ΕΘΝΙΚΟΝ ΑΣΤΕΡΟΣΚΟΠΕΙΟΝ ΑΘΗΝΩΝ

πλέον των 170 ετών προσφοράς στην έρευνα και την κοινωνία

Χαρτογράφηση με InSAR/GNSS της εδαφικής παραμόρφωσης και μοντέλα διάρρηξης των ισχυρών σεισμών στο Δυρράχιο (26/11/2019, M=6.4) και στο Ελαζίγκ (24/1/2020, M=6.8)

Dr Athanassios Ganas, NOA, aganas@noa.gr

Αθήνα, 6/3/2020

ΕΘΝΙΚΟΝ ΑΣΤΕΡΟΣΚΟΠΕΙΟΝ ΑΘΗΝΩΝ

πλέον των 170 ετών προσφοράς στην έρευνα και την κοινωνία

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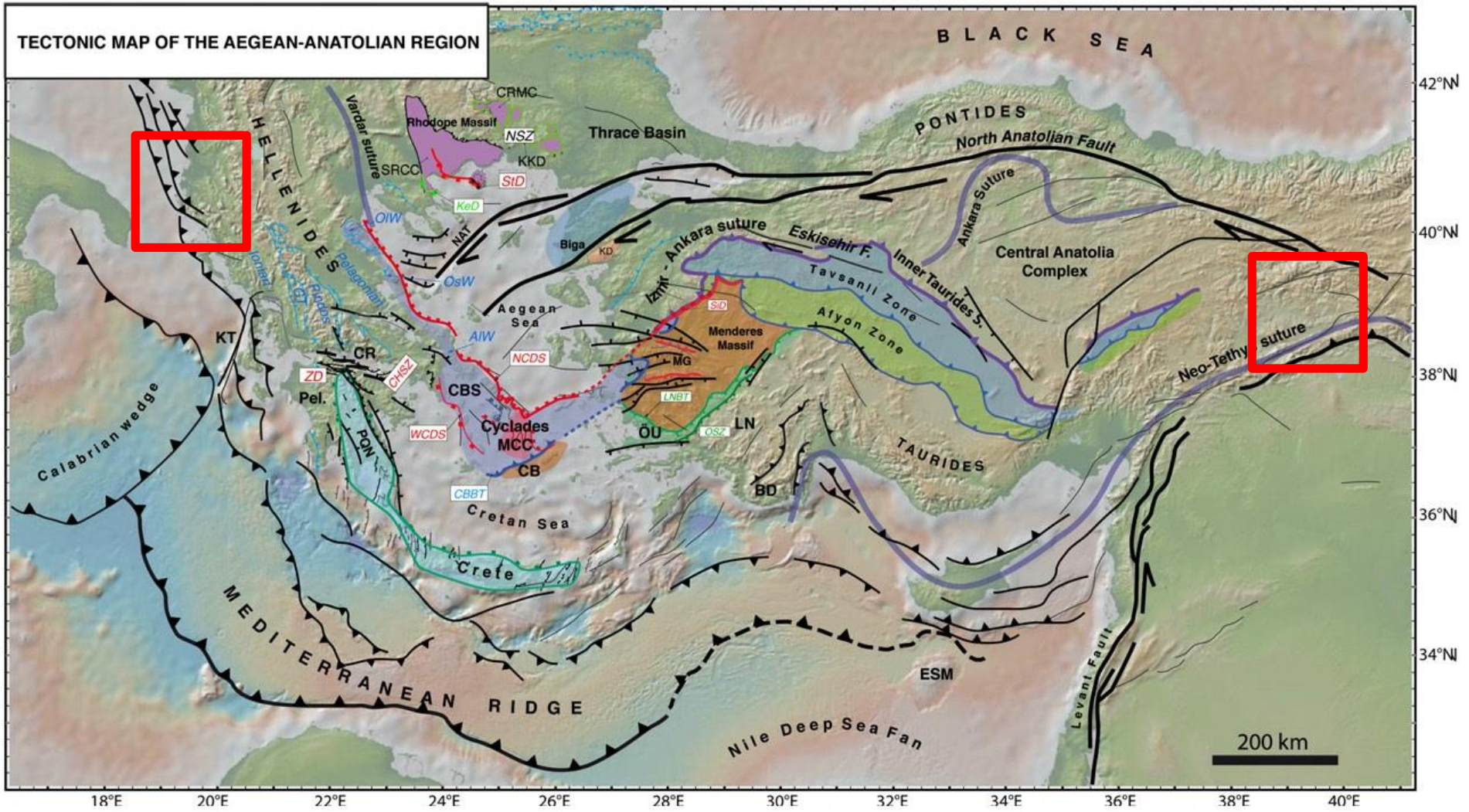
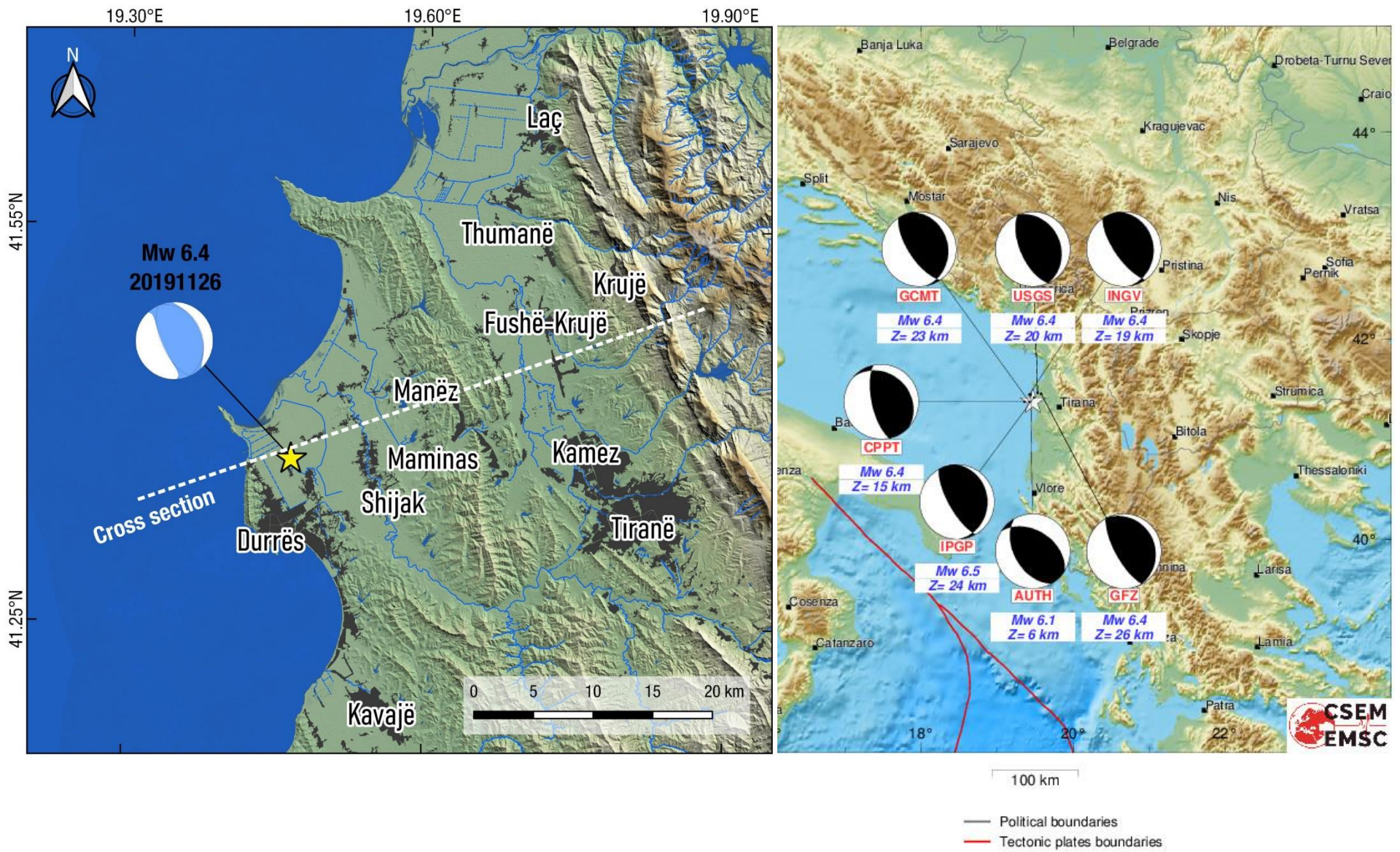
Talk outline

