



THE INDONESIA TSUNAMI BUOY DEVELOPMENT PROGRAM

TSUNAMI BUOY INDONESIA

Presented by:

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and others BPPT
Colleagues

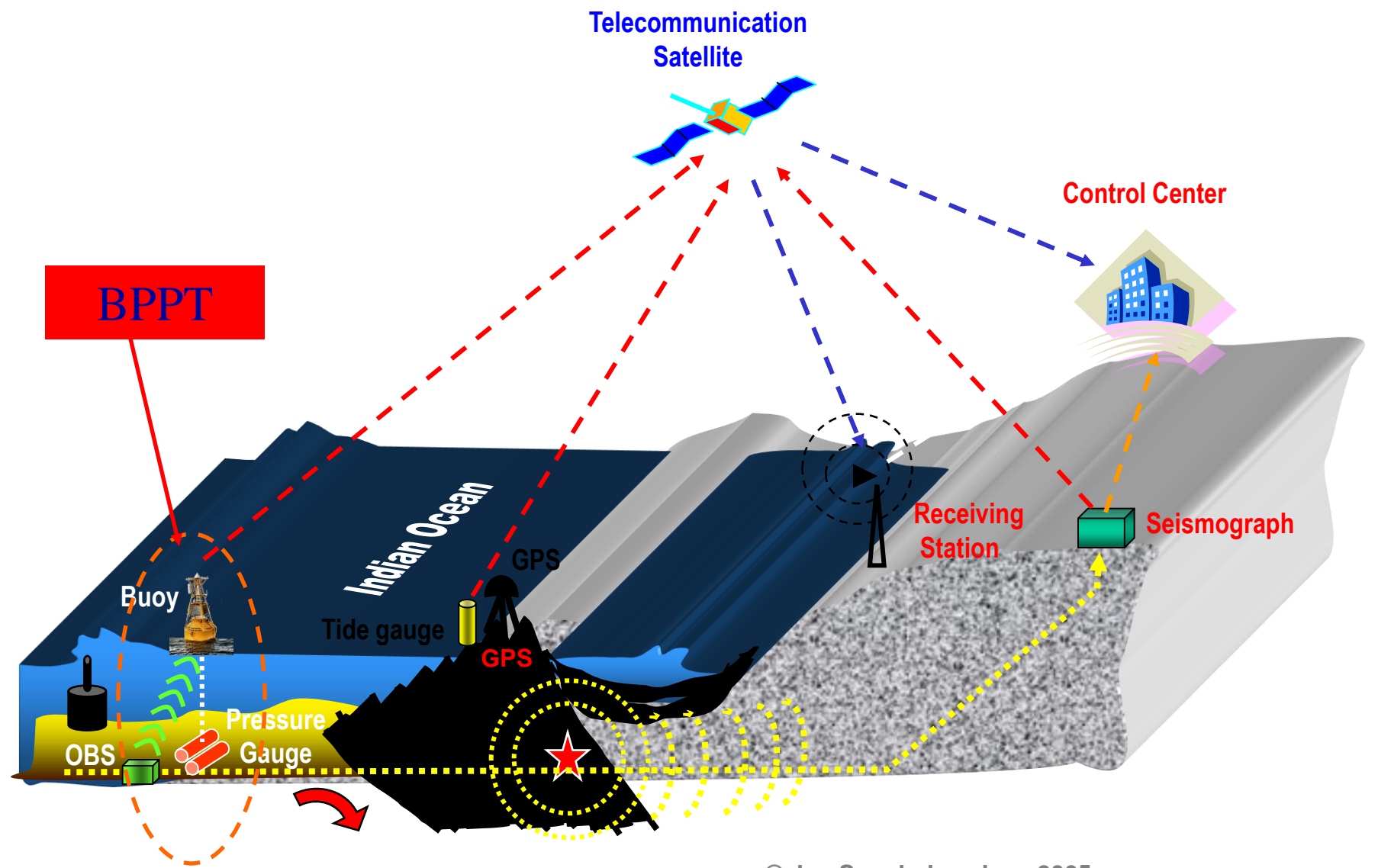
Presented on:

Twenty-fifth Session

of the Data Buoy Cooperation Panel

Paris, 28 September 2009

Design of Indonesian Tsunami Early Warning System





Indonesia Tsunami Buoy Development Program

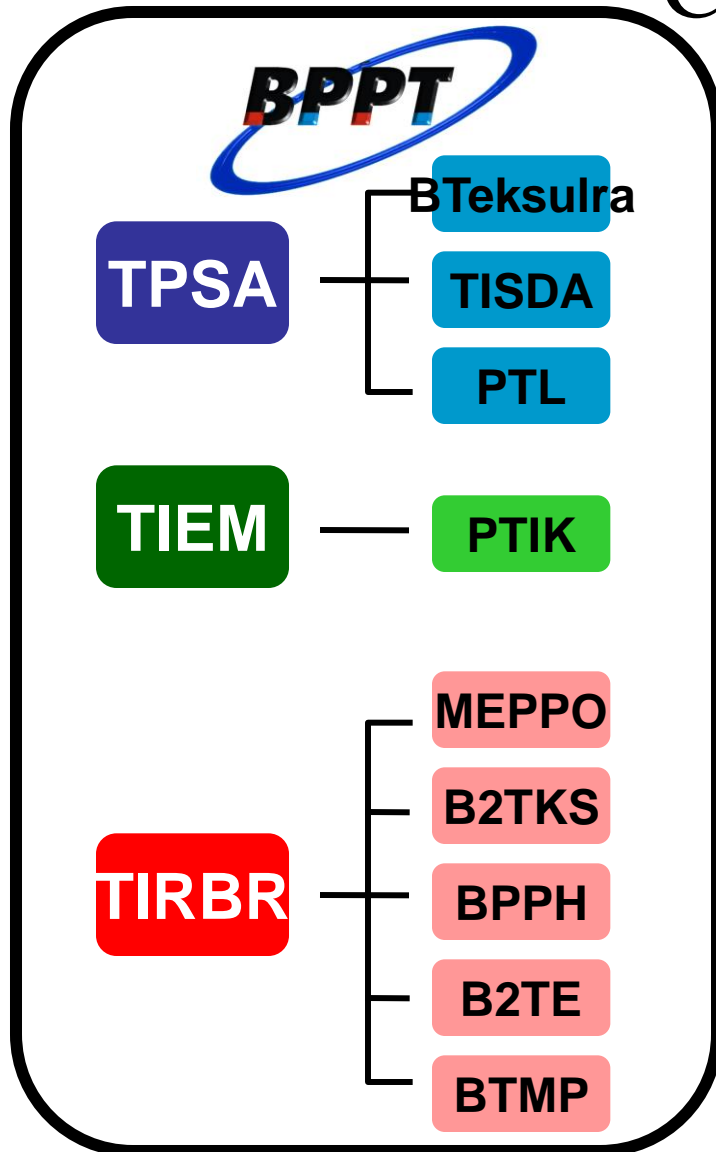
Priority Program of BPPT

2006 – 2008



Executing Units at BPPT and Collaborations

Indonesia Agencies



International Collaborations:

