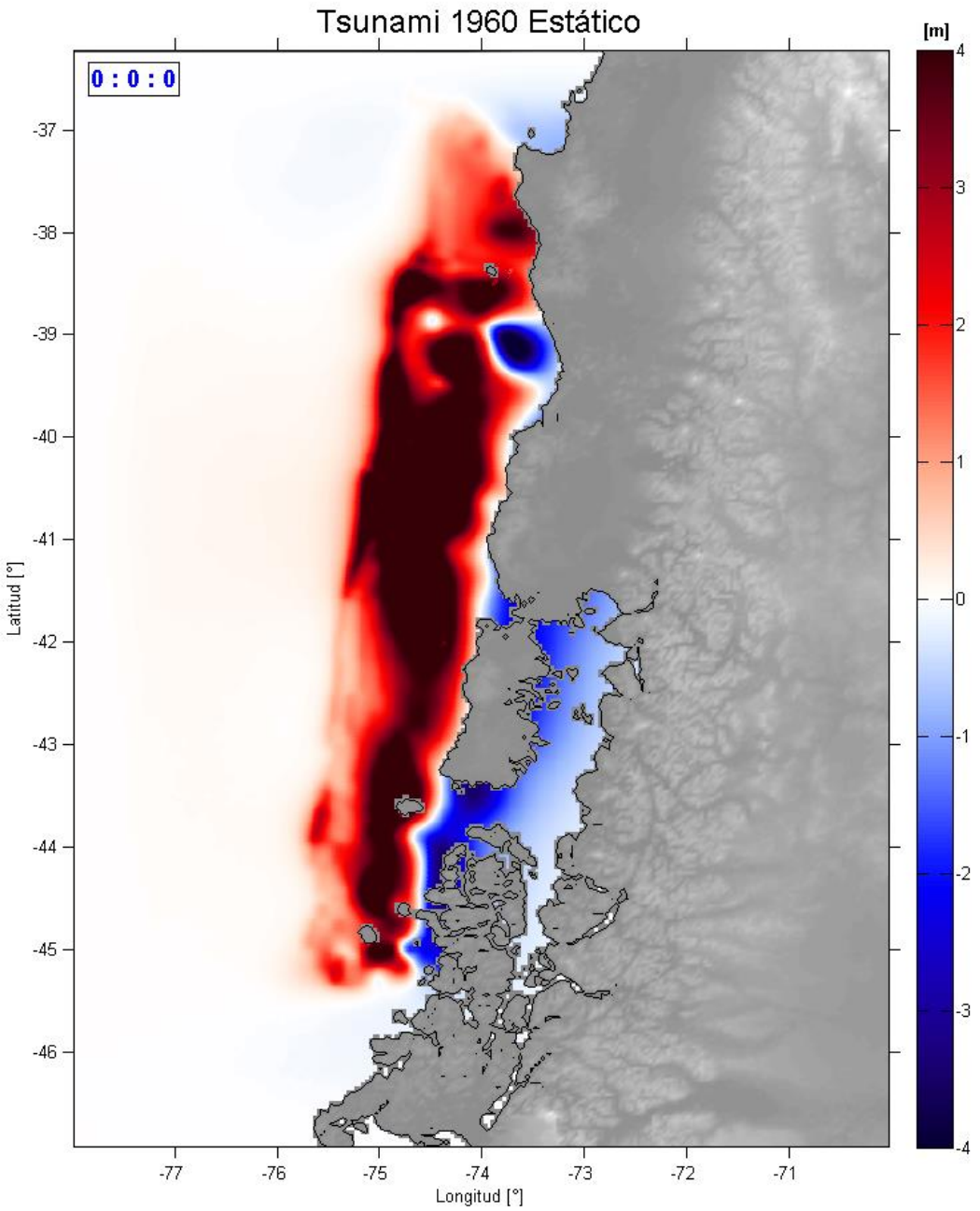
FUENTES

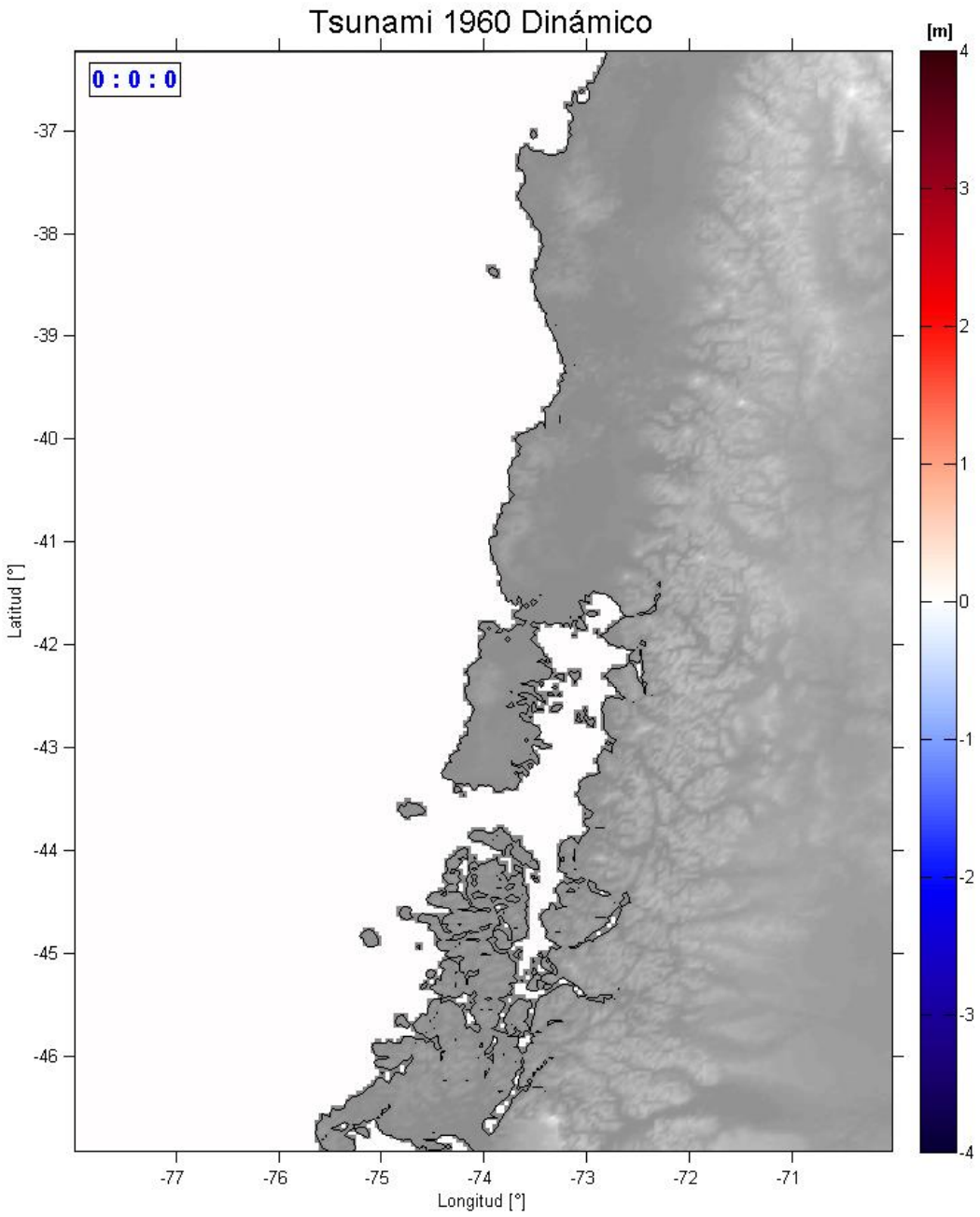
METEOTSUNAMI Y ASTEROIDES

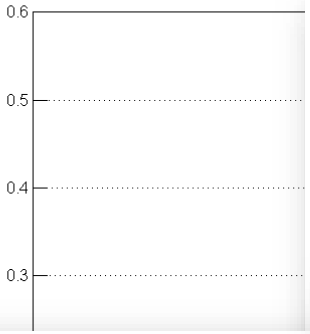
PERO ANTES….

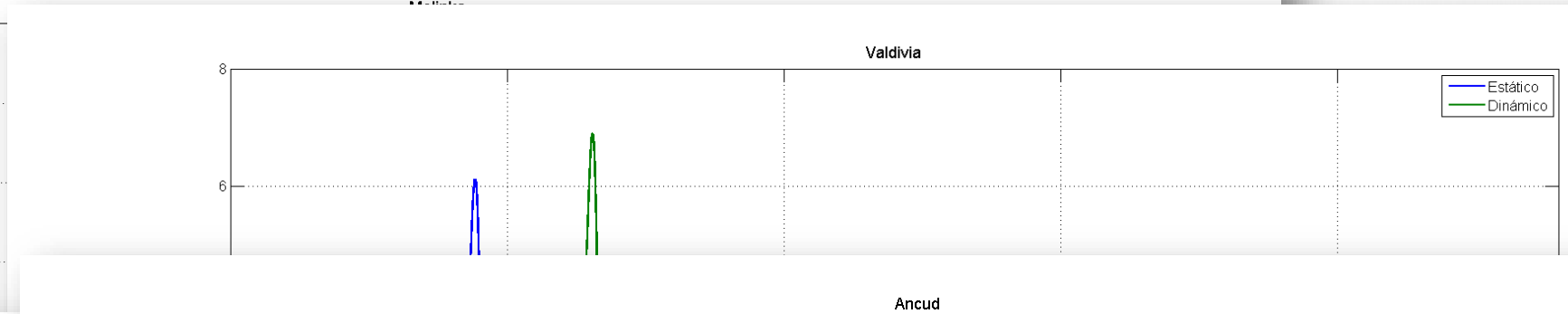
LO QUE DEBÍA!

