Zoning of the threat from torrential floods in municipalities of Colombia.

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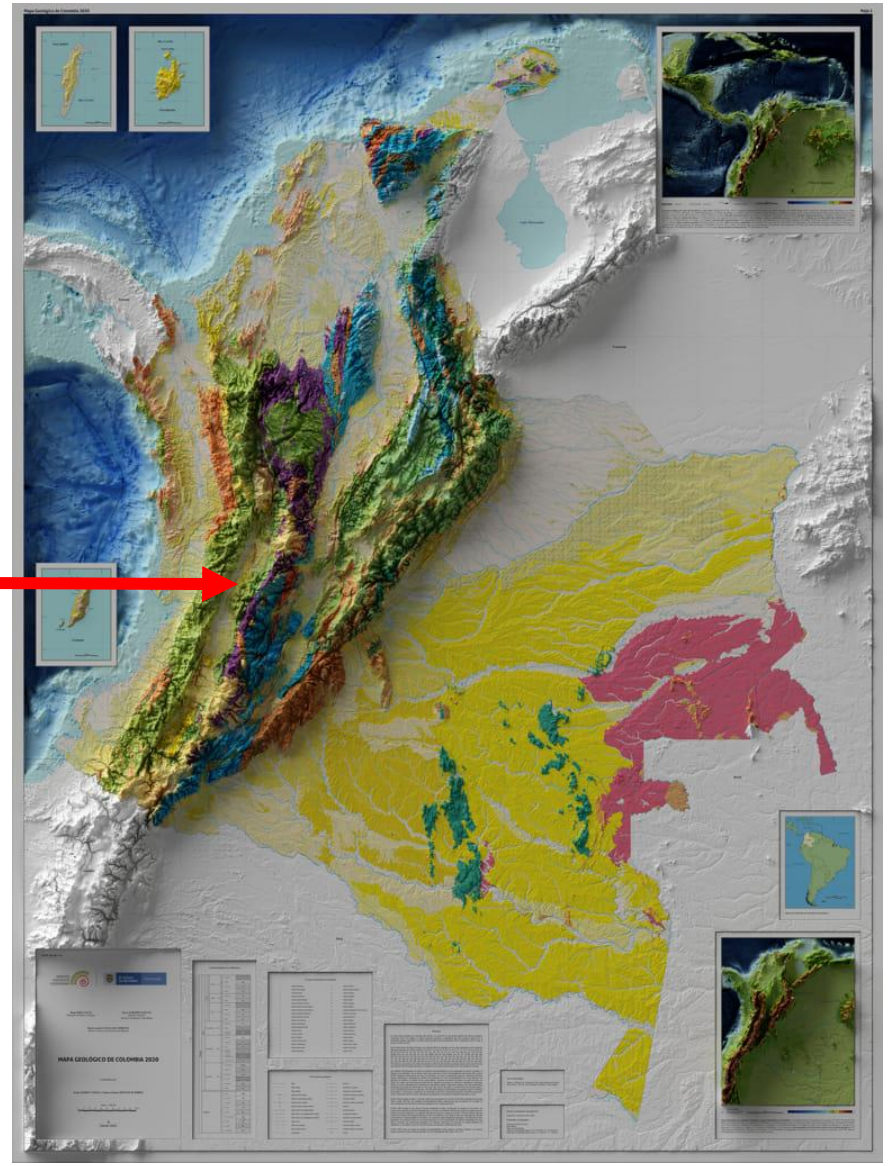
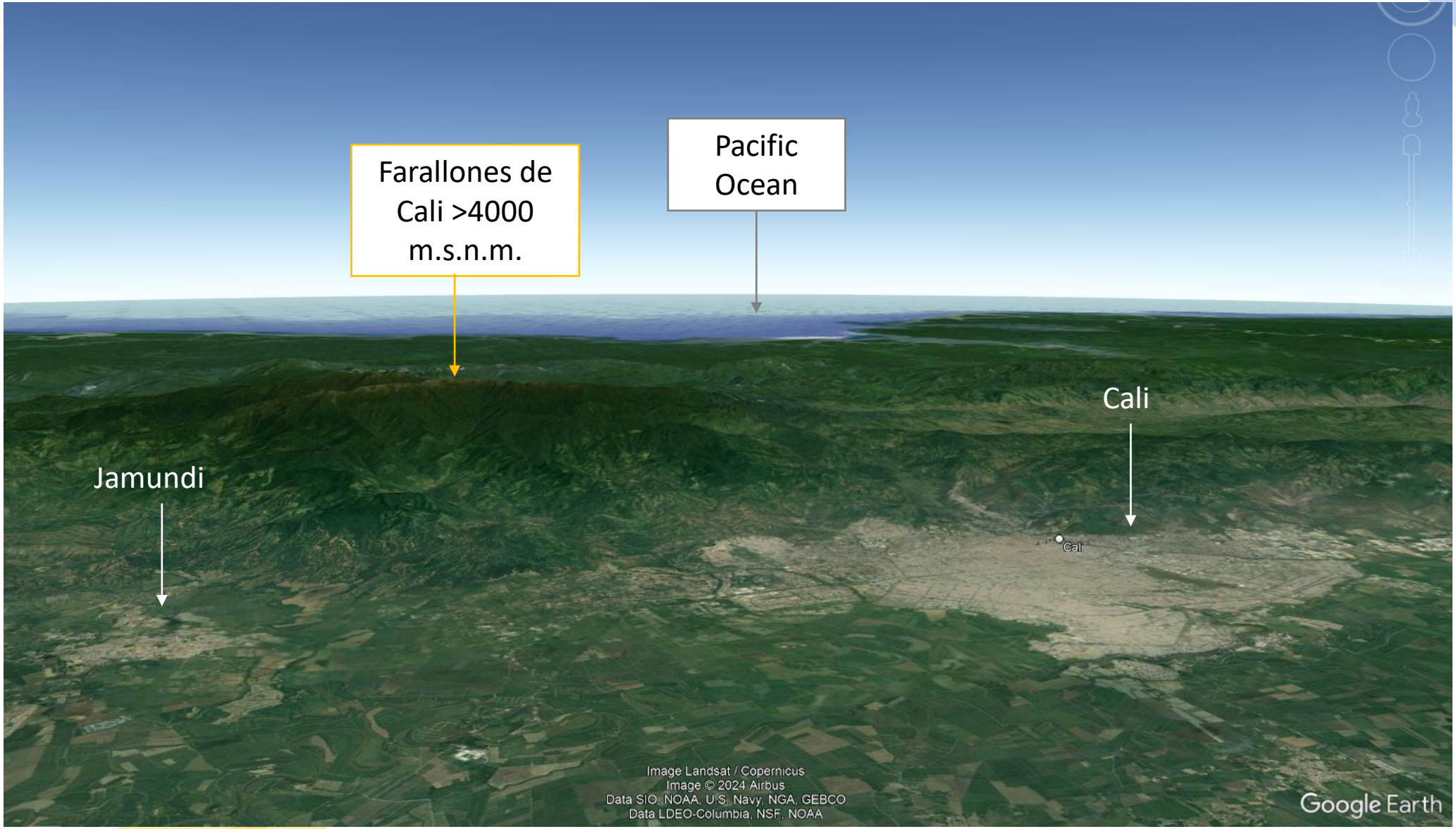
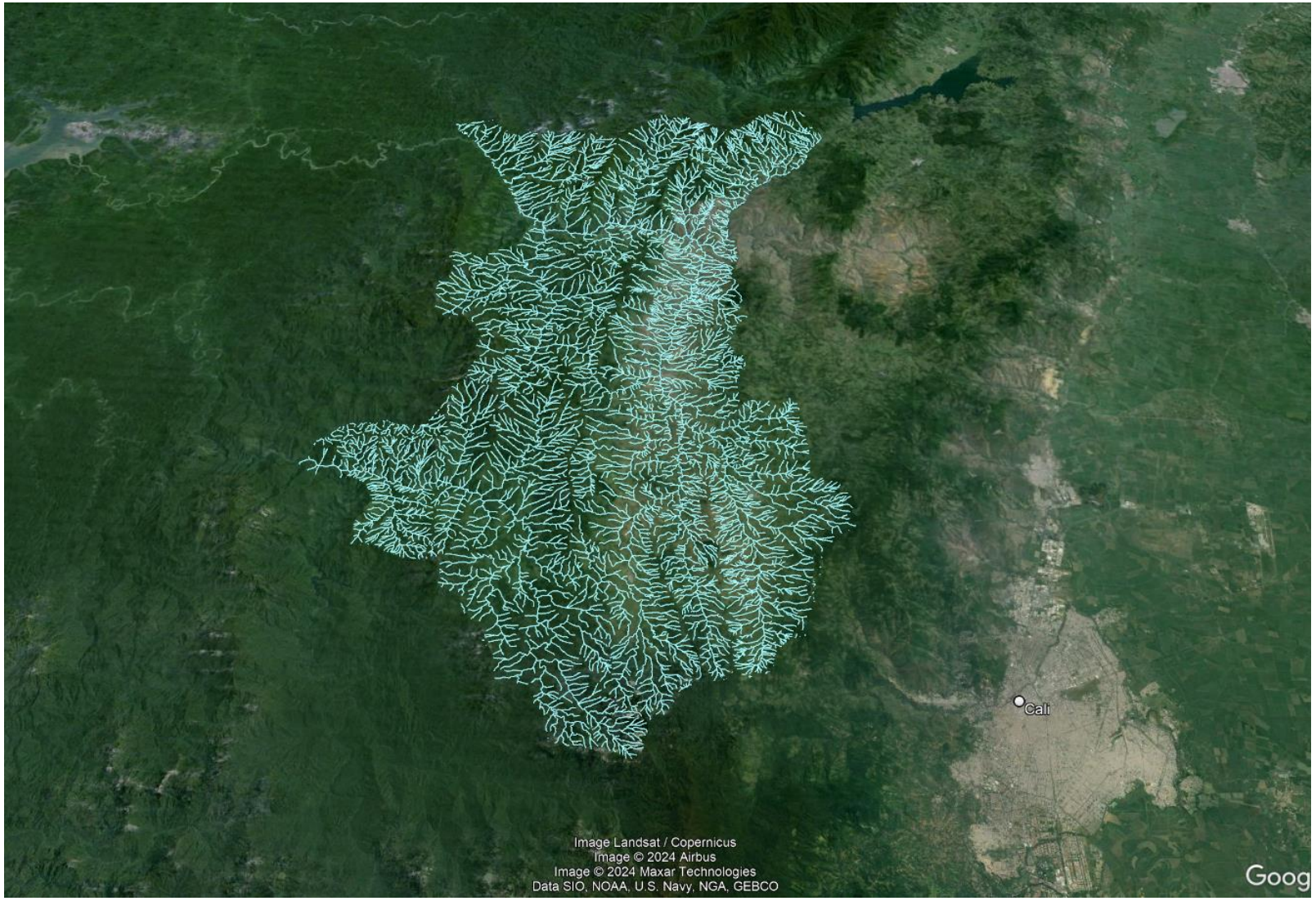
→ 80% lives here
→ 45.6 millions



