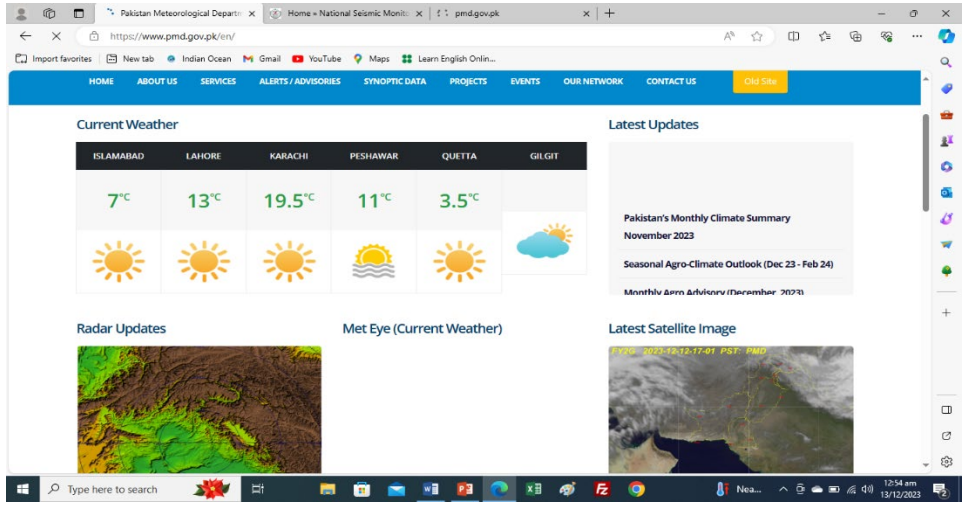
Pakistan Meteorological Department <ptws@isti.com>
To: Undisclosed Recipients

Event:
Public ID pmd2022owoh
Description
region name: Southwestern Pakistan
Origin:
Date 2022-07-31
Time 13:42:13.8 +/- 0.5 s

