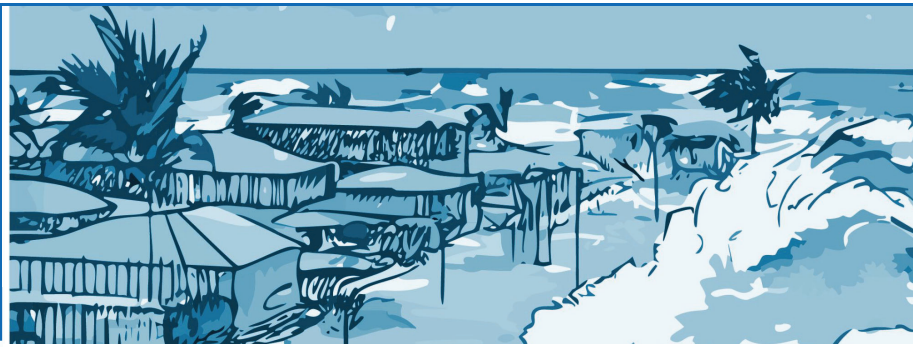
Tsunami Evacuation Mapping Workshop

30 June – 4 July 2025



CoastWAVE 2.0 Project

IOC-UNESCO (EU DG ECHO)

Dr. Frédéric Leone
Dr. Matthieu Péroche
Louis Monnier

Lesson #2

Method for identifying tsunami assembly points

Contact : matthieu.peroche@univ-montp3.fr

unesco
Intergovernmental Oceanographic Commission

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CoastWAVE NEAMTWS

LAGAM
LABORATOIRE DE GEOGRAPHIE ET D'AMENAGEMENT DE MONTPELLIER

UNIVERSITÉ PAUL VALÉRY MONTPELLIER 3

Lesson's overview

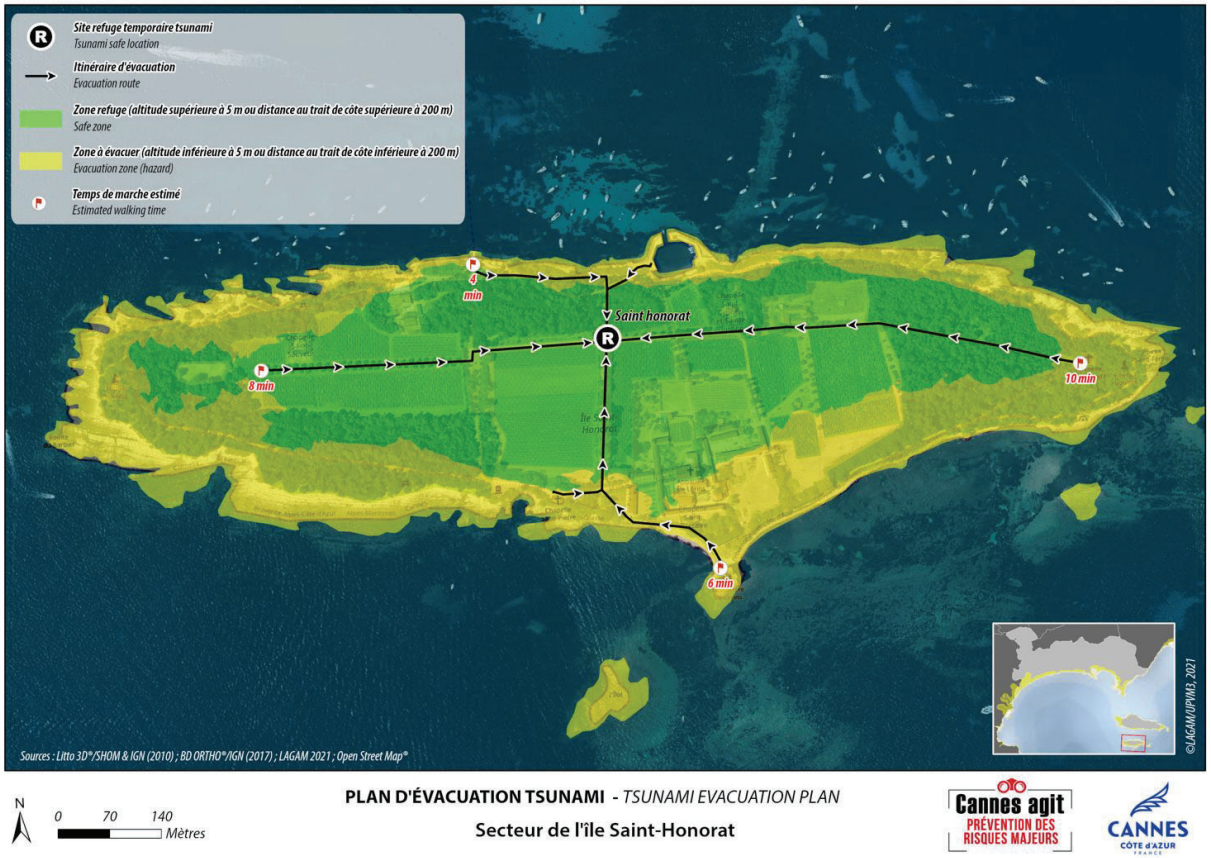
1. Theory

- Selection criteria
- Authorities validation process

2. Practice

- Mapping the entry points in the safe zone
- Assembly point pre-identification
- Field inspection & quality assessment
- Deliverable

Method for identifying tsunami assembly points



Why define tsunami assembly points?

- To give people a clear direction and a specific place to reach
- To identify and communicate the location both on maps and on the ground
- To help emergency services locate and regroup the population
- To encourage evacuation on foot to a safe and suitable area

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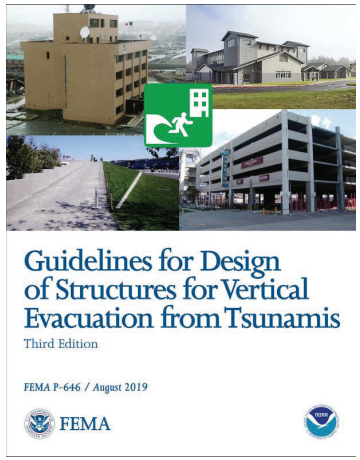
Lesson #2 | Method for identifying tsunami assembly points

Horizontal vs. Vertical Tsunami Assembly Points

	Horizontal Refuge	Vertical Refuge
Definition	Outdoor safe zone located outside the inundation area	Elevated structure (e.g. tall building or tower) designed to resist tsunami forces
Used in our studies?	✅ Yes, systematically	❌ No



https://www.fema.gov/sites/default/files/documents/fema_rsl_guidelines-for-design-of-structures-for-vertical-evacuation-from-tsunamis_050925.pdf

Why ?

- Safer in seismic contexts (no risk of collapse)
- Easily identifiable and accessible
- No structural evaluation required
- Requires strict engineering standards (e.g. FEMA guidelines)
- Risk if structure is not designed/tested
- Complex legal and technical validation

In French territories, walking short distances to safe areas is usually sufficient — **horizontal evacuation is both feasible and safer** in our context.

