OVSICORI–UNA

INSTITUTO DE INVESTIGACIÓN OBSERVATORIO VULCANOLÓGICO Y SISMOLÓGICO DE COSTA RICA

"Continuous GPS for earthquake cycle monitoring: the successful case of Nicoya in NW Costa Rica"

Marino Protti

Costa Rica Volcanological and Seismological Observatory

Universidad Nacional

OVSICORI-UNA

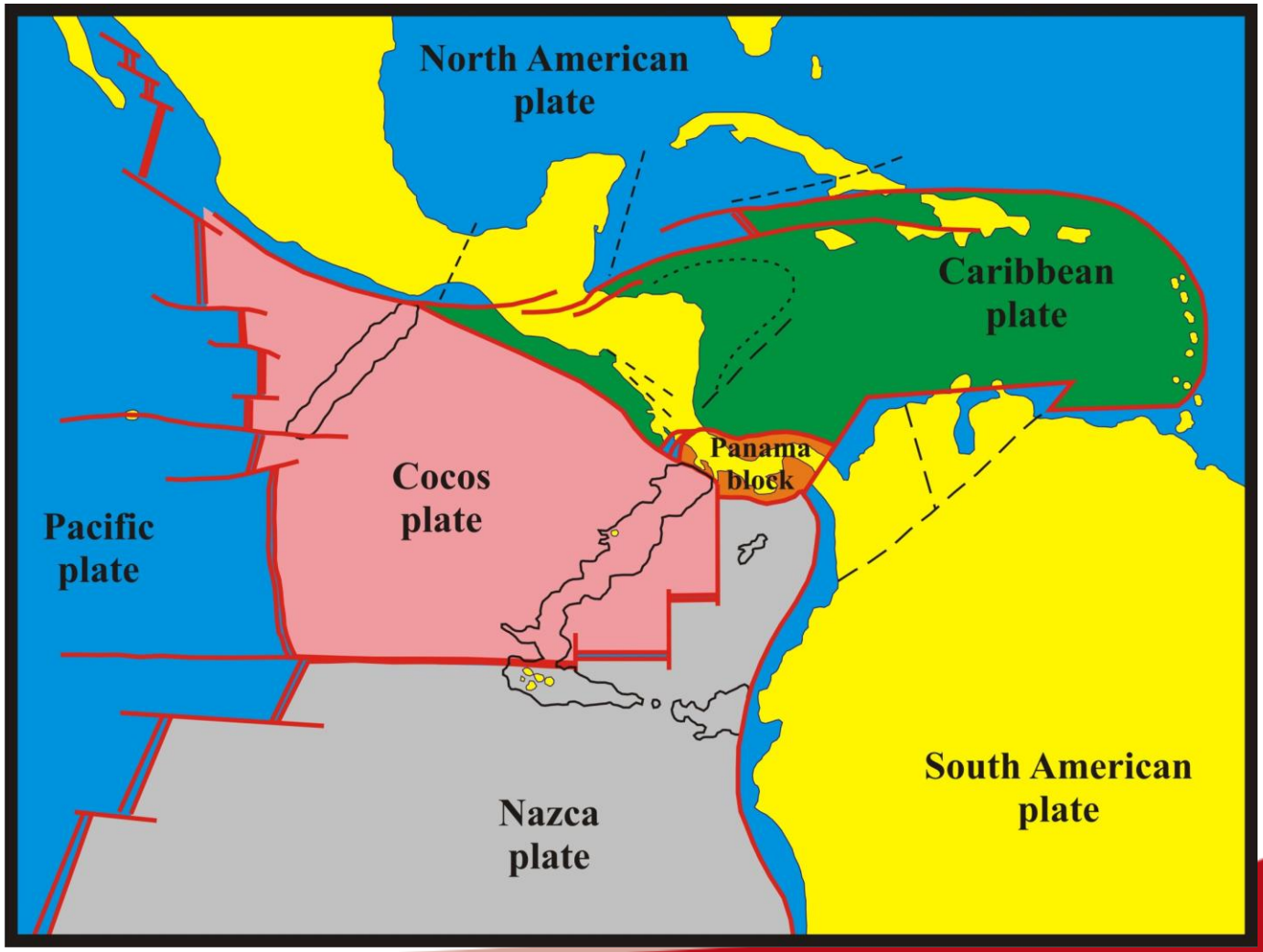
International Academic Cooperation

- **Geoff Abers, Columbia University.**
- **Tim Dixon, Rocco Malservici, Nick Voss and Yan Jiang, University of South Florida.**
- **Lujia Feng, Earth Observatory of Singapore.**
- **Karen Fisher, Brown University.**
- **Víctor González and Marino Protti, OVSICORI-UNA.**
- **Takeshi Iinuma, Tohoku University, Japan.**
- **Yoshiyuki Kaneda, IFREE-JAMSTEC, Japan.**
- **Teruyuki Kato, University of Tokyo, Japan.**
- **Paul Lundgren and Susan Owen, JPL-NASA.**
- **Jeff Marshall, California State University at Pomona.**
- **Tim Melbourne, Central Washington University.**
- **Andy Newman, Georgia Tech.**
- **MartinThorwart, CAU, Germany.**
- **Susan Schwartz and Daniel Sampson, University of California, Santa Cruz.**
- **Gerry Simila, California State University at Northridge.**
- **UNAVCO and IRIS consortiums.**

