Sources and Recurrence of Mega-Earthquakes & Tsunamis within the Hellenic Subduction System

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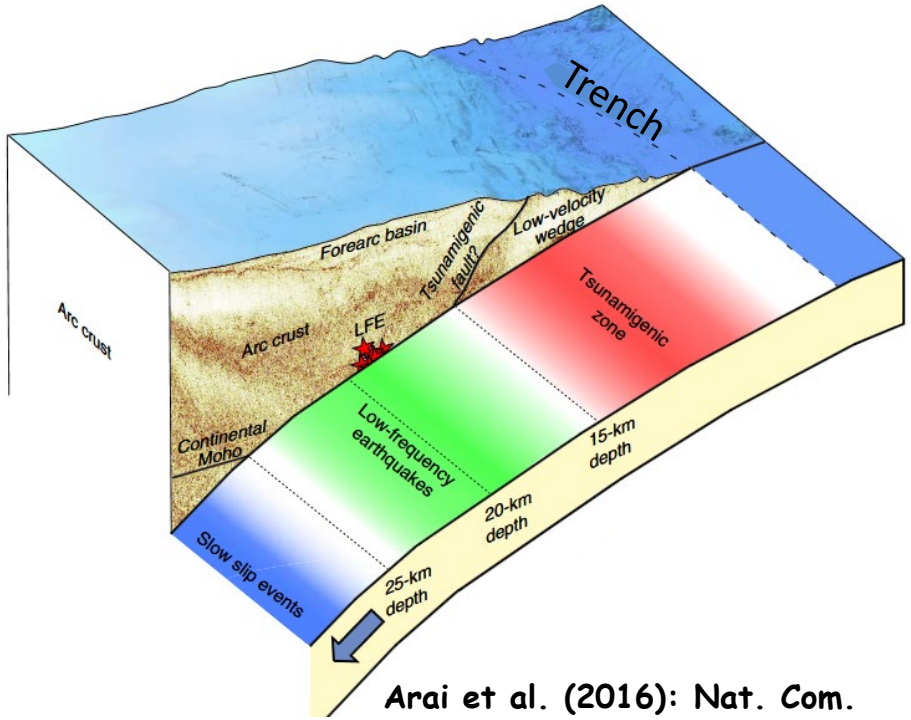
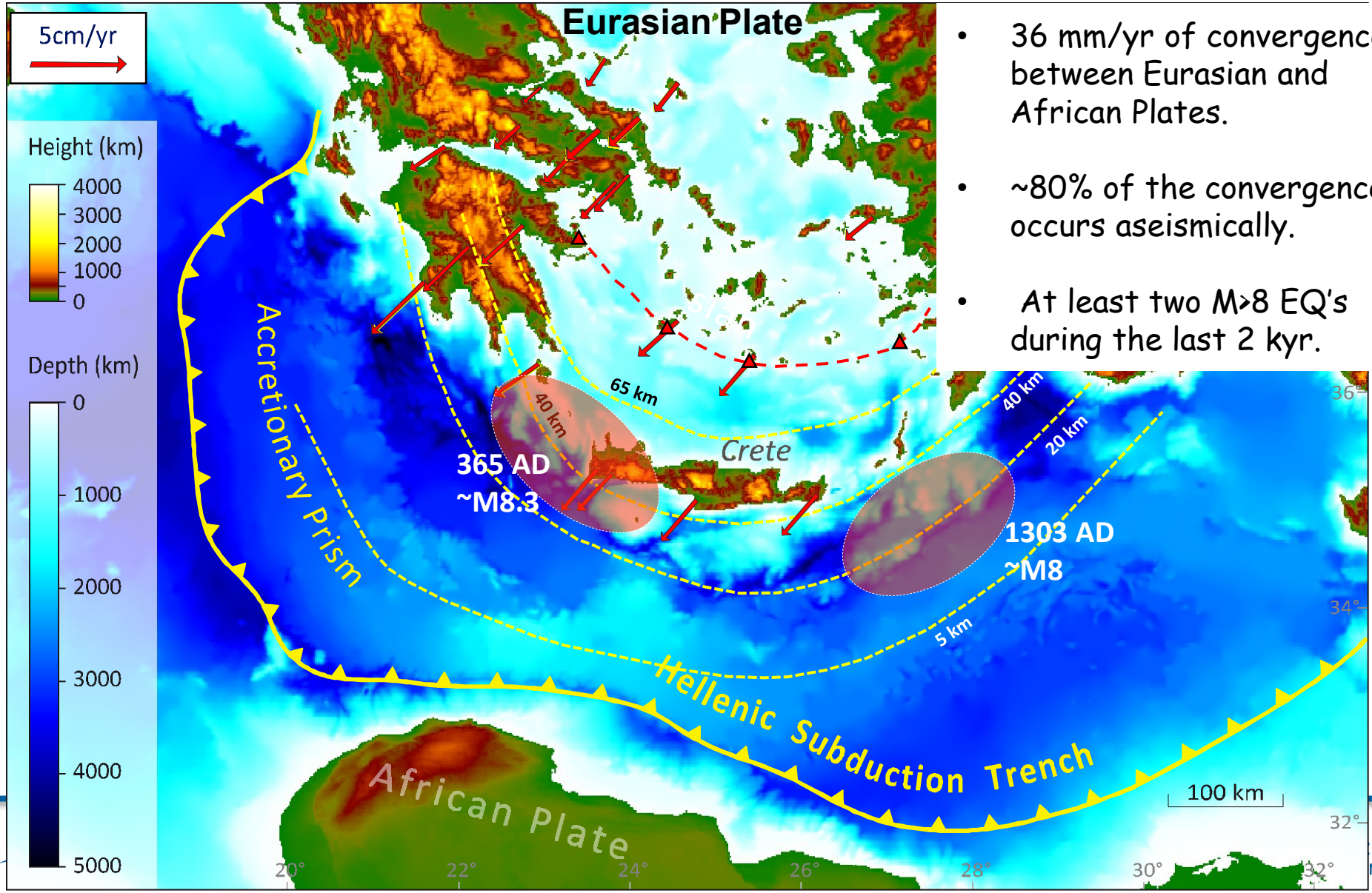


