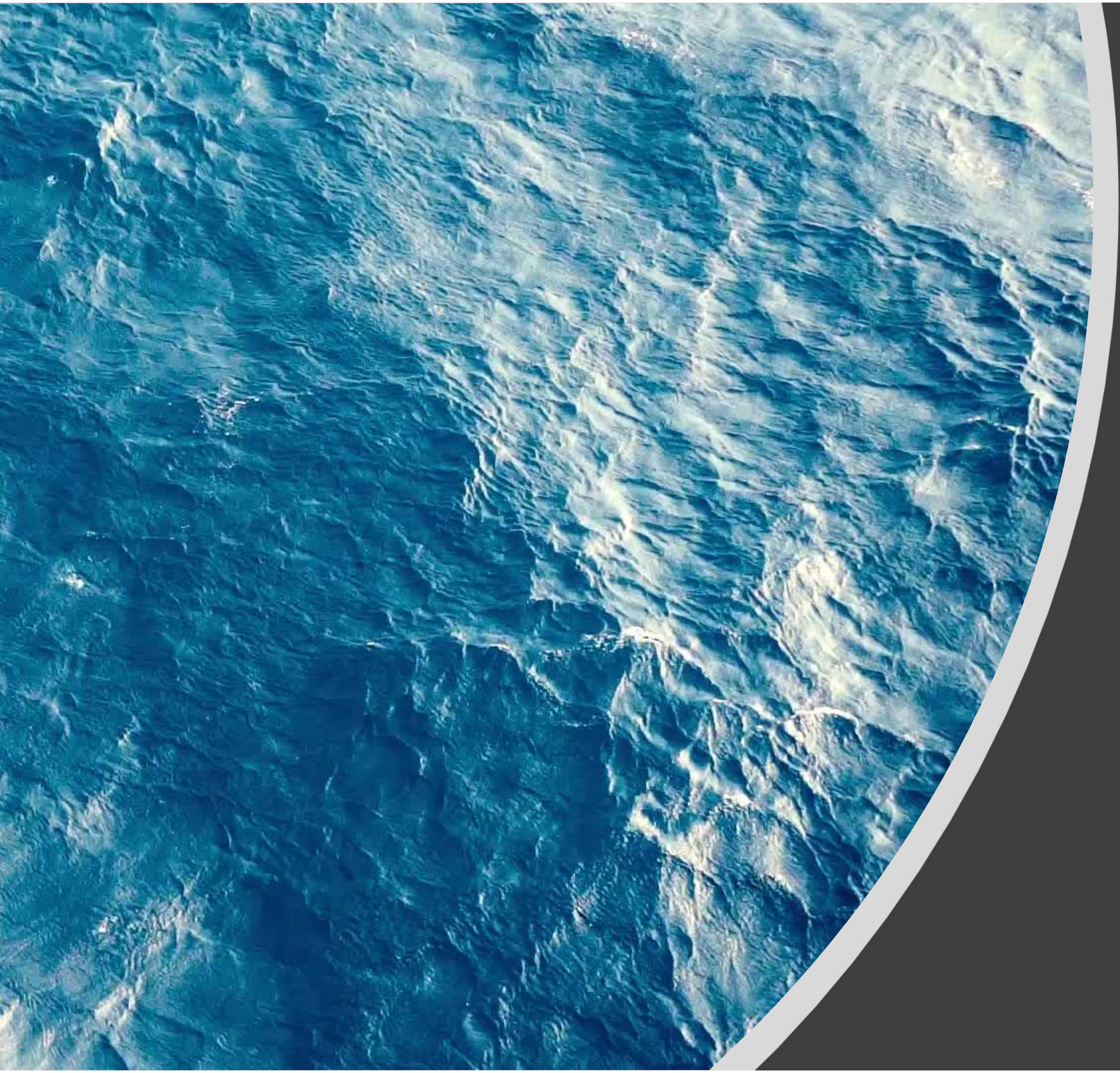

On the need for marine geospatial information for monitoring coastal hazards, sea level rise, or geomorphological processes.

Adam D Switzer

Earth Observatory of Singapore, Nanyang Technological University, Singapore

COASTAL HAZARDS

SINGAPORE

Sungei Buloh Wetland 2015

East Coast Park, 2016.

Tohoku Tsunami, Japan 2011

NHK Japan

Typhoon Haiyan, Philippines 2013

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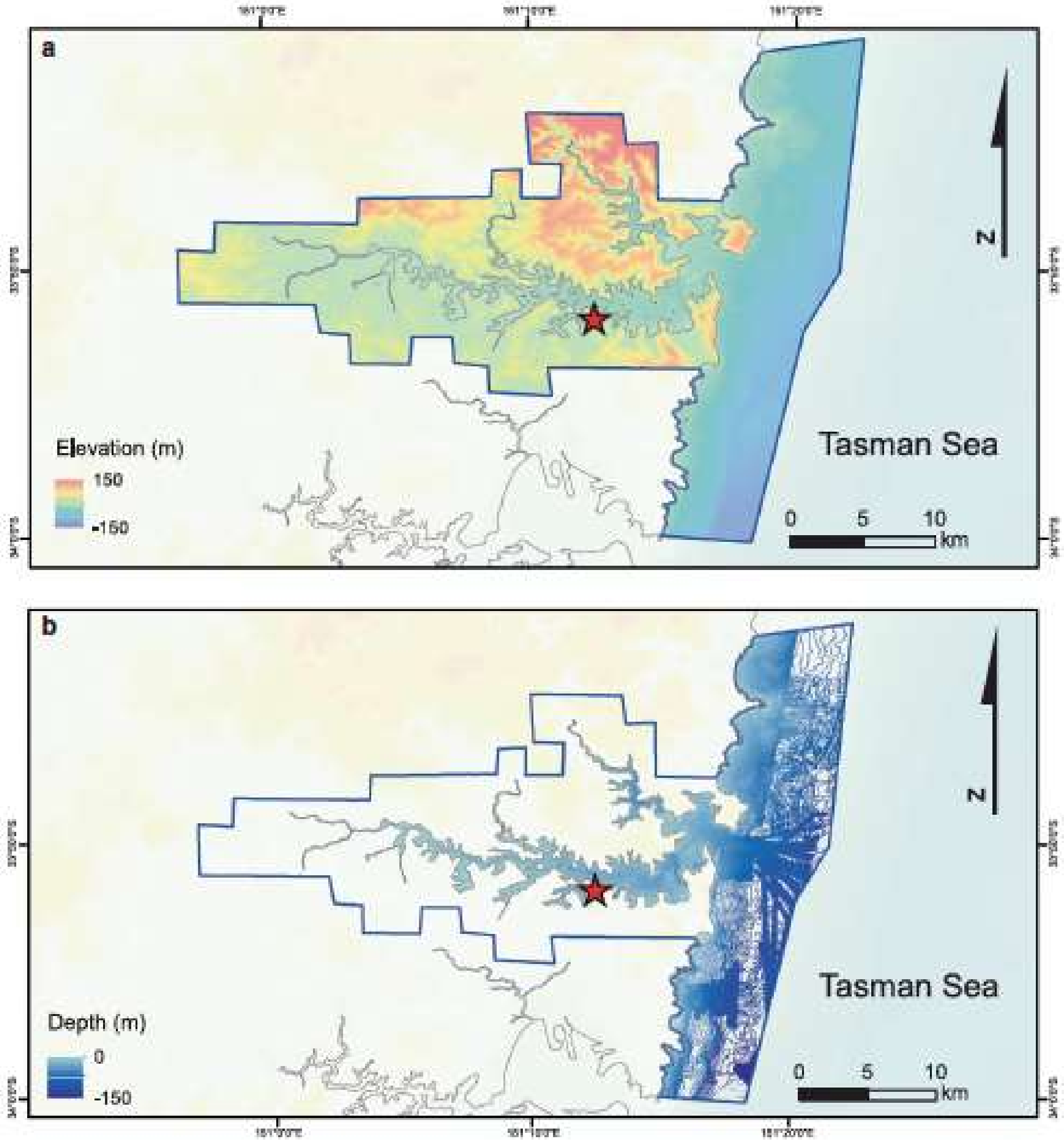
INTEGRATED DATASETS