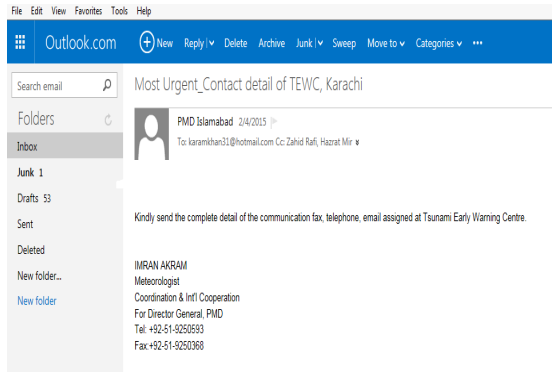


Modes of Early Warning Dissemination

SMS messenger

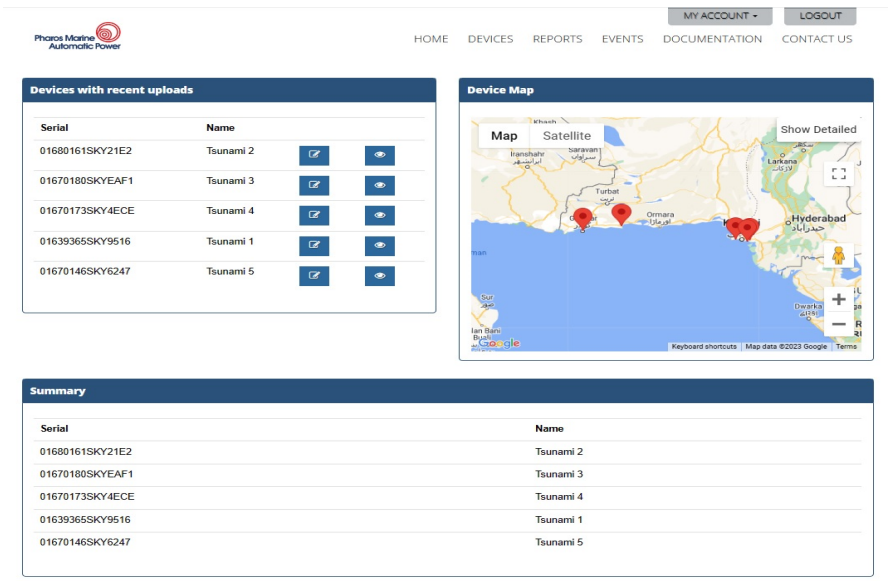


PMD Website



Email

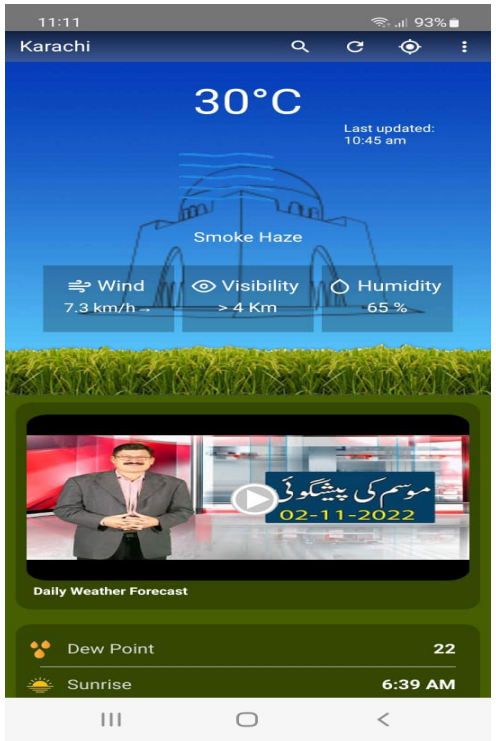
FAX



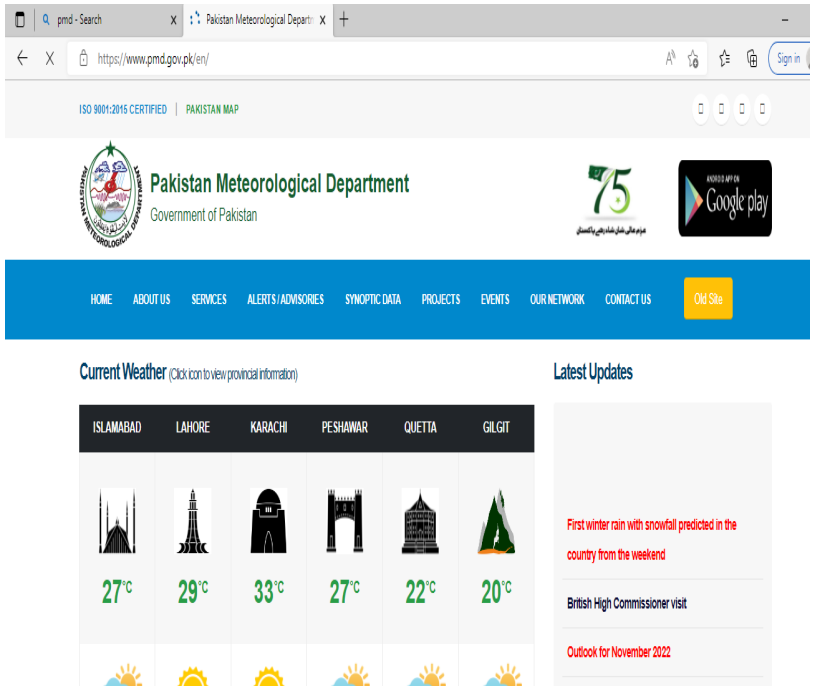
Siren Alarm System

PMD has established OWN MEDIA CENTER

Mobile applications



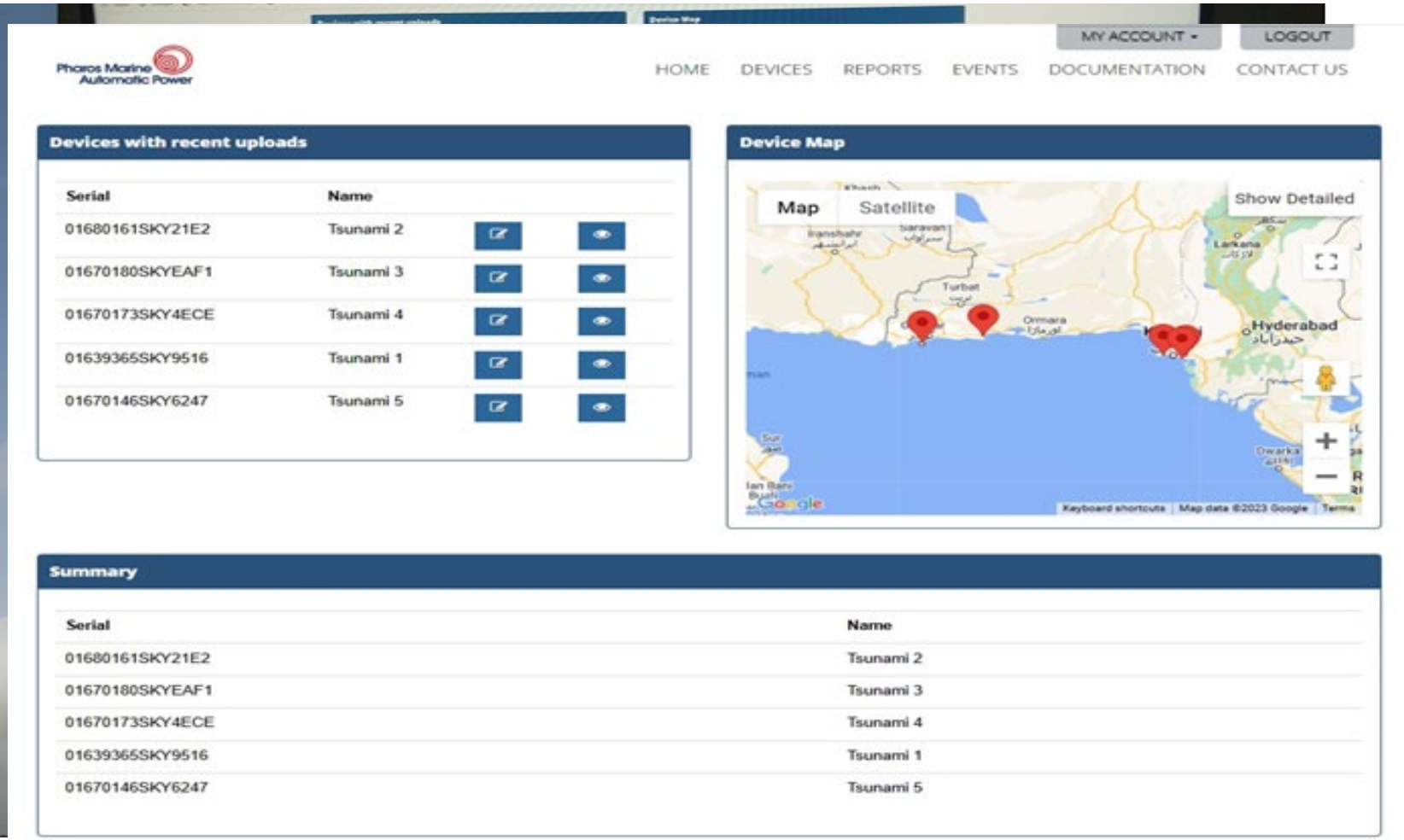
websites



Available on YouTube clip

Tsunami Sirens

Five Tsunami Sirens have been installed Gwadar, Pasni, three at Karachi district east and west).



GPS four stations for Makran subduction zone

PMD has installed in Karachi, Ormara, Pasni And Gwadar.

Trimble R9s

GNSS RECEIVER

Scalable GNSS Modularity

The Trimble® R9s receiver is a GNSS receiver designed to provide Survey professionals with maximum features and flexibility. The Trimble technologies provided in the Trimble R9s receiver are a unique and comprehensive combination.

Trimble CenterPoint™ RTX, Trimble xFill™ and Trimble 360 technologies are integrated into this receiver system to provide Surveyors with an outstanding option for their modular requirements.

Options and Upgrades

The Trimble R9s receiver platform allows you to purchase the options you what, when you want them. Whether you just need a simple receiver for post processing, a base receiver for transmitting RTK corrections, rover for mobile positioning, or a full base and rover capability, the Trimble R9s is scalable to meet your needs. You can also upgrade at anytime which means your technology investment can grow as your needs do.

Trimble CenterPoint RTX

Trimble CenterPoint RTX delivers RTK level precision anywhere in the world without the use of a local base station or Trimble VRS™ Network. Survey using satellite delivered, CenterPoint RTX corrections in areas where terrestrial based corrections are not available. When surveying over a great distance in a remote area, such as a pipeline or utility right of way, CenterPoint RTX eliminates the need to continuously move a base station or maintain connection to cell coverage.

Trimble xFill

Leveraging a worldwide network of Trimble GNSS reference stations and satellite datalinks, Trimble xFill seamlessly fills in for gaps in your RTK or VRS connection stream. In combination with a CenterPoint RTX subscription, survey level precisions are maintained for an infinite duration.

Trimble 360 Receiver

Powerful Trimble 360 receiver technology in the Trimble R9s receiver supports signals from all existing and planned GNSS constellations and augmentation systems. With two integrated Trimble Maxwell™ 6 chips, the Trimble R9s offers an unparalleled 440 GNSS channels. Trimble delivers business confidence with a sound GNSS investment for today and long into the future.