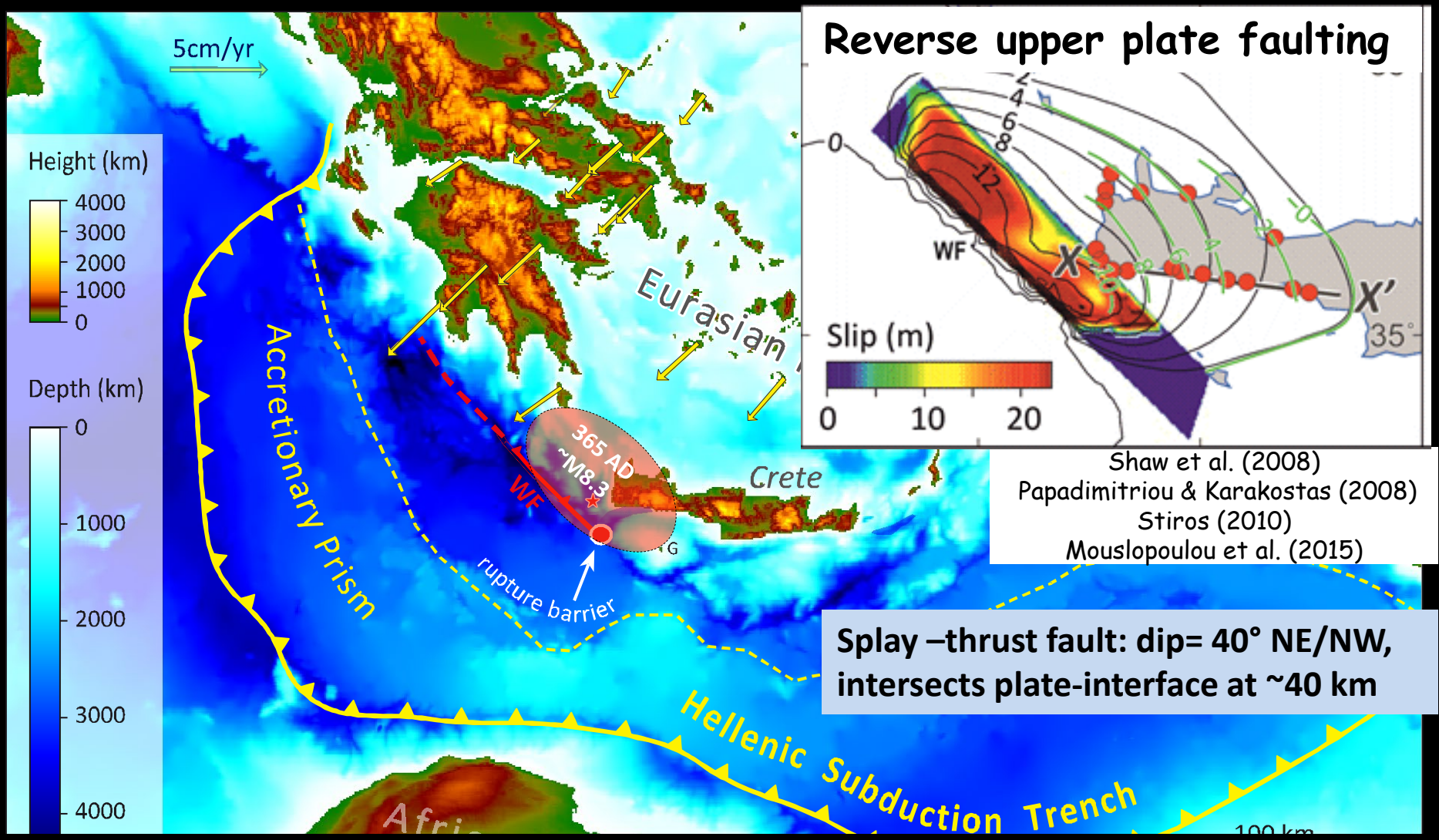
Arai et al. (2016): Nat. Com.

Aseismic Plate-Convergence & Historic Mega-Earthquakes: the Hellenic Subduction Paradox

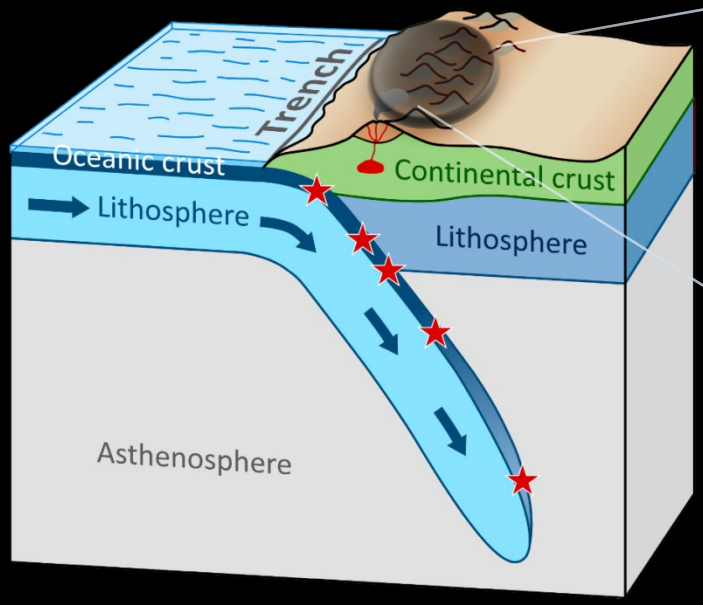


- 36 mm/yr of convergence between Eurasian and African Plates.
- ~80% of the convergence occurs aseismically.
- At least two M>8 EQ's during the last 2 kyr.

Source of 365 AD Mega Earthquake



How often do such mega-events occur?
Are there additional sources within the Hellenic forearc?



The land along subduction systems is a

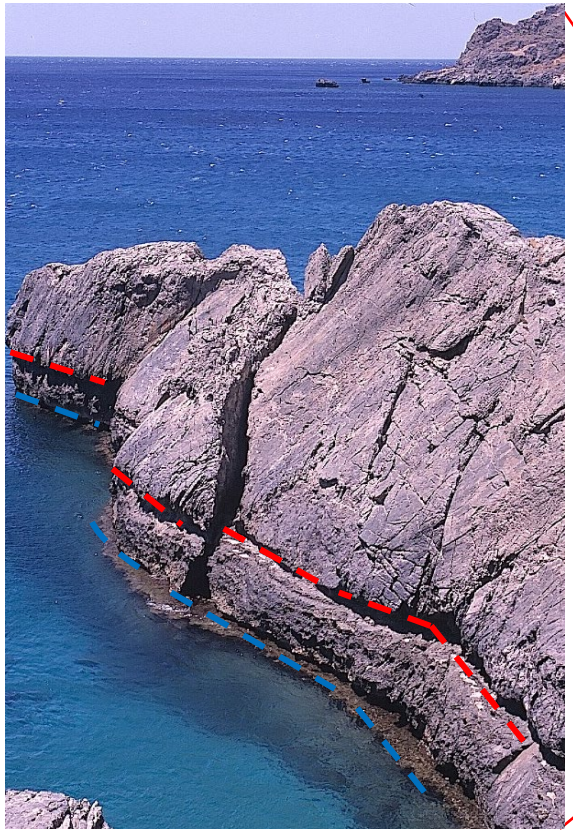
goldmine of earthquake data that reveal deep-seated processes.