The accurate assessment of coastal risk posed by hazards such as storms and tsunamis and the future impacts of rising sea levels requires:

- **The integration of high-resolution datasets of terrestrial, marine and cadastral datasets**
- **The sharing of data across political boundaries**
- **The testing of model sensitivity to changes in the environment**

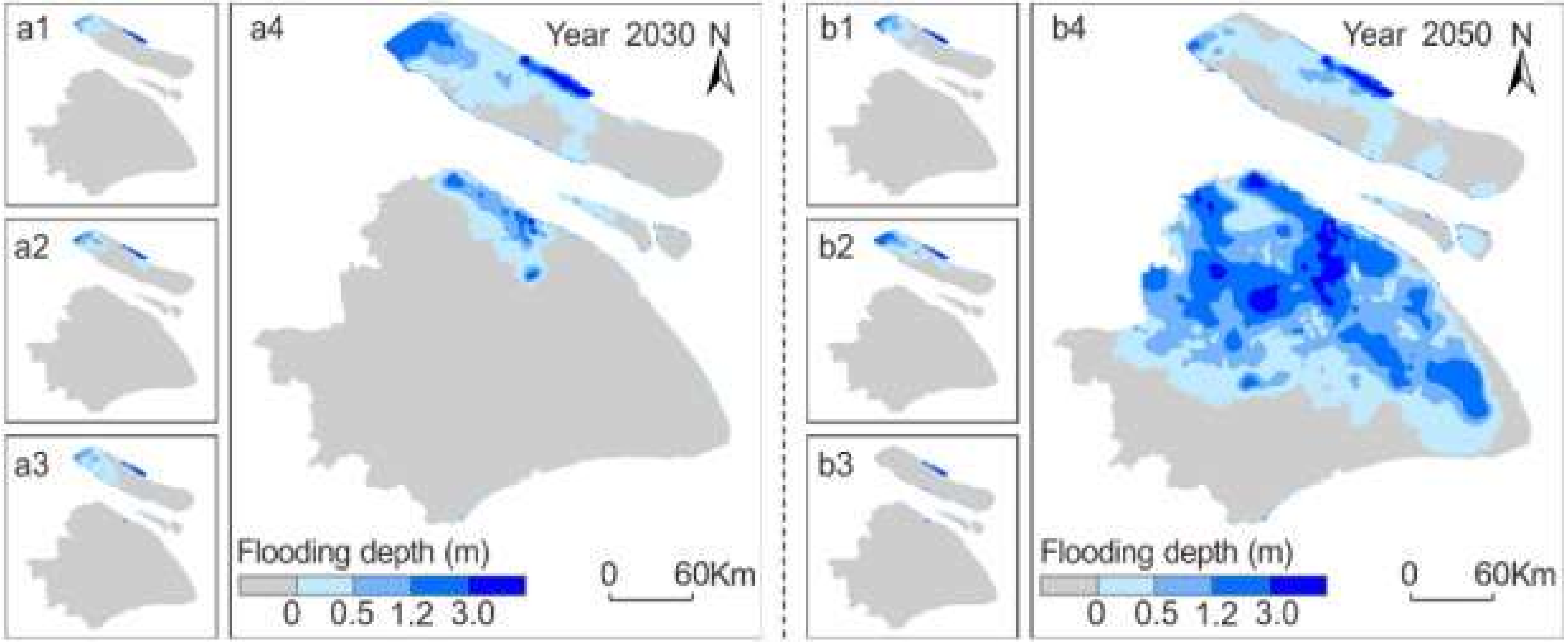


Wilson and Power, Scientific Data, 2018

MULTI-FACTOR ANALYSIS

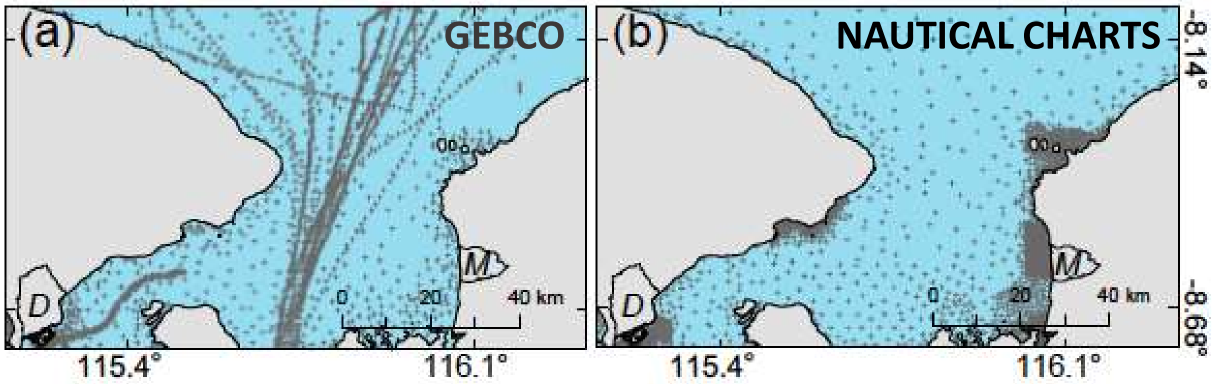
Estimated storm flooding in 2030 and 2050 for Shanghai, China.

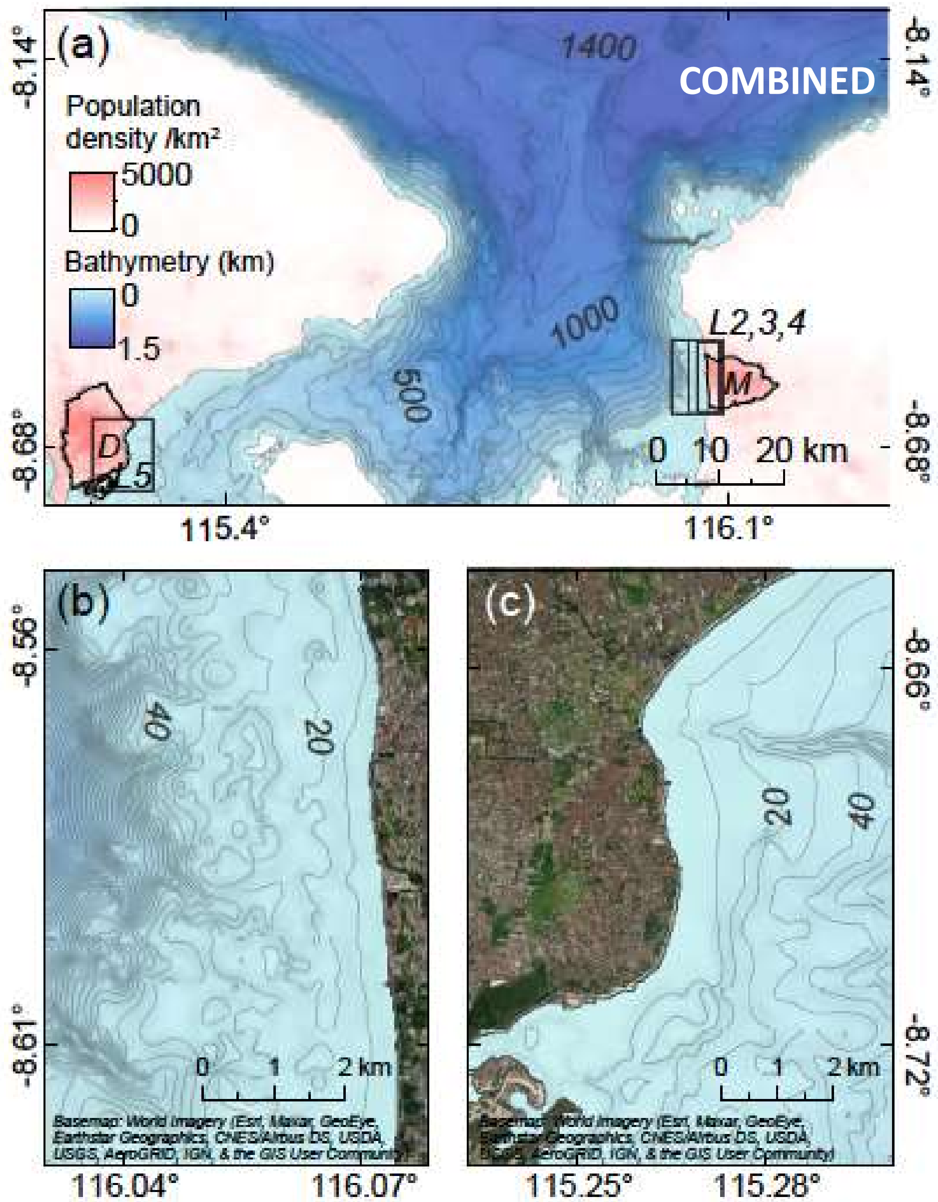
The flooding extent considers the individual effect of a1 sea level rise (a1/b1), land subsidence (a2/b2) and bathymetric change (a3/b3) respectively. Panels a4 and b4 present the compound scenario with 3 factors for 2030 and 2050.



