

TSUNAMI

PRESENTATION

Made by Tatiana Neves

01



What is a Tsunami?

- Tsunamis are giant waves caused by earthquakes or volcanic eruptions under the sea. Out in the depths of the ocean, tsunami waves do not dramatically increase in height.
- But as the waves travel in land, they build up to higher and higher heights as the depth of the ocean decreases.
- The speed of tsunami waves depends on ocean depth rather than the distance from the source of the wave.
- Tsunami waves may travel as fast over deep waters, only slowing down when reaching shallow waters.



A tsunami is a **series of waves** caused by **earthquakes** or **undersea volcanic eruptions**.

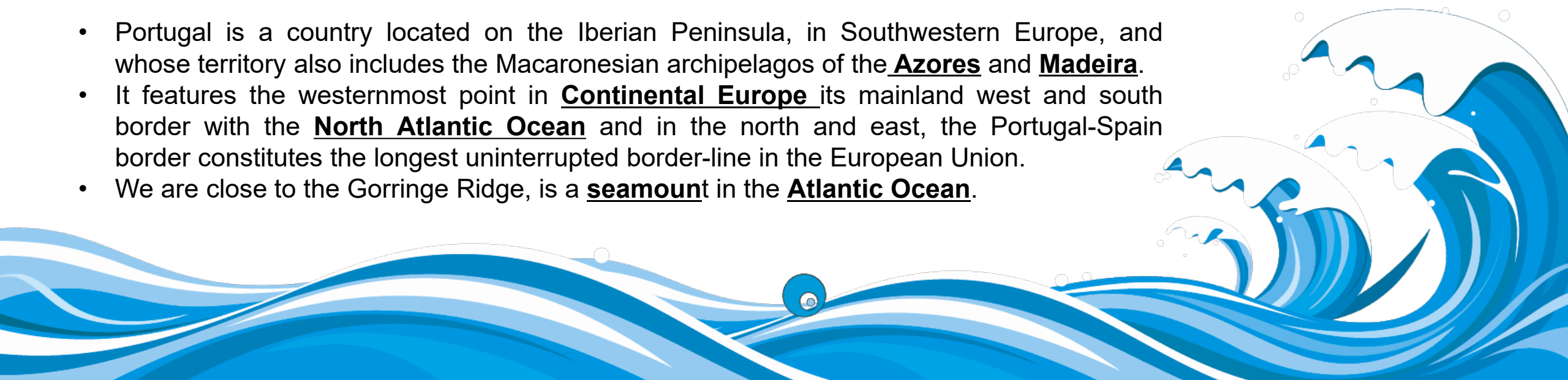


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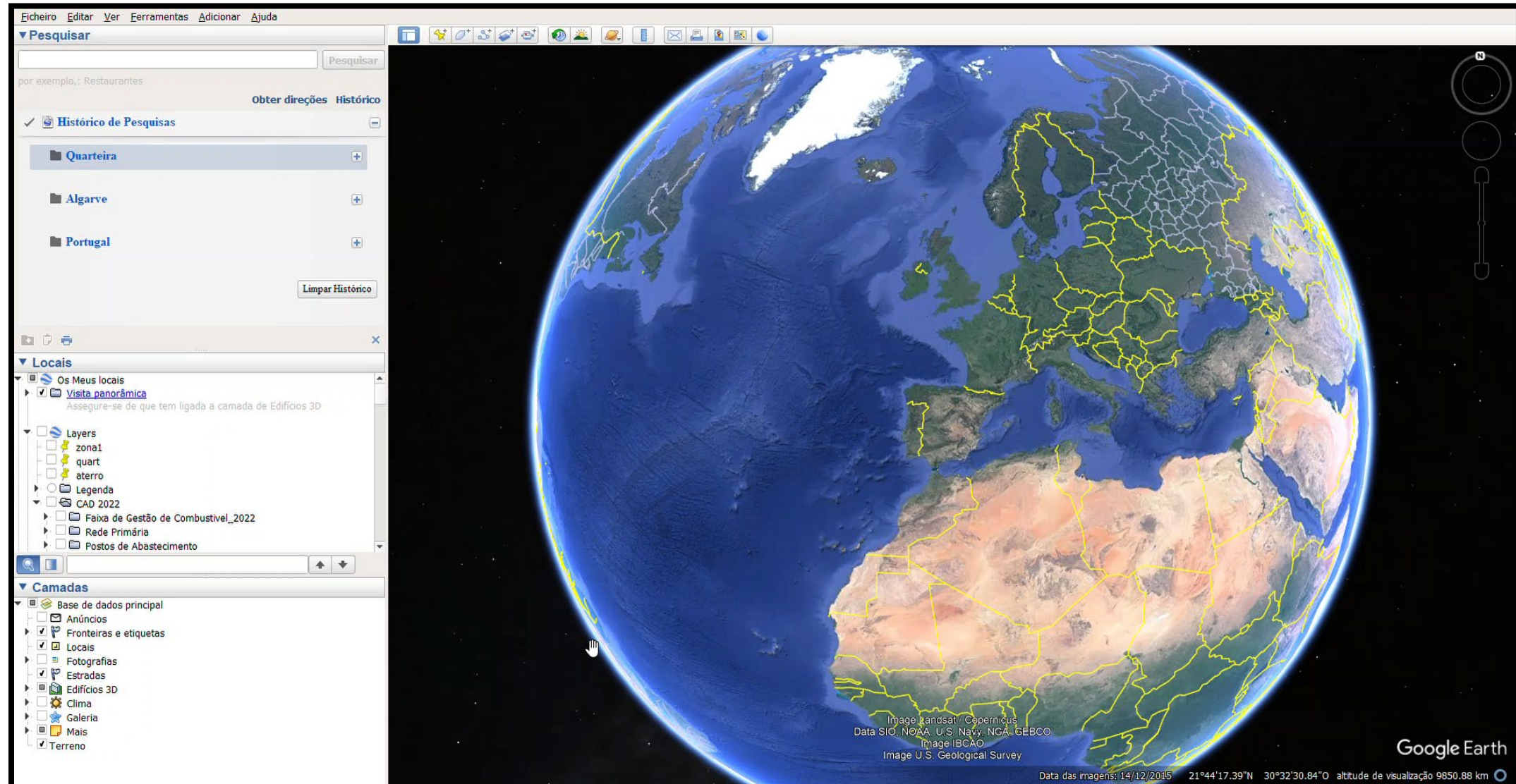


Our Location

- Portugal is a country located on the Iberian Peninsula, in Southwestern Europe, and whose territory also includes the Macaronesian archipelagos of the **Azores** and **Madeira**.
- It features the westernmost point in **Continental Europe** its mainland west and south border with the **North Atlantic Ocean** and in the north and east, the Portugal-Spain border constitutes the longest uninterrupted border-line in the European Union.
- We are close to the Gorringe Ridge, is a **seamount** in the **Atlantic Ocean**.



Lisbon is the **capital** and largest city by population, being also the main spot for tourists alongside **Porto** and **Algarve**.

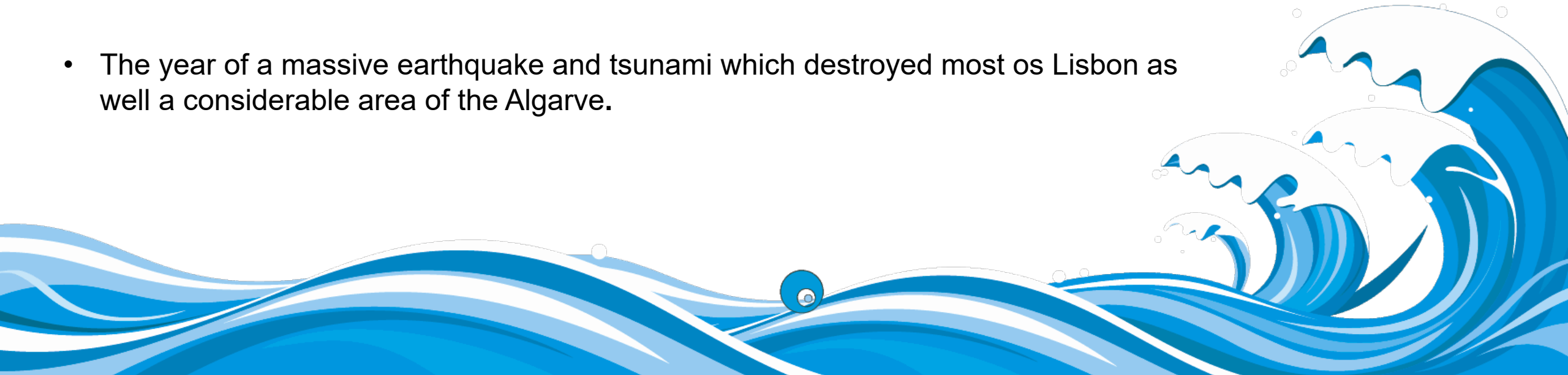


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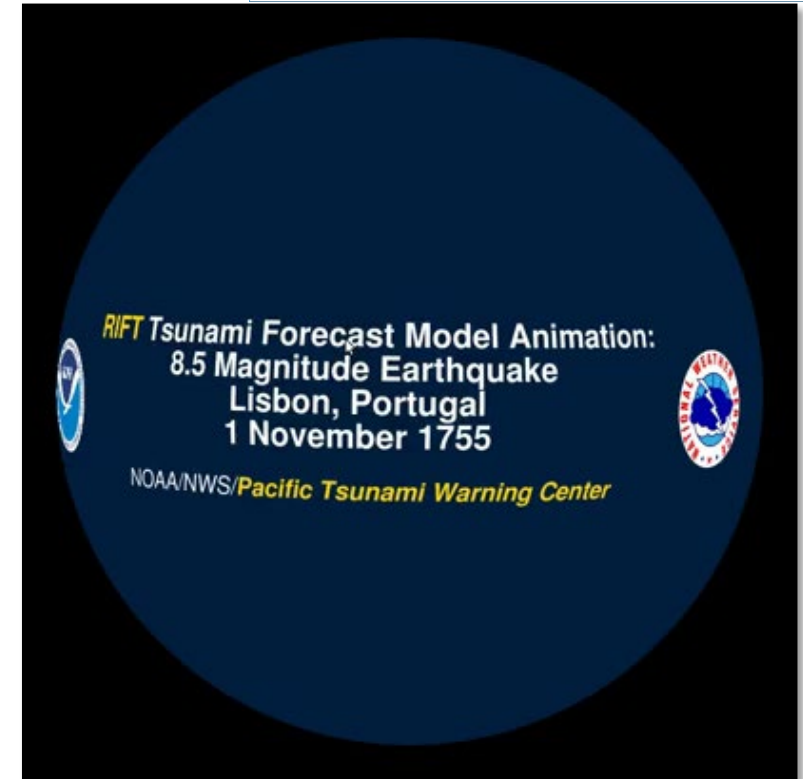


Tsunami Historical Series: Lisbon – 1755

- The year of a massive earthquake and tsunami which destroyed most of Lisbon as well as a considerable area of the Algarve.



