



# REVISITING THE 1114/5 CE EARTHQUAKE SEQUENCE IN SOUTHERN TURKEY THROUGH MODERN LENS

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## Introduction

- The study attempts to revisit the 1114/5 CE earthquake sequence using the February 2023 Türkiye doublet as a rare modern analogue
- Both sequences occurred in the same broad region, making comparison tectonically and geographically meaningful.
- The study test whether 2023 damage, timing, and fault behavior resemble the twelfth-century events.
- If similarity is robust, the 2023 sequence helps constrain chronology, extent, and character of the 1114/5 earthquakes.
- The study reverses the typical approach in historical seismology by using present seismicity to interpret a pre-instrumental earthquake sequence.

### 2023 Türkiye Sequence

### 1114/5 C.E. Sequence

On 6 February 2023, Mw 7.8 and Mw 7.5 earthquakes struck separate faults in southern Türkiye. The sequence caused catastrophic damage across southern Türkiye and northern Syria, with severe losses and widespread building collapse. Frequent aftershocks persisted for months along two rupture strands, supporting interpretation of the sequence as a doublet.

The 1114/5 sequence likely included at least two major November earthquakes, possibly preceded by an earlier August shock. Historical accounts describe severe destruction from Mamistra and Marash to Antioch, with landslides, collapse, and many deaths. Prolonged aftershocks lasted for months, indicating a complex sequence rather than a single isolated event.

