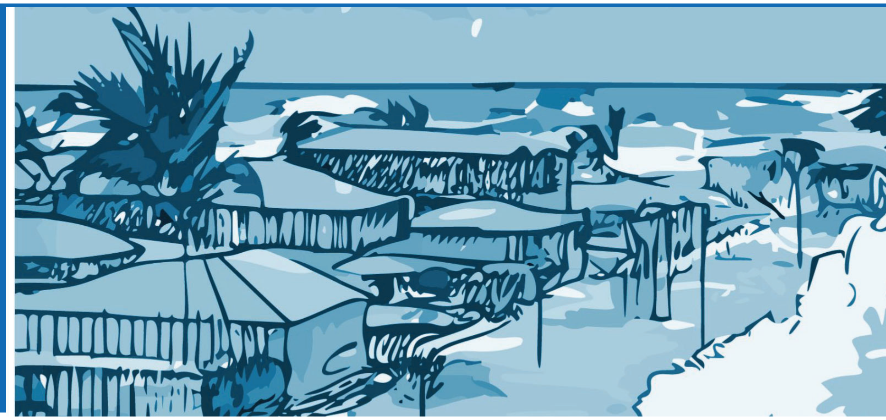
unami Evacuation apping Workshop



Montpellier, France

30 June – 4 July 2025

Dr. Matth
Pr. Fr
Lo
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CoastWAVE 2.0 Project

IOC-UNESCO (EU DG ECHO)

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Contact : matthieu.peroche@uni

CO

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European Union
Humanitarian Aid

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

CoastWAVE NEAMTWS

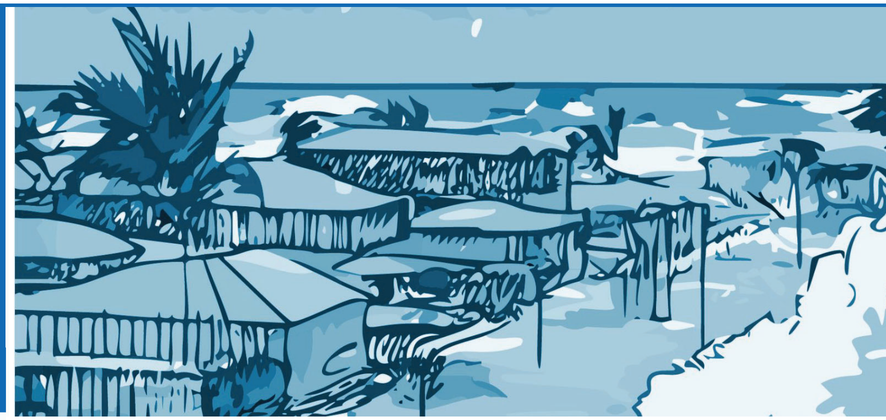
LAGAM LABORATOIRE DE GEOGRAPHIE ET D'AMENAGEMENT DE MONTPELLIER

UNIVERSITE PAU VA

you to all the workshop
ipants for this week of
edge sharing, for your
ement and your good mood
e this heatwave !

unami Evacuation
apping Workshop

30 June – 4 July 2025



CoastWAVE 2.0 Project

IOC-UNESCO (EU DG ECHO)

Dr. Matth
Lo

Lesson #1

Tsunami evacuation zone mapping

Contact : matthieu.peroche@uni

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Lesson's overview

Use of a DEM to map a "standardized" inland tsunami evacuation zone.

1. Theory

- Cannes area
- Presentation of the selected approach for evacuation area definition in France
- Pro and cons

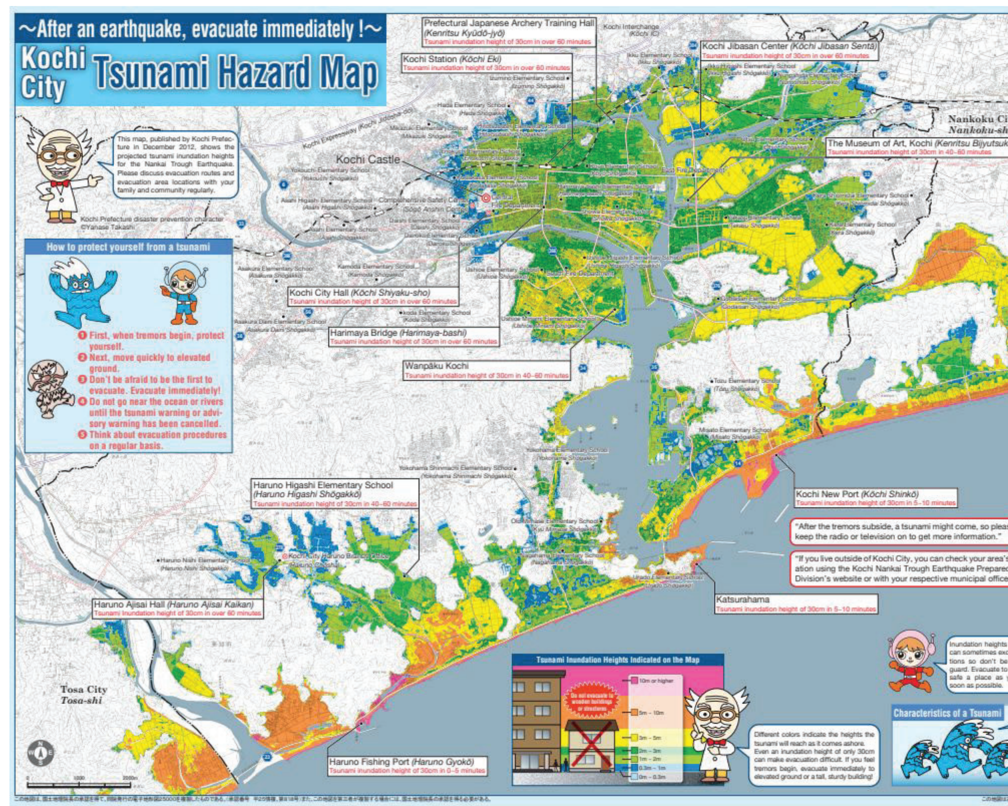
2. Practice

- Extract the altitude range set from numerical modelisation using DEM and GIS
- Corrections needed for a coherent evacuation zone
- Derivate safe zone

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

ng Tsunami Evacuation Zones: 4 Key Methods

- ifferent methods exist to map tsunami anger zones
- he choice depends on data availability, local nowledge, and technical capacity
- lethods range from advanced simulations to asic elevation-based approaches
- ach method offers trade-offs in precision, ffort, and accessibility



ng Tsunami Evacuation Zones - 1. Envelope from Multiple Simulations (deterministic or probabi

ition

nethod combines the results of several validated tsunami simulations to produce a single envelope senting the maximum potential inundation.

ations

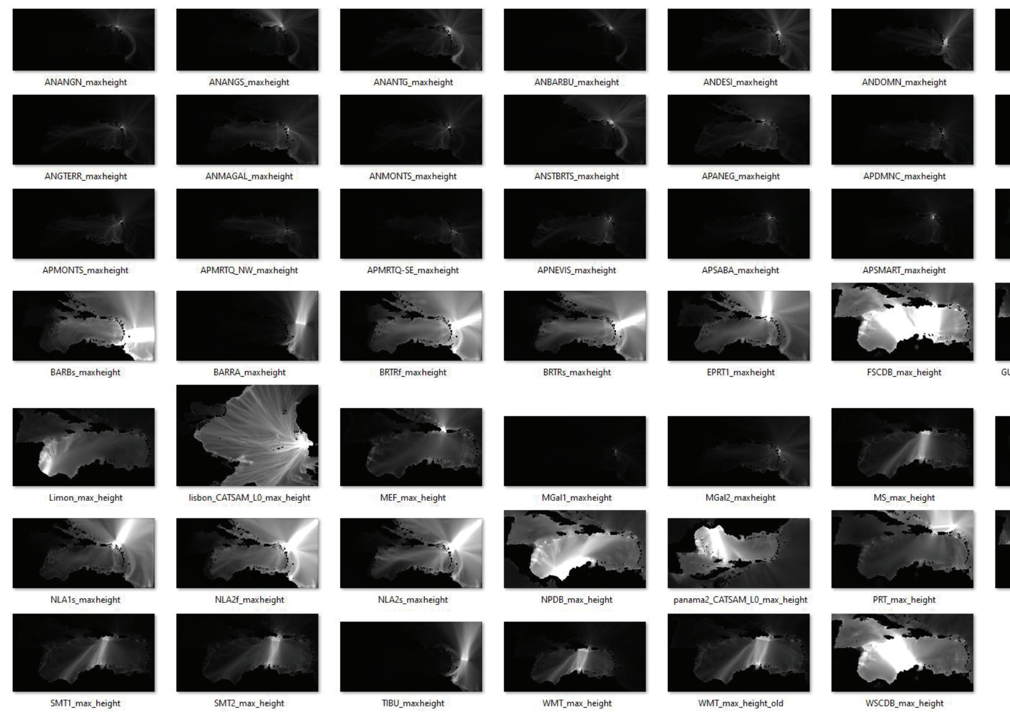
- gh-exposure coastal zones
- tical infrastructure (ports, airports, energy sites)

ths

- nservative and robust
- tailed outputs for maximums : wave arrival time, ter depth, flow speed
- egrates uncertainty from different scenarios
- eal for long-term planning and zoning

tions

- quires multiple simulations
- gh technical and financial cost
- t always feasible for small territories



ng Tsunami Evacuation Zones - 2 : Hydrodynamic Modelling (Single Scenario)

ition

rical simulation of tsunami generation, propagation, and inundation for **one predefined scenario** (o
-case plausible event).

cations

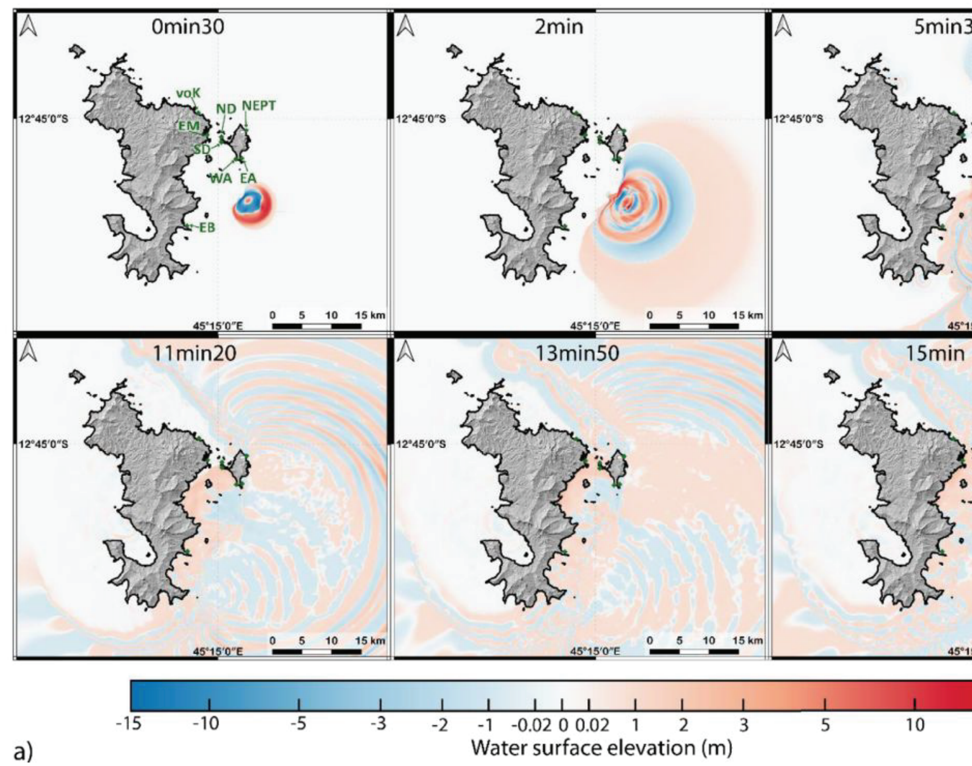
- igh-exposure coastal zones
- ritical infrastructure (ports, airports, energy sites)

gths

- hysically accurate and scenario-specific
- etailed outputs: wave arrival time, water depth, flow spe
- elps visualize and communicate local risk
- deal for long-term planning and zoning

ations

- equires multiple simulations
- nly reflects one event configuration
- lay miss other potential threat sources



Pablo Poulain et al, 2022

Tsunami evacuation zone mapping

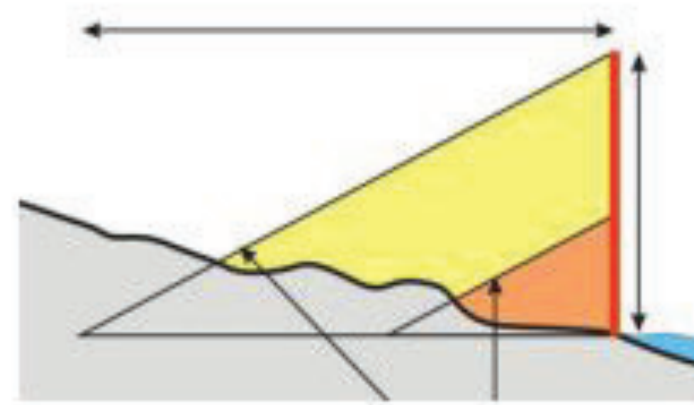
ng Tsunami Evacuation Zones - 3 : Topographic Projection from Simulated Coastal Heights

ition

lation zones are derived by **projecting simulated maximum wave heights onto land**, using a
l Elevation Model (DEM). No inland flood modelling is performed.

cations

erritories with access to tsunami simulations but limited modelling capacity
asier to generalize over **large coastal areas**
uitable for regional-scale evacuation planning



gths

ses outputs from actual tsunami scenarios
aster and less costly than full inundation models
equires fewer computational resources

ations

till needs accurate input data (DEM, coastal wave heights)
oesn't account for local hydrodynamics (flow, obstacles, direction)
lay overestimate or underestimate extent in flat or complex terrain

ng Tsunami Evacuation Zones - 4 : Simple Elevation-Based Method ("Bathtub")

ition

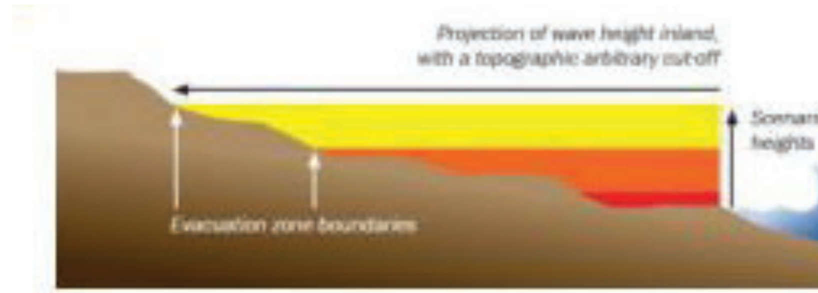
mi danger zones are mapped using a fixed elevation threshold (e.g. 10–15 m), without relying on simulation ts. It is also recommended to set a maximum inland penetration distance, to avoid unrealistic inland extent n.

ations

- erritories with no access to tsunami modelling
- seful for early-stage planning and awareness
- an be applied using basic topographic data (DEM)

ths

- equires no simulation
- asy to implement and to communicate to the public
- good starting point for evacuation planning



tions

- ay overestimate inland extent
- o information on wave dynamics or timing
- ssumptions must be validated by risk management authorities

