



Digitising New Zealand wine regions: an initial investigation

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overview

- Background
 - “terroir” x “cultiva”
 - Viticulture
 - wine making
 - Methods
 - Vector
 - Raster
 - Initial results
 - conclusions
- 
- specific personality

“terroir” and “cultiva”

- A " **terroir** " is a group of vineyards (or even vines) from the **same region**, belonging to a **specific appellation**, and **sharing the same type of soil, weather conditions, grapes and wine making savoir-faire**, which contribute to give its **specific personality** to the wine.

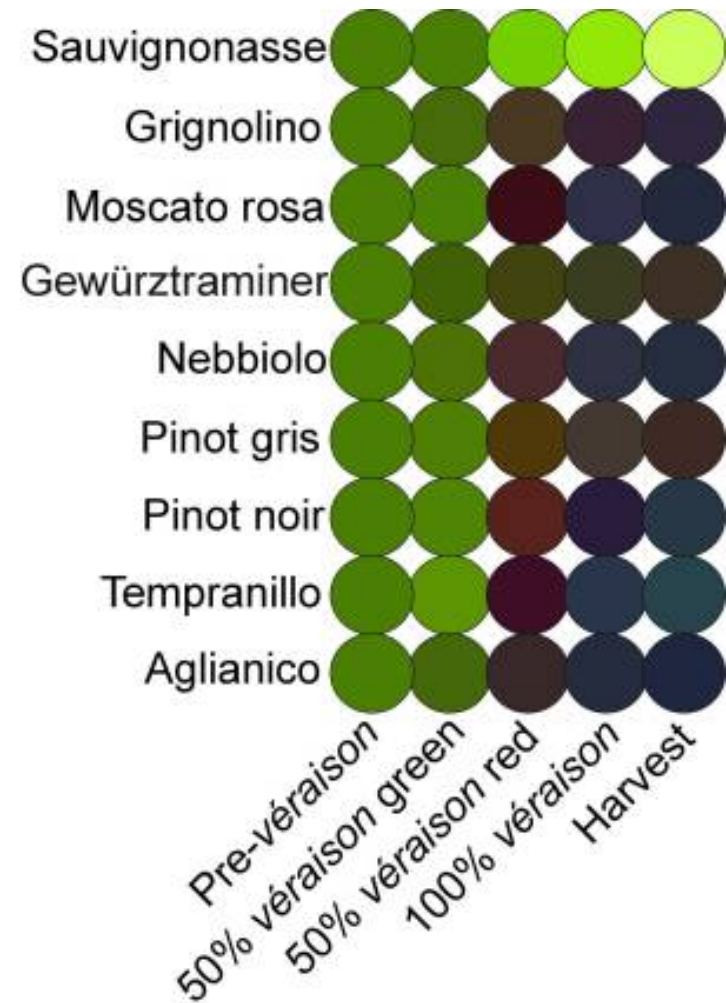
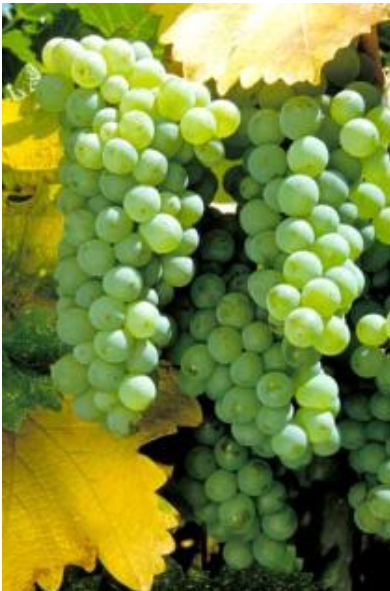
<http://www.terroir-france.com/theclub/meaning.htm>

“Terroir” X “Cultiva”

- Variety
- Clone
- Rootstock
- Soil
- Canopy management
- Terrain
- Pest Pressure
- Disease Pressure
- Climate
 - Rainfall
 - Humidity
 - Sunshine
- Wind speed
- Cluster microclimate
- Seasonal Variation
- Vineyard Practices

Cultivation practices

Grape varieties (“cultiva”)



+ Wine making => **specific personality**

Each choice in the successive steps of the elaboration of wine has repercussions on the taste and the quality of the wine

- **the terroir**
- **The climate (and the date of harvest)**
- **the grape-variety**
- **the type of container used for fermentation**
- **the temperature - the juice of grape is maintained during fermentation**
- **the fermentation period**
- **the type of container used for maturation**

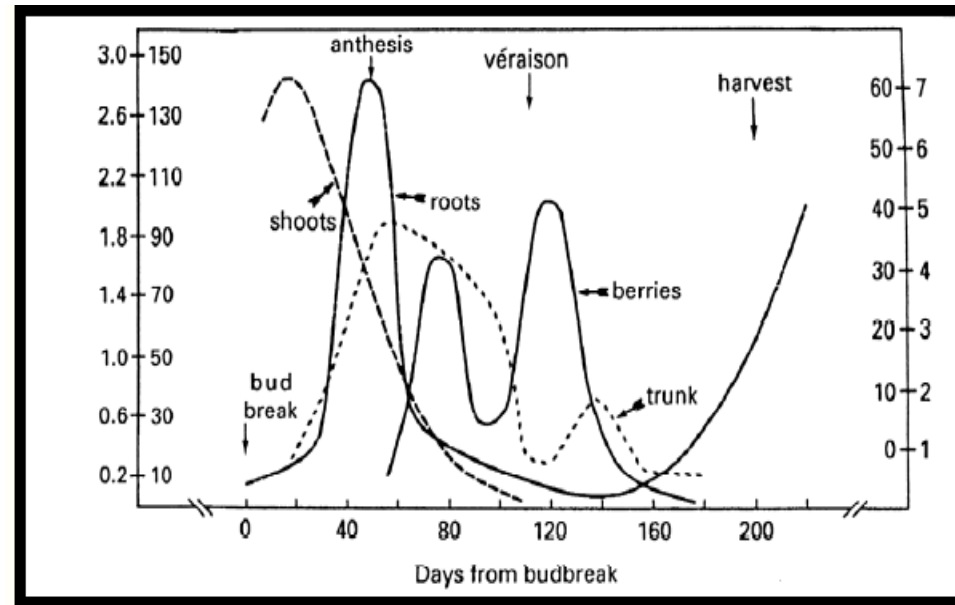
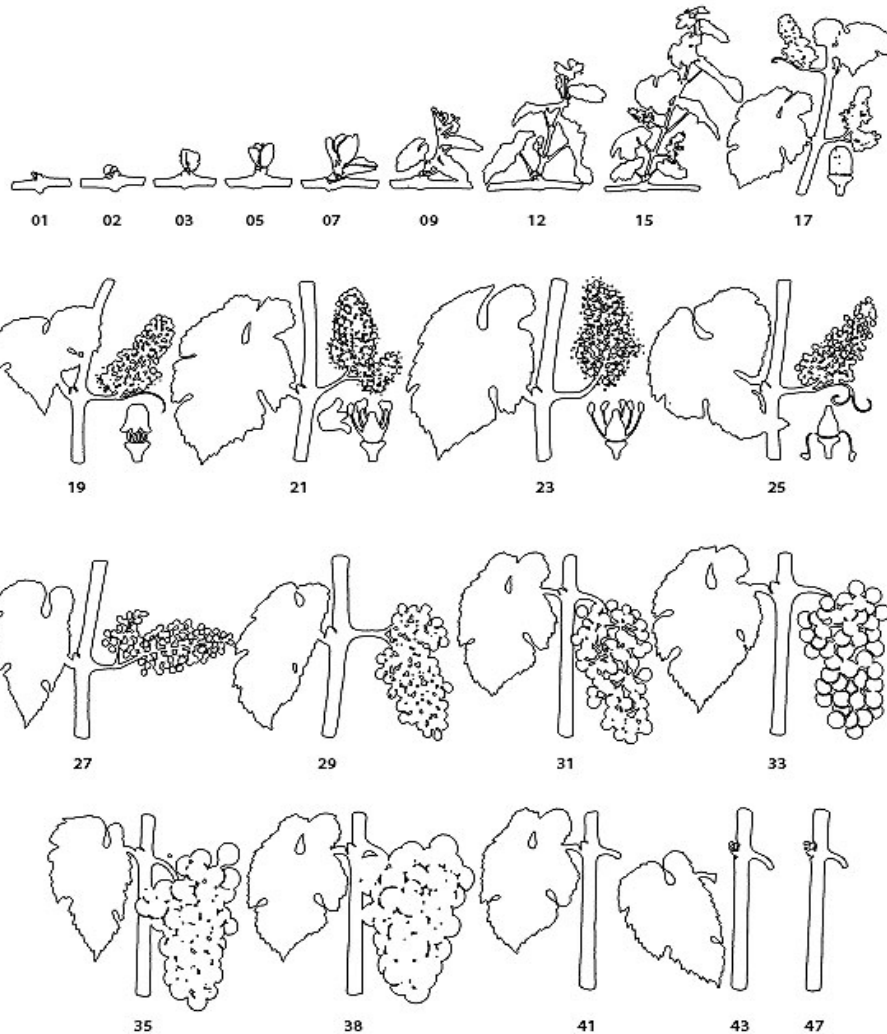
<http://www.terroir-france.com/wine/making.htm>

Grapevine phenology



precise data

Grapevine phenology



Wine tasting



Source: www.bryandownes.com/page9.html

Sommelier comments

come in many forms:

- video
- text
- ratings
- Audio
- web

and a note about sommelier comments...



What flavors are on the nose?

Soruce: <http://winedinedaily.com/wine/wine-quotes/item/wine-cartoon>

Literature review

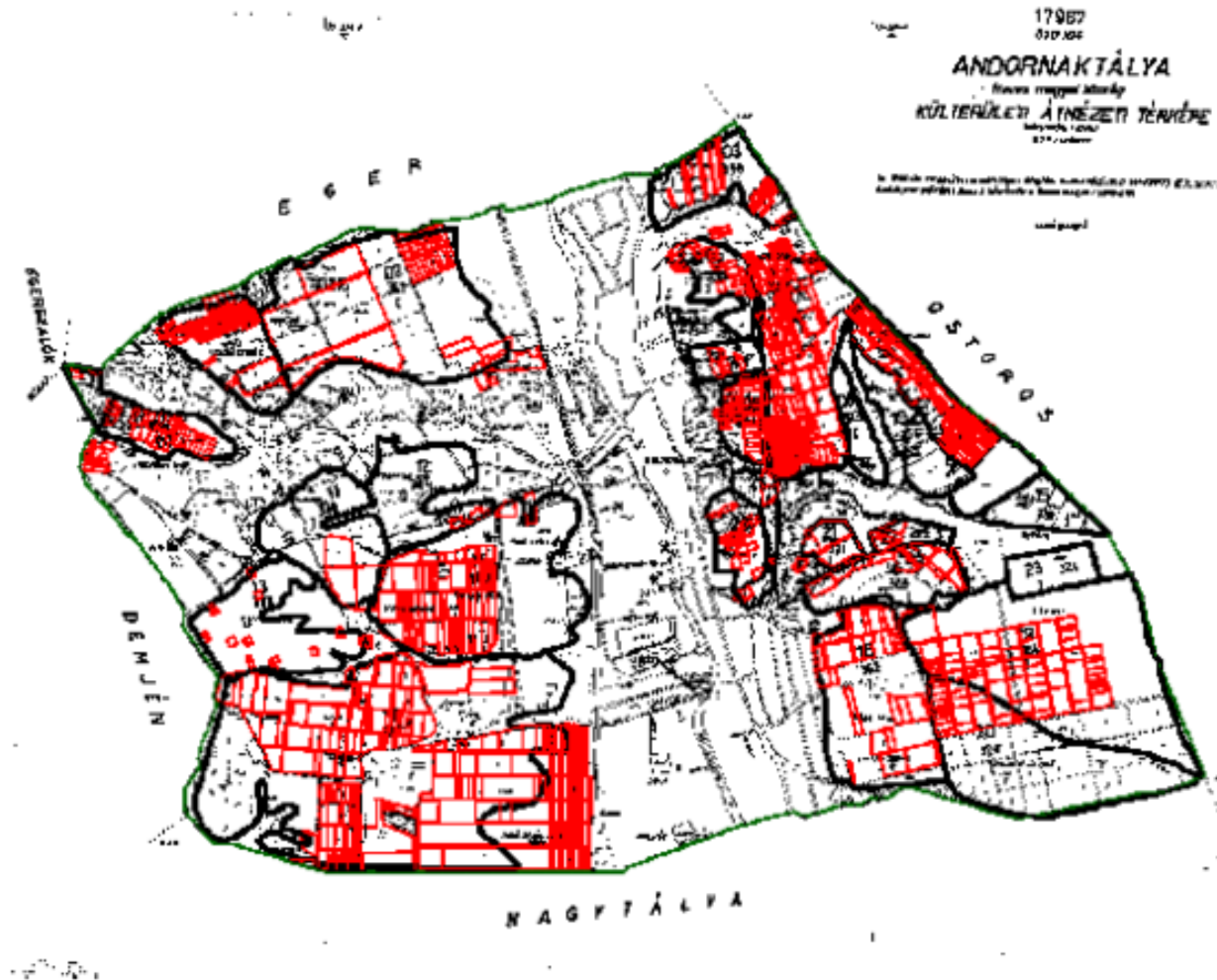


Figure 2. The map of potential lands for vineyards, and the existing vineyards

Martinovich, L., Katona, Z., Szenteleki, K., & Boto, E. P. (2010). *Updating the Evaluation of Hungarian Wine Producing Fields Using the National GIS Register (VINGIS)* 6pp. Retrieved June 15, 2010, from VINGIS: Managing Hungary's vineyards with Open Source:

http://www.oiv2007.hu/documents/viticulture/Hungarian_wine_GIS_register_VINGIS_OIV_jav_POSTER.pdf:3

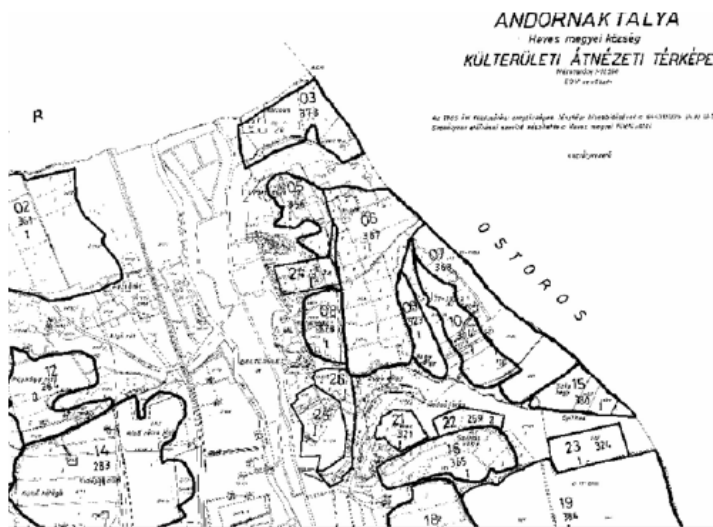


Figure 1. Map of the potential lands for vineyards

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Agrometeorology (frequency of winter frost damage, spring, fall frost damage), **Soil** (Soil type, Soil forming rock, PH and lime state, physical soil kind, water management features, Humus level, thickness of the production layer of soil. The area homogeneity concerning the soil type), **Water management** (water management of the area based on site observation), **degree of erosion**, The lie of the land, **Elevation** (slope degree and aspect, elevation above sea level on hill and mountainside, emergence from the environment on the plain and flat areas, relief, area surface on hill and ountainside, relief, area surface on plain and flat areas, environment proximity of woods, degree of built up areas), **area utilization**, **road conditions**.

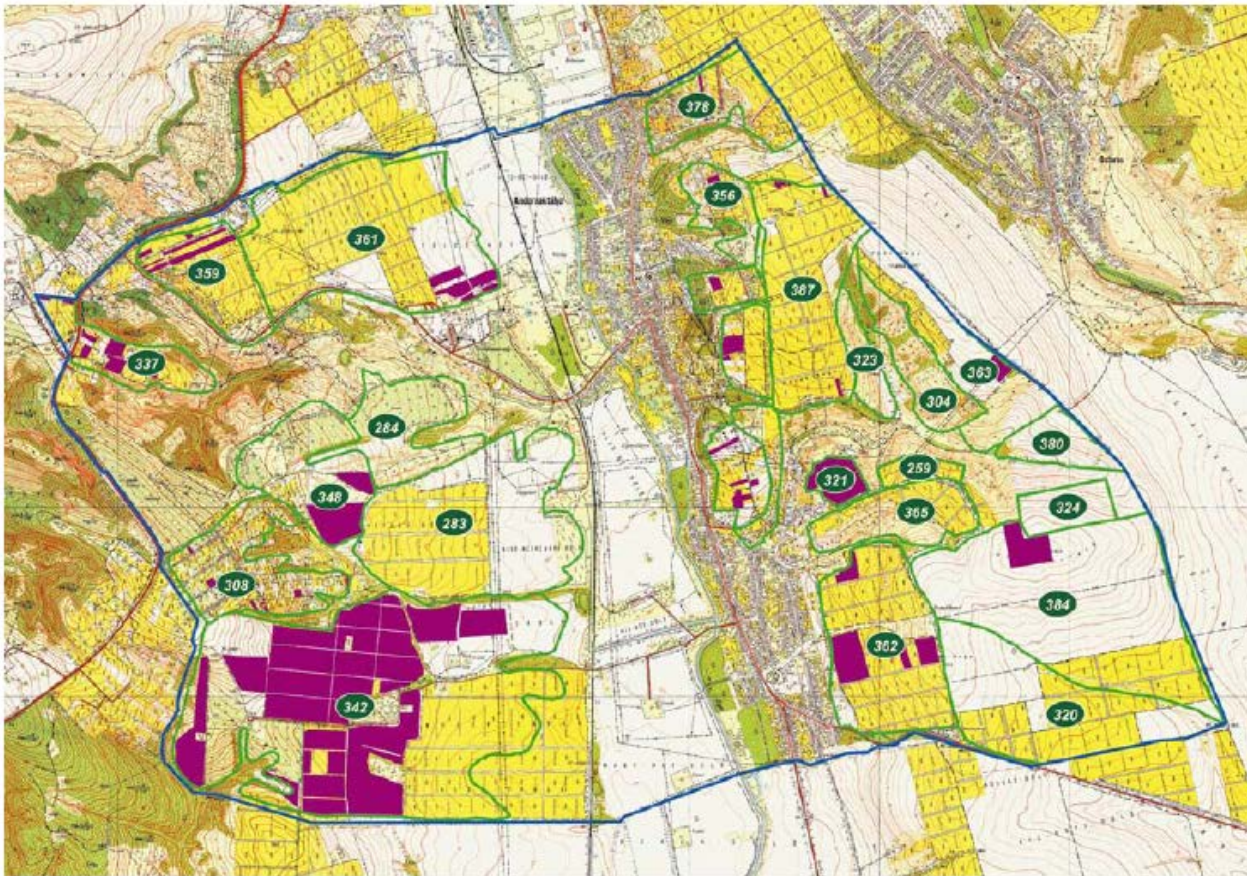
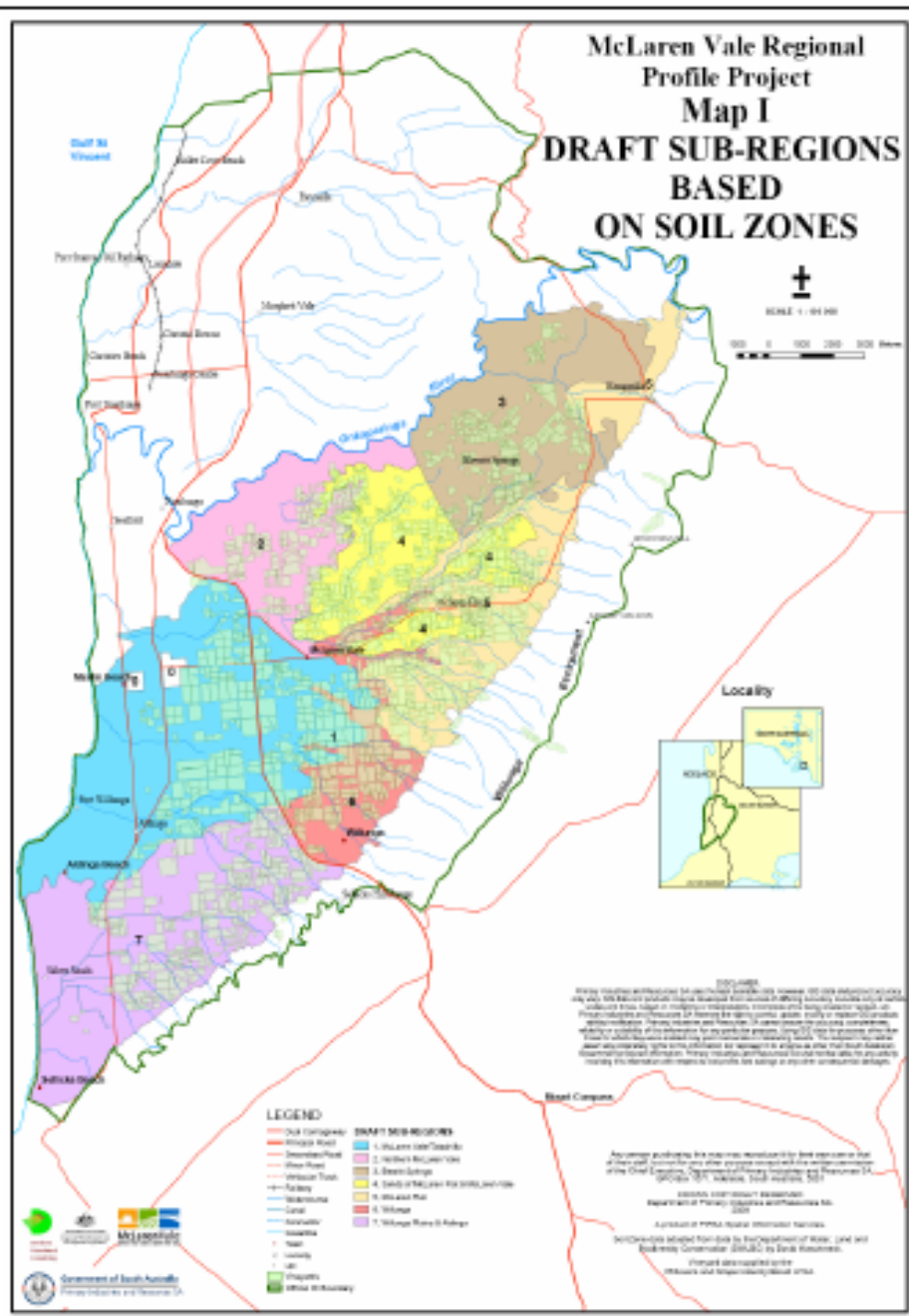


Figure 3. Vineyards with protected origin in Andornaktálya (Eger wine-growing region) Superior: Wine growing sites with more than 300 points. Wine: Bull's blood of Eger superior: Kékfrankos, Kadarka, Portugeiser (Kékoportó) Blauburger, Kék medoc, Zweigelt, Cabernet franc, Cabernet Sauvignon, Merlot, Pinot noir in accordance with Regulation of FVM No. 130/2003 (XII.31.)

Martinovich, L., Katona, Z., Szenteleki, K., & Boto, E. P. (2010). *Updating the Evaluation of Hungarian Wine Producing Fields Using the National GIS Register (VINGIS)* 6pp. Retrieved June 15, 2010, from VINGIS: Managing Hungary's vineyards with Open Source:

http://www.oiv2007.hu/documents/viticulture/Hungarian_wine_GIS_register_VINGIS_OIV_jav_POSTER.pdf:5



“The winery Clarendon Hills is famous for making Blewitt Springs wines and selling them for super prices in the US market”

Topography and ripening patterns

wine fight club. (2010:3) Retrieved from

www.lazyballerina.com/Winefightclub/winefightclubJul07.pdf

	McLaren Vale (Main Rd)	Willunga	McLaren Vale (Strout Rd)	McLaren Flat	Seaview	Kangarilla - Clarendon	Blewitt Springs	Aldinga
Ave	22.12	22.99	22.23	21.14	20.95	21.42	22.01	22.92

The Table shows the Mean January Temperature (MJT) and how it changes across the region. In McLaren Vale vineyard that are close to the ocean are warmer (and ripen earlier). Mean January Temperature is a simple way to describe the weather conditions that grapes experience before harvest.

Should McLaren Vale's differences be explained and celebrated or is in enough to know the whole area is a good wine region?

