Turkiye Syria 6 February 2023 Earthquakes;

Reconnaissance Visit Report and Seismological Aspects

Mehdi Zaré

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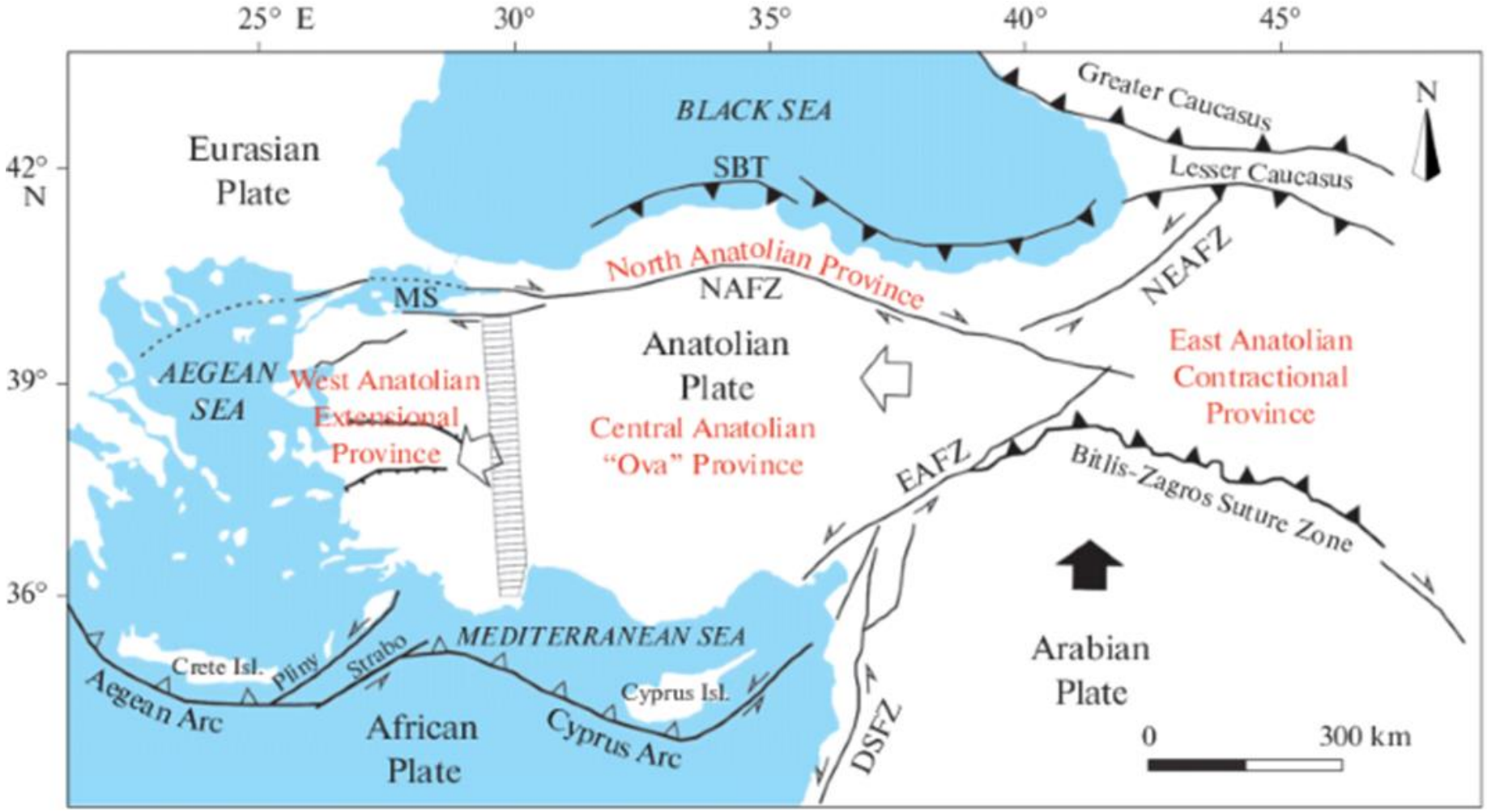
IIEES

12 June 2023

TURKIYE 6 FEB 2023 EARTHQUAKES M7.8, M7.5

By Mehdi ZARE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40°
45°
42° N
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36°
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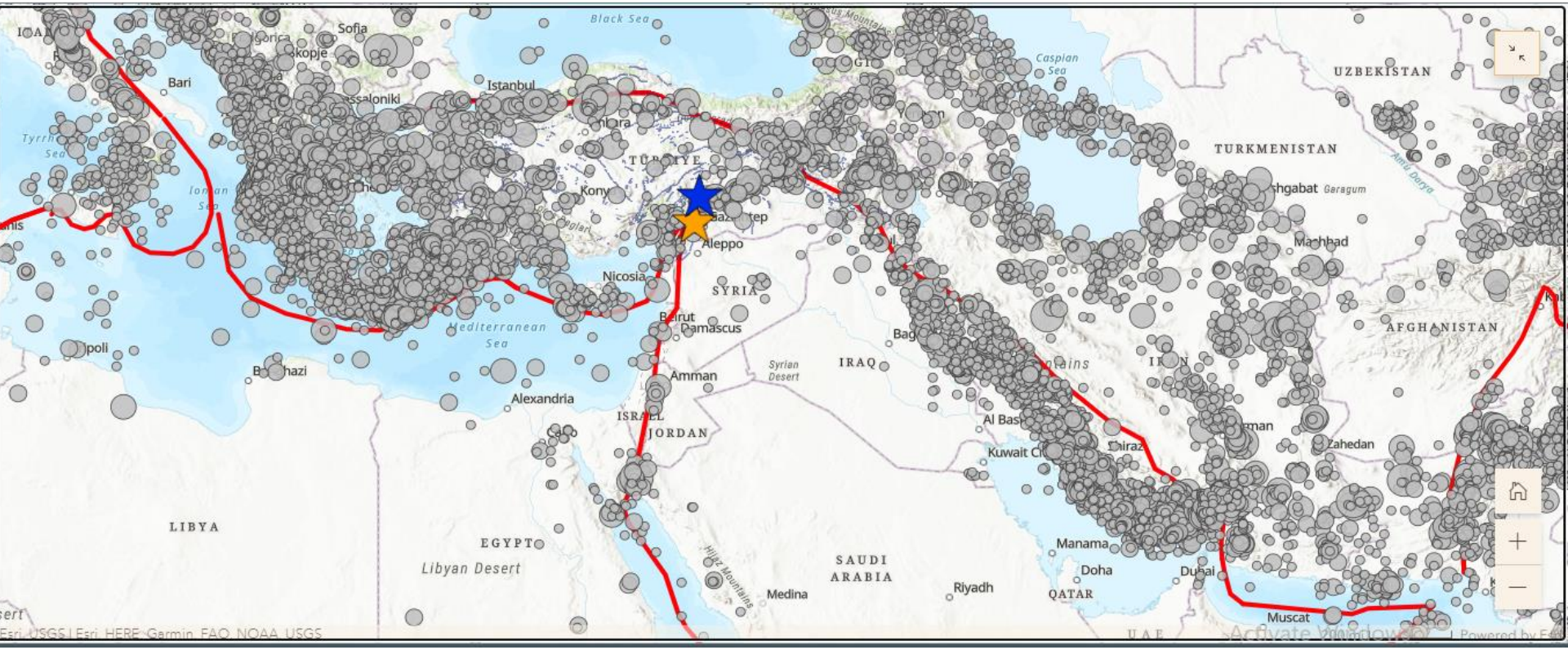
BLACK SEA
Eurasian Plate
SBT
Greater Caucasus
Lesser Caucasus
North Anatolian Province
NAFZ
NEAFZ
MS
AEGEAN SEA
West Anatolian Extensional Province
Anatolian Plate
Central Anatolian "Ova" Province
East Anatolian Contractional Province
EAFZ
Bitlis-Zagros Suture Zone
MEDITERRANEAN SEA
Crete Isl.
Pliny
Strabo
Aegean Arc
African Plate
Cyprus Isl.
Cyprus Arc
DSFZ
Arabian Plate
0
300 km


Black Sea
Caspian Sea
Sofia
Bari
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Aleppo
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Beirut
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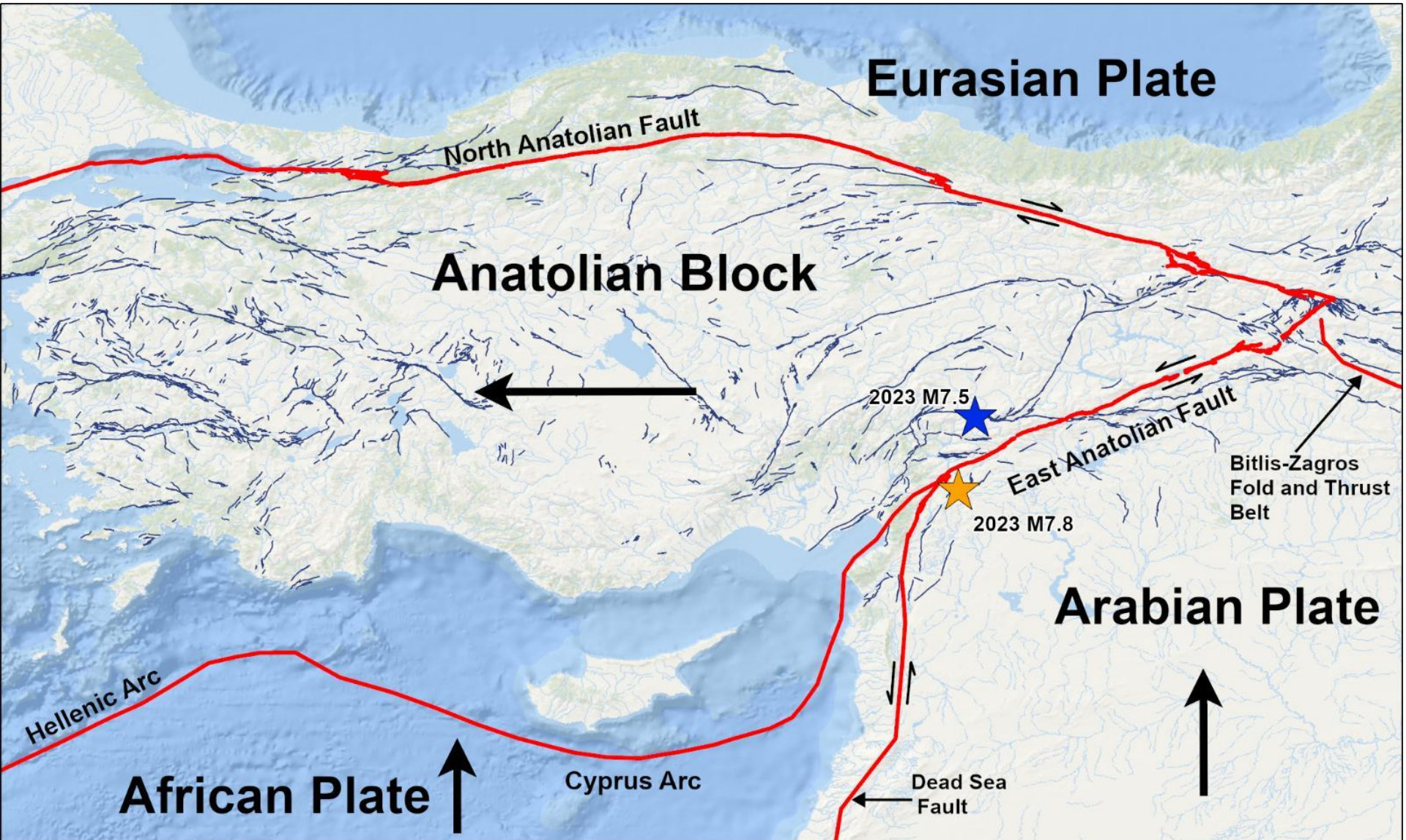
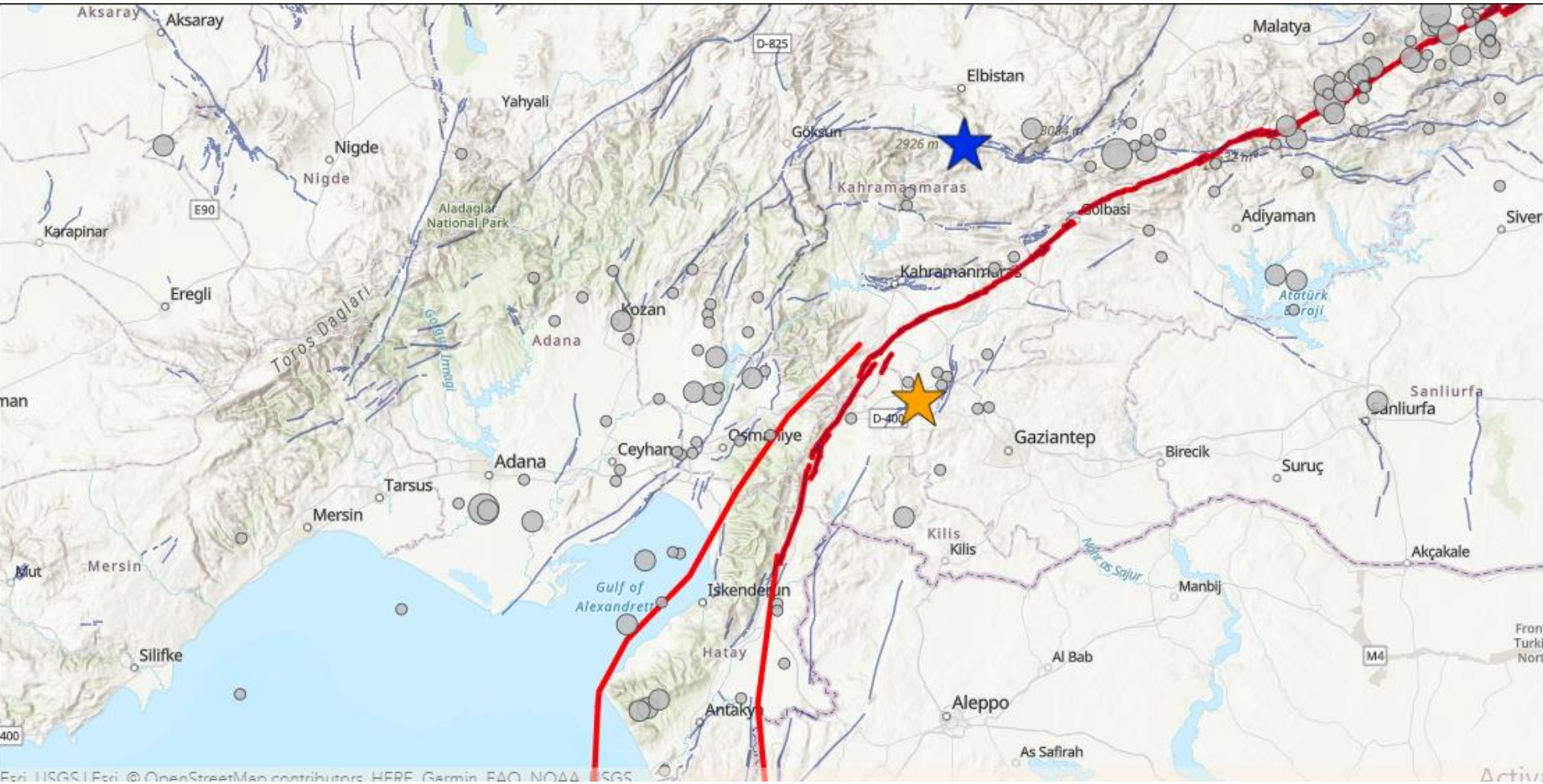
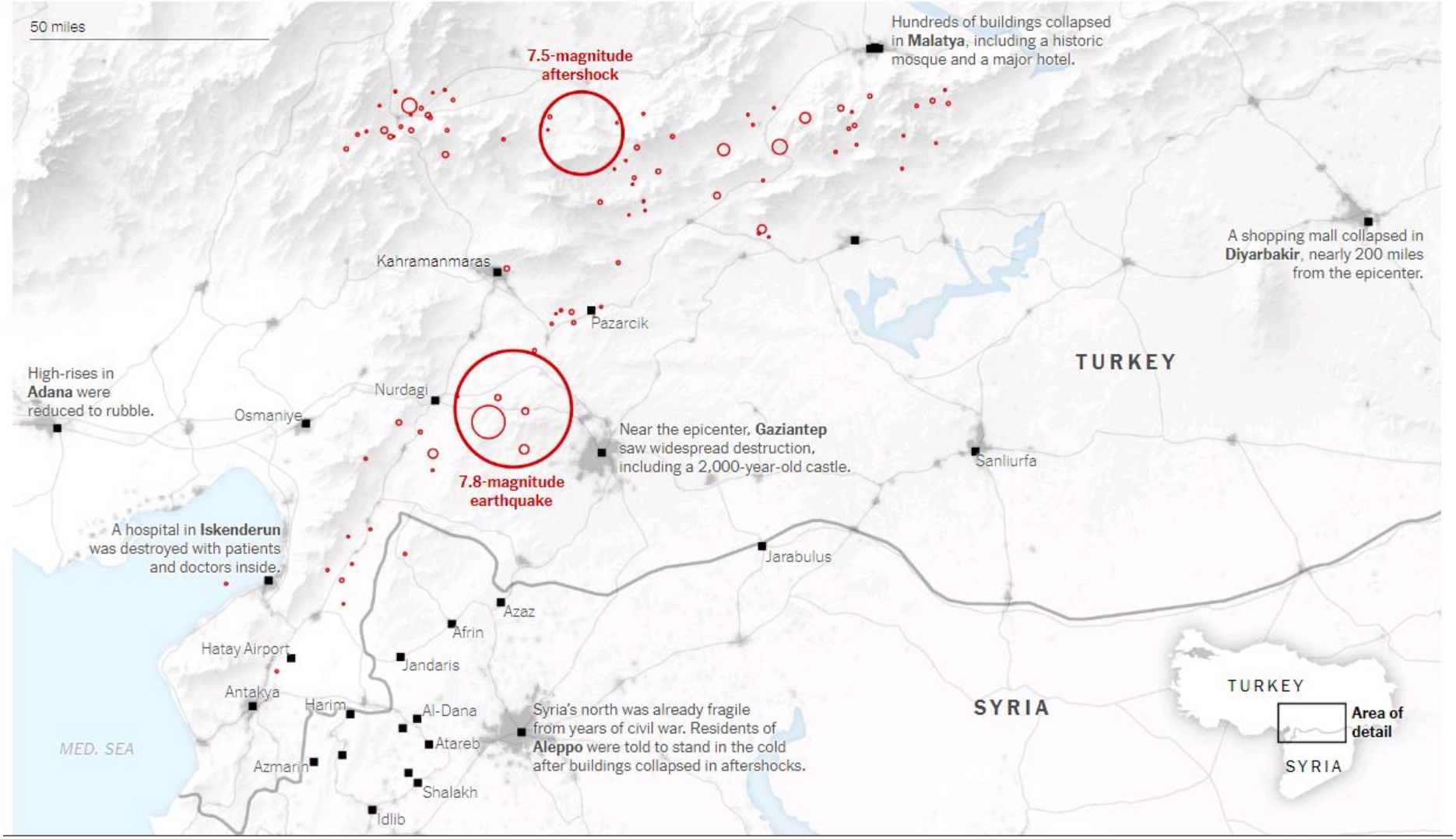
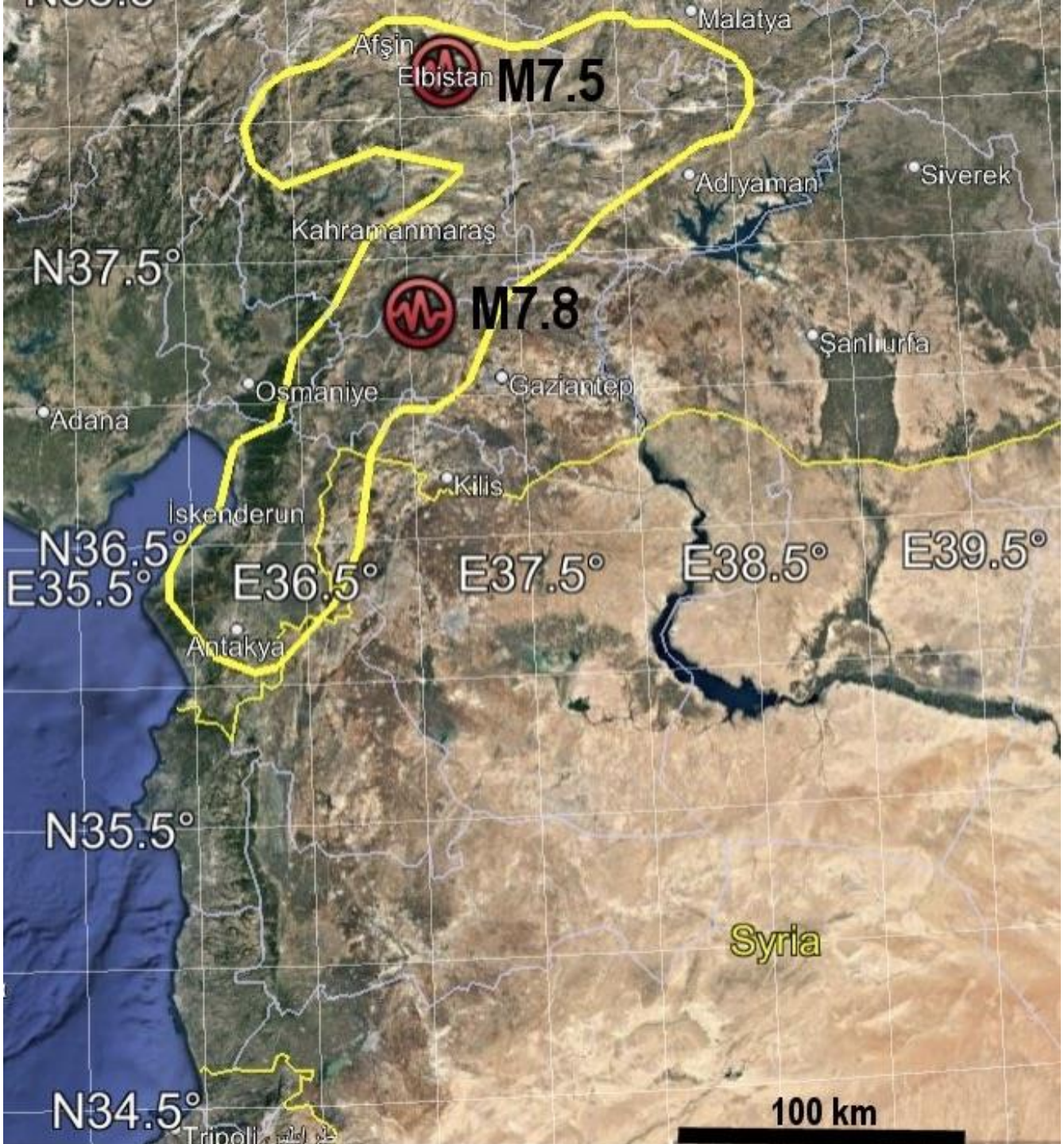
IRAQ
Syrian Desert
Mediterranean Sea
LIBYA
EGYPT
Libyan Desert
SAUDI ARABIA
Medina
Riyadh
QATAR
Doha
Manama
Dubai
Muscat
UZBEKISTAN
TURKMENISTAN
AFGHANISTAN
Mashhad
Zahedan
Esri, USGS | Esri, HERE, Garmin, FAO, NOAA, USGS

General Tectonic Map

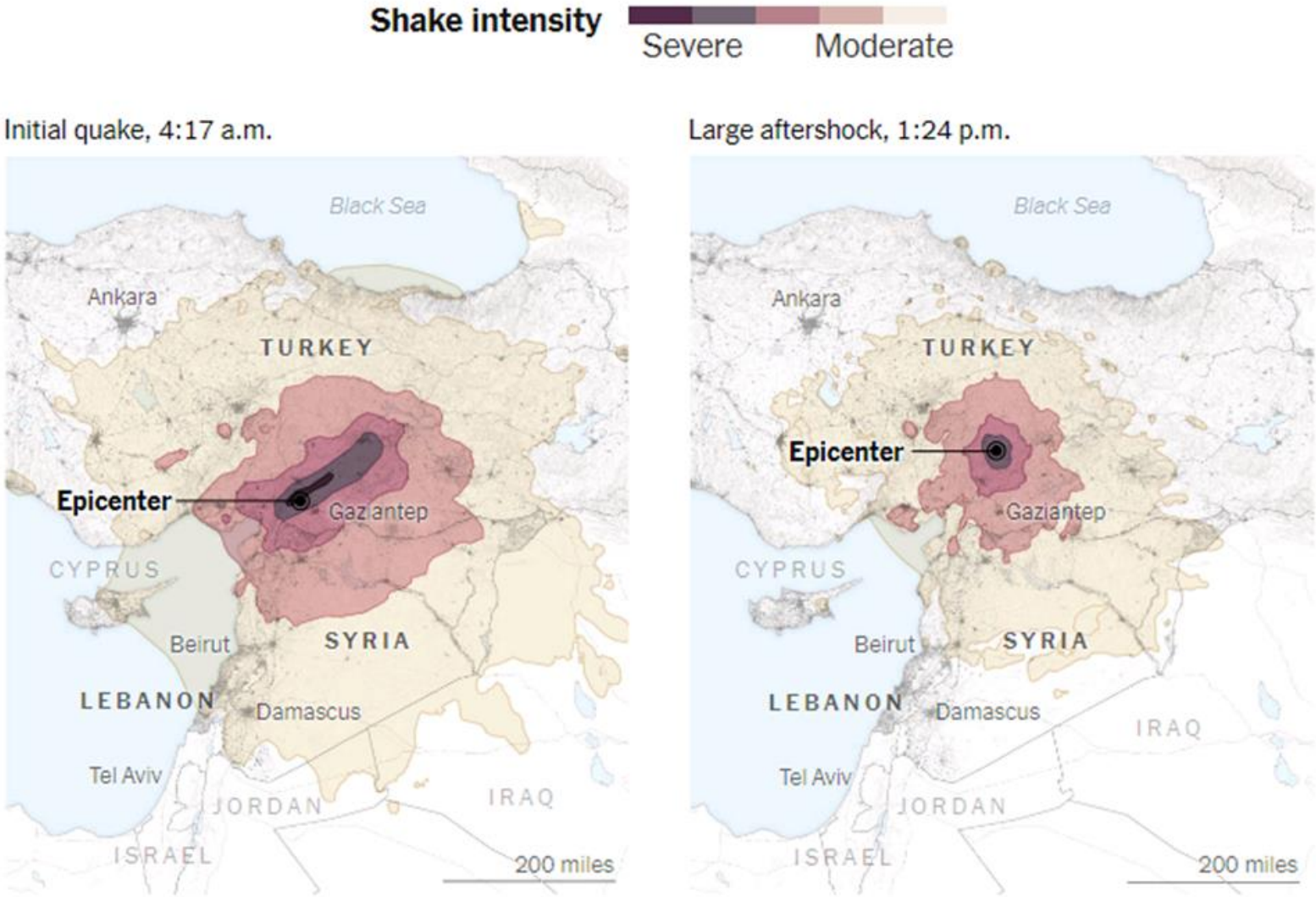



Aksaray
Aksaray
Malatya
D-825
Elbistan
Yahyali
Göksun
2926 m
3084 m
Nigde
Nigde
Kahramanmaras
E90
Aladaglar
National Park
Golbasi
Adiyaman
Karapinar
Kahramanmaras
Eregli
Toros Daglari
Kozan
Adana
Ataturk
Sanliurfa
D-400
Gaziantep
Ceyhan
Birecik
Adana
Suruç
Tarsus
Mersin
Kilis
Kilis
Akçakale
Mersin
Gulf of
Iskenderun
Manbij
Hatay
Al Bab
M4
Silifke
Aleppo
Antakya
As Safirah
Esri, USGS | Esri, © OpenStreetMap contributors, HERE, Garmin, FAO, NOAA, USGS


50 miles
7.5-magnitude aftershock
Hundreds of buildings collapsed in Malatya, including a historic mosque and a major hotel.
A shopping mall collapsed in Diyarbakir, nearly 200 miles from the epicenter.
Kahramanmaras
Pazarcik
TURKEY
High-rises in Adana were reduced to rubble.
Nurdagi
Osmaniye
7.8-magnitude earthquake
Near the epicenter, Gaziantep saw widespread destruction, including a 2,000-year-old castle.
Sanliurfa
A hospital in Iskenderun was destroyed with patients and doctors inside.
Jarabulus
Azaz
Afrin
Hatay Airport
Jandaris
Antakya
Harim
Al-Dana
Atareb
Syria's north was already fragile from years of civil war. Residents of Aleppo were told to stand in the cold after buildings collapsed in aftershocks.
SYRIA
MED. SEA
Azmarin
Shalakh
Idlib
TURKEY
Area of detail
SYRIA


Malatya
Afşin
Elbistan
M7.5
Adıyaman
Siverek
Kahramanmaraş
N37.5°
M7.8
Şanlıurfa
Osmaniye
Gaziantep
Adana
Kilis
İskenderun
N36.5°
E35.5°
E36.5°
E37.5°
E38.5°
E39.5°
Antakya
N35.5°
Syria
N34.5°
Tripoli
100 km

A major quake, and a surprising aftershock



Source: U.S. Geological Survey • Note: All times are local.


TEK YÖN
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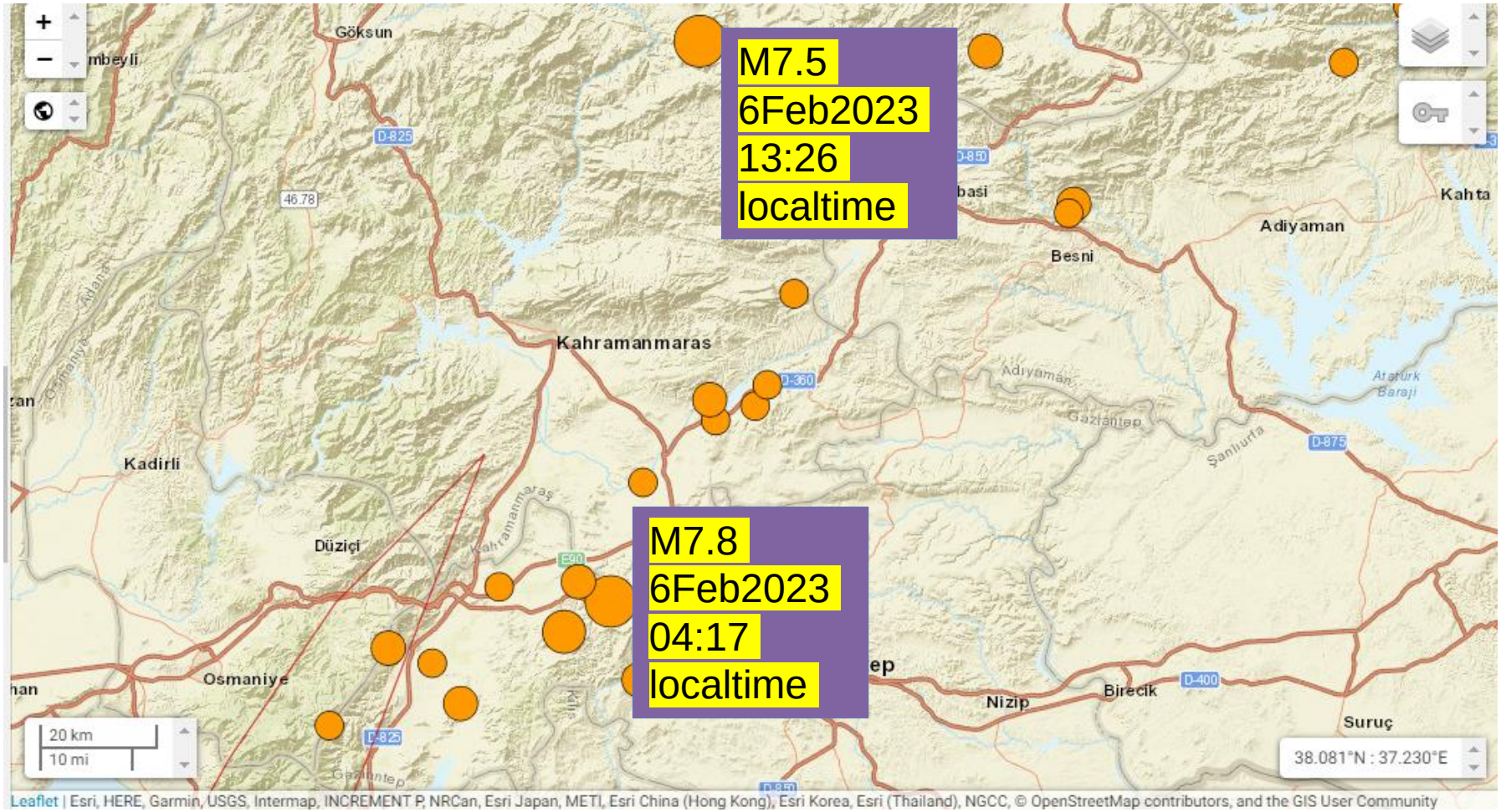
KONUT
DÜKKAN


M7.5
6Feb2023
13:26
localtime
M7.8
6Feb2023
04:17
localtime
Göksun
Kahramanmaras
Kadirli
Düziçi
Osmaniye
Besni
Adiyaman
Kahta
Nizip
Birecik
Suruç
Gaziantep
Şanlıurfa
Atatürk Baraji
D-825
D-850
D-360
D-875
D-400
E90
46.78
20 km
10 mi
38.081°N : 37.230°E
Leaflet | Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community


BULGARIA
RUSSIA
GEORGIA
GREECE
ARMENIA
IRAN
TURKEY
ANKARA
SYRIA
CYPRUS
IRAQ
LEBANON
ISRAEL
WEST BANK
JORDAN
SAUDI ARABIA
DAMASCUS
Istanbul
Kirklareli
Tekirdag
Edirne
Kocaeli
Yalova
Sakarya
Bartin
Zinguldak
Karabük
Düzce
Bolu
Çankiri
Kastamonu
Sinop
Samsun
Amasya
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Trabzon
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Gumushane
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Agri
Tokat
Sivas
Erzincan
Tunceli
Bingol
Mus
Bitlis
Van
Siirt
Batman
Hakkari
Sirnak
Mardin
Diyarbakir
Elazig
Malatya
Kahramanmaras
Adiyaman
Sanliurfa
Gaziantep
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Hatay
Aleppo
Ar Raqqah
Al Hasakah
Dayr Az Zawr
Idlib
Lattakia
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Damascus
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Antalya
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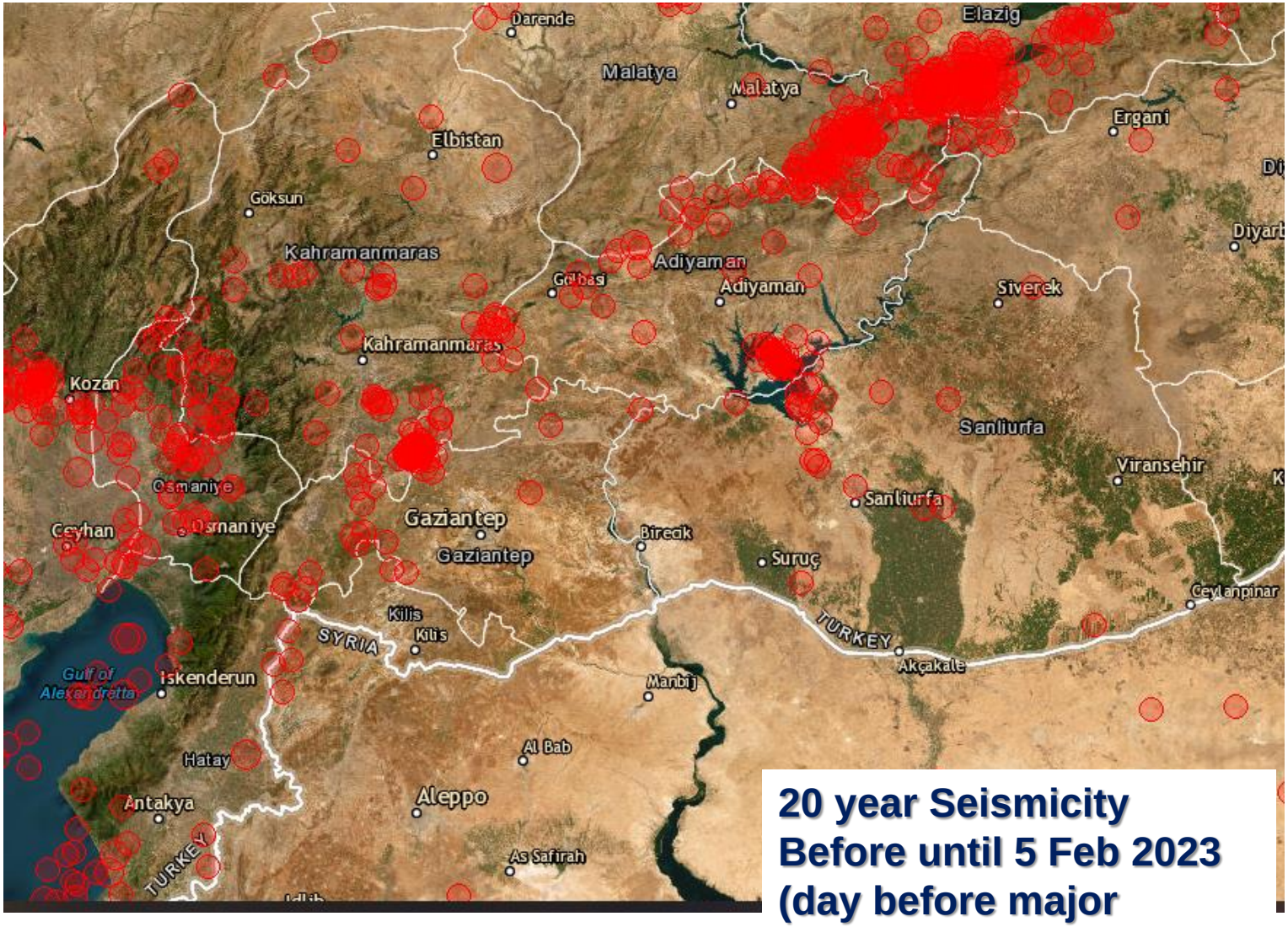
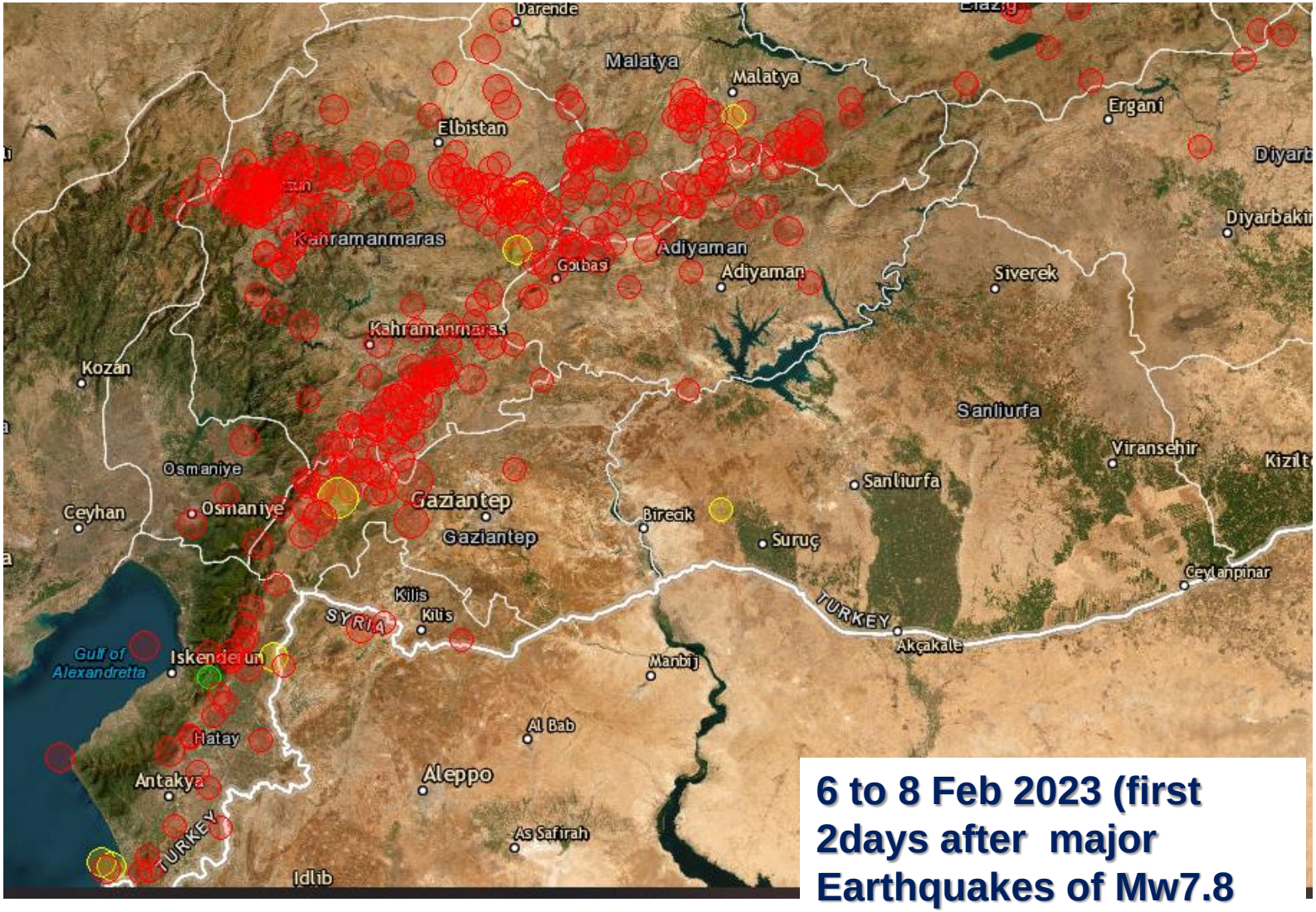
Kayseri
Yozgat
Cankiri
Approximate areas significantly impacted by the February 6 earthquakes

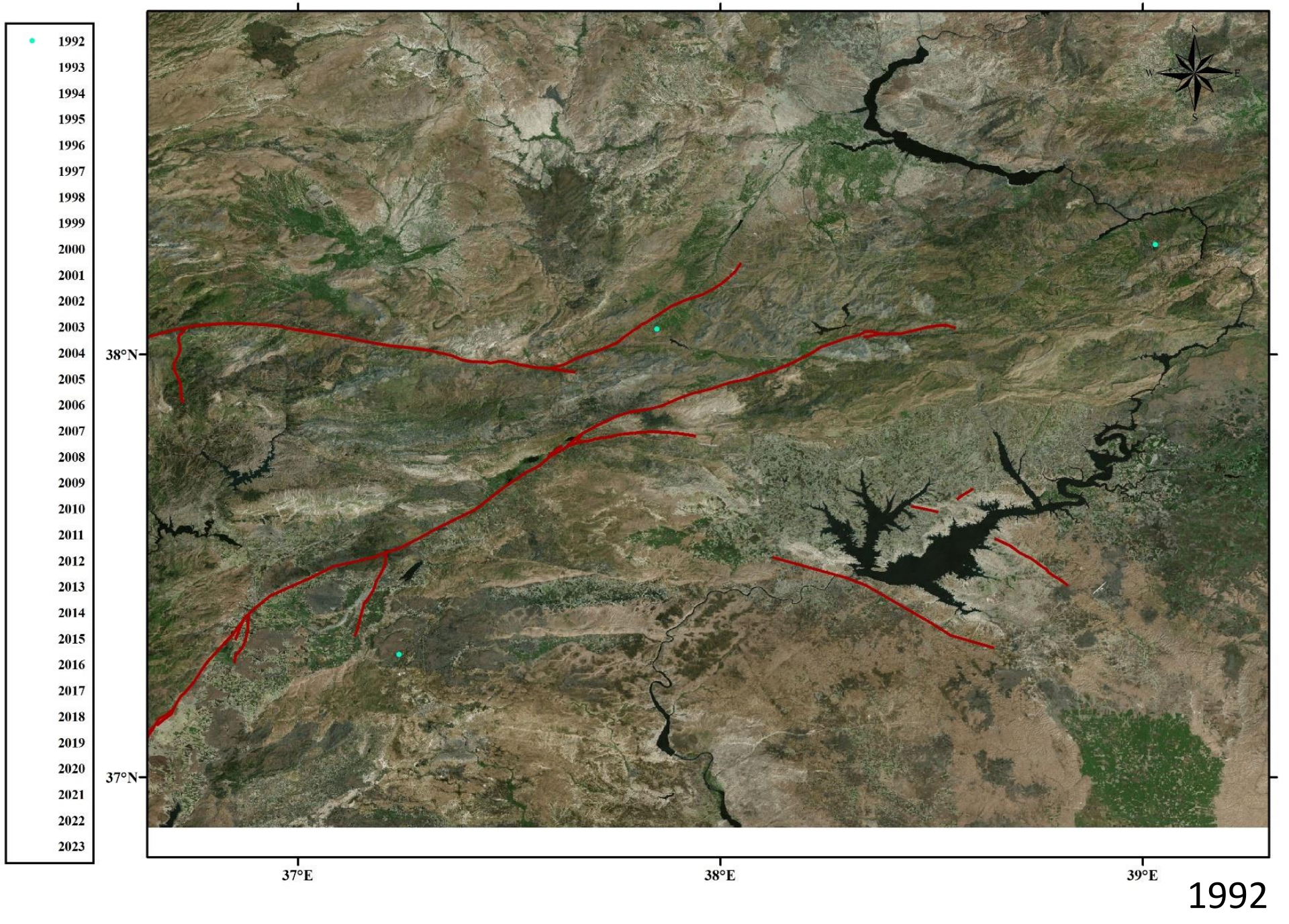


20 year Seismicity Before until 5 Feb 2023 (day before major Earthquakes) M>3.5



6 to 8 Feb 2023 (first 2days after major Earthquakes of Mw7.8 and Mw7.6)

