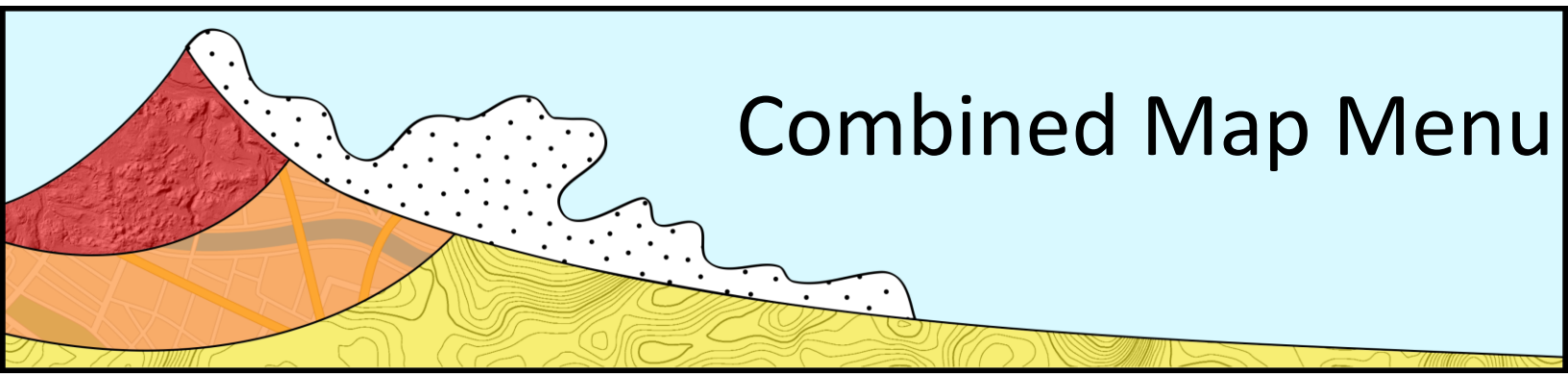
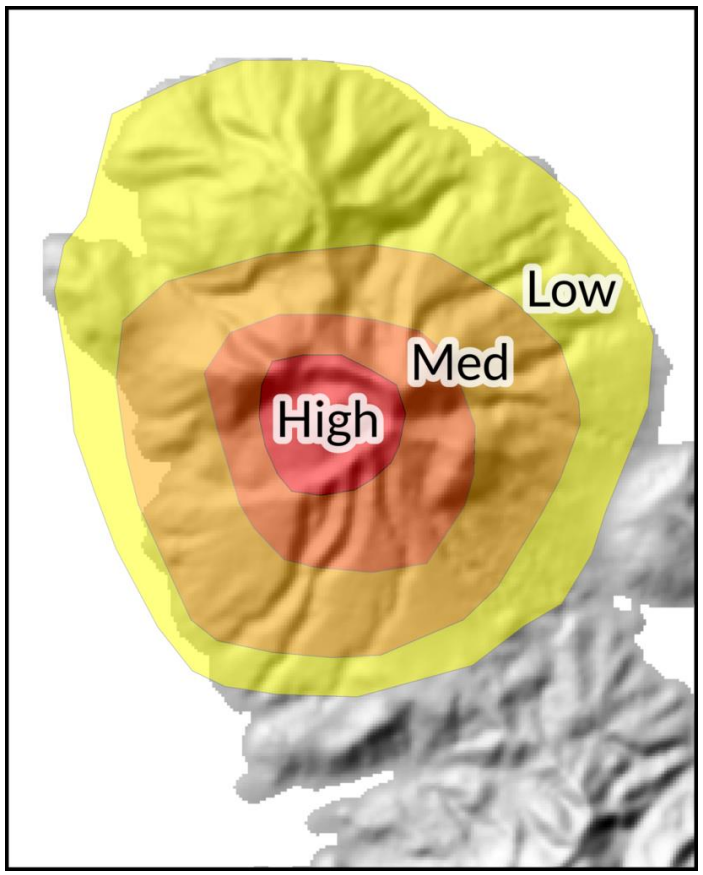
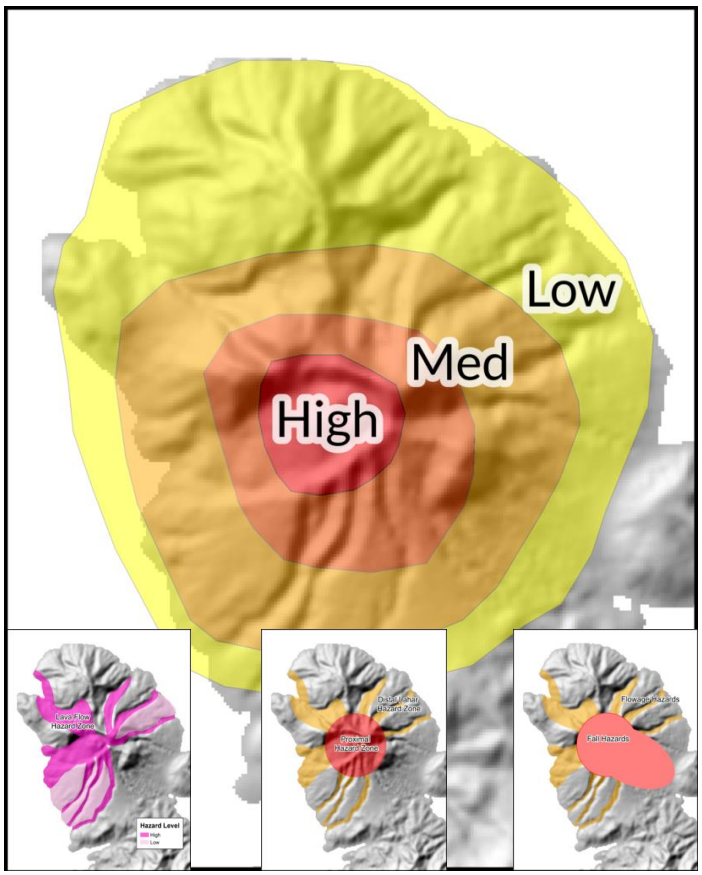

Combined Map Menu

Hazard Zone Presentation

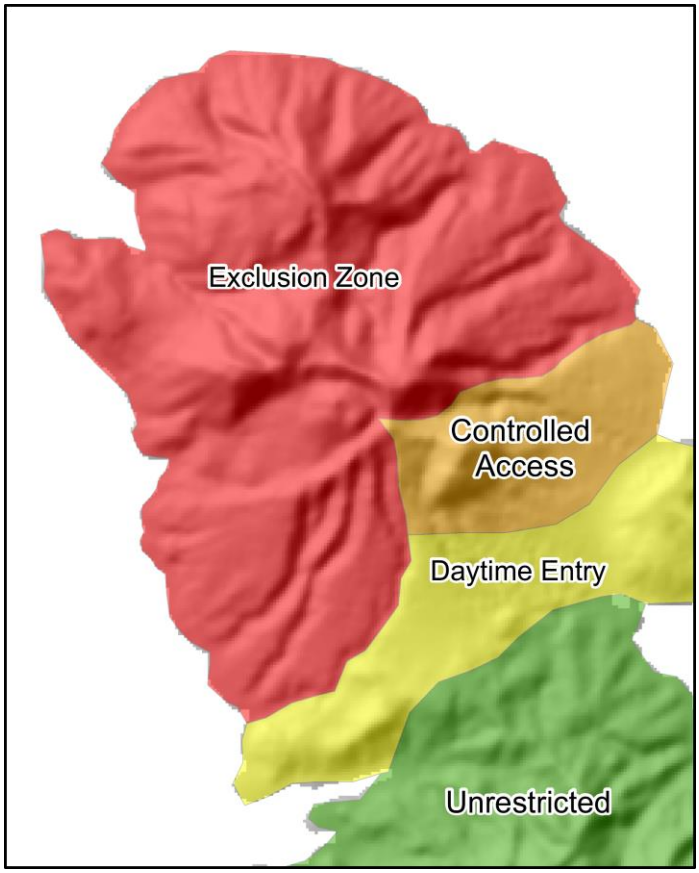
Hazard level-focused (integrated)



Hazard level-focused with single process insets

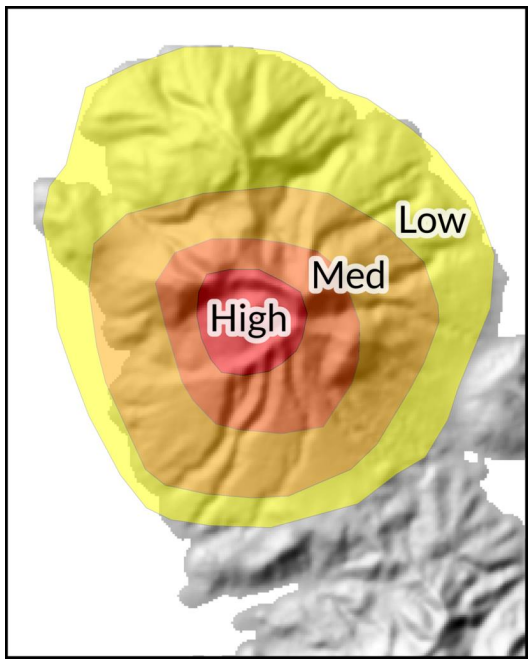


Hazard level-focused (administrative)

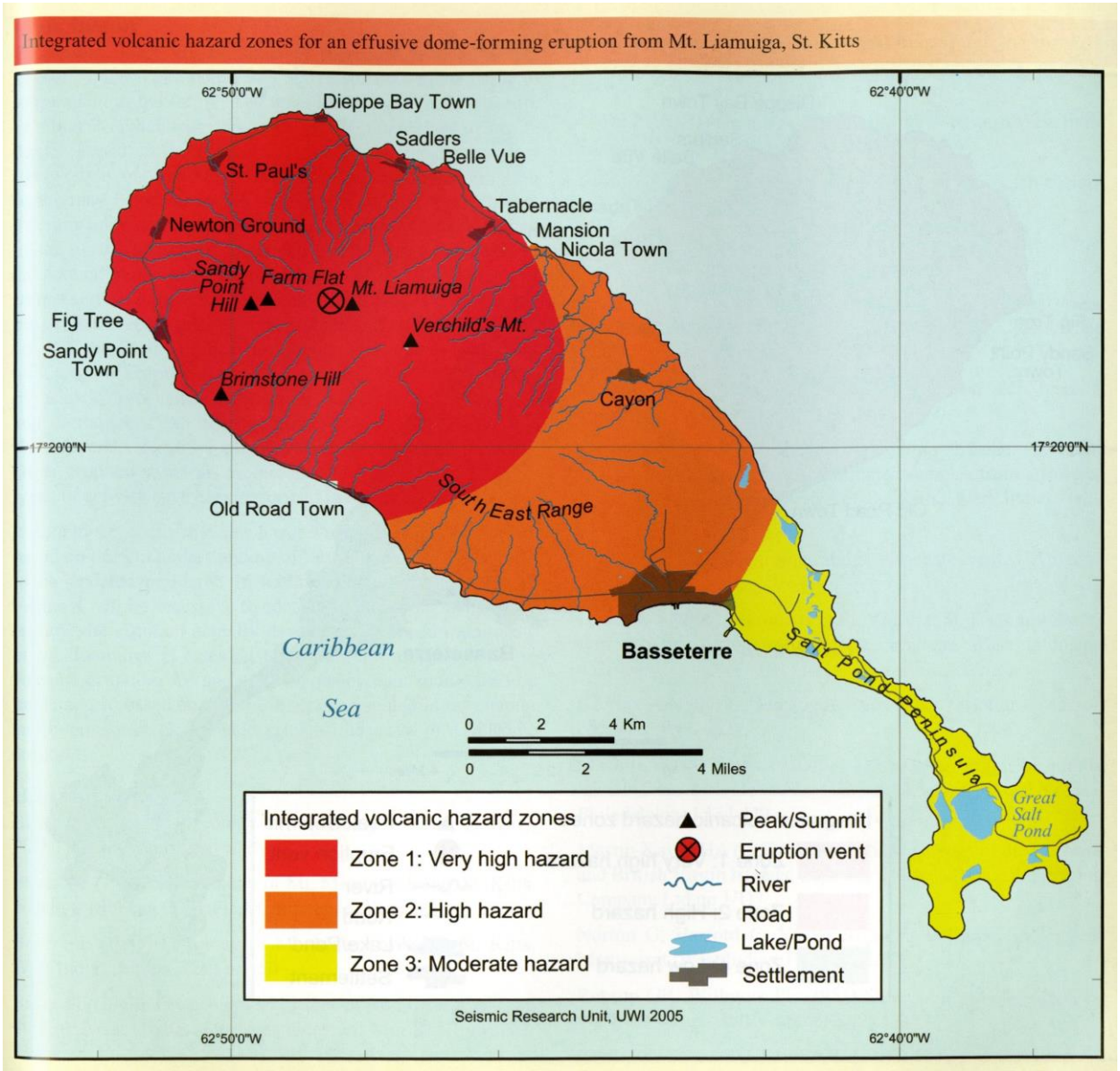


Hazard Zone Presentation

Hazard level-focused (integrated)

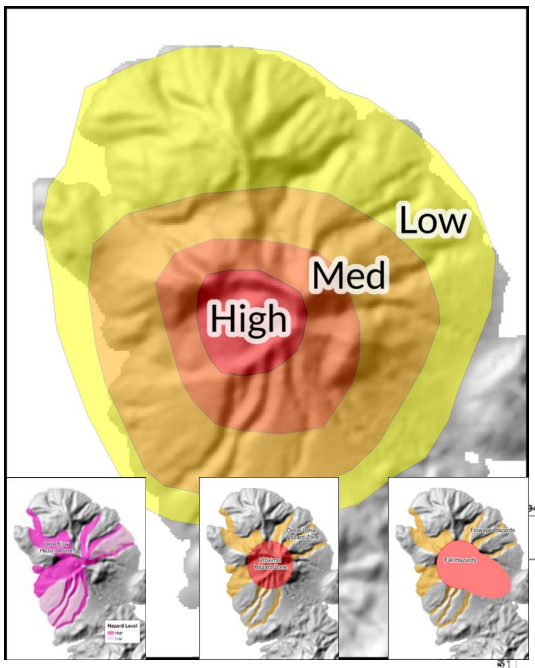


Liamuiga, Saint Kitts and Nevis
(Robertson, 2005)

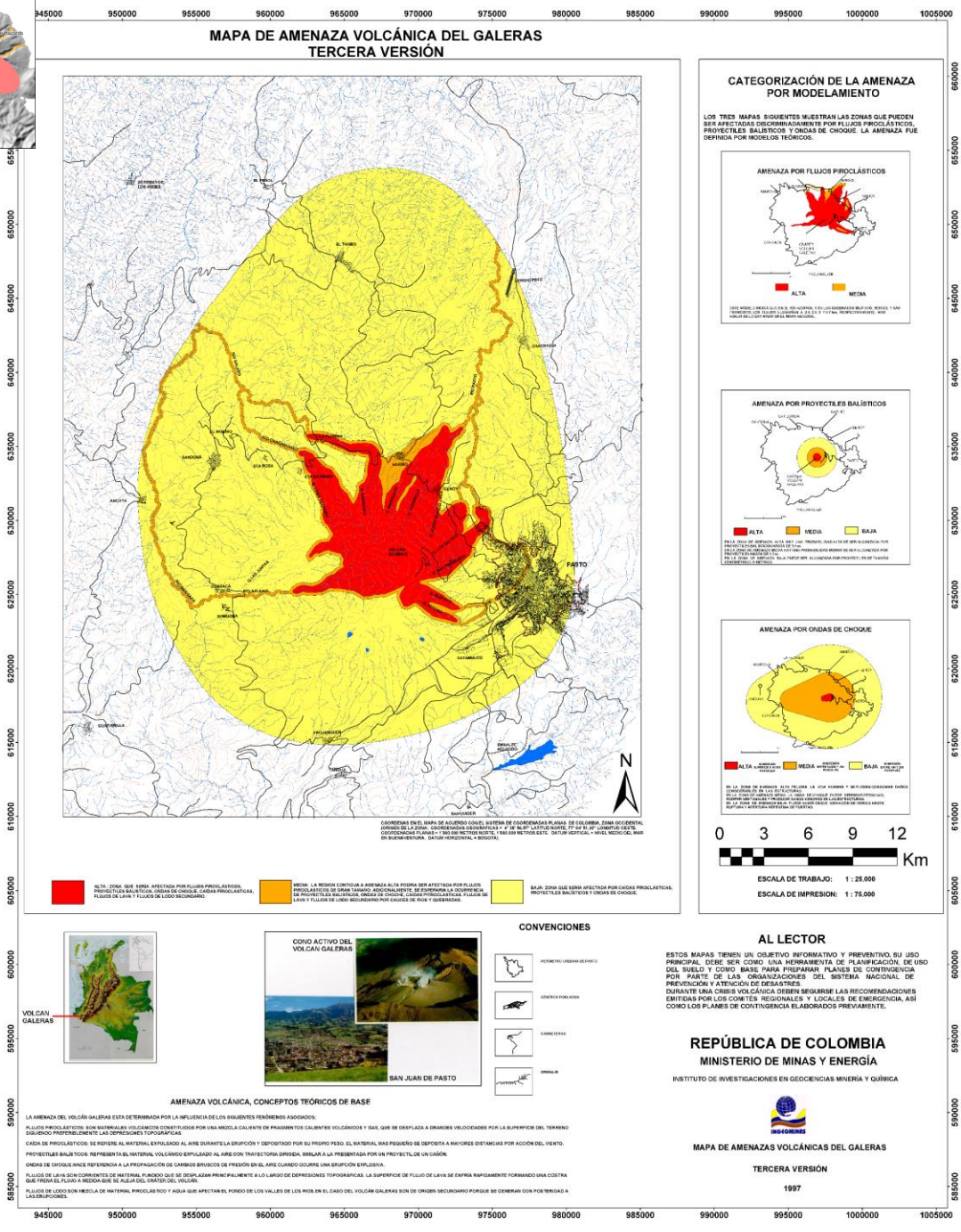


Hazard Zone Presentation

Hazard level-focused with single process insets

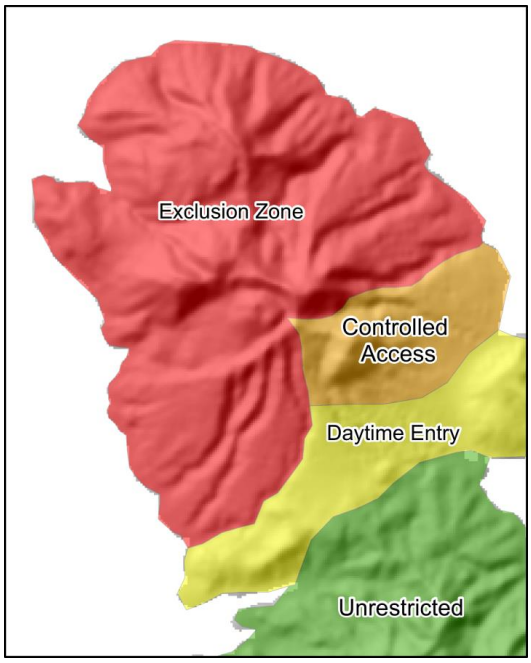


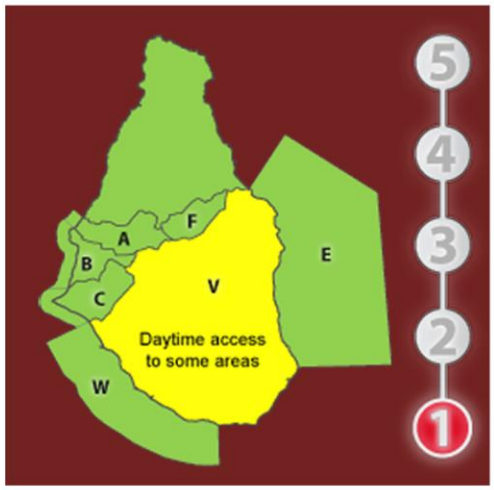
Galeras, Colombia
(Instituto Colombiano de Geología y Minería (INGEOMINAS), 1997)

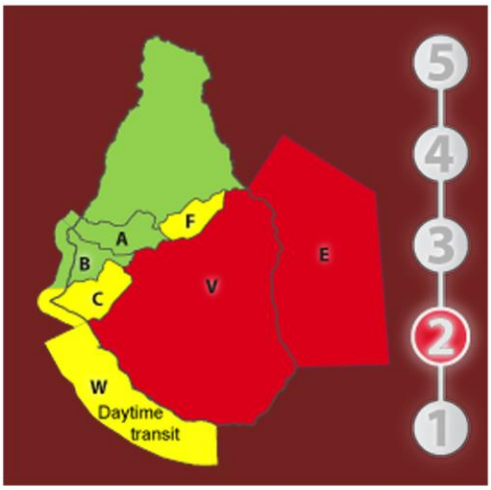


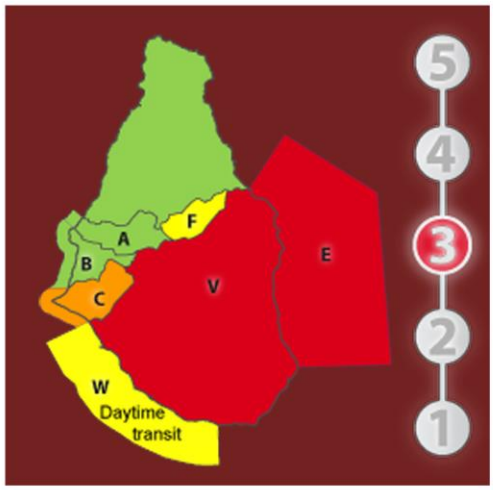
Hazard Zone Presentation

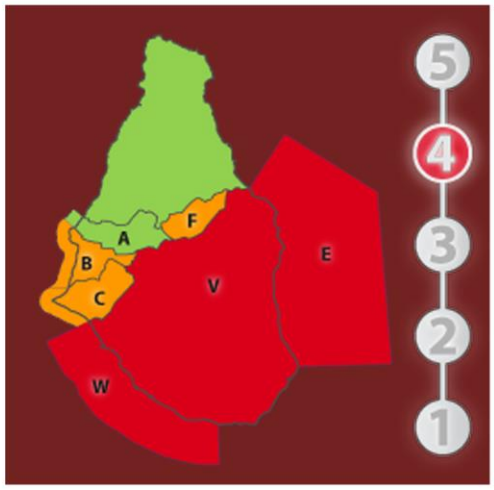
Hazard level-focused (administrative)

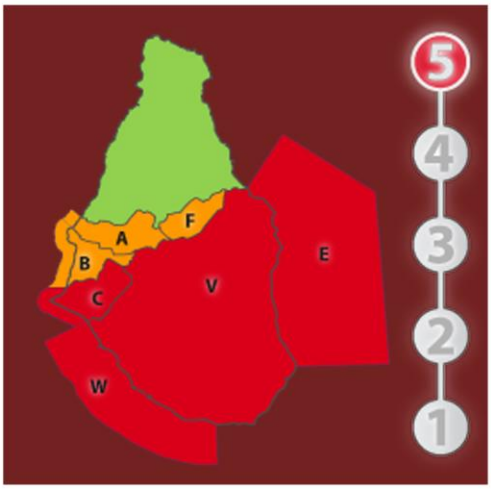












Access Restrictions
Unrestricted- Ashfall and lahars can be significant hazards in all areas, and require appropriate cautions.
Daytime Access- Access is permitted from 8:00 am until 4:00 pm. Access gates will be locked at all other times.
Daytime Access to Some Areas- Areas will be defined depending on the state and location of the volcanic activity.
Daytime Transit- Boats permitted to travel through the MEZ without stopping from 6:30 am to 5:30 pm.
Controlled Access- No access without approval from NDPRAC. Approval considered on a case-by-case basis. Gates will be locked at all times.
Essential Workers- No access apart from MVO and associated staff. Access for essential maintenance only with approval from NDPRAC. Gates will be locked at all times.