Tsunami evacuation zone mapping

mon Approach for French Territories

erational Choice

acuation planning in France began with the **Simple Elevation-Based Method (10 m threshold)**

lected due to the **lack of usable simulation data** and the need for **consistency across territories**

formed by **international practices**, **historical runup values**, and **partial modelling outputs**

ssive National Deployment

ethod first used in the **French Antilles (2013–2014)**

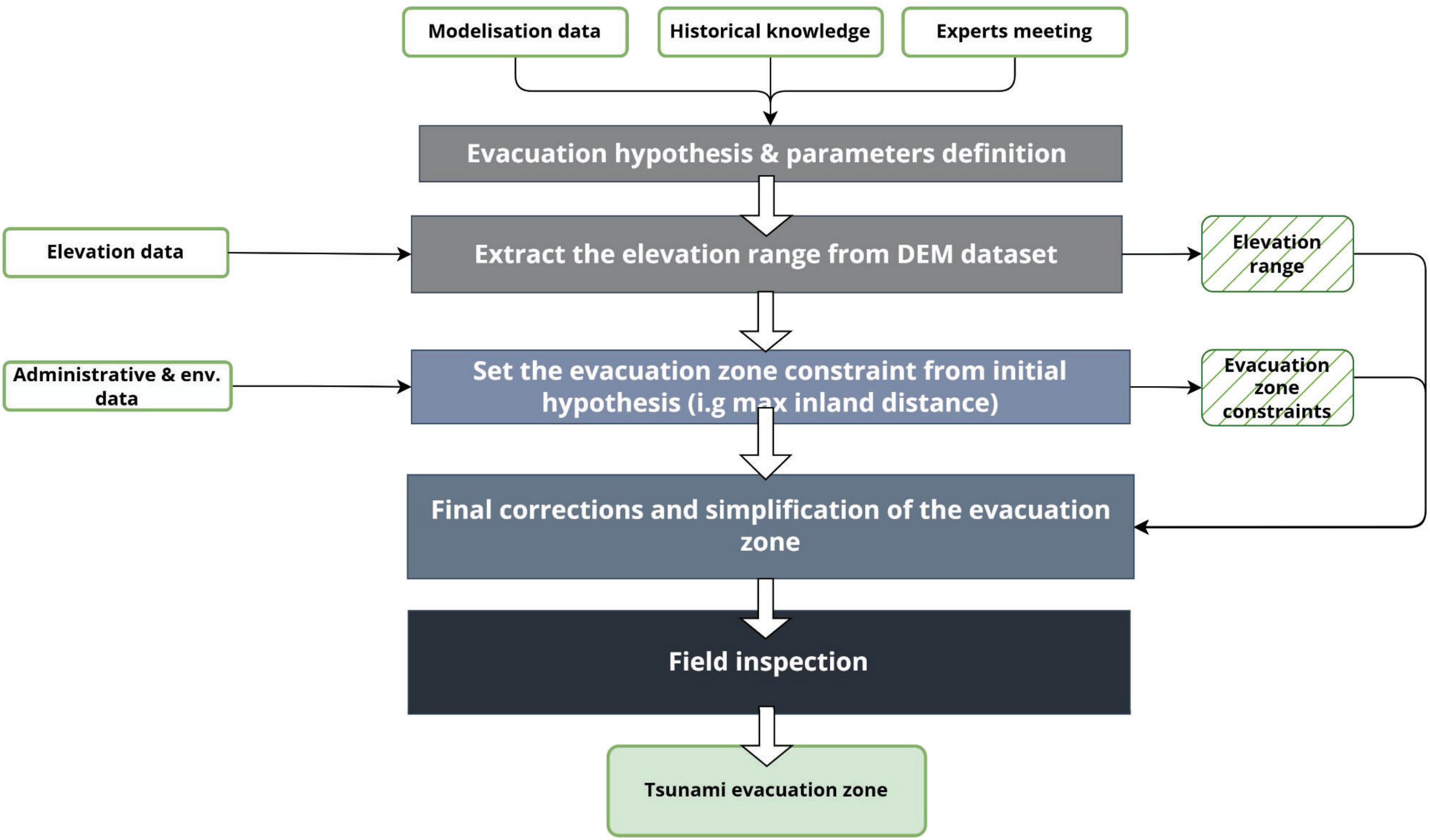
en **adapted and applied in the Mediterranean 019)** under the **TASOMA project**

ally **adopted in Mayotte (2020)** as a starting point r tsunami preparedness

A simple, shared method ha enabled nationwide progress tsunami evacuation plannin despite data gaps and regio diversity.

Tsunami evacuation zone mapping

iew of the theoretical stages



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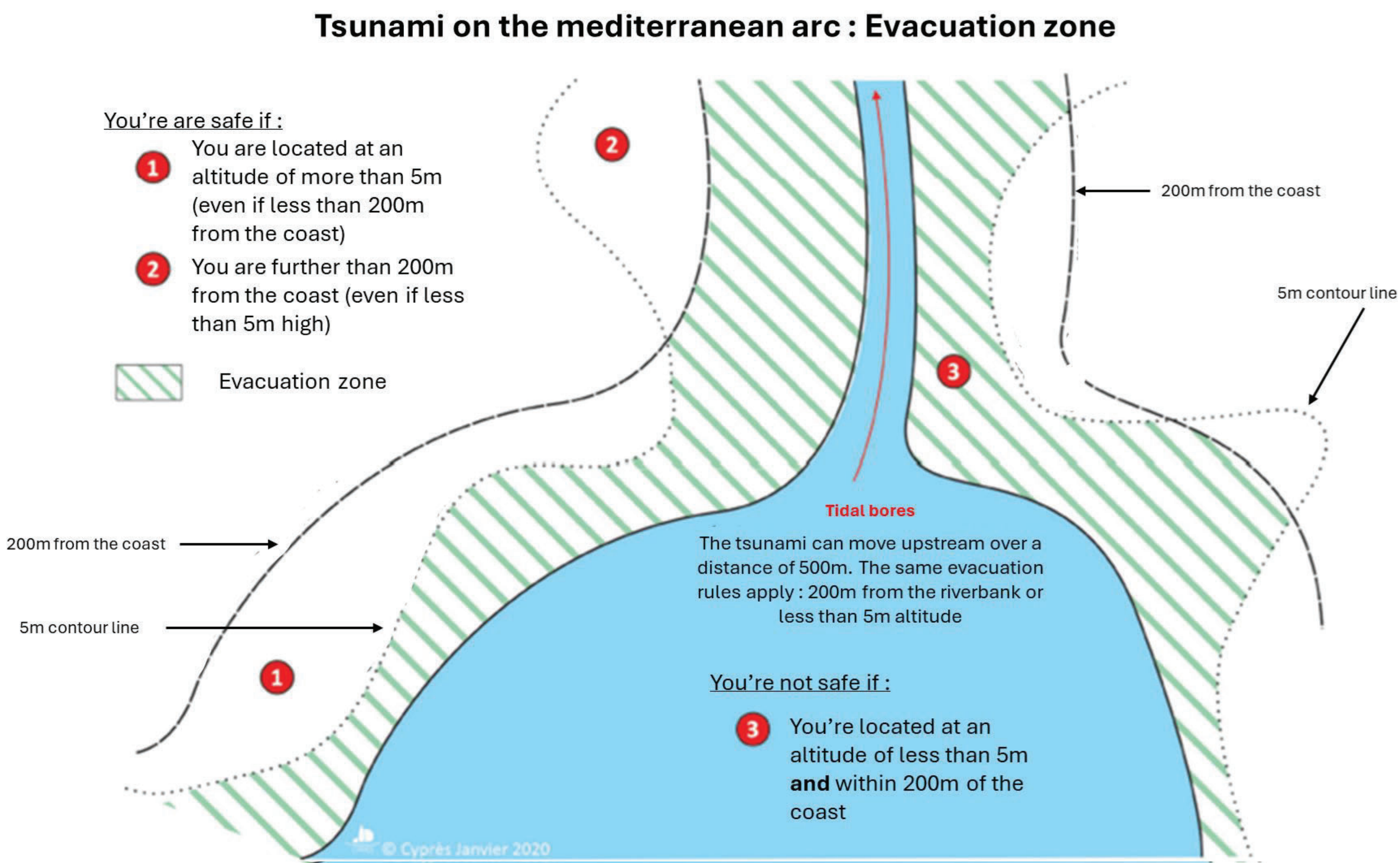
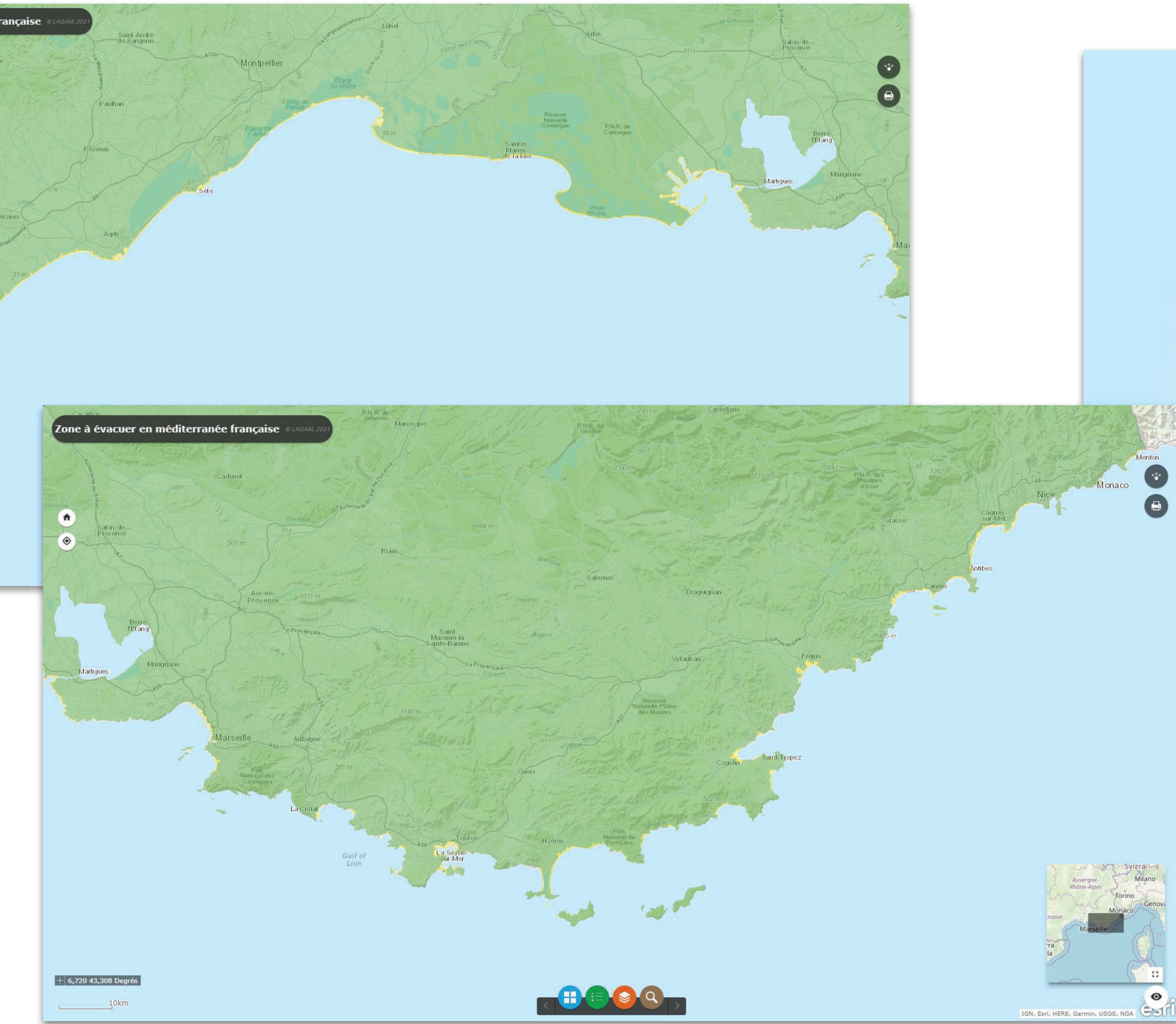
Tsunami evacuation zone mapping

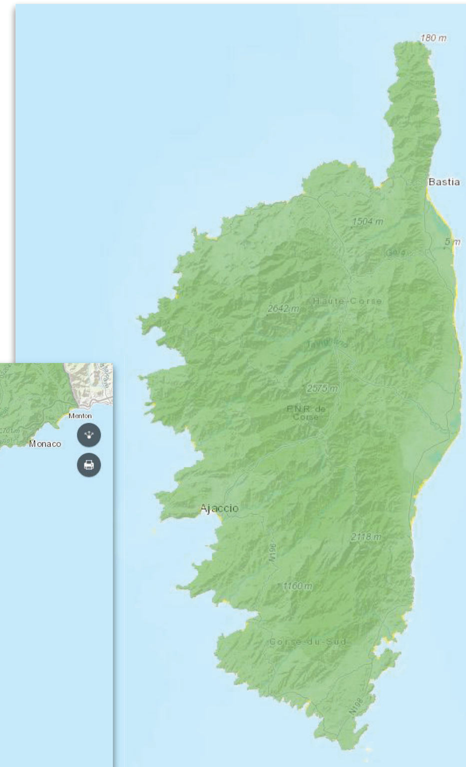
d tsunami evacuation zone definition for the french mediterranean coast



Tsunami evacuation zone mapping

d tsunami evacuation zone definition for the french mediterranean coast





Using this method, we
able to map the evacu
zone for the entire coa
in around a month duri

TASOMA Project

https://arcg.is/1vfGSz

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n #1

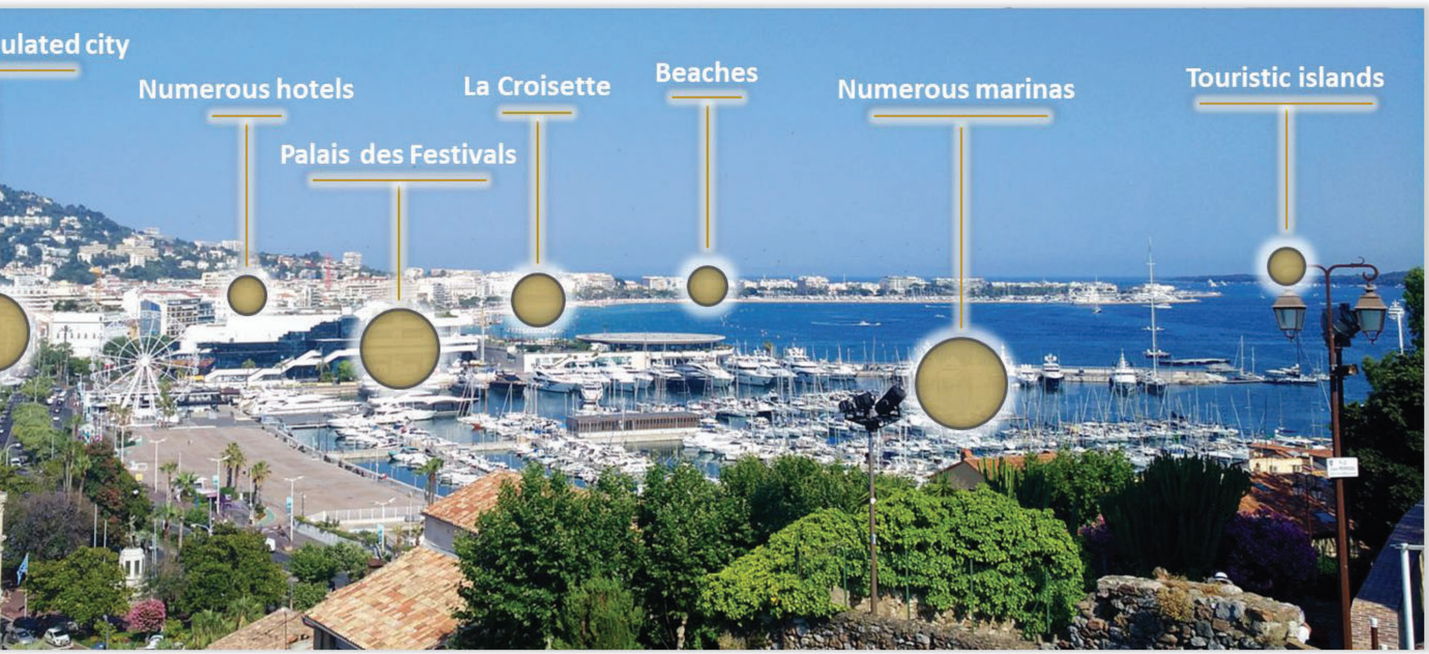
Tsunami evacuation zone mapping

Coastwave 2.0 Evacuation
Mapping Workshop

area presentation

- ✓ Population of 74,686 *(INSEE, 2019)*
- ✓ 3 million visitors per year
- ✓ 320 cruise passengers in 2017
- ✓ Nearly 130 hotels and 500 restaurants
- ✓ Accommodation capacity of 17,000 people

