Kinematics of the Sea of Marmara using GPS, InSAR and Underwater Geodetic Data Possible Influence of Crustal Heterogeneity

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Block Model around the Sea of Marmara

Material Properties — Model Dimension 2D — Method — Data

Based on McCaffrey (2002) McCaffrey etal (2007)

Model was carried out under the fully elastic conditions All materials have same elastic properties

GPS & Underwater Geodetic data
Reilinger etal (2006)
Aktuğ etal (2012)
Ergintav etal (2014)
Ozdemir 2016
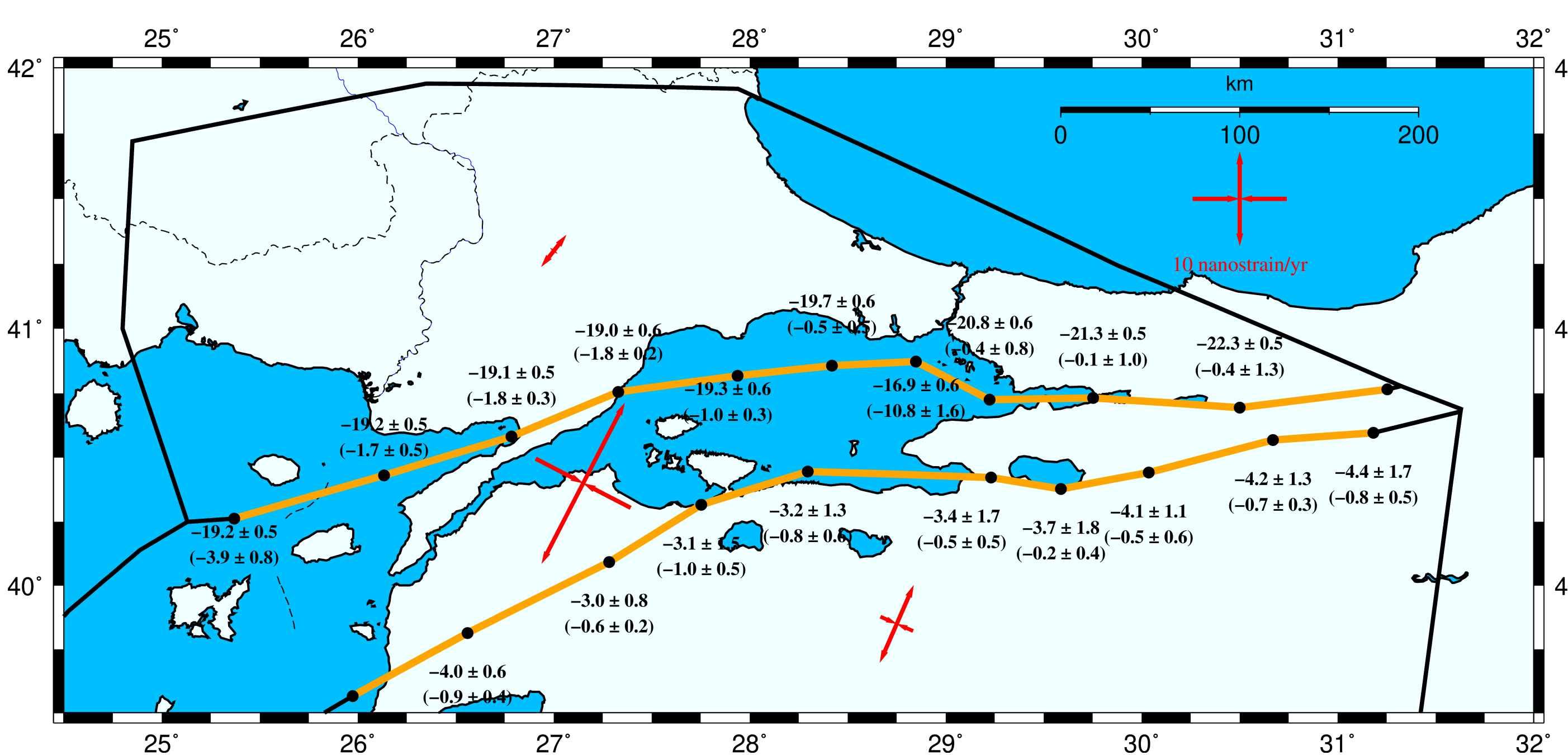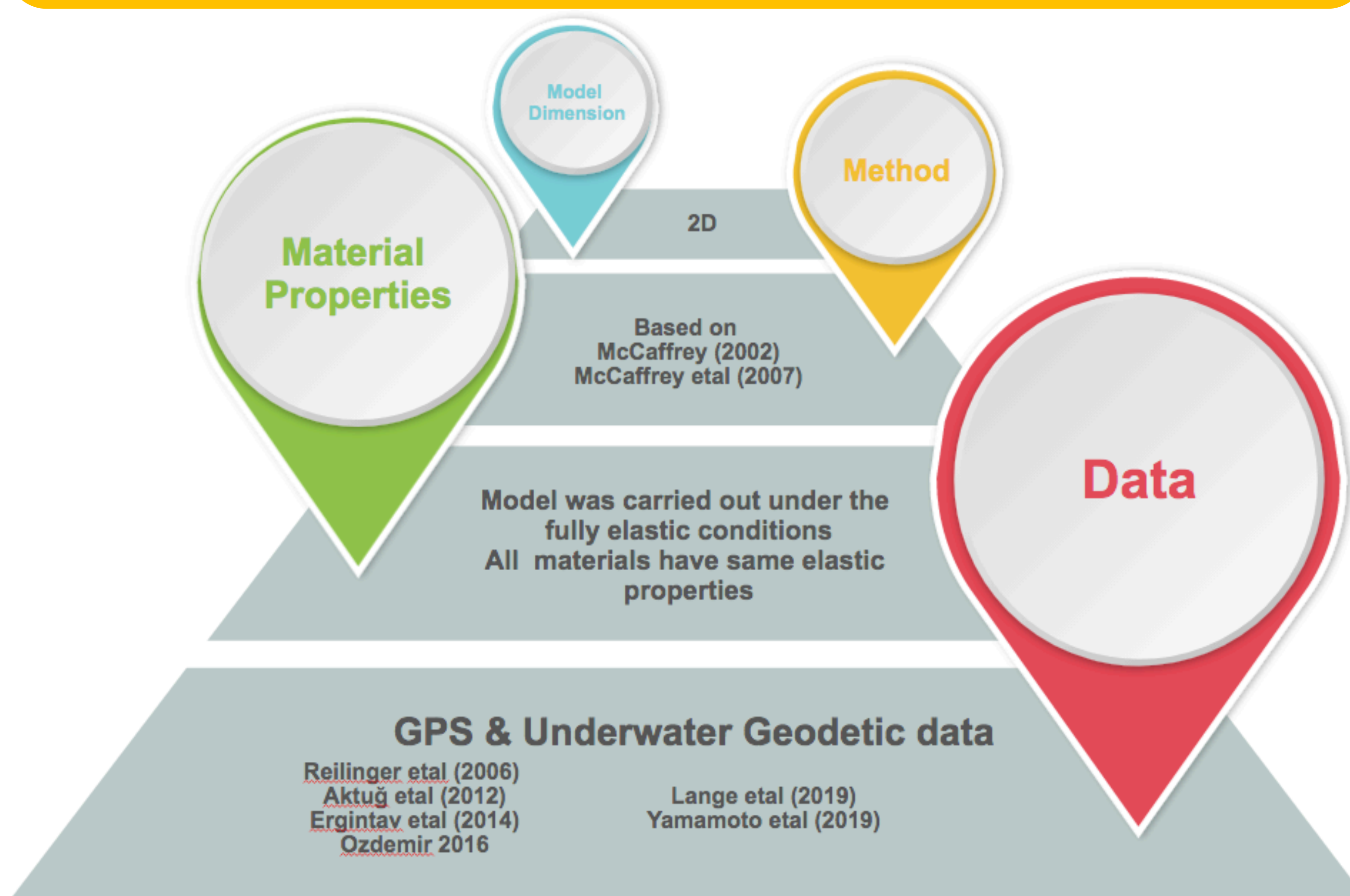Lange etal (2019)
Yamamoto etal (2019)

