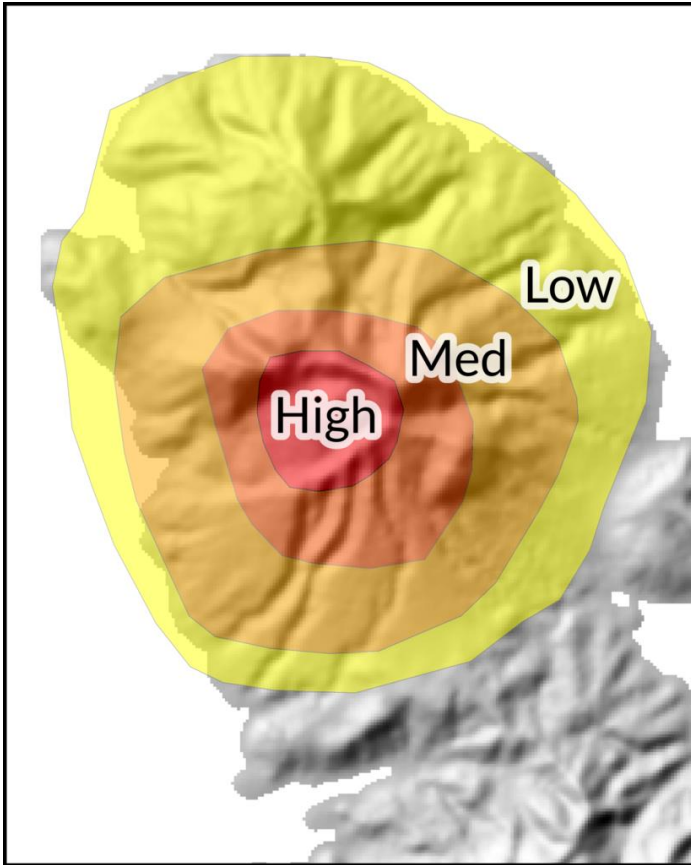


A horizontal banner with a light blue background. On the left, there is a stylized map graphic with a red mountain peak, a white dotted area, an orange grid, and yellow contour lines. The text "Cartoon Map Menu" is written in black on the right side of the banner.

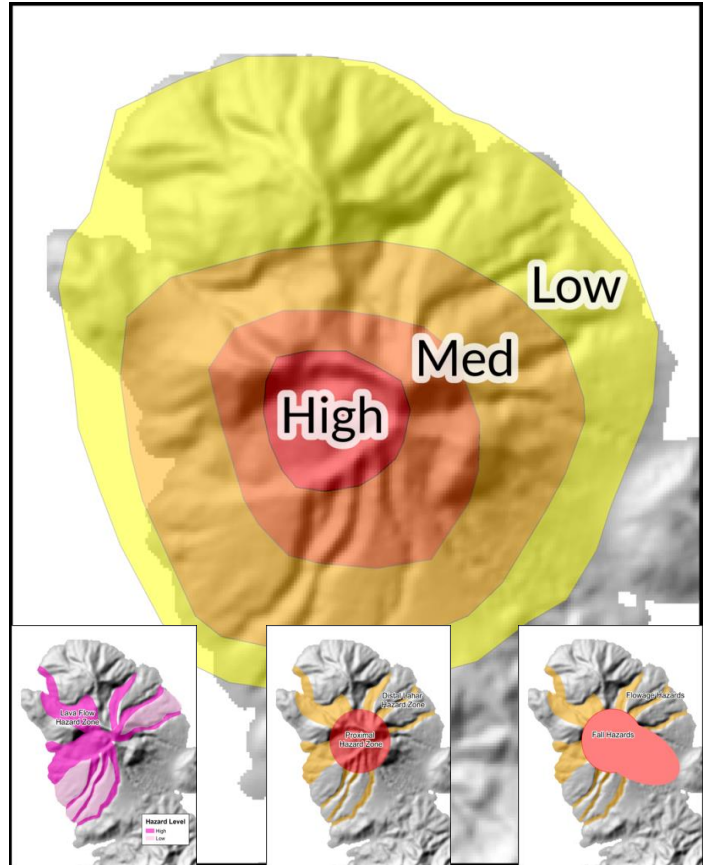
Cartoon Map Menu

Hazard Zone Presentation

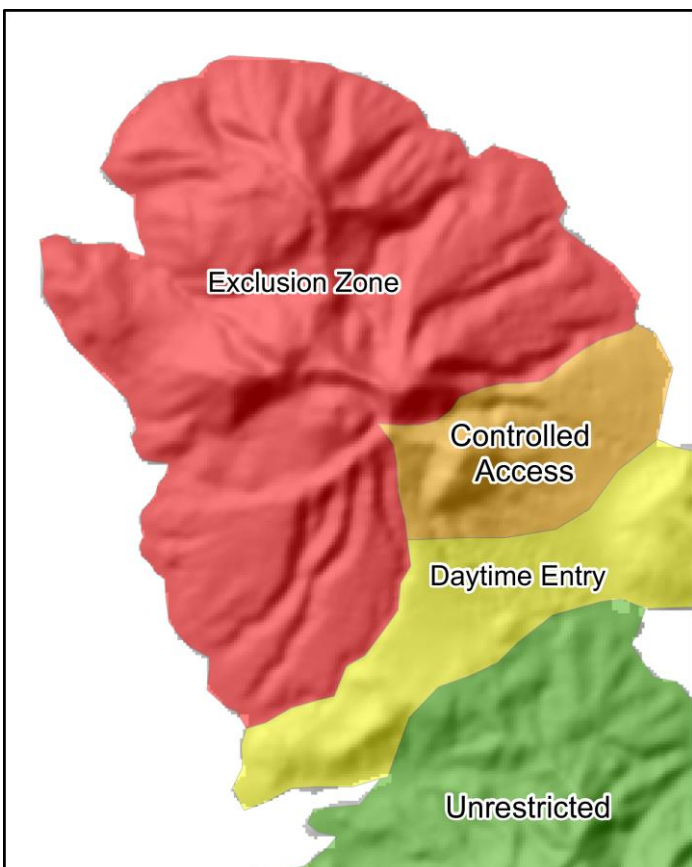
Hazard level-focused (integrated)



