Updated Probabilistic Seismic Hazard Maps for Turkey

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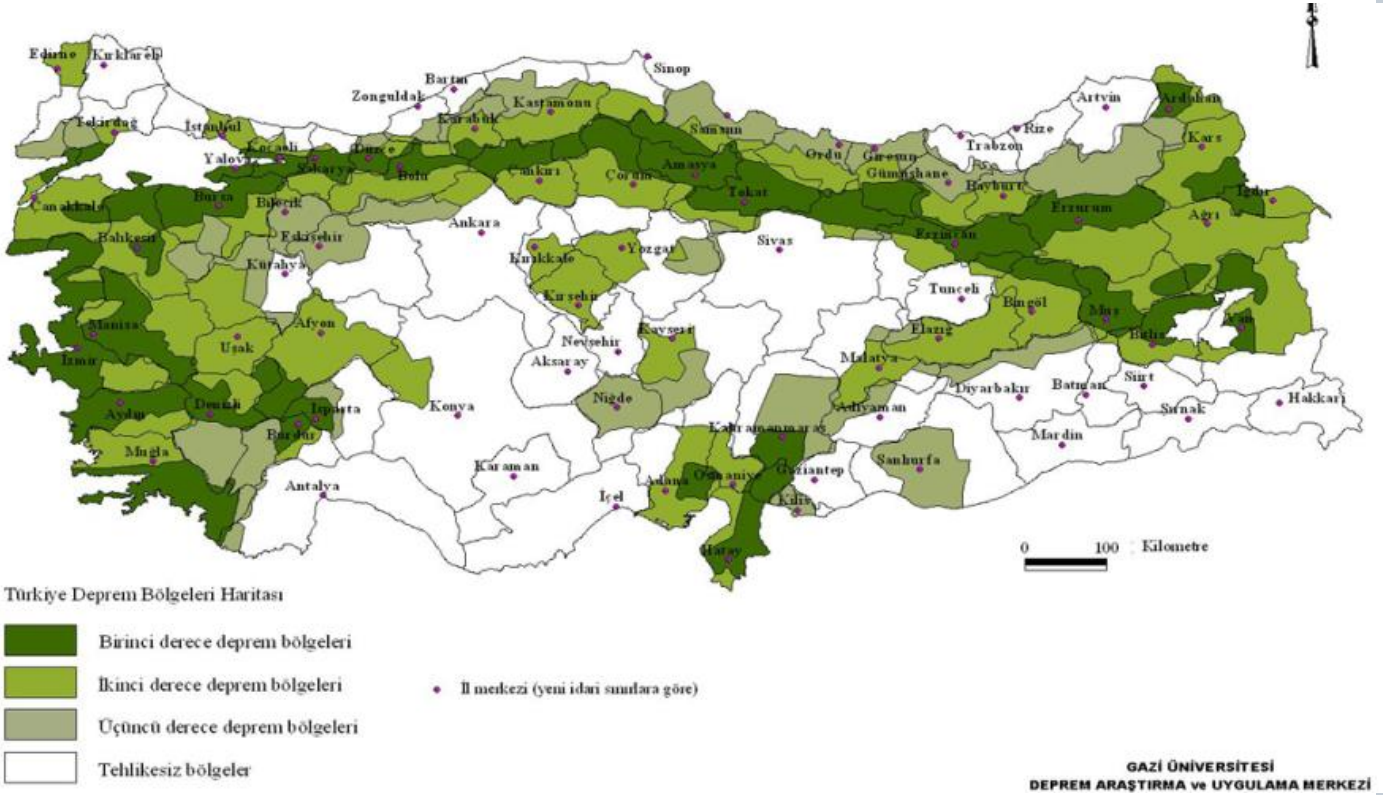
PSHA Workshop
Future directions for probabilistic seismic hazard assessment at a local, national andtransnational scale
5 to 7 September 2017, Lenzburg Switzerland

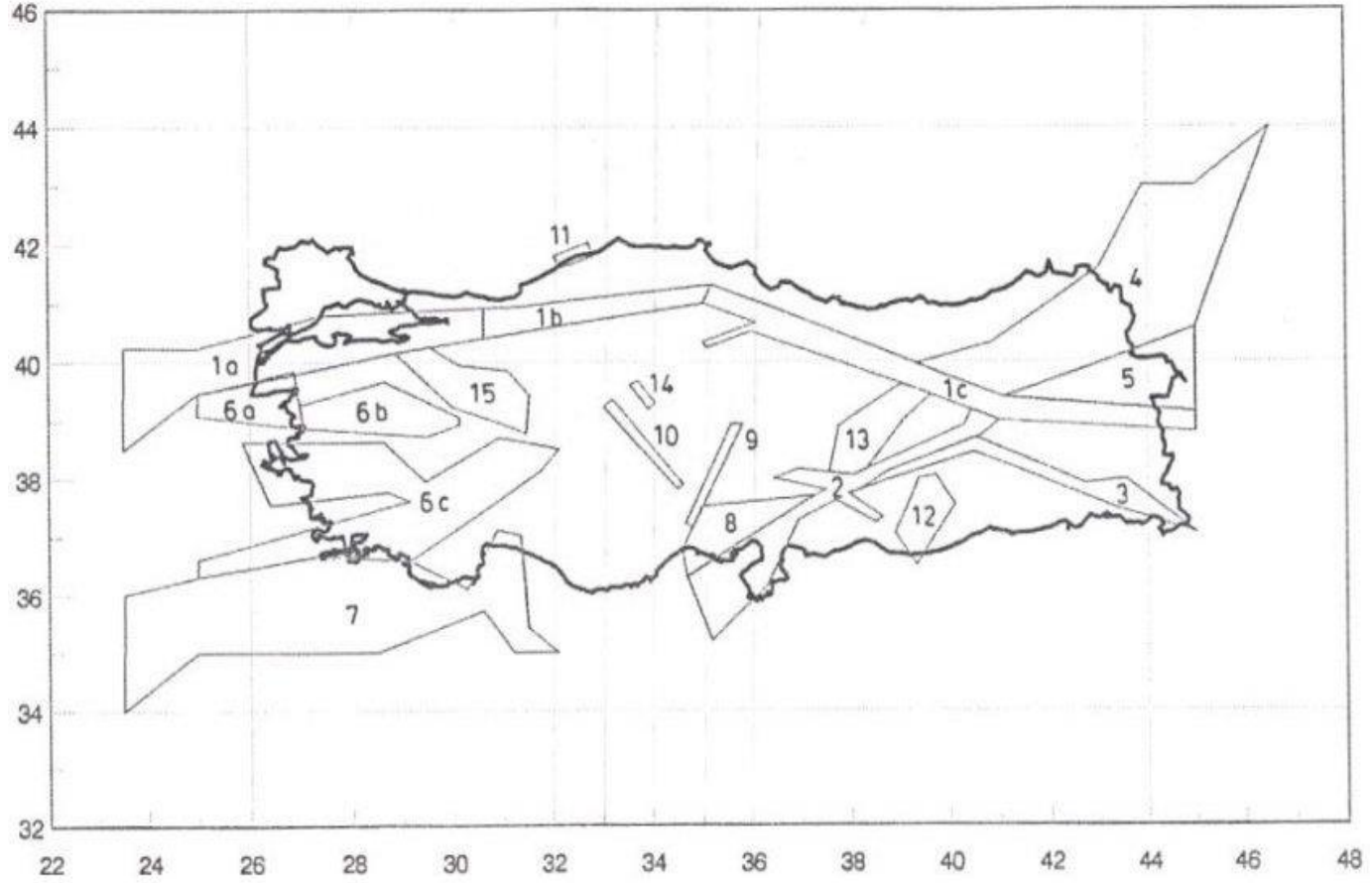
Three Generations of Seismic Hazard Mapping In Turkey

- Earliest maps based on observed damage, updated as earthquakes occurred (1945, 1947, 1963, 1972)



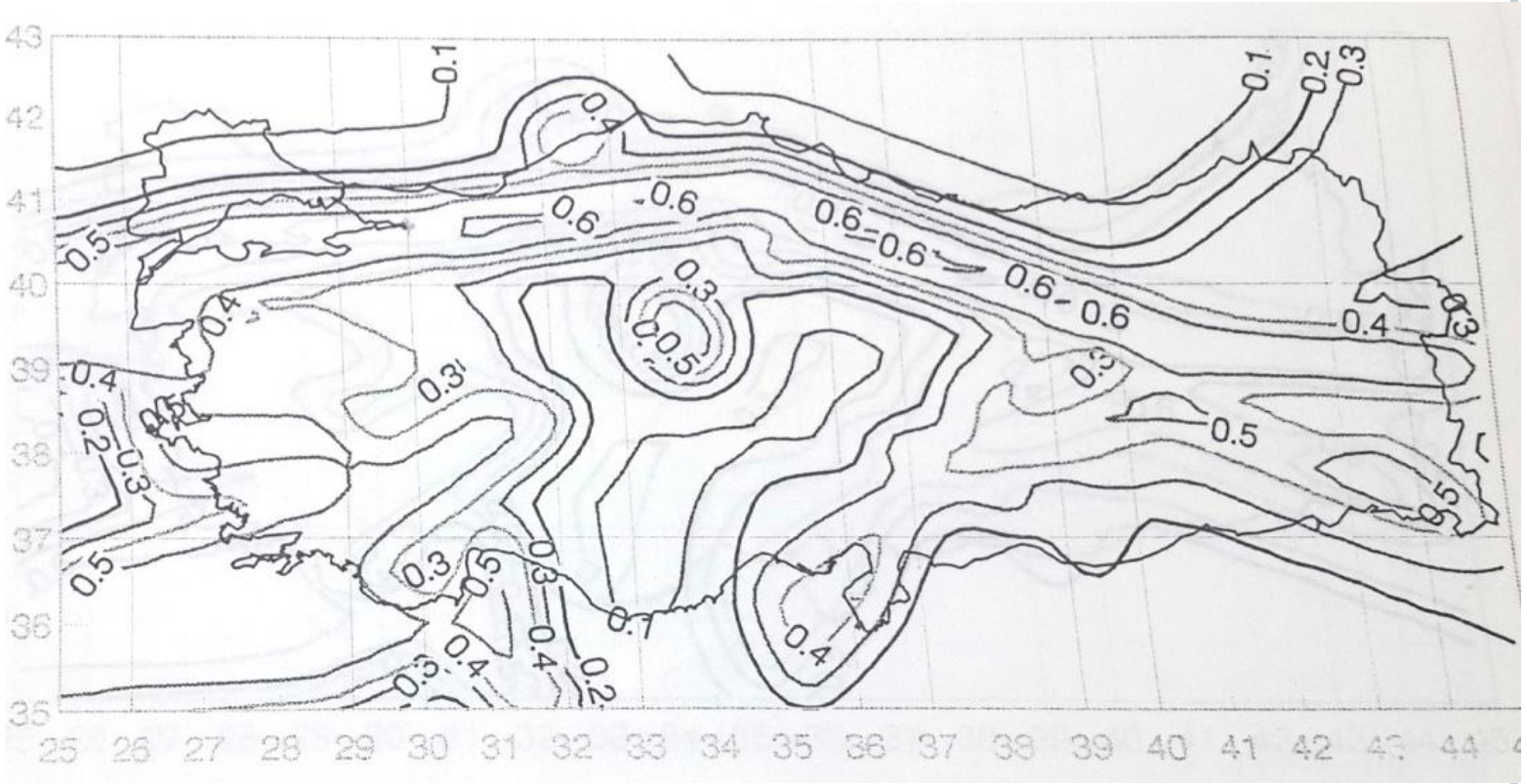
Three Generations of Seismic Hazard Mapping In Turkey