Fig 1. Slip rates on the Main Marmara Fault and Southern Branch of the North Anatolian Fault. The values in the parenthesis are the normal components, (-) shows extension, and the others are the strike slip component, (-) means right lateral. Red crosses are the principal strain rates within the each block. This figure was taken from Ozbey etal (2021).
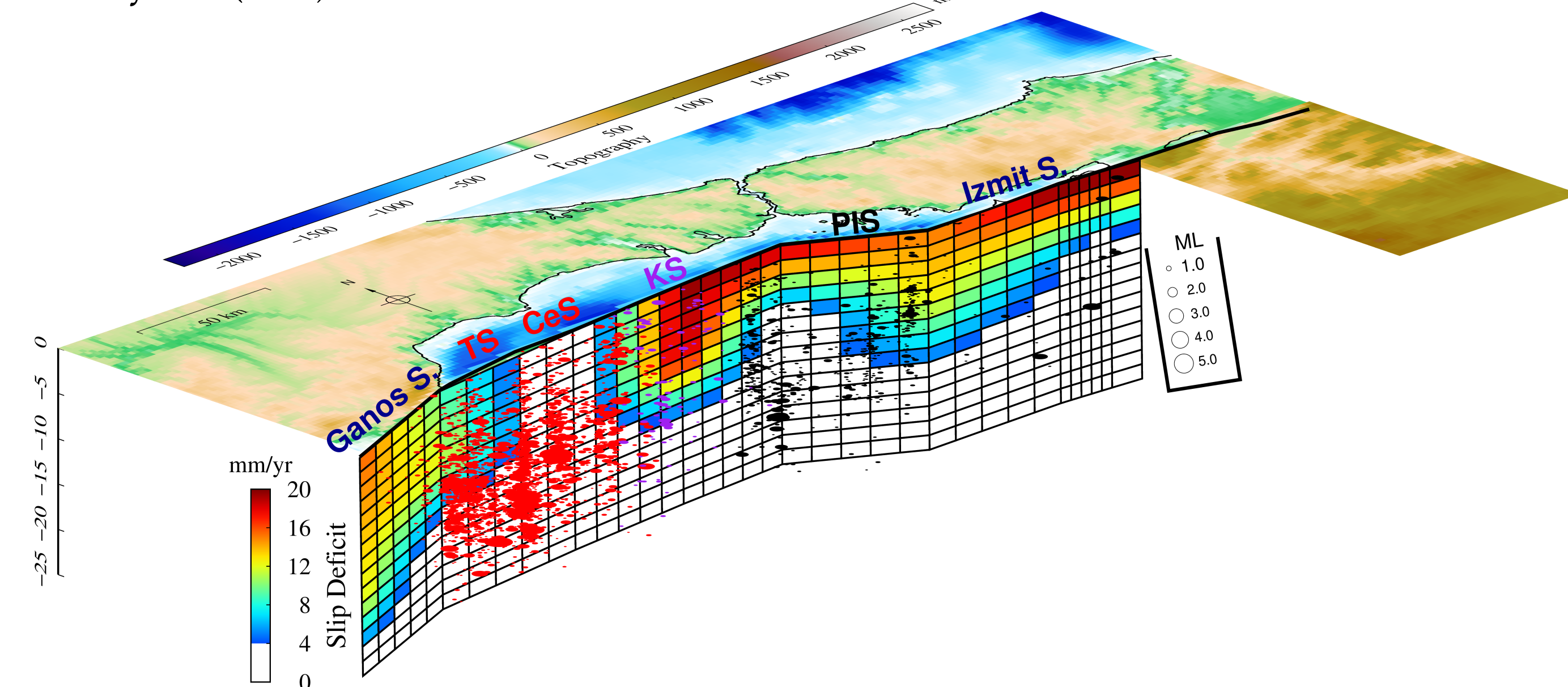

Fig 2. Cross-sectional profile is the representation of the slip deficit distribution of the MMF. Circles on the cross section show the seismic activity on the main branch. Red circles represent the earthquakes on the Tekirdag and Central segment (TS-CeS). Blue ones are the earthquakes that occur around the Kumburgaz segment (KS). Seismicity around Prince Island's Segment (PIS) was shown with black circles. Earthquake catalog is taken from Schmittbuhl et al. (2016) and has plotted by scaling according to their magnitude.

