

Ingenious technologies for reducing tsunami casualties in Indonesia

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Many people died by 2011 Japan Tsunami due to difficulties of realizing the approaching massive tsunami



Tsunami warning and updates after the earthquake



	3 min	28 min	44 min	1h22m
	1m	3m	8m	10m以上
	3m	6m	10m以上	10m以上
	6m	10m以上	10m以上	10m以上
	3m	6m	10m以上	10m以上
	2m	4m	10m以上	10m以上

Some(many) people thought ‘no need to escape from 3 m tsunami’ because, 1) They were protected by 5 m sea wall, and 2) warnings in the past were mostly over-estimated (**cry-wolf syndrome**)

Some (many) people could not hear the updates of the warning because they started to escape, or due to electricity failure

Okawa Primary School, 74 out of 108 children died



Teachers did not let them escape for 40 minutes after the earthquake. It was too late when they realized the massive tsunami, and run to a wrong direction.

They could have run to the hill in three minutes, but there was no such evacuation plan in advance.

The Lesson

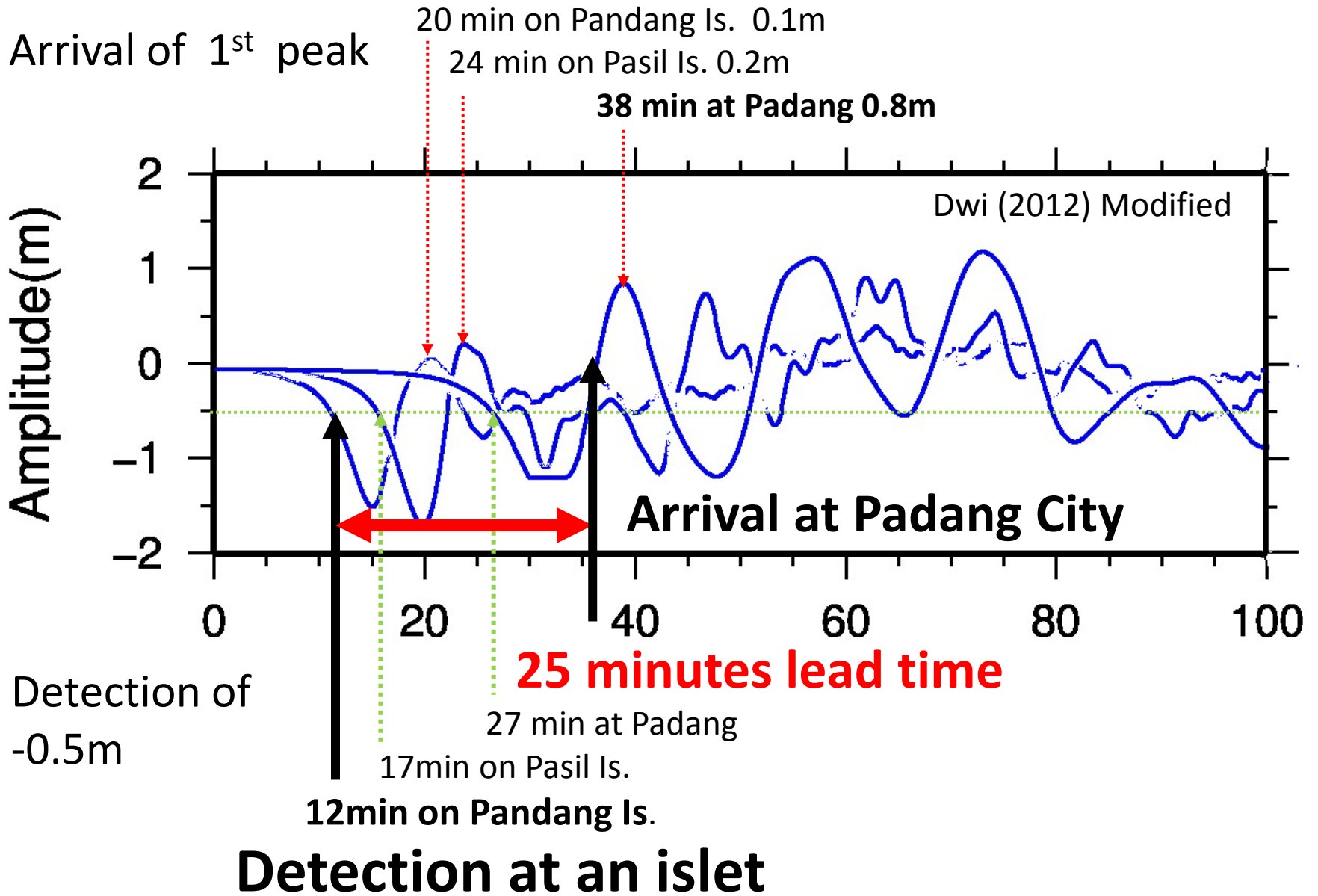
Providing people with accurate information of tsunami even only few minutes before arrival is crucial for survival.

