Small scale fault interactions in Southwestern Anatolia as revealed from Seismology & InSAR

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EGU2020-1068
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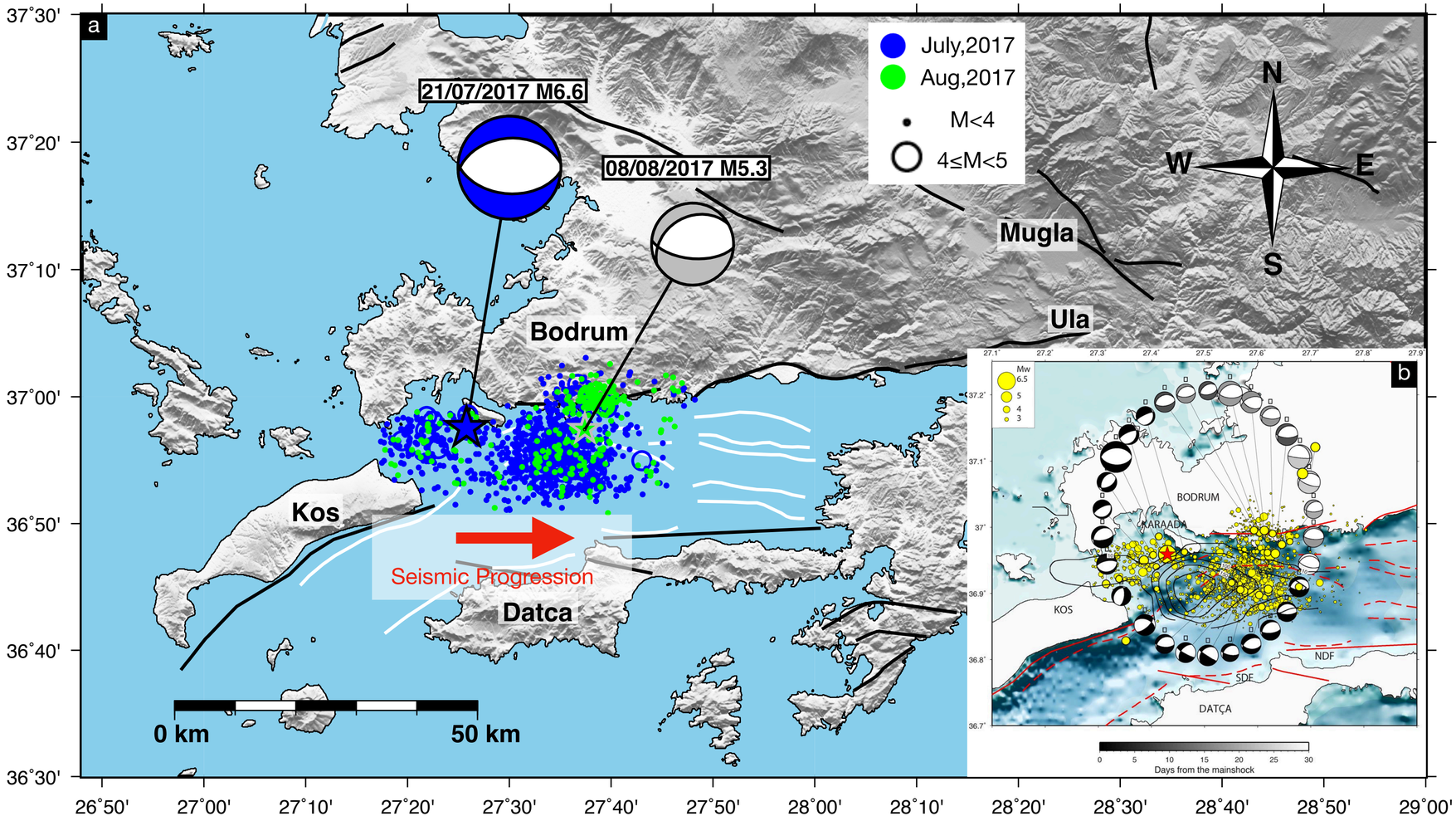
Motivation



2017 Mw6.6 Bodrum Earthquake struck the west of Gokova Bay between Bodrum Peninsula and Island of Kos.

- Following the 2017 main shock in addition to the aftershocks nearby the main fault, we observed triggered events which are part of the fault system that accommodated the opening of the Gokova Bay.
- The aftershock activity **propagates to the eastern edge** of the bay. The largest one occurred ~15 km far away from the main shock (August 08,2017 M5.3).
- Here we focus on an activity near Ula, Mugla. The earthquake sequence occurred 4 months after the Bodrum-Kos Earthquake.We explore the seismic interactions following the main shock.

