

Tsunami Evacuation Mapping Workshop

30 June – 4 July 2025



CoastWAVE 2.0 Project IOC-UNESCO (EU DG ECHO)

Dr. Matthieu Péroche
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Lesson #4 Graphical semiology and map layout



unesco
Intergovernmental
Oceanographic
Commission



Funded by
European Union
Humanitarian Aid



United Nations Decade
of Ocean Science
2021
2030
for Sustainable Development



LABORATOIRE
DE GEOGRAPHIE ET D'AMENAGEMENT
DE MONTPELLIER



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Lesson's overview

Produce a set of easy-to-understand maps covering the entire study area

1. Theory

- Information displayed on an evacuation map
- Symbolisation
- Map scale

2. Practice

- Arcgis pro's layout composer
- Single map layout
- Atlas / Map series layout

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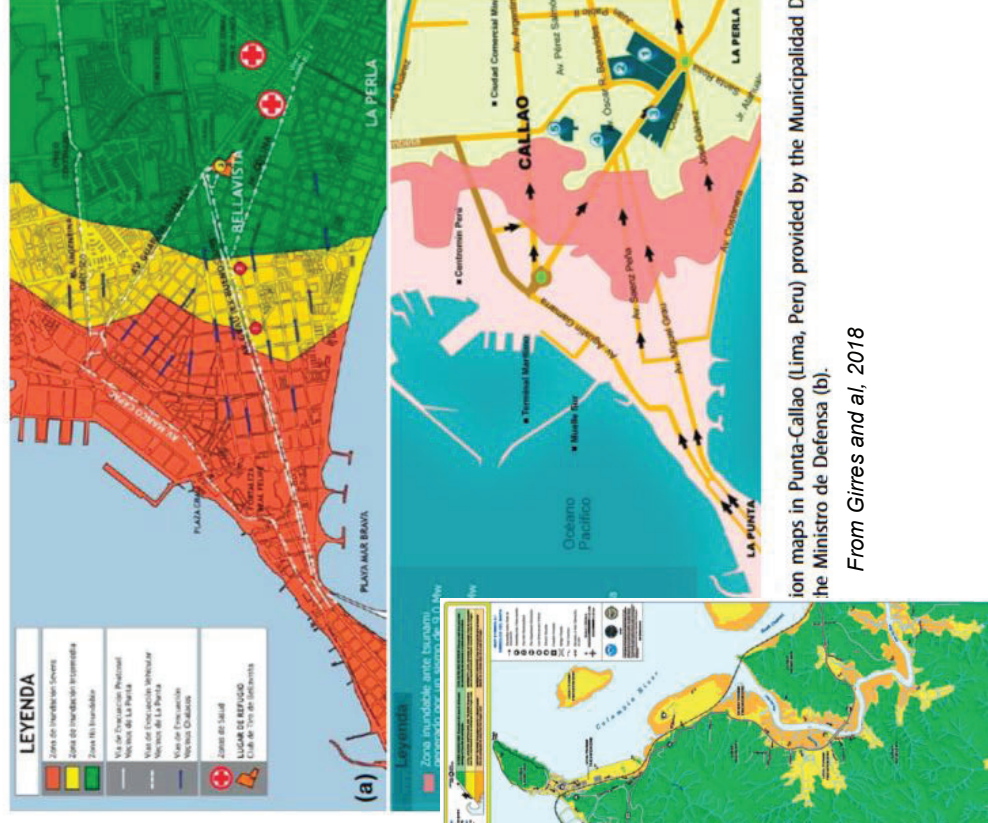


Diversity of designs in tsunami evacuation map



From Kurowski and al, 2011

Girres, J. F., Leone, F., Péroche, M., Gustave, G. & Gherardi, M. (2018). *Analysis of tsunami evacuation maps for a consensual symbolization rules proposal*. *International Journal of Cartography*



ion maps in Punta-Callao (Lima, Peru) provided by the Municipalidad Dis-
he Ministro de Defensa (b).

From Girres and al, 2018

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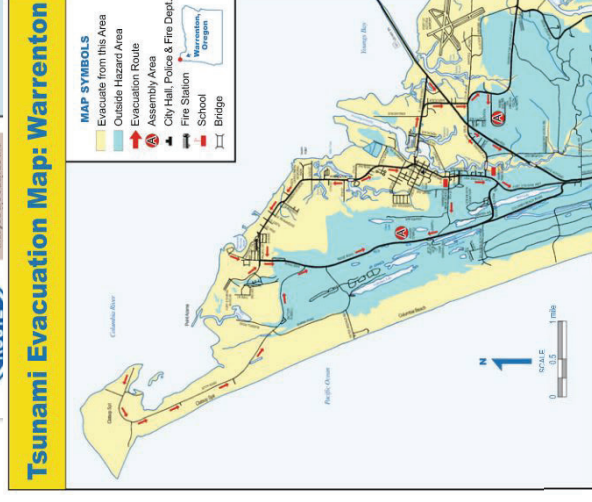
Information displayed on evacuation map

Most tsunami evacuation maps include :

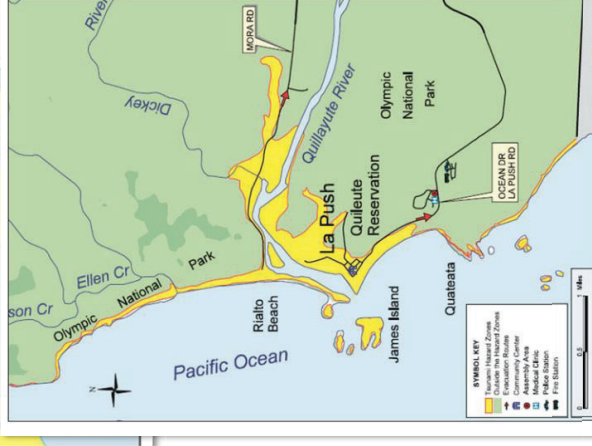
- **Hazard / evacuation zone**
- **Safe zone**
- **Assembly points (or areas)**
- **Evacuation guidance** (general direction or evacuation routes)

Within this frame, different choices can be made for :

- **Symbolisation**
- **Color scheme**
- **Scale**
- **Textual informations**
- **Basemap**



From Kurowski and al, 2011



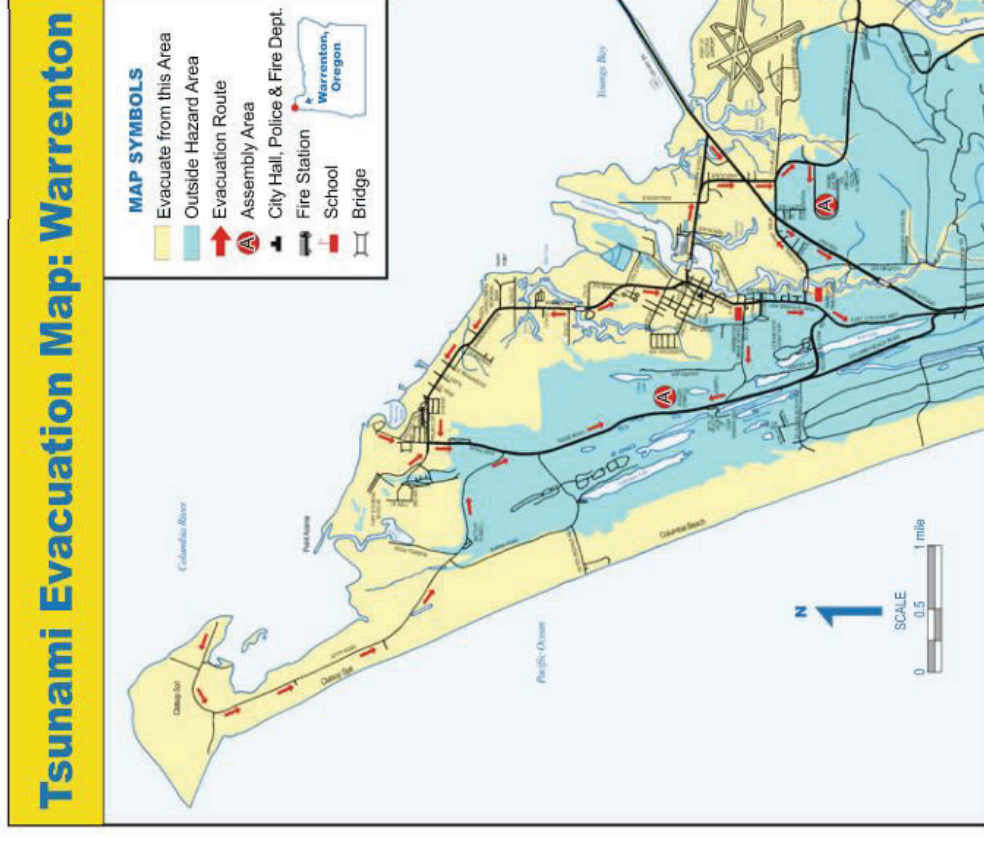
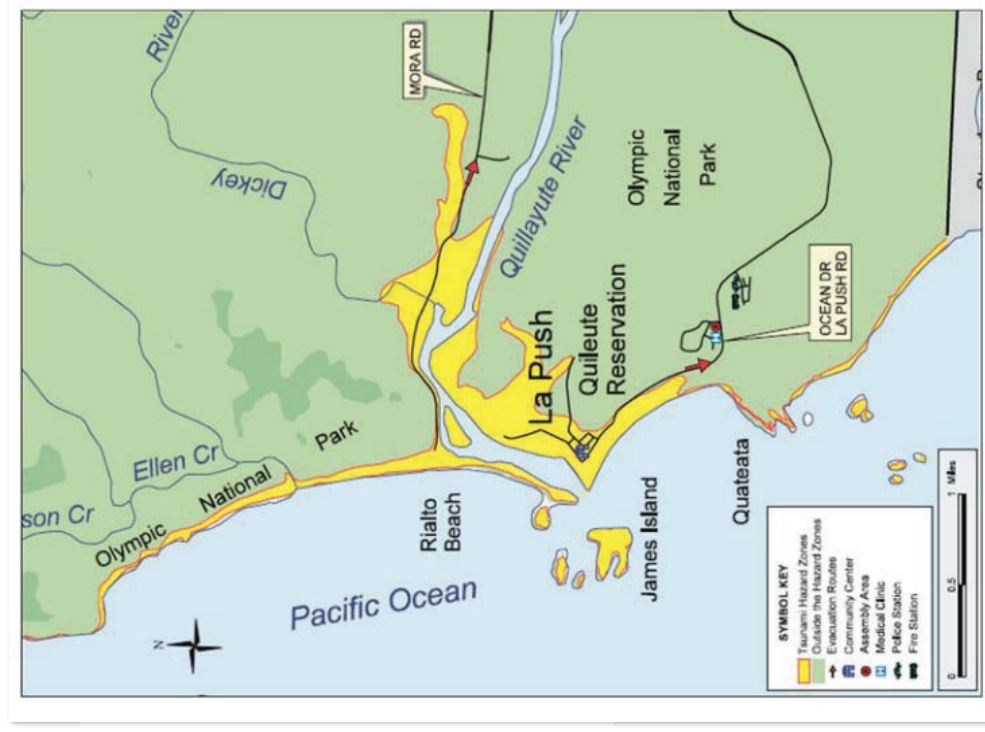
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Differences in :

- Scale
- Color scheme
- Assembly points/area symbol
- Infrastructure information
- Terrain information



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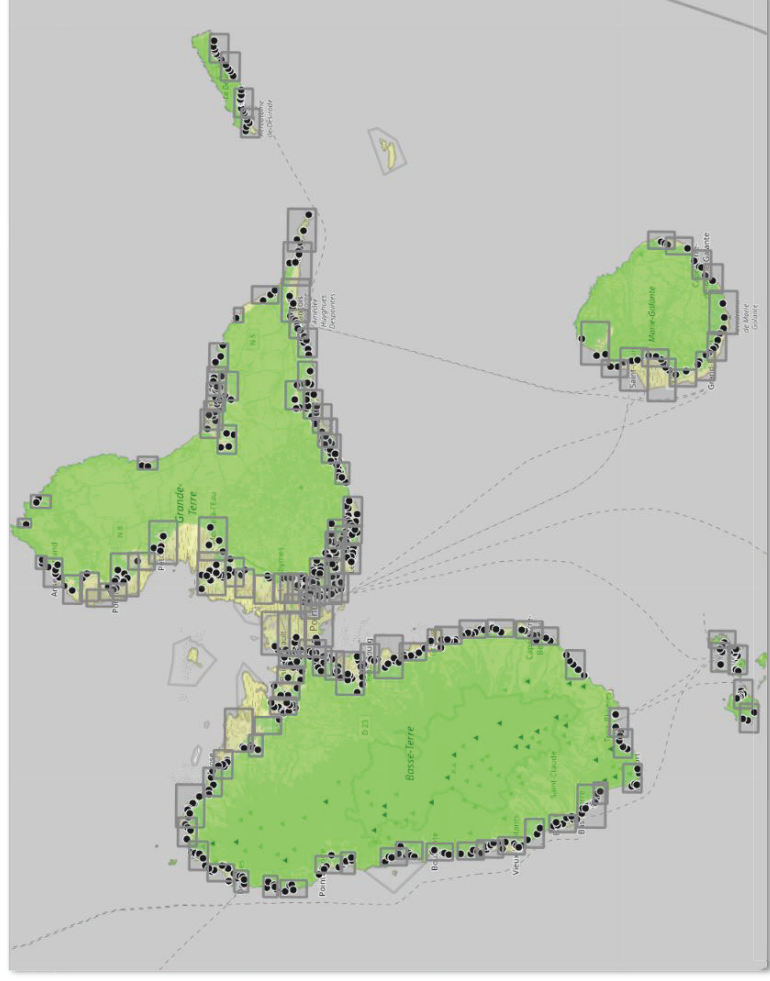
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Information displayed on evacuation map

From a scientific research project, the **EXPLOIT project** (2016-2018) in the French West Indies proposed a cartographic chart for evacuation plans which, a decade later, has become a standard in France.

