Tsunami hazards and risk mitigation in the Hellenic Arc

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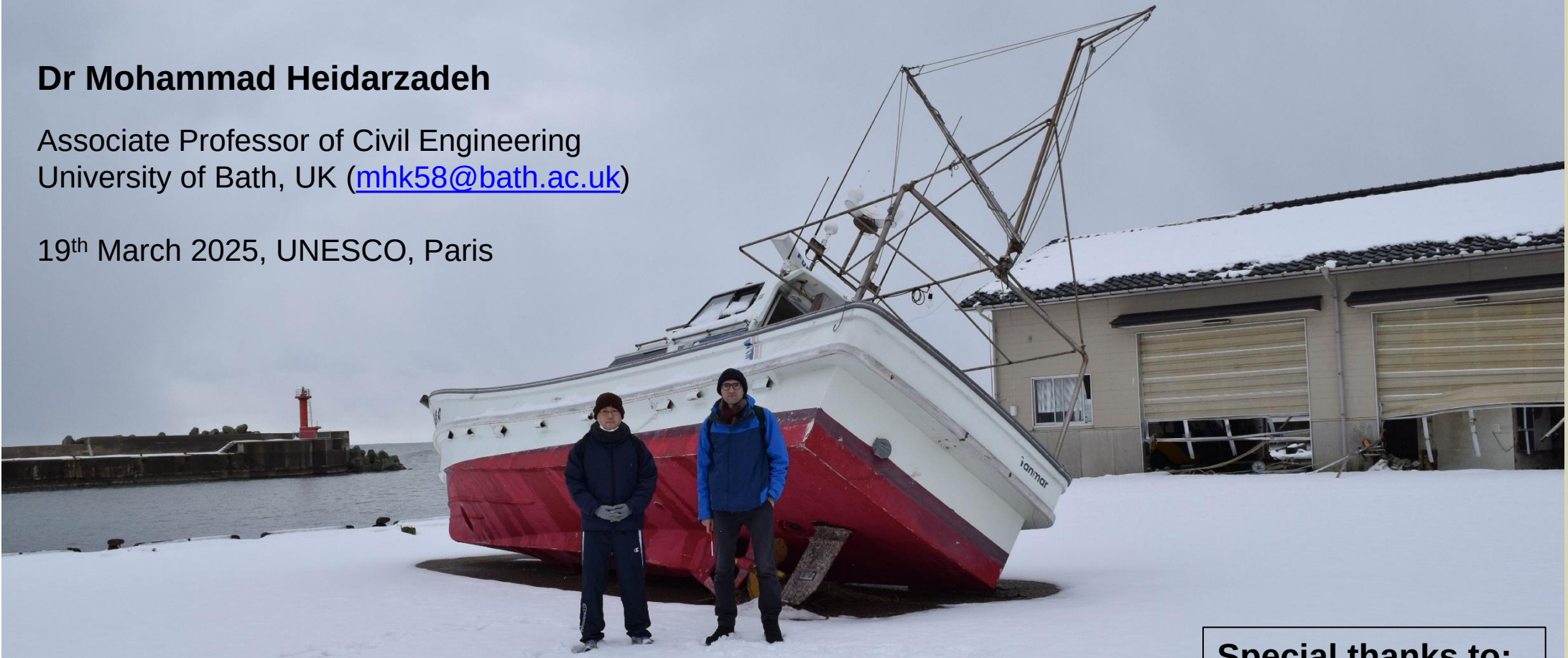

(c) Dr Mohammad Heidarzadeh
Field surveys of 1st January 2024 Noto Peninsula (Japan) M7.5 earthquake and tsunami

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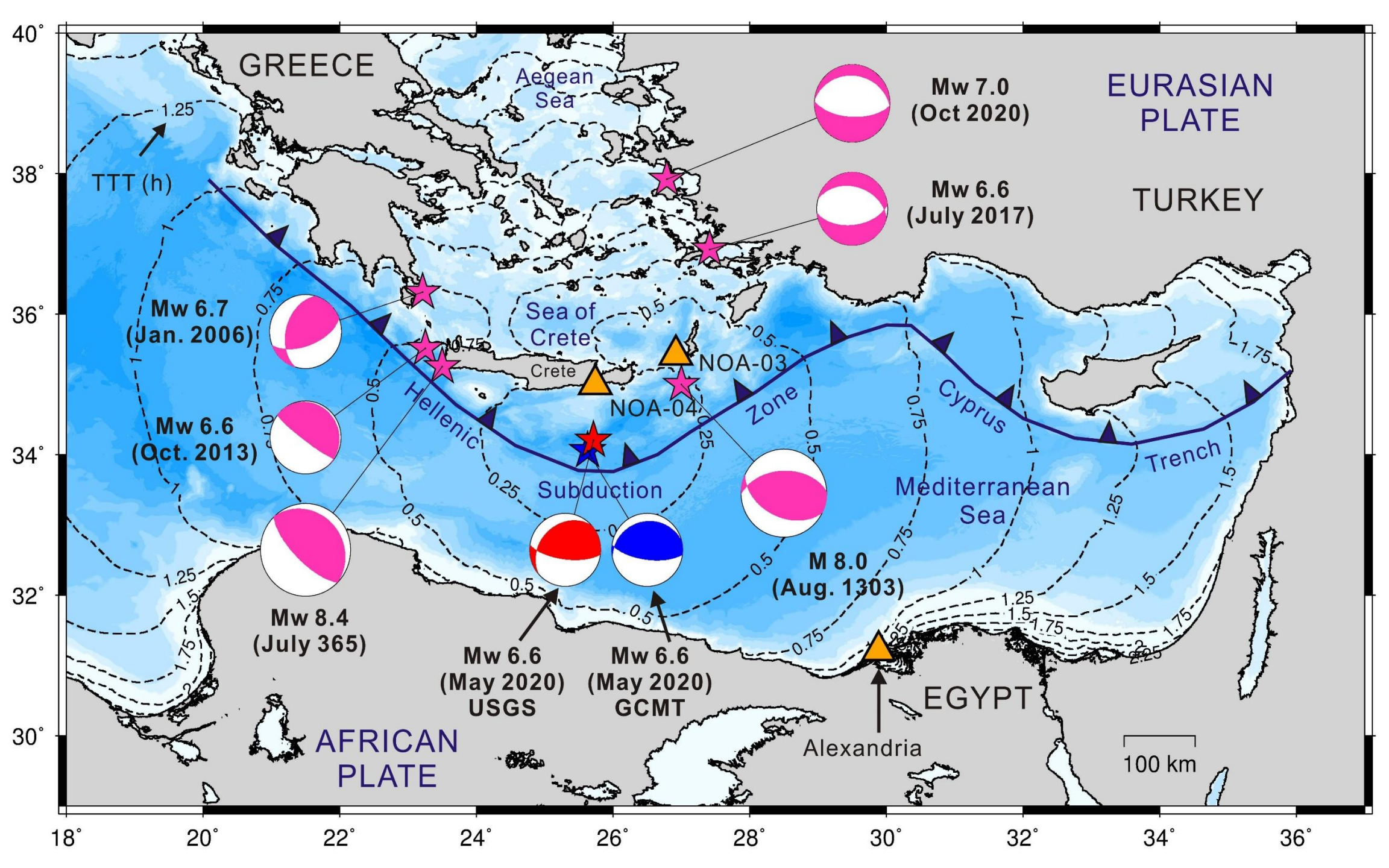
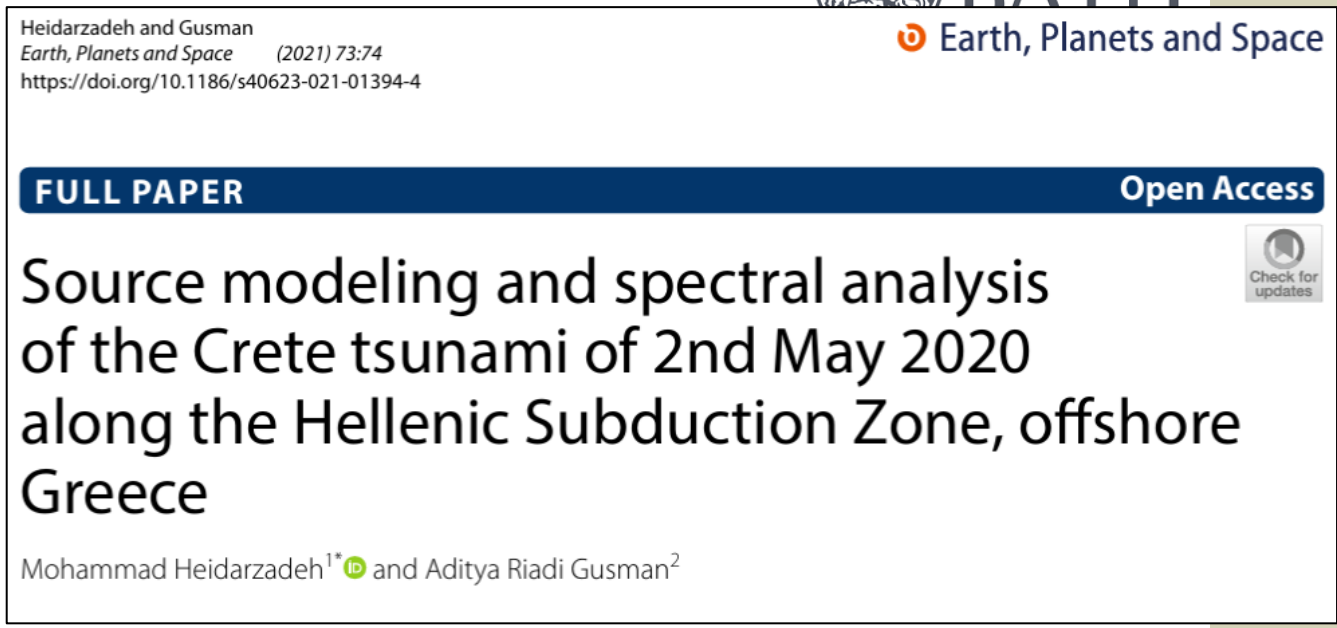
- Derya
- Anzhela
- Denis
- Jorge
- Gerassimos