NOAA, USA



GFZ – Germany

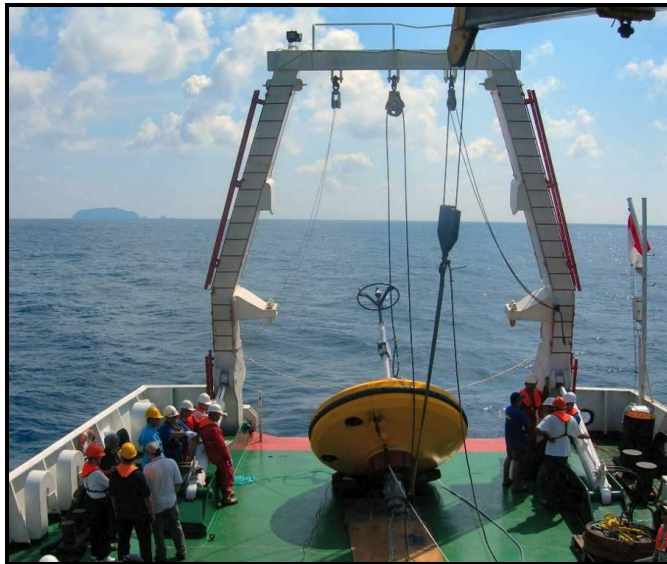


ATSB Malaysia



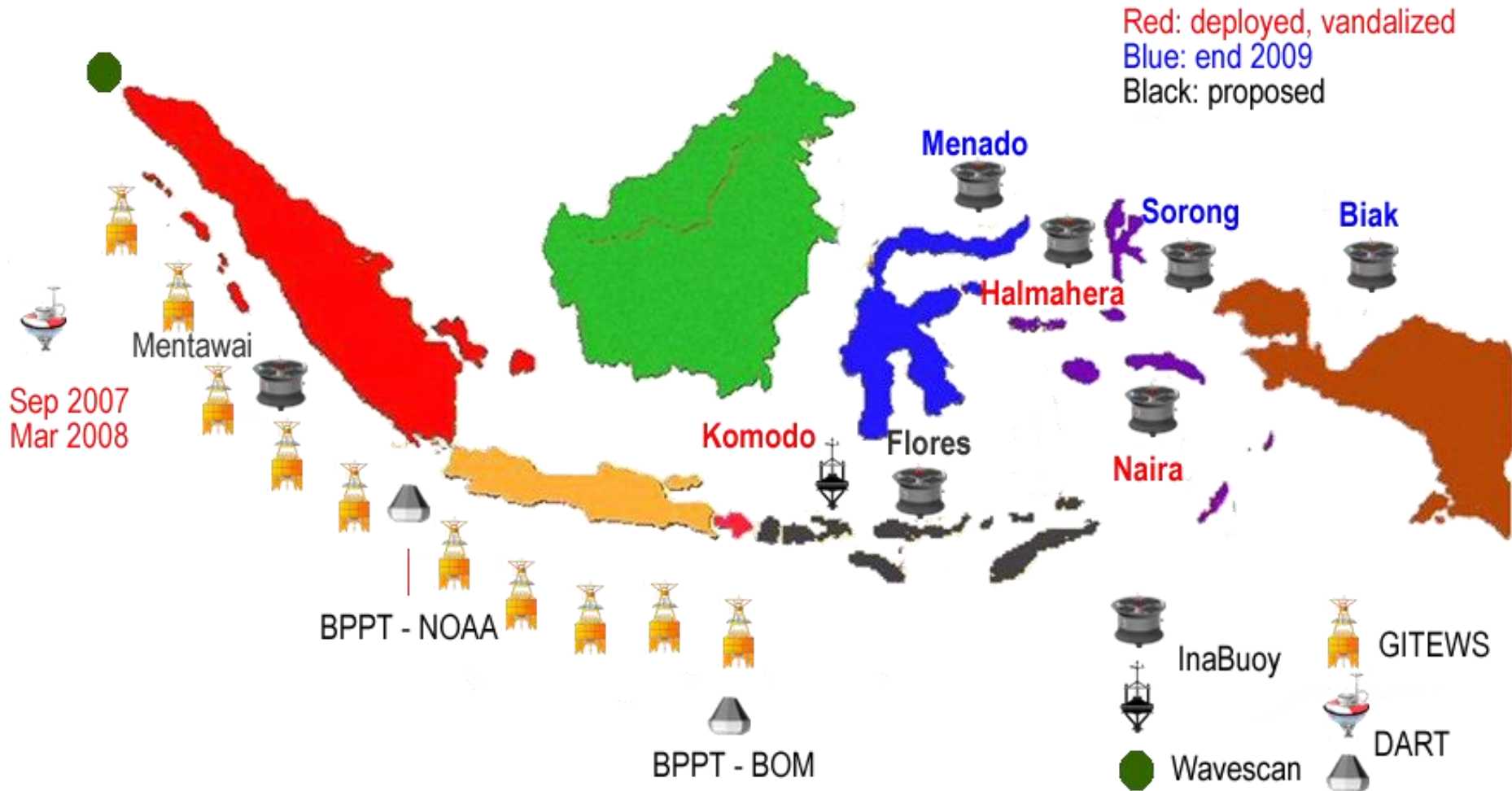
International Collaborations

- Germany-Indonesia Tsunami Early Warning System (GITEWS) on GITEWS Buoys (9 buoys)
- NOAA on DART Buoys (3 buoys)
- ATSB Malaysia on Wave Scan Tsunami Buoy (1 buoy)





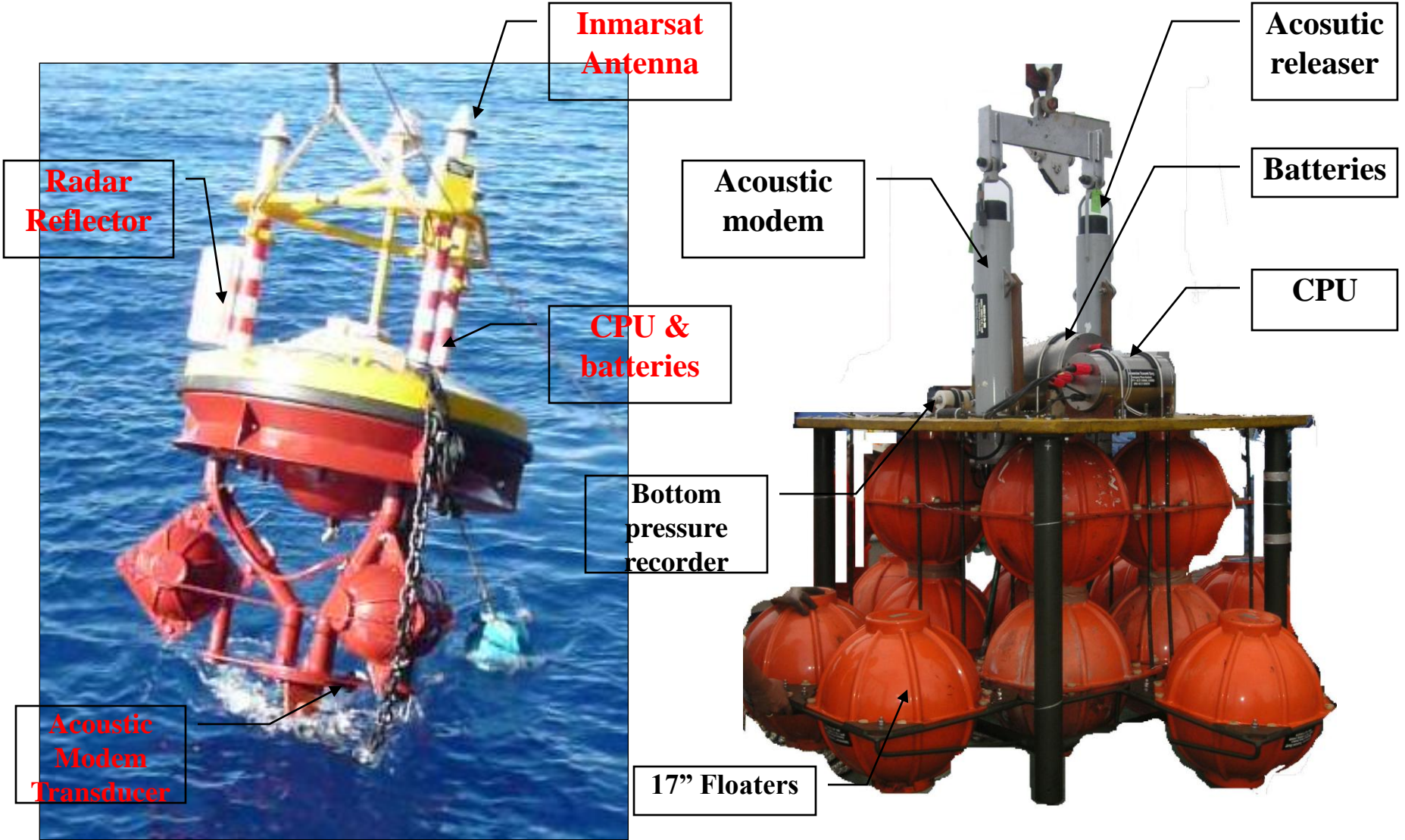
Current Indonesian Tsunameter Status



To replace NOAA's ETD
 [June 2008 – Sep 2008]



2006 Buoy & OBU Design (1st generation series)



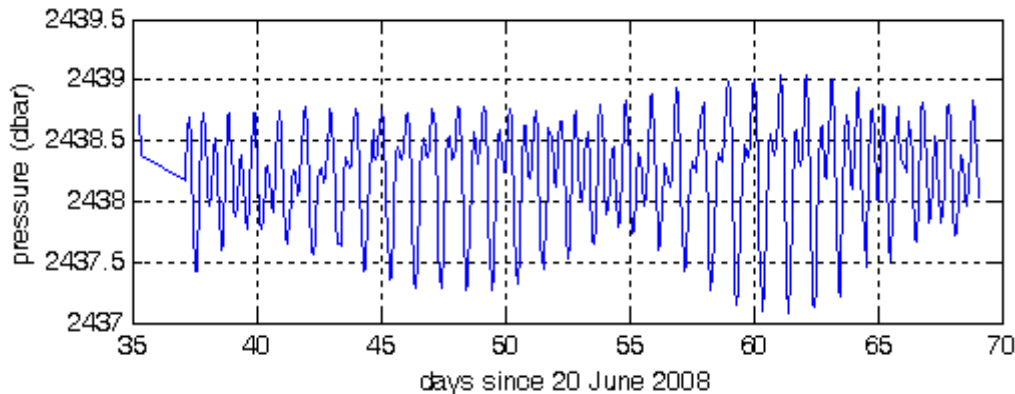
The Indonesian INA-BUOY Tsunameter

1st generation

–**KRAKATAU**: Indian Ocean at 6.5S, 104.0E, Southwest of Sunda Strait, 2053m depth (*Status: recovered and moved to Komodo, was replaced bwith the 2nd generation for a while, and to be replaced with DART-ETD by early 2010*)

–**KOMODO**: Flores Se, ~ 40nm north of Sumbawa Island (*status: recovered after drifting, mooring line was broken due to possible vandalism*)

Recorded Sea Level at KOMODO



Tsunami Buoy Array 2006 – 2008





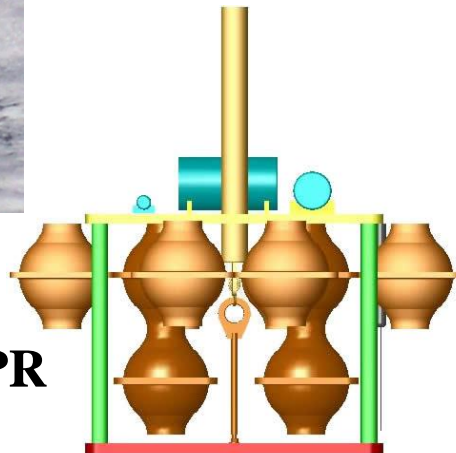
The Indonesian INA-BUOY Tsunameter *2nd Generation*

*deployment test in “KRAKATAU” site replacing
the 1st Gen Series in Sept 2008*

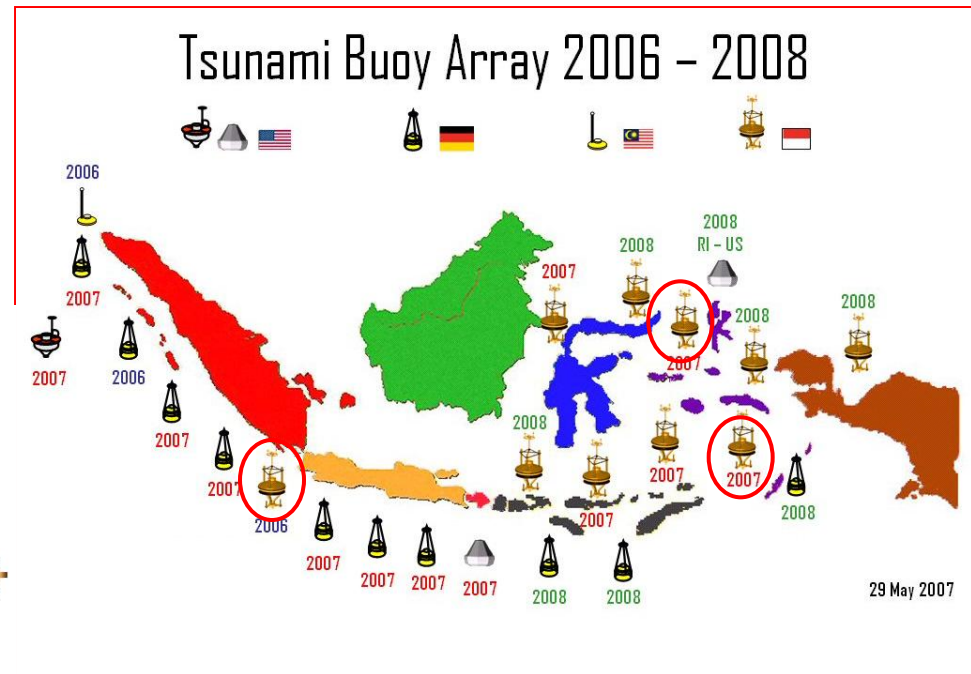
*Operational in HALMAHERA and ARU/NAIRA
since April 2009*