51.7 millions of inhabitants

SGC, 2021

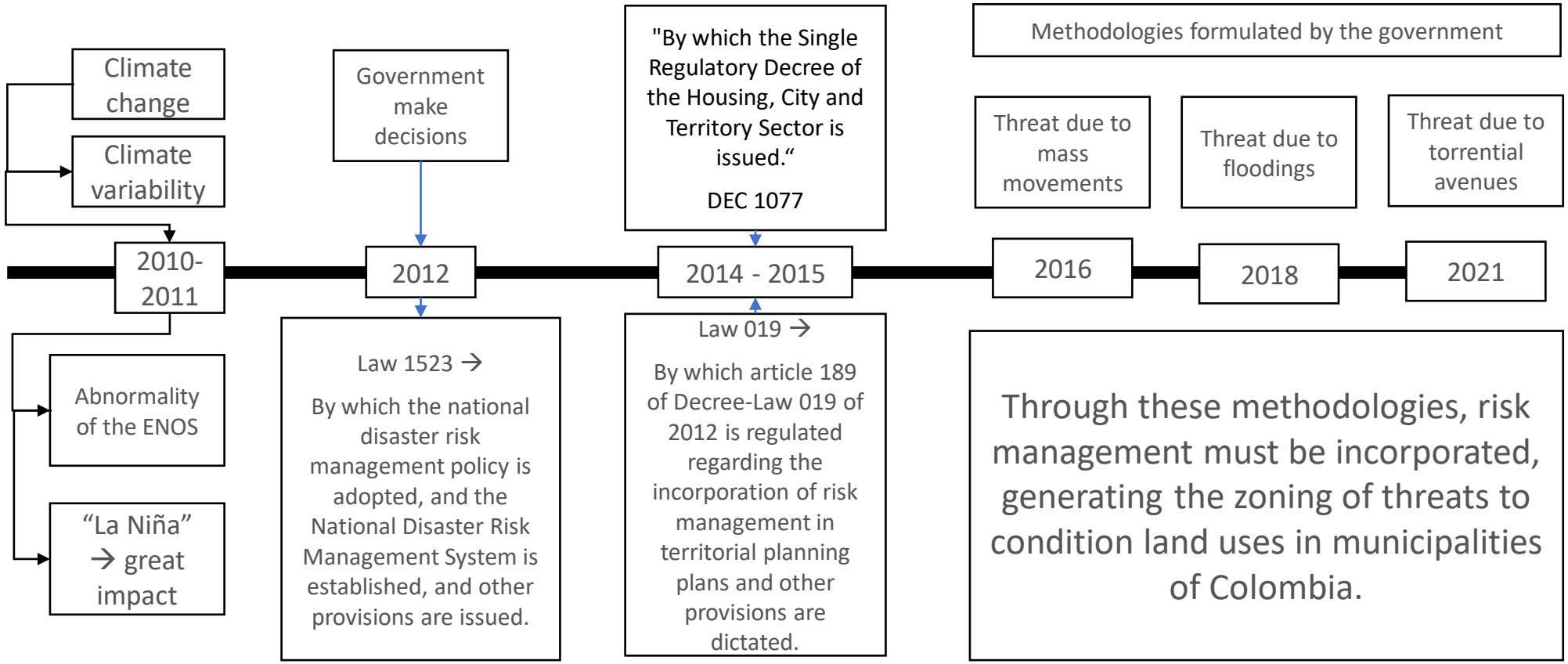

Farallones de Cali >4000 m.s.n.m.
Pacific Ocean
Cali
Jamundi
Cali
Image Landsat / Copernicus
Image © 2024 Airbus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Google Earth



886 $\underline{km^2}$

https://redmas.com.co/colombia/Videos-impactantes-de-las-inundaciones-en-Cali-desastres-en-clinicas-y-centros-comerciales-20240515-0049.html

1. Framework of risk management incorporation in municipalities in Colombia – zonification of hazards



2. Legal act and its methodology

- DEC 1807 → Torrential avenues threat → Article 10. Basic threat studies due to torrential floods. To determine the threat conditions due to torrential floods in urban soils, urban and rural expansion, the basic studies have the following minimum specifications:

1. Study area: **All channels present or with influence in the municipality** or district, which due to their topographic conditions may have torrential behavior.

