GNSS Stations Around the Pantanal Basin, and Preliminary Estimates of Intraplate Strain Rates in Central Brazil

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FAPESP Thematic Project: Pantanal, Chaco, Paraná Basins
AQDB (Aquidauana) Weekly SIRGAs time series, ITRF14

- Statistical analysis for time series cleaning;
- Stochastic model estimation (LSVCE)
- Velocity estimation with annual and semi-annual variations; time breaks

North

East

Up
Crustal Stresses from Earthquake Faulting Mechanisms
Maximum Horizontal Compression (estimates)

Assumpção et al., 2016
Crustal Stresses in Brazil
Intraplate Deformation Rate
Intraplate Strain Rate
Intraplate Strain Rate

Strain rate = \frac{(V_{rad2} - V_{rad1})}{\text{Distance}}
Intraplate Strain Rate

\[ V_{\text{rad}1} = V_{n1} \cos(Az1) + V_{e1} \sin(Az1) \]

\[ V_{\text{rad}2} = V_{n2} \cos(Az2-180) + V_{e2} \sin(Az2-180) \]

\[ \text{Strain rate} = \frac{(V_{\text{rad}2} - V_{\text{rad}1})}{\text{Distance}} \]
**Strain rate** = \( \frac{(V_{rad2} - V_{rad1})}{\text{Distance}} \)

**Good quality time series, 10 – 20 years (RBMC)**

PRMA:

\[ V_n = 13.065 \pm 0.009 \text{ mm/y} \]

\[ V_e = -2.878 \pm 0.010 \text{ mm/y} \]

(GIPSY-OASIS)
Strain Rates between all pairs of stations range from:

-1.0 E-9/y (shortening)

to

+0.4 E-9/y (extension)
Strain Rates between all pairs of stations range from: 

-1.0 E-9/y to +0.4 E-9/y
Stress patterns (from earthquake mechanisms)

- NW-SE compression
- Strain rate: NE-SW shortening
- ~E-W compression in central part
Stresses in sub-Andes (Ecuador)

S. Colombia – Ecuador – N. Peru

Stress tensors from foc.mec.

Nazca slab events

Naza-S.America interplate

Crustal seismicity Sub-Andes intrapl.
Comparison with Strain Data – sub-Andes

S. Colombia – Ecuador – N. Peru

North Andean Block (NAS):
ENE-WSW shortening

Inca Sliver (IS):
ESE-WNW shortening

Stress tensors from foc.mec.
Comparison with Strain Data – sub-Andes

S. Colombia – Ecuador – N. Peru

Ecuador sub-Andes:
G.R. Mag-Freq.
Mo release rate:
~ -30 E-9 /y
Mmax=7.5

GNSS strain rates: shortening of -20 to -60 E-9 /y

Sub-Andes: strain rate consistent with seismic moment release rate!
GNSS strain rates:
order of $0.4 - 1.0 \times 10^{-9} /y$

Brazil, SCR
G.R. Mag-Freq.
Mo release rate:
$\sim 0.03 \times 10^{-9} /y$

$M_{max} = 7.0$
In mid-plate Brazil, seismic release is one order of magnitude lower than deformation rate:

Different causes!
Points for future discussion

1) What causes NE-SW shortening rate in mid-plate South America? And possibly extensional rates along the coast?

2) The strain rates can be explained by:

- Global Glacial (Andean?) Isostatic Adjustment?
- Relaxation after large Andean earthquakes?
- Decadal deep hydrological cycles, climate change?
- Any relation with regional earthquakes?
Decadal variations: Noise or Geodynamics?

MTCO, Vertical
Thank you!