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NIWA

*Taihoro Nukurangi*

# *Climate and Severe Fire Seasons*

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*A report on climatic factors contributing to severe fire seasons in New Zealand*

*Prepared for*

**National Rural Fire Authority**

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**National Institute of Water and Atmospheric Research Ltd**

P O Box 109-695, Auckland
Tel (09) 375 2050 Fax (09) 375 2051

# Climate and Severe Fire Seasons

***T**his report summarises climatic patterns giving rise to severe fire seasons at a number of locations throughout New Zealand. Analysis also includes factors contributing to high fire seasons nationally.*

*Clive Heydenrych, Dr Jim Salinger, Dr Jim Renwick*

NIWA - Auckland
National Institute of Water and
Atmospheric Research Limited

P O Box 109 695 Auckland
Tel (09) 375 2050
Fax (09) 375 2051

# Executive Summary

1. Severe fire seasons experienced in New Zealand have been attributed to various synoptic climatic features. The National Rural Fire Authority has for a number of years been working towards an improved fire risk forecasting regime. The present National Institute of Water and Atmospheric Research (NIWA) report forms part of investigation of climatic factors that give rise to high seasonal and monthly severity fire risk.

2. NIWA have previously investigated linkages between climate predictors and severe fire seasons (Salinger, 1998). The present study builds on this earlier work, increasing the number of climate stations examined to 21 (previously 10), and investigating indices of regional climate to a total of 24 (previously 12), and updating the analysis to the year 2000 (previously 1995).

3. Regional and global circulation indices are used to characterise climate patterns on monthly time-scales in the Tasman Sea/New Zealand region. The Southern Oscillation Index (SOI), an index of sea surface temperatures (SST) in the New Zealand region, regional circulation indices and daily weather patterns are used to establish models of relationships with Seasonal Severity Rating (SSR) and Monthly Severity Rating (MSR) at twenty one specific sites over the October to April period.

4. Climate predictors have been linked to high SSR and MSR for different areas of New Zealand. For example; SOI is positively correlated to west coast stations of Hokitika, New Plymouth and Westport; zonal predictors (Z1, Z2 etc.) are positively correlated to east coast stations Coromandel, Gisborne, Christchurch and Kaikoura and negatively correlated to Hokitika and Westport; meridional predictors (M1, M2 etc) are positively correlated to stations sheltered from the south and southwest; Tauranga, Rotorua, Nelson and Wellington.

5. Relationships between daily weather patterns and high SSR and MSR values are more varied. For example anticyclones centered to the north west (HNW) of the country resulting in high positive correlations with east coast stations Coromandel, Tauranga, Gisborne, Wellington and Kaikoura; and anticyclones centered to the south east (HSE) of the country resulting in high positive correlations with west coast stations Hokitika, Westport, New Plymouth and Paraparaumu.

6. Onshore flow and troughs result in low SSR and MSR values or reduced fire risk. For example; northeast flow (NE) is negatively correlated with Corromandel, Tauranga and Kaikoura; troughs with moist north and northwest flow (TNW) is negatively correlated with most stations and particularly Coromandel, Nelson, Taupo, Tauranga and Wanganui.

7. High SSR/MSR using daily weather types is associated with most stations under southwest flow (SW), westerly flow (W) and anticyclones to the west (HW), northwest (HNW) southeast (HSE) and over central New Zealand (H). Similarly low SSR/MSR is associated with more stations under troughs to the northwest (TNW), southwest (TSW) and over New Zealand (T). Ridging anticyclones (R) and northeast flow (NE) are also associated with more low SSR/MSR values. Anticyclones to the east (HE) are not strongly associated with either high or low SSR/MSR.

8. Significant correlations at the 5% level, and prediction equations have been developed for most stations for seasonal (SSR) and monthly (MSR) periods. Dargaville, Dunedin and Taupo only had significant correlations between SSR and predictors at the 10% level. Several stations had at least one month where MSR had a weak significant relationship at 10% level (Auckland, Coromandel, Invercargill and Wanganui) and some stations had no significant relationships for some months (Auckland, Dargaville and Dunedin).

9. Seasonal SSR and months October, November, December and January MSR values tended to have higher significant correlations with predictors than during February, March and April.

10. The present report completes the work from the first year of a three-year program on Integrated Climate and Fire Season Severity Forecasting. Future work will investigate the linkage between high MSR and stations from various spatial group or districts and their responses to fire severity rating using other fire weather data and daily weather parameters.

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# Scope of the Study

Severe fire seasons experienced in New Zealand have been attributed to various synoptic climatic features, such as the presence of El Niño and La Niña events. The National Rural Fire Authority has reported variable success in their endeavour to uncover factors that cause high seasonal fire risk (Pearce et al., 1995). This is important because detection of discernible trends coupled with seasonal climate prediction would allow some anticipation of possible higher district fire risk seasons.

The National Institute of Water and Atmospheric Research (NIWA) have previously investigated linkages between climate predictors and severe fire seasons for 10 stations in New Zealand up to the year 1995 (Salinger, 1998). The present study builds on this earlier work by NIWA, increasing the number of climate stations examined to 21 (previously 10), and investigating indices of regional climate to a total of 24 (previously 12), and updating the analysis to the year 2000 (previously 1995).

The scope of this work is to improve the knowledge of climatic factors influencing fire season severity. The present report extends work presented in Salinger (1998) and involves detailed analysis of the relationships between global (such as El Niño and La Niña) and regional climate elements and monthly and seasonal fire season severity. The study will:

1. Provide a greater national coverage of fire risk regions for New Zealand.
2. Utilise a larger number of climatic predictors by including Kidson (2000) synoptic types for New Zealand.
3. Update analysis record to the year 2000.
4. Produce a report of climate factors causing high seasonal fire severity (SSR) for New Zealand.
5. Recommend indication of further work required.

# The Southern Oscillation and Circulation Indices

New Zealand's climate is dominated by its position in relation to the Pacific and Southern Oceans, and by the exposure of its elevated topography to migratory weather systems, of troughs of low pressure and anticyclones, in the predominantly westerly airflow of the southern mid-latitudes (Basher and Thompson, 1996). The Southern Oscillation has an important influence on the climate of New Zealand.

### The El Niño/Southern Oscillation

The El Niño is a natural feature of the global climate system. Originally it was the name given to the periodic development of unusually warm ocean waters along the tropical South American coast and out along the Equator to the dateline. Around thirty years ago, it was realised that the El Niño in the ocean is related to the "Southern Oscillation" in the atmosphere, a quasi-regular pressure seesaw between the western and eastern tropical Pacific. The combined ocean and atmosphere mode of oscillation is called the "El Niño - Southern Oscillation (ENSO) phenomenon".

When an El Niño is not present, trade winds blow westward across the Pacific, piling up warm surface water in the west, so Indonesian sea levels are about 50 cm higher than those in Ecuador. Cool, nutrient rich water wells up off the South American coast, supporting marine ecosystems and fisheries. Rainfall occurs in rising air over the warm water to the west, travels back east at upper levels and sinks again in the east, making the east Pacific relatively dry.

During an El Niño, the trade winds weaken, leading to a rise in sea surface temperature in the eastern equatorial Pacific and a reduction of upwelling off South America. Heavy rainfall and flooding occur over Peru and drought over Indonesia and Australia. The supplies of nutrient rich water off the South American coast are cut off due to the reduced upwelling, adversely affecting fisheries in that region. The region of heaviest rainfall expands eastwards, causing systematic flow-on effects in many parts of the global atmosphere. In the tropical South Pacific the pattern of occurrence of tropical cyclones shifts eastward, so there are more cyclones than normal in areas such as the Cook Islands and French Polynesia.

During a La Niña, the trade winds strengthen, resulting in an enhancement to the "normal" picture of warm waters in the west and cool in the east. Heavy rainfall and flooding now tend to occur over Indonesia and Australia, while droughts become more likely in Peru. In the tropical South Pacific the pattern of occurrence of tropical cyclones tends to be restricted further west than normal.

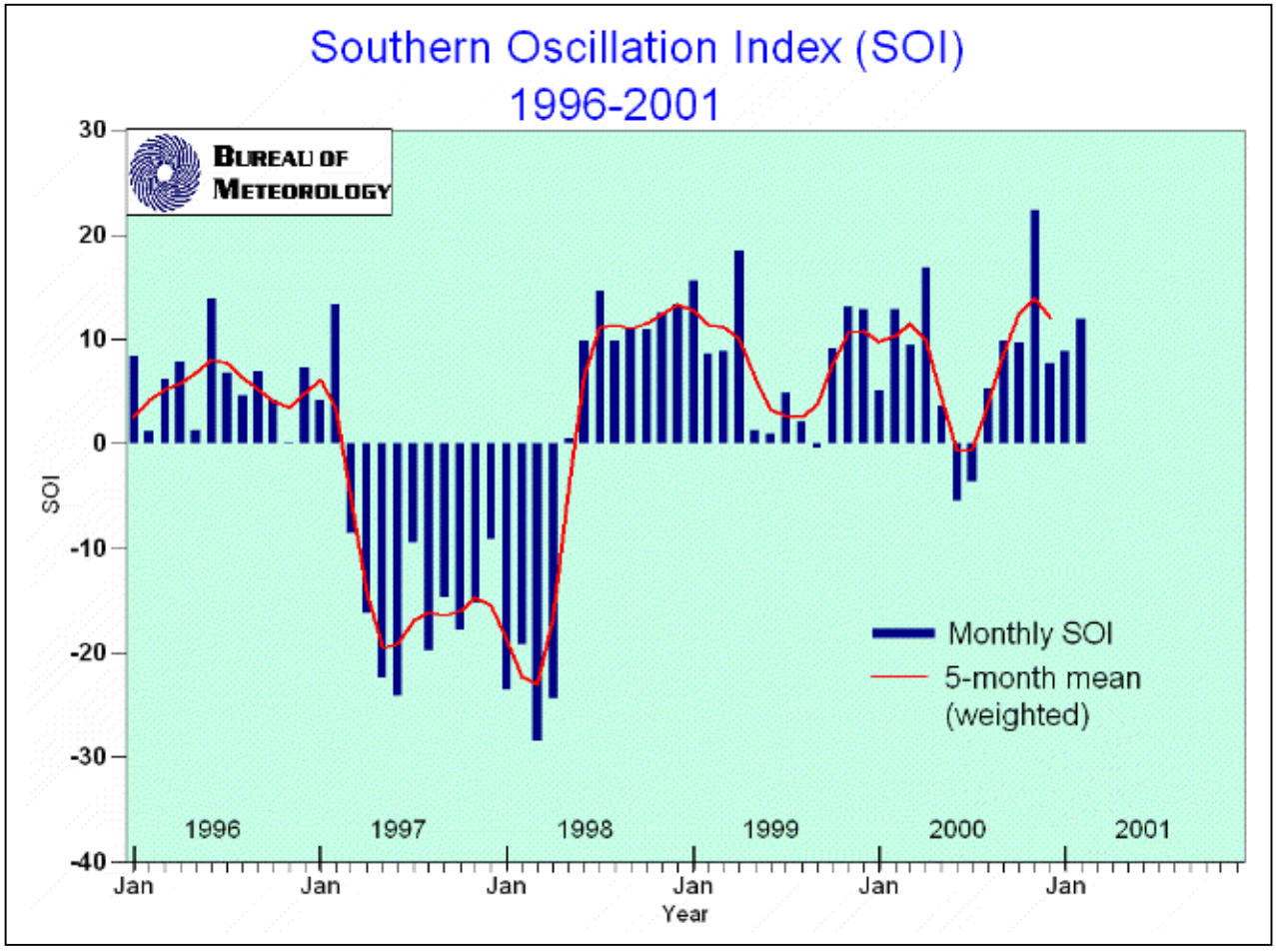



**Figure 1. The Southern Oscillation Index January 1995 – February 2001.**

The Southern Oscillation Index (SOI) is calculated from the pressure difference between Tahiti and Darwin. Anomalously low values of this index correspond to El Niño conditions, while the opposite conditions with an anomalously high SOI value are called La Niña episodes. El Niño and La Niña events occur about every 3 to 7 years, typically becoming established around April or May and persisting for about a year thereafter.

New Zealand is not usually affected as strongly by El Niño conditions as are parts of Australia, but there is nevertheless a significant influence. In El Niño years, New Zealand tends to experience stronger or more frequent winds from the west in summer, leading to drought in East Coast areas

and more rain in the west. In winter, the winds tend to be more from the south, bringing colder conditions to both the land and the surrounding ocean. In spring and autumn southwesterlies tend to be stronger or more frequent, providing a mix of the summer and winter effects.

The La Niña events, which occur at the opposite extreme of the Southern Oscillation Index cycle, have weaker impacts on New Zealand's climate. New Zealand tends to experience more northeasterly winds, which bring moister, rainy conditions to the northeast parts of the North Island. During winter, winds tend to be more from the north, bringing warmer conditions to both the land and sea surrounding the North Island. In spring and autumn more north easterly winds occur, and summer frequent easterly winds occur, particularly over northern New Zealand.

Figure 1 shows the SOI for the period 1995 to present. This shows that the SOI has been at either one of its two extremes during the various seasons analysed here. In 1997/98 the SOI was very strongly negative in a strong El Niño phase. More westerly and southwesterly winds occurred over New Zealand. In the 1998/99 season positive values of the SOI indicated a La Niña episode of moderate intensity, with more northeasterly winds. SOI values have since fluctuated between zero and almost +2 indicating variations in the strength of this long La Niña phase.

## Regional Circulation Indices

As a way of characterising predominant predominant weather patterns on monthly time-scales, a number of circulation indices for the Australia-New Zealand region are used in this study. Circulation indices were first developed by Trenberth (1975, 1976), added to by Salinger and Mullan (1992) and more recently extended by Kidson (2000). A monthly index for a pair of stations is simply the monthly mean pressure difference between the stations less the long-term mean monthly pressure difference calculated over a 30-year "normal" period. . A non-zero index implies an anomalous pressure gradient between the stations and hence an anomalous windflow perpendicular to the gradient. Hence, a north-south pressure difference indicates the strength of the wind in the west-east direction, while an east-west difference indicates north-south wind strength, and so on. The indices can be interpreted as a measure or indicator of the prevalent wind speed and directionThe indices can also be interpreted as a measure or indicator of the prevalent wind speed and direction.

Table 1 gives a list of circulation indices, the first seven of which were defined originally by Trenberth (1975, 1976). The three indices (MZ1, MZ2 and MZ3) were derived to capture aspects of New Zealand's circulation that are neither directly zonal (east/west) nor meridional (north/south). The synoptic circulation types described by Kidson (2000) and listed as the next 12 indices from TSW, T, etc. are given in Table 1 and shown in

Figure 2. The percentage frequency that these occur in any one year is given in Figure 2. Typical wind flow and strength patterns for each of these circulation indices are given in Table 2. Taking the Z1 index for example, a positive anomaly leads to an increase in the strength and frequency of westerlies across New Zealand, while a negative anomaly indicates an increase on the frequency of easterly winds across New Zealand (and by implication reduced westerlies). Many of these circulation indices are correlated and are not completely independent (see Table 3), with correlation coefficients exceeding at least ±0.5 highlighted in bold type.

In contrast, the daily weather pattern identified represent specific synoptic types. Thus a positive correlation with these indicates high fire risk associated with its *presence*, and likewise a negative correlation suggests a low fire risk associated with the occurrence of the type. For example, Tables 4 and 5 show that anticyclones in the central Tasman Sea with southwesterlies over New Zealand

(TNW) have significant positive correlations with SSR for Coromandel and negative correlations with SSR for Hokitika. Thus the higher frequency of this synoptic weather type will *increase* the SSR at Coromandel, and *decrease* the SSR at Hokitika. In contrast, TNW, a higher frequency of troughs in moist north to northwest flow decrease SSR in many localities, and more highs east of the South Island (HSE) increase SSR in many western locations.

**Table 1. Indices of circulation in the New Zealand region**

| Index | Pressure difference/Synoptic Type* | Type |
|---|---|---|
| Z1 | Auckland-Christchurch | Zonal westerlies |
| Z2 | Christchurch-Campbell Island | Zonal westerlies |
| Z3 | Auckland-Invercargill | Zonal westerlies |
| Z4 | Raoul Island- Chatham Island | Zonal westerlies |
| M1 | Hobart-Chatham Islands | Meridional southerlies |
| M2 | Hokitika-Chatham Island | Meridional southerlies |
| M3 | Hobart-Hokitika | Meridional southerlies |
| MZ1 | Gisborne-Hokitika | North-westerly flows |
| MZ2 | Gisborne-Invercargill | North-westerly flows |
| MZ3 | New Plymouth-Chatham Island | South-westerly flows |
| TSW | * Trough/southwesterly | Trough in southwest flow crossing New Zealand |
| T | * Trough | Trough in westerly flow crossing New Zealand |
| SW | * Southwesterly | Southwesterly flows |
| NE | * Northeasterly | Northeasterly flows |
| R | * Ridge | Ridge – light winds over the sotuh, easterlies over the north |
| HW | * High to southwest | High to west of the South Island with light south – southwesterly flows |
| HE | * High to east | High to the east with developing northwesterly flow |
| W | * Westerly | Westerly flow |
| HNW | * High to northwest | High west of the North Island with southwesterly flow |
| TNW | * Trough in northwest | Trough to the west preceeded by northwesterly flow |
| HSE | * High to southeast | High east of the South Island with easterly flow for the North Island and light winds elsewhere |
| H | * High | Light winds – North Island<br>Westerly flow – far south |

Synoptic Types: T indicates a trough in the flow
H indicates an anticyclone or ‘high’
R indicates a ridge of high pressure

**Figure 2. Cluster-mean (1000hPa) flow patterns used to categorise daily weather patterns (Kidson 2000). Percentage values represent the frequency of each type each year over the period studied.**

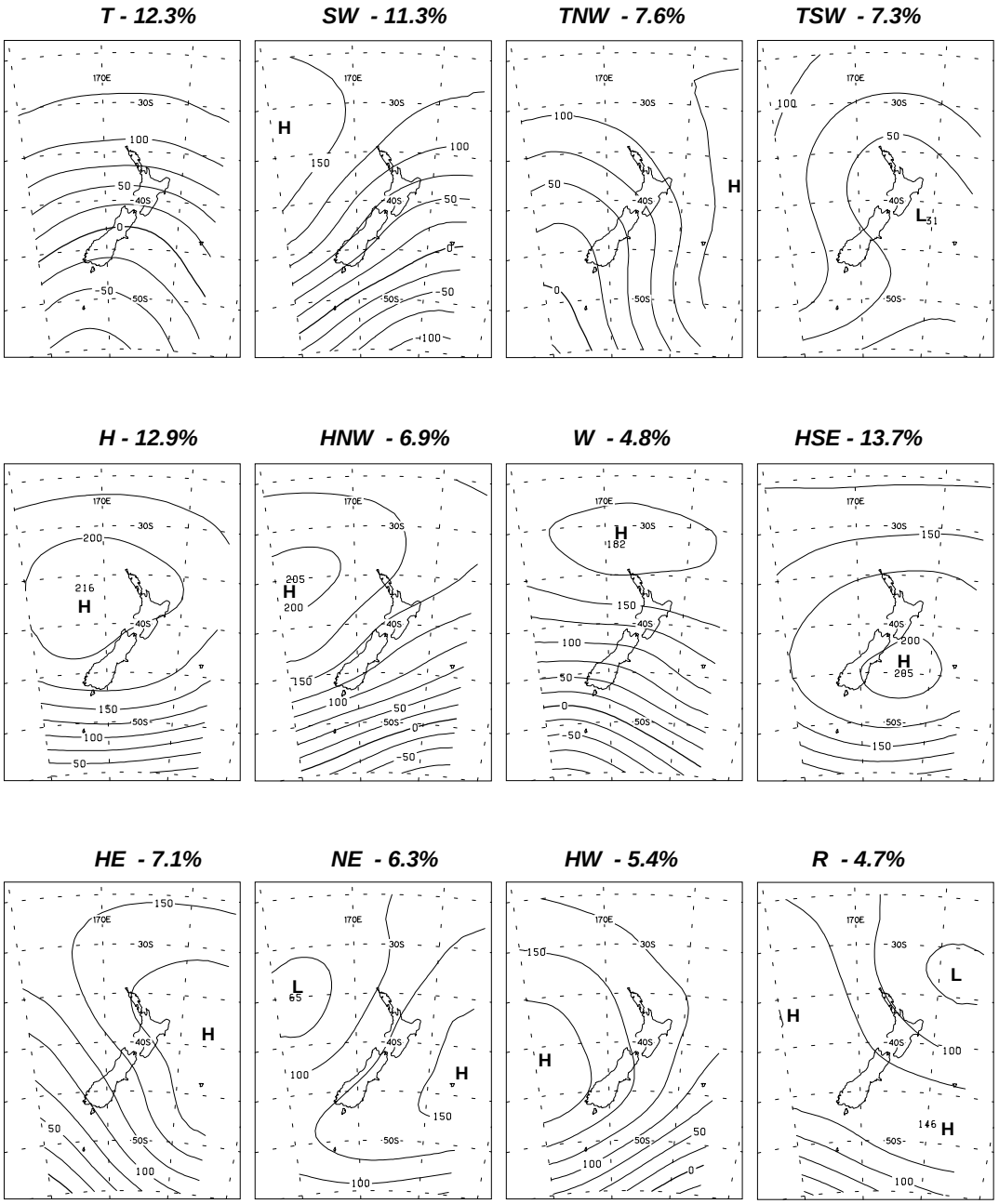


**Table 2. Typical flow patterns associated with circulation index anomalies.**

| Index | Positive anomaly | Negative anomaly |
|---|---|---|
| Z1 | Stronger westerlies over NZ | Stronger easterlies (weaker westerlies) |
| Z2 | Stronger westerlies south of NZ | Easterlies south of NZ |
| Z3 | Stronger west-northwest flow over NZ | East-southeast flow over NZ |
| Z4 | Stronger westerlies northeast of NZ | Easterlies to northeast of NZ |
| M1 | Stronger southerly flow NZ/Tasman | Northerlies over NZ/Tasman |
| M2 | Enhanced southerlies east of NZ | Northerly airflow east of NZ |
| M3 | Stronger southerlies in Tasman | Northerlies in Tasman |
| MZ1 | Stronger NNW especially over central NZ | SSE airflow especially over central NZ |
| MZ2 | Stronger north-westerlies over NZ | South-easterly winds over NZ |
| MZ3 | Stronger south-westerlies over NZ | North-easterlies over NZ |
| TSW | Westerly flows – North Island<br>Easterly flows – South Island | |
| T | Westerly flows | |
| SW | Southwesterly flows | |
| NE | Northeasterly flows | |
| R | Light winds | |
| HW | South – southwesterly flows | |
| HE | Developing northwesterly flows | |
| W | Westerly flows | |
| HNW | Southwesterly flows | |
| TNW | Northwesterly flows | |
| HSE | Easterly flows – North Island<br>Light winds – South Island | |
| H | Light winds – North Island<br>Southwesterly flows – South Island | |

# Methodology

## Stations and Circulation Indices

Linear regression methods are used to examine contemporary relationships with the fire season, and predict the Seasonal Severity Rating (SSR) at thirteen North Island and eight South Island stations. All stations had between 20 and 39 years of record. The predictors used in the study include:

- New Zealand Sea Surface Temperature (SST), a spatially averaged sea surface temperature over the region 30°S-45°S by 160°E -170°W,
- Southern Oscillation Index (SOI),
- The New Zealand regional circulation indices Z1, Z2, Z3, Z4, M1, M2, M3, MZ1, MZ2, MZ3,
- Frequency of occurrence of the synoptic circulation patterns TSW, T, SW, NE, R, HW, HE, W, HNW, TNW, HSE, H.

## Annual and Monthly Correlations with SSR

Relationships between SSR and climate indices for the 21 stations where investigated in two stages. Firstly, and building on the previous work reported in Salinger et al (1998), relationships between seasonal (warm season months from October through to April) SSR data and climate indices were investigated. Secondly, relationships between monthly SSR and climate indices were identified for individual months October through to April.

## Significance test of station correlations

Significance tests were carried out for both seasonal (October to April) and monthly correlation for SSR values. The p-value Pr(>|t|) is an index for the significance of a predictor. The smaller the p-value, the more significant the predictor.

## Linear regression model to predict SSR for each station

Linear regression models were developed using SYSTAT for both seasonal (October to April) indices and monthly indices for each station. Regression models for each station were developed for those indices that had the highest correlation coefficients and predictors with p-values less than 5%.

# Seasonal SSR results

The seasonal time series of the SSR and climate predictors are given in Appendix 1 and 2 respectively.

In this section, the results presented in the tables Table 3 to Table 50 (shown in Appendix 3) give the relationships between the regional fire seasonal severity rating index (SSR) and the circulation indices. Note that the synoptic description refers to the seven-month season, from October to April. Within the general description of the patterns there will be much variation in the overall patterns, on weekly, monthly and seasonal time-scales.

## Correlation between synoptic types and indices

Correlation coefficients between the predictors are listed in Table 3. This identifies which predictor is highly associated with other potential predictors.

The updated data to the year 2000 indicate that the correlations given in Salinger et al (1998) report are quite robsut, as recalculated values are close to those given earlier. For example Z1 vs Z3 and MZ2 has a correlation of 0.96 (0.96) and 0.81 (0.83) in the 1988 (and 2001) reports respectively. Key characteristics of Table 3 indicate the following very high correlations (>|0.8|) and strong correlations (>|0.5|):

The zonal indices over New Zealand of Z1, Z3 and MZ2 are all highly correlated with each other. Zonal index Z1 and MZ2 are also positively correlated with all other Z indices. MZ3, southwesterly flow is highly correlated with westerlies to the east of the North Island Z4) and M2, more southerly flow between New Zealand and the Chatham Islands. The SOI has negative correlations with zonal (westerly flow) and meridional (southerly flow) predictors. MZ3, indicating southwest flow is positively correlated to both zonal and meridional indices. Z1 has relatively high positive correlations with synoptic indices SW and HNW and negative correlations with R which are associated with southwesterly flow and northeasterly flow respectively. Synoptic weather type of southwest flow, SW, is negatively correlated to SOI and SST but positively correlated to zonal, meridional and MZ3 indices. HNW (southwesterly flow) is also positively correlated to zonal, meridional and MZ3 indices. R (with light northeasterly flow) is negatively correlated to MZ2 – which indicates northeast flow. TSW, HW, HE and W synoptic types had no strong correlations with any of the other indices.

## Correlation between Station SSR and climate indices

Correlations between the 21 stations and climate indices is given in Table 4. The bold values in the tables indicate which predictors are strongly correlated for each station.

Again there is a reasonable agreement for some stations in Table 4 with the previous NIWA 1988 report. For example Christchurch has correlations for the Z1 and MZ2 predictors of 0.51 (0.53) and 0.60 (0.61) in the 1988 (and 2001) reports respectively. However some stations had considerable variability, for example Dargaville had correlations for SOI and Z2 predictors of -0.25 (-0.38) and 0.40 (0.28) for the 1988 (and 2001) reports respectively.

Table 4 shows that for the seasons the individual station SSR indices are significantly correlated at the 5% confidence level, indicated in bold to various circulation indices and circulation types.

The SOI is positively correlated to the west coast stations of Hokitika, New Plymouth and Westport. Thus when the SOI is positive, with more easterly or northeasterly flow over New Zealand, fire risk is higher at these locations. In contrast it is negatively associated with the SOI at Gisborne and Kaikoura. When the SOI is negative more west to southwest flow occurs giving higher fire risk seasons in the eastern extremities of both islands. SST is significantly correlated to higher fire risk seasons at New Plymouth, Ohakea, Paraparaumu, Westport, Hokotiak and Queenstown. Thus above average SSTs in the New Zealand region lead to higher fire risk seasons in western areas of both islands.

The indices of zonal (west/east) circulation (Z1, Z2, Z3 and Z4 – westerly flow, and sometimes MZ2 – west to northwest flow) are positively correlated for Corromandel, Gisborne, Wellington and Kaikoura, and negatively correlated with Hokitika. Thus stronger westerly flow increased seasonal fire severity in many eastern regions, but decreased it in Westland. The reverse would be so with more easterlies than normal.

Of the meridional circulation indices (M1, M2 and M3 – southerly flow), M2 (south to southwest flow) had more significant associations. High fire risk seasons were related to more southerly quarter flow in those areas sheltered from the south to southwest – Tauranga, Rotorua, Gisborne, Nelson and Wellington. Invercargill, the most exposed location to this airflow, had low fire risk seasons in these situations. Of the cross-meridional/zonal indices, MZ1 was negatively associated with SSR in Tauranga, Rotorua and Nelson, all sheltered from enhanced southeast flow. Invercargill showed the opposite association. The index of southwest/northeast flow, MZ3, showed several significant relationships. Positive correlations occurred with Gisborne, Wellington, Nelson, Kaikoura and Christchurch, whilst negative correlations occurred with Westport and Hokitika. Thus more southwest flow over the country promotes higher SSRs in the former locations, whilst enahanced northeast flow produces higher SSRs at the two South Island west coast locations.

The relationships between SSR and daily weather types varied. TNW, troughs in northwesterlies gave the highest number of significant site correlations. With a higher occurrence of this type, SSR was reduced at Auckland, Christchurch, Coromandel, Kaikoura, Nelson, Taupo, Tauranga, Wanganui and Wellington. Thus moist northwest flows over the country with troughs reduce SSR in a number of localities. However, anticyclones located west of the South Island with southwest flow (HNW) raised SSR in many locations – Christchurch, Coromandel, Gisborne, Kaikoura, Nelson, Tauranga and Wellington. This same type lowered SSRs in Hokitika. Similarly, SW, southwest flow increased SSR in Gisborne, Kaikoura, Tauranga and Wellington and decreased SSR at Westport. The opposite, northeast flow (NE) lowered fire risk at eastern locations (Christchurch, Coromandel, Gisborne, Kaikoura, Nelson and Tauranga, and raised it on the west coast (Hokitika and Westport). Ridges with easterly flow also lowered SSR at Christchurch, Gisborne and Kaikoura. Anticyclones west of the South Island producing more southerly flow had positive correlations with SSR at Hokitika, but negative correlations with SSR at Gisborne, New Plymouth and Wanganui. Thus fire risk is increased at the former location, and decreased at the latter location in such situations. More anticyclones located just east of the South Island (HSE) increased risk at several sites – Hokitika, New Plymouth, Ohakea, Paraparaumu and Westport (Table 4).

## Significance test for station SSR and regressions

Table 5 shows significance levels [Pr(>|t|)] for linear regression with a single predictor variable for seasonal SSR values. Significance levels of less than 5% are bolded.

Examination of Table 5 indicates that station which have strong correlations |>0.5| between SSR and predictors are significant at the 5% level. Most stations with moderately strong correlations |>0.40| are also significant at (Pr<5%). Dargaville and Dunedin do not have any predictor relationships, which are significant at (Pr<5%). All stations have at least one predictor, which is significant at (Pr<0.1).

## Correlation between stations

Table 50 shows the relationship between station SSR indices, correlations of greater than |0.5| are in bold. Table 50 indicates certain key characteristics. Stations in the north of the North Island generally have strong positive correlations with ea other (Kaitaia, Auckland, Corromandel), as do stations in the north-central North Island (Corromandel, Rotorua, Taupo, Tauranga).

East coast stations have strong positive correlations (Corromandel, Gisborne, Wellington Kaikoura, Christchurch) between each other, and western – central North Island also have strong positive correlations (New Plymouth, Wanganui, Taupo, Tauranga). The southern North Island and northern South Island are also strongly associated with each other (Ohakea, Paraparauma, Nelson). Other stations with positive correlations between each other are the west coast South Island stations, and the southern South Island stations (Queenstown, Dunedin, Invercargill). The grouping of stations into fire weather regions will be the subject of future work.