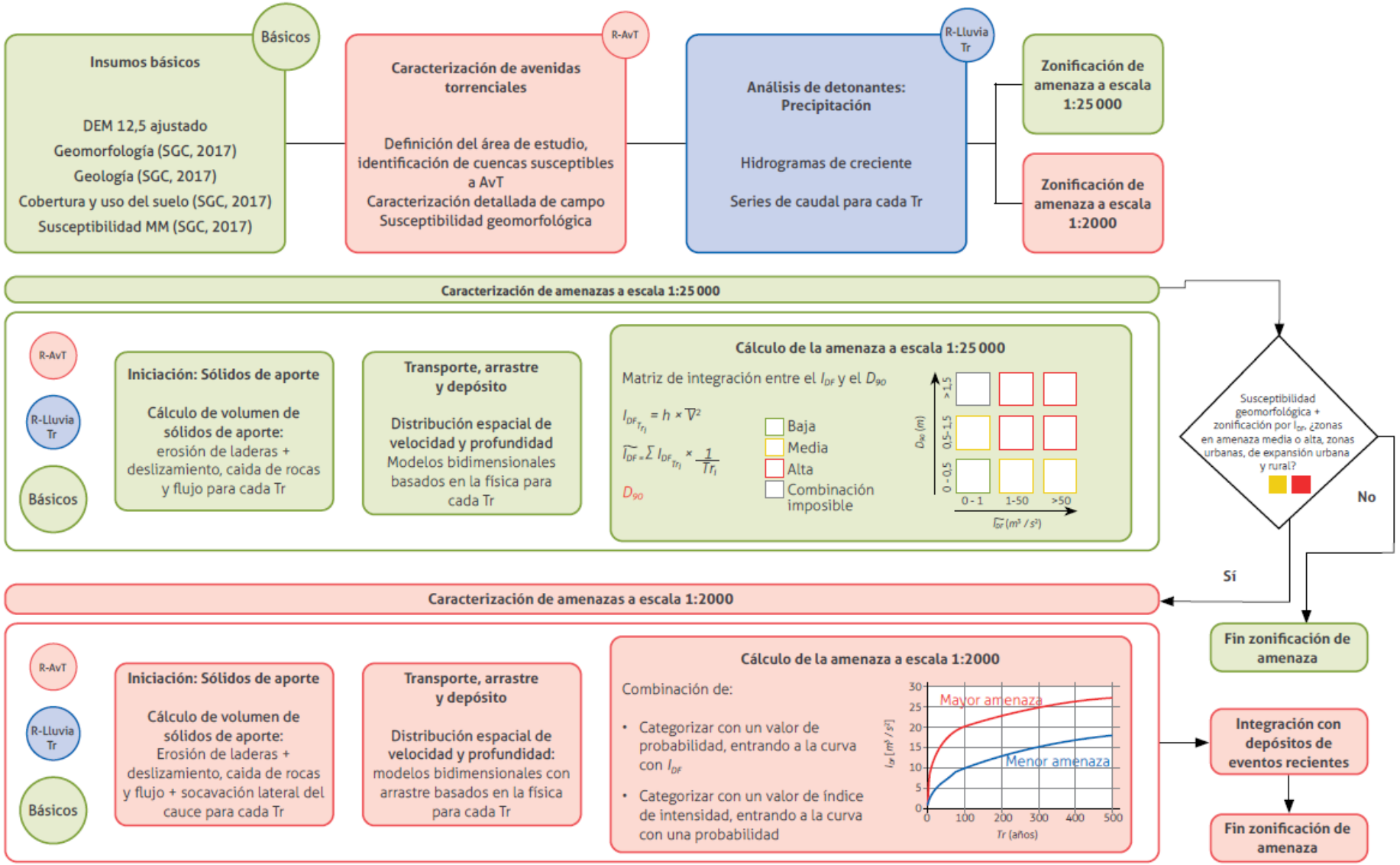
2. Inputs: At least the following inputs must be used: a) Geomorphology; b) Hydrological study of the basin, oriented to torrential flow, considering the sediment cycle; c) Hydraulic analysis of the area to be zoned, taking into account triggering factors such as precipitation or mass movements; d) The cartographic base used in zoning will correspond to a scale of 1:2,000.

3. Scope: For the zoning of the threat, it will be categorized as high, medium and low, depending on the frequency of occurrence of the events and their characteristics: the depth of the water sheet, the trawl materials and the speed of the flow.

At least one of the following analyzes is used: statistical, deterministic or probabilistic. In any case, the analyzes are carried out based on the magnitude of the threat, its intensity, consequences and the availability of information.

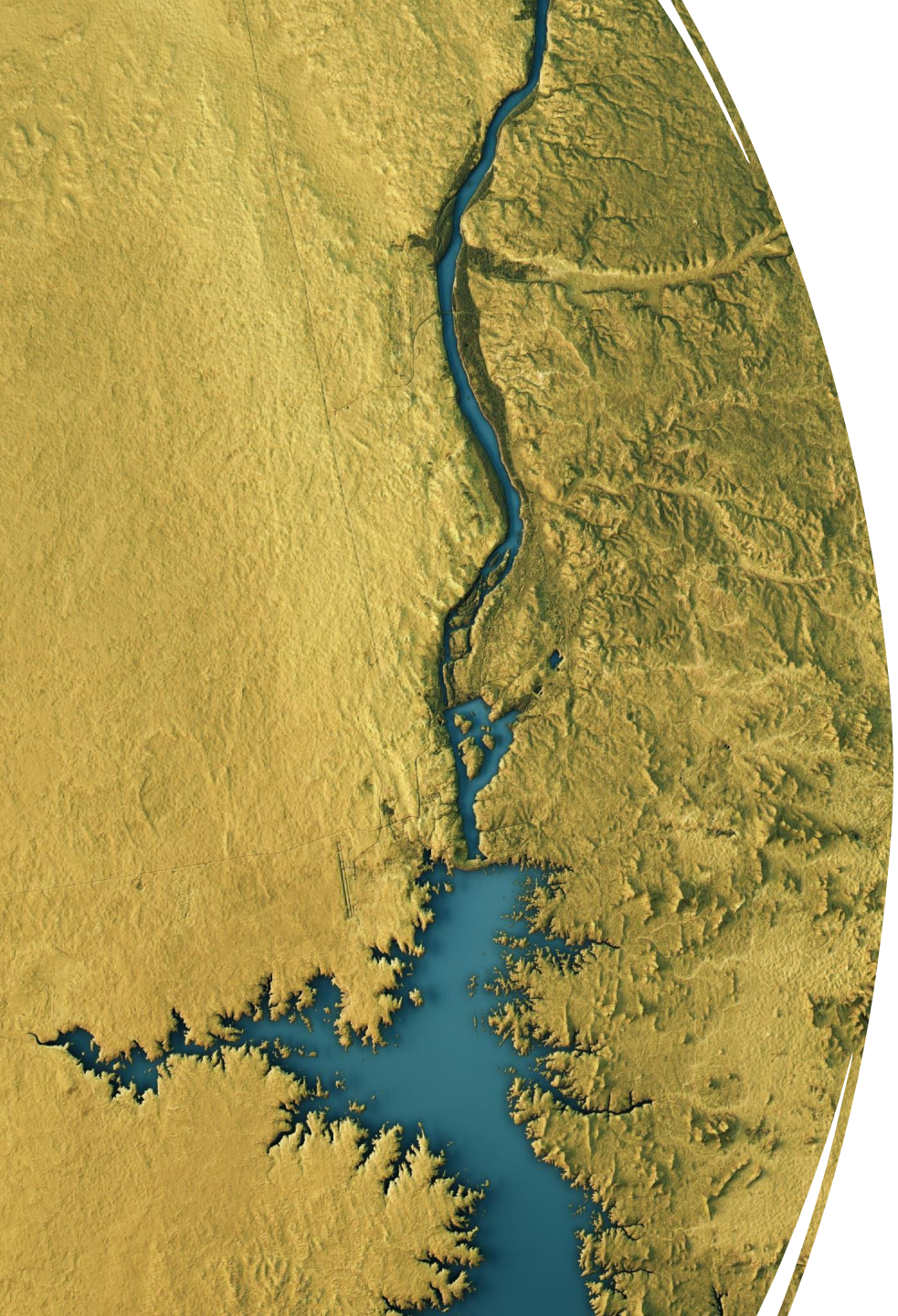
4. Products: Threat map due to torrential floods, in which the different levels of threat presented by the studied territory are delimited and zoned, according to the provisions of this article.

