

# Banda Aceh December 26th Earthquake monitored by GPS

C. Vigny (1) , W.J.F. Simons (2), S. Abu (3), Chalermchon Satirapod (4), M. Hashizume (5), Sarayut Yousamran (6), C. Subarya (7), K. Omar (8), H.Z. Abidin (9), A. Socquet (1), B.A.C. Ambrosius (1), and P. Tregonning(10)

(1) Laboratoire de Geologie, ENS-CNRS, France

(2) DEOS, TU-Delft, The Netherlands

(3) DSMM, Kuala Lumpur, Malaysia

(4-5) Chulalongkorn University, Bangkok, Thailand

(6) Royal Thai Survey Department (RTSD), Bangkok, Thailand

(7) BAKOSURTANAL, Cibinong, Indonesia

(8) University of Technology Malaysia (UTM), Malaysia

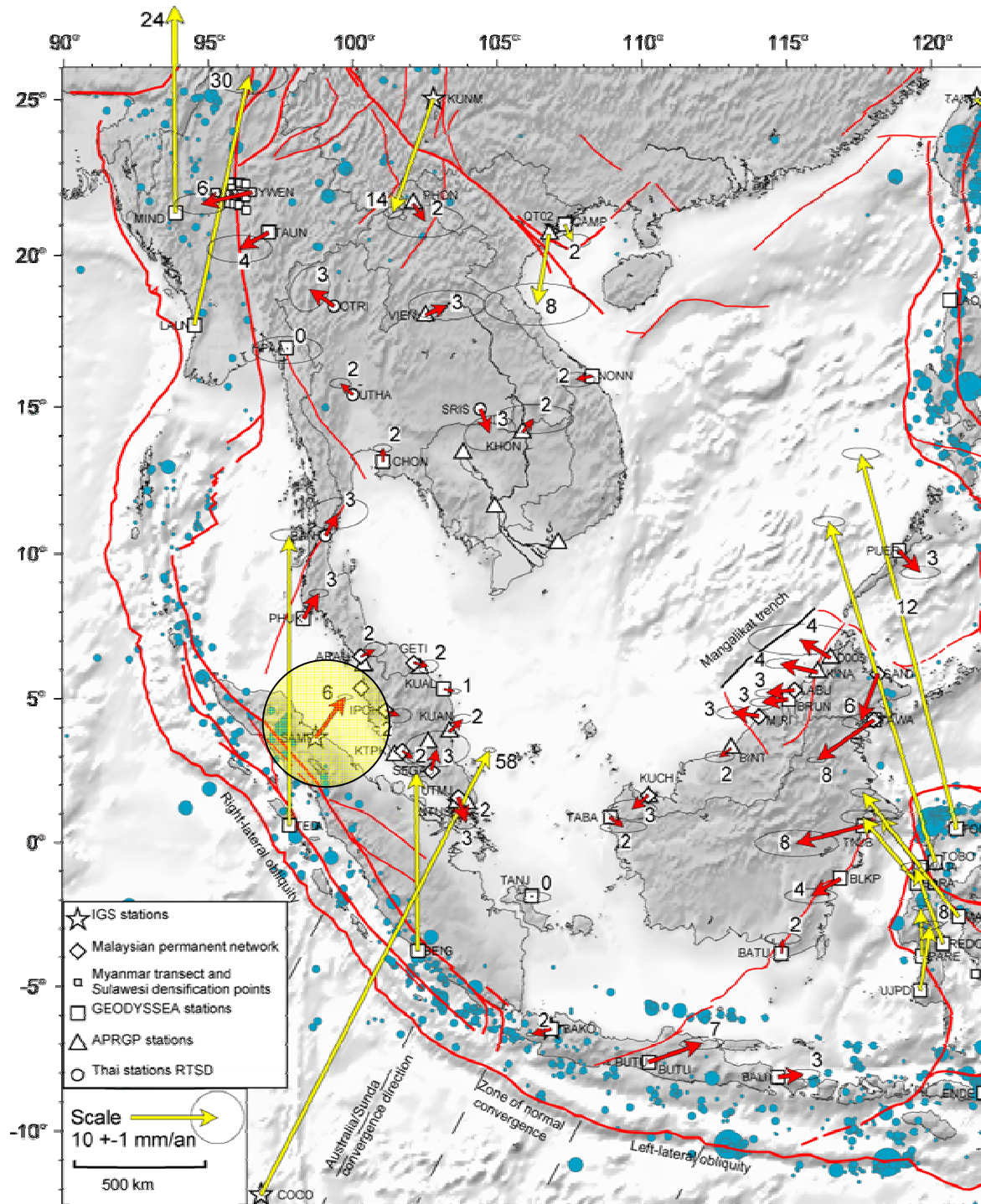
(9) Institute of Technology Bandung (ITB), Bandung, Indonesia

(10) University of Canberra, Australia

**SEAMERGES :**

**<http://www.deos.tudelft.nl/seamerges>**





An Earthquake there was not unexpected

**GEODYSSEA  
+  
SEAMERGES**

**GPS campaigns  
~100 sites**

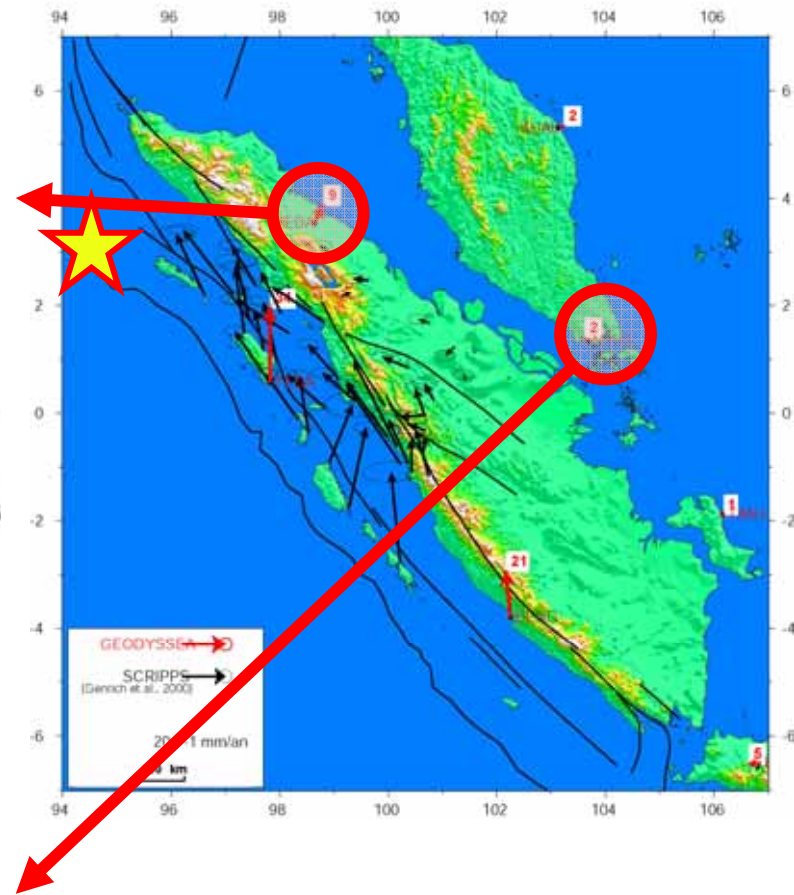
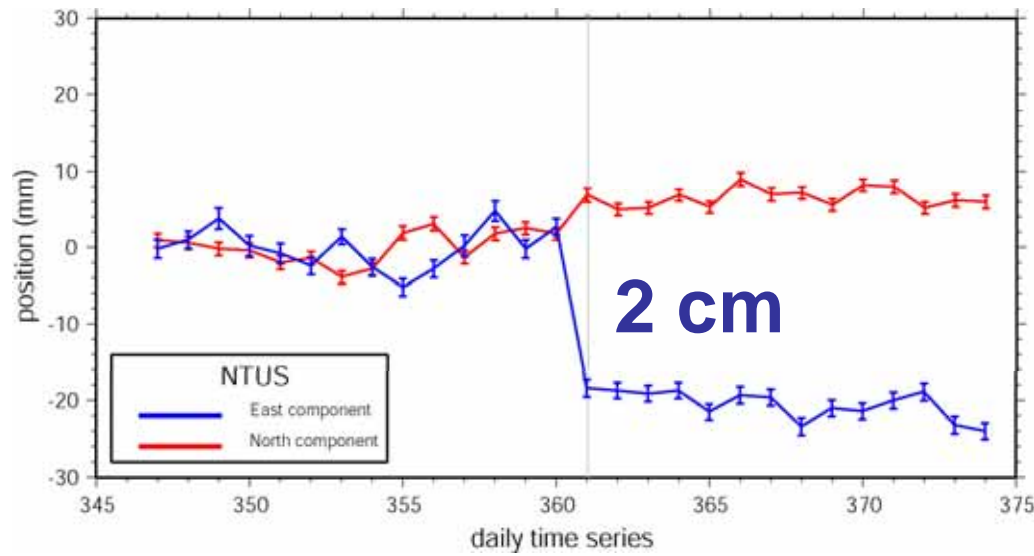
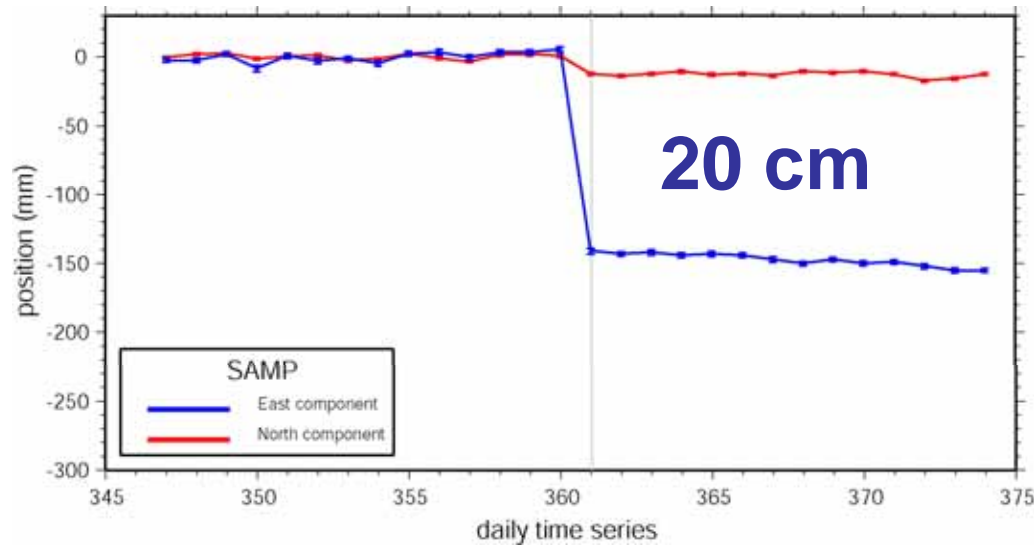
**Sundaland platelet**

