

# The Integral Tsunami?

Towards an integrated approach to tsunami risk assessment

## Acknowledgements

Vassar College

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L. Kong- UNESCO

International Union for the Conservation of Nature (IUCN)

Oxfam America

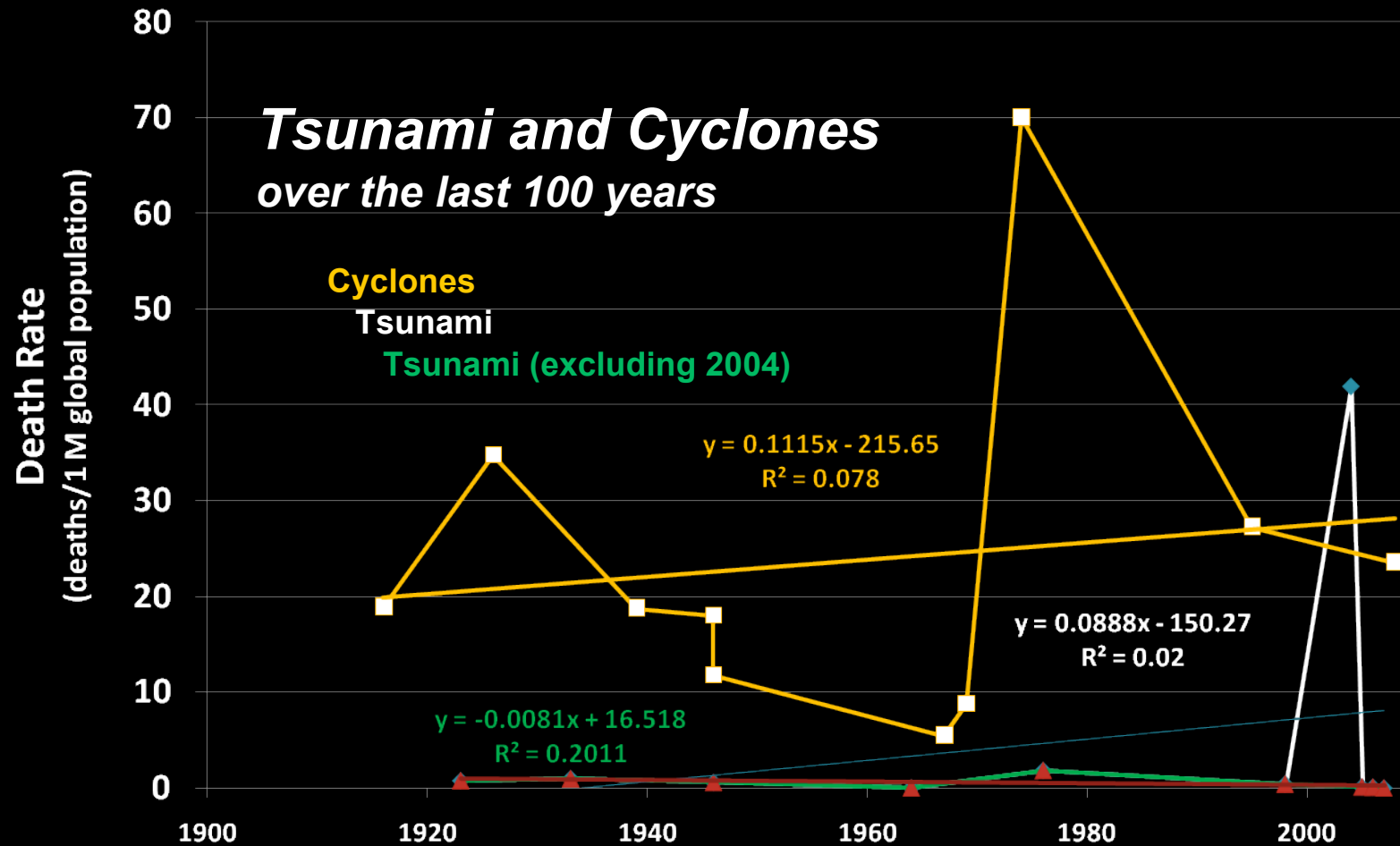
**Brian G. McAdoo**

Vassar College

*presently at* Stanford University

School of Earth Sciences

Woods Institute for the Environment



- The ten worst cyclones in the last 100 years killed almost 1,000,000 people or ~10,000 people on average per year
- Tsunami in the last 100 years killed almost 250,000 people (20,000 before 2004) or 2,500 (200) people per year
- The rate of cyclone deaths is outpacing global population growth rate
- The rate of tsunami deaths is also rising faster than global population
- Tsunami deaths are declining if 2004 is excluded- but is that reasonable?