Tsunami Historical Series: Lisbon – 1755



The tsunami generated by the 01.11.1755 earthquake affected mainly the coasts of the Iberian Peninsula and Northwest Morocco and was observed all over the North Atlantic coasts. The catastrophic dimensions of that phenomenon had a tremendous impact on the city of Lisbon. Lisbon was not the only Portuguese city affected by the catastrophe, the **south of the country**, in particular the **Algarve**, destruction was rampant. The tsunami destroyed some coastal fortresses in the Algarve and, at lower levels, it razed several houses. Almost all the coastal towns and villages of the Algarve were heavily damaged, except Faro, which was protected by the sandy banks of Ria Formosa. In Lagos, the waves reached the top of the city walls.

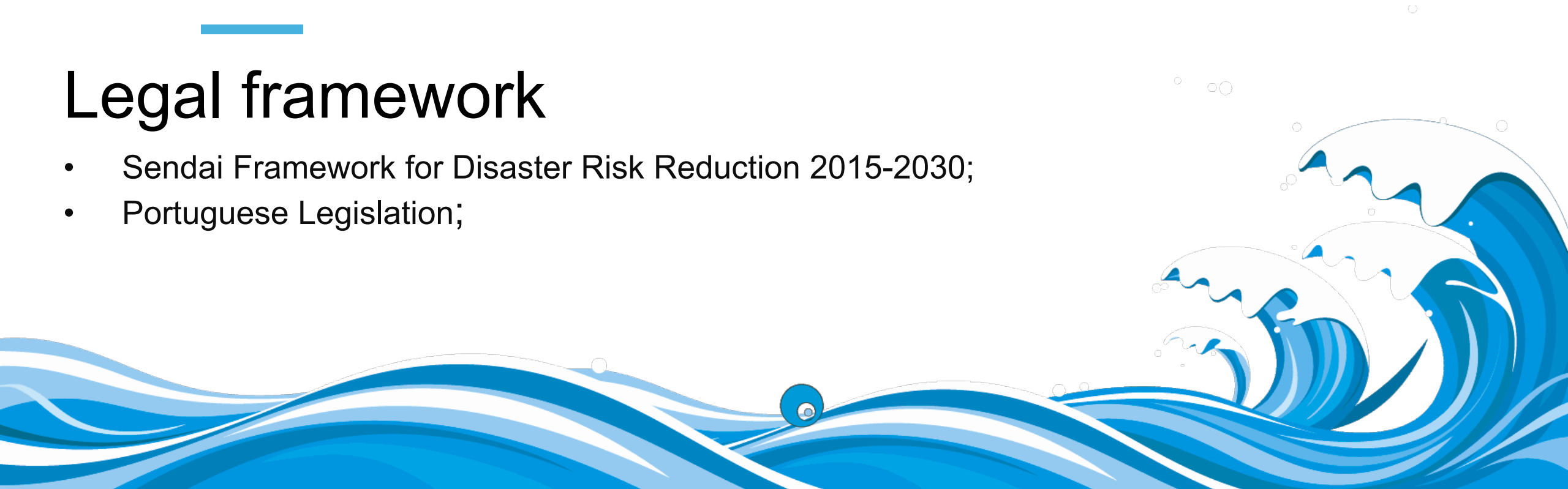
The historical documents reported waves of **15 m** height at Cape S. Vicente (Southwest Portugal).

04



Legal framework

- Sendai Framework for Disaster Risk Reduction 2015-2030;
- Portuguese Legislation;



Sendai Declaration

1

We, the Heads of State and Government, ministers and delegates participating in the Third United Nations World Conference on Disaster Risk Reduction, have gathered from 14 to 18 March 2015 in Sendai City of Miyagi Prefecture in Japan, which has demonstrated a vibrant recovery from the Great East Japan Earthquake in March 2011. Recognizing the increasing impact of disasters and their complexity in many parts of the world, we declare our determination to enhance our efforts to strengthen disaster risk reduction to reduce disaster losses of lives and assets from disasters worldwide.

2

We value the important role played by the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters during the past ten years. Having completed the assessment and review of and considered the experience gained under its implementation, we hereby adopt the Sendai Framework for Disaster Risk Reduction 2015-2030. We are strongly committed to the implementation of the new framework as the guide to enhance our efforts for the future.

3

We call all stakeholders to action, aware that the realization of the new framework depends on our unceasing and tireless collective efforts to make the world safer from the risk of disasters in the decades to come for the benefit of the present and future generations.

4

We thank the people and the Government of Japan as well as the City of Sendai for hosting the Third United Nations World Conference on Disaster Risk Reduction and extend our appreciation to Japan for its commitment to advancing disaster risk reduction in the global development agenda.



Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by UN Member States on 18 March 2015 at the Third UN World Conference on Disaster Risk Reduction in Sendai City, Miyagi Prefecture, Japan. The Sendai Framework is the first major agreement of the post-2015 development agenda, with seven targets and four priorities for action.

The Framework aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.

Portuguese Legislation



nº1/2019 of September 12th – Installation of signage in areas exposed to the risk of dam failure and areas exposed to the TSUNAMI risk and evacuation paths.

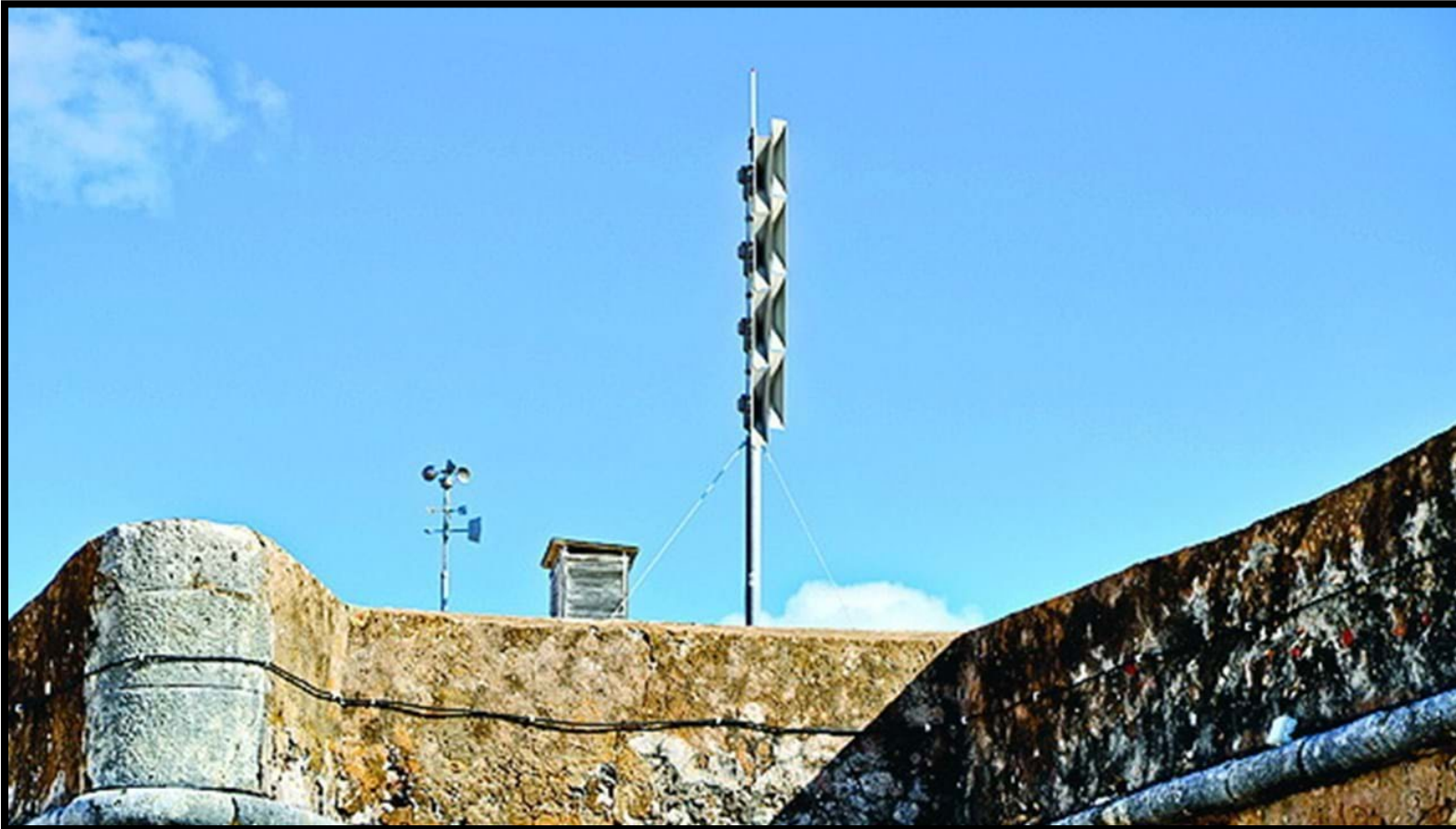
Article 4, point 6 – The need to install vertical signage for tsunami risk must be assessed on a case-by-case basis, through risk assessment, by the Municipal Civil Protection Services or another entity with jurisdiction in the area.