- Second generation based on PSHA, e.g. Erdik et al. (1985), Gülkan et al. (1993), Erdik et al. (1999), Demircioğlu et al. (2007) etc.



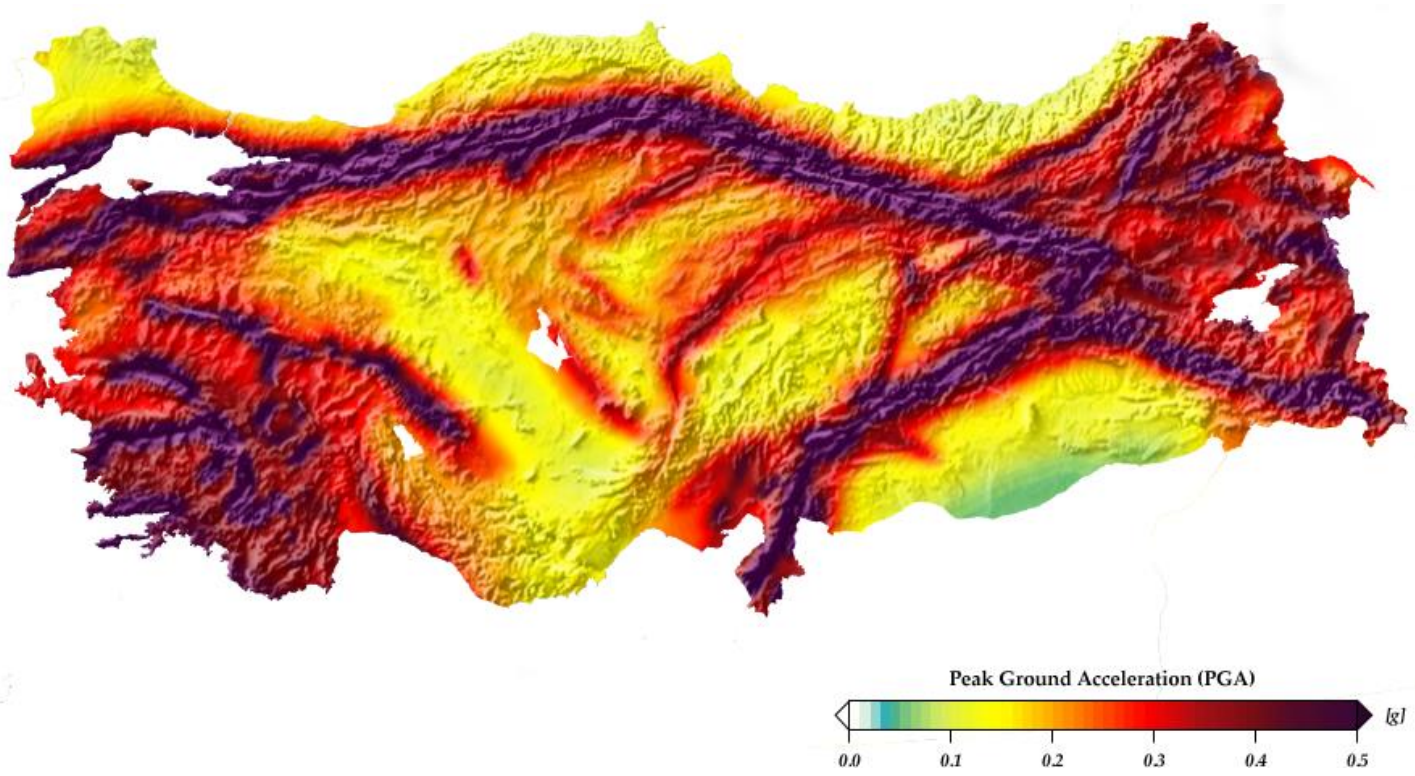
Three Generations of Seismic Hazard Mapping In Turkey

- Single tectonic region, except a few more recent ones areal sources only, one or few ground motion prediction models