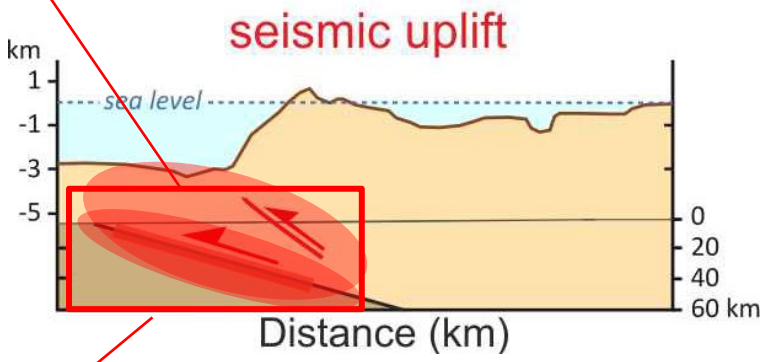
Why?

Landscape ‘records‘ large earthquakes

….remembers the past earthquakes!

Records and…

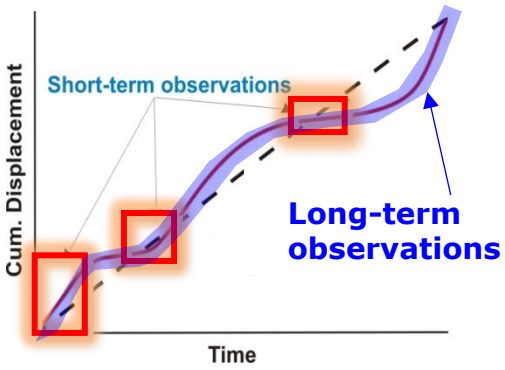




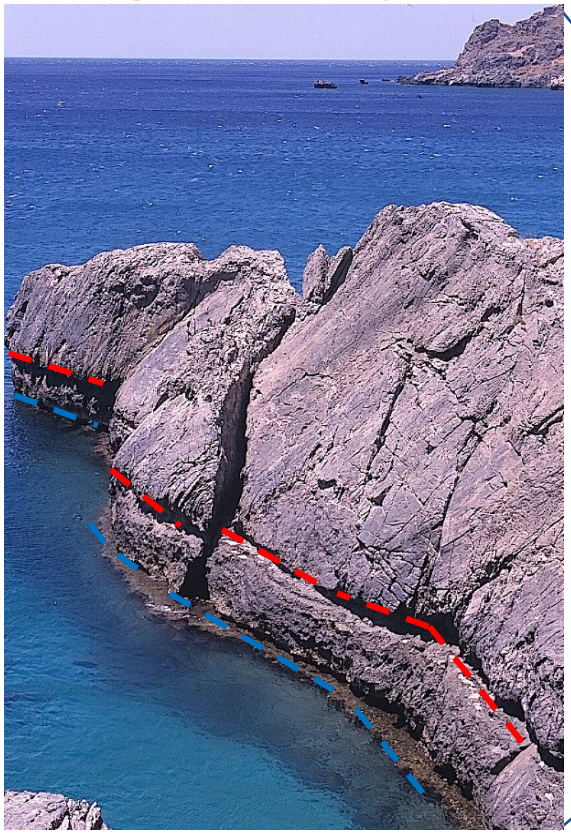
Landscape 'records' large earthquakes

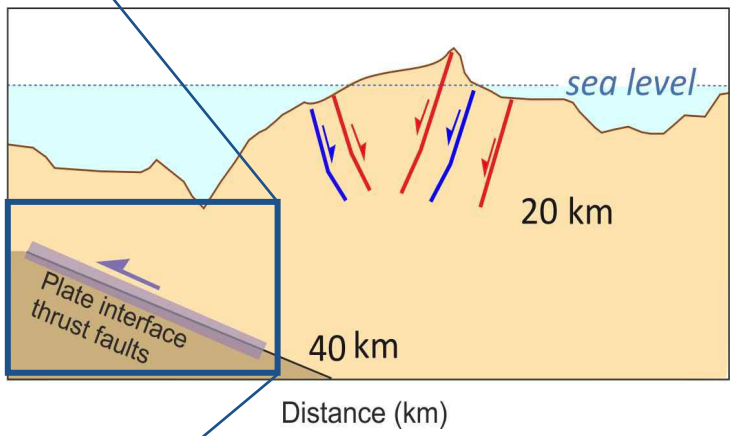
Case study: Crete

Non-periodic



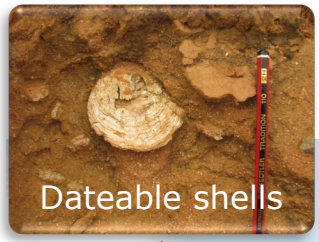
Single earthquake





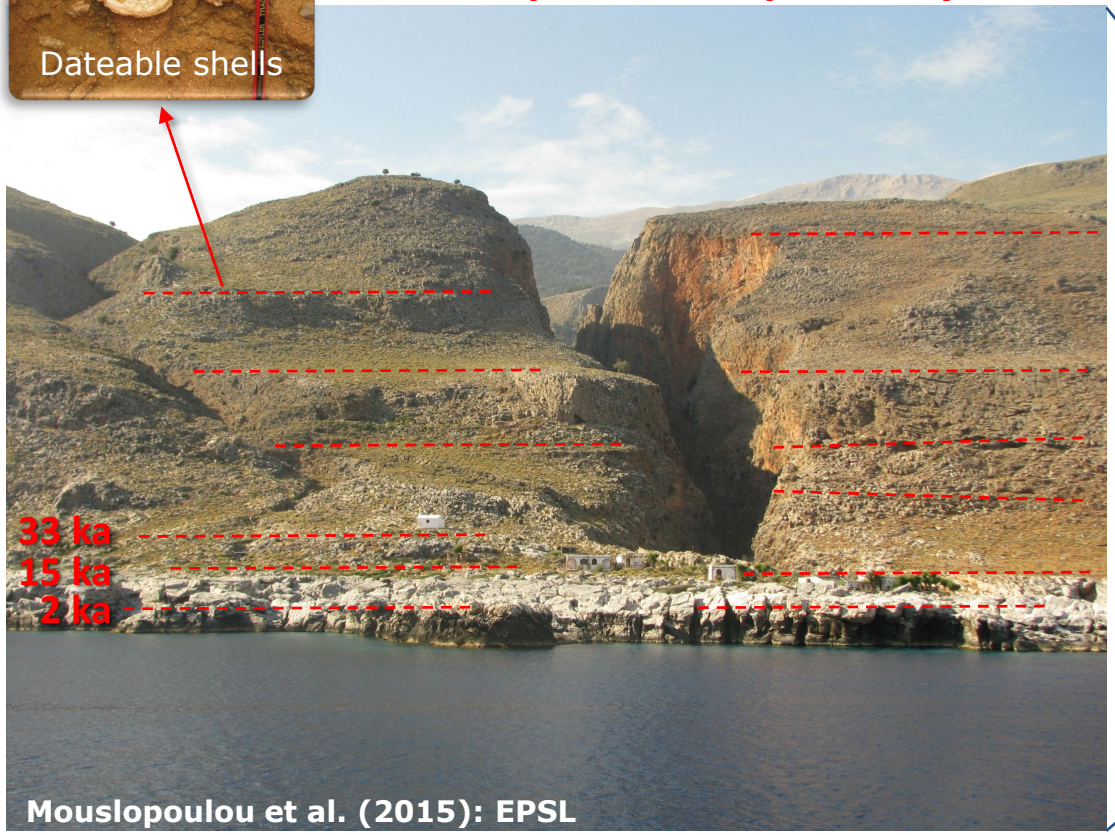
Vital for calculating seismic rates over thousand yearlong timescales → improved seismic hazard