GREECE
Aegean Sea
EURASIAN PLATE
TURKEY
Mw 7.0 (Oct 2020)
Mw 6.6 (July 2017)
TTT (h)
1.25
Mw 6.7 (Jan. 2006)
Mw 6.6 (Oct. 2013)
Sea of Crete
Crete
NOA-03
NOA-04
Hellenic
Subduction
Zone
Cyprus
Trench
Mediterranean Sea
M 8.0 (Aug. 1303)
Mw 8.4 (July 365)
Mw 6.6 (May 2020) USGS
Mw 6.6 (May 2020) GCMT
AFRICAN PLATE
EGYPT
Alexandria
100 km
40˚
38˚
36˚
34˚
32˚
30˚
18˚
20˚
22˚
24˚
26˚
28˚
30˚
32˚
34˚
36˚

The plan of this talk:

- An analysis of the 2nd May 2020 Crete event from the Hellenic Arc



Heidarzadeh and Gusman
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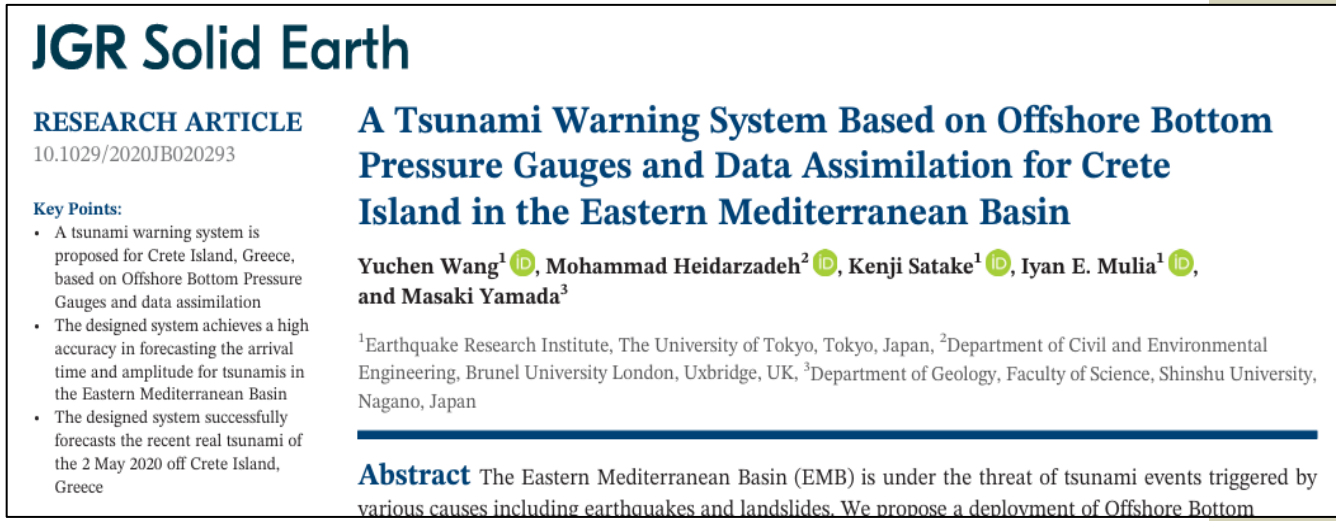
Earth, Planets and Space

FULL PAPER Open Access

Source modeling and spectral analysis of the Crete tsunami of 2nd May 2020 along the Hellenic Subduction Zone, offshore Greece

Mohammad Heidarzadeh[1*] and Aditya Riadi Gusman[2]

- A tsunami warning system for Crete Island



JGR Solid Earth

RESEARCH ARTICLE
10.1029/2020JB020293

Key Points:
- A tsunami warning system is proposed for Crete Island, Greece, based on Offshore Bottom Pressure Gauges and data assimilation
- The designed system achieves a high accuracy in forecasting the arrival time and amplitude for tsunamis in the Eastern Mediterranean Basin
- The designed system successfully forecasts the recent real tsunami of the 2 May 2020 off Crete Island, Greece