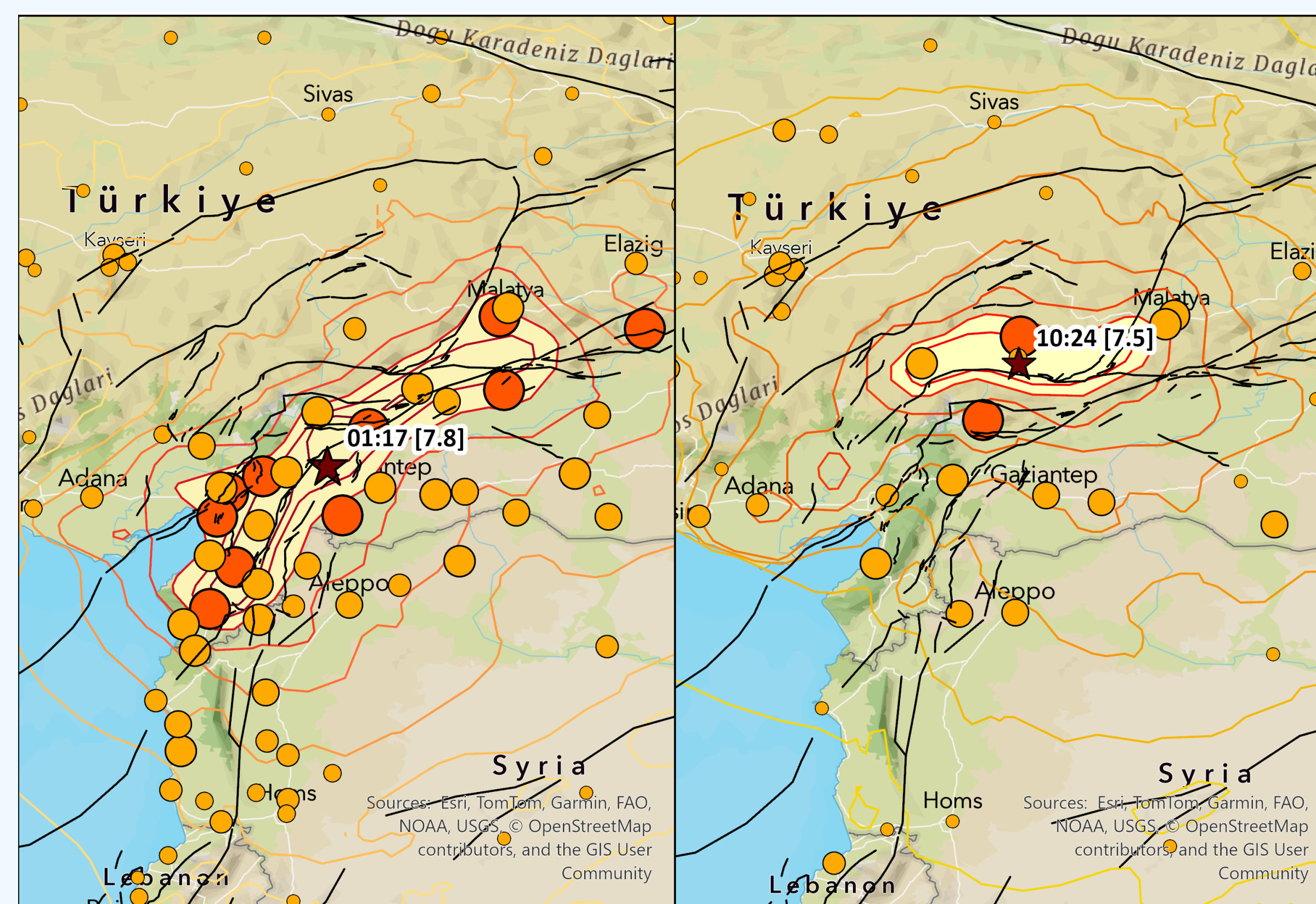


Figure 2: Intensity data points (IDPs) and isoseismals for the 2023 M7.8 Pazarcık earthquake (left) and isoseismals for the 2023 M7.5 Elbistan earthquake (right). The area delineated by isoseismals  $\geq 7$  is shown in yellow