Wang et al., Sci. Tot. Env. 2018

Southeast Asia





In southeast Asia much of the marine data is sparse both temporally and spatially.

Comparison of the point density of depth measurements from GEBCO and nautical charts.

Combining these data points identifies a north-south trending ridge with its base at 1.4 km water depth.

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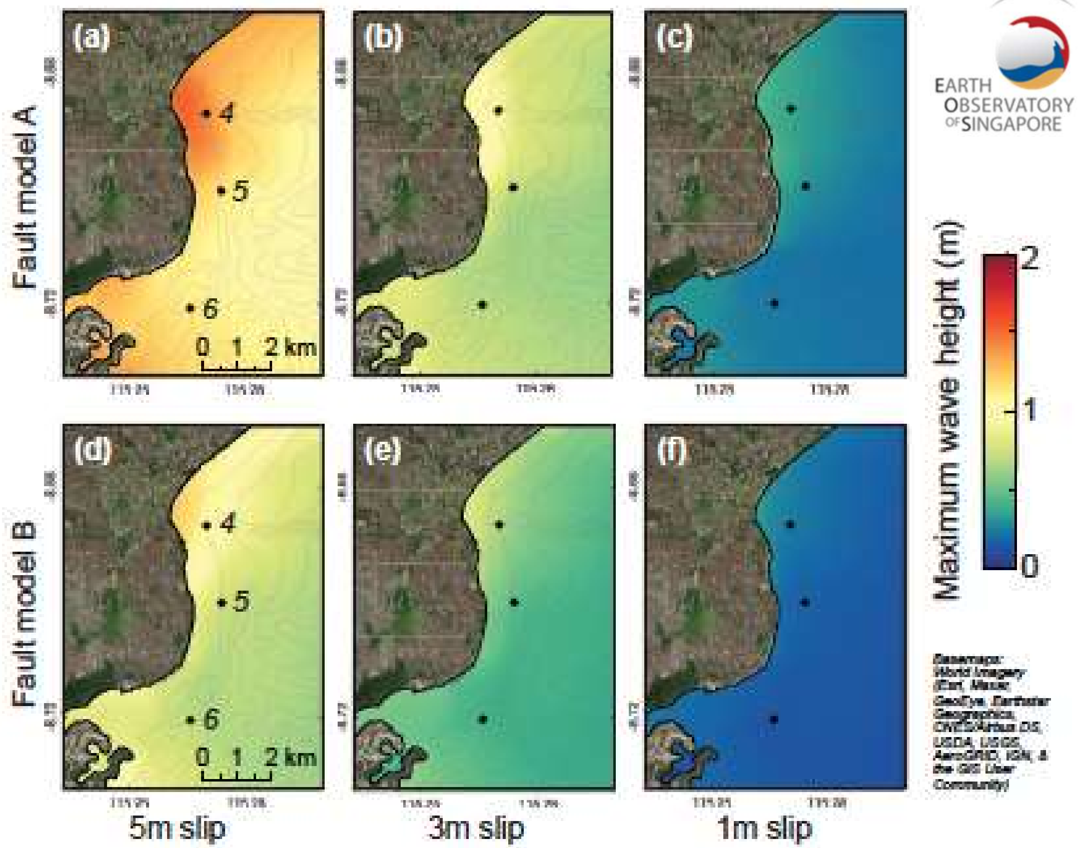
Felix et al., NHESS 2022

Tsunami hazard in Mataram, Lombok & Denpasar, Bali, Indonesia, from the Flores backarc

Southeast Asia



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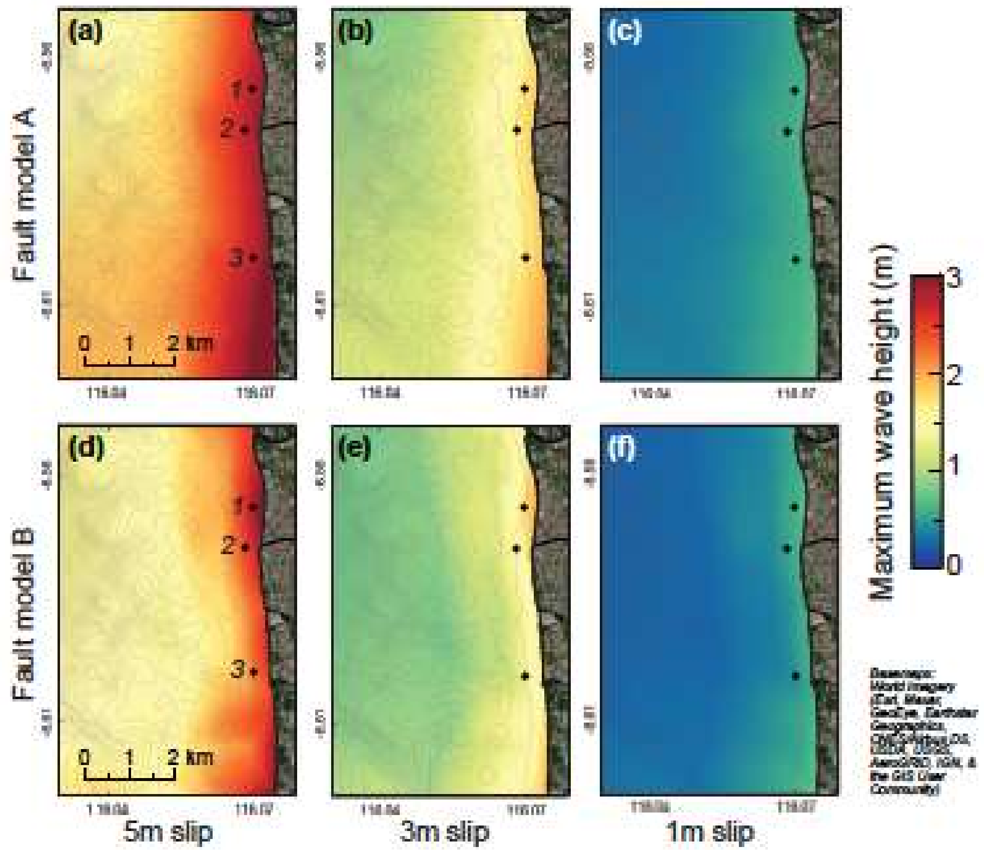

The first tsunami in Mataram arrives at <8 minutes, while in Denpasar it arrives at ~10-15 minutes. The peak of the first wave is at ~11 minutes and ~30 minutes in Mataram and Denpasar, respectively.

