A new study approach for the consequences of the great 1755 Lisbon earthquake in the Lesser Antilles.

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Introduction

- 1755: reminder concerning earthquake and associated tsunami

→estimated

→ Source(s

→lot of cas

people) and

→waves rea

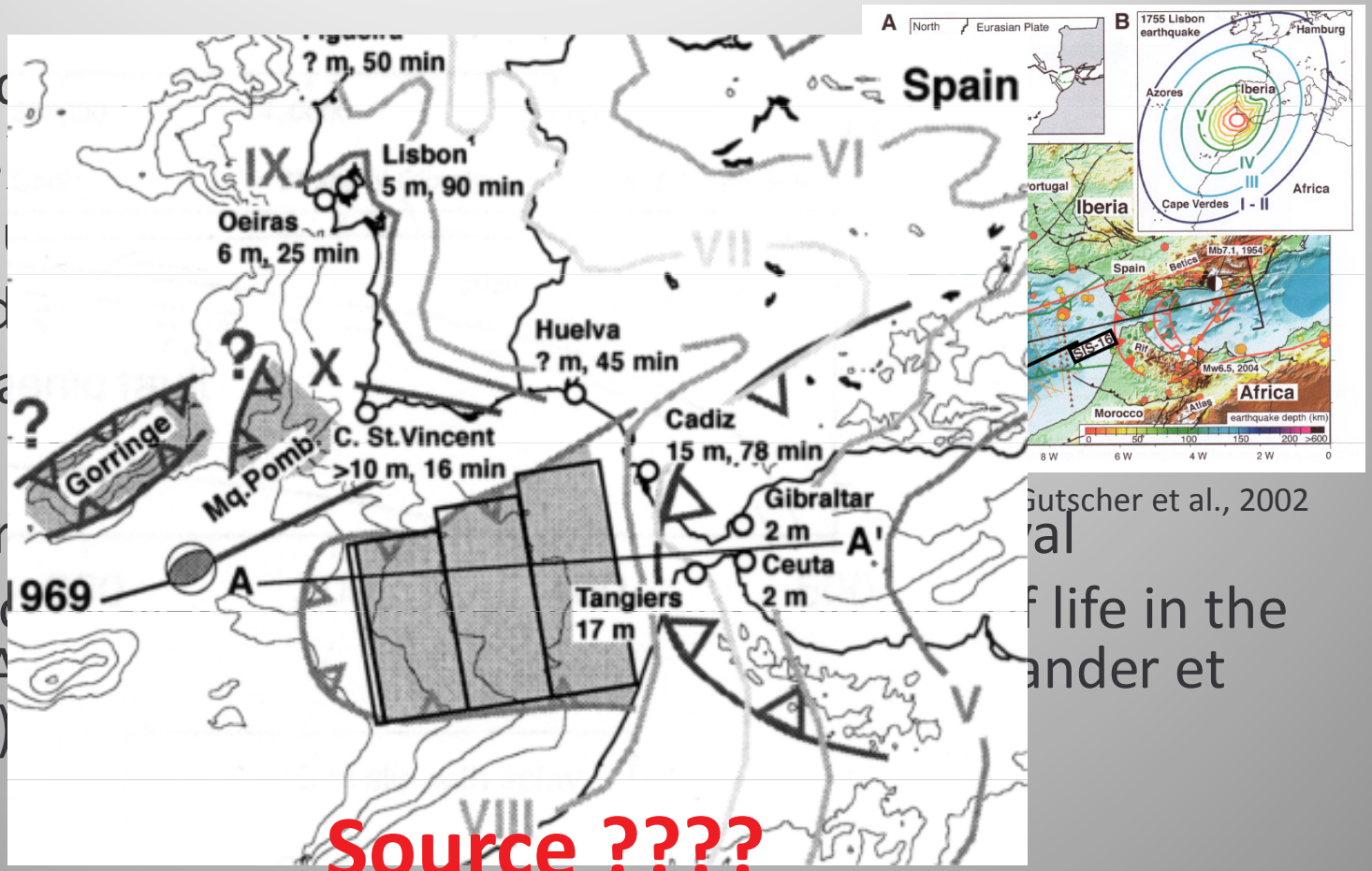
(Cadiz Gulf,

→reports fr

→ Reports

Açores (A

al., 2002)