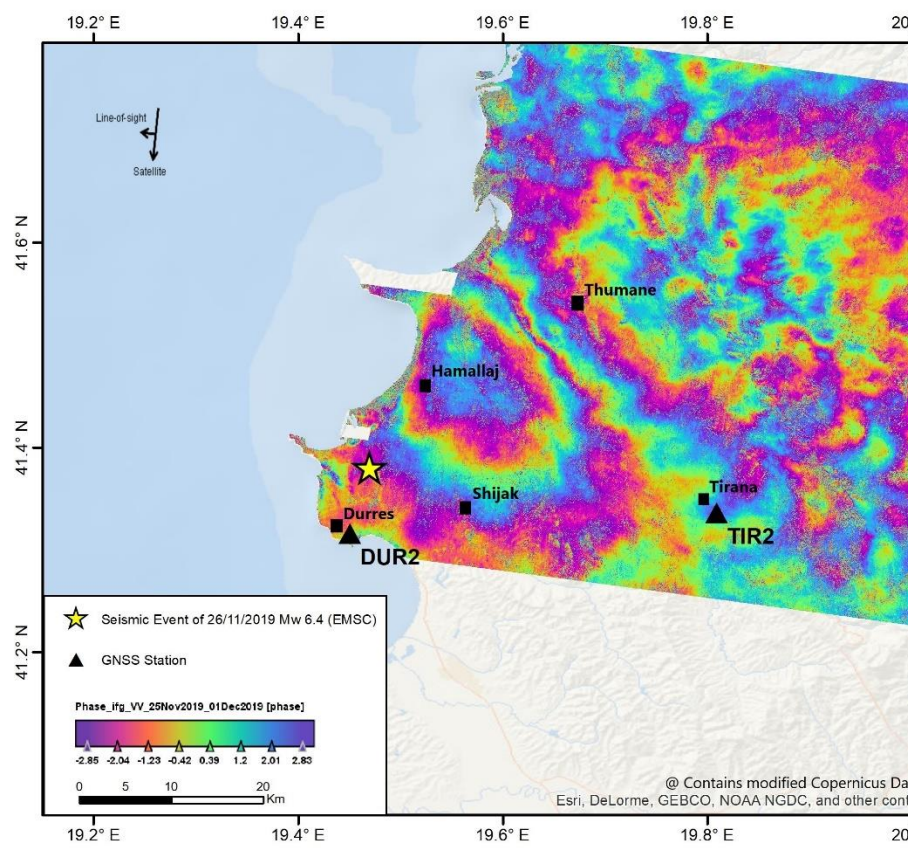
1. We identify the main source of the M6.4 earthquake that rocked north-central Albania on November 26, 2019 02:54 UTC
2. We identify the main source of the M6.8 earthquake that rocked eastern Turkey / Iran on January 24, 2020 17:55 UTC
3. We use space geodesy observations of ground displacement (GNSS and InSAR)
4. We model the source by inverting the displacement data