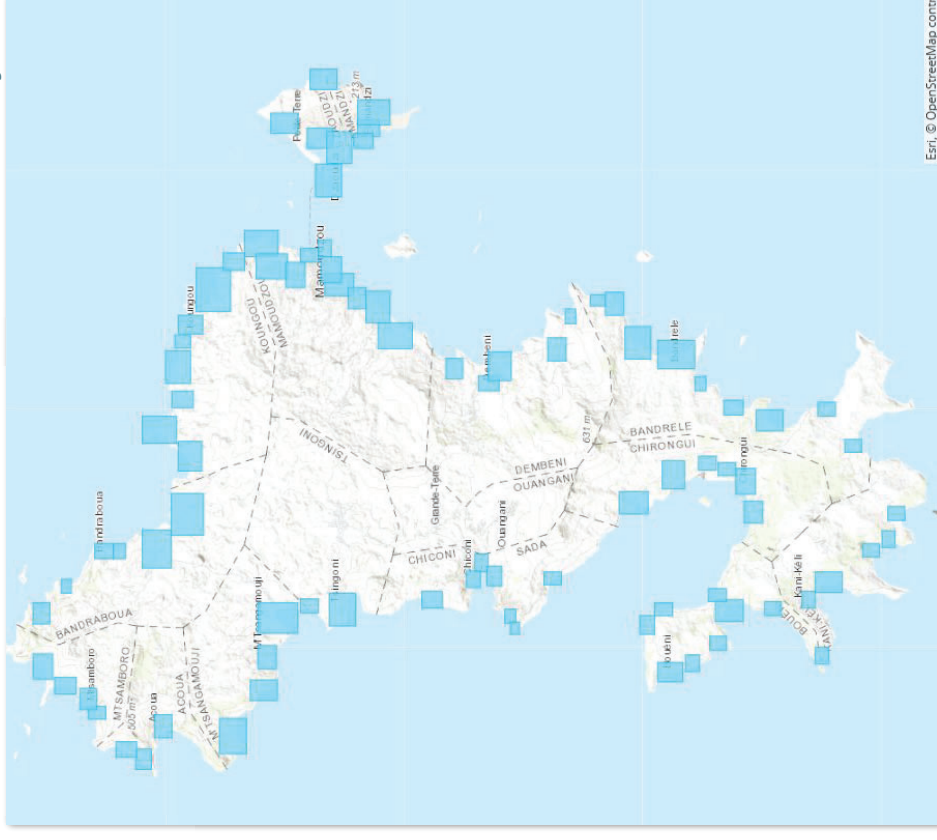


EXPLOIT

Université Montpellier Paul Valéry - LAGAM

Dr. Matthieu Péroche (matthieu.peroche@univ-montp3.fr) - Louis Monnier

EVACTSU Mayotte



Esri, © OpenStreetMap contributors

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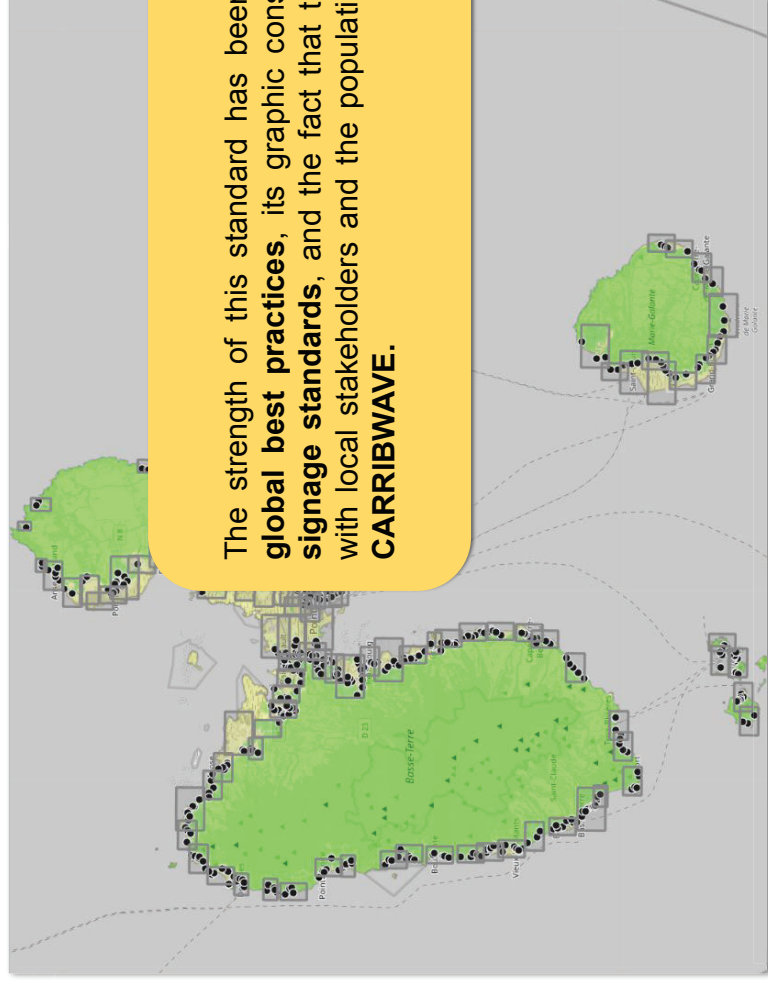
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Information displayed on evacuation map

From a scientific research project, the **EXPLOIT project** (2016-2018) in the French West Indies proposed a cartographic chart for evacuation plans which, a decade later, has become a standard in France.



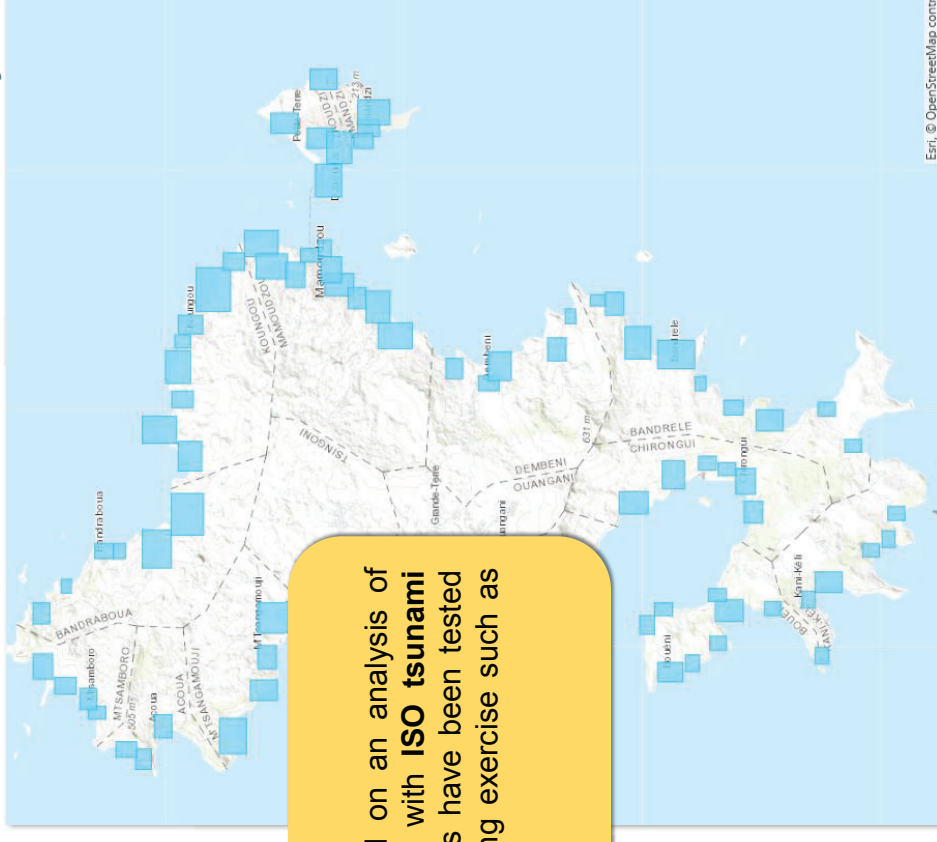
The strength of this standard has been based on an analysis of **global best practices**, its graphic consistency with **ISO tsunami signage standards**, and the fact that the plans have been tested with local stakeholders and the population during exercise such as **CARRIBWAVE**.

EXPLOIT

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Information displayed on evacuation map

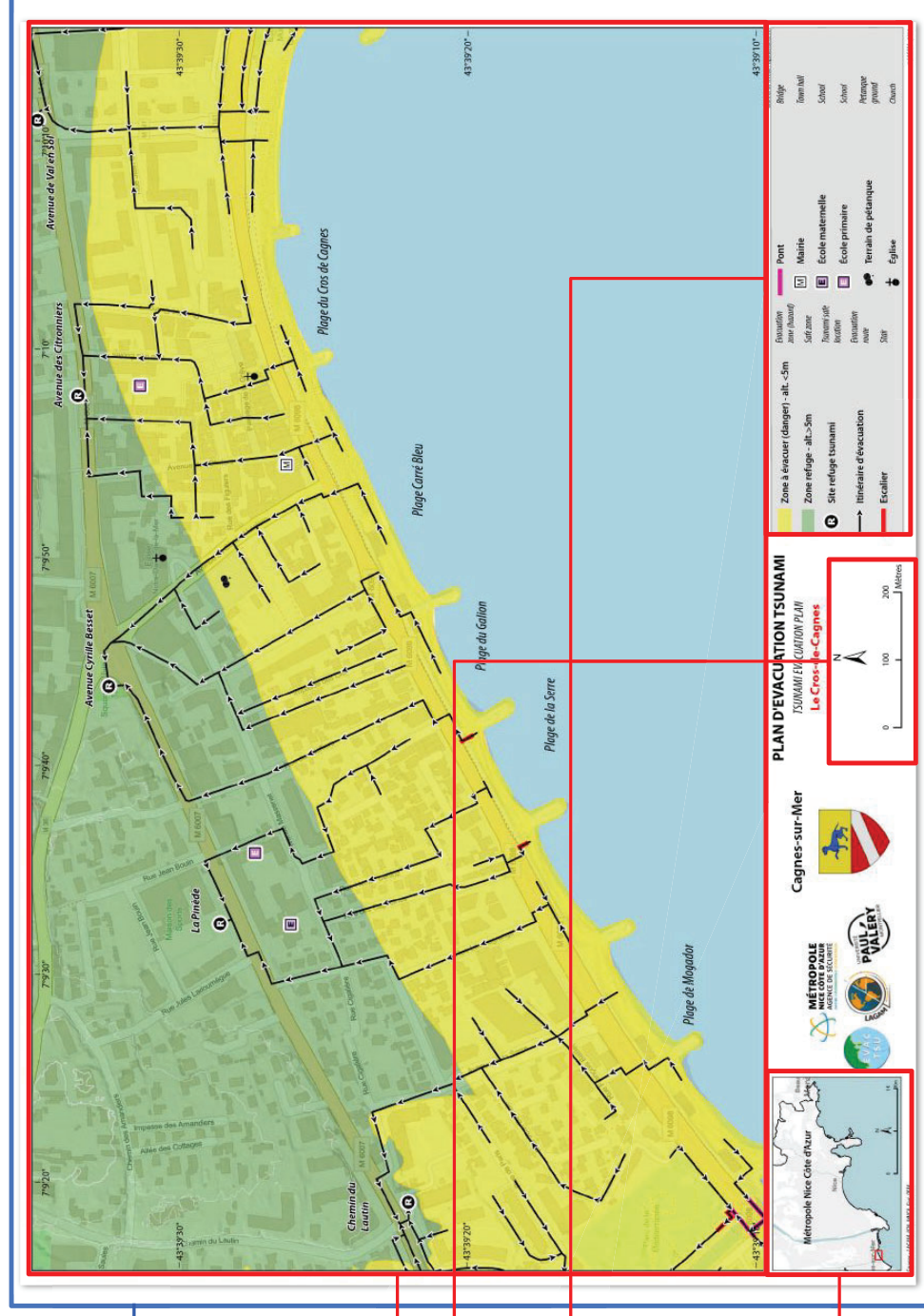
Layout

Map Canvas

Scale bar & north arrow

Legend

Overview map



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Information displayed on evacuation map

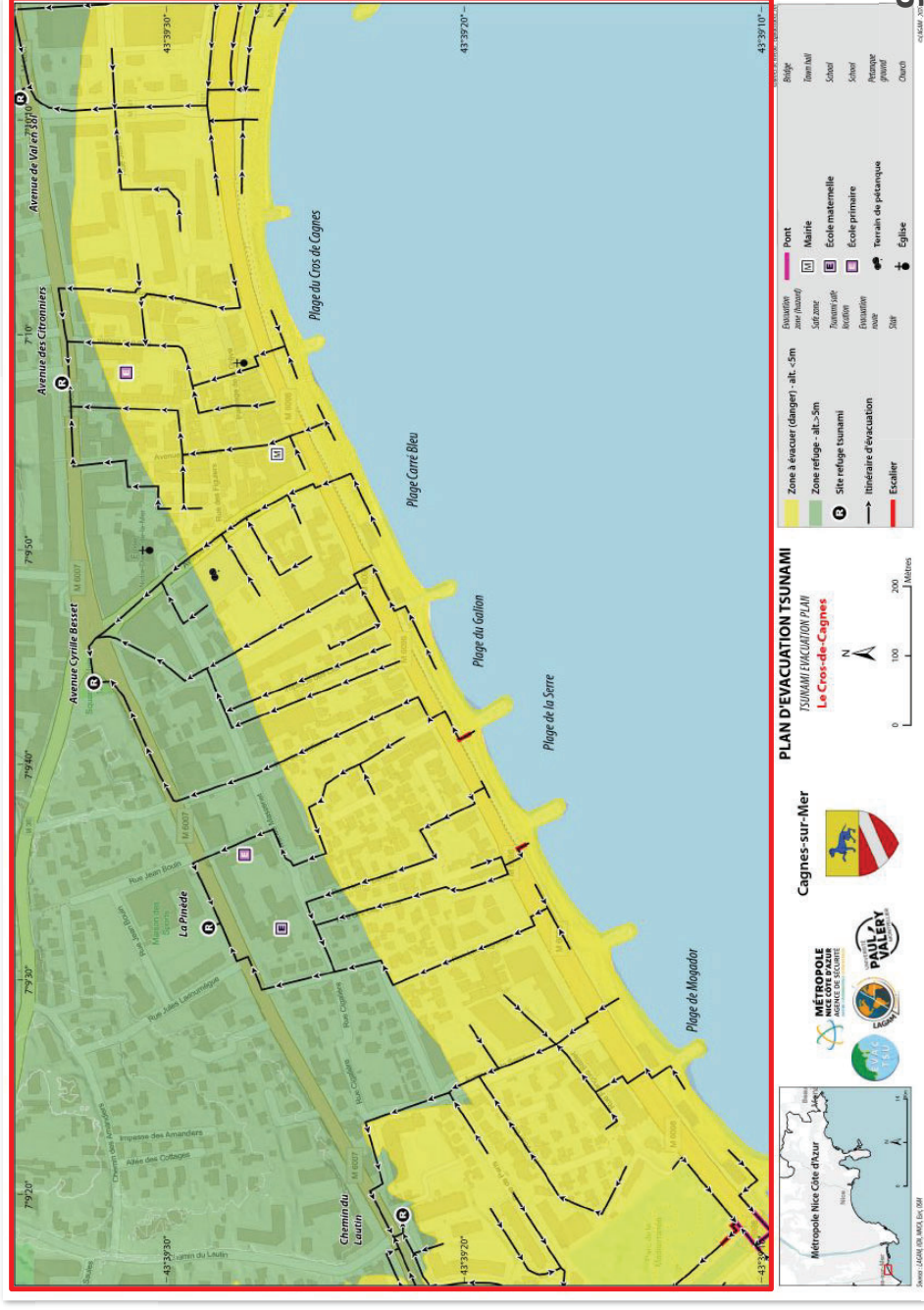
Map produced by the LAGAM
(*Montpellier's geography and urban
planning laboratory*) include :

Graphical informations

- Safe zone
- Evacuation zone
- Evacuation routes
- Assembly points
- POI

Textual informations

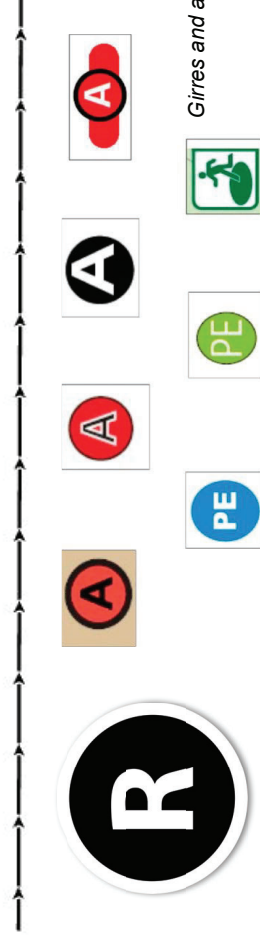
- Assembly points names
- Toponymy



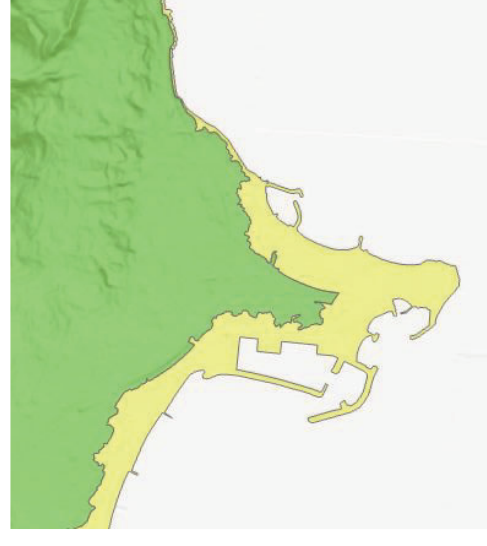
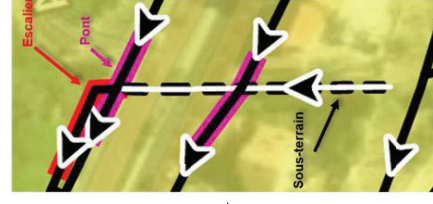
Symbolisation

Graphic choices for symbols must allow for a **clear and quick understanding** of the map information.