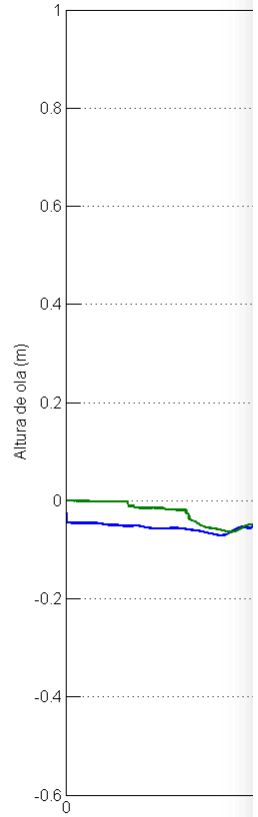
COMPARACIÓN DINÁMICO VS ESTÁTICO

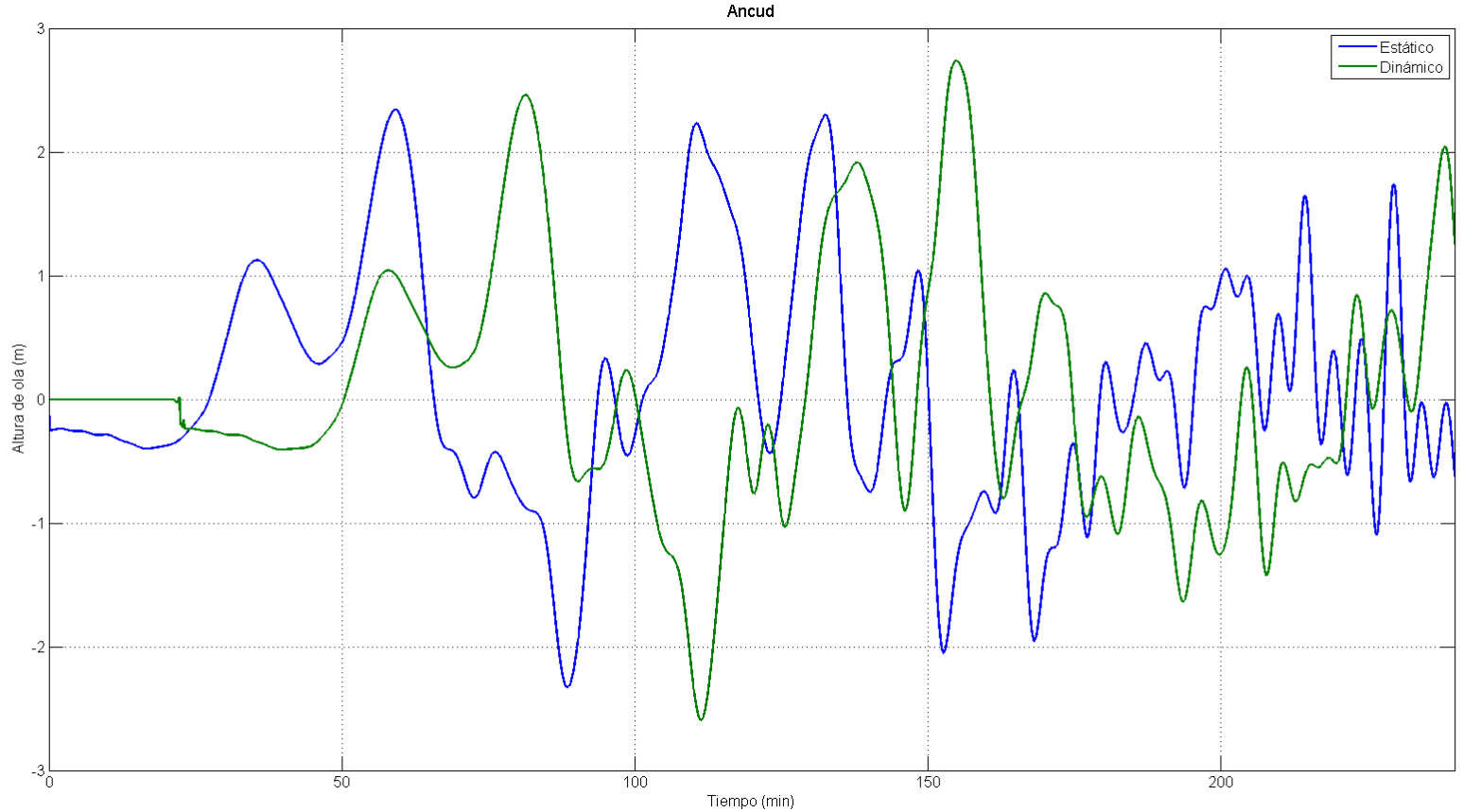

Tsunami 1960 Estático
0 : 0 : 0
[m]
4
3
2
1
0
-1
-2
-3
-4
-37
-38
-39
-40
-41
-42
-43
-44
-45
-46
Latitud [°]
-77
-76
-75
-74
-73
-72
-71
Longitud [°]


Tsunami 1960 Dinámico
0 : 0 : 0
[m]
4
3
2
1
0
-1
-2
-3
-4
-37
-38
-39
-40
-41
-42
-43
-44
-45
-46
Latitud [°]
-77
-76
-75
-74
-73
-72
-71
Longitud [°]

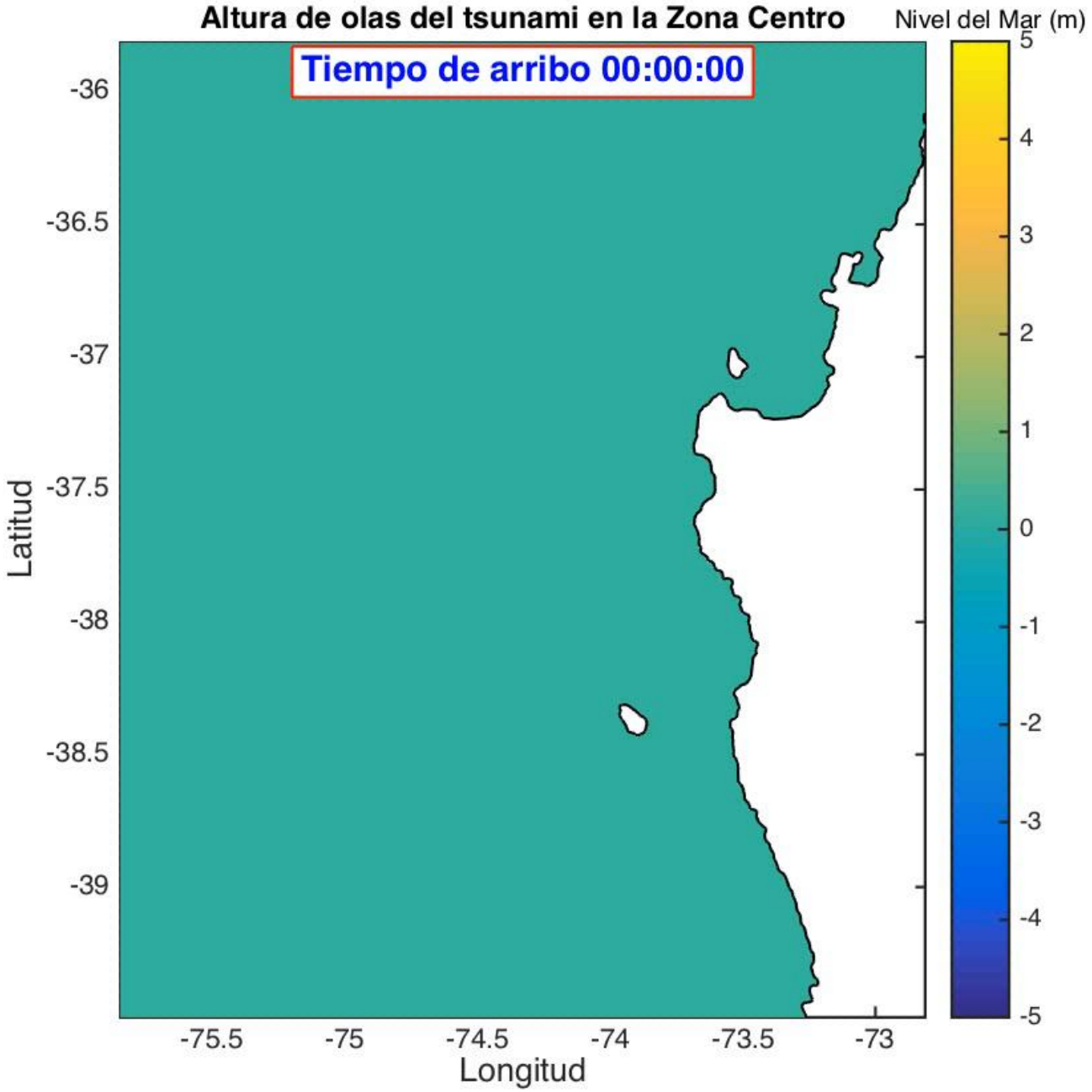

0.6
0.5
0.4
0.3


Valdivia
8
6
Estático
Dinámico


1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Altura de ola (m)
0


Ancud
3
2
1
0
-1
-2
-3
Altura de ola (m)
Estático
Dinámico
0
50
100
150
200
Tiempo (min)

MODELACIÓN POR LANDSLIDE


Altura de olas del tsunami en la Zona Centro
Nivel del Mar (m)
Tiempo de arribo 00:00:00
-36
-36.5
-37
-37.5
-38
-38.5
-39
Latitud
-75.5
-75
-74.5
-74
-73.5
-73
Longitud
5
4
3
2
1
0
-1
-2
-3
-4
-5