1Feb2023-12 June 2023 M>5.5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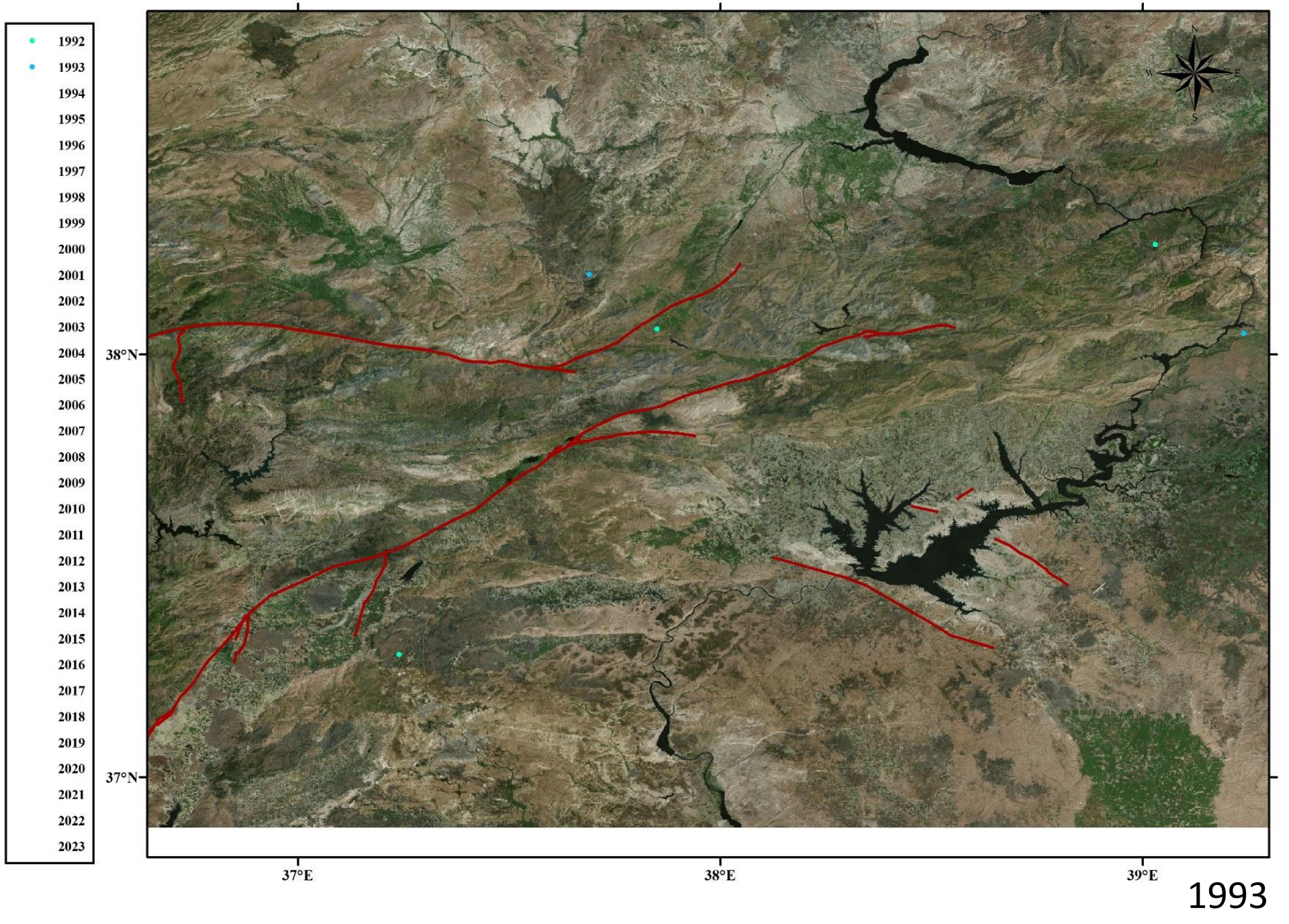
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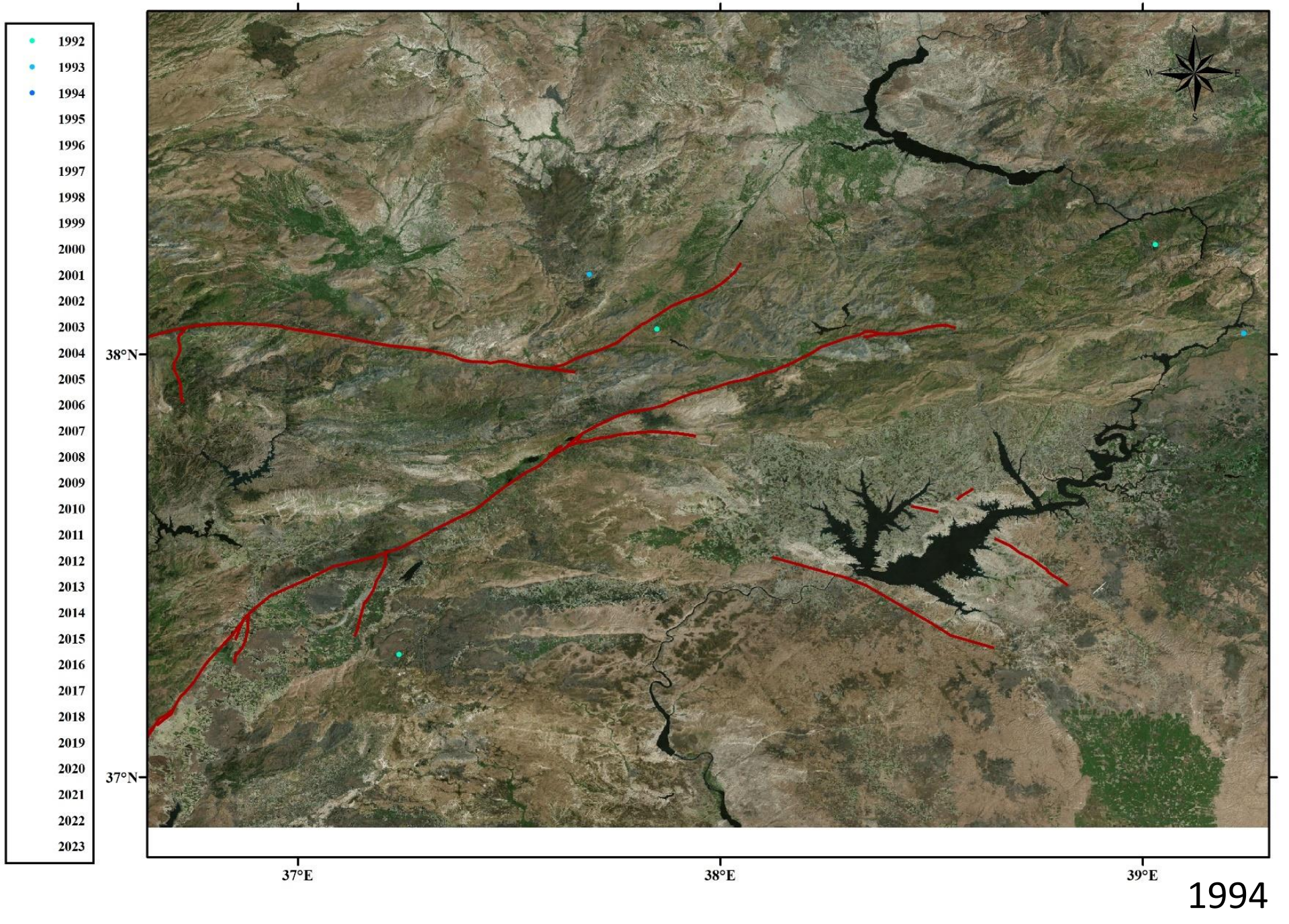
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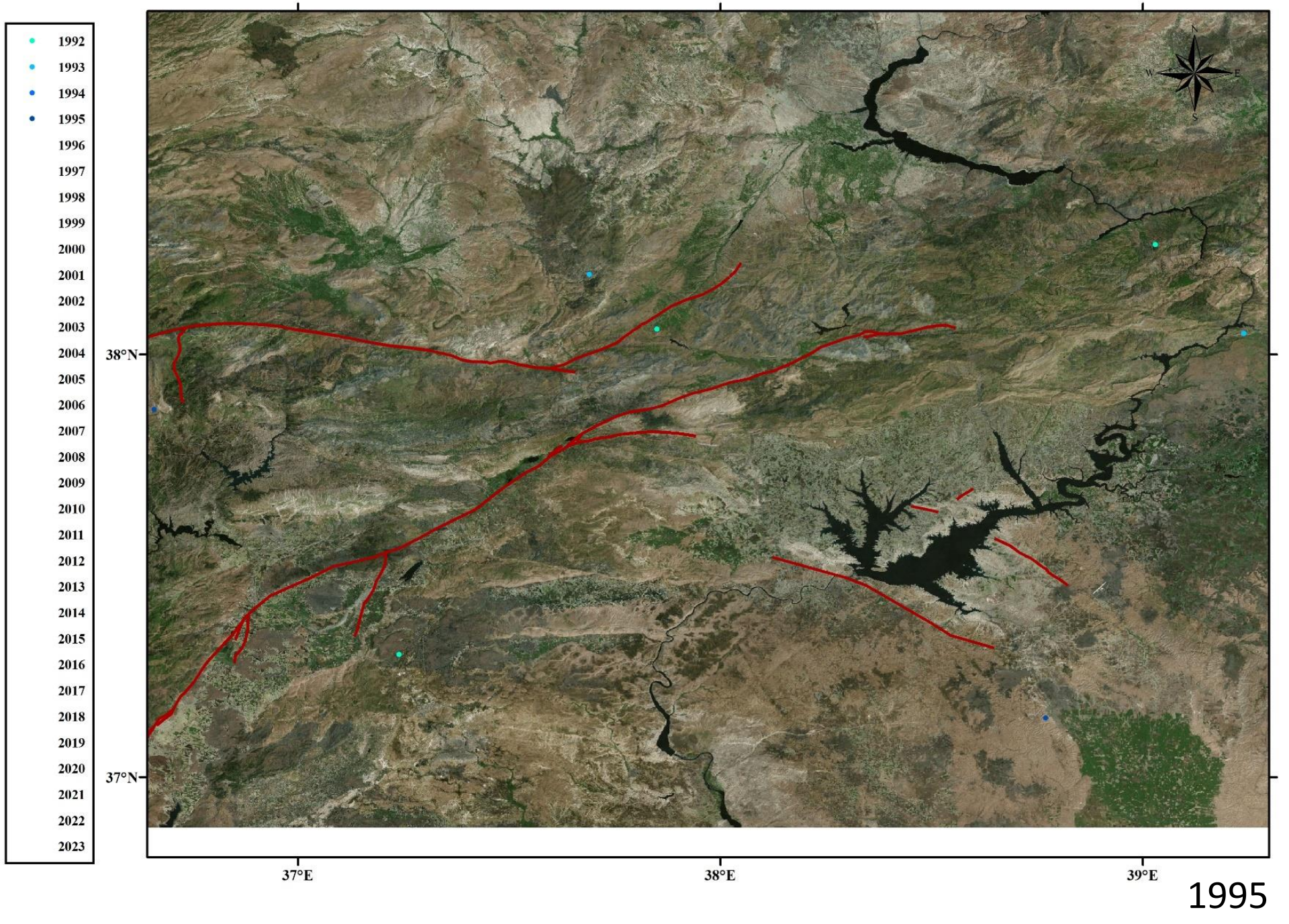
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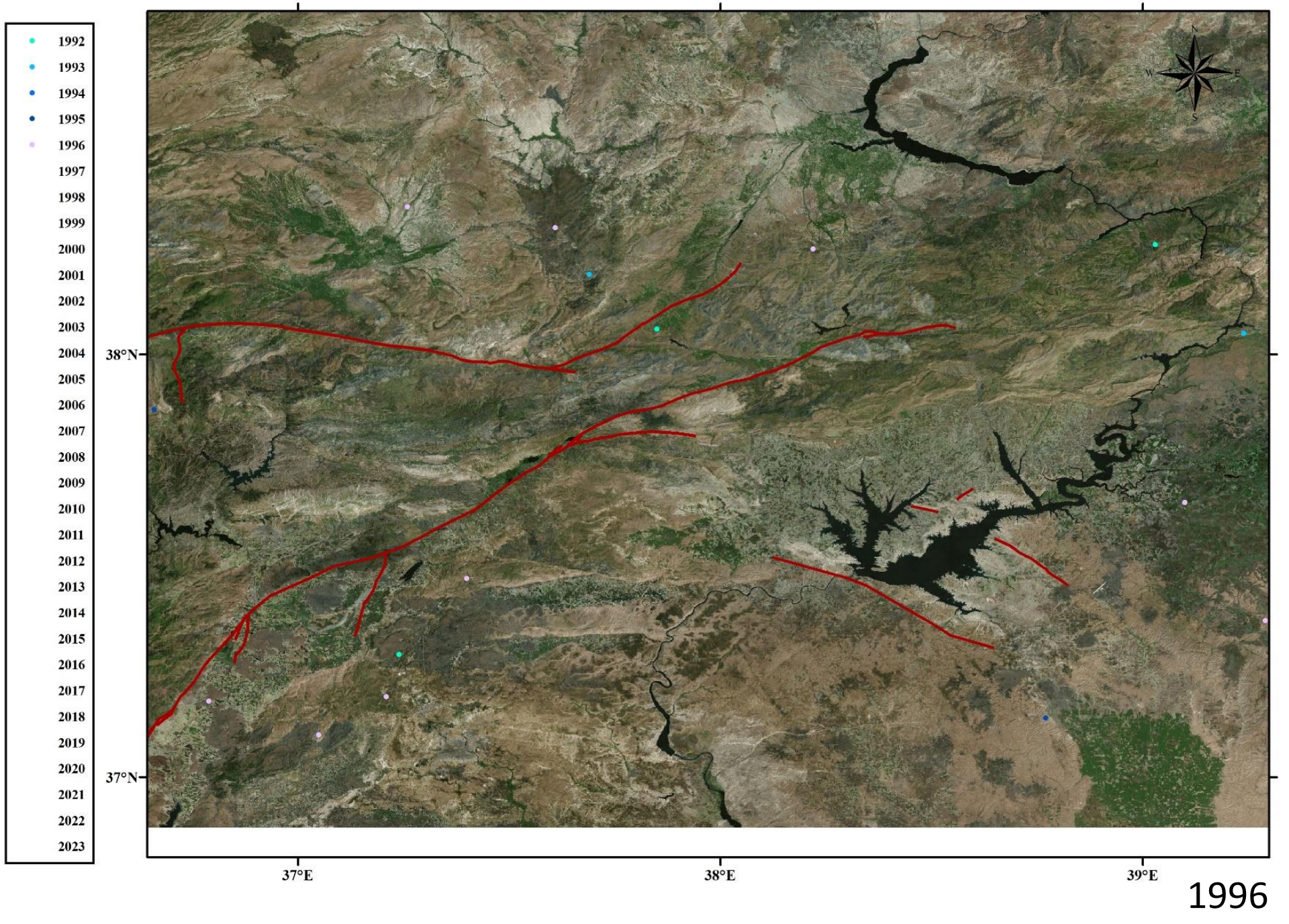
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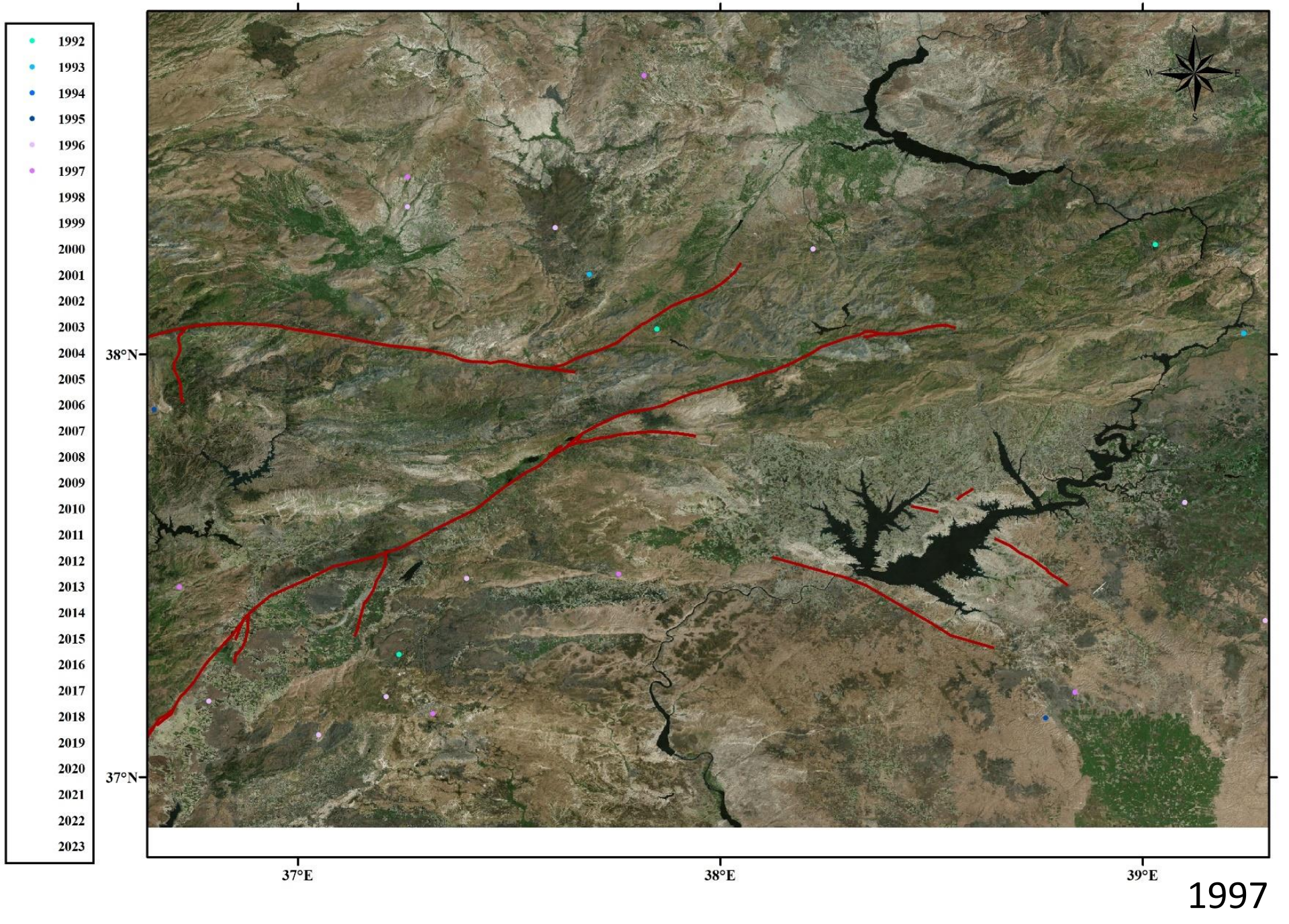
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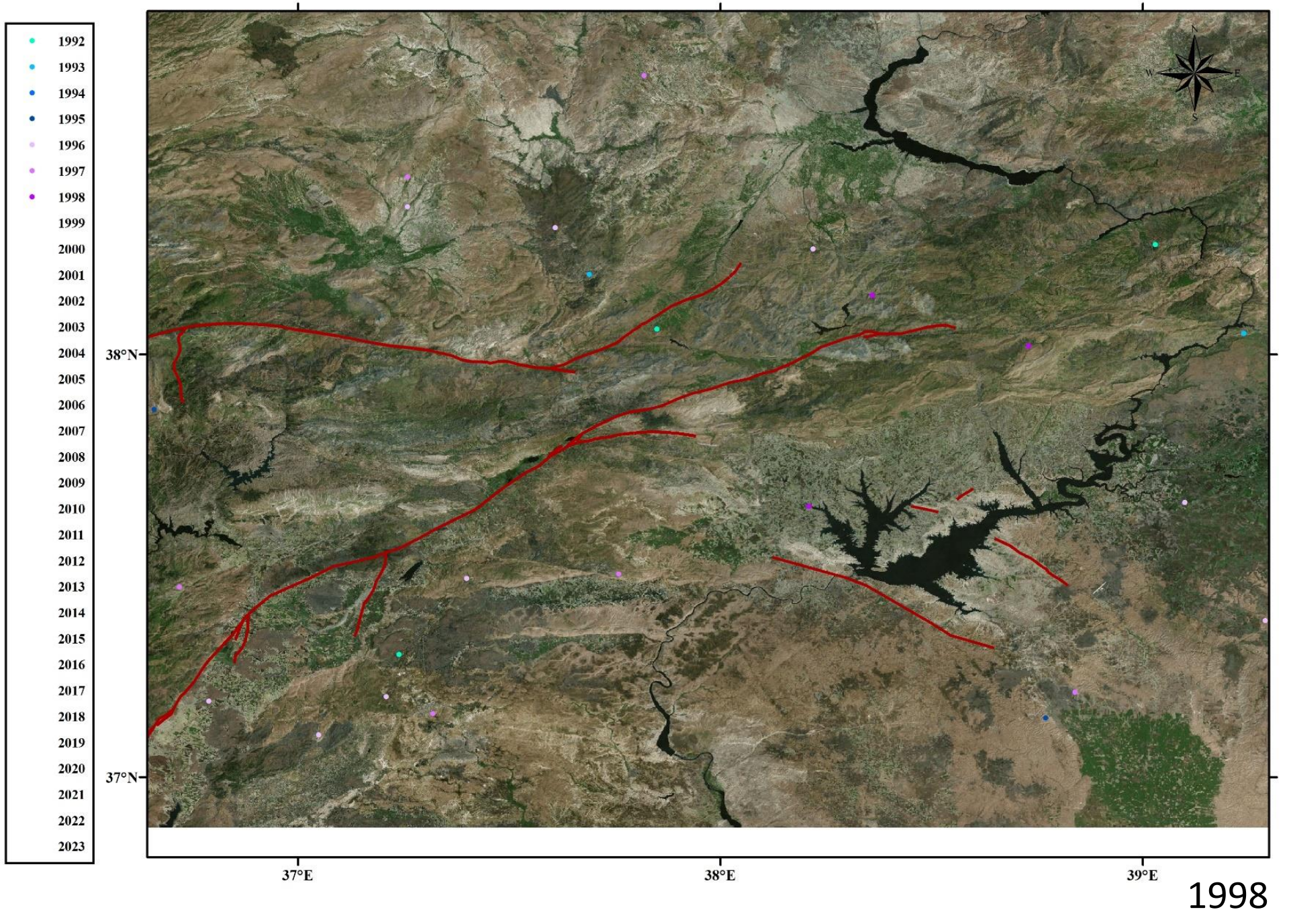
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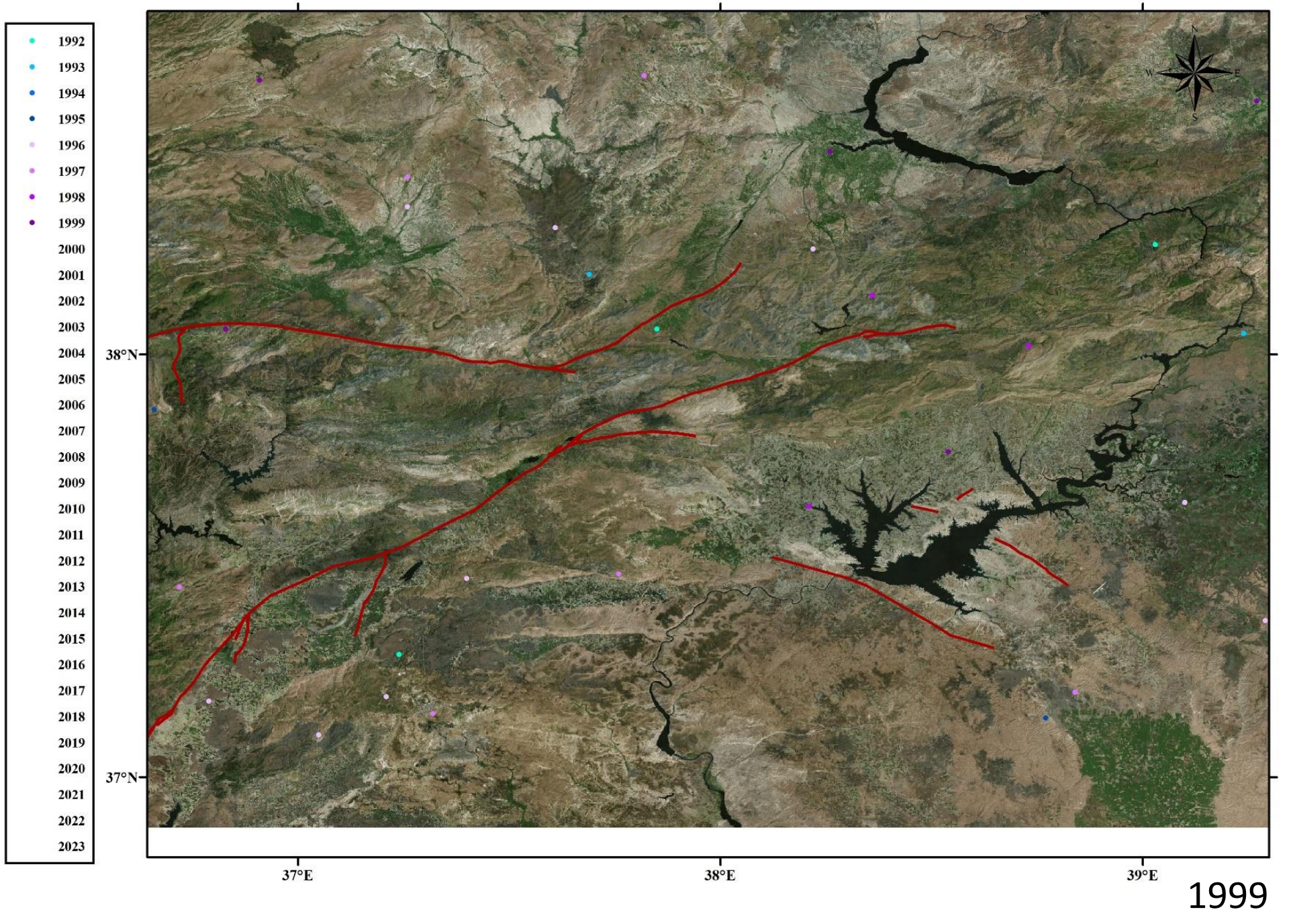
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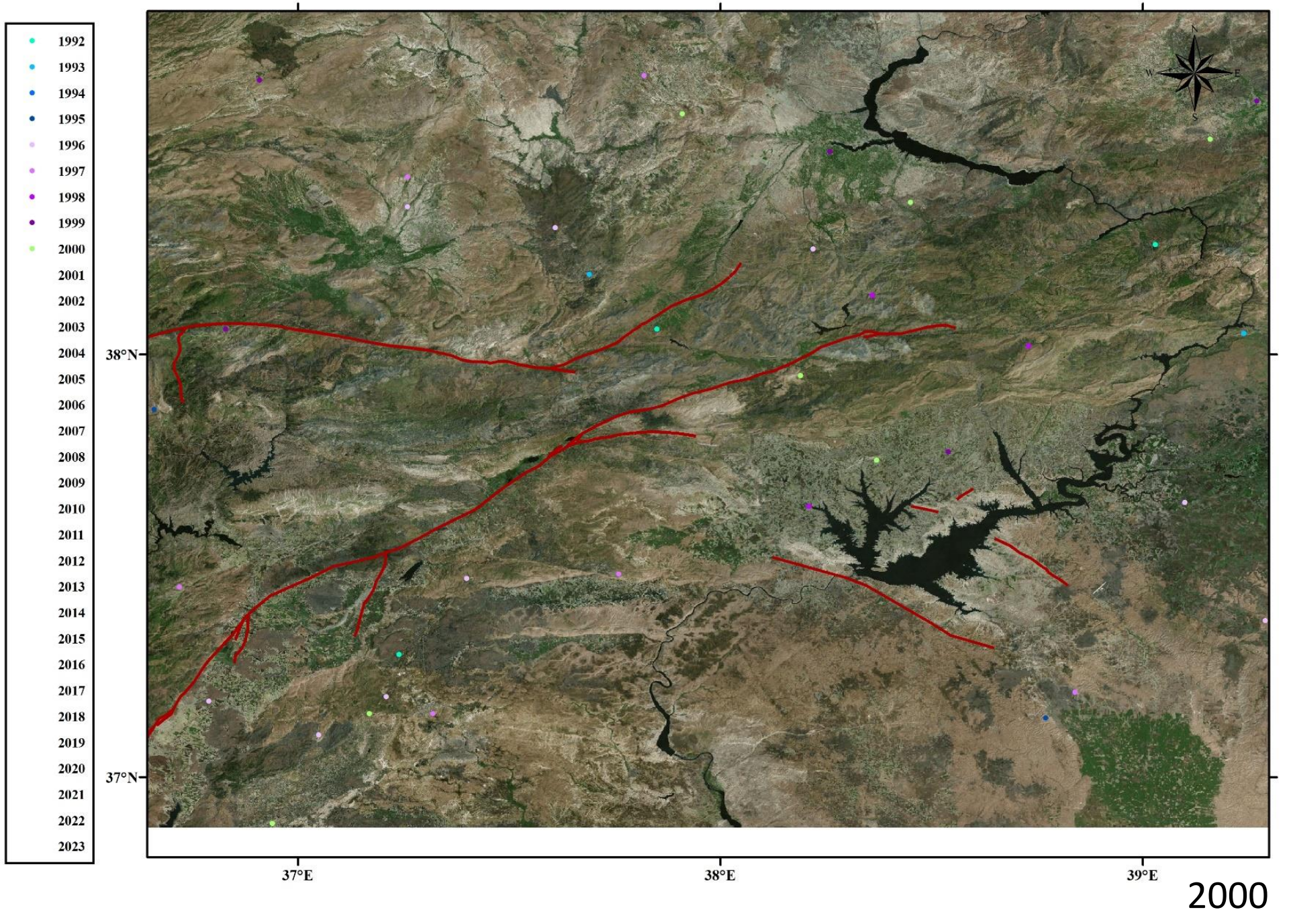
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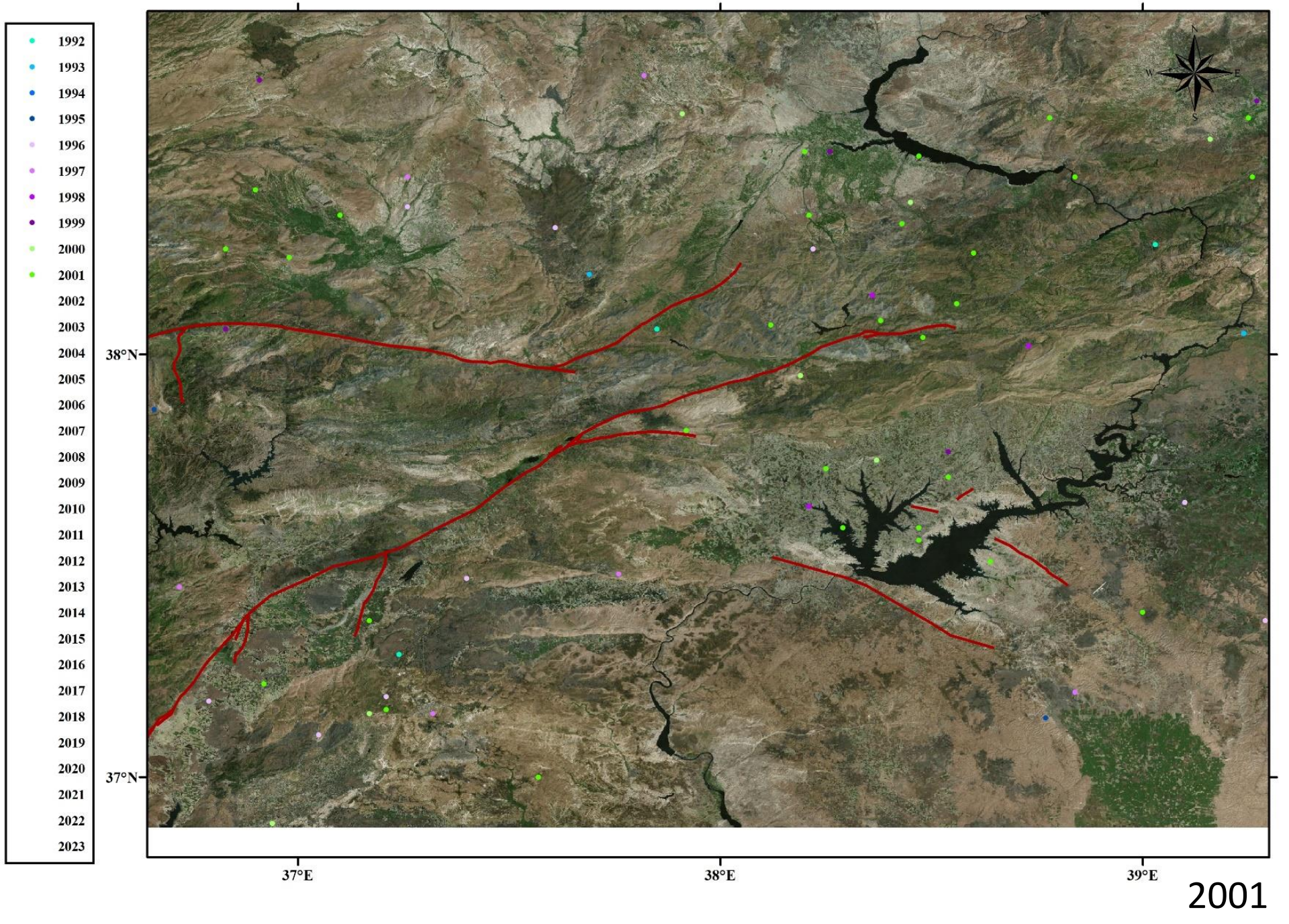
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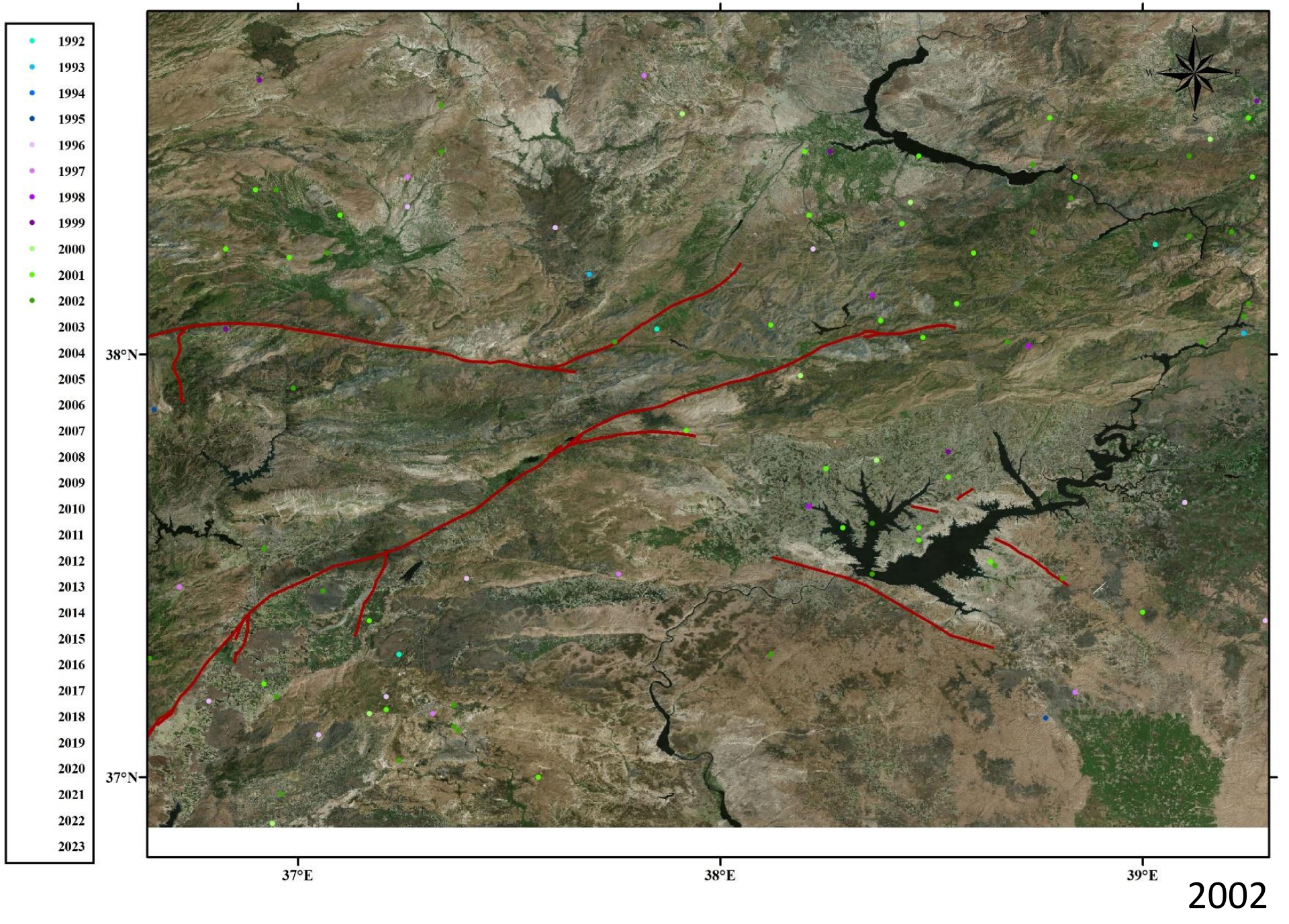
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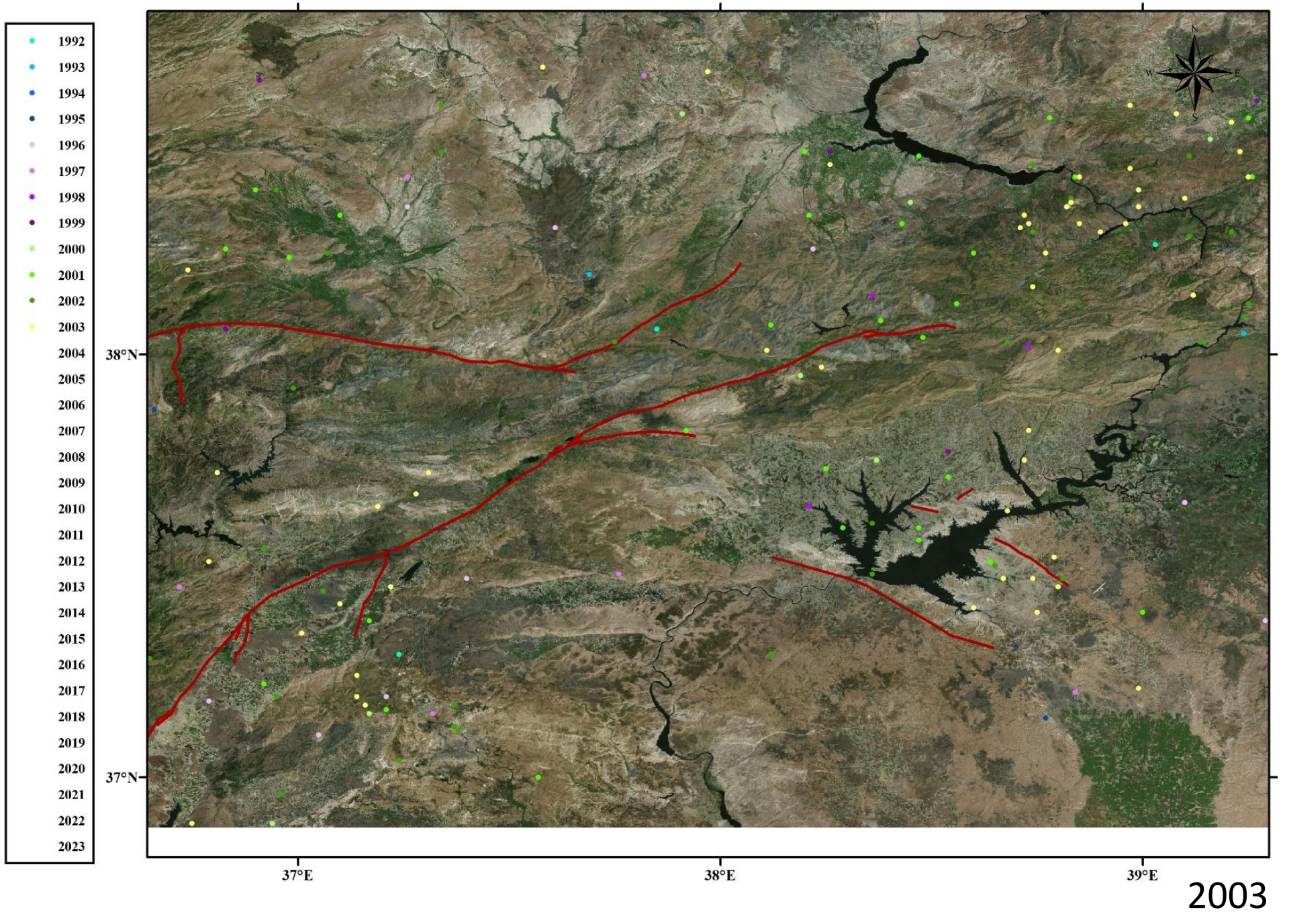
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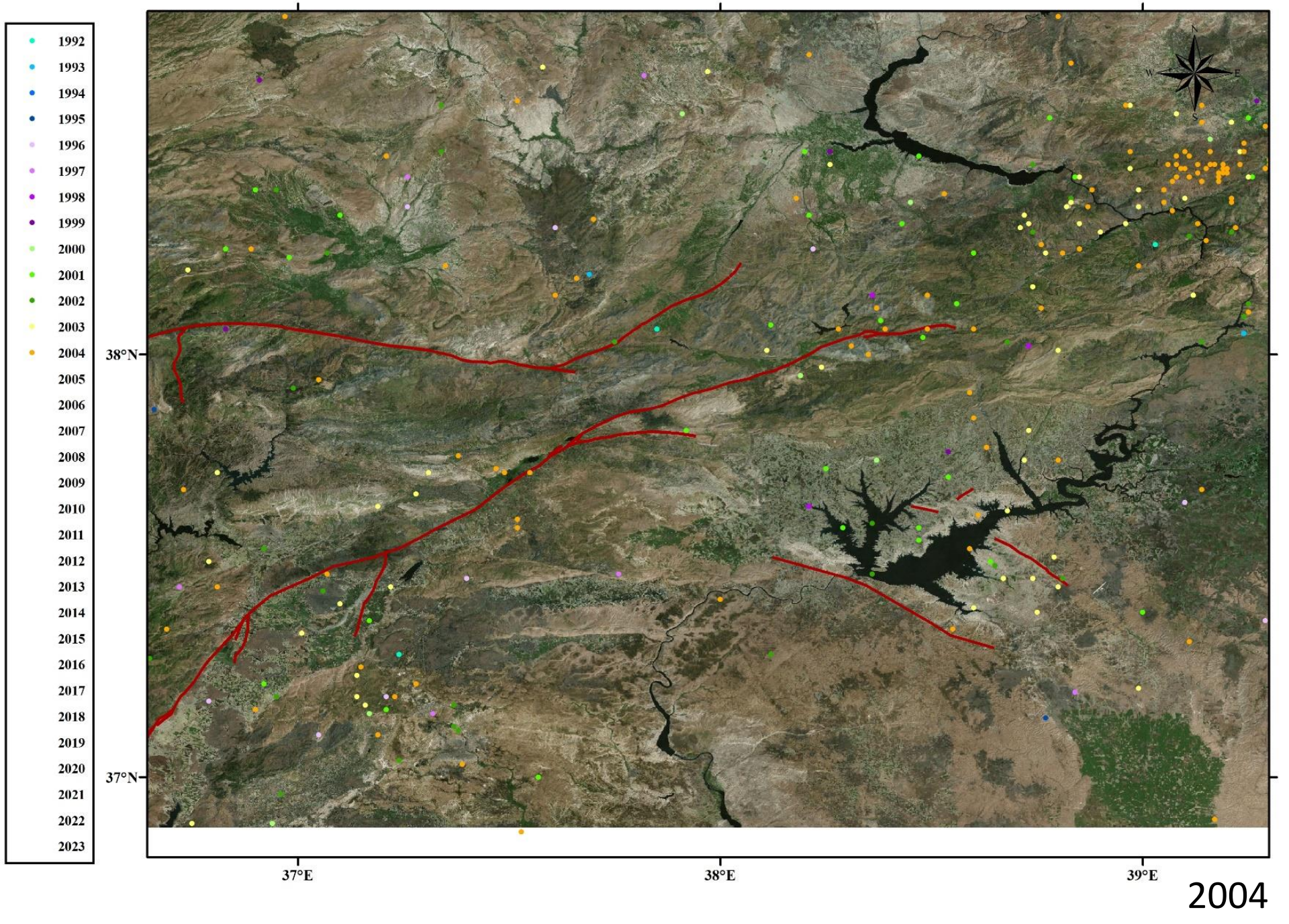
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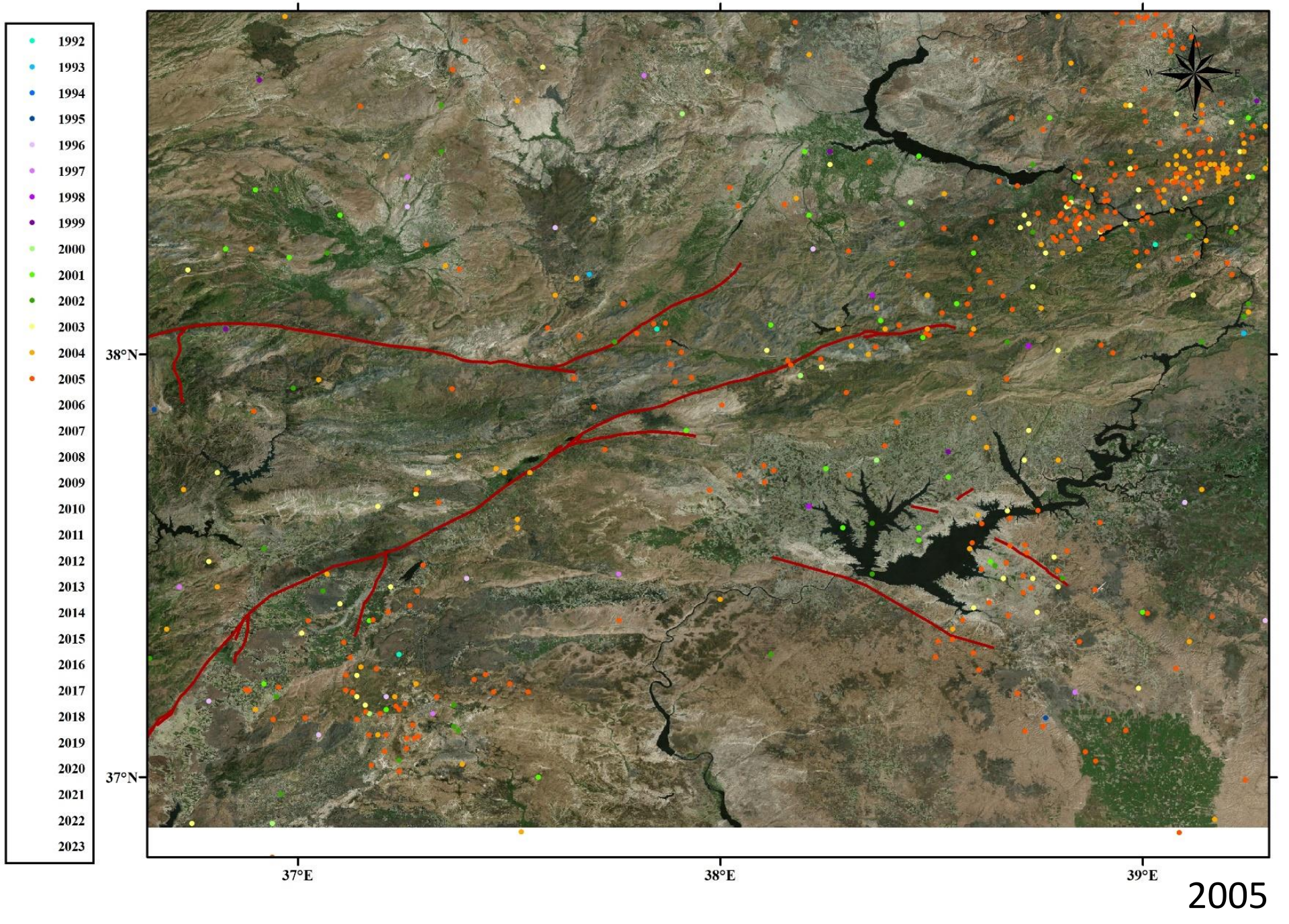
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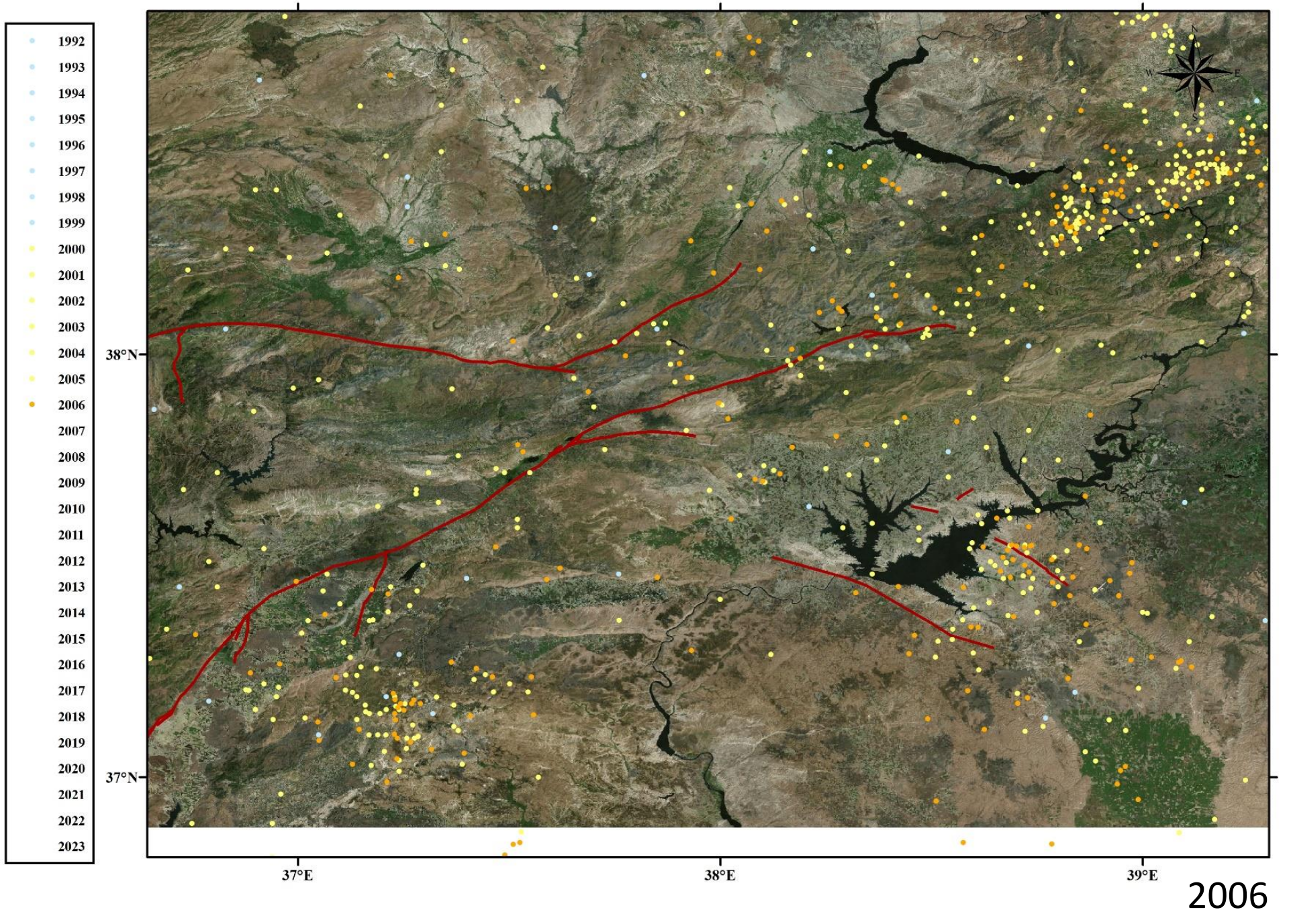
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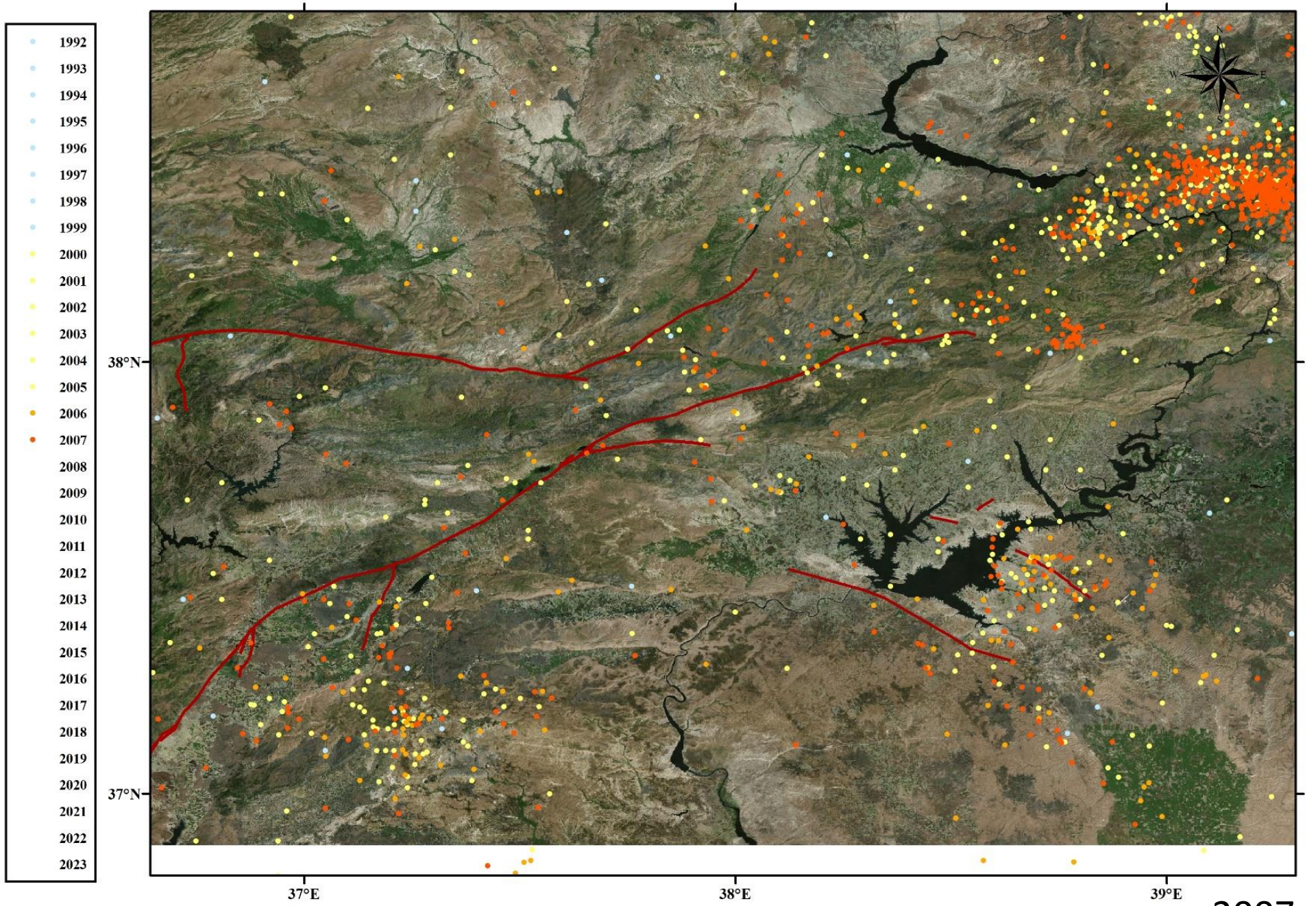
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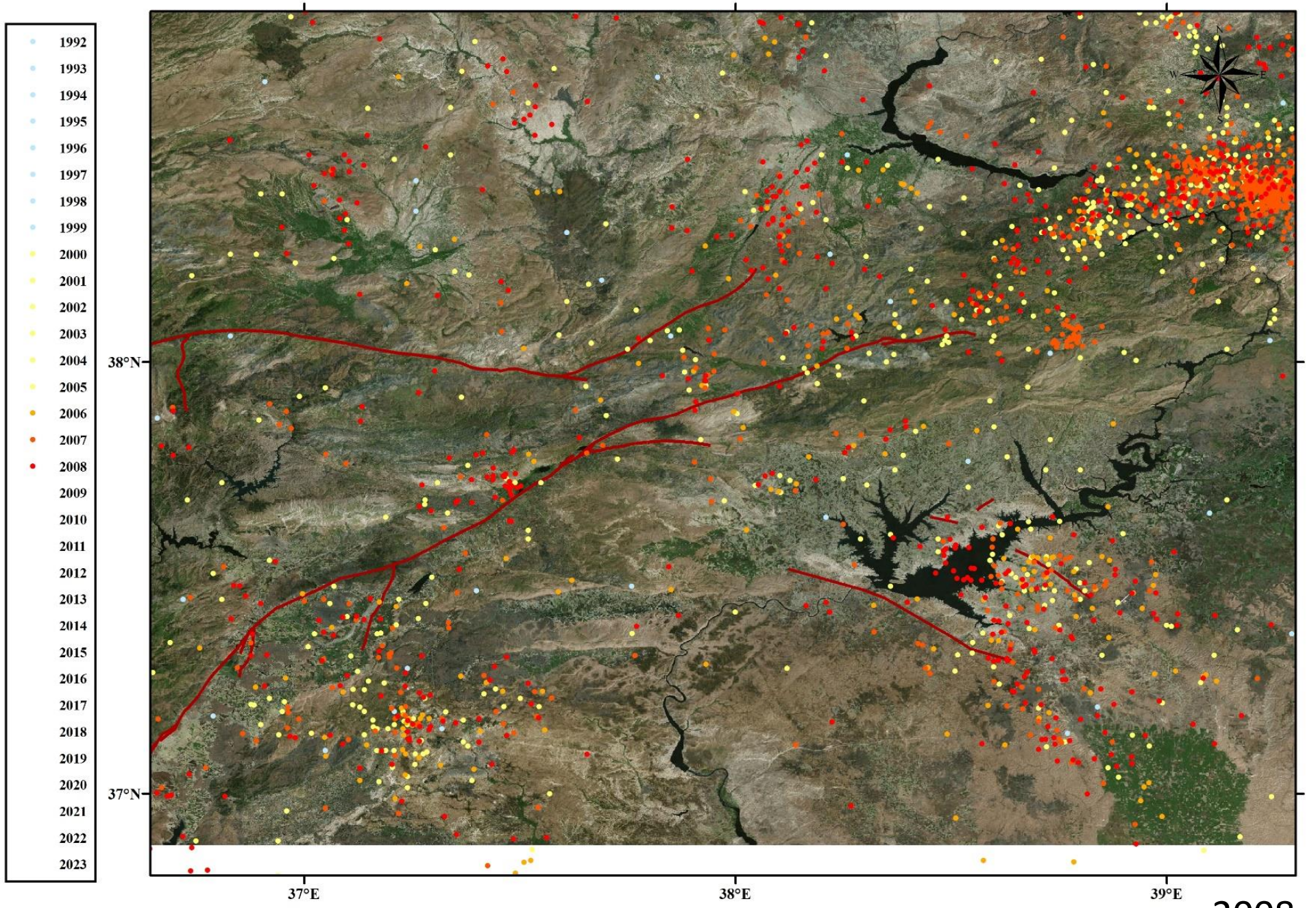
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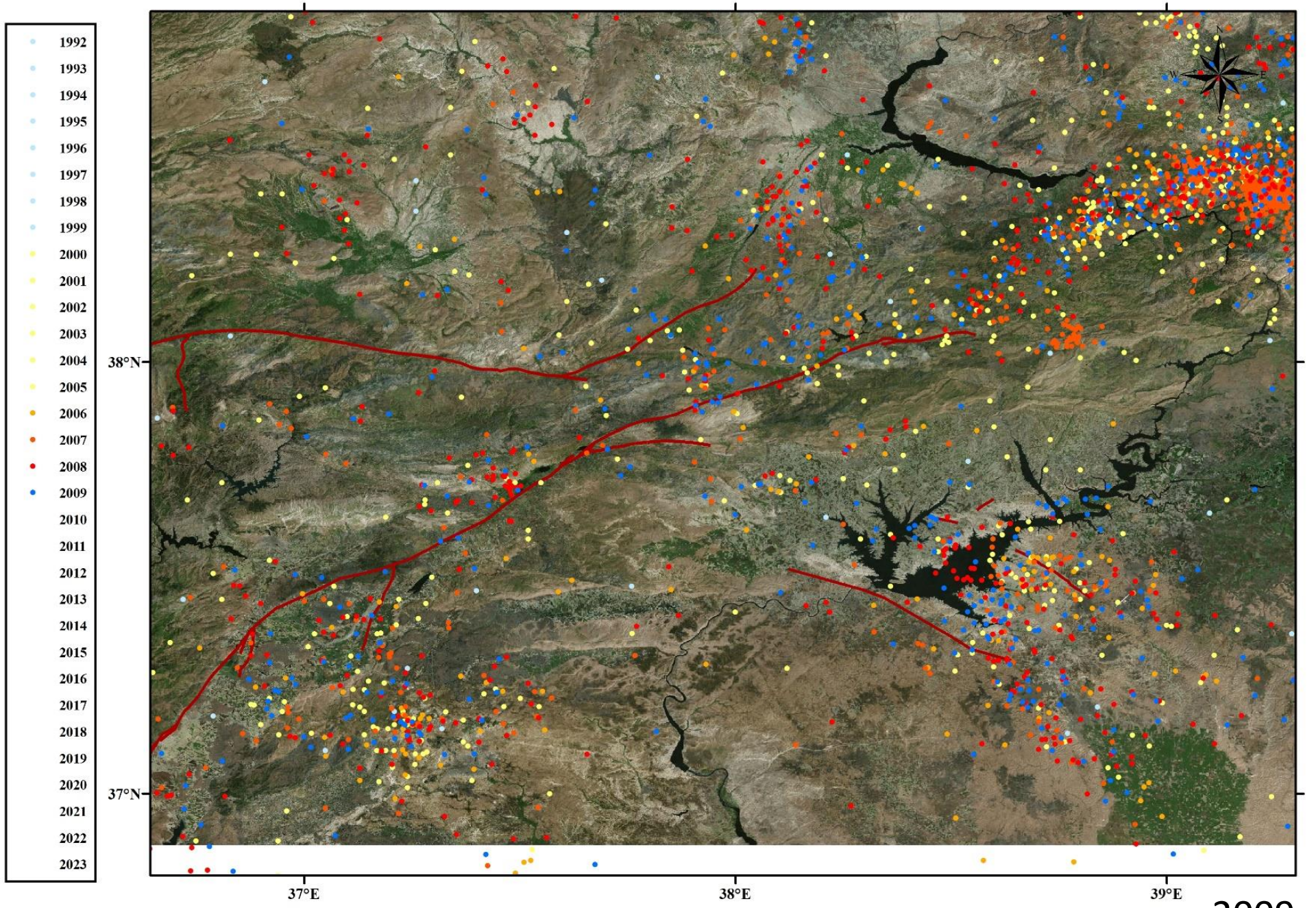
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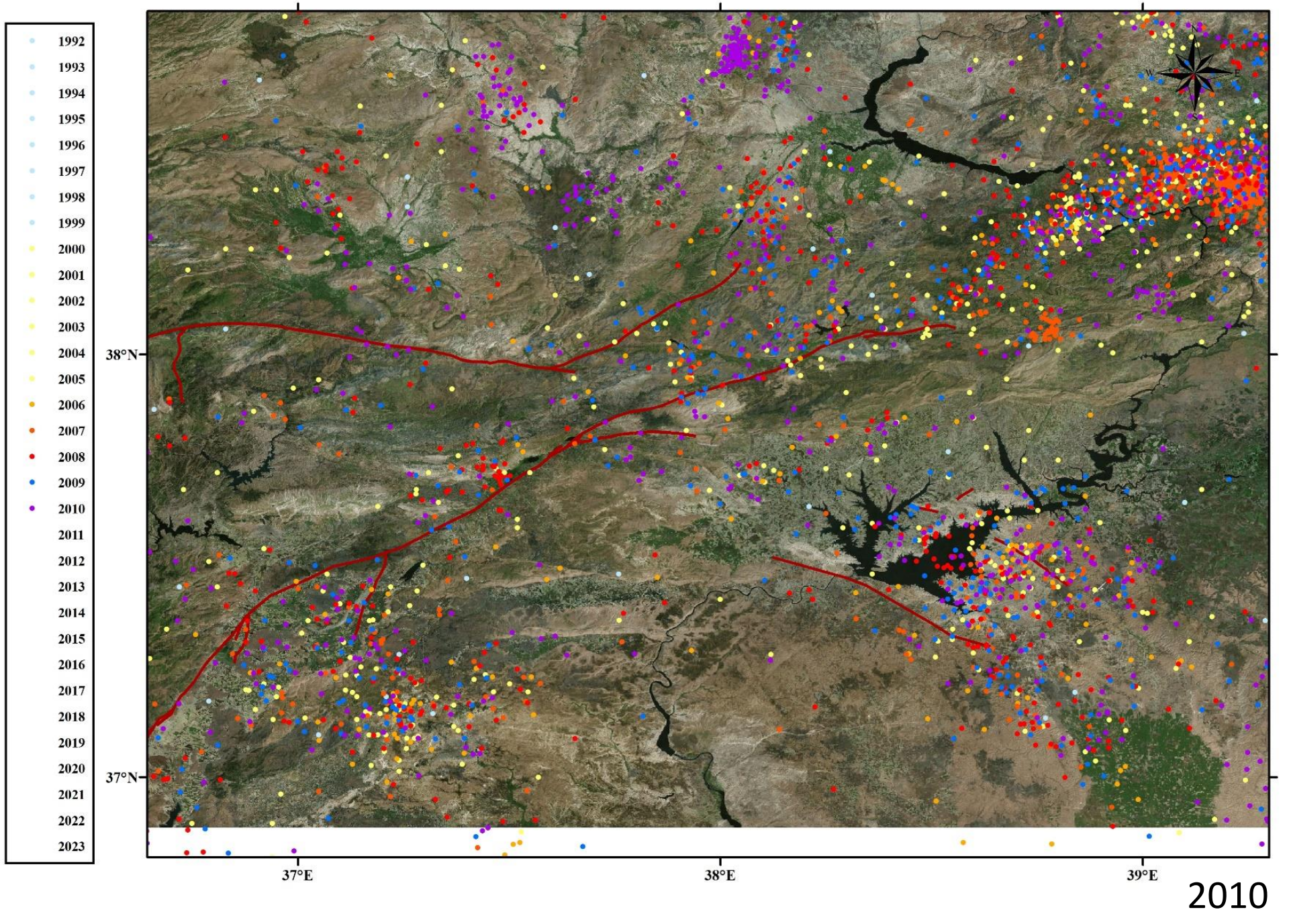
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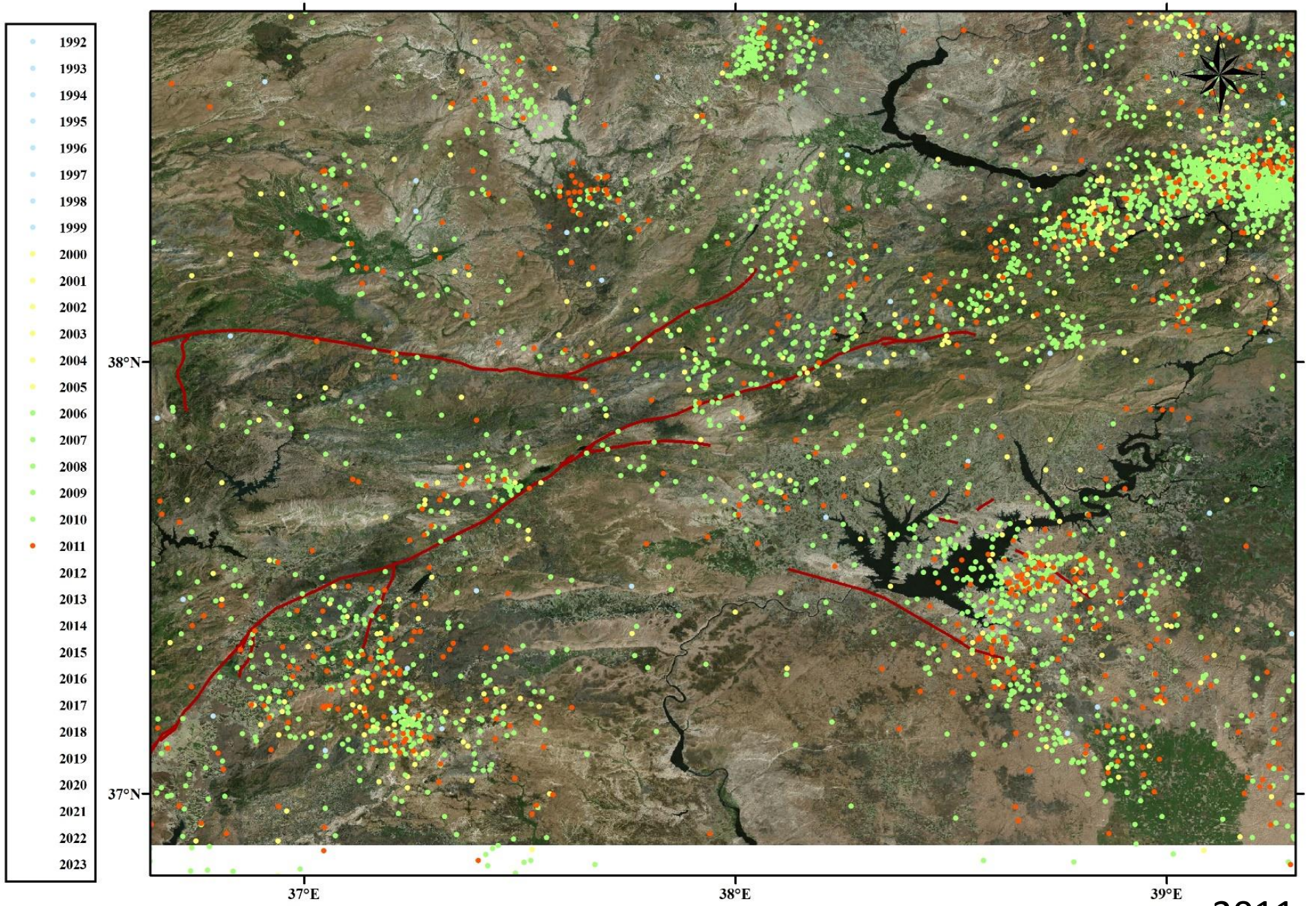
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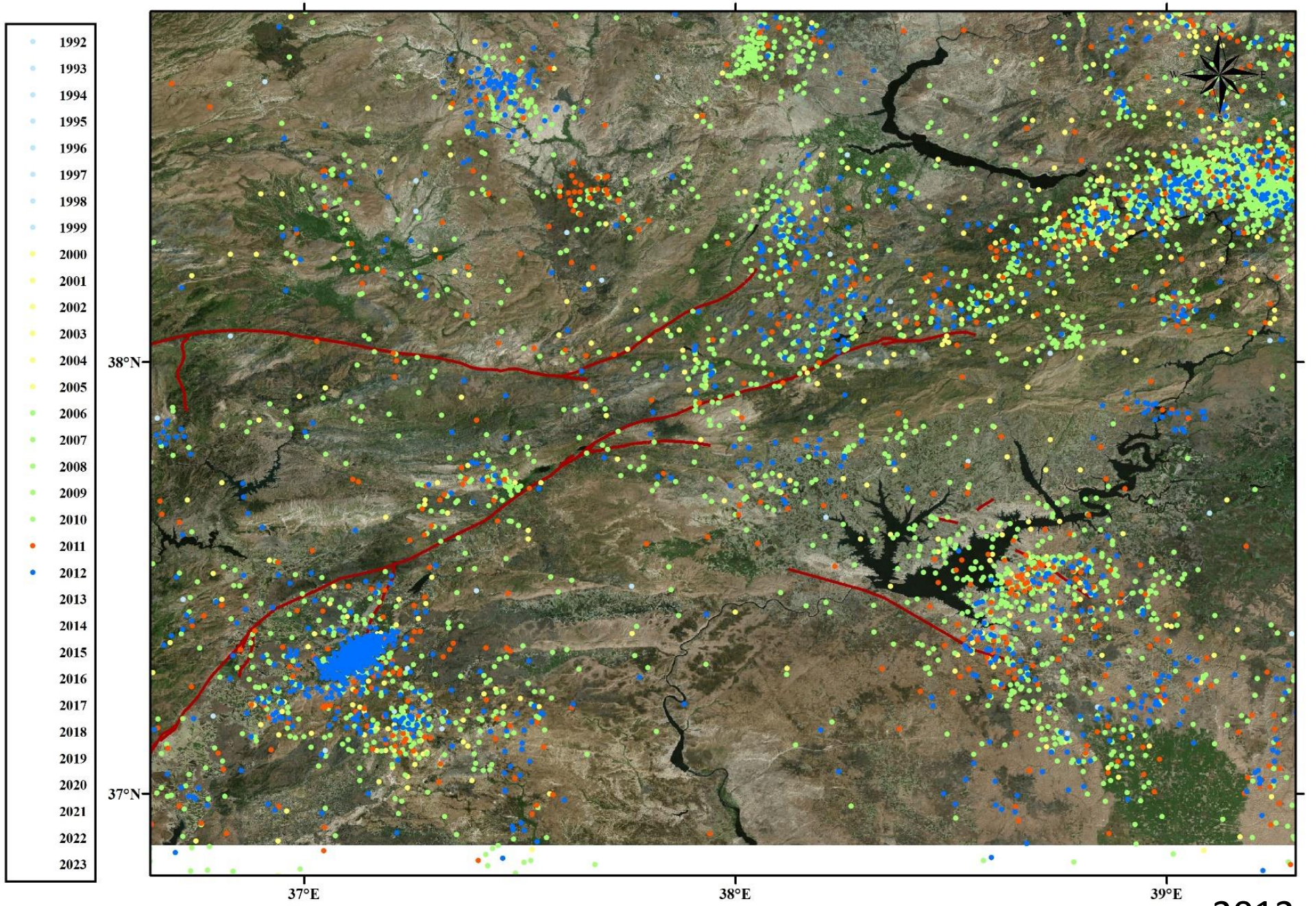
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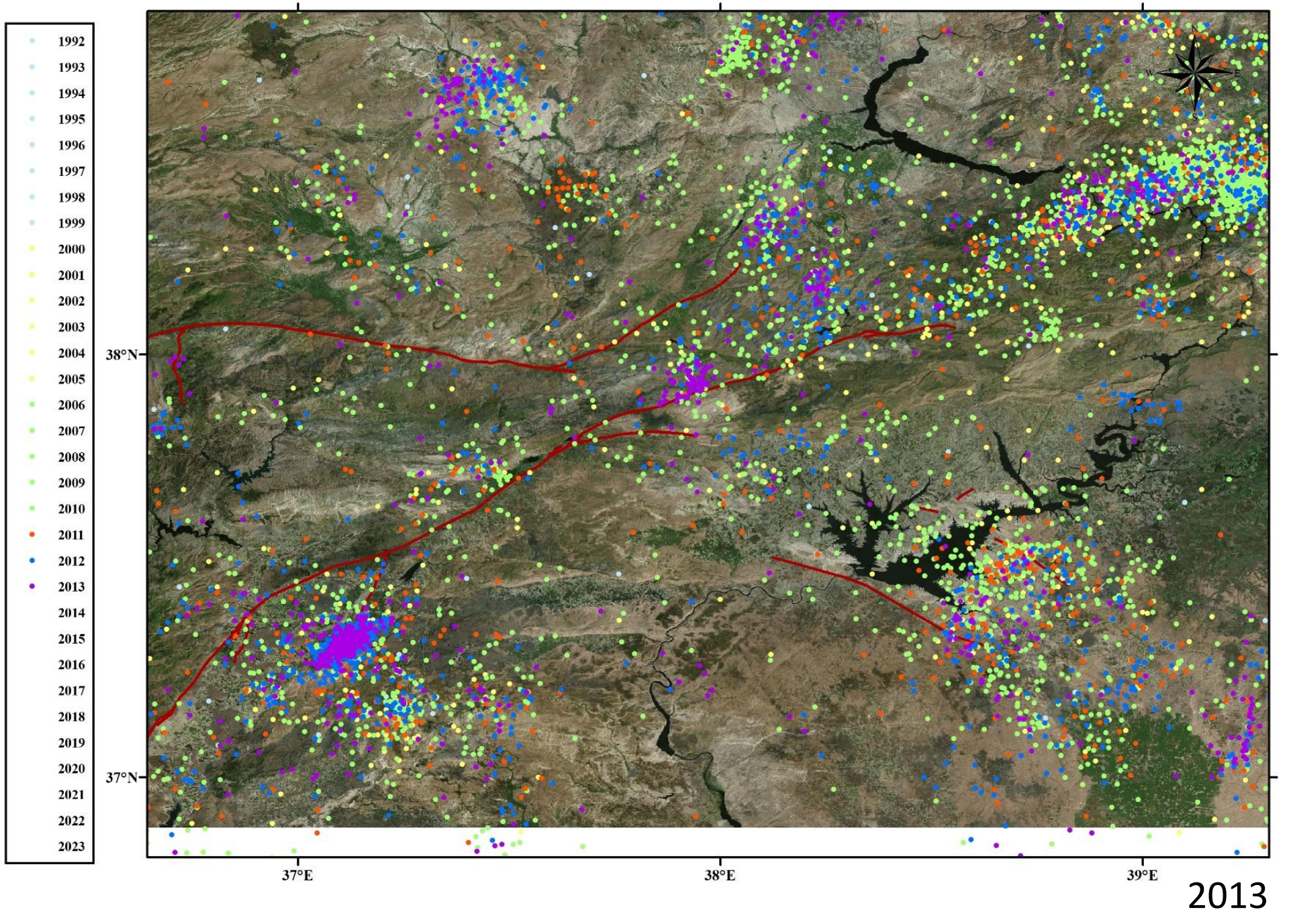
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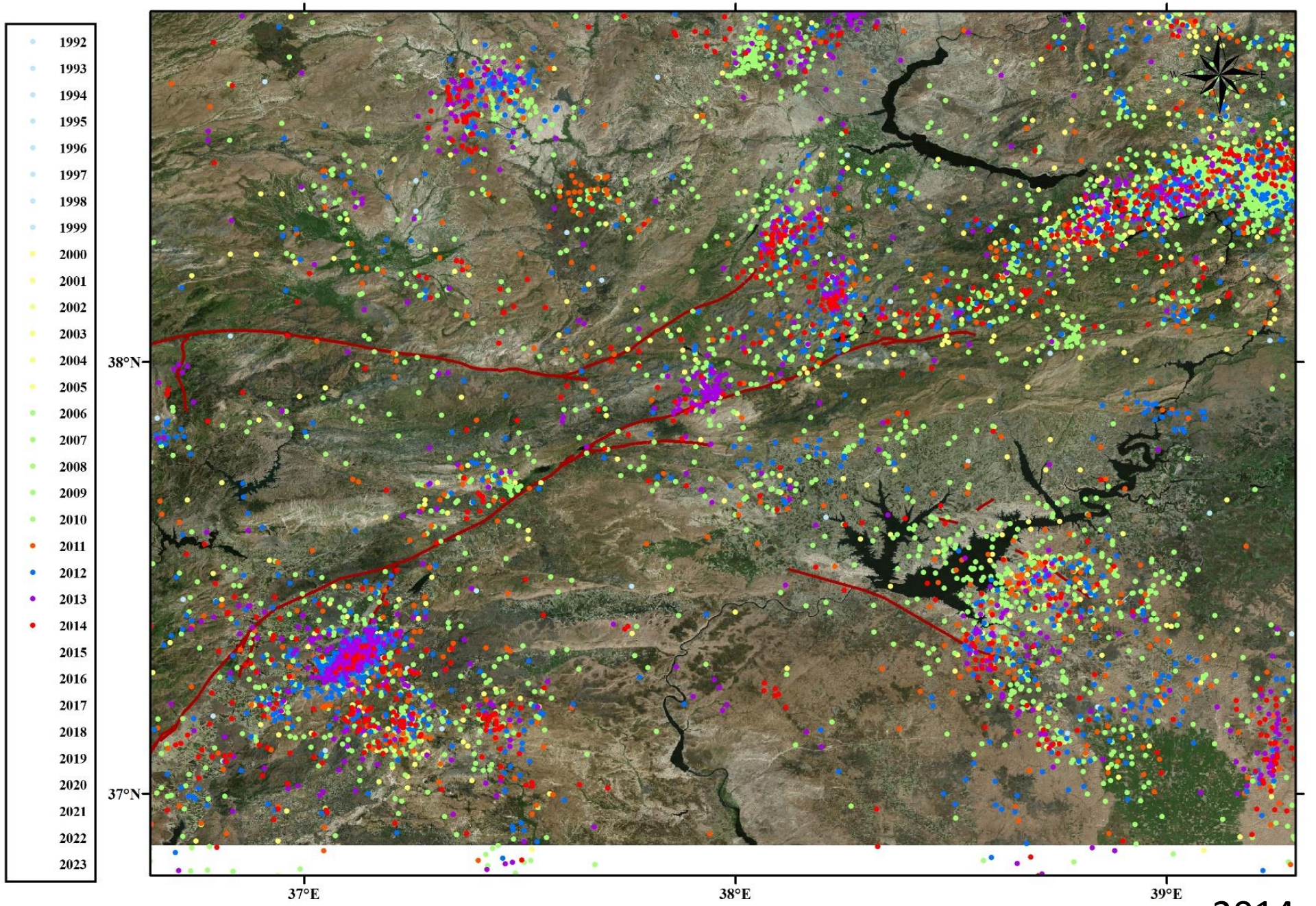
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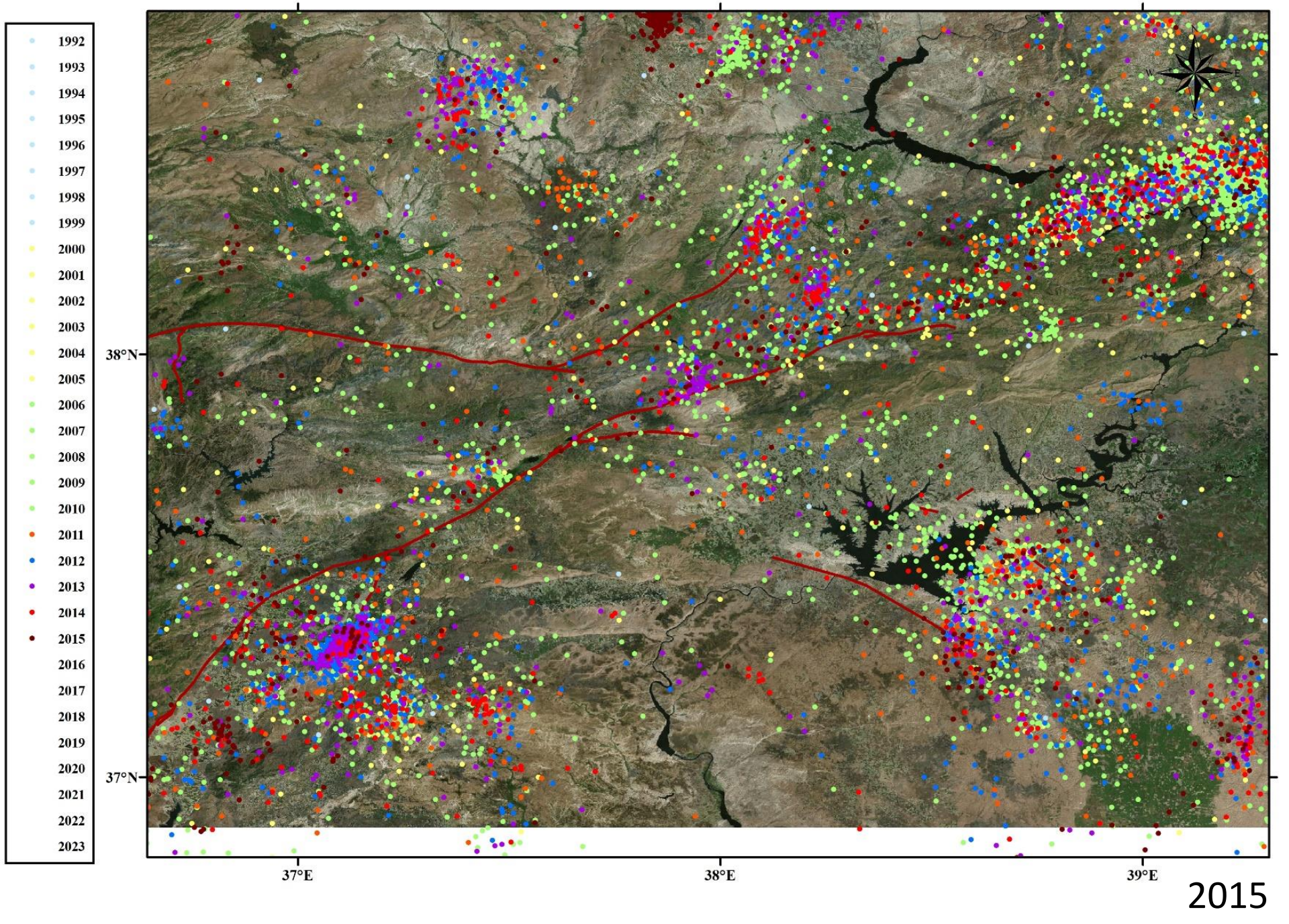
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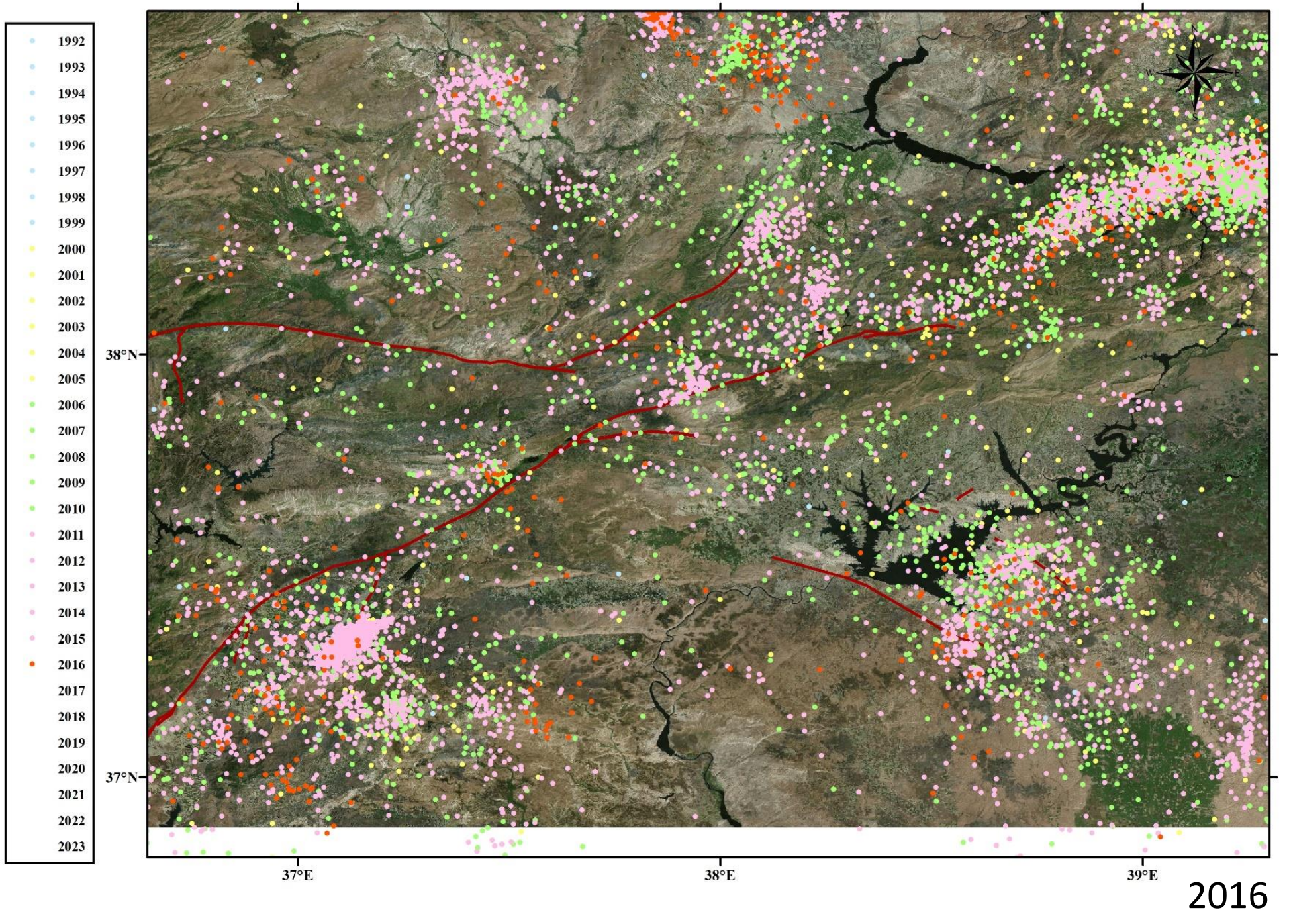
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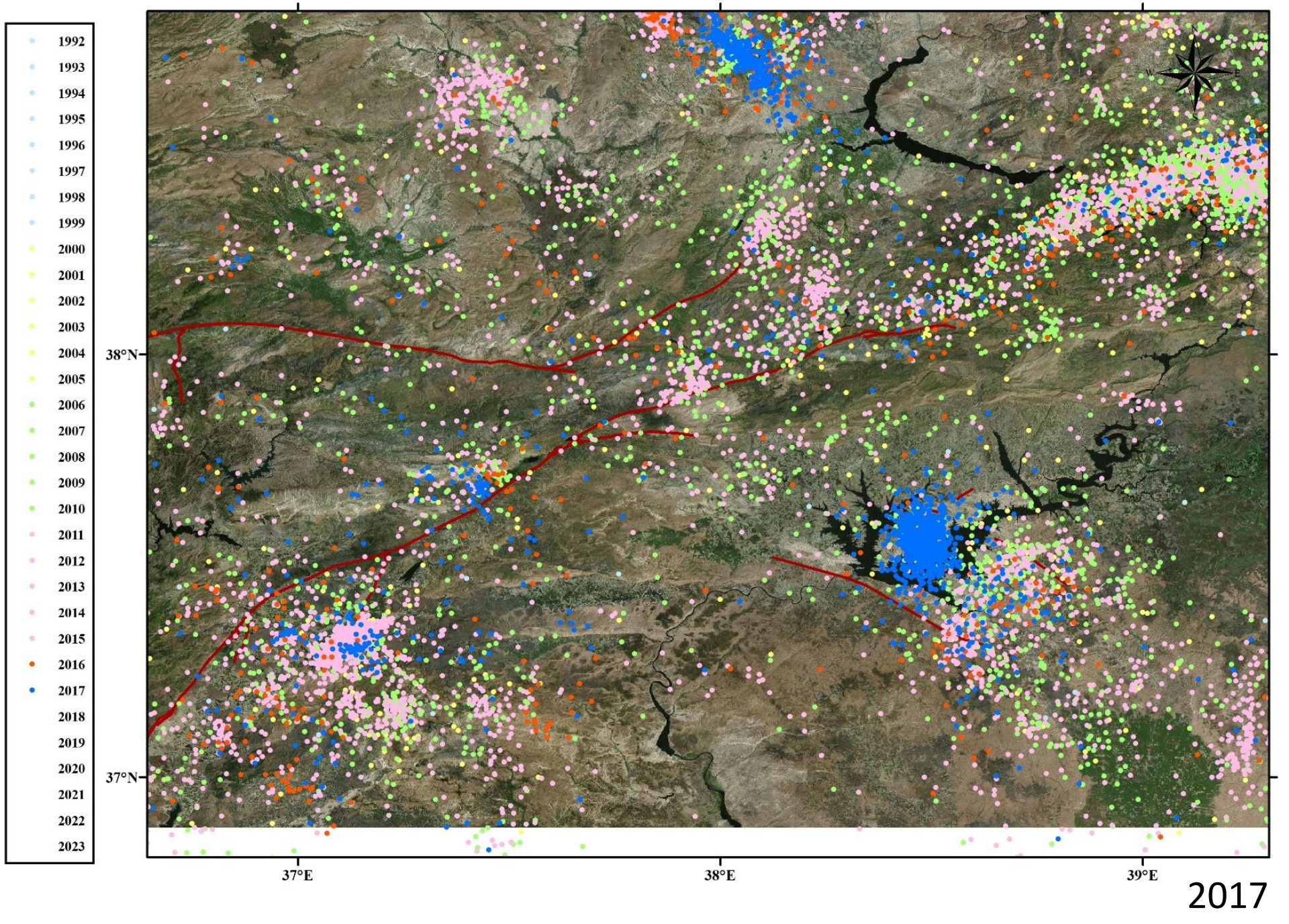
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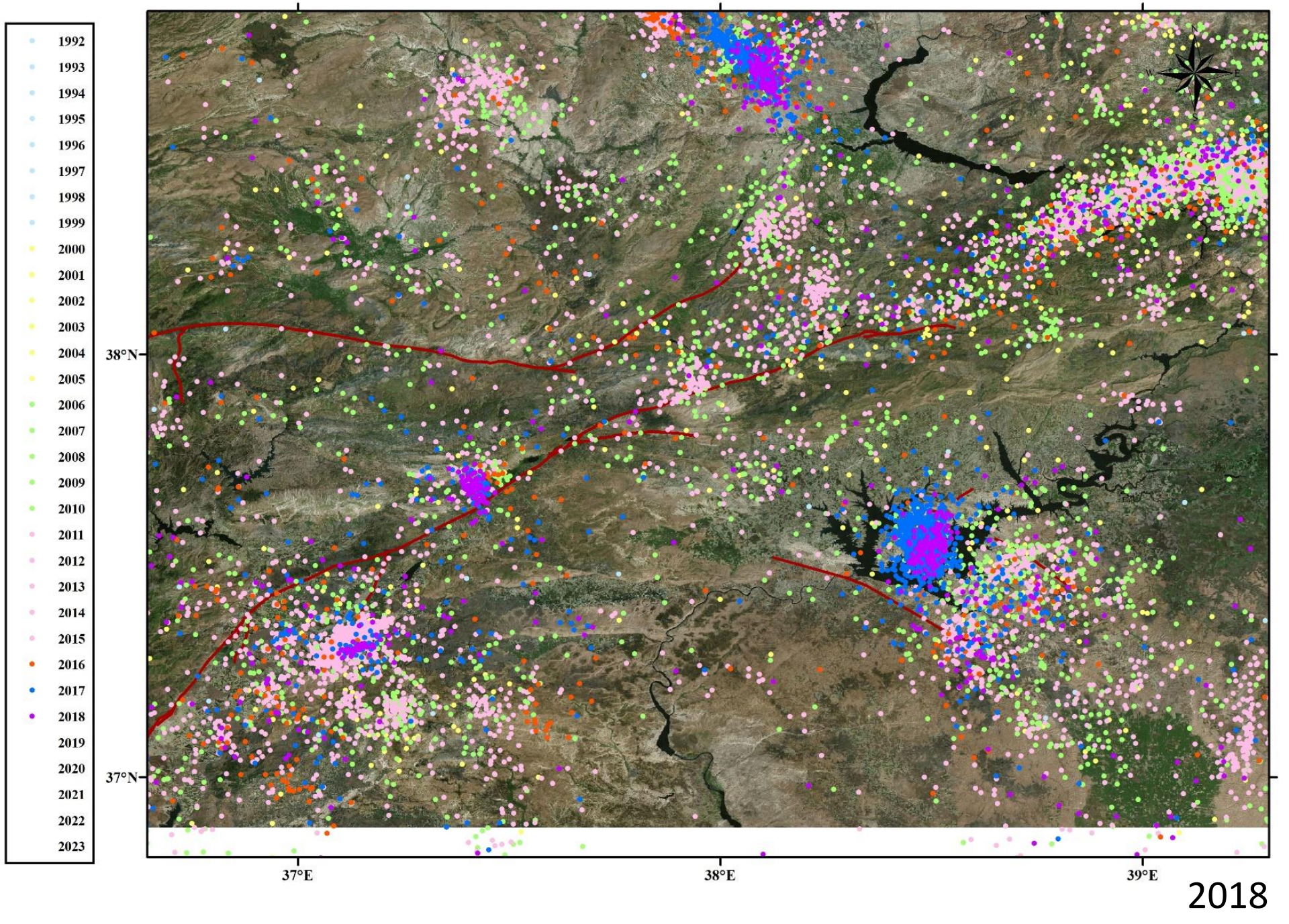
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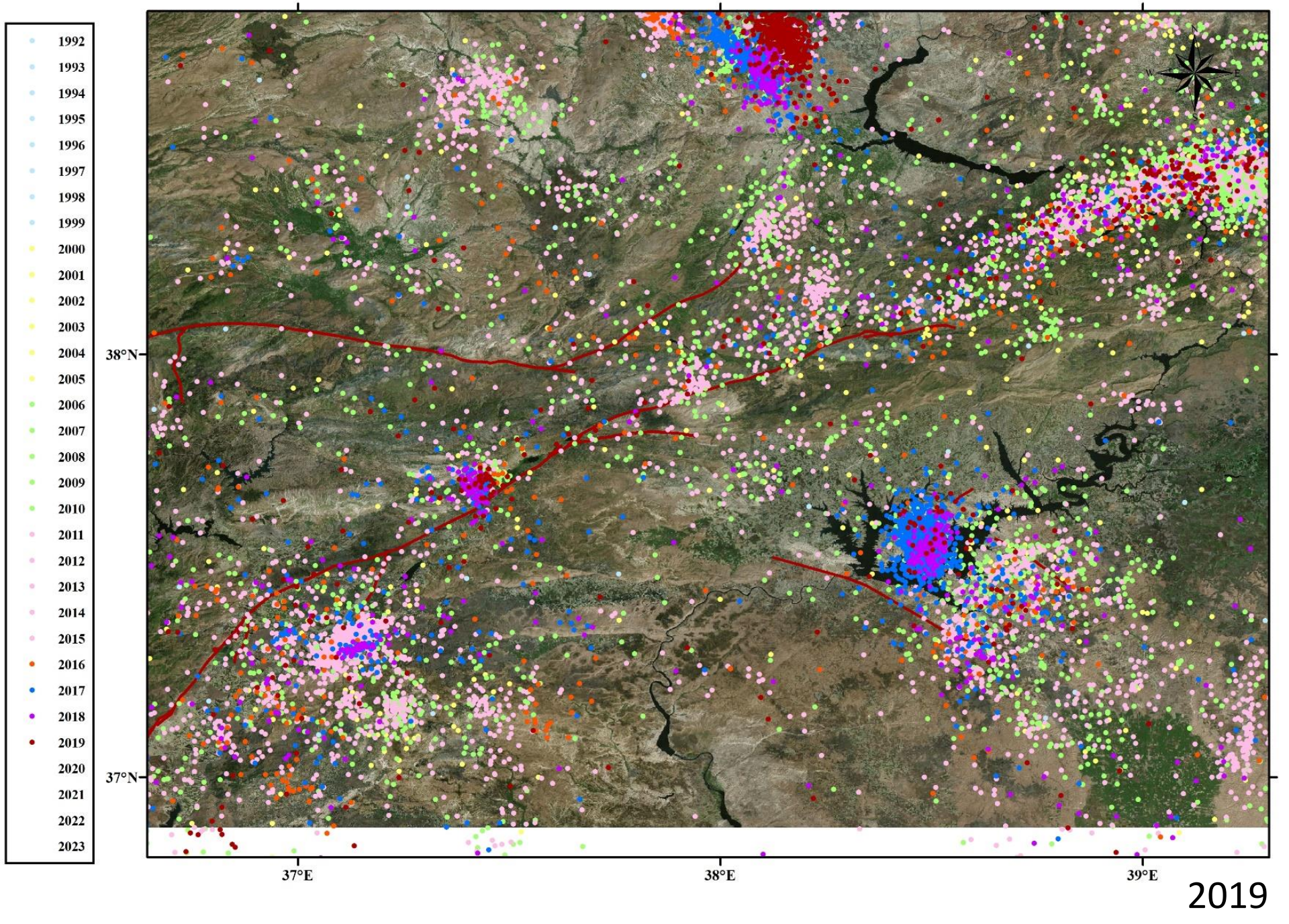
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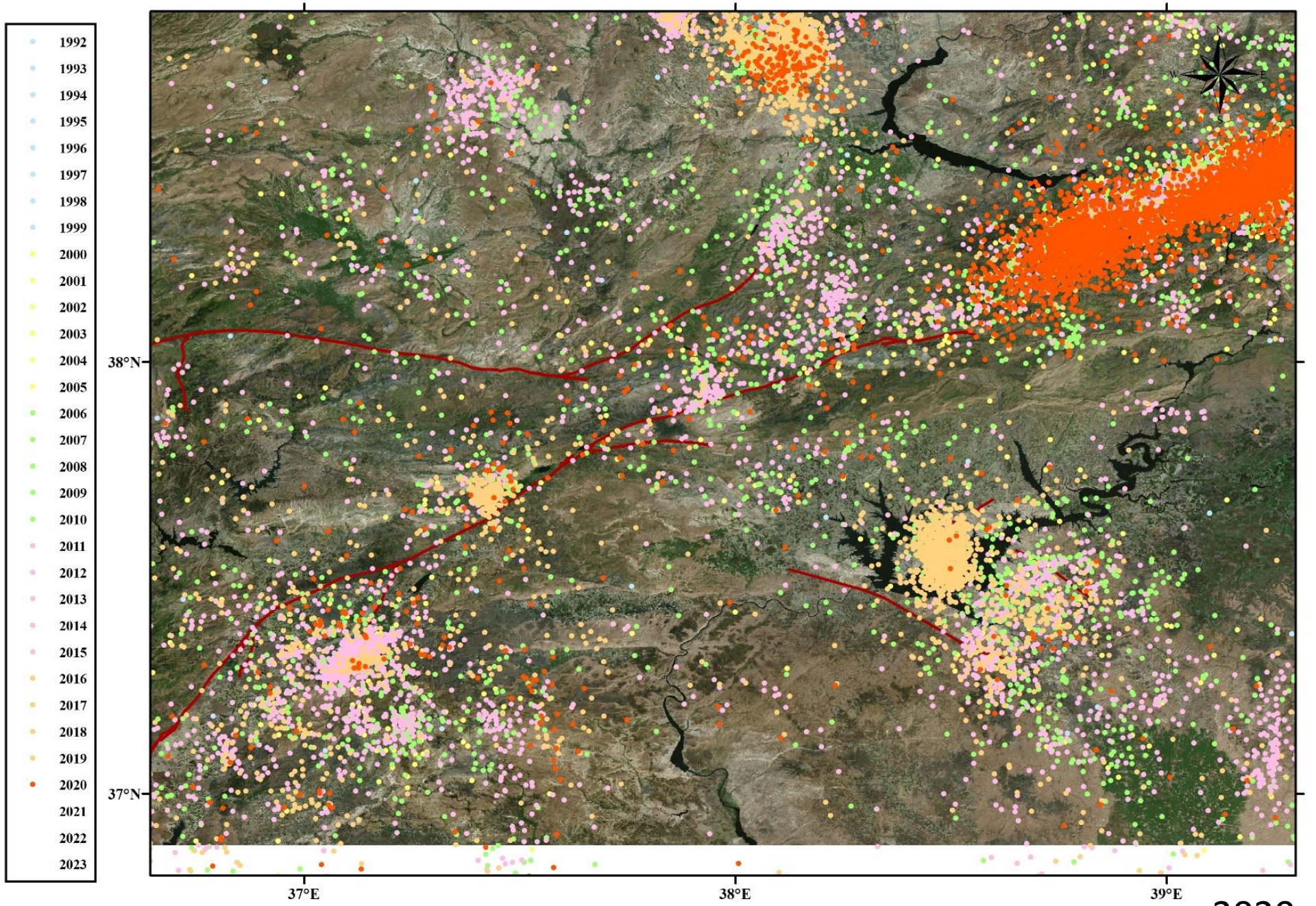
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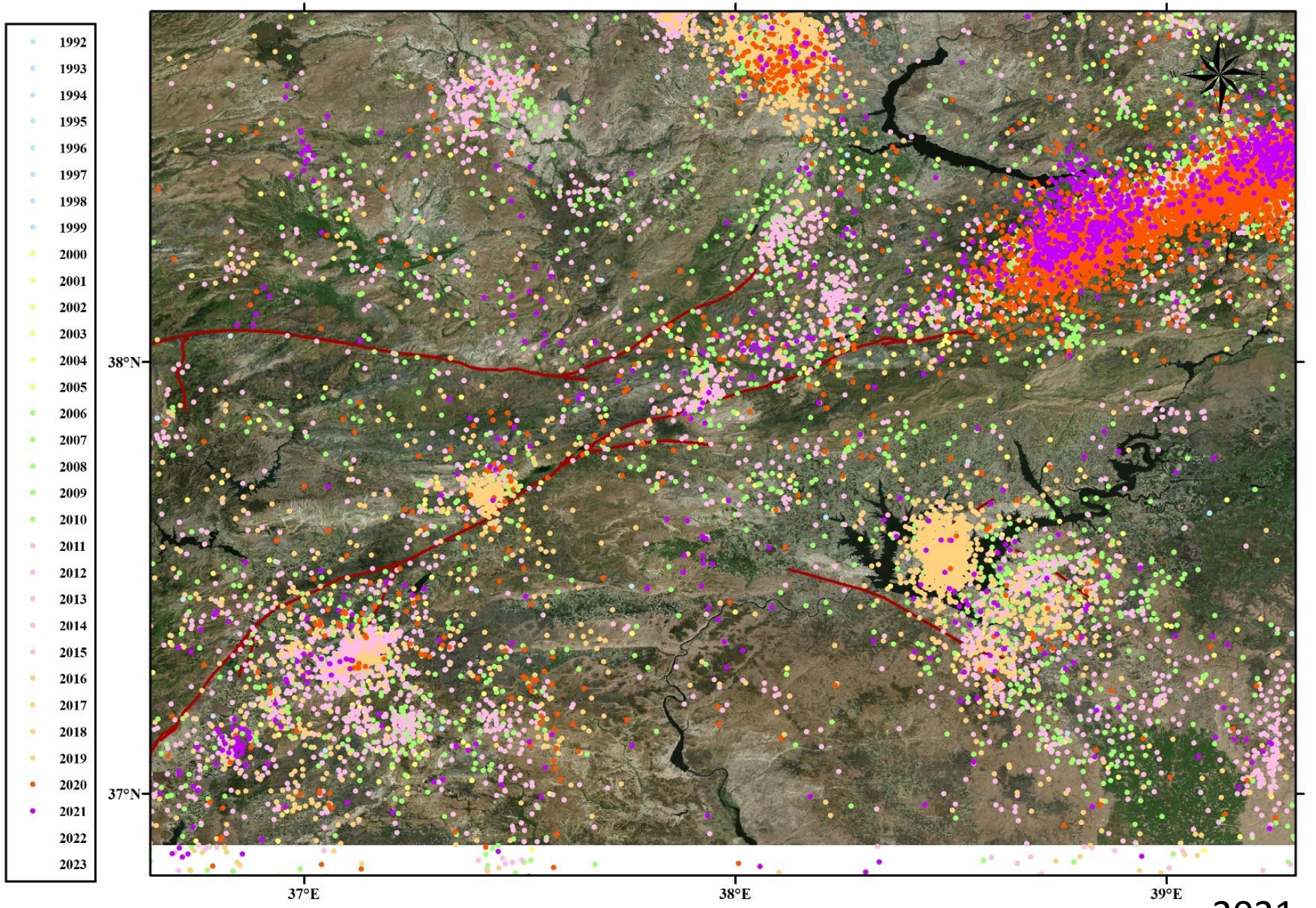
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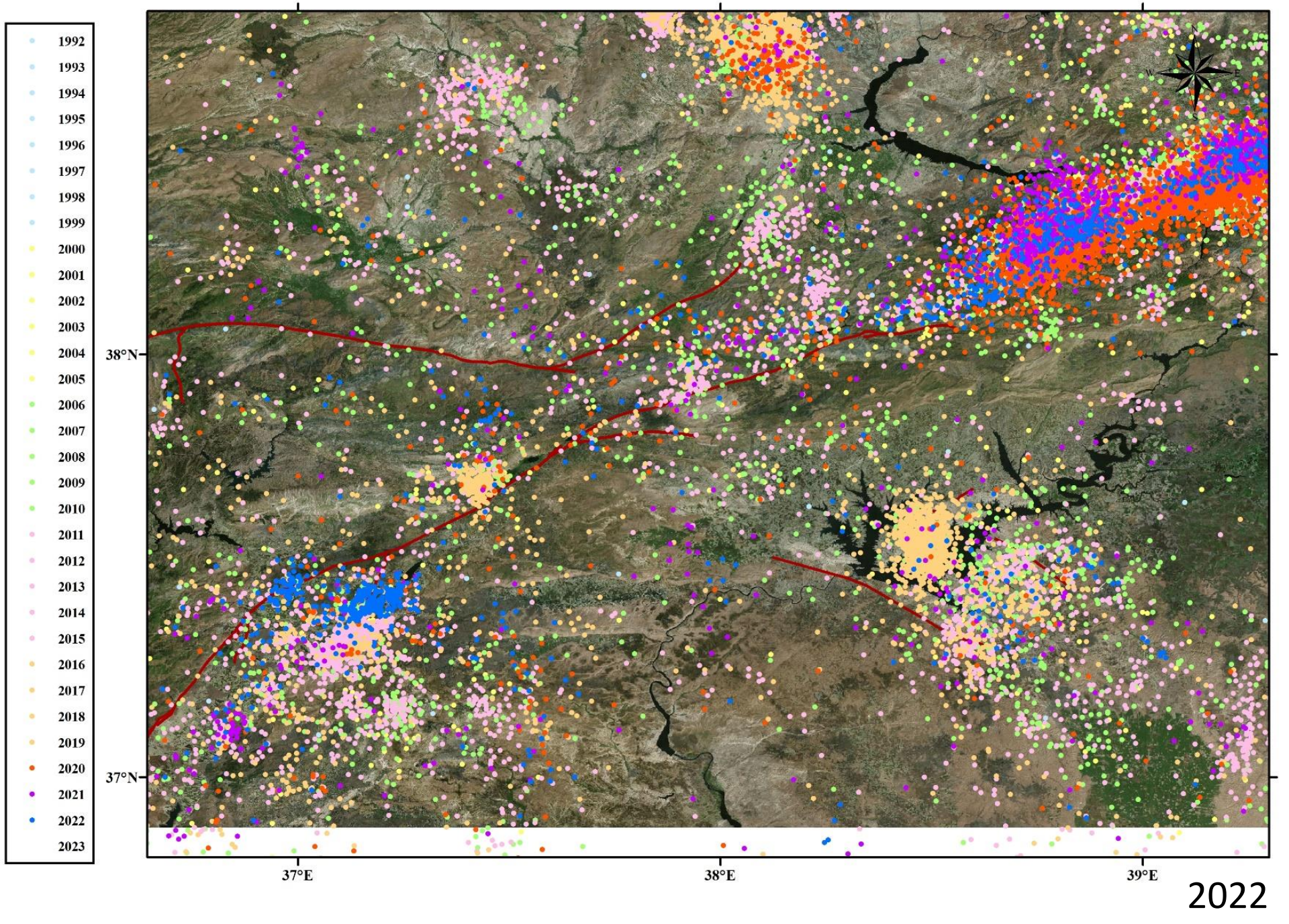
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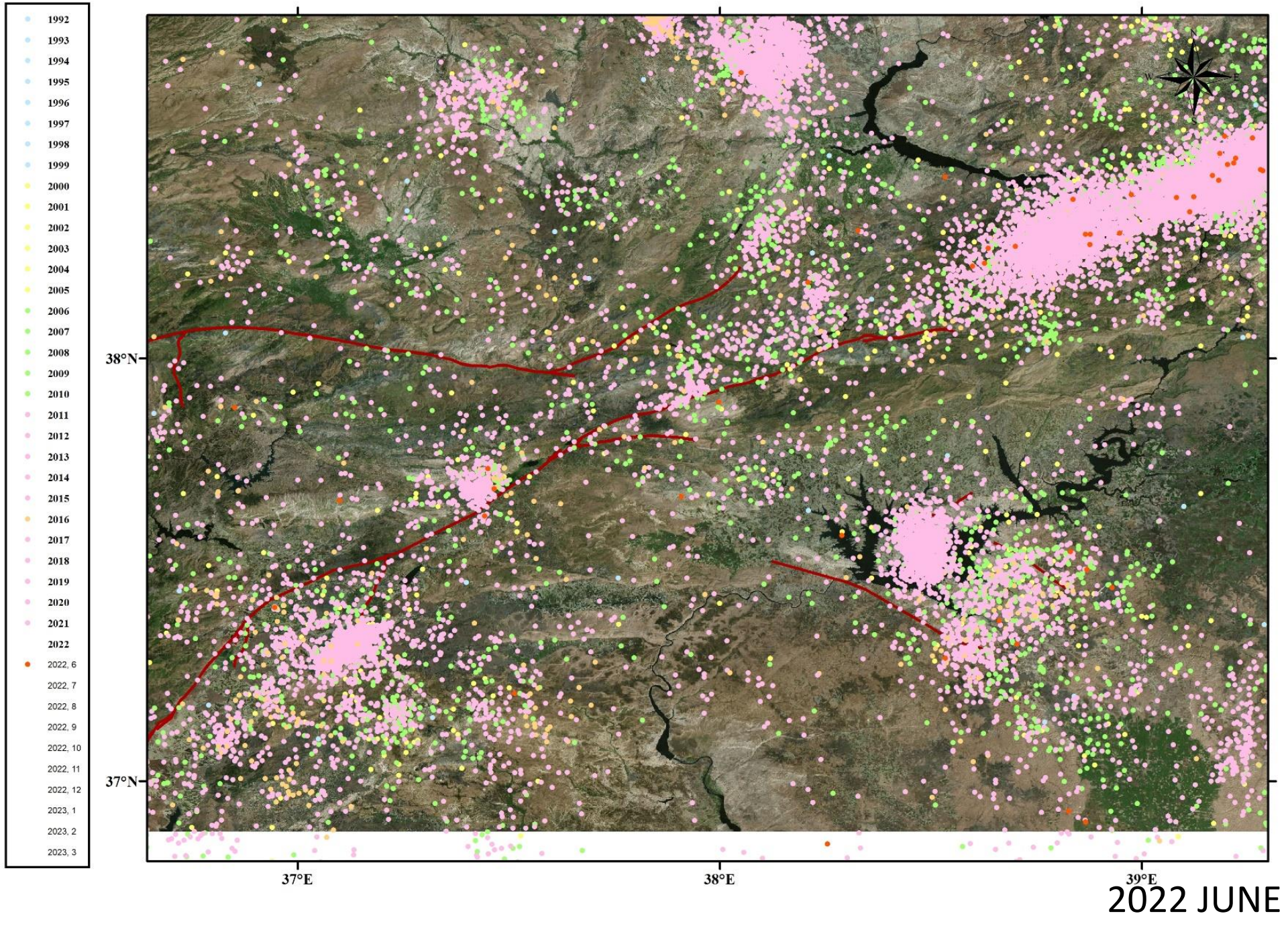
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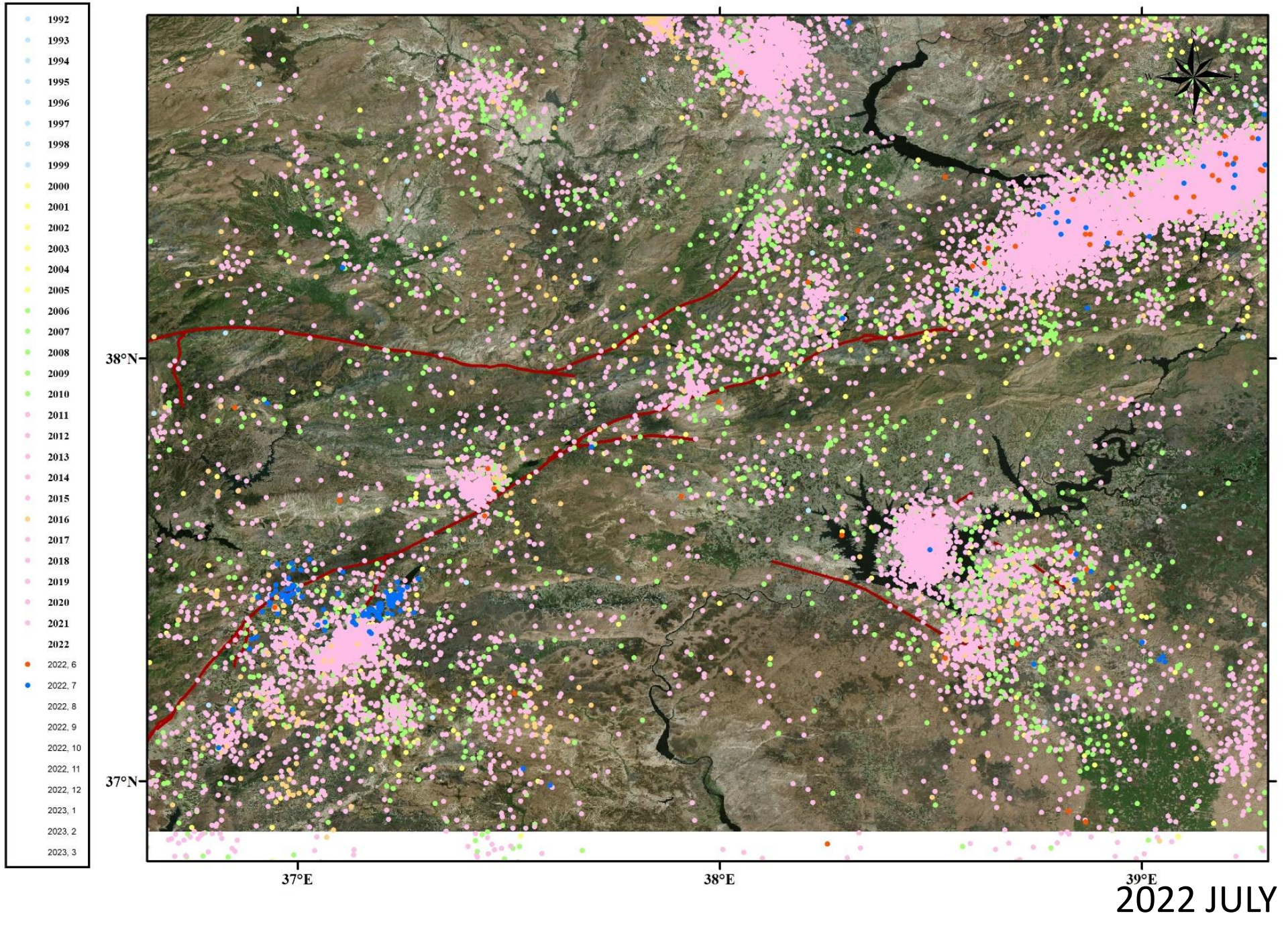
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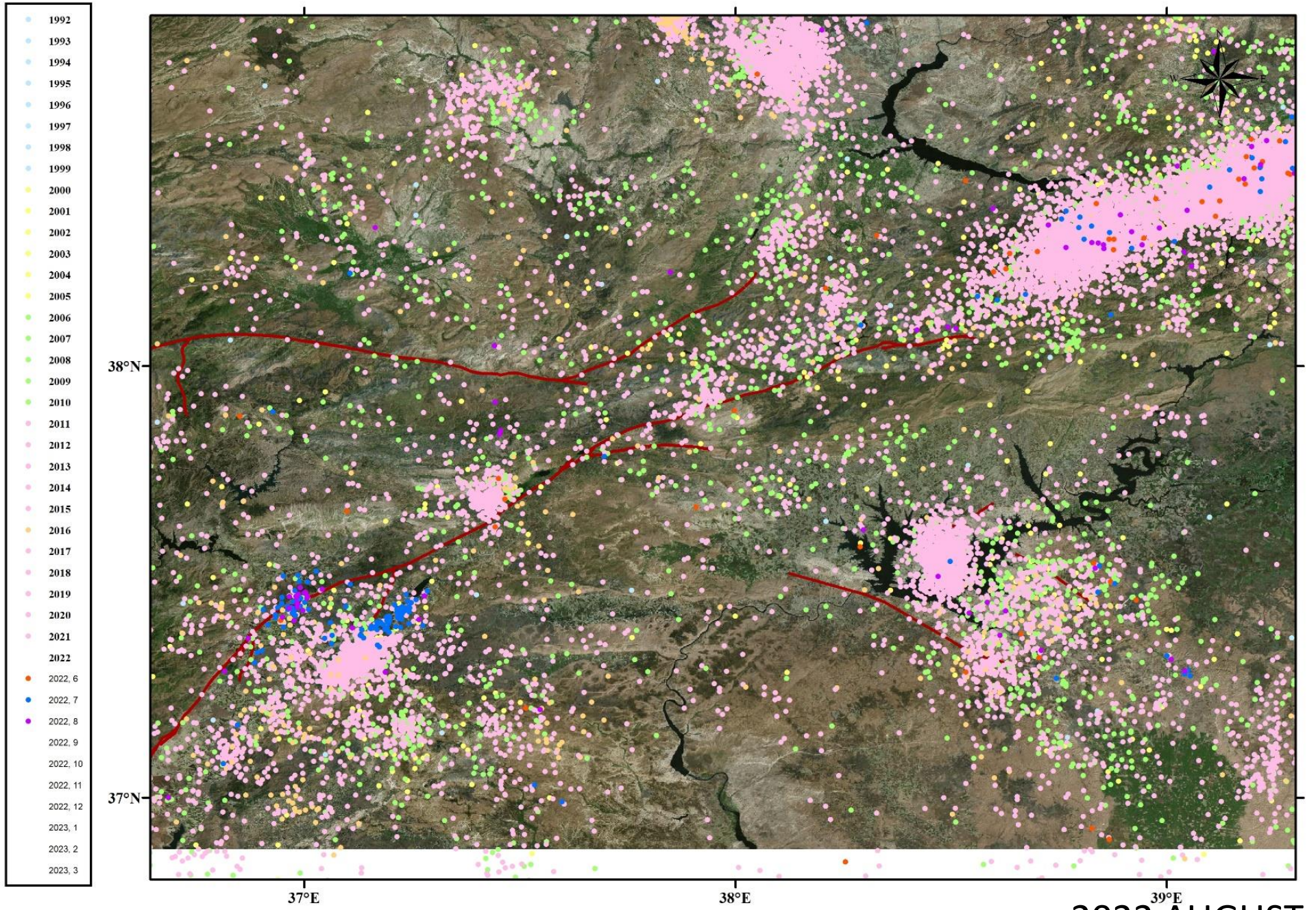
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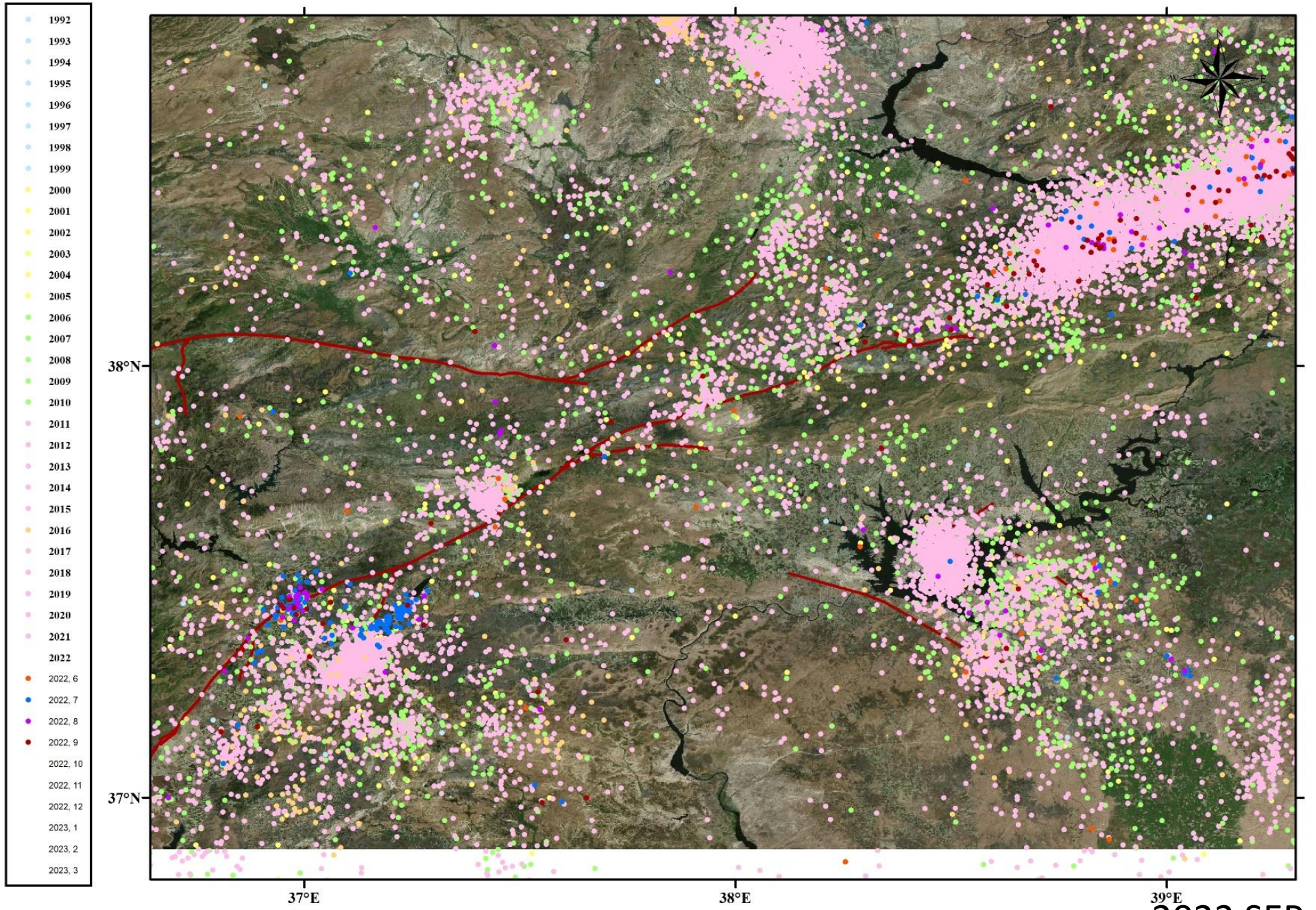
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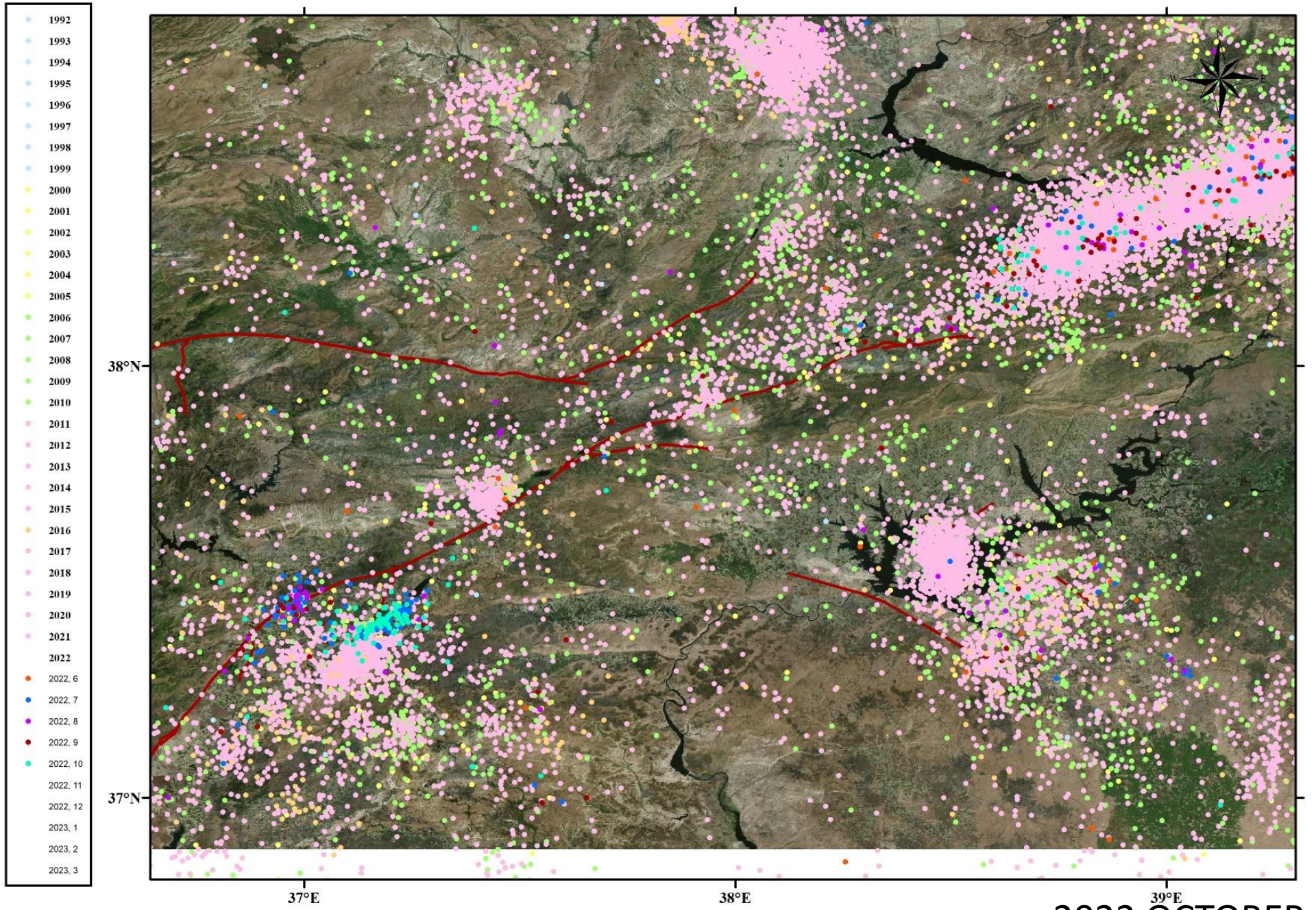