A technical document must be prepared that contains the methodology used and the results obtained.



1. Sediment flow intensity

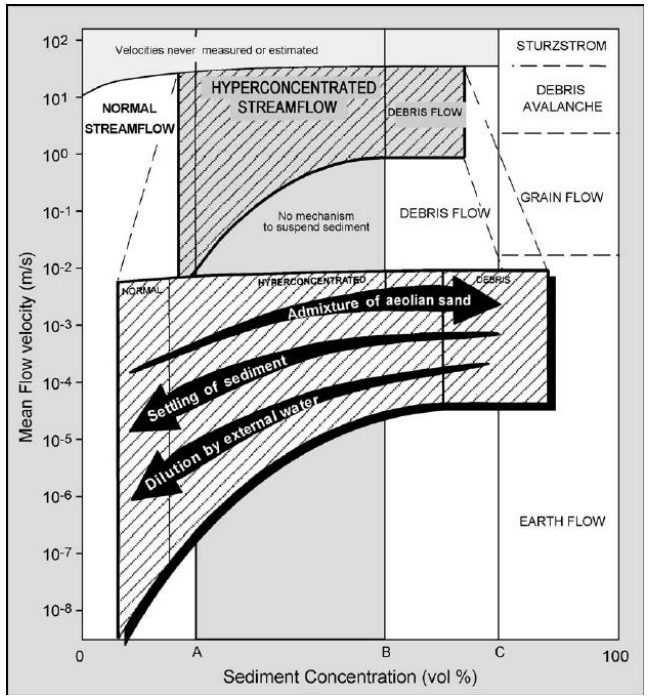
2. Impact of sediment or debris flow power



Inputs

- DEM → 2.5 m given by the environmental authority.
- Hydrological soil map → developed by the environmental authority, 1:25.000 – semi-detailed → adjusted lookup tables to usersoils
- Land use/land cover map → obtained by the municipality, 1:25.000
- Climate data: obtained from SWAT climate databases, monthly values were adjusted from national measures, only for precipitation and temperature.

3. Using SWAT to automatize some steps and save money



(modified from Pierson and Costa, 1987).