- **Simplicity** and **explicitness** are key in symbols choices, especially for the evacuation related information displayed on a map.
- For symbols with multiples colors, they should be chosen with a **high contrast level**.
- High-contrast color choices must take into account the superimposition of other (surface) symbols.
- Transparency use is limited to evacuation zone and safe zone in order to display the **basemap with elevation shading**.



Girres and al, 2016



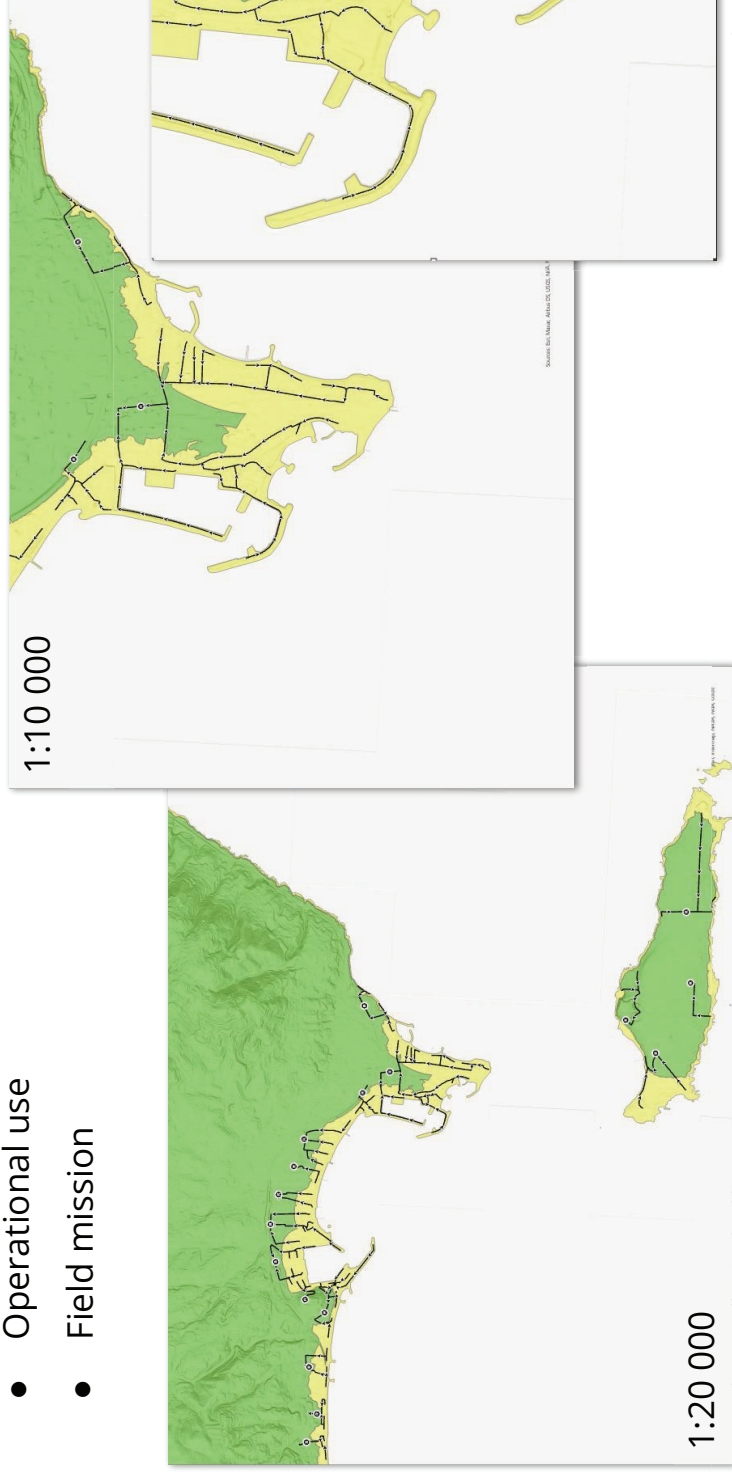
For Nice's metropol, multiple variations of the symbol evacuation route were proposed to represent **underground sections, bridges and staircases;**



Map scale

Scale must be chosen accordingly to match data's accuracy and the purpose of the map :

- Information / sensibilisation map
- Decision making support
- Operational use
- Field mission



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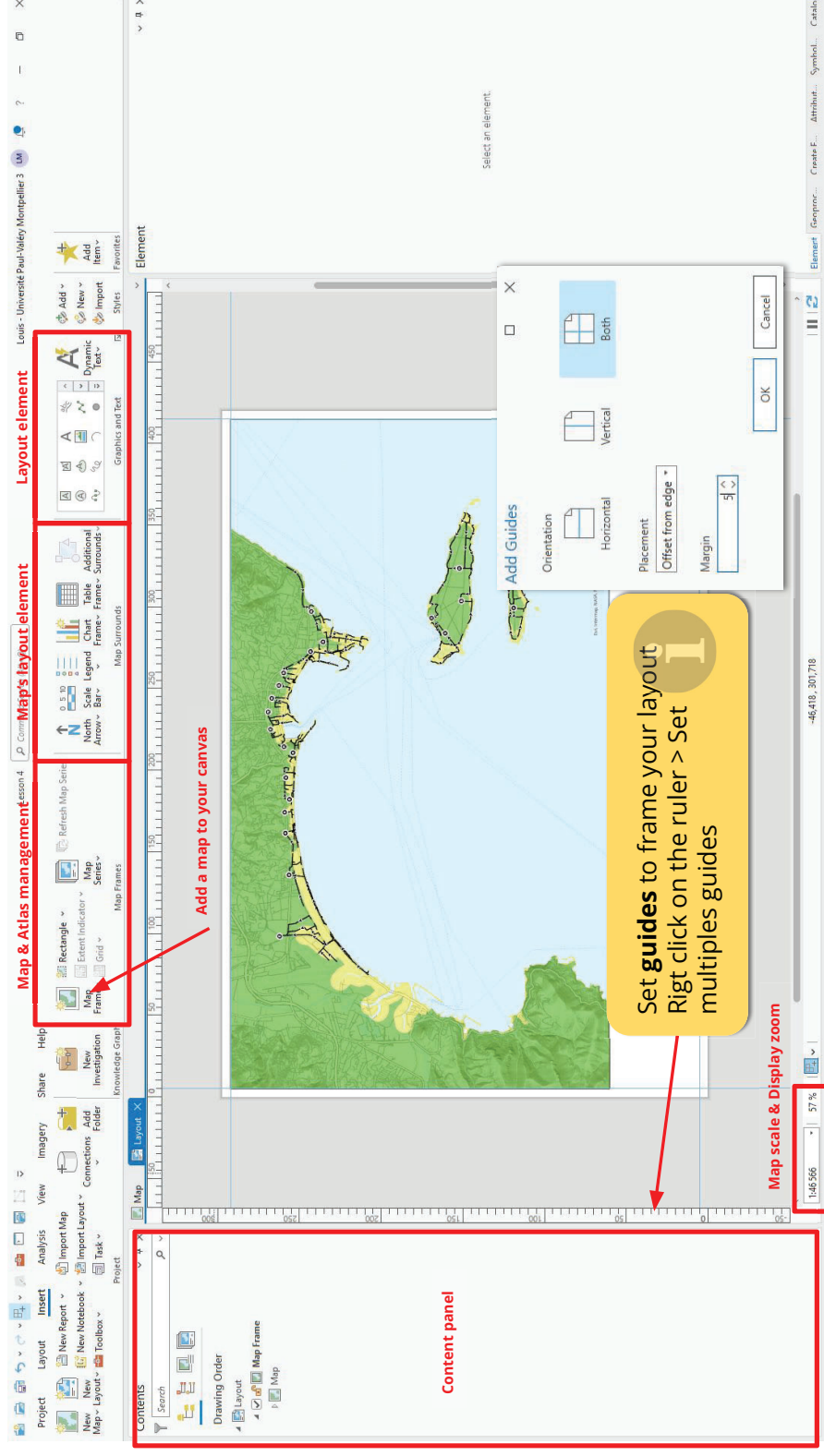
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Arcgis pro's layout composer

Go to **Top Ribbon > Insert > New Layout** and select a page size (A3 landscape)

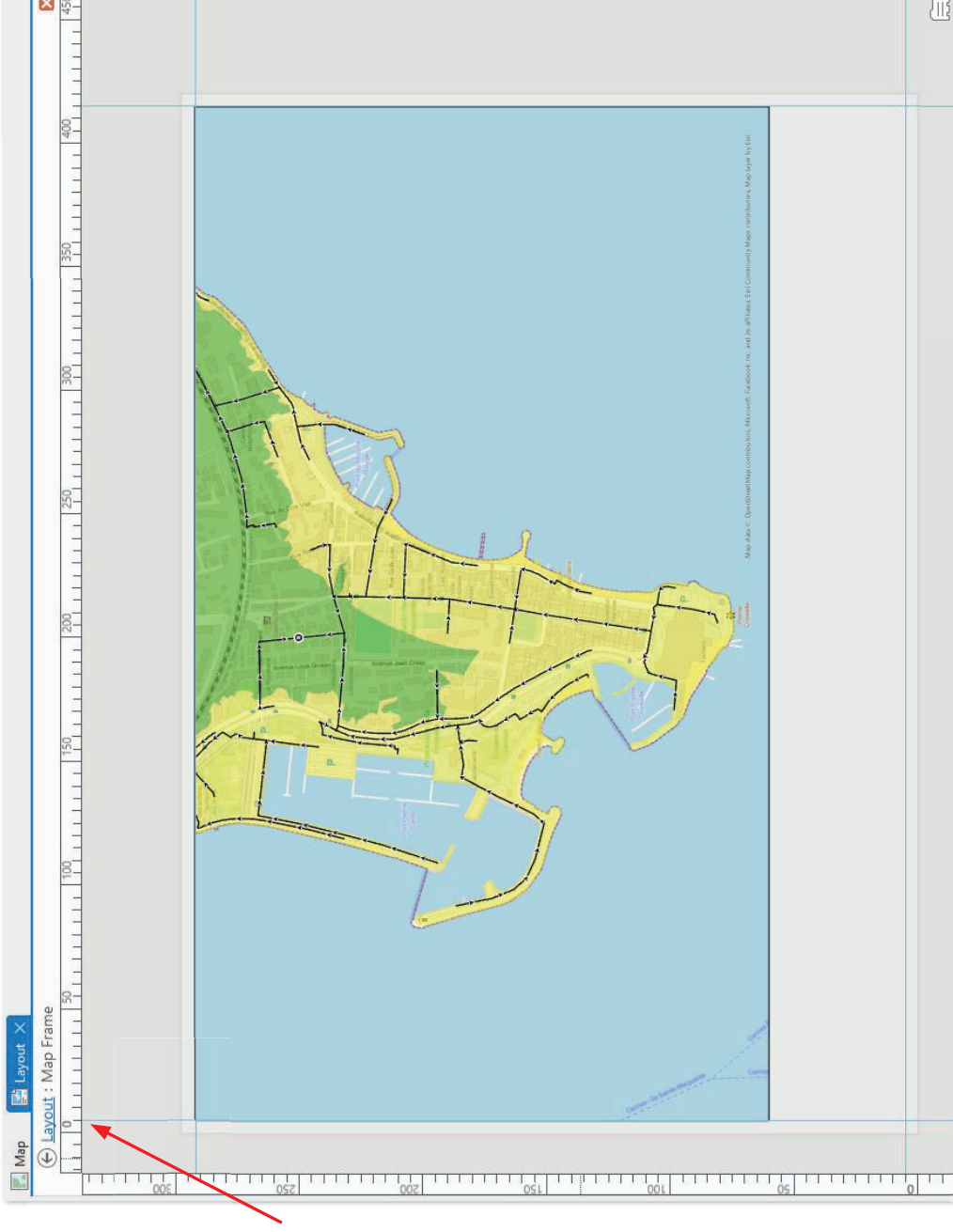


Arcgis pro's layout composer

Set your map canvas extent :

1. Right click on your map > **Activate (Q)**
2. **Pan** and **set the scale** with mouse wheel or with the bottom ribbon.
3. Click on **Layout** to return to layout edition

Make sure that all the the evacuation routes pointing to an assembly point are visible in the map extent.



Lesson #4

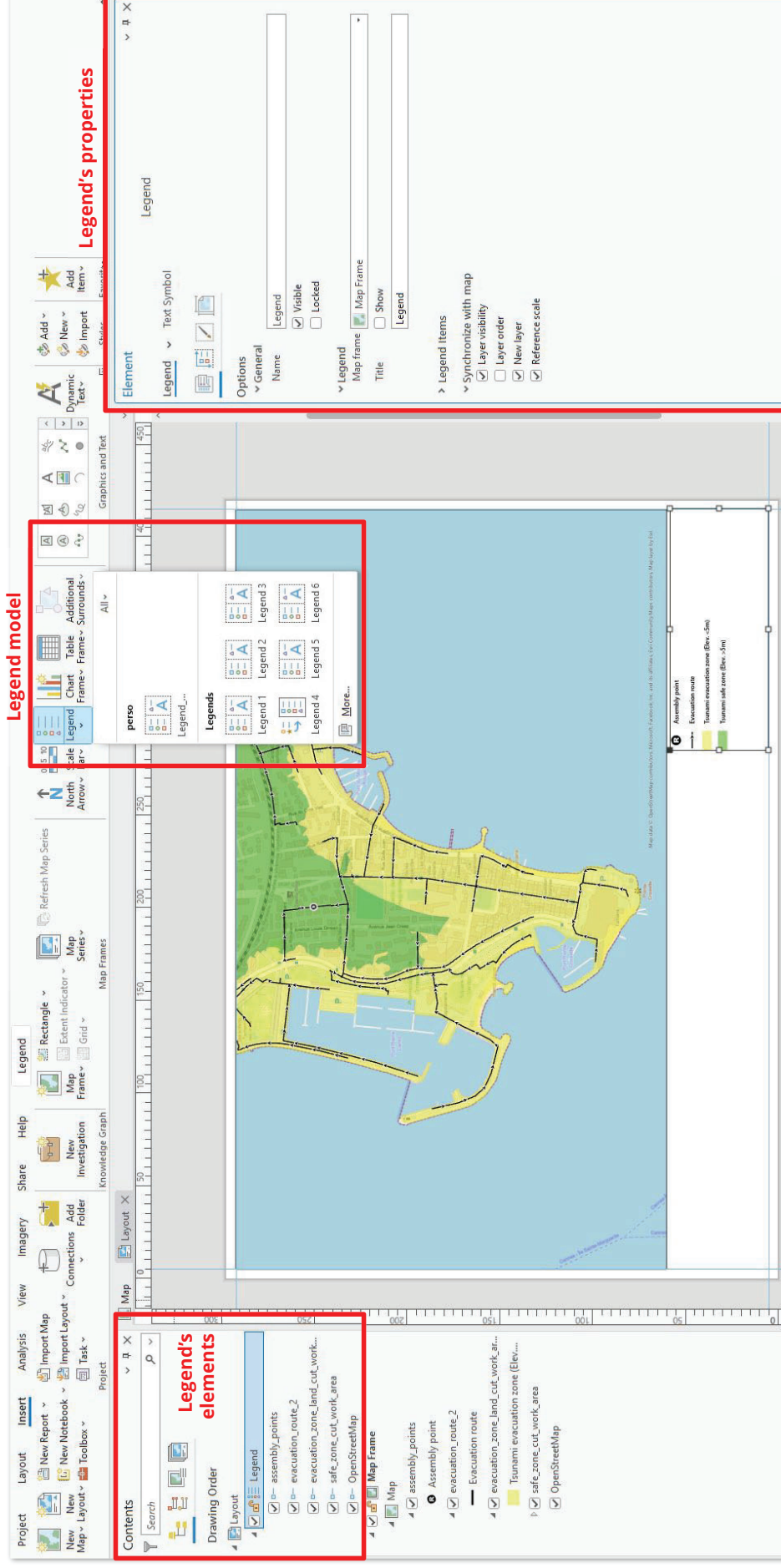
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Single map layout

- Add the map's legend



Single map layout

You can customize legend's behavior and legend's appearance either at a global level or at element's level.