# Post-Tsunami Survey Protocols

- pre-2004- mostly CEE and tsunami modelers
- post-2004- Geosciences
- Need for coastal ecologists
  - Mangroves/coral reef as buffers?
  - Salt marsh (Hurricane Katrina)?
  - Ecosystem services
- Economic geographers, planners, policy analysts, anthropologists, and ...?





**24 December 2004**  
M<sub>w</sub> = 9.2  
avg. runup 10-15 m  
max runup > 30 m

Gleebruk Village  
Nanggroe Aceh Darussalam  
Indonesia



natural disasters

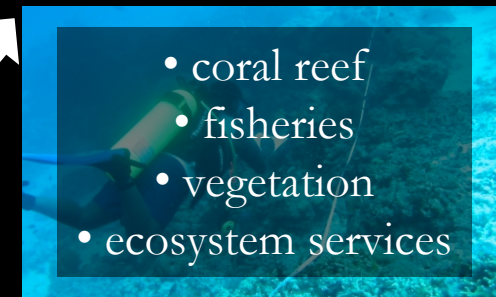
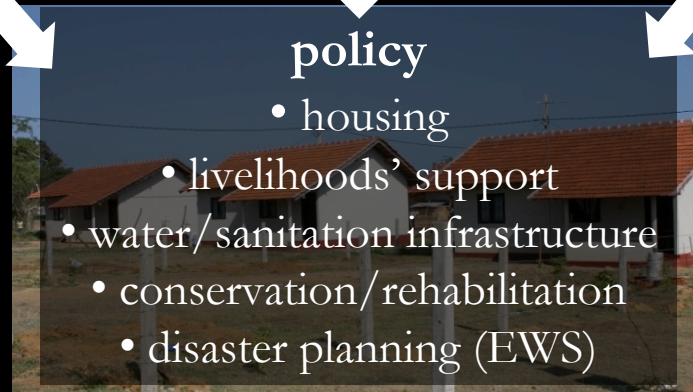
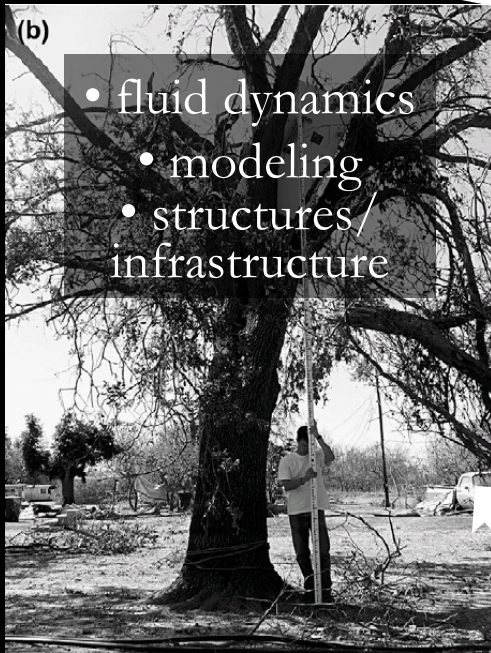


**risk = hazard x vulnerability**

**or**      natural *hazards*

**risk = hazard / resilience**

# Engineering ↔ Social Science ↔ Natural Science



## Post-Disaster Surveys







flow depth (d)