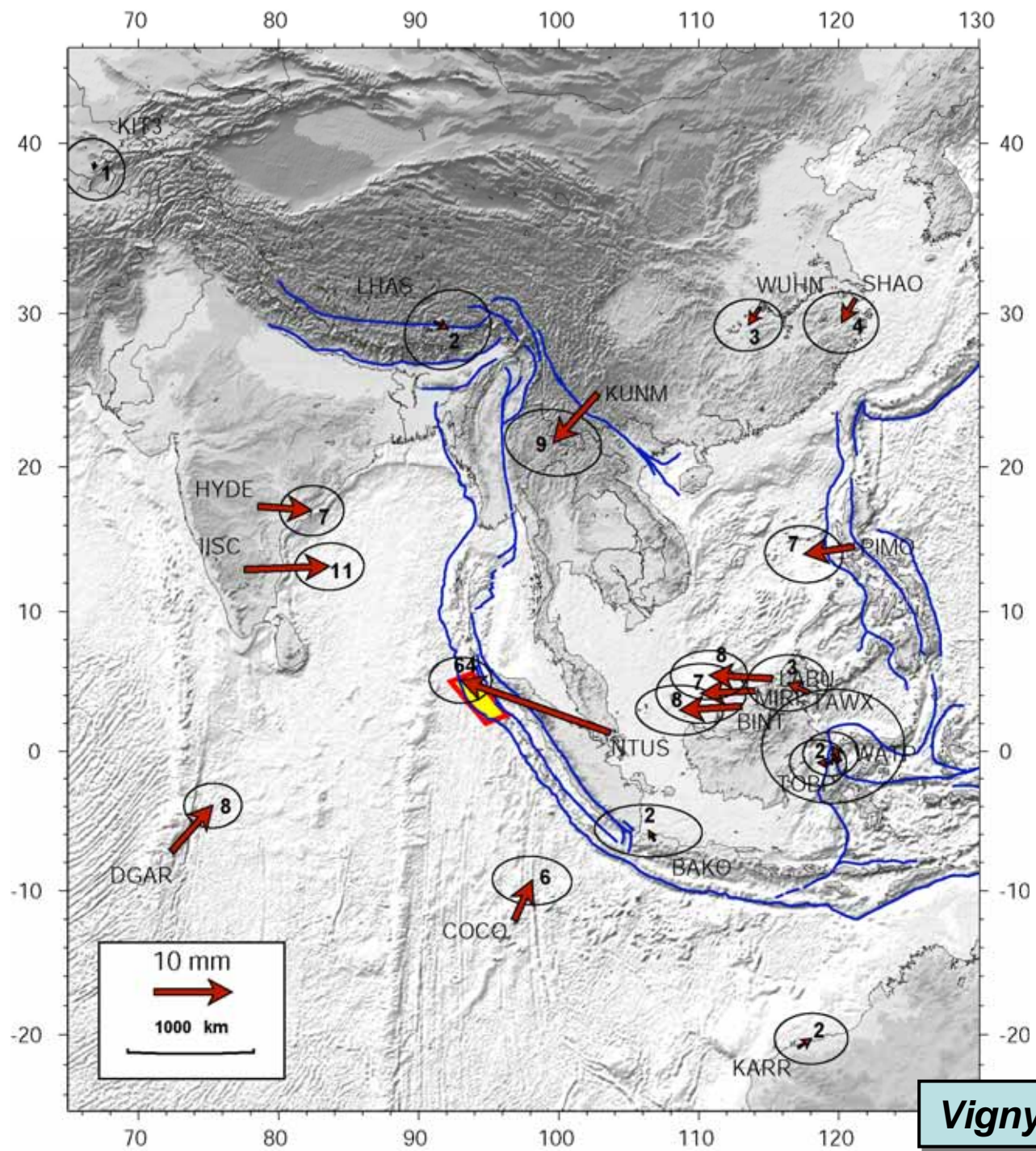
Socquet et al., 2003

Simons et al., 2004

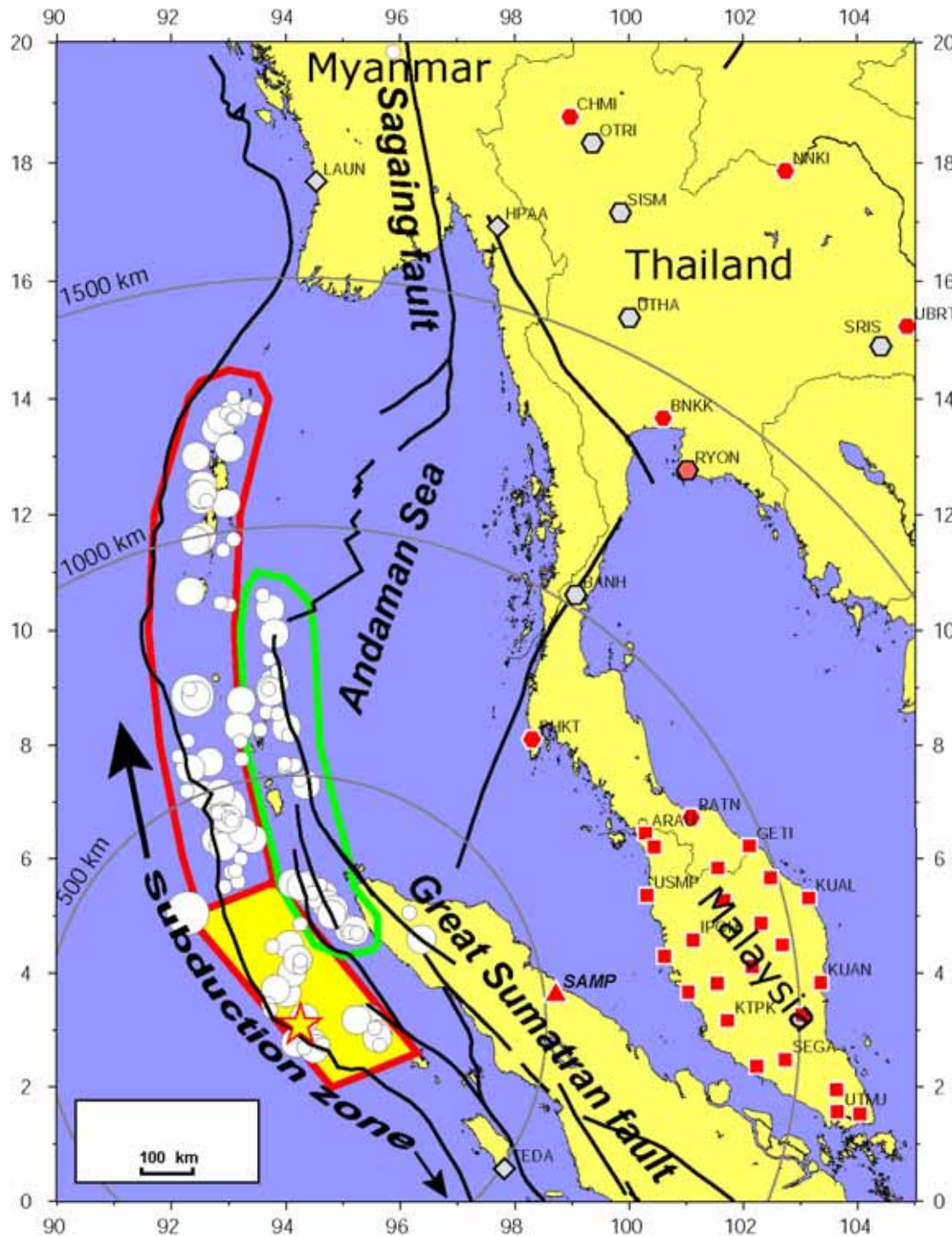
*Vigny et al., 2005*

Sumatra 92-94-96-98-00 (ITRF2000)  
ENS solution / ENS Sundaland (59.4.-99.3.0.30)





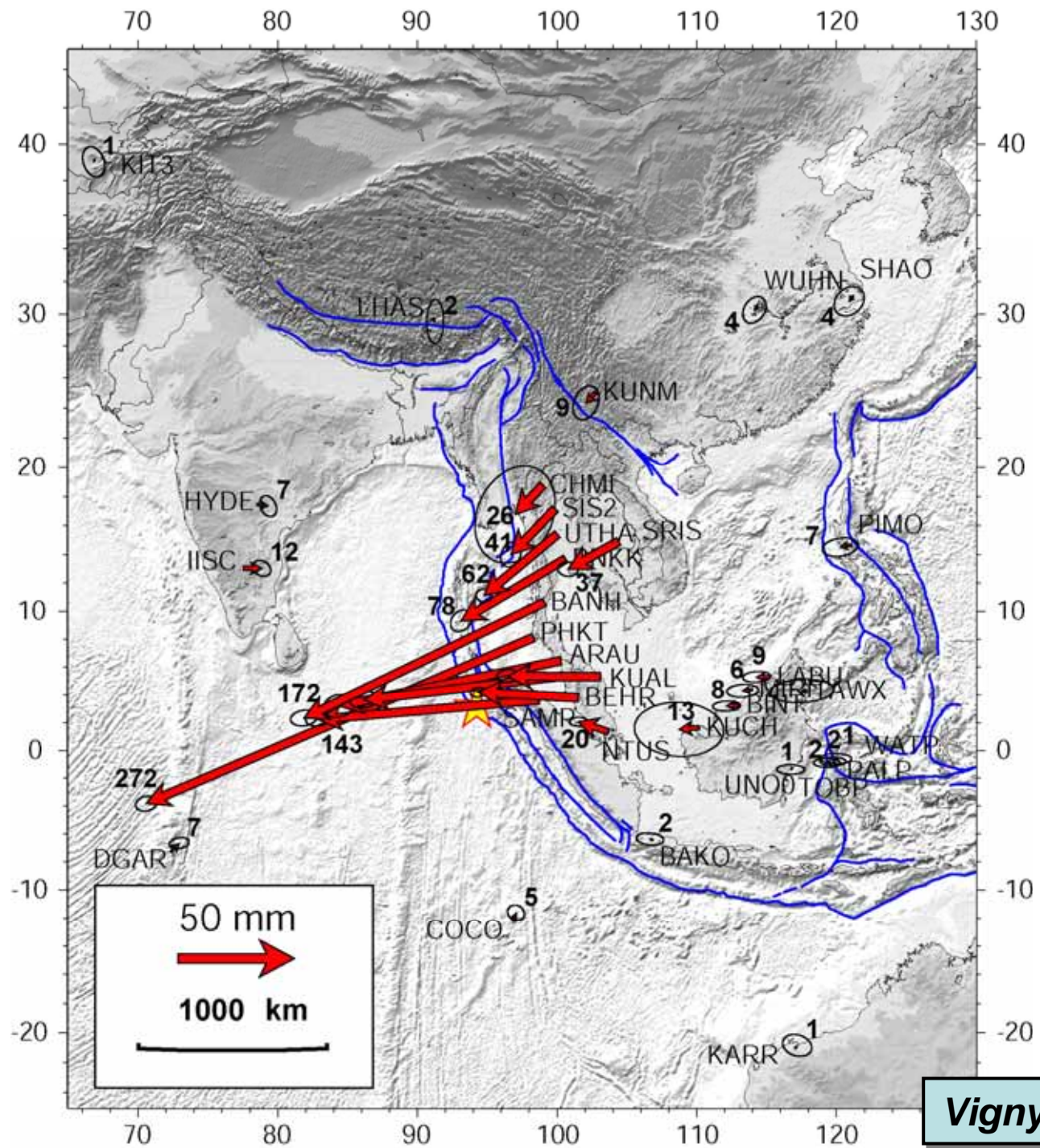
**Vigny et al., 2005**



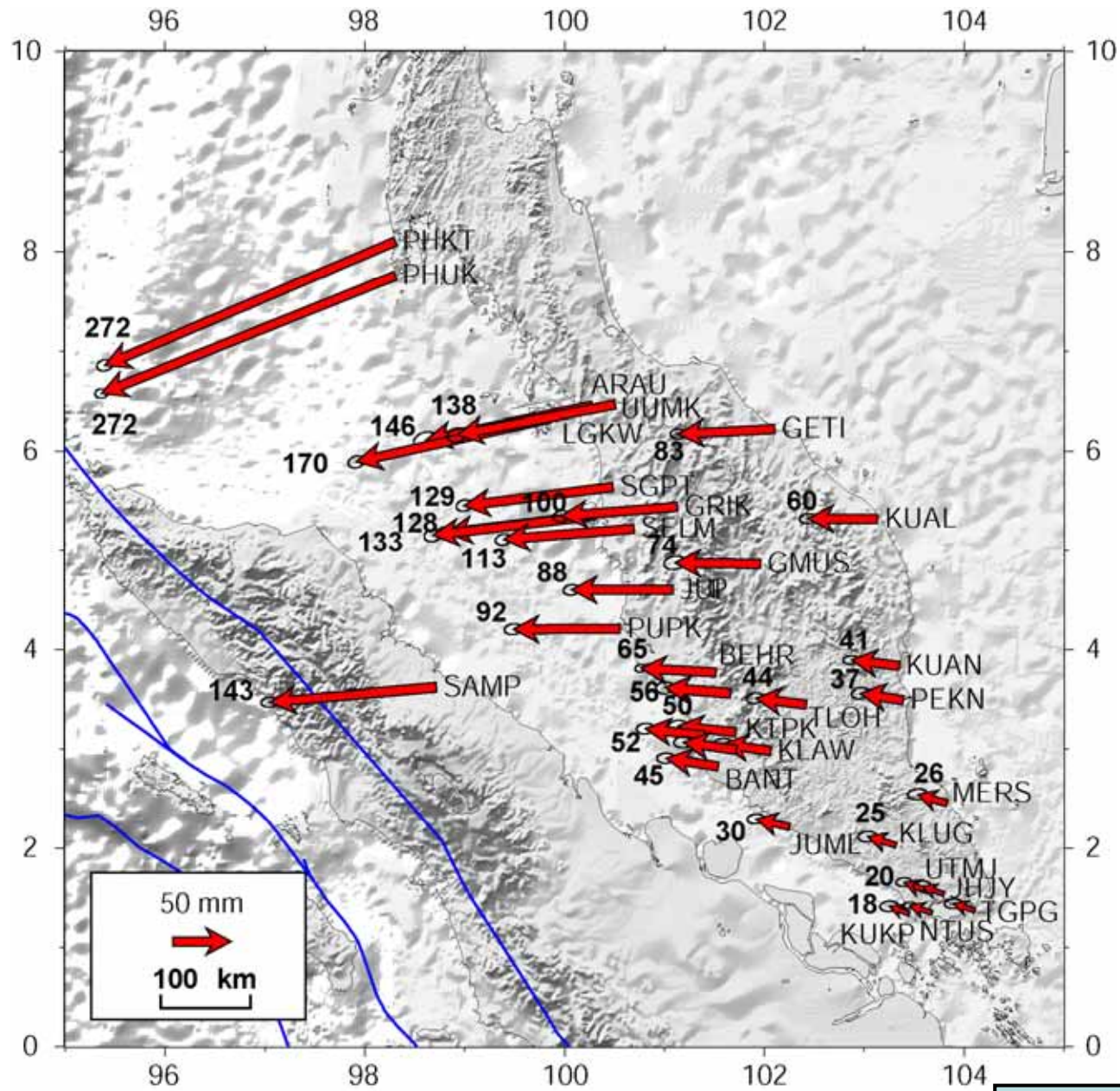
**Thanks to ASEAN  
national  
institutions  
(DSMM, UTM,  
RTSD, CU) and  
international  
cooperation  
(ASEAN/EU/Japan)**

