

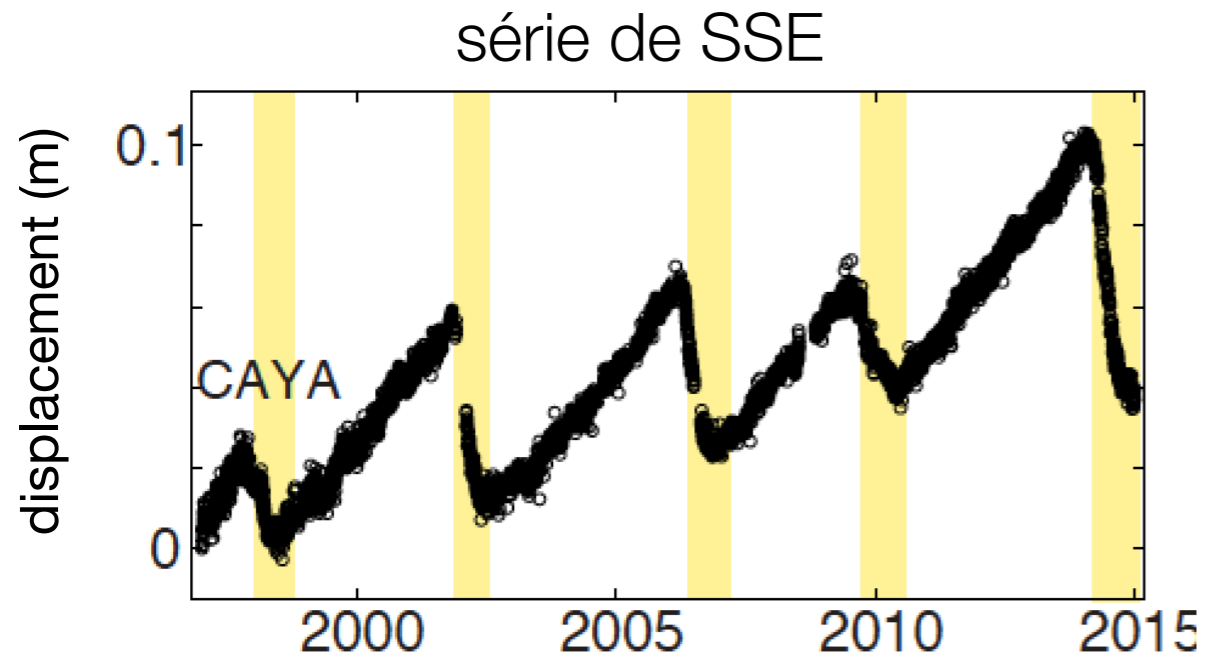


A geodetic matched-filter search for slow slip with application to the Mexico subduction zone

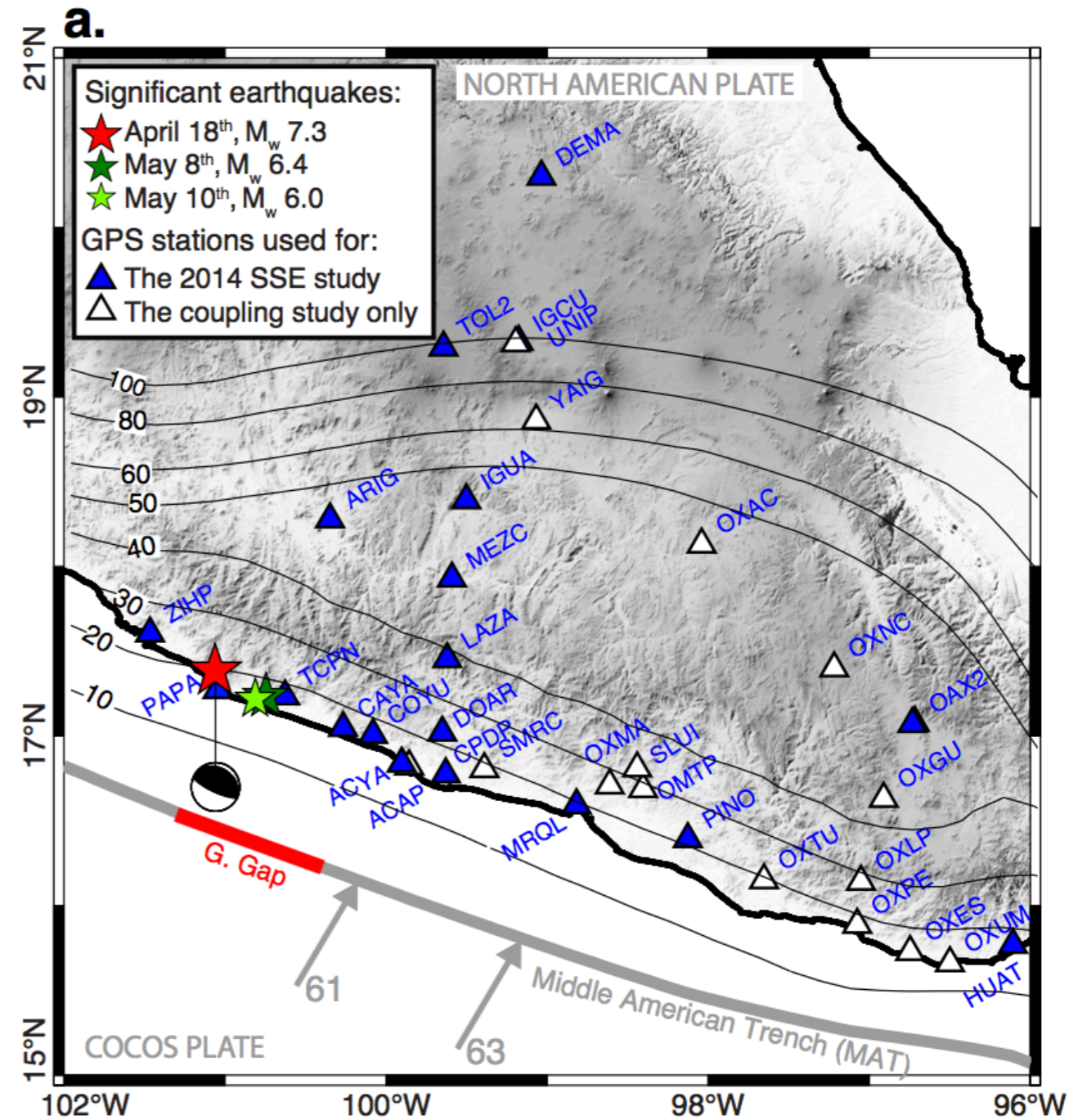
Baptiste Rousset, Michel Campillo, Cécile Lasserre, William Frank, Nathalie Cotte, Andréa Walpersdorf, Anne Socquet & Vladimir Kostoglodov

Cargèse workshop 2017

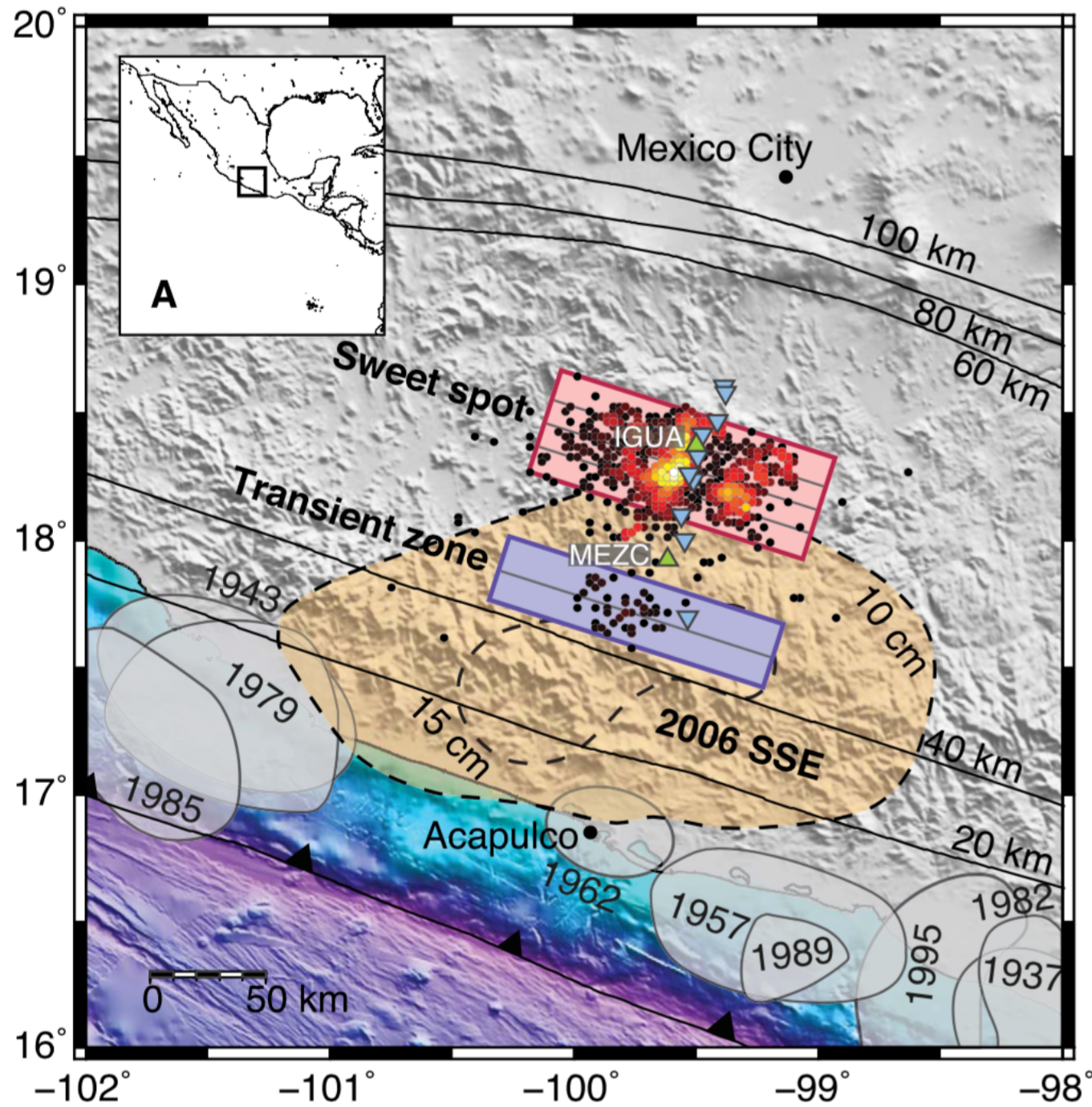
Slow Slip Events in Mexico



Series of Mw 7.6 Slow Slip Events in the Guerrero Area with ~ 3 years recurrence intervals.