A Tsunami Warning System Based on Offshore Bottom Pressure Gauges and Data Assimilation for Crete Island in the Eastern Mediterranean Basin

Yuchen Wang[1], Mohammad Heidarzadeh[2], Kenji Satake[1], Iyan E. Mulia[1], and Masaki Yamada[3]

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Abstract The Eastern Mediterranean Basin (EMB) is under the threat of tsunami events triggered by various causes including earthquakes and landslides. We propose a deployment of Offshore Bottom

May 2020 Crete event (M_w 6.6)

Seismic parameters

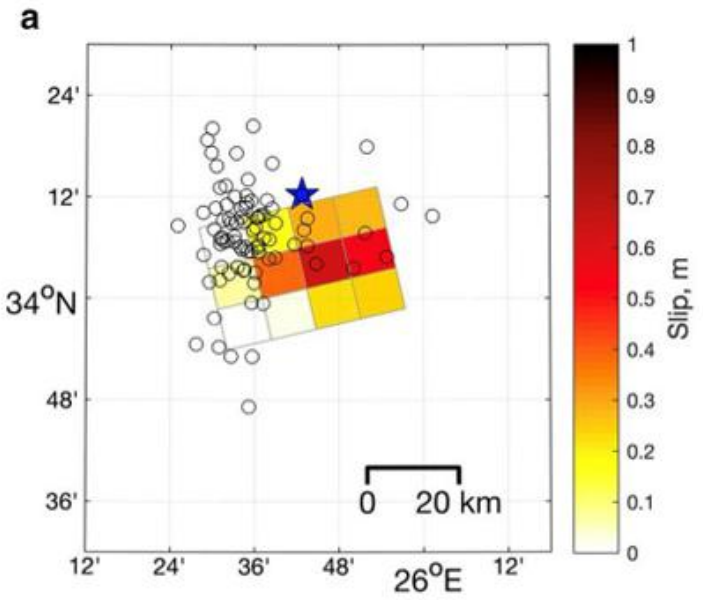

Table 1 Seismic parameters of the 2 May 2020 Crete Island earthquake from different seismological agencies

Seismic parameter	Seismological agency			
	USGS	GCMT	EMSC[a]	GFZ[b]
Moment magnitude (M_w)	6.6	6.6	6.6	6.6
Origin time (hh:mm:ss UTC)	12:51:06	12:51:9.8	12:51:05.4	12:51:06.5
Epicenter (Lon / Lat)	25.712 °E / 34.205 °N	25.63 °E / 34.06 °N	25.70 °E / 34.14 °N	25.75 °E / 34.27 °N
Depth (km)	11.5	12.0	10.0	10.0
Strike/Dip/rake angles (degrees)	229/31/46	257/24/71	N/A[c]	264/22/76

[a] European-Mediterranean Seismological Centre (https://www.emsc-csem.org); [b]Deutsches GeoForschungs Zentrum (http://geofon.gfz-potsdam.de/); [c]Not applicable

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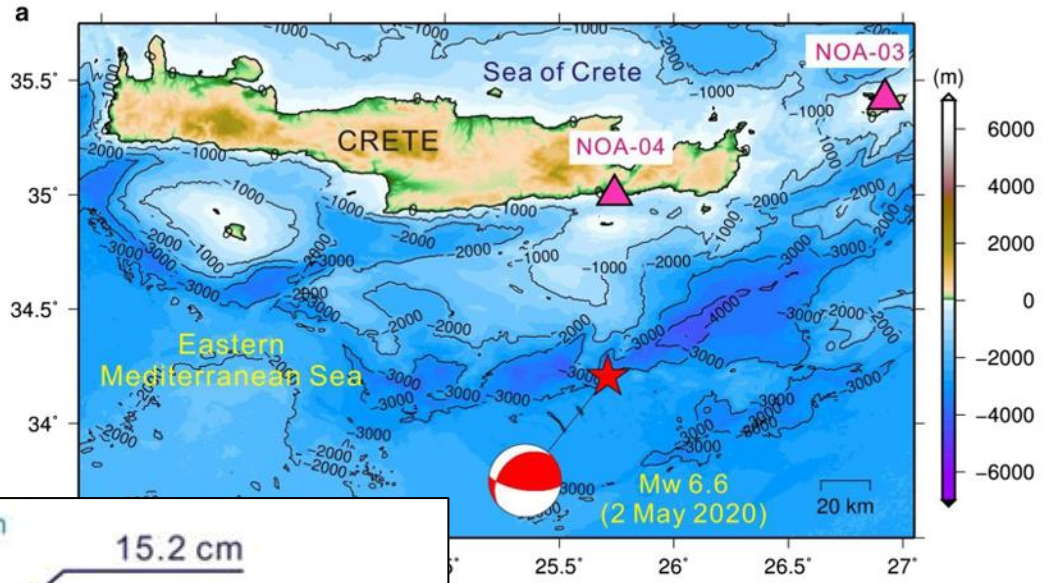
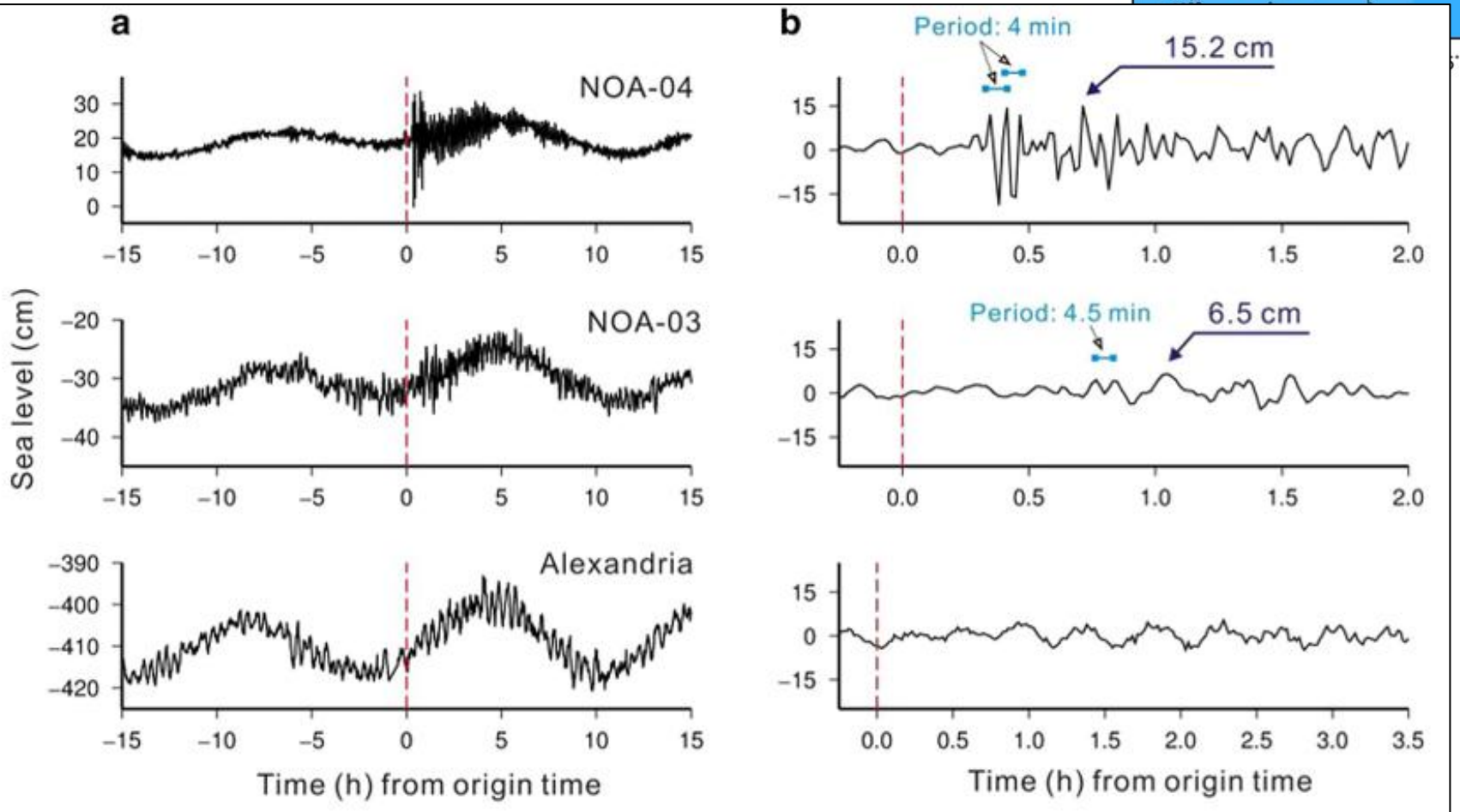
Tsunami is visible at two Greek stations:

