Understanding the coevolution of mountain building and seismic hazard in regions of continental convergence

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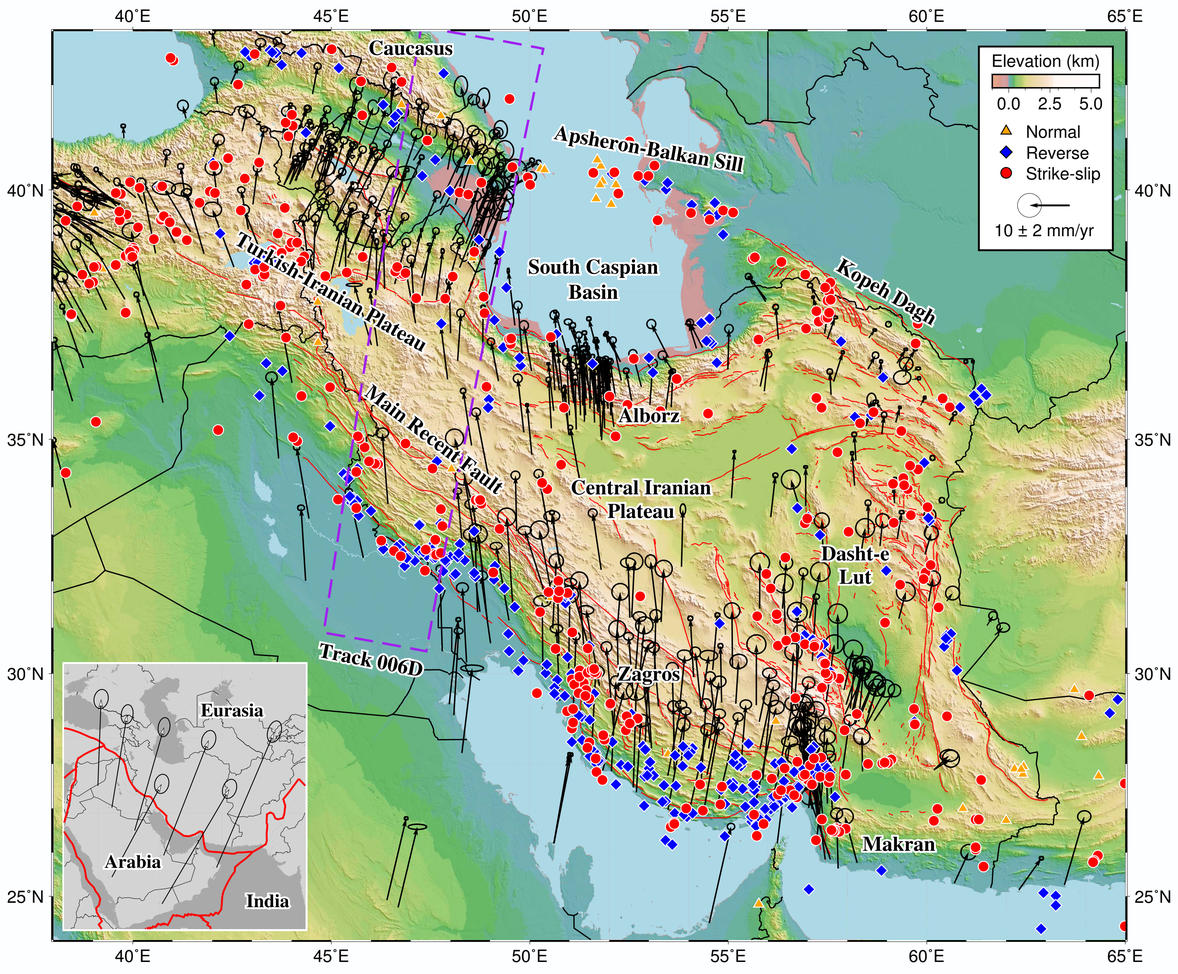
Introduction:

- Active continental convergence between Arabia and Eurasia (20-30 mm/yr, Khorrami et al., 2019) is driving spatially-complex deformation.
- 'Thin viscous sheet' continuum model can explain ~95% of the observed deformation field (Walters et al., 2017), but this is based on sparse GPS measurements (~50-100 km average spacing).
- Higher resolution velocity field would demonstrate if more complex rheological models are required, along with improving our understanding of the local seismic hazard.

Aims:

- Produce an updated velocity-field and strain rates for Iran using Sentinel-1 InSAR measurements and existing GNSS data (e.g. Walters et al., 2017).
- Develop a numerical model of the lithosphere, constrained by the velocity field, to investigate the dynamics of deformation in Iran.
- Improve our understanding of seismic hazard in Iran by identifying rapidly deforming areas and concentrations of strain on active fault structures.