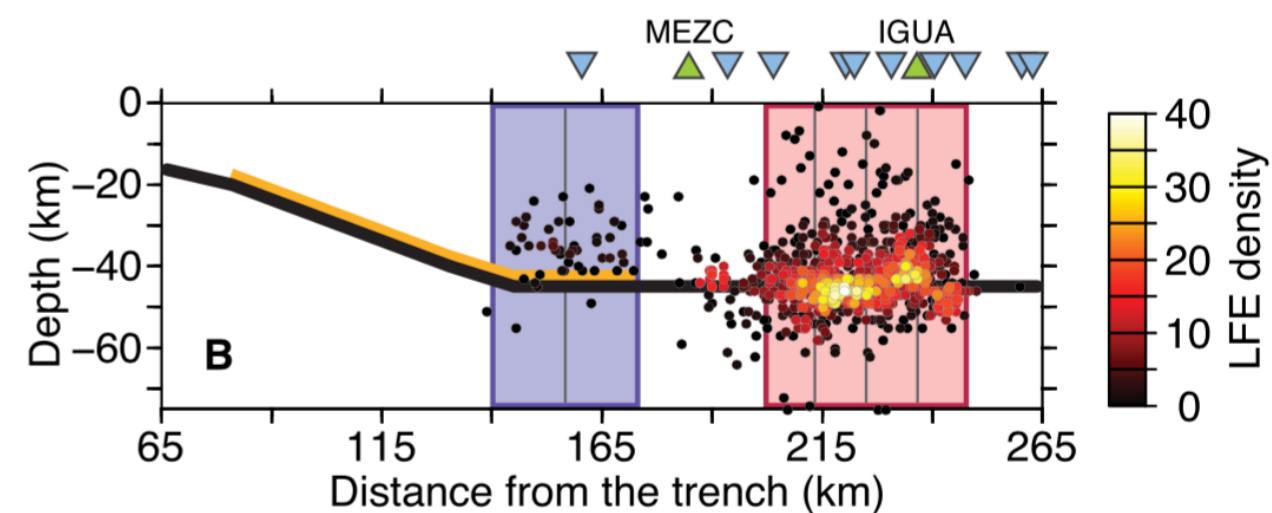


Low Frequency Earthquakes in Mexico

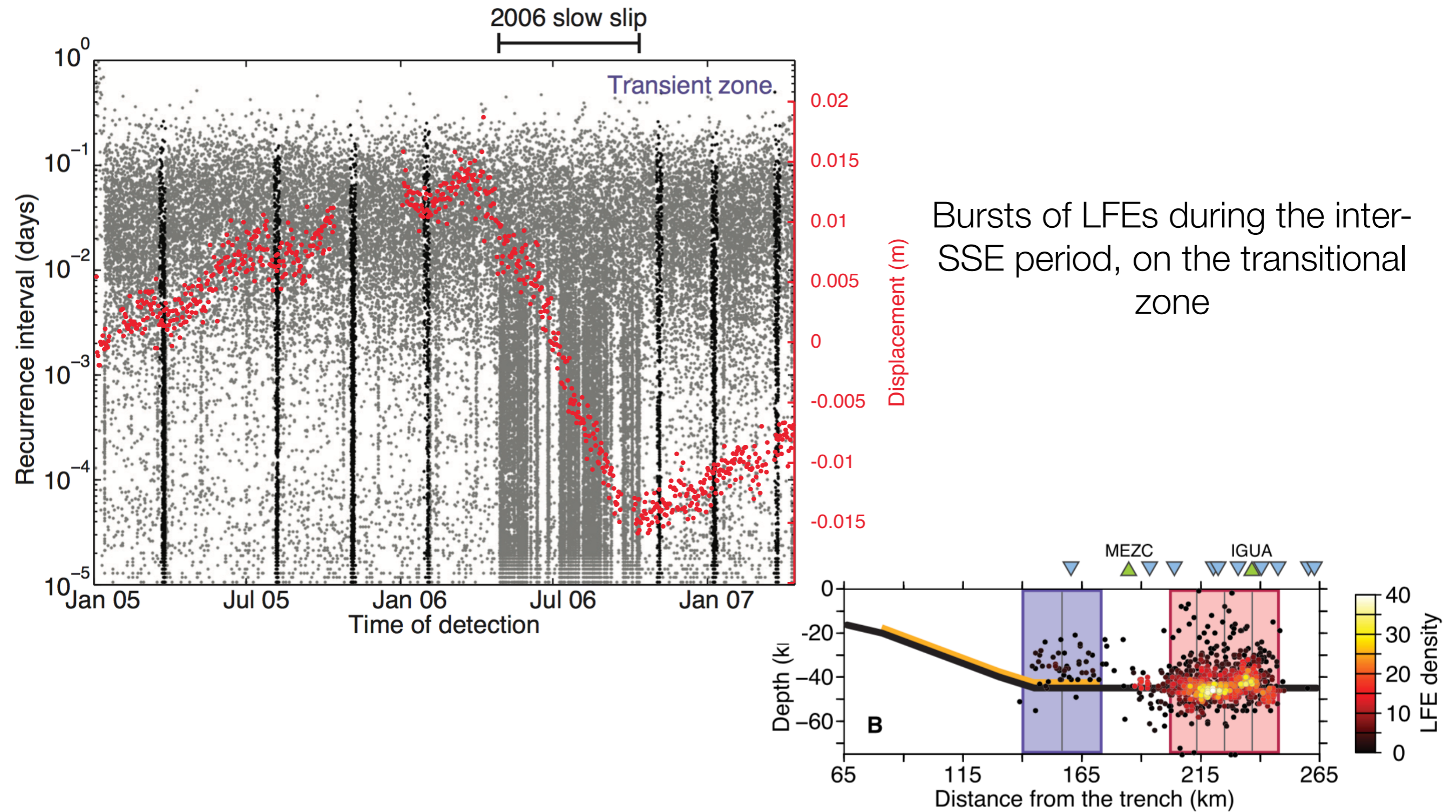


LFEs detected along the MASE profile clustered in two spots :

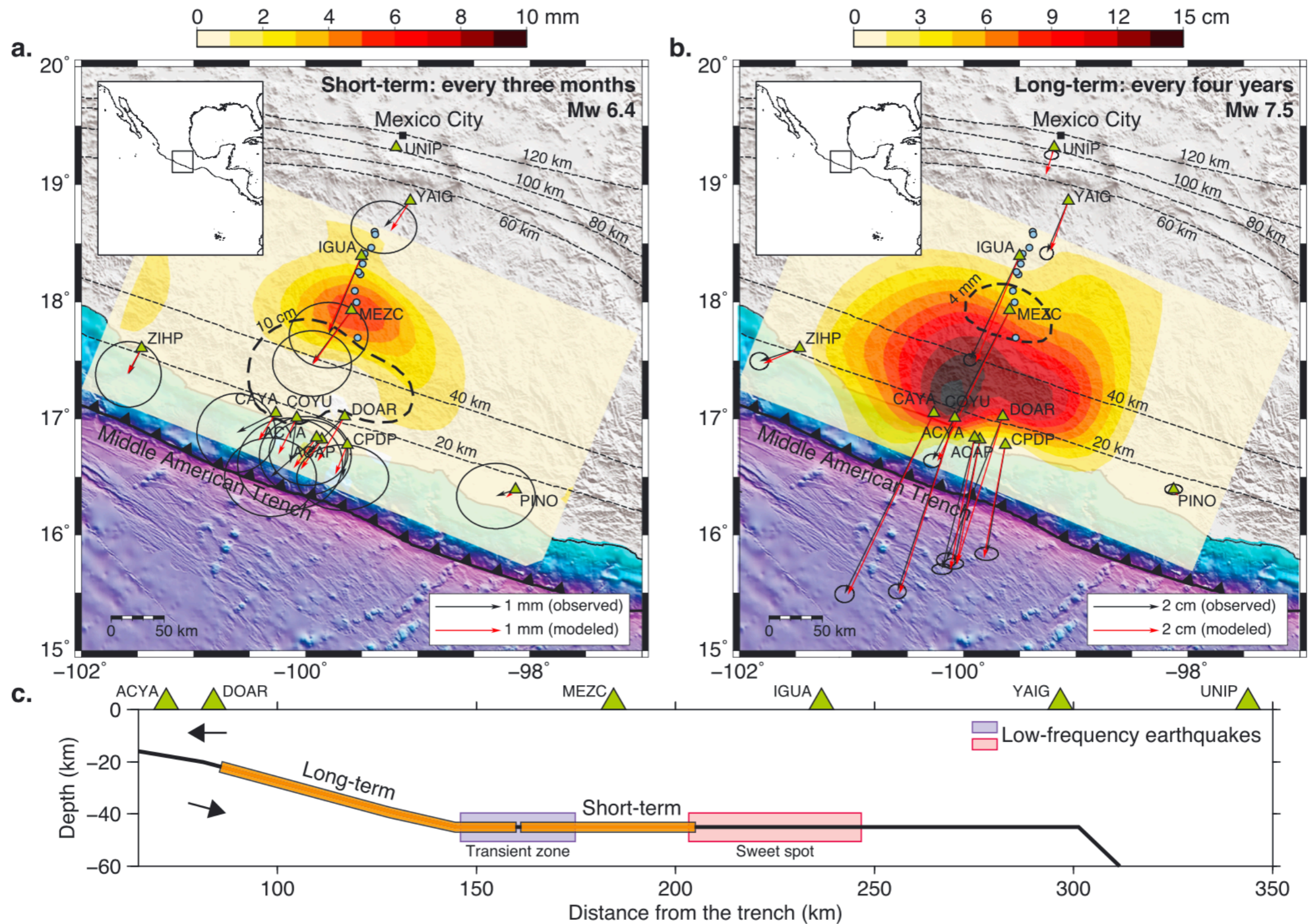
- the **sweet spot**
- the **transient zone**



Inter-SSE bursts of LFEs



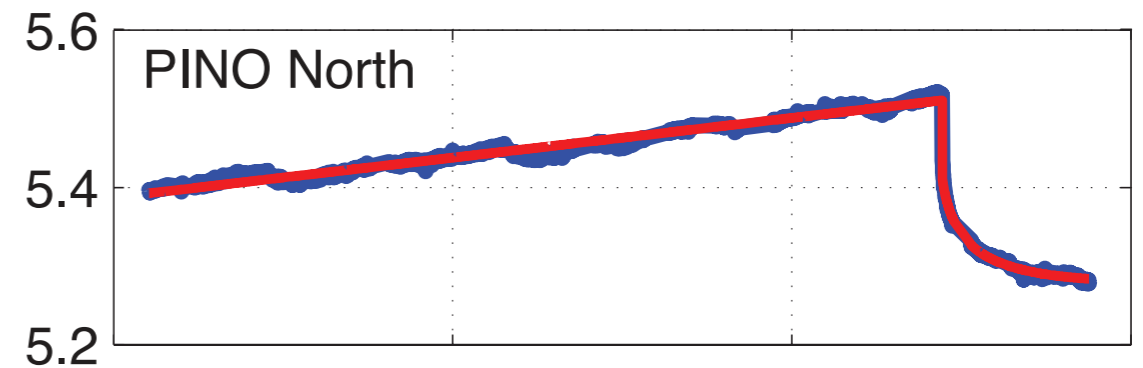
Average short-term SSE



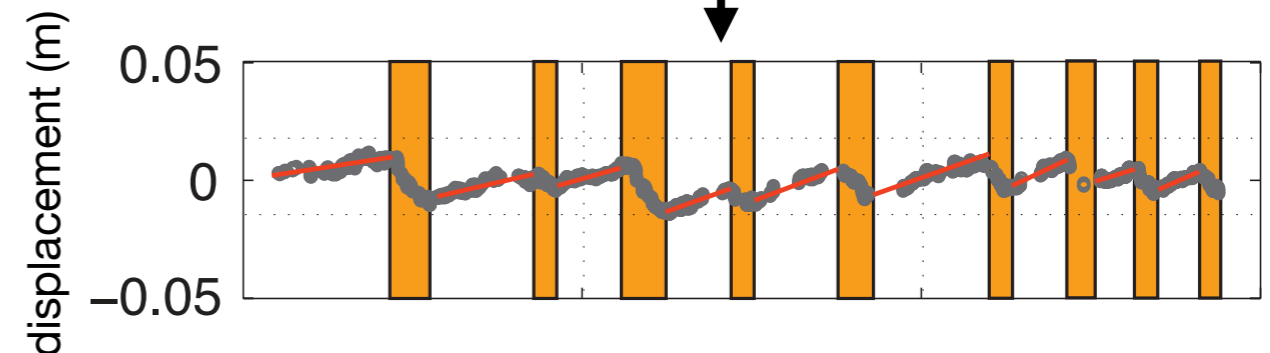
Processing of the GPS time series

Processing of the
GPS time series

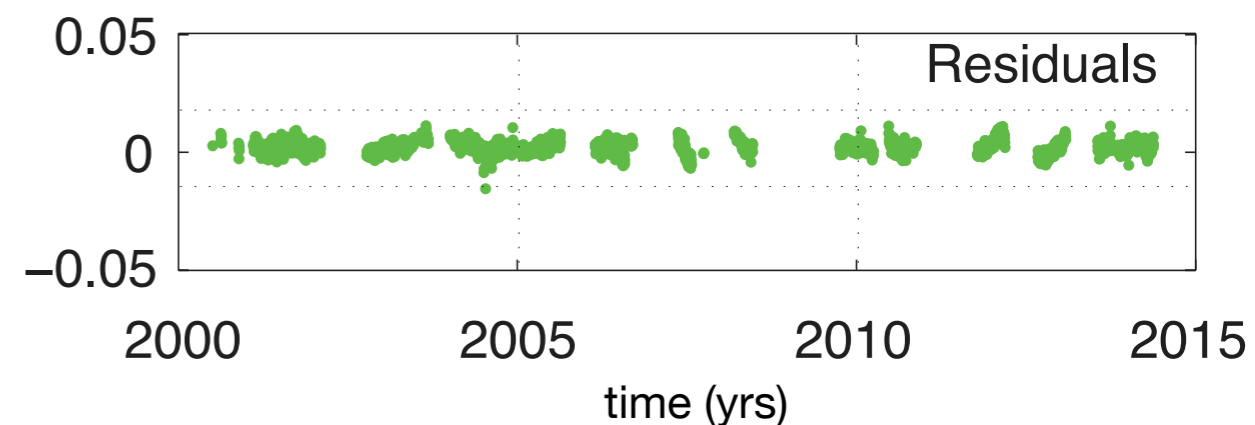
1. Raw data processed with Gamit /
Globk