Access the **legend's properties panel** directly in the layout or in the Contents panel through 4 menus :

Right click > Properties

General text symbol (font type, size, color, decoration)

-  Map connection
-  Title
-  Layers orders synchronisation with the map
-  Automatic column and font size adjustment
-  Word wrapping
-  Spacing between legend elements
-  Border
-  Background
-  Shadow
-  Position



Single map layout

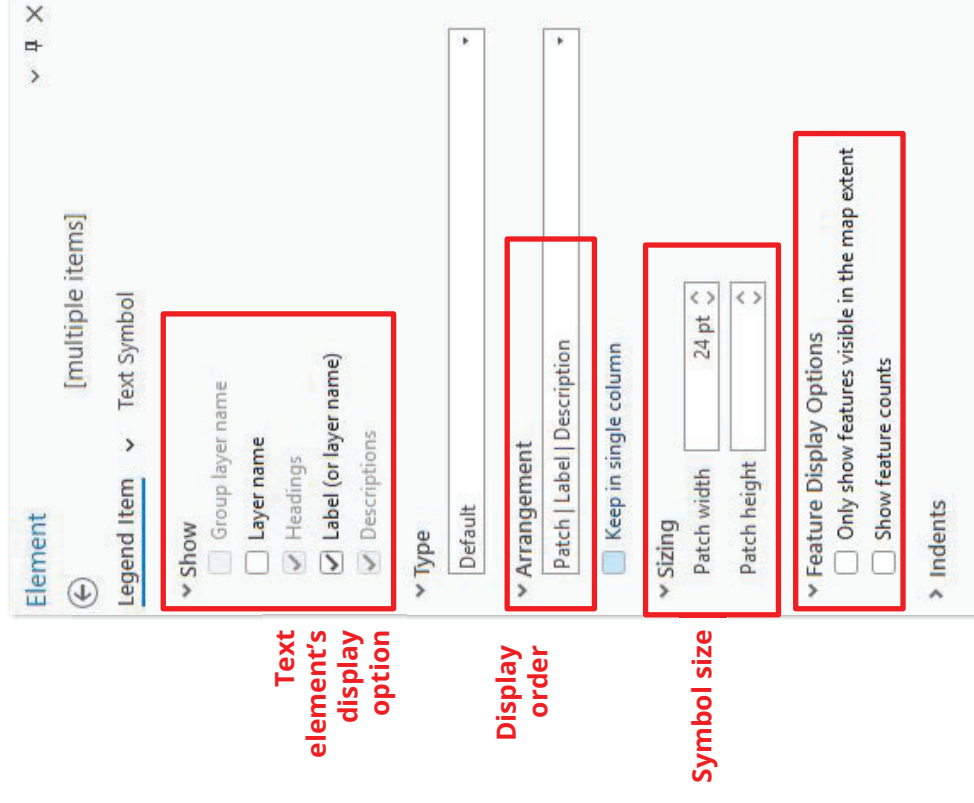
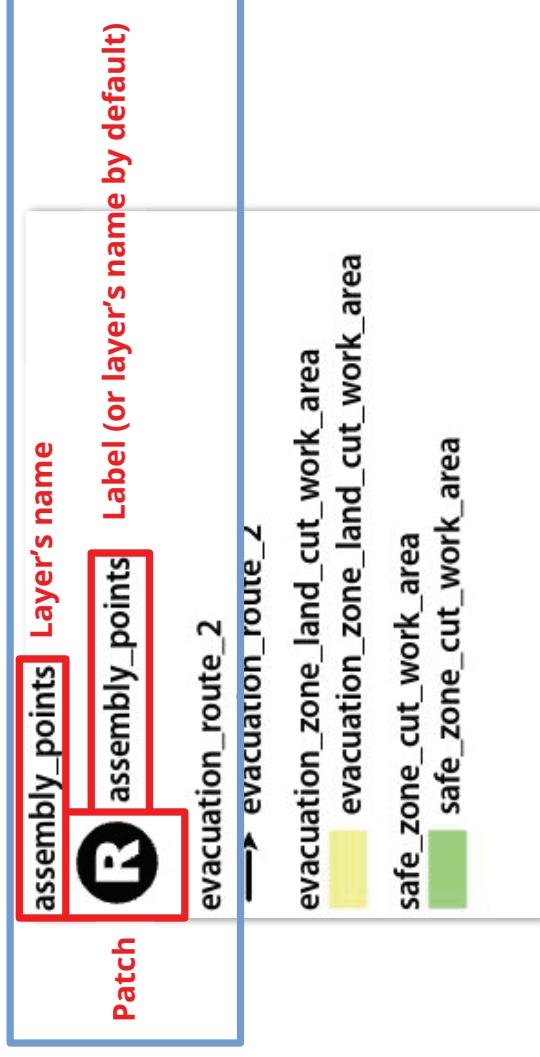
Appearance can be changed for a specific elements, or multiple elements at once :

Option 1 :

Select either one, multiple or all legend's element in content pane > **Right click** > **Properties**

Option 2 (for all legend elements)

In the **legend's properties panel** > **Legend items** > **Show properties** **Item**



**Text
element's
display
option**

**Display
order**

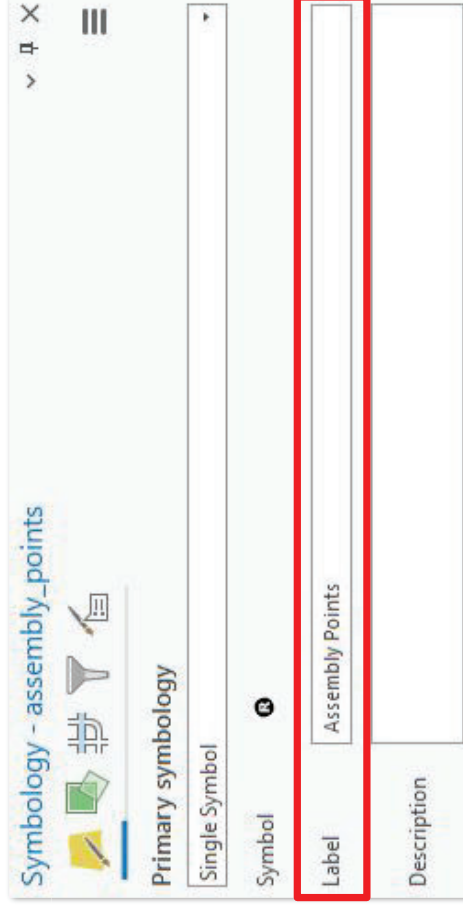
Symbol size

Single map layout

Element **labels** can be set in the **symbolology menu** of the corresponding layer.

- If no label is set, the layer's name is displayed by default.
- **Description** can also be shown in the legend.

Contents panel > Map Frame > Right click on the layer > Symbolology



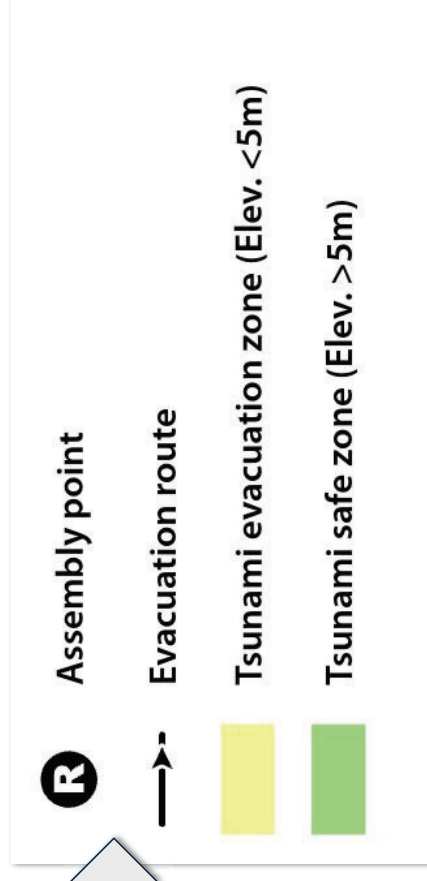
Change the appearance of your legend in order to match this layout :

1. Set the label for each layer
2. Set a bigger patch size for every legend's elements
3. Set the legend's spacing



You can save your legend's style or any element's style to use it in another project or to use it by default :

Contents panel > Right click on Legend > Save to style



Single map layout

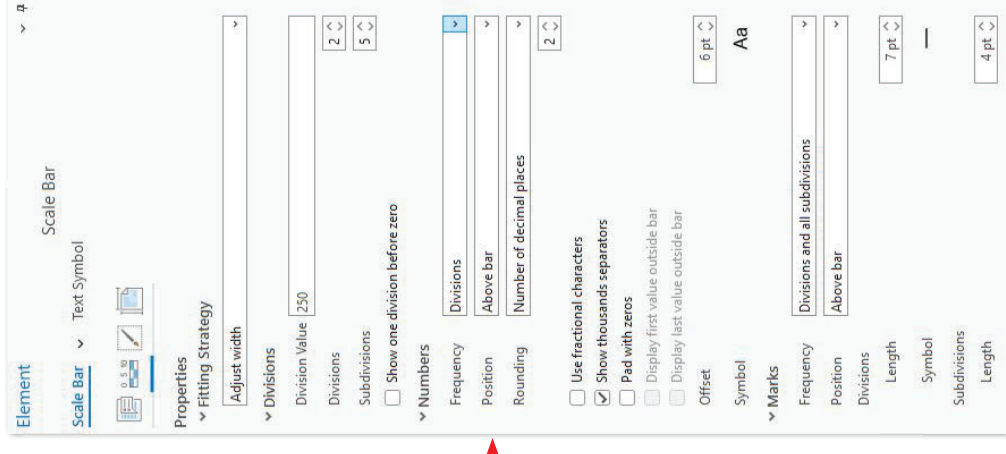
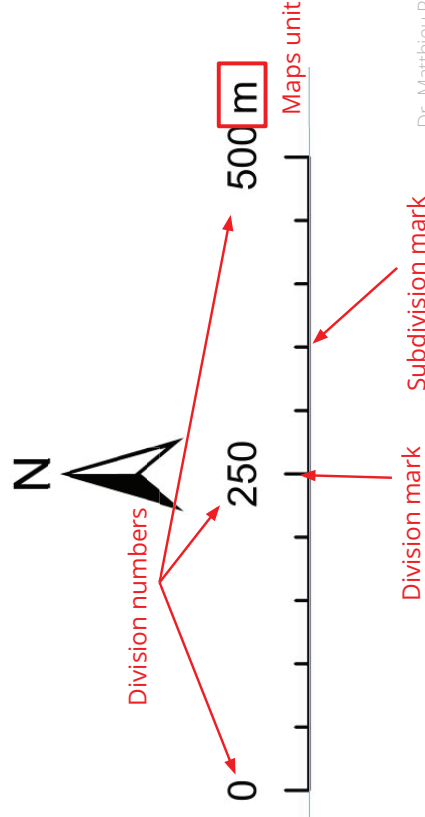
Like the legend, the north arrow and scale bar are **connected to a map frame**. They adapt dynamically to changes in the map's scale or orientation, and **fitting strategies** can therefore be used to determine how these elements respond to changes.

 **Numerical scale** can be added via **Top Ribbon > Dynamic text**

Add the north arrow and scale bar to the layout to match the layout below. Align these two elements with each other and the page.

1. In the **Scale Bar Properties** panel, set the map unit in meter and change the label position
2. Set the **division value** to 250
3. Change **marks frequency** and reduce the **subdivision's mark height**

Try out the different fitting strategies available and adjust the map scale to see how the scale bar reacts.

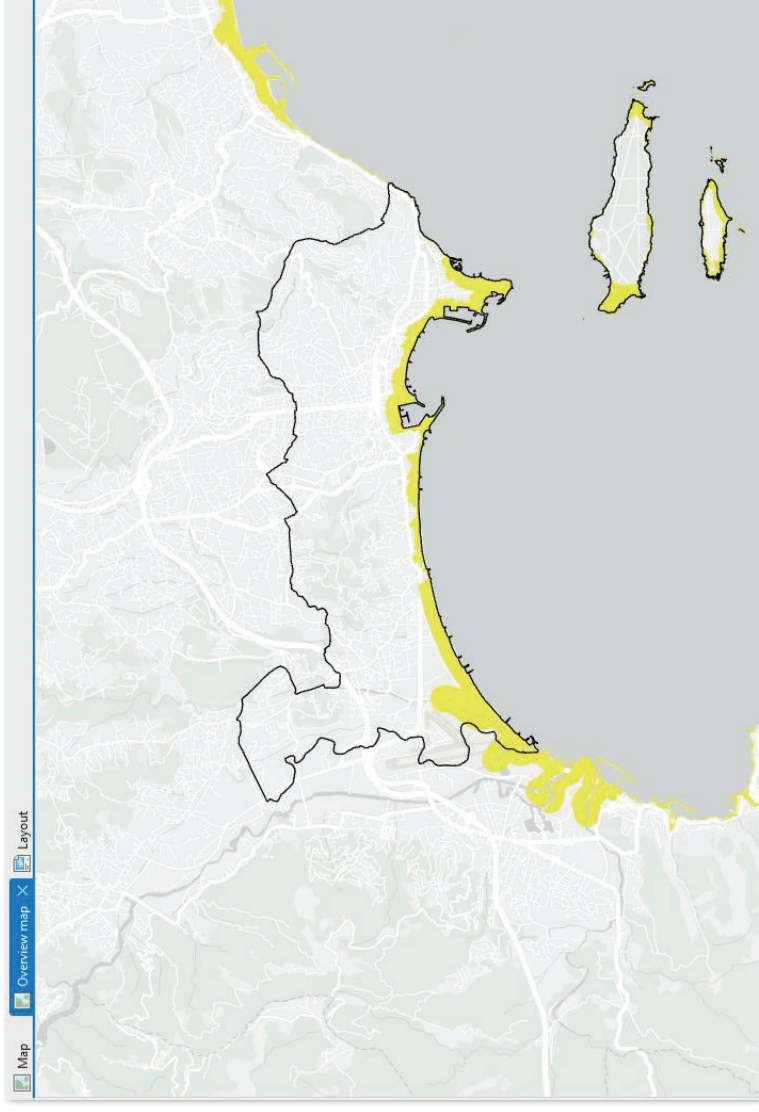


Single map layout

Overview map are used to display **main map's context**. The main map's extent is often shown with a shape marker.

