Near-Field Tsunami Early Warning and Preparedeness in the Mediterranean: the EU NEARTOWARN Project

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Beneficiary and Partners EU DG-ECHO

Coordinating Beneficiary:

- **Institute of Geodynamics,**
  National Observatory of Athens (NOAGI)
  Dr. Gerassimos A. Papadopoulos

Associated Beneficiaries:

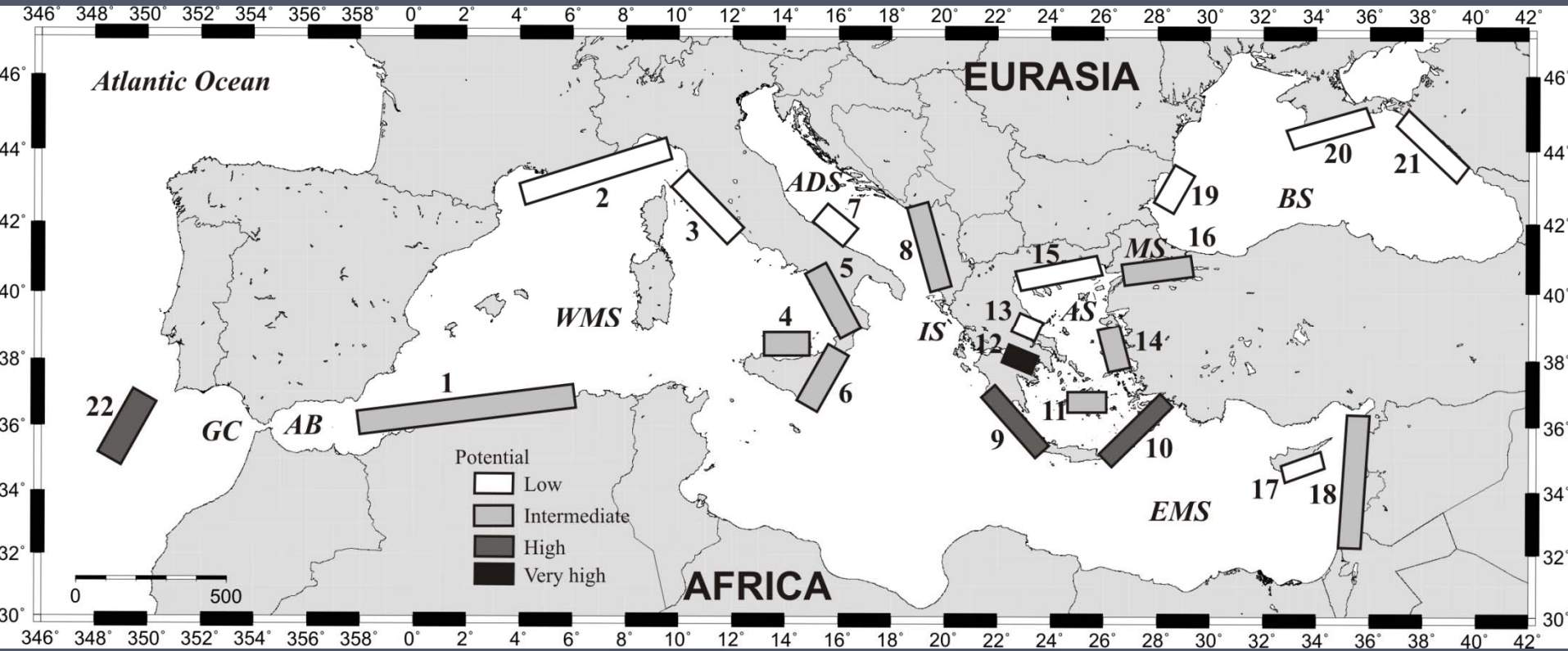
- Universita Di Bologna (UNIBO, Italy) – Prof. Stefano Tinti
- University of Cyprus (OC-UCY, Cyprus) – Prof. Georgios Georgiou
- ACRI-ST SAS (Sophia Antipolis, France) – Dr Olivia Lesne
- Univesidad de Cantabria (UC, Spain) – Assoc. Prof. Mauricio González
- Municipality of Rhodes (MOR, Greece) – MSc Ilias Argyris

Total Duration: 24 months **(2012 - 2013), Completed 31.12.2014**

Project http://www.neartowarntsunami.com/

Tsunamigenic Zonation Map in the Mediterranean and Connected Seas

(Papadopoulos et al., Marine Geology, 2014,)



Warning in near-field

- Assuming seismic signal is transmitted automatically, then
- ***ttr > tSD + {tED + tEI + tER}***
- ***tSD*** = time for EQ determination
- ***tED*** = time for making tsunami desicion
- ***tEI*** = time for tsunami information to population
- ***tER***= time to run away

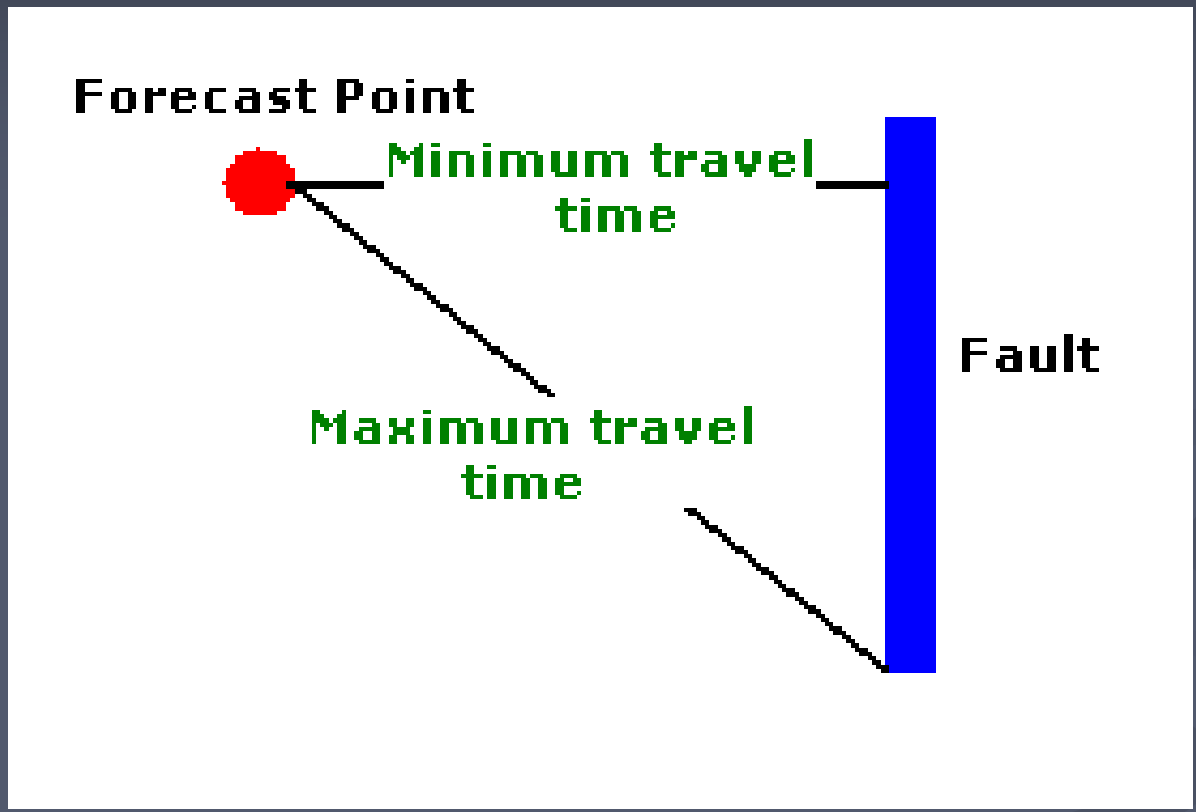
NEED TO MINIMIZE TIME OF WARNING!