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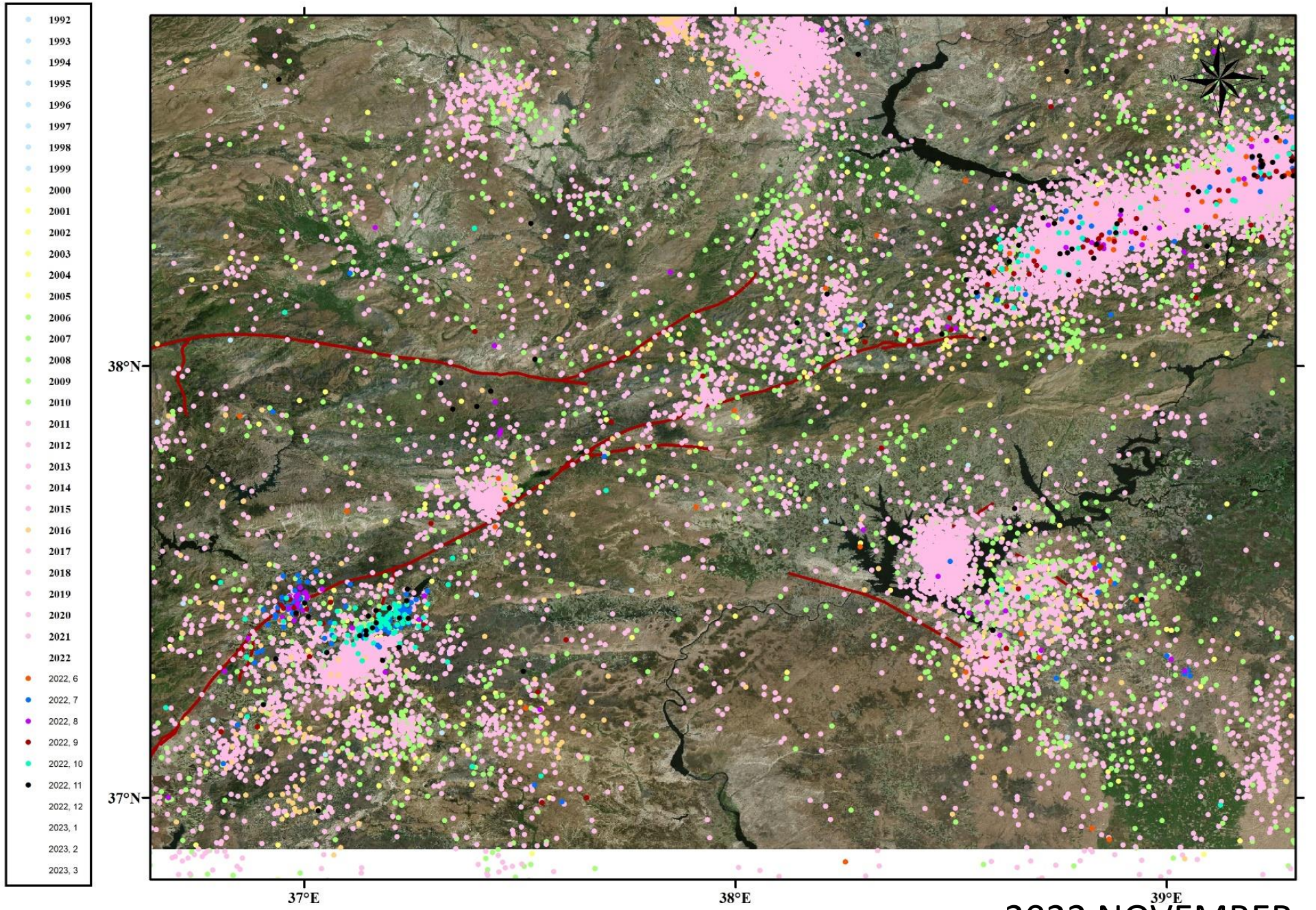
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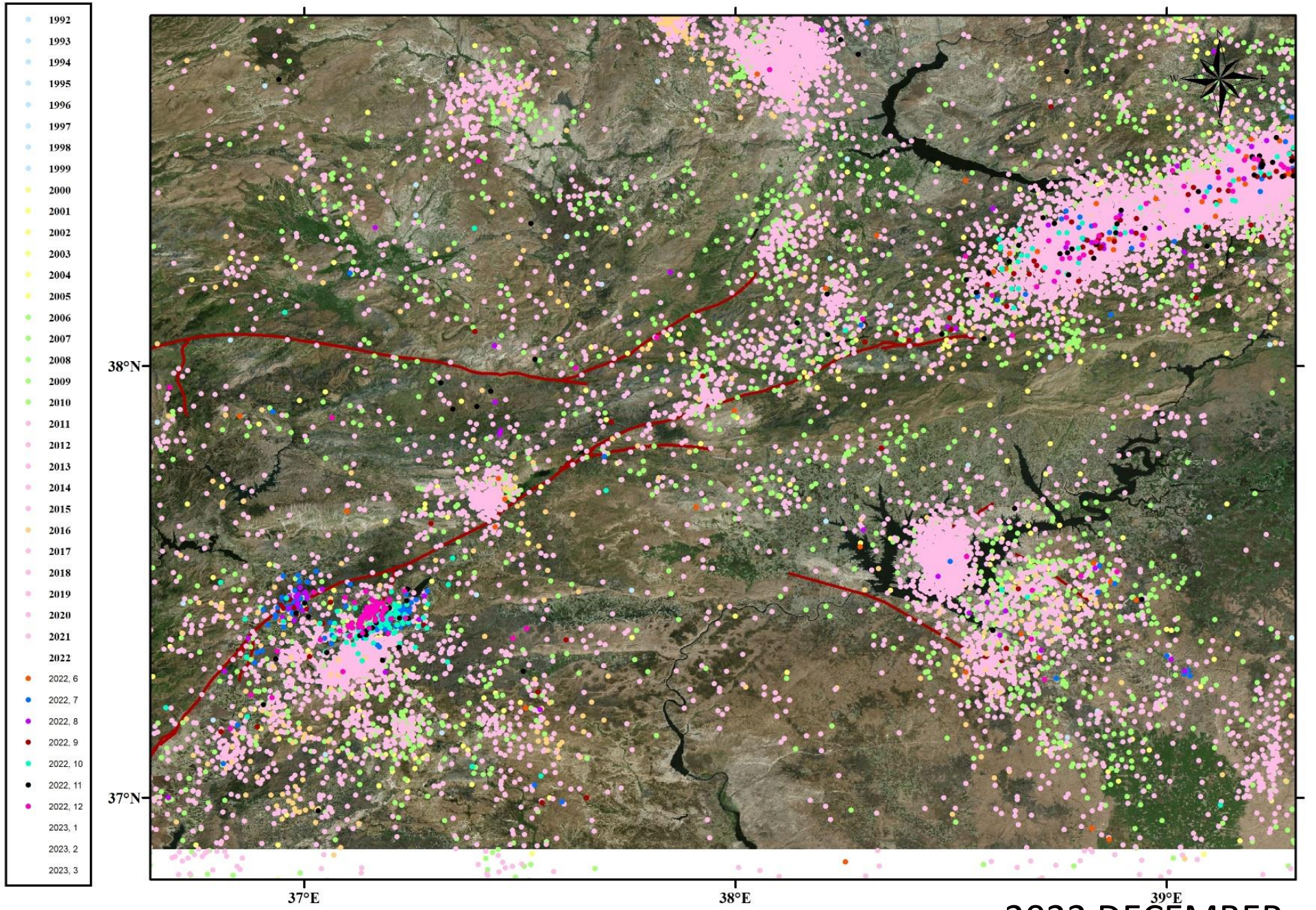
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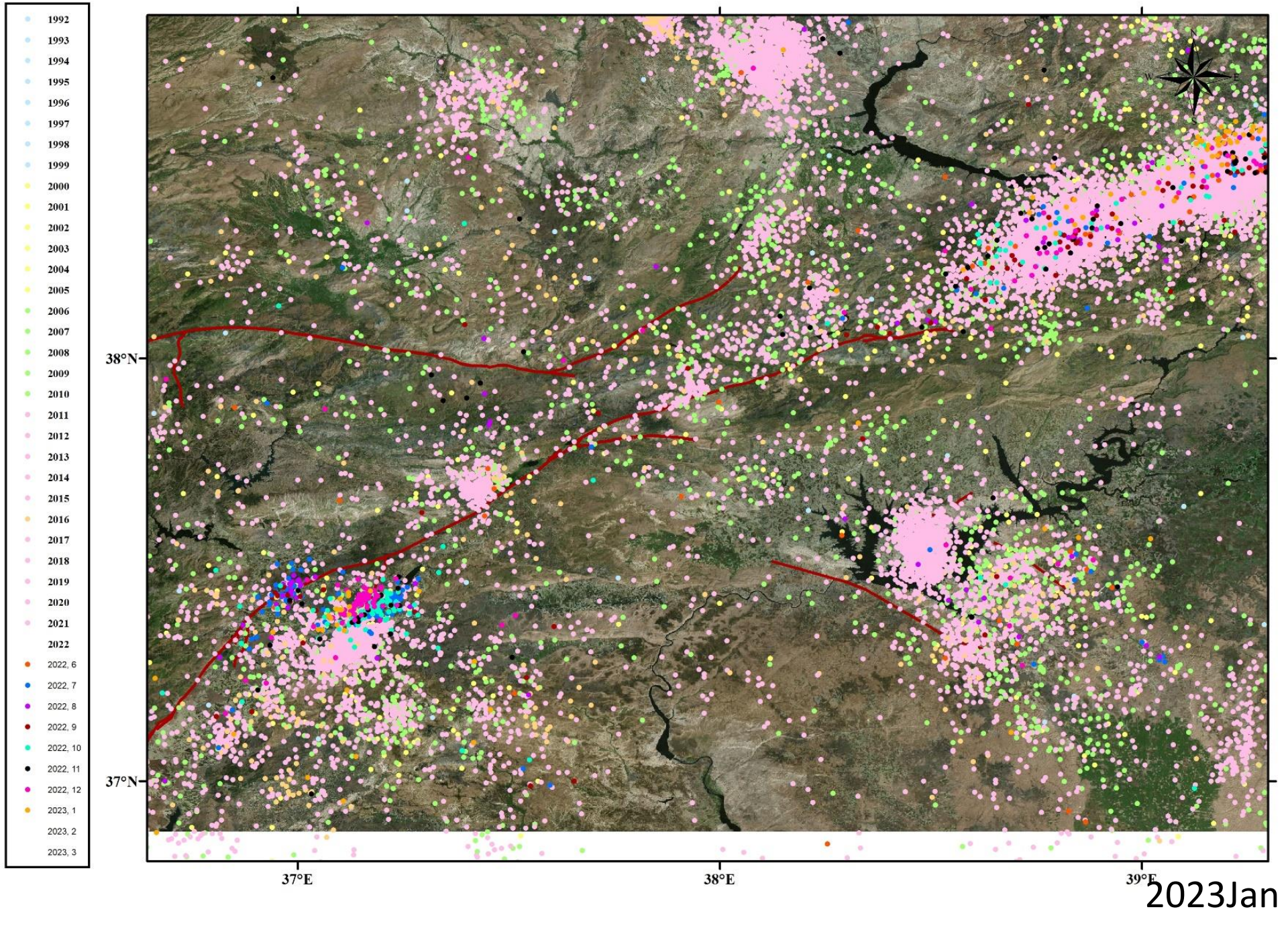
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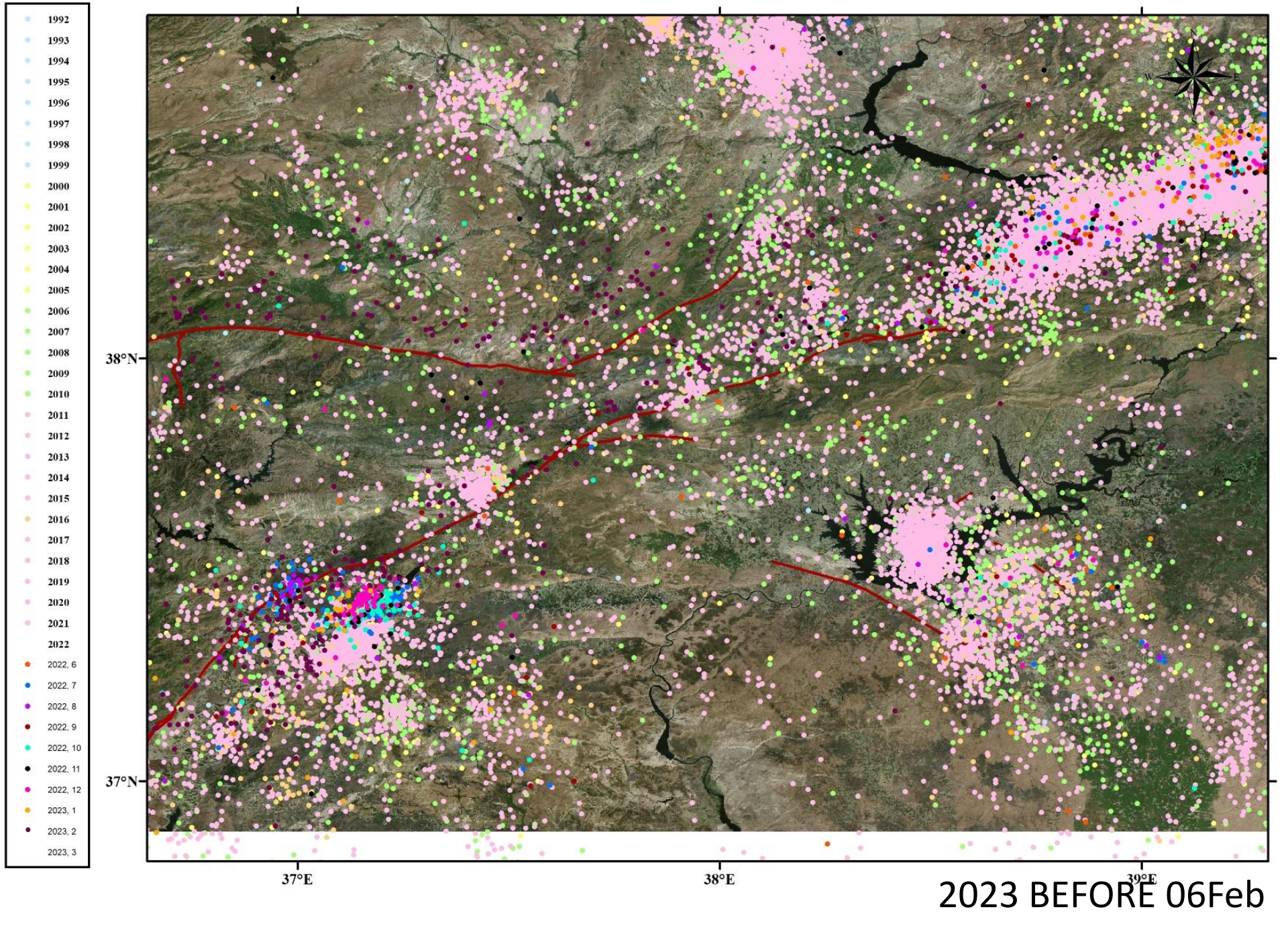

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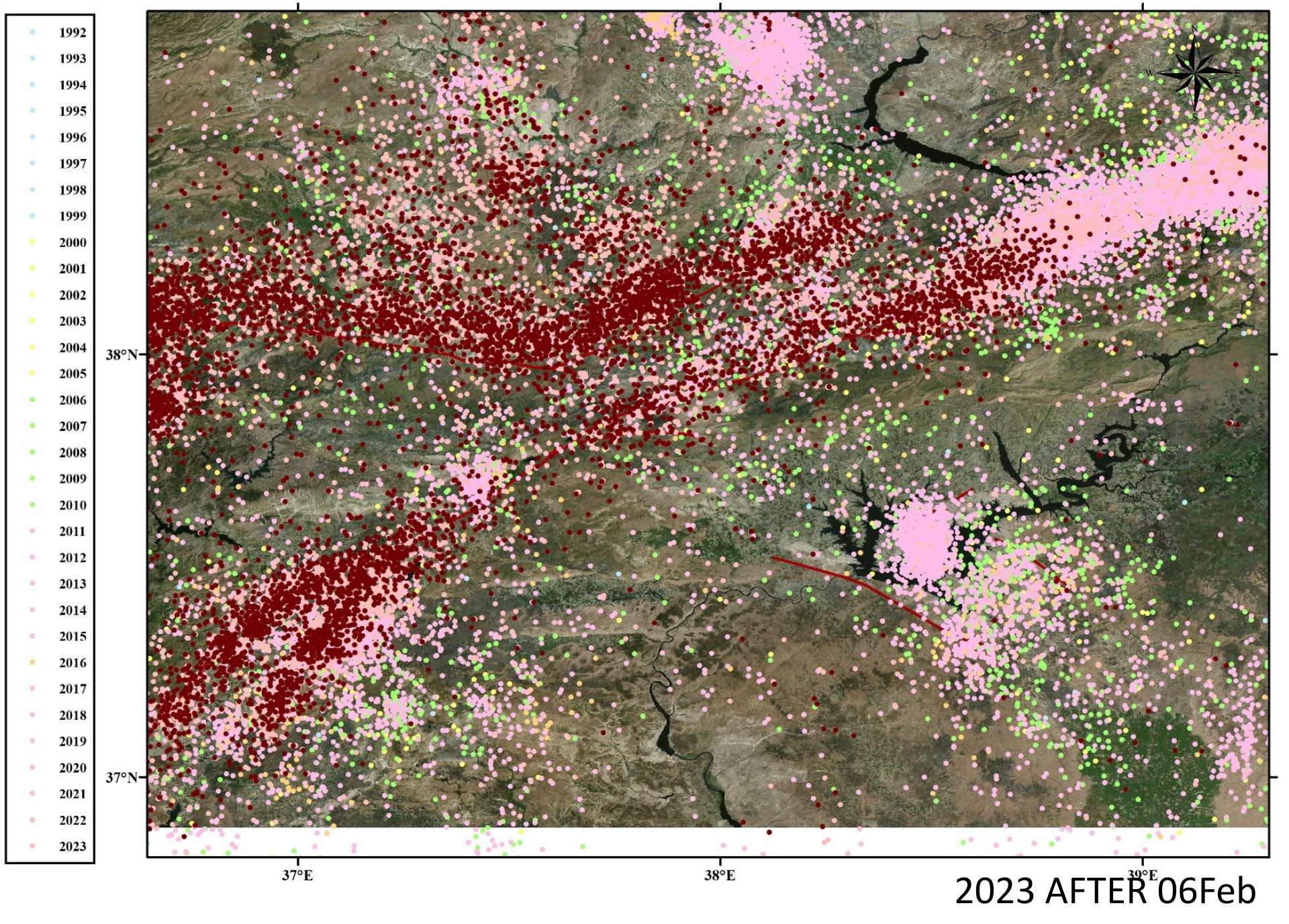
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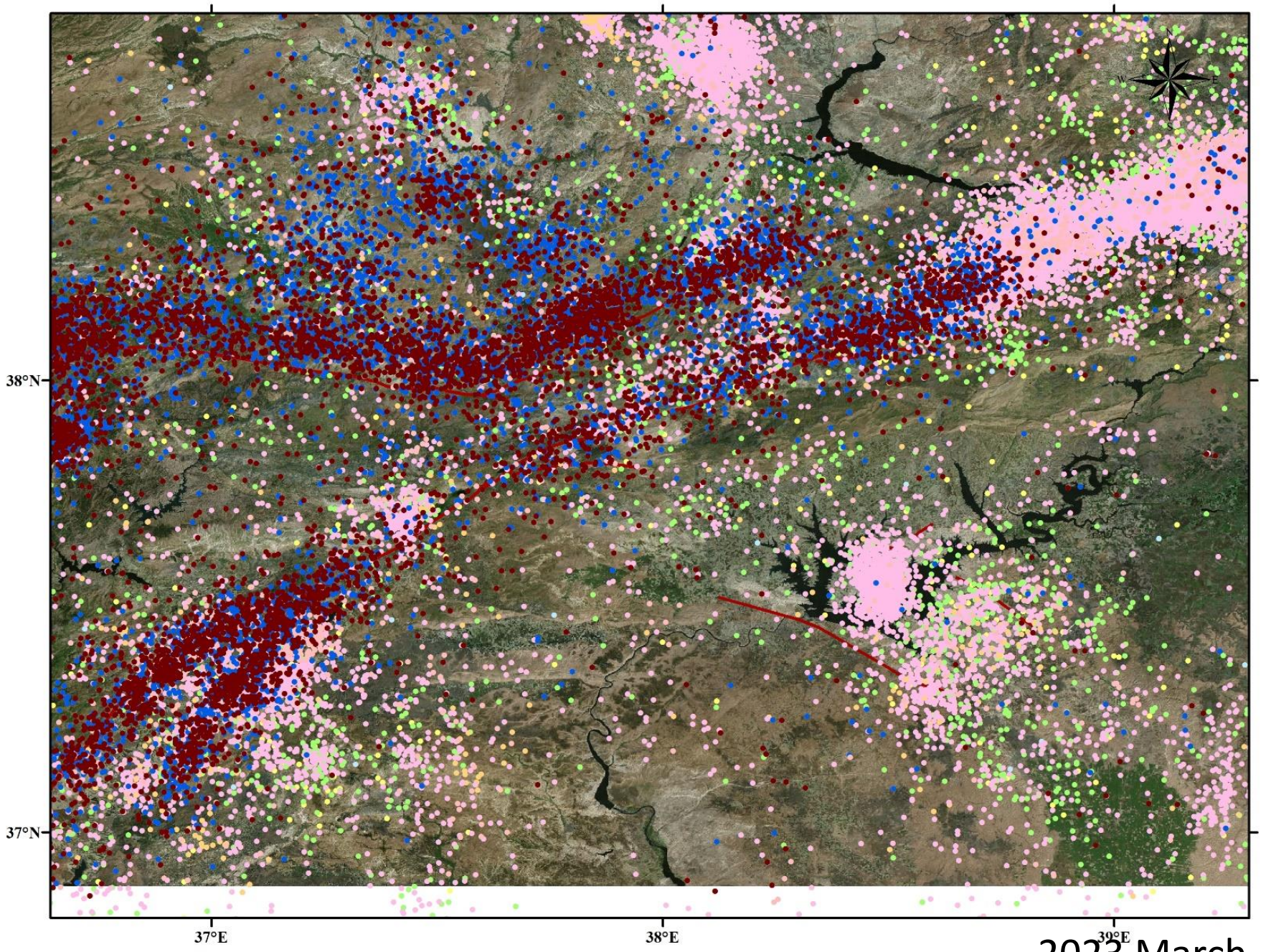
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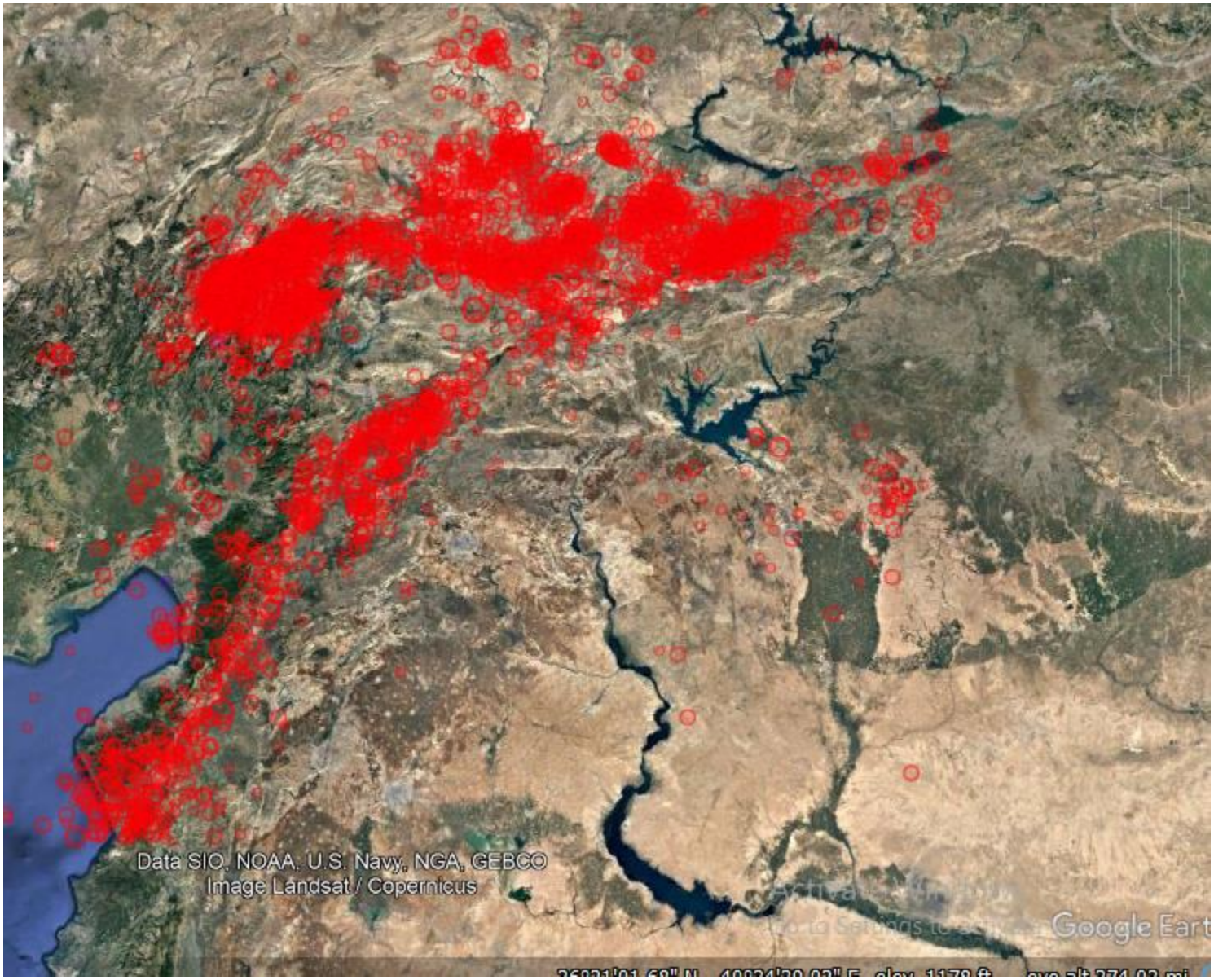
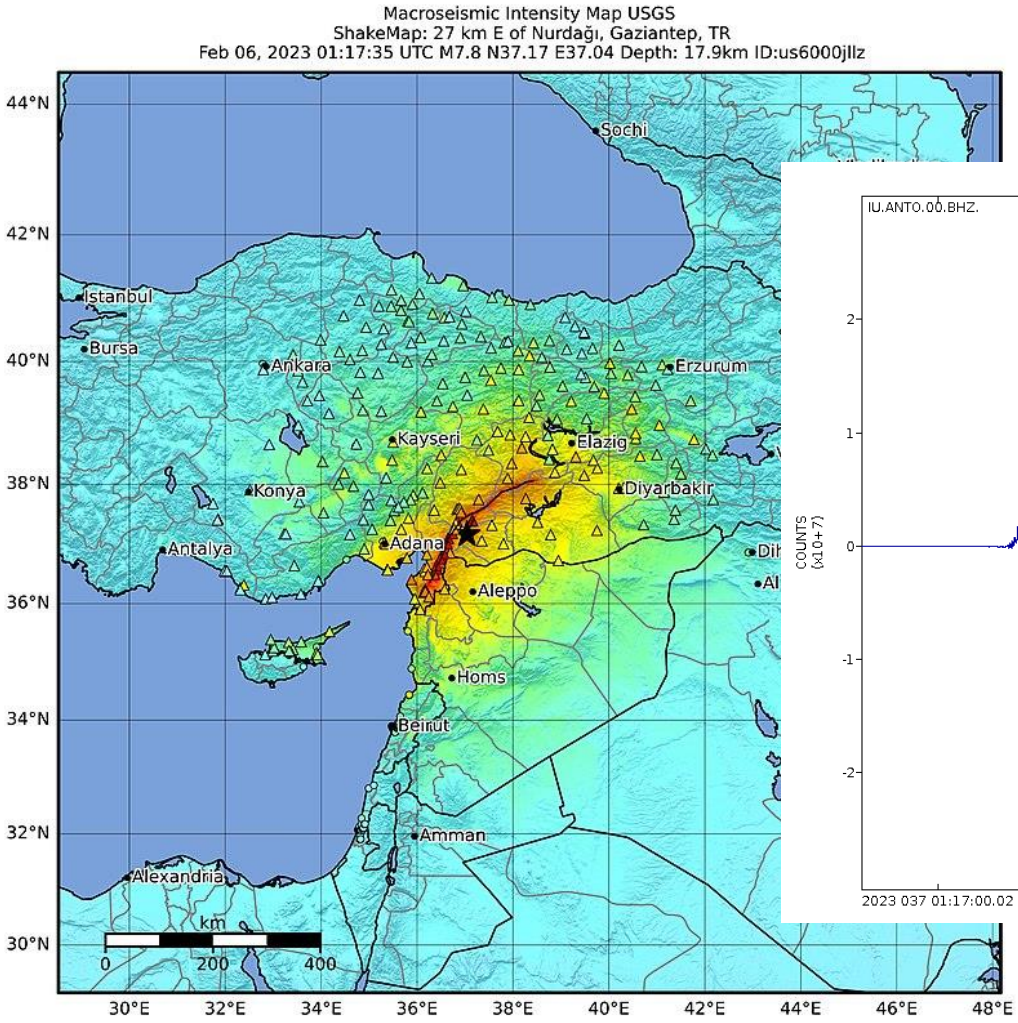
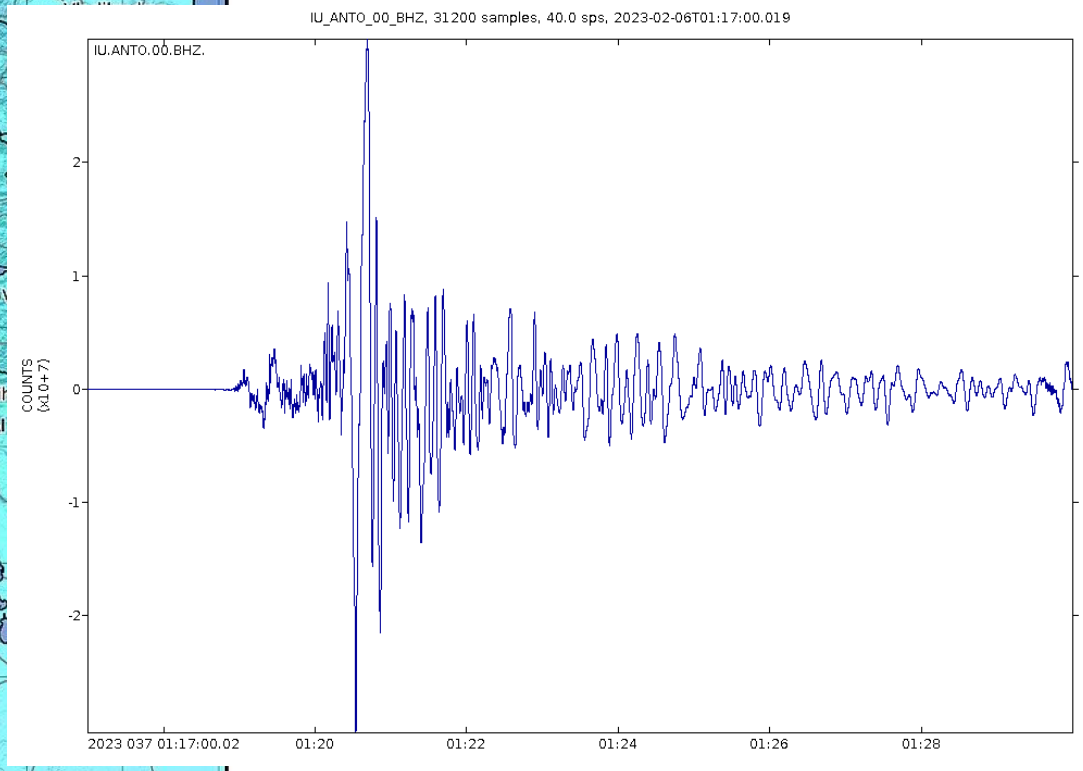
1 Feb 2023 – 12June 2023 (9460 EQ.s)M>2.0

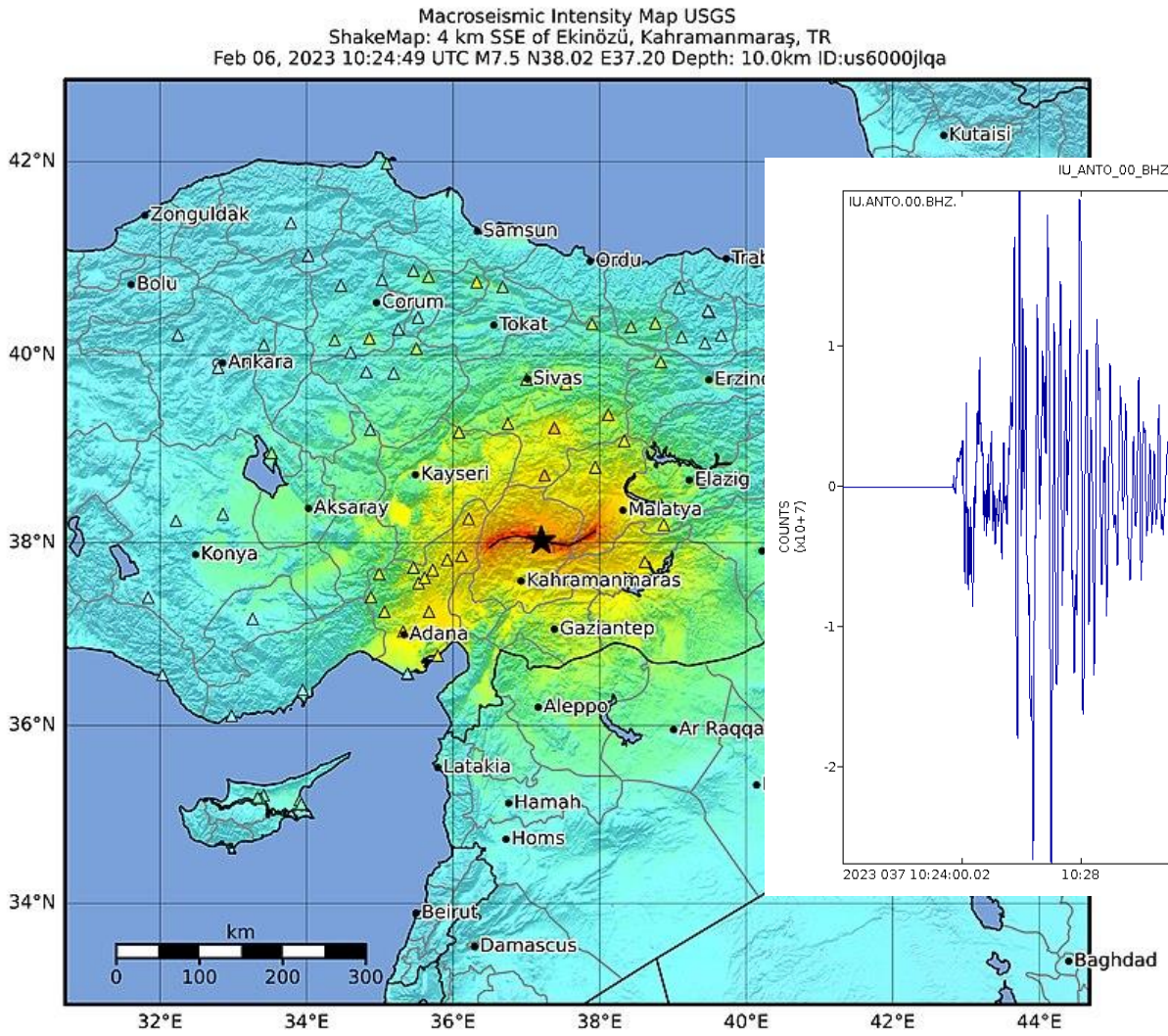


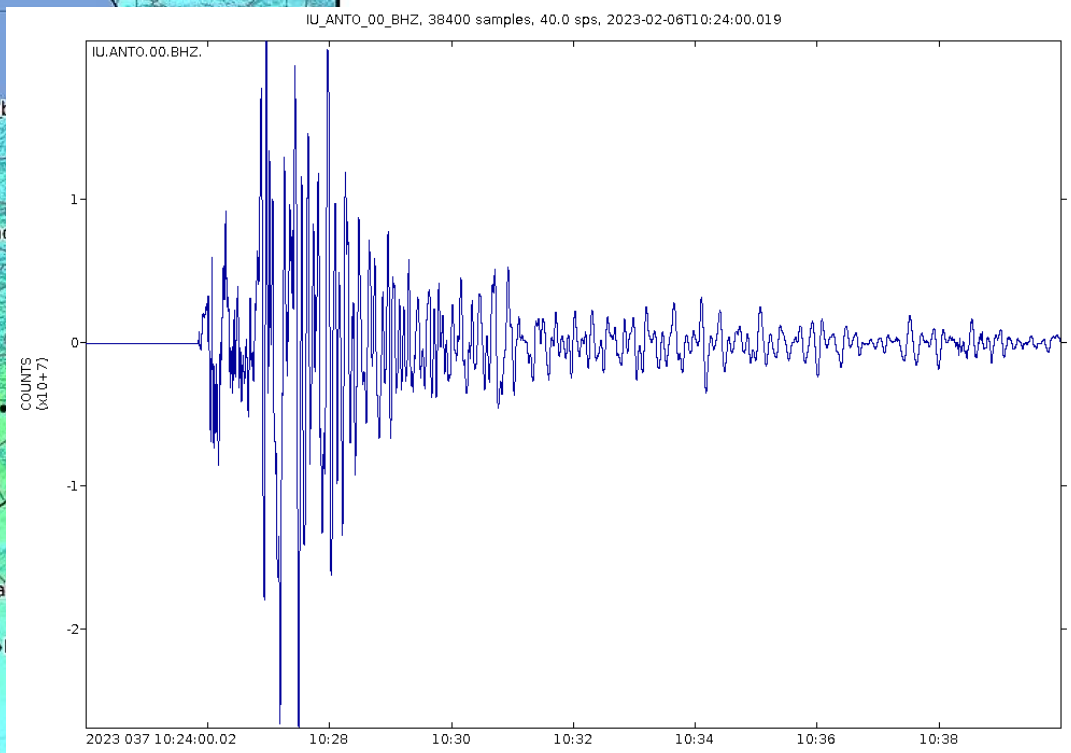




SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012)
Version 11: Processed 2023-02-11T23:20:14Z
△ Seismic Instrument ○ Reported Intensity ★ Epicenter ▭ Rupture





SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
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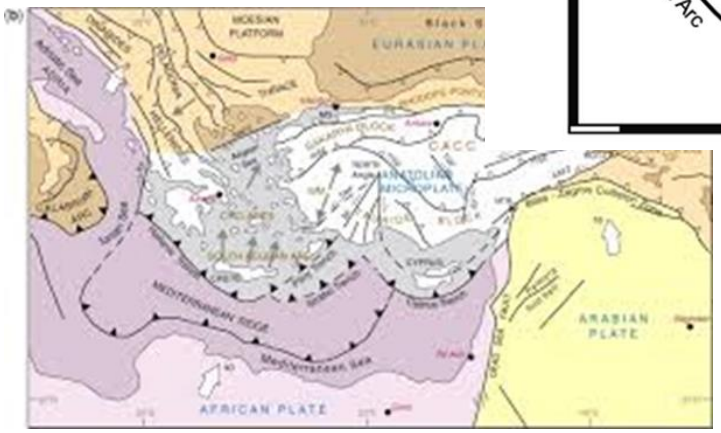
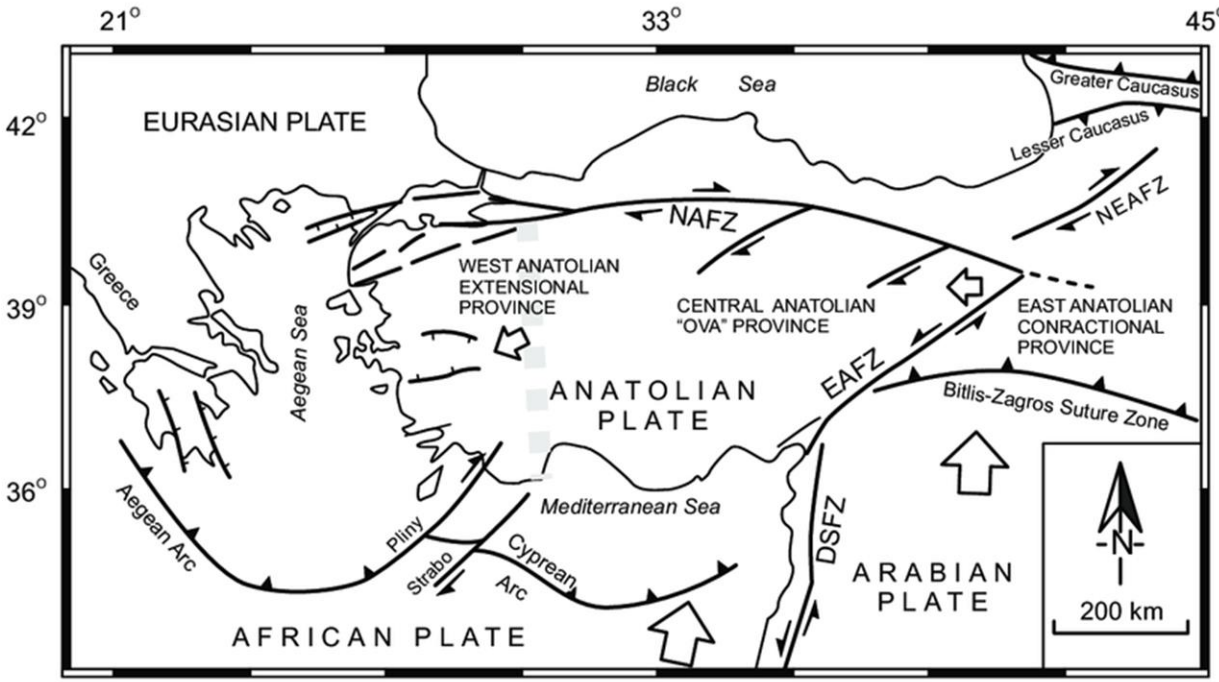
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+


EURASIAN PLATE
ARABIAN PLATE
AFRICAN PLATE
Mediterranean Sea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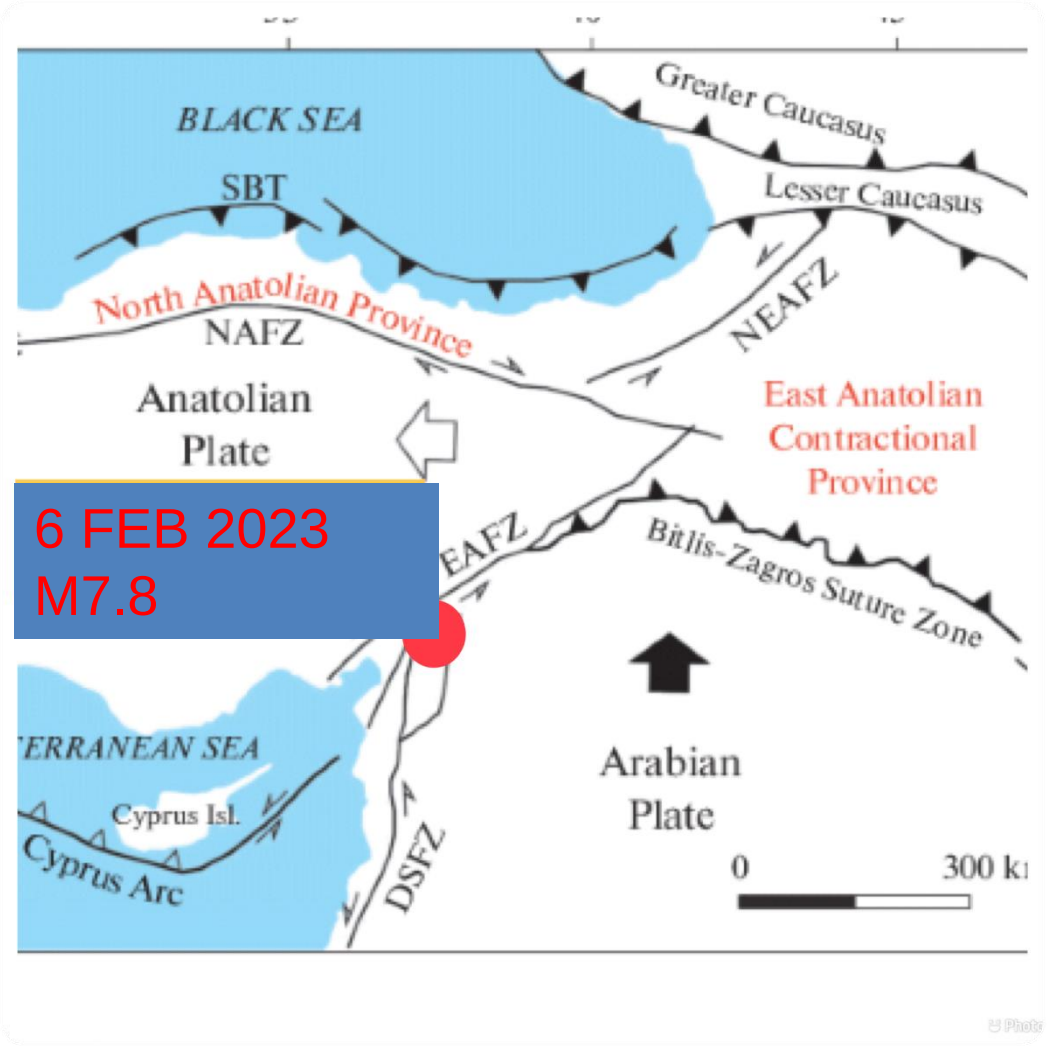
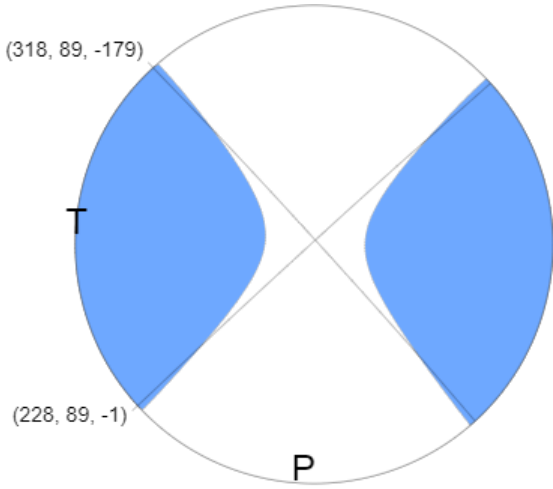
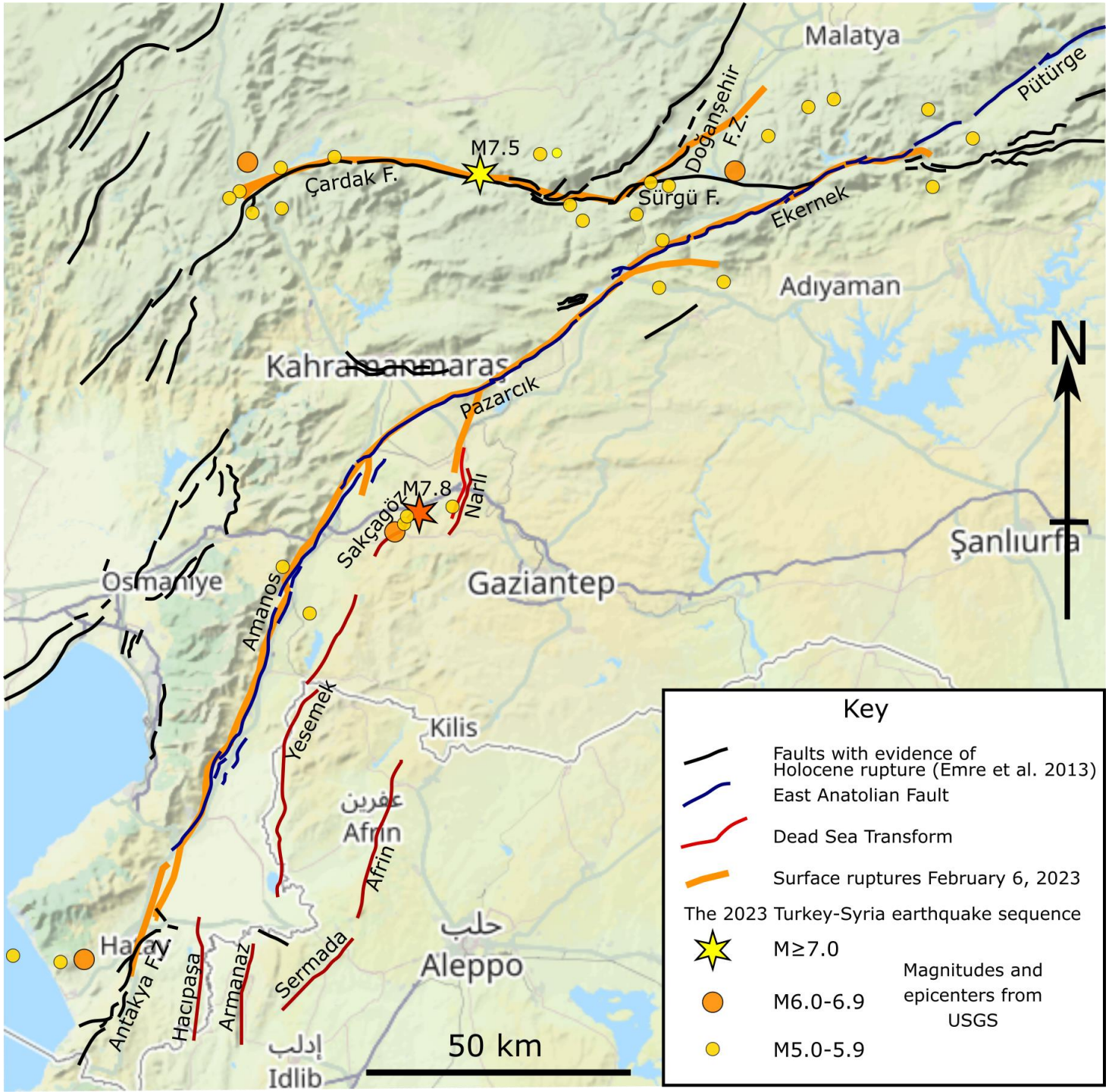
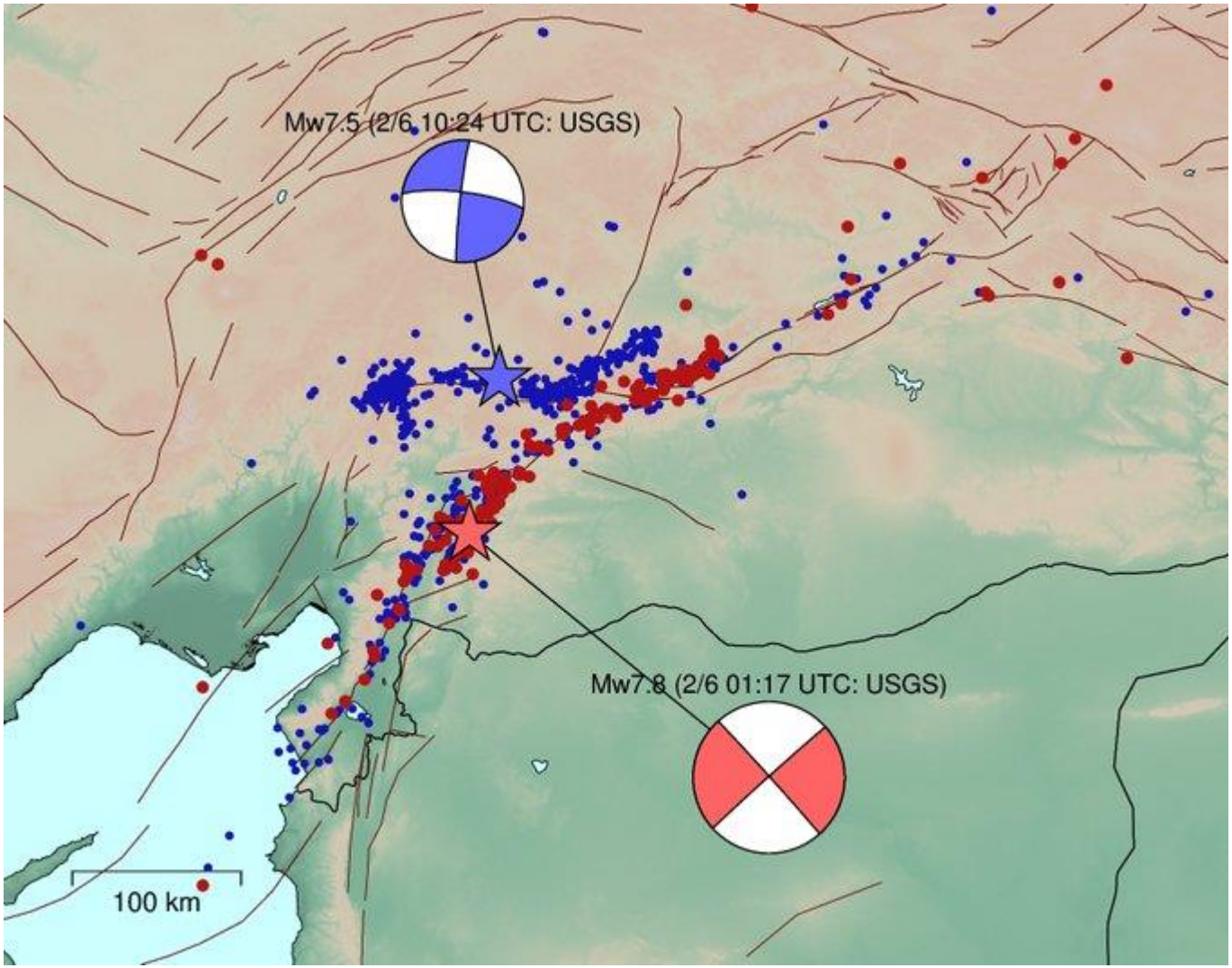
EURASIAN PLATE
Black Sea
Greater Caucasus
Lesser Caucasus
NAFZ
NEAFZ
Greece
Aegean Sea
WEST ANATOLIAN EXTENSIONAL PROVINCE
CENTRAL ANATOLIAN "OVA" PROVINCE
EAST ANATOLIAN CONRACTIONAL PROVINCE
ANATOLIAN PLATE
EAFZ
Bitlis-Zagros Suture Zone
Aegean Arc
Pliny
Strabo
Cyprean Arc
Mediterranean Sea
DSFZ
ARABIAN PLATE
AFRICAN PLATE
N
200 km


BLACK SEA
SBT
Greater Caucasus
Lesser Caucasus
North Anatolian Province
NAFZ
NEAFZ
Anatolian
Plate
East Anatolian
Contractional
Province
6 FEB 2023
M7.8
EAFZ
Bitlis-Zagros Suture Zone
ERRANEAN SEA
Cyprus Isl.
Cyprus Arc
DSFZ
Arabian
Plate
0
300 k

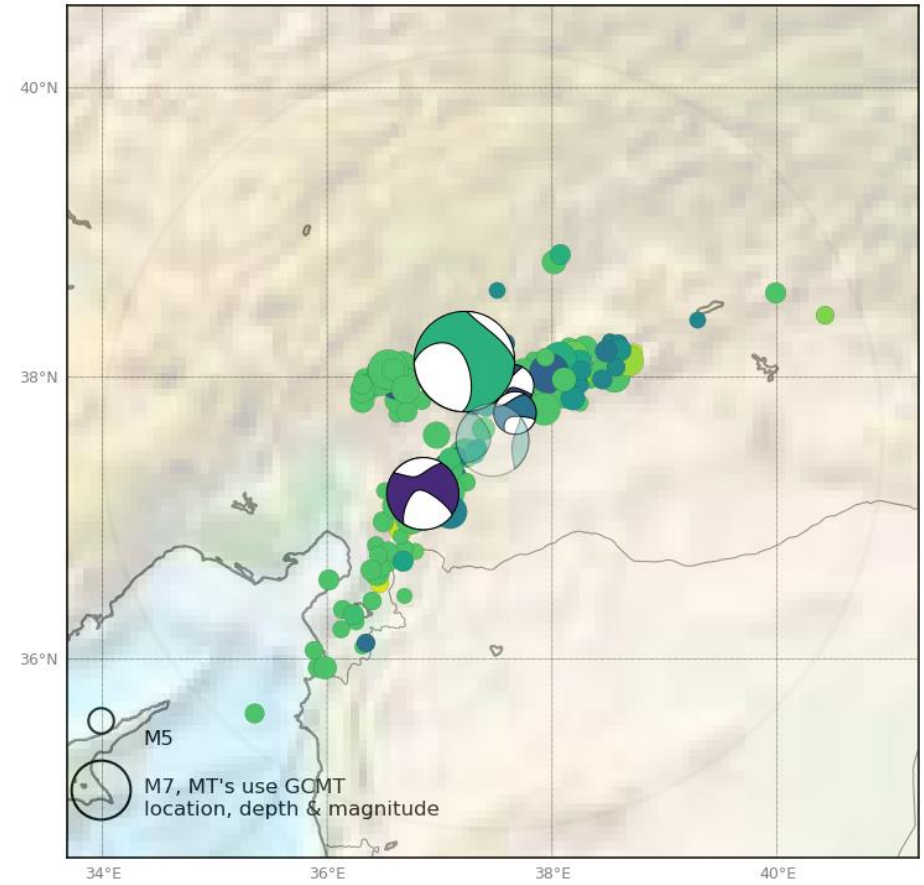

(318, 89, -179)
T
(228, 89, -1)
P

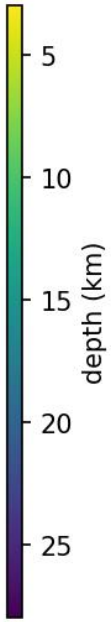

Malatya
Pütürge
Doğanşehir F.Z.
M7.5
Çardak F.
Sürgü F.
Ekernek
Adıyaman
N
Kahramanmaraş
Pazarcık
M7.8
Sakçagöz
Narlı
Şanlıurfa
Osmaniye
Amanos
Gaziantep
Yesemek
Kilis
عفرين
Afrin
Afrin
حلب
Aleppo
Hatay
Antakya F.
Hacıpaşa
Armanaz
Sermada
إدلب
Idlib
50 km
Key
Faults with evidence of Holocene rupture (Emre et al. 2013)
East Anatolian Fault
Dead Sea Transform
Surface ruptures February 6, 2023
The 2023 Turkey-Syria earthquake sequence
M≥7.0
M6.0-6.9
M5.0-5.9
Magnitudes and epicenters from USGS

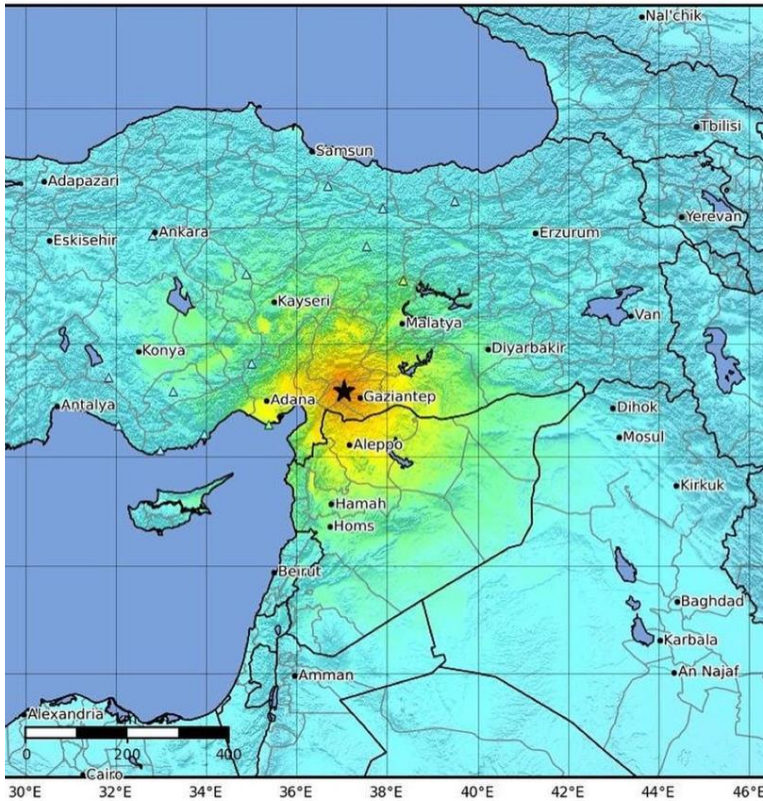
Elbistan Earthquake Mw7.5



Event: M7.8 Gaziantep, Turkey
2023-02-06T01:17:35 UTC Lat: 37.56° Lon: 37.47° depth: 14.9 km
Other events within 300 km radius; from 2023-02-03 to 2023-02-14; within 100 km depth; M ≥ 3.1





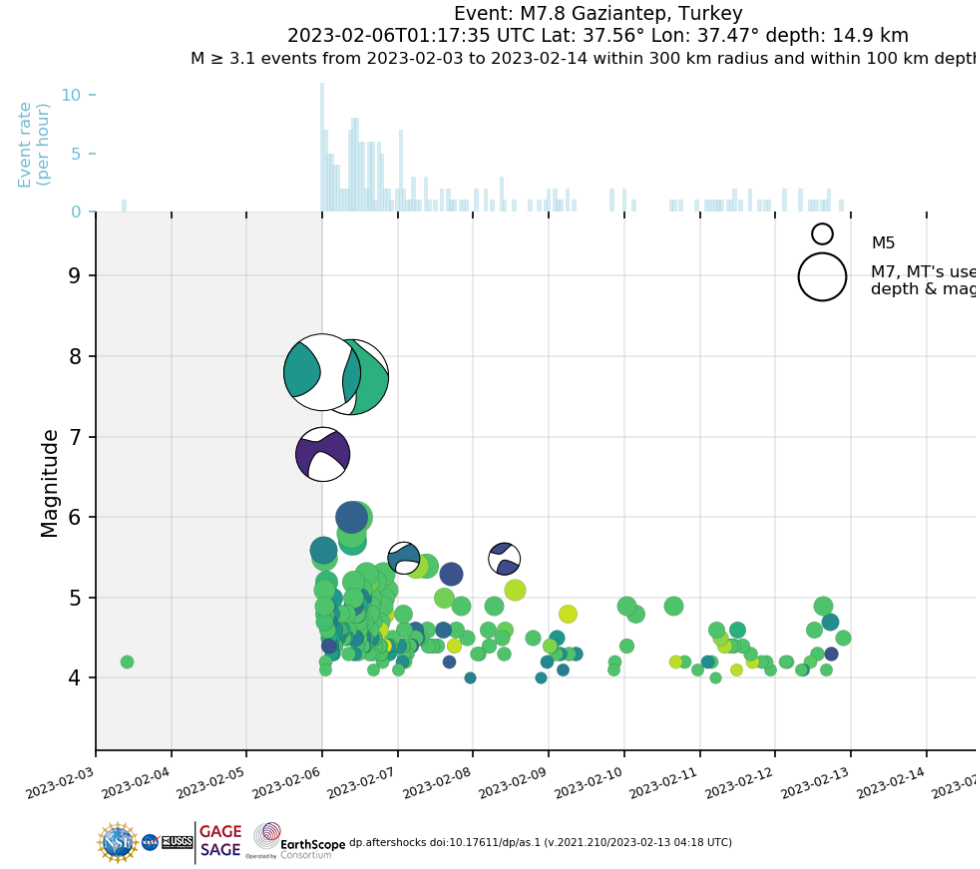


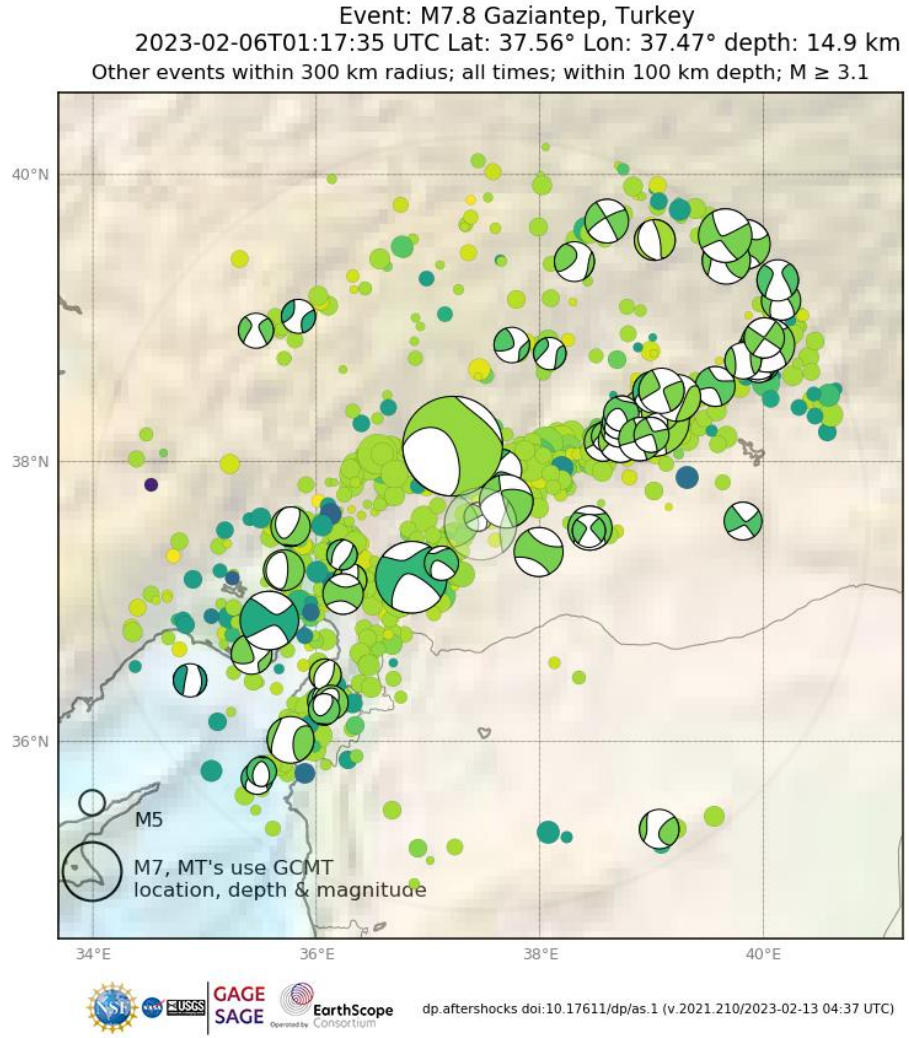
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

ale based on Worden et al. (2012) Version 2: Processed 2023-02-06T01:40:17
Seismic Instrument ○ Reported Intensity ★ Epicenter

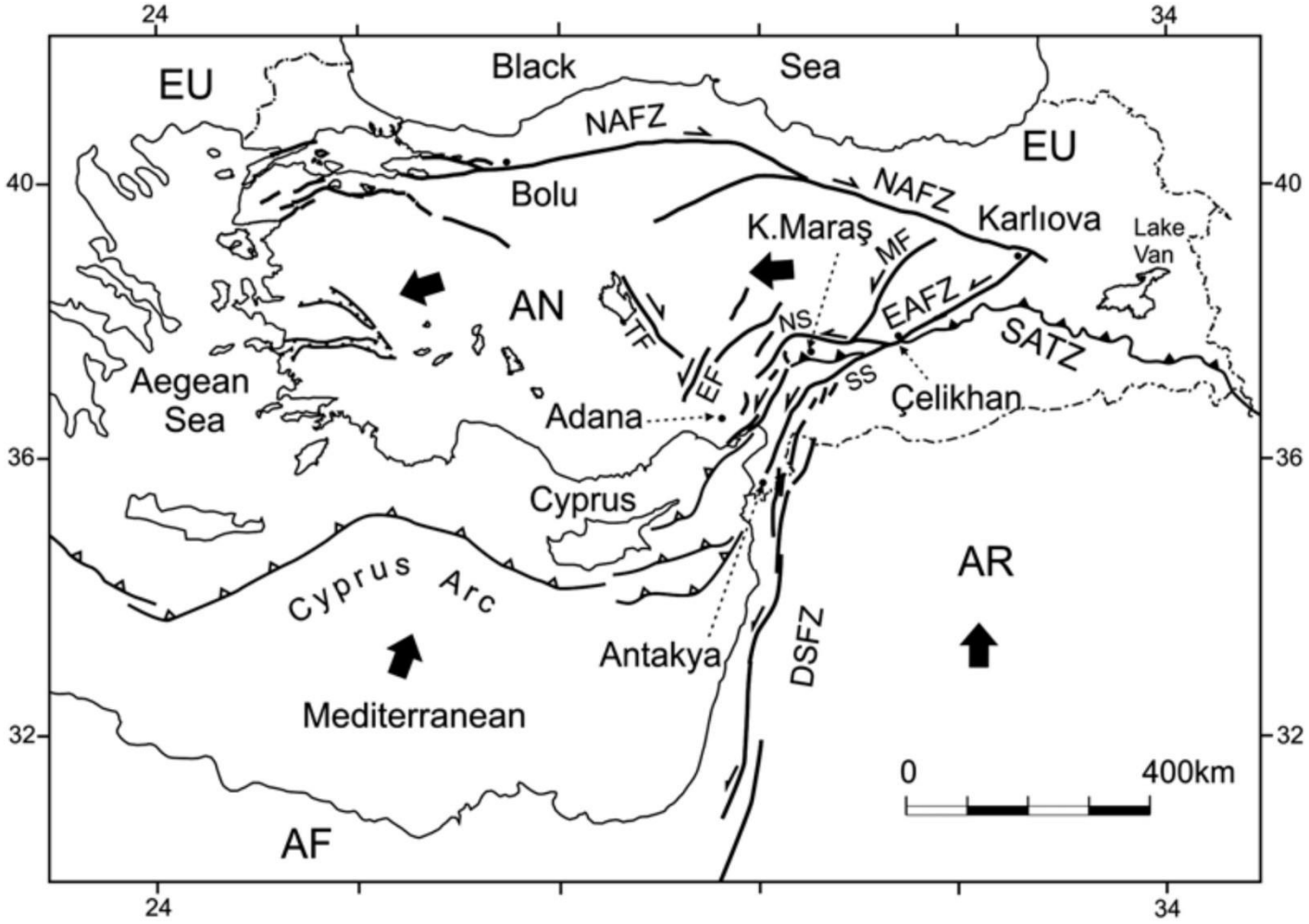
GAGE SAGE EarthScope Consortium

dp.aftershocks doi:10.17611/dp/as.1 (v.2021.210/2023-02-13 04:18 UTC)


Event: M7.8 Gaziantep, Turkey
2023-02-06T01:17:35 UTC Lat: 37.56° Lon: 37.47° depth: 14.9 km
M ≥ 3.1 events from 2023-02-03 to 2023-02-14 within 300 km radius and within 100 km depth
Event rate (per hour)
10
5
0
Magnitude
9
8
7
6
5
4
M5
M7, MT's use
depth & mag
2023-02-03
2023-02-04
2023-02-05
2023-02-06
2023-02-07
2023-02-08
2023-02-09
2023-02-10
2023-02-11
2023-02-12
2023-02-13
2023-02-14
GAGE
SAGE
EarthScope
Consortium
dp.aftershocks doi:10.17611/dp/as.1 (v.2021.210/2023-02-13 04:18 UTC)

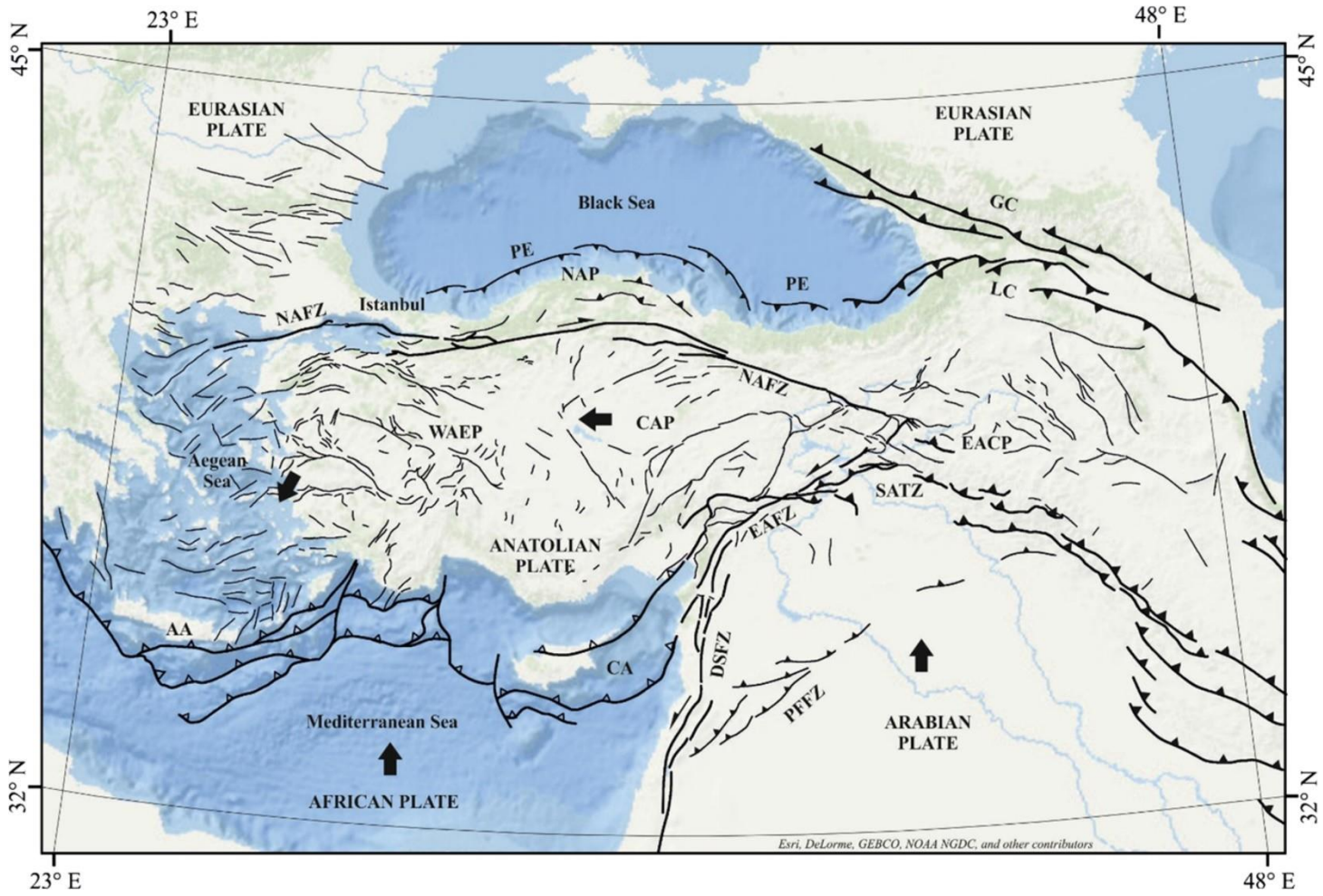

Event: M7.8 Gaziantep, Turkey
2023-02-06T01:17:35 UTC Lat: 37.56° Lon: 37.47° depth: 14.9 km
Other events within 300 km radius; all times; within 100 km depth; M ≥ 3.1
40°N
38°N
36°N
34°E
36°E
38°E
40°E
M5
M7, MT's use GCMT
location, depth & magnitude
GAGE
SAGE
EarthScope
Consortium
dp.aftershocks doi:10.17611/dp/as.1 (v.2021.210/2023-02-13 04:37 UTC)

THE MAIN FAULT SYSTEMS OF THE ANATOLIAN AND ARABIAN PLATES BOUNDARIES



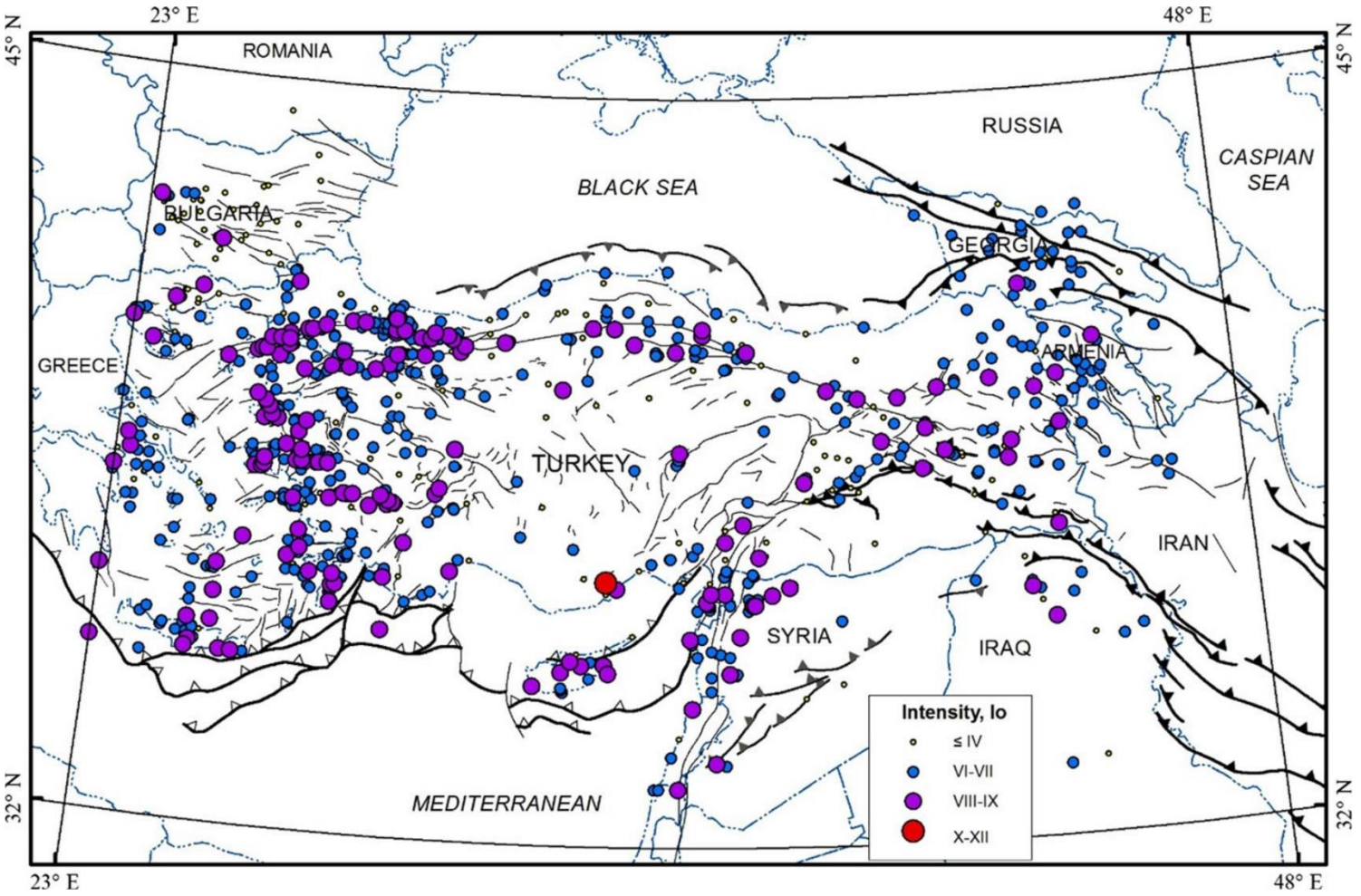
AN: Anatolian microplate; **AF**: African plate; **AR**: Arabian plate; **EU**: Eurasian plate; **NAFZ**: North Anatolian Fault Zone; **EAFZ**: East Anatolian Fault Zone; **DSFZ**: Dead Sea Fault Zone; **MF**: Malatya Fault; **TF**: Tuzgölü fault; **EF**: Ecemiş fault; **SATZ**: Southeast Anatolian Thrust Zone; **SS**: southern strand of the EAFZ; **NS**: northern strand of the EAFZ (From Duman and Emre, 2013).

ACTIVE FAULT MAP OF THE EASTERN MEDITERRANEAN REGION



The active fault map of Turkey illustrating the North Anatolian Fault Zone and the Eastern Anatolian Fault Zone among others (Source: Duman et al., 2016). The epicenter of the January 24, 2020 Eastern Turkey is located along the main strand of the Eastern Anatolian Fault Zone.