NOA-04: amplitude 15.2 cm

NOA-03: amplitude 6.5 cm





May 2020 Crete event (M_w 6.6)

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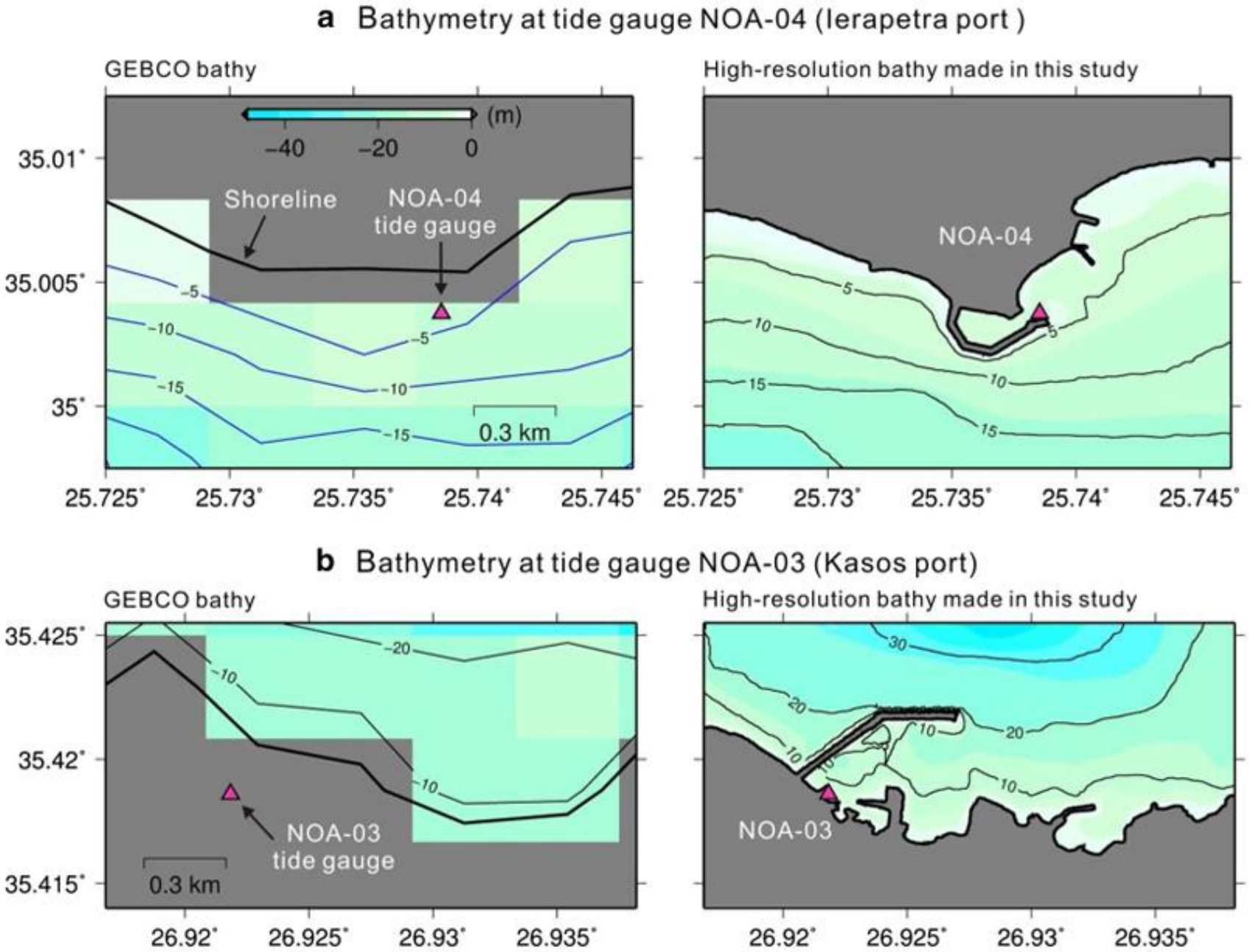
Making high-resolution bathymetry

It is expensive and time-consuming to make high-resolution bathymetry data, but it is **essential**.