Main Tasks of the Project

1. Supporting actions of interest for the entire NEAM region

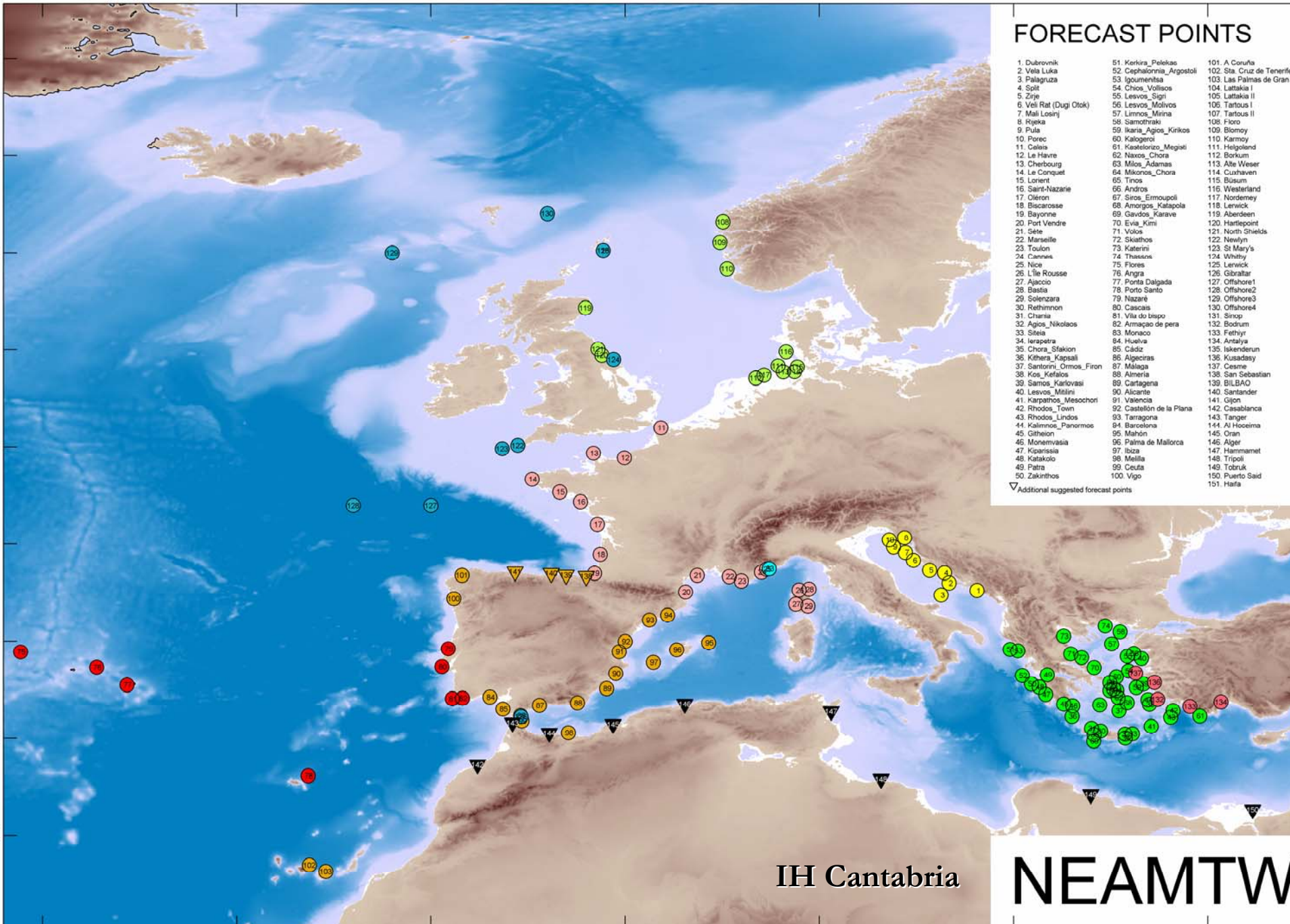
- Improvement of tsunami zonation in Mediterranean (NOA)
- A Comprenhensive state-of-the-art report on TWS's (ARCI-ST)
- Data base and Mapping of tsunami travel times in NEAM (IH Cantabria)
- Standardization of data bases of pre-simualated tsunamis (UNIBO)
- Improvement of infrustructure for a future TWS in Cyprus (UC)

A data base of near-field domains in NEAM



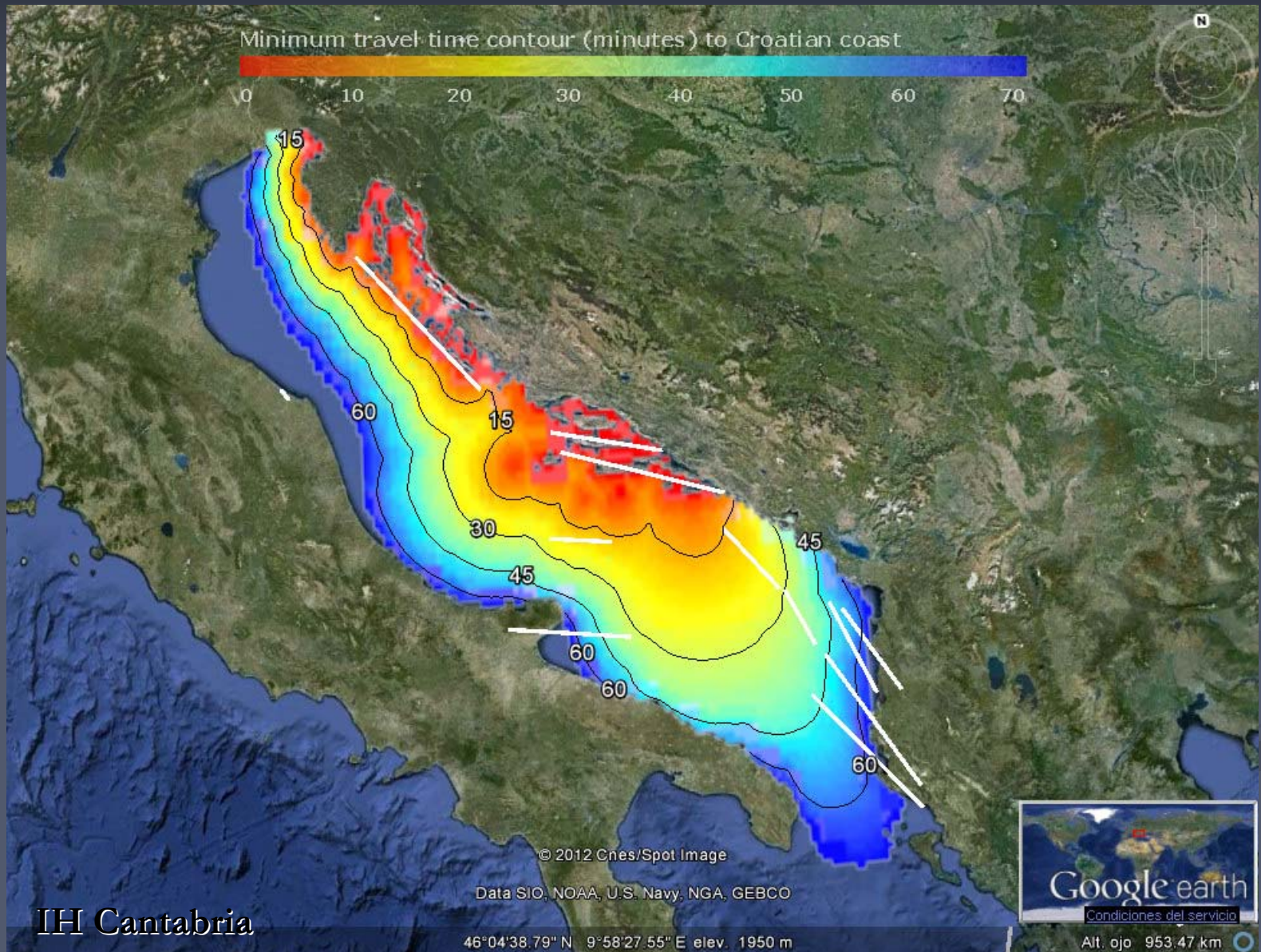
Max. and min. travel times from source to forecast point: ray propagation theory

