AI-DRIVEN DISASTER MITIGATION SOLUTION

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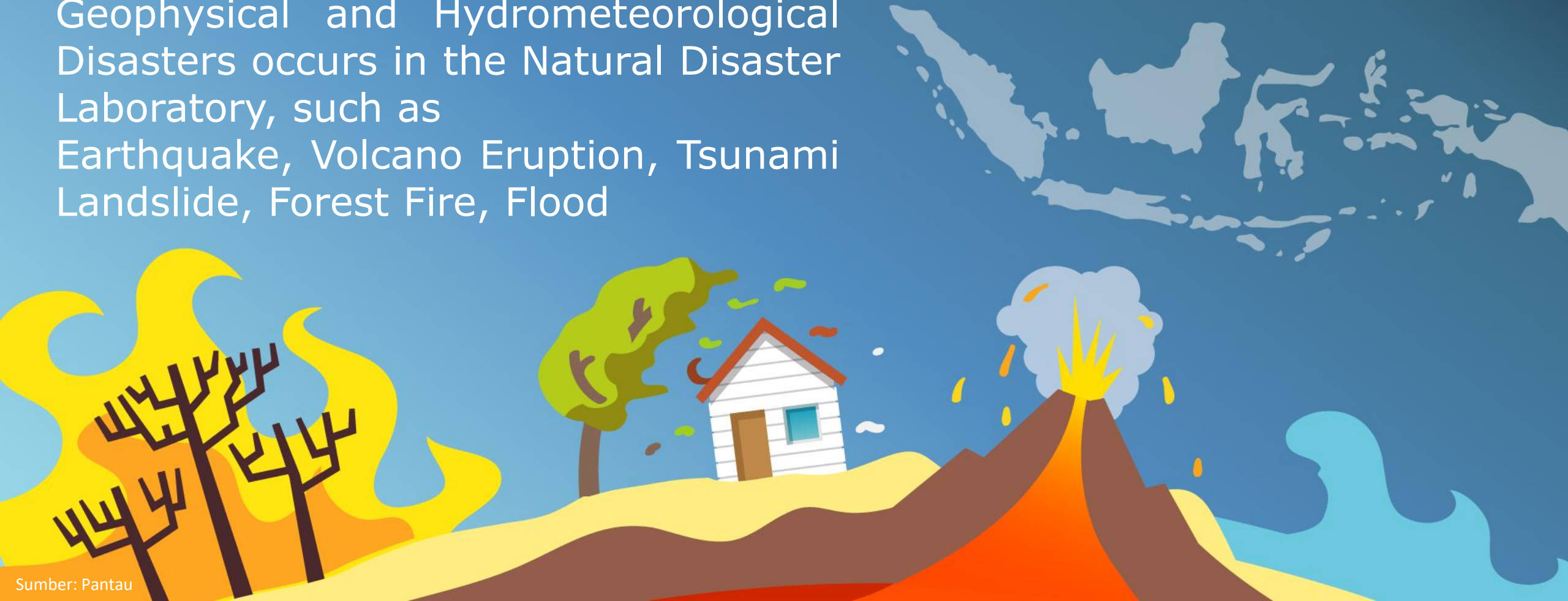
Sumber: Pantau

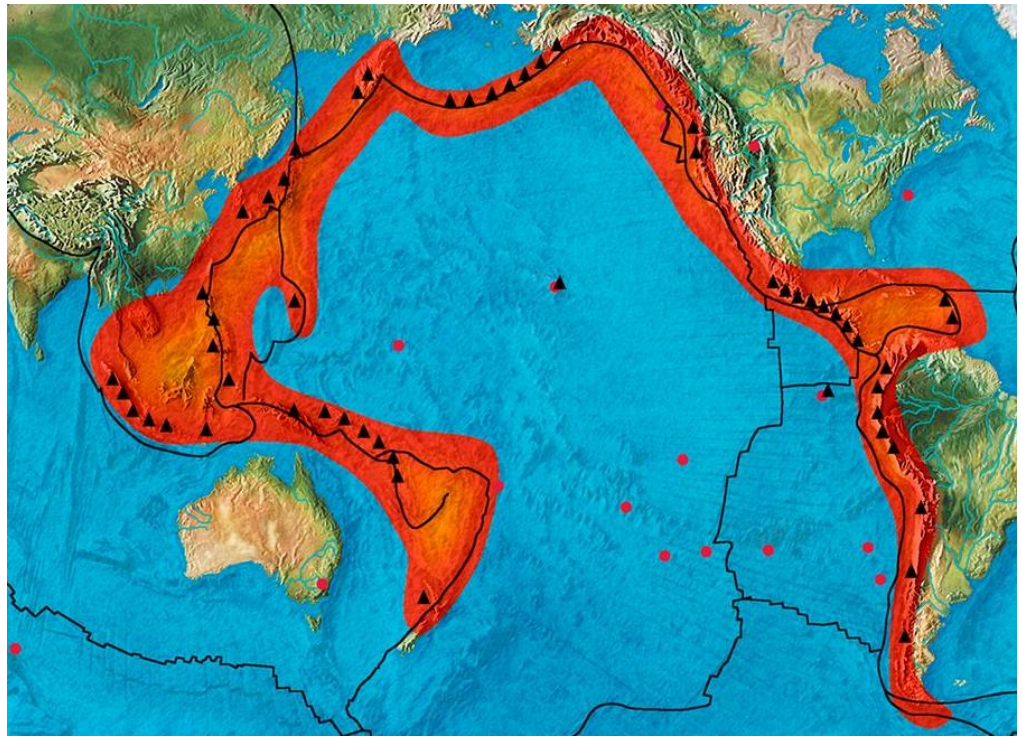
Indonesia : Natural Disaster Laboratory ?

The geography of Indonesia create vulnerability in many regions
Geophysical and Hydrometeorological Disasters occurs in the Natural Disaster Laboratory, such as
Earthquake, Volcano Eruption, Tsunami
Landslide, Forest Fire, Flood



Sumber: Pantau

Indonesia - The Ring of Fire



Sumber: World Risk Index, National Geographic Indonesia

Indonesia lies in the path of the most active earthquakes in the world due to it is surrounded by the Pacific Ring of Fire, and is located above three continental plate collisions, namely:

Eurasia **Indo-Australia** **Pacific**

According to the **World Risk Index 2020:** Indonesia has the risk of extreme natural disaster :

10,24%

Potential disasters in Indonesia can be grouped into two (2) main groups, namely main hazards and collateral hazards.

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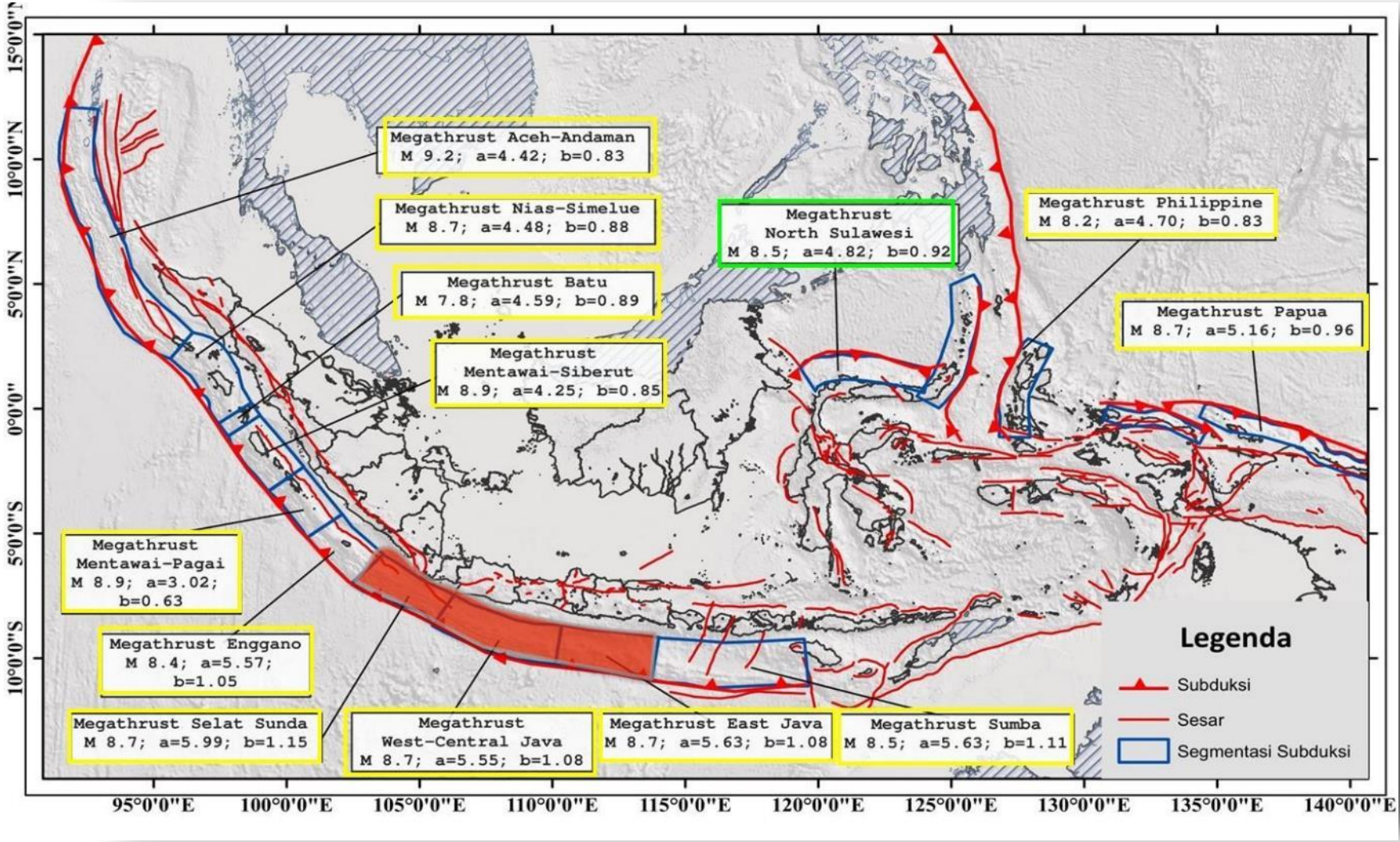
Potential of Natural Disaster Caused By Tectonic Activities