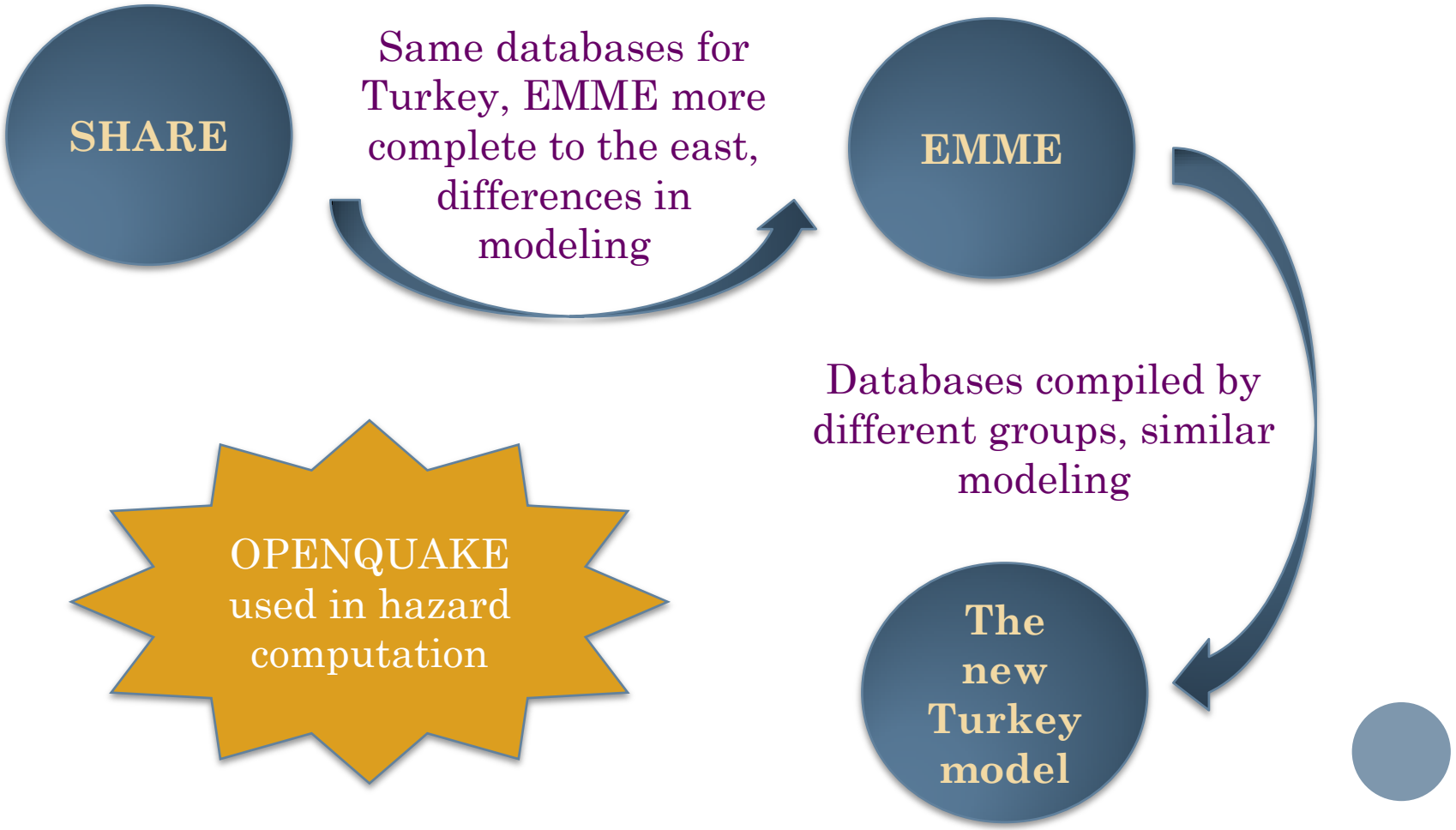


Three Generations of Seismic Hazard Mapping In Turkey

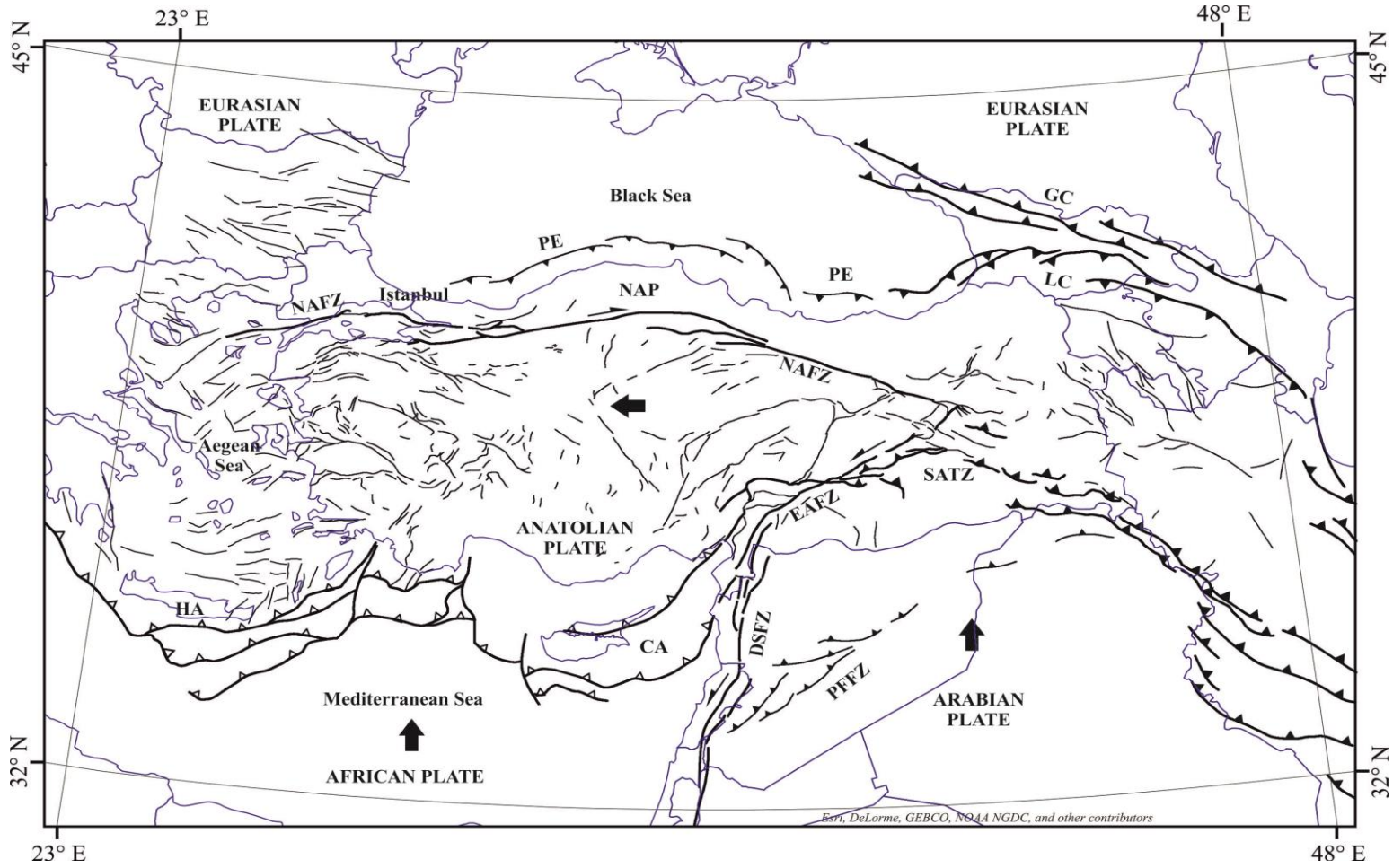
- Third generation: SHARE, EMME, new Turkish hazard model (several source models, detailed parameterisation)



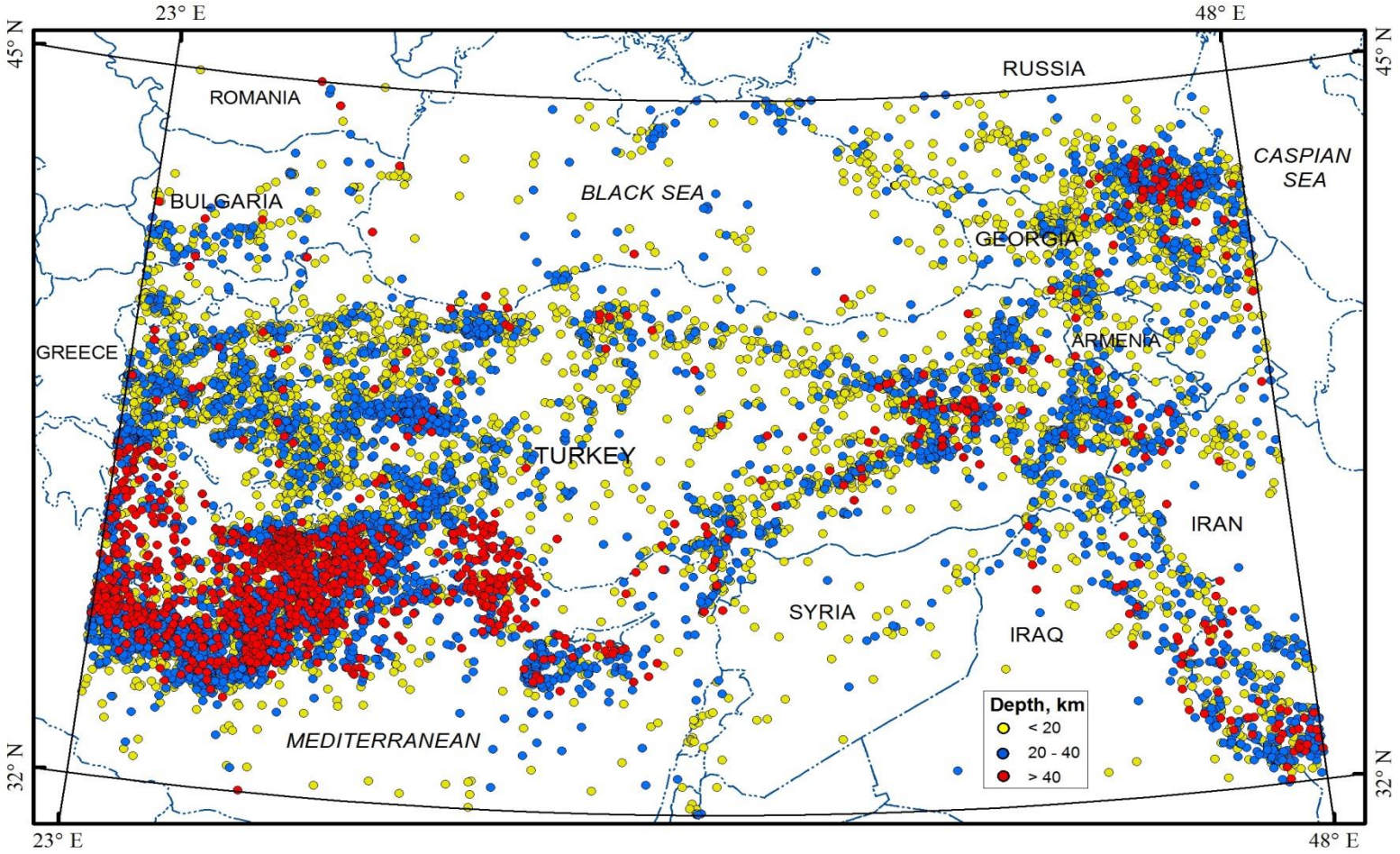
From SHARE to EMME, from EMME to the Turkey model



Active tectonic features of the region (from Emre et al., 2016)

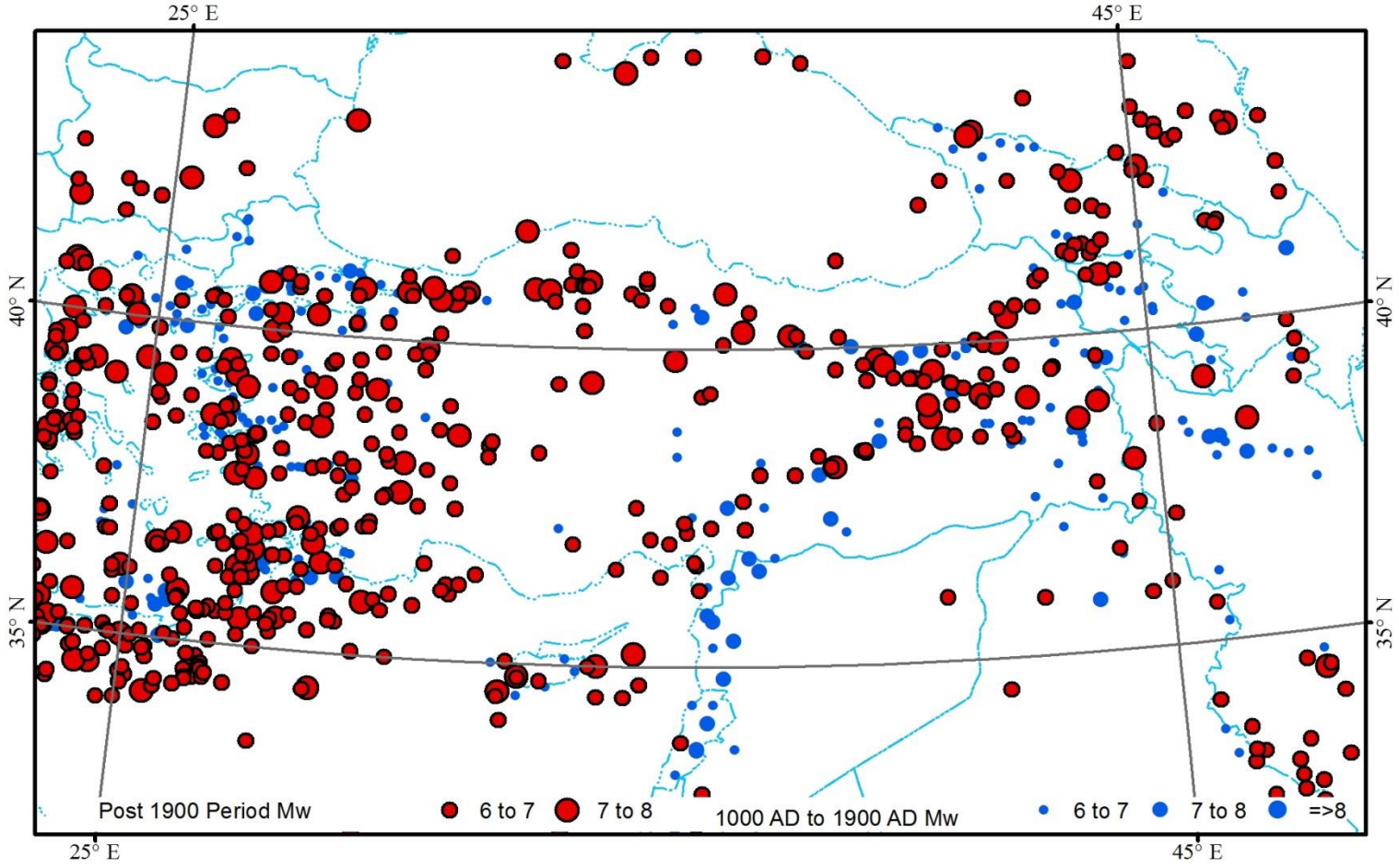


Distribution of post-1900 period earthquakes (Kadirioğlu et al., 2016)

