Comparing long-term and short-term fault slip-rates across Iran

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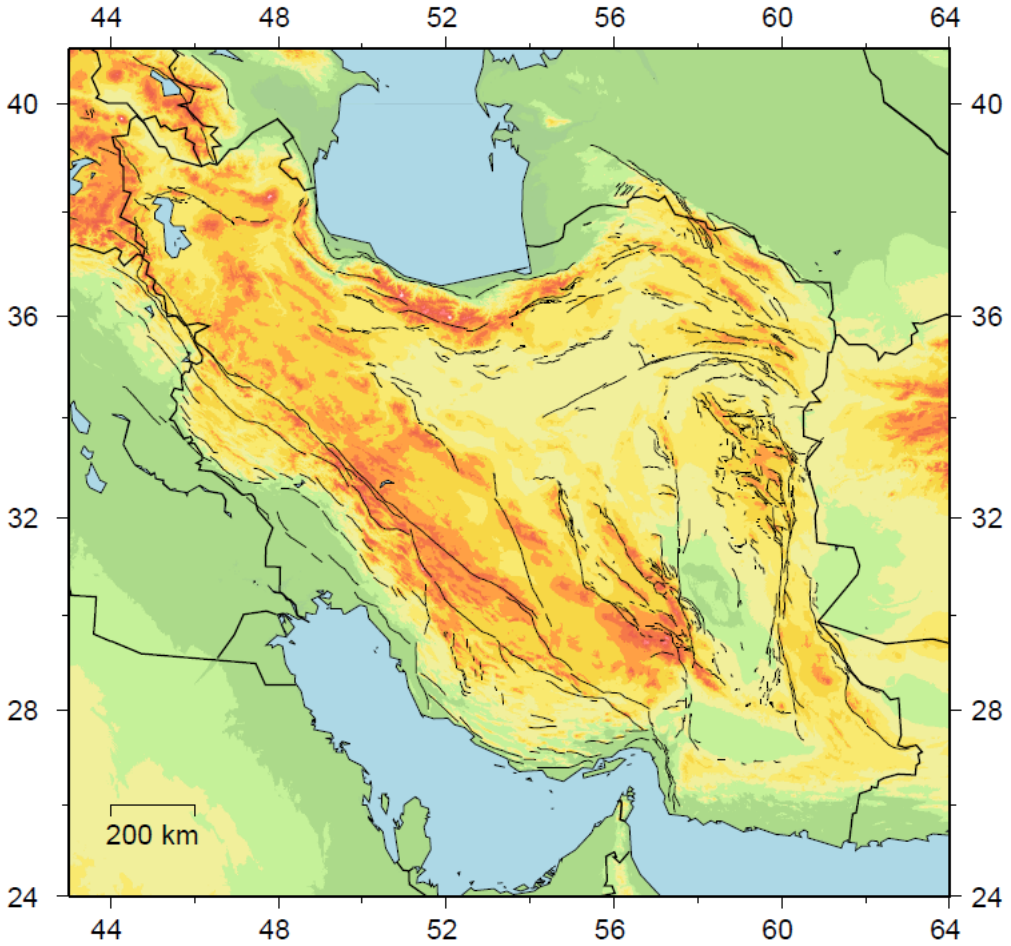
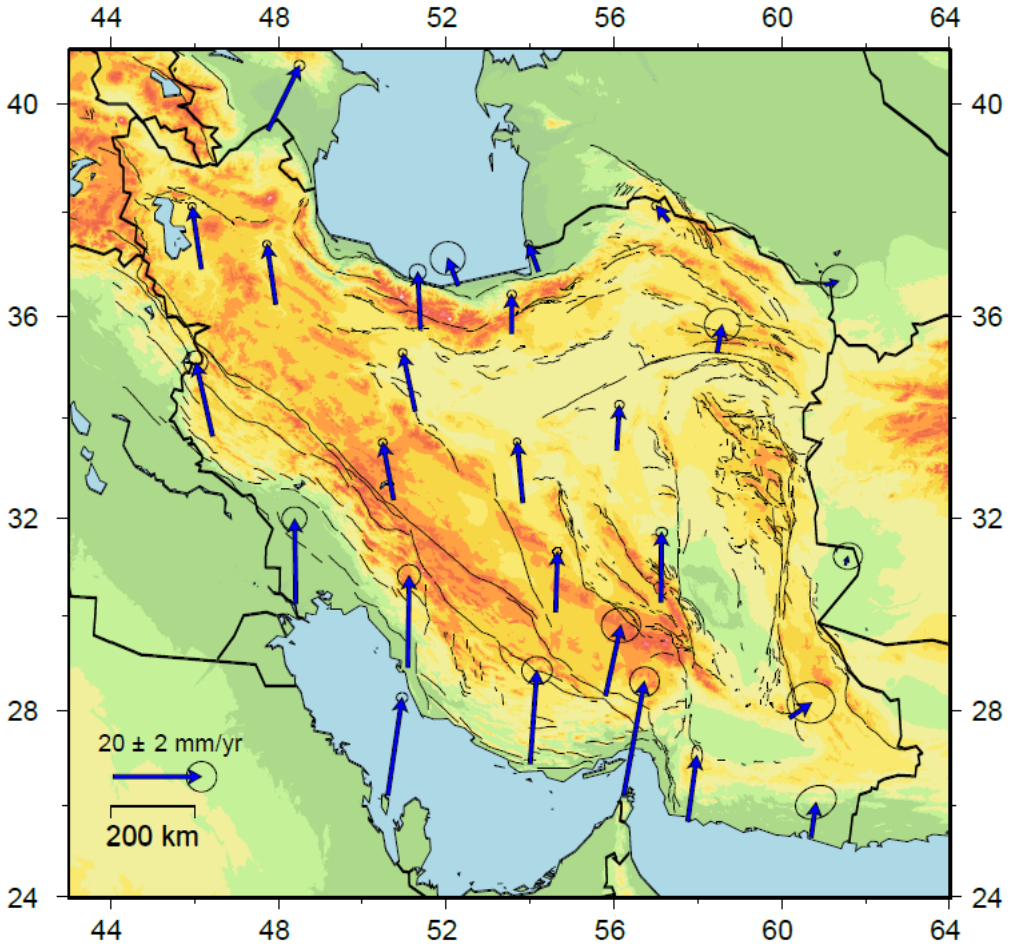
GPS velocity field - 2003