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Felix et al., NHESS 2022

Tsunami sensitivity to shallow bathymetry resolutions and optimising bathymetric inputs for tsunami simulations

Bathymetry

5m, 10m, 20m, 30m, 40, 50m, 100m, 200, 300m, 455m

(GEBCO)

TSUNAMI SIMULATION AND HAZARD ASSESSMENT FOR MEGATHRUST EARTHQUAKES ALONG THE COASTS OF THE SOLOMON ISLANDS

Supervisor: Bunichiro SHIBAZAKI[3], Yushiro FUJII[3]

Carlos Tatapu[1,2]

Probabilistic Near-Field Tsunami Source and Tsunami Run-up Distribution Inferred From Tsunami Run-up Records in Northern Chile

Tsunami scenario for Anyer and Cilegon

AIP Conference Proceedings 1987, 020020 (2018); https://doi.org/10.1063/1.5047305

Sugeng Pribadi[1,a)], Nanang T. Puspito[2], Muhamad Mahfud[1], and Akbar Ryan Setyahagi[3]

MODELING OF TSUNAMI WAVE ARRIVAL IN COASTAL AREAS OF WEST SULAWESI PROVINCE

Erwan Susanto (1*), Muhammad Arsyad (2), Subaer Subaer (3), Akbar Rian Setyahagi (4),

(1) Gowa Geophysical Station (BMKG)
(2) Makassar State University
(3) Makassar State University
(4) Nganjuk Geophysics Station (BMKG)
(*) Corresponding Author

Tsunami simulation in Puger Beach considering the combination of earthquake source in South Java

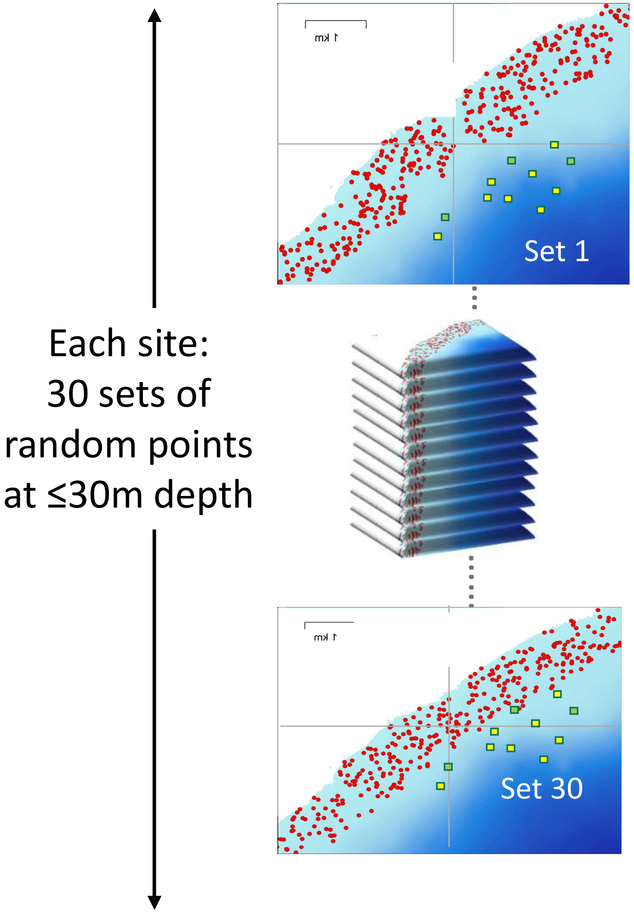
AIP Conference Proceedings 2278, 020037 (2020); https://doi.org/10.1063/5.0014684

Raden Denisio Edwin Rikarda[1,a)], Retno Utami Agung Wiyono[2,b)], Gusfan Halik[2], Entin Hidayah[2], and Munawir Bintang Pratama[3]

Recent studies that only use GEBCO bathymetry

Because of its coarse resolution, the tsunami hazard could be underestimated?

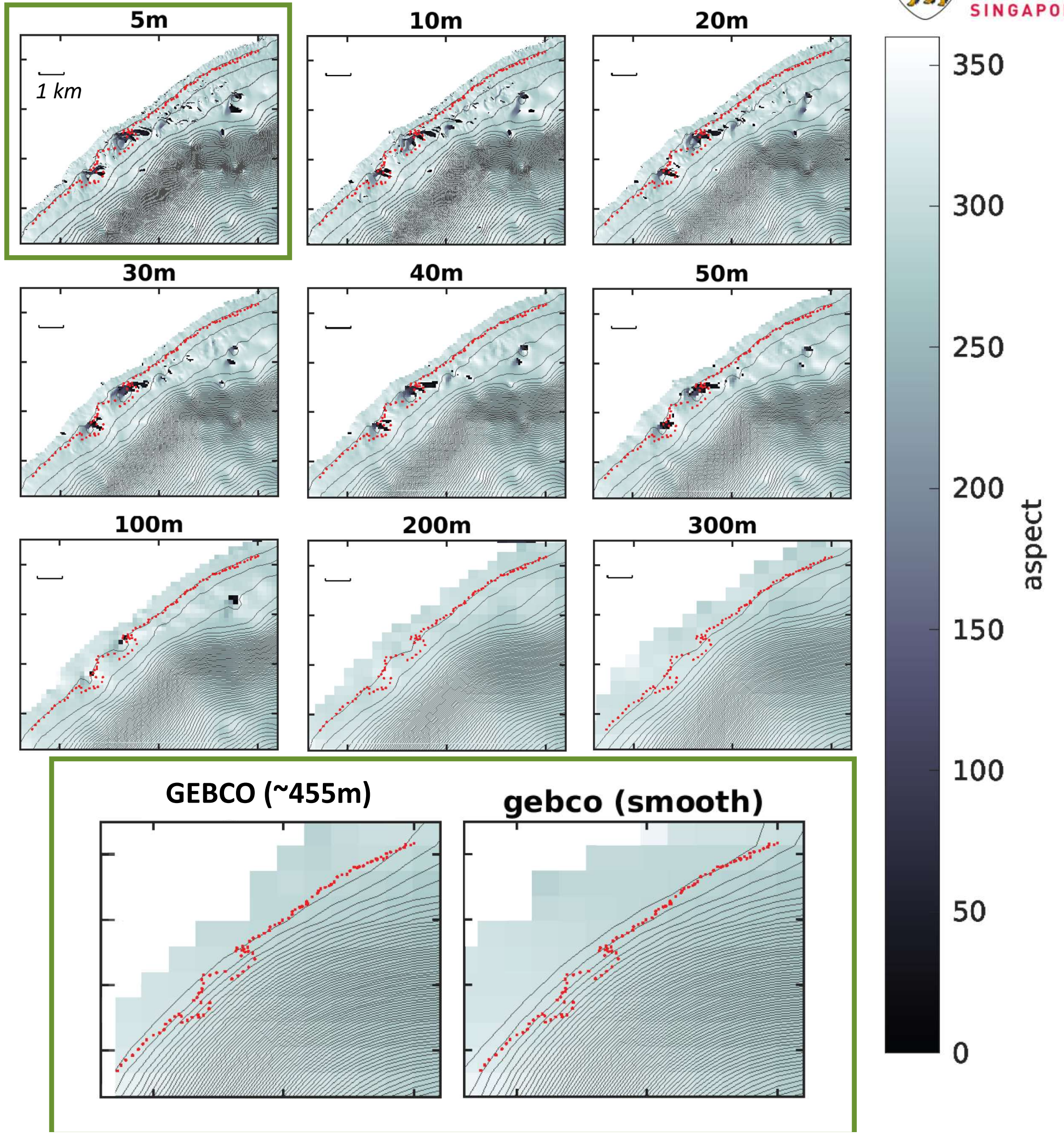
BATHYMETRY



Based on 1m NOAA Lidar data

Felix et al., *unpublished*

For each set of random points



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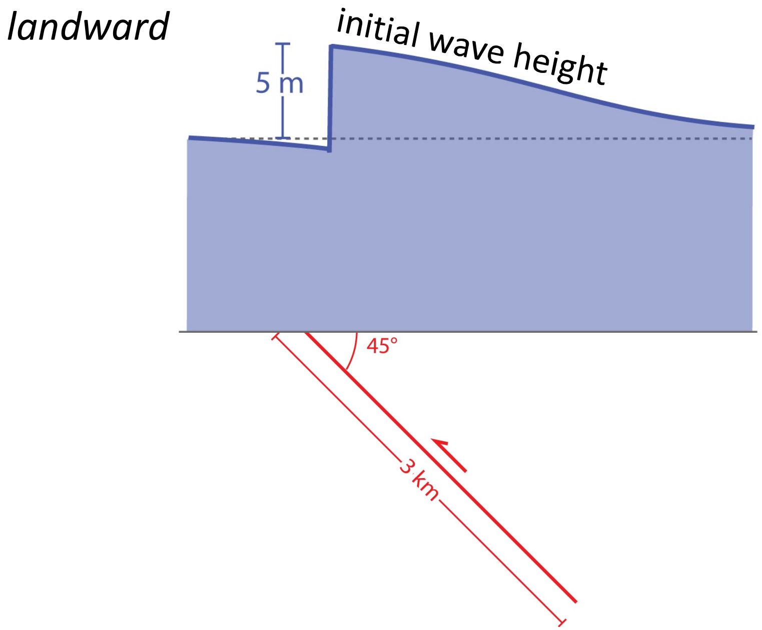
Baseline reference: **5m bathymetry**

Best representation of the real-life seafloor morphology.

