

“Turning Disaster into Knowledge”

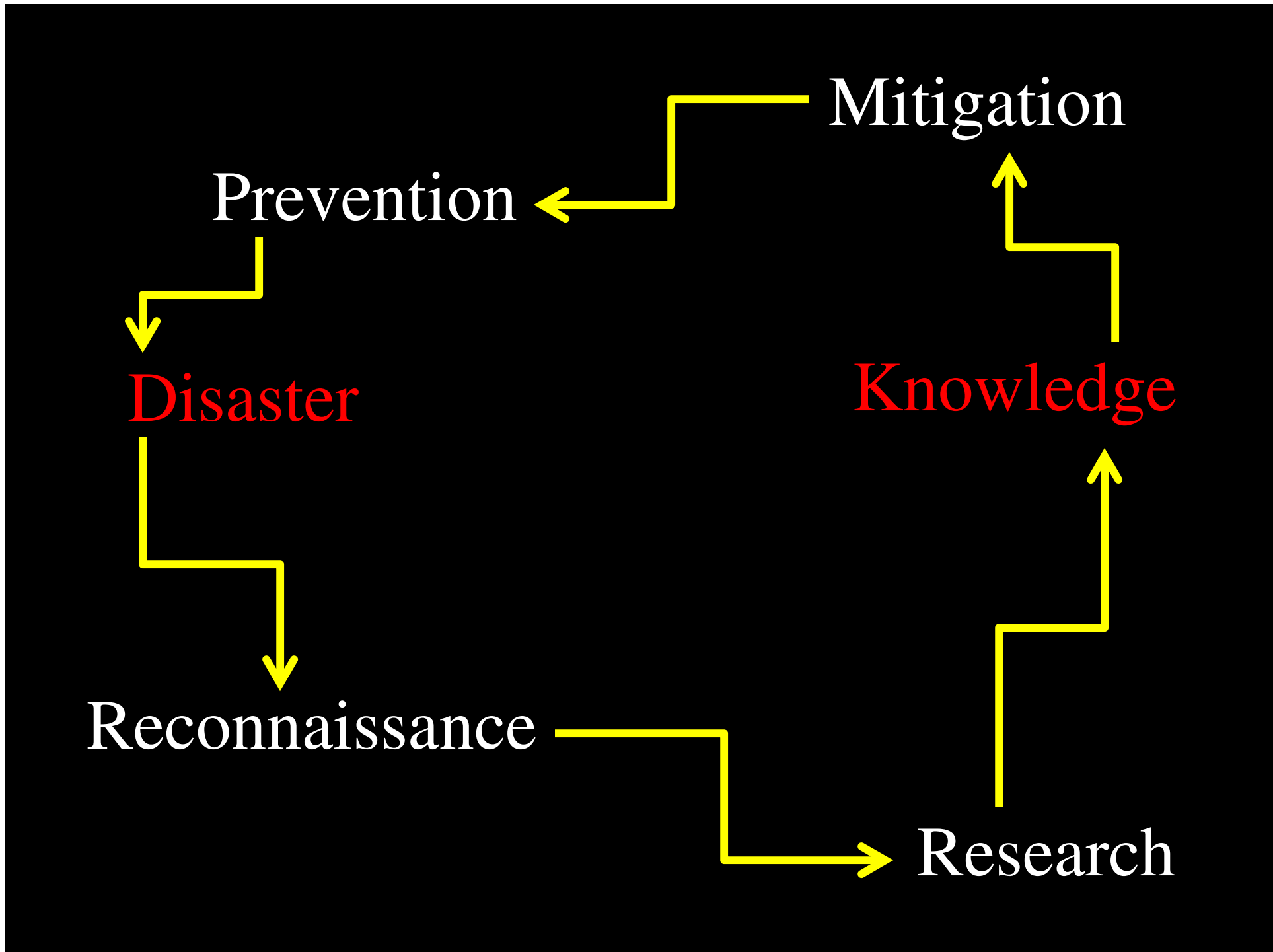
The M8.0 Pisco, Peru Earthquake of August 15, 2007

Brady R. Cox, Ph.D.

The University of Arkansas

NSF-Sponsored GEER Workshop: Berkeley, CA; May 18-19, 2009





Prevention ← Mitigation

Disaster

Knowledge

Reconnaissance

Research

GEER Field-Team Members

August 19 – 24, 2007

- Brady Cox, University of Arkansas
- Jorge Meneses, Kleinfelder
- Viviana Moreno, Catholic University of Peru
- Manuel Olcese, Catholic University of Peru
- Adrian Rodriguez-Marek, Washington State University
- Joseph Wartman, Drexel University