IH Cantabria

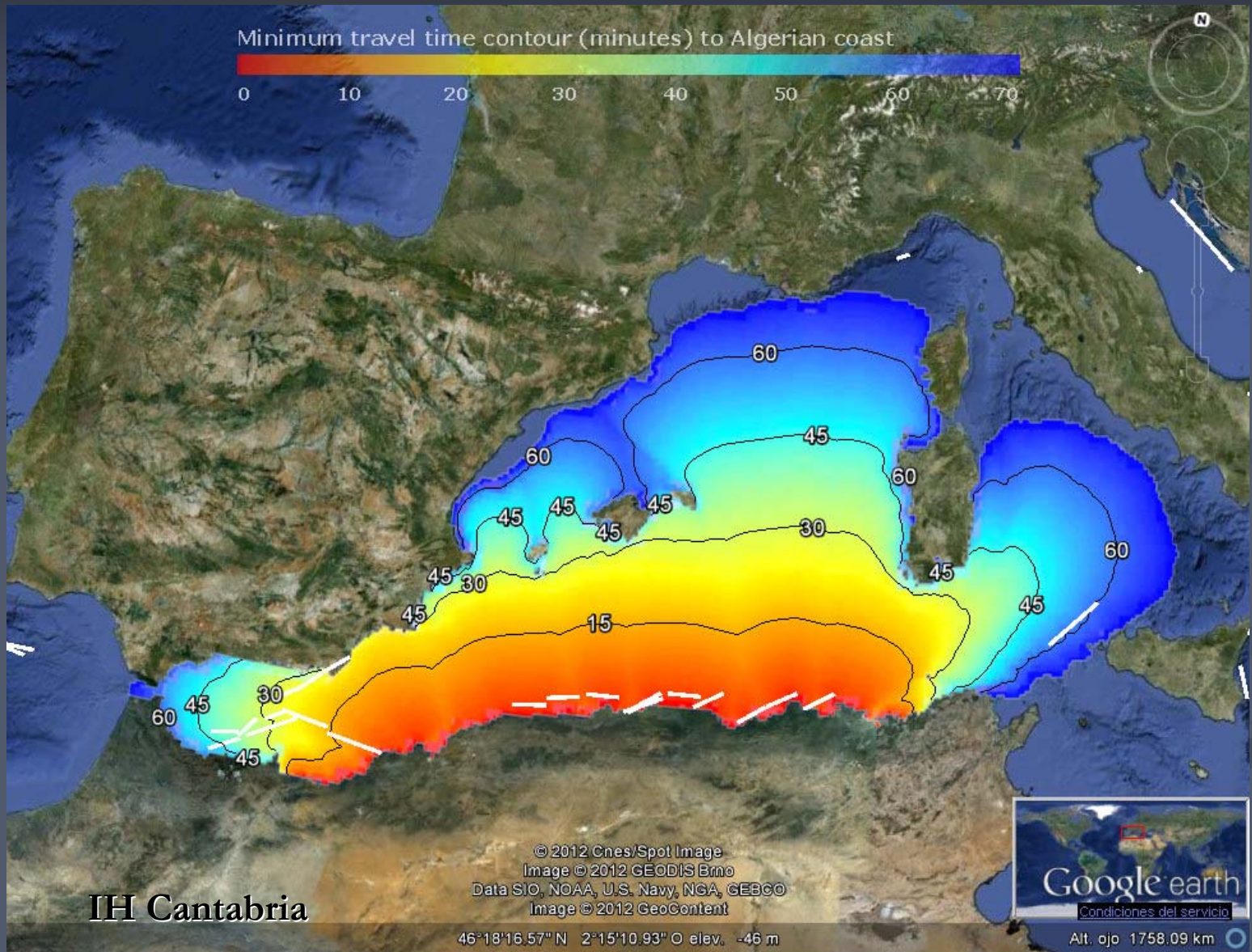

FORECAST POINTS
1. Dubrovnik
2. Vela Luka
3. Palagruza
4. Split
5. Zirje
6. Veli Rat (Dugi Otok)
7. Mali Losinj
8. Rijeka
9. Pula
10. Porec
11. Celais
12. Le Havre
13. Cherbourg
14. Le Conquet
15. Lorient
16. Saint-Nazarie
17. Oléron
18. Biscarosse
19. Bayonne
20. Port Vendre
21. Sète
22. Marseille
23. Toulon
24. Cannes
25. Nice
26. L'Île Rousse
27. Ajaccio
28. Bastia
29. Solenzara
30. Rethimnon
31. Chania
32. Agios_Nikolaos
33. Siteia
34. Ierapatra
35. Chora_Sfakion
36. Kithera_Kapsali
37. Santorini_Ormos_Firon
38. Kos_Kefalos
39. Samos_Karlovasi
40. Lesvos_Mitilini
41. Karpathos_Mesochori
42. Rhodos_Town
43. Rhodos_Lindos
44. Kalimnos_Panormos
45. Githeion
46. Monemvasia
47. Kiparissia
48. Katakolo
49. Patra
50. Zakinthos
51. Kerkira_Pelekas
52. Cephalonnia_Argostoli
53. Igoumenitsa
54. Chios_Vollisos
55. Lesvos_Sigri
56. Lesvos_Molivos
57. Limnos_Mirina
58. Samothraki
59. Ikaria_Agios_Kirikos
60. Kalogeroi
61. Kastelorizo_Megisti
62. Naxos_Chora
63. Milos_Adamas
64. Mikonos_Chora
65. Tinos
66. Andros
67. Siros_Ermoupoli
68. Amorgos_Katapola
69. Gavdos_Karave
70. Evia_Kimi
71. Volos
72. Skiathos
73. Katerini
74. Thassos
75. Flores
76. Angra
77. Ponta Dalgada
78. Porto Santo
79. Nazaré
80. Cascais
81. Vila do bispo
82. Armaçao de pera
83. Monaco
84. Hueiva
85. Cádiz
86. Algeciras
87. Málaga
88. Almeria
89. Cartagena
90. Alicante
91. Valencia
92. Castellón de la Plana
93. Tarragona
94. Barcelona
95. Mahón
96. Palma de Mallorca
97. Ibiza
98. Melilla
99. Ceuta
100. Vigo
101. A Coruña
102. Sta. Cruz de Tenerife
103. Las Palmas de Gran
104. Lattakia I
105. Lattakia II
106. Tartous I
107. Tartous II
108. Floro
109. Blomoy
110. Karmoy
111. Helgoland
112. Borkum
113. Alte Weser
114. Cuxhaven
115. Büsum
116. Westerland
117. Nordemey
118. Lerwick
119. Aberdeen
120. Hartlepoint
121. North Shields
122. Newlyn
123. St Mary's
124. Whithy
125. Lerwick
126. Gibraltar
127. Offshore1
128. Offshore2
129. Offshore3
130. Offshore4
131. Sinop
132. Bodrum
133. Fethiyr
134. Antalya
135. Iskenderun
136. Kusadasy
137. Cesme
138. San Sebastian
139. BILBAO
140. Santander
141. Gijon
142. Casablanca
143. Tanger
144. Al Hoceima
145. Oran
146. Alger
147. Hammamet
148. Tripoli
149. Tobruk
150. Puerto Said
151. Haifa
Additional suggested forecast points
IH Cantabria
NEAMTW