Last minutes Tsunami detection at near off-shore islets (example in West Sumatra)



Lead time to the large tsunami wave is longer

Simulation of off-Padang tsunami



Sea level stations are normally installed at a pier

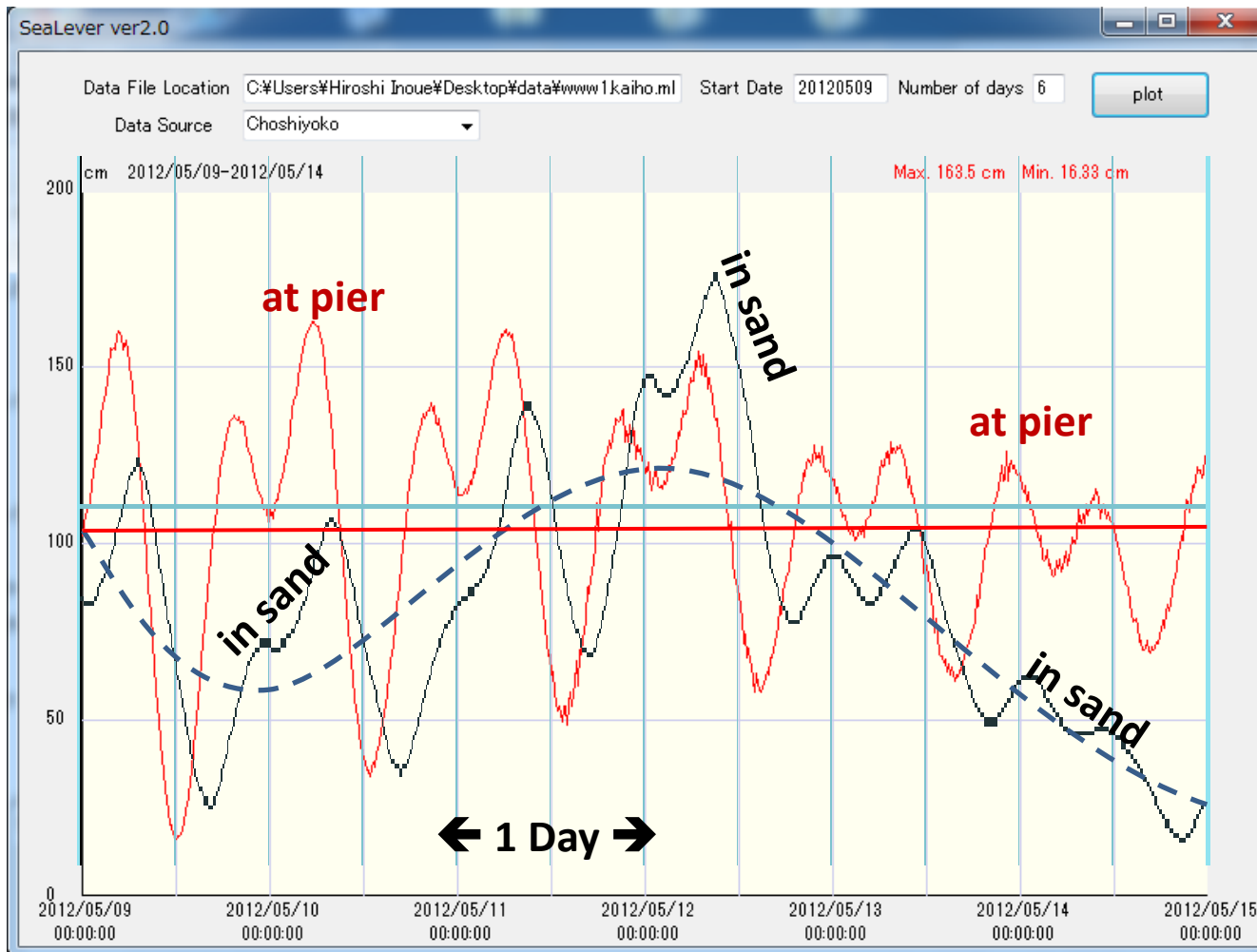