Gutscher et al., 2002

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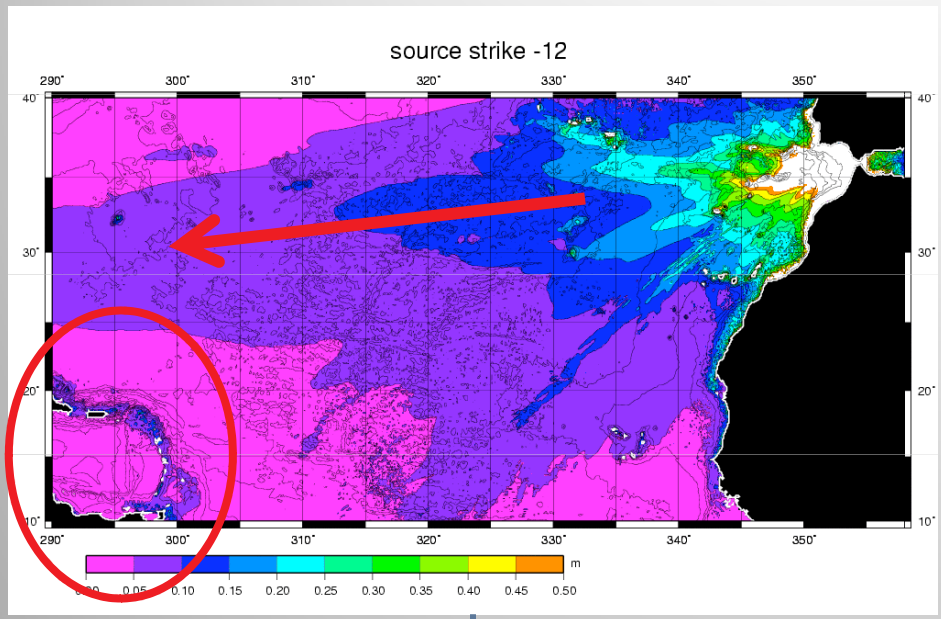
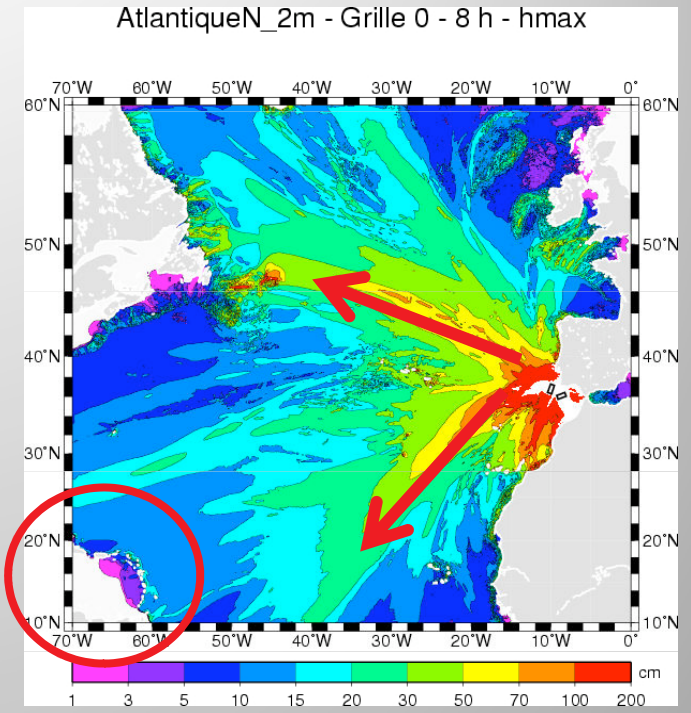
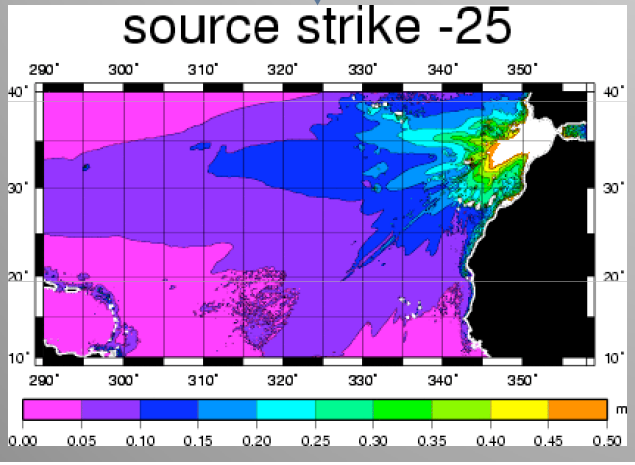
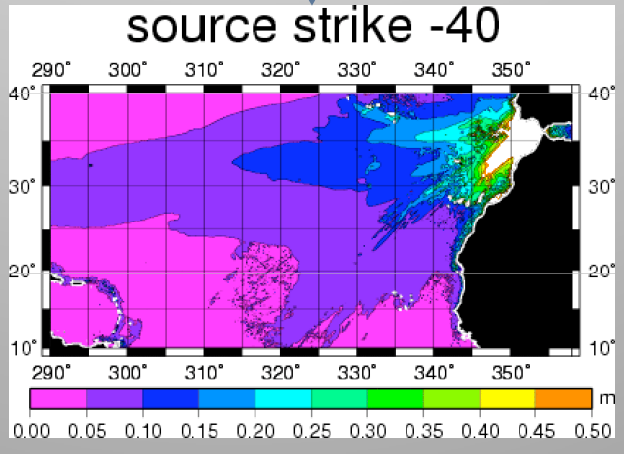
Modelling vs. Historical reports