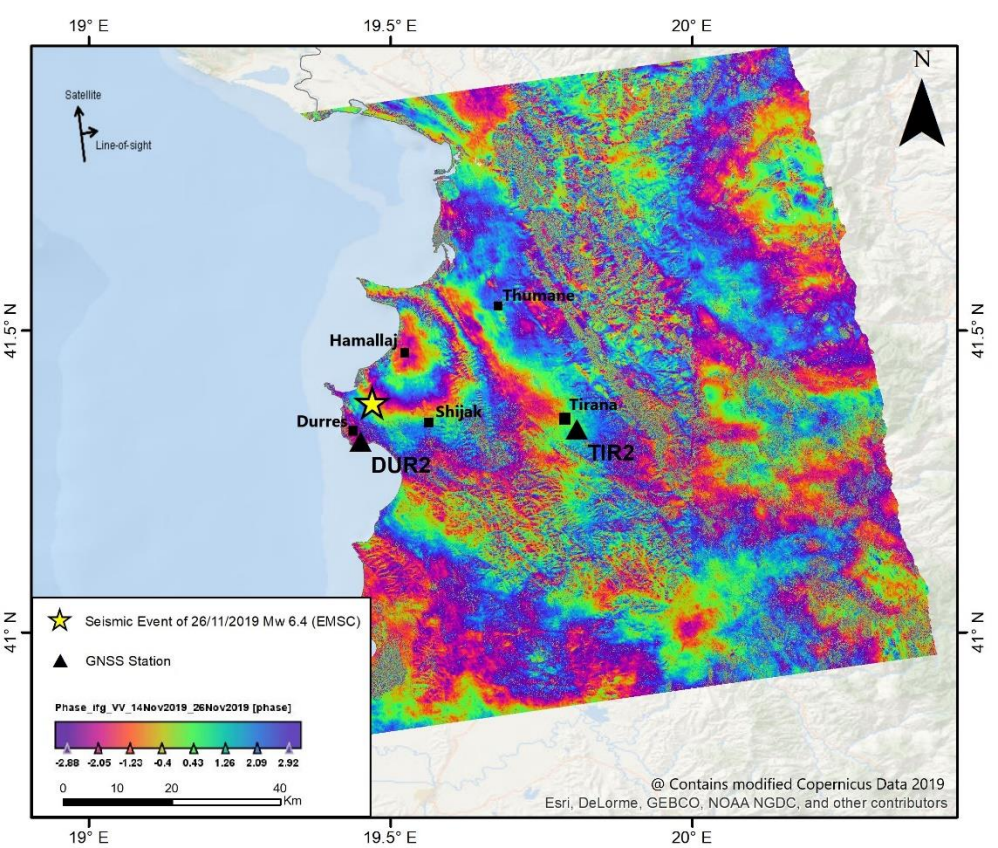
Tectonic Setting



Jolivet et al., Tectonophysics, 2013


19.30°E
19.60°E
19.90°E
41.55°N
41.25°N
N
Laç
Thumanë
Krujë
Fushë-Krujë
Manëz
Maminas
Kamez
Shijak
Tiranë
Durrës
Kavajë
Mw 6.4
20191126
Cross section
0 5 10 15 20 km
Banja Luka
Belgrade
Drobeta-Turnu Sever
Craio
Kragujevac
Sarajevo
Split
Mostar
Nis
Vratsa
Pristina
Sofia
Pernik
Prizren
Skopje
Strumica
Tirana
Bitola
Thessaloniki
Vlore
Larisa
Cosenza
Catanzaro
Lamia
Patra
44°
42°
40°
18°
20°
22°
GCMT
Mw 6.4
Z= 23 km
USGS
Mw 6.4
Z= 20 km
INGV
Mw 6.4
Z= 19 km
CPPT
Mw 6.4
Z= 15 km
IPGP
Mw 6.5
Z= 24 km
AUTH
Mw 6.1
Z= 6 km
GFZ
Mw 6.4
Z= 26 km
CSEM EMSC
100 km
Political boundaries
Tectonic plates boundaries