Figure (1) (a) Relocated main shock, aftershock distribution of July 21, 2017 Mw6.6 Bodrum-Kos Earthquake and (b) focal mechanisms (Konca et. al.,2019) (Faults from the study of Görür *et al*. (1995) and Kurt *et al*. (1999)., Emre *et al*. 2013)

EGU2020-1068

Motivation

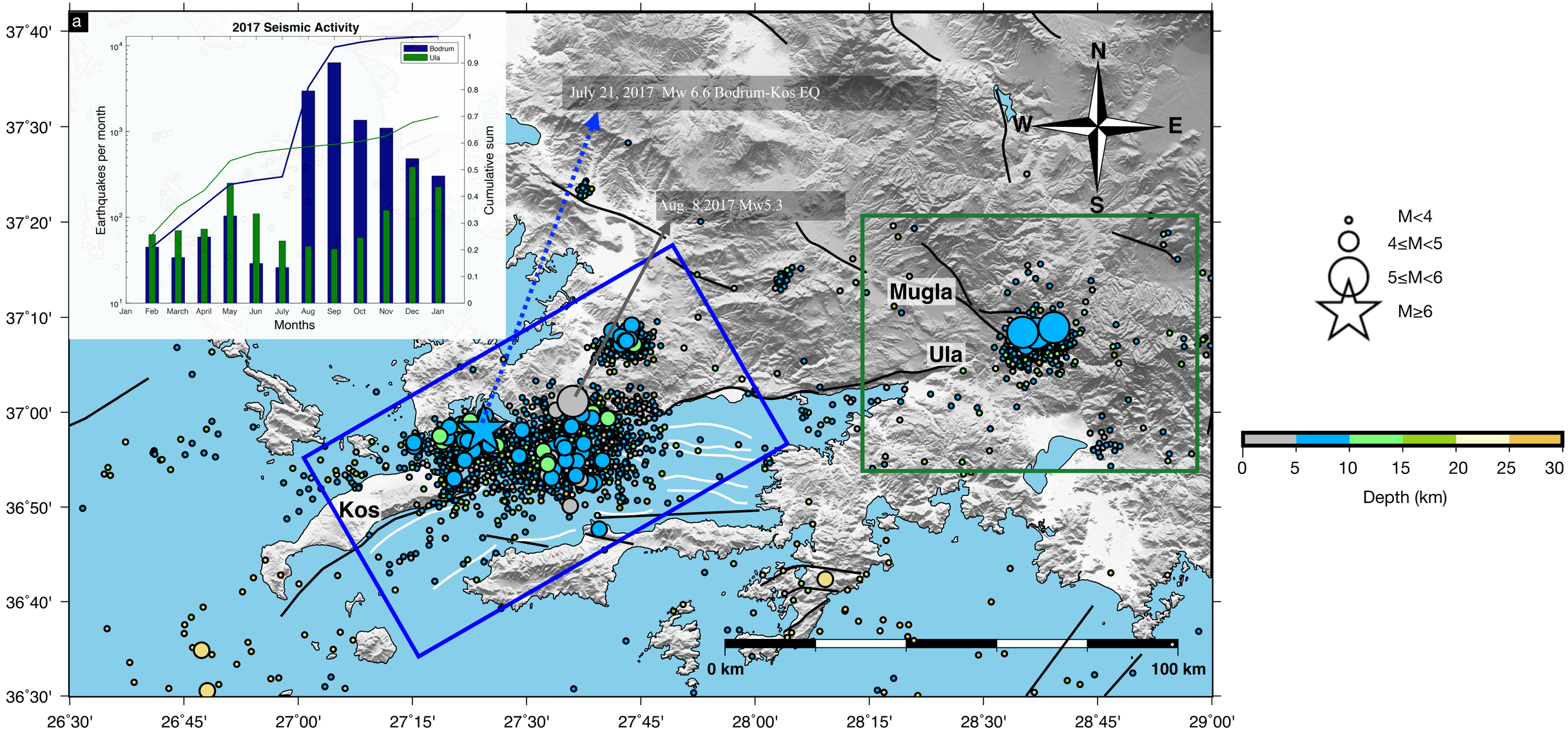


Figure (2) 2017 Seismicity map (data from KOERI).The blue star represents the location of July 21,2017Mw6.6 Bodrum-Kos Earthquake.(a) Number of earthquakes per month in 2017