→Negligible effect on Lesser Antilles

10 cm vs. 2-3 m

A possible origin of this large difference between amplitudes ?

The resonance effect

- **What ?**

→ phenomenon of trapping and amplification of wave energy (Woo et al, 2004)

- **Where ?**

→ semi-enclosed water body: harbor , lagoon, bay, fjord, etc.

- **When ?**

→ the period of arriving waves ≈ the eigenperiod of the water surface of the considered water body (Bellotti, 2007)

- **Harbor resona**
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  (Jansa et al., 20
  Escartin Garcia
- Some submarin

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nelf resonance

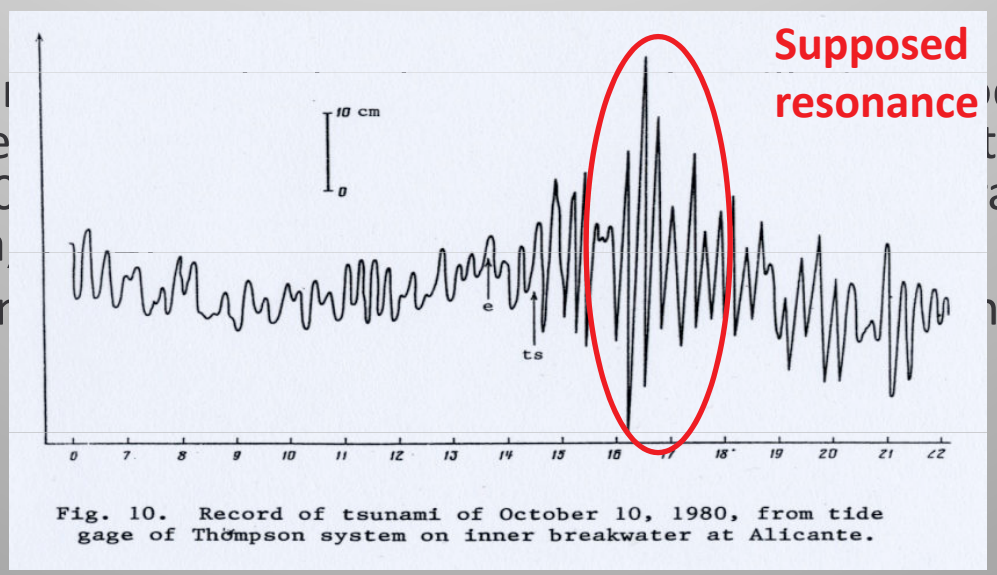


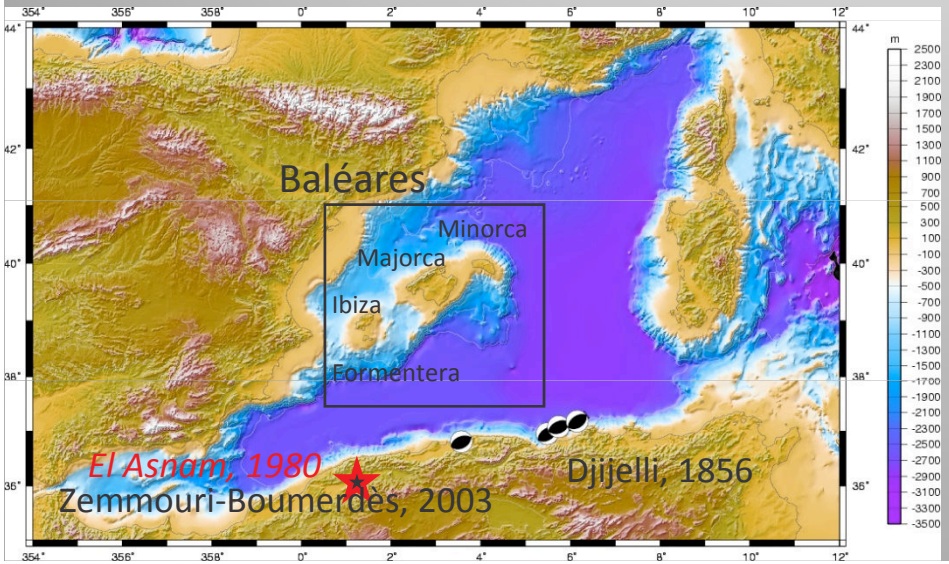
