Taupo Volcano Risk Assessment Lab

Taupo Volcano, New Zealand, is showing significant signs of unrest. You are a volcanic risk specialist based at Wairakei Volcano Observatory, who has been tasked to:

1) Forecast what is
   a) the most likely eruption from the volcano
   b) the maximum credible eruption for the volcano
2) Model tephra fall out for each of your scenarios
3) Estimate the number of towns, population and critical infrastructure which may be affected by tephra fall out
4) Estimate the likely impacts to each societal asset. Remember tephra fall thicknesses will be variable.
5) Suggest what should be priority actions for emergency management

Word Limit: 1500

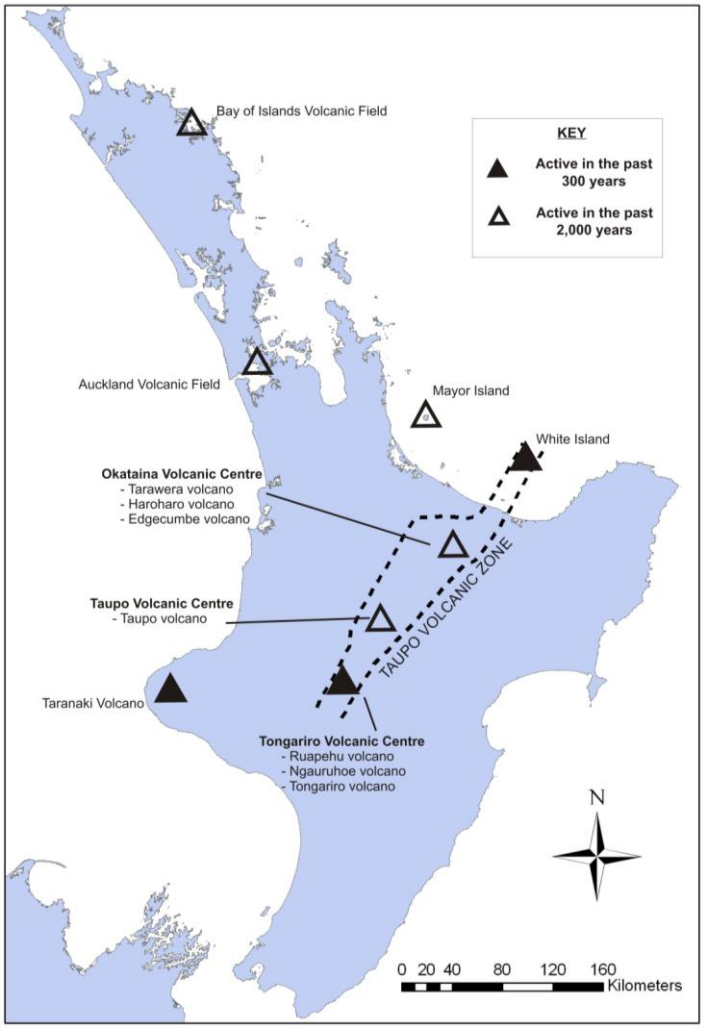

Figure 3: Taupo Volcanic Zone, New Zealand

Figure 2: Taupo volcano looking south (source: GNS Science)

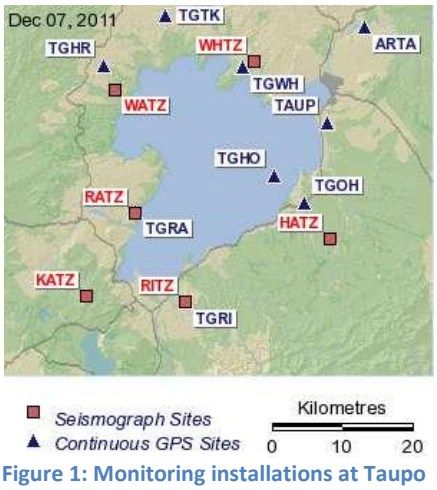

Figure 1: Monitoring installations at Taupo volcano (source: GeoNet)

Important Points

- You must justify all of your input parameters with defensible scientific arguments (even if a best guess). This is particularly important for modelling the tephra fall out.
- This is a summary document produced under urgency which should be easy to read and view results.
- Any maps, figures or tables should be clear, concise and easy to read.