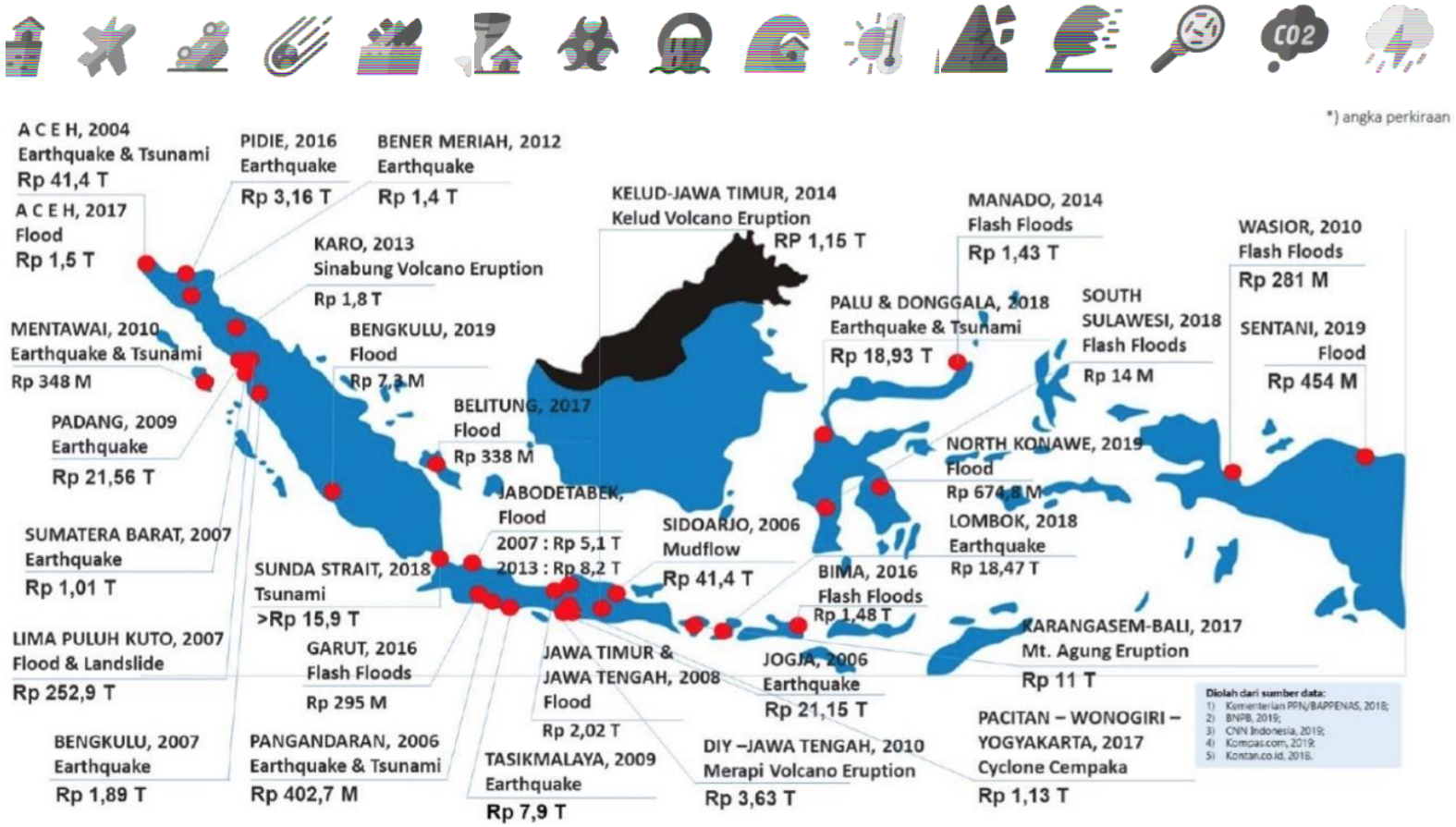
- ✓ 6 Subduction Zones
- ✓ 13 Segment Megathrust
- ✓ 295 Segments Active Faults

National Earthquake Map In 2017 Based On Megathrust Earthquake Sources



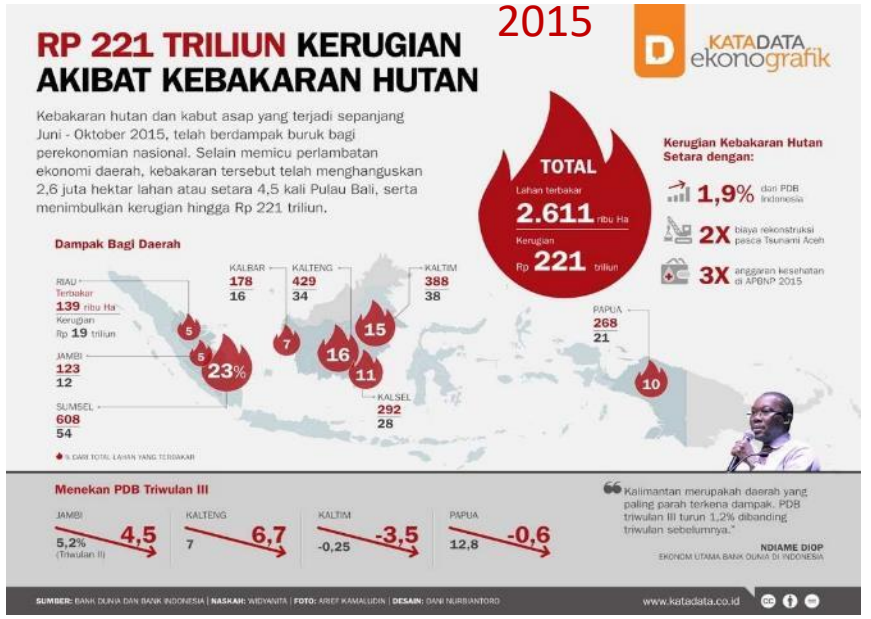
Ref: Pusat Studi Gempa Nasional, 2017

Economic Losses Due To Disaster

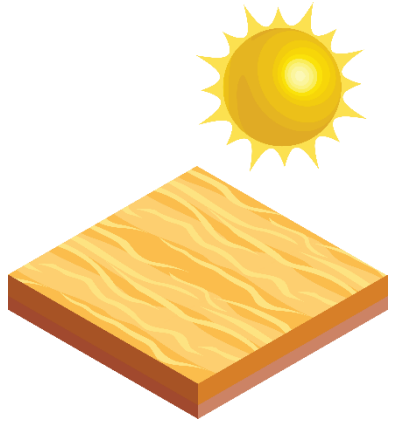


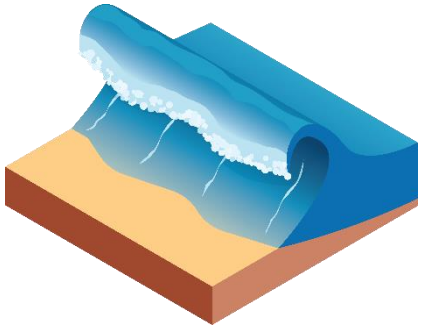
Economic Losses Due to Geological Disasters From 2004 - 2019 Reached Rp. 235.26 T (20 Billion USD)