Fig. 10. Record of tsunami of October 10, 1980, from tide gage of Thompson system on inner breakwater at Alicante.

Methodology applied for the 3 Algerian tsunamis in Western Mediterranean Sea

- Methodology used for TRANSFER project
- Aim at reproducing or explaining the recorded tide gage signals along Spanish, French and Algerian coasts and/or collected observations

3 Events: earthquake and associated tsunami

Jijel, 1856 ; Boumerdès, 2003 ; {*El Asnam, 1980*}

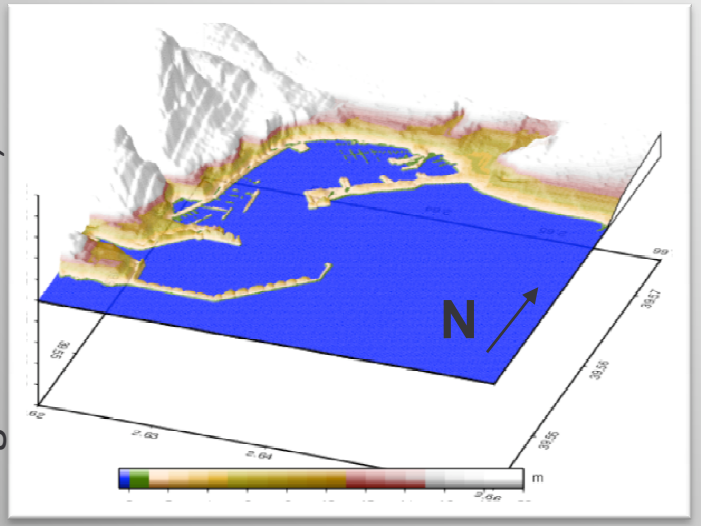


TRANSFER
Tsunami Risk ANd Strategies For the European Region

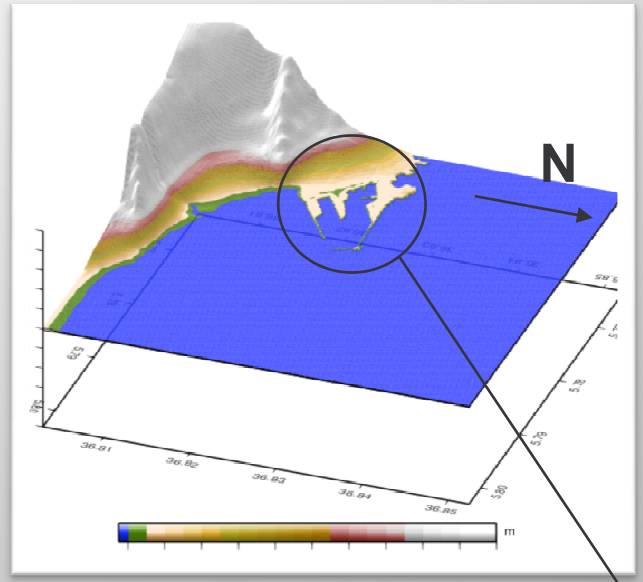
Bathymetric grids

High resolution grids (10 m) → made from georeferenced and digitized nautical maps