Motivation

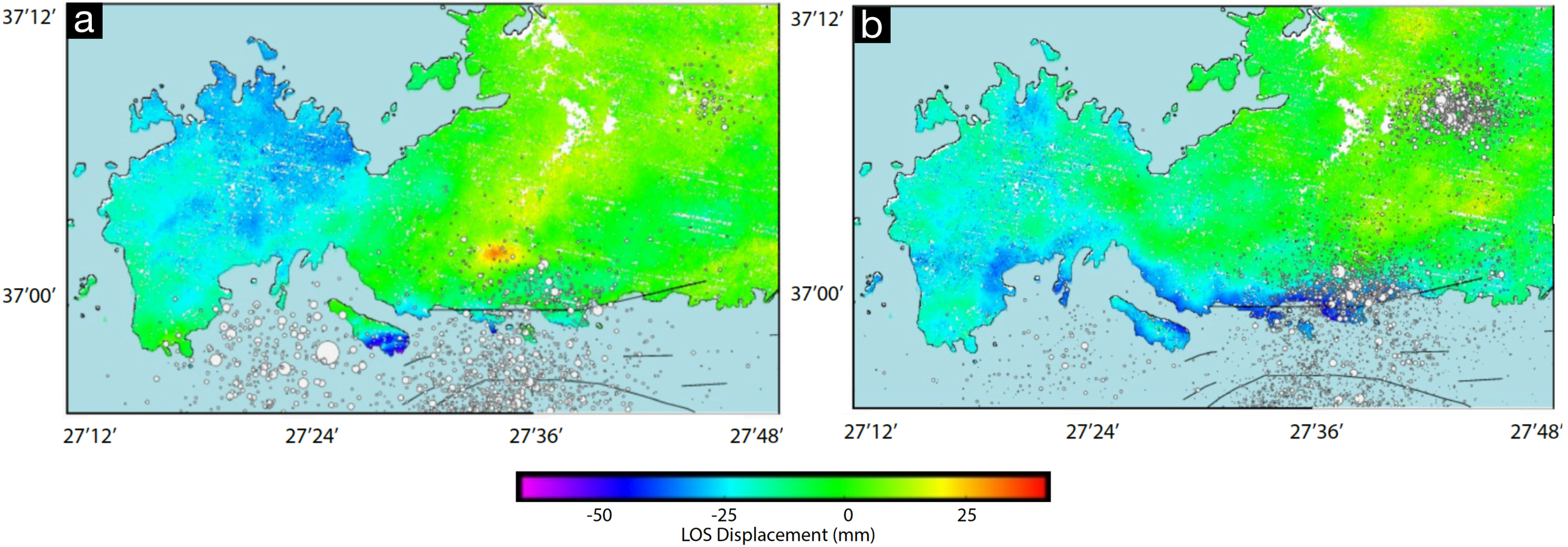
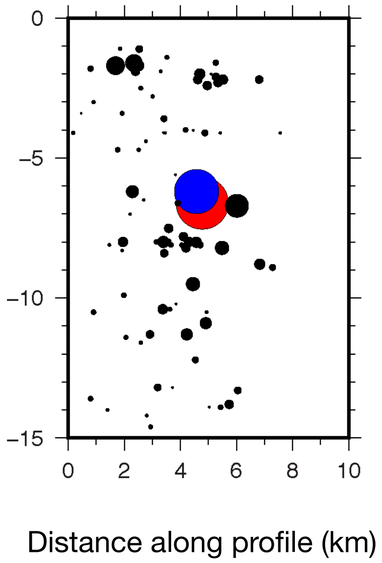
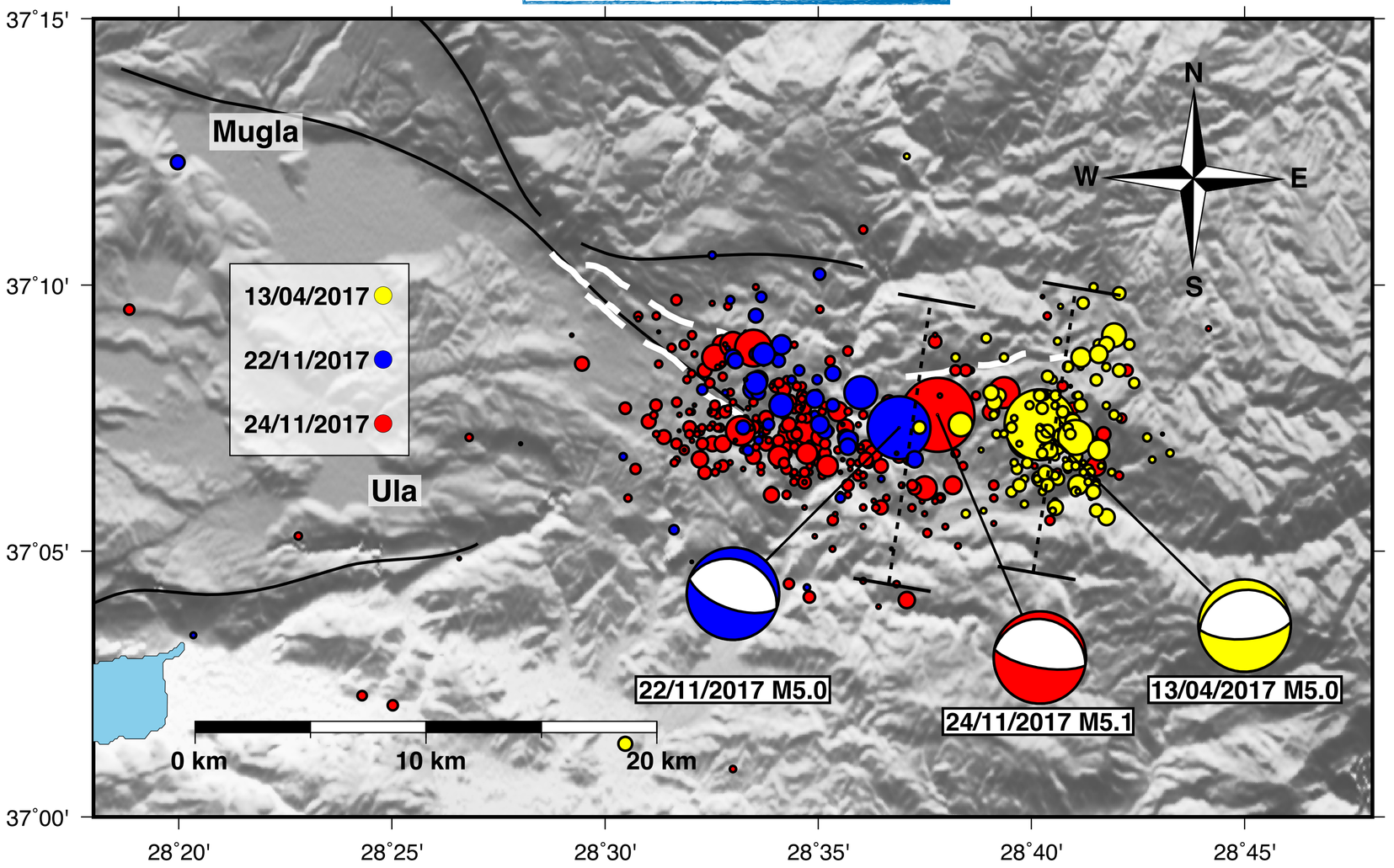