Smart for Many Applications

The Trimble R9s receiver's compact form factor, low power consumption and powerful feature set make for an ideal combination supporting a wide range of high-accuracy positioning applications, including:

- RTK and RTX rover
- Mobile field base station
- Post Processed data collection

The familiar Trimble web user interface provides full receiver status, configuration, data access, as well as a variety of security levels and access controls.

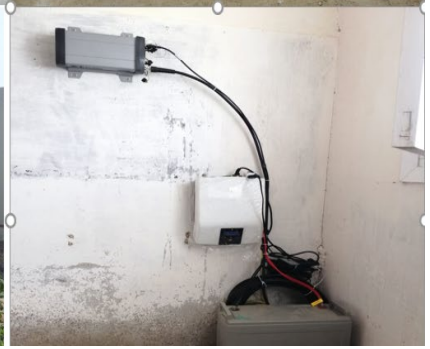
For simple hands-on configuration, the Trimble R9s receiver offers a seven-button, two line display and status information so that performing in-field configuration is practically effortless. Best of all, no handhelds are required to get datalogging started.

The Trimble R9s is available with an internal radio or with no radio. The radio model includes an internal UHF radio for transmitting and receiving RTK corrections. The no radio model can use a high power external radio for transmitting RTK corrections.

The Trimble R9s integrated lithium-ion battery can provide up to 15 hours of continuous power, easily spanning one days work. With stringent environmental specifications, the Trimble R9s is fully rugged to IP67 for dust and water and meets MIL-STD-810F standards for shock, vibration, humidity and temperature, to keep working even in harsh conditions.

Key Features

- Advanced satellite tracking with Trimble 360 receiver technology
- Convenient front panel display and configuration
- Bluetooth®, Ethernet, serial and USB support
- Data logging internally and to external drive
- Multiple data file formats
- Trimble CenterPoint RTX provides RTK level precision anywhere without the need for a base station or VRS network
- Trimble xFill technology provides seamless RTK coverage during connection outages



Key Performance Indicator(KPI)

School Safety Guidelines: Developed earthquake and tsunami safety guidelines for coastal schools.

Community Resilience: Established village disaster risk management committees and trained youth groups to promote resilience among communities.

Tsunami Warning System: A proposed tsunami warning system in Pakistan relies on seismic waveforms and requires deep-water and coastal gauges for effective warnings.

Tsunami and Earthquake Guidelines:

The draft tsunami and earthquake guidelines were finalized, after extensive coordination and feedback from key stakeholders.

These guidelines provide essential recommendations for risk reduction, early warning communication.

National School Safety Guidelines:A broader policy framework emerged, including the National School Safety Guidelines.
These guidelines address earthquake and tsunami preparedness in schools, fostering a holistic and coordinated approach to disaster risk reduction

Village Disaster Risk Management Committees:These committees consist of local community members, leaders, and experts.
Responsibilities include risk assessment, disaster planning, and coordination during emergencies. They facilitate communication, early warning dissemination, and evacuation procedures.

Youth Engagement:Training youth groups empowers the next generation to actively participate in disaster preparedness.
Youth can raise awareness, organize drills, and support vulnerable community members. Their energy and creativity enhance community resilience.

KPI Achievements

- Early Warning Systems (EWS): Piloted tsunami EWS in Karachi West, Malir, and Gwadar districts, strengthening communication tools and technologies.
- Capacity Building: Trained relevant provincial and district stakeholders in disaster response and relief, including search and rescue operations.
- Approximately 85% of community members are prepared to minimize disaster effects

The risk assessment are conducting for the three-kilometer-wide coastal belt in Karachi was a crucial step in enhancing tsunami and earthquake preparedness by PDMA sindh is conducting NESPAK

Vulnerability Mapping: Identified vulnerable areas within the coastal belt based on factors such as population density, infrastructure, and proximity to the shoreline.

Mapped potential impact zones to prioritize risk reduction measures.

Tsunami Evacuation Planning For pilot area Gwadar

The Following Team members has visited recently

1. Mr. Tariq Ibrahim (PMD) 2. Ms Ghazala Naeem (UNESCO) 3. Ms Hira Lodhi (NED)

National Activities

Data Collection: Reviewed existing studies, hazard maps, and local disaster management plans.

Field Surveys: Conducted site visits to critical infrastructure, potential evacuation routes, and safe zones.

Community Engagement: Held meetings with local authorities, community leaders, and residents. Organized workshops to gather input from stakeholders and raise awareness.

Launch an extensive public awareness campaign about tsunami risks and evacuation procedures.

Evacuation Routes: Current routes are inadequate; many are prone to congestion and flooding.