Roger and Hébert, 2008



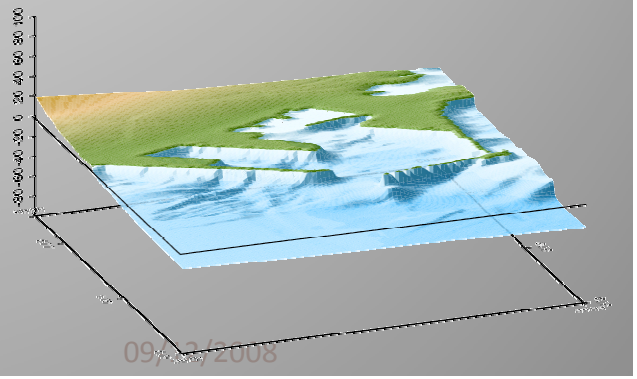
Palma Harbor, Spain



Jijel Harbor, Algeria

Yelles et al., in press

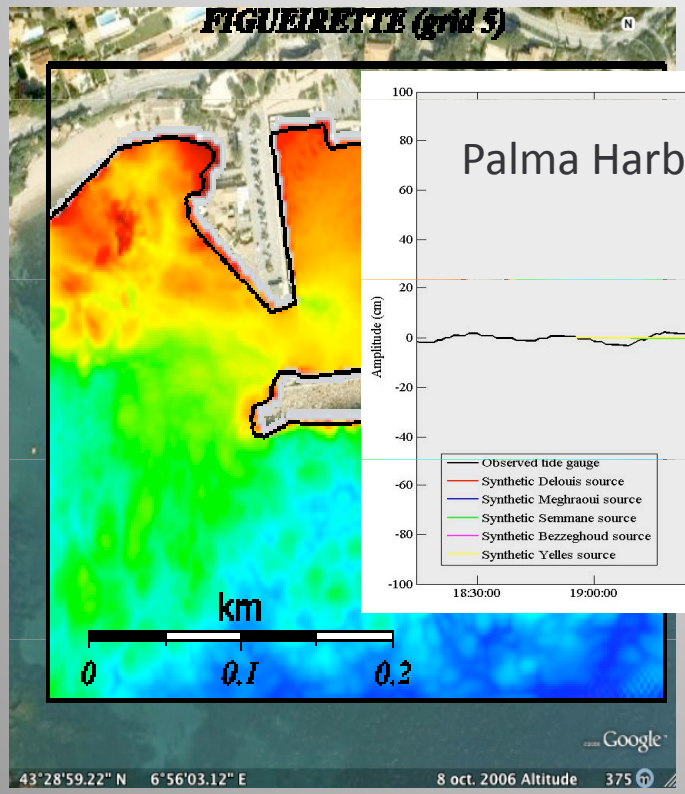
→ With respect of harbor structures

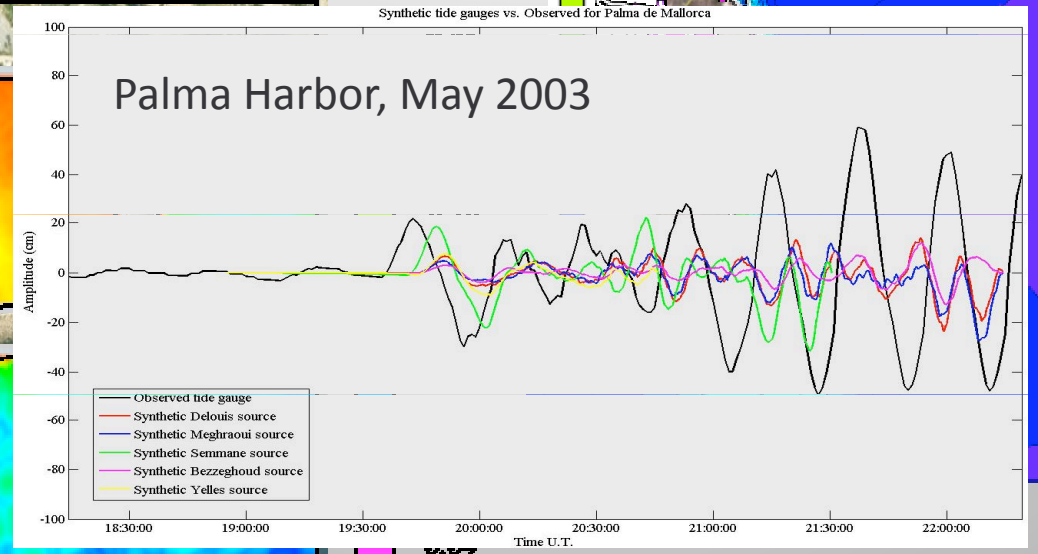


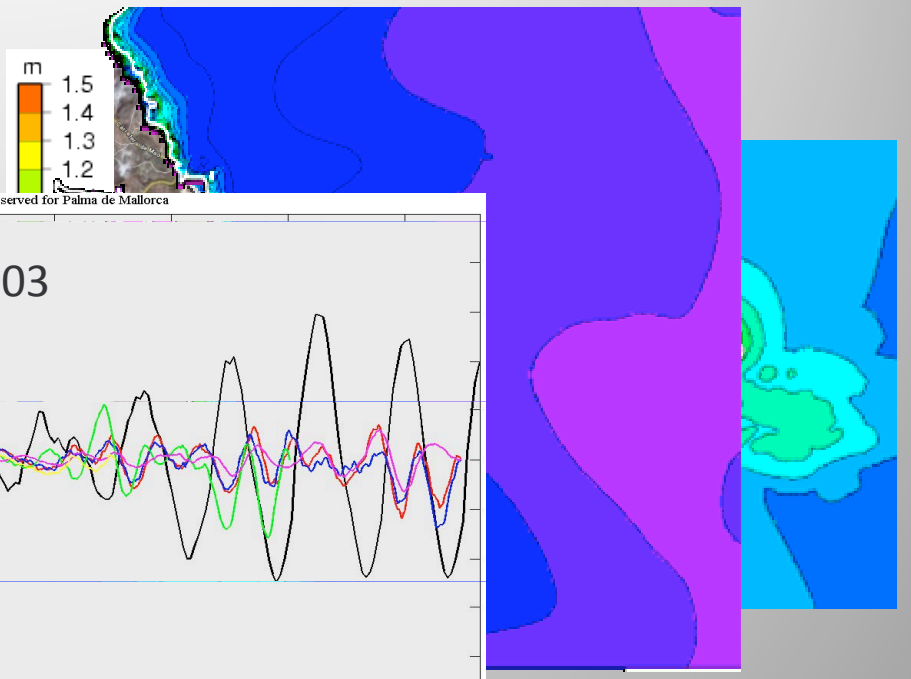
→ All the grids are adapted to the imbrication used by our modelling code during calculation