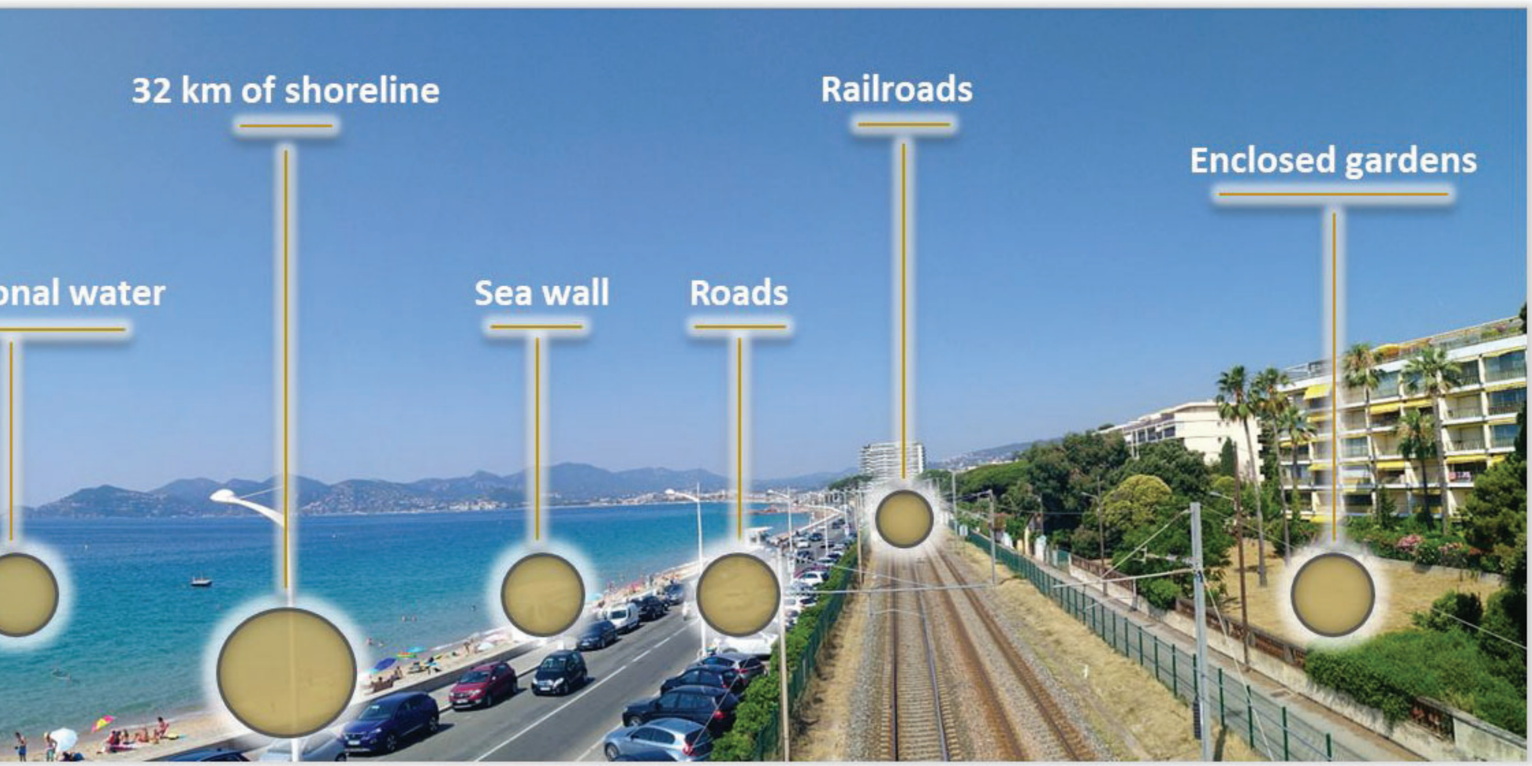
nnes evacuation challenges in case of tsunami alert …



s area presentation

he past year, awareness-raising activities (public meeting, meeting in schools) have been carried out locally, in particul boration with CENALT and DGSCGC.

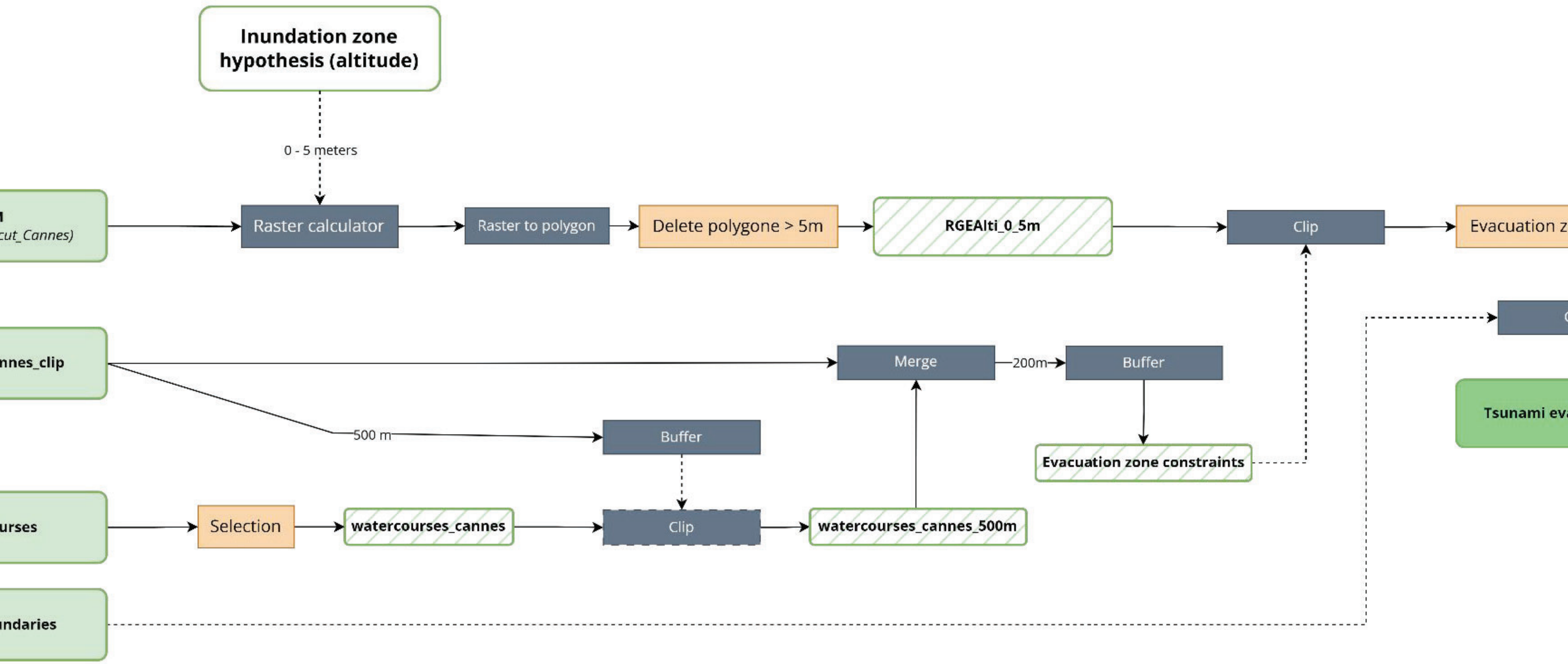
ssions within the national Tsunami working group have led to recommendations that have been validated at the national l entific partnership with the University Paul-Valéry Montpellier 3, has enabled the design of standardised evacuation plans mi signage according to a method already deployed in the French West Indies (Caribbean sea)



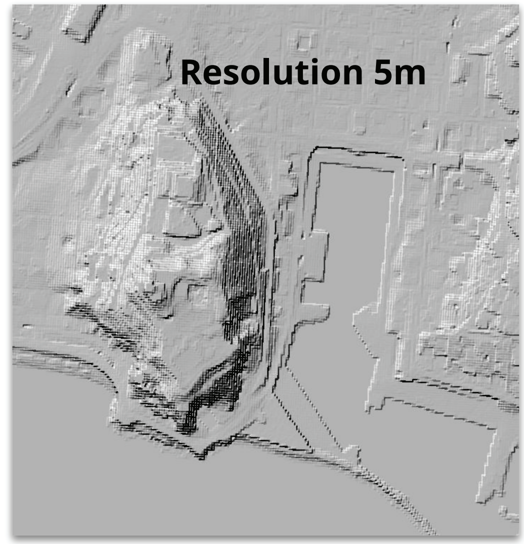
"The taking into account Tsunami hazard in Can part of a strong politic initiated since 2015 concerted managemen natural risks and a awareness of citizens".

Tsunami evacuation zone mapping

tailed overview



5m and 1m resolution DEM accessibility varies between countries.



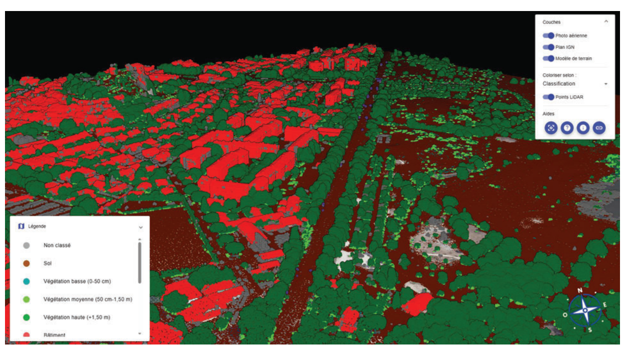
er accuracy for terrain
significant altitude
ation
resolution evacuation
e

Cons

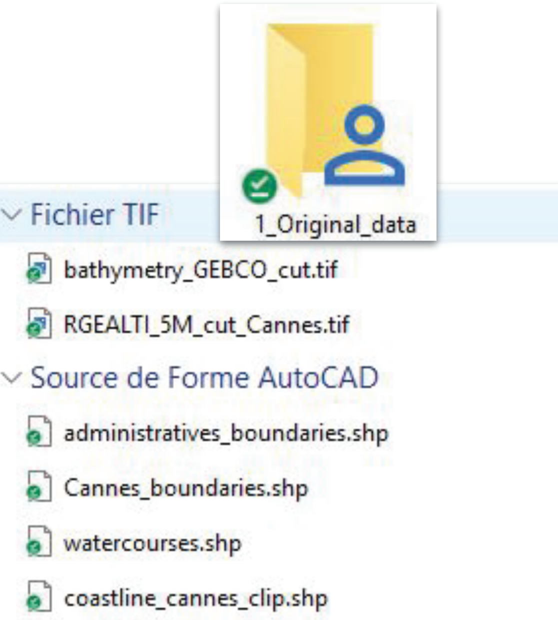
- Slow to process
- 1m res DEM cannot be used for a whole region on most computer.

mme national LiDAR HD :

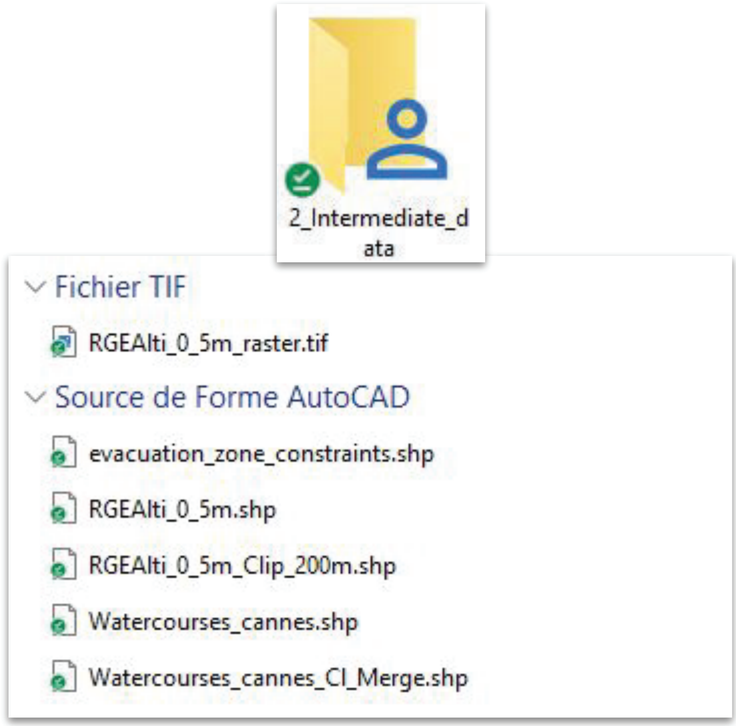
geoservices.ign.fr/lidarhd



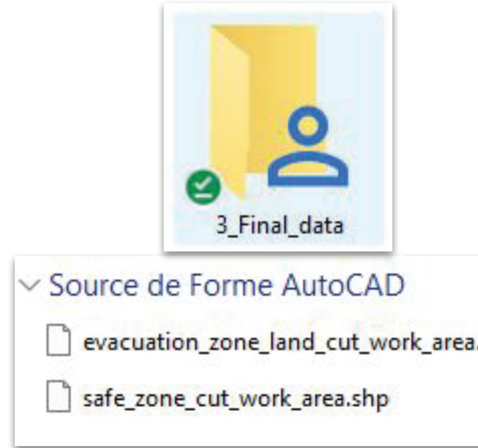
n's data



quired layers for the lesson



Processed layers



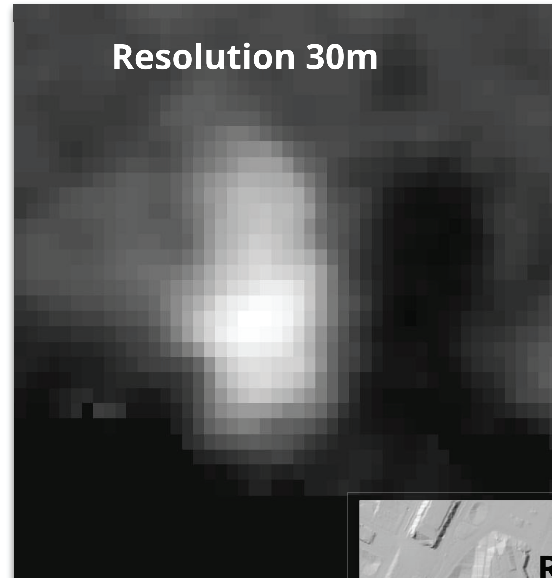
Results

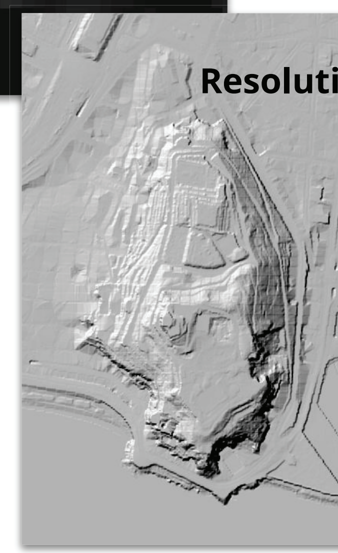
Tsunami evacuation zone mapping

olution DEM with a world coverage are largely available in open access.

ttle Radar Topography Mission (SRTM) -
os://dwtkns.com/srtm30m/

ernicus DEM - Global and European Digital Elevation Model
os://dataspace.copernicus.eu/explore-data/data-collections/copernicu
ontributing-missions/collections-description/COP-DEM





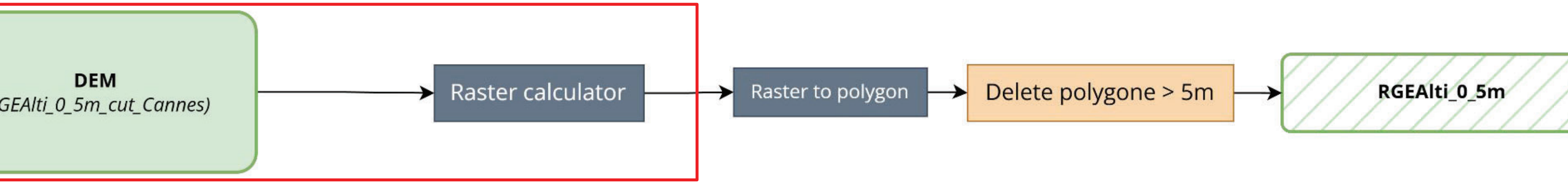
ast to process
uitable for large studie's
rea (country)
orld coverage

