

COSEISMIC AND EARLY POSTSEISMIC OF 23 NOVEMBER 2022 Mw = 5.9 DÜZCE EARTHQUAKE WITH InSAR AND GNSS MEASUREMENTS

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Motivation

The Mw=5.9 Düzce earthquake occurred on 23rd November 2022 on the west part of North Anatolian Fault (NAF).

In this study, we aim to investigate the source mechanism for the 23rd November 2022 Düzce Earthquake and associate it to the ruptures of 1999 Izmit (Mw = 7.4) and Düzce (Mw = 7.1) Earthquakes.

It can be seen from slip distributions of 1999 Izmit and Düzce Earthquakes (Fig.1), there is slip deficit on west of Efteni Lake, near the epicenter of 2022 earthquake.

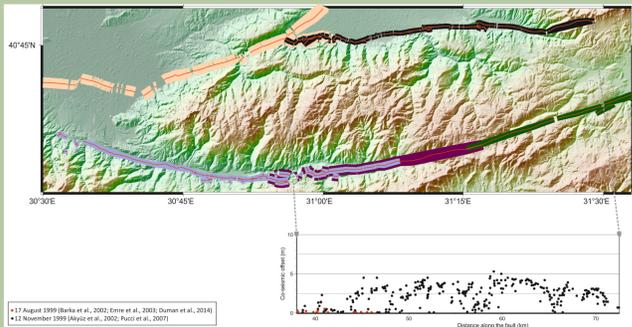


Fig.1 Slip distribution surface rupture traces of 1999 Izmit and Düzce Earthquakes. (Courtesy of Havva Neslihan Kıray)

On November 23, 2022 8 new continuous GNSS sites have established to monitor the postseismic deformation. (Fig.2)

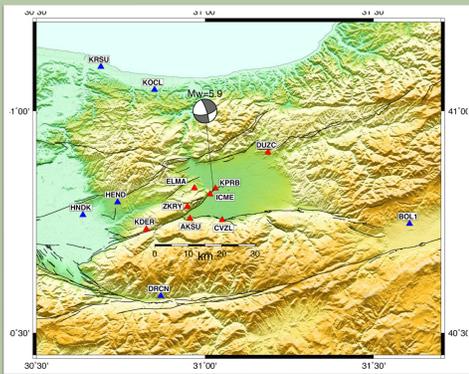


Fig.2 Locations of GNSS sites. Red triangles represents sites established by our team; blue triangles belongs Turkish National Permanent GNSS Network. (source mechanism from AFAD)

Coseismic Deformations

Data from stations of Turkish National Permanent GNSS Network and a near-field historical site(KDER) have processed to estimate the coseismic deformations. (Fig.3)

We have interseismic velocity of KDER site between 2006-2011 years from our former studies. This information helped us to know coordinates of the site right before the earthquake. For this study, coordinates of KDER site acquired again after the earthquake and coseismic displacement of the site has estimated. (Fig.4)

A coseismic interferogram is interpreted from 15 november - 27 november ascending data of Sentinel-1 satellite. (Fig.5)

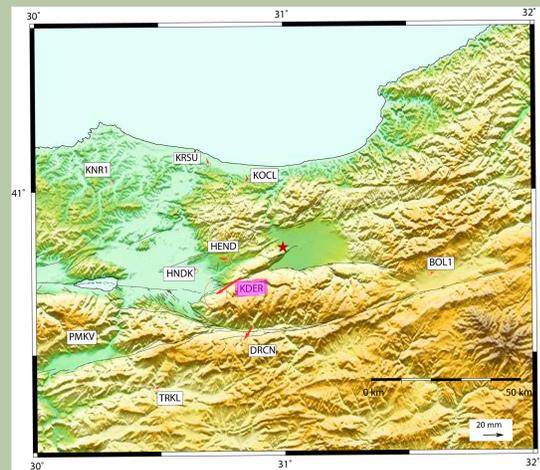


Fig.3 Coseismic displacements obtained from GNSS stations.

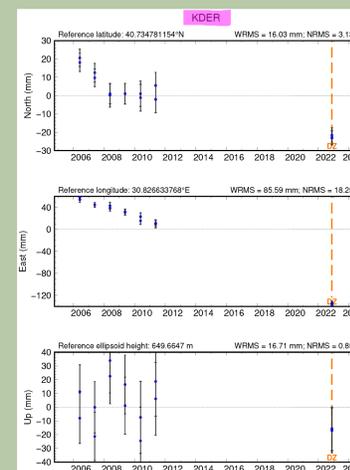


Fig.4 Time series of historical site named KDER

Postseismic Deformations

The data of continuous sites have collected and processed. Postseismic deformations are estimated for one month interval after the earthquake (Fig.6)

Maximum postseismic deformation is observed on AKSU site: 17.81 ± 2.18 mm at east and -1.5 ± 2.28 mm at north direction (Fig.5.a)

Since the first Sentinel-1 acquisition is on 27th November, which is 4 days after the earthquake, coseismic interferogram (Fig.5) has postseismic effect in it. AKSU GNSS site has ~8.5 mm postseismic displacement for first 4 days, it can be said that ~33% of InSAR coseismic deformation (~2.54 cm) is related with postseismic deformations.

