Tsunami_Risk

CLIENT II
Internationale Partnerschaften für nachhaltige Innovationen

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

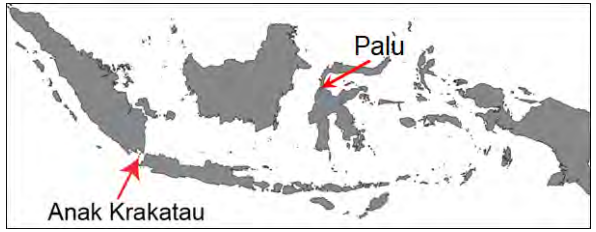
TSUNAMI_RISK

German-Indonesian cooperation on warning for non-seismic tsunamis

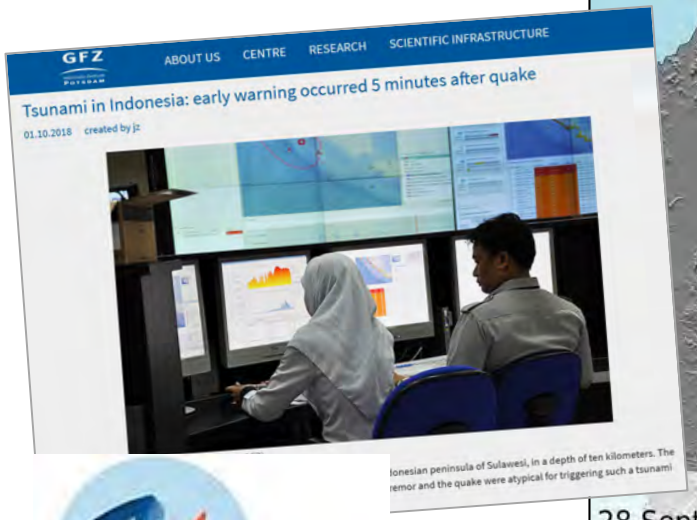
Jörn Lauterjung, GFZ Potsdam

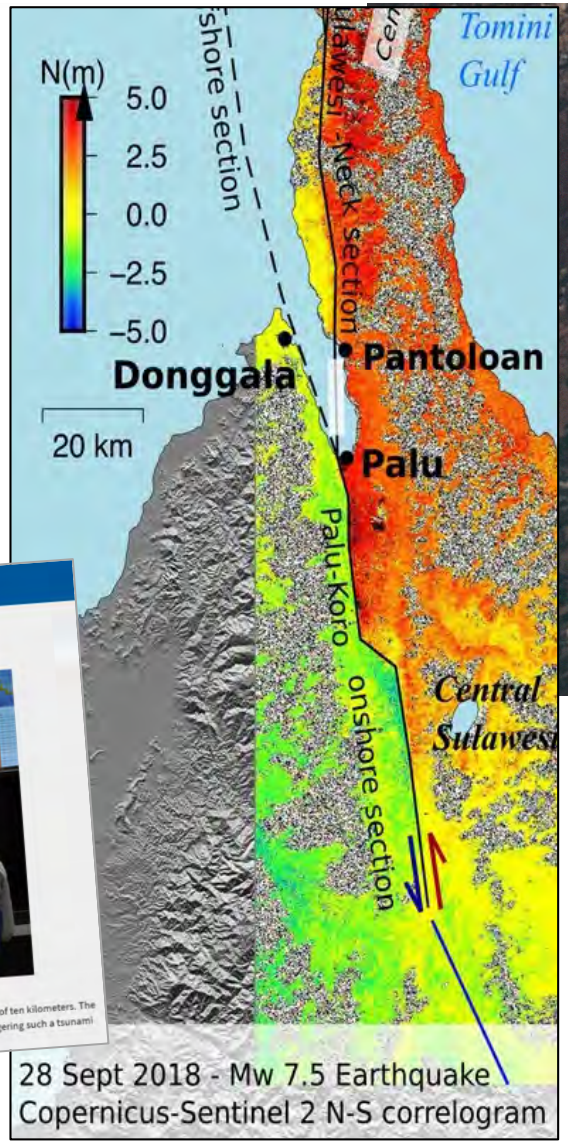
GFZ Helmholtz-Zentrum Potsdam
DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center
Technische Universität Braunschweig
Technische Universität Berlin
Freie Universität Berlin
Bundesanstalt Technisches Hilfswerk
gempa
BNPB
LIPI
BMKG
BPPT
Institut Teknologi Bandung 1920
LAPAN
Universitas Indonesia
Universitas Gadjah Mada

MOTIVATION: LANDSLIDE INDUCED TSUNAMI



Two events struck Indonesia in 2018
(a) Palu earthquake
(b) Krakatau collapse





Bacques et al. (2020) Nature

Heidarzadeh et al. (2019) Geophys. J. Int.