PERU →

Pisco EQ

Image NASA
Image © 2007 TerraMetrics
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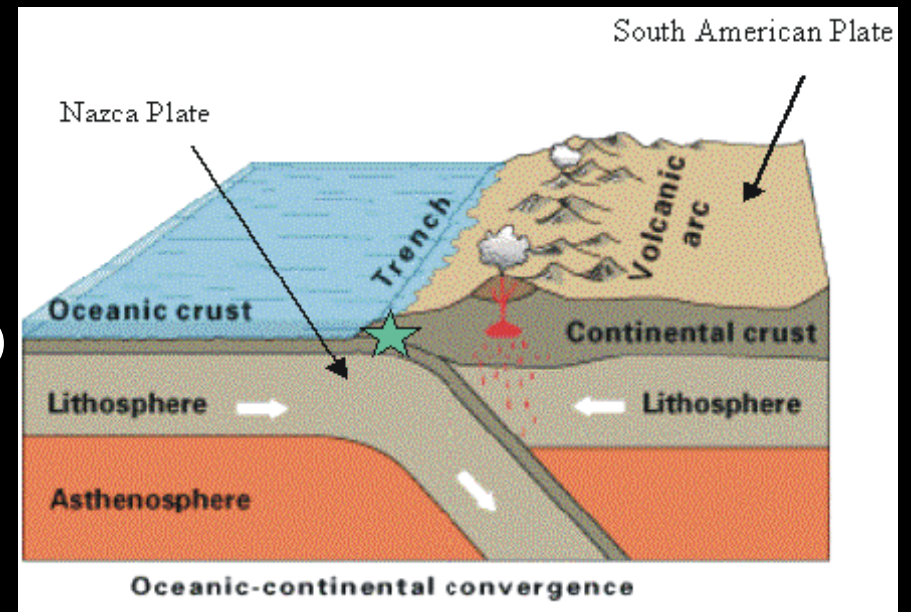
© 2007 Google™