1D Model with InSAR Data

Dimension 1D — Data InSAR Weiss etal (2020) — Parameters

Method — It mainly depends on Savage and Burford (1973)

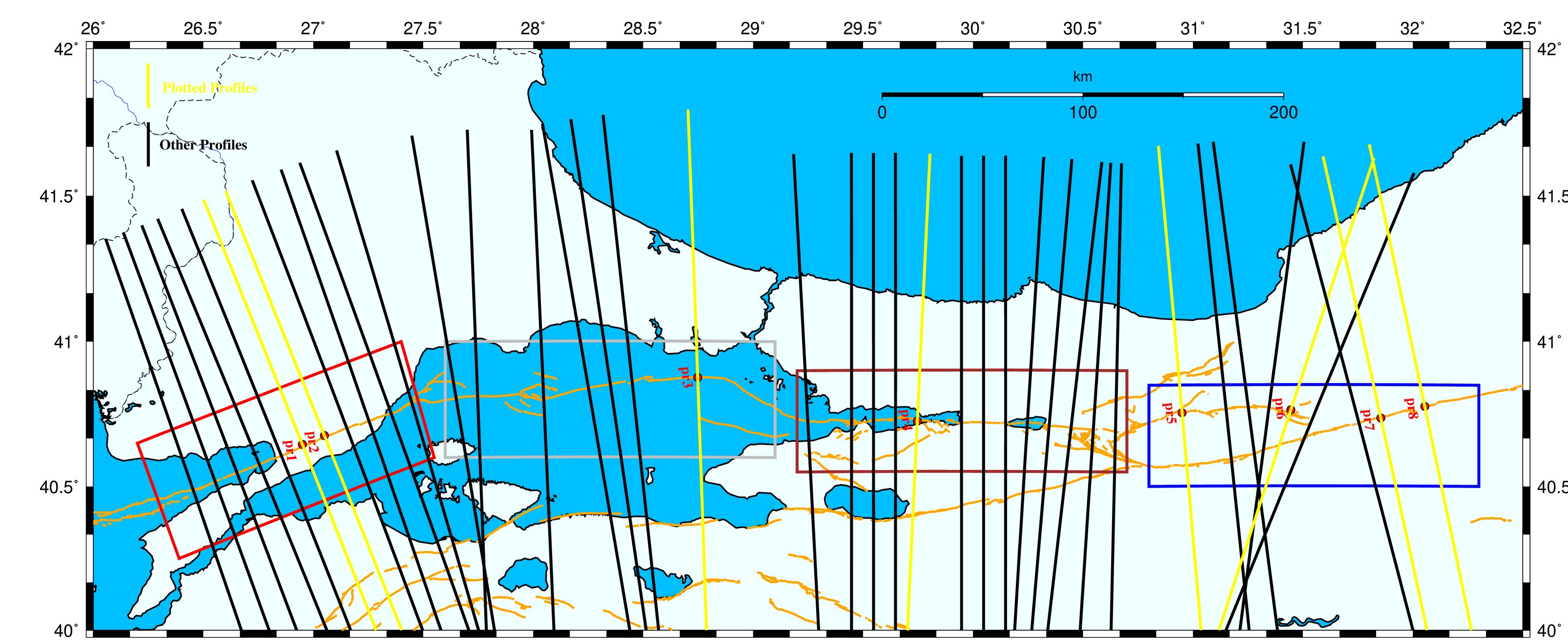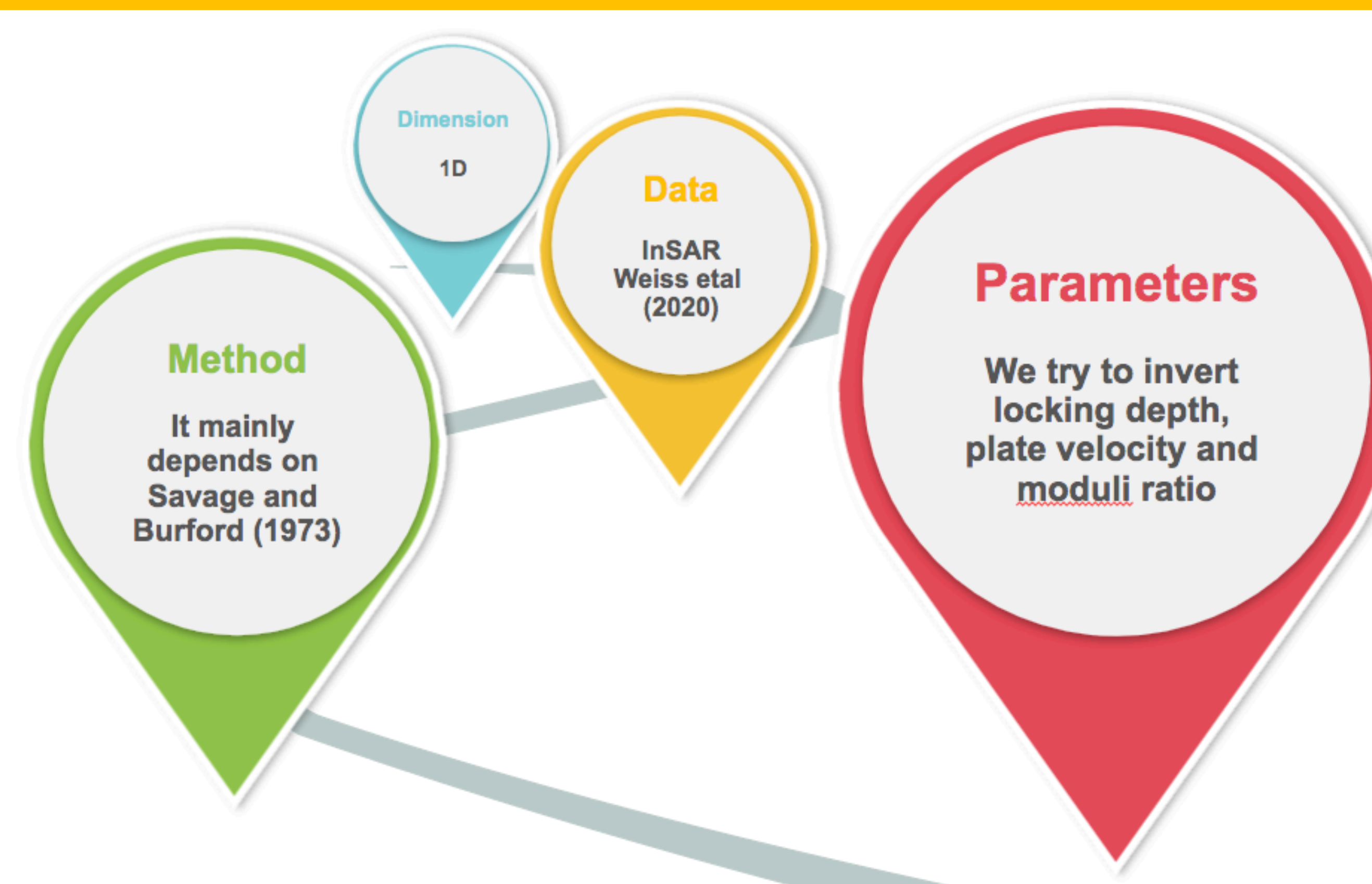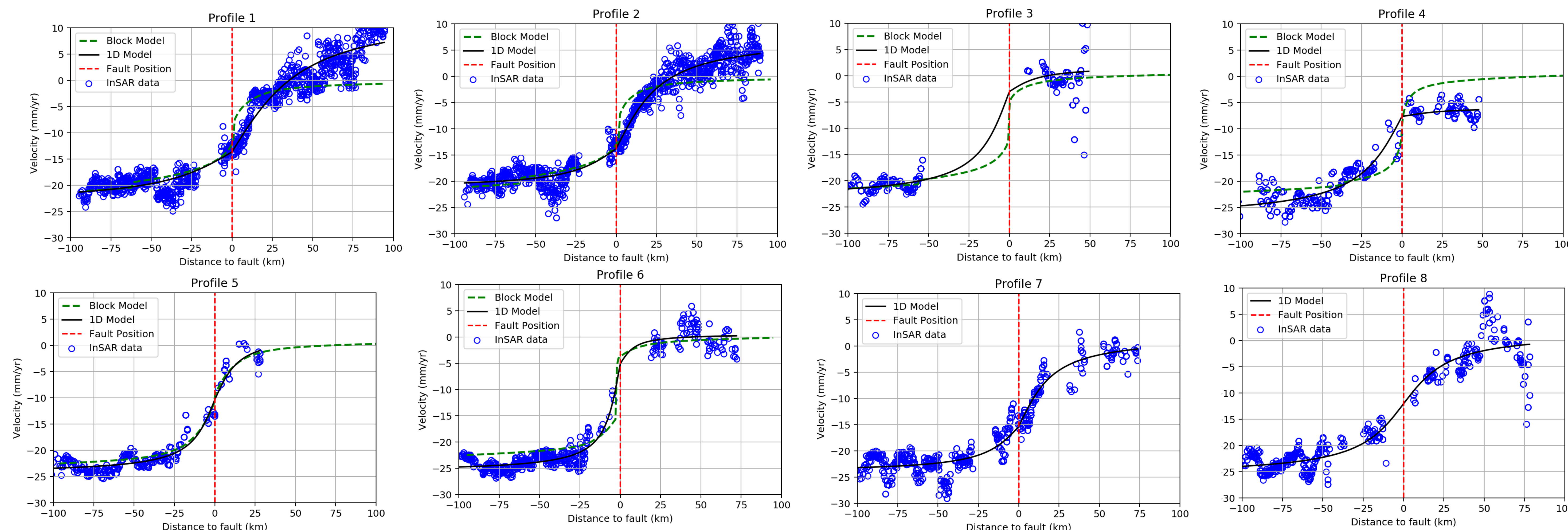We try to invert locking depth, plate velocity and moduli ratio