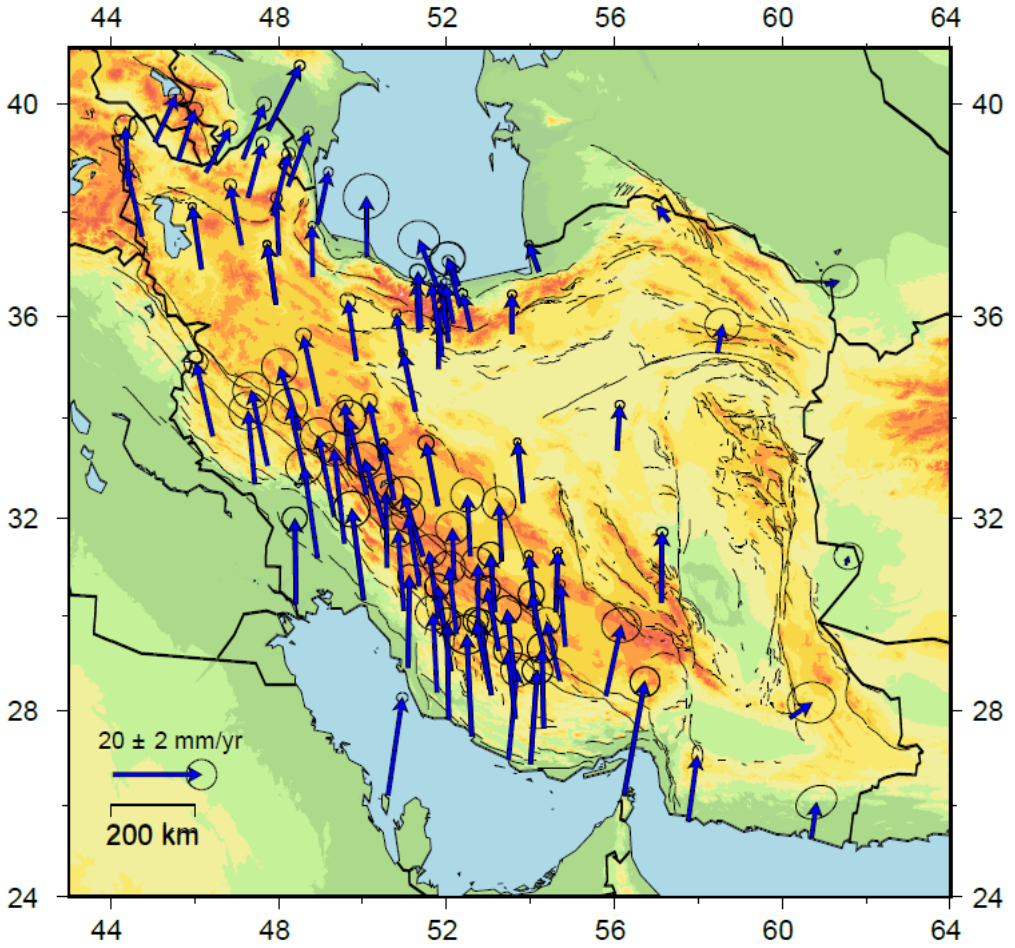
GPS velocity field - 2004

Vernant et al., 2004a
Vernant et al., 2004b



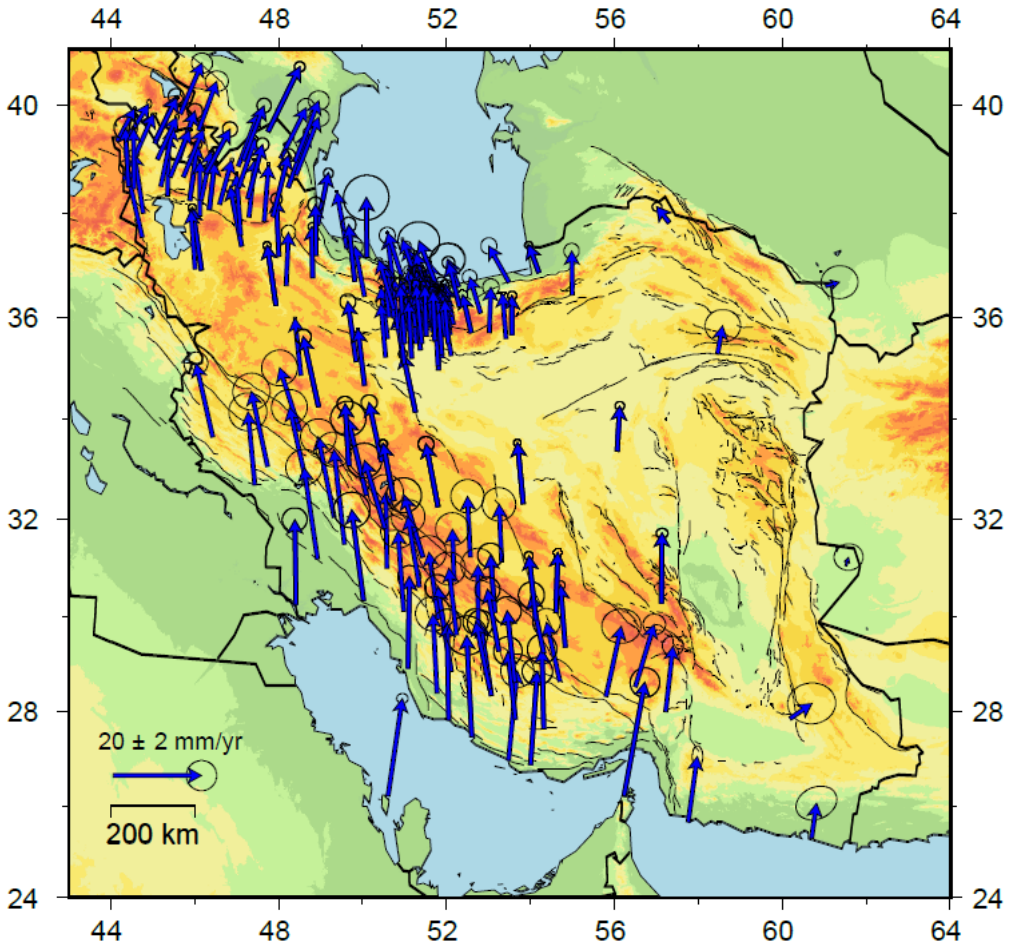
GPS velocity field - 2008

Vernant et al., 2004a
Vernant et al., 2004b
Walpersdorf et al., 2006
Masson et al., 2006
Tavakoli et al., 2008



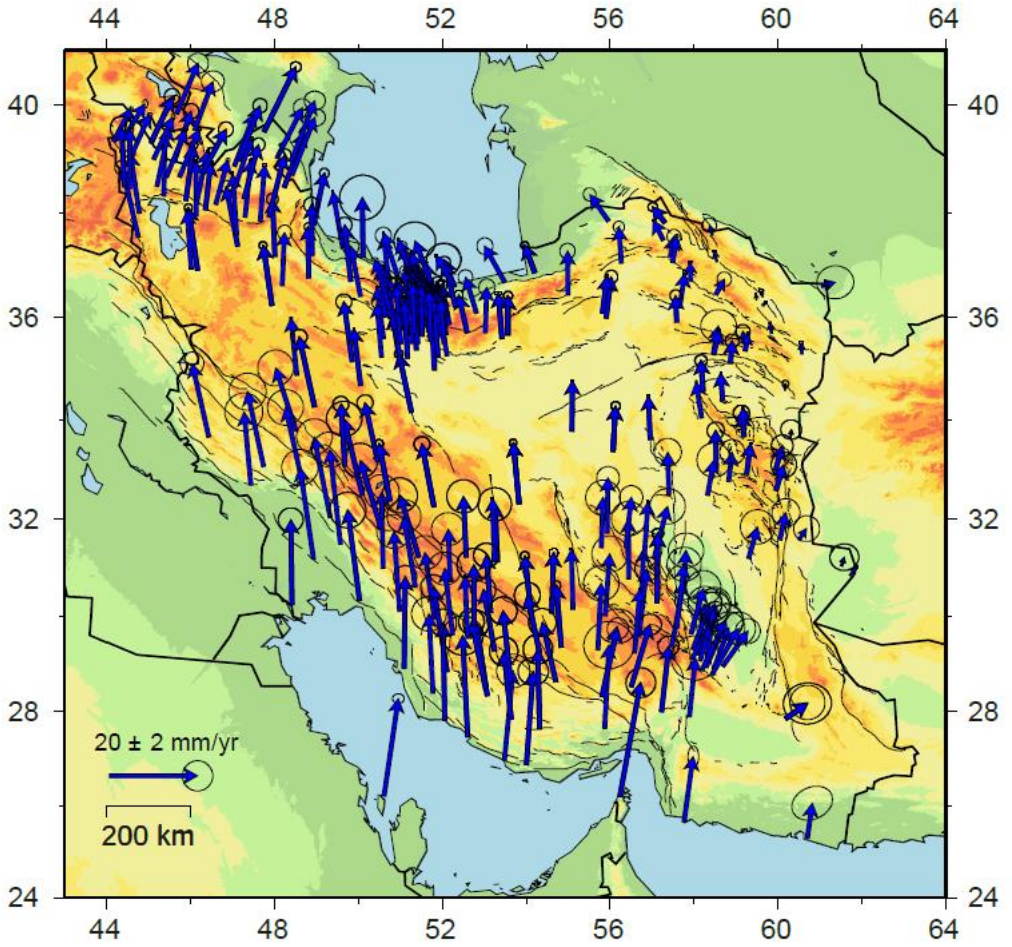
GPS velocity field - 2011

Vernant et al., 2004a
Vernant et al., 2004b
Walpersdorf et al., 2006
Masson et al., 2006
Tavakoli et al., 2008
Djamour et al., 2010
Djamour et al., 2011



GPS velocity field - 2014

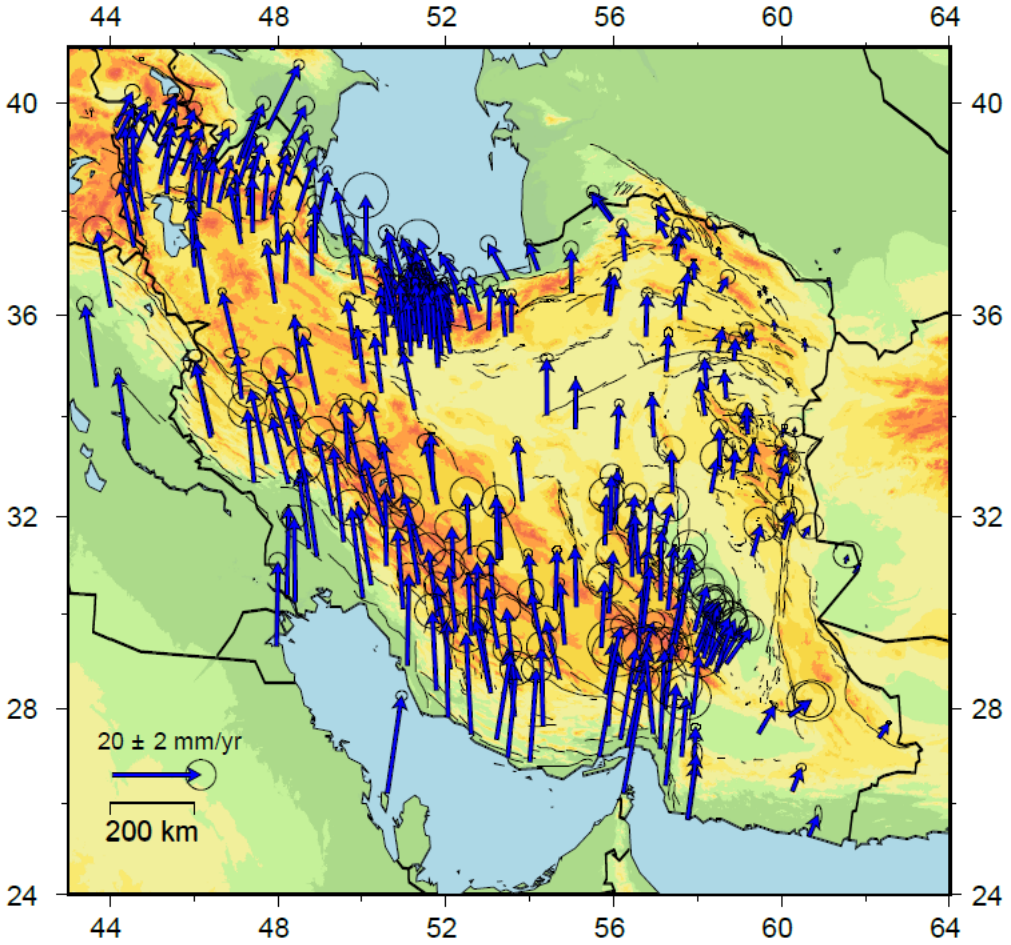
Vernant et al., 2004a
Vernant et al., 2004b
Walpersdorf et al., 2006
Masson et al., 2006
Tavakoli et al., 2008
Djamour et al., 2010
Djamour et al., 2011
Mousavi et al., 2013
Walpersdorf et al., 2014