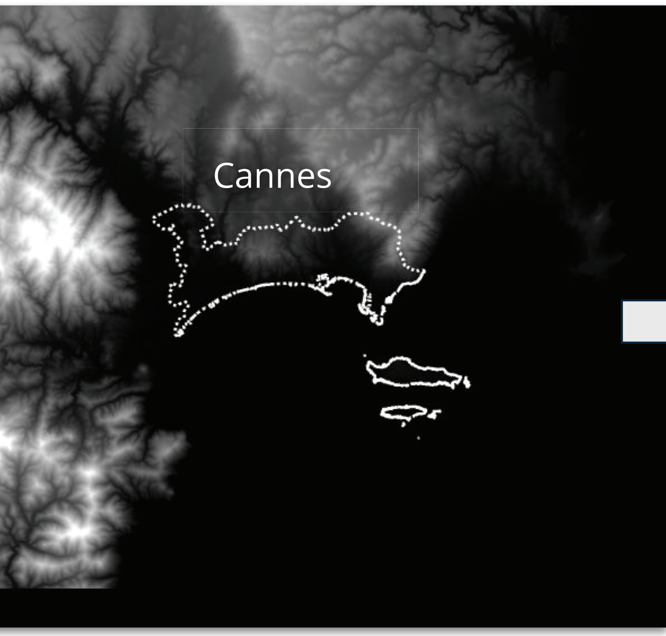
Cons
- Low evacuation zone precision
- Not suitable on terrain with significant altitude variation

n #1

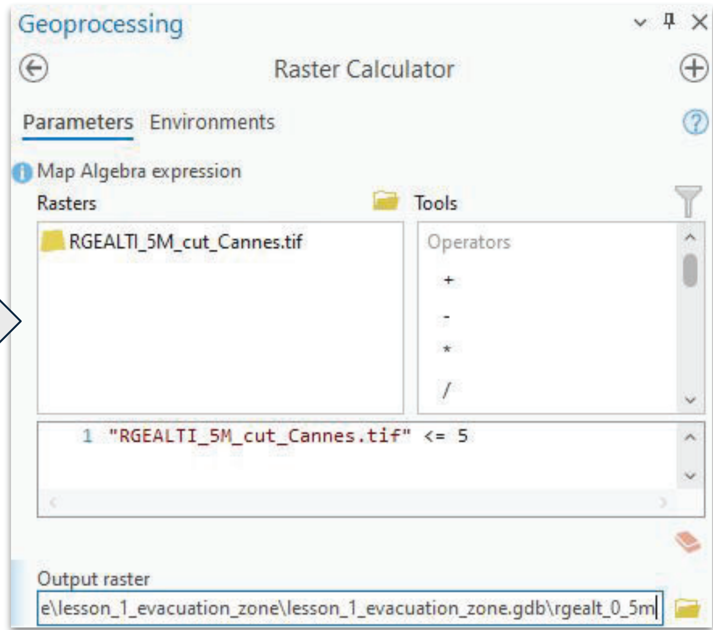
Tsunami evacuation zone mapping

Coastwave 2.0 Evacuation Mapping Workshop

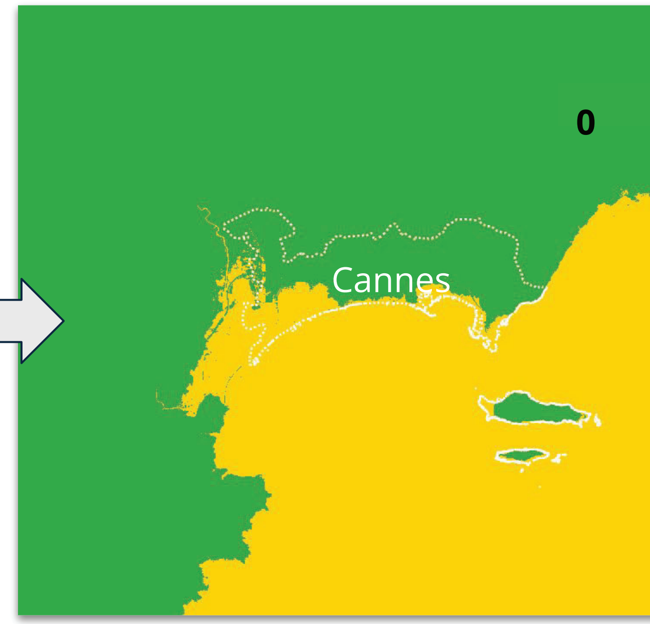




s in the image have a pixel elevation

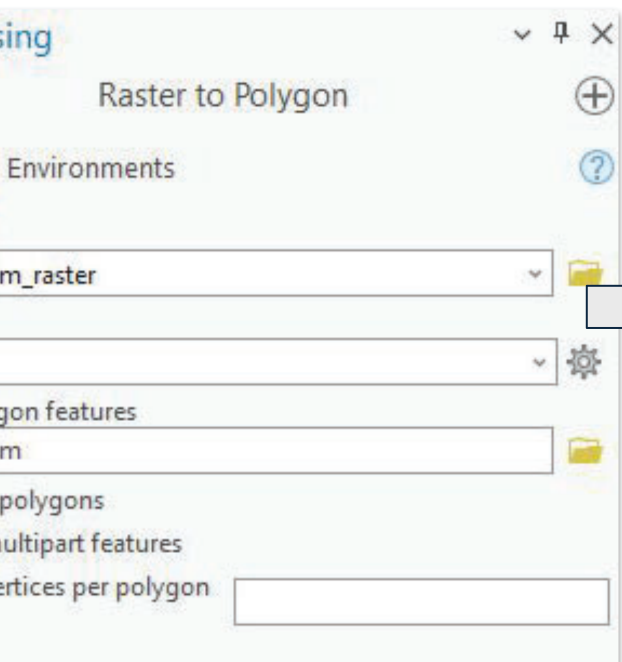


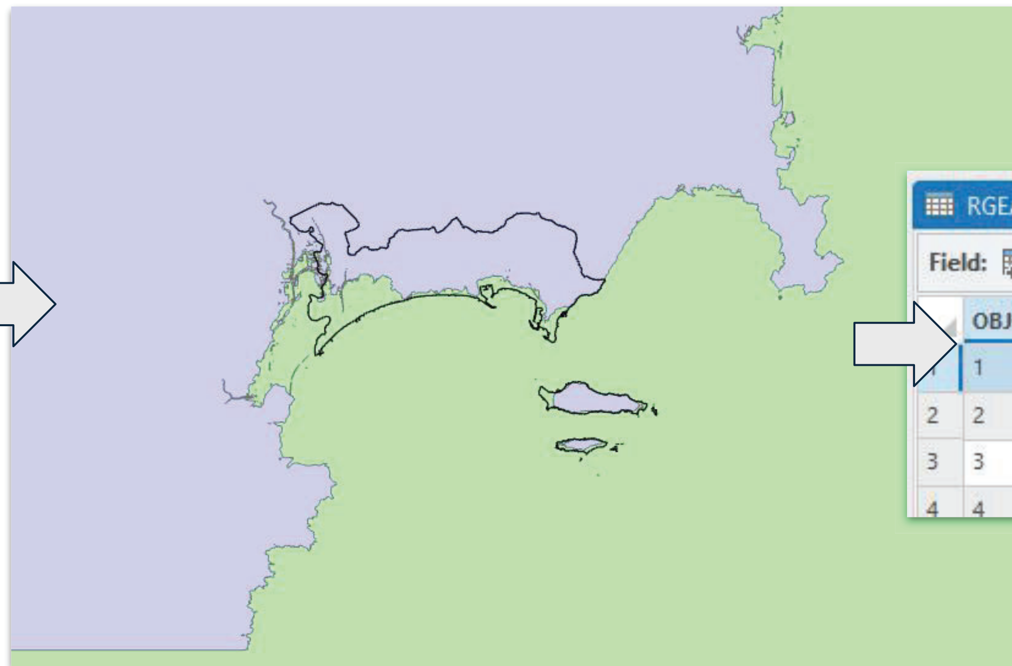
“LAYER_NAME” <= 5

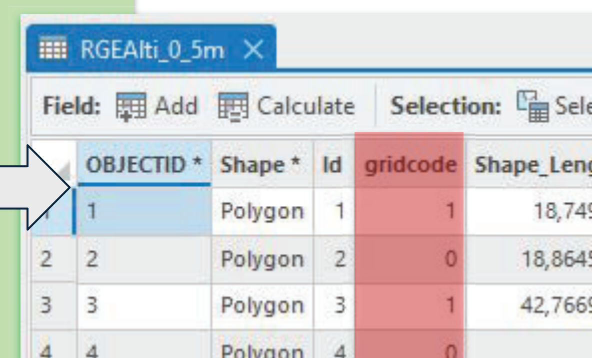


Pixel’s value is now “**0**” or “**1**” dep
the pixel elevation value match
condition or not.

Tsunami evacuation zone mapping

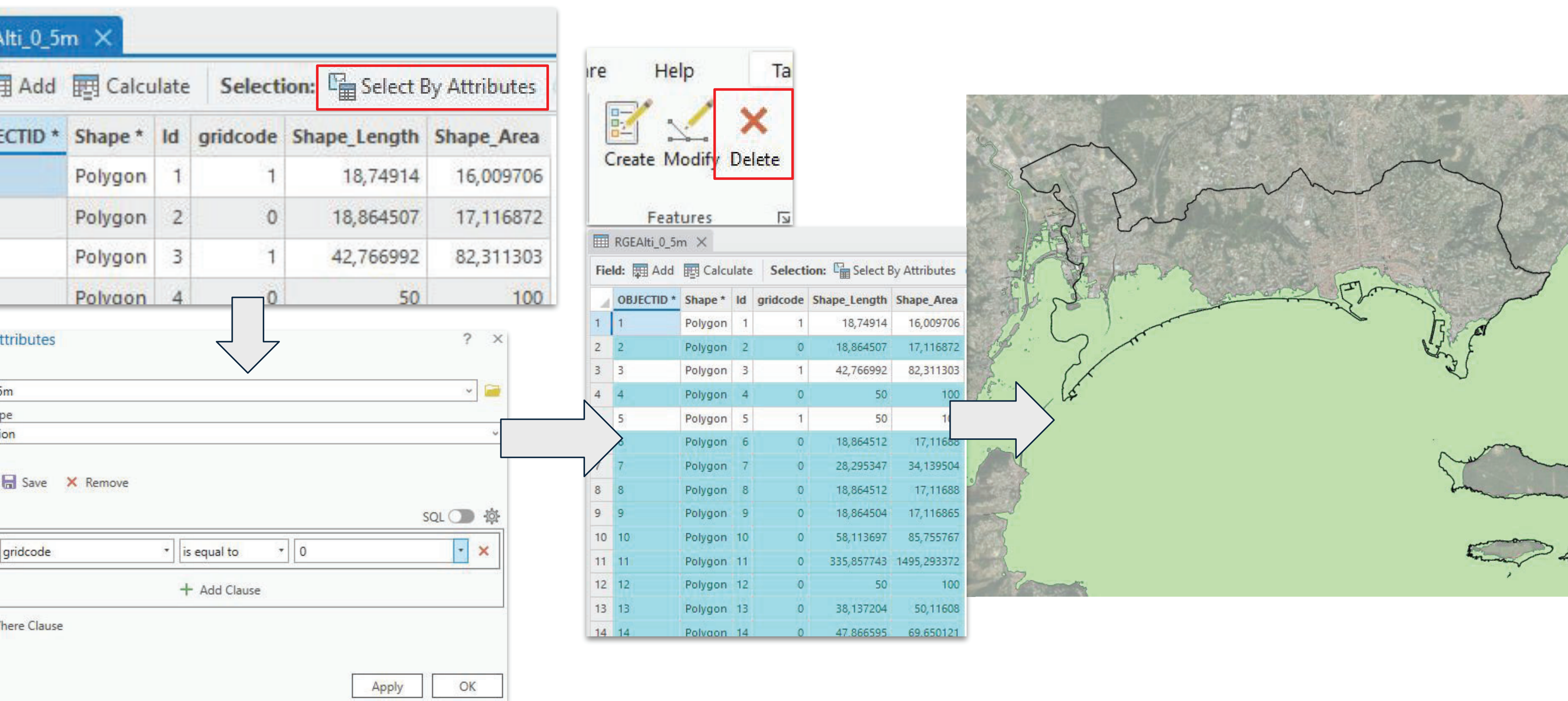




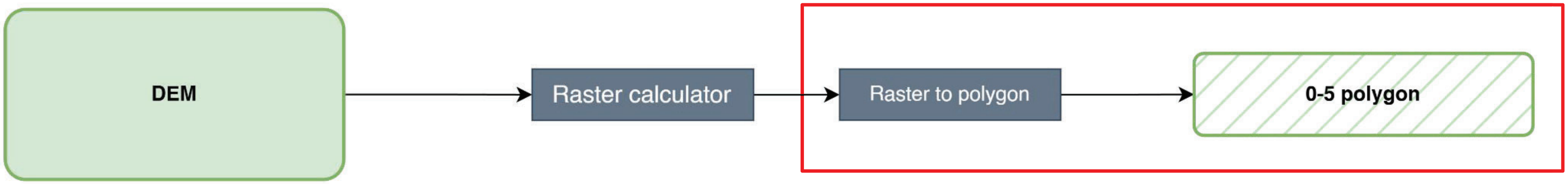


The previous raster's pixel values are in the field "**gridcode**".