Grape variety block boundaries overlaid onto a soil map for Inkameep vineyard in Vaseaux – Oliver

Type of soil (textural class) :

depth to bedrock; surface stoniness; texture (resulting from the size distribution of mineral particles); perviousness class; drainage class; depth to root restriction; shear strength; permeability; pH; salinity class and cation exchange capacity

Geology and Wine 10: Use of Geographic Information System Technology to Assess Viticulture Performance in the Okanagan and Similkameen Valleys, British Columbia Volume 32, Number 4 (2005)
<http://journals.hil.unb.ca/index.php/gc/article/view/2718/3167>

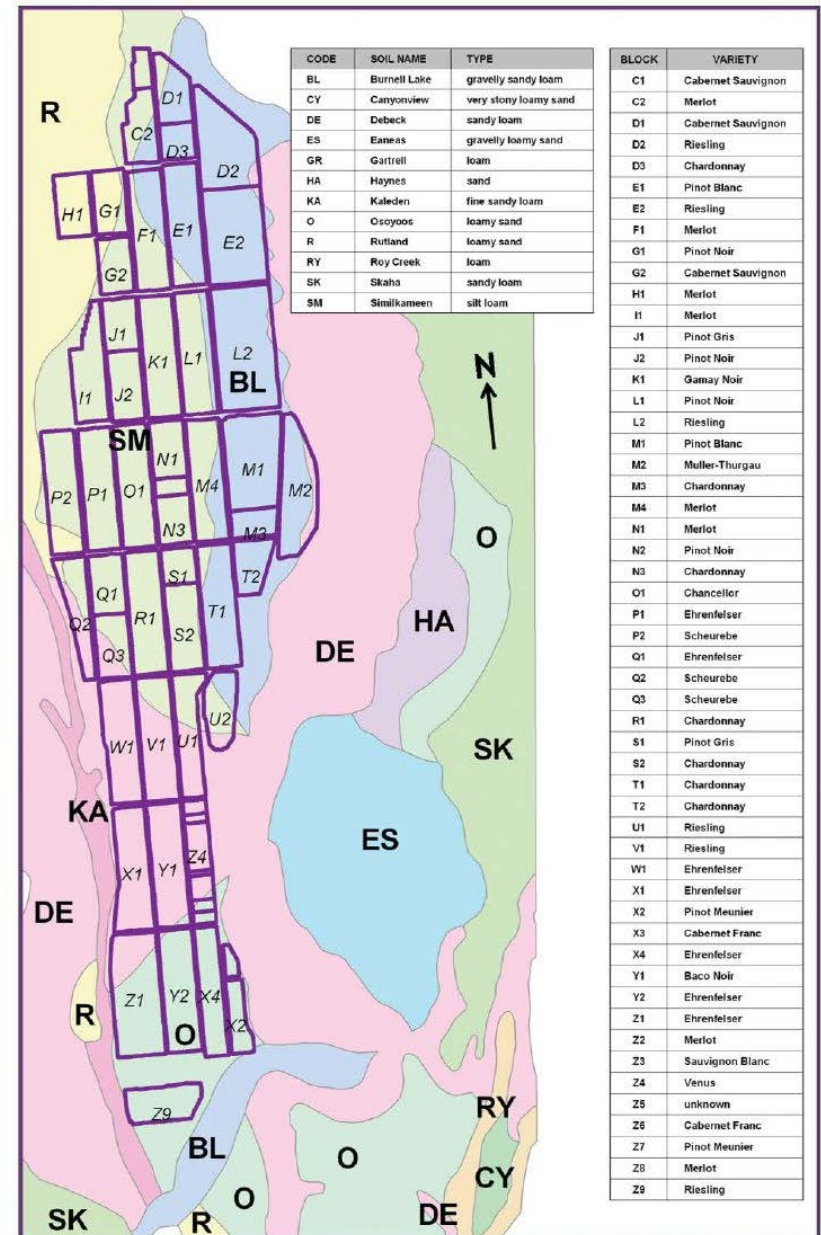


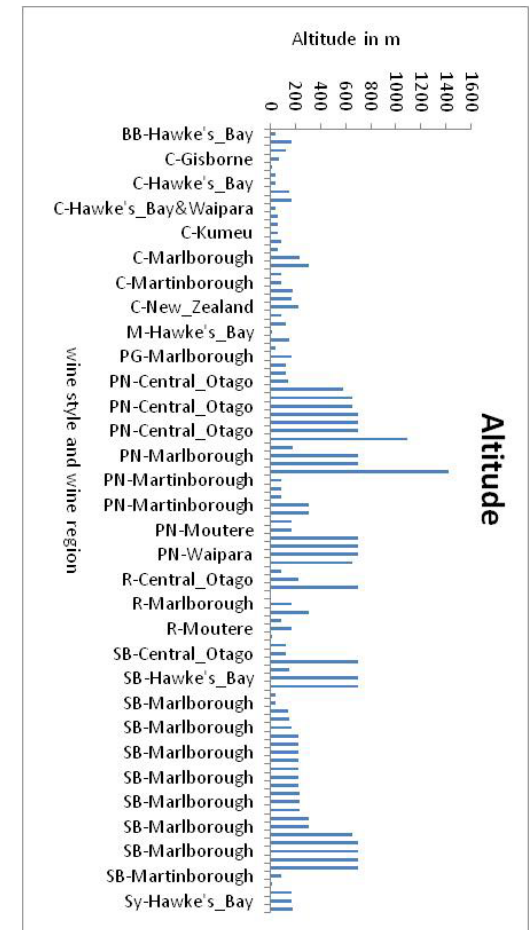
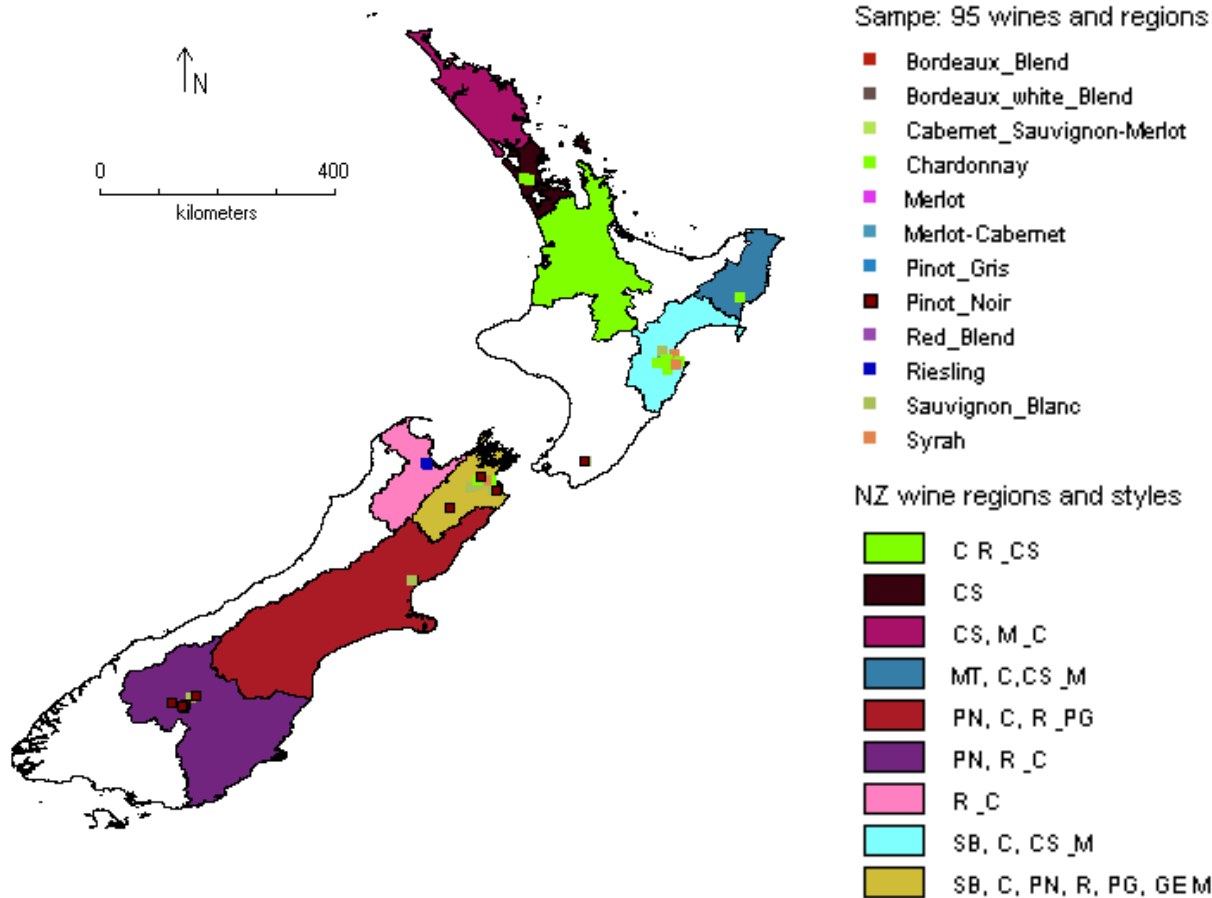
Figure 3. Grape variety block boundaries overlaid onto a soil map for Inkameep vineyard in Vaseaux – Oliver (Region 3). Type of soil (textural class) for each series is shown in the inset at top centre.

independent Vs dependent factors

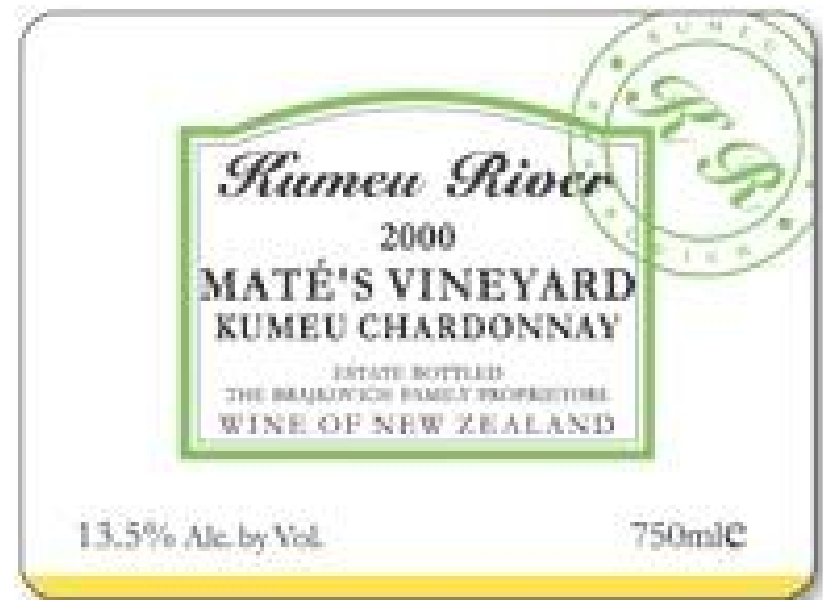
Methods used

- Vector (Point, Polygon ...)
- Raster

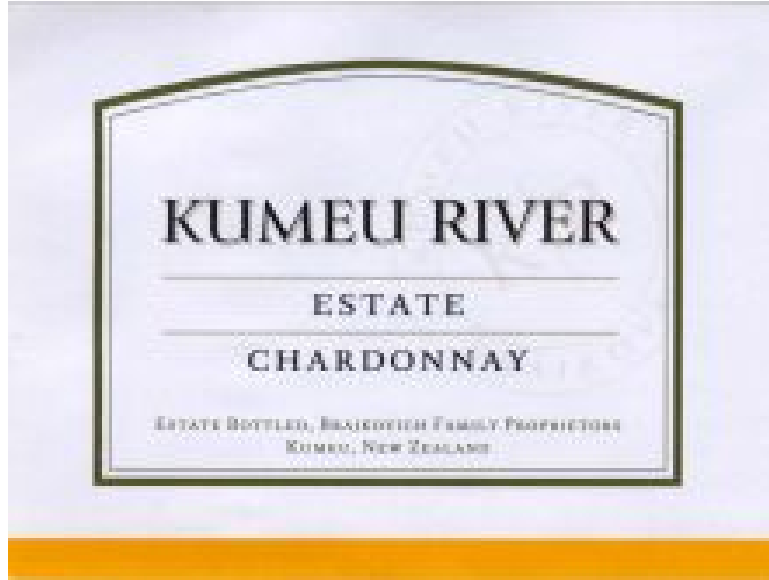
Point based



Wine labels



Vintages and sommelier comments



750ml Kumeu River Estate Chardonnay Auckland
The 2007 vintage was terrific and produced wonderful **Chardonnay** throughout the entire Kumeu River stable. The Estate Chardonnay from this vintage is **ripe, rich and beautifully** concentrated. The **beautiful peach** and **hazelnut aromas** along with the **rich silky texture** are **distinct characteristics** that we expect to see from this wine. Cellar to 2011/2012.

http://www.nzwineonline.com.au/content_common/pr-new-zealand-chardonnay_new-zealand-white-wine-kumeu-river-estate-auckland-chardonnay.seo

Text mining ; Sommelier comments

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Editors' Choice!

WineEnthusiast.com

 **WINEENTHUSIAST** 90 points
MAGAZINE

Viu Manent 2007 Reserva Chardonnay (Casablanca Valley)

For a first effort from Casablanca, Viu Manent has hit a home run. This wine is a classic New World Chard, meaning it's liberally oaked, vibrant, ripe and full of tropical fruit. But along with the obvious there are also notes of cinnamon, mineral, exotic apple and butterscotch. Imported by Baystate Wine Co. — **M.S.** Published 7/1/2008

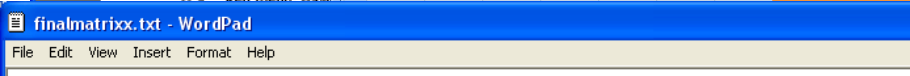
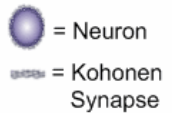
Best Buy!

WineEnthusiast.com

 **WINEENTHUSIAST** 90 points
MAGAZINE

Undurraga 2005 Aliwen Reserva Chardonnay (Central Valley)

This new wine from a venerable Chilean producer scores points all over the map. The nose is a smooth ride of white fruits and cleanliness, while the mouth pulsates with pear, green

[illegible]

Pinot Noir – Canterbury 1998-2004

C 1: sour, length, flower, mint, mellow youth, hot mocha success, chalky, muscular purpl, molass, anis approach char cranberri deep group integr raspberri roast strawberri wood, open, cook jammi, disjoint flabbi forest hollow inki neutral robust, characterist, woodi, apricot, citric, cashew fragrant ginger, auster bacon develop lactic licoric oliv rhubarb rubi, orang, dessert, coconut dill golden, gentl rough, astring leafi, guava menthol, leesi, leaf tomato, aromat oili round, blossom currant grass harmoni sharp thick ting warm, bean capsicum luscious opul sweati viscou, almond cloi hai medicin quinc syrapi, bark butterscotch cut hazelnut slight thin tree, banana mango pure, aggress bitter distinct fat fleshy flinti hard live lyche perfum petal rose steeli tight variet young

C 2: raci, concentr, pea, fig zesti, asparagu

C 3: chocol, dark, tea, coffe dusti earthi meaty mushroom, tannic, blackberri, cinnamon clove, cedar, brown leather persist readi syrah velvety

C 4: bake, oaki, alcohol floral lemon linger spici, delic fine heavi modest, ag ampl caramel gri subtl, nutti power strong

C 5: balanc, honei, riesl, appl, sweet

C 6: grassi, lean simpl, pink, pungent

C 7: citru, lime, melon, refresh

C 8: white, nectarin

C 9: soft solid veget winemak, bai bottl herbac

C 10: firm structur

C 11: black cola noir pinot plum silki tannin vintag, smoki, berri red

C 12: gooseberri, acid bright fruiti intens

C 13: cabernet merlot smooth suppl, dri

C 14: eleg layer smoke, complex tobacco

C 15: clean crisp fresh green herb light pepper tart, bodi medium tropic

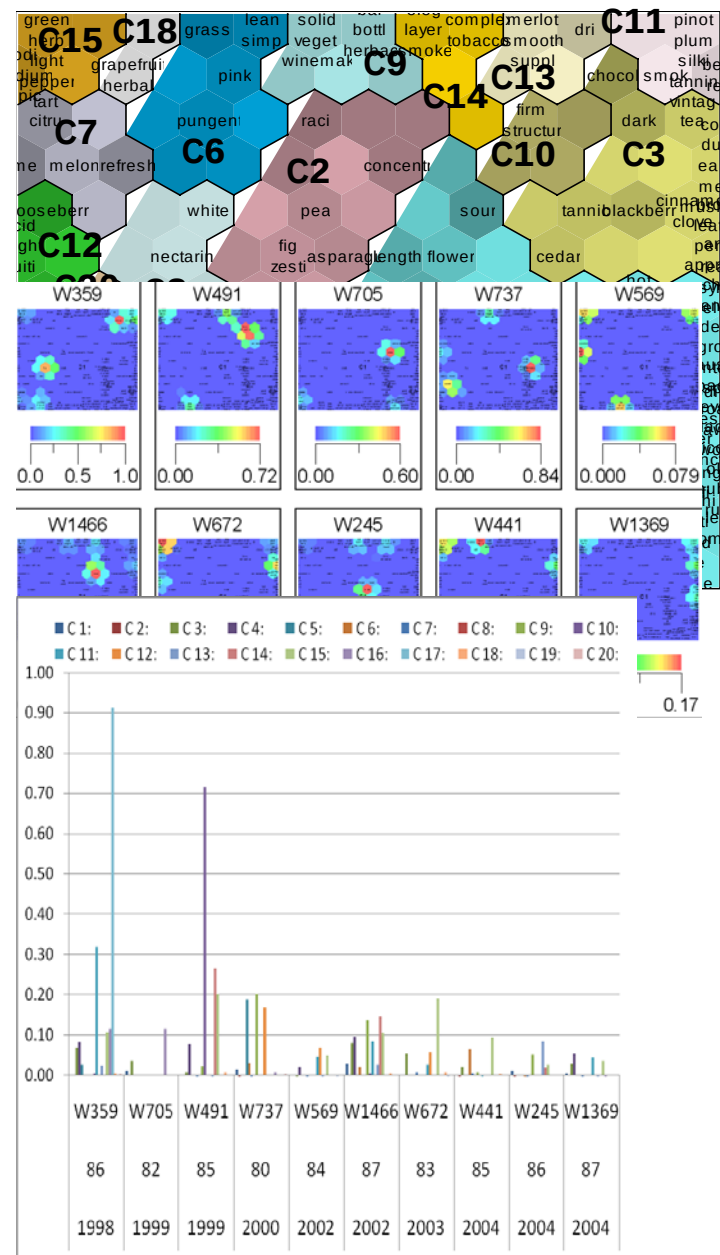
C 16: pear, chardonnai oak peach pineapple spice vanilla, butter toast

C 17: full

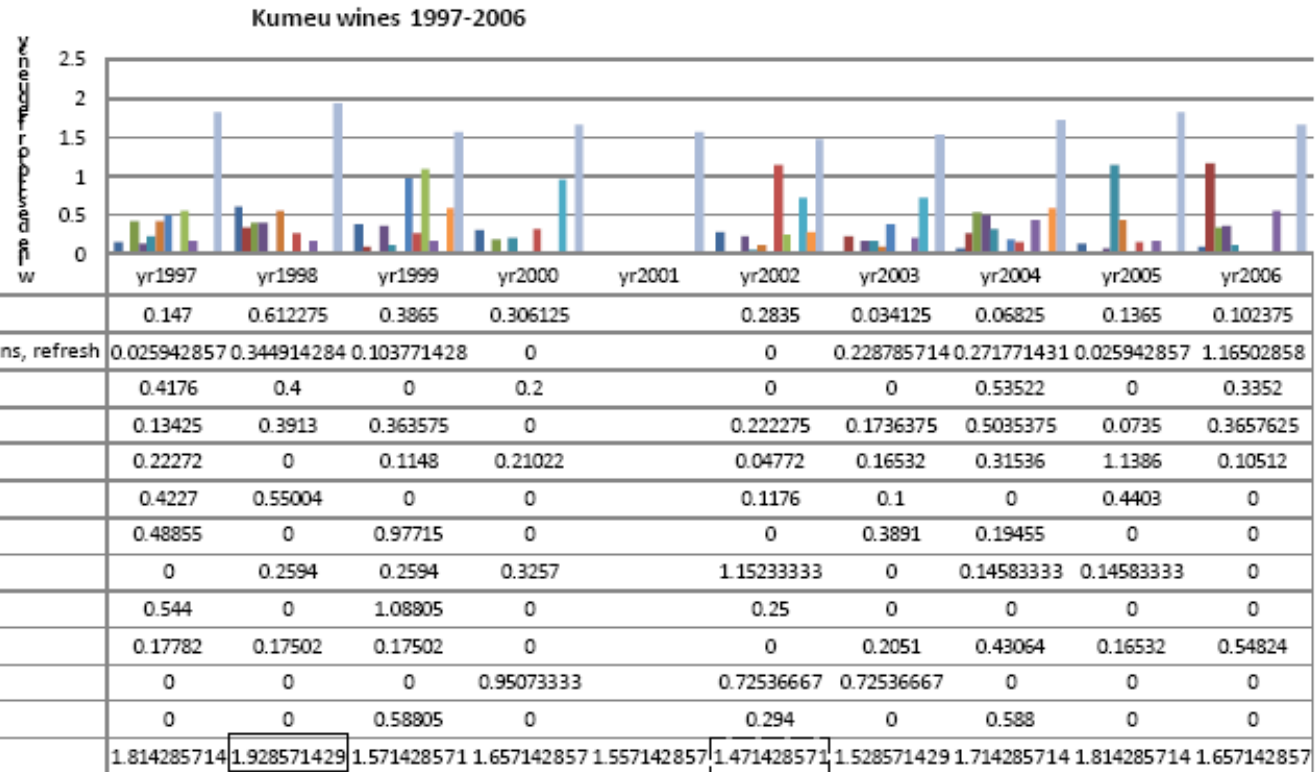
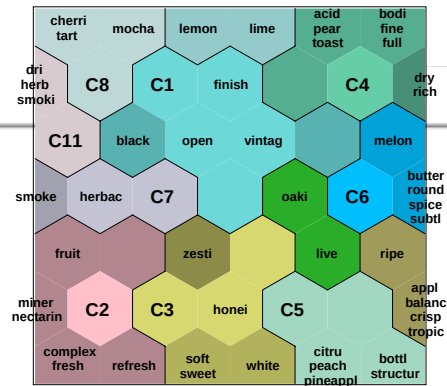
C 18: grapefruit herbal

C 19: dry miner rich

C 20: creami



Wine quality & climate data analysis



Observation on the graph is that year **1998** ^, the shows the highest ssd/meanT within the period analysed herein consists of high descriptor frequencies for clusters **C 2, C 3, C 6 and C 10** descriptors. Meanwhile, year **2002** with the lowest ssd/meanT consists of higher frequencies for **C 5, C 8 and C 11** descriptors. **Discriminant analysis** run on the data set produced **11 words (boxed in the left)** as contributing factors in determining the variable vintage (or year considered as a dependent variable on the 11 descriptors).

Statistical methods - discriminant

Variables Entered/Removed^{a,b,c,d} Step Entered Residual Variance

1	spice-42	29.138
2	sweet-45	22.022
3	pineappl-34	17.459
4	dri-12	13.715
5	complex-10	11.796
6	zesti-51	9.902
7	citru-9	7.384
8	fresh-16	5.851
9	open-31	5.038
10	tropic-48	3.675
11	structur-43	3.124

11 descriptors (from 30 Kumeu wine comments) found to be major contributing factors and their contribution in vintage-to-vintage variations within the period of 1997-2006.

