

The temporal variability of aseismic slip along the San Andreas Fault

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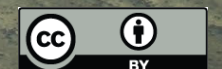
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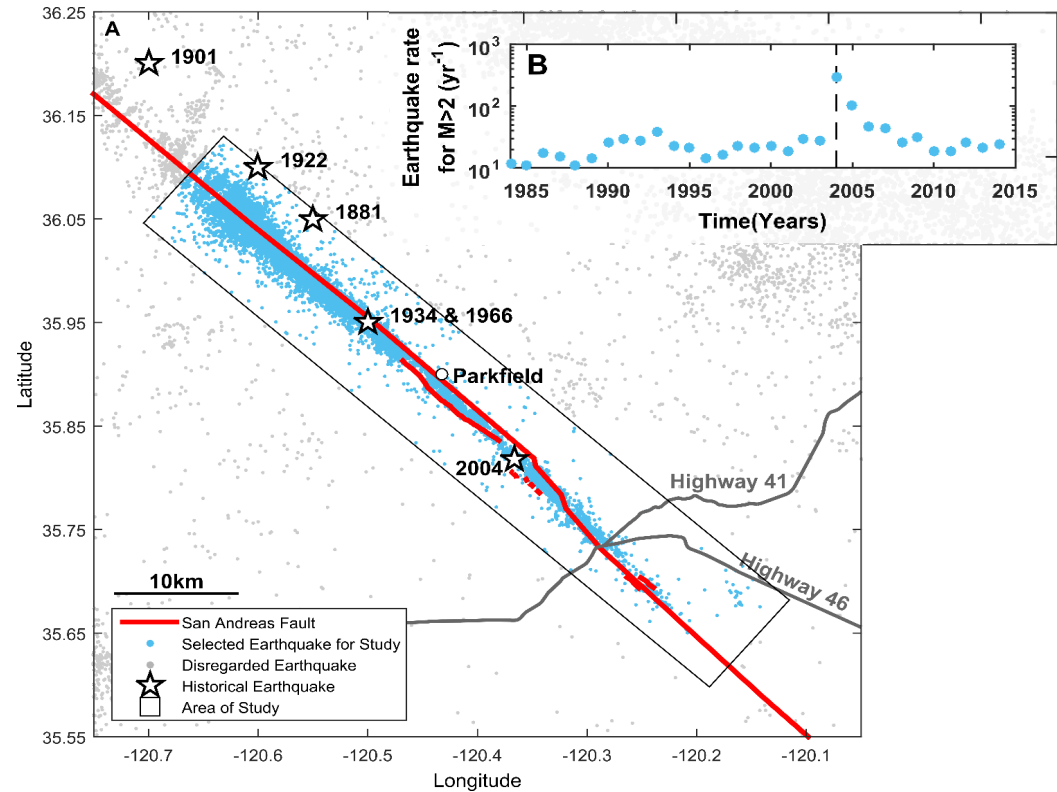
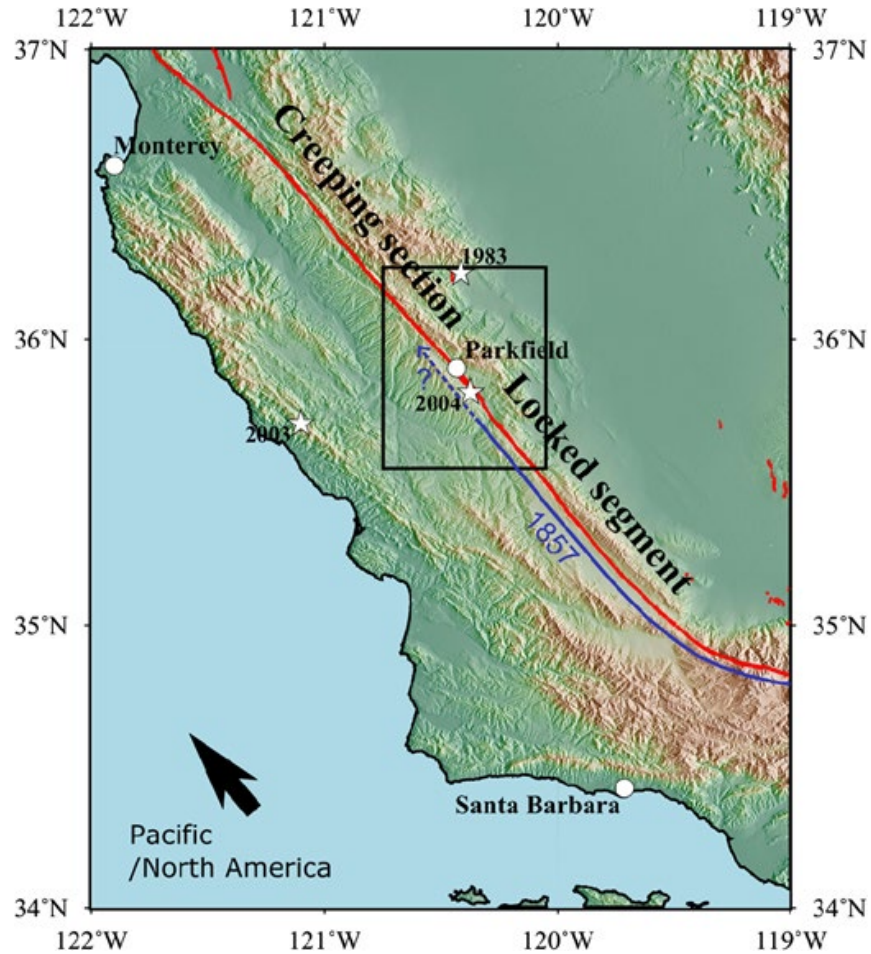
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EGU-2020