Fault zones from TRANSFER

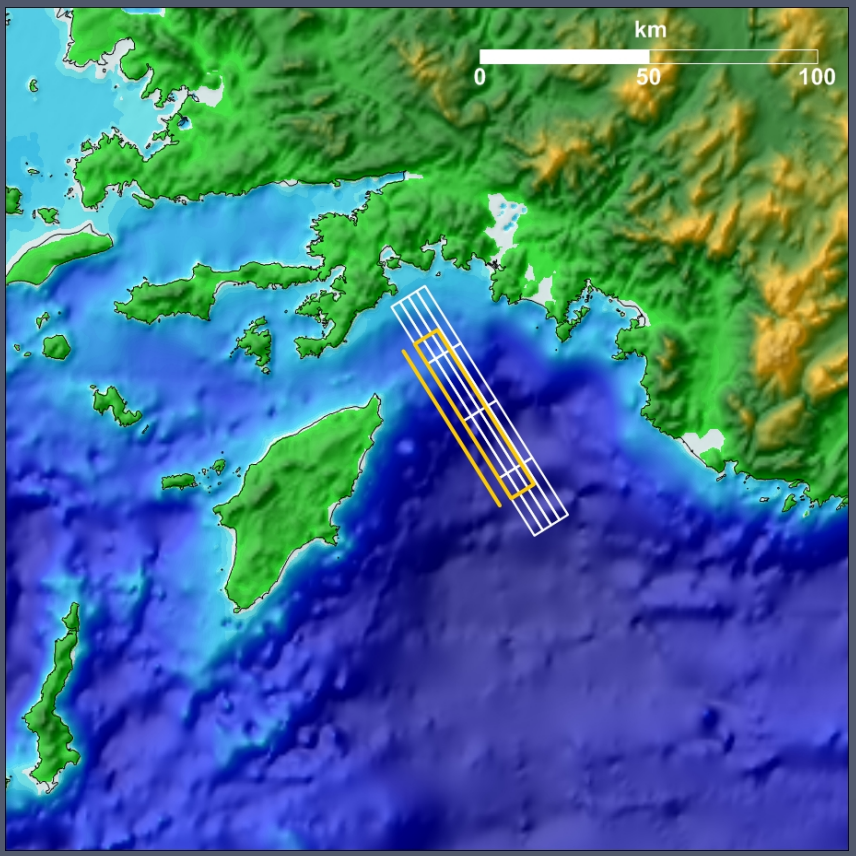
TS travel times in Adriatic Sea



TS travel times in North Algeria



A prototype Data Base for pre-simulated tsunami scenarios



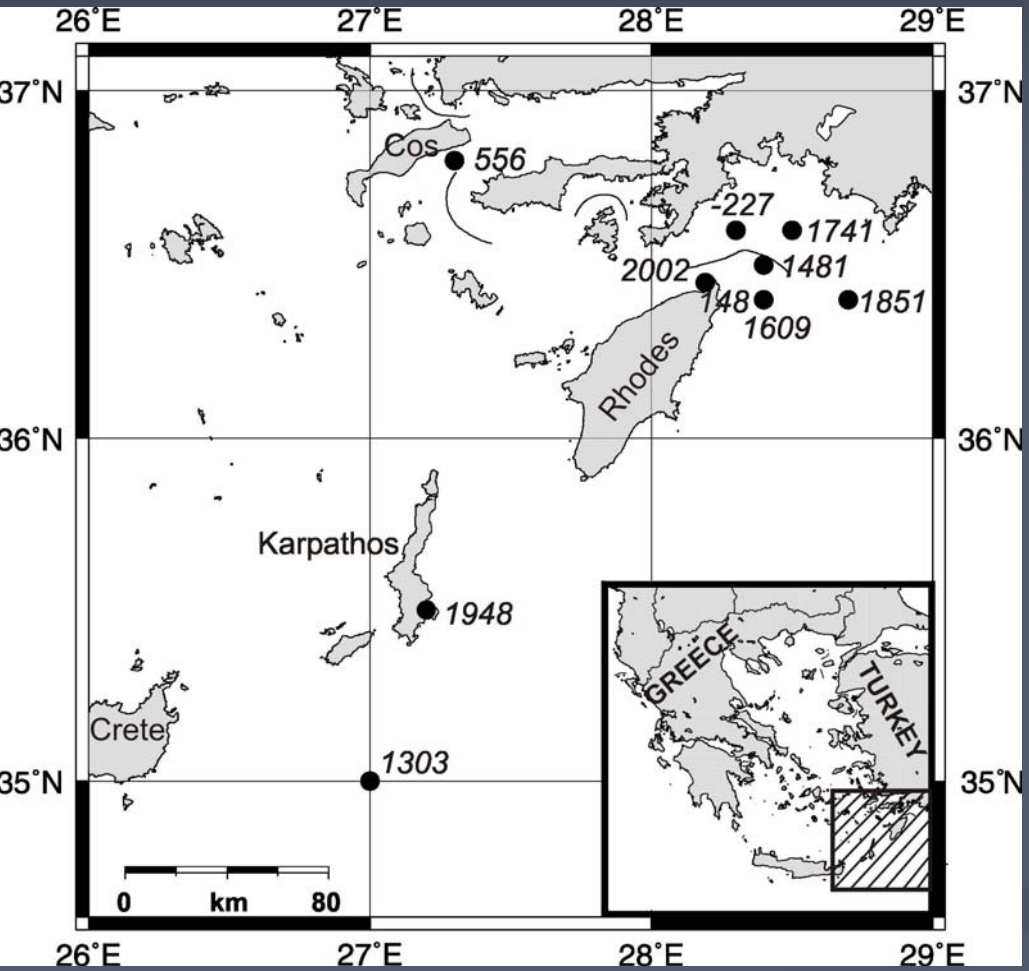
"Matching Scenario Database" (MSDB), UNIBO

A prototype Data Base for pre-simulated tsunami scenarios

- time series of water elevation and velocity components computed
  - in all the relevant forecast points and
  - in all the grid points having a depth lower than a given threshold, or comprised in a given depth interval
- wave elevation fields every *k* minutes over a suitably chosen simulation time
- arrival time fields (first positive of the wave elevation, first negative, time of arrival of the maximum and of the minimum)
- extreme wave elevation fields
- extreme velocity (x,y-components, modulus-angle) fields.