Standardized Canonical Discriminant Function Coefficients Function

	1	2	3	4	5	6	7
citru-9	-2.473	.591	.211	.553	-.764	.604	-.950
complex-10	12.264	-1.558	1.124	1.146	-.768	.863	-.452
dri-12	-10.025	1.610	.192	.012	.424	-.011	.608
fresh-16	-7.063	.772	-.648	-.850	1.166	-.046	-.132
open-31	4.818	1.016	-.878	-.044	-.420	.389	-.321
pineappl-34	5.751	1.290	1.193	-1.262	-.019	.184	.192
spice-42	5.799	1.292	.821	.241	.202	.036	-.252
structur-43	-3.040	-1.417	-1.103	.493	.175	-.116	.535
sweet-45	-3.033	2.587	-.343	-.286	.750	-.457	.367
tropic-48	-1.467	-.170	1.220	.504	.094	.487	.319
zesti-51	7.981	-.342	-1.257	.084	-.171	.348	.116

Coefficients of 7 functions used in the prediction of 9 classes of wines vintage 1997-2006 (without 2001) show relative impact (positive, negative) of descriptors.

regional ratings against climate: NZ wine regions



<http://winefeeds.wordpress.com/2009/03/15/new-zealand-wine-region-map/>

Marlborough SB vintage (1996-2006) descriptors & ratings

(veget-111 ≥ 0.37) and (fruit-37 ≤ 0) and (fresh-36 ≤ 0.26)
 $\Rightarrow$ rate scale=low (11.0/3.0)

(asparagu-8 ≥ 0.6) and (fruit-37 ≤ 0) $\Rightarrow$ rate scale=low (7.0/2.0)

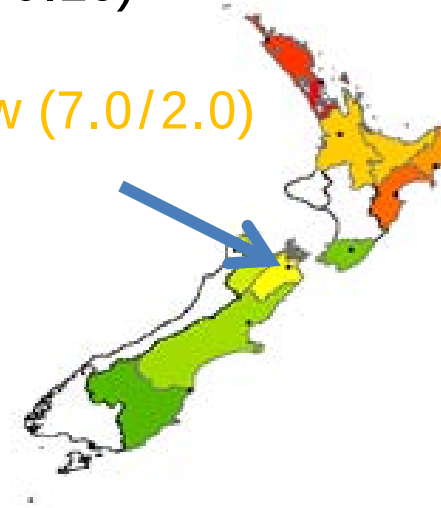
(sour-99 ≥ 0.94) $\Rightarrow$ rate scale=low (3.0/0.0)

(heavi-50 ≥ 0.9) $\Rightarrow$ rate scale=low (6.0/2.0)

(group-45 ≥ 0.84) $\Rightarrow$ rate scale=low (5.0/2.0)

(complex-22 ≥ 0.4) $\Rightarrow$ rate scale=high (24.0/10.0)

$\Rightarrow$ rate scale=med (325.0/71.0)



JRip rules show the correlations between Marlborough SB vintages and descriptors
381 Marlborough vintages was converted into matrix of 118 wine descriptors and
their rates transformed into

low <80 medium (med) >79 and <90 high >89 (100 point)

J48 *creami (creamy), bean, honei (honey), lime, melon, grassi (grassy), sweet, tropic, nectarine, eleg (elegant), apple, fruit, herbal, and linger.*

```
| | | | melon-68 <= 0
```

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| | fruit-37 > 0.05: med (11.0/2.0)
```

