

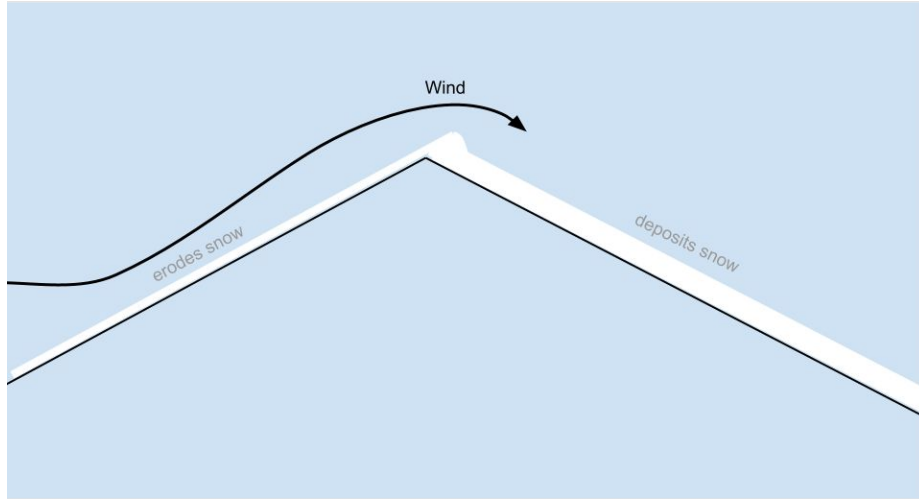
# Projecting Avalanche Risk onto Terrain

Sean Buchanan  
October 2019





# Aspect Matters!





# Slope Angle Matters!



# Elevation Matters!



# Relevant Terrain Parameters

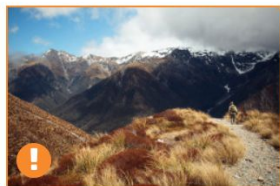
- Aspect
- Angle
- Elevation

Sort by:

[Danger Level ↓](#)

[North to South ↓](#)

[Last Updated ↓](#)



### Arthur's Pass

**3 Considerable Risk**

Dangerous conditions, conservative decision making essential.

Last updated: a day ago

[View full forecast](#)



### Tongariro

**2 Moderate Risk**

Heightened avalanche conditions on specific terrain features.

Last updated: 20 hours ago

[View full forecast](#)



### Mt Hutt

**2 Moderate Risk**

Heightened avalanche conditions on specific terrain features.

Last updated: 3 days ago

[View full forecast](#)



### Aoraki/Mt Cook

**2 Moderate Risk**

Heightened avalanche conditions on specific terrain features.

Last updated: 18 hours ago

[View full forecast](#)



### Queenstown

**2 Moderate Risk**

Heightened avalanche conditions on specific terrain features.

Last updated: 16 hours ago

[View full forecast](#)



### Wanaka

**2 Moderate Risk**

Heightened avalanche conditions on specific terrain features.

Last updated: 2 hours ago

[View full forecast](#)



### Fiordland

**2 Moderate Risk**

Heightened avalanche conditions on specific terrain features.

Last updated: a day ago

[View full forecast](#)



### Taranaki

**1 Low Risk**

Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.