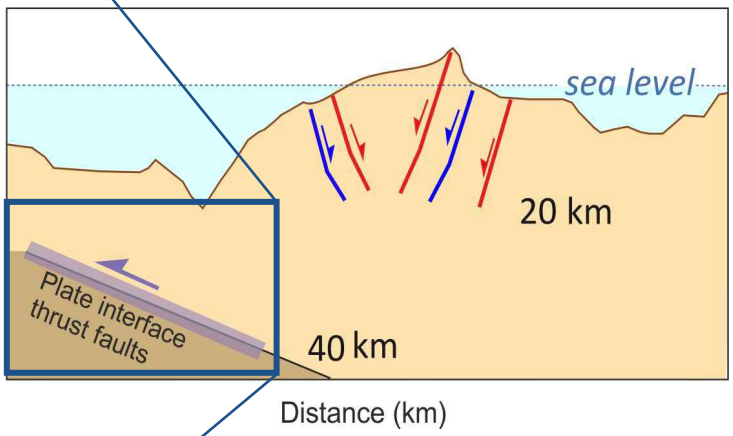
Landscape 'records' large earthquakes



Uplifted Paleoshorelines record multiple earthquake-cycles

Case study: Crete





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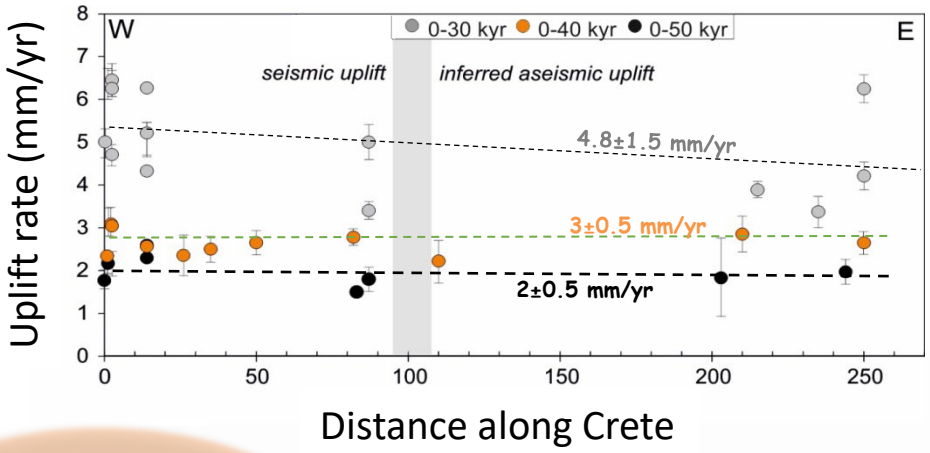
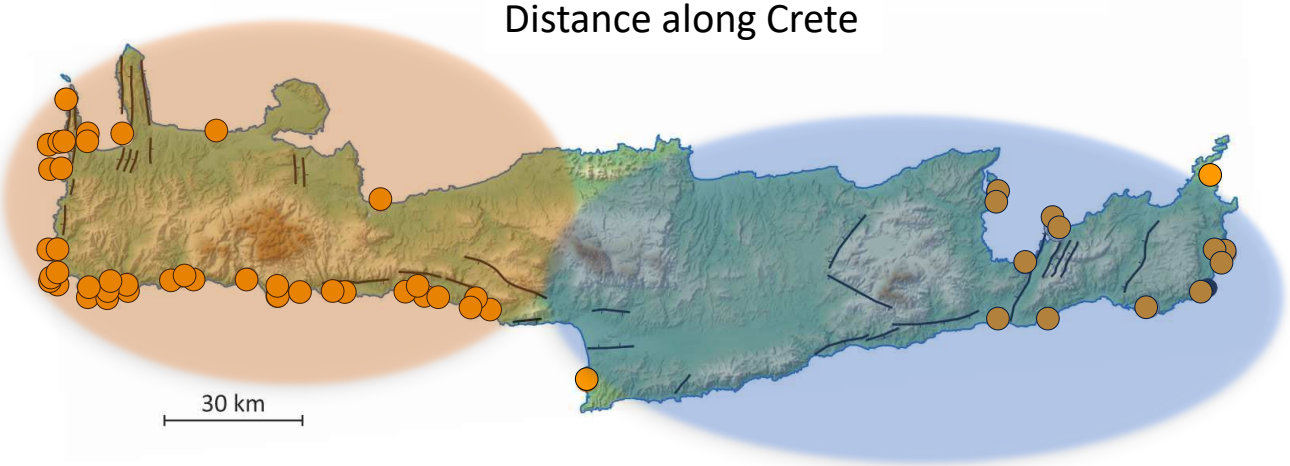
Mouslopoulou et al. (2015): GRL