**Table 3. Correlation coefficients between the seasonal predictors (October – April). Correlation coefficients which are >|0.5| are bolded.**

| | SOI | SST | _Z1 | _Z2 | _Z3 | _Z4 | _M1 | _M2 | _M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SOI** | **1.00** | **0.51** | **-0.65** | -0.31 | **-0.58** | **-0.73** | -0.45 | **-0.50** | -0.19 | 0.19 | -0.32 | **-0.63** | 0.31 | -0.20 | **-0.68** | 0.48 | 0.25 | 0.28 | -0.28 | -0.22 | -0.43 | -0.03 | **0.54** | -0.19 |
| **SST** | | **1.00** | -0.31 | -0.10 | -0.23 | **-0.51** | **-0.56** | -0.39 | -0.45 | 0.15 | 0.00 | -0.46 | -0.13 | -0.44 | **-0.53** | 0.31 | 0.19 | 0.08 | 0.06 | -0.07 | -0.16 | -0.11 | 0.47 | 0.19 |
| **_Z1** | | | **1.00** | **0.52** | **0.96** | **0.74** | 0.30 | 0.36 | 0.11 | 0.21 | **0.83** | **0.61** | -0.41 | 0.47 | **0.59** | -0.45 | **-0.60** | -0.34 | 0.20 | 0.33 | **0.52** | -0.13 | -0.42 | 0.26 |
| **_Z2** | | | | **1.00** | **0.59** | 0.37 | 0.26 | 0.48 | -0.06 | -0.27 | **0.51** | **0.51** | -0.34 | 0.14 | 0.37 | **-0.54** | **-0.53** | -0.07 | 0.05 | 0.34 | **0.66** | **-0.60** | -0.17 | **0.57** |
| **_Z3** | | | | | **1.00** | **0.69** | 0.21 | 0.30 | 0.03 | 0.24 | **0.91** | **0.56** | -0.42 | **0.51** | **0.56** | -0.42 | **-0.59** | -0.36 | 0.18 | 0.32 | **0.53** | -0.19 | -0.37 | 0.25 |
| **_Z4** | | | | | | **1.00** | **0.71** | **0.74** | 0.35 | -0.17 | 0.37 | **0.89** | -0.01 | **0.52** | **0.72** | -0.44 | -0.34 | -0.21 | 0.01 | 0.25 | 0.47 | -0.15 | **-0.70** | 0.06 |
| **_M1** | | | | | | | **1.00** | **0.74** | **0.78** | -0.36 | -0.11 | **0.76** | 0.21 | 0.41 | **0.55** | -0.39 | -0.11 | -0.04 | -0.32 | 0.21 | 0.38 | -0.30 | **-0.54** | 0.06 |
| **_M2** | | | | | | | | **1.00** | 0.17 | **-0.70** | -0.05 | **0.90** | 0.05 | 0.20 | **0.51** | -0.44 | -0.21 | 0.08 | -0.10 | 0.14 | **0.56** | -0.40 | -0.48 | 0.21 |
| **_M3** | | | | | | | | | **1.00** | 0.12 | -0.12 | 0.29 | 0.26 | 0.42 | 0.34 | -0.17 | 0.03 | -0.12 | -0.38 | 0.18 | 0.05 | -0.07 | -0.35 | -0.10 |
| **MZ1** | | | | | | | | | | **1.00** | 0.49 | -0.38 | -0.12 | 0.19 | -0.19 | 0.26 | -0.10 | -0.11 | -0.06 | -0.01 | -0.24 | 0.34 | 0.15 | -0.15 |
| **MZ2** | | | | | | | | | | | **1.00** | 0.22 | -0.46 | 0.42 | 0.30 | -0.25 | **-0.57** | -0.36 | 0.12 | 0.29 | 0.39 | -0.12 | -0.13 | 0.28 |
| **MZ3** | | | | | | | | | | | | **1.00** | -0.03 | 0.35 | **0.62** | -0.47 | -0.33 | 0.00 | -0.08 | 0.19 | **0.62** | -0.31 | **-0.58** | 0.17 |
| **TSW** | | | | | | | | | | | | | **1.00** | 0.18 | -0.27 | 0.34 | 0.02 | -0.01 | -0.29 | 0.01 | -0.42 | 0.11 | -0.32 | -0.25 |
| **T** | | | | | | | | | | | | | | **1.00** | 0.37 | -0.18 | -0.32 | -0.41 | -0.32 | 0.23 | 0.05 | -0.03 | -0.40 | -0.18 |
| **SW** | | | | | | | | | | | | | | | **1.00** | -0.43 | -0.15 | -0.22 | 0.08 | 0.01 | 0.44 | -0.14 | -0.48 | -0.15 |
| **NE** | | | | | | | | | | | | | | | | **1.00** | 0.18 | 0.15 | -0.37 | -0.44 | -0.47 | 0.44 | 0.00 | -0.15 |
| **R** | | | | | | | | | | | | | | | | | **1.00** | 0.13 | -0.07 | -0.33 | -0.32 | 0.18 | 0.18 | -0.36 |
| **HW** | | | | | | | | | | | | | | | | | | **1.00** | -0.09 | -0.47 | 0.06 | 0.04 | 0.18 | -0.19 |
| **HE** | | | | | | | | | | | | | | | | | | | **1.00** | 0.02 | 0.03 | 0.01 | 0.07 | -0.03 |
| **W** | | | | | | | | | | | | | | | | | | | | **1.00** | 0.00 | -0.47 | -0.13 | 0.45 |
| **HNW** | | | | | | | | | | | | | | | | | | | | | **1.00** | -0.37 | -0.21 | 0.29 |
| **TNW** | | | | | | | | | | | | | | | | | | | | | | **1.00** | -0.11 | -0.41 |
| **HSE** | | | | | | | | | | | | | | | | | | | | | | | **1.00** | -0.15 |
| **H** | | | | | | | | | | | | | | | | | | | | | | | | **1.00** |

**Table 4. Correlation coefficients between the 21 stations and seasonal predictors (October – April). Correlation coefficients which are are greater than 5% level are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.00 | 0.15 | -0.09 | 0.17 | -0.11 | -0.04 | 0.15 | 0.20 | 0.04 | **-0.51** | -0.27 | 0.07 | -0.20 | -0.33 | 0.18 | -0.16 | 0.23 | 0.18 | 0.34 | -0.09 | 0.08 | **-0.39** | 0.10 | 0.00 |
| **Christ** | -0.18 | 0.14 | **0.55** | **0.46** | **0.61** | 0.29 | -0.07 | 0.24 | **-0.34** | 0.03 | **0.62** | **0.30** | -0.28 | 0.06 | 0.23 | **-0.38** | **-0.36** | -0.03 | 0.30 | 0.19 | **0.34** | **-0.38** | 0.08 | 0.11 |
| **Corom** | -0.37 | 0.25 | **0.51** | **0.63** | **0.59** | 0.40 | 0.05 | 0.35 | -0.31 | -0.35 | **0.48** | 0.34 | -0.39 | 0.01 | 0.38 | **-0.57** | -0.29 | -0.26 | 0.49 | 0.31 | **0.54** | **-0.52** | -0.07 | 0.17 |
| **Darg** | -0.38 | -0.16 | 0.37 | 0.28 | 0.36 | 0.27 | 0.02 | 0.24 | -0.23 | -0.17 | 0.24 | 0.30 | -0.23 | 0.01 | 0.31 | -0.43 | -0.24 | -0.13 | 0.18 | 0.18 | 0.22 | -0.17 | 0.17 | -0.11 |
| **Dun** | 0.25 | 0.17 | 0.02 | 0.28 | 0.02 | -0.26 | -0.20 | -0.08 | -0.24 | 0.02 | 0.14 | -0.16 | -0.24 | -0.10 | -0.09 | -0.15 | 0.02 | 0.09 | 0.13 | -0.16 | 0.02 | -0.15 | 0.29 | 0.19 |
| **Gisb** | **-0.39** | -0.15 | **0.77** | **0.52** | **0.75** | **0.55** | 0.21 | **0.40** | -0.08 | -0.03 | **0.64** | **0.53** | **-0.40** | **0.34** | **0.56** | **-0.43** | **-0.39** | **-0.31** | 0.12 | 0.24 | **0.52** | -0.25 | -0.25 | 0.19 |
| **Hok** | **0.65** | **0.44** | **-0.60** | **-0.41** | **-0.55** | **-0.52** | **-0.35** | -0.31 | -0.25 | 0.07 | **-0.38** | **-0.45** | 0.25 | -0.24 | **-0.44** | **0.52** | 0.36 | **0.32** | -0.29 | -0.32 | **-0.55** | 0.07 | **0.47** | -0.34 |
| **Inver** | **0.37** | 0.30 | -0.24 | -0.04 | -0.16 | **-0.43** | **-0.37** | **-0.42** | -0.16 | **0.32** | 0.06 | **-0.42** | -0.10 | -0.12 | -0.30 | 0.30 | 0.14 | 0.17 | -0.04 | -0.23 | -0.26 | -0.02 | 0.24 | 0.12 |
| **Kaik** | **-0.39** | 0.06 | **0.72** | **0.42** | **0.73** | **0.55** | 0.20 | 0.29 | 0.01 | 0.04 | **0.64** | **0.43** | **-0.34** | 0.19 | **0.47** | **-0.49** | -0.33 | -0.25 | 0.28 | **0.39** | **0.52** | -0.35 | -0.20 | 0.13 |
| **Kait** | 0.27 | 0.26 | -0.16 | 0.23 | -0.12 | -0.18 | 0.01 | 0.18 | -0.17 | **-0.41** | -0.19 | 0.09 | -0.22 | -0.10 | -0.10 | -0.15 | 0.28 | 0.23 | 0.05 | -0.19 | 0.23 | -0.32 | 0.28 | -0.11 |
| **Nel** | -0.23 | 0.14 | 0.24 | **0.42** | 0.24 | 0.17 | 0.08 | **0.40** | -0.28 | -0.38 | 0.10 | **0.34** | -0.26 | -0.18 | 0.23 | **-0.35** | -0.13 | 0.06 | **0.33** | 0.04 | **0.39** | **-0.45** | 0.07 | 0.17 |
| **New P** | **0.52** | **0.46** | -0.33 | 0.07 | -0.18 | -0.40 | -0.21 | -0.32 | 0.01 | 0.14 | 0.03 | -0.37 | 0.21 | 0.08 | **-0.45** | 0.04 | 0.08 | **-0.53** | -0.24 | 0.30 | -0.30 | -0.33 | **0.52** | 0.20 |
| **Ohak** | 0.16 | **0.57** | -0.12 | 0.13 | -0.01 | -0.30 | **-0.38** | -0.11 | **-0.46** | -0.09 | 0.13 | -0.16 | -0.22 | -0.24 | -0.19 | 0.14 | 0.04 | -0.08 | -0.03 | -0.15 | 0.13 | -0.07 | **0.38** | 0.13 |
| **Parap** | 0.18 | **0.44** | -0.29 | -0.03 | -0.27 | **-0.34** | -0.32 | -0.03 | **-0.48** | -0.22 | -0.24 | -0.16 | -0.12 | **-0.47** | -0.28 | 0.10 | 0.14 | 0.22 | 0.21 | -0.17 | -0.08 | -0.15 | **0.47** | 0.00 |
| **Queen** | 0.25 | **0.45** | -0.08 | 0.29 | 0.04 | -0.25 | -0.09 | -0.17 | 0.03 | 0.03 | 0.23 | -0.21 | -0.09 | 0.11 | 0.00 | 0.06 | -0.03 | -0.14 | -0.23 | 0.00 | -0.05 | -0.42 | 0.25 | 0.22 |
| **Rotor** | -0.19 | 0.09 | 0.07 | 0.25 | 0.05 | 0.13 | 0.17 | 0.38 | -0.12 | **-0.56** | -0.14 | 0.27 | -0.22 | -0.27 | 0.26 | -0.27 | 0.22 | -0.15 | 0.25 | 0.13 | 0.16 | -0.31 | 0.06 | 0.05 |
| **Taupo** | 0.01 | 0.34 | -0.02 | 0.24 | 0.08 | -0.02 | 0.10 | 0.05 | 0.11 | -0.20 | 0.08 | 0.01 | 0.03 | 0.03 | 0.08 | -0.35 | 0.00 | 0.02 | -0.17 | 0.18 | 0.07 | **-0.56** | 0.38 | 0.22 |
| **Taur** | -0.36 | -0.06 | 0.27 | **0.52** | 0.31 | 0.28 | 0.15 | **0.39** | -0.17 | **-0.44** | 0.13 | 0.37 | -0.31 | -0.18 | **0.38** | **-0.49** | -0.12 | -0.23 | 0.35 | 0.21 | **0.41** | **-0.50** | 0.06 | 0.20 |
| **Wang** | 0.14 | **0.47** | 0.16 | **0.49** | 0.32 | 0.10 | 0.03 | 0.08 | -0.04 | -0.08 | 0.39 | 0.08 | -0.01 | 0.15 | -0.04 | -0.30 | -0.21 | **-0.55** | -0.06 | **0.48** | 0.15 | **-0.68** | 0.20 | 0.42 |
| **Well** | -0.22 | 0.07 | **0.49** | **0.54** | **0.53** | **0.37** | 0.13 | **0.47** | -0.25 | -0.26 | **0.44** | **0.50** | -0.34 | 0.08 | **0.33** | -0.24 | -0.35 | 0.06 | 0.05 | -0.02 | **0.69** | -0.29 | -0.15 | 0.18 |
| **West** | **0.57** | **0.52** | -0.28 | -0.29 | -0.23 | **-0.51** | **-0.39** | -0.36 | -0.24 | 0.25 | -0.02 | **-0.41** | -0.09 | -0.13 | -0.29 | **0.39** | 0.26 | 0.17 | -0.14 | **-0.43** | -0.16 | 0.04 | **0.52** | -0.26 |

**Table 5. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for season (October – April). Values which are less than 5% are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.995 | 0.403 | 0.590 | 0.307 | 0.529 | 0.817 | 0.373 | 0.226 | 0.851 | **0.002** | 0.129 | 0.552 | 0.242 | 0.059 | 0.299 | 0.352 | 0.278 | 0.274 | 0.051 | 0.605 | 0.517 | **0.021** | 0.553 | 0.975 |
| **Christ** | 0.282 | 0.389 | **0.000** | **0.003** | **0.000** | 0.073 | 0.687 | 0.127 | **0.034** | 0.869 | **0.000** | **0.038** | 0.076 | 0.753 | 0.158 | **0.015** | **0.016** | 0.884 | 0.065 | 0.244 | **0.020** | **0.016** | 0.585 | 0.515 |
| **Corom** | 0.100 | 0.266 | **0.018** | **0.002** | **0.005** | 0.074 | 0.843 | 0.121 | 0.171 | 0.125 | **0.028** | 0.128 | 0.078 | 0.977 | 0.088 | **0.007** | 0.204 | 0.255 | 0.025 | 0.173 | **0.011** | **0.015** | 0.761 | 0.457 |
| **Darg** | 0.089 | 0.485 | 0.098 | 0.211 | 0.105 | 0.238 | 0.922 | 0.288 | 0.312 | 0.449 | 0.295 | 0.192 | 0.307 | 0.972 | 0.169 | 0.052 | 0.288 | 0.561 | 0.445 | 0.447 | 0.337 | 0.458 | 0.474 | 0.632 |
| **Dun** | 0.142 | 0.320 | 0.957 | 0.074 | 0.903 | 0.121 | 0.259 | 0.749 | 0.143 | 0.968 | 0.418 | 0.505 | 0.136 | 0.524 | 0.609 | 0.354 | 0.879 | 0.543 | 0.426 | 0.333 | 0.710 | 0.331 | 0.076 | 0.256 |
| **Gisb** | **0.017** | 0.385 | **0.000** | **0.001** | **0.000** | **0.000** | 0.244 | **0.023** | 0.653 | 0.908 | **0.000** | **0.001** | **0.020** | **0.037** | **0.000** | **0.009** | **0.032** | **0.050** | 0.489 | 0.139 | **0.002** | 0.150 | 0.130 | 0.275 |
| **Hok** | **0.000** | **0.008** | **0.000** | **0.017** | **0.001** | **0.001** | **0.045** | 0.107 | 0.135 | 0.718 | **0.024** | **0.014** | 0.195 | 0.153 | **0.009** | **0.002** | 0.065 | **0.047** | 0.095 | 0.056 | **0.002** | 0.754 | **0.004** | 0.051 |
| **Inver** | **0.020** | 0.064 | 0.141 | 0.823 | 0.325 | **0.006** | **0.021** | **0.009** | 0.325 | **0.044** | 0.702 | **0.007** | 0.549 | 0.461 | 0.067 | 0.059 | 0.395 | 0.297 | 0.800 | 0.161 | 0.102 | 0.906 | 0.151 | 0.484 |
| **Kaik** | **0.020** | 0.735 | **0.000** | **0.010** | **0.000** | **0.001** | 0.254 | 0.081 | 0.950 | 0.820 | **0.000** | **0.007** | **0.045** | 0.289 | **0.004** | **0.003** | **0.048** | 0.157 | 0.098 | **0.022** | **0.001** | **0.038** | 0.271 | 0.448 |
| **Kait** | 0.130 | 0.151 | 0.421 | 0.247 | 0.541 | 0.328 | 0.986 | 0.424 | 0.381 | 0.025 | 0.312 | 0.868 | 0.303 | 0.618 | 0.551 | 0.437 | 0.062 | 0.268 | 0.782 | 0.337 | 0.342 | 0.094 | 0.143 | 0.545 |
| **Nel** | 0.170 | 0.421 | 0.159 | **0.009** | 0.161 | 0.313 | 0.623 | **0.016** | 0.098 | **0.021** | 0.538 | **0.038** | 0.133 | 0.287 | 0.164 | **0.031** | 0.464 | 0.734 | **0.048** | 0.829 | **0.018** | **0.005** | 0.689 | 0.311 |
| **NewP** | 0.009 | **0.023** | 0.115 | 0.759 | 0.413 | 0.052 | 0.333 | 0.122 | 0.970 | 0.520 | 0.872 | 0.072 | 0.333 | 0.695 | **0.028** | 0.853 | 0.727 | **0.008** | 0.260 | 0.150 | 0.150 | 0.113 | **0.009** | 0.355 |
| **Ohak** | 0.366 | **0.000** | 0.536 | 0.503 | 0.972 | 0.082 | **0.022** | 0.469 | **0.005** | 0.657 | 0.452 | 0.246 | 0.244 | 0.174 | 0.268 | 0.401 | 0.687 | 0.575 | 0.844 | 0.418 | 0.571 | 0.723 | **0.032** | 0.467 |
| **Parap** | 0.301 | **0.007** | 0.076 | 0.889 | 0.102 | **0.037** | 0.059 | 0.954 | **0.002** | 0.181 | 0.159 | 0.440 | 0.440 | **0.003** | 0.095 | 0.551 | 0.500 | 0.174 | 0.210 | 0.291 | 0.771 | 0.340 | **0.003** | 0.989 |
| **Queen** | 0.280 | **0.042** | 0.743 | 0.209 | 0.863 | 0.270 | 0.689 | 0.472 | 0.896 | 0.912 | 0.326 | 0.353 | 0.685 | 0.645 | 0.994 | 0.798 | 0.887 | 0.548 | 0.305 | 0.992 | 0.826 | 0.060 | 0.281 | 0.328 |
| **Rotor** | 0.275 | 0.596 | 0.700 | 0.142 | 0.778 | 0.456 | 0.329 | **0.024** | 0.504 | **0.000** | 0.431 | 0.096 | 0.200 | 0.117 | 0.124 | 0.110 | 0.216 | 0.386 | 0.142 | 0.442 | 0.325 | 0.074 | 0.732 | 0.792 |
| **Taupo** | 0.151 | 0.119 | 0.248 | 0.293 | 0.389 | 0.320 | 0.936 | 0.861 | 0.952 | 0.114 | 0.299 | 0.763 | 0.922 | 0.218 | 0.761 | 0.475 | 0.232 | 0.937 | 0.735 | 0.433 | 0.568 | **0.004** | 0.077 | 0.893 |
| **Taur** | 0.056 | 0.753 | 0.162 | **0.004** | 0.106 | 0.144 | 0.430 | **0.034** | 0.372 | **0.017** | 0.514 | 0.051 | 0.106 | 0.343 | **0.045** | **0.008** | 0.548 | 0.222 | 0.063 | 0.268 | **0.026** | **0.006** | 0.746 | 0.298 |
| **Wang** | 0.534 | **0.033** | 0.494 | **0.023** | 0.157 | 0.653 | 0.903 | 0.728 | 0.854 | 0.729 | 0.082 | 0.739 | 0.965 | 0.509 | 0.850 | 0.185 | 0.359 | **0.010** | 0.795 | **0.028** | 0.503 | **0.001** | 0.389 | 0.059 |
| **Well** | 0.171 | 0.664 | **0.001** | **0.001** | **0.000** | **0.019** | 0.486 | **0.005** | 0.130 | 0.124 | **0.005** | **0.004** | 0.056 | 0.571 | **0.044** | 0.156 | 0.065 | 0.834 | 0.799 | 0.924 | **0.000** | 0.100 | 0.339 | 0.278 |
| **West** | **0.001** | **0.004** | 0.148 | 0.128 | 0.231 | **0.005** | **0.039** | 0.052 | 0.212 | 0.186 | 0.915 | **0.028** | 0.643 | 0.487 | 0.123 | **0.036** | 0.167 | 0.373 | 0.475 | **0.020** | 0.421 | 0.833 | **0.004** | 0.172 |

# Monthly MSR results

Results of the month-by-month correlations and significance test of station MSR (monthly severity rating) versus predictors is given in Appendix 4.

In this section, the results presented in the tables Table 51 to Table 64 (shown in Appendix 4) give the relationships between the regional fire seasonal severity rating index (MSR) for each month and the circulation indices. Each month, for example October, has a table giving correlation of October Severity Rating versus predictor (Table 51) and October Significance Test for severity rating versus predictor (Table 52).

There is considerable variation from month to month of significant correlations between station MSR's and predictors. For example Christchurch has strong positive correlations (which are significant at the 5% level) between MSR and zonal predictors Z1, Z2 and Z3 for the months October, November, December and March, but not January, February and April. A similar theme is found in many stations.

The variation from month to month and seasonal significant correlation at the 5% level between MSR and predictors is shown in Table 45. Monthly (October to April) correlations between station MSR and predictors is given in, Table 51, Table 55, Table 57, Table 59, Table 61, Table 63 and the significance of the MSR versus predictor relationships in Table 52, Table 54, Table 56, Table 58, Table 60, Table 62, Table 64. Significant correlations are bolded in the tables.

In general more stations have significant correlations (at 5% level) in spring and early summer (October, November, December, January) than in late summer and autumn (February, March and April). The above tables indicate in general all stations had at least one significant correlation (at the 5% level) for the months October through to January. However in February (Invercargill and Wanganui), March (Auckland and Coromandel) and April (Queenstown) only had significant correlations at the 10% level. In April Dunedin had no significant correlations between MSR and climate predictors.

# Site Specific Relationships

Each of the 21 sites is presented in the following format. A synopsis of the major climate predictors resulting in high SSR season and low SSR are described, based on data from Table 4 and Table 5. A similar description is then provided for the monthly MSR situations that are linked to climate predictors for high fire risk, based on data presented in Appendix 4 (Table 51 to Table 64).

A figure is presented of the highest correlation between the station SSR and MSR values and climate predictors. Note that the correlations presented are only for those predictors that result in high SSR and MSR and not low SSR or MSR. As above, data is extracted from Table 4 and from Table 51 to Table 64.

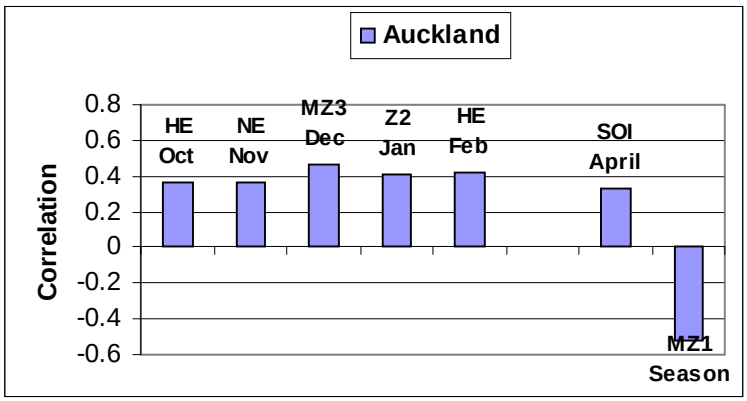
The top prediction equations and regression models for the station SSR are presented. Some stations like Auckland only had one significant relationship (at thr 5% level) and thus only one prediction equation and regression model is presented. The monthly MSR prediction equations and regression models are presented in Appendix 5.

## Auckland

Significant correlations between Auckland SSR values and climate predictors were found for -MZ1 and -TNW. Hence high SSR seasons occur when there is a predominance south easterly winds and low SSR seasons with troughs in north to northwest flows affecting Auckland. High monthly MSRs showed a progression from anticyclones east of the North Island in spring producing dry light northerly quarter winds (HE and NE), to anticyclones predominating in the Tasman Sea, or over northern New Zealand in December. This changed back to anticyclones to the east with light northerly flows over the region in February (HE) (see Figure 3).

Low monthly MSRs occurred in December with troughs and southwesterlies (TSW), and again in January, but also with troughs in north to northwesterlies (TNW). In February troughs over New Zealand and more northerlies than usual (T, M1) caused lower MSR values. Southwest flow (SW) in April also lowered the fire risk. Thus for the Auckland locality high fire risk is more likely in the late spring and early summer period under anticyclonic conditions, particularly when the ‘high’s are located east of the North Island.

**Figure 3**. **Highest significant correlation for Auckland SSR/MSR and climate predictors**.




**The prediction equation for Auckland SSR is:**
SSR = 2.11 – 0.10 MZ1 (Table 6)

**Table 6**. **Regression models for Auckland SSR**

Explained variance (predictability) is 27%
Pearson correlation is –0.52

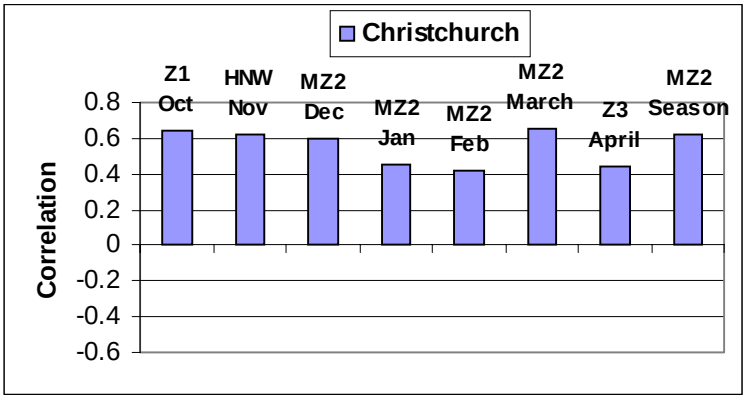
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.1112 | 0.1471 | 14.3552 | 0 |
| MZ1 | -0.0964 | 0.0287 | -3.3566 | 0.0021 |

## Christchurch

Significant correlations between Christchurch SSR values and climate predictors were found for Z1, Z2, Z3, -M3, MZ2, MZ3, -NE, -R, HNW and – TNW. Hence high SSR seasons are found with southwesterly, westerly, northwesterly and northerly flow and anticyclones predominating over the Tasman Sea. Low SSR values are associated with northeasterly flow and troughs over the South Island associated with northwesterly flow (see Figure 4)

High monthly MSR occur under westerly, northwesterly and northerly flow for most months October through to April. High MSR are also associated with anticyclones to the northwest, north and northeast between November and December and troughs to the south and southeast causing westerly and southwesterly flow especially in October and April. Low MSR values are found during November to March when troughs occur over New Zealand and result in northwesterly and southwesterly flow.

**Figure 4. Highest significant correlation for Christchurch SSR/MSR and climate predictors**




**The predicted equations for Christchurch SSR are:**
SSR = 5.276 + 0.173 MZ2 (Table 7)
SSR = 5.382 + 0.127 Z3 (Table 8).

**Table 7. Regression model MZ2 for Christchurch SSR**

Explained variance (predictability) is 38%
Pearson correlation is 0.62

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.276 | 0.3245 | 16.2595 | 0 |
| MZ2 | 0.1729 | 0.036 | 4.8074 | 0 |

**Table 8. Regression model Z3 for Christchurch SSR**

Explained variance (predictability) is 37%
Pearson correlation is 0.61

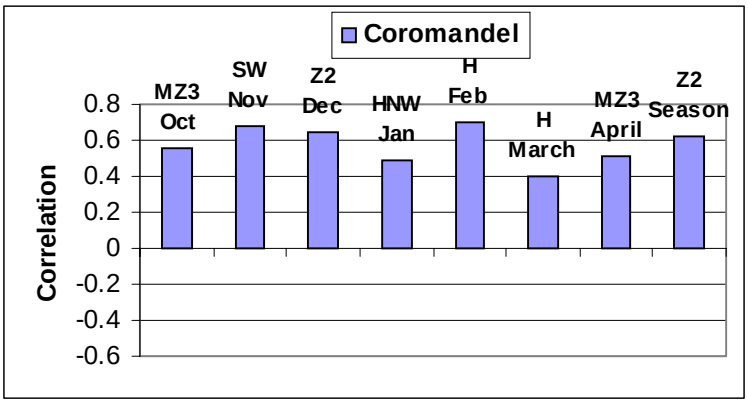
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.3817 | 0.3243 | 16.5964 | 0 |
| Z3 | 0.1266 | 0.0272 | 4.6557 | 0 |

## Coromandel

Significant correlations between Coromandel SSR values and climate predictors were found for Z1, Z2, Z3, MZ2, -NE, HNW, -TNW. Hence high SSR seasons are associated with westerly and northwesterly flow and anticyclones in the Tasman Sea. Likewise low SSR are associated with northeasterly flow and a trough over New Zealand with northwesterly flow (see Figure 5)

High monthly MSR occur under south and southwesterly flow for the months October to February and westerly flow from November to February. Furthermore anticyclones over the Tasman Sea from October through to February are also associated with high MSR values while troughs to the northwest and southwest result in low MSR values. In March there are no significant correlations, and in April only SOI and southwesterly flow are associated with MSR and climate predictors.

**Figure 5. Highest significant correlation for Coromandel SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 0.931 + 0.016 Z2 (Table 9)
SSR = 1.395 – 0.007 NE (Table 10).

**Table 9. Regression model Z2 for Coromandel SSR**

Explained variance (predictability) is 40%
Pearson correlation is 0.63

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9314 | 0.0675 | 13.792 | 0 |
| Z2 | 0.0157 | 0.0044 | 3.5337 | 0.0022 |

**Table 10. Regression model NE for Coromandel SSR**

Explained variance (predictability) is 33%
Pearson correlation is –0.57

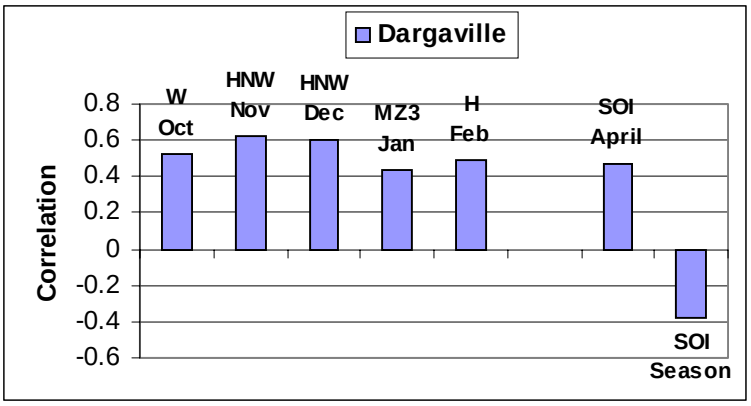
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.3947 | 0.1676 | 8.3214 | 0 |
| NE | -0.0071 | 0.0023 | -3.0415 | 0.0067 |

## Dargaville

Dargaville has only weak significant correlations (at 10% level) between SSR values and climate predictors –SOI, Z1 and –NE. Hence high SSR seasons occur when there is a predominance of westerly winds and negatively correlated to SOI. Likewise low SSR is weakly associated with northeast flow (see Figure 6)

High monthly MSR occur under westerly, southwesterly flow from November to January, and under northerly flow during October and February. March and April however have no significant association between MSR and wind flow. The months November and December are also associated with high MSR when anticyclones are situated to the west and north of the North Island.

**Figure 6. Highest correlations for Dargaville SSR/MSR and climate predictors**




**The predicted equation is:**
SSR = 0.786 – 0.015 SOI (Table 11).

**Table 11. Regression model SOI for Dargaville SSR**

Explained variance (predictability) is 15%
Pearson correlation is –0.38

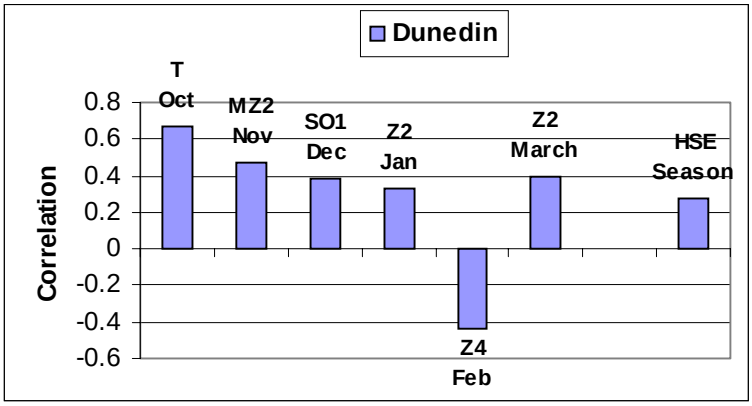
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.7859 | 0.1002 | 7.8394 | 0 |
| SOI | -0.0153 | 0.0085 | -1.795 | 0.0886 |

## Dunedin

Only weakly significant (at 10% level) correlations between Dunedin SSR values and climate predictors were found for Z2 and HSE. Hence high SSR is likely to be associated with westerly winds and anticyclonic conditions to the east of the South Island (see Figure 7).

Dunedin shows variable monthly patterns between high MSR and climate predictors. During spring (October – November) high MSR occurs with southwesterly to northwesterly flow with troughs to the south and anticyclones in the north Tasman Sea. Low MSR during spring is associated with troughs over North Island and anticyclone to east of the South Island. By December, high MSR is only associated with the SOI. In January a weak association with high MSR is found with westerly winds and in February this is reversed to easterly and northerly flow. By March high MSR is again associated with westerly and northerly flow. In April there are no significant relationships with MSR.