2. Removal of interseismic signal, linear term,
co-seismic step and post-seismic signals



3. Removal of slow-slip periods and linear
inter-SSE trends

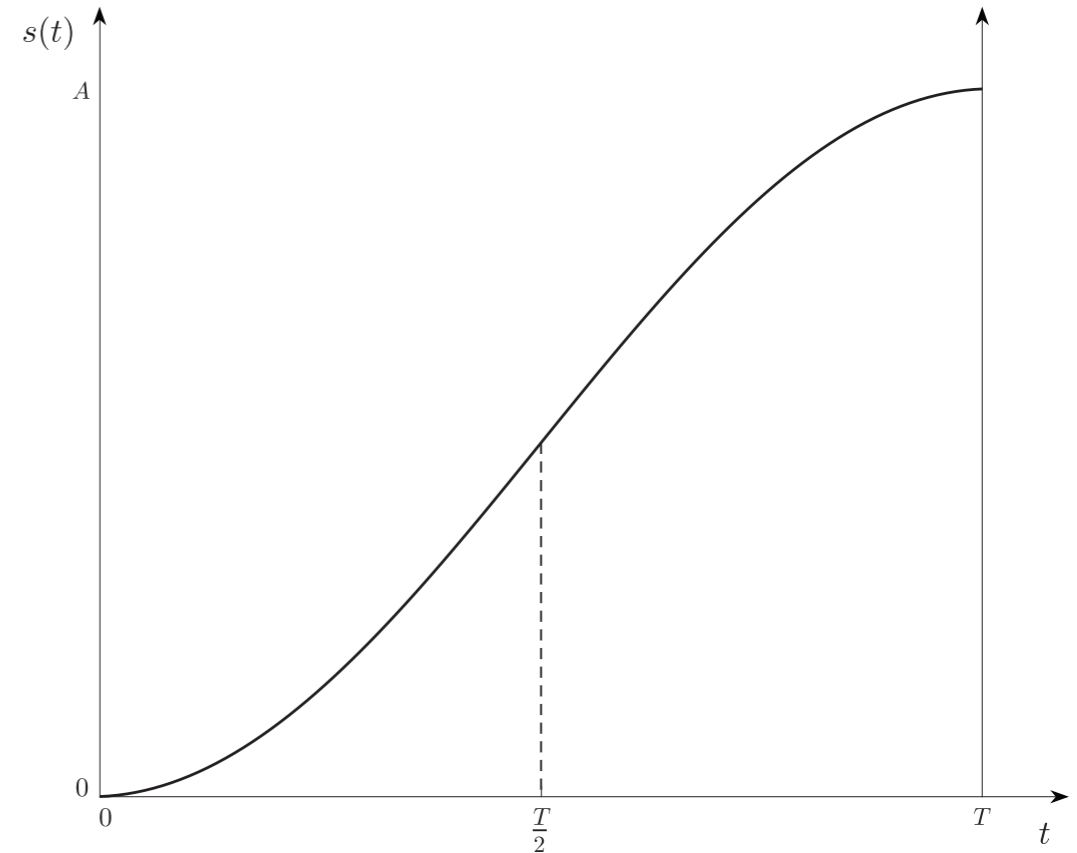
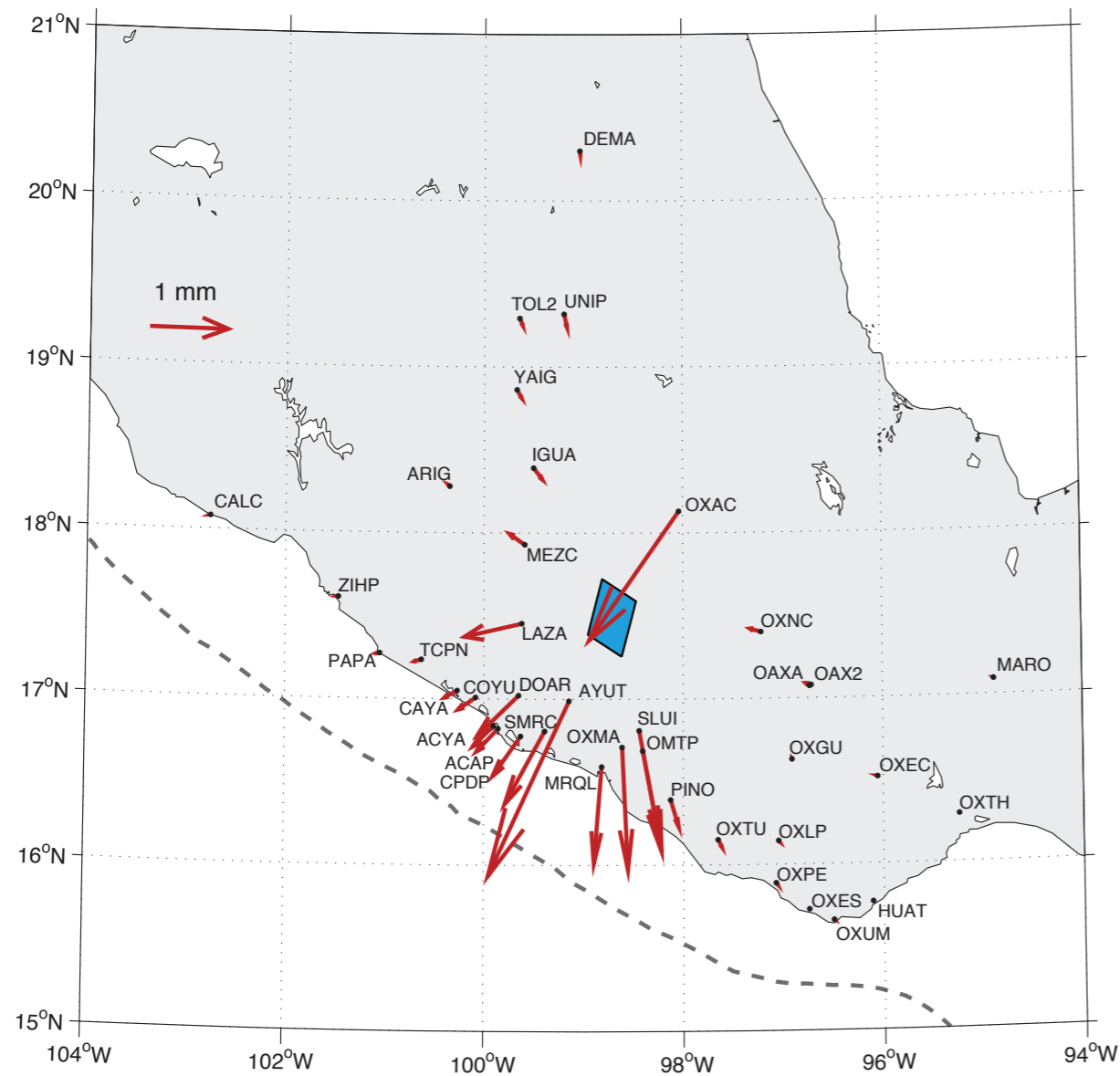