Sources : Coordinating Ministry for Economic Affairs



AI-driven Disaster Predictive Modelling



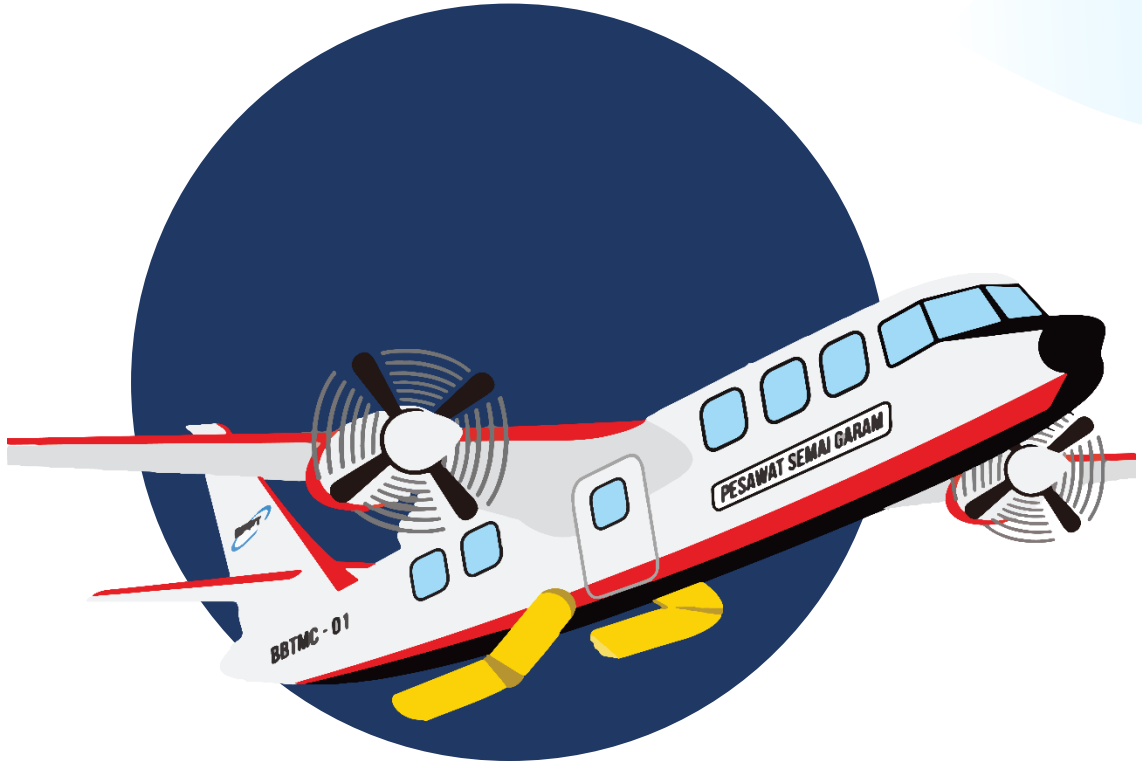


AI PREDICTIVE MODEL FOR L&F FIRE MITIGATION

Development of Hotspot forecast system and peat water level (TMAT)

AI-based can be the basis of policy recommendations - Impact-based Forecasting and Risk-based Warning

Early efforts to mitigate forest and land fires



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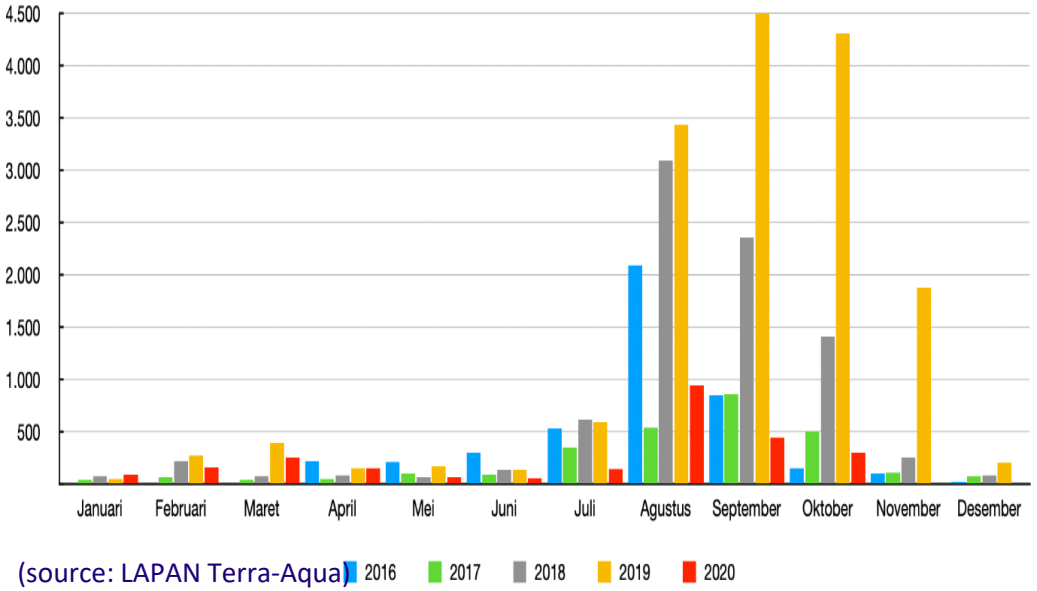
WMT → **Best Time**

L and F Fire

Hight Effectiveness

Hotspot Occurrences over Indonesia



(source: LAPAN Terra-Aqua)

Growing of Potential Clouds

Dry Season

- High Humidity
- Less Activity convective

Rarely Found

Wet Season

- High Humidity
- Rarely Activity Convective

Easy discoverable

Effectivity TMC Operation

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#DATASCIENCEEXPERIMENT

Hotspot and Peatland water relationship analysis

Machine Learning

Identify Data Source
Discover available Data

Data Analysis
Understanding Data

Hypothesis Validatio
Data Driven Decisions

Model Outcome
Build ML Model

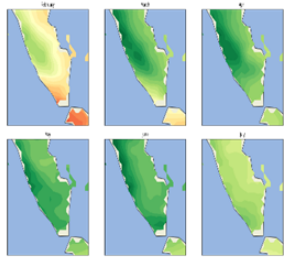
WEATHER DATA

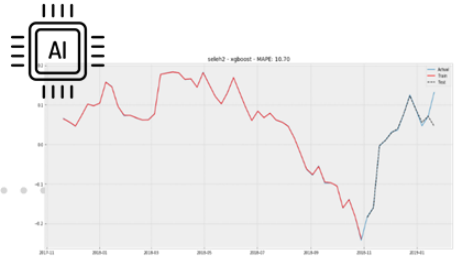
BMKG

ECMWF

Seasonal Climate Forecast

Historical Weather



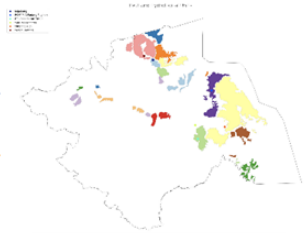


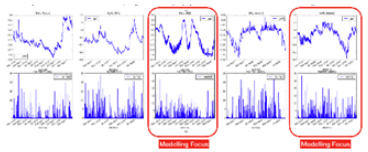
PEAT LAND GROUND WATER LEVEL

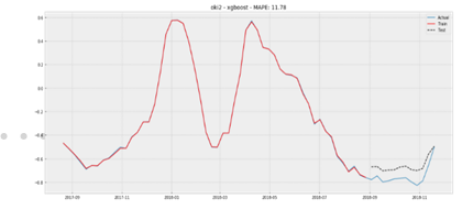
BPPT

Badan Restorasi Gambut

Peatland Monitoring Data



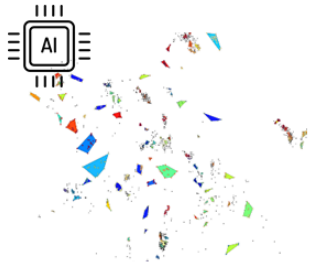




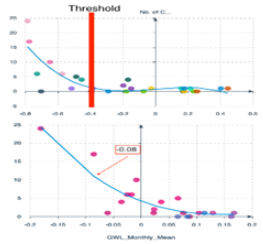
HOTSPOT

Hotspot Information as Forest/Land Fire's Alert

LAPAN Hotspot Guide



Hotspot Clustering



Korelasi Tinggi Muka Air tanah dan Titik Panas

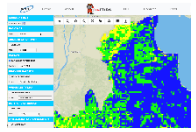
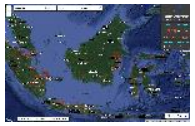
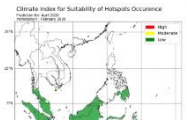
Model Prediksi Tinggi Muka Air Tanah

#DATAMINING

Disaster Mitigation

USED BY TEAM FOR

Operasi | Pencegahan | Historical/Real TIme | Forecast

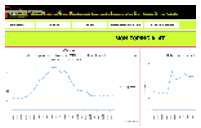
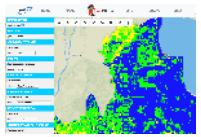
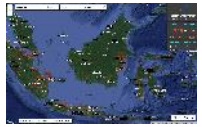
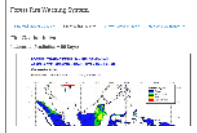
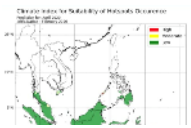
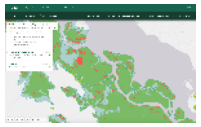
	BPPT		Ministry of Environment and Forestry	LAPAN	BMKG			BRG	BPPT Development.
	Smokies	INA-FDRS	SiPongi	Fire Hotspot	Weather Forecast	FDRS	Hotspot Forecast	Prims	MVP Phase 1
									