Figure (3) *Co-seismic* (a) and *post-seismic* **LOS displacement** (b) of 2017 Bodrum earthquake obtained from InSAR data (Copernicus/ESA Sentinel-1 satellite [2017]).

The west to east directed seismic progression of seismicity after the 2017 July Bodrum-Kos earthquake is quite clear both from temporal evolution of seismicity and the deformation pattern derived from InSAR data.The fault structures in Aegean region are segmented and seismic interaction between these segments can be usually observed in many cases. In our case, the Ula earthquakes are not triggered by the co-seismic slip of Bodrum earthquake. The activity seems to be related to the wide scale post-seismic deformation which seems to propagate toward east.

Seismicity *Ula*





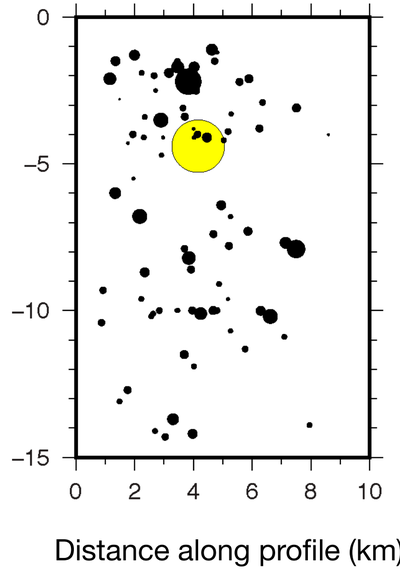


Figure (4) Relocated location distribution of 2017 seismic activity in Ula region.

Results from *seismology* and *geodesy*, both indicate that the **2017 activity occurred along a previously unknown normal fault** instead of the southeastern branches of the nearby Mugla Fault as proposed earlier. The new fault structure, which was recently mapped by Akyuz et al. (2018) on the surface follows the trend of active faults in Gökova Bay to the east and could shed light on the active tectonics of the Gökova fault zone. Dashed white lines represent this proposed fault by Akyuz et. al. for this area.