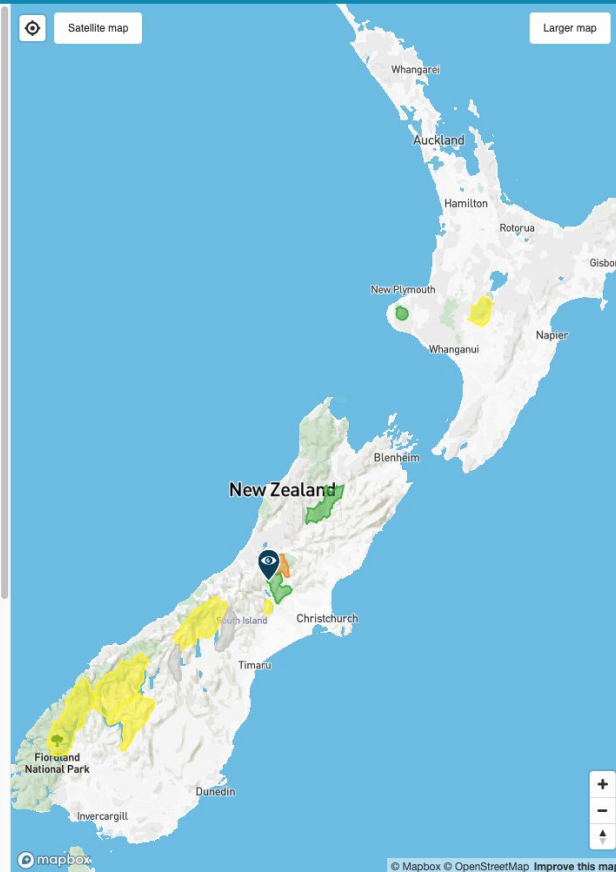
Last updated: 5 hours ago

[View full forecast](#)

Avalanche danger scale:



[What is this?](#)



**Public Observations > Share yours now >**

When you share your observations it lets everyone in the region know about the current conditions and helps to keep people safe.

[Let us know](#)



## High Alpine

Above 2300 meters



### 3 Considerable Risk

Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.

## Alpine

2300 - 1800 meters



### 3 Considerable Risk

Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.

## Sub Alpine

Below 1800 meters



### 2 Moderate Risk

Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.

Avalanche danger scale:



[? What is this?](#)

# Primary Avalanche Danger



**STORM  
SLAB**

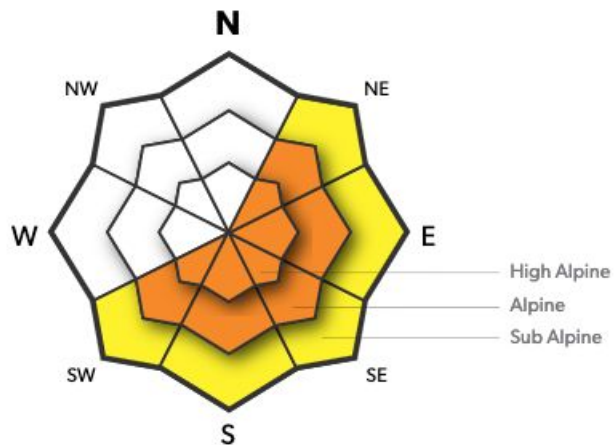
## Description

New snow is in the forecast with some heavy falls over Wednesday morning. Much of this will be sitting on a very slick surface and may not bond well. The winds will be blowing from a variety of directions over the day so you can expect to find this problem on many aspects. Human triggering may become likely, so be cautious around all slopes that have new snow on them. The higher you go, the more sensitive these slabs will be.