**Permanent GPS  
networks do exist  
in Malaysia and  
Thailand**

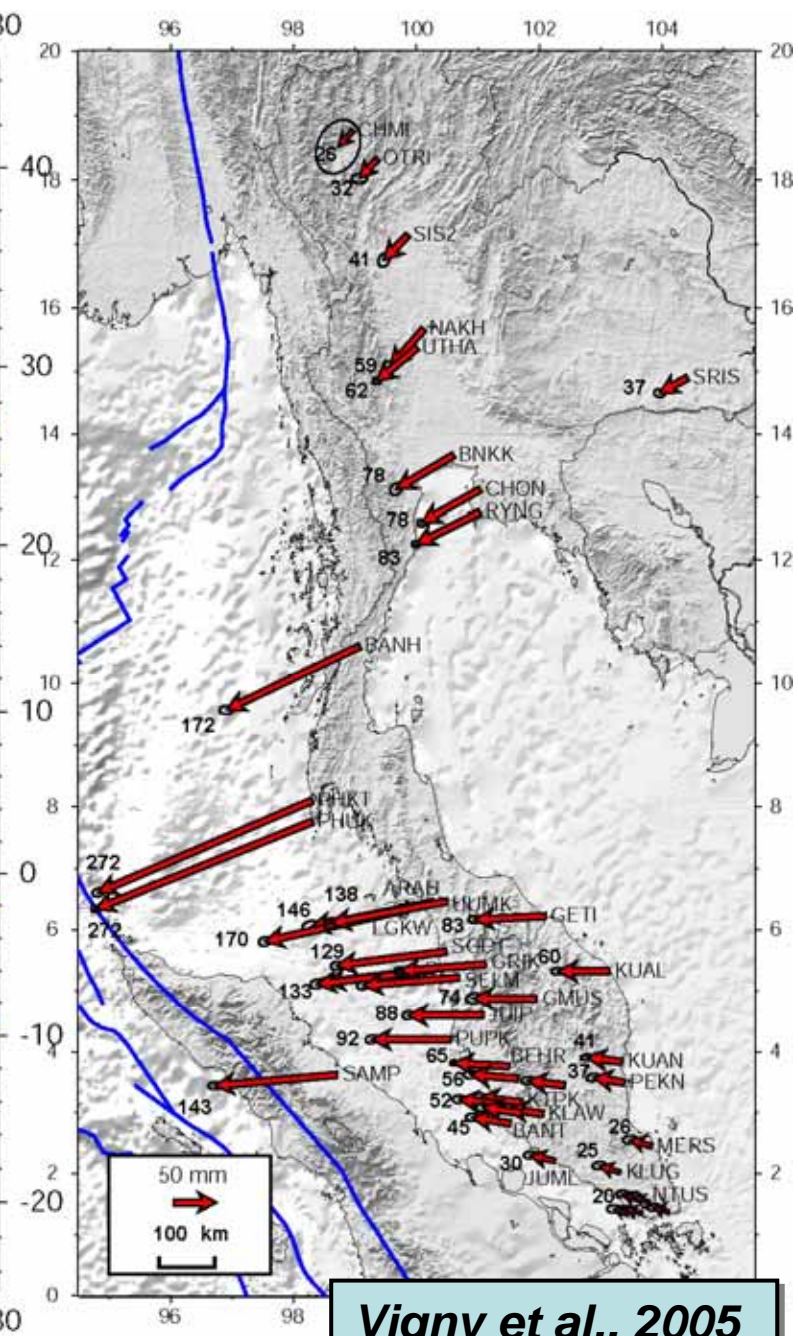
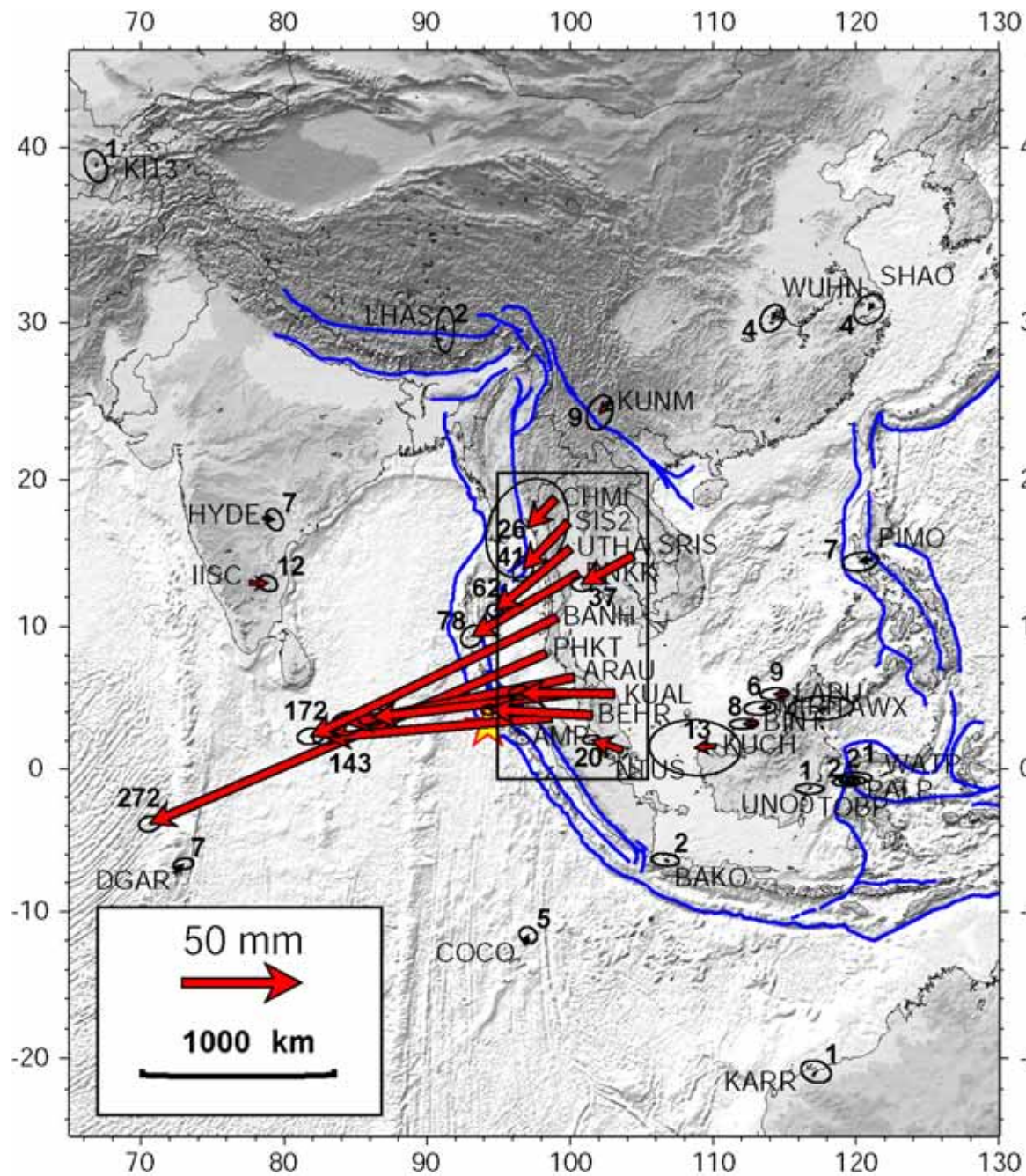
*Vigny et al., 2005*