EGU2020-1068

Seismicity *April,2017*

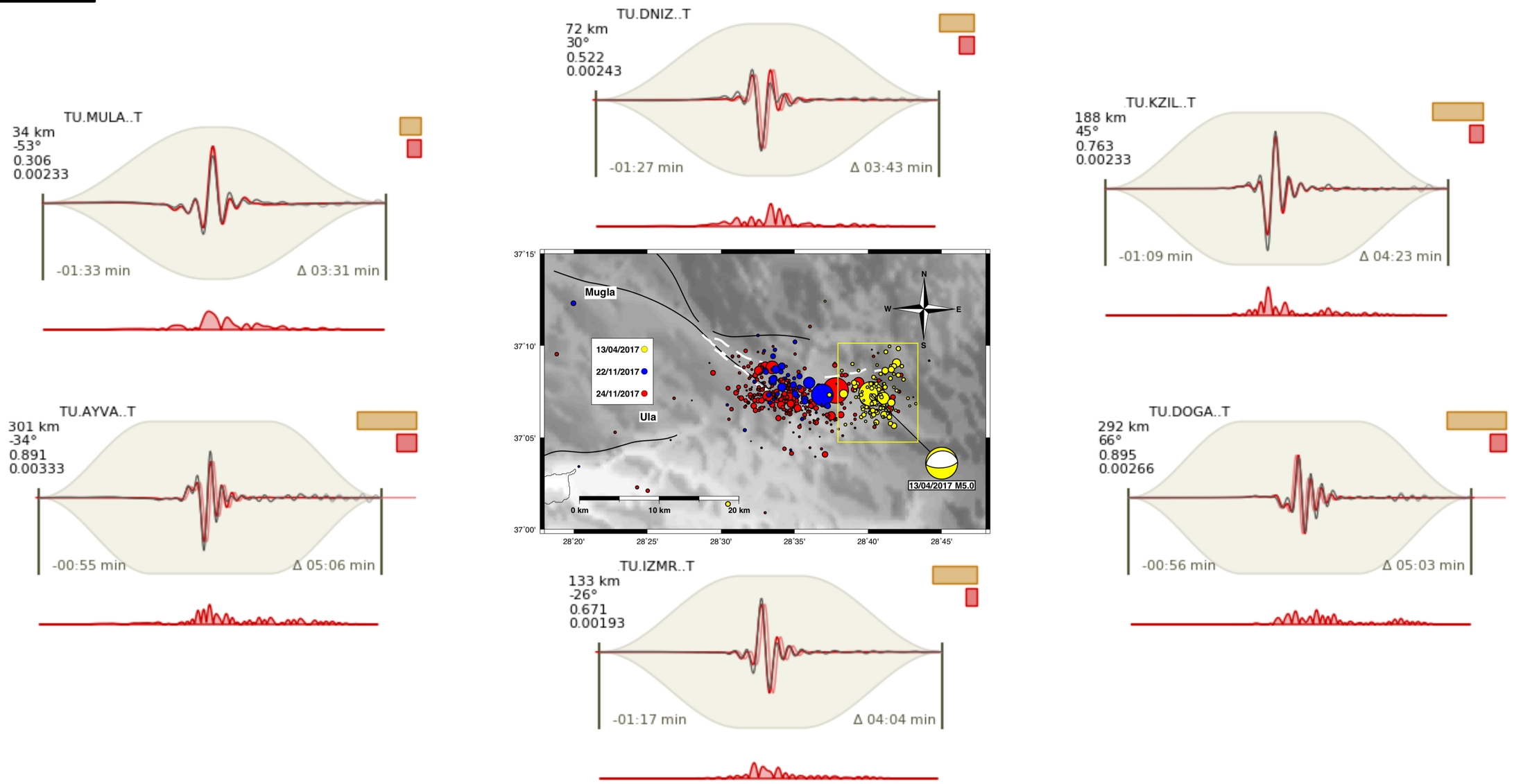
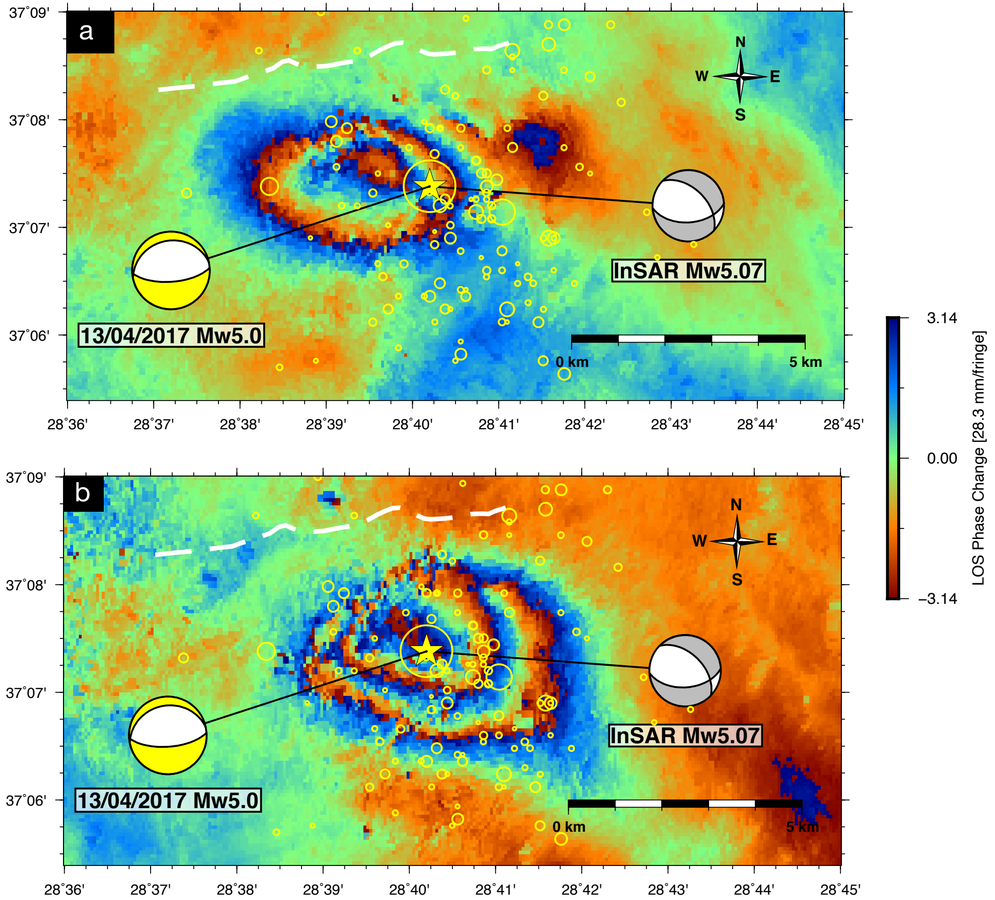