```
| linger-64 > 0: med (2.0)
```

Descriptors-Marlborough SB -j48



bean-12 > 0.75: low (2.0) veget-111 > 0: low (2.0)

fruit-37 <= 0.05: low (9.0/2.0) fresh-36 > 0: low (2.0)

honei-54 <= 0.49: med (278.0/57.0) finish-34 <= 0.1: med (4.0) bean-12
<= 0.75 lime-63 > 0: med (2.0) fruit-37 > 0.05: med (11.0/2.0) linger-
64 > 0: med (2.0)

finish-34 > 0.1: high (6.0/1.0) group-45 > 0 creami-25 > 0 melon-68 > 0:
high (2.0) tropic-109 > 0: high (3.0/1.0) lime-63 > 0: high (3.0/1.0)
sweet-104 > 0.52: high (2.0)grassi-43 > 0: high (2.0) melon-68 > 0:
high (3.0) nectarin-72 > 0: high (2.0) eleg-30 > 0: high (2.0)appl-5 > 0:
high (2.0)fruit-37 > 0.17: high (5.0) herbal-53 > 0.36: high (3.0)

NZ Chardonnay descriptors

Waipara

toast-8 ≤ 0.26

| citru-3 ≤ 0 : med (8.0/2.0)

| citru-3 > 0 : high (2.0/1.0)

toast-8 > 0.26 : high (3.0)

Gisborne

sweet-19 ≤ 0

| spice-18 ≤ 0

| | appl-1 ≤ 0.27 : med (28.0/7.0)

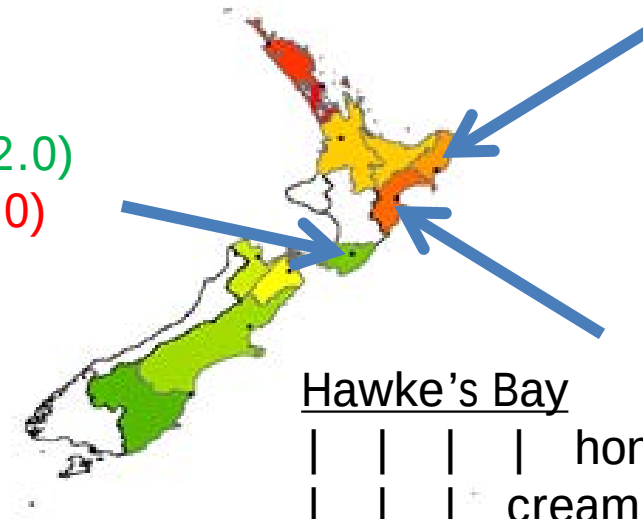
| | appl-1 > 0.27 : high (2.0)

| spice-18 > 0 : high (3.0/2.0)

sweet-19 > 0

| vanilla-23 ≤ 0 : med (3.0)

| vanilla-23 > 0 : low (3.0)



Hawke's Bay

| | | | honei-17 > 0 : high (2.0)

| | | | creami-9 > 0 : high (2.0)

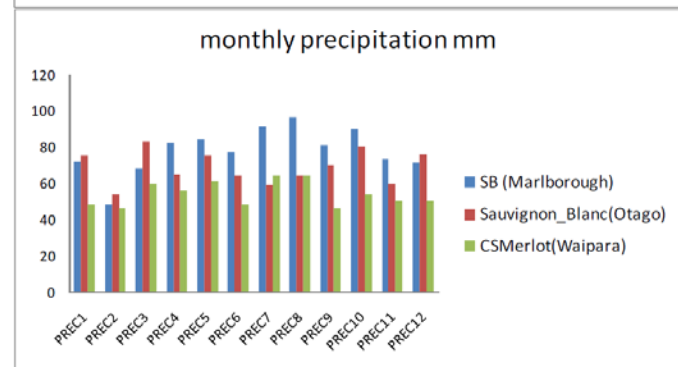
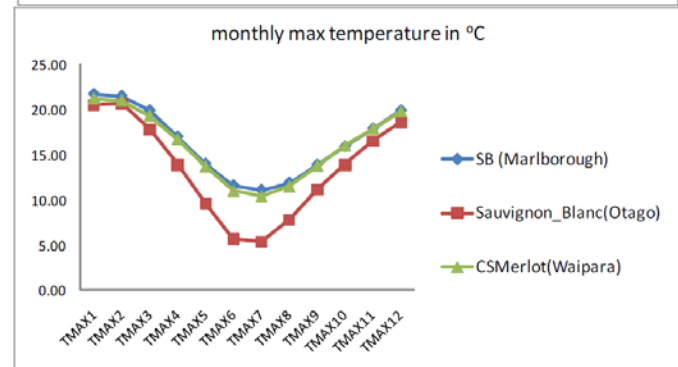
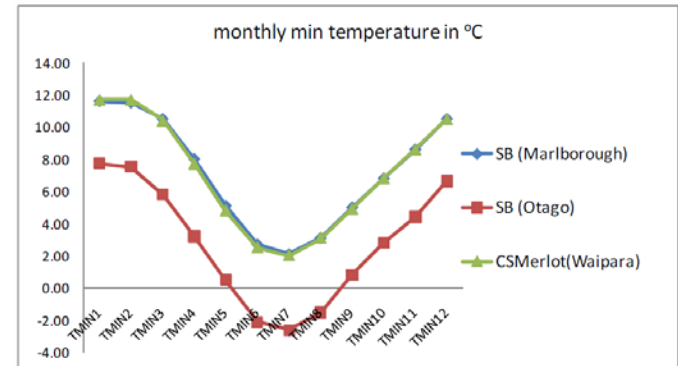
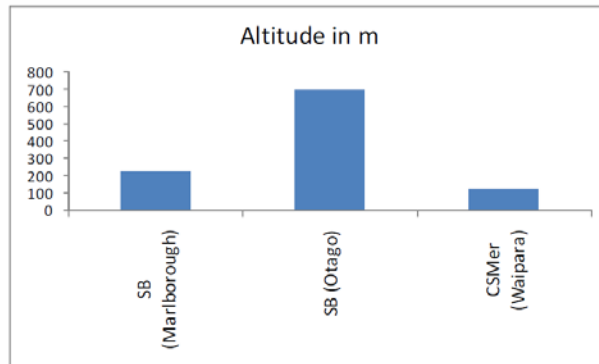
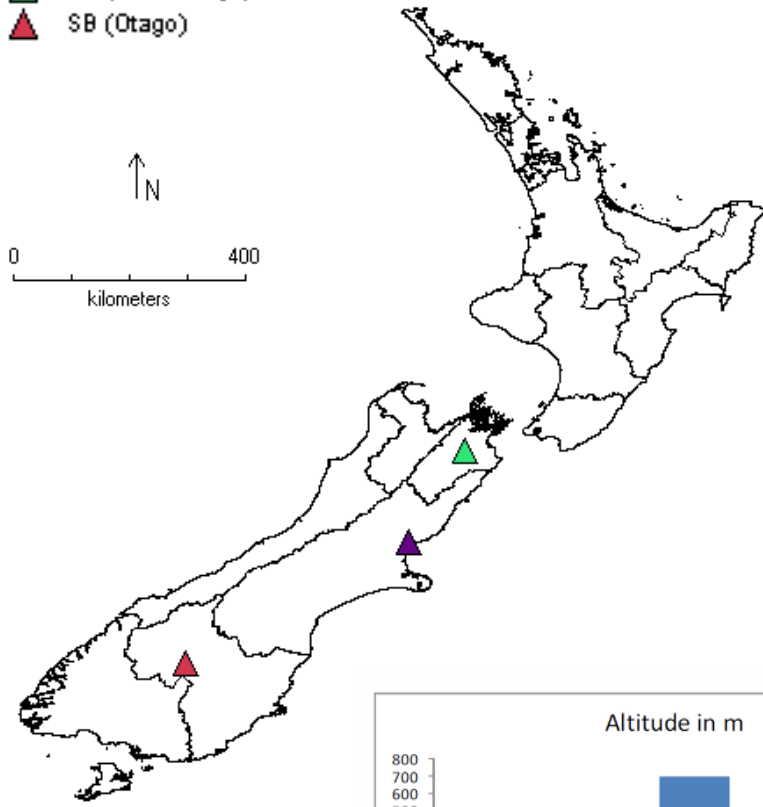
| | | | orang-23 > 0 : high (3.0)

| | | | ripe-28 > 0.23 : med (8.0/1.0)

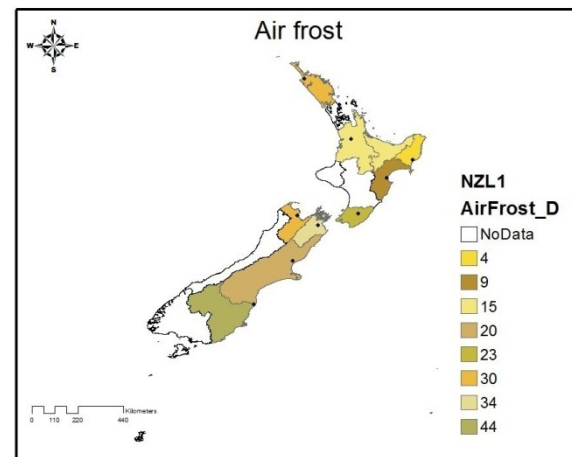
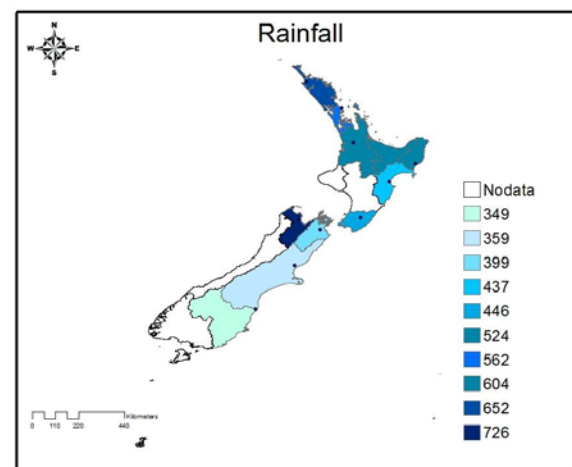
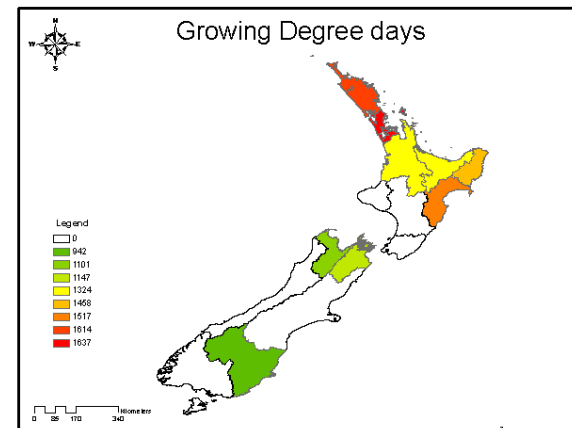
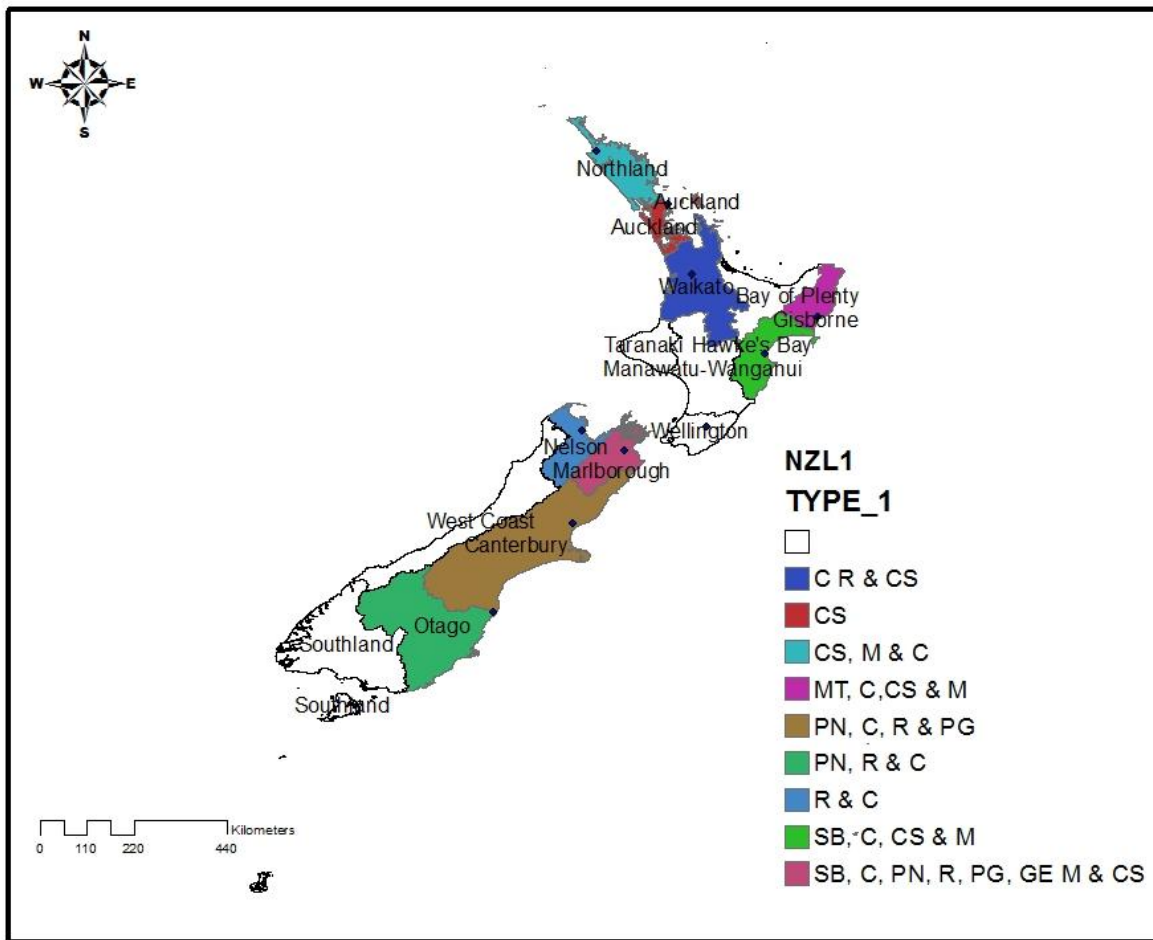
lime-19 > 0 : med (6.0/1.0)

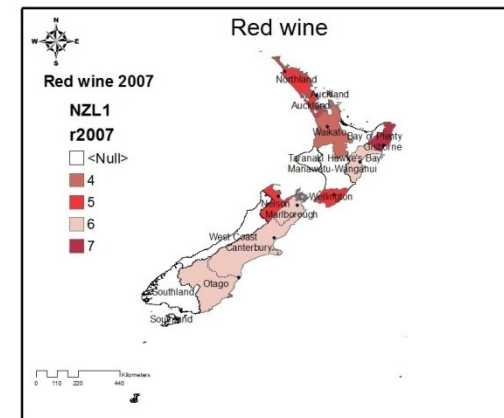
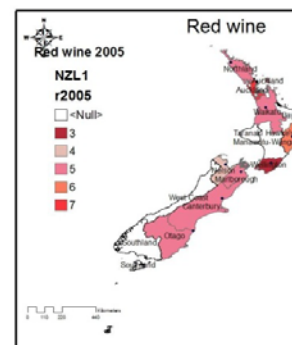
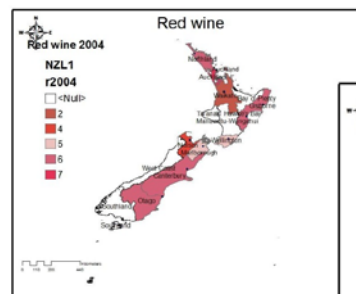
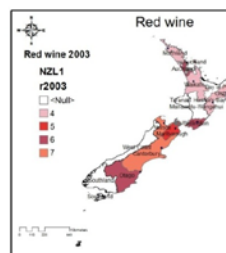
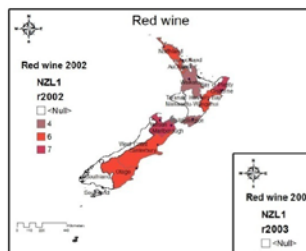
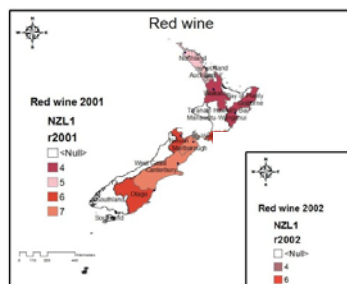
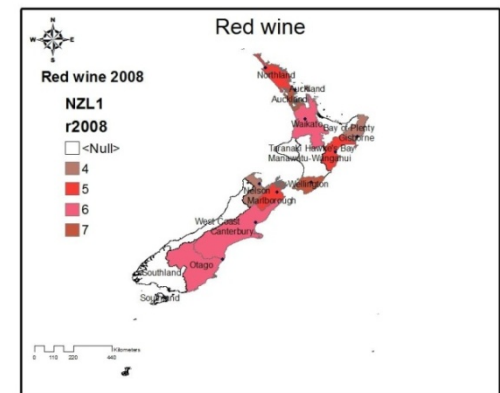
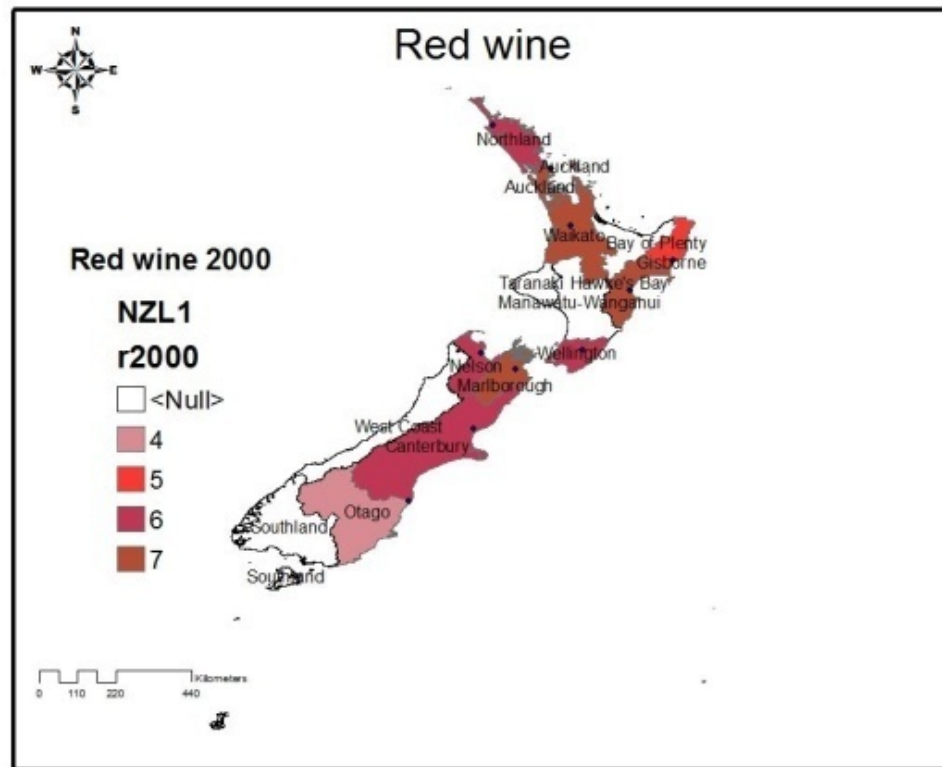
Point based

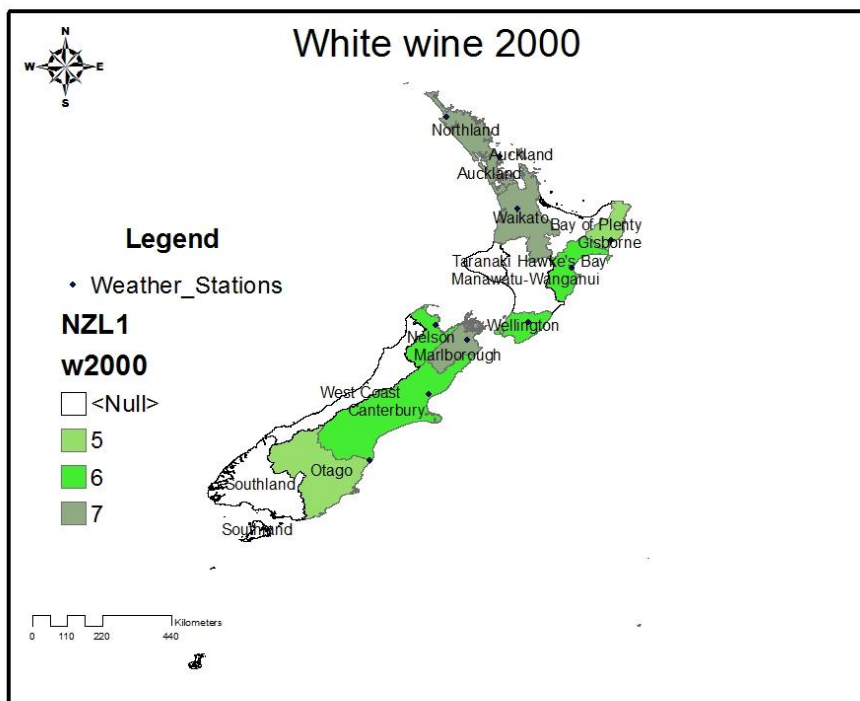
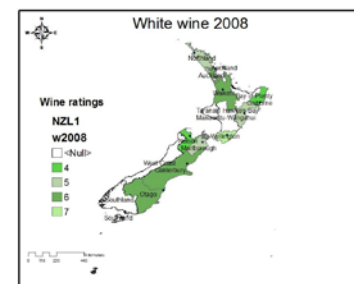
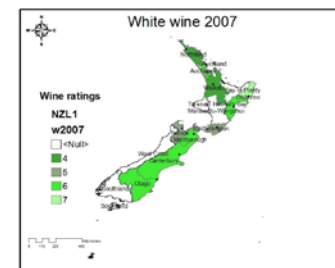
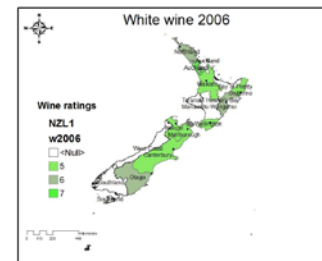
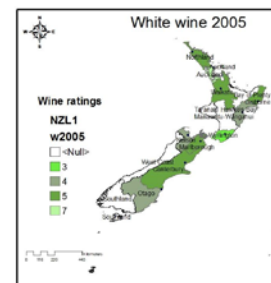
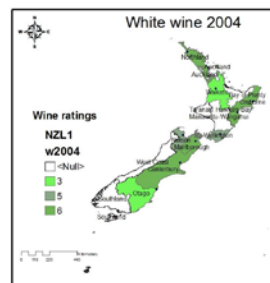
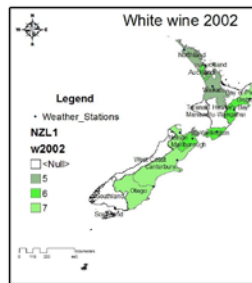
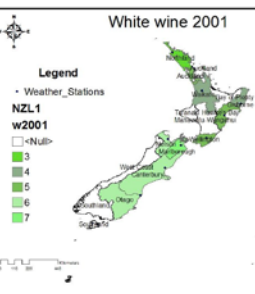
- ▲ CSMerlot (Waipara)
- ▲ SB (Marlborough)
- ▲ SB (Otago)



Polygon based @ the regional scale



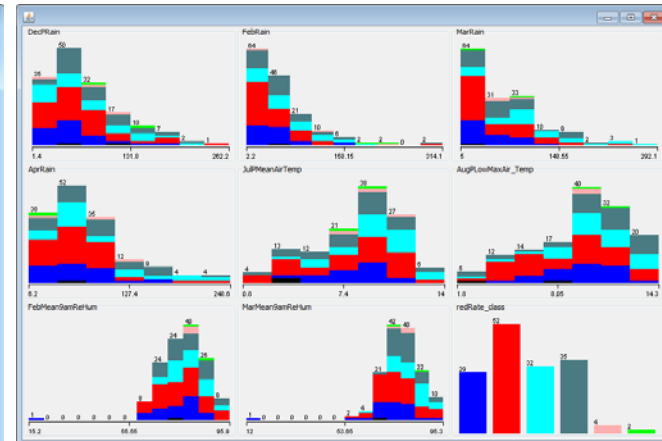
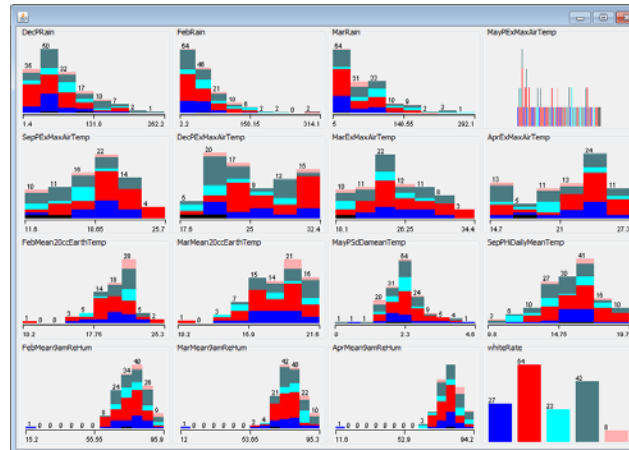




Polygon based

1. Rainfall
2. Mean Air Temperature
3. Extreme Maximum Air Temperature
4. Mean 20cc Earth Temperature
5. Mean 20cc Earth Temperature
6. Mean Vapour pressure
7. Growing degree days (GDD)
8. Days of Snow
9. Low Maximum Air Temperature
10. Standard (std) Day mean Temperature
11. Low Daily Mean Temperature
12. High (hi) Daily Mean Temperature
13. Mean 9 am Relative Humidity (RH)
14. Mean 9 am Temperature

wine	variable	F	sig	wine	variable	F	sig
white	Dec rainfall	9.113	0.003	red	Dec rainfall	5.381	0.022
	Feb rainfall	4.061	0.046		Feb rainfall	6.960	0.009
	March rainfall	11.906	0.001		March rainfall	19.581	0
	May extreme Max air T	6.473	0.013		April rainfall	6.127	0.014
	Sep extreme Max air T	12.233	0.001		July mean air T	4.527	0.035
	Dec extreme Max air T	5.792	0.019		Aug low Max air T	6.719	0.011
