



# **THE 2015 LEFKAS EARTHQUAKE (NOVEMBER 17, Mw 6.4)**

## **AN EPISODE IN THE GEODYNAMIC EVOLUTION OF IONIAN SEA**





# THE 2015 LEFKAS EARTHQUAKE (NOVEMBER 17, Mw 6.4)

AN EPISODE IN THE GEODYNAMIC EVOLUTION OF IONIAN SEA







**NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS**  
**POST GRADUATE PROGRAM**  
**ENVIRONMENTAL, DISASTER AND CRISES MANAGEMENT**



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## GEODYNAMIC & SEISMOTECTONIC SETTING

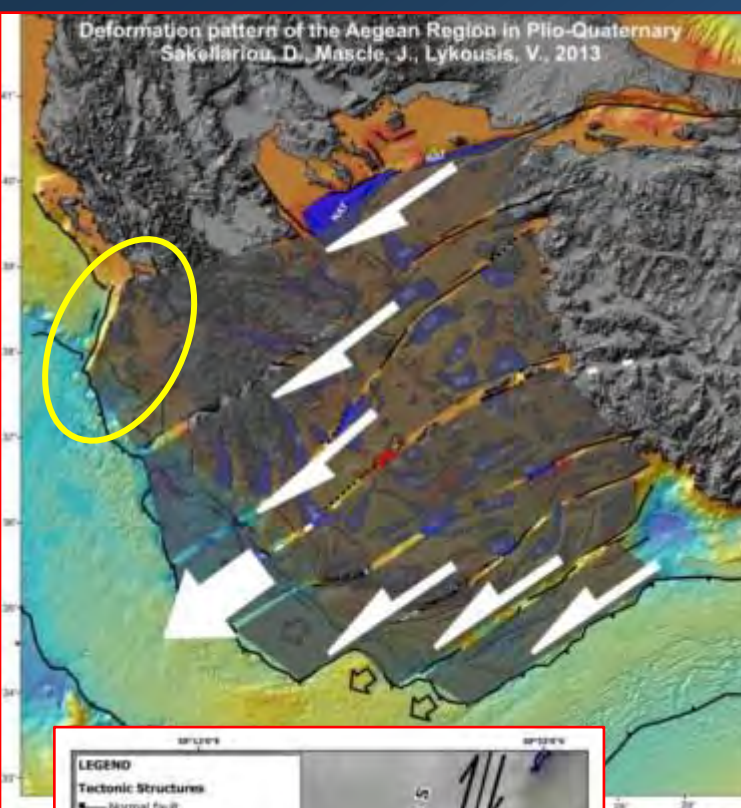




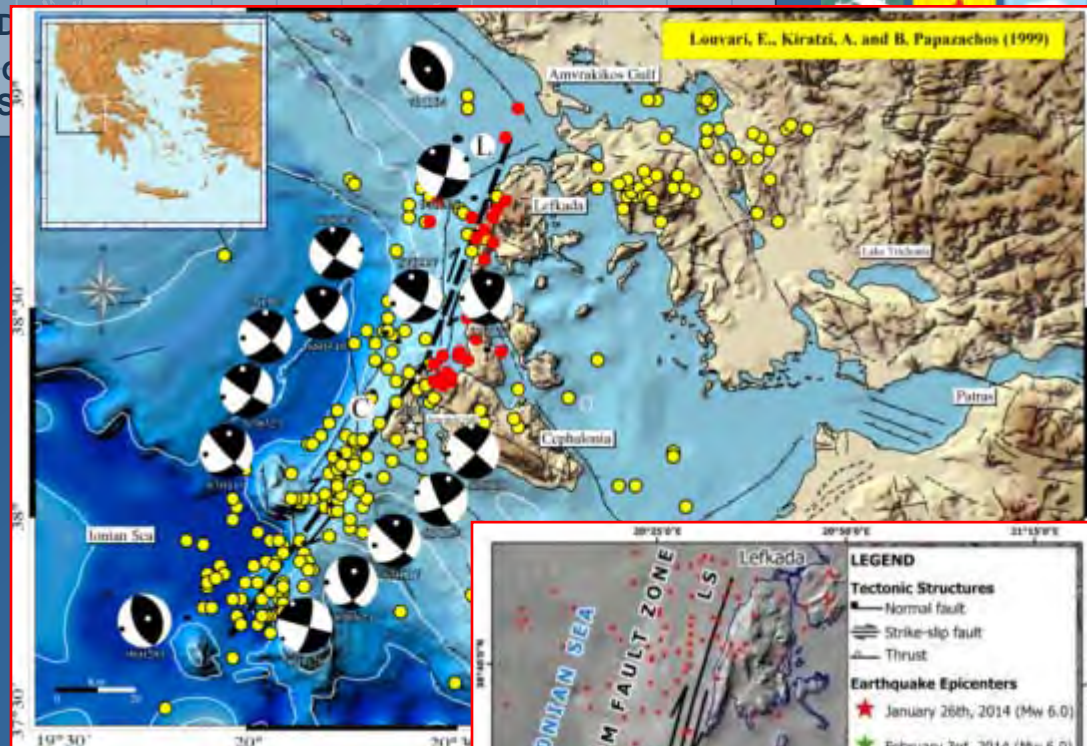
**MAIN TECTONIC ELEMENTS IN THE EASTERN MEDITERRANEAN  
THE HELLENIC ARC AND TRENCH SYSTEM**



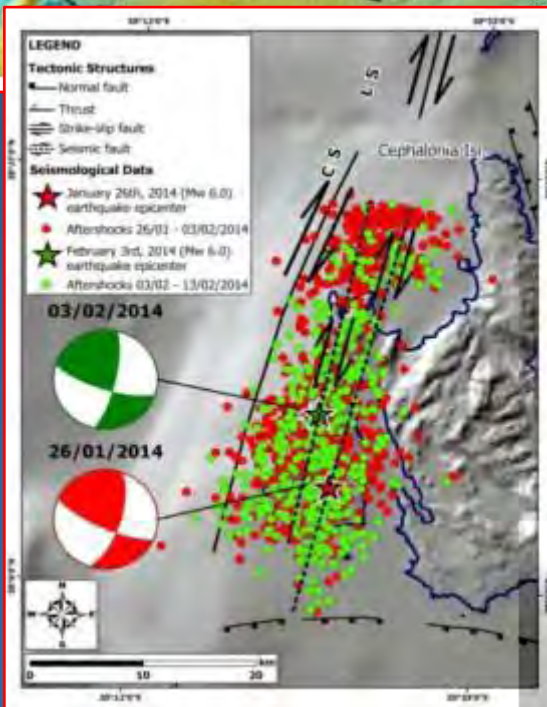
Deformation pattern of the Aegean Region in Plio-Quaternary  
Sakellariou, D., Mascle, J., Lykousis, V. 2013



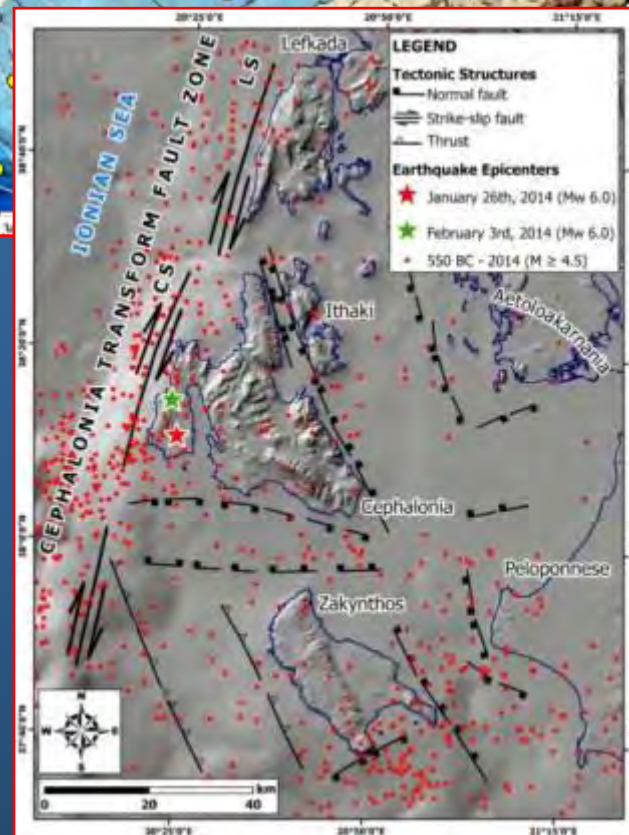
Louvari, E., Kiratzi, A. and B. Papazachos (1999)



**LEGEND**  
**Tectonic Structures**  
— Normal fault  
— Thrust  
— Strike-slip fault  
— Seismic fault  
**Seismological Data**  
★ January 26th, 2014 (Mw 6.0) earthquake epicenter  
● Aftershocks 26/01 - 03/02/2014  
★ February 3rd, 2014 (Mw 6.0) earthquake epicenter  
● Aftershocks 03/02 - 13/02/2014