+ 500 killed; + 50,000 buildings destroyed

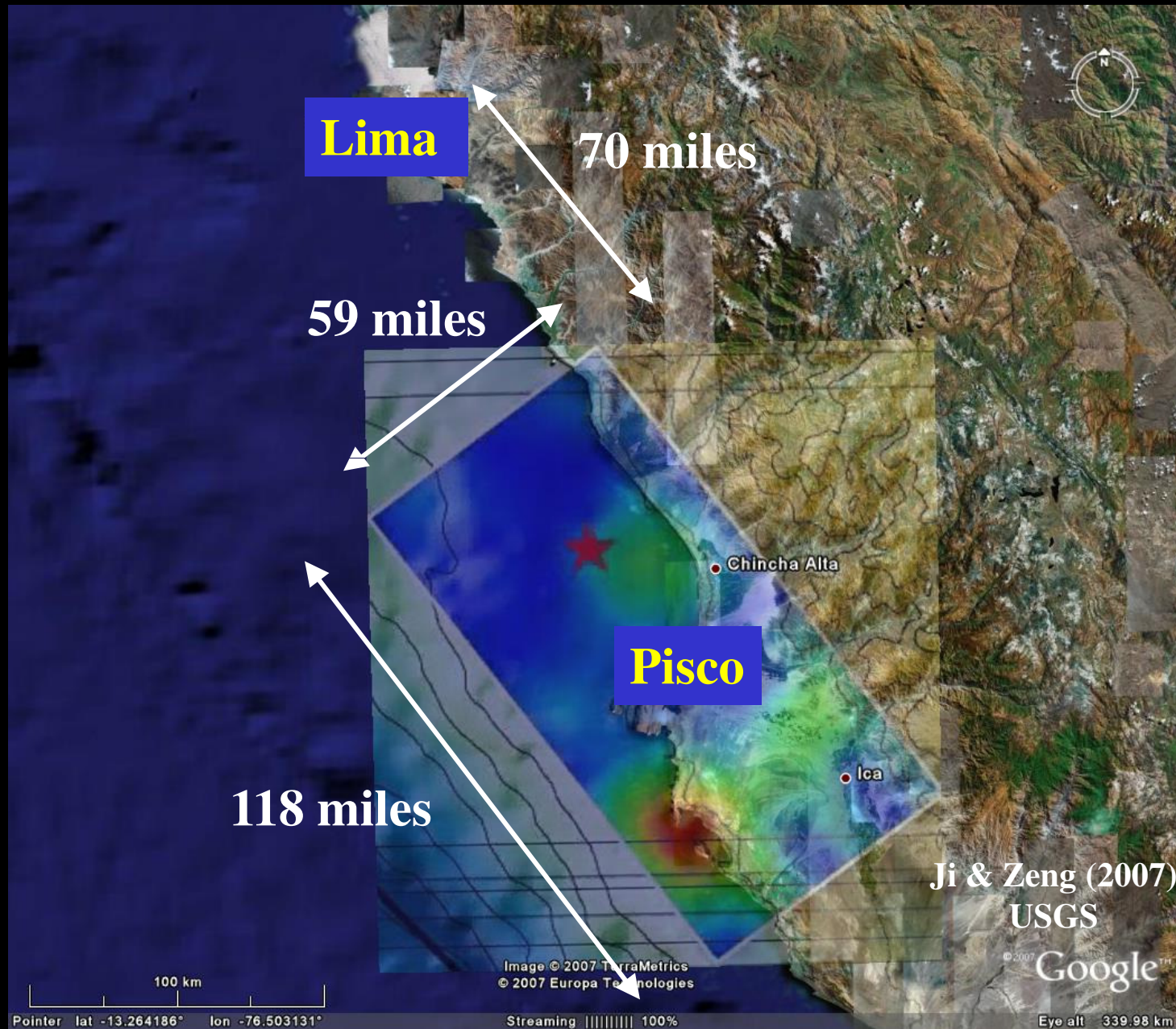


Seismological Information

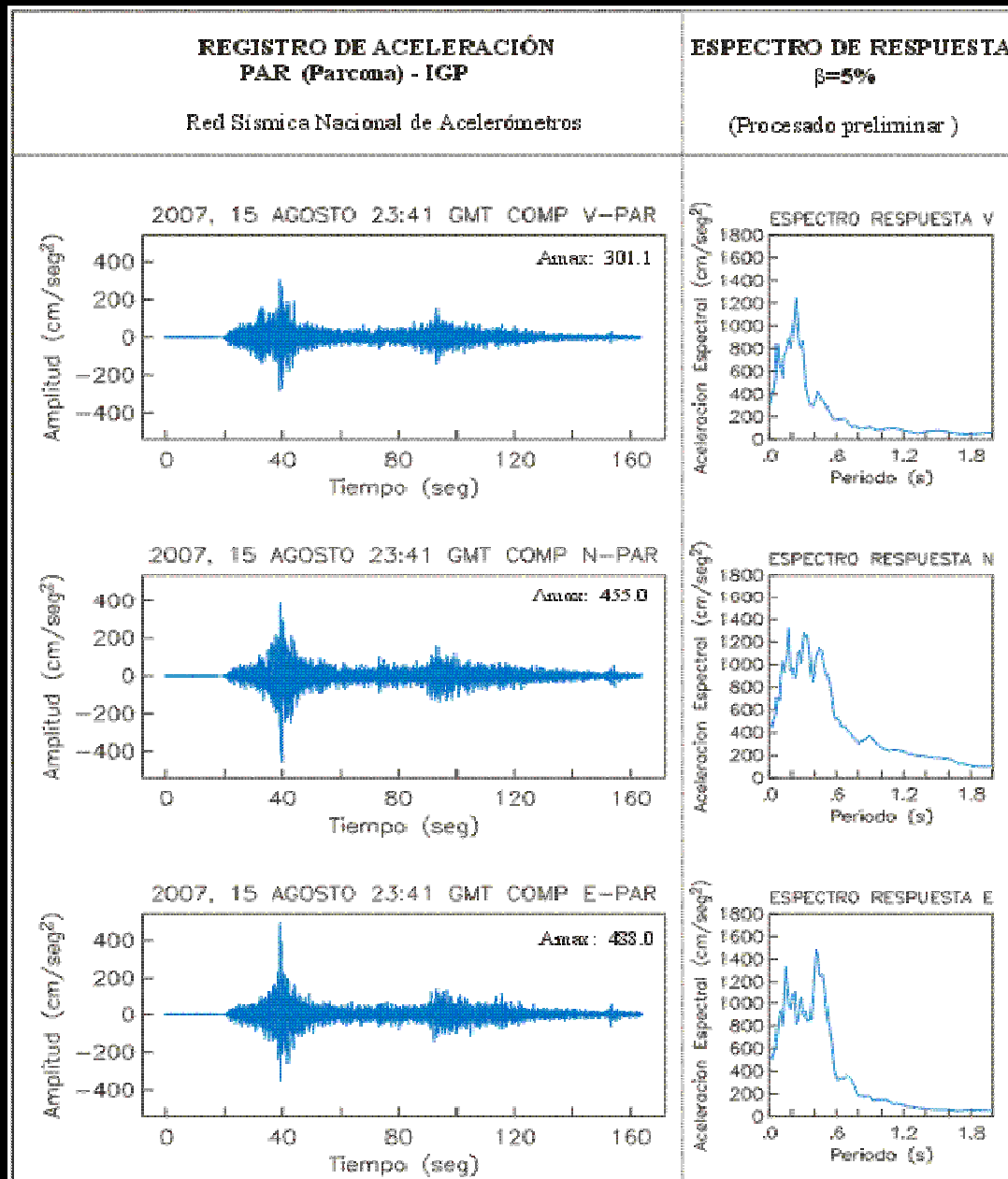
- **Moment Magnitude:**
 - $M_w = 8.0$
- **Fault Type:**
 - Interface Subduction Event between the Nazca and South American Plates
- **Hypocentral Depth:**
 - 39 km (24 miles)
- **Fault dimensions:**
 - 190 km along strike (118 miles)
 - 95 km down dip (59 miles)



Fault Rupture Plane



Recorded Ground Motions



Parcona Record (Ica)

- Distance = 39 km
- Instrument on soil
- PGA = 0.49 g
- Two distinct phases of shaking
- Duration > 2 min

Courtesy of IGP

Liquefaction Observations



Focus Sites

- **Canchamaná Massive Lateral Spread**
 - At least 3 km long by 1 km wide ??
 - At least 5 m of horizontal displacement ??
- **Tambo de Mora Liquefaction**
 - Single-story home foundation failures
 - Settlements of 30-90 cm
- **Google Earth Tour**
 - Spatial Connections