4. Take the temporal derivative

The synthetic templates

Processed GPS
Time Series

Library of
synthetic signals



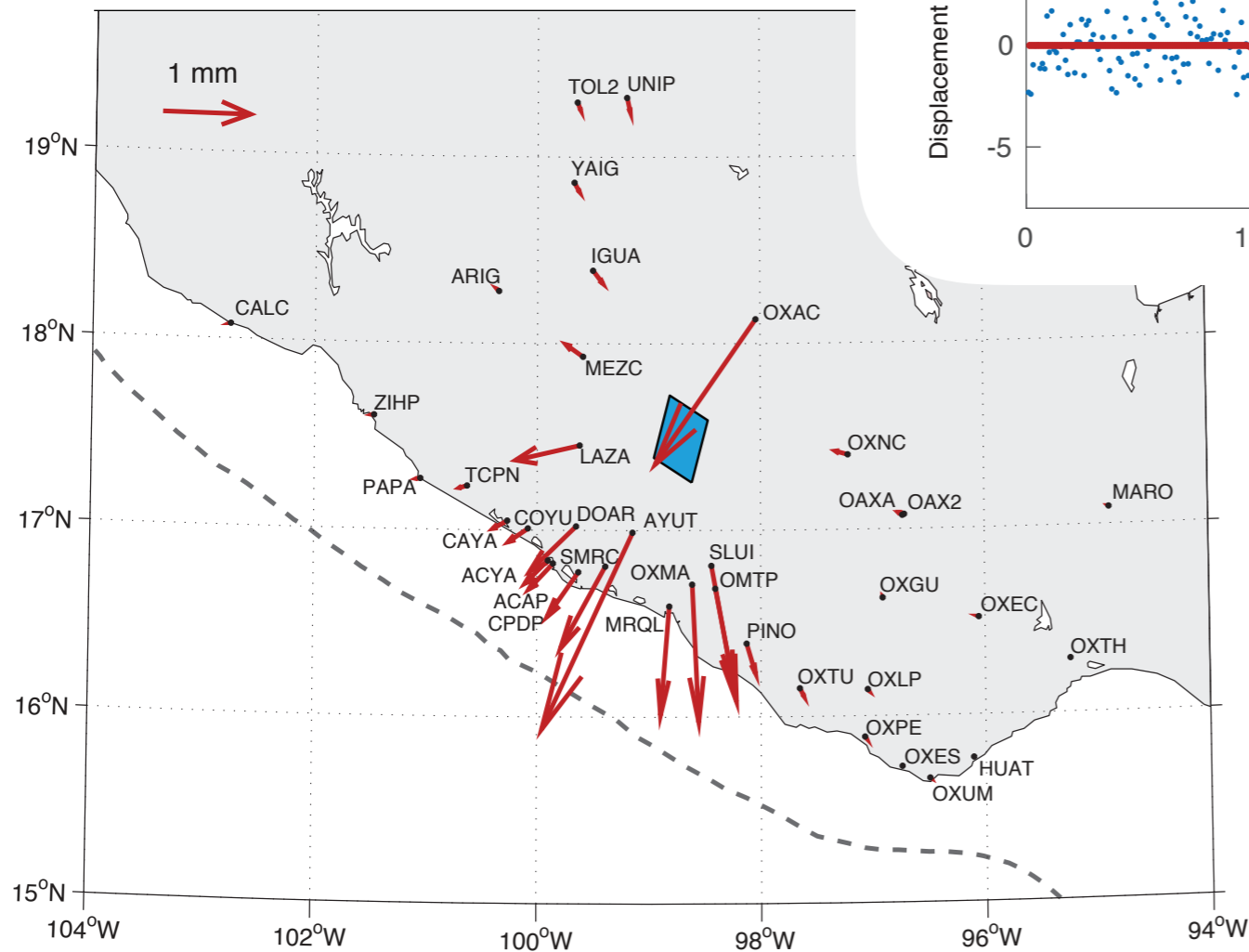
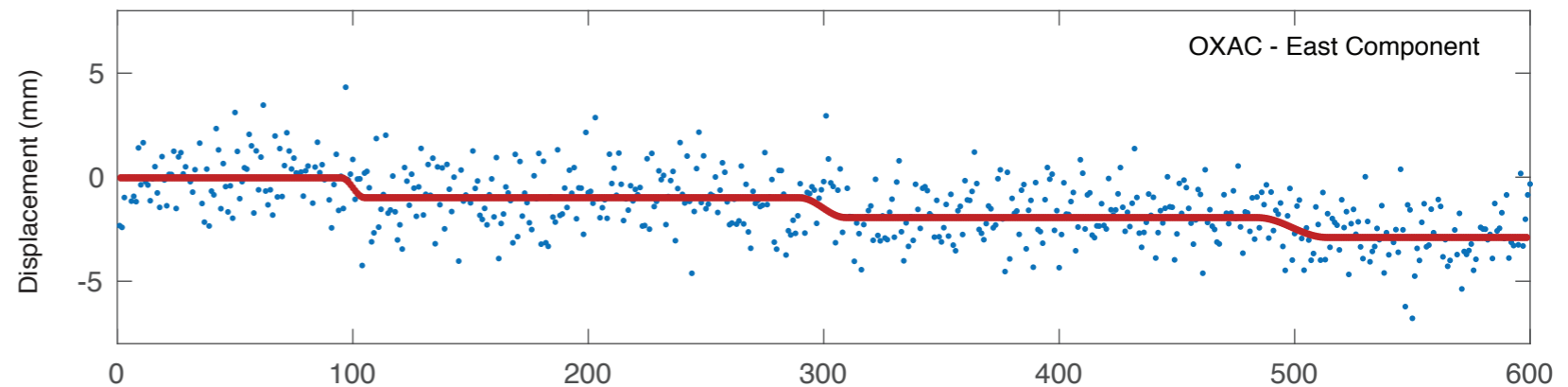
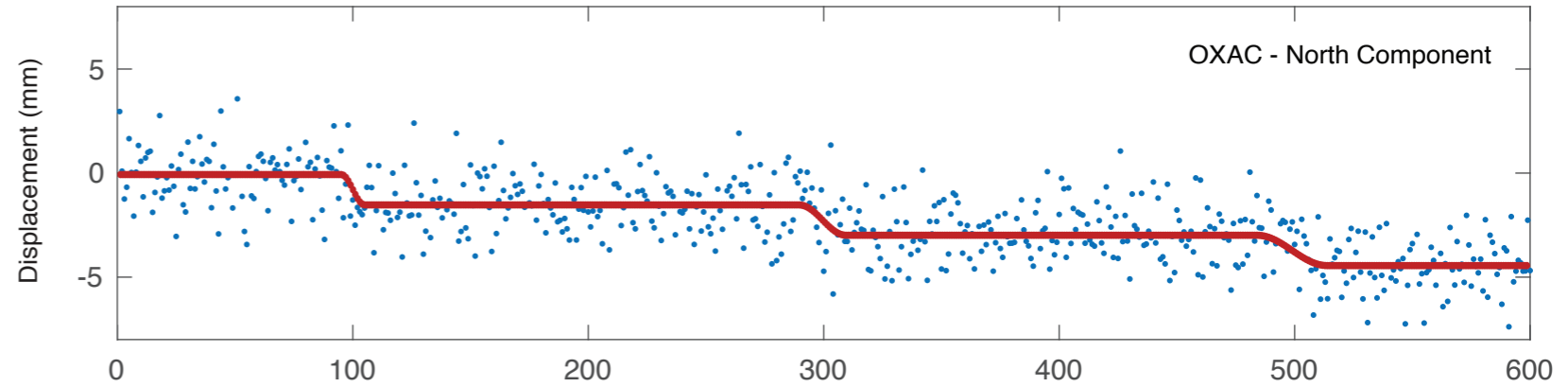
Parameters :