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

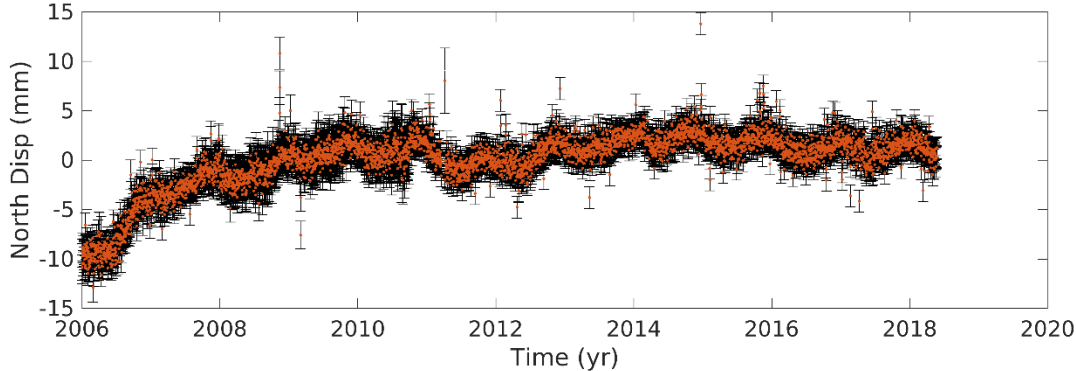
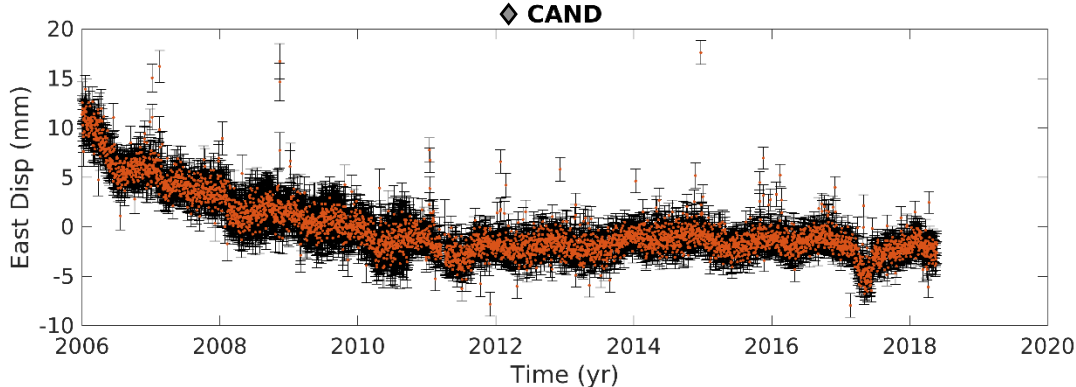
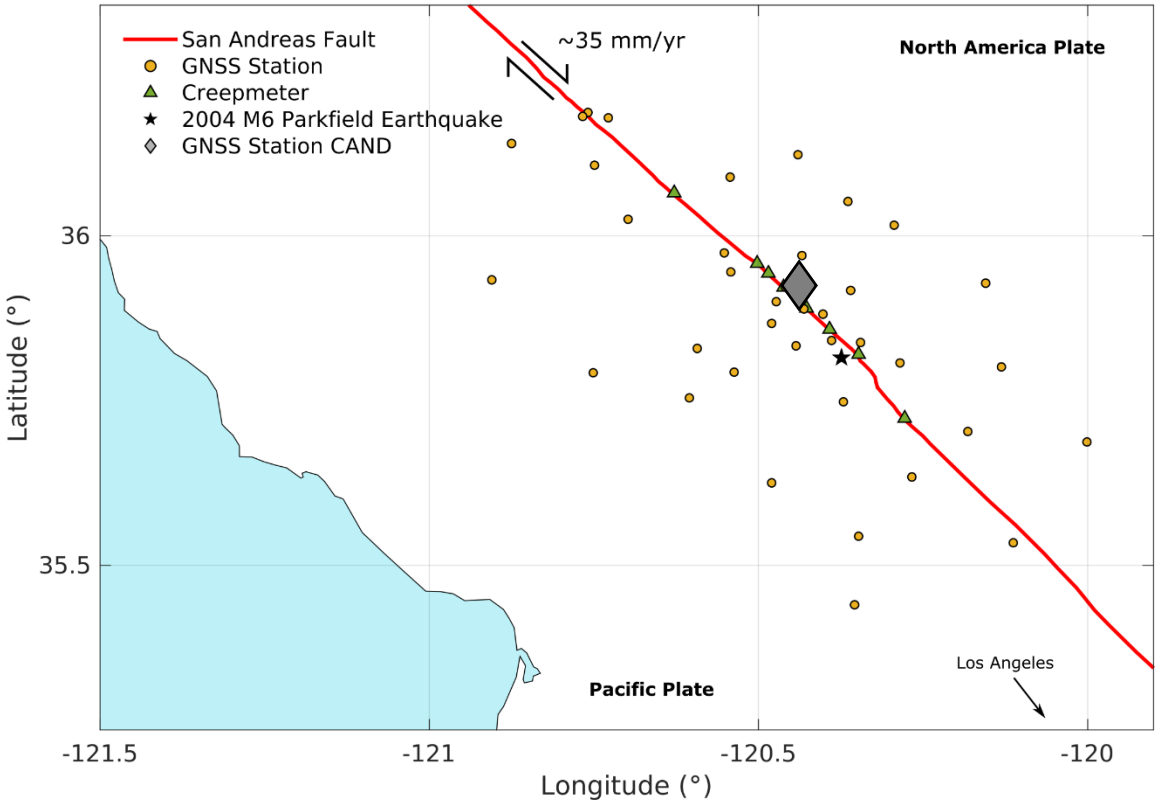