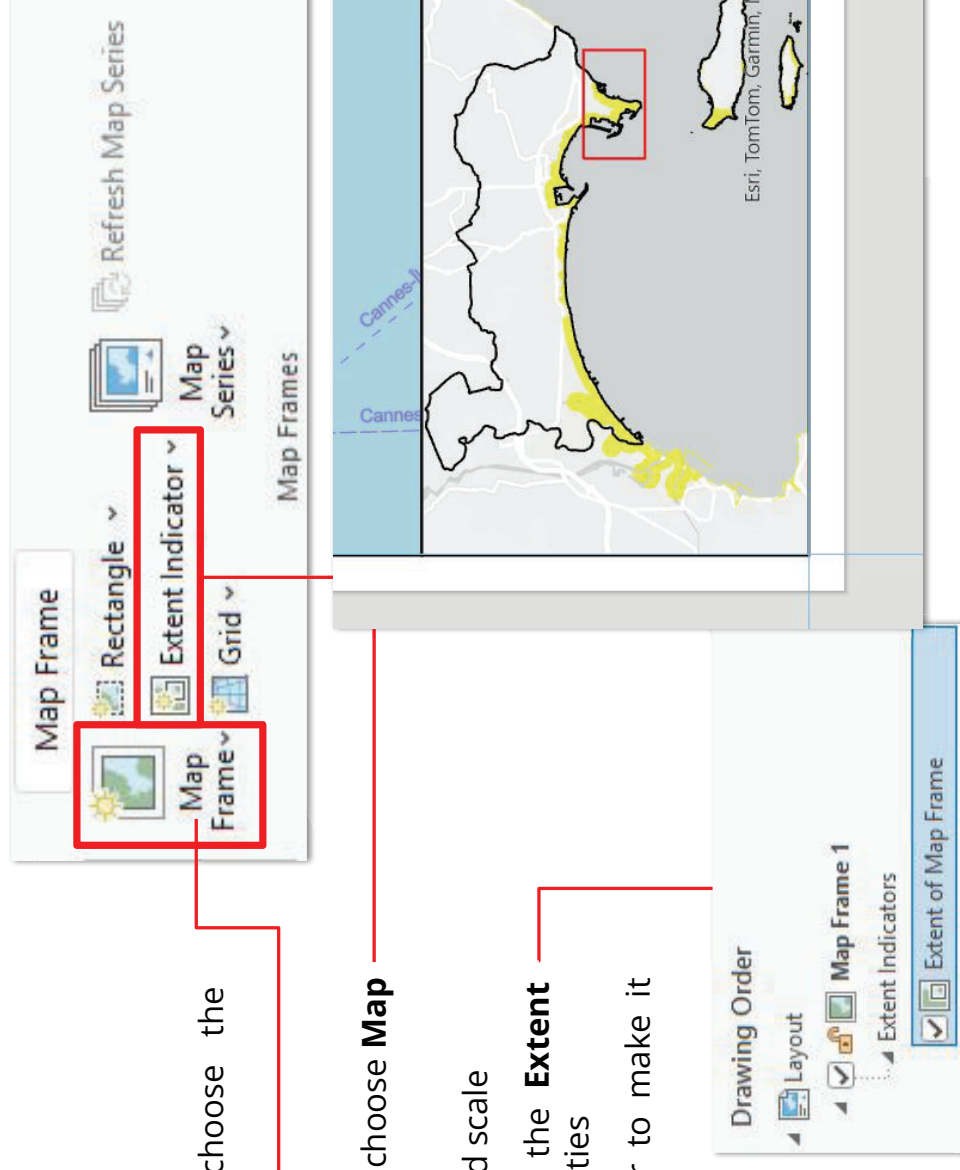
Since the overview map's frame is smaller, we need to create a map with less layers in order to ensure readability

1. **Top ribbon > New Map**
2. Rename it in *Overview map* in the **Contents** panel
3. Choose a minimalist basemap :
Top ribbon > Map > Basemap
4. **Add** Cannes administrative boundaries and the evacuation zone layers



Single map layout

1. Go back to the **Layout** tab
2. Click on **Map Frame** and choose the overview map
3. Add it to your layout
4. In the **Extent indicator** option, choose **Map Frame**
5. Set the overview map extent and scale
6. In the **Contents** panel, select the **Extent Indicators** > right click > Properties
7. Customize the extent indicator to make it stand out



Lesson #4

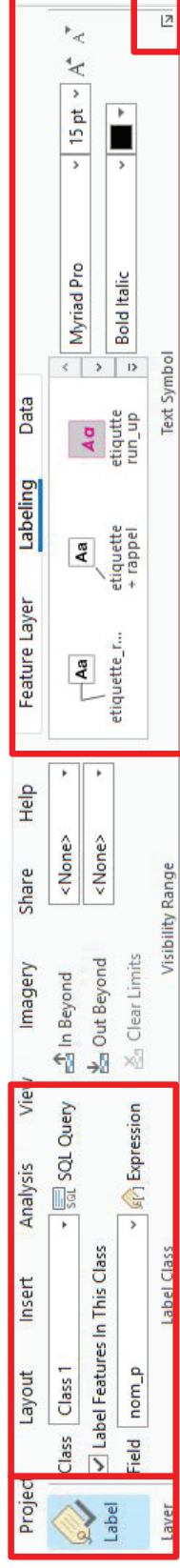
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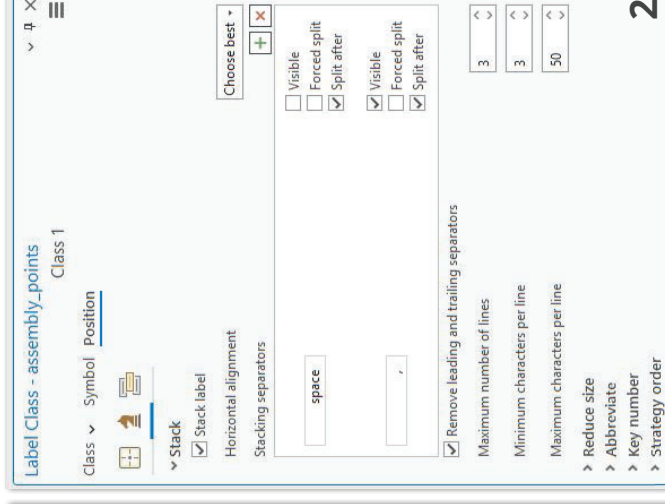
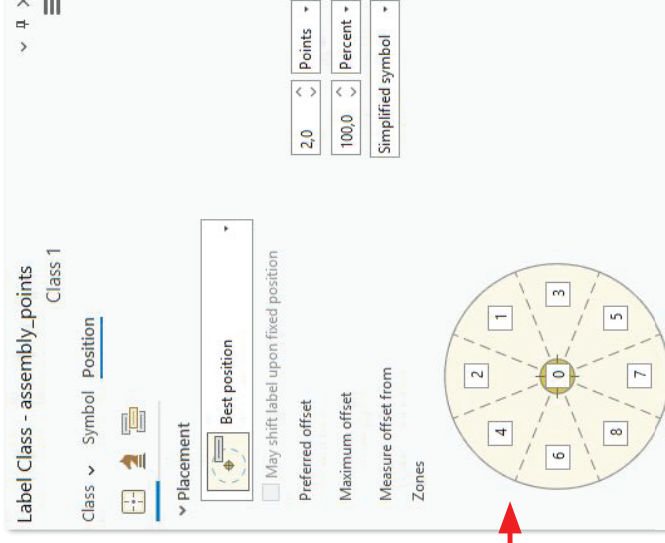


Single map layout

Labels are text elements used to display an attribute's value for each layer's feature. Assembly point name must be **labelled** on the evacuation map.



- In the **Contents** panel, select the Assembly point layer.
- **Top ribbon > Labelling**
- In the **Label Class** menu> **Field**, select the assembly point name's field (**nom_p**)
- Activate labelling with **Label** in the **Layer** menu
- Customize label's appearance and position by expanding the **Text Symbol** menu
- Advanced position parameters are available to set preferred placement, display order and label's fitting strategies (world wrap, abbreviation field, number of lines)



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Single map layout

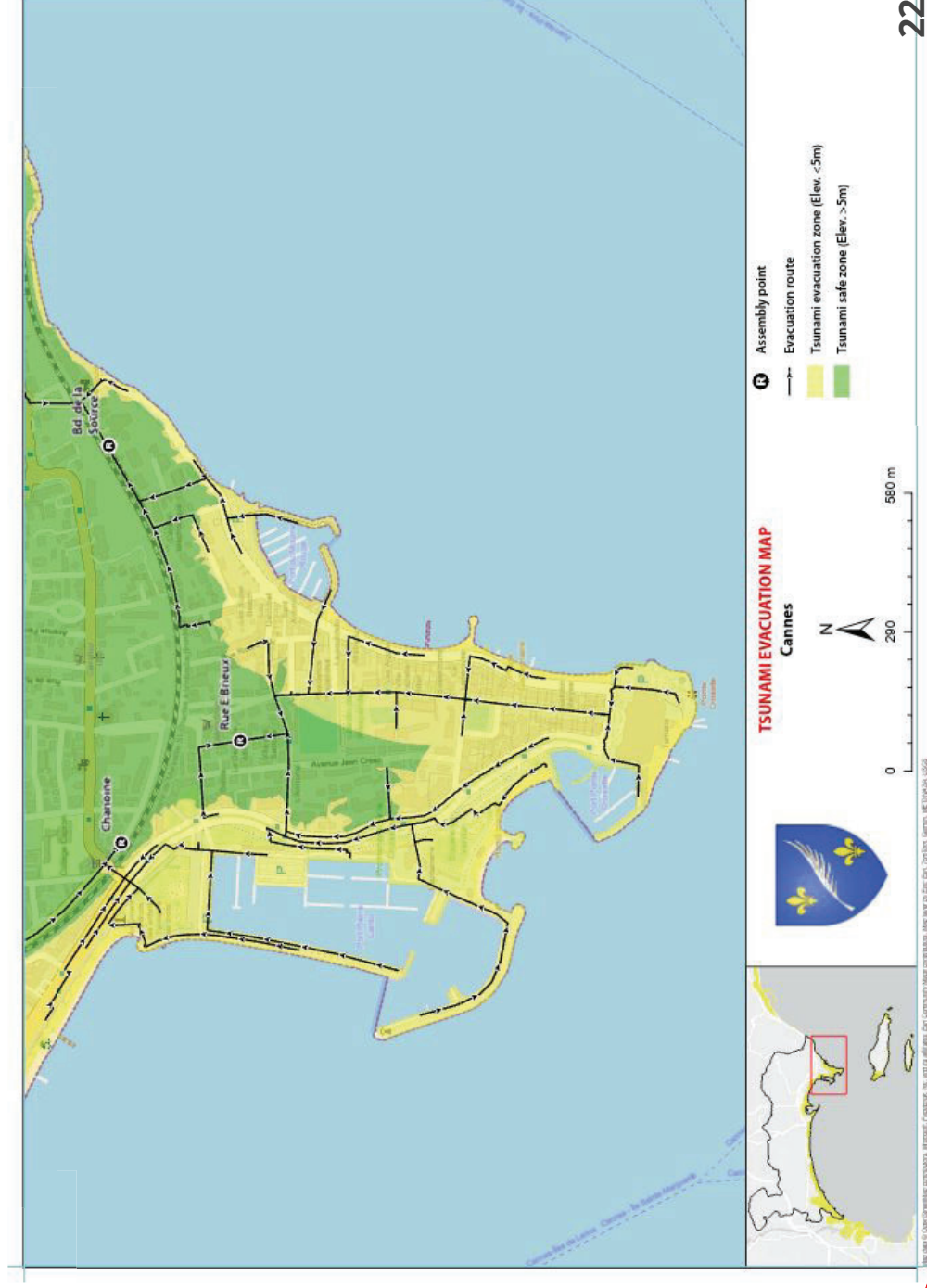
At this point, almost all the elements synchronized with our main map are set up.



Add a title to our map and logo (1_Original_data folder) in the layout's bottom ribbon

Using ESRI's basemap automatically add credits in our map frame.

Add a **Dynamic text** > **Service Layer Credits** in order to control their position and style



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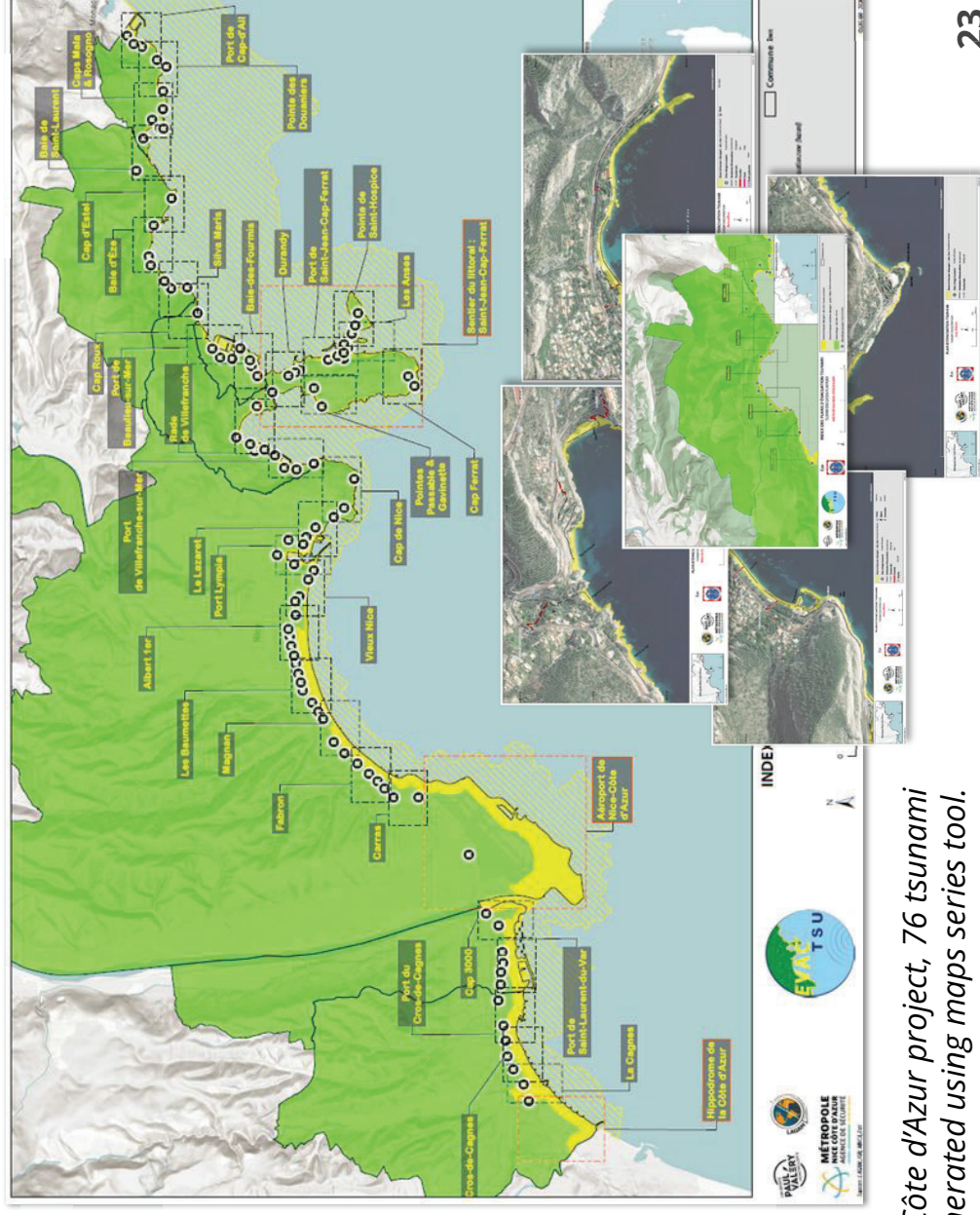
Atlas / Map series layout

Atlas (QGIS) or Map series (ArcGIS) are **automatically generated series of pages from a single layout**, with each page showing a different extent.

Dynamic elements such as data table, chart or dynamic text can be added to the layout and will be updated for each pages.

The map series extents can be set :

- **From layer's features geometry (spatial)**
- From bookmarks (spatial)
- From a set of layers (thematic)



As part of the EVACTSU - Nice Côte d'Azur project, 76 tsunami evacuation maps were generated using maps series tool.