- Location
- Amplitude of slip
- Slipping area
- Duration

Synthetic tests

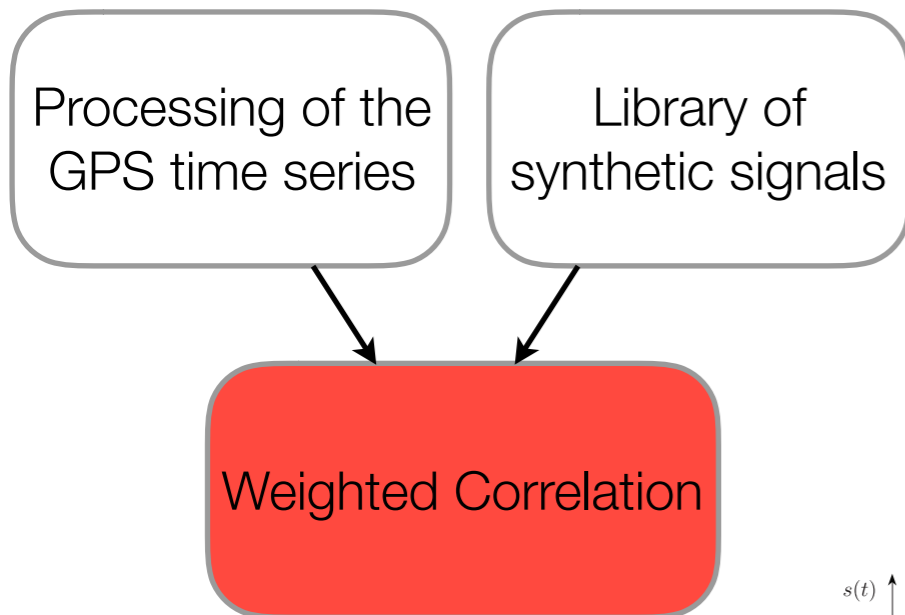
Processing of the
GPS time series

Library of
synthetic signals

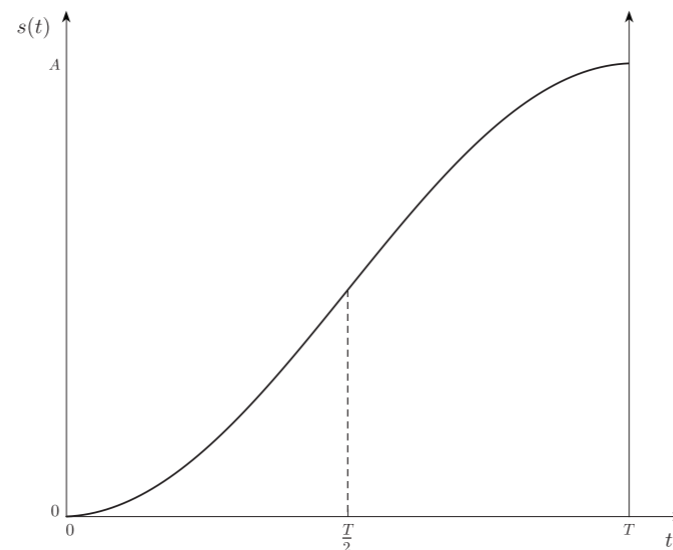


Synthetic time series
White and coloured noise
+ transient events

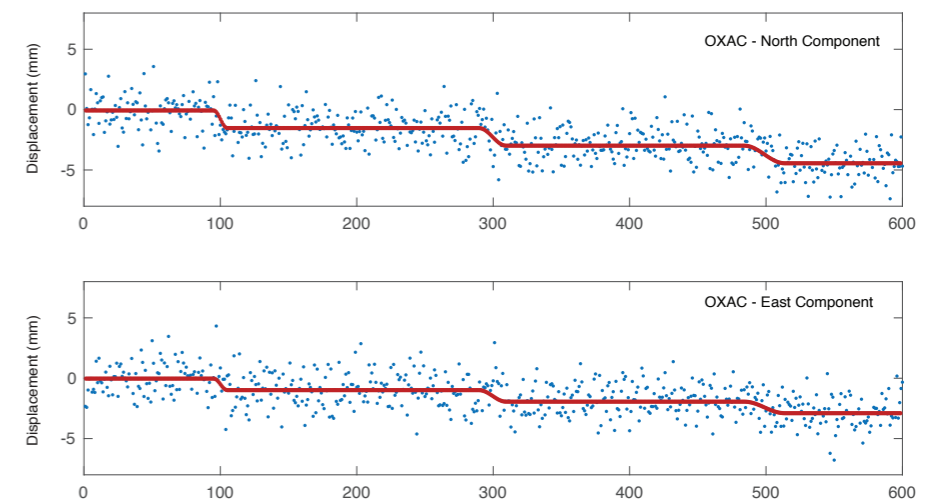
Weighted correlation function



(1) Computation of the cross correlation for each individual GPS time series

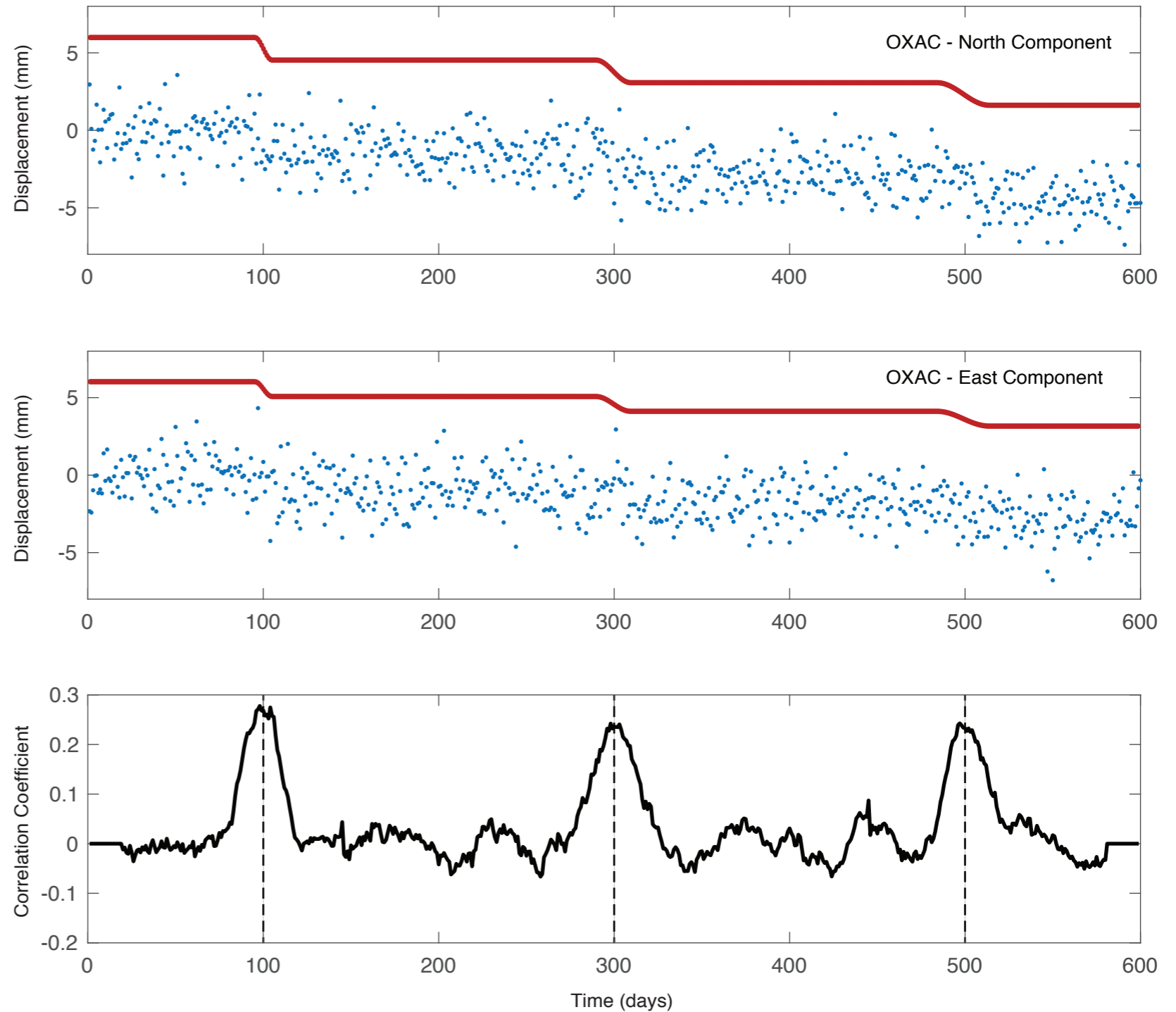
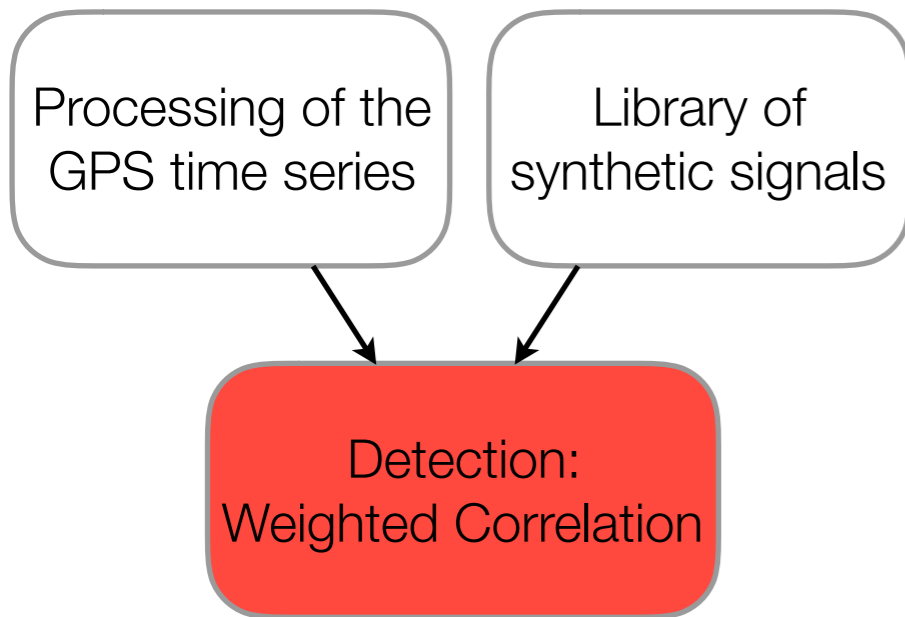


*



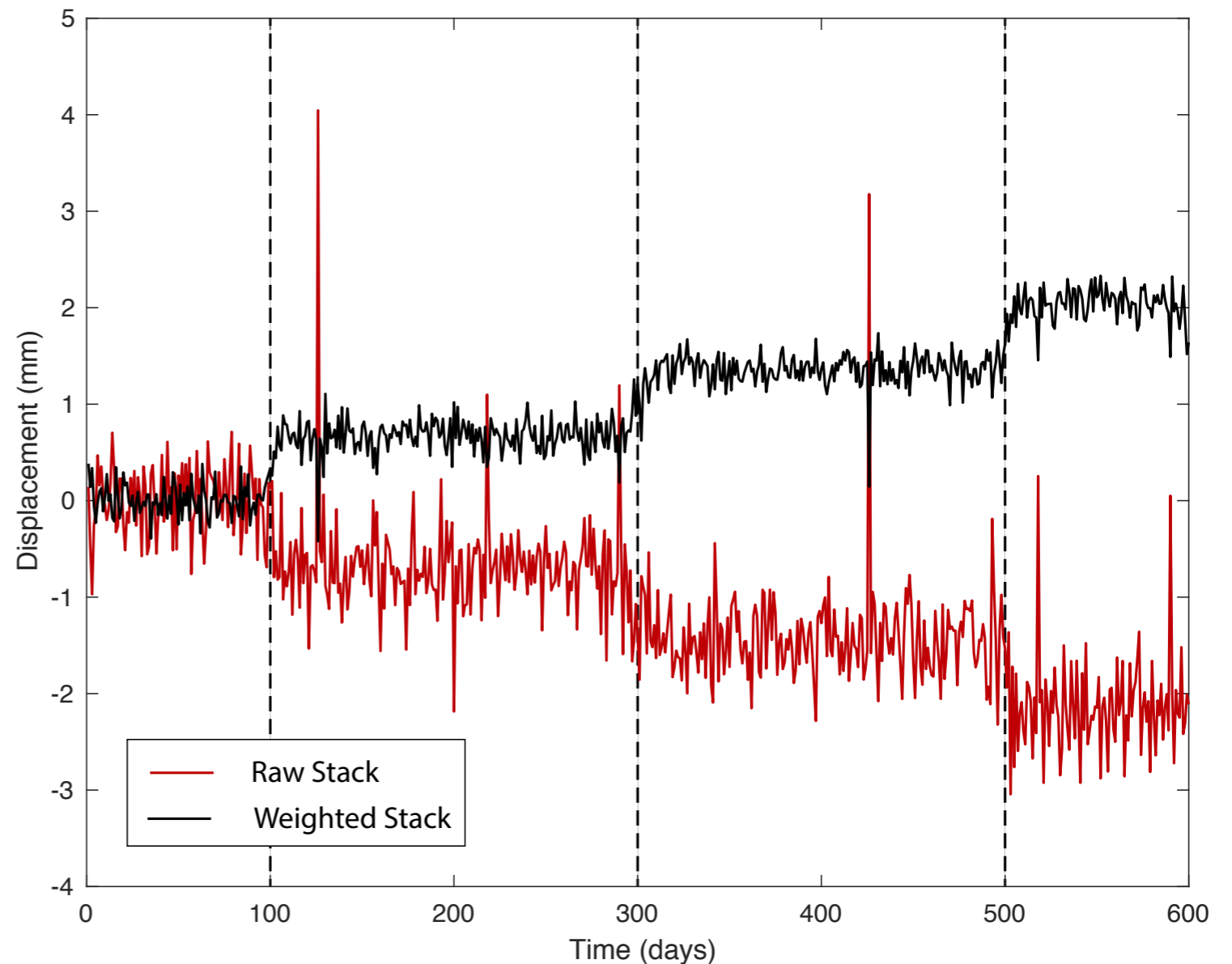
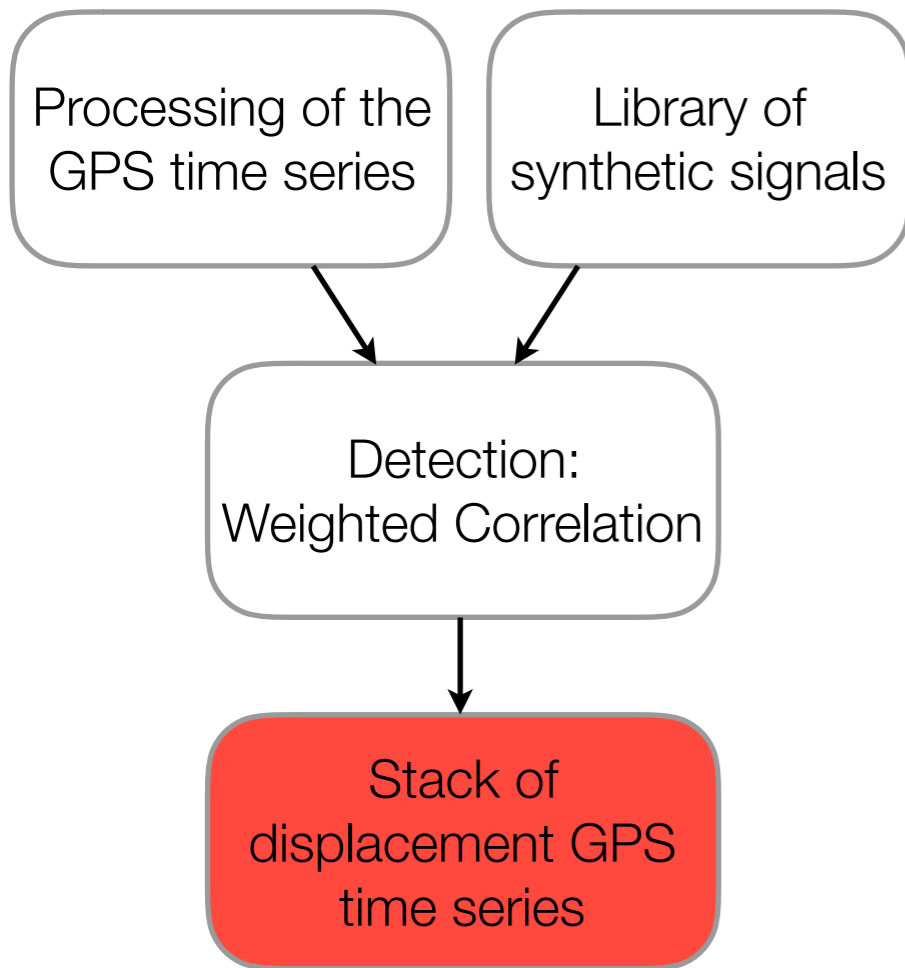
(2) Sum all the correlation functions, **weighted by the amplitude of the synthetic template**