MOTIVATION: VOLCANO INDUCED TSUNAMI

Tsunami_Risk

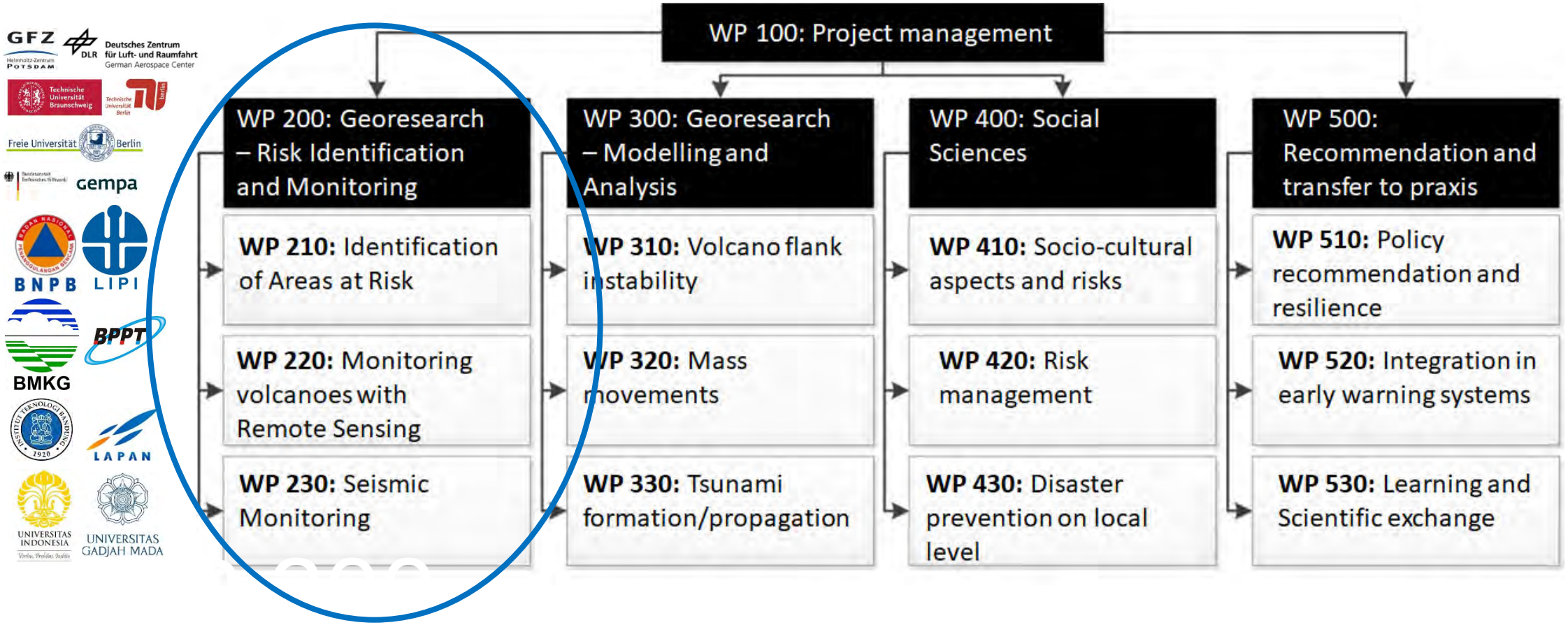
Two events struck Indonesia in 2018
(a) Palu earthquake
(b) Krakatau collapse

Anak Krakatau in December 2018

Satellite radar observations by German satellite TerraSAR-X

Tsunami damage in December 2018

Projectstructure



Tsunami_Risk

Constructing a Catalogue

Multicriteria Decision Analysis:

→ H/D-ratio of the volcano (height versus distance from the sea) (20%)
→ Slope angle (20%)
→ Eruption history (30%)
→ Tsunami & edifice instability history (20%)
→ Further hazardous features (Calderas, vegetation or hydrothermal alteration of the flanks, underwater edifice extent, etc.) (10%)

$$Score = Factor1 \cdot Weight1 + Factor2 \cdot Weight2 + Factor3 \cdot Weight3 + \ldots$$