NOA earthquake catalogue 1964-2014 January 16, 171,186 events  
[http://www.gain.noa.gr/services/tell\\_catalogue.php](http://www.gain.noa.gr/services/tell_catalogue.php)  
(c) NOA, 2014

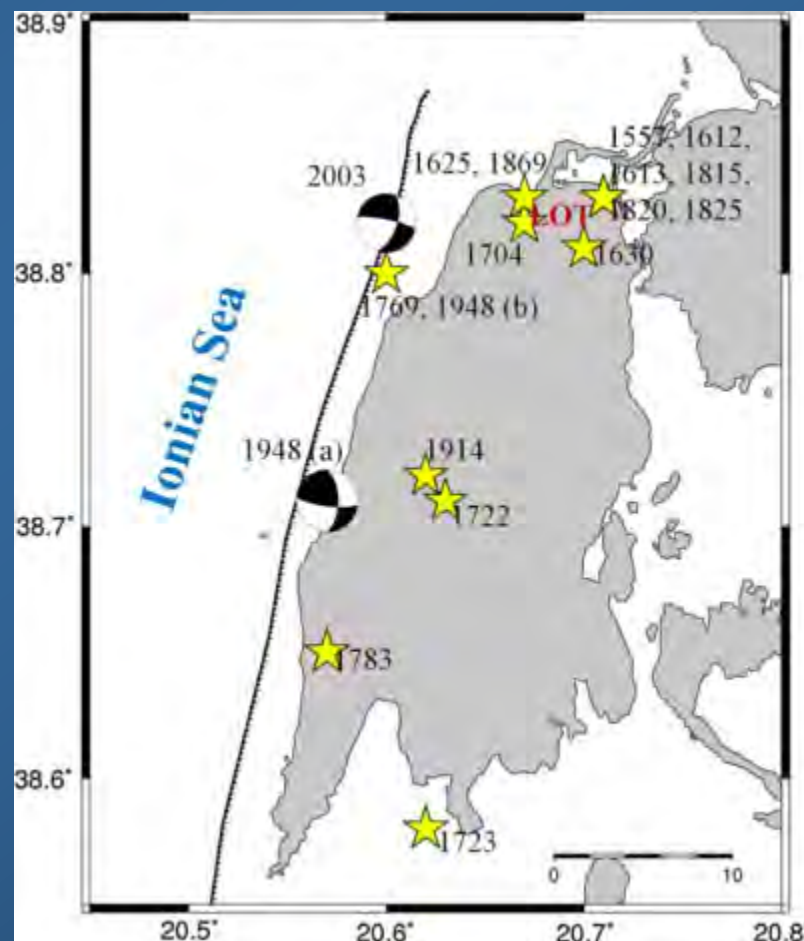


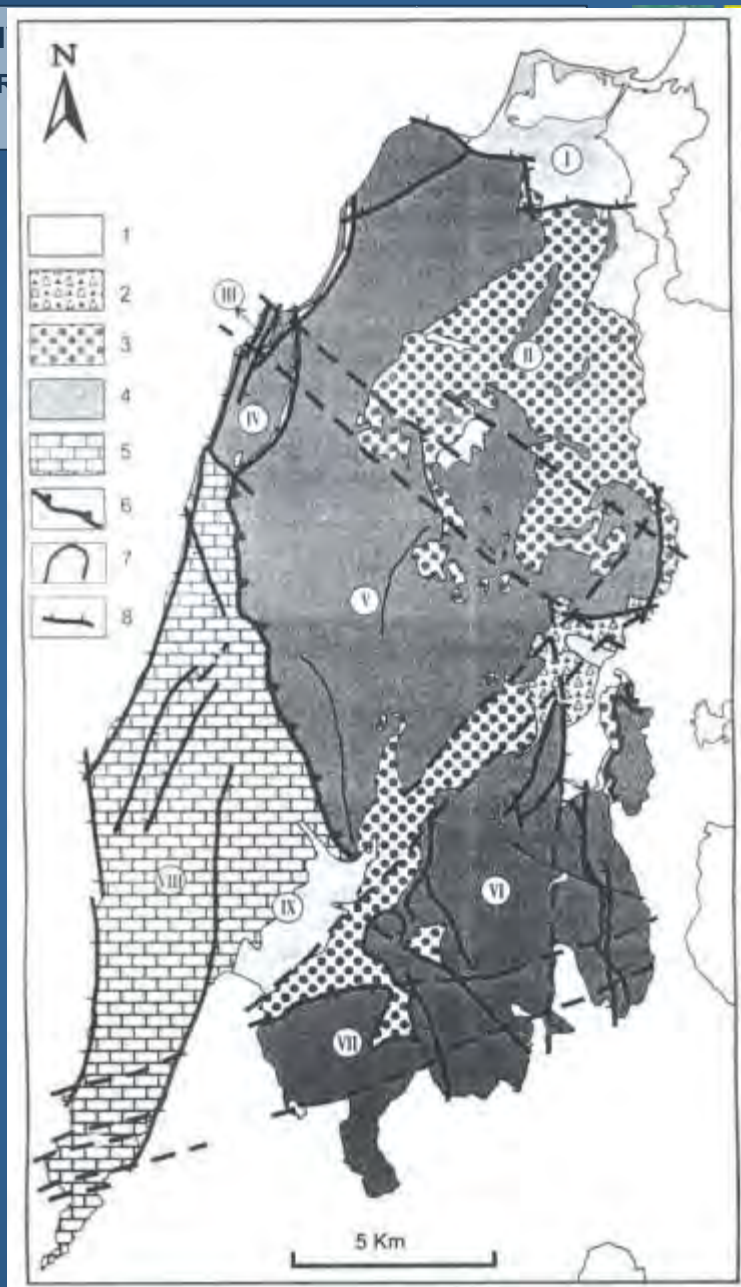
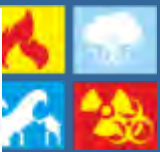




## HISTORIC AND INSTRUMENTAL EARTHQUAKES IN LEFKAS ISLAND

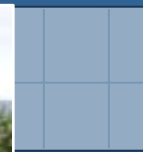
1557	M = 6.2	I <sub>max</sub> = 8
1612 – May 26	M = 6.3	I <sub>max</sub> = 8-10
1613 – October 2	M = 6.3	I <sub>max</sub> = 8-10
1625 – June 18	M = 6.5	I <sub>max</sub> = 9-10
1630 – July 2	M = 6.4	I <sub>max</sub> = 9-10
1704 – November 22	M = 6.4	I <sub>max</sub> = 9-10
1722 – June 5	M = 6.3	I <sub>max</sub> = 8-9
1723 – February 22	M = 6.5	I <sub>max</sub> = 8-9
1769 – October 12	M = 6.4	I <sub>max</sub> = 9-10
1783 – March 23	M = 6.6	I <sub>max</sub> = 10
1815	M = 6.3	I <sub>max</sub> = 8-9
1820 – February 21	M = 6.6	I <sub>max</sub> = 8-9
1825 – January 1	M = 6.7	I <sub>max</sub> = 9-10
1869 – December 28	M = 6.7	I <sub>max</sub> = 10
1914 – November 27	M = 6.3	I <sub>max</sub> = 9
1948 – April 22	M = 6.5	I <sub>max</sub> = 9
June 30	M = 6.4	I <sub>max</sub> = 10
2003 – August 14	M = 6.2	I <sub>max</sub> = 8