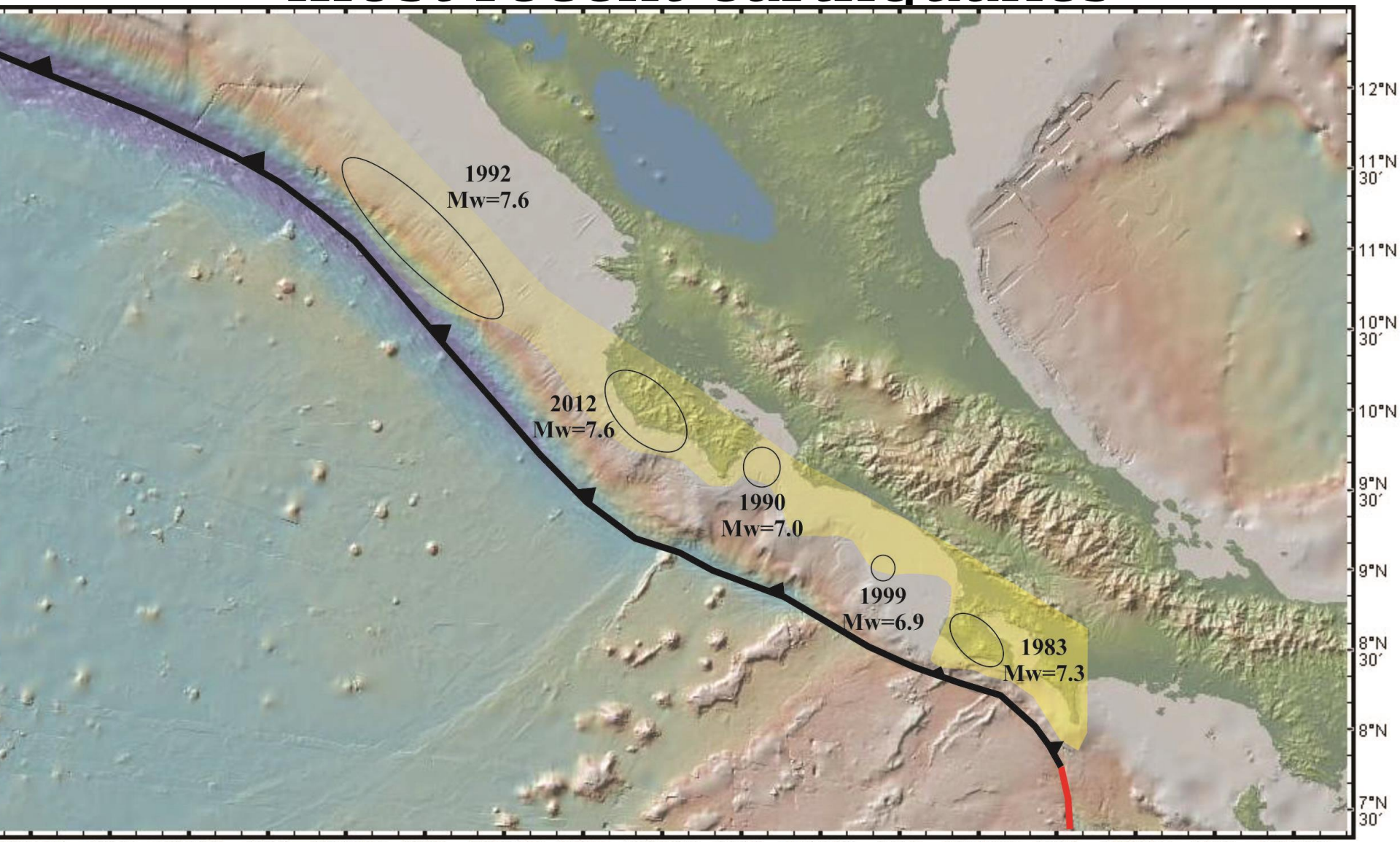
Summary

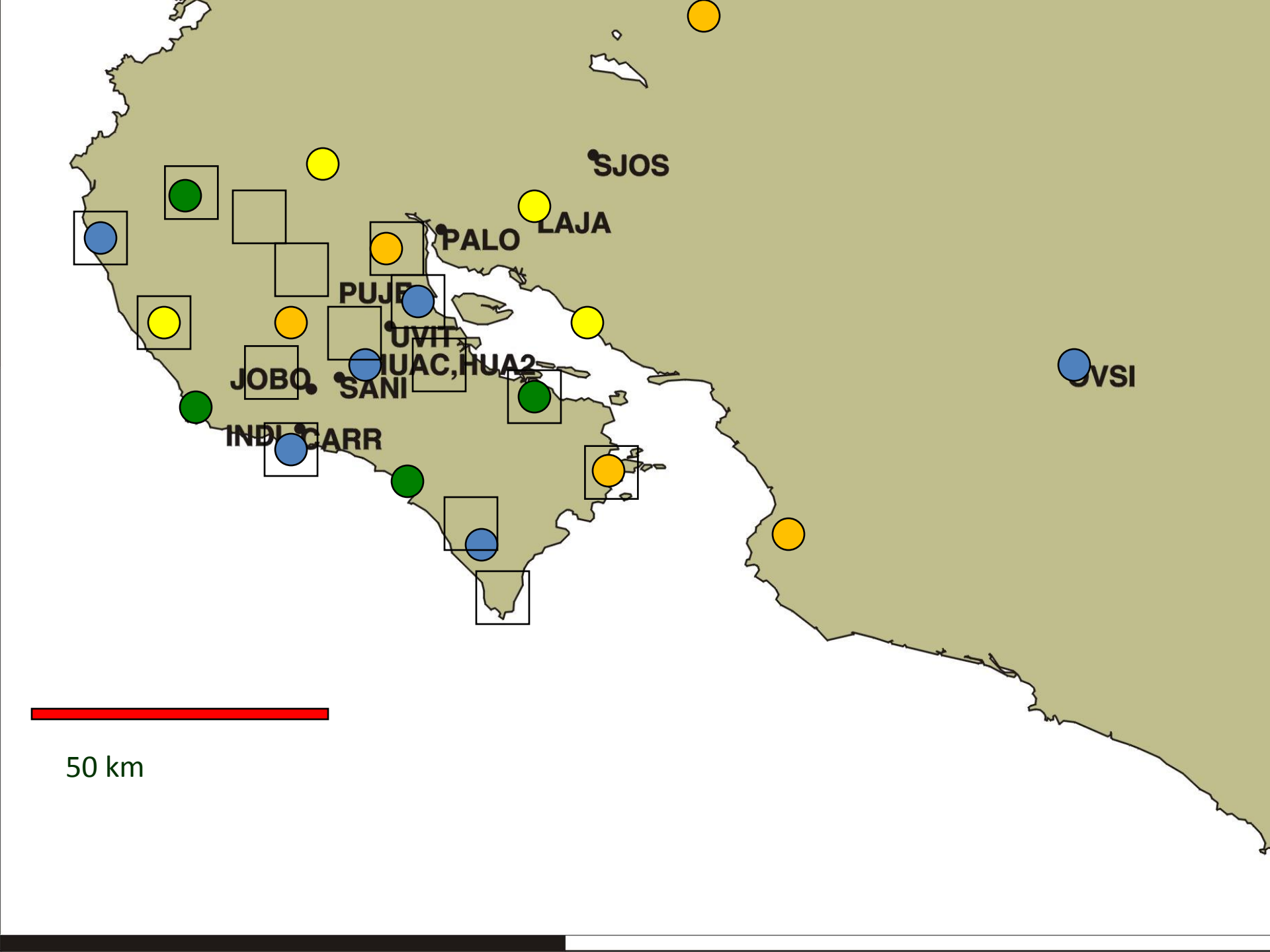
- We identified a seismic gap where a large earthquake had to occur.
- Instrumented the region with GPS antennas.
- Anticipated the future rupture area of the fault.
- Recorded the expected earthquake, its co-seismic and post-seismic deformation.