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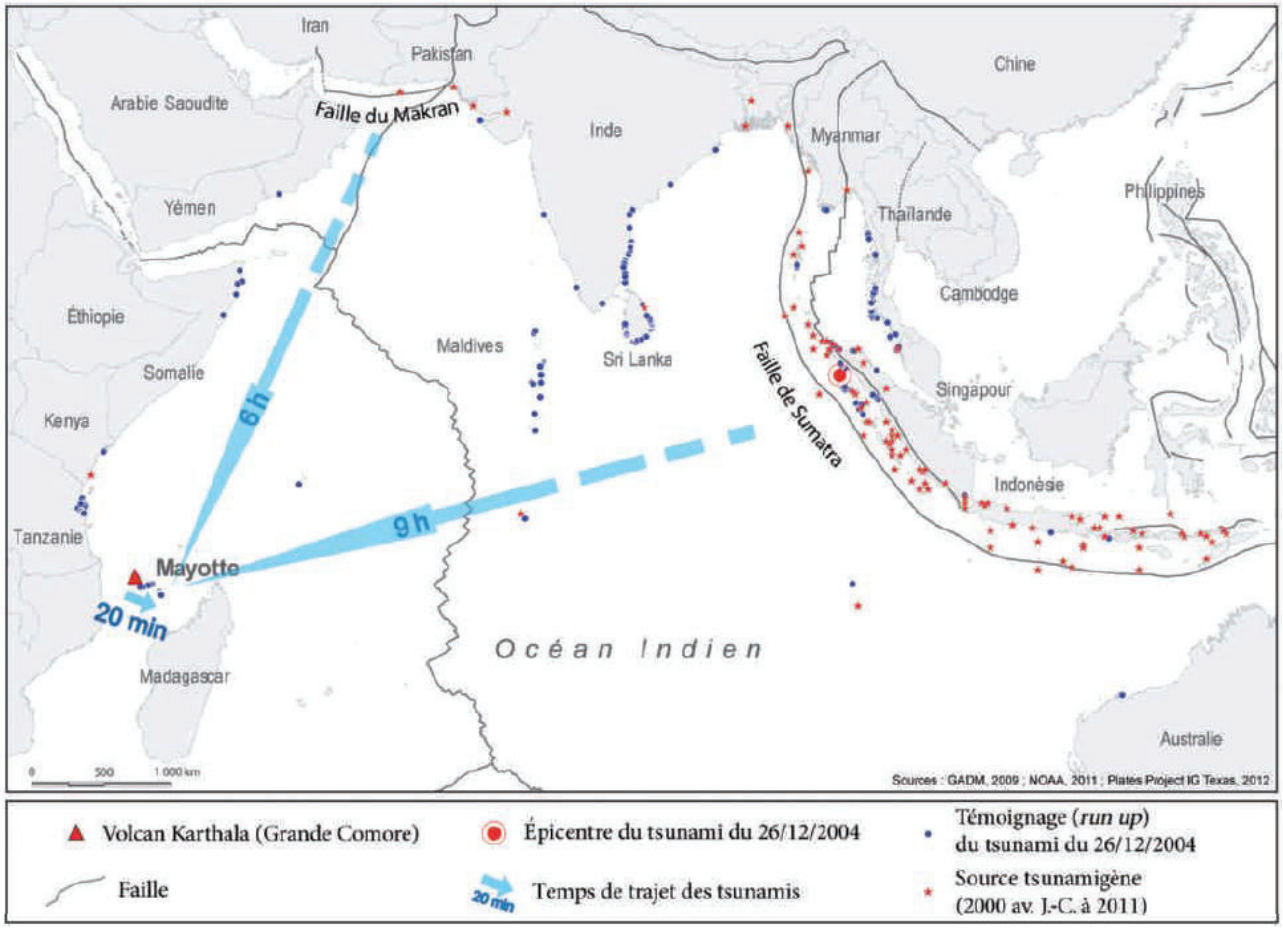
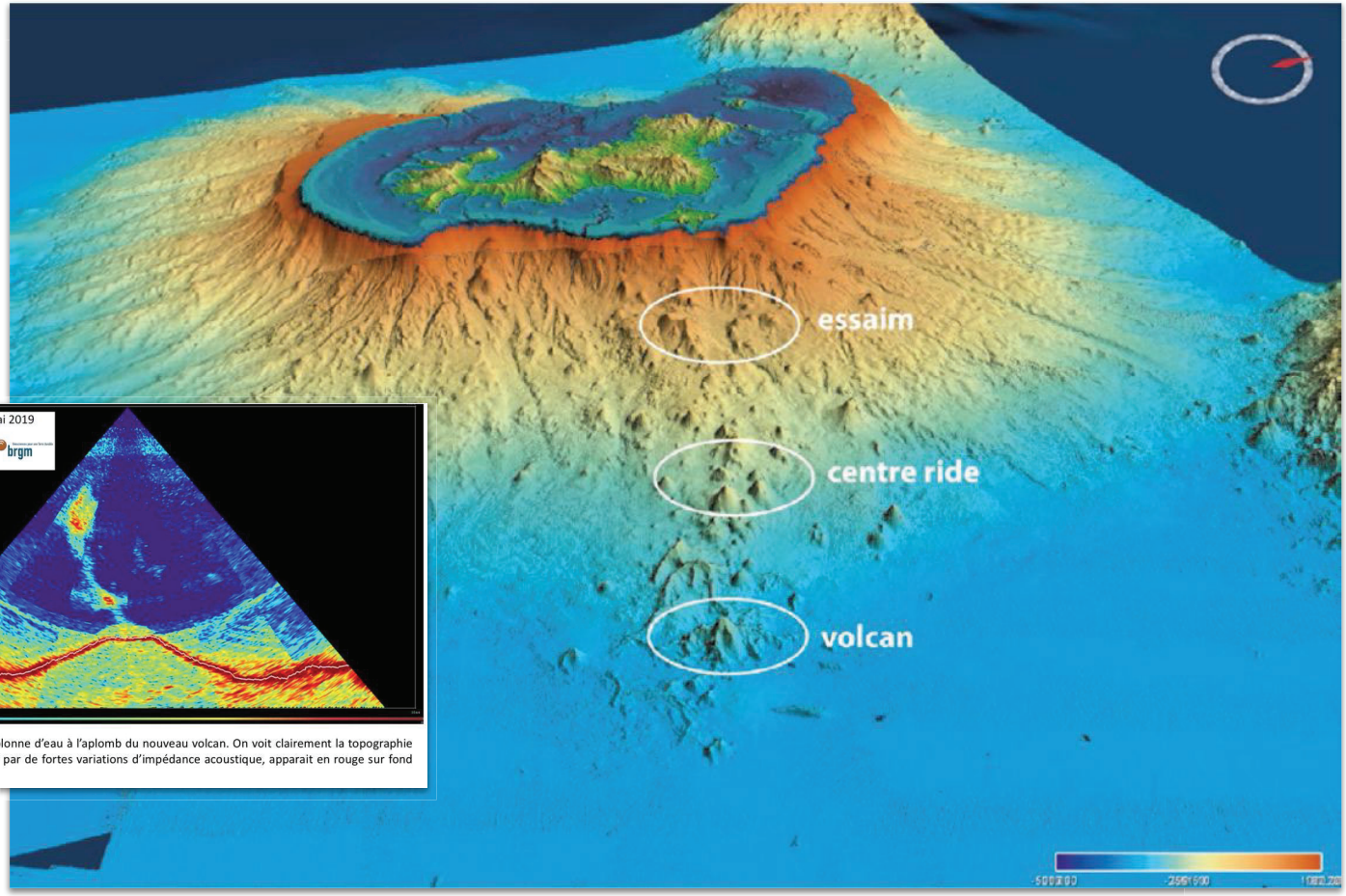
Modelled distant tsunami sources and effects of the 2004 tsunami in Mayotte



Several potential local sources linked to the seismic-volcanic activity of a new submarine volcano named Fani Maoré (May 2018)



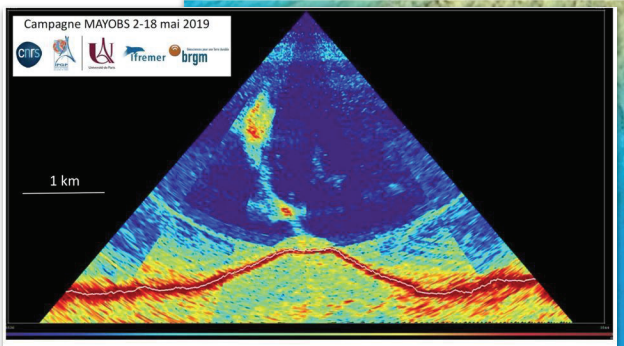
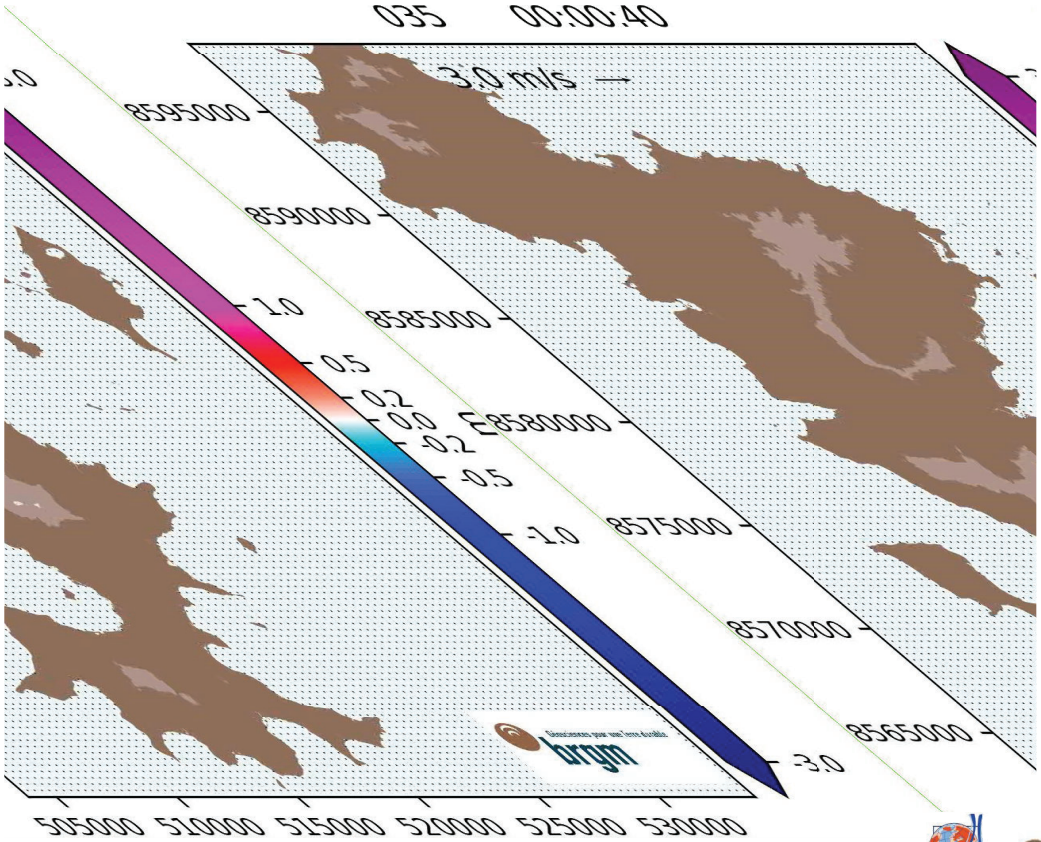


Image multifaisceaux de la colonne d'eau à l'aplomb du nouveau volcan. On voit clairement la topographie du volcan. Le panache, défini par de fortes variations d'impédance acoustique, apparait en rouge sur fond bleu.