Fire Danger Rating		●				●			
Peatland Ground Water Level	● 🕒							● 🕒	● ● 📅
Hotspot	●	●	●	● 🕒		● 🕒	●	●	
Fuel						●			
Weather and climate					● ●				
Total economic value		●							
Smoke Spread Image						●			
Stats			●						

Disaster Mitigation

USED BY TEAM FOR

Operasi | Pencegahan | Historical/Real TIme | Forecast

Current Landscape | Where Our MVP Fits

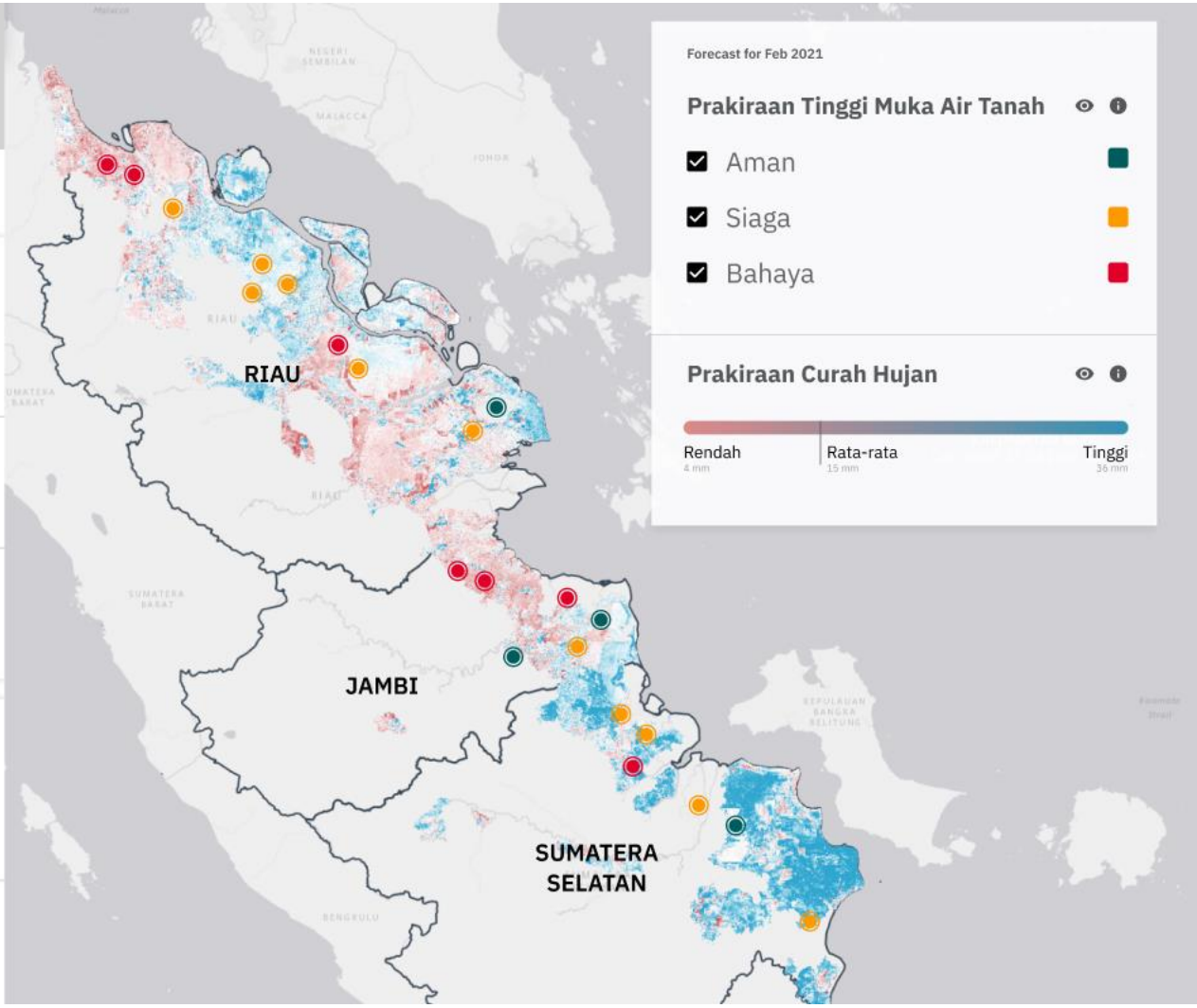
	BPPT		Ministry of Environment and Forestry	LAPAN	BMKG			BRG	BPPT
	Smokies	INA-FDRS	SiPongi	Fire Hotspot	Weather Forecast	FDRS	Hotspot Forecast	Prims	MVP Phase 1
									
Purpose	Ground water level monitoring	Forest fire warning system	Hotspots fire area (stats and graphics)	Observed hotspot locations	Weather forecast	Forest fire warning system	Hotspot forecast	Condition of peatlands in Indonesia and the progress of peatland restoration efforts.	Early forest fire warning system to prevent fire risk in each province using AI
Forecast Capability	None	None	None	None	Short-Term 7 days (weather) 30 days (climate)	Short-Term 6 days	Long-Term Monthly	None	Mid/Long-Term 1-3 months (*3-6 month in Phase 2*)
Information Provided	Ground water level data from 2 stations	▪ Fire weather index ▪ Human factor ▪ Fuels (index for how much can be burned) ▪ Total economic value		Hotspot observation data from 4 satellite	Weather and climate forecast	▪ Fire Weather Index ▪ Fine Fuel Moisture ▪ Smoke Spread Image ▪ Hotspots Distribution	Hotspot	▪ Peatland geometry ▪ Peatland water monitoring ▪ Hostpots ▪ Scars	▪ Hotspot ▪ Seasonal climate forecast ▪ Peatland ground water level
Users	Weather Mod Team	▪ Fire Fighter ▪ BPBD	▪ Public ▪ Fire Fighter	▪ Public ▪ Weather Mod Team	Public	▪ Fire Fighter ▪ BPBD			▪ Weather Mod team ▪ BNPB

BPPT – GWL READING STATION

Disaster Mitigation

Prakiraan Tinggi Muka Air Tanah

Periode 6 Bulan	Nov	Dec	Jan'21	Feb'21	Mar'21	Apr '21
Jumlah stasiun dengan TMAT rendah (< 40 cm)						
SUMATERA						
Riau						
33 Stasiun	3	5	7	25	13	4
Jambi						
5 Stasiun	0	0	1	3	1	0
Sumatera Selatan						
6 Stasiun	1	0	1	1	1	0
KALIMANTAN						
Kalimantan Barat						
7 Stasiun	3	2	0	2	1	0
Kalimantan Selatan						
3 Stasiun	0	0	0	1	1	0