DMCA

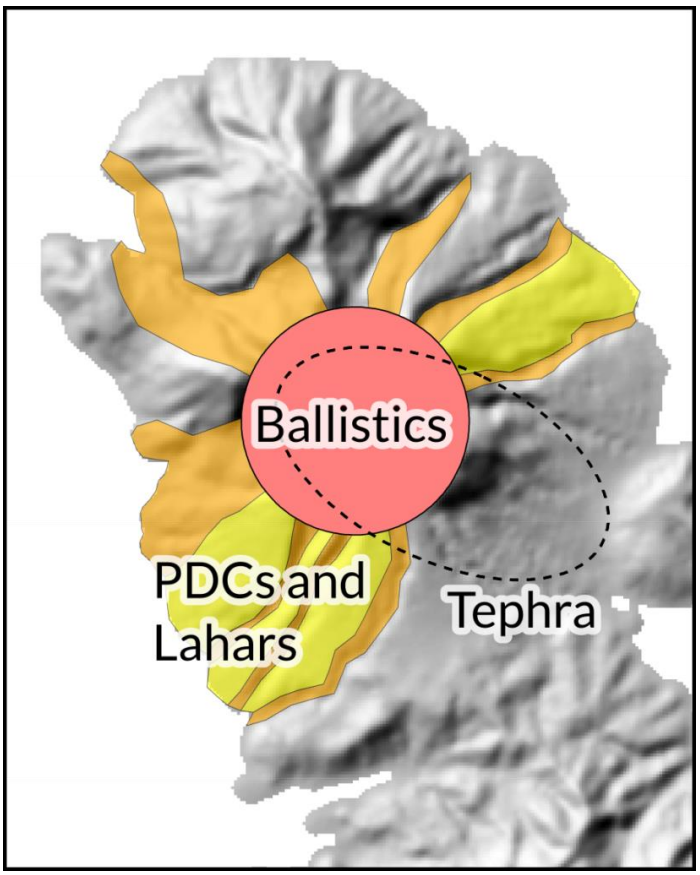
mvo
Montserrat Volcano Observatory

Further information: www.mvo.ms

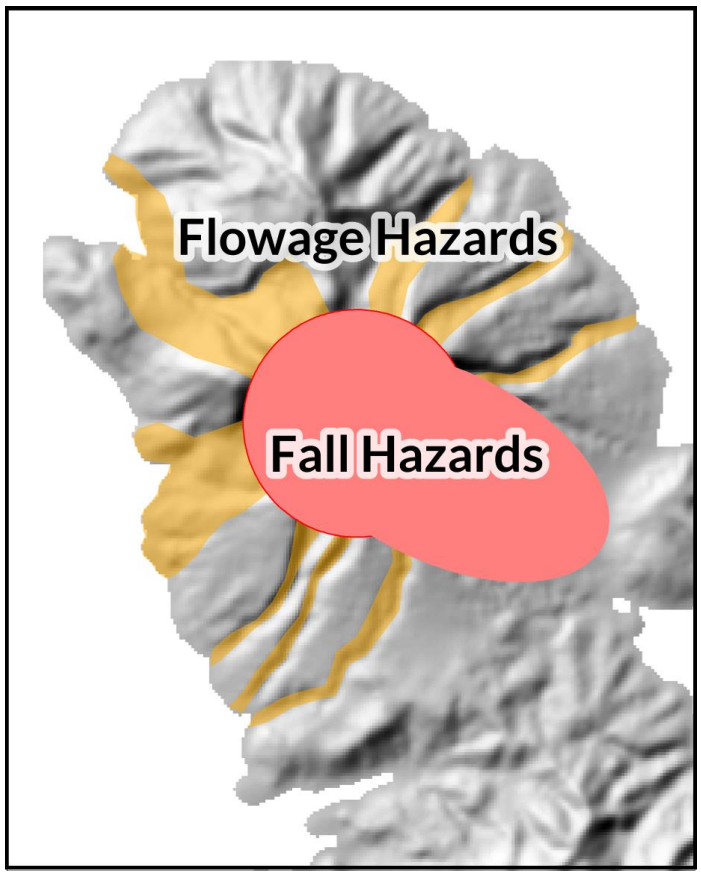
Soufrière Hills, Montserrat
(Montserrat Volcano Observatory (MVO))

Hazard Zone Presentation

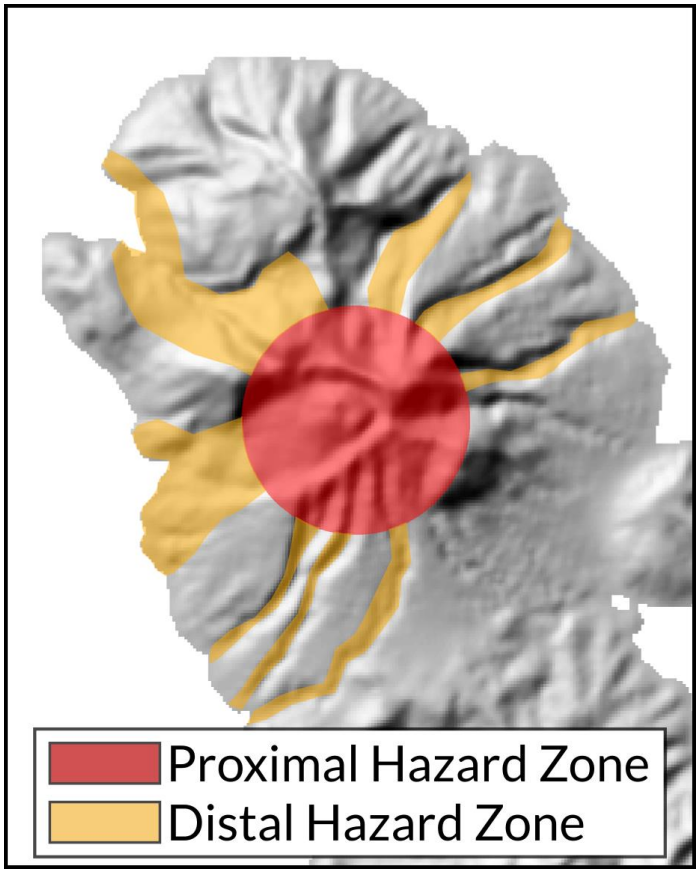
Hazard process-focused (separated)



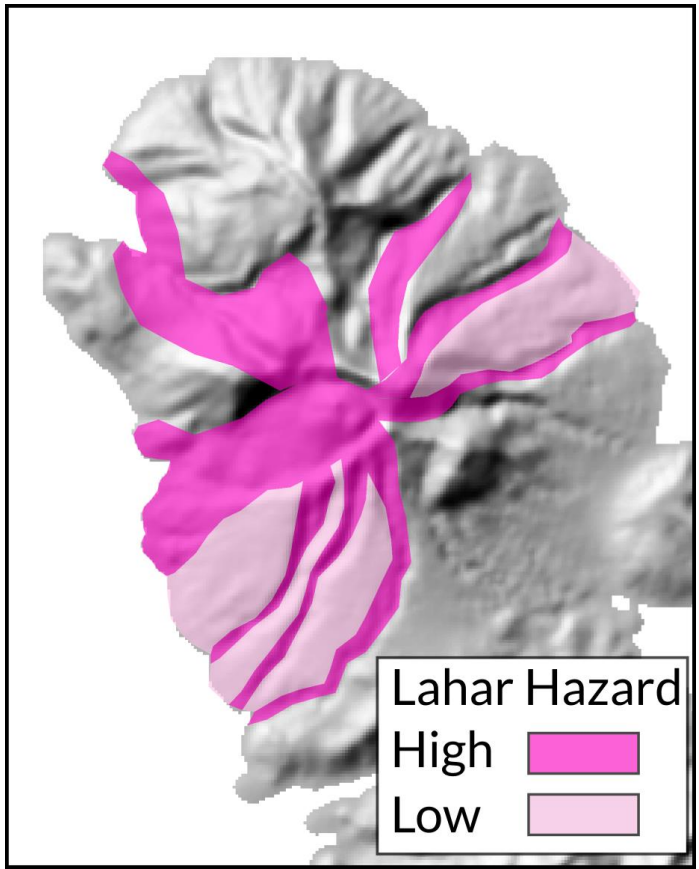
Hazard process-focused (grouped by process type)



Hazard process-focused (grouped by location)

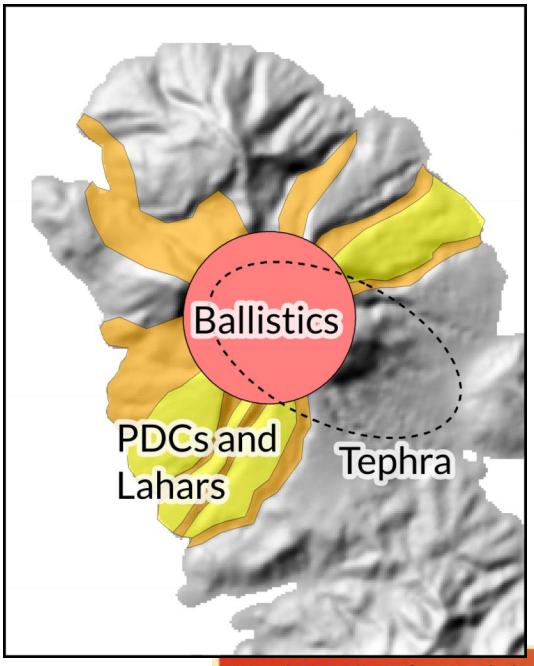


Hazard process-focused (single hazard process)



Hazard Zone Presentation

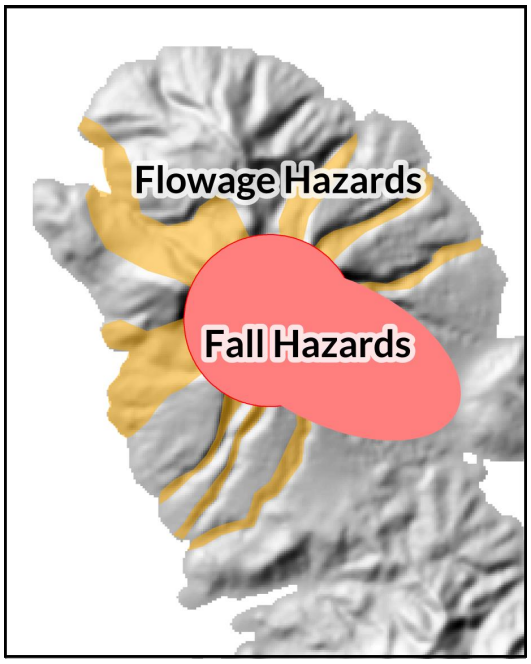
Hazard process-focused (separated)



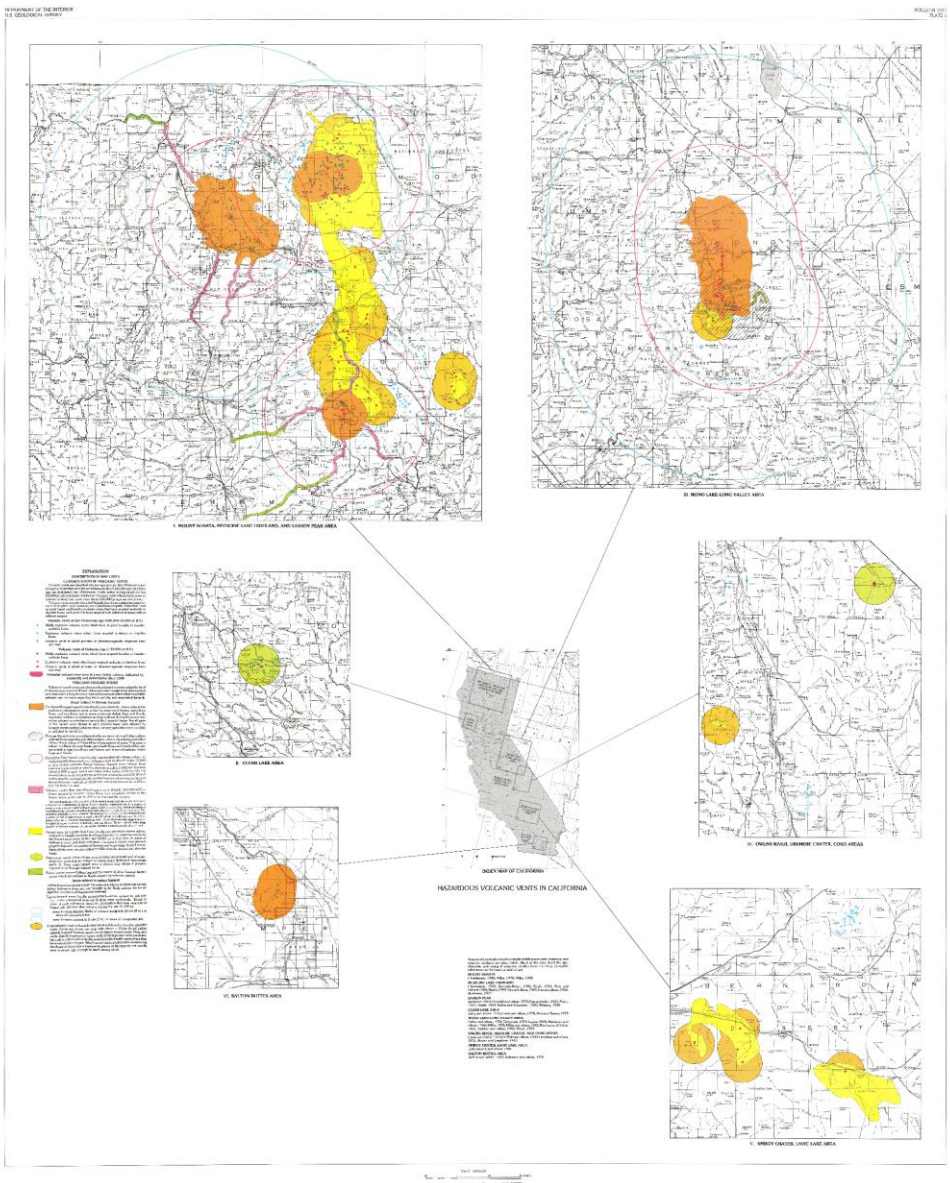
Liamuiga, Saint Kitts and Nevis (Robertson, 2005)

Hazard Zone Presentation

Hazard process-focused
(grouped by process type)



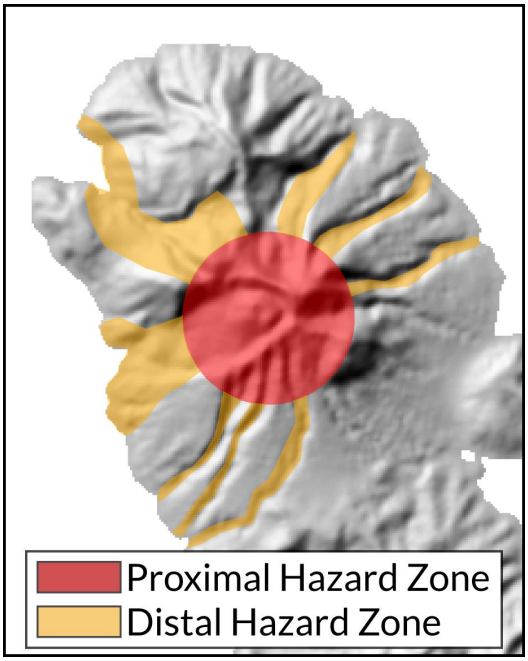
California (regional), United States
(Miller, 1989)



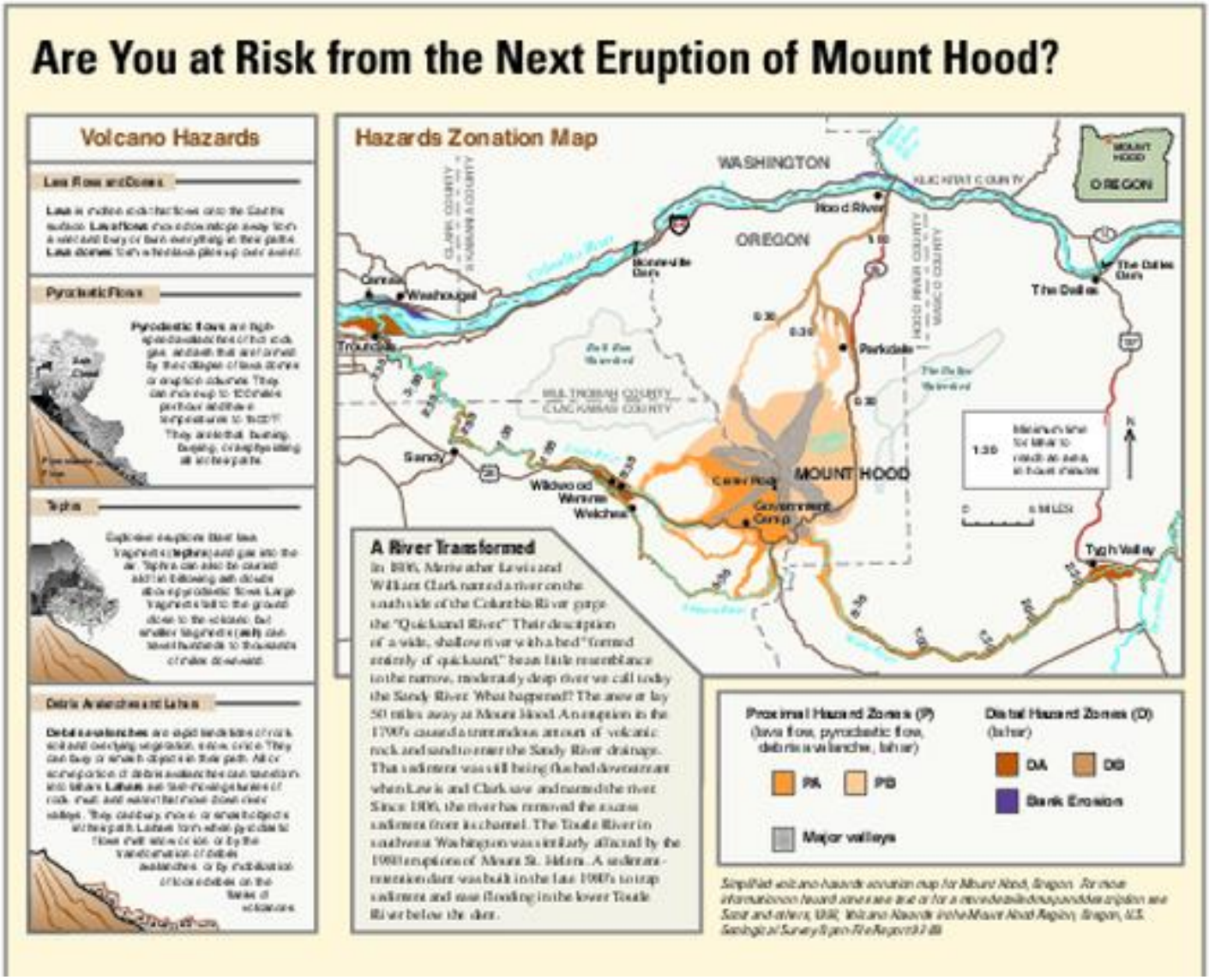
POTENTIAL HAZARDS FROM FUTURE VOLCANIC ERUPTIONS IN CALIFORNIA

Hazard Zone Presentation

Hazard process-focused
(grouped by location)

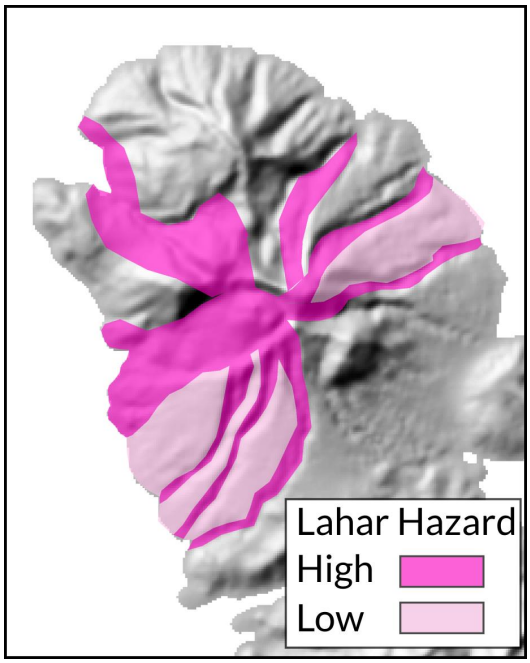


Hood, United States (cropped)
(Gardner et al. 2000)

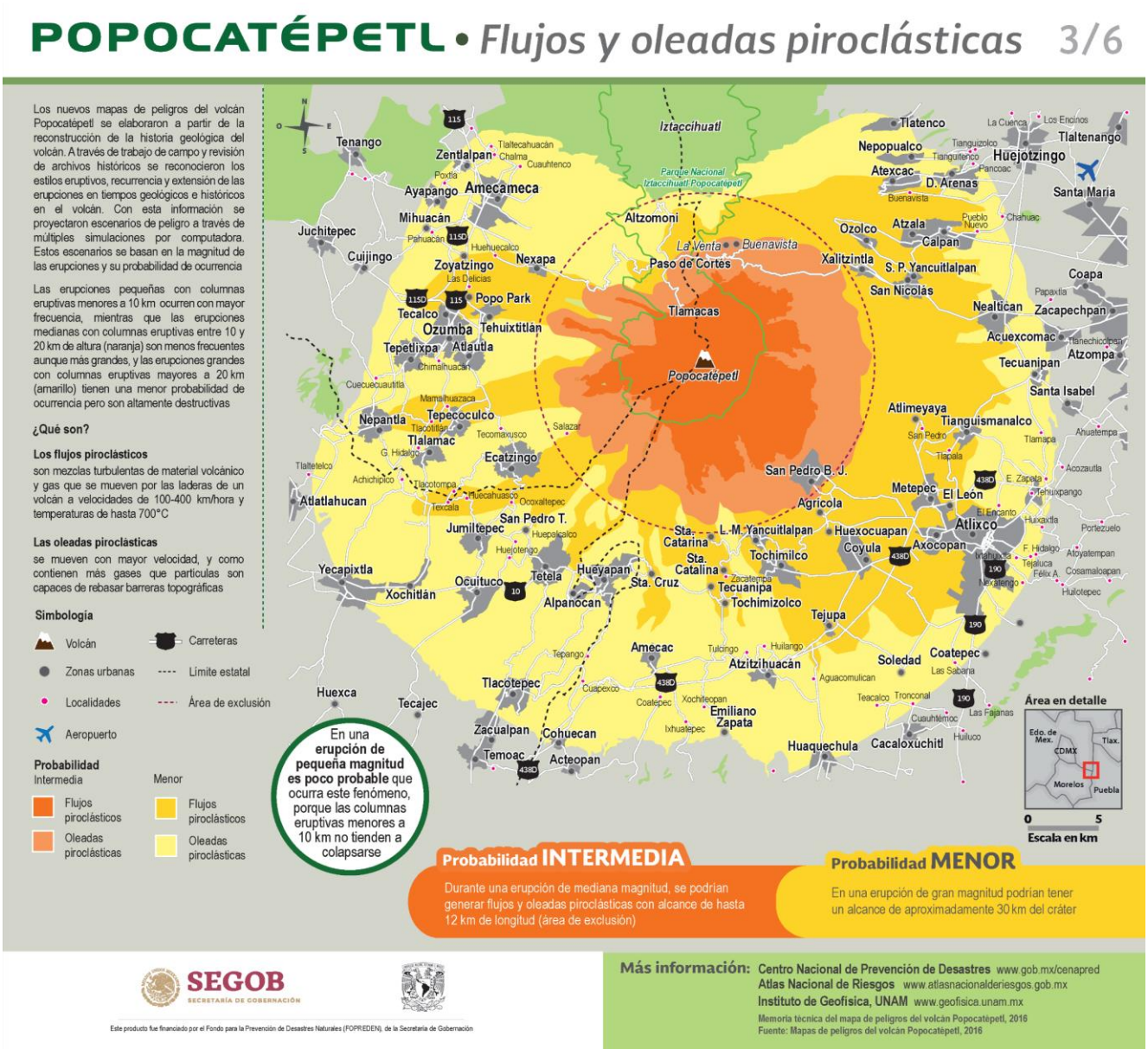


Hazard Zone Presentation

Hazard process-focused
(single hazard process)

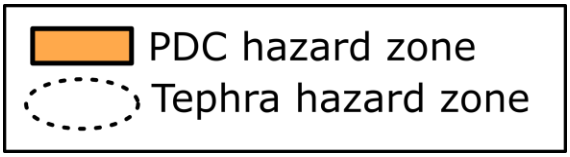


Popocatépetl, Mexico (cropped)
(Instituto de Geofísica Universidad Nacional Autónoma de México (IG-UNAM), Centro Nacional de Prevención de Desastres (CENAPRED), Secretaría de Gobernación (SEGOB), 2016)

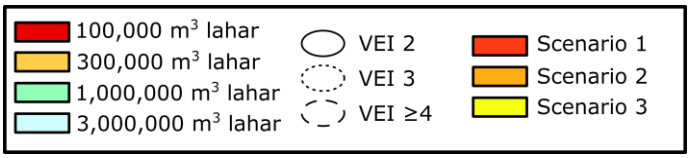


Probability and Zone Definition

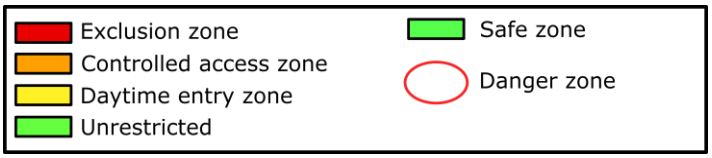
Hazard Process Name



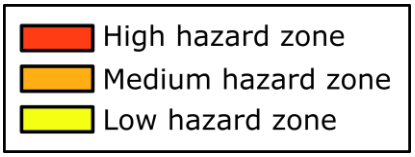
Scenario Name



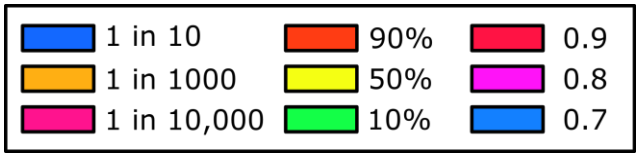
Access



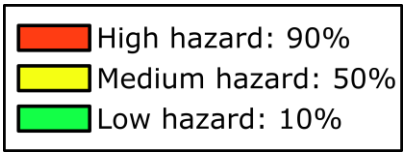
Qualitative Relative Probability



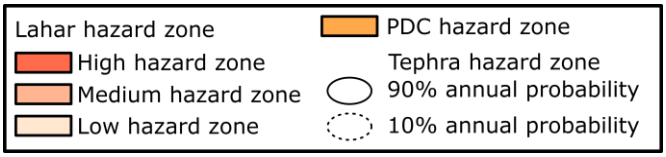
Numeric Probability



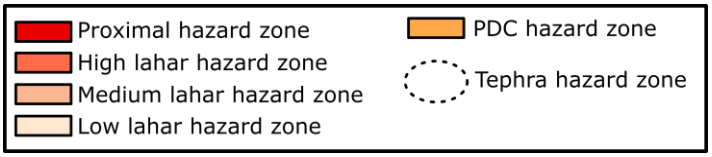
Qualitative & Numeric Probability



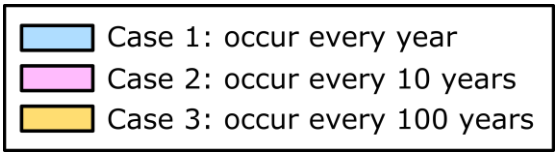
Process, Qualitative & Numeric Probability