GPS velocity field - 2018

Vernant et al., 2004a
Vernant et al., 2004b
Walpersdorf et al., 2006
Masson et al., 2006
Tavakoli et al., 2008
Djamour et al., 2010
Djamour et al., 2011
Mousavi et al., 2013
Walpersdorf et al., 2014
Khorrami et al., in review

Plus interseismic strain accumulation from InSAR

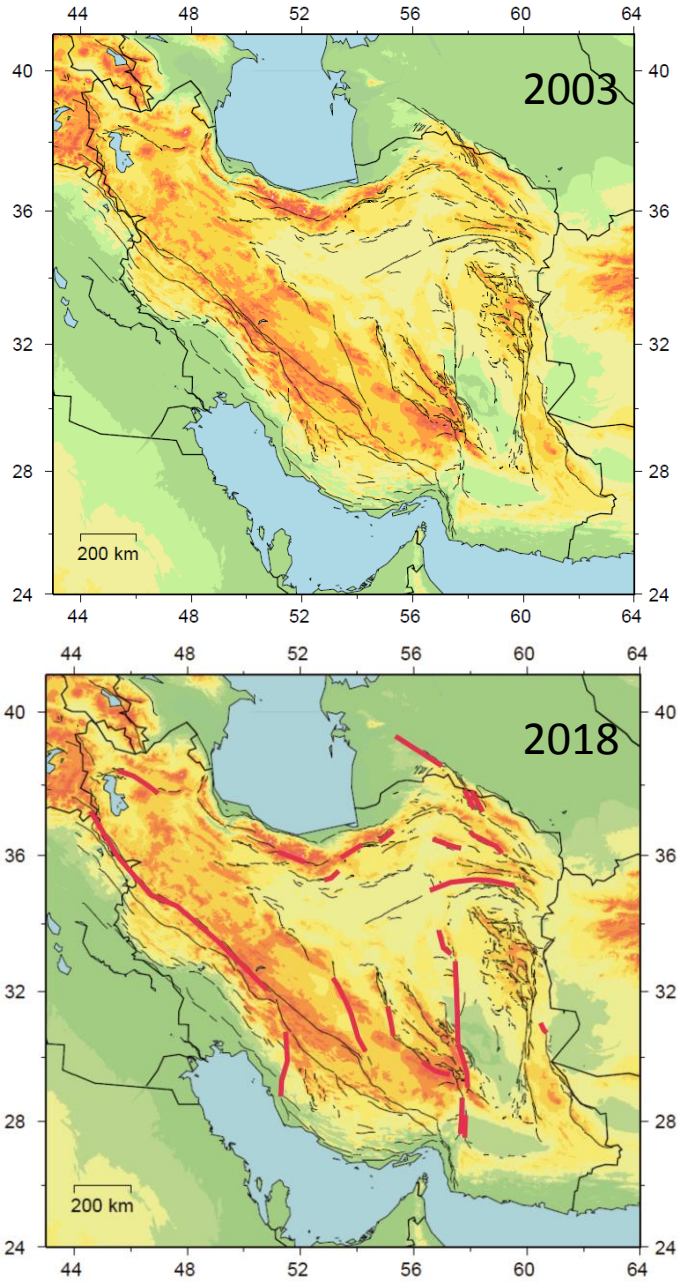


Geomorphic slip-rates

A number of studies …

Hessami et al., 2003
Ritz et al., 2003
Regard et al., 2005
Regard et al., 2006
Fattahi et al., 2006
Fattahi et al., 2007
Le Dortz et al., 2009
Shabanian et al., 2009
Hollingsworth et al., 2010
Walker et al., 2010
Rizza et al., 2011
Walker and Fattahi, 2011
Javidfakhr et al., 2011
Fattahi et al., 2011
Rizza et al., 2013
Fattahi et al., 2014
Farbod et al., 2016

(Apologies if I have missed anyone off)



Comparing long-term and short-term rates

Are measurements of present-day interseismic strain accumulation representative of the long-term slip-rates on the faults?

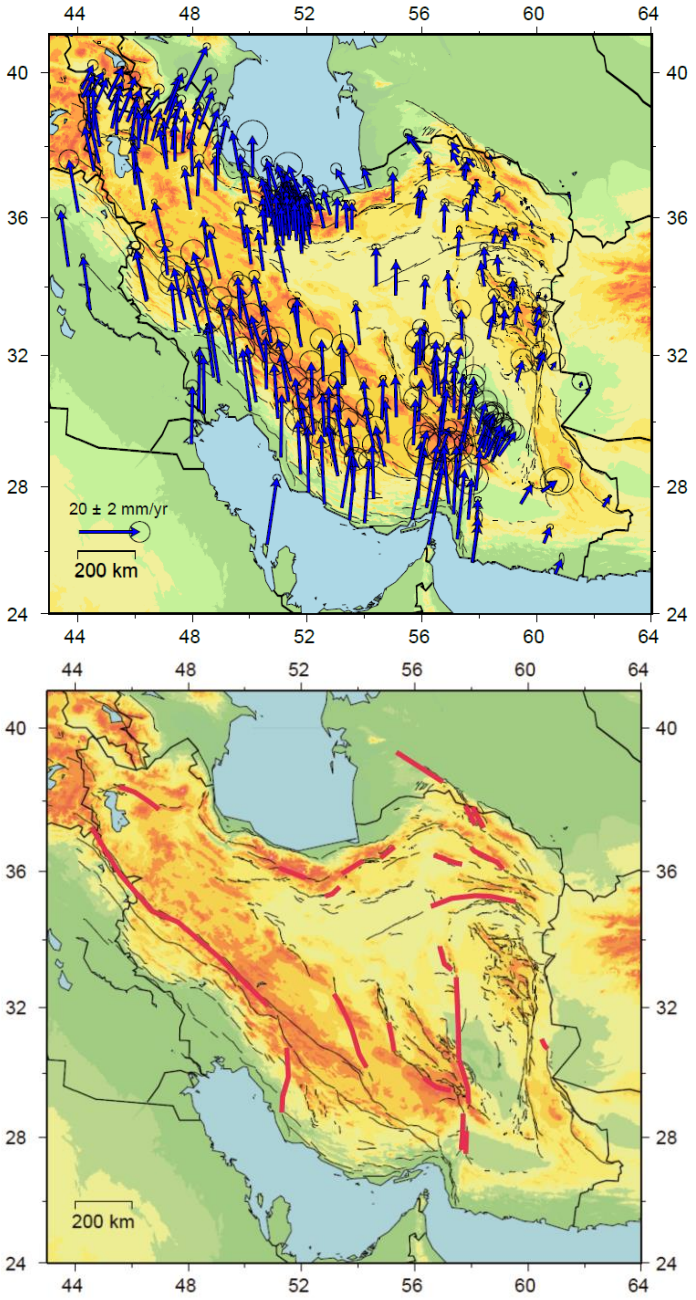
Or

Can we use long-term fault slip-rates to infer what is happening at the present day

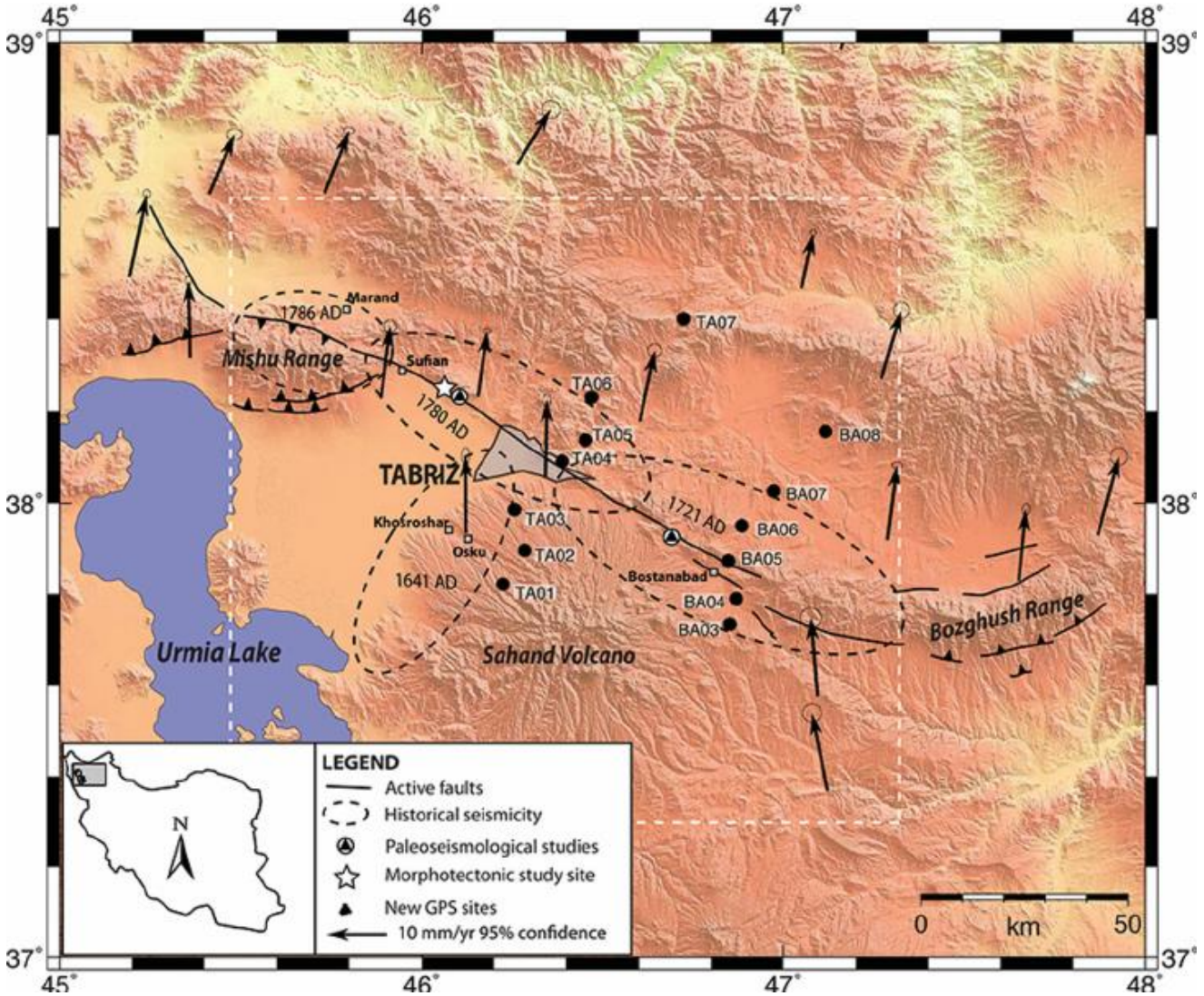
In many parts of Iran the faults are too closely spaced to resolve with GPS