Models show low amplitudes along the coast (1 to 2 m) but a very short travel time



Modeling of a tsunami triggered by slope instability off the coast of Petite-Terre (R. Pedreros)

The east coast of Petite-Terre remains the most exposed to the effects of a tsunami (close sources and absence of protective reefs).

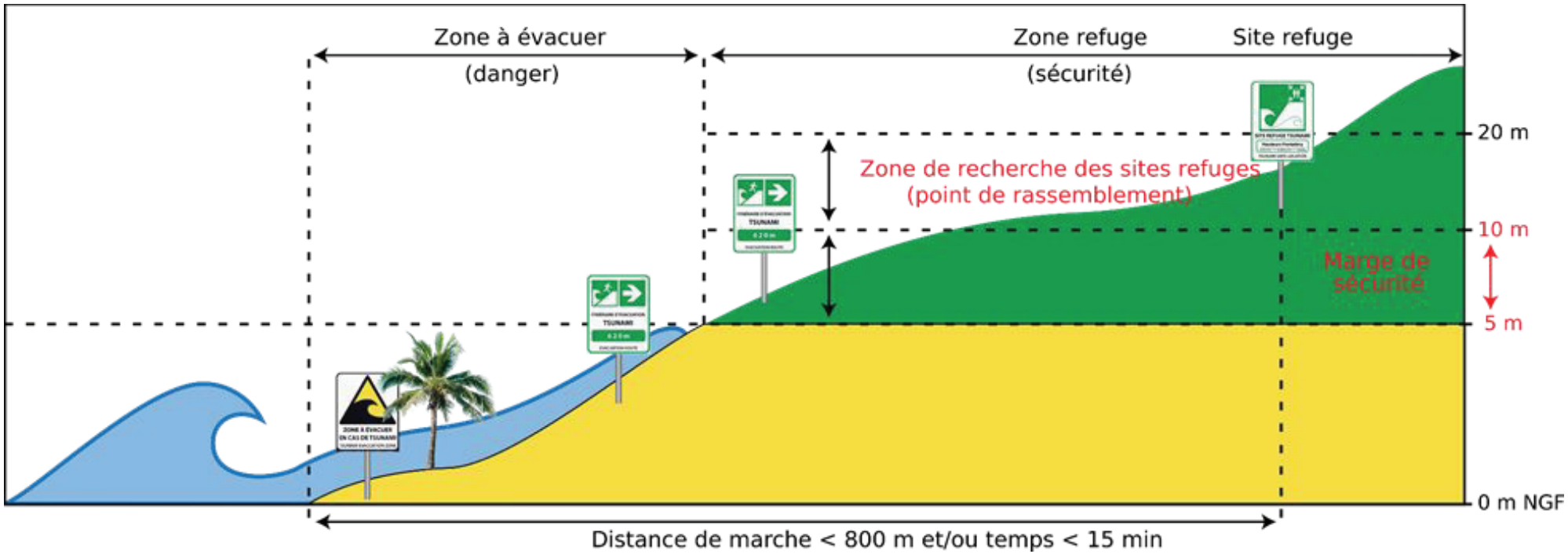
The models generate local water level rises of more than one meter, resulting in surges of several meters on the coast.

The scenarios modeled for the east of Petite-Terre show very short arrival times for the waves on the coast, ranging from **a few minutes in the east of Petite-Terre to around 18 minutes for** the east coast of Grande-Terre.

> Be prepared for a phenomenon that is moderate in amplitude but can arrive very quickly.

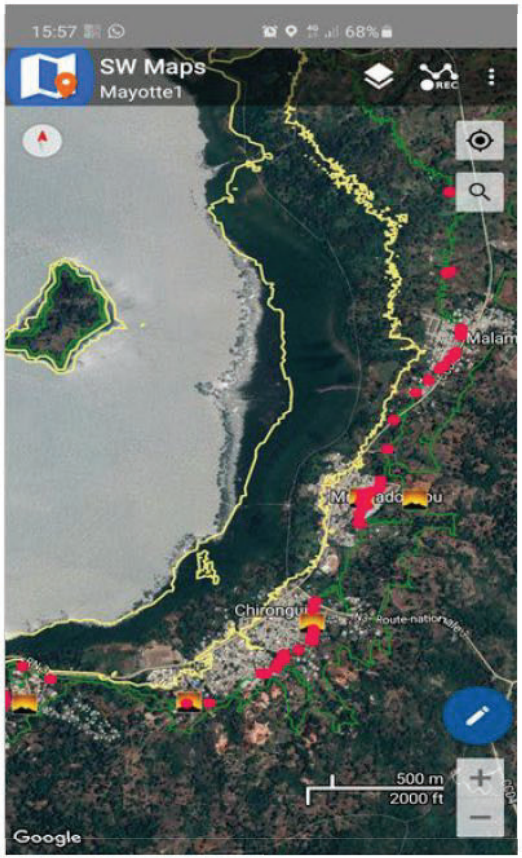
Search areas for refuge sites

Evacuation zone set between 0 and 5 m altitude in Mayotte



Pre-survey for eligible refuge sites using aerial imagery and field surveys (August 2020)

Field Research orientation using refuge zone entry points automatically generated in GIS (intersection points between isolines and roads : **red dots here**)



12 Criteria for selecting refuge sites (temporary assembly/meeting/refuge places)

> We walked 100 km in three weeks !

1. The right altitude

Select topographic sites higher than the upper limit of evacuation zone

But with a safety margin of a few meters (5 m here)

> Horizontal evacuation

2. The right distance

Ensure that the site is less than a 15-minute walk (or < 800 m) from the evacuation zone

No need to go too high or too far !

Beyond that, people become exhausted or demotivated

3. A good accessibility

Favor if possible a good accessibility with multiple routes

Avoid stairs and narrow passages (unless there is no other choice > mark them on the evacuation plan)

4. A sustainable availability

Check the current and future availability of sites

No construction projects planned

> Check this with the local authorities

5. A secure zone and more...

If possible, choose a secure and safe site, in particular with regard to road traffic or buildings collapse in case of tsunami triggered by an earthquake

And why not a fully equipped, shaded, with hot and cold drinks, and pastis on request!

6. A strategic view

Preferably with a view of the sea

Seeing the source of danger is one way to track the tsunami and the situation

7. Easy to find

A Public and/or well-known site with a good reputation

8. Go higher if need

Always offer the possibility of going higher to reassure people

9. The right capacity

With adequate capacity

(less of a problem on road sections)

Depending on the areas to be evacuated (day, night, rush hour, low or high tourist season

> This requires a frequentation study

10. Do not disturb the spirits

A place without cultural restrictions

(no cemeteries for example)

11. Don't pile on the problems

Avoid exposing the site to other natural hazards

12. Do not disturb…

Always stay away from sensitive and strategic locations to manage the crisis (police forces, firefighters centers, town hall) to clear access routes in case of emergency.

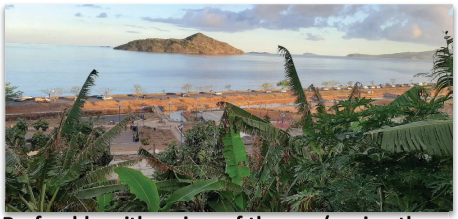
Criteria for selecting refuge sites (temporary assembly/meeting/refuge places)

Topographic sites higher than the upper limit of evacuation zone
But with a safety margin of a few meters (5 m) > Horizontal evacuation

Less than a 15-minute walk (or < 800 m) from the evacuation zone
(No need to go too high or too far !)

Favor if possible a good accessibility with multiple routes
Avoid stairs and narrow passages

Check the current and future availability of sites (no construction planned)



Preferably with a view of the sea (seeing the source of danger is one way to track the tsunami)

If possible, a secure and safe site (in particular with regard to road traffic)

A place without cultural restrictions (no cemeteries)

Avoid exposing the site to other natural hazards

Public and/or well-known site with a good reputation

Always offer the possibility of going higher to reassure people

With adequate capacity (less of a problem on road sections)

Always stay away from sensitive and strategic locations to manage the crisis

Validation levels and process for refuges sites

Depending on the target territory, its territorial organization, levels of competence, and levels of responsibility

Mayotte

Principle of hierarchical bottom-up validation

3. **Préfet / Senior State Authority** (highest representative of the State at the departmental level, appointed by the government, guarantor of public service, responsible for administrative control and enforcing State policy)

2. **Government departments in charge of risk and crisis management** (here at the departmental level)
> SIDPC (Prefecture) with technical support from DEAL (Department responsible for risk management)

1. **Community** via an *ad hoc* committee with :
- Local elected officials (mayor, deputy mayors)
- Municipal technical services (DGS)
- Fire department
- Municipal police
- Representative of state services
- Others (population via associations, elected representatives of the local community)
- And ourselves as researchers !