Islets have no pier



Experiment of pressure sensor in sand





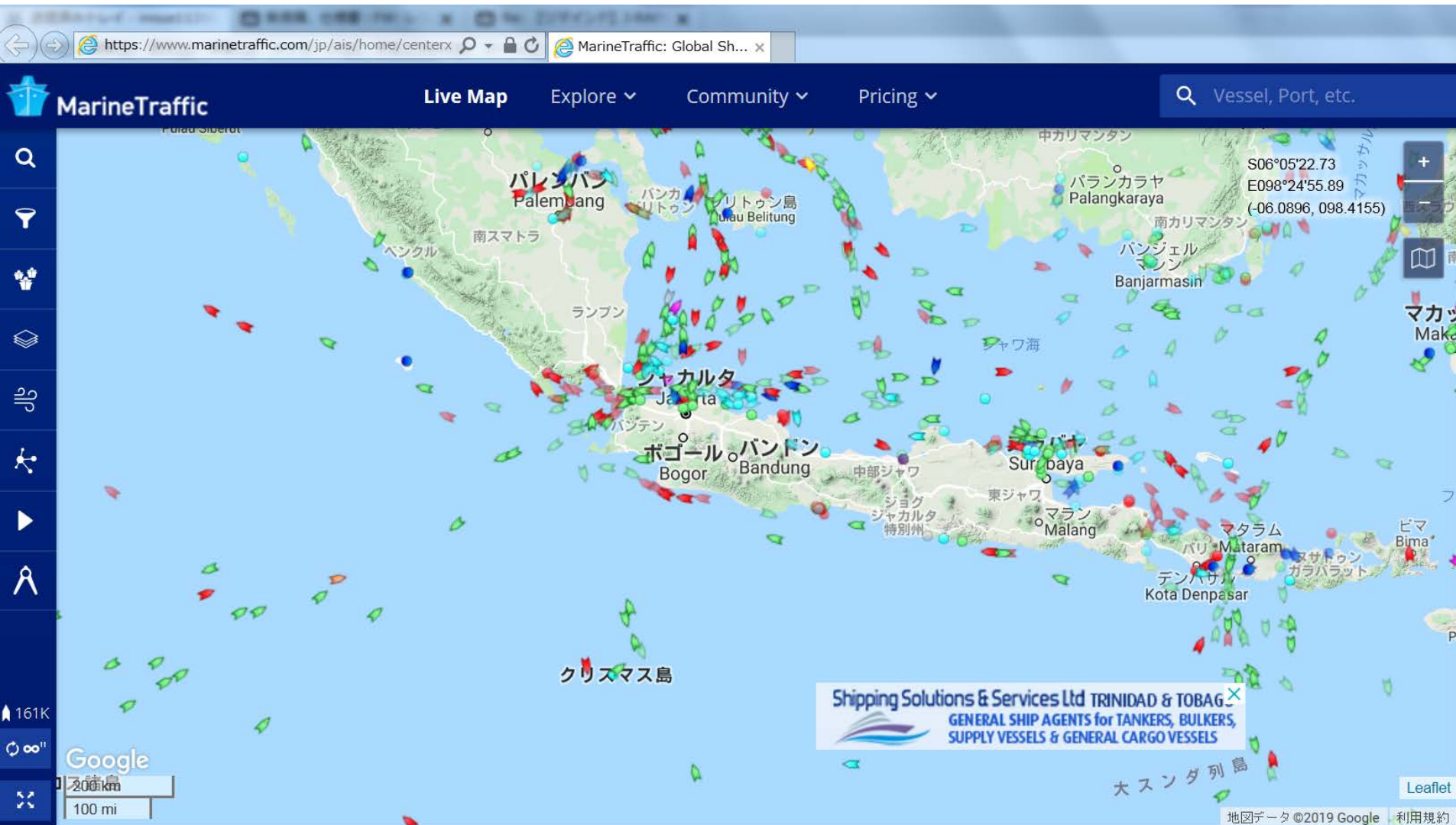
Water pressure in sand on land is affected by ground water in long periods, but **good enough for tsunami detection**