**Figure 7. Highest significant correlation for Dunedin SSR/MSR and climate predictors**




**The predicted equations are**
SSR = 1.195 + 0.005 HSE (Table 12)
SSR = 1.932 + 0.019 Z2 (Table 13).

**Table 12. Regression model HSE for Dunedin SSR**

Explained variance (predictability) is 8%
Pearson correlation is 0.28

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.1945 | 0.487 | 2.4525 | 0.0195 |
| HSE | 0.005 | 0.0029 | 1.704 | 0.0975 |

**Table 13. Regression model Z2 for Dunedin SSR**

Explained variance (predictability) is 8%
Pearson correlation is 0.28

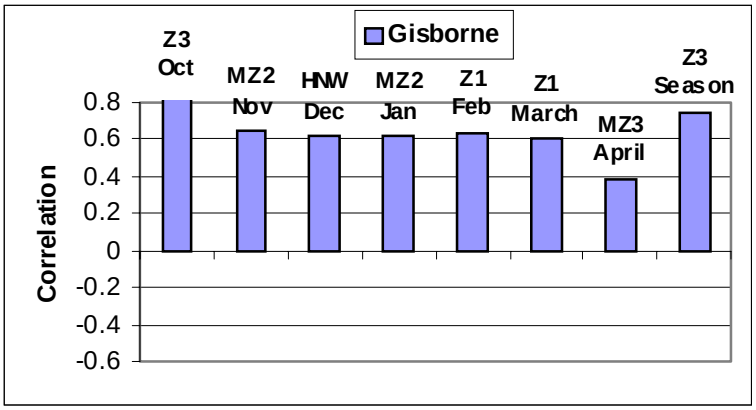
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.9323 | 0.1614 | 11.973 | 0 |
| Z2 | 0.0191 | 0.0113 | 1.6926 | 0.0997 |

## Gisborne

Significant correlations between Gisborne SSR values and climate predictors were found for Z1, Z2, Z3, Z4, M2, MZ2, MZ2, -TSW, T, SW, -NE, R, -HW and HNW. Hence high SSR seasons occur under northwesterly to southerly wind flow, troughs to the south and anticyclones over the north Tasman Sea. Low SSR seasons occur with troughs over the South Island and ridging of anticyclone over the South Island (see Figure 8)

For most months high monthly MSR occur under southwesterly, westerly and northwesterly air flows with troughs to the south of the South Island and anticyclones over the north Tasman Sea. Low MSR values are associated with troughs over the North Island and ridging anticyclones over the South Island with southerly flow.

**Figure 8. Highest significant correlation for Gisborne of monthly SSR and climate predictors**




**The predicted equations are**
SSR = 4.183 + 0.151 Z3 (Table 14)
SSR = 4.212 + 0.163 MZ2 (Table 15).

**Table 14. Regression model Z3 for Gisborne SSR**

Explained variance (predictability) is 56%
Pearson correlation is 0.75

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 4.183 | 0.2728 | 15.3337 | 0 |
| Z3 | 0.1511 | 0.0225 | 6.7239 | 0 |

**Table 15. Regression model MZ2 for Gisborne SSR**

Explained variance (predictability) is 38%
Pearson correlation is 0.62

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 4.2118 | 0.3257 | 12.9334 | 0 |
| MZ2 | 0.1631 | 0.035 | 4.6547 | 0 |

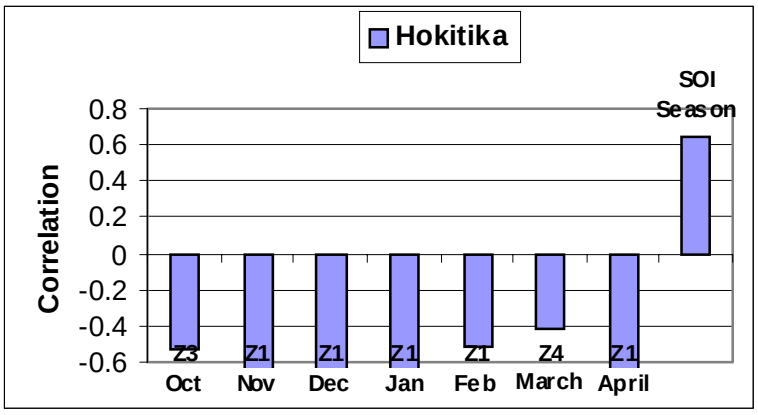
## Hokitika

Significant correlations between Hokitika SSR values and climate predictors were found for SOI, SST, -Z1, -Z2, -Z3, –Z4, -M1, -MZ2, -MZ3, -SW, NE, HW, -HNW, HSE. Hence high SSR seasons occur under northeasterly to southeasterly flow, a ridge of high pressure to east and west of the South Island and a trough over North Island. Low SSR seasons are associated with southwesterly flow and anticyclonic circulation over the north Tasman Sea (see Figure 9).

High monthly SSR are found in most months under easterly, southeast and northeast wind flow, troughs over the North Island and ridging anticyclones to the west and east of the South Island.

Low MSR, like the SSR, are associated with southwesterly flow, troughs to the south of South Island and anticyclonic circulation over the Tasman Sea.

**Figure 9. Highest significant correlation for Hokitika of monthly SSR and climate predictors**




**The predicted equations are:**
SSR = 0.176 + 0.005 SOI (Table 16)
SSR = 0.169 – 0.005 Z1 (Table 17).

**Table 16. Regression model SOI for Hokitika SSR**

Explained variance (predictability) is 42%
Pearson correlation is 0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1758 | 0.0118 | 14.8844 | 0 |
| SOI | 0.0053 | 0.0011 | 4.8836 | 0 |

**Table 17. Regression model Z1 for Hokitika SSR**

Explained variance (predictability) is 37%
Pearson correlation is -0.61

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1692 | 0.0121 | 14.0118 | 0 |
| Z1 | -0.0047 | 0.0011 | -4.3841 | 0.0001 |

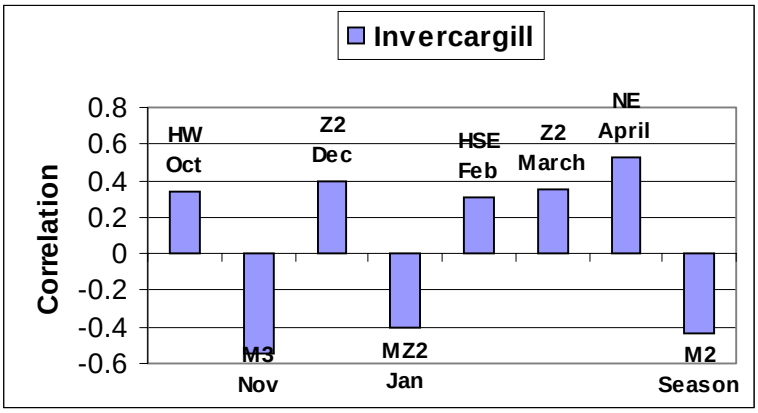
## Invercargill

Significant correlations between Invercargill SSR values and climate predictors were found for SOI, M2, M3, MZ1 and MZ3. Hence high SSR seasons occur when there is a predominance of northerly, northeast and northwest wind flow (see Figure 10).

High monthly MSR occur with anticyclones either centered to the west (October and December) or to the east (November) of the South Island and associated northerly and easterly wind flow

(November , December and January). February and March only have weak associations and a tendency of high MSR with westerly flow. By April high MSR is established with northeasterly flow. Low MSR tend to be associated with troughs to the south and southeast of the South Island.

**Figure 10. Highest significant correlation for Invercargill SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 0.693 – 0.012 M2 (Table 18)
SSR = 0.702 – 0.007 Z4 (Table 19)

**Table 18. Regression model M2 for Invercargill SSR**

Explained variance (predictability) is 19%
Pearson correlation is -0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.693 | 0.0424 | 16.352 | 0 |
| M2 | -0.0122 | 0.0041 | -2.9657 | 0.0053 |

**Table 19. Regression model Z4 for Invercargill SSR**

Explained variance (predictability) is 18%
Pearson correlation is -0.43

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.7015 | 0.0426 | 16.4711 | 0 |
| Z4 | -0.0067 | 0.0023 | -2.8828 | 0.0065 |

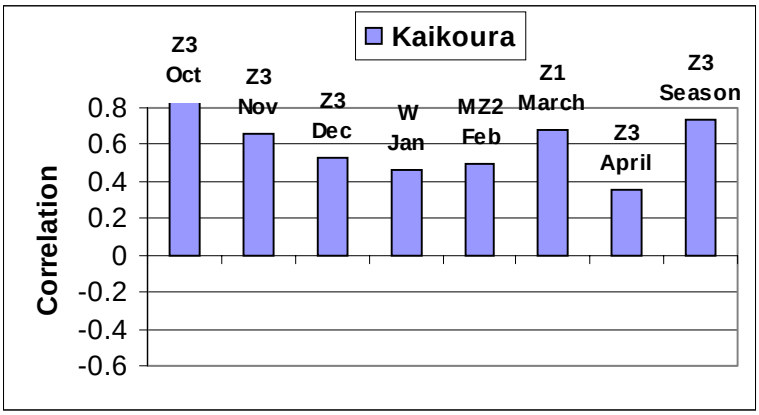
## Kaikoura

Significant correlations between Kaikoura SSR values and climate predictors were found for -SOI, Z1, Z2, Z3, MZ2, MZ3, -TSW, SW, -NE, W, HNW. Hence high SSR seasons occur with westerly, northwesterly and southwesterly flow, and anticyclones to the northwest and north of the North Island and troughs to the south and south east of the South Island (see Figure 11).

High monthly MSR occur for months October to March with troughs to the south and southeast of South Island and anticyclones to the northwest and north of the North Island with associated

westerly, northwesterly and south westerly flow. In April MSR has only a weaker association with westerly flow.

**Figure 11. Highest significant correlation for Kaikoura SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 1.343 + 0.056 Z3 (Table 20)
SSR = 1.321 + 0.064 MZ2 (Table 21).

**Table 20. Regression model Z3 for Kaikoura SSR**

Explained variance (predictability) is 53%
Pearson correlation is 0.73

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.3428 | 0.1102 | 12.1881 | 0 |
| Z3 | 0.0561 | 0.0091 | 6.1432 | 0 |

**Table 21. Regression model MZ2 for Kaikoura SSR**

Explained variance (predictability) is 40%
Pearson correlation is 0.64

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.3213 | 0.1256 | 10.5206 | 0 |
| MZ2 | 0.0644 | 0.0136 | 4.7372 | 0 |

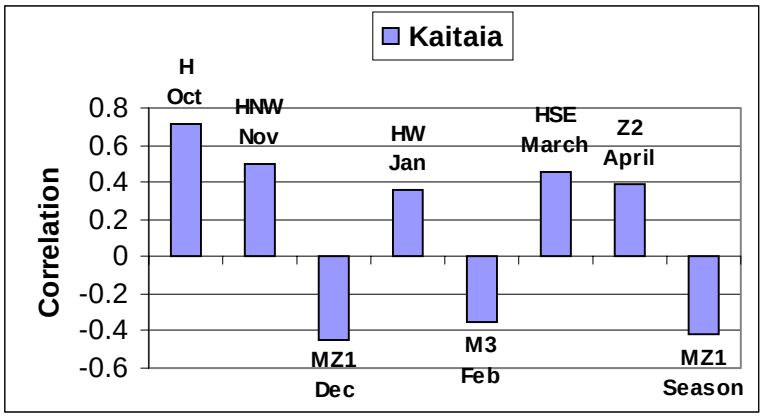
## Kaitaia

Significant correlation between Kaitaia SSR values and climate predictors were only found for (–MZ1). This indicates that high SSR seasons occur with southeasterly wind flow anomalies (see Figure 12).

From October to January high monthly MSR tend to occur under anticyclonic circulation to the north, northwest and west of the North Island that is associated with westerly, southerly and southeast flow. Low MSR during this period is associated with troughs to the south, southeast and

west of New Zealand. By February and March the strongest association with high MSR tends to be with southerly winds and anticyclones situated to the south east of New Zealand. In April high MSR is linked to the zonal westerly flow.

**Figure 12. Highest significant correlation for Kaitaia SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 2.092 – 0.081 MZ1 (Table 22).
SSR = 2,780 – 0.011 TNW (Table 23).

**Table 22. Regression model MZ1 for Kaitaia SSR**

Explained variance (predictability) is 18%
Pearson correlation is –0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.092 | 0.1526 | 13.7103 | 0 |
| MZ1 | -0.0811 | 0.0316 | -2.5648 | 0.0156 |

**Table 23. Regression model TNW for Kaitaia SSR**

Explained variance (predictability) is 11%
Pearson correlation is –0.32

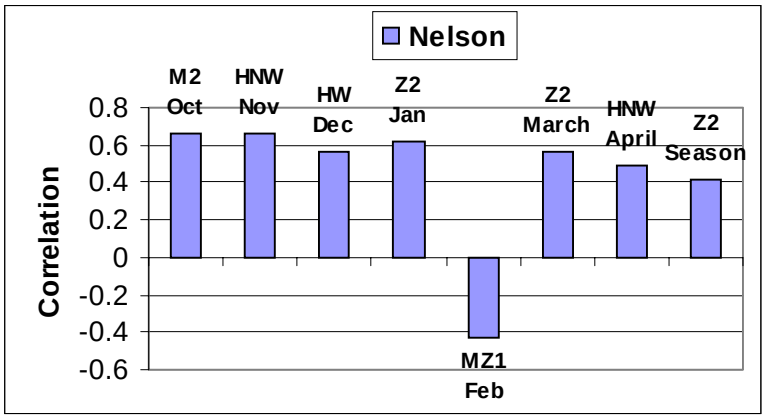
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.7798 | 0.4747 | 5.8555 | 0 |
| TNW | -0.0108 | 0.0057 | -1.8732 | 0.0708 |

## Nelson

Significant correlations between Nelson SSR values and climate predictors were found for Z2, M2, MZ3, -NE, HE, HNW, - TNW. Hence high SSR seasons are found under anticyclonic conditions situated off the east and north west of New Zealand and associated southerly, southwesterly and westerly wind flow. Low SSR occurs with troughs to the north west and also under northeasterly flow (see Figure 13).

High monthly MSR can be found for all months with a westerly flow. From October to January high MSR is also associated with southeasterly, southerly and southwesterly flow, anticyclones situated to the northwest and over New Zealand, and troughs to the southeast of New Zealand. During this period low MSR is associated with troughs to the northwest. In February only westerly and southeasterly winds are associated with high MSR. By March and April, high MSR is associated with anticyclones to the north west, westerly and southerly flow. As in spring and early summer, low MSR is associated with troughs to the northwest and anticyclones to the southeast of New Zealand.

**Figure 13. Highest significant correlation for Nelson SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 2.275 + 0.041 M2 (Table 24)
SSR = 2.159 + 0.032 Z2 (Table 25).

**Table 24. Regression model M2 for Nelson SSR**

Explained variance (predictability) is 15%
Pearson correlation is 0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.275 | 0.173 | 13.128 | 0.0 |
| M2 | 0.041 | 0.016 | 2.527 | 0.016 |

**Table 25. Regression model Z2 for Nelson SSR**

Explained variance (predictability) is 18%
Pearson correlation is 0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.1594 | 0.1719 | 12.5602 | 0 |
| Z2 | 0.0319 | 0.0116 | 2.7538 | 0.0093 |

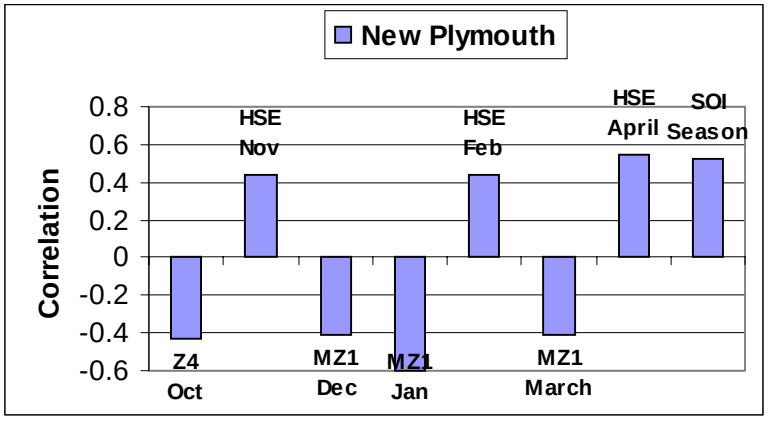
## New Plymouth

Significant correlations between New Plymouth SSR values and climate predictors were found for SOI, SST, -SW, -HW and HSE. Hence high SSR seasons are found with positive SOI and SST

values and anticyclones situated to the southeast of New Zealand. Low SSR is associated with anticyclones to the west and troughs to the southeast (see Figure 14).

High monthly MSR tends to be associated with either anticyclones situated over the North Island (October and March) or anticyclones to the southeast or south for the remaining months. High MSR is also associated with southeast flow during December, January and March. The only association with low MSR takes place in April under anticyclonic circulation to the east of the North Island.

**Figure 14. Highest significant correlation for New Plymouth SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 0.025 + 0.003 HSE (Table 26)
SSR = 0.496 + 0.012 SOI (Table 27).

**Table 26. Regression model HSE for New Plymouth SSR**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.025 | 0.151 | 0.165 | 0.871 |
| HSE | 0.003 | 0.001 | 2.849 | 0.009 |

**Table 27. Regression model SOI for New Plymouth SSR**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

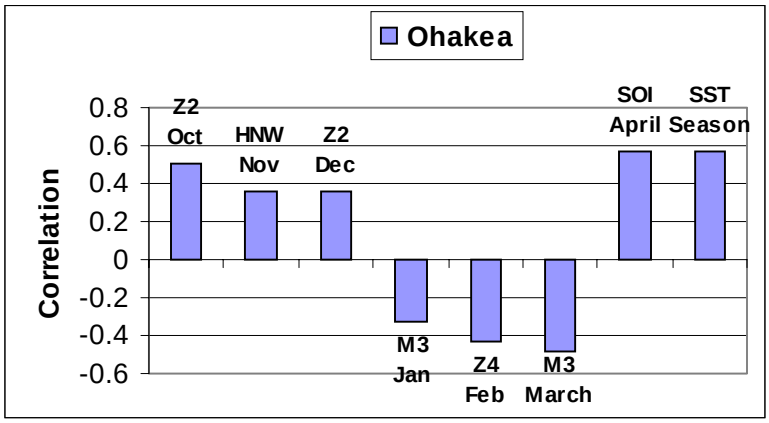
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4962 | 0.0485 | 10.2269 | 0 |
| SOI | 0.0123 | 0.0043 | 2.8797 | 0.0087 |

## Ohakea

Significant correlations between Ohakea SSR values and climate predictors were found for SST, HSE, -M1 and -M3. Hence high SSR seasons occur when there is a predominance of anticyclones to the southeast of New Zealand, northerly wind flow and above average SST values for New Zealand (see Figure 15).

High monthly MSR is very variable from month to month. In October high MSR is associated with westerly wind flow; in November southeast flow and anticyclones to the northwest and in December northerly, westerly wind flow and anticylonic circulation to the southeast. In January northerly and southeasterly wind flow gave high MSR values, in February above average SST, easterly wind flow and anticyclones to the southeast and in March above average SST, northerly flow and anticyclones over North Island. April was associated with above average SOI and easterly flow. Low MSR values tend to be associated with troughs to the south, southwest and northwest of New Zealand.

**Figure 15. Highest significant correlation for Ohakea SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 2.641 + 1.410 SST (Table 28)
SSR = 2.896 – 0.040 M3 (Table 29).

**Table 28. Regression model M3 for Ohakea SSR**

Explained variance (predictability) is 21%
Pearson correlation is -0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.8957 | 0.1801 | 16.0787 | 0 |
| M3 | -0.0398 | 0.0134 | -2.9631 | 0.0056 |

**Table 29. Regression model SST for Ohakea SSR**

Explained variance (predictability) is 33%
Pearson correlation is 0.57

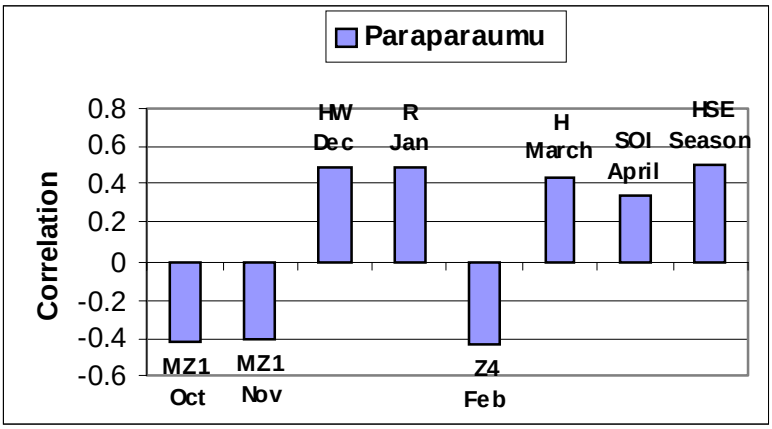
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.641 | 0.139 | 18.957 | 0.000 |
| SST | 1.410 | 0.353 | 3.994 | 0.003 |

## Paraparaumu

Significant correlations between Paraparaumu SSR values and climatic predictors were found for SST, -Z4, -M3, -T, HSE. Hence high SSR seasons occur when anticyclone are situated to the southeast of New Zealand and are associated with easterly and northerly wind flow. Low SSR seasons are associated with troughs to the south (see Figure 16).

High monthly MSR are associated with anticyclones for most months. In October and March the high pressures are situated over and to the north west of the North Island. From December to February, anticyclones are found to the southwest and southeast. Furthermore high MSR also occur under westerly and southeasterly flow between October and January. Low MSR values occur with troughs to the south and northwest.

**Figure 16. Highest significant correlation for Paraparaumu SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 0.444 + 0.005 HSE (Table 30)
SSR = 1.498 – 0.027 M3 (Table 31)

**Table 30. Regression model HSE for Paraparaumu SSR**

Explained variance (predictability) is 25%
Pearson correlation is 0.50

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4445 | 0.2656 | 1.6738 | 0.1031 |
| HSE | 0.0054 | 0.0016 | 3.3757 | 0.0018 |

**Table 31. Regression model M3 for Paraparaumu SSR**

Explained variance (predictability) is 22%
Pearson correlation is -0.47

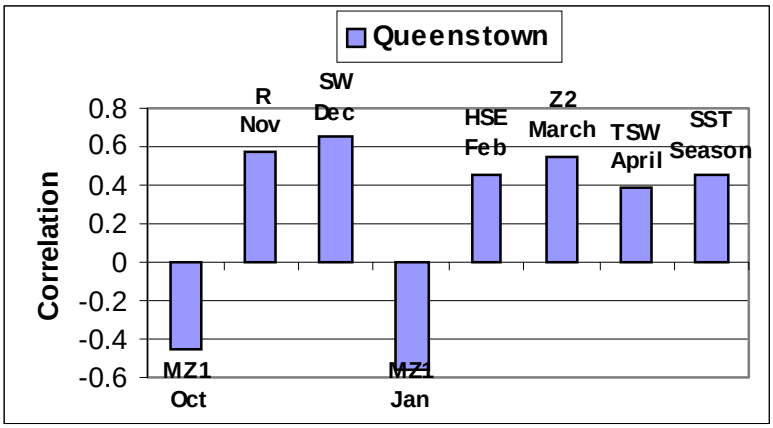
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.4981 | 0.11 | 13.6138 | 0 |
| M3 | -0.0266 | 0.0085 | -3.1127 | 0.0037 |

## Queenstown

Significant correlations between Queenstown SSR values and climatic predictor were found for SST and a weak correlation with -TNW. Hence high SSR seasons are associated with above average SST and low SSR values with troughs to the northwest of New Zealand (see Figure 17).

High monthly MSR has strong variability from month to month. In October high MSR is associated with anticyclones over New Zealand and southeast winds; in November ridging highs over the South Island and troughs to the northwest of the North Island and in December southerly and southwesterly wind flow. In January high MSR is associated with westerly and southeasterly wind flow, in February anticyclones to the southeast, in March back to anticyclone situated over the New Zealand and April had a weak association with troughs to the southwest of New Zealand.

**Figure 17. Highest significant correlation for Queenstown SSR/MSR and climate predictors**




**The predicted equation is:**
SSR = 1.412 + 0.770 SST (Table 32)

**Table 32. Regression model SST for Queenstown SSR**

Explained variance (predictability) is 20%
Pearson correlation is 0.45

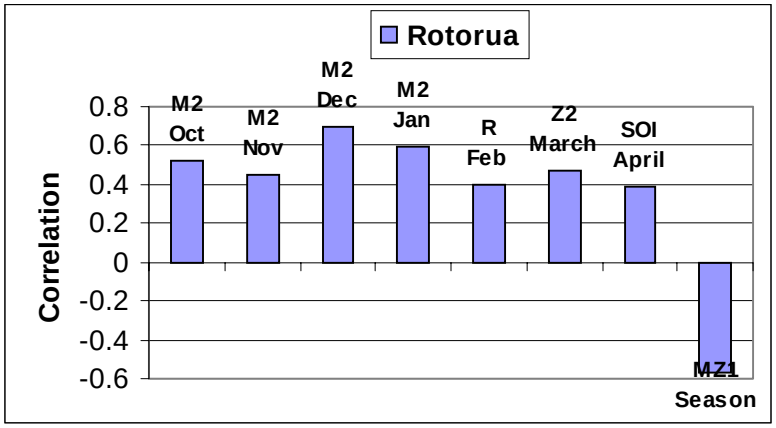
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.4115 | 0.1308 | 10.7897 | 0 |
| SST | 0.7698 | 0.3536 | 2.1769 | 0.0423 |

## Rotorua

A significant correlation between Rotorua SSR values and climatic predictors was found for –MZ1. Hence high SSR seasons are found with southeast wind flow (see Figure 18).

High monthly MSR values over the months October to January are generally associated with anticyclones over the central, northwest and west of the North Island and troughs to the southwest of the country. High MSR is also found with southeast, southwest, south and west winds during these months. In February there is a change to the MSR associated with ridging anticyclones over the South Island and northerly flow. In March high MSR is associated with westerly, southwesterly and southerly wind flow and in April with positive SOI values. Low MSR values tend to be associated for most months with troughs to the northwest and southwest.

**Figure 18. Highest significant correlation for Rotorua SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 1.130 – 0.054 MZ1 (Table 33)
SSR = 1.021 + 0.016 M2 (Table 34).

**Table 33. Regression model MZ1 for Rotorua SSR**

Explained variance (predictability) is 32%
Pearson correlation is -0.57

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.13 | 0.07 | 16.1413 | 0 |
| MZ1 | -0.0543 | 0.0137 | -3.965 | 0.0004 |

**Table 34. Regression model M2 for Rotorua SSR**

Explained variance (predictability) is 15%
Pearson correlation is 0.38

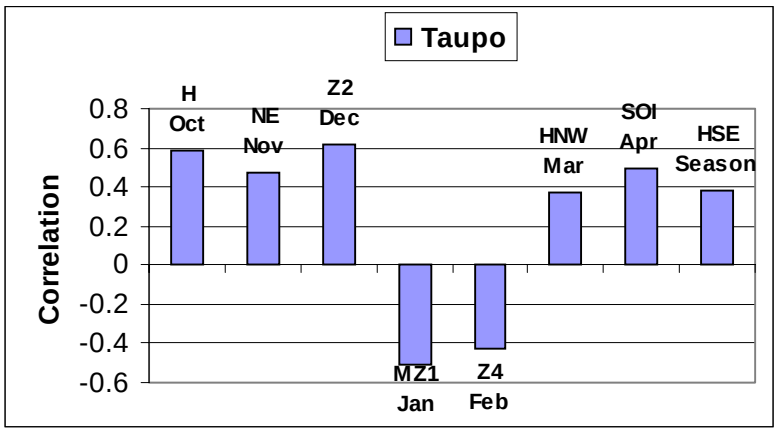
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.0207 | 0.0701 | 14.5676 | 0 |
| M2 | 0.0156 | 0.0066 | 2.3751 | 0.0235 |

## Taupo

A significant correlation between Taupo SSR values and climatic predictors was found for –TNW and a weak correlation with HSE. Hence high SSR seasons are found with anticyclones to the southeast of New Zealand and low SSR with troughs to the northwest (see Figure 19).

High monthly MSR is associated with anticyclones situated over New Zealand (October), to the east (November) and northwest (December and January). High MSR is also found with westerly winds in December and southeasterly winds in January and February. In March MSR only has a weak association with anticyclones to the northwest but a significant association with positive SOI in April. Low MSR tend to be associated with troughs to the southwest and northwest between January and March.

**Figure 19. Highest significant correlation for Taupo SSR/MSR and climate predictors**




**The predicted equation is:**
SSR = 0.479 + 0.003 HSE (Table 35).

**Table 35. Regression model HSE for Taupo SSR**

Explained variance (predictability) is 15%
Pearson correlation is 0.38

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4787 | 0.2964 | 1.6151 | 0.1219 |
| HSE | 0.0032 | 0.0017 | 1.8618 | 0.0774 |

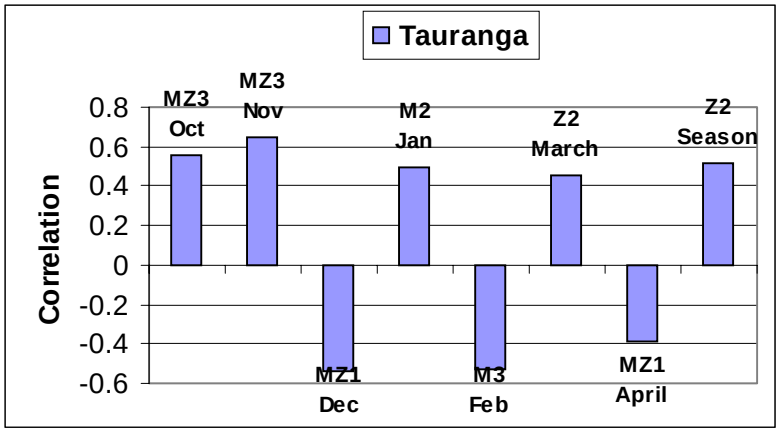
## Tauranga

Significant correlations between Tauranga SSR values and climatic predictors were found for Z2, M2, -MZ1, SW, -NE, HNW, -TNW. Hence high SSR seasons occur with an anticyclone to the northwest and trough to the southwest of New Zealand and winds from the west, south and southeast. Low SSR is associated with northeast flow and troughs to the northwest (see Figure 20).

From October to February, high monthly MSR values are found with troughs to the south and southwest and anticyclones to the northwest and over New Zealand. High MSR are also associated

with westerly, southwesterly, southerly and southeasterly winds during these months. In March the only association of high MSR is with westerly winds and in April with southeasterly winds. Low MSR values tend to be associated with troughs to the northwest of New Zealand and northeast flow.

**Figure 20. Highest significant correlation for Tauranga SSR/MSR and climate predictors**




**The predicted equations for Tauranga are:**
SSR = 1.696 + 0.030 Z2 (Table 36)
SSR = 1.892 – 0.077 MZ1 (Table 37).

**Table 36. Regression model Z2 for Tauranga SSR**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.6963 | 0.1365 | 12.4244 | 0 |
| Z2 | 0.0303 | 0.0095 | 3.1967 | 0.0035 |

**Table 37. Regression model MZ1 for Tauranga SSR**

Explained variance (predictability) is 19%
Pearson correlation is -0.43

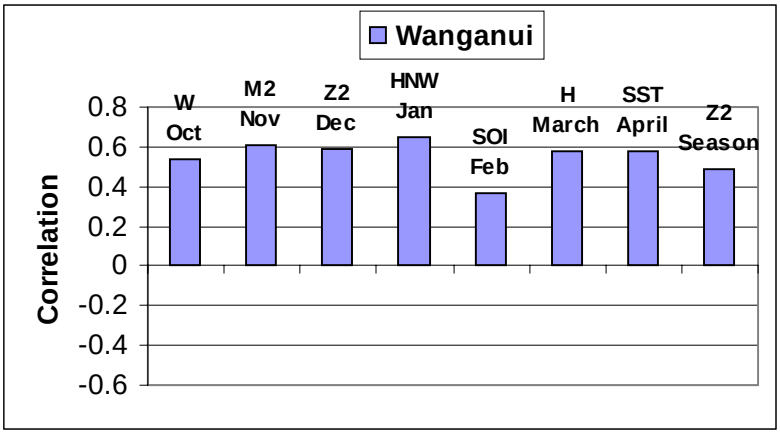
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.892 | 0.162 | 11.649 | 0.0 |
| MZ1 | -0.077 | 0.031 | -2.538 | 0.017 |

## Wanganui

Significant correlations between Wanganui SSR values and climatic predictors were found for SST, Z2, -HW, W, -TNW. Hence high SSR seasons occur with anticyclones to the north of New Zeland and westerly wind flow. Low SSR seasons are associated with anticyclones to the west of the South Island and troughs with northwesterlies over New Zealand (see Figure 21).

From October to December high monthly MSR occur under anticylonic circulation to the north and northwest and associated northwesterly, westerly and southwesterly flow. In January high MSR still occurs with anticyclone to the northwest, but southeasterly flow replaces the westerly flow. In February there is only a weak association with positive SOI values. In March, SST and northerly flow and in April above average SOI and SST give higher MSR values. Low MSR tends to be associated with northeast flow and a trough to the northwest.

**Figure 21. Highest significant correlation for Wanganui SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 0.823 + 0.019 Z2 (Table 38)
SSR = 0.348 + 0.008 W (Table 39).

**Table 38. Regression model Z2 for Wanganui SSR**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.822 | 0.118 | 6.987 | 0.0 |
| Z2 | 0.019 | 0.008 | 2.480 | 0.023 |

**Table 39. Regression model W for Wanganui SSR**

Explained variance (predictability) is 23%
Pearson correlation is 0.48

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.348 | 0.234 | 1.490 | 0.153 |
| W | 0.008 | 0.004 | 2.374 | 0.028 |

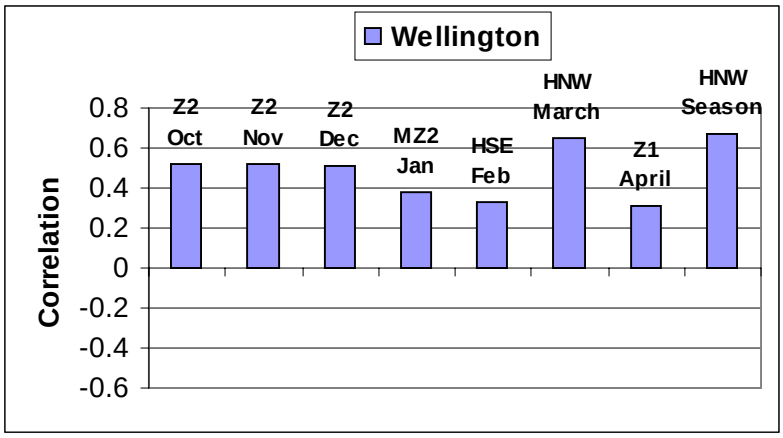
## Wellington

Significant correlations between Wellington SSR values and climatic predictors were found for Z1, Z2, Z3, Z4, M2, MZ2, MZ3, SW and HNW. Hence high SSR seasons occur with anticyclones to

the northwest of North Island and southerly, southwesterly, westerly and northwesterly wind flow (see Figure 22).