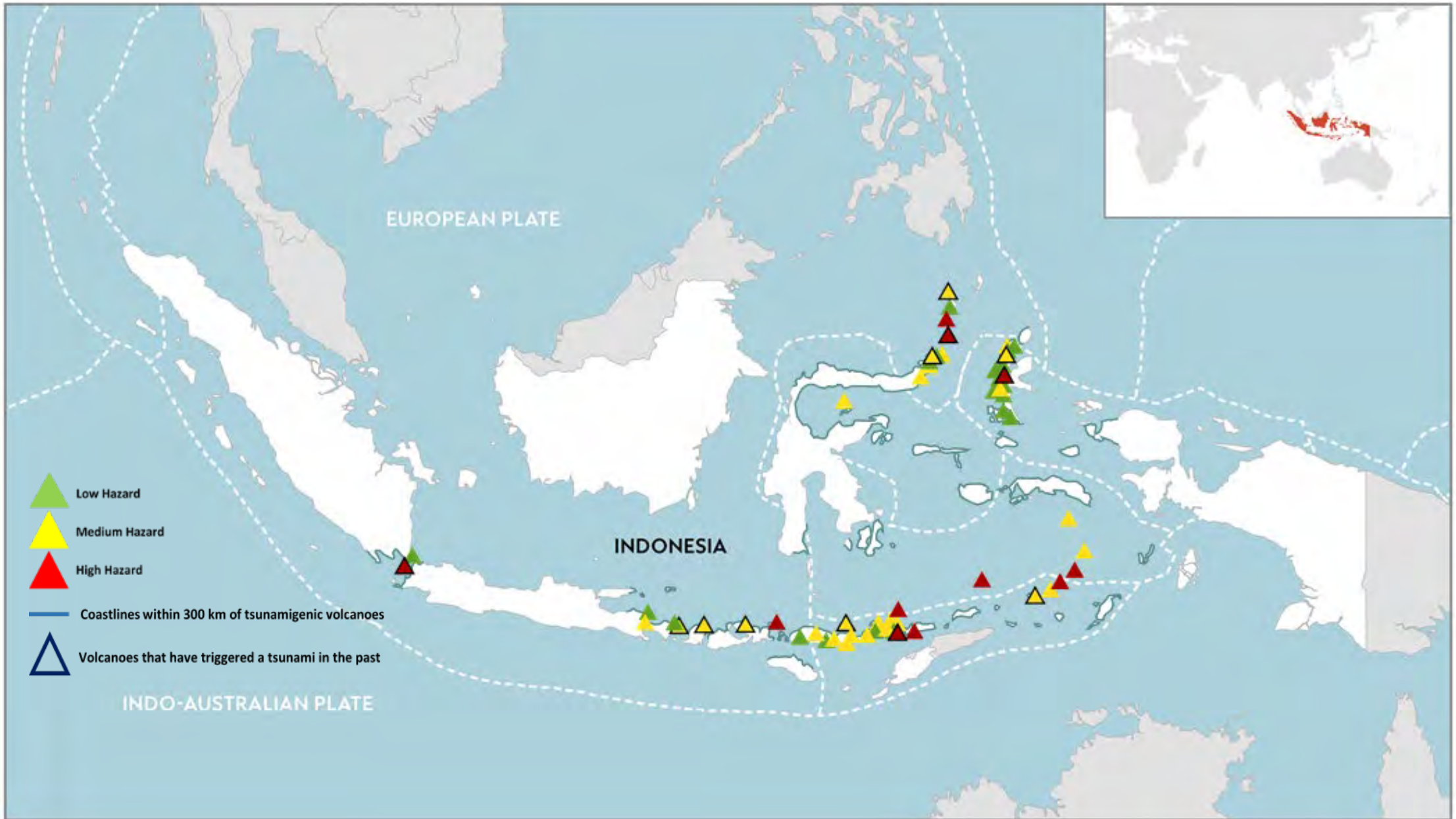
Point Value e.g. (0-100 or 1,2,3…)

Point Weight e.g. (10%)

