UNIVERSITY CONTRIBUTIONS TO RISK REDUCTION IN A POST-DISASTER CONTEXT:

A CASE STUDY OF REORIENTING RESEARCH EFFORTS AT SAN VICENTE VOLCANO, EL SALVADOR

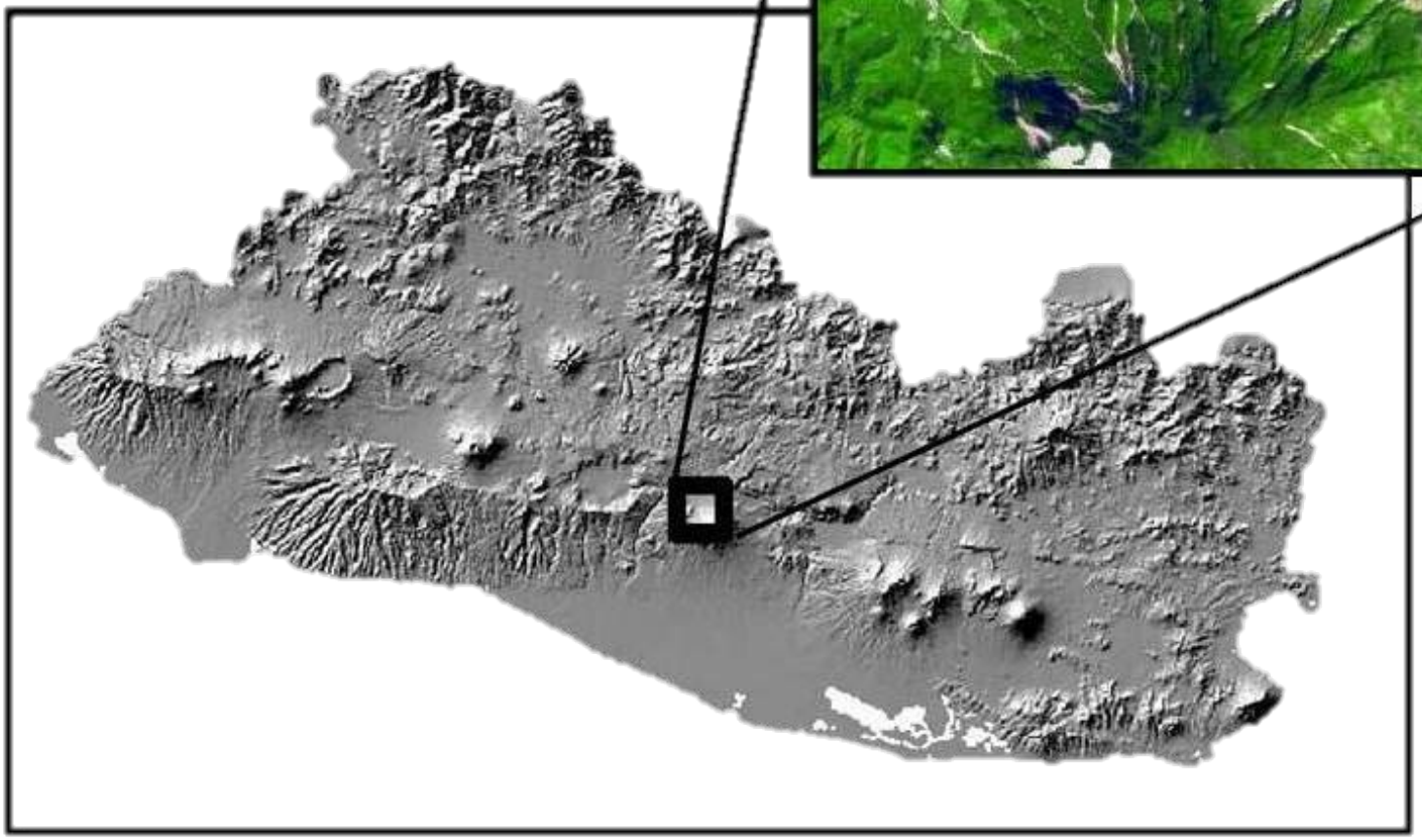
Luke Bowman[1], John Gierke[1], and Fredy Cruz Centeno[2]

[1]Geological & Mining Engineering & Sciences Department
Michigan Technological University, 1400 Townsend Dr, Houghton, MI 49931

