Seismic Networks and Possibilities for Combining GPS and InSar Data in Argentina: A Case Study for the Salta Mw 6.3 Earthquake in 2010

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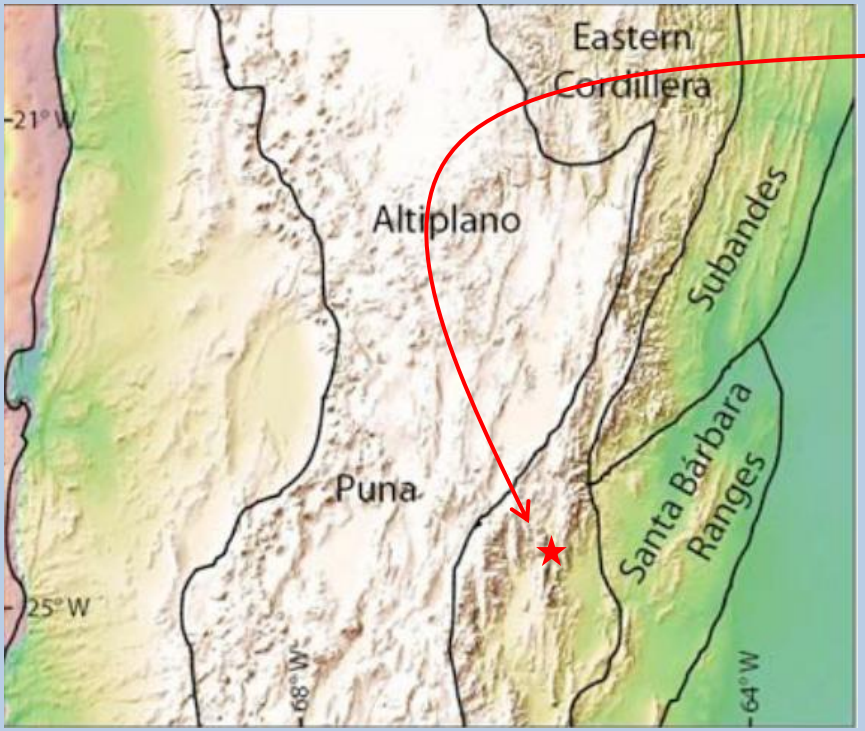
IRIS-UNAVCO – Chile 2015

Grupo de Sismotectonica

CONICET

CIGEOBIO

Salta earthquake on 27 Feb 2010



-Magnitude around 6

-Focal depth around 10 km

Availability of regional seismic waveforms from permanent and temporary PASSCAL stations

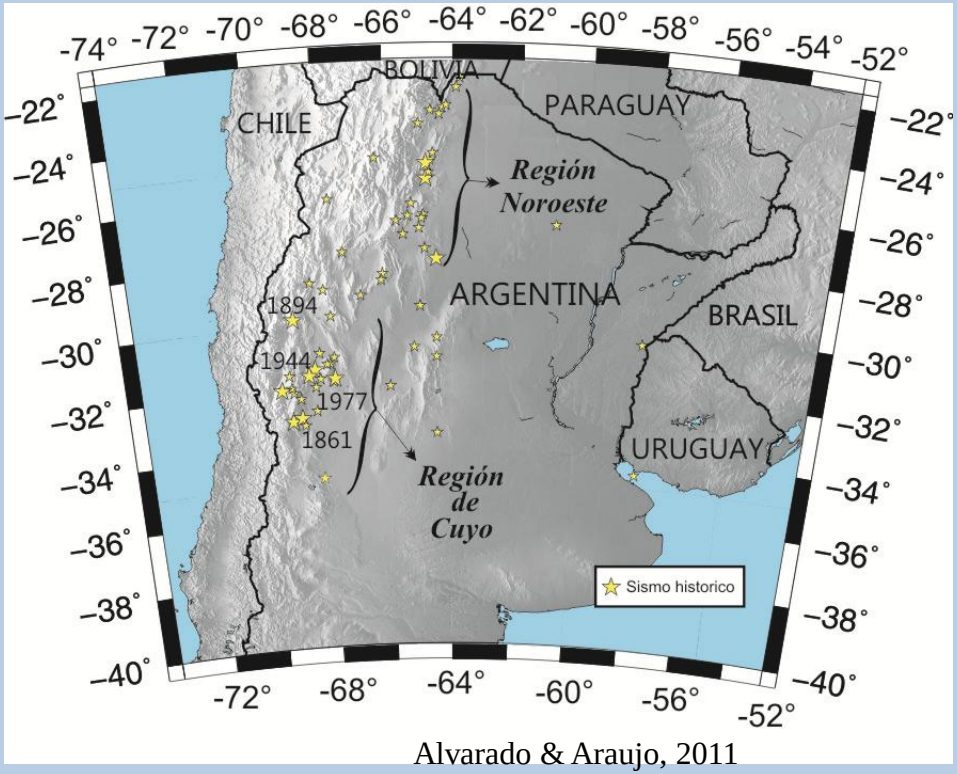
Seismic intensities
IV to V
620000 inhab.

3 deaths

➢ ***What are the seismic parameters in the seismotectonic framework ?***

➢ ***Regional Seismicity of that day***

HISTORICAL SEISMICITY



Alvarado & Araujo, 2011

Most earthquakes are located in the frontal part of Sistema Santa Bárbara

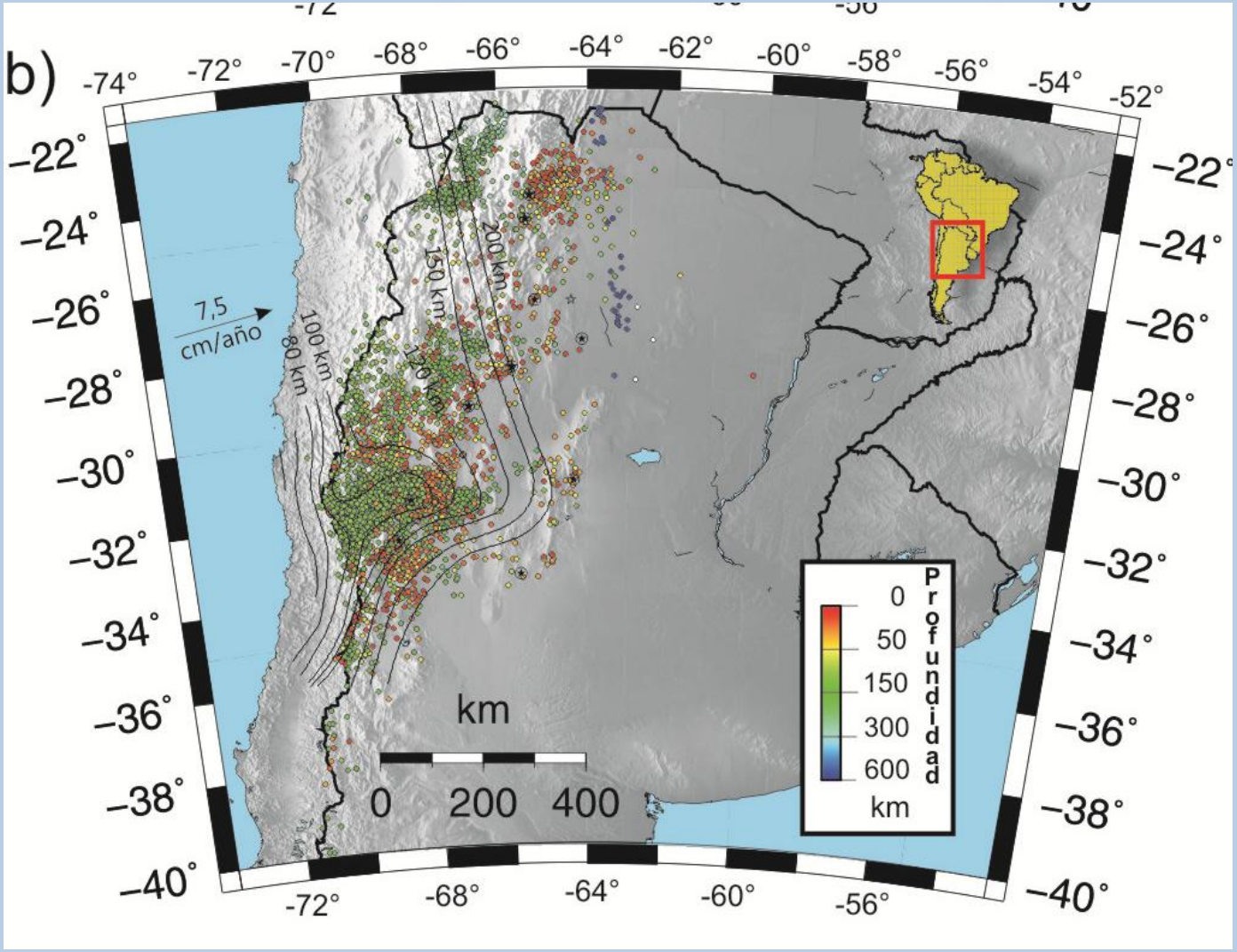
Long history of damaging earthquakes in Salta