Surface buoy



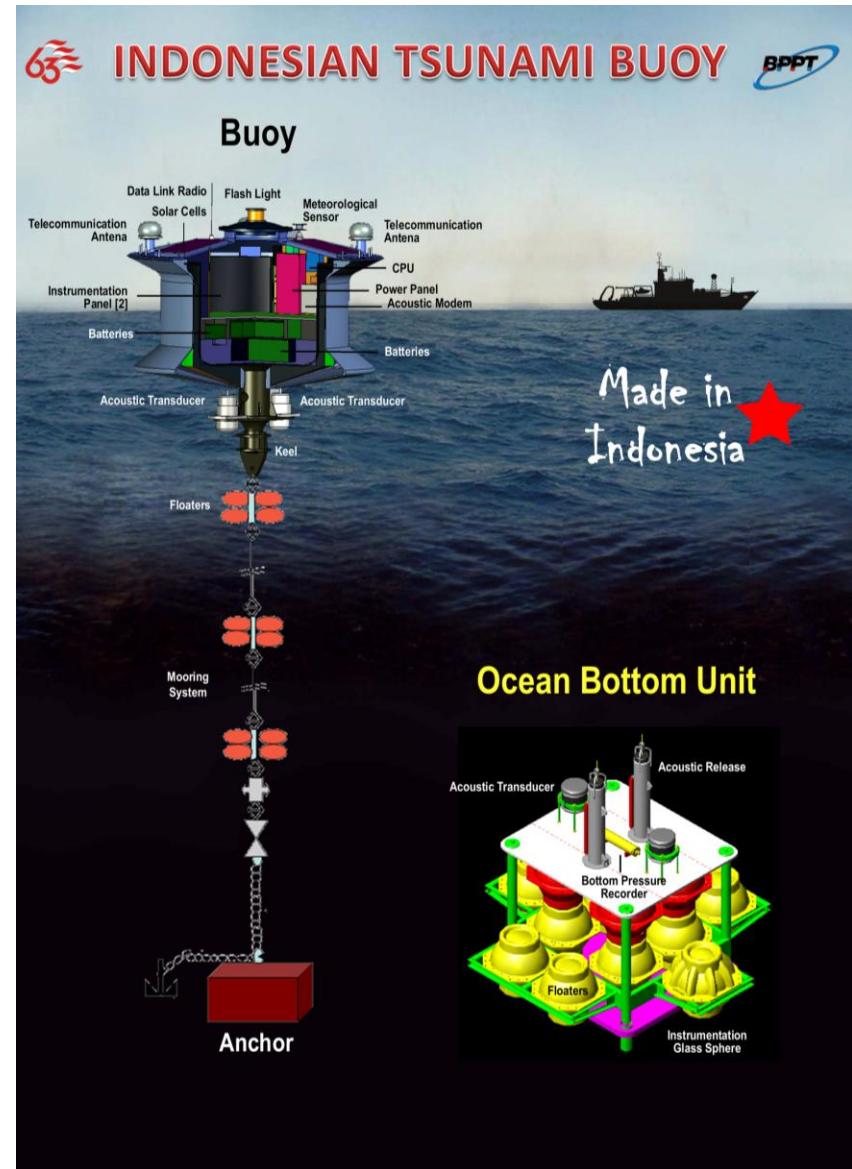
Bottom Unit / BPR





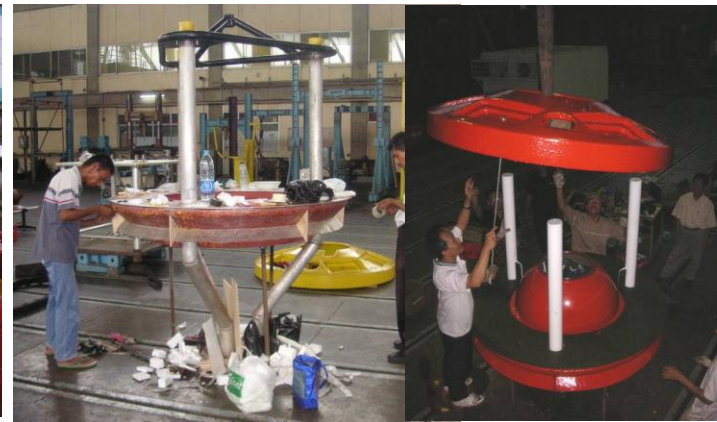
InaBuoy Engineering Design 2007-2008, 2nd Generation

- First prototype was successfully deployed in Indian Ocean, south of Lampung
- 2 other units have been deployed in eastern Indonesia waters in April-May 2009
- 3 others are under construction at BPPH Surabaya and B2TKS Serpong
- 3 others are still under final design and early step of manufacturing





Design and Manufacture @ BPPT's Facilities





Hydrodynamics & Structural Tests



Deep Sea Mooring

Indonesian Tsunami Buoy

Buoy

1" Nylon Rope Stretching Test

Mooring Analysis

- This is a starting off and a potential surface float mooring
- This is a surface solution, using 70% of the surface buoyancy
- Total Buoyancy is about 3kg = 228.3
- Vertical load (kg) = 1201.2 Horizontal load (kg) = 422.9
- Mooring line diameter = 40mm (40mm) Diameter is used
- 1" Nylon
- Mooring System Length (m) Buoyancy (kg) Weight (kg) d (mm) d (in) Tension (kg) Angle (deg)

Mooring System Length (m)	Buoyancy (kg)	Weight (kg)	d (mm)	d (in)	Tension (kg)	Angle (deg)
1.000 000	1.22	0.220	3.0718	0.121	0.0	0.0
2.000 000	8.59	1.497	3.649 22.8	0.143	0.0	0.0
3.000 000	8.76	1.50	3.6322	0.142	0.0	0.0
4.000 000	200.03	4.330	3.6322	0.142	0.0	0.0
5.000 000	480.0	10.511	8.1	0.315	0.0	0.0
6.000 000	50.0	1.330	3.6322	0.142	0.0	0.0
7.000 000	6.00	0.600	2.00175	0.0787	0.0	0.0
8.000 000	50.0	1.330	3.6322	0.142	0.0	0.0
9.000 000	6.00	0.600	2.00175	0.0787	0.0	0.0
10.000 000	50.0	1.330	3.6322	0.142	0.0	0.0
11.000 000	6.00	0.600	2.00175	0.0787	0.0	0.0
12.000 000	50.0	1.330	3.6322	0.142	0.0	0.0
13.000 000	6.00	0.600	2.00175	0.0787	0.0	0.0
14.000 000	480.0	10.511	8.1	0.315	0.0	0.0
15.000 000	6.00	0.600	2.00175	0.0787	0.0	0.0
16.000 000	50.0	1.330	3.6322	0.142	0.0	0.0
17.000 000	6.00	0.600	2.00175	0.0787	0.0	0.0
18.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0
19.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0
20.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0
21.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0
22.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0
23.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0
24.000 000	5.00	0.500	1.61620	0.0636	0.0	0.0