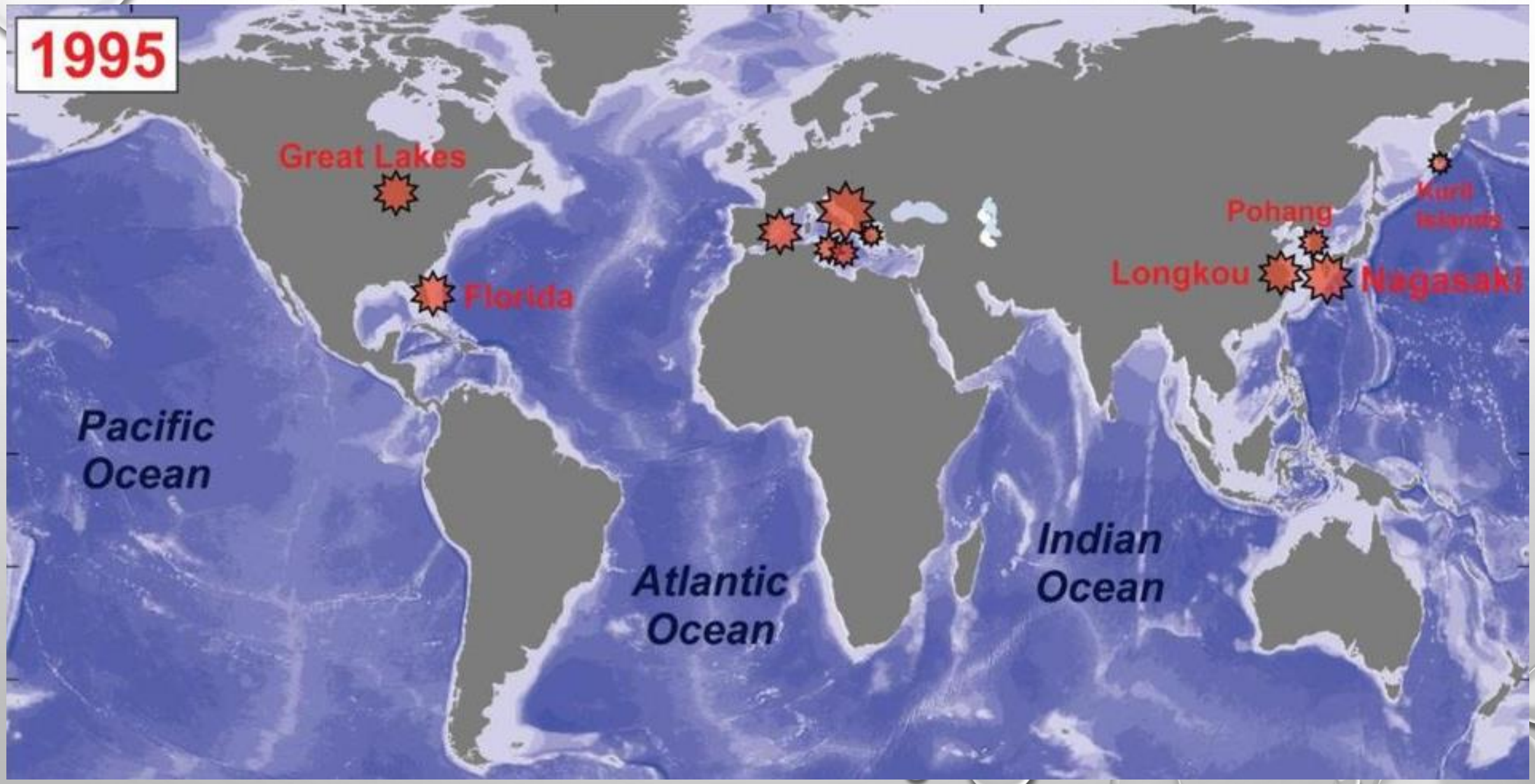
AHORA SI…. ☺

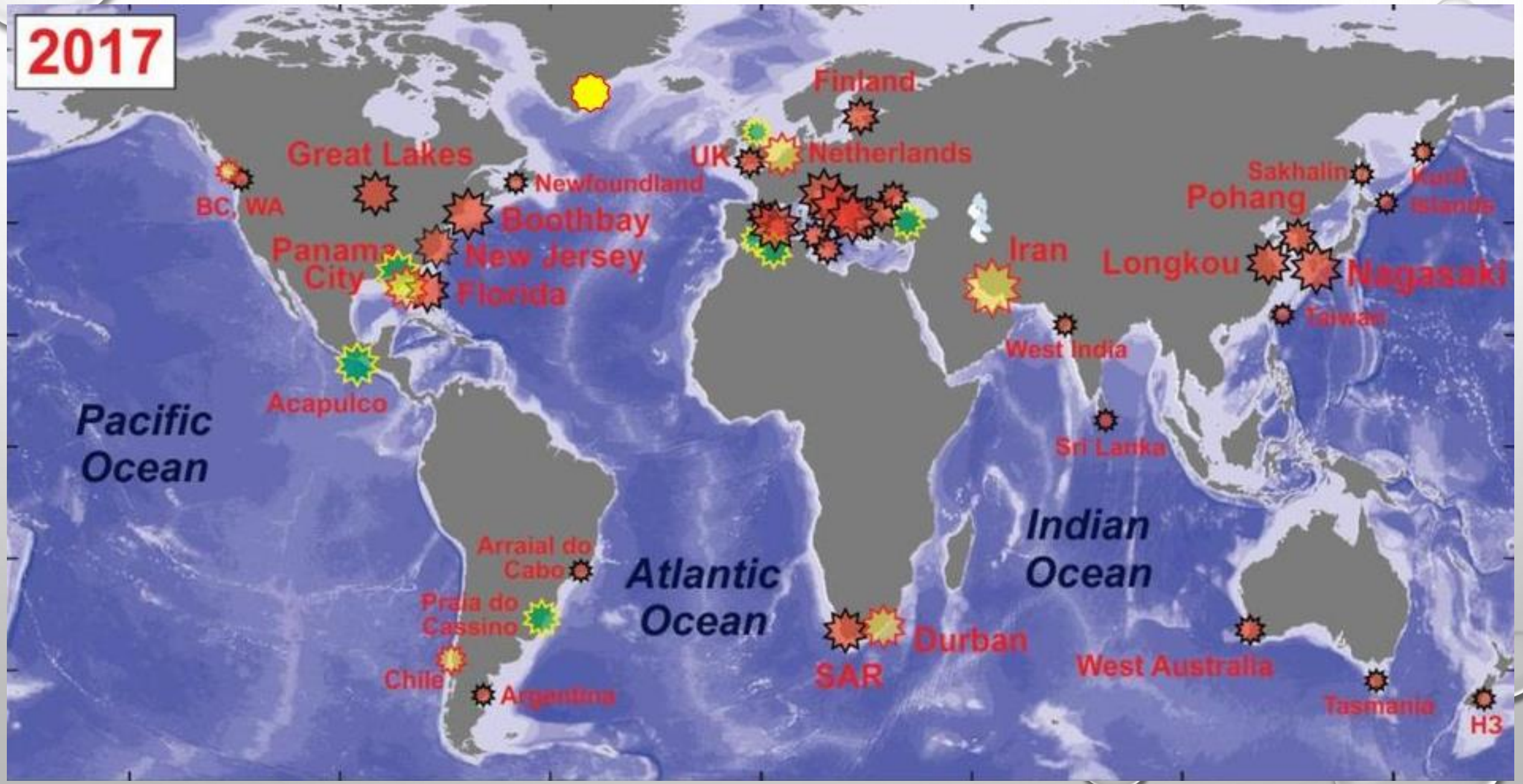
METEOTSUNAMI

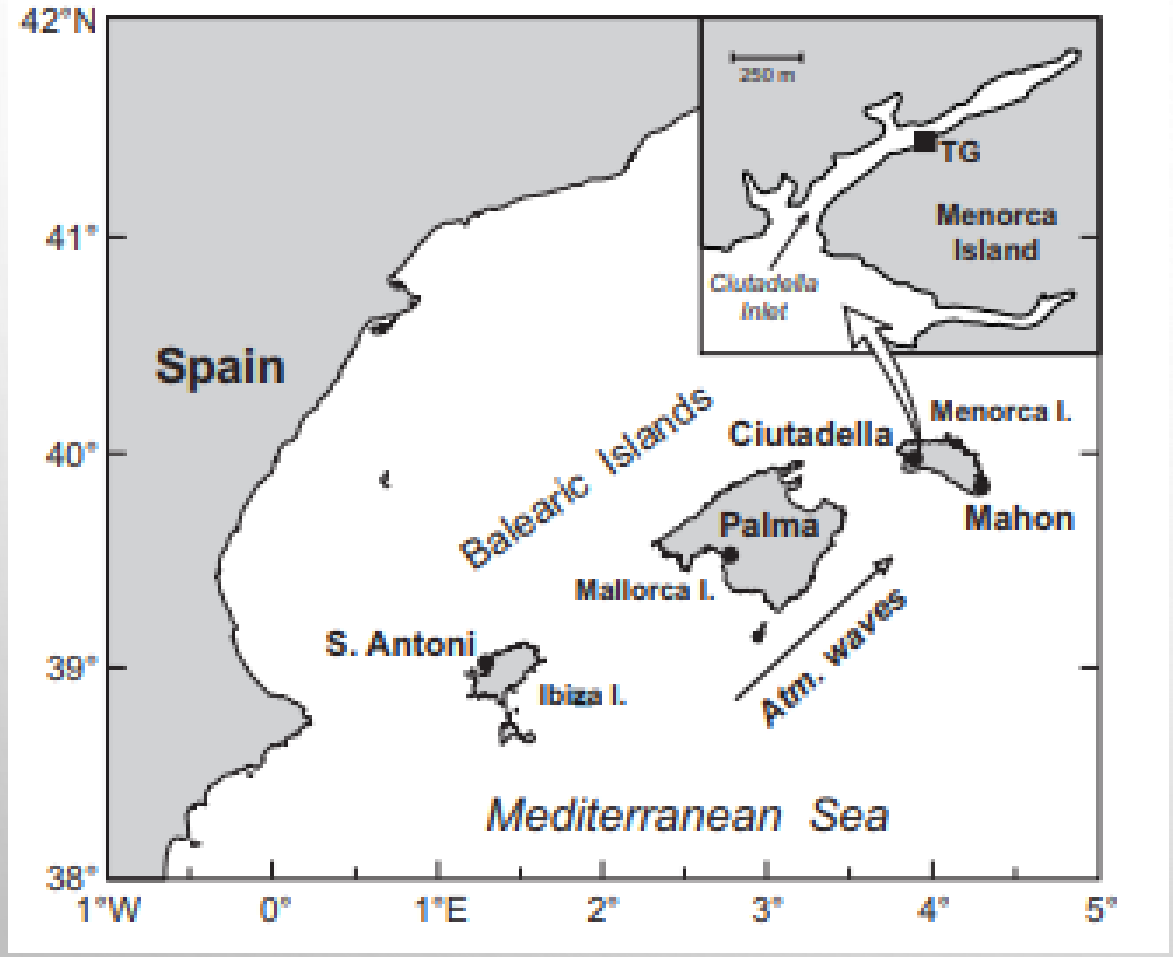
Meteotsunami en el puerto de Ciudadella, Isla de Menorca. (Rabinovich y Montserrat, 1998)