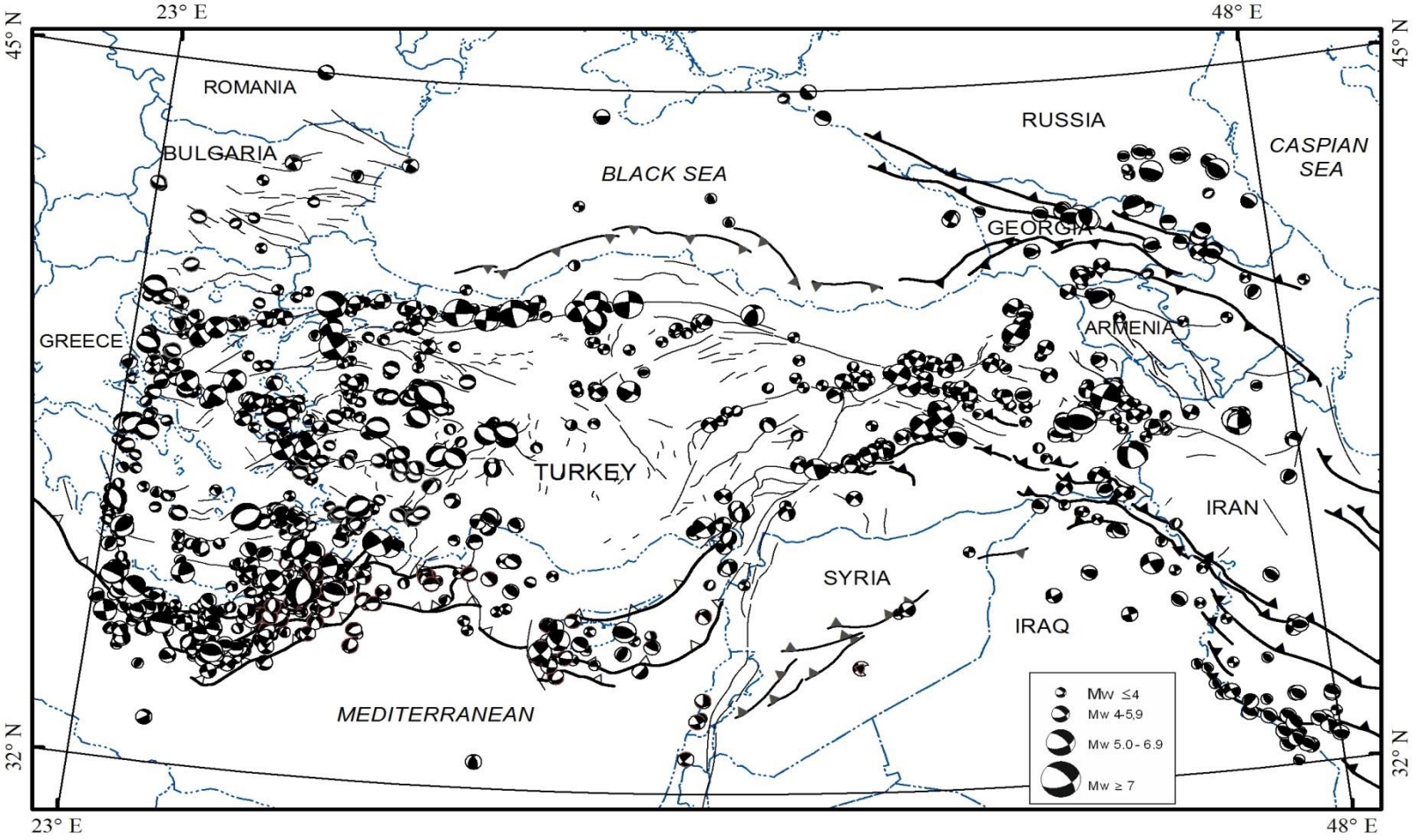


The homogenized catalogue was declustered using the Gardner and Knopoff (1974) method after testing several alternatives *(Eroglu Azak et al., 2017)*

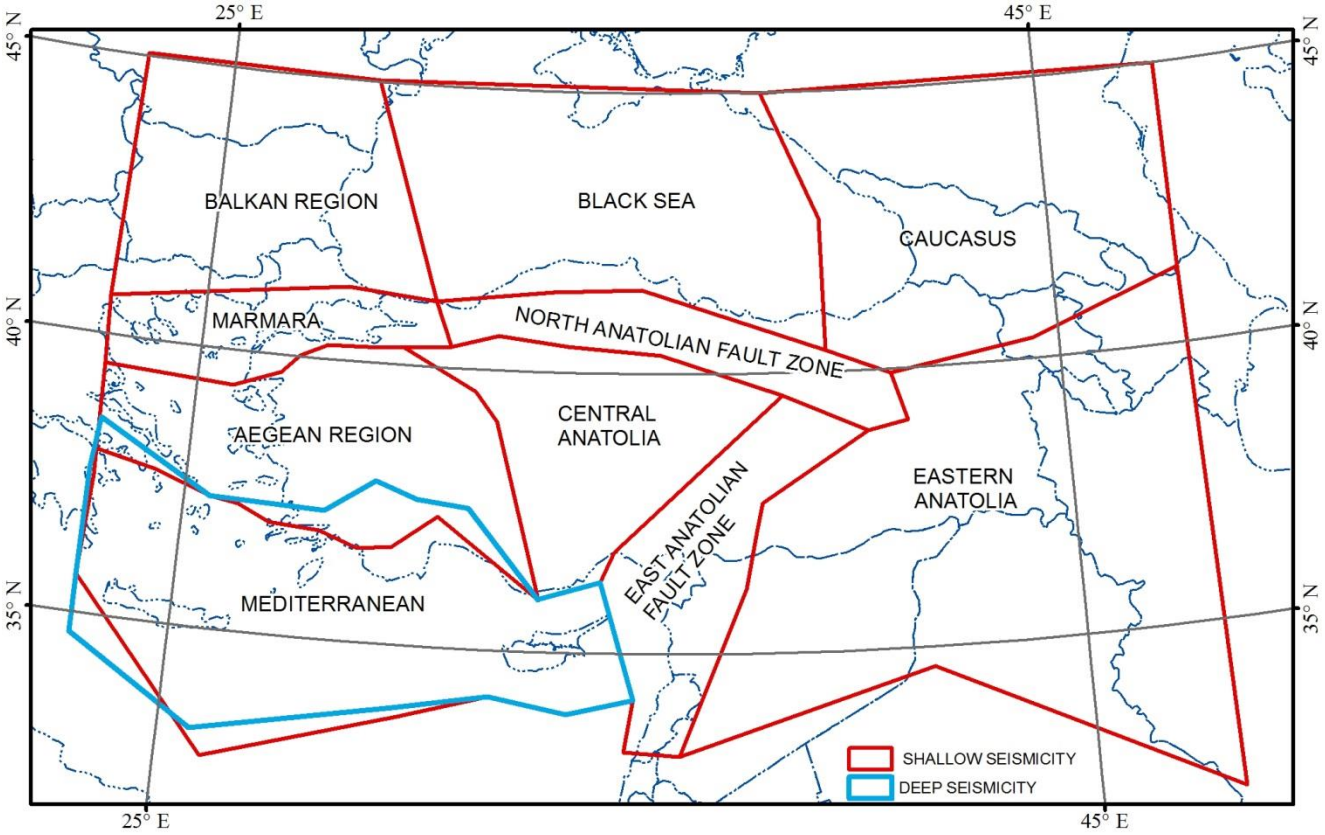
All earthquakes with magnitude larger than 6.0



Fault plane solutions (from Duman et al., 2016)