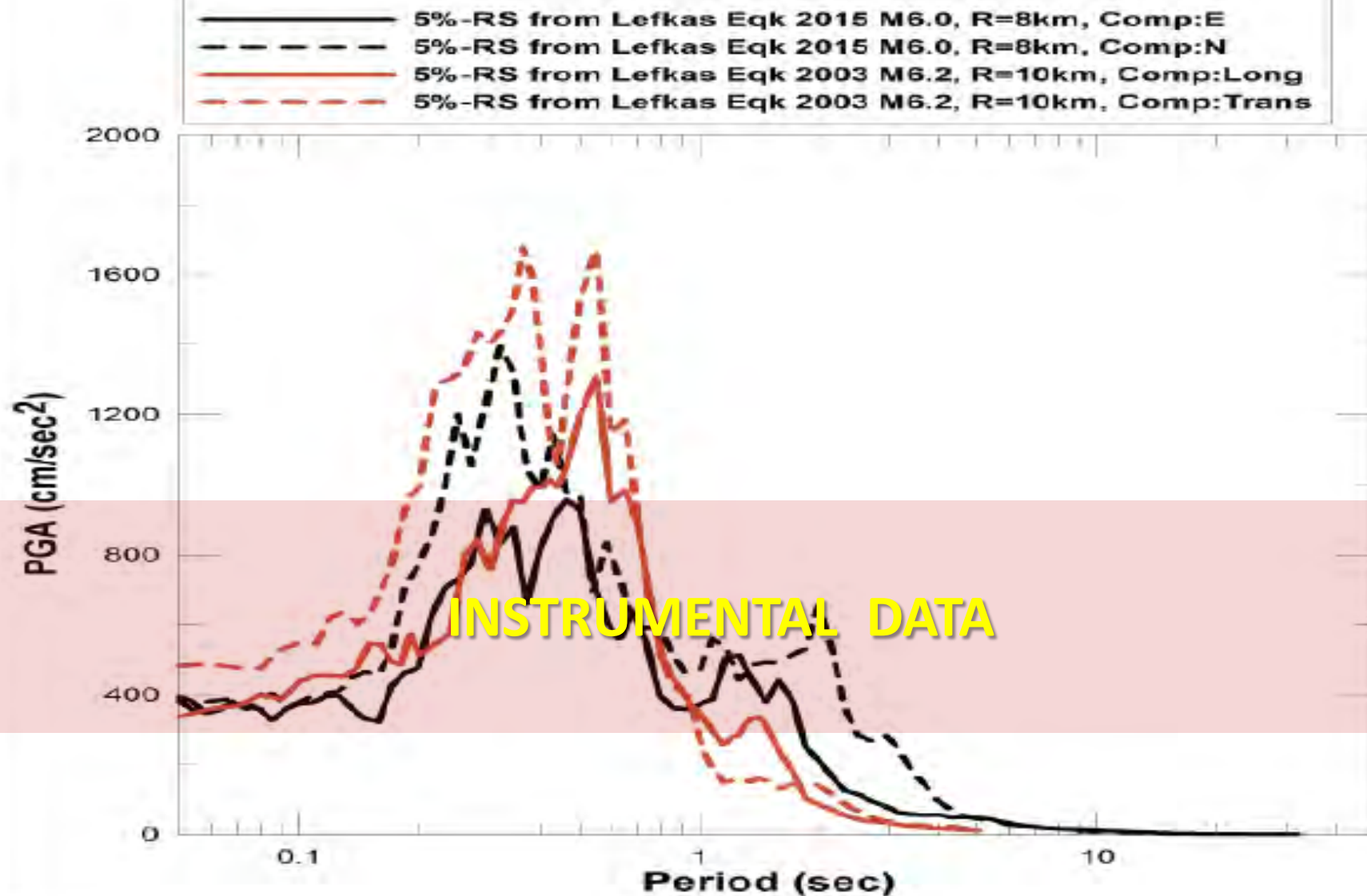
## Lekkas et al. (2001)







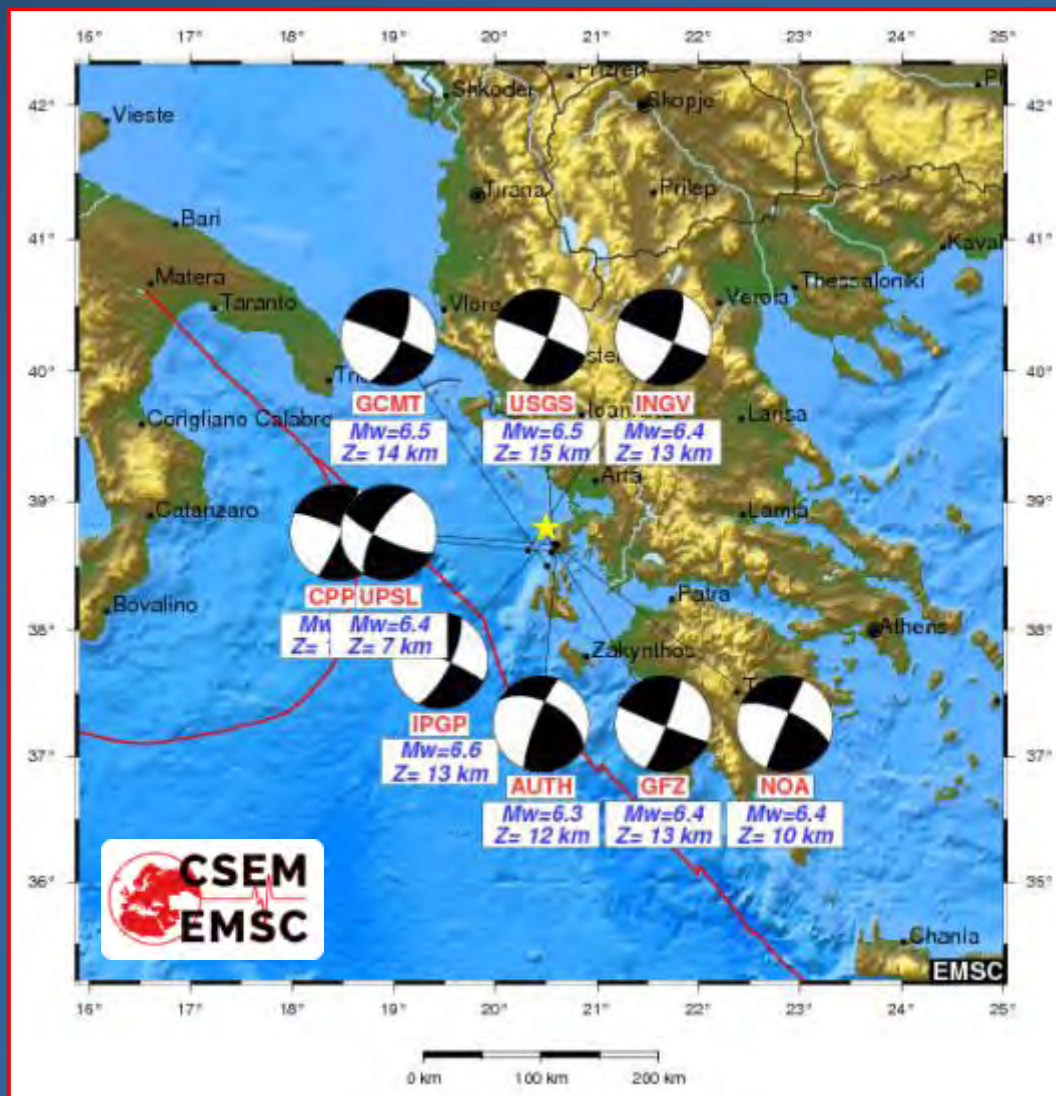
Comparison Eqks in LEFKAS 2003 & 2015

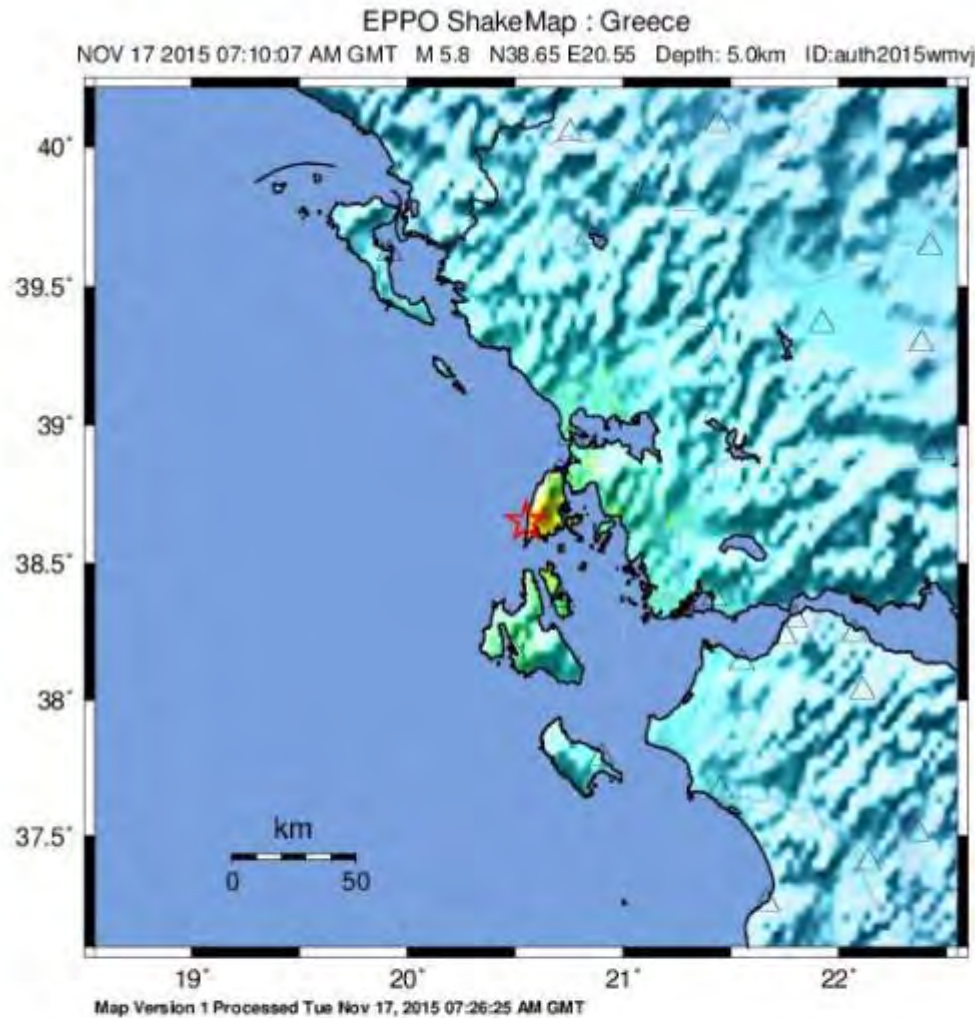






## November 17, 2015 Lefkas Earthquake





PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2011)