From October to January high monthly MSR occurs with anticyclones over the north and northwest of the North Island with southwesterly, westerly and northwesterly flow. In February high MSR is associated with anticyclones to the southeast of New Zealand, but in March and April there is a change back to the spring situation of anticyclone to the north and southwesterly, westerly and northwesterly flow. Low MSR tends to be associated with northeasterly flow, troughs to the northwest and southwest of New Zealand.

**Figure 22. Highest significant correlation for Wellington SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 1.750 + 0.034 HNW (Table 40)
SSR = 1.607 + 0.018 Z2 (Table 41).

**Table 40. Regression model HNW for Wellington SSR**

Explained variance (predictability) is 44%
Pearson correlation is 0.67

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.7503 | 0.4078 | 4.2916 | 0.0001 |
| HNW | 0.0341 | 0.0063 | 5.4346 | 0 |

**Table 41. Regression model Z2 for Wellington SSR**

Explained variance (predictability) is 30%
Pearson correlation is 0.55

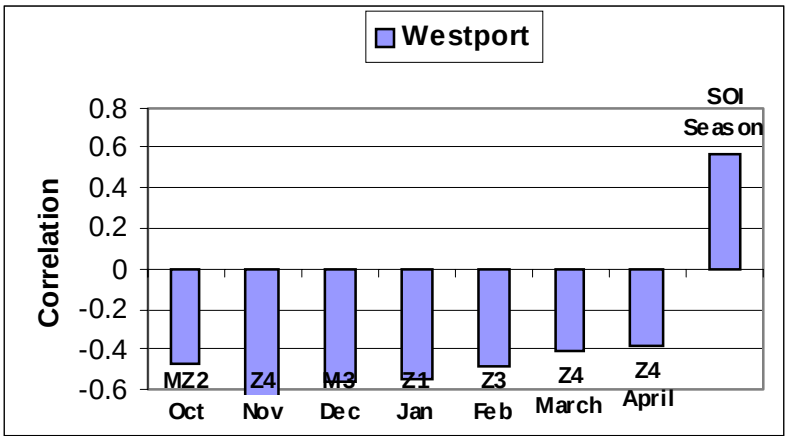
| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.6217 | 0.1833 | 19.7598 | 0 |
| Z2 | 0.0506 | 0.0126 | 4.0125 | 0.0003 |

## Westport

Significant correlations between Westport SSR seasons and climatic predictors were found for SOI, SST, -Z4, -M1, -MZ3, NE, -W, HSE. Hence high SSR seasons occur with anticyclones to the southeast of New Zealand, easterly, northeasterly and northerly wind flow and positive SOI and SST values. Low SSR seasons are associated with westerly flow (see Figure 23).

High monthly MSR occurs for all months between October and April under easterly wind flow. High MSR is also associated with anticyclones to the southeast (November and April) and to the west (December). Further associations for high MSR occur under northerly, southeasterly and northeasterly wind flow from November to January. Low MSR months are generally associated with troughs over New Zealand, southwesterly and westerly flow.

**Figure 23. Highest significant correlation for Westport SSR/MSR and climate predictors**




**The predicted equations are:**
SSR = 0.259 + 0.007 SOI (Table 42)
SSR = 0.234 + 0.187 SST (Table 43)
SSR = 0.018 + 0.001 HSE (Table 44).

**Table 42. Regression model SOI for Westport SSR**

Explained variance (predictability) is 33%
Pearson correlation is 0.57

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2594 | 0.0212 | 12.2517 | 0 |
| SOI | 0.0068 | 0.0019 | 3.6195 | 0.0012 |

**Table 43. Regression model SST for Westport SSR**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2342 | 0.0213 | 10.9889 | 0 |
| SST | 0.1869 | 0.059 | 3.1677 | 0.0038 |

**Table 44. Regression model HSE for Westport SSR**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.0182 | 0.0728 | 0.2496 | 0.8048 |
| HSE | 0.0014 | 0.0004 | 3.1760 | 0.0037 |

# Discussion

## Data record length

The present study has analysed a network of 21 stations over the breadth of the country with a view to providing a greater and more up to date coverage of fire risk for New Zealand. This study has used the same methodology as used by Salinger (1998). Results from the analysis presented in this report indicate that there is significant agreement on results from some of the regions. For example Christchurch had very consistent results from the two studies, however Dargaville did show differences, which could be considered significant. One of the reasons attributed to the variation is the record length. Data length for the two stations used in the study were 40 and 21 years for Christchurch and Dargaville respectively. It would be preferable in any future studies to use a standardized record length. Presently a number of stations only have 20-25 years of data records while other stations have more than 40 years.

## Climate predictors

A number of climate predictors used in the analysis have very strong correlations (>0.9) between predictors (Table 3), these include Z1 and Z3, Z3 and MZ2, M2 and MZ3. While there are significant similarities, enough variations do exist for the seasonal and monthly SSR and predictor data to warrant using all of these predictors.

A total count of significant correlation for high and low seasonal SSR and monthly MSR with climate predictors is given in Table 45, Table 46 and Table 47 respectively. Table 45 shows that the predictors with the highest count (greatest frequency) are; Z3, Z1, Z2 (westerly flow), MZ2 (northwesterly flow) and MZ3 (southwesterly flow). Comparison between Table 46 and Table 47 of the daily weather types show that high SSR/MSR is associated with most stations under southwest flow (SW), westerly flow (W) and anticyclones to the west (HW), northwest (HNW) southeast (HSE) and over central New Zealand (H). Similarly low SSR/MSR is associated with more stations under troughs to the northwest (TNW), southwest (TSW) and over New Zealand (T). Ridging anticyclones (R) and northeast flow (NE) are also associated with more low SSR/MSR values. Anticyclones to the east (HE) are not strongly associated with either high or low SSR/MSR.

## High SSR/MSR and climate predictors

An analysis of the all 24 predictors for seasonal SSR and monthly MSR correlations are shown in Table 48 (see also Table 4 and Table 45). Significant correlations between seasonal SSR values and climate predictors have been found for all stations except Dargaville, Dunedin and Taupo at the 5% level. Note that Taupo has a significant correlation predictor at 5% level but with a negative synoptic climate predictor (TNW). Dargaville, Dunedin and Taupo all had weaker correlations between SSR and climate predictors at the 10% significance level.

**Table 45. Count of Significant Correlations (at 5% level) with high SSR/MSR ***

| | Season | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Total |
|---|---|---|---|---|---|---|---|---|---|
| **SOI** | 6 | 2 | 1 | 2 | 5 | 4 | 3 | 9 | **32** |
| **SST** | 7 | 0 | 0 | 2 | 3 | 3 | 2 | 1 | **18** |
| **Z1** | 6 | 9 | 12 | 7 | 8 | 6 | 5 | 4 | **57** |
| **Z2** | 9 | 9 | 12 | 14 | 10 | 3 | 10 | 4 | **71** |
| **Z3** | 6 | 8 | 12 | 6 | 8 | 6 | 5 | 3 | **54** |
| **Z4** | 8 | 4 | 10 | 4 | 4 | 6 | 4 | 4 | **44** |
| **M1** | 4 | 1 | 4 | 1 | 1 | 3 | 1 | 1 | **16** |
| **M2** | 5 | 6 | 9 | 8 | 5 | 1 | 1 | 4 | **39** |
| **M3** | 3 | 1 | 1 | 4 | 1 | 6 | 3 | 0 | **19** |
| **MZ1** | 5 | 7 | 5 | 7 | 12 | 4 | 1 | 1 | **42** |
| **MZ2** | 6 | 8 | 10 | 5 | 8 | 5 | 4 | 2 | **48** |
| **MZ3** | 8 | 8 | 12 | 8 | 7 | 1 | 6 | 3 | **53** |

**Table 46. Count of significant correlations (at 5% level) with high SSR/MSR**

| | Season | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Total |
|---|---|---|---|---|---|---|---|---|---|
| **TSW** | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | **3** |
| **T** | 1 | 4 | 0 | 0 | 3 | 0 | 0 | 0 | **8** |
| **SW** | 4 | 0 | 9 | 7 | 3 | 0 | 1 | 1 | **25** |
| **NE** | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | **7** |
| **R** | 0 | 0 | 1 | 1 | 3 | 1 | 0 | 0 | **6** |
| **HW** | 1 | 2 | 0 | 9 | 3 | 0 | 0 | 0 | **15** |
| **HE** | 1 | 1 | 1 | 0 | 0 | 3 | 0 | 0 | **6** |
| **W** | 2 | 3 | 5 | 5 | 1 | 3 | 1 | 0 | **20** |
| **HNW** | 7 | 7 | 12 | 6 | 6 | 2 | 4 | 2 | **46** |
| **TNW** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **1** |
| **HSE** | 5 | 0 | 4 | 0 | 0 | 5 | 2 | 3 | **19** |
| **H** | 0 | 9 | 1 | 1 | 3 | 4 | 6 | 1 | **25** |

**Table 47. Count of significant correlation (at 5% level) with low SSR/MSR**

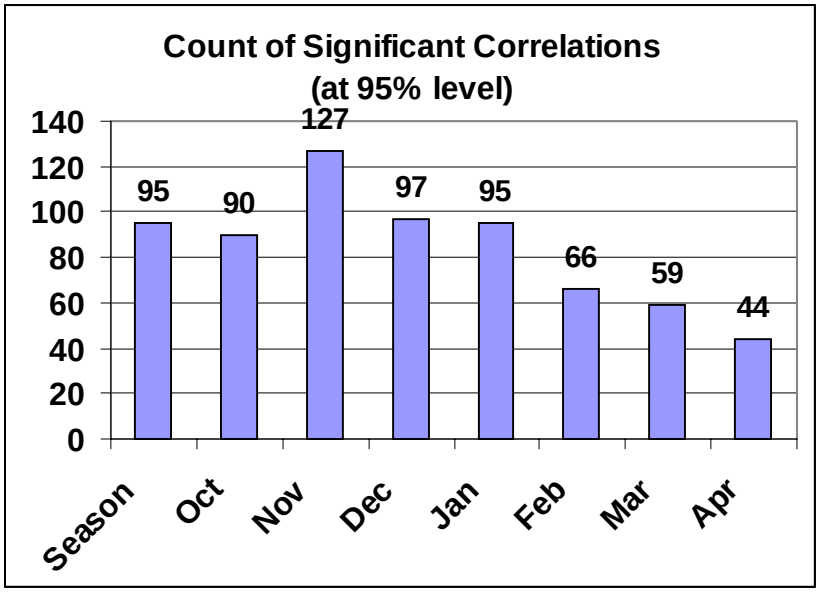
| | Season | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Total |
|---|---|---|---|---|---|---|---|---|---|
| **TSW** | 2 | 0 | 4 | 7 | 3 | 3 | 4 | 0 | **23** |
| **T** | 1 | 4 | 2 | 1 | 4 | 1 | 1 | 0 | **14** |
| **SW** | 2 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | **10** |
| **NE** | 6 | 2 | 0 | 2 | 5 | 2 | 1 | 0 | **18** |
| **R** | 2 | 4 | 0 | 0 | 1 | 0 | 4 | 0 | **11** |
| **HW** | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| **HE** | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | **4** |
| **W** | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | **3** |
| **HNW** | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | **4** |
| **TNW** | 7 | 5 | 7 | 3 | 8 | 4 | 11 | 0 | **45** |
| **HSE** | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | **6** |
| **H** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | **1** |

**Table 48. Summary table: Stations with no significant correlations of seasonal (SSR) and monthly (MSR) with climate predictors.**

| | No significant correlations at 5% level | No significant correlations at 10% level |
|---|---|---|
| **Season** | Dargaville, Dunedin, Taupo | - |
| **October** | - | - |
| **November** | - | - |
| **December** | - | - |
| **January** | - | - |
| **February** | Invercargill, Wanganui | - |
| **March** | Auckland, Coromandel, Dargaville, Taupo | Auckland, Dargaville |
| **April** | Auckland, Dunedin, Queenstown | Dunedin |

The month November has the highest count of significant correlations (at 5% level) between MSR and the 24 predictors (see Figure 24). Conversely, the months of February, March and April had decreasingly fewer relationships between MSR and climate predictors. Figure 24 shows quite clearly the relative consistency in the months October to January and then from February, changing climate patterns resulting in decreased association with high MSR.

**Figure 24. Count for all stations of significant correlations (at 5% level) between high SSR/MSR and 24 climate predictors**




A number of stations showed fairly consistent associations between high MSR and specific climate indictors for the months October to January and either a reversal or change to other synoptic climate modes during February. For example, from October to January Wellington has high MSR values associated with anticyclones situated to the northwest of New Zealand and southwesterly, westerly and northwesterly wind flow. In February high MSR is linked to anticyclones southeast of the

country and no significant relationship was found with wind flow from the westerly quadrant. During March and April the spring and early summer pattern is reestablished.

March and April tended to have much fewer and weaker associations between MSR and climate predictors. Auckland and Dargaville in March and Dunedin in April having no significant correlations between MSR and climate predictors at either the 5% or 10% confidence level.

A summary of the key features for each station is presented in Table 49.

**Table 49**. **Station Summary Table**

| Station | Data record (yrs) | Wind direction with high SSR/MSR | Climate predictors with high SSR/MSR | No Significant relationship | Highest correlated stations (SSR) |
|---|---|---|---|---|---|
| **Auckland** | 34 | S, SW, W | SST, Z2, M1/2, MZ1/3, SW, HW, HNW, SW | March no signif. | Kaitaia, Rotorua Coromandel |
| **Christchurch** | 40 | W, NW, N | SST, Z1/2/3, M1/2/3, HE, MZ2/3, W, T, HNW, H | | Coromandel, Kaikoura, Gisborne |
| **Coromandel** | 21 | S, SW, W, NW | SOI, Z1/2/3/4, M2, HW, MZ2/3, SW, HNW, H, HE | March signif. at 10% | Kaikoura, Gisborne, Rotorua |
| **Dargaville** | 21 | S, SW, W, NW, N | SOI, Z1/2/3, M2/3, MZ3, SW, W, HNW, H | SSR signif. at 10% March no signif. | Rotorua, Tauranga, Taupo |
| **Dunedin** | 37 | SW, W, NW, N | SOI, Z1/2/3/4, M1/3, MZ2/3, T, SW, HNW | SSR signif. at 10% April no signif. | Queenstown |
| **Gisborne** | 38 | S, SW, W, NW | SOI, Z1/2/3/4, M2, SW, MZ1/2/3, T, W, HNW, | - | Kaikoura |
| **Hokitika** | 36 | N, NE, E, SE | SOI, SST, Z1/2/3/4, M1/2, MZ2/3, TSW, NE, R, HSE | - | Westport, Paraaraumu, New Plymouth |
| **Invercargill** | 40 | E, N, | Z1/2/3, M1/2/3, MZ1/2/3, HW, HE, HSE, NE | February signif. at 10% level | Ohakea, Queenstown |
| **Kaikoura** | 36 | SW, W, NW | SOI, Z1/2/3/4, T, M2, MZ1/2/3, SW, W, HNW, | - | Gisborne, Christch, Coromandel |
| **Kaitaia** | 33 | SE, S, W | Z2, M2/3, MZ1, H, HNW, W, HW, HSE, | - | Rotoura, Auckland, Coromandel, Taupo, |
| **Nelson** | 38 | SE, S, SW, W | SOI, Z1/2, M2, MZ1/3, HNW, SW, HW | - | Paraparaumu, Wellington, Rotorua |
| **New Plymouth** | 25 | SE | SOI, SST, MZ1, H, R, HSE,, | - | Wanganui, Taupo, Hokitika |
| **Ohakea** | 37 | E, SE, W, N | SST, SOI, Z2/4, M1/3, HNW, HSE, H | - | Paraparaumu, Westport, Invercargill |
| **Paraparaumu** | 38 | SE, S, W | SOI, SST, Z/2/3/4, M2/3, HNW, HW, R, H | - | Ohakea, Nelson, Hokitika |
| **Queenstown** | 21 | SE, S, SW, W, | SST, Z2, M2, MZ1, SW, TNW, HSE, H | - | Dunedin, Invercargill |
| **Rotorua** | 36 | SE, S, SW, W, | SOI, Z2/4, M1/2, MZ1/3, HNW, SW, HW, H, R | - | Kaitaia, Tauranga, Coromandel |
| **Taupo** | 30 | SE, W | SOI, Z2, MZ1, NE, SW, HW, HNW, H | - | New Plymouth, Wanganui, Kaitaia |
| **Tauranga** | 30 | SE, S, SW, W, | SOI, Z1/2/3/4, TNW, MZ3, MZ1, NE, M3 | - | Rotorua, Coromandel, Taupo |
| **Wanganui** | 21 | SE, S, SW, W, NW | SOI, SST, Z1/2/3/4, W, M1/2/3,MZ2, SW, HNW, | February signif.. at 10% level | New Plymouth, Taupo, Tauranga |
| **Wellington** | 40 | SE, S, SW, W, NW | Z1/2/3/4, M2, MZ1/2/3, SW, W, T, H, HNW | - | Coromandel, Kaikoura, Gisborne, Christchurch |
| **Westport** | 30 | N, NE, E, SE, | SOI, SST, Z1/3/4, M1/2/3, MZ1/2/3, NE, HSE, HW | - | Hokitika, Ohakea |

# Directions for future and ongoing work

The present report completes the work from the first year of a three-year program on Integrated Climate and Fire Season Severity Forecasting. Associations between seasonal SSR and monthly MSR and climate predictors have now been established for 21 stations around the country.

Initial results from this study indicate that various stations have similar responses to fire severity risks due to such factors as their spatial location and their climatic characteristics. Future work will investigate the nature of these districts and their response to fire severity risk in more detail with other data from the Fire Weather Index system (FWI) and the National Rural Fire Authority's fire weather station network.

High fire season typically only occurs during part of the season, as this report has shown by the highly variable correlation between monthly (MSR) and climate predictors from October to April. Based on these results other daily weather features such as daily mean sea level pressure will be investigated for linkages with high MSR periods. This work will focus on two distinct climate regions.

NIWA is the key agency involved with seasonal and monthly climate forecasting in New Zealand. The seasonal climate forecasting techniques utilised by NIWA and new relationships uncovered here, will be used in the production of seasonal fire danger outlooks for specific indicator stations in the key fire climate regions.

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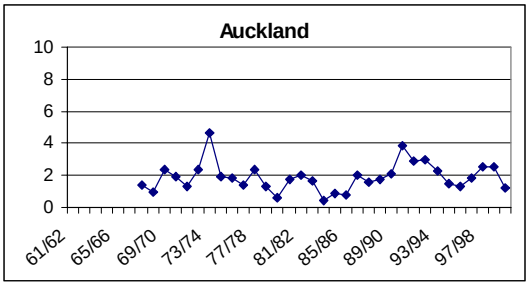
# Appendix 1: Seasonal SSR values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10
8
6
4
2
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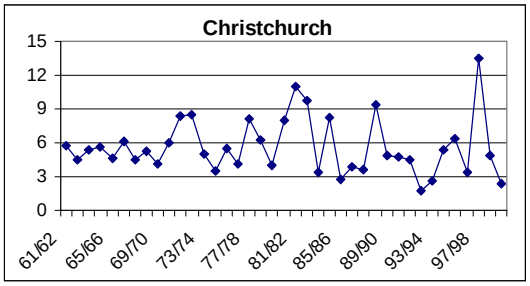
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98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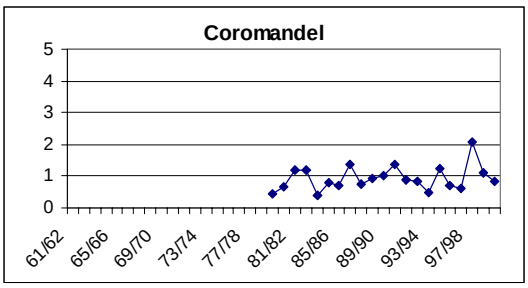
15
12
9
6
3
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98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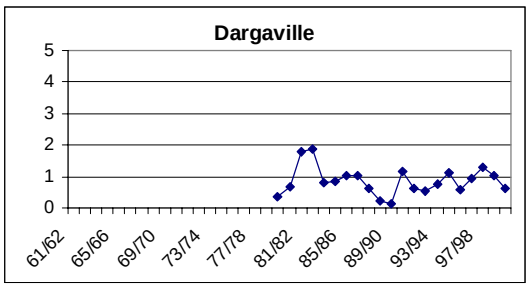
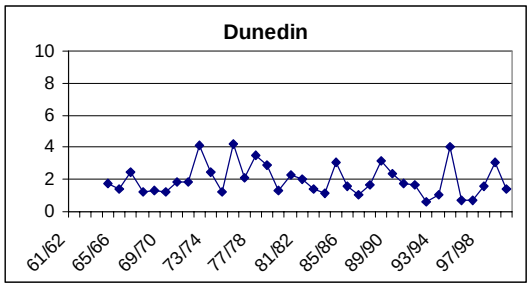
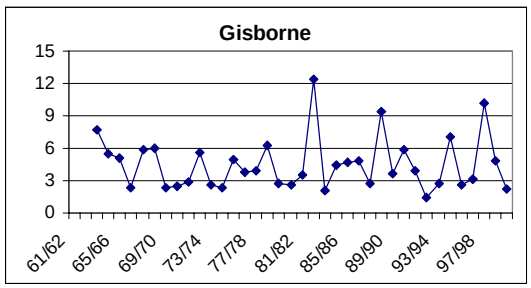
5
4
3
2
1
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Dargaville
5
4
3
2
1
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Dunedin
10
8
6
4
2
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Gisborne
15
12
9
6
3
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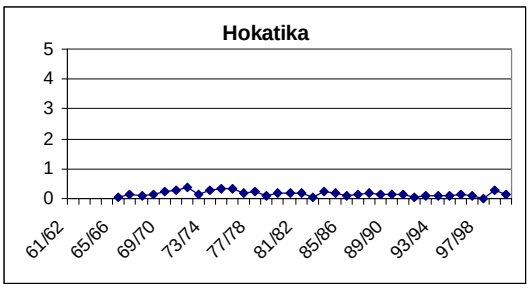
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Hokatika
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4
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2
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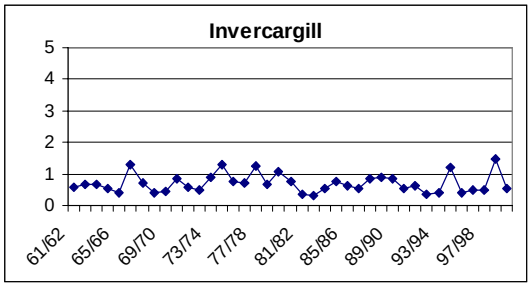
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98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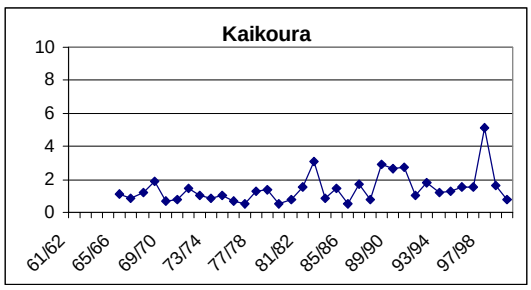
5
4
3
2
1
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98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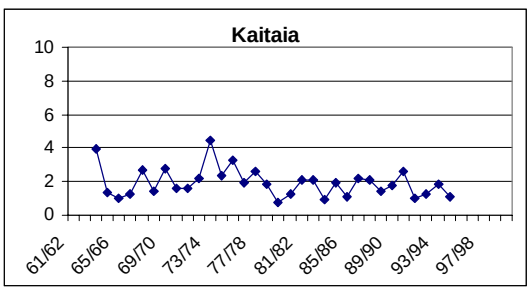
10
8
6
4
2
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Kaitaia
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8
6
4
2
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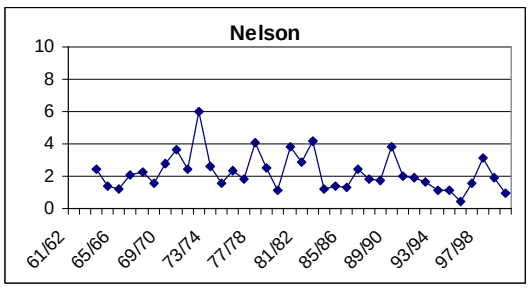
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Nelson
10
8
6
4
2
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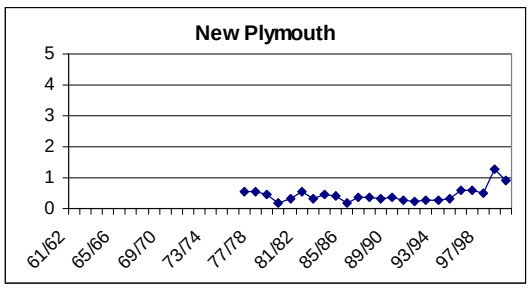
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


New Plymouth
5
4
3
2
1
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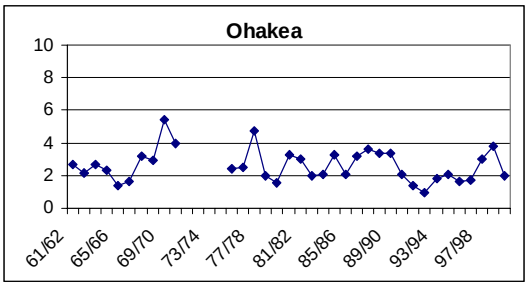
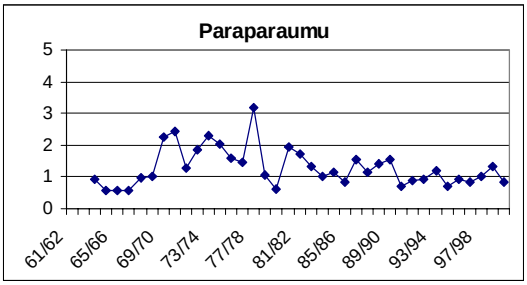
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Ohakea
10
8
6
4
2
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Paraparaumu
5
4
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2
1
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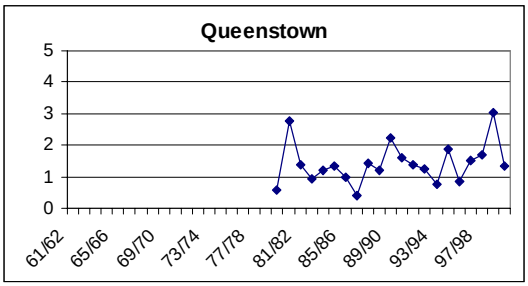
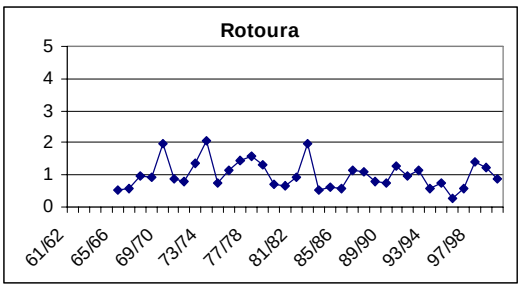
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Queenstown
5
4
3
2
1
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Rotoura
5
4
3
2
1
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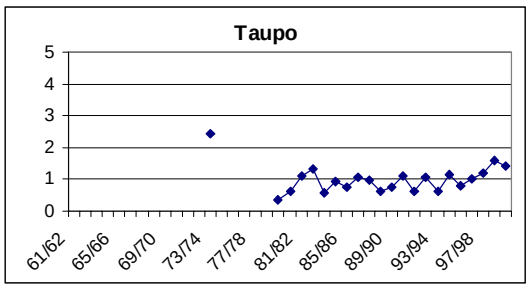
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Taupo
5
4
3
2
1
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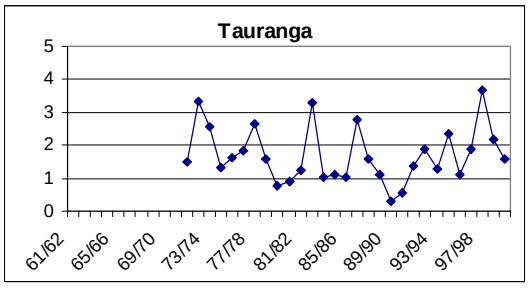
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98


Tauranga
5
4
3
2
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69/70
73/74
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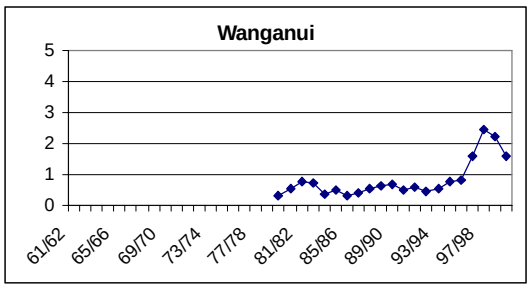
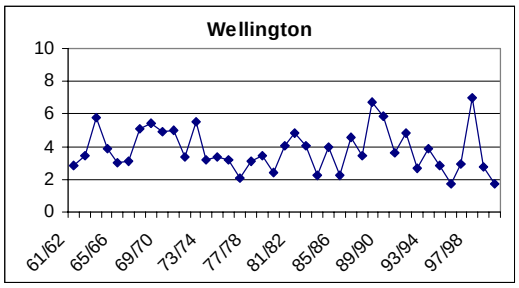
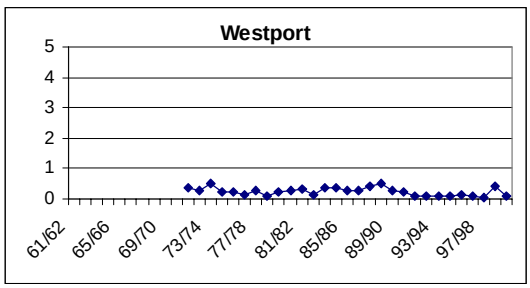
81/82
85/86
89/90
93/94
97/98


Wanganui
5
4
3
2
1
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98

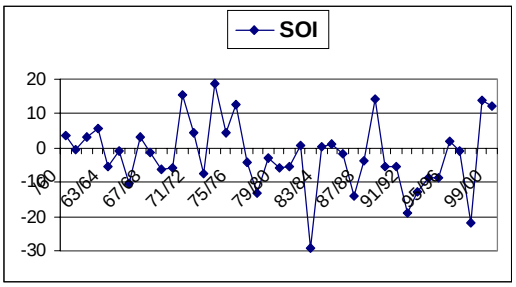

Wellington
10
8
6
4
2
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98

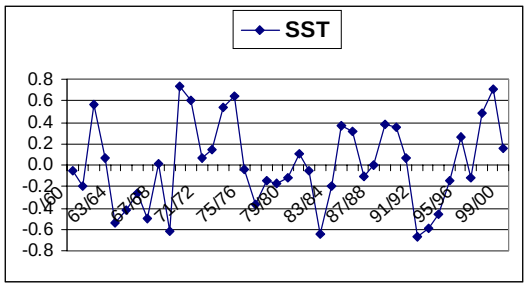

Westport
5
4
3
2
1
0
61/62
65/66
69/70
73/74
77/78
81/82
85/86
89/90
93/94
97/98

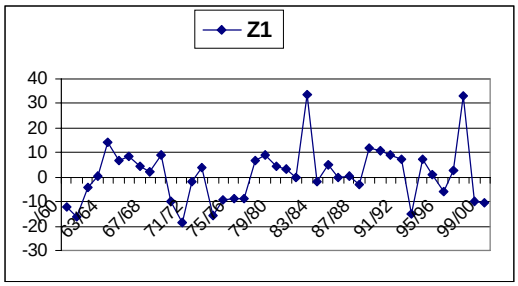
# Appendix 2: Seasonal climate predictors

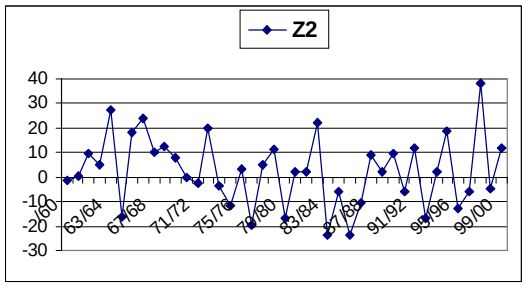
**Seasonal time series (October to April) for climate predictors for the period 1960 to 2000.**

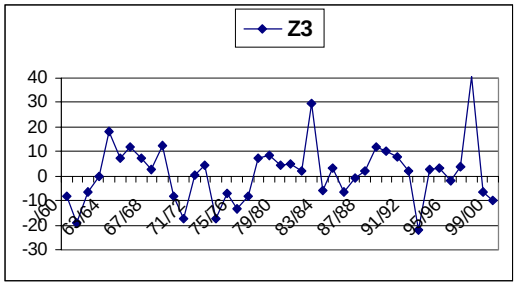
The SOI values are as defined in the Southern Oscillation section, NZSST are departures from the 1961-90 average in 0.01 degrees Celsius, and the regional circulation indices are departures from the 1961-90 averaging period.