Hazard level-focused with single process insets

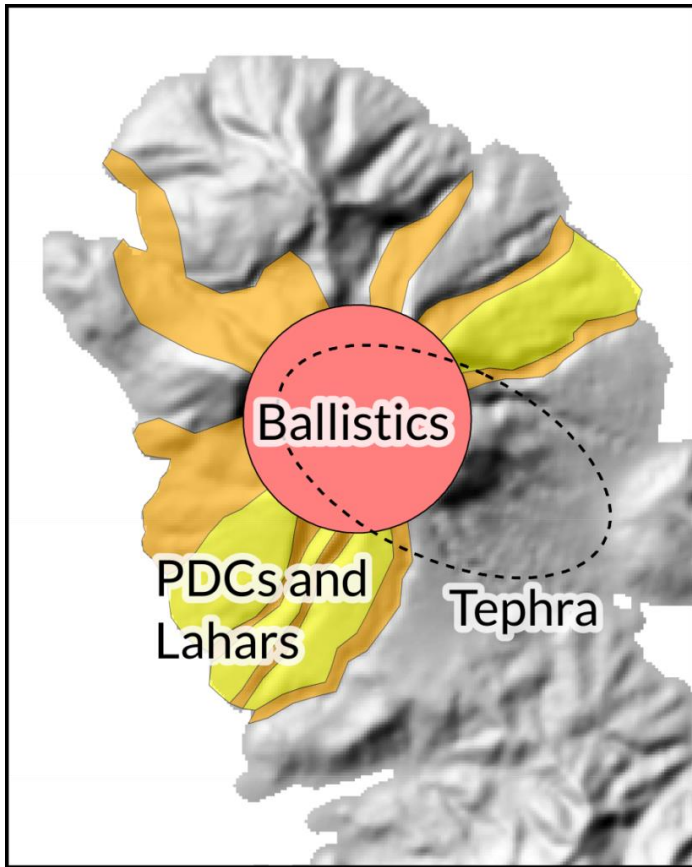


Hazard level-focused (administrative)

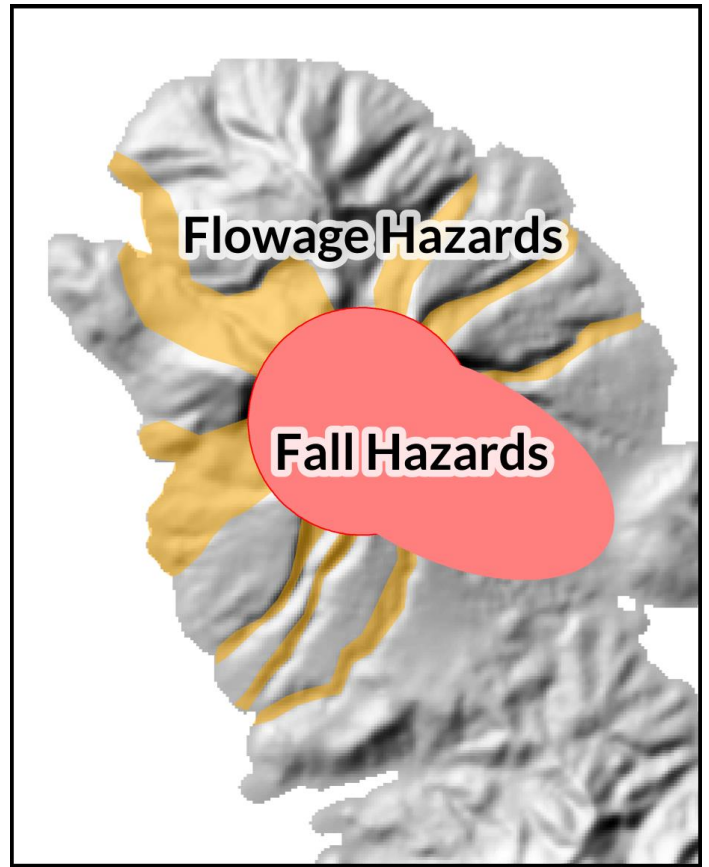


Hazard Zone Presentation

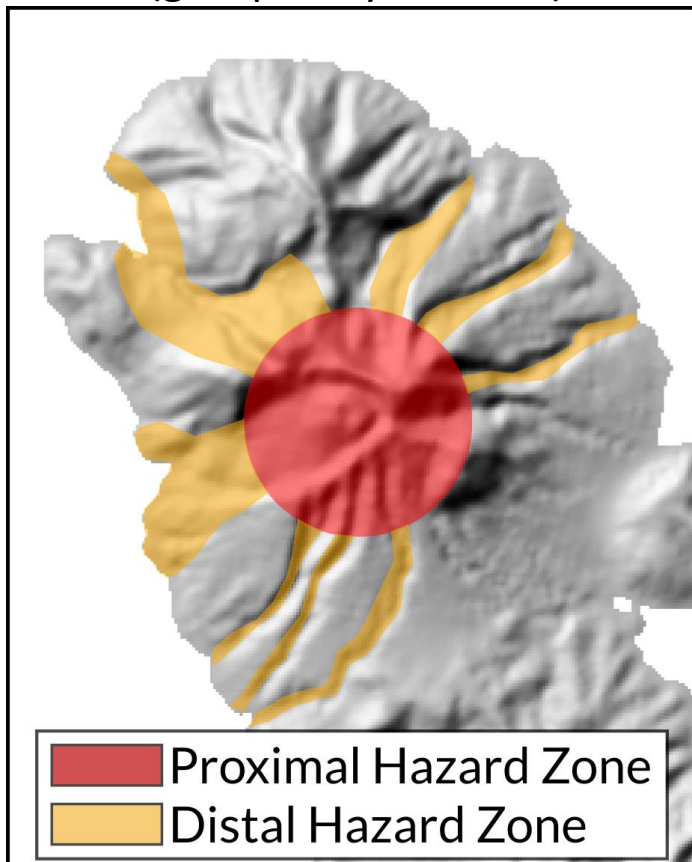
Hazard process-focused (separated)



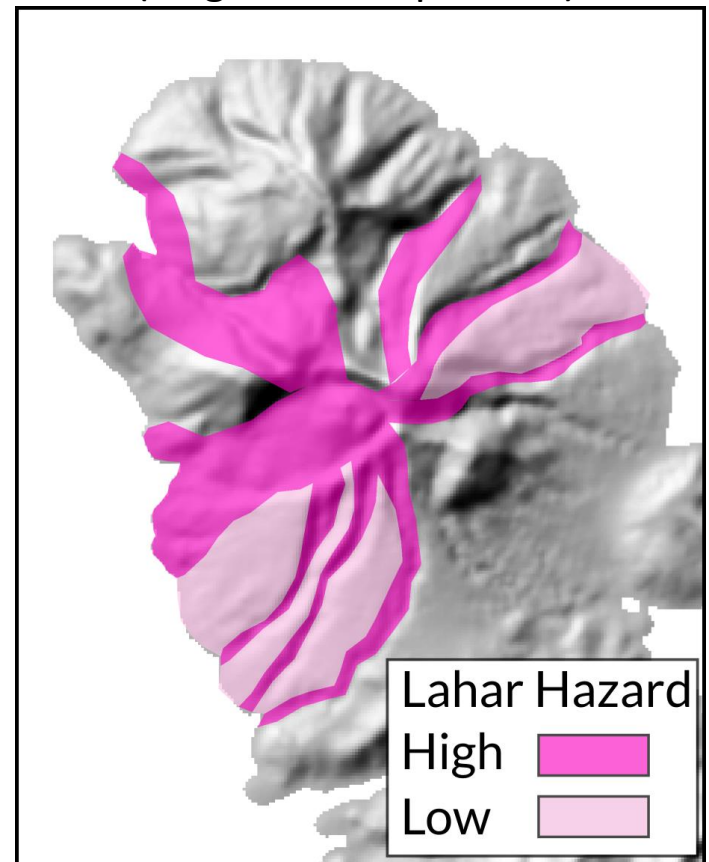
Hazard process-focused
(grouped by process type)