Jahuay Slope Failure + 400-m long







Continue to the South



Pan American Hwy Embankment Failure





To Tambo de Mora



Tambo de Mora Liquefaction Damage







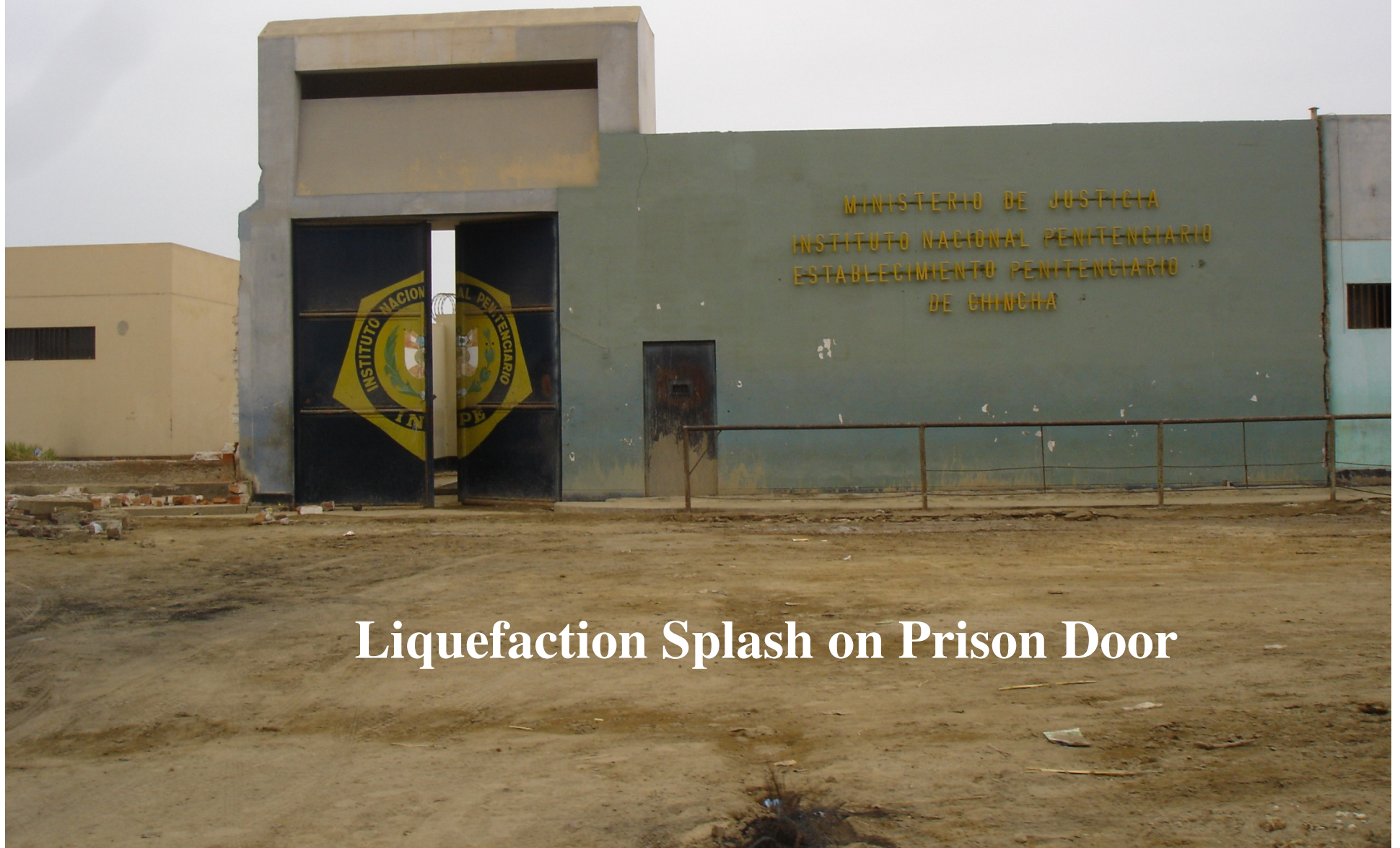
To Chincha Prison

Chincha Prison