Safe Zones: Identified high-ground areas are insufficient to accommodate the entire population.

Infrastructure Development : Construct new and maintain existing evacuation routes to ensure they remain passable during emergencies.

Meeting with Gwadar Development Authority and Local Government

Community Consultation

Consultation with District Administration and Line Departments

Policy dialogues held at the national and provincial levels play a crucial role in shaping Pakistan's framework for earthquake and tsunami risk reduction. These dialogues facilitate collaboration among stakeholders, including government agencies, experts, and community representatives. By discussing policies, guidelines, and strategies, they contribute to a more resilient coastal region.

1. NTWC Karachi
2. PDMA sindh and Baluchistan
3. Marine time security
4. NDMA
5. NED university
6. Private local Media
7. And other stakeholder

The pilot of the Tsunami Early Warning Systems (EWS) in Karachi West, Malir, and Gwadar districts was a significant step toward enhancing preparedness.

Sensor Deployment: Four Broadband seismometer Installed seismometers. These sensors provide real-time data for early warning systems.

Communication Infrastructure:Strengthened communication tools, including sirens, mobile alerts, and community engagement.

Ensured that warnings reach residents promptly with their local language and local Media .

International and Local Testing and Drills:Conducted regular drills to familiarize communities with evacuation procedures. Tested the effectiveness of the warning systems.

International Cooperation: Pakistan has been already made an agreement with UAE and Oman for share real time seismic station data other data as well.

Structural Resilience:

Buildings should adhere to seismic-resistant construction standards.
Regular inspections and maintenance are essential to keep structures safe.

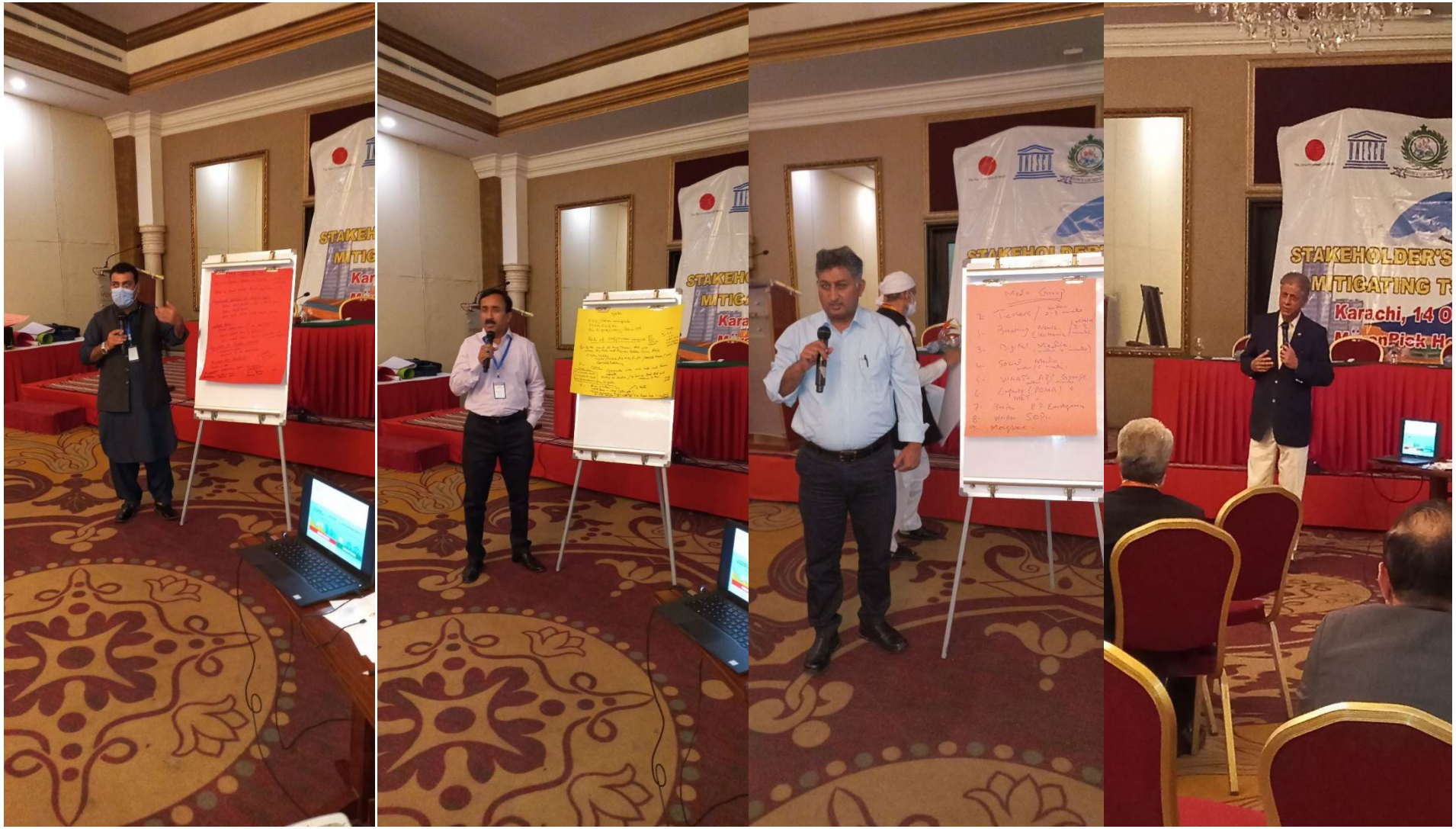
Early Warning Systems:

Schools should be equipped with early warning systems that provide alerts for earthquakes and tsunamis.
Communication channels (such as sirens or mobile alerts) should be in place to disseminate warnings.

Emergency Supplies:

Schools should maintain emergency kits containing essentials like water, first aid supplies.

Preparation of Drill among stakeholder




UNDP
al Department
arning Centre
Drill


At Karachi west


Tsunami Evacuation Drill
2021
Civil Defense Desk


CP SCHOOL
Drill at
Karachi Malir


Tsunami Evacuation Drill
2021
Provincial Disaster Management Authority
PDMA Desk

At Gwadar


BEWARE OF TSUNAMI
Tsunami Evacuation Drill
2021
Fire Birgade Desk
UNDP

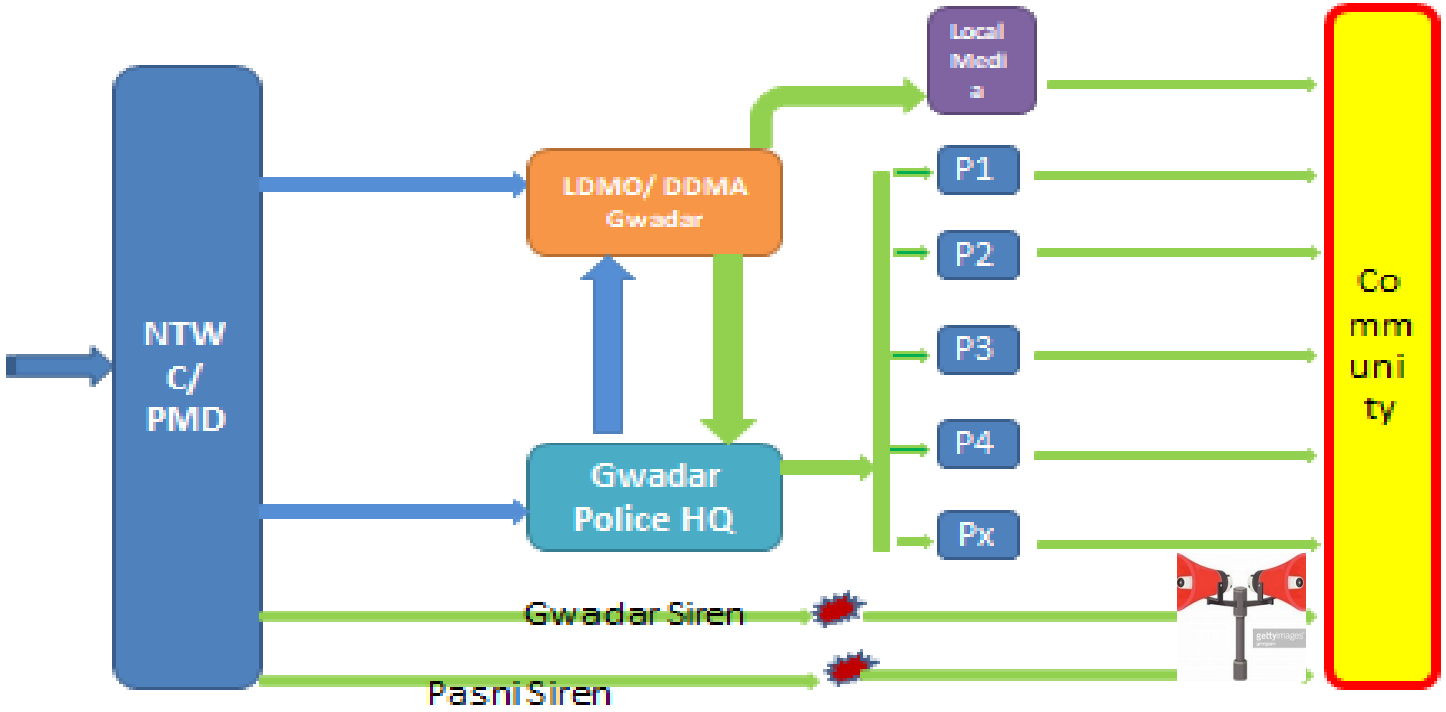

UNDP
Pakistan Meteorological Department

Available Communication Networks

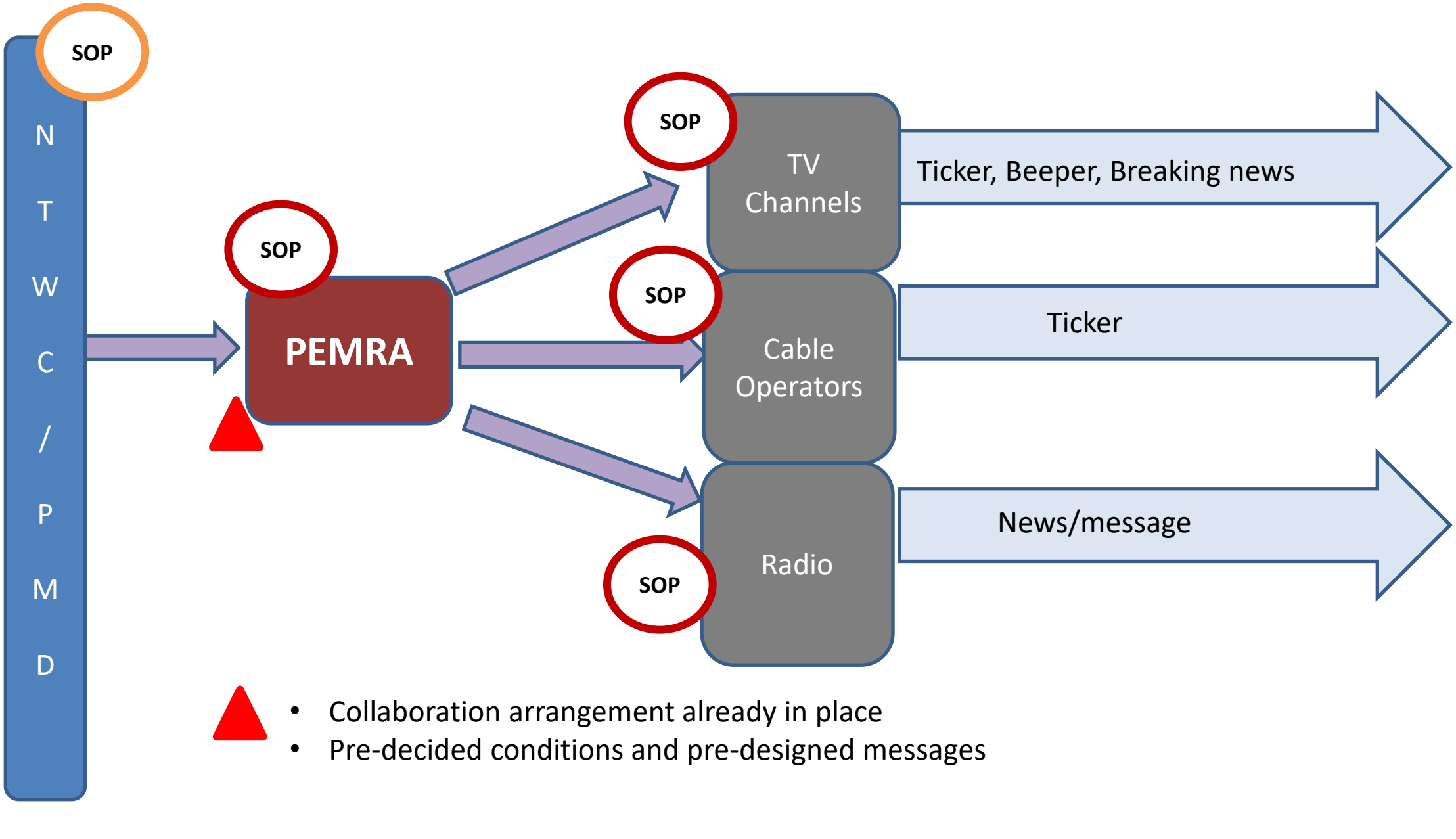
No single network is covering 100 % population