$$V = \sqrt{g d}$$

2 April 2007  
M<sub>w</sub> = 8.1  
avg. runup 6 m  
max runup ~ 12 m

Titiana  
Ghizo Island  
Solomon Islands





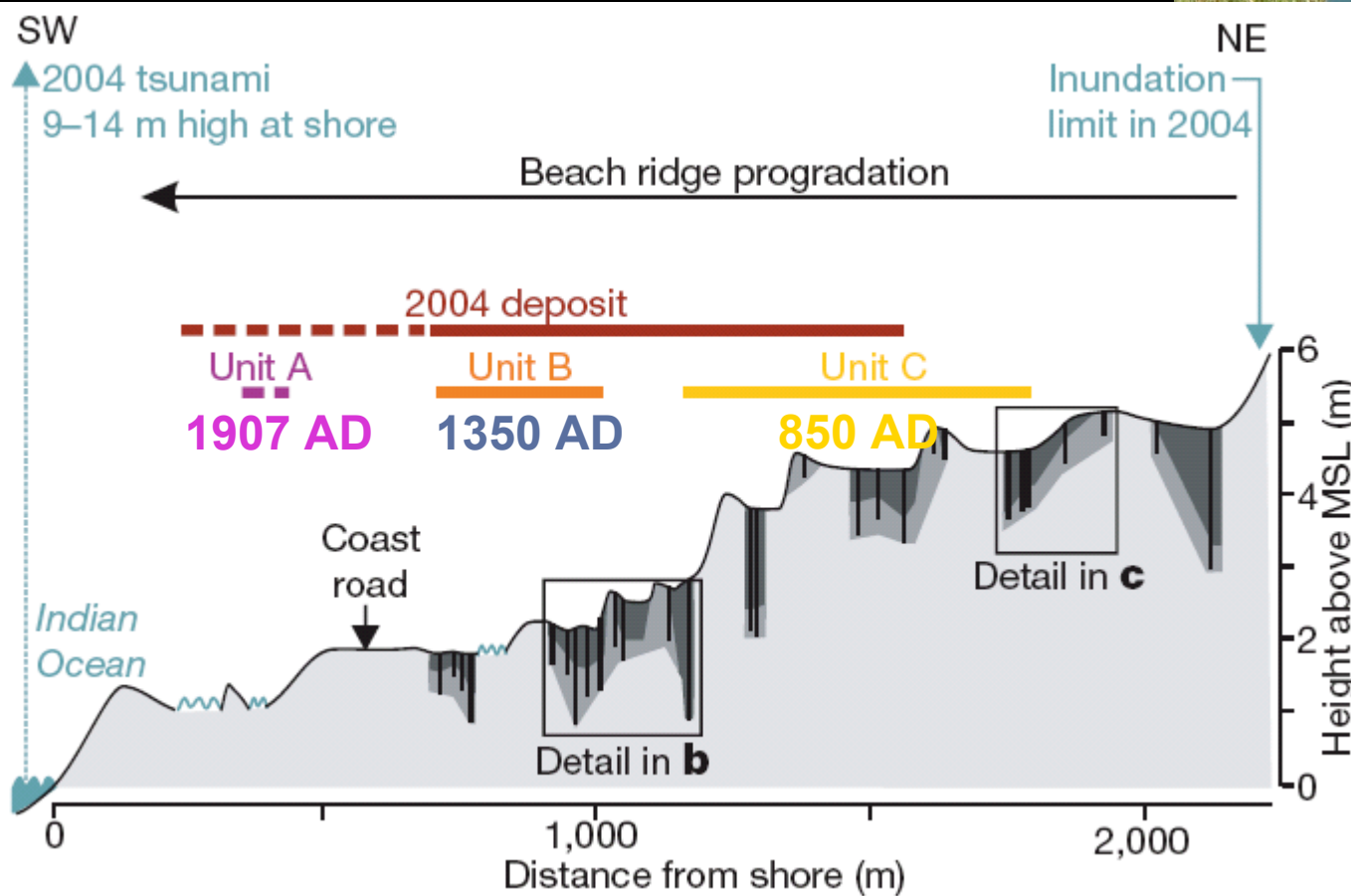
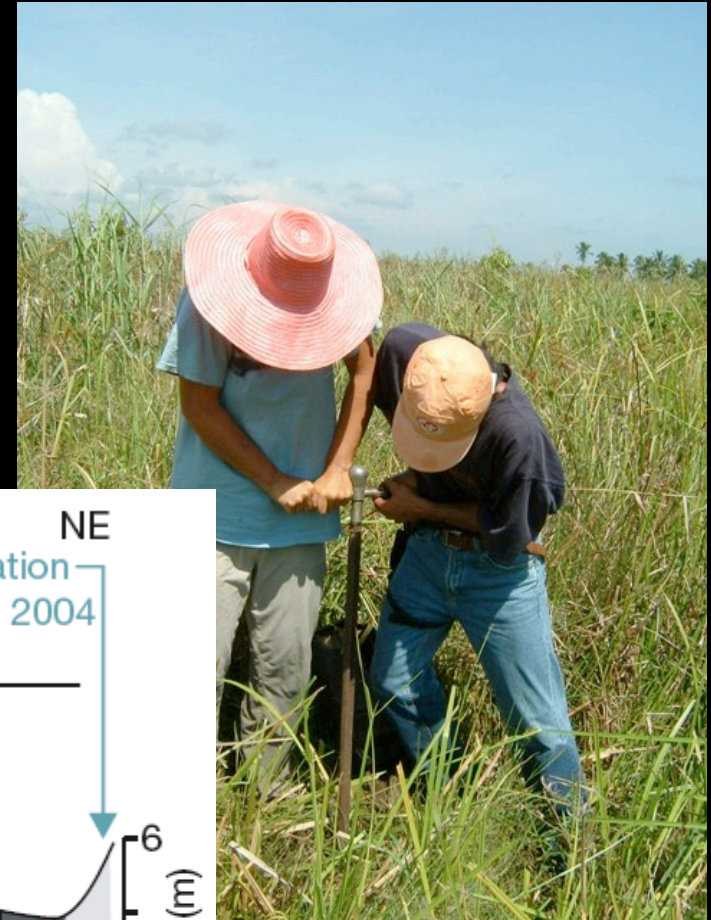
**Pailongge**  
Ghizo Island  
Solomon Islands