[2]Ciencias Agronomicas, Universidad de El Salvador - Facultad Multidisciplinaria Paracentral, Frente de Estadio Vicentino, San Vicente, El Salvador

Michigan Tech

San Vicente Volcano, El Salvador



Evolution of Crisis Response Systems in El Salvador

Hurricane Mitch 1998

2001 Earthquakes

SNET
Servicio Nacional de Estudios Territoriales

2005 Santa Ana Eruption & Hurricane Stan Lahar

PROTECCION CIVIL
EL SALVADOR

Hurricane Ida 2009

WEAKNESSES IDENTIFIED

Poor Hazard Awareness
High Vulnerability
Lack of Preparation
Lack of Coordination

2011 Tropical Depression 12E

Hurricane Ida (Nov. 7-9, 2009)

- 480 mm of rainfall over 3 days, **360 mm in 5-hr**
- Debris flows inundated 5 towns
- Over 200 fatalities; 60 people were never found

Photo Credit: Fredy Cruz Centeno

Photo Credit: Fredy Cruz Centeno

UES-FMP Contributions to Subsequent Disaster Risk Reduction Efforts

- Recognized chaotic, redundant aid efforts
- Acted as liaison between governmental and NGOs
- Solicited external help and reoriented research priorities to contribute to new DRR efforts

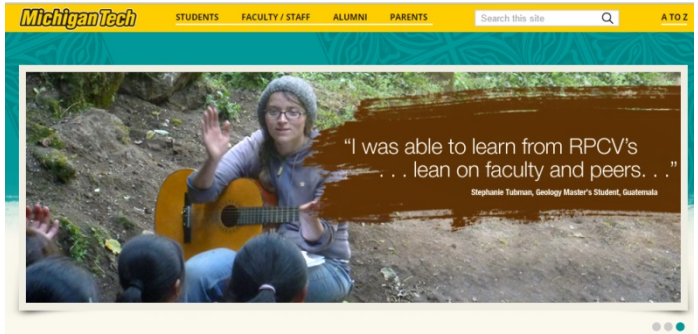
Evolution of MTU/UES-FMP Collaboration

2006-13

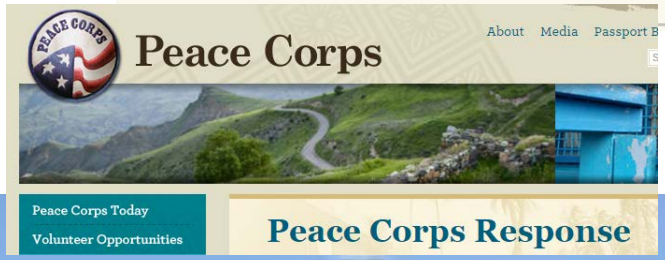
Michigan Tech

NSF PIRE Partnerships for International Research and Education

Ongoing



2010-11



FULBRIGHT

2012-14

USAID FROM THE AMERICAN PEOPLE

PARTNERSHIPS FOR ENHANCED ENGAGEMENT IN RESEARCH (PEER)

CEPRODE

CENTRO DE PROTECCIÓN PARA DESASTRES

Risk Reduction and Emergency Management “Diploma”

1) Risk assessment and social/physical vulnerability
2) Disaster and Emergency Management Protocol
3) Risk Communication

Tropical Storm 12E

- Up to 1400 mm of rainfall (80% of annual) over 12 days in San Vicente
- Yellow/Orange Alerts for 10 days
- Certificate participants thrust into real-life emergency management

USAID
FROM THE AMERICAN PEOPLE

PARTNERSHIPS FOR ENHANCED ENGAGEMENT IN RESEARCH (PEER)

Michigan Tech

NSF PIRE Partnerships for International Research and Education

Universidad de El Salvador — Centro América — Hacia la Libertad — Por la Cultura

Integration of ground-based monitoring and satellite remote sensing for forecasting landslides and flooding hazards in volcanic terrains

Slope Stability Modeling

- Modeling showed vulnerability of slope to rainfall
- Depth to water table was most important variable