## EPPO ShakeMap

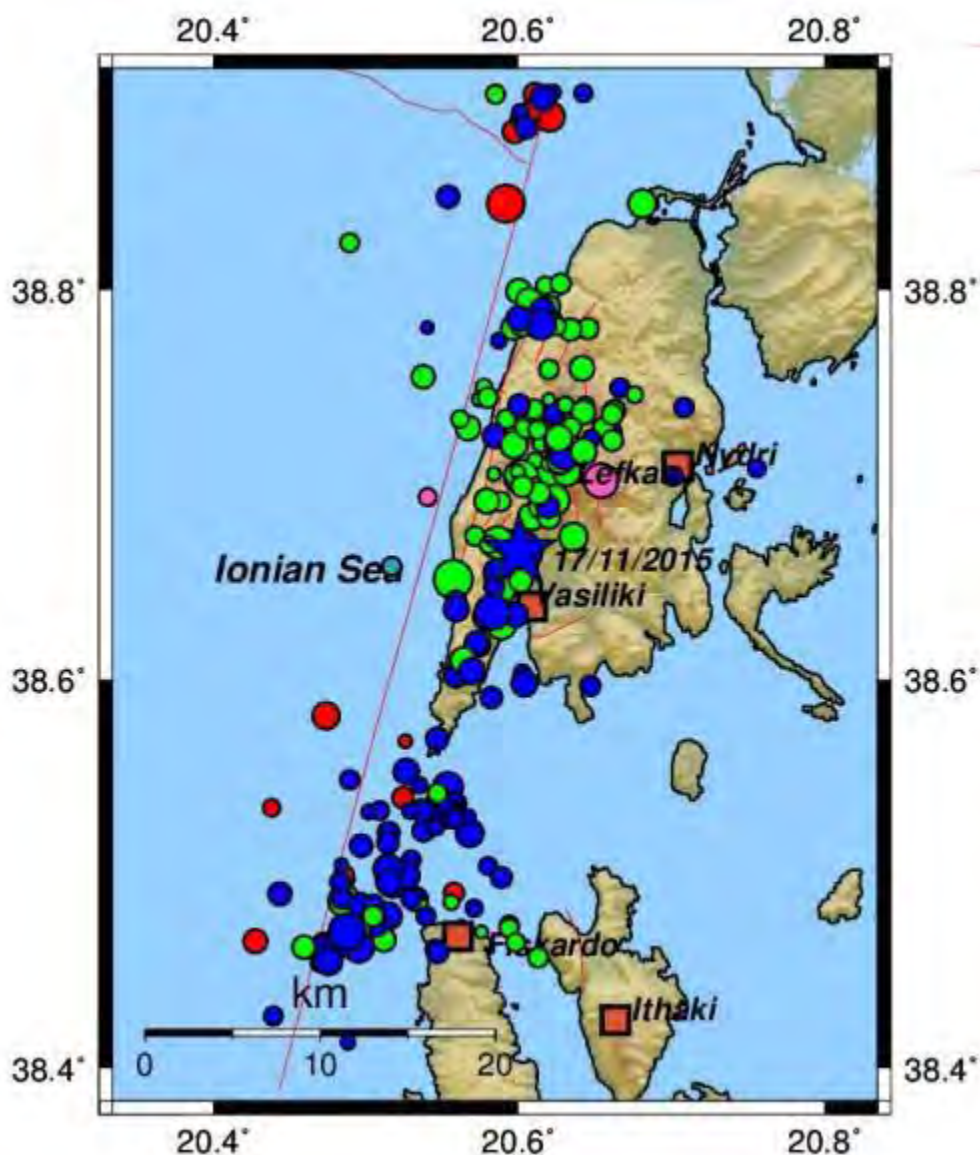
Generated in less than 10min  
after the origin time of the event





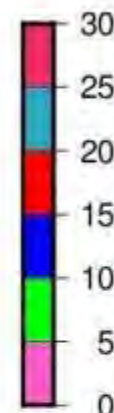
## Peak Acceleration Map





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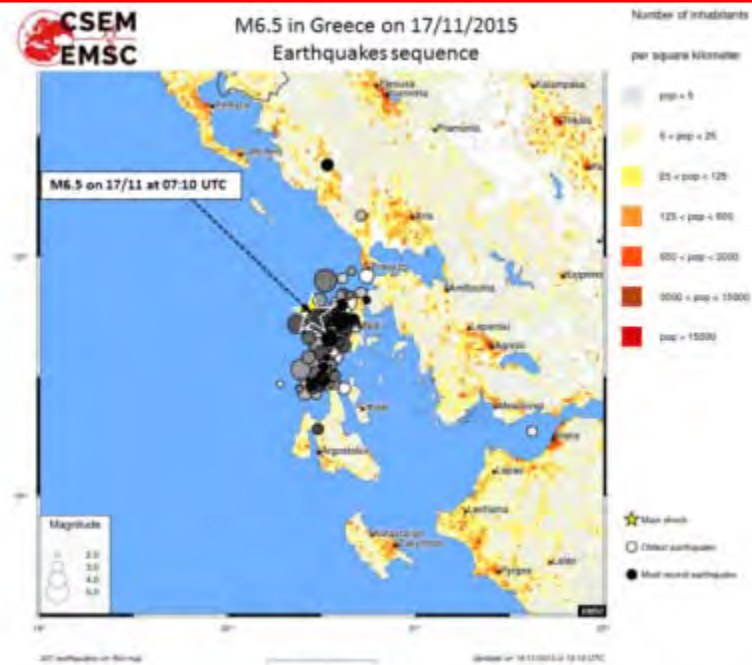
DEPTH (KM)

- M 1.0
- M 2.0
- M 3.0
- M 4.0
- M 5.0
- M 6.0
- Magnitude Scale

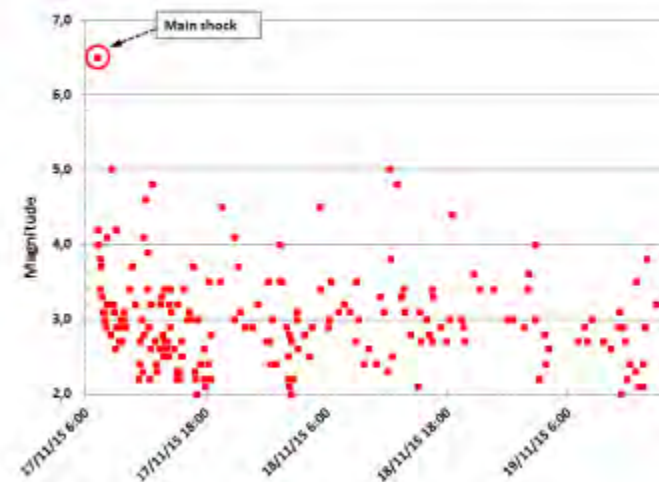
2015/11/17 09:10:07  
Magnitude: 6.0 ML  
Latitude: 38.6757°N  
Longitude: 20.5720°E  
Depth: 12.0 km



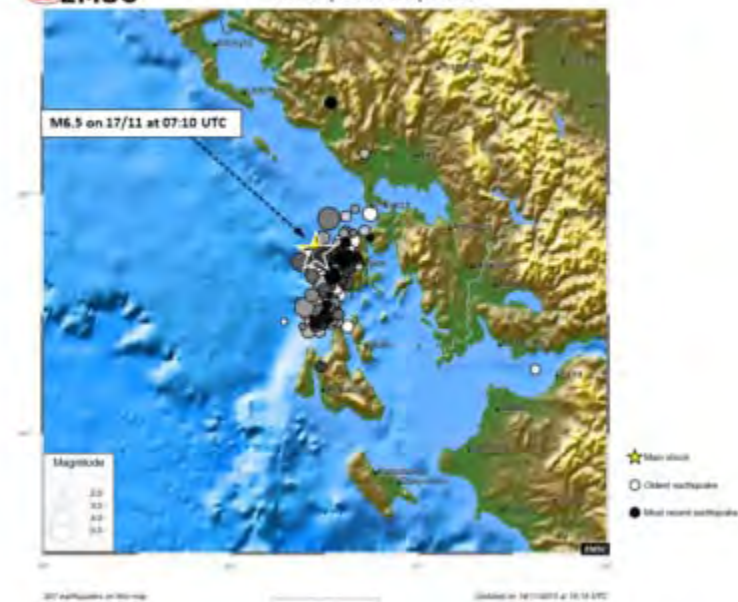
# M6.5 in Greece on 17/11/2015 Earthquakes sequence