Tsunami results using all the models will be compared relative to the 5m bathymetry.

TSUNAMI MODELING

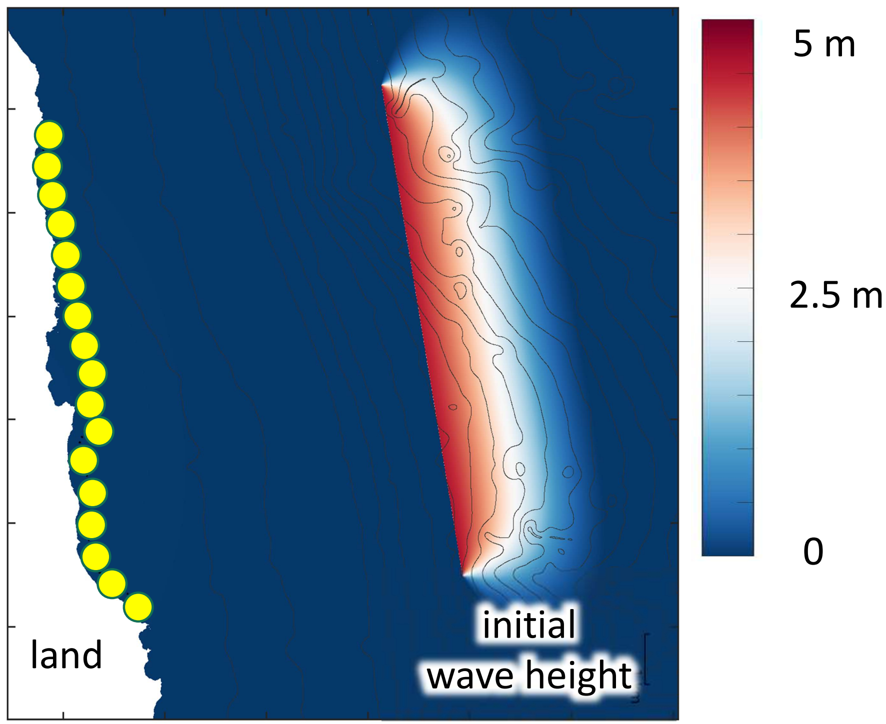
Tsunami at the source has 5m height



final tsunami — final water depth

$$\frac{n}{n_0} = \frac{h}{h_0}^{-1/4}$$

initial tsunami — initial depth



Basic tsunami model to generate 5m tsunami

100 gauges at 10m water depth to record the arrival time & the maximum wave heights

Felix et al., *unpublished*

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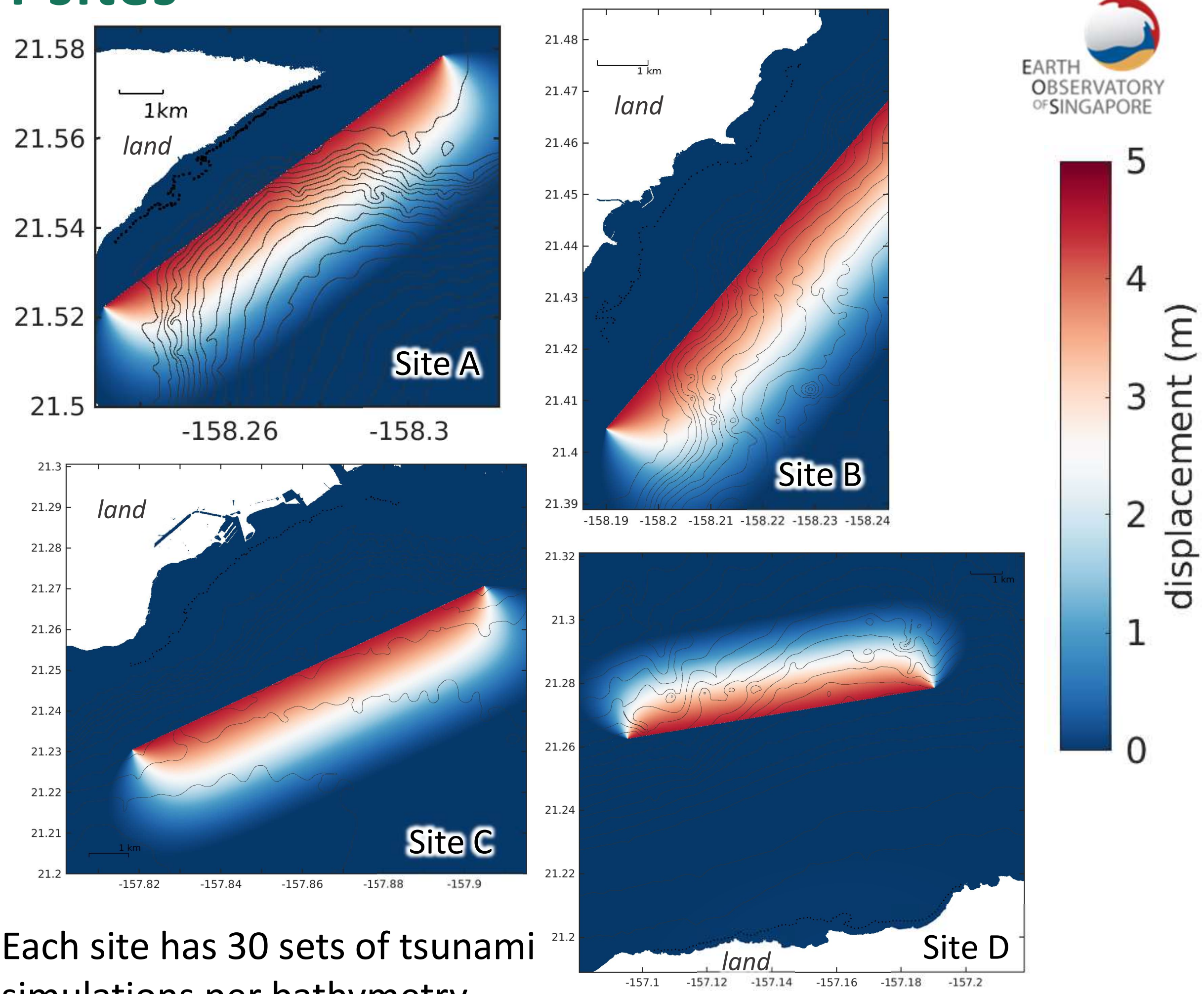
TSUNAMI MODELING