Figure (5) Examples of the waveform fits for the April event. Source mechanism was remodelled from regional seismic waveforms (from DDA network) by using the Grond (Pyrocko) Tool for this event.

EGU2020-1068

InSAR *April,2017*

We also modeled the slip due to the event in April 2017 and the double earthquakes of November 2017 using InSAR data.Before modeling,all interferograms are corrected by using the GACOS(Generic Atmospheric Correction Online Service) tropospheric phase delay products. The second step of our pre-process is mask and deramp the data based on the correlation level.The displacement data are sub-sampled by using quadtree parametrisation in Kite Tool (Pyrocko).



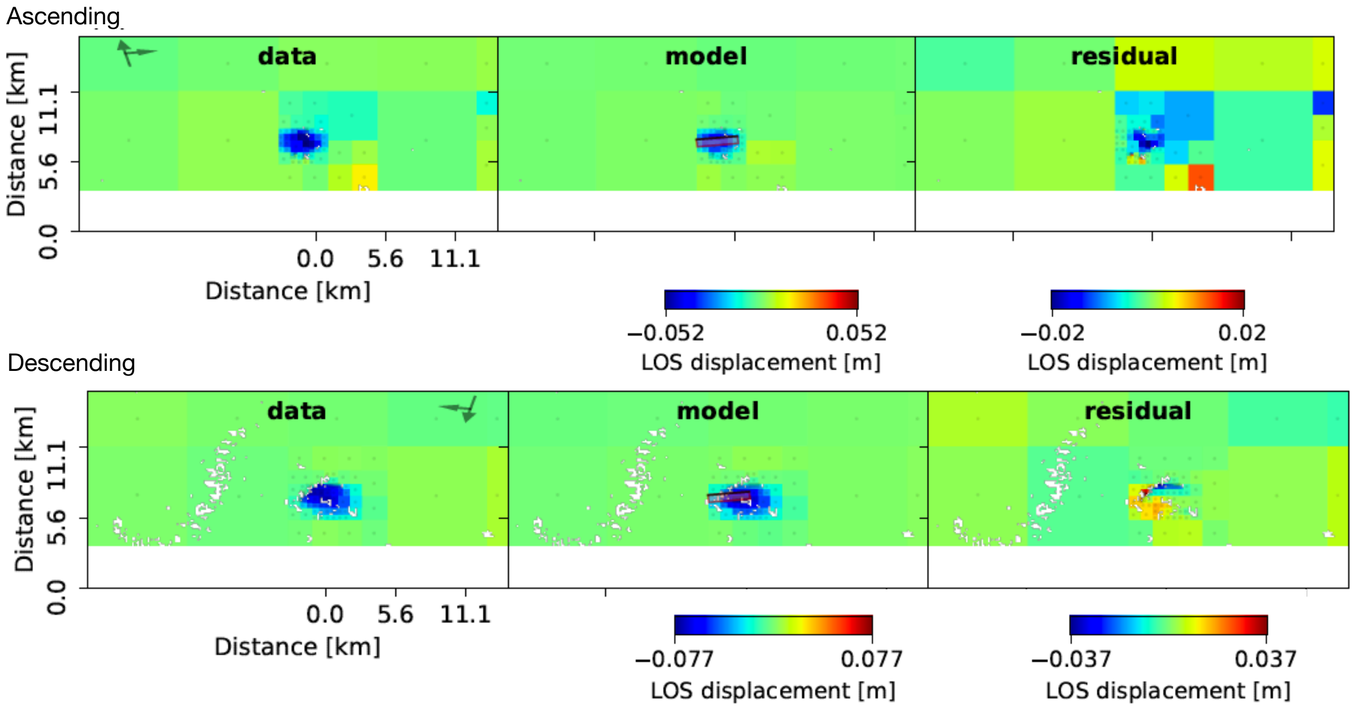


Figure (6) Surface deformation of this event are obtained from both ascending (a) and descending (b) orbits of the Sentinel-1A/B satellites. (a) The data from 13/04/2017-25/04/2017 and (b) 08/04/2017-08/05/2017 are processed by using ISCE software (Rosen P.,et al.,2015). Yellow beachball represents the fault mechanism of this event from seismology and the **gray** one indicates that the **InSAR modeli**ng result.