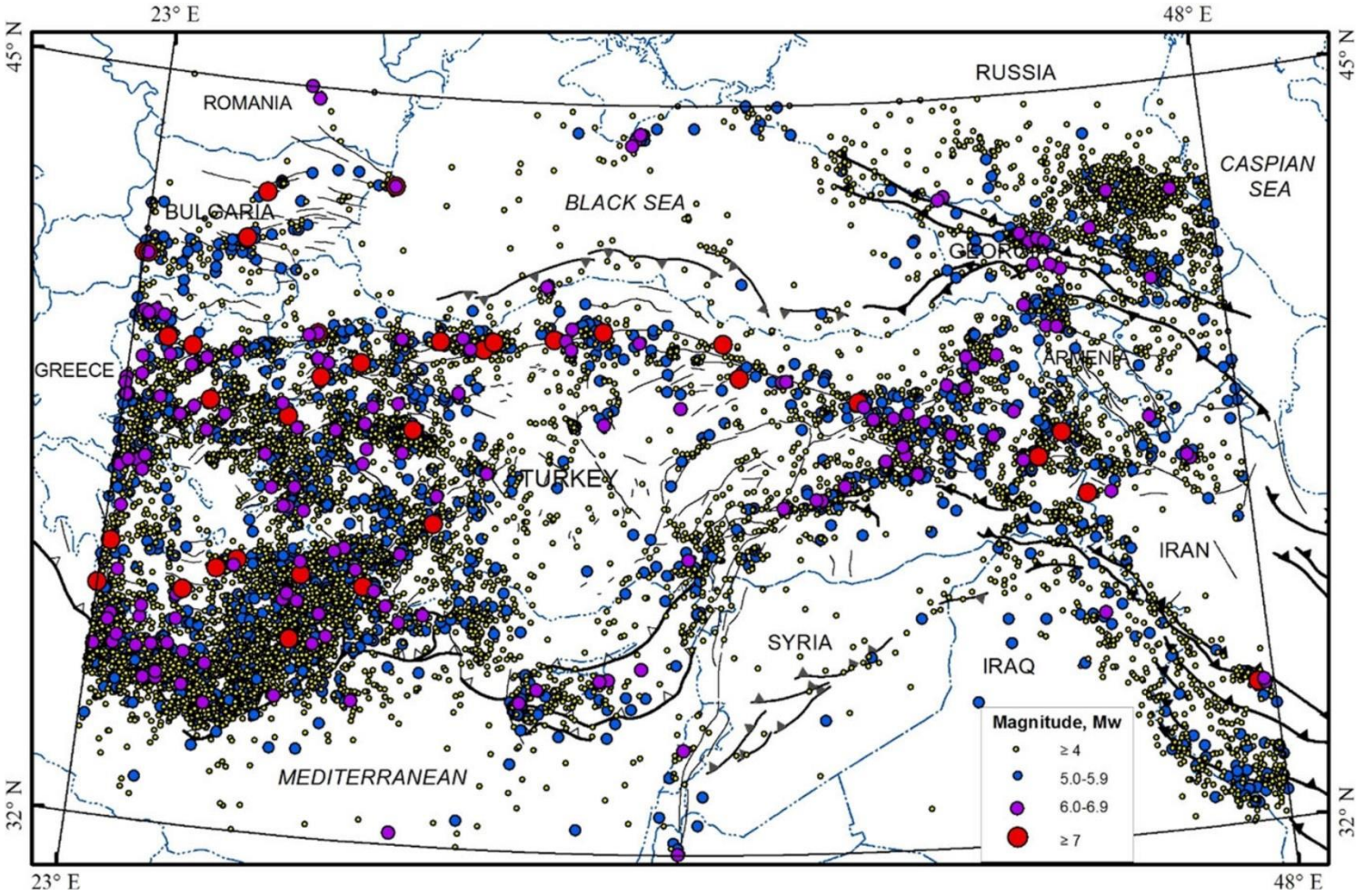
HISTORICAL SEISMICITY OF THE ANATOLIA REGION



Historical earthquake distribution across Turkey and the surrounding region from BC 2000 to AD 1900. Symbols represent the epicentral intensity.

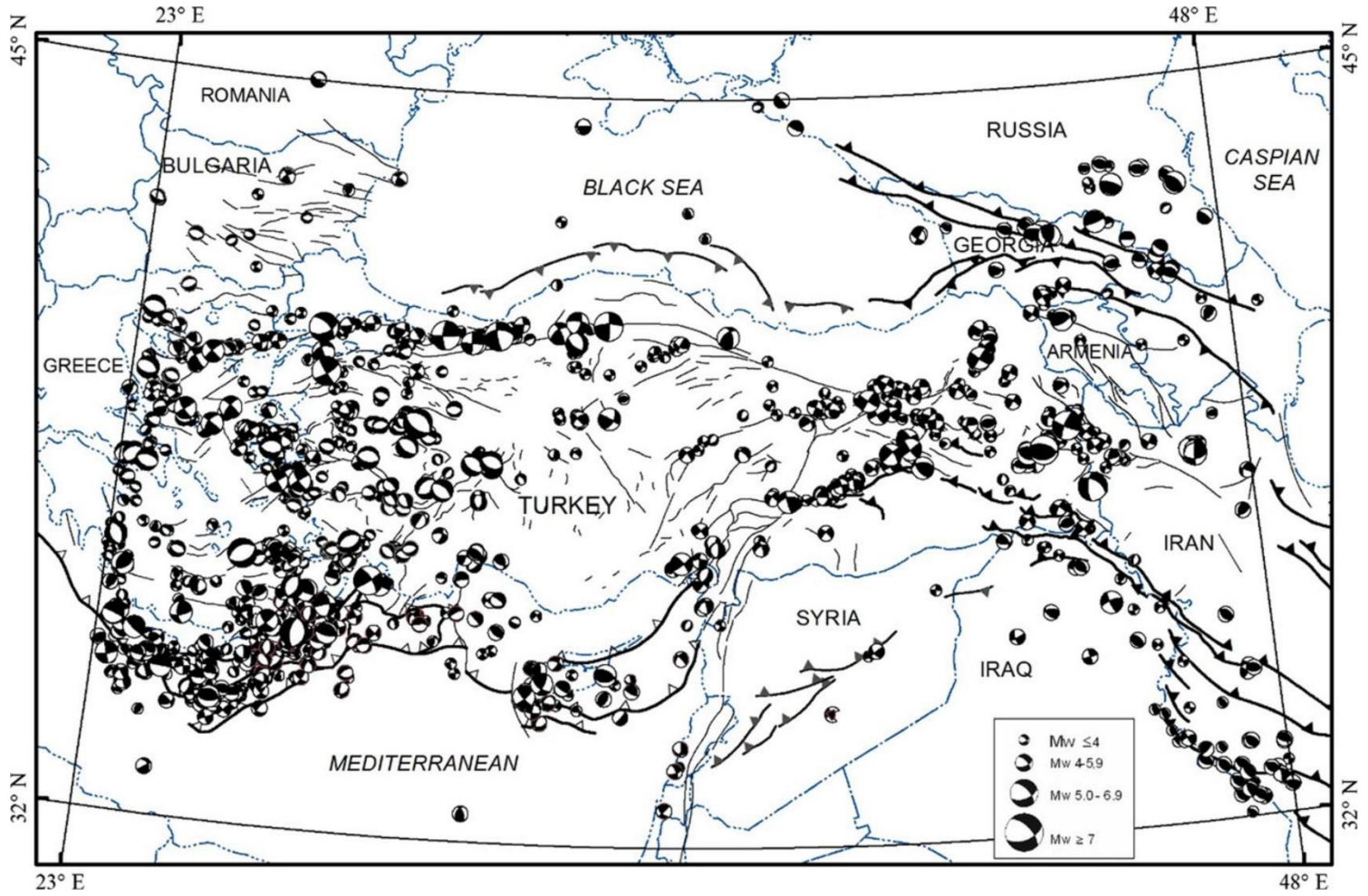
Source: Duman et al. (2016)

RECENT SEISMICITY OF THE ANATOLIA REGION



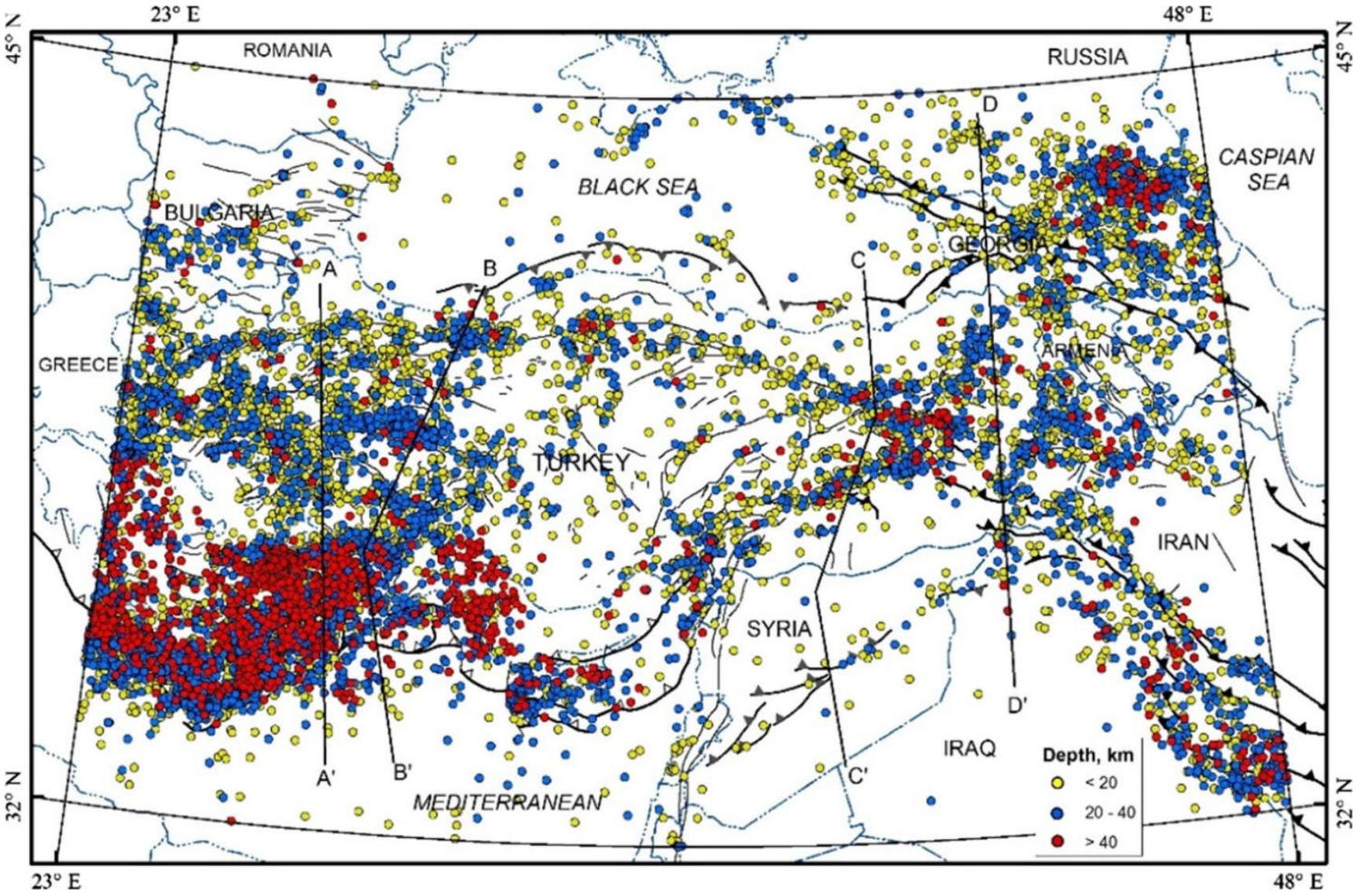
Seismicity of the Anatolia region from 1900 to .2012
The earthquakes with moment magnitude Mw ≥ 4.0 are presented.
Source: Duman et al. ((2016

FOCAL MECHANISM SOLUTIONS OF EARTHQUAKES AND ACTIVE FAULTS IN TURKEY



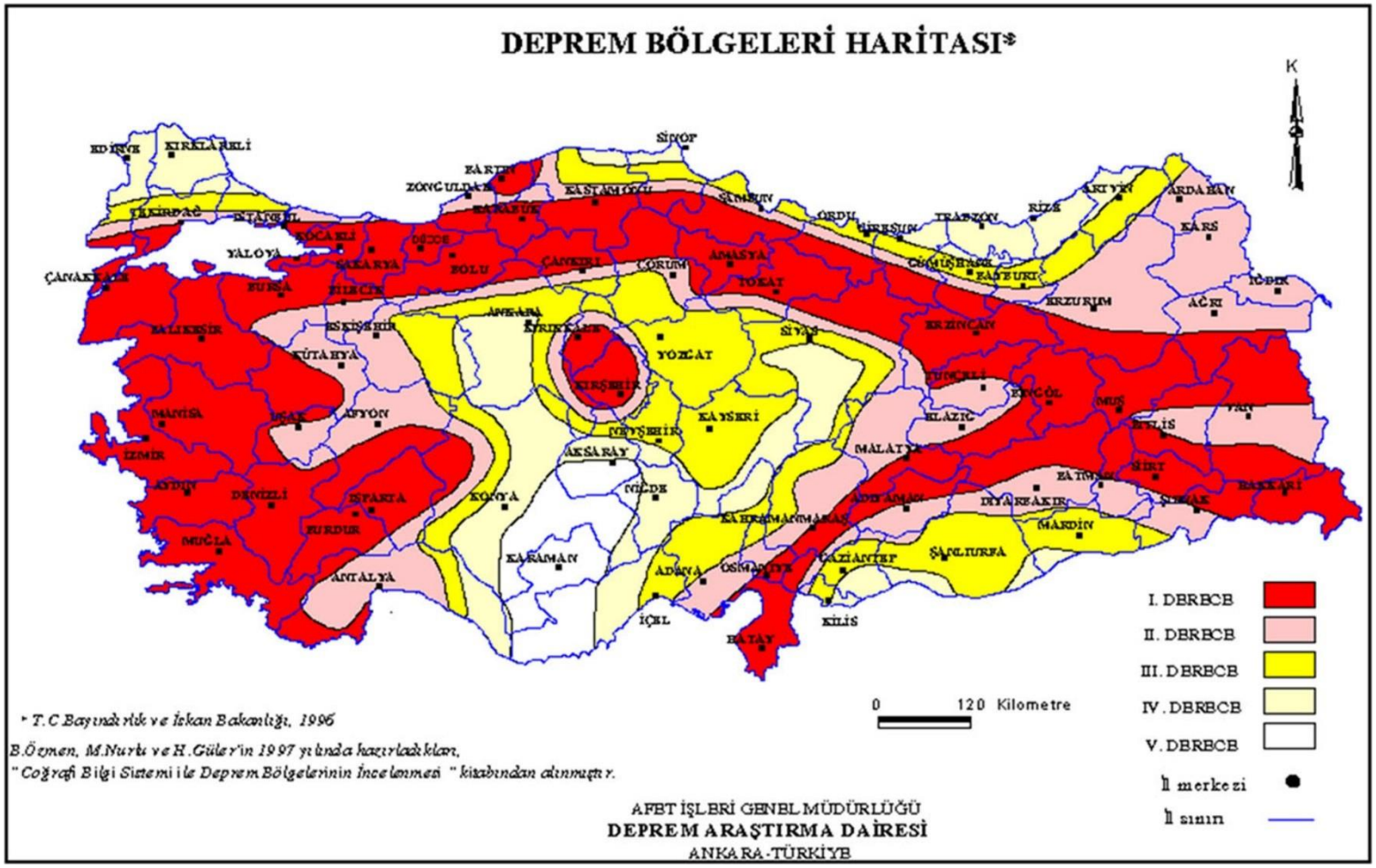
Distributions of the lower hemisphere equal area projection plots of the focal mechanism solutions of earthquakes and active faults in Turkey and the surrounding region. The size of each beachball is related to the earthquake magnitude. The strike slip earthquakes prevails along the North Anatolian and the East Anatolian Fault Zones.
Source: Duman et al. (2016)

SEISMICITY FROM 1900 TO 2012 ACROSS TURKEY



Distribution of the seismicity from 1900 to 2012 across Turkey and the surrounding region based on focal depth
Source: Duman et al. (2016)

THE 1996 EARTHQUAKE ZONATION MAP OF TURKEY



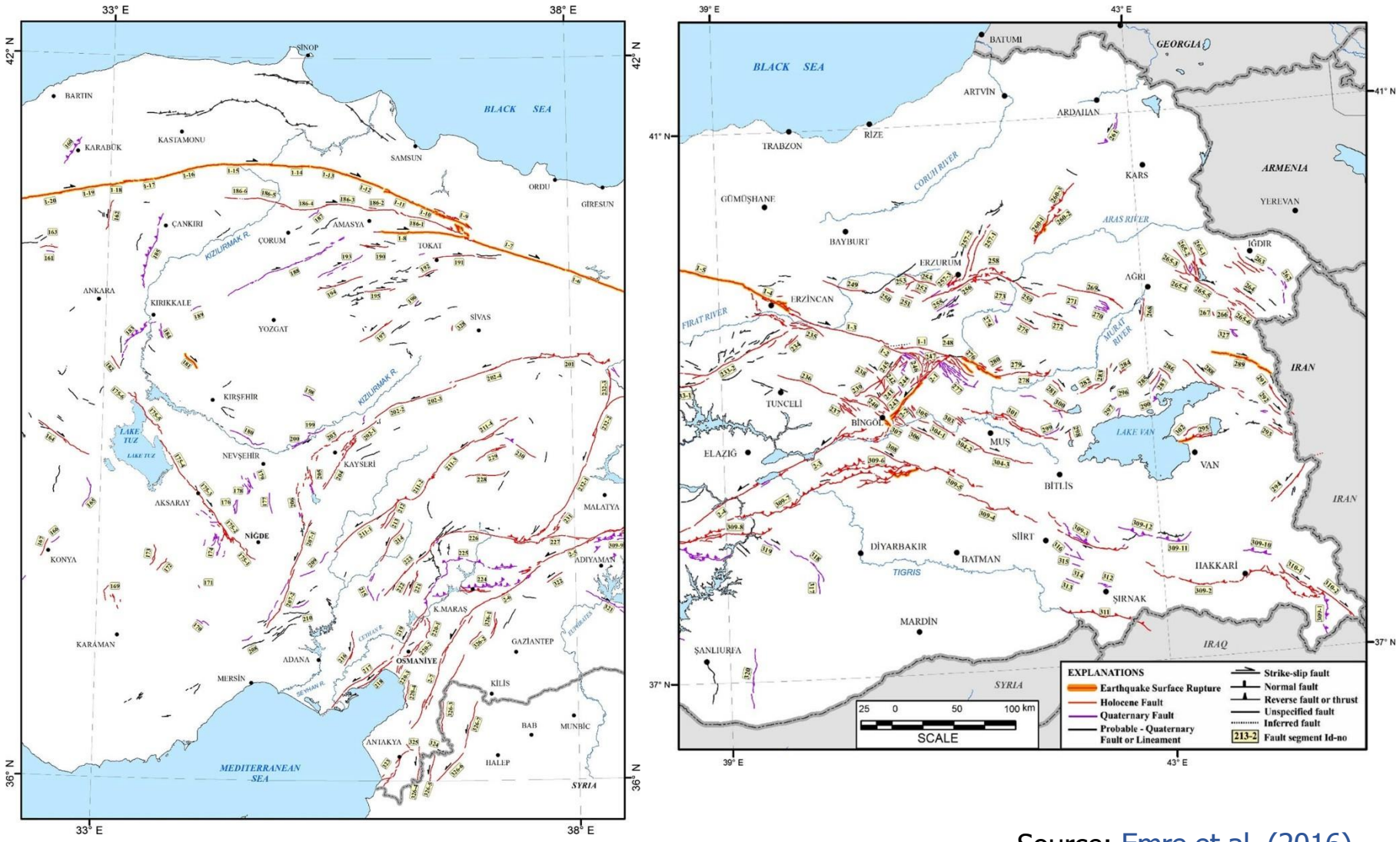
The 1996 earthquake zonation map of Turkey (http://www.deprem.gov.tr/tr/kategori/deprem-bolgeleriharitasi-28841). **Zone 1 represents the highest seismic hazard** whereas pink, yellow and light yellow colors represent Zones 2, 3 and 4 respectively that display the decreasing trend in seismic hazard. The white color is the no seismic hazard zone. Source: Akkar et al. (2018).

THE 2019 EARTHQUAKE HAZARD MAP OF TURKEY

The new Earthquake Hazard Map of Turkey has been prepared with much more detailed data considering the latest earthquake source parameters, earthquake catalogs and new mathematical models. It came into force on January 1, 2019. Unlike the previous earthquake zonation map, in the new map, instead of the earthquake zones, the highest ground acceleration values were shown and the concept of "earthquake zone" was eliminated.

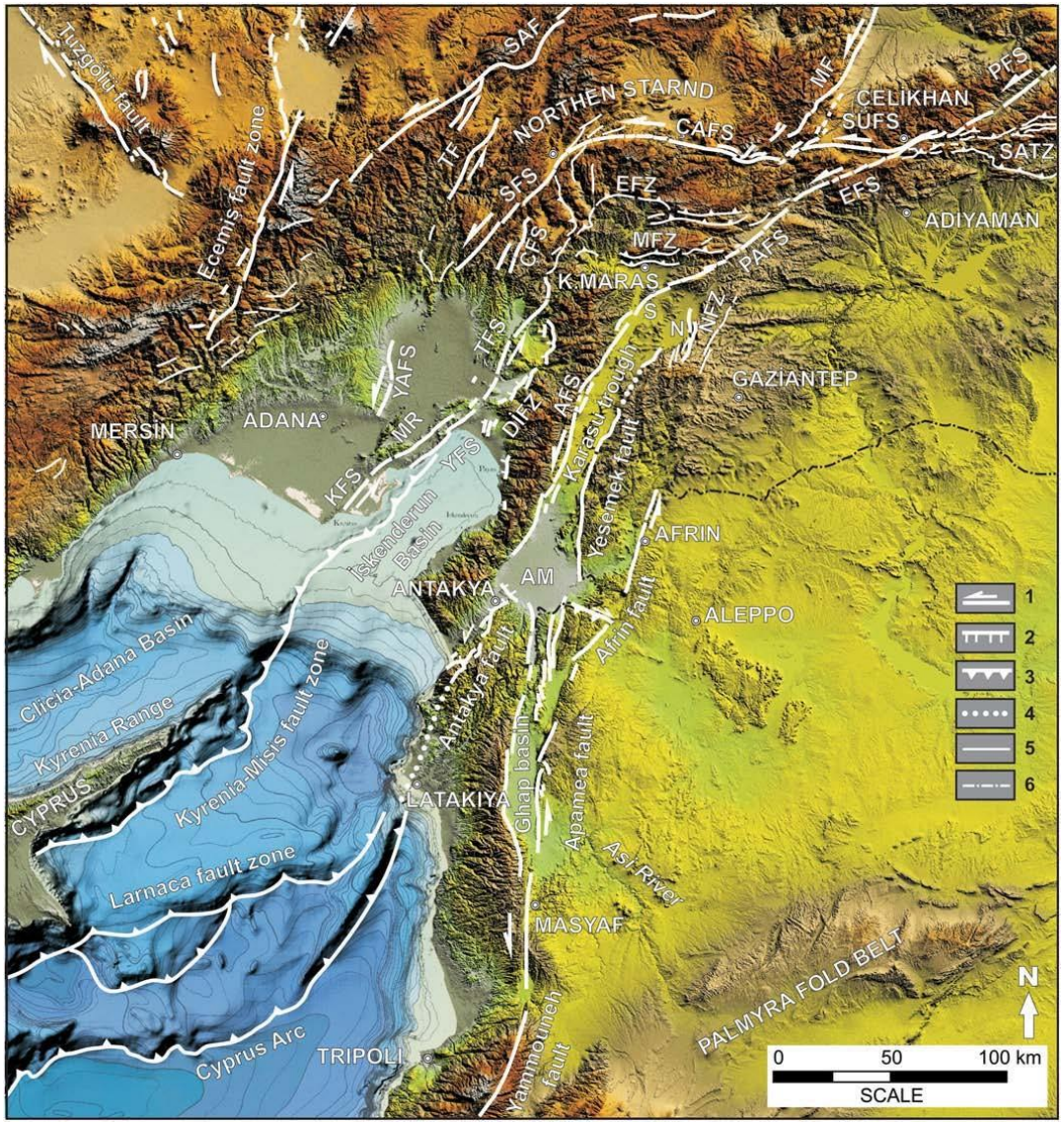
Source: https://deprem.afad.gov.tr/deprem-tehlike-haritasi

THE EAST ANATOLIAN STRIKE-SLIP FAULT SYSTEM



Source: Emre et al. (2016)

THE ACTIVE LEFT-LATERAL STRIKE-SLIP EAST ANATOLIAN FAULT SYSTEM

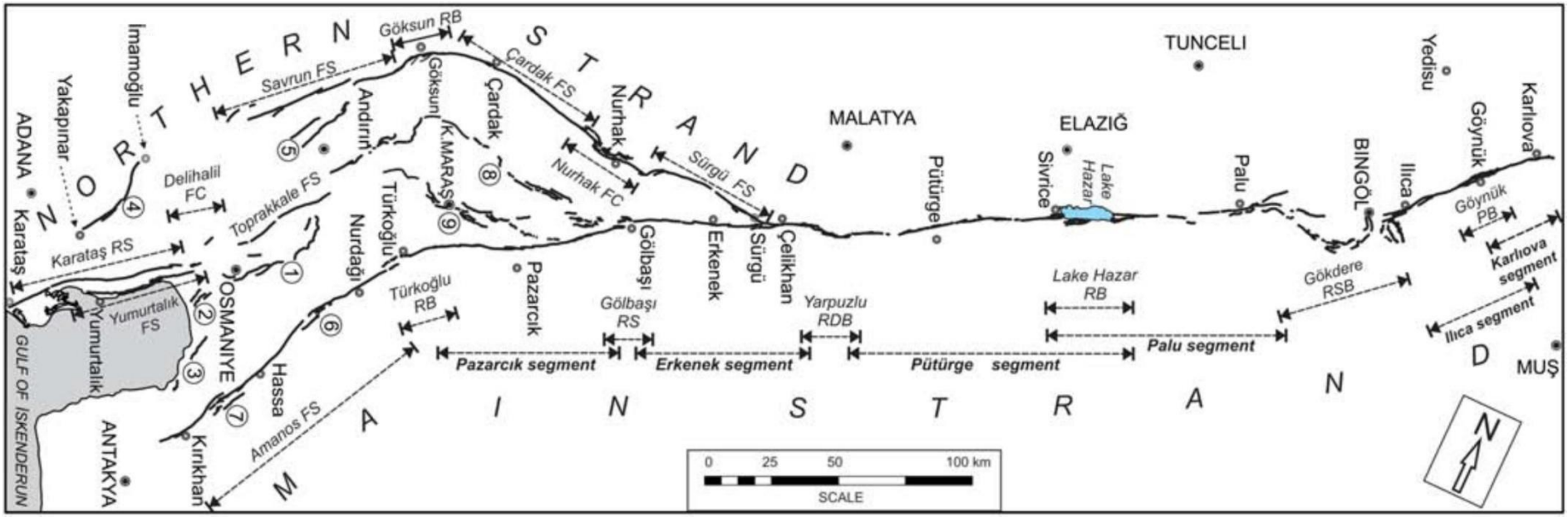


Active fault map of the Eastern Mediterranean region

(1) left-lateral strike-slip fault
(2) normal fault
(3) reverse/thrust fault
(4) inferred fault
(5) secondary fault
(6) national boundary

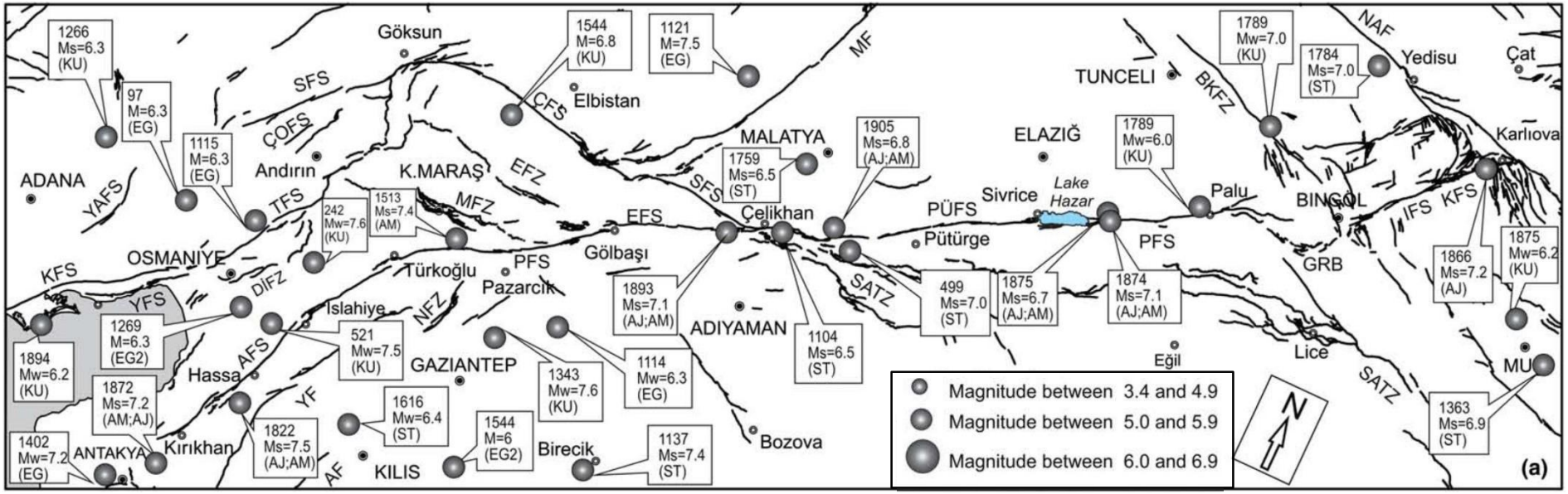
Source: Duman and Emre (2013)

THE EAST ANATOLIAN STRIKE-SLIP FAULT SYSTEM



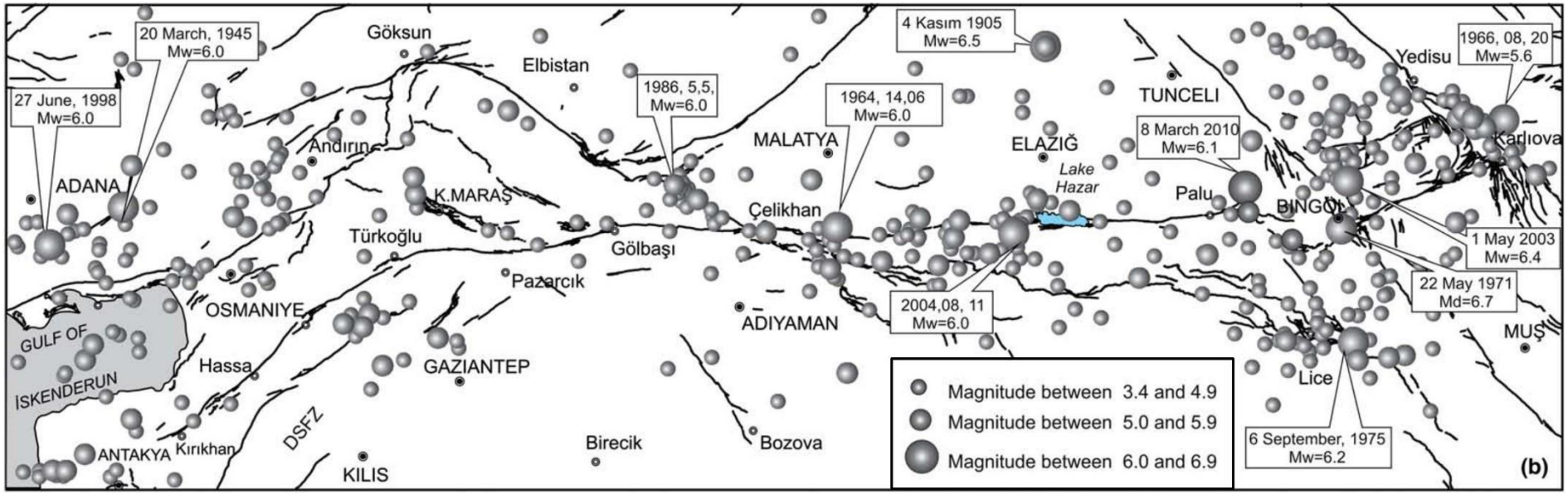
Map of the East Anatolian strike-slip fault system showing strands, segments and fault jogs. **FS**: fault Segment; **RB**: releasing bend; **RS**: releasing stepover; **RDB**: restraining double bend; **RSB**: restraining bend; **PB**: paired bend; (**1**) Düziçi–Osmaniye fault segment; (**2**) Erzin fault segment; (**3**) Payas fault segment; (**4**) Yakapınar fault segment; (**5**) Çokak fault segment; (**6**) Islahiye releasing bend; (**7**) Demrek restraining stepover; (**8**) Engizek fault zone; (**9**) Maraş fault zone. Source: Duman and Emre (2013).

DISTRIBUTION OF HISTORICAL EARTHQUAKES ALONG THE EAST ANATOLIAN FAULT SYSTEM



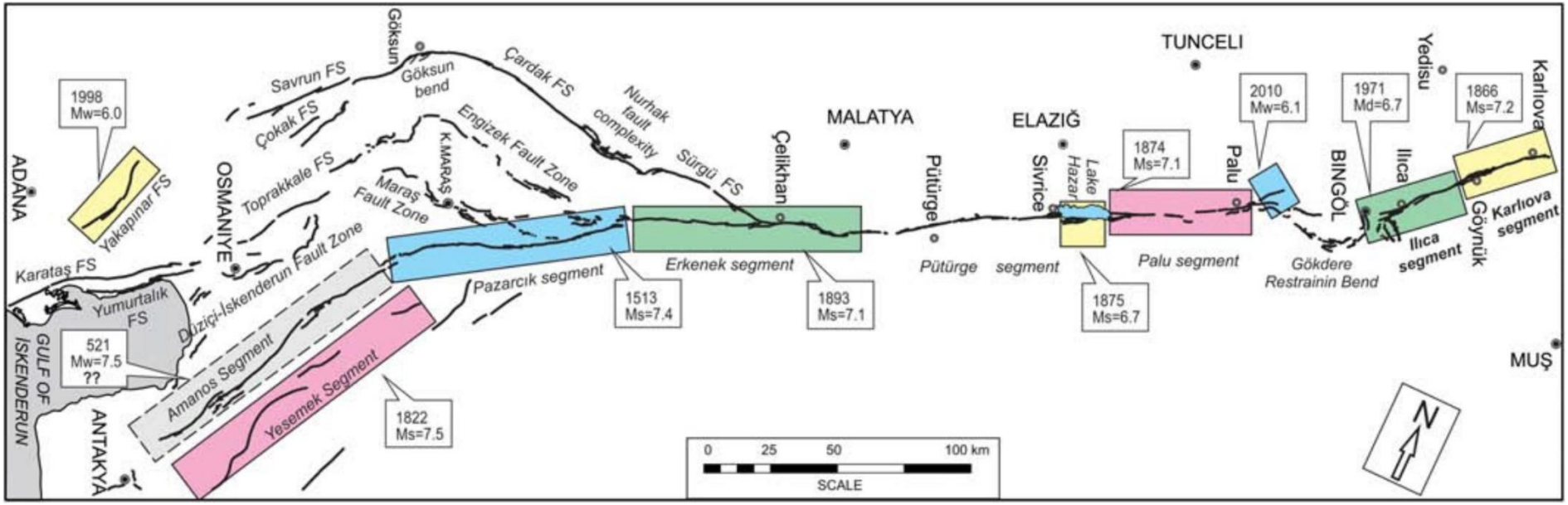
Source: Duman and Emre (2013)

DISTRIBUTION OF INSTRUMENTALLY RECORDED EARTHQUAKES ALONG THE EAST ANATOLIAN FAULT SYSTEM



Source: Duman and Emre (2013)

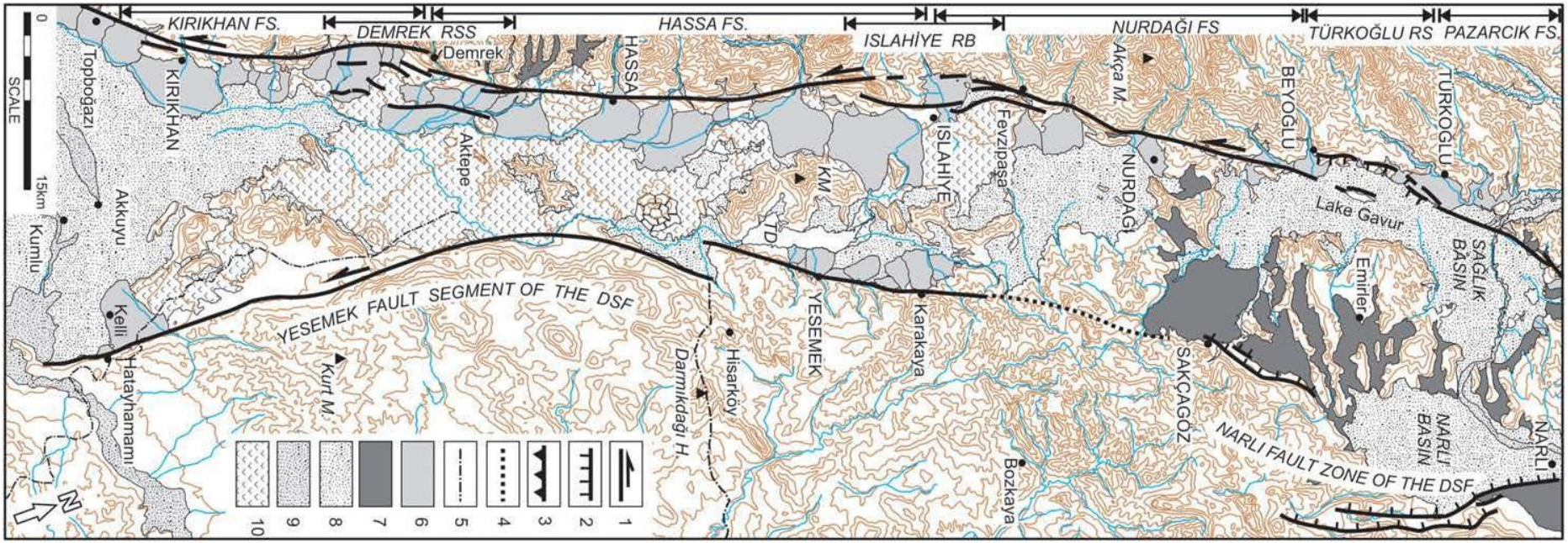
THE RUPTURED SOUTHERN PART OF THE MAIN STRAND OF THE EAST ANATOLIAN FAULT SYSTEM



Surface ruptures produced by large earthquakes during the 19th and 20th centuries along the East Anatolia Fault System. Ruptured fault segments are highlighted (Duman and Emre, 2013). The 2023 earthquake was generated by the rupture of the southern part of the main strand of the East Anatolia Fault System comprising the Erkenek, Pazarcık and Amanos fault segments.

THE RUPTURED SOUTHERN PART OF THE MAIN STRAND OF THE EAST ANATOLIAN FAULT SYSTEM

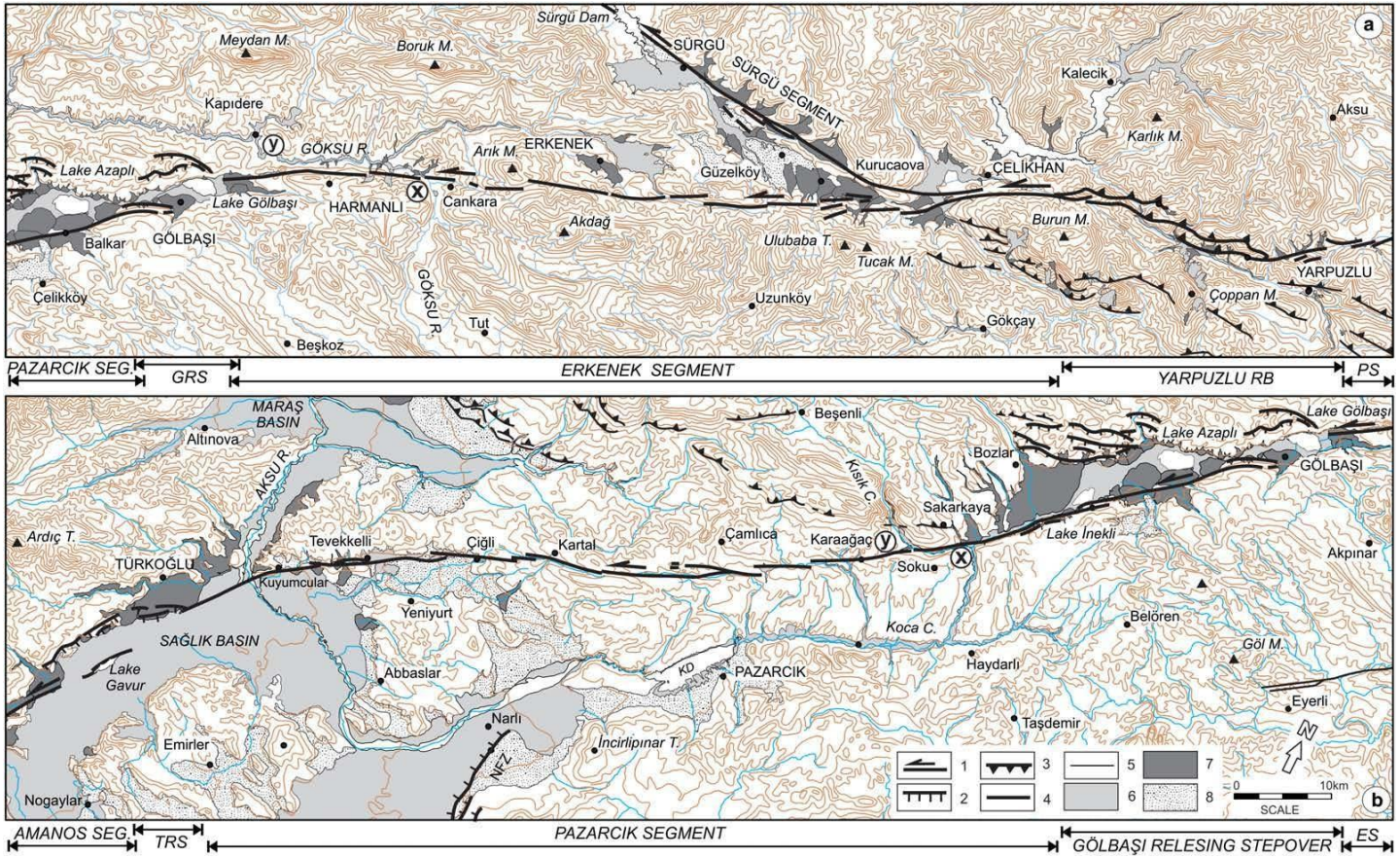
THE AMANOS FAULT SEGMENTS



Map of the Amanos fault segments of the East Anatolian fault system. **1**: left-lateral strike-slip fault; **2**: normal fault; **3**: reverse or thrust fault; **4**: inferred fault; **5**: national boundary; **6**: undifferentiated Holocene deposits; **7**: undifferentiated Quaternary deposits; **8**: Holocene lake and floodplain deposits; **9**: Holocene riverbed deposits, **10**: undifferentiated Quaternary volcanics. Source: Duman and Emre (2013)

THE RUPTURED SOUTHERN PART OF THE MAIN STRAND OF THE EAST ANATOLIAN FAULT SYSTEM

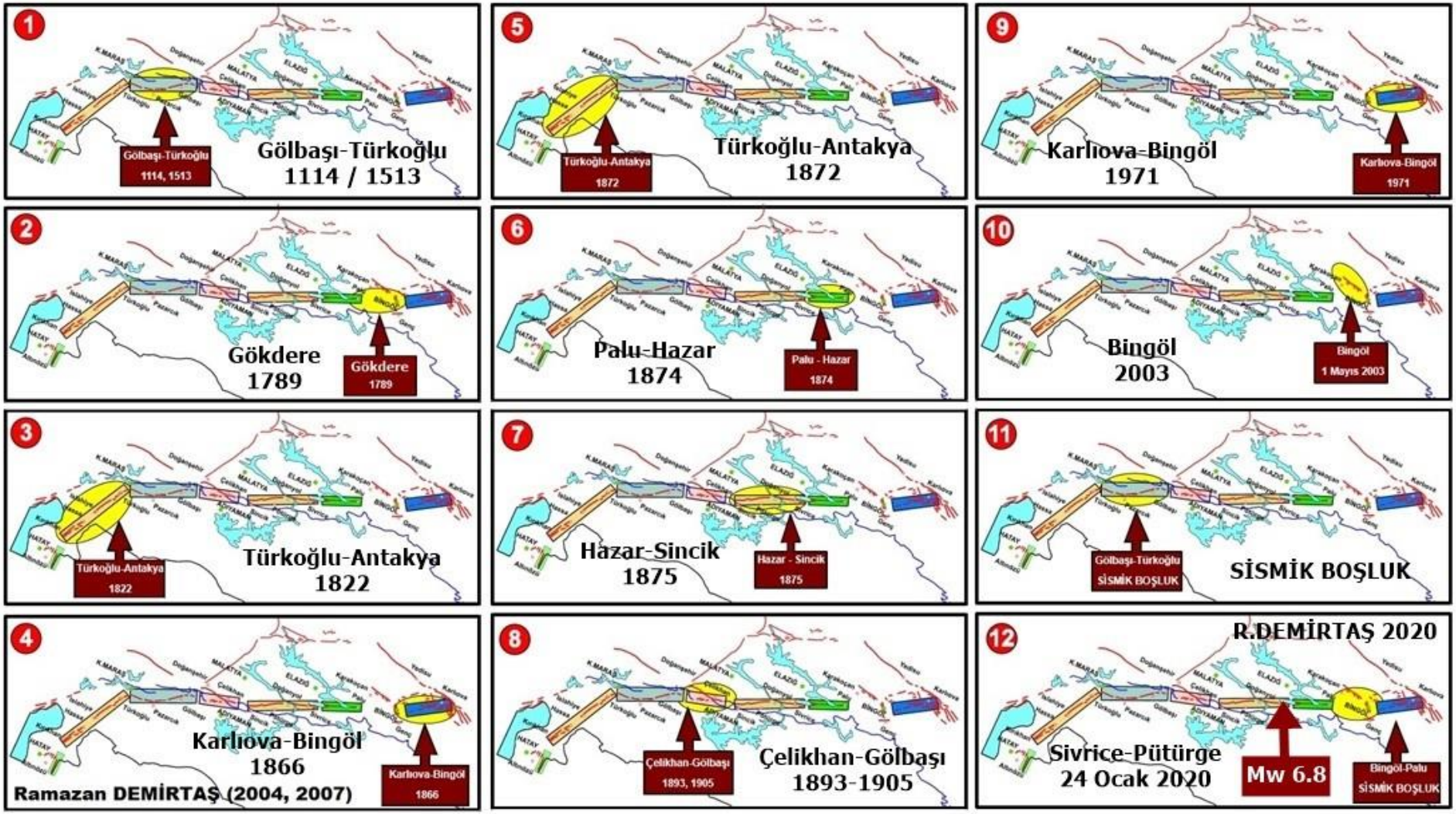
THE ERKENEK AND PAZARCIK FAULT SEGMENTS



Map of the Erkenek and Pazarcik fault segments of the East Anatolia fault system. **1**: left lateral strike-slip fault; **2**: normal fault; **3**: reverse or thrust fault; **4**: East Anatolian Fault; **5**: Southeastern Anatolian Thrust Zone; **6**: undifferentiated Holocene deposits; **7**: undifferentiated Quaternary deposits; **8**: landslide Source: Duman and Emre (2013)

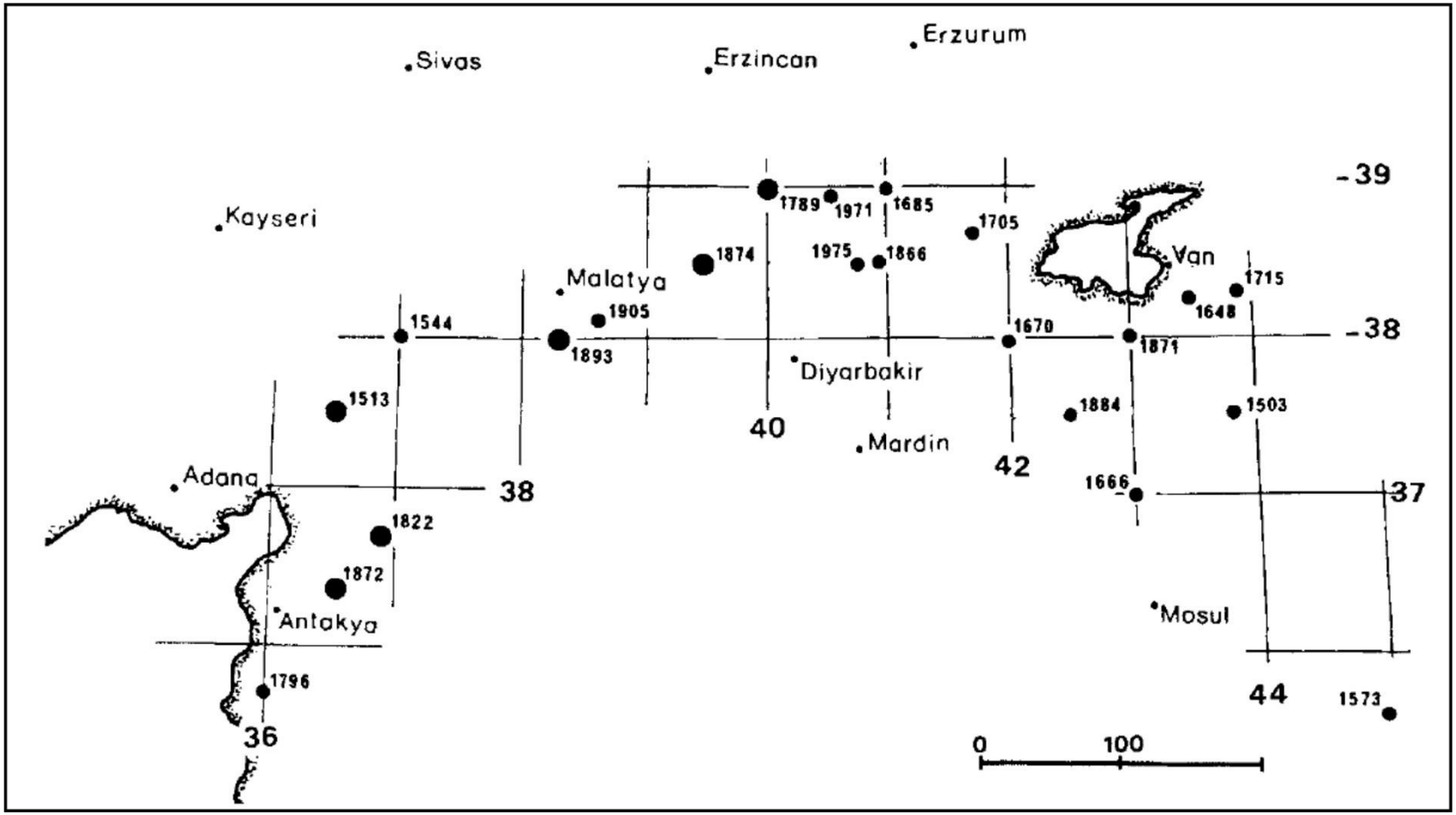
THE EAST ANATOLIAN STRIKE-SLIP FAULT SYSTEM

LARGE EARTHQUAKES AND SEISMIC GAPS



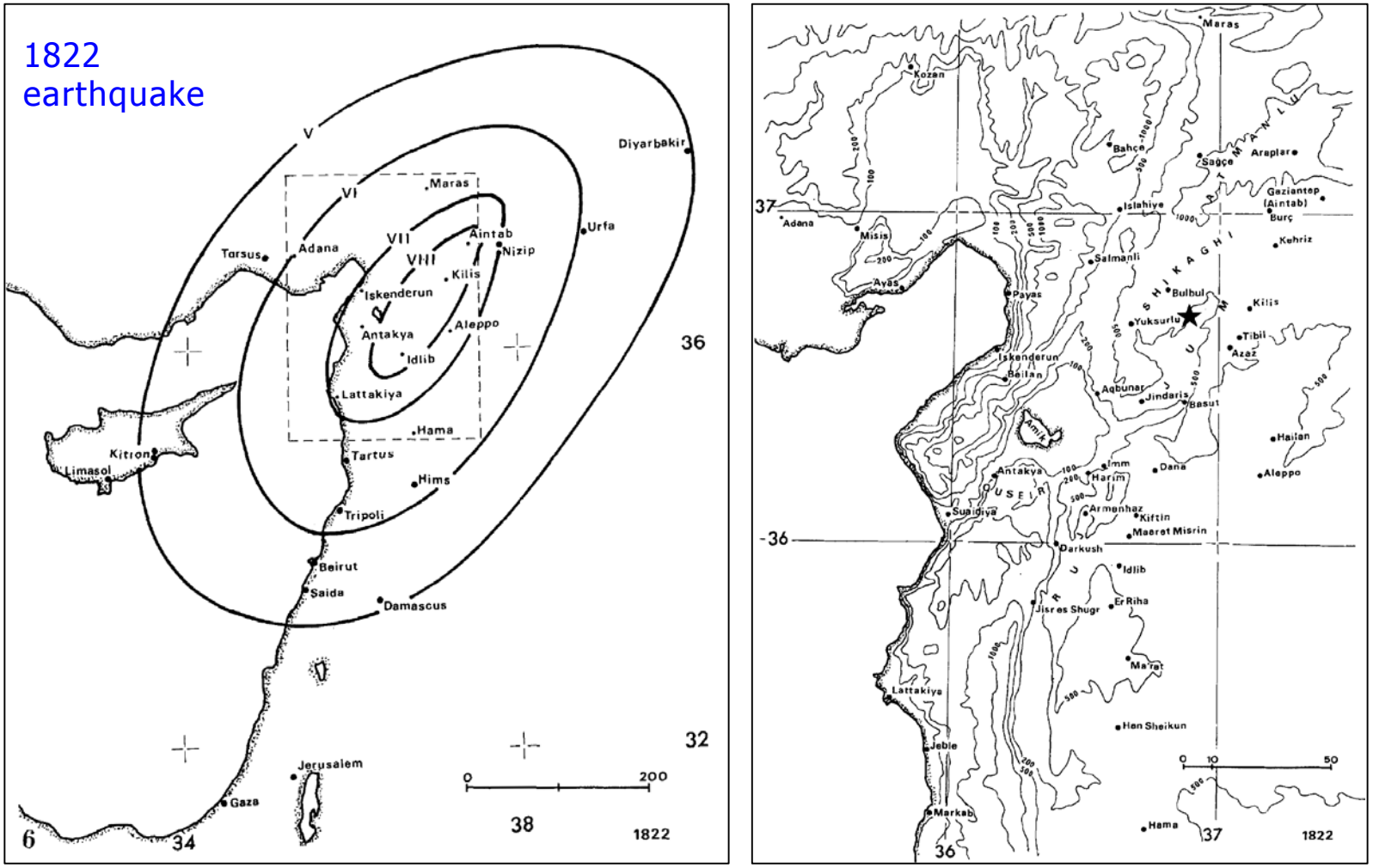
Source: https://twitter.com/Paleosismolog/status/1221394032661880833/photo/1

HISTORICAL EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM



Distribution of earthquakes in the East Anatolian fault zone from 1500 to 1988, marked with year of occurrence. Size of dots corresponds to magnitudes 6.0 and 7.0 respectively. Source: Ambraseys (1989)

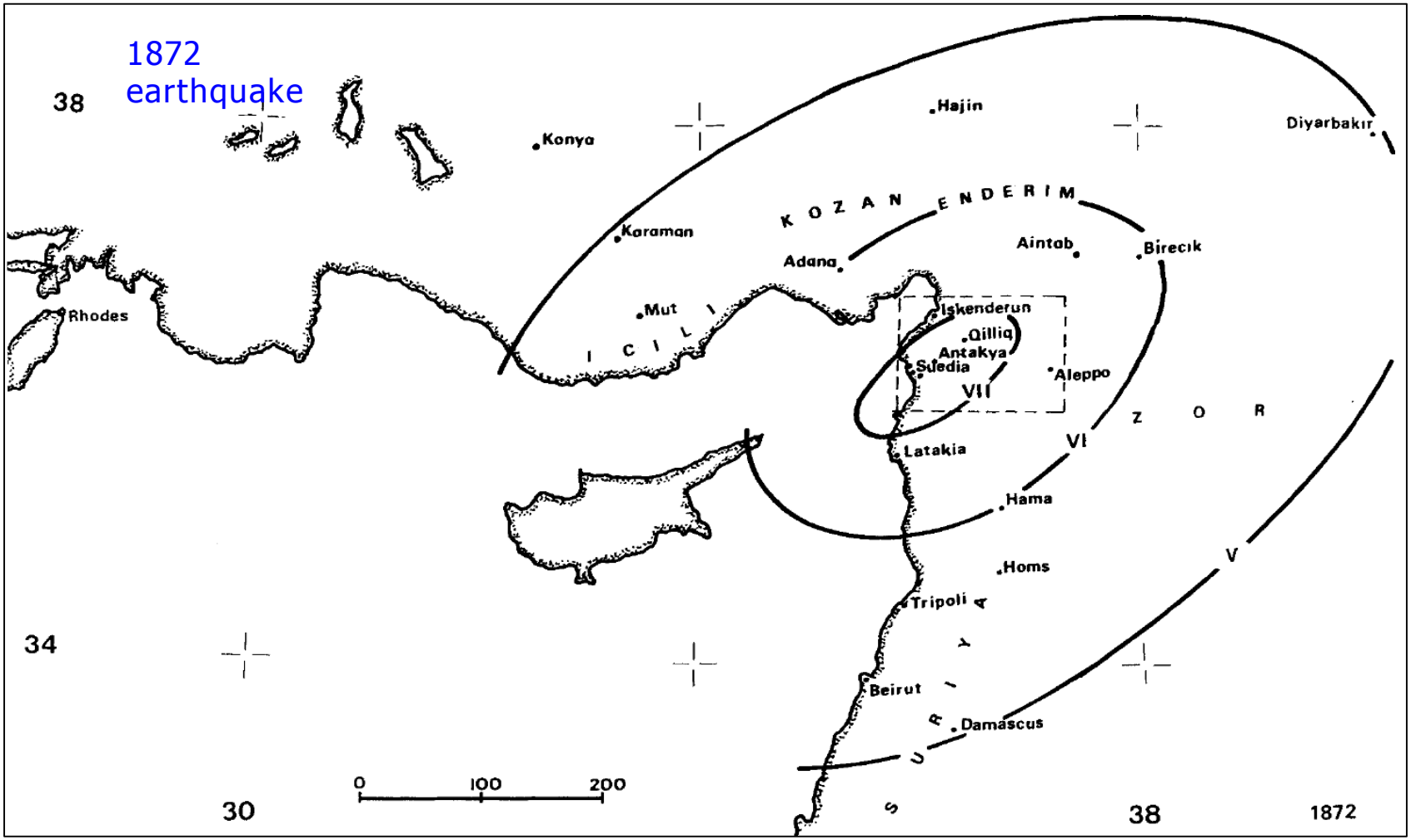
HISTORICAL EARTHQUAKES AND DAMAGED LOCALITIES IN THE EAST ANATOLIAN FAULT SYSTEM



Isoseismal map and epicentral area of the Aafrine earthquake of 1822

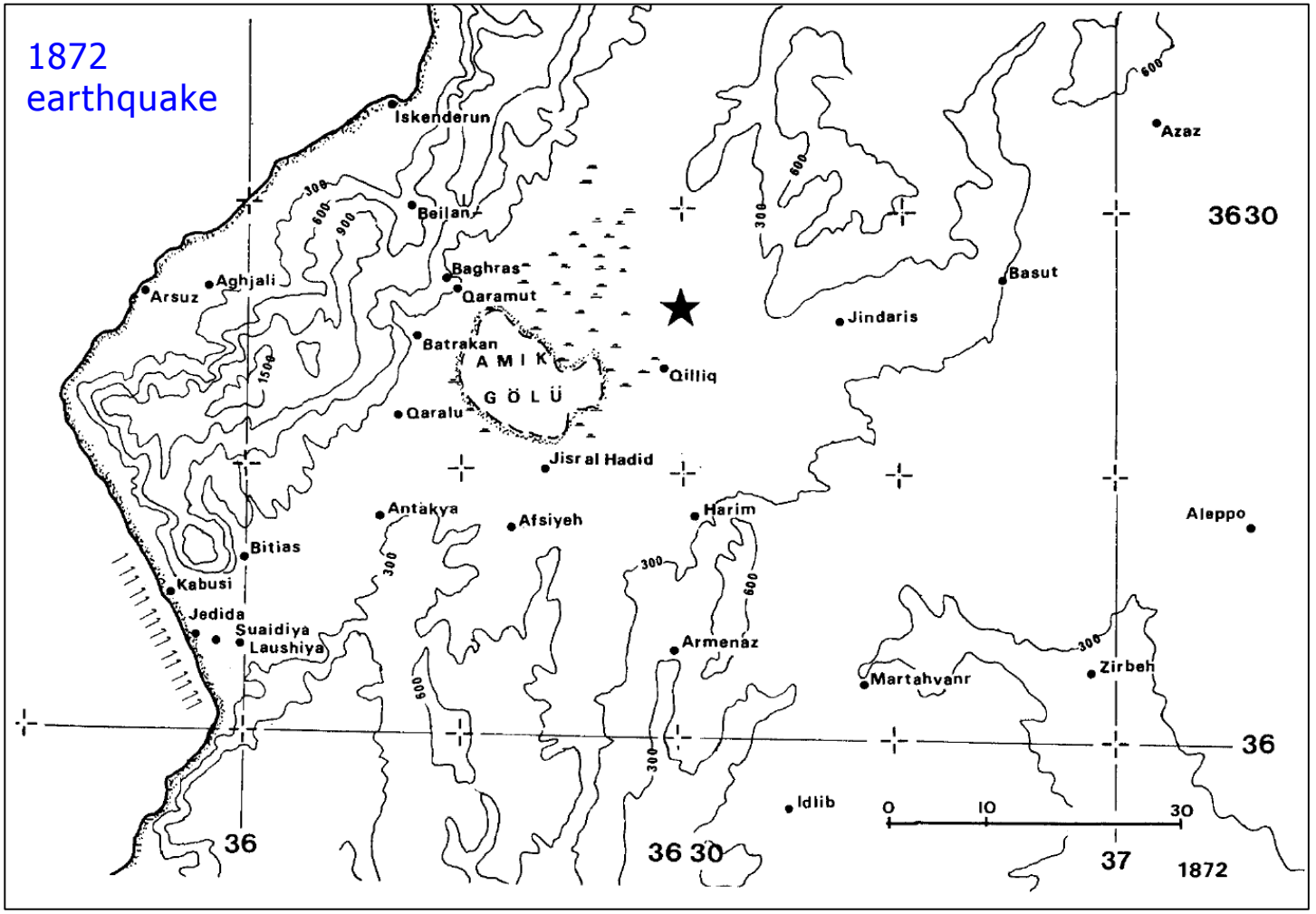
Source: Ambraseys (1989)

HISTORICAL EARTHQUAKES AND DAMAGED LOCALITIES IN THE EAST ANATOLIAN FAULT SYSTEM



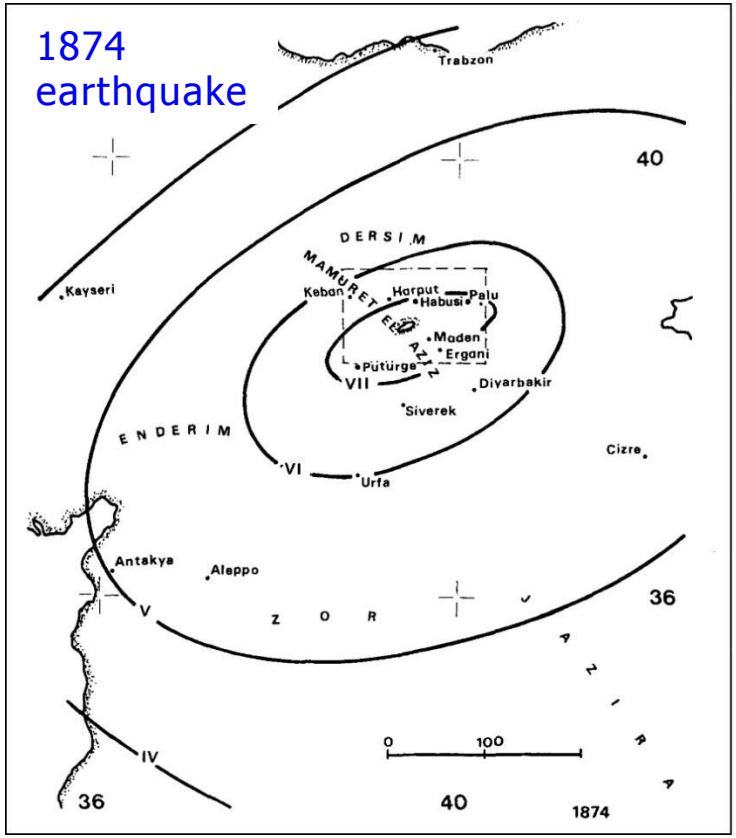
Isoseismal map of the earthquake of Amik Gölü in 1872
Source: Ambraseys (1989)

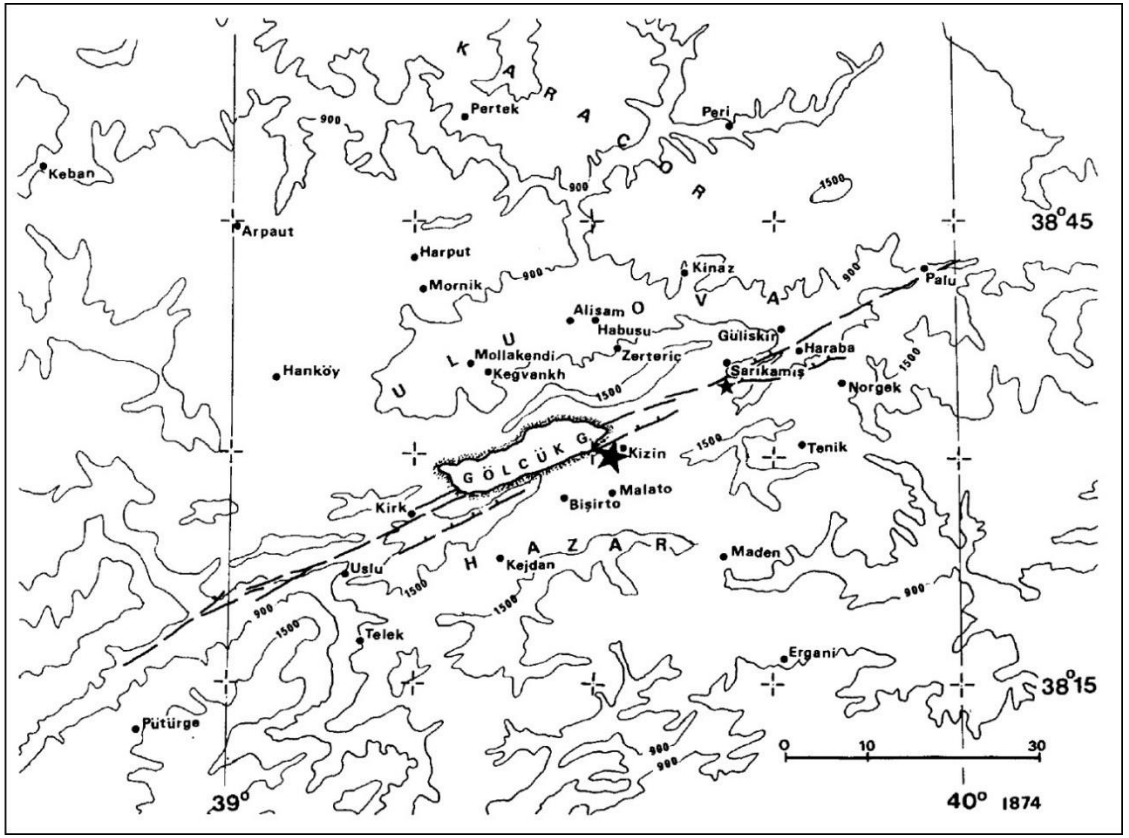
HISTORICAL EARTHQUAKES AND DAMAGED LOCALITIES IN THE EAST ANATOLIAN FAULT SYSTEM



Epicentral area of the 1872 earthquake. Star shows approximate macroseismic epicentre and arrows point to the coastal area subjected to flooding by sea waves. Source: Ambraseys (1989)

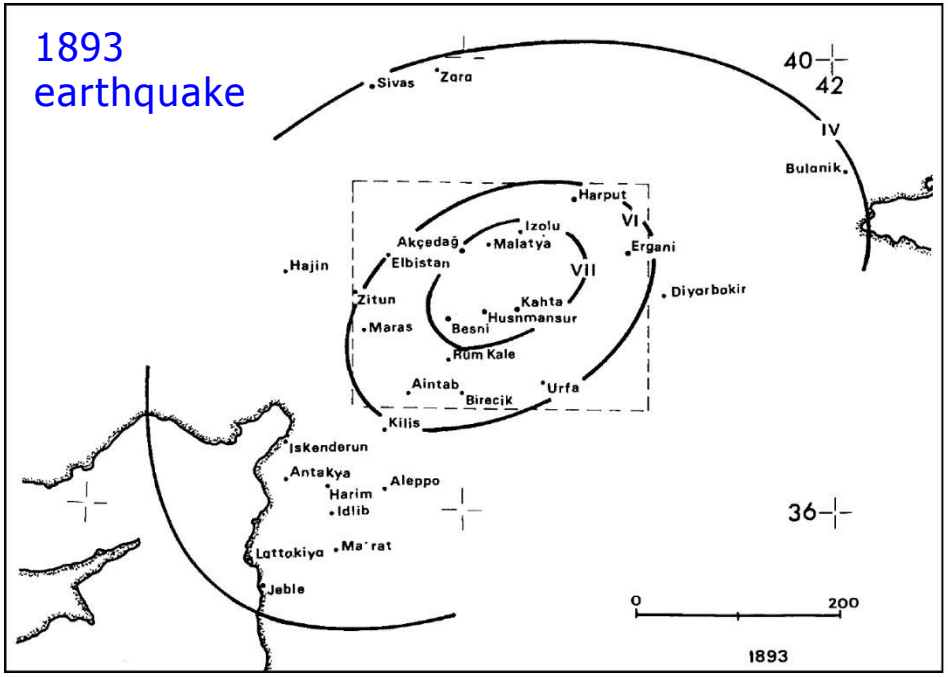
HISTORICAL EARTHQUAKES AND DAMAGED LOCALITIES IN THE EAST ANATOLIAN FAULT SYSTEM

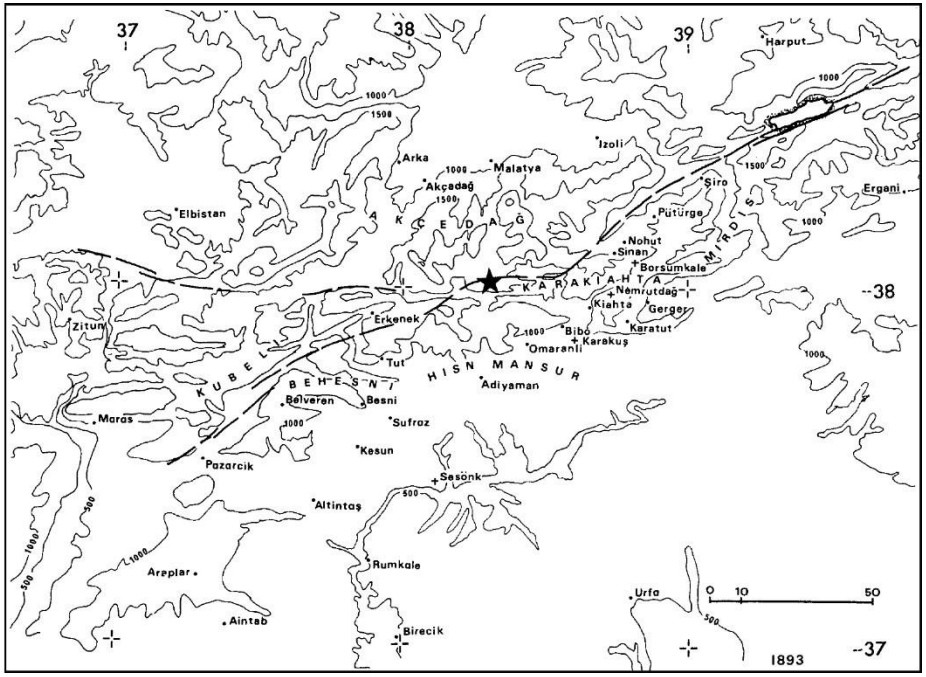




Epicentral region of the Gölcük Gölü earthquake of 1874. Dashed lines show the approximate location of East Anatolian Fault in the epicentral region. Large star indicates adopted location of epicentre and small star shows epicentre of foreshock of January 14, 1874. Source: Ambraseys (1989)

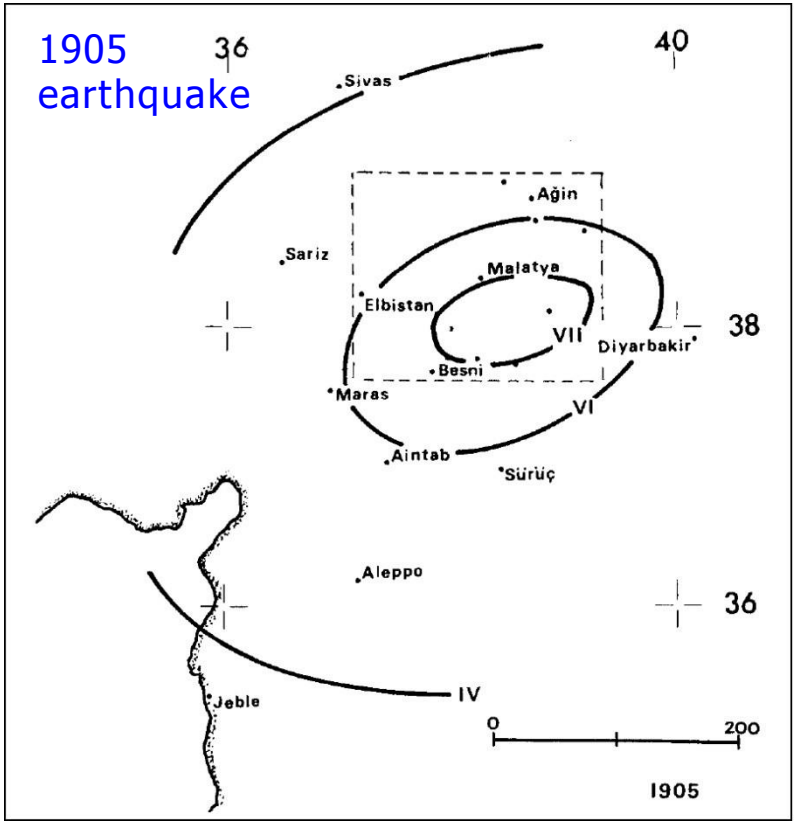
HISTORICAL EARTHQUAKES AND DAMAGED LOCALITIES IN THE EAST ANATOLIAN FAULT SYSTEM

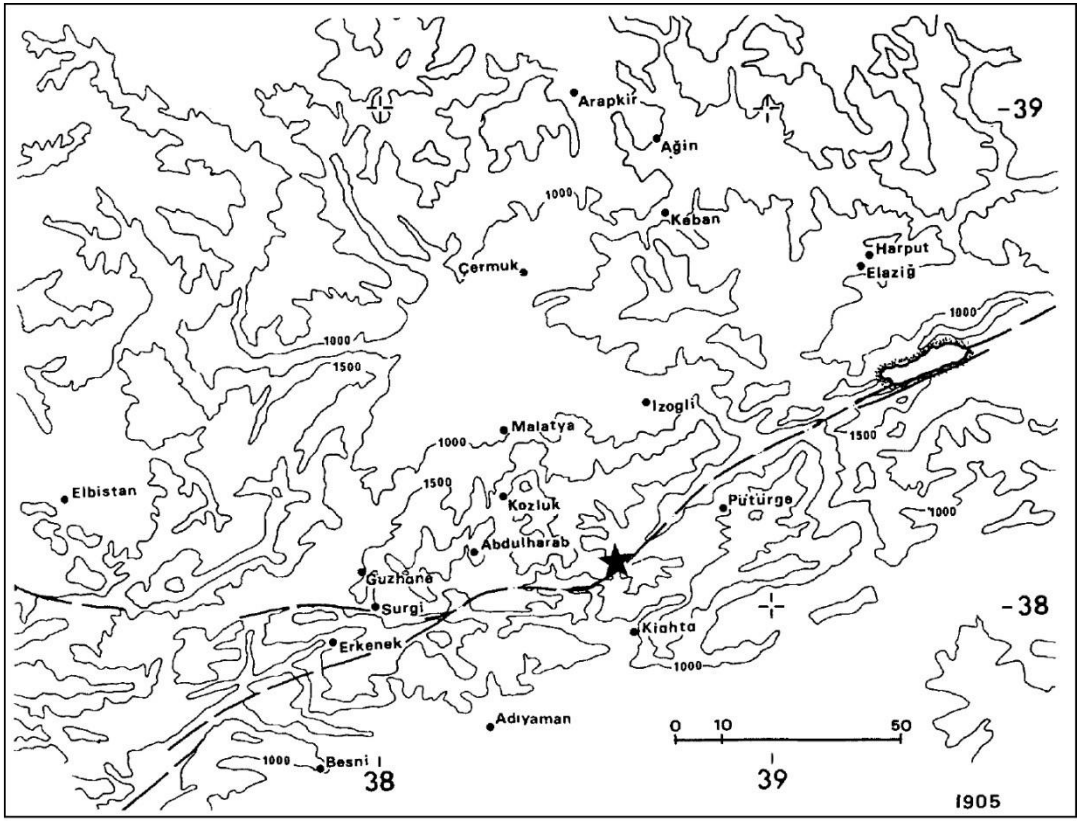




Macroseismic intensities and epicentral area of South Malatya earthquake of 1893. Dashed lines show the East Anatolian Fault system and star shows adopted location of the epicenter. Crosses indicate abandoned sites. Source: Ambraseys (1989)

HISTORICAL EARTHQUAKES AND DAMAGED LOCALITIES IN THE EAST ANATOLIAN FAULT SYSTEM

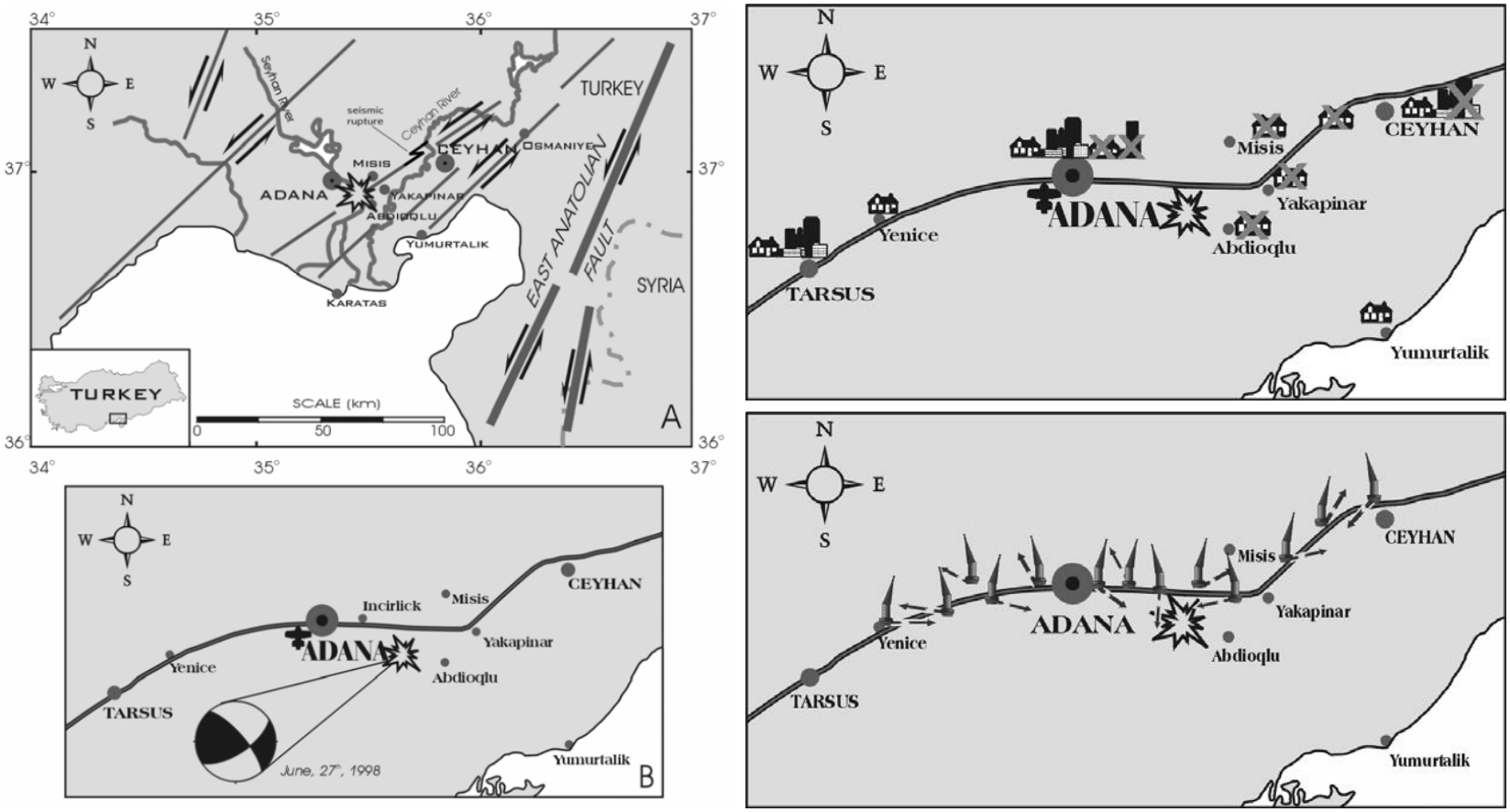




Macroseismic intensities and epicentral area of the Malatya earthquake of 1905. Dashed lines show location of East Anatolian Fault System and star shows adopted macroseismic epicenter. Source: Ambraseys (1989)

STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

THE 27 JUNE 1998 Mw=6.3 ADANA EARTHQUAKE



Geotectonic map of the wider meizoseismal area with the location of the epicenter (**A**) and the focal mechanism (**B**). (**C**) Simplified map of the damage distribution (X) and the type of buildings (tall buildings, old residential structures) after the main shock. (**D**) The geographic distribution of minarets collapse along with the direction of the collapse. Source: Lekkas and Vassilakis, 1999, in Advances in Earthquake Engineering, Earthquake Resistant Engineering Structures, Wit Press.

STRONGEST EARTHQUAKES IN TURKEY SINCE 1998

Source: https://www.aljazeera.com/news/2023/2/8/infographic-how-big-were-the-earthquakes-in-turkey-syria

STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

THE 27 JUNE 1998 Mw=6.3 ADANA EARTHQUAKE

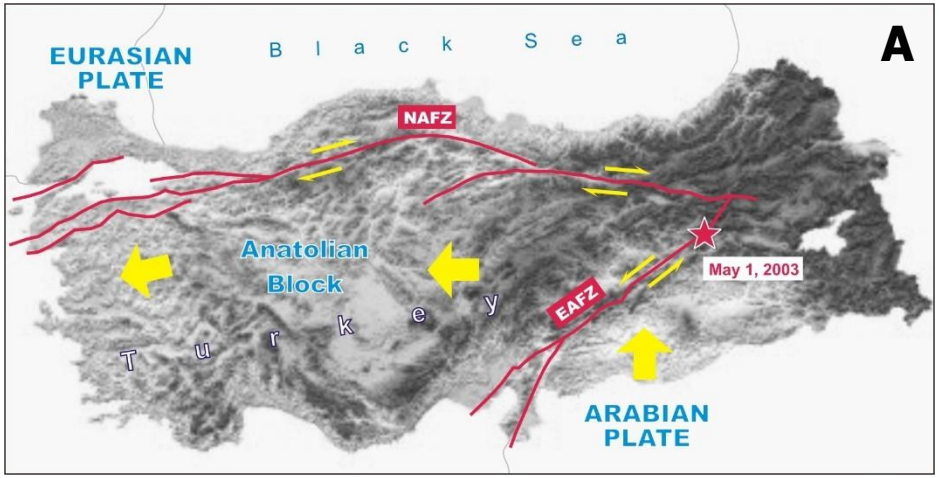


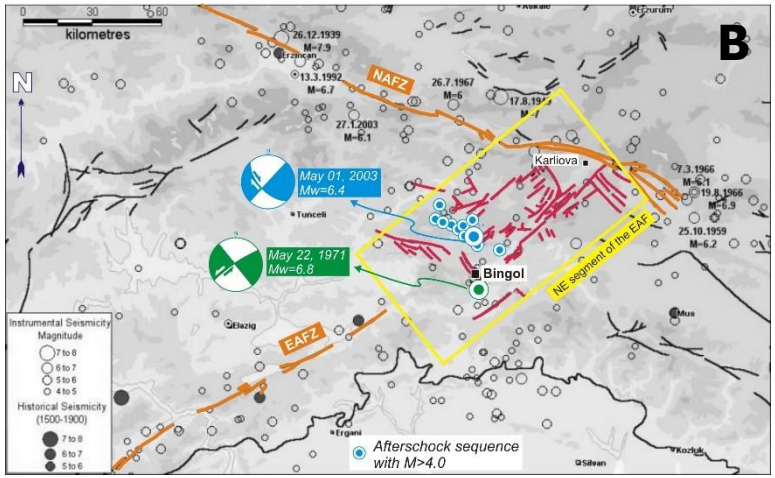


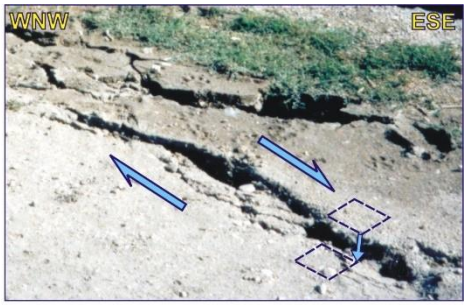

Characteristic views of the impact of the earthquake on residential reinforced-concrete buildings, buildings with load-bearing masonry walls and monumental structures in the area affected by the 1998 Adana earthquake. Source: personal archive of Professor Dr. Efthymis Lekkas, available online: https://www.elekkas.gr/index.php/en/epistimoniko-ergo/scientificmissions/1621-adana-ceyhan-1998.