Atlas / Map series layout

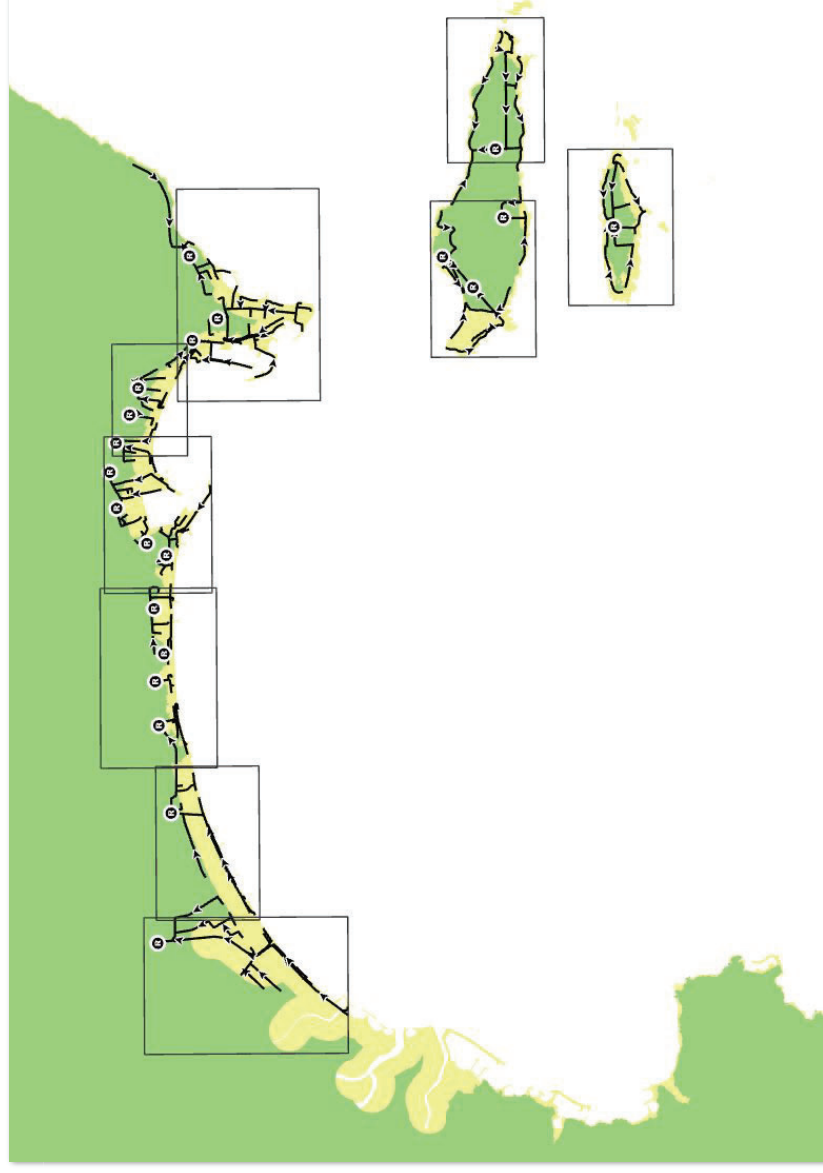
Map series extents will be set up from an **index layer** : **map_series_extent** (1_Original_data) :

Using a **index layer** to set the extents allows to use fields to :

- Set a name for each extent, which can be accessed via dynamic text.
- Control the order in which the page will be generated
- Group the pages based on field's value
- Set *custom scale for each extent*

This layer can be built manually or automatically generated with build-in tools when working on larger area :

- **Grid Index Features** (Creates a grid to cover an extent)
- **Strip Map Index Features** (Creates polygons along a linear features e.g : coastline)



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Graphical semiology and map layout



Atlas / Map series layout

Index layer's fields

Each entity must be named after a known location

- Neighborhood
- Landmark (airport, plaza)
- Natural feature (cap, island)

A numerical field can be added to set the map scale for each extent.

When working with multiple municipalities, a dedicated field should be added to group the map series pages on municipalities name.

maps_series_extent				Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy			
FID	Shape *	Id	Nom	NomIndex			
1	Polygon	0	de la Gare de marchandises	Gare de marchandises			
2	Polygon	0	de l'Aéroport de Cannes Mandelieu	Aéroport de Cannes Mandelieu			
3	Polygon	0	du Vieux port	Vieux port			
4	Polygon	0	de la Croisette	La Croisette			
5	Polygon	0	de la Pointe de la Croisette	La Pointe de la Croisette			
6	Polygon	0	de l'île Saint-Honorat	L'île Saint-Honorat			
7	Polygon	0	de l'île Sainte-Marguerite - Partie Ouest	L'île Sainte-Marguerite - Partie Ou...			
8	Polygon	0	de l'île Sainte-Marguerite - Partie Est	L'île Sainte-Marguerite - Partie Est			
9	Polygon	0	du boulevard du Midi Est	Boulevard du Midi Est			
Click to add new row.							

Atlas / Map series layout

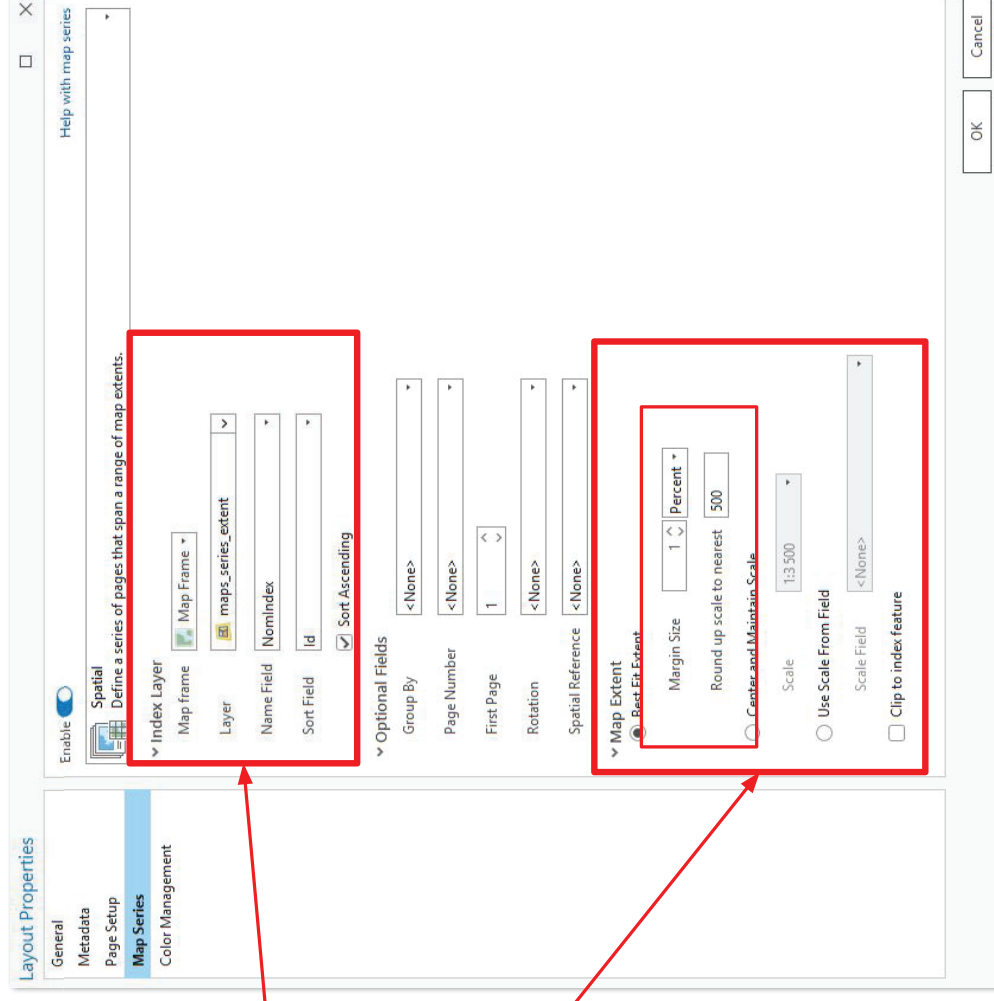
Activate **Map Series** from the **Layout** tab or **Layout's** properties in the content panel.

1. Choose the **map's frame to which the map series will apply**.
2. Select the **Index layer**
3. Select the **name** and **sort** fields

The **map extent** can be set in a variety of ways :

- By setting a margin around index feature's geometries.
- With constant scale for all map series pages.
- Dynamically from each feature using a scale field

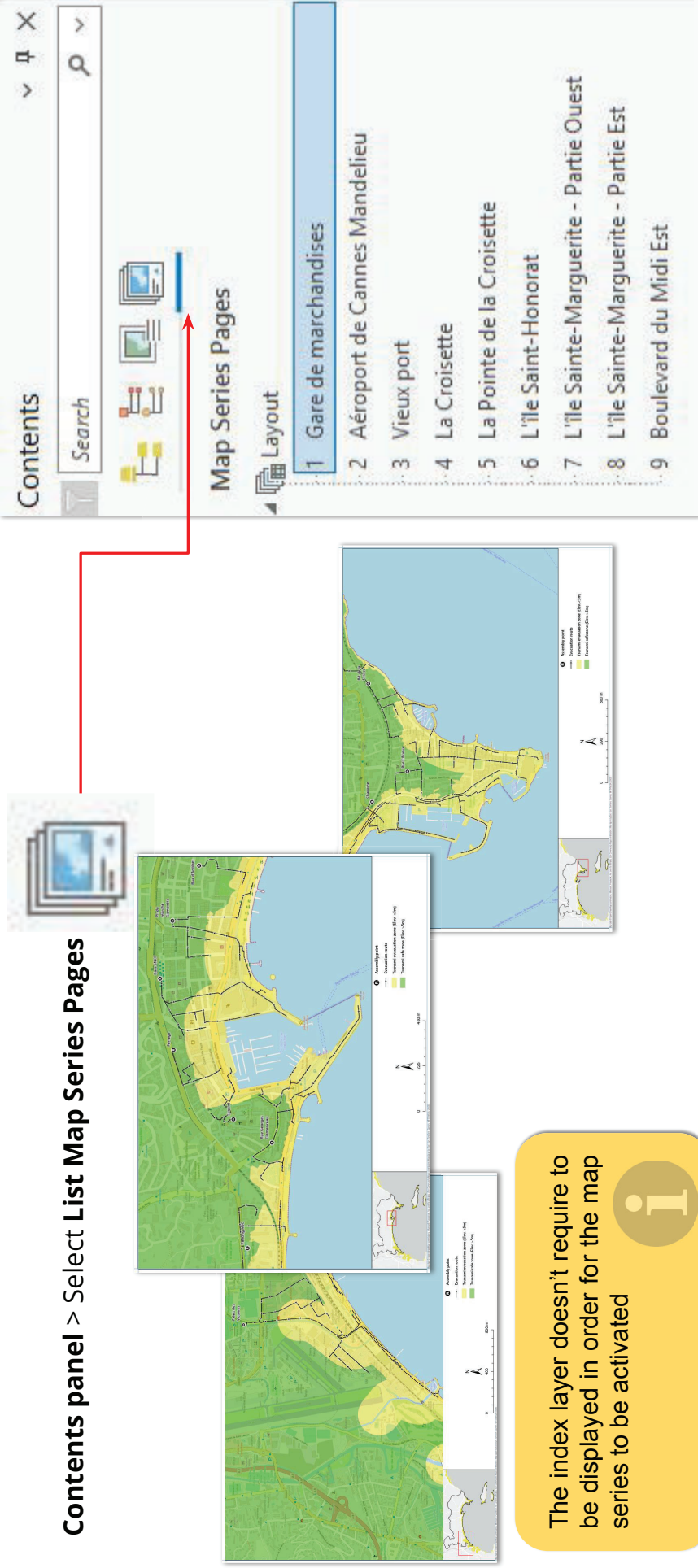
Since the polygons of the index layers are not all the same size, a dynamic map extent setting must be chosen.



Atlas / Map series layout

Once a map series is activated, you can select wich page will be displayed on your the page's layout.

Contents panel > Select **List Map Series Pages**



The diagram illustrates the process of selecting a map series page for display in a map layout. It shows three map thumbnails, a 'Contents' panel with a 'Map Series Pages' tab, and a 'Layout' panel showing a list of map series pages. A red arrow points from the 'Map Series Pages' tab to the 'Layout' panel.

Contents

Search

Map Series Pages

Layout

- 1 Gare de marchandises
- 2 Aéroport de Cannes Mandelieu
- 3 Vieux port
- 4 La Croisette
- 5 La Pointe de la Croisette
- 6 L'île Saint-Honorat
- 7 L'île Sainte-Marguerite - Partie Ouest
- 8 L'île Sainte-Marguerite - Partie Est
- 9 Boulevard du Midi Est

The index layer doesn't require to be displayed in order for the map series to be activated



Atlas / Map series layout

Map series allow to set up **dynamic text elements** to display layer, project or layout's specific information, i.g :

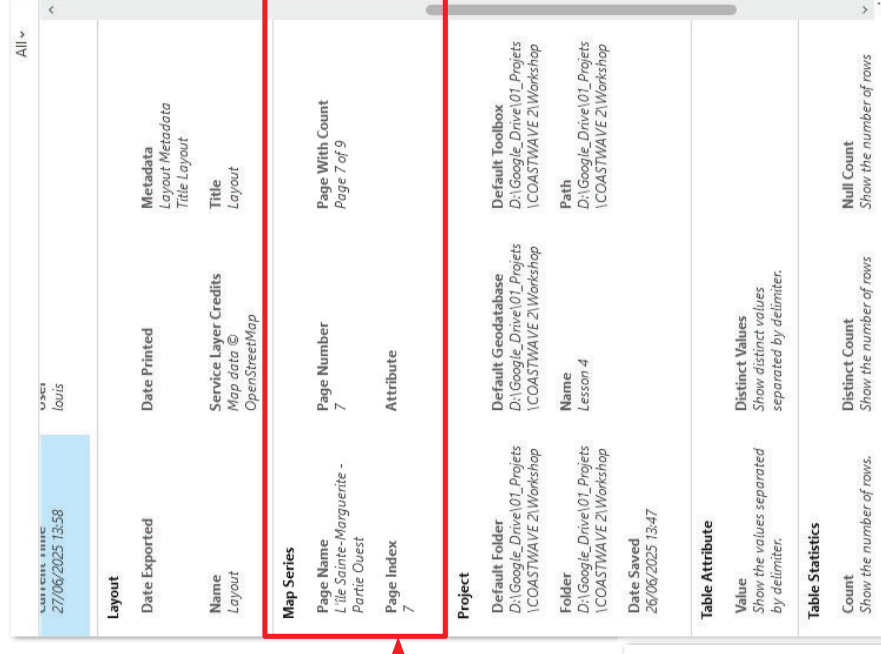
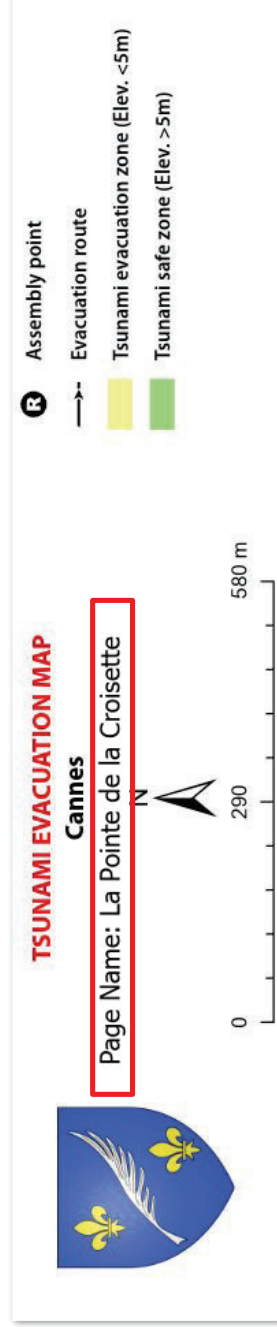
- Attribute table
- Field value
- Author / Date / Metadata
- Scale

To insert Dynamic text :

Layout tab > Top ribbon > Dynamic Text



Add the page name on your layout :



Atlas / Map series layout

You can **combine static and dynamic text** within one text element.