Analysis restricted to a few ‘simple’ areas, where there is only one or a small number of major active faults

We are presenting a simplified view – not appropriate for earthquake hazard studies

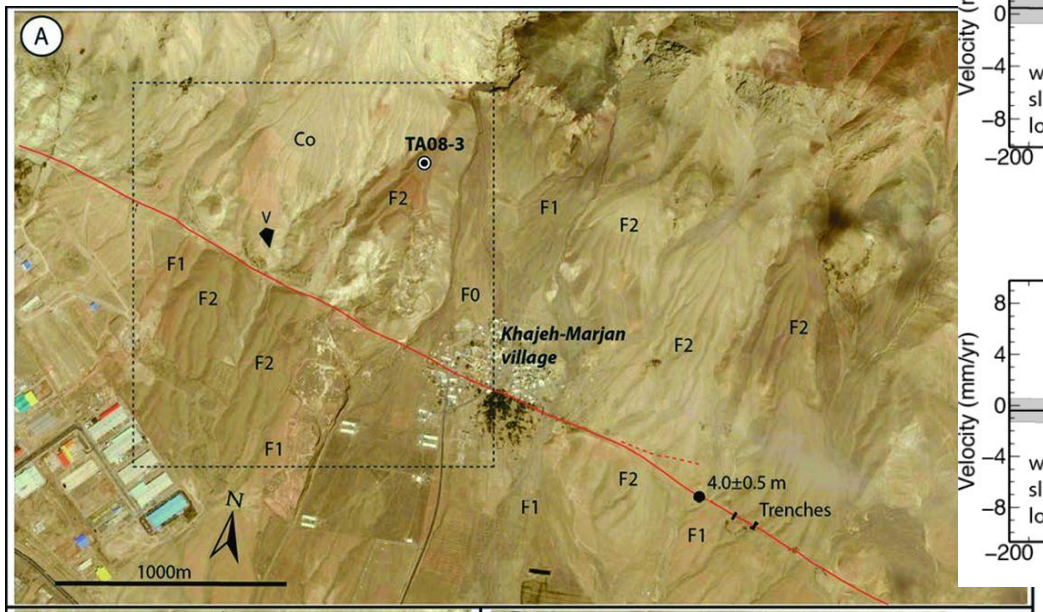


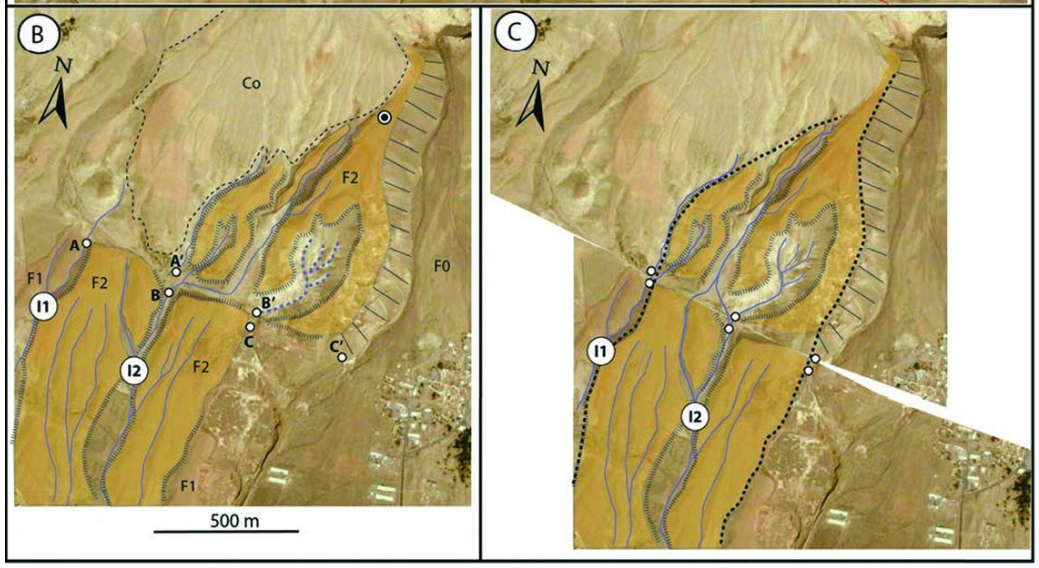
Comparison: The Tabriz Fault

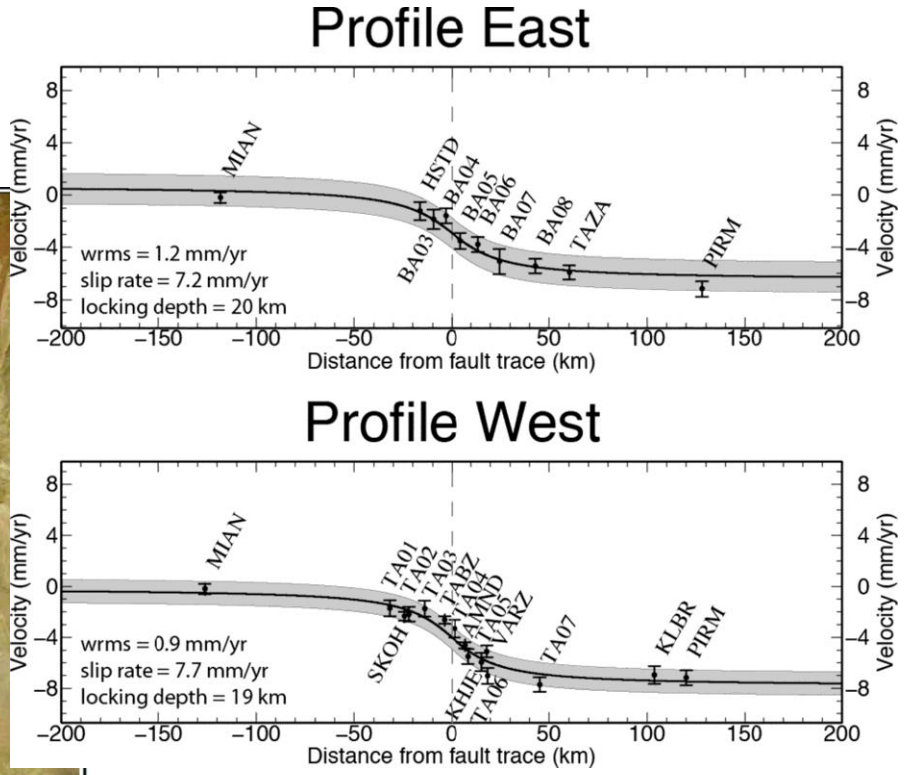


Rizza et al., 2013