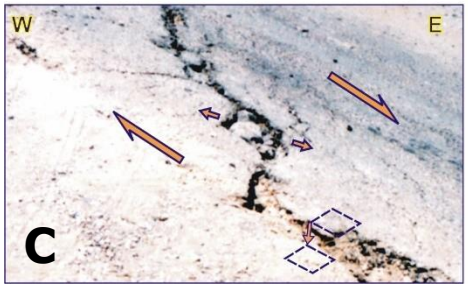
STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

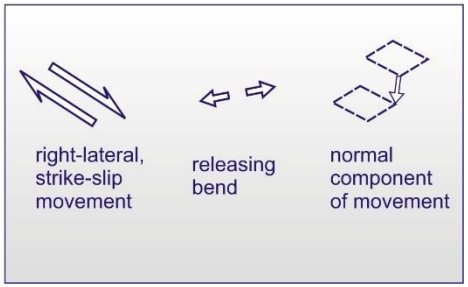
THE 1 MAY 2003 Mw=6.4 BINGÖL EARTHQUAKE







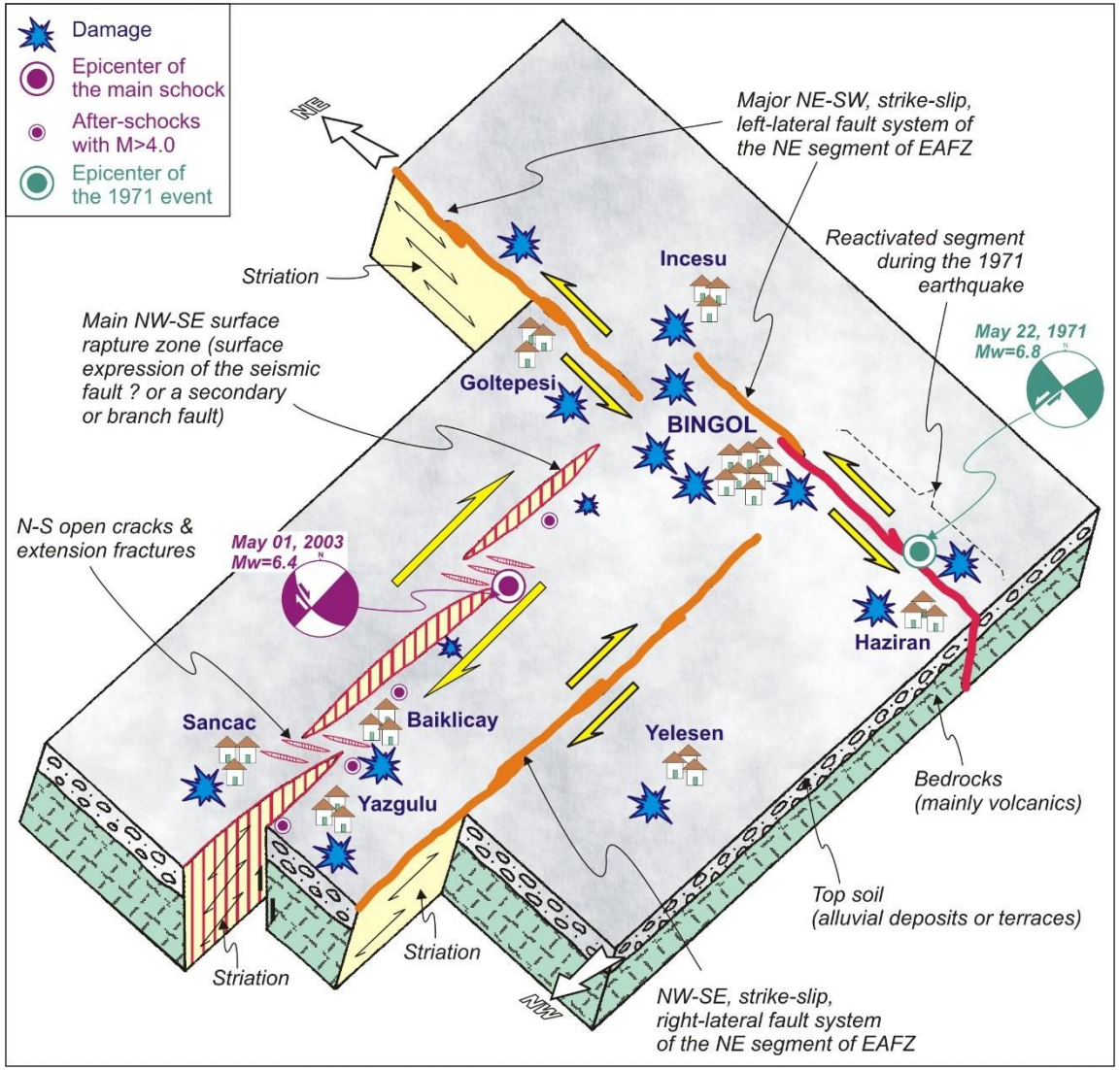




(A)Location map of the 1 May 2003 Bingöl earthquake.
(B)Simplified seismotectonic regime of the area affected by the 1 May 2003 Bingöl earthquake.
(C)Kinematic interpretation of the NW-SE surface ruptures mapped in the field of the area affected by the 1 May 2003 Bingöl earthquake.
Source: Lozios, Lekkas and Danamos (2004), in the 13th World Conference on Earthquake Engineering.

STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

THE 1 MAY 2003 Mw=6.4 BINGÖL EARTHQUAKE



Schematic block-diagram representing the tectonic structures, environmental effects and damages occurred during the 1 May 2003, Mw=6.4 Bingöl earthquake.

Source: Lozios, Lekkas and Danamos (2004), in the 13th World Conference on Earthquake Engineering

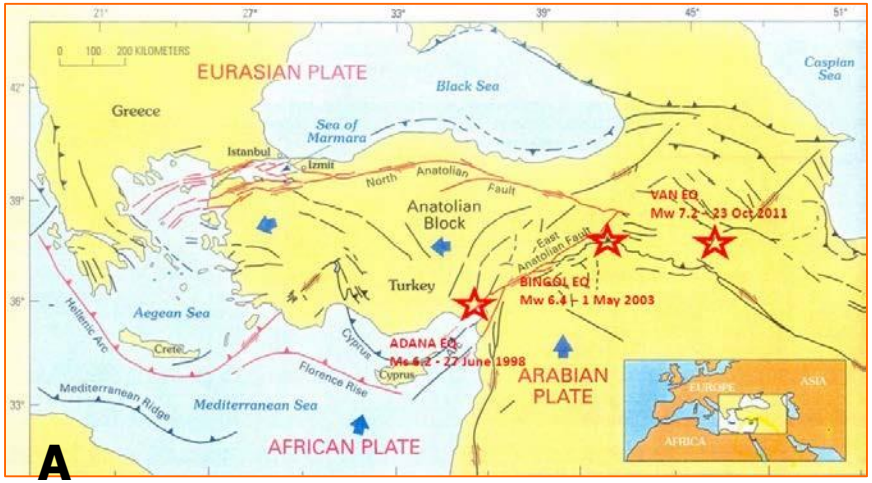
STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

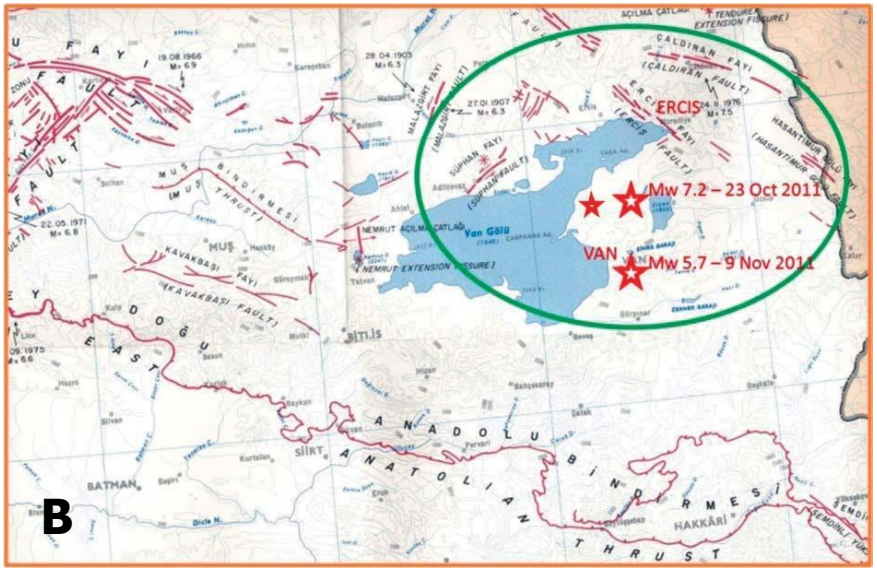
THE 1 MAY 2003 Mw=6.4 BINGÖL EARTHQUAKE

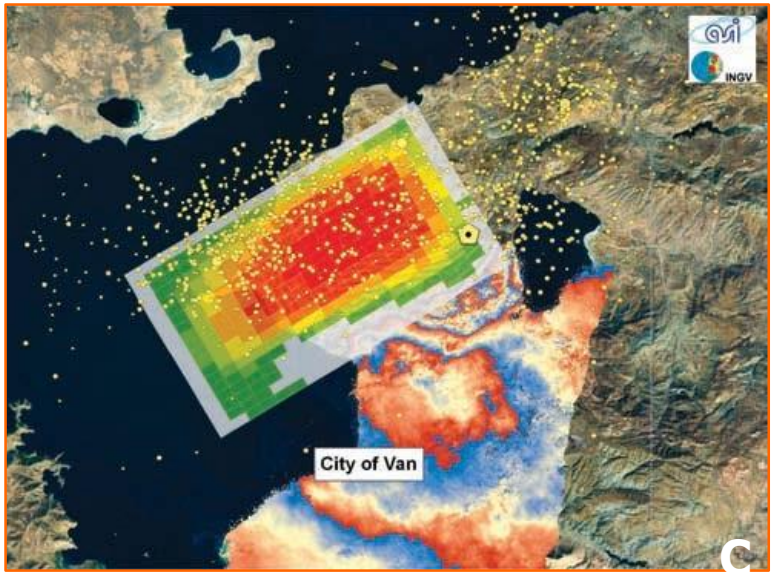
Characteristic views of the impact of the earthquake on residential reinforced-concrete buildings in the area affected by the 2003 Bingöl earthquake. Source: personal archive of Professor Dr. Efthymis Lekkas, available online: https://www.elekkas.gr/index.php/en/epistimoniko-ergo/scientificmissions/1627-bingol-2003.

STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

THE 23 OCTOBER 2011 Mw=7.2 VAN EARTHQUAKE







(A)Geotectonic map of Greece and Anatolia and the epicenters of the 1998 Adana, 2003 Bingöl and 2011 Van earthquakes along the East Anatolia Fault.

(B)Main faults of the area affected by the 23 October 2011 Mw=7.2 Van earthquake.

(**C**) Seismicity, slip model and surface displacement for the 2011 Van earthquake.

Source: Carydis et al., (2012), in the International Journal of Earthquake Engineering

STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

THE 23 OCTOBER 2011 Mw=7.2 VAN EARTHQUAKE

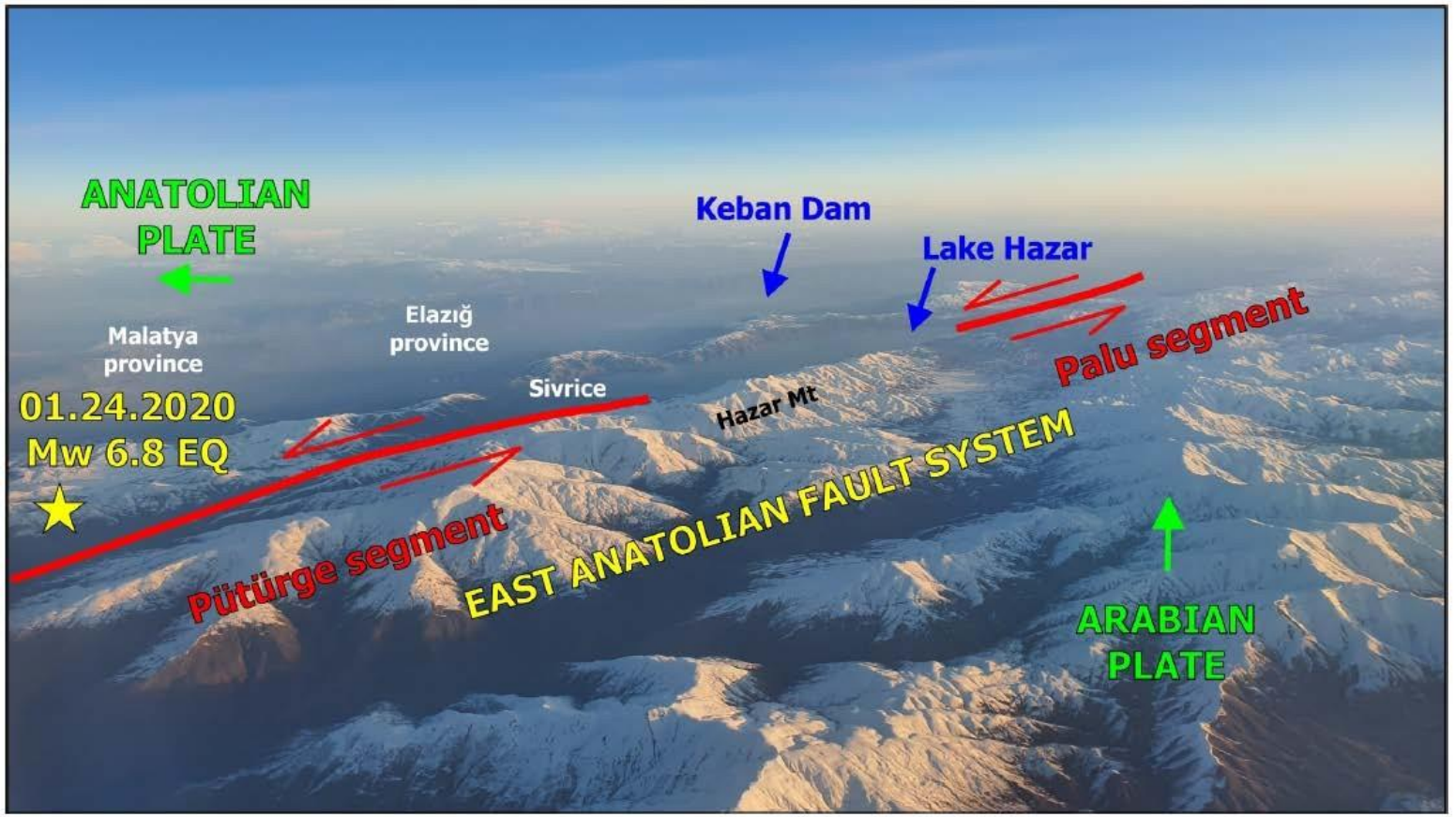





Characteristic views of the impact of the earthquake on residential reinforced-concrete buildings, buildings with load-bearing masonry walls and monumental structures in the area affected by the 2011 Van earthquake. Source: personal archive of Professor Dr. Efthymis Lekkas, available online: https://www.elekkas.gr/index.php/en/epistimoniko-ergo/scientificmissions/1082-m-turkey.

STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998

THE 24 JANUARY 2020 Mw=6.8 ELAZIĞ EARTHQUAKE



The 24 January 2020 earthquake was generated by the rupture of the Pütürge segment of the East Anatolian Fault System, which comprises a major active left-lateral strike-slip fault zone in eastern Turkey. It forms the tectonic boundary between the Anatolian Plate and the northward-moving Arabian Plate. The most affected areas were the Elazığ city and the Malatya city in the respective provinces. Damage was also reported in Sivrice and Pütürge districts. Source: Lekkas, Carydis and Mavroulis (2020), in the Newsletter of the EDCMS.

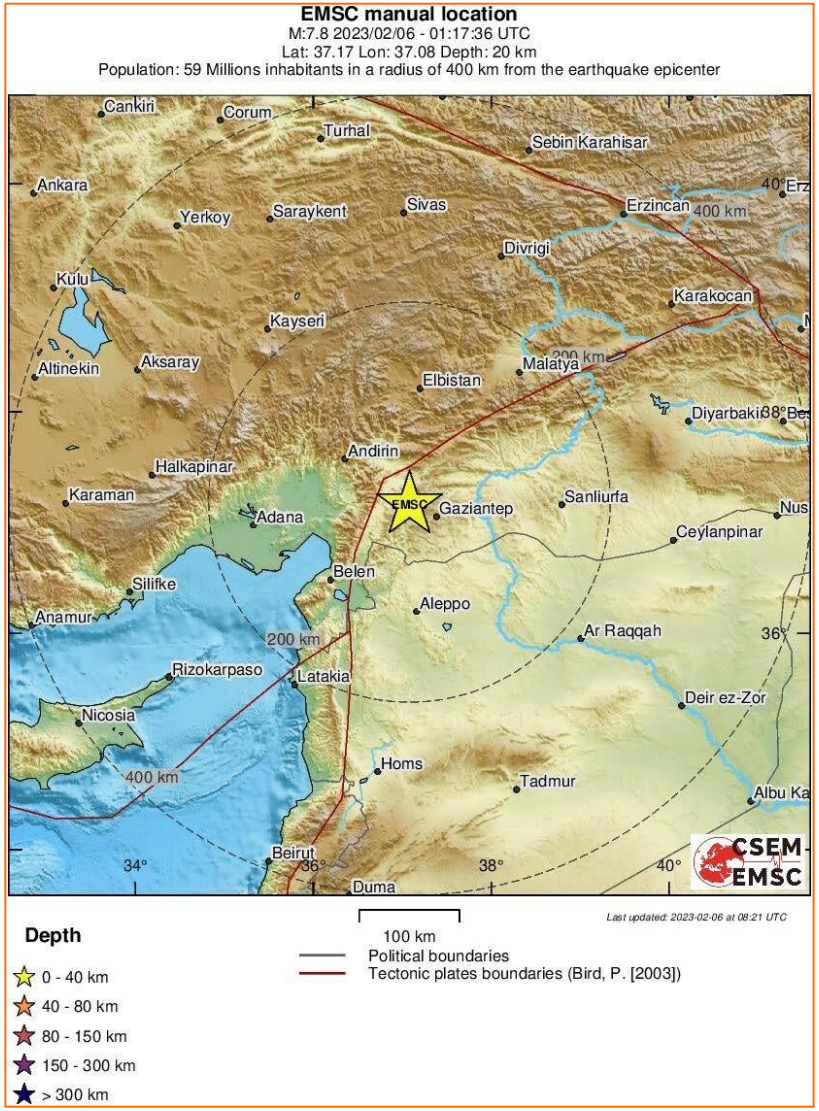
STRONGEST EARTHQUAKES IN THE EAST ANATOLIAN FAULT SYSTEM SINCE 1998
THE 24 JANUARY 2020 Mw=6.8 ELAZIĞ EARTHQUAKE

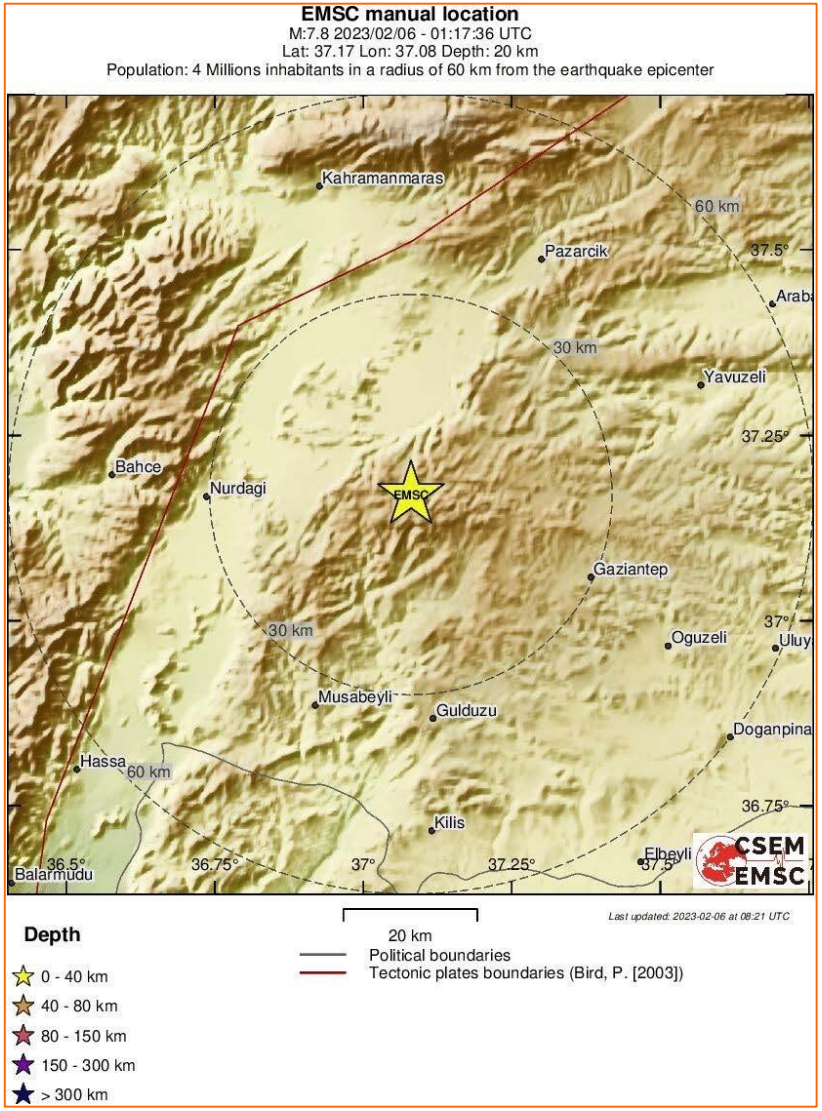




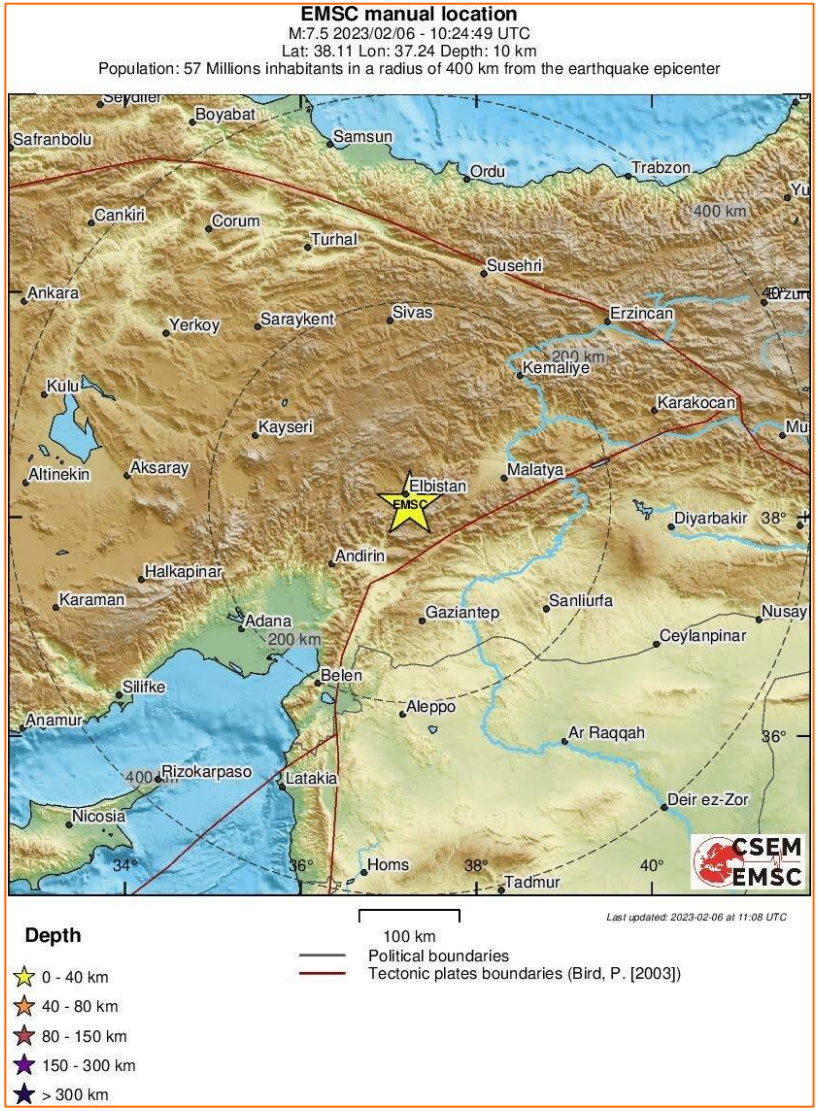

Characteristic views of the impact of the earthquake on residential reinforced-concrete buildings in Elaziğ city that suffered the most by the earthquake. Source: Lekkas, Carydis and Mavroulis (2020), in the Newsletter of the EDCMS.

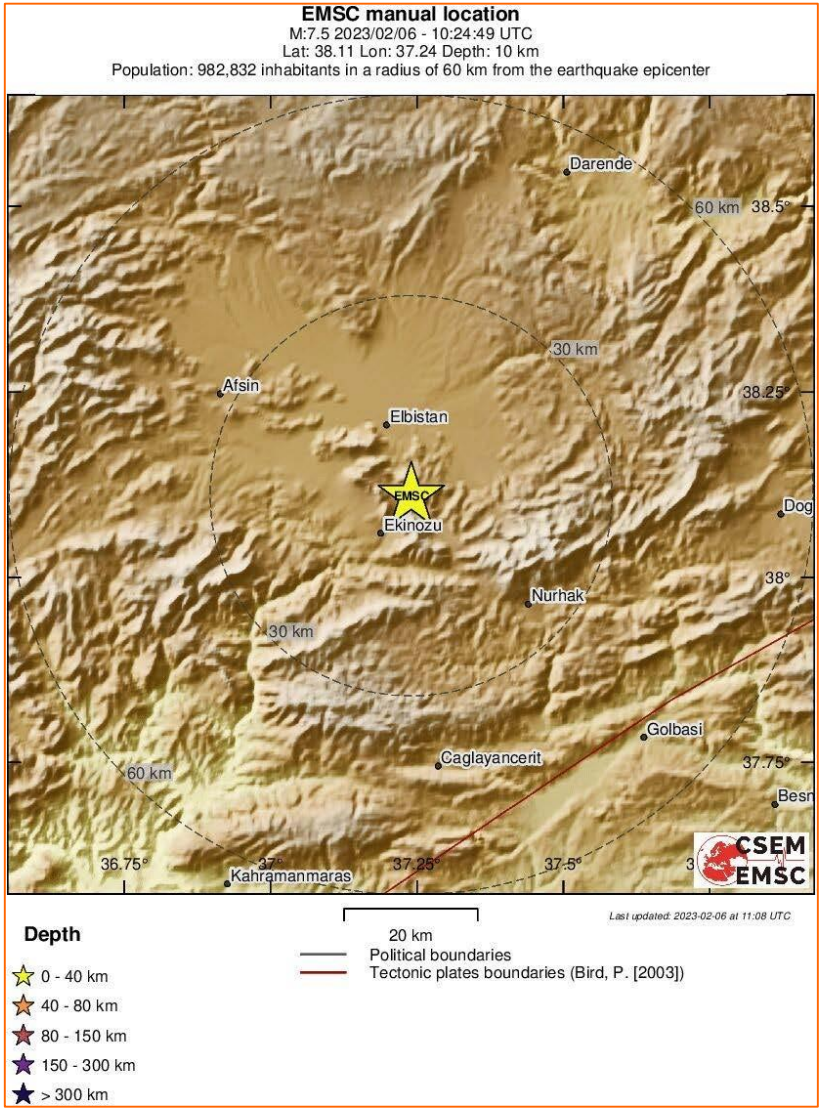
EPICENTER OF THE 6 FEBRUARY 2023, Mw=7.8 EARTHQUAKE IN THE EAST ANATOLIA FAULT ZONE





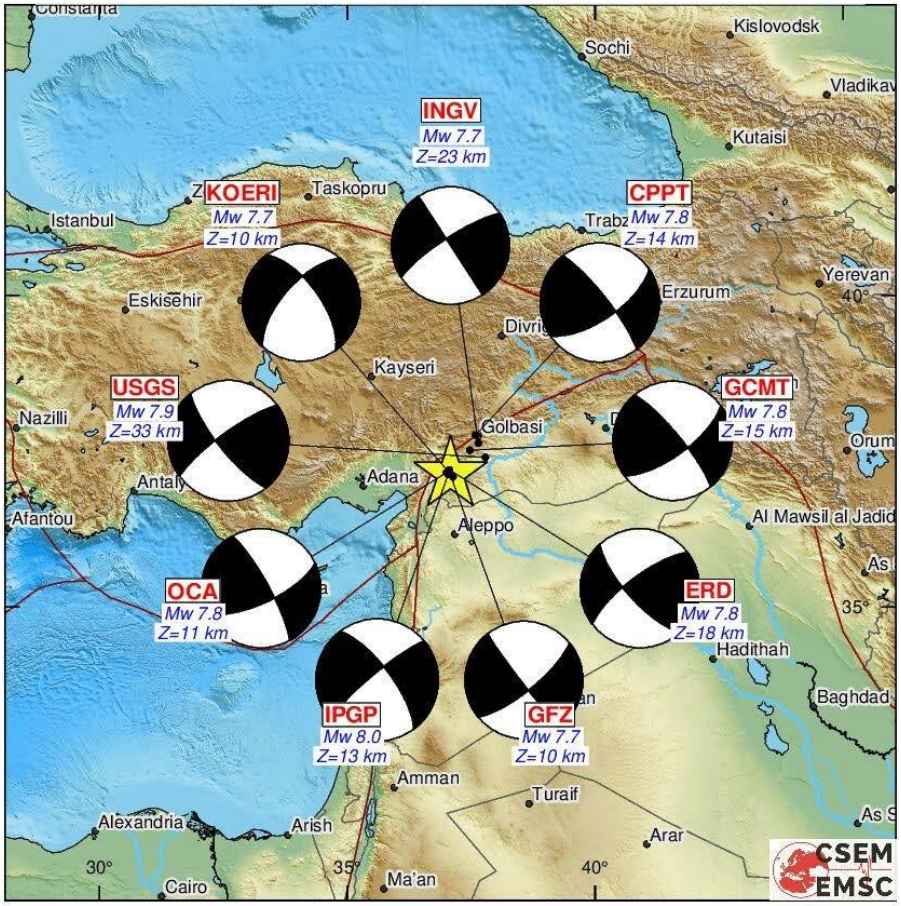
EPICENTER OF THE 6 FEBRUARY 2023, Mw=7.5 EARTHQUAKE IN THE EAST ANATOLIA FAULT ZONE



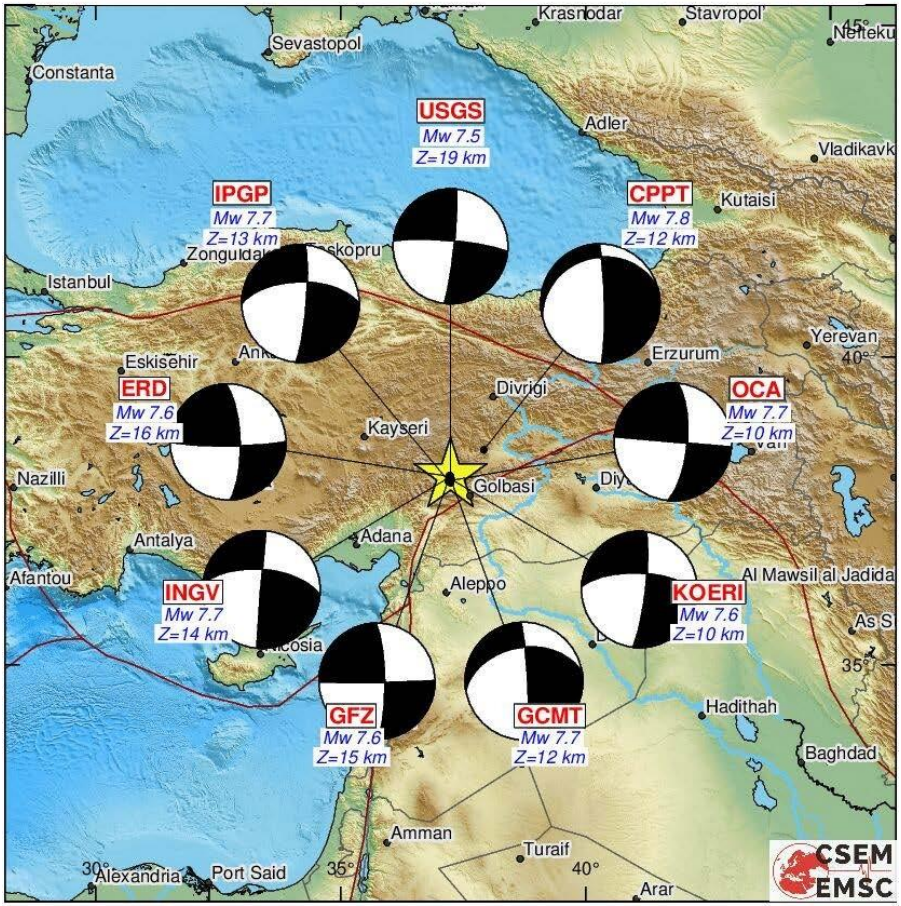


QUICK SOLUTIONS AND REGIONAL MOMENT TENSORS FOR THE 6 FEBRUARY 2023 EARTHQUAKES

Moment Tensor map of earthquake:
Mag: 7.8 2023-02-06 01:17:36 UTC
Lat: 37.17 Lon: 37.08 Depth: 20.0 km

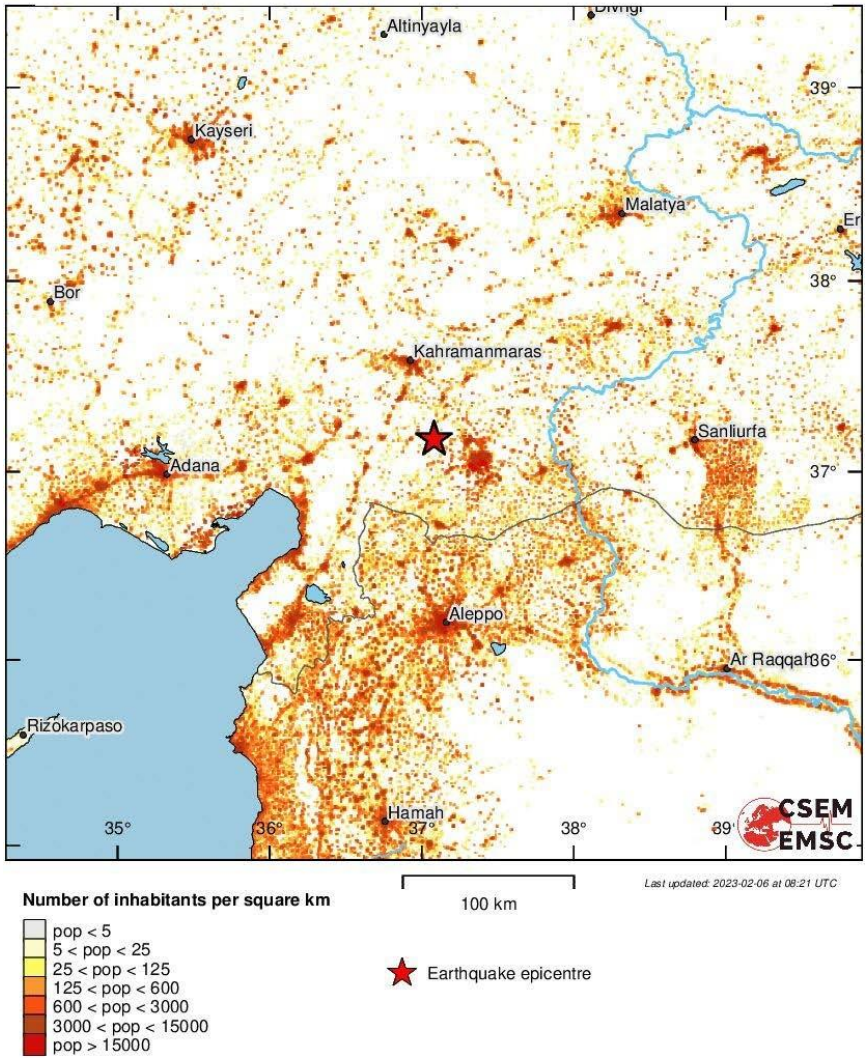


Moment Tensor map of earthquake:
Mag: 7.5 2023-02-06 10:24:49 UTC
Lat: 38.11 Lon: 37.24 Depth: 10.0 km



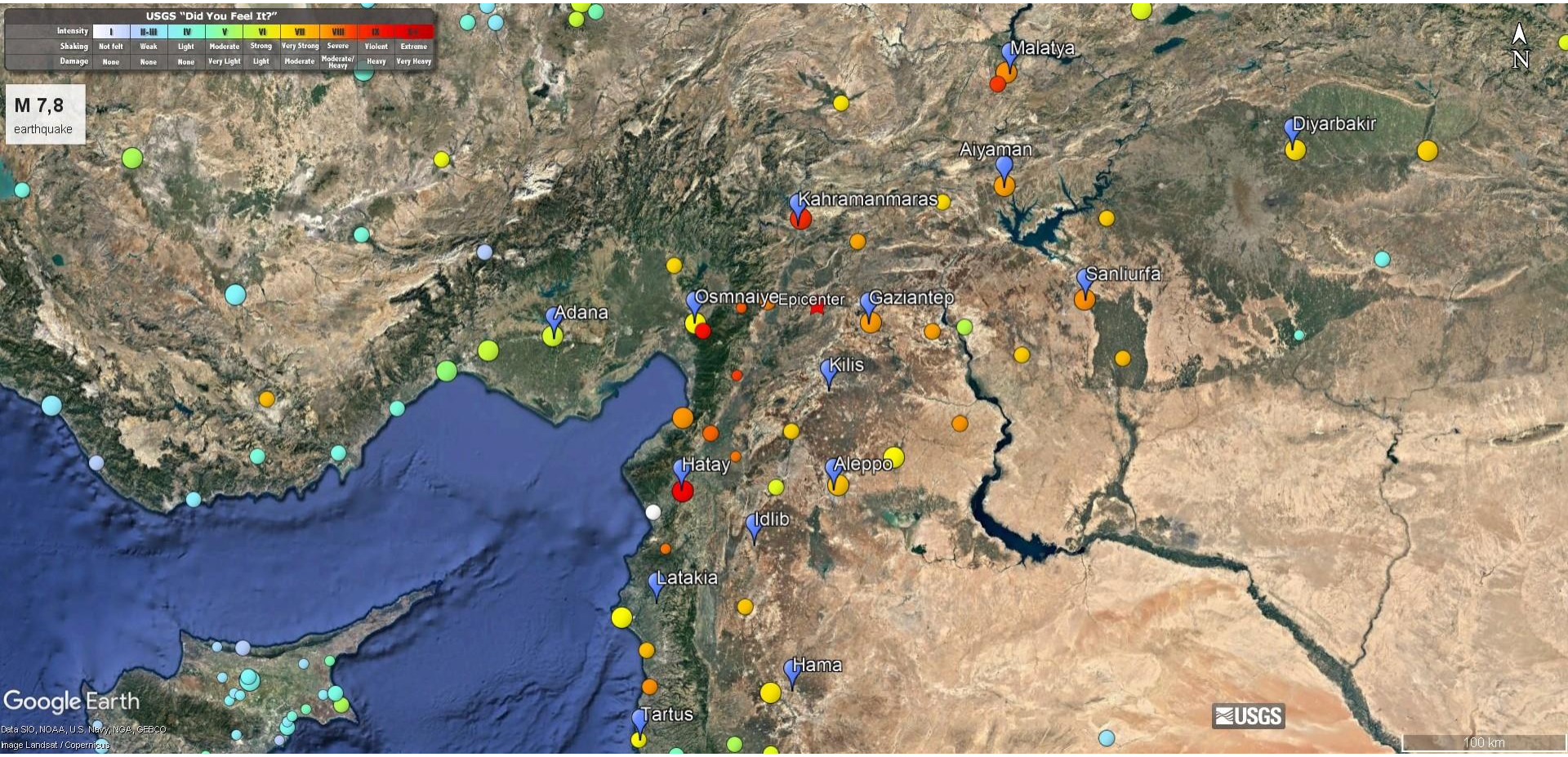
DISTRIBUTION OF POPULATION IN THE EPICENTRAL AREA OF THE 6 FEBRUARY 2023 EARTHQUAKES

Population in the epicentral area: ~29 Millions inhabitants
M:7.8 2023/02/06 - 01:17:36 UTC
Lat: 37.17 Lon: 37.08 Depth: 20 km



SENSITIVITY OF THE FEBRUARY 2023 EARTHQUAKES BASED ON TESTIMONIES

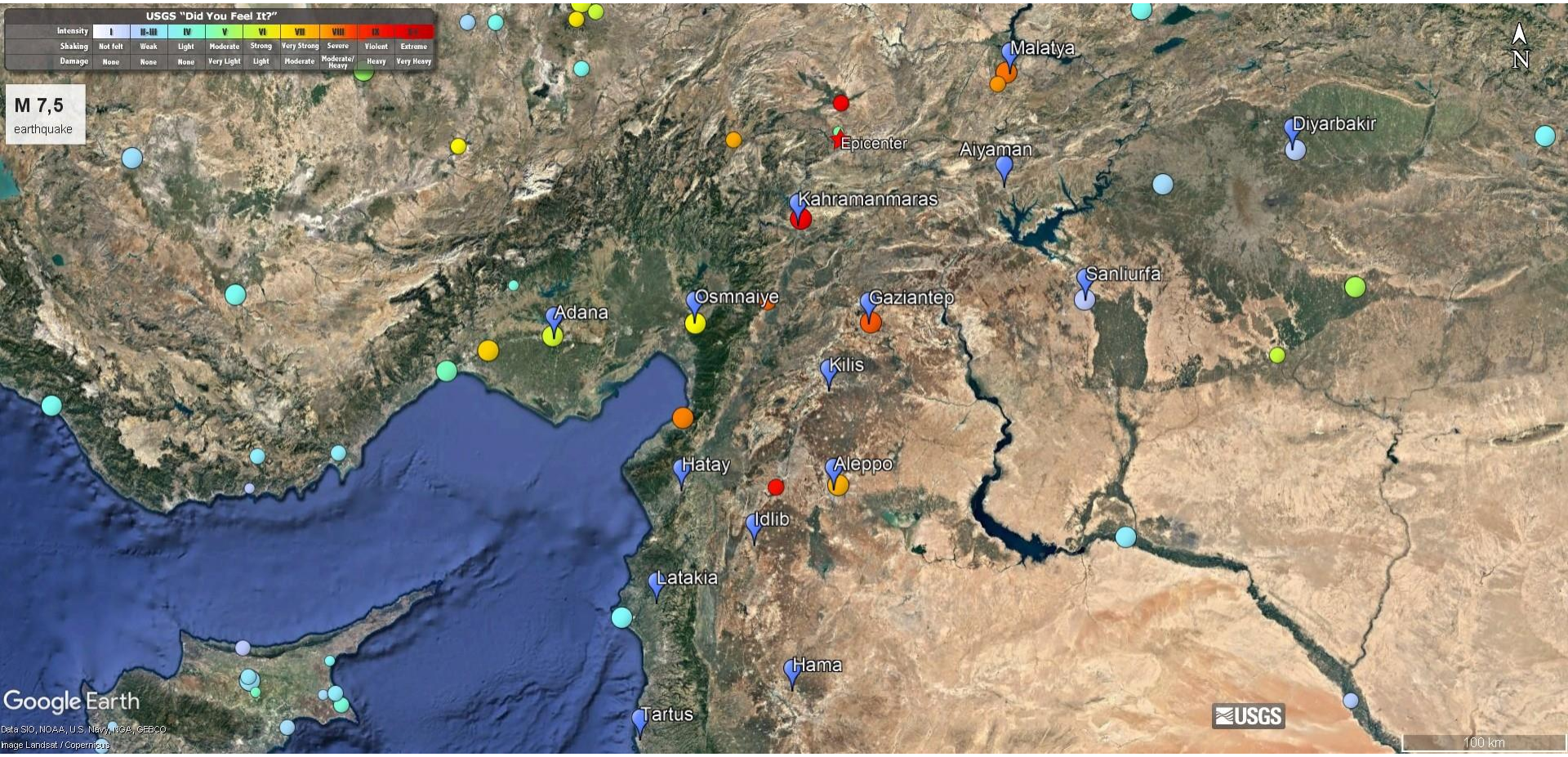
THE Mw=7.8 EARTHQUAKE



Data source available online in USGS

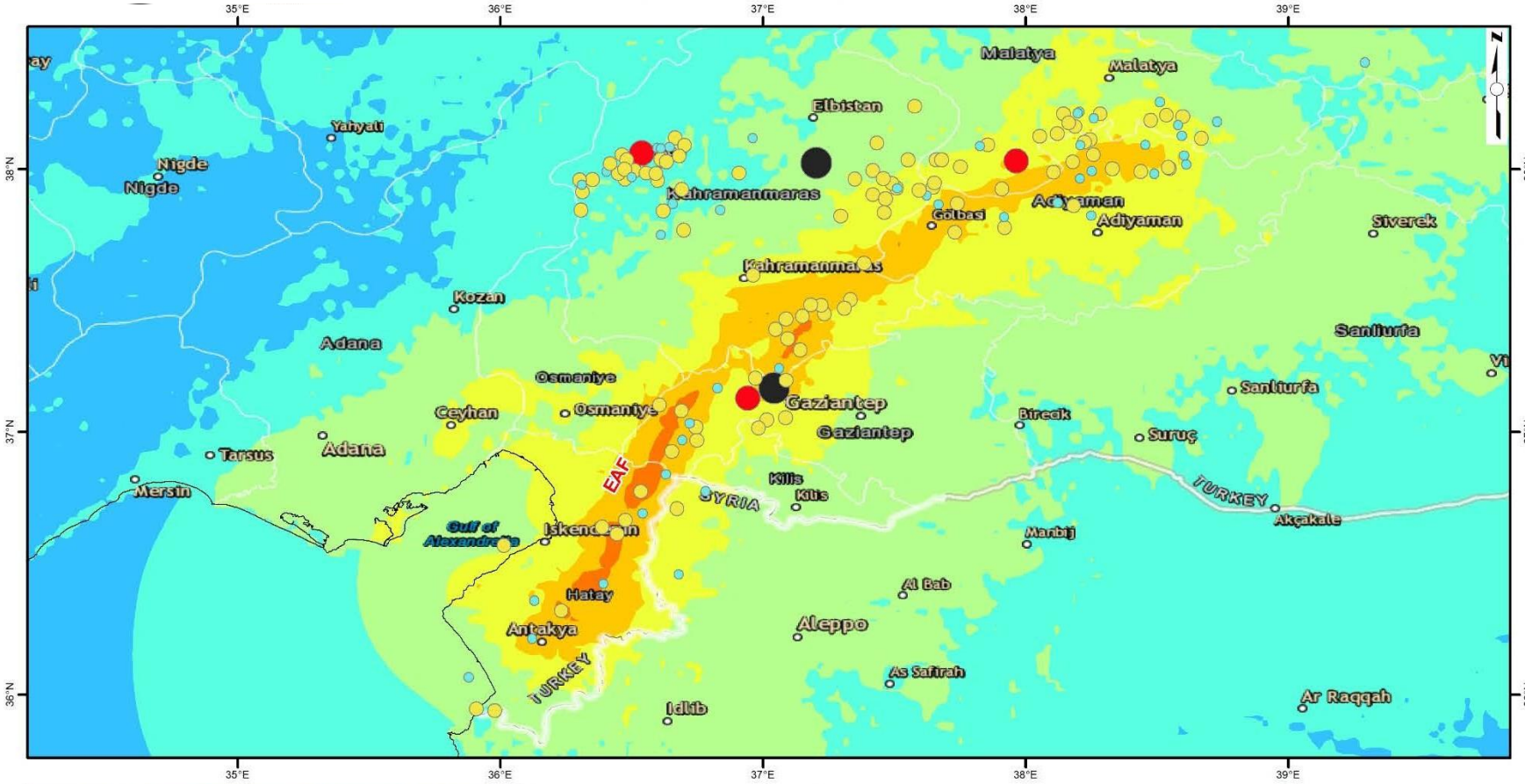
SENSITIVITY OF THE FEBRUARY 2023 EARTHQUAKES BASED ON TESTIMONIES

THE Mw=7.5 EARTHQUAKE

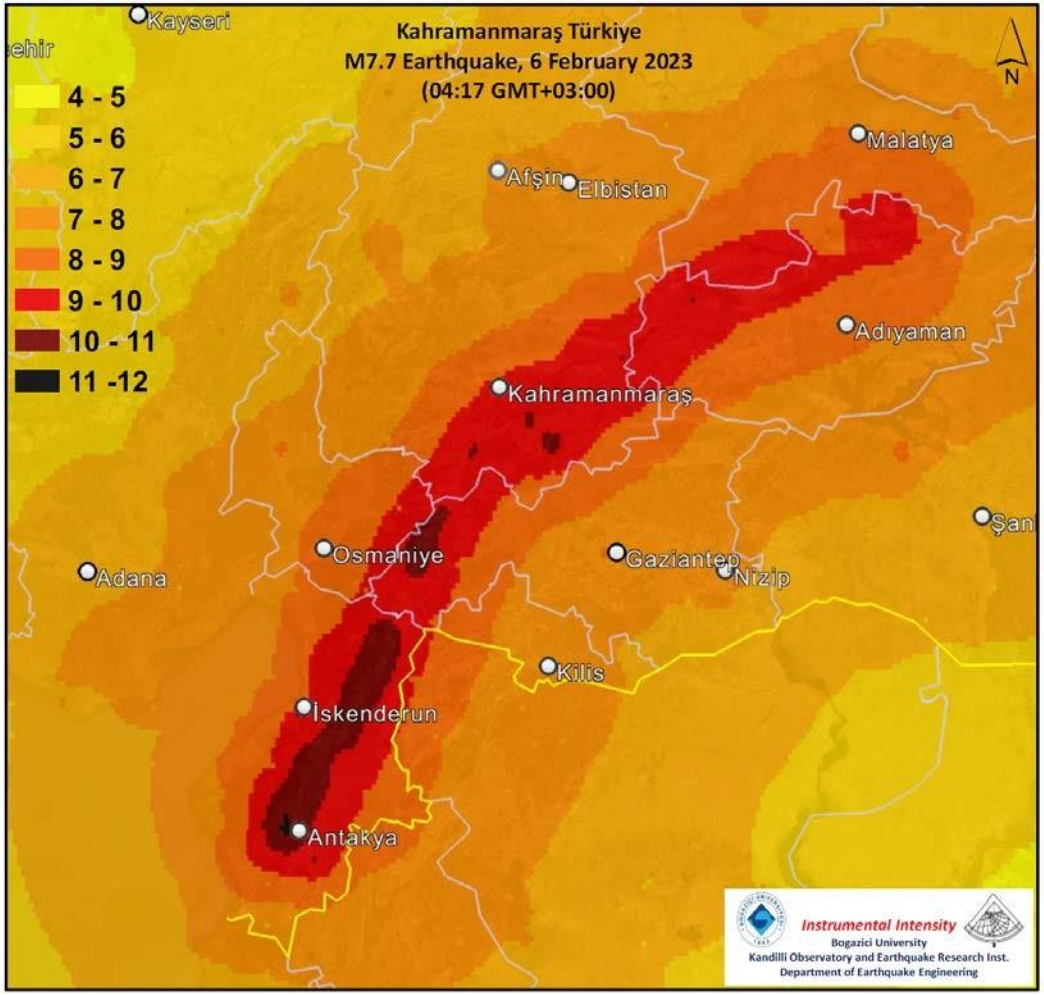


Data source available online in USGS

INTENSITY MAP
FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE



INSTRUMENTAL INTENSITY
FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE

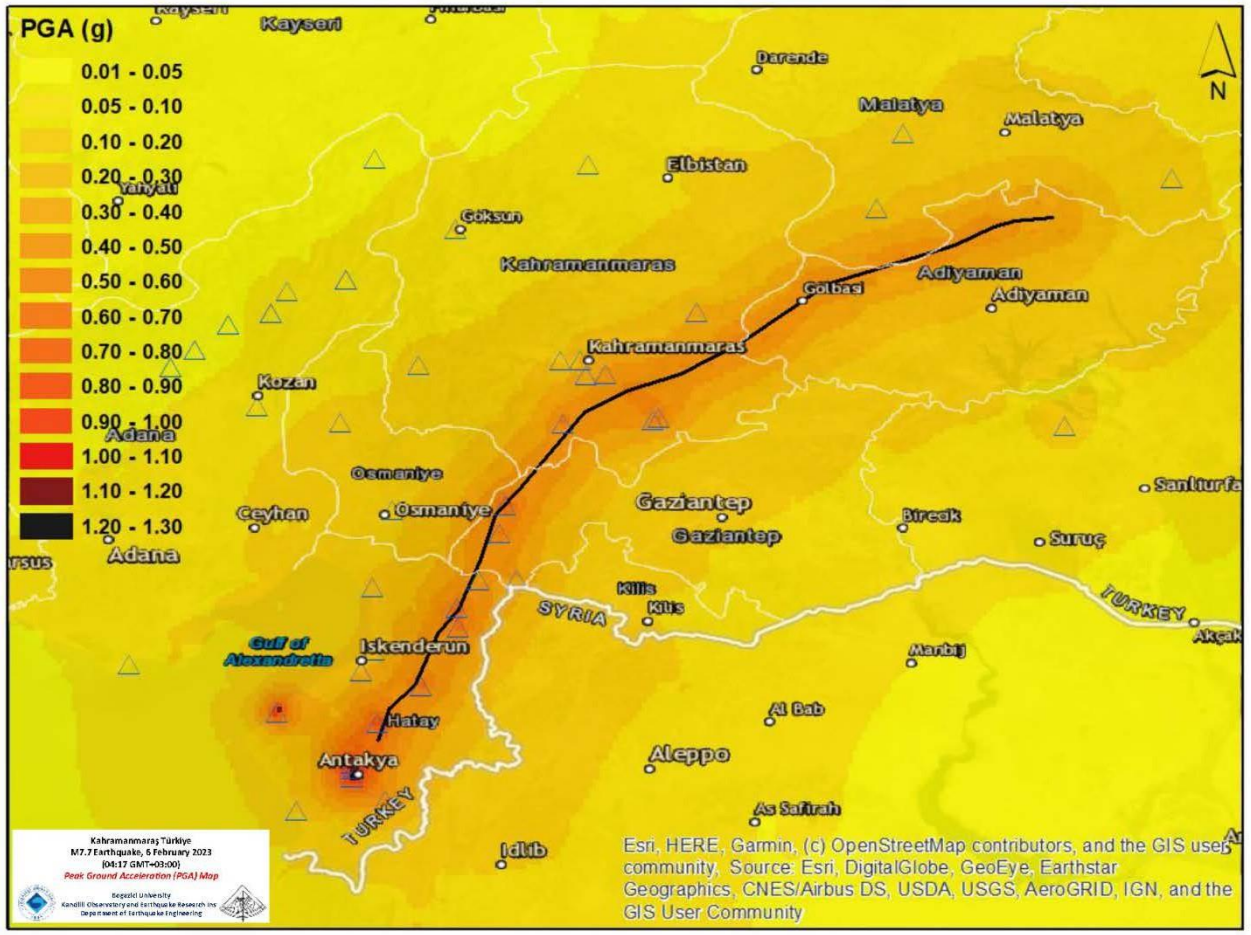


A fault rupture of 290 km length corresponding to the Erkenek, Pazarcık and Amanos segments of the East Anatolian Fault Zone (Emre et al., 2018) and station recordings within a distance of 100 km from the fault are considered in the ground motion estimation.

Source: https://www.emsc-csem.org/Doc/Additional_Earthquake_Report/1218444/Kahramanmaras-Gaziantep_Earthquake_06-02-2023_(04.17)-Bogazici_University_Earthquake_Engineering_Department.pdf


Gaziantep Kalesi

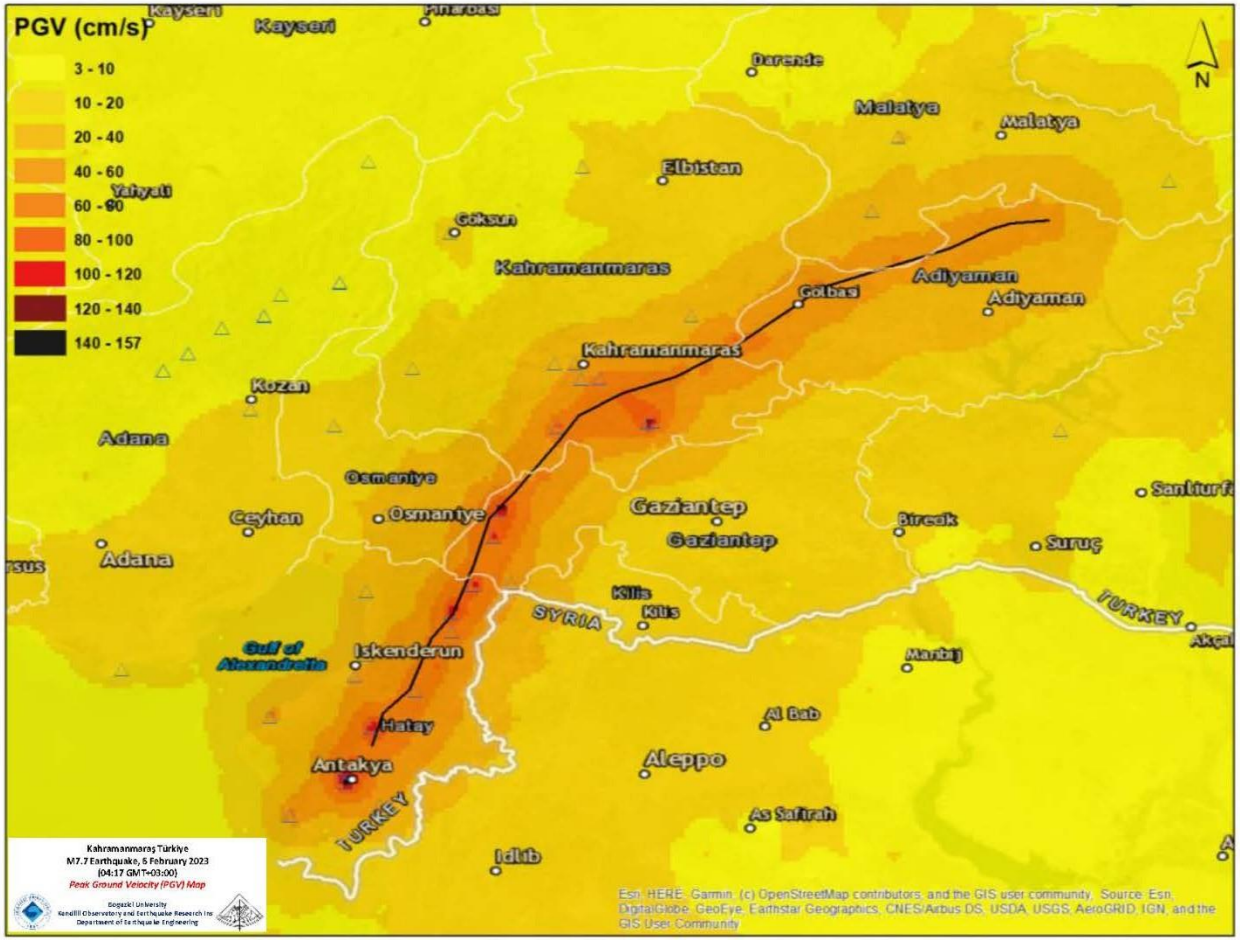
PEAK GROUND ACCELERATION
FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE



eak Ground Acceleration Map for the 6 February 2023 Mw=7.8 earthquake

Source: https://eqe.boun.edu.tr/sites/eqe.boun.edu.tr/files/kahramanmaras-gaziantep_earthquake_06-02-2023_04.17-bogazici_university_earthquake_engineering_department_v6.pdf

PEAK GROUND VELOCITY
FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE

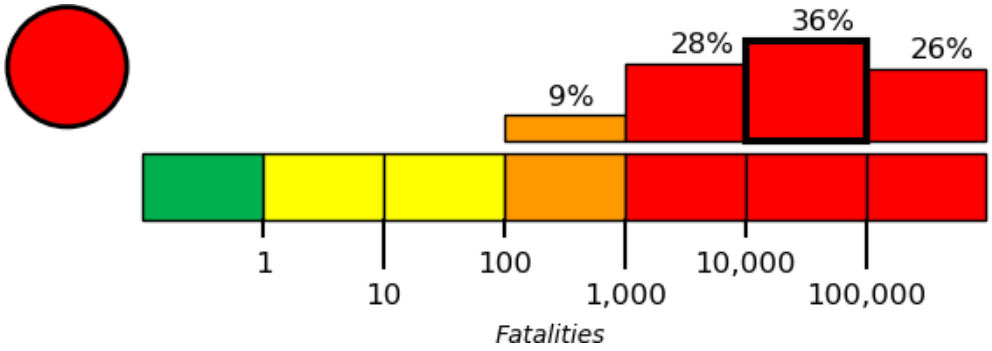


Peak Ground Velocity Map for the 6 February 2023 Mw=7.8 earthquake

Source: https://eqe.boun.edu.tr/sites/eqe.boun.edu.tr/files/kahramanmaras-gaziantep_earthquake_06-02-2023_04.17-bogazici_university_earthquake_engineering_department_v6.pdf

ESTIMATED LOSSES
FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE

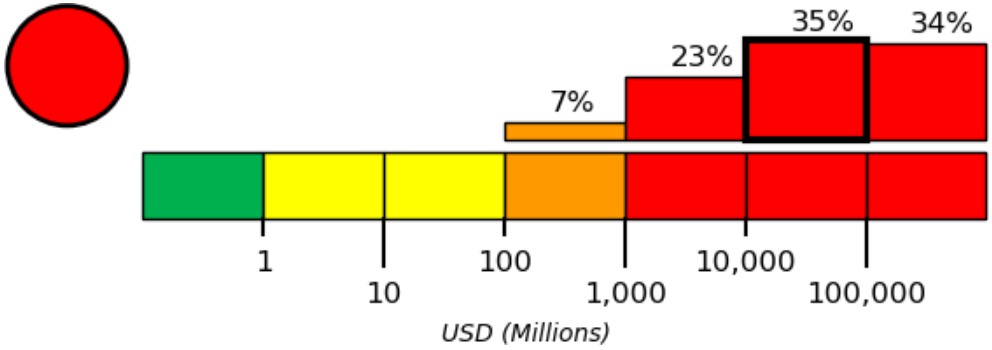
Estimated Fatalities



Red alert for shaking-related fatalities. High casualties and extensive damage are probable and the disaster is likely widespread. Past red alerts have required a national or international response.

Source: https://earthquake.usgs.gov/realtime/product/losspager/us6000jllz/us1676265789059/onepager.pdf

Estimated Economic Losses



Red alert for economic losses. Estimated economic losses are 1-10% GDP of Turkey.

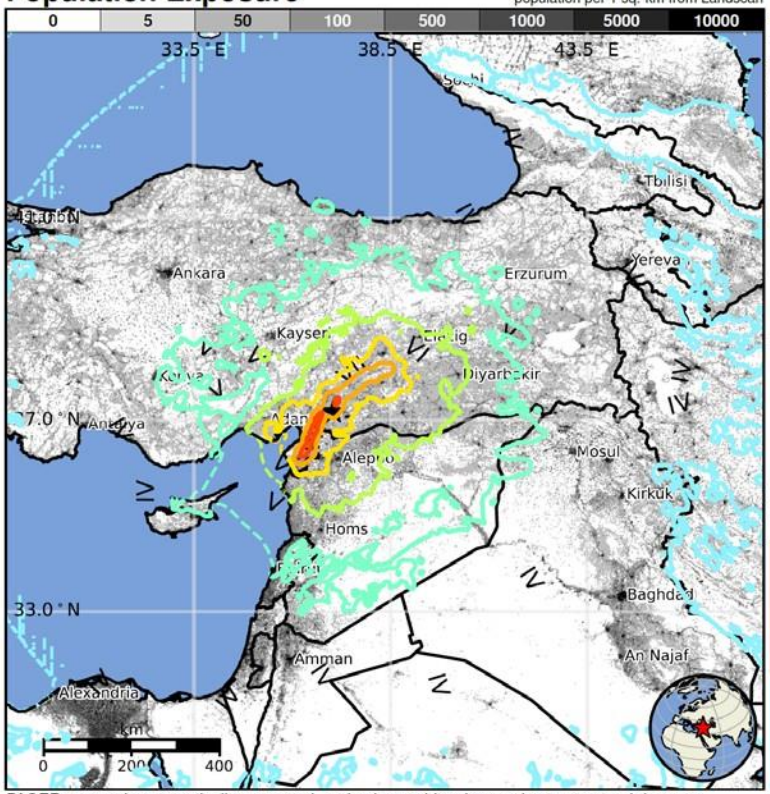
POPULATION EXPOSURE
THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE SHAKING

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k=x1000)		–*	11,586k*	241,683k	23,075k	12,660k	7,816k	1,204k	740k	1k
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	None	None	None	V. Light	Light	Moderate	Mod./Heavy	Heavy	V. Heavy
	Vulnerable Structures	None	None	None	Light	Moderate	Mod./Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure



PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
https://earthquake.usgs.gov/earthquakes/eventpage/us6000jllz#pager

Structures

Overall, the population in this region resides in structures that are extremely vulnerable to earthquake shaking, though some resistant structures exist. The predominant vulnerable building types are unreinforced brick masonry and low-rise nonductile concrete frame with infill construction.

Historical Earthquakes

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
2001-06-25	73	5.4	V(26k)	0
1992-03-13	361	6.6	IX(151k)	498
1975-09-06	359	6.7	VIII(1k)	2k

Recent earthquakes in this area have caused secondary hazards such as landslides that might have contributed to losses.

Selected City Exposure

from GeoNames.org

MMI	City	Population
IX	Asagi Karafakili	1k
IX	Hassa	10k
IX	Islahiye	<1k
IX	Narli	<1k
IX	Aktepe	<1k
IX	Buyuk Dalyan	2k
IV	Cairo	7,735k
IV	Baghdad	7,216k
IV	Alexandria	3,812k
IV	Istanbul	11,174k
III	Ankara	3,517k

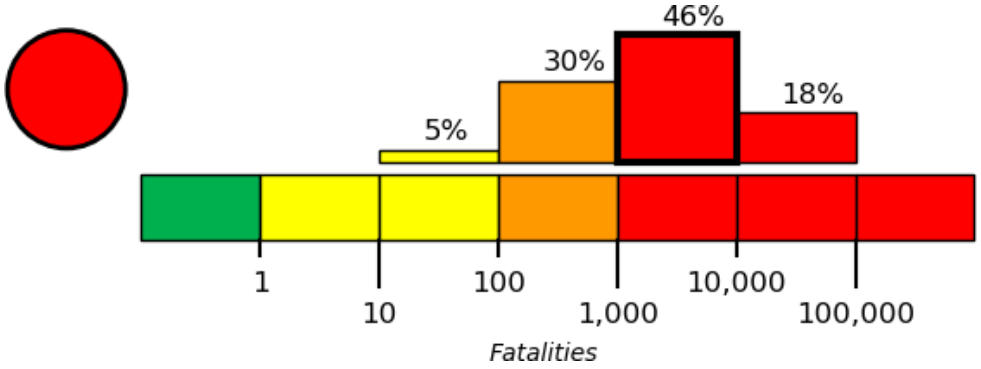
bold cities appear on map. (k=x1000)

Event ID: us6000jllz

Source: https://earthquake.usgs.gov/realtime/product/losspager/us6000jllz/us/1676265789059/onepager.pdf

ESTIMATED LOSSES
FOR THE 6 FEBRUARY 2023 Mw=7.5 EARTHQUAKE

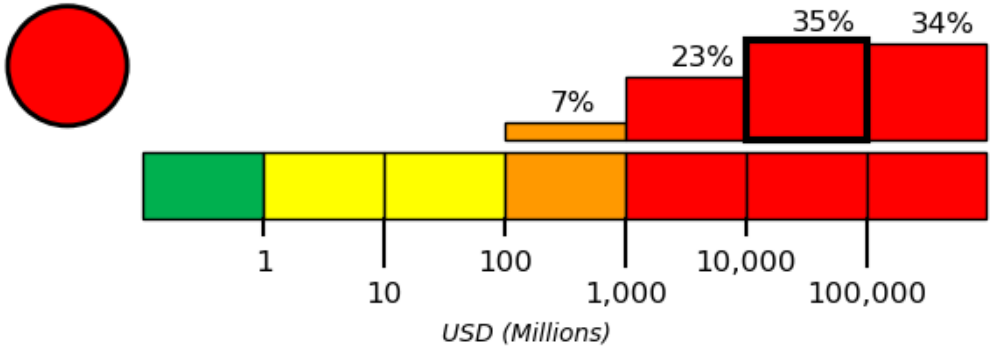
Estimated Fatalities



Red alert for shaking-related fatalities. High casualties and extensive damage are probable and the disaster is likely widespread. Past red alerts have required a national or international response.

Source: https://earthquake.usgs.gov/realtime/product/losspager/us6000jlqa/us/1676051495827/onepager.pdf

Estimated Economic Losses



Red alert for economic losses. Estimated economic losses are 0-1% GDP of Turkey.

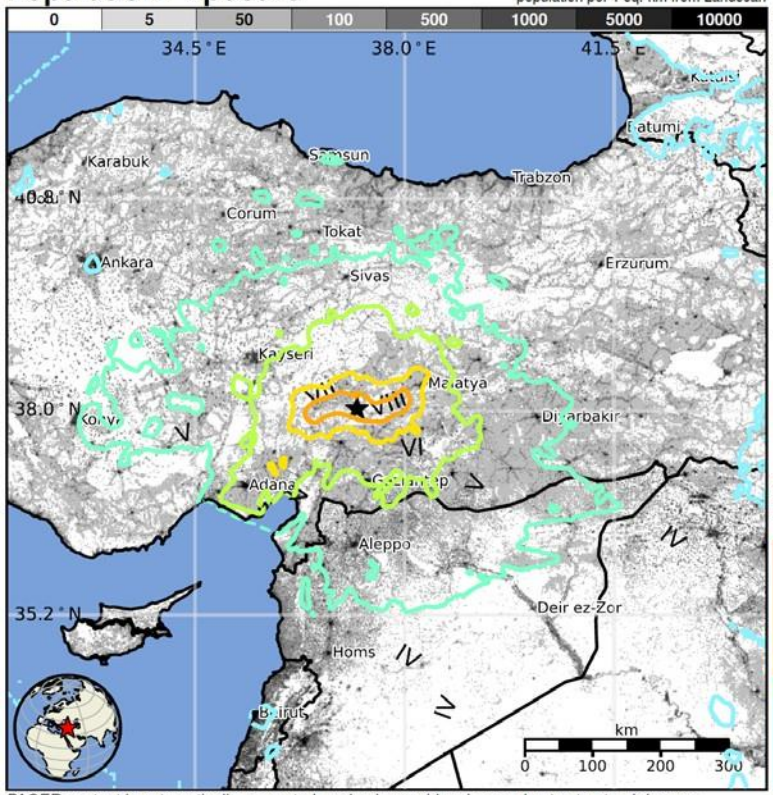
POPULATION EXPOSURE
TO THE 6 FEBRUARY 2023 Mw=7.5 EARTHQUAKE SHAKING

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k=x1000)		–*	5,975k*	77,850k	18,384k	7,899k	1,381k	249k	69k	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	None	None	None	V. Light	Light	Moderate	Mod./Heavy	Heavy	V. Heavy
	Vulnerable Structures	None	None	None	Light	Moderate	Mod./Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure



PAGER content is automatically generated, and only considers losses due to structural damage.
Limitations of input data, shaking estimates, and loss models may add uncertainty.
https://earthquake.usgs.gov/earthquakes/eventpage/us6000jlqa#pager

Structures

Overall, the population in this region resides in structures that are a mix of vulnerable and earthquake resistant construction. The predominant vulnerable building types are adobe block and dressed stone/block masonry construction.

Historical Earthquakes

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
2000-08-19	388	4.1	V(9k)	0
1992-03-13	281	6.6	IX(151k)	498
1975-09-06	315	6.7	VIII(1k)	2k

Recent earthquakes in this area have caused secondary hazards such as landslides that might have contributed to losses.

Selected City Exposure

from GeoNames.org

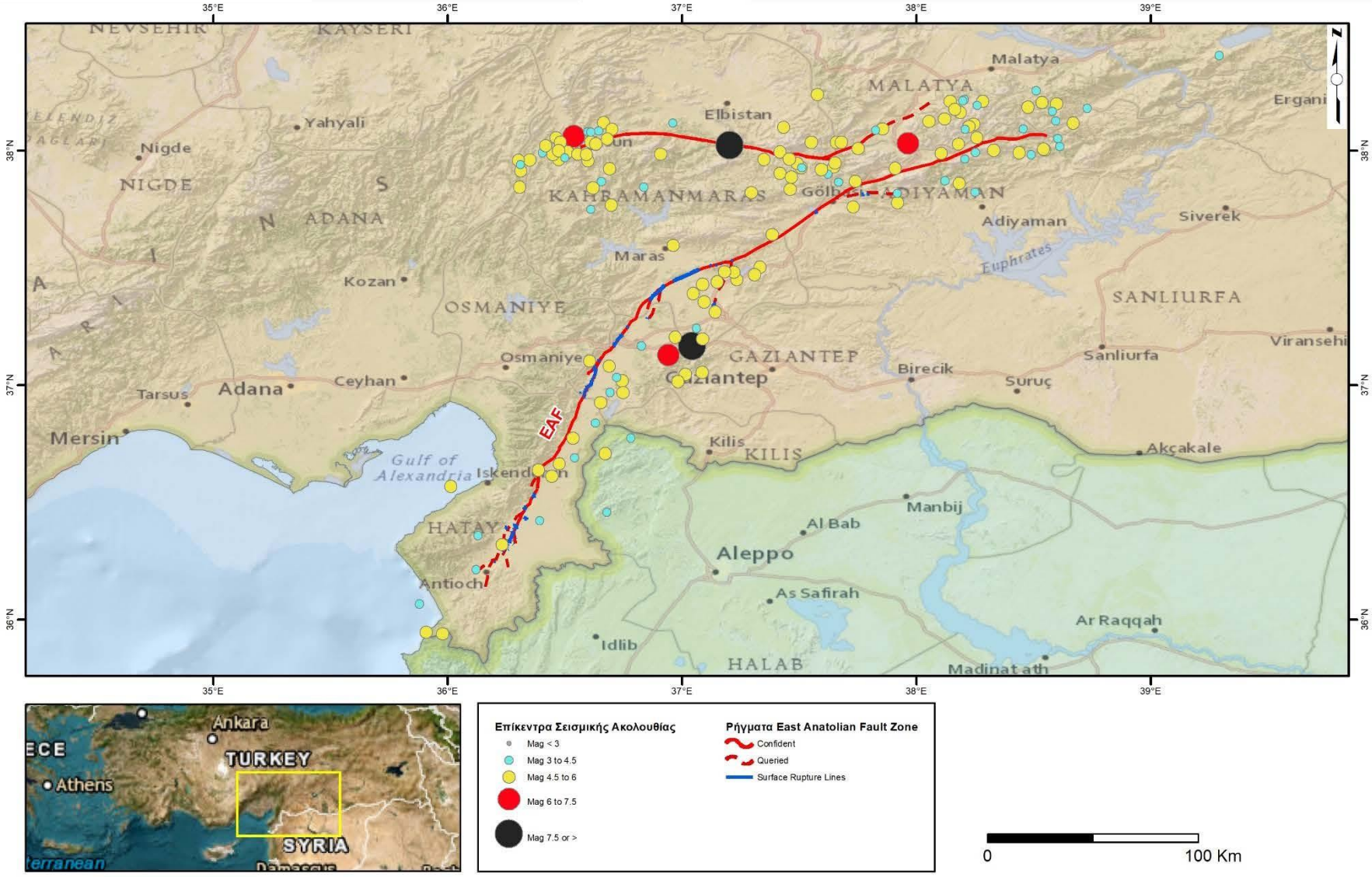
MMI	City	Population
IX	Cardak	<1k
IX	Dogansehir	15k
IX	Goksun	34k
VIII	Celeyke	6k
VIII	Nurhak	9k
VIII	Surgu	<1k
V	**Aleppo**	**1,602k**
IV	Mosul	1,740k
IV	Baghdad	7,216k
IV	**Beirut**	**1,916k**
III	**Ankara**	**3,517k**

bold cities appear on map. (k=x1000)

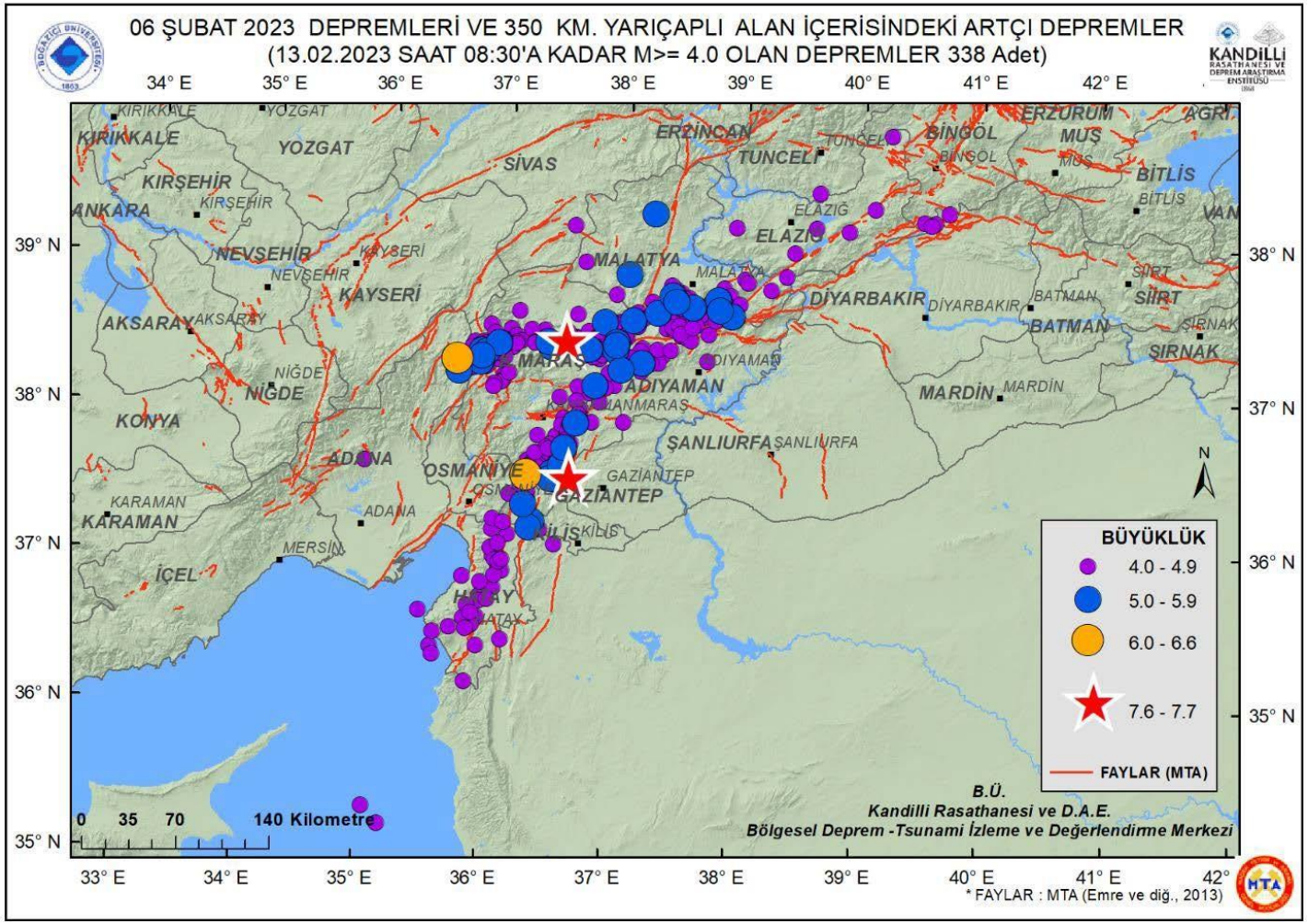
Event ID: us6000jlqa

Source: https://earthquake.usgs.gov/realtime/product/losspager/us6000jlqa/us/1676051495827/onepager.pdf

SPATIAL DISTRIBUTION OF THE FEBRUARY 2023 EARTHQUAKE EPICENTERS ALONG THE SOUTHEASTERN PART OF THE EAST ANATOLIA

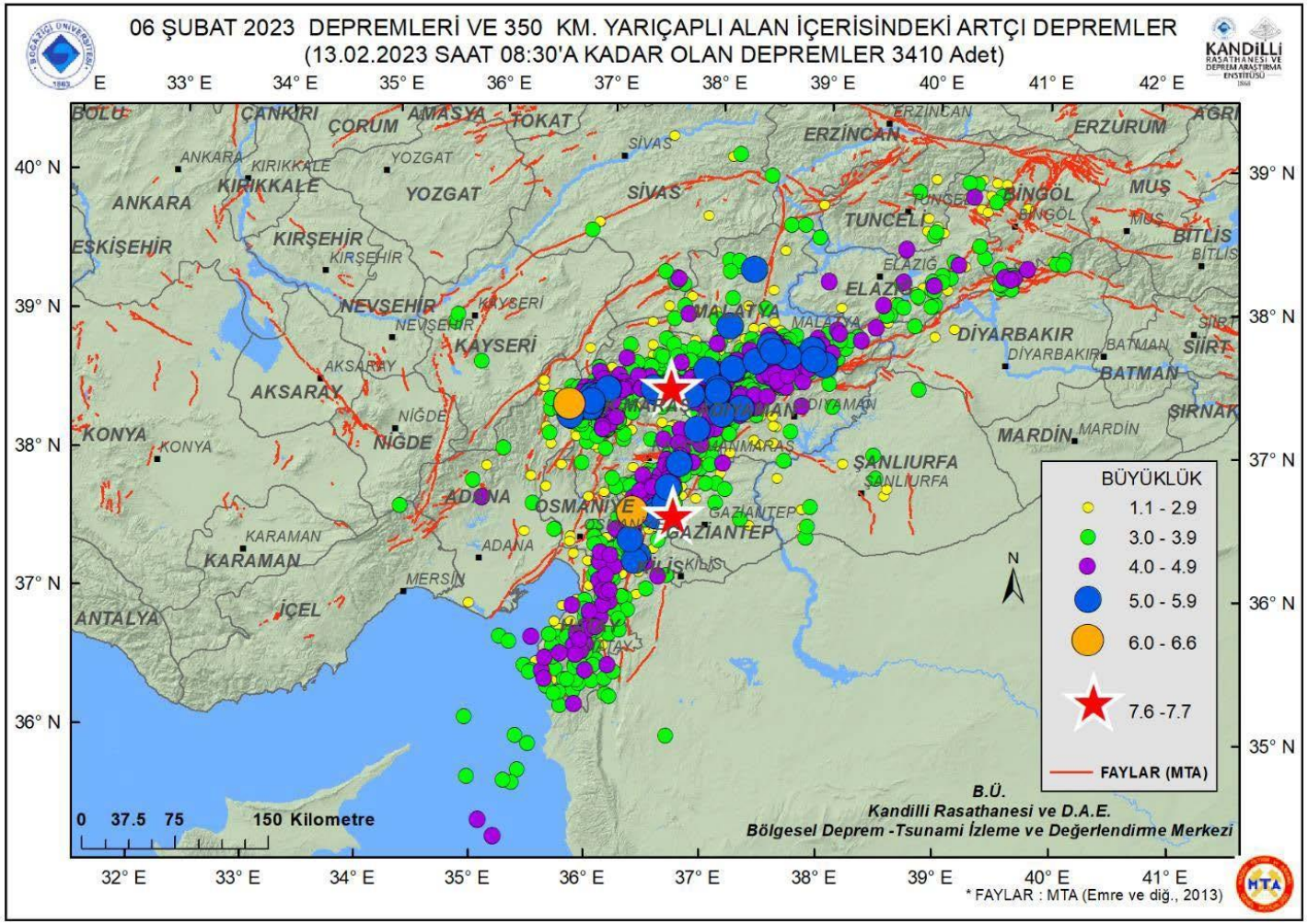


SPATIAL DISTRIBUTION OF THE FEBRUARY 2023 EARTHQUAKE EPICENTERS ALONG THE SOUTHEASTERN PART OF THE EAST ANATOLIA



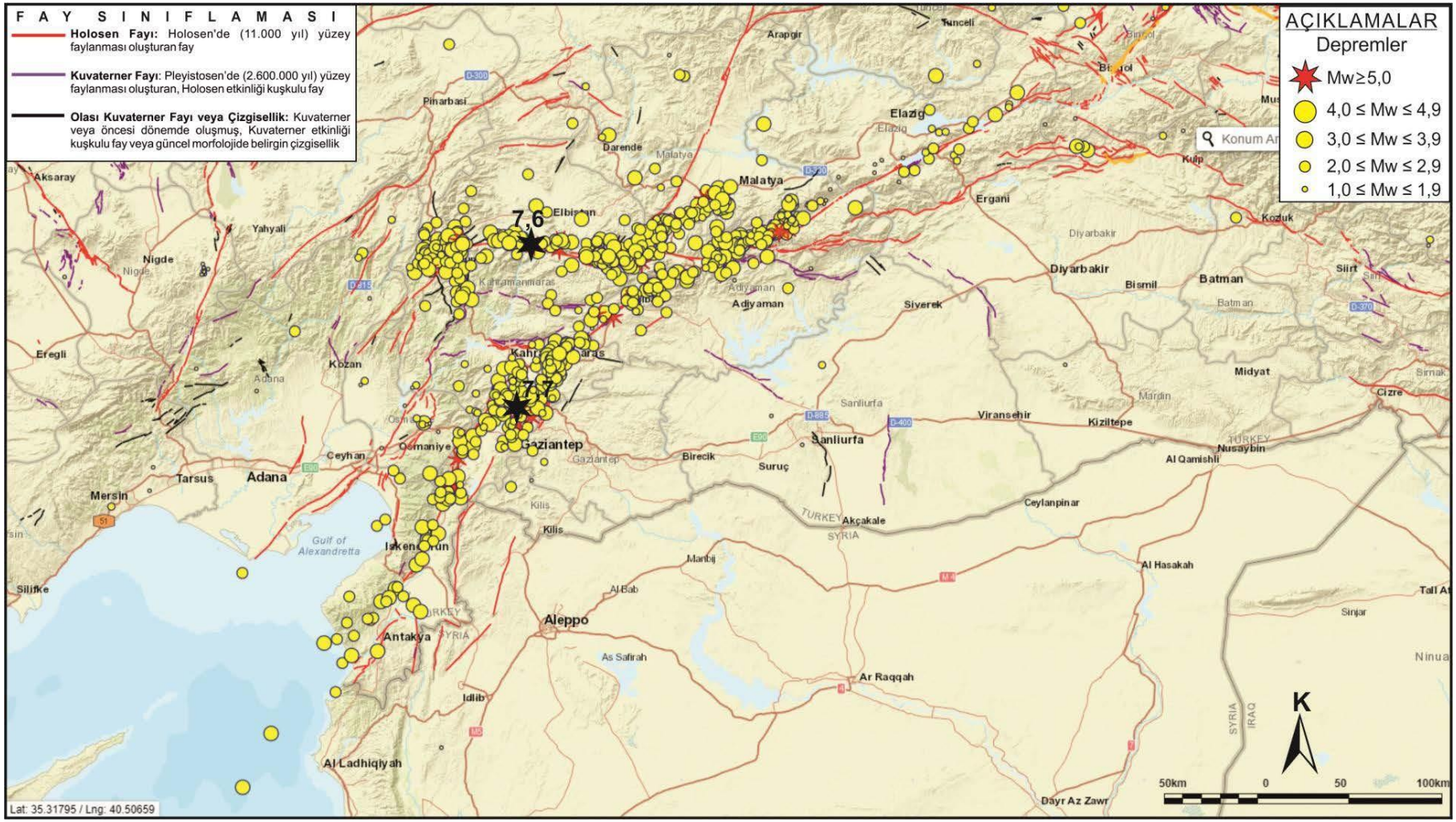
Source: http://www.koeri.boun.edu.tr/sismo/2/wp-content/uploads/2023/02/20230206_0117_GAZIANTEP.pdf

SPATIAL DISTRIBUTION OF THE FEBRUARY 2023 EARTHQUAKE EPICENTERS ALONG THE SOUTHEASTERN PART OF THE EAST ANATOLIA



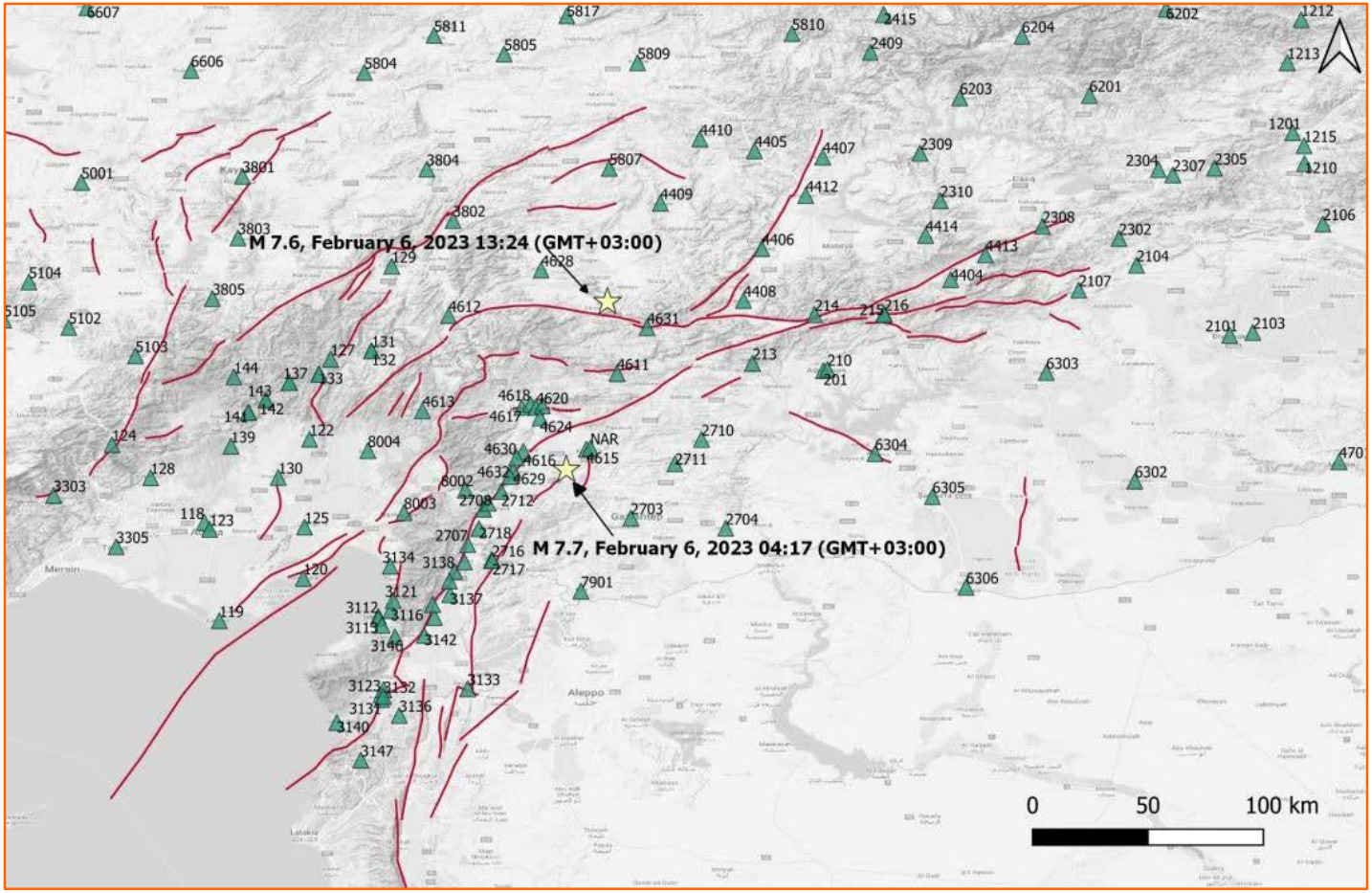
Source: http://www.koeri.boun.edu.tr/sismo/2/wp-content/uploads/2023/02/20230206_0117_GAZIANTEP.pdf

SPATIAL DISTRIBUTION OF THE FEBRUARY 2023 EARTHQUAKE EPICENTERS ALONG THE SOUTHEASTERN PART OF THE EAST ANATOLIA



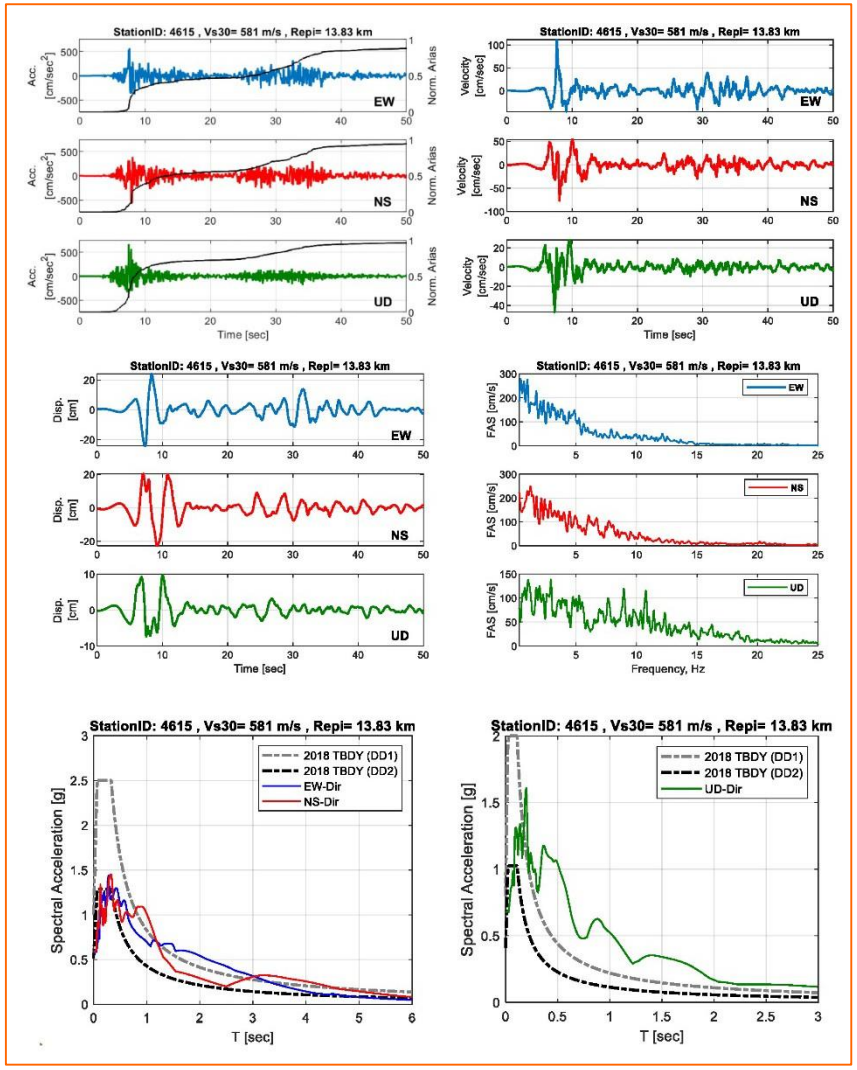
Source: http://www.deprem.gov.tr/

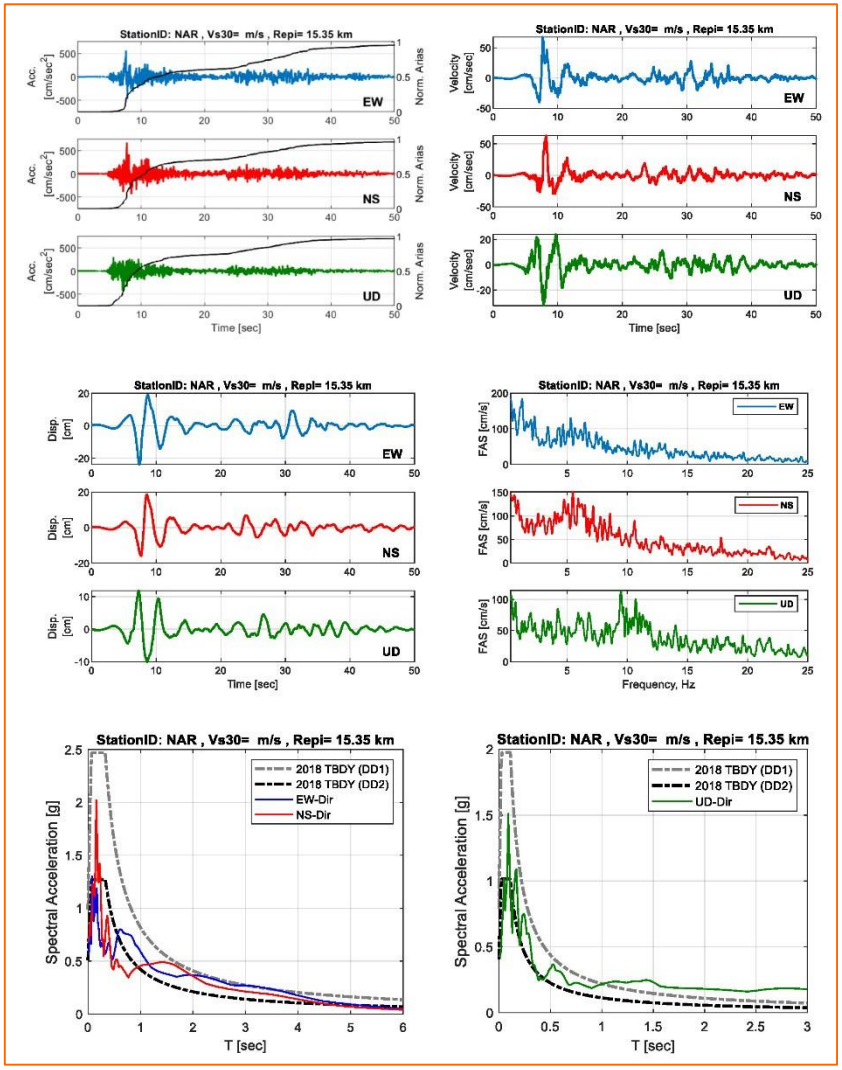
STRONG GROUND MOTION



The yellow stars correspond to the epicenters of the Mw=7.8 Kahramanmaraş – Gaziantep and Mw=7.5 Ekinözü – Kahramanmaraş Earthquakes occurred on 6 February 2023. AFAD stations are shown with green triangles. Red lines represent the faults compiled from Active Fault Maps of Turkey, MTA (Mineral Research & Exploration General Directorate).