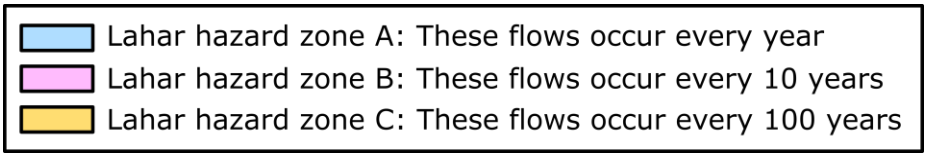
Process & Qualitative Probability



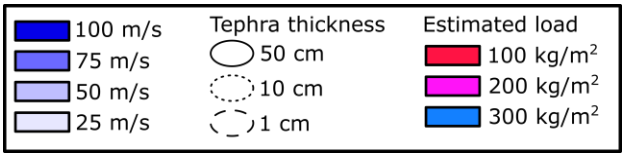
Recurrence Interval



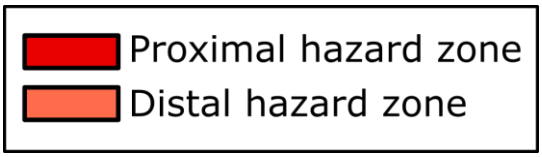
Process & Recurrence Interval



Estimated Value or Hazard Intensity Metric (HIM)

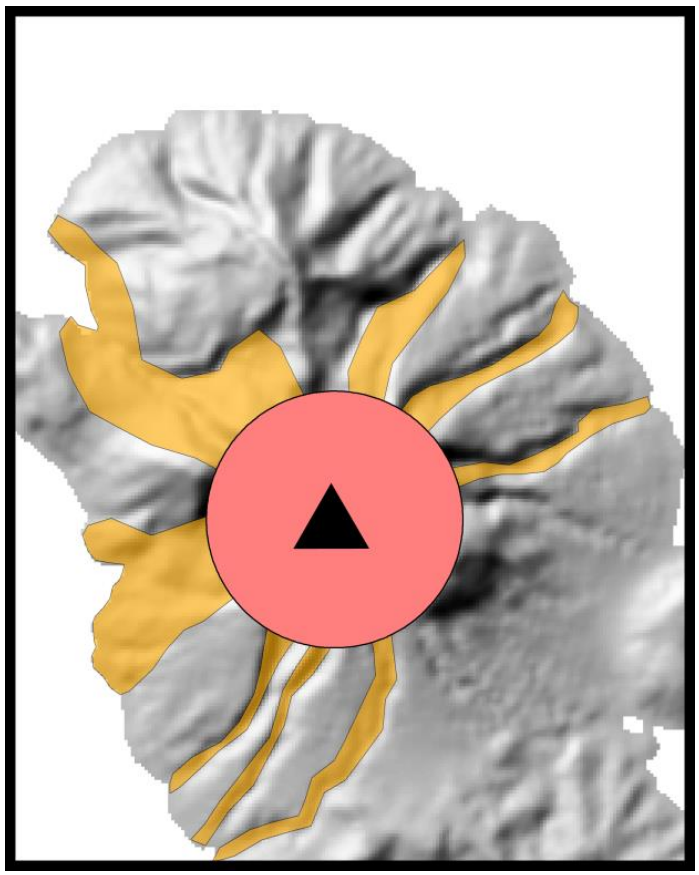


Location or source name

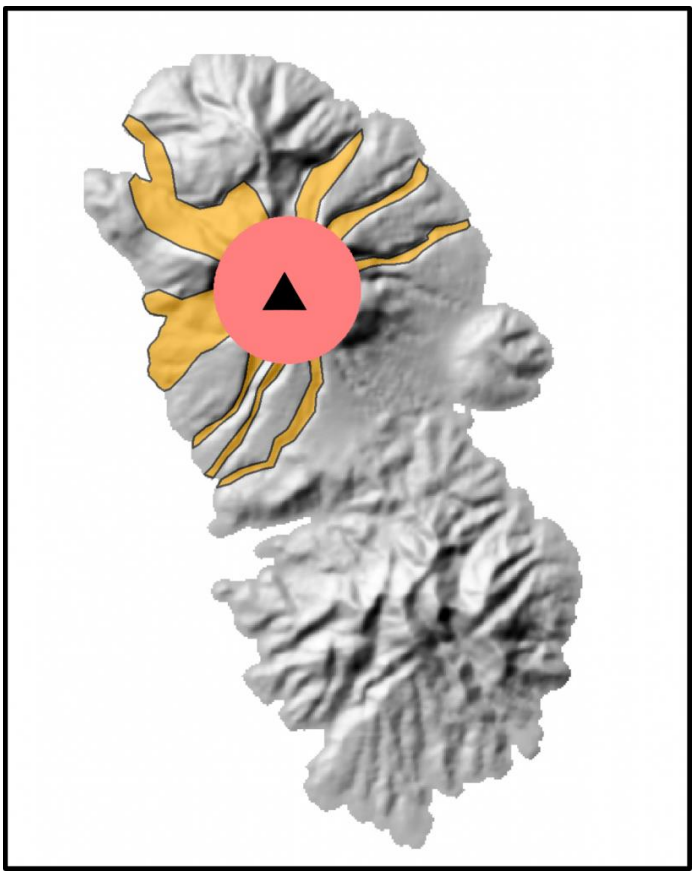


Spatial Scale

Volcano-scale

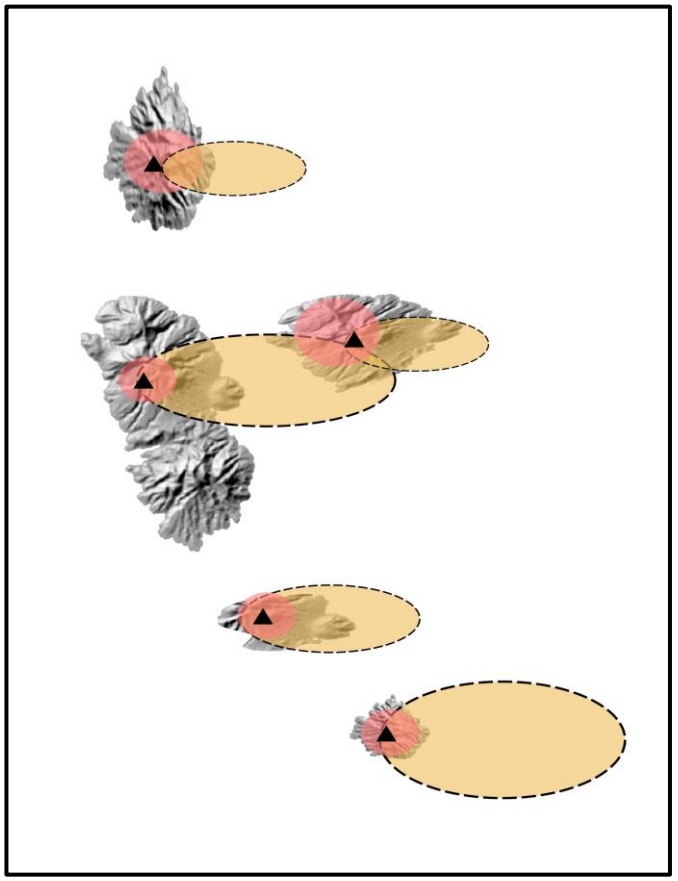


Entire island/Island-scale



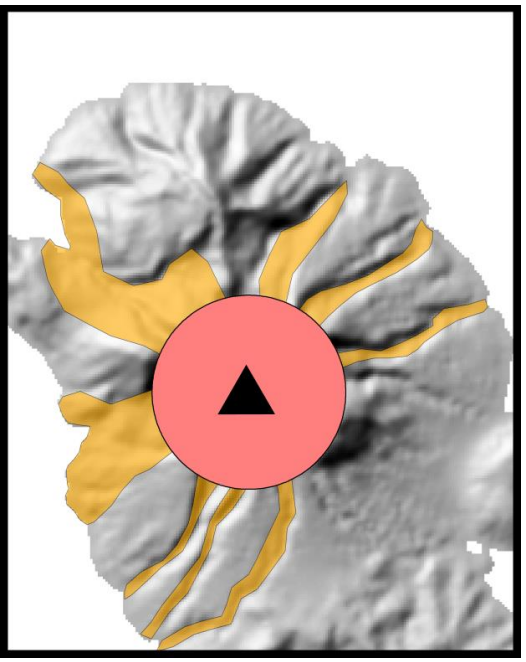
Flank or drainage-scale

Regional-scale

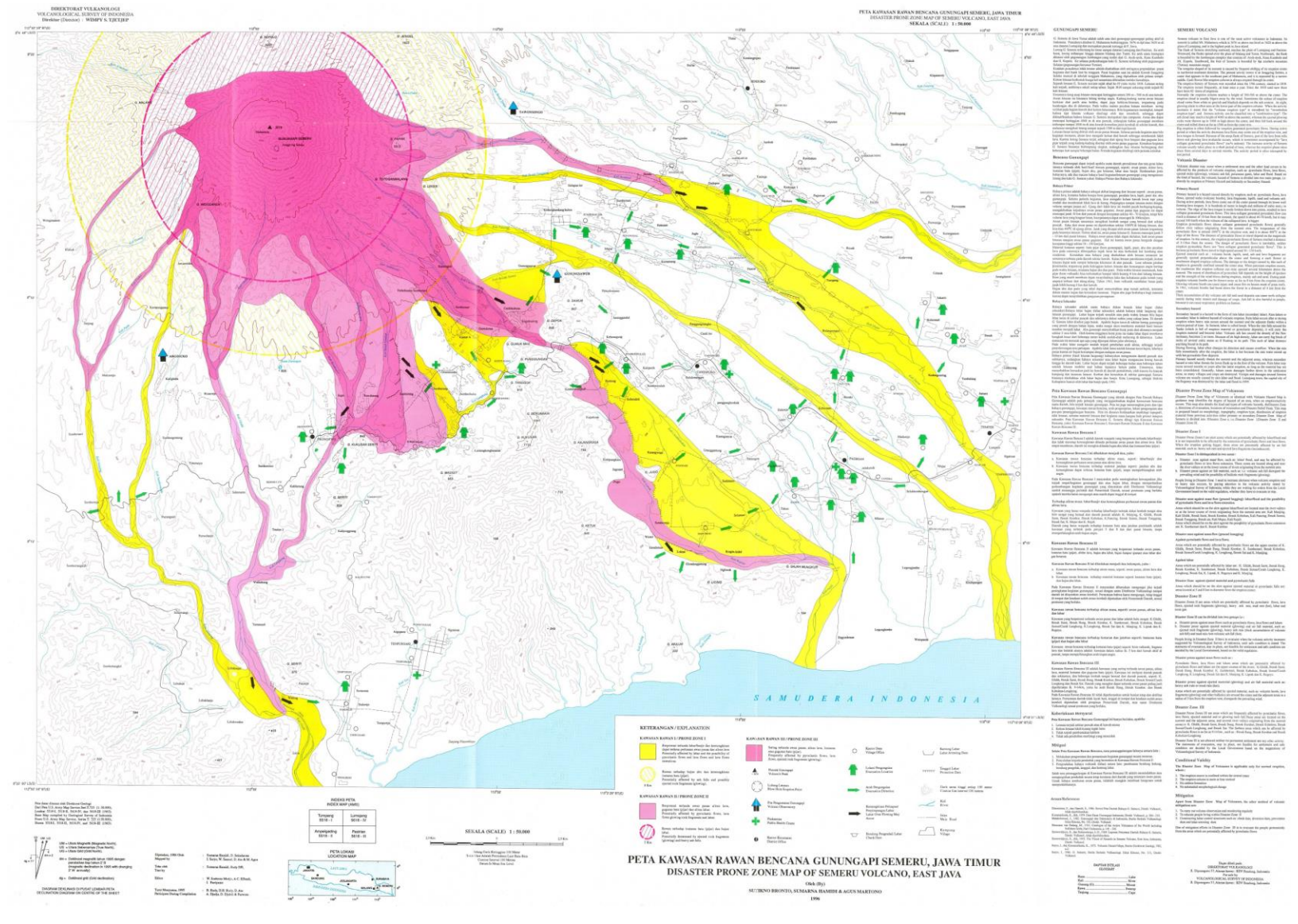


Spatial Scale

Volcano-scale

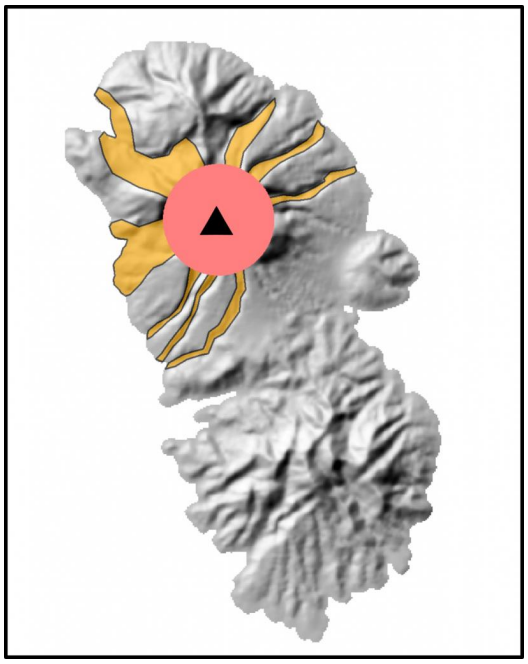


Semeru, Indonesia
(Bronto et al. 1996)

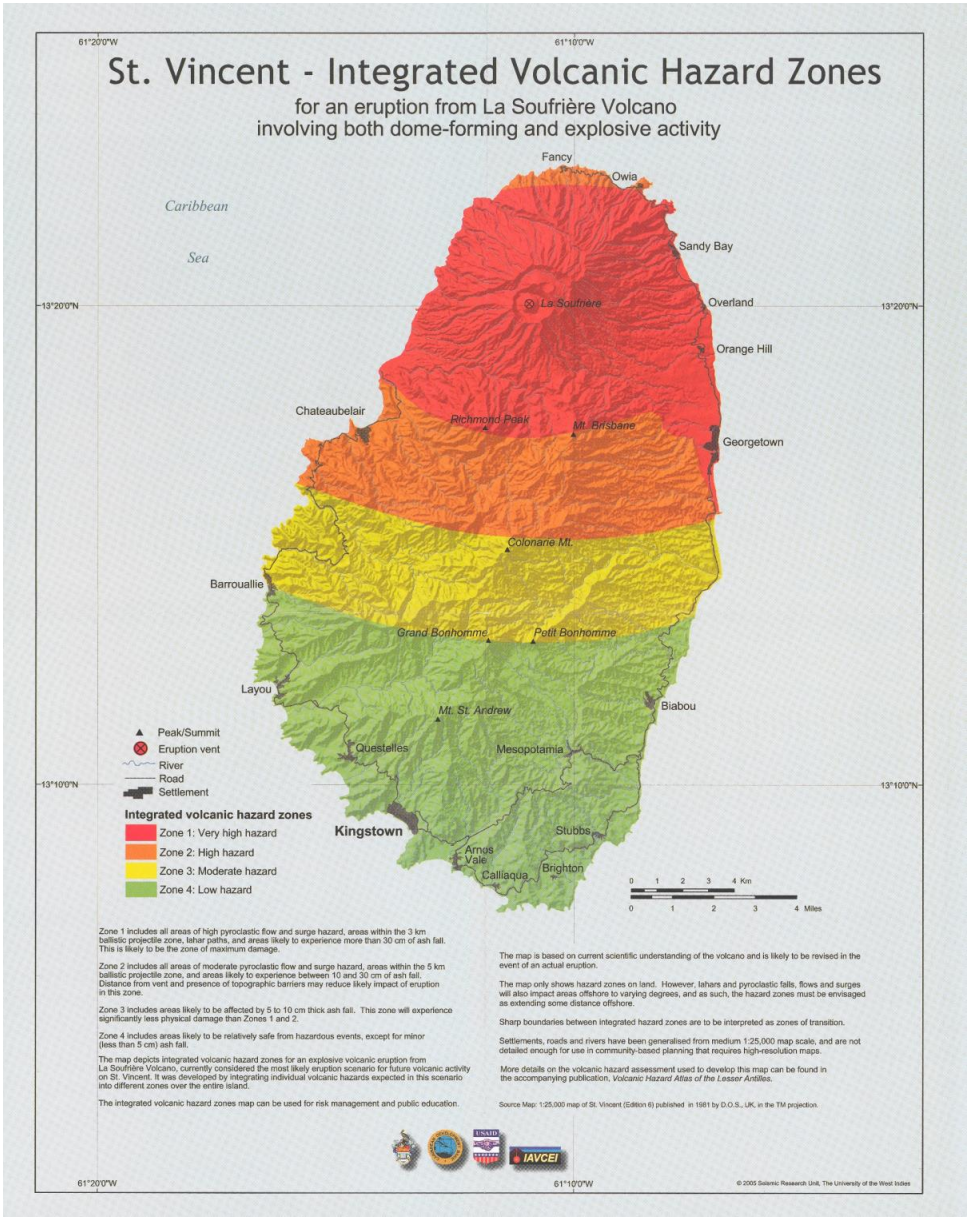


Spatial Scale

Entire island/Island-scale



Soufrière St. Vincent, Saint Vincent and the Grenadines
(Robertson, 2005)



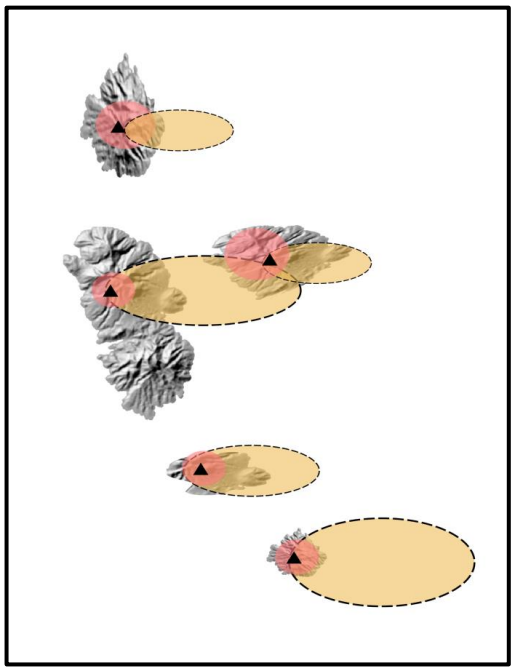
Spatial Scale

Flank or drainage-scale

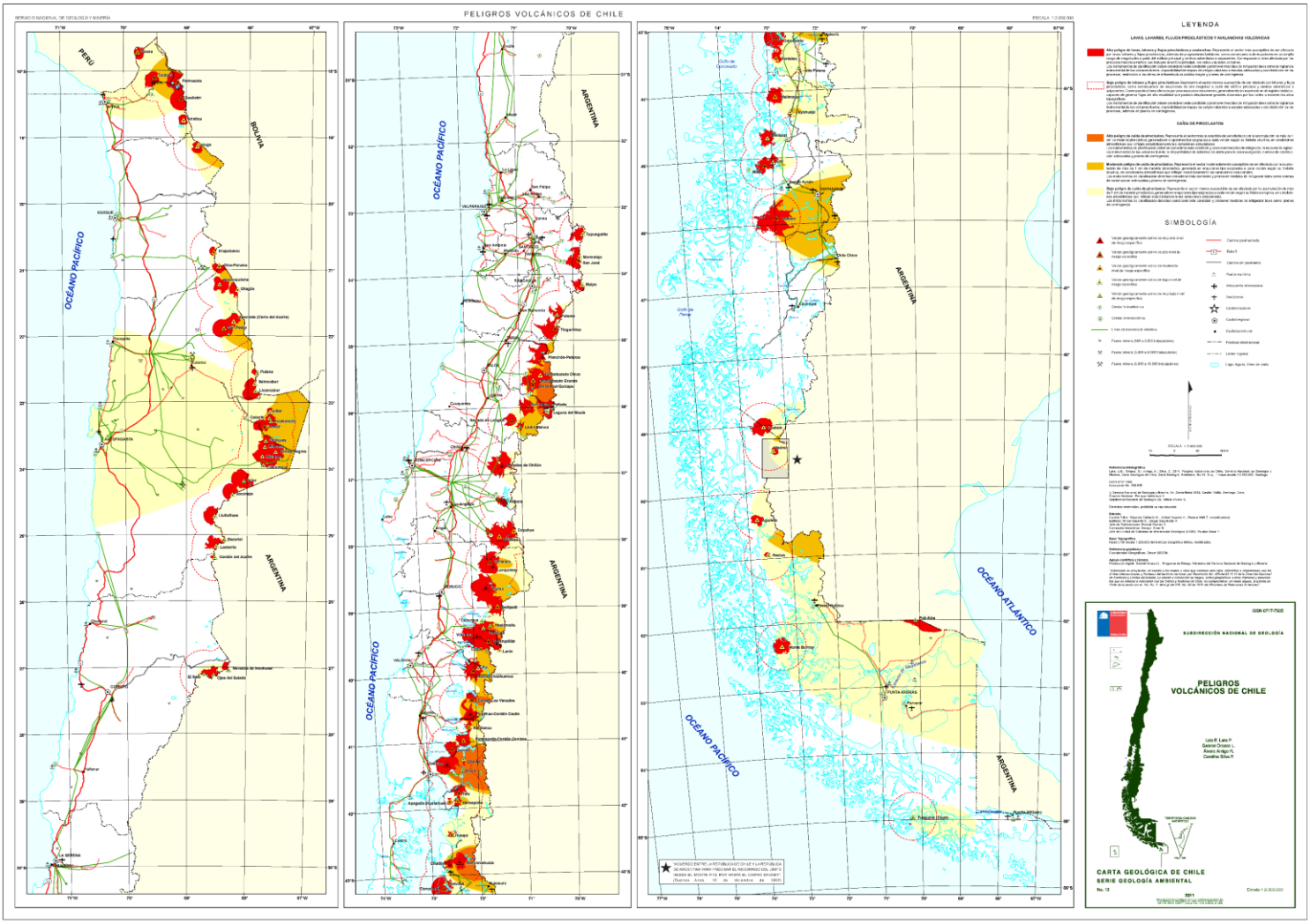
Ruapehu, New Zealand
(GNS Science (compiler), 2019)

Spatial Scale

Regional-scale



Chile (regional)
(Lara et al., 2011)



Temporal Scale

Background (Long-term) Hazard Maps

- usually created in advance of volcanic unrest
- intended to show the possible distribution of volcanic hazards over long (years to decades) time frames
- often based on a combination of methods that incorporate eruptive history, geologic records, and/or modeling
- may be based on either specific scenarios (e.g. most likely, worst-case) or on all possible activity
- low-likelihood but high-impact hazards may be included
- often accompany long-term hazard assessments produced by geological surveys
- most suited to general hazard awareness and land-use planning purposes
- often used during volcanic crises, but may not be well-suited to this purpose, unless scenarios relevant to the crisis were included on the map

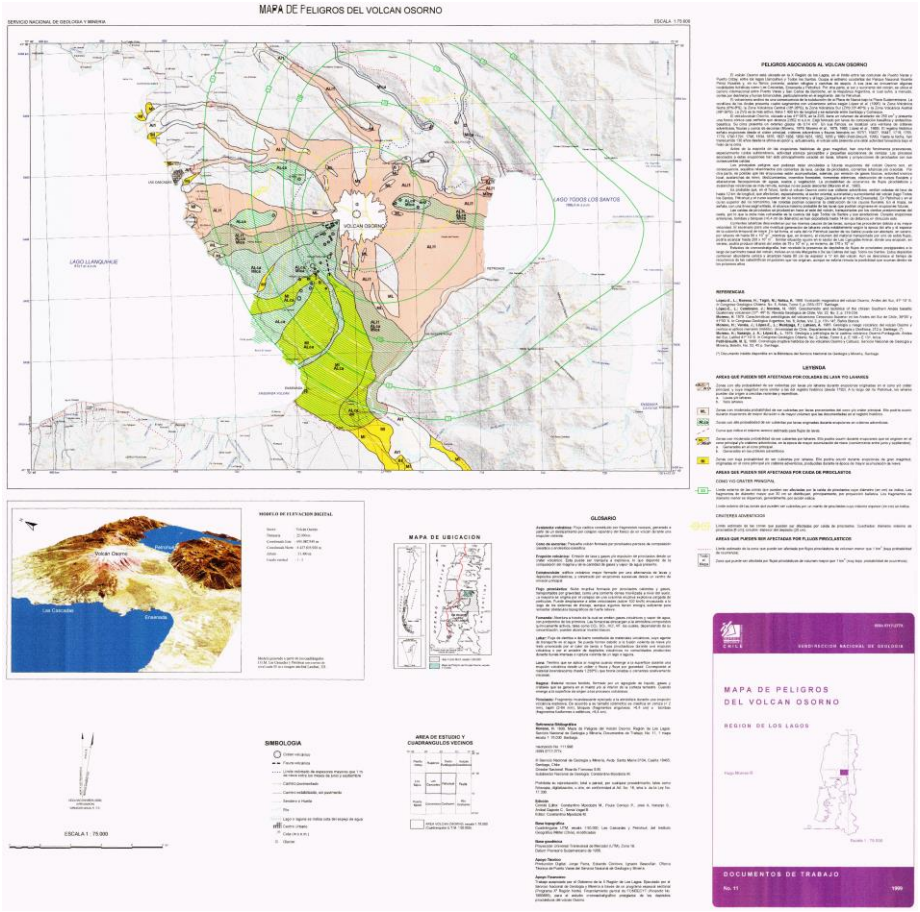
Crisis (Short-term) Hazard Maps

- usually created at the start of volcanic unrest or during an eruption
- usually intended for crisis-management purposes and show the likely distribution of hazards based on current conditions over short (days to months) or very short (hours to days) time frames
- often also based on eruptive history and geologic records, but they incorporate more information about the current state or specific conditions of the volcano
- commonly based on modeling, with many modeling-based crisis maps serving as forecasts with very short (hours to days) time
- best-suited to managing volcanic crises
- may be presented in non-traditional formats such as interactive web-maps or smart phone applications