Michel et al., 2018

78 GPS Time series (2006-2018)

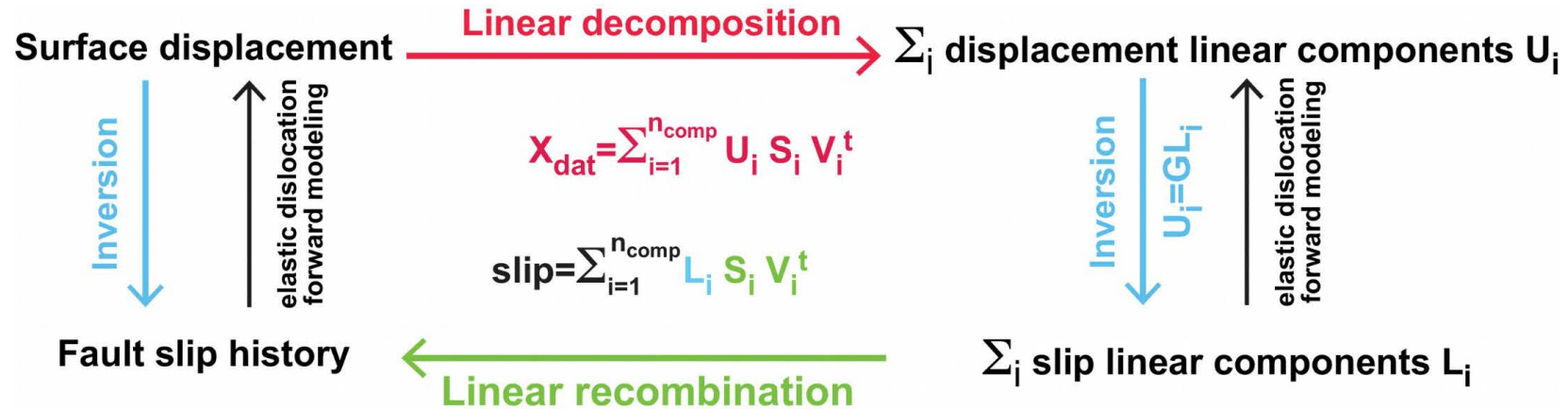
Goal: Describe the SAF slip rate temporal variation.

- 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



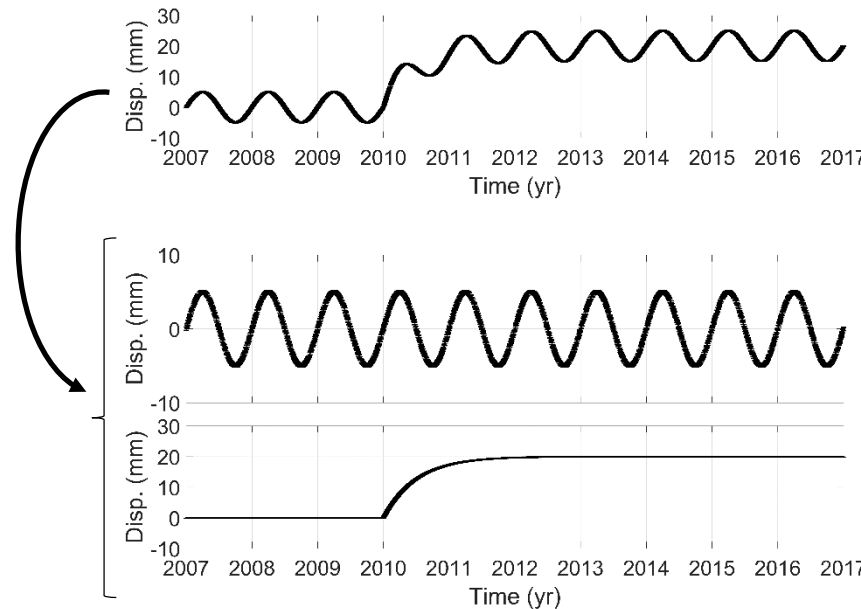
Detrended time series

PCAIM-ICAIM approach



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

Choudrey and Roberts 2003



Initial time series
 (Seasonal + Postseismic signal)

(Seasonal signal)