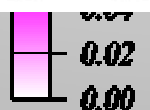
First step

→ look at the maximum sea elevation (Hmax); use of numerical tide gages









The most resonant site for tsunami arrivals in Balearic

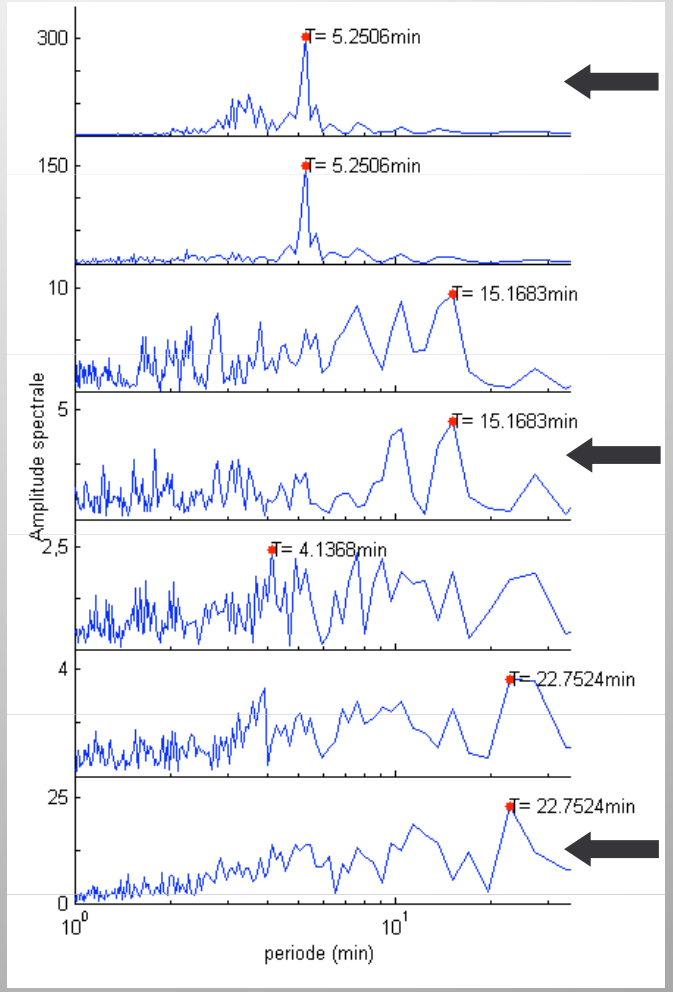
If it does not explain the reported amplifications in specific areas,