Fig 3. Black lines and yellow lines are the profiles perpendicular to the Main Marmara fault. Profiles which are shown yellow are plotted below. They are numbered from west to east. Orange lines are the faults around the region and it was taken from Emre etal (2018).
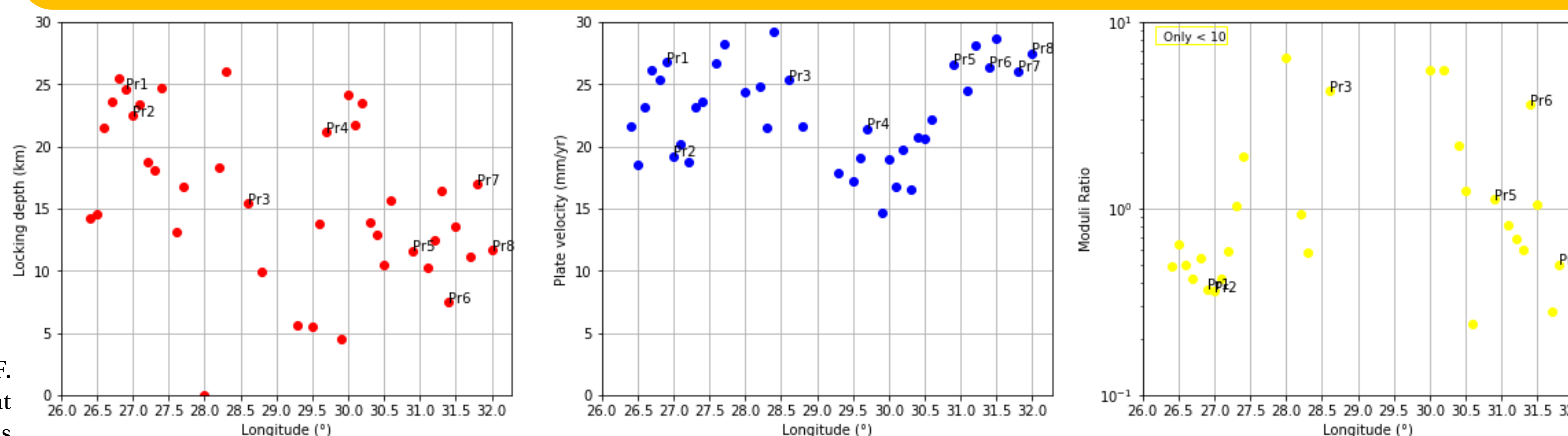

Inversion Results

Fig 4. Locking depth (left), plate velocity (center) and moduli ratio (right) values coming from arctangent inversion. They are plotted as a function of longitude.

Conclusion

✓ Most of the profiles are consistent with both block and 1d models, although some of them still have problems.
✓ Profile 1 and 2 show a possible existence of the secondary fault 5-10 km north of the main branch
✓ Profiles across the sea still have the lack of data to claim a possible crustal heterogeneity.
✓ Profile 5 is the region where the Abant 1957 and Mudurnu 1967 ruptures occur. It shows that the fault accumulates elastic strain.
✓ Profile 7-8 are the easternmost part of our study are and there are no known secondary faults around it. Both profiles reveal a non-symmetric behavior.
✓ In order to determine whether a crustal heterogeneity for the Marmara region we aim to generate different types of models.

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