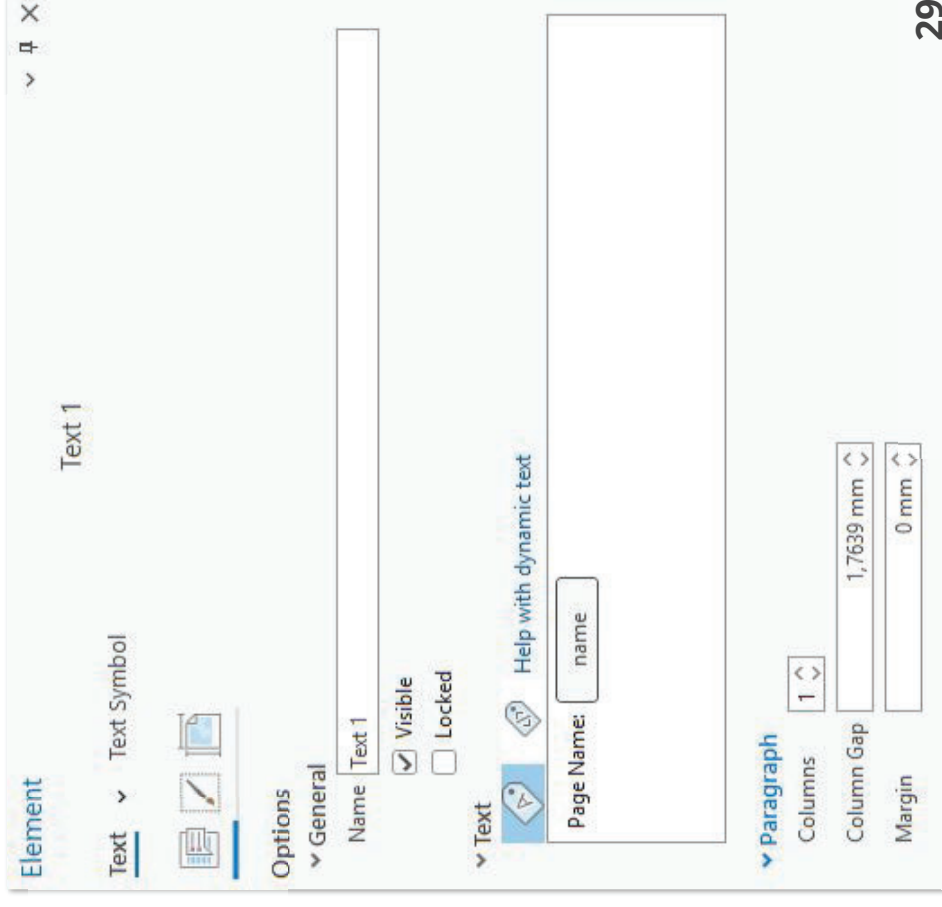
Dynamic Text preset can be edited :

Select your dynamic text element > **Right click** > **Properties**

1. Remove the static text **"Page Name:"** and keep only the "name" tag
2. Choose another pertinent dynamic text element to add to your layout



The size of the dynamic text element **will be adjusted** based on the length of the page name, which may result in it **overlapping** with other layout elements.



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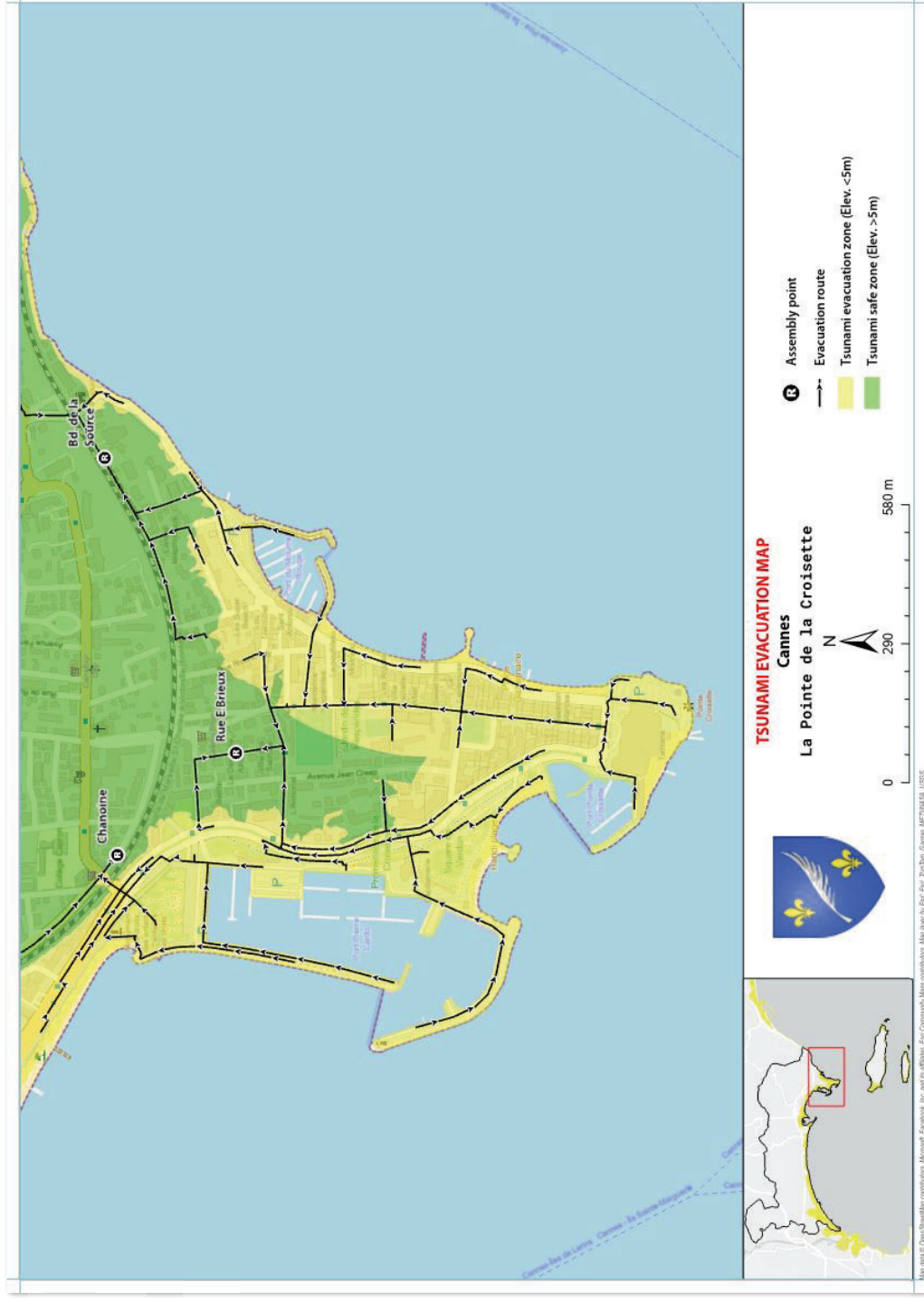
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Atlas / Map series
layout

Result :



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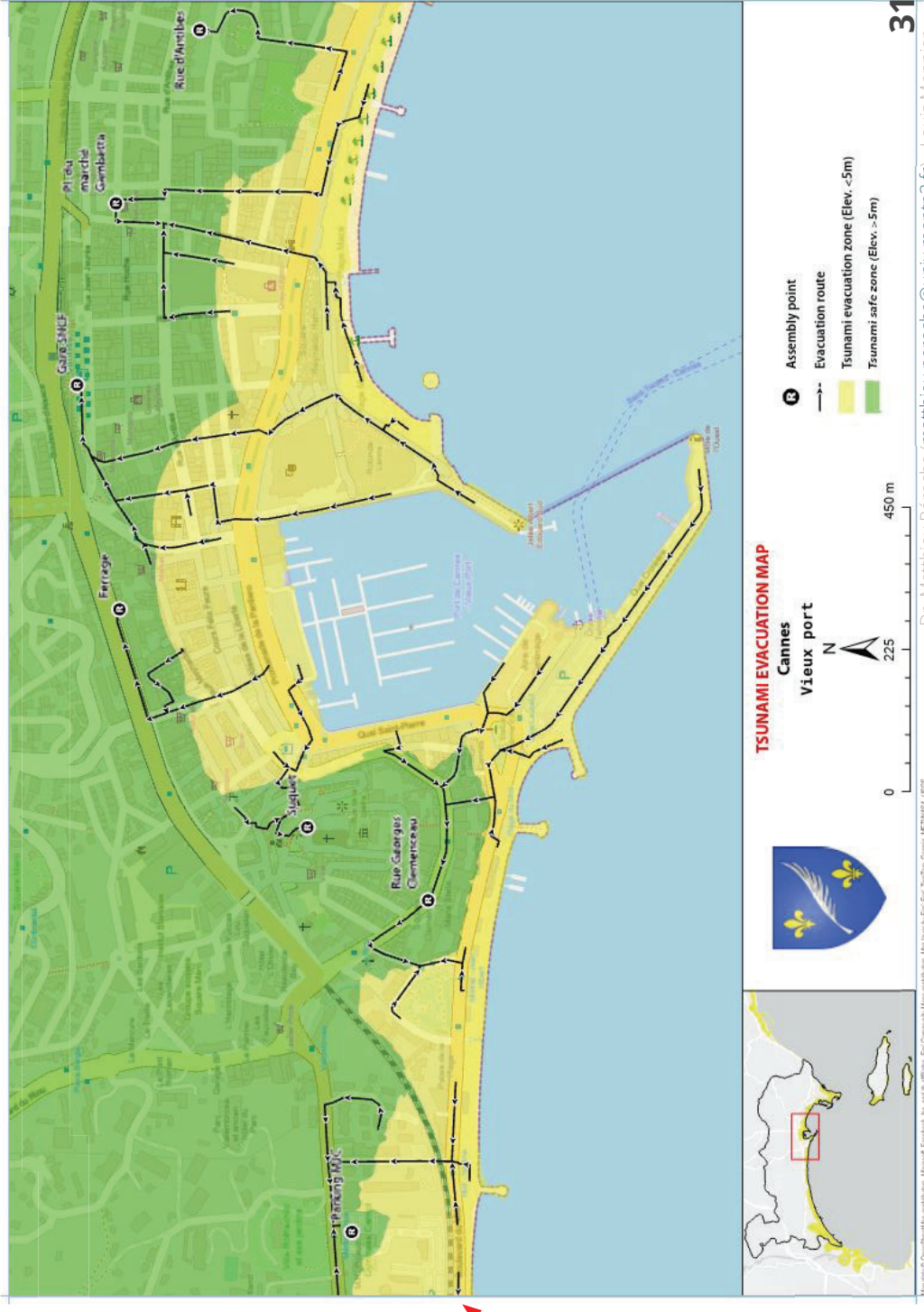
Atlas / Map series layout

In many cases, basemaps provided by ESRI doesn't display all the information needed.

⇒ **Cultural / Political / Administrative basemap**

doesn't include terrain information

Basemap : OpenStreetMap



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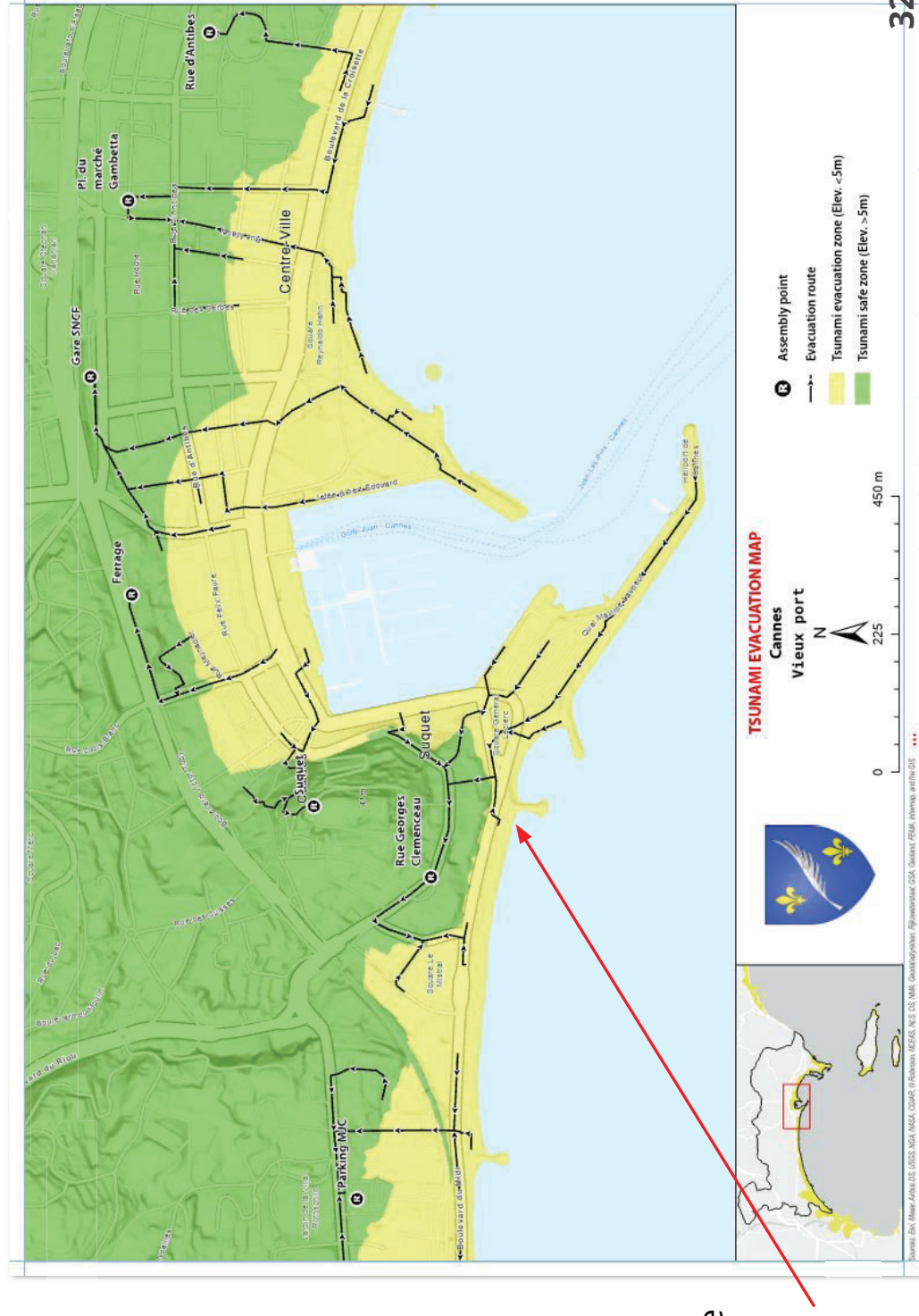


Atlas / Map series layout

In many cases, basemap
provided by ESRI doesn't
provide all the information
needed.

⇒ **Terrain basemap** doesn't
include buildings or landmark.
At the scale of our evacuation
plans, only the most important
sections of the road network are
displayed.

Basemap : Terrain with labels



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Atlas / Map series layout

Terrain elevation must be displayed on tsunami evacuation map. The most commons ways to provide this information are **contour lines** and **hillshade**.