Hazard process-focused
(grouped by location)



Hazard process-focused
(single hazard process)



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

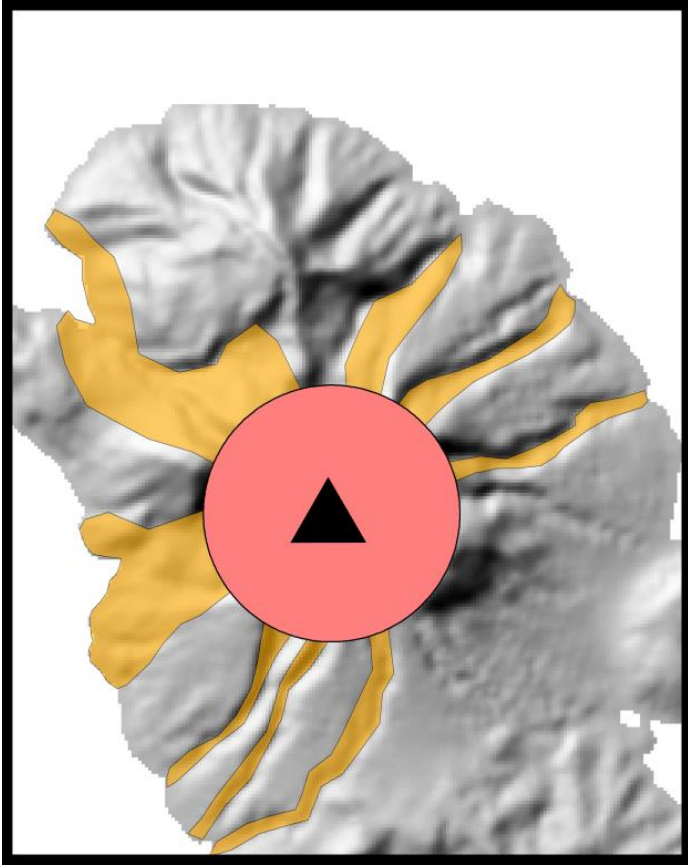
Process & Recurrence Interval

Estimated Value or Hazard Intensity Metric (HIM)