600 + Prisoners Escaped



To Head Scarp



Liquefaction Splash on Prison Door



3-m High Head Scarp

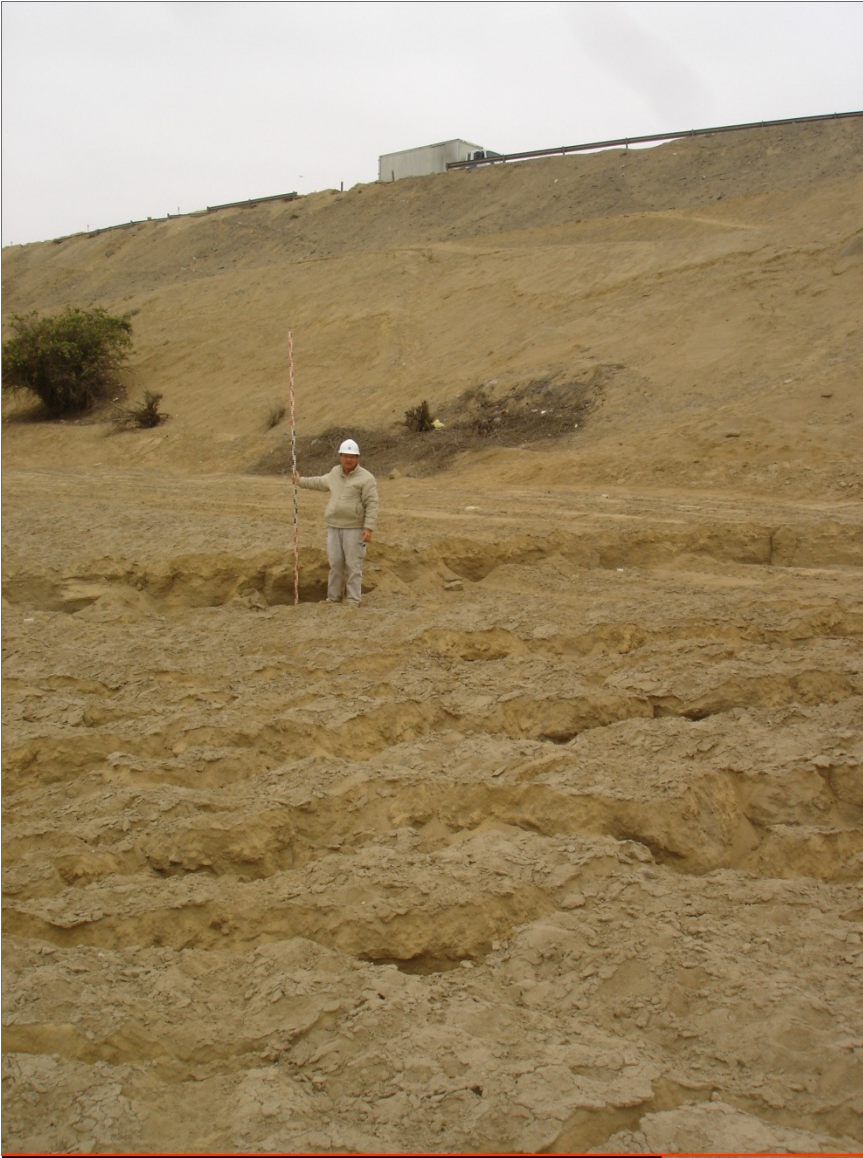


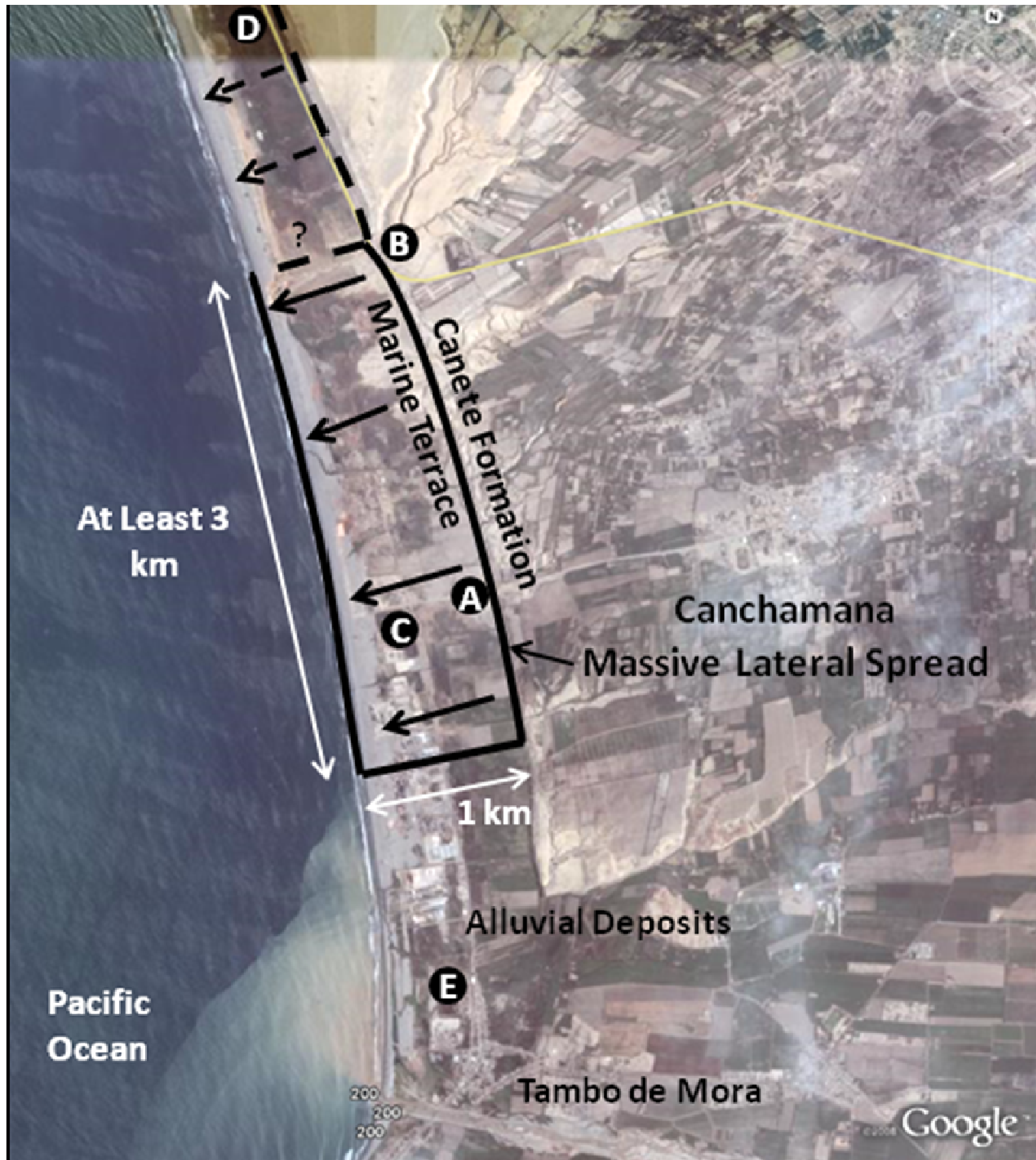
**Tension Cracks Filled
with Liquefaction
Ejecta**