Arcgis don't allow to add multiple basemap on a single map, but the **tiles** or **imagery** layers used in the basemaps can be imported as standalone layer, allowing to compose your own basemap. 1

In your **map's tab** > **Top ribbon** > **Map** > **Add Data** > **Data**



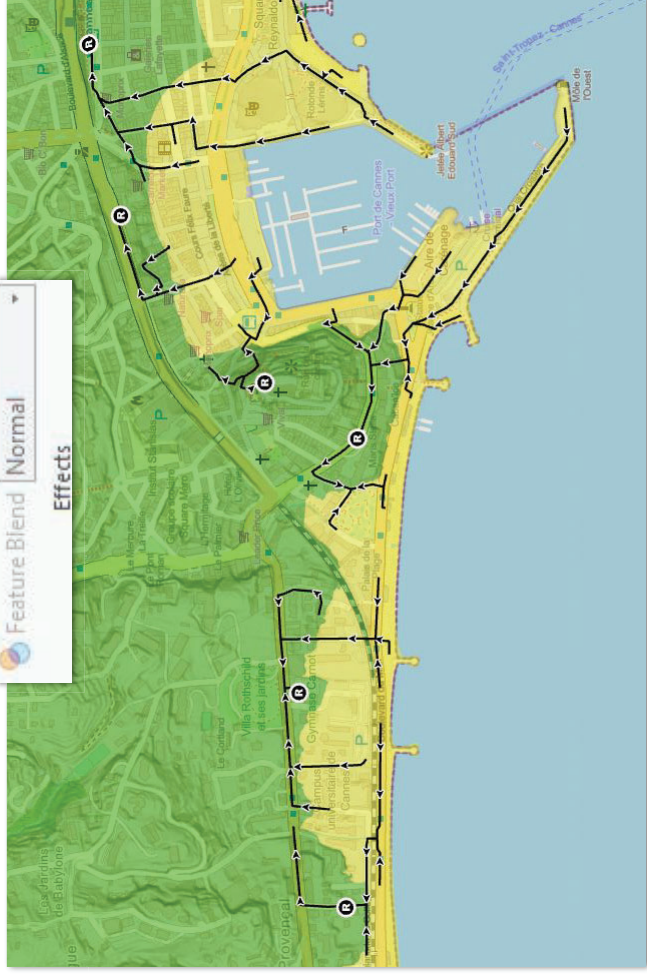
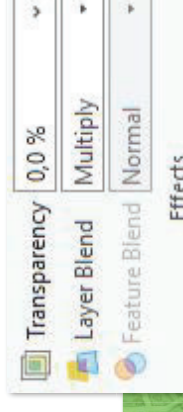
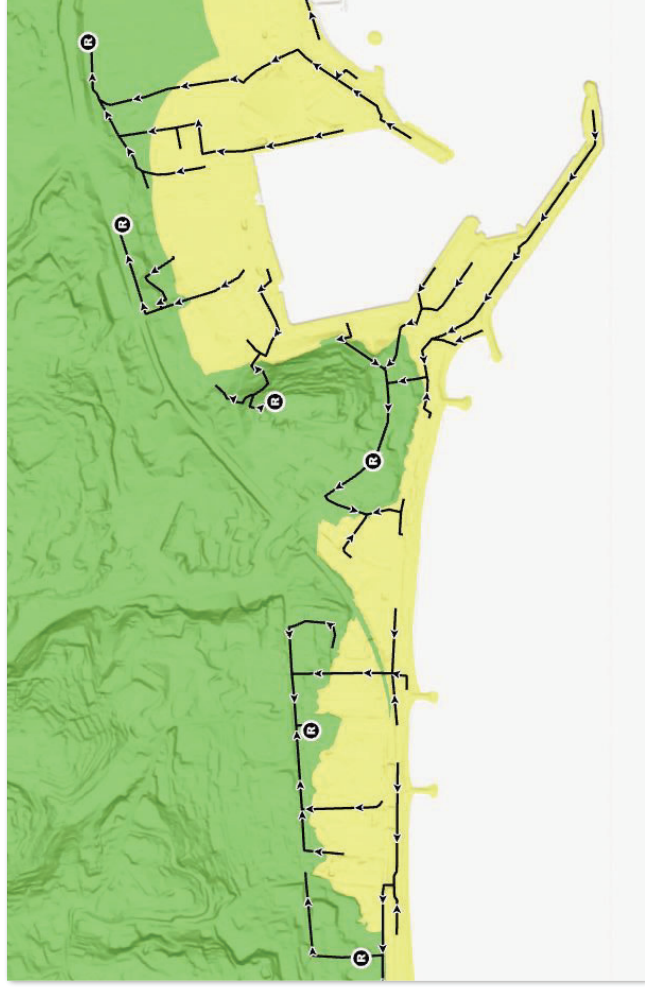
In the **Add Data** window, select **Living atlas** and search for **"Hillshade"**



Atlas / Map series layout

In order to display both **OpenstreetMap** basemap and the **World Hillshade** tile layer, **transparency** and / or **blending mode** should be adjusted.

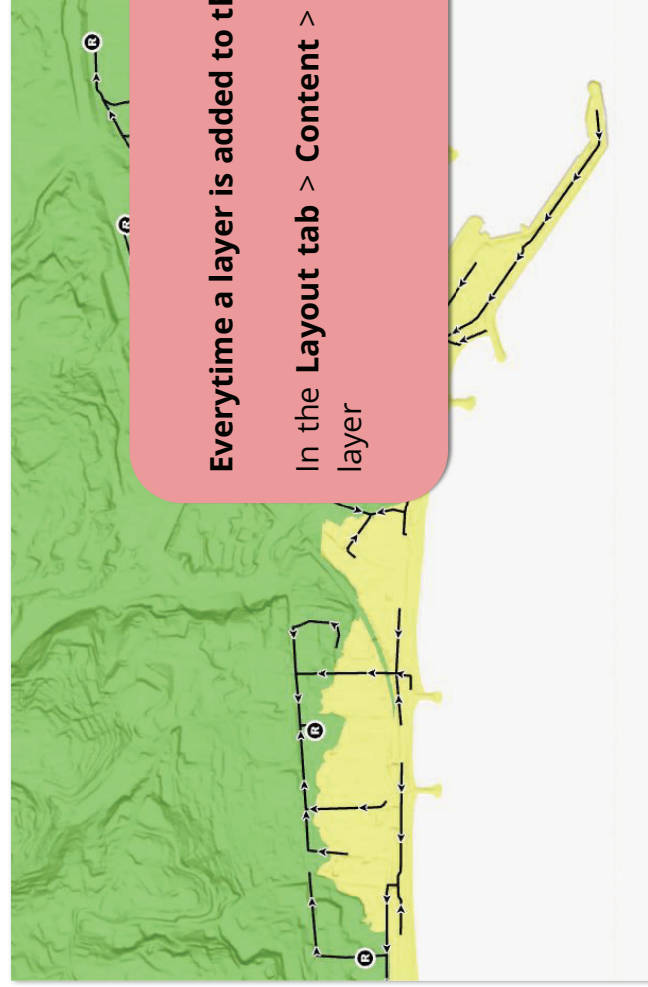
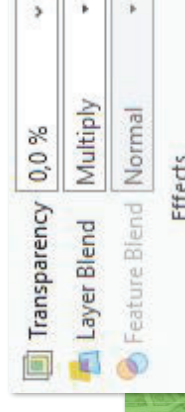
Select the World Hillshade layer > **Top ribbon** > **Tile Layer** > **Effects**



Atlas / Map series layout

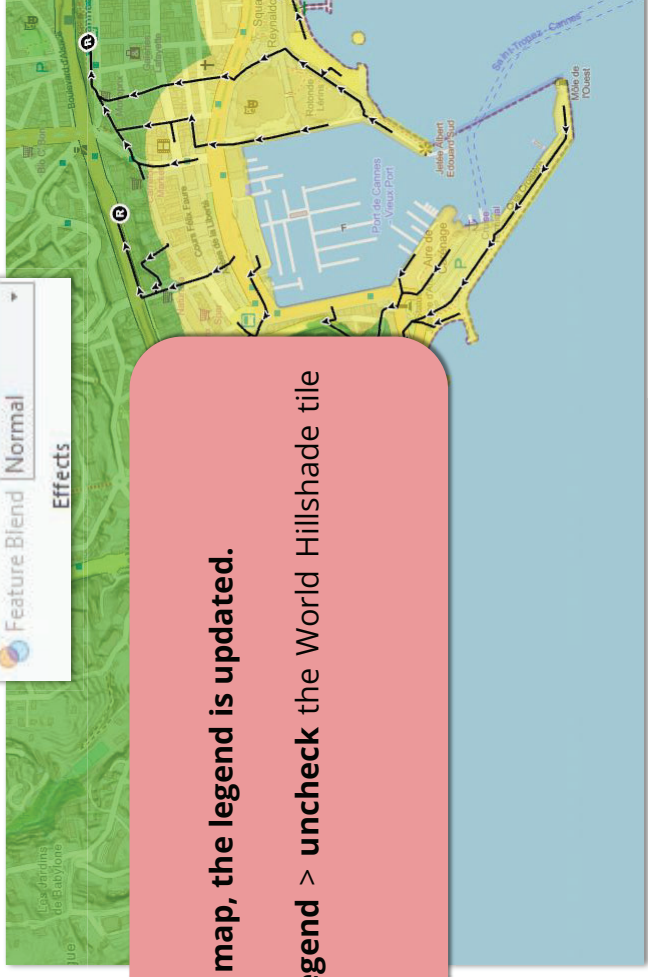
In order to display both **OpenstreetMap** basemap and the **World Hillshade** tile layer, **transparency** and / or **blending mode** should be adjusted.

Select the World Hillshade layer > **Top ribbon** > **Tile Layer** > **Effects**



Everytime a layer is added to the map, the legend is updated.

In the **Layout tab** > **Content** > **Legend** > **uncheck** the World Hillshade tile layer



Lesson #4

Graphical semiology and map layout

Coastwave 2.0 Evacuation
Mapping Workshop

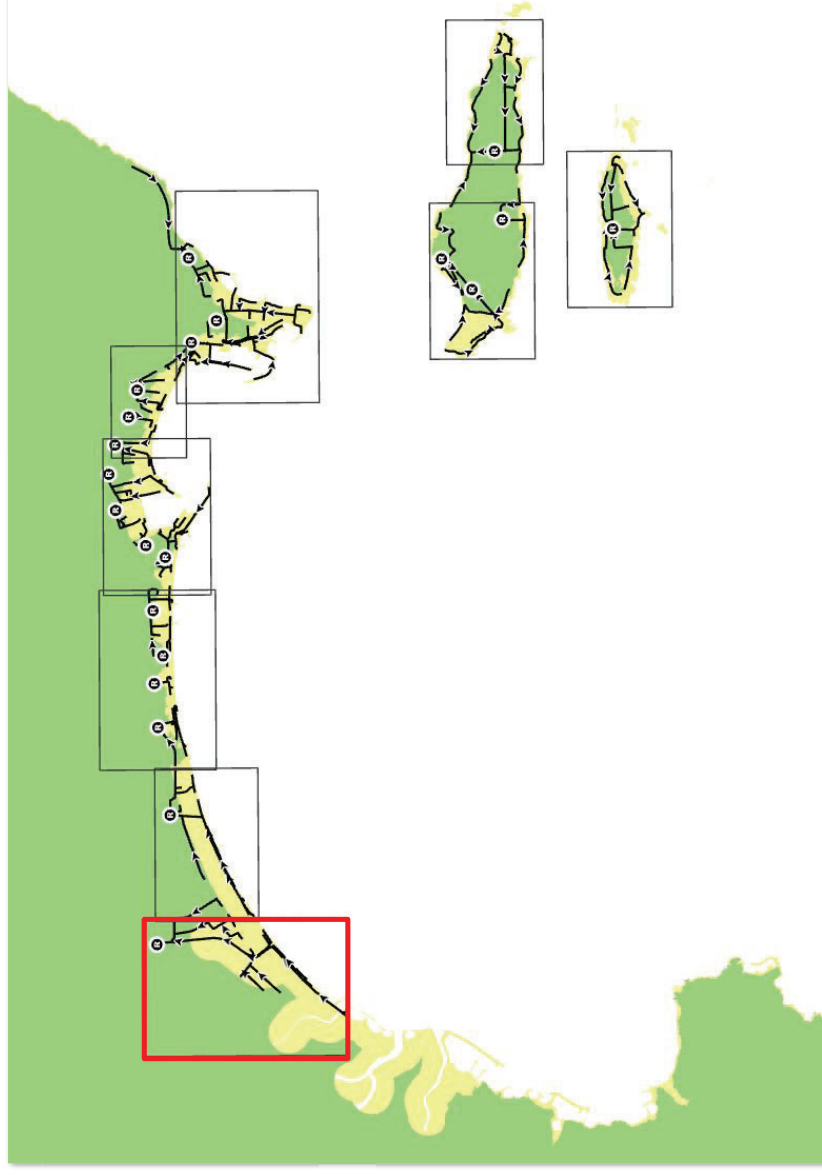


Atlas / Map series layout

One of the map extent need a layout set on **portrait** mode



How would you solve this problem ?



Lesson #4

Graphical semiology and map layout

Coastwave 2.0 Evacuation
Mapping Workshop



Atlas / Map series layout

Exporting a map series :

Layout tab > Top ribbon > Share > **Export Layout**



1

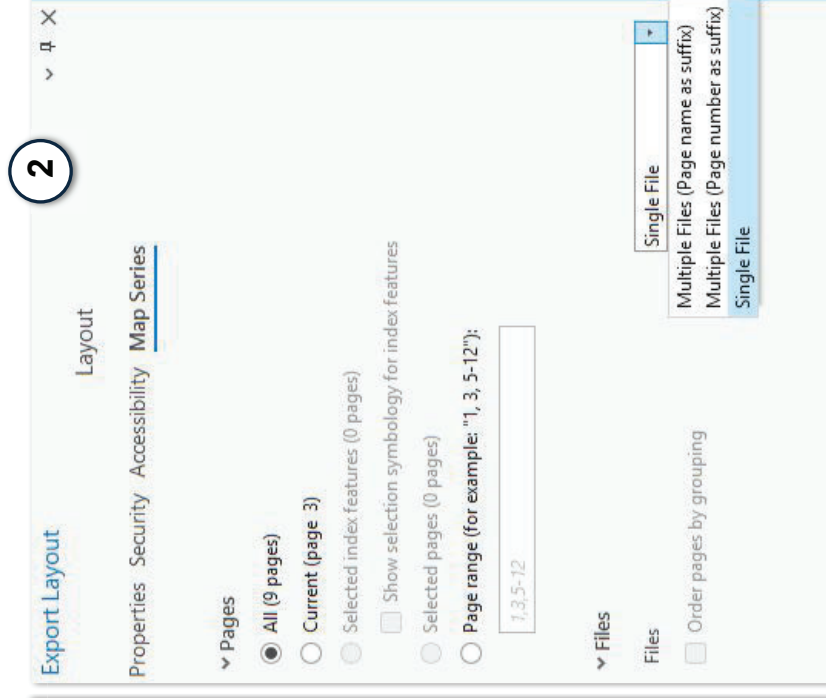
The **Properties menu** allows you to set the file format, export resolution and destination folder.

2

The **Map Series menu** allows you to choose which pages will be exported, and whether they will be exported as independent files or as a single file.



1



2

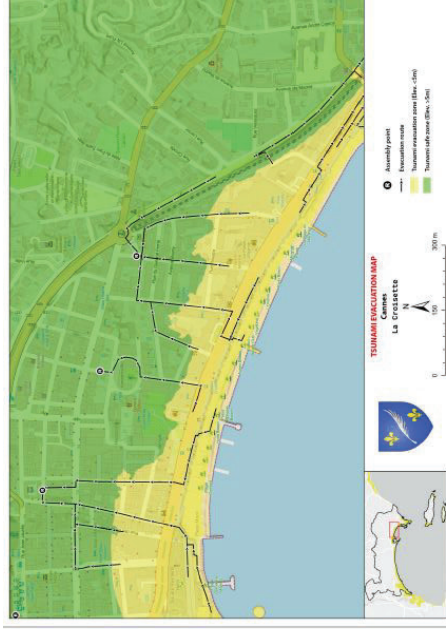
Lesson #4

Graphical semiology and map layout

Coastwave 2.0 Evacuation
Mapping Workshop



Atlas / Map series layout



Tsunami Evacuation Mapping Workshop



CoastWAVE 2.0 Project IOC-UNESCO (EU DG ECHO)

Dr. Matthieu Péroche
Louis Monnier



Intergovernmental
Oceanographic
Commission



Funded by
European Union
Humanitarian Aid



United Nations Decade
of Ocean Science
2021
2030
for Sustainable Development



LABORATOIRE
DE GEOGRAPHIE ET D'AMENAGEMENT
DE MONTPELLIER



30 June – 4 July 2025

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