Portuguese Legislation

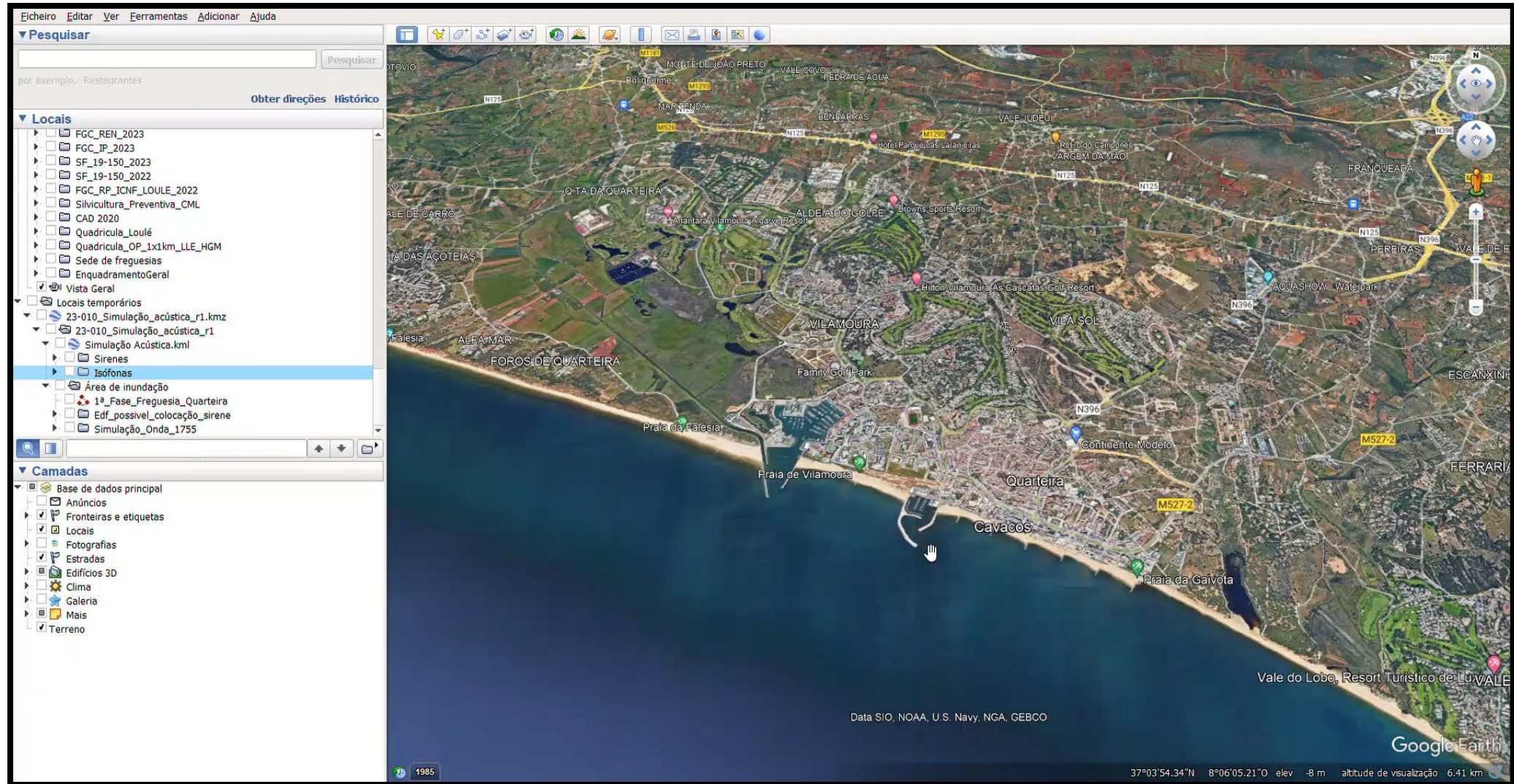


Resolution n°2/2019 of September 12th – Approval of the Directive on technical standards for the operationalization of Tsunami warning systems using sirens.

“Among the various means that can be used to disseminate civil protection warnings in the event of TSUNAMI, the use of sirens is one of the most used on an international scale. In this sense, it is necessary to establish guidelines for the installation of acoustic warning systems for sirens (...).”



Sound Warning Stations

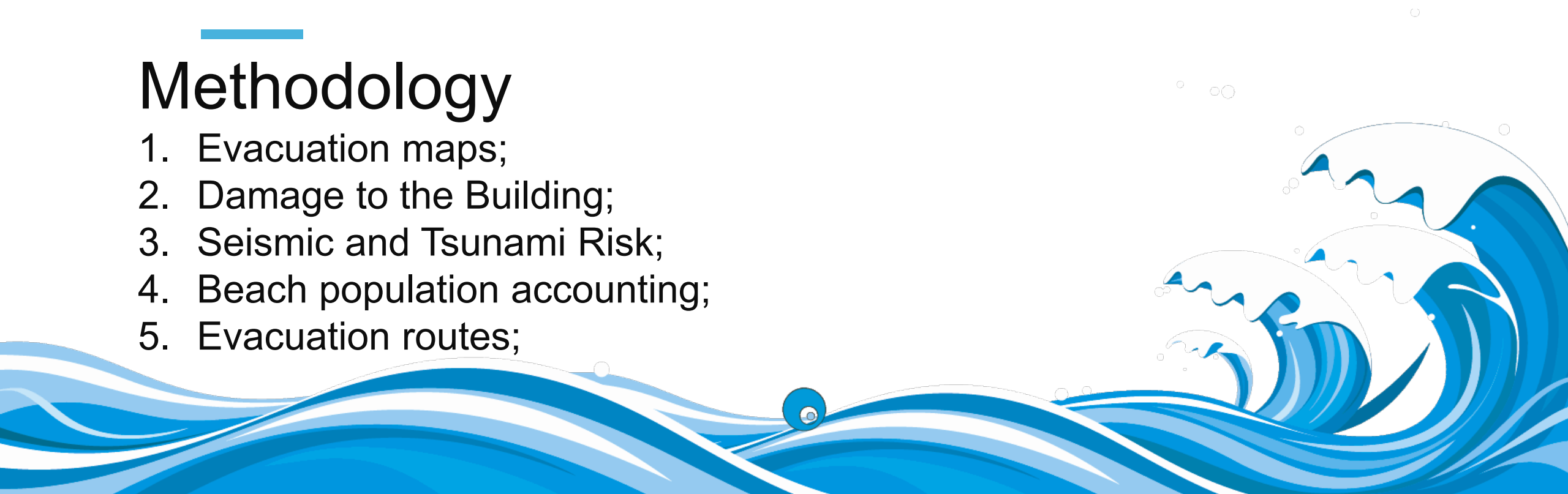


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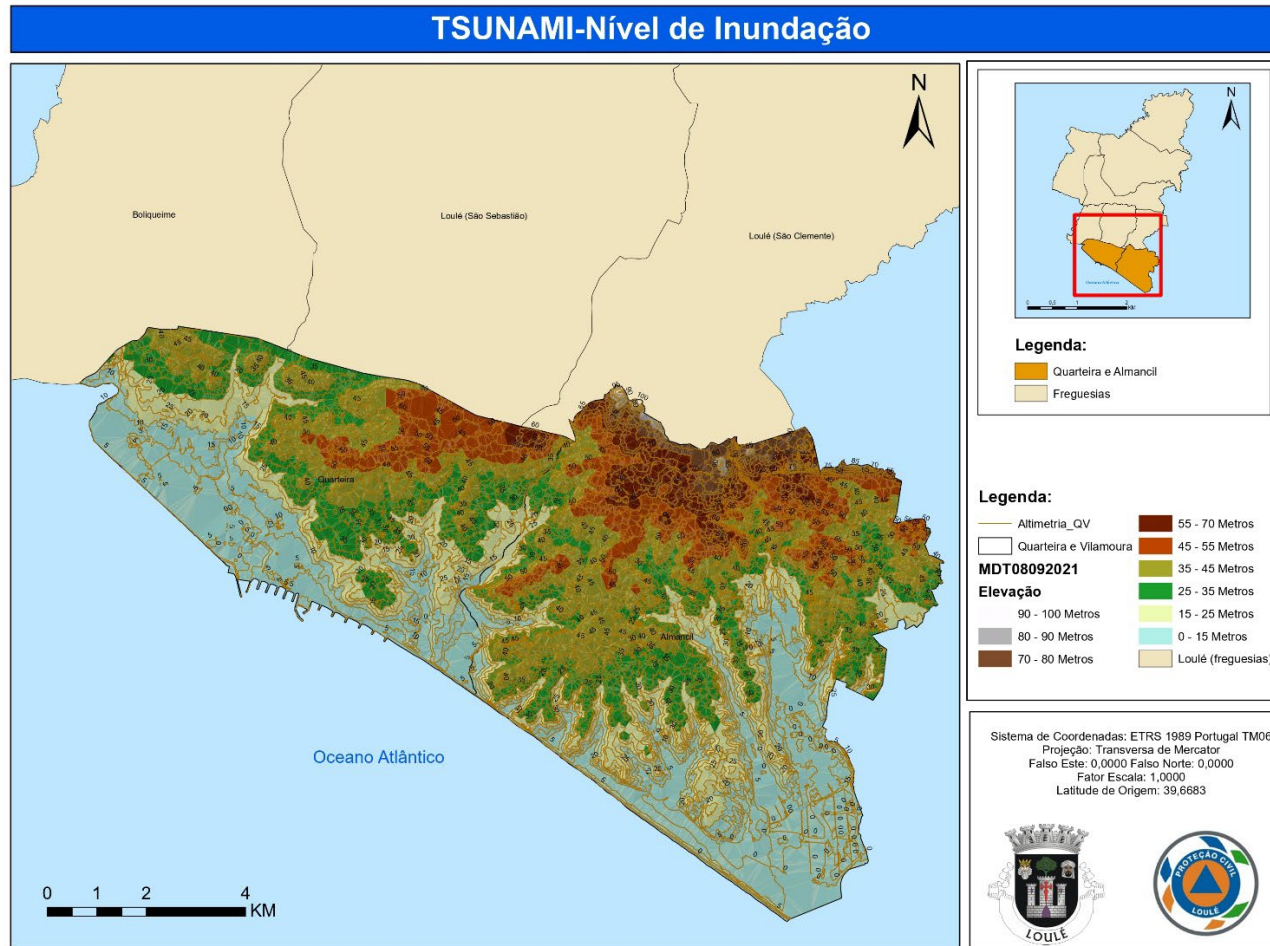