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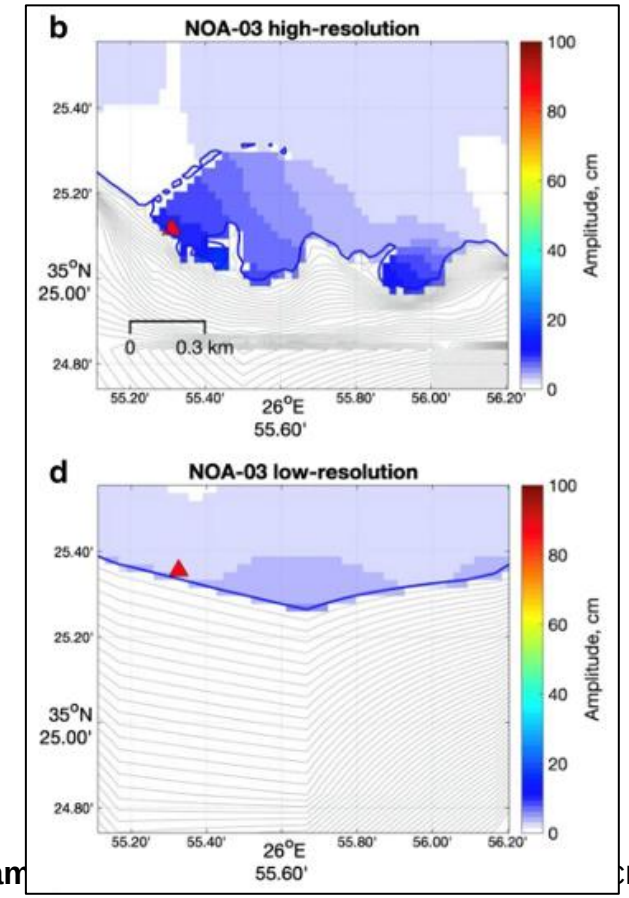
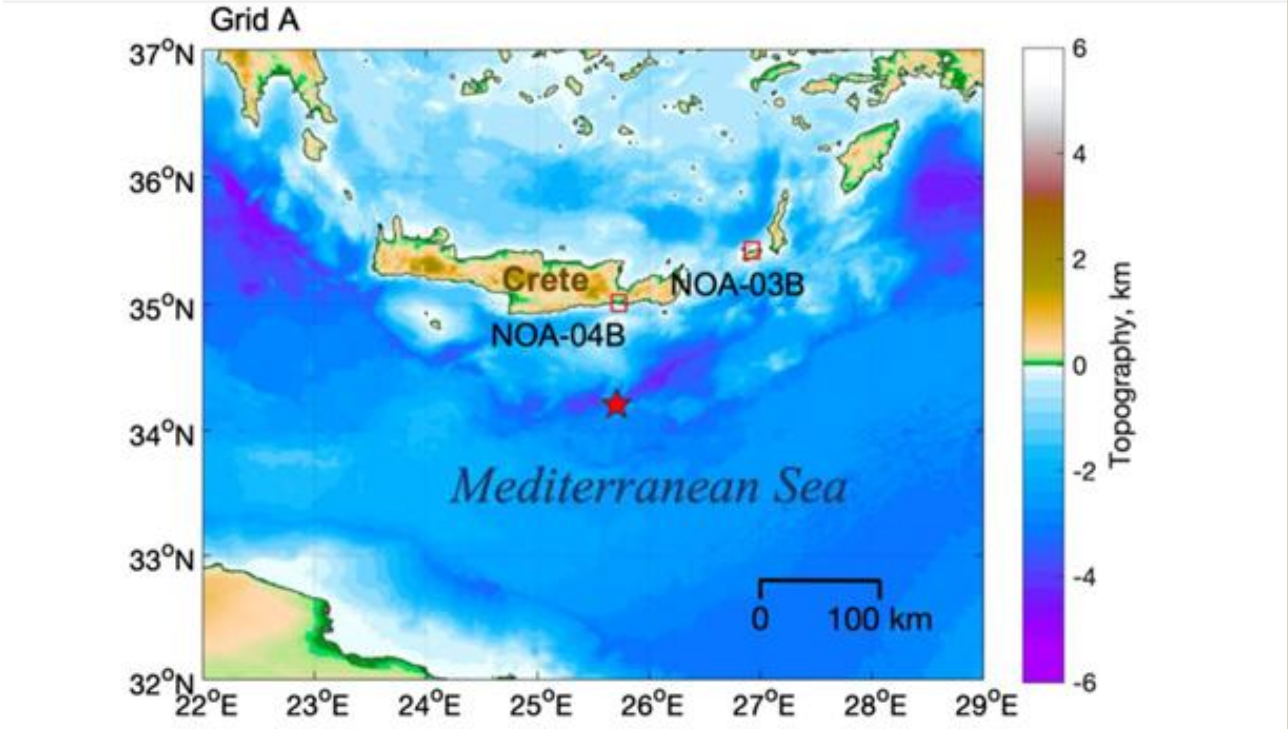
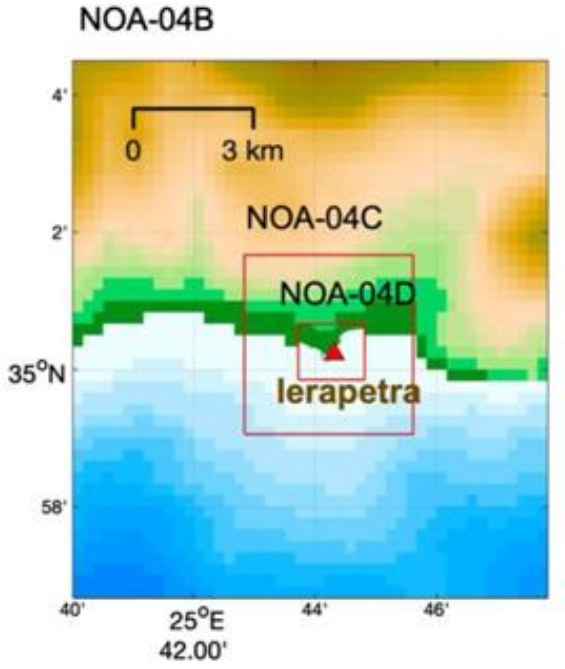
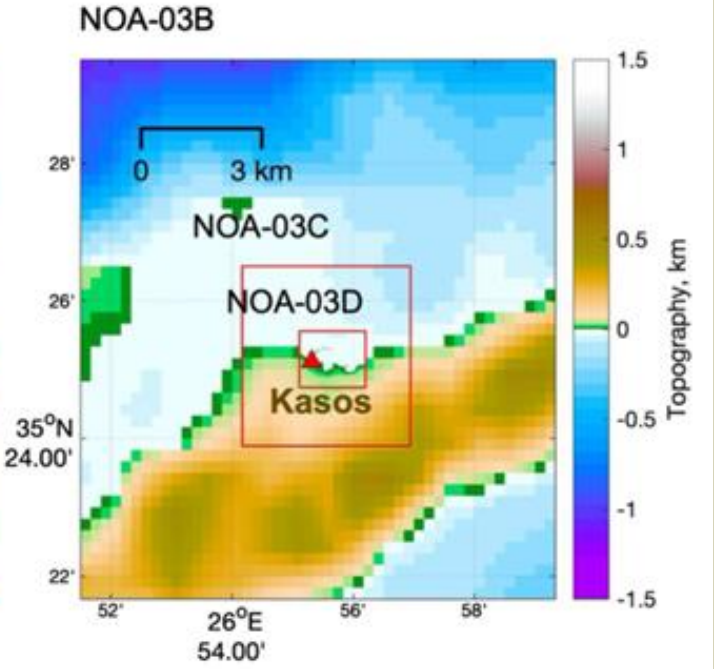
Tsunami source inversion

- Four-level nested grid
- Linear SWEs
- Model COMCOT









May 2020 Crete event (M_w 6.6)