Participatory validation of refuge sites in each of the 16 coastal municipalities (January 2021)

Session schedule (2 to 3 hours):

- Presentation of the context (risks, challenges, evacuation)
- Questions and answers
- Practical exercises **on screen** and **then in the field**

Objectives:

- ✔ Check the suitability of the site
- ✔ Move, delete, or add to it
- ✔ Look at possible developments
- ✔ Test certain routes
- ✔ Name it
- ✔ Validate the site

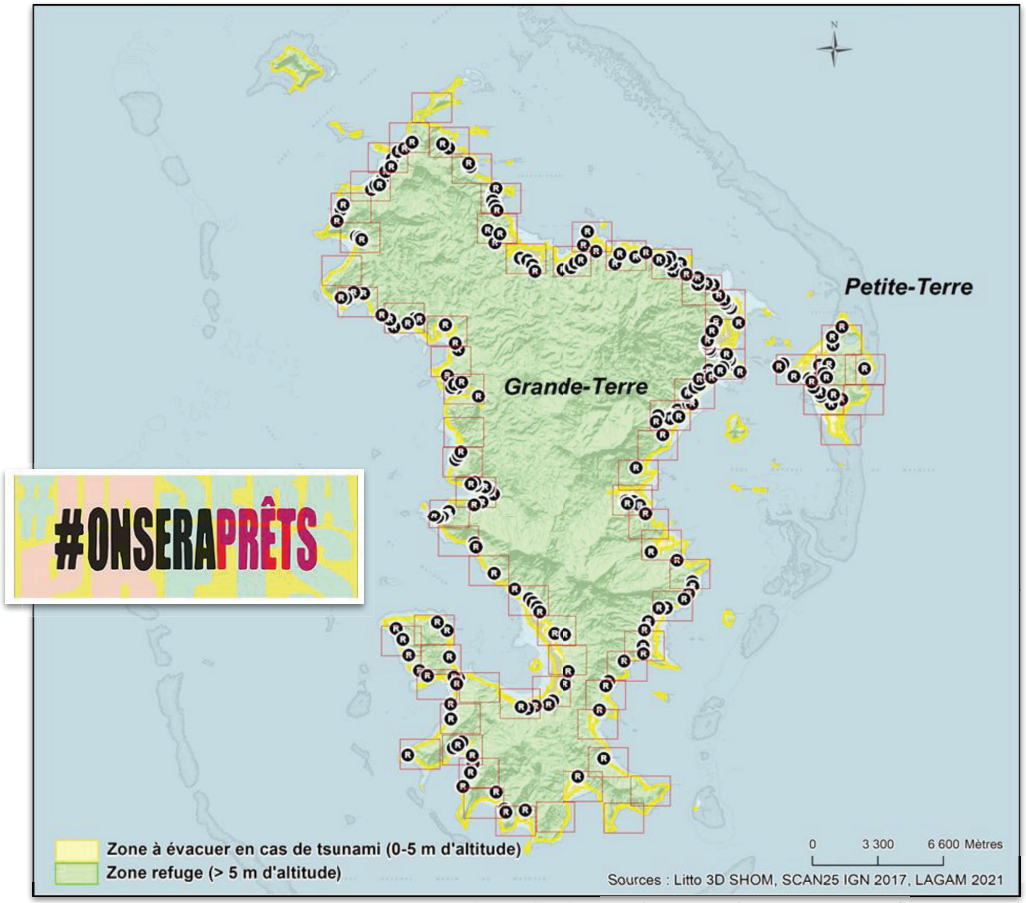
> 90 people met and involved in the process

Final validation and presentation to the public (press conference)

> 216 shelters approved by the Prefect in October 2021 (**14 months after the first field surveys**)

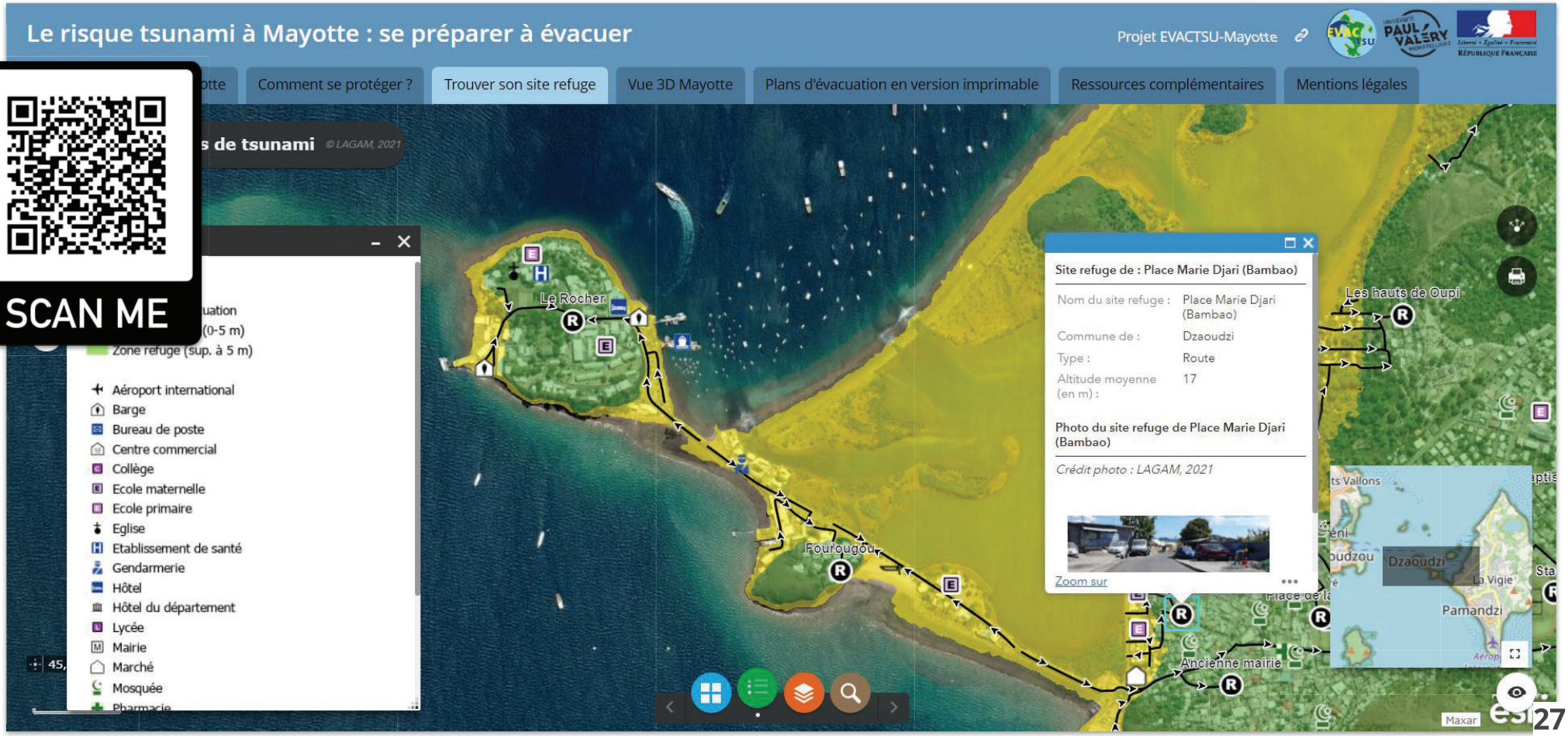
> 87 plans edited (16 communes)
> 3 prevention videos
> 1 website internet and more...

Launch of the official preventive information campaign by the Prefect on October 20, 2021, and **inauguration of the EVACTSU project website**

