

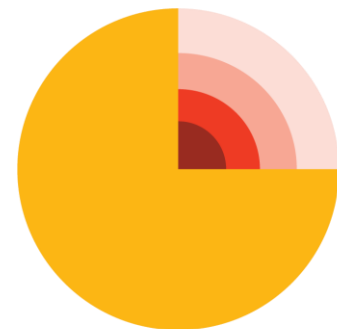
Kick-off Meeting

ChEESE 2P

Cléa Lumina Denamiel
Ruđer Bošković Institute (RBI)



& the RBI team: Ivica Vilibić & Iva Tojčić



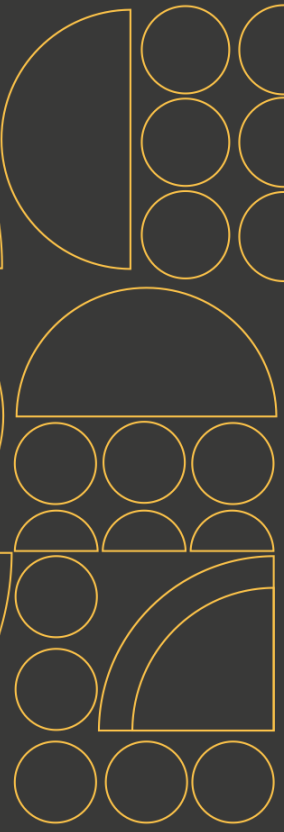
ChEESE



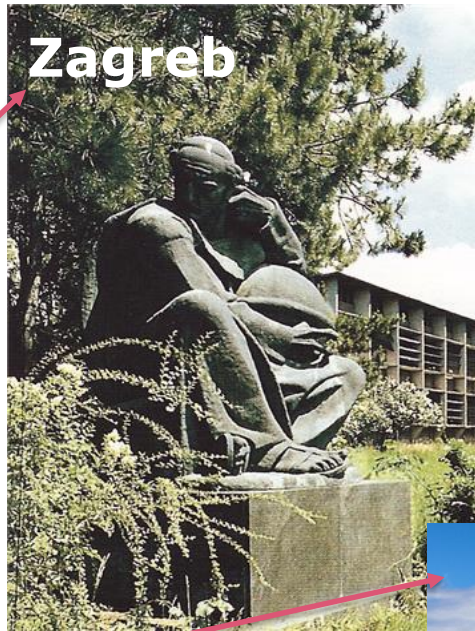
01

Who are we?
&
What are we
going to do?





Zagreb



*Institut
Ruđer
Bošković*



Split



**Division for Marine and
Environmental Research**

**Laboratory for marine physics and
chemistry of water systems**



RBI contribution to the ChEESE 2P project

A- Staff effort

Work Package	RBI Participation
WP1: Project Management	2.00
WP2: Exascale technical challenges in flagship codes	0.00
WP3: Co-design with European HPC vendors and technologies	0.00
WP4: Simulation ecosystem	2.00
WP5: Farming Pilot Demonstrators	24.00
WP6: SCs and service enabling using EuroHPC infrastructures	6.00
WP7: Dissemination, outreach and capacity building	2.00

= $36/976 \approx$ **4%**

Allocated EU budget: **€102 062.50**

RBI contribution to the ChEESE 2P project

B- Croatian State financing

Co-financing (50%)

Agreed with the Ministry of Science

Post-Doc & PhD positions

Will be decided at the RBI level. Miss recent call as GA not signed but hopeful for next call

C- Tasks, Role & Deliverables

Task Participation

T1.1 to T1.5, T4.1, T5.1, T5.2, T6.1, T6.2, T7.1, T7.4, T7.6

Main roles

HySEA flagship code, meteotsunamis

Deliverables

SCs report and datasets from WP6/PD4

In brief: implementing and testing the meteotsunami capabilities within the ChEESE flagship codes

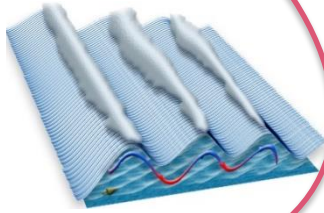
02

Atmospheric Tsunamis or Meteotsunamis



What?