## Trend

Increasing

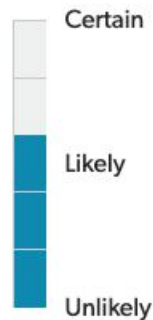
## Dangerous Aspects



## Time of Day

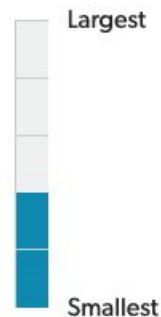
All Day

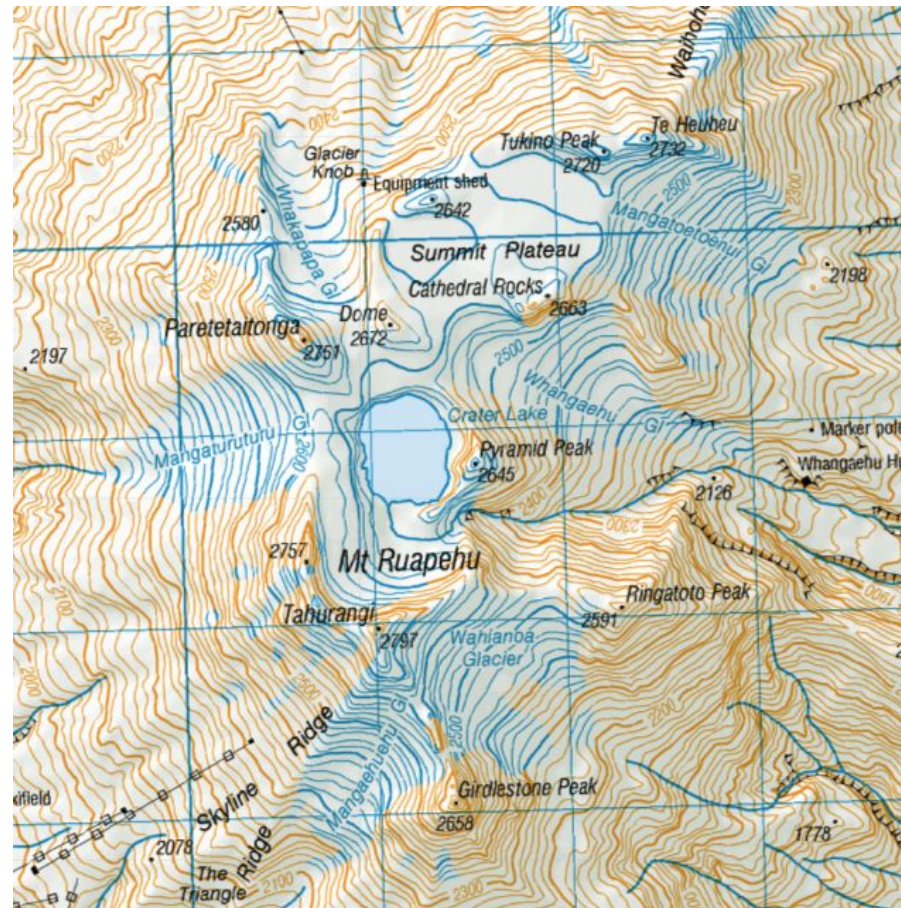
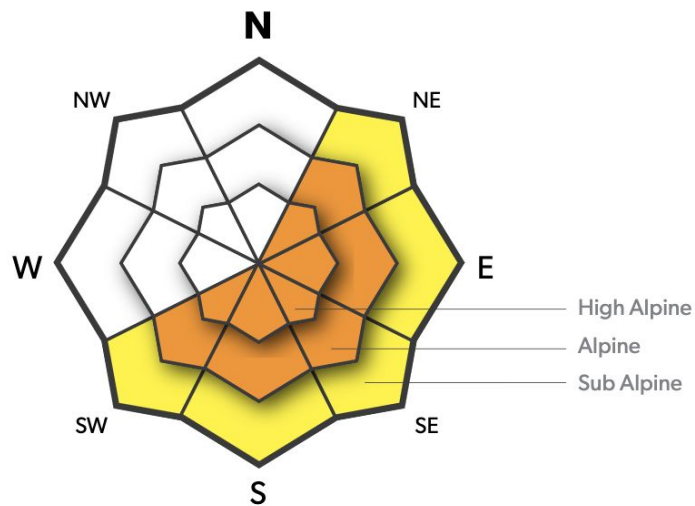
## Likelihood



[What does this mean?](#)


## Size







# Digital elevation model



Land Information  
New Zealand  
data to inform

LINZ DATA SERVICE


Search for data & maps

Search

Help

Sean Buchanan

8 000m



NZ 8m Digital Elevation Model (2012)

LINZ / National Topographic Office

Updated

18 Aug 2016

About

Metadata

Tiles Table

History

Services

Comments (0)

Suitable for cartographic visualisation only. It was created by the interpolation of 20m contours with post-processing and filtering it is not suitable for terrain analysis.

This 8m Digital Elevation Model (DEM) was originally created by Geographx (geographx.co.nz) and was primarily derived from January 2012 LINZ Topo50 20m contours (data.linz.govt.nz/layer/768).

For a full description of the how the DEM was generated refer to this layer's metadata.

License

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☐

You must attribute the creator in your own works.

Information

Category

Topographic > NZ Topo 50 Data > Relief

Tags

New Zealand

Regions

New Zealand

Metadata

Dublin Core, ISO 19115/19139

Technical Details

Layer ID

51768

Data type

Grid

Resolution

8.000m

Services

Raster Query API, Catalog Service (CS-W), data.govt.nz Atom Feed

History

Added

13 May 2014

Last updated

18 Aug 2016

Revisions

14 - Browse all revisions

Current revision

Imported on Aug. 18, 2016 from 115 GeoTIFF sources in NZGD2000 / New Zealand Transverse Mercator 2000.

Search

Streets

Find address or place.