	Mar extreme Max air T	4.470	0.038		Feb mean 9am RH	6.038	0.015
	April extreme Max air T	6.750	0.011		March mean 9am RH	12.803	---
	Feb mean 20cc Earth T	4.744	0.032				
	March mean 20cc Earth T	4.020	0.048				
	May std daily mean T	3.971	0.048				
	Sep high daily mean T	7.938	0.006				
	Feb mean 9am RH	4.965	0.027				
	March mean 9am RH	13.710	---				
	April mean 9am RH	7.479	0.007				



@ the regional scale

wine rating and independent variables

region	rate	rule No	Condition 1	Condntion 2	Condition 3	Condition 4
Auckland 1	5	2/11	Mar mean 9am RH > 72.8	Mar mean 9am RH <= 81.9	Aug low max air temp > 12.7	
	5	3/11	Mar mean 9am RH > 72.8	Mar mean 9am RH > 81.9		
	6	4/12	Mar mean 9am RH > 72.8	Mar mean 9am RH <= 81.9	Aug low max air temp <= 12.7	Mar mean 9am RH > 80.6
	7	1/9	Mar mean 9am RH <= 72.8			
	7	7/9	Mar mean 9am RH > 72.8	Mar mean 9am RH <= 81.9	Aug low max air temp <= 12.7	Mar mean 9am RH <= 80.6
Caterbury 2	4	1/7	Mar mean 9am RH <= 72.8	FebRain > 62		
	4	2/7	Mar mean 9am RH > 72.8	DecPRain > 83.6		
	6	1/12	Mar mean 9am RH <= 72.8	FebRain <= 62	FebRain <= 40.8	
	6	5/12	Mar mean 9am RH > 72.8	DecPRain <= 83.6	FebRain > 18.6	
	7	2/9	Mar mean 9am RH <= 72.8	FebRain <= 62	FebRain > 40.8	
	7	8/9	Mar mean 9am RH > 72.8	DecPRain <= 83.6	FebRain <= 18.6	
Gisborne 3	4	3/7	Mar mean 9am RH > 72.8	JulPMeanAirTemp > 8.9	DecPRain <= 54.8	
	5	4/11	Mar mean 9am RH > 72.8	JulPMeanAirTemp > 8.9	DecPRain > 54.8	
	6	6/12	Mar mean 9am RH > 72.8	JulPMeanAirTemp <= 8.9		
	7	3/9	Mar mean 9am RH <= 72.8			
Hawkes Bay 4	4	4/7	Mar mean 9am RH > 72.8	FebRain > 47.8		
	5	5/11	Mar mean 9am RH > 72.8	FebRain <= 47.8	Aug low max air temp > 10.1	
	6	2/12	Mar mean 9am RH <= 72.8	DecPRain > 38.4		
	6	7/12	Mar mean 9am RH > 72.8	FebRain <= 47.8	Aug low max air temp <= 10.1	
	7	4/9	Mar mean 9am RH <= 72.8	DecPRain <= 38.4		
Marlborough 5	4	5/7	Mar mean 9am RH > 72.8	MarRain > 68		
	5	6/11	Mar mean 9am RH > 72.8	MarRain <= 68		
	7	5/9	Mar mean 9am RH <= 72.8			
Nelson 6	4	6/7	Mar mean 9am RH > 72.8	MarRain > 113		
	5	7/11	Mar mean 9am RH > 72.8	Aug low max air temp > 10		
	6	8/12	Mar mean 9am RH > 72.8	Aug low max air temp <= 10		
	7	6/9	Mar mean 9am RH <= 72.8			
Northland 7	4	7/7	Mar mean 9am RH > 72.8	MarRain > 33.7	Mar mean 9am RH <= 88.1	MarRain > 62.2
	5	8/11	Mar mean 9am RH > 72.8	MarRain <= 113	MarRain > 84.8	
	6	9/12	Mar mean 9am RH > 72.8	MarRain <= 113	MarRain <= 84.8	
Waikato 8	2	1/1	Mar mean 9am RH > 72.8	MarRain <= 33.7		
	3	1/2	Mar mean 9am RH <= 72.8			
	5	9/11	Mar mean 9am RH > 72.8	MarRain > 33.7	Mar mean 9am RH <= 88.1	MarRain <= 62.2
Wairarapa 9	3	2/2	Mar mean 9am RH > 72.8	DecPRain > 102.6		
	5	10/11	Mar mean 9am RH > 72.8	DecPRain <= 102.6	Mar mean 9am RH <= 80	
	6	10/12	Mar mean 9am RH > 72.8	MarRain > 33.7	Mar mean 9am RH > 88.1	
	6	11/12	Mar mean 9am RH > 72.8	DecPRain <= 102.6	Mar mean 9am RH > 80	Mar mean 9am RH <= 86.9
	7	9/9	Mar mean 9am RH > 72.8	DecPRain <= 102.6	Mar mean 9am RH > 80	Mar mean 9am RH > 86.9
Otago 10	5	1/11	Mar mean 9am RH <= 72.8	FebRain > 36.6		
	5	11/11	Mar mean 9am RH > 72.8	FebRain <= 57.2		
	6	3/12	Mar mean 9am RH <= 72.8	FebRain <= 36.6		
	6	12/12	Mar mean 9am RH > 72.8	FebRain > 57.2		

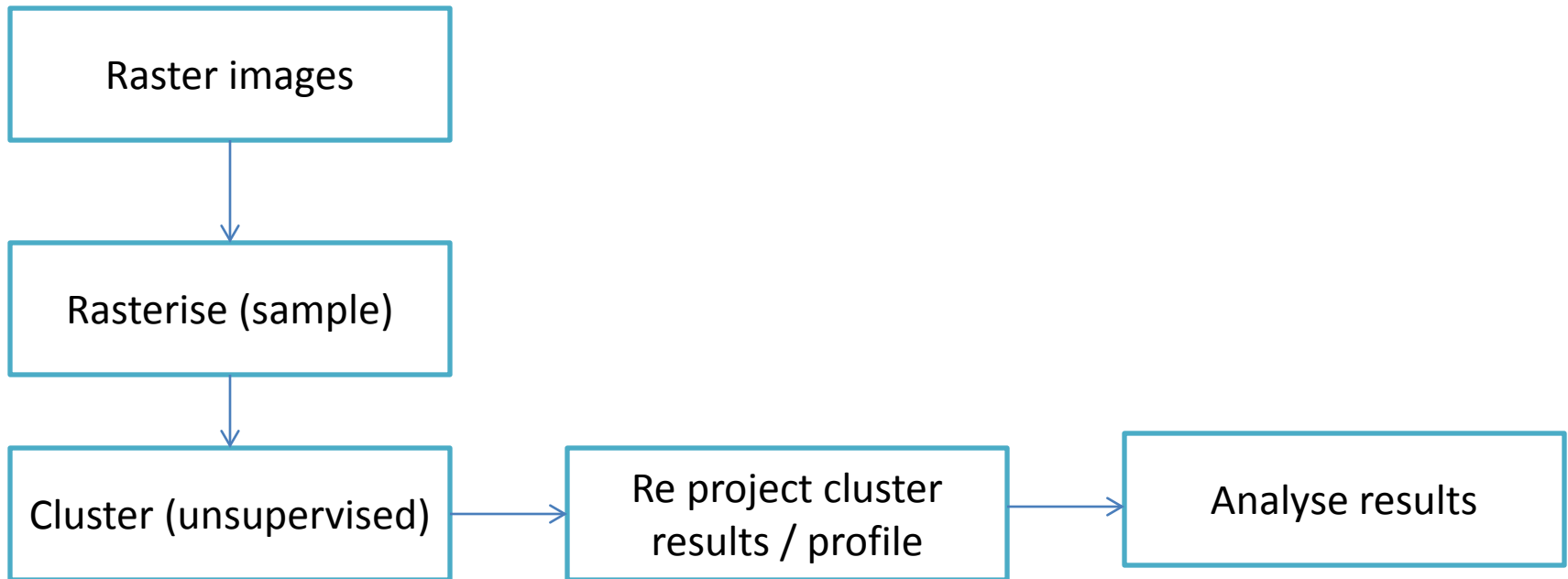
region	rate	rule No	Condition 1	Condntion 2	Condition 3	Condition 4		