Tsunami Buoy Sea Operations

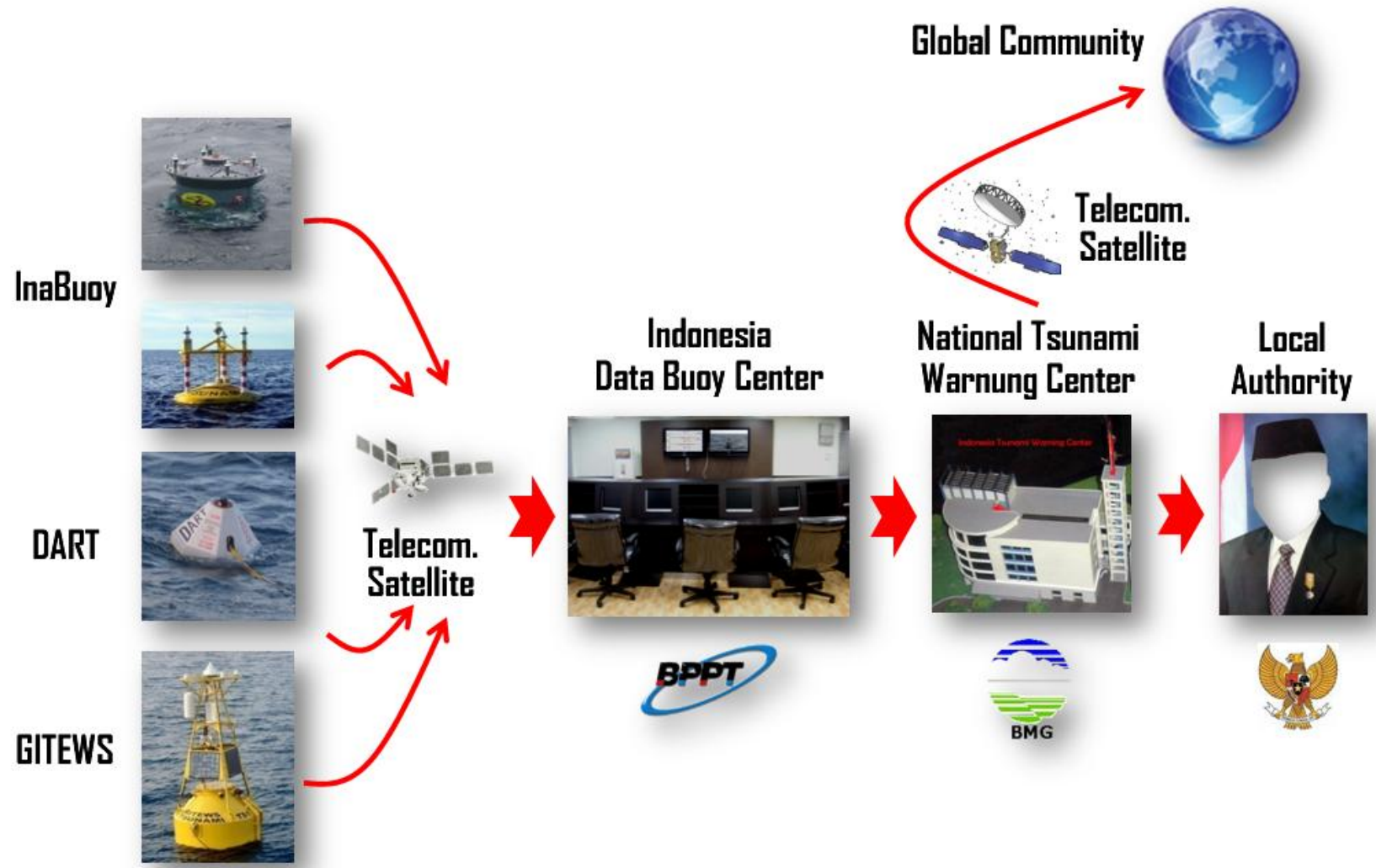


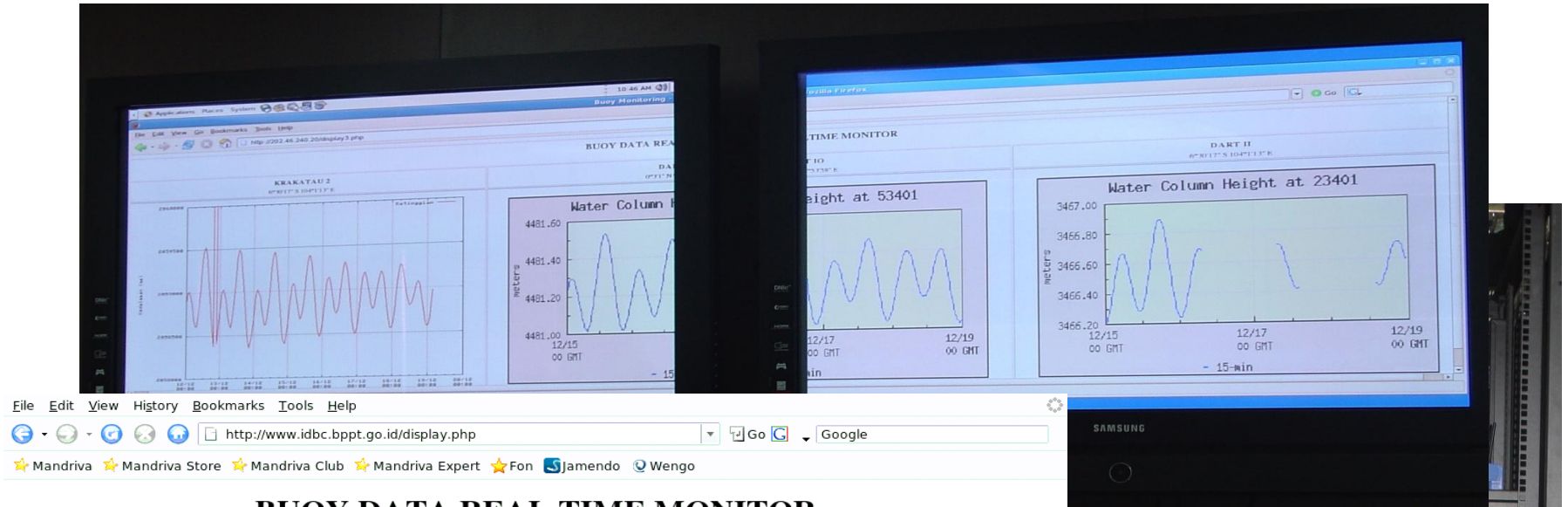


READ DOWN STATION (RDS)

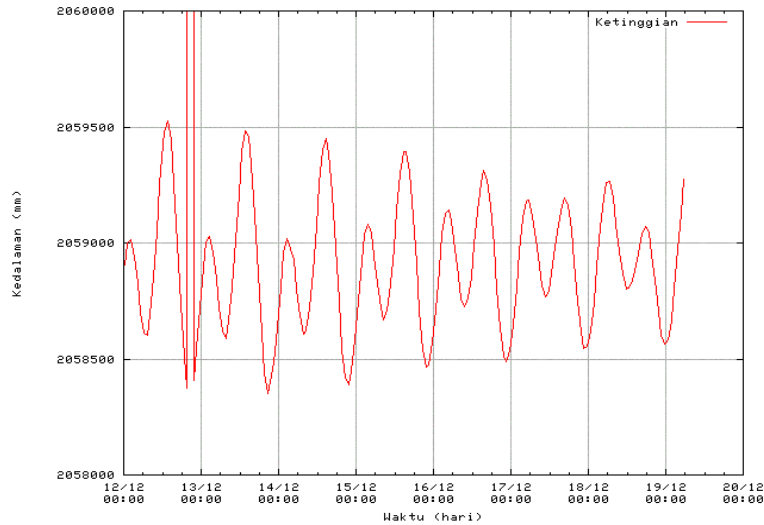
- BPPT 1ST BLD, 20TH FLOOR, South Wing
- Operational 24h continuously
- 10 operators are divided into 5 groups and 3 shifts
- Two-ways data link to BMKG