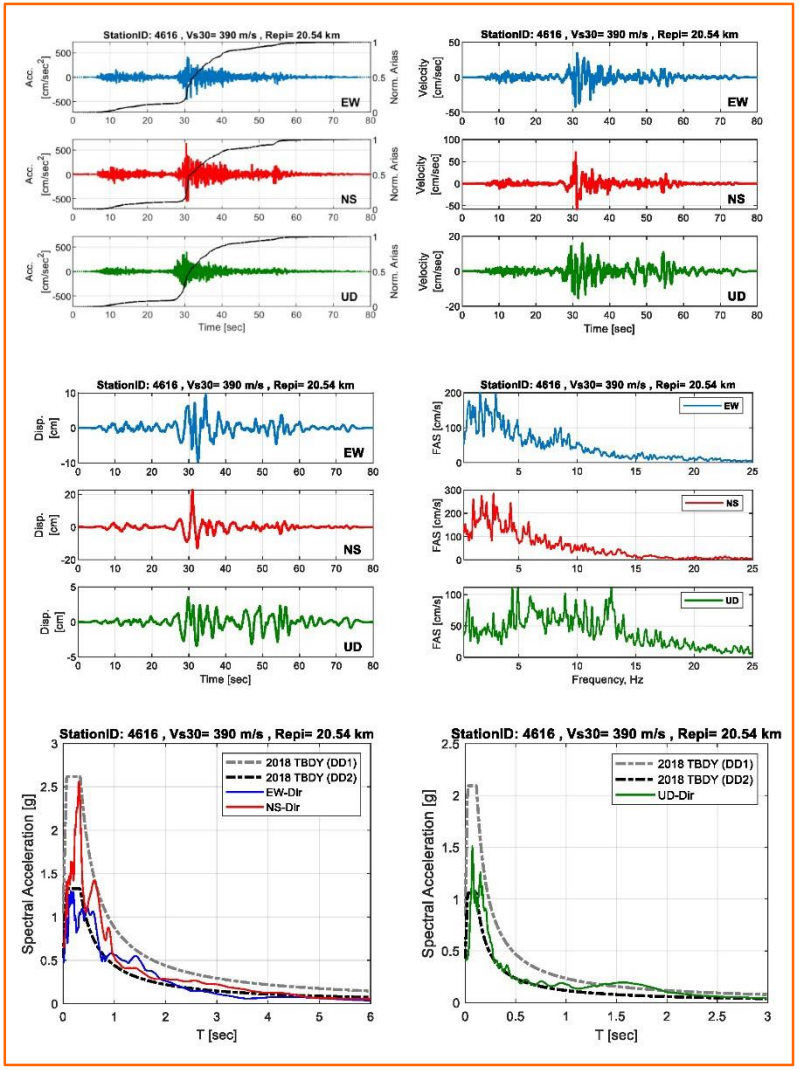
STRONG GROUND MOTION RECORDINGS

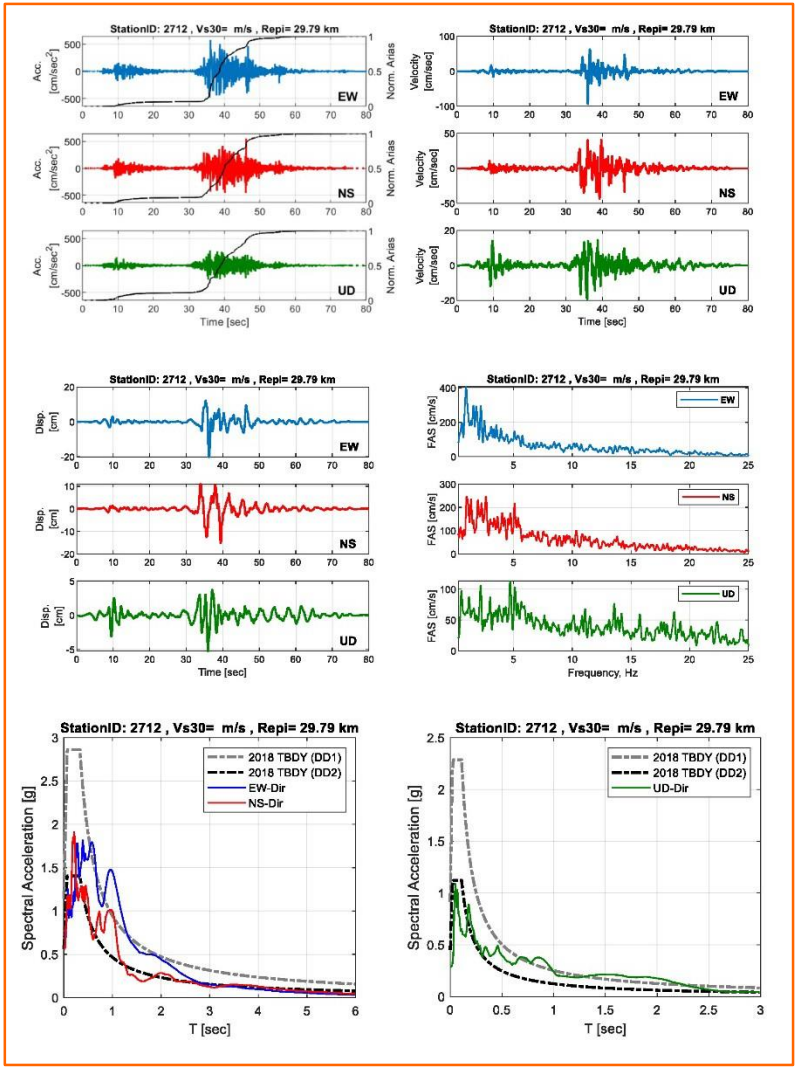




Source: https://eqe.boun.edu.tr/sites/eqe.boun.edu.tr/files/kahramanmaras-gaziantep_earthquake_06-02-2023_04.17-bogazici_university_earthquake_engineering_department_v6.pdf

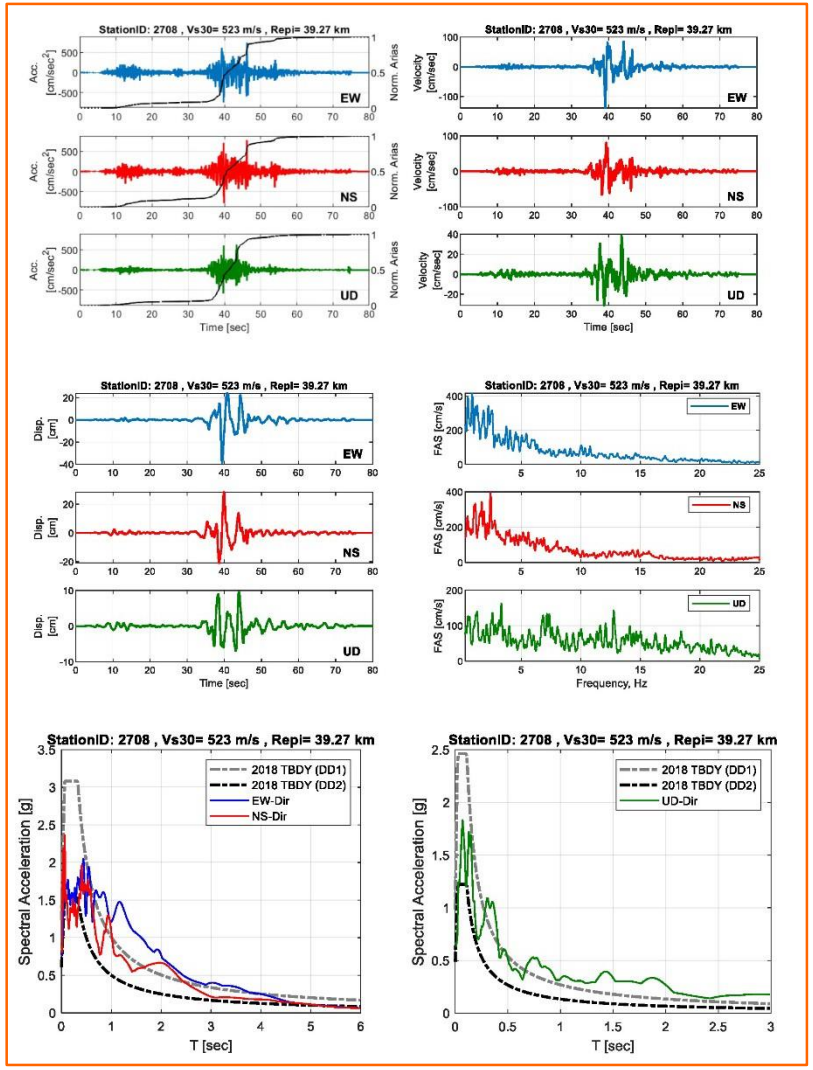
STRONG GROUND MOTION RECORDINGS

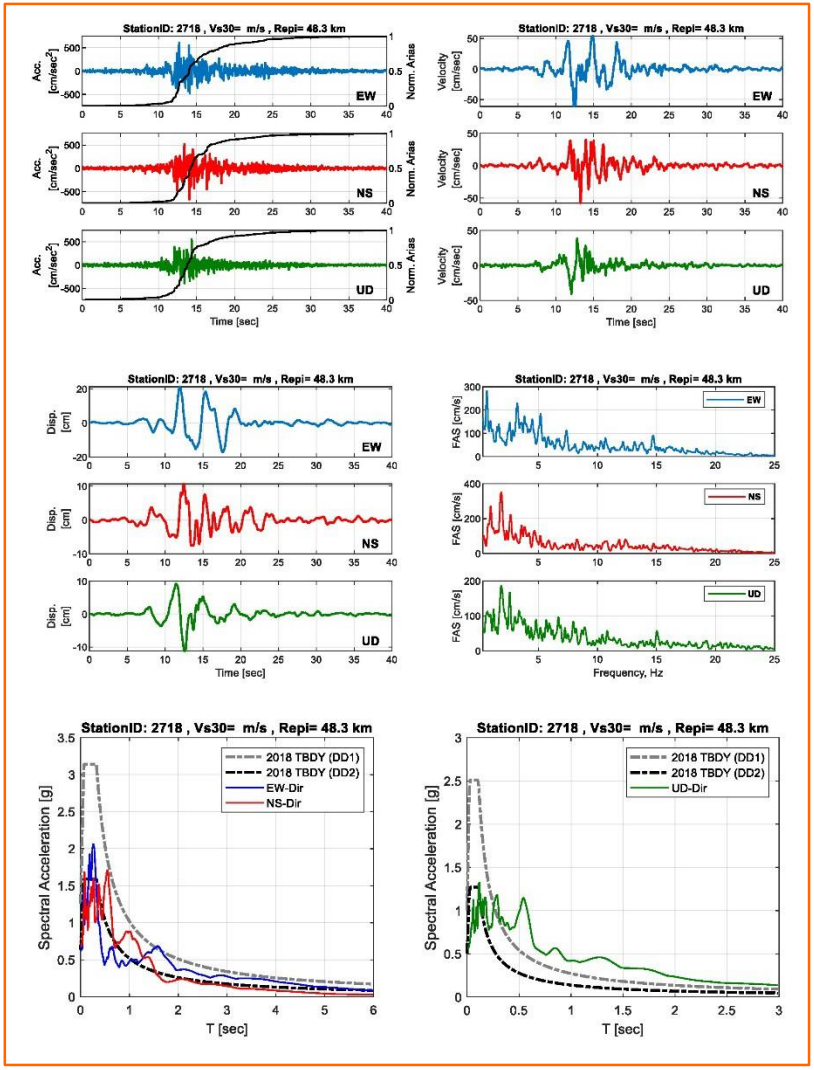




Source: https://eqe.boun.edu.tr/sites/eqe.boun.edu.tr/files/kahramanmaras-gaziantep_earthquake_06-02-2023_04.17-bogazici_university_earthquake_engineering_department_v6.pdf

STRONG GROUND MOTION RECORDINGS





Source: https://eqe.boun.edu.tr/sites/eqe.boun.edu.tr/files/kahramanmaras-gaziantep_earthquake_06-02-2023_04.17-bogazici_university_earthquake_engineering_department_v6.pdf

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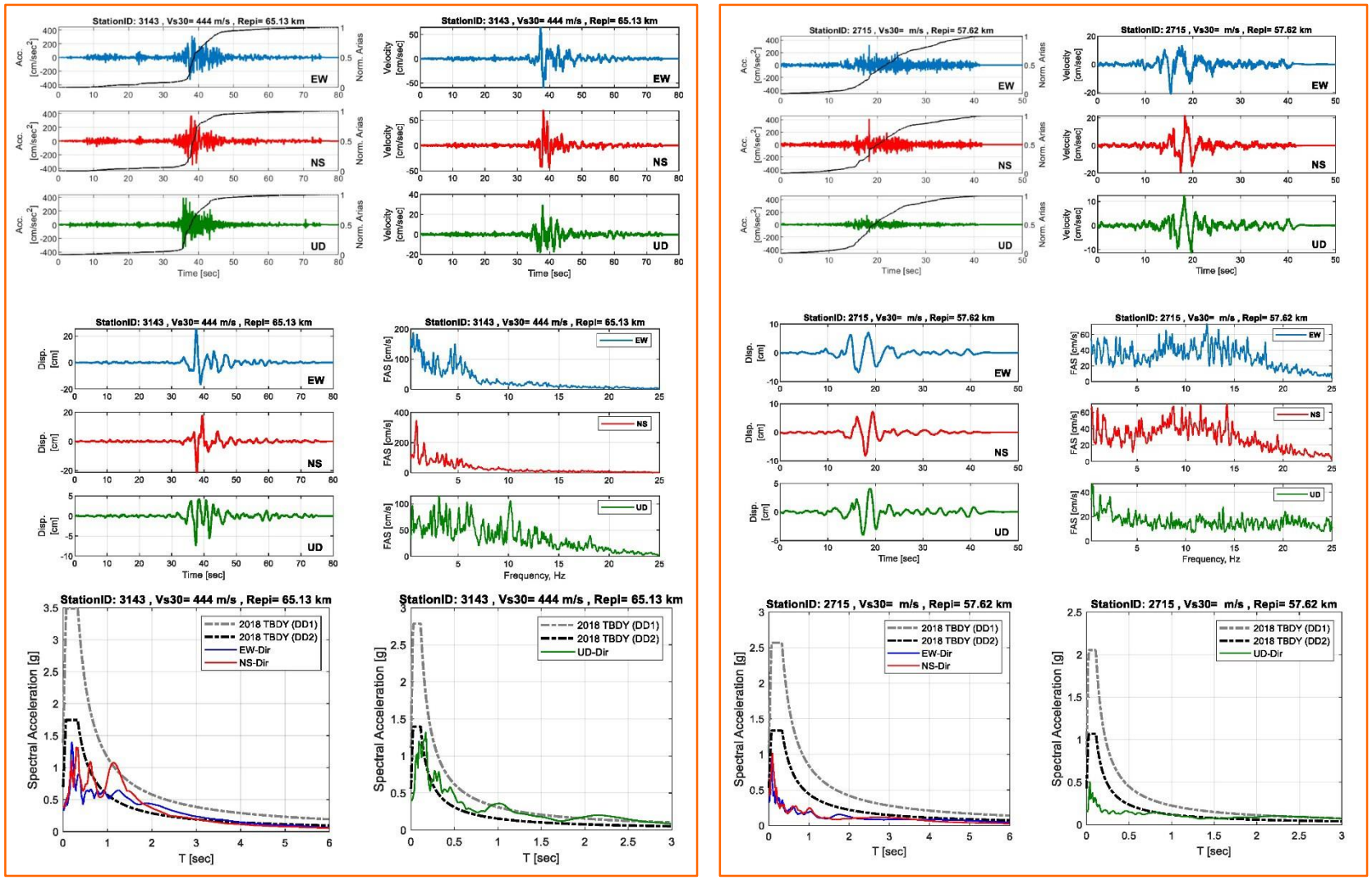

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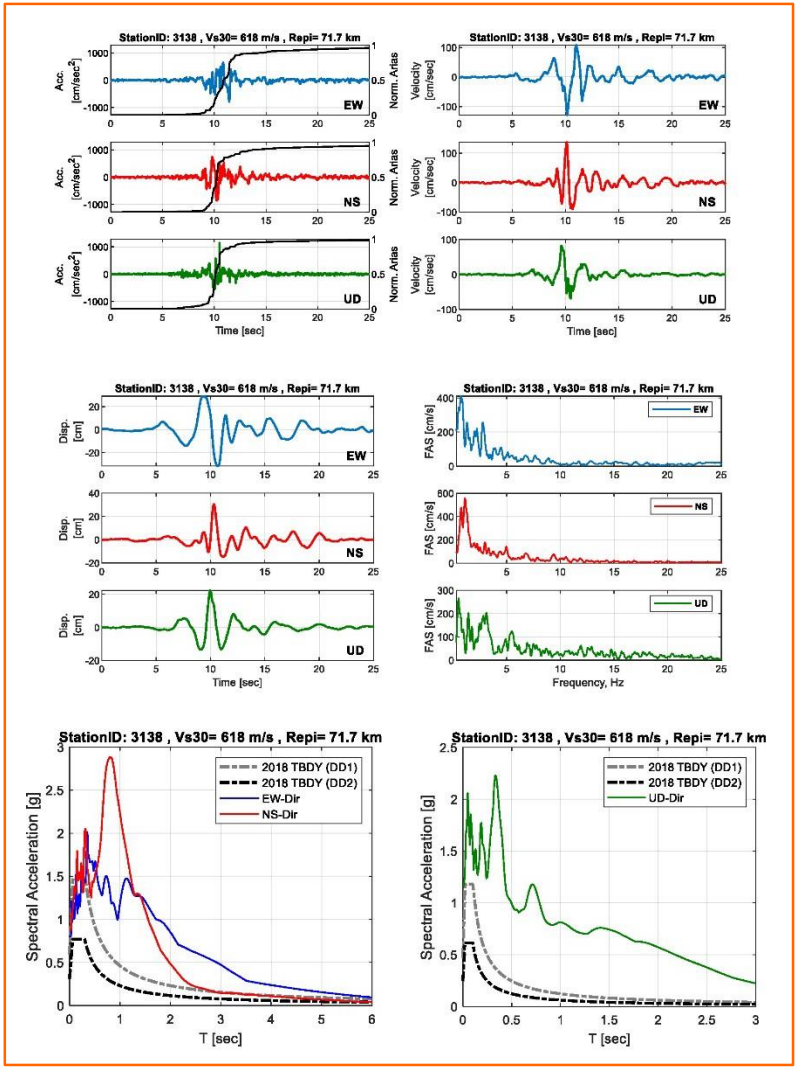

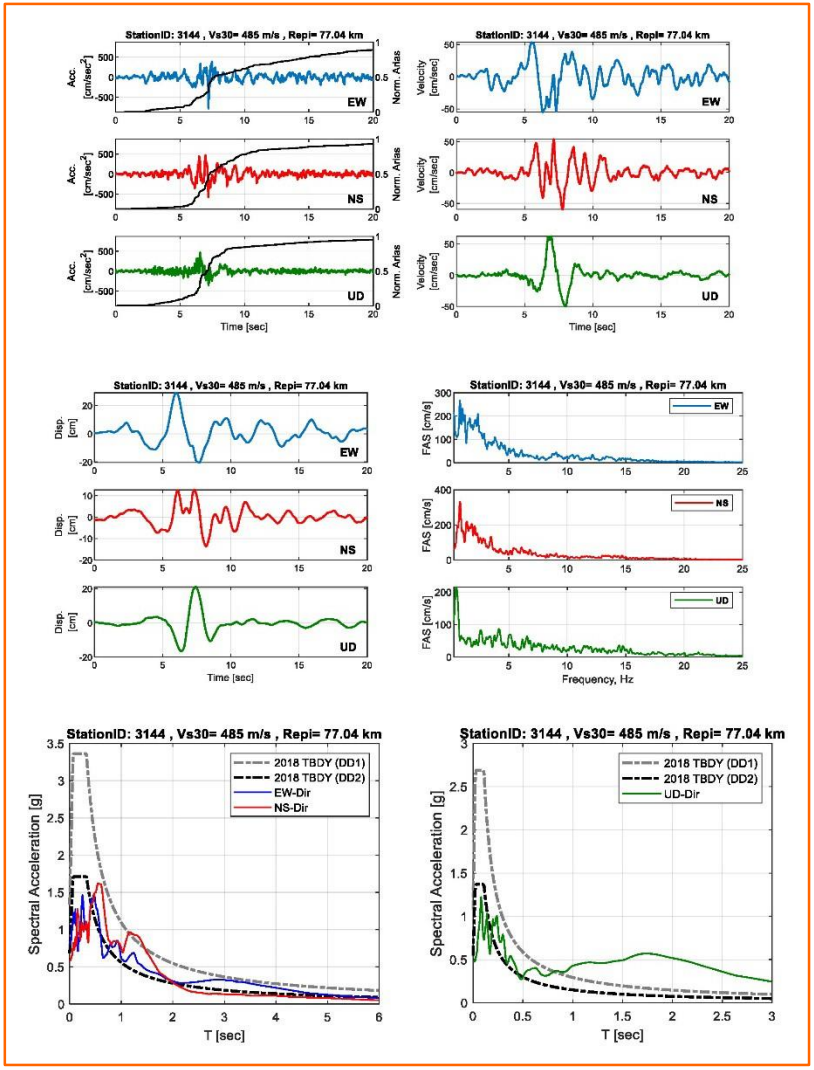

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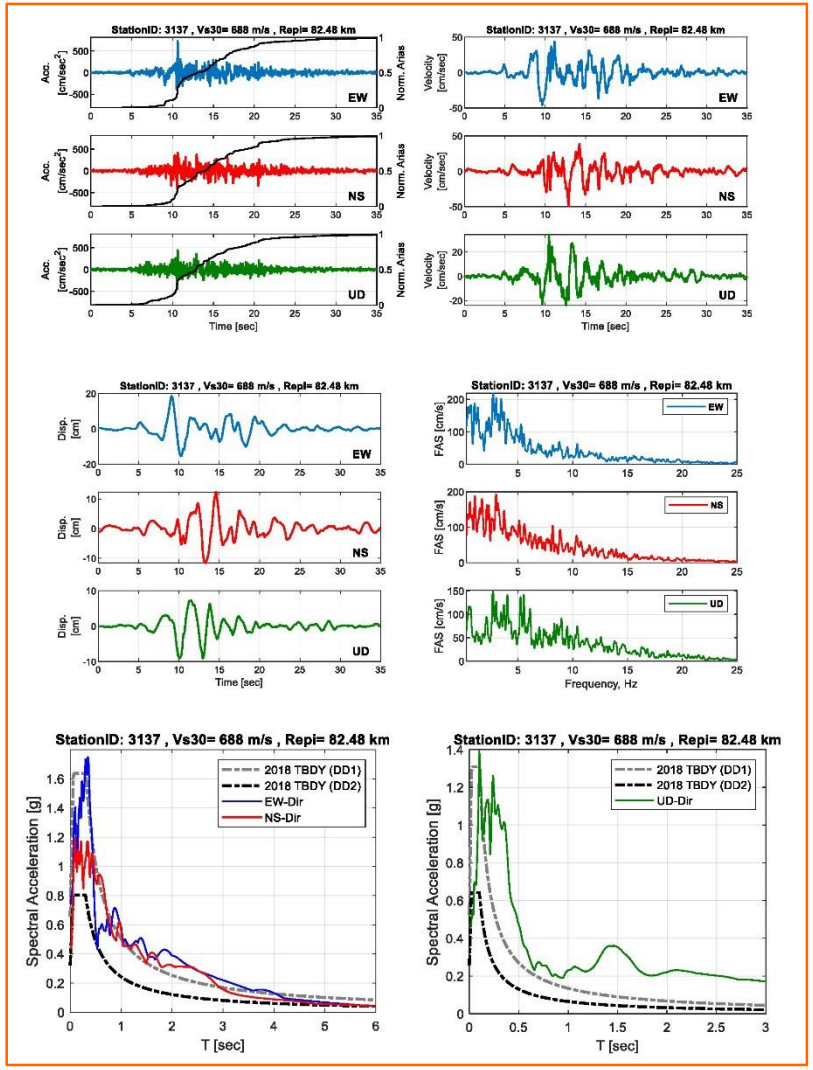

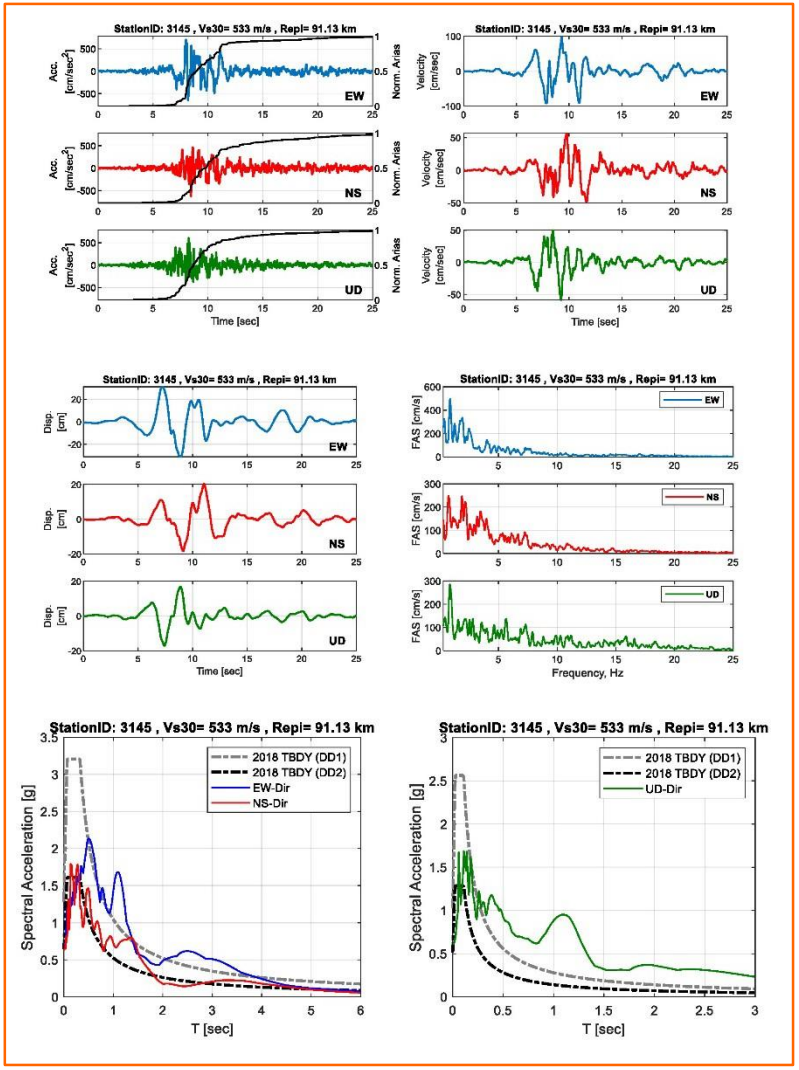

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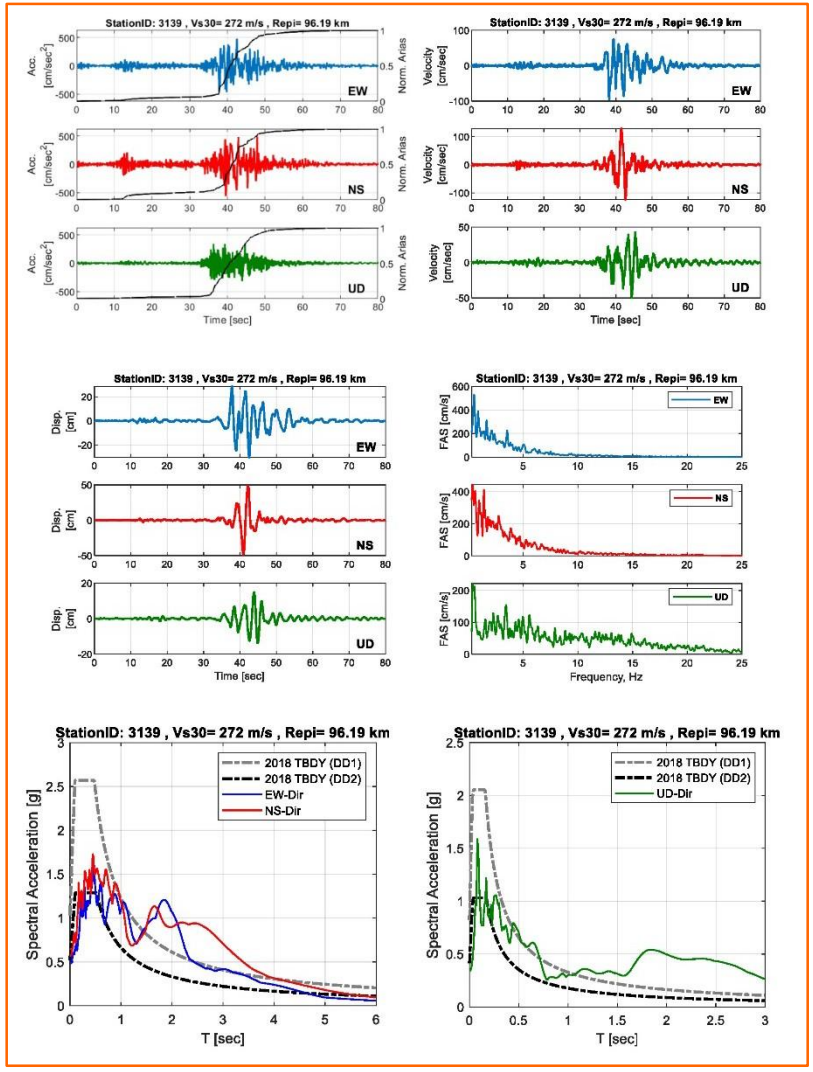
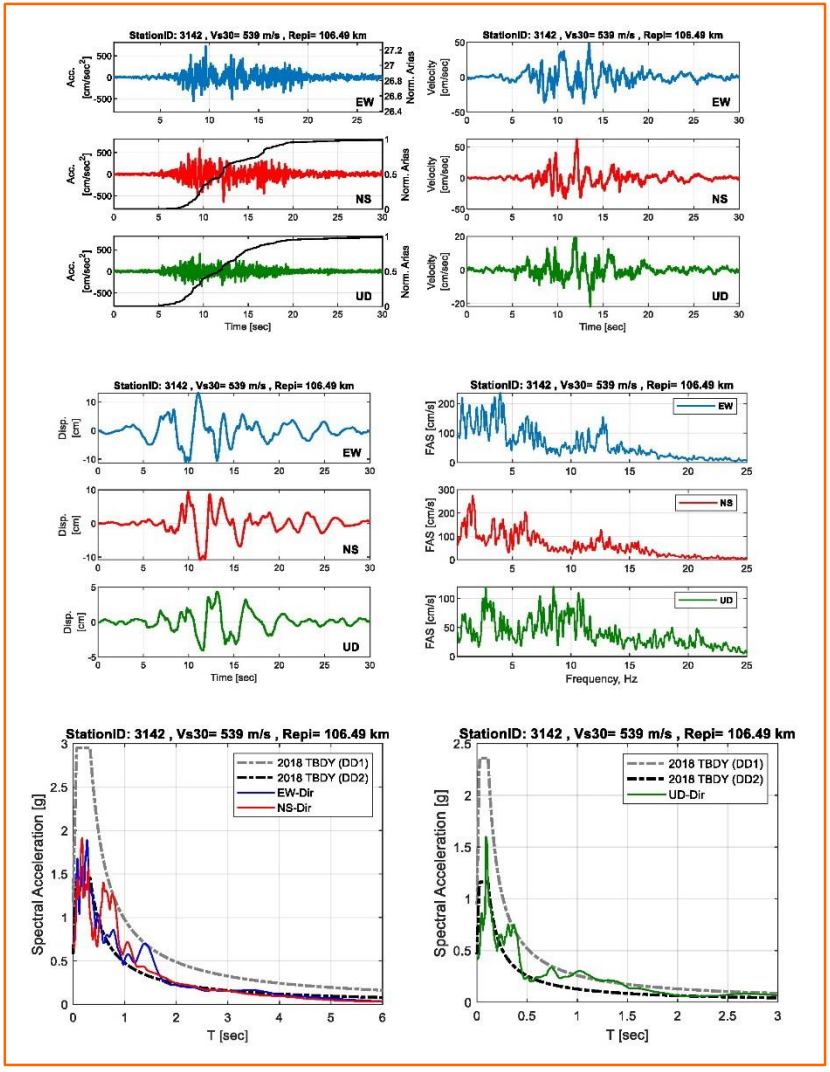
STRONG GROUND MOTION RECORDINGS





Source: https://eqe.boun.edu.tr/sites/eqe.boun.edu.tr/files/kahramanmaras-gaziantep_earthquake_06-02-2023_04.17-bogazici_university_earthquake_engineering_department_v6.pdf

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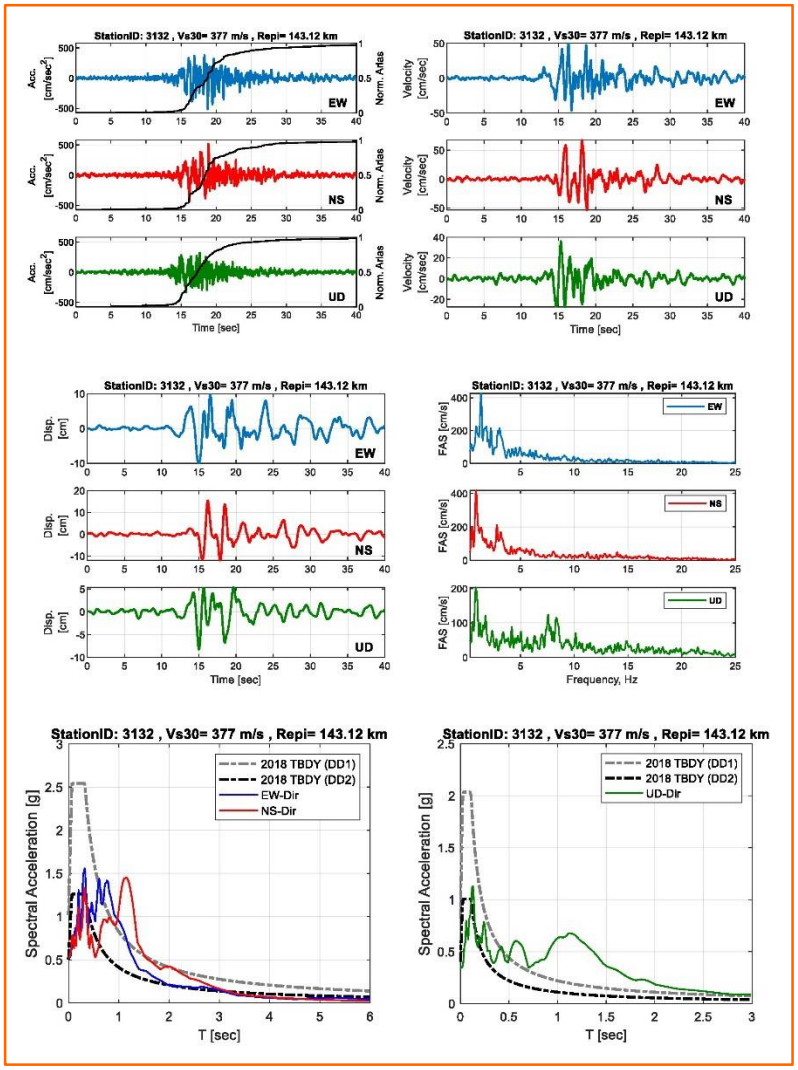

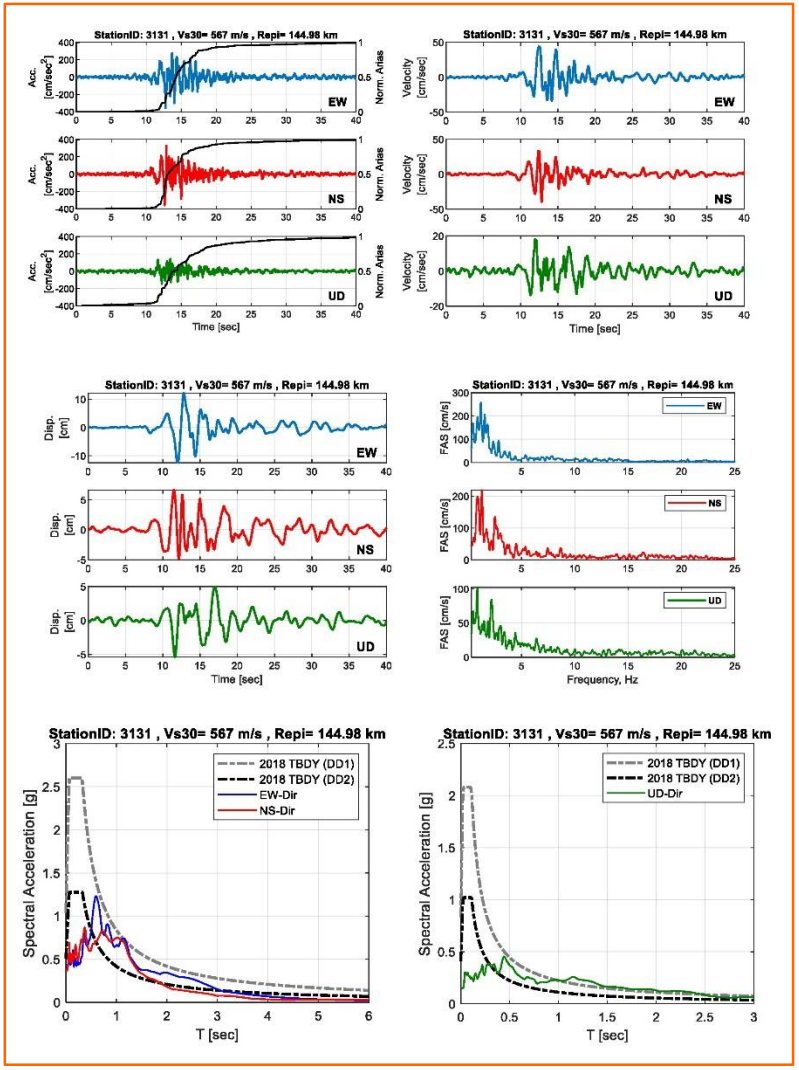

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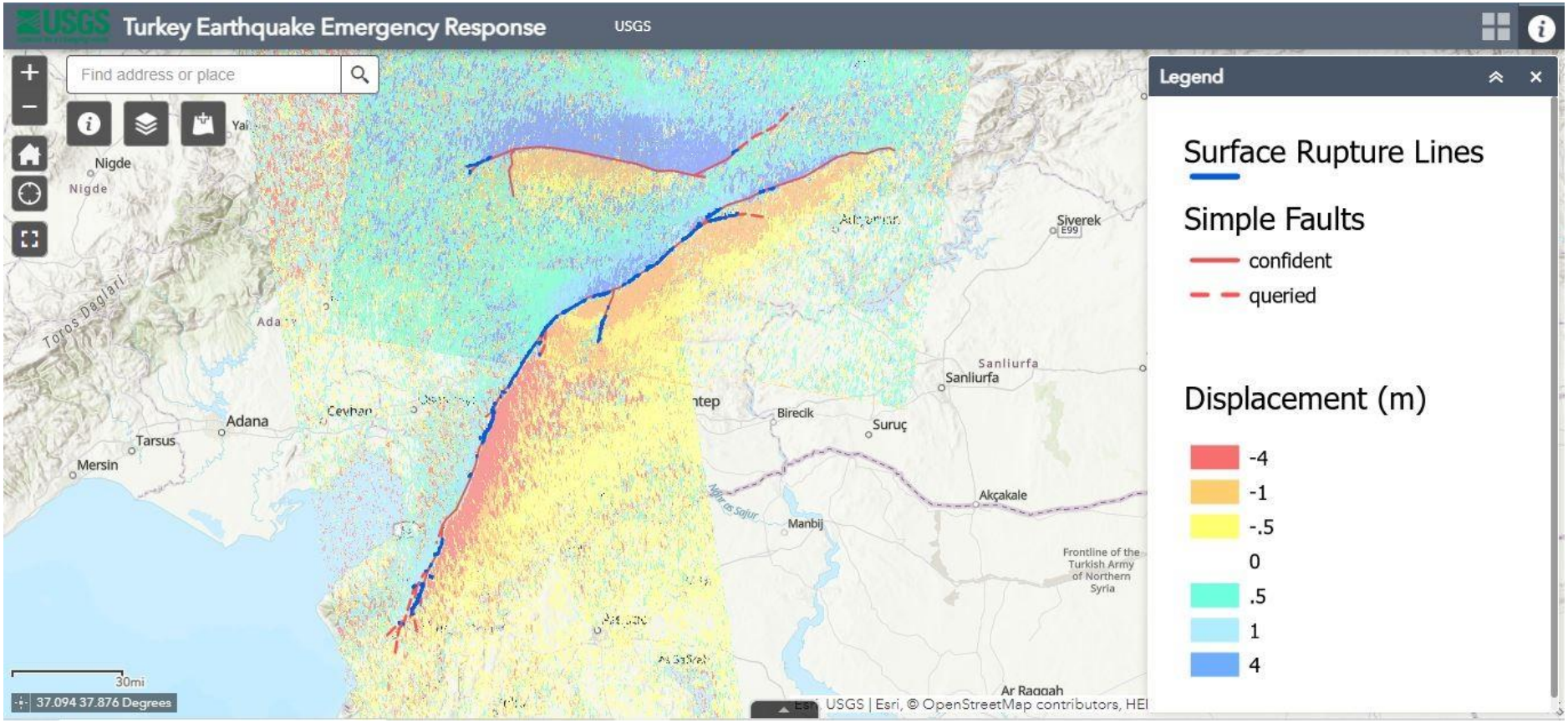
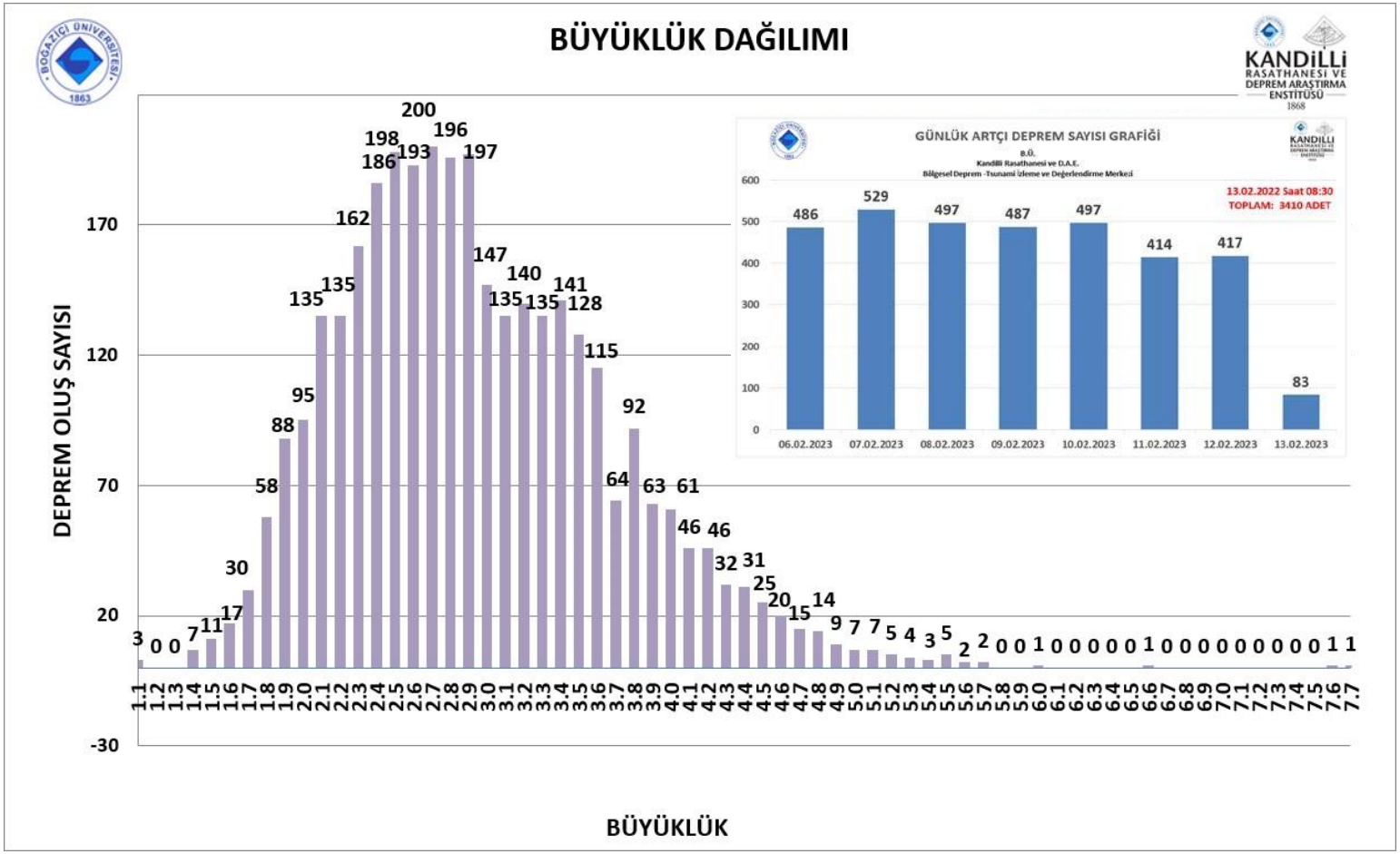
SURFACE RUPTURES AND SURFACE DISPLACEMENT BY THE 6 FEBRUARY 2023 EARTHQUAKES



Source: Turkey Earthquake Emergency Response by USGS
https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5229bb842bd64b688d769abbefe43b46

AFTERSHOCK SEQUENCE
OF THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE



The aftershock sequence from 6 to 13 February 2023 comprised 3410 seismic events.
The diagram illustrates their distribution according to their magnitude.
Source: http://www.koeri.boun.edu.tr/sismo/2/wp-content/uploads/2023/02/20230206_0117_GAZIANTEP.pdf

DETECTION OF SURFACE RUPTURES BY USING SATELLITE IMAGERY AND REMOTE SENSING TECHNIGUES

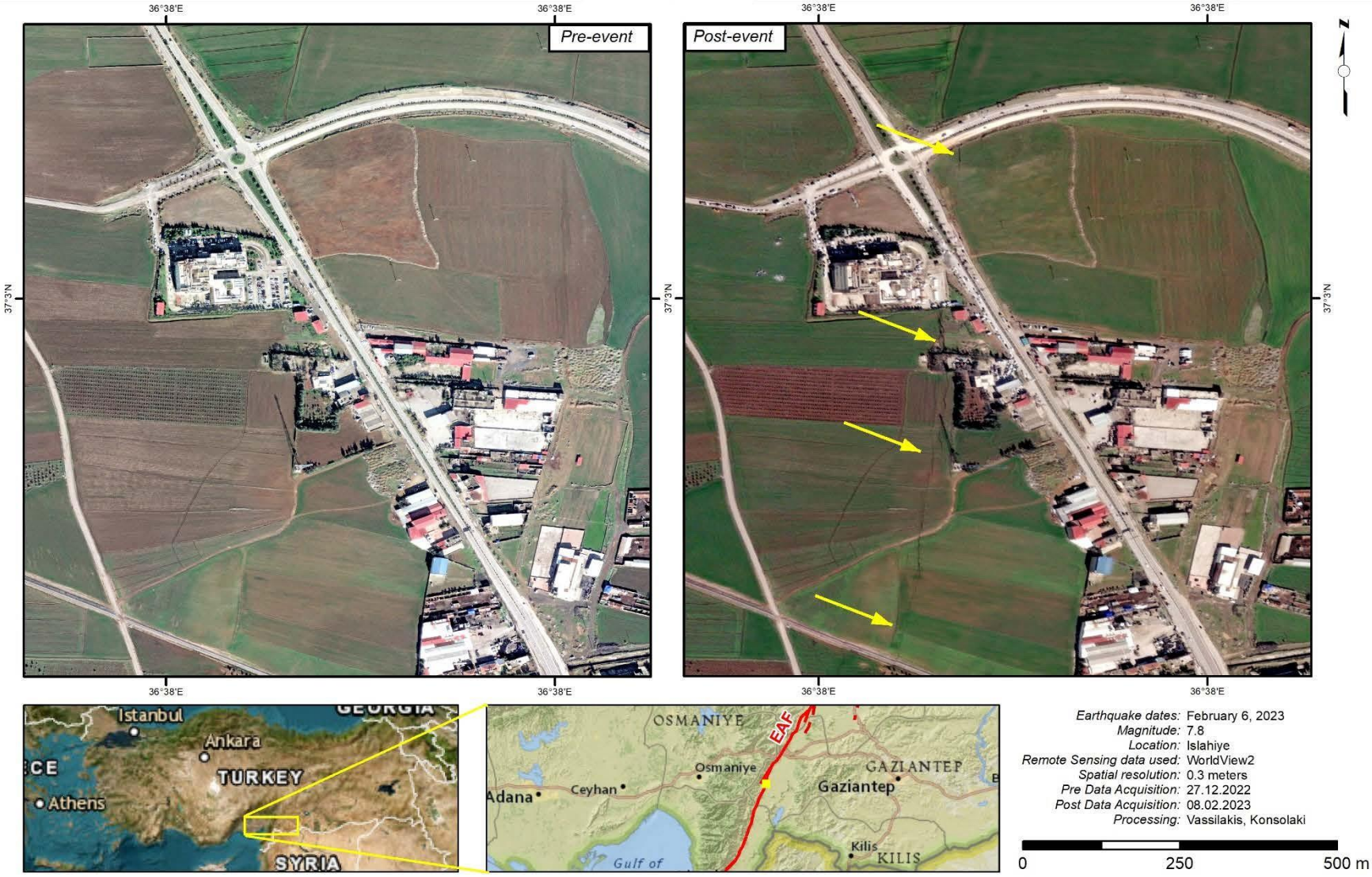
The comparative monitoring of the phenomenon through the use of satellite imagery was carried out by the staff of the Remote Sensing Laboratory of the Faculty of Geology and Geoenvironment (National and Kapodistrian University of Athens) on two levels:

(a) identification of coseismic surface ruptures and their spatial distribution in the field of the activated segments of the East Anatolian fault system and

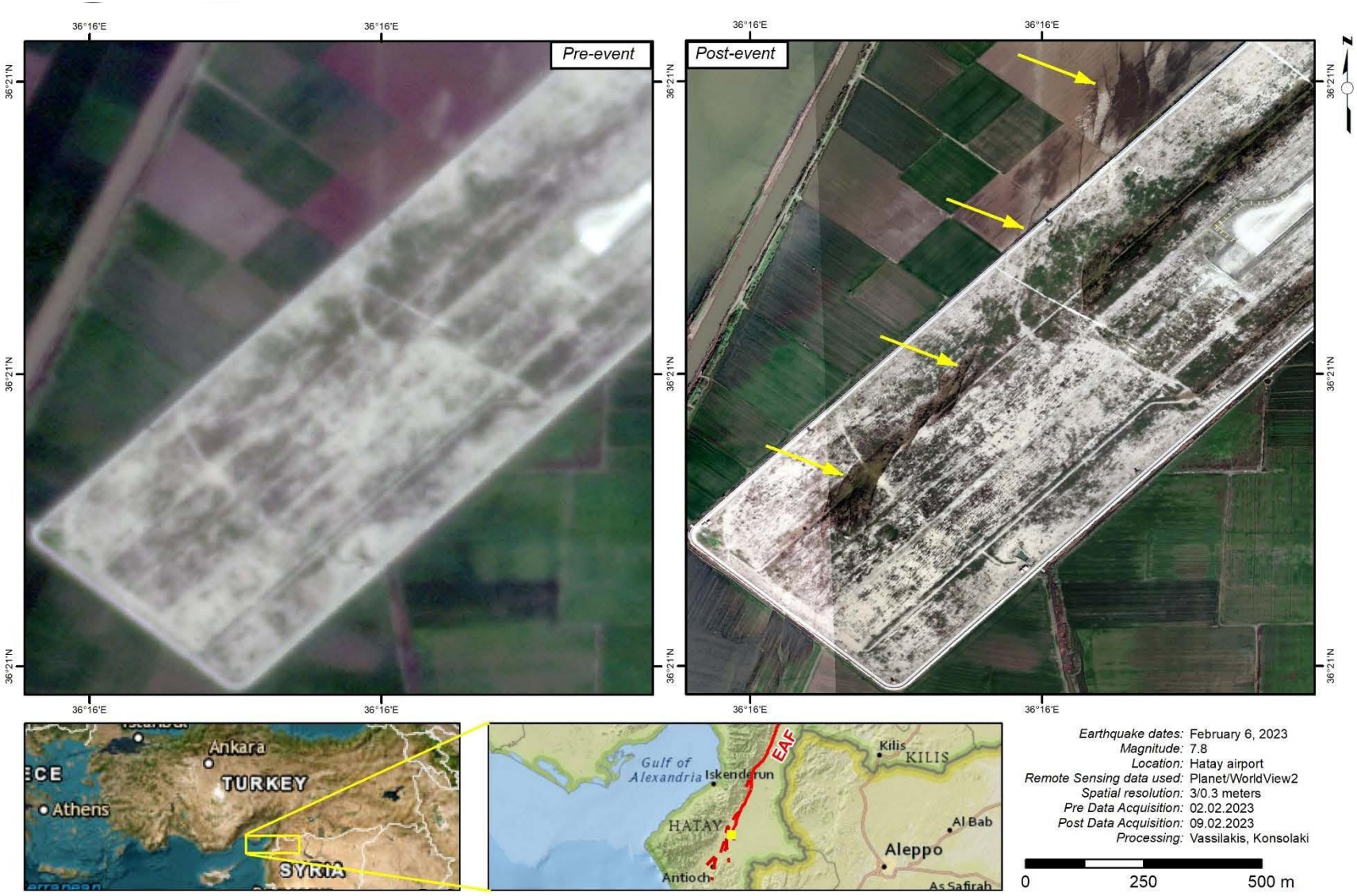
(b) mapping structural failures of residential buildings and basic infrastructure observed in the areas of Antakya, Kahramanmaraş, Nurdağı, İslahiye and other neighboring urban centers.

Satellite images from Planet and WorldView2 satellites with a spatial resolution of 3 m and 0.30 m respectively, before and after the earthquake were used. They revealed the formation and widening of ruptures with a dominant left-lateral component and major failures in the building stock due to synergy of aggravating factors.

DETECTION OF SURFACE RUPTURES BY USING SATELLITE IMAGERY AND REMOTE SENSING TECHNIGUES – ISLAHIYE



DETECTION OF SURFACE RUPTURES BY USING SATELLITE IMAGERY AND REMOTE SENSING TECHNIGUES – HATAY AIRPORT



DETECTION OF SURFACE RUPTURES IN THE FIELD

The scientific team of the National and Kapodistrian University of Athens (Prof. E. Lekkas, Prof. Em. P. Carydis, Assoc. Prof. E. Vassilakis, Dr. S. Mavroulis, MSc I. Argyropoulos) initially used traditional methods of geological mapping and field assessment of disaster impact in the field for the detection of primary earthquake environmental effects. Furthermore, they exploited the advantages of modern and innovative methodologies, such as Unmanned Aerial Vehicles (UAV). Flights were carried out at several sites of interest and primary and secondary environmental effects along with macroseismic effects on buildings were recorded in an attempt to understand the magnitude of the earthquakes and to interpret their mechanisms and effects.

They detected primary effects in several areas with impact mainly on the road network and other infrastructures, residential buildings and agricultural plots.

These ruptures present the same orientation with the active faults of the main strand of the East Anatolian Fault System in the area. Their properties (length, width, offset and throw) presented variations from site to site.

They caused considerable impact on several elements of the built environment of the area including buildings, segments of the road network, house and warehouse perimeter walls, irrigation canals, railways and other facilities and structures. They also caused deformation in farmlands.

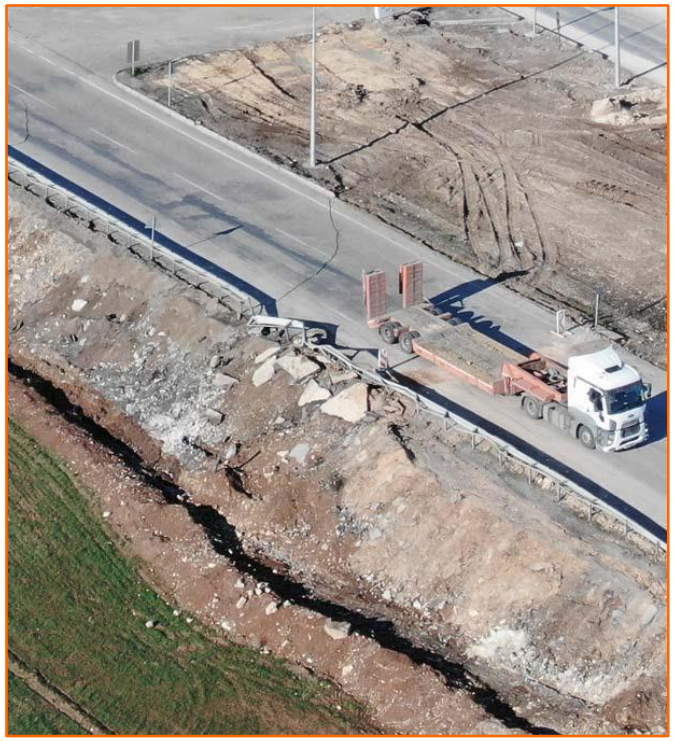
DETECTION OF SURFACE RUPTURES FROM FIELD SURVEY

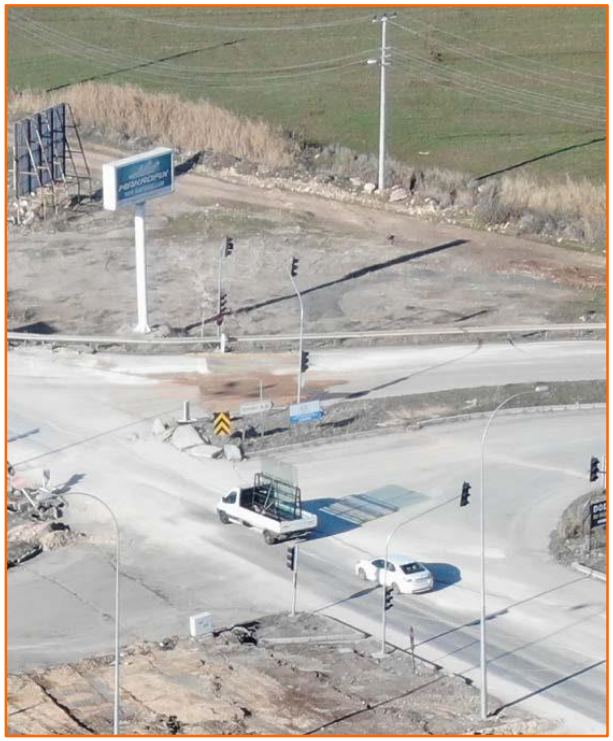
Surface ruptures were observed in the Gökçedere area, located close to the mountain front of Nurdağı area. The ruptures cut the road and adjacent slopes and fields and caused damage to pavements and tombs in a cemetery. The residential buildings with which the ruptures intersected partially collapsed.

DETECTION OF SURFACE RUPTURES FROM FIELD SURVEY

In this site the surface ruptures destroyed part of the road network of the Gökçedere area. The structures formed in the field revealed strike-slip motion along the fault which coincides with the active structures of the main strand of the East Anatolian Fault System in this part of the earthquake-affected area.

DETECTION OF SURFACE RUPTURES FROM FIELD SURVEY



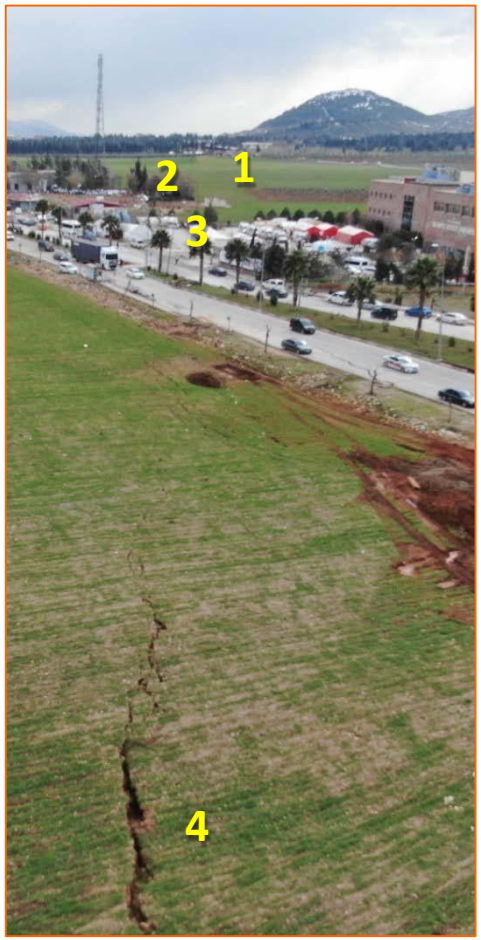


The ground ruptures destroyed many parts of the road network. Others suffered minor damage due to the strike-slip motion along the ruptures, which were immediately repaired and traffic continued, while others suffered major damage that could not be repaired quickly and traffic was interrupted for a long period of time. In this site, the ruptures were observable over a long distance on both sides of the road and in adjacent fields.

DETECTION OF SURFACE RUPTURES FROM FIELD SURVEY

Buildings and infrastructure located within the deformation zone of the coseismic surface ruptures suffered very heavy structural damage including total collapse. The bulidings in this site were totally destroyed (CB: Collapsed buildings in the middle figure). Along the same ruptured zone, rockfalls were also triggered.

DETECTION OF SURFACE RUPTURES FROM FIELD SURVEY

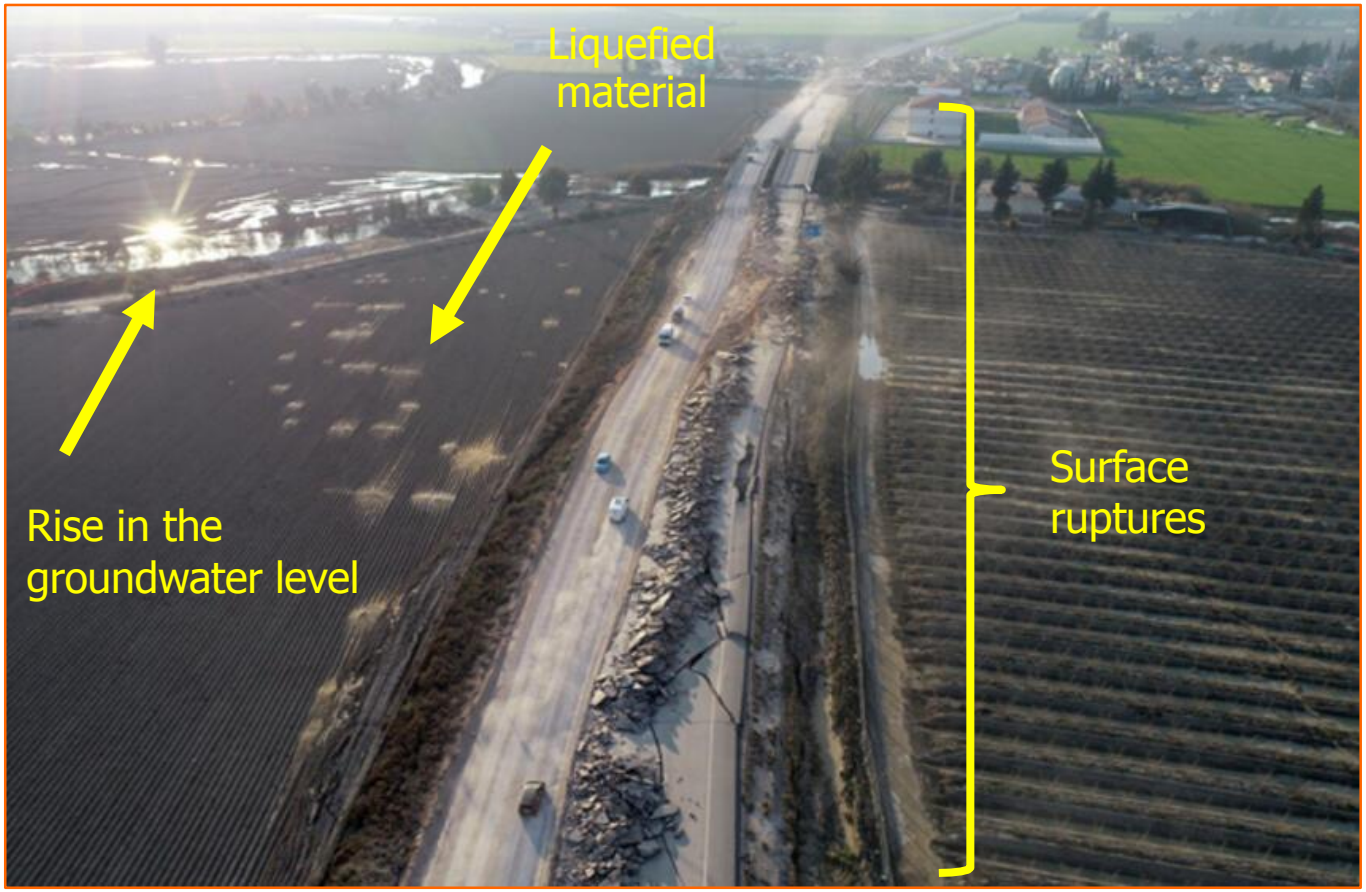


Surface ruptures caused damage in roads, pavements and warehouse perimeter walls and deformation in fields and concrete slabs. **1**: Surface ruptures in a field. **2**: Cracked and disrupted perimeter wall. **3**: Deformed concrete slabs. **4**: Large gaps were formed along the observed surface ruptures.

SURFACE RUPTURES OF THE 6 FEBRUARY 2023 EARTHQUAKES

The Antakya Demirözü highway, the road connecting Antakya to Reyhanlı district suffered heavy damage by the severe earthquake ground motion. The road was heavily cracked for a length of about 1 km.

SURFACE RUPTURES OF THE 6 FEBRUARY 2023 EARTHQUAKES ALONG WITH LIQUEFACTION AND RISE OF THE GROUNDWATER LEVEL



The ruptures observed in the road connecting Antakya to Reyhanlı district were accompanied by lateral speading related to liquefaction phenomena and generated close to the affected road. The liquefaction phenomena included ejection of liquefied material through cracks and formation of sand boils. Furthermore, large parts of adjacent fields were covered by water due to groundwater level rising.

SURFACE RUPTURES OF THE 6 FEBRUARY 2023 EARTHQUAKES

Surface ruptures observed in the Kahramanmaras located in the northern part of the earthquake-affected area. The ruptures have affected farmland and displaced irrigation channels and roads.
Source: https://twitter.com/i/status/1627070146799079430

SURFACE RUPTURES OF THE 6 FEBRUARY 2023 EARTHQUAKES

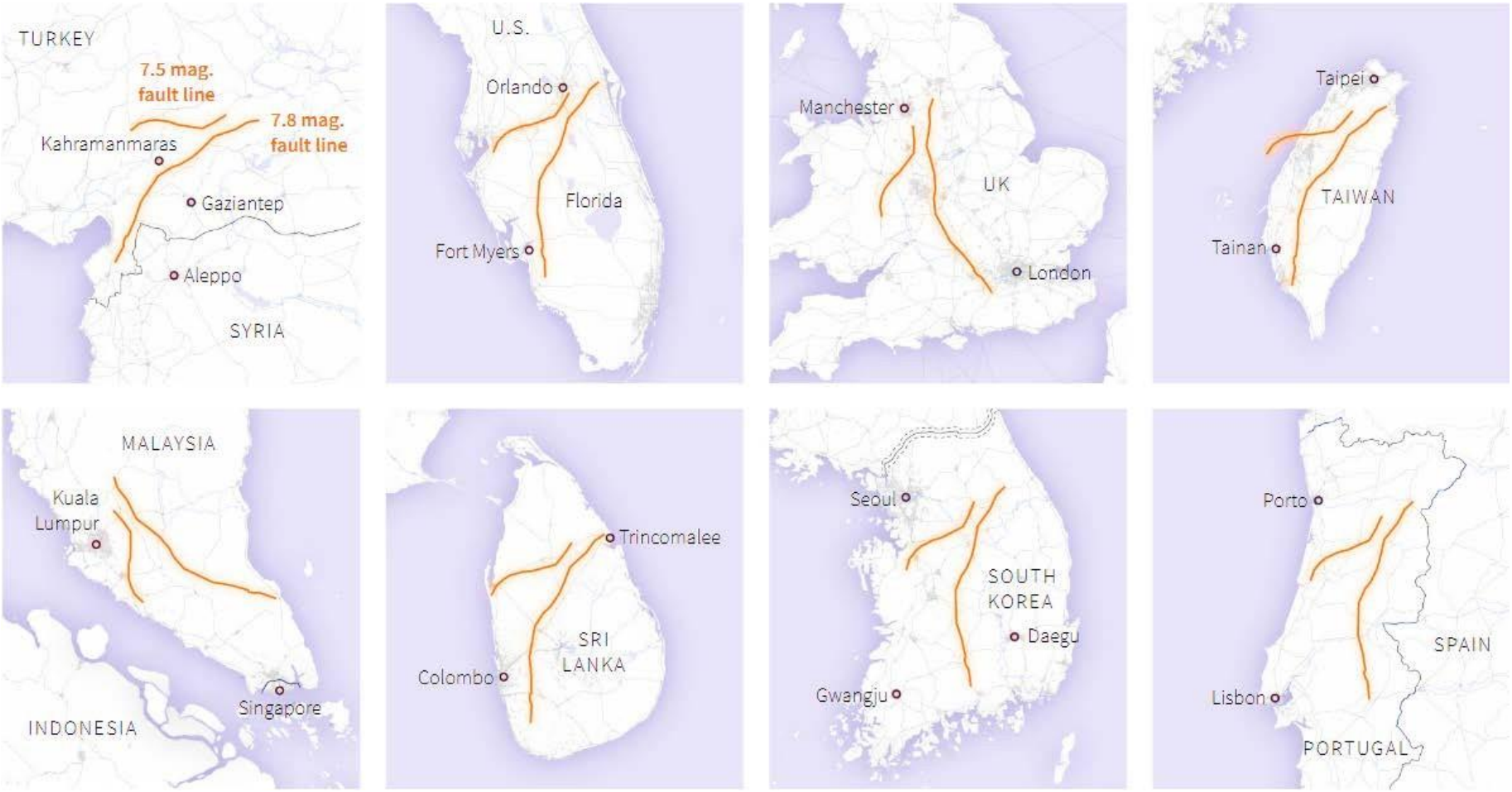
Surface ruptures observed near Tevekkelli, Kahramanmaraş. The ruptures have affected farmland, displaced irrigation channels and caused damage to roads.
Source: https://www.youtube.com/watch?v=hf2EY43bmD0

SURFACE RUPTURES OF THE 6 FEBRUARY 2023 EARTHQUAKES

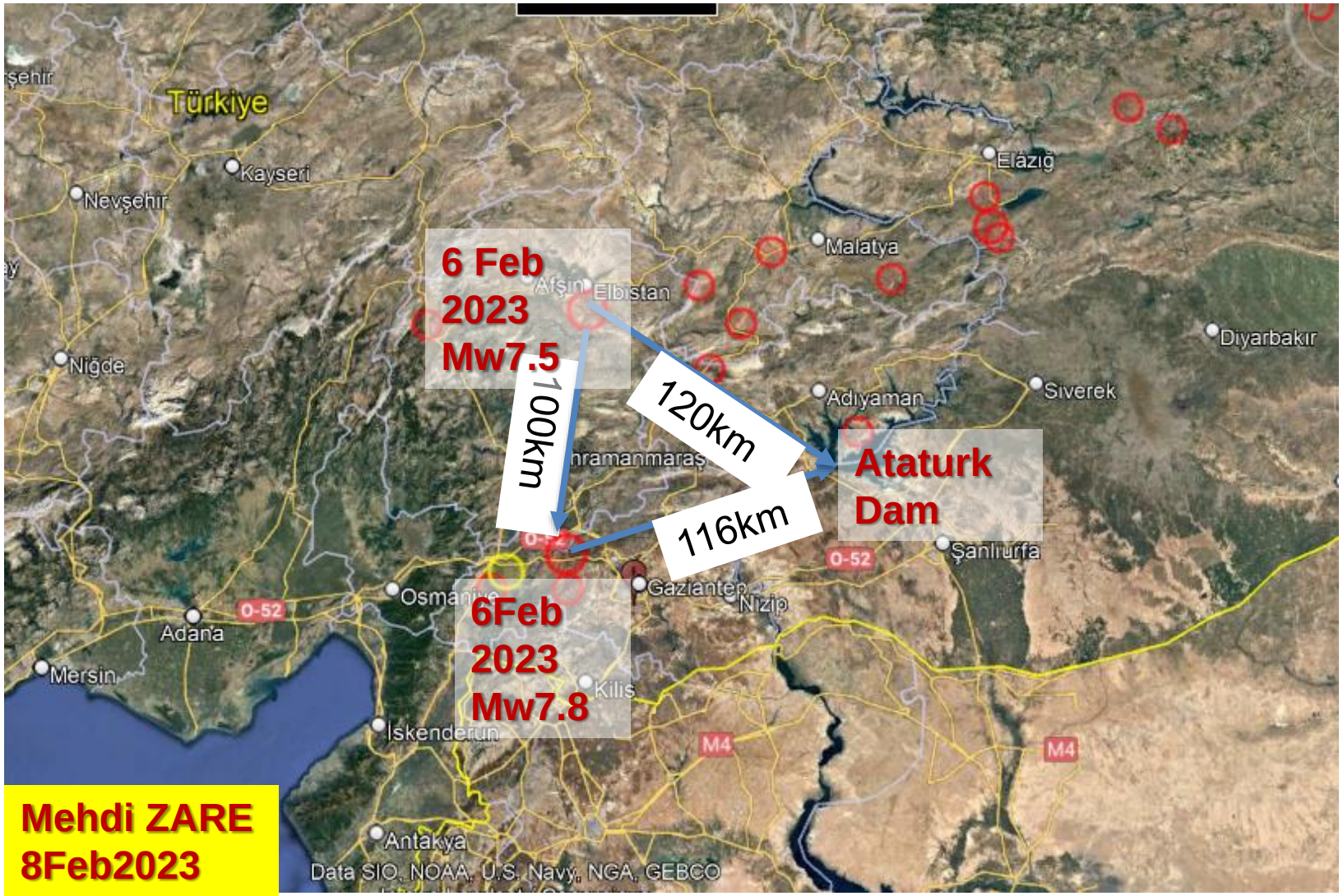
Surface ruptures in Kahramanmaraş. They affected roads and farmlands and triggered rockfalls and landslides along their path. The mobilized material reached adjacent segments of the road network resulting in temporary traffic disruption in lanes.