PEAT TMA FORECAST WILL HELP DETERMINE EFFECTIVE, EFFICIENT AND ACCOUNTABLE WEATHER MODIFICATION TECHNOLOGY OPERATIONS

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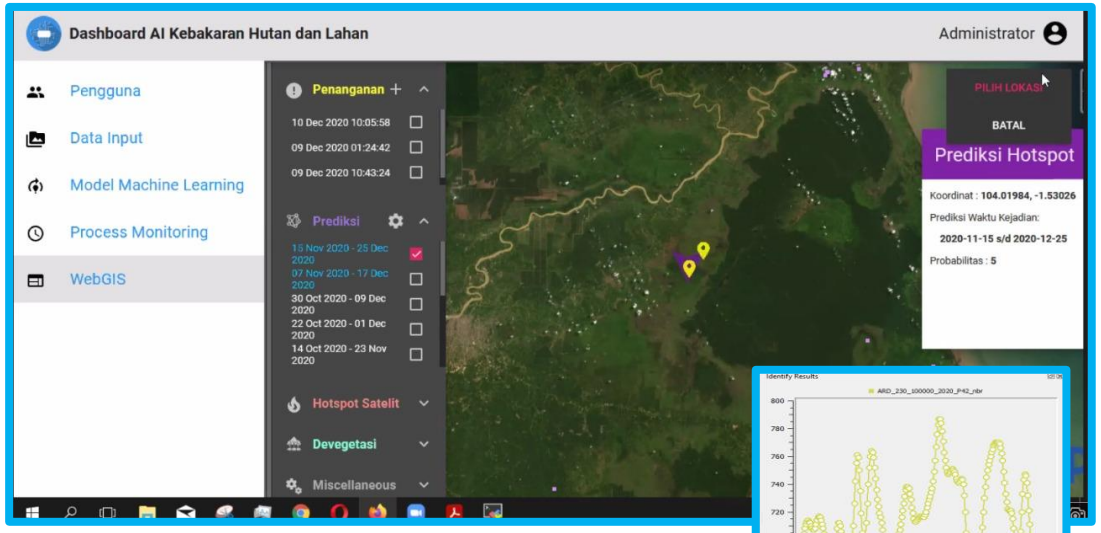
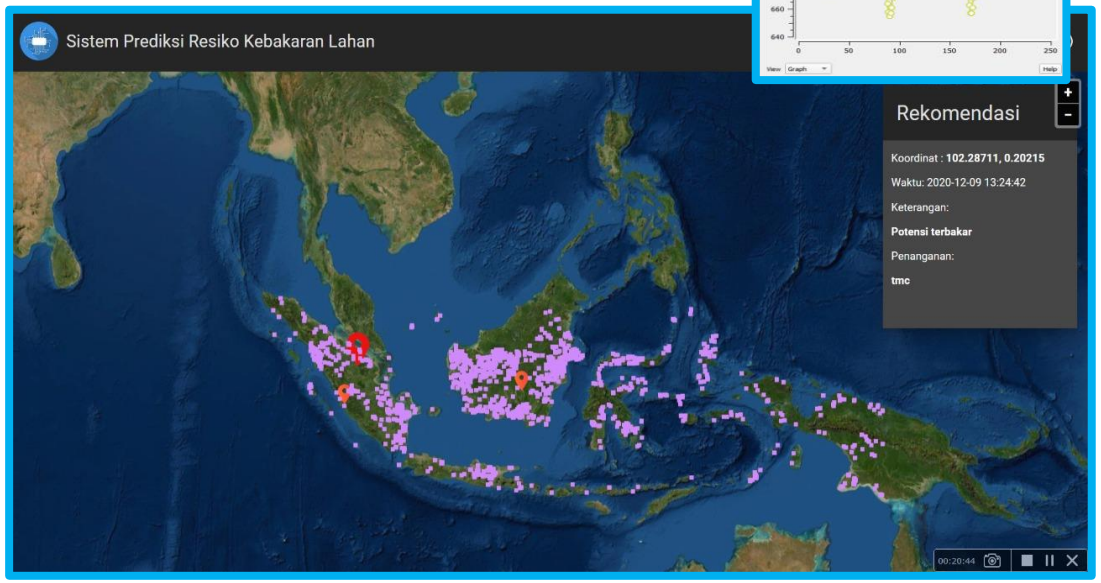
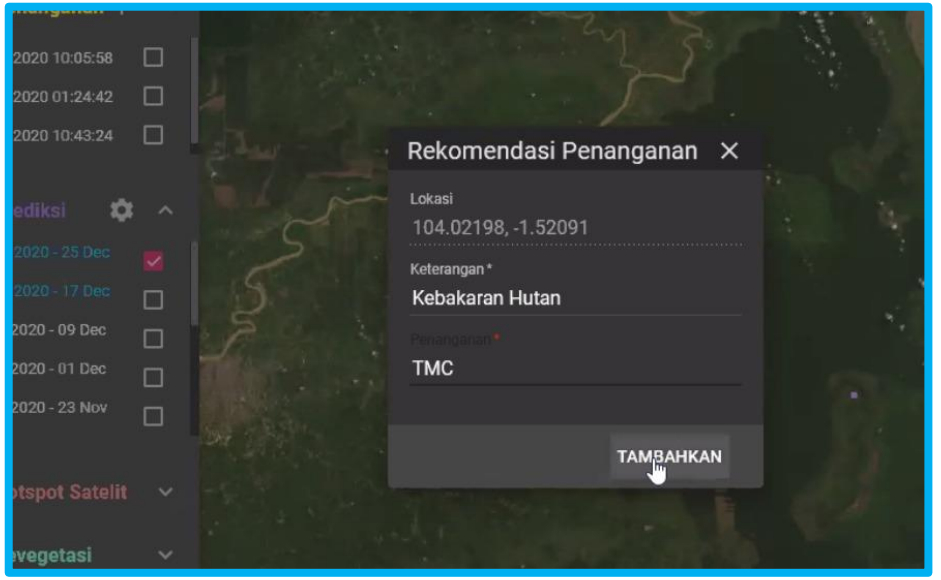


PEKA - API

Forest and Land Fire Prediction System with Period 8 Days for the Next 1 Month.

- Used Machine Learning
- Early Warning System for Forest and Land Fire Risks in an area..
- *Hyperparameter Input*, using satellite/Citra data, installed sensor, and other parameters
- Monitoring Devegetation of forest and land





AI KARHUTLA

Big Data:

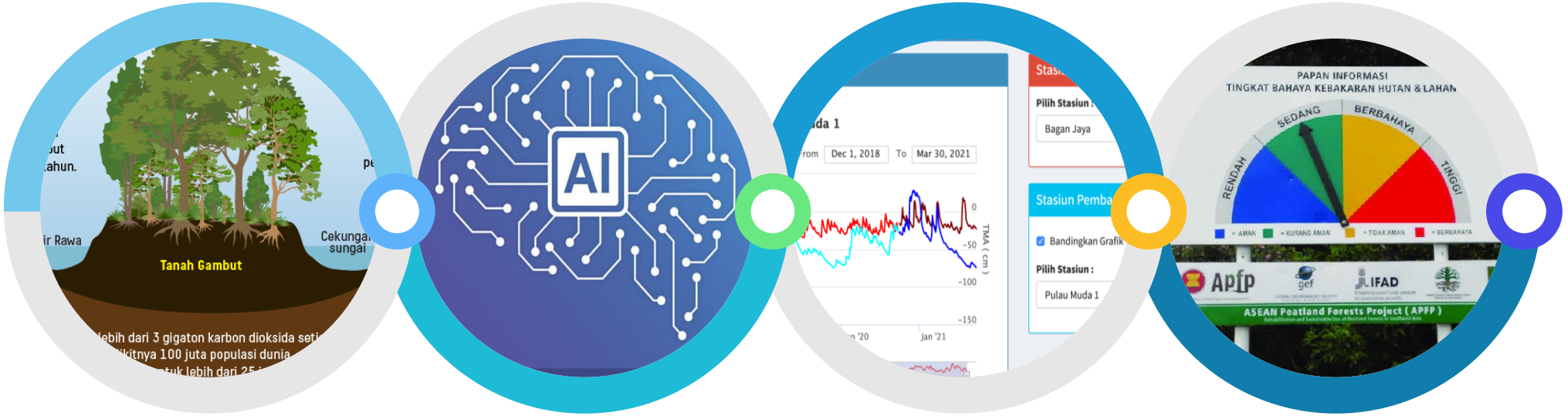
2

- ✓ TMA Peatland at 6 Province in Sumatera & Kalimatan
- ✓ 50 Station, 3 years, Resolution 10 minutes

Prediction Results:

4

- ➢ TMA Peatland Daily
- ➢ 50 Stations, For the next 3 months



1

Time Series Forecasting:

3

- ❖ Data Preprocessing
- ❖ Seasonality Analysis
- ❖ Model Fitting and Evaluation
- ❖ Prediction

Outcomes:

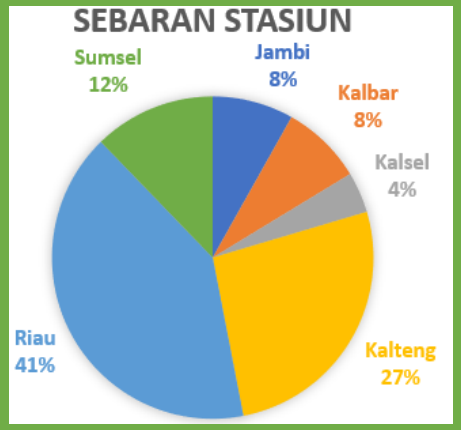
- ❑ Strengthening EWS Karhutla
- ❑ Supporting input in Preventive policy
- ❑ Evaluation of Mitigation Efforts