Weighted correlation function



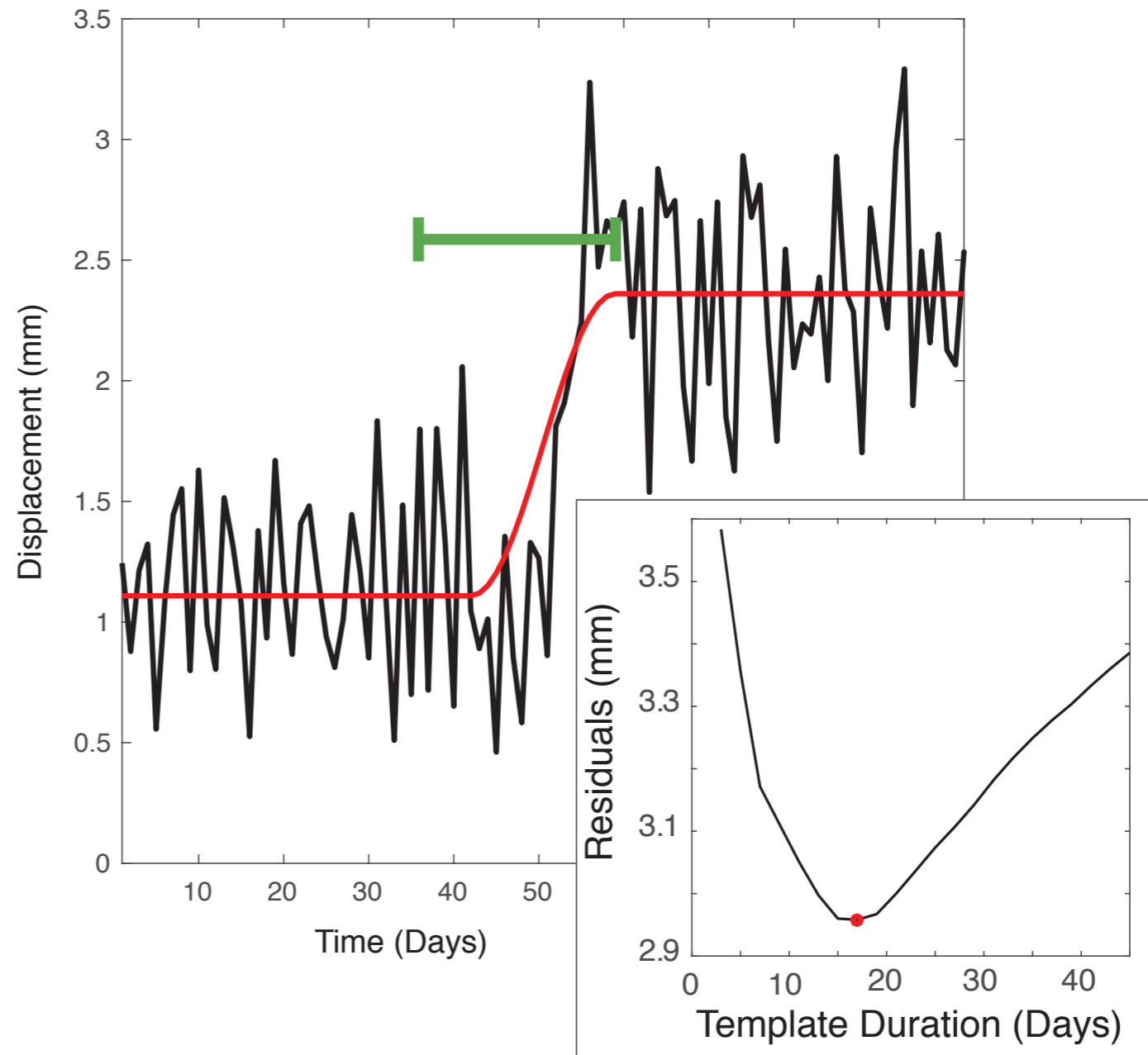
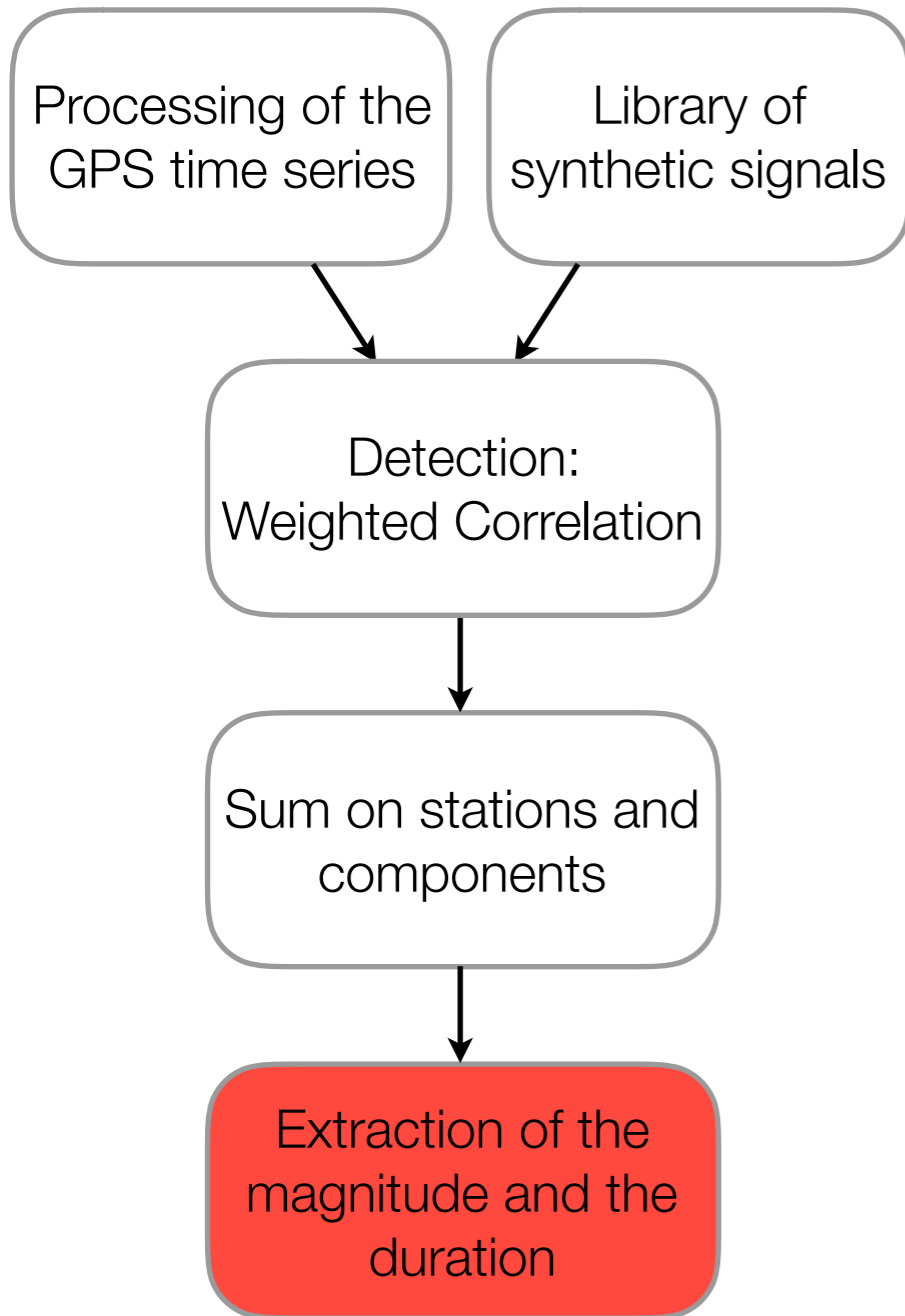
Normalised correlation function, stacked over the East and North time series, and **weighted by the amplitude of the synthetic template**

Stack of the GPS time series

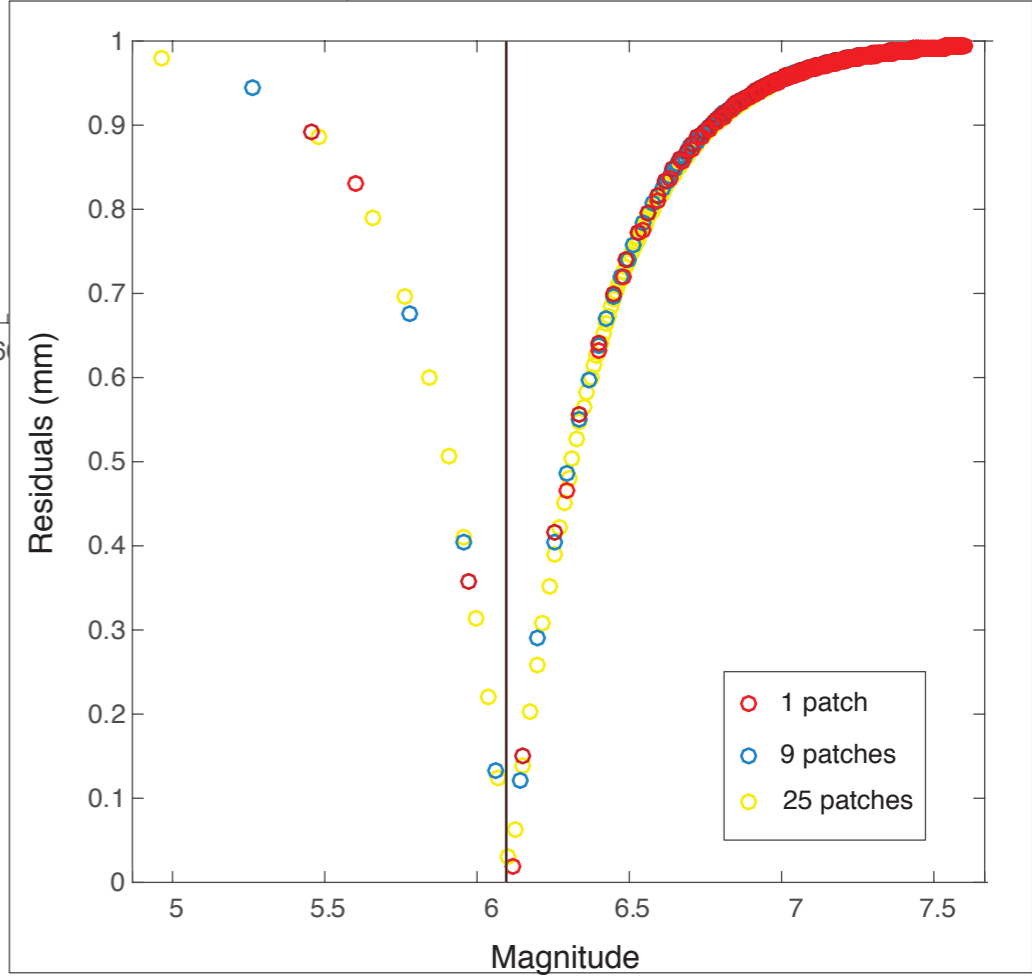
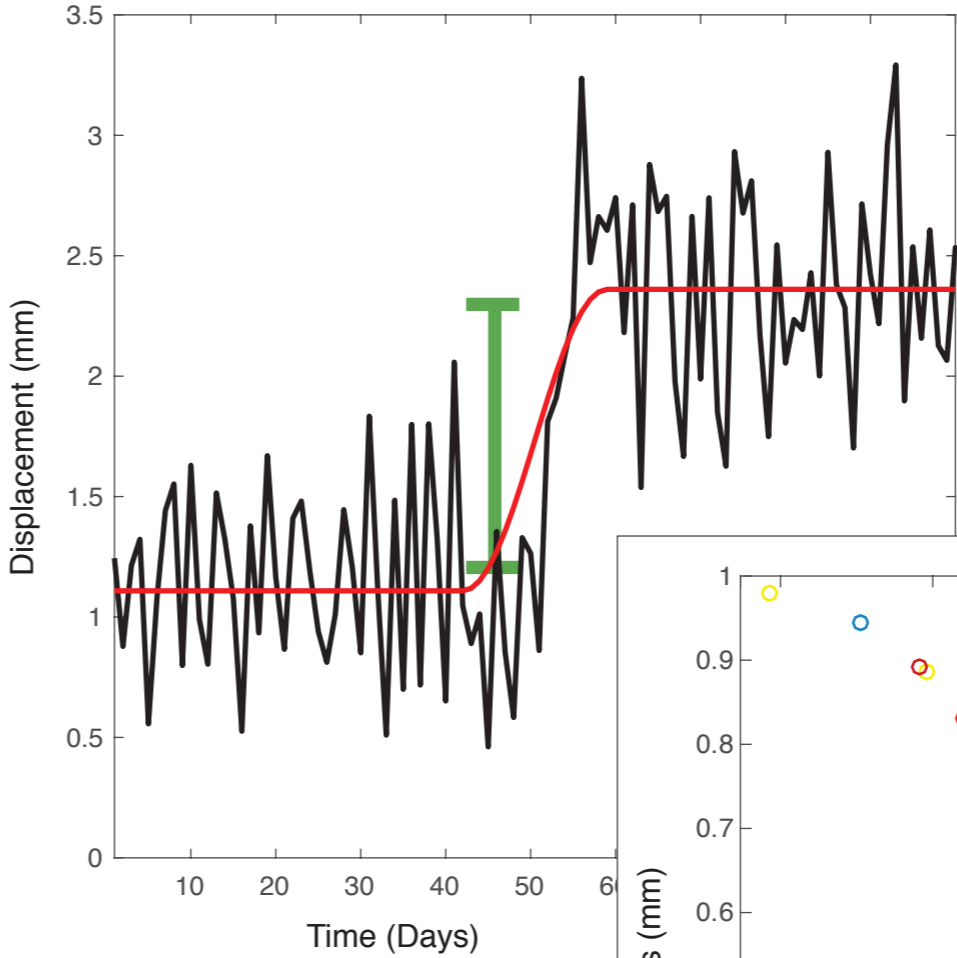
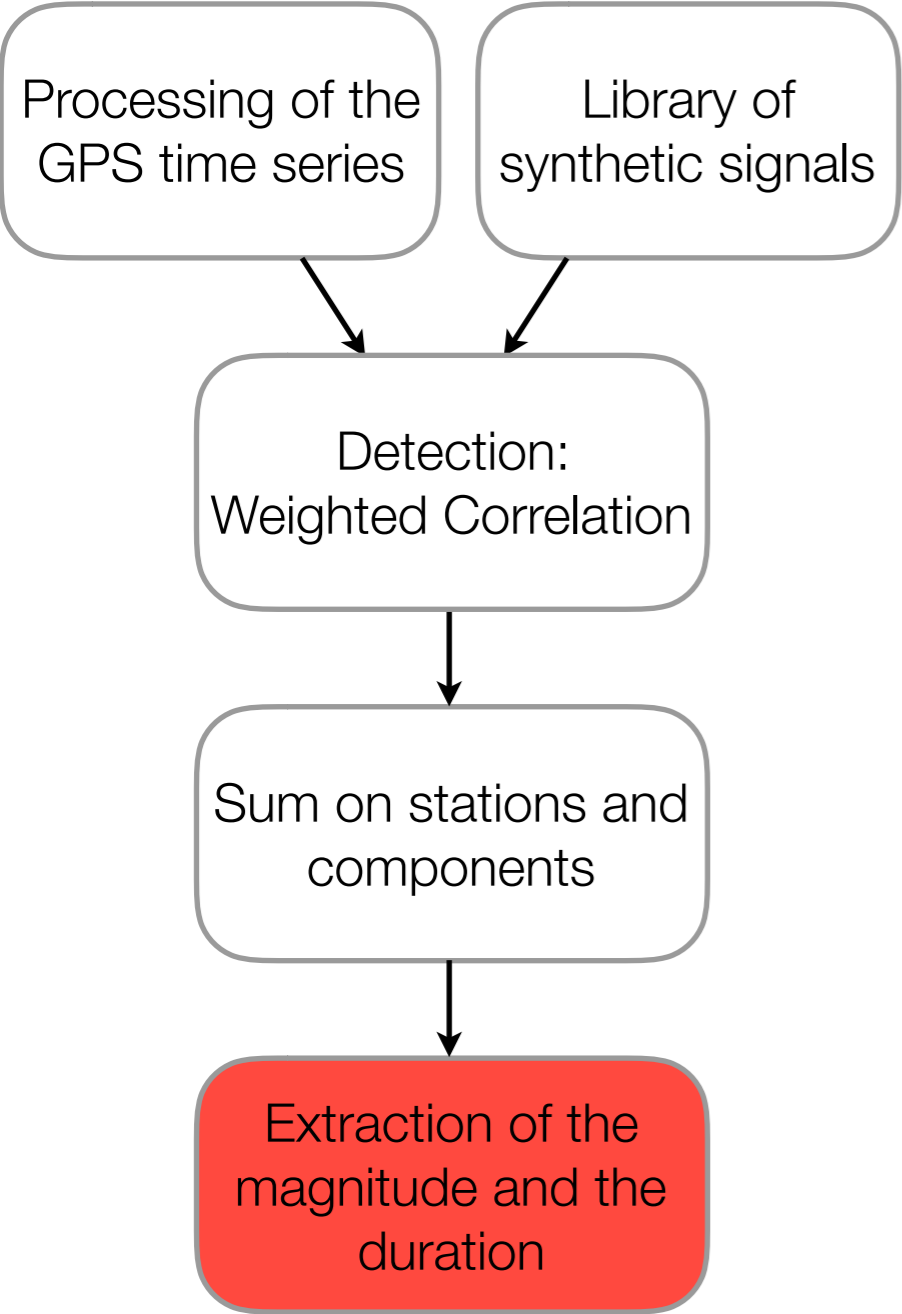