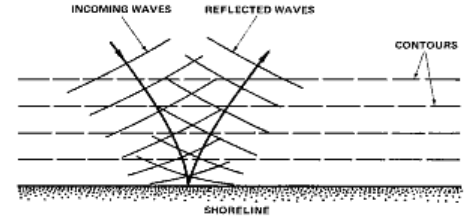
WEATHER



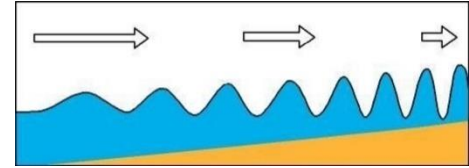
RESONANCE



Reflection



Shoaling



01

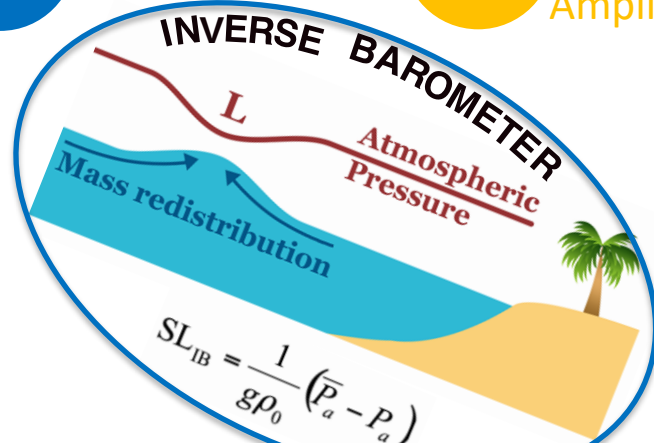
Atmosphere



SONIC BOOM

02

Ocean

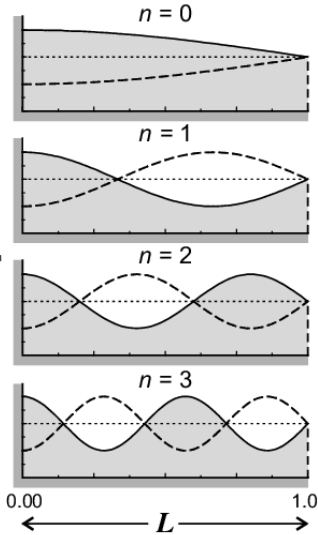


$$SL_{IB} = \frac{1}{g\rho_0} (\bar{p}_a - p_a)$$

03

Nearshore Amplification

Harbor & Bay Seiches



Where?

Weather related hotspots:



Croatia

Highest meteotsunami wave ever witnessed in Vela Luka



Balearic Islands

Early warning system since 1980's



Great Lakes

Several deaths associated with meteotsunami events



And many other locations ...



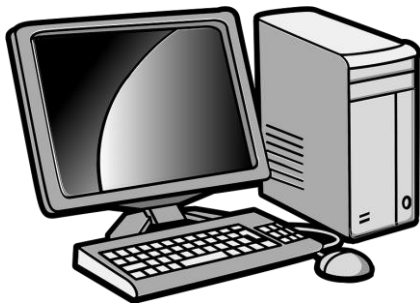
Sonic boom related hotspots:



Everywhere

Meteotsunami hazards linked to sonic boom related events still unknown





01

Atmospheric Models

Weather related events:

- localized and specialized
- baroclinic
- non-hydrostatic
- kilometer-scale models
- numerically expansive!

Sonic boom related events:

- Global
- barotropic
- T170 grid (about 70 km resolution)
- numerically cheap!

How?

02

Ocean Models

Both:

- barotropic
- atmospheric forcing (pressure and wind)
- tides
- usage of meshes instead of grids
- numerically expansive!

Weather related events:

- localized and specialized
- up to 10m along the coast

Sonic boom related events:

- global
- at least 1.5 km at the coast
- should include Earth's curvature terms, coordinate rotation to remove pole singularity, etc.