Buoy Data Flow in InaTEWS

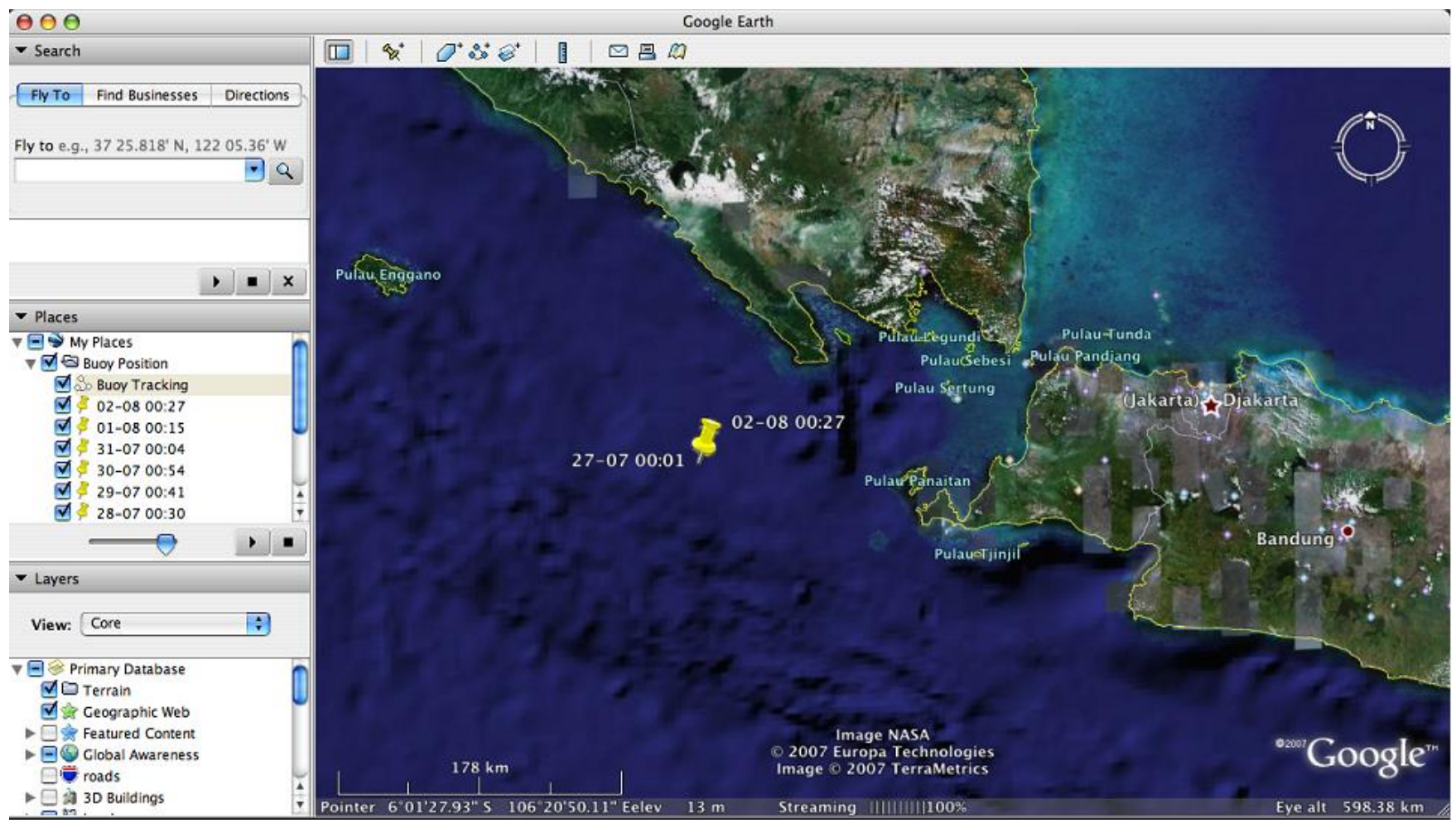




BUOY DATA REAL TIME MONITOR



Buoy Position Monitor



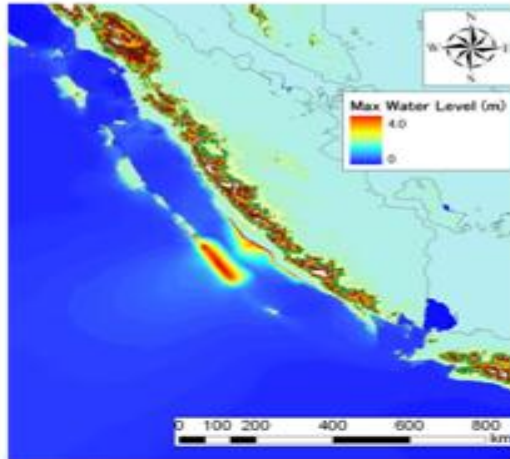


Post analysis of 12 Sept 2007 Earthquake

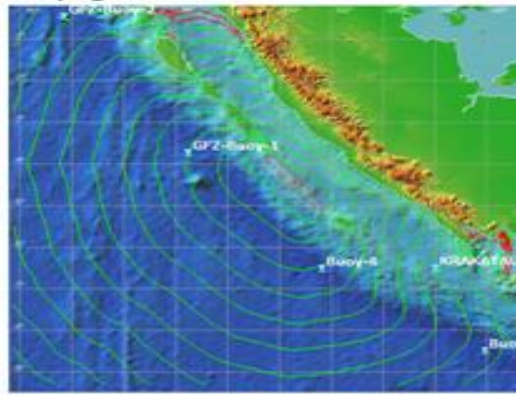
- Location: Indian Ocean, west of Bengkulu, Sumatra
- Local time: 18.10 WIB
- Magnitude: 8.4
- Depth: 10km (shallow)
- During the 12 Sept 2007 EQ, 'Krakatau' was working offline due to unscheduled maintenance of the surface buoy

Bengkulu Earthquake & Tsunami, 12 September 2007

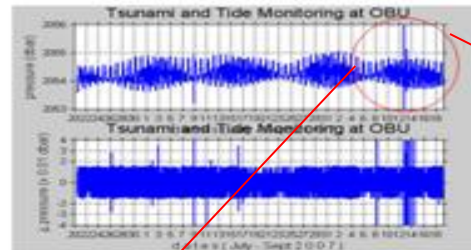
Amplitude



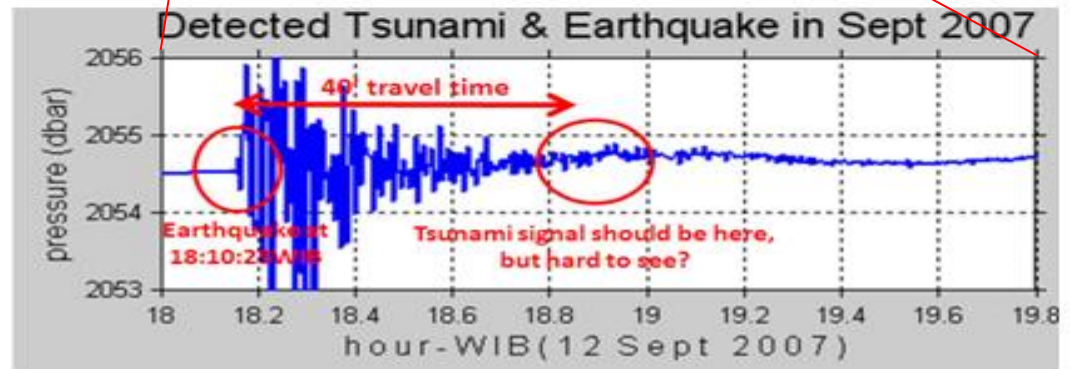
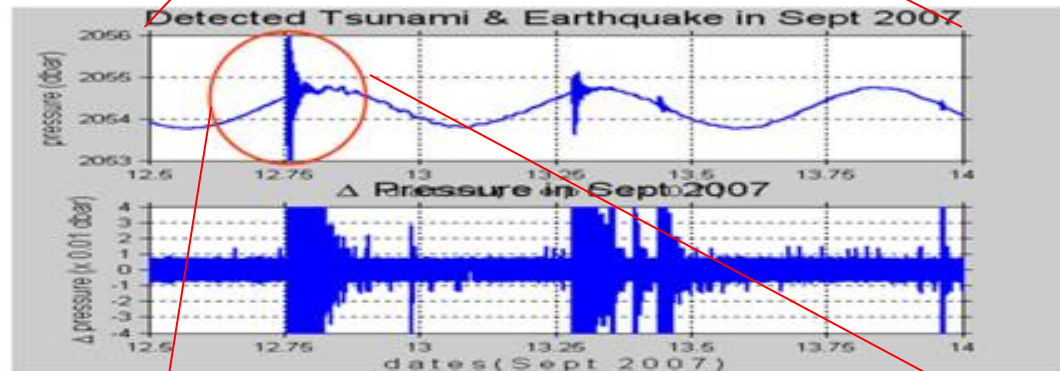
Propagation time



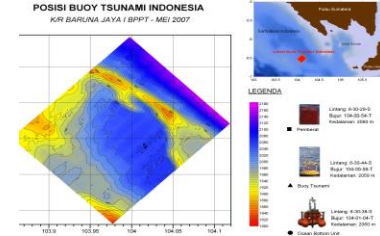
Each contour represents 5 minutes travel time



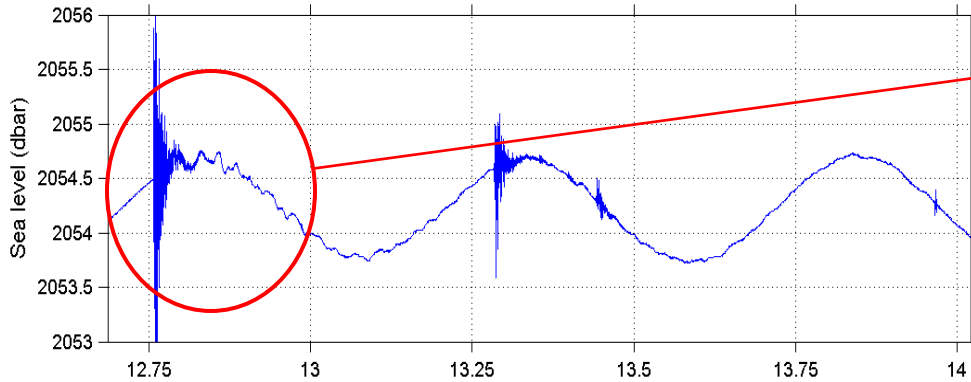
12 September 2007 Bengkulu Earthquake & Tsunami Detected by InaBuoy Krakatau



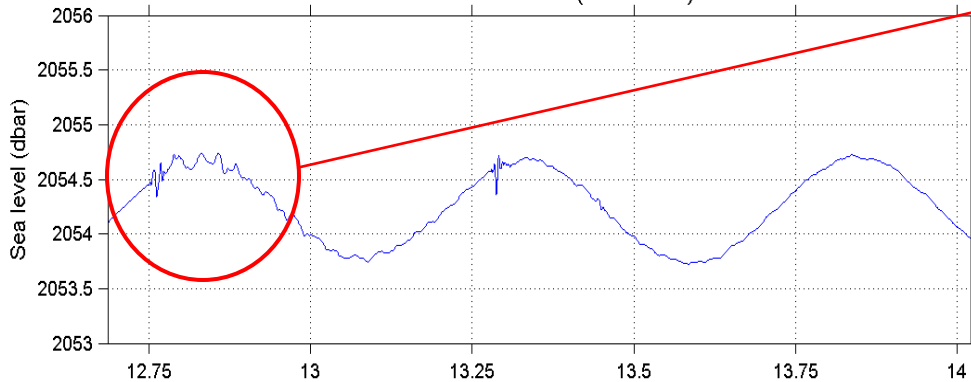
EQ (andTsunami) on 12 Sept 2007 observed by Indonesian Krakatau Tsunameter



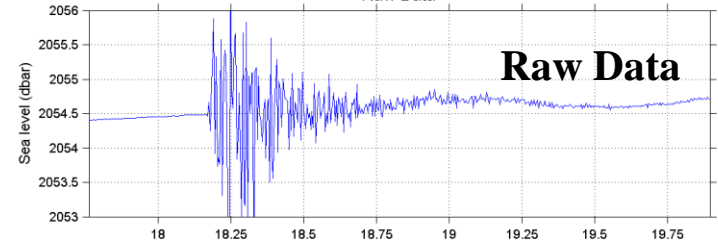
TIME SERIES DATA: 12-13 SEPT 2007
Raw Data



Low Pass Filtered (> 0.1 hrs)

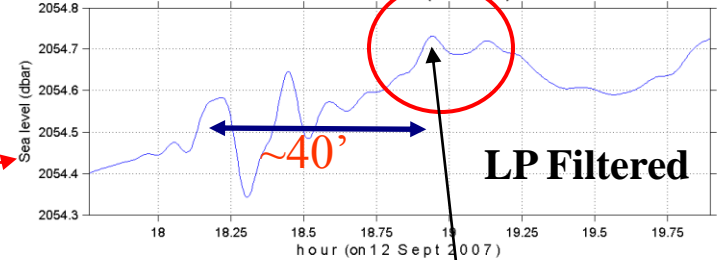


EARTHQUAKE: 12 SEPT 2007
Raw Data



Raw Data

Low Pass Filtered (> 0.1 hrs)