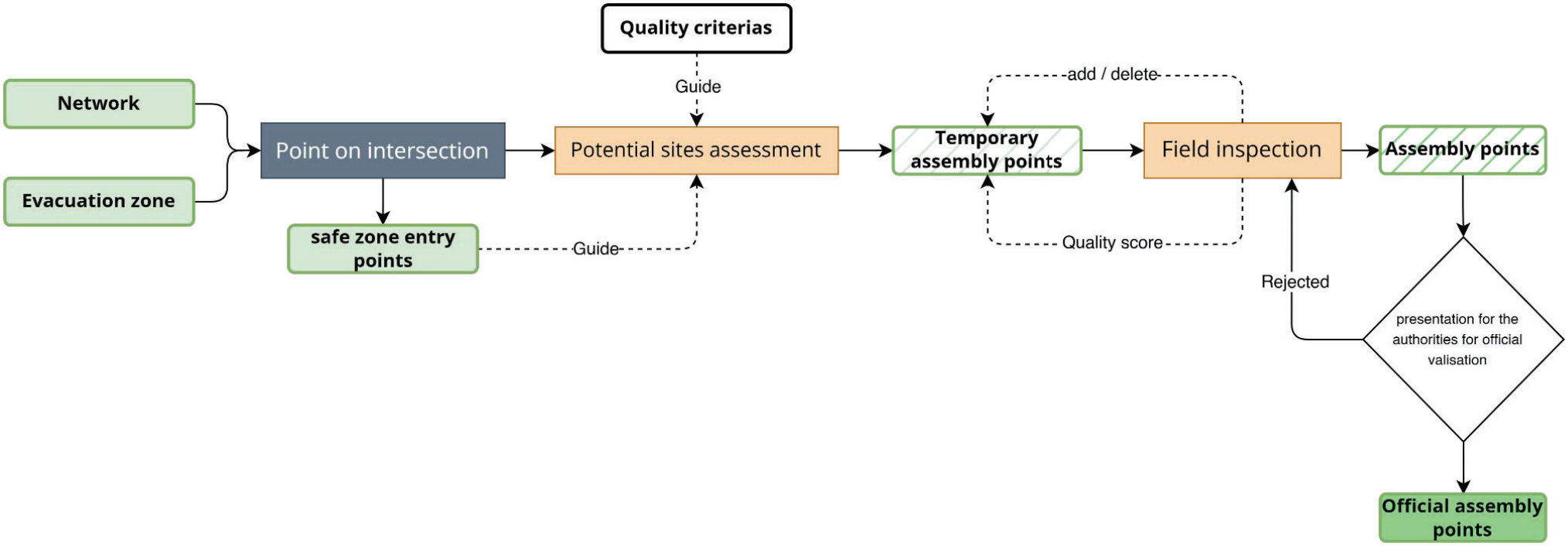


Website with interactive map

https://arcg.is/1be4iC0



Method for identifying tsunami assembly points



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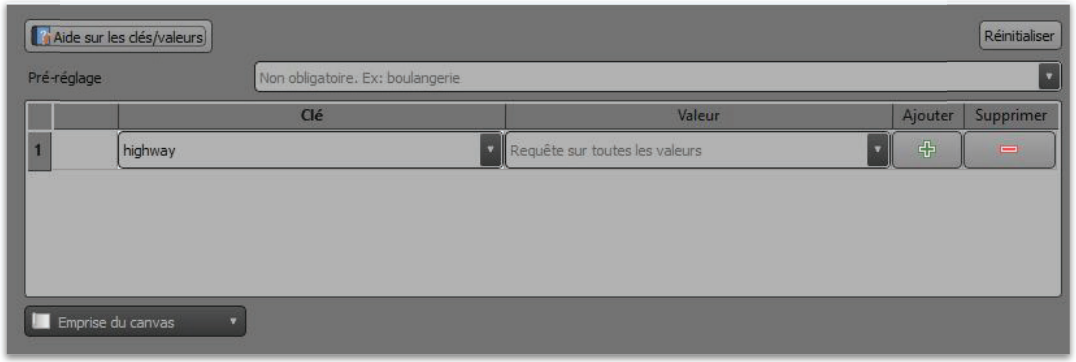
Download road's network

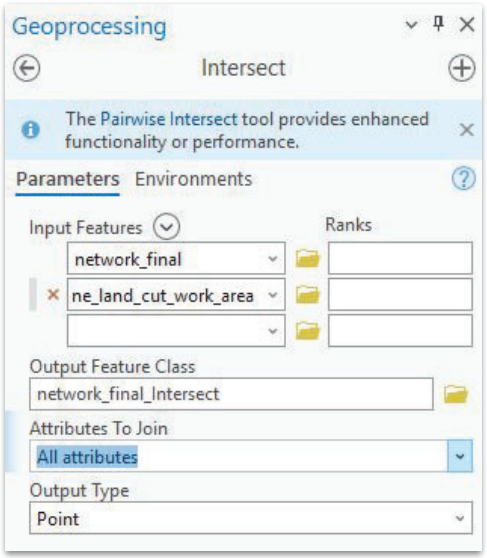
1. Use **QuickOSM** in QGIS :
   - **Key** : highway
   - **Value** : all
2. Discard non-linear features

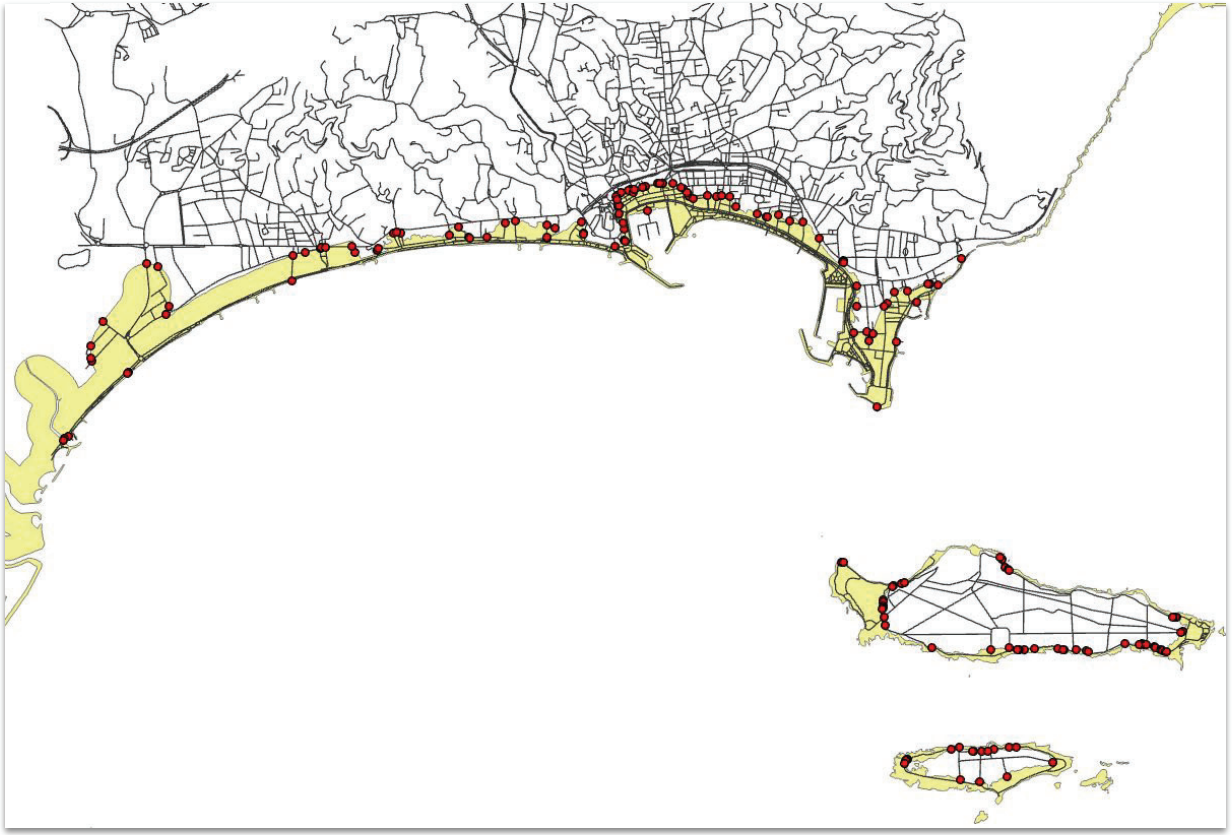


- For more info on data's values : https://wiki.openstreetmap.org/wiki/Map_features#Highway

Safe zone entry points

Use the **intersect** geoprocessing tool to generate point on intersections between roads features and the evacuation zone.

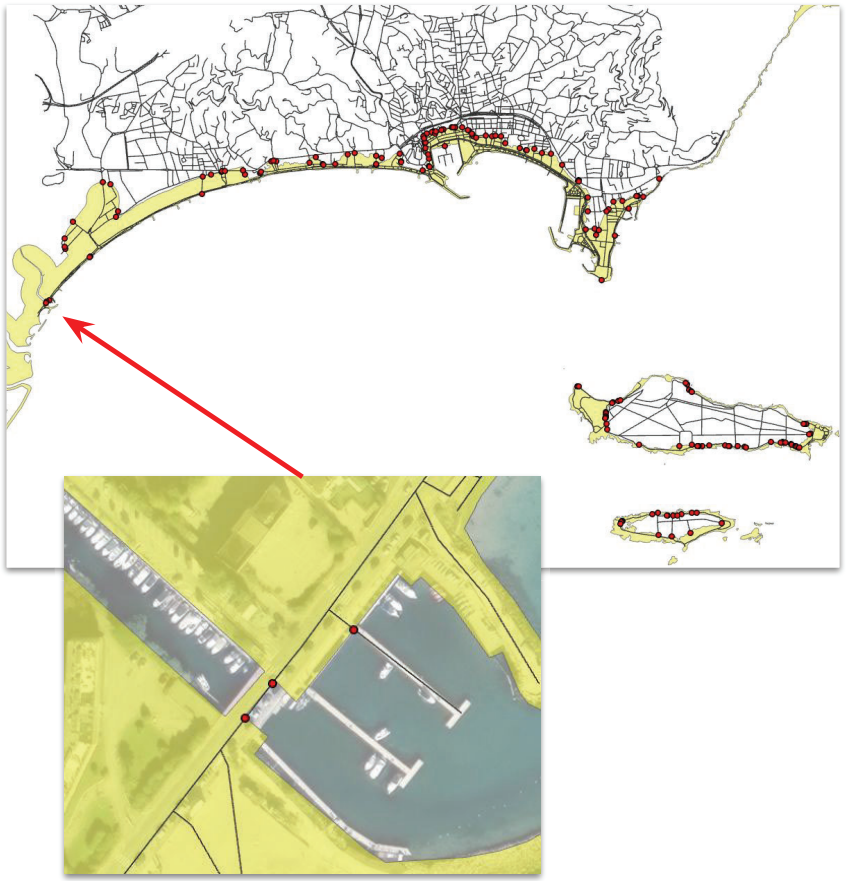




Safe zone entry points

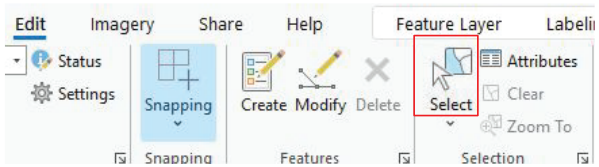
Due to intersecting geometry between in some areas (port, levees, dock), irrelevant points features can be generated.