*Vigny et al., 2005*

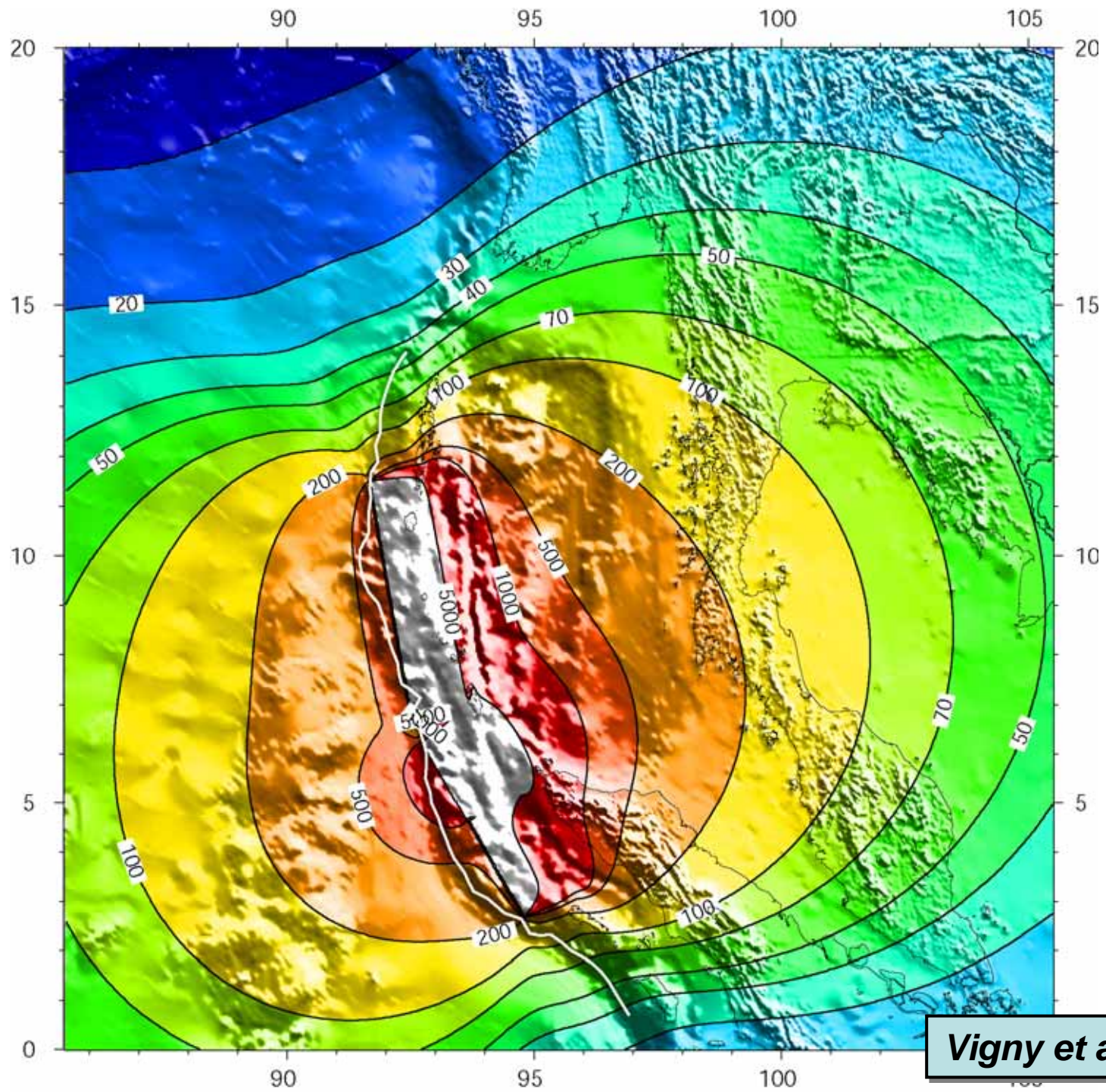


*Vigny et al., 2005*

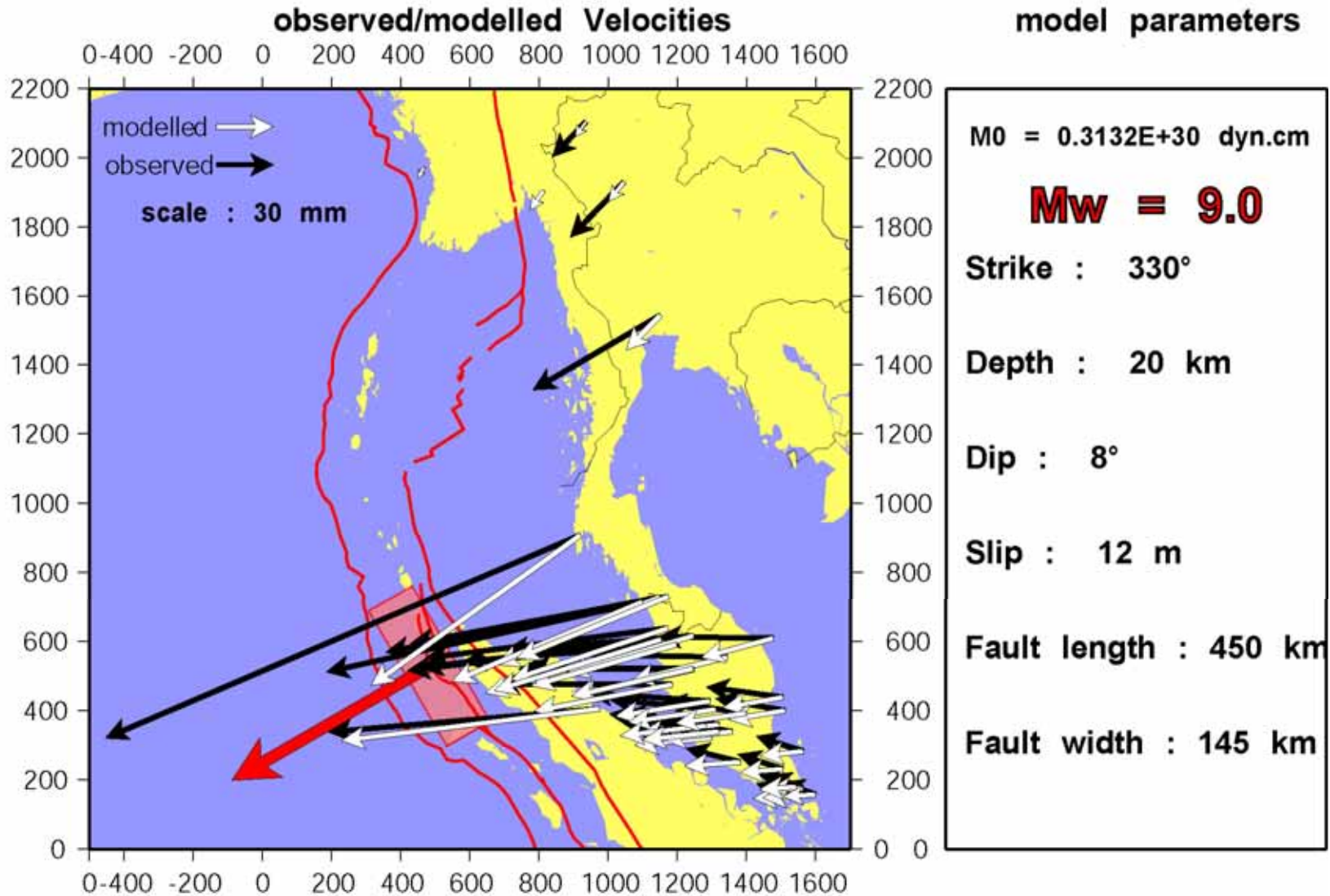


**Vigny et al., 2005**



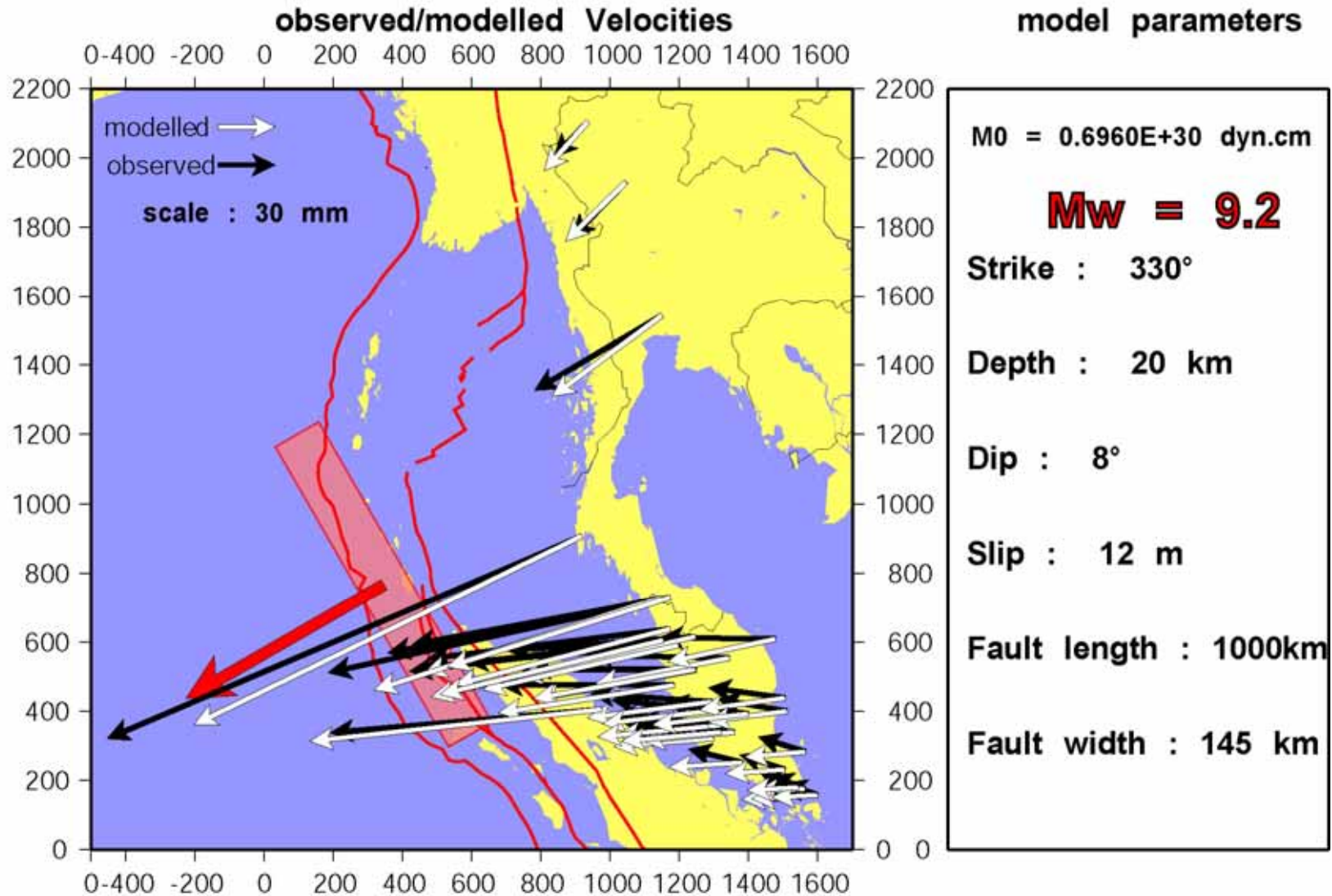


*Vigny et al., 2005*



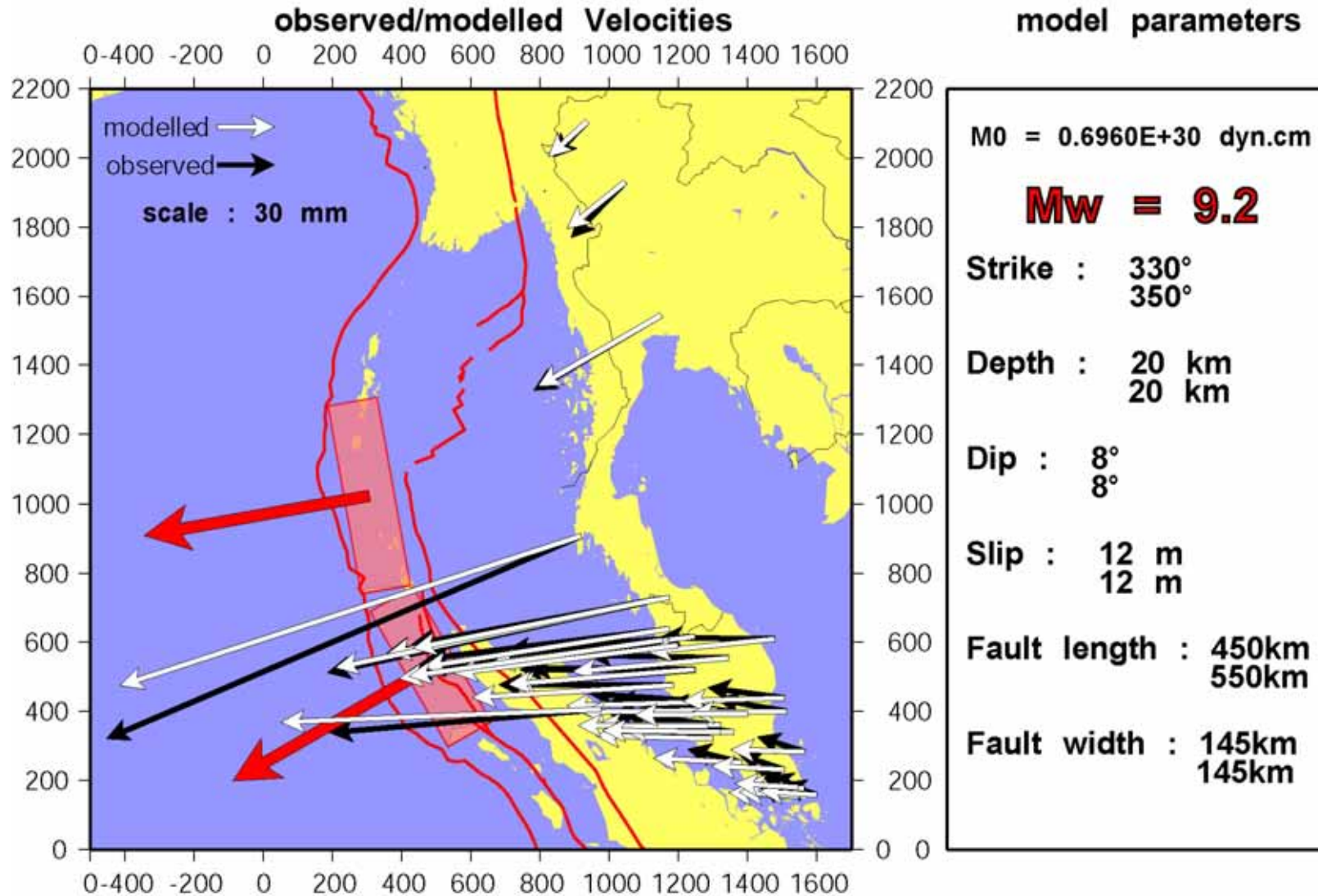
**A rupture of 450 km length gives the reported magnitude ( $M_w=9.0$ )  
but it does not fit the observed deformation**

*Vigny et al., 2005*



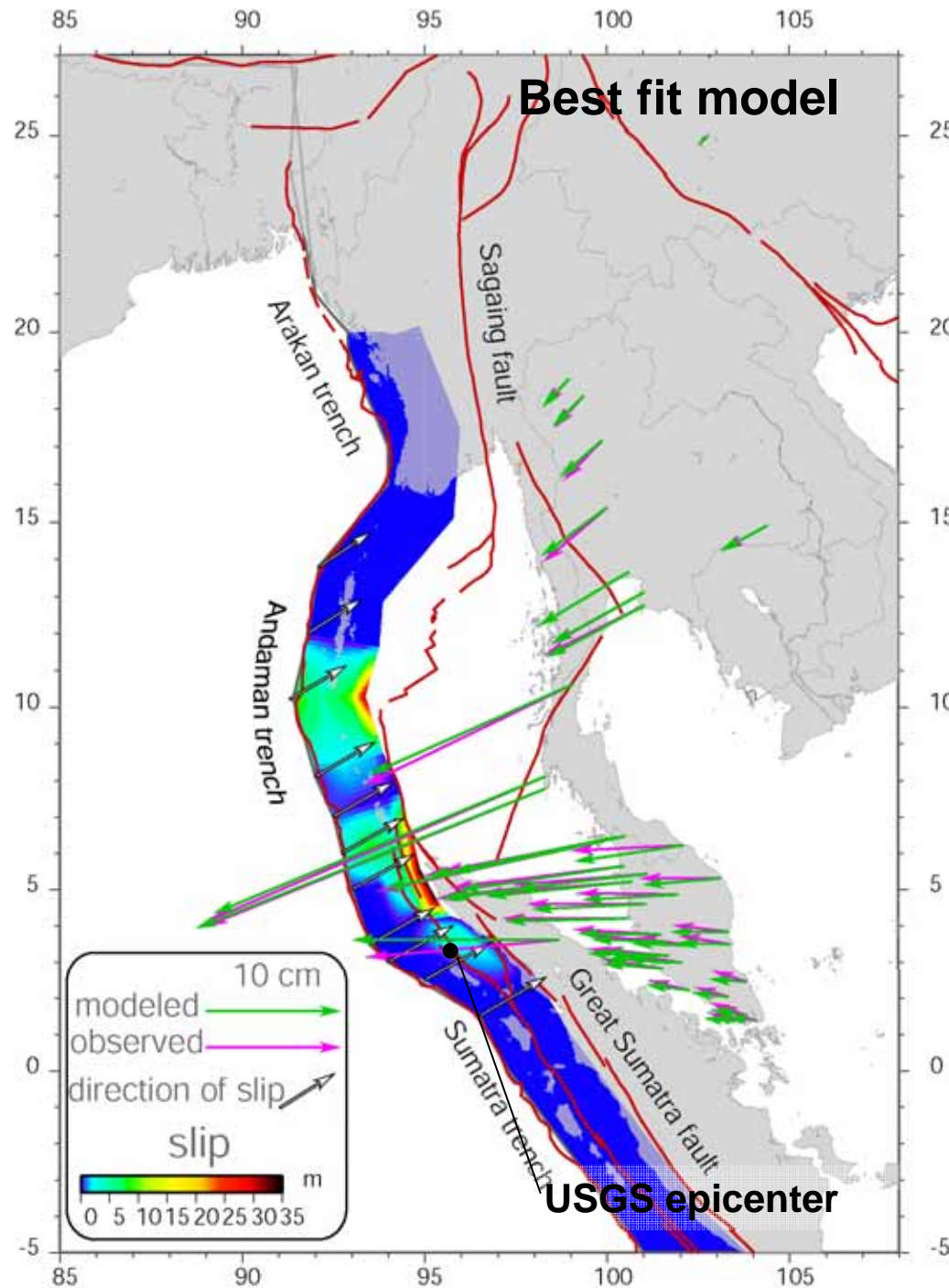
**A rupture of 1000 km length is required to fit far field deformation  
it corresponds to a larger magnitude  $M_w=9.2$**

*Vigny et al., 2005*



**Curvature of the trench must be taken into account to fit observed directions in Northern Malaysia**

*Vigny et al., 2005*



**1/ rupture length = 1200 km**

**Northward propagation  
from the epicenter**

**2/ heterogeneous slip**

- Almost no slip in the south

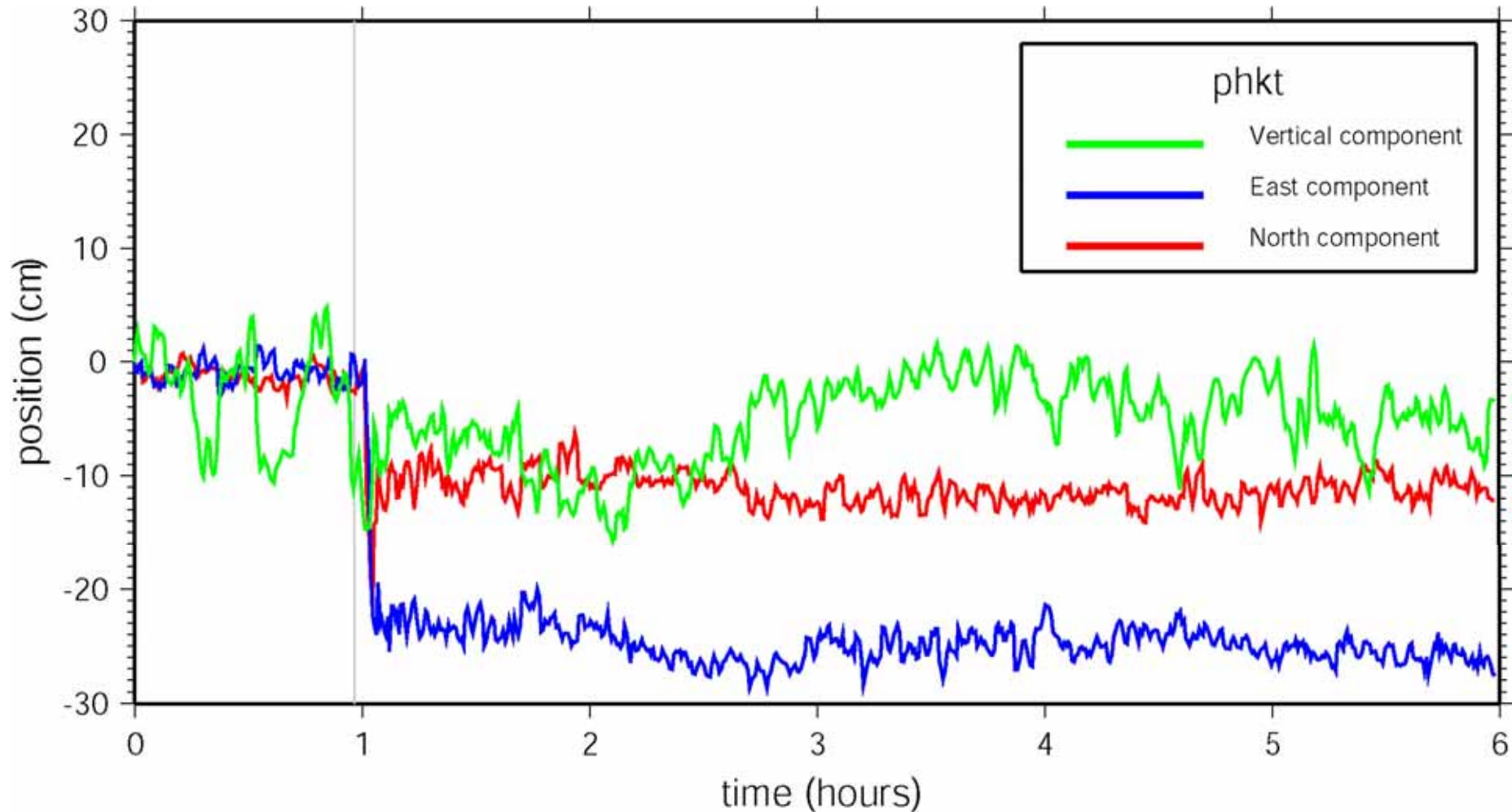
- Patch of very large slip at  
the northern tip of Sumatra  
(in front of Phuket), 200 km  
north of the epicenter