		6	1/10	Feb rain <= 18.5				
Auckland 1	4	1/7	Feb rain > 15.8	Feb mean 9am RH <= 85.5	Sep hi dmean temp <= 15.2			
	5	1/11	Feb rain > 15.8	Feb mean 9am RH > 85.5				
	6	2/10	Feb rain > 15.8	Feb mean 9am RH <= 85.5	Sep hi dmean temp > 15.2	Mar Ex max air temp <= 24.8		
	7	1/6	Feb rain > 15.8	Feb mean 9am RH <= 85.5	Sep hi dmean temp > 15.2	Mar Ex max air temp > 24.8		
Caterbury 2	4	2/7	Feb rain > 15.9	Sep hi dmean temp <= 14.2	Sep Ex max air temp > 20.9			
	5	2/11	Feb rain > 15.8	Sep hi dmean temp <= 14.2	Sep Ex max air temp <= 20.10			
	6	3/10	Feb rain > 15.8	Sep hi dmean temp > 14.2	Mar mean 9am RH > 67.3			
	7	2/6	Feb rain > 15.8	Sep hi dmean temp > 14.2	Mar mean 9am RH <= 67.3			
Gisborne 3	4	3/7	Feb rain > 15.8	Mar mean 9am RH > 76.9	Feb rain > 37.6			
	5	3/11	Feb rain > 15.8	Mar mean 9am RH > 76.10	Feb rain <= 37.6			
	6	4/10	Feb rain > 15.8	Mar mean 9am RH <= 76.10	Mar mean 9am RH > 73.2			
Hawkes Bay 4	7	3/6	Feb rain > 15.8	Mar mean 9am RH <= 76.10	Mar mean 9am RH <= 73.2			
	4	4/7	Feb rain > 15.8	Apr mean 9am RH <= 77.3	Sep hi dmean temp <= 17			
	5	4/11	Feb rain > 15.8	Apr mean 9am RH > 77.3	Sep hi dmean temp <= 17			
	6	5/10	Feb rain > 15.8	Apr mean 9am RH <= 77.3	Sep hi dmean temp > 17			
Marlborough 5	7	4/6	Feb rain > 15.8	Apr mean 9am RH > 77.3	Sep hi dmean temp <= 15.1			
	3	1/3	Feb rain > 15.8	Apr ex max air temp <= 22.8				
	5	5/11	Feb rain > 15.8	Apr Ex max air temp > 22.8	Mar Ex max air temp <= 26	Sep Ex max air temp > 15.8		
	6	6/10	Feb rain > 15.8	Apr Ex max air temp > 22.8	Mar Ex max air temp <= 26.7			
Nelson 6	7	5/6	Feb rain > 15.8	Apr Ex max air temp > 22.8	Mar Ex max air temp > 26.7	Sep Ex max air temp > 15.8		
	5	6/11	Feb rain > 15.8	Mar mean 20cc Earth temp <= 18.6				
Northland 7	6	7/10	Feb rain > 15.8	Mar mean 20cc Earth temp > 18.6				
	3	2/3	Feb rain > 15.8	Mar mean 20cc Earth temp > 19	Dec rain <= 123.6	Mar rain > 46.6	Maysd dmean temp <= 1.4	
	3	3/3	Feb rain > 15.8	Mar mean 20cc Earth temp > 19	Dec rain <= 123.6	Mar rain > 46.6	Maysd dmean temp > 1.4	Dec rain > 79.4
	4	5/7	Feb rain > 15.8	Mar mean 20cc Earth temp > 19	Dec rain < 123.6	Mar rain > 46.6	Maysd dmean temp > 1.4	Dec rain <= 79.4
	5	7/11	Feb rain > 15.8	Mar mean 20cc Earth temp > 19	Dec rain <= 123.6	Mar rain <= 46.6		
Waikato 8	5	8/11	Feb rain > 15.8	Mar mean 20cc Earth temp > 19	Dec rain > 123.6			
	6	8/10	Feb rain > 15.8	Mar mean 20cc Earth temp <= 19.5				
	4	6/7	Feb rain > 15.8	Sep hi dmean temp > 15.3				
Wairarapa 9	5	9/11	Feb rain > 15.8	Sep hi dmean temp <= 15.3				
	5	10/11	Feb rain > 15.8	Feb rain > 57.2	Feb mean 9am RH <= 83.4			
	6	9/10	Feb rain > 15.8	Feb mean 9am RH > 83.4				
Otago 10	7	6/6	Feb rain > 15.8	Feb rain <= 57.2				
	4	7/7	Feb rain > 15.8	Apr mean 9am RH > 77				
	5	11/11	Feb rain > 15.8	Mar mean 9am RH <= 77	Apr Ex max air temp <= 16.3			
	6	10/10	Feb rain > 15.8	Mar mean 9am RH <= 77	Apr Ex max air temp > 16.3			

Auckland: August low maximum (max) air temperate. Other regions December, February and March monthly total rainfall as deterministic factors

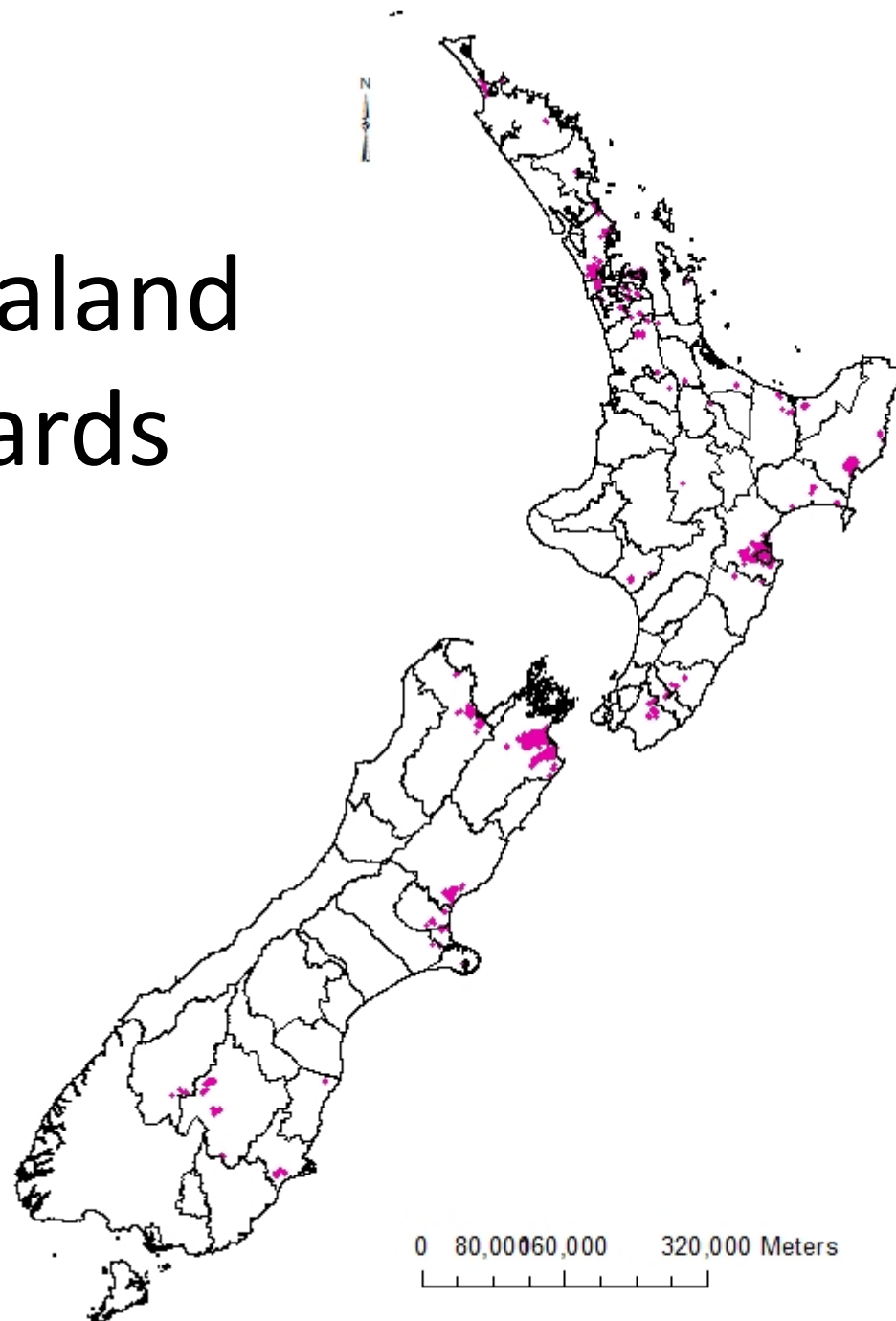
red wine regional rating is March mean 9 am relative humidity (RH)

RASTER BASED

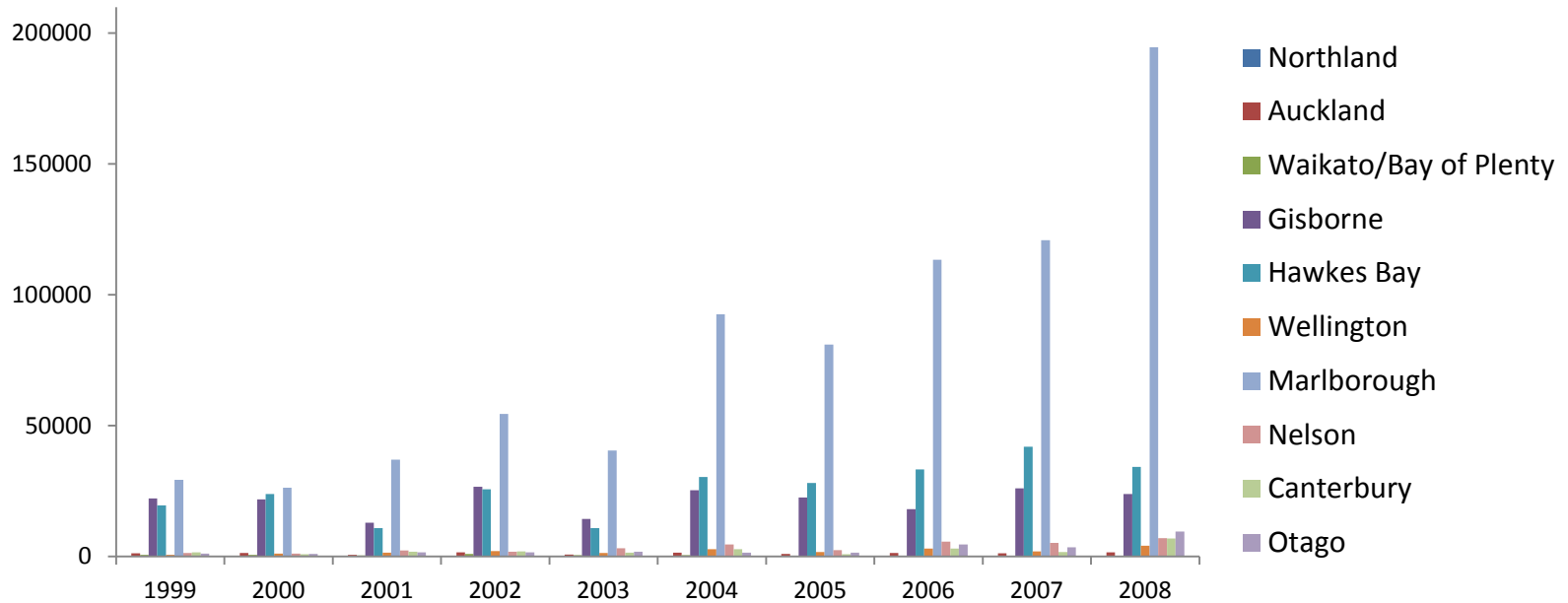
The methodology



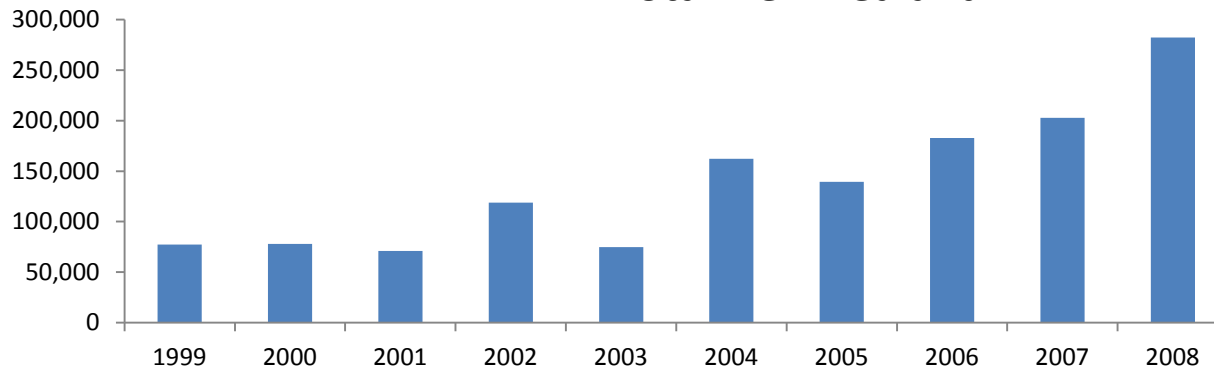
New Zealand Vineyards



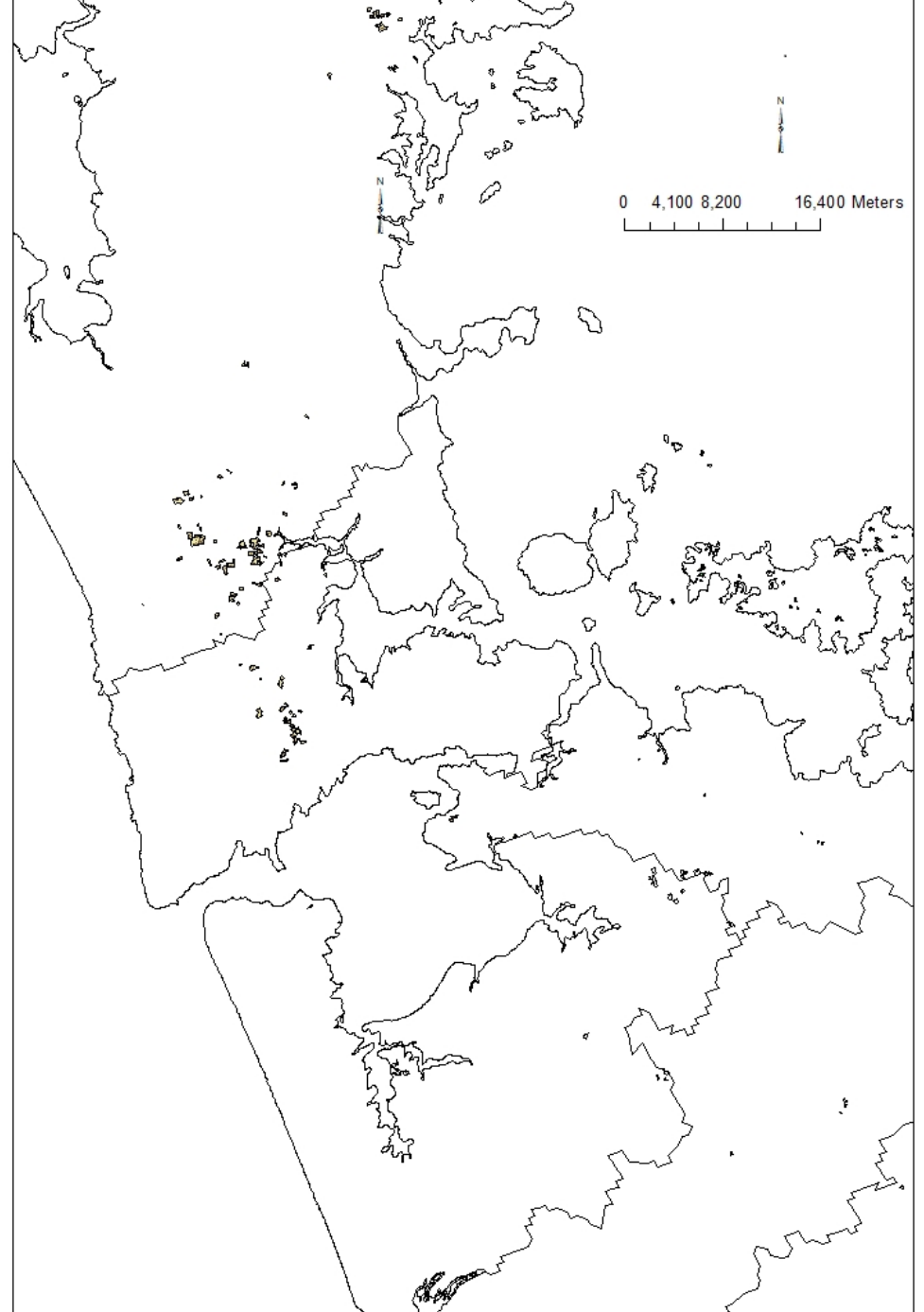