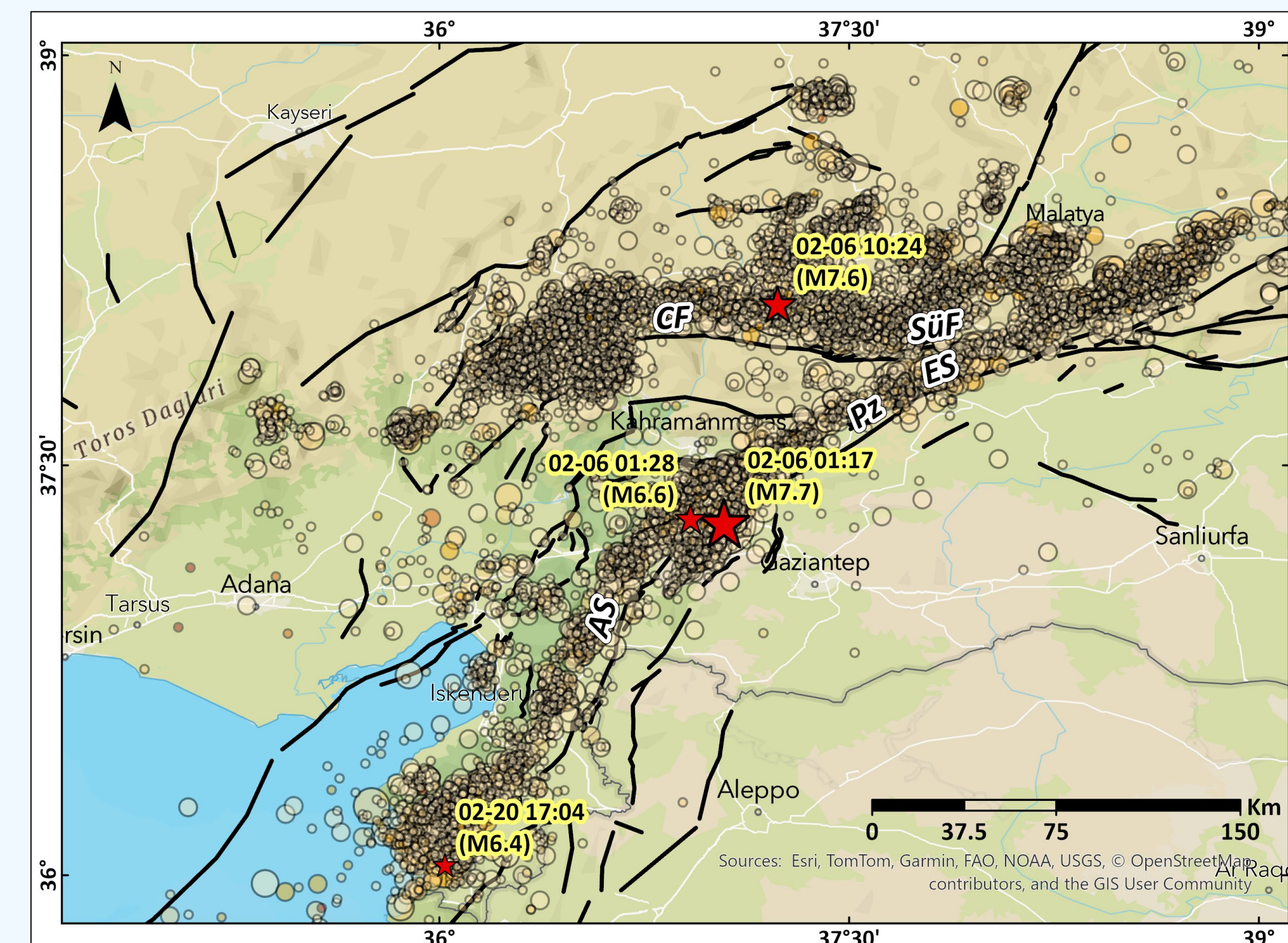


Figure 1: The earthquakes ( $M \geq 3$ ) in Türkiye between 6 February 2023 and 10 June 2025. The four large earthquakes ( $M > 6$ ) are noted in red stars along with the magnitude. Also portrayed are the East Anatolian fault zone (EAFZ, Arpat and Şaroğlu, 1972) segments of Amanos fault (AS); Erkenek (ES); Pazarcık (Pz); Pütürge (PS), and the Sürgü-Misis fault zone (SMFZ, Kaymakci et al., 2010) segments of Çardak (CF); Göksun bend (Gb); Savrun (SaS); and Sürgü (SÜF) (Emre et al., 2018). Source of the events: Disaster and Emergency Management Authority (AFAD)