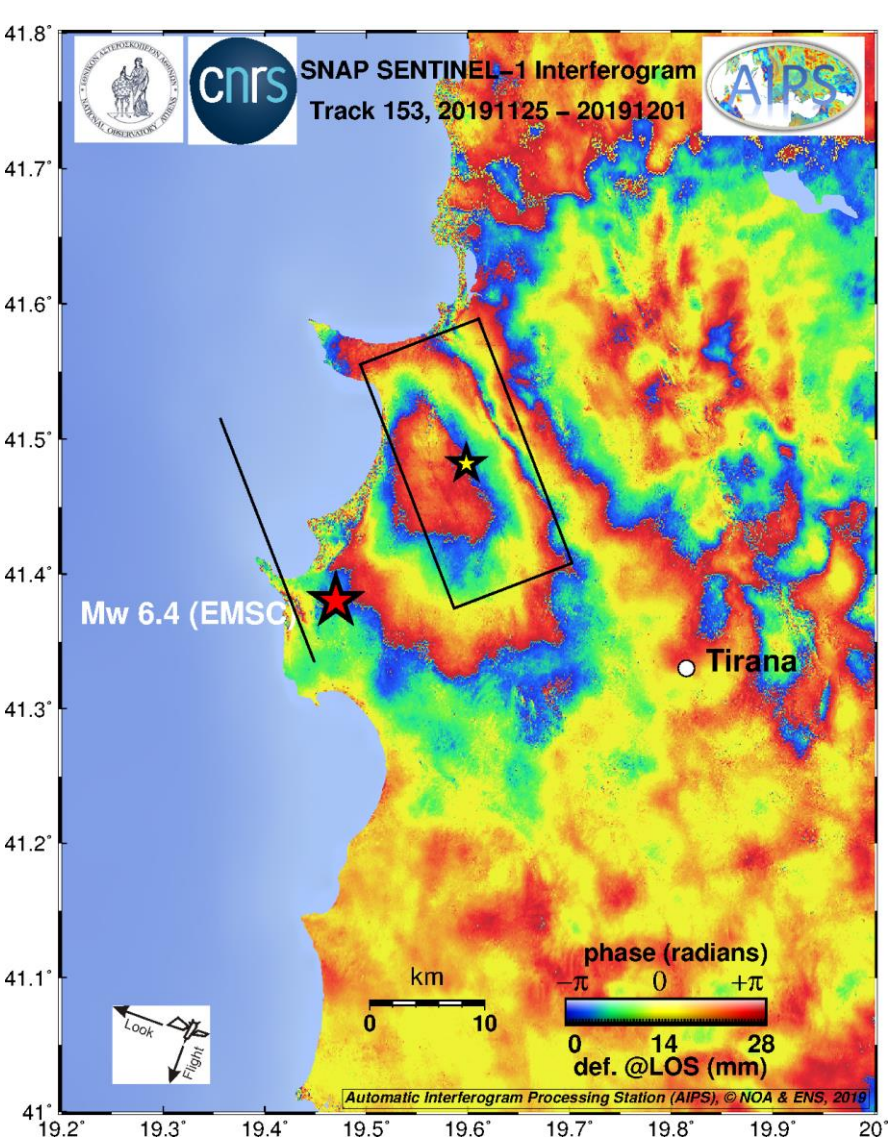


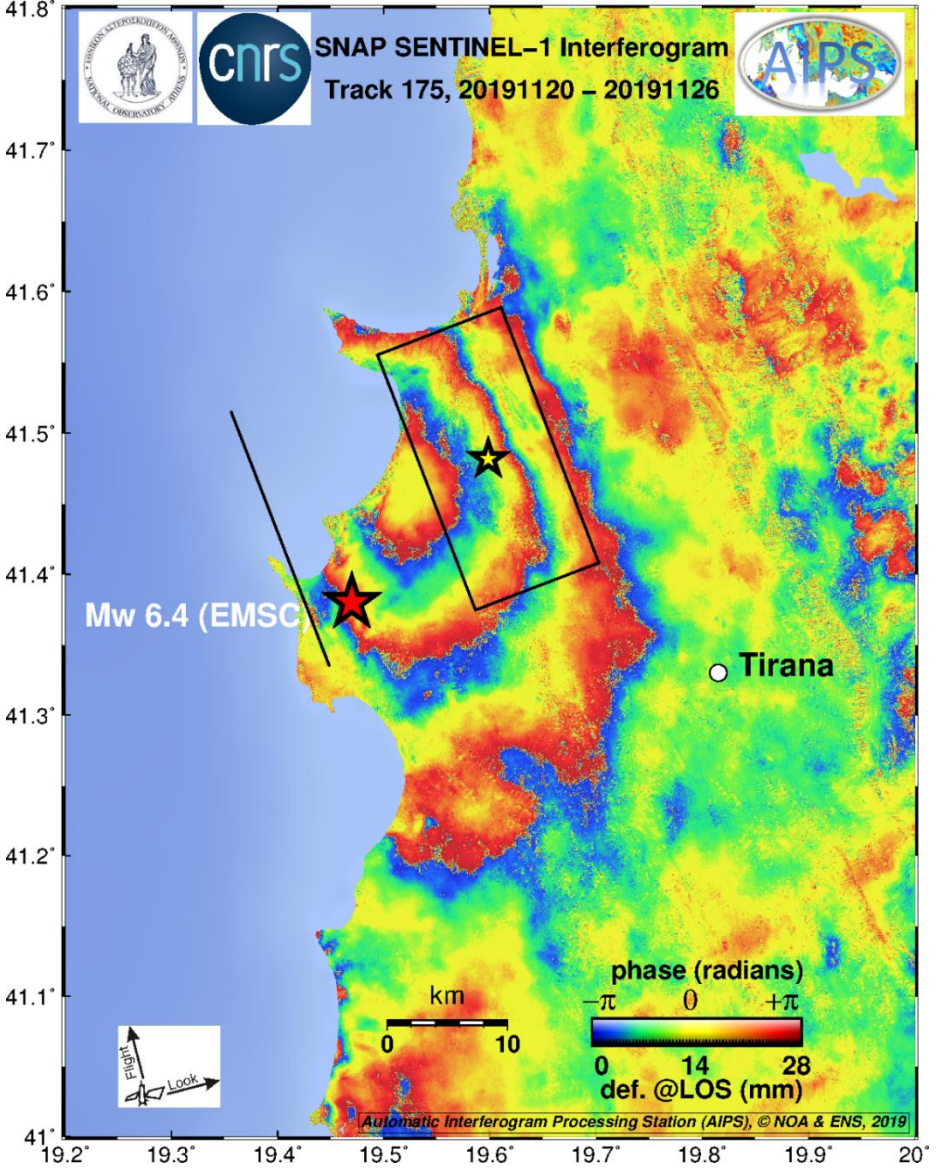
We use Differential SAR Interferometry to capture the deformation produced by the Durres earthquake. We constructed co-seismic interferograms by combining topographic information with SAR acquisitions from the Sentinel-1 satellites for both ascending track 175 and descending track 153.

The SAR acquisitions were processed with the open-source SNAP v7.0 ESA software.

For the ascending track the pre-event acquisition is from 14/11/2019 and the repeat pass is from 26/11/2019.

For the descending track the pre- and post-event acquisitions are from 25/11/2019-01/12/2019 respectively



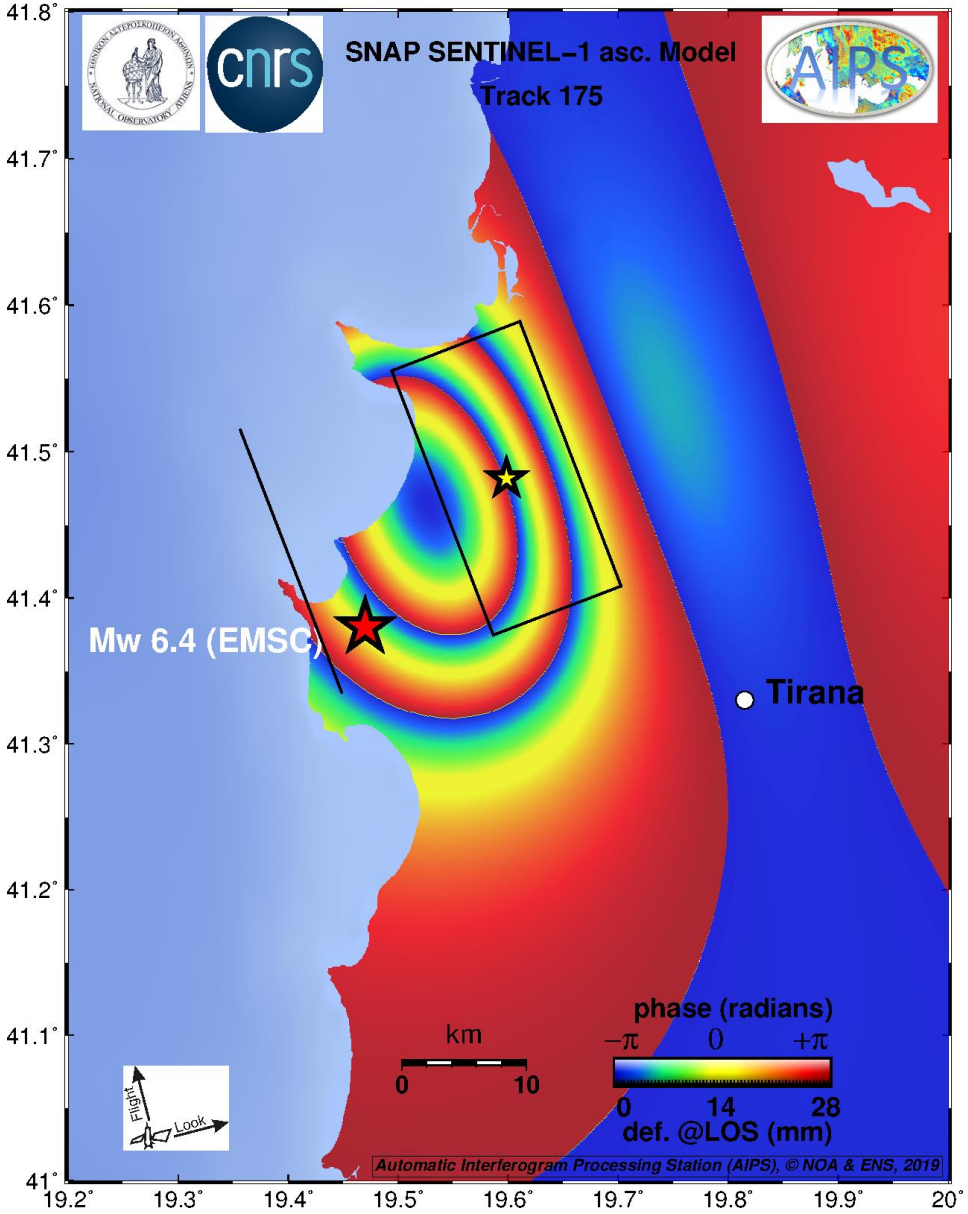


The InSAR fringe pattern shows a 40-km long, NW-SE arrangement of three (3) fringes with a maximum LOS displacement of about +8.4 cm near the village Hamallaj (15 km NE of Durres).

INVERSION

Assuming a half-space elastic model with uniform slip along a rectangular fault surface, the source of the ground deformation was inverted using the available geodetic data (GNSS and InSAR).

Durres Data: 54 points (wrapped phase) for ascending track and 31 for descending track
We use the programme inverse6 (http://github.com/pbriole/inverse6).



The geodetic fault-model is in agreement with published moment tensor solutions showing a NNW-SSE fault plane (for example the USGS solution has attributes 337°/27°/91°; strike/dip-angle/rake angle).

