Extremes in PSHA: M_{max} & Large Multiplets

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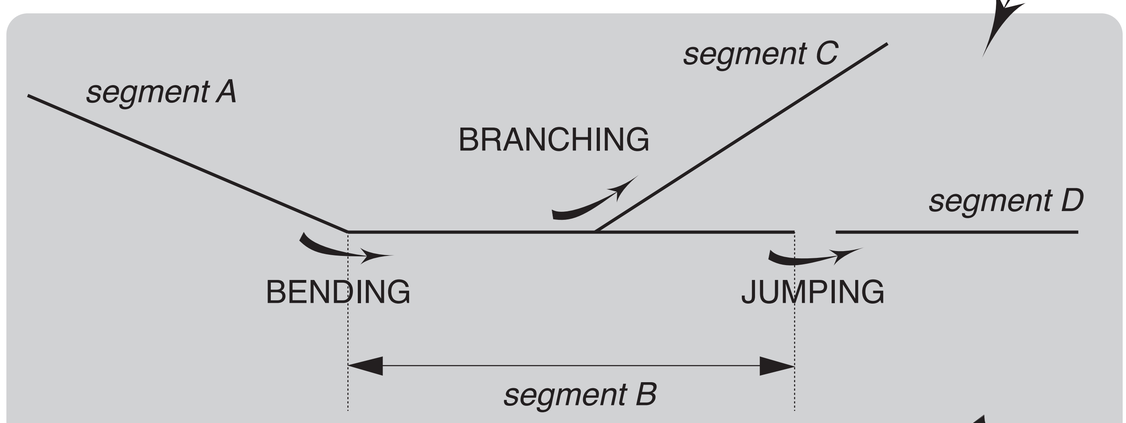
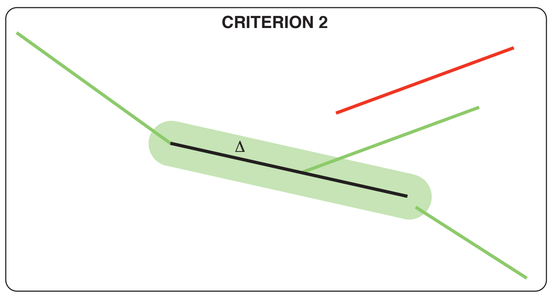
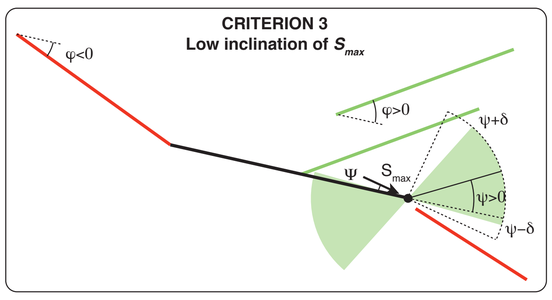
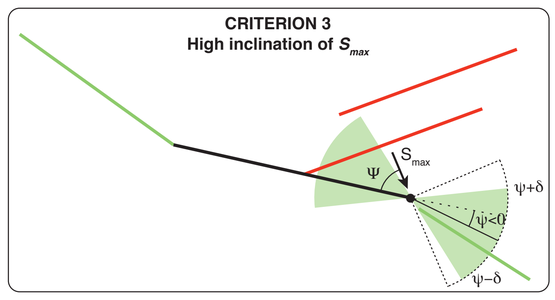
What is the maximum earthquake magnitude expected by dynamic stress?