Source: Global News
https://www.youtube.com/watch?v=Da6pa_KW1EM

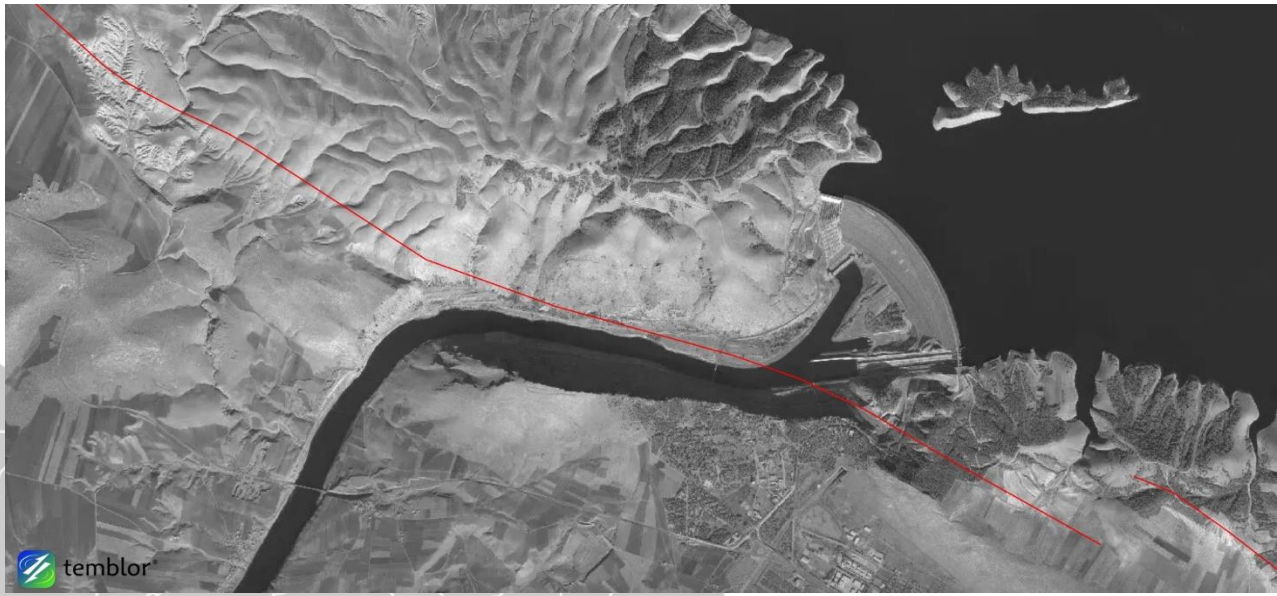
THE SIZE OF THE RUPTURE
COMPARED TO OTHER WELL-KNOWN LAND MASSES



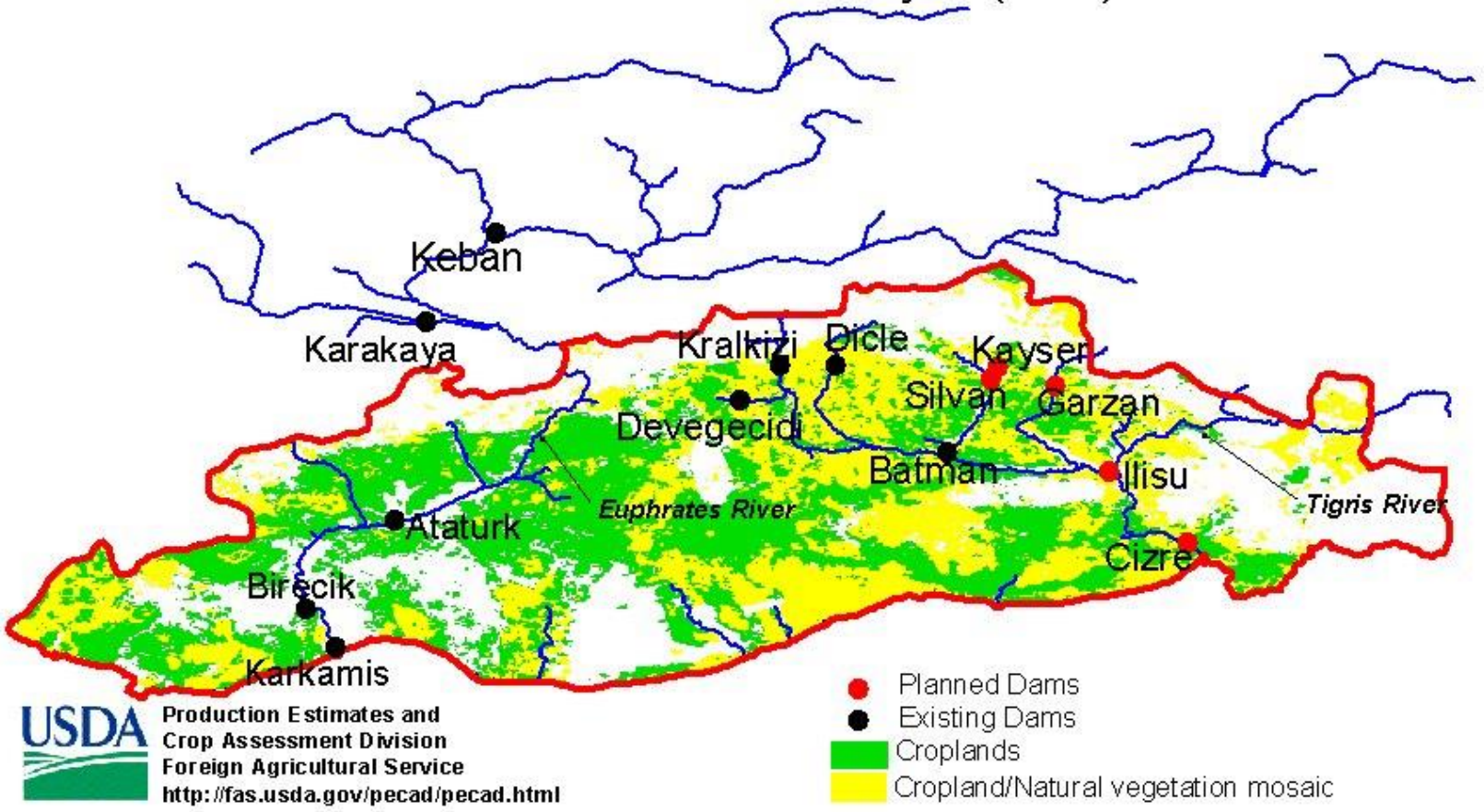
The extent of the ruptured faults is comparable to the length of Taiwan, South Korea, or Portugal revealing the properties of a devastating earthquake with indescribable impact on a high populated area. Source: https://www.reuters.com/graphics/TURKEY-QUAKE/RUPTURE/gdpzqdzwwvw/.


Türkiye
Kayseri
Nevşehir
Niğde
Elâzığ
Malatya
Afşin
Elbistan
Diyarbakır
Adıyaman
Siverek
Şanlıurfa
Gaziantep
Nizip
Osmaniye
Adana
Mersin
Kilis
İskenderun
Antakya
O-52
M4
6 Feb
2023
Mw7.5
100km
120km
116km
Ataturk
Dam
6Feb
2023
Mw7.8
Mehdi ZARE
8Feb2023
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Atatürk Dam
Location Şanlıurfa-Adıyaman, Turkey
Construction began 1983
Opening date 1992
capacity 48,700,000,000 m3
Surface area 817 km2
Power Station
Turbines 8 x 300 MW Francis-type
Installed capacity 2,400 MW
Annual generation 8,900 gigawatt-hours



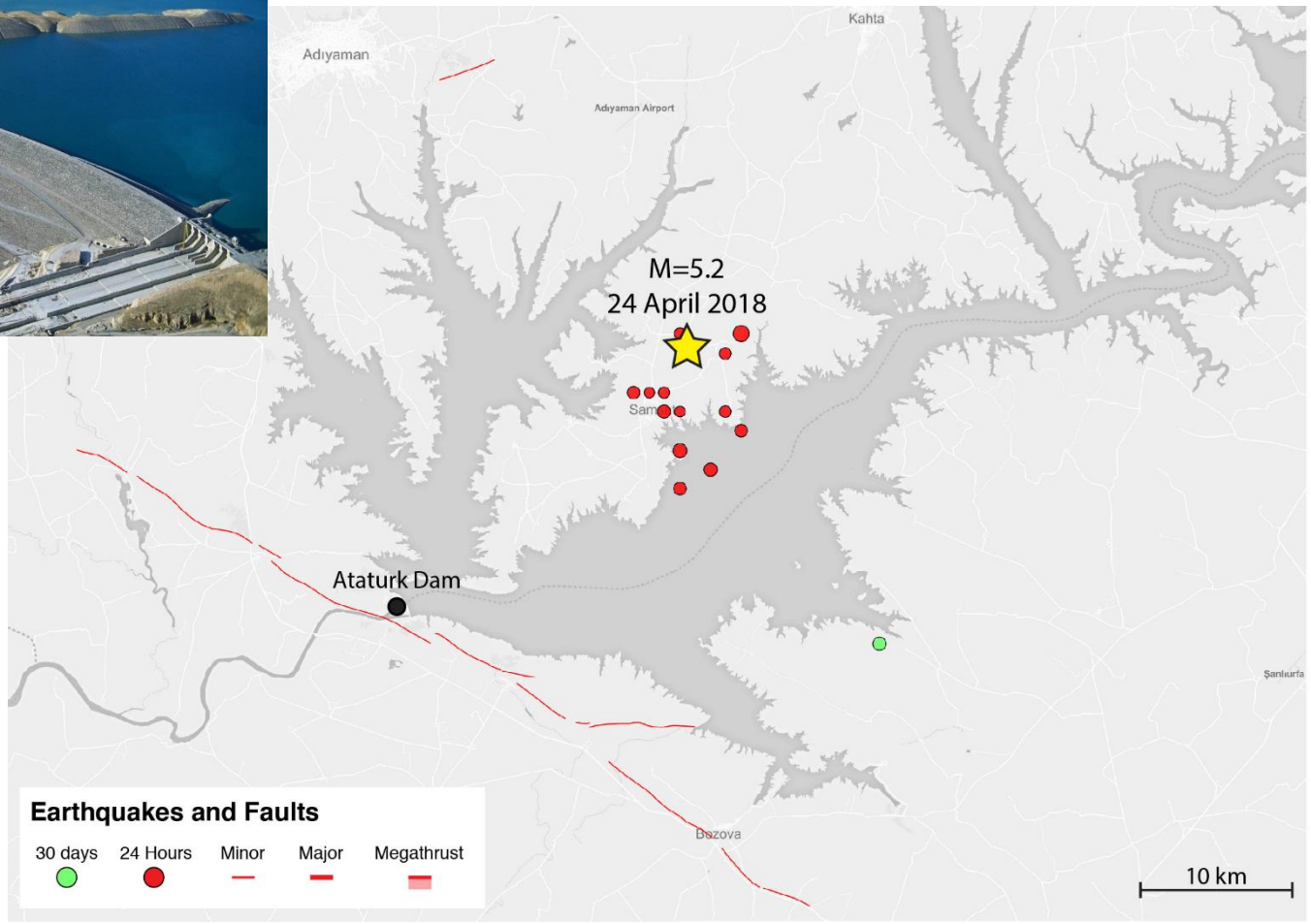
Dam Locations within the Southeastern Anatolia Project (GAP)

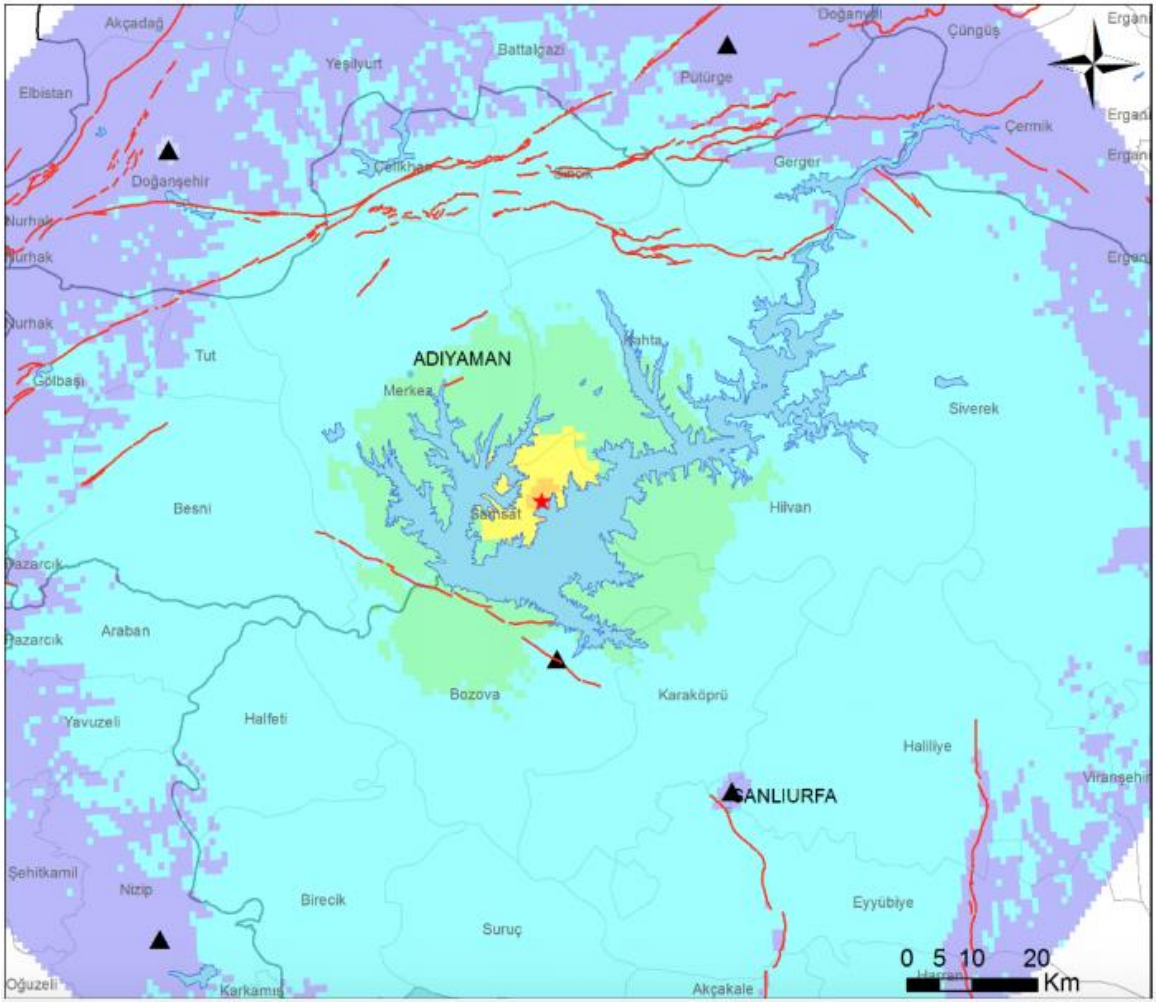


USDA

Production Estimates and
Crop Assessment Division
Foreign Agricultural Service
http://fas.usda.gov/pecad/pecad.html


DSİ


Kahta
Adıyaman
Adıyaman Airport
M=5.2
24 April 2018
Atatürk Dam
Şanlıurfa
Bozova
Earthquakes and Faults
30 days
24 Hours
Minor
Major
Megathrust
10 km


Akçadağ
Yeşilyurt
Battalgazi
Doğanyol
Çüngüş
Elbistan
Pütürge
Çermik
Doğanşehir
Çelikhan
Gerger
Nurhak
Tut
ADIYAMAN
Kahta
Gölbaşı
Merkez
Siverek
Besni
Şambat
Hilvan
Araban
Bozova
Karaköprü
Yavuzeli
Halfeti
Halilliye
ŞANLIURFA
Şehitkamil
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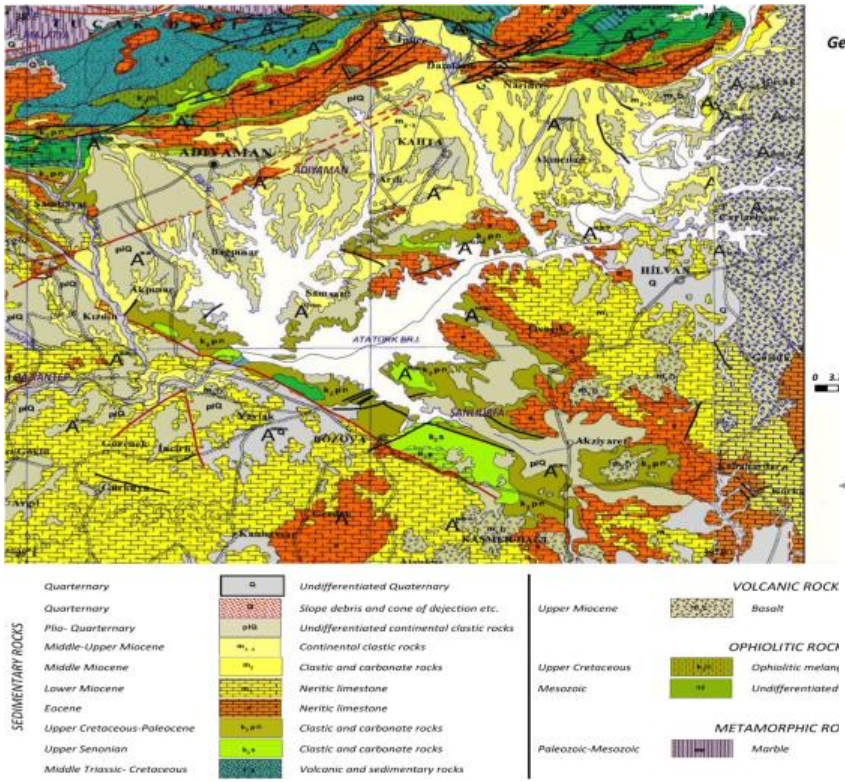
Birecik
Suruç
Eyyübiye
Oğuzeli
Karkamış
Akçakale
0 5 10 20
Km



Geology of Atatürk Dam and Surrounding

SEDIMENTARY ROCKS

Quaternary	Q	Undifferentiated Quaternary
Quaternary		Slope debris and cone of dejection etc.
Plio- Quarternary	pliQ	Undifferentiated continental clastic rocks
Middle-Upper Miocene		Continental clastic rocks
Middle Miocene		Clastic and carbonate rocks
Lower Miocene		Neritic limestone
Eocene		Neritic limestone
Upper Cretaceous-Paleocene		Clastic and carbonate rocks
Upper Senonian		Clastic and carbonate rocks
Middle Triassic- Cretaceous		Volcanic and sedimentary rocks

VOLCANIC ROCK

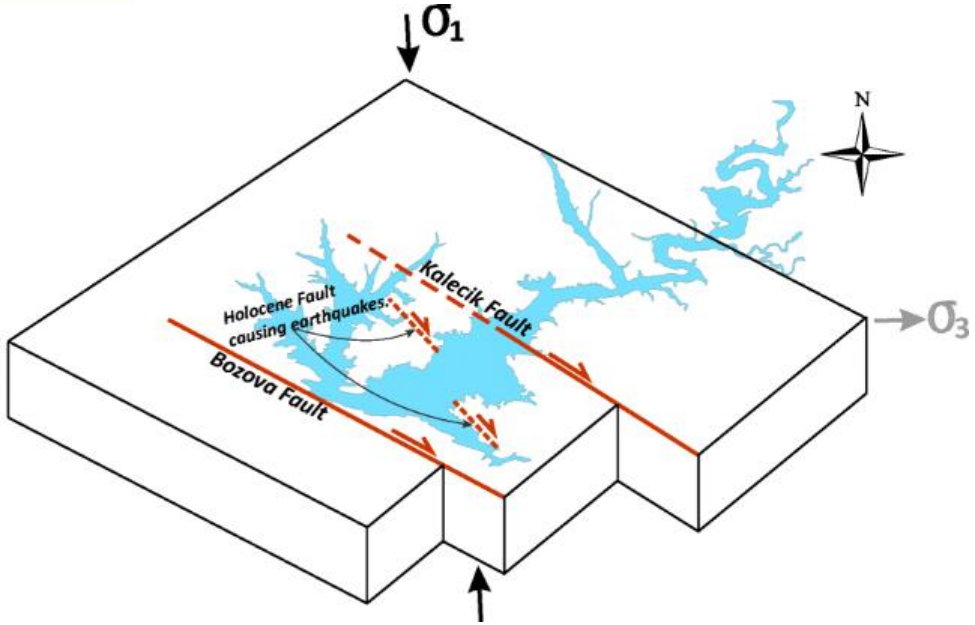
Upper Miocene	Basalt

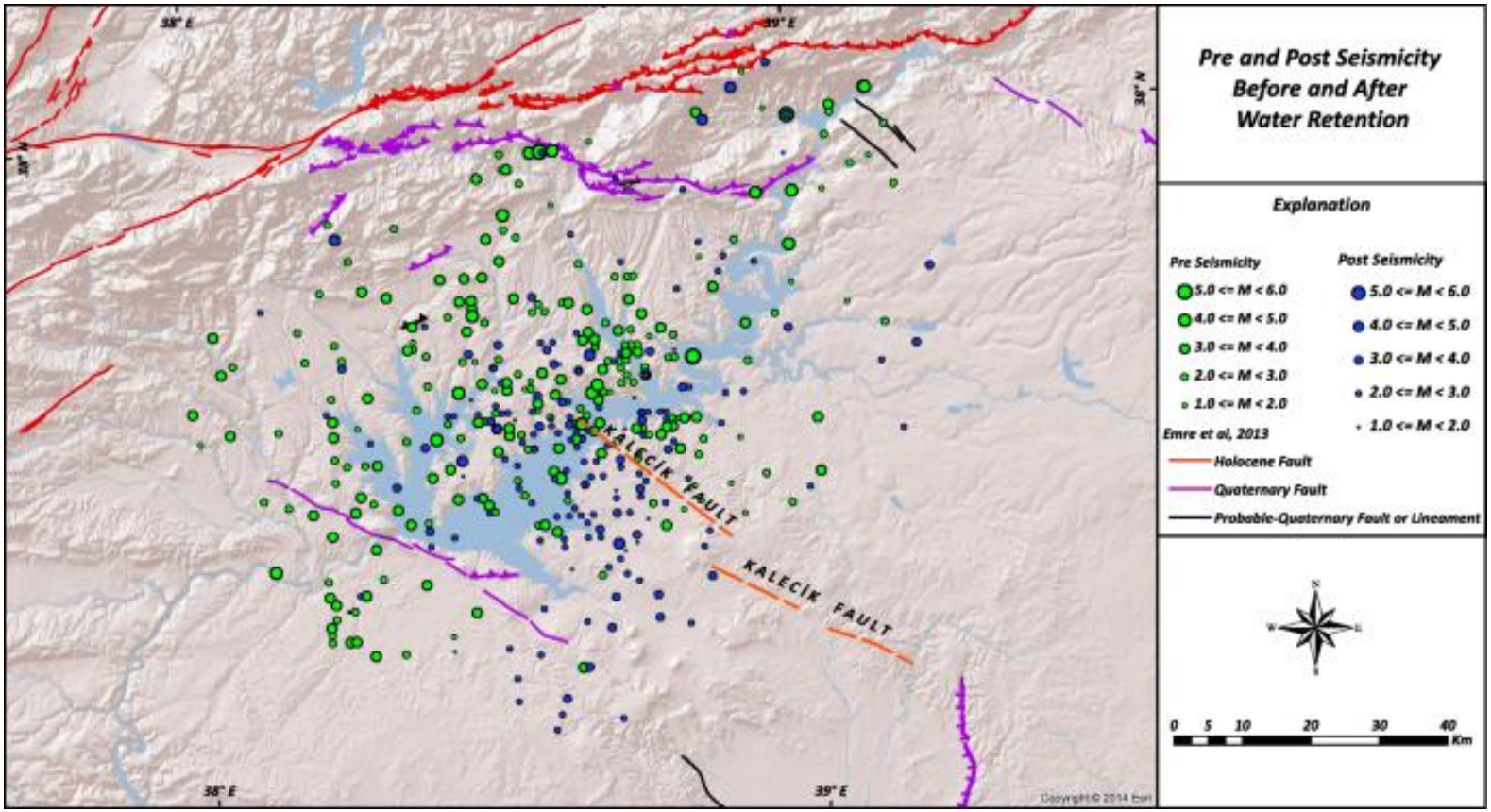
OPHIOLITIC ROCK

Upper Cretaceous	Ophiolitic melan
Mesozoic	Undifferentiated

METAMORPHIC RO

Paleozoic-Mesozoic	Marble

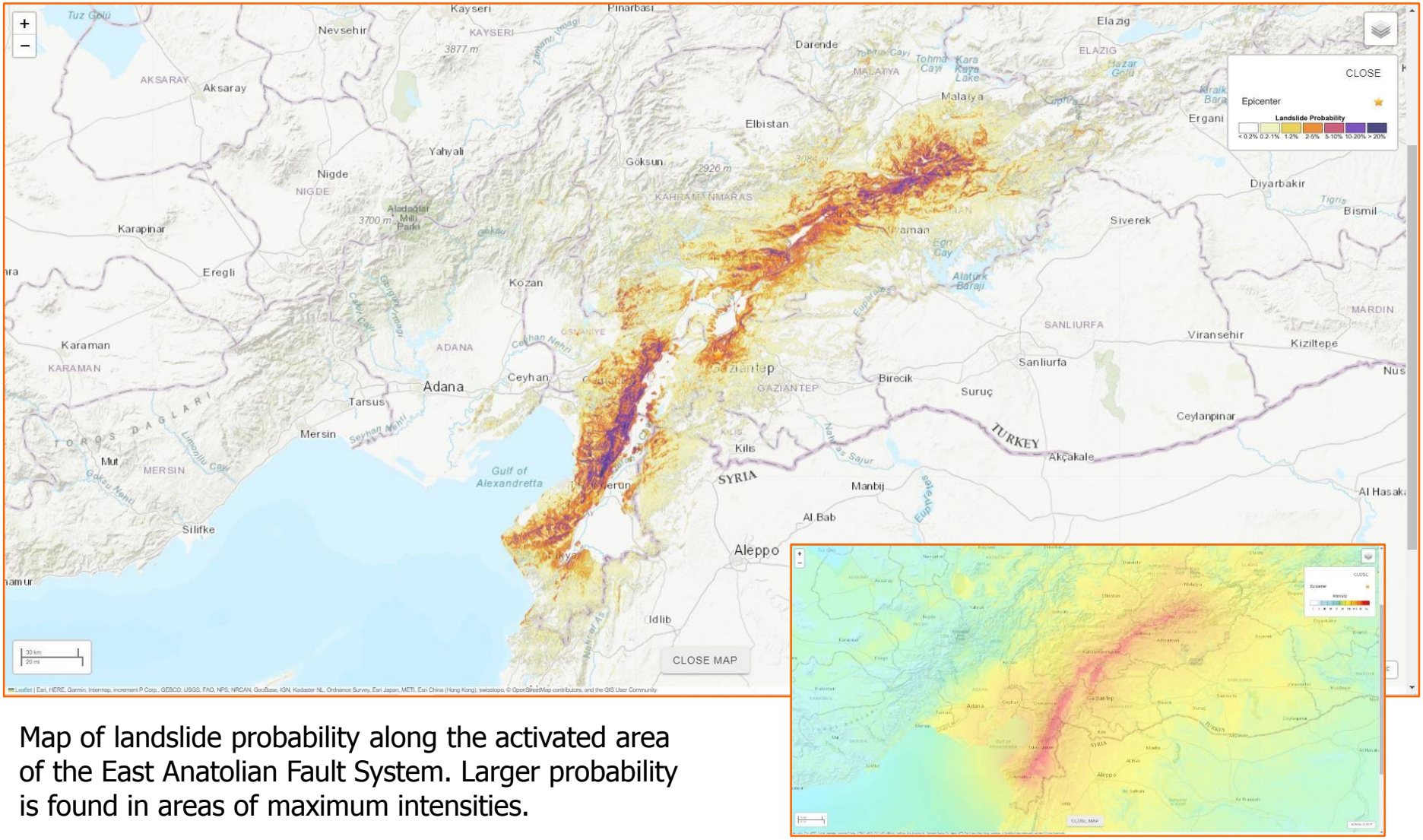



38° E
39° E
38° N
KALECIK FAULT
KALECIK FAULT
38° E
39° E
Pre and Post Seismicity
Before and After
Water Retention
Explanation
Pre Seismicity
5.0 <= M < 6.0
4.0 <= M < 5.0
3.0 <= M < 4.0
2.0 <= M < 3.0
1.0 <= M < 2.0
Post Seismicity
5.0 <= M < 6.0
4.0 <= M < 5.0
3.0 <= M < 4.0
2.0 <= M < 3.0
1.0 <= M < 2.0
Emre et al, 2013
Holocene Fault
Quaternary Fault
Probable-Quaternary Fault or Lineament
0 5 10 20 30 40
Km

20 Feb 2023, Mw6.4, Hatay


Hatay

LANDSLIDE PROBABILITY
FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE

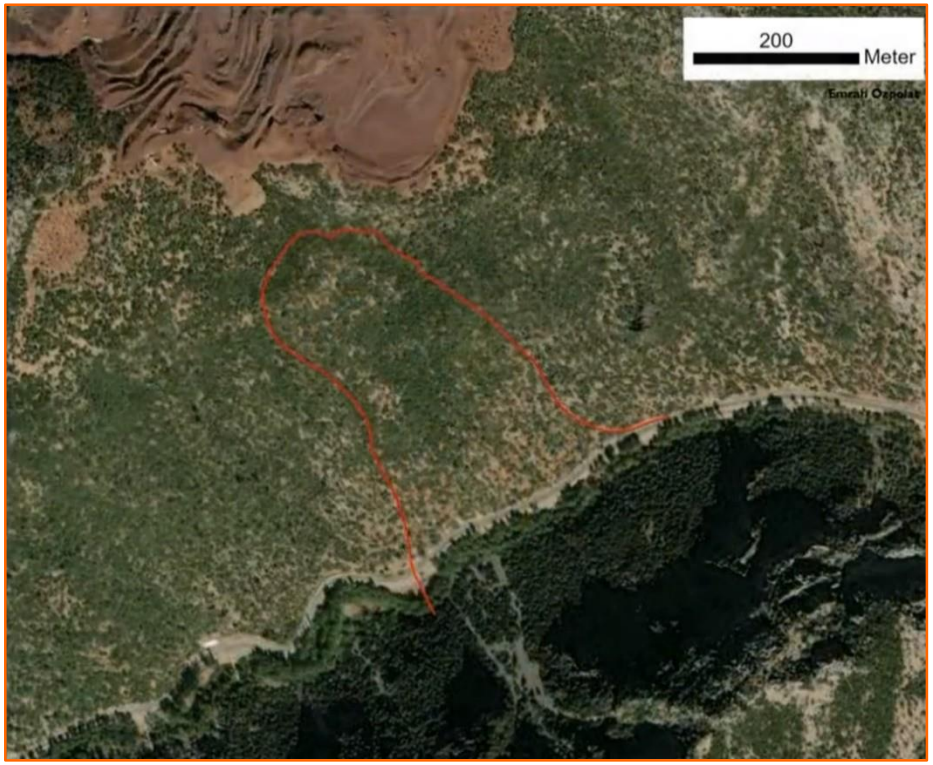


Map of landslide probability along the activated area of the East Anatolian Fault System. Larger probability is found in areas of maximum intensities.

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

Earthquake-triggered landslides were observed close or along the surface ruptures.
They included slides (left figure) and rockfalls (right figure.(
Characteristic drone views from Nurdağı area (Gaziantep province.(

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES



A large landslide, around 200 meters wide, discovered through satellite imagery not far from Islahiye, Gaziantep Province, as a result of the Mw=7.8 earthquake in Turkey.

Sources:
https://twitter.com/WxNB_/status/1624470130510991361
https://twitter.com/emrhozpolat/status/1624542795401764868

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

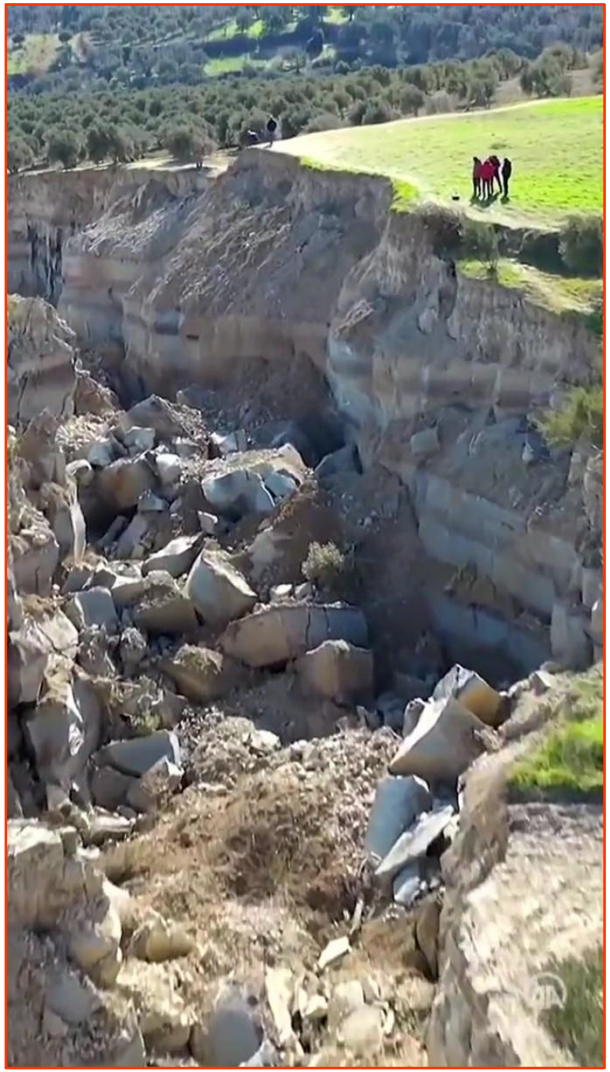
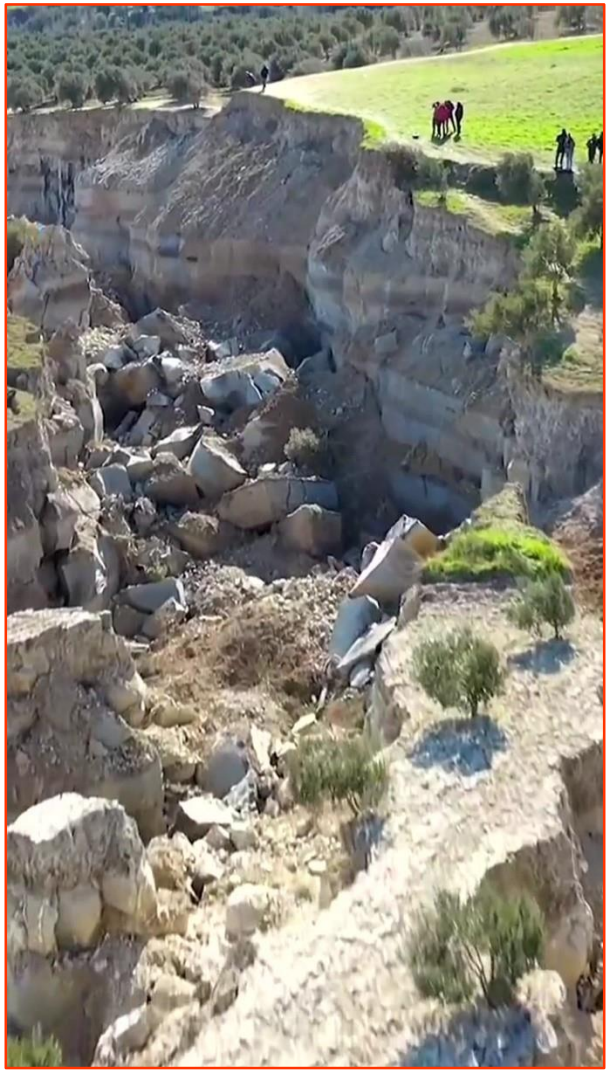
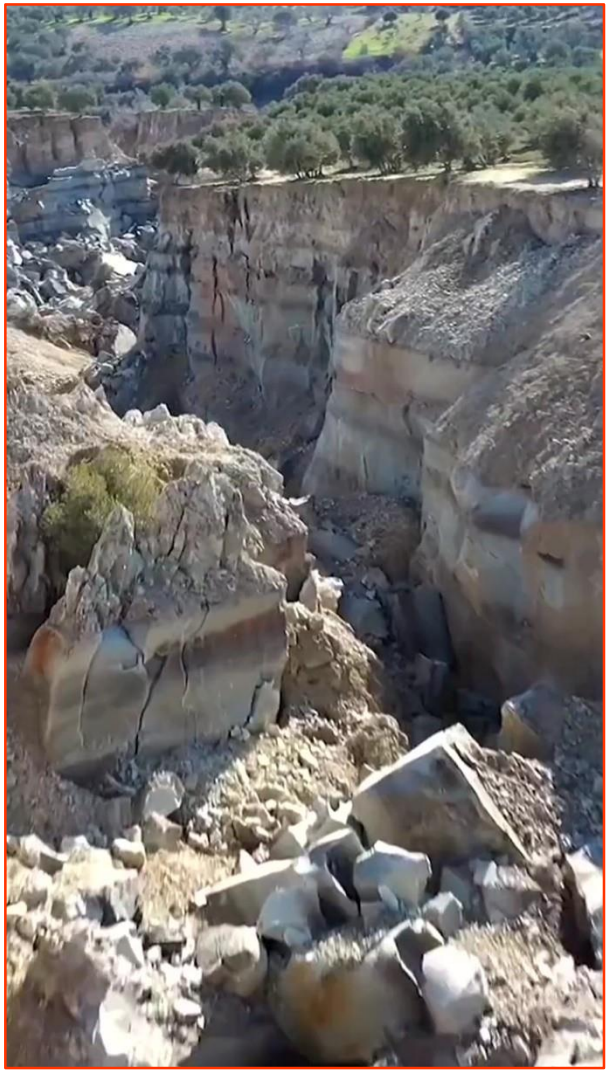
The road between the rural Değirmencik and İdilli neighborhoods of Gaziantep's İslahiye district was closed due to the earthquake-induced landslide. The bed of Idilli Stream was filled with falling rocks and a pile of earth. Source: https://www.aa.com.tr/tr/pg/foto-galeri/islahiyede-depremin-ardindan-heyelanla-kapanan-yolda-inceleme-suruyor/0.

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

A large rift was generated by the 6 February 2023 earthquake in the Altınözü district of Hatay and cut an olive field in half. It has width of 200 meters, length of 400 meters and depth of 50 meters. Villagers said that they heard an explosion and saw lights flashing over the site. The images presented in the following pages are derived from several internet sources.

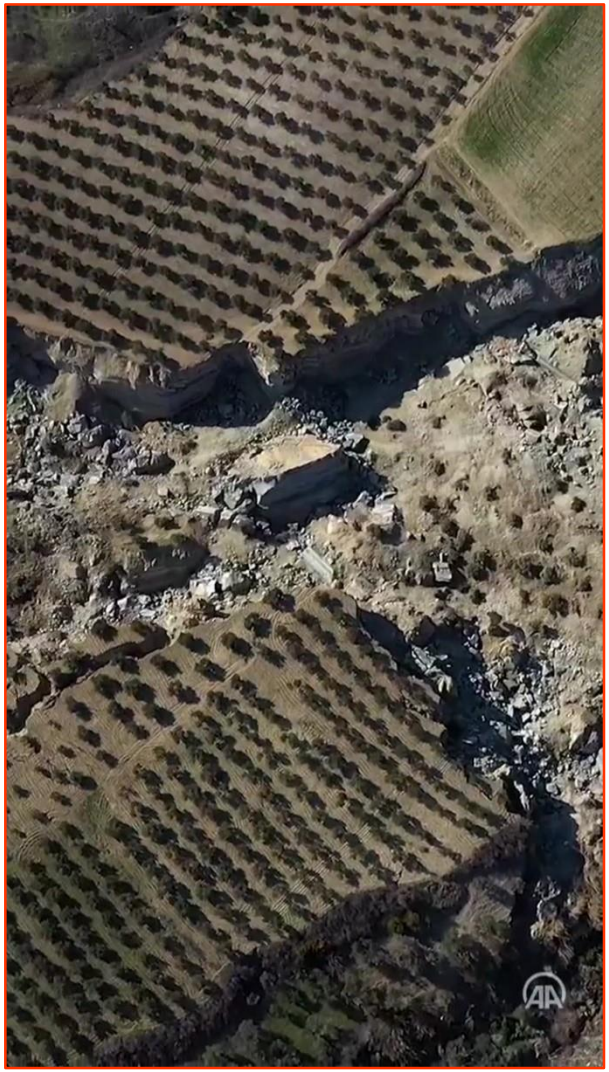
Source: https://twitter.com/MrGeoscopy/status/1624330753453486080

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

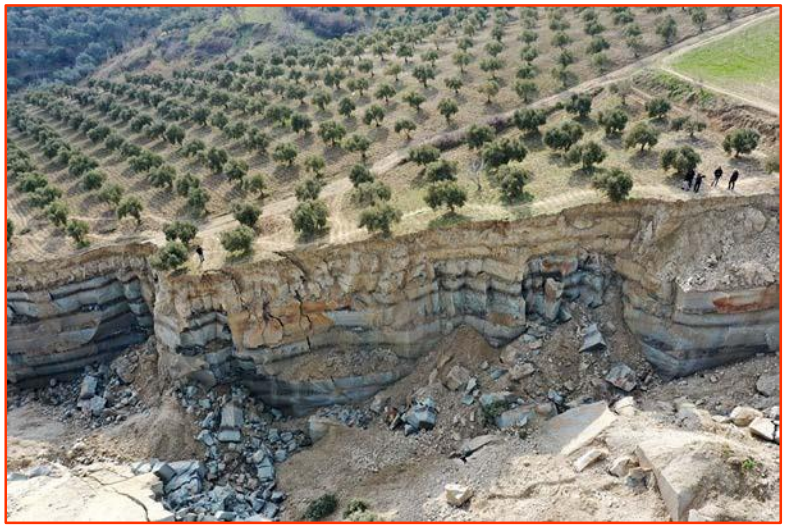
Source: https://twitter.com/i/status/1625471165207814148

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES



Source: https://twitter.com/i/status/1625471165207814148

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES



Source: https://twitter.com/TurkishIndy/status/1624685801308143618

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

Rockfalls were generated by the earthquake along a hill adjacent to Bektasli village, causing damage to buildings and 49 fatalities. Boulders were detached from the mountain and then rolled and crushed one-story houses in the village resulting in total destruction.

Source:
https://www.cnnturk.com/turkiye/deprem-kayalari-yuvarladi-koydeki-49-kisi-hayatini-kaybetti?page=6

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

In the Bektaşlı village of the Kırıkhan district of Hatay, the rocks that broke off the mountain due to the effect of the earthquake rolled and fell on the one-story houses. Source: https://www.cnnturk.com/turkiye/deprem-kayalari-yuvarladi-koydeki-49-kisi-hayatini-kaybetti?page=6

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

Büyüknacar village is located at the top of the Pazarcık district of Kahramanmaraş. About 84 percent of the houses in the village were destroyed by the 6 February 2023 earthquakes.

According to citizens, on the night of the earthquake the Sakı Baba mountain seemed to slide towards the village.

Source: https://www.cnnturk.com/turkiye/kahramanmarasin-en-zirvedeki-dag-koyu-168-kisi-hayatini-kaybetti-sadece-20-ev-ayakta-kaldi?page=4

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

The Kızılzarf Mountain in the Kurucaova village of Doğanşehir district in Malatya province was also affected by the 6 February 2023 earthquakes. According to the villagers, the mountain split into two after the Mw=7.8 earthquake. Red arrows point the head scarp of the landslide. Source: https://www.cnnturk.com/turkiye/11-ili-yikan-deprem-dogansehirdeki-dagi-ikiye-ayirdi

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES



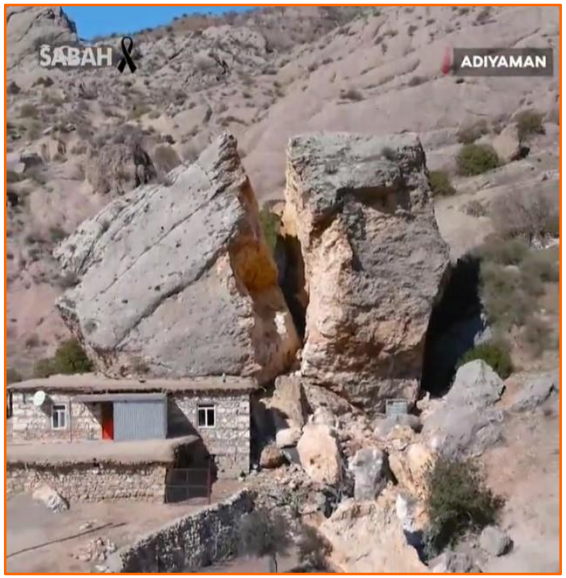

Part of the road leading from Kahramanmaraş to Malatya collapsed leaving only two of the four road lanes in place. In some places the landslide was 8 meters long. In addition, rockfalls were generated from adjacent slopes. Source: https://www.cnnturk.com/turkiye/depremin-otoyollardaki-tahribati-hem-yarildi-hem-coktu?page=2

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

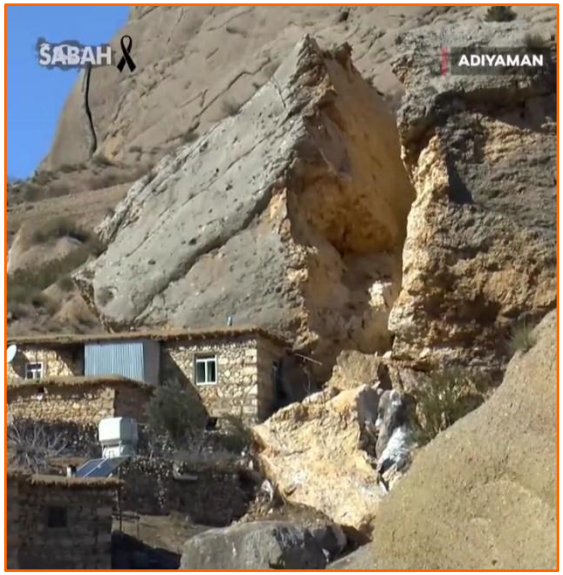
Rockfalls were triggered along slopes in Islahiye area, causing damage to the railroad. Landslide prevention measures were taken, however the nets failed due to the large volume of the mobilized material.

Source: https://twitter.com/sabah/status/1626171009043775488

LANDSLIDES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

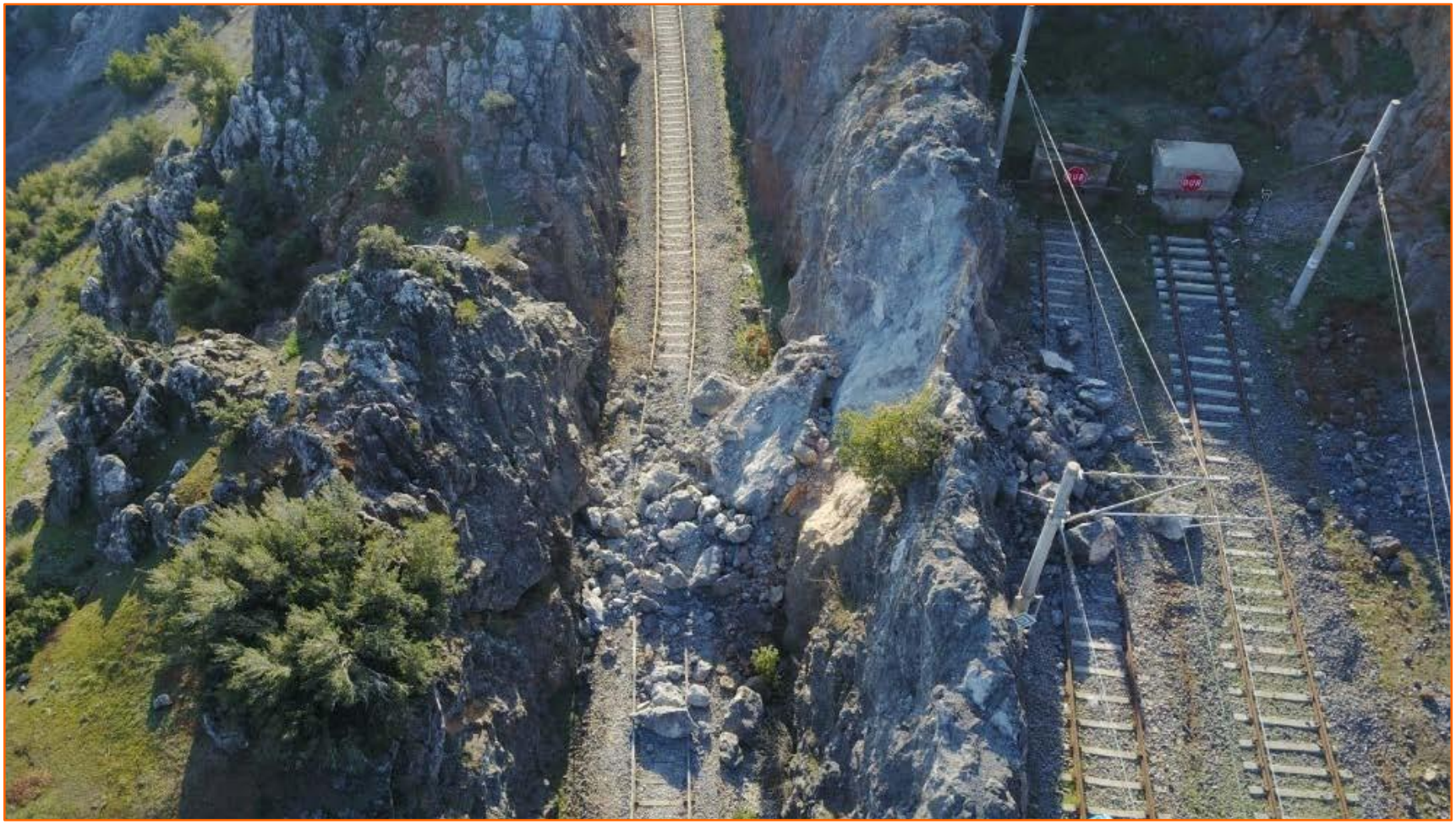


Huge boulders were detached from a slope and ended up in the village, crushing houses in the Eski Kahta (Adıyaman) area.



Source:
https://twitter.com/sabah/status/1625801963186098176

ROCKFALLS TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES



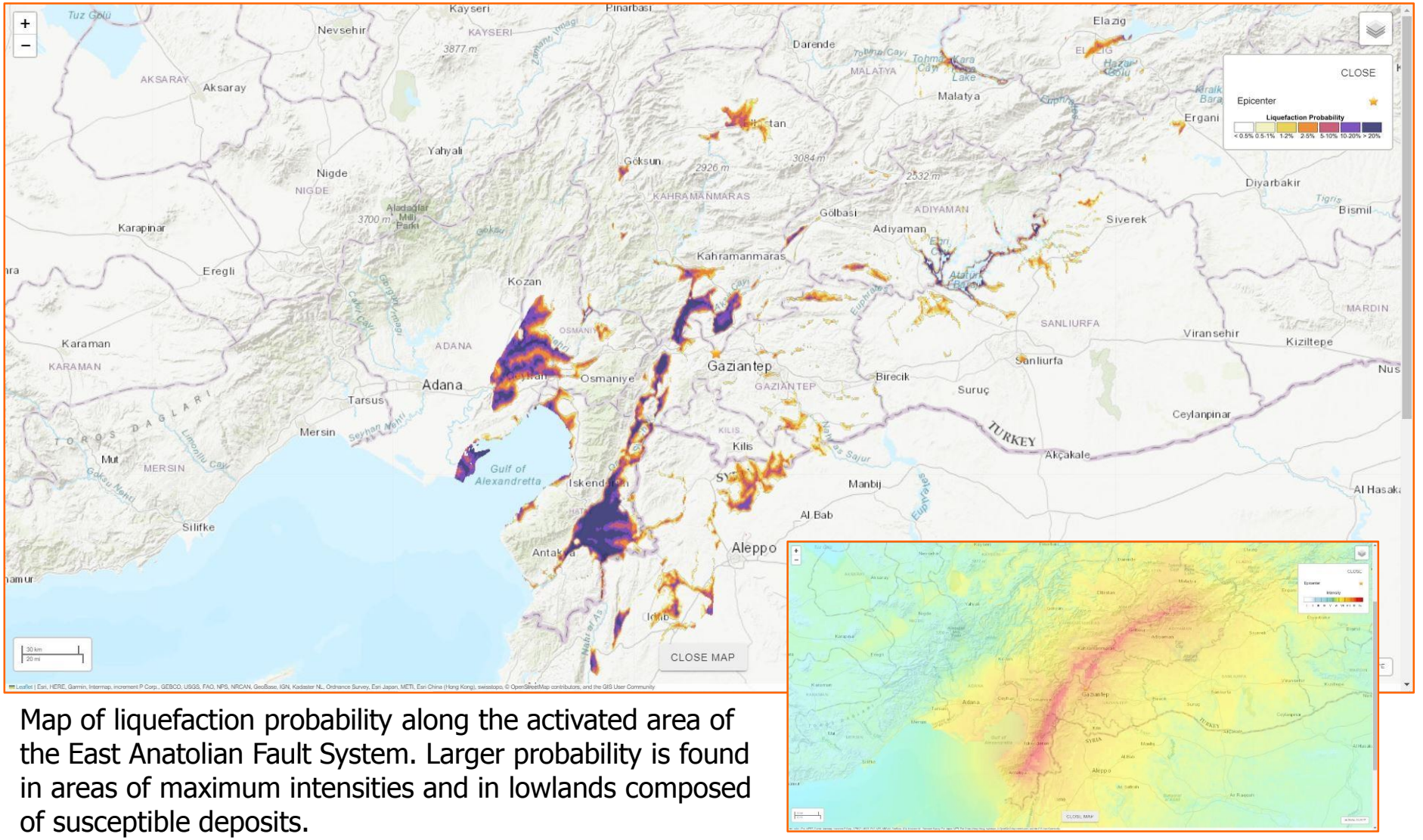
Boulders rolled over from the mountain onto the rails close to Fevzipaşa train station, Gaziantep.

Source:
https://www.dailysabah.com/turkey/roads-railways-walls-fields-moved-by-turkiye-quake-report/news

SINKHOLES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

After two major earthquakes in Kahramanmaraş, 3 giant pits were formed in Yavuzlar Park in Gaziantep.
Source: https://www.cnnturk.com/turkiye/gaziantepte-depremin-etkisi-ile-3-dev-cukur-olustu?page=2

LIQUEFACTION PROBABILITY
FOR THE 6 FEBRUARY 2023, Mw=7.8 EARTHQUAKE



Map of liquefaction probability along the activated area of the East Anatolian Fault System. Larger probability is found in areas of maximum intensities and in lowlands composed of susceptible deposits.

GROUND FAILURES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

A lateral spreading failure on a river bank affected the road between Adana and Gaziantep.
The images are derived from a video tweeted by Sokagin Sesi Gazetesi.
Source: https://twitter.com/sokaginsesigaz1/status/1622689001332215853

GROUND FAILURES TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

The collapse of the road to the village of Koseli, which passes over the Adıyaman-Sanliurfa-Gaziantep Highway is attributed to earthquake-induced lateral spreading. The huge ground cracks are representative of the earthquake magnitude.

Source: https://twitter.com/sabah/status/1624723740113137664

LIQUEFACTION PHENOMENA
TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

Liquefaction phenomena were triggered in several parts of the affected area. They comprised ejection of liquefied material from cracks, which covered large parts of the road and affected adjacent structures and infrastructures.

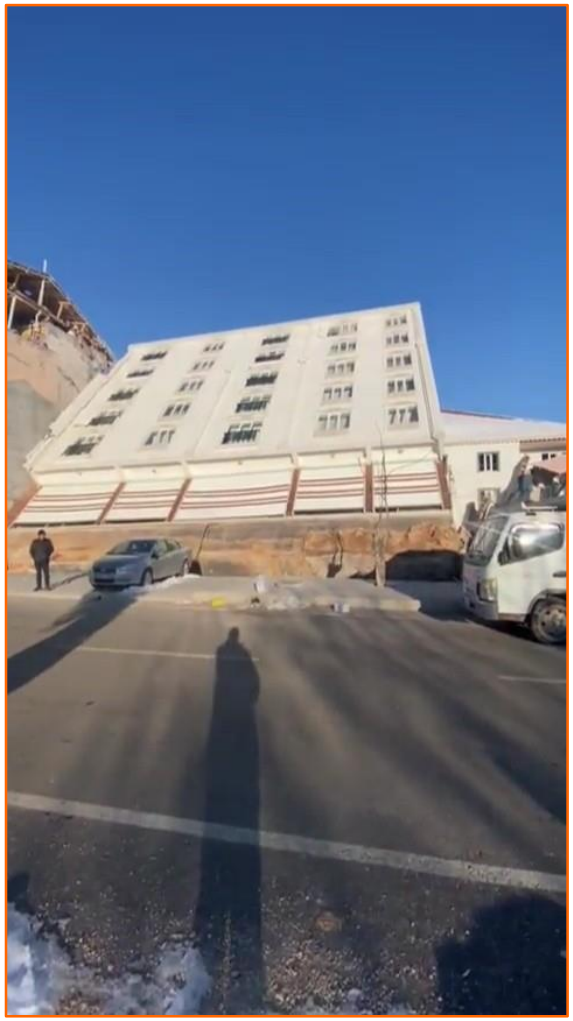
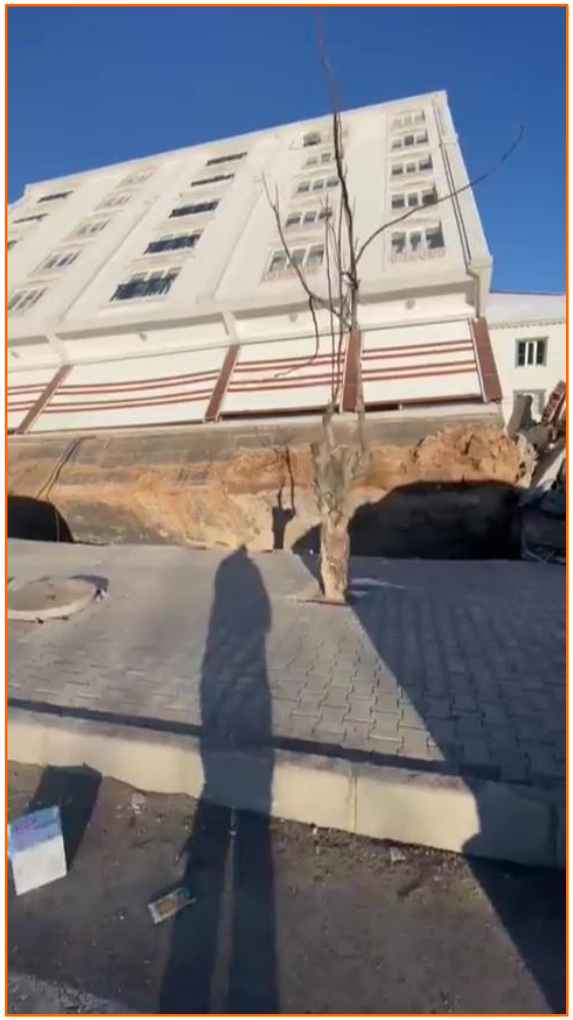
LIQUEFACTION PHENOMENA TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

Earthquake-triggered liquefaction phenomena and subsidence reported from the northeastern end of the Hatay city center. Source: https://twitter.com/geodesist_a/status/1624410147853414400

LIQUEFACTION PHENOMENA TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES

Source: https://twitter.com/MeteoredUK/status/1624076908903243778

LIQUEFACTION PHENOMENA TRIGGERED BY THE 6 FEBRUARY 2023 EARTHQUAKES


Liquefaction phenomena resulted in tilting of a building with no damage in the upper floors.
Source: https://twitter.com/aysekarahasan/status/1623767921758461953

EARTHQUAKE ENVIRONMENTAL EFFECTS ON THE COASTAL ZONE

ISKENDERUN (ALEXANDRETTA) FLOOD

Shortly after the earthquake, the roads, buildings and infrastructures of the coastal part in the southern Hatay region were flooded. The water raised and inundated land.

The inundation is attributed to the earthquake-triggered widespread subsidence of several tens of centimeters and liquefaction-related phenomena in the coastal area composed of marine deposits. The liquefaction of the marine deposits as the result of the repeated and excessive earthquake ground shaking.

The coastal part of Iskenderun (Alexandretta) was flooded and evacuated due to the risk of both earthquake and rising water.

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

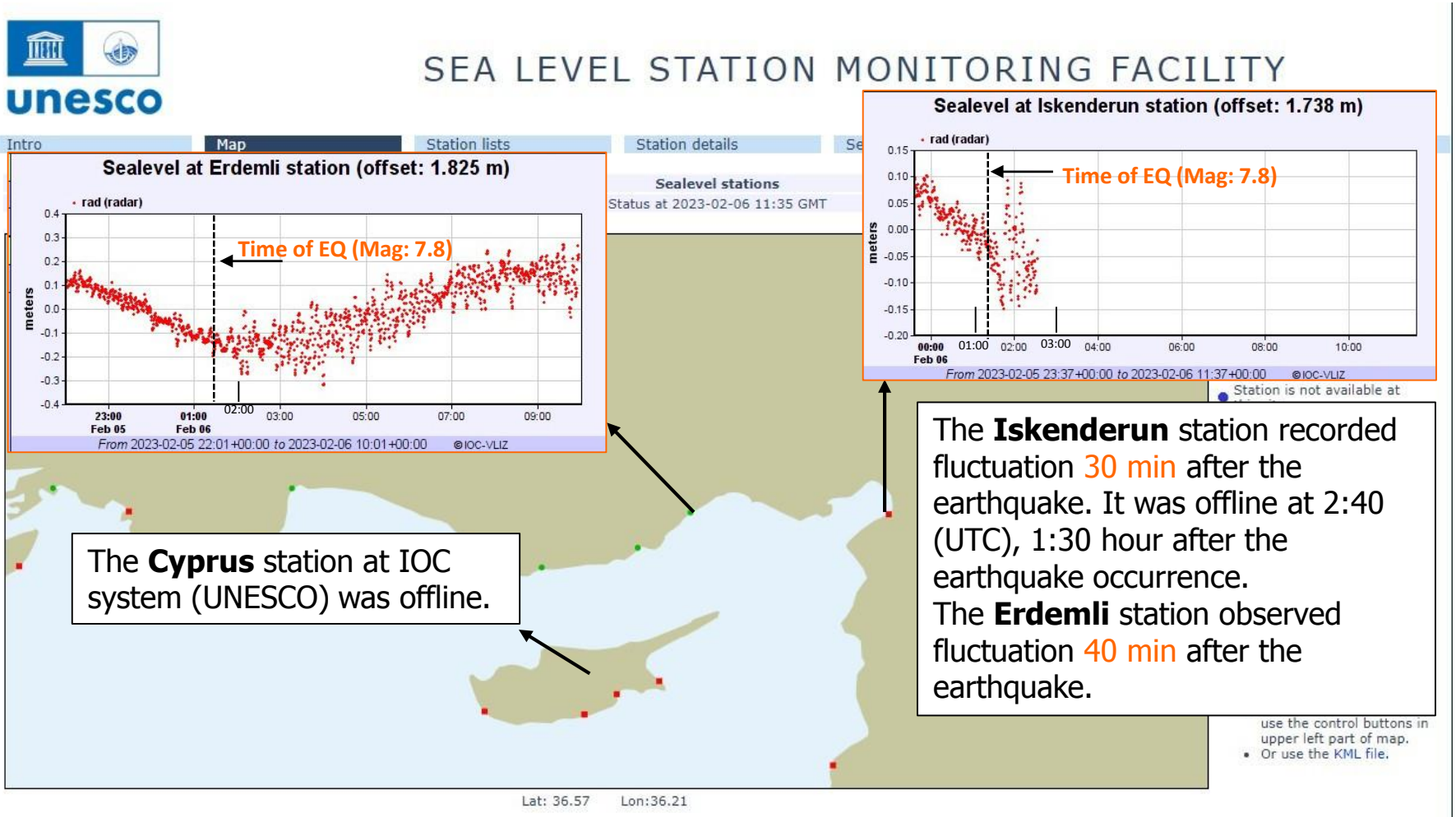
ISKENDERUN (ALEXANDRETTA) FLOOD

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

ISKENDERUN (ALEXANDRETTA) FLOOD

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

SEA LEVEL CHANGES



The **Cyprus** station at IOC system (UNESCO) was offline.

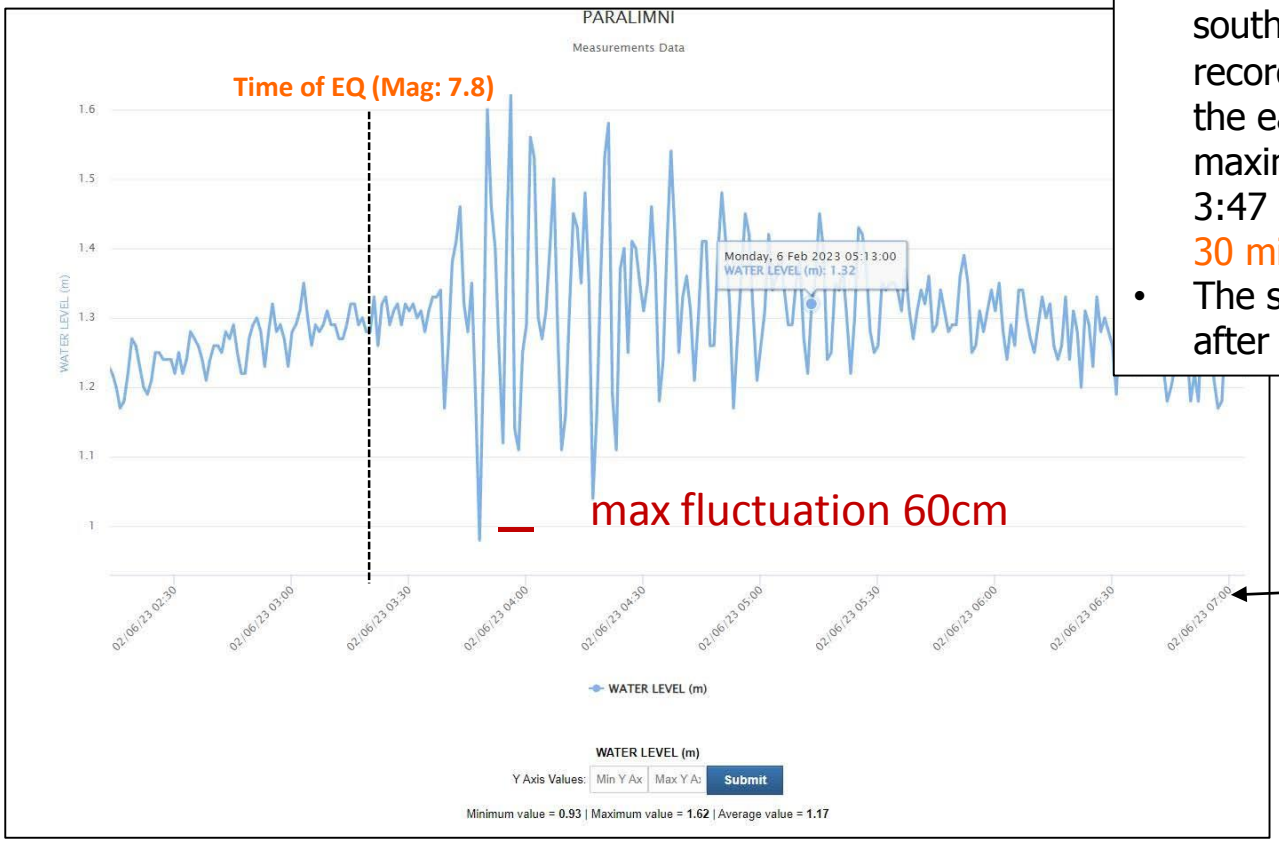
The **Iskenderun** station recorded fluctuation 30 min after the earthquake. It was offline at 2:40 (UTC), 1:30 hour after the earthquake occurrence.
The **Erdemli** station observed fluctuation 40 min after the earthquake.

Source: IOC, UNESCO (https://www.ioc-sealevelmonitoring.org/)

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

CYPRUS – TSUNAMI WAVES

- The **Paralimni** station in the southeastern Cyprus coast recorded fluctuation 20 min after the earthquake occurrence, with maximum fluctuation of 60 cm at 3:47 (+02:00 UTC, local time), 30 min after the EQ.
- The sea lever looks normal again after 2 hours, from the EQ time.

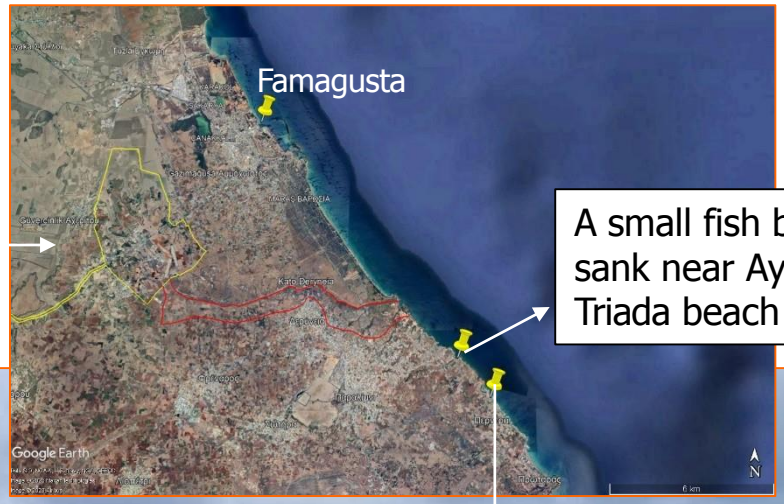


Data Access: Sectors of Geodesy/Hydrography/photogrammetry, DEPARTMENT OF LANDS AND SURVEYS, MINISTRY OF INTERIOR REPUBLIC OF CYPRUS, **Georgios Kokosis** - Secretary of the Cyprus National Hydrographic Committee // Thanks to: Nicolas Papadimitriou & Christodoulos Hadjigeorgiou, Cypriot Geological Survey Department and Dr. Polidorou Miltiadis, University of Cyprus

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

CYPRUS – TSUNAMI WAVES

Source: Paralimni Marine Station, Police Border Marine of Cyprus



A small fish boat sank near Ayia Triada beach

Sea withdrawal: sea level inside the marina was significantly lowered

Total bottom exposure

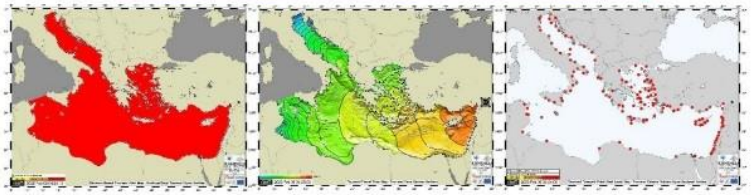
Colden Coast area, Paralimni

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

SEA LEVEL CHANGES AND TSUNAMI WAVES

DENIZ SEVIYESI OLCUM DEGERLERI:

ULKE	OLCUM NOKTASI	ENLEM	BOYLAM	VARIS ZAMANI	DALGA YUKSEKLIGI(M)	PERIYOT(DK)
TURKIYE	HATAY ISKENDERUN	36.4156	35.8852	0449TSI 06 SUB	00.12	11.0
TURKIYE	MERSIN ERDEMLI	36.5637	34.2554	0510TSI 06 SUB	00.13	06.0
KKTC	GAZIMAGUSA	35.1232	33.9495	0522TSI 06 SUB	00.17	12.0



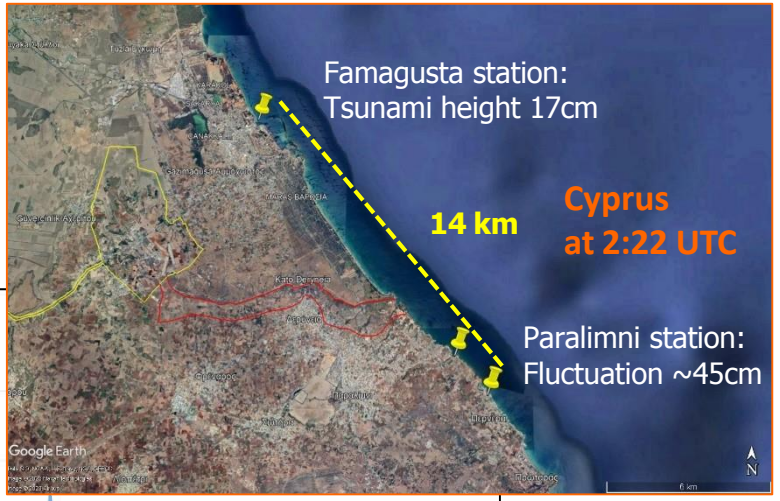
Source: Kandilli Observatory and Earthquake Research Institute (http://www.koeri.boun.edu.tr/)

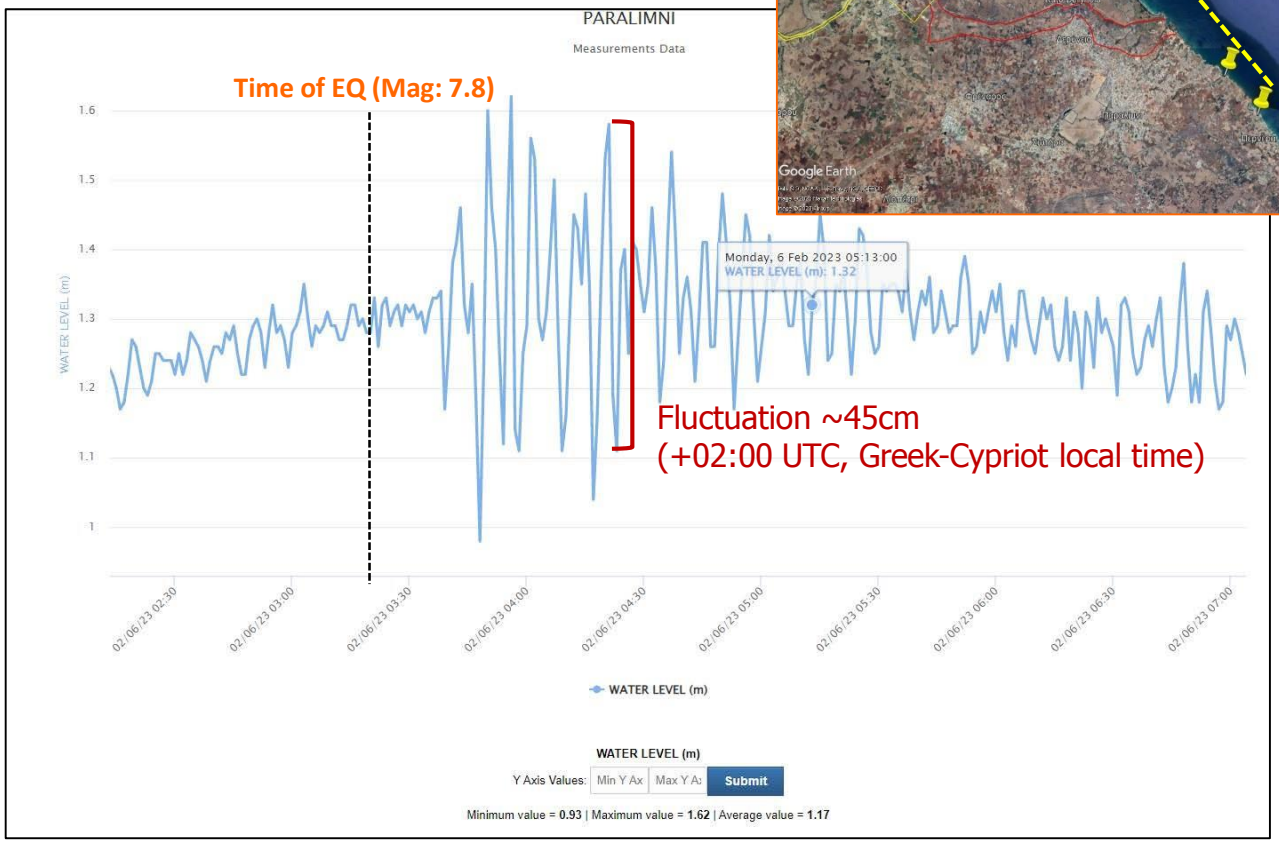
The Kandilli Institute reported sea lever rise of **17 cm** in Famagusta station at 5:22 (+03:00 UTC, local time). This local time is for the Turkey- Cypriot area, but for the Greek-Cypriot area is 4:22 (+02:00 UTC, local time).

Karaman
Kilis Kilis
Dipkarpaz Ριζοκάρπασο
Yeni Erenköy Γιαλούσα
Girne Κερύνεια
Λευκωσία
Έγκωμη
Πόλη Χρυσοχούς
Κύπρος
Gazimağusa Αμμόχωστος
Αγ. Νάπα
Πάφος
Πέγεια
Λάρνακα
Λεμεσός
Λατάκια
Λευκάς Βαλανέαι
Masyaf
Ταρτούς
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
100 km
N

EARTHQUAKE ENVIRONMENTAL EFFECTS ON COASTAL ZONE

CYPRUS – TSUNAMI WAVES





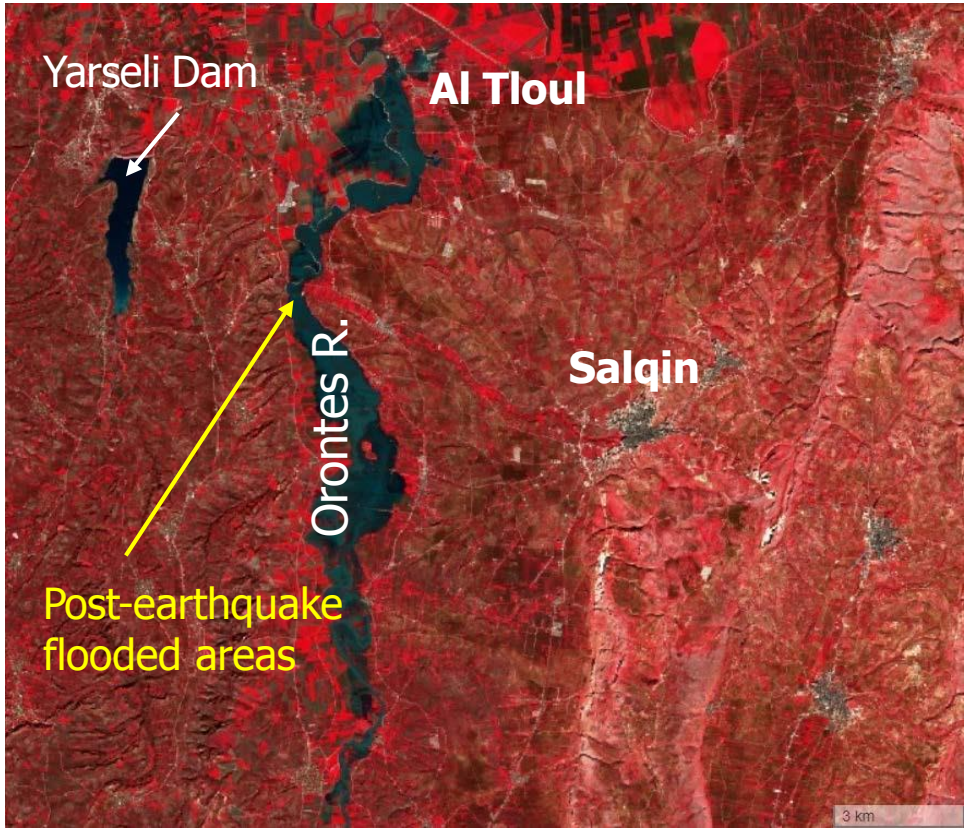
EARTHQUAKE IMPACT ON PORT INFRASTRUCTURE
FIRE AT ISKENDERUN (ALEXANDRETTA) PORT

Coastal facilities at Iskenderun (Alexandretta) port collapsed and a big fire was started from the container storage area. All activities in the port were disrupted for four days.

EARTHQUAKE IMPACT ON DAM INFRASTRUCTURE

FLOOD ATTRIBUTED TO LOCAL DAM FAILS IN TURKEY – SYRIA BORDERS

Flood of Orontes River (Al Assi) in the Syrian-Türkyie border



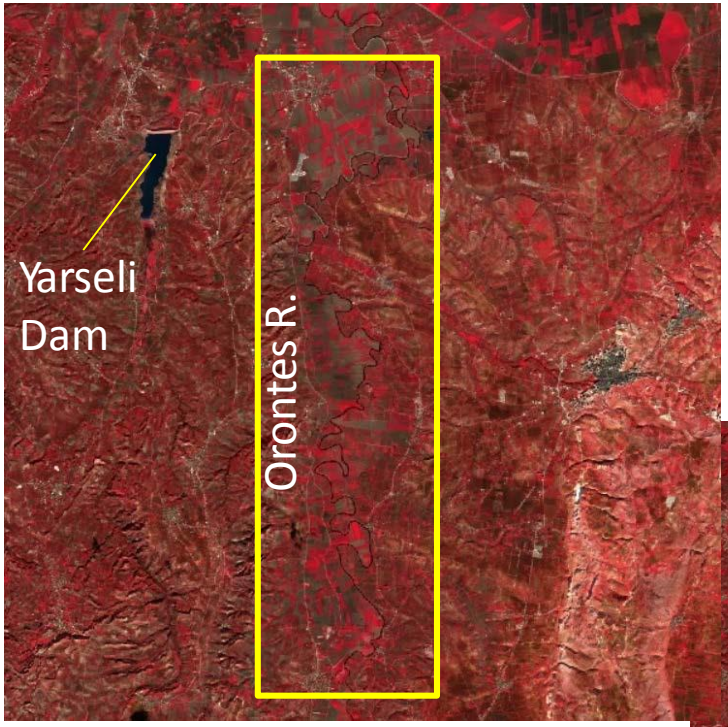
Map illustrating satellite-detected floodwaters along the Orontes (Al Assi) River on the Syria-Türkyie border close to the Al Tloul and Jakara towns. Sentinel-2 imagery acquired on 9 February 2023 show the floodplain of Orontes R. flooded after the earthquake. Within the analyzed area of 210 km^2 about 18 km^2 appears to be flooded. The floods were triggered by the opening of local dams and the damage induced to certain water-related infrastructures along the river by the the earthquake. The flood event led to the displacements of people from the village of Al-Tloul (Salqin Nahiyah Subdistrict, Harem District, Idlib Governorate) to nearby camps as several houses have been submerged by water, leading to 7,000 evacuated people and 1,000 flooded houses across the nearby villages of Hardana, Delbiya, Jakara, and Hamziyeh.

Sentinel-2 imagery - 9 February 2023

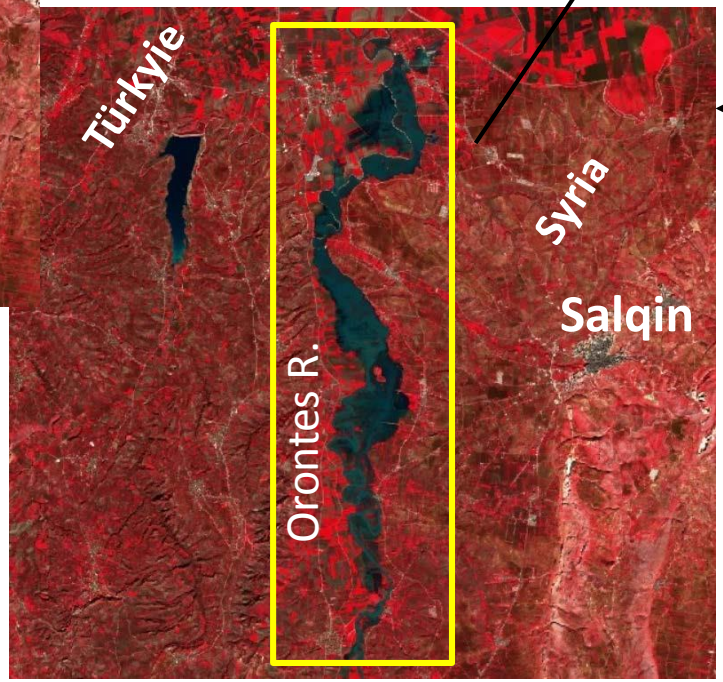
Source: ECHO (2023) Syria - Dam break and floods, ECHO Daily Flash of 14 February 2023.