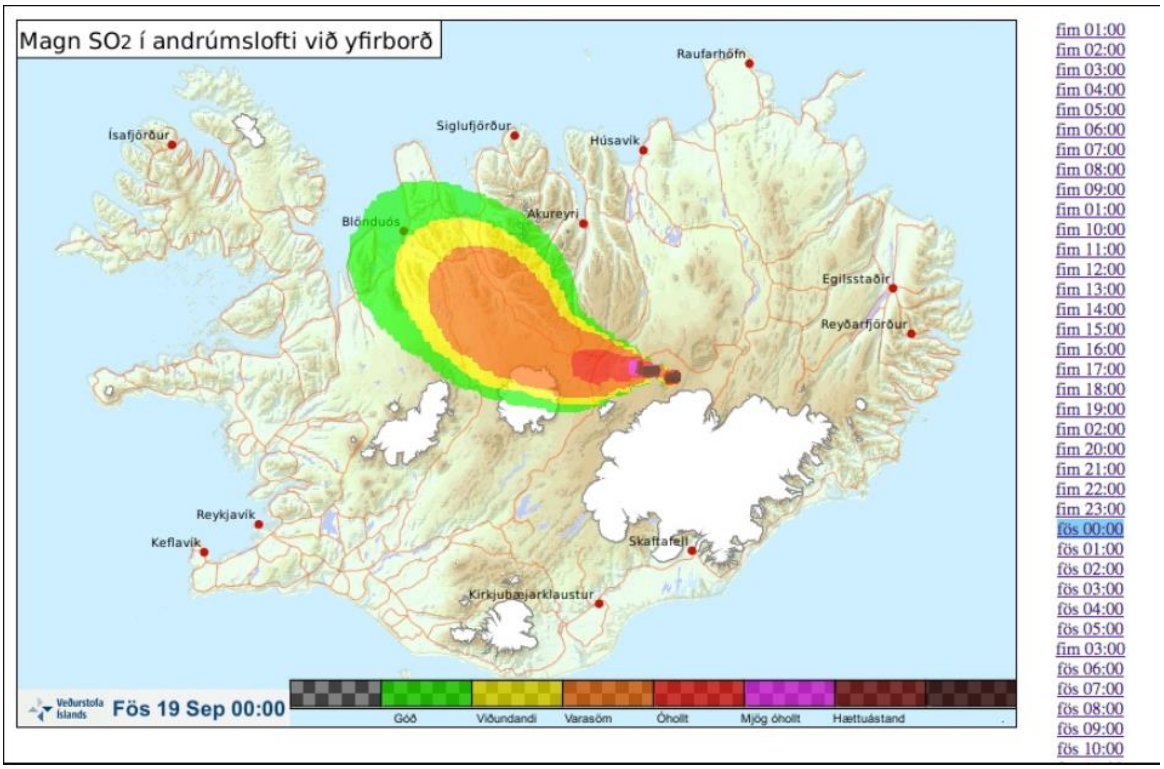
Temporal Scale

Background (Long-term) Hazard Map

Osorno, Chile
(Moreno, 1999)



Crisis (Short-term) Hazard Map



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fös 03:00
fös 04:00
fös 05:00
fim 03:00
fös 06:00
fös 07:00
fös 08:00
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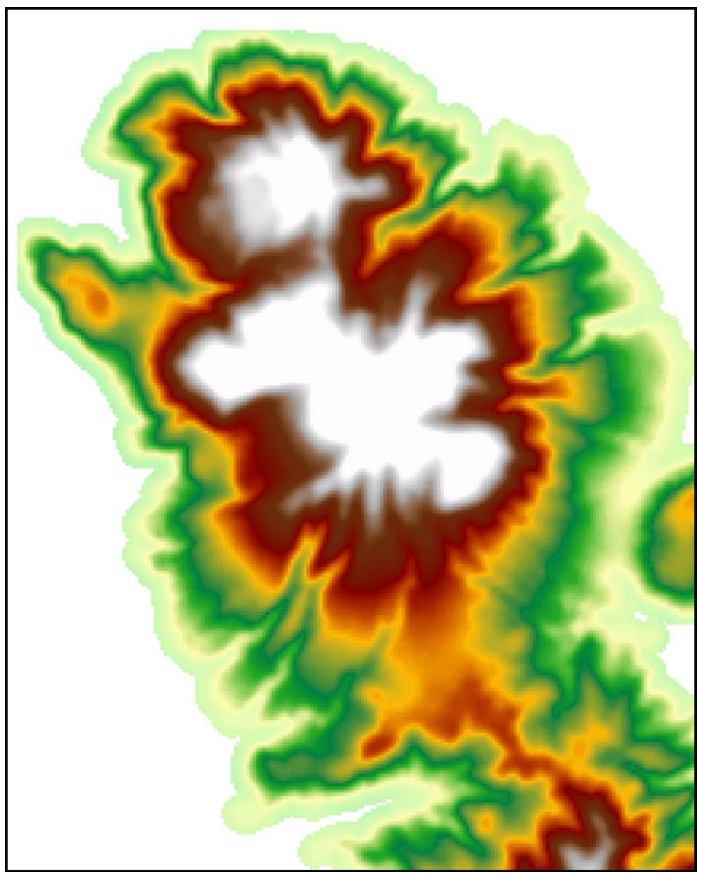
fös 10:00

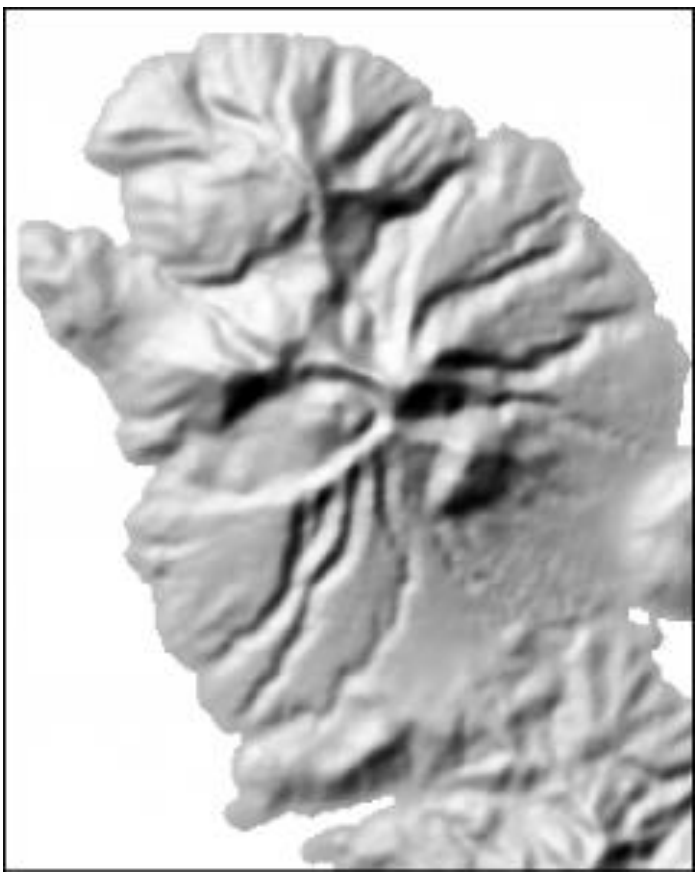
Holuhraun (Askja) &
Bárdarbunga, Iceland
(Iceland Meteorological Office (IMO), 2014)

Basemap Type

DEM

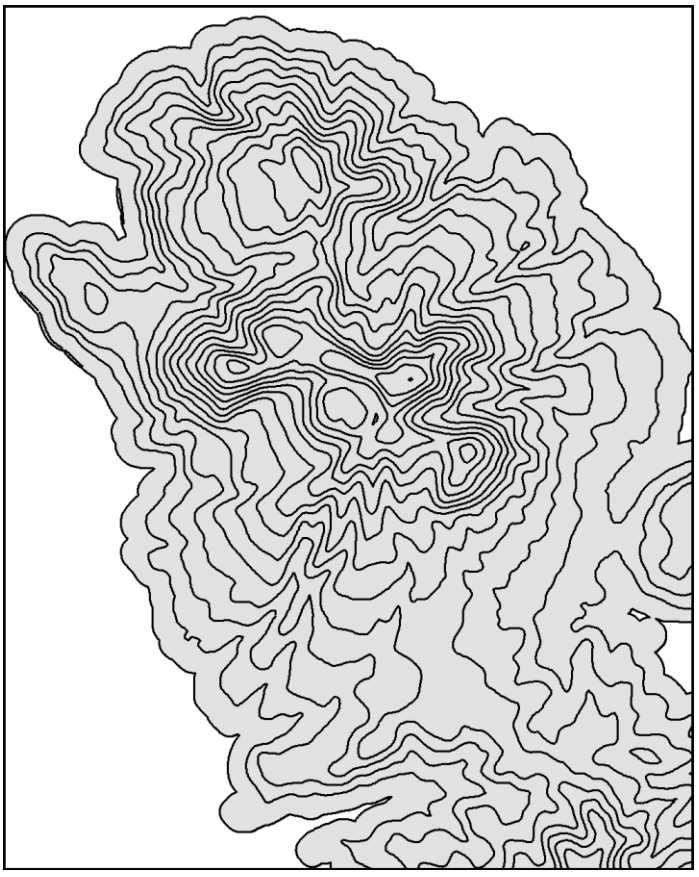


Hillshade DEM



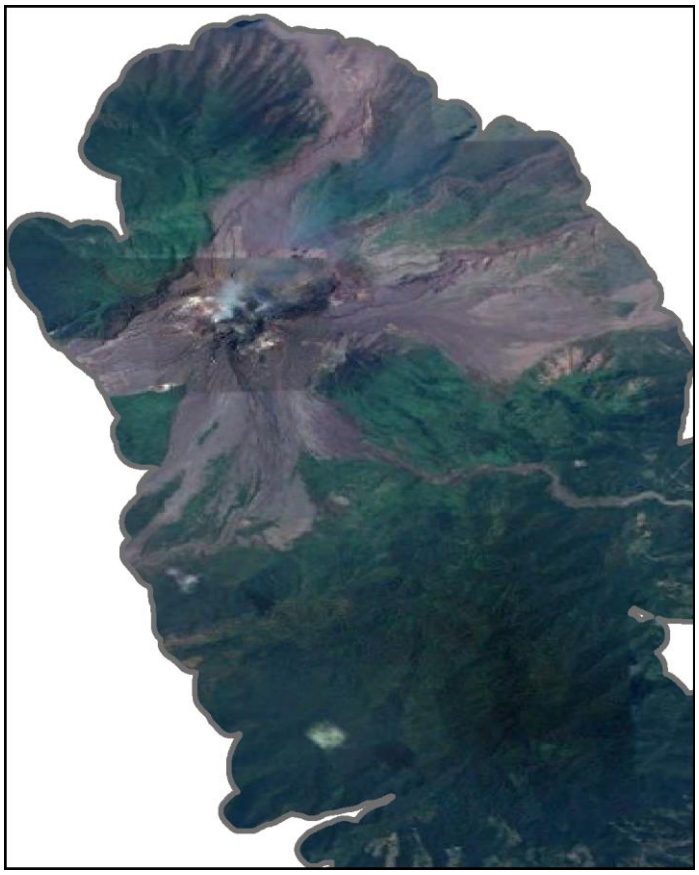
TIN DEM

Contour Lines

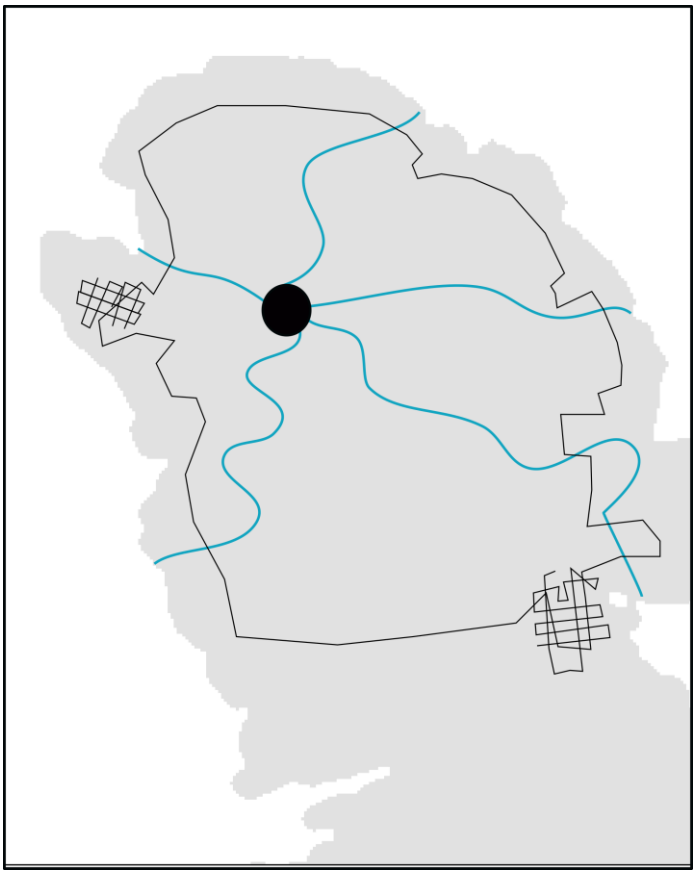


Basemap Type

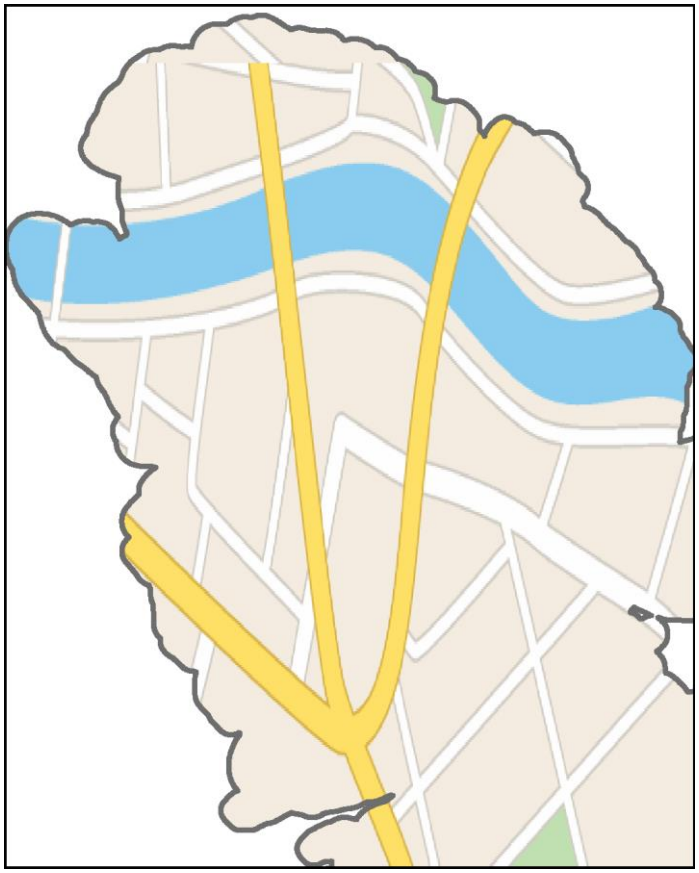
Satellite image/photograph



Simple/sketch base map

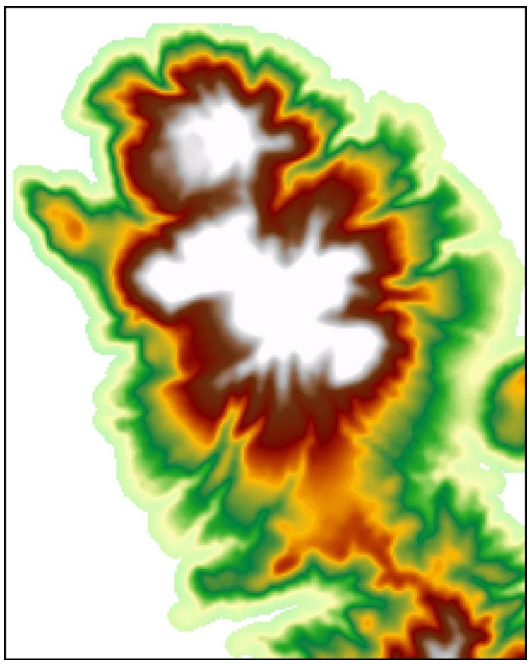


Street map



Basemap Type

DEM



Cumbal, Colombia
(Méndez et al., 2014)

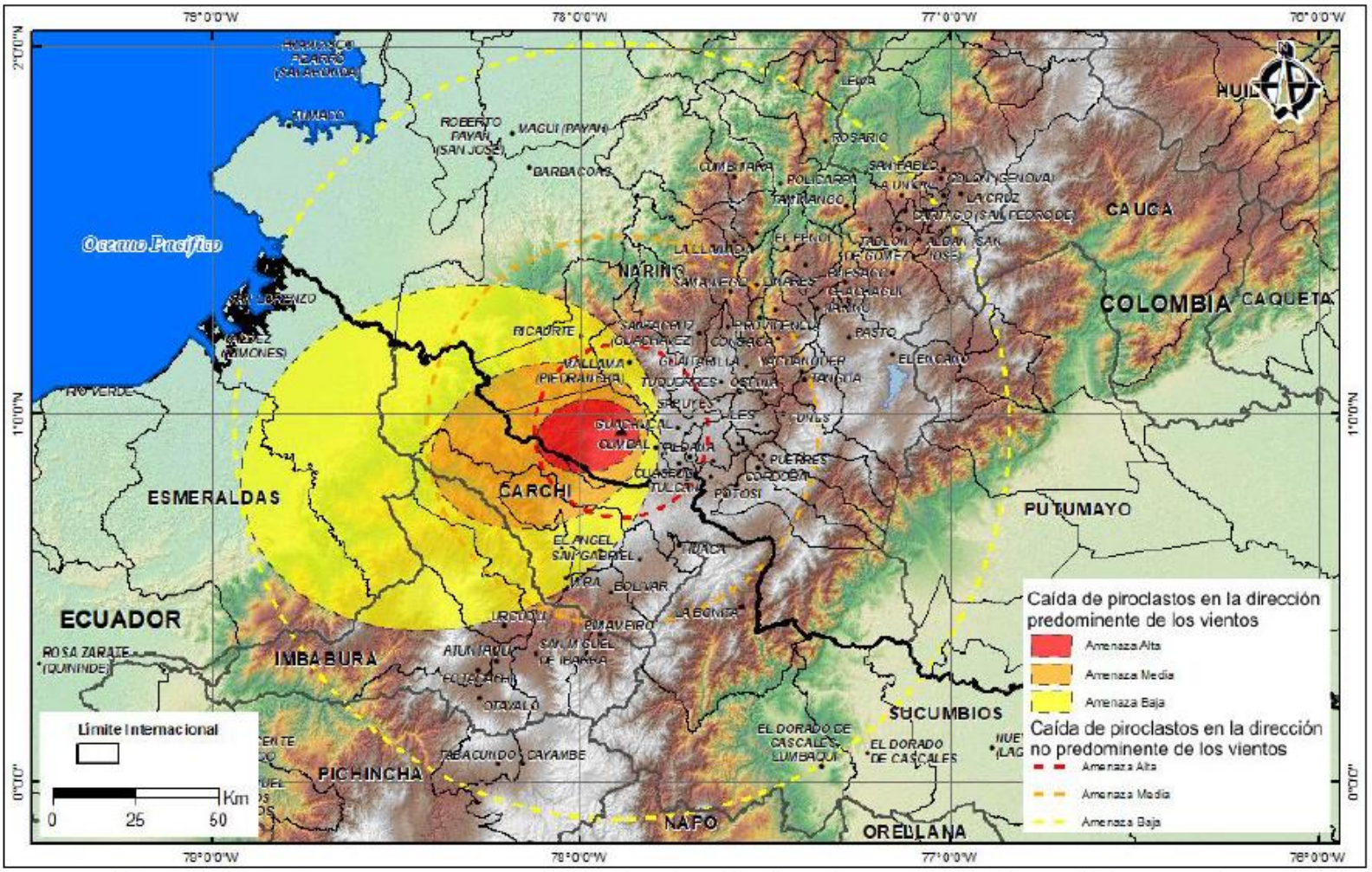
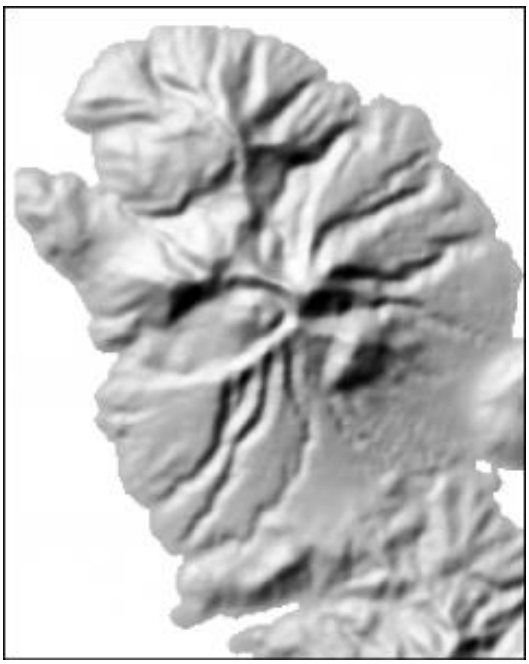


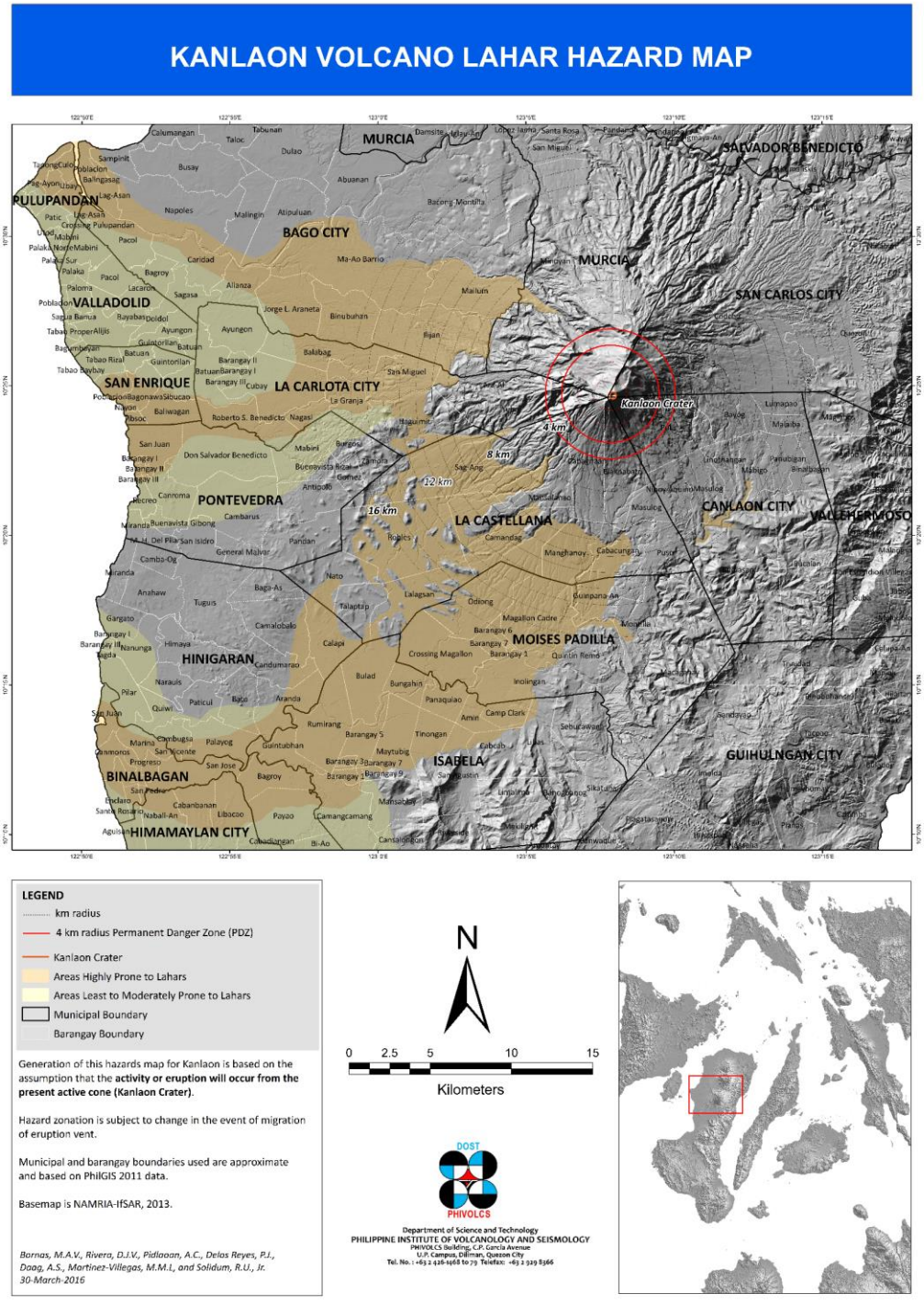
Figura 14. Amenaza por caída de piroclastos transportados eólicamente.