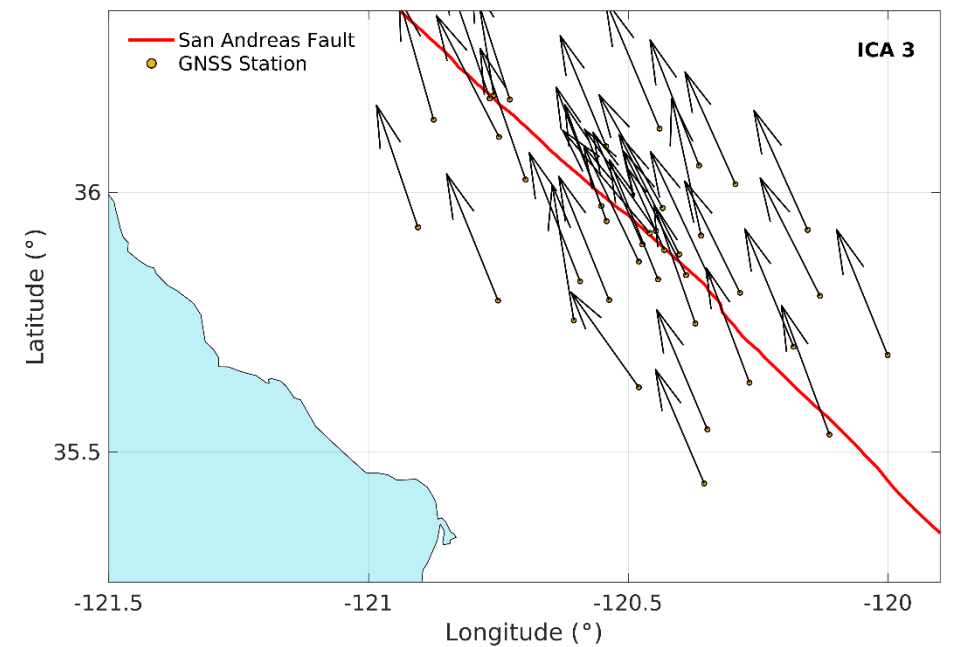
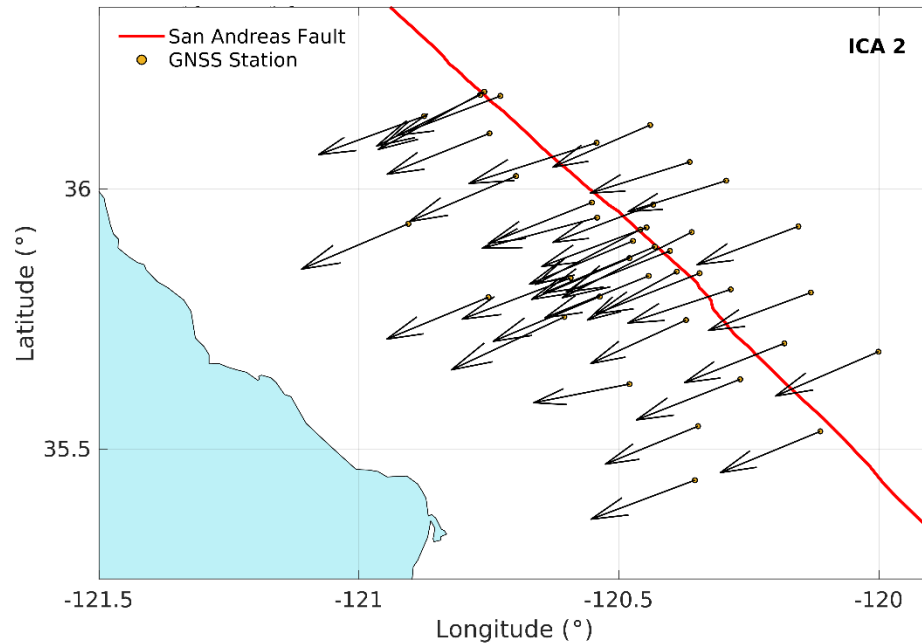
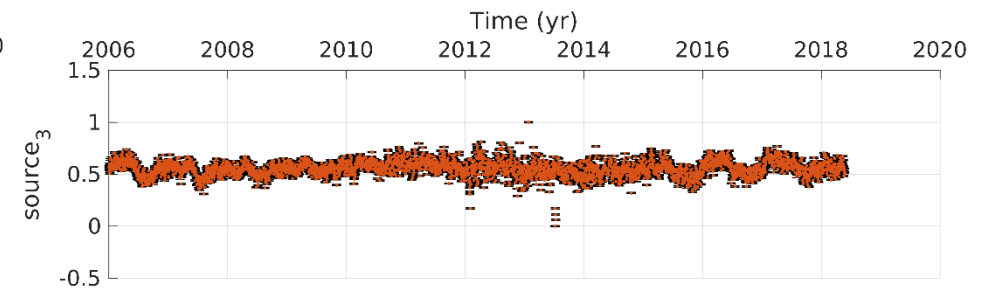
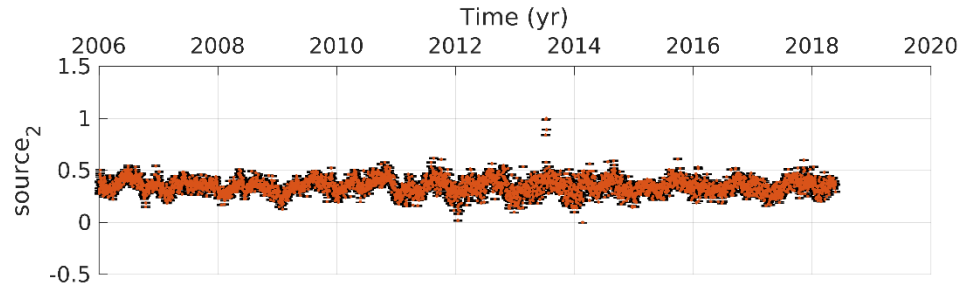
(Postseismic signal)