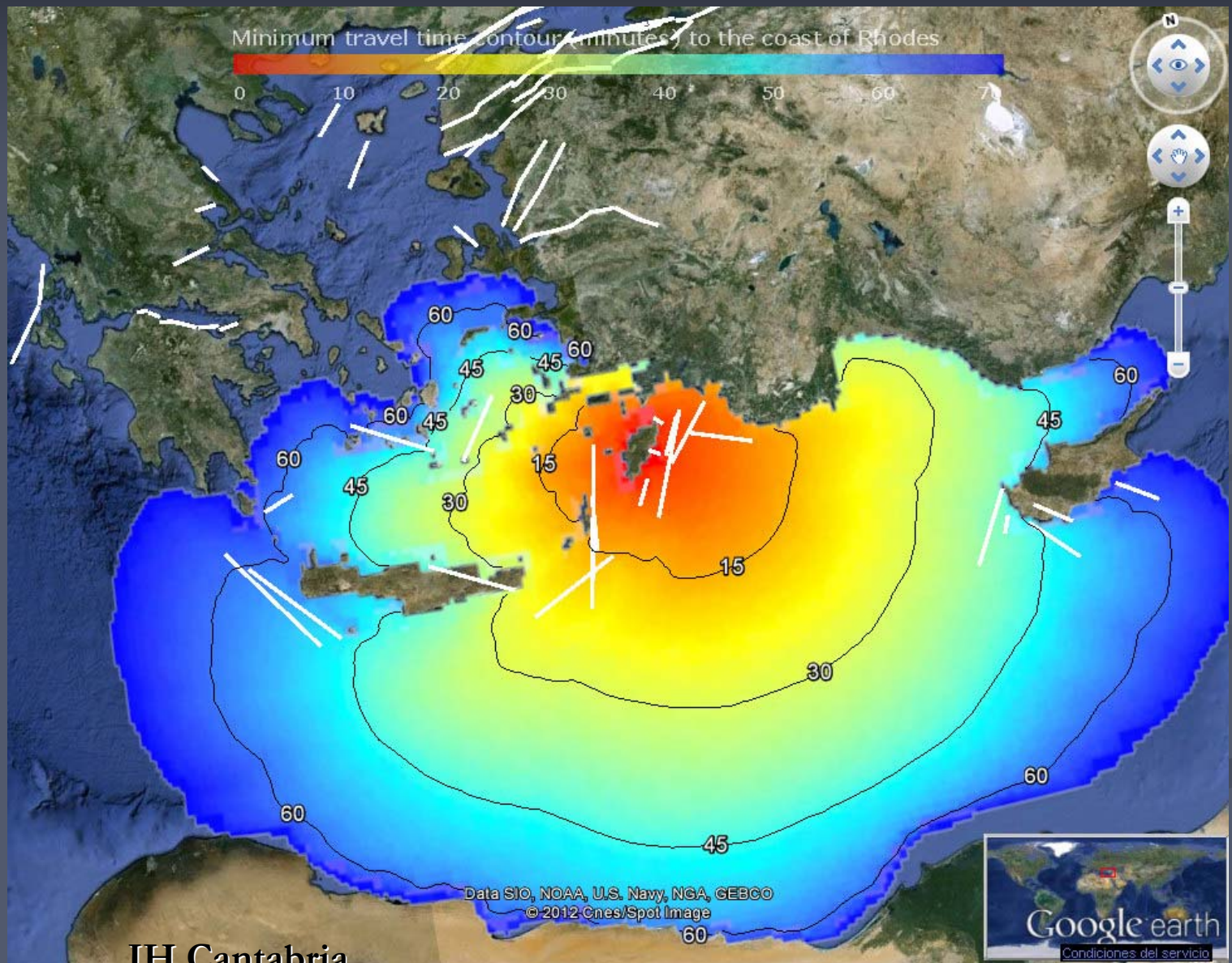
"Matching Scenario Database" (MSDB), UNIBO

Test site of Rhodes



- Very high seismicity
- Several historical tsunamis (AD 148, 1303, 1481, 1609, 1741, 1851)
- Master test site along with Fetiye
- EU FP6 TRANSFER

TS travel times in Rhodes



Main Tasks of the Project

2. Development of an operational local TWS in Rhodes (NOA, MoR)

- Creation of a network of Seismic Early Warning Devices
- Installation of 2 radar-type tide-gauges
- Development of a Local Tsunami Decision Matrix for Rhodes (NOA)
- Data base of tsunami travel times in Rhodes (IH Cantabria)
- Standardization of data bases of pre-simualated tsunamis (UNIBO)
- Organization of a Geographical Management System

Main components of the system

Upstream Component

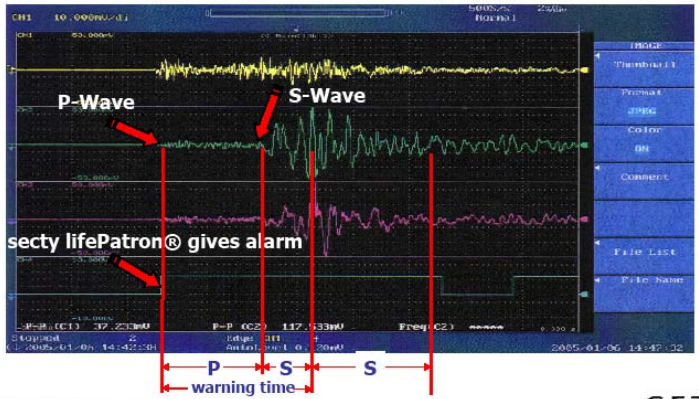
- Seismic Alert network
- Tide-gauge network
- Pre-simulated tsunami scenarios

Downstream Component

- Alerting civil protection in Rhodes
- Geographical Management System
- Alerting Population