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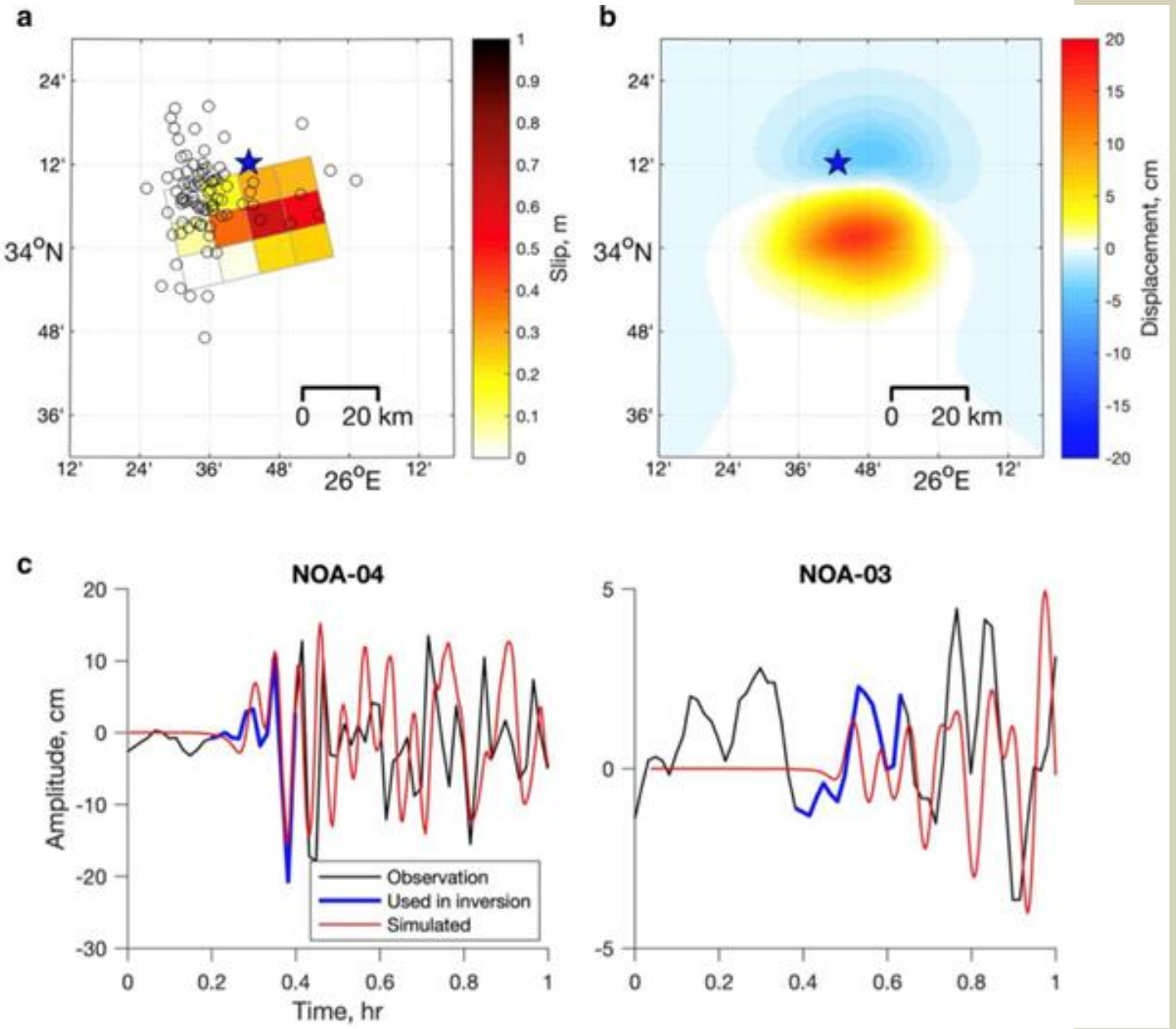
Tsunami source inversion

- Max slip = 0.64 m
- Mean slip = 0.28 m
- Length = 40 km
- Width = 30 km



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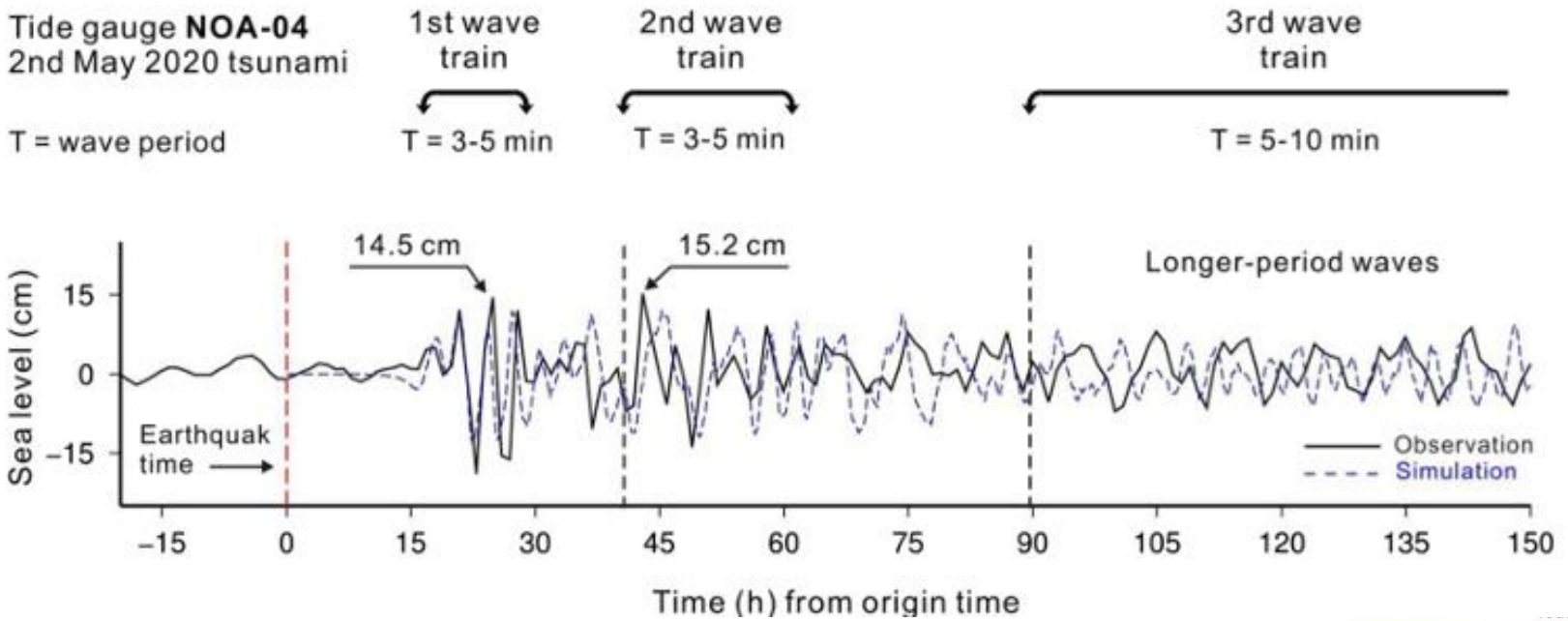
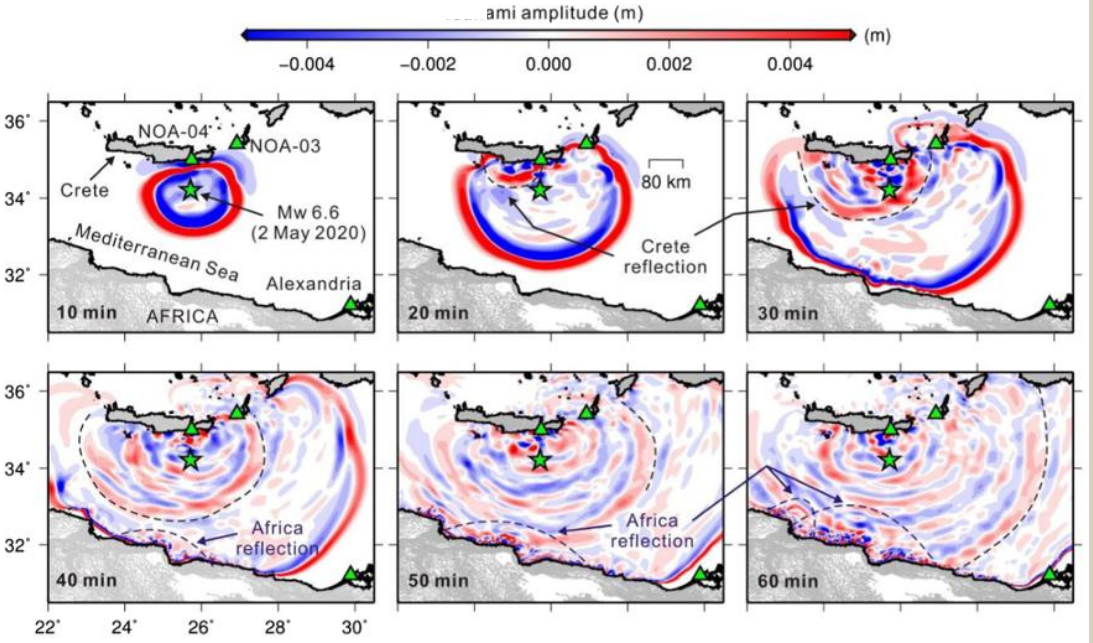
May 2020 Crete event (M_w 6.6)