ICA: Spatio - Temporal components

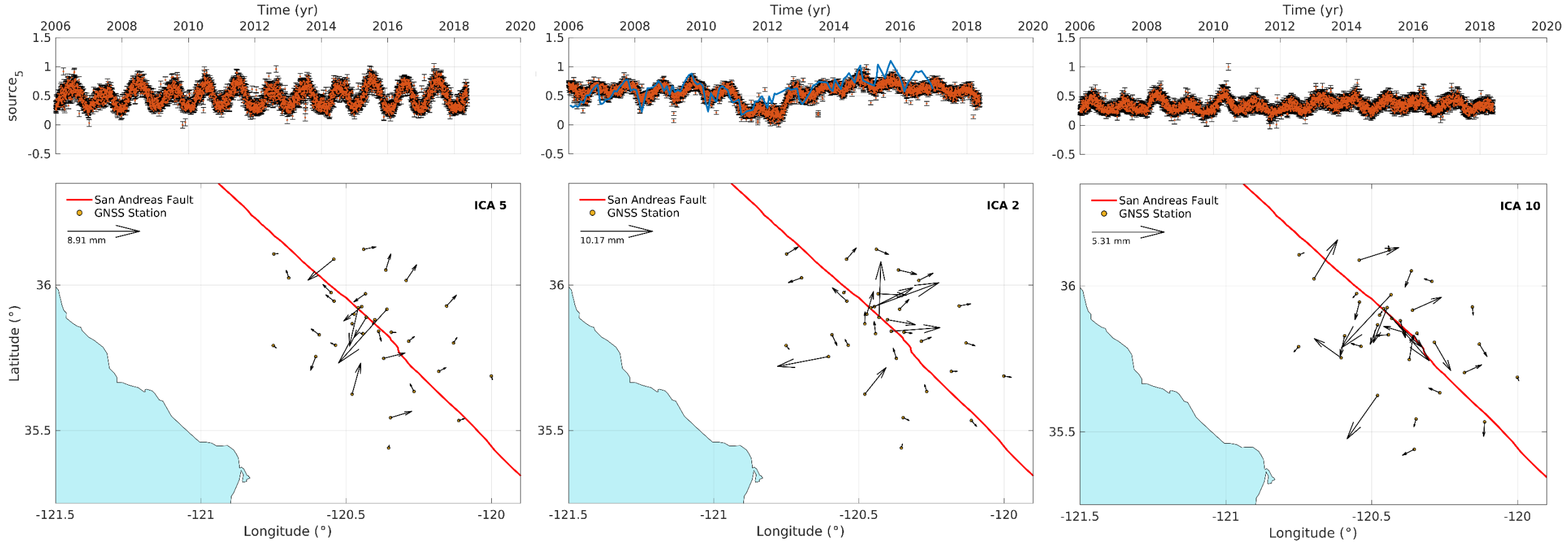
Common
Mode



Not interested in
this component



ICA: Spatio - Temporal components



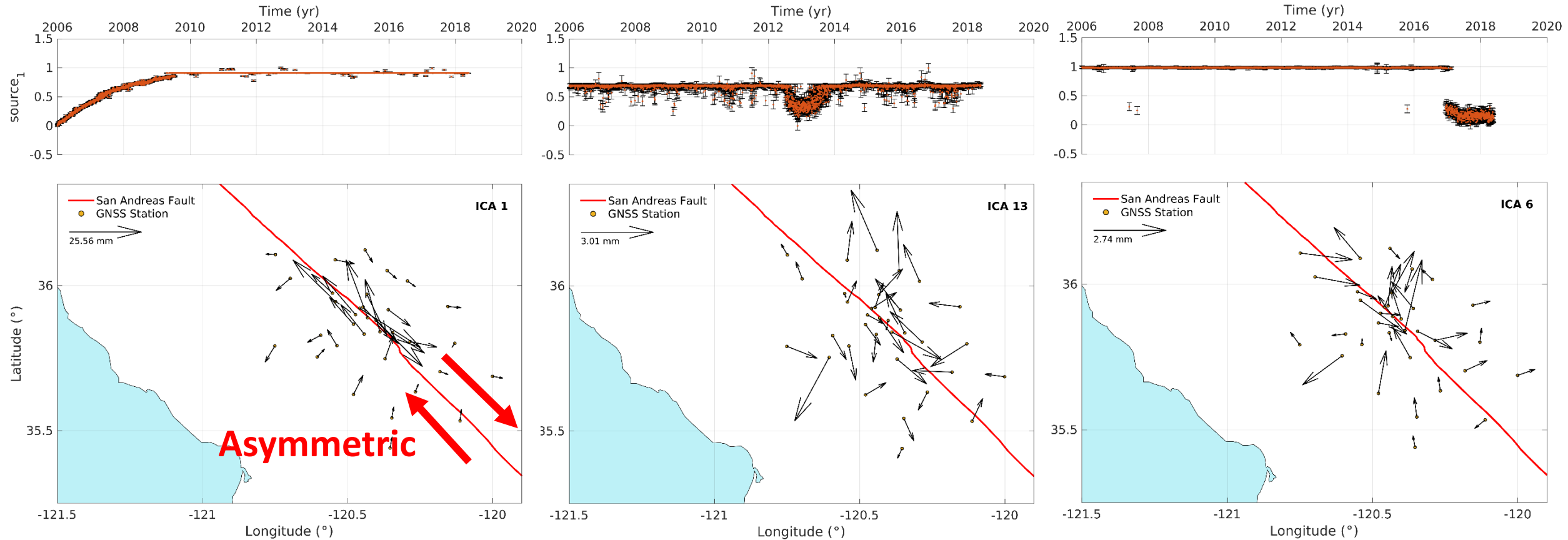
X

X

X

Seasonal deformation

