The temporal variability of aseismic slip along the San Andreas Fault

Sylvain MICHEL
Romain JOLIVET
Adriano GUALANDI
Olivier LENGLINÉ
Blandine GARDONIO
Manon DALAISON
Angelique BENOIT

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San Andreas Regional Setting

- Regular M6 Earthquakes: every 24.5±9 years
  - Last one in 2004
- Area massively studied:
  - Parkfield’s project (1983)
  - Densely instrumented
  - Historical records

Michel et al., 2018

**Goal:** Describe the SAF slip rate temporal variation.

**How?**
- Using 39 GNSS stations (Horizontal components)
- Applying blind source separation technique (vbICA) to retrieve tectonic signal
- Inversion of retrieved signal to get slip on the fault

Processed by JPL
PCAIM-ICAIM approach

Blind source separation technique: Variational Bayesian Independent Component Analysis (vbICA)

Choudrey and Roberts 2003
ICA: Spatio - Temporal components

Common Mode

Not interested in this component
ICA: Spatio - Temporal components

Seasonal deformation
ICA: Spatio-Temporal components

Asymmetric

Interested in this component

Post-seismic deformation
ICs Inversion and Repeaters

**SSEs Inversion:**
- We recombine the components we are interested in
- Take GPS between 0-20 km North of Parkfield earthquake ⇒ provide displacement rate profile
- 1.5D Inversion: Infinite along strike fault discretized along depth (20 patch)
- Radiguet et al., 2011 regularization scheme + Constraint: Cannot decelerate under interseismic slip rate

**Repeaters:** Relocalisation with HYPODD + Clustering of earthquakes + Correlation coefficient >0.85 on P- and S-waves
Results

Creepmeters (USGS)
Slow Slip Events Detection

Idealized Postseismic Detection Threshold

Khoshmanesh and Shirzaei, 2018

=> SSE detection from InSAR
Conclusion

From 39 GPS stations, we detected variation of slip rate relative to the postseismic along Parkfield’s section of the San Andreas Fault.

• Using vbICA technique, we separated tectonic sources from non-tectonics ones.
  ⇒ At least 10 major SSEs between 2006 and 2018.5
• Future work
  ⇒ 3D inversion of each SSEs
  ⇒ Look at InSAR time series for the 2017 event:
    Sentinel Data (every 6-12 days)

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