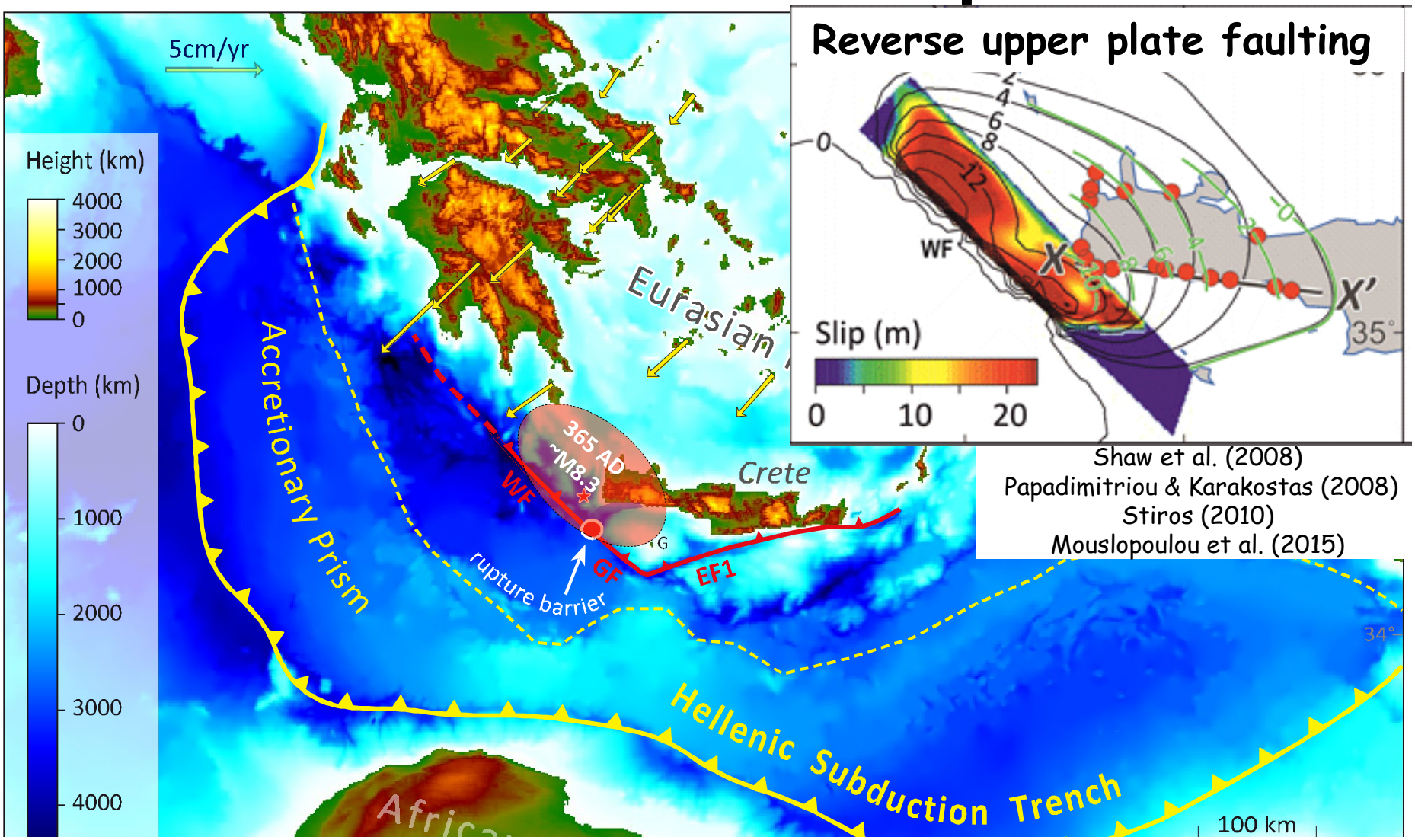




Spatially uniform – temporally transient uplift on Crete during the last 50 ka

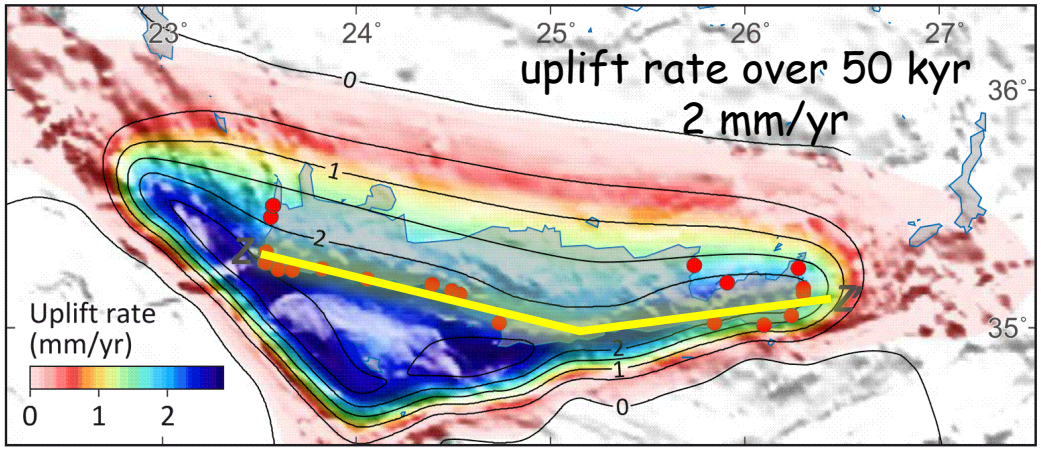
Which are the responsible faults?

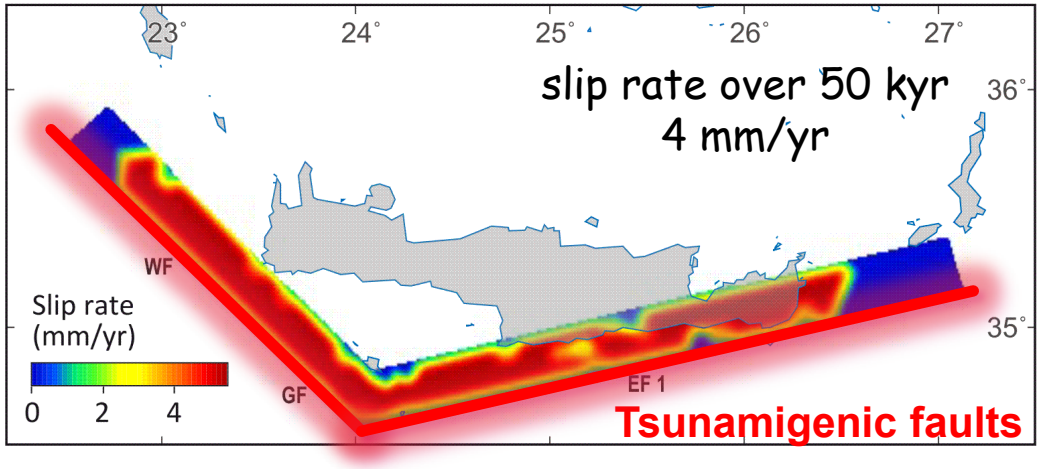
Which faults drive uplift?