Methodology

1. Evacuation maps;
2. Damage to the Building;
3. Seismic and Tsunami Risk;
4. Beach population accounting;
5. Evacuation routes;

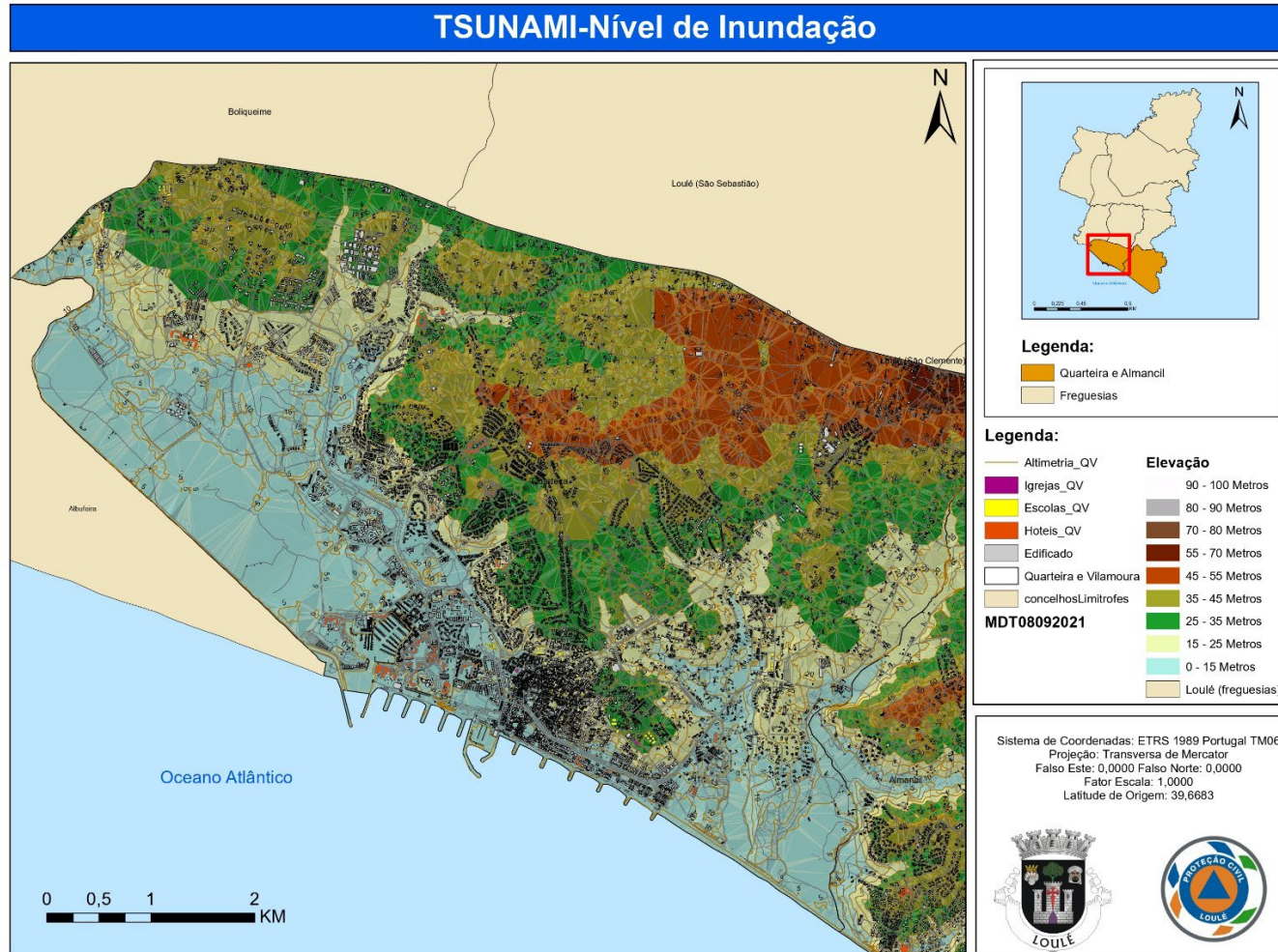


Digital Terrain Model



- Digital Terrain Models (DTM) sometimes called Digital Elevation Models (DEM) is a topographic model of the bare Earth that can be manipulated by computer programs.
- The data files contain the elevation data of the terrain in a digital format which relates to a rectangular grid. Vegetation, buildings and other cultural features are removed digitally - leaving just the underlying terrain. DTMs are used especially in civil engineering, geodesy & surveying, geophysics, geography and remote sensing.
- This Digital Terrain Model (MDT) is an interpolation of Contour Curves or Isolines with the same elevation value in relation to sea level, with this we could calculate the expected flooding area and consequently determine the safe zones.
- The worst-case scenario in mind, which would be a 15-metre wave, taking into account what happened in 1755.

Flood and Safe Areas Map



- Flood and safe areas map, the flood map is calculated by superimposing on the Digital Terrain Models (DTM):
 1. The expected wave height (15 m);
 2. The distribution of Classified Buildings,
 3. The Population
 4. And cartography of the road network
- Where the estimated flood area is considered “Evacuation Zone ” and the non-flooded “Safe Zones”.

Building Damage Study

The 2011 census made it possible to analyze the age of buildings, the number of floors and the type of material used in their construction.



EDIFICADO – INE, BGE

Instrumento de Trabalho do Sistema Estatístico Nacional (até 22/2020), de 13 de Maio, de recente alteração, registado no INE sob o nº 9665, válido até 31/12/2021.

CENSOS 2011
INSTITUTO NACIONAL DE ESTATÍSTICA

Questionário de EDIFÍCIO

Para proceder ao correcto preenchimento deste questionário, deverá fazer as perguntas necessárias aos proprietários ou moradores do edifício.

1 Localização geográfica

Município: _____ DTMNFR: _____ Secção/Subsecção: _____ Edifício: _____
Freguesia: _____

2 Endereço

Avenida: _____ Rua: _____ Estrada: _____ Travessa: _____ Praça: _____ Praceta: _____ Largo: _____ Outra (especificar): _____
Tipo de via: _____
Designação da via: _____

9 Em que época foi construído o edifício?

Até 1919 _____ De 1961 a 1990 _____
De 1919 a 1945 _____ De 1991 a 1995 _____
De 1946 a 1960 _____ De 1996 a 2000 _____
De 1961 a 1970 _____ De 2001 a 2005 _____
De 1971 a 1980 _____ De 2006 a 2011 _____

10 Qual o principal material utilizado no revestimento exterior do edifício?

Reboco tradicional ou marmorite _____
Pedra _____
Azulejo, ladrilho cerâmico ou mosaico _____
Outros (madeira, vidro,...) _____

11 Qual a estrutura de construção do edifício?

Betão armado _____
Paredes de alvenaria estrutural _____
Paredes de alvenaria sem placa _____