Oldest record in Argentina history:

13 de setiembre de 1692: *"Destruyó la pequeña población de Talavera del Esteco, en la provincia de Salta, causó 13 muertes y heridos. Produjo daños considerables en la ciudad de Salta. La intensidad máxima estimada alcanzó los IX grados en la escala Mercalli modificada y tuvo una magnitud M= 7.0 grados en la escala de Richter"*

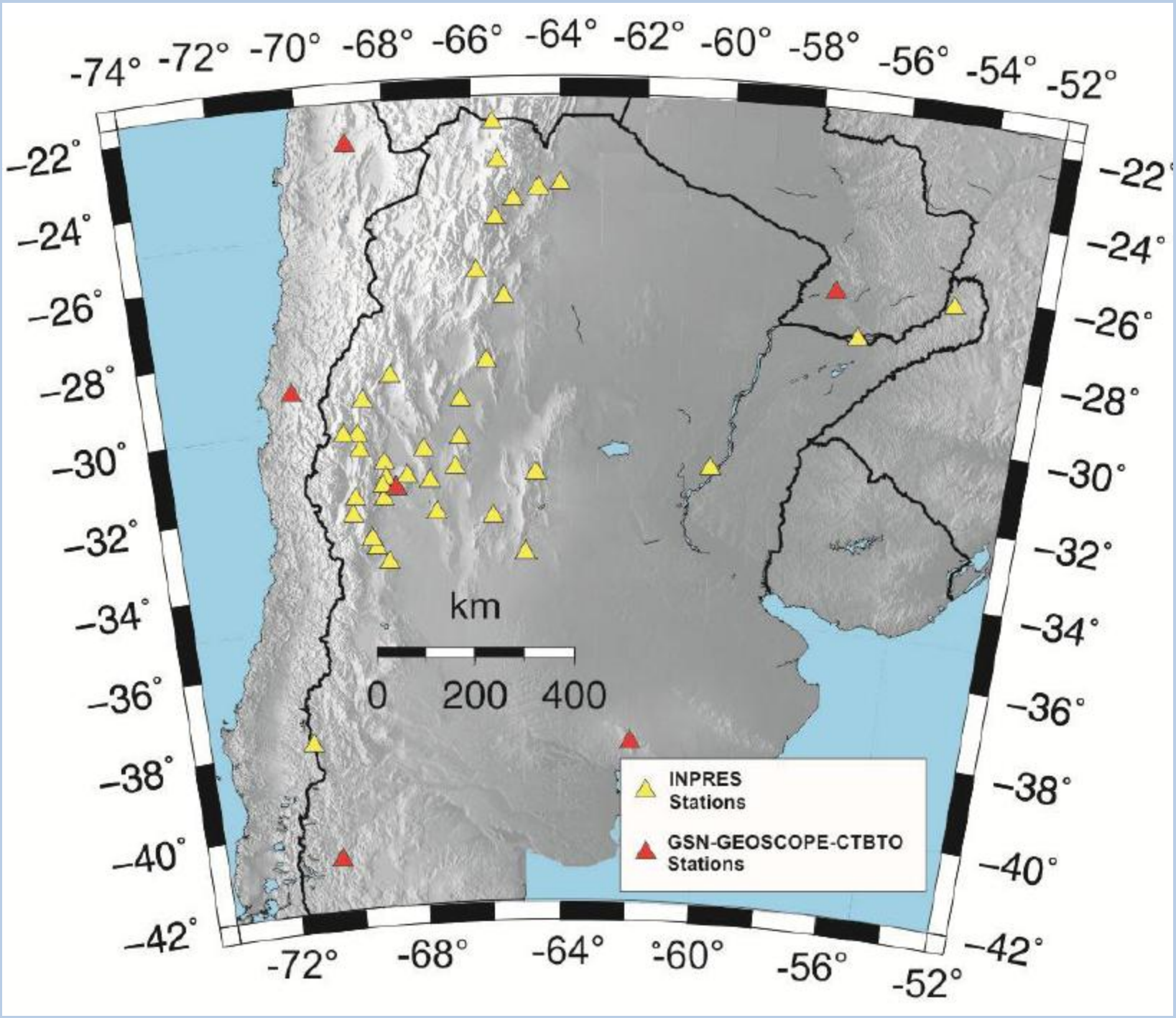
25 de agosto de 1948: "*Se produce otro terremoto de importancia en la historia sísmica de nuestro país"*

MODERN SEISMICITY from INPRES

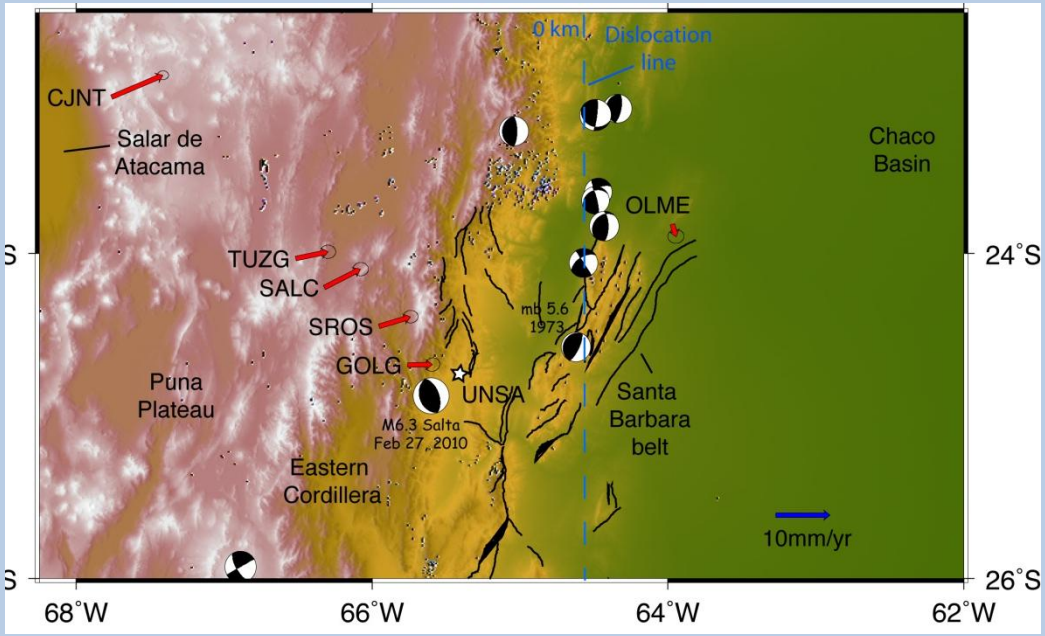


Alvarado & Araujo, 2011

Moderate seismicity in the same area with poor seismic locations


-74° -72° -70° -68° -66° -64° -62° -60° -58° -56° -54° -52°
-22°
-24°
-26°
-28°
-30°
-32°
-34°
-36°
-38°
-40°
-42°
-72° -68° -64° -60° -56° -52°
km
0 200 400
INPRES Stations
GSN-GEOSCOPE-CTBTO Stations

LARGER MAGNITUDE for MODERN SEISMICITY since 1977



GCMT solutions and GPS vectors before the earthquake by PAGA network (UofArizona – UNSJ collaboration)

Most focal mechanisms show reverse solutions and focal depths at intermediate crustal levels or fixed during the inversions