The geodetic centroid is located about 15 km to the NE of the EMSC epicentre

Surface Projection of the east-dipping modelled fault

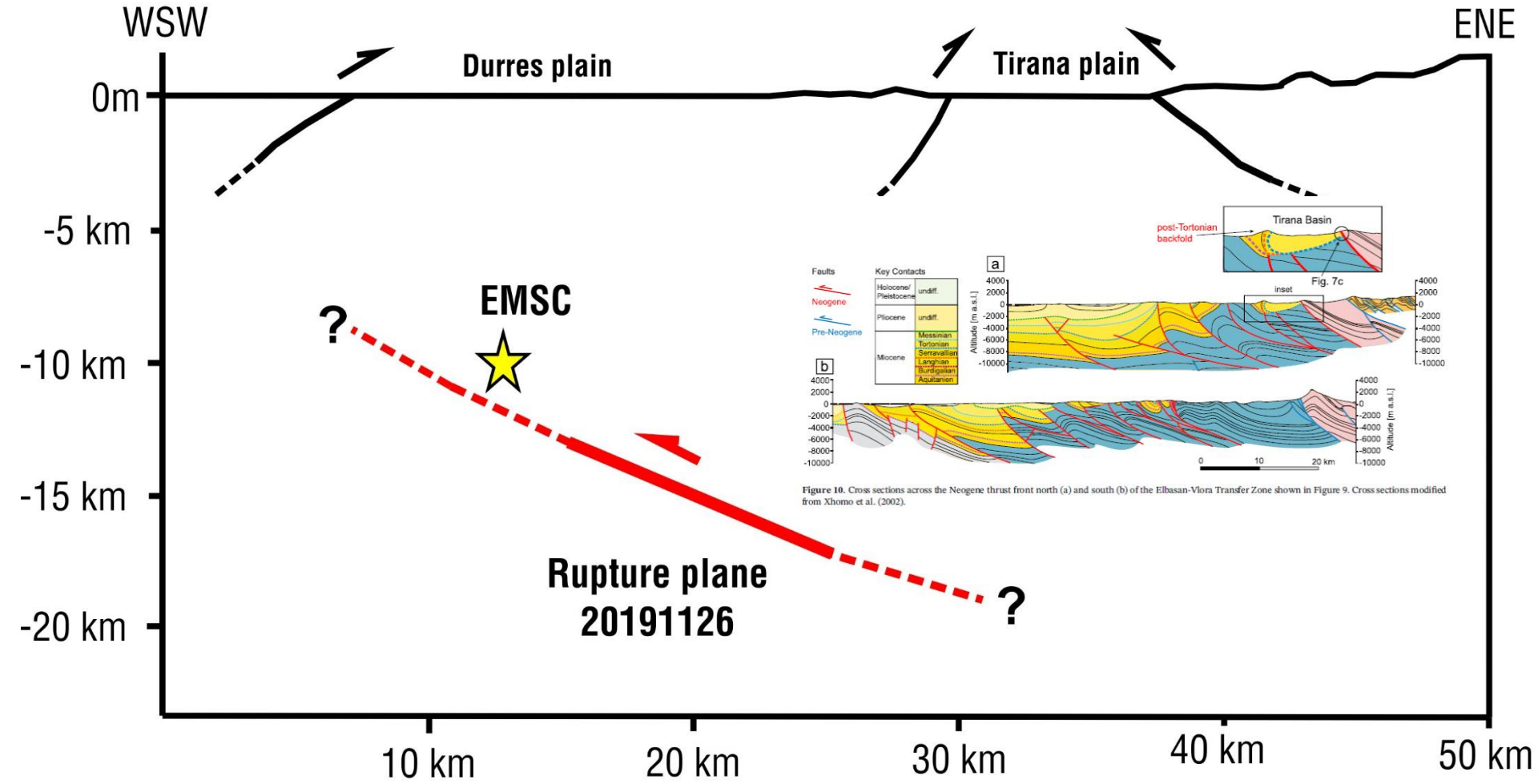


Figure 10. Cross sections across the Neogene thrust front north (a) and south (b) of the Elbasan-Vlora Transfer Zone shown in Figure 9. Cross sections modified from Xhomo et al. (2002).

This geometry is compatible with a blind thrust fault that may root on the main basal thrust *i.e.* along the main Ionian thrust front that separates Adria-Apulia from Eurasia

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Keywords:
GNSS, Aegean, displacement, earthquake, scaling

A 20-YR DATABASE (1997-2017) OF CO-SEISMIC DISPLACEMENTS FROM GPS RECORDINGS IN THE AEGEAN AREA AND THEIR SCALING WITH Mw AND HYPOCENTRAL DISTANCE.

Athanassios Ganas[1*], Nikoletta Andritsou[1,2], Chrysanthi Kosma[1], Panagiotis Argyrakis[1], Varvara Tsironi[1], George Drakatos[1]

$M_w^{PGD} = [LOG(PGD) + 8.2849]/(1.6810 - 0.2453LOGR)$

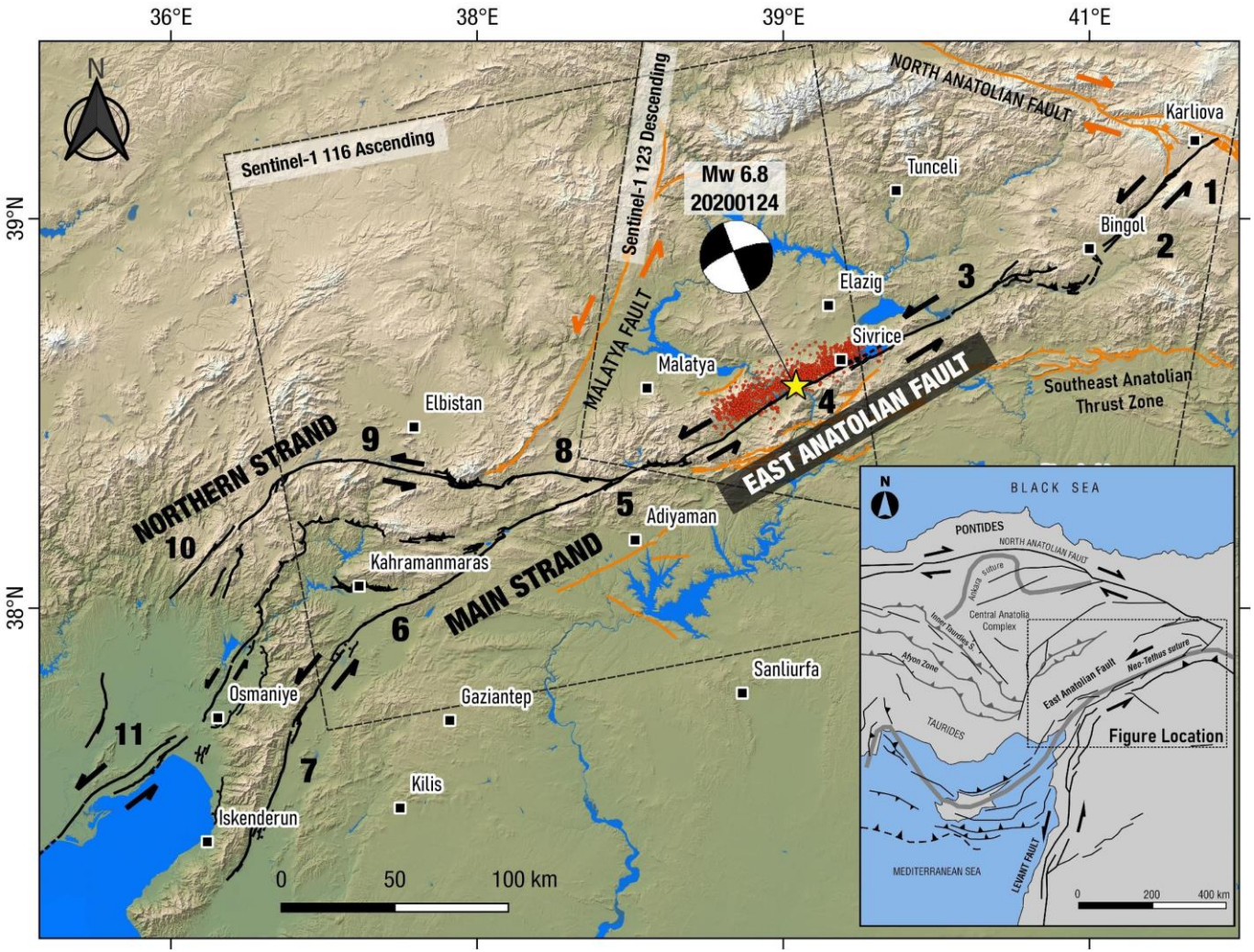
$M_w^{PGD-S} = [LOG(PGD-S) + 8.0839]/(1.6793 - 0.2447LOGR)$