14 O edifício é servido por um sistema de recolha regular e organizada de resíduos sólidos urbanos?

Sim _____
Não _____

15 Os espaços comuns no interior do edifício permitem a circulação em cadeira de rodas até à entrada dos alojamentos?

Sim _____
Não _____

16 Qual a configuração do R/C?

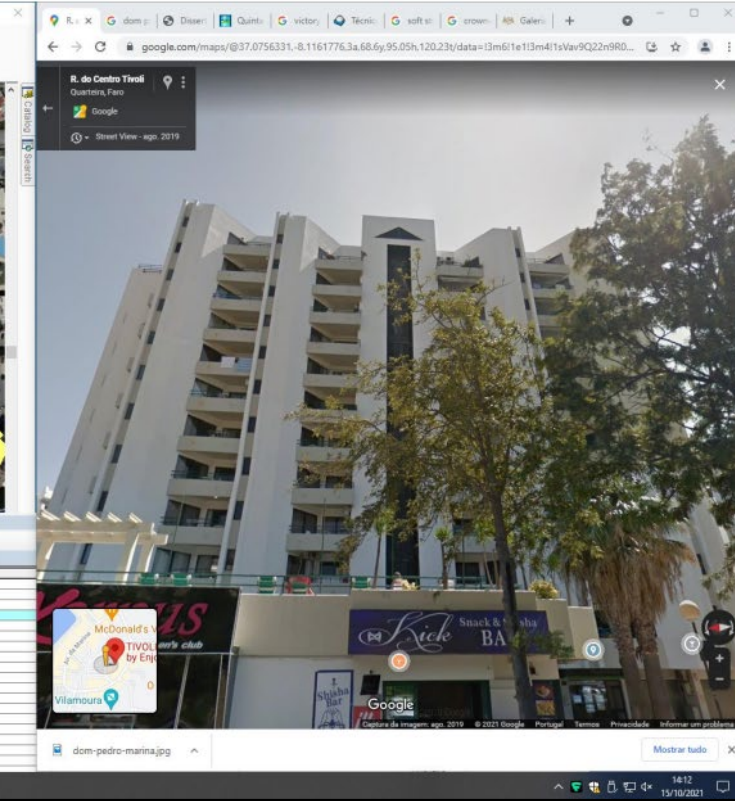
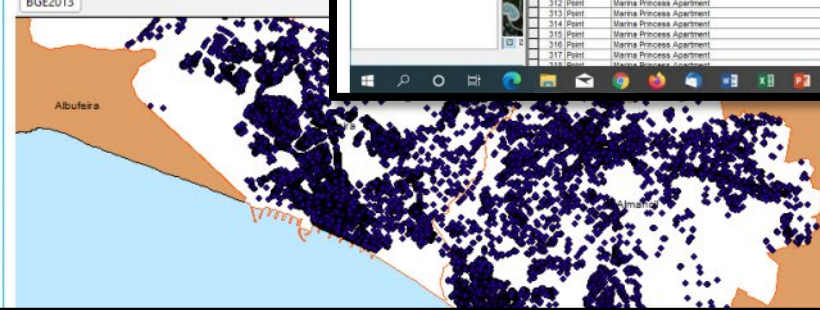
Com compartimentação semelhante à dos andares superiores _____
Com espaço interior amplo na sua maior parte _____
Com colunas na sua maior parte _____

17 O edifício é isolado, cinco vezes mais alto que os adjacentes ou tem com eles um contacto reduzido e inferior a 1/4 da sua superfície em planta?

Sim _____
Não _____

HOTÉIS

ID	Shape	DESIGNAÇÃO
300	Point	Hotel Vila Gale Marina
301	Point	Marina Mar
302	Point	Dom Pedro Marina Boutique Hotel & Golf
303	Point	Tivoli Sea View
304	Point	Tivoli Apartment by Enjoy Portugal
305	Point	Apartamentos Algarve
306	Point	All-Club Marina de Vilamoura
307	Point	Hotel Vila Gale Ampaluz
308	Point	Garettos Golf & Spa
309	Point	Tivoli Marina Vilamoura-Algarve Resort
310	Point	Marina Processa Apartment
311	Point	Marina Processa Apartment
312	Point	Marina Processa Apartment
313	Point	Marina Processa Apartment
314	Point	Marina Processa Apartment
315	Point	Marina Processa Apartment
316	Point	Marina Processa Apartment
317	Point	Marina Processa Apartment
318	Point	Marina Processa Apartment



Assessment of damage to the building taking into account seismic action



Vulnerabilities of construction periods, V_i

Classe	Época de construção	V_i
1	Alvenaria (<1919)	0,81
2	Alvenaria (1919-1945)	0,75
3	Betão (1946-60)	0,70
4	Betão (1961-85)	0,60
5	Betão (>1985; até 5 pisos)	0,52
6	Betão (>1985; 5-10 pisos)	0,54
7	Betão (>1985; + 10 pisos)	0,56
8	Betão > 2000	0,40

Vulnerability modifying factors

- Número de pisos
- Estado de Conservação
- Regularidade em planta
- R/C vazado (soft-storeys)
- Pisos recuados

Type of soils (EC-8)

Damage Level	Description	Marker Color
D0	No damage	Green
D1	Cracking of non-structural elements, such as dry walls, brick or stucco external cladding	Light Green
D2	Major damage to the non-structural elements, such as collapse of a whole masonry infill wall; minor damage to load bearing elements	Yellow
D3	Significant damage to load-bearing elements, but no collapse	Orange
D4	Partial structural collapse (individual floor or portion of building)	Red
D5	Full collapse	Dark Red



Legend for damage levels:

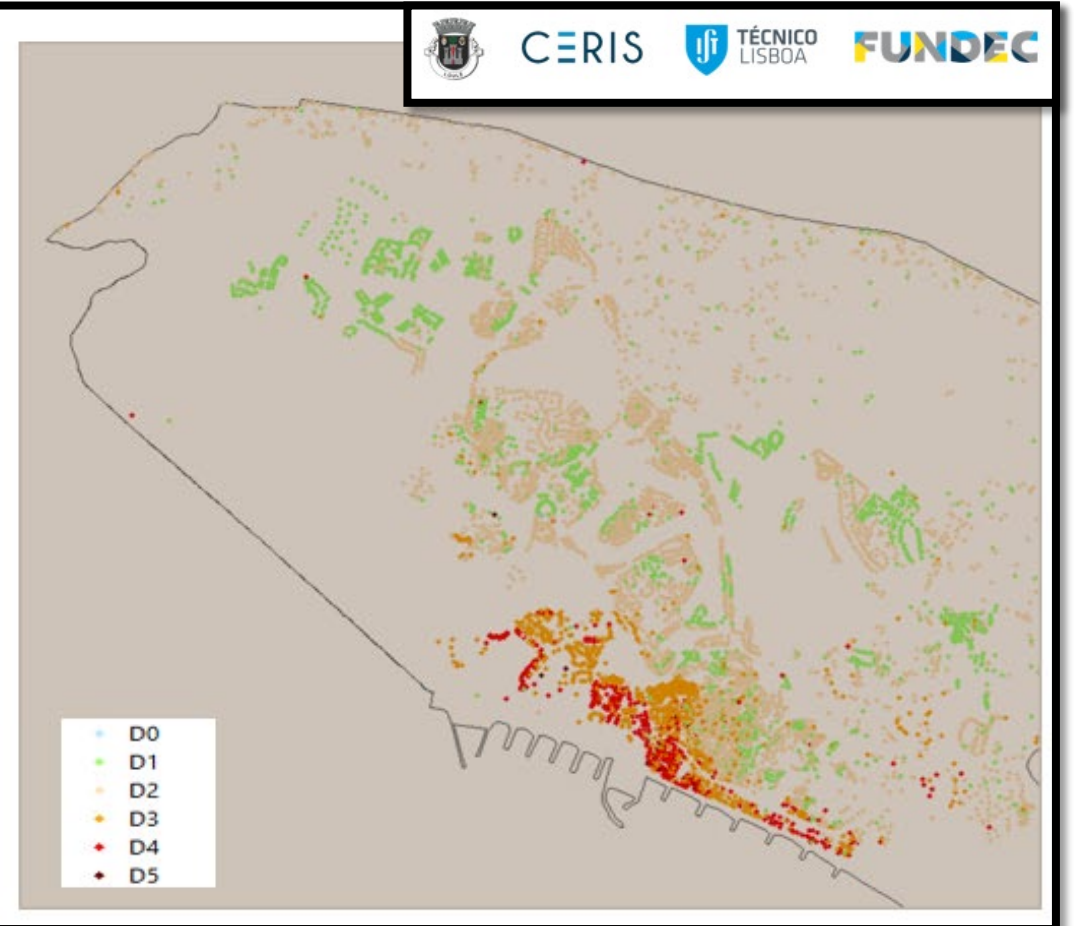
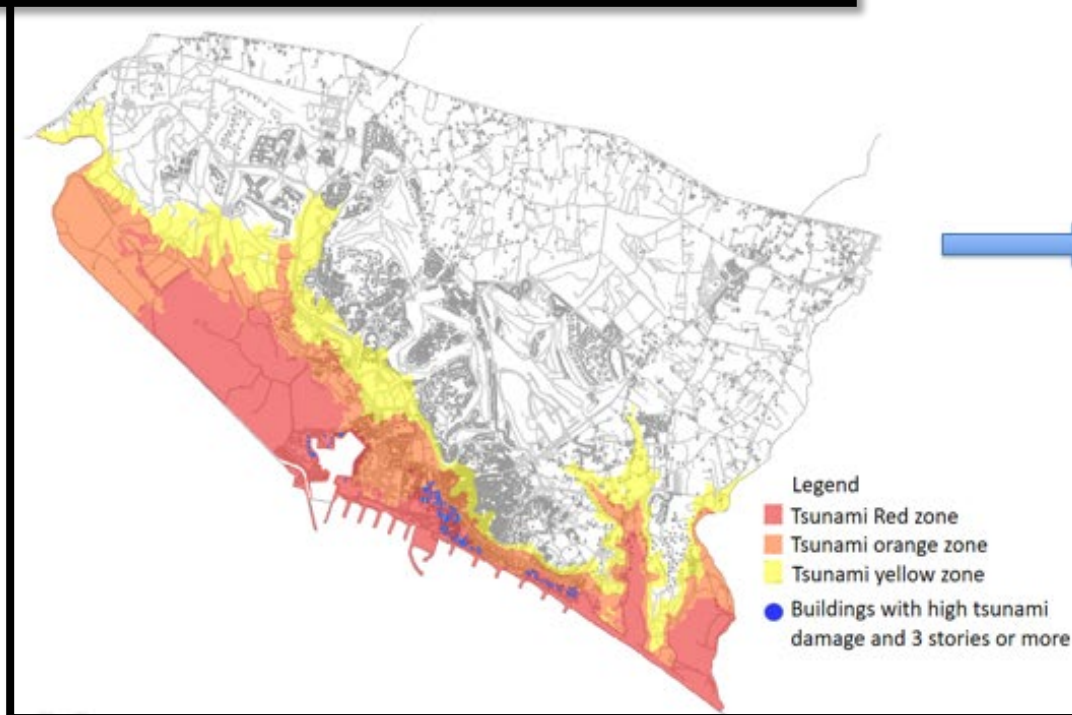
- Light Blue: D0
- Light Green: D1
- Yellow: D2
- Orange: D3
- Red: D4
- Dark Red: D5