# LETTERS

## A 1,000-year sediment record of tsunami recurrence in northern Sumatra

Katrin Monecke<sup>1</sup>†, Willi Finger<sup>2</sup>, David Klarer<sup>3</sup>, Widjo Kongko<sup>4</sup>†, Brian G. McAdoo<sup>5</sup>, Andrew L. Moore<sup>6</sup> & Sam U. Sudrajat<sup>7</sup>



**ULULAJU BEACH, BUSUNG – SIMEULUE**



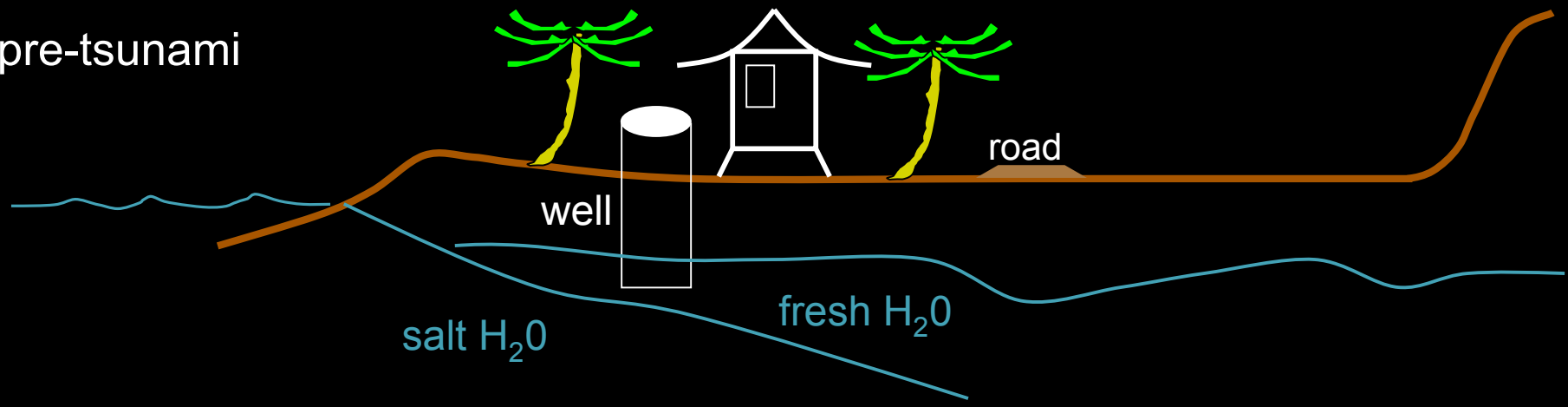