- Hardly any slip around  
7°North

**3/ deep slip**

*Vigny et al., 2005*

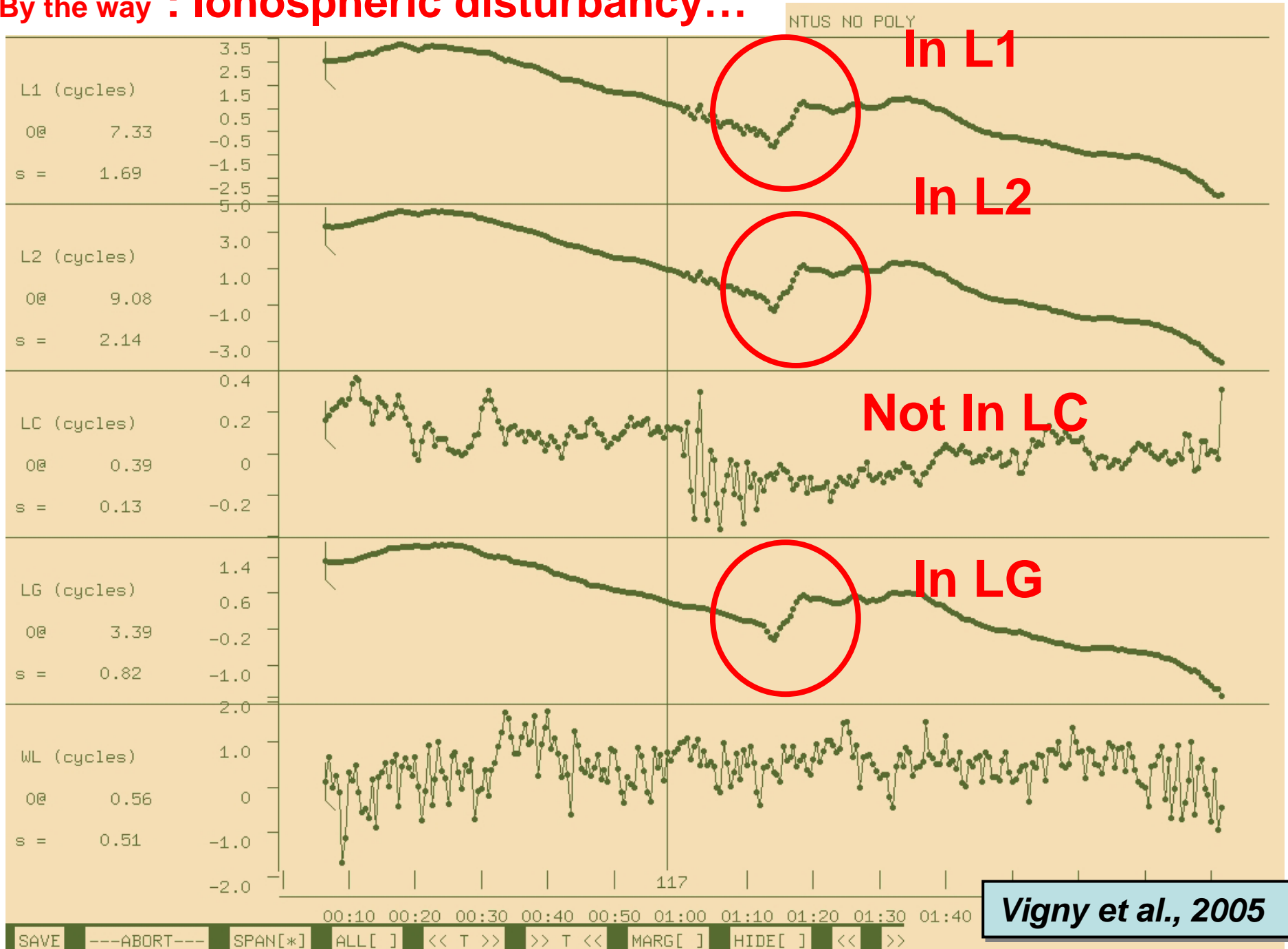
# “Kinematic” Solution

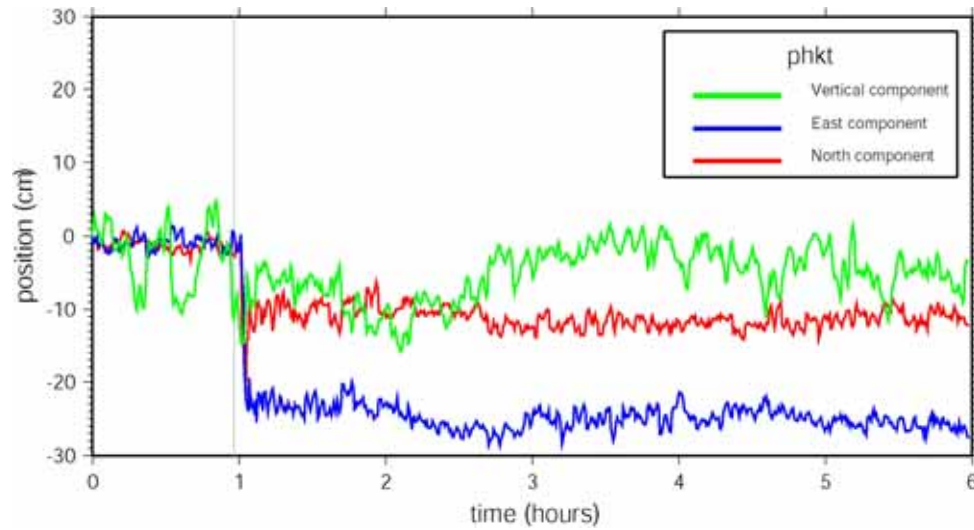


epoch-by-epoch positioning of the GPS station show the co-seismic step

*Vigny et al., 2005*

# By the way : Ionospheric disturbancy...

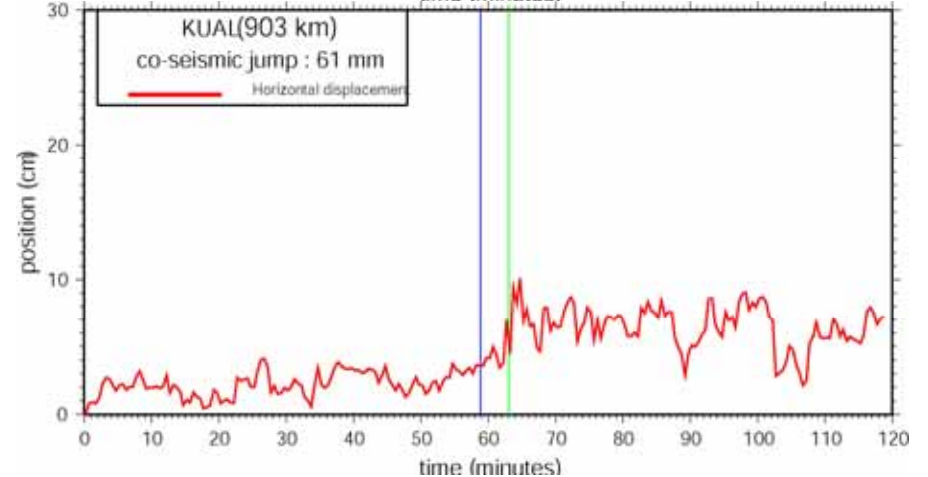
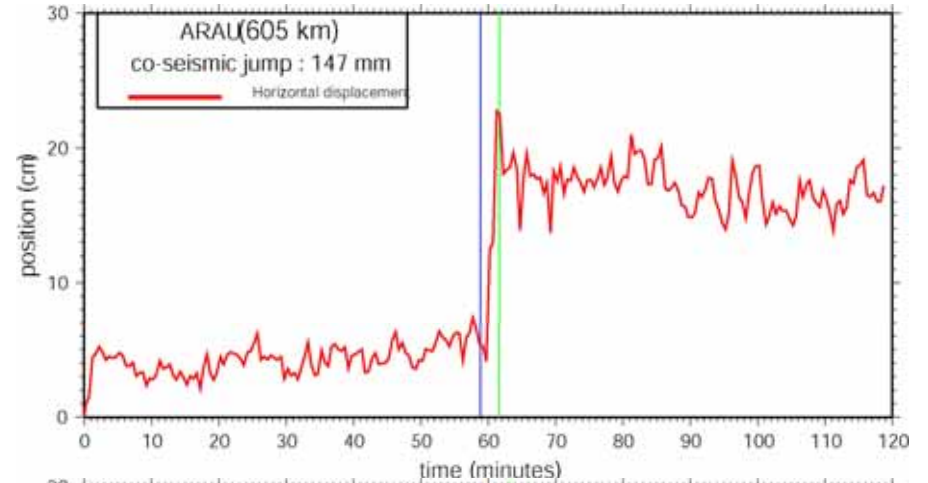
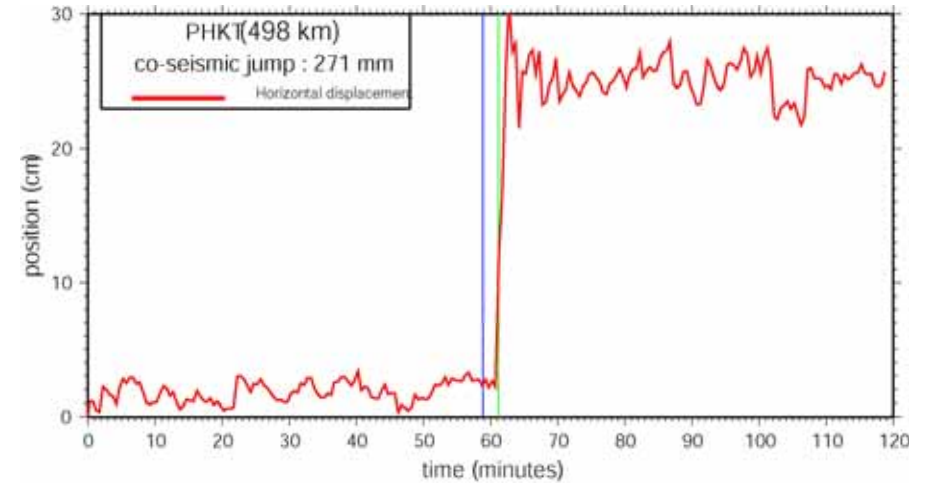




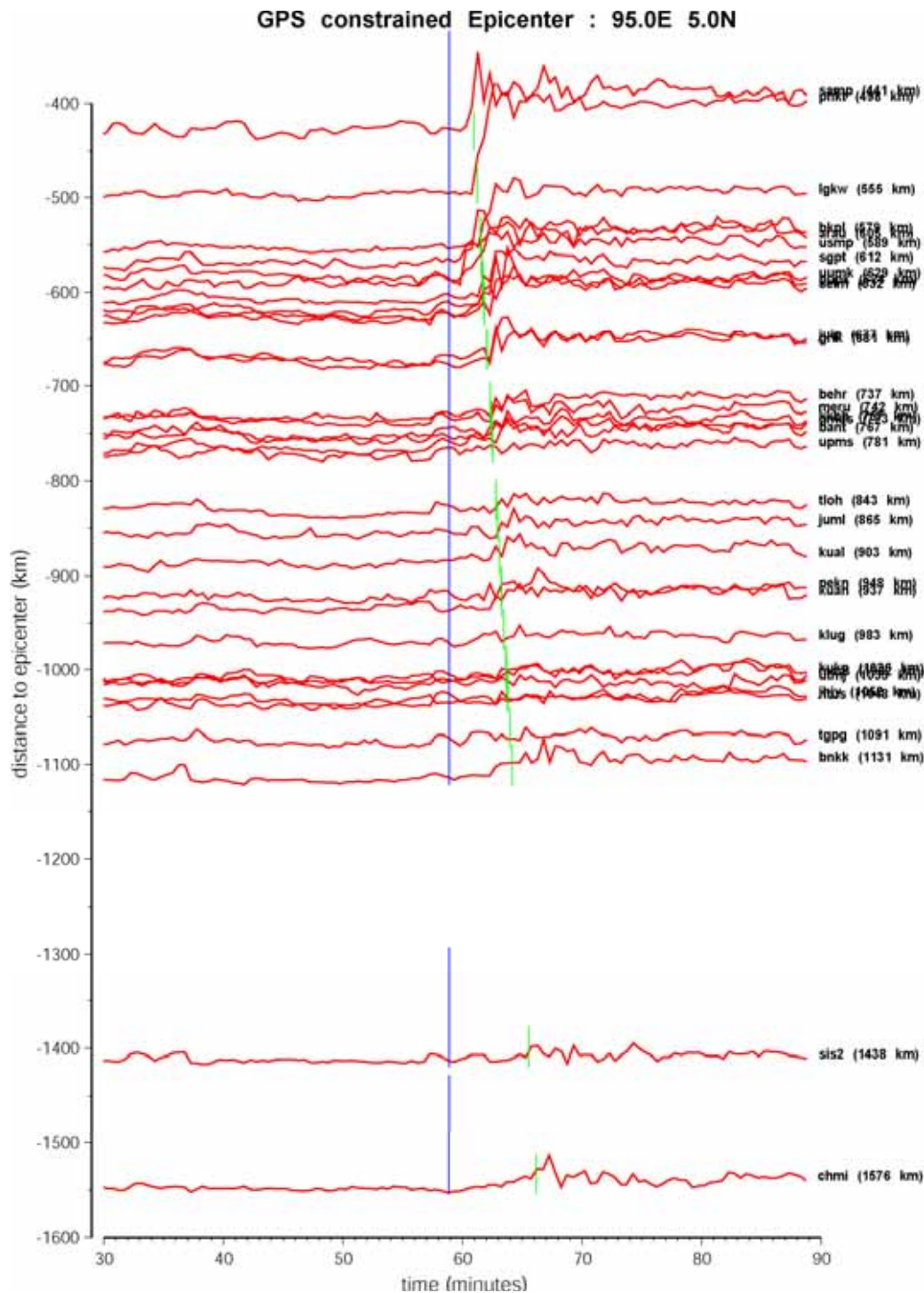
**“Kinematic” (epoch-by-epoch) positioning of the GPS station show the co-seismic step...**