Combined earthquake and tsunami damage



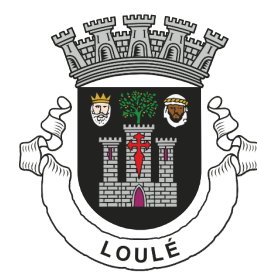
Zone	Description	Aggravated Index
Red	Buildings with heights between 0m and 5m (inclusive)	+2
Orange	Buildings with heights between 5m and 10m (inclusive)	+1.25
Yellow	Buildings with heights between 10m and 15m (inclusive)	+0.5
White	Buildings with heights greater than 15m	0

Inundation zones and mid-rise buildings with high tsunami severe damage



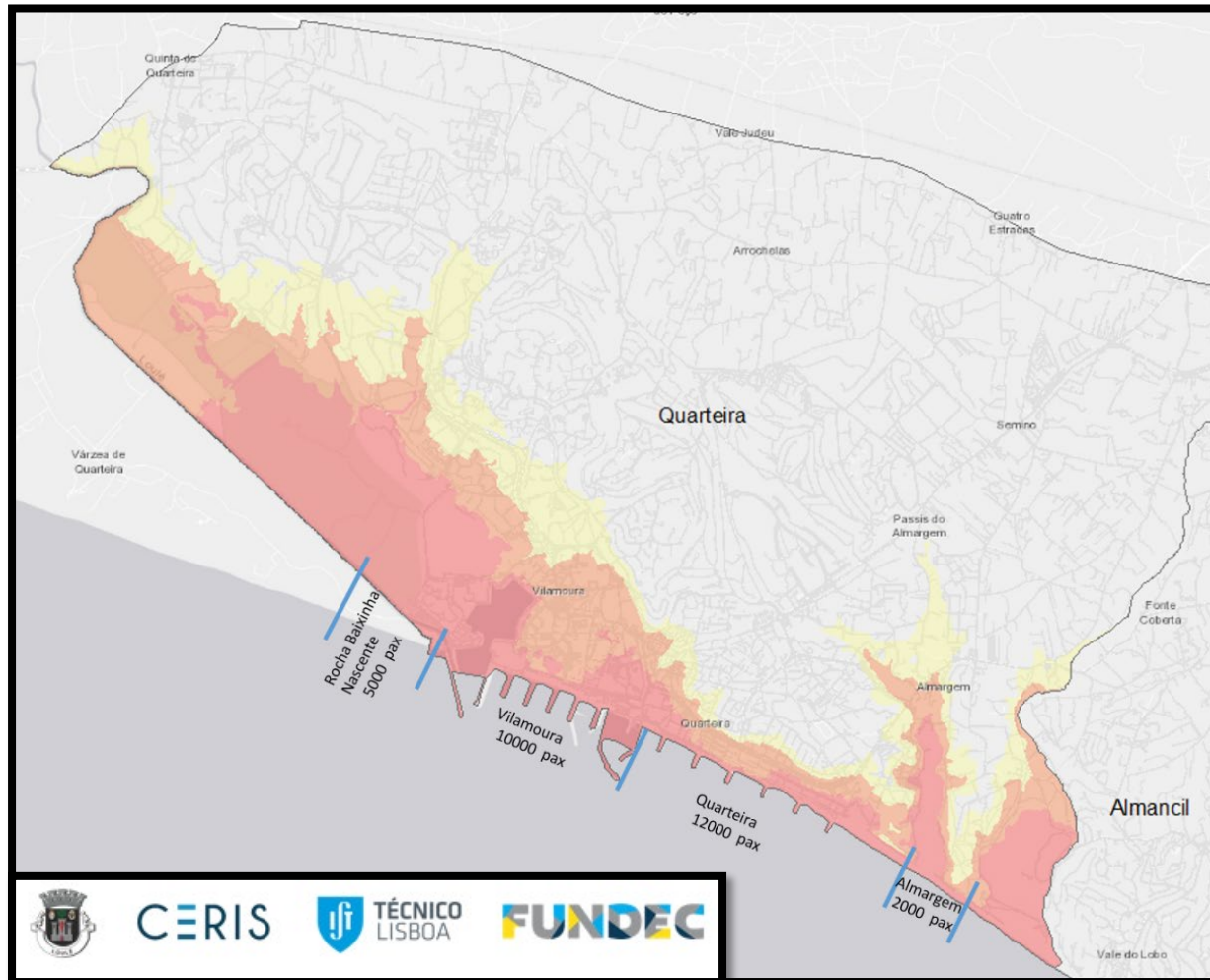
Beach population accounting

Creation of Evacuation Routes



Beach population accounting

Creation of Evacuation Routes



- Tsunami arrival time in Loulé could be 30 minutes.
- However, if the alert is given after registering on the tide gauge in Sagres, we only have 15 minutes to evacuate the area.
- To define the tsunami evacuation routes, based on the assessment of the damage caused by the earthquake, it was verified which routes did not present obstruction problems due to the collapse of structures.
- The slopes of each section were calculated. It was considered that the speed, for example, of walking in the area would correspond to 1.8 km/h, that is, 0.5 m/s.

Maximum capacity on beaches, referring to the bathing season from 1/Jun to 30/Sep 2021 (Source: <https://apambiente.pt/apa/arh-do-algarve>) (infopraia.apambiente)

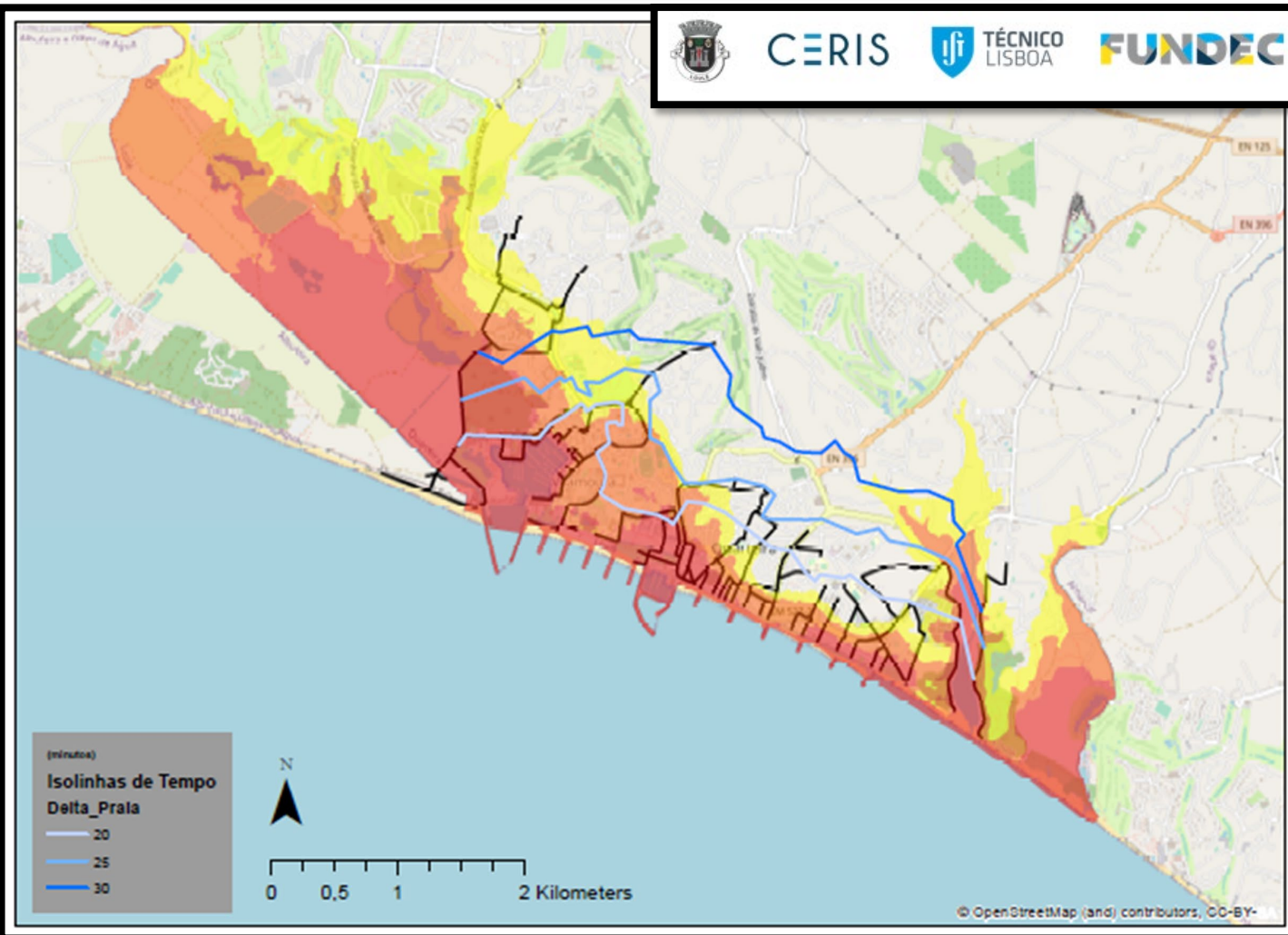


CERIS



FUNDEC

For the population to be able to carry out these times, it is important that they are informed about the procedures to be carried out and the paths to follow.