Tectonics of Iran



Map of the active tectonics of Iran. Circles indicate earthquake locations taken from the Global Centroid Moment Tensor Catalogue between 01/01/1976 to 31/12/2018. Red lines on the primary map indicate fault traces (Walker et al., 2013), arrows show GNSS horizontal velocities with 67% error ellipsoids (Kreemer et al., 2014, DeMets et al., 2010), and red lines on the inset map indicate plate boundaries (Bird, 2003) . The dotted purple line highlights track 006D for Sentinel-1 (right).

Why Iran:

- Contains some of the fastest, actively-deforming mountain ranges in the world, such as the Zagros, the Alborz, and the Kopeh Dagh.
- Largely (semi-) arid, making it a prime target for InSAR due to the high coherence.
- ~350 GPS measurements of horizontal velocity available to support the InSAR observations (Walters et al., 2017).

We have chosen the Main Recent Fault, a ~800 km long right-lateral strike-slip fault, as an initial target for InSAR time series analysis.

Study	Method	Slip rate (mm/yr)
Talebian and Jackson (2002)	Geomorphological offsets	10-17
Authemayou et al. (2009)	Cosmogenic 36Cl	3.5-12.5
Alipoor et al. (2012)	Geomorphological offsets	1.6-3.2
Vernant et al. (2004)	GNSS	1-5
Hatzfeld et al. (2010)	GNSS	2-4

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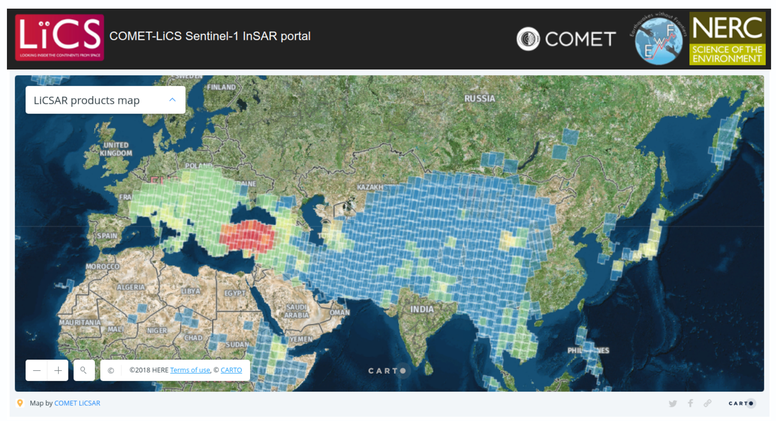
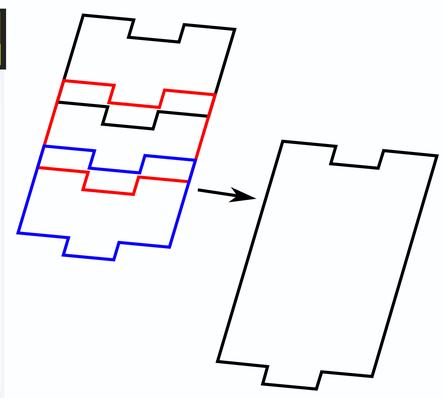
InSAR

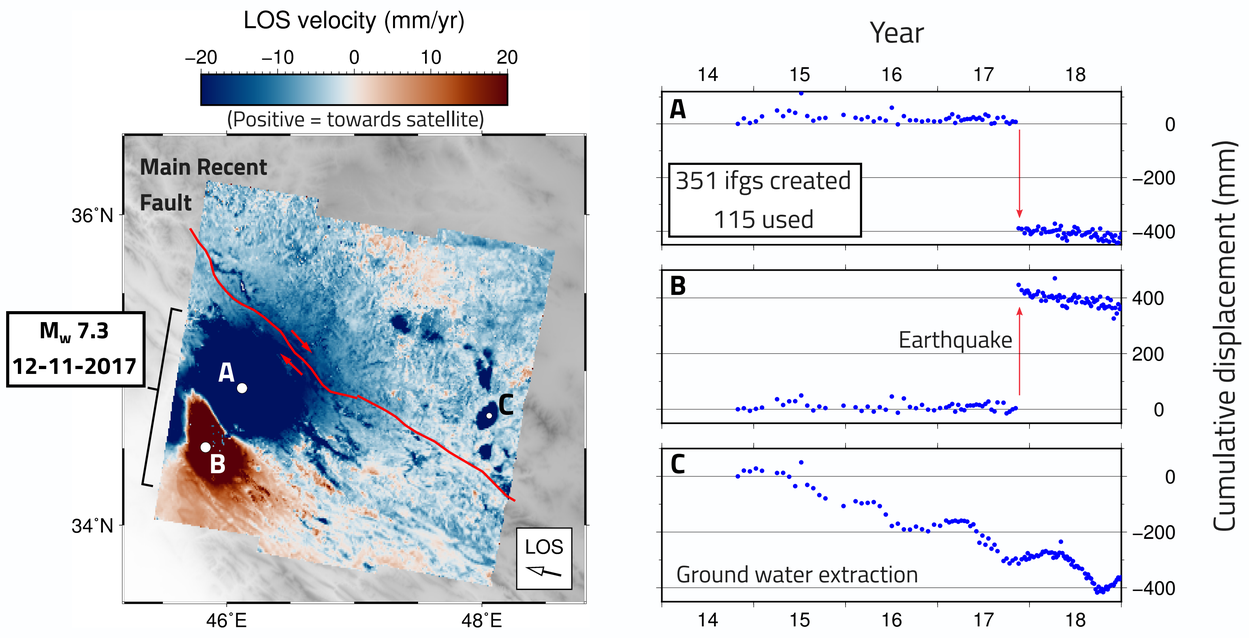
We use interferograms generated as part of the LiCS project (González et al., 2016). These are processed in frames that are then mosaiced together along-track.