**BEFORE MARCH 28**



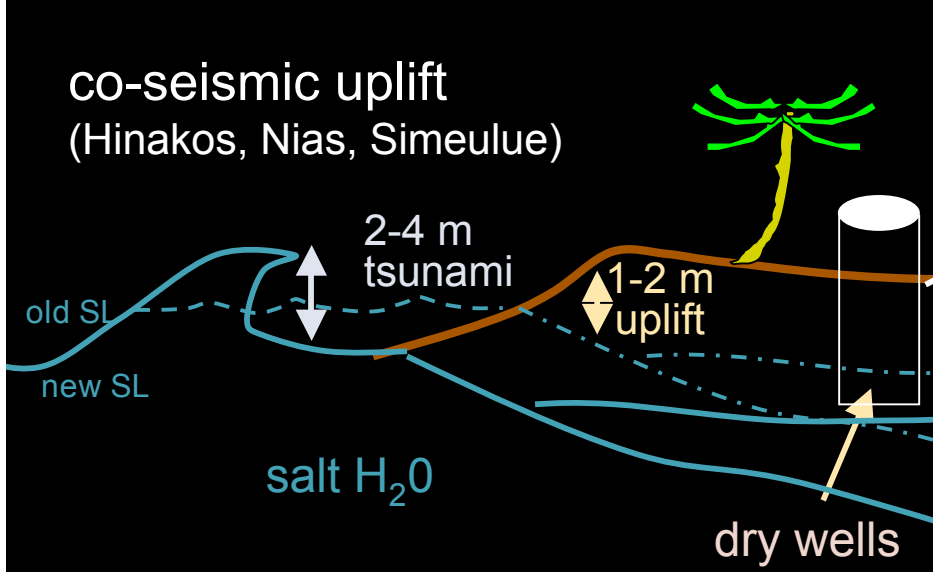
**AFTER MARCH 28**



pre-tsunami



co-seismic uplift  
(Hinakos, Nias, Simeulue)



flow depth  
decreased by 1-2 m



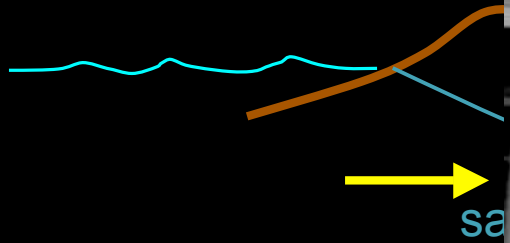




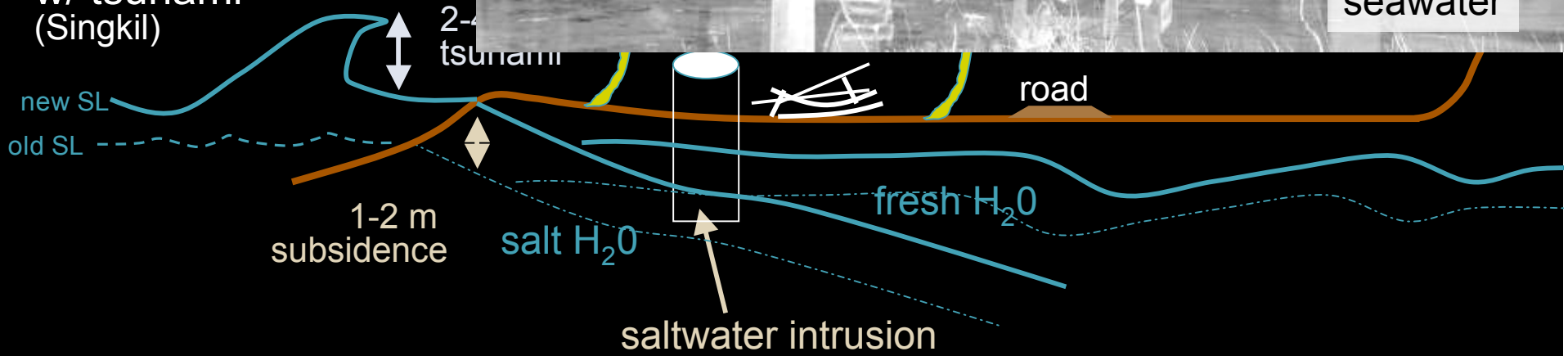
Ranongga  
Solomon Islands



pre-tsunami



co-seismic subsidence w/ tsunami (Singkil)