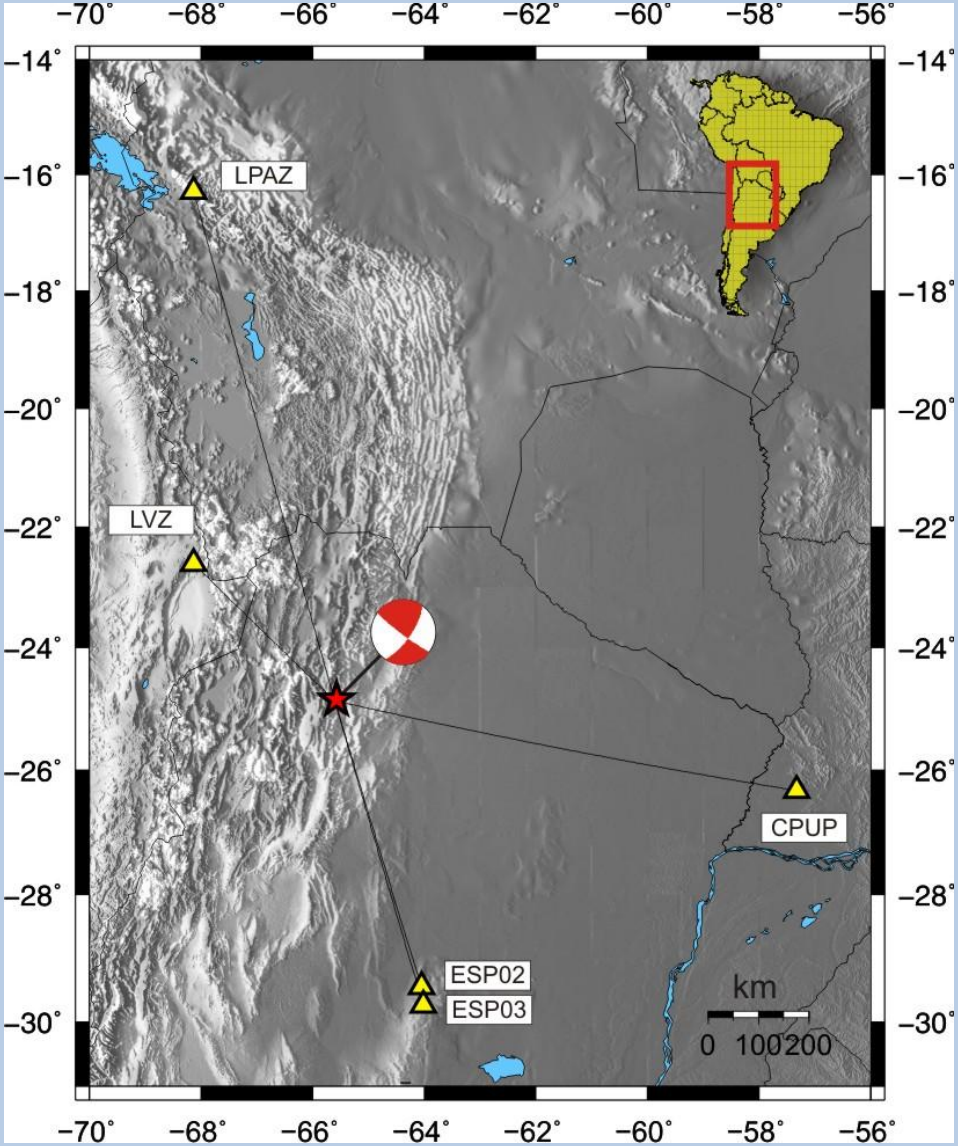
GCMT solution for 27/FEB/2010 earthquake:

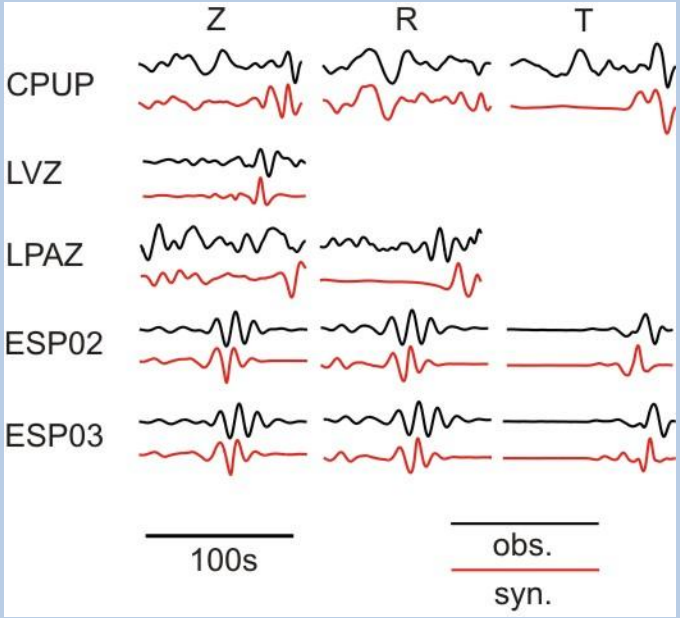
Mw 6.2

Focal Depth 27 km

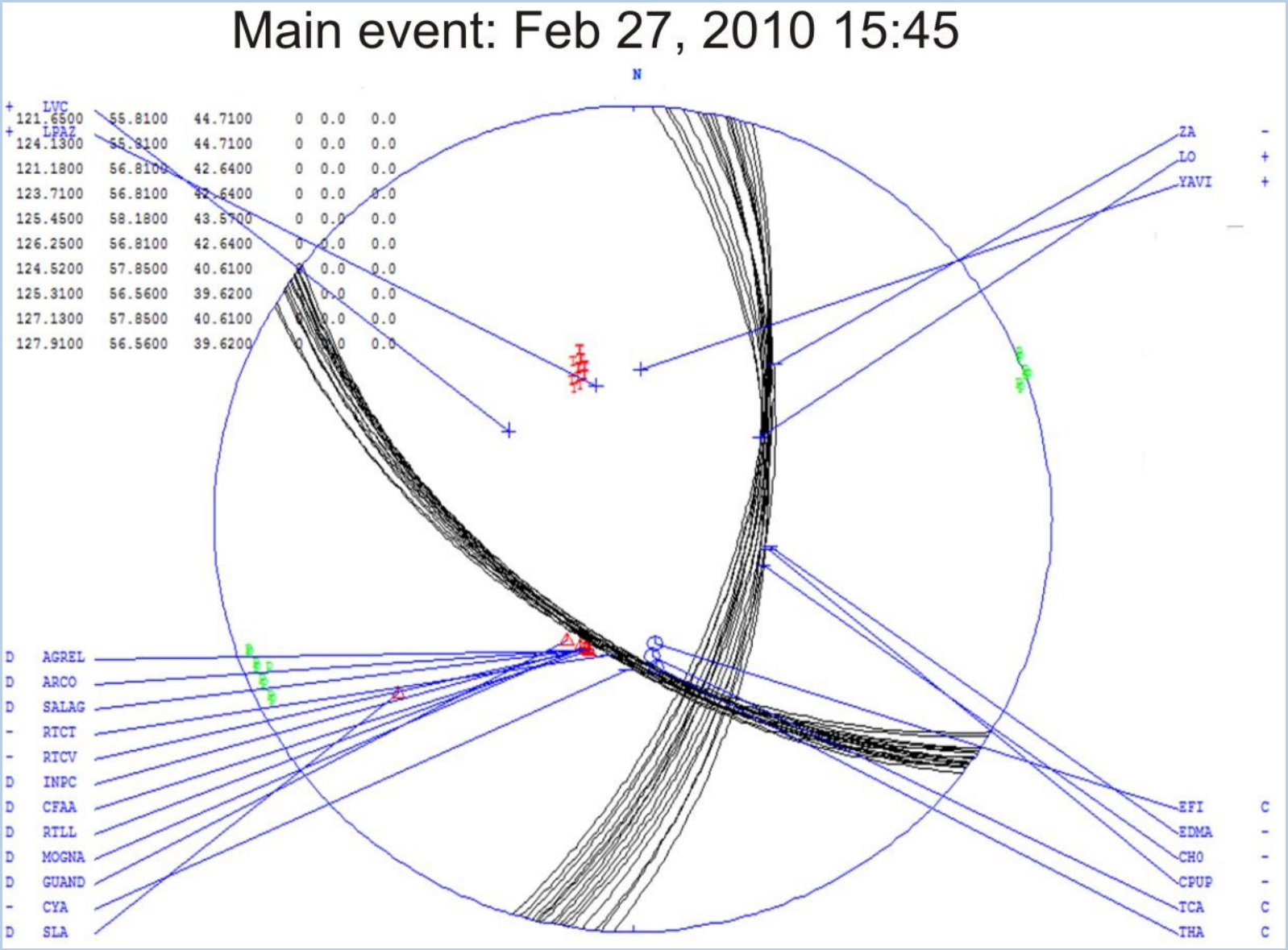
reverse focal mechanism

Regional seismic waveform modeling results

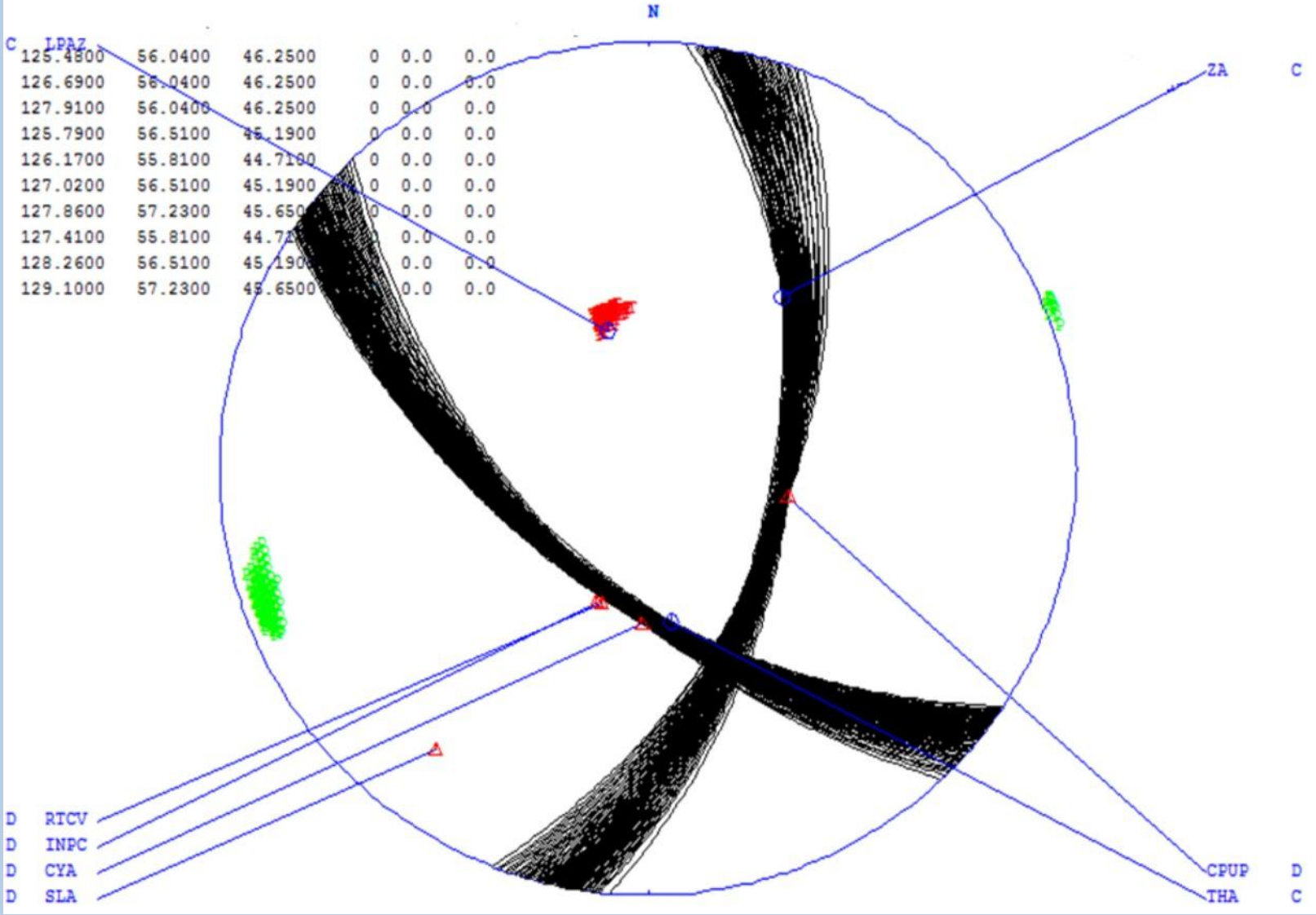




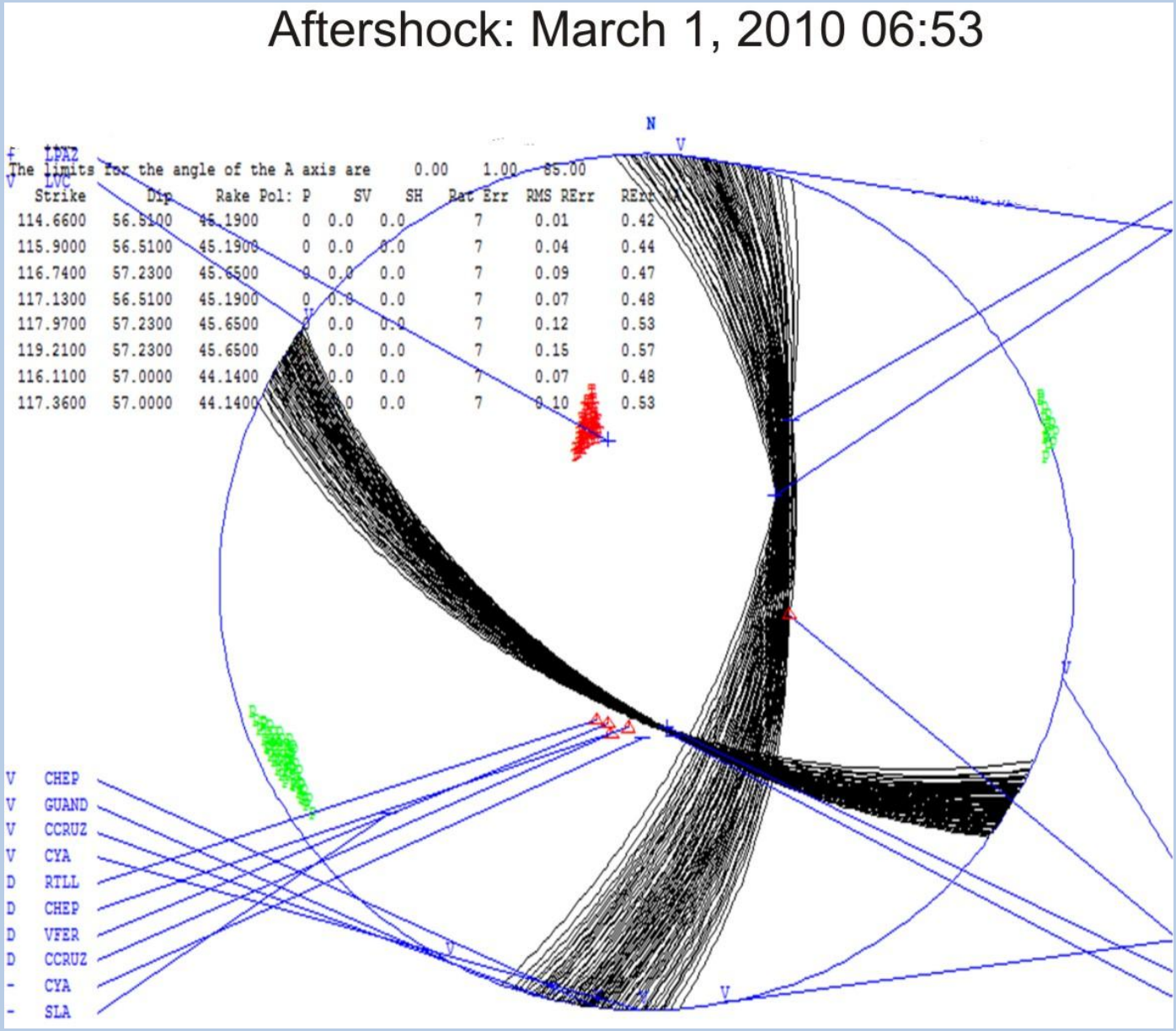
First motion analyses using the permanent seismic network data from INPRES