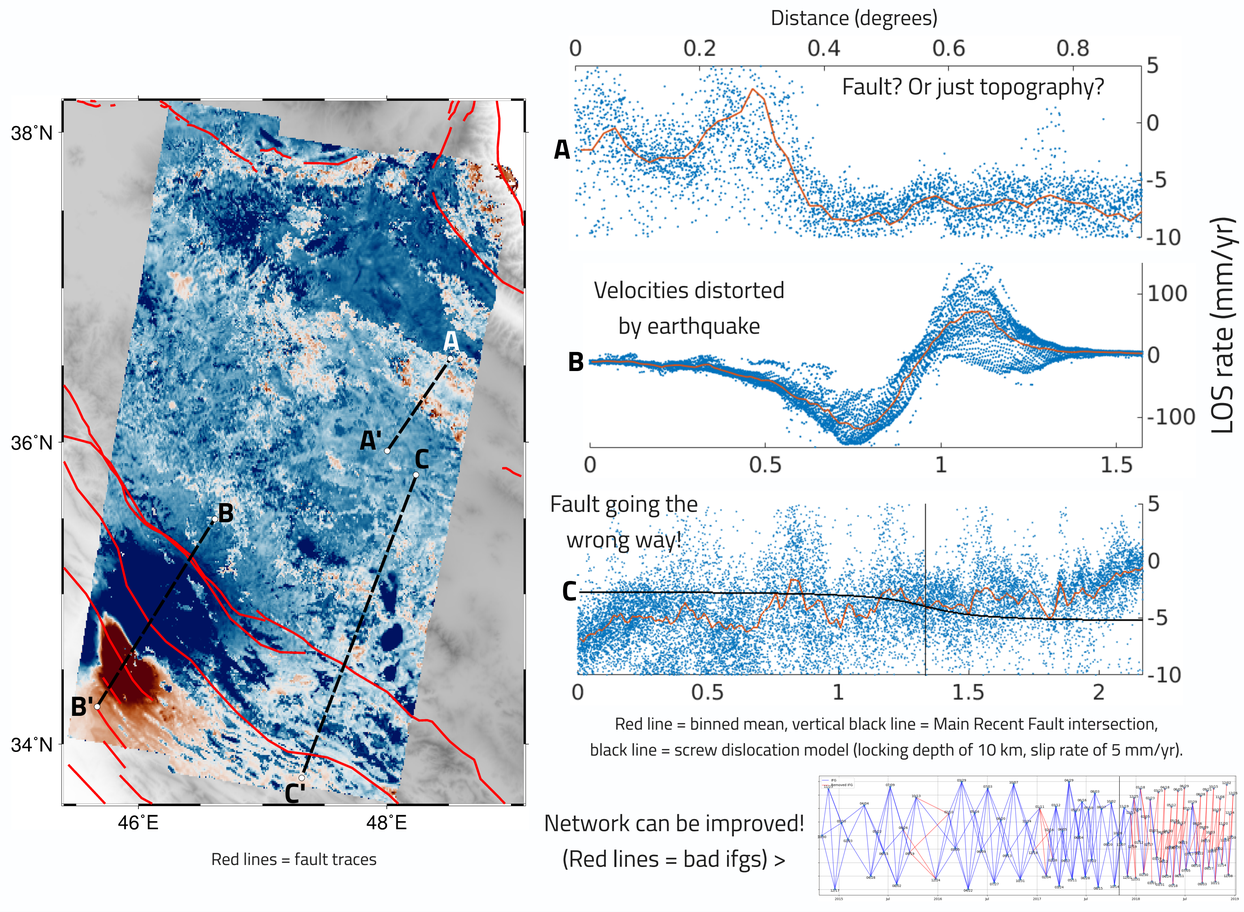


- Time series analysis - LiCSBAS ("https://github.com/yumorishita/LiCSBAS").
- Atmospheric corrections - Generic Atmospheric Correction Online Service for InSAR (GACOS) (Yu et al., 2018).

Single Frame Time Series



Two Frame Mosaiced Time Series



Red lines = fault traces

Red line = binned mean, vertical black line = Main Recent Fault intersection, black line = screw dislocation model (locking depth of 10 km, slip rate of 5 mm/yr).

Network can be improved!
(Red lines = bad ifgs) >