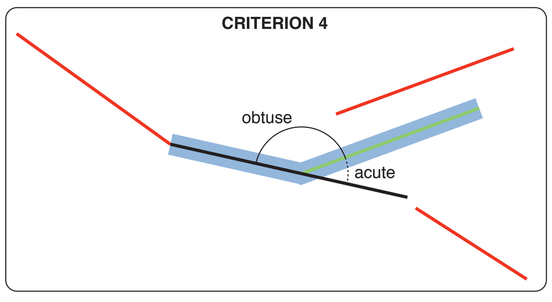


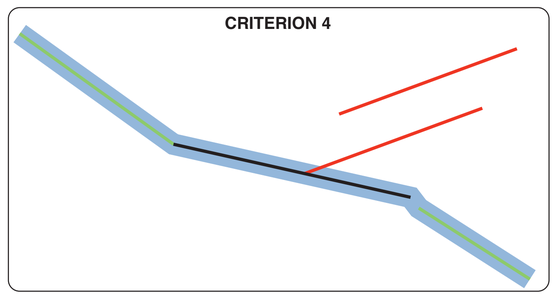


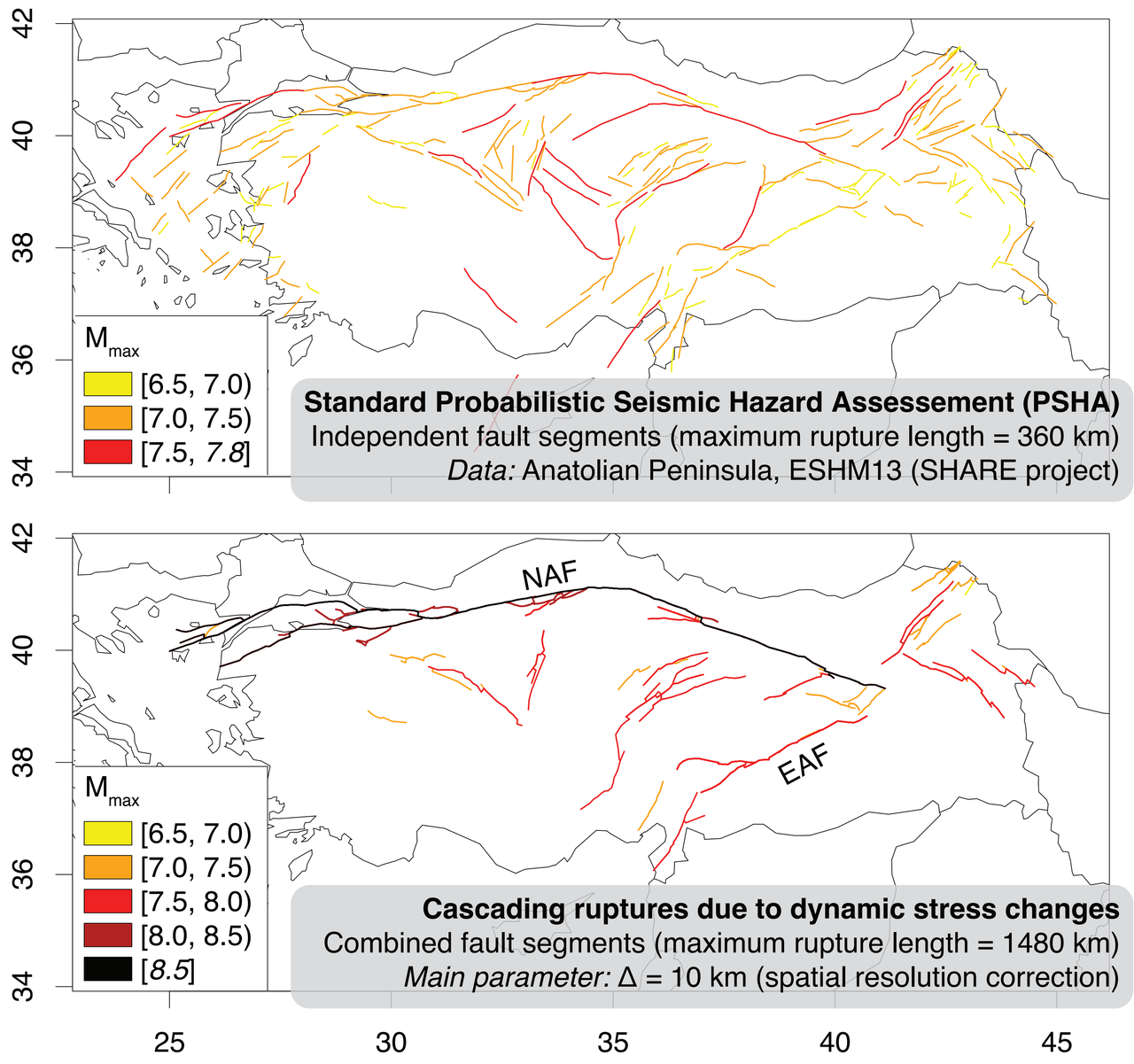
Multi-segment rupture algorithm
based on **dynamic stress** literature
1: Left- or right-lateral, same dip sign
2: Jumping rule
3: Bending/branching rule
4: Segment association