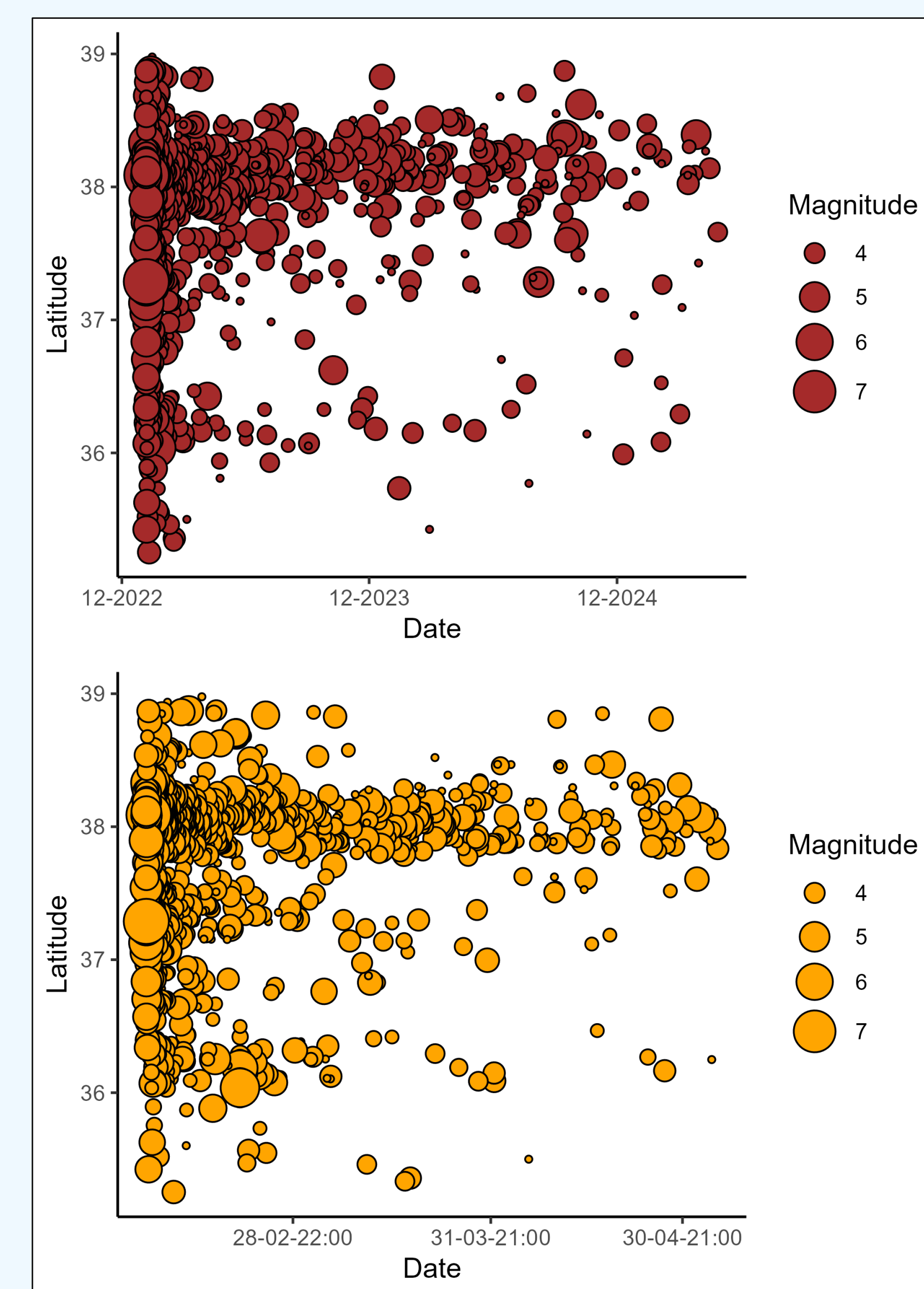


Figure 3: S spatiotemporal distribution of the earthquake occurrences ( $M \geq 3.5$ ) between 5 February 2023 and 12 June 2025 (upper); The same distribution portrayed in (a) but focused on the first three months (between 6 February 2023 and 5 May 2023). Note the distribution along latitude  $\sim 38^\circ$  N and  $\sim 36^\circ$ – $37^\circ$  N denoting the activity along the northern and southern strands of the Sürgü–Misis fault zone (SMFZ) and East Anatolian fault zone (EAFZ), respectively (source: the Türkiye AFAD catalog)

## Constraining the Twelfth Century C.E. Historical Sequence

- Since the 1114/5 earthquakes occurred close together, damage was analyzed as one sequence rather than assigned to individual shocks.
- We compared 27 historical and 69 modern IDPs using kernel density estimation to identify spatial damage patterns.
- Both the 1114/5 and 2023 sequences show two main damage hotspots: Kahramanmaraş–Elbistan in the north and Antakya in the south.
- Spatial similarity suggests that at least one 1114/5 earthquake likely exceeded magnitude 7, comparable to the 2023 events.
- Historical reports, paleoseismological findings, and stress-transfer evidence favor two distinct large earthquakes on different fault segments, not a single event.