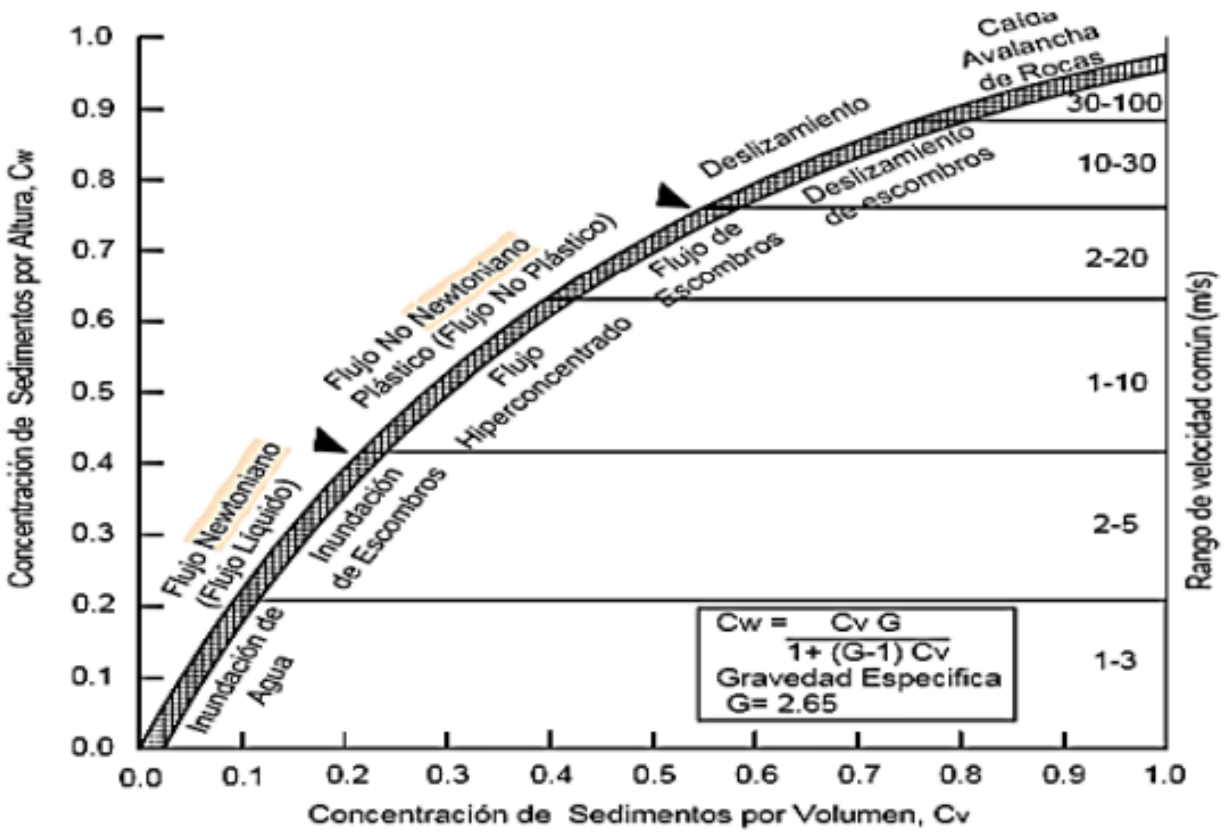
Each river-stream-channel

1 Rheologic classification of ‘‘normal’’ stream flows, hyper concentrated stream flows, and debris flows

2 Amount of solids contribution to the phenomenon

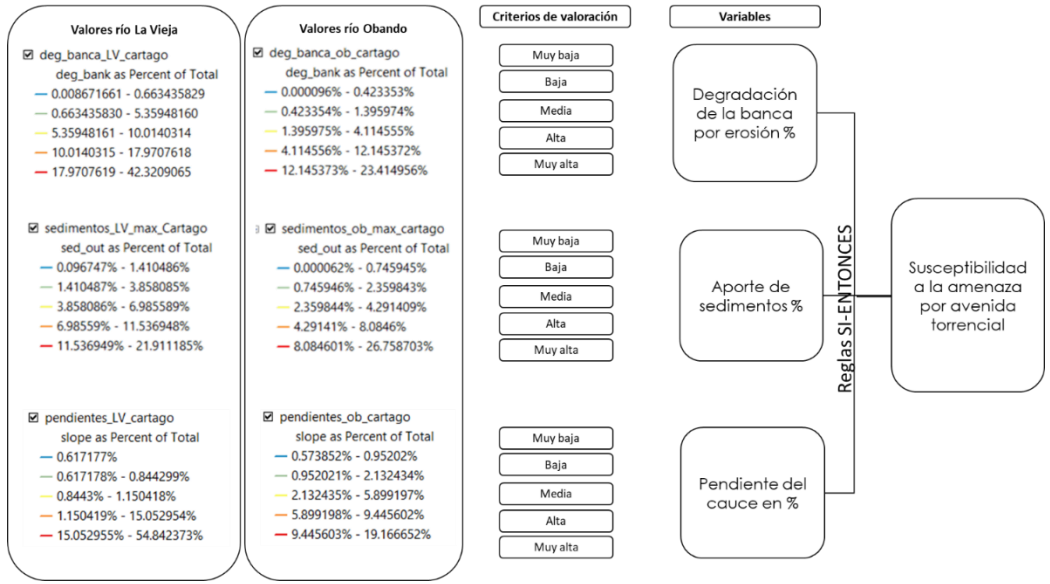
SWAT

Methodology → reology phase

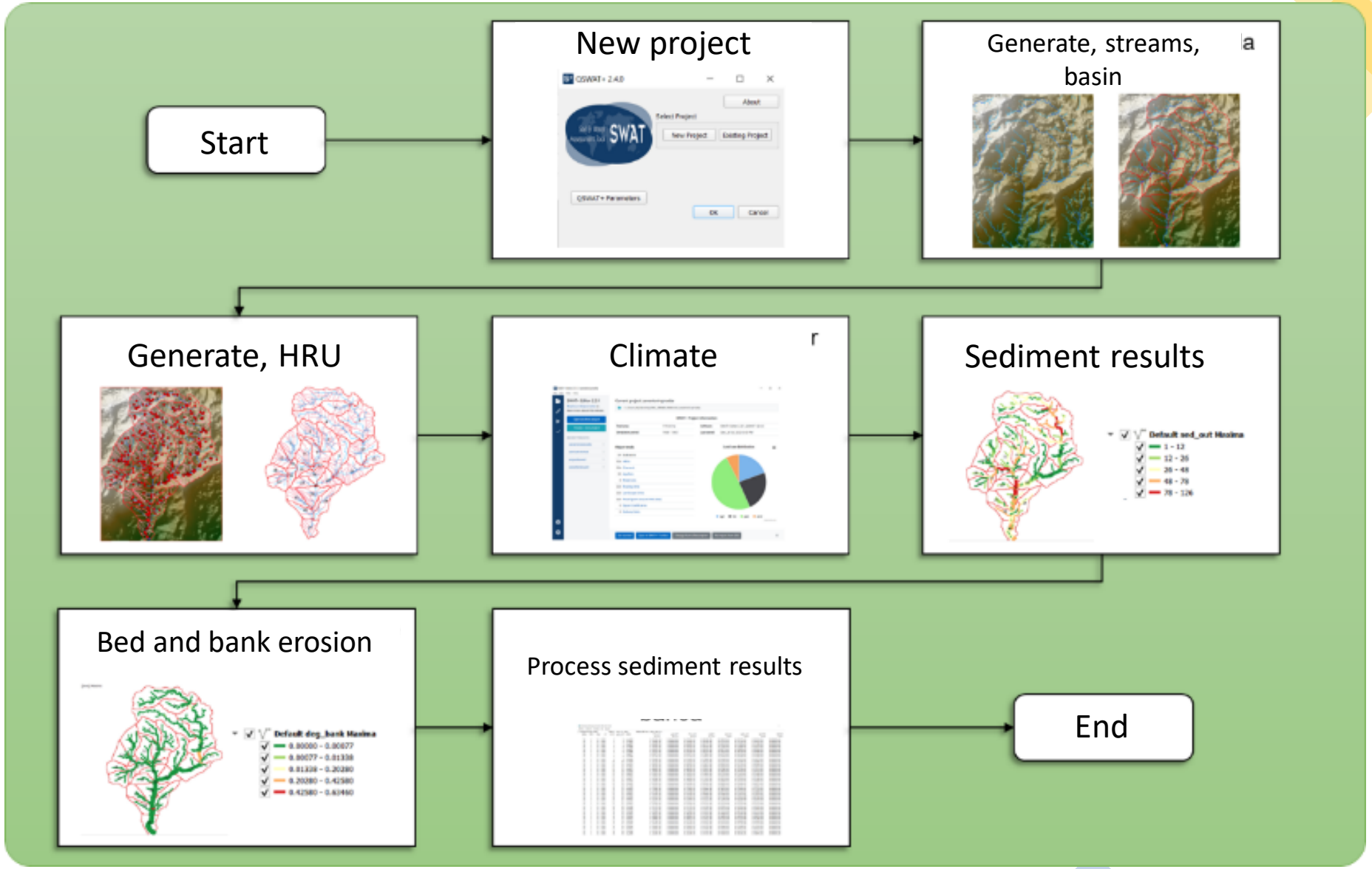


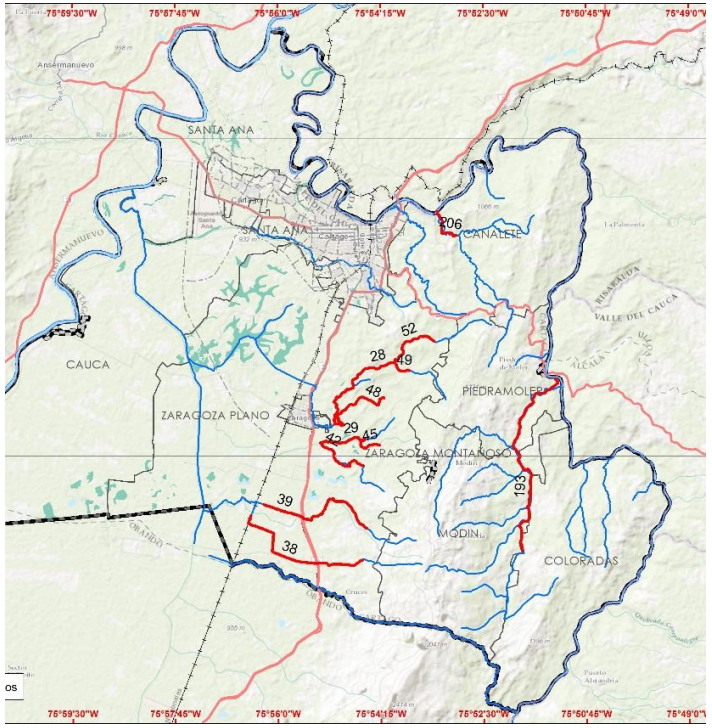
Reference: Suarez, 2000

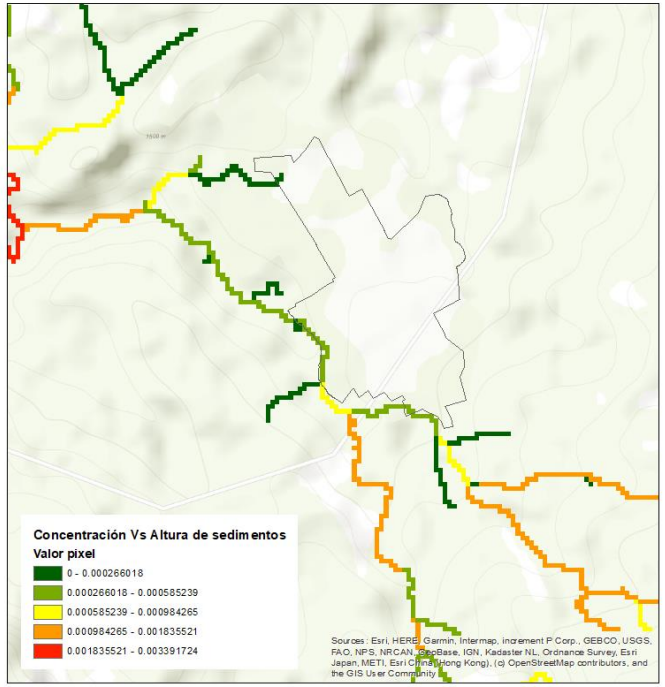
Fuzzy logic

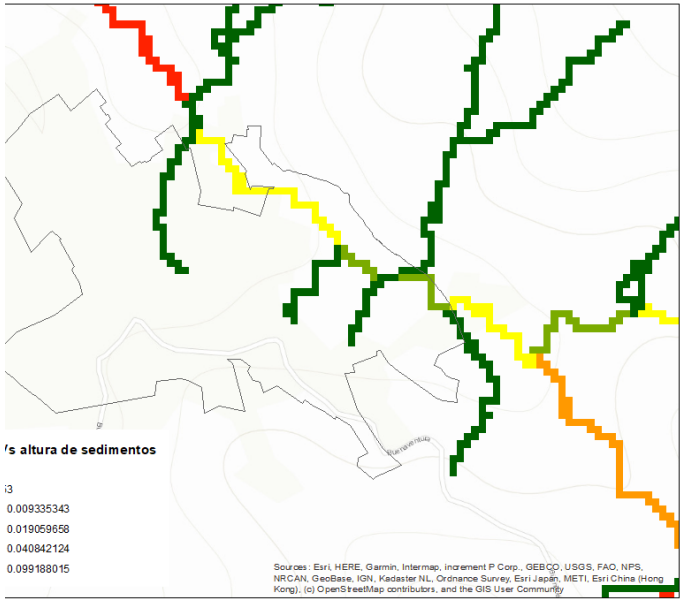


Reference: Hincapié, 2023


Start
New project
Generate, streams, basin
Generate, HRU
Climate
Sediment results
Bed and bank erosion
Process sediment results
End