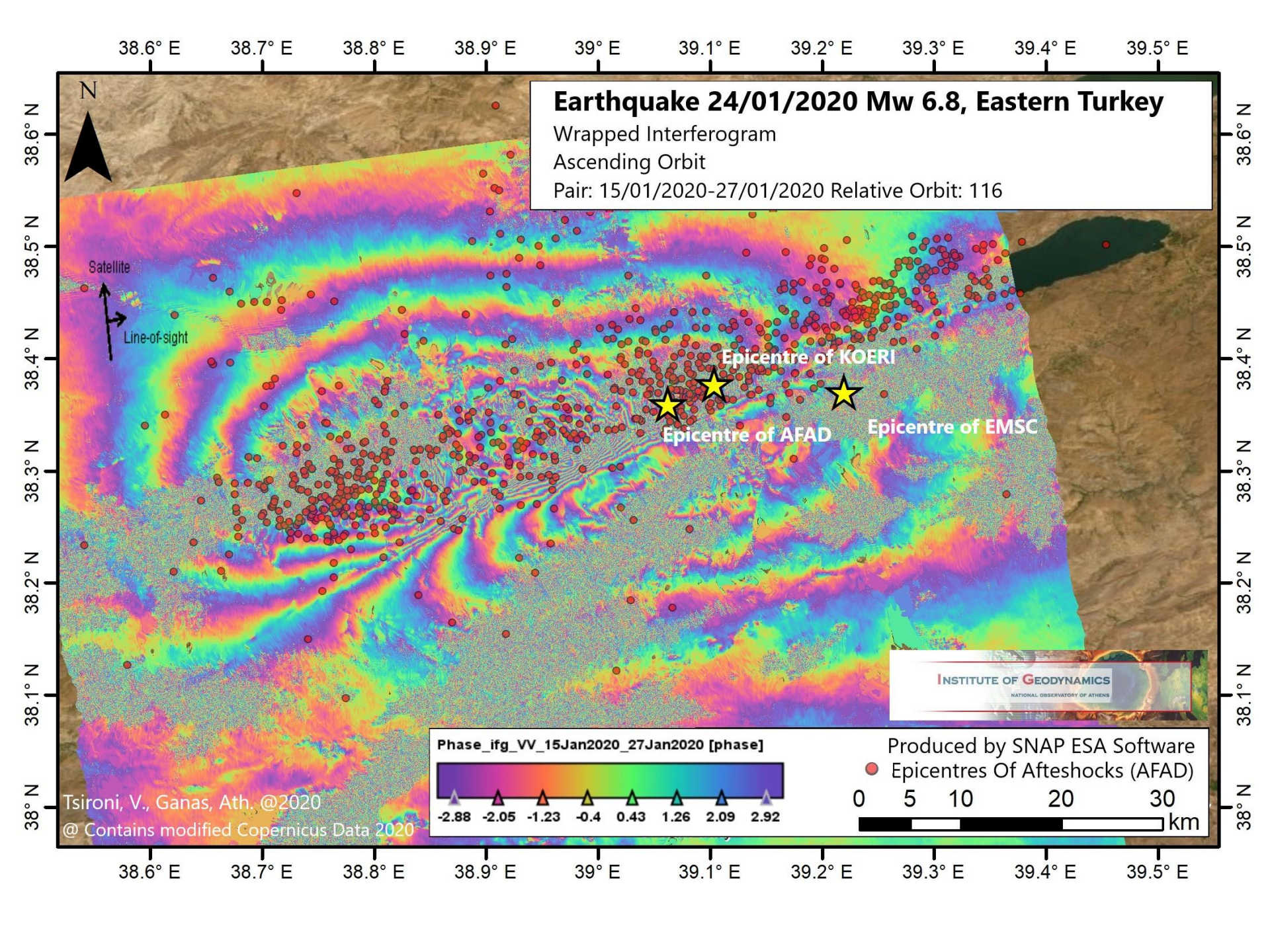
Mw(PGD)=6.44 and Mw(PGDS)=6.42

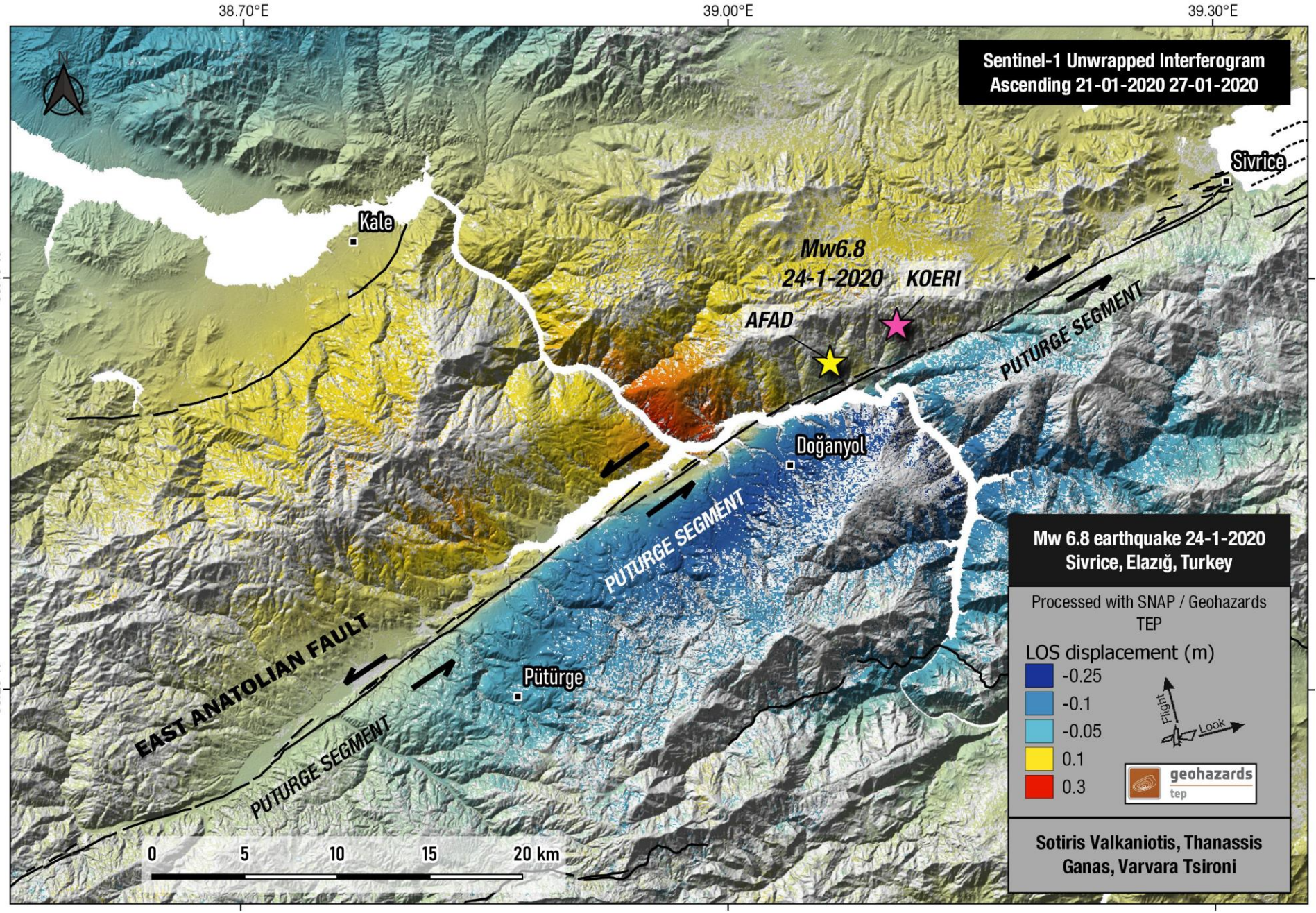
Durres Talk Summary

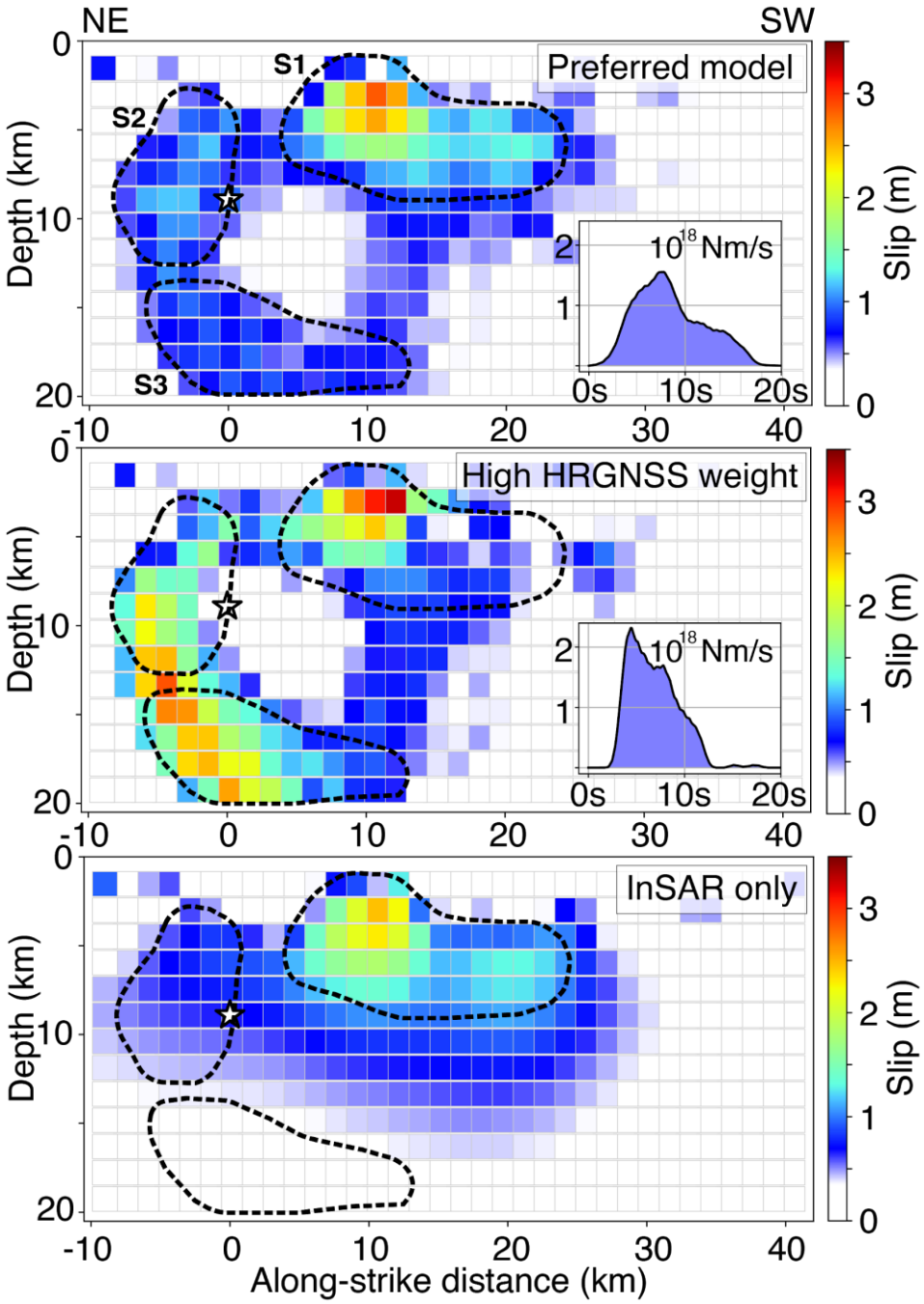
1. We identify the main source of the M6.4 earthquake that rocked north-central Albania on November 26, 2019 to be located within the frontal area of the basal thrust of the Dinaric-Hellenic orogen
2. The seismic structure is the low-angle thrust fault (22 by 11 km) that dips towards east (23°) and continues towards the south
3. Geodetic data GNSS & InSAR show ground motion to the SW and UP in agreement with seismology
4. Geodetic data helped locate the epicentre better as seismology failed because of network problems.