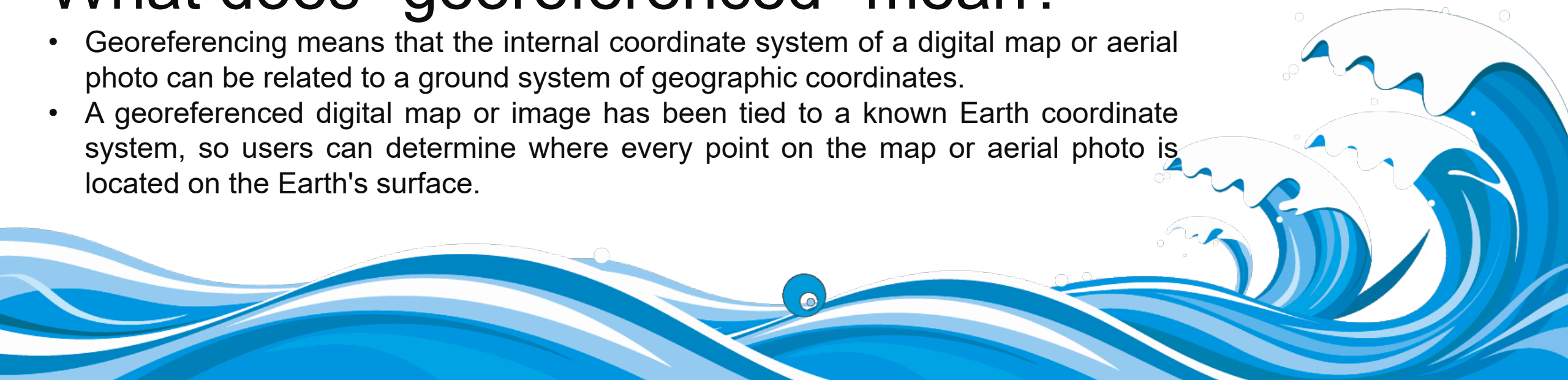
- The populations of the areas of Vilamoura and Quarteira have the possibility of reaching safe locations during the alert period, while those of Rocha Baixinha Nascente, due to the long distance to travel, may face additional problems.
- For the Almargem area we are in a mixed situation, so rapid alert and knowledge on the part of the population of what to do immediately are essential.
- To draw up the evacuation time isolines, the journey times from the beach or marina were added, calculated in order to determine the places where it would be possible to reach in 10, 15 and 20 minutes after the alert.
- A **10 minute** period was also added to take into account the reaction time and exit from the sand until the start of the evacuation routes.

06



What does "georeferenced" mean?

- Georeferencing means that the internal coordinate system of a digital map or aerial photo can be related to a ground system of geographic coordinates.
- A georeferenced digital map or image has been tied to a known Earth coordinate system, so users can determine where every point on the map or aerial photo is located on the Earth's surface.



Georeferenced Signage



The screenshot displays the GeoProteçãoCivil web application interface. The browser address bar shows the URL: https://geouloule.cm-loule.pt/MuniSIG/Html5Externo/Index.html?viewer=GeoProteocivil.GeoProtCivil_HMTL5#. The application header includes the logo for GeoProteçãoCivil and the text "GEOLOULÉ | SIG Municipal". A search bar with the placeholder "Pesquisa..." and a "Log out" button are also present.

The main interface features a "Layers" panel on the left with the following options:

- Todas as Layers Disponíveis
- A filtrar as layers... (with a "Filtro" button)
- Rede de Pontos de Água
- Percursos Vigilância
- Zonas de Cheia
- Subida Nível Mar
- Tsunami
- Sinalética
- Caminho Evacuação
- Área Inundável
- Áreas de Risco Potencial Significativo de Inundação (ARPSI) (ARH Alg.)
- DAE (Desfibrilhador Automático Externo)
- Infraestruturas de Apoio

The map shows the coastal region of Loulé, Portugal, with various municipalities labeled: ALTE, BENAFIM, SALIR, TÔR, QUERENÇA, LOULÉ, BOLIQUEIME, QUARTEIRA, and AMANCIL. The map includes a scale bar (0, 3, 6km) and a "Base Vet..." button. A "MANUAL DE APOIO" link is visible in the bottom right corner.

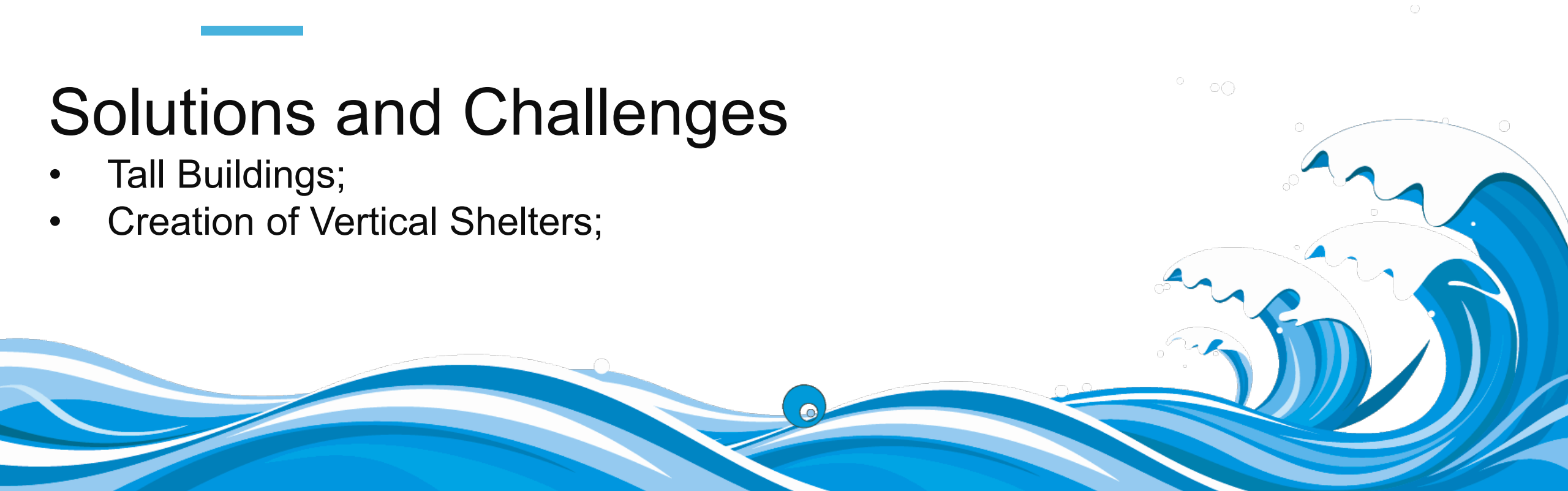


07



Solutions and Challenges

- Tall Buildings;
- Creation of Vertical Shelters;



Solutions and Challenges

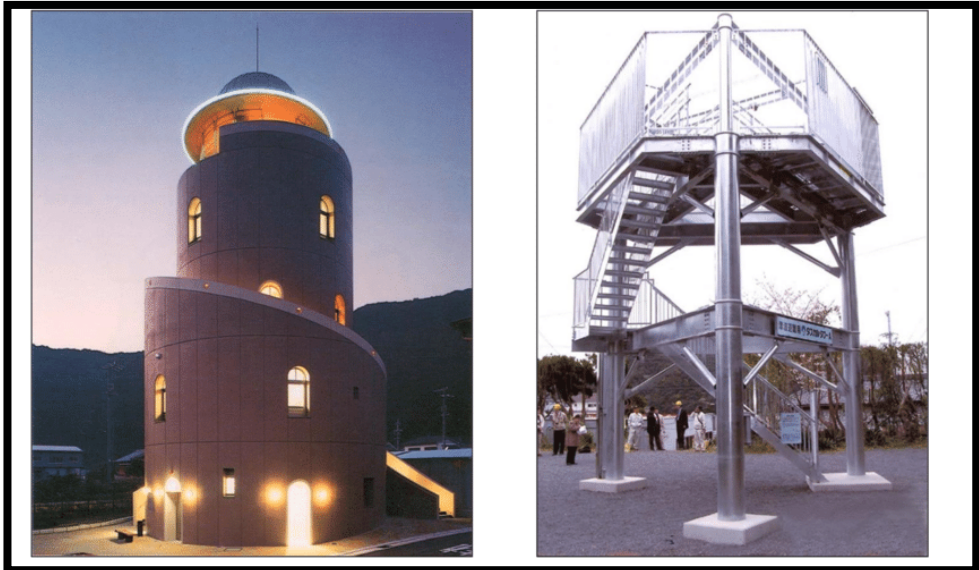


The screenshot displays the Google Earth interface with a map of Loulé, Portugal. The map shows a coastal area with several beaches labeled, including Praia da Faísia, Praia de Vilamoura, Praia de Santa Eulália, Praia da Quinta do Lago, and Praia de Faro. The map is overlaid with various data layers, including roads (N124, N125, N270, N396, N508, N520, N521-1, N521-2, N526, N527-2, N520-1, N520-2, N520-4, N520-5, N520-6, N520-7, N520-8, N520-9, N520-10, N520-11, N520-12, N520-13, N520-14, N520-15, N520-16, N520-17, N520-18, N520-19, N520-20, N520-21, N520-22, N520-23, N520-24, N520-25, N520-26, N520-27, N520-28, N520-29, N520-30, N520-31, N520-32, N520-33, N520-34, N520-35, N520-36, N520-37, N520-38, N520-39, N520-40, N520-41, N520-42, N520-43, N520-44, N520-45, N520-46, N520-47, N520-48, N520-49, N520-50, N520-51, N520-52, N520-53, N520-54, N520-55, N520-56, N520-57, N520-58, N520-59, N520-60, N520-61, N520-62, N520-63, N520-64, N520-65, N520-66, N520-67, N520-68, N520-69, N520-70, N520-71, N520-72, N520-73, N520-74, N520-75, N520-76, N520-77, N520-78, N520-79, N520-80, N520-81, N520-82, N520-83, N520-84, N520-85, N520-86, N520-87, N520-88, N520-89, N520-90, N520-91, N520-92, N520-93, N520-94, N520-95, N520-96, N520-97, N520-98, N520-99, N520-100) and localities (Loulé, Telheiro, Boliqueime, Benfarras, Vargem da Mão, Vale de Equas, Escanxinas, Vila Moura, Faro, etc.).