Comparison: The Tabriz Fault



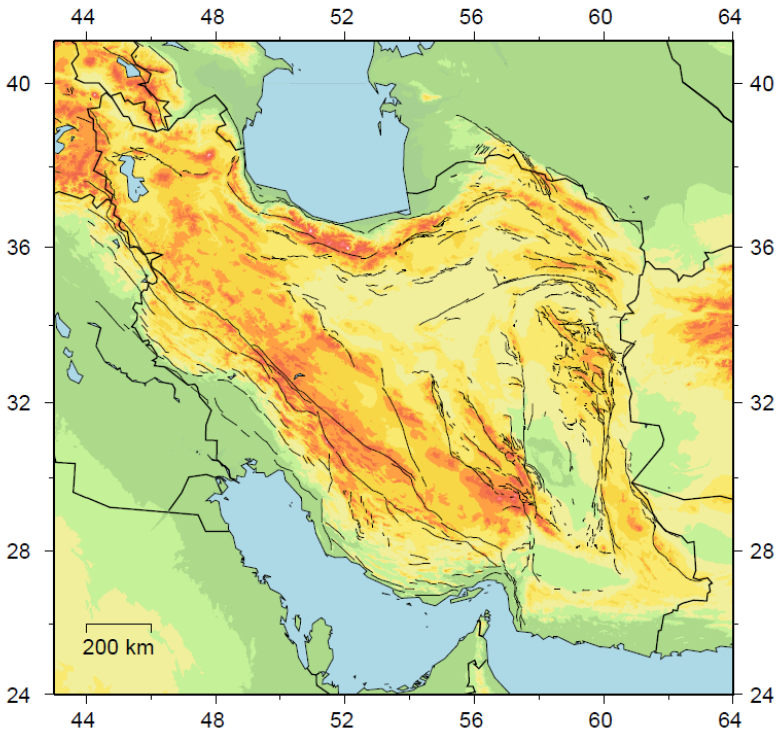


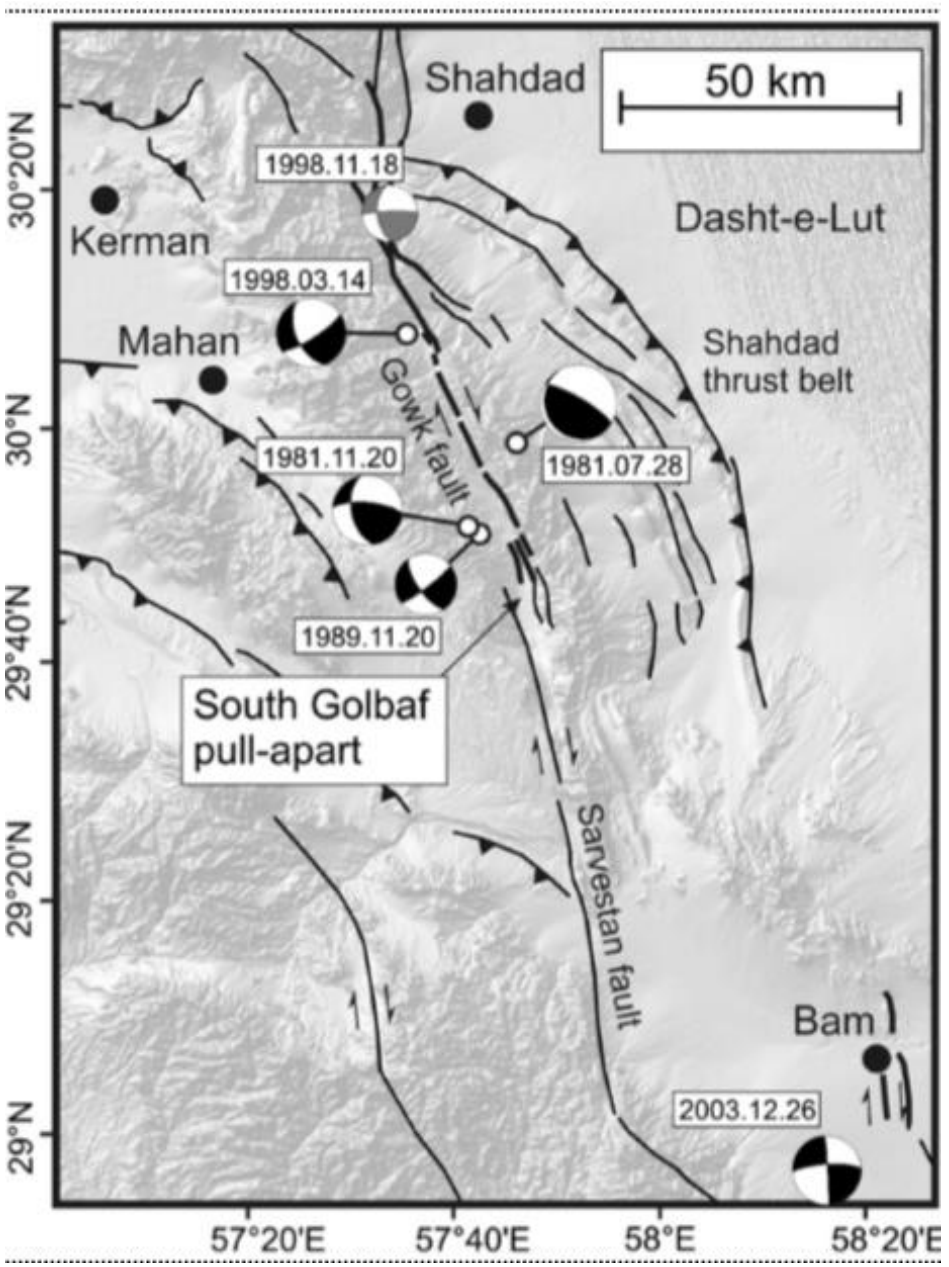


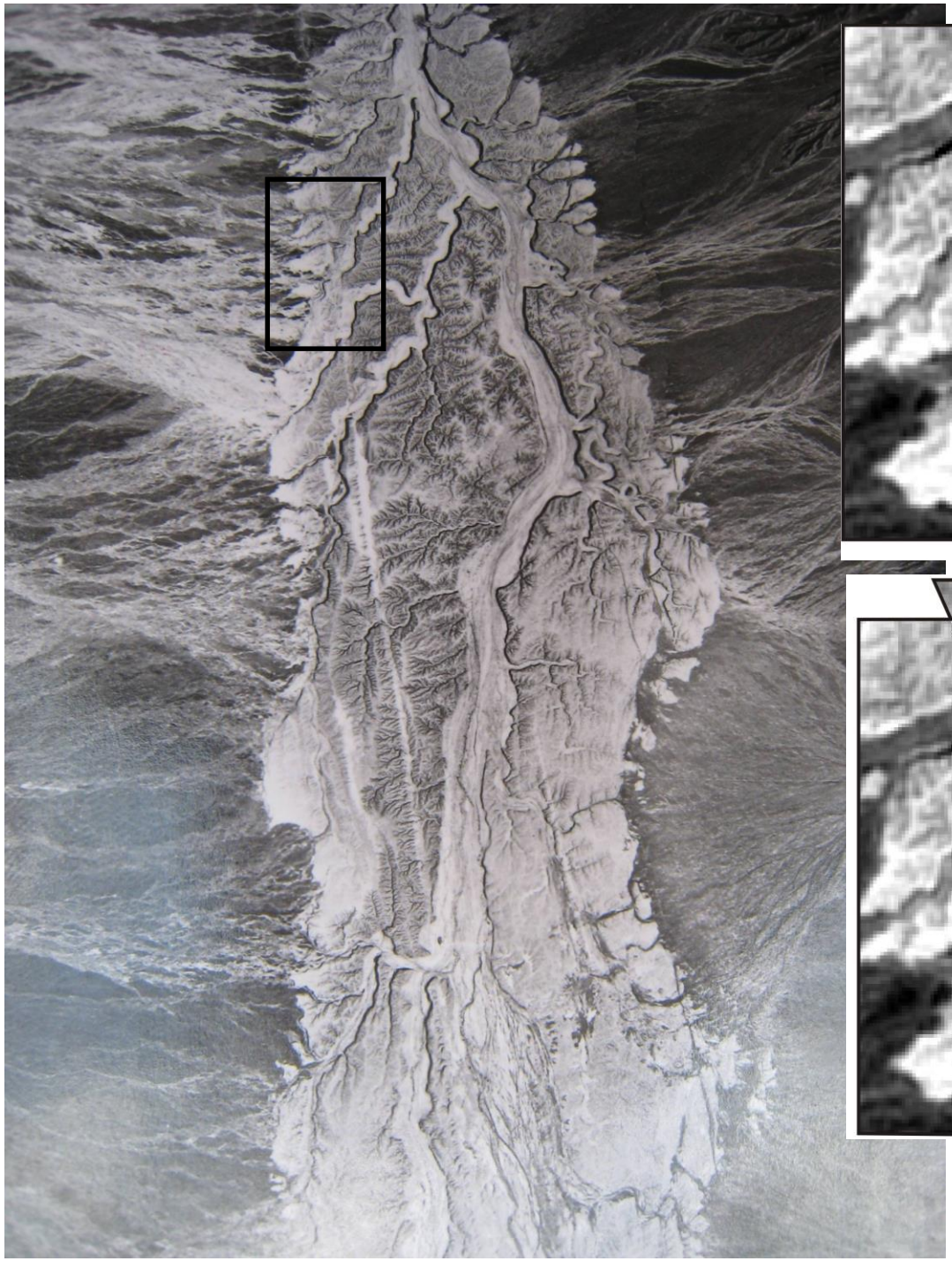
GPS slip-rate: 7.3 +/- 1.3 mm/yr
PS InSAR: 6 +/- 3 mm/yr

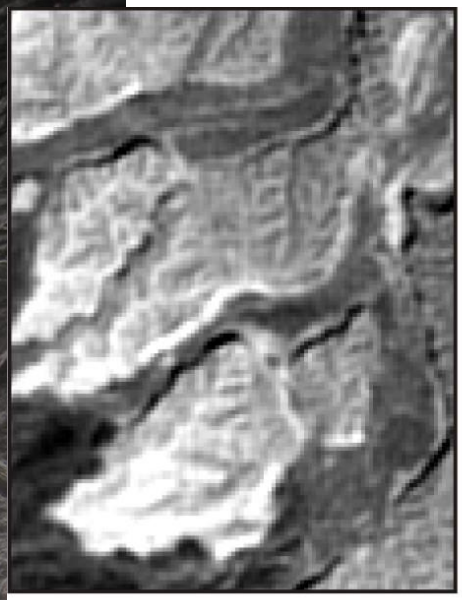
Displacement: 320 +/- 40 m
Age: ~45 ka (OSL, IRSL)
Slip-rate: 6.5-7.3 mm/yr
(c.f. Hessami et al., 2003)