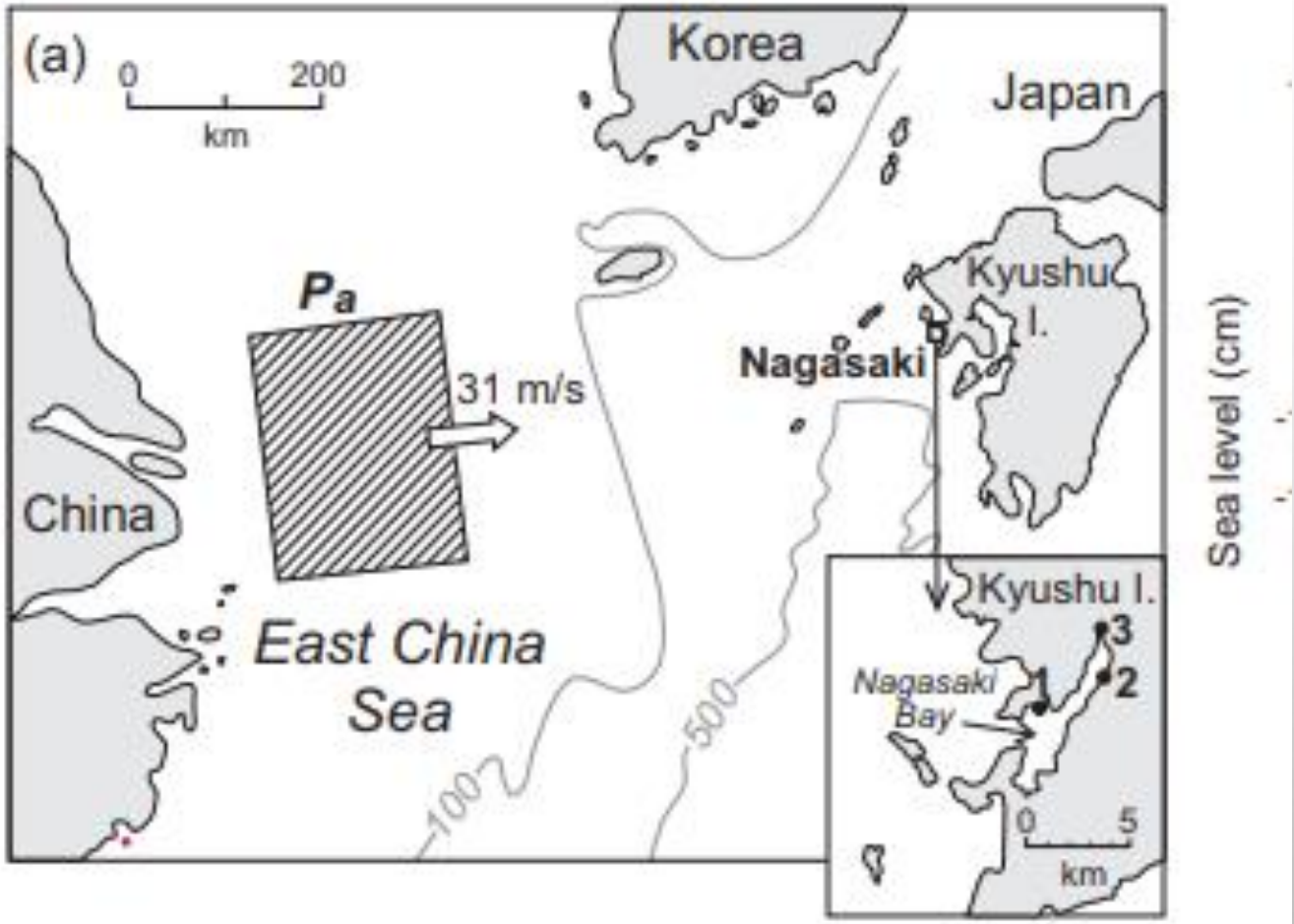
CARACTERÍSTICAS

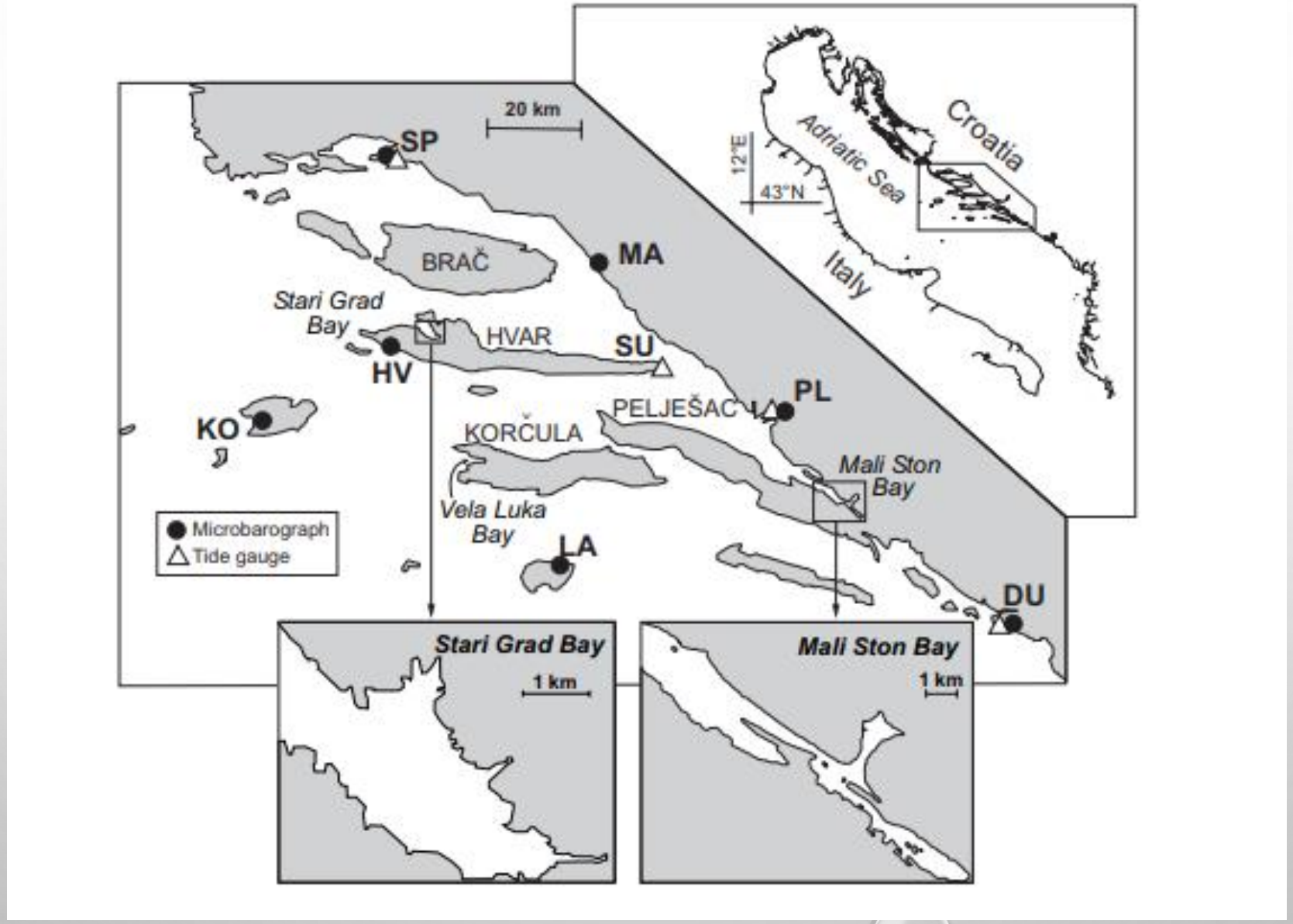
- Puertos o Bahías con alta amplificación y resonancia.
- Lugares geográficos cerrados o semi-cerrados.
- Anomalía atmosférica a pequeña escala.
- Propagación hacia la entrada del puerto o bahía.
- Resonancia.

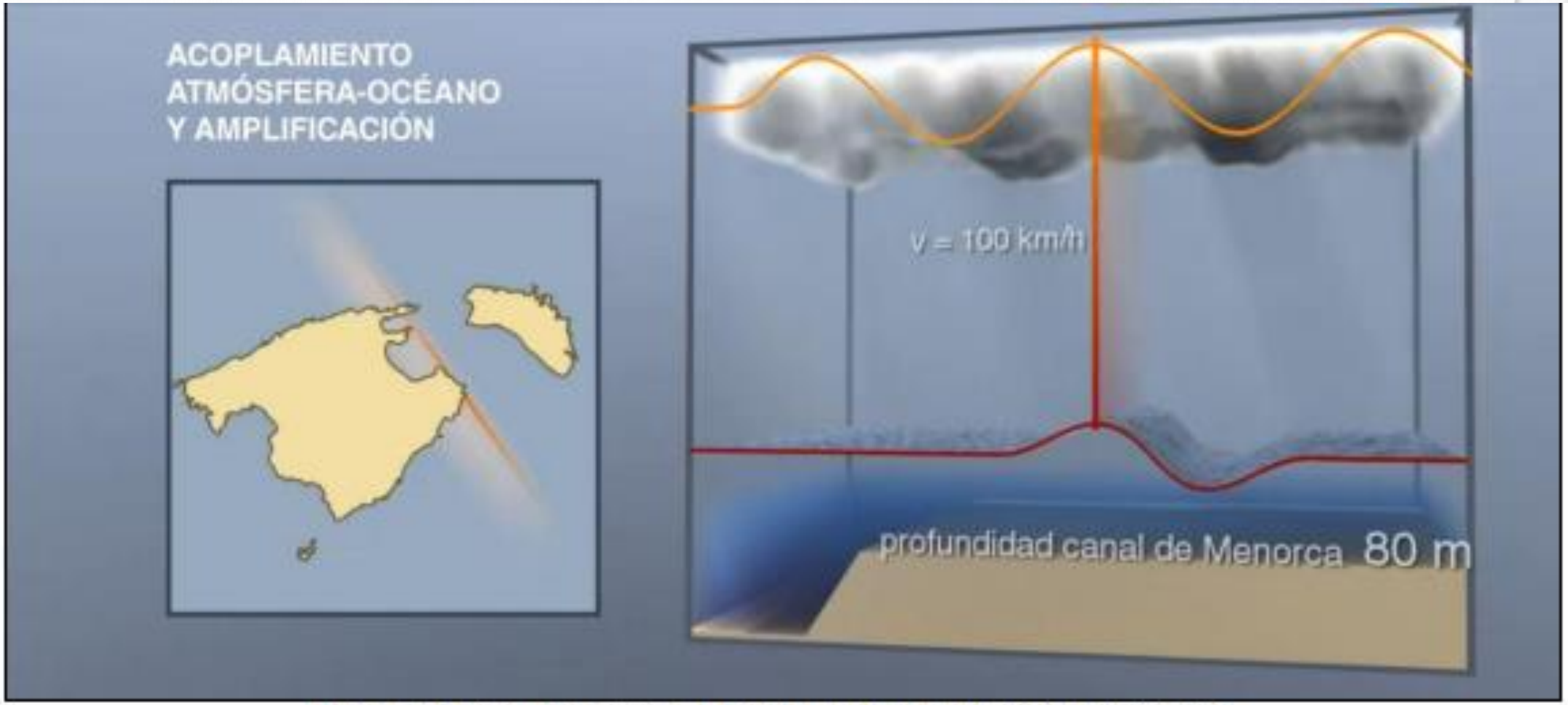

1995
Great Lakes
Florida
Pohang
Longkou
Nagasaki
Pacific Ocean
Atlantic Ocean
Indian Ocean


2017
Finland
Great Lakes
UK
Netherlands
Newfoundland
BC, WA
Boothbay
Panama City
New Jersey
Florida
Iran
Sakhalin
Pohang
Longkou
Nagasaki
Taiwan
West India
Acapulco
Pacific Ocean
Sri Lanka
Indian Ocean
Arraial do Cabo
Atlantic Ocean
Praia do Cassino
Durban
SAR
Chile
Argentina
West Australia
Tasmania
H3