SOI
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


SST
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


Z1
40
30
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


Z2
40
30
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00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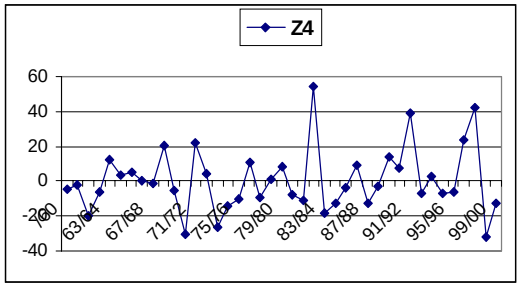
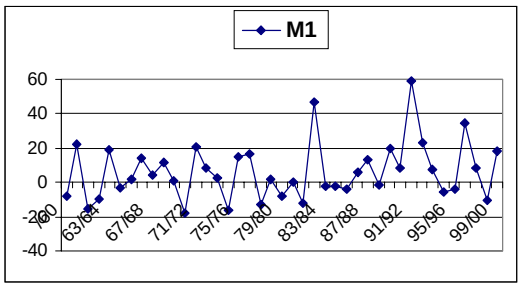
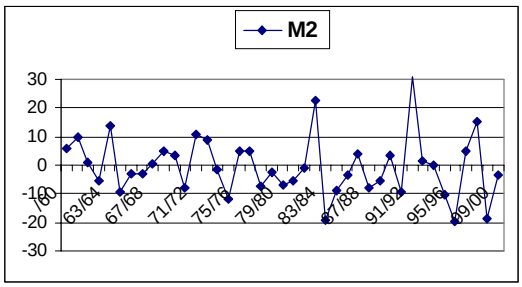
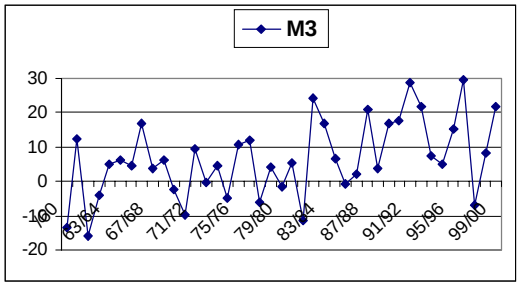
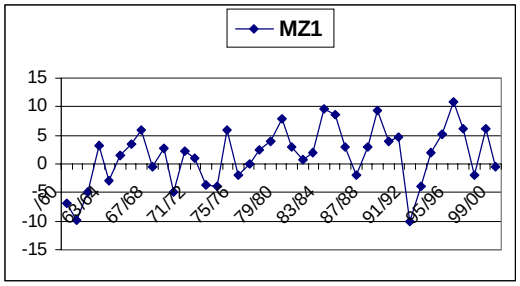
40
30
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00

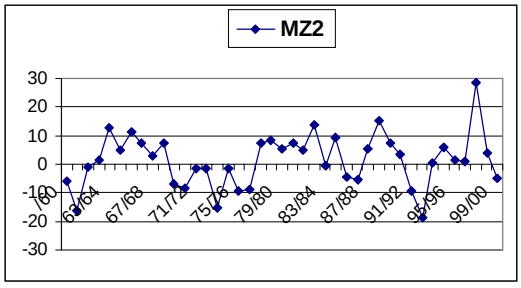

Z4
60
40
20
0
-20
-40
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00

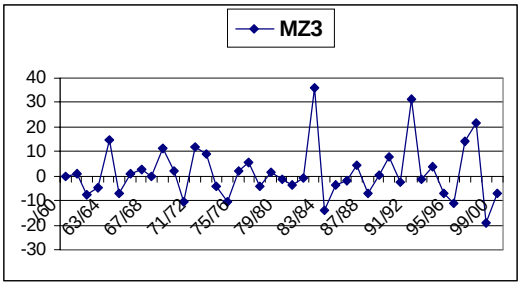

M1
60
40
20
0
-20
-40
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


M2
30
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


M3
30
20
10
0
-10
-20
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


MZ1
15
10
5
0
-5
-10
-15
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


MZ2
30
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


MZ3
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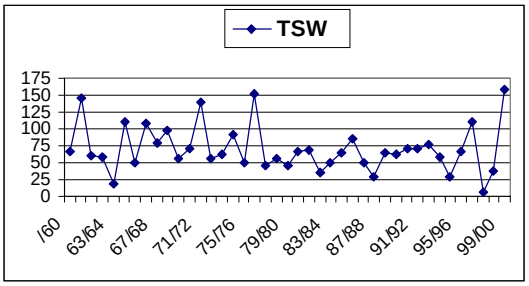
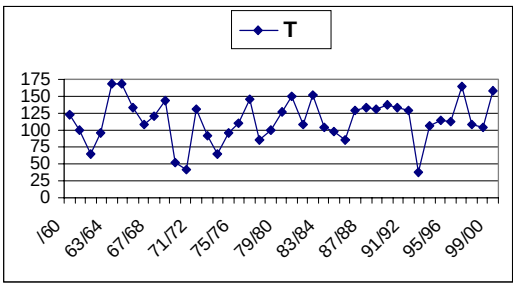
30
20
10
0
-10
-20
-30
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


TSW
175
150
125
100
75
50
25
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


T
175
150
125
100
75
50
25
0
/60
63/64
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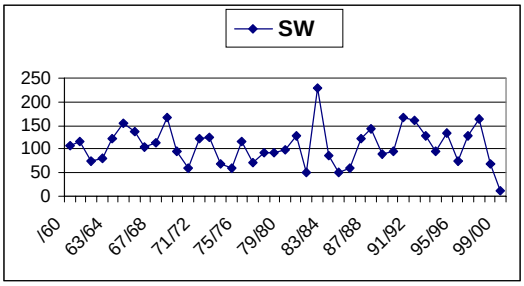
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


SW
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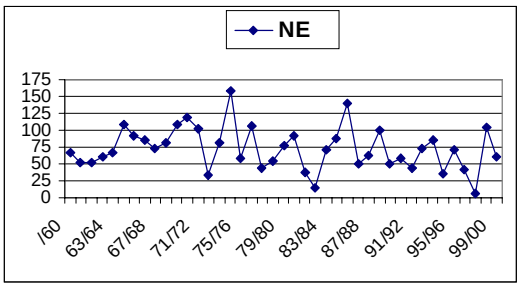
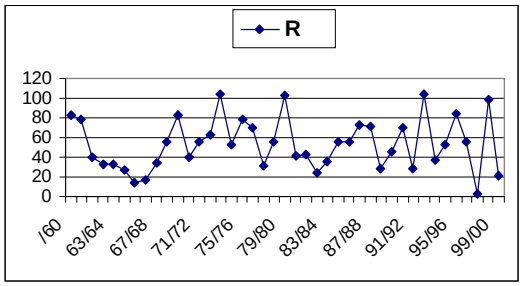
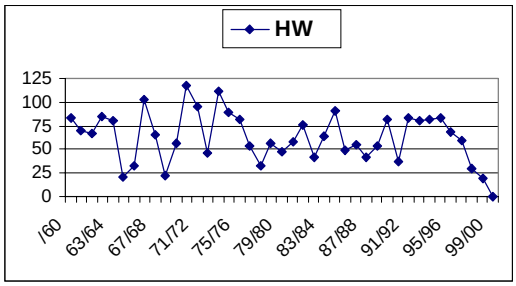
200
150
100
50
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


NE
175
150
125
100
75
50
25
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


R
120
100
80
60
40
20
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


HW
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100
75
50
25
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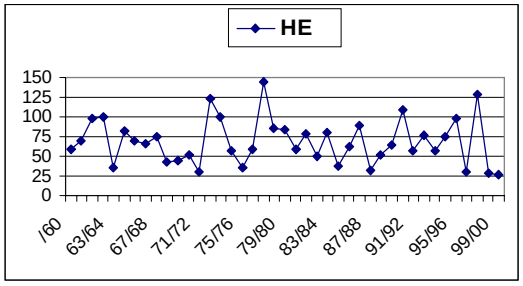
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


HE
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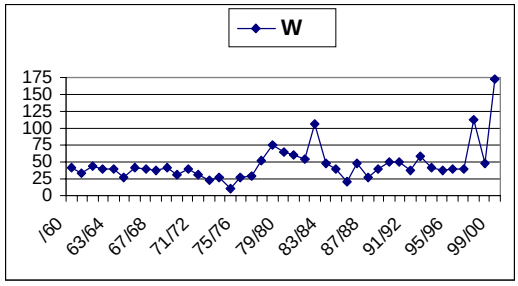
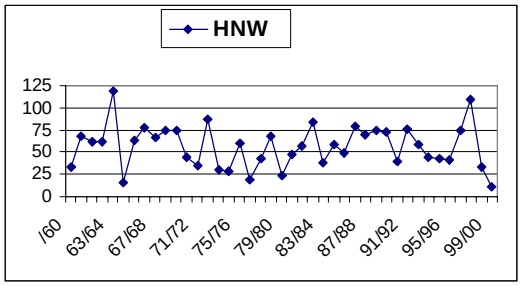
125
100
75
50
25
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


W
175
150
125
100
75
50
25
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


HNW
125
100
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50
25
0
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67/68
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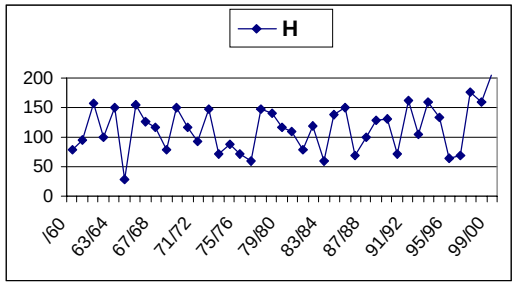
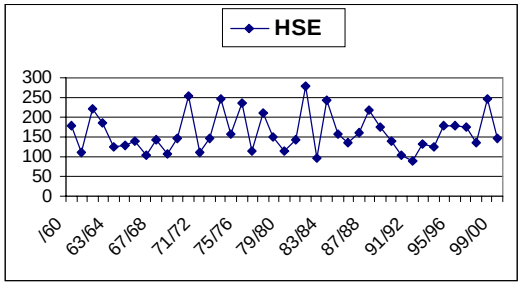
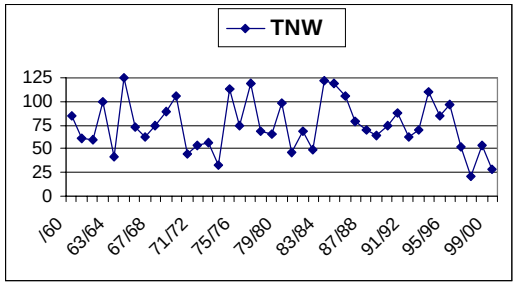
75/76
79/80
83/84
87/88
91/92
95/96
99/00


H
200
150
100
50
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


HSE
300
250
200
150
100
50
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00


TNW
125
100
75
50
25
0
/60
63/64
67/68
71/72
75/76
79/80
83/84
87/88
91/92
95/96
99/00

# Appendix 3: Correlation between station SSR

**Table 50. Correlation coefficients of SSR (October – April) between the 21 stations. Correlation coefficients which are >|0.5| are bolded.**

| | Auck | Christ | Cor | Darg | Dun | Gisb | Hok | Inver | Kaik | Kait | Nel | New P | Ohak | Parap | Quen | Rot | Taupo | Taur | Wang | Well | West |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | **1.00** | 0.03 | **0.51** | 0.14 | 0.08 | -0.01 | 0.00 | 0.03 | 0.24 | **0.61** | 0.31 | 0.02 | 0.07 | 0.33 | 0.31 | **0.57** | 0.34 | 0.27 | 0.23 | 0.21 | 0.07 |
| **Christ** | | **1.00** | **0.60** | 0.45 | 0.38 | **0.58** | -0.03 | -0.06 | **0.59** | 0.07 | **0.52** | 0.04 | 0.45 | 0.24 | 0.18 | 0.22 | 0.16 | 0.38 | 0.32 | **0.52** | 0.12 |
| **Corom** | | | **1.00** | 0.49 | 0.23 | **0.66** | -0.42 | -0.05 | **0.80** | **0.61** | 0.48 | 0.14 | 0.33 | 0.12 | 0.20 | **0.65** | **0.59** | **0.62** | **0.50** | **0.59** | -0.18 |
| **Darg** | | | | **1.00** | -0.01 | 0.47 | -0.17 | -0.32 | 0.28 | 0.43 | 0.35 | 0.11 | 0.04 | 0.12 | -0.04 | **0.55** | **0.54** | **0.55** | 0.22 | 0.05 | -0.16 |
| **Dun** | | | | | **1.00** | 0.25 | 0.21 | 0.49 | -0.06 | 0.23 | 0.40 | 0.19 | 0.51 | 0.30 | **0.54** | 0.19 | 0.15 | 0.19 | 0.08 | 0.13 | 0.30 |
| **Gisb** | | | | | | **1.00** | -0.46 | -0.15 | **0.70** | 0.11 | 0.25 | -0.10 | 0.14 | -0.18 | 0.00 | 0.33 | 0.33 | 0.49 | 0.27 | **0.52** | -0.12 |
| **Hok** | | | | | | | **1.00** | 0.40 | -0.41 | 0.37 | 0.07 | **0.51** | 0.44 | **0.55** | 0.31 | 0.09 | -0.03 | -0.18 | -0.01 | -0.20 | **0.60** |
| **Inver** | | | | | | | | **1.00** | -0.23 | 0.04 | -0.01 | 0.33 | **0.54** | 0.24 | **0.53** | -0.05 | 0.05 | -0.05 | 0.16 | -0.16 | 0.38 |
| **Kaik** | | | | | | | | | **1.00** | 0.02 | 0.20 | -0.01 | 0.16 | -0.14 | 0.12 | 0.19 | 0.35 | 0.33 | 0.48 | **0.58** | -0.18 |
| **Kait** | | | | | | | | | | **1.00** | 0.30 | 0.49 | 0.43 | 0.45 | -0.04 | **0.70** | **0.63** | 0.37 | 0.37 | 0.11 | 0.33 |
| **Nel** | | | | | | | | | | | **1.00** | -0.05 | **0.53** | **0.62** | 0.38 | **0.54** | 0.19 | 0.49 | 0.11 | **0.50** | 0.10 |
| **New P** | | | | | | | | | | | | **1.00** | 0.34 | 0.16 | 0.47 | 0.12 | **0.66** | 0.25 | **0.76** | -0.24 | 0.15 |
| **Ohak** | | | | | | | | | | | | | **1.00** | **0.75** | 0.48 | 0.25 | 0.21 | 0.18 | 0.24 | 0.37 | **0.63** |
| **Parap** | | | | | | | | | | | | | | **1.00** | 0.33 | 0.49 | 0.01 | 0.28 | -0.04 | 0.19 | 0.40 |
| **Queen** | | | | | | | | | | | | | | | **1.00** | 0.08 | 0.33 | -0.05 | 0.46 | 0.14 | 0.22 |
| **Rotor** | | | | | | | | | | | | | | | | **1.00** | **0.61** | **0.67** | 0.27 | 0.21 | 0.07 |
| **Taupo** | | | | | | | | | | | | | | | | | **1.00** | **0.62** | **0.65** | -0.06 | -0.14 |
| **Taur** | | | | | | | | | | | | | | | | | | **1.00** | **0.54** | 0.23 | -0.17 |
| **Wang** | | | | | | | | | | | | | | | | | | | **1.00** | 0.15 | -0.23 |
| **Well** | | | | | | | | | | | | | | | | | | | | **1.00** | 0.11 |
| **West** | | | | | | | | | | | | | | | | | | | | | **1.00** |

# Appendix 4:
# Monthly MSR correlations and significance tests

## October

**Table 51. Correlation coefficients for station SSR and predictors for October. Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | -0.34 | -0.17 | 0.08 | 0.13 | 0.05 | -0.23 | -0.21 | -0.14 | -0.17 | -0.01 | 0.05 | -0.11 | -0.17 | -0.16 | -0.17 | 0.17 | 0.05 | -0.02 | **0.36** | -0.08 | 0.21 | -0.10 | -0.11 | 0.21 |
| **Christ** | 0.28 | 0.16 | **0.64** | 0.14 | **0.62** | **0.33** | -0.18 | 0.07 | -0.30 | 0.30 | **0.63** | 0.34 | -0.03 | **0.59** | -0.08 | -0.16 | -0.31 | -0.12 | -0.13 | 0.05 | -0.11 | -0.12 | -0.16 | -0.12 |
| **Corom** | -0.12 | 0.13 | 0.38 | 0.37 | 0.38 | 0.28 | -0.01 | **0.48** | -0.41 | -0.02 | 0.32 | **0.57** | -0.28 | -0.06 | 0.04 | -0.27 | **-0.48** | -0.03 | -0.05 | 0.42 | **0.45** | -0.31 | -0.05 | 0.19 |
| **Darg** | 0.06 | 0.01 | -0.05 | 0.25 | -0.03 | -0.28 | -0.30 | 0.05 | **-0.45** | -0.05 | 0.02 | 0.03 | -0.11 | -0.35 | -0.26 | -0.30 | -0.24 | 0.19 | -0.08 | 0.52 | 0.23 | -0.31 | 0.41 | 0.29 |
| **Dun** | 0.22 | 0.13 | **0.58** | 0.16 | **0.57** | **0.37** | -0.14 | 0.15 | -0.31 | 0.23 | **0.57** | **0.37** | -0.01 | **0.67** | -0.06 | -0.14 | **-0.34** | -0.26 | -0.29 | 0.05 | -0.09 | -0.15 | -0.27 | -0.08 |
| **Gisb** | 0.17 | 0.16 | **0.83** | 0.28 | **0.84** | **0.60** | -0.09 | 0.12 | -0.23 | **0.49** | **0.82** | **0.52** | -0.28 | **0.60** | 0.18 | -0.23 | -0.24 | **-0.41** | -0.02 | 0.26 | 0.08 | -0.27 | **-0.32** | -0.19 |
| **Hok** | 0.18 | 0.13 | **-0.51** | **-0.36** | **-0.52** | -0.26 | 0.02 | -0.09 | 0.10 | -0.11 | **-0.48** | -0.28 | **0.42** | -0.23 | -0.15 | -0.10 | 0.16 | **0.44** | -0.14 | -0.31 | -0.31 | 0.31 | 0.30 | 0.04 |
| **Inver** | 0.07 | 0.11 | -0.09 | 0.01 | -0.07 | -0.09 | -0.16 | 0.00 | -0.21 | -0.06 | -0.05 | -0.07 | 0.08 | 0.05 | -0.21 | -0.09 | -0.06 | **0.34** | -0.17 | -0.20 | 0.06 | 0.04 | 0.00 | 0.11 |
| **Kaik** | 0.24 | 0.11 | **0.82** | 0.26 | **0.83** | **0.56** | -0.19 | 0.13 | -0.36 | **0.47** | **0.82** | **0.52** | -0.18 | **0.58** | 0.19 | -0.20 | -0.25 | -0.30 | 0.02 | 0.31 | -0.14 | -0.19 | **-0.35** | -0.18 |
| **Kait** | **-0.37** | 0.11 | -0.09 | **0.40** | -0.11 | -0.26 | 0.17 | **0.39** | -0.11 | **-0.45** | -0.19 | 0.24 | -0.19 | **-0.40** | **-0.37** | -0.21 | -0.18 | 0.34 | -0.17 | -0.16 | **0.59** | **-0.36** | -0.04 | **0.71** |
| **Nel** | **-0.37** | 0.05 | 0.09 | **0.59** | 0.05 | 0.09 | **0.45** | **0.66** | 0.04 | **-0.59** | -0.10 | **0.48** | -0.32 | -0.31 | 0.20 | -0.33 | -0.26 | -0.06 | -0.05 | 0.18 | **0.65** | **-0.54** | -0.18 | **0.40** |
| **New P** | -0.19 | -0.36 | -0.25 | 0.38 | -0.22 | **-0.43** | -0.02 | 0.08 | -0.09 | -0.26 | -0.16 | -0.11 | -0.08 | **-0.53** | -0.08 | -0.24 | 0.04 | 0.10 | 0.03 | 0.36 | 0.19 | -0.23 | 0.25 | **0.42** |
| **Ohak** | -0.05 | 0.06 | -0.07 | **0.33** | -0.08 | -0.11 | 0.10 | 0.22 | -0.05 | -0.20 | -0.08 | 0.11 | -0.05 | -0.18 | 0.20 | -0.31 | -0.13 | -0.13 | 0.24 | 0.07 | 0.00 | **-0.38** | 0.08 | 0.29 |
| **Parap** | -0.31 | -0.01 | -0.12 | **0.46** | -0.16 | -0.20 | 0.32 | **0.41** | 0.08 | **-0.48** | -0.22 | 0.19 | -0.07 | **-0.45** | 0.02 | -0.20 | -0.18 | 0.21 | -0.08 | 0.05 | **0.41** | -0.28 | -0.08 | **0.43** |
| **Queen** | -0.17 | -0.02 | -0.32 | 0.17 | -0.29 | -0.30 | 0.12 | 0.17 | 0.03 | **-0.44** | -0.28 | -0.09 | 0.27 | -0.13 | -0.16 | -0.01 | -0.11 | -0.01 | -0.37 | 0.07 | 0.01 | -0.04 | -0.11 | **0.43** |
| **Rotor** | -0.17 | -0.02 | 0.11 | **0.44** | 0.08 | 0.01 | 0.25 | **0.58** | -0.15 | **-0.37** | -0.02 | **0.47** | -0.25 | **-0.39** | -0.02 | -0.22 | **-0.36** | -0.05 | 0.01 | **0.40** | **0.43** | **-0.50** | -0.16 | **0.58** |
| **Taupo** | -0.16 | -0.13 | -0.13 | 0.29 | -0.12 | -0.16 | 0.15 | 0.35 | -0.09 | -0.26 | -0.10 | 0.22 | -0.10 | -0.25 | -0.08 | -0.31 | -0.12 | 0.14 | -0.40 | 0.19 | -0.05 | 0.10 | -0.11 | **0.59** |
| **Taur** | -0.29 | -0.08 | **0.39** | **0.52** | 0.36 | 0.23 | 0.16 | **0.48** | -0.19 | -0.10 | 0.26 | **0.56** | -0.33 | -0.21 | 0.04 | -0.26 | -0.23 | -0.11 | -0.05 | **0.44** | **0.55** | -0.35 | -0.29 | **0.43** |
| **Wang** | 0.14 | 0.23 | **0.44** | **0.53** | **0.48** | 0.14 | -0.13 | 0.15 | -0.31 | 0.22 | **0.50** | 0.36 | -0.29 | 0.16 | 0.03 | **-0.47** | -0.32 | -0.38 | -0.19 | **0.54** | -0.14 | -0.31 | -0.15 | 0.37 |
| **Well** | -0.18 | 0.10 | **0.39** | **0.52** | **0.37** | 0.03 | 0.06 | 0.29 | -0.14 | -0.14 | **0.32** | **0.34** | -0.20 | 0.19 | -0.06 | **-0.35** | **-0.36** | -0.14 | 0.00 | -0.13 | **0.33** | **-0.42** | -0.19 | **0.35** |
| **West** | -0.13 | 0.00 | **-0.42** | -0.16 | **-0.46** | -0.21 | 0.19 | 0.19 | 0.08 | -0.33 | **-0.47** | -0.05 | 0.11 | -0.33 | -0.10 | -0.03 | 0.03 | 0.33 | -0.06 | -0.10 | 0.05 | 0.04 | 0.13 | 0.23 |

**Table 52. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for October . Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.056 | 0.335 | 0.643 | 0.463 | 0.781 | 0.189 | 0.238 | 0.45 | 0.354 | 0.936 | 0.773 | 0.556 | 0.331 | 0.361 | 0.336 | 0.344 | 0.762 | 0.908 | **0.039** | 0.645 | 0.252 | 0.564 | 0.539 | 0.25 |
| **Christ** | 0.085 | 0.319 | **0** | 0.382 | **0** | **0.04** | 0.264 | 0.651 | 0.063 | 0.067 | **0** | **0.036** | 0.842 | **0** | 0.641 | 0.34 | 0.053 | 0.48 | 0.441 | 0.742 | 0.498 | 0.454 | 0.341 | 0.484 |
| **Corom** | 0.609 | 0.563 | 0.085 | 0.097 | 0.09 | 0.225 | 0.964 | **0.029** | 0.064 | 0.946 | 0.154 | **0.007** | 0.221 | 0.789 | 0.861 | 0.232 | **0.026** | 0.88 | 0.818 | 0.059 | **0.043** | 0.174 | 0.822 | 0.414 |
| **Darg** | 0.811 | 0.981 | 0.834 | 0.28 | 0.907 | 0.216 | 0.192 | 0.813 | **0.042** | 0.817 | 0.927 | 0.908 | 0.626 | 0.124 | 0.265 | 0.178 | 0.295 | 0.401 | 0.732 | 0.016 | 0.323 | 0.17 | 0.066 | 0.206 |
| **Dun** | 0.204 | 0.436 | **0** | 0.347 | **0** | **0.027** | 0.417 | 0.38 | 0.067 | 0.176 | **0** | **0.028** | 0.977 | **0** | 0.714 | 0.418 | **0.04** | 0.119 | 0.087 | 0.758 | 0.615 | 0.381 | 0.109 | 0.635 |
| **Gisb** | 0.312 | 0.337 | **0** | 0.096 | **0** | **0** | 0.594 | 0.467 | 0.18 | **0.002** | **0** | **0.001** | 0.099 | **0** | 0.28 | 0.163 | 0.161 | **0.011** | 0.913 | 0.124 | 0.627 | 0.111 | **0.05** | 0.251 |
| **Hok** | 0.297 | 0.472 | **0.002** | **0.031** | **0.001** | 0.127 | 0.926 | 0.594 | 0.575 | 0.527 | **0.004** | 0.108 | **0.011** | 0.183 | 0.388 | 0.578 | 0.348 | **0.008** | 0.411 | 0.069 | 0.071 | 0.073 | 0.085 | 0.821 |
| **Inver** | 0.651 | 0.501 | 0.568 | 0.929 | 0.657 | 0.584 | 0.333 | 0.998 | 0.197 | 0.705 | 0.744 | 0.692 | 0.631 | 0.783 | 0.191 | 0.604 | 0.701 | **0.033** | 0.307 | 0.23 | 0.706 | 0.794 | 0.998 | 0.523 |
| **Kaik** | 0.159 | 0.528 | **0** | 0.132 | **0** | **0** | 0.277 | 0.442 | **0.034** | **0.004** | **0** | **0.001** | 0.295 | **0** | 0.287 | 0.238 | 0.145 | 0.077 | 0.912 | 0.07 | 0.408 | 0.271 | **0.04** | 0.298 |
| **Kait** | **0.035** | 0.538 | 0.615 | **0.023** | 0.547 | 0.145 | 0.34 | **0.024** | 0.551 | **0.009** | 0.298 | 0.174 | 0.301 | **0.022** | **0.033** | 0.24 | 0.321 | 0.053 | 0.337 | 0.385 | **0** | **0.041** | 0.838 | **0** |
| **Nel** | **0.024** | 0.748 | 0.58 | **0** | 0.759 | 0.608 | **0.005** | **0** | 0.824 | **0** | 0.574 | **0.003** | 0.054 | 0.06 | 0.244 | 0.045 | 0.123 | 0.715 | 0.749 | 0.292 | **0** | **0.001** | 0.283 | **0.015** |
| **New P** | 0.367 | 0.085 | 0.247 | 0.067 | 0.313 | **0.035** | 0.91 | 0.714 | 0.661 | 0.216 | 0.452 | 0.601 | 0.708 | **0.009** | 0.71 | 0.256 | 0.837 | 0.631 | 0.868 | 0.08 | 0.372 | 0.27 | 0.23 | **0.042** |
| **Ohak** | 0.1 | 0.717 | 0.565 | **0.002** | 0.524 | 0.244 | 0.221 | **0.029** | 0.981 | **0.011** | 0.365 | 0.236 | 0.185 | **0.028** | 0.707 | **0.033** | 0.417 | 0.513 | 0.68 | 0.898 | **0.028** | **0.008** | 0.752 | **0.002** |
| **Parap** | 0.062 | 0.942 | 0.462 | **0.004** | 0.345 | 0.241 | 0.052 | **0.013** | 0.627 | **0.003** | 0.183 | 0.264 | 0.688 | **0.006** | 0.884 | 0.235 | 0.283 | 0.222 | 0.627 | 0.778 | **0.012** | 0.09 | 0.619 | **0.009** |
| **Queen** | 0.456 | 0.92 | 0.159 | 0.467 | 0.208 | 0.181 | 0.598 | 0.473 | 0.905 | **0.047** | 0.226 | 0.685 | 0.233 | 0.563 | 0.493 | 0.966 | 0.636 | 0.957 | 0.098 | 0.758 | 0.982 | 0.872 | 0.646 | 0.053 |
| **Rotor** | 0.336 | 0.929 | 0.521 | **0.008** | 0.656 | 0.951 | 0.155 | **0** | 0.384 | **0.027** | 0.929 | **0.005** | 0.14 | **0.022** | 0.898 | 0.2 | **0.036** | 0.768 | 0.96 | **0.017** | **0.01** | **0.002** | 0.366 | **0** |
| **Taupo** | 0.463 | 0.564 | 0.539 | 0.185 | 0.589 | 0.478 | 0.486 | 0.105 | 0.695 | 0.225 | 0.636 | 0.32 | 0.667 | 0.252 | 0.71 | 0.153 | 0.572 | 0.534 | 0.055 | 0.389 | 0.814 | 0.651 | 0.629 | **0.003** |
| **Taur** | 0.131 | 0.664 | **0.037** | **0.004** | 0.057 | 0.229 | 0.419 | **0.009** | 0.313 | 0.592 | 0.165 | **0.002** | 0.078 | 0.276 | 0.825 | 0.168 | 0.23 | 0.569 | 0.792 | **0.016** | **0.002** | 0.063 | 0.121 | **0.021** |
| **Wang** | 0.532 | 0.31 | **0.045** | **0.014** | **0.026** | 0.54 | 0.563 | 0.51 | 0.173 | 0.338 | **0.021** | 0.108 | 0.205 | 0.498 | 0.888 | **0.031** | 0.155 | 0.093 | 0.398 | **0.012** | 0.53 | 0.166 | 0.514 | 0.097 |
| **Well** | 0.261 | 0.552 | **0.013** | **0.001** | **0.021** | 0.844 | 0.694 | 0.071 | 0.391 | 0.39 | **0.046** | **0.036** | 0.219 | 0.248 | 0.719 | **0.028** | **0.025** | 0.396 | 0.991 | 0.436 | **0.042** | **0.008** | 0.247 | **0.029** |
| **West** | 0.497 | 0.998 | **0.024** | 0.4 | **0.012** | 0.284 | 0.336 | 0.318 | 0.68 | 0.084 | **0.01** | 0.779 | 0.573 | 0.082 | 0.586 | 0.867 | 0.888 | 0.076 | 0.736 | 0.613 | 0.788 | 0.83 | 0.504 | 0.237 |