REGIONAL TECTONIC SETTING

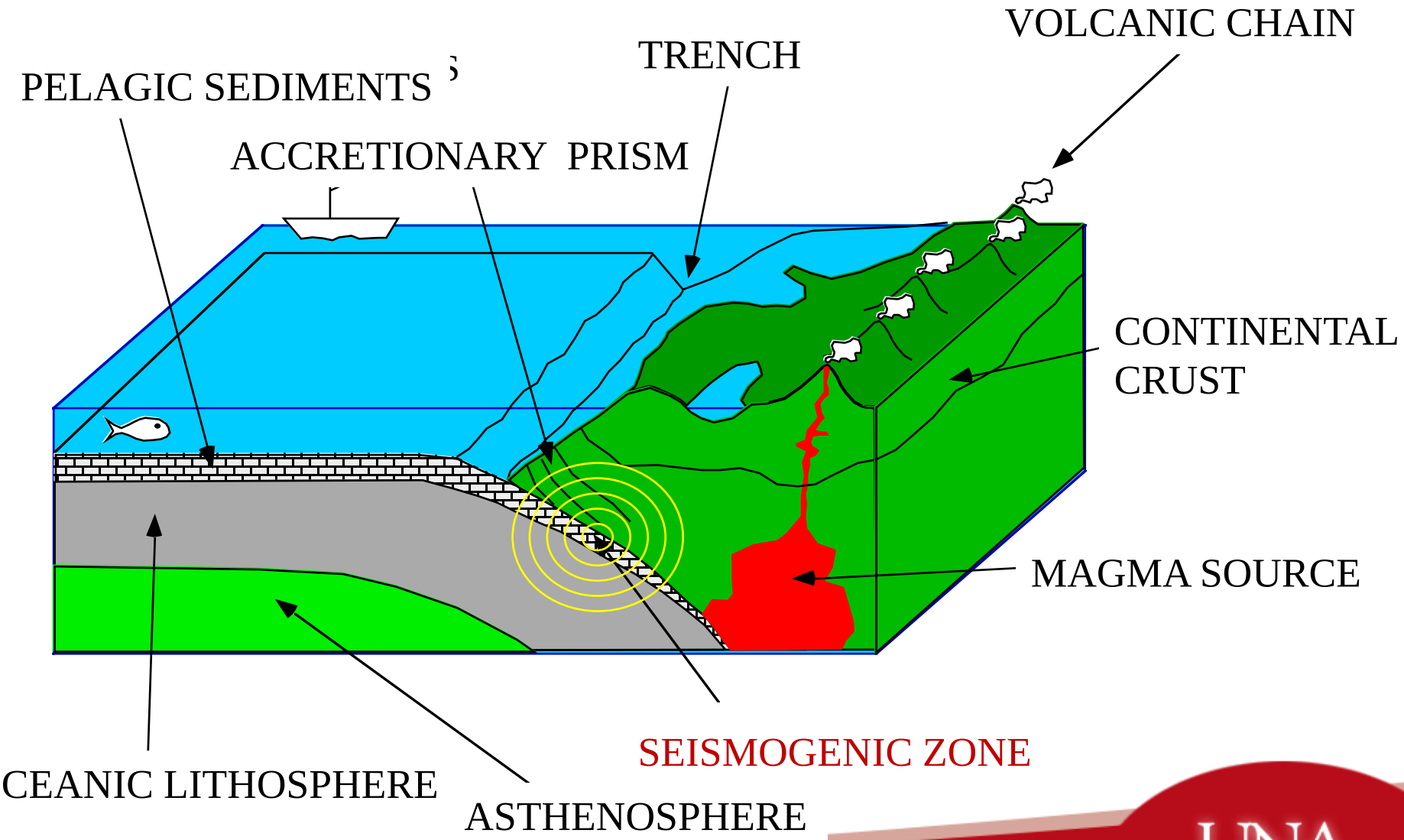


Seismogenic zone and most recent earthquakes



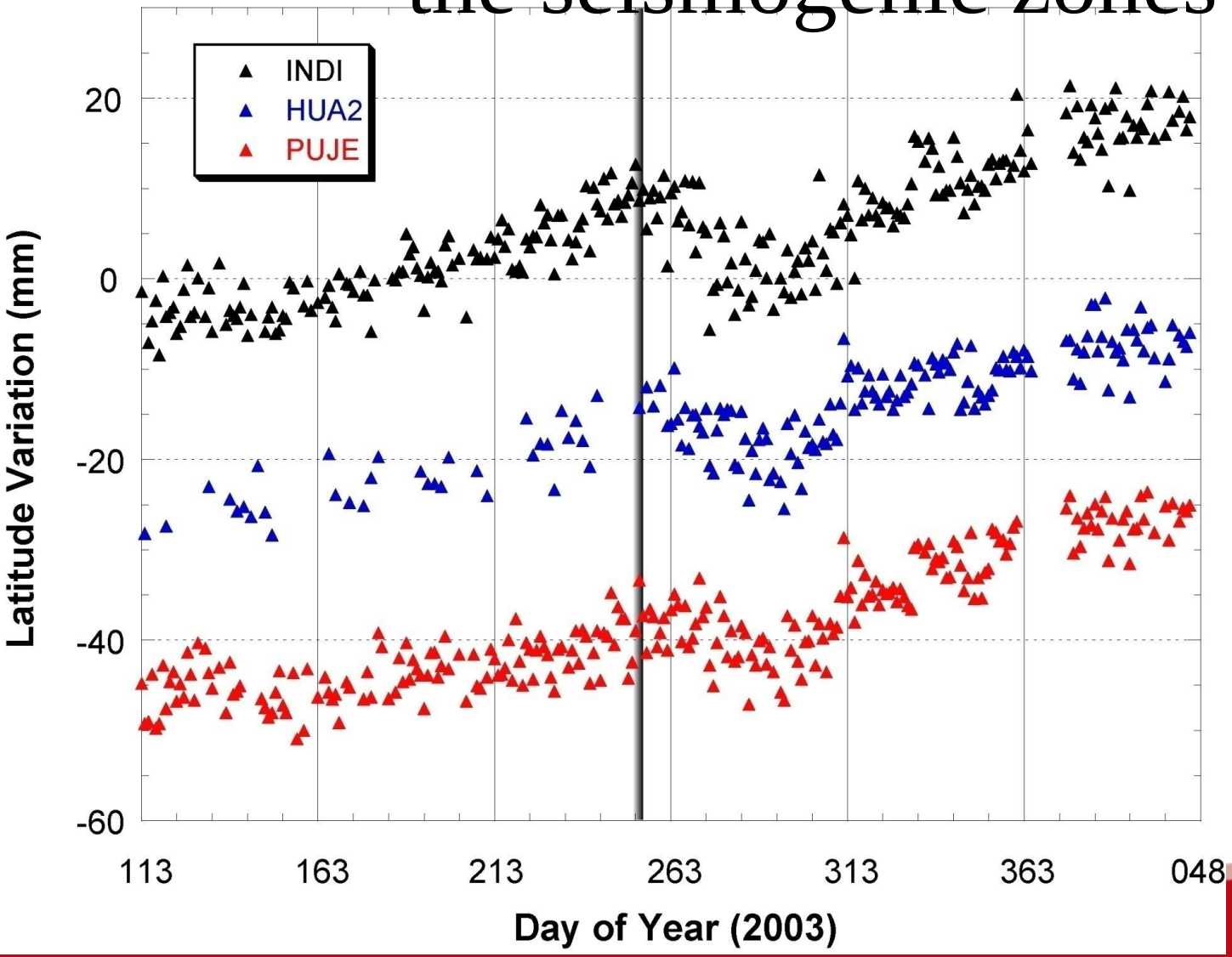

SJOS
LAJA
PALO
PUJE
UVIT
IUAC,HUA2
JOBO
SANI
INDI
CARR
OVSI
50 km

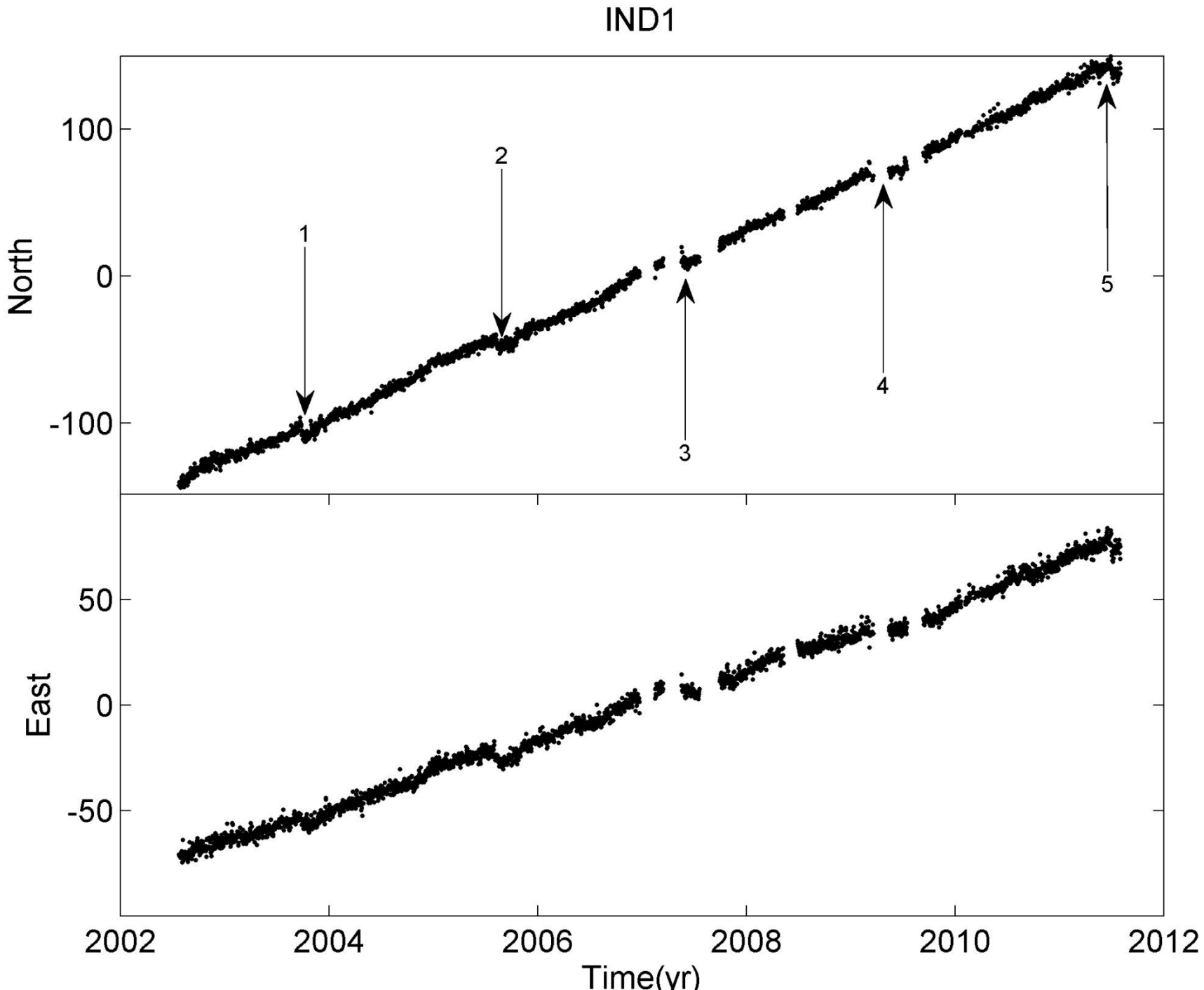
Subduction zone



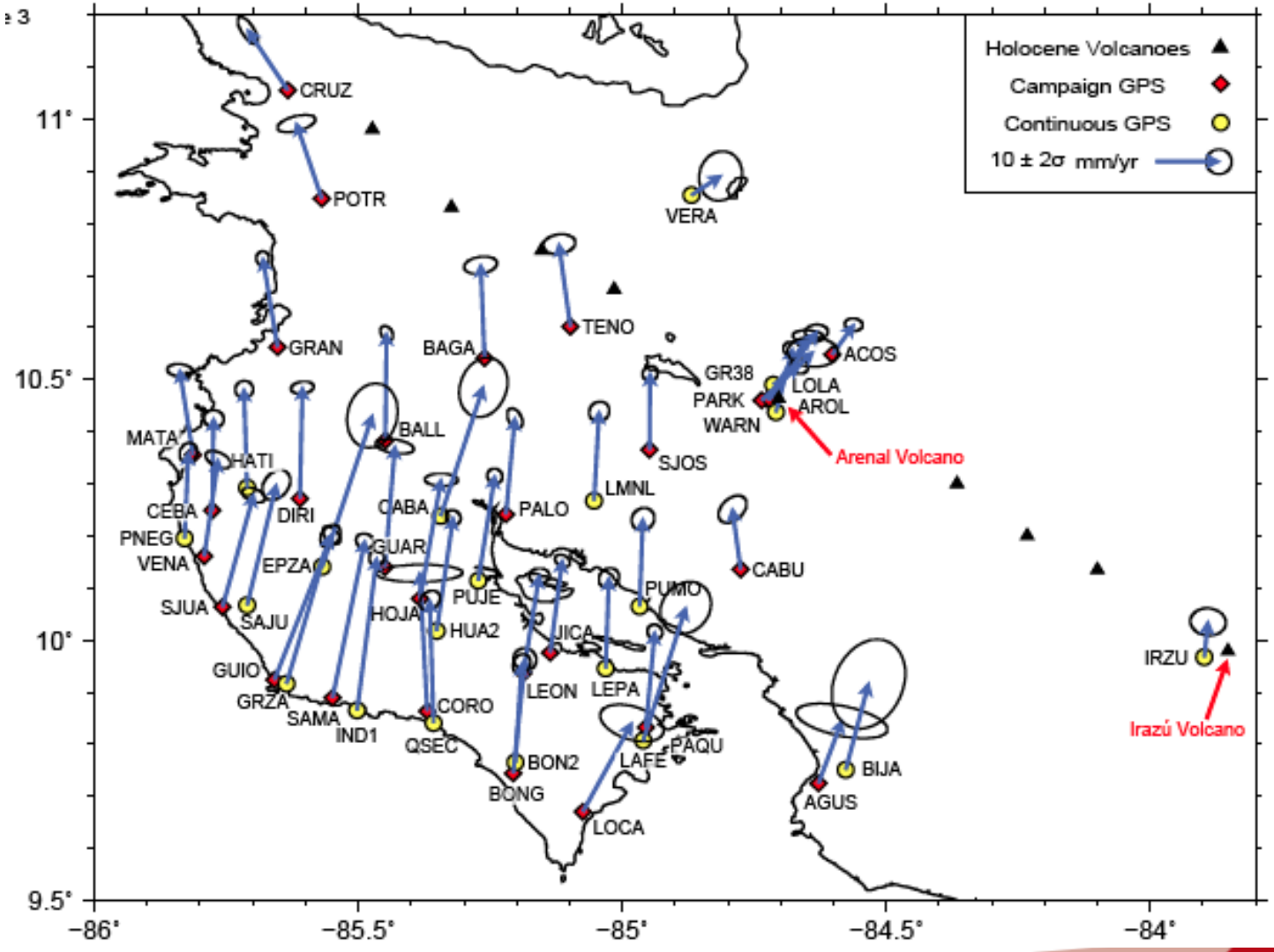
Sámara, May 2008

First slow slip event recorded whitin the seismogenic zones



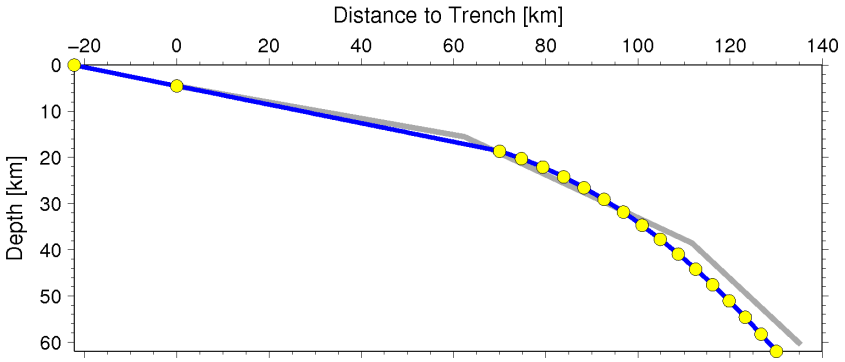

IND1
North
East