Aftershock: Feb 27, 2010 15:47

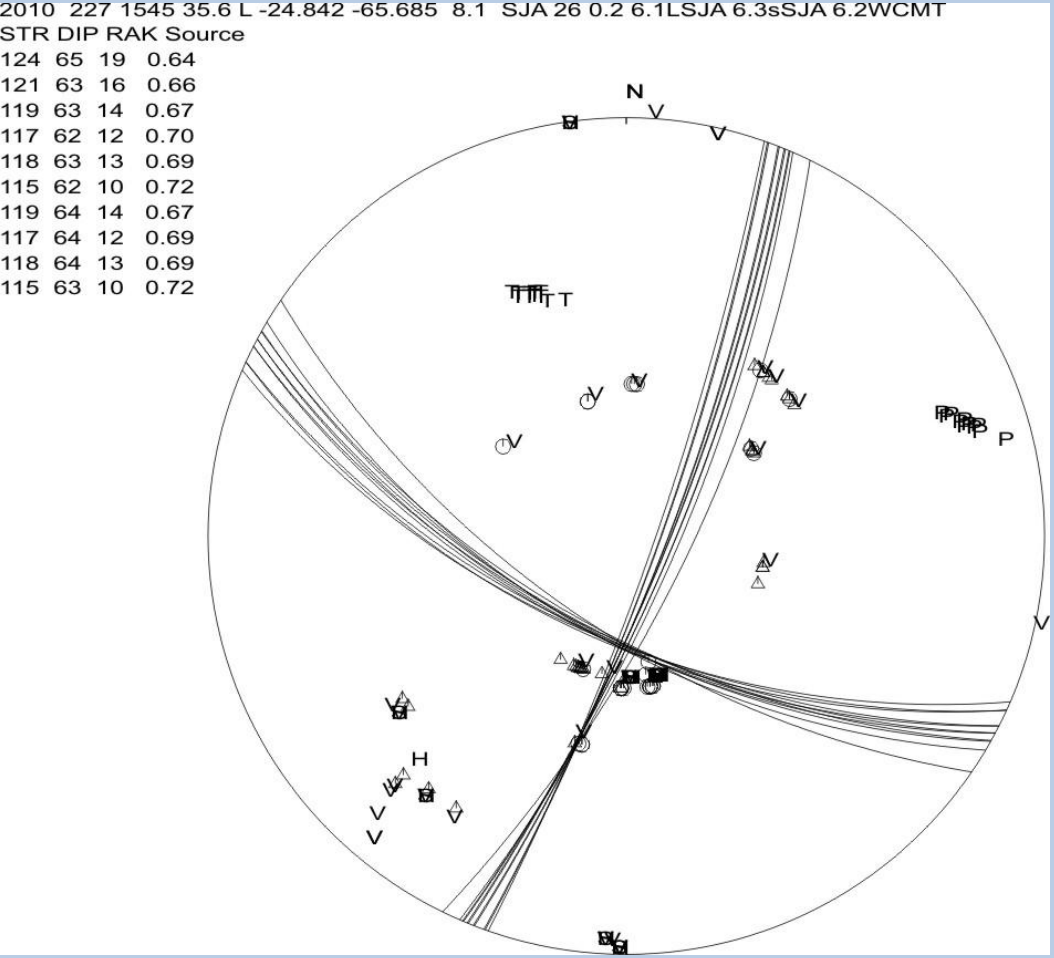


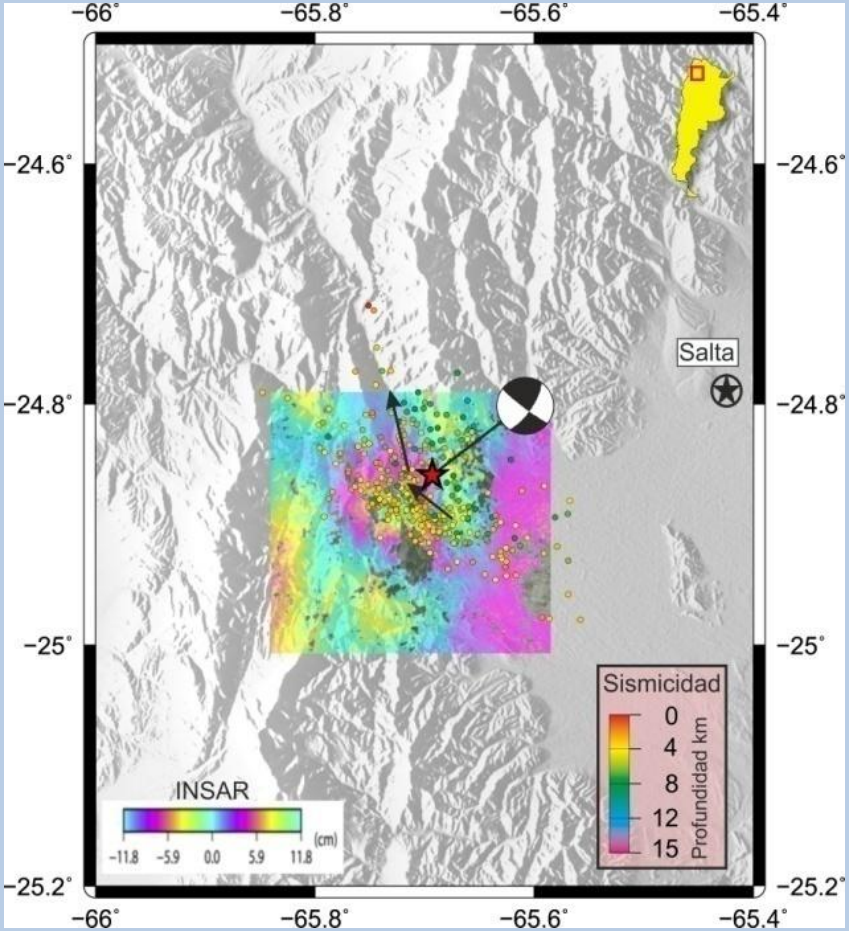
Aftershock: March 1, 2010 06:53



First motion analyses for many aftershocks and InSar analyses

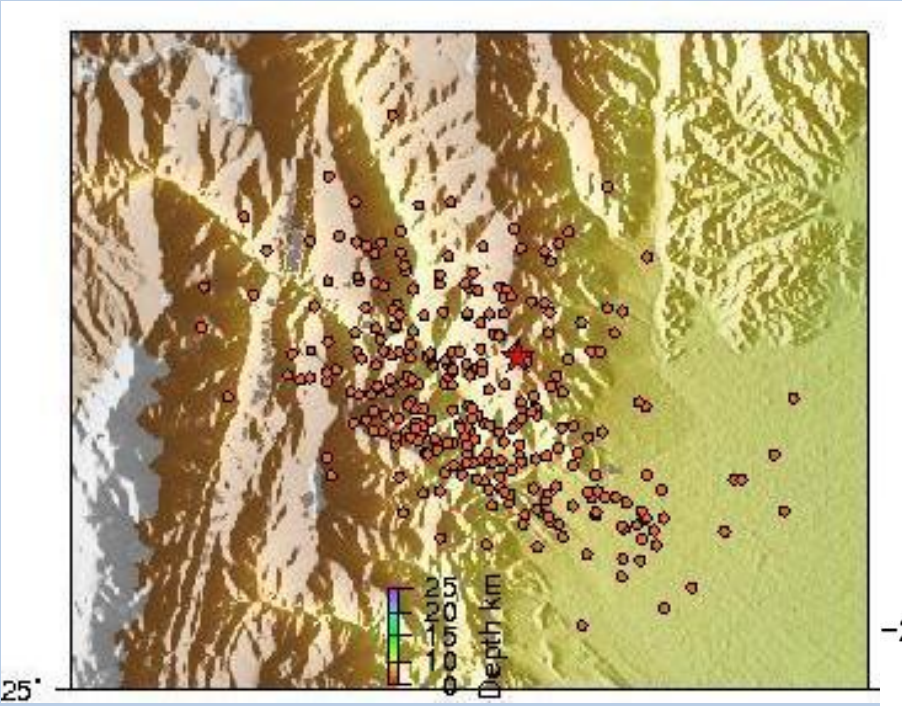
2010 227 1545 35.6 L -24.842 -65.685 8.1 SJA 26 0.2 6.1LSJA 6.3sSJA 6.2WCMT
STR DIP RAK Source
124 65 19 0.64
121 63 16 0.66
119 63 14 0.67
117 62 12 0.70
118 63 13 0.69
115 62 10 0.72
119 64 14 0.67
117 64 12 0.69
118 64 13 0.69
115 63 10 0.72