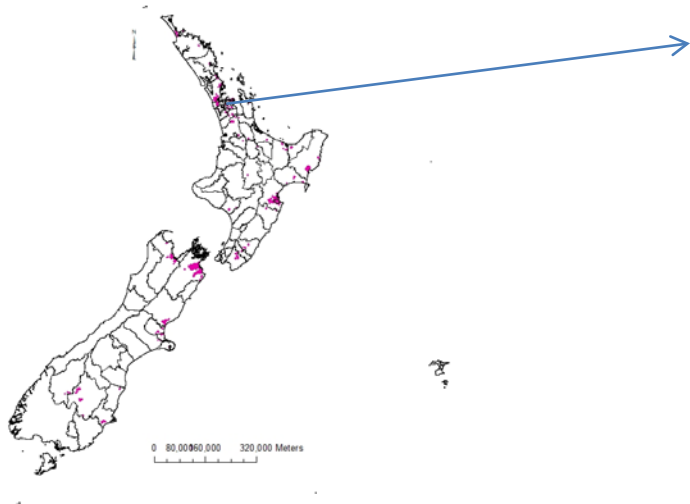
by Region (tonnes crushed)



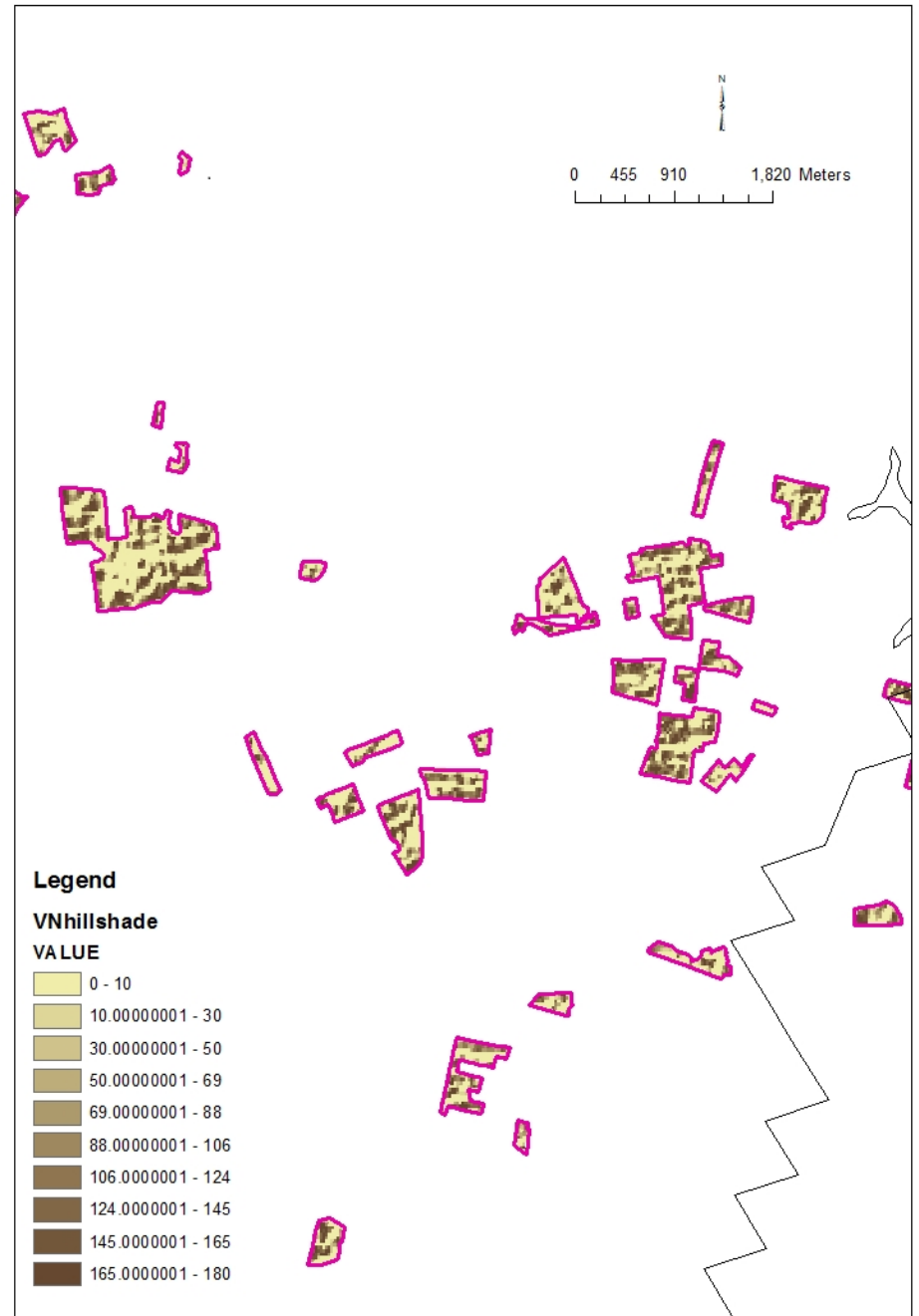
Total New Zealand



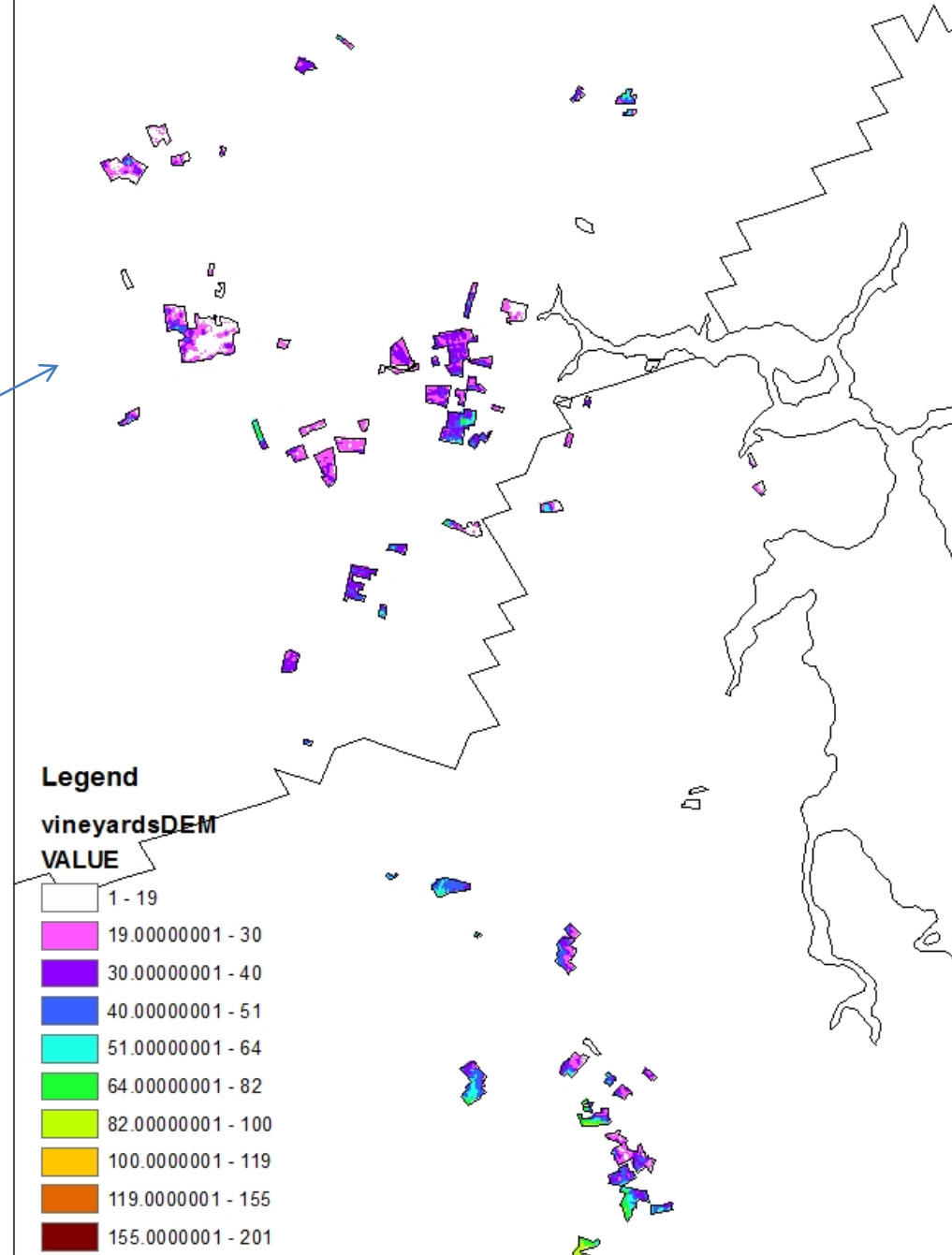
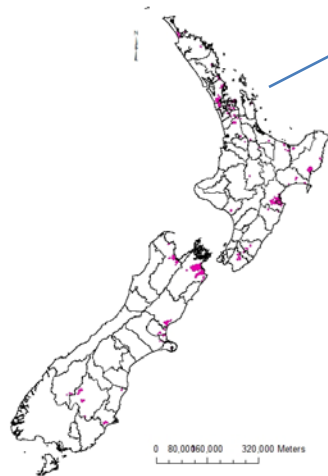
Digital Elevation Map DEM hill shade

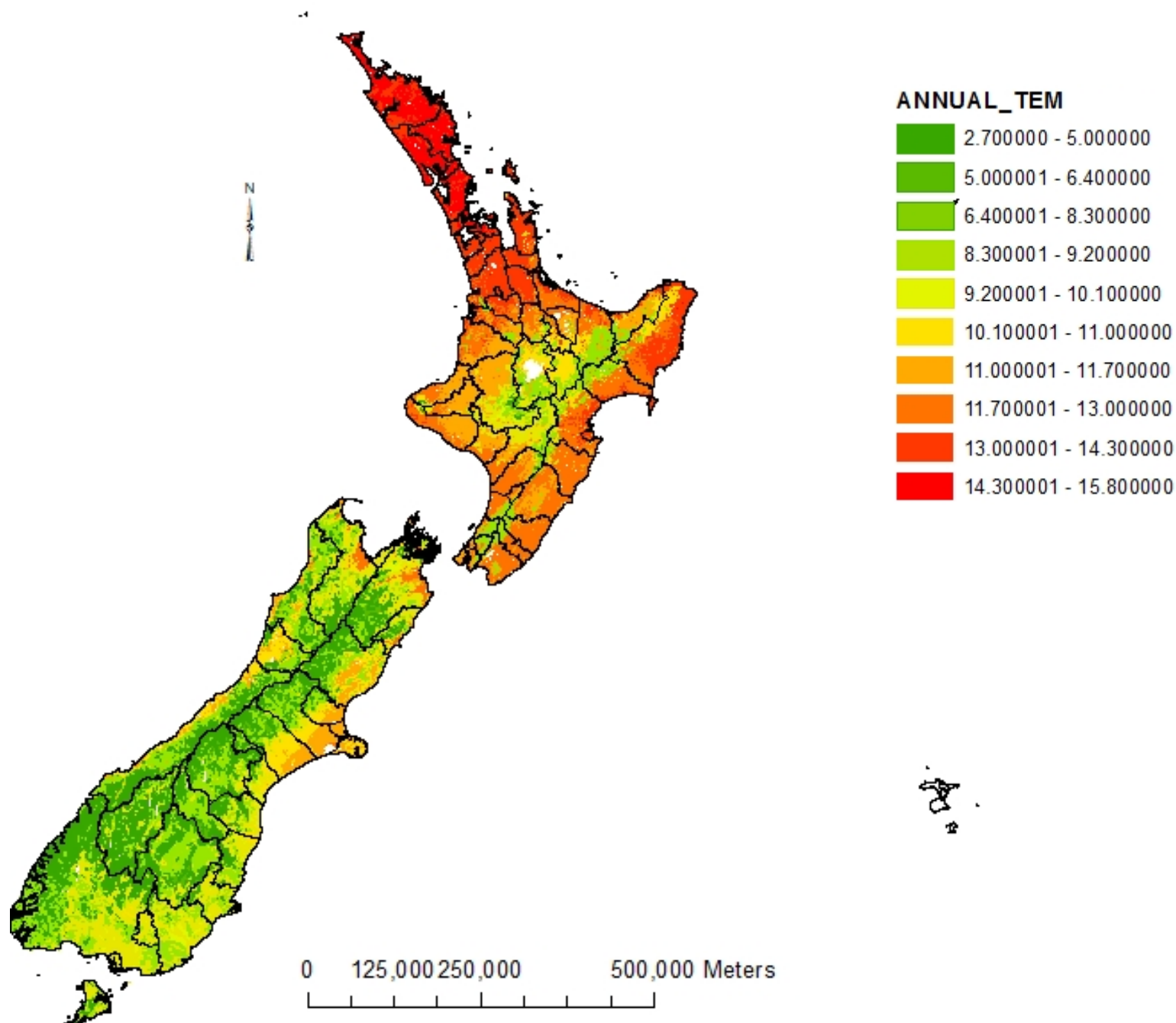


Digital Elevation Map DEM Hill shade



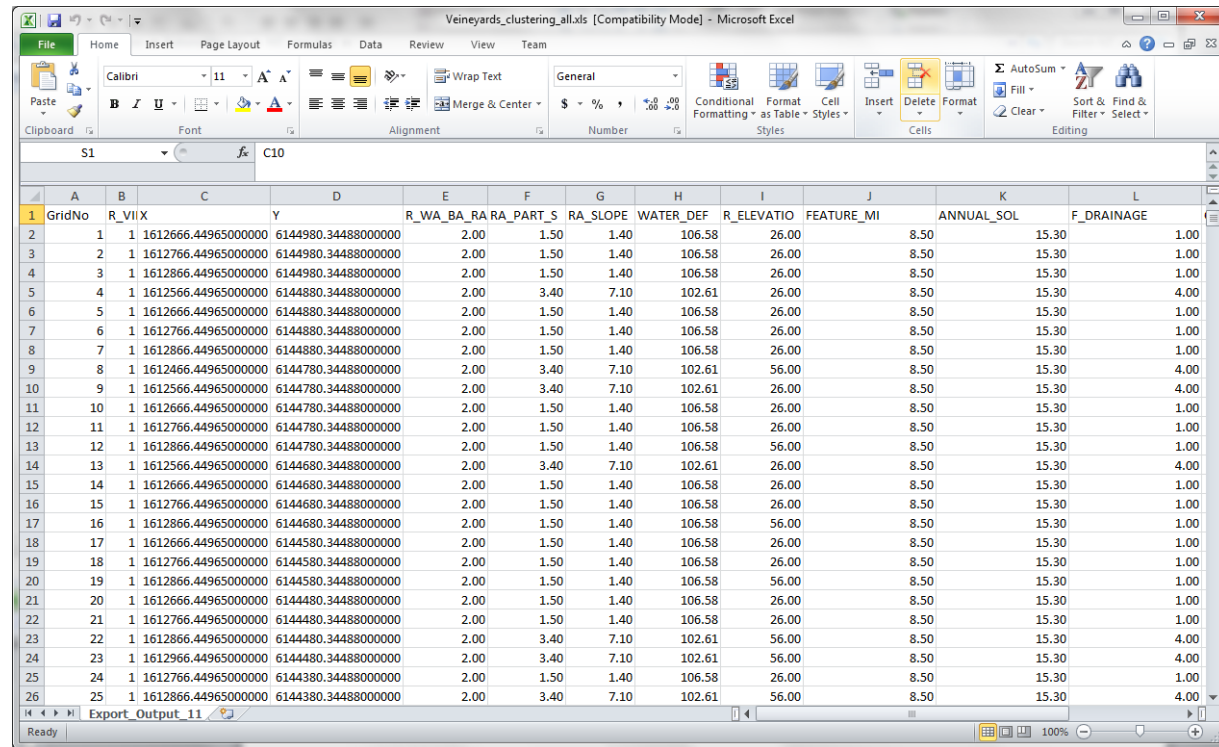
Digital Elevation Map DEM Elevation





Dependent variables for NZ vineyard polygons

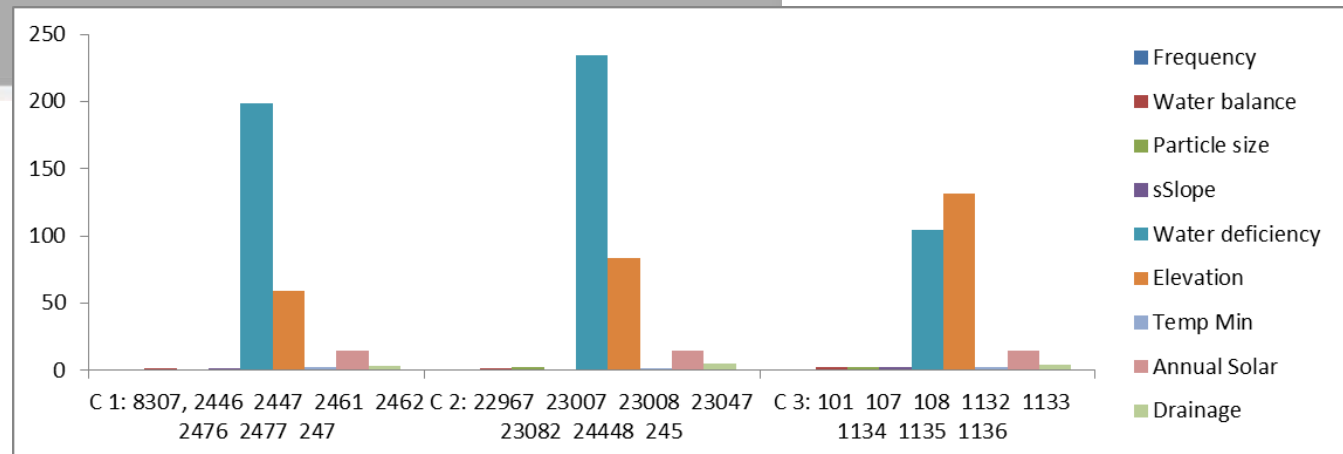
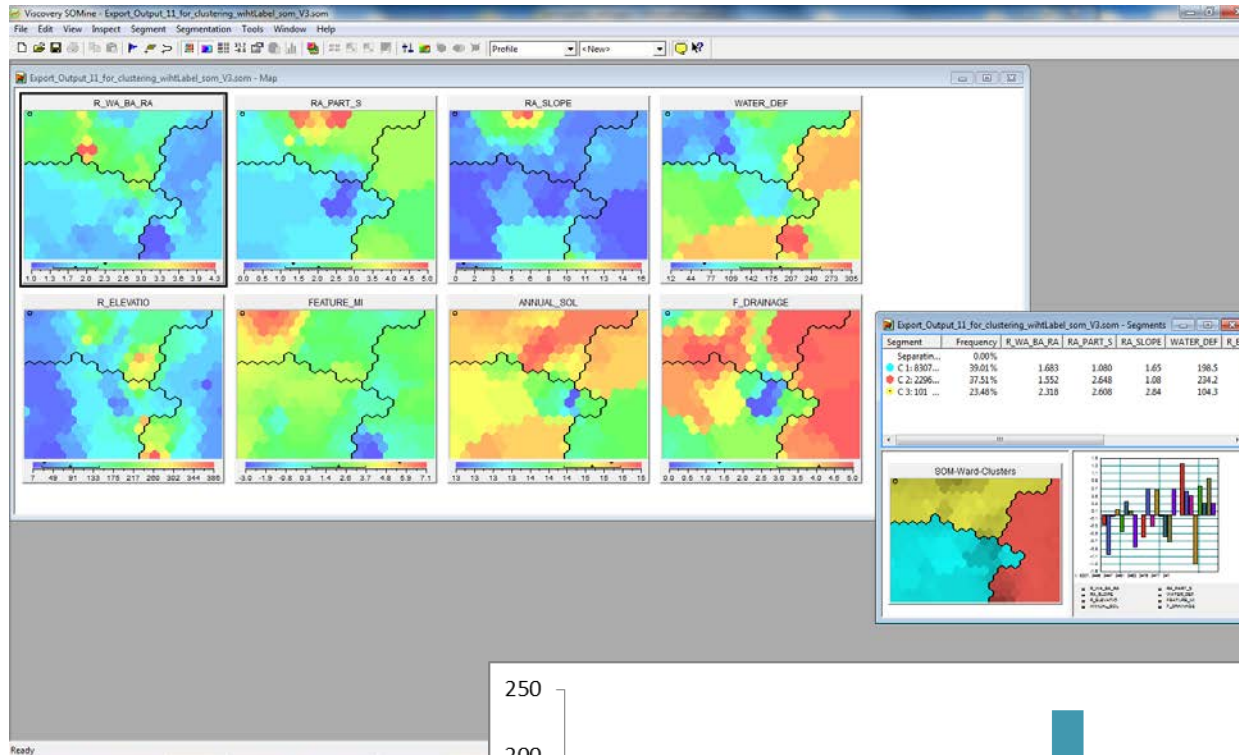
1. Water balance
2. Soil particle size
3. Slope
4. Water deficiency
5. Elevation
6. Temp Min
7. Annual Solar
8. Drainage
9. For 27343 pixels

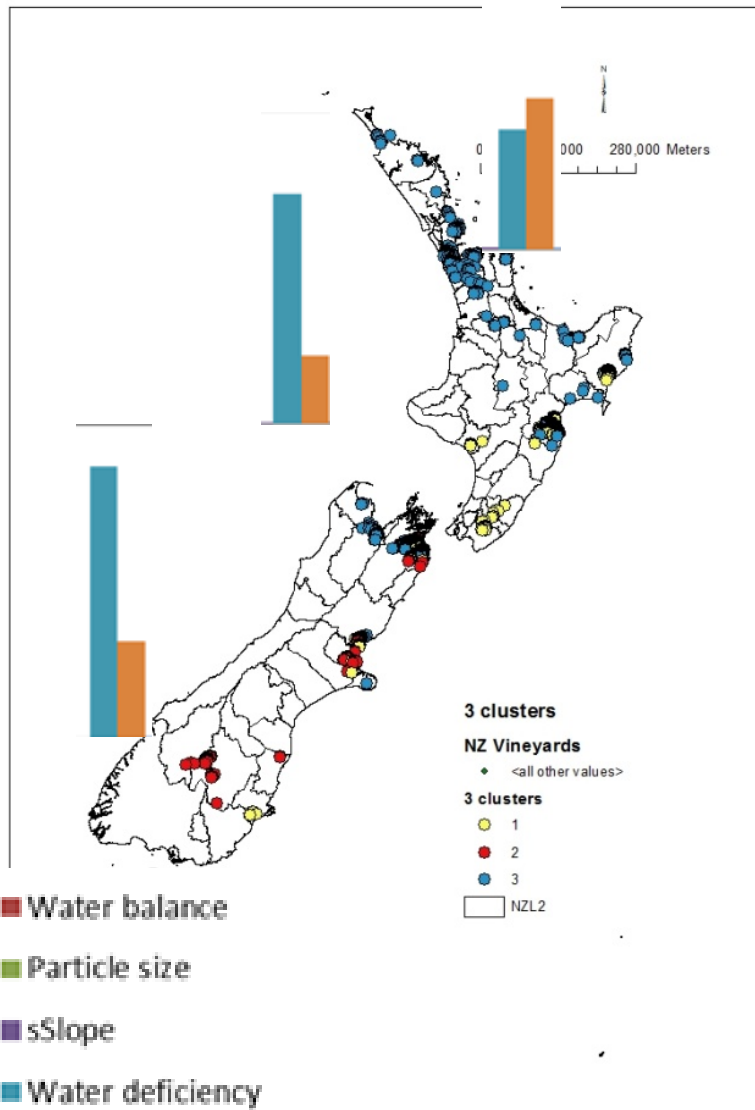


The screenshot shows a Microsoft Excel spreadsheet titled "Veineyards_clustering_all.xls [Compatibility Mode] - Microsoft Excel". The spreadsheet contains a table with 12 columns and 26 rows of data. The columns are labeled as follows: A (GridNo), B (R_VII_X), C (Y), D (R_WA_BA_RA_RA_PART_S), E (RA_SLOPE), F (WATER_DEF), G (R_ELEVATIO), H (FEATURE_MI), I (ANNUAL_SOL), J (F_DRAINAGE), K, and L. The data rows are numbered 1 to 26. The table contains numerical data for each of the 12 columns across the 26 rows.

A	B	C	D	E	F	G	H	I	J	K	L
GridNo	R_VII_X	Y	R_WA_BA_RA_RA_PART_S	RA_SLOPE	WATER_DEF	R_ELEVATIO	FEATURE_MI	ANNUAL_SOL	F_DRAINAGE		
1	1	1612666.44965000000	6144980.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
2	2	1612766.44965000000	6144980.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
3	3	1612866.44965000000	6144980.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
4	4	1612566.44965000000	6144880.34488000000	2.00	3.40	7.10	102.61	26.00	8.50	15.30	4.00
5	5	1612666.44965000000	6144880.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
6	6	1612766.44965000000	6144880.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
7	7	1612866.44965000000	6144880.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
8	8	1612466.44965000000	6144780.34488000000	2.00	3.40	7.10	102.61	56.00	8.50	15.30	4.00
9	9	1612566.44965000000	6144780.34488000000	2.00	3.40	7.10	102.61	26.00	8.50	15.30	4.00
10	10	1612666.44965000000	6144780.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
11	11	1612766.44965000000	6144780.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
12	12	1612866.44965000000	6144780.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
13	13	1612566.44965000000	6144680.34488000000	2.00	3.40	7.10	102.61	26.00	8.50	15.30	4.00
14	14	1612666.44965000000	6144680.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
15	15	1612766.44965000000	6144680.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
16	16	1612866.44965000000	6144580.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
17	17	1612666.44965000000	6144580.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
18	18	1612766.44965000000	6144580.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
19	19	1612866.44965000000	6144480.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
20	20	1612666.44965000000	6144480.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
21	21	1612766.44965000000	6144480.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
22	22	1612866.44965000000	6144480.34488000000	2.00	3.40	7.10	102.61	56.00	8.50	15.30	4.00