Seismic Alert Devices (SAD's) for SEW

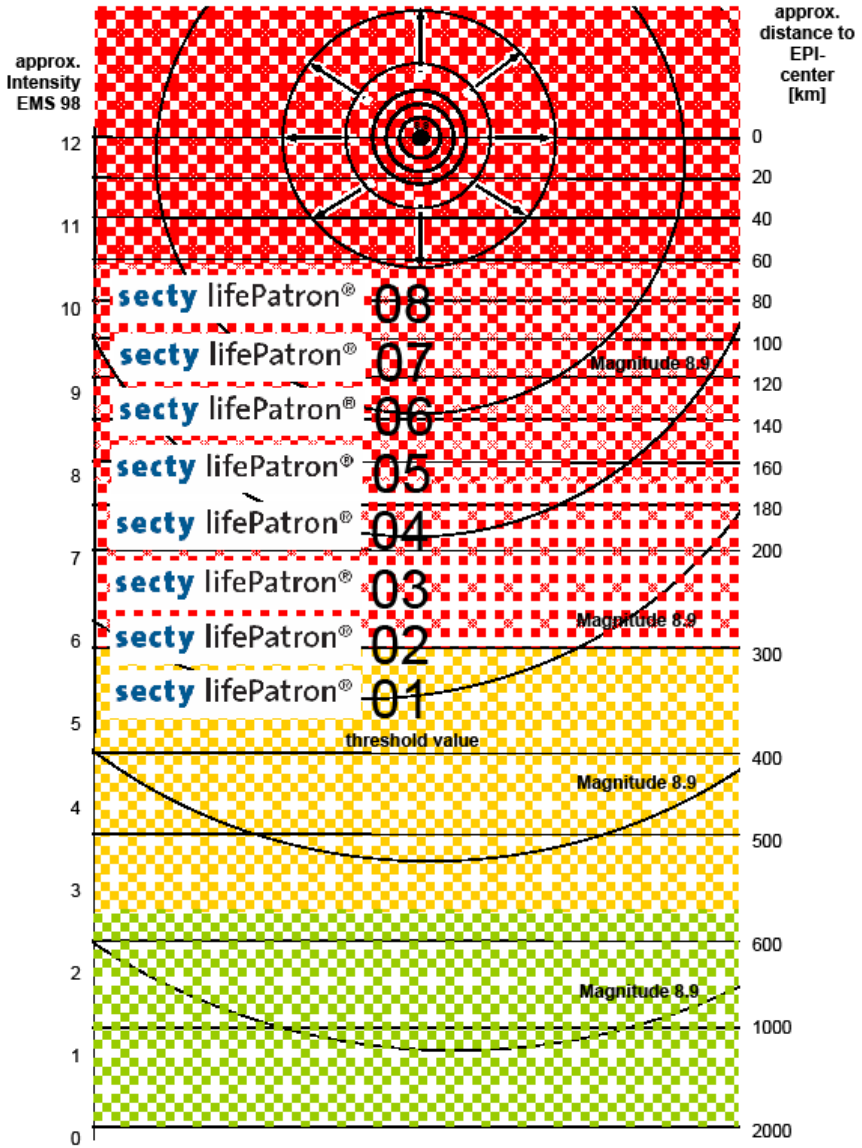
Earthquake: Turkey/ Düzce, Nov.1999



secty electronics®

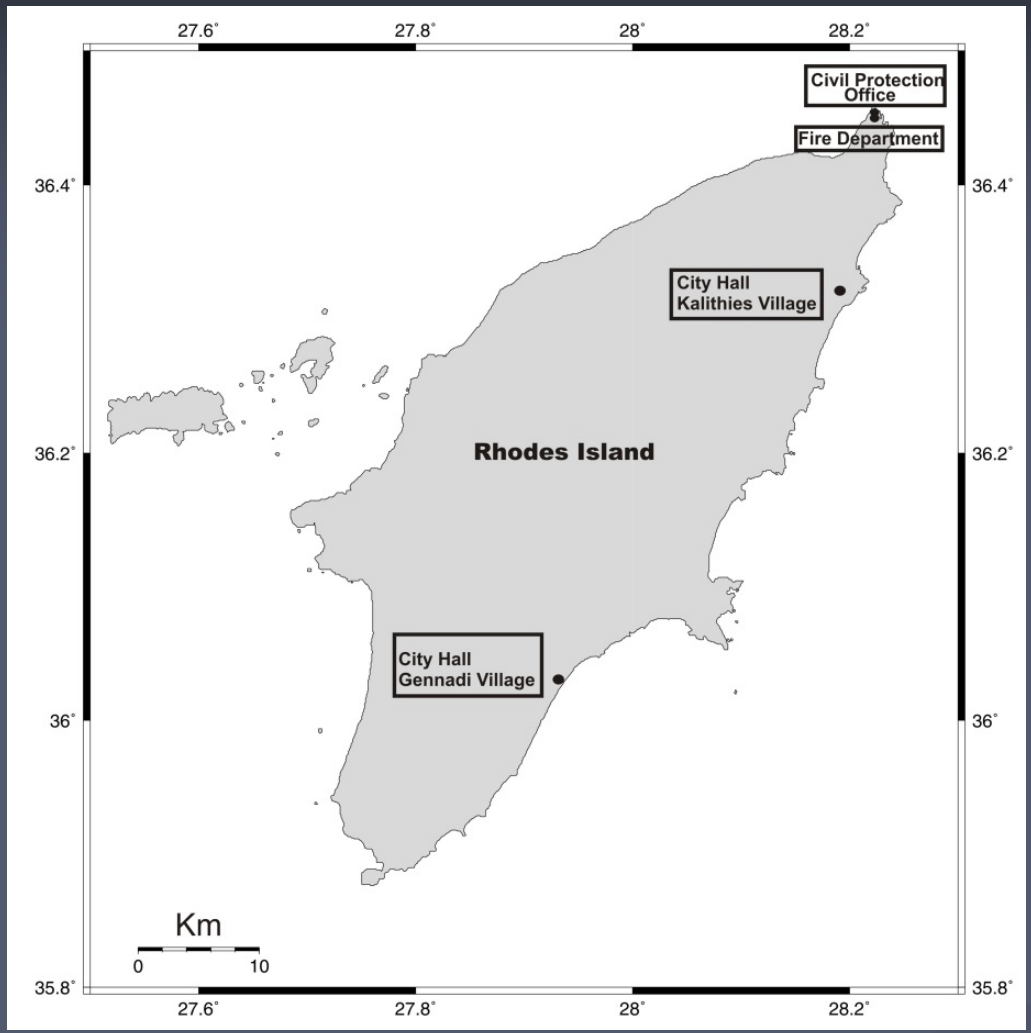
GFZ Potsdam

Approx. example of an earthquake of 8.9 Magnitude

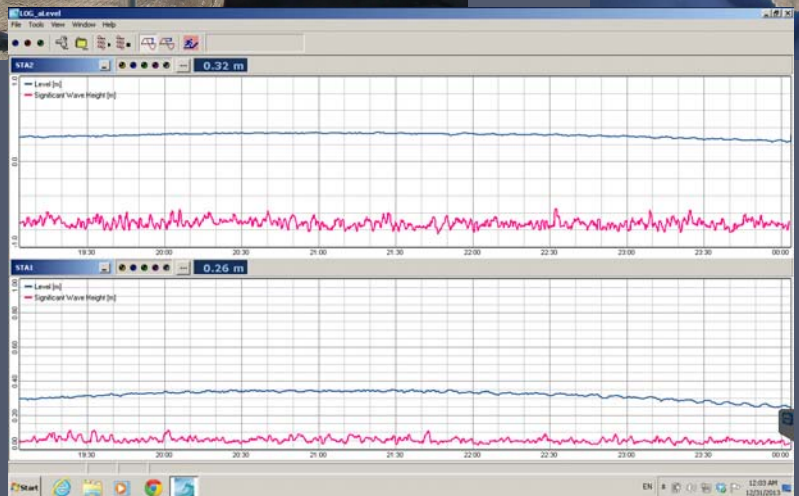


Seismic Alert Network
4 stations in Rhodes/8 sensors

Seismic Alert Network



Tide-gauge sites in Rhodes



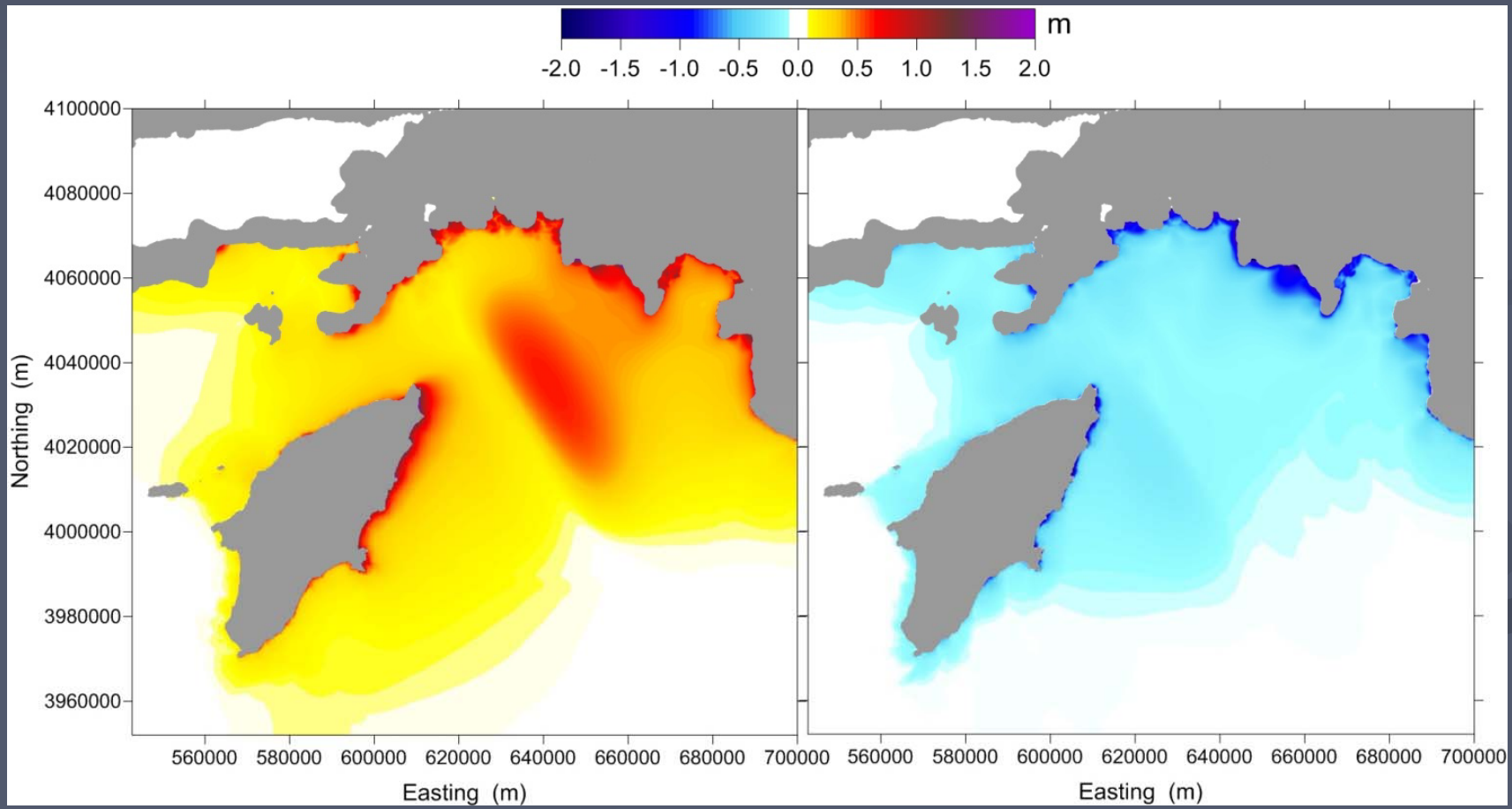