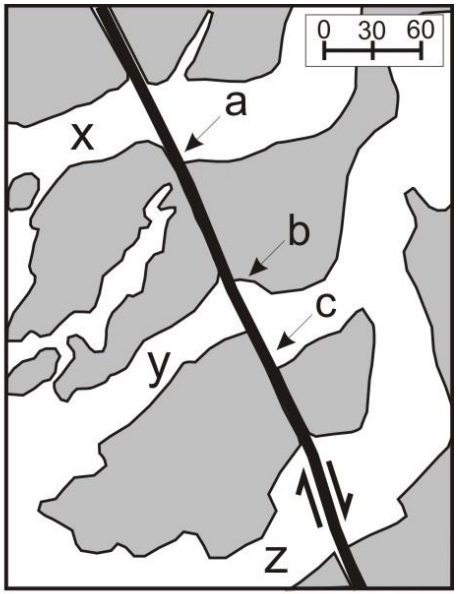
Comparison: The Gowk Fault

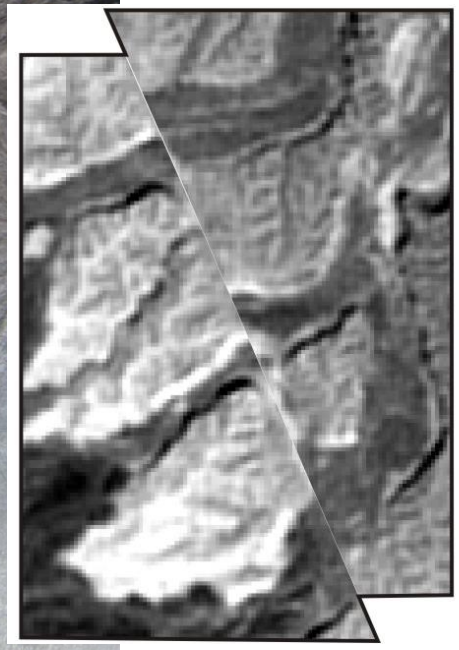


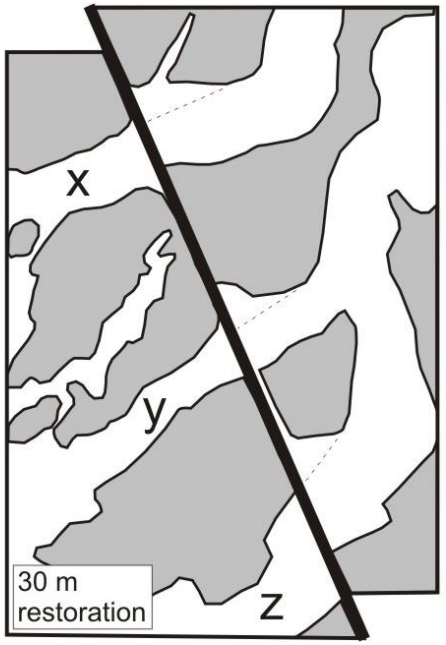




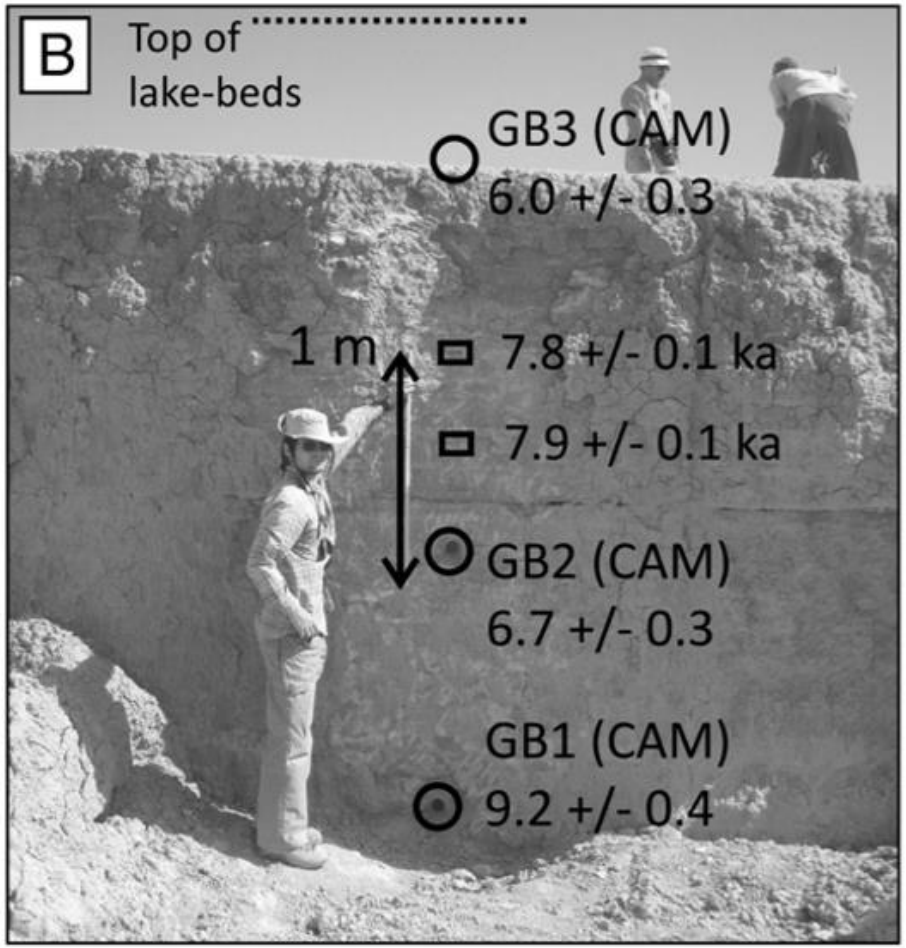


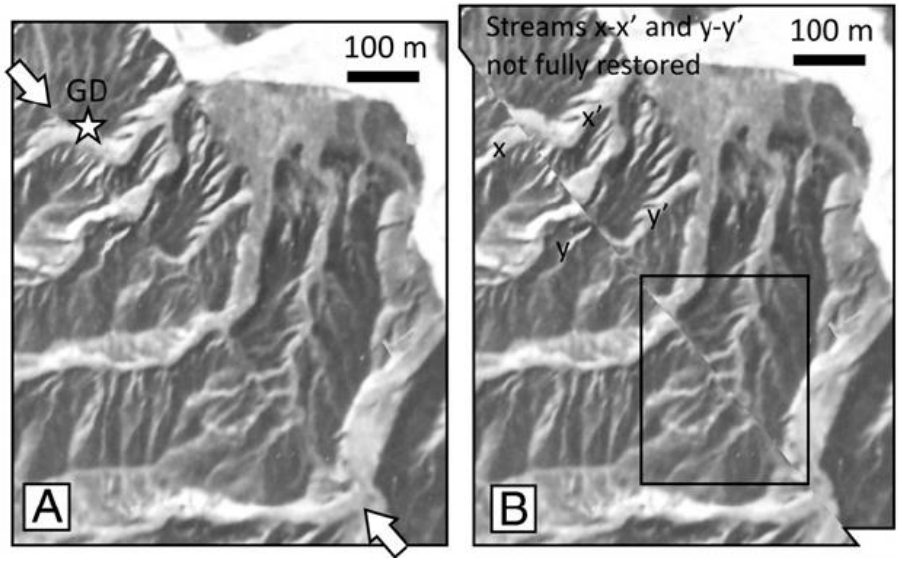






~30 +/- 5 m lateral disp.



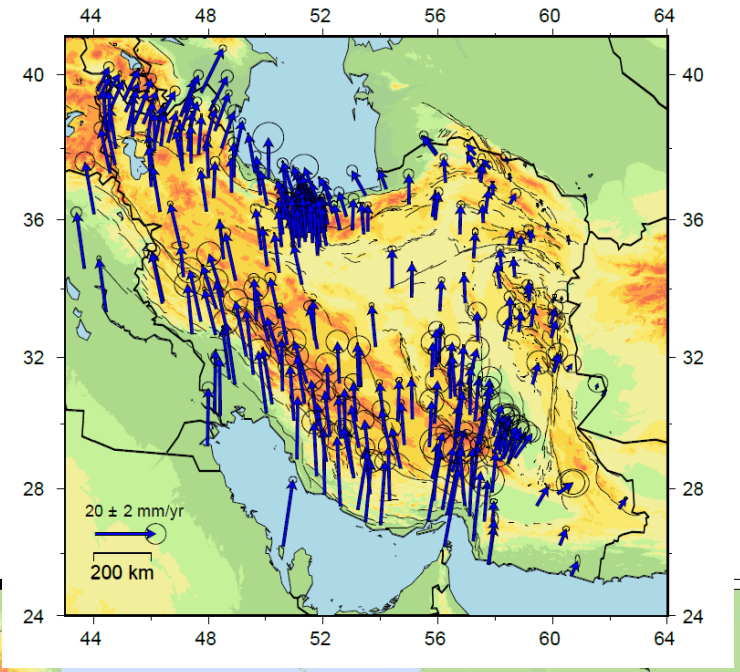


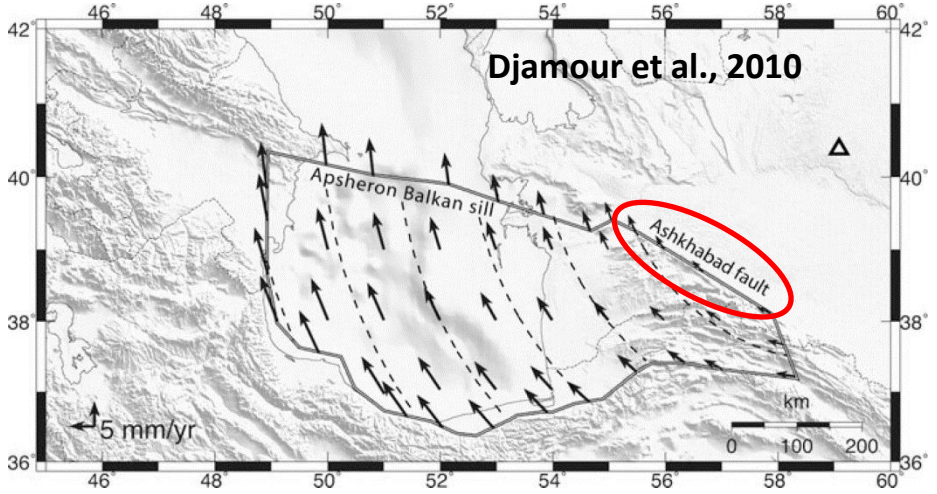
Displacement: 60 +/- 5 m
Age at surface: 12.9 +/- 0.7 ka
Slip-rate: 4.4-4.9 mm/yr
(Fattahi et al., 2014)