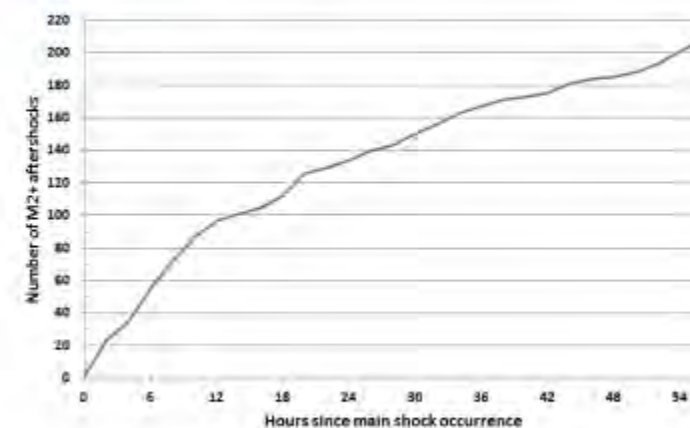
# M6.5 in Greece on 17/11/2015 Earthquakes sequence

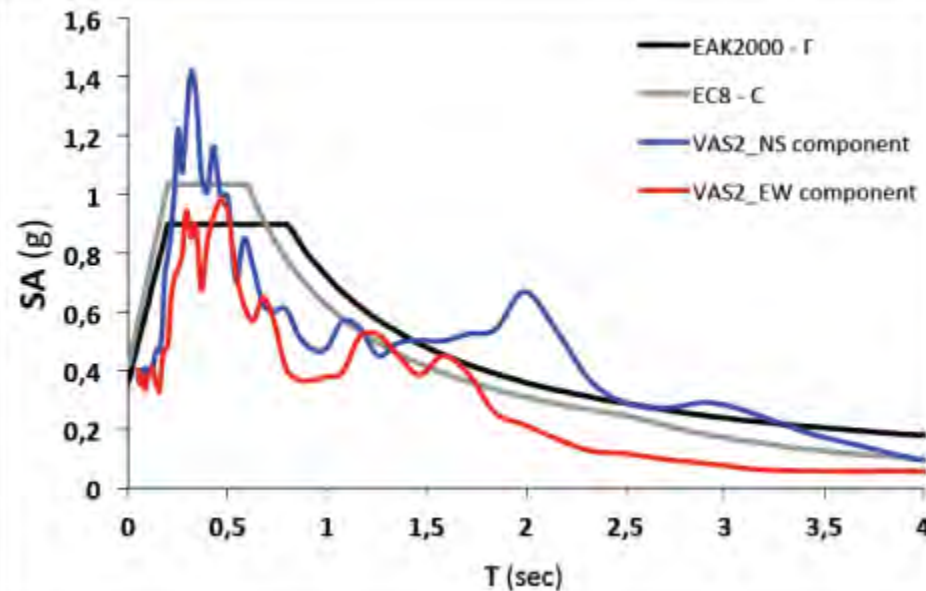


# M6.5 in Greece on 17/11/2015 Earthquakes sequence



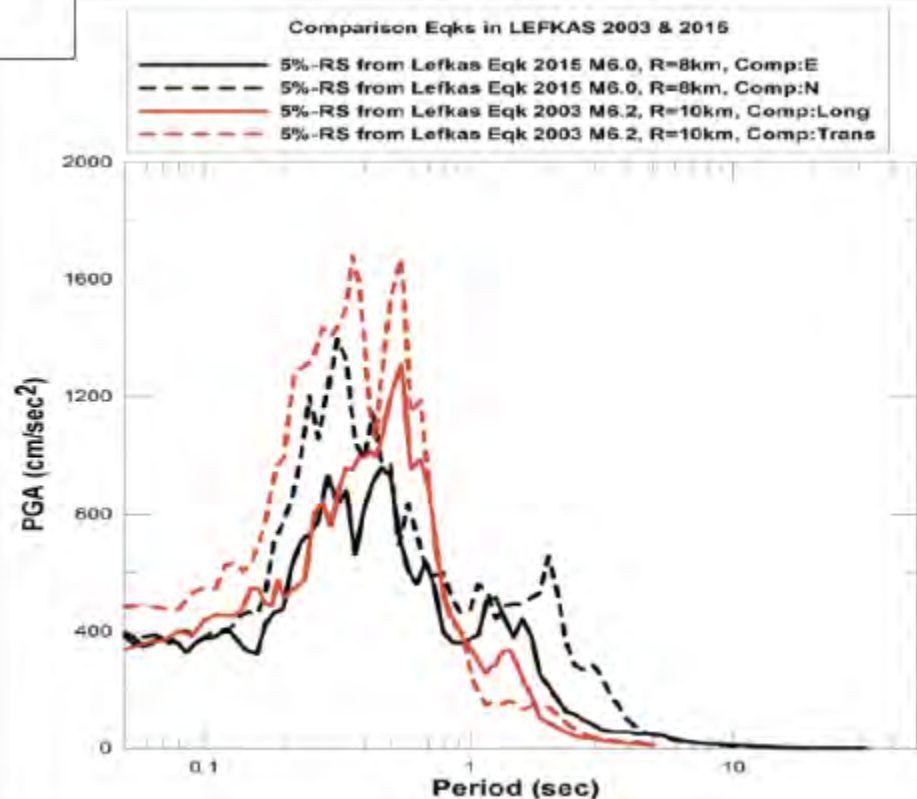
# M6.5 in Greece on 17/11/2015 Earthquakes sequence



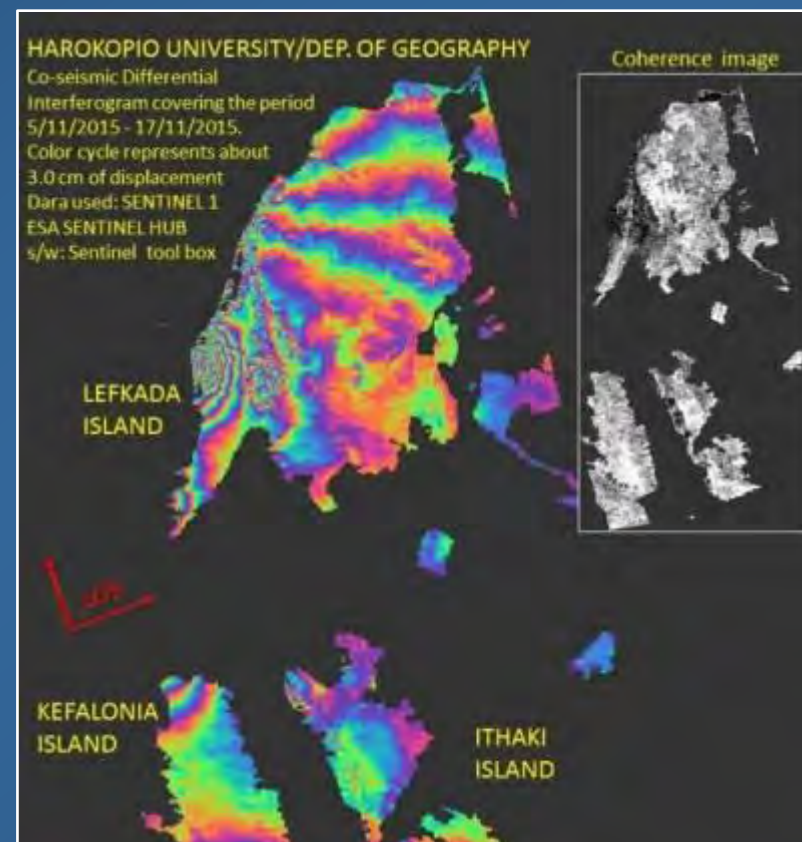
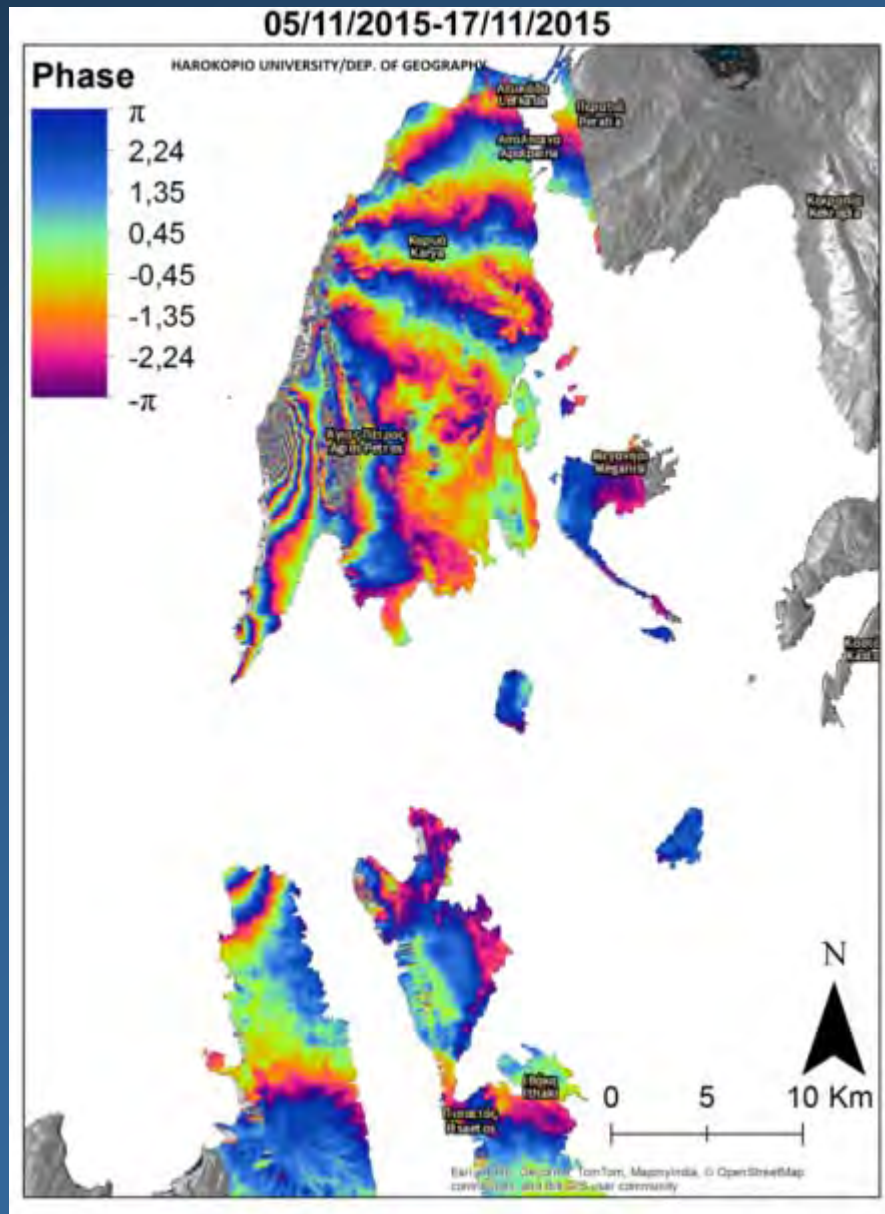