ICA: Spatio-Temporal components

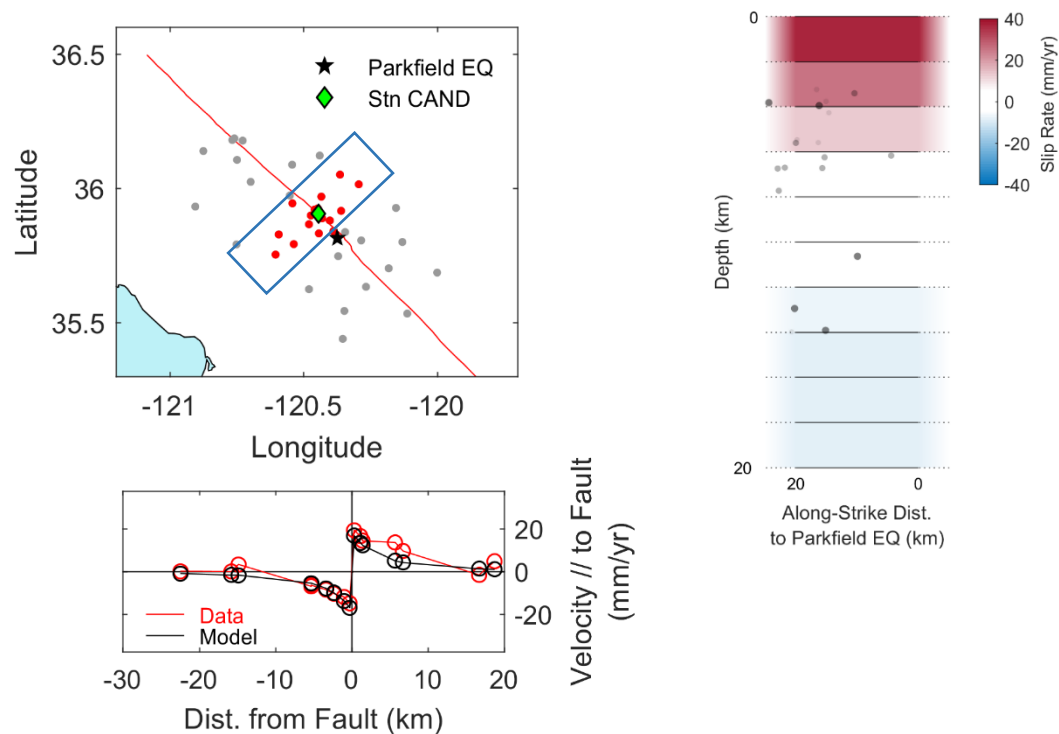


✓
Interested in this component

✓
Post-seismic deformation



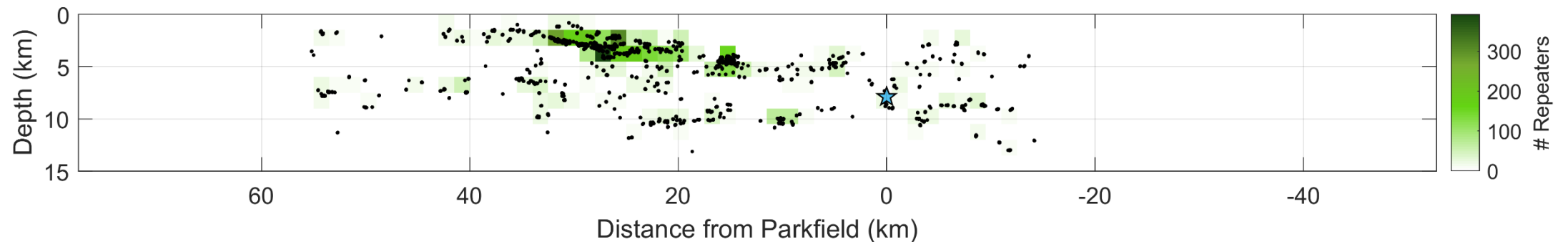
ICs Inversion and Repeaters



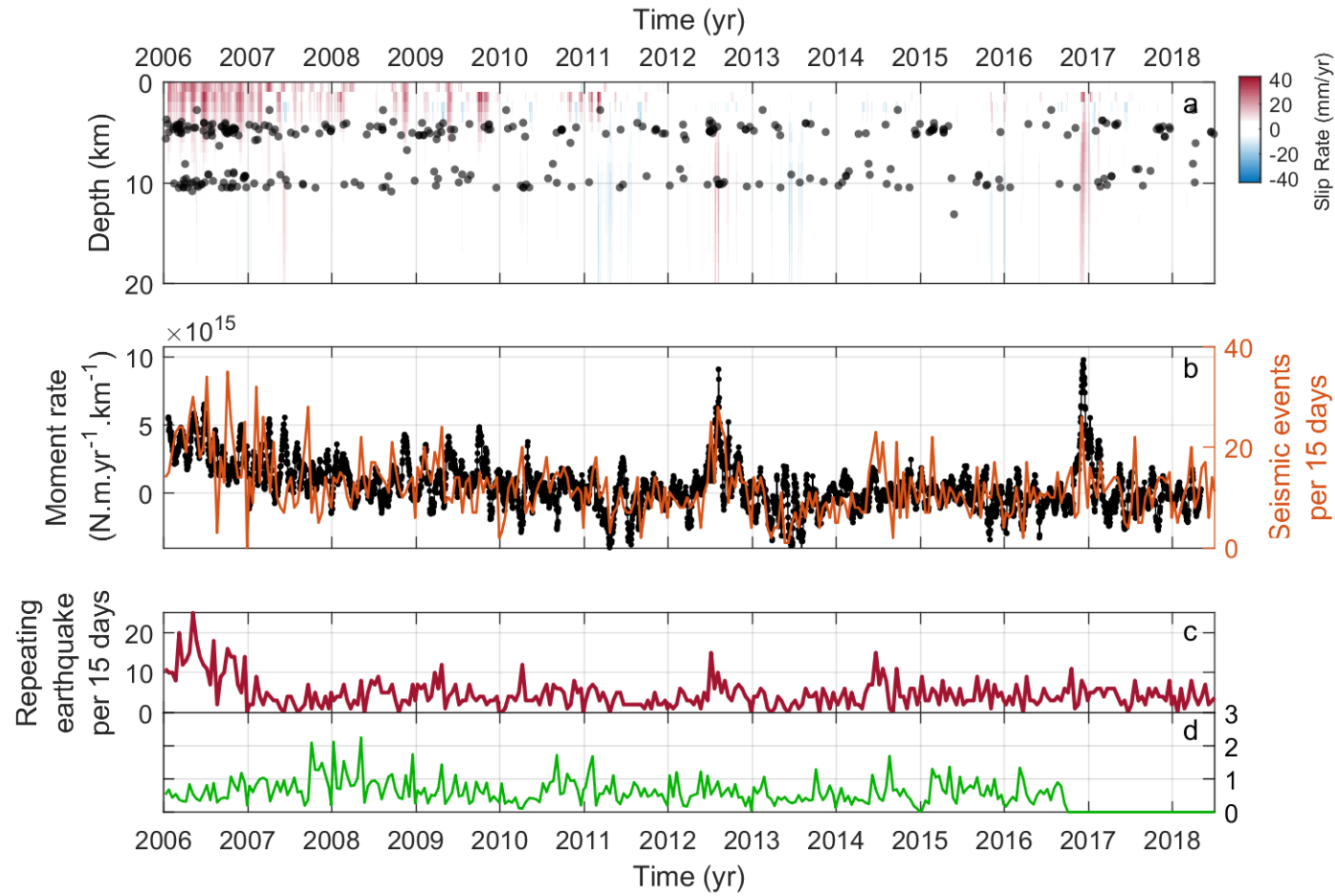
SSEs Inversion:

- 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

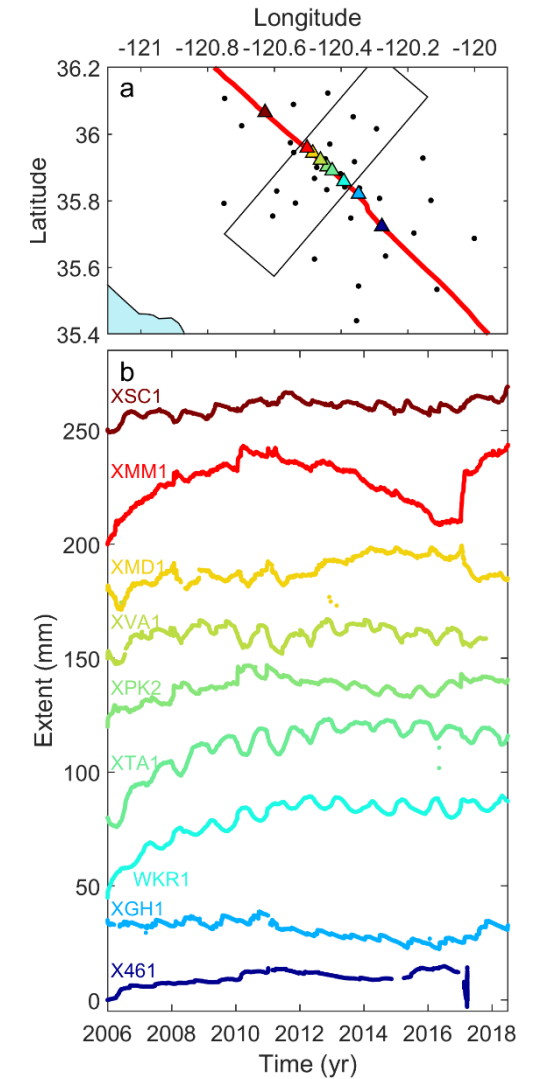
Repeaters: Relocalisation with HYPODD + Clustering of earthquakes + Correlation coefficient >0.85 on P- and S-waves



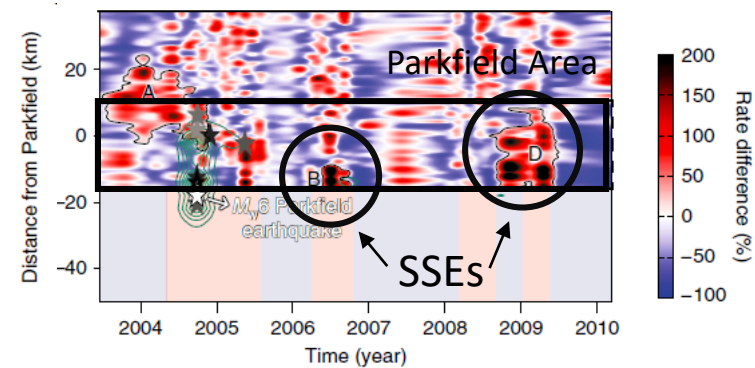
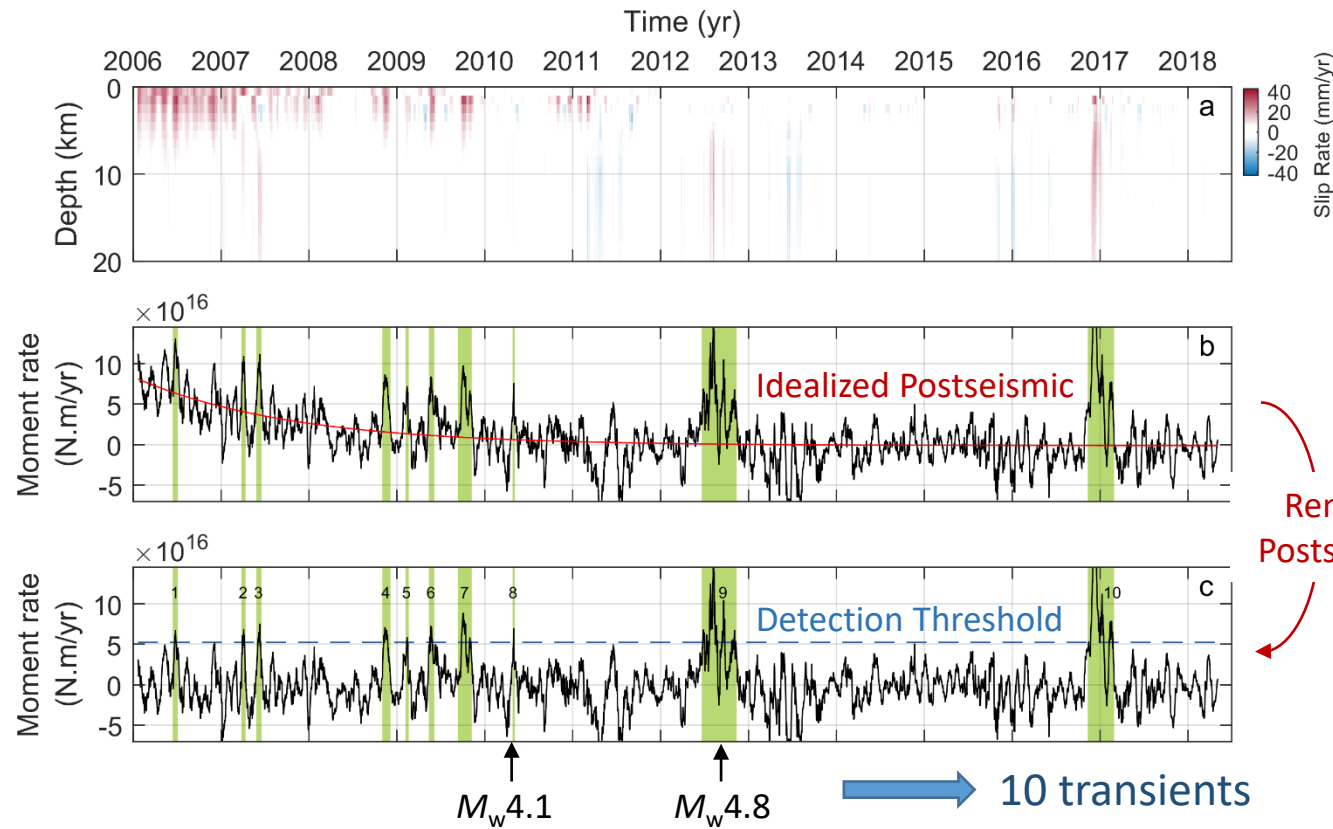
Results