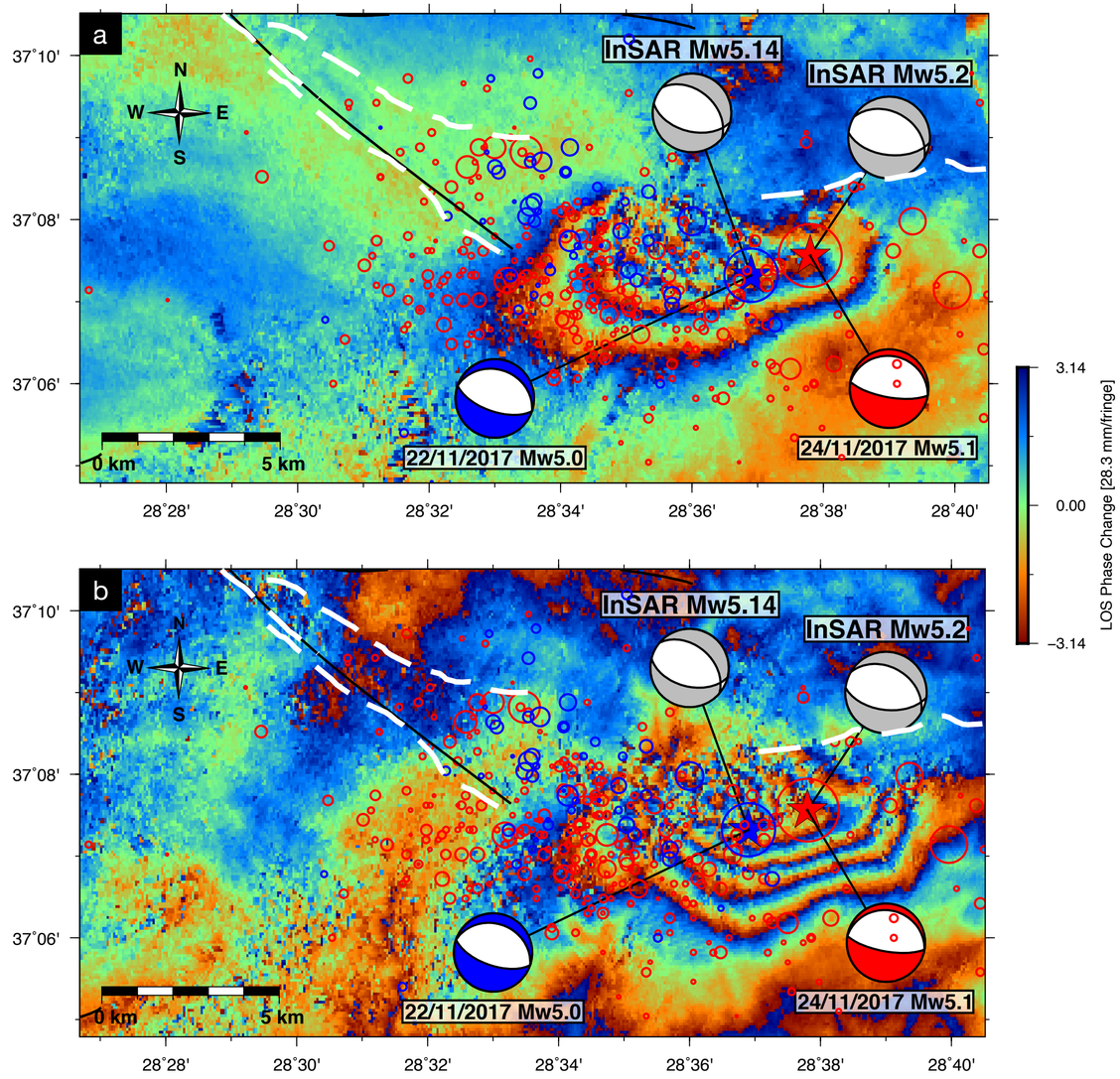
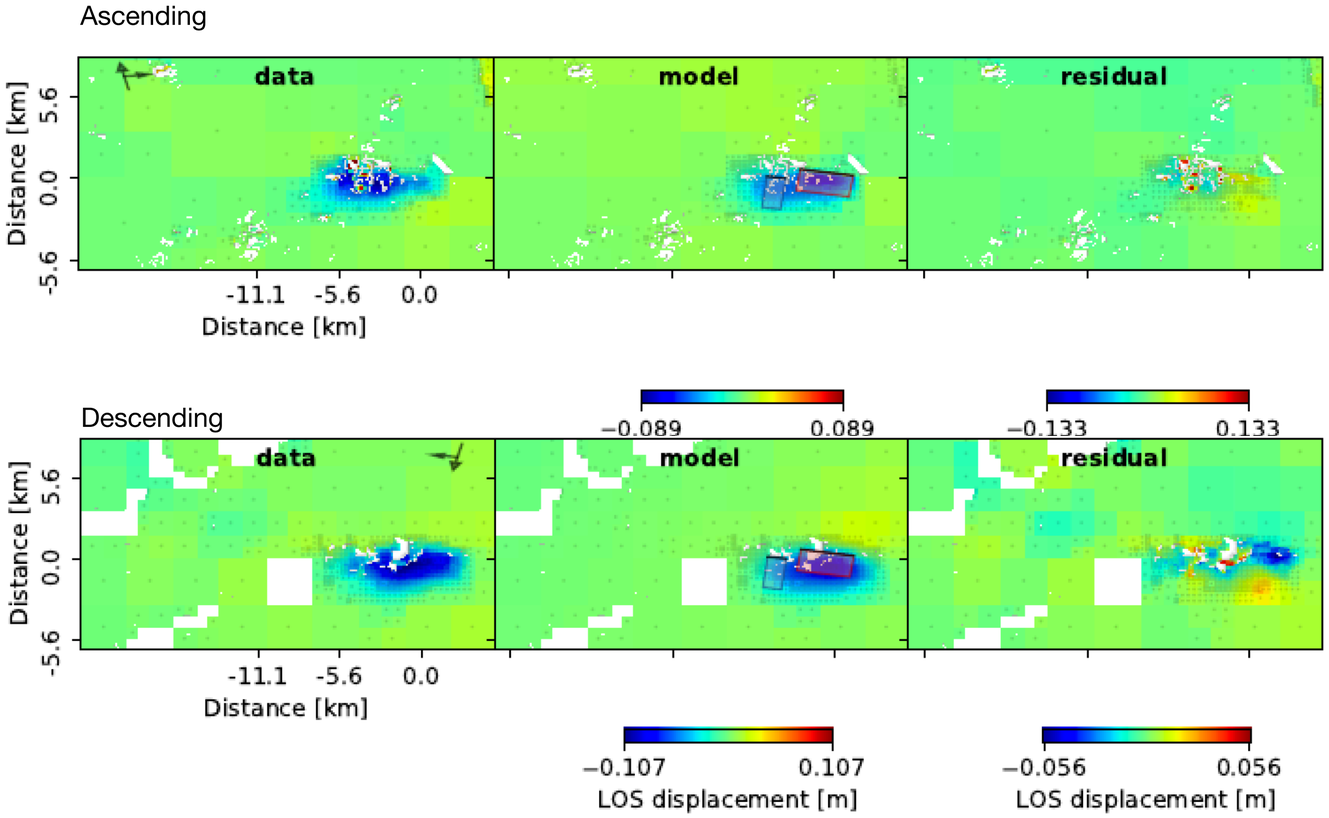


