MOHID & Tsunamis
generation, propagation and risk analysis

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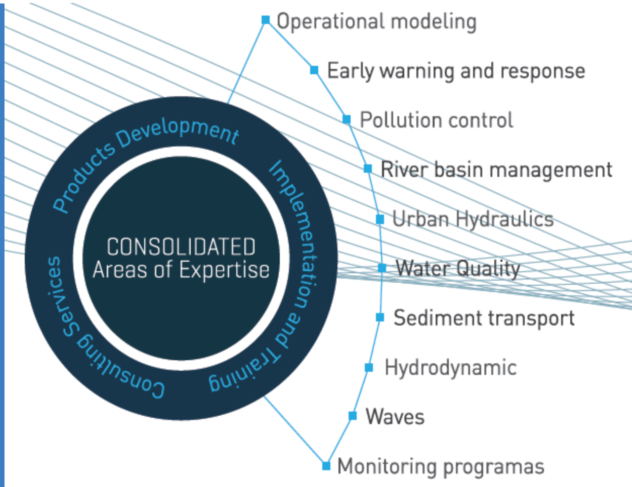
HIDROMOD

HIDROMOD is an international company acting in the areas of:

- ✓ **Consultancy:** Water cycle modelling and information technologies
- ✓ **Services:** Real time data and modeling integration, Forecast systems, Early warning systems, Professional support (e.g. *Portugal, Spain, France, Brazil, Argentina, Colombia, Malaysia, Oman*)



- ✓ High qualified staff with several Ph.D. and Ms.C.
- ✓ Over 500 projects in the last 27 years
- ✓ 1/3 – R&D Projects

Tsunami and MOHID

Sumatra–Andaman earthquake (2004)

- ✓ Occurred at 00:58:53 UTC on 26 December, with an epicentre off the west coast of northern Sumatra, Indonesia.
- ✓ Magnitude of 9.1–9.3 Mw, reaching a Mercalli intensity up to IX.
- ✓ The earthquake was caused by a rupture along the fault between the Burma Plate and the Indian Plate.
- ✓ A series of large tsunami waves up to 30 metres (100 ft) high were created by the underwater seismic activity.
- ✓ The tsunamis killed an estimated 227,898 people in 14 countries.

Tsunami and MOHID (SCHEMA Project, Gardi et al., 2011)

- ✓ The Scenarios for Hazard-induced Emergencies Management (SCHEMA).
- ✓ The objective was the design, development and validation of a methodology for assessing the impacts of natural hazards with special emphasis on tsunamis.
- ✓ Validation of the MOHID model with measurements at Seychelles island.
- ✓ Setúbal was the Portuguese test site.