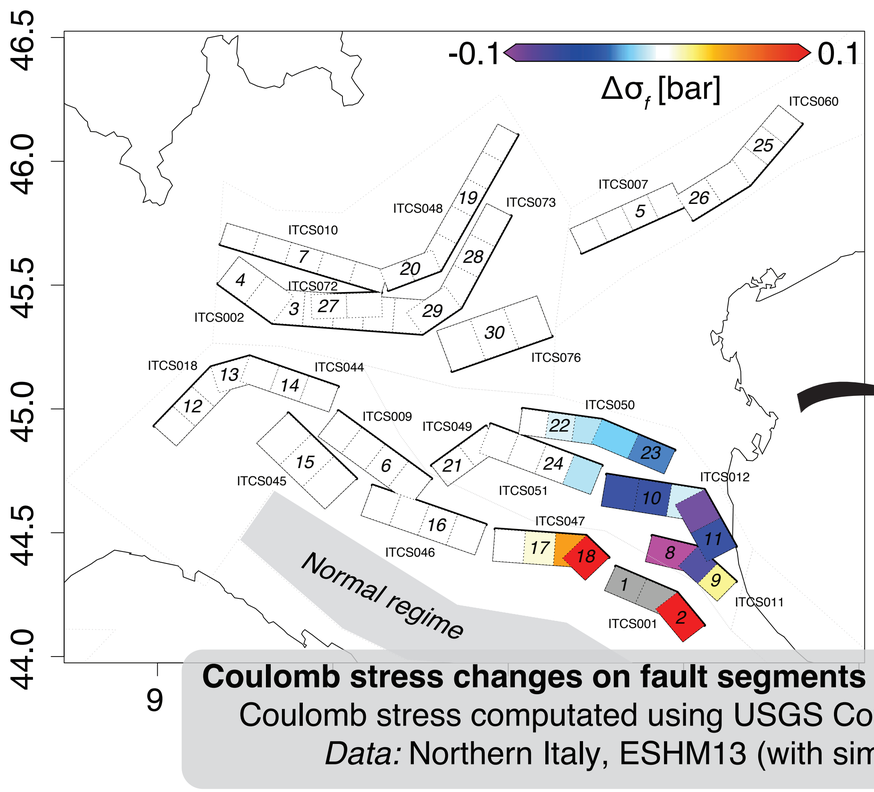


Standard Probabilistic Seismic Hazard Assessement (PSHA)
Independent fault segments (maximum rupture length = 360 km)
Data: Anatolian Peninsula, ESHM13 (SHARE project)

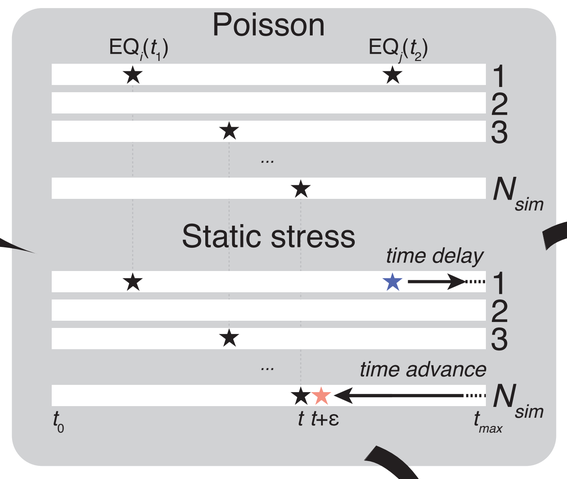
Cascading ruptures due to dynamic stress changes
Combined fault segments (maximum rupture length = 1480 km)
Main parameter: Δ = 10 km (spatial resolution correction)

To learn more:
Mignan, A., L. Danciu and D. Giardini (2015), Reassessment of the Maximum Fault Rupture Length of Strike-Slip Earthquakes and Inference on Mmax in the Anatolian Peninsula, Turkey, *Seismol. Res. Lett.*, 86, 890-900, doi: 10.1785/0220140252