42°N
41°
40°
39°
38°
1°W
0°
1°E
2°
3°
4°
5°
250 m
TG
Menorca Island
Ciutadella Inlet
Spain
Balearic Islands
Ciutadella
Menorca I.
Mahon
Palma
Mallorca I.
S. Antoni
Ibiza I.
Atm. waves
Mediterranean Sea


(a)
0
200
km
Korea
Japan
Pa
31 m/s
China
East China Sea
Kyushu I.
Nagasaki
Kyushu I.
Nagasaki Bay
1
2
3
0
5
km
100
500
Sea level (cm)


20 km
SP
MA
BRAČ
Stari Grad
Bay
HVAR
HV
SU
PL
PELJEŠAC
KO
KORČULA
Mali Ston
Bay
Vela Luka
Bay
LA
DU
Microbarograph
Tide gauge
Croatia
Adriatic Sea
Italy
12°E
43°N
Stari Grad Bay
1 km
Mali Ston Bay
1 km

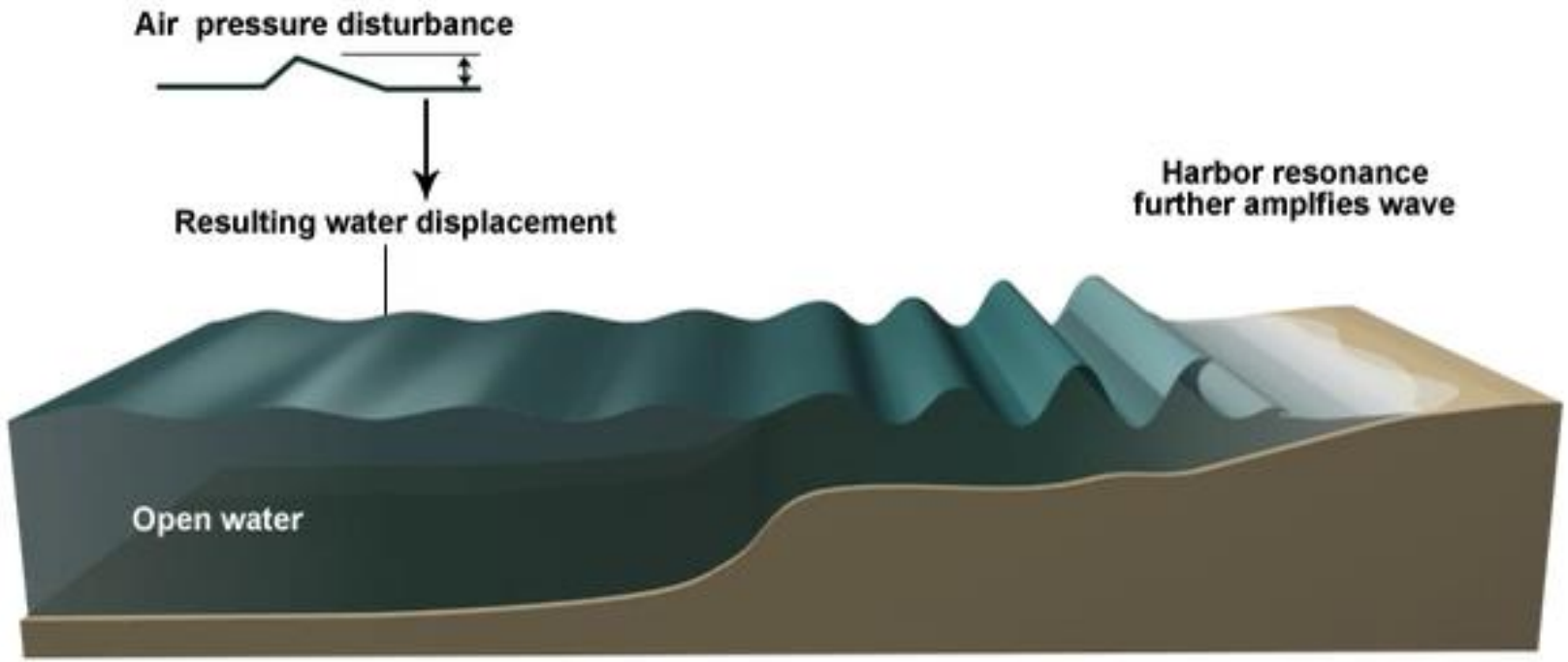


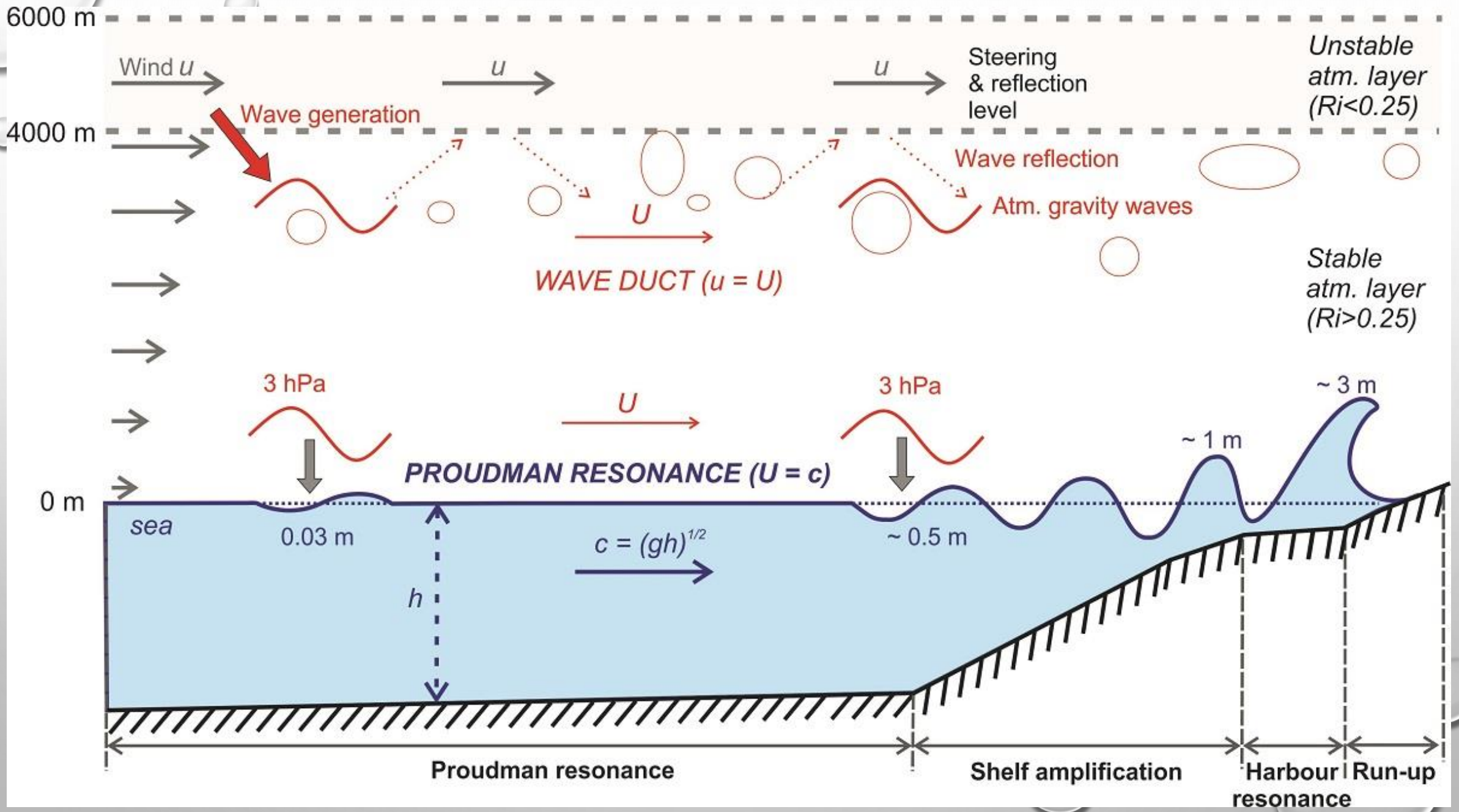
Fuente: Centro Superior de Investigaciones Científicas (CSIC).

Fuente: <http://cazatormentas.net>. Desarrollo de la Rissaga o meteotsunam acaecido en Ciutadella (Maó), 16 de junio de 2006.