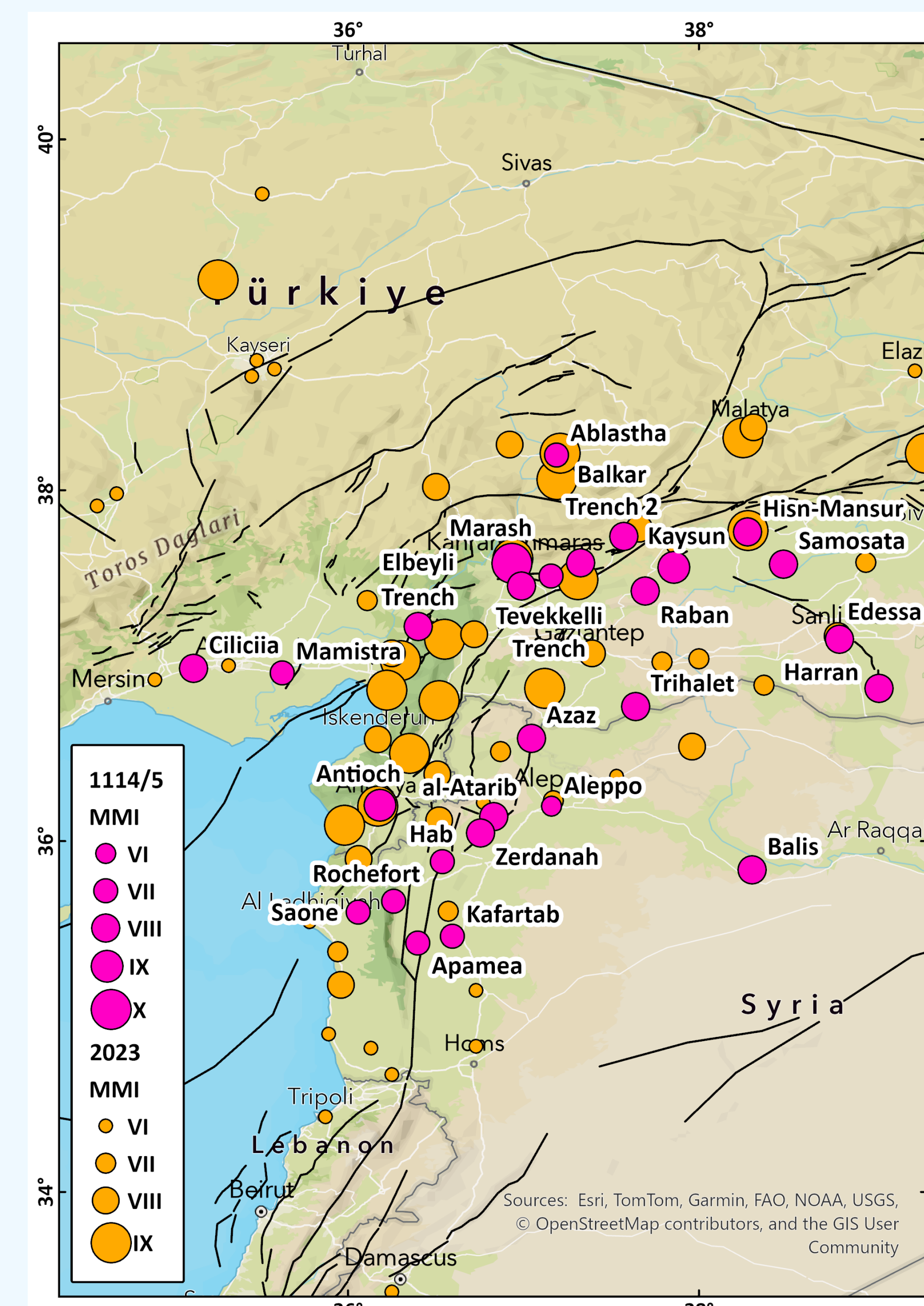


Figure 4: Interpreted IDPs of the historical 1114/5 C.E. sequence superimposed on the U.S. Geological Survey (USGS) IDPs of the 2023 Pazarcık M 7.8 and Elbistan M 7.5 earthquakes.