CATALOGUE COMPLETENESS



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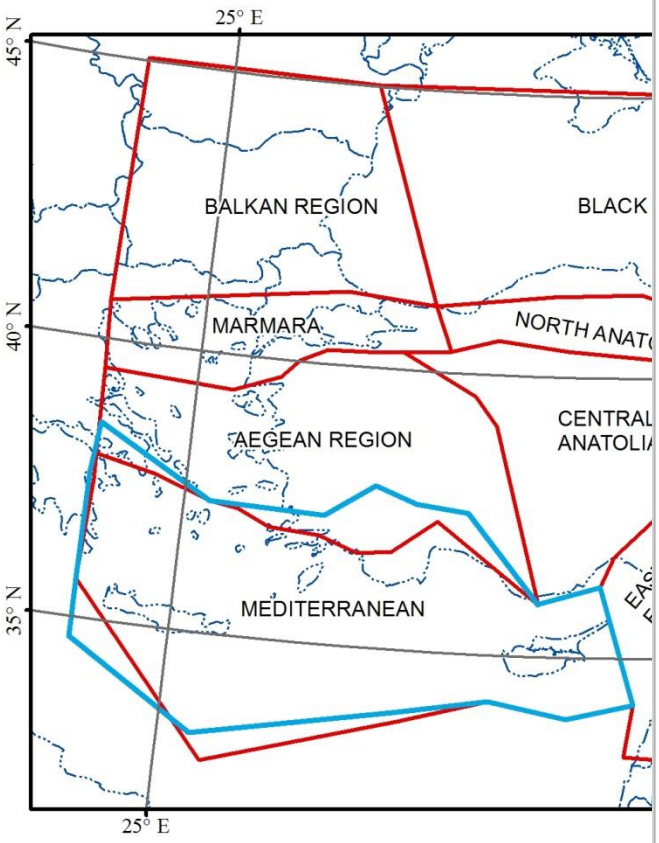
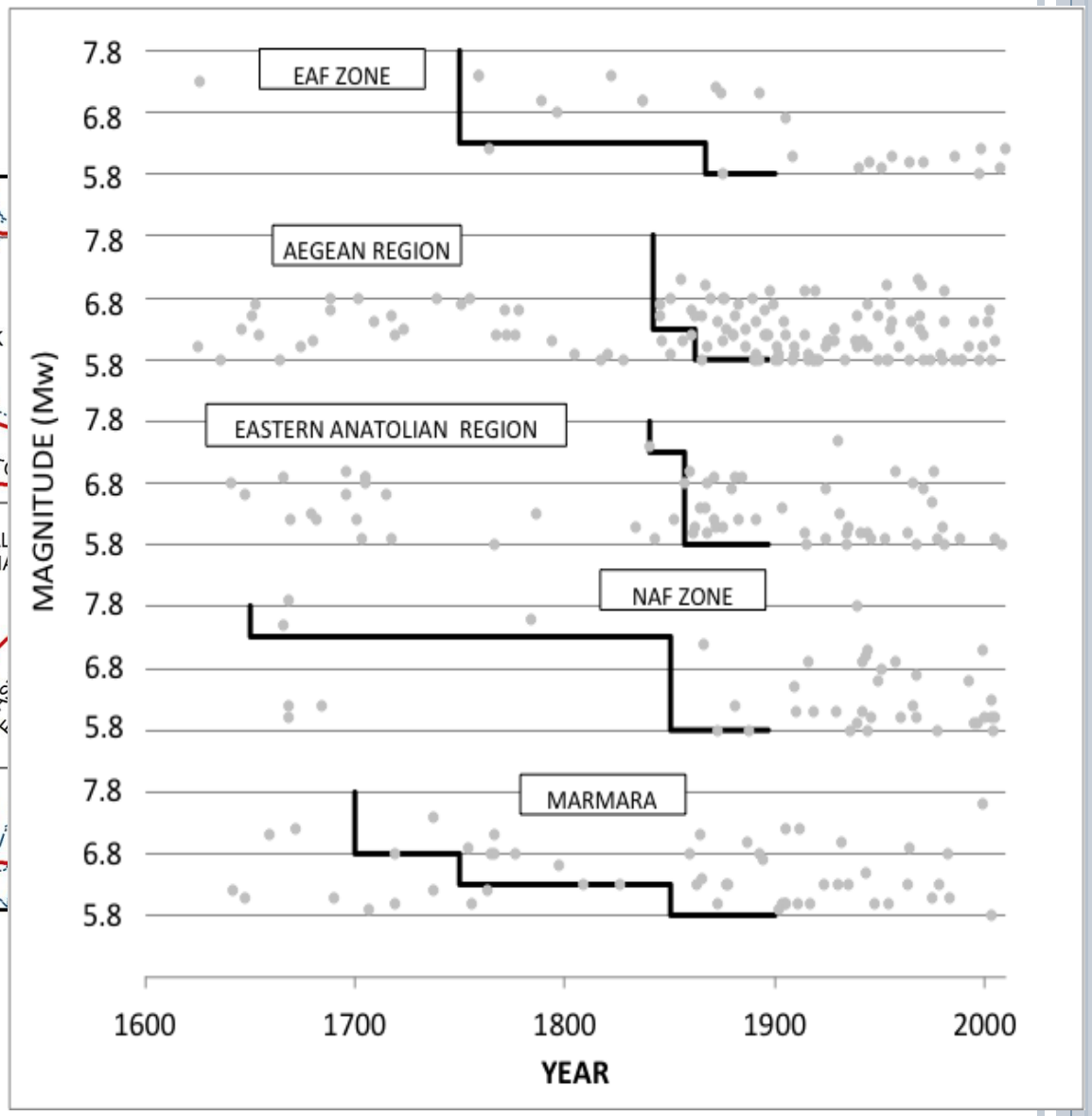
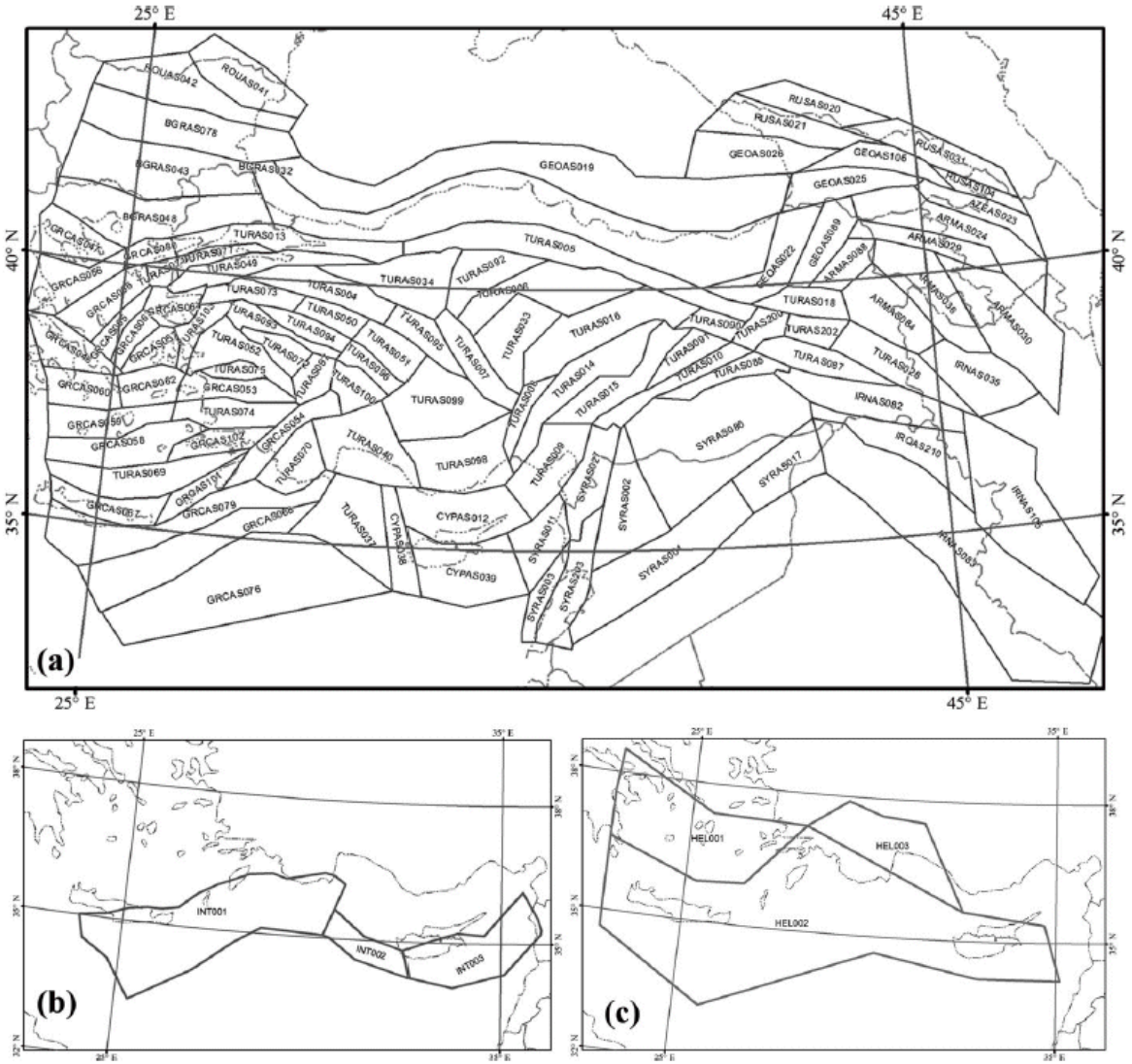