2nd step

- Accurate study of recorded signal → FFT (Fast Fourier Transform)

  → reveals frequency peaks

Sahal et al., in progress



Figueirette Harbor

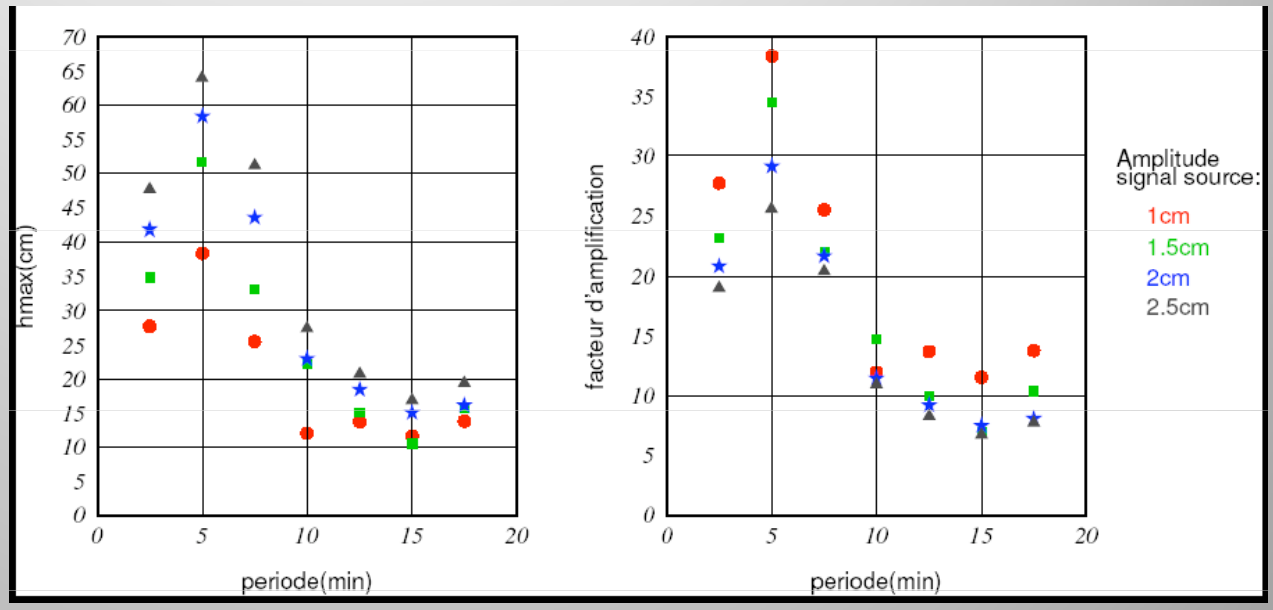
Arrival on Southern French Coasts

Meghraoui Source

Use of synthetic signals (Ampl. and period known)