NZ 8m Digital Elevation Model (2012)

18GB

Te Kuiti

Waitara

New Plymouth

Oakura

Inglewood

Stratford

Eltham

Opunake

Hawera

Patea

Te Kuiti

Taumarunui

Turangi

Ohakune

Waiouru

Taihape

SH 3

SH 4

SH 43

SH 30

SH 1

SH 54

SH

Lake Taupo

Tongariro National Park

20 km

10 mi

Basemap

© Mapbox

© OpenStreetMap



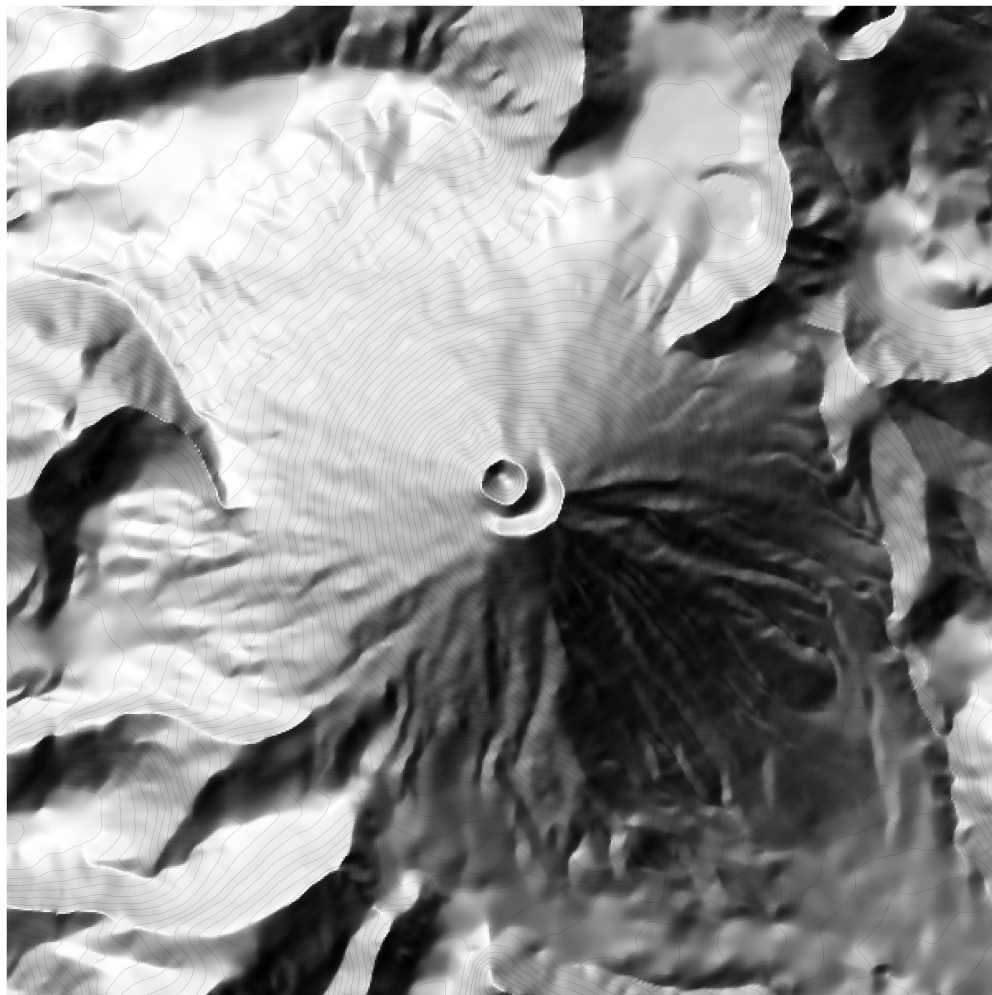


```
# load raster
rasterName='IL.tif'
src = rasterio.open(rasterName)
imarray=src.read()
z=imarray[0,:,:]

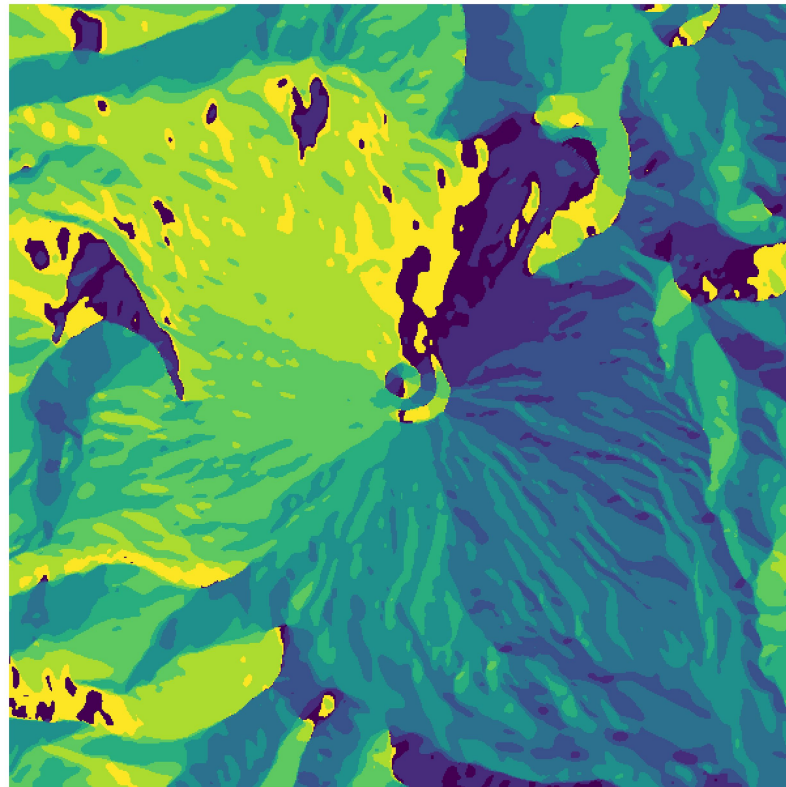
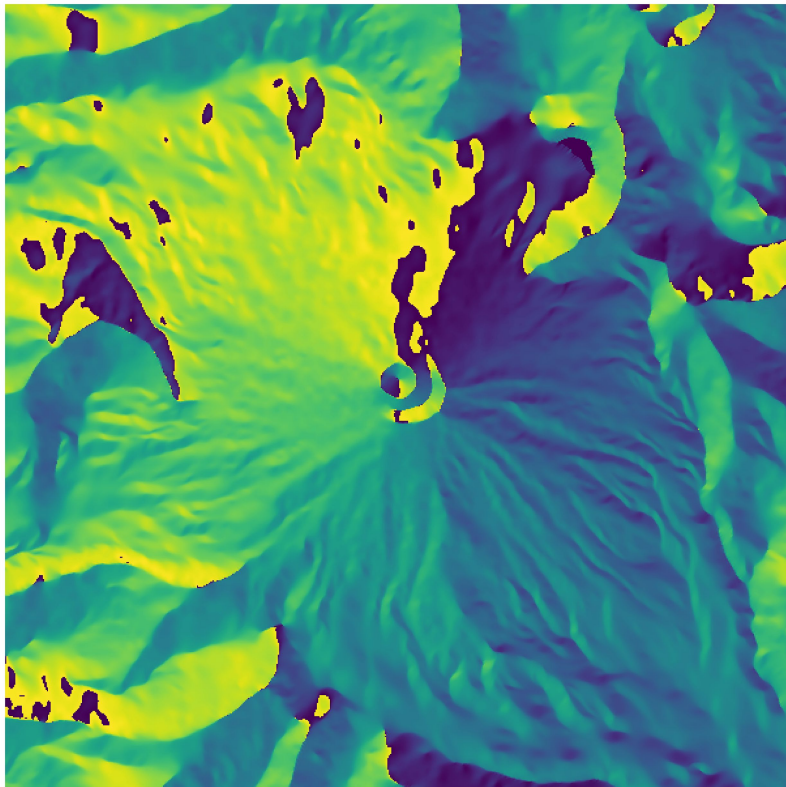