THE AREA SOURCE MODEL



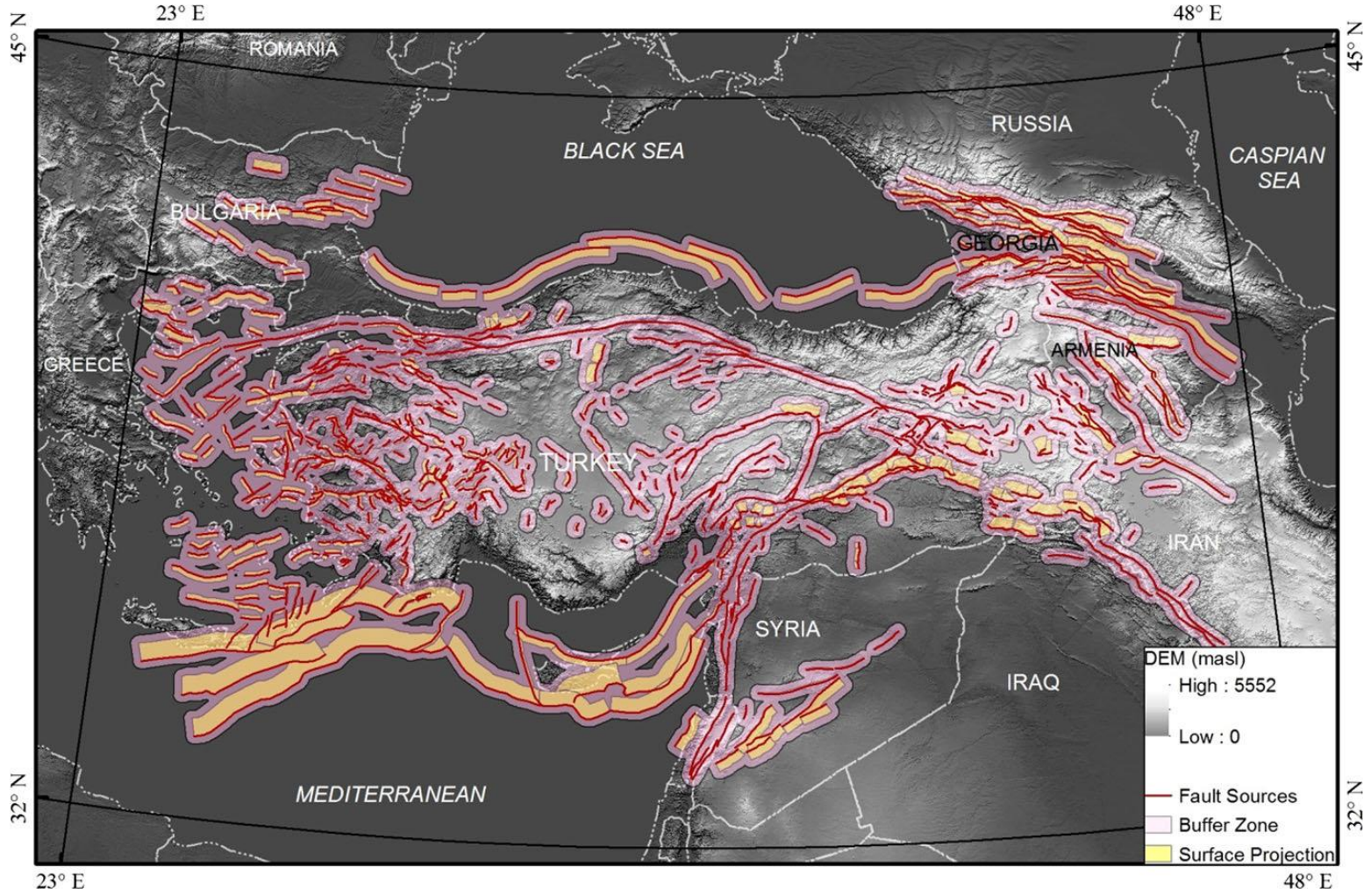
a Active shallow crustal sources, b subduction interface sources and c subduction in-slab sources

Full parameterisation in terms of:

- Mmax (3 levels, based on maximum observed magnitude and characteristic magnitude from fault segments
- Depth distribution (based on hypocental depth and fault depths)
- Rake angle (percentages based on observed earthquake mecahnisms and fault data
- Predominant strike and dip angles (fault database)
- Recurrence (earthquake catalogue and its completeness

Sesetyan et al. (2016)

The fault source model and smoothed seismicity in the background



Demircioğlu et al. (2017)

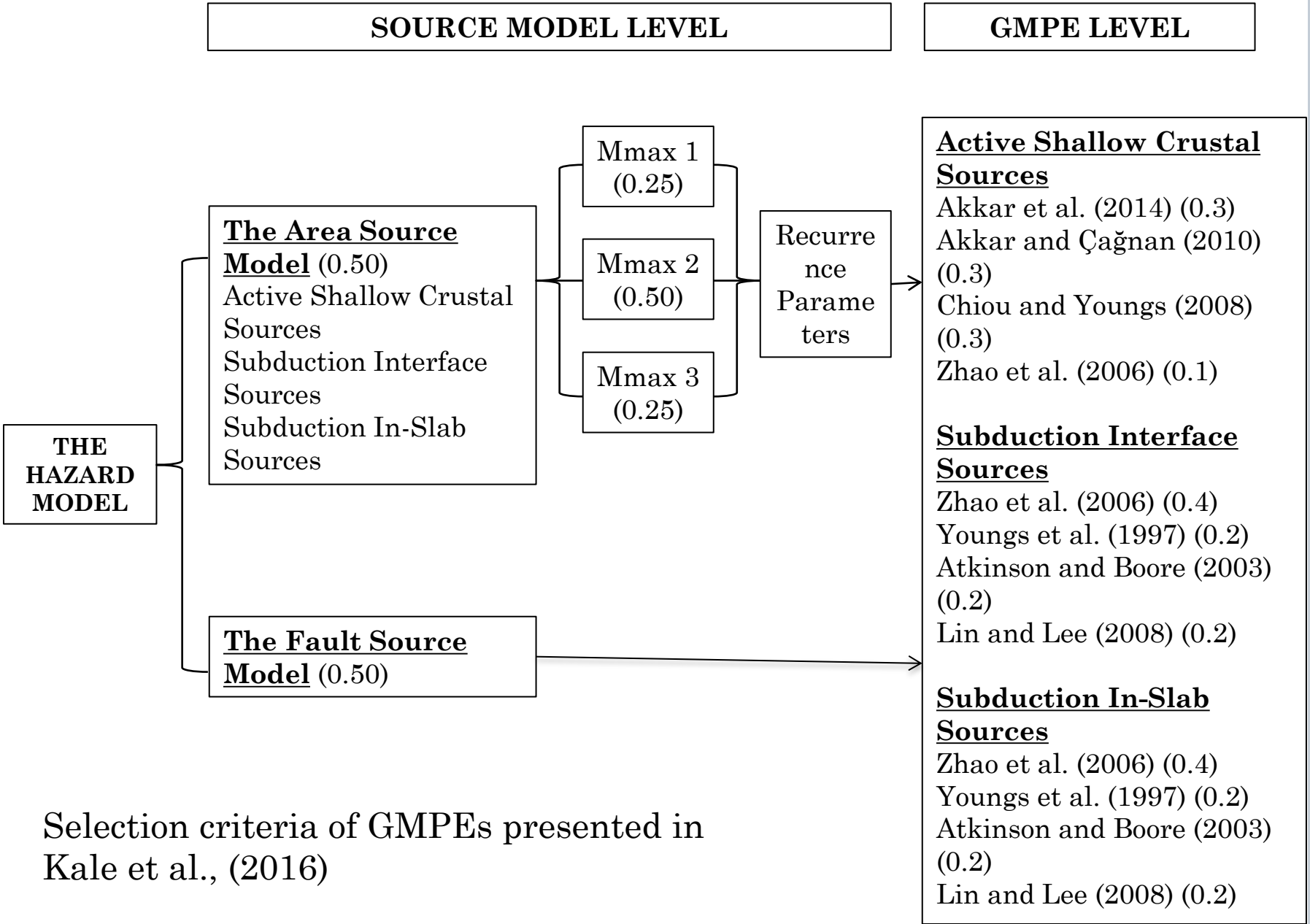
Fault source parameterization

- Characteristic magnitude (based on segment dimensions and source scaling relations)
- Dip angle (from the fault database)
- Depth distribution (from the fault database)
- Rake angle (from the fault database)
- Slip rate on each segment in a range of min-max
- *b-value* (taken from the corresponding completeness / tectonic region)
- Activity (computed with the above parameters by Youngs and Coppersmith, 1985, truncated exponential model
- Magnitudes 6 and larger allowed to occur on faults

Smoothed seismicity parameterization

- Point sources representing grids of 0.1°
- Buffer zones of 15 km around surface projection of fault sources
- Magnitudes < 6 in the buffer zones occurring on the grid sources
- Magnitudes up to Mmax occurring on grid sources outside buffer zones
- All geometric parameters adopted from area sources
- *b-value* taken from the corresponding completeness / tectonic region
- *a-value* computed with a 50 km normal smoothing of the earthquake catalogue

THE LOGIC TREE



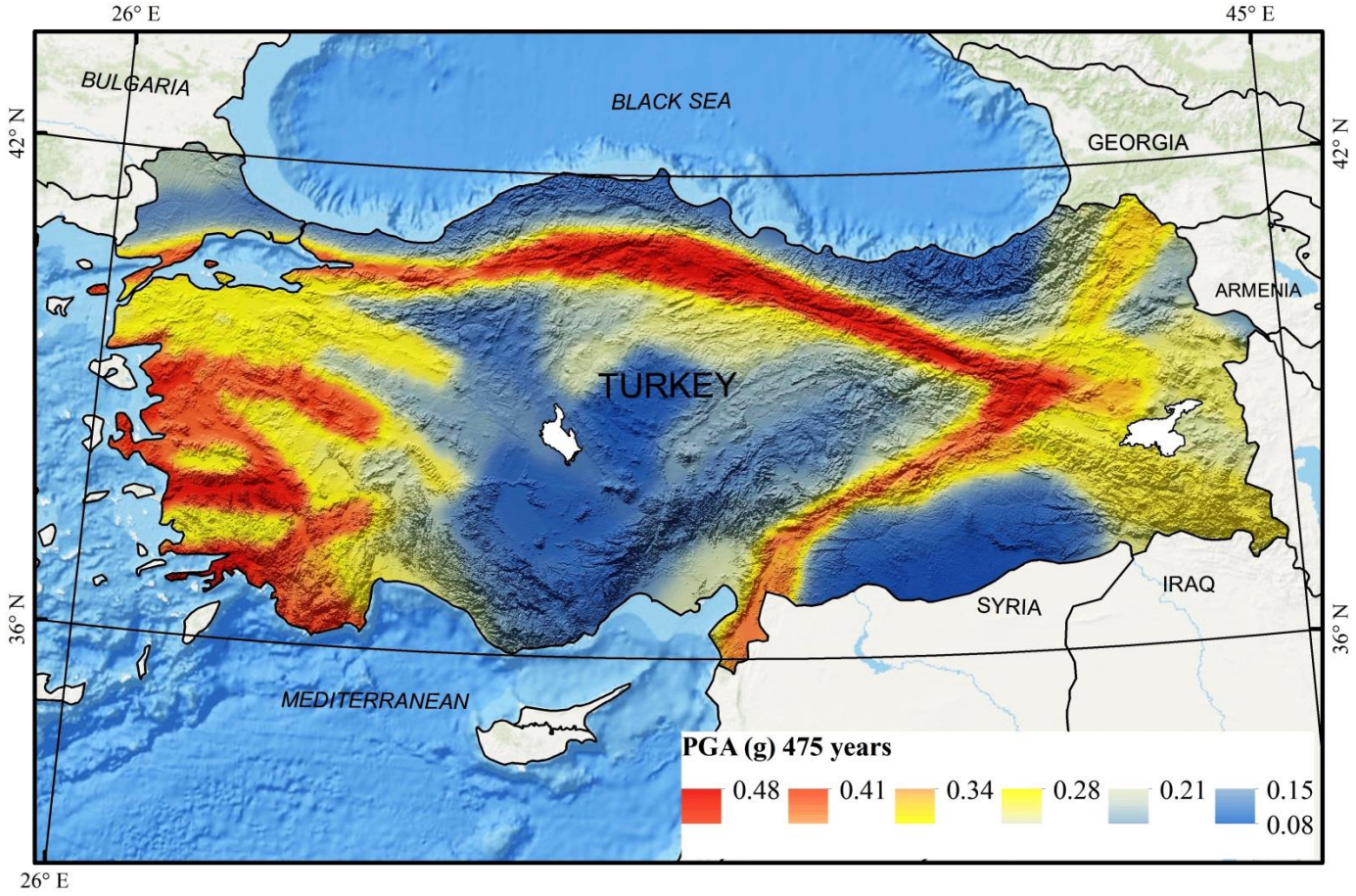
Selection criteria of GMPEs presented in Kale et al., (2016)