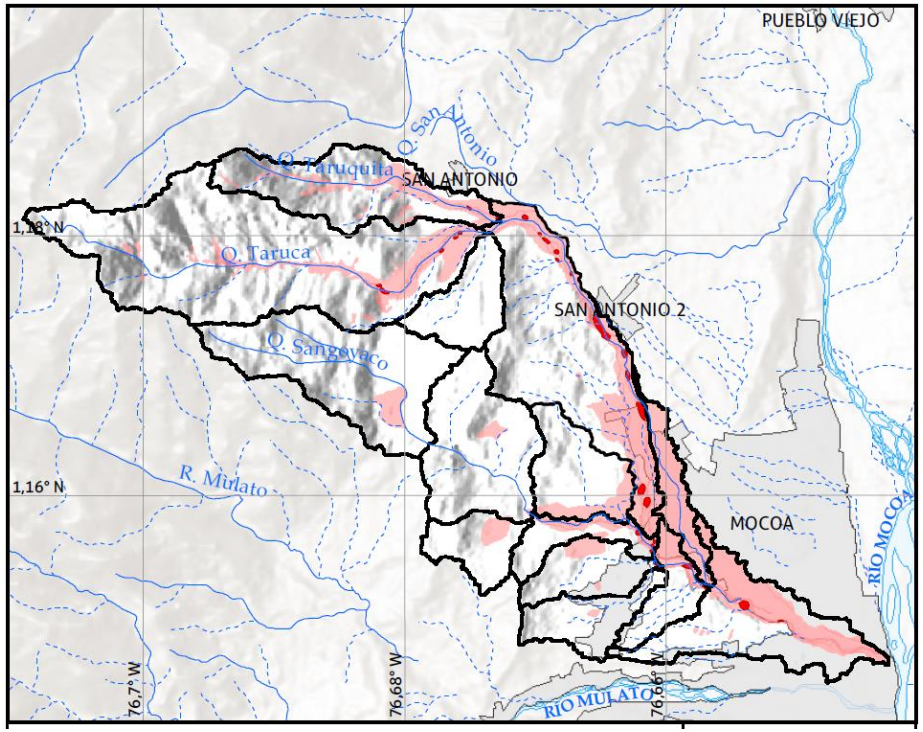


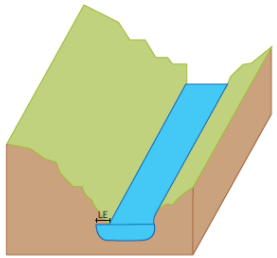


Results

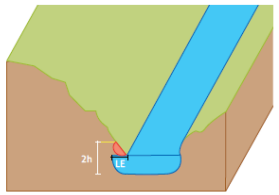
- Municipalities analyzed with SWAT: Cartago and Dagua, Department of Valle del Cauca
- First “round”