Acceleration response spectra ( $D=0.05$ ) of the VAS2 recording (black lines), in comparison with those of the Lefkas (LEF1: red lines) of the August 14, 2003 earthquake (M 6.2) ▼

▲ Acceleration response spectra ( $D=0.05$ ) of the VAS2 recording of the November 17, 2015 earthquake, in comparison with EAK2000 and EC8 elastic design spectra.







**COSEISMIC DIFFERENTIAL  
INTERFEROGRAM (5.11-17.11.2015)**

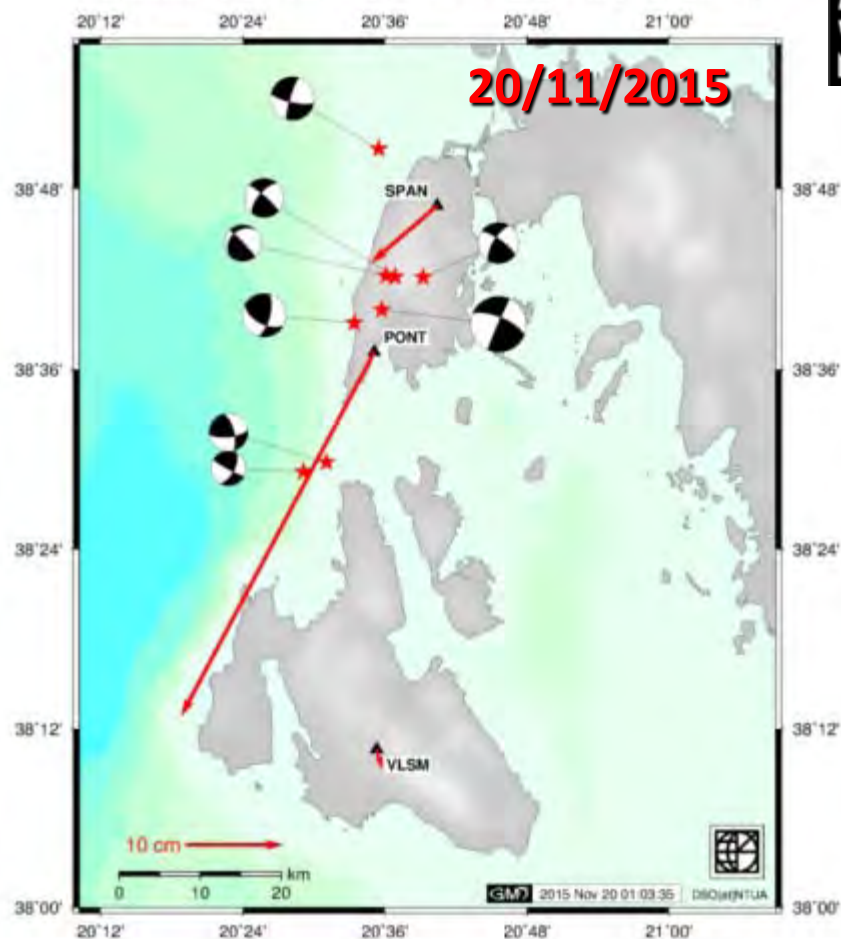


**SURFACE DEFORMATION  
MEASUREMENTS**

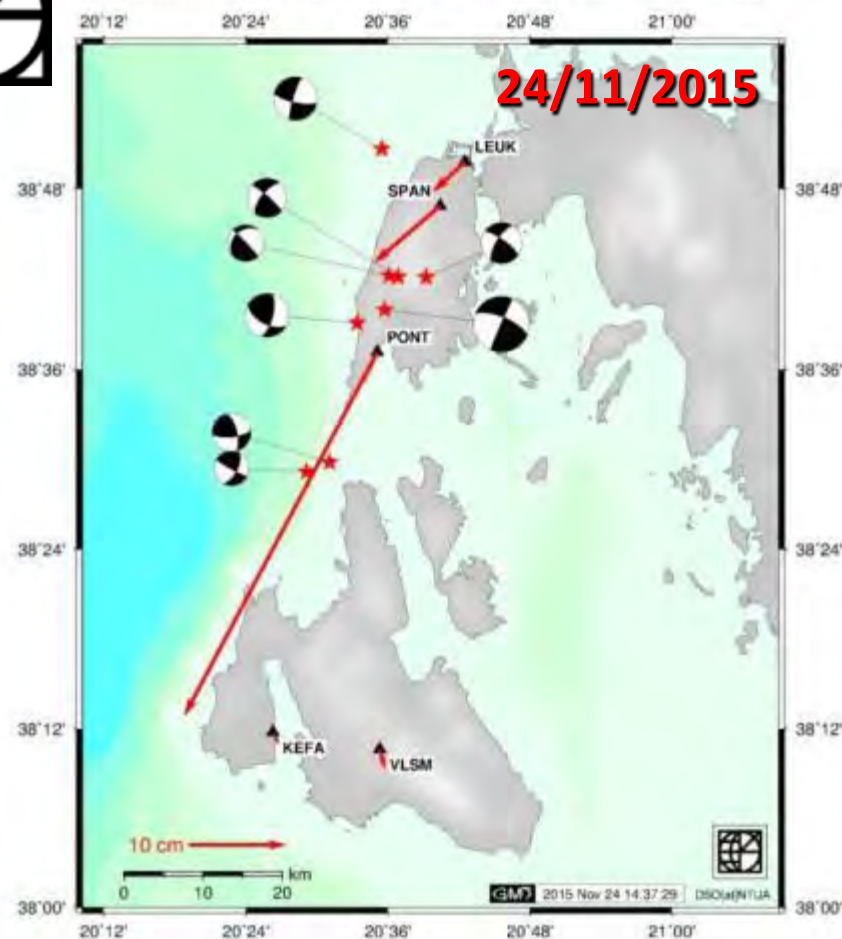


## Preliminary data analysis for GNSS stations at Lefkada region Anastasiou et al. (2015)

Preliminary results for GPS stations displacements



Preliminary results for GPS stations displacements



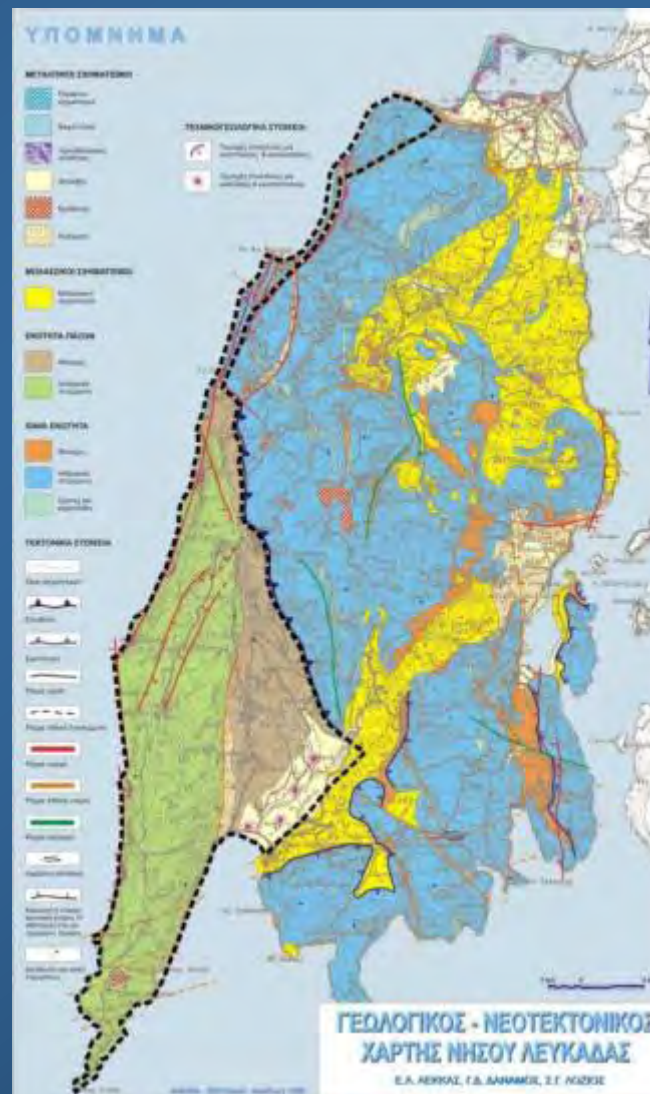




## EARTHQUAKE ENVIRONMENTAL EFFECTS



## LEFKAS EARTHQUAKE-STRICKEN AREA WITH EARTHQUAKE ENVIRONMENTAL EFFECTS







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## Boulder crushed house in Ponti village







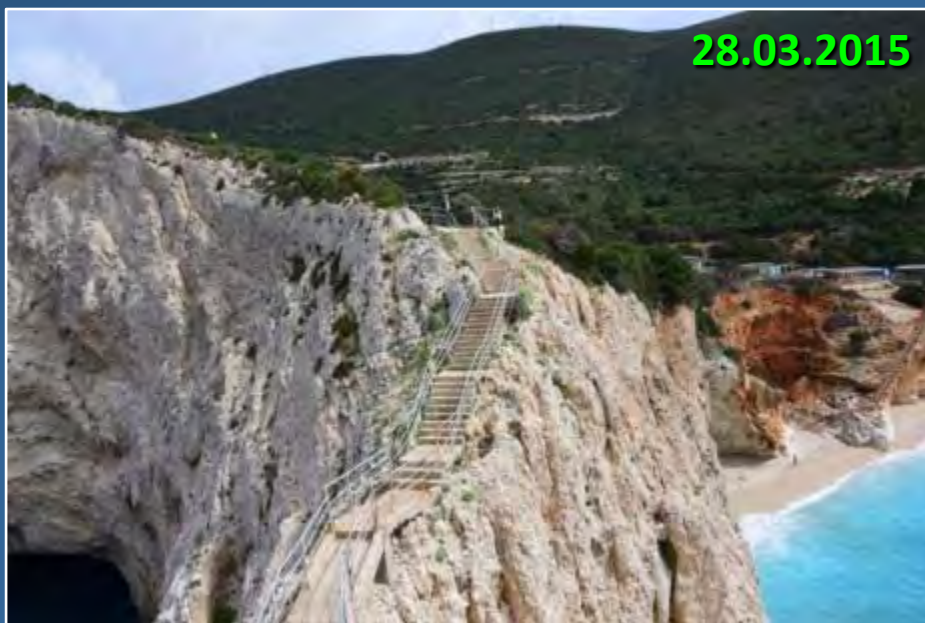