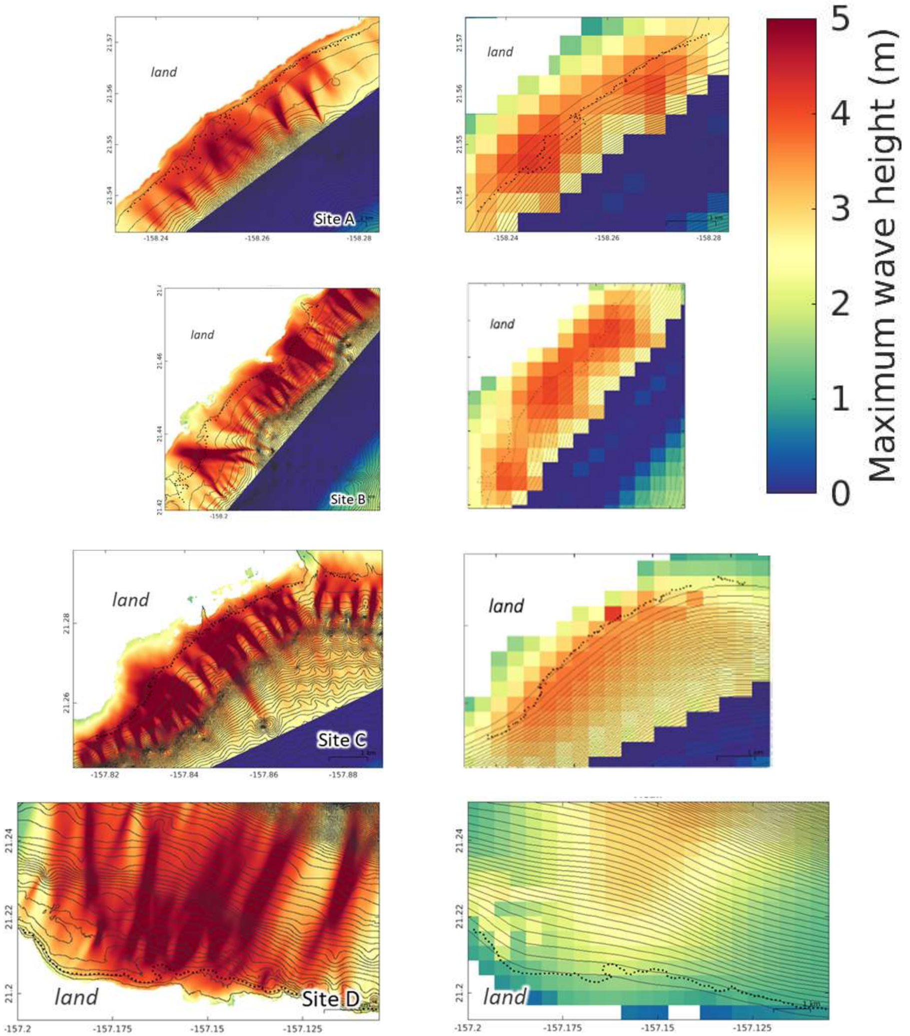
Tsunami height is much lower in GEBCO

4 sites



Each site has 30 sets of tsunami simulations per bathymetry resolution + 2 GEBCO datasets

Felix et al., *unpublished*



5m bathymetry

GEBCO (~455m)

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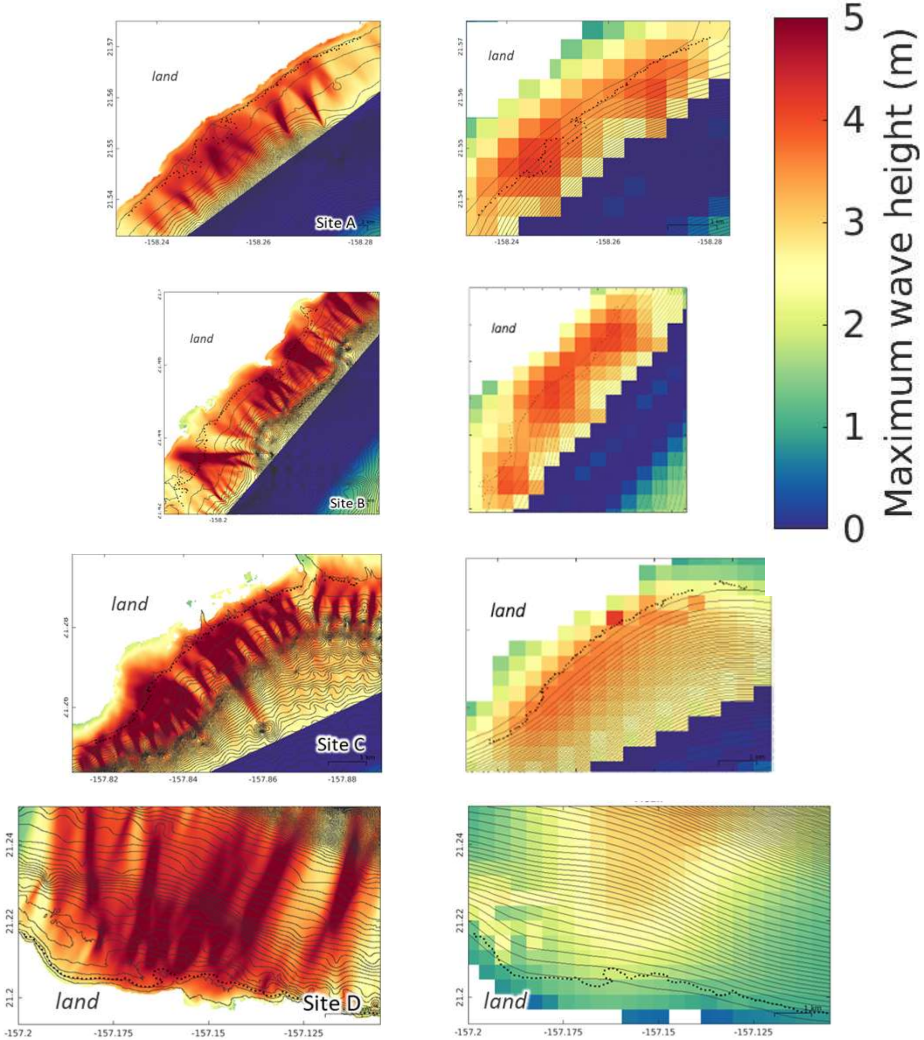
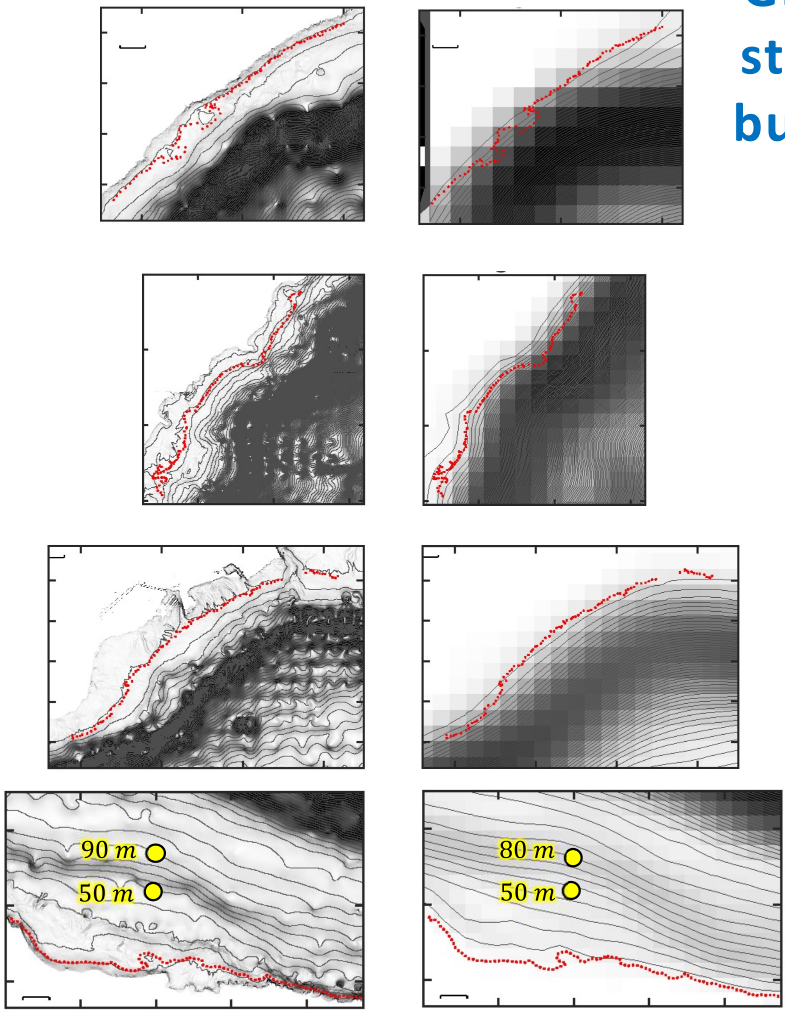
Tsunami height is lower in GEBCO