Basemap Type

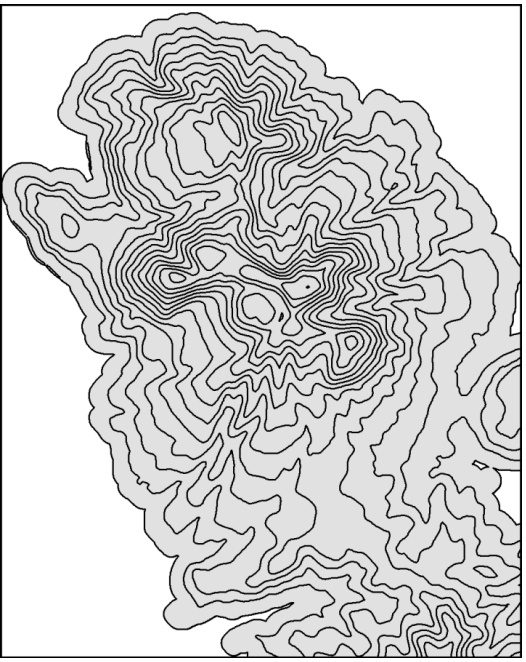
Hillshade DEM



Kanlaon, Philippines
(Bornas et al., 2016)

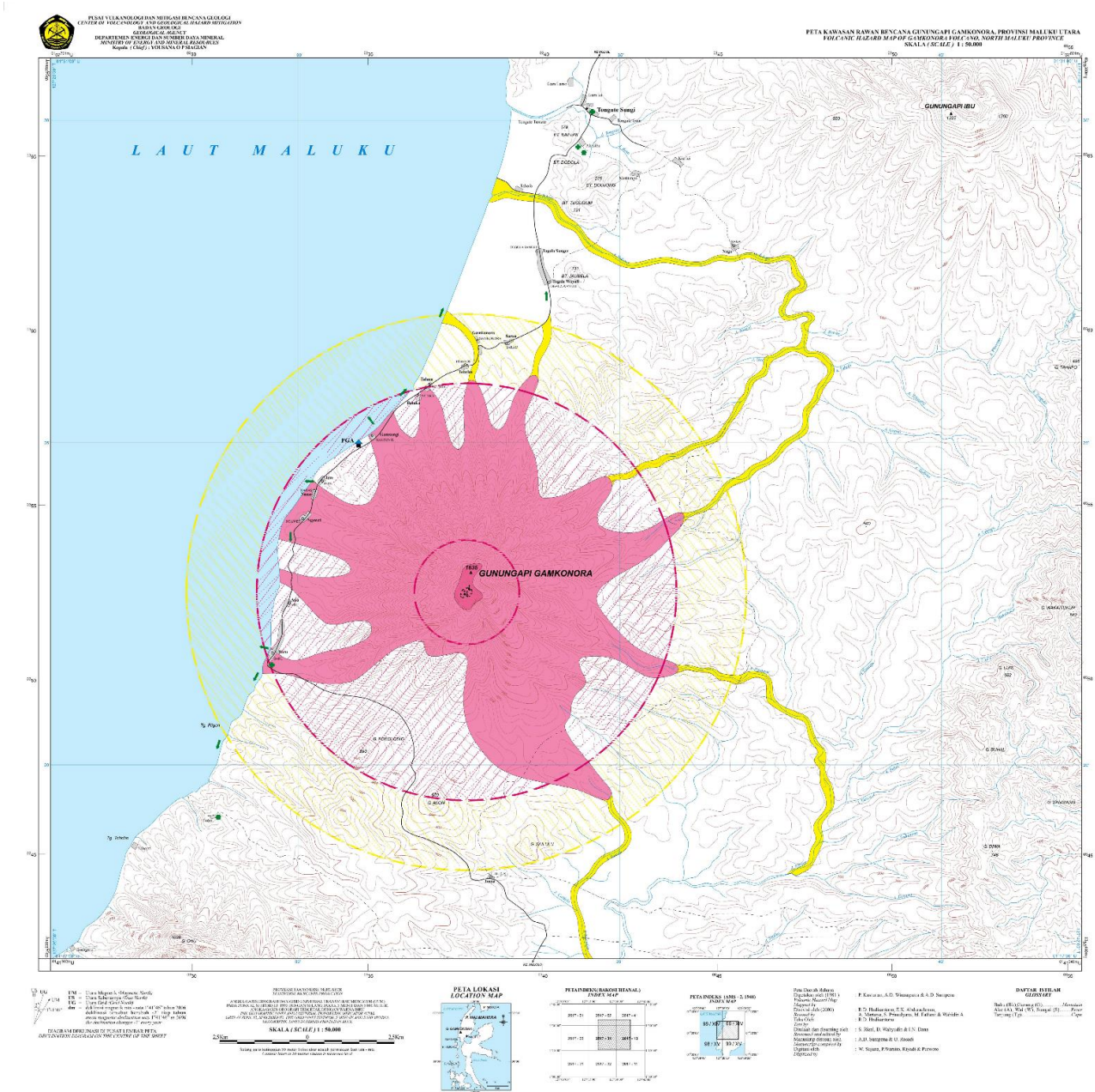


Basemap Type



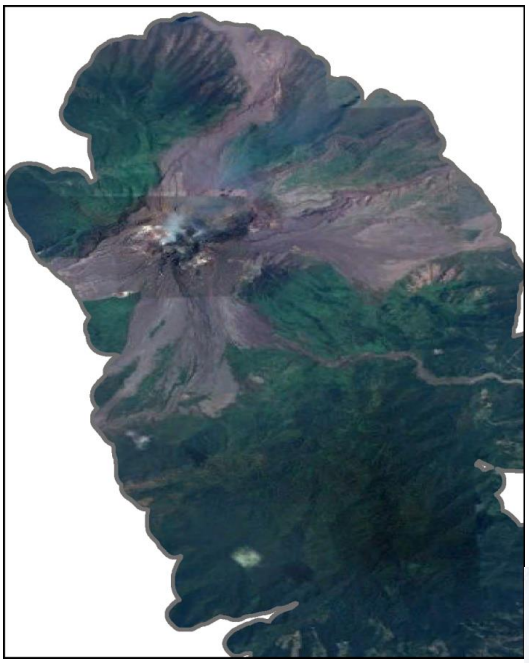
Contour Lines

Gamkonora, Indonesia (cropped)
(Hadisantono et al., 2006)

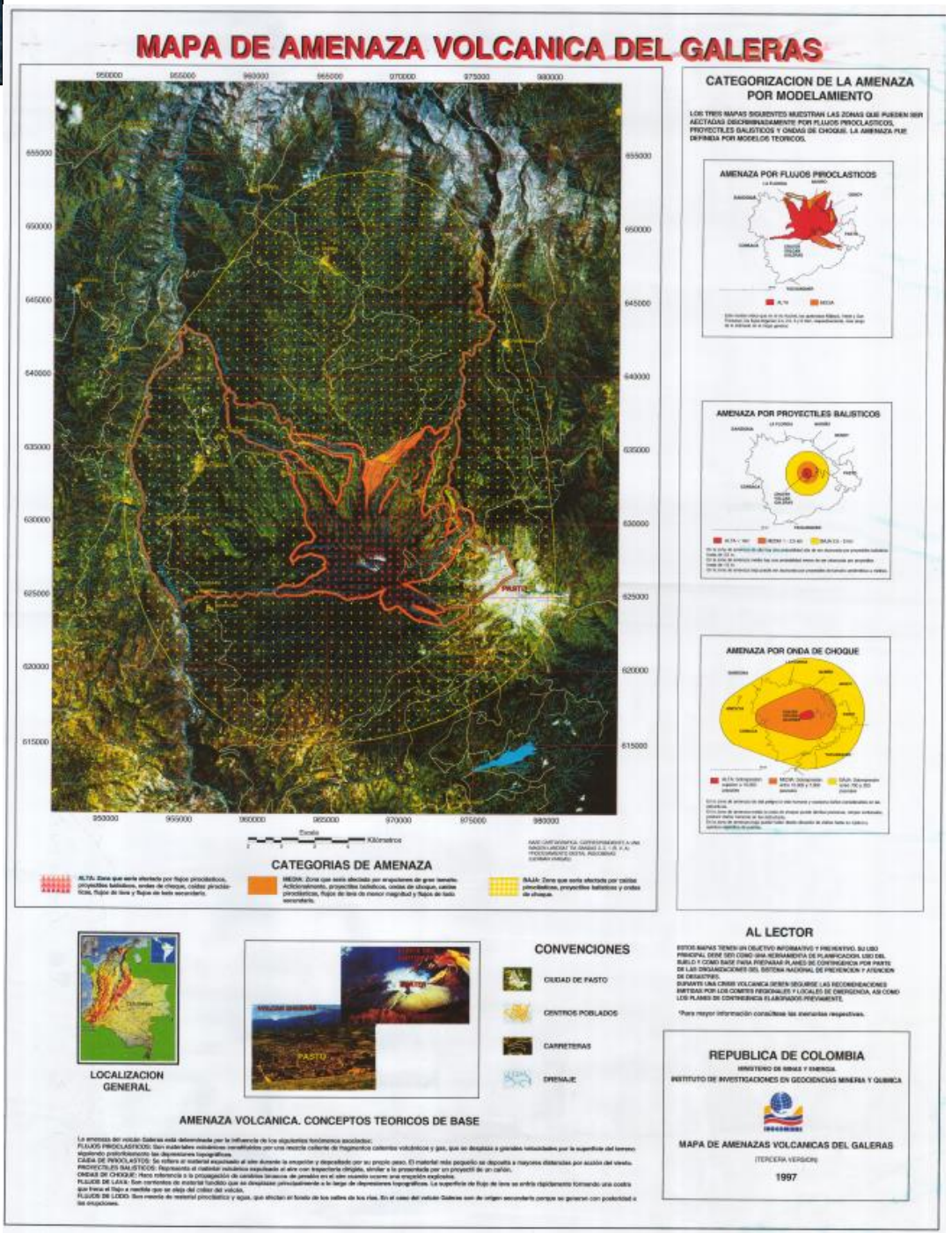


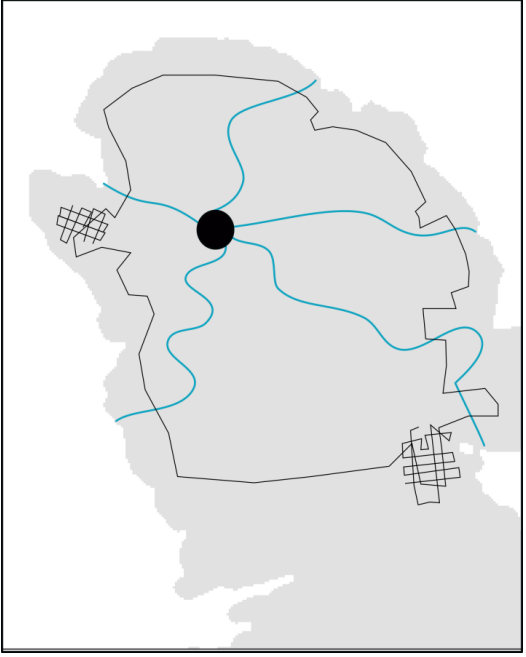
Basemap Type

Satellite image/photograph



Galeras, Colombia
(Instituto Colombiano de Geología y Minería (INGEOMINAS), 1997)

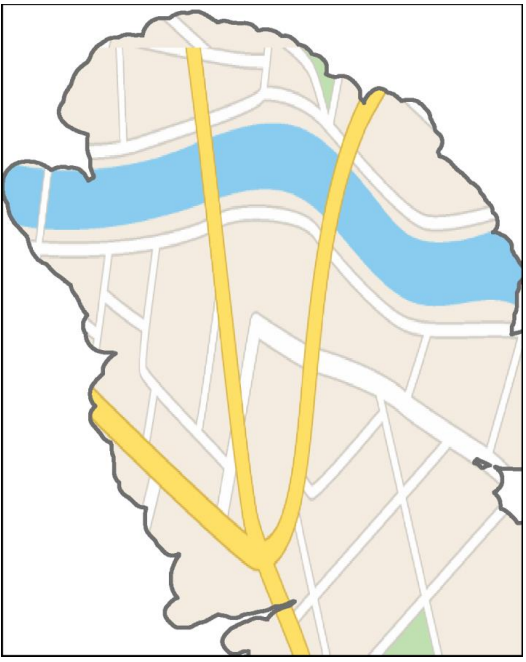




Basemap Type

Simple/sketch base map

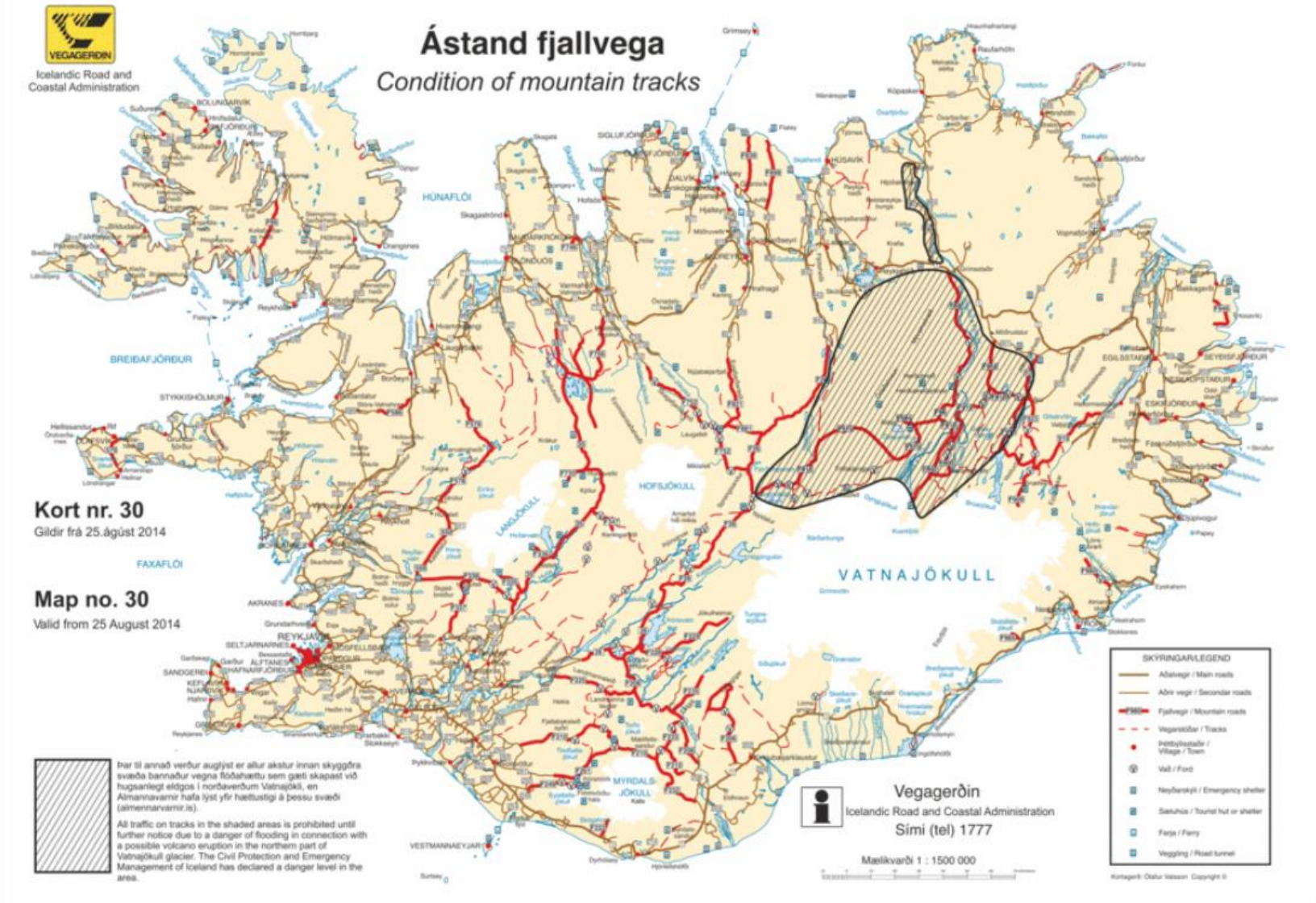
St. Catherine, Grenada
(Robertson, 2005)



Basemap Type

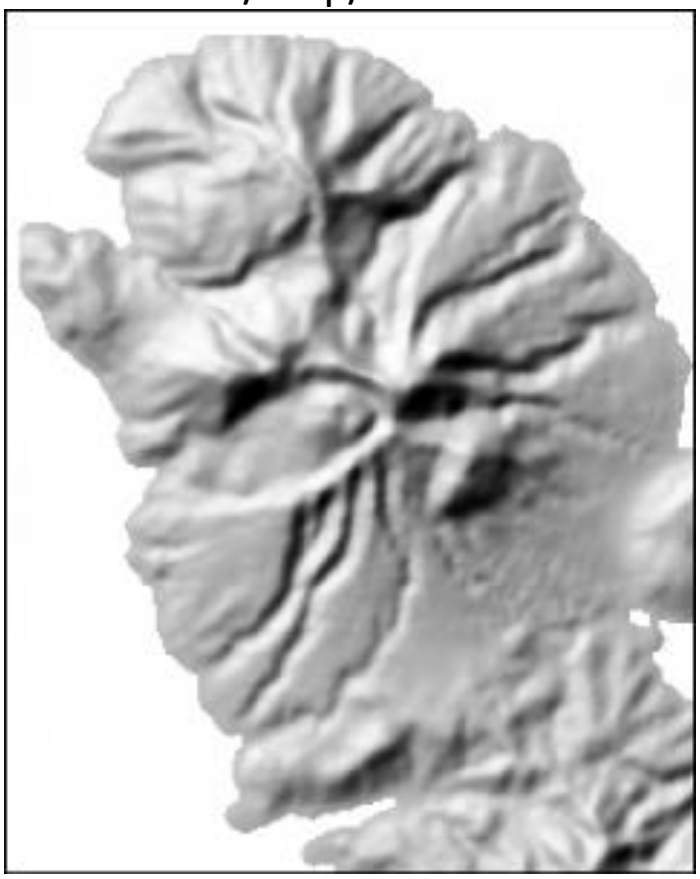
Street map

Holuhraun (Askja) & Bárdarbunga, Iceland
(Icelandic Road and Coastal Administration, 2014)

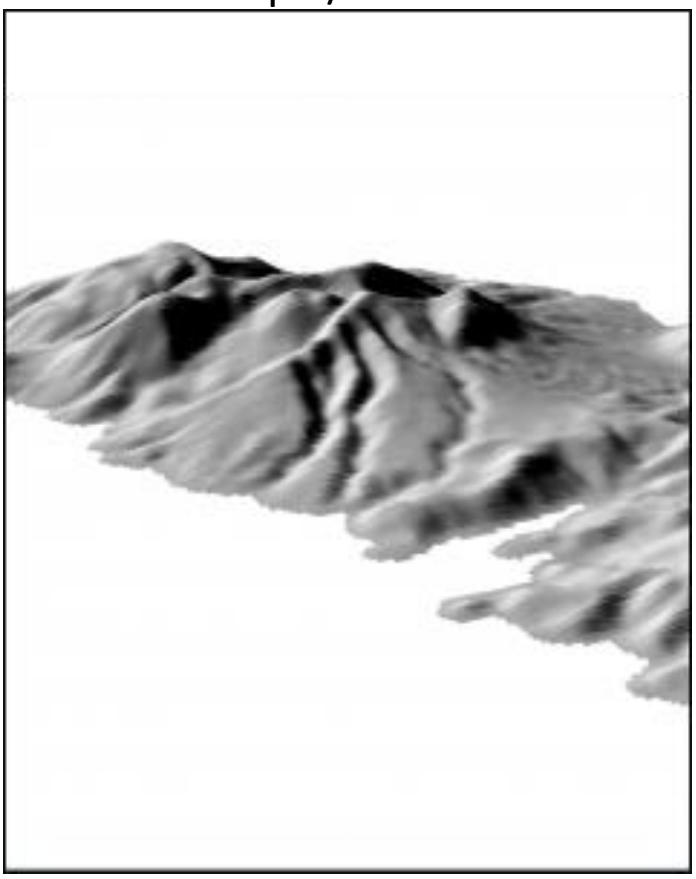


Dimensionality or Map View Type

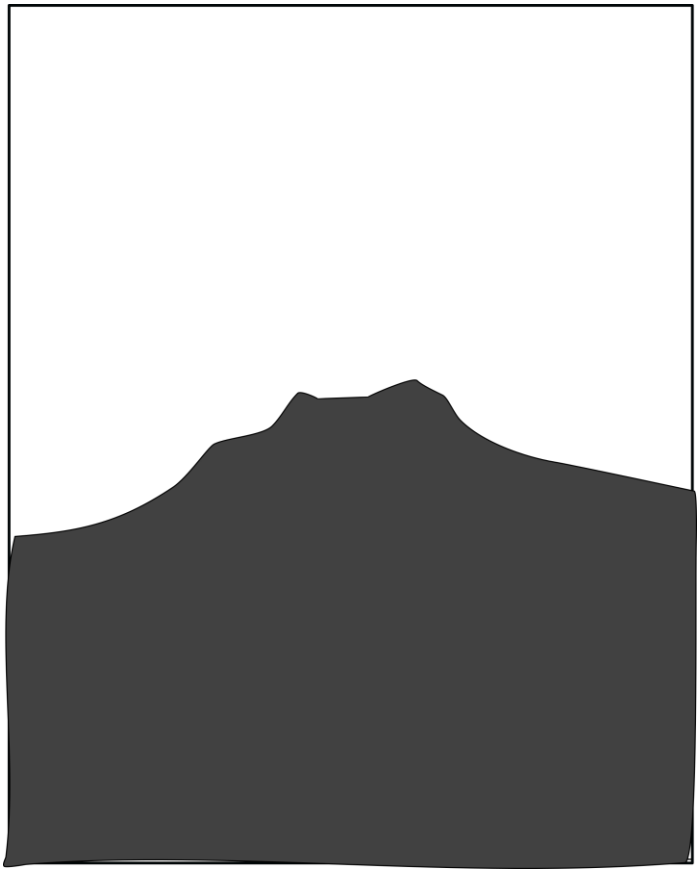
Plan/map/2D view



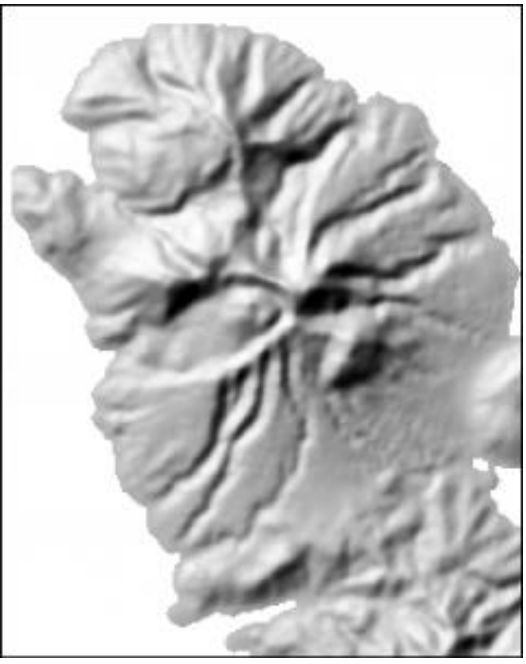
Oblique/3D view



Cross-sectional view



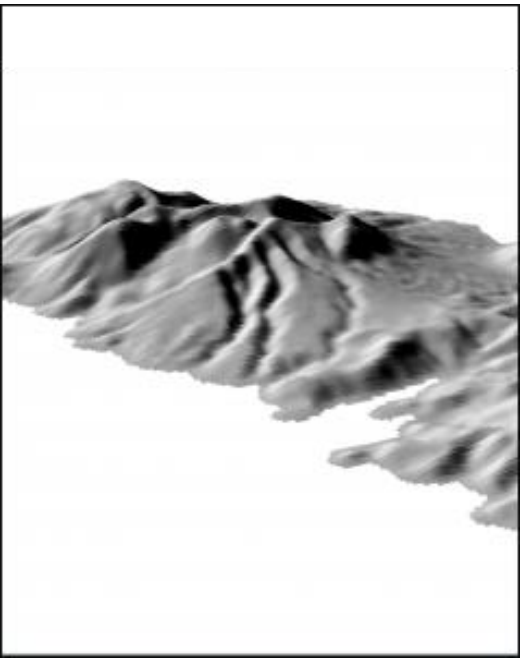
Dimensionality or Map View Type



Plan/map/2D view

Liamuiga, Saint Kitts and Nevis
(Robertson, 2005)

Dimensionality or Map View Type



Oblique/3D view

Yasur, Vanuatu (cropped)
(Vanuatu Meteorology & Geo-Hazards Department)

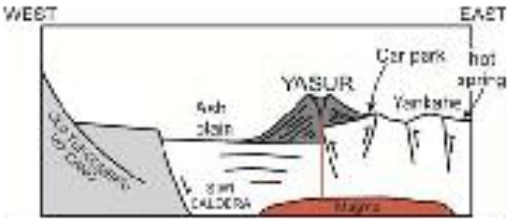
Volcano Fact Sheet

Yasur Volcano – Yenkahe Caldera

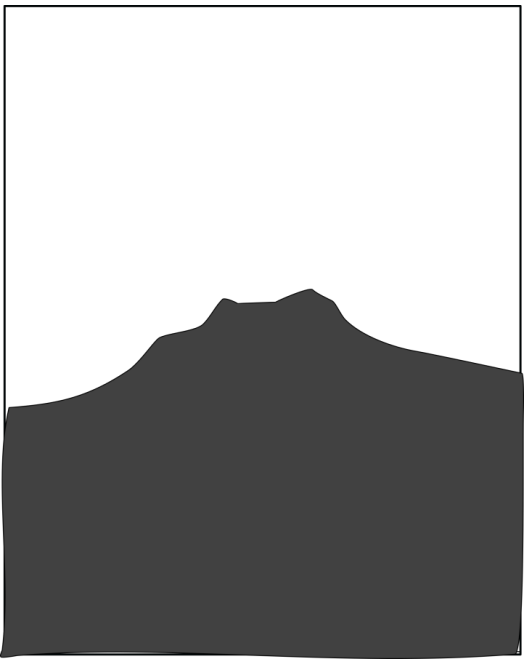
Description

- Yasur, located at the SE tip of Tanna Island, is a mostly unvegetated 361-m-high scoria cone with a nearly circular, 400-m-wide summit crater.
- Yasur is the most frequently visited of the Vanuatu volcanoes.
- It has been in more-or-less continuous activity since Captain Cook observed ash eruptions in 1774.
- This style of activity may have continued for the past 800 years.