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**Porto Katsiki**



**28.03.2015**



**17.11.2015**





**EQ**  
**17.11.2015**

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**Porto Katsiki**



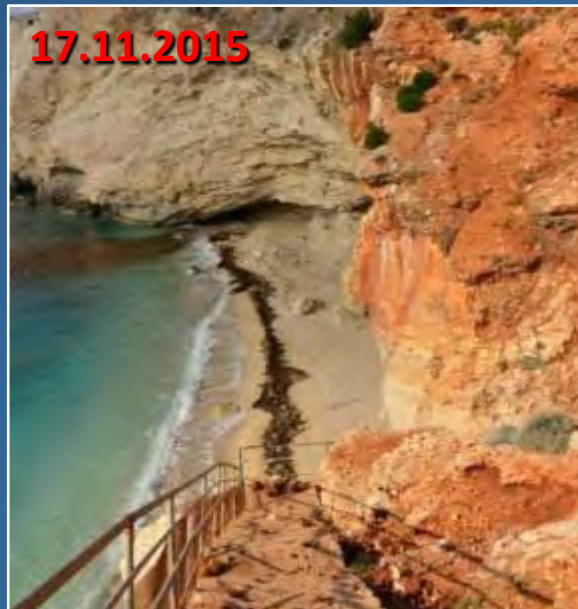




**28.03.2015**



**17.11.2015**

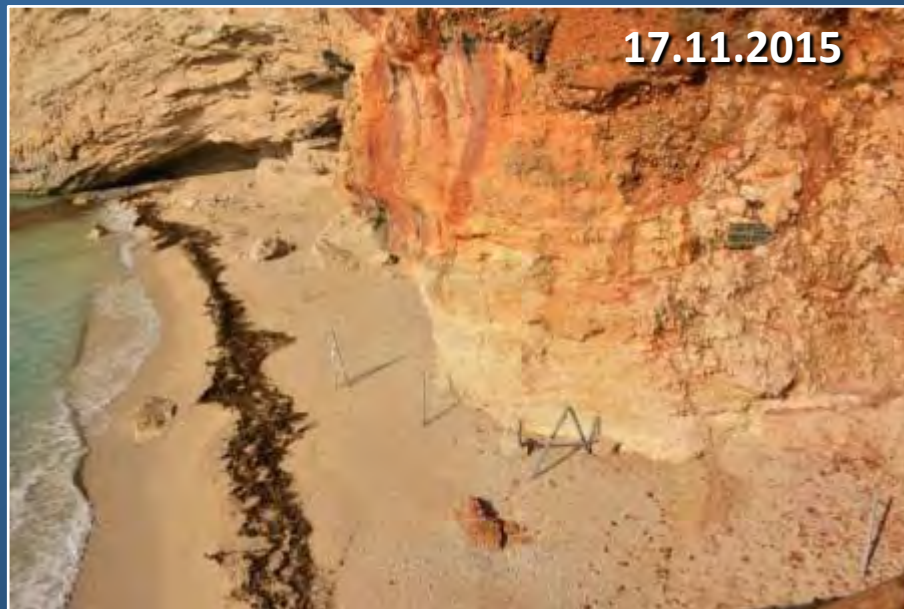


**Porto Katsiki**

**17.11.2015**



**17.11.2015**







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17.11.2015

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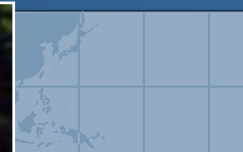


**Egremni**





**Lefkada Earthquake**  
**14.8.2003**



**Agios Nikitas**



**Lefkada Earthquake**  
**17.11.2015**





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17.11.2015

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**17.11.2015**

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EQ  
17.11.2015

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EQ  
14.08.2003

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**2014 Cephalonia Earthquakes  
Myrtos Coastal Area**