5m bathymetry   GEBCO (~455m)



$$n = n_0 \times \sqrt[4]{\frac{90\,m}{50\,m}} = \mathbf{1.16}\boldsymbol{n_0}$$

$$n = n_0 \times \sqrt[4]{\frac{80\,m}{50\,m}} = \mathbf{1.12}\boldsymbol{n_0}$$

GEBCO: Absence of steep slopes, lower buildup of tsunamis

initial height

initial depth

$$n = n_0 \times \sqrt[4]{\frac{h_0}{h}}$$

final depth

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$$\frac{n}{n_0} = \frac{h}{h_0}^{-1/4}$$

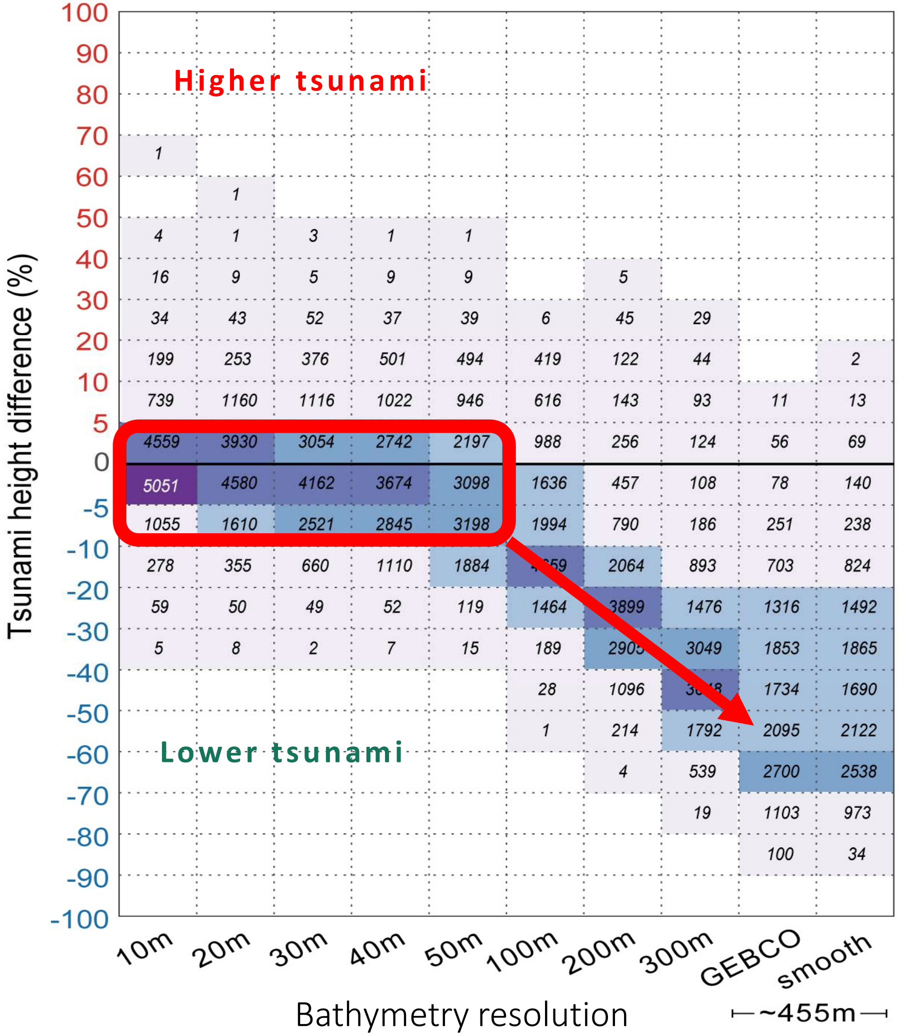
GEBCO tsunami height amplification is 0.04 lower than the 5m bathymetry

Felix et al., *unpublished*

What are the differences in the tsunami height and arrival time?

all comparisons are relative to the results of the 5m bathymetry

Lower tsunami height (20-70%)

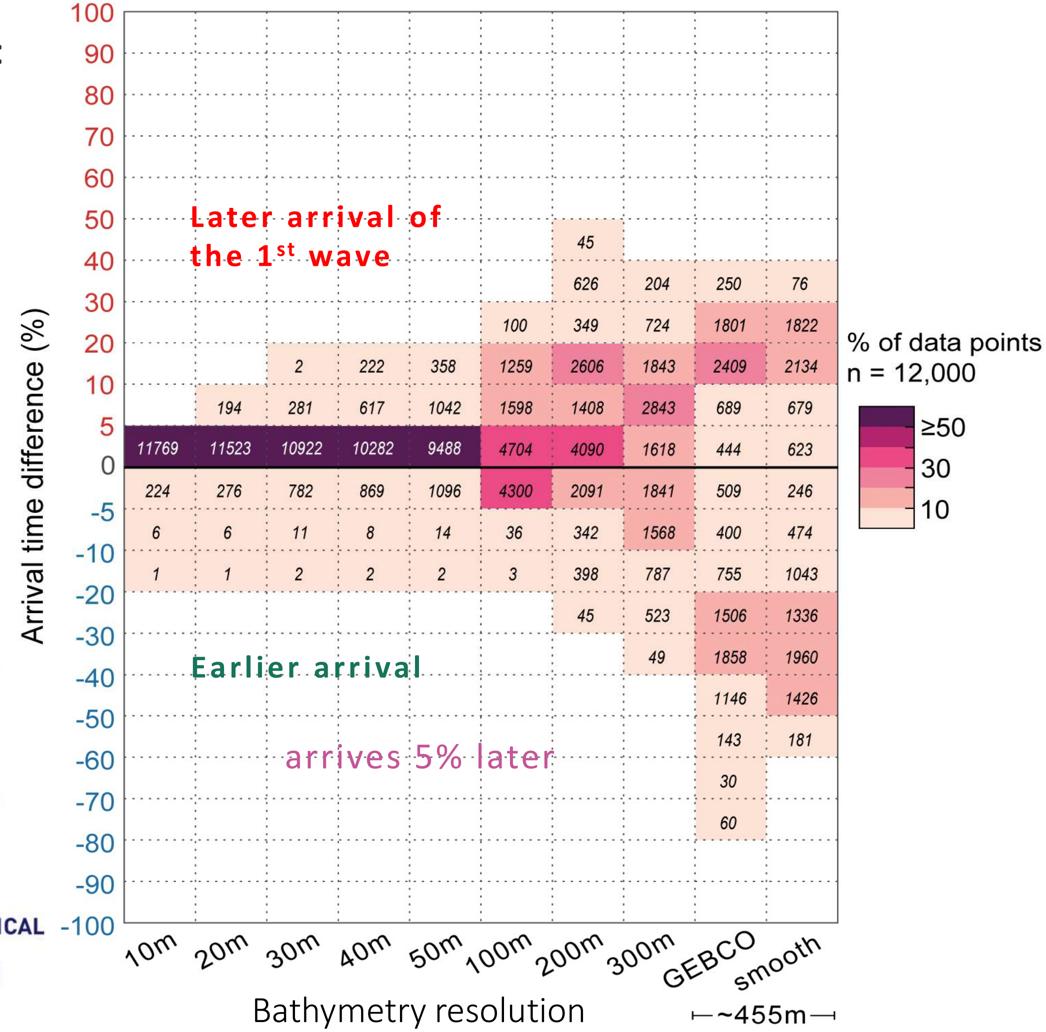


Each column: 100 gauge records x30 models x4 sites)

% of data points n = 12,000

≥50
30
0

Arrival time 20-40% earlier, or 10-30% later



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INTEGRATED DATASETS

The need for integration of high-resolution datasets of terrestrial, marine and cadastral datasets has never been greater.