# November

**Table 53. Correlation coefficients for station SSR and predictors for November. Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | -0.18 | 0.15 | -0.12 | -0.09 | -0.14 | -0.07 | 0.08 | 0.07 | 0.05 | -0.18 | -0.15 | 0.00 | -0.02 | -0.13 | 0.10 | **0.36** | 0.30 | 0.18 | -0.08 | -0.17 | -0.03 | -0.28 | -0.07 | -0.08 |
| **Christ** | -0.09 | 0.14 | **0.59** | **0.59** | **0.58** | **0.47** | 0.13 | **0.54** | -0.24 | -0.23 | **0.51** | **0.56** | -0.27 | 0.05 | 0.30 | -0.28 | -0.25 | -0.13 | -0.06 | **0.50** | **0.60** | **-0.41** | -0.21 | 0.14 |
| **Corom** | -0.26 | 0.09 | **0.61** | **0.52** | **0.59** | **0.46** | 0.28 | **0.60** | -0.09 | -0.26 | **0.51** | **0.57** | -0.37 | 0.15 | **0.68** | 0.00 | -0.04 | -0.09 | -0.37 | 0.28 | **0.64** | **-0.51** | -0.36 | -0.10 |
| **Darg** | **-0.53** | -0.10 | **0.59** | **0.46** | **0.58** | 0.42 | 0.19 | 0.42 | -0.08 | 0.06 | **0.52** | **0.54** | -0.42 | 0.04 | **0.46** | -0.18 | -0.22 | 0.04 | -0.29 | **0.49** | **0.62** | -0.19 | -0.06 | -0.14 |
| **Dun** | -0.11 | -0.16 | 0.27 | **0.46** | **0.38** | 0.01 | -0.30 | 0.05 | -0.41 | 0.11 | **0.47** | 0.12 | **-0.39** | -0.03 | 0.07 | -0.14 | -0.22 | 0.01 | 0.09 | 0.08 | 0.31 | -0.10 | -0.06 | 0.31 |
| **Gisb** | -0.21 | 0.01 | **0.60** | **0.62** | **0.62** | **0.40** | 0.05 | 0.28 | -0.14 | 0.13 | **0.65** | **0.40** | **-0.34** | 0.23 | **0.41** | -0.24 | -0.27 | -0.23 | 0.07 | 0.34 | **0.59** | **-0.38** | **-0.35** | 0.04 |
| **Hok** | 0.24 | 0.18 | **-0.76** | **-0.46** | **-0.70** | **-0.61** | -0.27 | -0.31 | -0.12 | -0.24 | **-0.62** | **-0.50** | **0.35** | -0.29 | **-0.56** | **0.54** | 0.31 | 0.20 | -0.24 | **-0.48** | **-0.47** | 0.08 | **0.49** | 0.04 |
| **Inver** | 0.04 | 0.24 | -0.15 | 0.12 | -0.09 | -0.37 | **-0.55** | -0.18 | **-0.55** | 0.03 | 0.06 | -0.22 | **-0.34** | **-0.34** | **-0.41** | 0.13 | -0.15 | 0.16 | **0.35** | 0.10 | -0.07 | 0.00 | **0.34** | **0.36** |
| **Kaik** | -0.17 | -0.11 | **0.65** | **0.43** | **0.66** | **0.53** | 0.18 | **0.44** | -0.09 | 0.09 | **0.63** | **0.54** | **-0.34** | 0.30 | **0.62** | -0.23 | -0.12 | -0.19 | -0.20 | 0.20 | **0.37** | -0.23 | -0.26 | -0.08 |
| **Kait** | -0.14 | 0.04 | 0.34 | **0.40** | 0.32 | 0.24 | 0.23 | 0.31 | 0.08 | -0.11 | 0.29 | 0.31 | -0.12 | 0.00 | **0.46** | 0.13 | -0.10 | -0.11 | -0.27 | **0.39** | **0.50** | **-0.58** | -0.20 | -0.04 |
| **Nel** | -0.25 | -0.05 | **0.39** | **0.52** | **0.36** | **0.39** | **0.41** | **0.61** | 0.08 | **-0.52** | 0.22 | **0.53** | -0.23 | 0.01 | **0.42** | -0.23 | -0.01 | -0.09 | -0.07 | **0.38** | **0.66** | **-0.40** | **-0.37** | 0.06 |
| **New P** | 0.05 | 0.09 | -0.22 | -0.03 | -0.18 | -0.30 | 0.02 | -0.07 | 0.08 | -0.29 | -0.16 | -0.16 | -0.17 | 0.02 | -0.07 | 0.05 | 0.14 | 0.24 | -0.11 | -0.20 | 0.11 | 0.15 | **0.44** | -0.35 |
| **Ohak** | -0.12 | 0.20 | 0.10 | 0.30 | 0.12 | -0.03 | -0.02 | 0.19 | -0.17 | **-0.41** | 0.09 | 0.11 | -0.28 | -0.01 | 0.11 | -0.07 | -0.02 | -0.10 | -0.25 | 0.30 | **0.36** | -0.18 | 0.22 | -0.01 |
| **Parap** | 0.06 | 0.06 | **-0.38** | -0.16 | -0.36 | -0.19 | 0.07 | 0.14 | -0.01 | **-0.41** | **-0.39** | -0.03 | 0.09 | -0.23 | -0.19 | 0.26 | 0.19 | 0.24 | -0.20 | -0.18 | -0.14 | -0.09 | 0.21 | 0.13 |
| **Queen** | 0.12 | 0.14 | -0.40 | -0.18 | -0.40 | -0.39 | -0.22 | -0.30 | -0.07 | -0.08 | -0.34 | -0.37 | 0.16 | -0.35 | -0.41 | -0.05 | **0.57** | -0.09 | 0.24 | -0.36 | -0.11 | **0.46** | 0.08 | 0.19 |
| **Rotor** | -0.27 | -0.02 | 0.19 | 0.27 | 0.18 | 0.21 | 0.17 | **0.45** | -0.10 | **-0.38** | 0.09 | **0.38** | -0.22 | 0.01 | 0.32 | 0.09 | -0.17 | 0.03 | -0.26 | 0.20 | **0.38** | **-0.34** | -0.02 | -0.01 |
| **Taupo** | 0.05 | 0.31 | 0.18 | 0.32 | 0.20 | 0.05 | 0.05 | 0.05 | 0.04 | 0.06 | 0.25 | 0.09 | -0.10 | -0.02 | 0.27 | **0.47** | -0.27 | 0.15 | **-0.48** | 0.28 | 0.33 | -0.35 | 0.15 | -0.23 |
| **Taur** | -0.24 | -0.04 | **0.61** | **0.37** | **0.60** | **0.59** | **0.38** | **0.59** | 0.06 | -0.06 | **0.51** | **0.65** | -0.35 | 0.31 | **0.65** | -0.11 | -0.24 | -0.03 | -0.21 | 0.21 | **0.40** | -0.37 | -0.21 | -0.18 |
| **Wang** | -0.28 | -0.10 | **0.50** | **0.49** | **0.50** | **0.51** | **0.47** | **0.61** | 0.18 | -0.29 | 0.39 | **0.59** | -0.25 | 0.31 | **0.60** | -0.16 | -0.16 | -0.16 | -0.41 | 0.25 | **0.53** | -0.32 | -0.21 | -0.26 |
| **Well** | -0.25 | 0.02 | **0.36** | **0.52** | **0.36** | **0.33** | 0.17 | **0.48** | -0.14 | **-0.38** | 0.30 | **0.41** | -0.27 | 0.00 | **0.43** | -0.14 | -0.09 | -0.17 | -0.17 | **0.34** | **0.52** | **-0.45** | -0.21 | 0.14 |
| **West** | 0.28 | 0.32 | **-0.68** | -0.29 | **-0.62** | **-0.72** | -0.32 | **-0.50** | -0.05 | -0.20 | **-0.48** | **-0.64** | 0.27 | **-0.39** | **-0.39** | **0.51** | 0.11 | 0.21 | -0.17 | **-0.39** | -0.20 | 0.14 | **0.48** | -0.08 |

**Table 54. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for November. Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.319 | 0.406 | 0.506 | 0.633 | 0.437 | 0.713 | 0.664 | 0.685 | 0.794 | 0.309 | 0.407 | 0.993 | 0.919 | 0.488 | 0.598 | **0.04** | 0.09 | 0.308 | 0.667 | 0.338 | 0.851 | 0.116 | 0.707 | 0.658 |
| **Christ** | 0.606 | 0.401 | **0** | **0** | **0** | **0.003** | 0.44 | **0** | 0.136 | 0.158 | **0.001** | **0** | 0.101 | 0.758 | 0.061 | 0.085 | 0.128 | 0.44 | 0.727 | **0.001** | **0** | **0.009** | 0.189 | 0.4 |
| **Corom** | 0.255 | 0.695 | **0.003** | **0.016** | **0.005** | **0.035** | 0.221 | **0.004** | 0.701 | 0.253 | **0.018** | **0.007** | 0.1 | 0.51 | **0.001** | 0.987 | 0.862 | 0.7 | 0.095 | 0.226 | **0.002** | **0.018** | 0.114 | 0.66 |
| **Darg** | **0.013** | 0.662 | **0.004** | **0.038** | **0.006** | 0.055 | 0.416 | 0.057 | 0.738 | 0.793 | **0.015** | **0.011** | 0.056 | 0.875 | **0.038** | 0.447 | 0.328 | 0.851 | 0.204 | **0.026** | **0.003** | 0.408 | 0.809 | 0.553 |
| **Dun** | 0.513 | 0.364 | 0.105 | **0.005** | **0.024** | 0.971 | 0.079 | 0.771 | 0.013 | 0.509 | **0.004** | 0.47 | **0.018** | 0.851 | 0.672 | 0.409 | 0.205 | 0.972 | 0.6 | 0.647 | 0.068 | 0.572 | 0.73 | 0.065 |
| **Gisb** | 0.221 | 0.94 | **0** | **0** | **0** | **0.015** | 0.788 | 0.096 | 0.403 | 0.431 | **0** | **0.014** | **0.039** | 0.179 | **0.013** | 0.155 | 0.1 | 0.164 | 0.687 | **0.041** | **0** | **0.019** | **0.034** | 0.83 |
| **Hok** | 0.163 | 0.288 | **0** | **0.006** | **0** | **0** | 0.113 | 0.072 | 0.481 | 0.166 | **0** | **0.002** | **0.042** | 0.089 | **0** | **0.001** | 0.07 | 0.248 | 0.173 | **0.003** | **0.005** | 0.664 | **0.003** | 0.813 |
| **Inver** | 0.794 | 0.147 | 0.37 | 0.478 | 0.606 | **0.02** | **0** | 0.285 | **0** | 0.841 | 0.728 | 0.183 | **0.037** | **0.035** | **0.009** | 0.433 | 0.371 | 0.319 | **0.027** | 0.532 | 0.659 | 1 | **0.034** | **0.025** |
| **Kaik** | 0.332 | 0.523 | **0** | **0.01** | **0** | **0.001** | 0.294 | **0.007** | 0.607 | 0.607 | **0** | **0.001** | **0.046** | 0.085 | **0** | 0.194 | 0.509 | 0.281 | 0.26 | 0.255 | **0.027** | 0.178 | 0.128 | 0.654 |
| **Kait** | 0.421 | 0.804 | 0.054 | **0.019** | 0.069 | 0.185 | 0.201 | 0.074 | 0.652 | 0.526 | 0.103 | 0.08 | 0.502 | 0.998 | **0.007** | 0.483 | 0.58 | 0.551 | 0.133 | **0.024** | **0.003** | **0** | 0.266 | 0.817 |
| **Nel** | 0.139 | 0.784 | **0.018** | **0.001** | **0.029** | **0.017** | **0.011** | **0** | 0.63 | **0.001** | 0.195 | **0.001** | 0.174 | 0.965 | **0.009** | 0.17 | 0.948 | 0.589 | 0.667 | **0.02** | **0** | **0.015** | **0.025** | 0.726 |
| **New P** | 0.829 | 0.662 | 0.299 | 0.887 | 0.39 | 0.156 | 0.927 | 0.762 | 0.717 | 0.174 | 0.446 | 0.461 | 0.441 | 0.94 | 0.743 | 0.806 | 0.509 | 0.258 | 0.614 | 0.346 | 0.598 | 0.488 | 0.031 | 0.098 |
| **Ohak** | 0.487 | 0.245 | 0.545 | 0.079 | 0.477 | 0.866 | 0.905 | 0.255 | 0.321 | **0.012** | 0.594 | 0.519 | 0.103 | 0.957 | 0.51 | 0.686 | 0.902 | 0.546 | 0.143 | 0.078 | **0.029** | 0.299 | 0.203 | 0.94 |
| **Parap** | 0.723 | 0.739 | **0.02** | 0.332 | 0.03 | 0.266 | 0.675 | 0.398 | 0.942 | **0.011** | **0.016** | 0.873 | 0.589 | 0.17 | 0.261 | 0.122 | 0.255 | 0.144 | 0.227 | 0.293 | 0.4 | 0.578 | 0.211 | 0.44 |
| **Queen** | 0.61 | 0.532 | 0.071 | 0.443 | 0.07 | 0.082 | 0.344 | 0.184 | 0.778 | 0.745 | 0.134 | 0.104 | 0.477 | 0.117 | 0.065 | 0.826 | **0.008** | 0.698 | 0.302 | 0.11 | 0.625 | **0.036** | 0.744 | 0.398 |
| **Rotor** | 0.123 | 0.898 | 0.285 | 0.122 | 0.306 | 0.219 | 0.315 | **0.007** | 0.566 | **0.024** | 0.602 | **0.026** | 0.21 | 0.967 | 0.061 | 0.624 | 0.325 | 0.879 | 0.13 | 0.244 | **0.025** | **0.044** | 0.914 | 0.974 |
| **Taupo** | 0.808 | 0.074 | 0.583 | 0.236 | 0.482 | 1 | 0.996 | 0.801 | 0.834 | 0.563 | 0.262 | 0.683 | 0.478 | 0.901 | 0.45 | **0.024** | 0.201 | 0.135 | **0.025** | 0.518 | 0.309 | 0.083 | 0.474 | 0.154 |
| **Taur** | 0.201 | 0.838 | **0** | **0.048** | **0.001** | **0.001** | **0.042** | **0.001** | 0.767 | 0.742 | **0.005** | **0** | 0.066 | 0.102 | **0** | 0.578 | 0.207 | 0.878 | 0.267 | 0.277 | **0.029** | 0.051 | 0.279 | 0.357 |
| **Wang** | 0.22 | 0.674 | **0.022** | **0.023** | **0.02** | **0.017** | **0.031** | **0.003** | 0.44 | 0.197 | 0.078 | **0.005** | 0.273 | 0.166 | **0.004** | 0.492 | 0.482 | 0.475 | 0.065 | 0.271 | **0.014** | 0.152 | 0.356 | 0.26 |
| **Well** | 0.123 | 0.896 | **0.023** | **0.001** | **0.023** | **0.037** | 0.308 | **0.002** | 0.383 | **0.018** | 0.068 | **0.009** | 0.098 | 0.995 | **0.006** | 0.395 | 0.605 | 0.289 | 0.296 | **0.035** | **0.001** | **0.004** | 0.2 | 0.406 |
| **West** | 0.139 | 0.092 | **0** | 0.126 | **0** | **0** | 0.089 | **0.006** | 0.801 | 0.305 | **0.008** | **0** | 0.157 | **0.036** | **0.037** | **0.004** | 0.584 | 0.284 | 0.375 | **0.034** | 0.3 | 0.455 | **0.008** | 0.695 |

# December

**Table 55. Correlation coefficients for station SSR and predictors for December. Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | -0.01 | 0.13 | 0.28 | **0.45** | 0.24 | 0.14 | 0.12 | **0.45** | -0.18 | -0.31 | 0.07 | **0.46** | **-0.35** | -0.13 | **0.44** | -0.21 | -0.14 | **0.36** | -0.17 | 0.08 | **0.39** | -0.09 | 0.00 | 0.20 |
| **Christ** | 0.19 | **0.45** | **0.49** | **0.52** | **0.57** | 0.07 | -0.20 | 0.09 | **-0.36** | 0.06 | **0.60** | 0.19 | **-0.34** | -0.08 | 0.22 | -0.25 | -0.16 | 0.26 | 0.26 | **0.46** | 0.26 | -0.17 | -0.13 | 0.13 |
| **Corom** | -0.23 | 0.00 | 0.32 | **0.64** | 0.26 | 0.10 | 0.12 | **0.51** | -0.25 | -0.33 | 0.12 | **0.49** | **-0.52** | -0.13 | 0.41 | -0.42 | -0.06 | **0.49** | -0.02 | 0.14 | **0.57** | -0.33 | 0.07 | 0.37 |
| **Darg** | **-0.40** | -0.27 | 0.37 | 0.29 | 0.26 | 0.33 | 0.27 | **0.45** | 0.02 | -0.20 | 0.03 | **0.50** | -0.27 | 0.13 | 0.33 | -0.29 | -0.14 | 0.25 | -0.15 | 0.15 | **0.60** | -0.17 | -0.03 | -0.03 |
| **Dun** | 0.38 | 0.32 | -0.02 | 0.32 | -0.04 | -0.15 | -0.04 | 0.20 | -0.21 | -0.26 | -0.05 | 0.13 | -0.26 | -0.16 | 0.26 | -0.20 | 0.23 | 0.29 | 0.01 | -0.01 | 0.25 | -0.28 | 0.06 | 0.16 |
| **Gisb** | 0.02 | 0.12 | **0.61** | **0.48** | **0.54** | **0.35** | 0.16 | **0.45** | -0.11 | -0.09 | 0.36 | **0.57** | **-0.40** | 0.09 | **0.44** | **-0.37** | -0.32 | 0.20 | -0.03 | **0.37** | **0.62** | -0.28 | -0.05 | 0.21 |
| **Hok** | 0.21 | -0.13 | **-0.65** | -0.10 | **-0.62** | **-0.34** | -0.10 | 0.04 | -0.18 | **-0.38** | **-0.52** | -0.21 | 0.29 | -0.26 | -0.29 | 0.24 | **0.48** | 0.17 | -0.04 | -0.08 | **-0.39** | -0.27 | 0.09 | 0.05 |
| **Inver** | 0.15 | 0.24 | -0.03 | **0.40** | -0.01 | -0.22 | -0.19 | 0.08 | **-0.32** | -0.11 | 0.04 | 0.03 | -0.29 | -0.20 | 0.01 | -0.17 | -0.04 | **0.34** | 0.13 | -0.10 | 0.22 | -0.17 | 0.24 | 0.21 |
| **Kaik** | -0.14 | 0.21 | **0.49** | **0.41** | **0.53** | 0.22 | -0.04 | 0.18 | -0.19 | 0.06 | **0.48** | 0.28 | -0.26 | 0.01 | 0.36 | -0.21 | -0.33 | 0.09 | 0.12 | **0.36** | 0.28 | -0.10 | -0.12 | 0.11 |
| **Kait** | 0.19 | 0.15 | -0.01 | **0.39** | -0.01 | -0.12 | 0.05 | 0.29 | -0.14 | **-0.45** | -0.10 | 0.15 | -0.21 | 0.02 | 0.31 | -0.23 | 0.26 | 0.39 | -0.18 | 0.02 | 0.09 | -0.33 | 0.01 | 0.08 |
| **Nel** | 0.26 | 0.22 | 0.15 | **0.42** | 0.13 | 0.24 | 0.20 | **0.54** | -0.11 | **-0.50** | -0.08 | **0.47** | -0.19 | 0.03 | **0.45** | -0.27 | 0.05 | **0.56** | -0.12 | 0.22 | 0.18 | **-0.38** | -0.06 | -0.04 |
| **New P** | 0.11 | -0.16 | -0.03 | 0.22 | -0.01 | 0.10 | 0.12 | 0.29 | -0.06 | **-0.41** | -0.11 | 0.18 | -0.01 | 0.16 | 0.08 | -0.28 | 0.13 | 0.00 | -0.06 | 0.16 | -0.17 | -0.02 | -0.04 | 0.02 |
| **Ohak** | 0.22 | **0.42** | 0.16 | **0.36** | 0.19 | -0.16 | -0.24 | 0.07 | **-0.39** | -0.05 | 0.24 | 0.07 | **-0.49** | -0.10 | 0.12 | -0.21 | -0.08 | 0.25 | 0.23 | 0.16 | 0.12 | -0.24 | **0.35** | 0.05 |
| **Parap** | 0.22 | 0.32 | -0.03 | 0.23 | -0.01 | 0.07 | 0.06 | 0.33 | -0.17 | **-0.34** | -0.13 | 0.27 | -0.17 | -0.03 | 0.22 | -0.17 | 0.10 | **0.49** | -0.02 | 0.06 | -0.06 | -0.13 | 0.06 | -0.15 |
| **Queen** | 0.02 | 0.11 | 0.23 | 0.34 | 0.17 | 0.34 | 0.36 | **0.45** | 0.16 | -0.25 | 0.03 | **0.46** | -0.21 | 0.21 | **0.64** | -0.27 | -0.20 | 0.13 | -0.25 | 0.00 | 0.43 | -0.21 | -0.02 | -0.01 |
| **Rotor** | 0.02 | 0.06 | 0.33 | **0.48** | 0.24 | **0.39** | 0.32 | **0.70** | -0.08 | **-0.47** | -0.03 | **0.69** | **-0.38** | 0.07 | **0.52** | **-0.48** | -0.02 | **0.46** | -0.13 | 0.25 | **0.37** | **-0.34** | 0.05 | 0.07 |
| **Taupo** | 0.12 | 0.24 | 0.03 | **0.46** | 0.02 | -0.17 | -0.08 | 0.22 | -0.29 | -0.30 | -0.04 | 0.16 | -0.33 | -0.36 | 0.22 | -0.17 | 0.18 | **0.62** | 0.16 | -0.01 | 0.16 | -0.11 | -0.07 | 0.11 |
| **Taur** | -0.11 | -0.28 | -0.02 | **0.51** | -0.09 | 0.02 | 0.27 | **0.49** | 0.03 | **-0.54** | -0.24 | 0.37 | -0.31 | -0.20 | 0.21 | -0.33 | 0.09 | **0.51** | -0.02 | 0.15 | 0.36 | **-0.40** | 0.10 | **0.41** |
| **Wang** | 0.19 | 0.27 | **0.53** | **0.59** | **0.57** | 0.20 | 0.02 | 0.22 | -0.16 | -0.02 | **0.51** | 0.30 | -0.25 | -0.09 | 0.42 | -0.22 | -0.19 | 0.11 | 0.15 | **0.46** | 0.28 | -0.16 | -0.23 | 0.09 |
| **Well** | 0.08 | 0.29 | **0.39** | **0.51** | **0.42** | 0.15 | -0.02 | 0.30 | -0.25 | -0.12 | **0.36** | **0.33** | **-0.39** | -0.05 | **0.36** | -0.28 | -0.20 | 0.28 | 0.05 | **0.35** | 0.23 | -0.26 | 0.02 | 0.21 |
| **West** | 0.10 | 0.33 | **-0.40** | 0.05 | -0.31 | **-0.50** | **-0.46** | -0.16 | **-0.56** | -0.09 | -0.11 | -0.30 | -0.16 | **-0.41** | -0.24 | 0.18 | 0.31 | **0.44** | 0.20 | -0.22 | -0.18 | -0.07 | 0.21 | 0.19 |

**Table 56. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for December. Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.953 | 0.459 | 0.109 | **0.009** | 0.187 | 0.429 | 0.516 | **0.008** | 0.307 | 0.08 | 0.692 | **0.007** | **0.045** | 0.472 | **0.011** | 0.244 | 0.421 | **0.04** | 0.33 | 0.662 | **0.024** | 0.605 | 0.98 | 0.26 |
| **Christ** | 0.256 | **0.004** | **0.001** | **0.001** | **0** | 0.658 | 0.217 | 0.59 | **0.025** | 0.7 | **0** | 0.241 | **0.036** | 0.629 | 0.185 | 0.132 | 0.33 | 0.103 | 0.114 | **0.003** | 0.114 | 0.307 | 0.431 | 0.439 |
| **Corom** | 0.317 | 0.993 | 0.151 | **0.002** | 0.26 | 0.665 | 0.611 | **0.019** | 0.269 | 0.145 | 0.612 | **0.023** | **0.015** | 0.568 | 0.063 | 0.055 | 0.785 | **0.025** | 0.921 | 0.559 | **0.007** | 0.147 | 0.77 | 0.098 |
| **Darg** | 0.07 | 0.238 | 0.098 | 0.2 | 0.261 | 0.145 | 0.242 | **0.042** | 0.933 | 0.389 | 0.886 | 0.021 | 0.238 | 0.565 | 0.149 | 0.206 | 0.547 | 0.275 | 0.522 | 0.504 | **0.004** | 0.46 | 0.886 | 0.905 |
| **Dun** | **0.021** | 0.056 | 0.928 | 0.061 | 0.816 | 0.378 | 0.837 | 0.244 | 0.23 | 0.124 | 0.771 | 0.466 | 0.13 | 0.349 | 0.128 | 0.246 | 0.17 | 0.09 | 0.935 | 0.933 | 0.146 | 0.101 | 0.741 | 0.36 |
| **Gisb** | 0.912 | 0.475 | **0** | **0.003** | **0.001** | **0.034** | 0.354 | **0.005** | 0.503 | 0.585 | **0.028** | **0** | **0.013** | 0.602 | **0.006** | **0.024** | 0.053 | 0.235 | 0.85 | **0.024** | **0** | 0.096 | 0.763 | 0.223 |
| **Hok** | 0.228 | 0.468 | **0** | 0.549 | **0** | **0.046** | 0.553 | 0.831 | 0.296 | **0.023** | **0.001** | 0.219 | 0.09 | 0.126 | 0.086 | 0.171 | **0.004** | 0.325 | 0.814 | 0.636 | **0.021** | 0.112 | 0.618 | 0.793 |
| **Inver** | 0.35 | 0.135 | 0.873 | **0.012** | 0.942 | 0.169 | 0.257 | 0.645 | **0.044** | 0.514 | 0.832 | 0.858 | 0.078 | 0.212 | 0.939 | 0.302 | 0.832 | **0.033** | 0.428 | 0.563 | 0.176 | 0.314 | 0.139 | 0.199 |
| **Kaik** | 0.437 | 0.219 | **0.003** | **0.014** | **0.001** | 0.201 | 0.836 | 0.309 | 0.269 | 0.752 | **0.003** | 0.097 | 0.128 | 0.967 | **0.032** | 0.22 | 0.055 | 0.599 | 0.486 | **0.035** | 0.097 | 0.57 | 0.48 | 0.534 |
| **Kait** | 0.302 | 0.417 | 0.969 | **0.026** | 0.95 | 0.5 | 0.762 | 0.097 | 0.442 | **0.008** | 0.588 | 0.399 | 0.251 | 0.896 | 0.083 | 0.19 | 0.15 | **0.027** | 0.316 | 0.91 | 0.623 | 0.058 | 0.967 | 0.66 |
| **Nel** | 0.12 | 0.198 | 0.36 | **0.009** | 0.439 | 0.161 | 0.233 | **0.001** | 0.498 | **0.002** | 0.648 | **0.003** | 0.264 | 0.873 | **0.006** | 0.103 | 0.768 | **0** | 0.463 | 0.191 | 0.284 | **0.021** | 0.712 | 0.81 |
| **New P** | 0.605 | 0.453 | 0.873 | 0.305 | 0.962 | 0.656 | 0.585 | 0.172 | 0.775 | **0.049** | 0.619 | 0.393 | 0.977 | 0.442 | 0.717 | 0.178 | 0.537 | 0.99 | 0.791 | 0.45 | 0.433 | 0.941 | 0.858 | 0.926 |
| **Ohak** | 0.204 | **0.01** | 0.349 | **0.03** | 0.275 | 0.362 | 0.161 | 0.668 | **0.017** | 0.753 | 0.168 | 0.692 | **0.002** | 0.554 | 0.498 | 0.22 | 0.662 | 0.149 | 0.185 | 0.356 | 0.488 | 0.154 | **0.038** | 0.754 |
| **Parap** | 0.189 | 0.053 | 0.852 | 0.163 | 0.931 | 0.696 | 0.745 | **0.046** | 0.316 | **0.039** | 0.457 | 0.112 | 0.325 | 0.846 | 0.19 | 0.309 | 0.571 | **0.002** | 0.919 | 0.708 | 0.741 | 0.436 | 0.715 | 0.364 |
| **Queen** | 0.937 | 0.629 | 0.326 | 0.136 | 0.458 | 0.132 | 0.108 | **0.04** | 0.497 | 0.274 | 0.903 | **0.035** | 0.351 | 0.37 | **0.002** | 0.232 | 0.378 | 0.587 | 0.268 | 0.984 | 0.052 | 0.352 | 0.926 | 0.964 |
| **Rotor** | 0.905 | 0.734 | 0.054 | **0.003** | 0.157 | **0.021** | 0.064 | **0** | 0.643 | **0.005** | 0.868 | **0** | **0.026** | 0.677 | **0.001** | **0.004** | 0.911 | **0.005** | 0.469 | 0.143 | **0.027** | **0.043** | 0.764 | 0.686 |
| **Taupo** | 0.585 | 0.278 | 0.897 | **0.029** | 0.929 | 0.431 | 0.73 | 0.306 | 0.176 | 0.164 | 0.871 | 0.458 | 0.129 | 0.096 | 0.322 | 0.441 | 0.401 | **0.002** | 0.473 | 0.951 | 0.456 | 0.625 | 0.762 | 0.628 |
| **Taur** | 0.584 | 0.141 | 0.922 | **0.005** | 0.66 | 0.919 | 0.151 | **0.007** | 0.888 | **0.002** | 0.213 | **0.047** | 0.103 | 0.305 | 0.268 | 0.085 | 0.634 | **0.005** | 0.927 | 0.443 | 0.055 | **0.034** | 0.604 | **0.028** |
| **Wang** | 0.406 | 0.236 | **0.014** | **0.005** | **0.007** | 0.396 | 0.935 | 0.344 | 0.501 | 0.92 | **0.017** | 0.182 | 0.268 | 0.712 | 0.061 | 0.344 | 0.418 | 0.635 | 0.512 | **0.037** | 0.223 | 0.486 | 0.306 | 0.699 |
| **Well** | 0.613 | 0.073 | **0.015** | **0.001** | **0.009** | 0.366 | 0.886 | 0.062 | 0.119 | 0.451 | **0.025** | **0.039** | **0.013** | 0.769 | **0.025** | 0.085 | 0.226 | 0.085 | 0.774 | **0.029** | 0.161 | 0.108 | 0.893 | 0.193 |
| **West** | 0.618 | 0.081 | **0.033** | 0.793 | 0.103 | **0.006** | **0.013** | 0.408 | **0.002** | 0.645 | 0.587 | 0.118 | 0.419 | **0.029** | 0.209 | 0.357 | 0.103 | **0.016** | 0.296 | 0.245 | 0.336 | 0.719 | 0.284 | 0.324 |

## January

**Table 57. Correlation coefficients for station SSR and predictors for January. Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.00 | -0.02 | 0.15 | **0.39** | 0.19 | 0.11 | 0.06 | 0.30 | -0.20 | -0.19 | 0.12 | 0.29 | **-0.44** | 0.13 | 0.26 | -0.32 | -0.12 | 0.13 | 0.13 | 0.21 | 0.29 | **-0.41** | 0.08 | 0.25 |
| **Christ** | -0.17 | 0.09 | **0.39** | **0.29** | **0.40** | 0.19 | 0.04 | 0.14 | -0.10 | 0.03 | **0.44** | 0.19 | -0.19 | 0.25 | 0.03 | -0.27 | -0.17 | 0.00 | 0.17 | 0.01 | 0.01 | 0.02 | -0.10 | **0.33** |
| **Corom** | -0.37 | -0.06 | 0.32 | **0.45** | 0.33 | 0.29 | 0.22 | **0.45** | -0.20 | -0.34 | 0.23 | **0.42** | -0.39 | 0.03 | 0.38 | **-0.44** | -0.35 | -0.21 | 0.32 | 0.15 | **0.49** | -0.42 | 0.03 | **0.44** |
| **Darg** | -0.09 | -0.01 | 0.36 | 0.38 | 0.38 | 0.30 | 0.15 | 0.41 | -0.28 | -0.16 | 0.30 | **0.43** | -0.42 | 0.31 | 0.25 | -0.41 | -0.33 | -0.04 | -0.01 | 0.03 | 0.16 | -0.35 | 0.05 | 0.35 |
| **Dun** | 0.15 | 0.12 | -0.01 | **0.33** | -0.03 | -0.02 | -0.05 | 0.07 | -0.15 | -0.22 | -0.03 | -0.01 | -0.12 | -0.19 | -0.02 | -0.13 | 0.11 | 0.13 | 0.22 | -0.23 | -0.02 | -0.03 | 0.06 | 0.32 |
| **Gisb** | **-0.45** | -0.16 | **0.54** | **0.31** | **0.56** | **0.34** | 0.05 | 0.15 | -0.10 | 0.25 | **0.61** | 0.28 | **-0.36** | **0.39** | 0.15 | **-0.33** | **-0.46** | -0.10 | 0.30 | 0.15 | 0.12 | -0.01 | -0.07 | 0.31 |
| **Hok** | **0.41** | **0.38** | **-0.71** | -0.28 | **-0.71** | **-0.57** | -0.21 | **-0.33** | 0.06 | -0.21 | **-0.70** | **-0.48** | **0.35** | **-0.42** | **-0.40** | 0.30 | **0.51** | 0.22 | **-0.34** | -0.27 | -0.24 | -0.10 | 0.27 | -0.27 |
| **Inver** | 0.15 | -0.07 | **-0.38** | 0.12 | **-0.40** | -0.26 | -0.06 | -0.02 | -0.07 | **-0.31** | **-0.42** | -0.15 | 0.12 | **-0.36** | -0.22 | -0.03 | 0.19 | 0.20 | -0.03 | -0.21 | 0.00 | -0.24 | 0.28 | 0.23 |
| **Kaik** | **-0.37** | -0.19 | **0.40** | 0.14 | **0.42** | **0.36** | 0.21 | 0.25 | 0.03 | 0.02 | **0.37** | **0.32** | -0.30 | **0.38** | 0.31 | -0.20 | -0.24 | -0.12 | 0.09 | **0.46** | 0.17 | -0.05 | -0.23 | 0.11 |
| **Kait** | 0.29 | 0.15 | 0.02 | 0.31 | 0.07 | 0.01 | 0.06 | 0.34 | -0.28 | **-0.35** | -0.04 | 0.28 | -0.29 | 0.07 | 0.14 | -0.32 | 0.17 | **0.36** | -0.21 | -0.01 | 0.22 | **-0.43** | 0.14 | 0.25 |
| **Nel** | -0.11 | -0.01 | 0.15 | **0.64** | 0.15 | 0.19 | 0.21 | **0.53** | -0.28 | **-0.52** | 0.06 | **0.42** | -0.18 | -0.05 | **0.41** | **-0.39** | -0.12 | 0.18 | 0.23 | 0.12 | **0.35** | **-0.49** | 0.01 | **0.36** |
| **New P** | 0.07 | 0.17 | -0.32 | 0.14 | -0.29 | -0.31 | -0.06 | 0.06 | -0.14 | **-0.59** | -0.39 | -0.09 | -0.05 | -0.26 | 0.07 | -0.09 | **0.42** | -0.26 | -0.01 | -0.13 | 0.31 | -0.39 | 0.33 | 0.04 |
| **Ohak** | 0.03 | 0.25 | -0.28 | 0.23 | -0.24 | -0.29 | -0.17 | 0.08 | **-0.33** | **-0.36** | -0.21 | -0.06 | -0.08 | -0.24 | 0.07 | -0.06 | 0.09 | 0.02 | 0.03 | -0.20 | 0.16 | **-0.43** | 0.28 | 0.30 |
| **Parap** | 0.31 | **0.36** | **-0.38** | 0.06 | **-0.36** | -0.28 | -0.02 | 0.12 | -0.15 | **-0.47** | **-0.43** | -0.04 | 0.21 | -0.24 | -0.15 | -0.10 | **0.49** | **0.44** | -0.13 | -0.20 | -0.11 | -0.29 | 0.11 | -0.02 |
| **Queen** | 0.07 | 0.04 | -0.36 | **0.41** | -0.40 | -0.26 | 0.19 | 0.09 | 0.20 | **-0.55** | -0.41 | -0.12 | -0.05 | **-0.52** | 0.08 | 0.15 | 0.11 | 0.10 | 0.06 | -0.04 | 0.25 | **-0.50** | 0.26 | 0.35 |
| **Rotor** | -0.14 | 0.02 | 0.26 | **0.50** | 0.26 | 0.32 | **0.36** | **0.59** | -0.12 | **-0.47** | 0.09 | **0.54** | -0.28 | 0.14 | **0.42** | **-0.49** | -0.04 | 0.27 | 0.06 | 0.28 | **0.40** | **-0.51** | 0.00 | 0.20 |
| **Taupo** | 0.04 | -0.04 | -0.11 | 0.33 | -0.09 | -0.04 | 0.23 | 0.37 | -0.09 | **-0.51** | -0.24 | 0.26 | **-0.47** | -0.10 | 0.31 | -0.33 | 0.21 | 0.09 | -0.16 | 0.10 | **0.43** | **-0.55** | 0.24 | 0.12 |
| **Taur** | **-0.41** | -0.17 | 0.26 | **0.40** | 0.28 | 0.23 | 0.17 | **0.49** | -0.22 | **-0.42** | 0.16 | **0.44** | -0.29 | 0.08 | **0.44** | **-0.55** | -0.10 | -0.12 | 0.19 | 0.19 | **0.47** | -0.33 | 0.05 | 0.25 |
| **Wang** | -0.18 | -0.02 | -0.11 | 0.27 | -0.13 | -0.06 | 0.16 | 0.25 | -0.06 | **-0.50** | -0.26 | 0.14 | -0.29 | -0.33 | 0.22 | -0.15 | 0.02 | -0.13 | 0.22 | 0.05 | **0.65** | **-0.49** | 0.26 | 0.23 |
| **Well** | -0.16 | 0.07 | **0.31** | **0.32** | **0.34** | 0.16 | 0.03 | 0.20 | -0.17 | 0.00 | **0.36** | 0.23 | -0.18 | **0.35** | 0.18 | -0.20 | -0.27 | 0.07 | 0.00 | 0.23 | 0.06 | -0.11 | -0.12 | 0.06 |
| **West** | **0.48** | **0.37** | **-0.55** | -0.02 | **-0.53** | **-0.49** | -0.15 | -0.14 | -0.08 | **-0.40** | **-0.53** | -0.32 | 0.06 | **-0.38** | -0.30 | 0.31 | 0.28 | **0.55** | -0.18 | -0.29 | -0.21 | -0.27 | 0.27 | -0.15 |

