Coastal deformation of Northen Chile: Seismic cycle balance from InSAR data

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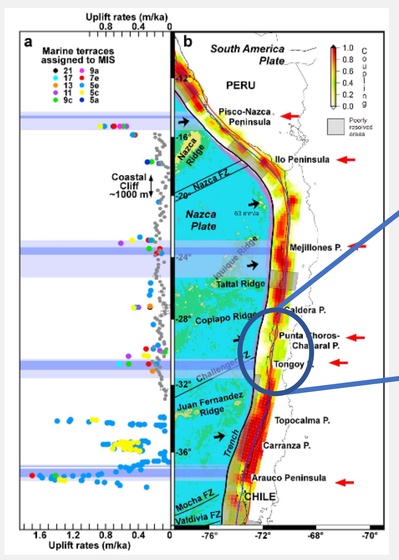
Problematic

From 18°S to 33°S, the Chilean coast is observed to subside during and shortly after major earthquakes while a coastal uplift with rates ranging between 0.1 and 0.3 mm/a has been inferred for the last 400 ka (Regard et al., 2010; Melnick, 2016) . This uplift is located above the transitional zone from the fully locked region to the brittle-ductile transition, often named segment C. This segment C is partly creeping and intermediate earthquakes can also nucleate. We here want to investigate if this uplift is related to some plastic deformation induced by the mechanical behaviour of segment C. To do so, we need to know where along the interface of the subduction zone, when during the seismic cycle and how the uplift occurs.
To answer these questions, we propose to provide a balance of the vertical deformation at the coast during a seismic cycle. We use InSAR data of Sentinel-1 satellite with ISCE code, and construct time series using a multipixel time series analysis (Jolivet et al., 2018). The objective is to propose simple mechanical models to be investigated to understand the mechanics of plate interface responsible for the short-term observations and the long-term uplift.

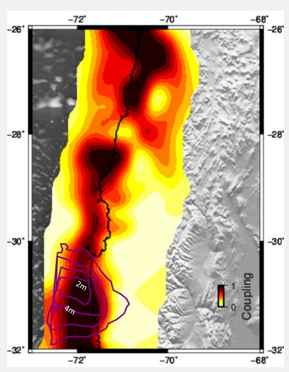
Context

Long term deformation



Compilation of marine terrace uplift rates and coupling from Métois et al. 2016 (Saillard et al. 2017)

Zone of interest: La Serena where the Mw 8.3 Illapel earthquake occured



Coupling from Métois et al. 2016 and co-seismic slip in a joint inversion (Tilmann et al.2016)

- 2015 *Mw*8.3 Illapel earthquake
- Possibility to calculate with InSAR the co-, post- and possibly the inter-seismic uplift.
- Marine terrace uplift: long term dat available
- Transition between low and strong coupling: possibility to compare vertical displacement with earthquake and with low coupling.