SUMMARY OF MONITORING DATA

All monitoring parameters are suggesting that an eruption is imminent

- Over the past 12 months a series of deep (10-20 km) long period earthquakes have been observed close to Taupo volcano.
- Over the past month there has been a sequence of shallow, high-frequency (volcano-tectonic or VT) earthquakes have been observed. Rates of deep and shallow long-period seismicity have also increased.
- >100 VT earthquakes have been recorded over the past 24 hours, with many felt by the local population causing panic. Earthquake foci are mainly at 5-4 km depth. Over the last 3 hours earthquake foci have begun to cluster (56 events <M3.0) at 4 km depth (±500 m).
- Three gravity surveys completed over the past 150 hours indicate a significant gravity anomaly on the eastern side of Lake Taupo. This has been interpreted as ponded fluid magma with an estimated volume of 2.3 km^3.
- InSAR and continuous GPS indicate vertical deformation over a 2500 m^2 area of eastern Lake Taupo. This correlates near-perfectly with the location of the intruded body detected by the gravity surveys. Maximum vertical deformation is 2.3m, and deformation appears to be accelerating at a rate of ~10 cm/day/day.
- Geothermal systems in the local Taupo area have significantly increased in Temperature and concentrations in SO2, CO2. Many new geothermal 'features' have developed on the eastern shores of Lake Taupo. Isotope analysis indicates there is an increasing magmatic signature in the gases.
- Eastern Lake Taupo has warmed by 3 degrees - thought to be the result of increased fumarole activity
- Sulphur slicks (plumes) have been observed in eastern Lake Taupo.

PREVAILING WINDS

- The MetService has indicated that a strong prevailing Westerly wind is expected over the central North Island for the next 48 hours.

VOLCANIC INPUT DATA

Use the Tephra2 ash fall out model on V-Hub.

1) Create an account with V-Hub
2) Open the Tephra2 Tool (Resource Warehouse > Online Simulation Tools). Make sure you open the full Version, not the student version.
3) Open the "supporting documents" link
4) Read or watch the Tephra2 Tutorial Scripts.
5) Open Tephra 2 and begin to add input parameters to model ash fall out distribution for Taupo
6) WIND FILE: select: "from the west" from the drop down menu
7) GRID FILE: Upload "create_grid.txt"
8) Config File: ignore (we're free styling!)
9) Check the box if you want to save your model parameters (recommended)
10) Plume Height: DECIDE what is likely for your eruption model (do some research...think about what the monitoring data is telling you and find a paper which might tell you about this)
11) Eruption Mass: DECIDE what is likely for your eruption model (do some research... think about what the monitoring data is telling you and find a paper which might tell you about this)
12) Max Grainsize: DECIDE what is likely for your eruption model (do some research... find a paper which might tell you about this)
13) Min Grainsize: DECIDE what is likely for your eruption model (do some research...find a paper which might tell you about this)
14) Median Grainsize: DECIDE what is likely for your eruption model (do some research...find a paper which might tell you about this)
15) Vent Easting (UTM): Select the vent location (decide where on Lake Taupo this might be). Remember this is in UTM or Universal Transverse Mercador projection. You can get this location from a GIS, such as Google Earth (see Tool>Options)
16) Vent Northing (UTM): Select the vent location (decide where on Lake Taupo this might be). Remember this is in UTM or Universal Transverse Mercador projection. You can get this location from a GIS, such as Google Earth (see Tool>Options)
17) Eddy Constant: 0.04
18) Diffusion Coefficient: DECIDE what is likely for your eruption model (do some research... find a paper which might tell you about this)
19) Fall Time Threshold: DECIDE what is likely for your eruption model (do some research... find a paper which might tell you about this). This can be a bit tricky....so something around 100000 would be credible
20) Lithic Density: DECIDE what is likely for your eruption model (do some research... find a paper which might tell you about this)
21) Pumice Density: DECIDE what is likely for your eruption model (do some research... find a paper which might tell you about this)
22) Column Steps: 100 is probably sufficient
23) Plume Model: 0 (assumes it is a well mixed plume)
24) SIMULATE!!!
25) Try analysing different scenarios - sensitivity analysis
26) Decide which two eruption scenarios best fit your needs for your analysis (MLE & MCE).
27) Save/download the Isopach, Inputs, Outputs
28) Plot the isopach onto a map of the central North Island (either do this in GIS or manually - depending on how awesome you are with GIS)
29) Analyse number of societal components impacted by what intensity of ashfall
30) Research the likely impact for each societal component.
31) Write up report.