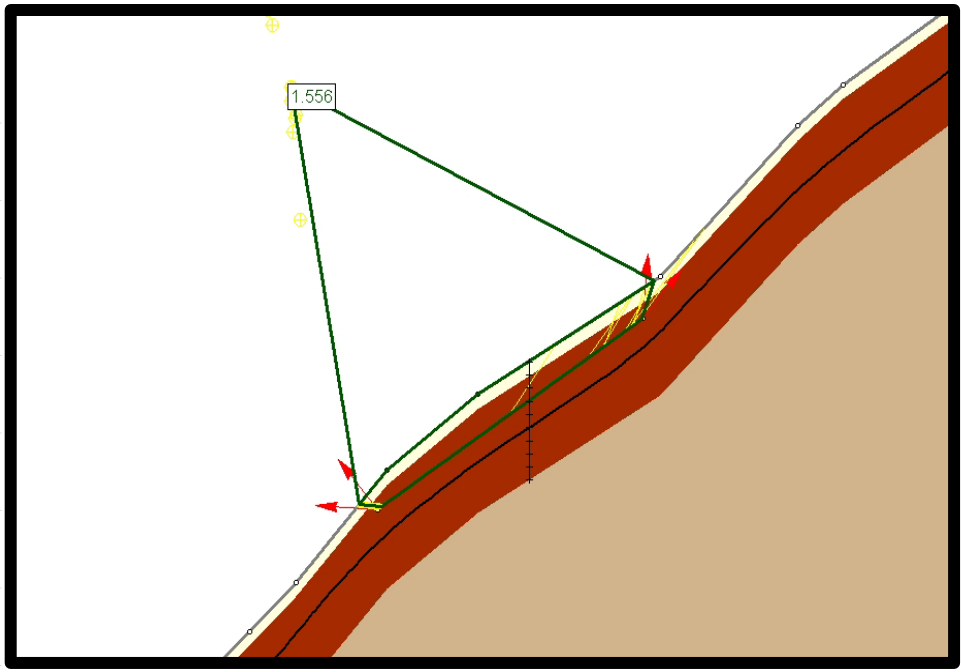
Nat Hazards
DOI 10.1007/s11069-014-1422-y

ORIGINAL PAPER

Hazard assessment of rainfall-induced landslides: a case study of San Vicente volcano in central El Salvador

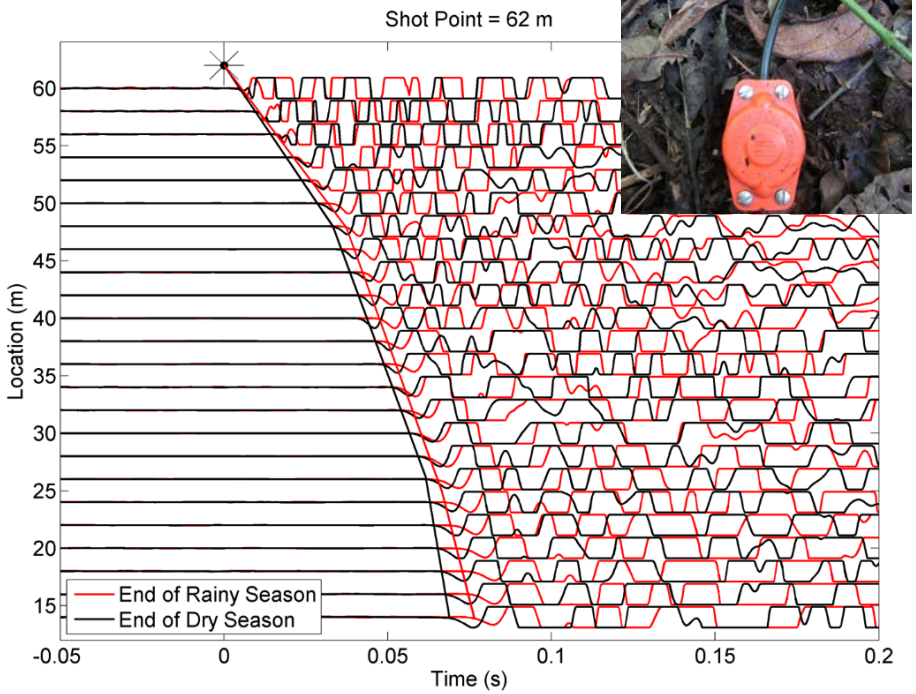
Daniel M. Smith · Thomas Oommen · Luke J. Bowman · John S. Gierke · Stanley J. Vitton

Time (h)	Cumulative Rainfall (mm)	Factor of Safety (Bishop Simplified)
1	0.8	1.556
20	93.8	1.391
30	117.8	1.381
35	332.0	0.910
37	431.8	0.796
40	443.8	0.930
100	485.2	1.413