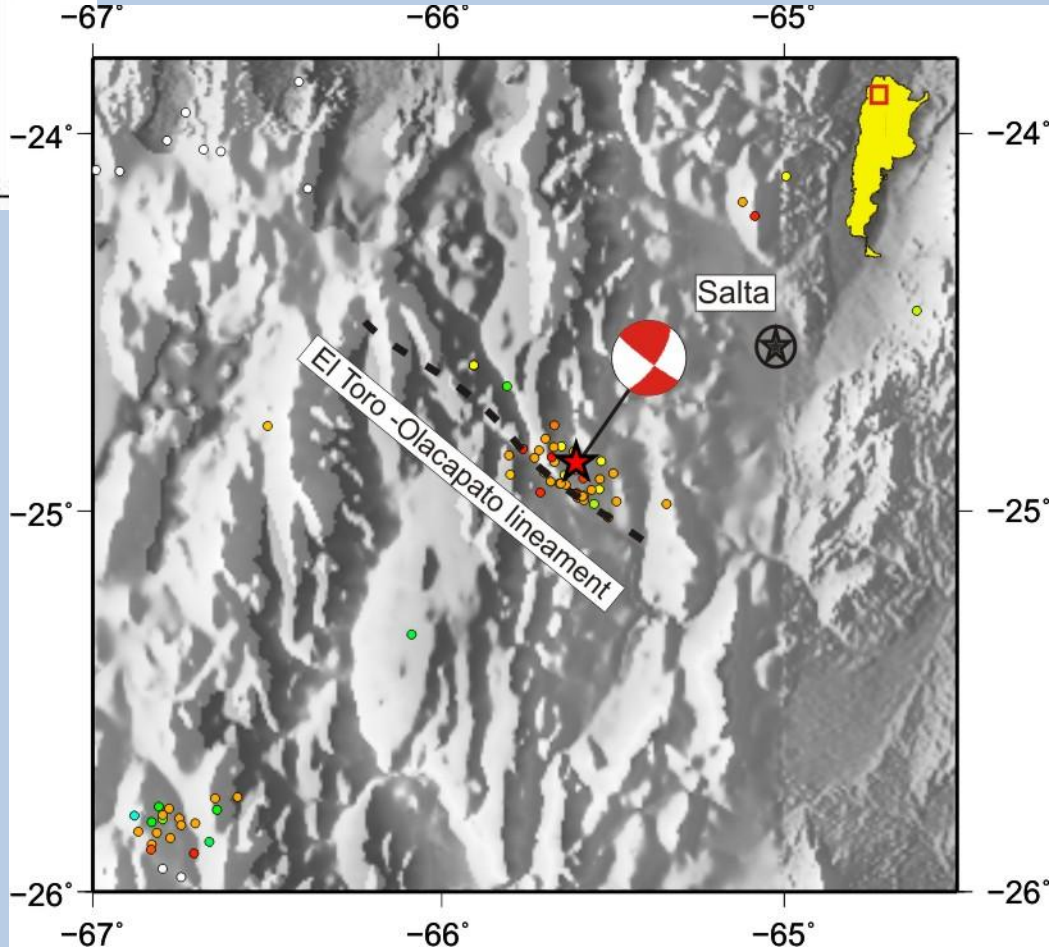




Scott et al., 2014 (JSAMES)