All individual weights should add to 100%

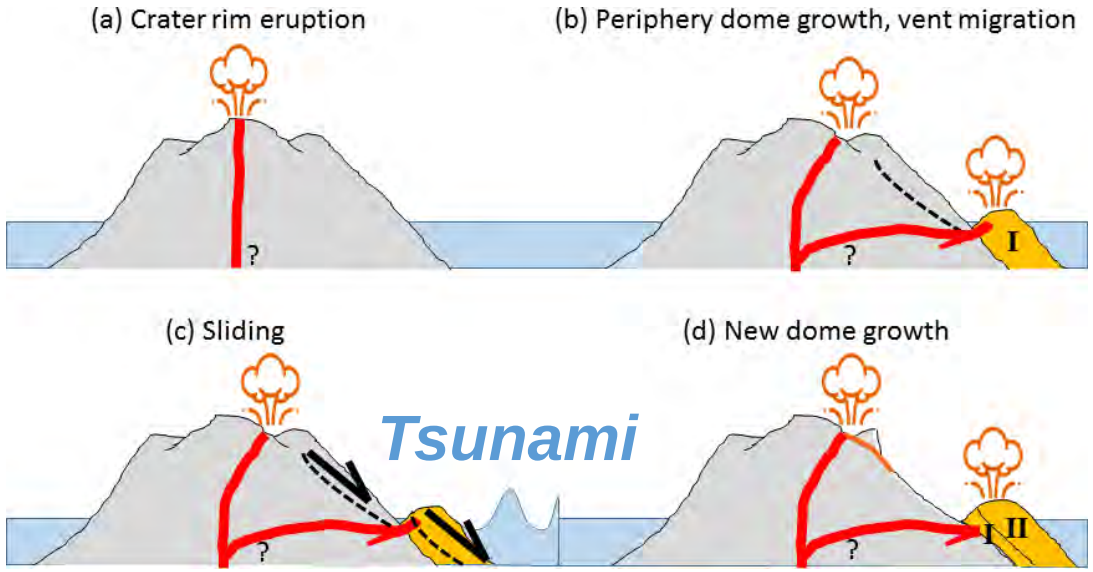
GFZ Helmholtz-Zentrum Potsdam DLR UNIVERSITAS GADJAH MADA

Zorn et al., (2022): https://doi.org/10.5194/egusphere-2022-130


EUROPEAN PLATE
INDONESIA
INDO-AUSTRALIAN PLATE
Low Hazard
Medium Hazard
High Hazard
Coastlines within 300 km of tsunamigenic volcanoes
Volcanoes that have triggered a tsunami in the past

Monitoring volcanoes with Remote Sensing

- **Preliminary work:**
  - Joint analysis of SAR, multispectral and thermal satellite data
  - Analysis of the growth and collapse of a littoral lava dome
  - Dome collapse caused a **tsunami**