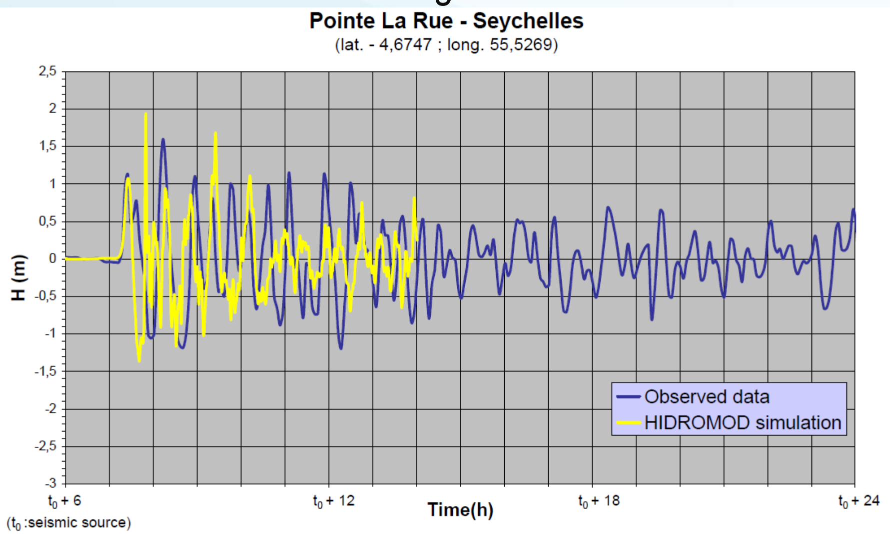
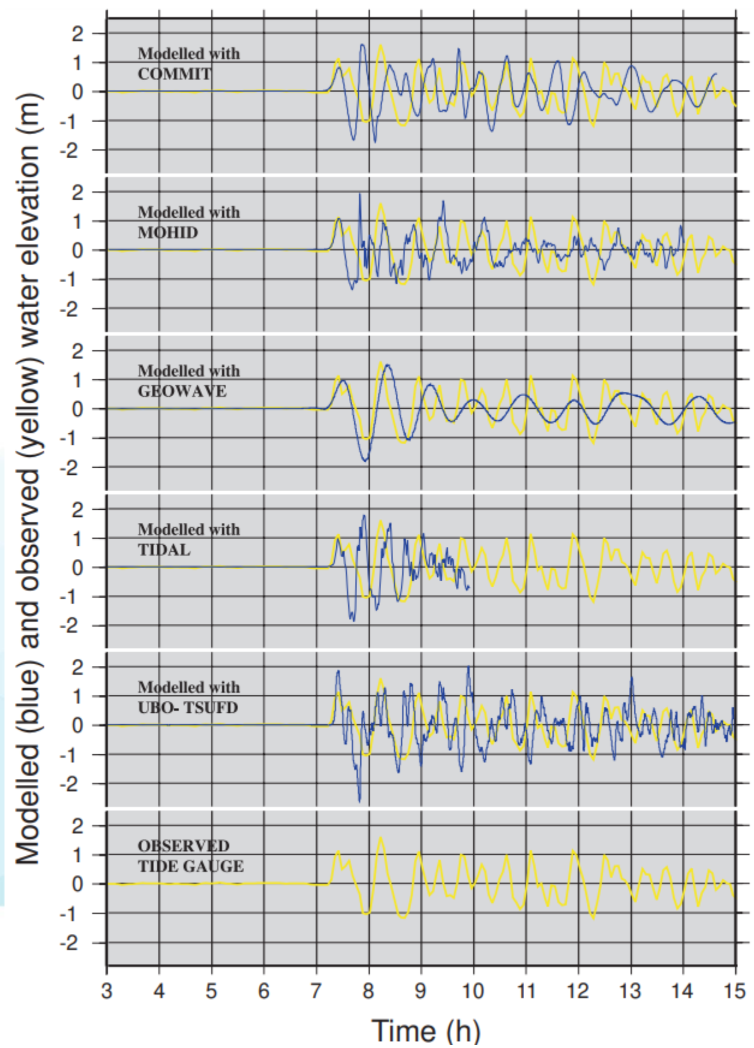


Figure 40 - Tide gauge produced by HIDROMOD compared to the recorded tide gauge at Pointe Larue.



Tsunami and MOHID (SCHEMA Project, Ribeiro et al. 2011)

✓ **Where:**

- Sado Estuary, Portugal.