**...and allow to determine the seismic wave arrival time**

***Vigny et al., 2005***





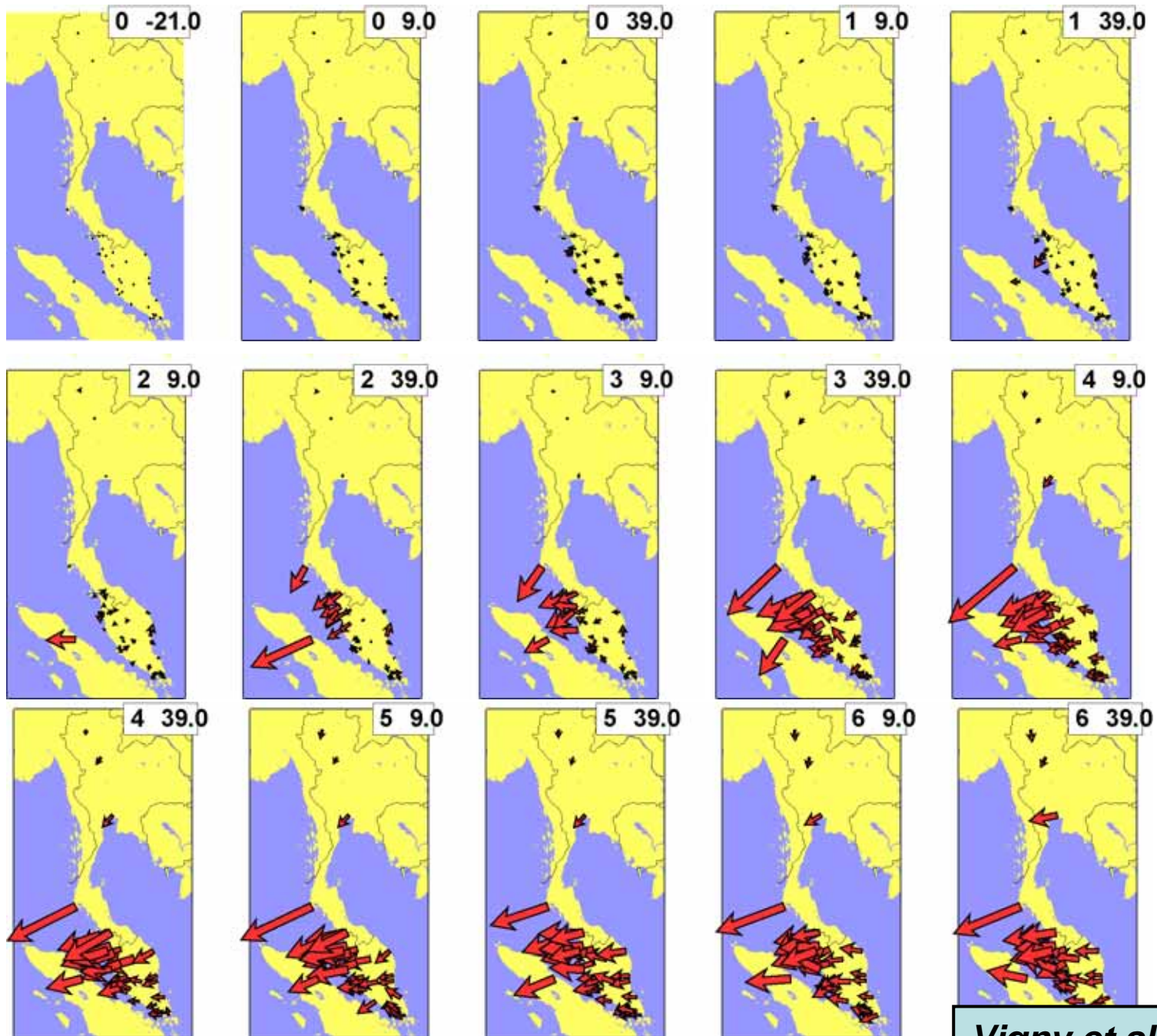


Assuming a  
velocity of 3.6  
km/s for seismic  
waves

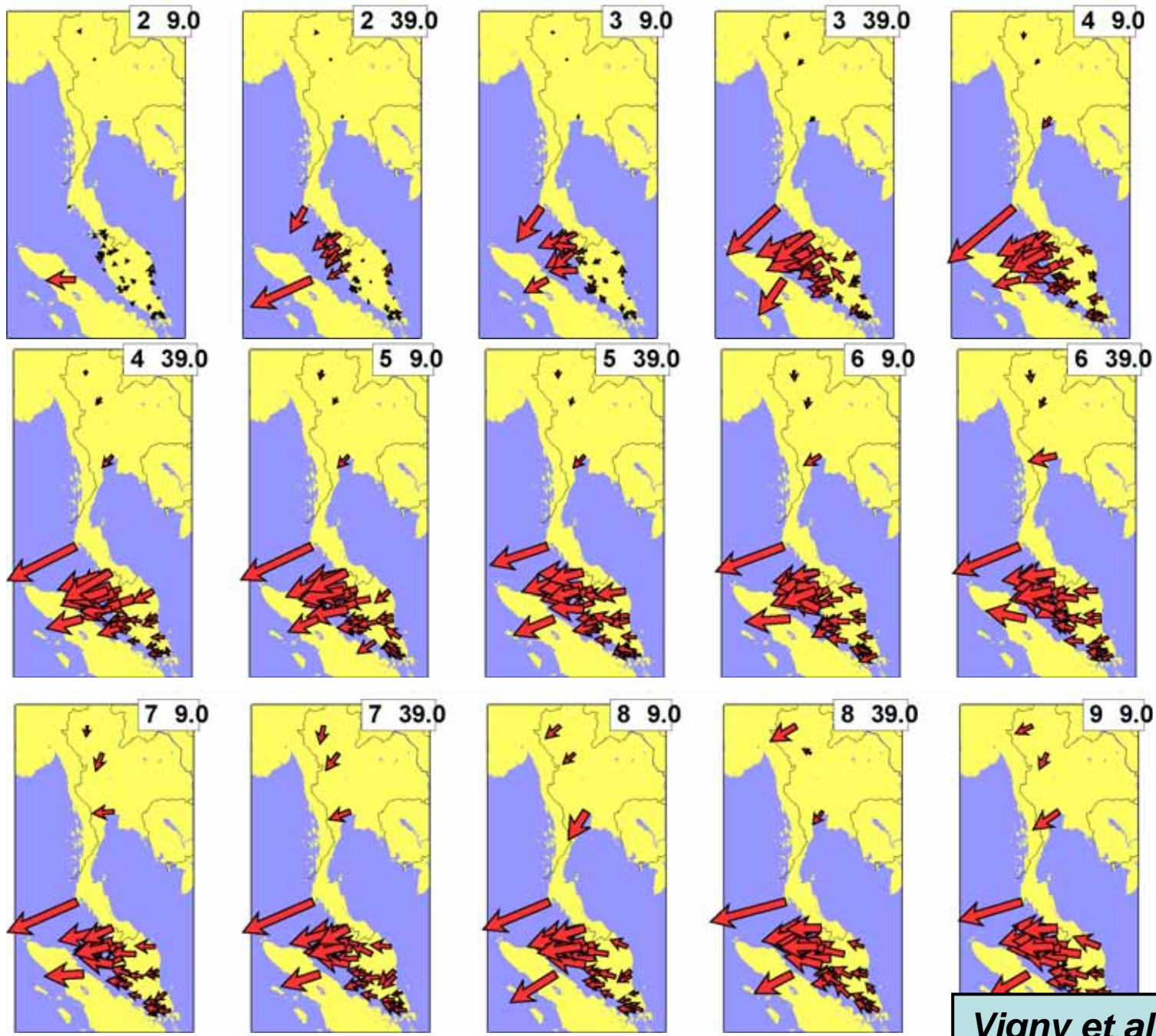
relocation of the  
source of the  
seismic energy is  
needed to match  
and sort arrival  
times at stations