Along Geologic Interface

Large Tension Cracks Below Failed Embankment





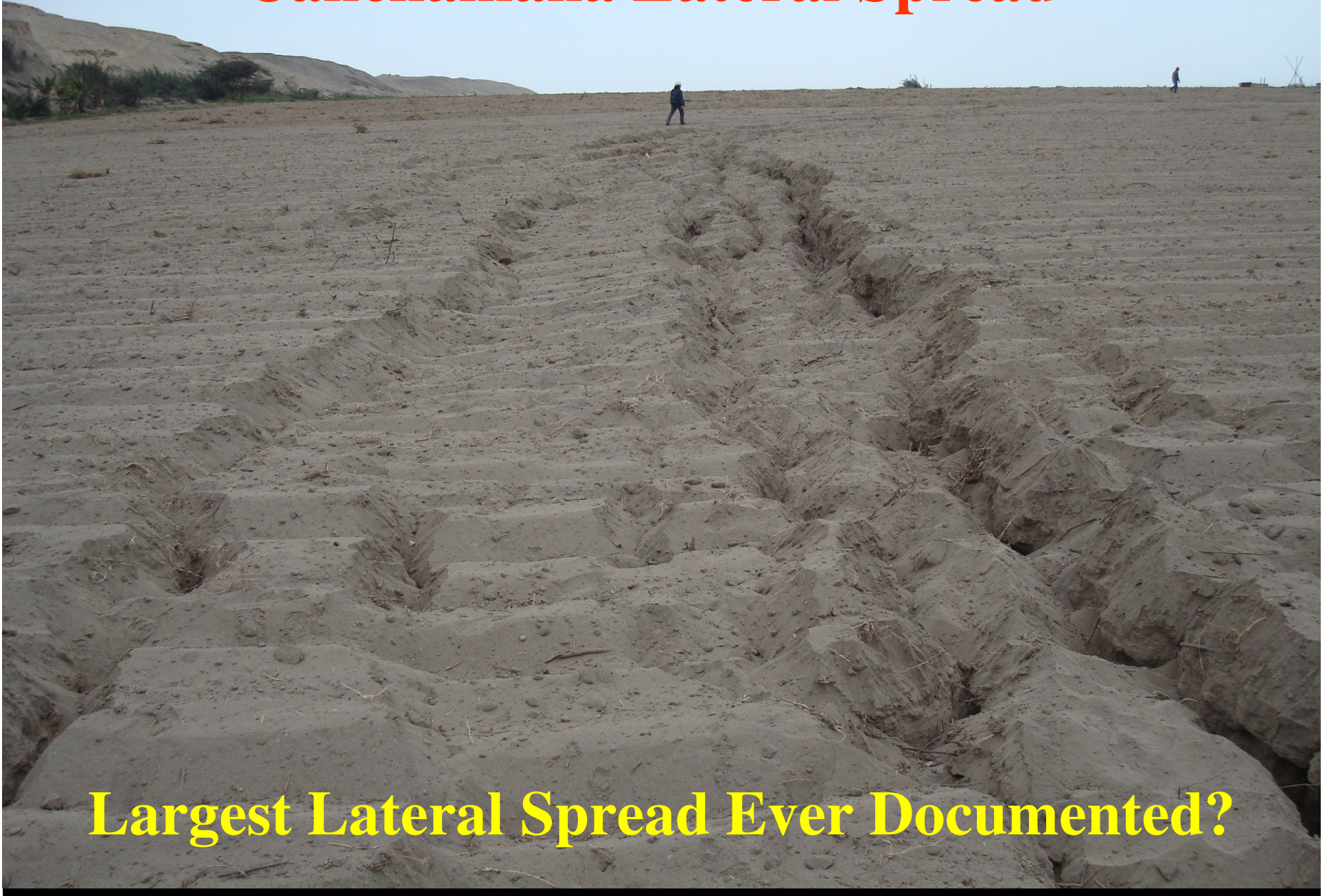
Lateral displacement of +5 m from adding up the widths of tension cracks

Feature too large to quantify spatially in the field given limited time frame

Did it move as a coherent block?