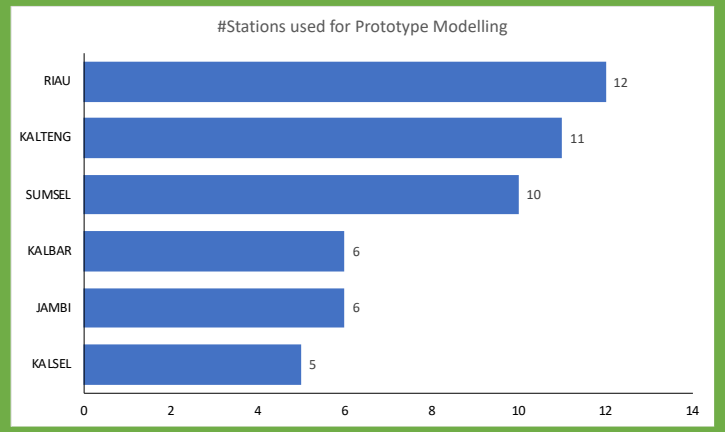
Kerjasama BPPT – BRGM – BMKG

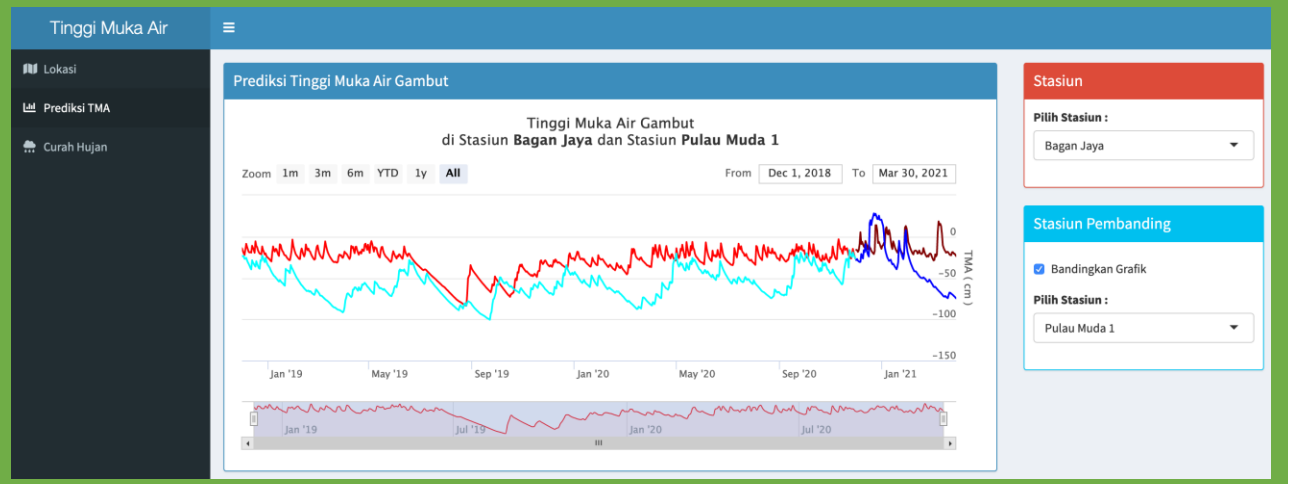
DEVELOPMENT OF A PEATLAND FORECAST SYSTEM BASED ON ARTIFICIAL INTELLIGENCE

Time Series Forecasting

The results of this forecast become the basis for policy recommendations for early efforts to mitigate forest and land fires







MODEL TEST CASE

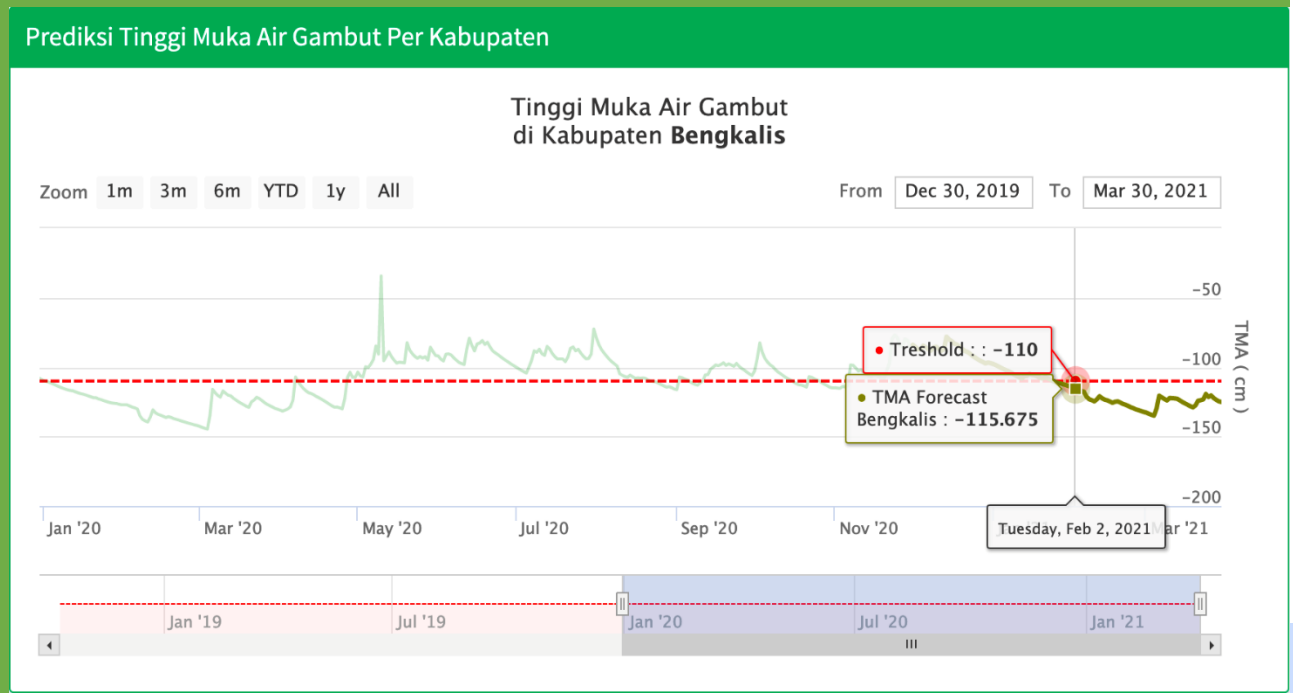
50 Station

OUTPUT :

Prediction of TMAT in the next three (3) months

In 6 Main Provinces Where KARHUTLA Occurred

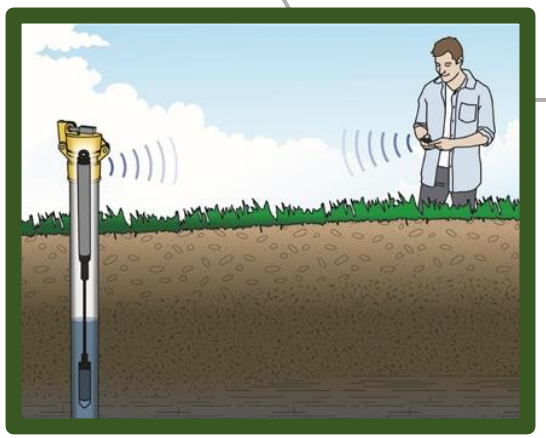
(Riau, Jambi, Sumsel, Kalbar, Kalteng, dan Kalsel)



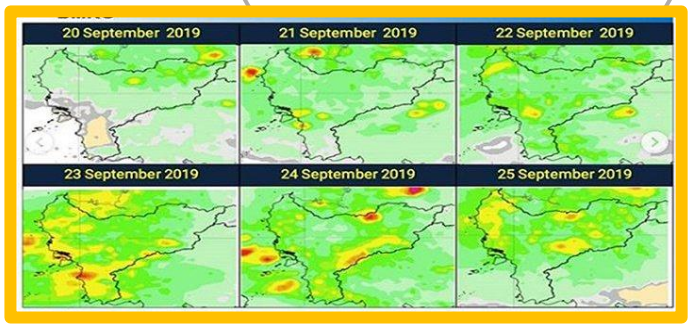
http://wxmod.bppt.go.id/index.php/riset/ai-karhutla

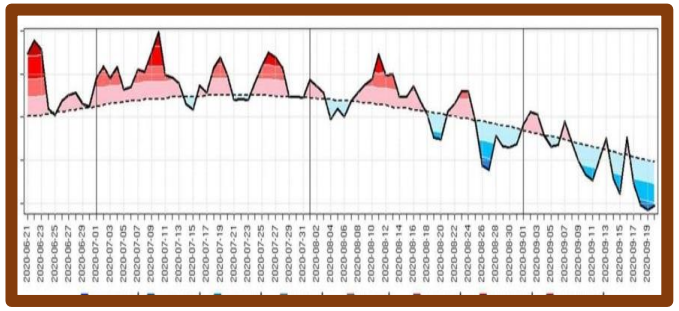
FUTURE DEVELOPMENT

Used only TMA Peatland as the Single Input



- Daily Historical Data of weather parameters (3 - 4 years);





Daily Long-Term Weather Forecast (90 – 120 days)

Input Data in Algorithm machine learning/deep learning as predictor variable and part of product verification of TMA Model prediction.