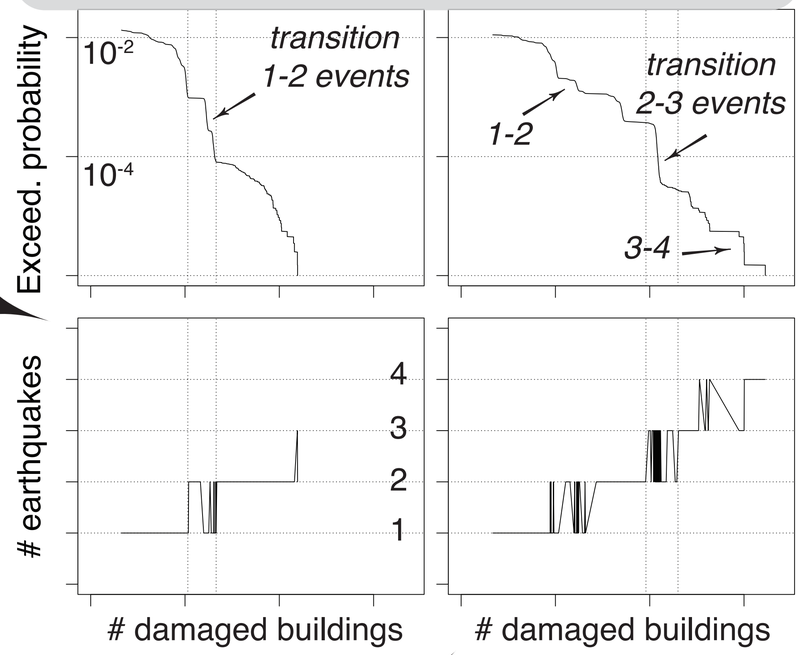
What is the largest earthquake cluster expected by static stress?

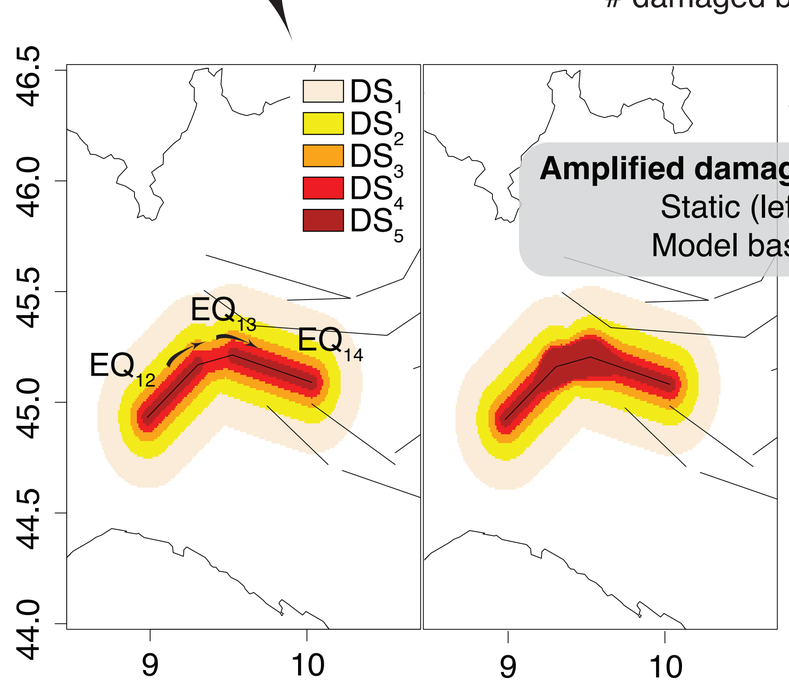


Coulomb stress changes on fault segments in thrust regime
Coulomb stress computated using USGS Coulomb 3 software
Data: Northern Italy, ESHM13 (with simplifed segments)



Risk curve fattening due to earthquake clustering
Poisson process (left) vs. stress interactions (right)
Impact on critical infrastructures mostly ($Pr<10^{-4}$)





Amplified damage due to earthquake clustering
Static (left) vs. dynamic vulnerability (right)
Model based on ductility capacity reduction

To learn more:
Mignan, A., S. Wiemer and D. Giardini (2014), The quantification of low-probability-high-consequences events: part I. A generic multi-risk approach, *Nat. Hazards*, 73, 1999-2022, doi: 10.1007/s11069-014-1178-4
Mignan, A., L. Danciu and D. Giardini (2016), Considering large earthquake clustering in seismic risk analysis, *Nat. Hazards*, doi: 10.1007/s11069-016-2549-9