seawater

flow depth *increased* by 1-2 m

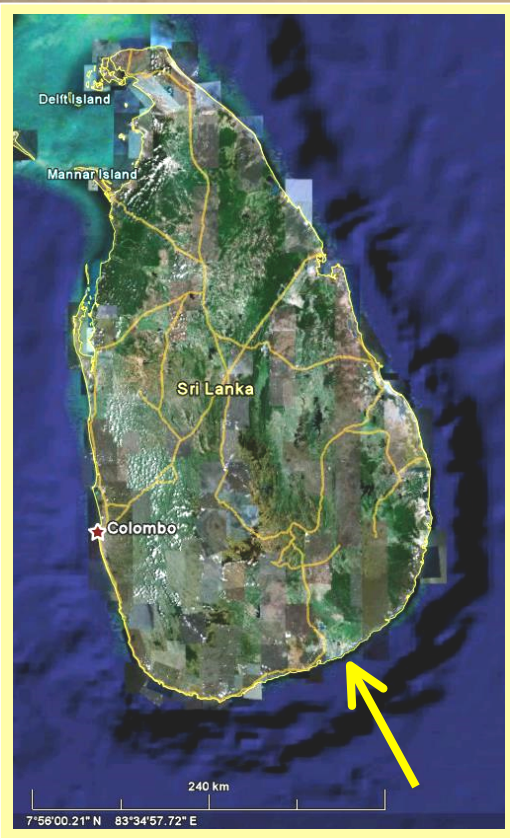






**Yala National Park  
Sri Lanka**

**Yala Village**  
5 cm in resort



**Yala Safari**  
7 m in resort  
*27 dead*





Solomon Islands  
2 April 2007  
Magnitude 8.1





Solomon Islands  
2 April 2007  
Magnitude 8.1

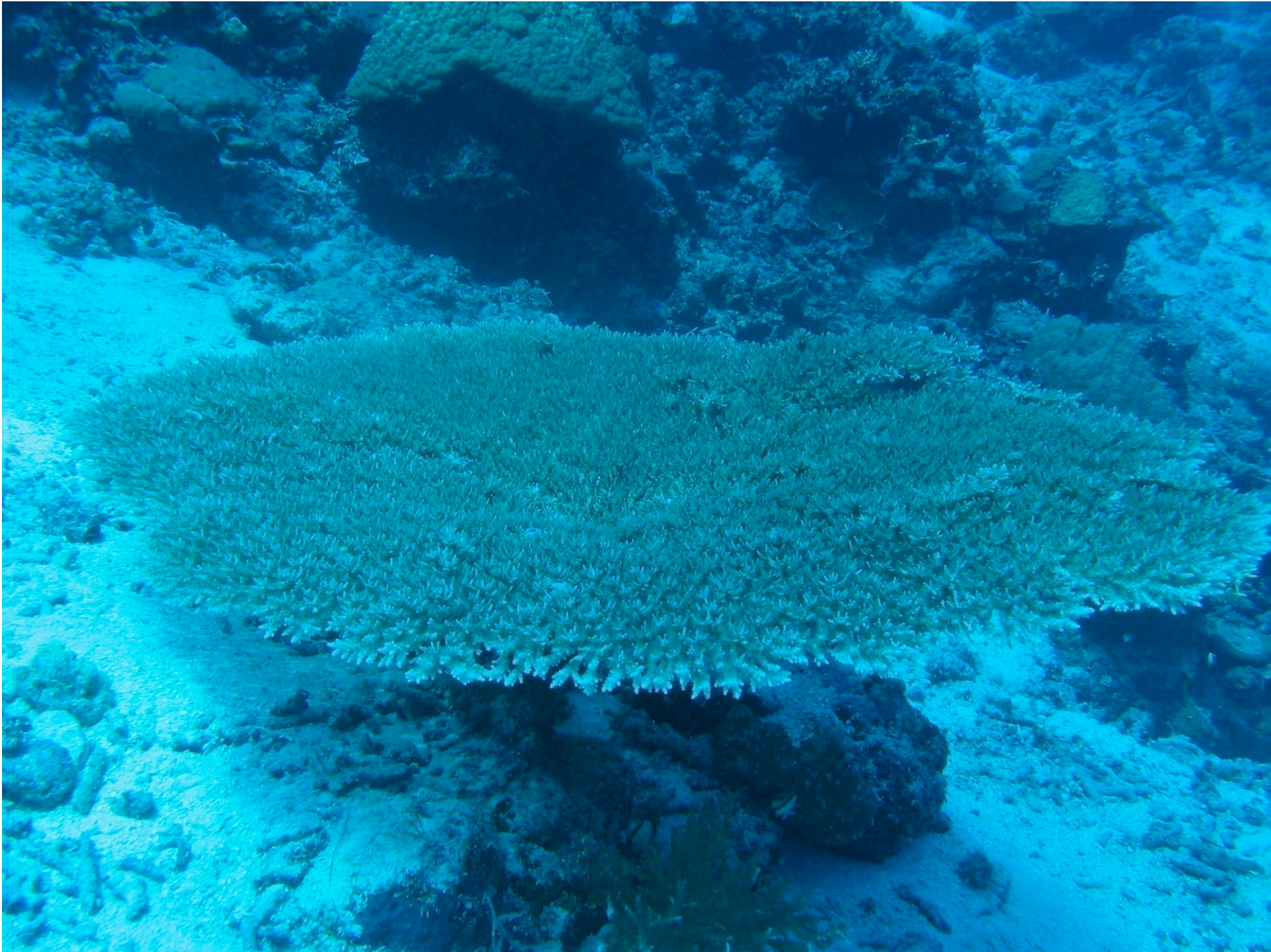


















Solomon Islands  
2 April 2007  
Magnitude 8.1



McAdoo et al. (2008)  
Solomon Islands Tsunami, One Year Later  
Eos, Transactions, AGU, **89** (18)