✓ **Why:**

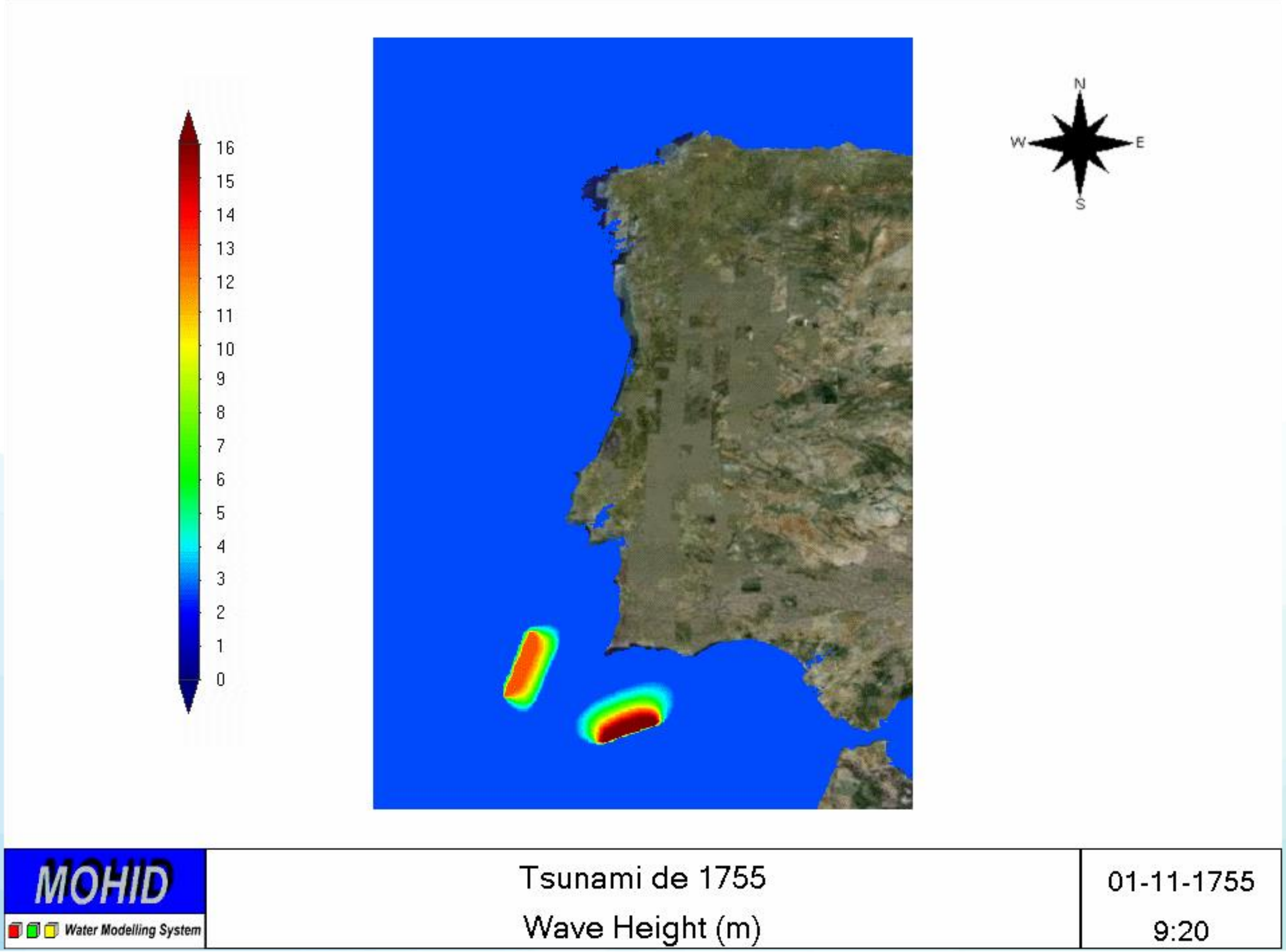
- Two significant population areas:
  - ❖ City of Setúbal and the Península of Tróia.
- Proximity to the river.
- Along with Lisbon it was one of the most affected areas by the 1755 earthquake and consequent tsunami.
- The presence of major industries.
- Development of new touristic facilities.

Tsunami and MOHID (present)