Parameters delivered

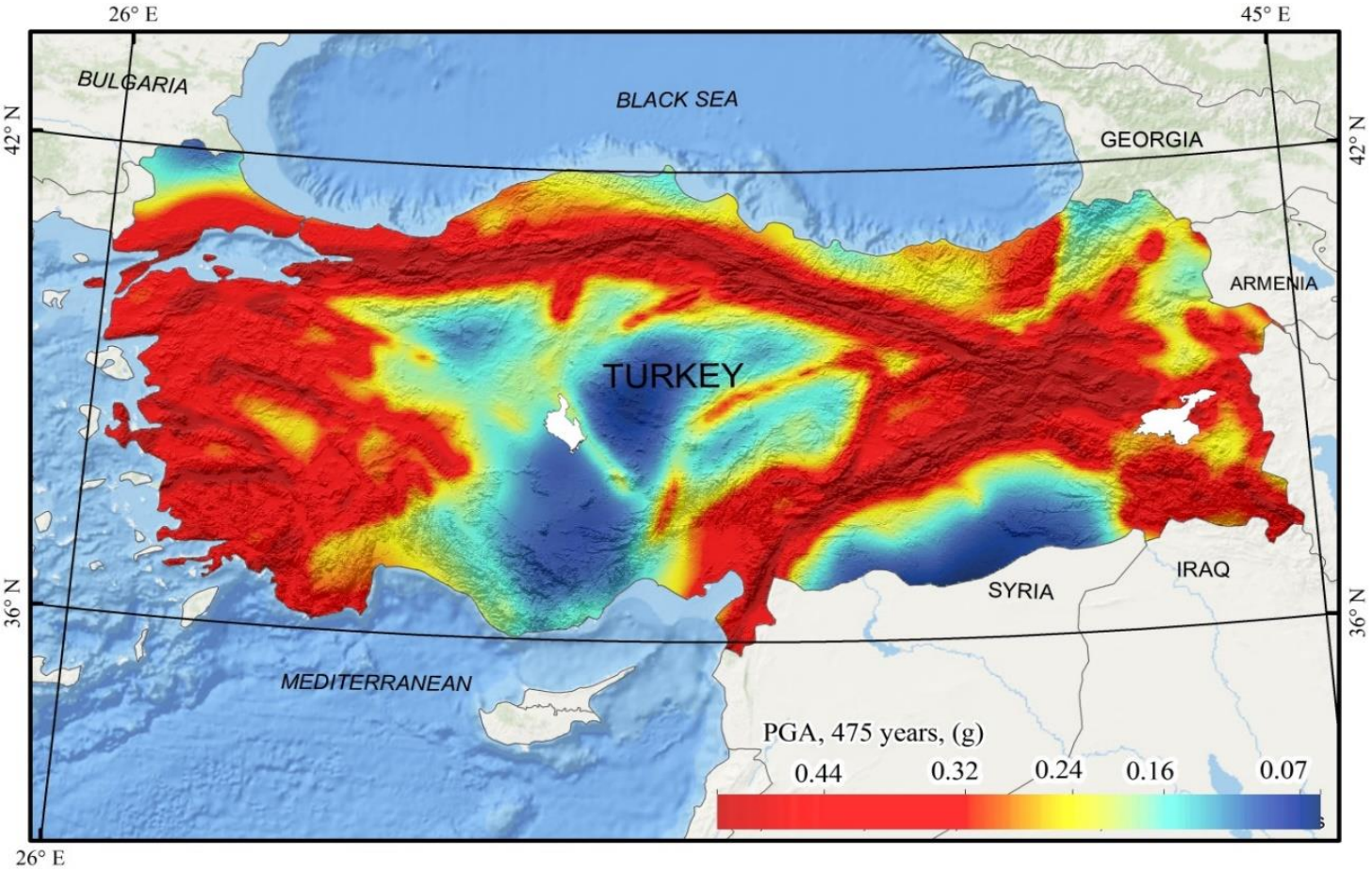
- Mean PGA, PGV, SA (T=0.2 s) and SA (T=1.0 s) corresponding to 43, 72, 475 and 2475 years return periods as requested by the new Turkish earthquake resistant design code

  Based on the project results, the Disaster and Emergency Management Authority of Turkey has also designed a web tool for the computation of the design spectra for any selected locality