**Table 58. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for January. Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.898 | 0.97 | 0.342 | **0.017** | 0.231 | 0.517 | 0.82 | 0.071 | 0.181 | 0.222 | 0.424 | 0.084 | **0.01** | 0.476 | 0.141 | 0.07 | 0.492 | 0.466 | 0.466 | 0.244 | 0.099 | **0.019** | 0.671 | 0.168 |
| **Christ** | 0.227 | 0.522 | **0.011** | **0.044** | **0.008** | 0.226 | 0.981 | 0.327 | 0.333 | 0.994 | **0.003** | 0.202 | 0.247 | 0.127 | 0.863 | 0.093 | 0.313 | 0.988 | 0.308 | 0.95 | 0.962 | 0.885 | 0.535 | **0.041** |
| **Corom** | 0.068 | 0.857 | 0.122 | **0.024** | 0.099 | 0.17 | 0.442 | **0.03** | 0.242 | 0.095 | 0.223 | **0.041** | 0.081 | 0.914 | 0.086 | **0.047** | 0.119 | 0.363 | 0.16 | 0.513 | **0.025** | 0.059 | 0.897 | **0.043** |
| **Darg** | 0.659 | 0.984 | 0.098 | 0.077 | 0.081 | 0.166 | 0.574 | 0.054 | 0.216 | 0.451 | 0.173 | **0.042** | 0.058 | 0.167 | 0.279 | 0.062 | 0.142 | 0.854 | 0.971 | 0.883 | 0.494 | 0.115 | 0.832 | 0.118 |
| **Dun** | 0.507 | 0.458 | 0.949 | **0.049** | 0.961 | 0.968 | 0.647 | 0.567 | 0.212 | 0.148 | 0.974 | 0.923 | 0.498 | 0.261 | 0.888 | 0.444 | 0.523 | 0.44 | 0.191 | 0.174 | 0.91 | 0.851 | 0.727 | 0.059 |
| **Gisb** | **0.003** | 0.388 | **0** | **0.039** | **0** | **0.032** | 0.911 | 0.32 | 0.382 | 0.185 | **0** | 0.072 | **0.028** | **0.018** | 0.361 | **0.046** | **0.005** | 0.548 | 0.076 | 0.366 | 0.479 | 0.969 | 0.663 | 0.063 |
| **Hok** | **0.013** | **0.027** | **0** | 0.088 | **0** | **0** | 0.257 | **0.048** | 0.653 | 0.257 | **0** | **0.003** | **0.042** | **0.011** | **0.019** | 0.077 | **0.002** | 0.202 | **0.045** | 0.12 | 0.158 | 0.581 | 0.112 | 0.117 |
| **Inver** | 0.434 | 0.686 | **0.022** | 0.399 | **0.017** | 0.118 | 0.65 | 0.985 | 0.542 | **0.04** | **0.011** | 0.387 | 0.484 | **0.023** | 0.182 | 0.871 | 0.247 | 0.226 | 0.849 | 0.199 | 0.986 | 0.136 | 0.085 | 0.15 |
| **Kaik** | **0.021** | 0.287 | **0.013** | 0.363 | **0.009** | **0.03** | 0.282 | 0.13 | 0.944 | 0.995 | **0.02** | **0.05** | 0.081 | **0.026** | 0.071 | 0.258 | 0.157 | 0.489 | 0.593 | **0.006** | 0.318 | 0.764 | 0.177 | 0.535 |
| **Kait** | 0.096 | 0.405 | 0.892 | 0.084 | 0.707 | 0.962 | 0.737 | 0.051 | 0.114 | **0.047** | 0.831 | 0.11 | 0.107 | 0.696 | 0.453 | 0.07 | 0.354 | **0.043** | 0.237 | 0.952 | 0.216 | **0.013** | 0.434 | 0.168 |
| **Nel** | 0.431 | 0.997 | 0.329 | **0** | 0.276 | 0.238 | 0.286 | **0** | 0.052 | **0** | 0.593 | **0.007** | 0.297 | 0.777 | **0.013** | **0.017** | 0.492 | 0.293 | 0.174 | 0.487 | **0.031** | **0.002** | 0.961 | **0.029** |
| **New P** | 0.848 | 0.385 | 0.16 | 0.437 | 0.232 | 0.149 | 0.706 | 0.719 | 0.398 | **0.002** | 0.098 | 0.738 | 0.821 | 0.224 | 0.755 | 0.659 | **0.043** | 0.227 | 0.973 | 0.539 | 0.135 | 0.059 | 0.121 | 0.836 |
| **Ohak** | 0.864 | 0.136 | 0.09 | 0.177 | 0.154 | 0.087 | 0.315 | 0.633 | **0.045** | **0.027** | 0.202 | 0.732 | 0.634 | 0.161 | 0.69 | 0.731 | 0.618 | 0.899 | 0.857 | 0.251 | 0.36 | **0.008** | 0.097 | 0.072 |
| **Parap** | 0.076 | **0.025** | **0.025** | 0.648 | **0.036** | 0.092 | 0.866 | 0.461 | 0.318 | **0.002** | **0.01** | 0.832 | 0.216 | 0.152 | 0.387 | 0.552 | **0.002** | **0.007** | 0.436 | 0.24 | 0.516 | 0.086 | 0.53 | 0.908 |
| **Queen** | 0.859 | 0.813 | 0.132 | **0.049** | 0.119 | 0.267 | 0.492 | 0.631 | 0.654 | **0.006** | 0.112 | 0.684 | 0.835 | **0.015** | 0.718 | 0.525 | 0.623 | 0.655 | 0.787 | 0.86 | 0.278 | **0.022** | 0.255 | 0.122 |
| **Rotor** | 0.356 | 0.888 | 0.115 | **0.002** | 0.098 | 0.057 | **0.048** | **0** | 0.359 | **0.003** | 0.517 | **0.001** | 0.102 | 0.414 | **0.012** | **0.003** | 0.813 | 0.122 | 0.752 | 0.109 | **0.016** | **0.002** | 0.995 | 0.242 |
| **Taupo** | 0.851 | 0.863 | 0.607 | 0.11 | 0.678 | 0.835 | 0.285 | 0.071 | 0.683 | **0.011** | 0.256 | 0.222 | 0.024 | 0.659 | 0.146 | 0.122 | 0.328 | 0.667 | 0.464 | 0.649 | **0.04** | **0.007** | 0.279 | 0.58 |
| **Taur** | **0.021** | 0.405 | 0.145 | **0.023** | 0.11 | 0.205 | 0.43 | **0.005** | 0.187 | **0.018** | 0.352 | **0.014** | 0.133 | 0.665 | **0.017** | **0.002** | 0.6 | 0.528 | 0.329 | 0.317 | **0.009** | 0.079 | 0.797 | 0.199 |
| **Wang** | 0.535 | 0.872 | 0.564 | 0.329 | 0.453 | 0.74 | 0.398 | 0.325 | 0.898 | **0.033** | 0.194 | 0.629 | 0.206 | 0.139 | 0.331 | 0.506 | 0.946 | 0.588 | 0.346 | 0.835 | **0.002** | **0.023** | 0.264 | 0.307 |
| **Well** | 0.257 | 0.617 | **0.041** | **0.03** | **0.023** | 0.309 | 0.991 | 0.186 | 0.171 | 0.868 | **0.016** | 0.122 | 0.276 | **0.031** | 0.285 | 0.213 | 0.093 | 0.667 | 0.978 | 0.152 | 0.72 | 0.503 | 0.476 | 0.71 |
| **West** | **0.012** | **0.042** | **0.003** | 0.999 | **0.005** | **0.007** | 0.385 | 0.513 | 0.576 | **0.024** | **0.005** | 0.099 | 0.776 | **0.042** | 0.112 | 0.105 | 0.146 | **0.002** | 0.357 | 0.133 | 0.276 | 0.15 | 0.157 | 0.423 |

## February

**Table 59. Correlation coefficients for station SSR and predictors for February . Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.00 | **0.43** | -0.15 | 0.01 | -0.02 | -0.33 | **-0.36** | -0.26 | -0.26 | 0.06 | 0.08 | -0.26 | -0.15 | **-0.35** | -0.13 | 0.20 | -0.04 | -0.13 | **0.42** | -0.08 | -0.15 | -0.31 | 0.26 | 0.08 |
| **Christ** | -0.29 | **0.32** | 0.24 | **0.39** | **0.32** | -0.08 | **-0.32** | -0.04 | **-0.38** | 0.08 | **0.43** | -0.01 | -0.22 | 0.12 | -0.09 | -0.27 | -0.13 | 0.00 | **0.35** | 0.28 | 0.16 | -0.10 | -0.02 | **0.42** |
| **Corom** | -0.32 | 0.27 | **0.59** | **0.60** | **0.69** | 0.29 | -0.11 | **0.44** | -0.36 | -0.22 | **0.58** | **0.47** | -0.39 | -0.29 | 0.14 | **-0.46** | -0.13 | -0.09 | **0.63** | **0.54** | **0.69** | **-0.53** | -0.12 | **0.70** |
| **Darg** | -0.01 | 0.03 | 0.00 | 0.35 | 0.09 | -0.16 | -0.37 | 0.13 | **-0.50** | -0.26 | 0.19 | 0.05 | -0.04 | -0.06 | -0.17 | -0.32 | -0.10 | -0.17 | 0.32 | 0.19 | 0.22 | -0.33 | 0.10 | **0.49** |
| **Dun** | 0.12 | 0.22 | -0.16 | 0.12 | -0.14 | **-0.44** | **-0.35** | -0.11 | **-0.37** | -0.03 | 0.00 | -0.20 | -0.11 | -0.08 | -0.21 | -0.10 | -0.14 | -0.08 | -0.05 | 0.01 | -0.04 | -0.01 | 0.33 | 0.28 |
| **Gisb** | -0.22 | -0.09 | **0.65** | 0.18 | **0.65** | **0.44** | -0.05 | 0.15 | -0.16 | 0.19 | **0.56** | 0.32 | -0.28 | 0.09 | 0.20 | -0.12 | -0.19 | -0.25 | 0.26 | **0.56** | 0.17 | -0.09 | -0.13 | 0.30 |
| **Hok** | 0.16 | 0.06 | **-0.51** | -0.11 | **-0.50** | **-0.45** | -0.17 | 0.04 | -0.25 | -0.23 | **-0.42** | -0.13 | -0.20 | -0.29 | **-0.36** | -0.09 | 0.14 | 0.16 | -0.22 | -0.17 | 0.03 | 0.19 | 0.32 | 0.15 |
| **Inver** | 0.25 | 0.22 | -0.15 | 0.10 | -0.12 | -0.22 | -0.19 | -0.08 | -0.20 | 0.09 | -0.02 | -0.10 | -0.07 | 0.02 | -0.21 | -0.06 | -0.11 | -0.13 | -0.13 | -0.01 | -0.06 | -0.12 | 0.31 | 0.31 |
| **Kaik** | **-0.39** | 0.32 | **0.48** | 0.24 | **0.50** | 0.17 | -0.11 | -0.01 | -0.14 | 0.20 | **0.51** | 0.11 | -0.18 | -0.04 | 0.06 | **-0.40** | -0.12 | -0.12 | 0.30 | **0.36** | **0.35** | -0.10 | 0.03 | 0.29 |
| **Kait** | -0.07 | 0.16 | -0.03 | 0.08 | 0.07 | -0.24 | -0.24 | 0.05 | **-0.35** | -0.17 | 0.08 | 0.03 | **-0.49** | -0.21 | -0.26 | -0.01 | 0.29 | -0.13 | 0.24 | 0.11 | 0.06 | -0.32 | 0.28 | 0.27 |
| **Nel** | **-0.32** | -0.02 | -0.02 | **0.39** | 0.02 | -0.27 | -0.07 | 0.29 | -0.28 | **-0.46** | -0.05 | 0.17 | -0.24 | -0.08 | 0.20 | -0.32 | 0.11 | -0.03 | 0.05 | -0.08 | -0.05 | -0.28 | 0.19 | 0.21 |
| **New P** | **0.36** | 0.03 | -0.37 | 0.20 | -0.27 | -0.40 | -0.20 | 0.08 | -0.29 | -0.07 | -0.14 | 0.00 | -0.03 | -0.06 | -0.37 | -0.30 | 0.00 | -0.10 | -0.15 | 0.18 | 0.03 | -0.21 | **0.44** | 0.23 |
| **Ohak** | -0.19 | **0.35** | **-0.35** | 0.02 | -0.24 | **-0.43** | -0.26 | -0.09 | -0.27 | -0.17 | -0.15 | -0.19 | -0.21 | -0.29 | -0.17 | -0.09 | 0.27 | -0.19 | 0.07 | -0.14 | -0.14 | -0.15 | **0.35** | 0.15 |
| **Parap** | -0.20 | 0.21 | -0.31 | 0.10 | -0.25 | **-0.43** | -0.19 | 0.02 | -0.26 | -0.30 | -0.19 | -0.13 | -0.20 | -0.32 | 0.01 | -0.19 | 0.14 | -0.01 | 0.11 | -0.27 | -0.09 | -0.11 | **0.34** | 0.07 |
| **Queen** | 0.15 | 0.42 | -0.13 | 0.24 | -0.04 | -0.35 | -0.32 | 0.06 | -0.41 | 0.09 | 0.15 | 0.02 | 0.01 | -0.11 | -0.05 | -0.10 | -0.42 | -0.34 | -0.01 | -0.05 | -0.14 | -0.36 | **0.46** | 0.41 |
| **Rotor** | -0.32 | 0.07 | -0.21 | 0.16 | -0.09 | -0.36 | -0.27 | 0.04 | **-0.37** | **-0.39** | -0.10 | -0.08 | **-0.46** | -0.22 | -0.04 | -0.09 | **0.40** | -0.19 | 0.21 | 0.11 | -0.11 | **-0.37** | 0.16 | 0.31 |
| **Taupo** | 0.17 | -0.04 | -0.34 | 0.30 | -0.14 | **-0.43** | -0.28 | 0.08 | -0.37 | **-0.42** | -0.09 | -0.07 | -0.08 | -0.21 | -0.15 | 0.00 | 0.11 | 0.04 | 0.28 | -0.24 | -0.11 | **-0.44** | 0.24 | 0.11 |
| **Taur** | **-0.40** | -0.14 | -0.14 | 0.34 | -0.02 | -0.24 | -0.30 | 0.26 | **-0.53** | **-0.45** | -0.08 | 0.13 | **-0.45** | -0.15 | 0.07 | -0.24 | 0.01 | -0.06 | 0.30 | 0.02 | -0.09 | **-0.37** | 0.17 | **0.52** |
| **Wang** | 0.29 | 0.18 | -0.20 | 0.14 | -0.09 | -0.02 | -0.13 | 0.08 | -0.20 | 0.17 | 0.01 | 0.11 | 0.29 | 0.21 | -0.31 | -0.37 | -0.15 | -0.10 | -0.11 | 0.05 | -0.03 | -0.31 | 0.31 | 0.31 |
| **Well** | -0.13 | 0.20 | 0.10 | 0.29 | 0.16 | -0.23 | -0.19 | 0.04 | -0.26 | -0.01 | 0.25 | 0.03 | -0.13 | -0.09 | 0.00 | -0.22 | -0.08 | 0.03 | 0.12 | -0.01 | 0.01 | -0.30 | **0.33** | 0.09 |
| **West** | 0.06 | -0.14 | **-0.41** | -0.29 | **-0.46** | **-0.45** | -0.13 | 0.02 | -0.17 | -0.08 | -0.34 | -0.13 | 0.13 | -0.31 | -0.29 | -0.09 | 0.04 | 0.08 | -0.24 | -0.29 | -0.19 | 0.31 | 0.32 | -0.01 |

**Table 60. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for February. Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.979 | **0.011** | 0.408 | 0.994 | 0.885 | 0.059 | **0.035** | 0.141 | 0.139 | 0.719 | 0.670 | 0.130 | 0.410 | **0.043** | 0.487 | 0.258 | 0.841 | 0.463 | **0.016** | 0.642 | 0.413 | 0.079 | 0.144 | 0.677 |
| **Christ** | 0.066 | **0.045** | 0.138 | **0.018** | **0.050** | 0.626 | **0.045** | 0.798 | **0.016** | 0.576 | **0.006** | 0.913 | 0.172 | 0.484 | 0.591 | 0.091 | 0.420 | 0.999 | **0.028** | 0.087 | 0.333 | 0.557 | 0.895 | **0.008** |
| **Corom** | 0.152 | 0.341 | **0.007** | **0.001** | **0.000** | 0.210 | 0.697 | **0.018** | 0.081 | 0.114 | **0.005** | **0.018** | 0.080 | 0.208 | 0.539 | **0.036** | 0.565 | 0.701 | **0.002** | **0.011** | **0.001** | **0.014** | 0.611 | **0.000** |
| **Darg** | 0.850 | 0.865 | 0.969 | 0.200 | 0.775 | 0.477 | 0.094 | 0.688 | **0.024** | 0.404 | 0.441 | 0.904 | 0.857 | 0.781 | 0.467 | 0.163 | 0.676 | 0.452 | 0.156 | 0.398 | 0.338 | 0.147 | 0.677 | **0.023** |
| **Dun** | 0.536 | 0.182 | 0.331 | 0.582 | 0.374 | **0.006** | **0.034** | 0.462 | **0.030** | 0.947 | 0.975 | 0.213 | 0.513 | 0.624 | 0.224 | 0.554 | 0.409 | 0.625 | 0.753 | 0.932 | 0.811 | 0.960 | 0.051 | 0.094 |
| **Gisb** | 0.177 | 0.611 | **0.000** | 0.323 | **0.000** | **0.006** | 0.784 | 0.410 | 0.360 | 0.246 | **0.000** | 0.053 | 0.089 | 0.592 | 0.235 | 0.497 | 0.264 | 0.141 | 0.126 | **0.000** | 0.327 | 0.612 | 0.452 | 0.067 |
| **Hok** | 0.476 | 0.710 | **0.002** | 0.380 | **0.001** | **0.006** | 0.312 | 0.927 | 0.176 | 0.271 | **0.009** | 0.378 | 0.260 | 0.091 | **0.036** | 0.604 | 0.427 | 0.354 | 0.206 | 0.331 | 0.858 | 0.287 | 0.059 | 0.386 |
| **Inver** | 0.103 | 0.176 | 0.370 | 0.472 | 0.499 | 0.181 | 0.236 | 0.711 | 0.208 | 0.695 | 0.930 | 0.573 | 0.653 | 0.908 | 0.208 | 0.737 | 0.501 | 0.423 | 0.424 | 0.950 | 0.718 | 0.471 | 0.056 | 0.056 |
| **Kaik** | **0.018** | 0.054 | **0.003** | 0.209 | **0.003** | 0.325 | 0.503 | 0.904 | 0.442 | 0.225 | **0.002** | 0.564 | 0.293 | 0.834 | 0.753 | **0.017** | 0.500 | 0.510 | 0.076 | **0.036** | **0.037** | 0.584 | 0.863 | 0.087 |
| **Kait** | 0.711 | 0.370 | 0.870 | 0.650 | 0.681 | 0.170 | 0.187 | 0.778 | **0.047** | 0.354 | 0.674 | 0.867 | **0.004** | 0.242 | 0.145 | 0.961 | 0.097 | 0.457 | 0.184 | 0.528 | 0.743 | 0.068 | 0.113 | 0.131 |
| **Nel** | **0.047** | 0.904 | 0.902 | **0.028** | 0.965 | 0.096 | 0.685 | 0.102 | 0.100 | **0.006** | 0.738 | 0.354 | 0.159 | 0.658 | 0.228 | 0.054 | 0.510 | 0.870 | 0.768 | 0.630 | 0.753 | 0.095 | 0.267 | 0.213 |
| **NewP** | **0.047** | 0.930 | 0.098 | 0.212 | 0.289 | 0.062 | 0.358 | 0.535 | 0.135 | 0.549 | 0.617 | 0.866 | 0.884 | 0.798 | 0.076 | 0.148 | 0.990 | 0.641 | 0.489 | 0.397 | 0.881 | 0.317 | **0.031** | 0.283 |
| **Ohak** | 0.208 | **0.034** | **0.035** | 0.949 | 0.130 | **0.008** | 0.126 | 0.529 | 0.121 | 0.404 | 0.343 | 0.229 | 0.217 | 0.081 | 0.309 | 0.610 | 0.114 | 0.275 | 0.678 | 0.407 | 0.415 | 0.377 | **0.035** | 0.380 |
| **Parap** | 0.215 | 0.196 | 0.056 | 0.627 | 0.115 | **0.006** | 0.242 | 0.959 | 0.124 | 0.091 | 0.233 | 0.414 | 0.244 | 0.053 | 0.975 | 0.250 | 0.419 | 0.975 | 0.528 | 0.111 | 0.602 | 0.528 | **0.042** | 0.690 |
| **Queen** | 0.547 | 0.052 | 0.563 | 0.336 | 0.831 | 0.106 | 0.151 | 0.832 | 0.066 | 0.676 | 0.504 | 0.942 | 0.982 | 0.642 | 0.838 | 0.675 | 0.055 | 0.133 | 0.978 | 0.844 | 0.552 | 0.108 | **0.037** | 0.062 |
| **Rotor** | 0.077 | 0.696 | 0.229 | 0.316 | 0.647 | **0.031** | 0.115 | 0.802 | **0.027** | **0.018** | 0.584 | 0.687 | **0.005** | 0.202 | 0.815 | 0.590 | **0.018** | 0.264 | 0.217 | 0.542 | 0.532 | **0.030** | 0.353 | 0.074 |
| **Taupo** | 0.424 | 0.839 | 0.102 | 0.152 | 0.523 | **0.035** | 0.189 | 0.719 | 0.077 | **0.043** | 0.668 | 0.758 | 0.700 | 0.339 | 0.504 | 0.998 | 0.622 | 0.843 | 0.189 | 0.262 | 0.627 | **0.036** | 0.276 | 0.614 |
| **Taur** | **0.049** | 0.446 | 0.515 | 0.052 | 0.974 | 0.223 | 0.114 | 0.140 | **0.002** | **0.011** | 0.755 | 0.428 | **0.013** | 0.452 | 0.730 | 0.205 | 0.961 | 0.762 | 0.110 | 0.928 | 0.660 | **0.048** | 0.386 | **0.004** |
| **Wang** | 0.091 | 0.521 | 0.452 | 0.277 | 0.918 | 0.956 | 0.621 | 0.446 | 0.311 | 0.981 | 0.825 | 0.466 | 0.206 | 0.351 | 0.179 | 0.100 | 0.526 | 0.652 | 0.647 | 0.825 | 0.906 | 0.177 | 0.172 | 0.177 |
| **Well** | 0.332 | 0.209 | 0.594 | 0.149 | 0.408 | 0.143 | 0.250 | 0.952 | 0.127 | 0.901 | 0.154 | 0.958 | 0.432 | 0.590 | 0.980 | 0.172 | 0.607 | 0.837 | 0.463 | 0.973 | 0.959 | 0.062 | **0.039** | 0.589 |
| **West** | 0.949 | 0.508 | **0.022** | 0.071 | **0.007** | **0.013** | 0.475 | 0.879 | 0.449 | 0.912 | 0.051 | 0.408 | 0.516 | 0.101 | 0.126 | 0.628 | 0.840 | 0.695 | 0.203 | 0.129 | 0.323 | 0.100 | 0.089 | 0.976 |

# March

**Table 61. Correlation coefficients for station SSR and predictors for March. Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.00 | 0.01 | 0.07 | 0.12 | 0.04 | -0.01 | 0.05 | 0.24 | -0.13 | -0.09 | 0.01 | 0.25 | 0.10 | -0.11 | 0.04 | -0.07 | -0.25 | -0.12 | 0.04 | -0.33 | 0.05 | -0.32 | 0.18 | 0.23 |
| **Christ** | -0.19 | 0.00 | **0.60** | **0.60** | **0.65** | 0.23 | 0.00 | 0.18 | -0.17 | 0.14 | **0.65** | **0.31** | **-0.47** | 0.17 | 0.26 | -0.22 | **-0.37** | -0.04 | 0.27 | **0.35** | 0.12 | **-0.49** | 0.09 | 0.20 |
| **Corom** | 0.02 | -0.04 | 0.09 | 0.25 | 0.08 | 0.17 | 0.14 | 0.26 | -0.02 | -0.21 | -0.03 | 0.26 | -0.18 | -0.09 | -0.11 | -0.38 | -0.17 | 0.14 | -0.06 | -0.11 | 0.38 | -0.20 | 0.05 | 0.40 |
| **Darg** | -0.22 | -0.13 | 0.21 | 0.00 | 0.14 | 0.11 | 0.08 | 0.23 | -0.11 | -0.12 | 0.04 | 0.26 | -0.23 | 0.03 | 0.06 | -0.07 | -0.14 | -0.10 | 0.23 | 0.03 | 0.07 | -0.33 | 0.09 | 0.15 |
| **Dun** | 0.03 | 0.00 | 0.18 | 0.40 | 0.21 | -0.17 | -0.18 | 0.08 | **-0.35** | 0.06 | 0.28 | 0.10 | -0.30 | -0.18 | -0.02 | -0.25 | -0.25 | 0.12 | 0.22 | -0.03 | -0.09 | -0.26 | 0.27 | 0.21 |
| **Gisb** | -0.27 | -0.09 | **0.60** | **0.48** | **0.55** | **0.33** | 0.08 | 0.24 | -0.09 | 0.12 | **0.47** | **0.39** | -0.27 | 0.23 | 0.24 | -0.13 | **-0.44** | -0.06 | 0.03 | 0.30 | **0.44** | **-0.38** | -0.12 | 0.24 |
| **Hok** | **0.41** | -0.03 | -0.32 | -0.29 | -0.28 | **-0.41** | -0.17 | -0.30 | 0.00 | 0.18 | -0.15 | **-0.34** | -0.09 | -0.24 | -0.13 | 0.09 | 0.31 | -0.07 | -0.01 | -0.18 | -0.27 | 0.16 | **0.39** | -0.32 |
| **Inver** | 0.17 | 0.04 | 0.09 | **0.35** | 0.10 | -0.11 | -0.11 | 0.09 | -0.26 | 0.02 | 0.16 | 0.09 | **-0.37** | -0.15 | -0.08 | -0.09 | -0.06 | 0.26 | 0.05 | 0.03 | -0.10 | -0.21 | 0.14 | 0.19 |
| **Kaik** | **-0.37** | -0.09 | **0.68** | **0.59** | **0.66** | **0.41** | 0.26 | 0.30 | 0.15 | 0.09 | **0.57** | **0.46** | **-0.40** | 0.27 | **0.39** | -0.31 | -0.44 | 0.01 | 0.09 | 0.24 | **0.36** | **-0.36** | -0.07 | 0.29 |
| **Kait** | 0.25 | -0.11 | 0.02 | 0.10 | 0.02 | -0.23 | -0.19 | 0.03 | -0.32 | 0.07 | 0.10 | 0.03 | -0.02 | -0.10 | -0.16 | -0.15 | -0.18 | -0.09 | 0.16 | -0.24 | 0.02 | -0.28 | **0.46** | -0.10 |
| **Nel** | -0.16 | -0.09 | 0.29 | **0.57** | 0.30 | 0.06 | 0.09 | 0.25 | -0.08 | -0.13 | 0.26 | 0.27 | -0.24 | -0.11 | 0.25 | -0.29 | -0.22 | -0.02 | 0.07 | -0.05 | **0.38** | **-0.50** | 0.05 | 0.32 |
| **NewP** | 0.36 | 0.21 | -0.26 | 0.19 | -0.16 | -0.18 | -0.21 | 0.07 | -0.38 | **-0.41** | -0.14 | -0.10 | 0.17 | -0.12 | -0.28 | -0.40 | 0.08 | 0.01 | -0.28 | -0.03 | -0.10 | -0.24 | 0.17 | **0.41** |
| **Ohak** | 0.17 | **0.38** | 0.08 | 0.27 | 0.14 | -0.30 | **-0.36** | -0.09 | **-0.48** | 0.11 | 0.27 | -0.07 | -0.26 | **-0.36** | -0.20 | 0.12 | **-0.34** | -0.11 | 0.16 | -0.22 | 0.02 | **-0.44** | 0.30 | **0.42** |
| **Parap** | 0.01 | 0.20 | 0.11 | 0.32 | 0.10 | -0.05 | 0.11 | 0.22 | -0.03 | -0.09 | 0.09 | 0.22 | -0.11 | -0.24 | 0.11 | -0.23 | -0.19 | -0.04 | 0.07 | -0.18 | 0.14 | **-0.34** | 0.07 | **0.43** |
| **Queen** | 0.21 | 0.21 | 0.33 | **0.55** | 0.38 | 0.15 | -0.09 | 0.10 | -0.28 | -0.07 | 0.39 | 0.11 | -0.31 | 0.10 | 0.11 | -0.32 | -0.26 | 0.30 | -0.28 | 0.38 | 0.27 | -0.28 | -0.24 | **0.49** |
| **Rotor** | -0.12 | -0.13 | 0.29 | **0.47** | 0.25 | 0.05 | 0.06 | **0.37** | -0.22 | -0.20 | 0.17 | **0.38** | -0.24 | -0.14 | 0.13 | -0.26 | -0.29 | -0.01 | 0.08 | 0.00 | 0.33 | **-0.43** | 0.11 | 0.31 |
| **Taupo** | 0.12 | -0.02 | 0.03 | 0.30 | 0.03 | -0.04 | -0.01 | 0.27 | -0.30 | -0.32 | -0.02 | 0.20 | -0.18 | -0.15 | 0.05 | -0.26 | -0.21 | 0.07 | 0.16 | 0.10 | 0.37 | **-0.42** | 0.10 | 0.15 |
| **Taur** | 0.04 | -0.26 | **0.39** | **0.46** | **0.38** | 0.16 | 0.06 | 0.30 | -0.17 | -0.03 | 0.31 | 0.38 | -0.11 | 0.05 | 0.18 | **-0.57** | -0.32 | -0.07 | 0.21 | 0.14 | 0.27 | **-0.41** | 0.15 | 0.25 |
| **Wang** | 0.03 | **0.48** | 0.17 | 0.32 | 0.30 | 0.06 | -0.25 | 0.00 | **-0.45** | -0.14 | 0.33 | -0.04 | -0.12 | 0.01 | 0.02 | -0.34 | -0.19 | -0.22 | 0.03 | 0.30 | 0.04 | **-0.39** | 0.00 | **0.58** |
| **Well** | 0.04 | -0.02 | **0.60** | **0.57** | **0.56** | 0.29 | 0.15 | 0.30 | -0.03 | 0.08 | **0.46** | **0.45** | **-0.39** | 0.03 | 0.26 | -0.24 | **-0.44** | -0.14 | 0.15 | 0.06 | **0.65** | **-0.55** | -0.07 | **0.43** |
| **West** | **0.39** | 0.01 | -0.25 | -0.02 | -0.21 | **-0.41** | -0.06 | -0.17 | 0.05 | -0.05 | -0.12 | -0.25 | -0.20 | -0.35 | -0.10 | -0.23 | 0.14 | -0.18 | -0.05 | -0.18 | 0.09 | 0.01 | 0.37 | 0.08 |