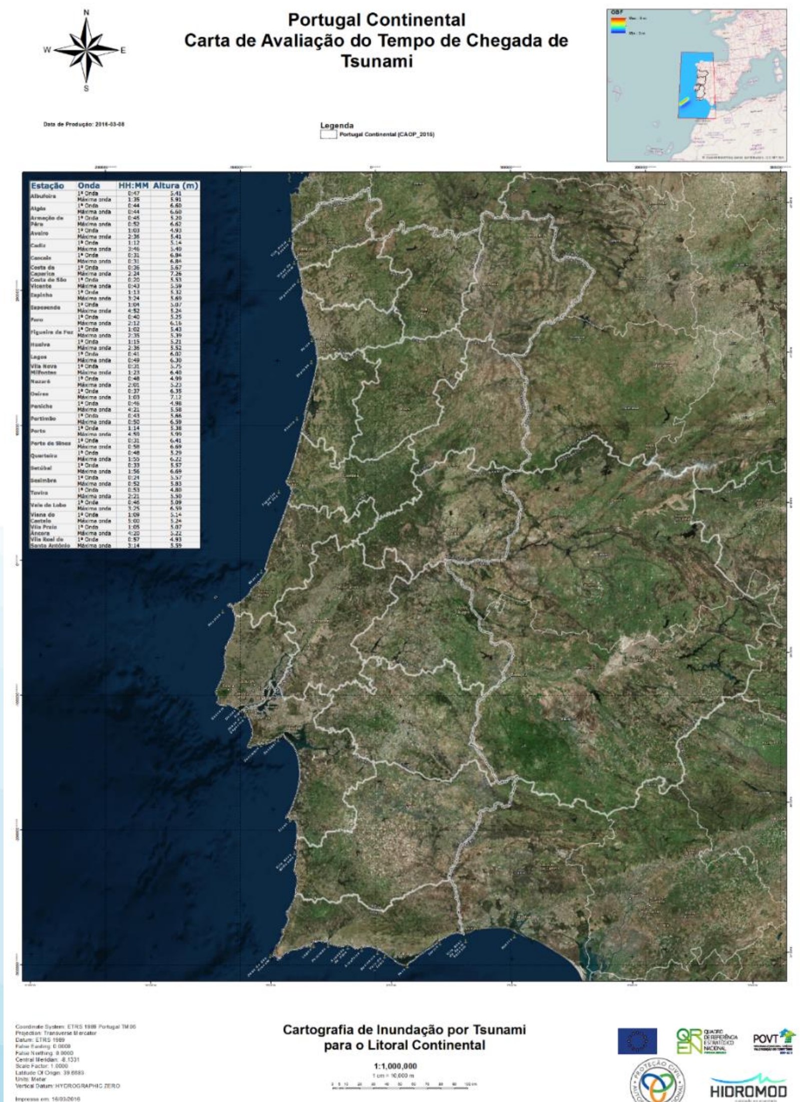
Tsunami generation

- ✓ In 2016 implementation new tsunami generation method.
- ✓ For the tsunami generation, a methodology similar to that adopted by the Cornell Multi-grid Coupled Tsunami Model (COMCOT) is used, which includes approximations for the consideration of Okada (1985) and Mansinha and Smylie (1971) instantaneous rupture processes and transient fault (eg, transient fault, landslide).
- ✓ This new method takes in consideration the fault parameter.

Tsunami propagation



Tsunami propagation



Estação	Onda	HH:MM	Altura (m)
Albufeira	1ª Onda	0:47	5.41
	Máxima onda	1:35	5.91
Algés	1ª Onda	0:44	6.60
	Máxima onda	0:44	6.60
Armação de Pêra	1ª Onda	0:45	5.20
	Máxima onda	0:52	6.62
Aveiro	1ª Onda	1:03	4.93
	Máxima onda	2:36	5.41
Cadiz	1ª Onda	1:12	5.14
	Máxima onda	3:46	5.40
Cascais	1ª Onda	0:31	6.84
	Máxima onda	0:31	6.84
Costa da Caparica	1ª Onda	0:36	5.67
	Máxima onda	2:24	7.26
Costa de São Vicente	1ª Onda	0:20	5.53
	Máxima onda	0:43	5.59
Espinho	1ª Onda	1:13	5.32
	Máxima onda	3:24	5.69
Esposende	1ª Onda	1:04	5.07
	Máxima onda	4:52	5.24
Faro	1ª Onda	0:40	5.25
	Máxima onda	2:12	6.16
Figueira da Foz	1ª Onda	1:02	5.43
	Máxima onda	2:35	5.39
Huelva	1ª Onda	1:15	5.21
	Máxima onda	2:36	5.52
Lagos	1ª Onda	0:41	6.02
	Máxima onda	0:49	6.30
Vila Nova Milfontes	1ª Onda	0:31	5.75
	Máxima onda	1:23	6.40
Nazaré	1ª Onda	0:48	4.99
	Máxima onda	2:01	5.23
Oeiras	1ª Onda	0:37	6.35
	Máxima onda	1:03	7.12
Peniche	1ª Onda	0:46	4.98
	Máxima onda	4:21	5.58
Portimão	1ª Onda	0:43	5.66
	Máxima onda	0:50	6.59
Porto	1ª Onda	1:14	5.38
	Máxima onda	4:59	5.99
Porto de Sines	1ª Onda	0:31	6.41
	Máxima onda	0:58	6.69
Quarteira	1ª Onda	0:48	5.29
	Máxima onda	1:55	6.22
Setúbal	1ª Onda	0:33	5.57
	Máxima onda	1:56	6.69
Sesimbra	1ª Onda	0:24	5.57
	Máxima onda	0:52	5.83
Tavira	1ª Onda	0:53	4.80
	Máxima onda	2:21	5.50
Vale do Lobo	1ª Onda	0:46	5.09
	Máxima onda	3:25	6.59
Viana do Castelo	1ª Onda	1:09	5.14
	Máxima onda	5:00	5.24
Vila Praia Âncora	1ª Onda	1:05	5.07
	Máxima onda	4:20	5.22
Vila Real de Santo António	1ª Onda	0:57	4.93
	Máxima onda	3:14	5.59