(www.volcano.si.edu)

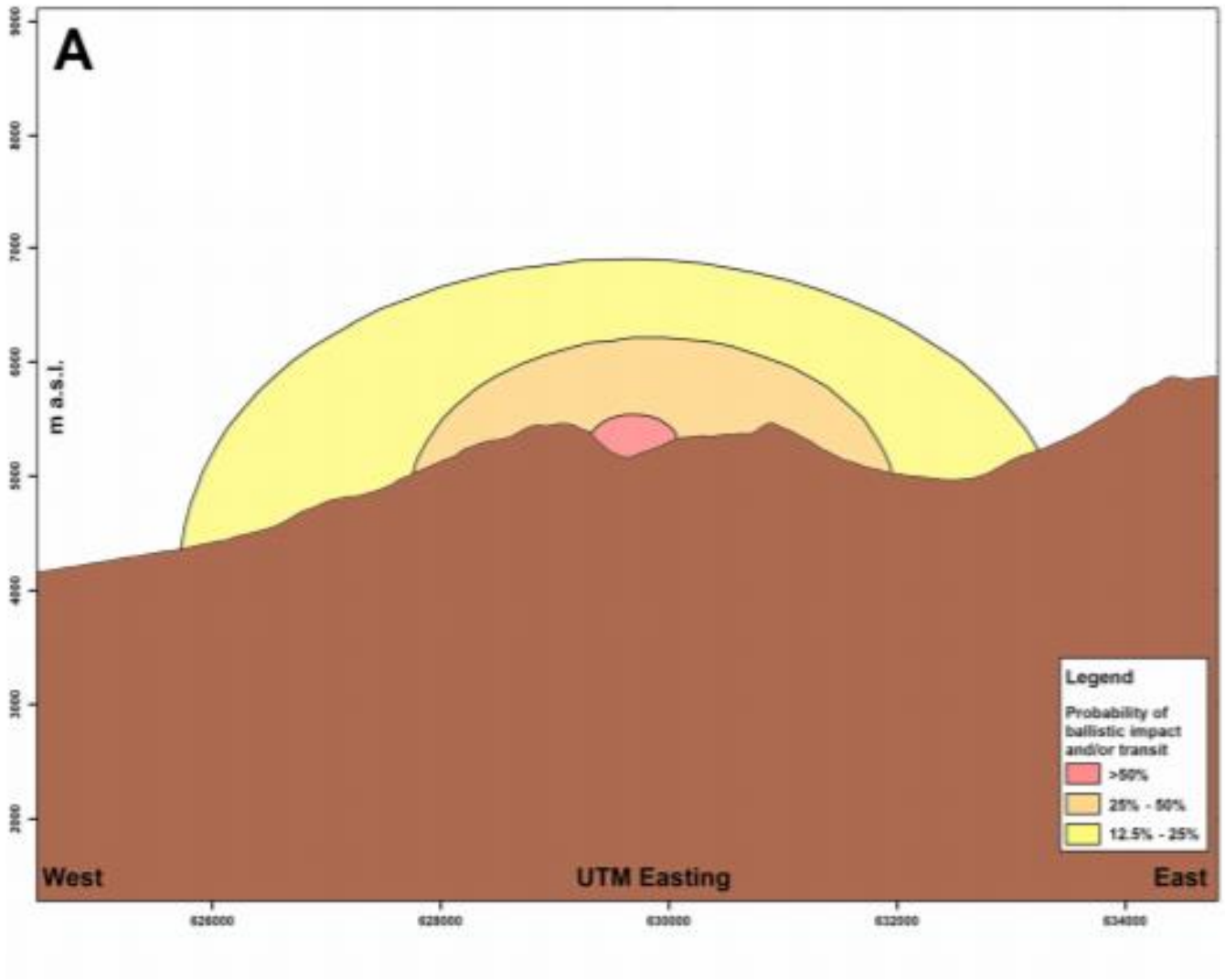


Dimensionality or Map View Type



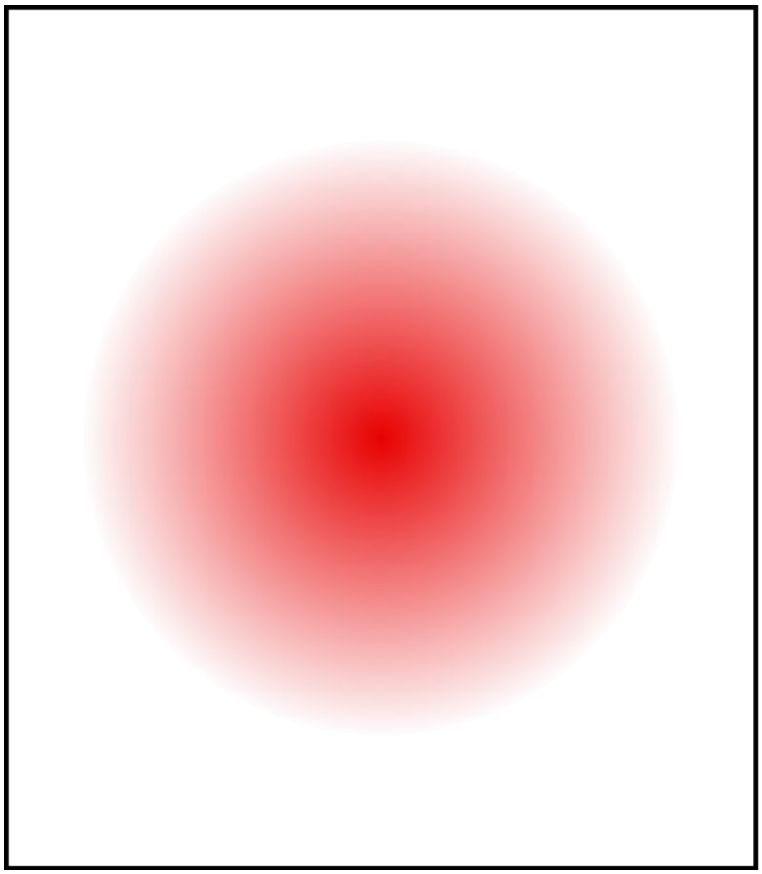
Cross-sectional view

Lascar, Chile
(Bertin, 2017)

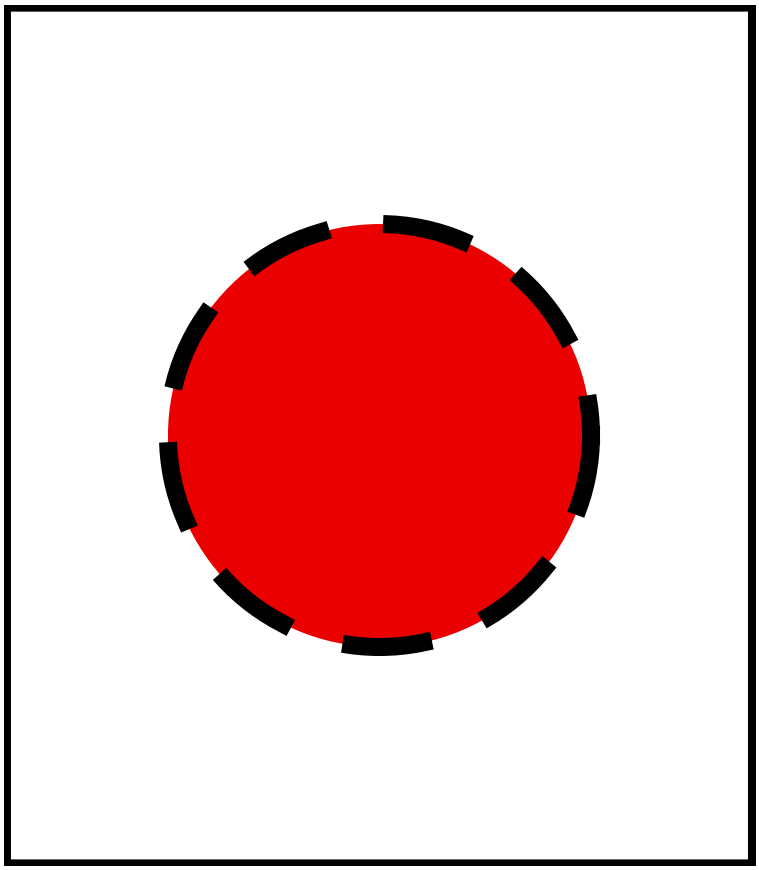


Uncertainty Visualization

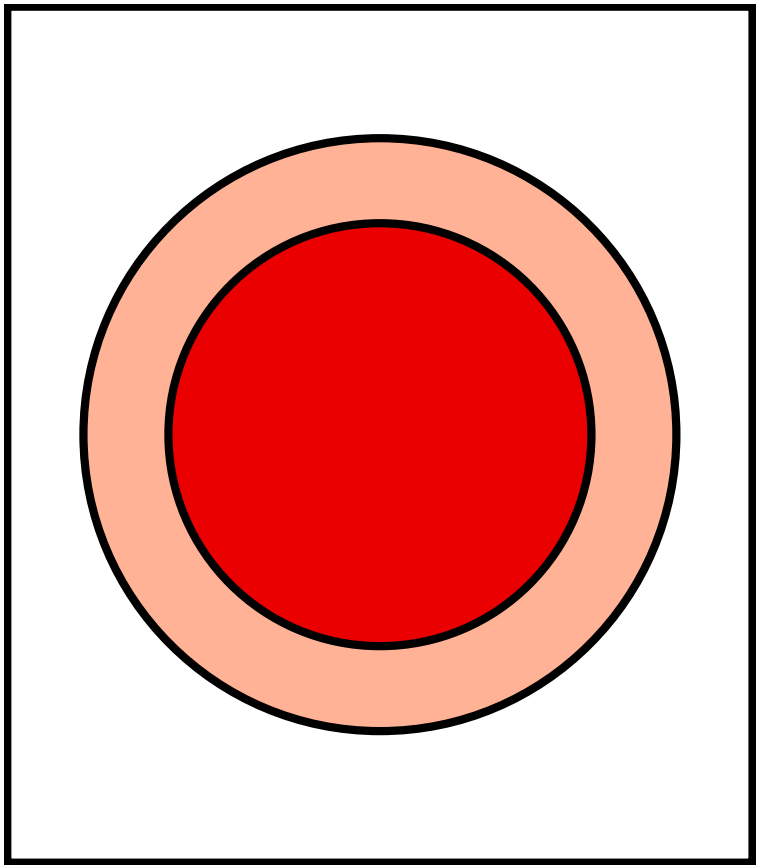
Fuzzy boundaries or gradational colors



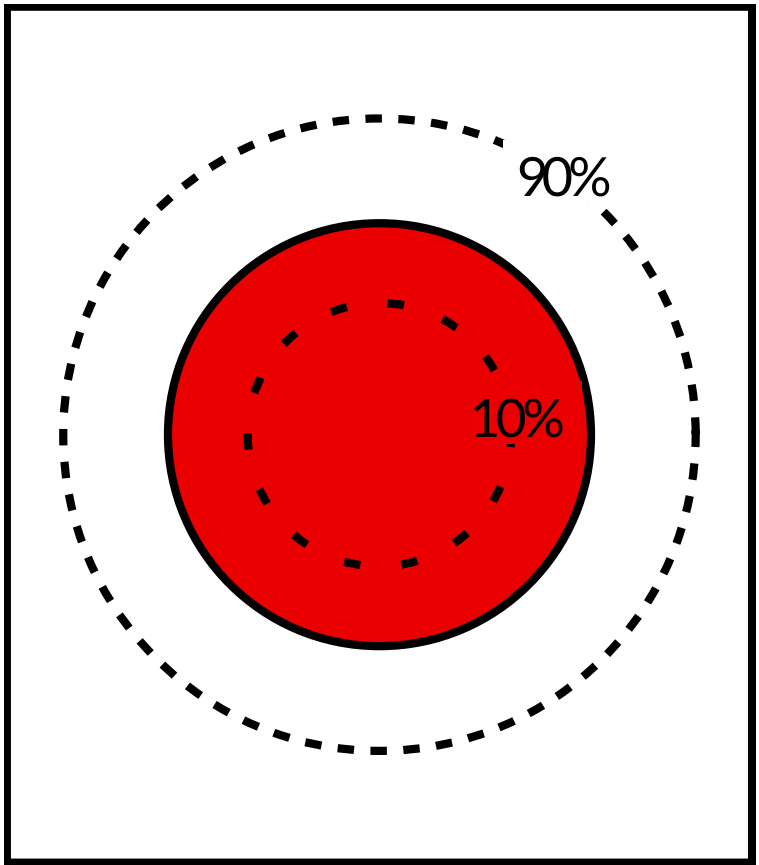
Boundary symbology



Buffer zones

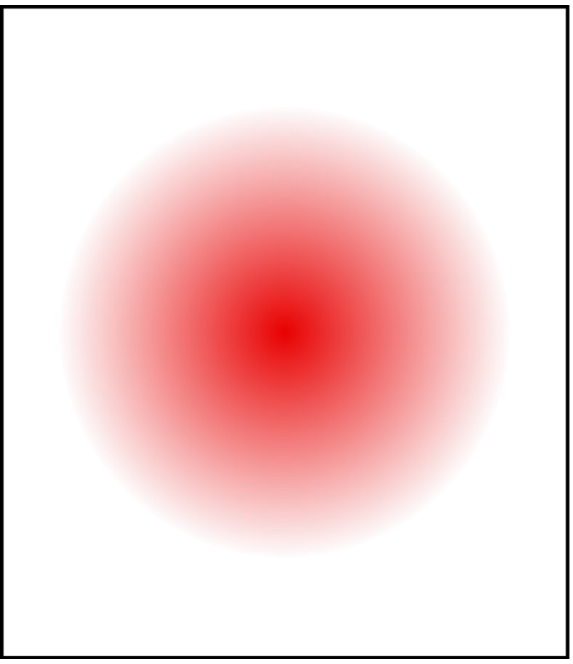


Confidence intervals

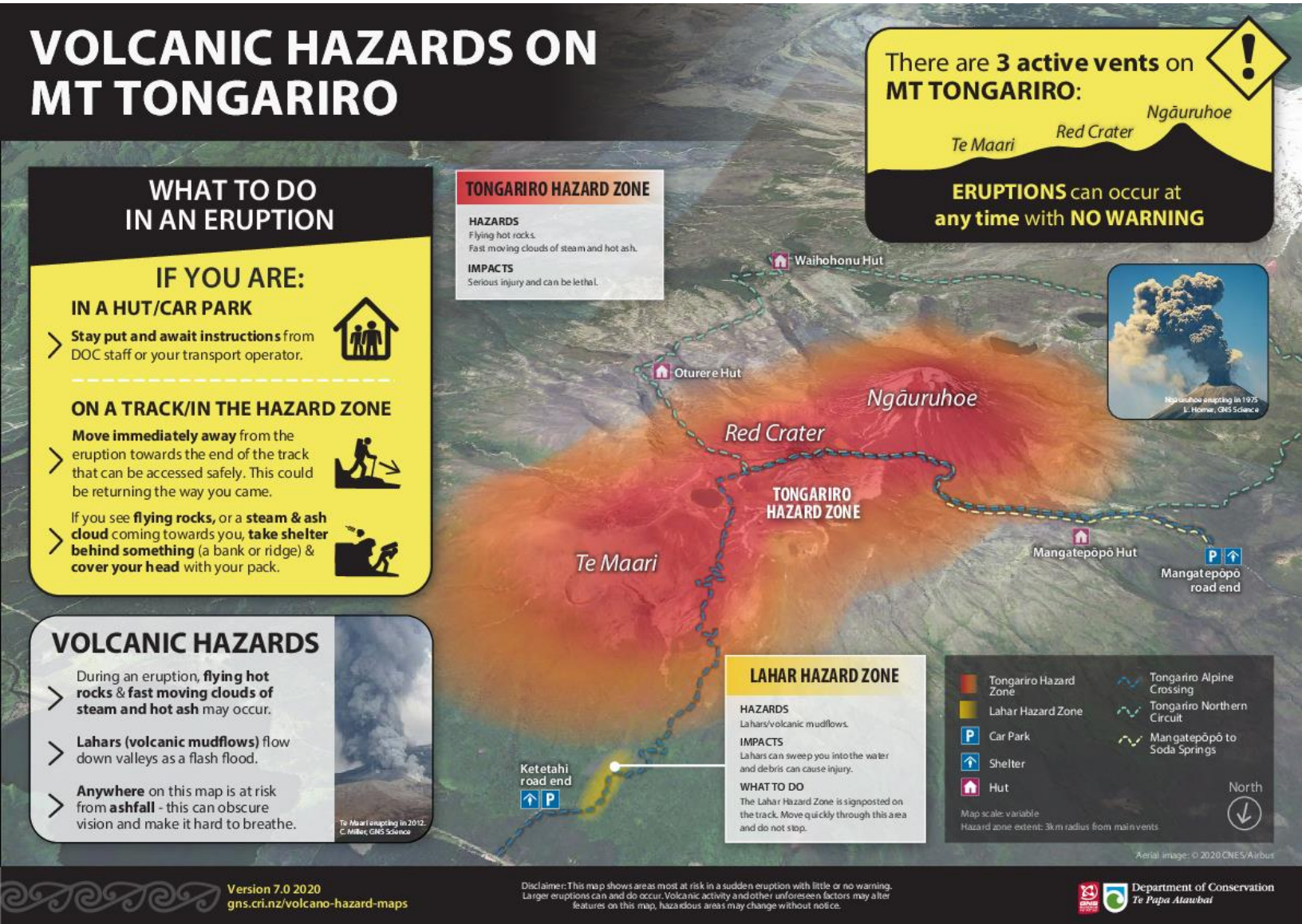


Uncertainty Visualization

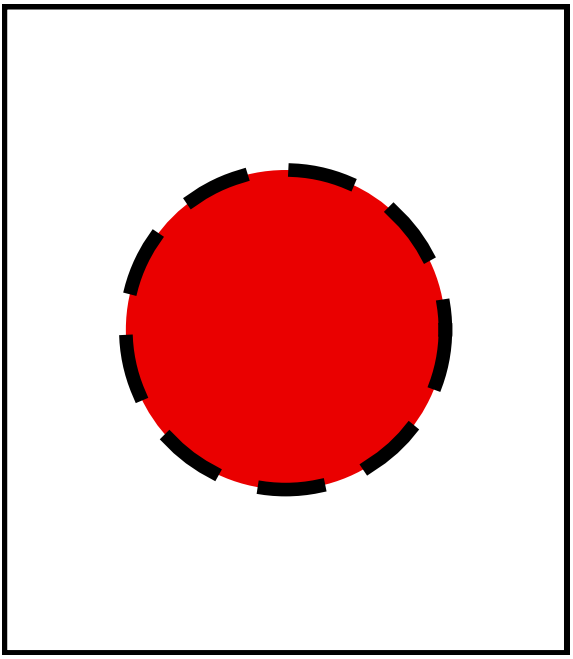
Fuzzy boundaries or gradational colors



Tongariro, New Zealand
(GNS Science (compiler), 2020)

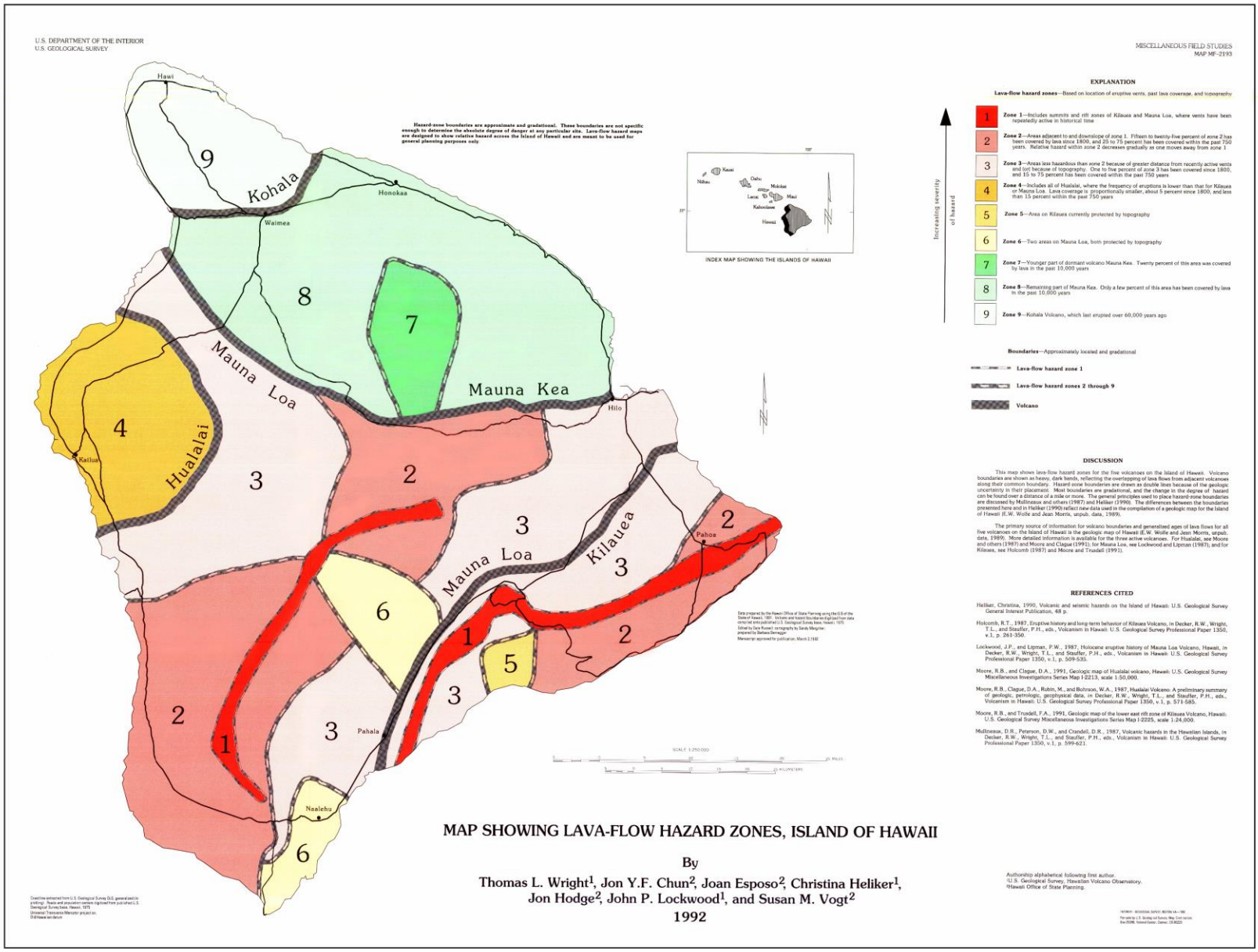


Uncertainty Visualization

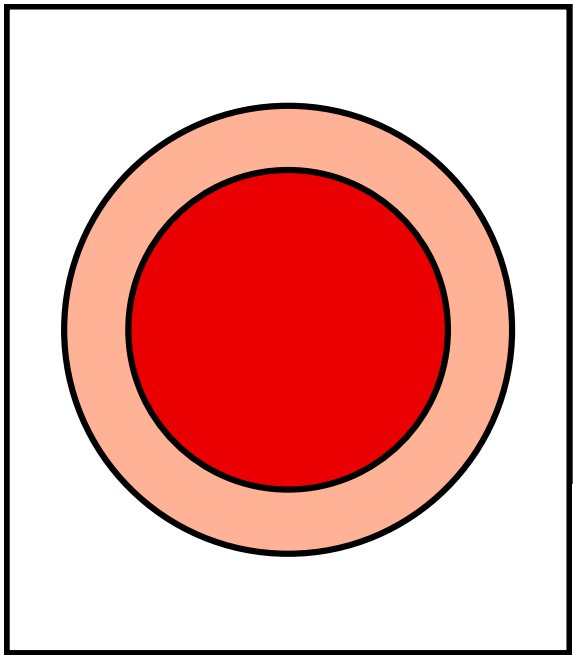


Boundary symbology

Hawai‘i (regional), United States
(Wright et al., 1992)

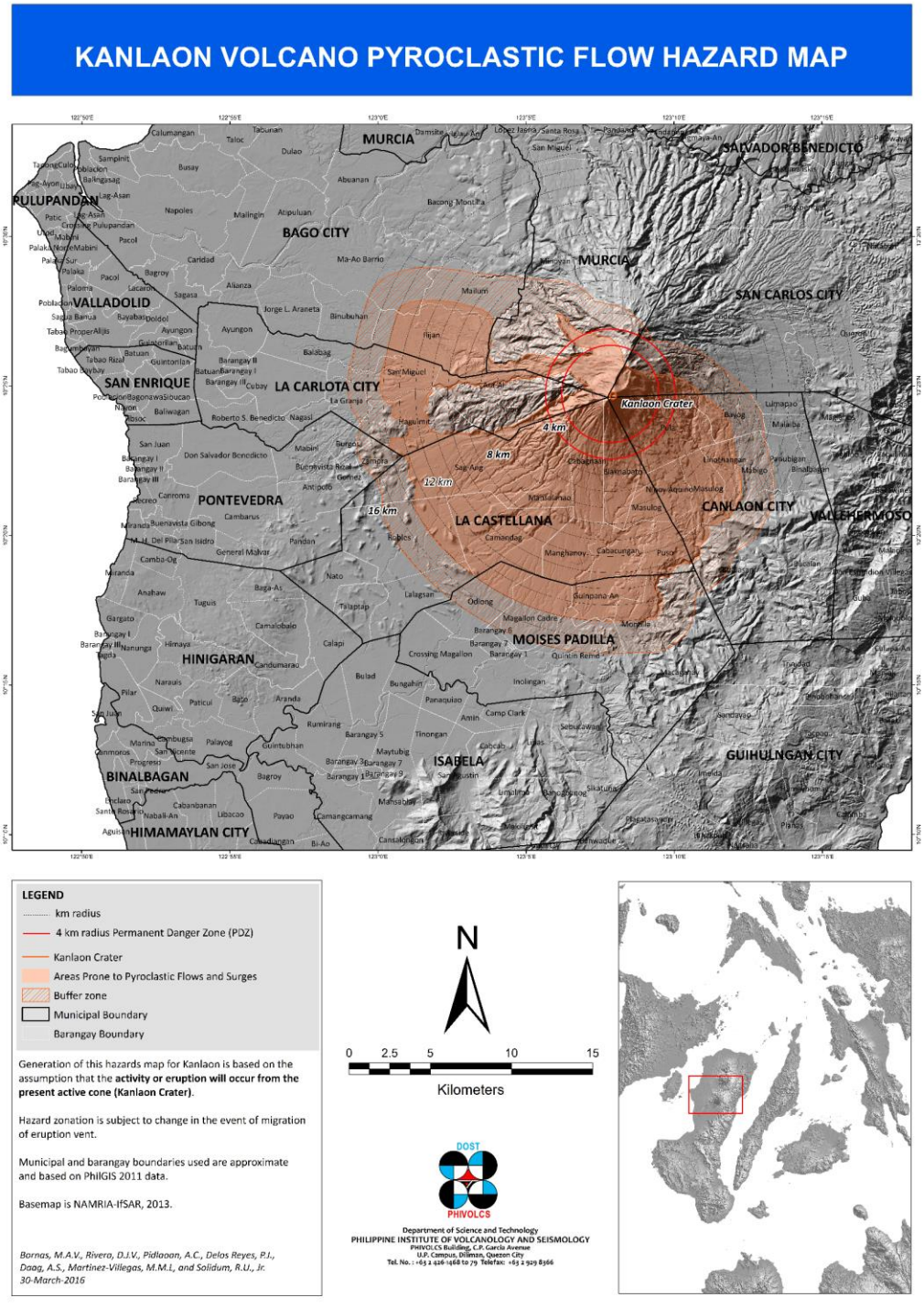


Uncertainty Visualization

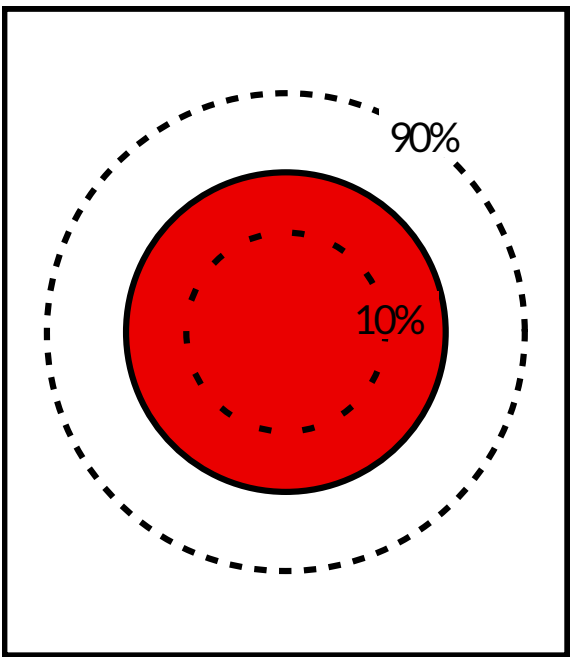


Buffer zones

Kanlaon, Philippines
(Bornas et al., 2016)