Geographical Management System

- Web-based, open access to multiple users
- GIS layers of background information (topography, road maps, critical facilities etc.)
- Tsunami hazard/vulnerabilitiy/risk maps
- Pre-simulated tsunami scenarios

and more

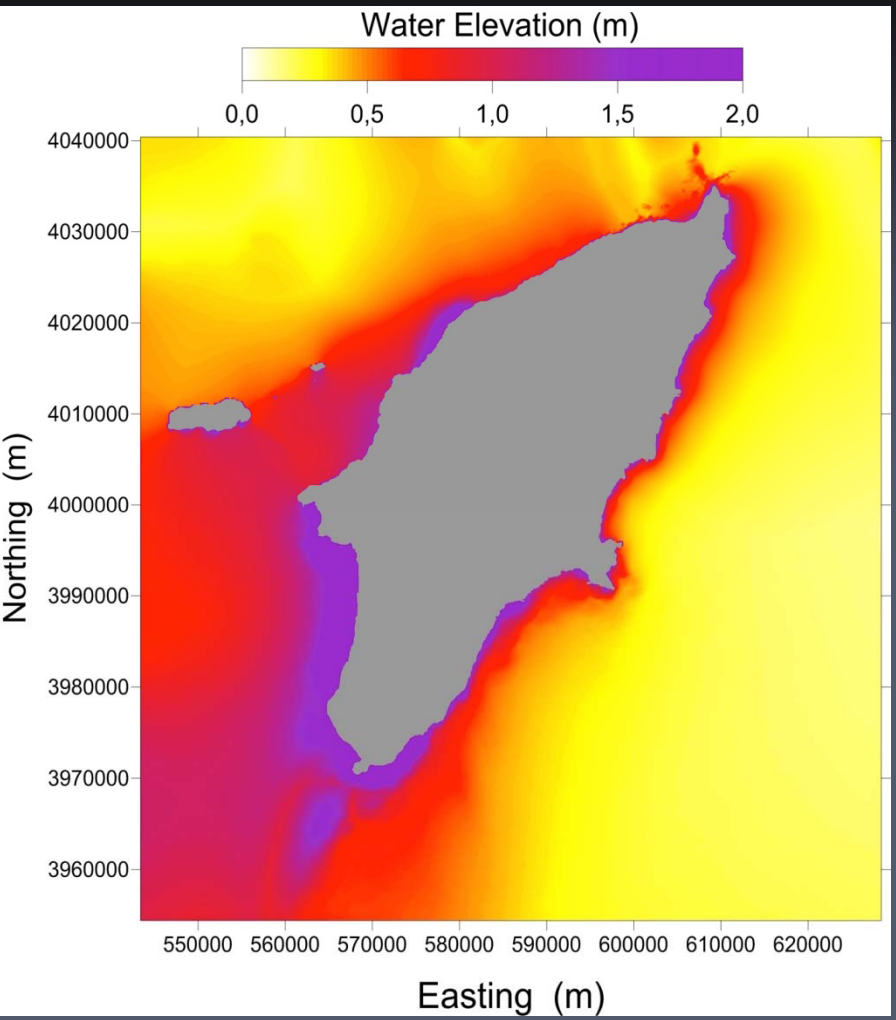
Extreme wave elevation fields
Local Earthquake (LEQ) Scenario

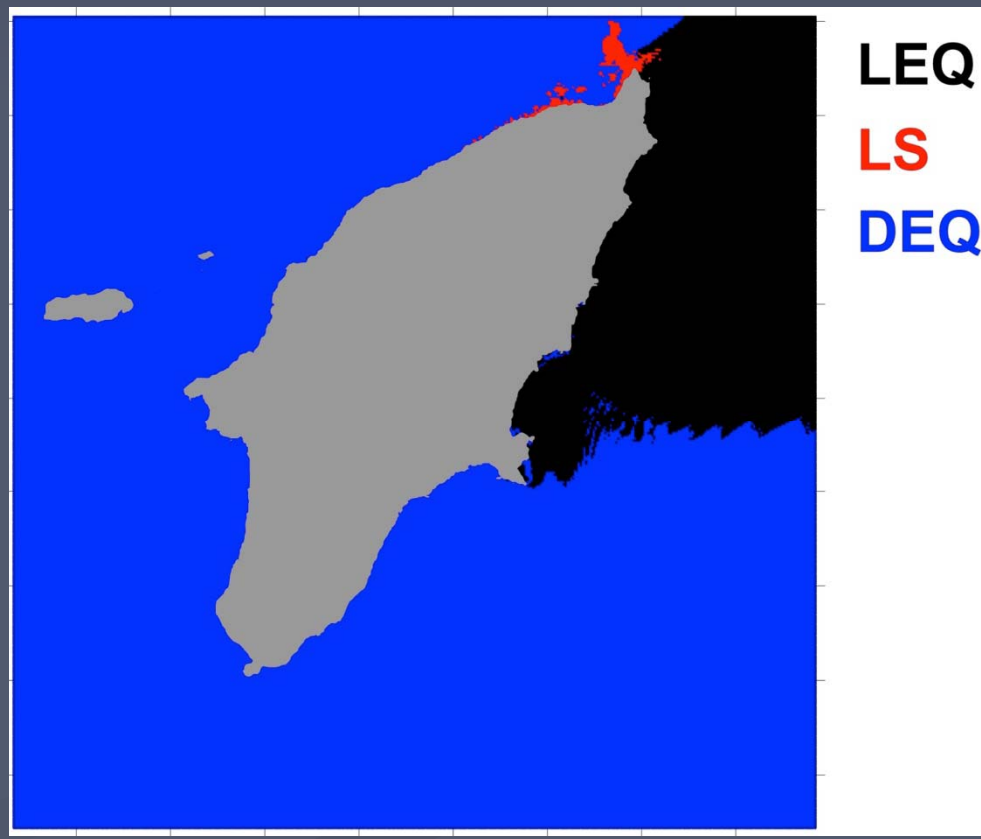
(Tinti et al., UNIBO)