100
0
-100
50
0
-50
1
2
3
4
5
2002
2004
2006
2008
2010
2012
Time(yr)

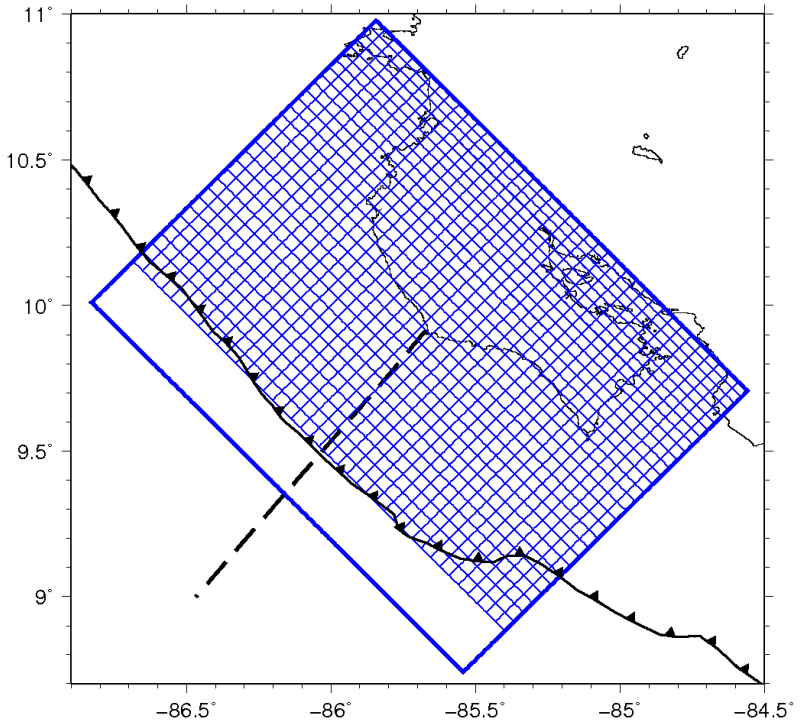
1996 – 2010 Nicoya regional velocity field



Feng et al., 2012

Interseismic Megathrust Coupling Model

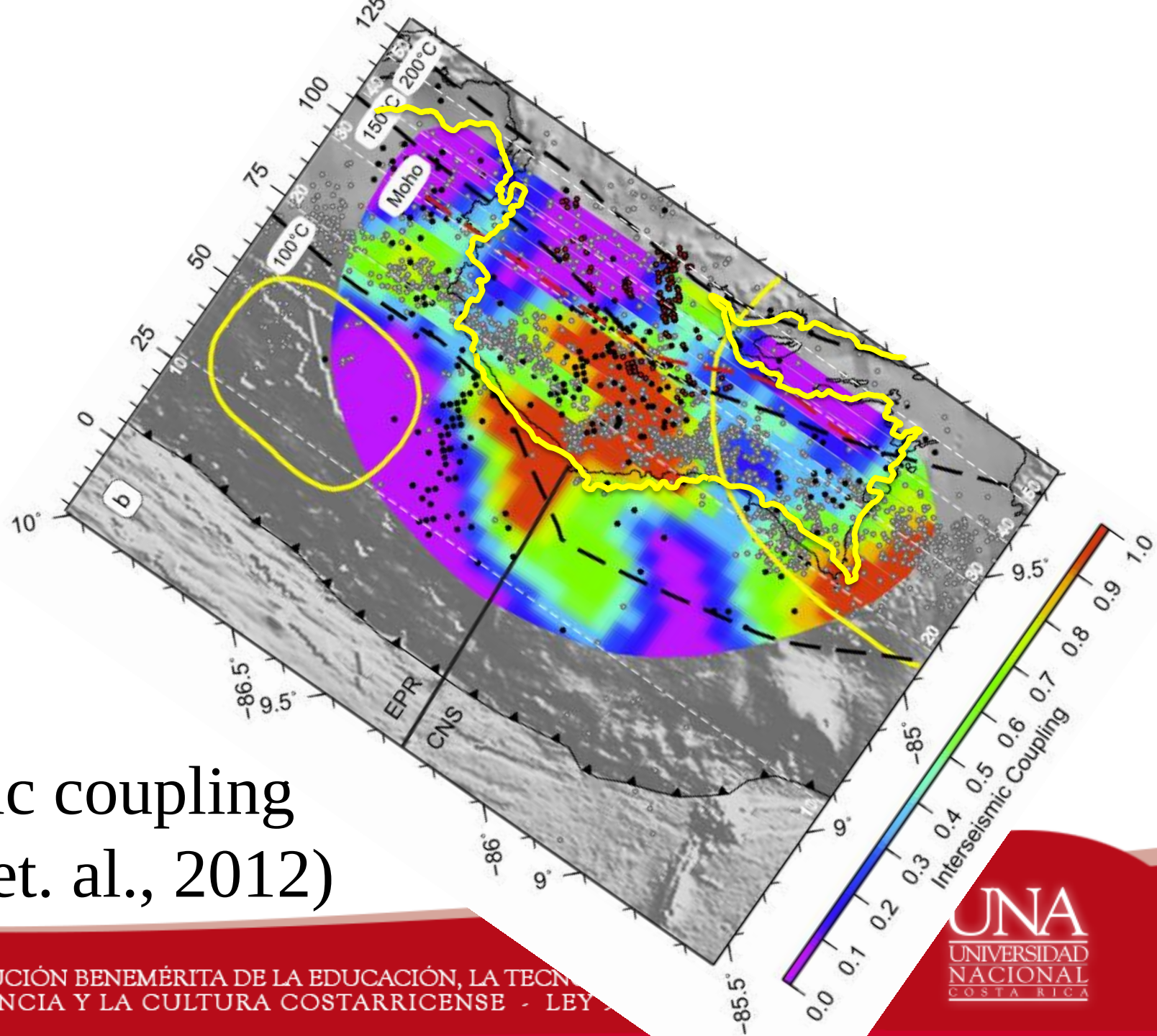




- Okada model

  (*Okada BSSA 1992*)
- Stress minimization smoothing
- Interface determined by maximum seismicity method
- Free surface at trench
- Maximum displacement at the plate convergent rate of