Figure (7) Surface deformation of these events are obtained from both ascending (a) and descending(b) orbits of the Sentinel-1 A/B satellites.The data from 03/11/2017-21/12/2017(a)and 04/11/2017-16/12/2017(b)are processed by using ISCE software (Rosen P., et al.,2015). Blue and red beachballs indicate that the fault mechanism from seismology and the **gray beachball** represents the **InSAR model**ing.



CONCLUSION

➢**Co-seismic** and **post-seismic** InSAR analysis show that the seismic activity following the *2017 Bodrum-Kos* propagated from western Gökova Bay where rupture occurred toward east including the Ula region.

➢Comparison of seismicity beneath Gökova Bay and Ula region shows that the seismicity in these two regions are *temporally correlated.*

➢4 months of delay between the Bodrum earthquake and the Ula activity implies that the activity did not initiate due to coseismic rupture. However, observed propagation of seismic activity and **post-seismic** deformation *toward east* might have eventually led to the activity along the Ula fault.

➢We show that the interpretations of the moderate size earthquakes should be studied by using **multidisciplinary** data sets. This study cannot be realized without any *geodetic* or *seismic* data.

➢The geometry and slip depth from InSAR data are consistent with the focal mechanism of the earthquakes. The fault planes of the November events and the April event show that the newly discovered Ula fault has a segmented character with nearly **EW directed** strike and 55 degree dip change.

➢The 2017 Ula activity occurred along a previously unknown normal fault instead of the southeastern branches of the nearby Mugla Fault as proposed earlier.

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EGU2020-1068

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