Uncertainty Visualization



Confidence intervals

Rincón de la Vieja, Costa Rica
(Alvarado et al. 2022)

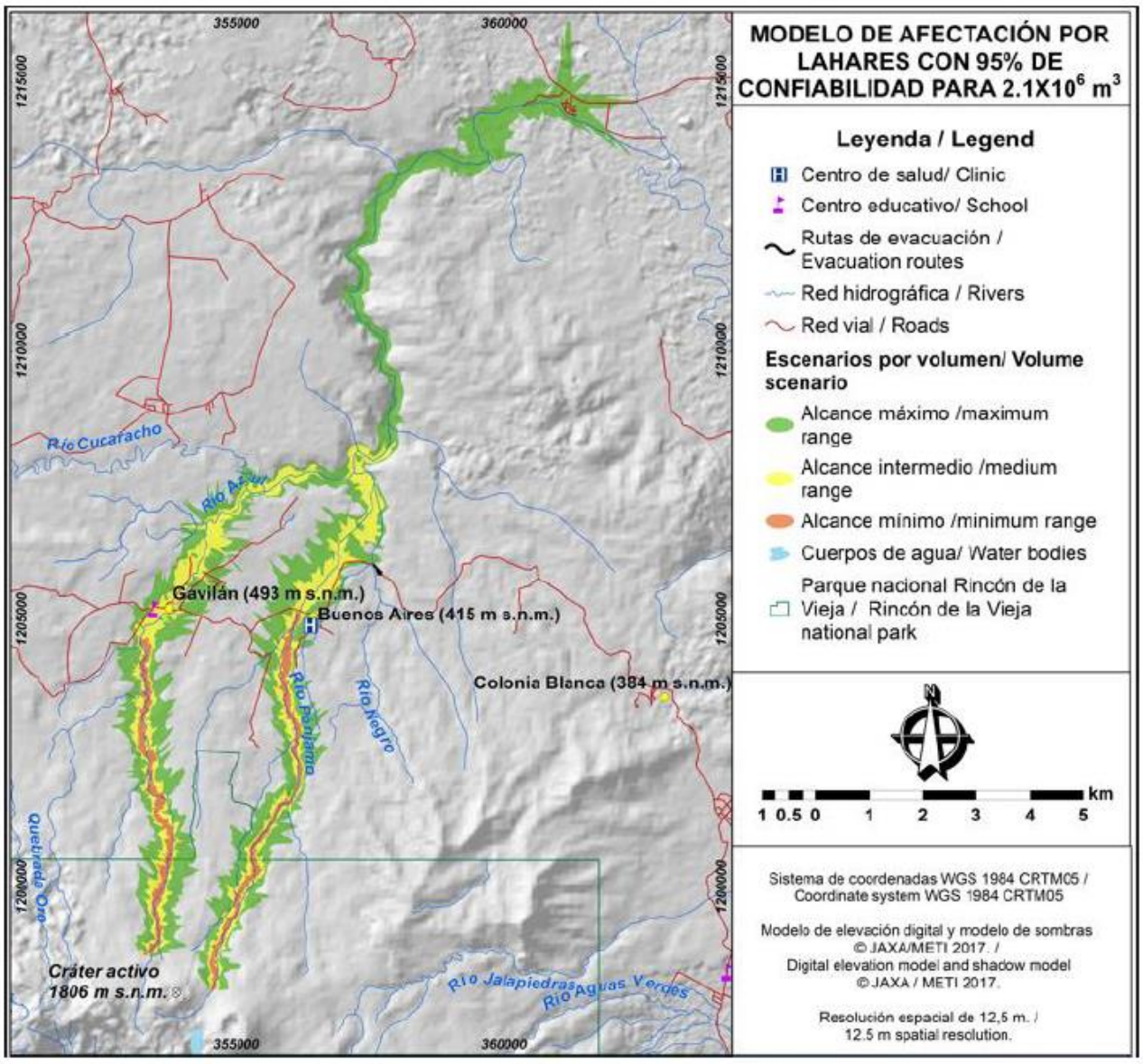


Fig. 6.45: Modelo de lahares con volumen de 2.1 x 10^6 m^3 con 95 % de confiabilidad (modificado de Alpízar, 2018).

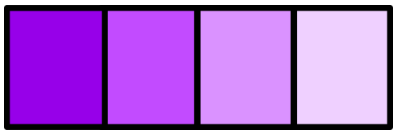
Color Scheme

Red-to-green

- Order is fairly universal among cultures and used globally for security warnings and traffic lights
- Well suited for conveying relative hazard level
- May incorrectly imply that green zones are 'safe' rather than lowest
- Pose issues for the color-blind

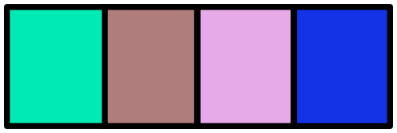
Red-to-yellow

- Well suited for conveying ordered, relative hazard levels
- No zones are misinterpreted to be 'safe' rather than lowest
- More accessible for the color-blind



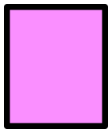
Dark-to-light (color or grayscale)

- Well suited for conveying ordered, relative hazard levels
- Most effective when darkest/most saturated color = high hazard
- More accessible for the color-blind



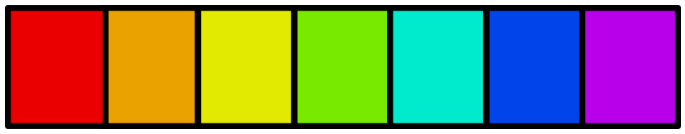
Categorical or qualitative

- Colors without logical ordering are well-suited to maps with separate zones for different hazards, such as hazard-process focused maps
- Not well-suited for hazard-level focused maps as the colors cannot be easily ordered



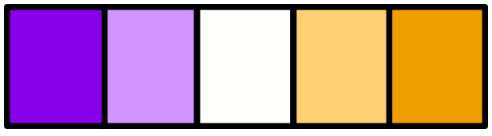
Single color

- Well suited for simple maps displaying only one hazard process



Rainbow

- Visually appealing, commonly used for continuous data
- Pose problems for the color blind and pose issues for visual perception (see https://www.climate-lab-book.ac.uk/2014/end-of-the-rainbow/)



Diverging

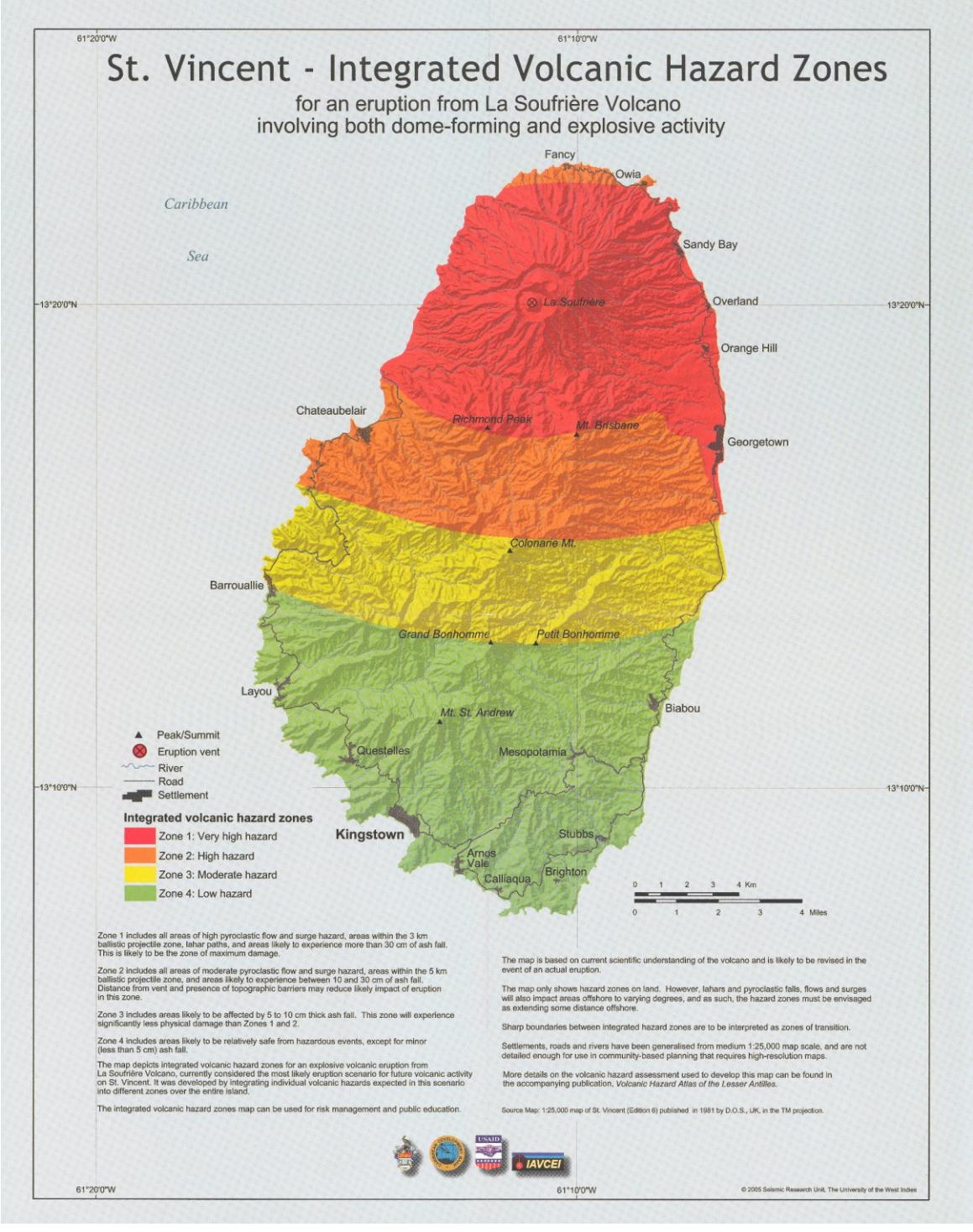
- Only well-suited for data with a special central value, e.g. elevation data with sea level as that value
- Can introduce misperceptions on hazard maps

Color Scheme

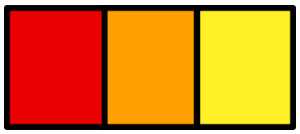
Red-to-green

- Order is fairly universal among cultures and used globally for security warnings and traffic lights
- Well suited for conveying relative hazard level
- May incorrectly imply that green zones are ‘safe’ rather than lowest
- Pose issues for the color-blind

Red to Green



Color Scheme



Red-to-yellow

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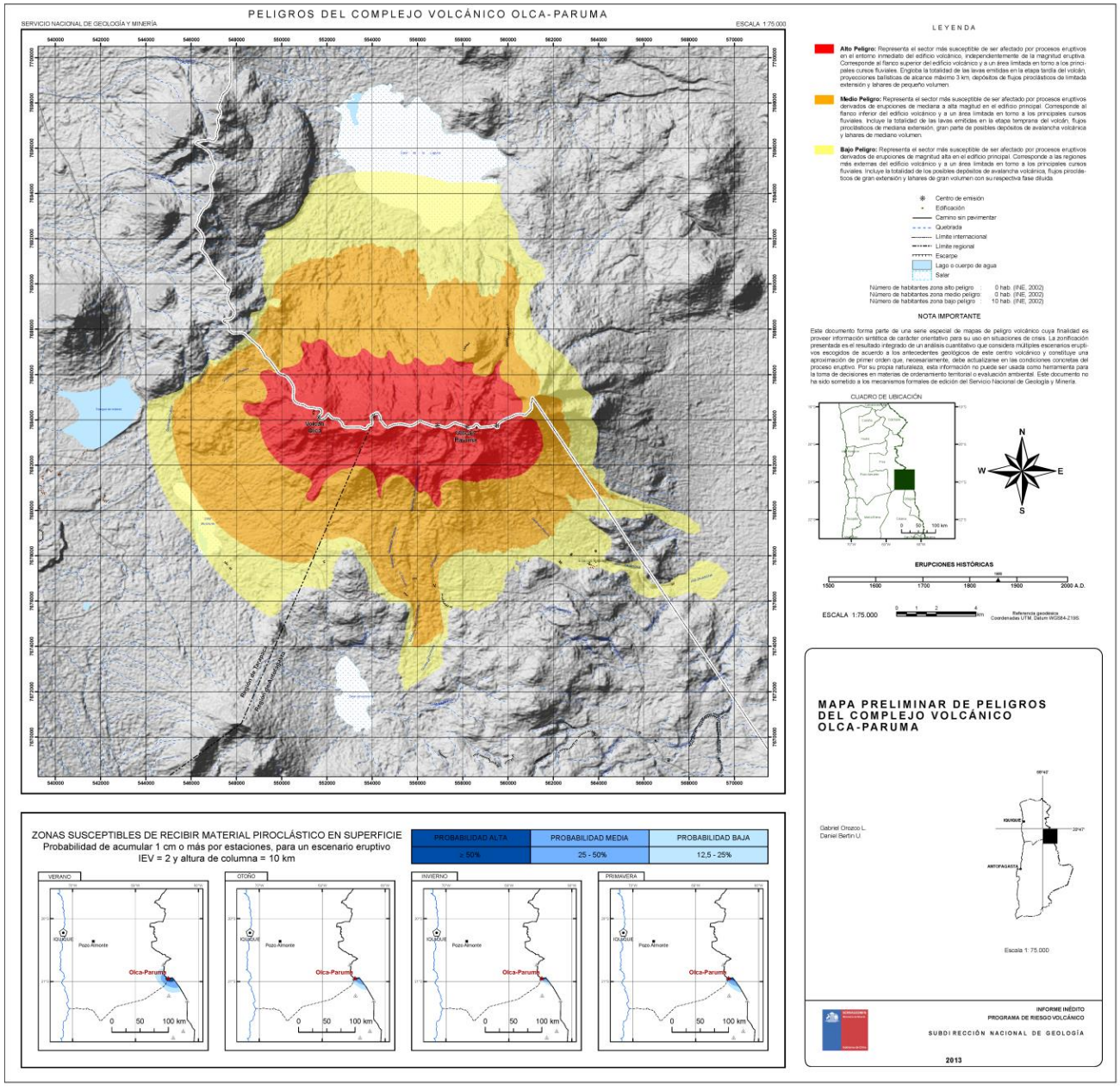
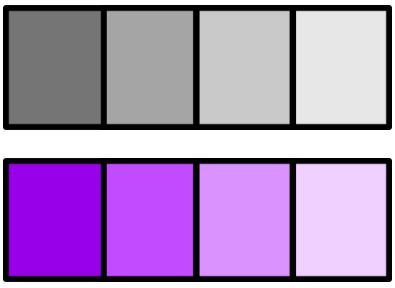
Red to Yellow



Mentolat, Chile
(Kraus, 2012)

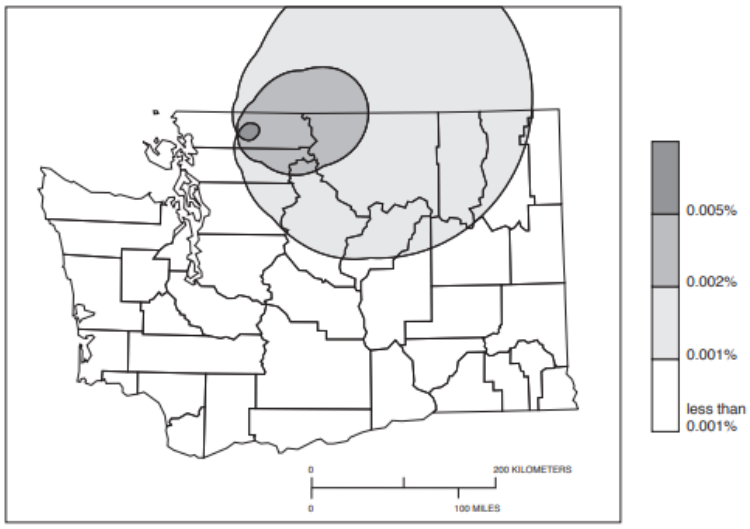
Color Scheme



Dark-to-light (color or grayscale)

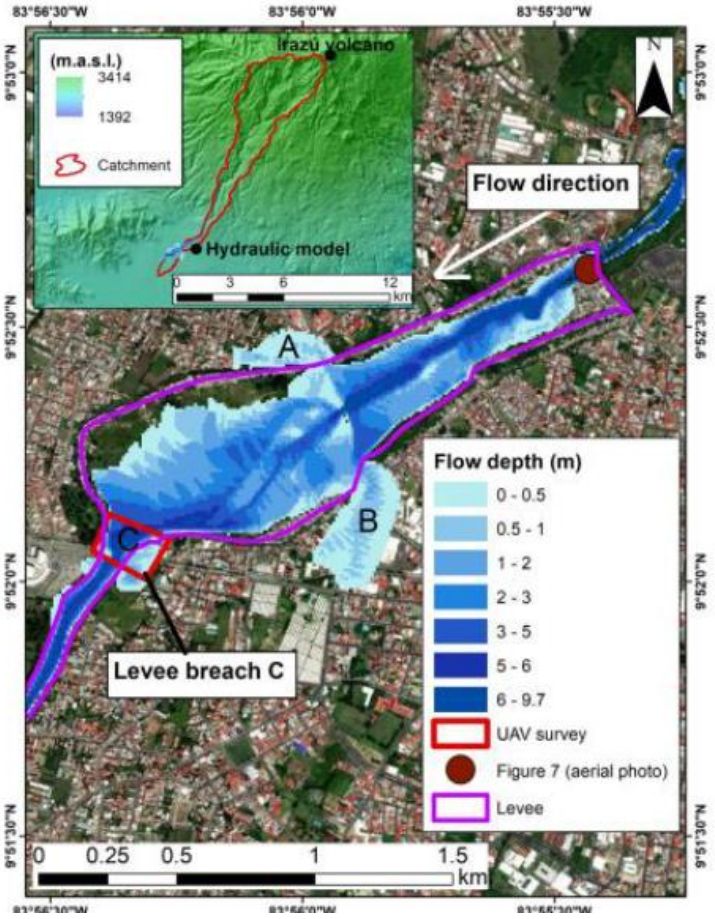
- Well suited for conveying ordered, relative hazard levels
- Most effective when darkest/most saturated color = high hazard
- More accessible for the color-blind

Light to dark (grayscale)



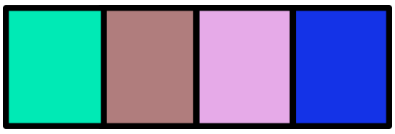
Baker, United States
(Gardner et al. 1995)

Light to dark (color)



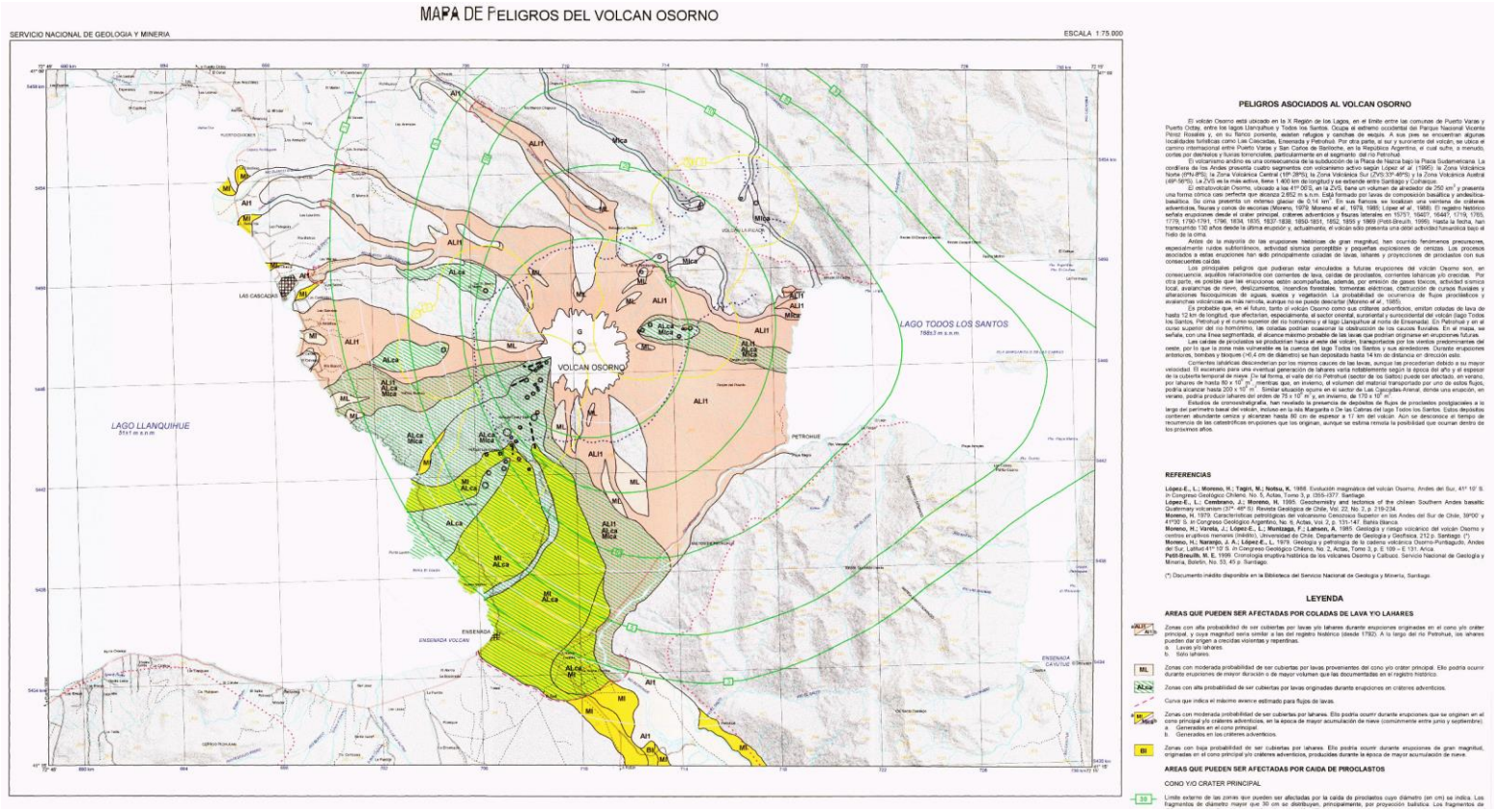
Irazú, Costa Rica
(Alvarado et al. 2021)

Color Scheme



Categorical or qualitative

- Colors without logical ordering are well-suited to maps with separate zones for different hazards, such as hazard-process focused maps
- Not well-suited for hazard-level focused maps as the colors cannot be easily ordered



Osorno, Chile (cropped)
(Moreno, 1999)

Color Scheme

Single color

- Well suited for simple maps displaying only one hazard process

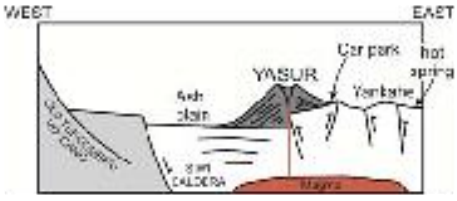
Volcano Fact Sheet

Yasur Volcano – Yenkahe Caldera

Description

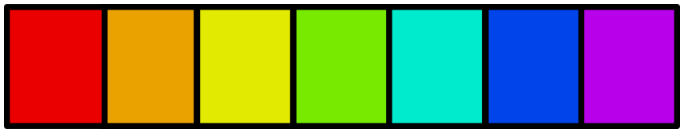
- Yasur, located at the SE tip of Tanna Island, is a mostly unvegetated 361-m-high scoria cone with a nearly circular, 400-m-wide summit crater.
- Yasur is the most frequently visited of the Vanuatu volcanoes.
- It has been in more-or-less continuous activity since Captain Cook observed ash eruptions in 1774.
- This style of activity may have continued for the past 800 years.