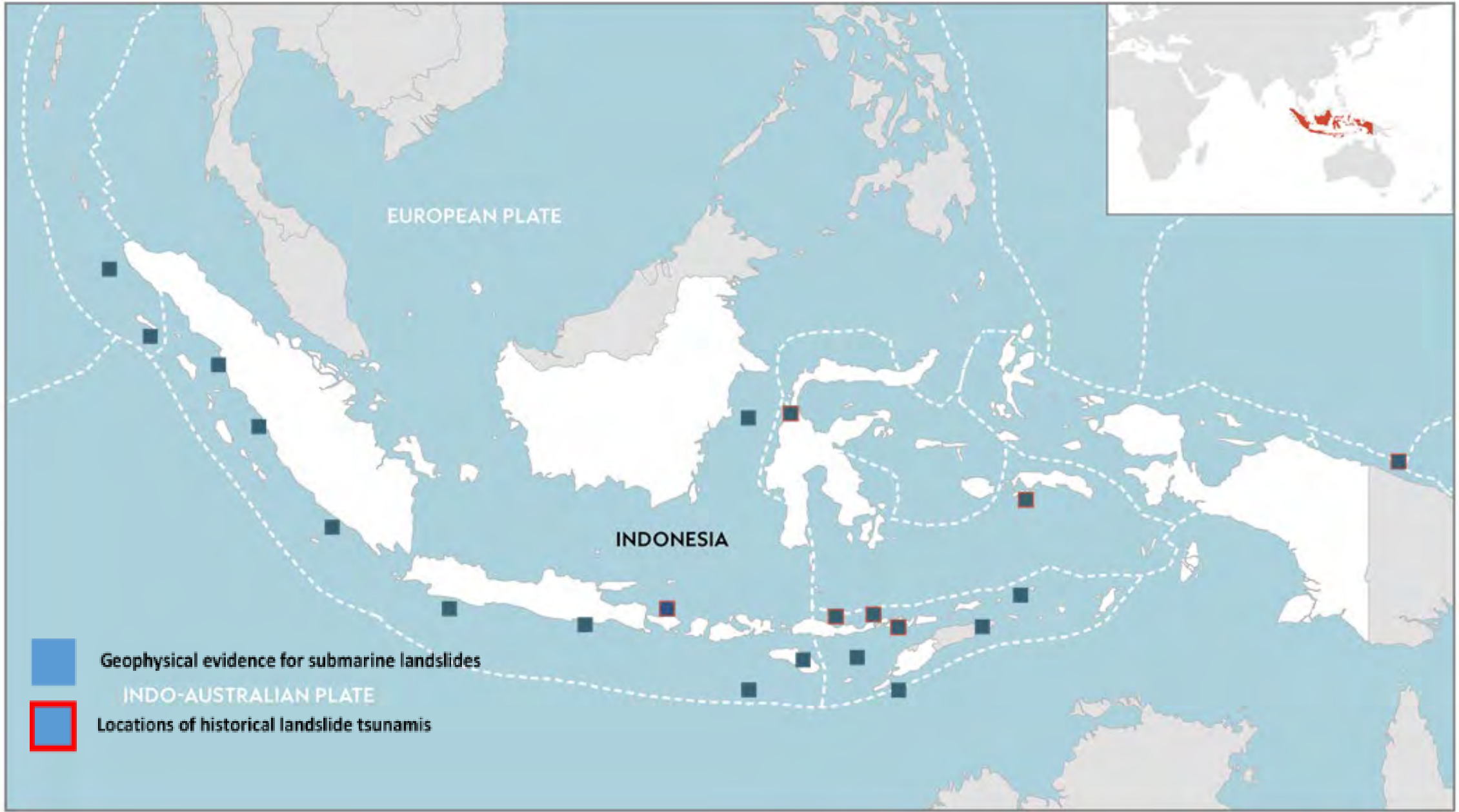
Contents lists available at ScienceDirect
Journal of Volcanology and Geothermal Research
journal homepage: www.elsevier.com/locate/jvolgeores

Growth and collapse of a littoral lava dome during the 2018/19 eruption of Kadovar Volcano, Papua New Guinea, analyzed by multi-sensor satellite imagery

Simon Plank[a,*], Thomas R. Walter[b], Sandro Martinis[a], Simone Cesca[b]