Methodology → Solid contribution

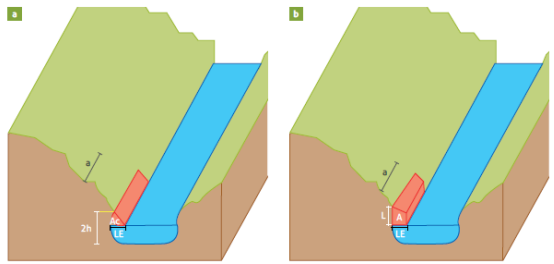




» Figura 39. Longitud de erosión de la banca por acción del flujo

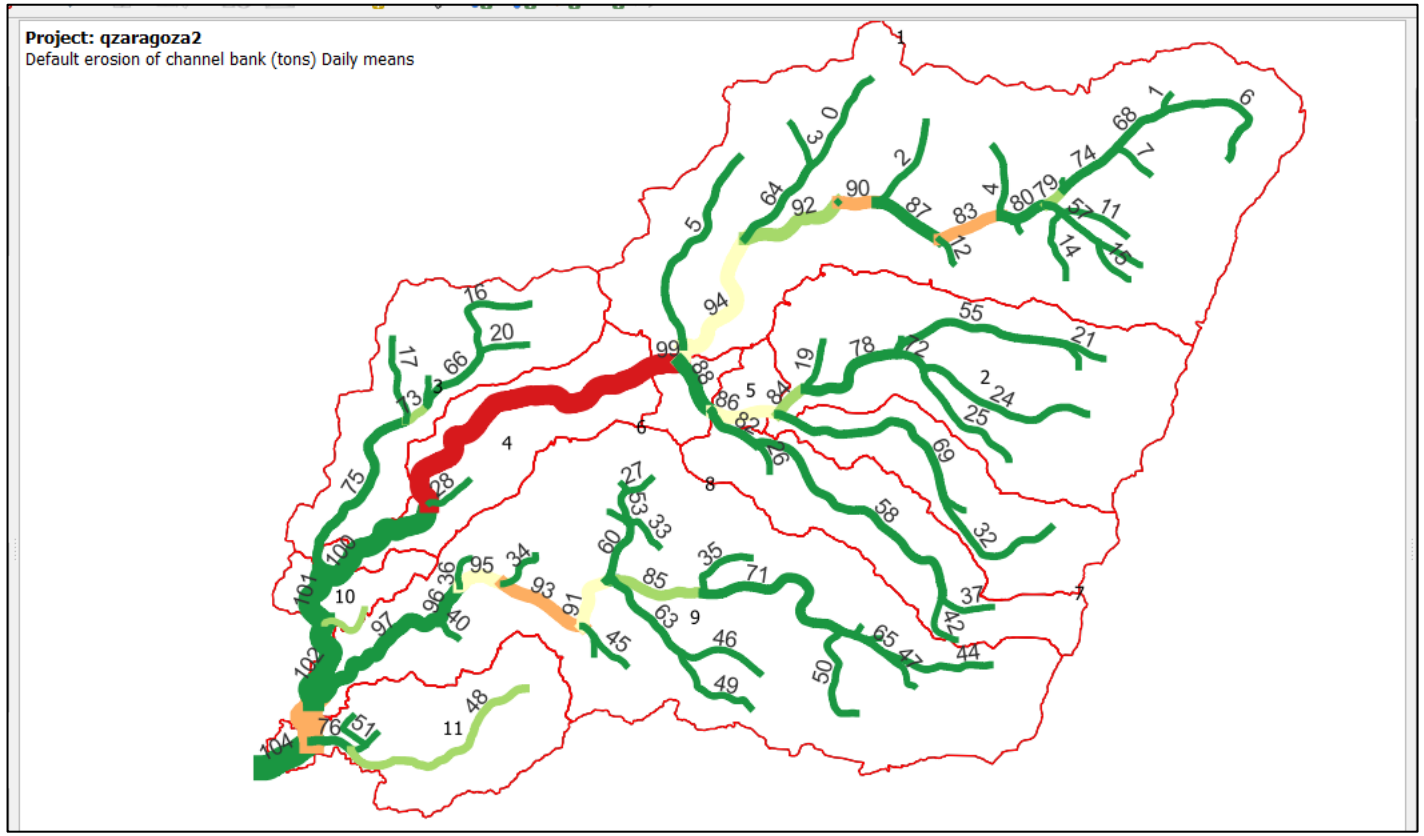


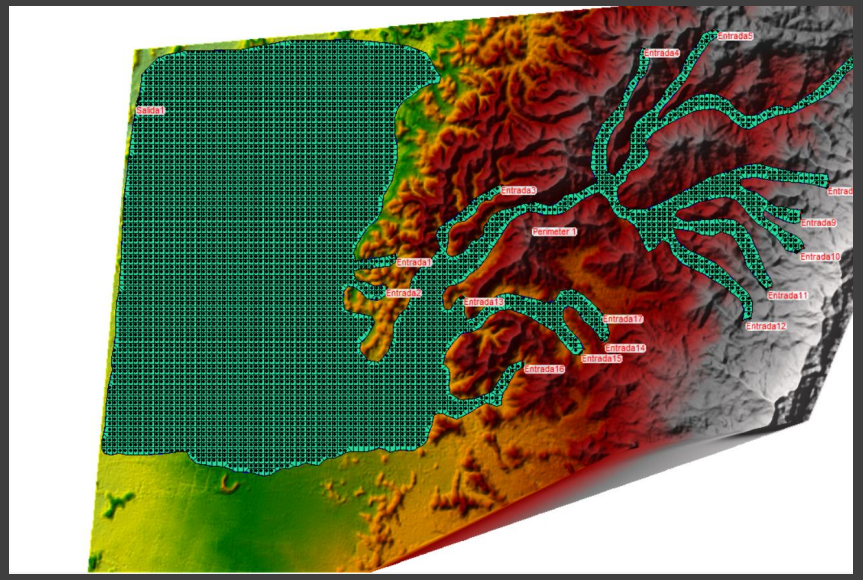
» Figura 40. Definición de los límites de análisis para la estabilidad de la banca

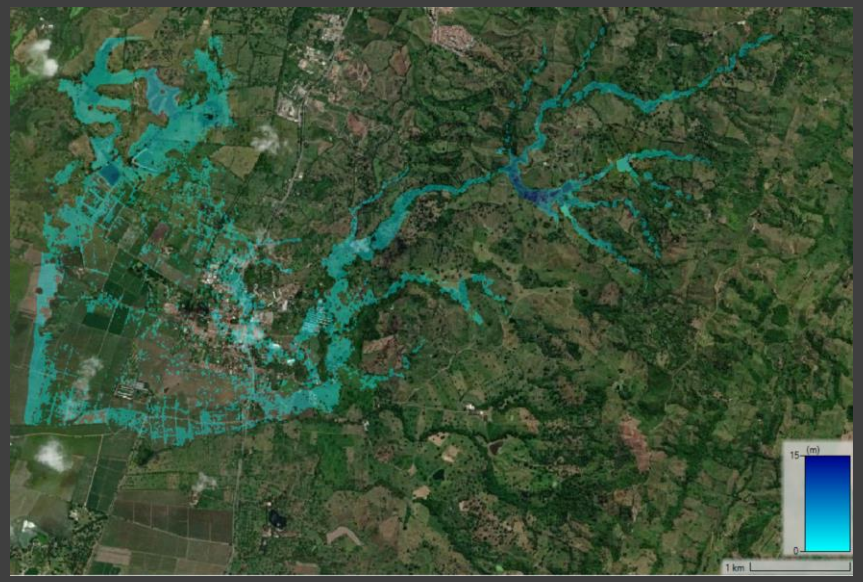


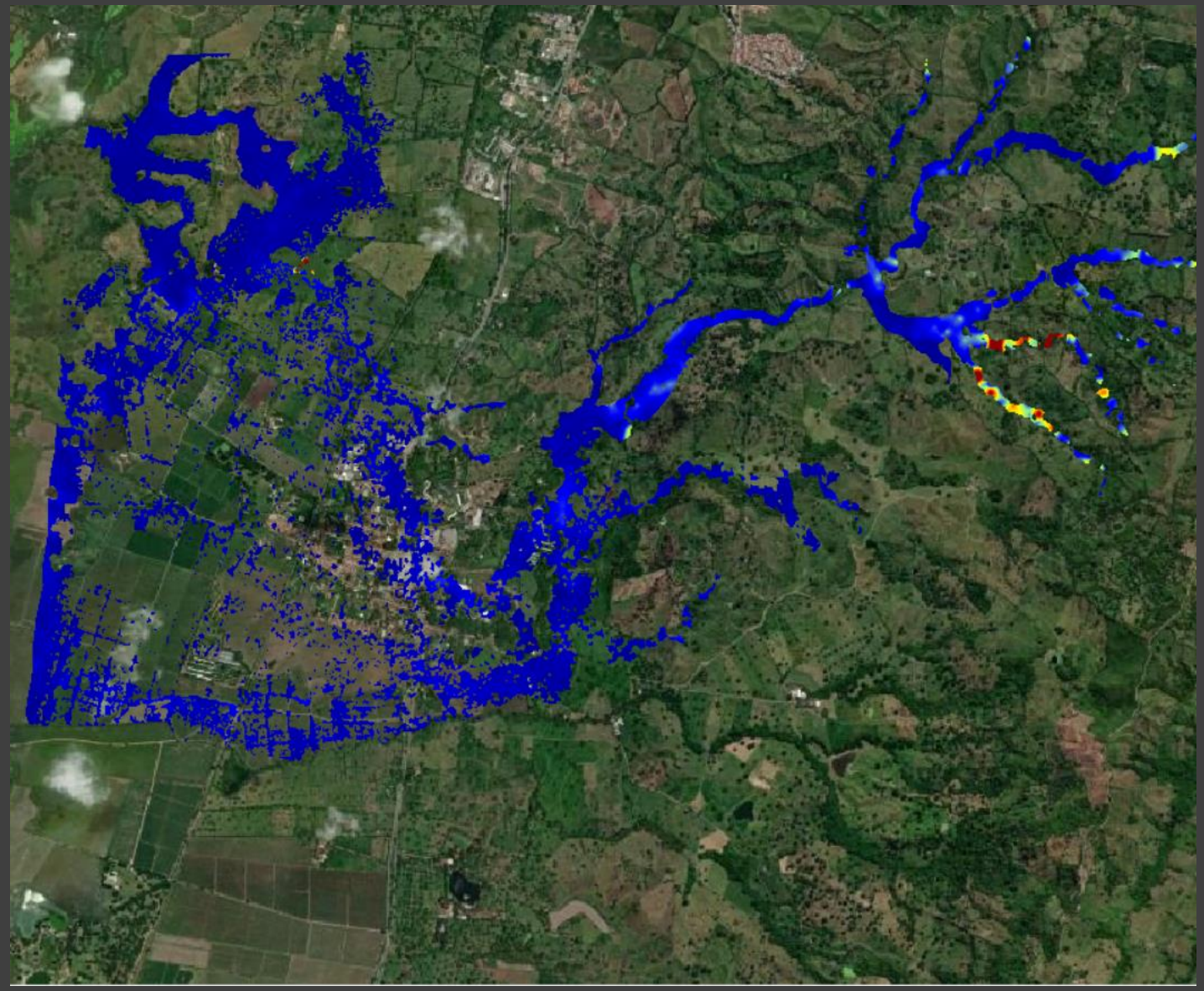
» Figura 41. Esquemas de aporte de volumen por acción de la socavación lateral
a) Inestabilidad de laderas, b) análisis de falla *cantilever*