Sum of the GPS time series, **weighted by the amplitude of the synthetic template**

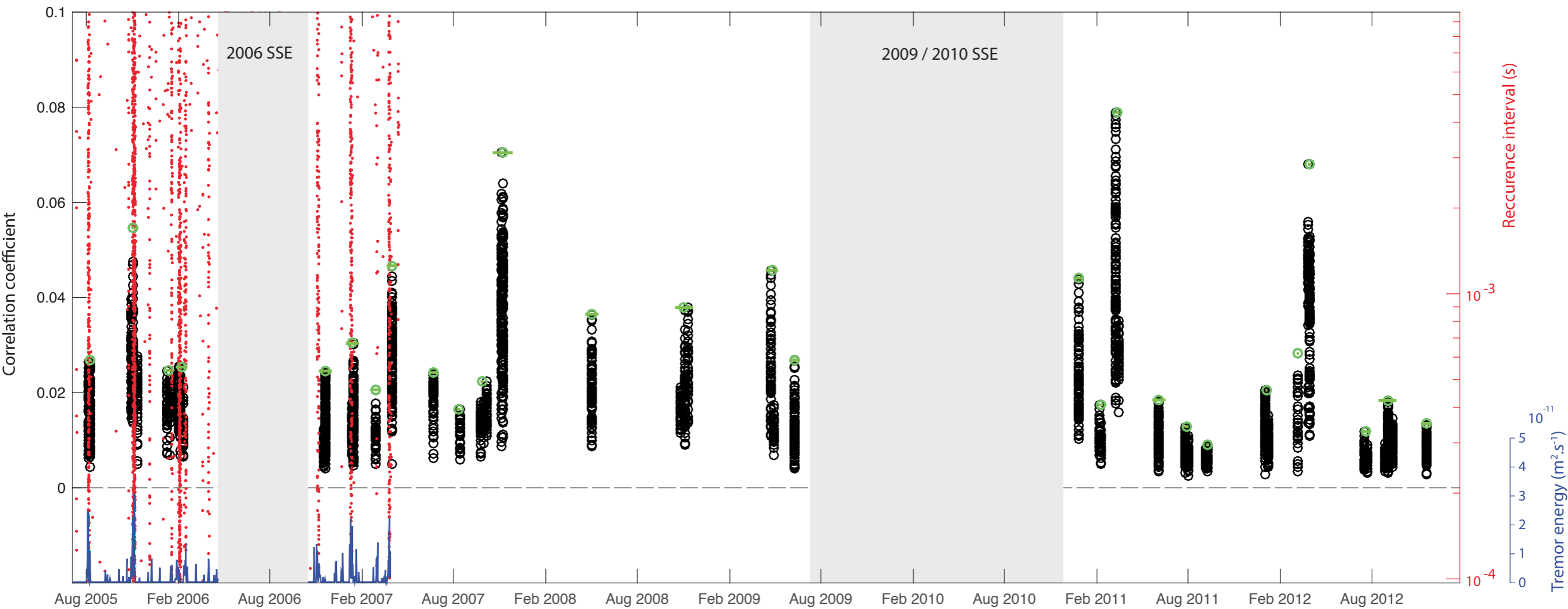
Estimation of the events duration



Estimation of the events magnitude

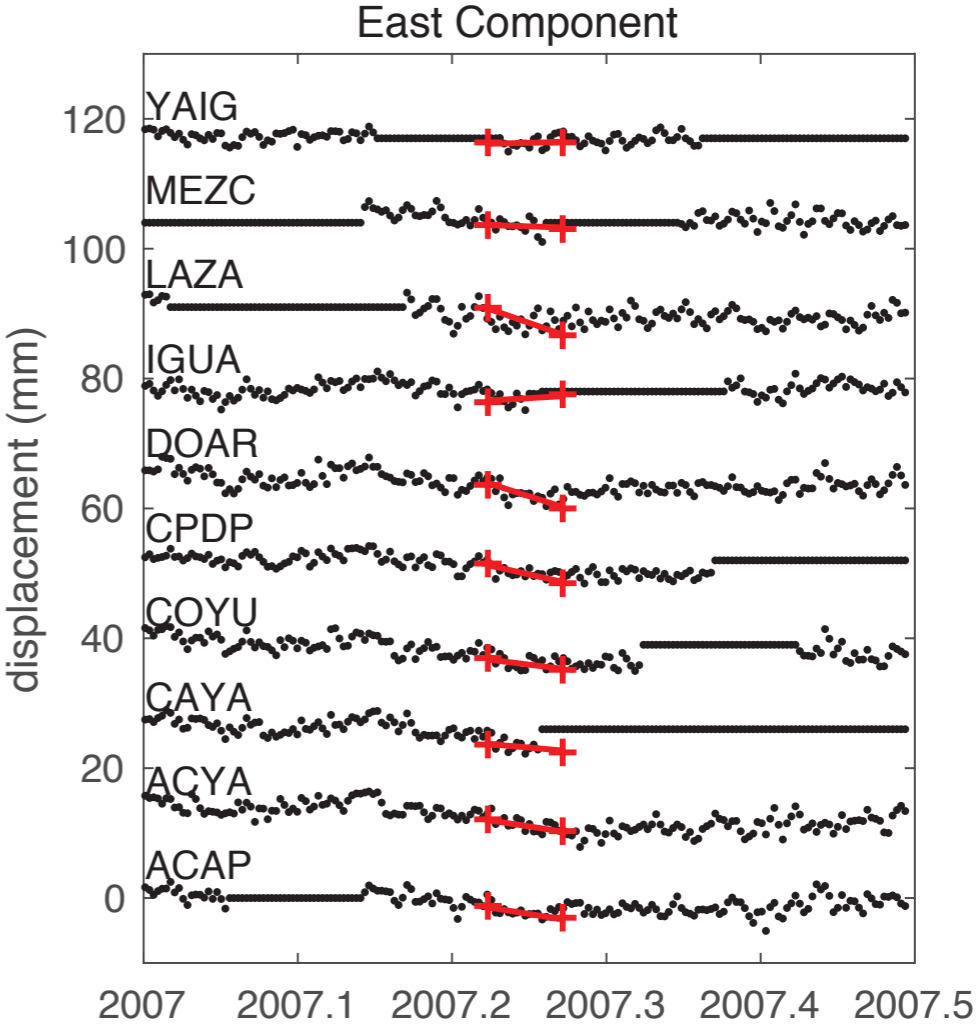
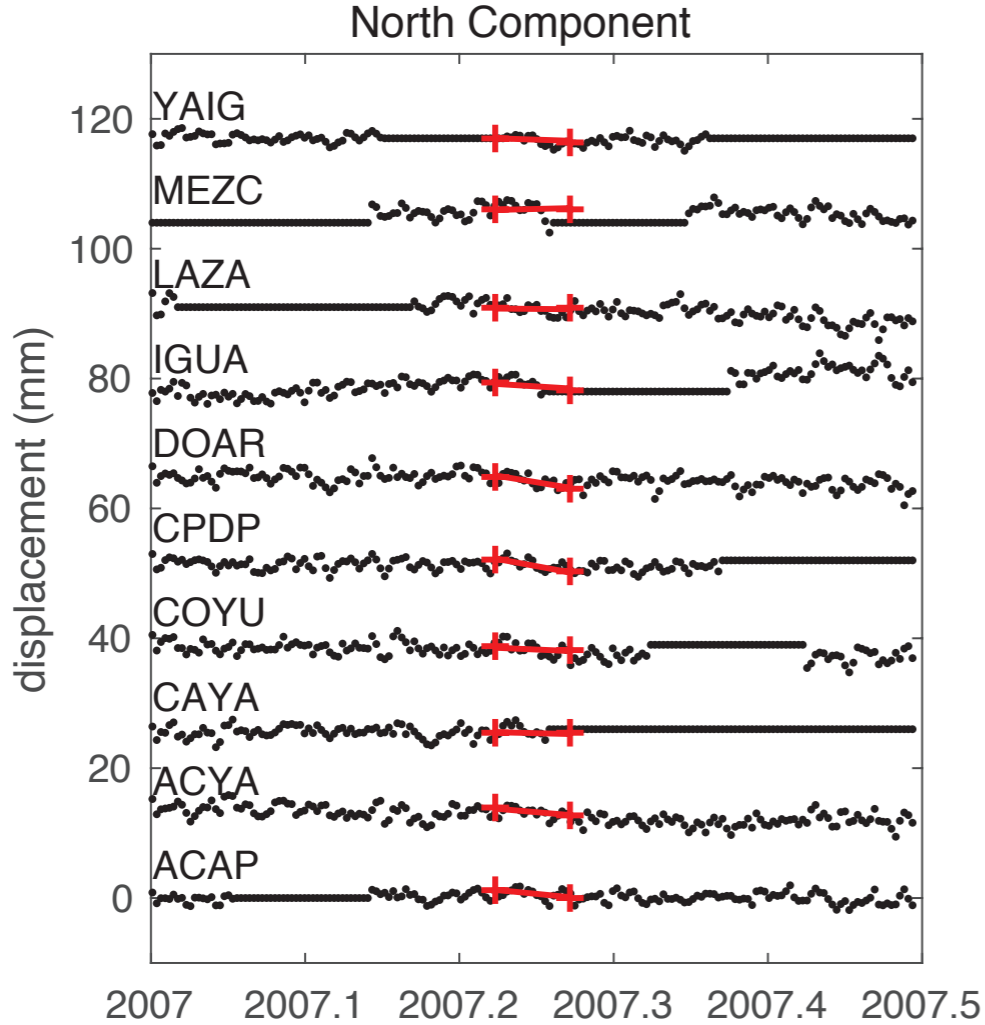
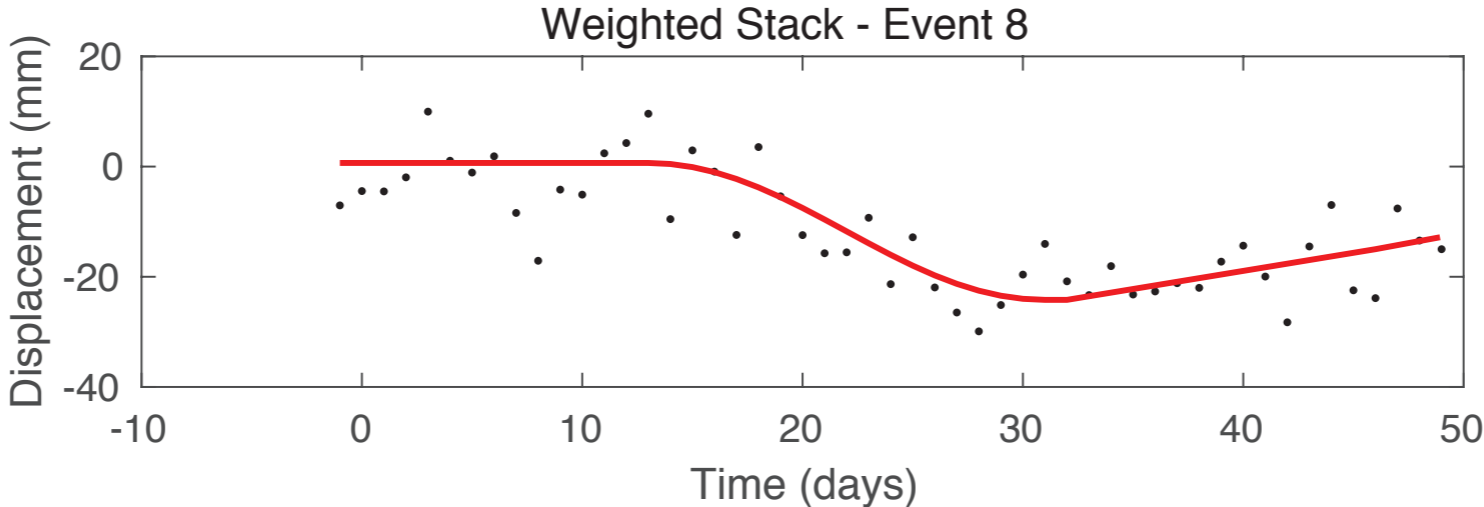