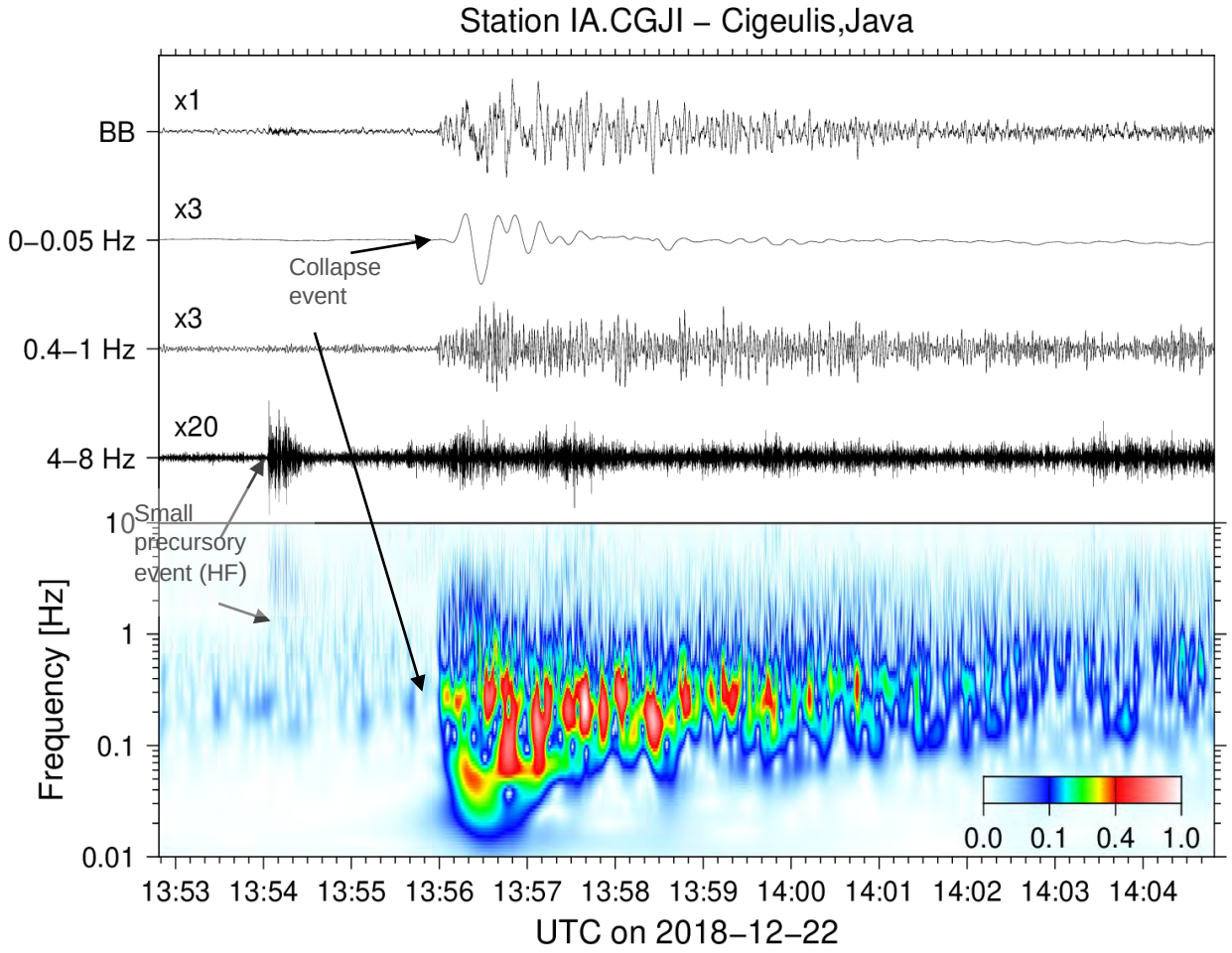
[a] German Aerospace Center (DLR), German Remote Sensing Data Center, D-82234 Oberpfaffenhofen, Germany
[b] GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany

Identification of Areas at Risk (Landslides)

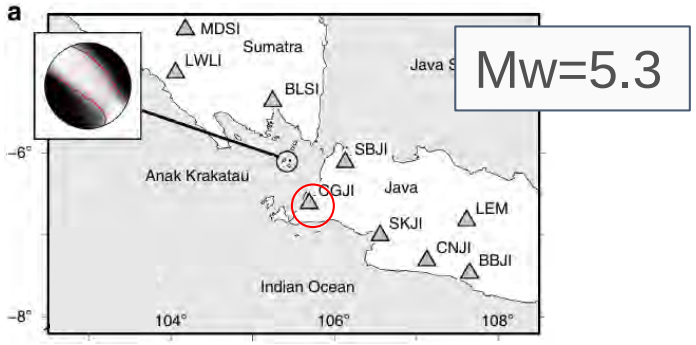


Seismic monitoring

Aim: Develop concepts for seismic early warning for volcanic collapse & landslide tsunami triggers



Walter et al. (2019, Nat Comm.)



Mw=5.3

- Collapse easily seismically detected on broad frequency range
- The challenges:
  - distinguish collapse events from tectonic earthquakes
  - provide fast location and source estimate
  - is existing network dense enough?

Monitoring strategy and Conclusions

Open points and questions:

- Need of regional or even local monitoring,
- Real-time monitoring of (submarine) landslides and volcanoes difficult (compared to earthquakes),
- Robust and cost-effective instruments not yet available,
- Implementation of new technologies desirable,
- Need to involve several different scientific agencies

Elements of a solution

- Establishment of a multi-hazard cadastre (basis for a tailored monitoring strategy)
- Risk analysis based on multi-hazard cadastre („risk-ranking“)
- Cable based solutions (OBS, Pressure sensors, DAS technologies)
- Development of a flexible monitoring strategy: basic monitoring below a given threshold (e.g. by satellite monitoring), densified monitoring by temporary deployed instruments above threshold