Remove them before saving the layer

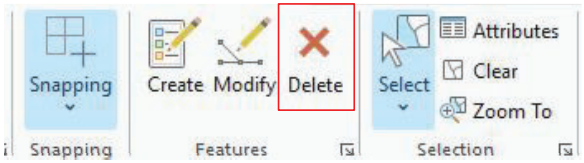


Select the irrelevant points feature and delete them :

1. **Top ribbon** > **Edit** > **Select**



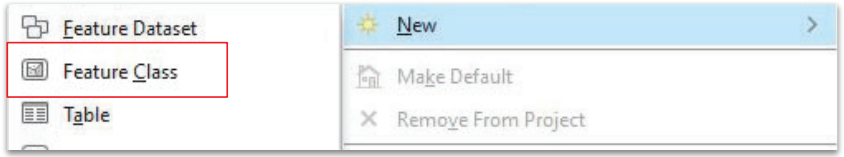
2. **Top ribbon** > **Features** > **Delete**



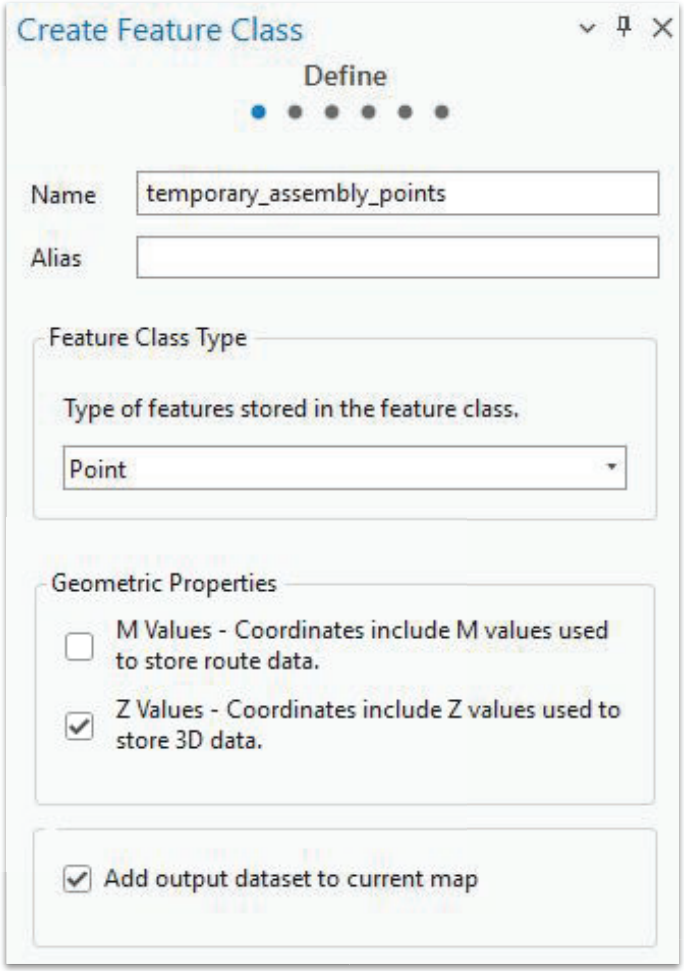
Assembly points pre-identification

Create a **temporary_assembly_points** layer :

1. **Top ribbon** > **View** > **Catalog Panel**
2. **Catalog panel** > **Project** > **Databases** > "project database"
3. Right click > **New** > **Feature Class**



4. **Name** your layer
5. Set the **geometry** type
6. Click on **Next**



Assembly points pre-identification

1. **Set up the fields in the layer's dataset :**

Create **4 fields** and set the **Data Type** for each field **:**

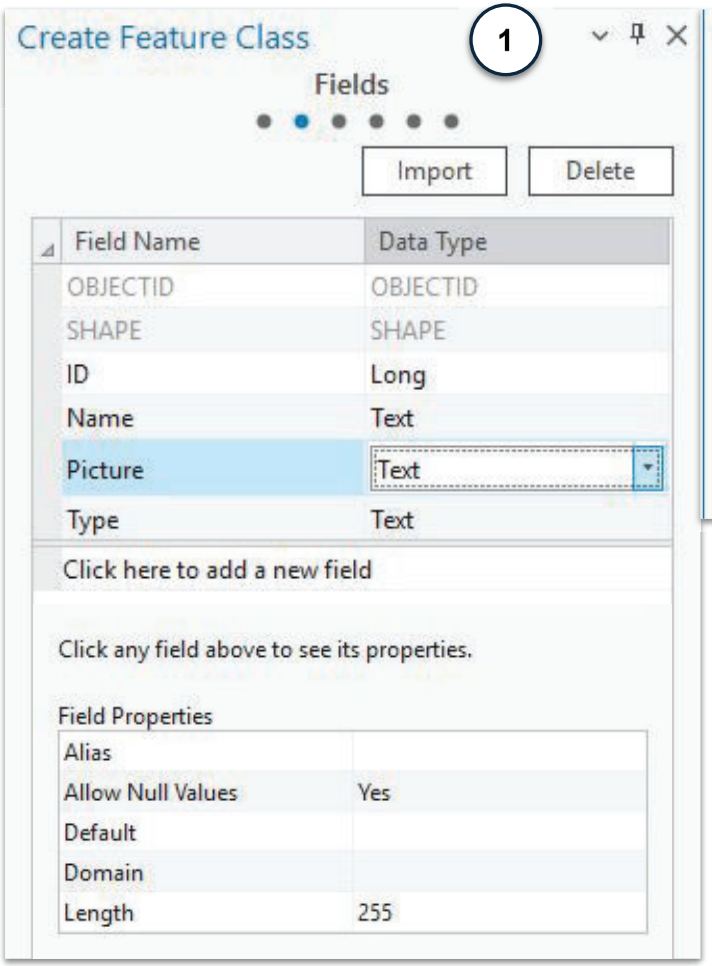
   a. **ID** (Long)
   b. **NAME** (Text)
   c. **Picture** (Text)
   d. **Type** (Text)

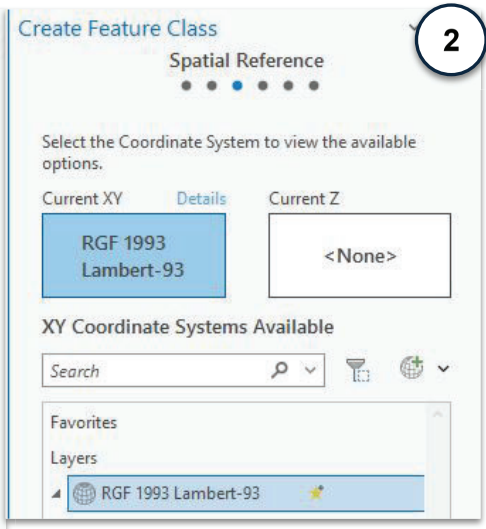
2. **Set the coordinate system**

Create **4 fields** and set the **Data Type** for each field **:**

Select **RGF 1993 Lambert-93** (EPSG: 2154)

3. Click on **Finish**

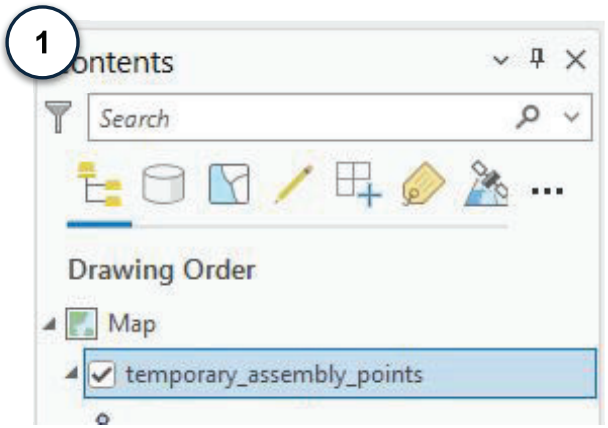


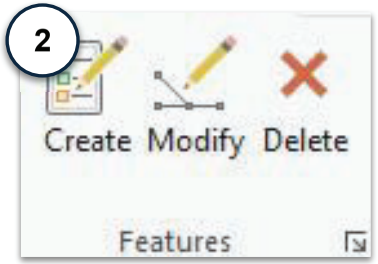


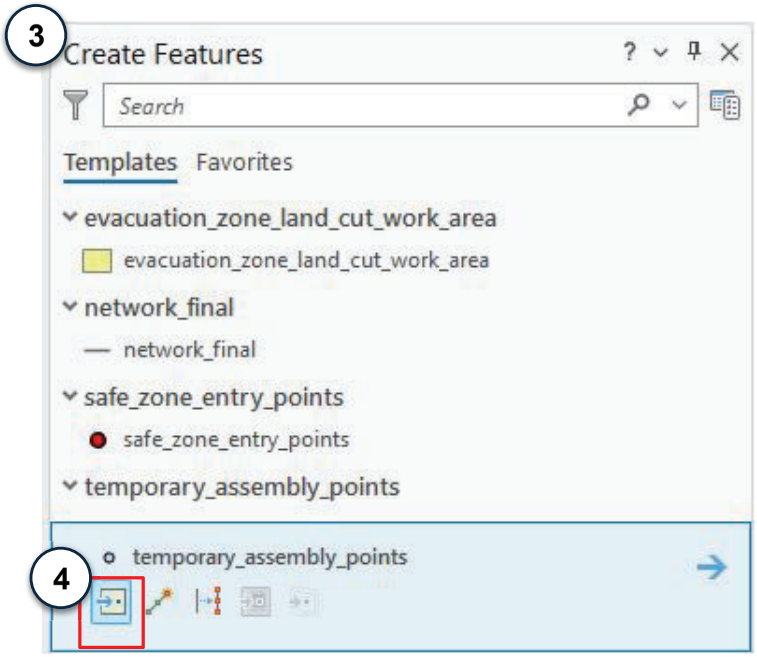
Assembly points pre-identification

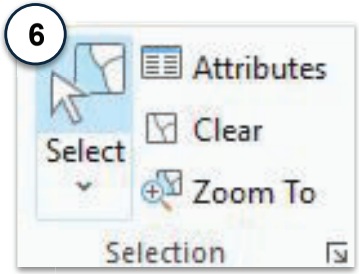
In order to create new features :