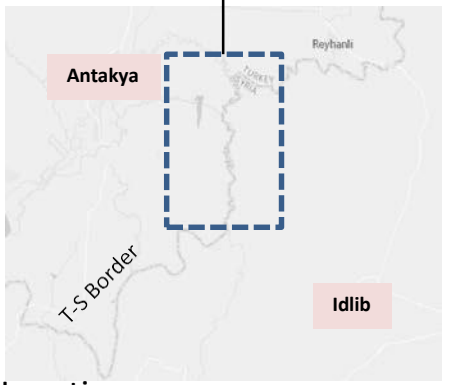
EARTHQUAKE IMPACT ON DAM INFRASTRUCTURE

FLOOD ATTRIBUTED TO LOCAL DAM FAILS IN TURKEY – SYRIA BORDERS



Sentinel-2 imagery - 9 Feb 2023

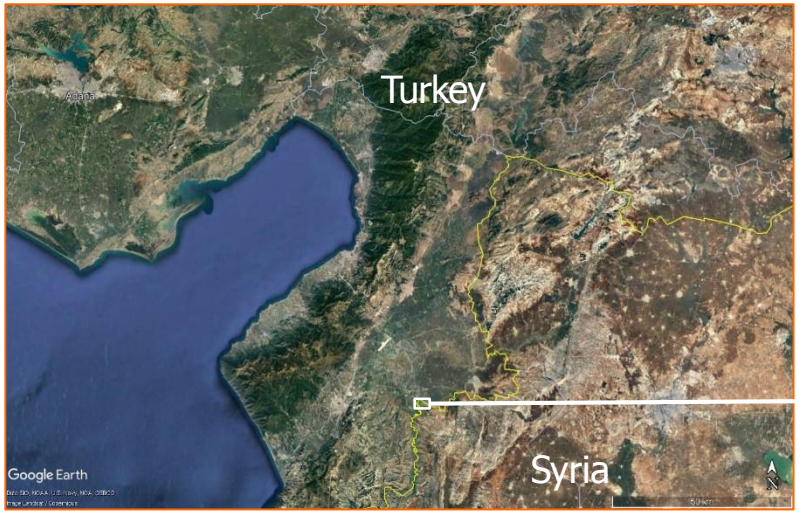


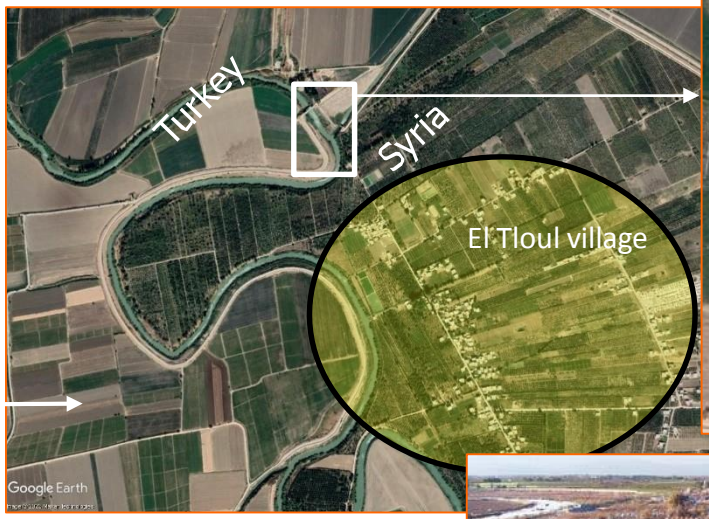


Location map

EARTHQUAKE IMPACT ON DAM INFRASTRUCTURE

FLOOD ATTRIBUTED TO LOCAL DAM FAILS IN TURKEY – SYRIA BORDERS





Flooding in the Syrian village of Al-Tloul,
after a dam collapsed following the deadly earthquake

EARTHQUAKE IMPACT ON ROAD INFRASTRUCTURE

HIGHWAY STATUS AFTER DAMAGE INDUCED BY RUPTIURES, LANDSLIDES AND LIQUEFACTION PHENOMENA

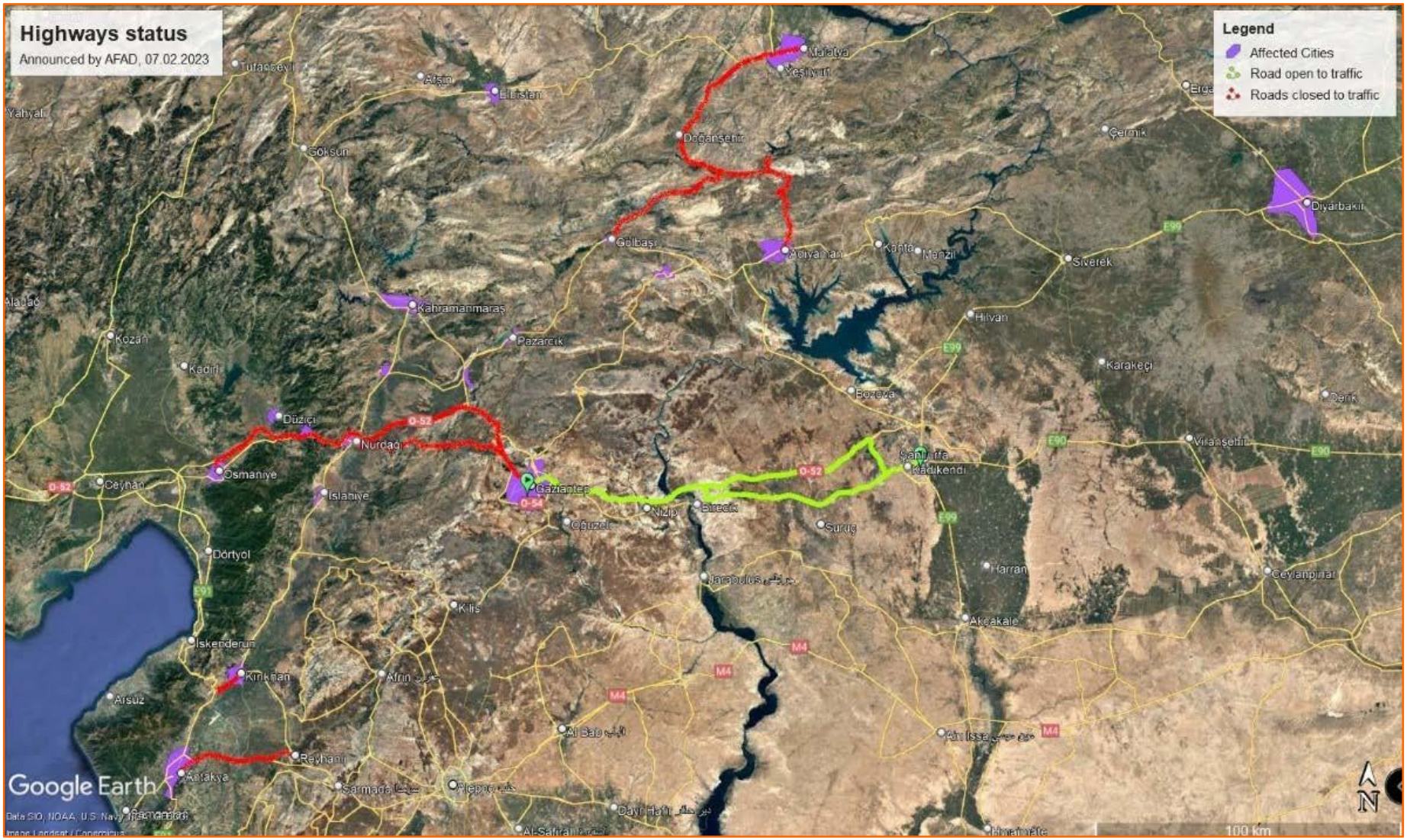
The earthquake caused primary effects comprising surface ruptures and secondary effects such as landslides comprising rockfalls and slides along the ruptures and steep slopes, liquefaction phenomena, hydrological anomalies and tsunami. As shown in previous sections, several segments of the networks and infrastructures were affected. The road network were heavily affected resulting in either temporary or permanent traffic disruption. Based on the Press Bulletin of AFAD on the day following the earthquake (https://en.afad.gov.tr/press-bulletin-about-the-earthquake-in-kahramanmaras---9), the highway status in the earthquake-affected area was as follows:

- Adıyaman - Çelikhan road route is closed to traffic.
- Balıkburnu Bridge at Adıyaman-Çelikhan-Sürgü route was demolished.
- Şanlıurfa-Gaziantep road is open to traffic.
- The Osmaniye - Gaziantep direction is completely closed to traffic.
- The Hatay - Reyhanlı public road is completely closed to traffic.
- Hatay Kırıkhan - Topboğaz road is closed to traffic.
- Adıyaman Gölbaşı - Malatya route is closed to traffic due to landslide and concrete fall in the tunnel.

A map with the highway status on 7 February follows.

EARTHQUAKE IMPACT ON ROAD INFRASTRUCTURE

HIGHWAY STATUS AFTER DAMAGE INDUCED BY RUPTIURES, LANDSLIDES AND LIQUEFACTION PHENOMENA

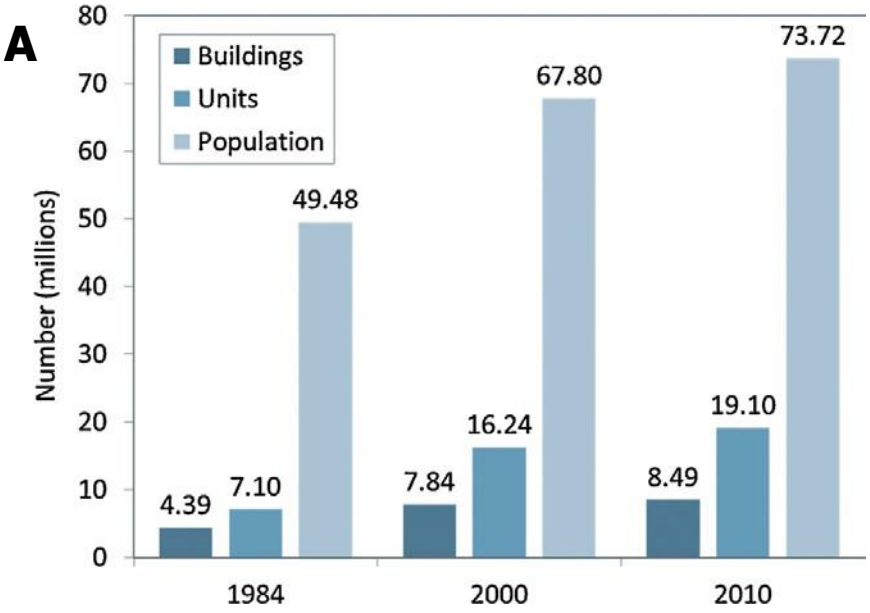


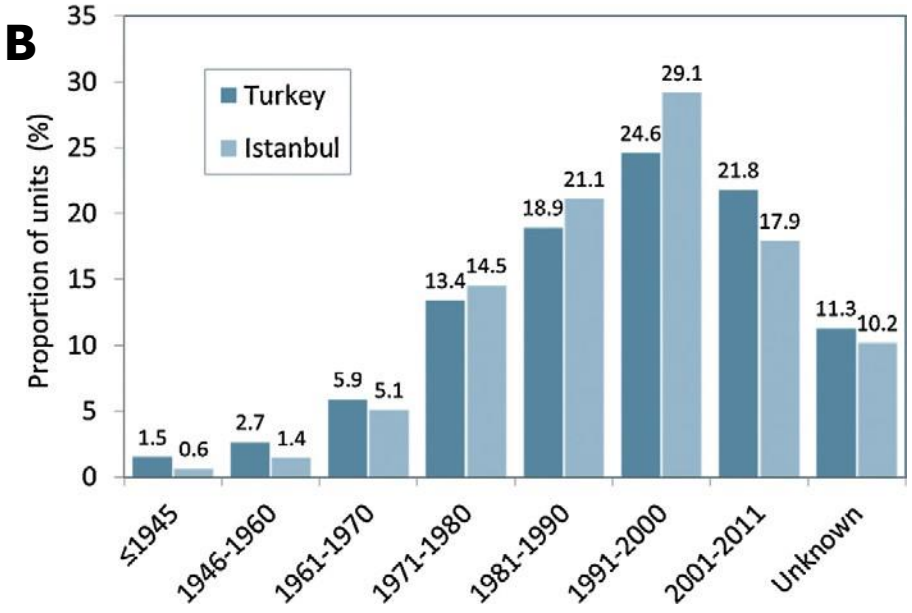
EARTHQUAKE IMPACT ON RAILWAY INFRASTRUCTURE

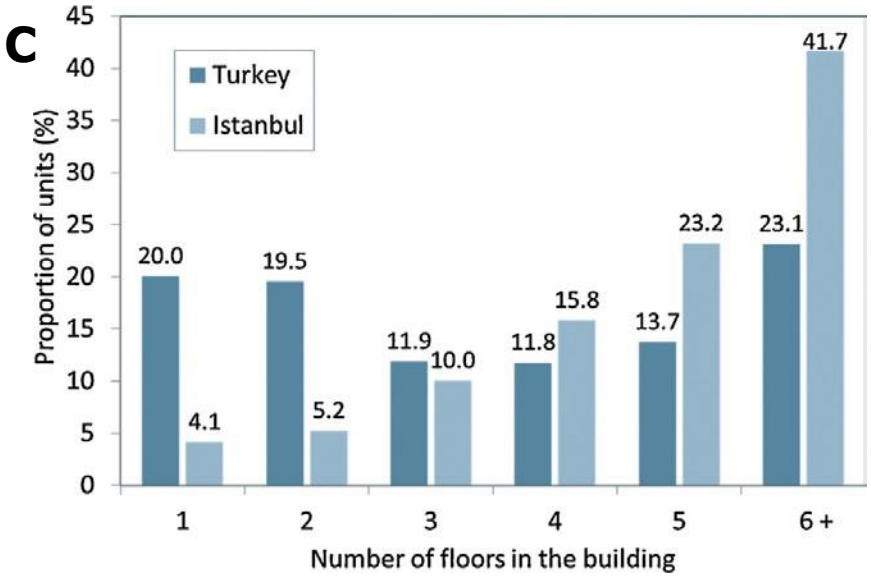
DEFORMATION OF RAILWAY TRACKS BY SURFACE RUPTURES

Railway tracks were heavily deformed due to the surface ruptures. They were restored few days after the occurence of the earthquake.

RESIDENTIAL BUILDINGS IN TURKEY







(**A**) Total number of buildings and occupancy units in Turkey

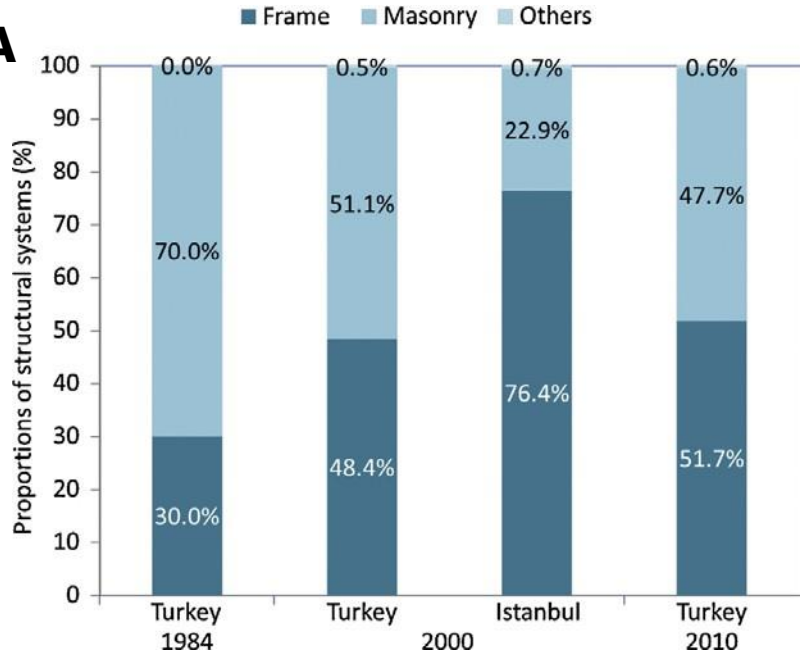
(B)Proportions of occupancy units by the construction year of buildings in Istanbul and Turkey

(C)Distribution of occupancy units by the number of floors in the building in Istanbul and Turkey

Sources: Gunes (2015) and the Turkish Statistical Institute (TUIK)

DOMINANT TYPES OF RESIDENTIAL BUILDINGS IN TURKEY

A



(A)Distribution of buildings in Istanbul and Turkey by their structural system: frame, masonry, other type.

(B)Representative examples of buildings based on their construction period. Four generations are presented: 1960s, 1970s, 1980s, 1990s and later.

Sources: Gunes (2015) and the Turkish Statistical Institute (TUIK)

B

1st generation buildings (1960s)

2nd generation buildings (1970s)

3rd generation buildings (1980s)

4th generation buildings (90s and later)

DAMAGE TO SECONDARY STRUCTURAL ELEMENTS WITH PARTIAL COLLAPSING

The load-bearing system of many buildings' has not suffered significant damage, in contrast to the external infill masonry, as well as some (internal) partition walls, which have -in some cases- completely collapsed.

DAMAGE TO THE LOAD-BEARING SYSTEM WITHOUT TOTAL COLLAPSING

In several cases, although the structures have not completely collapsed, their load-bearing system has suffered significant damage that is considered beyond repair.

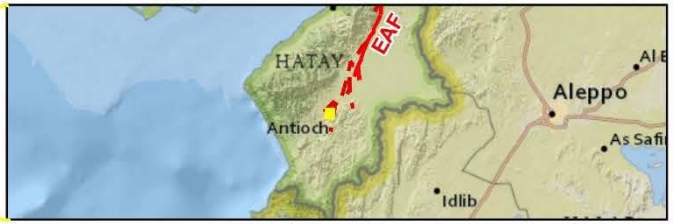
DAMAGE TO LOAD-BEARING SYSTEM WITH TOTAL COLLAPSING OF BUILDINGS

High-rise buildings have completely collapsed, while it is striking that the majority of collapses occurred within the outline of their floor plans. Inside these particular hills of rubble there are people trapped.

OTHER DAMAGE TO INDUSTRIAL BUILDINGS AND PLACES OF WORSHIP

Significant damage can be seen in industrial buildings, while in places of worship (mosques) damage of the same extent was not observed, except for the collapse of several minarets. Due to the time when the first seismic excitation occurred (04:17 local time), most of these spaces were vacant.

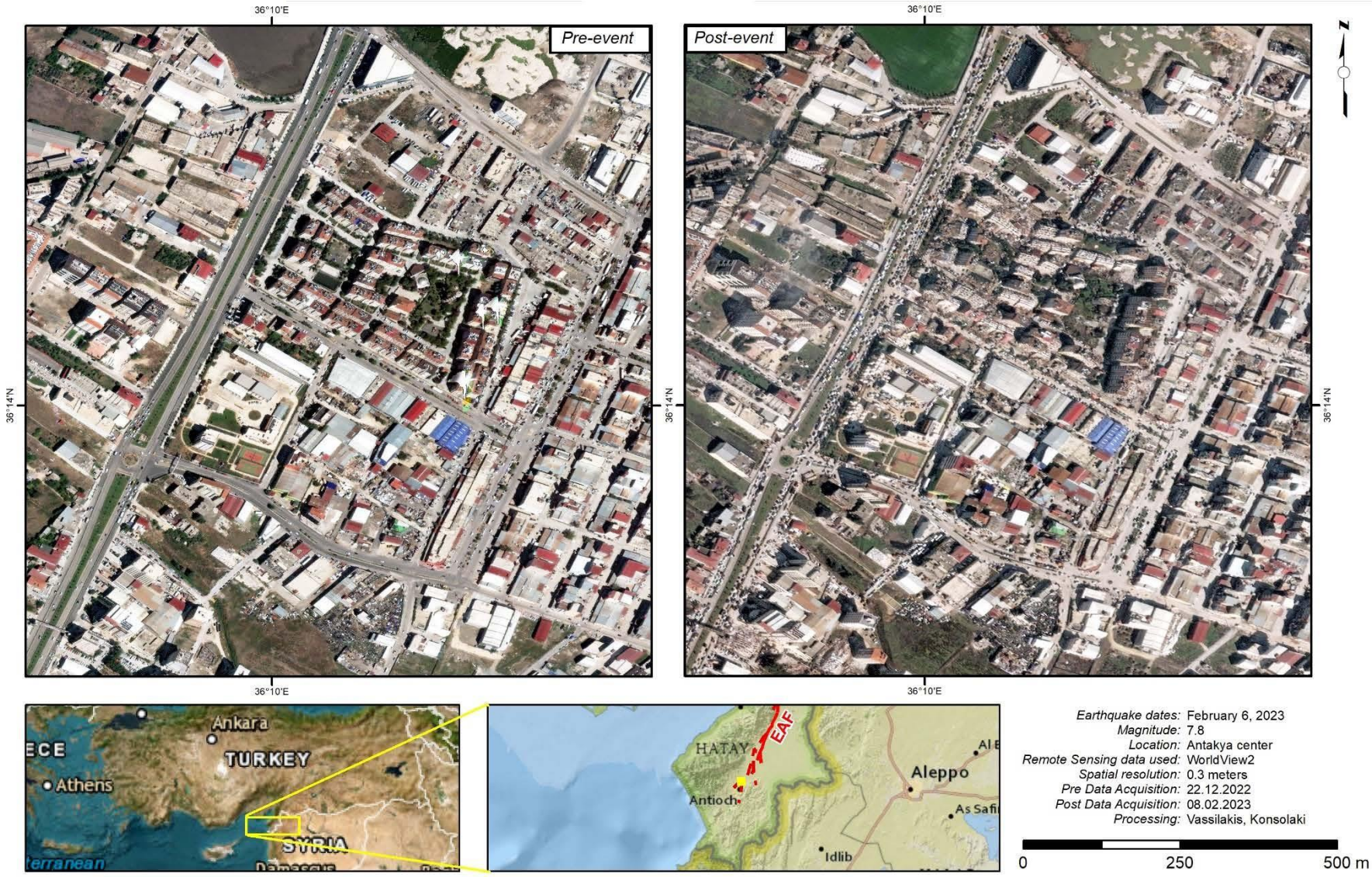
SPATIAL DISTRIBUTION OF THE EARTHQUAKE BUILDING DAMAGE BASED ON SATELLITE IMAGERY AND REMOTE SENSING – ANTAKYA (1)



Earthquake dates: February 6, 2023
Magnitude: 7.8
Location: Antakya center
Remote Sensing data used: WorldView2
Spatial resolution: 0.3 meters
Pre Data Acquisition: 22.12.2022
Post Data Acquisition: 08.02.2023
Processing: Vassilakis, Konsolaki

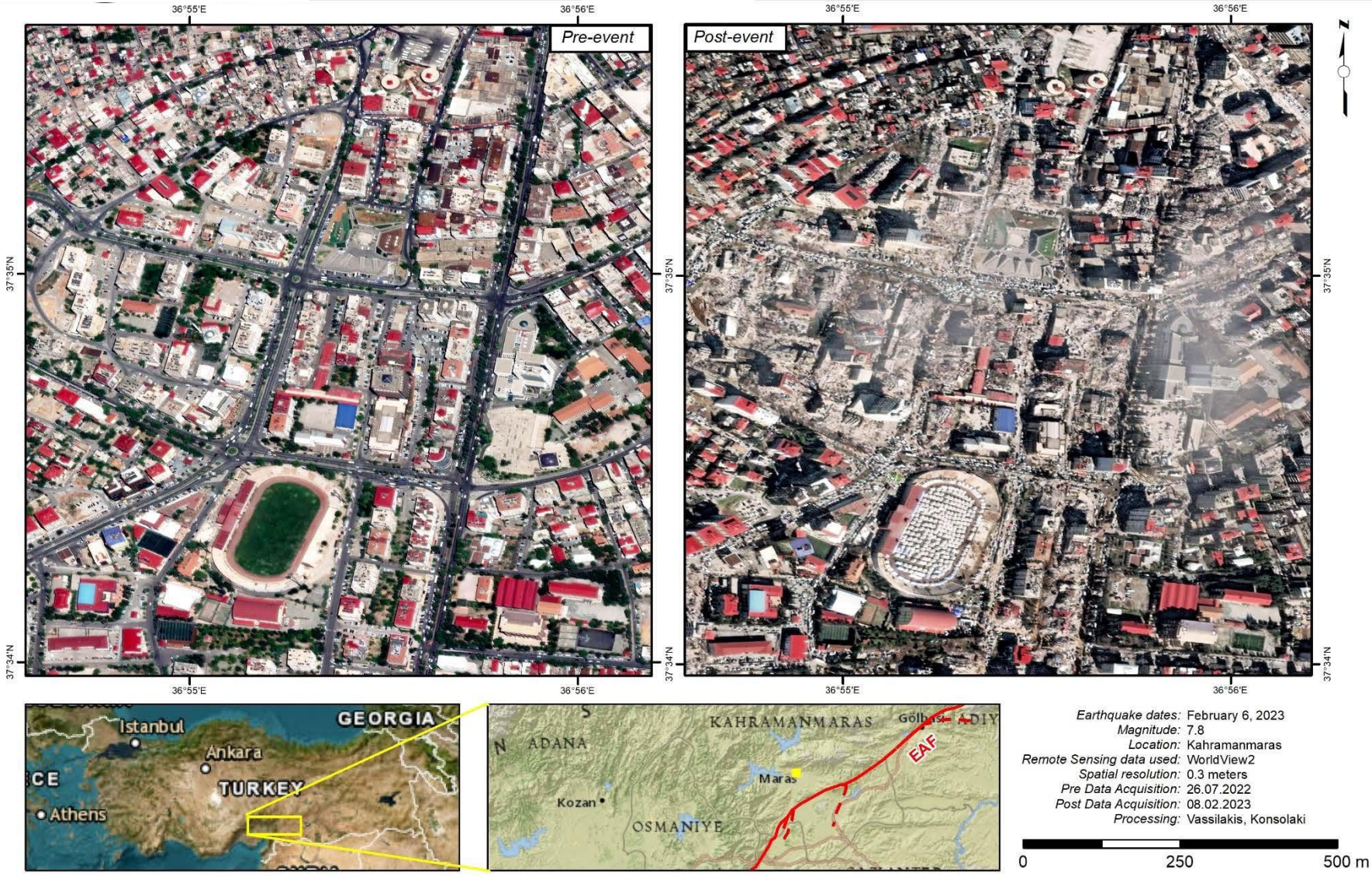
0 250 500 m

SPATIAL DISTRIBUTION OF THE EARTHQUAKE BUILDING DAMAGE BASED ON SATELLITE IMAGERY AND REMOTE SENSING – ANTAKYA (2)

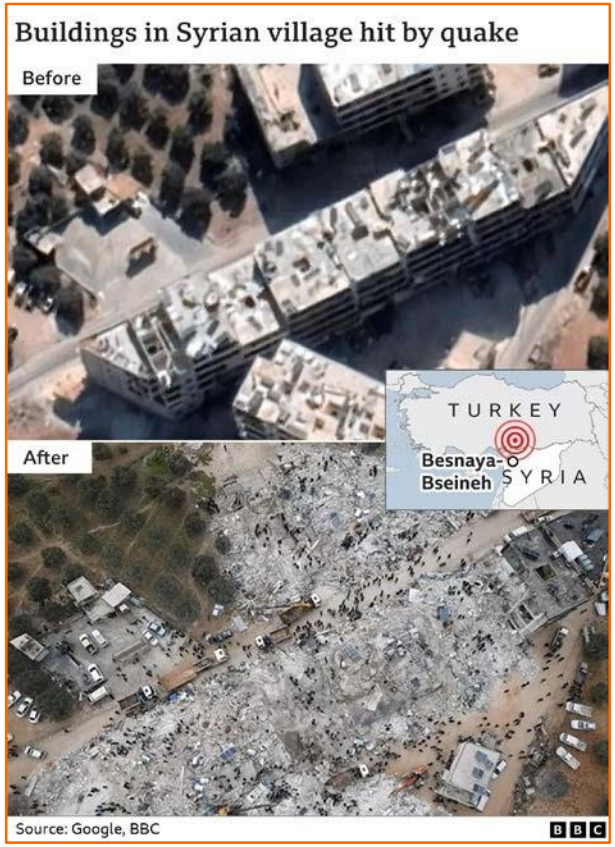


Earthquake dates: February 6, 2023
Magnitude: 7.8
Location: Antakya center
Remote Sensing data used: WorldView2
Spatial resolution: 0.3 meters
Pre Data Acquisition: 22.12.2022
Post Data Acquisition: 08.02.2023
Processing: Vassilakis, Konsolaki

SPATIAL DISTRIBUTION OF THE EARTHQUAKE BUILDING DAMAGE BASED ON SATELLITE IMAGERY AND REMOTE SENSING – KAHRAMANMARAŞ



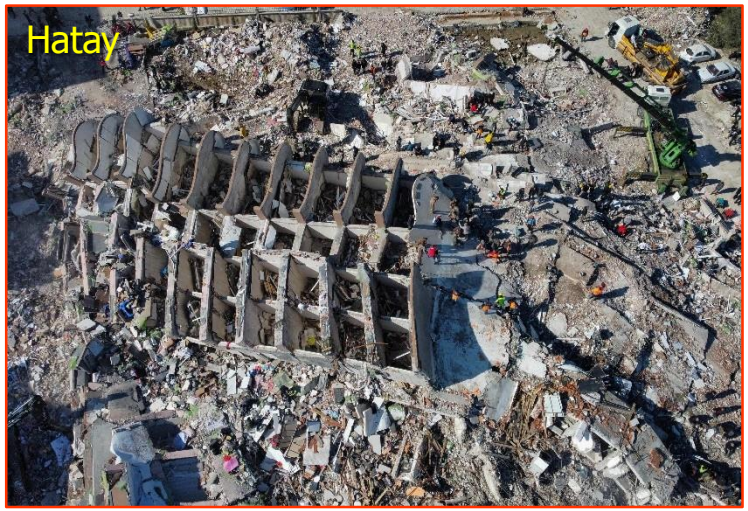
EARTHQUAKE BUILDING DAMAGE
BEFORE AND AFTER THE 6 FEBRYARY DISASTER



All types of structures were affected by the 6 February 2023 earthquakes in Turkey and Syria. Residential buildings and monumental buildings including mosques suffered very heavy structural damage including total collapse. Source: https://www.bbc.com/news/world-europe-64544998

EARTHQUAKE BUILDING DAMAGE

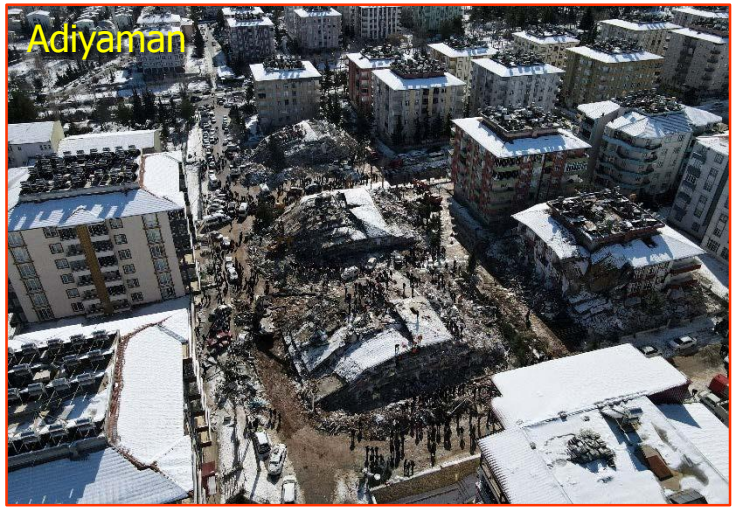
RESIDENTIAL AREAS IN TURKEY RAZED TO THE GROUND



Source: https://english.elpais.com/international/2023-02-09/gallery-aerial-images-reveal-scale-of-earthquake-devastation-in-turkey-and-syria.html#foto_gal_2

EARTHQUAKE BUILDING DAMAGE

RESIDENTIAL AREAS IN TURKEY RAZED TO THE GROUND



Source: https://english.elpais.com/international/2023-02-09/gallery-aerial-images-reveal-scale-of-earthquake-devastation-in-turkey-and-syria.html#foto_gal_2

EARTHQUAKE BUILDING DAMAGE
RESIDENTIAL AREAS IN TURKEY RAZED TO THE GROUND

Source: https://www.theatlantic.com/photo/2023/02/turkey-syria-earthquake-photos/672958/

EARTHQUAKE BUILDING DAMAGE

RESIDENTIAL AREAS IN TURKEY AND SYRIA RAZED TO THE GROUND

Source: https://english.elpais.com/international/2023-02-09/gallery-aerial-images-reveal-scale-of-earthquake-devastation-in-turkey-and-syria.html#foto_gal_2

EARTHQUAKE BUILDING DAMAGE
RESIDENTIAL AREAS IN SYRIA RAZED TO THE GROUND

Sources: https://edition.cnn.com/2023/02/11/middleeast/turkey-syria-earthquake-recovery-intl/index.html
https://www.theatlantic.com/photo/2023/02/turkey-syria-earthquake-photos/672958/

EXCEPTIONS TO THE RULE

NOT AFFECTED BUILDINGS AND CITY IN THE EARTHQUAKE-AFFECTED AREA

▲ In both devastating earthquakes, Elbistan State Hospital in the epicenter district of the second major quake, Hatay Dörtyol State Hospital, Malatya Battalgazi State Hospital and Maternity and Children's Hospital in Malatya did not suffer even the slightest damage. This fact is attributed to the seismic isolation devices placed in their columns
Source: ttps://www.hurriyetdailynews.com/seismic-isolation-devices-prevent-damage-in-four-hospitals-180830

▲ No buildings were destroyed in Hatay's Erzin district during the devastating earthquakes that jolted the southern provinces, with the mayor announcing that there are no casualties in the district as he has not allowed illegal construction.
Source: https://www.hurriyetdailynews.com/district-suffers-no-loss-in-devastating-quakes-180815

EARTHQUAKE IMPACT ON COMMUNICATION NETWORKS AND RECOVERY MEASURES

Earthquakes have disrupted communications and electricity supplies in affected areas.

Field and energy cuts occurred in mobile communication in the provinces of Kahramanmaraş, Hatay, Gaziantep, Adana, Osmaniye and Adıyaman.

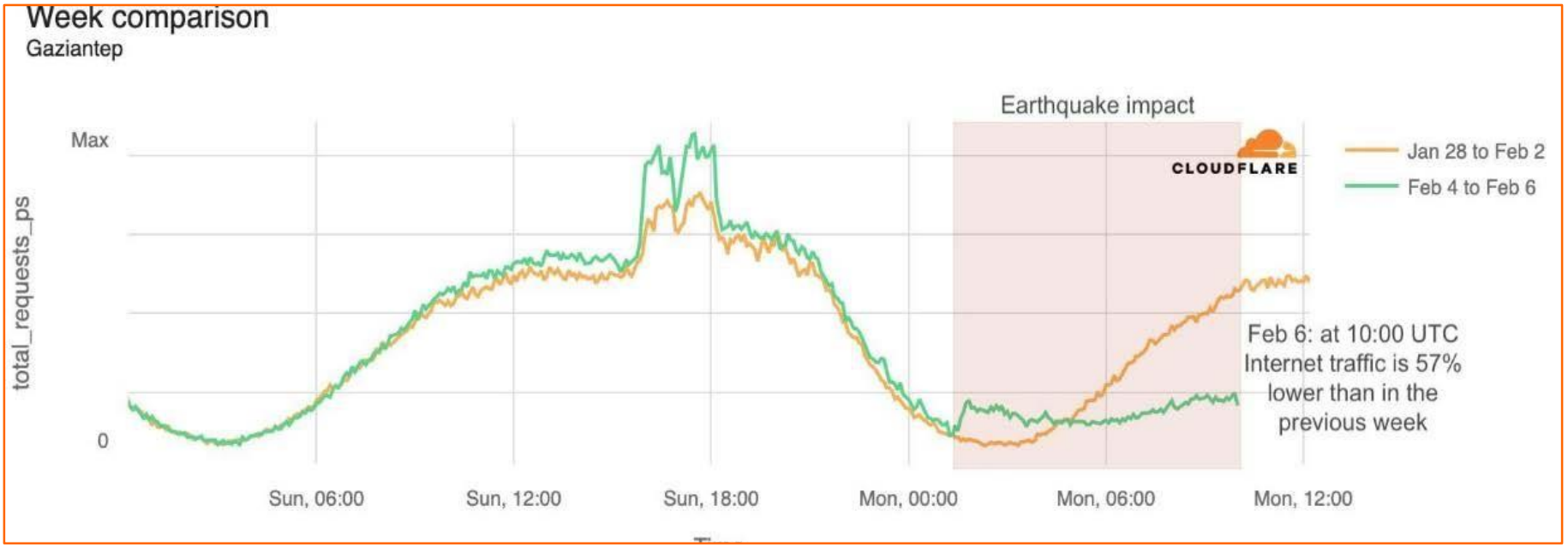
Mobile base stations and generators and teams were dispatched to earthquake zones.

Works have been initiated by the operators to open the lines that were closed due to bills and debt for our citizens who may have urgent needs in communication services in the region.

80 satellite VSAT communication terminals were dispatched to the region.

Source: https://en.afad.gov.tr/press-bulletin--5-about-the-earthquake-in-kahramanmaras-pazarcik

EARTHQUAKE IMPACT ON INTERNET TRAFFIC



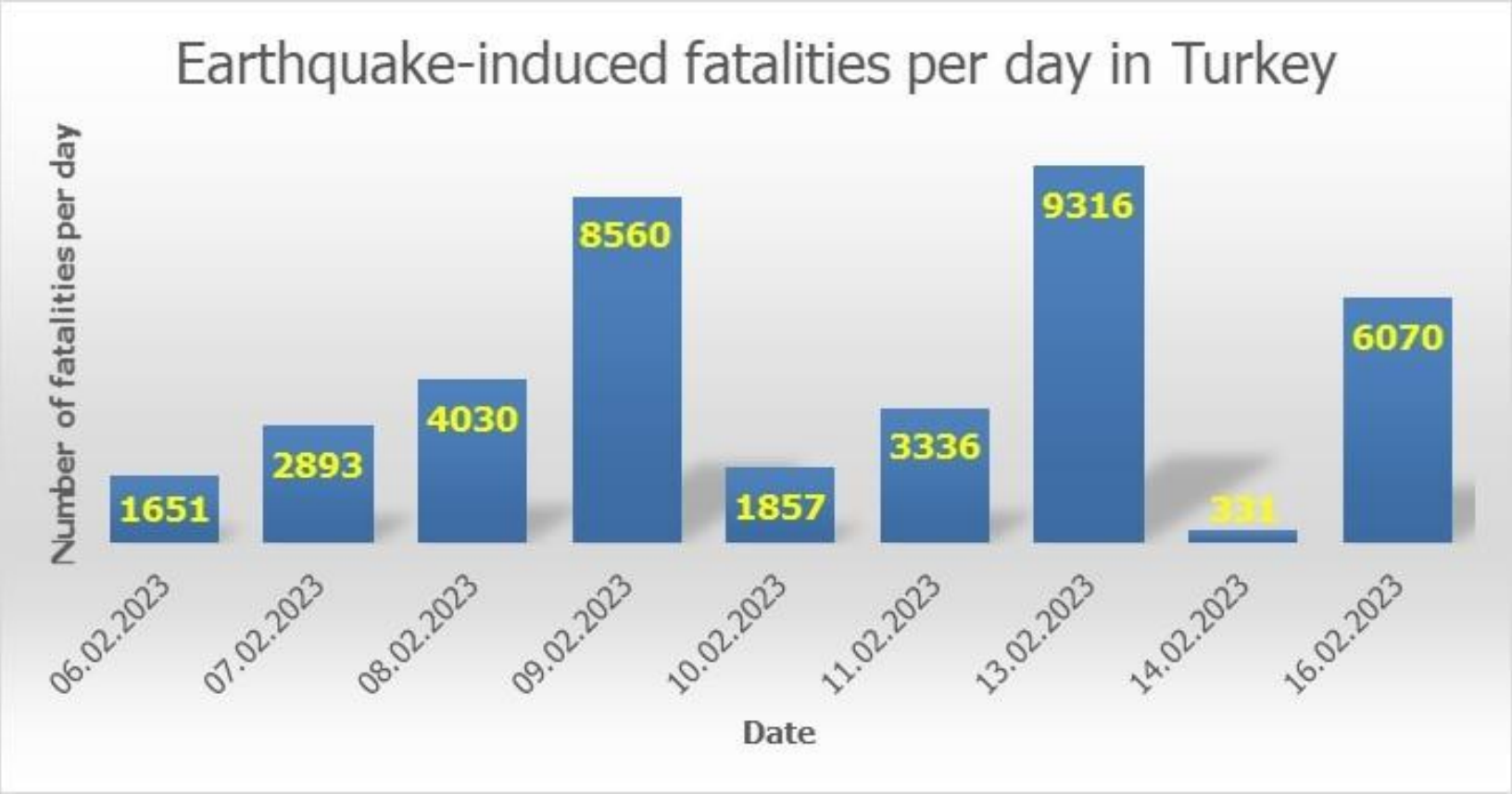
Internet traffic tracker Cloudflare Radar found that compared to the same time in the previous week traffic was decreased by:

- 57% in the city of Gaziantep and
- 94% in the Kahramanmaraş Province.

Traffic drops are also visible in the provinces of Şanlıurfa, Kilis, Hatay, Osmaniye, Adiyaman, Diyarbakır, Malatya, Mardin, and Adana.

Source:
https://www.datacenterdynamics.com/en/news/turkish-internet-disrupted-by-devastating-earthquakes-telcos-deploy-mobile-base-stations/

HUMAN LOSSES
DUE TO THE 6 FEBRUARY 2023 EARTHQUAKE DISASTER



Data from AFAD Press Bulletins from 6 to 16 February 2023 available online in AFAD site (https://en.afad.gov.tr/). Total fatalities: 38,044 people.

EARTHQUAKE IMPACT IN NUMBERS
10 DAYS AFTER THE 6 FEBRUARY 2023 EARTHQUAKE DISASTER

4734	Aftershocks
264,389	Search and Rescue workers and Volunteers
11,488	Assistant teams from third countries deployed to the affected areas
12,600	Vehicles deployed to the affected areas
26	Ships delivered personnel and materials
33,908,749	Units of hot meal distributed
20,722,136	Liters of water distributed
386,874	Medical tents sent to provinces
172,265	AFAD tents installed
498,225	People received psychosocial support

Source: AFAD, Press Bulletin 32 as of 16 February 2023
https://en.afad.gov.tr/press-bulletin-32-about-the-earthquake-in-kahramanmaras

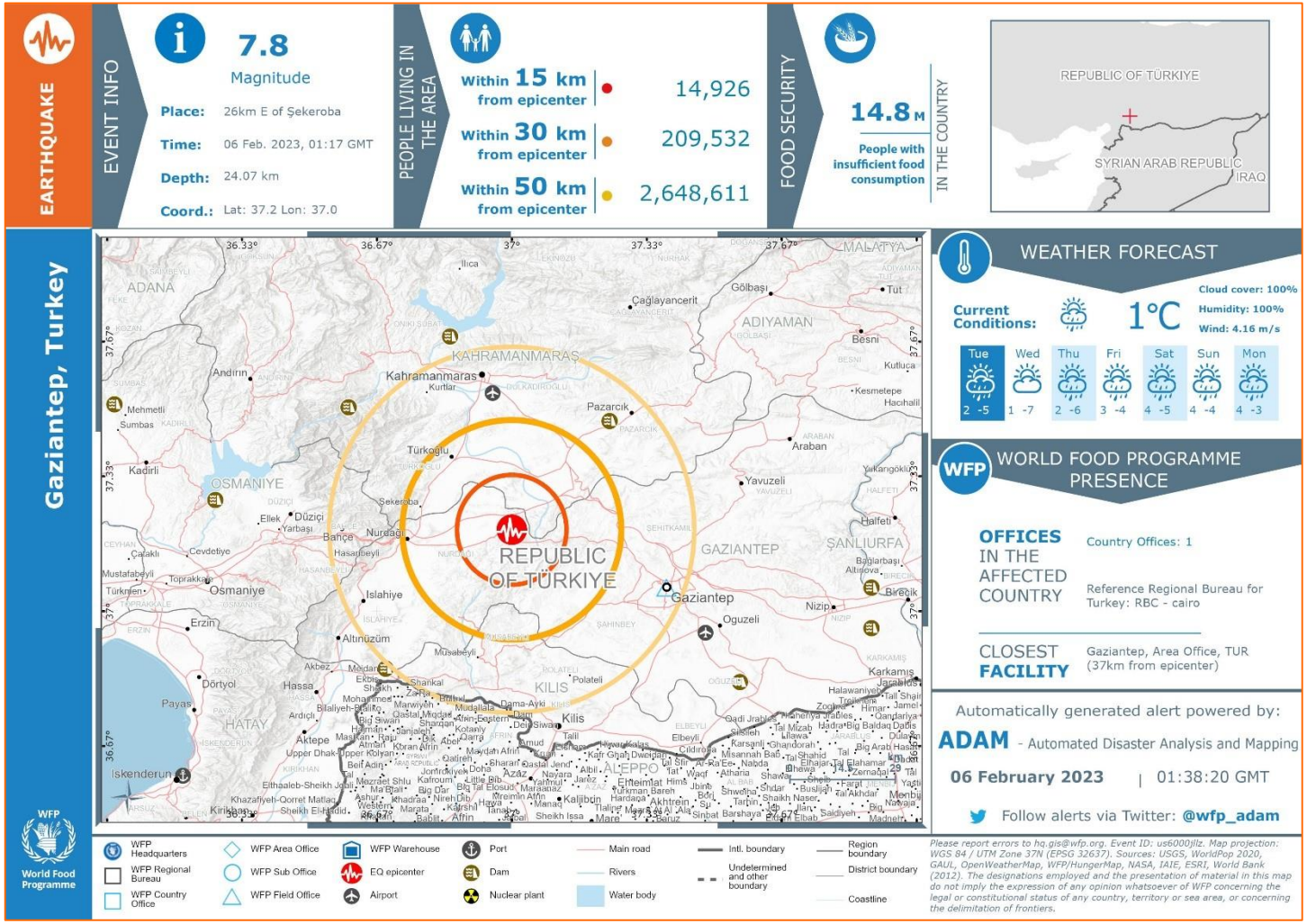
EARTHQUAKE IMPACT IN NUMBERS

13 DAYS AFTER THE 6 FEBRUARY 2023 EARTHQUAKE DISASTER

		Source
41,156	Fatalities in Turkey (20.02.2023)	
5814	Fatalities in Syria (20.02.2023)	
at least **171,843**	People displaced in NW Syria	
430,000	People evacuated affected zone in Turkey (18.02.2023)	
23,000,000	People affected (WHO)	
105,000	Buildings (out of 830,806 assessed) to be demolished/heavily damaged in Turkey (18.02.2023)	
264,000	Apartments destroyed in Turkey (18.02.2023)	
294,165	Illegal buildings in the earthquake zone regularized after 2018 in Turkey	
296	Hours after the earthquake survivor rescued	
at least **105**	Countries pledged support for victims of the earthquake, including humanitarian aid	
at least **88**	Countries provided S&R units to Turkey	

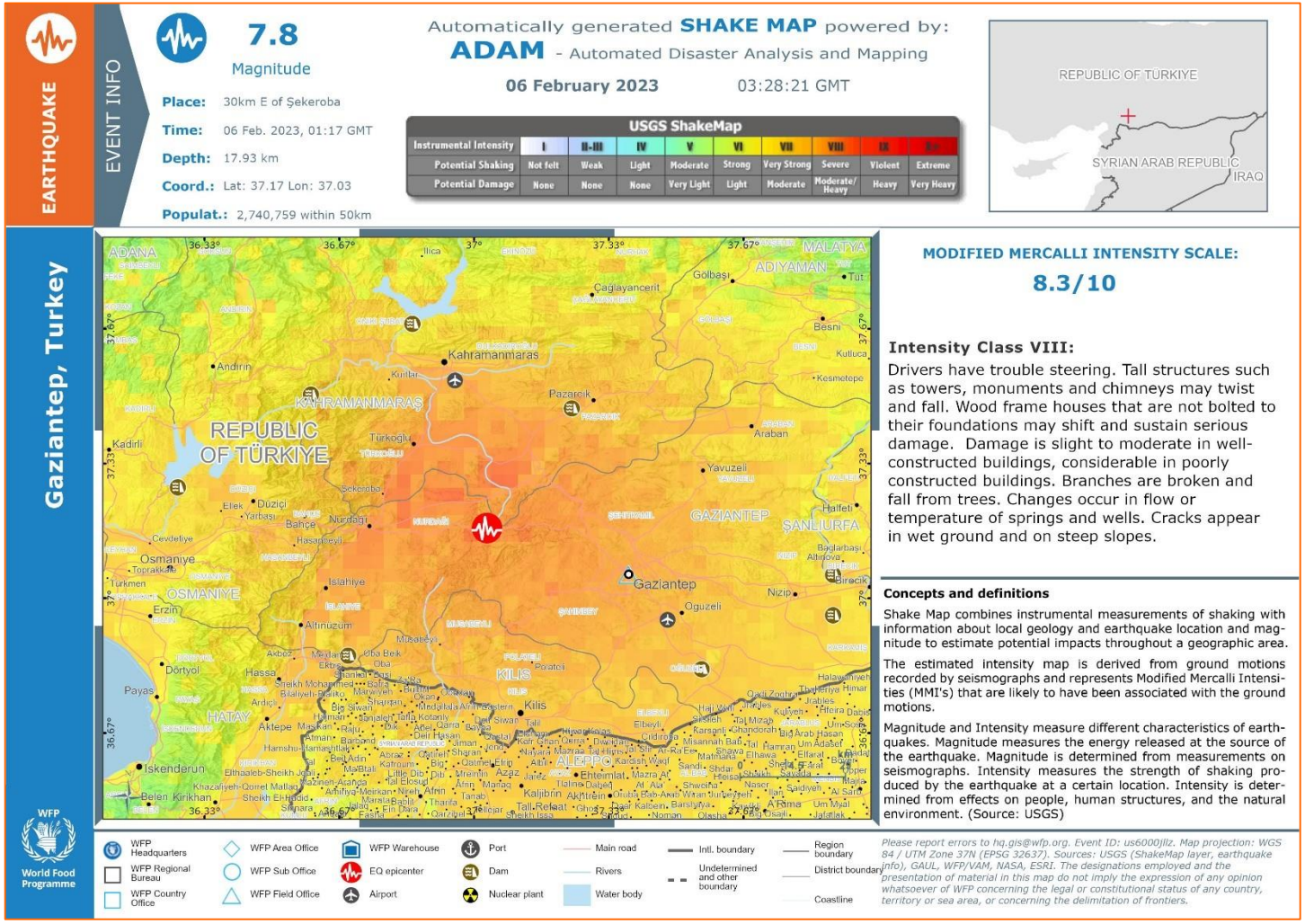
Sources: trtworld.com, reuters.com, dw.com, wikipedia.org

AUTOMATICALLY GENERATED DISASTER ALERT FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE



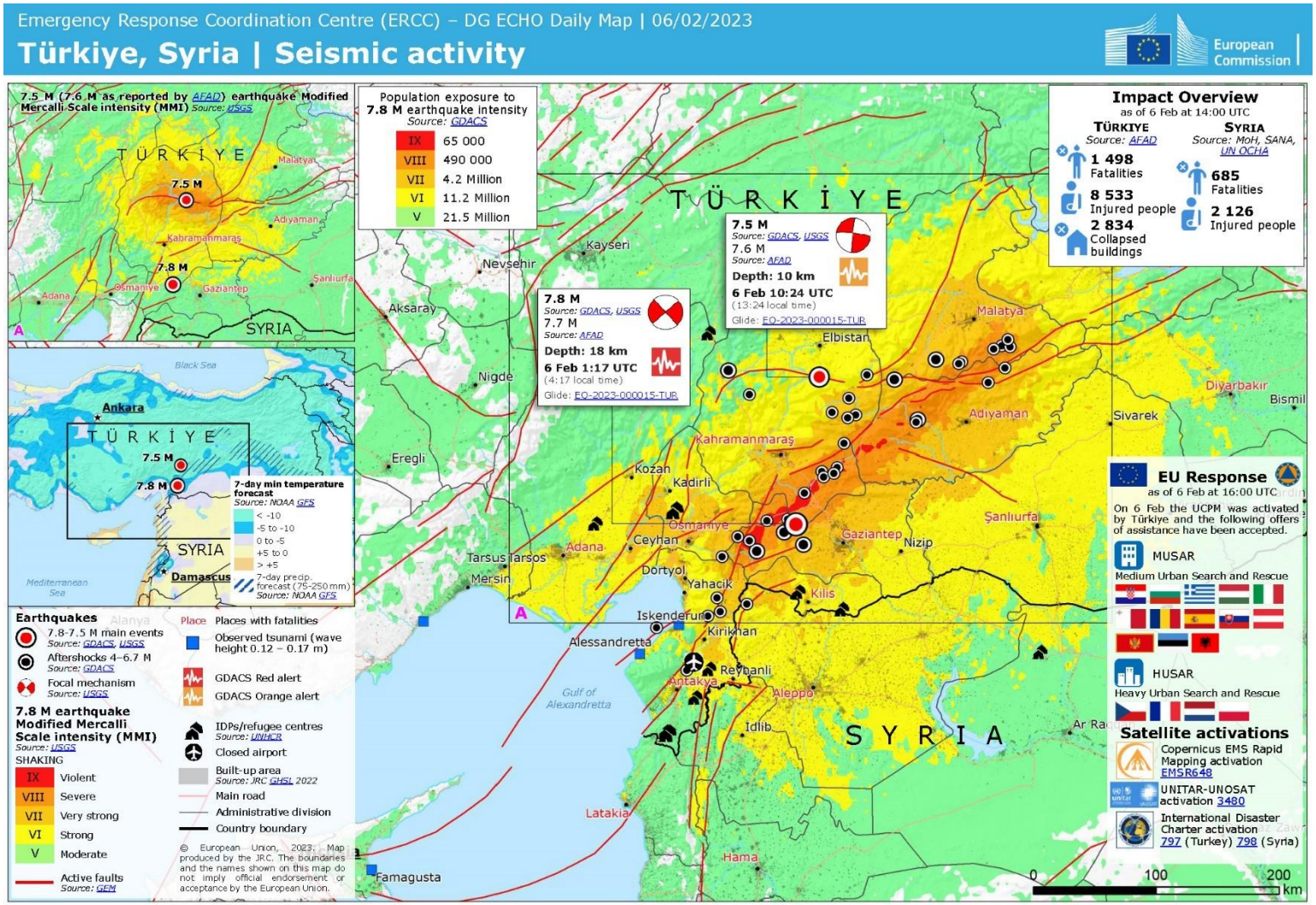
Automatic Disaster Analysis and Mapping (ADAM) Disaster Alerts
https://twitter.com/WFP_ADAM/status/1622410463328747520/photo/1

AUTOMATICALLY GENERATED SHAKE MAP FOR THE 6 FEBRUARY 2023 Mw=7.8 EARTHQUAKE



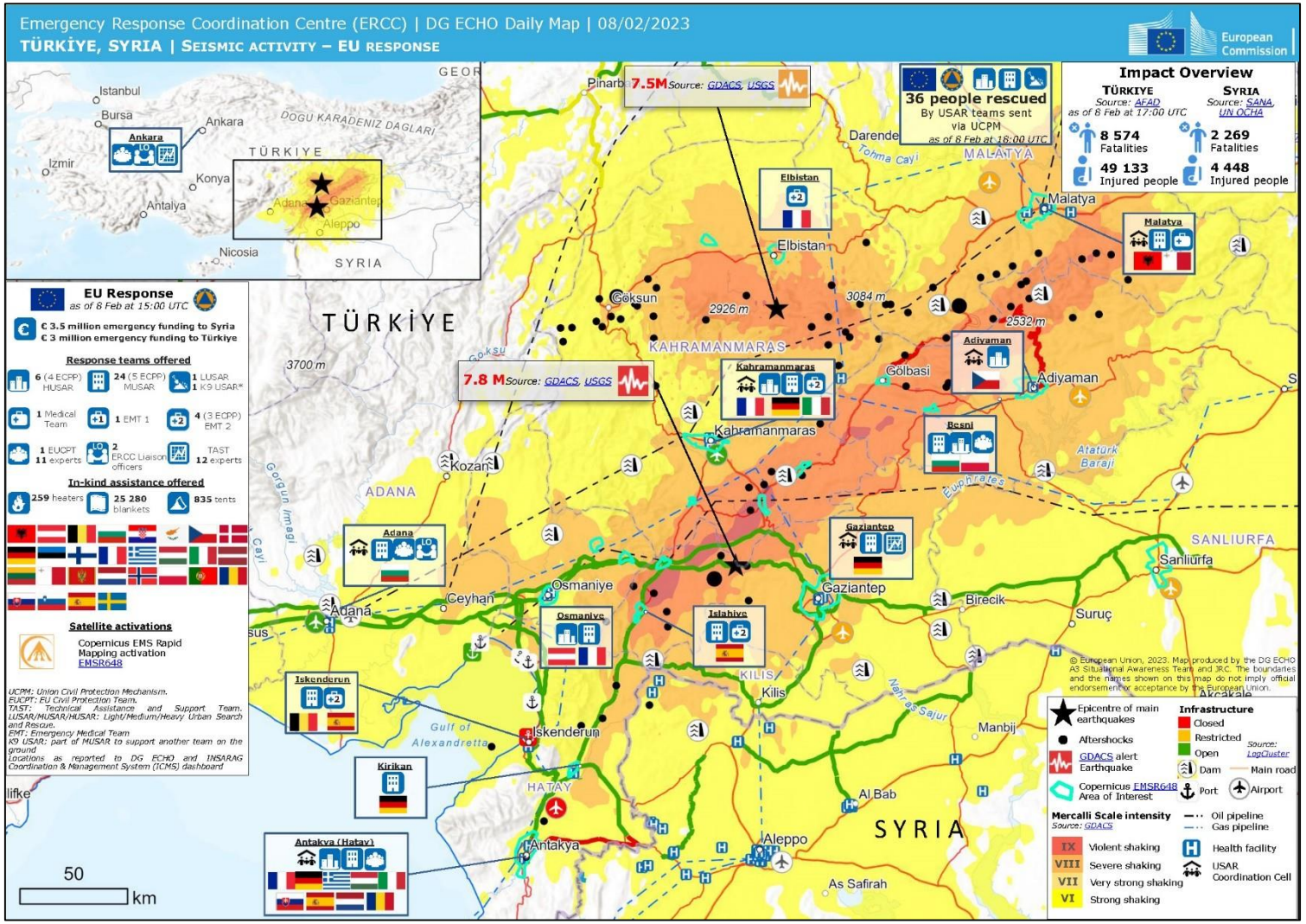
Automatic Disaster Analysis and Mapping (ADAM) Disaster Alerts
https://twitter.com/WFP_ADAM/status/1220804828819009537/photo/1

EMERGENCY RESPONSE COORDINATION CENTER - DG ECHO DAILY MAP ON 6 FEBRUARY 2023



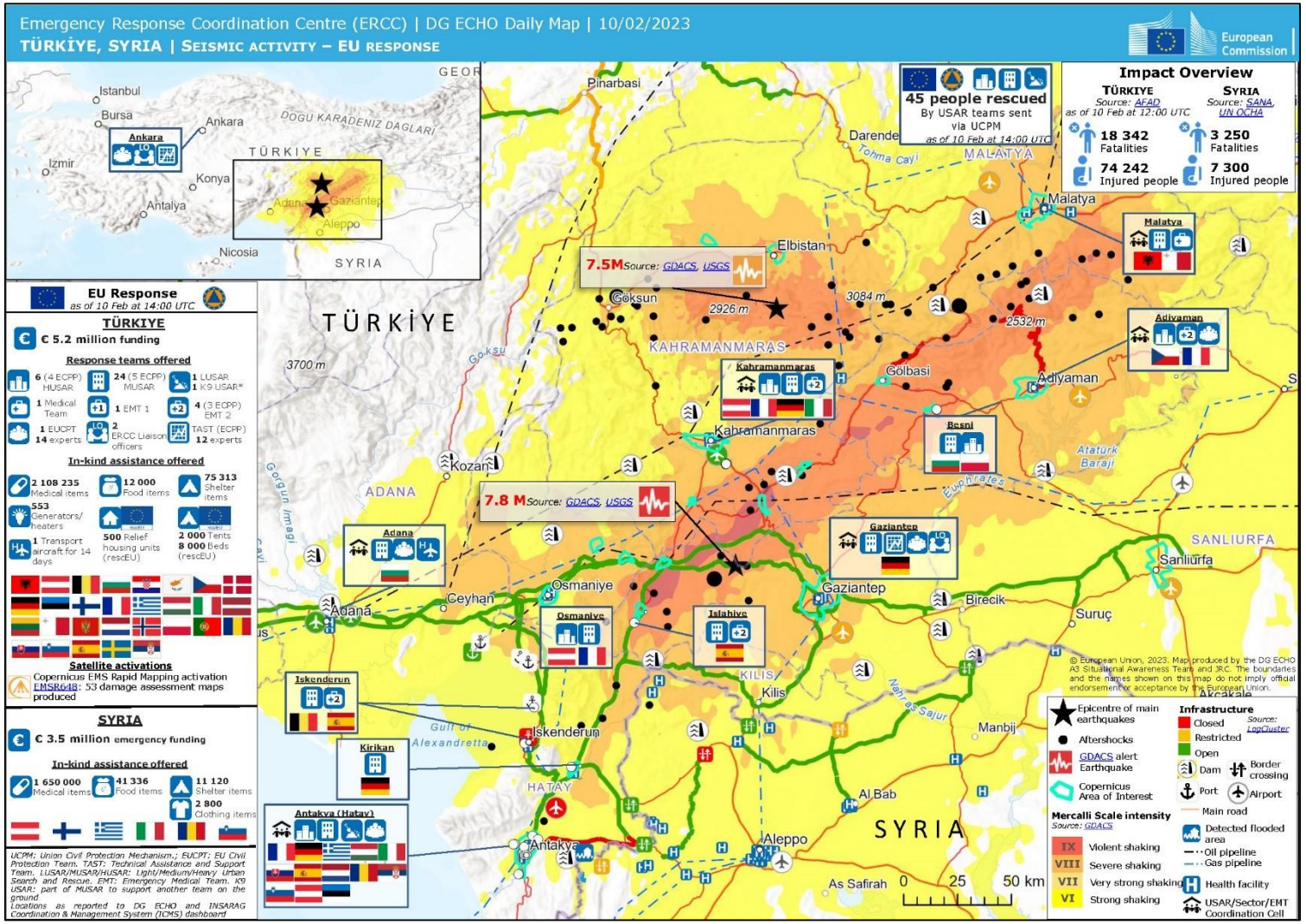
https://erccportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/4393

EMERGENCY RESPONSE COORDINATION CENTER - DG ECHO DAILY MAP ON 8 FEBRUARY 2023



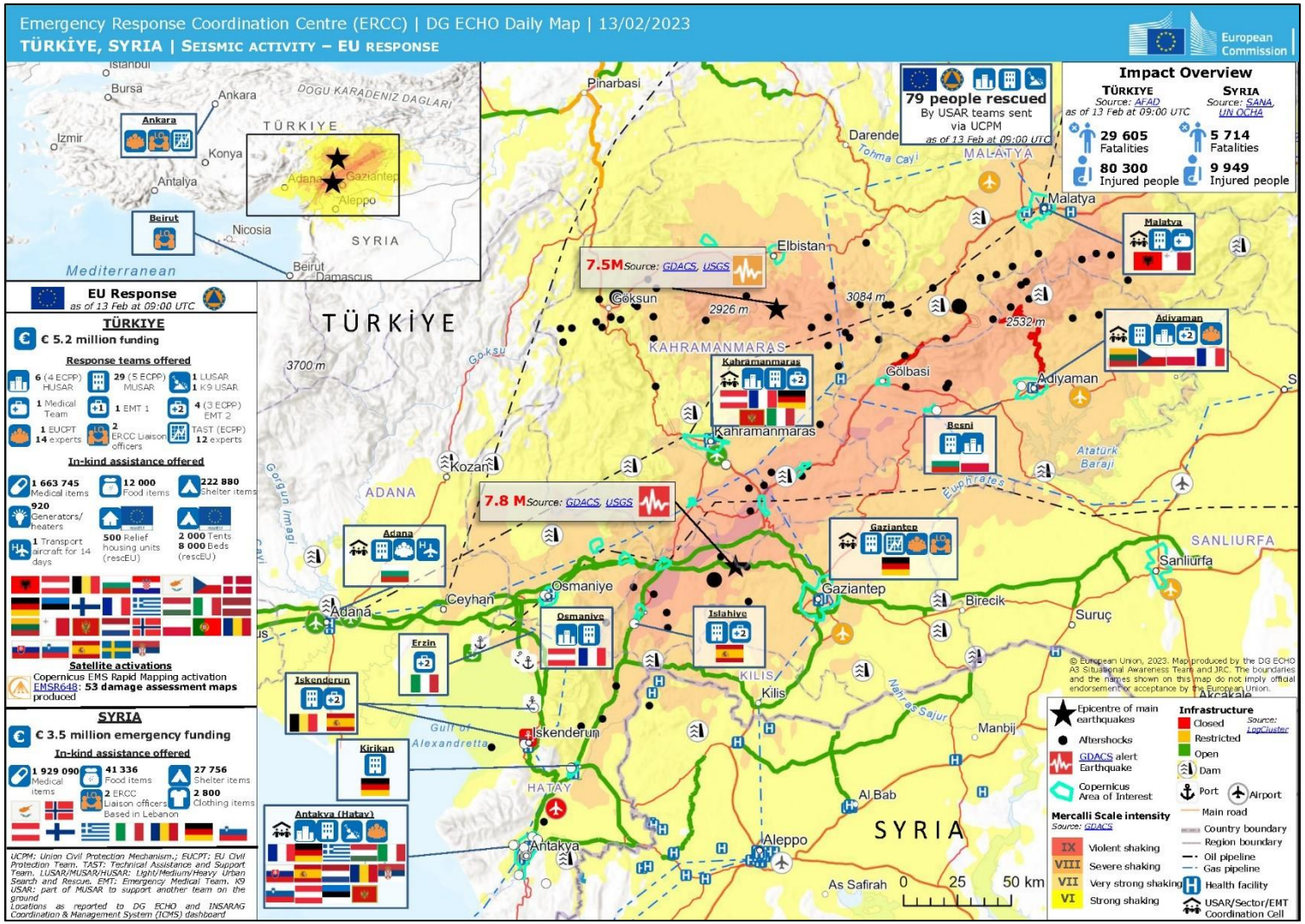
https://erccportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/4396

EMERGENCY RESPONSE COORDINATION CENTER - DG ECHO DAILY MAP ON 10 FEBRUARY 2023



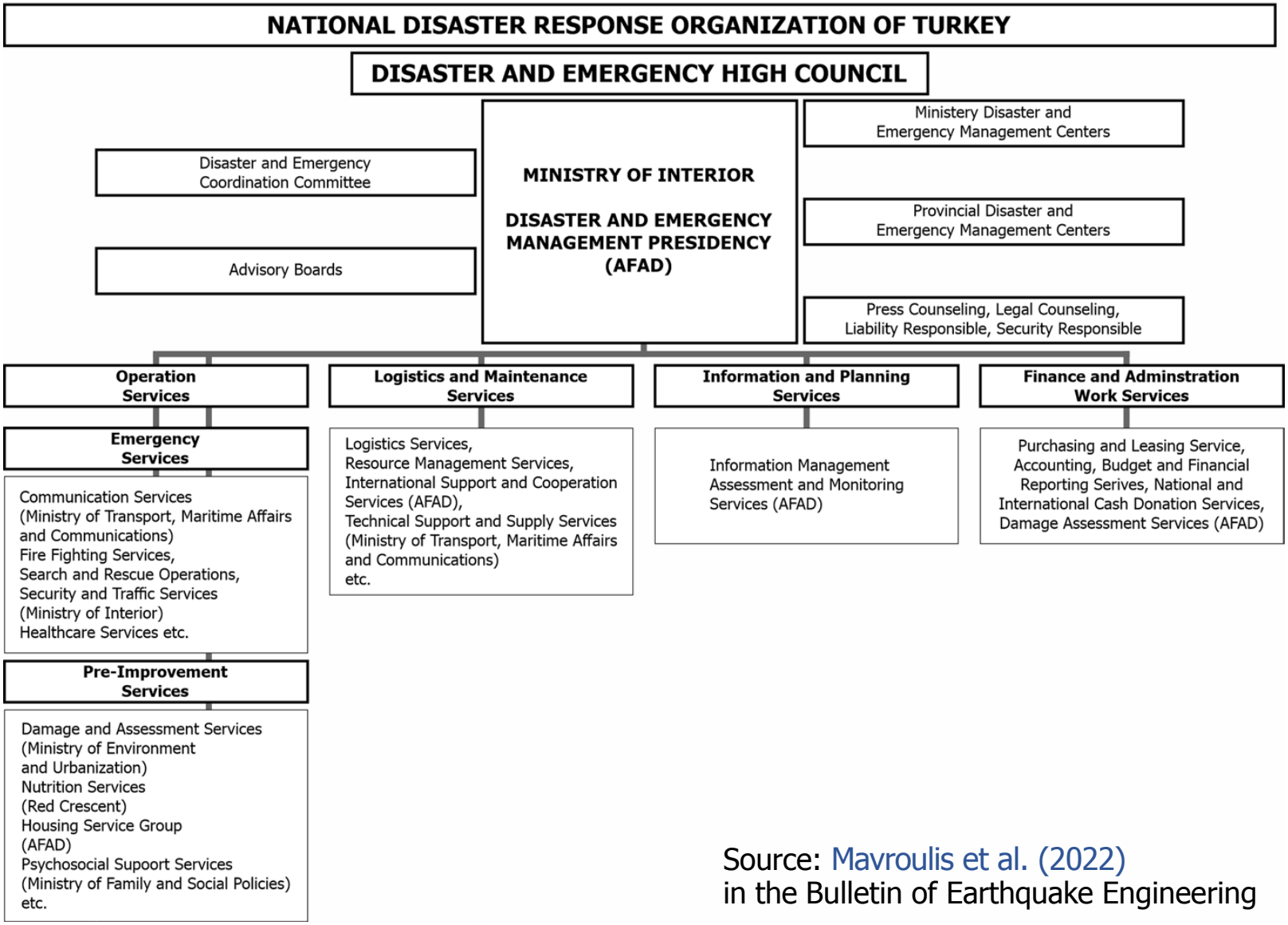
https://erccportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/4399

EMERGENCY RESPONSE COORDINATION CENTER - DG ECHO DAILY MAP ON 13 FEBRUARY 2023



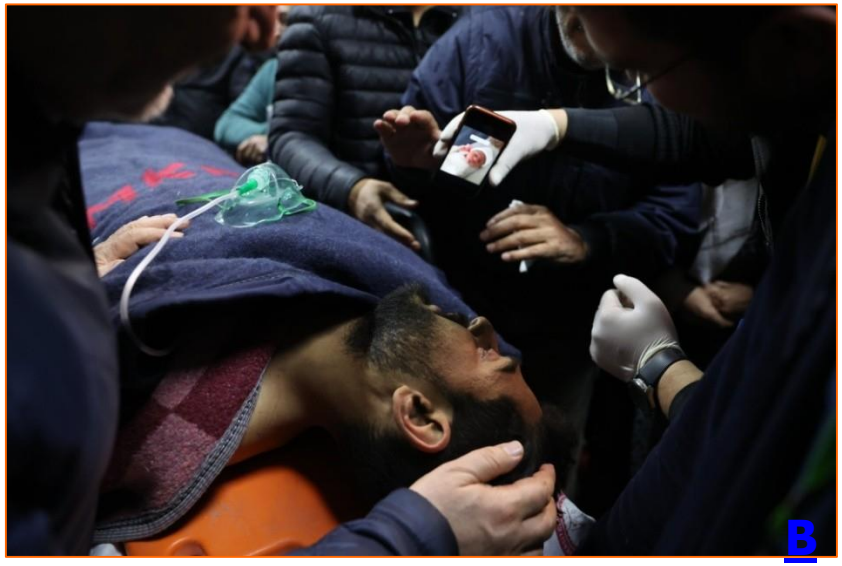
https://erccportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/4401

THE NATIONAL DISASTER RESPONSE ORGANIZATION IN TURKEY



Source: Mavroulis et al. (2022)
in the Bulletin of Earthquake Engineering

SEARCH AND RESCUE OPERATIONS
MIRACLE RESCUES FROM THE RUBBLES



(A)Search and rescue teams carry a person pulled alive from rubble **296 hours** after earthquakes, in Hatay province, Türkiye, Feb. 18, 2023.
(B)Mustafa Avcı, 34, is shown a photo of his baby by medical crews after his rescue on the **261st hour** in Hatay province, Türkiye, Feb. 16, 2023.
(C)Mehmet Ali Şakiroğlu, 26, lies on a stretcher as he's wheeled into the hospital following his rescue on the **261st hour** in Hatay province, Türkiye, Feb. 16, 2023.

Source: Daily Sabah, AA Photos

SEARCH AND RESCUE OPERATIONS
MIRACLE RESCUES FROM THE RUBBLES

(A)Neslihan Kılınç is brought to a hospital after being rescued from the rubble of a collapsed building in Kahramanmaraş, southeastern Turkey, Fed. 16, 2023.
(B)Aleyna Ölmez, 17, was rescued from the rubble of the building in which she was trapped in for **248 hours** after the earthquake in Kahramanmaraş, Turkey, Feb. 16, 2023.
(C)Rescue teams transfer the 74-year-old woman to an ambulance after being rescued, Kahramanmaraş, southern Turkey, Feb. 15, 2023.

Source: Daily Sabah, AA and IHA Photos

SEARCH AND RESCUE OPERATIONS
MIRACLE RESCUES FROM THE RUBBLES

Rescue workers carry 17-year-old Muhammed Enes Yeninar to the ambulance after pulling him out of the wreckage in Kahramanmaraş province **198 hours** following the deadly earthquakes in southeastern Türkiye, Feb. 14, 2023.

18-year-old Muhammed Cafer Çetin is carried to the ambulance after being rescued from the rubble in the Adıyaman province **198 hours** following the deadly earthquakes in southeastern Türkiye, Feb. 14, 2023.

Source: Daily Sabah, AA Photos

SEARCH AND RESCUE OPERATIONS
MIRACLE RESCUES FROM THE RUBBLES

◄Kaan, 12, holds the hand of one of his rescuers as they carry him to an ambulance after pulling him from rubble **182 hours** after twin quakes that struck southeastern Türkiye, Feb. 13, 2023 (AA Photo).

▲ Rescue teams carry 6-year-old Hivay Üşer to the ambulance in Adıyaman province **178 hours** after the deadly earthquakes in southeastern Türkiye Feb. 13, 2023 (Source: AA Photo).

◄ Rescue team members carry 11-year-old Lena Maradini, who was rescued **160 hours** after the earthquake, in Hatay, southern Türkiye, Feb. 12, 2023 (Source: EPA Photo).

SEARCH AND RESCUE OPERATIONS
MIRACLE RESCUES FROM THE RUBBLES

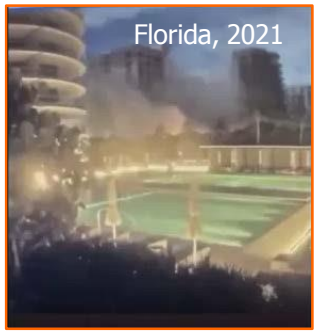

A

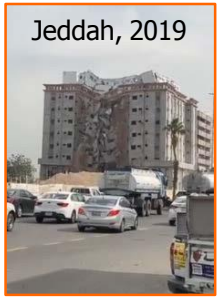

B


C

(**A**) Mustafa Sarıgül being removed from the rubble, in Hatay, Feb. 12, 2023 (AA Photo). (**B**) 30-year-old Hikmet Yiğitbaş was searched and rescued during the **100th hour**, Antakya, Hatay, Feb. 10, 2023 (AA Photo). (**C**) 10-day-old baby Yağız Ulaş is tended to by two medical officers after being rescued from the wreckage **90 hours** after the deadly earthquakes in Hatay province, Feb. 10, 2023 (IHA Photo).

MISINFORMATION
MISCAPTIONED/FAKE IMAGES/VIDEOS & FRAUDS ON-LINE





Hours after the 6 February 2023, Mw=7.8 Turkey-Syria earthquake pictures and video footages from previous disasters in other countries were shared in social media by people claiming that they showed damage caused by this particular tremor.
Source: https://newschecker.in
Furthermore, scammers in TikTok were channeling donations away from real charities, and into their own PayPal accounts and cryptocurrency wallets.
Source: https://www.bbc.com/news/world-europe-64599553)

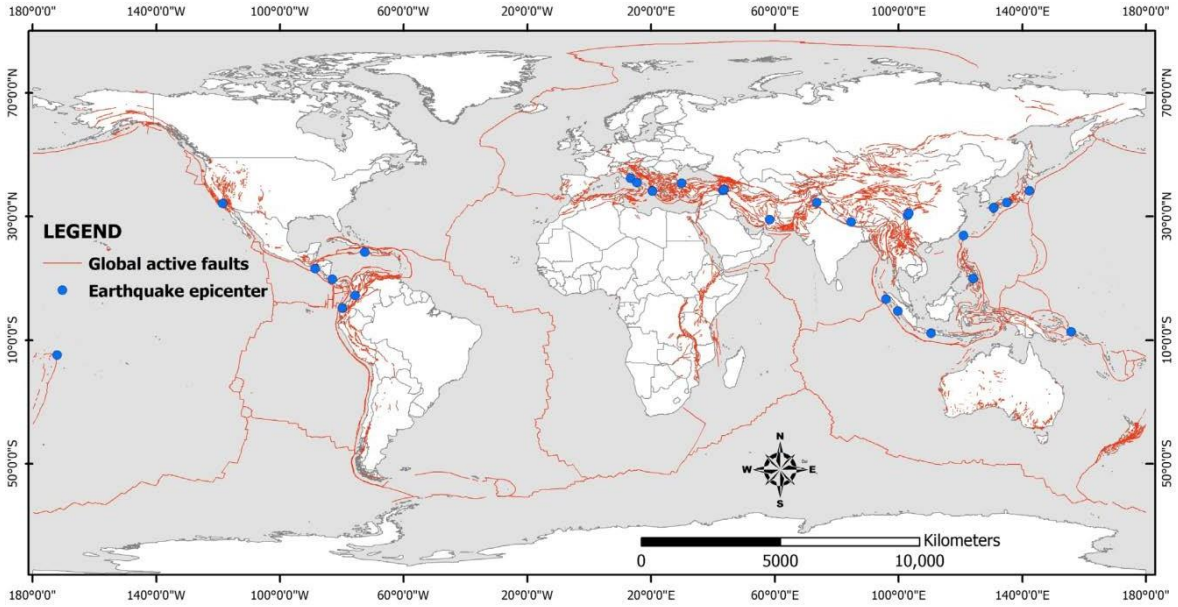

TikTok Live account


TikTok | 2018 Photo

IMPACT OF EARTHQUAKES ON PUBLIC HEALTH

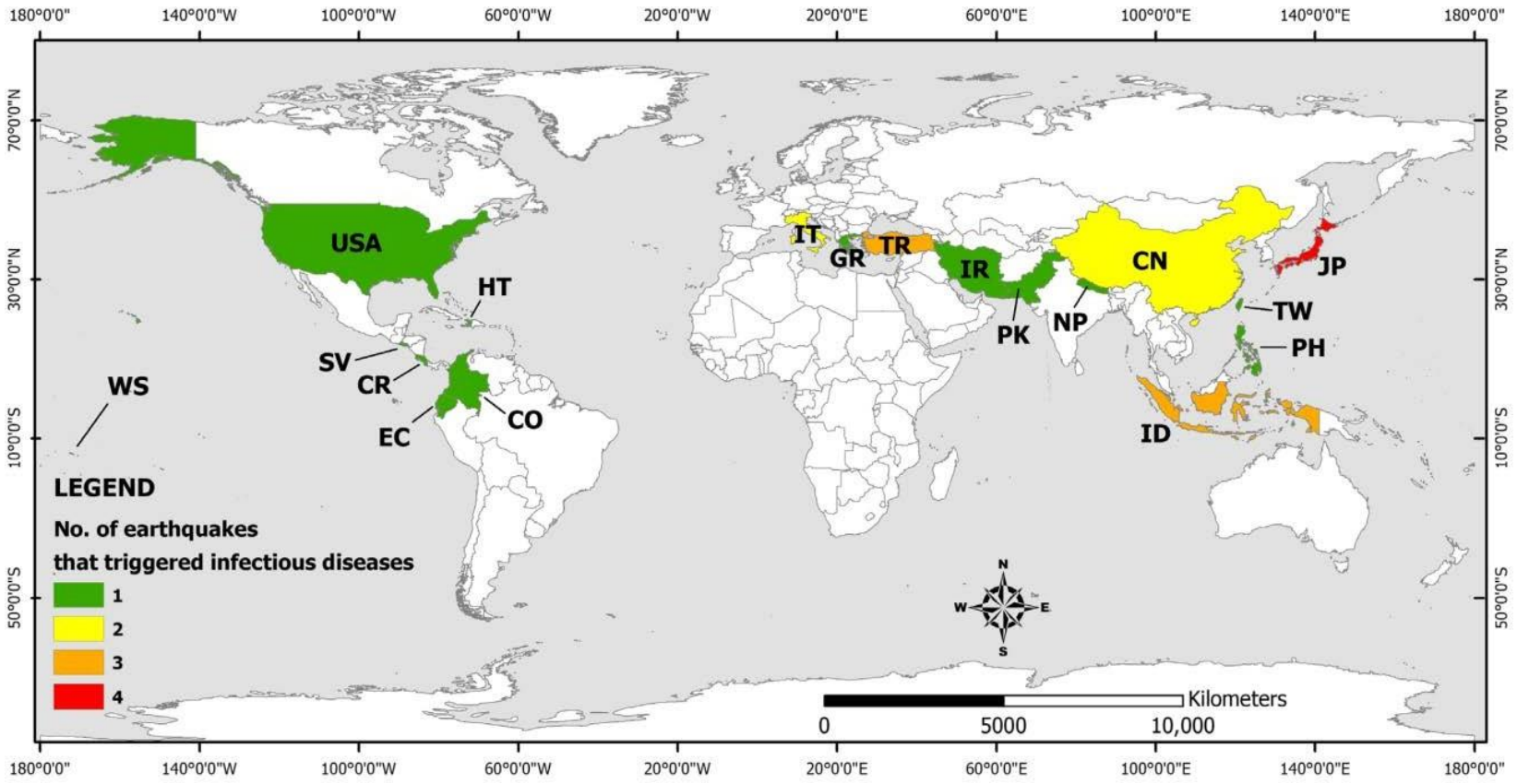
Reporting of the infectious disease occurrence after destructive earthquakes generated around the world between 1980 and 2016 showed that the incidence of infectious diseases increased after each of these earthquake events. Respiratory, gastrointestinal, and skin infections are the most common infections detected in the post-earthquake period. The recording of wound infections is also pronounced.

The timing and magnitude of an earthquake, its area of occurrence (proximity to active faults, coastlines and mountain fronts), the earthquake-triggered environmental effects including landslides, hydrological anomalies, and tsunamis, and the synergy with different types of natural hazards can play an essential role in the increased incidence of infectious diseases.



Map illustrating the active faults of the world and the epicenters of the earthquakes that have induced infectious diseases in the post-earthquake period. Source: Mavrouli et al. (2023), in Microorganisms.

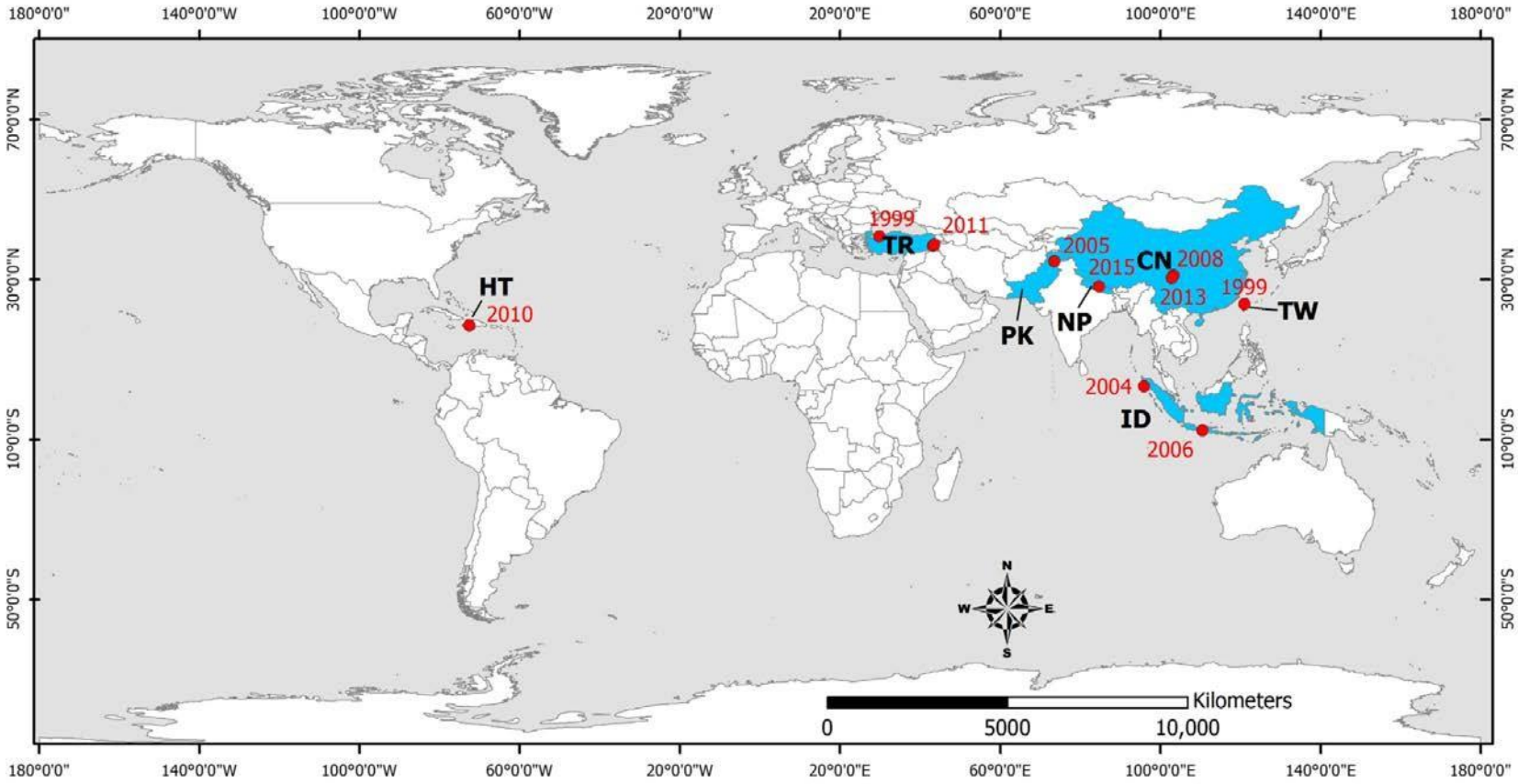
IMPACT OF EARTHQUAKES ON PUBLIC HEALTH
EARTHQUAKE-INDUCED INFECTIOUS DISEASES AROUND THE WORLD



Distribution of the countries affected by earthquake-triggered infectious diseases. Turkey is among those countries that have experienced adverse conditions from the infectious disease emergence in the period following a devastating earthquake. Source: Mavrouli et al. (2023), in Microorganisms.

IMPACT OF EARTHQUAKES ON PUBLIC HEALTH

SPATIAL DISTRIBUTION OF EARTHQUAKE-INDUCED WOUND AND SKIN INFECTIONS



Countries affected by earthquake-triggered wound and skin infections. HT: Haiti, **TR: Turkey**, PK: Pakistan, NP: Nepal, CN: China, ID: Indonesia. The epicenters of the studied earthquakes are also illustrated (red dots), along with the occurrence year (red numbers).


ΠΥΡΟΣΒΕΣΤΙΚΟ ΣΩΜΑ
ΠΥΡΟΣΒΕΣΤΙΚΟ ΣΩΜΑ