Point of the system design

- 1) To know what is crucial
- 2) To meet the minimum requirement
- 3) To use the latest technology

with ingenuity

Tsunami Detection using Commercial Ships



Small boats near the costs are lot more

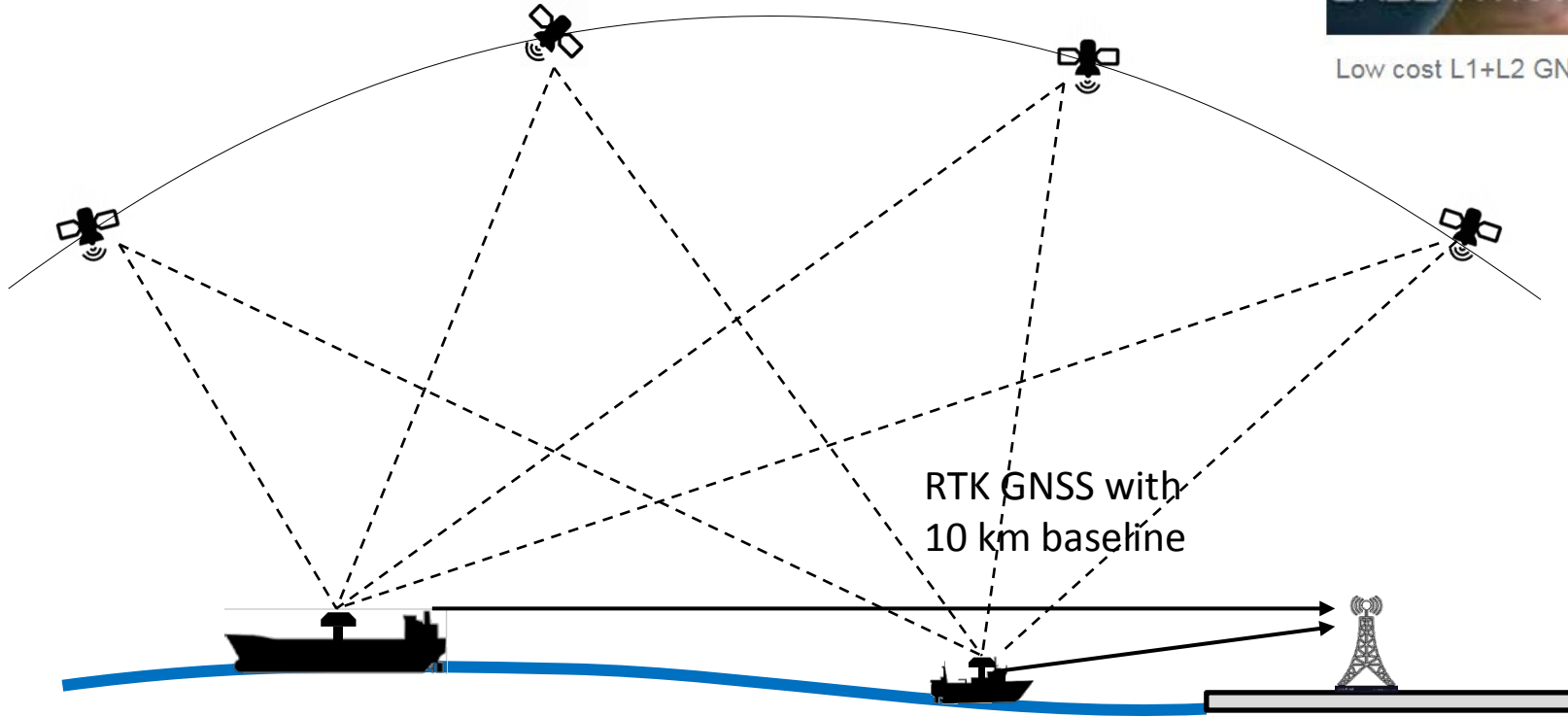
Realtime GNSS 10 cm accuracy

Low-Cost
Receiver
for few hundred
US dollars



RTKITE
GNSS RTK RECEIVER MOD

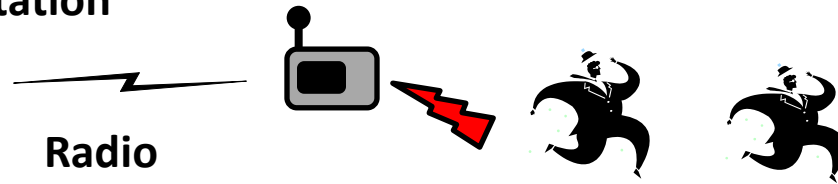
Low cost L1+L2 GNSS RTK receiver f...