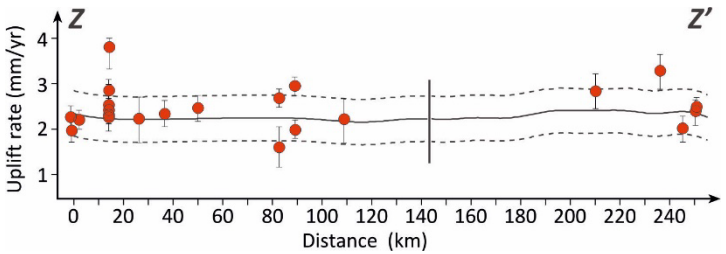


Requirement for uniform uplift along Crete

Upper-plate thrust faulting drives uplift on Crete







Good agreement between modeled & measured data

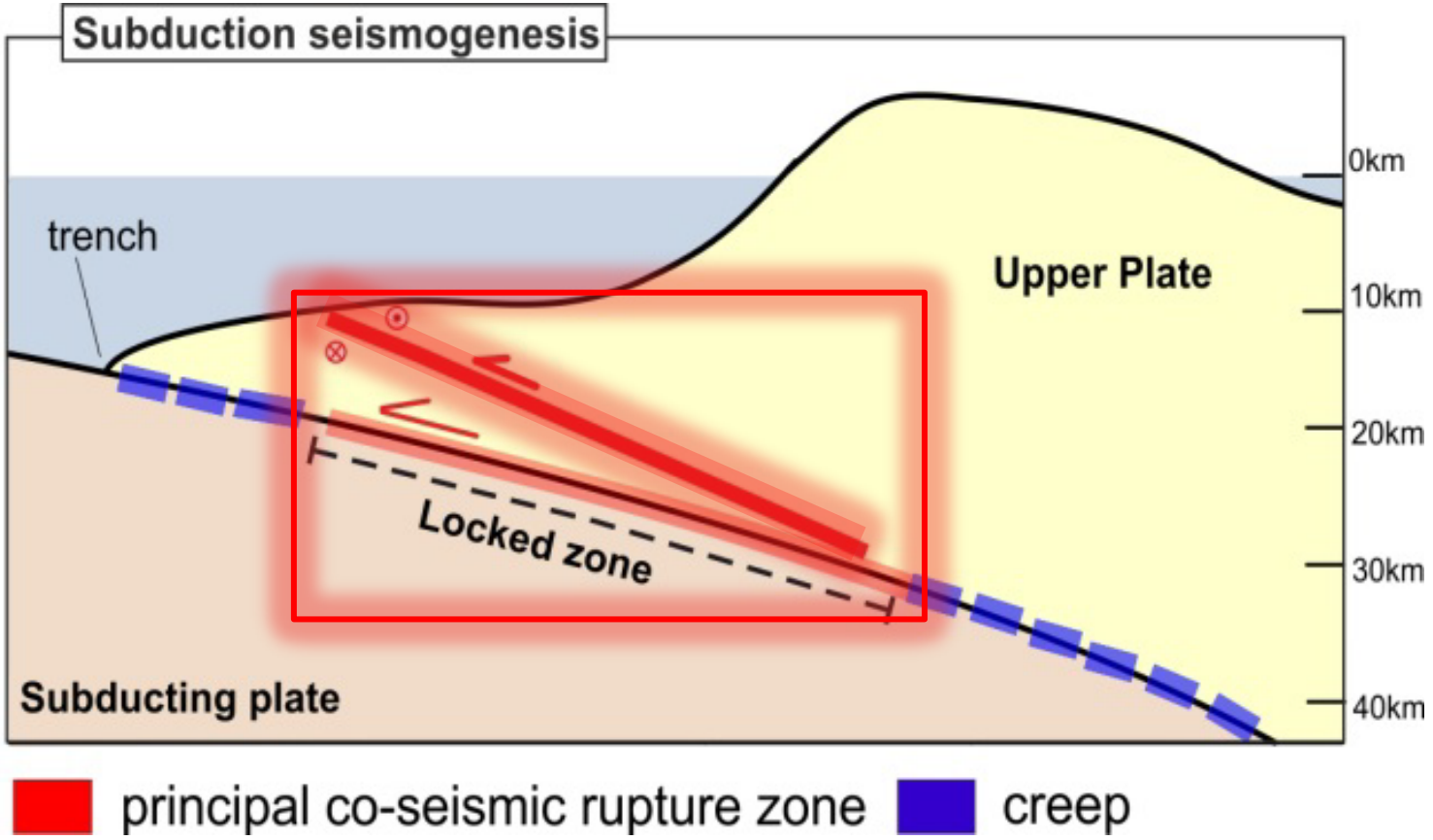
Slip rate of ~4±0.5 mm/yr on each fault can reproduce the ~2 mm/yr of long-term uplift rate along Crete

Mouslopoulou et al. (2015): GRL

Fault ID	Average Recurrence Interval (50 kyr)	Average Recurrence Interval (5-20 kyr)
WF	5	1,5
GF	2,5	0,8
EF1	5	1,2
All faults	**1,3**	**0,4**

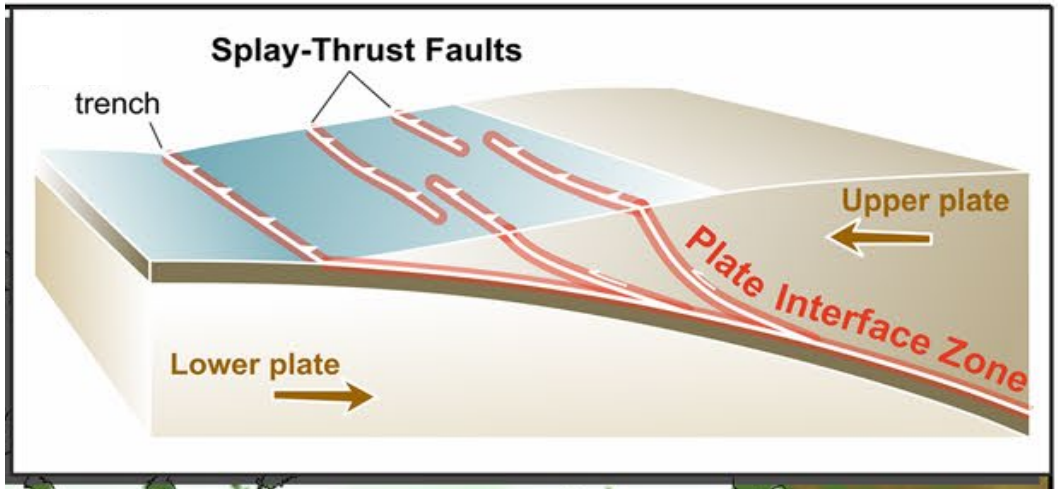
Order of magnitude changes in the RI of large earthquakes