Again, a  
relocation of 200  
km to the north is  
requested

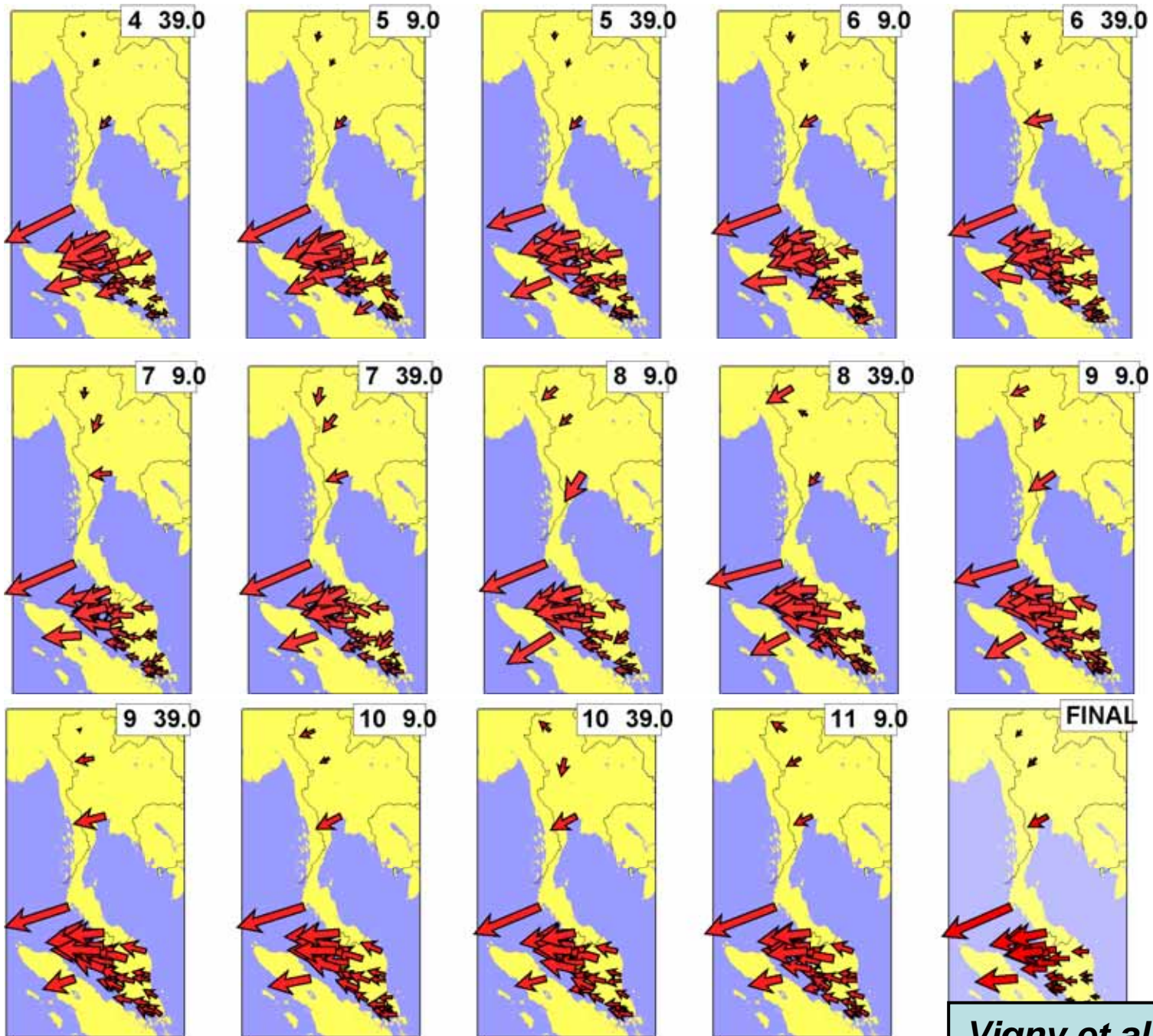
*Vigny et al., 2005*



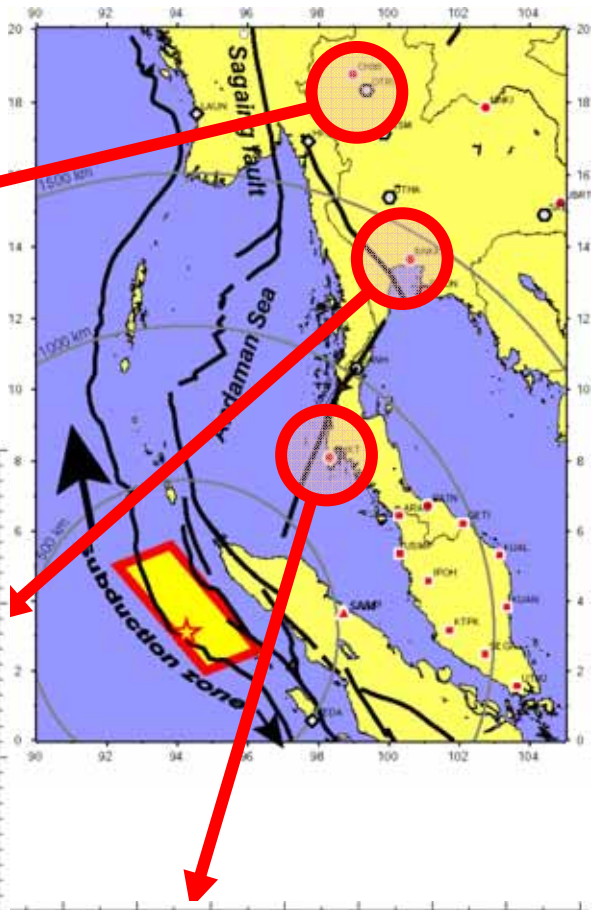
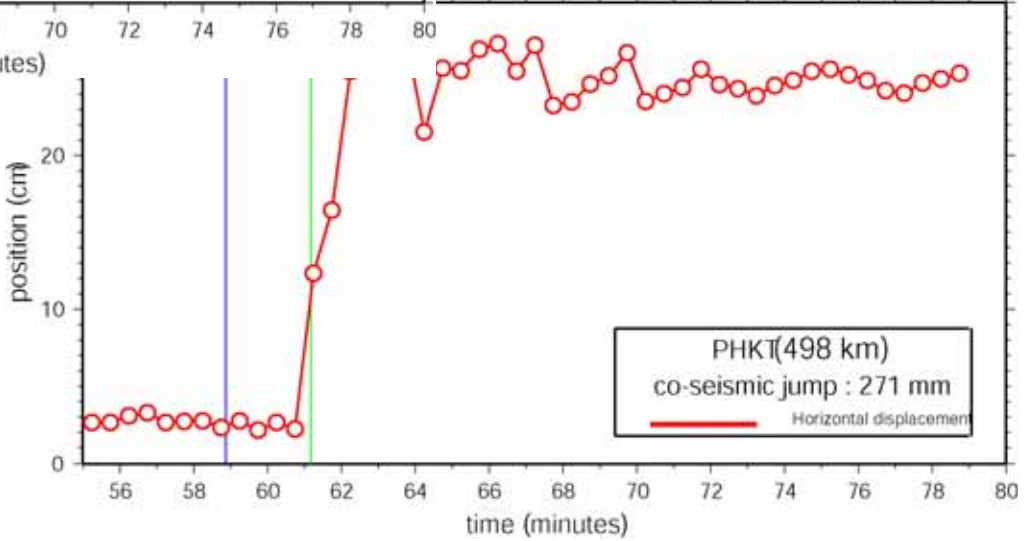
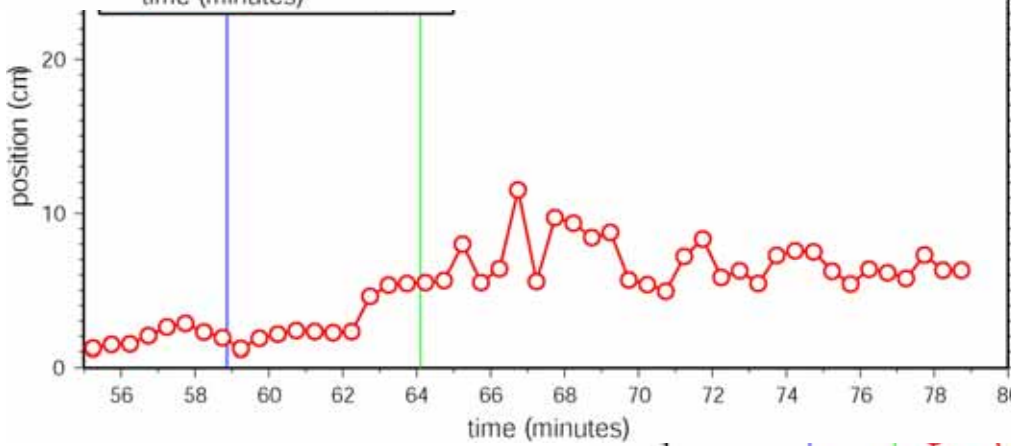
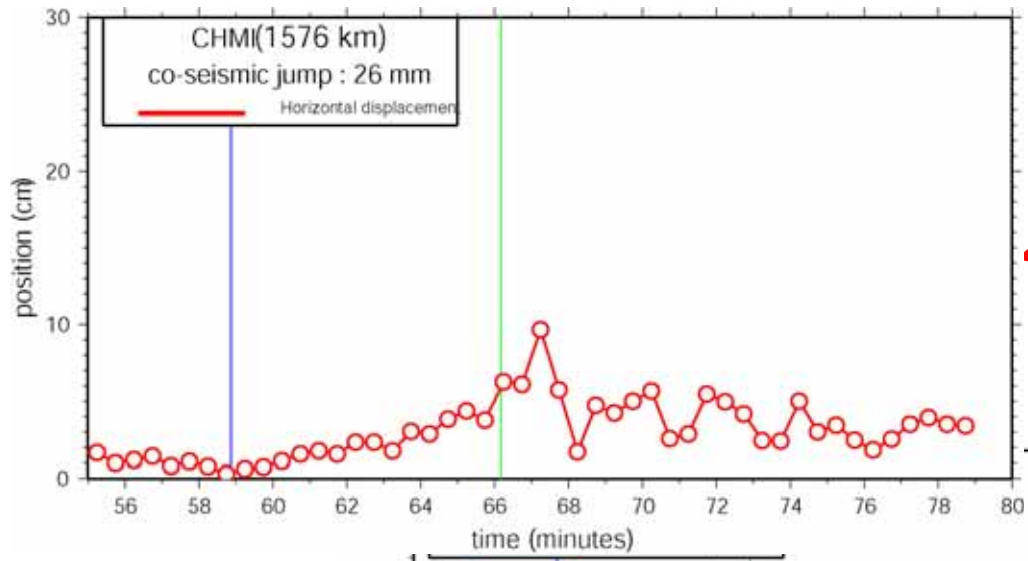
*Vigny et al., 2005*



*Vigny et al., 2005*



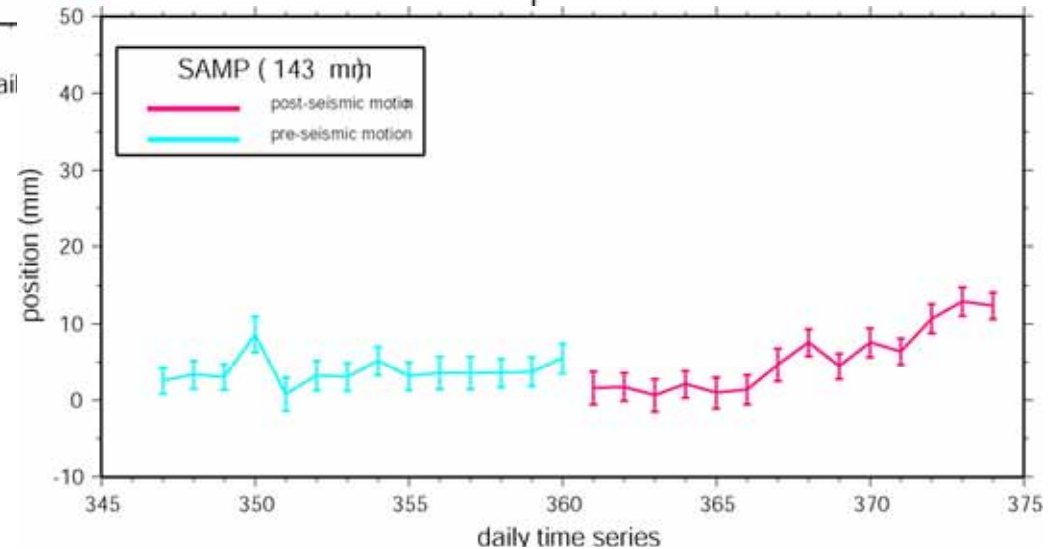
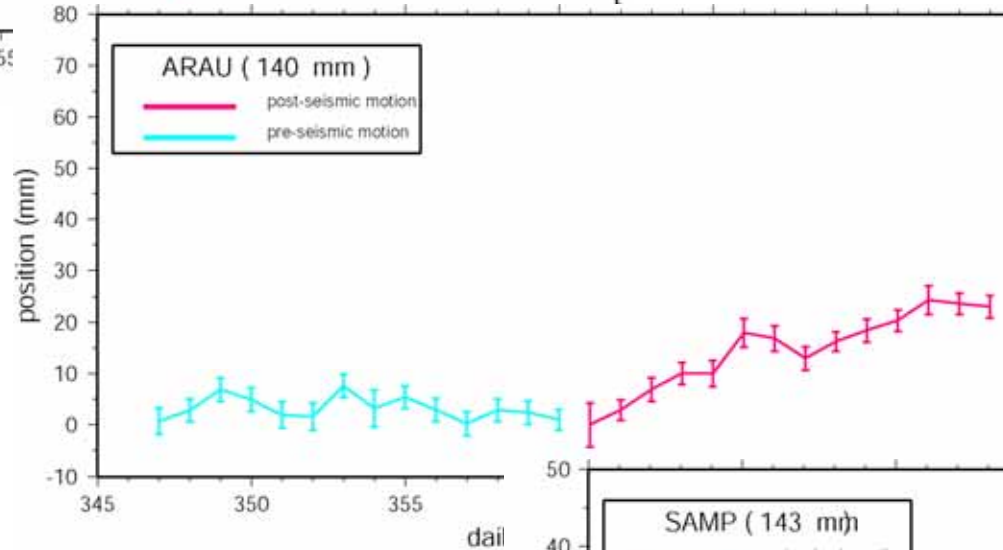
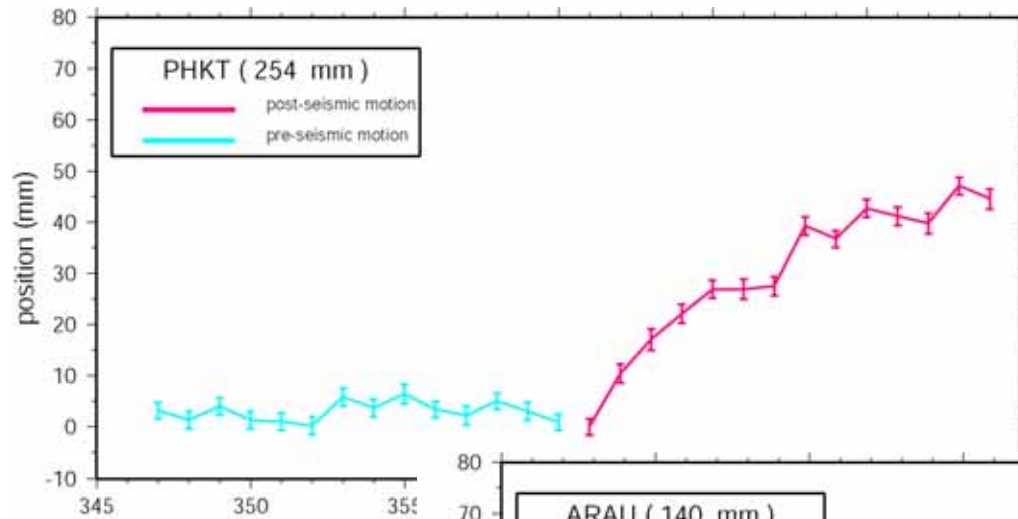
*Vigny et al., 2005*

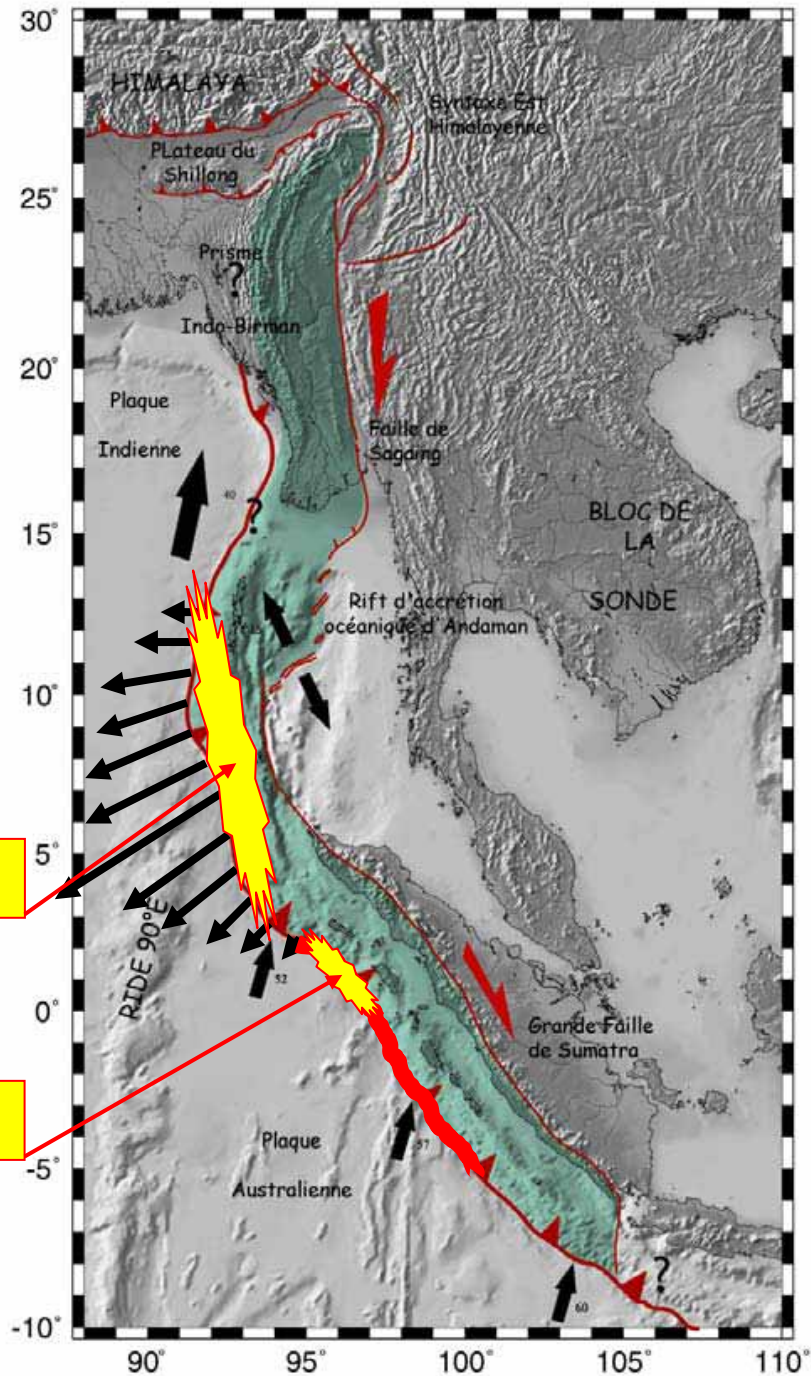


Indication of source directivity is pointed by larger “rise times” at northern stations