Prediction Results :

- Increasing the accuration of TMA peatland
- Reliable to Support Mitigation Efforts

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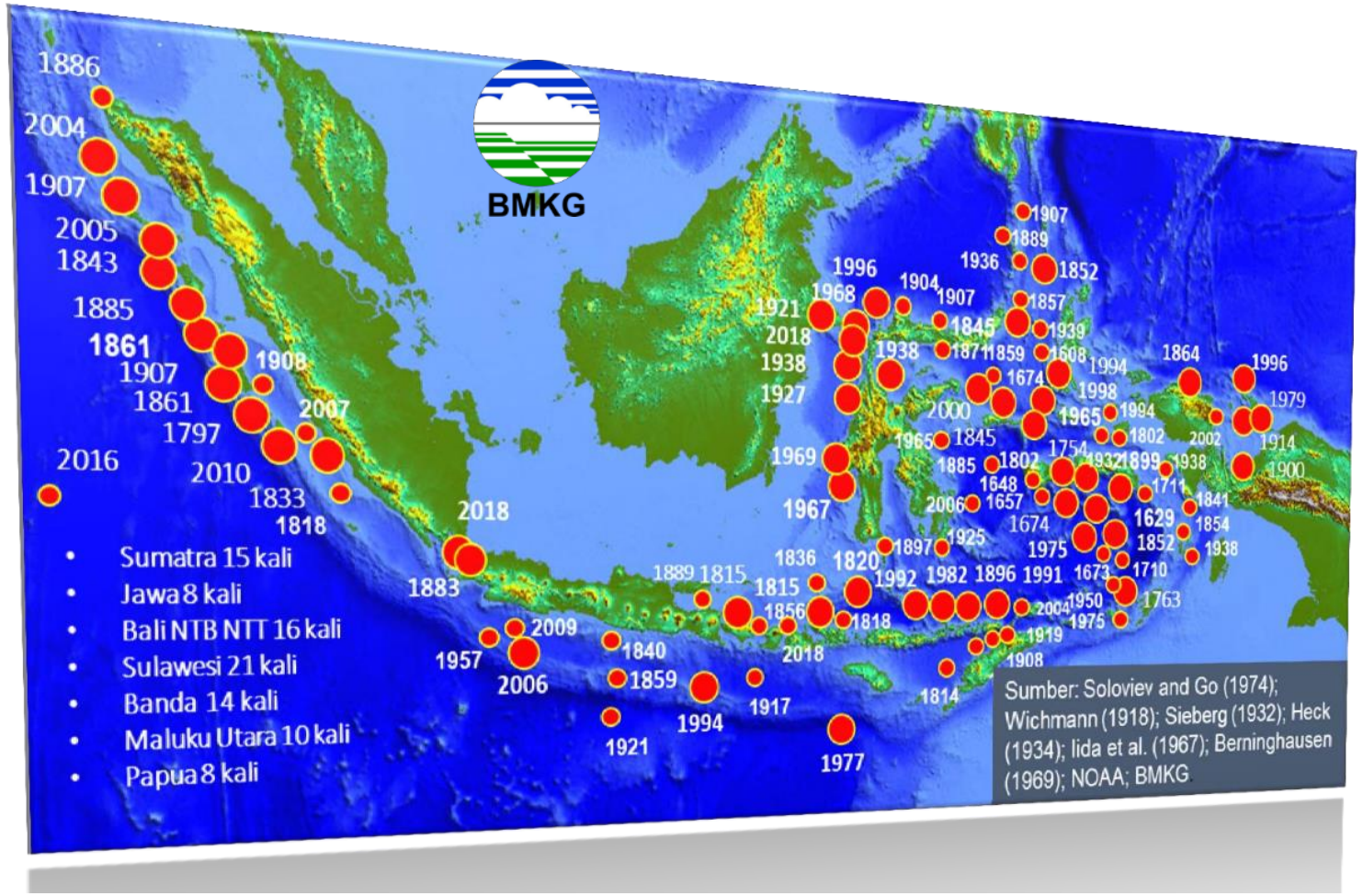
AI-DRIVEN TSUNAMI EARLY WARNING

Empowering Indonesia Tsunami Early Warning System

BMKG-BPPT-BIG

Indonesia Tsunami Event Data for the Period 1674-2018



Number Of Tsunami Events And It's Sources

- ✓ 99 times; tsunami destructive with diverse intensities
- ✓ 54 times; Tsunami Due To Volcanic Eruption
- ✓ >3 times; Tsunami caused by undersea landslide
- ✓ > 6 times; tsunami triggered by unknown factors

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INDONESIA
TSUNAMI EARLY WARNING SYSTEM

Peraturan Presiden No. 93 Tahun 2019
Tentang Penguatan dan Pengembangan Sistem Inovasi
Gempa Bumi dan Peringatan Dini Tsunami.

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DEVELOPMENT AI FOR THE EARLY WARNING SYSTEM OF TSUNAMI

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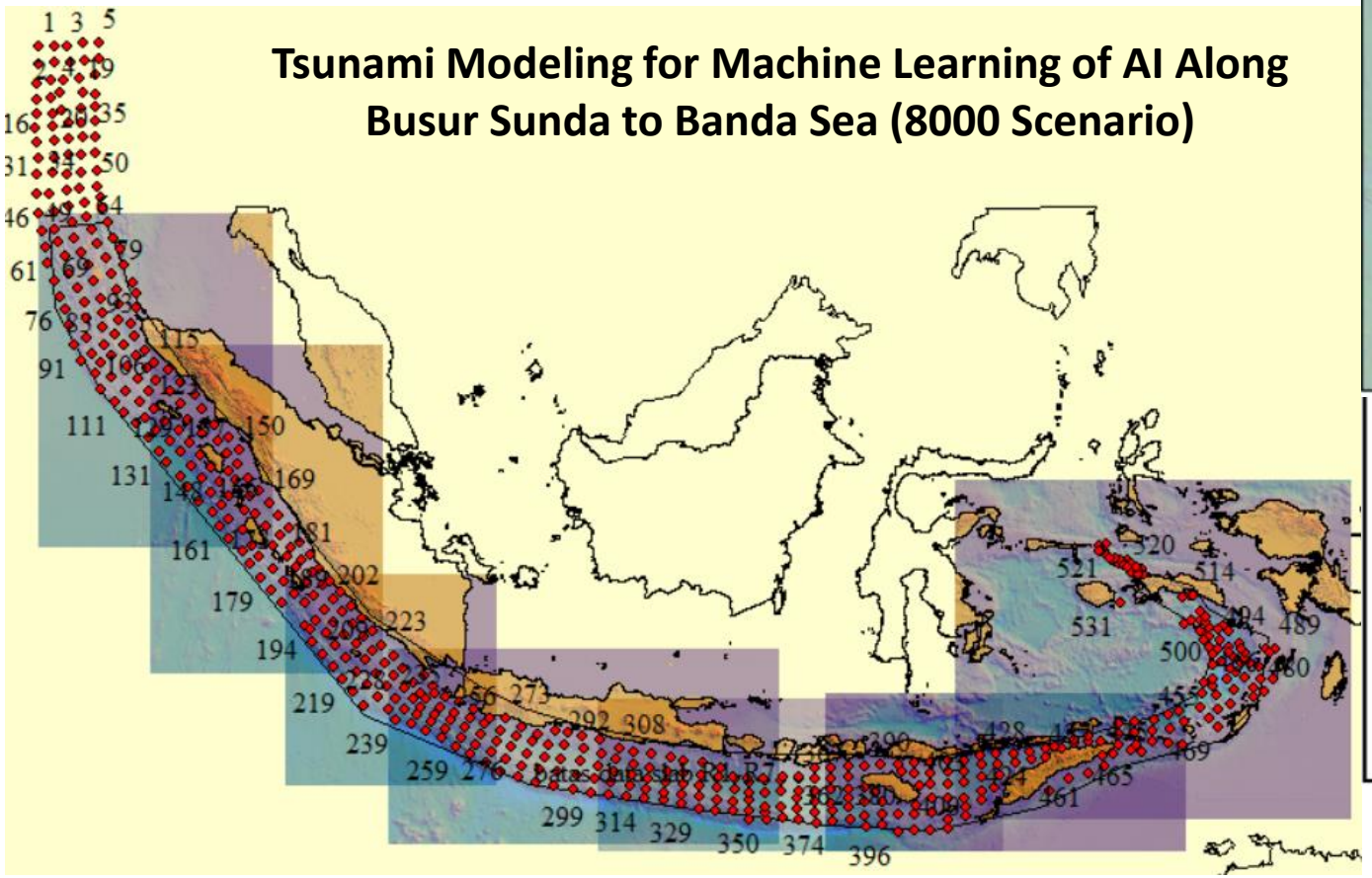
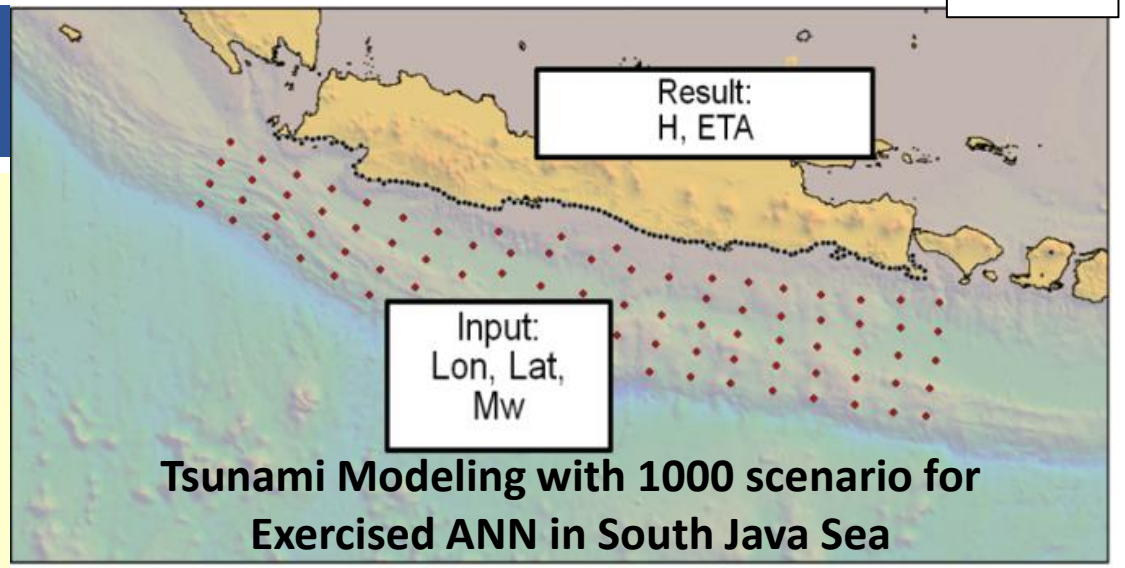
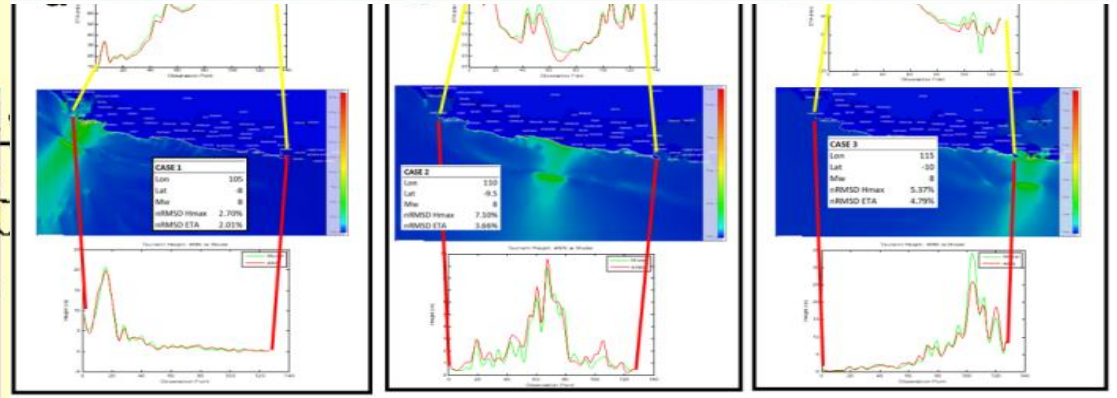
AI Tsunami Program in 2020-2021