→**Determine harbor eigenperiod**

→spectral analysis of tide gage records and eigenvalues analysis

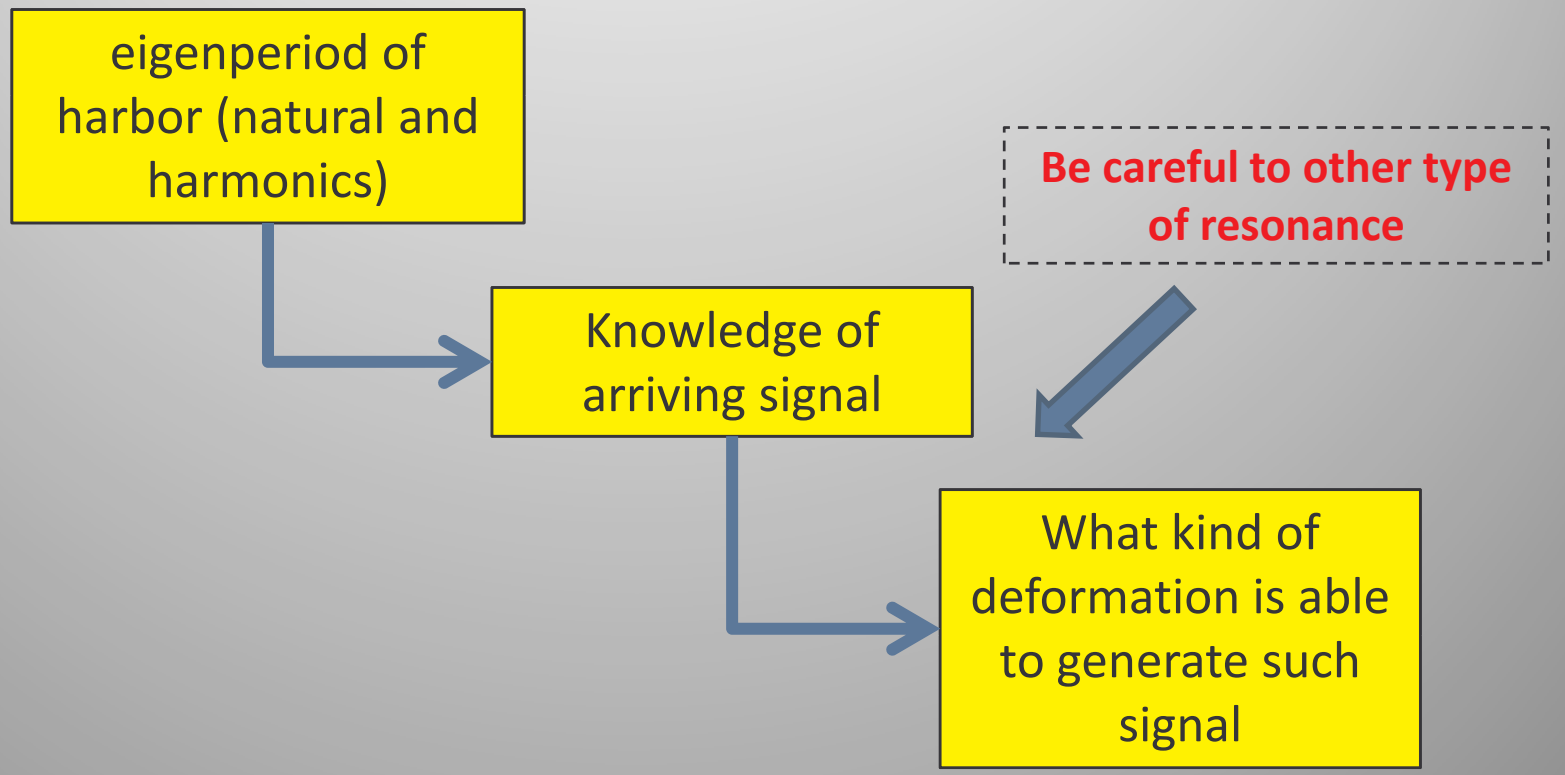


→**<u>Thus</u> we know what kind of signal is able to make the water body to react**

3rd step

- Go back to the geometric parameters of the source...

→ Inverse problem:



Summary: An indirect approach

- Use of more accurate bathymetric data (around 10 m)
- Study of eigenperiod of harbours, bays, inlets, etc.

→Use of synthetic signals to determine eigenperiod

→comparison between this eigenperiod and the frequency range of the tsunami signal

→Go back to the source : is the proposed source able to generate a period-like tsunami?

Conclusion

- This method could explain the great sea elevation values in Antilles during 1755 event and allow to select on or several possible sources
- We could protect harbors using these eigenvalues knowledge (*Monso de Prat and Garcia, 1994*)
- Today we are not able to reproduce amplification exactly → need to add dispersion and Boussinesq equations in our calculation (test)

Perspectives

- Make accurate grids on specific harbors in Antilles
- Compute with proposed sources of 1755 earthquake
- Compare recorded signal to historical data

→ If it does not explain amplitudes: frequency analysis

Thank you !