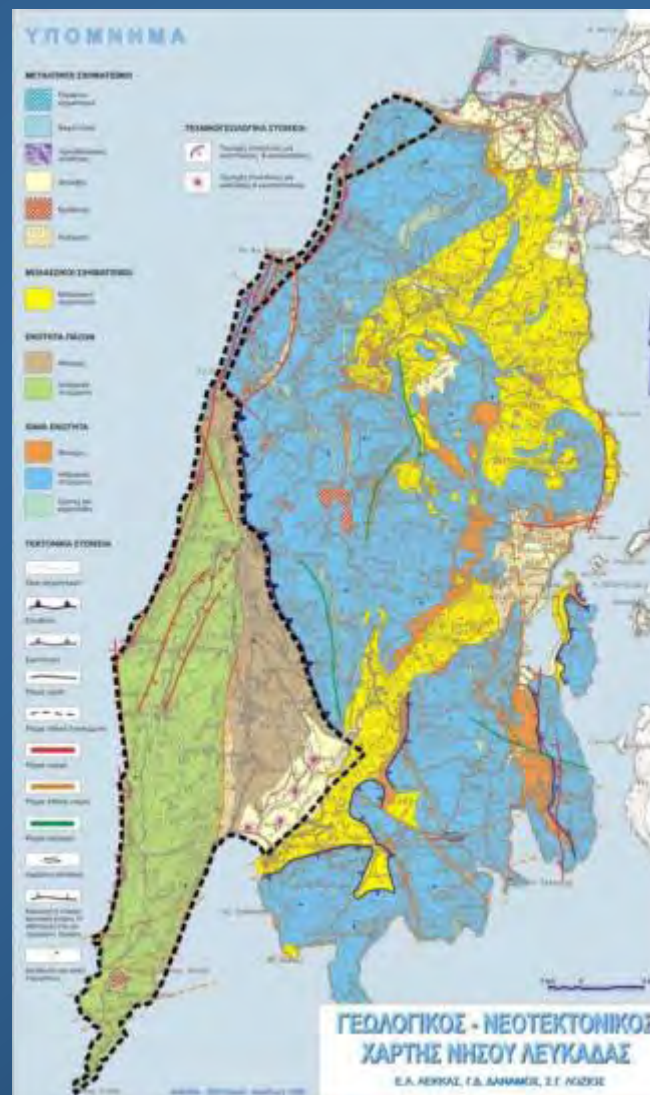
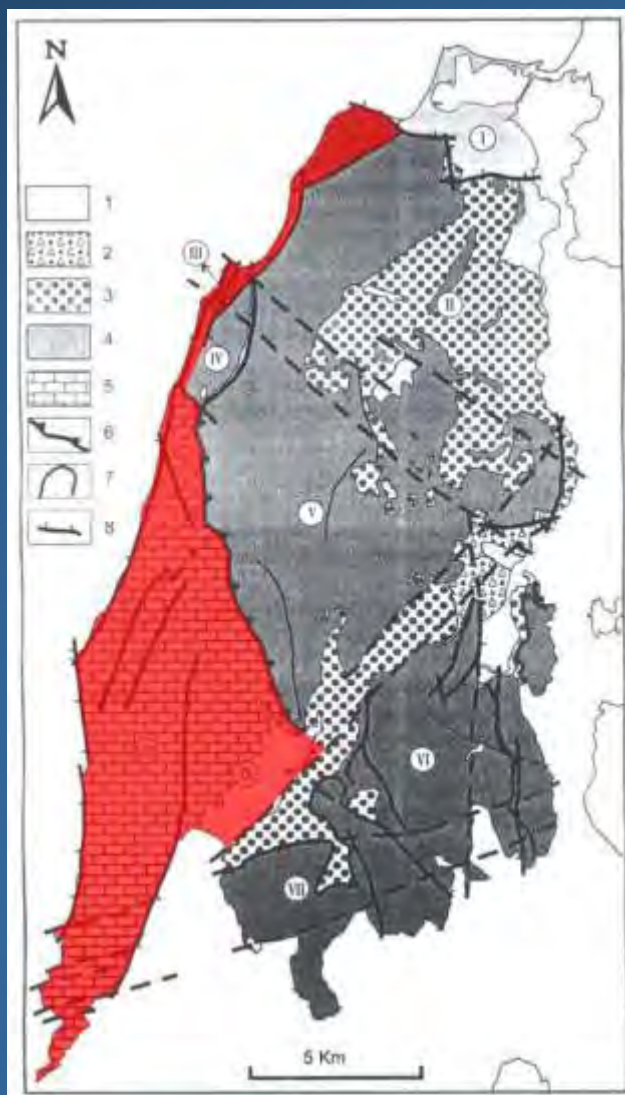








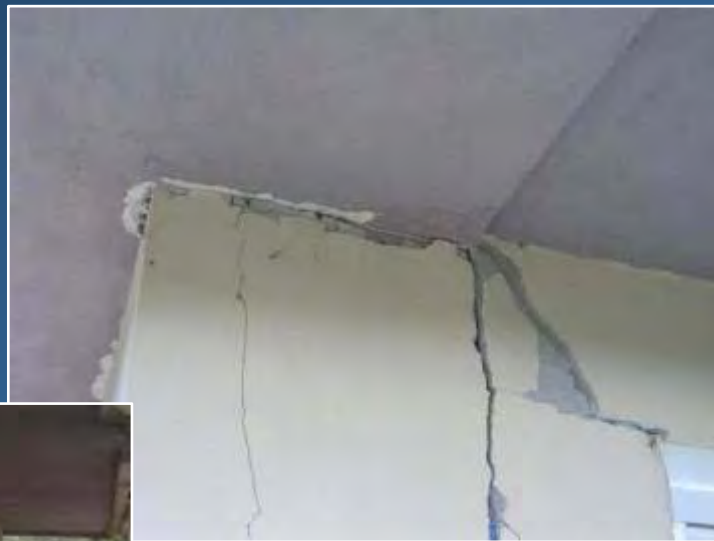
## LEFKAS EARTHQUAKE-STRICKEN AREA WITH BUILDING DAMAGE







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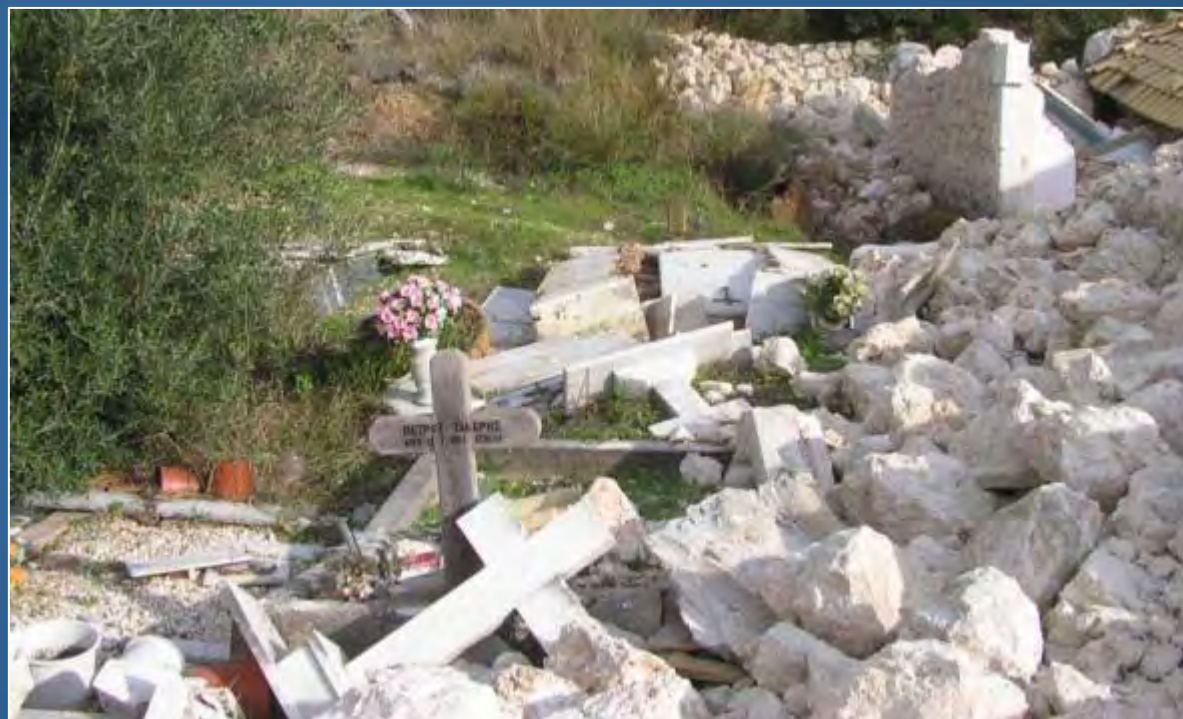
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**DAMAGE TO INFRASTRUCTURE**









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**RESPONSE**





2015/11/17	09:10	<b>Lefkas earthquake (Mw 6.4)</b>
	14:00	Arrival of Governmental and Institutional Officials including the Deputy Minister of Infrastructure, the General Secretary of Civil Protection, the Chief of the Hellenic Fire Service and the President of Earthquake Planning and Protection Organization (EPPO) for coordination of response actions and damage assessment
	17:00	Arrival of EPPO team of geologists and engineers for damage assessment
	19:00	Convention of Civil Protection Coordination body in Lefkas
	19:00	Arrival of members of the Department of Dynamic Tectonic Applied Geology (DTAG), Faculty of Geology and Geo-environment, NKUA
2015/11/18		Day-long field reconnaissance of the Lefkas earthquake effects by members of DTAG
	18:00	Convention of Civil Protection Coordination body in Lefkas Island
2015/11/19		Day-long field reconnaissance of the Lefkas earthquake effects by members of DTAG
	19:00-21:00	Conduction of training seminar entitled "Earthquake protection of schools" for primary education teachers
	19:00	Convention of Civil Protection Coordination body in Lefkas Island
2015/11/20		Day-long field reconnaissance of the Lefkas earthquake effects by members of DTAG
	10:00-13:00	Conduction of training seminar entitled "Earthquake protection of schools" for primary education teachers
	20:00	Convention of Civil Protection Coordination body in Lefkas Island



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## Civil Protection Coordination body in Lefkas







## EPPO seminar for primary and secondary education teachers “Earthquake protection of schools”











## Lefkas Earthquake 14.8.2003





## Lefkas Earthquake 14.8.2003







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**LEFKAS 2015**

# THE 2015 LEFKAS EARTHQUAKE (NOVEMBER 17, Mw 6.4)

## AN EPISODE IN THE GEODYNAMIC EVOLUTION OF IONIAN SEA