Ships are moving, no way to control, changing draft(load), so not suitable for sea level change observations, but it should work for Tsunami

Dissemination of warning using Mosque Speakers; A big advantage of Islamic countries. Everybody can hear the voice, and the systems are well maintained.

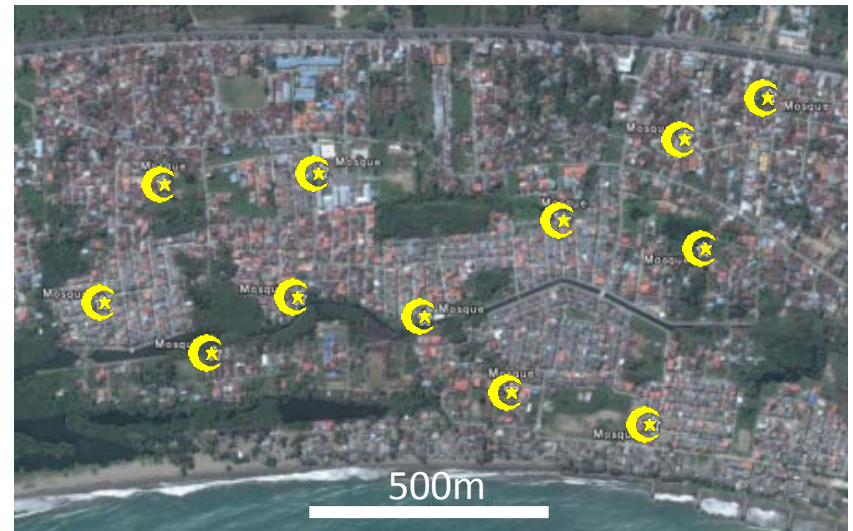
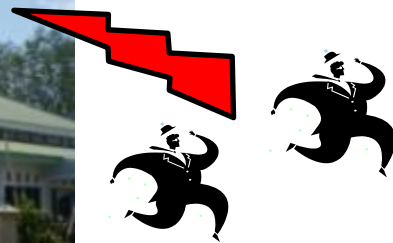
Monitoring Agency → Local Gov. → Local Radio Station



Mosque at every 200-300m (Tabin, Padang)