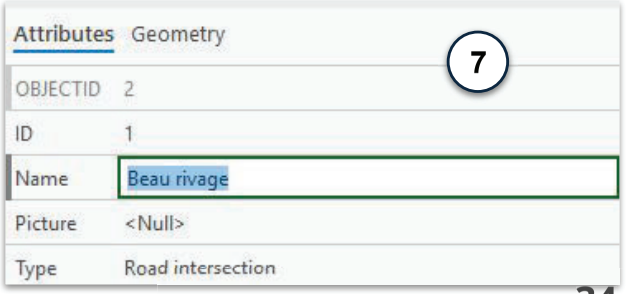
1. Select **temporary_assembly_points** in the **Contents panel**
2. In the **Top ribbon > Edit > Create**
3. Select the layer in the **Create Features** panel
4. Select **Point**
5. Create feature by clicking on the map canvas
6. Toggle the Attributes panel (**Top ribbon** > **Edit** > **Attributes**)
7. Fill in the value











Assembly points pre-identification

Identify the 12 most suitable places for assembly points

Time for field work

- **Quality assessment** for temporary assembly points
- If possible, bring someone with you from your teams and another one **from the community** (technical staff, ...)
- Take **geotagged photos**
- **Collect data** using GIS mobile application (SW Maps, QField, Fieldmap)

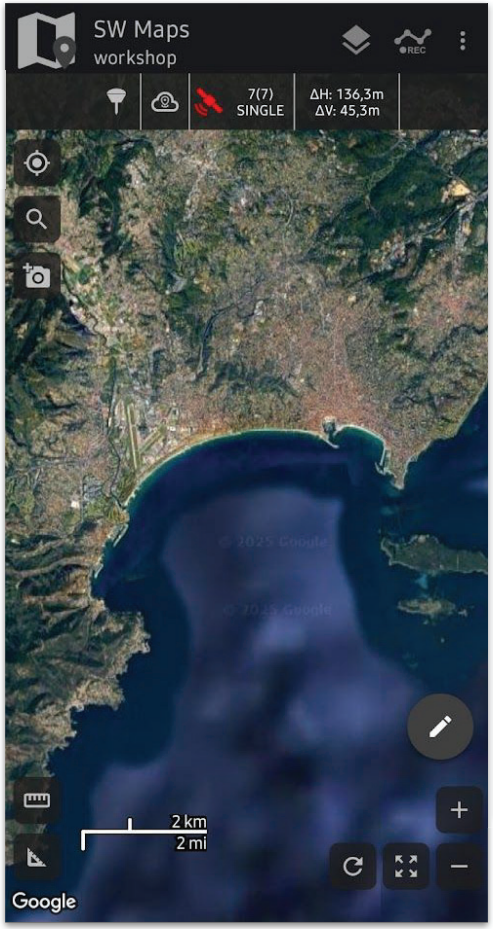
Field mapping : SW Maps

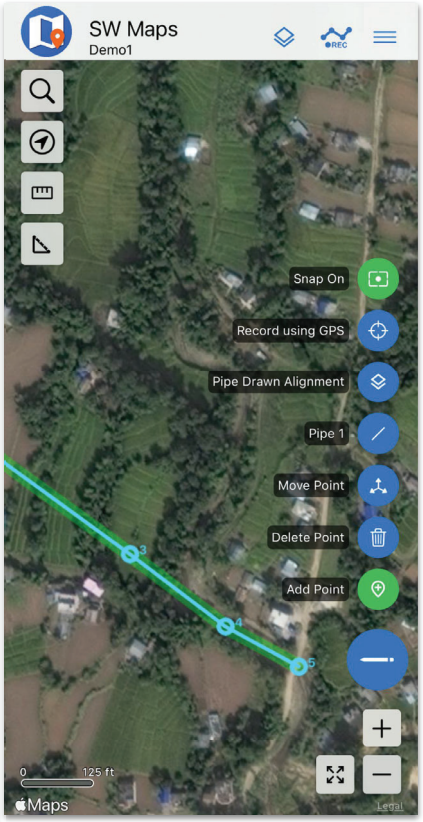
SW Maps is a free GIS mobile mapping application available for both Android and Apple phones.

SW Maps provide all the features needed during the field work :

- Load multiples layers in various formats (kml, shapefile, geopackage, etc.)
- Create layers
- Symbology management
- Edit layer's feature geometry
- Edit layer's data attributes
- Link photos with feature
- Measure distance / area
- Record GPS track

SW Maps Android User manual : https://aviyaantech.com/SwMaps/assets/SW%20Maps%20Manual%20V3.0.pdf

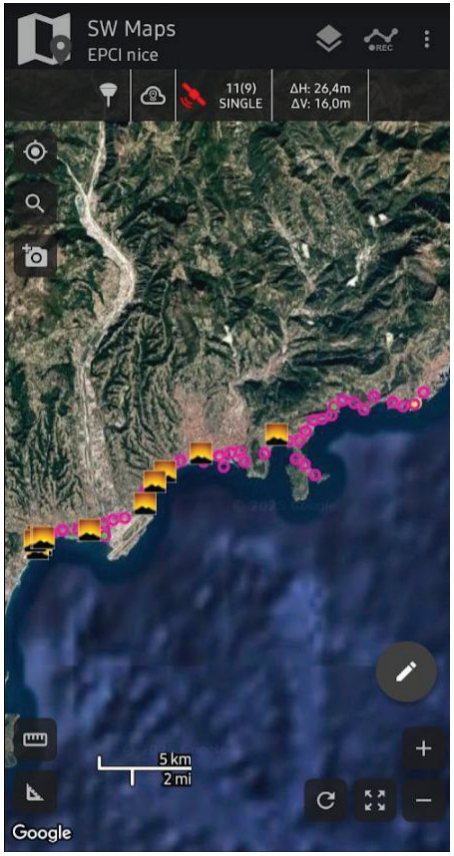


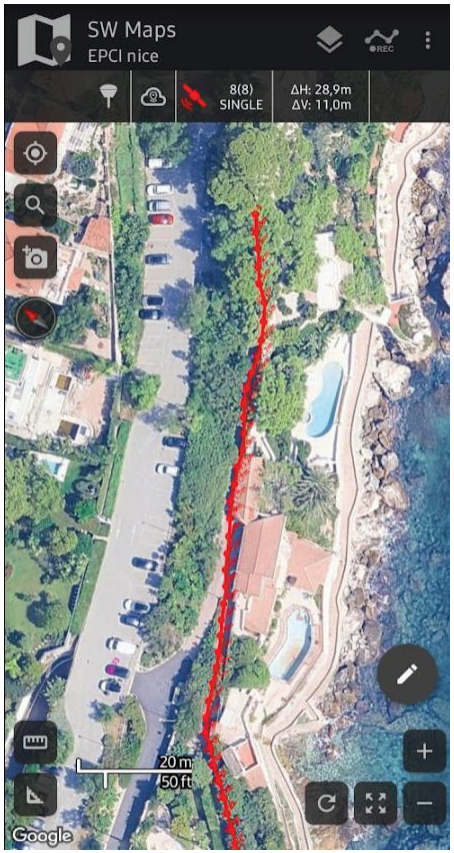


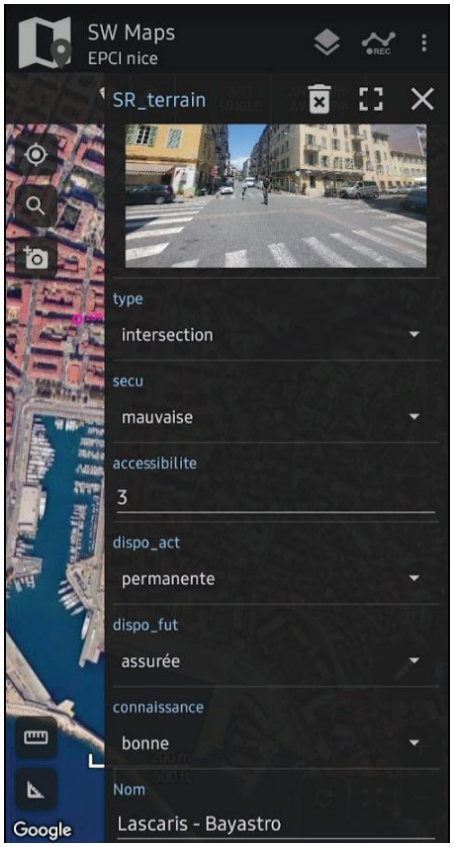
Field mapping : SW Maps

SW Maps doesn't allow to add or remove a layer's field once it have been imported on the phone. Layer's field configuration must be done in a **desktop GIS software.**

Setting up the field beforehand allows us to set **constraints, domains or attachments on the field values**, making the process of filling in data easier, and reducing the risk of error.