# calculate gradient
dz=np.gradient(z)

# calculate slope angle
angle=np.arctan(np.linalg.norm(dz,axis=0))

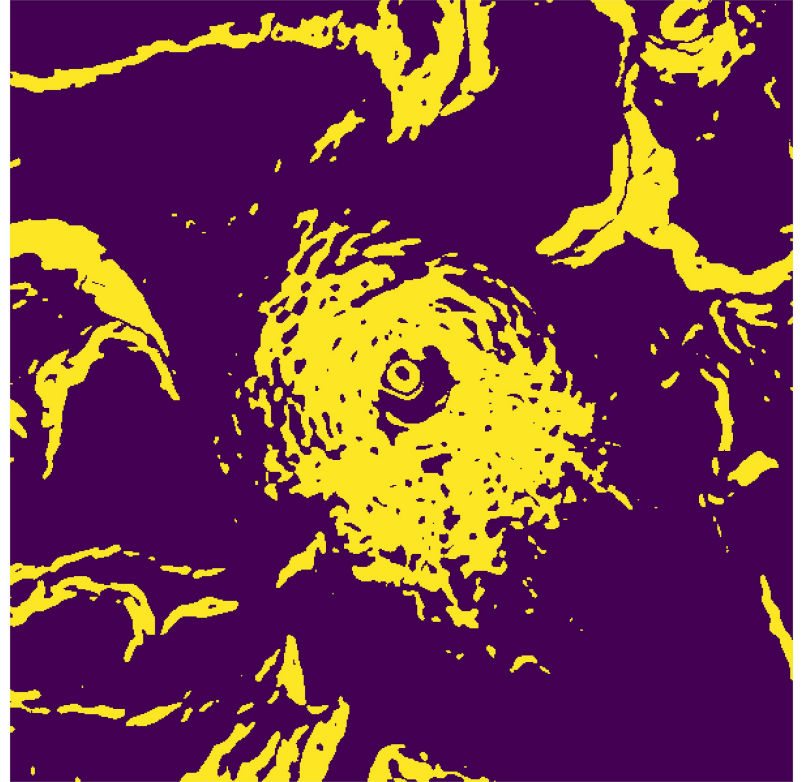
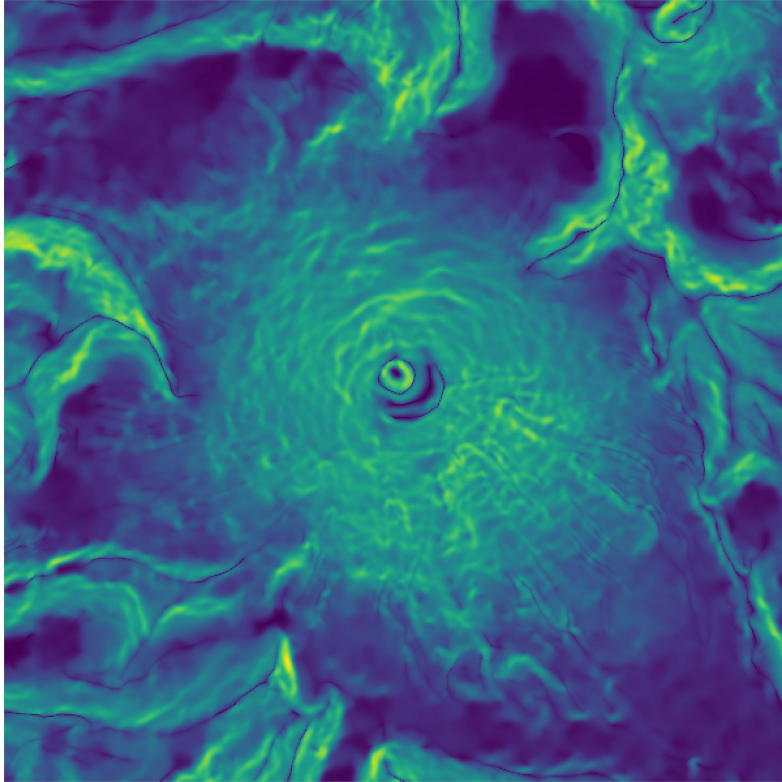
# calculate slope aspect
aspect=np.arctan2(-dz[1],dz[0])
```