(www.volcano.si.edu)



Yasur, Vanuatu (cropped)
(Vanuatu Meteorology & Geo-Hazards Department)

Color Scheme



Rainbow

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- Pose problems for the color blind and pose issues for visual perception (see https://www.climate-lab-book.ac.uk/2014/end-of-the-rainbow/)

Rainbow

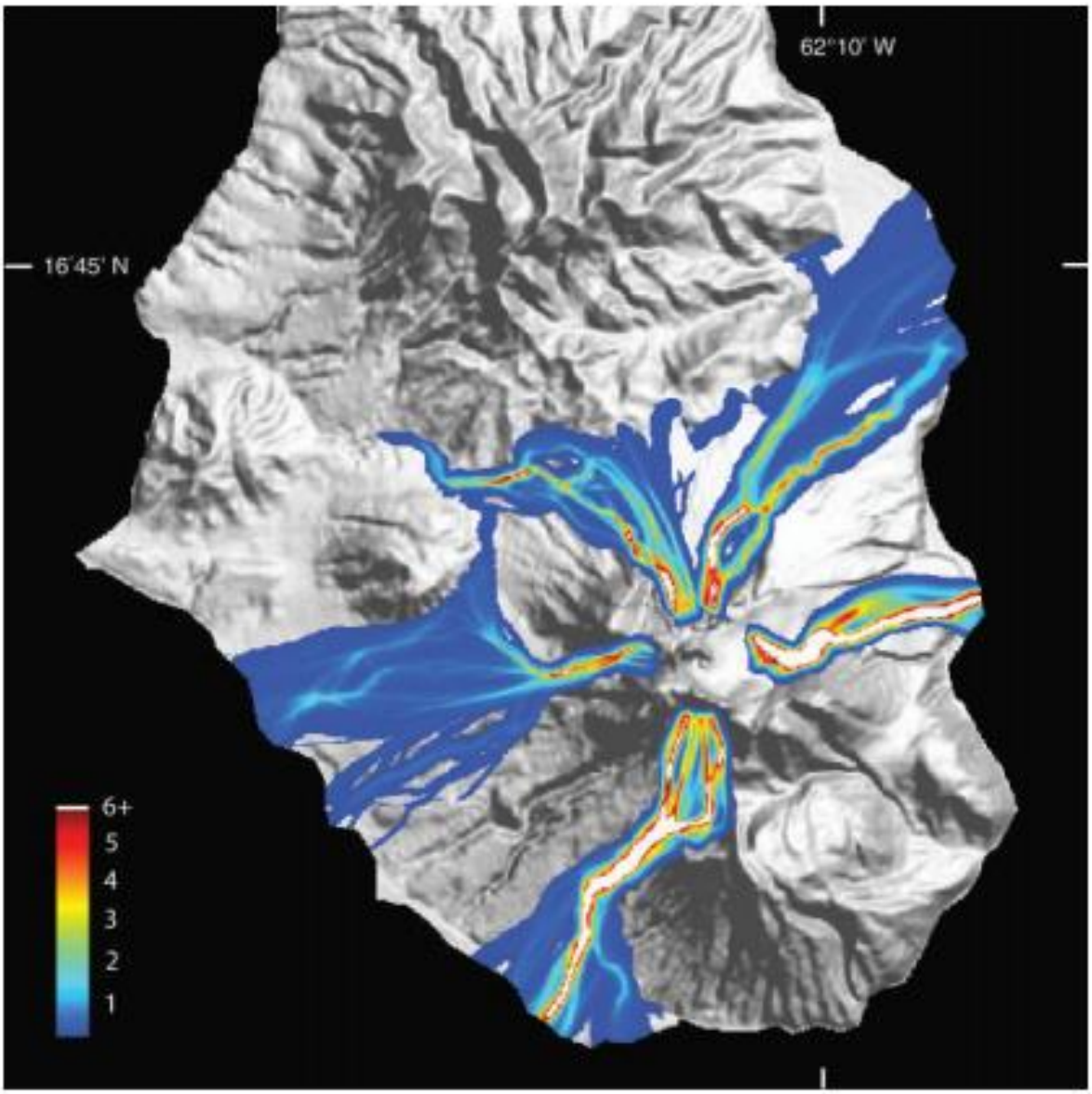
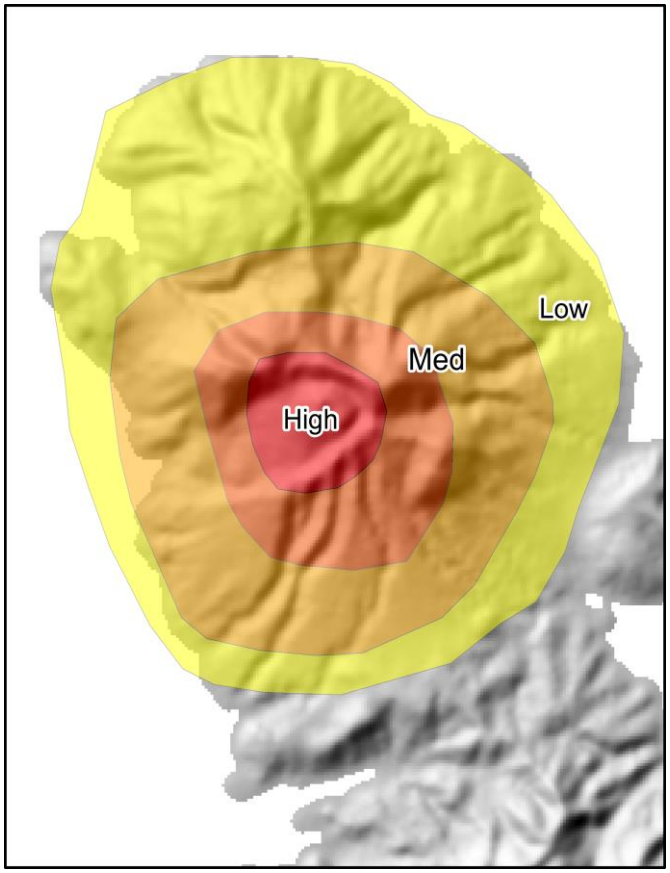


Fig. 9. The PYROFLOW simulation ensemble, representing the equivalent of 66 years' worth of 1996–1998 activity constrained by the analysis of the directional growth of the dome.

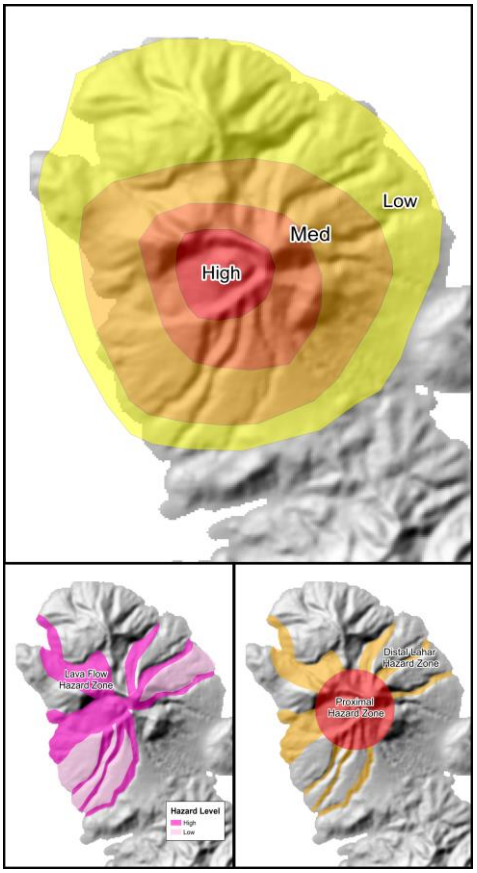
Soufrière Hills, Montserrat
(Wadge, 2009)

Map Layout

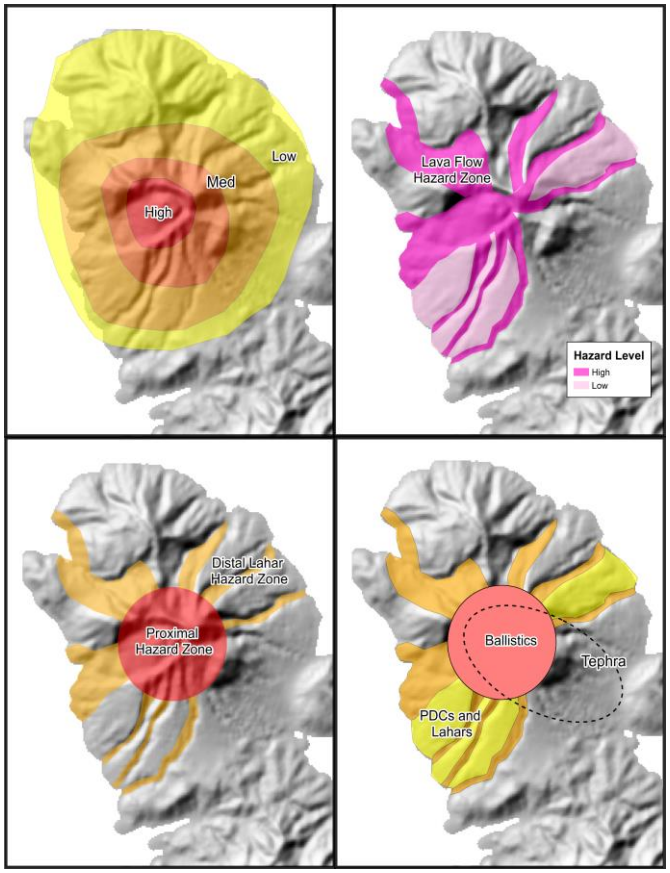
Main Map Panel



Main Map with Insets

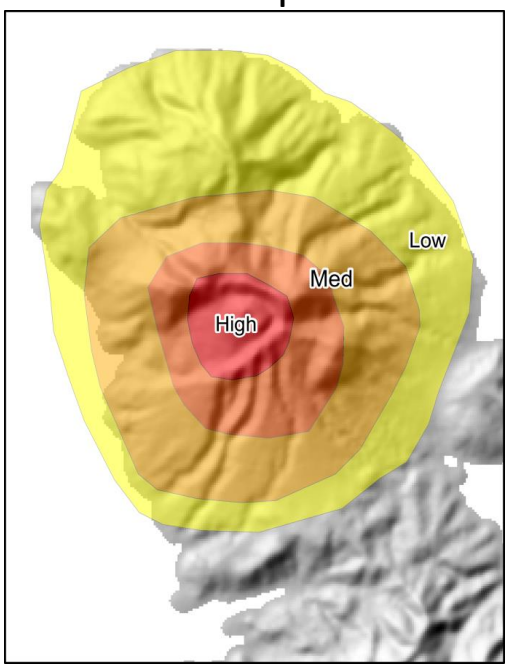


Series of Small Panels

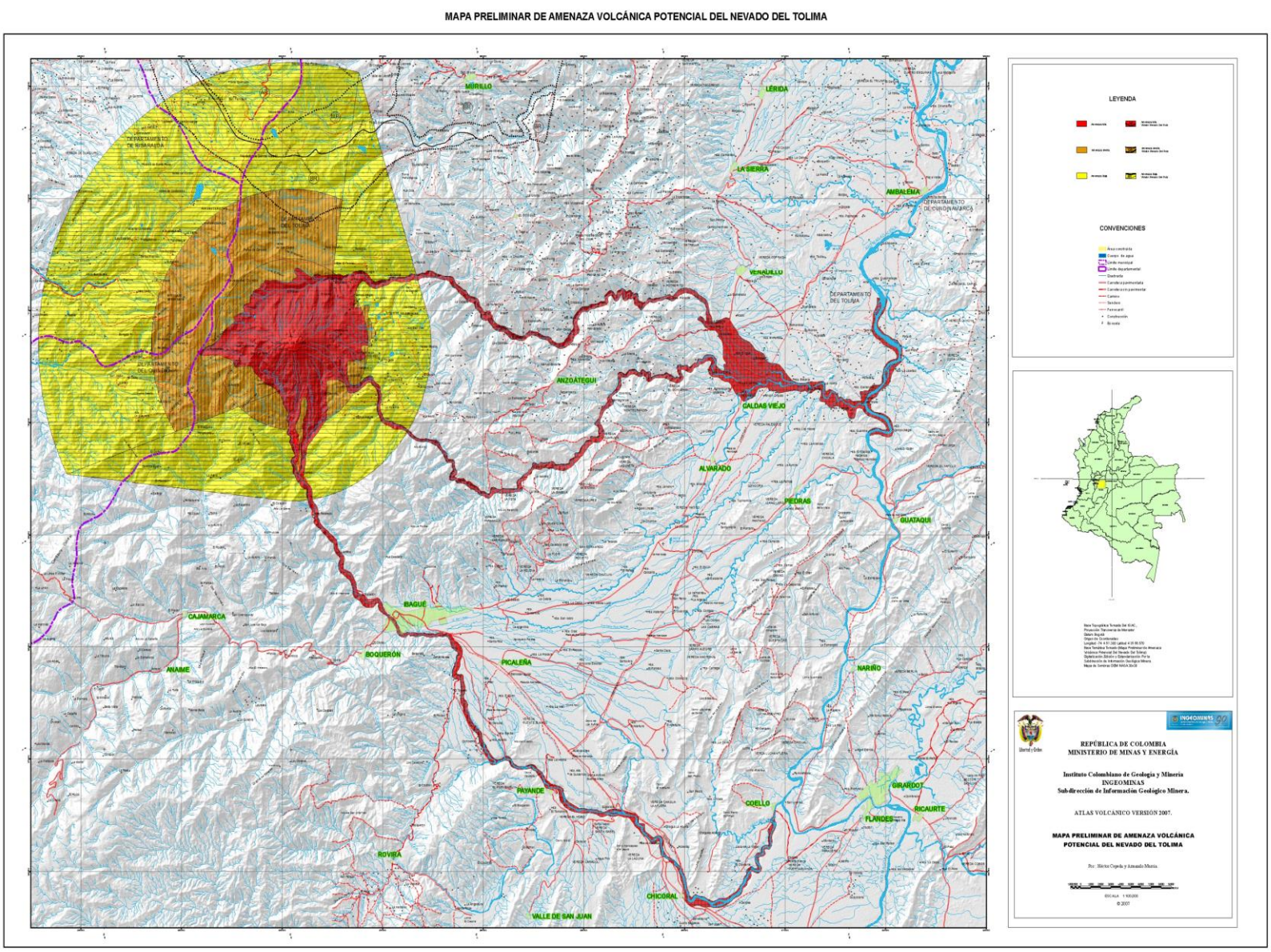


Map Layout

Main Map Panel

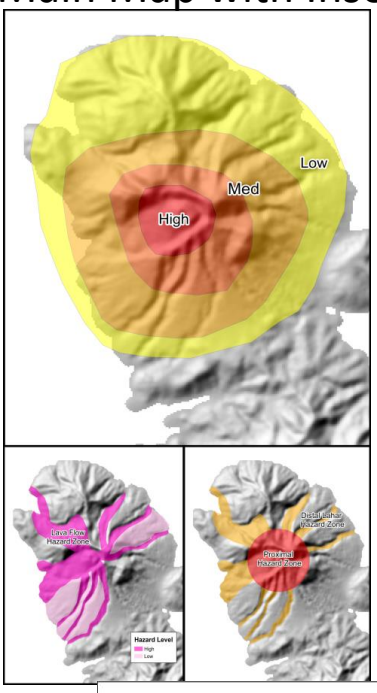


Nevado del Tolima, Colombia
(Cepeda & Murcia, 2007)

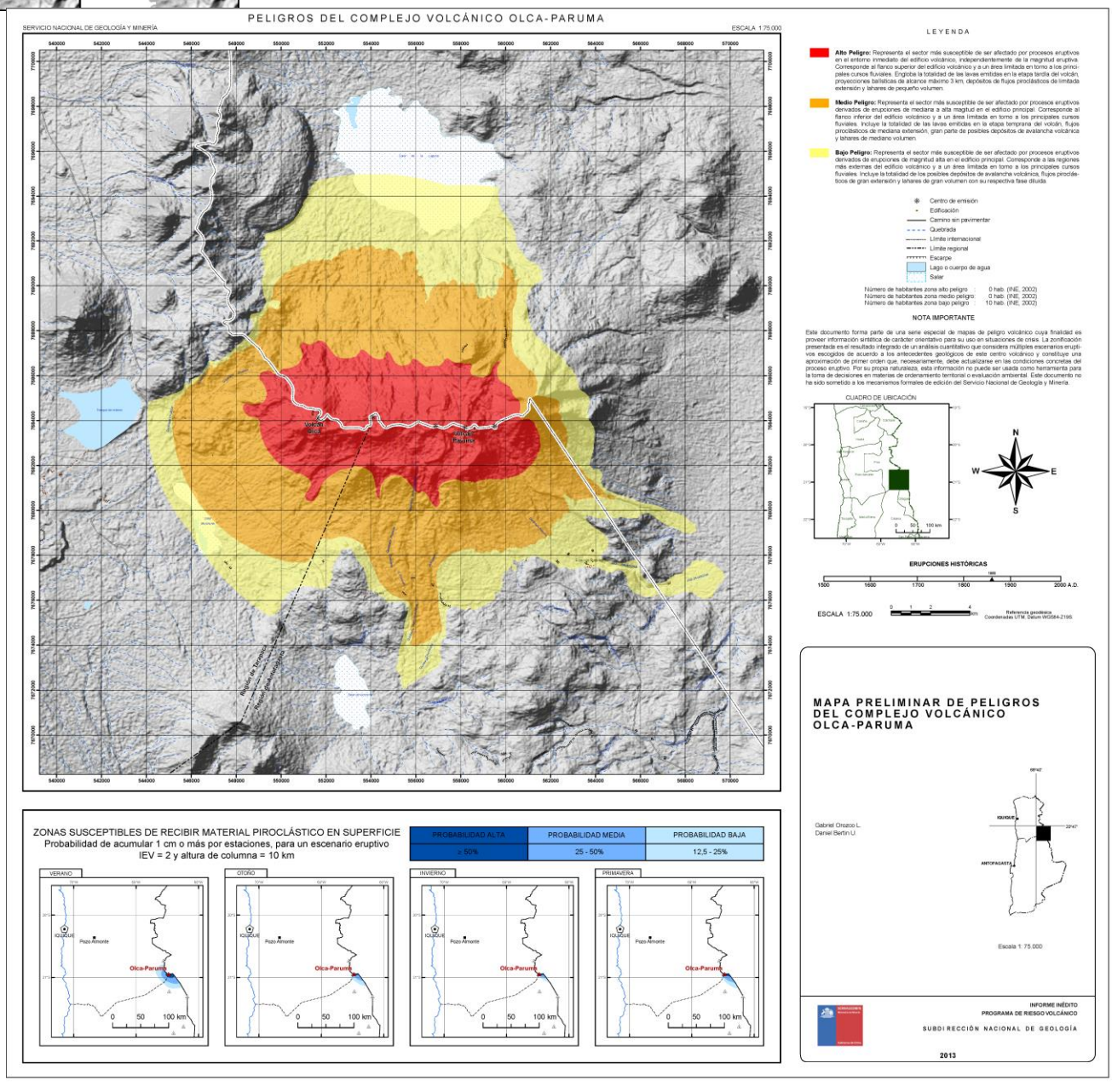


Map Layout

Main Map with Insets

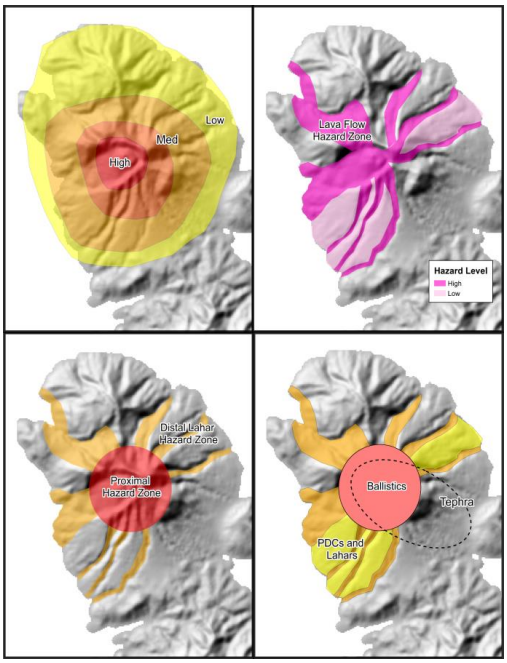


Mentolat, Chile
(Kraus, 2012)

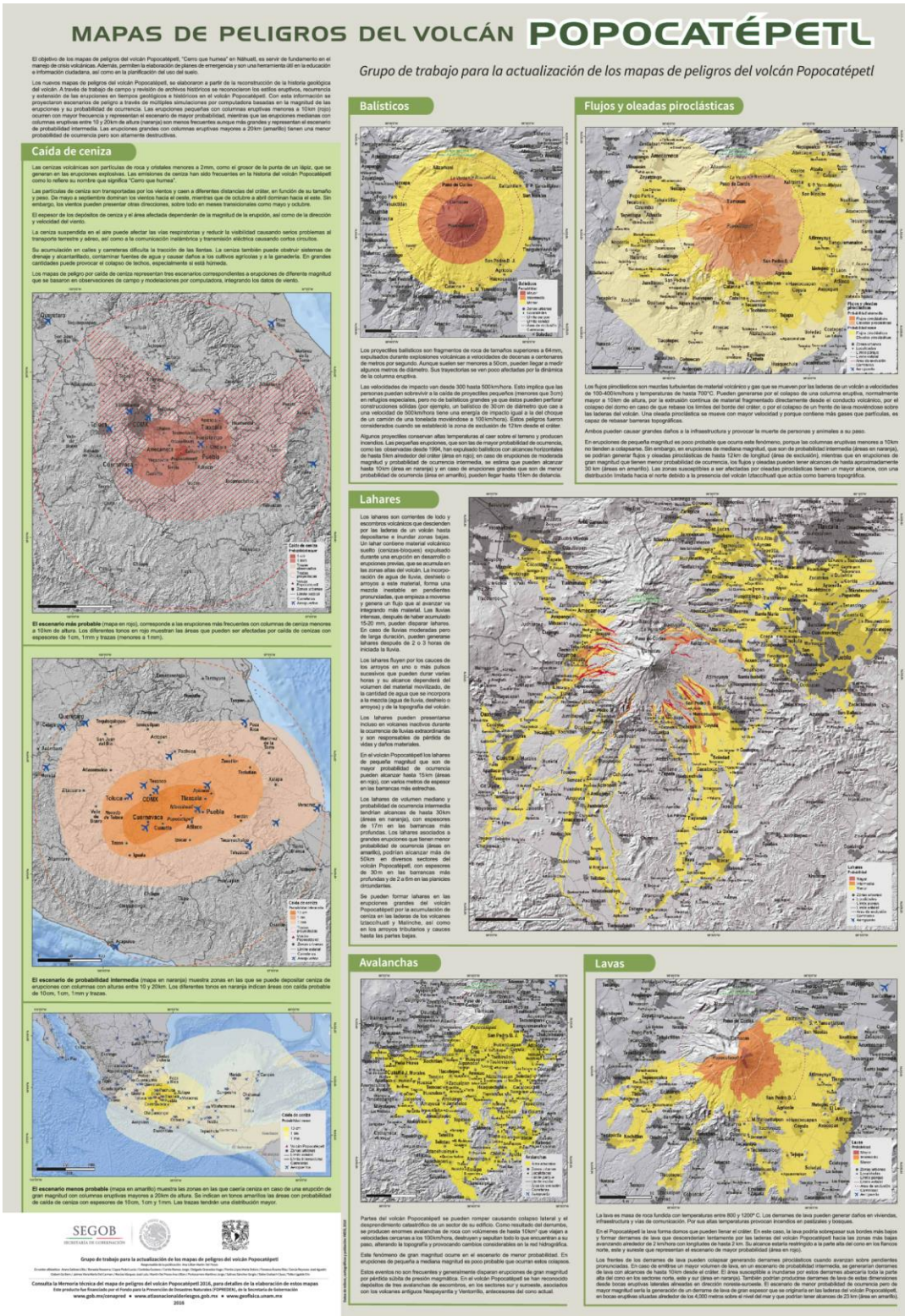


Map Layout

Series of Small Panels



Popocatépetl, Mexico
Martin Del Pozzo et al., 2016)



Map element	Description
action	The map describes what to do during unrest or eruption
alert level scheme	The alert level scheme for the volcano is described
area map	An area map is included that shows the regional context
audience and/or purpose	The intended audience or purpose is described
cartographic legend	A legend is provided for cartographic symbols (e.g. roads, lakes)
color scheme order	Color scheme is in order (e.g. red = high hazard)
conditional validity	The conditions under which the map is valid are described (e.g. VEI < 5, central vent eruptions)
coordinates	Geographic coordinates are shown
eruptive history	The eruptive history of the volcano is described
evacuation route	Evacuation routes are visually depicted on the map
expiration	The conditions that will trigger map revision are described (e.g. summit changes, a time limit, new information)
glossary of terms	Geological terms are defined in a glossary section
hazard details	Hazard processes are defined or described
hazard travel time	Hazard process arrival times or velocities are depicted or described
hazard zone description	Hazard zones have accompanying descriptions beyond labels
hazard zone legend	A legend is provided for the hazard zones
impact details	Impact details (e.g. roof collapse, crop damage) are described
impact locations	Specific towns or drainages are named or listed
insets	Insets containing non-map information are included
methods	Hazard zonation methods are described in the text
more information source	Sources for additional information are given
north arrow	A north arrow is included
oblique image included	Oblique (3D) inset images of the terrain or hazard zones are shown
other volcanoes	Hazard zones from nearby volcanoes are also shown on the map
past deposits	Deposits from previous eruptions are shown visually
person hours	The amount of time required to make the map is stated
photos	Photos of the volcano, deposits, impacts, etc. are shown
population information	Population information (e.g. numbers of inhabitants in towns or hazard zones) is depicted or described
references	Reference literature is cited
safe areas	Safe areas, including shelters or muster points, are depicted
scale bar	A scale bar is included
version number	Version numbers or a revision history is provided
wind rose diagram	A wind rose diagram of either wind directions or tephra dispersal directions is provided

Scenario Types

- no specific scenario/all scenarios
- most-likely
- worst-case
- specific past eruptions
- analog volcanoes
- sizes of eruptions or of hazard processes
- styles of eruption or of hazard processes
- many thousands of scenario combinations (probabilistic)
- specific or current conditions
- possible location or direction
- season during which an eruption might occur
- composition of a future eruption

Many maps may use a combination of different scenario types or may use different scenarios for different zones.