23	23	1612966.44965000000	6144480.34488000000	2.00	3.40	7.10	102.61	56.00	8.50	15.30	4.00
24	24	1612766.44965000000	6144380.34488000000	2.00	1.50	1.40	106.58	26.00	8.50	15.30	1.00
25	25	1612866.44965000000	6144380.34488000000	2.00	3.40	7.10	102.61	56.00	8.50	15.30	4.00
26	26	1612566.44965000000	6144380.34488000000	2.00	3.40	7.10	102.61	56.00	8.50	15.30	4.00

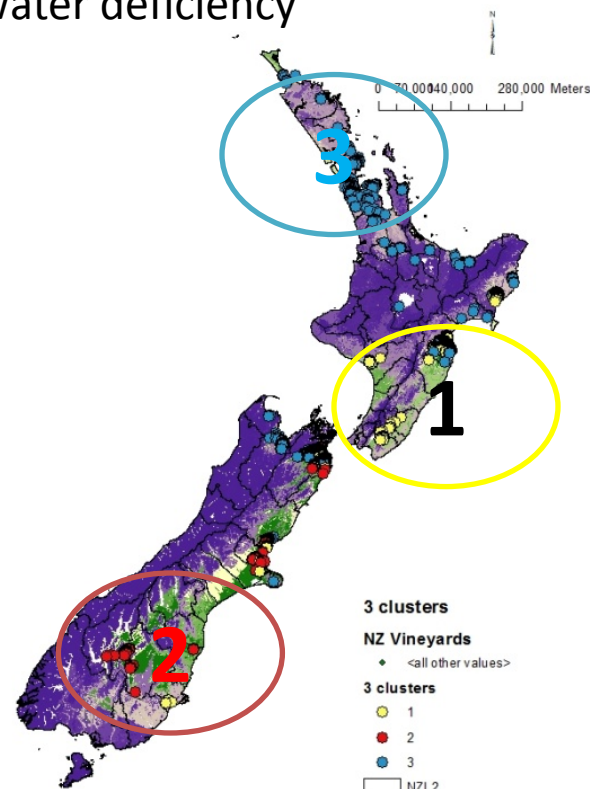
Pixel (data) clustering with SOM



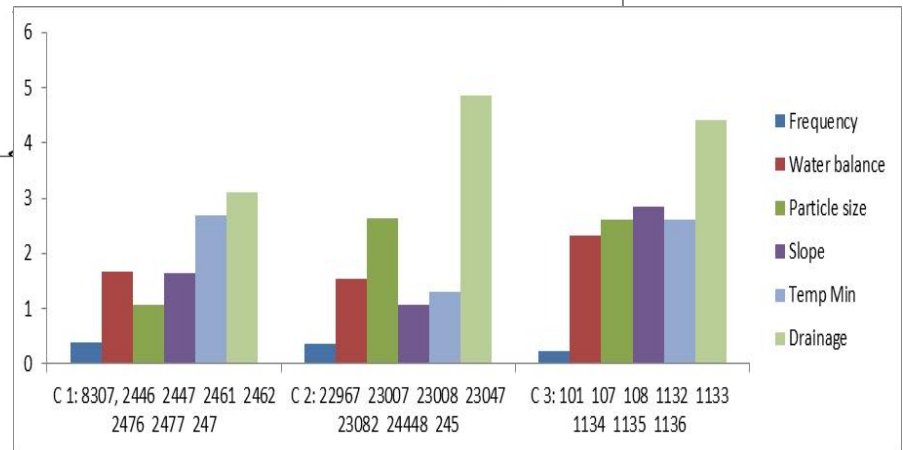


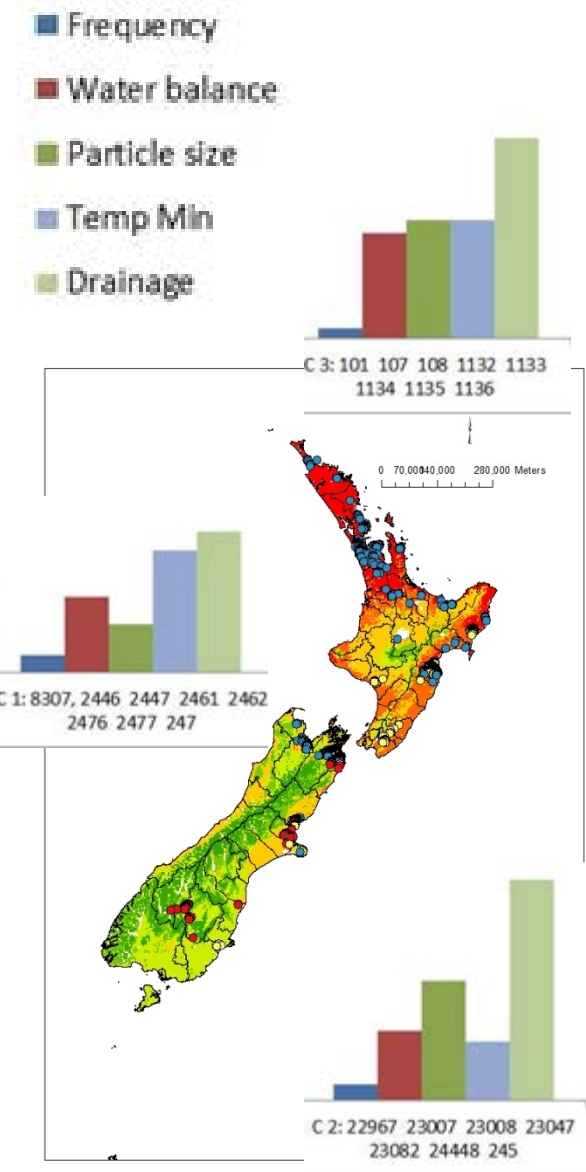
- Water balance
- Particle size
- sSlope
- Water deficiency
- Elevation
- Temp Min
- Annual Solar
- Drainage

Water deficiency

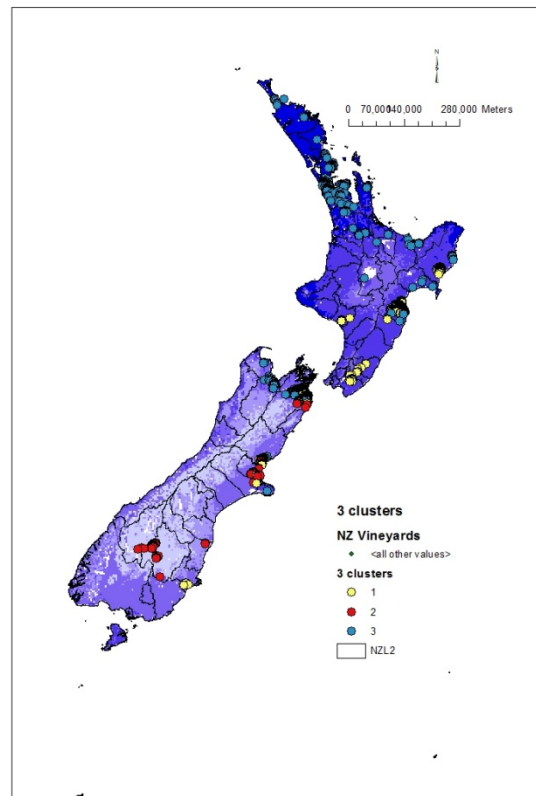


- Separation...
- C 1: 8307...
- C 2: 2296...
- C 3: 101 ...

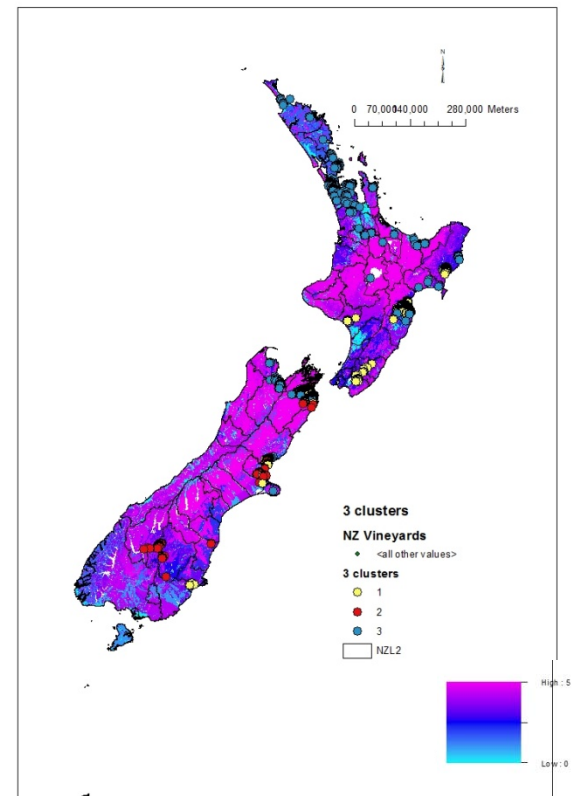




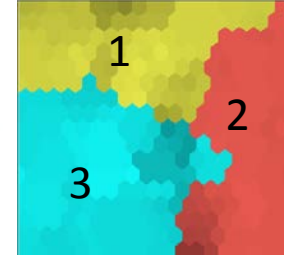
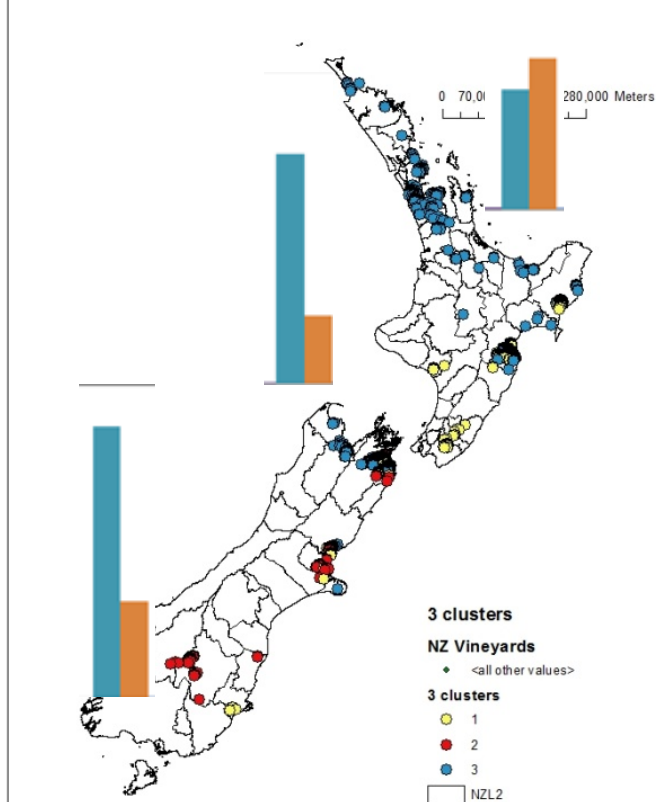
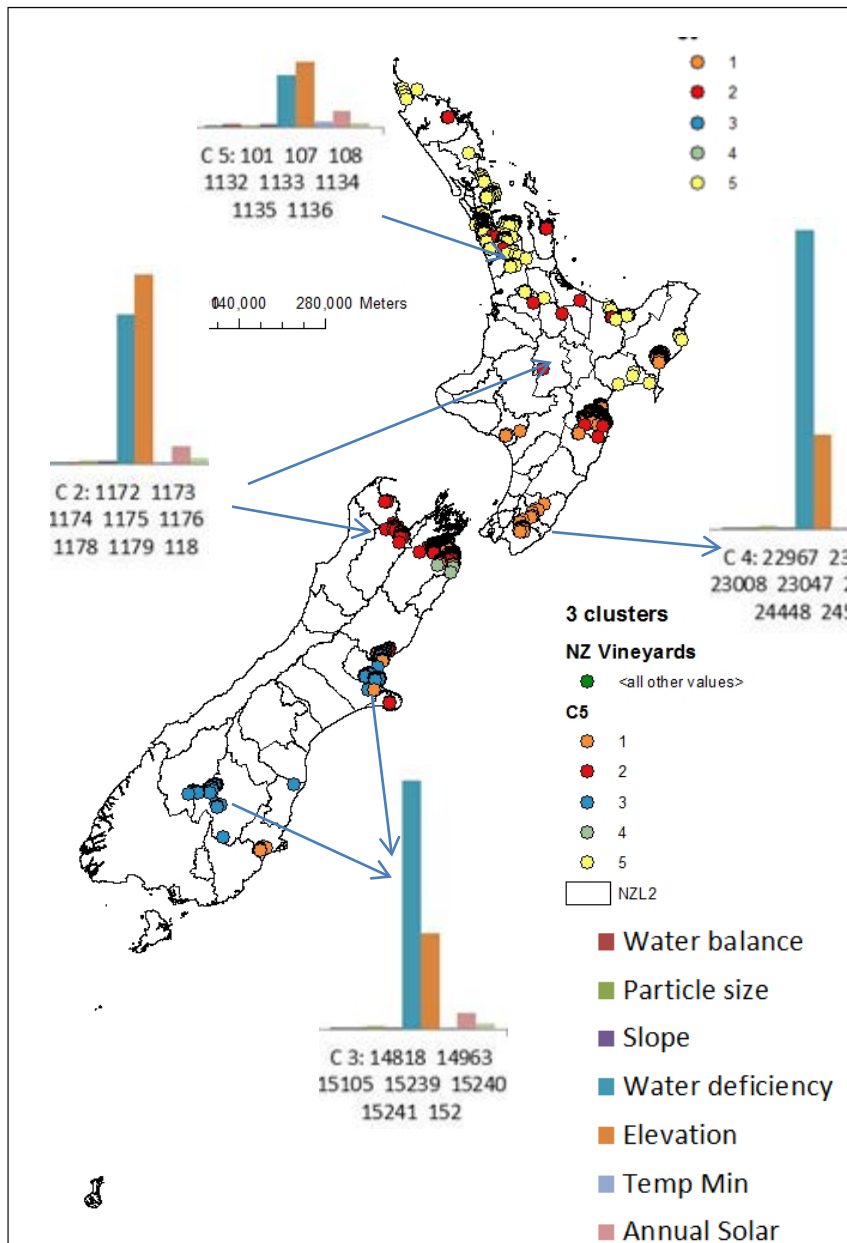
Annual temperature



Temperature minimum



Drainage

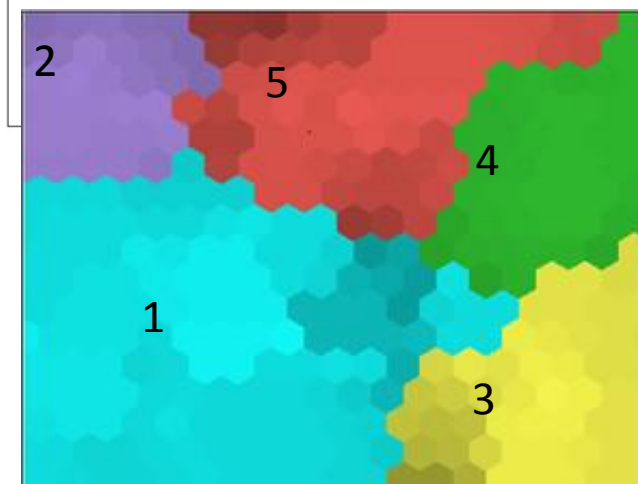


Separation...

• C 1: 8307...

• C 2: 2296...

• C 3: 101 ...



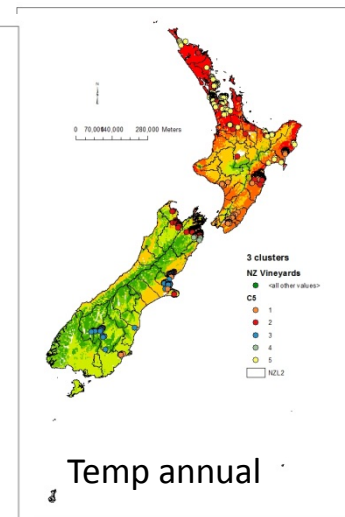
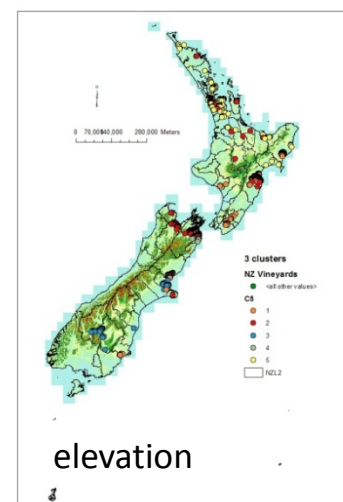
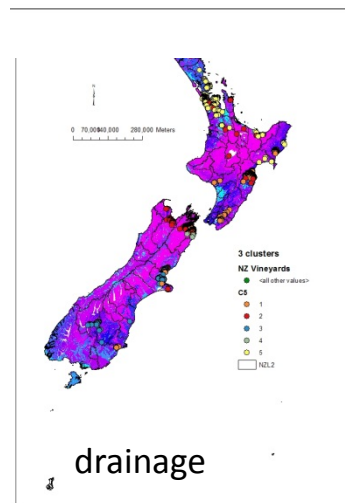
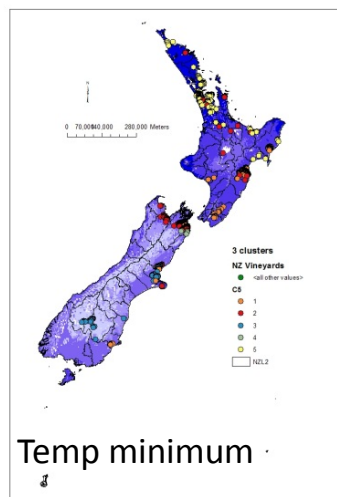
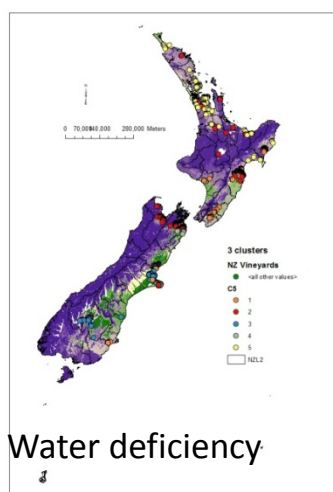
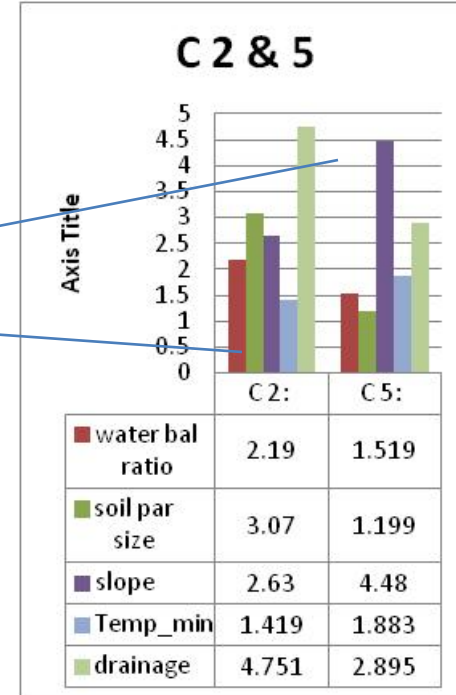
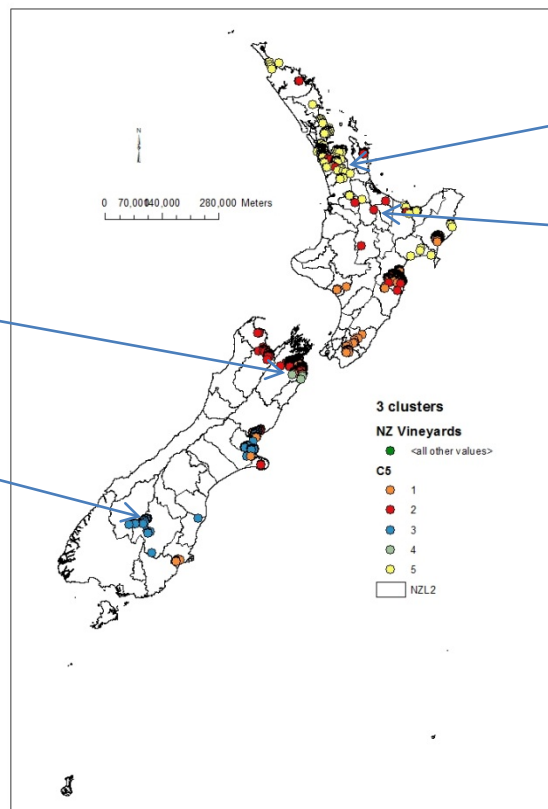
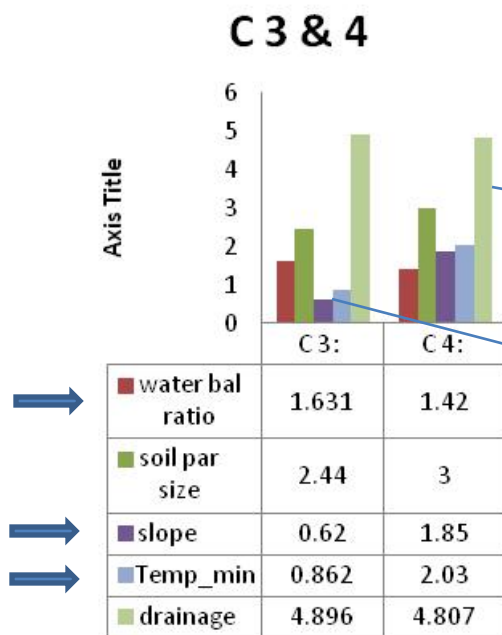
• C 1: 8307...

• C 2: 2296...

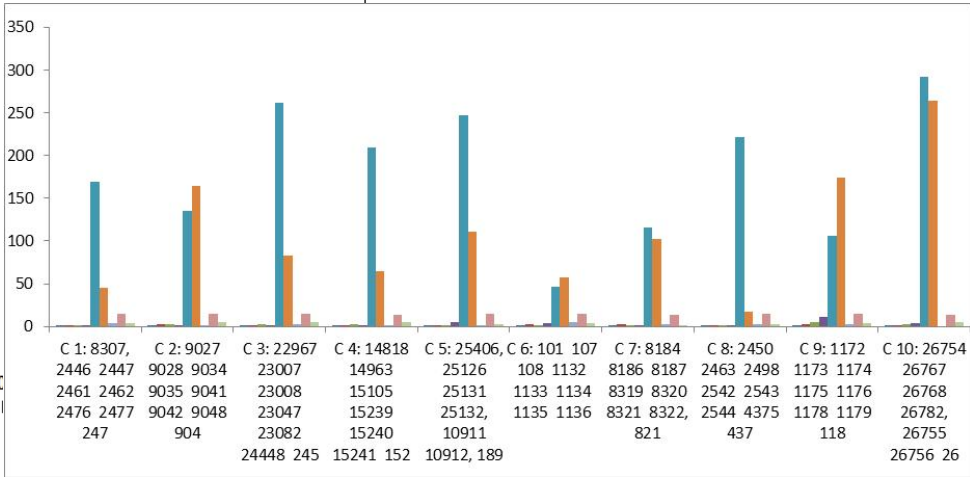
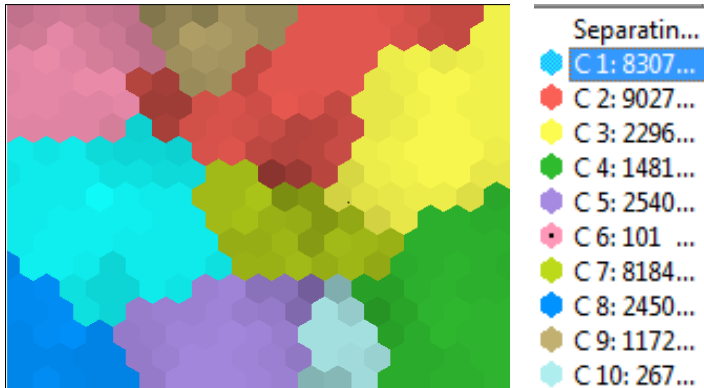
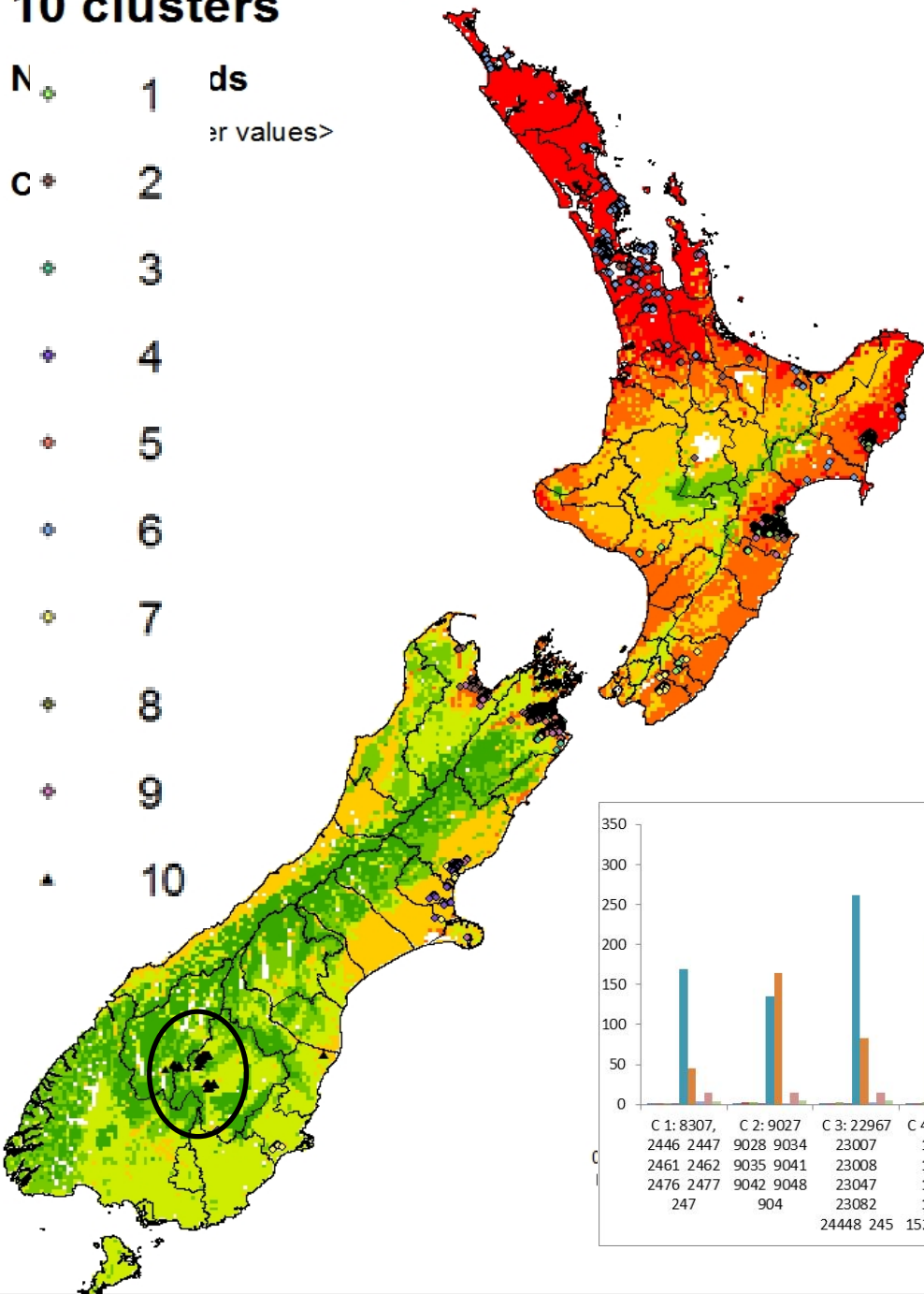
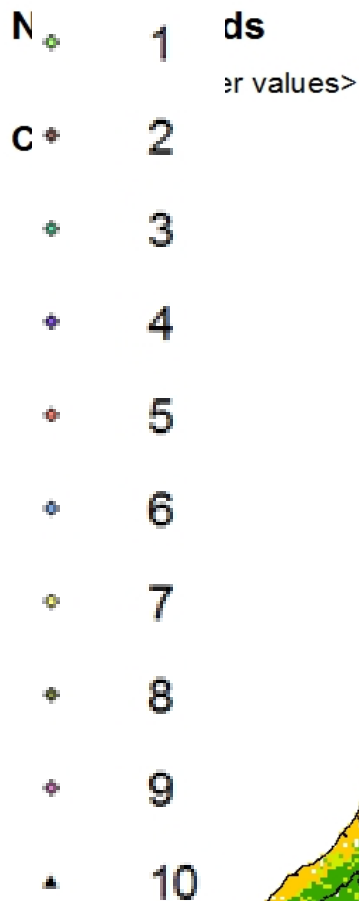
• C 3: 101 ...

• C 4: 2296...

• C 5: 101 ...

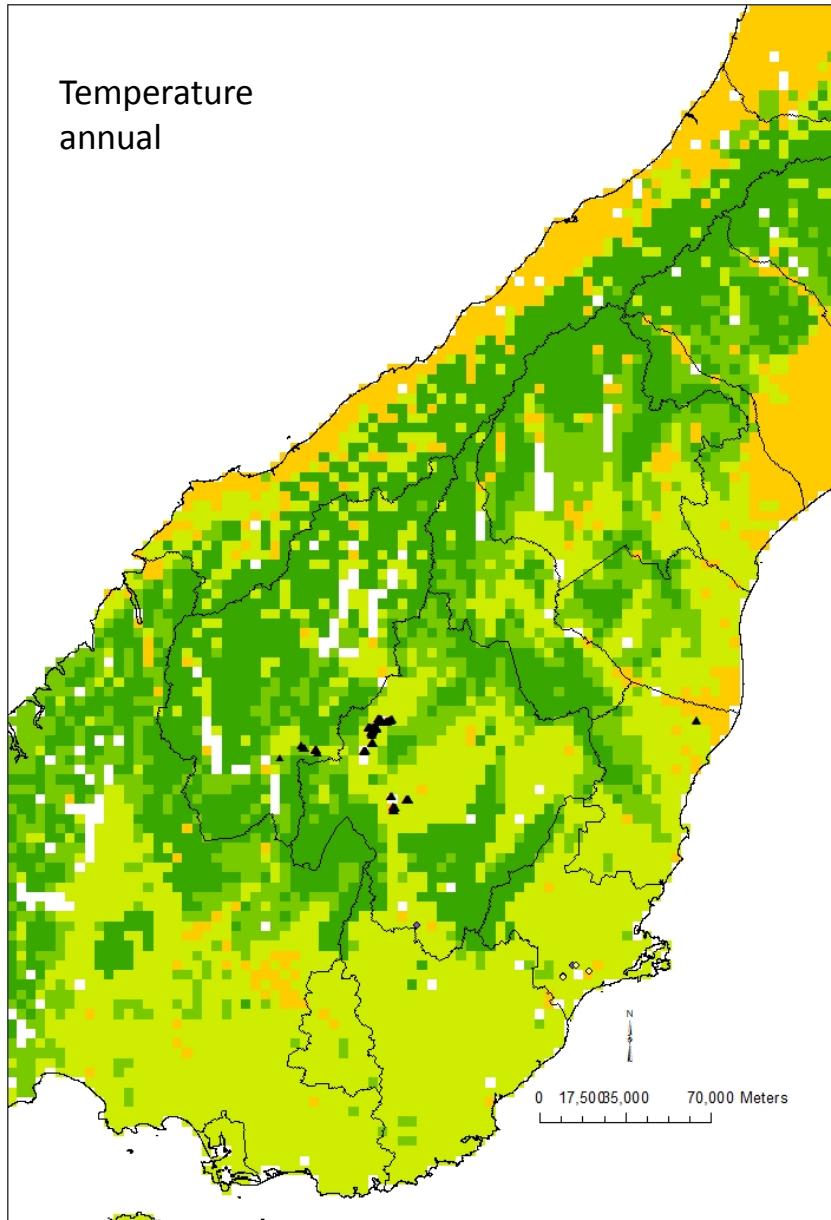


10 clusters

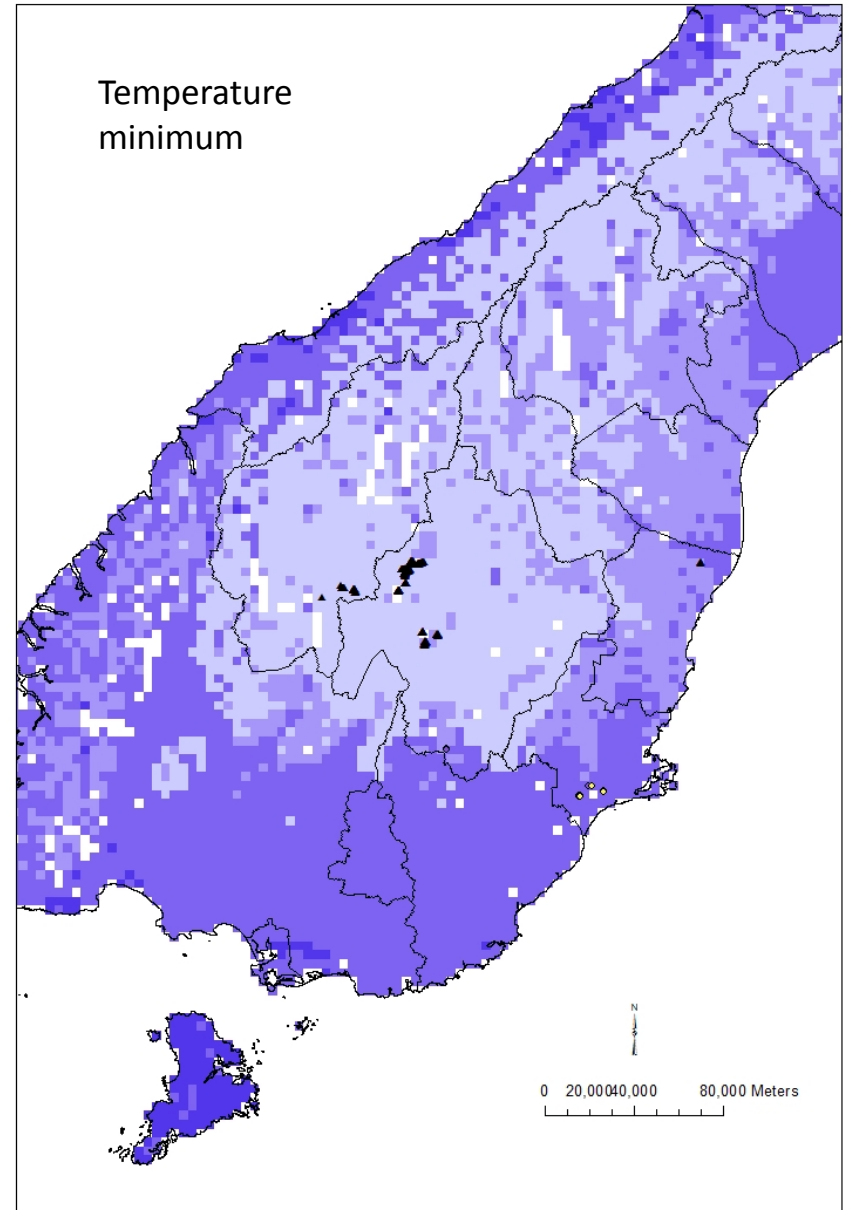


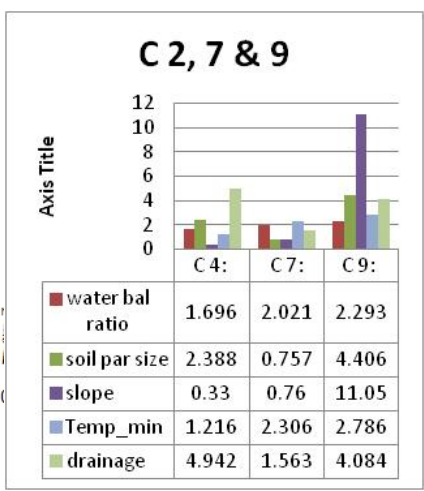
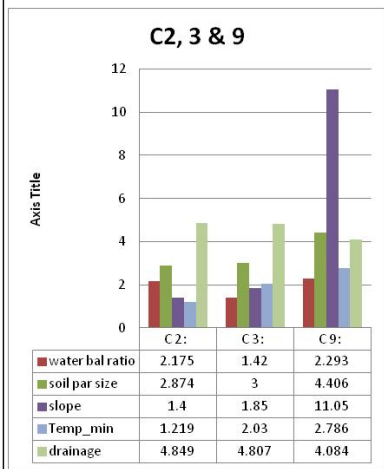
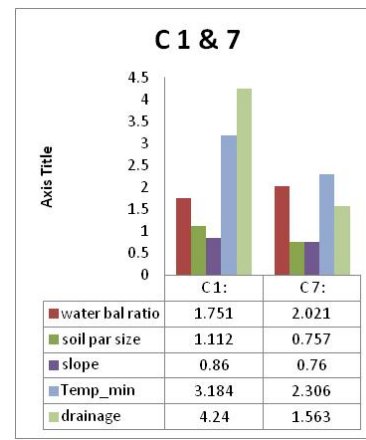
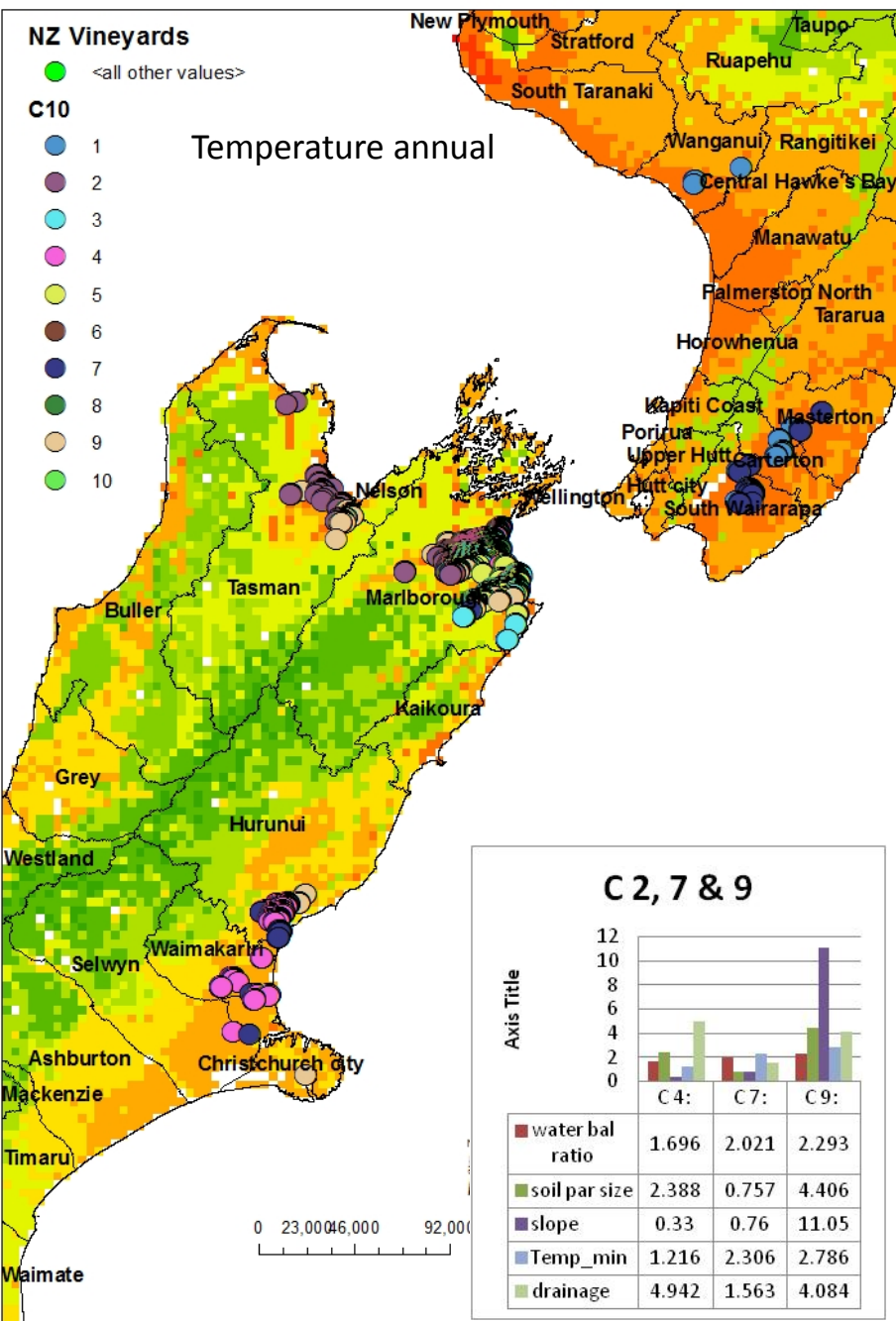
- Water balance
- Particle size
- Slope
- Water deficiency
- Elevation
- Temp Min
- Annual Solar
- Drainage

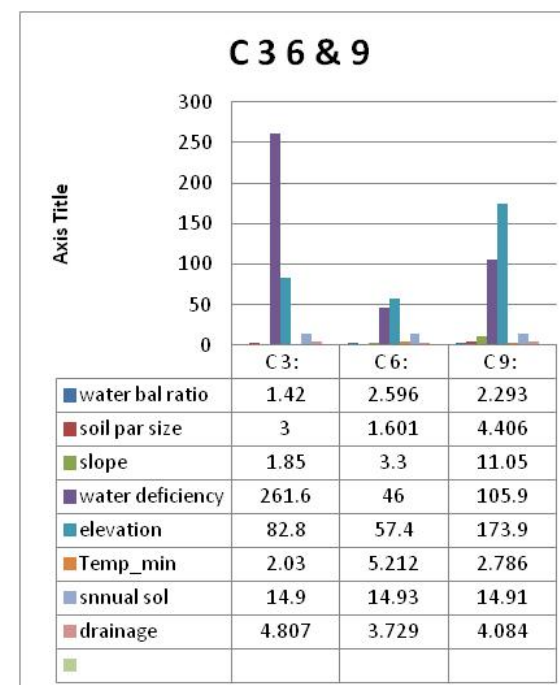
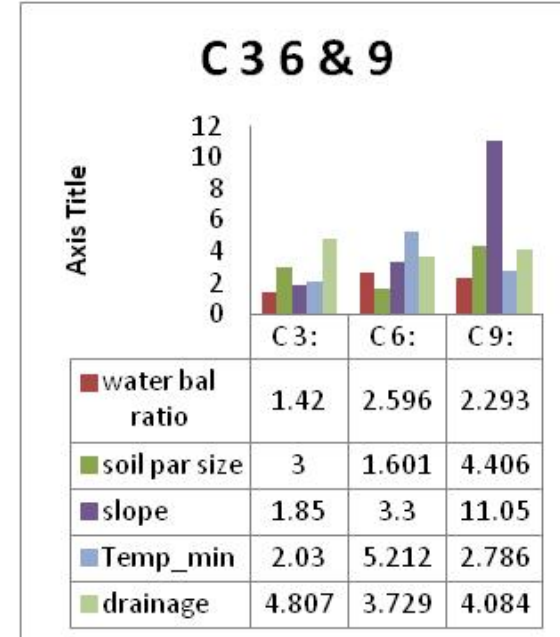
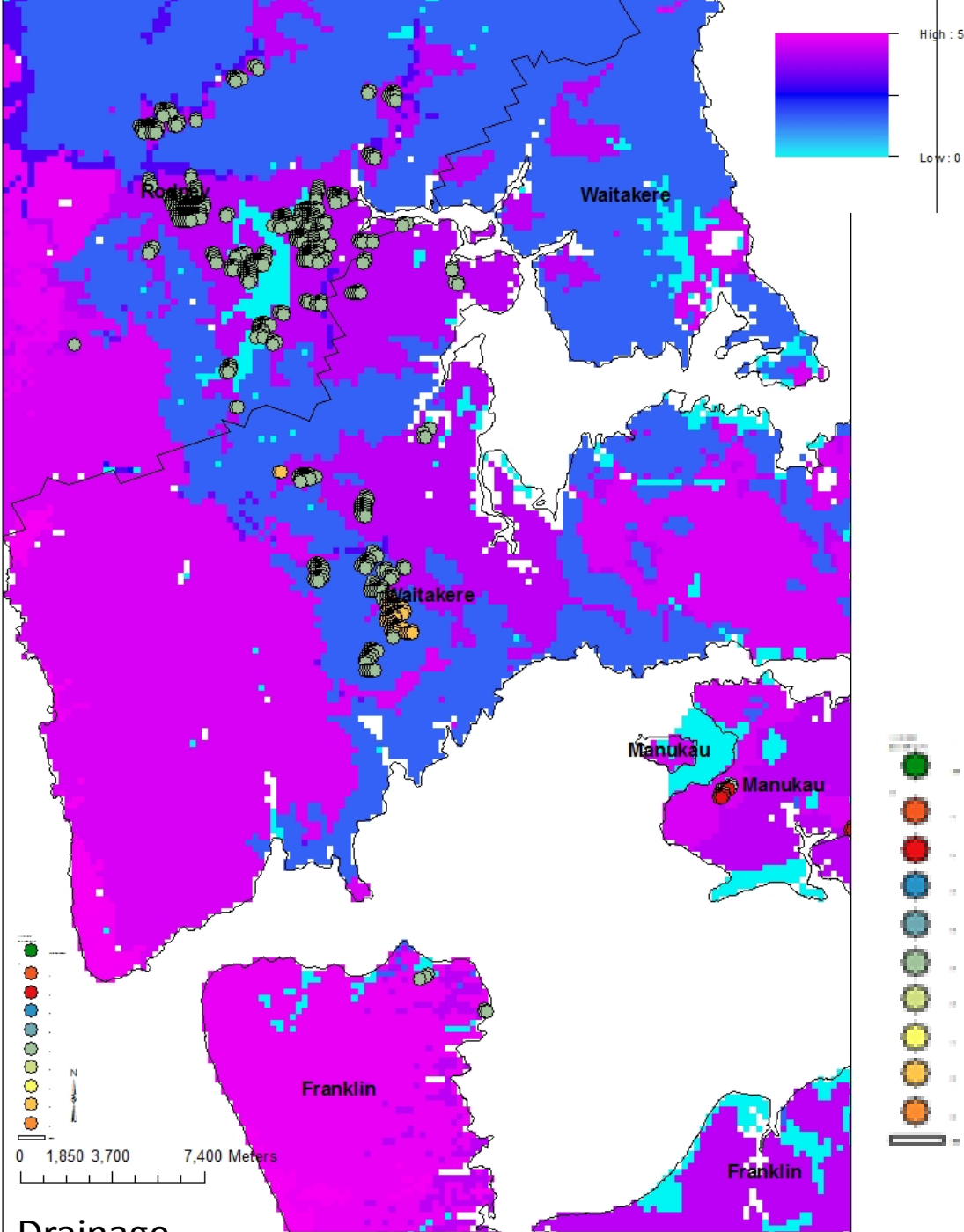
Temperature
annual



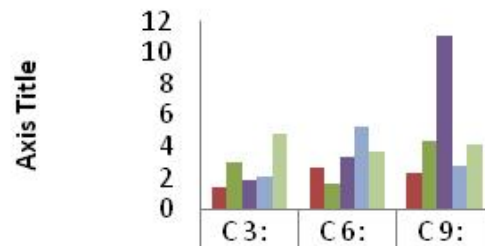
Temperature
minimum





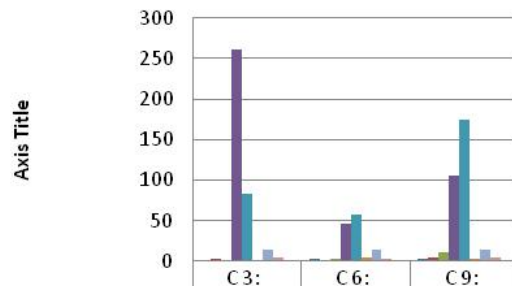


C 3 6 & 9

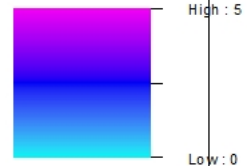
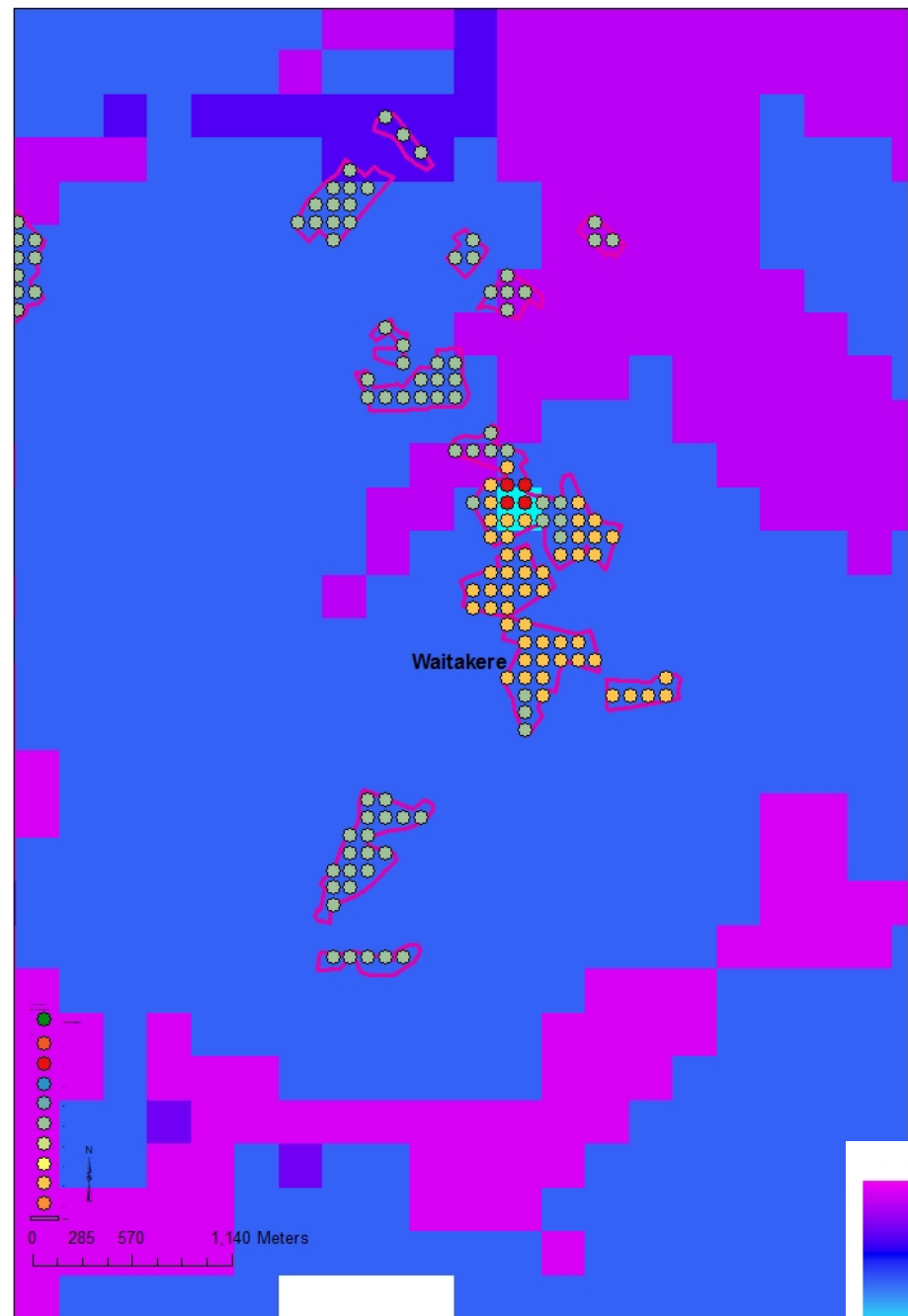


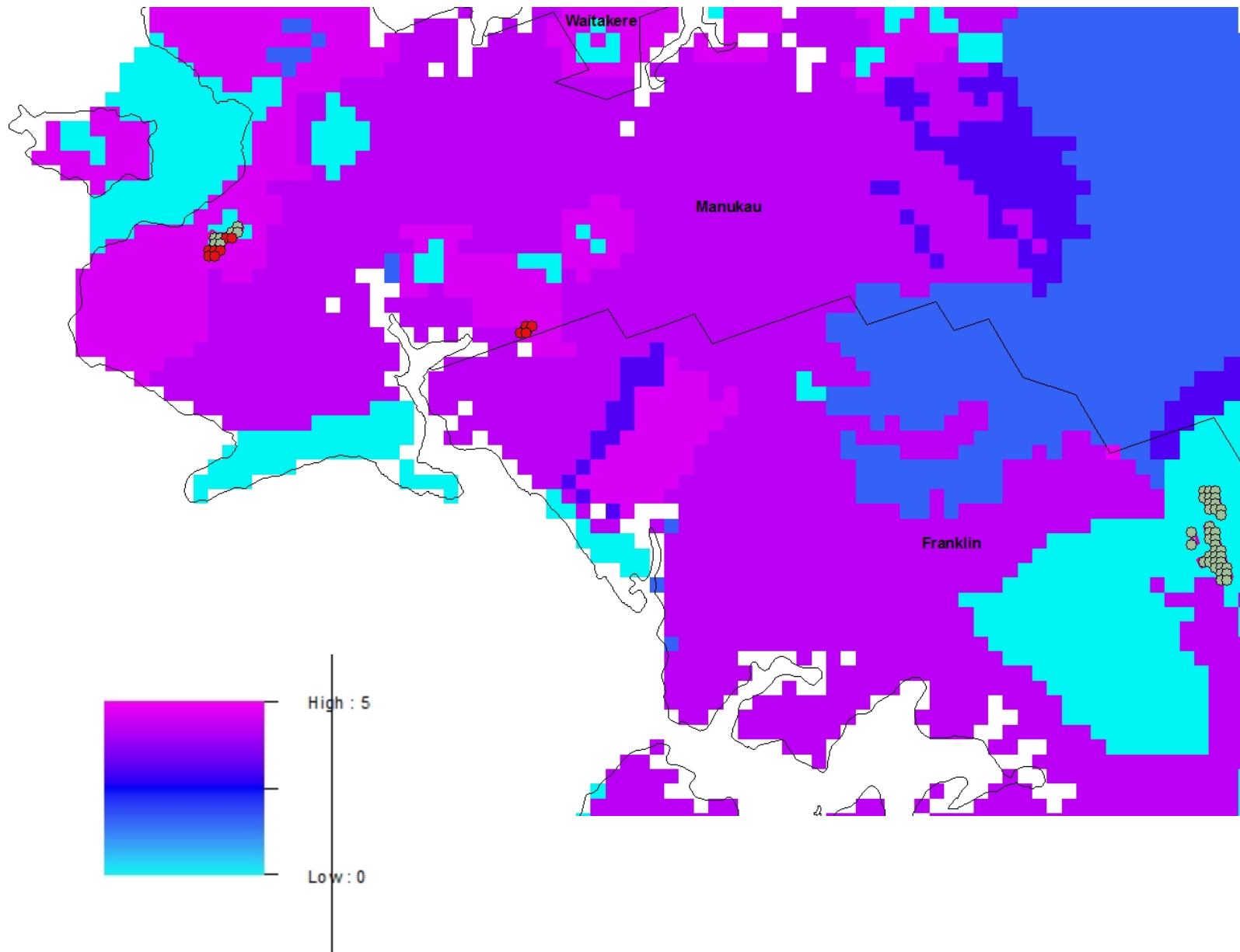
water bal ratio	1.42	2.596	2.293
soil par size	3	1.601	4.406
slope	1.85	3.3	11.05
Temp_min	2.03	5.212	2.786
drainage	4.807	3.729	4.084

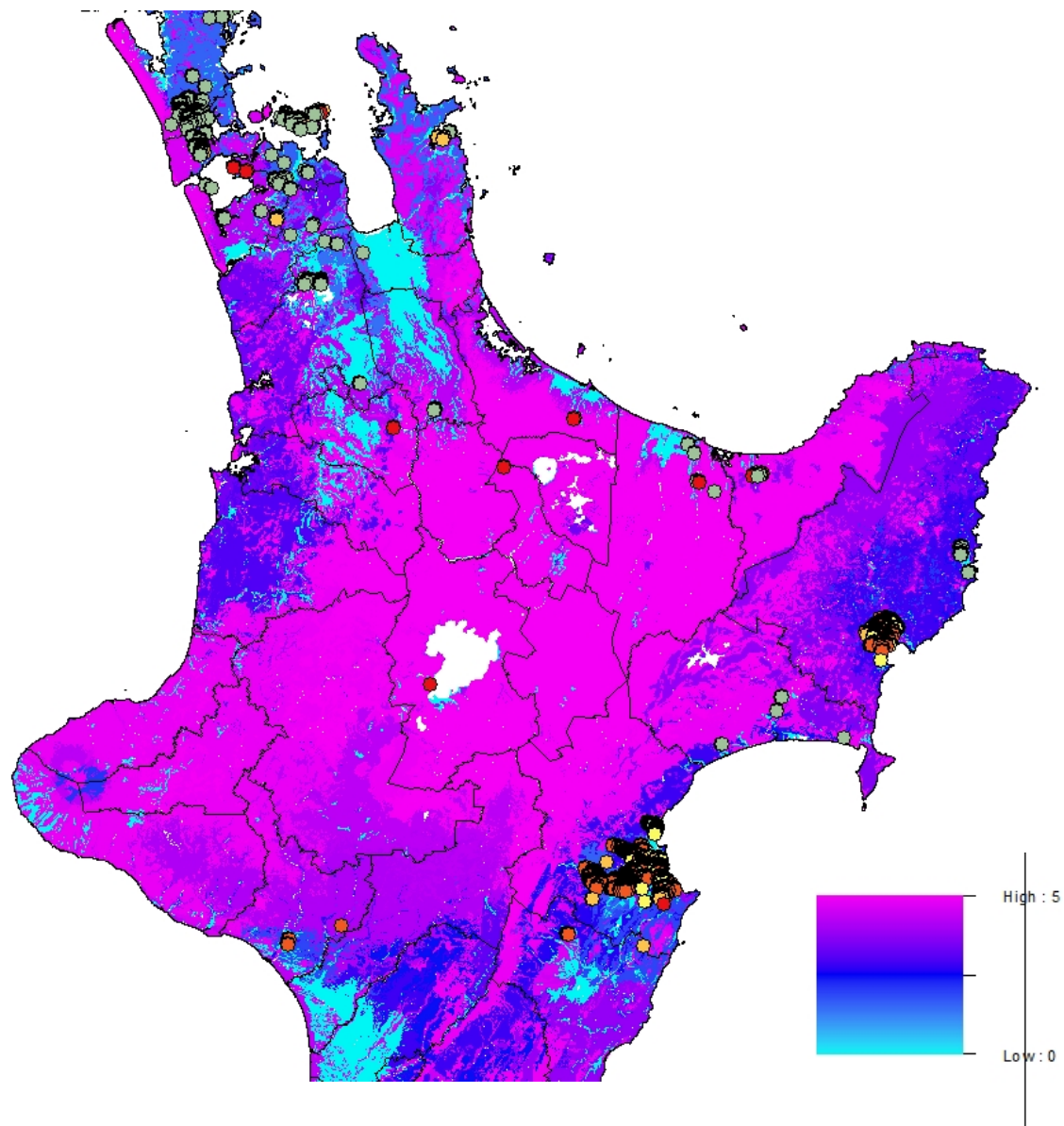
C 3 6 & 9

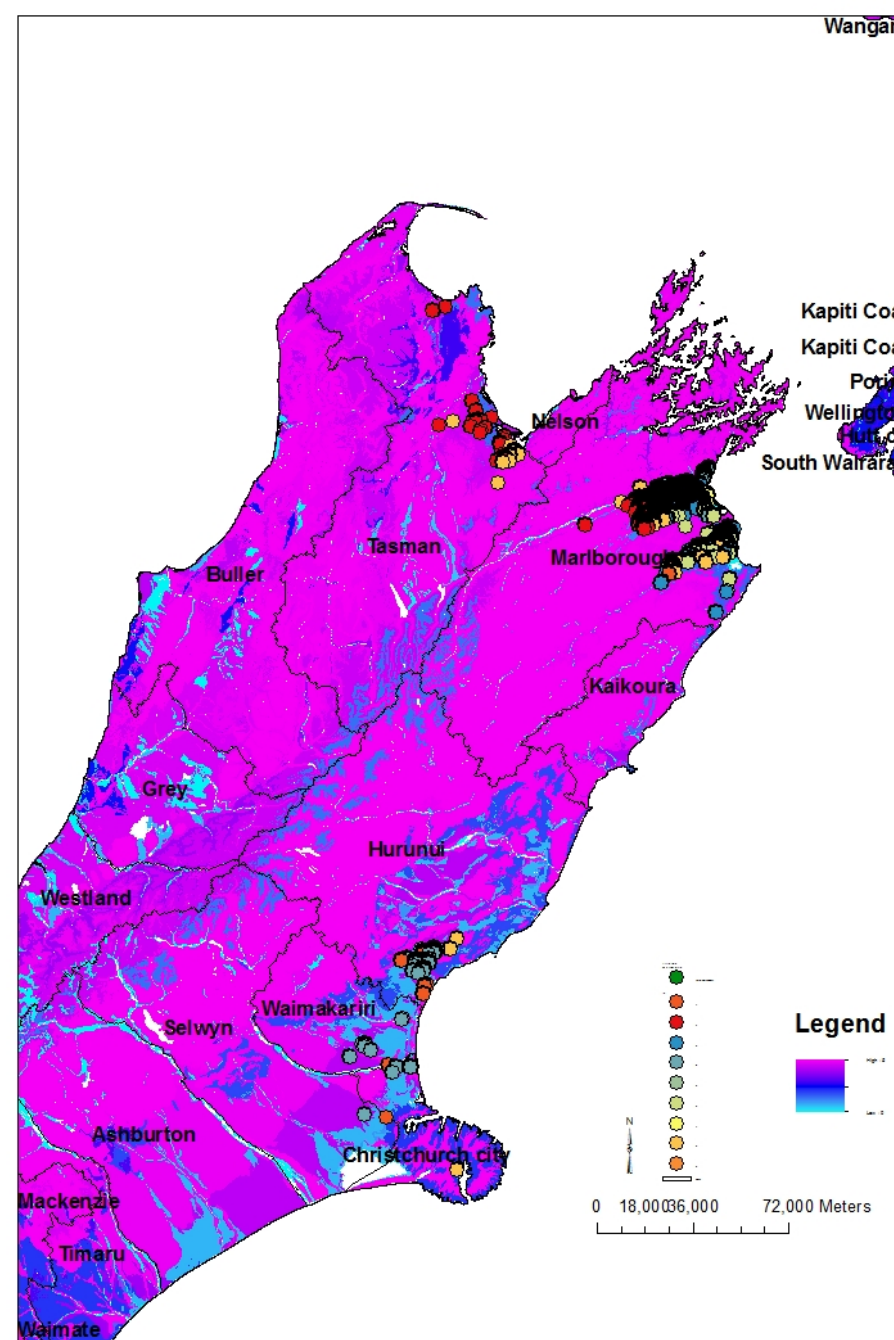
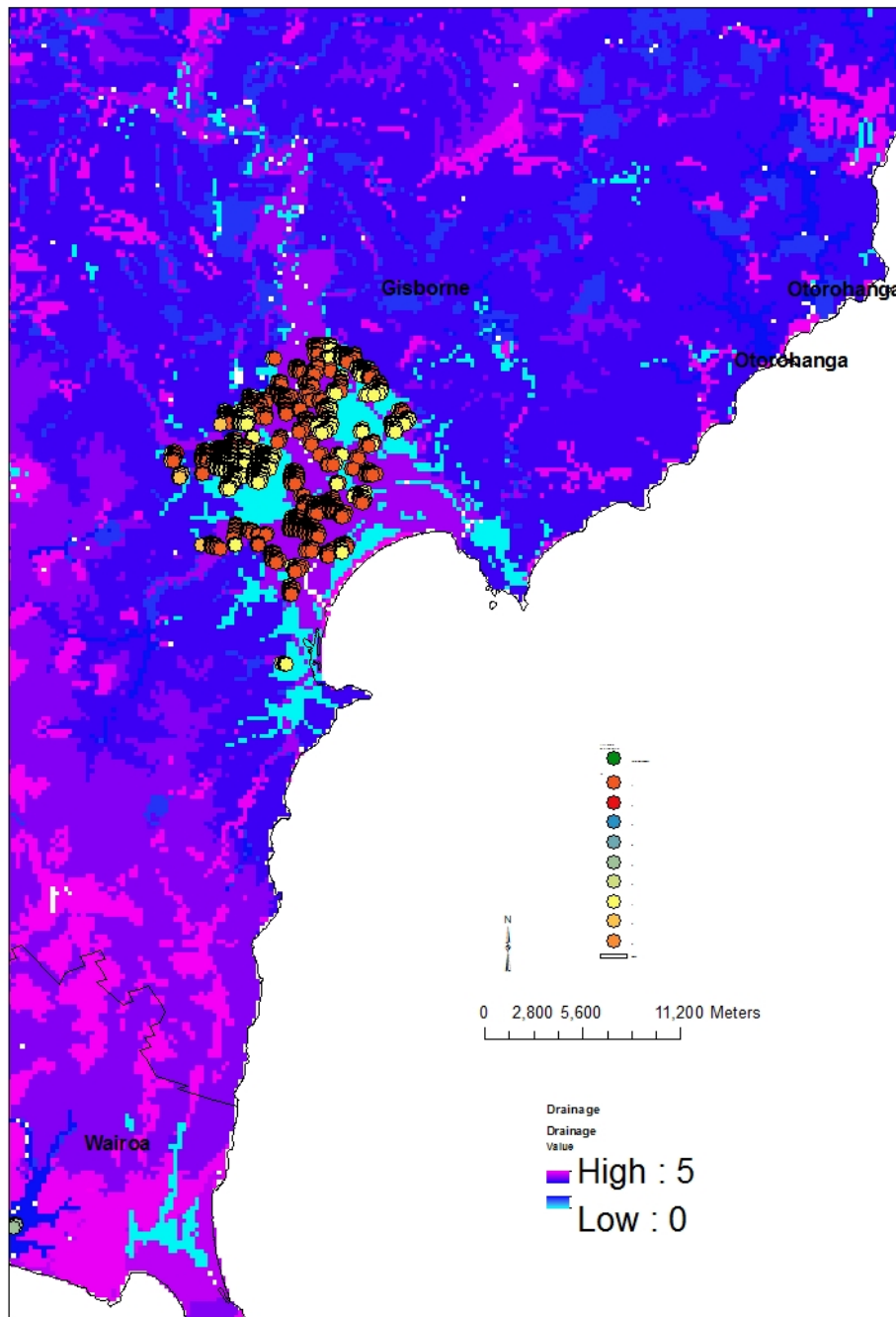


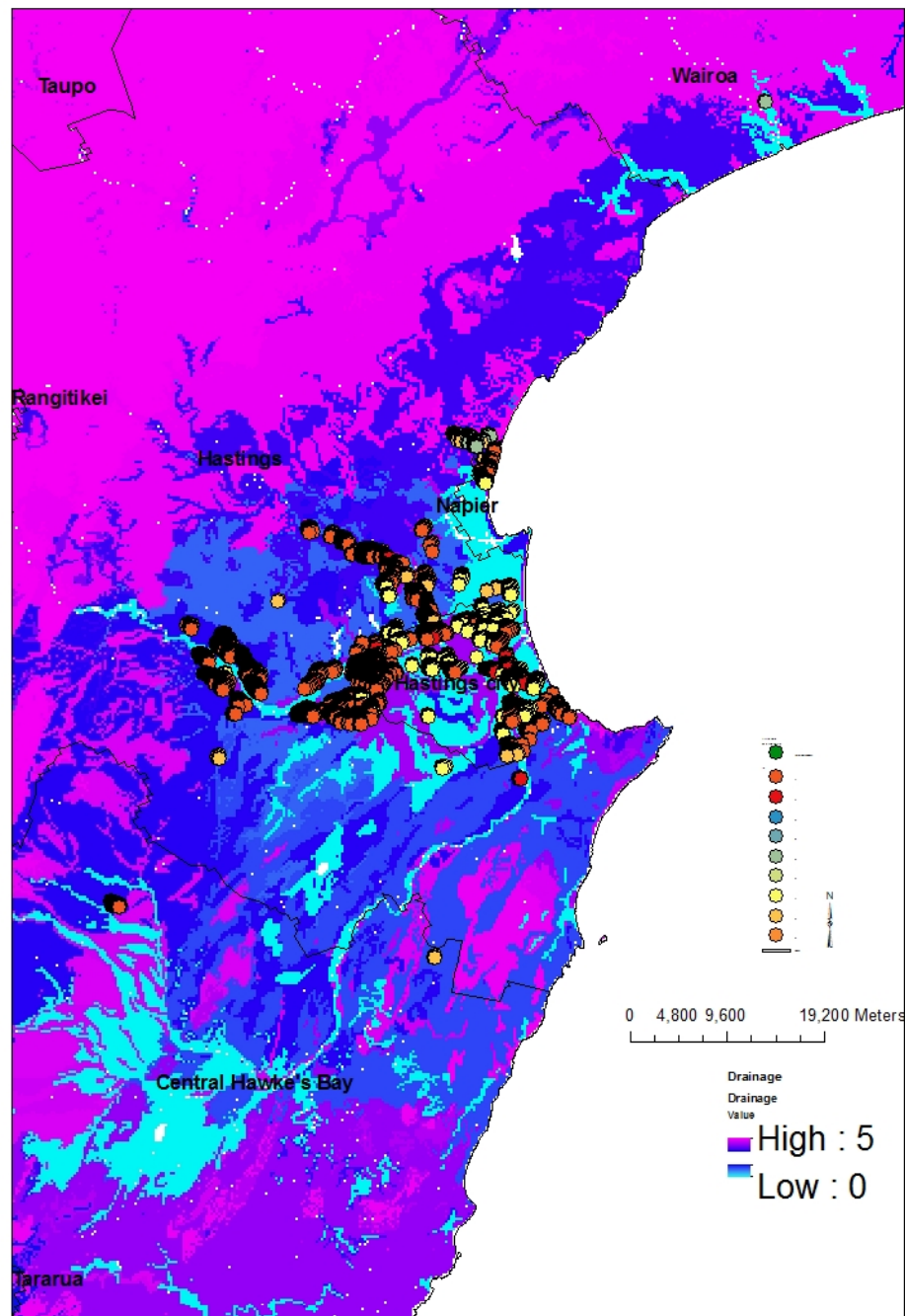
water bal ratio	1.42	2.596	2.293
soil par size	3	1.601	4.406
slope	1.85	3.3	11.05
water deficiency	261.6	46	105.9
elevation	82.8	57.4	173.9
Temp_min	2.03	5.212	2.786
snnual sol	14.9	14.93	14.91
drainage	4.807	3.729	4.084











conclusions

- Climate and “terroir “ of NZ wine regions are very unique and can be defined.
- Of the variable studied:
 - @ the regional scale and within regions
 - water deficiency
 - elevation
 - soil particle size
 - water balance
 - Temperature min

The methodology show potential

Further analysis required to exactly define NZ “terroirs”