Scenarios aggregate

(Tinti et al., UNIBO)





Local Seismic & Tsunami Early Warning System in Rhodes: how it works?

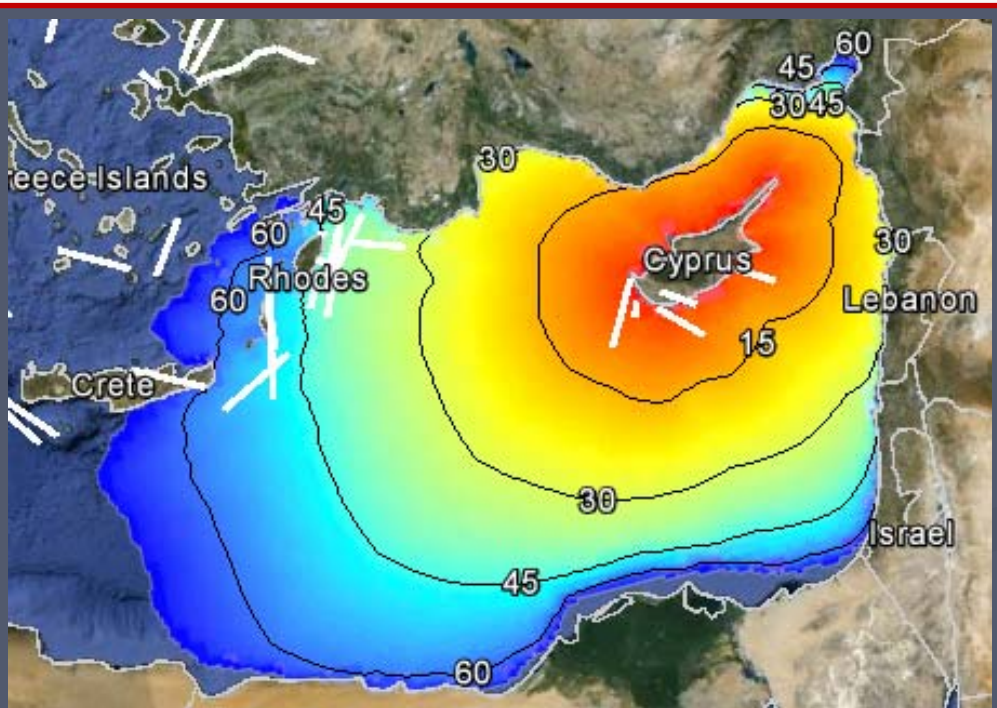
- Seismic Alert Devices are triggered in less than 25 sec with EQ's of M≥6 at distance up to 100 km
- Civil Protection mobilizes immediately
- Sea level records provide a secondary support
- Geographical Management System for crisis management

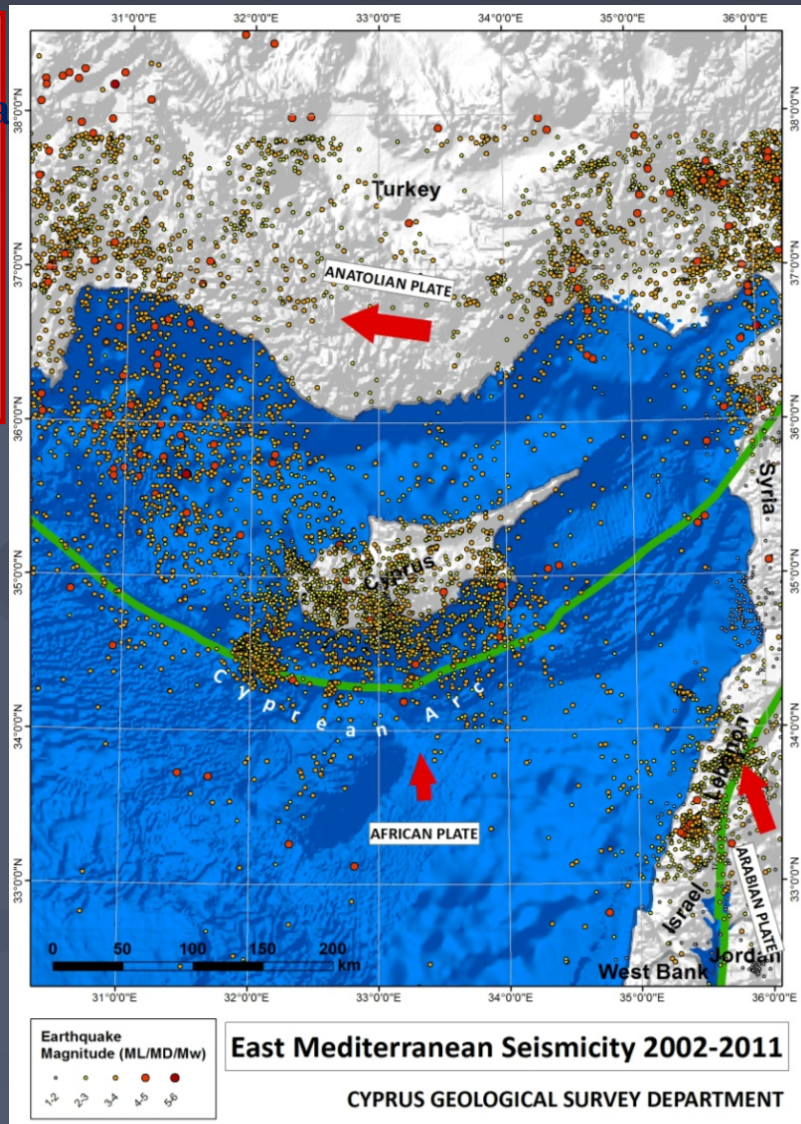
University of Cyprus
Oceanography Centre

NEAR to WARN
Project for Tsunami

Prospects of a local tsunami warning system

- A dense network of tide-gauges is in place
- Need seismic alert devices activated when a strong earthquake is detected
- Need a Geographical Management System





Thanks for coming in Rhodes!

International Workshop on

Mega Earthquakes & Tsunamis in Subduction Zones -Forecasting Approaches and Implications for Hazard Assessment

Rhodes Isl., 6-8 Oct. 2014