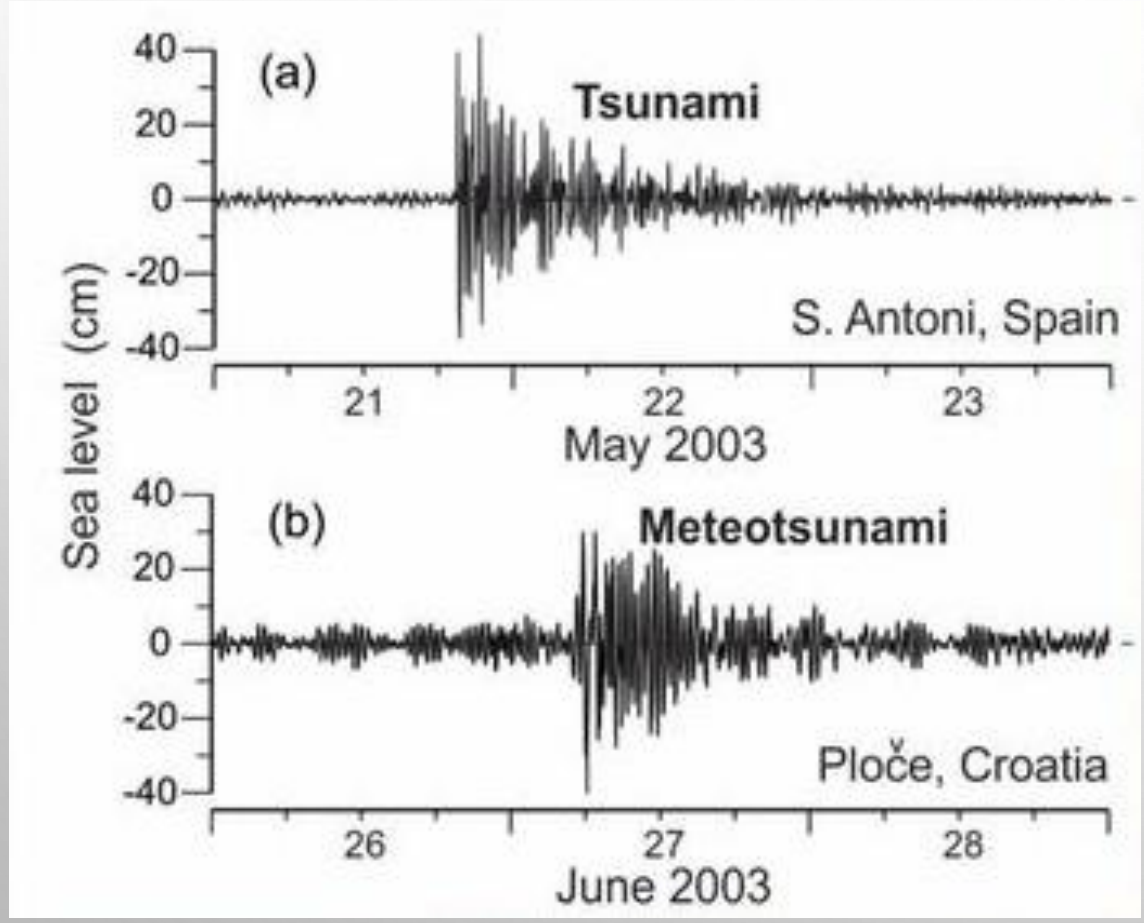
Meteotsunamis

Generation of a Meteotsunami

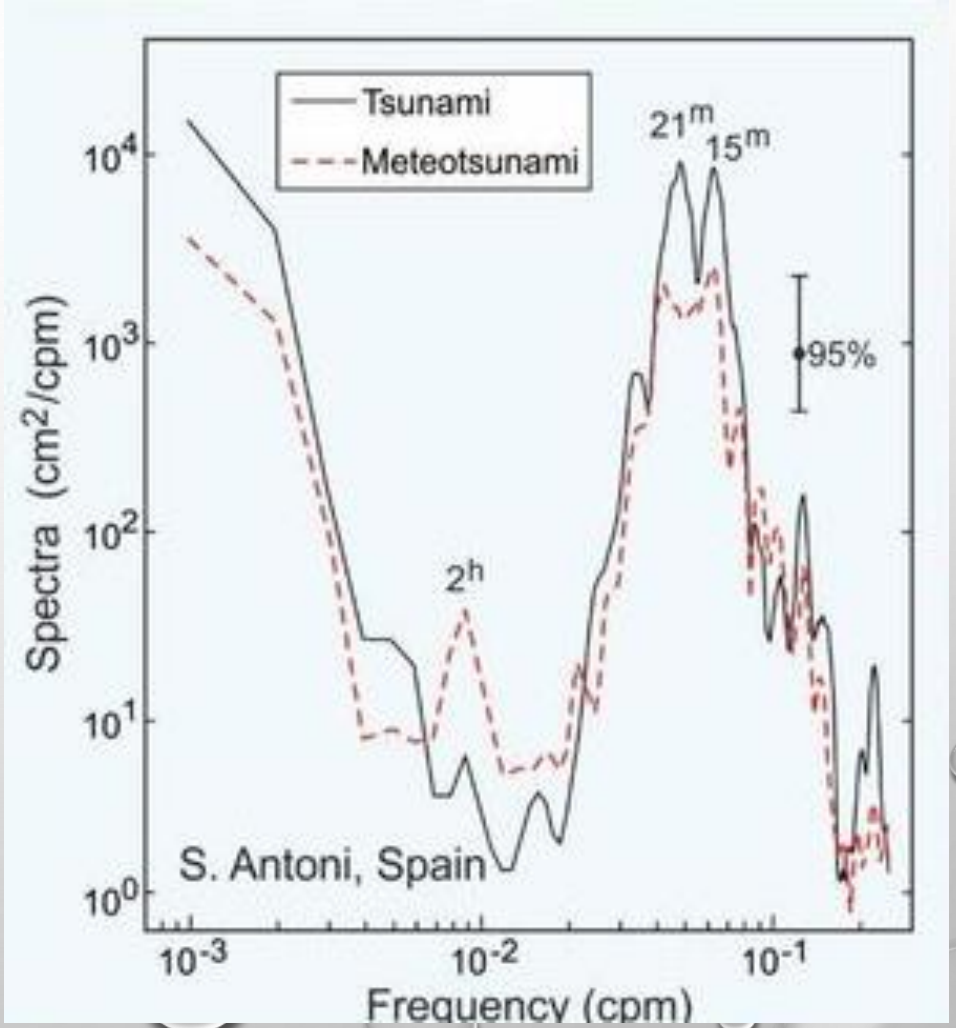



6000 m
4000 m
0 m
Wind u
u
u
Steering
& reflection
level
Unstable
atm. layer
(Ri<0.25)
Wave generation
Wave reflection
Atm. gravity waves
U
WAVE DUCT (u = U)
Stable
atm. layer
(Ri>0.25)
3 hPa
U
3 hPa
~ 3 m
~ 1 m
PROUDMAN RESONANCE (U = c)
sea
0.03 m
h
c = (gh)^1/2
~ 0.5 m
Proudman resonance
Shelf amplification
Harbour
resonance
Run-up