Tsunami evacuation zone mapping



Tsunami evacuation zone mapping

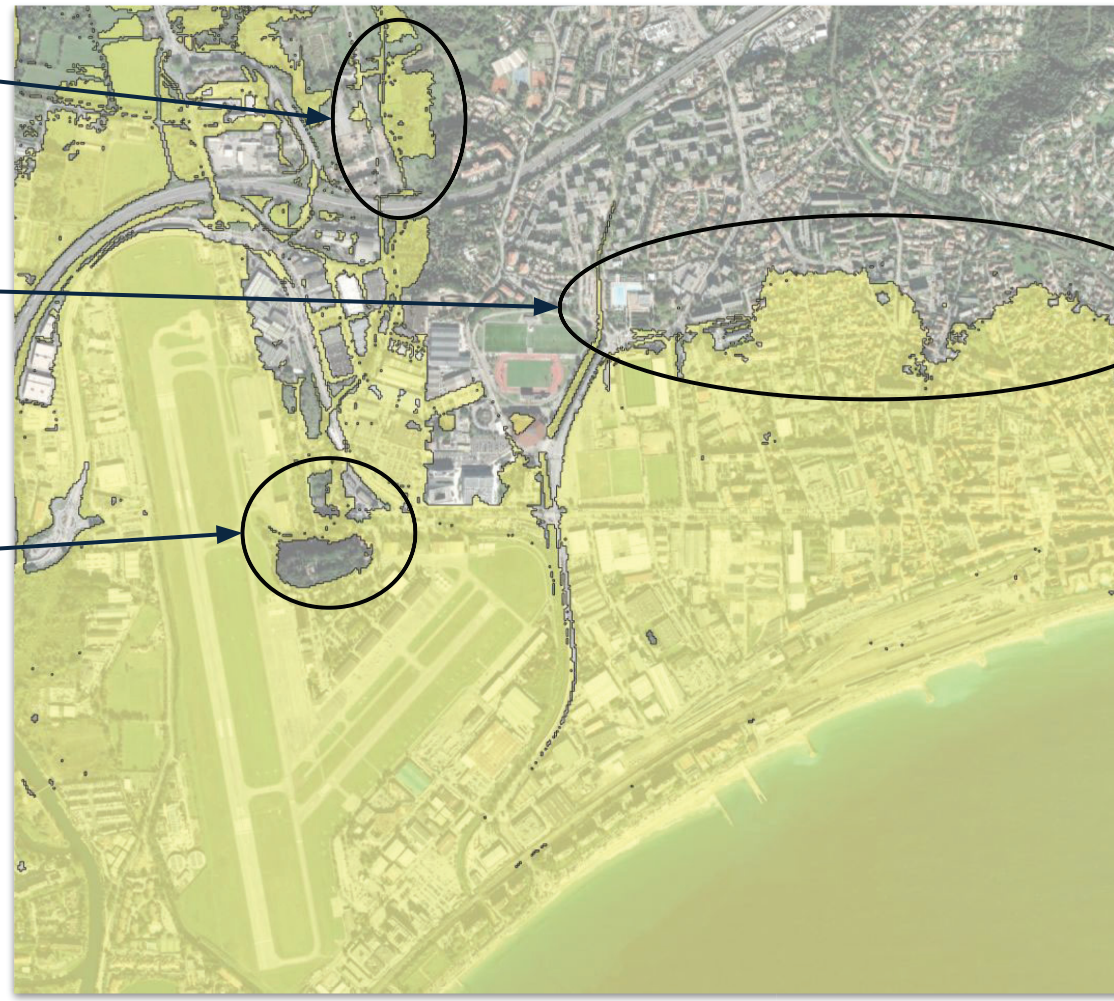


tain a polygon with a very
e level of detail that leads to
l geometries to be
lized

Isolated polygon

Polygon's edges need simplification

local variations in altitude must be deleted



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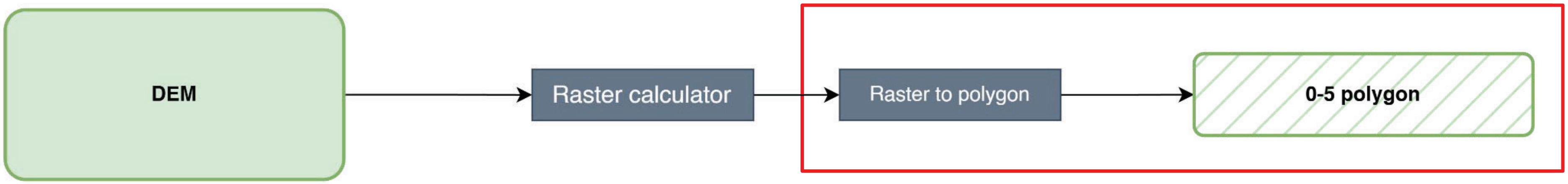
Tsunami evacuation zone mapping



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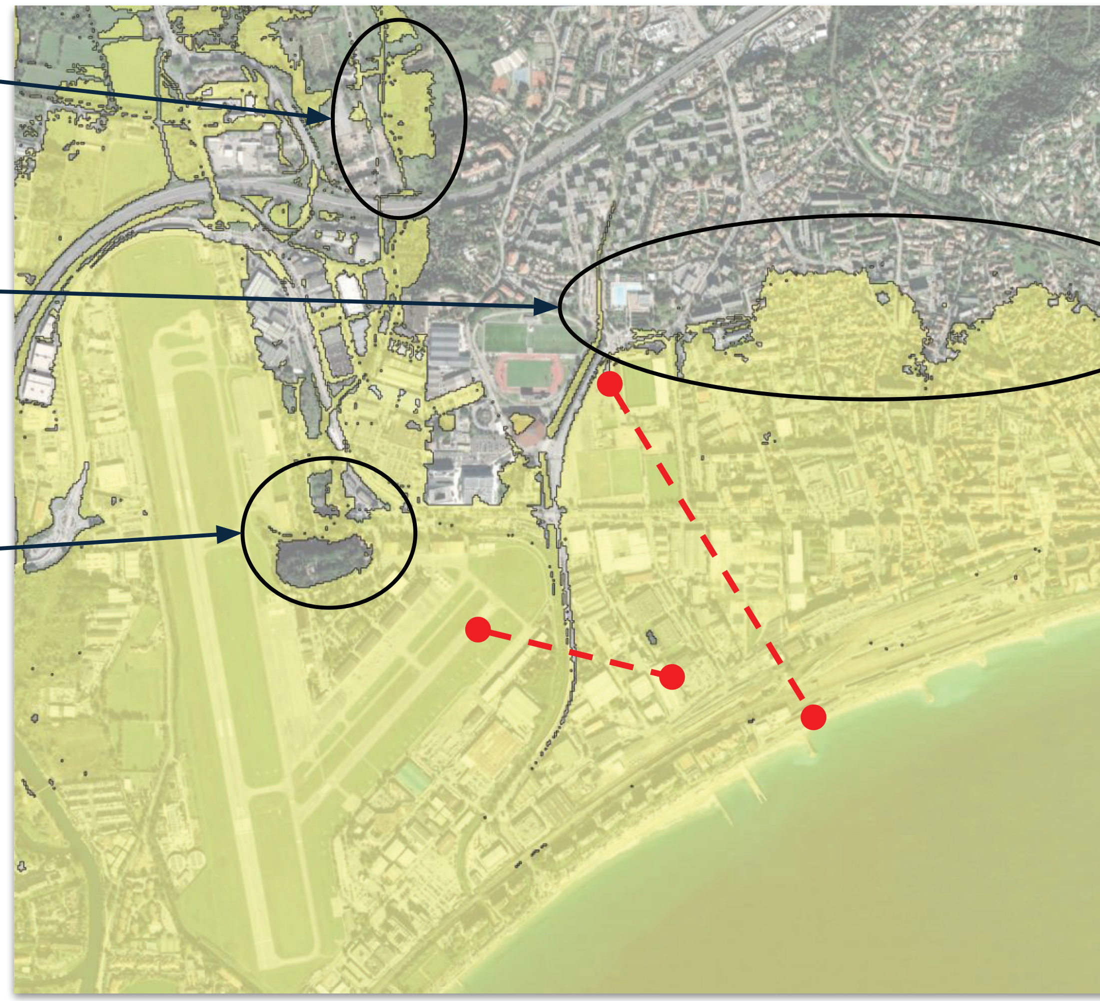
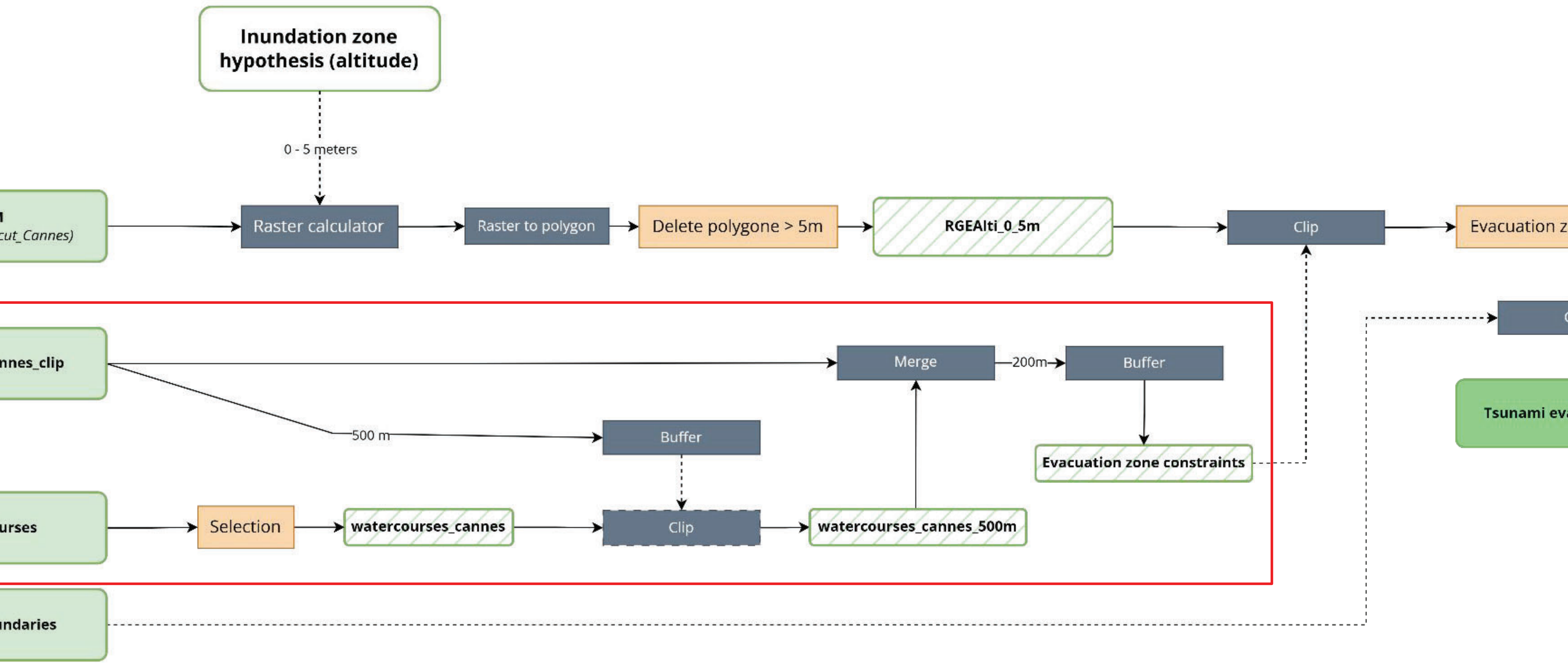


his step, **we need to take into account the**
ssumptions regarding **maximum distances**
nd **around watercourses**.

Tsunami evacuation zone mapping



Tsunami evacuation zone mapping

Only open-air hydrographic network will be taken into account for the evacuation zone

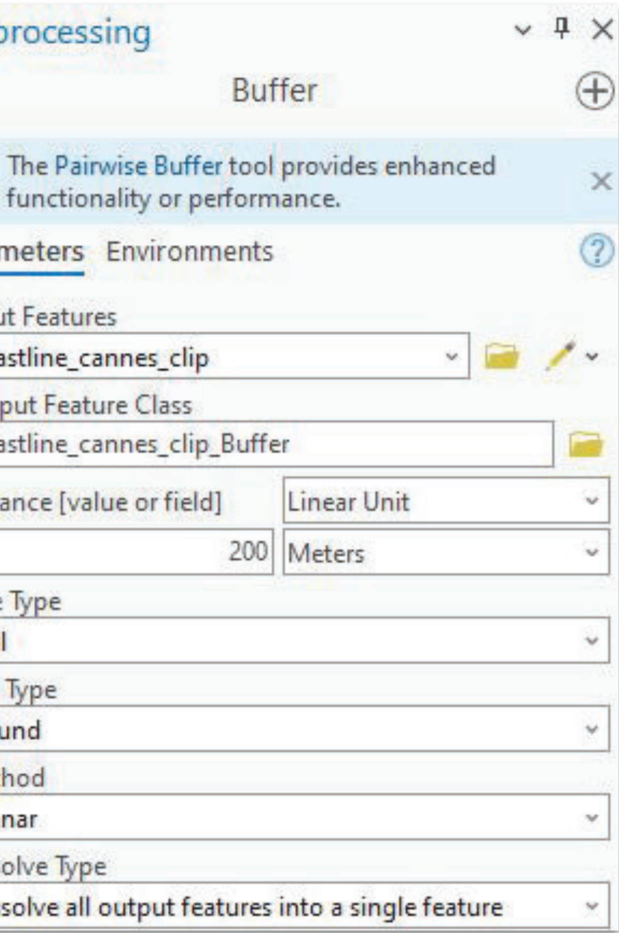
⇒ During **field mission** or trough **aerial image interpretation**