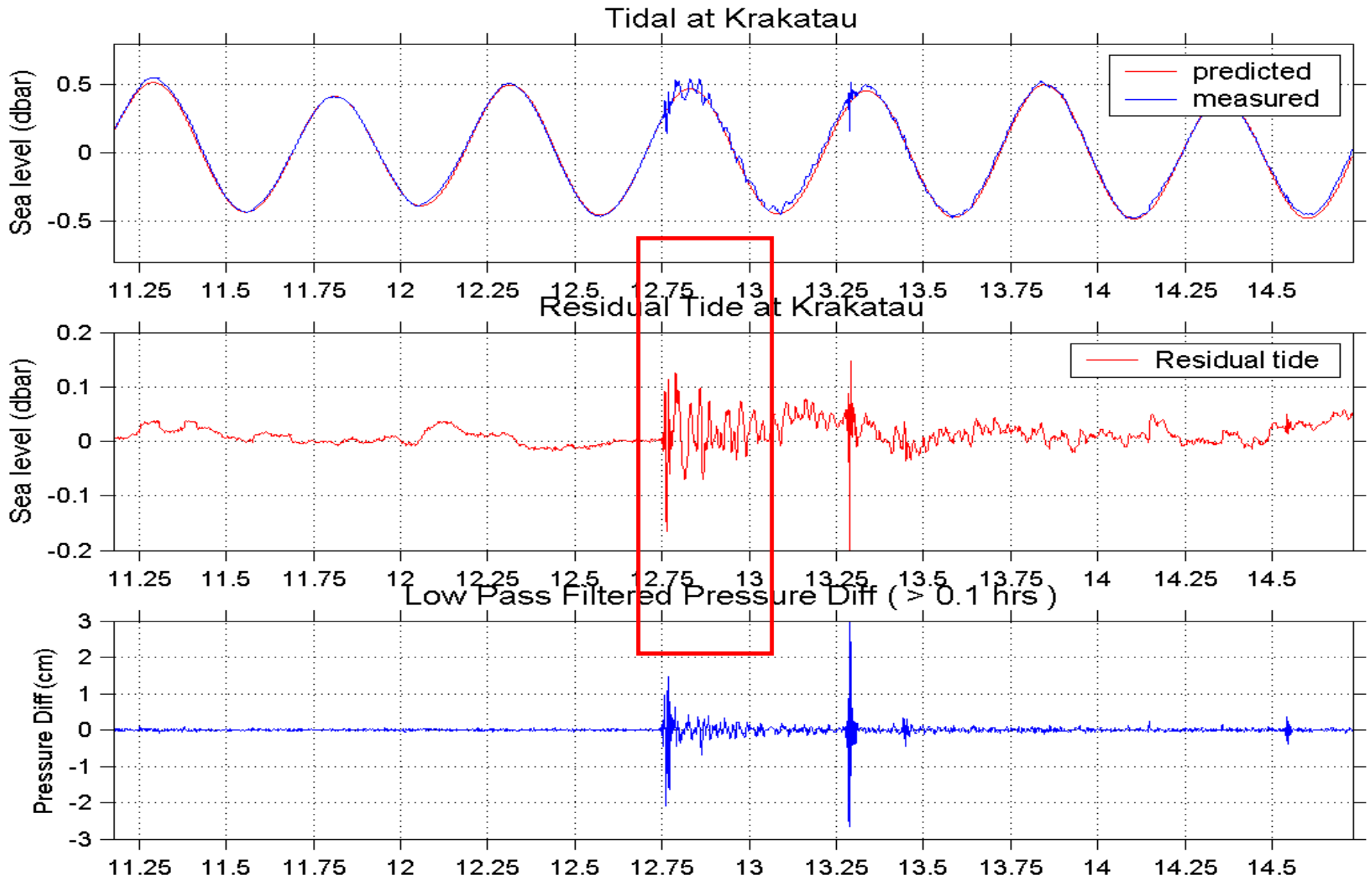
LP Filtered

detected Tsunami signals?

Predictive Filtering and
detiding algorithms are
required in real time !

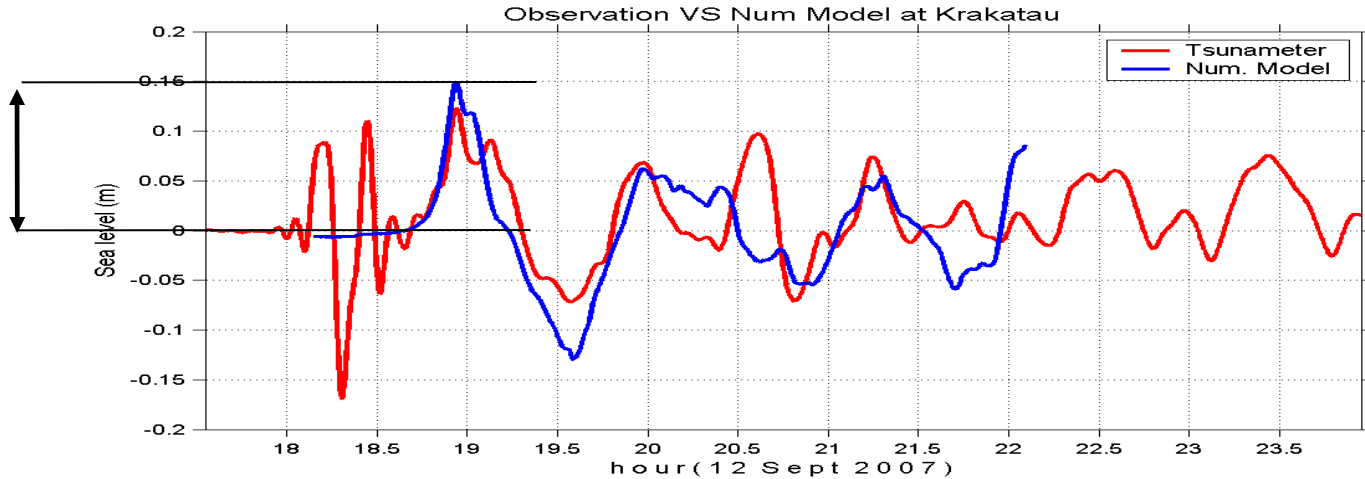


Recorded Vs Predicted Sea Level for Krakatau Tsunameter



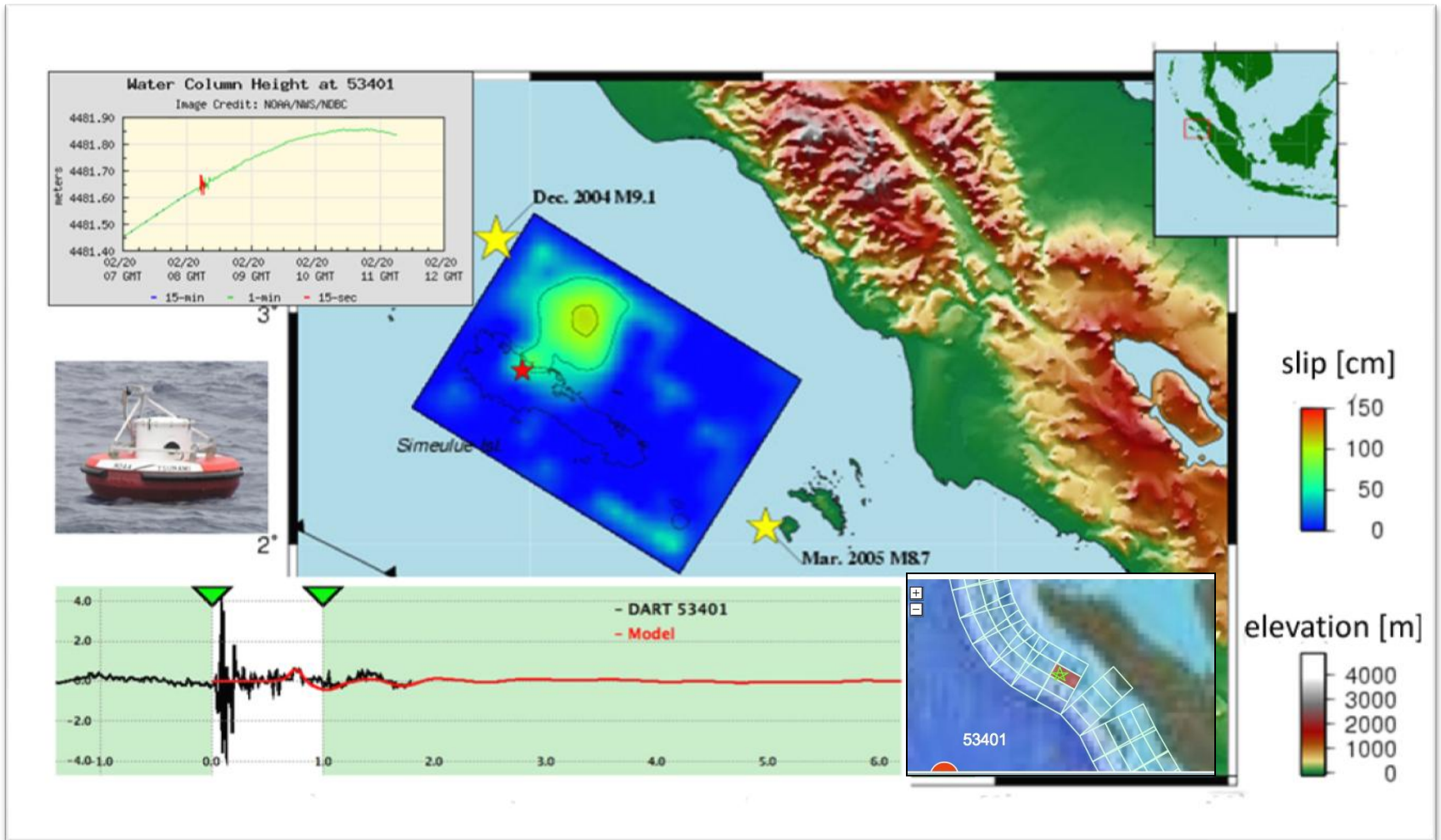
Bengkulu EQ 12 Sept 2007

**Tsunami
signal**



- **TUNAMI (Tohoku University's Numerical-Analysis for Investigation of Tsunami) Numerical model (blue line) of Tsunami wave height was performed separately.**
- **The tsunami source and their parameter are adopted from USGS Parameter Source which their dimension are estimated by Okal Formula giving the size of 191x96 Km and maximum slip 5.5 m**
- **Well agree between observation and numerical model for the first tsunami peak wave**
- **Discrepancies are due to coarse bathymetrical data and assumption defined in the open boundaries**