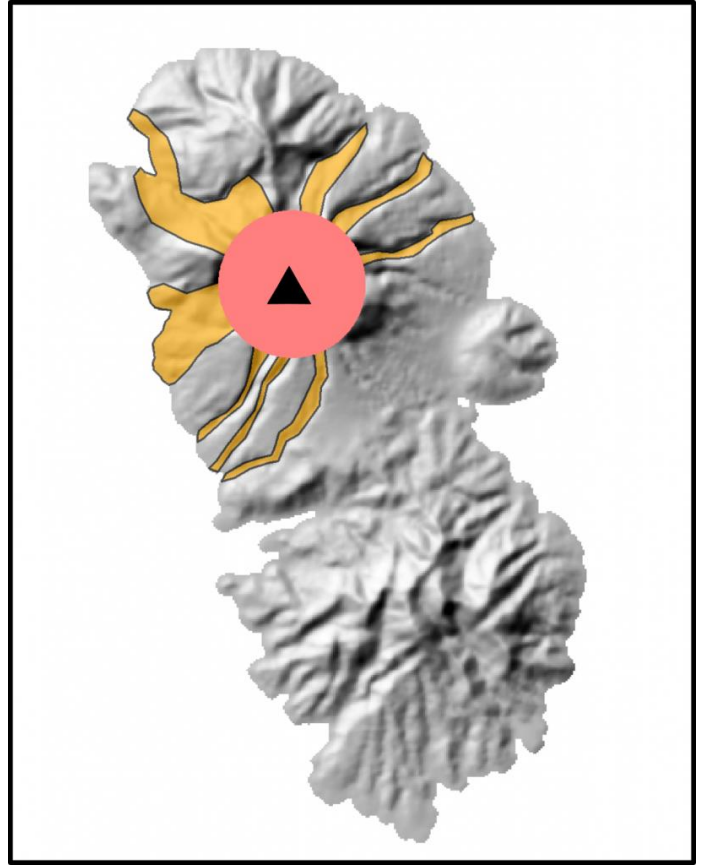
Location or source name

Spatial Scale

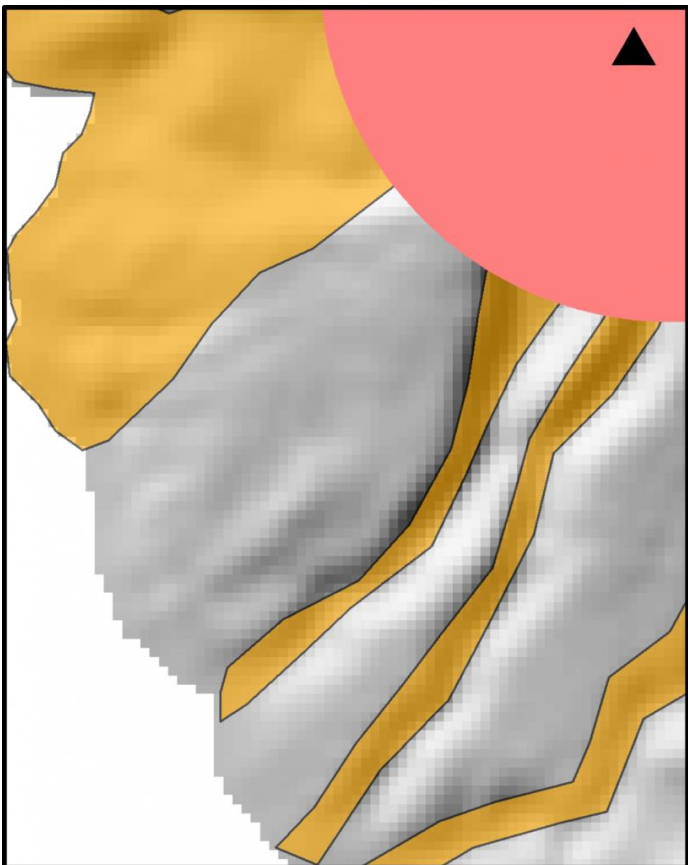
Volcano-scale



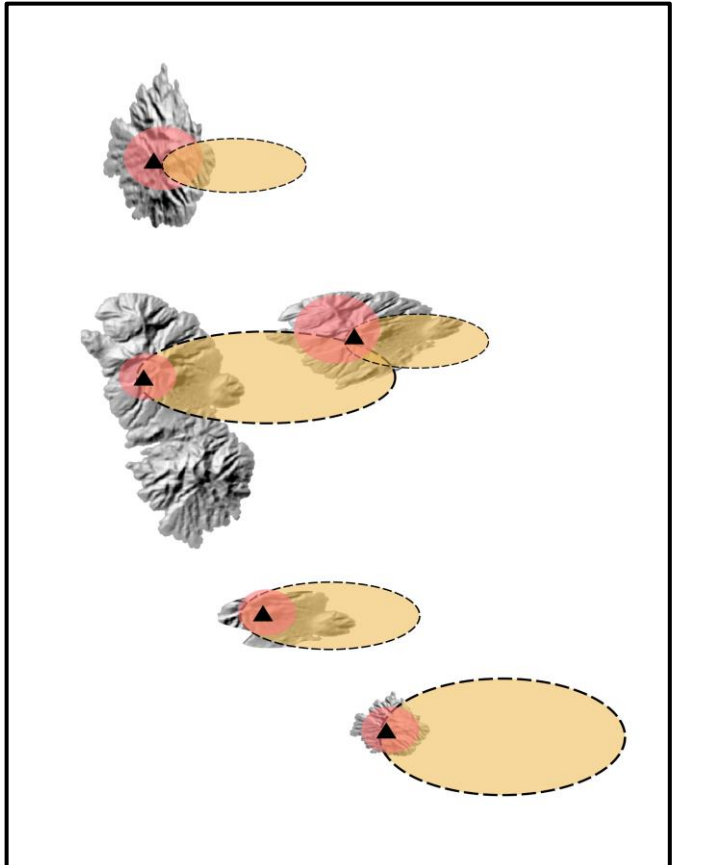
Entire island/Island-scale



Flank or drainage-scale



Regional-scale



Temporal Scale

Background (Long-term) Hazard Maps

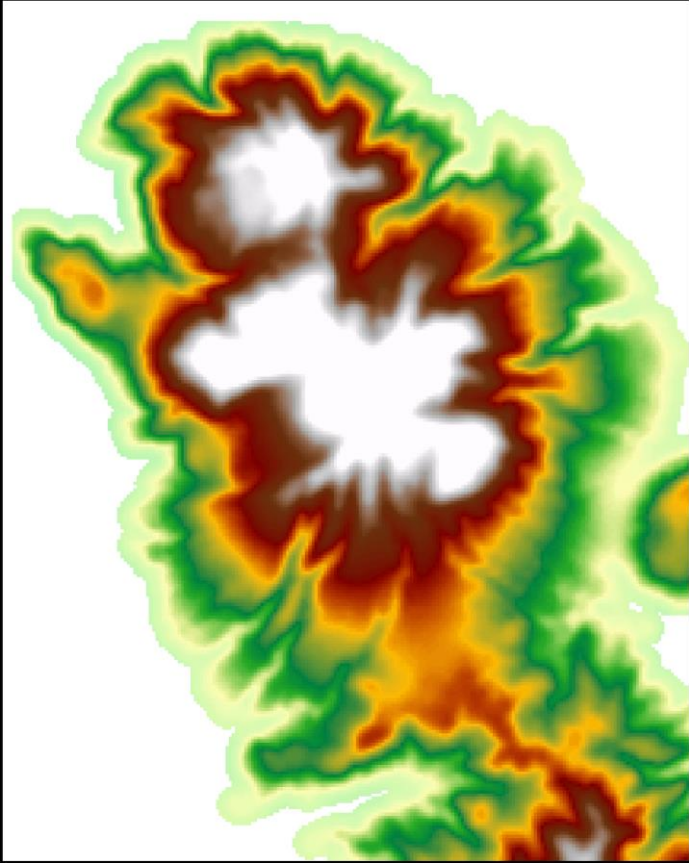
- usually created in advance of volcanic unrest
- intended to show the possible distribution of volcanic hazards over long (years to decades) time frames
- often based on a combination of [methods](#) that incorporate eruptive history, geologic records, and/or modeling
- may be based on either specific [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

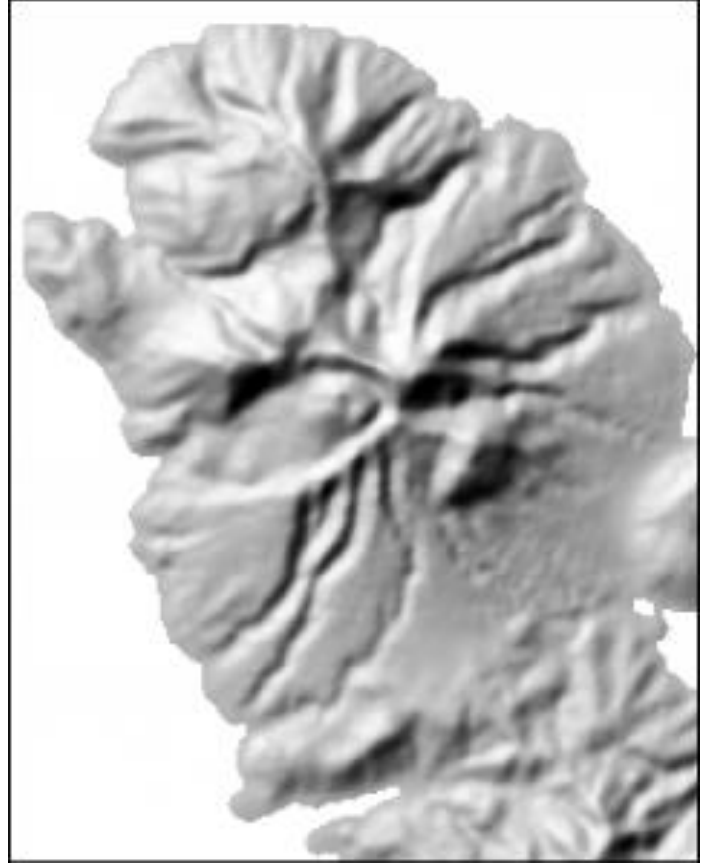
- usually created at the start of volcanic unrest or during an eruption
- usually intended for [crisis-management purposes](#) and show the likely distribution of hazards based on current conditions over short (days to months) or very short (hours to days) time frames
- often also based on eruptive history 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