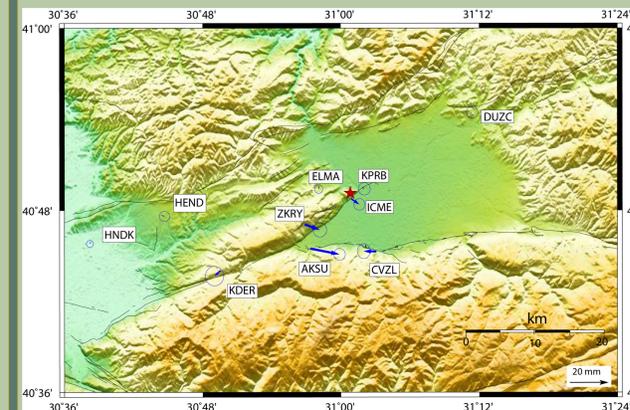


Fig.6 Postseismic displacements of GNSS sites. 1 month after the November 23 Düzce Earthquake

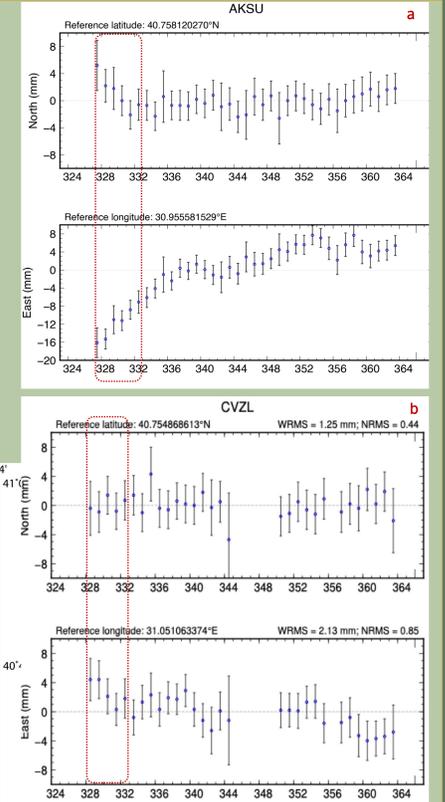


Fig.5 a.) Time series of GNSS site named AKSU. Red dashed line shows InSAR data coverage after the earthquake. b.) Time series of GNSS site named CVZL. This site is located on the south of NAF and approximately on the edge of the deformation zone.

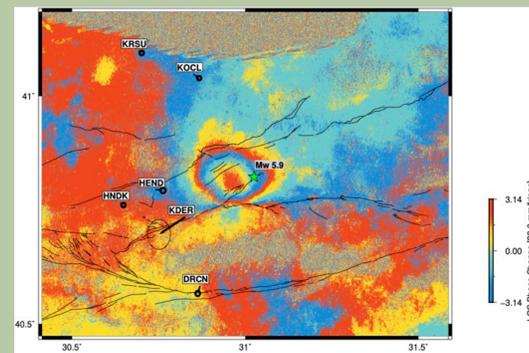


Fig.5 Coseismic interferogram from Sentinel-1 data. GNSS sites that have coseismic displacements are shown with black vectors.

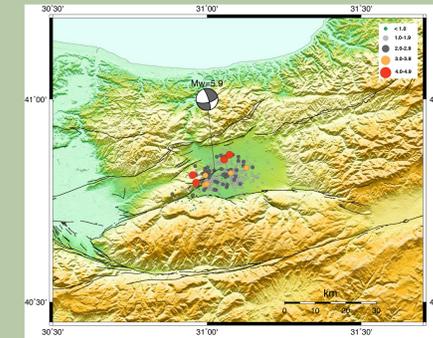


Fig.7 1 month interval aftershocks. (Aftershocks from AFAD)

Modelling

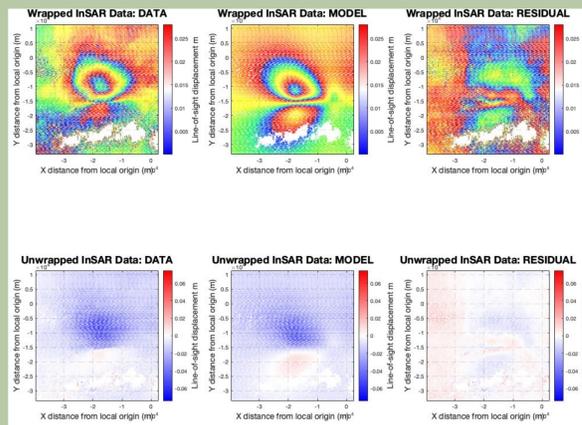


Fig.8 A preliminary model and parameters

Conclusions

- The earthquake occurred at the overlap of the rupture zones of 1999 Izmit and Düzce Earthquakes (west of Efteni Lake on Düzce segment).
- The earthquake co-seismic slip is on the area that we think there is a slip deficit after 1999 earthquakes.
- Our GNSS and InSAR data showed that the coseismic deformation is around <6 cm in the near field and ~33% of the InSAR coseismic deformation field is related with postseismic deformations.
- Since the continuous GNSS network stations showed any significant postseismic deformations, it is important to have near-field observations to estimate postseismic behavior.

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References:
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