03

Stochastic Models

Why?

- to account for the uncertainty
- to build surrogate models
- to derive meteotsunami hazards

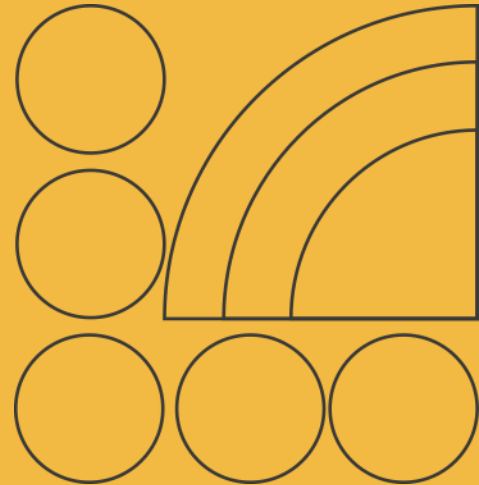
When?

- in forecast mode & climate studies for Weather related events
- derivation of the planetary meteotsunami hazards for Sonic boom related events

A lot of work ahead ...

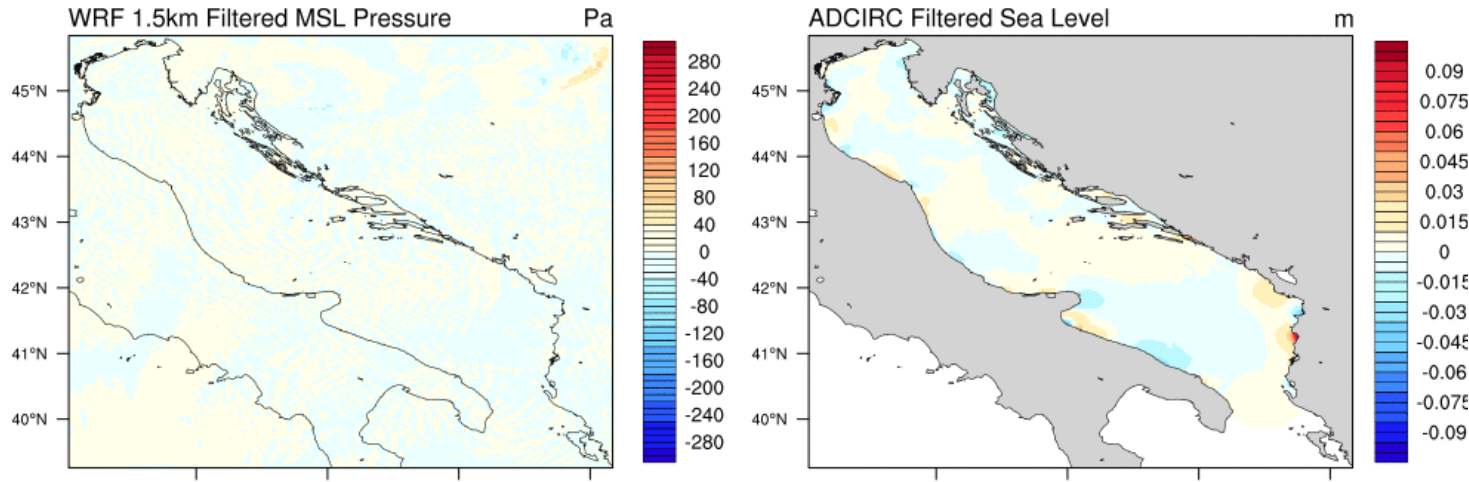


A Weather related Event



2014-06-25 00:00:00 UTC

AdriSC Atmosphere-Ocean Modelling Suite



Denamiel, C., Šepić, J., Vilibić, I., 2018. Impact of geomorphological changes to harbor resonance during meteotsunamis: The Vela Luka Bay test case. *Pure Appl. Geophys.*, 175(11), 3839–3859.

Denamiel, C., Šepić, J., Ivanković, D., Vilibić, I., 2019a. The Adriatic Sea and coast modelling suite: Evaluation of the meteotsunami forecast component. *Ocean Modelling*, 135, 71–93.