Subduction seismogenesis within the HSS

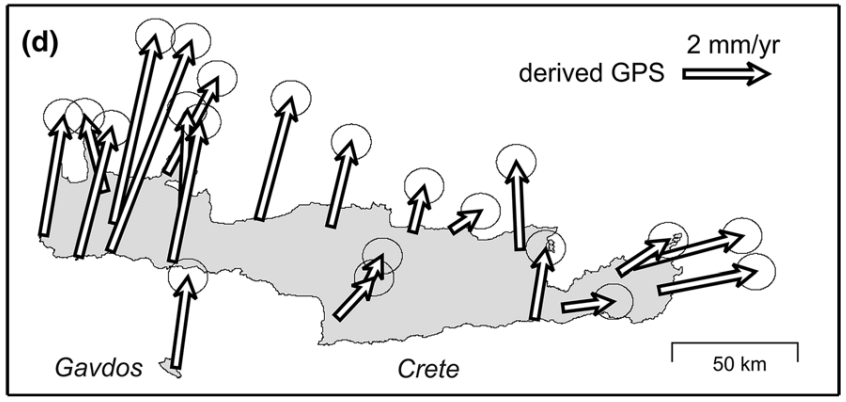


Large splay-thrust faults are the locus of great historic tsunamigenic earthquakes globally