Seismic relocation

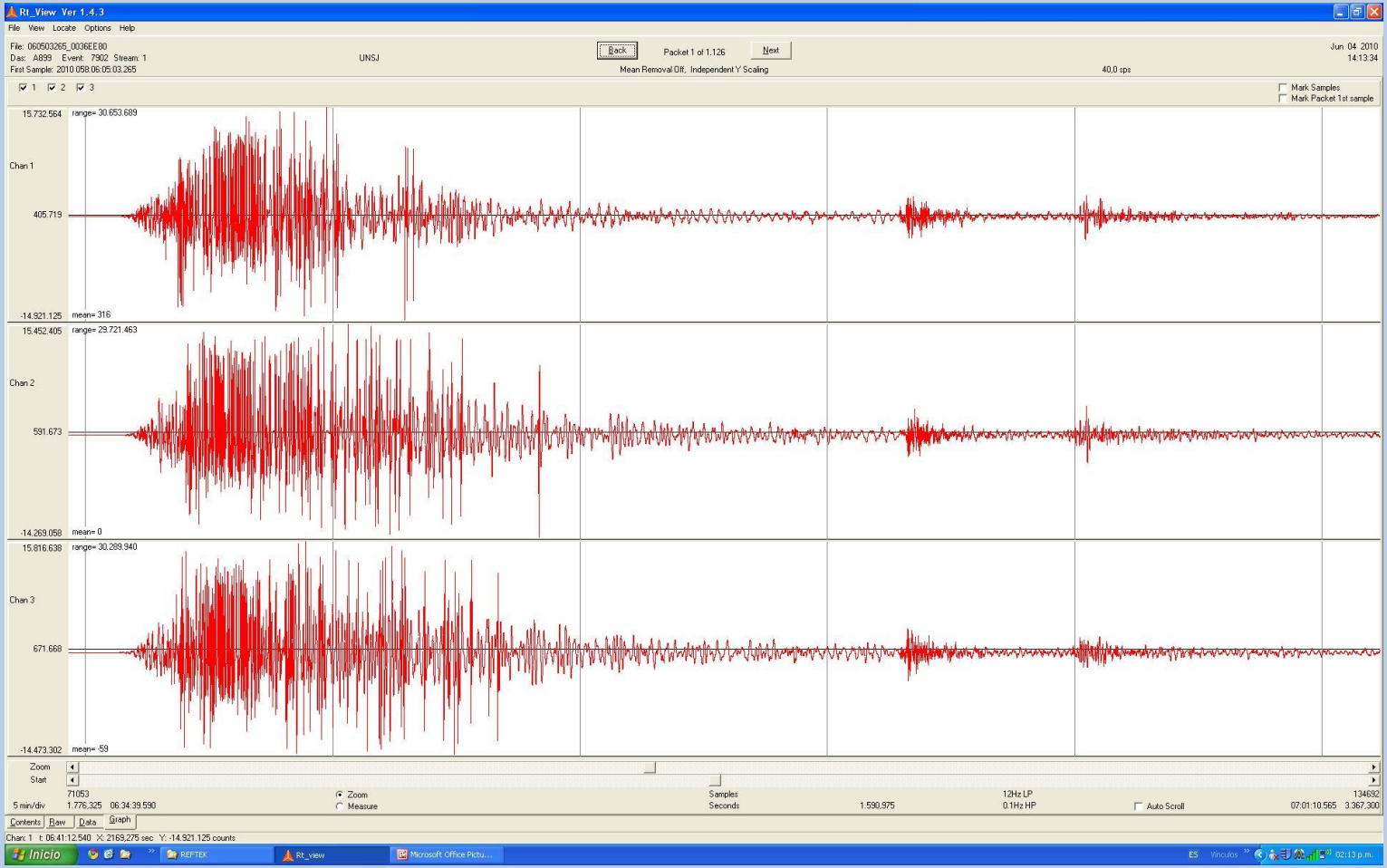




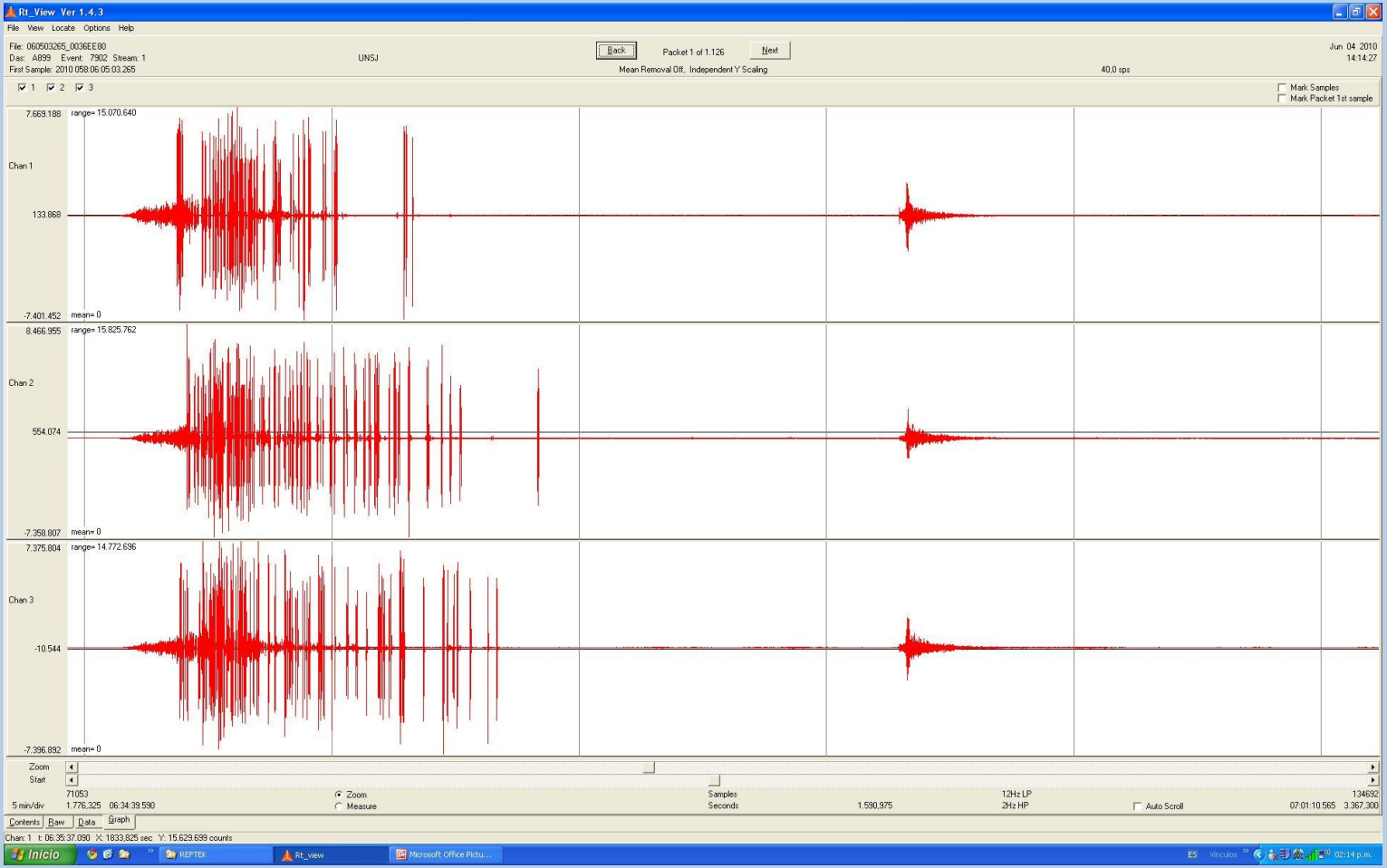
Results are consistent with the activation of a structure of NW-SE trend and strike-slip motion in the El Toro – Olacapato fault system

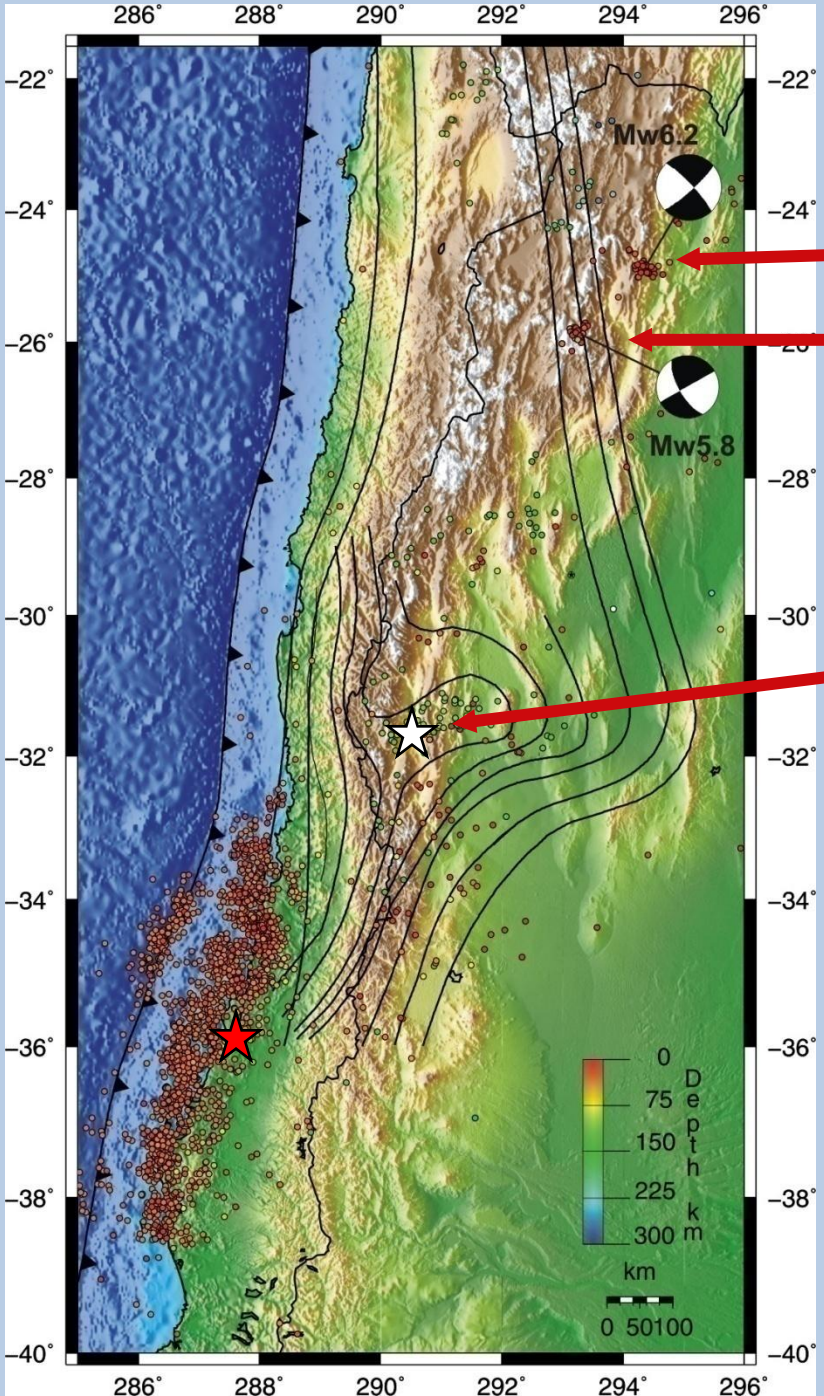
Seismic record from a broandband seismic station at the UNSJ

Registro del 27 de febrero de 2010 en la UNSJ



Registros filtrados





Seismicity during the following 4 months after the Mw 8.8 Maule earthquake in Chile (INPRES, Argentina)

8 horas.