Non cased drainage

Cased drainage

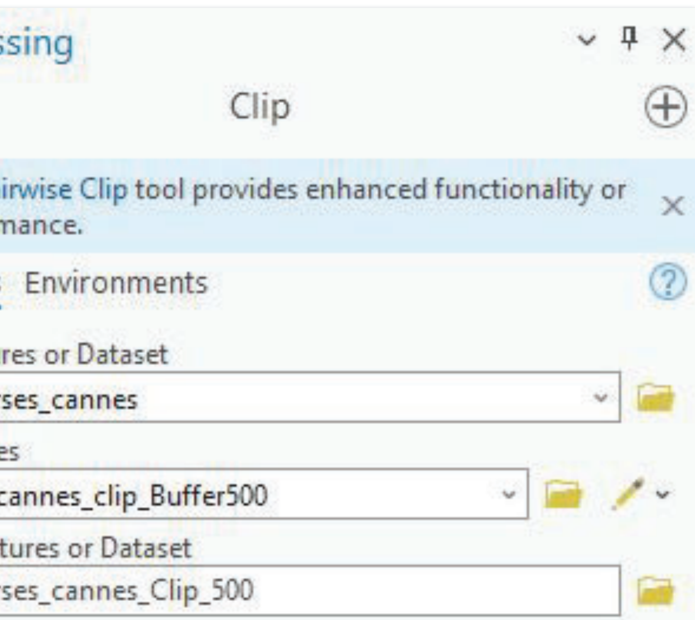
Tsunami evacuation zone mapping

nerate **500 meters buffer** on clipped coastline

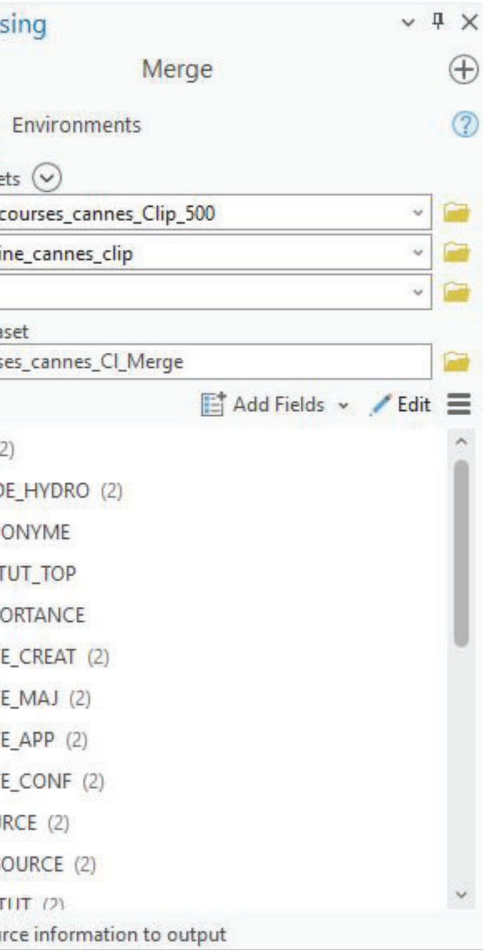


Tsunami evacuation zone mapping

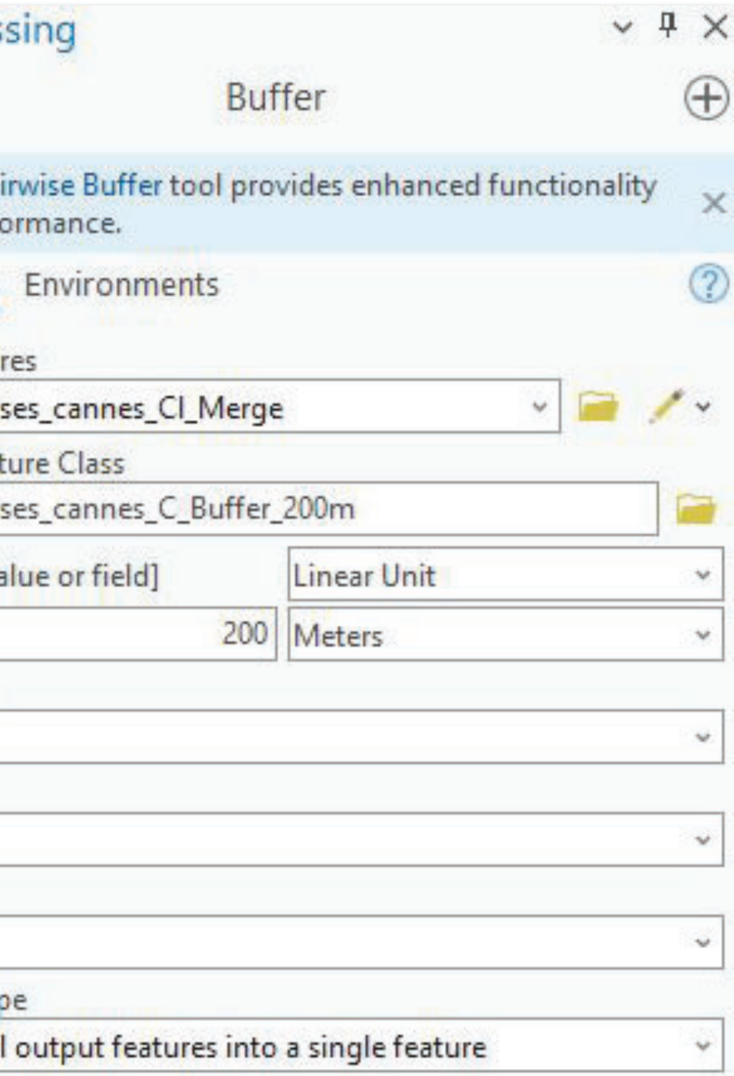
course with previous buffer

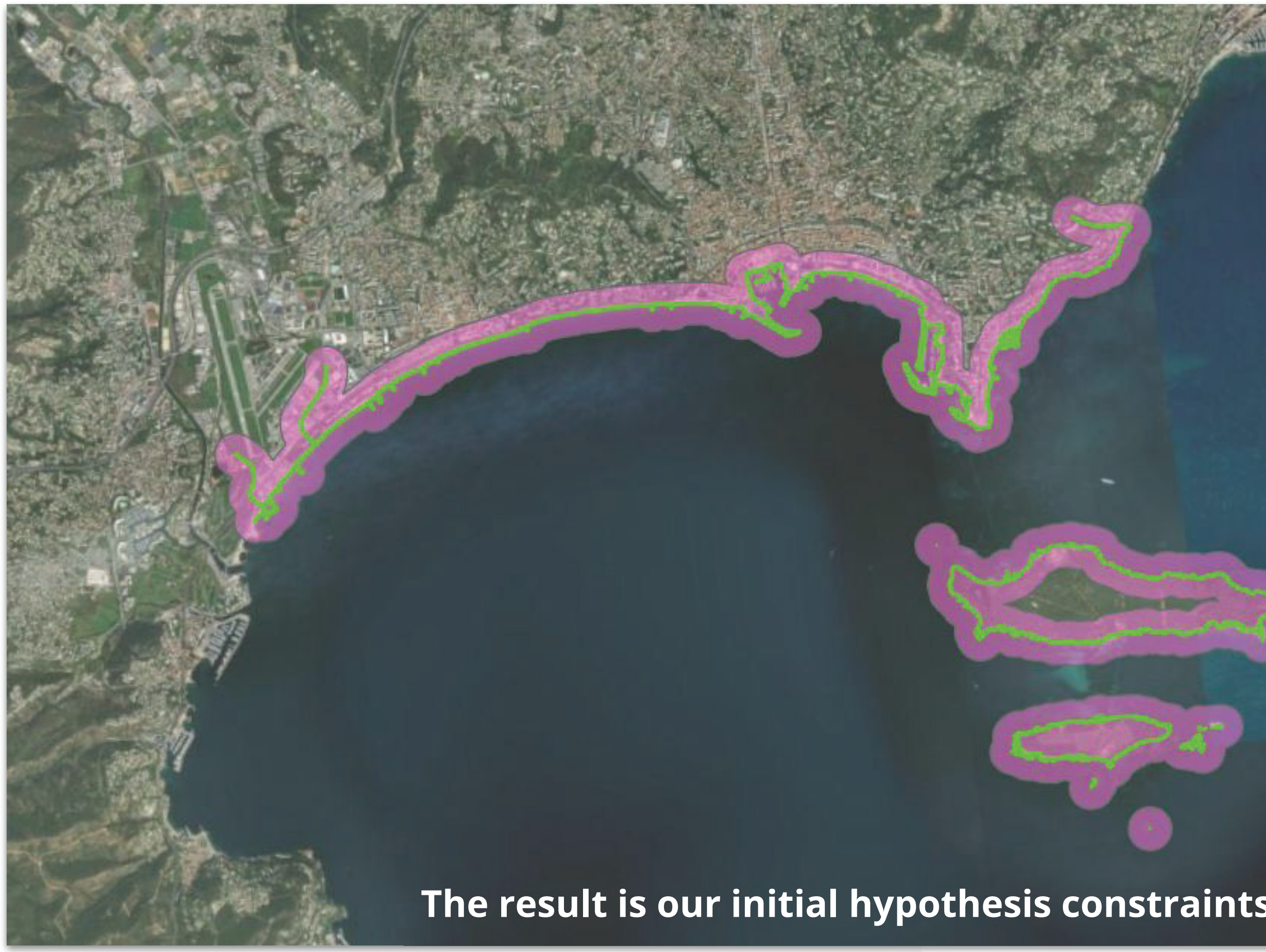


e both watercourse & coastline

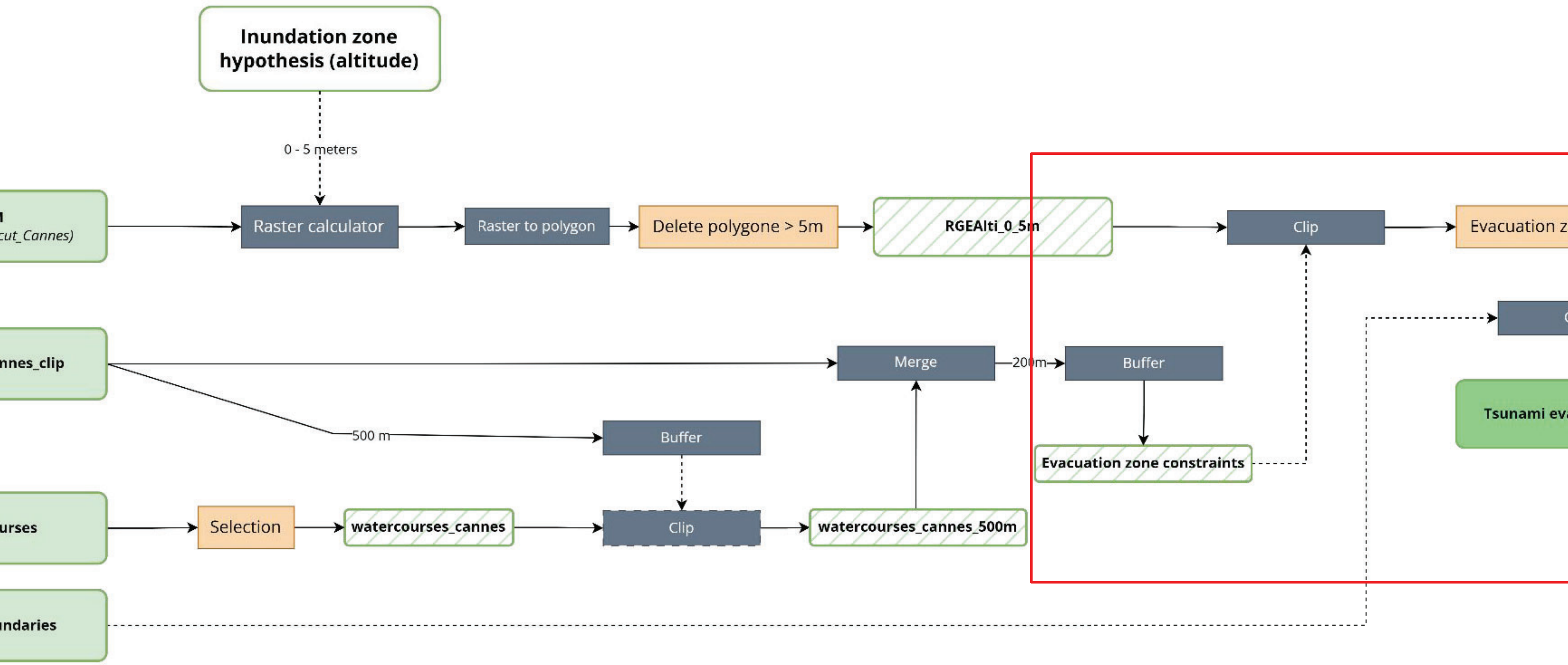


200 meters buffers with the merged layer and export the result as "**evacuation_zone_constraints**"





Tsunami evacuation zone mapping



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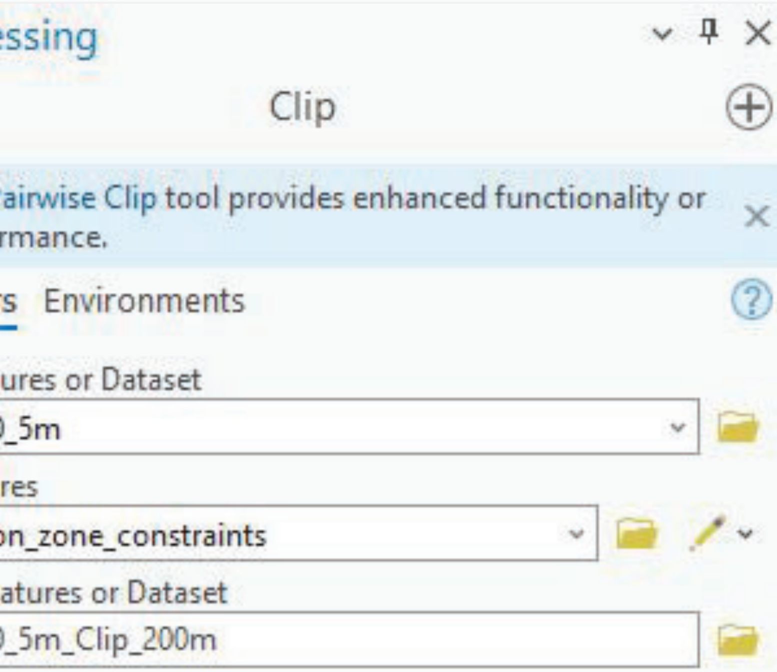
Tsunami evacuation zone mapping

RGEAlti_0_5m on the **evacuation_zone_constraints** layer.

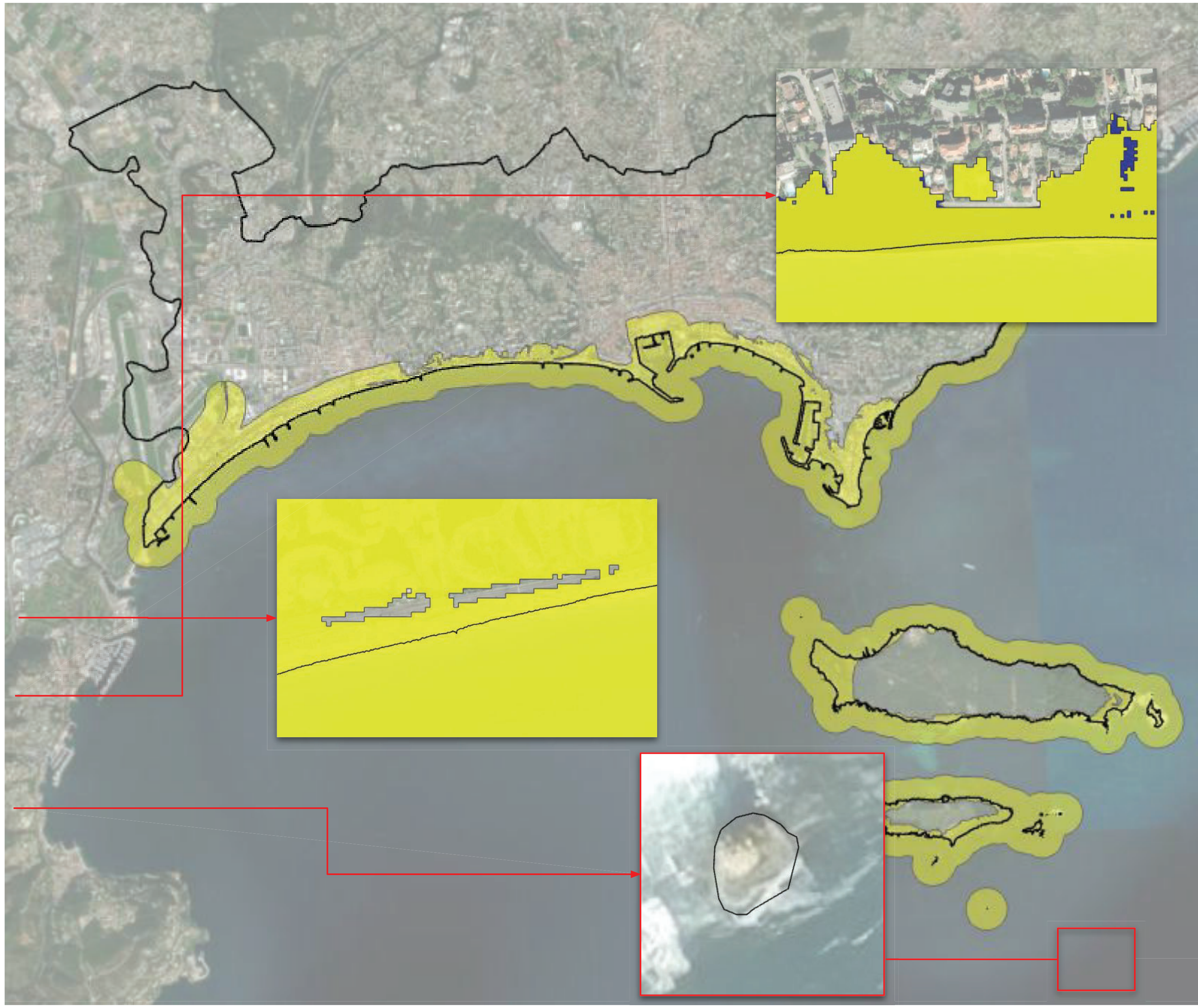


on #1 | Tsunami evacuation zone mapping

g the RGEAlti_0_5m with nstraints polygon provide **raw version** of the tion zone which will be o create the final tsunami tion zone.

tions are needed at this

- moving off-lands parts
- moving holes due to local vation change
- moving parts not nnected with the sea
- oothing the polygon's ges
- moving small inhabited et



& Dilation on Vector Data

r the
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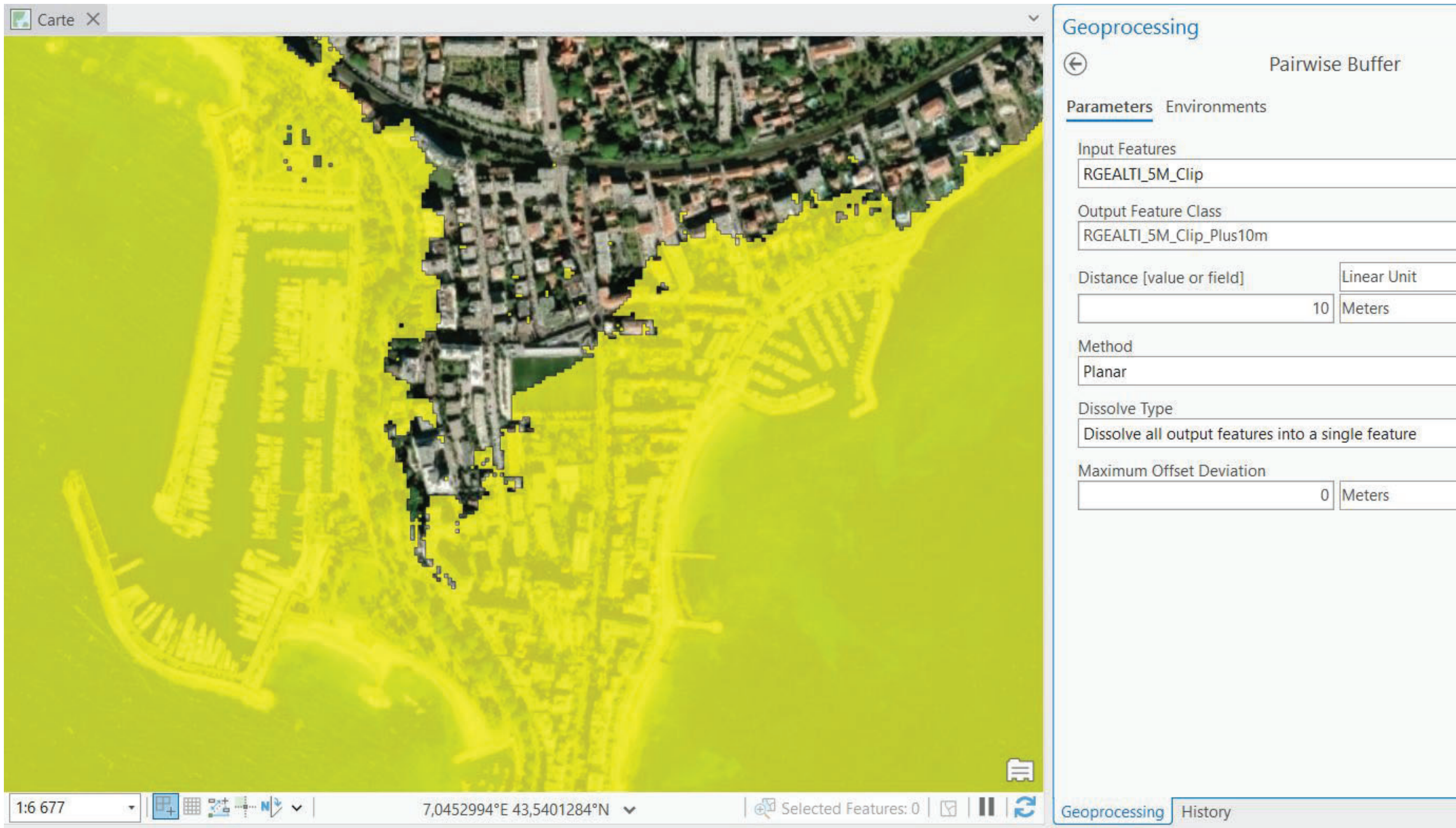