Tsunami oscillations:

Several wave trains are seen. A bigger tsunami could make longer oscillations.

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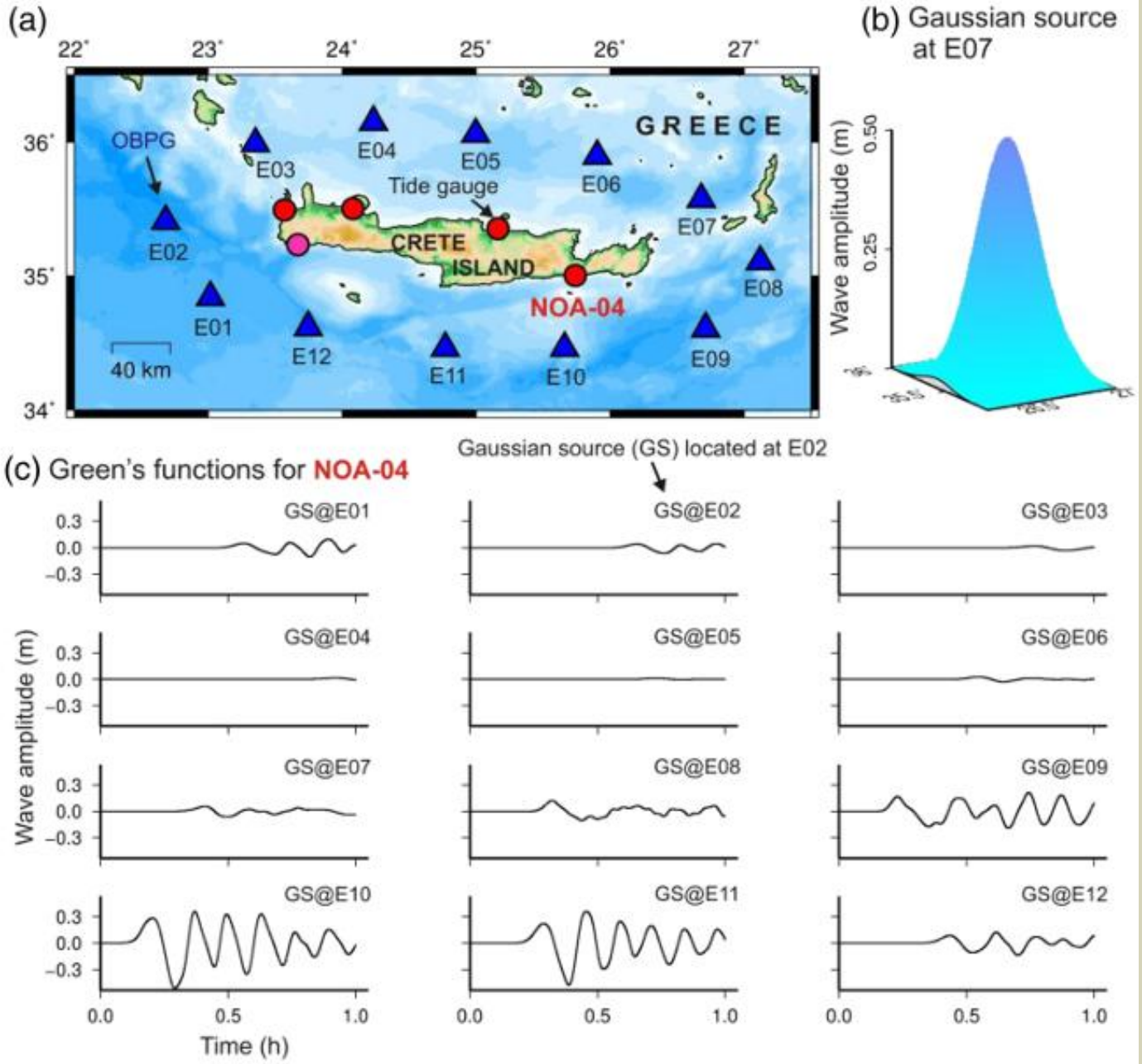
A warning system based on DARTs

We propose a deployment of Offshore Bottom Pressure Gauges (OBPGs or DARTs) around Crete Island, which would enable tsunami early warning by data assimilation.