Why did lateral movement stop at the alluvial deposits?

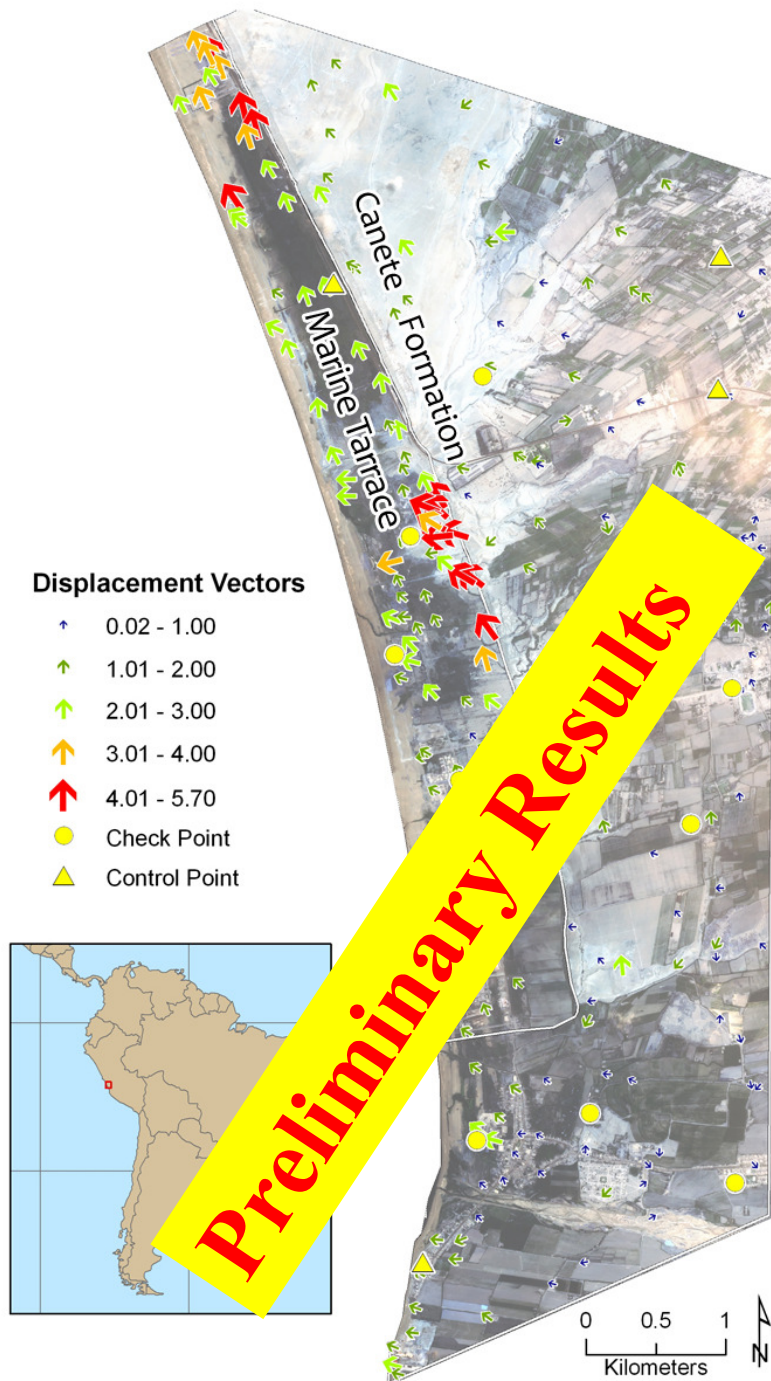
Canchamaná Lateral Spread



Largest Lateral Spread Ever Documented?

Analysis of Pre- and Post-EQ High-Resolution Satellite Images

- Images purchased by GEER for ~ \$2k (ORS; Tasked Quickbird)
- Could not afford the optimal type of images (Basic Product ~ \$15k)
- Processed by CAST at UA
- Combination of SRTM and ASTER DEM's
- ~ 6 km long and 1 km wide (3.7 x 0.6 miles)



NSF-Funded Research

(just notified)

- **Ultra High-Resolution (sub-pixel) Satellite Image Processing of the Lateral Spread**
 - DEM from Stereo Images supplemented with LiDAR, Better Ground Control, Basic Product
- **Geotechnical Investigation and Analysis**
 - Remote sensing for WHAT happened, Geotech Investigation for WHY it happened
- **Landslide Inventory and Ground Failure Database Development**

Recon Hazards...

Dog that bit me
by a sand boil!