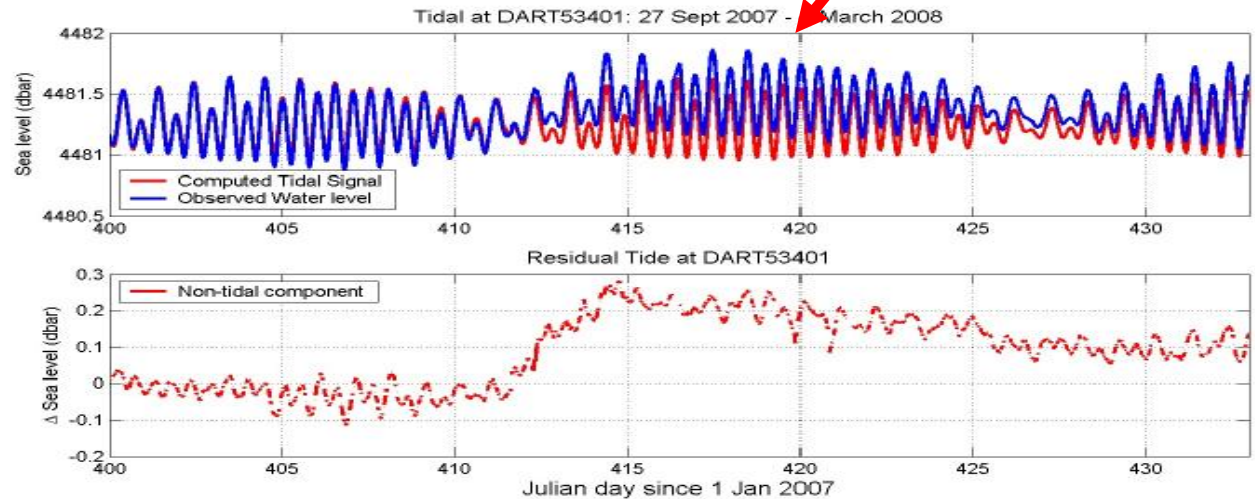
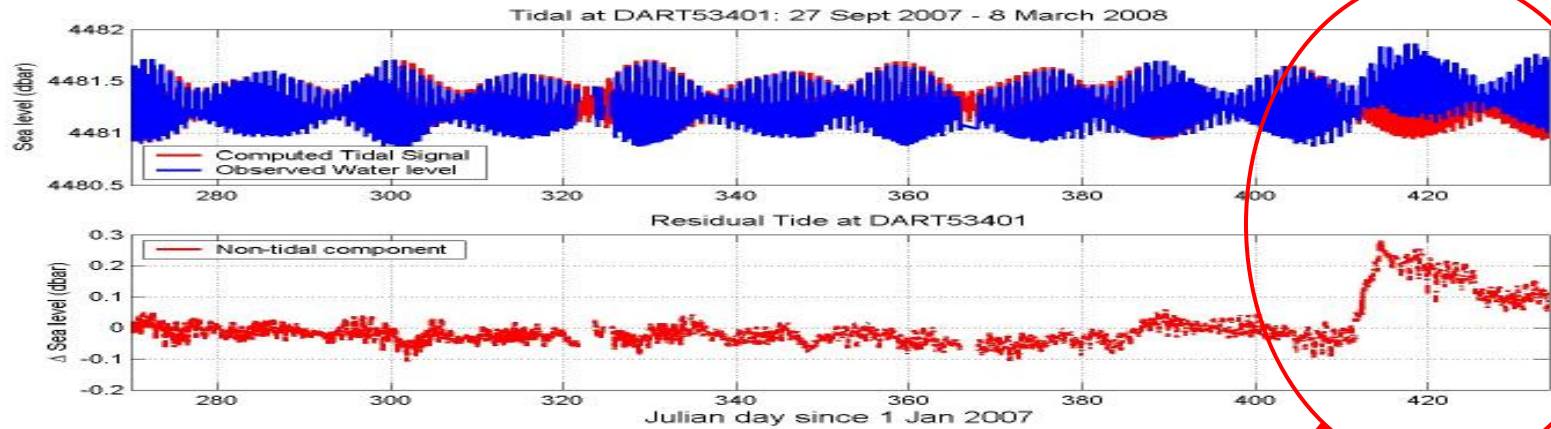
Simeulue (Sinabang) Earthquake & Tsunami Detected by DART-IO 0N92E #53401 20 February 2008, M 7.4



Other Oceanographic Aspects

Observed by DART 53401 Tsunameter (0N, 92E)

Sea level anomalies recorded in Indian Ocean



Vandalisms issues:

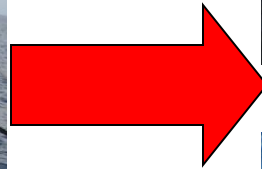
- Several cases:
 - Indonesian KOMODO Buoy: broken mooring line in end Sept 2008, redeployment in Oct 2008, and vandalized again in early Nov 2008 → fixed, operational until 7 Sept 2009, and get vandalized again.
 - German's buoy mooring line was cut below keel (May 2007) → fixed
 - Indonesian 'Krakatau' buoy was missing on 31 Dec 2007
 - DART-II 53401 Indian Ocean buoy stops transmission on 14 March 2008 → vandalized all surface buoy instruments
 - DART-ETD South of Bali have lost contact since 25 September 2008
- Intensify socialization to the local/national fisheries communities and local authorities

KOMODO Tsunameter (Flores Sea)

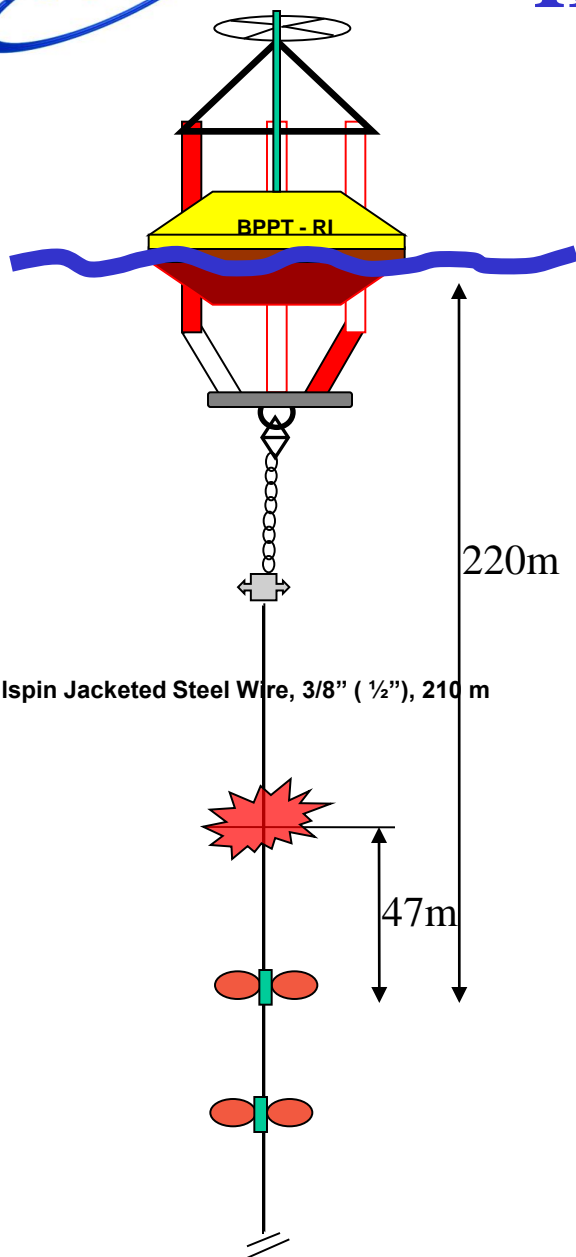
November 2008



Two weeks
later

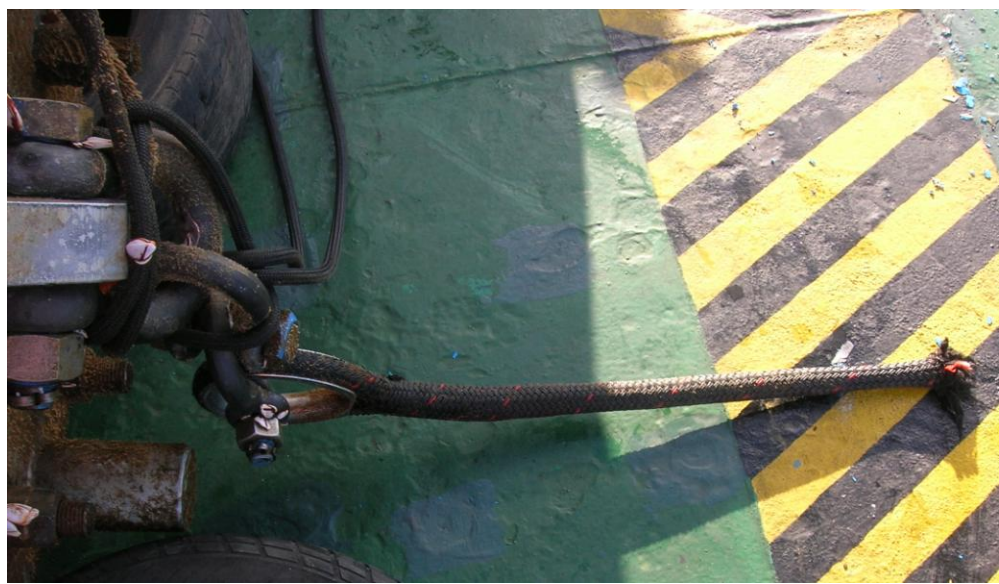


KRAKATAU Tsunameter (Indian Ocean, south of Sumatra)



GITEWS Buoy (Indian Ocean, west of Sumatra)