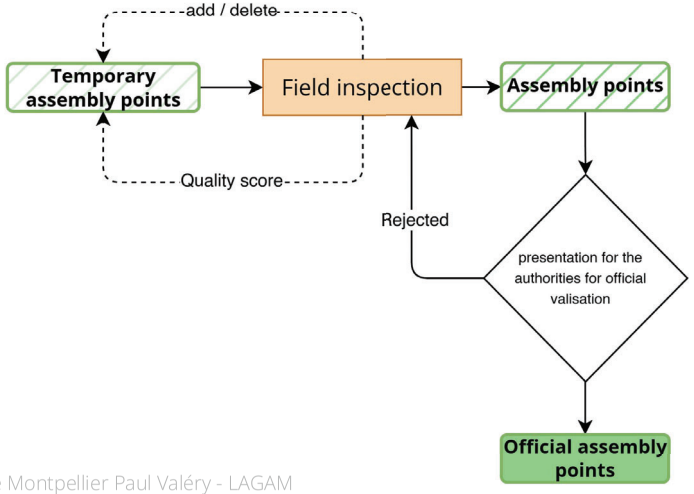


Assembly points pre-identification

Experience sharing : the importance of field work

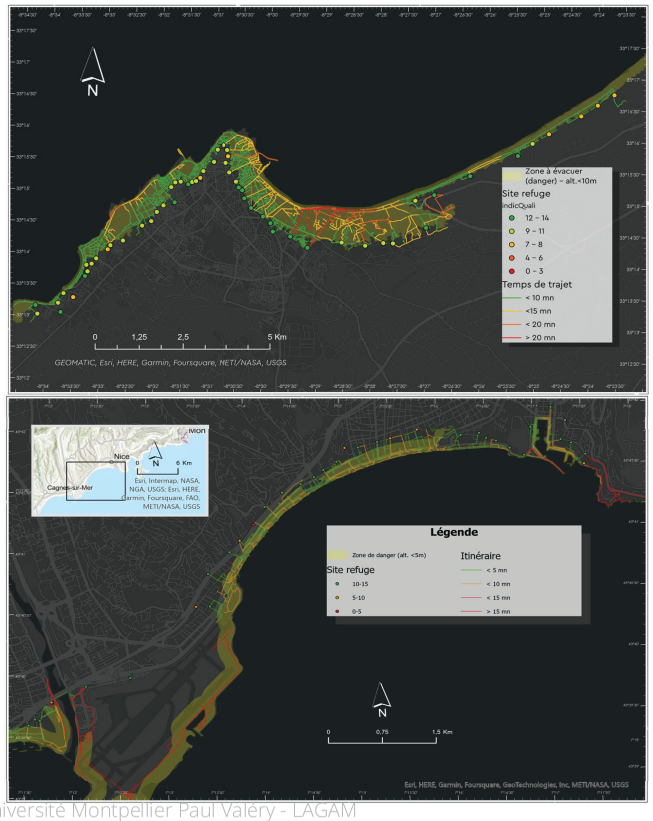
The most important step in this process is to validate assembly points with the local authorities.

- Present each refuge site
- Discuss the advantages and disadvantages of each assembly points
- Improve coverage where it's needed
- Allow to take into account future urban change
- Benefit from local knowledge



The most important step in this process is to validate assembly points with the local authorities.

Supports documents must be produced to give insight during the validation meetings.

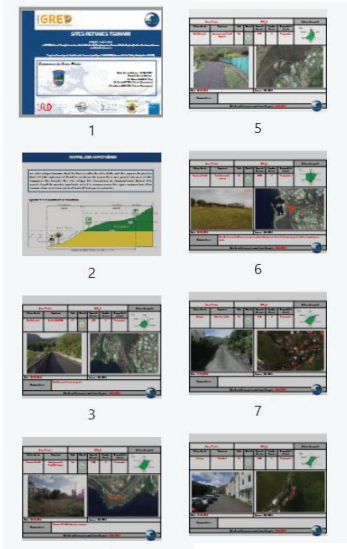


Case-Pilote		CSP_3					Critères de qualité
Nature du site	Nom local	Note	Qualité	Capacité d'accueil	Nombre d'accès	Disponibilité actuelle	
Bord de route	Ancienne route Fond Bourlet	14	R	222	2	Permanente	

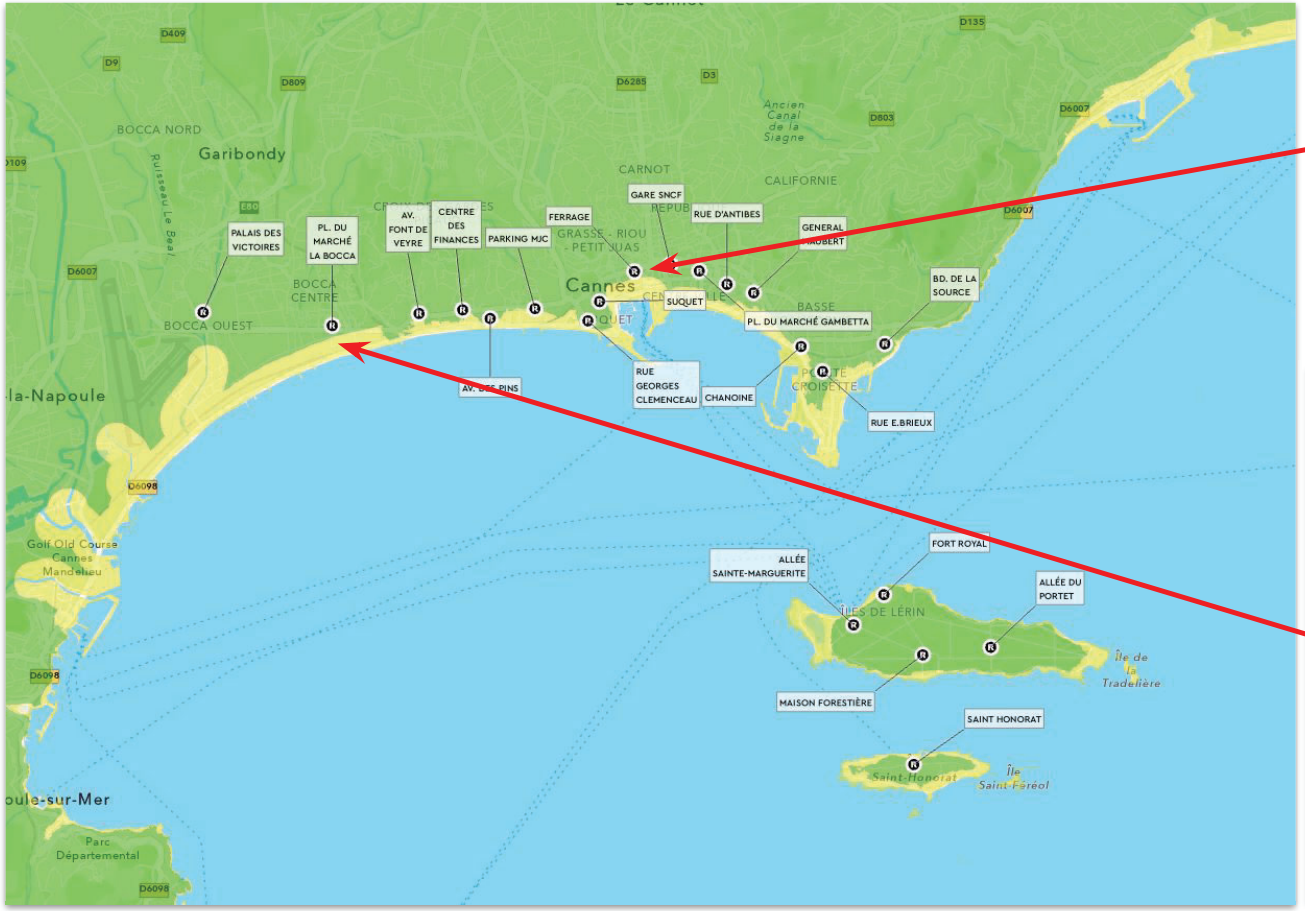
Date : 09/05/2016 | Source : IGN, 2013

Commentaires

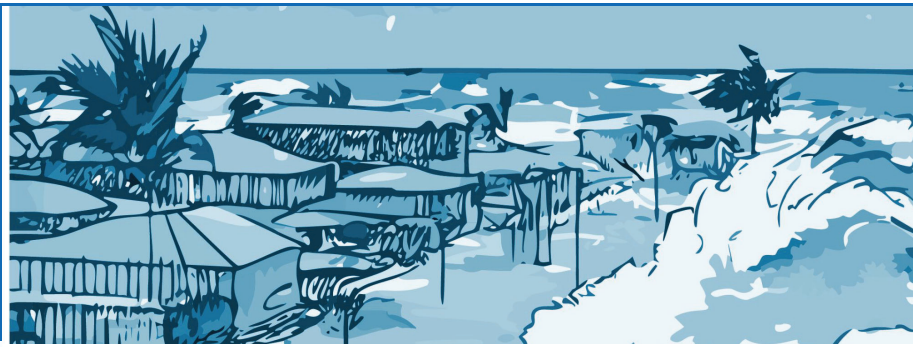
Date de validation par le comité local d'experts : 12/04/2017



21 official assembly points in Cannes



Tsunami Evacuation Mapping Workshop



CoastWAVE 2.0 Project

IOC-UNESCO (EU DG ECHO)

30 June – 4 July 2025

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Intergovernmental Oceanographic Commission

Funded by European Union Humanitarian Aid

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

CoastWAVE NEAMTWS

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