8 días

17 minutos

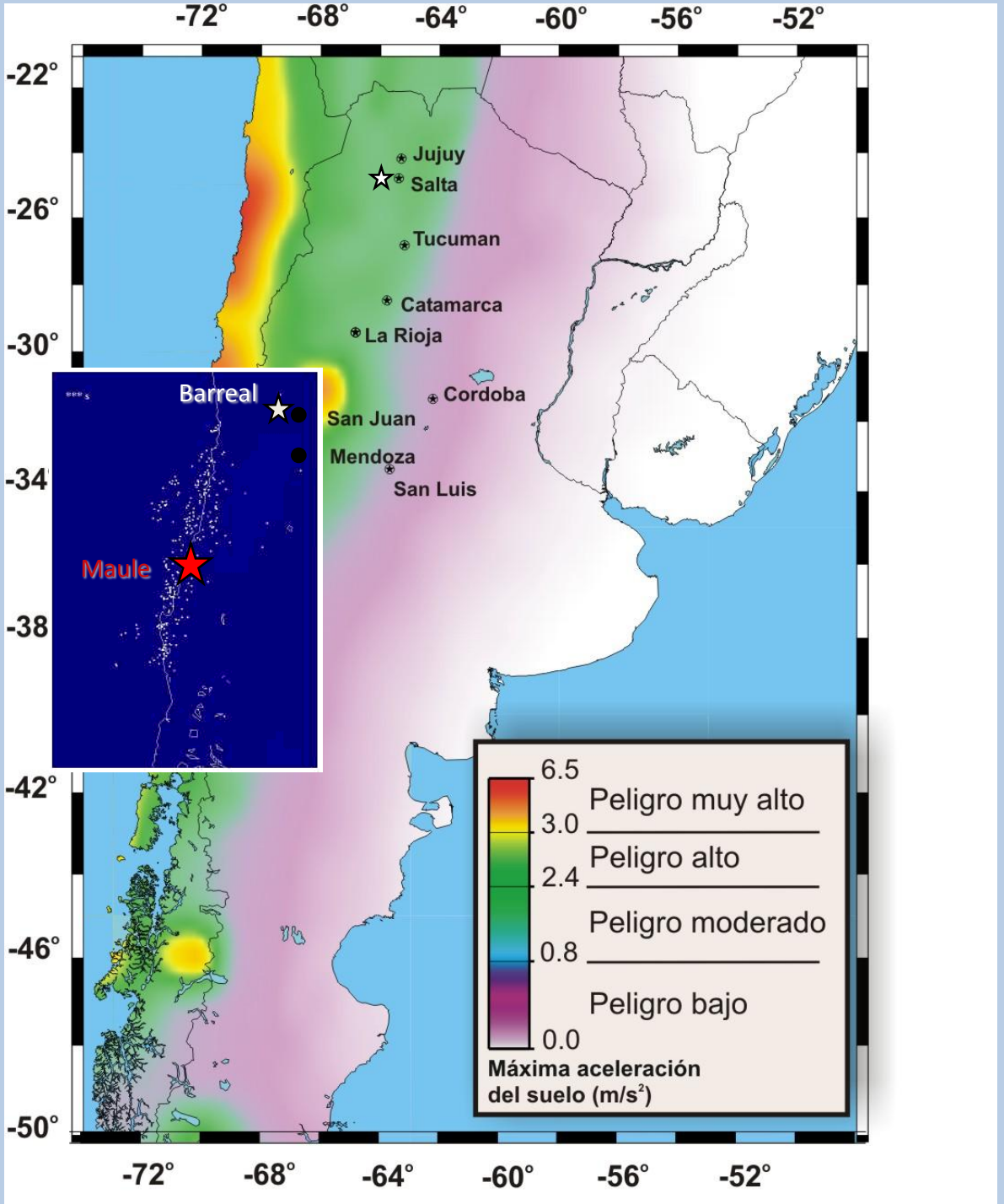
Rupture model

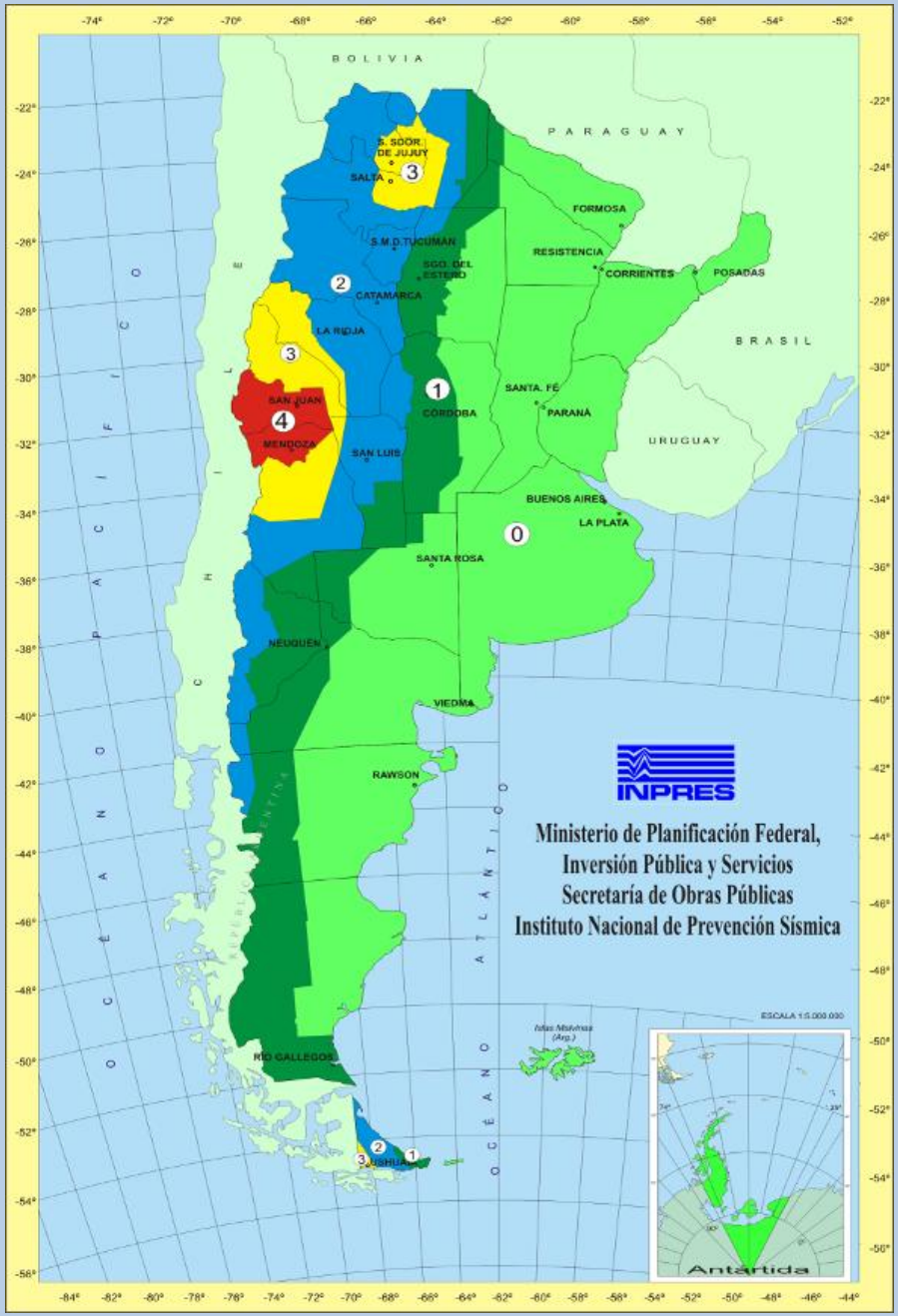
0 -180 seg

Eric Kiser & Miaki Ishii, Univ. Harvard

*”We observe a **significant increase in the rate of seismic activity at distances confined to within two to three rupture lengths of the mainshock.** Thus, we conclude that the regional hazard of larger earthquakes is increased after a mainshock, but the global hazard is not.”*

Parsons & Velasco, 2011 Nature Geosciences




BOLIVIA
PARAGUAY
BRASIL
URUGUAY
CHILE
OCEANO PACIFICO
OCEANO ATLANTICO
S. SDOR. DE JUJUY
SALTA
FORMOSA
S.M.D.TUCUMAN
SGO. DEL ESTERO
RESISTENCIA
CORRIENTES
POSADAS
CATAMARCA
LA RIOJA
SAN JUAN
MENDOZA
SAN LUIS
CORDOBA
SANTA FE
PARANA
BUENOS AIRES
LA PLATA
SANTA ROSA
NEUQUEN
VIEDMA
RAWSON
RIO GALLEGOS
USHUAIA
Islas Malvinas (Arg.)
Antartida
INPRES
Ministerio de Planificación Federal,
Inversión Pública y Servicios
Secretaría de Obras Públicas
Instituto Nacional de Prevención Sísmica
ESCALA 1:5.000.000

Conclusions

Combining data from different seismic networks and InSAR allowed an integral analyses to characterize hazardous seismic faults

Regional broadband seismic records were able to separate seismic events (local and regional) after the big 2010 earthquake in Chile

Argentina needs an effort integrating geophysical-geodesy data and increasing capacity building of their integrated analyses (especially supporting young students and scientists)