Basemap Type

DEM



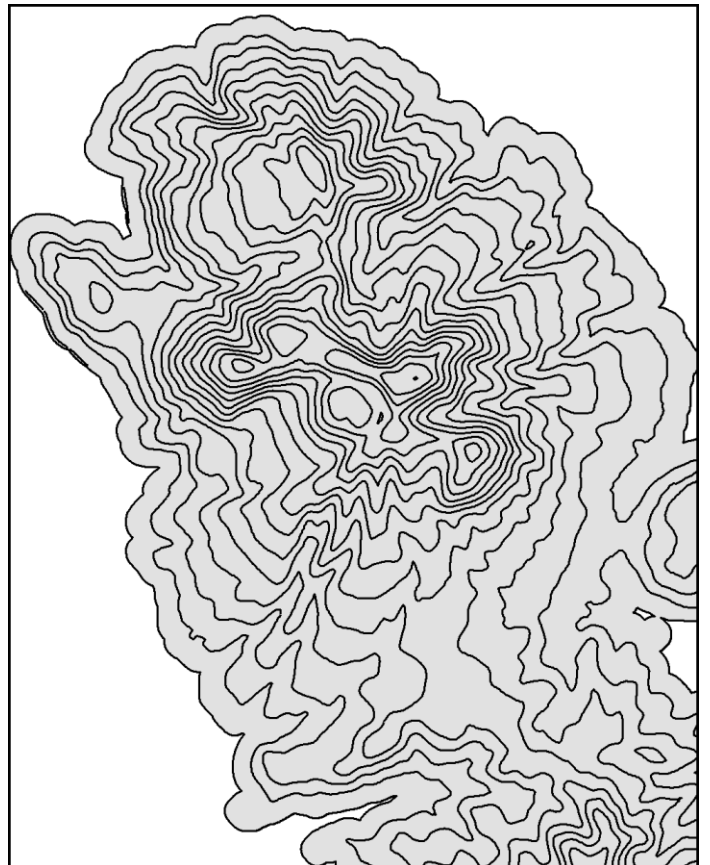
Hillshade DEM



TIN DEM



Contour Lines

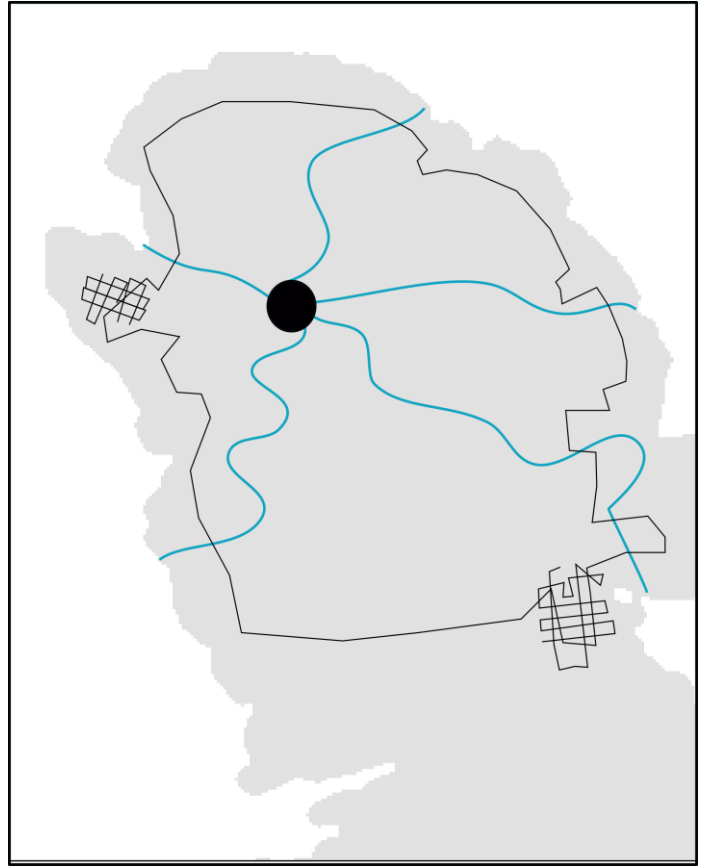


Basemap Type

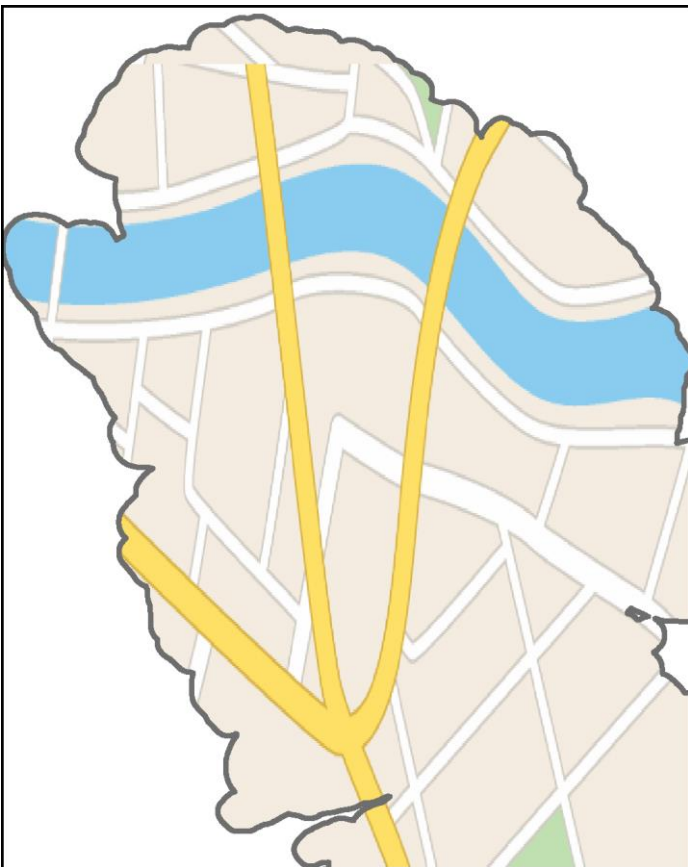
Satellite image/photograph



Simple/sketch base map

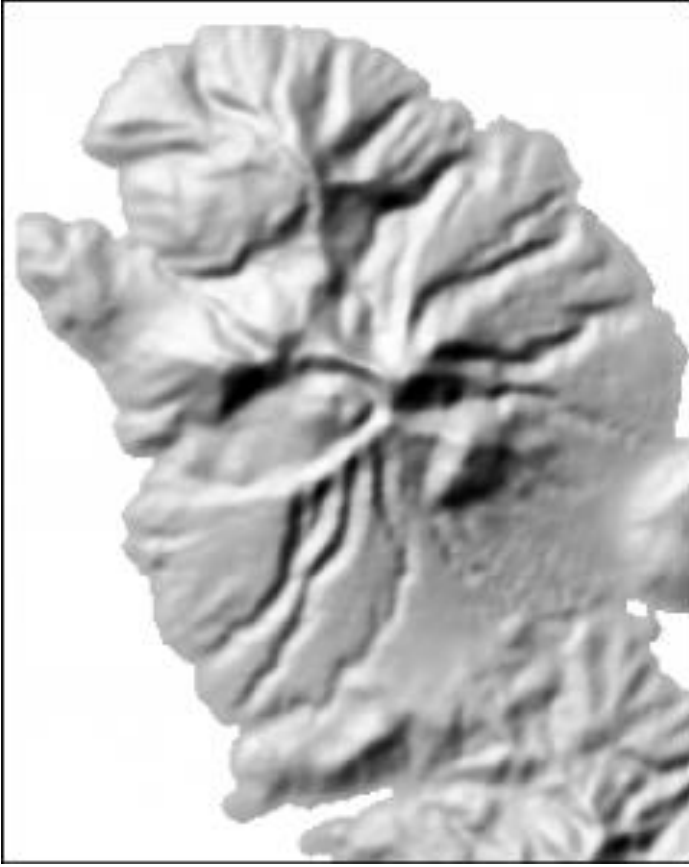


Street map

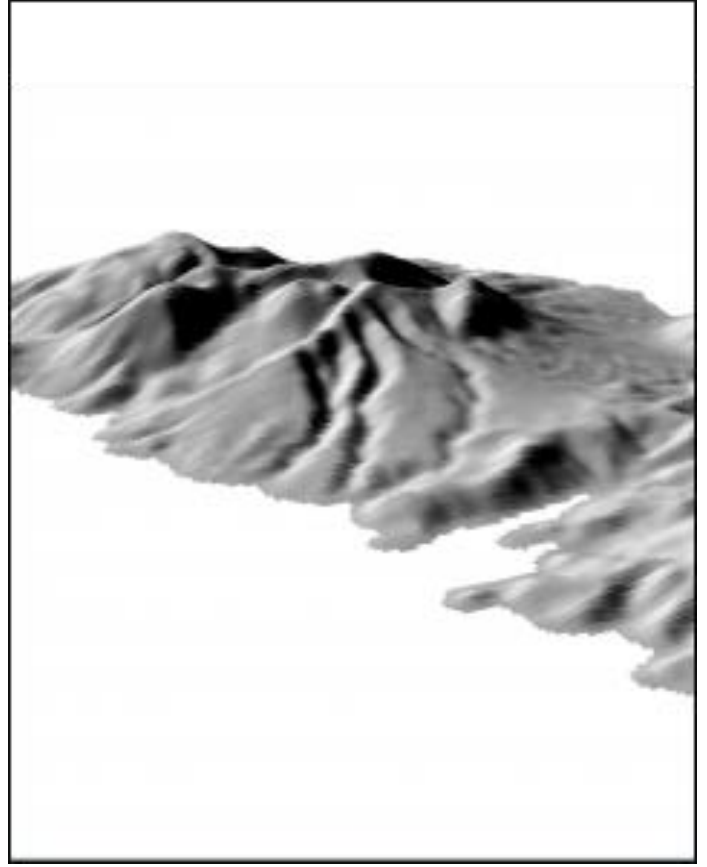


Dimensionality or Map View Type