• GSM (Mobile)	Limited
• Landline	Extremely Limited
• **Police Wireless (post)**	Available mostly
• **Levi (Wireless)**	Available mostly
• Navy (HF & VHF)	Limited
• Coast Guard (HF & VHF) mostly	Available
• Army (HF & VHF) mostly	Available

Proposed LDMO onward TEW Chain



Gaps Pakistan Electronic Media Regulatory Authority



- Collaboration arrangement already in place
- Pre-decided conditions and pre-designed messages

Conclusion

- Oceanic disasters such as tsunamis, cyclones have a devastating impact on the coastal belt of Pakistan.
- These disasters can cause loss of life, damage to infrastructure, and distraction of livelihoods.
- It is important that we take serious actions to address the impact of these disasters and implement prevention and mitigation strategies to reduce their impact.
- Prevention and mitigation strategies such as include
  - Building resilient infrastructure near coastal belt
  - Educating communities on how to react and preparation for such disasters.

Suggestion

- Since the first peak of the mock tsunami in Gwadar arrives at the open coast and at the harbor 12 – 20 minutes after the origin time of the dis-location.
- National early warning system, evacuation routes and emergency shelter locations should be indicated in the hazard map to help the population and local authorities in the event of a future tsunami occurrence.

Self-response training for communities is the best solution.

– Detection of early warning via on natural sign

– Basic emergency response (how and where to evacuate)

Proposed study Paleo-Tsunami Deposits 2024 along coastline Pakistan

Fig 5 & 6: Dr. Brian, dewatering pit. In 2nd photo Marco taking core sampling. When the water comes into pit then we have the choice to run rotating hollow bit into ground to take core samples at different depths. Core sampling is also say lot about the subsurface, if properly place and arrange these samples on ground surface.

Taking Core samples/ Cross sectional samples

We can also use the technique to take core samples by driving a hollow bit machine operated manually. If the water don't allow you to work in pit, then you have the choice to take core samples. During the course of training we also able to get cross cut samples of different layer. One such cross section of layers encounter in Lampolu samples which we named Tsunami Mummy (shown in Photo No:7)

Fig:7. The cross sectional sample of a pit showing all layers from top to bottom as shown in fig No.3. This Tsunami Mummy were brought to the regional workshop in Jakarta.

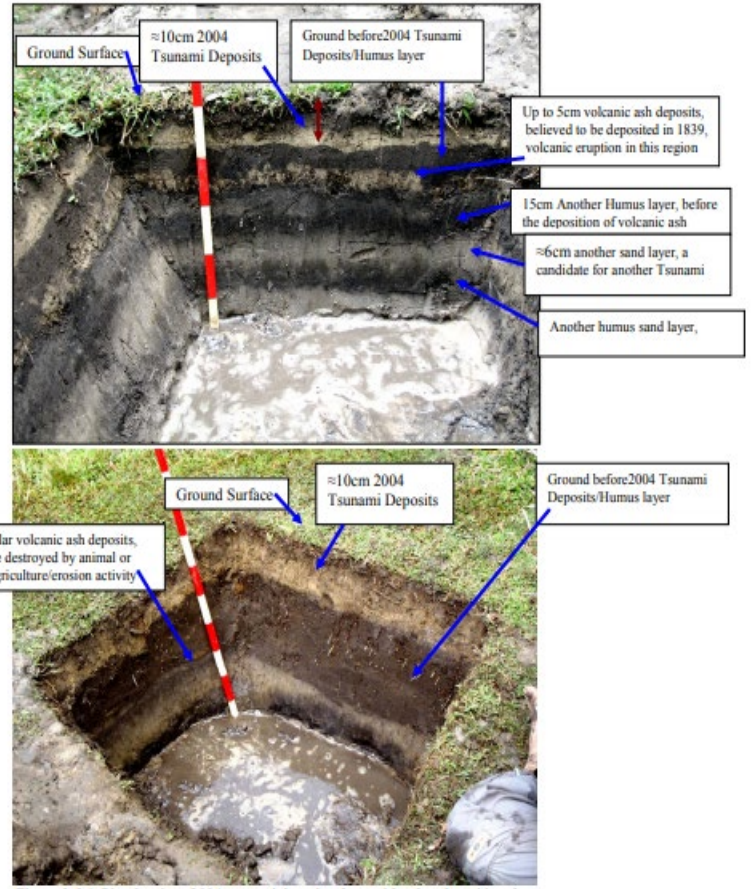


Figure 3 &4. Pits showings 2004 tsunami deposits along with other depositional layers Lampuk, Bande Aceh Indonesia.(13th July, 2011).

Thank