The January 24, 2020 *Mw 6.8* Doğanyol-Sivrice, Turkey Earthquake on the East Anatolian Fault Zone Imaged by Space Geodesy




Earthquake 24/01/2020 Mw 6.8, Eastern Turkey
Wrapped Interferogram
Ascending Orbit
Pair: 15/01/2020-27/01/2020 Relative Orbit: 116
N
Satellite
Line-of-sight
Epicentre of KOERI
Epicentre of AFAD
Epicentre of EMSC
INSTITUTE OF GEODYNAMICS
NATIONAL OBSERVATORY OF ATHENS
Phase_ifg_VV_15Jan2020_27Jan2020 [phase]
-2.88 -2.05 -1.23 -0.4 0.43 1.26 2.09 2.92
Produced by SNAP ESA Software
Epicentres Of Afteshocks (AFAD)
0 5 10 20 30
km
Tsironi, V., Ganas, Ath., @2020
@ Contains modified Copernicus Data 2020
38.6° E
38.7° E
38.8° E
38.9° E
39° E
39.1° E
39.2° E
39.3° E
39.4° E
39.5° E
38.6° N
38.5° N
38.4° N
38.3° N
38.2° N
38.1° N
38° N


38.70°E
39.00°E
39.30°E
38.40°N
38.20°N
Sentinel-1 Unwrapped Interferogram
Ascending 21-01-2020 27-01-2020
Kale
Sivrice
Mw6.8
24-1-2020
KOERI
AFAD
PUTURGE SEGMENT
Doğanyol
PUTURGE SEGMENT
EAST ANATOLIAN FAULT
Pütürge
PUTURGE SEGMENT
0
5
10
15
20 km
Mw 6.8 earthquake 24-1-2020
Sivrice, Elazığ, Turkey
Processed with SNAP / Geohazards TEP
LOS displacement (m)
-0.25
-0.1
-0.05
0.1
0.3
Flight
Look
geohazards tep
Sotiris Valkaniotis, Thanassis Ganas, Varvara Tsironi



Slip inversion results. The preferred slip model is outcome from the joint inversion of InSAR and HR-GNSS with equal weights to each data set.

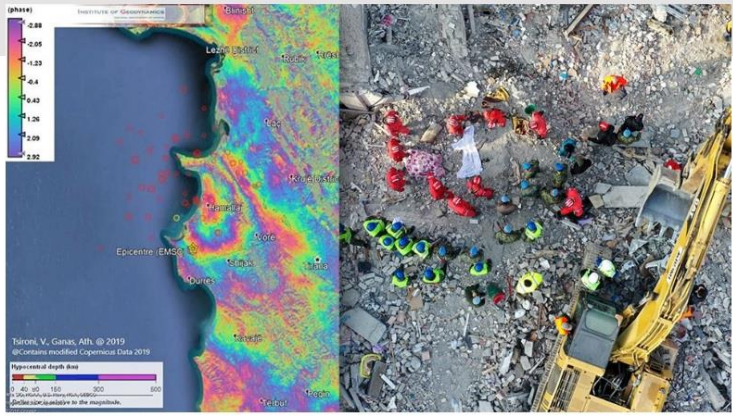
Melgar et al. in preparation

Elazig Talk Summary

1. We identify the main source of the M6.8 earthquake on January 24, 2020 to be located within the Puturge segment of the East Anatolia Fault Zone.
2. The seismic structure is the high-angle left-lateral fault (40 by 15 km) that ruptured towards the southwest
3. Geodetic data GNSS & InSAR show ground motion in agreement with seismology
4. Geodetic data helped determine the slip distribution of the rupture (3 slip patches surrounding one asperity).

Κόσμος #TAGS: Σεισμός • Σεισμός στην Αλβανία • Εθνικό Αστεροσκοπείο Αθηνών

Σεισμός στην Αλβανία: Πάνω από 8 εκατοστά ανυψώθηκε το έδαφος στο Δυρράχιο



Βασίλης Γούλας | 27/11/2019, 20:20 5

Μελέτη του Εθνικού Αστεροσκοπείου Αθηνών δείχνει την ανύψωση του εδάφους μετά τον φονικό σεισμό των 6,4 Ρίχτερ - Δείτε το γράφημα που παρουσίασαν οι ερευνητές - Σε επιφυλακή οι σεισμολόγοι - Αναμένουν νέους ισχυρούς μετασεισμούς

215 SHARES

ΣΧΕΤΙΚΑ ΑΡΘΡΑ

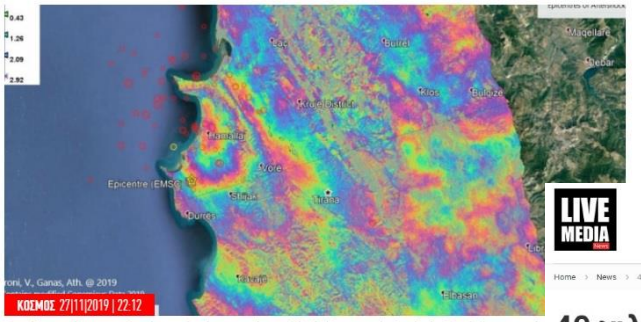
Σεισμός στην Αλβανία - Βίντεο: Η στιγμή που η ΕΜΑΚ ανασύρει ζωντανό από τα ερείπια

27/11/2019, 15:14

ΚΟΣΜΟΣ

ΜΕΓΑΛΕΣ ΖΗΜΙΕΣ ΣΤΗ ΧΩΡΑ

Σεισμός στην Αλβανία: Το έδαφος στο Δυρράχιο ανυψώθηκε κατά 8,4 εκατοστά! [εικόνα]



Ανυψώθηκε το έδαφος στα Δυρράχιο μετά από τον σεισμό στην Αλβανία / Φωτογραφία: Facebook_Εθνικό Αστεροσκοπείο

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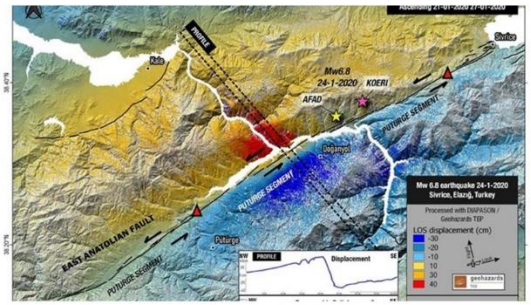
40 χιλιόμετρα η διάρρηξη απο τον σεισμό στην Τουρκία

170 2020/01/28



Ευχαριστώ!