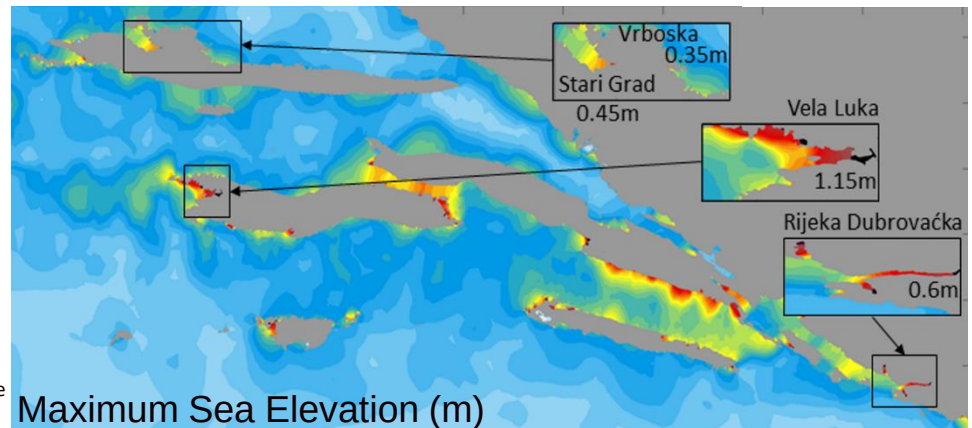
Denamiel, C., Šepić, J., Huan, X., Bolzer, C., Vilibić, I., 2019b. Stochastic surrogate model for meteotsunami early warning system in the eastern Adriatic Sea. *J. Geophys. Res. Oceans*, 124, 8485–8499.

Denamiel, C., Huan, X., Šepić, J., Vilibić, I., 2020. Uncertainty Propagation Using Polynomial Chaos Expansions for Extreme Sea Level Hazard Assessment: The Case of the Eastern Adriatic Meteotsunamis. *J. Phys. Oceanogr.*, 50(4), 1005–1021.

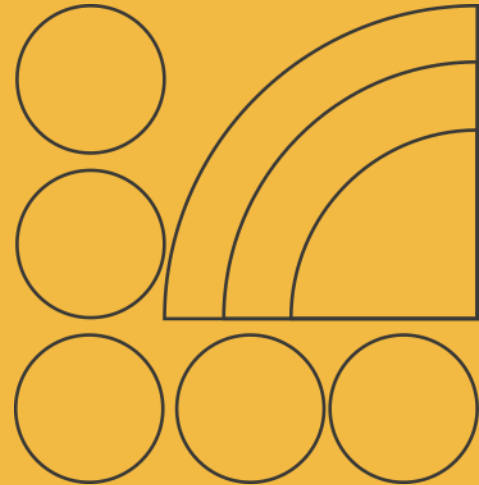
Denamiel, C., Huan, X., Vilibić, I., 2021. Conceptual Design of Extreme Sea-Level Early Warning Systems Based on Uncertainty Quantification and Engineering Optimization Methods, *Front. Mar. Sci.*, 8, 562.

Denamiel, C., Tojčić, I., & Vilibić, I., 2022. Meteotsunamis in orography-free, flat bathymetry and warming climate conditions. *Journal of Geophysical Research: Oceans*, 127, e2021JC017386.

Tojčić, I., Denamiel, C., Vilibić, I., 2021. Performance of the Adriatic early warning system during the multi-meteotsunami event of 11–19 May 2020: an assessment using energy banners. *Nat. Hazards Earth Syst. Sci.*, 21, 2427–2446.