Tsunami Modeling for Machine Learning of AI Along Busur Sunda to Banda Sea (8000 Scenario)





Tsunami Modeling with 1000 scenario for Exercised ANN in South Java Sea



Deviation of AI-Modeling (Hmax & ETA): Less than ~ 6%

Use Case South Java

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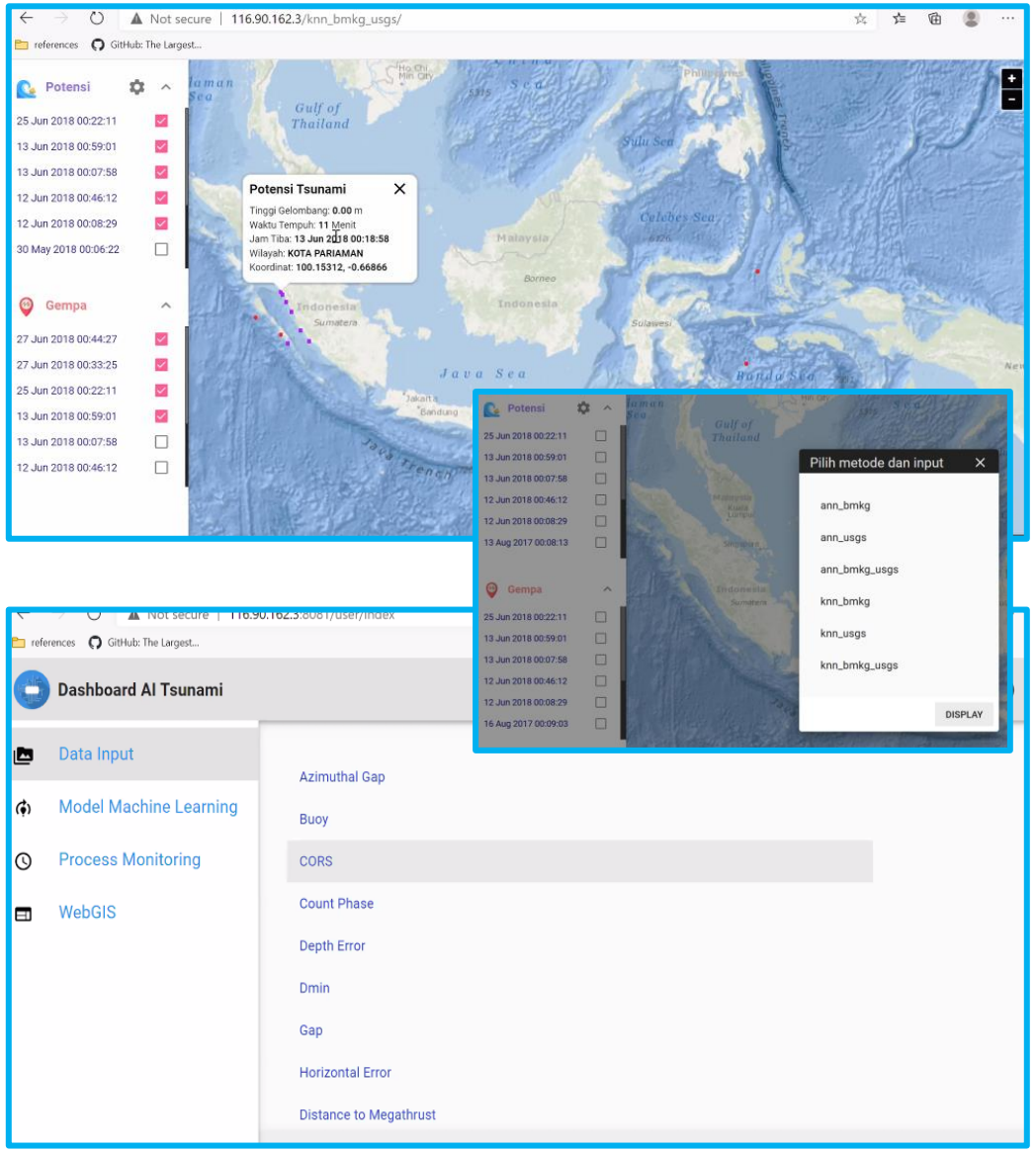
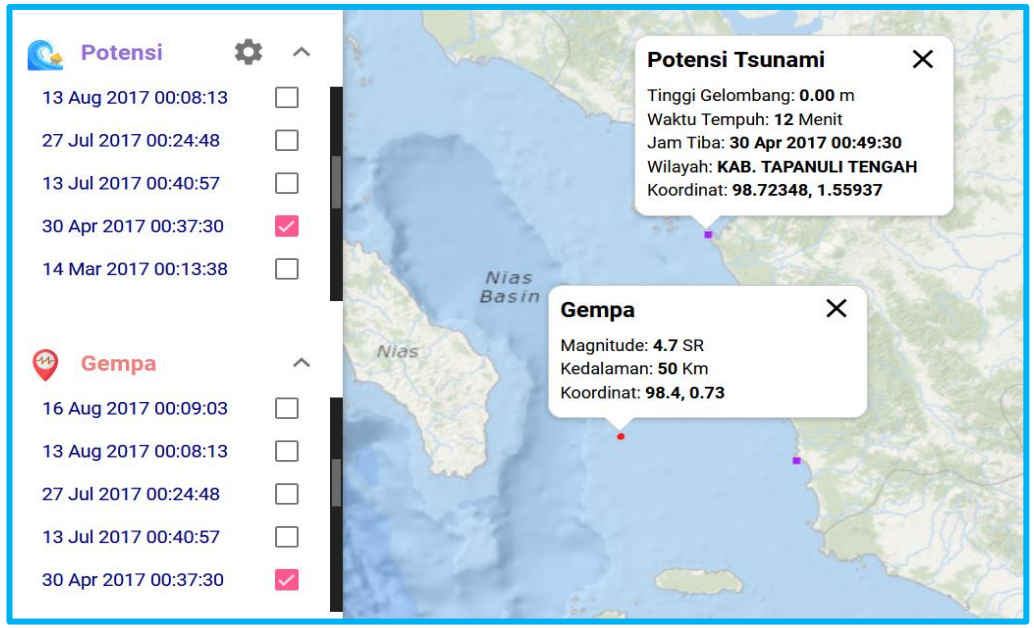
PEKA - TSUNAMI

Tsunami Prediction System, Travel Time, Location and Wave Height.

- Used Machine Learning
- Tsunami Prediction if an earthquake occurs with a certain scale in a certain area.
- Predicted travel time, specific locations along the coast, and estimated wave height (run-up) when it reaches land.
- *Hyperparameter Input*, using simulation data, Data from sensors such as InaBuoy, InaCBT and other parameters.





BRIN
BADAN RISET
DAN INOVASI NASIONAL

ASEAN IVO

THANK YOU
DOMO ARIGATOU
TERIMA KASIH