*Vigny et al., 2005*

**No pre-seismic motion was detected.  
Post Seismic deformation will go on for years ...  
and may be for decades**





## Modification of seismic hazard in the area

There is a higher risk of a near future events in the vicinity

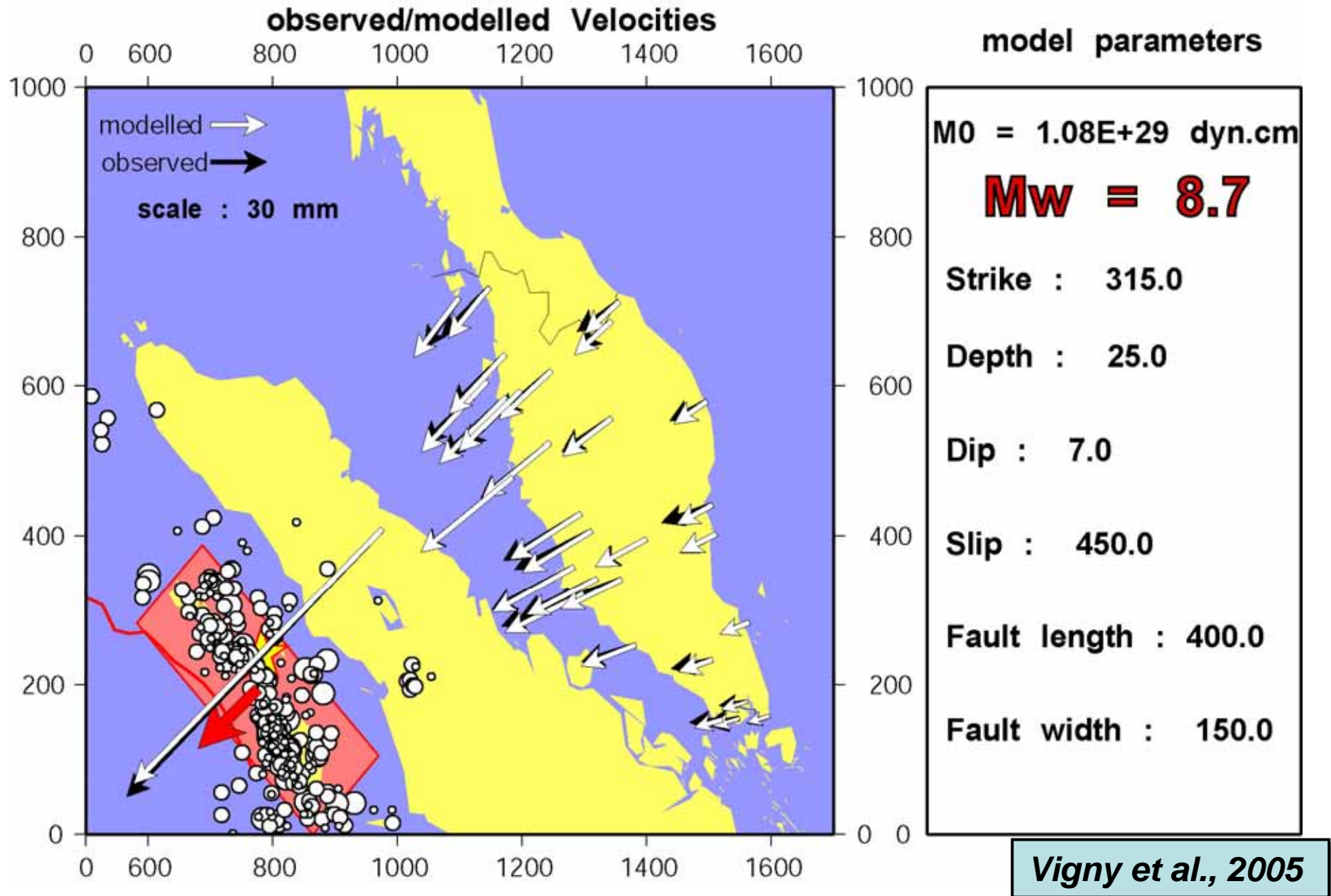
1/ further South on the subduction

26 December 2004

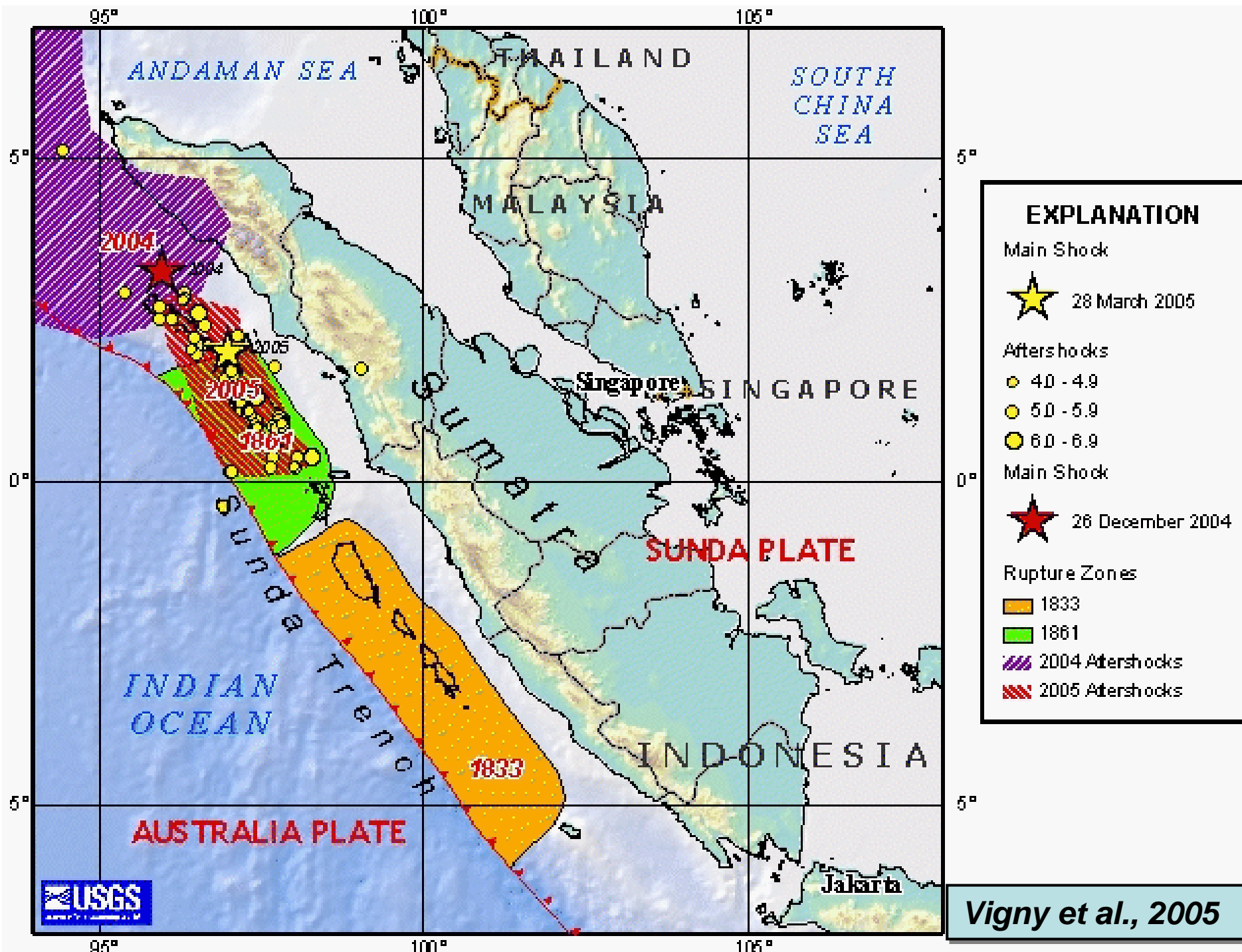
28 March 2005

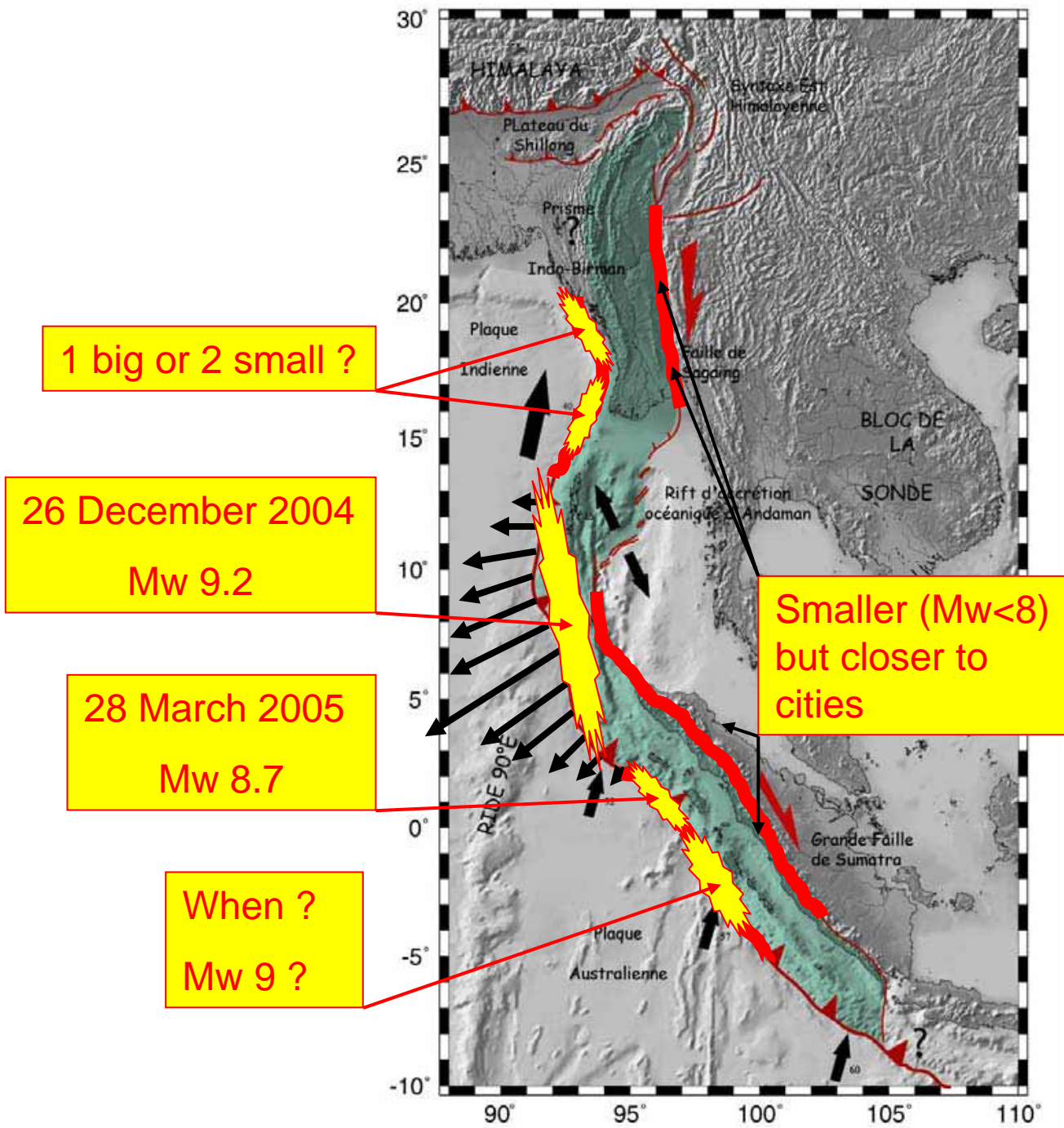
Vigny et al., 2005

# Nias Earthquake of March 28th









1 big or 2 small ?

26 December 2004  
Mw 9.2

28 March 2005  
Mw 8.7

When ?  
Mw 9 ?

Smaller (Mw<8)  
but closer to  
cities

**Modification of seismic hazard in the area**

**There is a higher risk of a near future event**

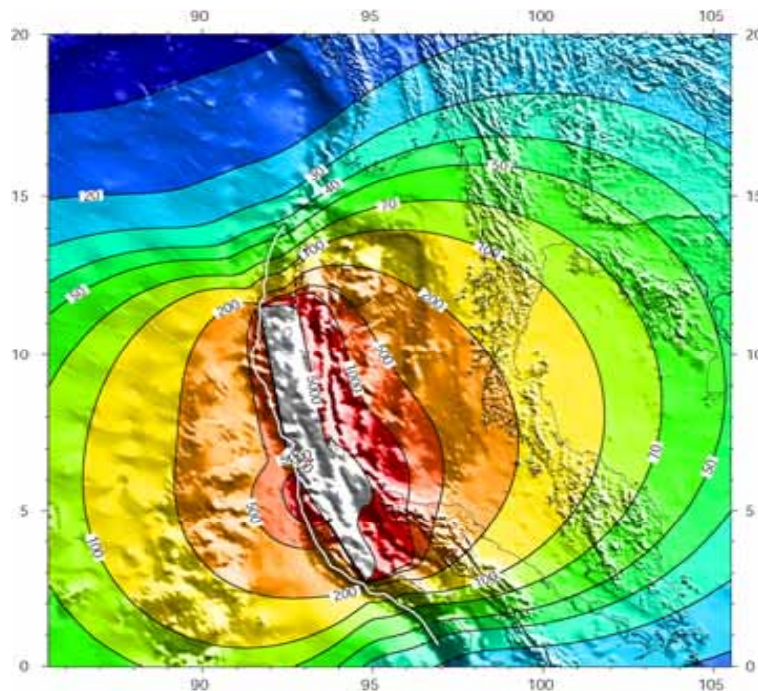
**1/ further South on the subduction**

**2/ further North on the subduction**

**3/ on the Great Sumatran Fault**

**4/ on the Sagaing fault**

*Vigny et al., 2005*



Thanks and appreciations are extended to the different national agencies and universities (DSMM, RTSD, BAKOSURTANAL, UTM, CU) for sharing their regional GPS data in the framework of the SEAMERGES project

Our sympathy goes to the family and relatives of the Phuket station operator who lost her life in the Tsunami disaster.

#### References

Monitoring of the December 26th 2004 mega-thrust earthquake in SE Asias by GPS

**Vigny, et al.,**

*Geophysical Research abstracts, trans. EGU, EGU05-A-10732, 2005*

Insight into the 2004 Sumatra-Andaman earthquake from GPS measurements in southeast Asia

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*Nature, vol 436, 14/07/05, pp201-206, doi:10.1038/nature03937, 2005*

***Vigny et al., 2005***