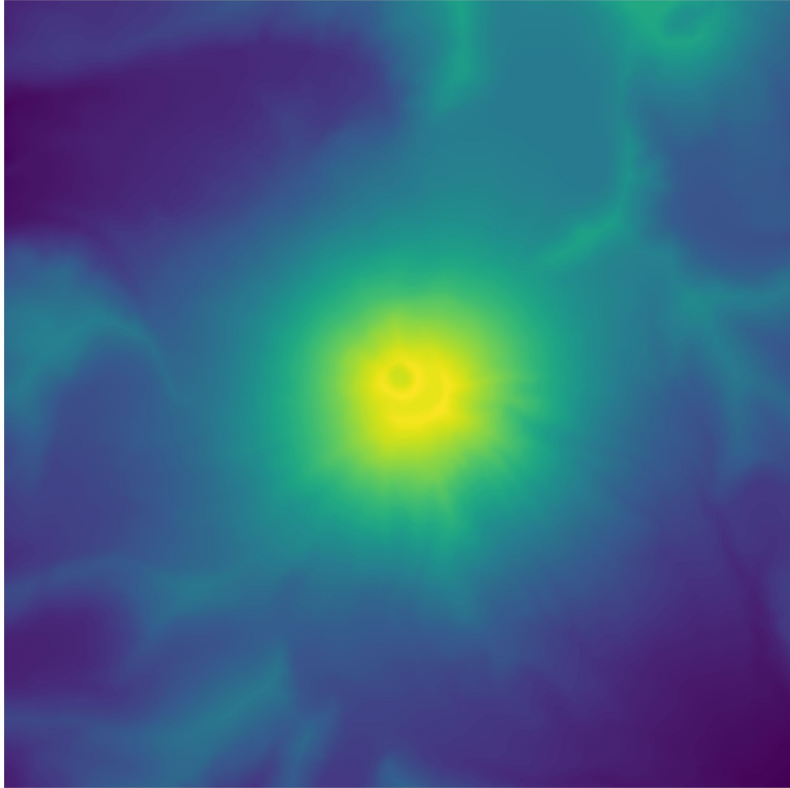
# Slope aspect



# Slope angle mask

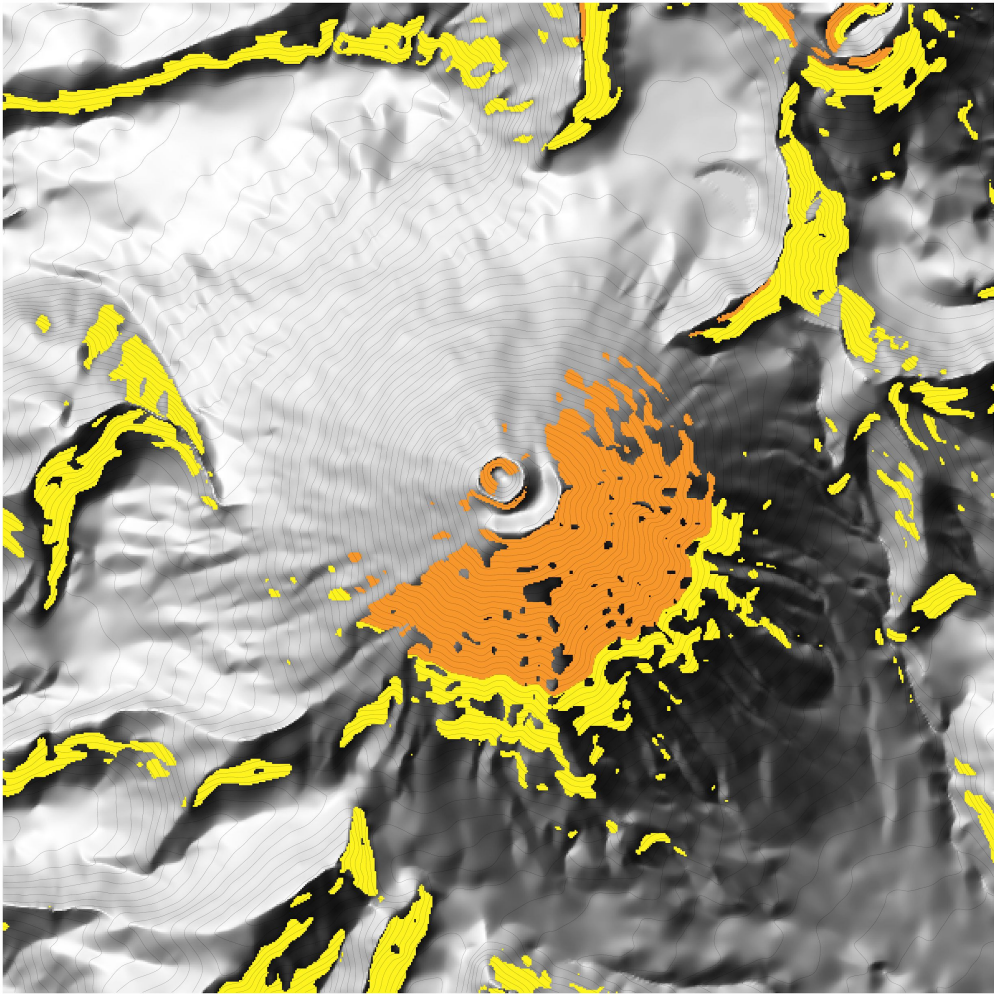
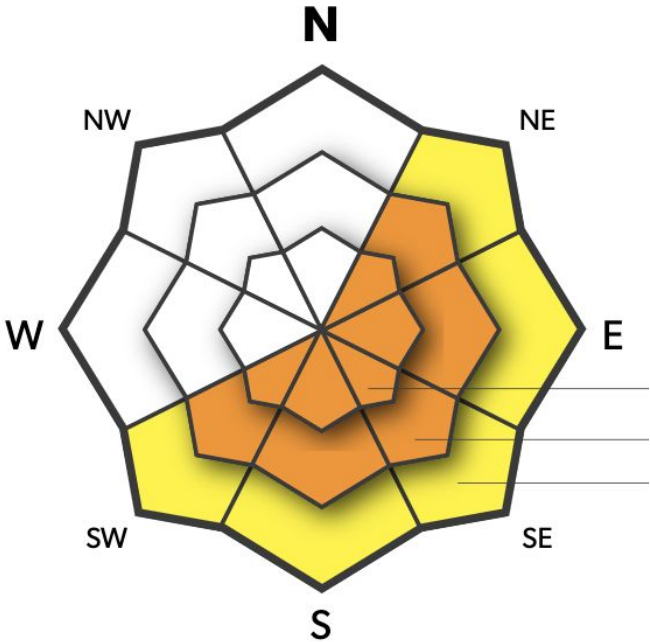