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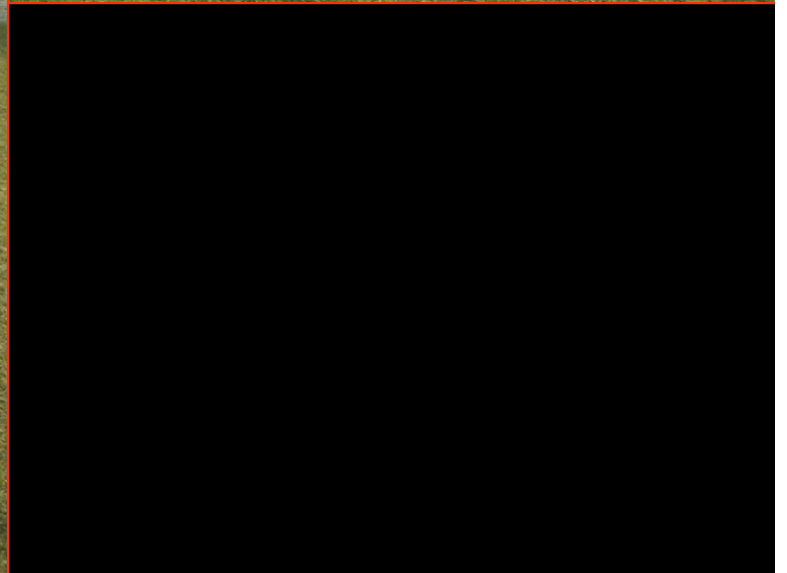
Questions ?



Villa, Lima
90 km (56 miles)
North Of the Fault
Rupture Plane



Las Lagunas





Port of Pisco

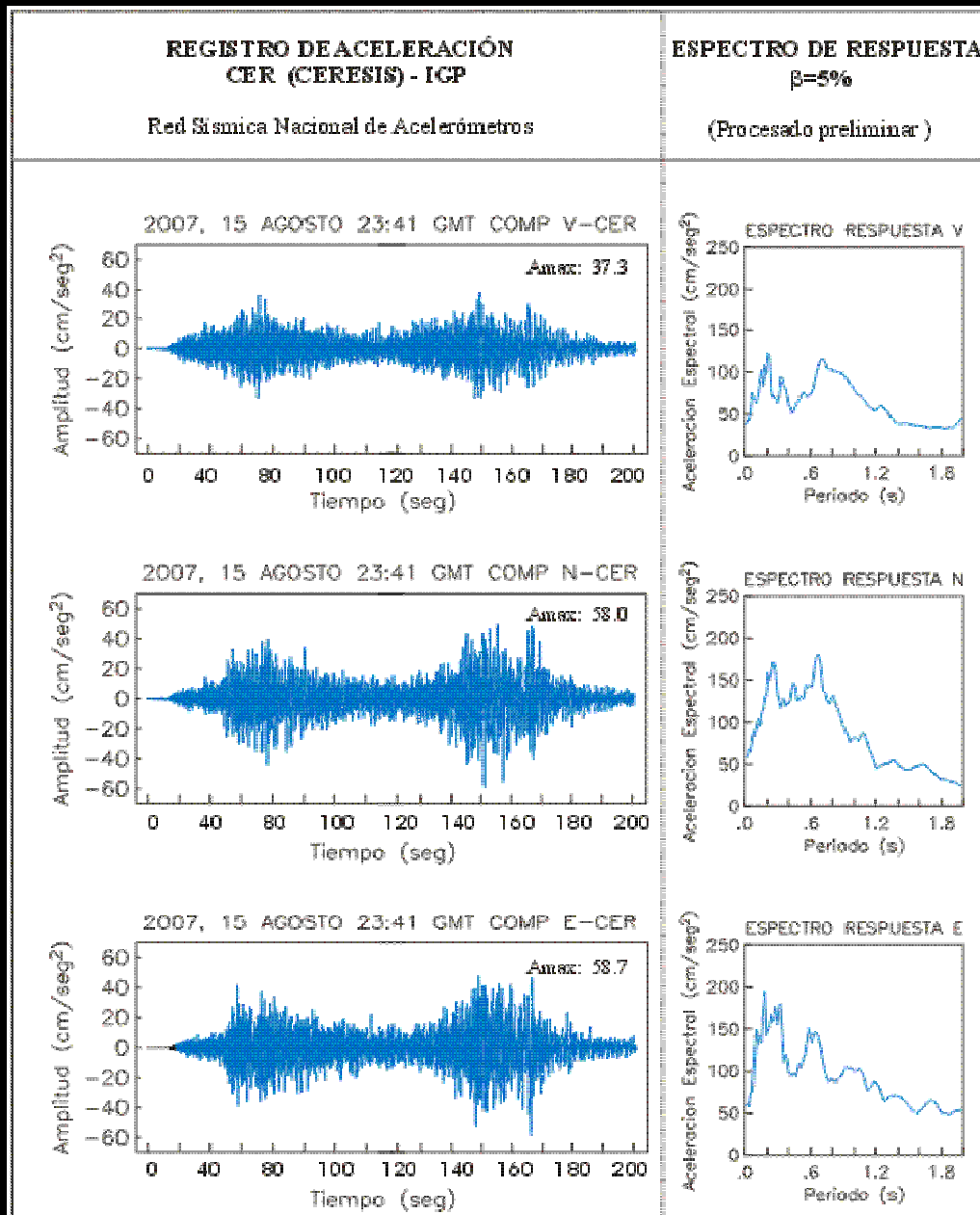




Recorded Ground Motions

CERESIS Record (Lima)

- Distance = 102 km
- Instrument on stiff soil
- PGA = .06 g



Courtesy of IGP