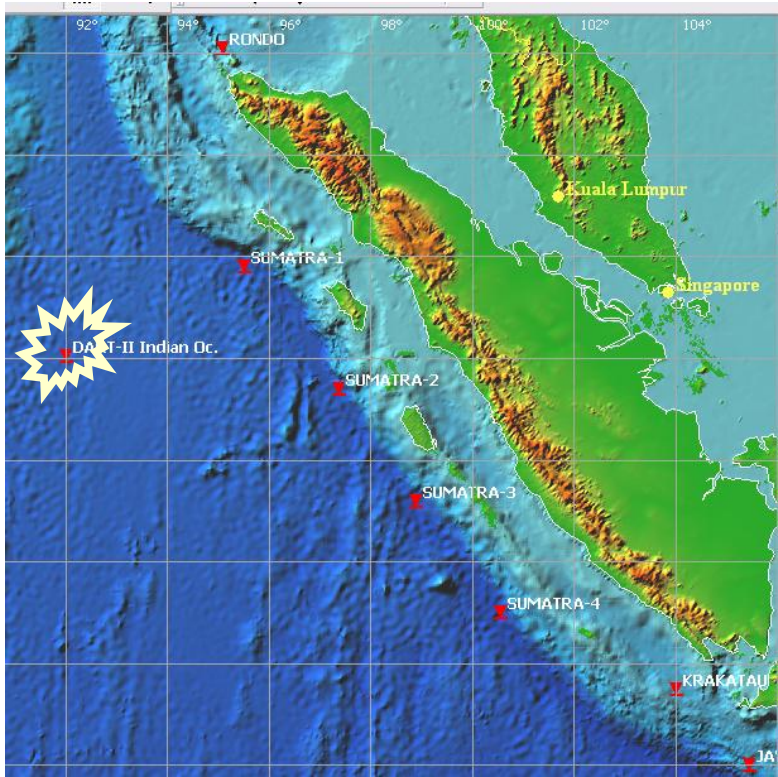
- Fisherman Net, or
- Unexpected high sea state, or
- Broken mooring line





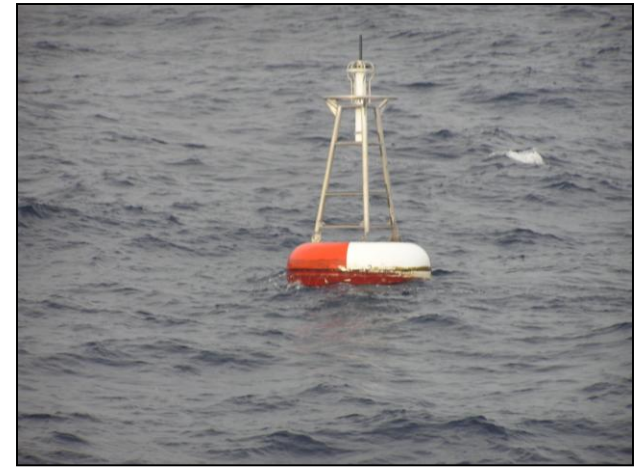
DART-II Standard 0N 92E (Indian Ocean, west of Sumatra)

Re-visited on 20 August 2009



ATLAS Buoy:

Entangled Tuna fishing gear on a mooring line



Preventing Vandalism



Development Programs

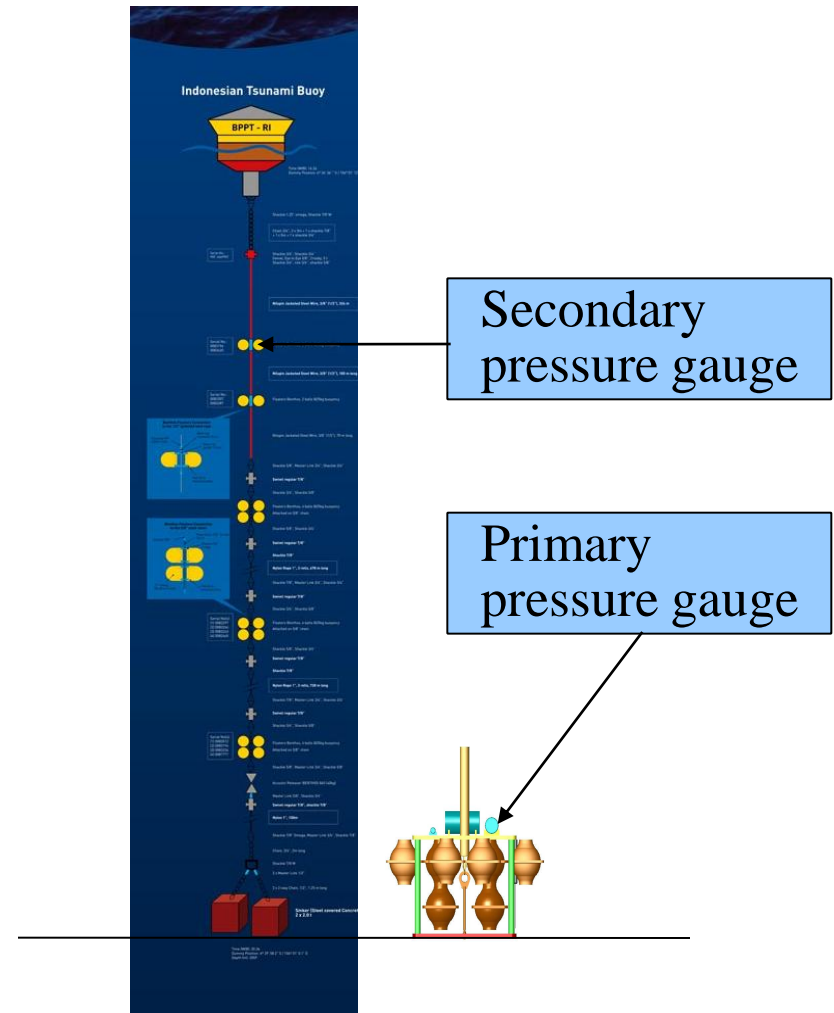
- Local tsunami detection system
- Data utilization



Development Programs

Parallel operation of 2 pressure sensors in one tsunameter:

- one @ BPR sitting at the bottom
- the other one attached on the mooring line





Baruna Jaya Ship Particulars

Ship Particulars	BARUNA JAYA I	BARUNA JAYA II	BARUNA JAYA III	BARUNA JAYA IV
				
Call Sign	YEAS	YEAT	YEAU	PLIQ
Port of Registry	Jakarta, Indonesia	Jakarta, Indonesia	Jakarta, Indonesia	Jakarta, Indonesia
Purposes	Multipurpose Deep-Sea Research	Seismic & Hydrographic Research	Hydrography, Oceanography, Geology	Oceanography, Fishery
Classification	BV, BKI A 100 I MS	BV.1 - 3/3E	Bureau Veritas / 37N318	BKI A 100 I MS
Builder	CMN, Cherbourg - France	CMN, Cherbourg - France	CMN, Cherbourg - France	CMN, Cherbourg - France
Launched	1989	1989	1989	1995
GRT	1189 T	1184 T	1184 T	1219 T
NRT	355 T	389 T	355 T	365 T
L DA	60.40 m	60.40 m	60.40 m	60.40 m
L BP	55.25 m	55.689 m [L WL]	52.39 m	55.25 m
Width	11.60 m	11.60 m	11.60 m	12.10 m
Depth at Upper Deck	6.50 m	6.50 m	5.50 m	6.50 m
Draft mean	4.10 m	4.50 m	4.08 + 1.7 m [Survey equipment]	4.15 m
Cruising Speed	10 knots	10 knots	10 knots	10 knots
Accommodation	17 crew, 33 scientists & engineers	17 crew, 33 scientists & engineers	17 crew, 33 scientists & engineers	17 crew, 33 scientists & engineers
Owner	BPPT Indonesia	BPPT Indonesia	BPPT Indonesia	BPPT Indonesia
Main Engines	2x1100 HP(850rpm),Niigata Pielstick 5 PAsL	2x1100 HP(850rpm),Niigata Pielstick 5 PAsL	2x1100 HP(850rpm),Niigata Pielstick 5 PAsL	2x1100 HP(850rpm),Niigata Pielstick 5 PAsL
Auxiliary Engine	1 unit Baudouin 270 HP (1,500 rpm)	1 Baudouin 270 HP (1,500 rpm)	2 shaft driven generator, 2x628 KVA 1 Diesel Generator, Detroit Diesel 200 KVA	1x270 HP(1,500rpm), Baudouin 6M26S
Synchronous Alternator	1 Leroy Somer 200 KV [RPM 1500]	1 Leroy Somer 200 KV [RPM 1500]	1 Leroy Somer 200 KV [RPM 1500]	1 Leroy Somer 200 KV [RPM 1500]
Alternator	2 Leroy Somer 625 KVA [RPM 1500]	2 Leroy Somer 625 KVA [RPM 1500]	2 Leroy Somer 625 KVA [RPM 1500]	2 Leroy Somer 625 KVA [RPM 1500]
Bow Thruster	1 Pleuger 200 HP [1450 rpm]	1 Pleuger 200 HP [1,500 rpm]	1 Pleuger 200 HP [1,500 rpm]	Schottel STT 170 LKT - 200 HP
Propeller Type	CPP type 417 CCW [4 blades]	CPP type 417 CCW [4 blades]	CPP type 417 CCW [4 blades]	CPP 4 blades Renou Dardel CCP 1504
Fuel Tank Capacity	HSD 260,000 liters, Lubricant 14,000 liters	HSD 260,000 liter, Lubricant 14,000 liter	HSD 260,000 liter, Lubricant 11,000 liter	HSD 190,000 liter, Lubricant 11,000 liter
Fresh Water Tank Capacity	93.70 T	90 T	90 T	90 T + RO
Fuel Consumption	7.7 T per day [Full speed]	7.7 T per day	7.7 T per day	7.7 T per day
Life Raft	6 x 20 PAX + 1 x 15 PAX	5 x 20 PAX + 2 x 15 PAX + 1 x 25 PAX	6 x 20 PAX	6 x 25 PAX + 2 x 16 PAX
Rubber Boat	1	1	1	1
Navigation	Radar Raccal Decca 1670, GPS	Radar Furuno S Band, AIS, GPS	Radar Furuno 115, GPS	Radar Raytheon ARPA S Band, GPS
Telecommunication	SSB, GMDSS A-3, Inmarsat C	SSB, GMDSS A3, Inmarsat C	SSB, GMDSS A3, Inmarsat C	SSB, Inmarsat C
Main Survey Instrument	ELAC 4700 Echosounder, Side Scan Sonar	Seismic 2D, 480 Channels, Side Scan Sonar	Kongsberg EM 12 Multibeam Echosounder	SeaBeam 10500, Fish Finder, Simrad EK 500, Color Sonar, SBP Dratech 3.5 KHz

Technology Center for Marine Survey Balai Teknologi Survei Kelautan



Barina Jaya I

Barina Jaya II

Barina Jaya III

Barina Jaya IV

Thank you

Barina Jaya Survey Vessels

Hydrography – Oceanography Geology – Geophysics Marine Environment & Fishery