# Elevation





Dangerous Aspects





forecast:	
id:	14738
lastEdited:	"2019-09-03 19:07:42"
created:	"2019-09-03 19:04:20"
validPeriod:	"24hrs"
regionId:	1
forecaster:	"Ben McKay"
altitudeDanger:	
0:	
rating:	1
description:	"Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features."
altitudeFrom:	2300
1:	
rating:	1
description:	"Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features."
altitudeTo:	2300
altitudeFrom:	1800
2:	
rating:	1
description:	"Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features."
altitudeFrom:	1800
avalancheDangers:	
0:	
priority:	"Primary"
description:	"Rain will fall to the summits across the region over Tuesday night and Wednesday. This will turn the snowpack surface to slush. If you are sinking deep into loose slushy snow then its best to avoid long steep slopes where enough wet and loose snow can slide down hill gathering more mass as it goes. Keep to low angle terrain to avoid this problem."
time:	
start:	"00:00:00"
end:	"00:00:00"
isAllDay:	true
trend:	"NoChange"
character:	
title:	"Loose Wet"
iconUrl:	"/assets/265355727f/loosewet.jpg"
likelihood:	2
size:	1

## Plan

[View billing](#)

Pay-as-you-go

## Current billing cycle usage

### Sessions

Map Loads for Web

132 / 50,000 free loads



### APIs

Raster Tiles API

16,182 / 750,000 free tile requests



### Storage

Tilesets

163 MB / 53.7 GB



## COMPUTE

Free Tier

12 MONTHS FREE

Amazon EC2

# 750 Hours

per month

Resizable compute capacity in the Cloud.

750 hours per month of Linux, RHEL, or SLES  
t2.micro instance usage

750 hours per month of Windows t2.micro  
instance usage



<http://www.metsean.xyz/avalanche?date=20190820>



<http://www.metsean.xyz/avalanche?date=20190820>

# Wrapping up

- A useful tool for trip planning. Still need to apply good backcountry practices when in the field.
- FATMAP app can be used to do similar shading - but not linked to [avalanche.net.nz](http://avalanche.net.nz) and expensive.

## Limitations:

- Only mapping start zones.

## To do:

- Single forecasting zone