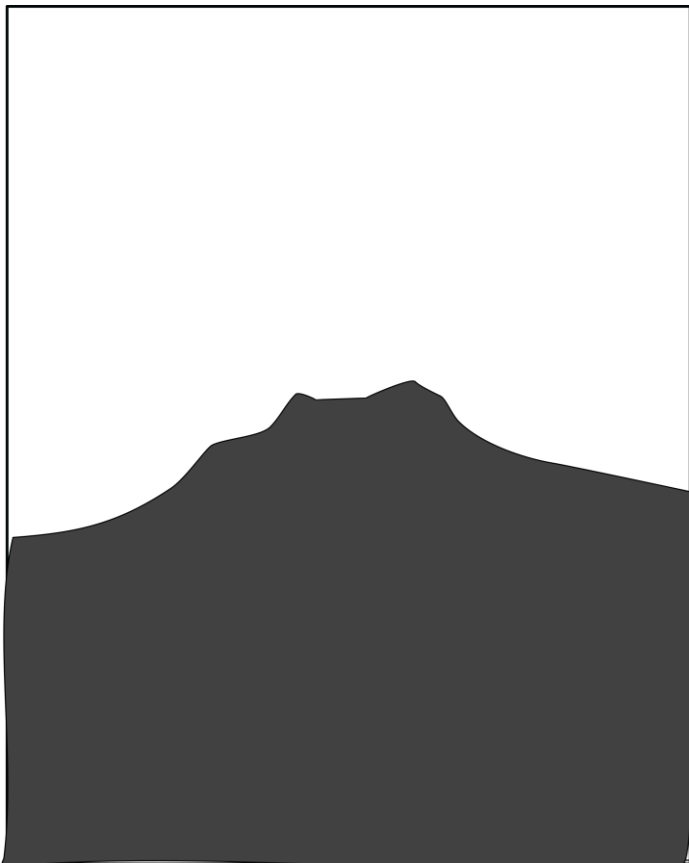
Plan/map/2D view



Oblique/3D view

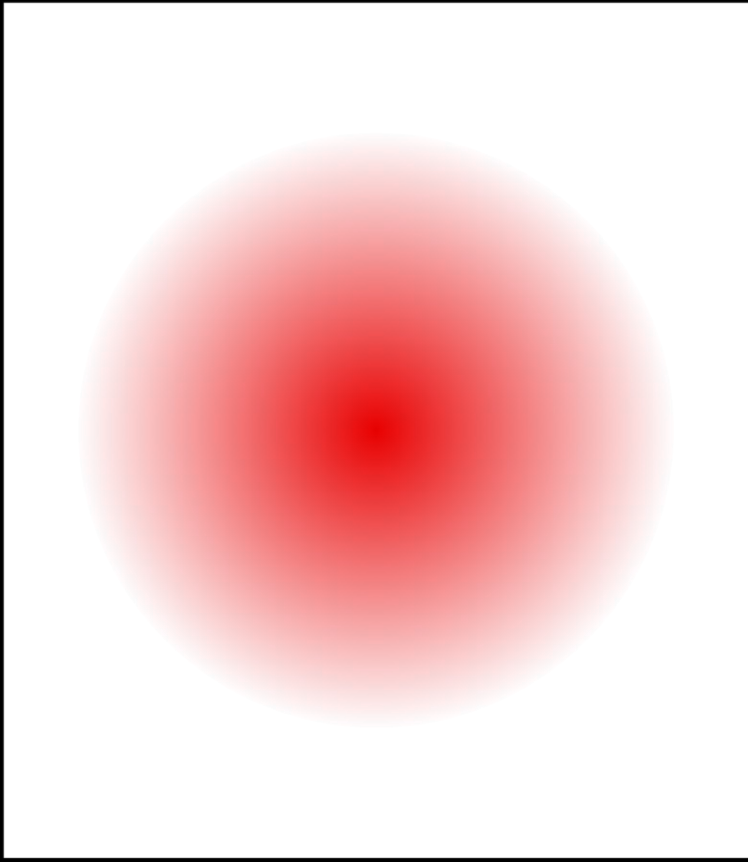


Cross-sectional view

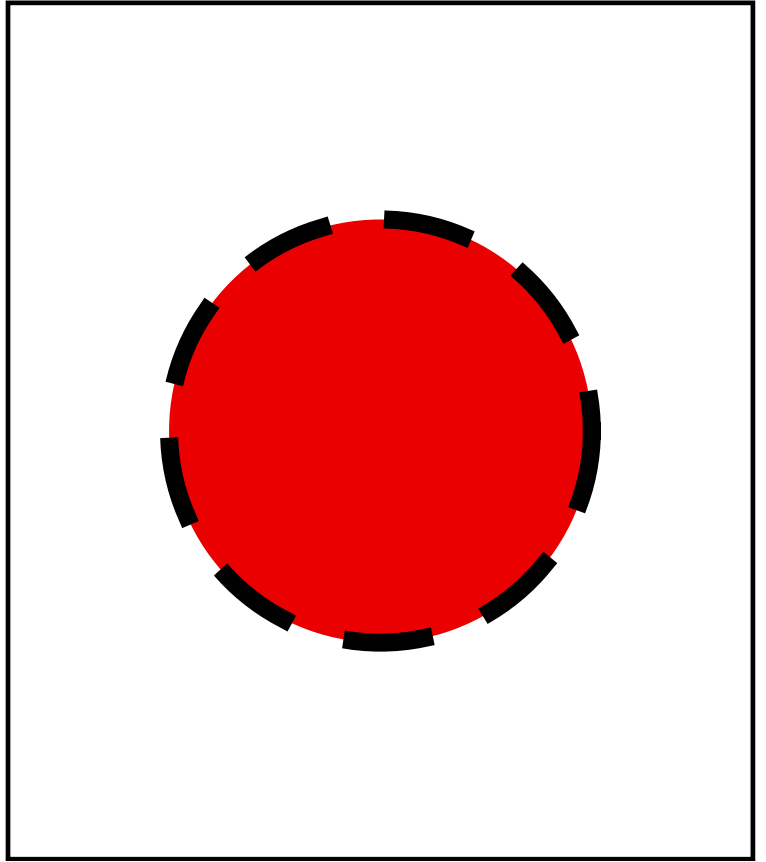


Uncertainty Visualization

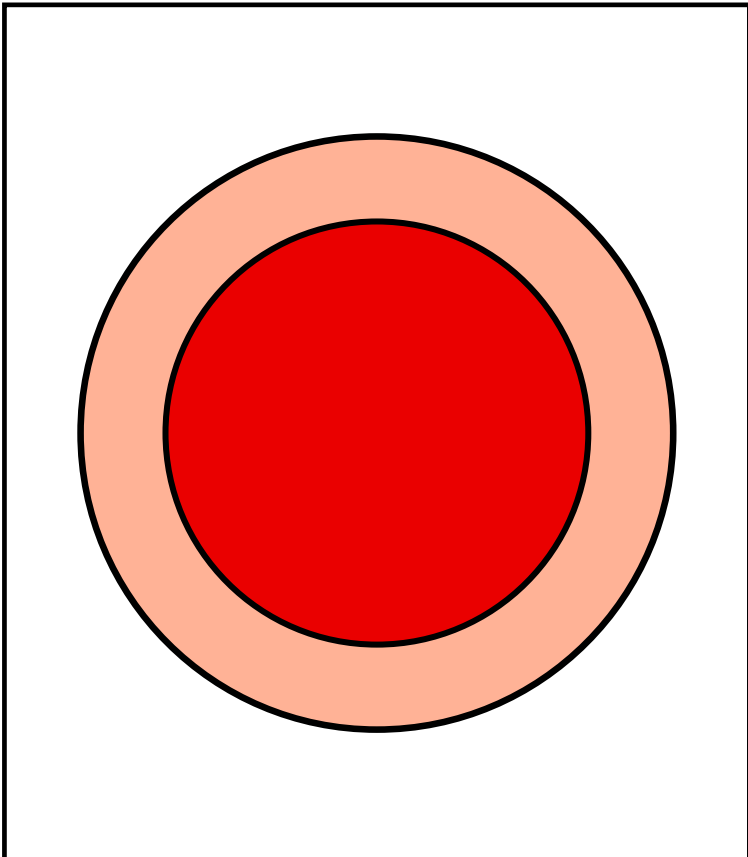
Fuzzy boundaries or gradational colors



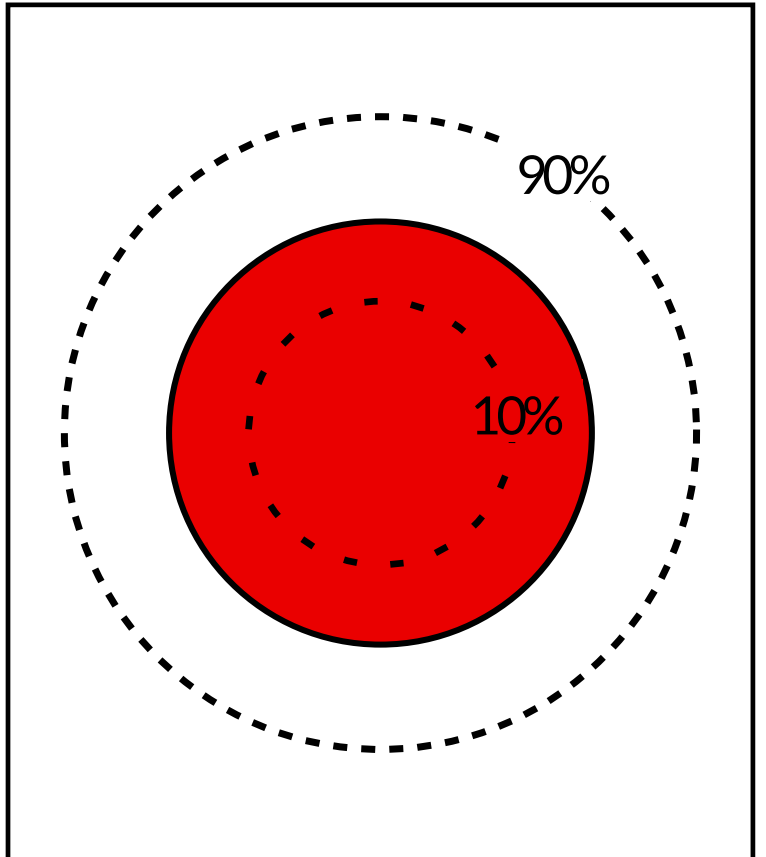
Boundary symbology



Buffer zones