The interface includes a search bar at the top left with the text "Pesquisar" and a search button. Below the search bar, there is a list of search results under the heading "Locais". The list contains several entries, each with a checkbox and a description: "OBJECTID: 135", "OBJECTID: 136", "OBJECTID: 137", "OBJECTID: 138", "OBJECTID: 10", "OBJECTID: 140", "OBJECTID: 141", and "OBJECTID: 142". The entry "Tsunami_Loule" is selected and highlighted in blue.

At the bottom left, there is a "Camadas" (Layers) panel with a tree view showing various layers: "Base de dados principal", "Anúncios", "Fronteiras e etiquetas", "Locais", "Fotografias", "Estradas", "Edifícios 3D", "Clima", "Galeria", "Mais", and "Terreno". The "Locais" layer is checked and expanded.

The bottom right corner of the map shows the Google Earth logo and the text "Data SIO, NOAA, U.S. Navy, NGA, GEBCO". The bottom status bar displays the date and time of the image: "Data das imagens: 14/12/2015 37°05'02.58"N 8°02'40.30"W elev 56 m altitude de visualização 21.91 km".



Examples of vertical shelters



Hotel Vila Galé Marina



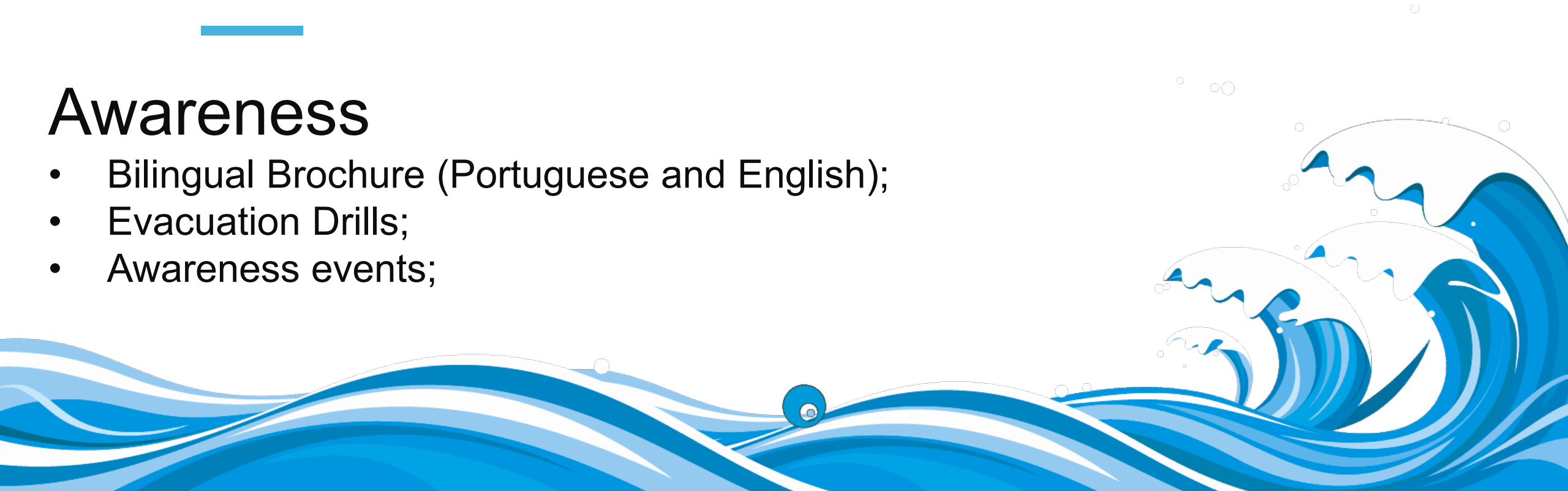
Hotel Tivoli Marina

08



Awareness

- Bilingual Brochure (Portuguese and English);
- Evacuation Drills;
- Awareness events;



EM CASO DE AVISO DE TSUNAMI

- Afaste-se das zonas junto à costa e dirija-se para pontos altos;
- Encaminhe-se para os locais indicados pelas autoridades, ou para os locais previamente assinalados como os Pontos de Encontro;
- Siga as principais rotas de evacuação em caso de sismo, tsunami, ou sempre que haja indicação por parte das autoridades;
- Haverá alerta sonoro seguido de mensagem, fique atento durante a fuga.

Principais falhas em Portugal Continental

- Falha do Sudoeste
- Falha do Sudoeste Interior de Tejo (SIT)
- Falha do Alentejo - Algarve (ATA)
- Falha do Leste - Região do Algarve
- Falha do Algarve
- Falha do Norte
- Falha do Atlântico



CONCELHO DE LOULÉ

O concelho de Loulé localiza-se na região do Algarve, uma região de moderada a elevada perigosidade sísmica dada a proximidade das placas Ibérica (Euro-Asiática) e Africana.

TSUNAMI

Saiba Proteger-se
Conheça os Sinais.

Se estiver na rua:

- Mantenha-se afastado dos edifícios, postes de eletricidade e árvores;
- Dirija-se para um local seguro;
- Esteja atento e siga as informações difundidas pelas autoridades.



QUARTEIRA

PRINCIPAIS ROTAS DE EVACUAÇÃO PARA OS LOCAIS SEGUROS NA CIDADE.



SINAIS NATURAIS DE TSUNAMI

- SENTIR um sismo muito forte ou de longa duração;
 - VÊR um aumento ou diminuição da subida do nível do mar;
 - OUVIR um barulho estranho e/ou alto vindo do mar.
- CORRA** para locais altos ou para o interior, longe da costa.

ESTEJA ATENTO A ESTES SINAIS.



Seguir nesta direção



Zona Segura

Não aguarde pelas ordens de evacuação oficiais, pois pode não haver tempo suficiente.

LOCAIS SEGUROS

1. Av. do Parque
2. Caminho das Alfarrobeiras
3. Rua Melvin Jones
4. Escola EB1 D. Francisca de Aragão
5. Restaurante "O Marujo"
6. Rua da Madrugada
7. Telepizza
8. Escola Básica de Quarteira
9. Igreja de São Pedro do Mar
10. Play Arena Quarteira
11. Escolas Dra. Laura Alres
12. Av. Papa Francisco
13. Rua da Fonte Santa

CIDADE DE QUARTEIRA



"work in process" and "work in progress"

CISION
ID: 109146420

PORTUGAL
resident
18-01-2024

Méio: Imprensa
País: Portugal
Área: 425,04cm²

Âmbito: Informação Geral
Periodo: Semanal
Pág: 14, 1

Tsunami signposting set up in Quarteira and Vilamoura

PROJECT || Around 140 signposts have been set up along the coastal areas of Quarteira and Vilamoura to help people know where to go in the event of a tsunami. The project has also signposted 13 "safe" meeting points which are located in higher altitude areas, such as the church of São Pedro do Mar, the St. Francisca de Aragão and Dr. Laura Alves schools and Avenida Papa Francisco.

The worst warning stations have also been set up that will be "beats in the case of an alert", Loulé Municipal Council announced in a statement to the press.

The signposts include the distances between the several points of the network and were created to be as easy to understand as possible.

The evacuation routes "are always the shortest, but instead the safest," the local council added.

Tatiana Neves from Loulé's Civil Protection Service explained that the project was developed with the "worst-case scenario in mind, which would be a 15-metre wave, taking into account what happened in 1952 - the year of a massive earthquake which destroyed most of Lisbon as well as a considerable area of the Algarve.

Shelters identified in the ground area due to be built in Vilamoura, where the terrain is mostly flat, particularly near Praia da Falésia.

Now that the signposting has been set up, the next step will involve raising awareness about the possibility of tsunamis and what should be done in the event of one. According to the local council, a bilingual brochure available in Portuguese and English is being created, while awareness events are being planned.

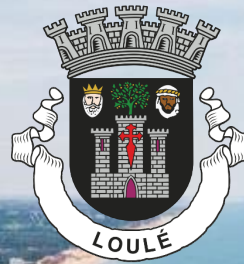
"It's not enough to just do something. The last step is getting all this information across to the population. People have to know how to behave in these situations," Fieldwork is fundamental, at schools for example, in order for people to know how the signposts work," said professor Carlos Oliveira from Lisbon's Instituto Superior Técnico, who led the project alongside the municipal civil protection team.

As he explained, these kinds of signposting projects already exist in towns and cities such as Faro, Lagos, Lagos and Lagos, although in Quarteira some "interventions" were made.

A second phase of the project is due to be carried out in Almancil, which also has a 15-metre-long coastline.

Loulé Mayor Vítor Almeida has highlighted the importance of making sure organisations are prepared for these potentially life-threatening events.

"The safety of human communities is one of the four responsibilities of public authorities. The majority of the population lives on the coast, and Portugal is no exception. In recent years, we have systematically worked to prepare ourselves for an exceptional and tragic event. Be it an earthquake, a tsunami, a storm, or a drought with potentially disastrous consequences. Our first commitment is to like the mayor said we.



THANKS!

Made by Tatiana Neves