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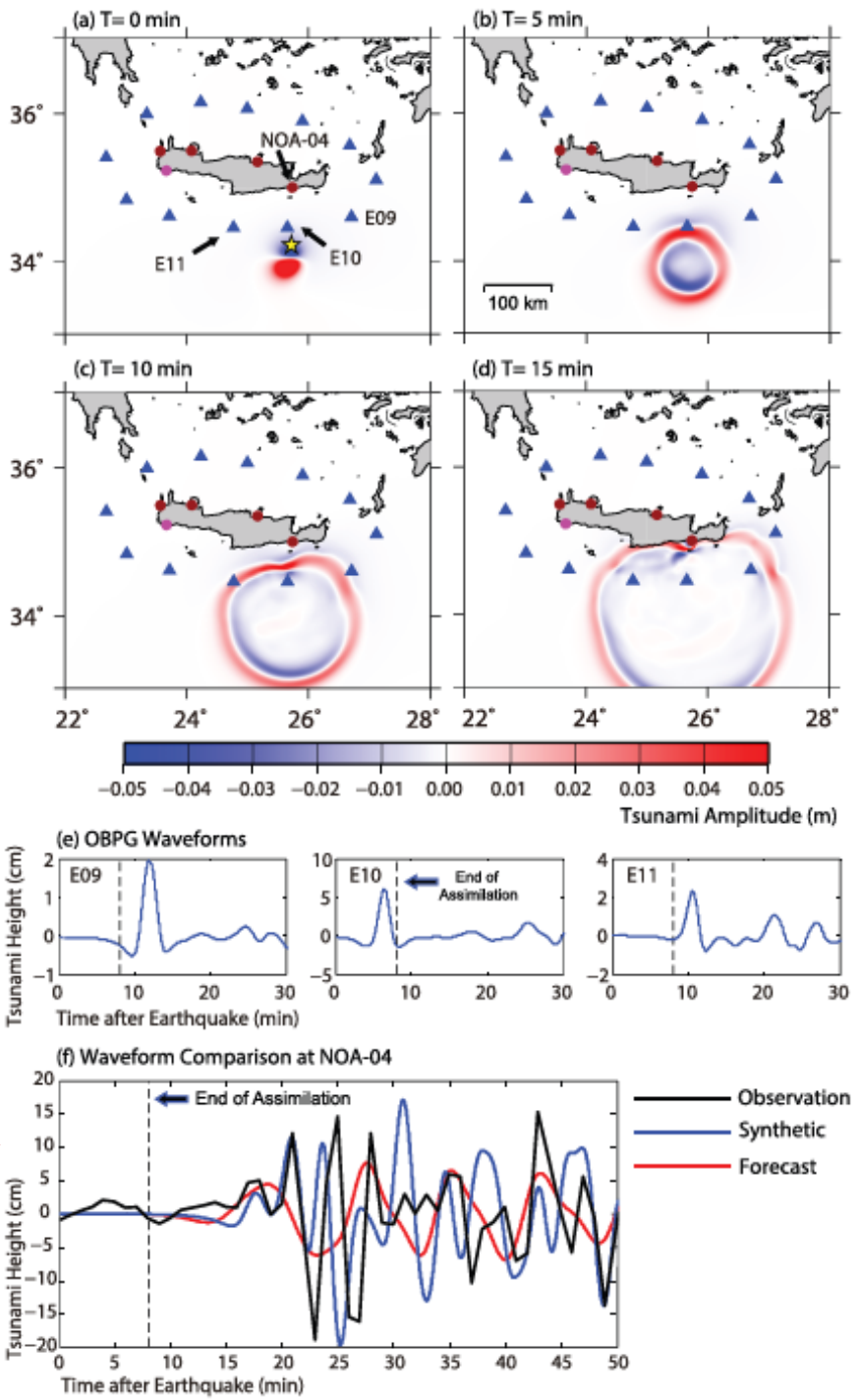
A warning system based on DARTs

The performance of the systems was tested for the May 2020 Crete event (M_w 6.6).

By assimilating **only 8 min** of actual tsunami observations, the tsunami is forecasted fairly well in terms of arrival time and max amplitudes.



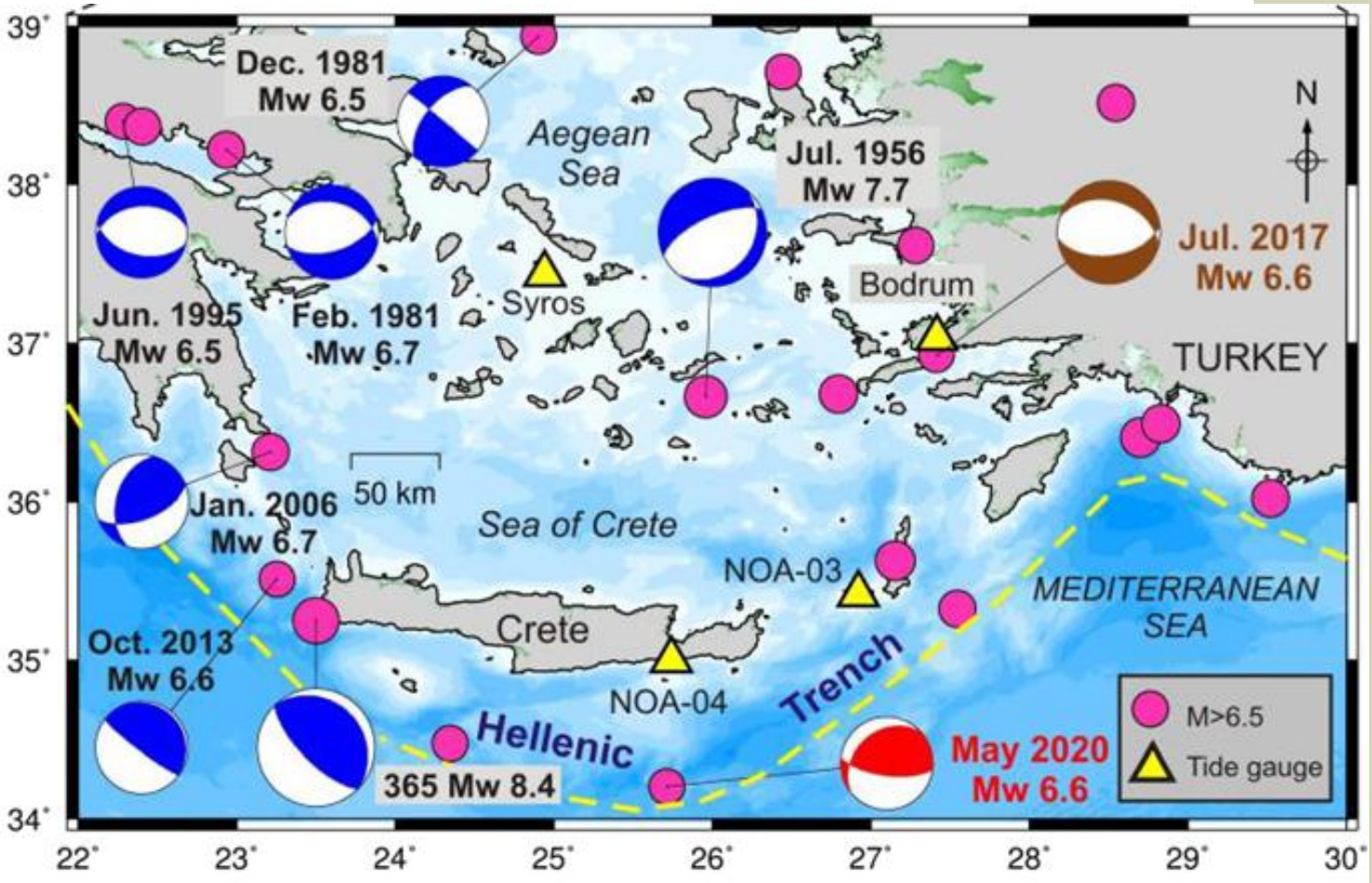
Conclusions

1) Hellenic Arc is obviously a massive source of tsunami in East Mediterranean

2) The need for high-resolution bathymetries from the coastal areas in the region.

3) Multiple wave reflections in the region can intensify tsunami hazards.

4) A DART-based tsunami data assimilation system is proved to be useful for warning.



Thank you!

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