Confidence intervals



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



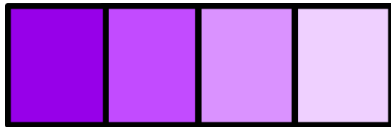
Red-to-yellow

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



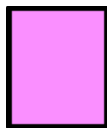
Dark-to-light (color or grayscale)

- 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/>)

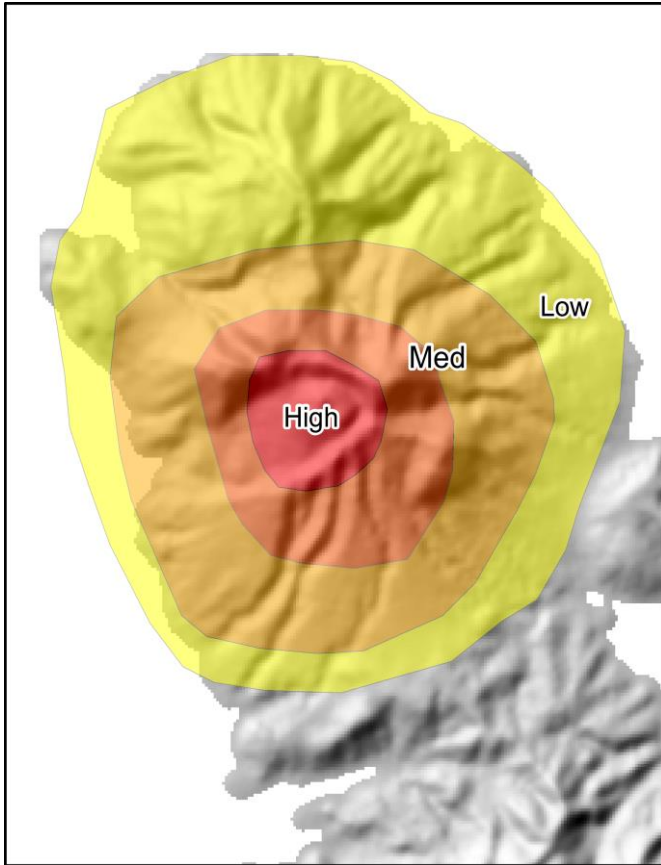