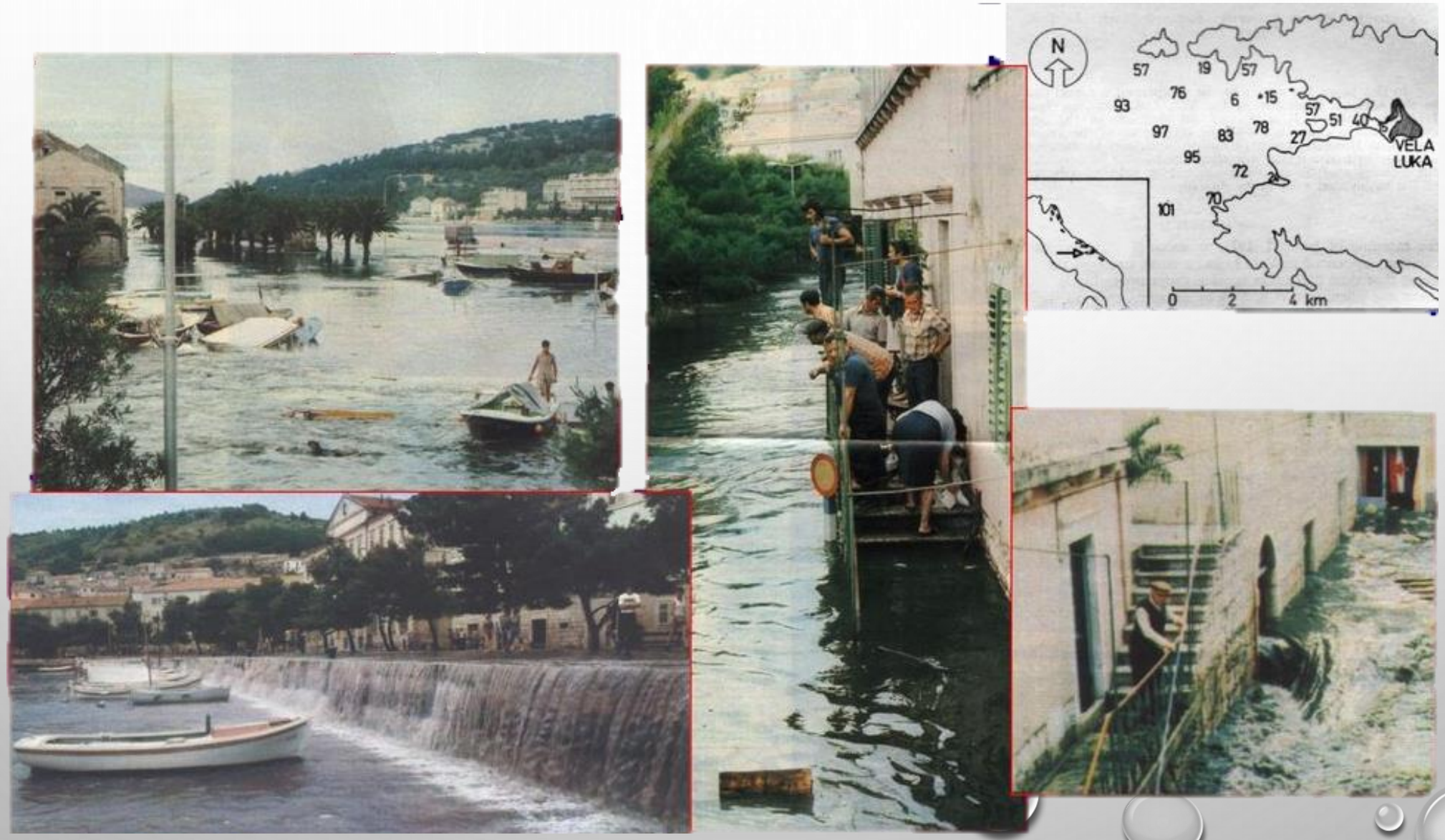
Registros de tsunami y meteotsunami



Espectros de tsunami y meteotsunami

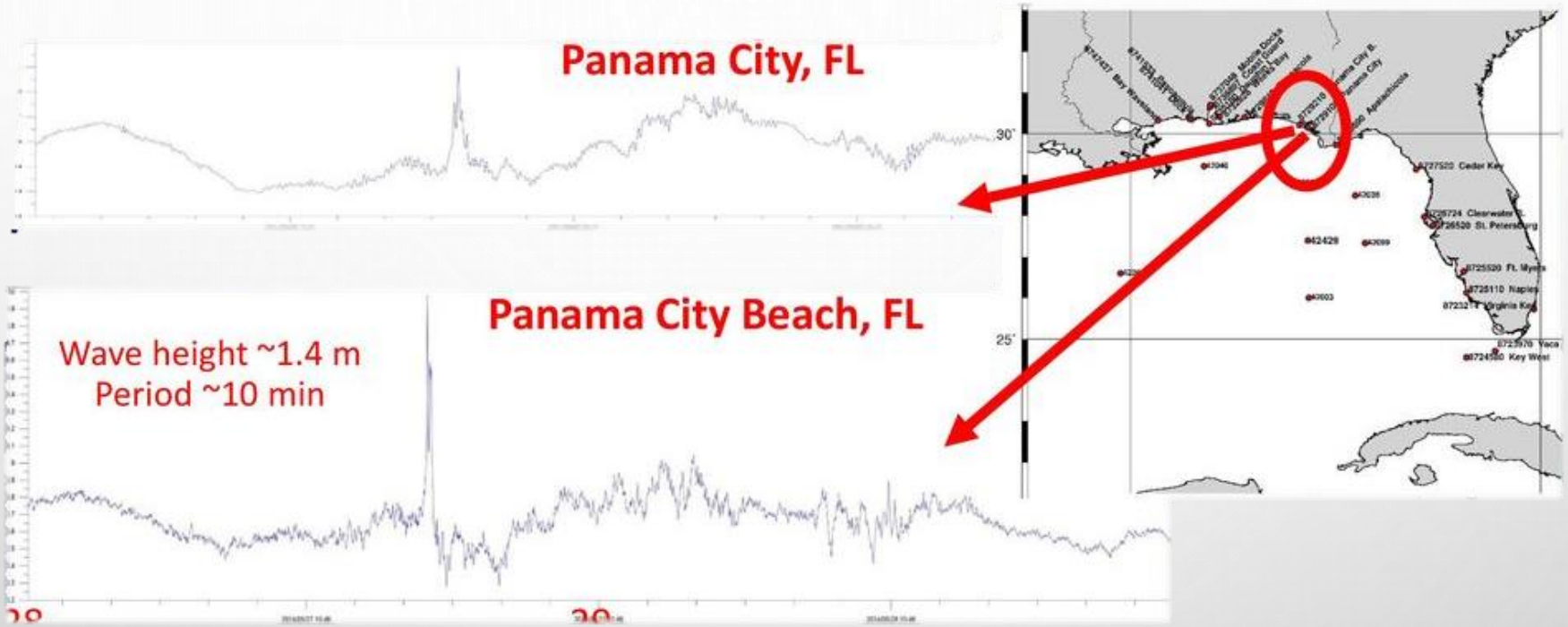


Meteotsunami en Vela Luka Croacia, el 21 de Junio de 1978

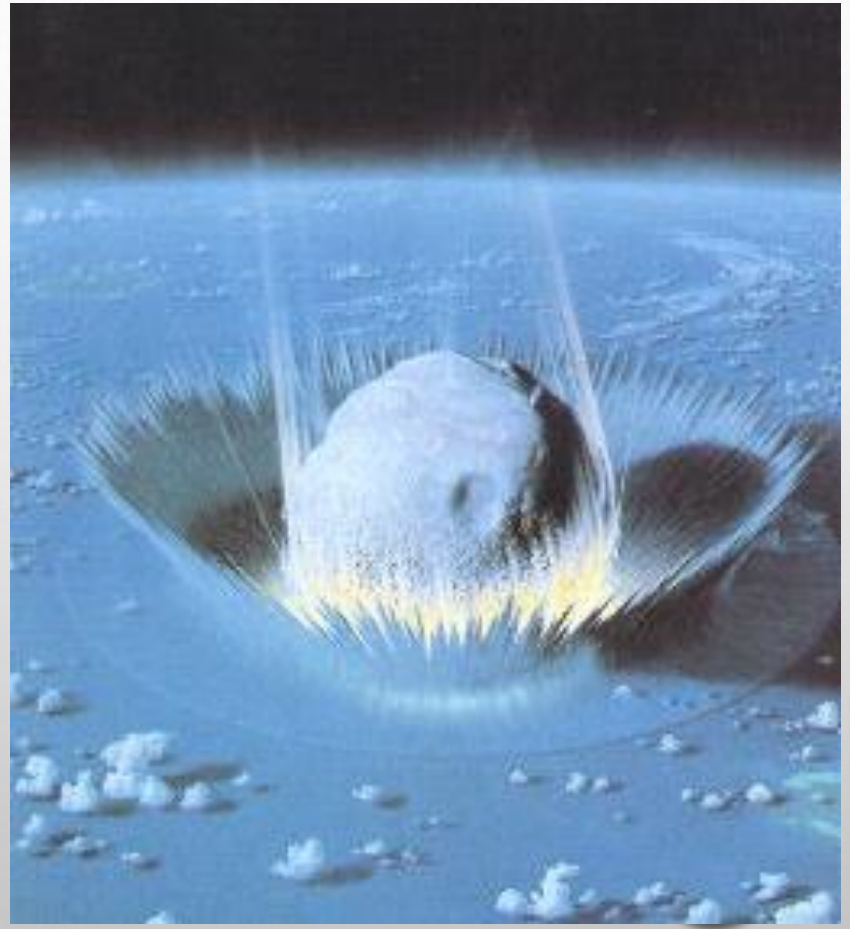


Meteotsunami en el Golfo de México

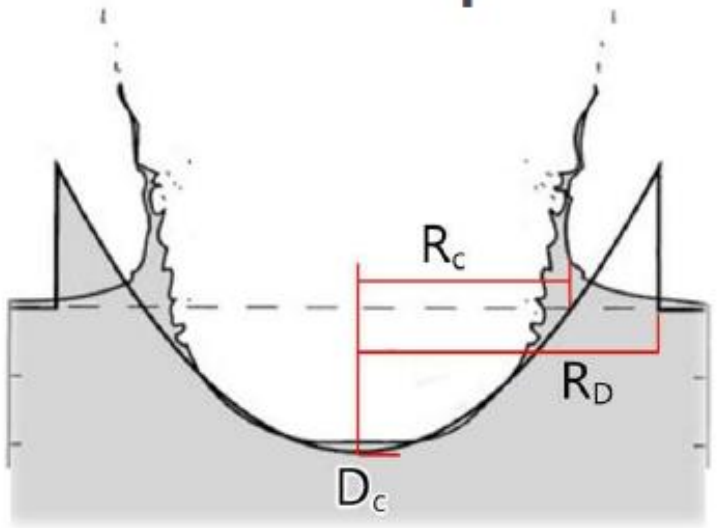
Ciudad de Panamá, Florida. El 28 de marzo de 2014