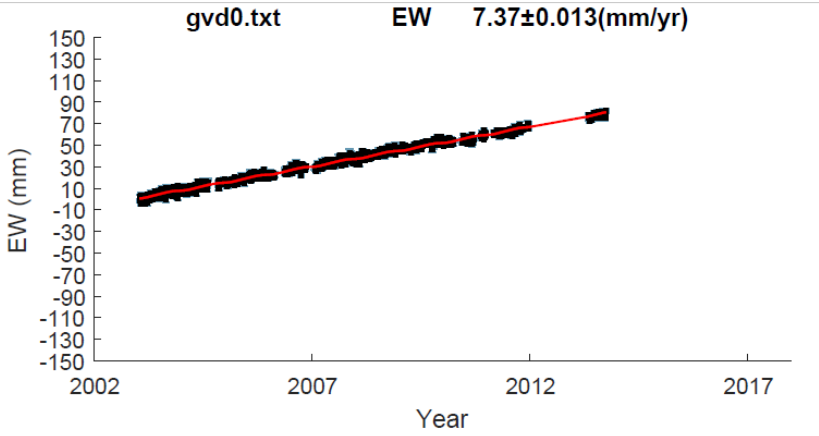
Interseismic strain accumulation

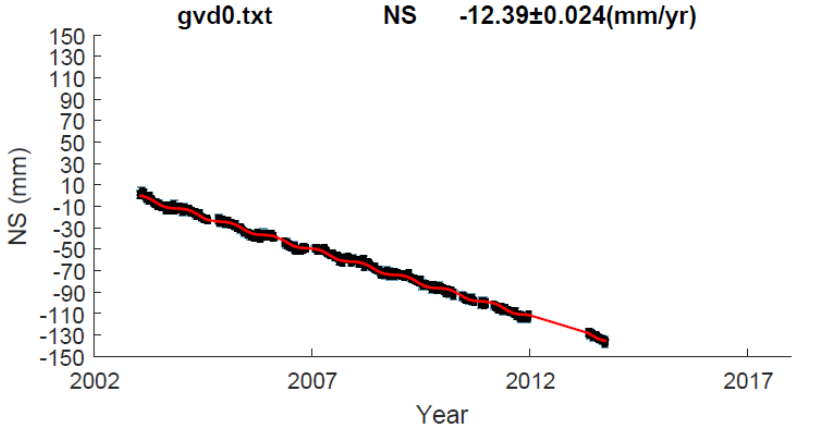


21 GNSS timeseries from Crete & Gavdos (2004-2017)



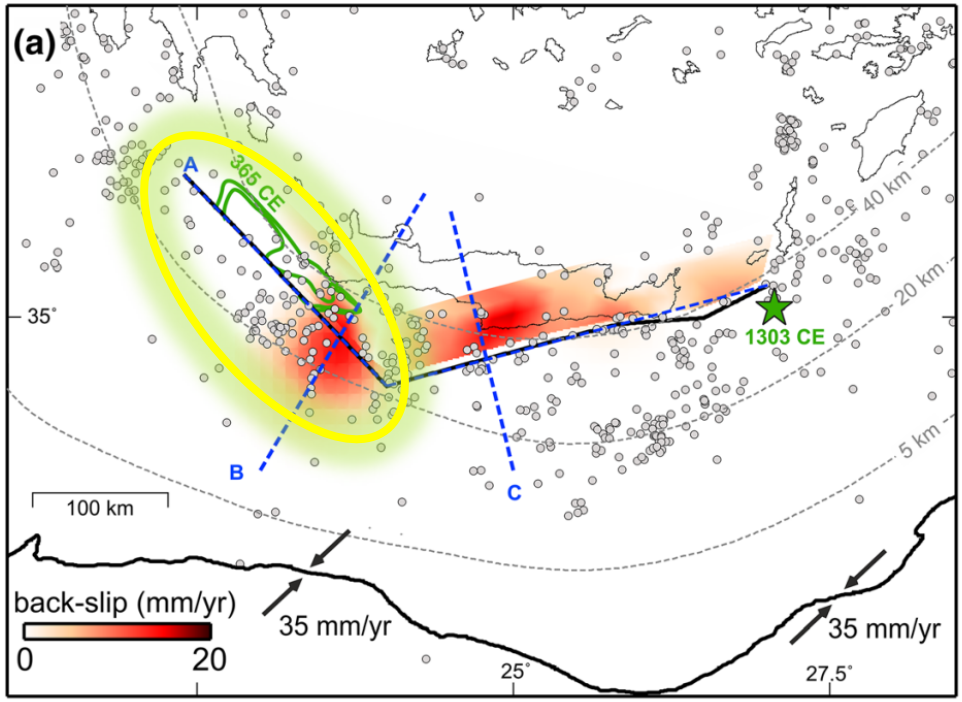
An example from Gavdos

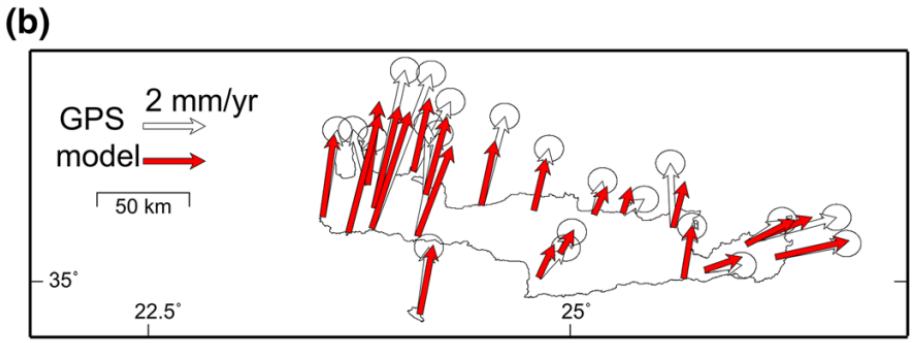


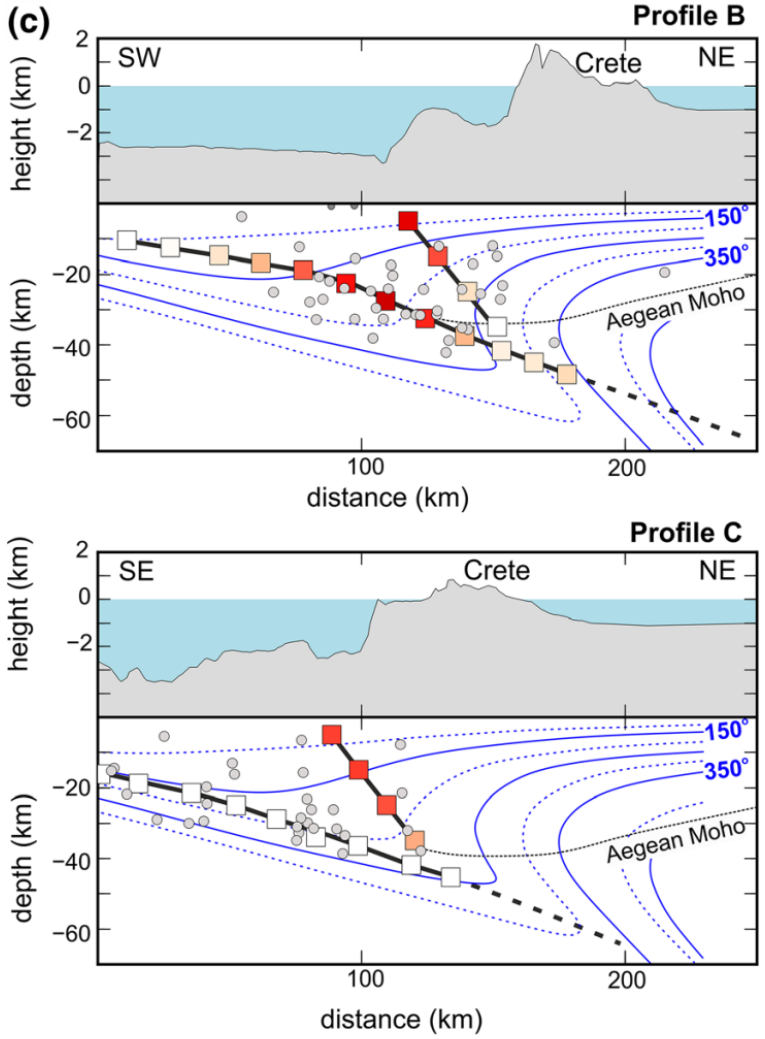


Saltogianni et al. (2020): GRL

Locking within the southern Hellenic forearc



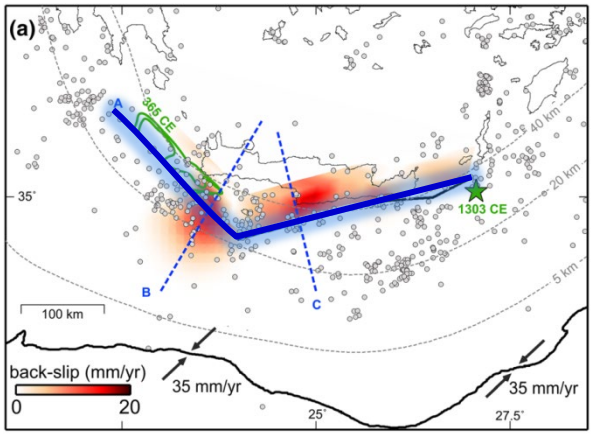




Saltogianni et al. (2020): GRL

Our model reveals which sections of the plate interface zone are presently locked and accumulate significant elastic strain that may be released in future large-magnitude earthquakes

Locking on discrete faults within the plate-interface zone



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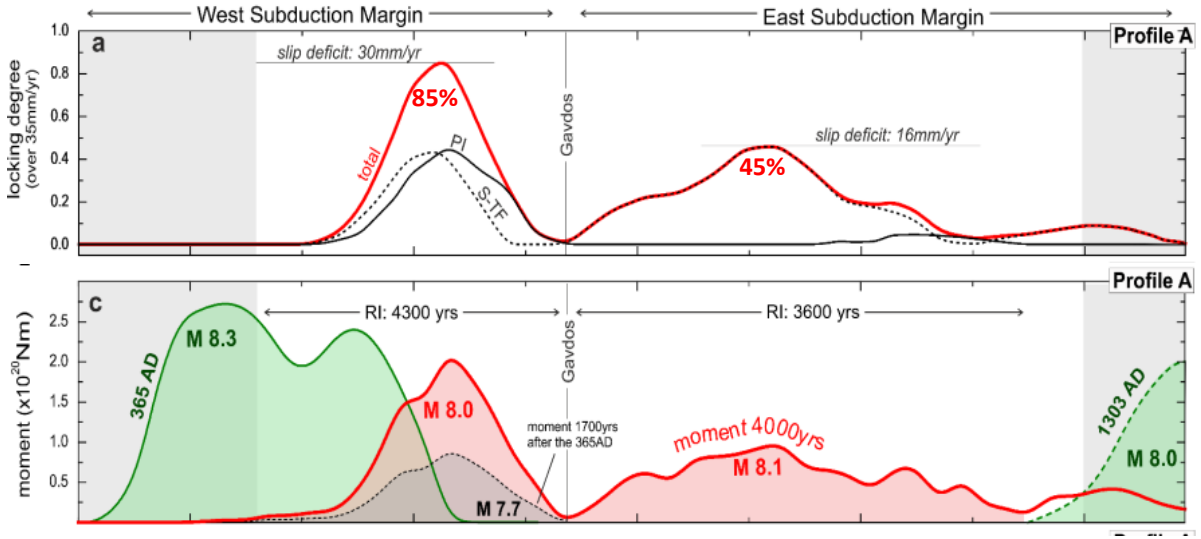

- **Western margin locally twice as locked (85%) compared to eastern (45%).**
- **Accumulated geodetic moment beneath central-eastern Crete equivalent to a M8.1 EQ.**

Although western Crete has been more active seismically in Holocene, seismic and tsunami hazard may be more elevated in the eastern section of the HSS.

Summary

Large tsunamigenic within the Hellenic forearc earthquakes probably occur on splay-thrust faults

Mega-earthquakes may occur in clusters, with order of magnitude changes in their recurrence intervals

Faults within the Hellenic forearc have accumulated elastic strain capable of producing M8 events & associated tsunami (anytime in the future)