Method

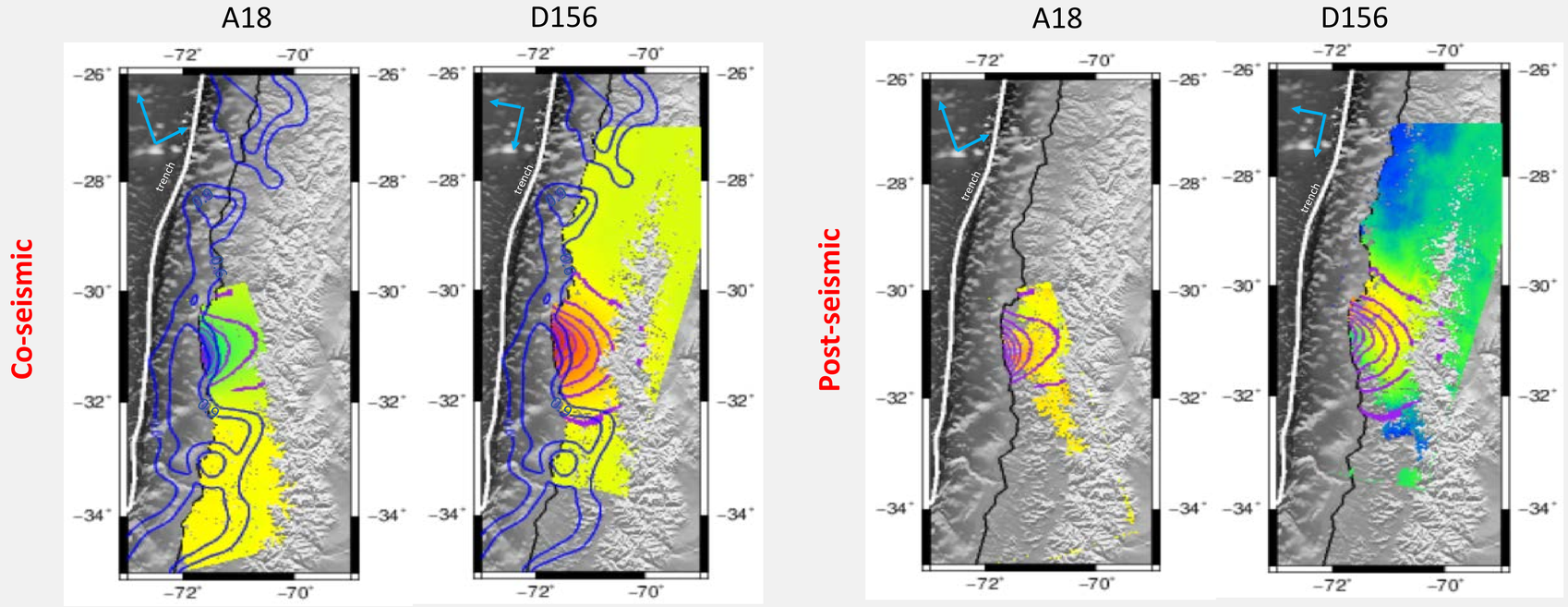
1) Construct interfeorgrams for the co- and post-seismic period using InSAR data from Sentinel-1 satellite with ISCE code.
Interest : the precision of vertical InSAR data is few millimeters.

2) Construct time serie: Recover the evolution of the interferograms phase in time and space

Methods
- NSBAS method: time serie from network of interferograms
- multipixel time series analysis (Jolivet et al., 2018)

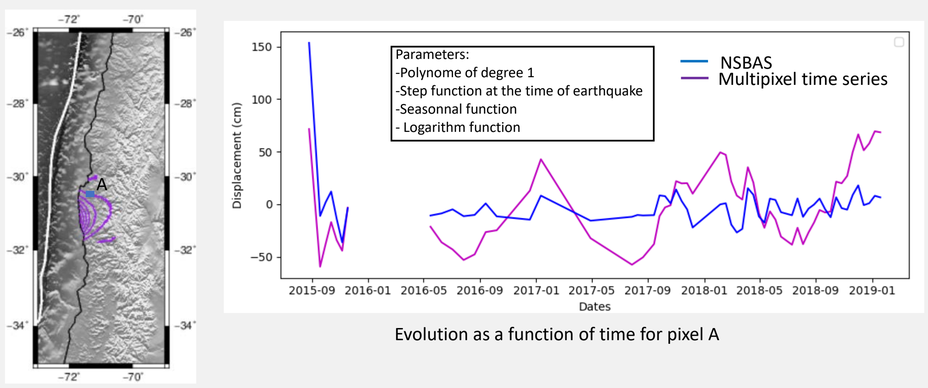
First steps:
- Comparaison of methods
- Exploration of inversion parameters to estimate their effects on the models.

Interferograms



Time series

Premilinary results



Evolution as a function of time for pixel A

Discussion

- Co-seismic deformation: in good accordance with previously published models
- Post-seismic deformation: Afterslip around co-seismic slip patch (creep or viscous relaxation?). Behavior in the high slip patch?
- Interseismic deformation along the northern part of the track?

Perspectives

- Construct time series
- Substract the horizontal component to provide a vertical balance during the different periods of the seismic cycle
- Compare uplift balances along the seismic asperity of the Illapel earthquake, the afterslip region, and within the low and fully coupled segments northward
- Provide mechanicals set-ups to investigate the mechanics responsible for the short- and the long-term deformation.

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F. Tilmann et al. (2016), The 2015 Illapel earthquake, central Chile: A type case for a characteristic earthquake?, *Geophys. Res. Lett.*, *43*, 574–583, doi:10.1002/2015GL066963.