Displacement: 30 +/- 5 m
Age at surface: 6.3 +/- 0.2 ka
Slip-rate: 3.8 – 5.7 mm/yr
(Walker et.al. 2010; Fattahi et al., 2014)

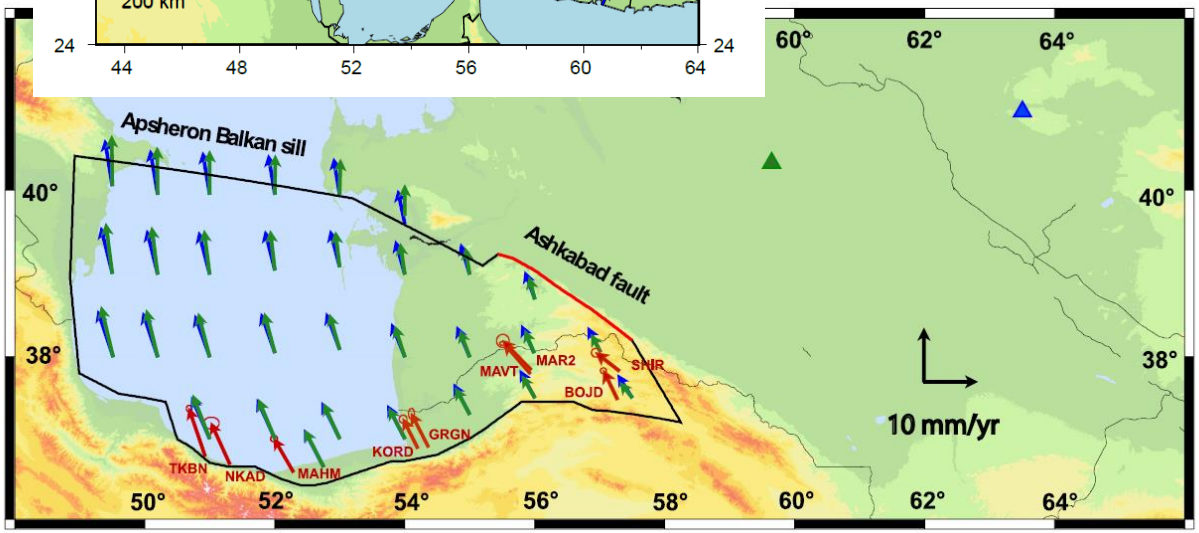
GPS rate: 4.4 +/- 0.4 mm/yr
(Walpersdorf et al., 2014)

Comparison:
The eastern Caspian

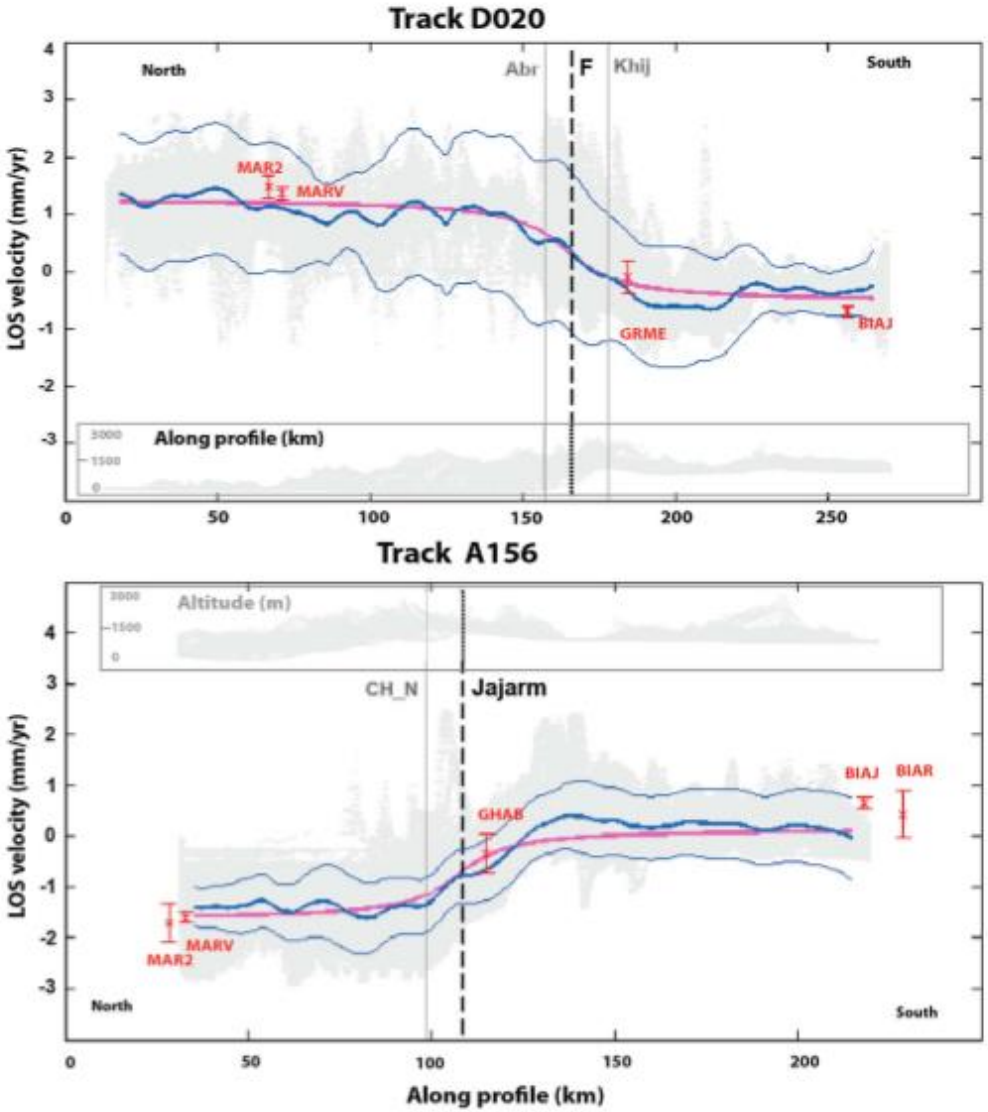


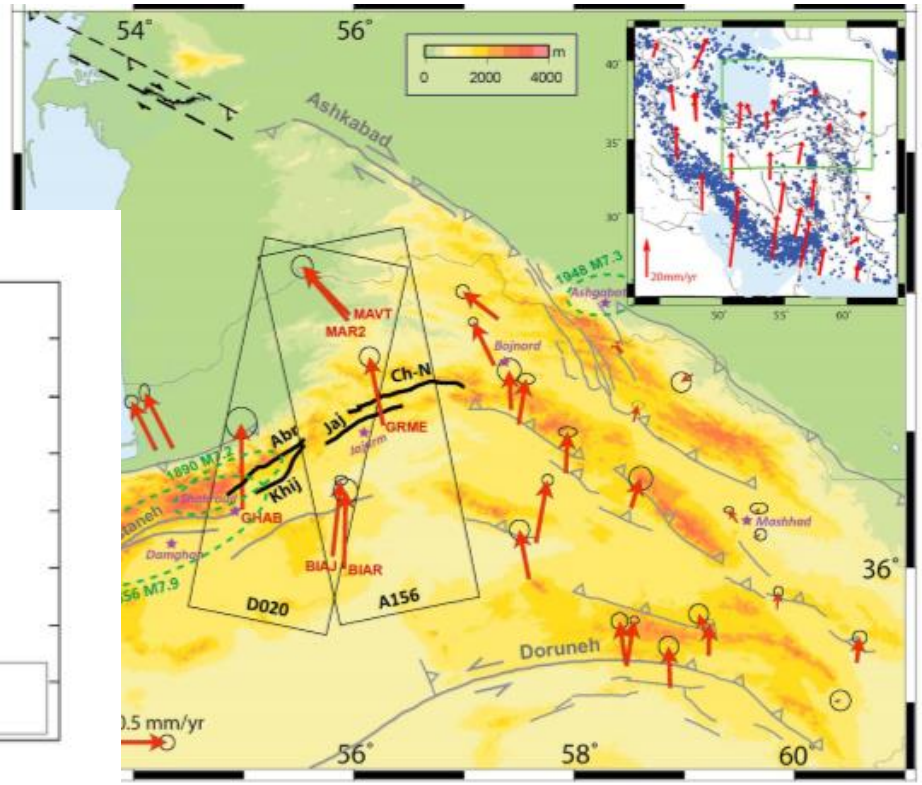


Predicts relatively slow slip-rates along the eastern margins



- Slip-rate is: **4.0-5.5 mm/yr**
- **Agreement between RADAR, GPS, and geology (~4-7 mm/yr)**
- **No historical earthquakes - hazard**