Niu Manra Village (Gilbertese)  
Ghizo, Solomon Islands





**Coral Mining  
near Rekawa  
Sri Lanka**





Simeulue Island  
Aceh Province  
Indonesia





Batuhiu, Indonesia  
17 July 2006  
M = 7.8  
6-8 m average runup





**Sally Abbott**  
Feinstein International Center  
Tufts University  
Hambantota, Sri Lanka



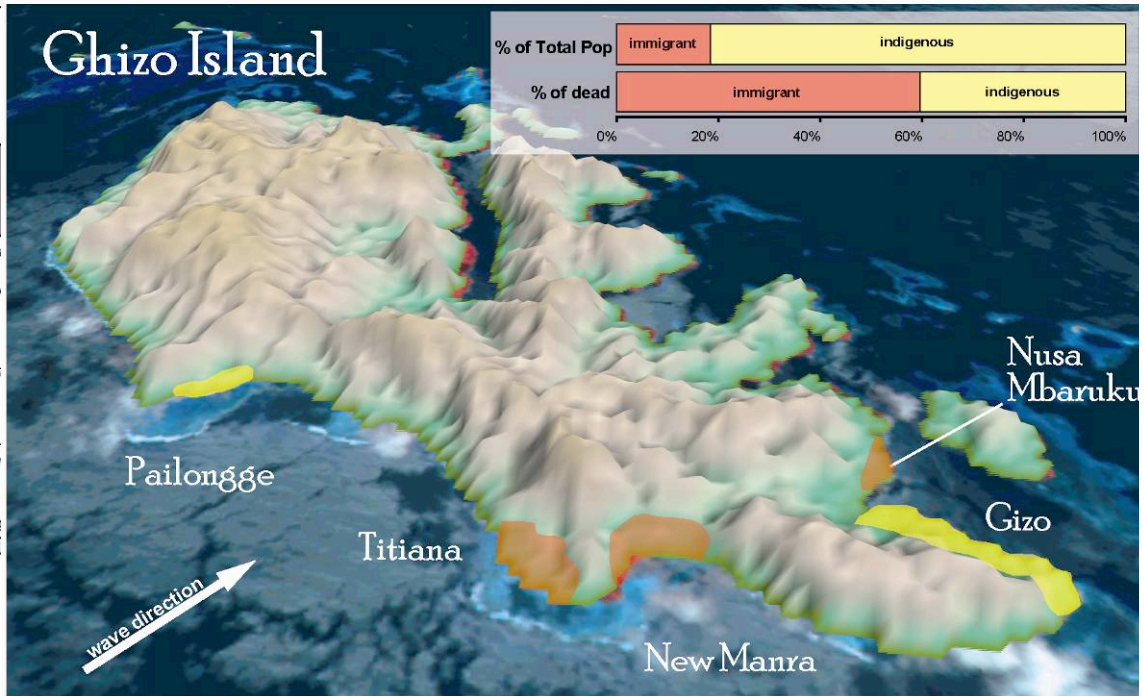
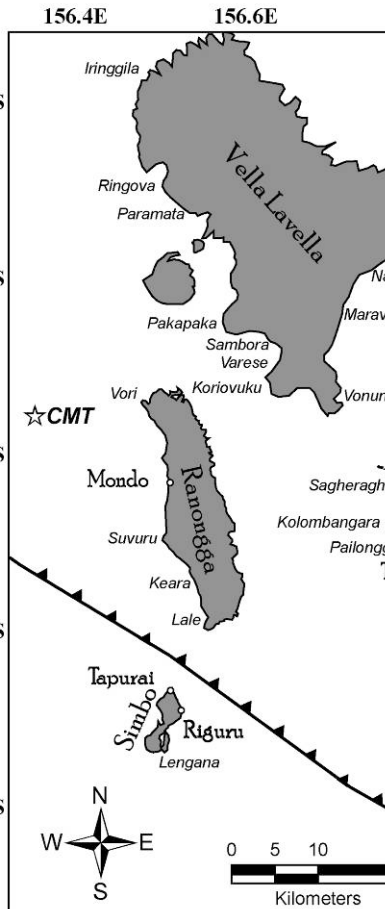
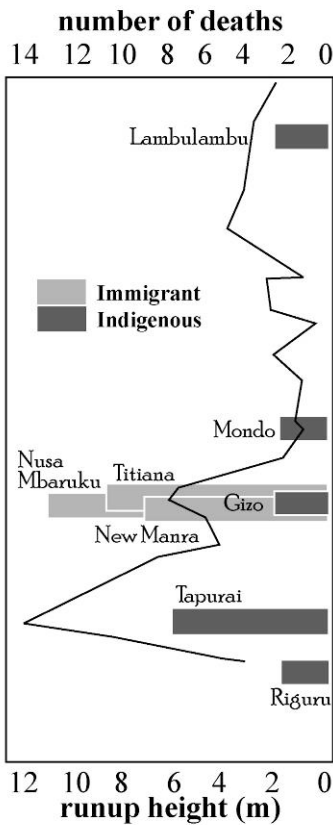
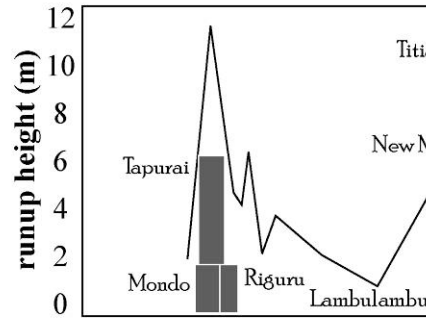






Hambantota  
Sri Lanka





McAdoo, Moore and Baumwoll  
**Indigenous knowledge and the near field population response during the 2007 Solomon Islands tsunami**  
 Natural Hazards, 2008





**Danger!! Mines!!**



# hazards

GEOPHYS, EESS,  
GES, CEE, RV2C

volcanic  
seismic

mass  
movements  
climate

# RISK

human systems  
ecosystems

engineering  
policy

# resilience solutions

NatCap (eco-serv)  
ANTHRO (ej/ik)  
SOCIO-ECON

CEE, SBE, COS  
Public Policy  
(ER&P; SP)



# Tsunami SAFE

**S**trong shaking? **A**ltered ocean? **F**ast to hills! **E**ventually return home after 2



## Aftershocks

no tsunamis  
relieve pressure  
decrease over time

## False Predictions

### Strong Shaking

over one minute  
trouble standing  
emptying lagoons

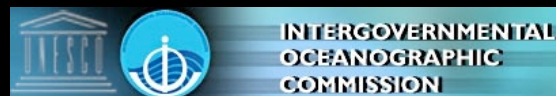
### Run to the Hills!

do not bring stuff with you  
stay for 2 hours

### Permanent changes

uplift/subsidence  
well water

### Stress







# UNESCO/IOC Post-Tsunami Surveys

- Civil and Environmental Engineers
- Geoscientists
- Coastal Ecologists
  - Ecosystem services
  - Mangroves/coral reef as buffers?
  - Salt marsh (Hurricane Katrina)?
- Economic geographers, planners, policy analysts, anthropologists, ...?