Tsunami evacuation zone mapping

& Dilation on Vector Data

ne
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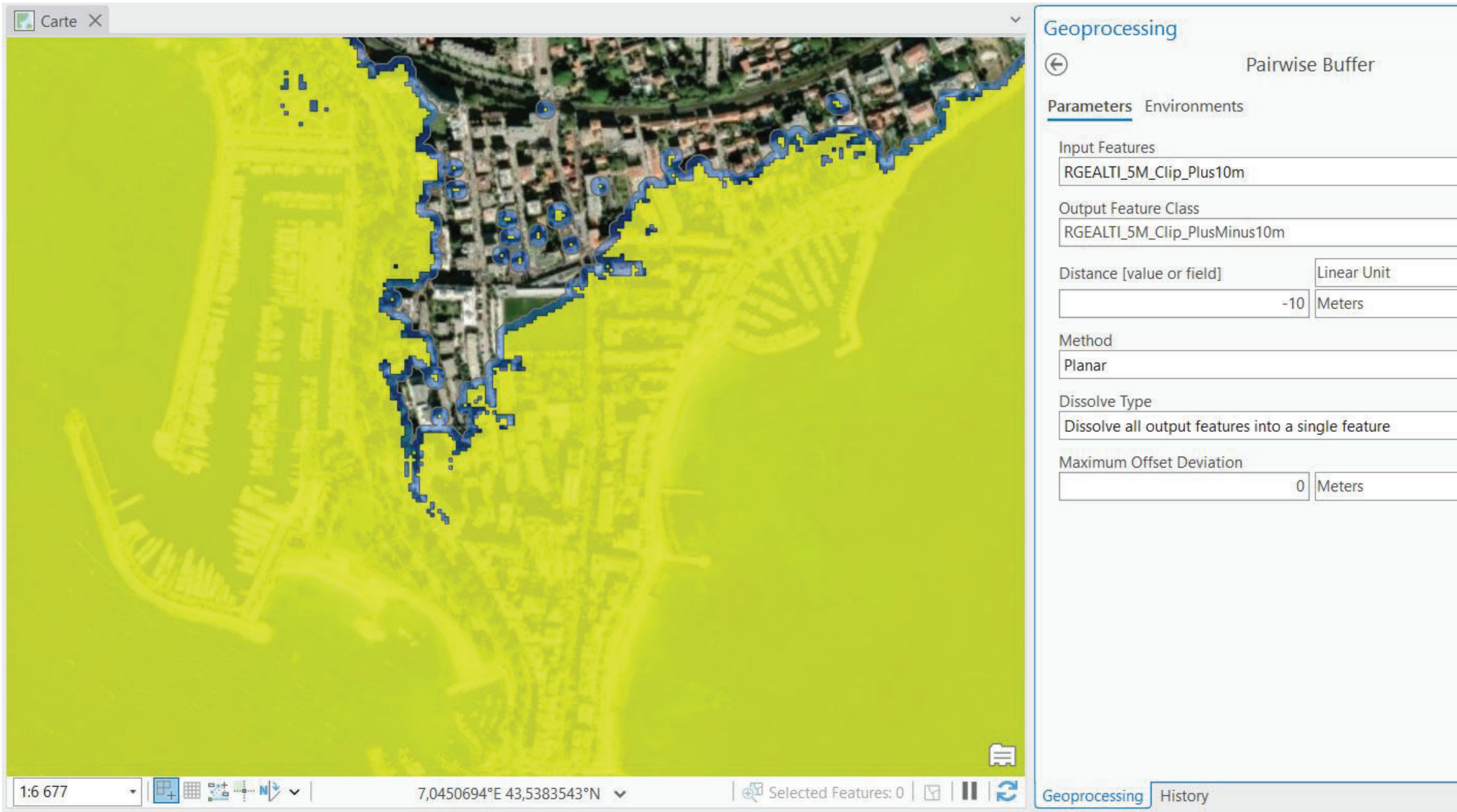

& Dilation on Vector Data

d geometry
nplified
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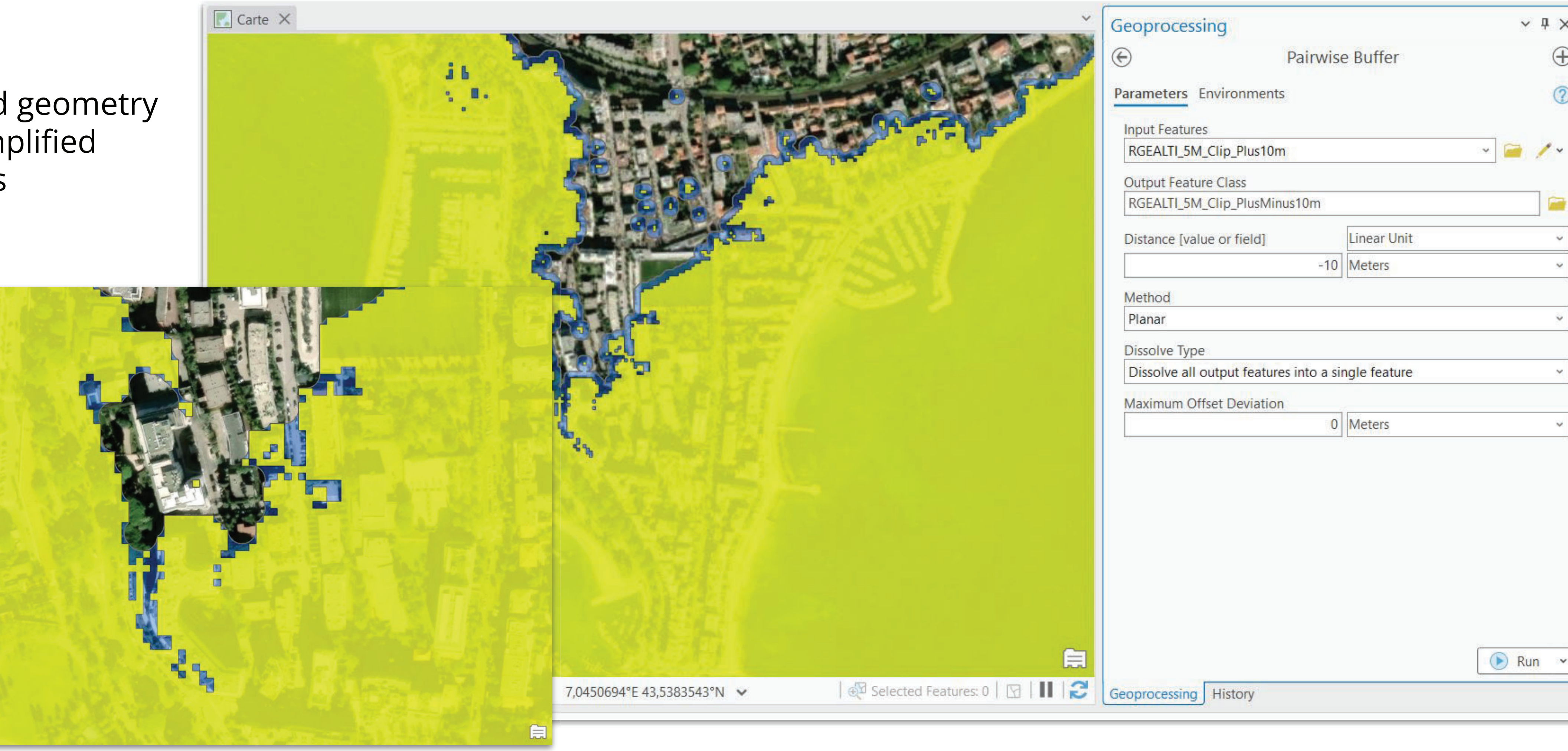
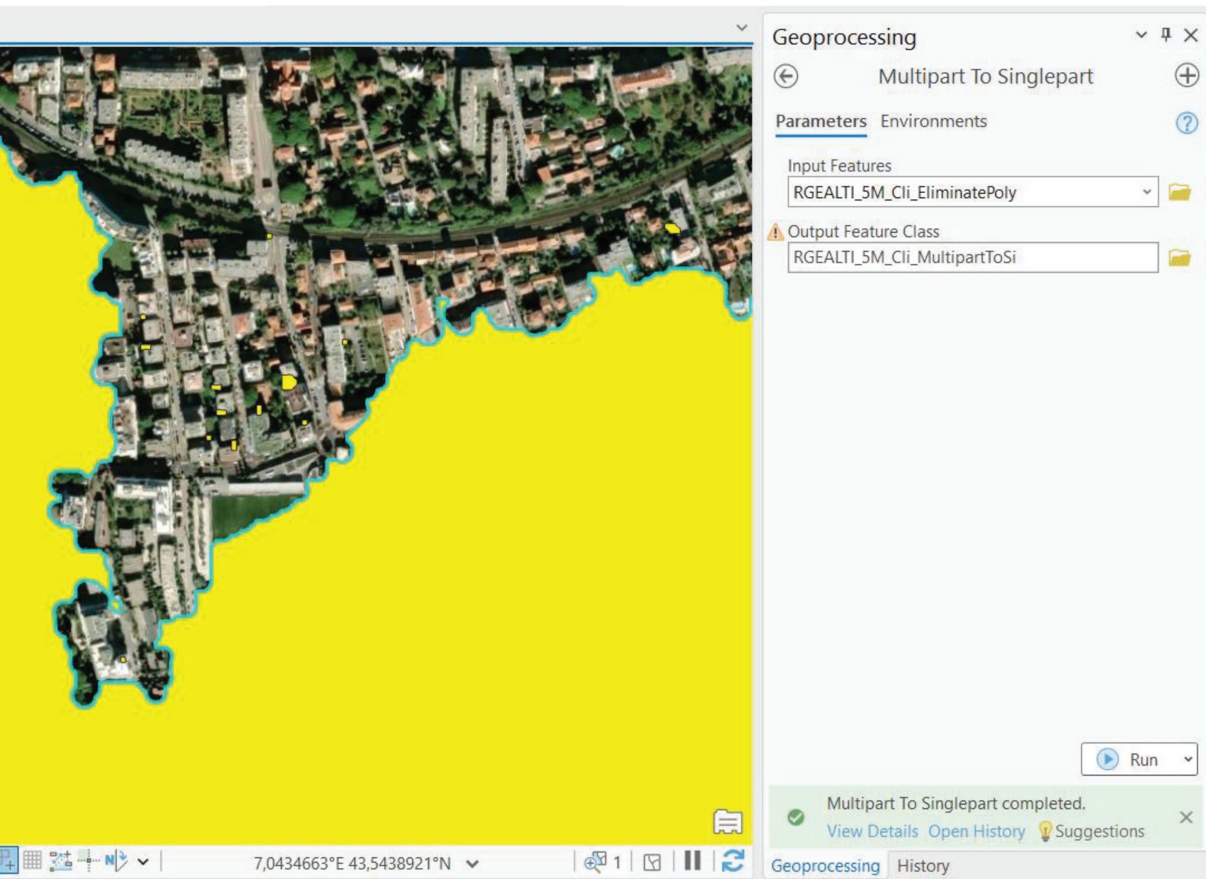


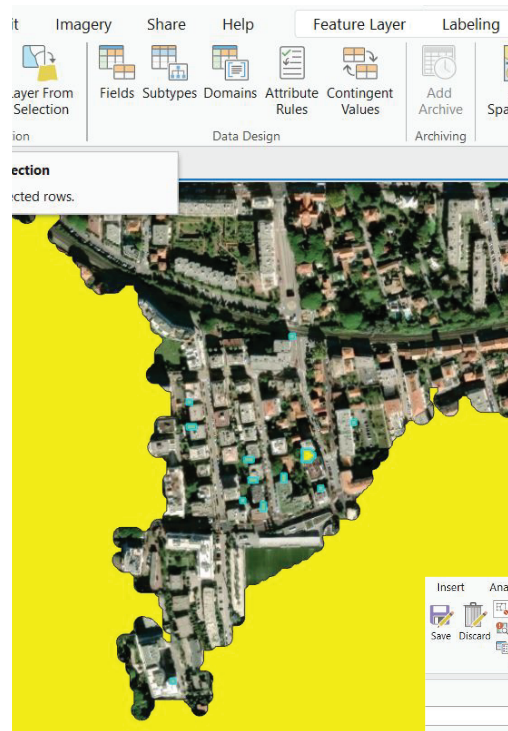
Tsunami evacuation zone mapping

nate Polygon Part geoprocessing tool allows holes larger than the ***minimum hole size*** parameter
ult of the algorithm can vary significantly depending on the input parameters.

ate Polygon Part geoprocessing tool allows holes larger than the ***minimum hole size*** parameter
ult of the algorithm can vary significantly depending on the input parameters.