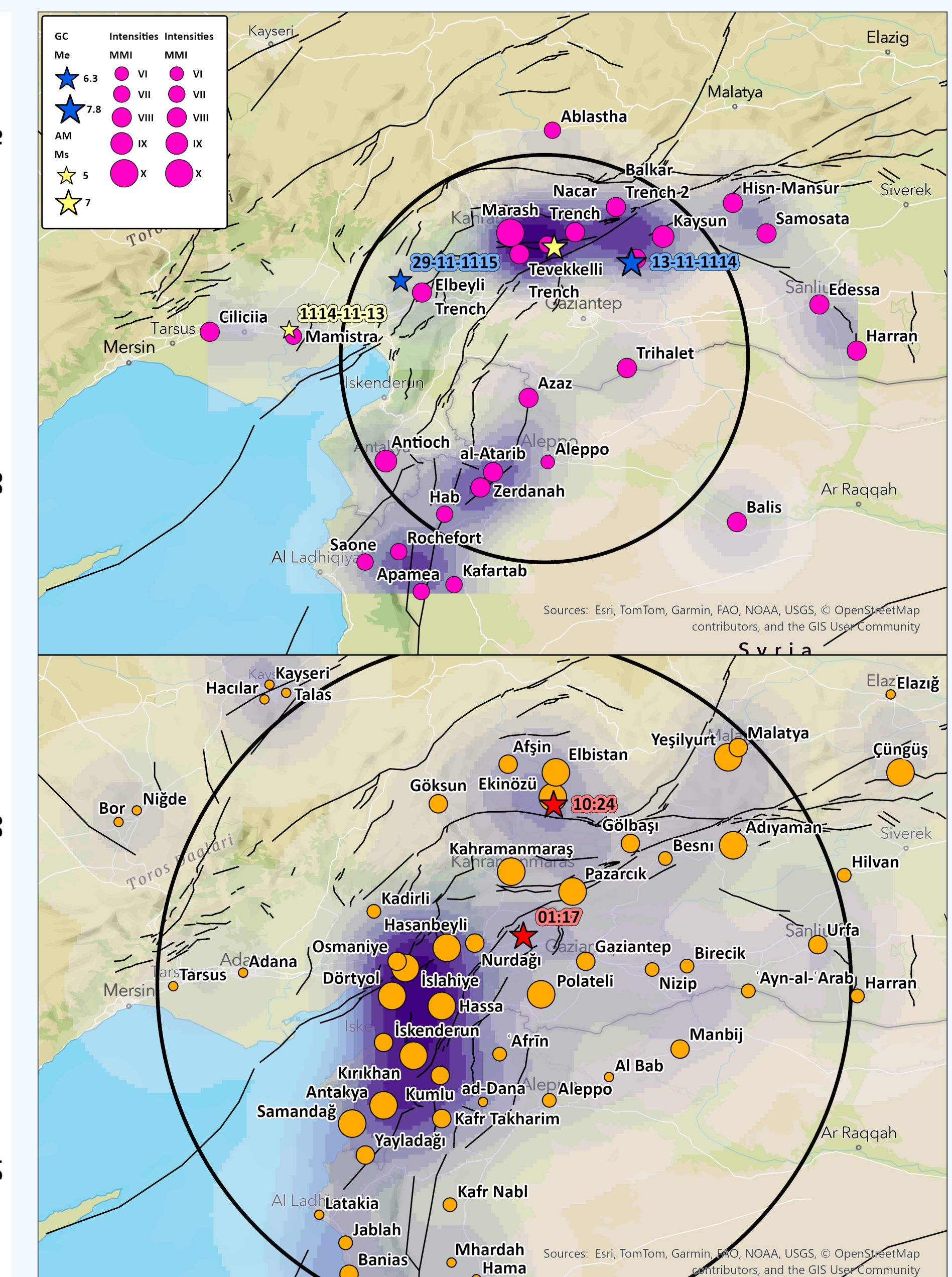


Figure 5: Standard distance and kernel density of IDPs (MMI scale ranging VI - X) distribution following the 13 and 29 November 1114/5 earthquakes (upper) and IDPs (MMI scale ranging VI - IX) distribution of the M 7.8 Pazarcık and the M 7.5 Elbistan earthquakes (lower).

## Summary

- Comparing 1114/5 with the 2023 doublet reveals two recurring damage hotspots: Kahramanmaraş–Elbistan in the north and Antakya in the south.
- At least one 12th century earthquake likely exceeded magnitude 7, because the overall damage pattern closely resembles the 2023 sequence.
- The 1114/5 sequence probably involved two distinct large earthquakes, but whether it was a true doublet remains uncertain.