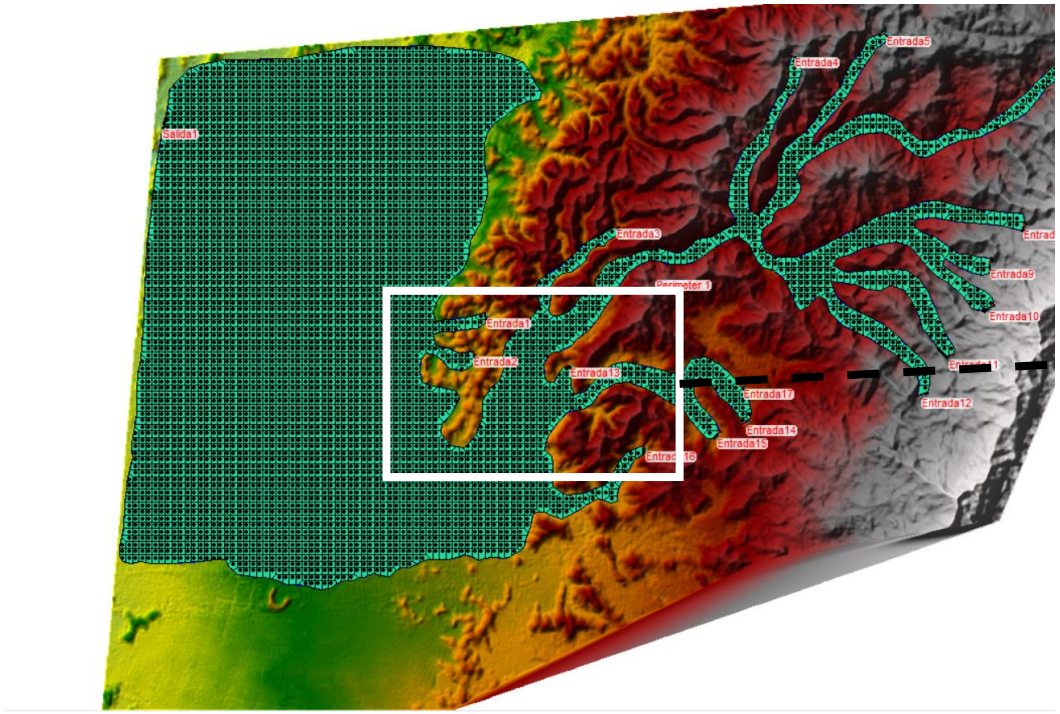
deg_btm	deg_bank
tons	tons

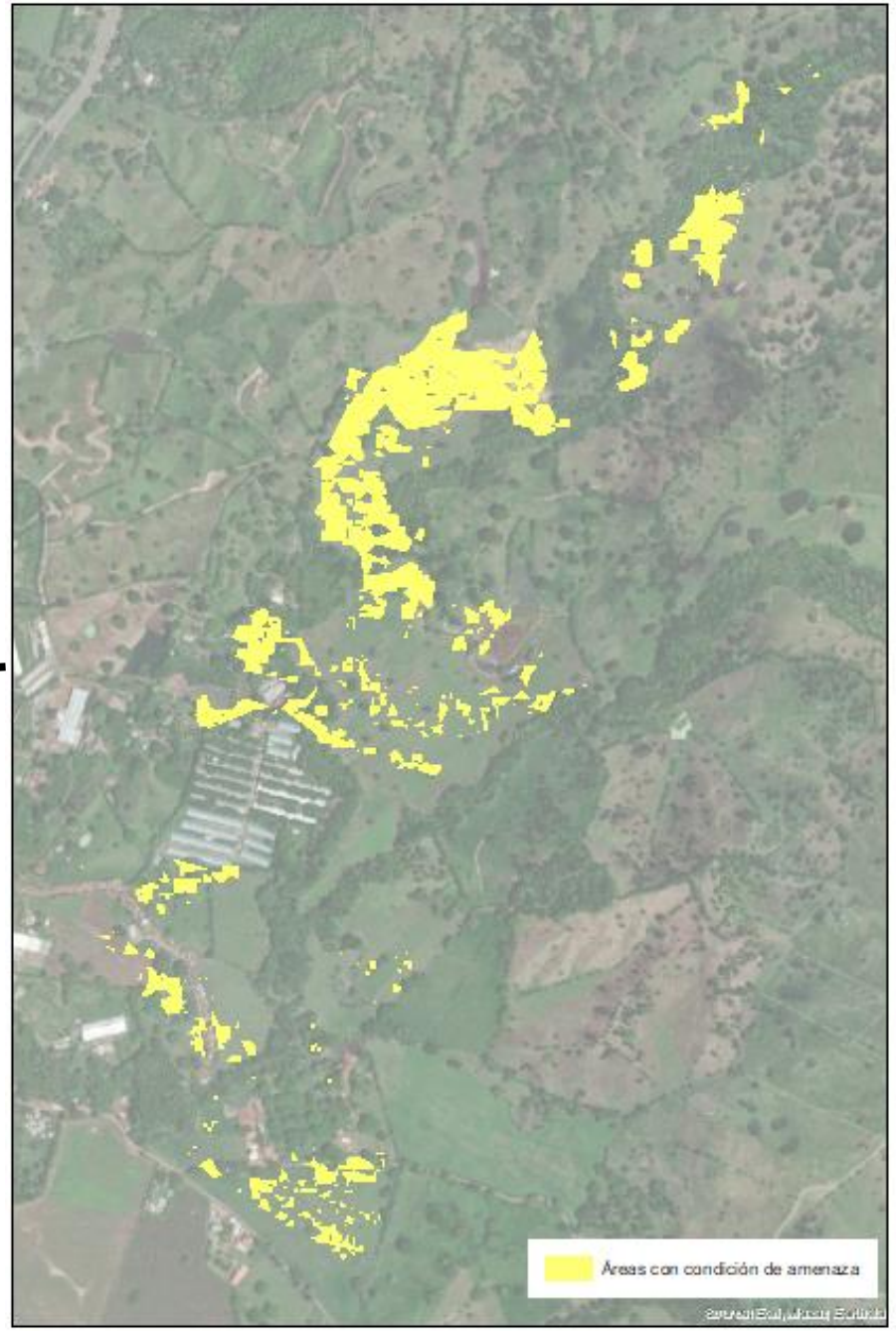



Entrada5
Entrada4
Saida1
Entrada3
Perimeter_1
Entrada9
Entrada10
Entrada8
Entrada11
Entrada2
Entrada13
Entrada17
Entrada12
Entrada14
Entrada15
Entrada16


15
(m)
0
1 km



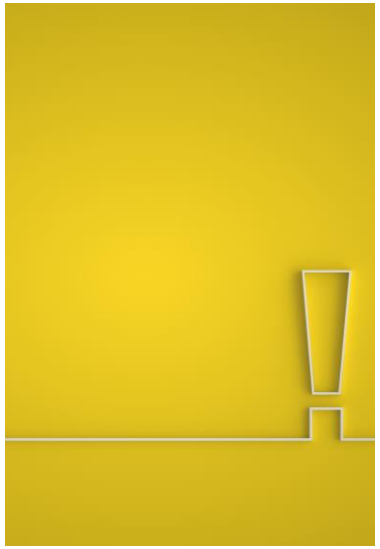

Entrada5
Entrada4
Salida1
Entrada3
Entrada9
Perimeter 1
Entrada1
Entrada2
Entrada13
Entrada17
Entrada12
Entrada14
Entrada15
Entrada10


Áreas con condición de amenaza

Conclusions

Disadvantage of using SWAT in the country's context

- Soil maps → there are no measurement of soil with respect to hydrological groups, which means that we don´t have the soil characteristics to produce sediment data, nevertheless, there are some exceptions, such as the Department of Valle del Cauca, which has a soil detailed study.
- Model calibration, there is a lack of information towards measurement of water flow, and sediment concentration in the water…



SWAT usefulness

- Due to the country’s complexity, SWAT is the best instrument to solve issues related to the cost of the studies, allowing the accomplishment of the legal requirement.
- The field workdays are more effective whenever the campaigns go to the points identified as potential risk previously.
- In terms of the country's security situation, SWAT allows decision makers to work remotely.

With all my gratitude for your time, thank you!!