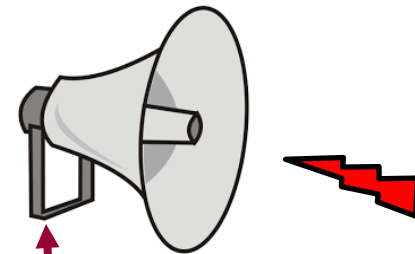
Automated Message Relay



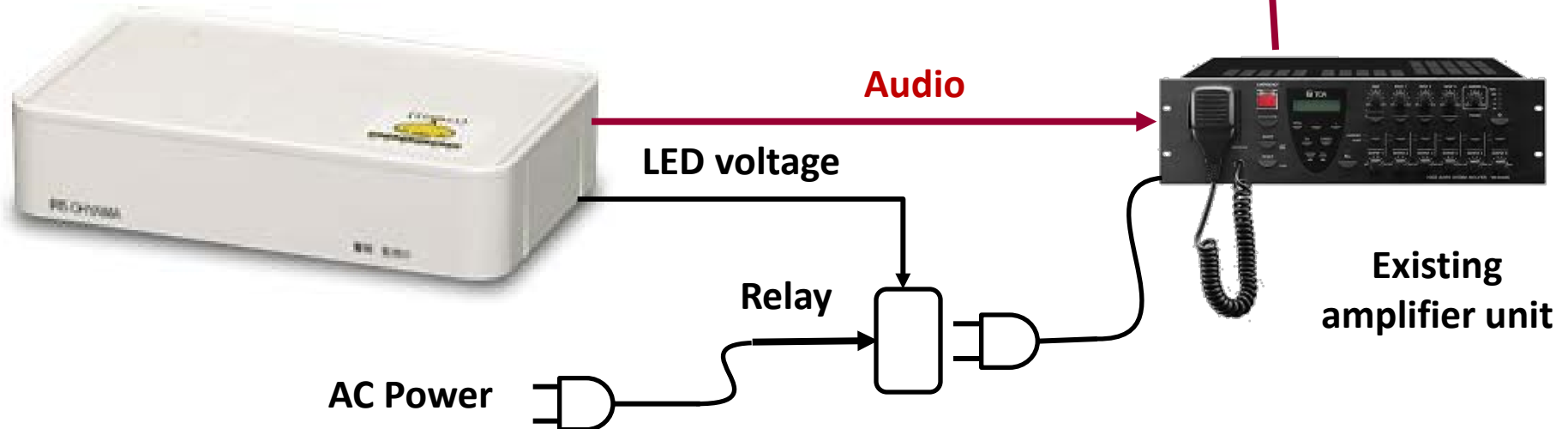
But, how to automatically switch on and announce the message?

Automated power on and message relaying system through FM radio

IRIS OYAMA EQA-001
¥7,000 (700,000 Rp)
76MHz-90MHz FM (adjustable)
0.8W standby power
Detecting Warning Chime
Relaying voice and warning light



Warning chime followed by warning message



Tsunami Evacuation with Life Jacket



90 % of the cause of the casualties by 2011 Japan tsunami was drowning. Some may be by debris or hypothermia, but about half may be pure drowning, who could have survived if they wore a life jackets when they escape.





**Tsunami life jacket
100 USD**



50 USD



30 USD

Not very expensive. But would people buy to prepared for tsunami which may not occur during the whole life?

DIY life Jacket that children can make in sawing classes

Daddy's old shirt



one more



Styrofoam from trash



+

+

Science and Technology of Tsunami Vertical Evacuation



Coconut trees remained in Banda Aceh, 2004



Coconut trees remained in Tonga, 2009

Science: Why coconut trees are so tall?

Working Hypothesis

Coconut trees have that shape in order to survive from huge tsunami which occurs every hundred years.

If the hypothesis is true,

The top of coconut tree is a best places to escape from Tsunami.
If you reach there, and stay long, you can get shade, food and water
(if you have a big knife).

Technology: How to climb?, by everybody



Conclusion

Disaster occurs because people forget it.

Disasters can be reduced if people do not forget.

Disasters can be further reduced by people's ingenuity.

Let's think