Application to the Guerrero GPS data

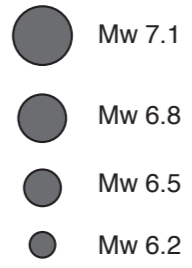
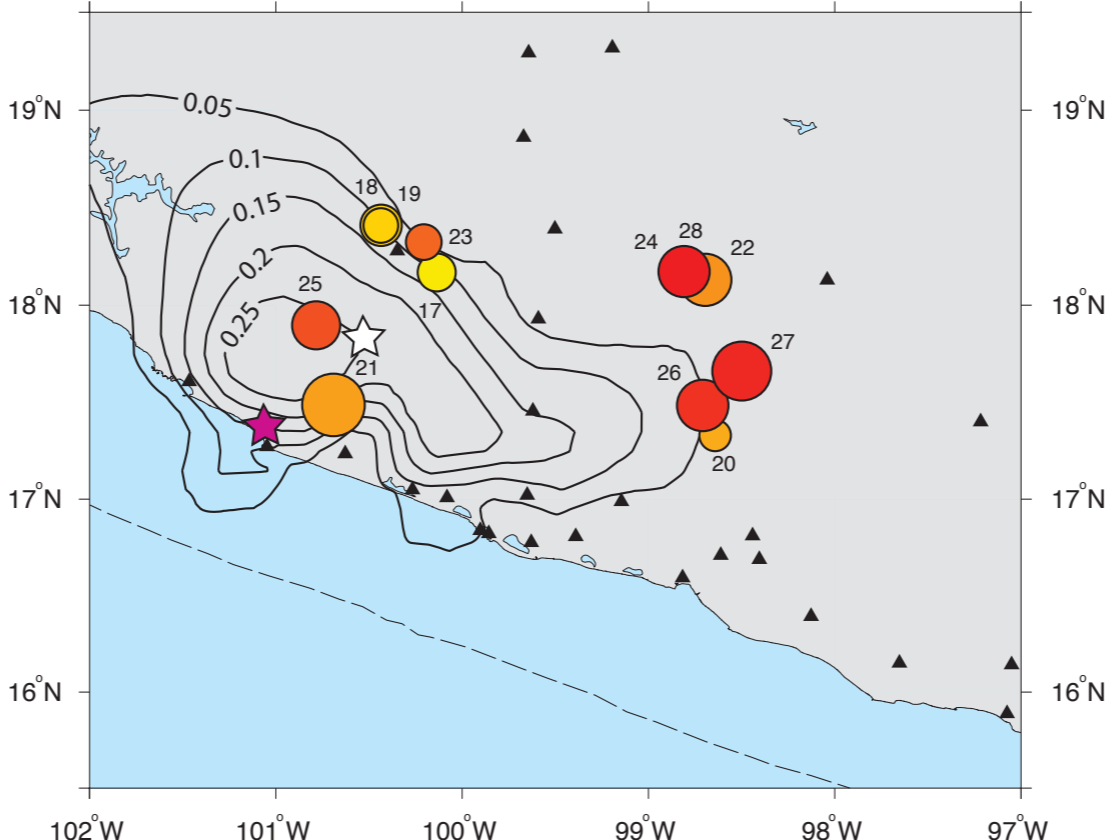
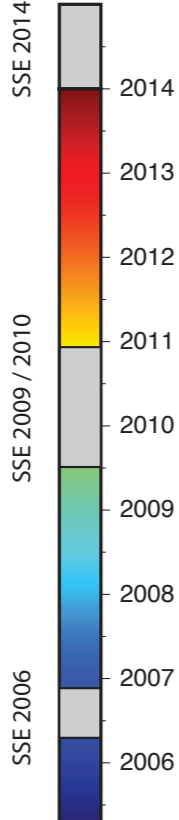
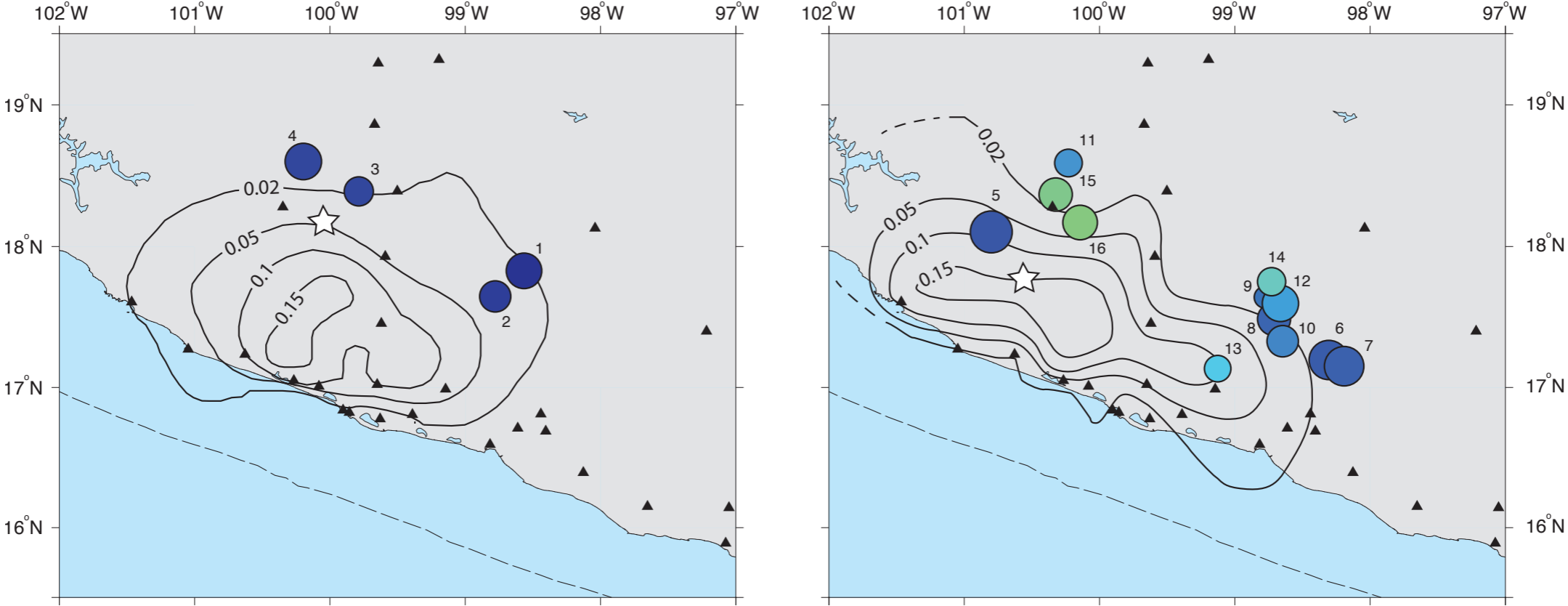


Detection of 28 events from 2005 to 2013

Example of stack an transient event



Locations of the detected events



From Rousset et al., JGR., 2017

Conclusion

We developed a method:

- (1) to detect short-term transient aseismic events*
- (2) to characterise their location, duration and magnitude*

Compare to other methods, like the NIF:

- The detection threshold of the geodetic matched filter is lower, because it takes into account the redundancy of information in a network of stations.
- It is particularly suited for short-term transients.
- It doesn't allow neither to characterise the spatial extent of slow slips, nor any propagation.

Applied to the Mexico subduction:

- We have detected 28 new transients events (Mw 6.3 to Mw 7.1) from 2005 - 2014.
- They are located at the down-dip edge of the large slow-slip events.