- **In southeast Asia it is essential to future sustainable development.**
- **A deep understanding of the sensitivity of modelling to issues such as bathymetry and coastal roughness are important.**
- **Efforts such as the UN-NGGIM are vital to the future of coastal communities.**

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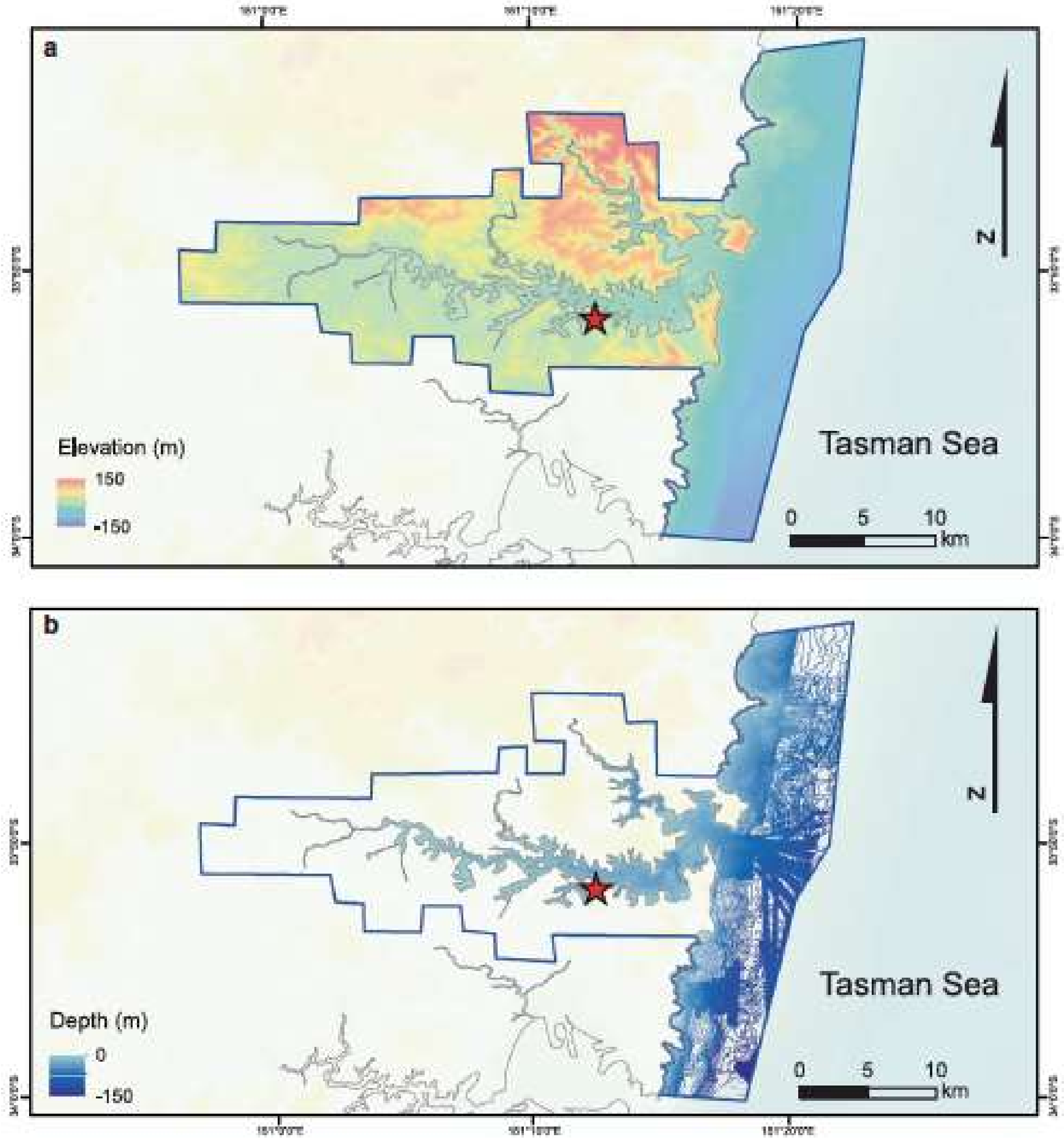
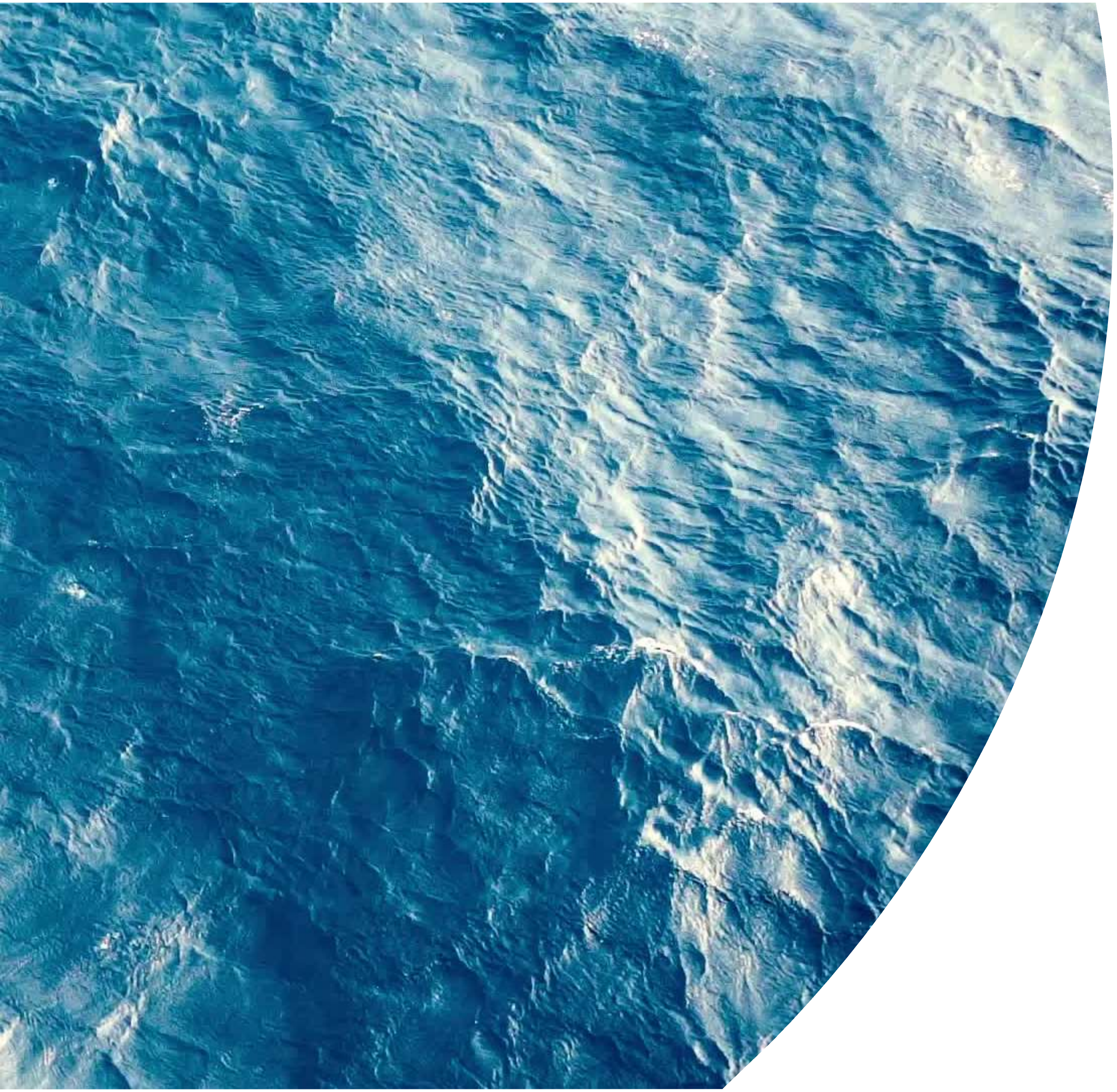


Wilson and Power, Scientific Data, 2018



As our climate changes and our coastal communities grow, we must do everything we can to share data and knowledge to move towards greater coastal sustainability.

Adam D Switzer

Earth Observatory of Singapore, Nanyang Technological University, Singapore

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