  (*DeMets et al. GJI 2010*)



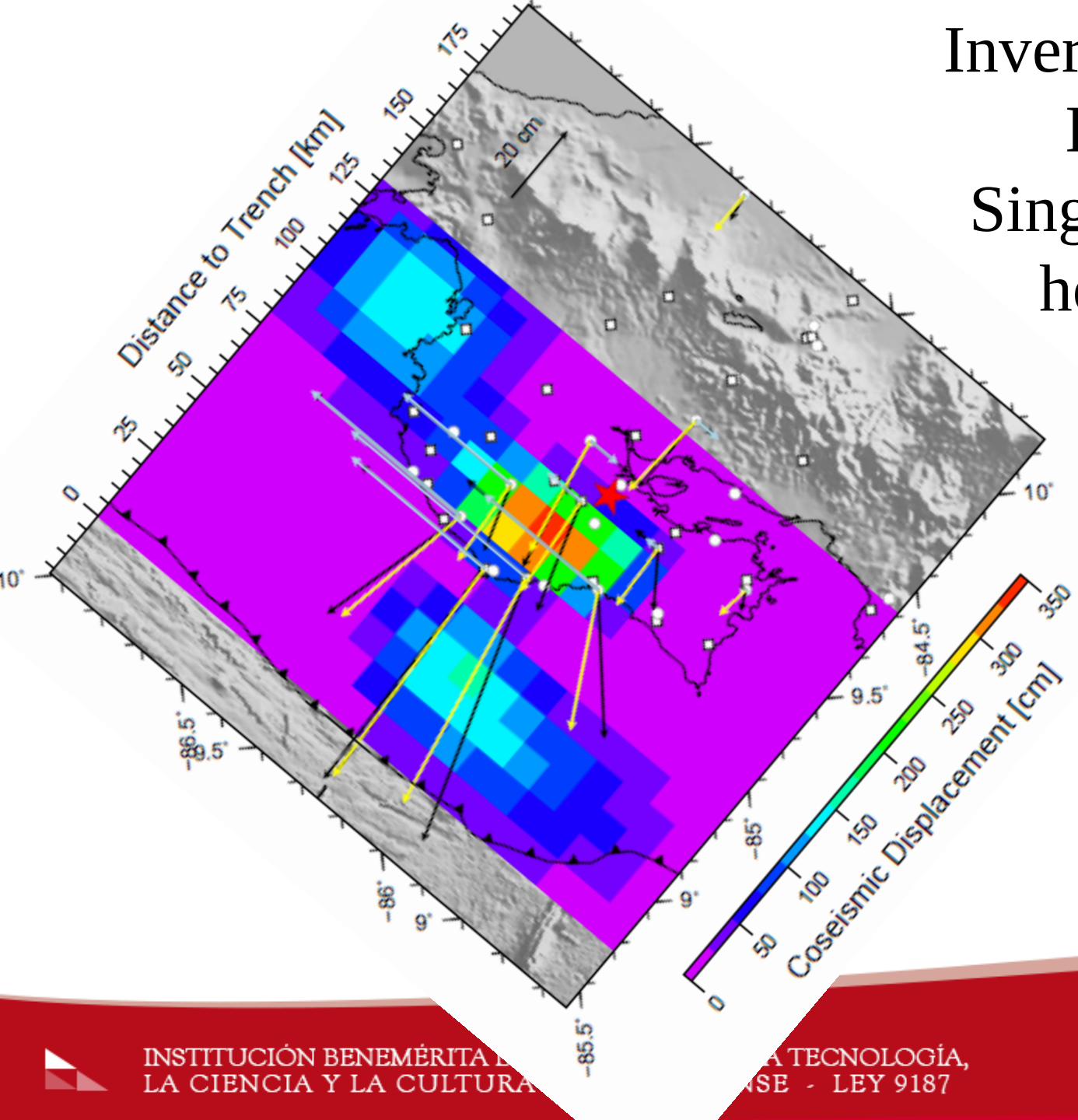
Elastic coupling (Feng et. al., 2012)