Tsunami propagation and inundation

Risk analysis

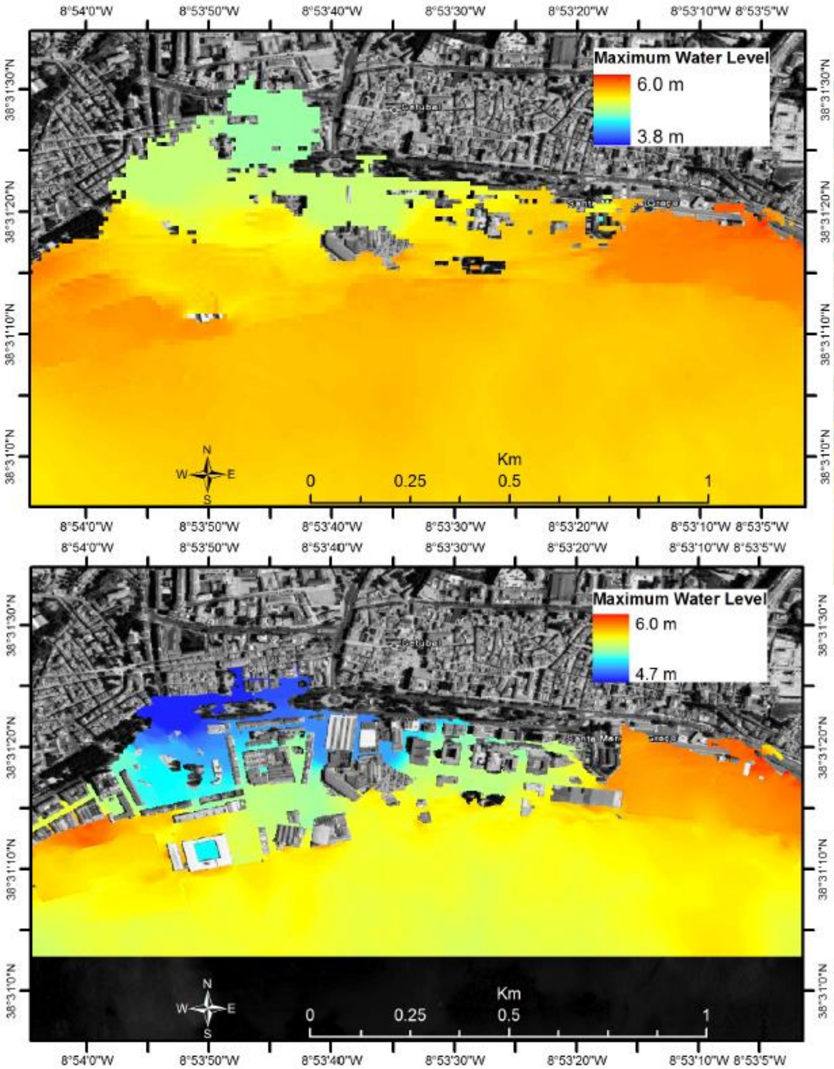
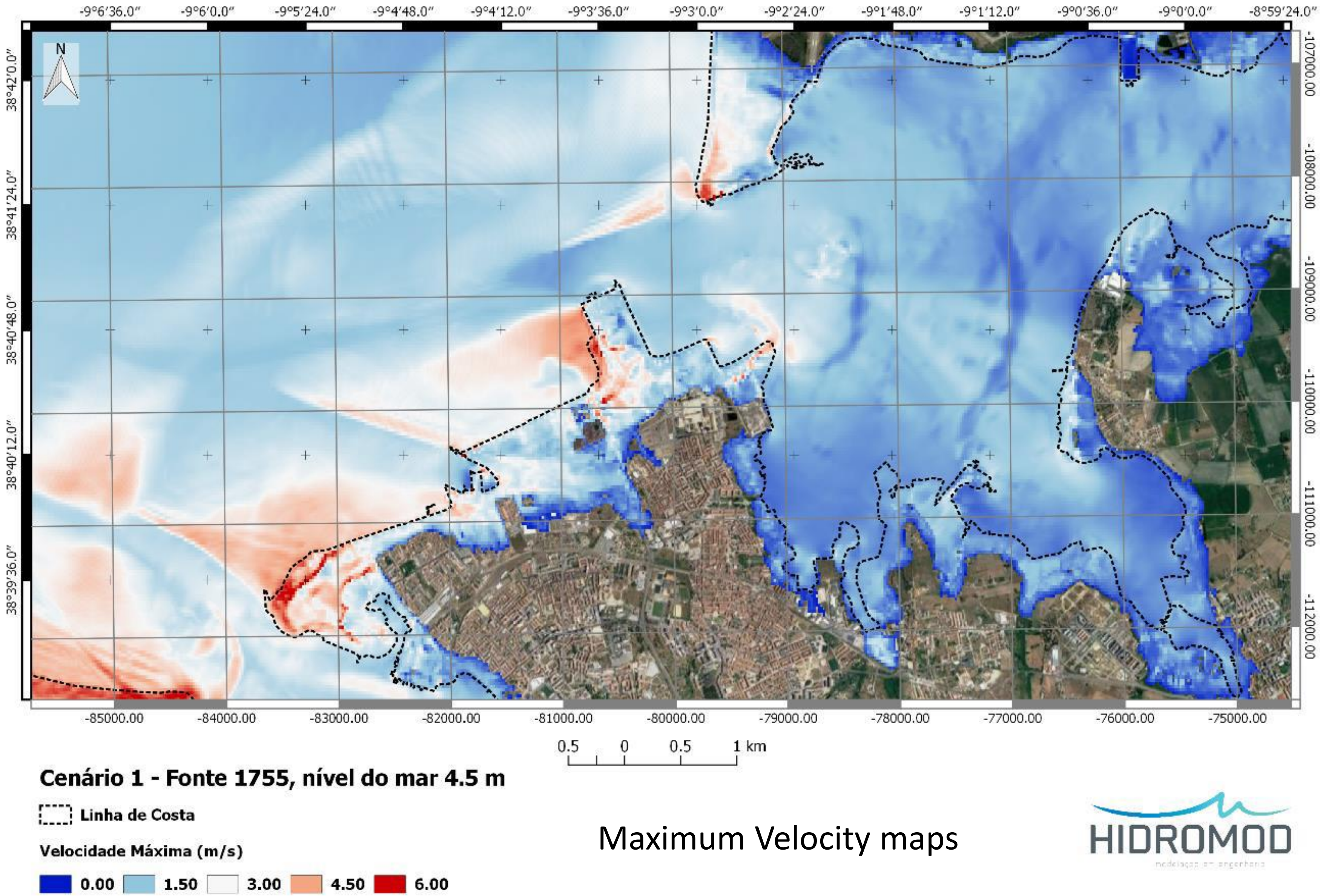


Fig. 5. Setúbal Inundation areas considering topography only (top) and including buildings (bottom).

Risk analysis



Maximum Velocity maps

Risk analysis

Maximum Inundation Area

Bibliography

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- ✓ Ribeiro J, Silva A, Leitão P. High resolution tsunami modelling for the evaluation of potential risk areas in Setúbal (Portugal). Natural Hazards and Earth System Science. 2011; 11(8): 2371-2380.

Thank you for your attention

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