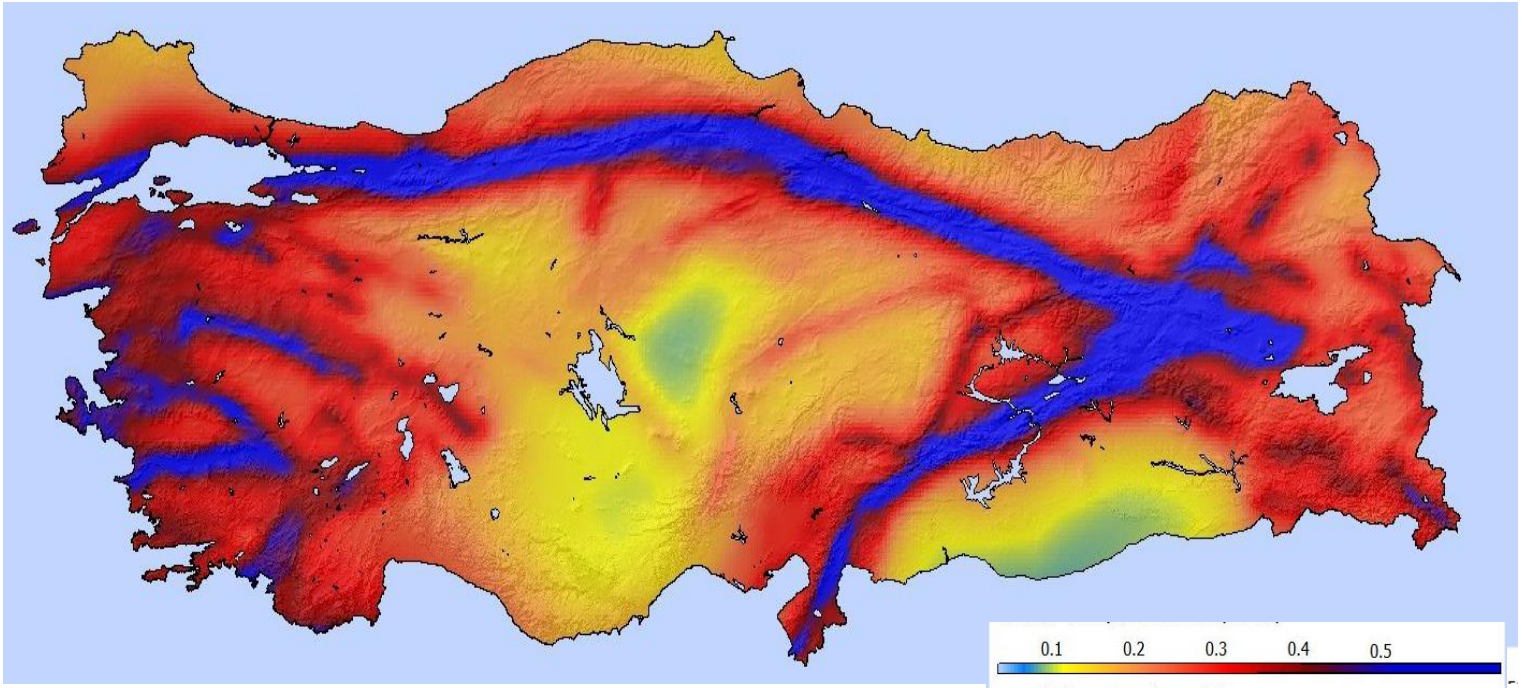
Area source model 475 years PGA



Fault source model 475 years PGA



475 YEARS PGA, 0.5 AND 0.5 WEIGHTED COMBINATION OF THE TWO SOURCE MODELS



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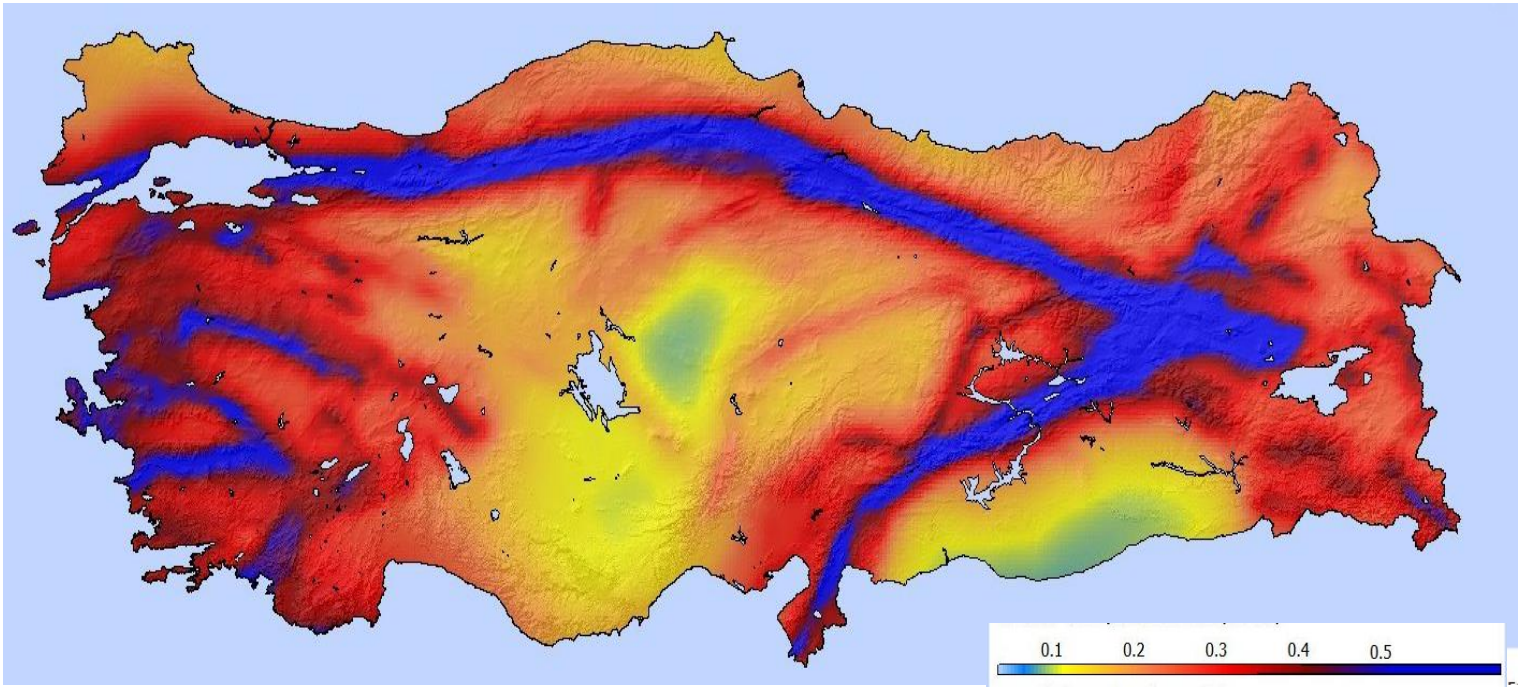
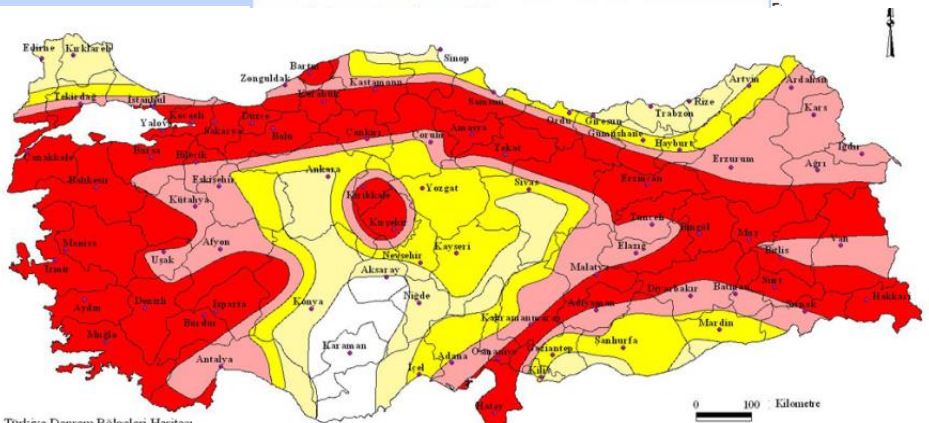


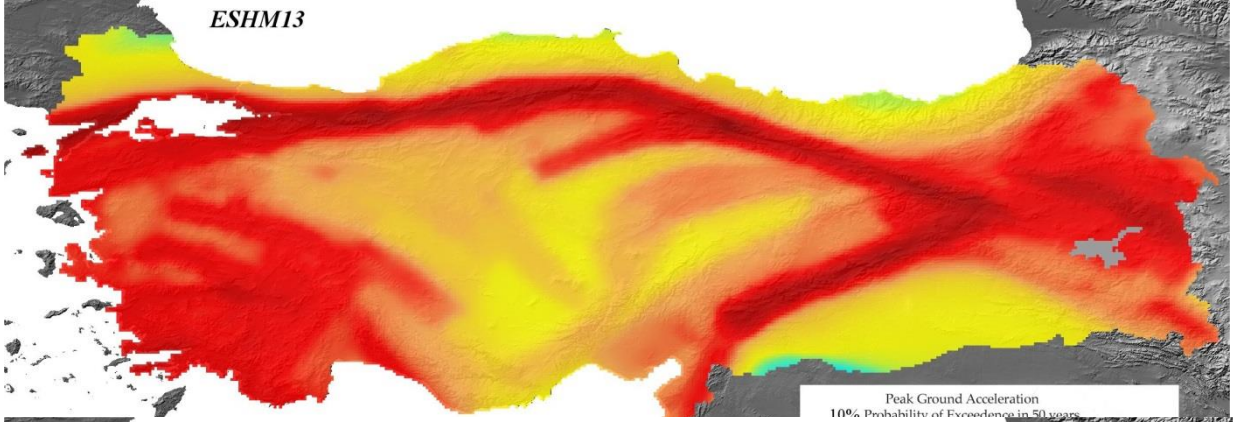
Earthquake zoning map (1996)

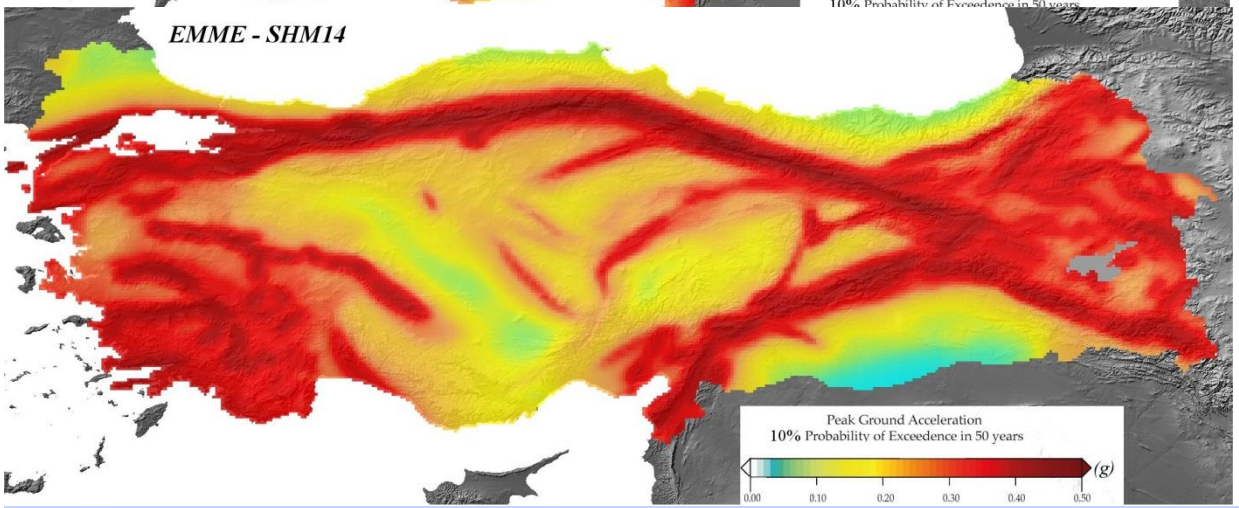


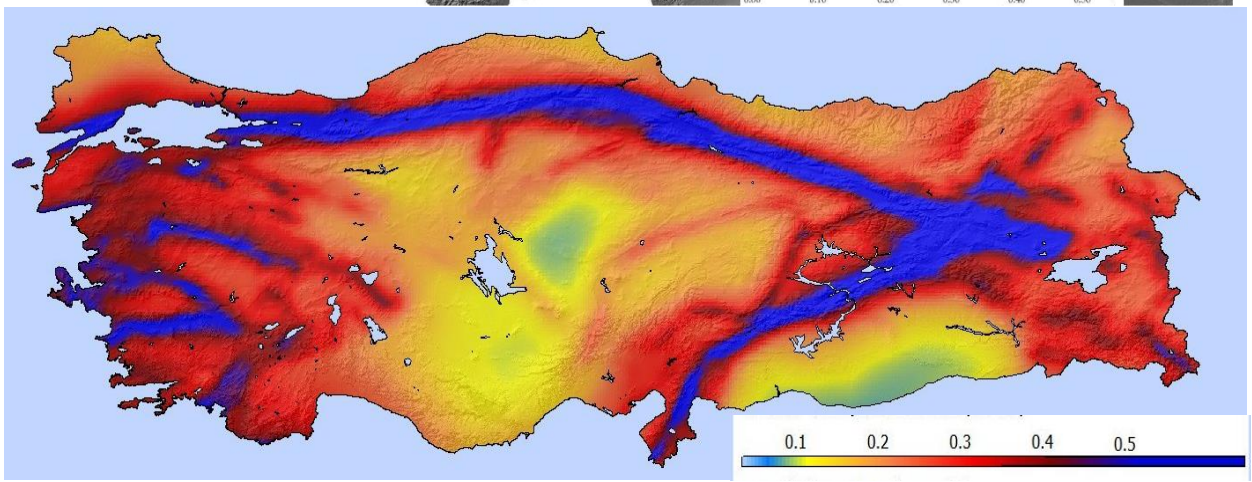
SHARE

EMME

The new Turkey model







- The project was launched and funded by the Prime Ministry Disaster and Emergency Management Authority (Project Code: UDAP-Ç-13-06), also supported by the Turkish Catastrophe Insurance Pool.
- All mentioned articles are now available online in the Bulletin of Earthquake Engineering.

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