Geophysical Surveys: Electrical Resistivity & Seismic Refraction

- 2011 Tropical Storm 12E cracks inconclusive
- Perched water tables as potential trigger, but insufficient rainfall in 2013 to see change



Ongoing Efforts

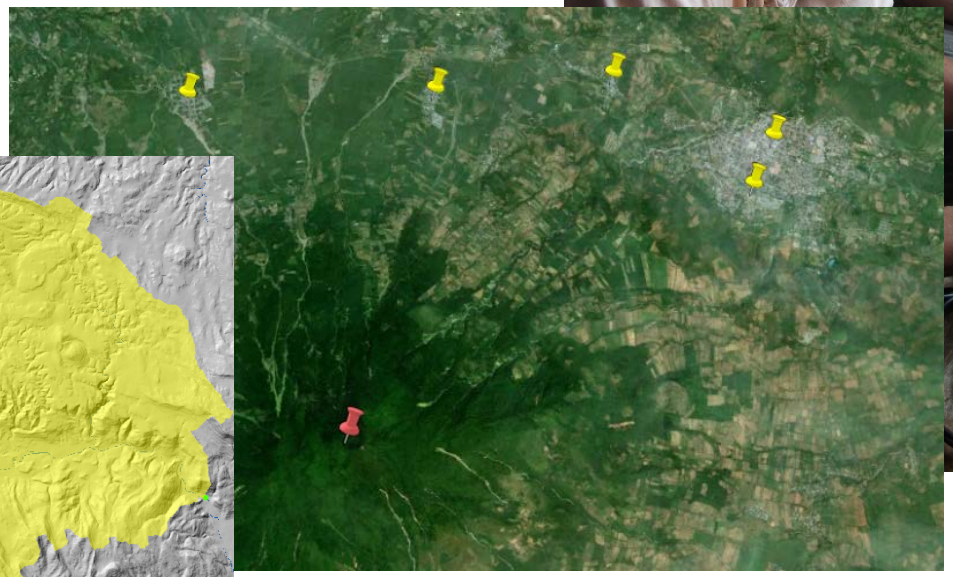
GIS and LaharZ modelling workshops

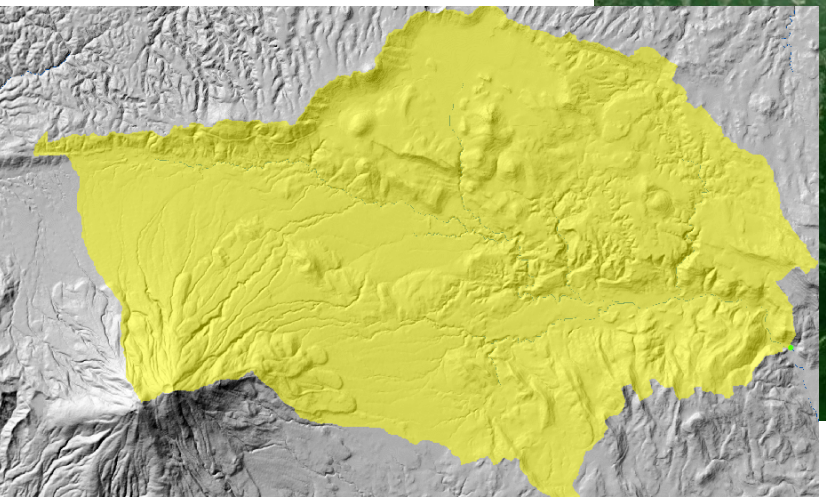
Dissemination of hazard maps

Surface Crack Monitoring

Remote Sensing and Modeling

- 6 Weather stations monitoring precipitation
- Water-level monitoring in hand-dug wells and the upper and lower portions of the Rio Acahuapa
- Intensive workshop at Michigan Tech, supported by PEER





Continuing Challenges

- Clunky virtual learning and communication
- Equipment procurement & security
- Institutional Barriers
  - Administrative and accounting
  - Highly variable political climate within government and institutions

Lessons Learned

- Formal agreements are important
- Frequent face-to-face engagement is vital
- Careful listening on our part

Acknowledgements

- Peace Corps Response
- UES-FMP Agricultural Sciences Department
- Fulbright Student Scholar Program
- USAID/NSF: Partnerships for Enhanced Engagement of Research (PEER)
- NSF PIRE Grant 0530109
- Proteccion Civil
- Centro de Proteccion para Desastres (CEPRODE)
- USGS VDAP (LaharZ Workshop)