September 5th, 2012

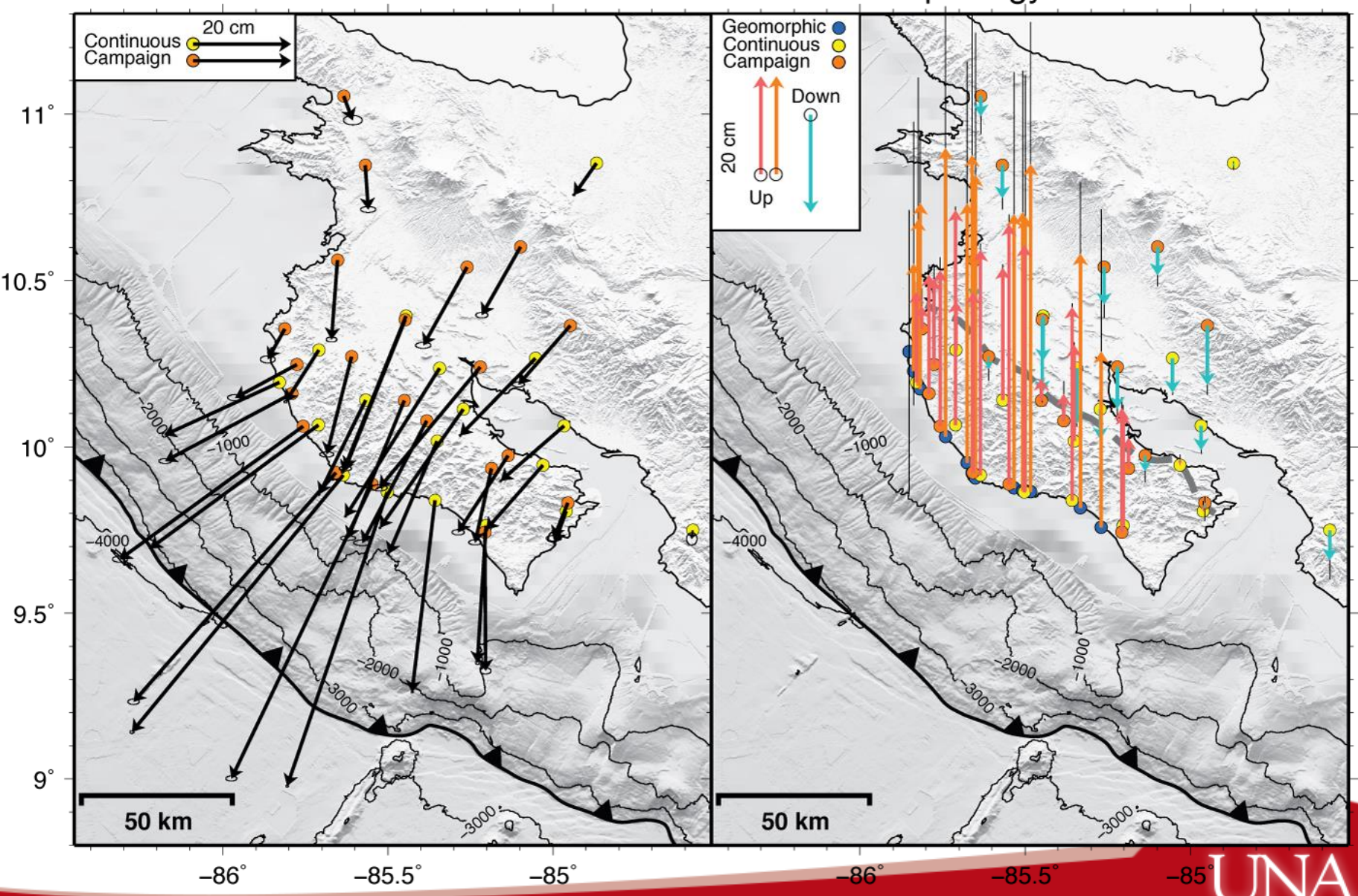
8:42 AM

Mw=7.6

Inversion done by Lujia Feng in Singapore only 2 hours after the earthquake

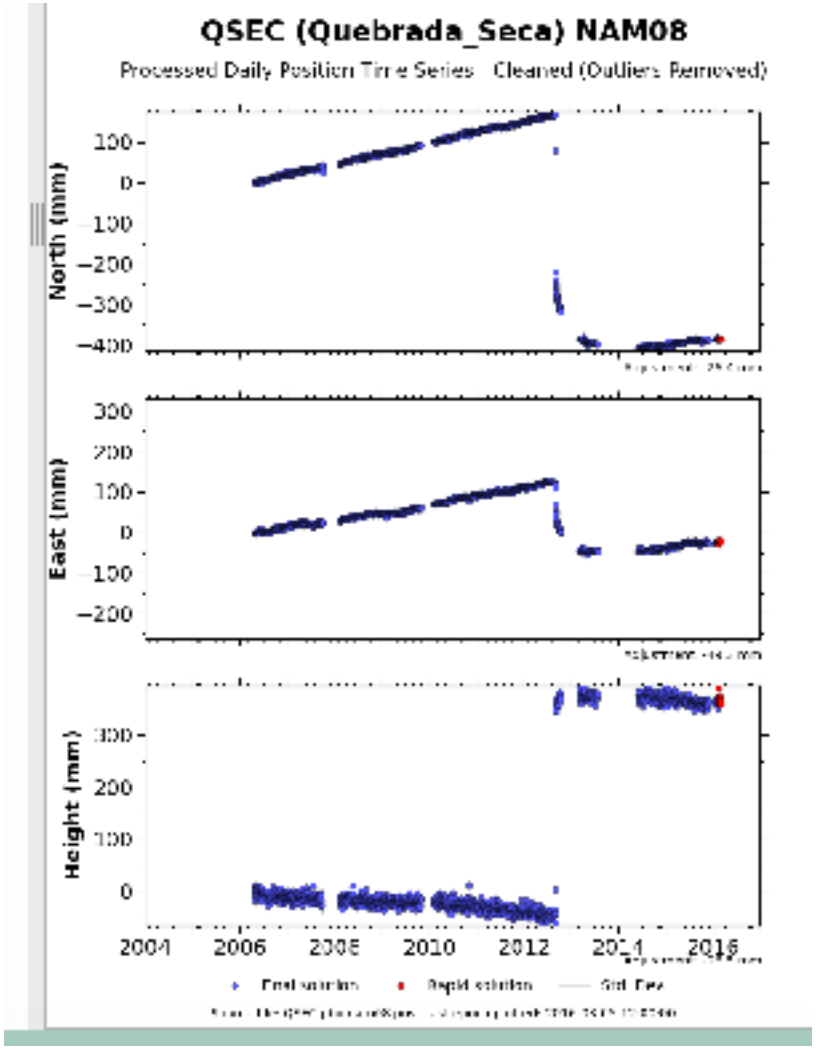


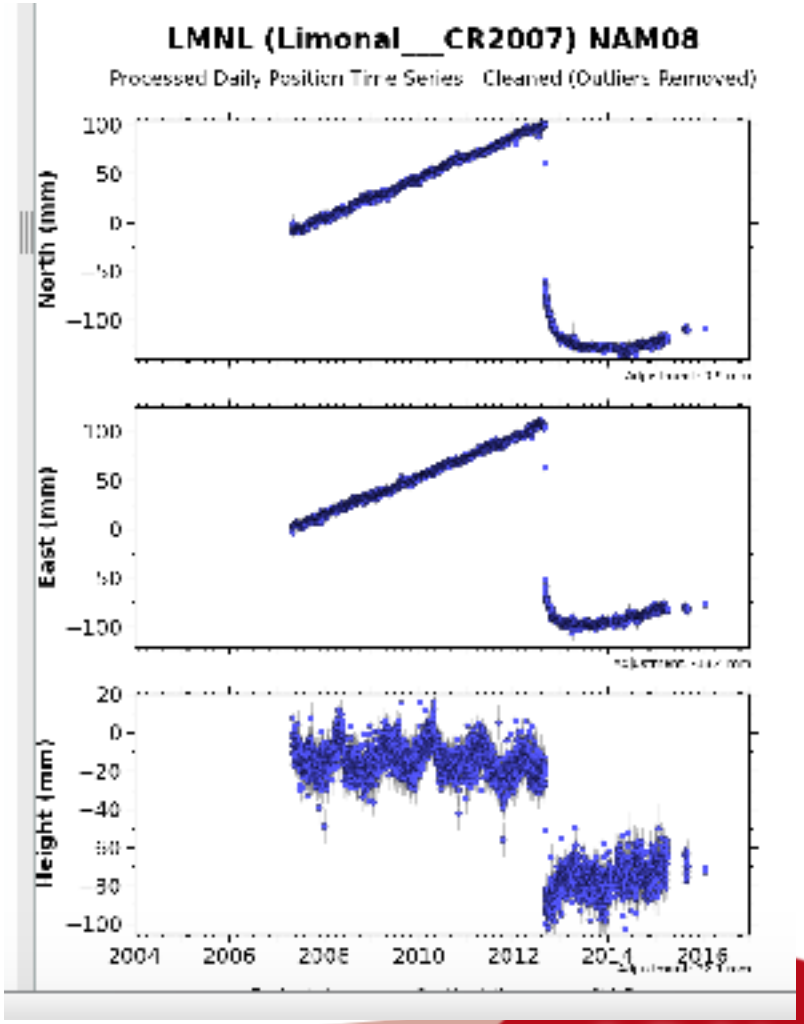
Coseismic offset from GPS and Geomorphology