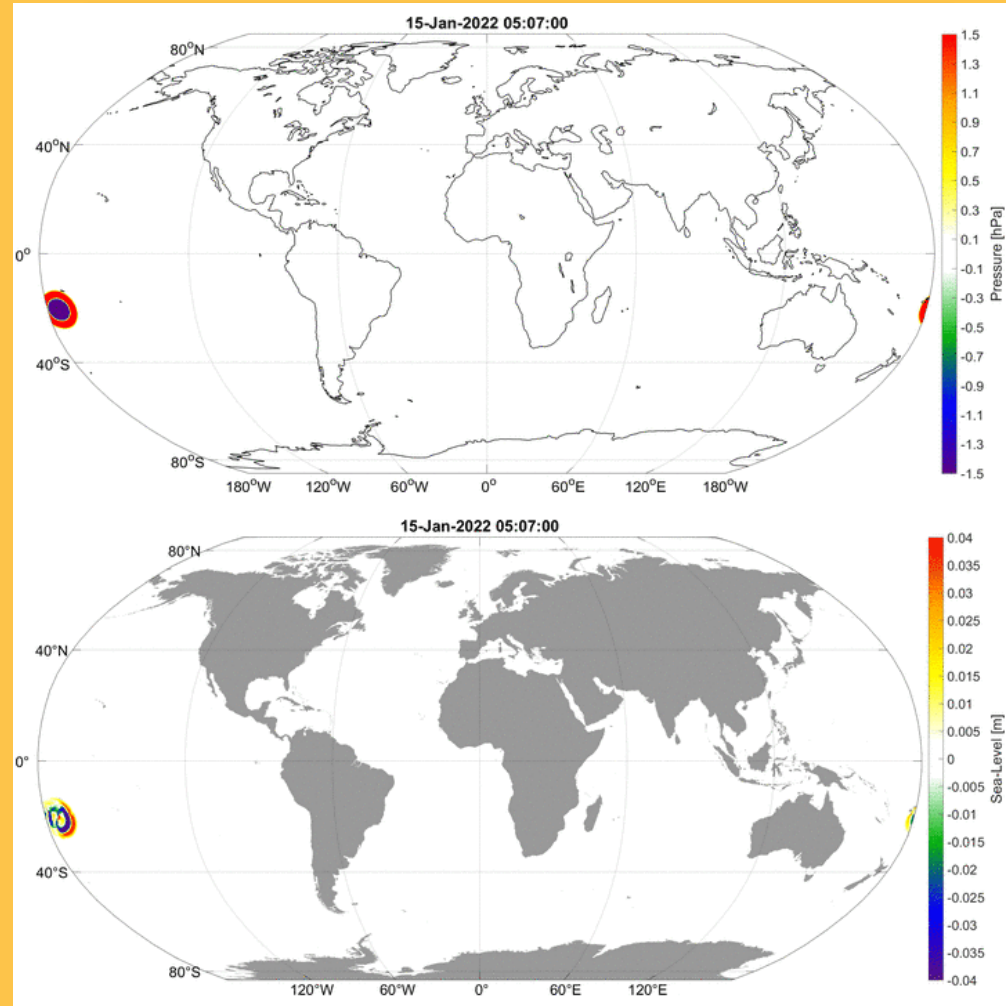


A Sonic Boom related Event



Hunga Tonga–Hunga Ha’apai volcano eruption

- Atmospheric Tsunamis Associated with Lamb waves (ATAL) model: based on ADCIRC model with mesh of 20 km in deep-ocean to 1.5 km nearshore
- What is the speed of the deep-ocean Proudman resonance? -> 212 m/s found with this model!
- Can planetary meteotsunami hazards be as destructive as the tsunami events? -> yes for 10 times stronger Lamb waves!



Denamiel, C., Vasylykevych, S., Žagar, N., Zemunik, P., Vilibić, I., 2022. Destructive potential of planetary meteotsunami waves beyond the Hunga Tonga–Hunga Ha’apai volcano eruption. BAMS, <https://doi.org/10.1175/BAMS-D-22-0164.1>

RBI role:

Implementing and **testing** the
meteotsunami capabilities within the
ChEESE flagship codes

RBI expertise:

Cumulative experience: +30 years (and
+50 publications) of meteotsunami studies

AdriSC operational model: first
meteotsunami forecast including
deterministic and stochastic modelling

ATAL model: global ocean model capable of
capturing the main properties of the sonic
boom related events



Thank you



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