TSUNAMI POR METEORITOS

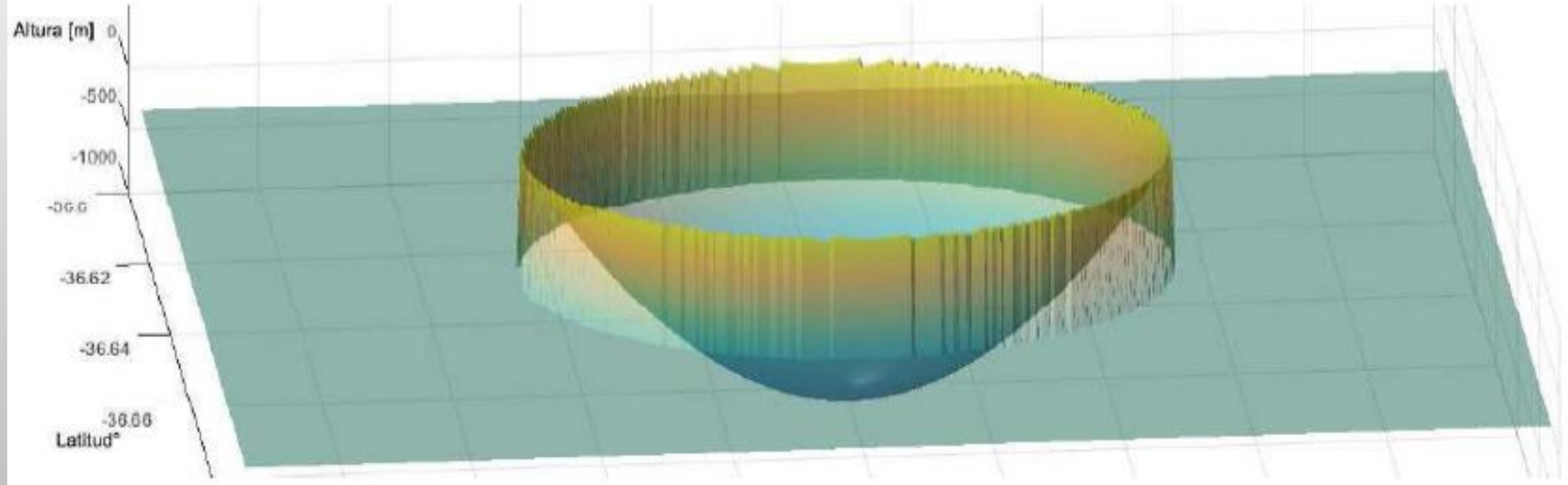


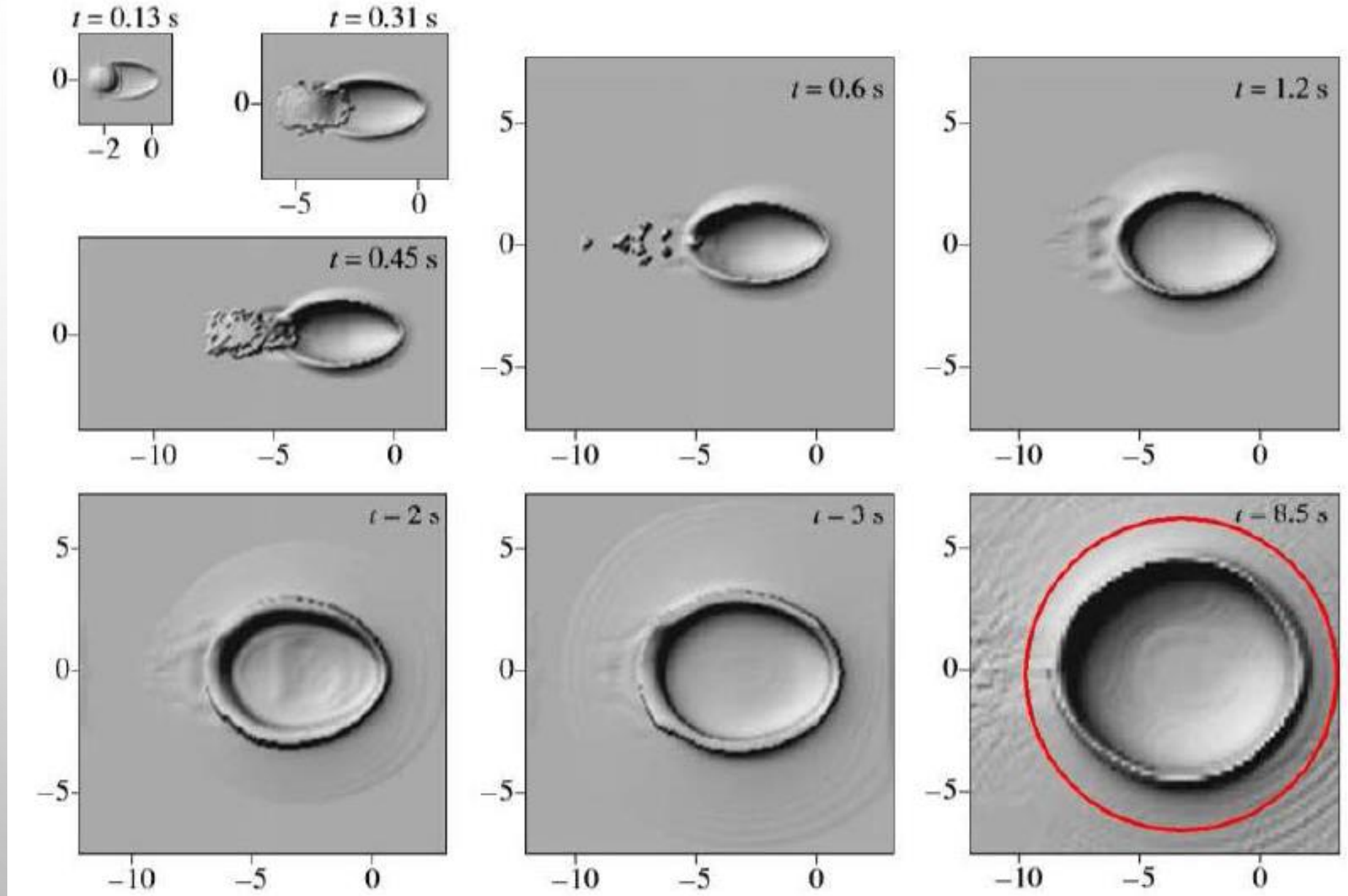
El Impacto



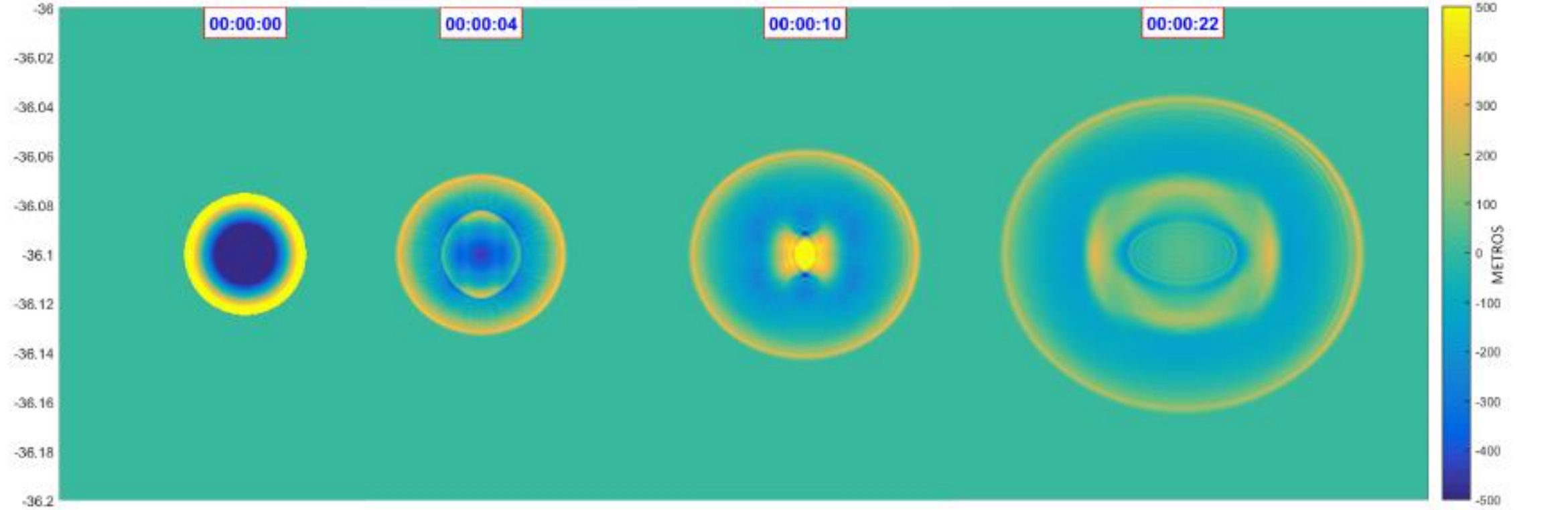
$$\eta(r,0) = D_c\left(\frac{1-r^2}{R_c^2}\right) \qquad ;\mid r \mid \leq R_D$$

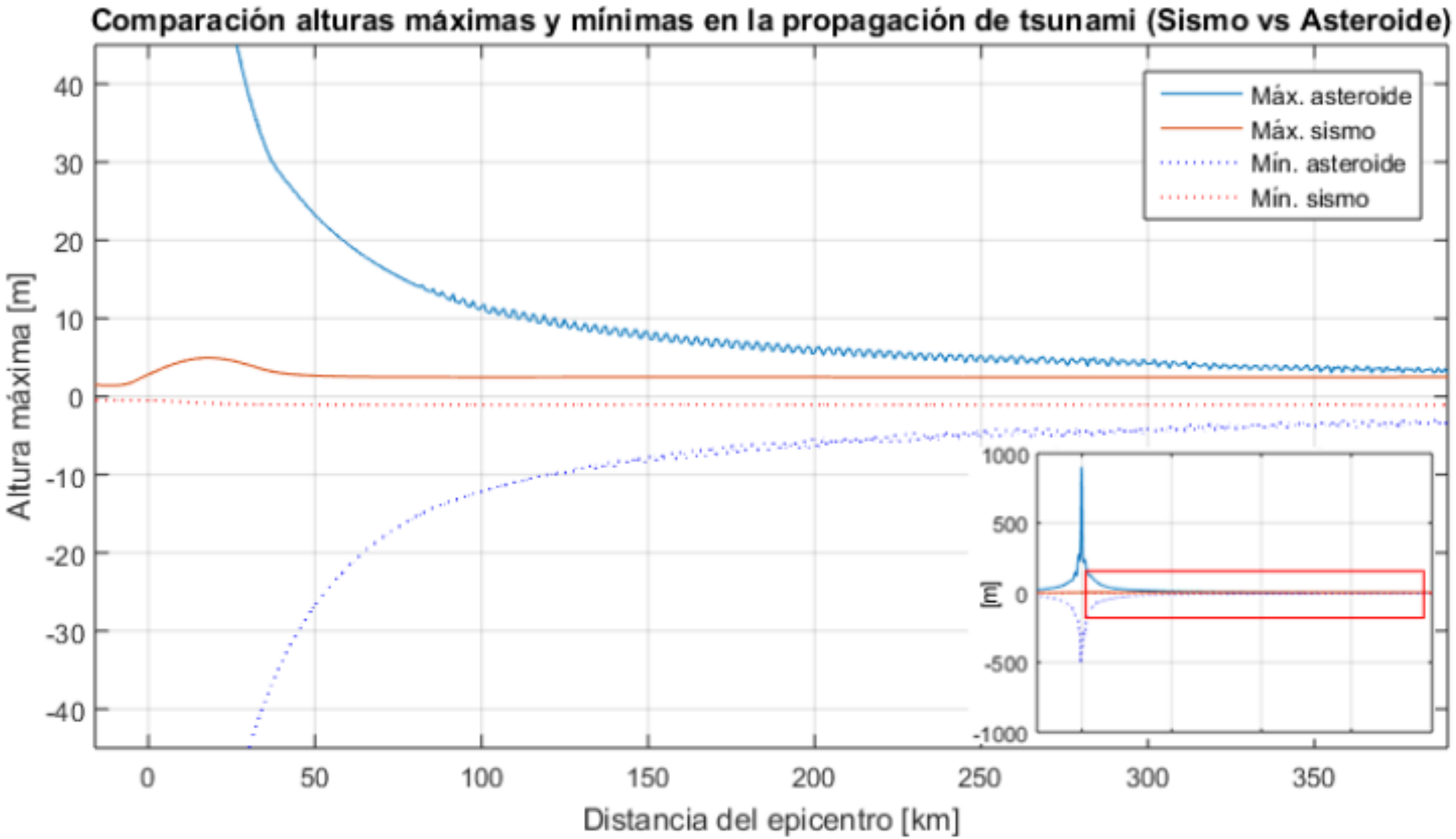
$$\eta(r,0) = 0 \qquad ;\mid r \mid > R_D$$




t = 0.13 s
t = 0.31 s
t = 0.45 s
t = 0.6 s
t = 1.2 s
t = 2 s
t = 3 s
t = 8.5 s

Evolución de la condición inicial




Comparación alturas máximas y mínimas en la propagación de tsunami (Sismo vs Asteroide)
Máx. asteroide
Máx. sismo
Mín. asteroide
Mín. sismo
Altura máxima [m]
Distancia del epicentro [km]
40
30
20
10
0
-10
-20
-30
-40
0
50
100
150
200
250
300
350
1000
500
0
-500
-1000
[m]