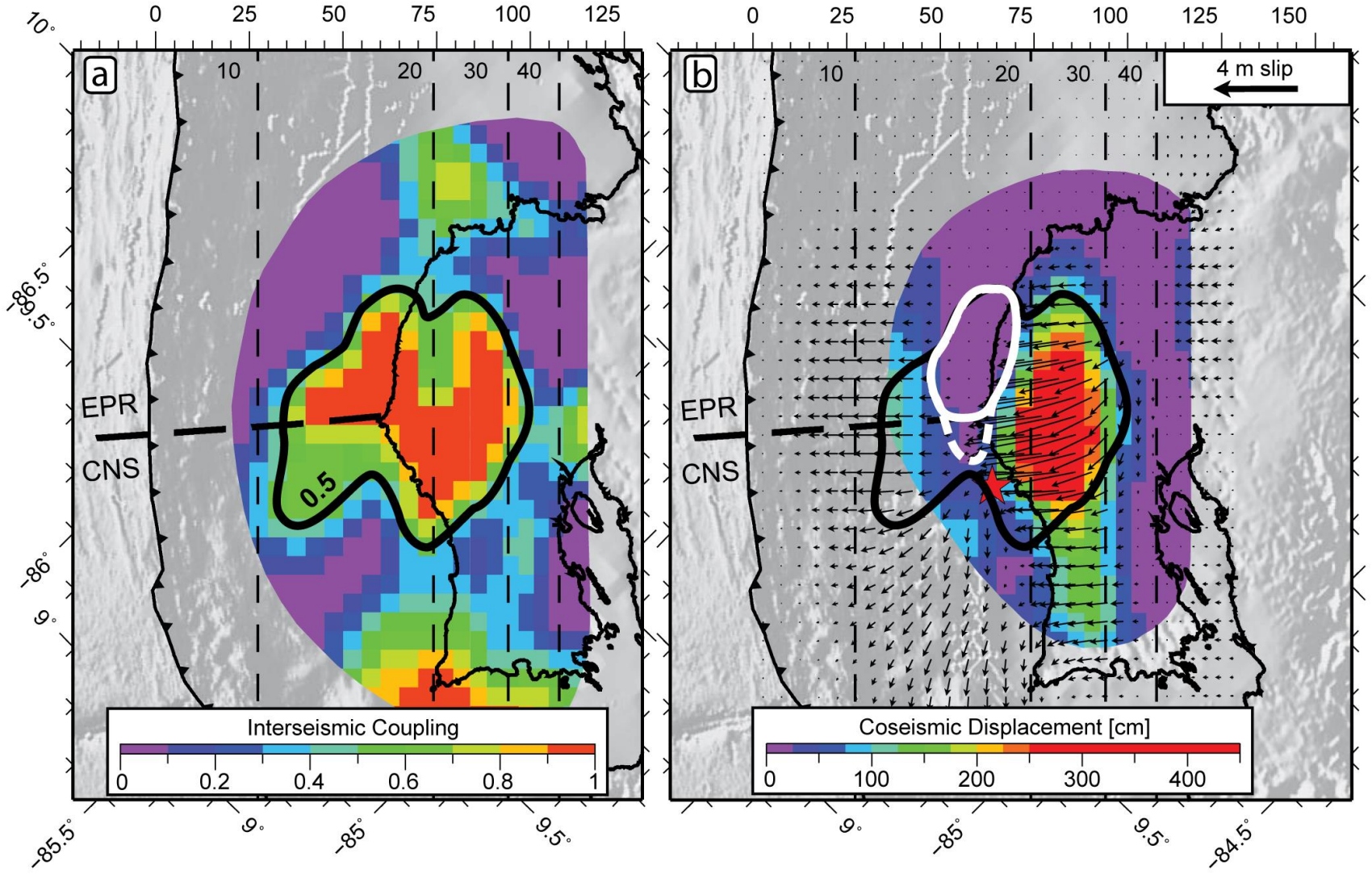

A year after the earthquake

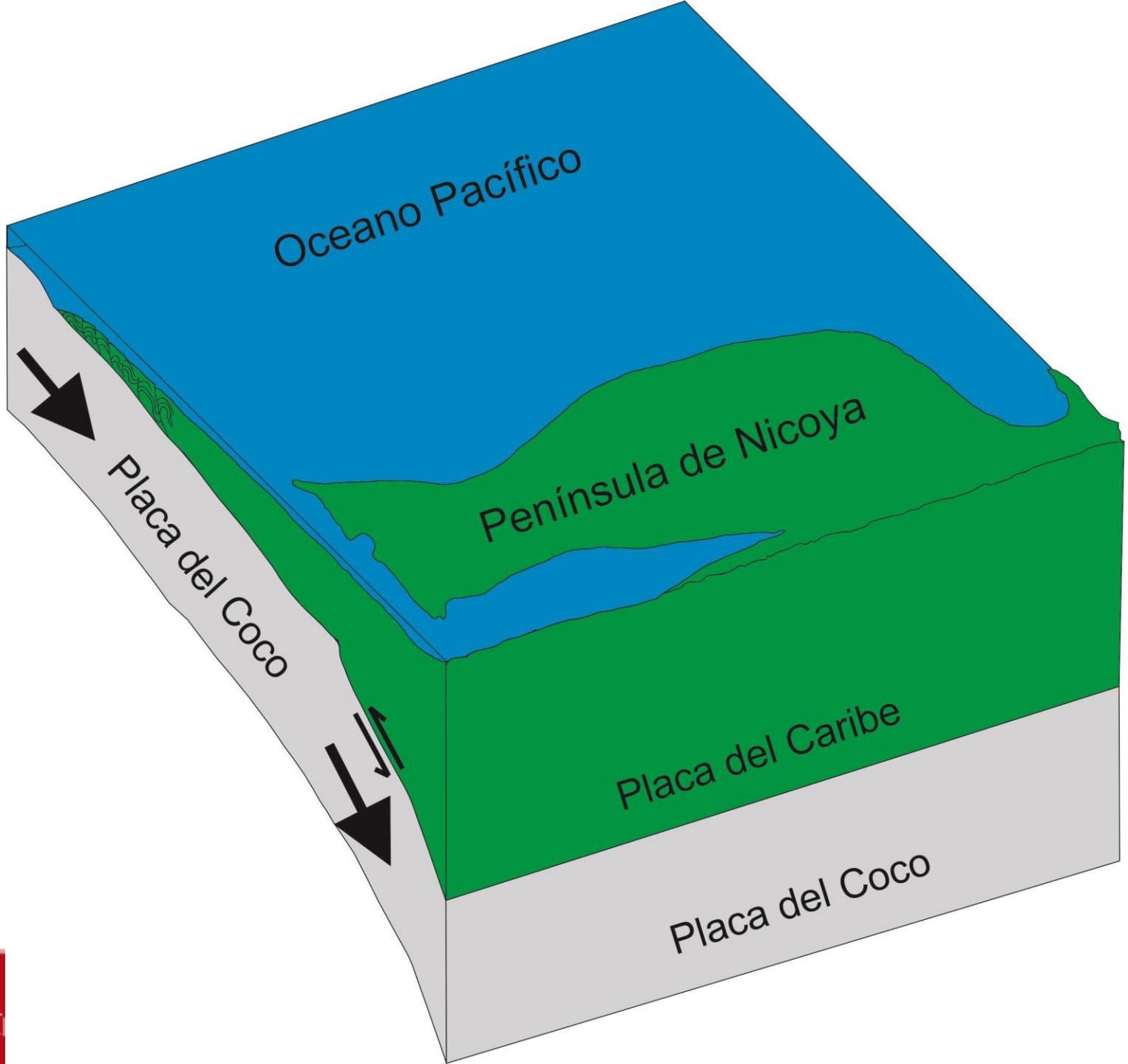
Post-seismic deformation



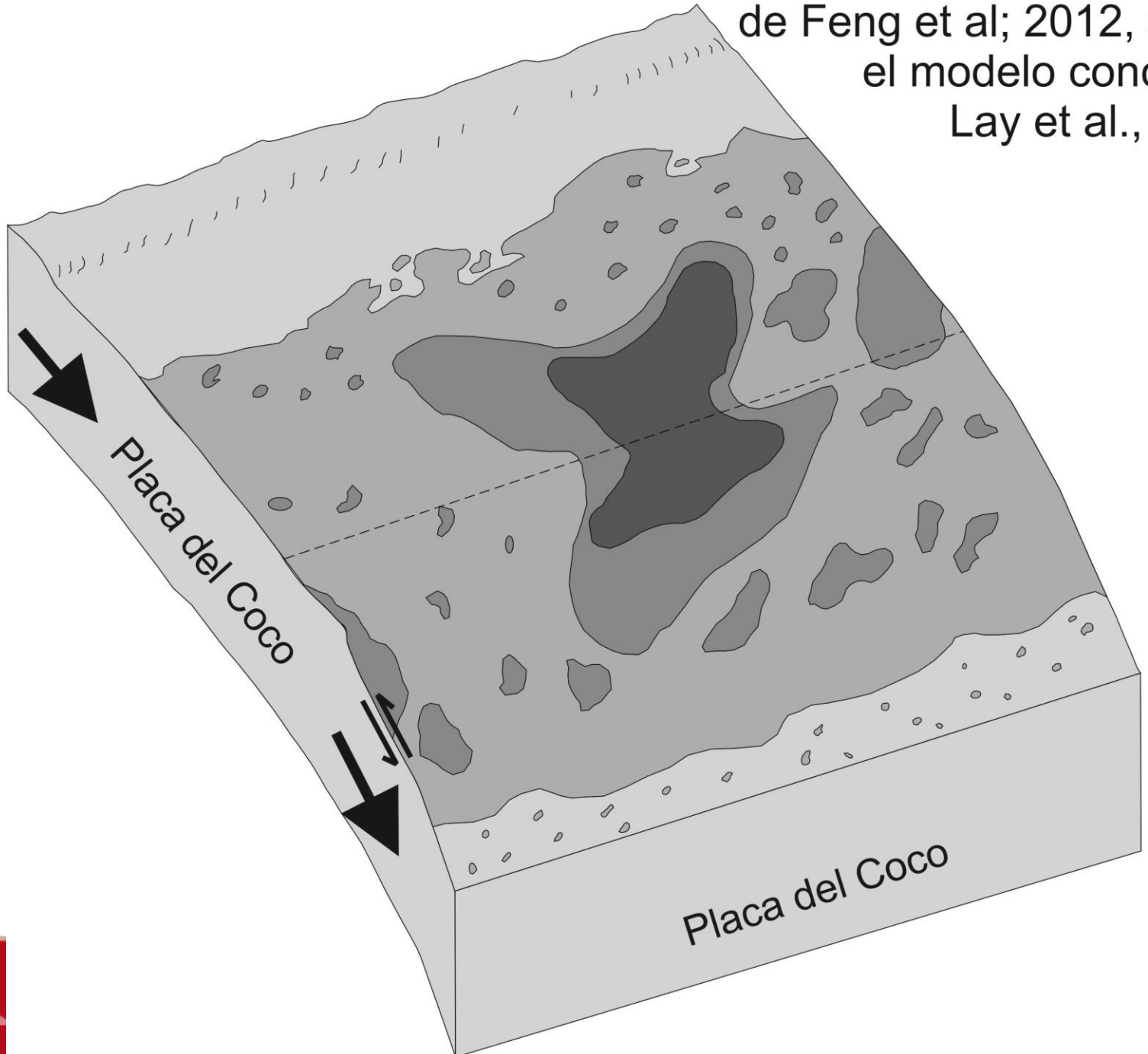


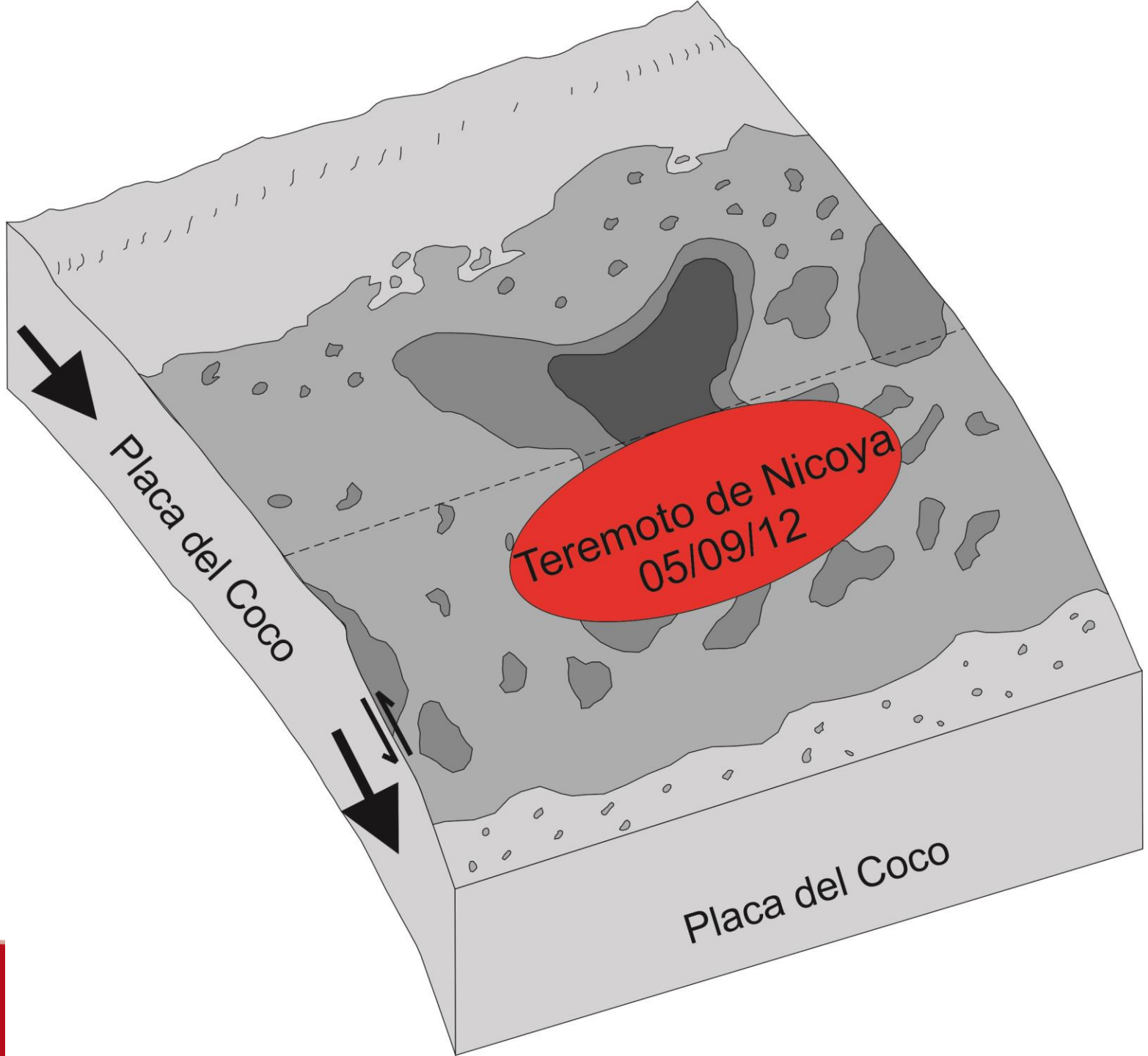
Before and after




Oceano Pacífico
Península de Nicoya
Placa del Coco
Placa del Caribe
Placa del Coco

Representación esquemática de los resultados de Feng et al; 2012, siguiendo el modelo conceptual de Lay et al., 2012.




Placa del Coco
Teremoto de Nicoya
05/09/12
Placa del Coco

CONCLUSIONS

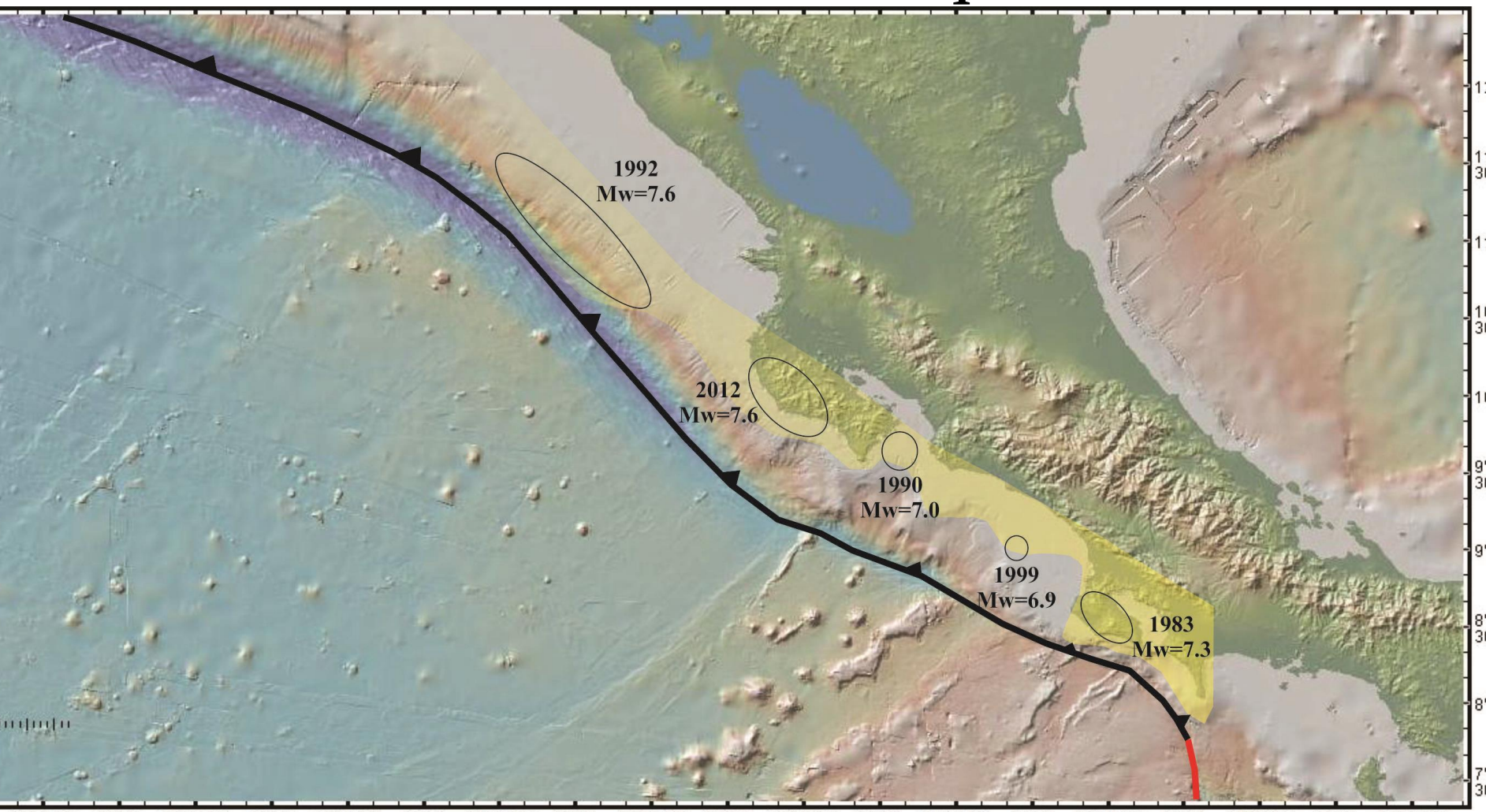
- The instrumentation of the Nicoya peninsula was a successful experiment crowned with the occurrence of the September 5th, 2012 Nicoya earthquake.

- The Nicoya experiment socially contributed in helping reducing the impact of the Nicoya 2012 earthquake.

- Since the Nicoya 2012 earthquake only partially filled the Nicoya seismic gap, the occurrence of another large earthquake is an scenario that can not exclude.

- This pre-seismic, co-seismic and post-seismic monitoring effort is an excellent example of true and transparent international scientific cooperation.

Seismogenic zone and most recent earthquakes



Configuración de la futura red de monitoreo geodinámico del OVSICORI-UNA en el sur de Costa Rica.

One last conclusion …

- CGPS (and InSAR) are be the best tools for the advancement of earthquake prediction.


THANK YOU