Diverging

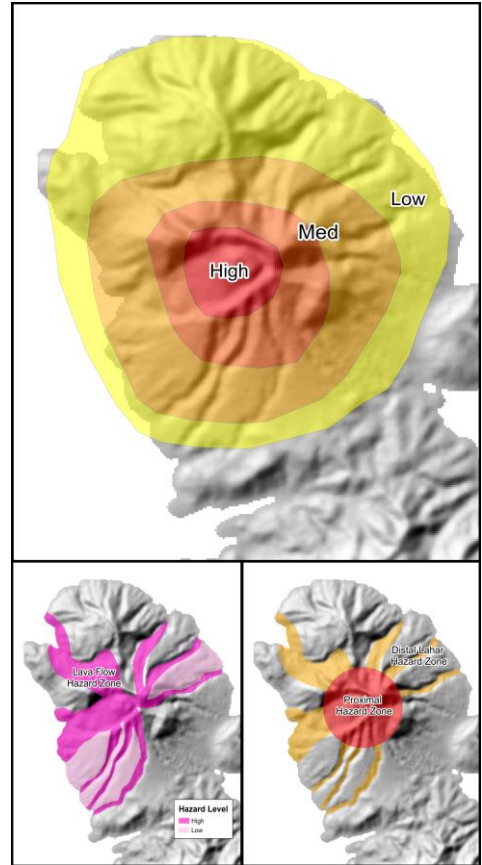
- Only well-suited for data with a special central value, e.g. elevation data with sea level as that value
- Can introduce misperceptions on hazard maps

Map Layout

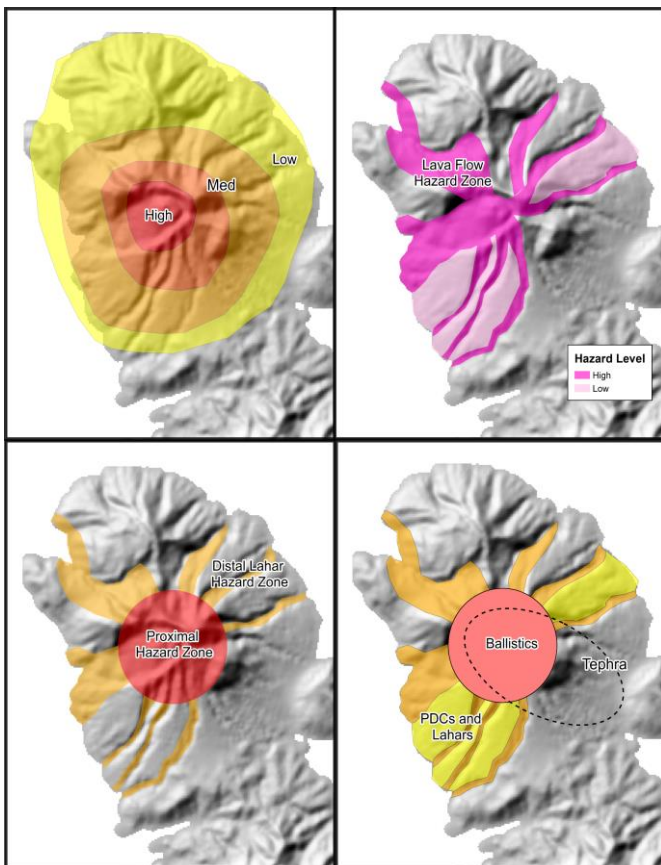
Main Map Panel



Main Map with Insets



Series of Small Panels



| 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.