Creepmeters (USGS)

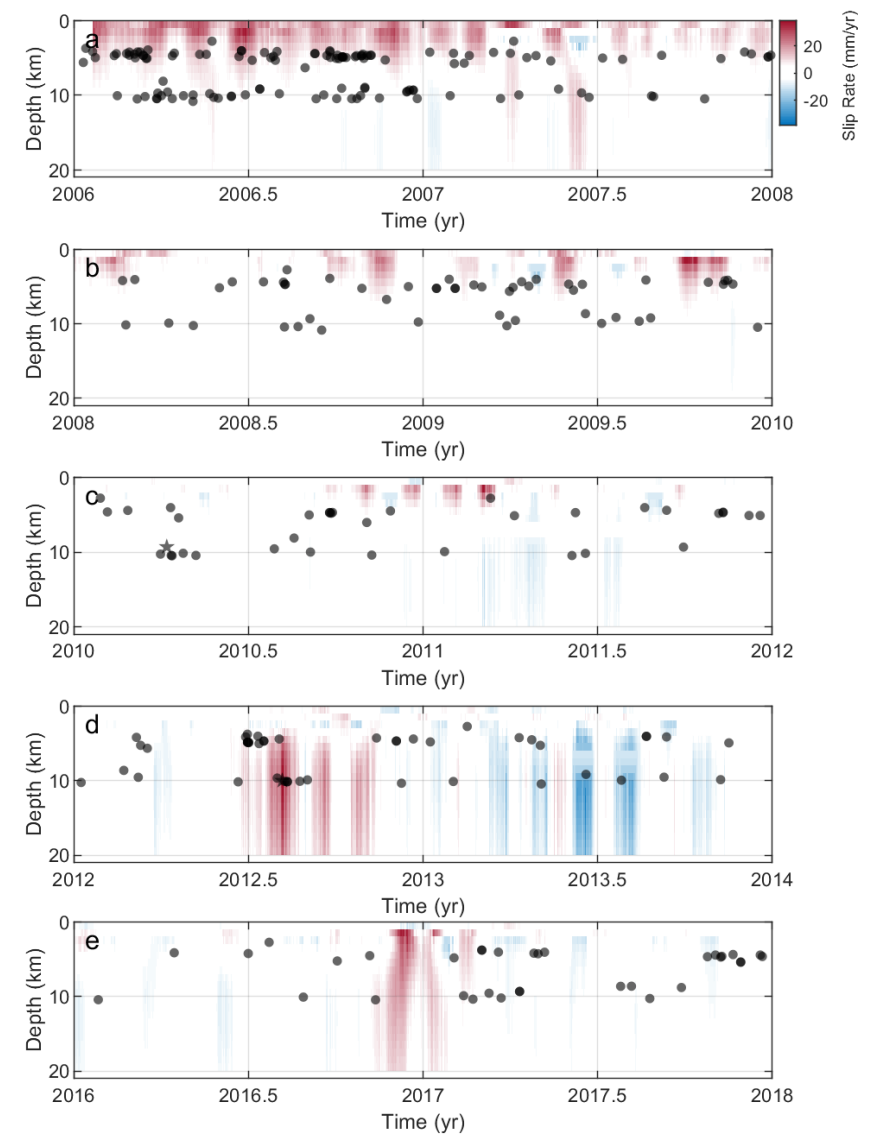


Slow Slip Events Detection



Khoshmanesh and Shirzaei, 2018
 => SSE detection from InSAR

Zoom on time periods



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 vblCA 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)