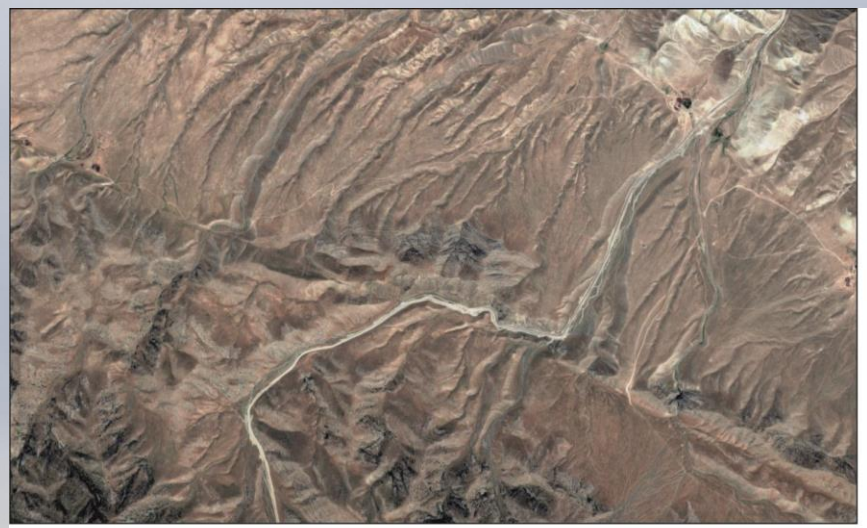


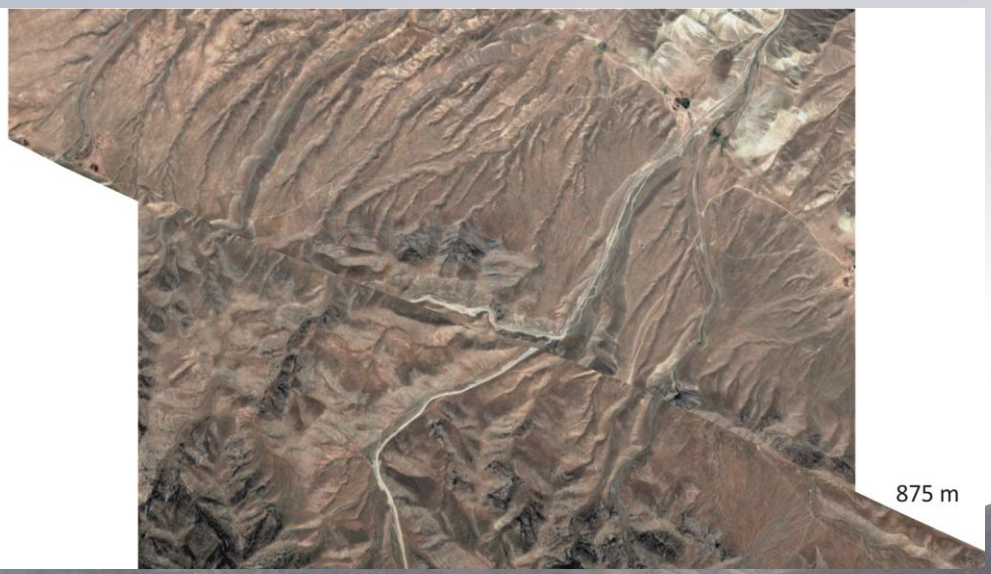


InSAR has been used for the Ashkabad fault, but gives a range of values: **6-12 mm/yr (Walters et al., 2013)**

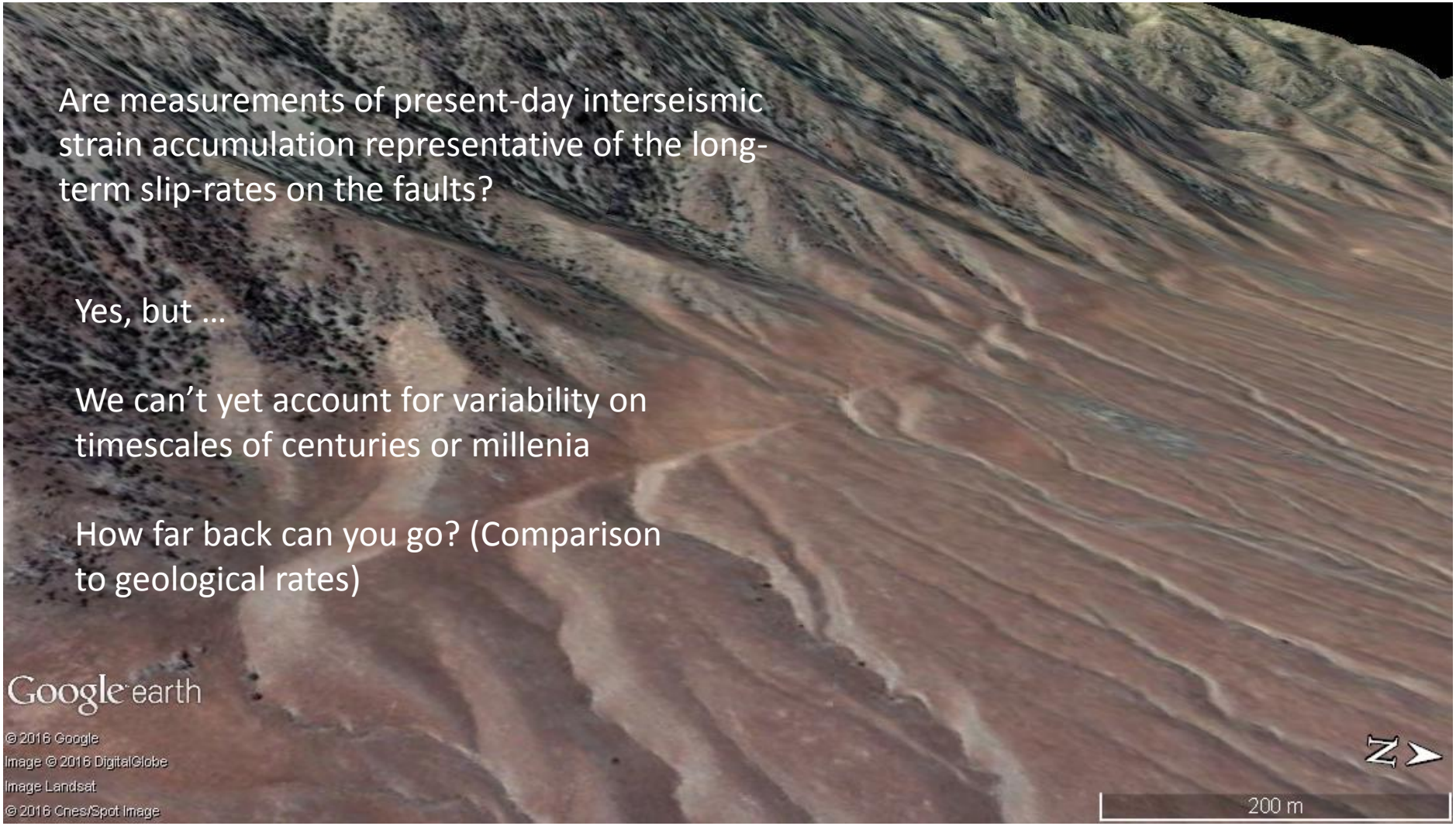
GPS suggests either **7.5 mm/yr** or **3 mm/yr (Djamour et al., 2010; Mouzavi et al., 2013)**

So we can try and measure the slip rate using fieldwork

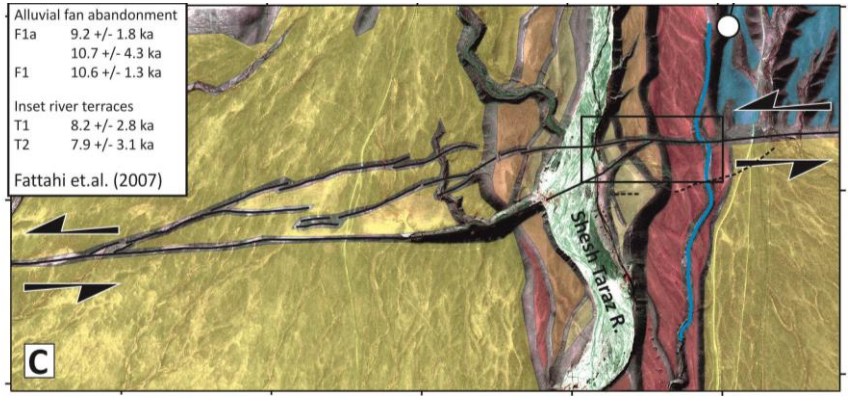




Age ~100 ka (uncorrected for fading)

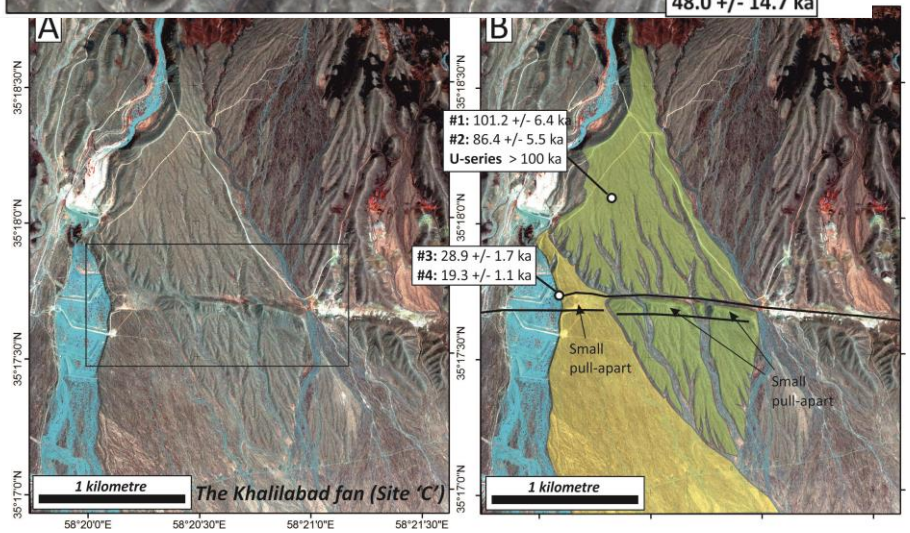

Are measurements of present-day interseismic strain accumulation representative of the long-term slip-rates on the faults?
Yes, but …
We can't yet account for variability on timescales of centuries or millenia
How far back can you go? (Comparison to geological rates)
Google earth
© 2016 Google
Image © 2016 DigitalGlobe
Image Landsat
© 2016 Cnes/Spot Image
N
200 m

Thank you



25 m in ~10 ka

150 m in ~50 ka



~50 m in 20 ka
260 m in 100 ka