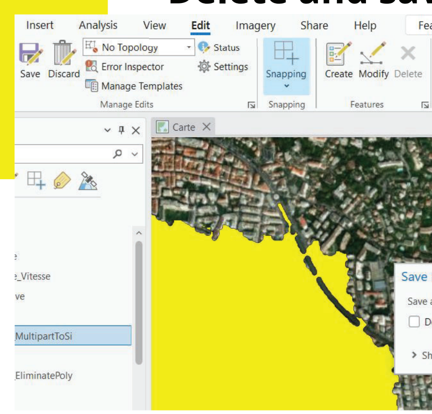
Select





Inverse selectio

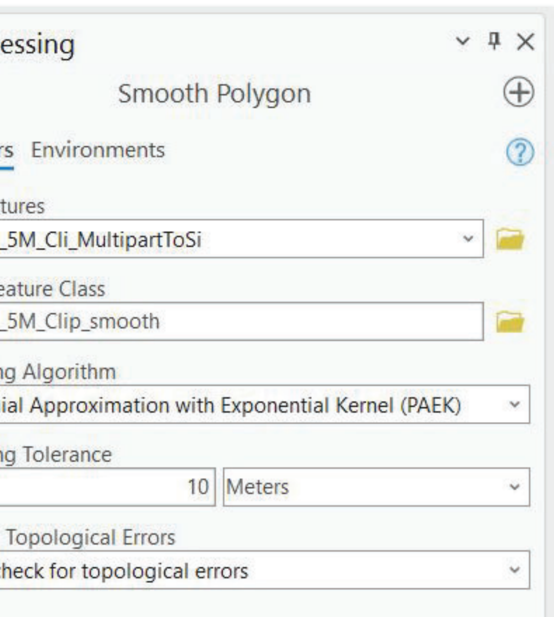
Delete and sav

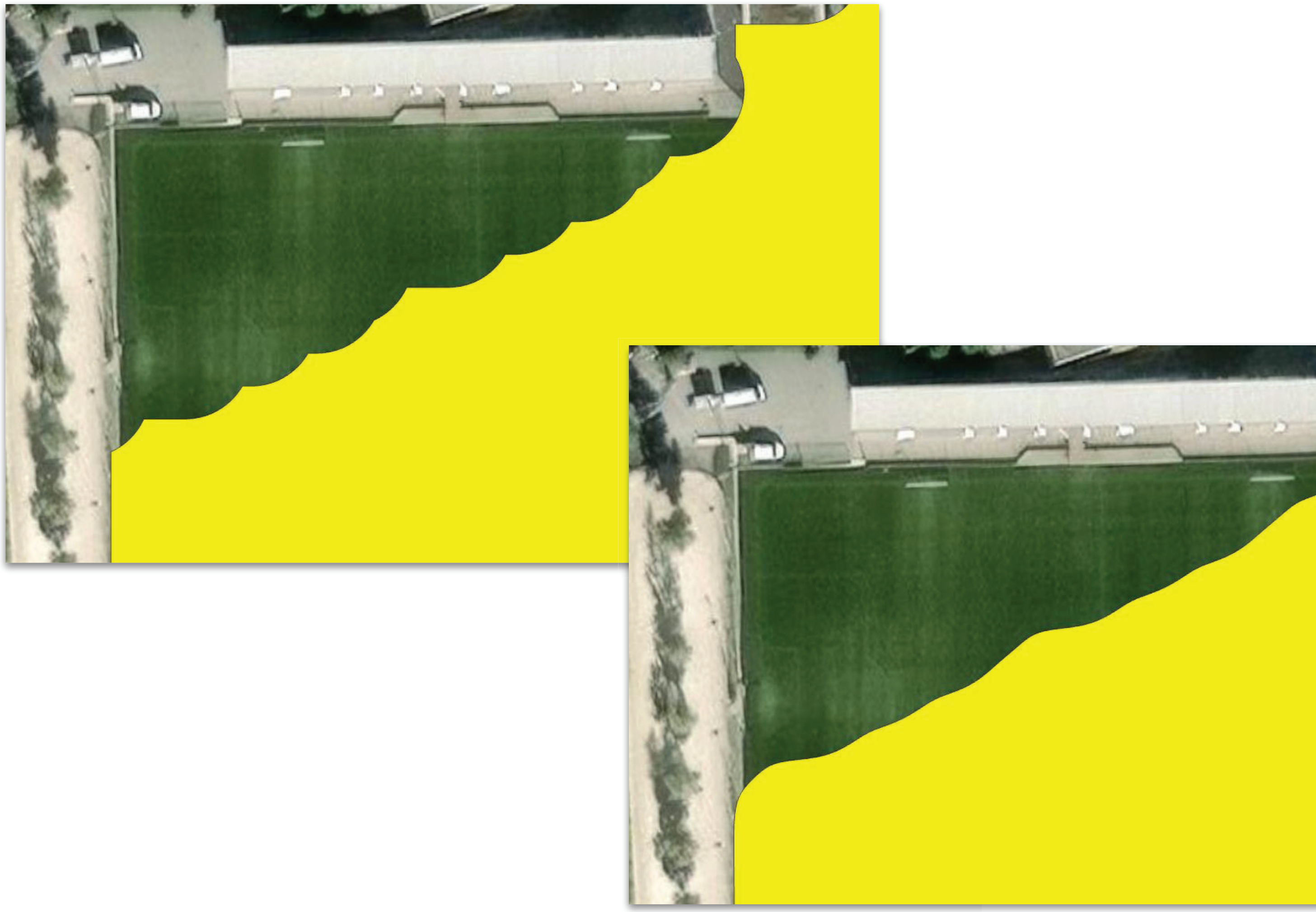


Tsunami evacuation zone mapping

moothing for Clearer Boundaries

th the evacuation_zone o reduce angular s and improve boundary bility.



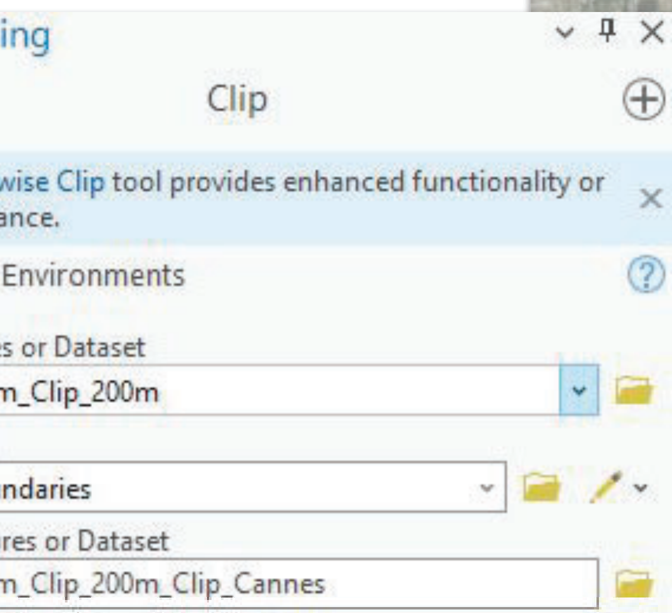


Tsunami evacuation zone mapping

: off-land parts by the layer with Cannes es polygon.

g the layer with coastline ssible if the communitie's s aren't accurate along

erate a polygon using a ution coastline and the our work area



Tsunami evacuation zone mapping

e that the result of the clipping operations is conform to our initial hypothesis (0-5m high & 200m inland or 50(
r watercourses that are connected to the sea)

Tsunami evacuation zone mapping

cation is mandatory in order to detect the need for local adaptations that assessed through imagery analysis.

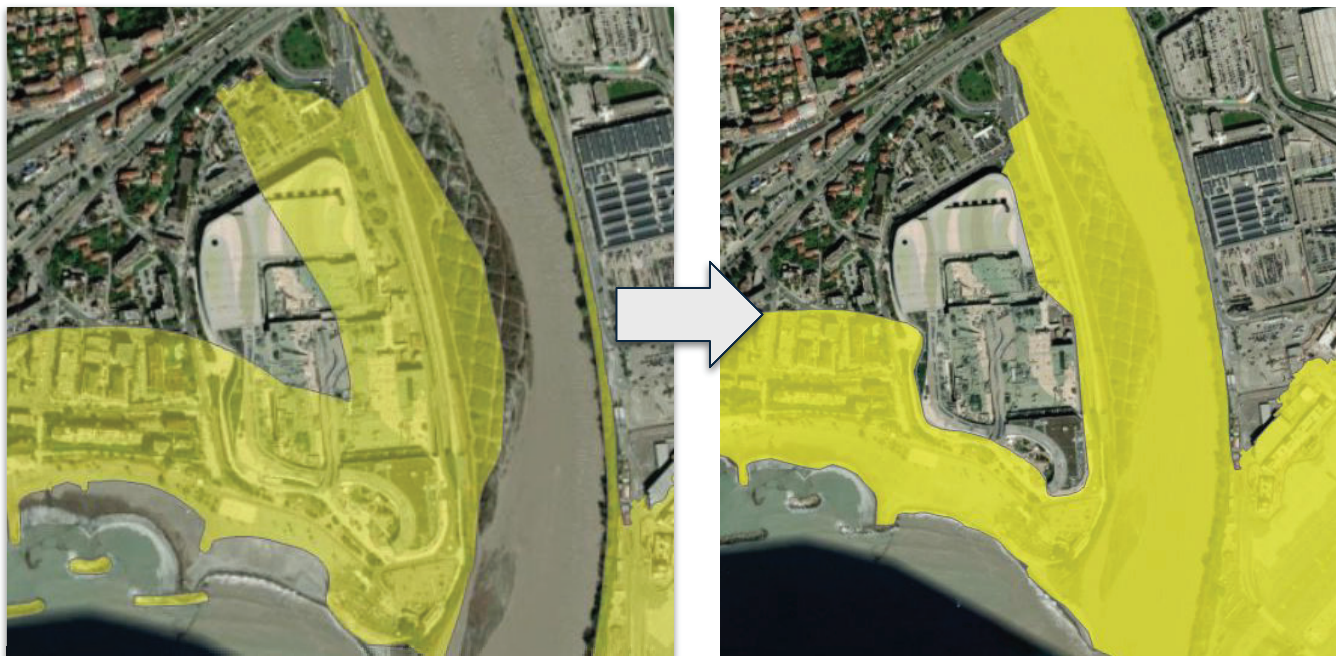
Lidar's 0-5m range extracti

00, Nice's metropole's largest mall

e large numbers of visitors, the decided to make an exception to the evacuation instructions for this enter : people already in the mall will inside.

allowed to take into account the onstructed seafront terrace that ilable on satellite imagery at the f the project.

ation zone along the mall was ased on the field verification and Lidar data

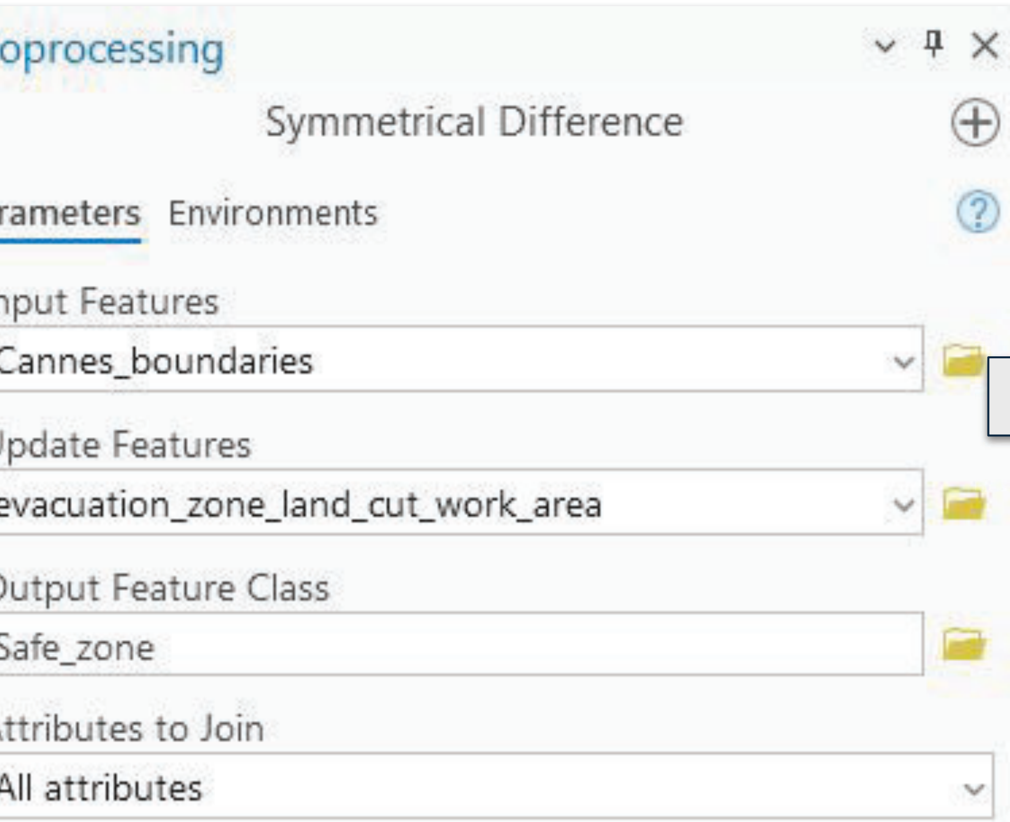


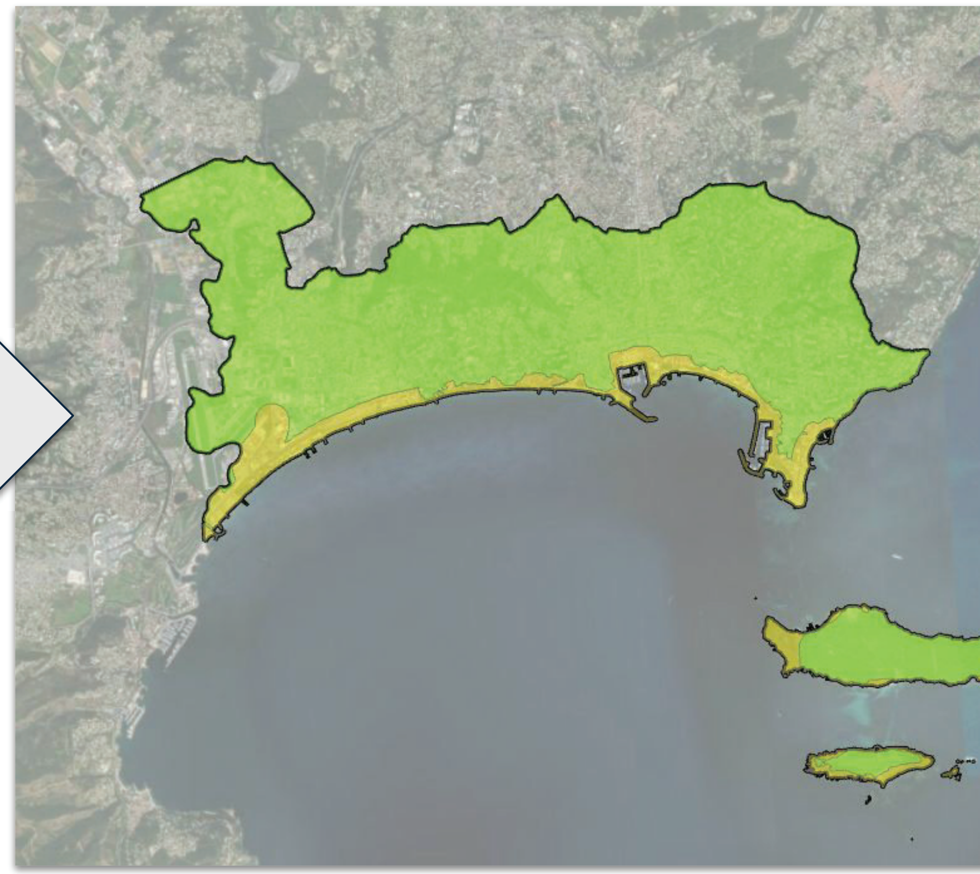
Tsunami evacuation zone mapping

Generate the tsunami safe zone !

Tsunami evacuation zone mapping

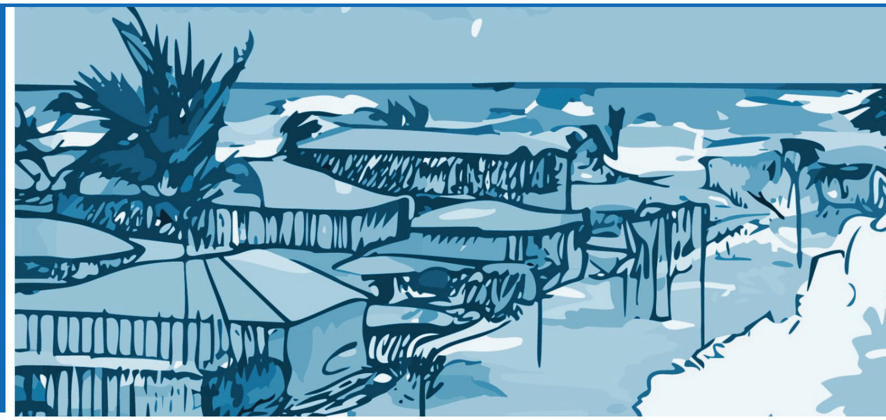
se the **Symmetrical difference** tool between the evacuation zone and Cannes boundaries to enerate the safe zone





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

unami Evacuation
apping Workshop



CoastWAVE 2.0 Project

IOC-UNESCO (EU DG ECHO)

Dr. Matth
Lo

30 June – 4 .

Contact : matthieu.peroche@uni

CO

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