**Table 62. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for March. Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.996 | 0.933 | 0.7 | 0.498 | 0.823 | 0.935 | 0.767 | 0.176 | 0.463 | 0.618 | 0.962 | 0.157 | 0.595 | 0.541 | 0.81 | 0.684 | 0.16 | 0.507 | 0.809 | 0.059 | 0.77 | 0.07 | 0.309 | 0.202 |
| **Christ** | 0.239 | 0.998 | **0** | **0** | **0** | 0.161 | 0.983 | 0.261 | 0.294 | 0.392 | **0** | **0.048** | **0.003** | 0.303 | 0.103 | 0.183 | **0.019** | 0.825 | 0.1 | **0.031** | 0.464 | 0.002 | 0.605 | 0.233 |
| **Corom** | 0.925 | 0.842 | 0.678 | 0.264 | 0.723 | 0.453 | 0.523 | 0.247 | 0.93 | 0.342 | 0.904 | 0.239 | 0.433 | 0.686 | 0.621 | 0.087 | 0.467 | 0.551 | 0.781 | 0.632 | 0.094 | 0.395 | 0.816 | 0.069 |
| **Darg** | 0.328 | 0.568 | 0.338 | 0.983 | 0.54 | 0.635 | 0.728 | 0.306 | 0.64 | 0.603 | 0.85 | 0.234 | 0.318 | 0.907 | 0.788 | 0.758 | 0.544 | 0.658 | 0.315 | 0.891 | 0.763 | 0.147 | 0.692 | 0.503 |
| **Dun** | 0.854 | 0.998 | 0.29 | **0.013** | 0.208 | 0.308 | 0.283 | 0.643 | **0.034** | 0.744 | 0.091 | 0.547 | 0.073 | 0.306 | 0.928 | 0.148 | 0.136 | 0.484 | 0.189 | 0.869 | 0.62 | 0.124 | 0.105 | 0.225 |
| **Gisb** | 0.097 | 0.597 | **0** | **0.002** | **0** | **0.044** | 0.619 | 0.141 | 0.608 | 0.482 | **0.003** | **0.014** | 0.113 | 0.179 | 0.148 | 0.426 | **0.007** | 0.737 | 0.862 | 0.071 | **0.007** | **0.019** | 0.466 | 0.148 |
| **Hok** | **0.013** | 0.883 | 0.062 | 0.083 | 0.097 | **0.012** | 0.316 | 0.078 | 0.981 | 0.302 | 0.39 | **0.043** | 0.591 | 0.159 | 0.46 | 0.599 | 0.072 | 0.674 | 0.936 | 0.295 | 0.118 | 0.348 | **0.021** | 0.059 |
| **Inver** | 0.304 | 0.786 | 0.596 | **0.025** | 0.52 | 0.485 | 0.488 | 0.566 | 0.102 | 0.892 | 0.311 | 0.583 | **0.021** | 0.351 | 0.621 | 0.599 | 0.73 | 0.116 | 0.766 | 0.867 | 0.541 | 0.193 | 0.386 | 0.241 |
| **Kaik** | **0.028** | 0.594 | **0** | **0** | **0** | **0.013** | 0.12 | 0.077 | 0.398 | 0.598 | **0** | **0.004** | **0.018** | 0.116 | **0.021** | 0.072 | **0.008** | 0.957 | 0.627 | 0.157 | **0.035** | **0.035** | 0.675 | 0.086 |
| **Kait** | 0.164 | 0.532 | 0.918 | 0.59 | 0.895 | 0.203 | 0.292 | 0.879 | 0.069 | 0.709 | 0.595 | 0.853 | 0.895 | 0.587 | 0.388 | 0.415 | 0.328 | 0.612 | 0.378 | 0.174 | 0.928 | 0.117 | **0.008** | 0.587 |
| **Nel** | 0.345 | 0.588 | 0.08 | **0** | 0.069 | 0.738 | 0.574 | 0.125 | 0.64 | 0.452 | 0.11 | 0.103 | 0.149 | 0.512 | 0.142 | 0.08 | 0.199 | 0.902 | 0.667 | 0.747 | **0.021** | **0.002** | 0.779 | 0.053 |
| **NewP** | 0.078 | 0.305 | 0.216 | 0.372 | 0.456 | 0.381 | 0.312 | 0.754 | 0.058 | **0.04** | 0.492 | 0.641 | 0.42 | 0.577 | 0.184 | 0.053 | 0.717 | 0.965 | 0.193 | 0.896 | 0.653 | 0.257 | 0.422 | **0.047** |
| **Ohak** | 0.326 | **0.02** | 0.639 | 0.102 | 0.405 | 0.072 | **0.028** | 0.589 | **0.003** | 0.532 | 0.11 | 0.663 | 0.132 | **0.032** | 0.244 | 0.503 | **0.043** | 0.534 | 0.351 | 0.206 | 0.909 | **0.007** | 0.078 | **0.01** |
| **Parap** | 0.938 | 0.23 | 0.521 | 0.051 | 0.541 | 0.782 | 0.514 | 0.178 | 0.866 | 0.611 | 0.576 | 0.181 | 0.523 | 0.16 | 0.514 | 0.177 | 0.263 | 0.797 | 0.675 | 0.296 | 0.411 | **0.037** | 0.69 | **0.008** |
| **Queen** | 0.342 | 0.352 | 0.131 | **0.008** | 0.08 | 0.514 | 0.683 | 0.647 | 0.211 | 0.746 | 0.075 | 0.617 | 0.165 | 0.653 | 0.63 | 0.161 | 0.258 | 0.184 | 0.221 | 0.087 | 0.239 | 0.223 | 0.302 | **0.023** |
| **Rotor** | 0.498 | 0.437 | 0.09 | **0.004** | 0.147 | 0.767 | 0.714 | **0.028** | 0.187 | 0.252 | 0.329 | **0.022** | 0.167 | 0.409 | 0.469 | 0.131 | 0.09 | 0.933 | 0.634 | 0.995 | 0.057 | **0.011** | 0.512 | 0.067 |
| **Taupo** | 0.592 | 0.919 | 0.905 | 0.157 | 0.877 | 0.865 | 0.975 | 0.197 | 0.149 | 0.124 | 0.91 | 0.34 | 0.421 | 0.508 | 0.825 | 0.228 | 0.336 | 0.737 | 0.465 | 0.636 | 0.081 | **0.043** | 0.658 | 0.494 |
| **Taur** | 0.838 | 0.173 | **0.034** | **0.011** | **0.038** | 0.41 | 0.759 | 0.105 | 0.366 | 0.886 | 0.098 | 0.036 | 0.569 | 0.781 | 0.357 | **0.001** | 0.094 | 0.713 | 0.278 | 0.467 | 0.16 | **0.026** | 0.435 | 0.188 |
| **Wang** | 0.905 | **0.025** | 0.443 | 0.151 | 0.18 | 0.787 | 0.262 | 0.999 | **0.036** | 0.532 | 0.134 | 0.848 | 0.599 | 0.961 | 0.945 | 0.136 | 0.402 | 0.341 | 0.895 | 0.183 | 0.857 | **0.08** | 0.986 | **0.006** |
| **Well** | 0.785 | 0.923 | **0** | **0** | **0** | 0.066 | 0.348 | 0.057 | 0.831 | 0.638 | **0.003** | **0.004** | **0.013** | 0.847 | 0.113 | 0.136 | **0.005** | 0.386 | 0.351 | 0.715 | **0** | **0** | 0.686 | **0.006** |
| **West** | **0.034** | 0.965 | 0.176 | 0.924 | 0.265 | **0.026** | 0.759 | 0.378 | 0.774 | 0.772 | 0.53 | 0.177 | 0.29 | 0.066 | 0.596 | 0.231 | 0.484 | 0.35 | 0.783 | 0.339 | 0.646 | 0.953 | 0.051 | 0.661 |

# April

**Table 63. Correlation coefficients for station SSR and predictors for April. Significant correlation at (5% level) are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | NE | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.33 | 0.04 | -0.25 | 0.05 | -0.27 | -0.27 | 0.03 | 0.03 | 0.02 | -0.21 | -0.26 | -0.08 | -0.04 | -0.34 | **-0.40** | 0.06 | 0.05 | 0.22 | -0.02 | -0.28 | 0.13 | -0.28 | 0.24 | 0.19 |
| **Christ** | -0.02 | 0.05 | **0.41** | 0.28 | **0.44** | 0.25 | 0.07 | 0.07 | 0.03 | 0.20 | **0.44** | 0.19 | -0.12 | 0.23 | **0.41** | -0.07 | -0.24 | 0.05 | -0.15 | 0.10 | 0.01 | 0.05 | -0.20 | 0.06 |
| **Corom** | **0.42** | 0.01 | 0.24 | 0.24 | 0.19 | 0.33 | 0.22 | **0.50** | -0.12 | -0.26 | 0.02 | **0.51** | 0.09 | -0.03 | -0.01 | -0.12 | -0.29 | -0.02 | -0.03 | 0.05 | 0.31 | -0.11 | -0.26 | 0.31 |
| **Darg** | **0.47** | 0.01 | 0.22 | 0.39 | 0.23 | -0.07 | -0.14 | 0.20 | -0.37 | -0.15 | 0.19 | 0.19 | -0.06 | 0.10 | -0.09 | -0.13 | -0.27 | 0.13 | 0.10 | -0.27 | 0.21 | -0.26 | 0.00 | 0.13 |
| **Dun** | 0.08 | 0.09 | 0.04 | 0.22 | 0.08 | -0.14 | -0.15 | -0.05 | -0.18 | 0.08 | 0.15 | -0.05 | -0.06 | 0.02 | -0.02 | 0.01 | 0.05 | 0.13 | -0.20 | -0.16 | 0.05 | 0.03 | 0.05 | 0.02 |
| **Gisb** | 0.11 | 0.02 | 0.32 | 0.28 | 0.27 | **0.33** | 0.16 | **0.35** | -0.10 | -0.07 | 0.19 | **0.39** | -0.17 | 0.02 | 0.22 | -0.09 | -0.27 | -0.11 | -0.08 | 0.14 | 0.27 | -0.03 | **-0.33** | **0.39** |
| **Hok** | **0.42** | 0.07 | **-0.71** | **-0.34** | **-0.65** | **-0.62** | **-0.33** | **-0.38** | -0.14 | -0.07 | **-0.49** | **-0.51** | 0.17 | -0.32 | **-0.42** | 0.23 | 0.29 | 0.07 | -0.07 | -0.29 | **-0.35** | -0.09 | **0.70** | **-0.33** |
| **Inver** | -0.13 | -0.04 | -0.04 | -0.06 | -0.06 | -0.19 | -0.19 | -0.13 | -0.16 | 0.19 | 0.02 | -0.12 | -0.01 | -0.18 | -0.21 | **0.53** | -0.14 | 0.04 | 0.12 | -0.09 | -0.05 | 0.05 | -0.04 | 0.13 |
| **Kaik** | -0.06 | 0.23 | **0.33** | 0.23 | **0.36** | 0.32 | 0.12 | 0.14 | 0.04 | 0.02 | 0.31 | 0.21 | -0.16 | 0.13 | 0.22 | -0.27 | -0.19 | -0.12 | 0.01 | 0.31 | 0.02 | -0.03 | -0.17 | 0.16 |
| **Kait** | 0.25 | -0.03 | 0.22 | **0.39** | 0.21 | 0.10 | 0.16 | 0.25 | 0.00 | -0.07 | 0.20 | 0.25 | -0.09 | 0.06 | 0.07 | -0.01 | -0.26 | 0.09 | -0.22 | -0.16 | 0.09 | -0.07 | -0.03 | 0.25 |
| **Nel** | 0.11 | 0.14 | 0.25 | **0.44** | 0.27 | 0.15 | 0.09 | **0.35** | -0.21 | -0.28 | 0.19 | 0.32 | -0.07 | -0.02 | 0.08 | 0.07 | -0.18 | 0.04 | -0.22 | -0.09 | **0.49** | 0.03 | **-0.34** | 0.31 |
| **NewP** | **0.48** | 0.16 | -0.08 | 0.22 | -0.07 | -0.17 | 0.07 | -0.03 | 0.14 | -0.04 | -0.02 | -0.08 | 0.21 | -0.27 | -0.39 | -0.08 | 0.24 | 0.09 | **-0.43** | -0.17 | 0.15 | -0.11 | **0.55** | -0.16 |
| **Ohak** | **0.57** | 0.21 | -0.23 | 0.00 | -0.17 | **-0.42** | -0.31 | -0.26 | -0.21 | 0.07 | -0.04 | -0.29 | 0.23 | -0.15 | -0.14 | 0.32 | 0.03 | 0.13 | -0.21 | -0.25 | -0.11 | 0.15 | 0.26 | -0.19 |
| **Parap** | **0.34** | 0.21 | -0.08 | 0.07 | -0.04 | -0.30 | -0.20 | -0.15 | -0.16 | -0.07 | 0.06 | -0.21 | 0.16 | -0.04 | -0.23 | 0.17 | -0.18 | -0.02 | -0.02 | -0.18 | -0.03 | 0.01 | 0.25 | -0.05 |
| **Queen** | 0.33 | 0.18 | 0.29 | 0.33 | 0.30 | 0.12 | 0.14 | 0.14 | 0.08 | 0.10 | 0.28 | 0.21 | 0.39 | -0.04 | 0.09 | -0.04 | -0.22 | -0.03 | -0.33 | 0.22 | 0.28 | 0.18 | -0.23 | 0.15 |
| **Rotor** | **0.39** | -0.02 | 0.06 | 0.19 | 0.03 | 0.12 | 0.19 | 0.25 | 0.04 | -0.25 | -0.06 | 0.21 | 0.13 | -0.06 | 0.22 | 0.10 | -0.13 | 0.09 | -0.23 | -0.21 | 0.20 | 0.15 | -0.18 | 0.10 |
| **Taupo** | **0.49** | 0.18 | 0.06 | 0.34 | 0.07 | -0.05 | 0.02 | 0.13 | -0.09 | -0.16 | 0.04 | 0.08 | -0.02 | -0.09 | 0.08 | -0.03 | 0.04 | 0.17 | -0.26 | -0.19 | 0.17 | -0.04 | -0.01 | 0.10 |
| **Taur** | 0.29 | 0.07 | 0.12 | **0.41** | 0.13 | 0.06 | 0.14 | 0.30 | -0.09 | **-0.39** | 0.01 | 0.24 | -0.03 | 0.06 | 0.00 | -0.12 | -0.01 | 0.16 | -0.09 | -0.13 | **0.37** | -0.27 | -0.19 | 0.18 |
| **Wang** | **0.47** | **0.58** | 0.10 | 0.29 | 0.14 | -0.06 | 0.12 | -0.10 | 0.25 | 0.05 | 0.20 | -0.11 | 0.10 | 0.12 | -0.30 | -0.11 | 0.37 | -0.39 | -0.16 | 0.22 | 0.02 | -0.17 | -0.04 | 0.13 |
| **Well** | 0.13 | 0.12 | **0.31** | 0.20 | 0.28 | 0.22 | 0.13 | 0.22 | -0.02 | -0.08 | 0.23 | 0.25 | 0.11 | 0.14 | 0.21 | -0.01 | -0.12 | 0.08 | **-0.42** | 0.07 | 0.14 | 0.30 | -0.31 | 0.19 |
| **West** | 0.33 | -0.21 | -0.22 | -0.02 | -0.26 | **-0.38** | -0.14 | -0.02 | -0.20 | -0.12 | -0.18 | -0.10 | -0.02 | -0.17 | -0.28 | 0.24 | -0.05 | 0.36 | -0.24 | -0.35 | -0.01 | -0.13 | **0.38** | -0.05 |

**Table 64. Significance levels [Pr(>|t|)] for linear regression with a single predictor variable for April. Values which are less than 0.05 are bolded.**

| | SOI | SST | Z1 | Z2 | Z3 | Z4 | M1 | M2 | M3 | MZ1 | MZ2 | MZ3 | TSW | T | SW | V38 | R | HW | HE | W | HNW | TNW | HSE | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Auck** | 0.053 | 0.808 | 0.149 | 0.787 | 0.122 | 0.118 | 0.869 | 0.876 | 0.921 | 0.234 | 0.132 | 0.673 | 0.822 | 0.055 | **0.021** | 0.741 | 0.799 | 0.225 | 0.905 | 0.12 | 0.455 | 0.12 | 0.171 | 0.291 |
| **Christ** | 0.9 | 0.767 | **0.009** | 0.076 | **0.004** | 0.116 | 0.689 | 0.658 | 0.862 | 0.227 | **0.005** | 0.246 | 0.464 | 0.152 | **0.009** | 0.658 | 0.135 | 0.764 | 0.352 | 0.551 | 0.945 | 0.761 | 0.229 | 0.701 |
| **Corom** | **0.05** | 0.958 | 0.284 | 0.287 | 0.394 | 0.137 | 0.334 | **0.018** | 0.599 | 0.234 | 0.928 | **0.015** | 0.696 | 0.914 | 0.966 | 0.61 | 0.198 | 0.924 | 0.892 | 0.844 | 0.166 | 0.65 | 0.248 | 0.176 |
| **Darg** | **0.027** | 0.971 | 0.319 | 0.073 | 0.305 | 0.746 | 0.531 | 0.377 | 0.09 | 0.504 | 0.398 | 0.402 | 0.806 | 0.682 | 0.687 | 0.585 | 0.229 | 0.569 | 0.664 | 0.238 | 0.35 | 0.245 | 0.992 | 0.572 |
| **Dun** | 0.641 | 0.614 | 0.813 | 0.183 | 0.631 | 0.41 | 0.386 | 0.787 | 0.288 | 0.636 | 0.368 | 0.754 | 0.725 | 0.92 | 0.898 | 0.936 | 0.769 | 0.461 | 0.232 | 0.36 | 0.761 | 0.859 | 0.763 | 0.898 |
| **Gisb** | 0.502 | 0.919 | 0.053 | 0.089 | 0.098 | **0.042** | 0.337 | **0.032** | 0.545 | 0.655 | 0.254 | **0.016** | 0.324 | 0.93 | 0.194 | 0.6 | 0.105 | 0.531 | 0.618 | 0.406 | 0.108 | 0.882 | **0.045** | **0.018** |
| **Hok** | **0.01** | 0.68 | **0** | **0.044** | **0** | **0** | **0.049** | **0.024** | 0.428 | 0.698 | **0.003** | **0.001** | 0.339 | 0.063 | **0.012** | 0.183 | 0.09 | 0.678 | 0.71 | 0.087 | **0.039** | 0.623 | **0** | **0.049** |
| **Inver** | 0.42 | 0.808 | 0.798 | 0.714 | 0.706 | 0.251 | 0.249 | 0.432 | 0.335 | 0.24 | 0.894 | 0.46 | 0.971 | 0.261 | 0.195 | **0.001** | 0.404 | 0.816 | 0.449 | 0.57 | 0.775 | 0.763 | 0.793 | 0.445 |
| **Kaik** | 0.715 | 0.185 | **0.047** | 0.184 | **0.032** | 0.055 | 0.485 | 0.409 | 0.8 | 0.892 | 0.062 | 0.221 | 0.355 | 0.45 | 0.196 | 0.117 | 0.285 | 0.51 | 0.955 | 0.066 | 0.924 | 0.86 | 0.344 | 0.358 |
| **Kait** | 0.153 | 0.859 | 0.216 | **0.026** | 0.237 | 0.565 | 0.375 | 0.167 | 0.978 | 0.681 | 0.27 | 0.164 | 0.618 | 0.757 | 0.689 | 0.941 | 0.145 | 0.618 | 0.229 | 0.385 | 0.62 | 0.718 | 0.876 | 0.168 |
| **Nel** | 0.497 | 0.393 | 0.126 | **0.006** | 0.097 | 0.356 | 0.606 | **0.032** | 0.197 | 0.094 | 0.25 | 0.052 | 0.683 | 0.917 | 0.628 | 0.696 | 0.286 | 0.818 | 0.187 | 0.587 | **0.002** | 0.843 | **0.042** | 0.06 |
| **NewP** | **0.016** | 0.44 | 0.717 | 0.298 | 0.754 | 0.409 | 0.724 | 0.872 | 0.494 | 0.843 | 0.93 | 0.691 | 0.32 | 0.195 | 0.057 | 0.728 | 0.265 | 0.659 | **0.038** | 0.44 | 0.49 | 0.6 | **0.005** | 0.466 |
| **Ohak** | **0** | 0.209 | 0.166 | 0.986 | 0.315 | **0.01** | 0.064 | 0.126 | 0.211 | 0.685 | 0.813 | 0.077 | 0.178 | 0.375 | 0.4 | 0.06 | 0.845 | 0.463 | 0.229 | 0.135 | 0.538 | 0.399 | 0.119 | 0.27 |
| **Parap** | **0.038** | 0.201 | 0.619 | 0.663 | 0.823 | 0.066 | 0.232 | 0.379 | 0.338 | 0.686 | 0.705 | 0.208 | 0.346 | 0.819 | 0.168 | 0.302 | 0.292 | 0.898 | 0.928 | 0.299 | 0.842 | 0.967 | 0.133 | 0.752 |
| **Queen** | 0.133 | 0.426 | 0.196 | 0.135 | 0.18 | 0.595 | 0.537 | 0.53 | 0.729 | 0.662 | 0.209 | 0.342 | 0.084 | 0.865 | 0.689 | 0.857 | 0.328 | 0.905 | 0.148 | 0.338 | 0.218 | 0.438 | 0.311 | 0.507 |
| **Rotor** | **0.018** | 0.891 | 0.729 | 0.278 | 0.881 | 0.502 | 0.278 | 0.143 | 0.824 | 0.139 | 0.708 | 0.219 | 0.456 | 0.738 | 0.201 | 0.552 | 0.473 | 0.625 | 0.176 | 0.225 | 0.25 | 0.385 | 0.29 | 0.553 |
| **Taupo** | **0.015** | 0.398 | 0.792 | 0.101 | 0.754 | 0.8 | 0.933 | 0.541 | 0.664 | 0.46 | 0.837 | 0.705 | 0.924 | 0.667 | 0.705 | 0.898 | 0.862 | 0.431 | 0.228 | 0.388 | 0.449 | 0.859 | 0.961 | 0.642 |
| **Taur** | 0.123 | 0.696 | 0.526 | **0.023** | 0.491 | 0.744 | 0.458 | 0.103 | 0.651 | **0.031** | 0.954 | 0.21 | 0.872 | 0.757 | 0.982 | 0.523 | 0.962 | 0.412 | 0.644 | 0.488 | **0.049** | 0.15 | 0.33 | 0.348 |
| **Wang** | **0.029** | **0.004** | 0.66 | 0.195 | 0.524 | 0.787 | 0.595 | 0.666 | 0.253 | 0.816 | 0.369 | 0.618 | 0.655 | 0.615 | 0.181 | 0.642 | 0.101 | 0.083 | 0.483 | 0.35 | 0.949 | 0.461 | 0.876 | 0.565 |
| **Well** | 0.416 | 0.47 | **0.049** | 0.224 | 0.085 | 0.178 | 0.435 | 0.17 | 0.888 | 0.643 | 0.158 | 0.124 | 0.517 | 0.412 | 0.197 | 0.942 | 0.481 | 0.619 | **0.009** | 0.686 | 0.398 | 0.064 | 0.051 | 0.241 |
| **West** | 0.072 | 0.264 | 0.238 | 0.918 | 0.159 | **0.038** | 0.475 | 0.931 | 0.301 | 0.529 | 0.332 | 0.605 | 0.934 | 0.38 | 0.147 | 0.212 | 0.812 | 0.055 | 0.211 | 0.06 | 0.968 | 0.505 | **0.04** | 0.807 |

# Appendix 5: Station summary data

## Auckland

Auckland region has the following key characteristics:

### Seasonal

- SSR is negatively correlated with MZ1 (-0.51) (Table 4).
- Linear regression of SSR with MZ1 is significant at 5% level (Table 5).
- Auckland is strongly positively correlated with regions (Table 50);
  Coromandel (0.51)
  Kaitaia (0.61)
  Rotorua (0.57)

### Monthly

- Correlations between high MSR with predictors tend to be weak and variable from month to month (Table 51 to Table 64 and Figure 3).
- Correlations tend to be weak (less than |0.5<|) but all months except March are significant at 5% level. March is significant at 10%level (Table 50 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.354 + 0.003 TNW (Table 65)
  November: MSR = 1.0496 + 0.004 NE (Table 66)
  December: MSR = 1.689 + 0.023 MZ3 (Table 67)
  January: MSR = 3.225 +0.036 Z2 (Table 68)
  February: MSR = 1.994 + 0.022 HE (Table 69)
  March: none
  April: MSR = 1.019 + 0.016 SOI (Table 70).

**Table 65. Regression model HE for Auckland (October)**

Explained variance (predictability) is13%
Pearson correlation is 0.36

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.3543 | 0.11 | 3.2203 | 0.003 |
| HE | 0.0027 | 0.0012 | 2.1574 | 0.0388 |

**Table 66. Regression model NE for Auckland (November)**

Explained variance (predictability) is 13%
Pearson correlation is 0.36

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.0496 | 0.1975 | 5.3138 | 0 |
| NE | 0.0038 | 0.0018 | 2.1404 | 0.0403 |

**Table 67. Regression model MZ3 for Auckland (December)**

Explained variance (predictability) is 21%
Pearson correlation is 0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.689 | 0.1983 | 8.5177 | 0 |
| MZ3 | 0.023 | 0.008 | 2.8788 | 0.0072 |

**Table 68. Regression model Z2 for Auckland (January)**

Explained variance (predictability) is 17%
Pearson correlation is 0.41

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.225 | 0.423 | 7.629 | 0 |
| Z2 | 0.036 | 0.014 | 2.530 | 0.016 |

**Table 69. Regression model HE for Auckland (February)**

Explained variance (predictability) is 17%
Pearson correlation is 0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.9942 | 0.6494 | 3.0706 | 0.0044 |
| HE | 0.0222 | 0.0086 | 2.5617 | 0.0155 |

**Table 70. Regression model SOI for Auckland (April)**

Explained variance (predictability) is11%
Pearson correlation is 0.33

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.019 | 0.125 | 8.172 | 0.0 |
| SOI | 0.016 | 0.008 | 2.006 | 0.053 |

## Christchurch

Christchurch region has the following key characteristics:

### Seasonal

- SSR is strongly positively correlated with MZ2 (0.62), Z3 (0.61) and Z1 (0.55) (Table 4).
- Linear regression of SSR with Z1, Z2, Z3, M3, MZ2, MZ3, NE, R, HNW and TNW are significant at 5% level (Table 5).
- Christchurch is strongly positively correlated with regions (Table 50);
  Coromandel (0.61)
  Gisborne (0.58)
  Kaikoura (59)
  Nelson (0.52)
  Wellington (0.52)

### Monthly

- Correlations between high MSR and predictors is strongly positive (>0.6) for October, November, December and March and slightly weaker for the other months (Table 51 to Table 64 and Figure 4).
- All months shown in Figure 4 are significant at 5% level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 3.068 + 0.113 Z1 (Table 71)
  November: MSR = 2.446 + 0.045 HNW (Table 72)
  December: MSR = 5.742 + 0.144 MZ2 (Table 73)
  January: MSR = 7.130 + 0.109 MZ2 (Table 74)
  February: MSR = 7.662 + 0.154 MZ2 (Table 75)
  March: MSR = 5.029 + 0.142 MZ2 (Table 76)
  April: MSR = 2.448 + 0.029 Z3 (Table 77)

### Table 71. Regression model Z1 for Christchurch (October)

Explained variance (predictability) is 40%
Pearson correlation is 0.64

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.0676 | 0.5972 | 5.137 | 0 |
| Z1 | 0.1133 | 0.0226 | 5.012 | 0 |

### Table 72. Regression model HNW for Christchurch (November)

Explained variance (predictability) is 36%
Pearson correlation is 0.62

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.4456 | 0.8345 | 2.9306 | 0.0058 |
| HNW | 0.0453 | 0.0099 | 4.5877 | 0.0001 |

**Table 73. Regression model MZ2 for Christchurch (December)**

Explained variance (predictability) is35%
Pearson correlation is 0.60

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.7418 | 0.6733 | 8.5275 | 0 |
| MZ2 | 0.1435 | 0.0318 | 4.5048 | 0.0001 |

**Table 74. Regression model MZ2 for Christchurch (January)**

Explained variance (predictability) is 21%
Pearson correlation is 0.45

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 7.1298 | 0.8037 | 8.8715 | 0 |
| MZ2 | 0.1093 | 0.0349 | 3.1305 | 0.0033 |

**Table 75. Regression model MZ2 for Christchurch (February)**

Explained variance (predictability) is 18%
Pearson correlation is 0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 7.6619 | 0.8285 | 9.2475 | 0 |
| MZ2 | 0.1521 | 0.0524 | 2.9036 | 0.0061 |

**Table 76. Regression model MZ2 for Christchurch (March)**

Explained variance (predictability) is 42%
Pearson correlation is 0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.0286 | 0.5944 | 8.4595 | 0 |
| MZ2 | 0.1419 | 0.0269 | 5.2767 | 0 |

**Table 77. Regression model Z3 for Christchurch (April)**

Explained variance (predictability) is 20%
Pearson correlation is 0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.4481 | 0.257 | 9.527 | 0 |
| Z3 | 0.0285 | 0.0093 | 3.0462 | 0.0042 |

## Coromandel

Corromandel region has the following key characteristics:

### Seasonal

- High SSR is strongly positively correlated (>0.5) with predictors Z1/2/3, MZ2 and HNW and low SSR is associated with predictors NE (-0.57) and TNW (-0.52)(Table 4).
- Linear regression of SSR with Z1, Z2, Z3, MZ2, HNW, NE, and TNW are significant at 5% level (Table 5).
- Coromandel is strongly positively correlated with regions (Table 50);
  Christchurch (0.60) Gisborne (0.66)
  Kaikoura (0.80) Kaitaia (0.61)
  Rotorua (0.65) Taupo (0.59)
  Tauranga (0.62) Wanganui (0.50)
  Wellington (0.59).

### Monthly

- High MSR is generally strongly correlated with predictors for most months and particularly in February with H (0.7). (Table 51 to Table 64 and Figure 5).
- All months except March have linear regressions that are significant at 5% level. The month March is significant at the 10% level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.338 +0.004 MZ3 (Table 78)
  November: MSR = 0.177 + 0.003 SW (Table 79)
  December: MSR = 0.895 + 0.018 Z2 (Table 80)
  January: MSR = 1.220 + 0.017 HNW (Table 81)
  February: MSR = 0.915 +0.007 H (Table 82)
  March: MSR = 0.599 + 0.002 H (Table 83)
  April: MSR = 0.468 + 0.006 MZ3 (Table 84)

**Table 78. Regression model MZ3 for Coromandel (October)**

Explained variance (predictability) is 32%
Pearson correlation is 0.56

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.3379 | 0.0356 | 9.5007 | 0 |
| MZ3 | 0.0044 | 0.0015 | 3.0117 | 0.0072 |

**Table 79. Regression model SW for Coromandel (November)**

Explained variance (predictability) is 47%
Pearson correlation is 0.68

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1771 | 0.1472 | 1.2031 | 0.2437 |
| SW | 0.0032 | 0.0008 | 4.0739 | 0.0006 |

**Table 80. Regression model Z2 for Coromandel (December)**

Explained variance (predictability) is 41%
Pearson correlation is 0.64

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8954 | 0.1405 | 6.3712 | 0 |
| Z2 | 0.0176 | 0.0049 | 3.6013 | 0.0019 |

**Table 81. Regression model HNW for Coromandel (January)**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.2195 | 0.3841 | 3.1752 | 0.005 |
| HNW | 0.0169 | 0.007 | 2.4295 | 0.0252 |

**Table 82. Regression model H for Coromandel (February)**

Explained variance (predictability) is 49%
Pearson correlation is 0.70

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9149 | 0.1708 | 5.3567 | 0 |
| H | 0.0066 | 0.0015 | 4.2826 | 0.0004 |

**Table 83. Regression model H for Coromandel (March)**

Explained variance (predictability) is 16%
Pearson correlation is 0.40

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.5993 | 0.1359 | 4.4109 | 0.0003 |
| H | 0.0015 | 0.0008 | 1.9274 | 0.069 |

**Table 84. Regression model MZ3 for Coromandel (April)**

Explained variance (predictability) is 26%
Pearson correlation is 0.51

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4681 | 0.055 | 8.5164 | 0 |
| MZ3 | 0.0057 | 0.0022 | 2.6497 | 0.0154 |

## Dargaville

Dargaville region has the following key characteristics:

**Seasonal**

- High SSR is weakly correlated with predictors SOI (-0.38), Z1 (0.37) and low SSR is associated with NE (-0.43) (Table 4).
- Linear regression of SSR with SOI, Z1 and NE are only significant at 10%level (Table 5).
- Dargaville is strongly positively correlated with regions (Table 50);
  Rotorua (0.55)
  Taupo (0.54)
  Tauranga (0.55)

**Monthly**

- High MSR is strongly correlated (> 0.6) from October to December and thereafter tends to have much weaker associations with predictors (Table 51 to Table 64).
- All months except March have significant linear regressions at 5% level which has no significant linear regressions at 5% or 10% levels (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.076 + 0.002 W (Table 85)
  November: MSR = 0.058 + 0.009 HNW (Table 86)
  December: MSR = 0.201 + 0.015 HNW (Table 87)
  January: MSR = 1.562 + 0.019 MZ3 (Table 88)
  February: MSR = 0.920 + 0.005 H (Table 89)
  March: none
  April: MSR = 0.530 + 0.012 SOI (Table 90)

**Table 85. Regression model W for Dargaville (October)**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.0756 | 0.0897 | 0.8427 | 0.4099 |
| W | 0.0021 | 0.0008 | 2.6495 | 0.0158 |

**Table 86. Regression model HNW for Dargaville (November)**

Explained variance (predictability) is 39%
Pearson correlation is 0.62

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.0575 | 0.2064 | 0.2788 | 0.7834 |
| HNW | 0.009 | 0.0026 | 3.4618 | 0.0026 |

**Table 87. Regression model HNW for Dargaville (December)**

Explained variance (predictability) is 37%
Pearson correlation is 0.60

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.201 | 0.2904 | 0.6919 | 0.4973 |
| HNW | 0.0148 | 0.0045 | 3.307 | 0.0037 |

**Table 88. Regression model MZ3 for Dargaville (January)**

Explained variance (predictability) is 19%
Pearson correlation is 0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.5619 | 0.2664 | 5.8637 | 0 |
| MZE | 0.0191 | 0.0088 | 2.1769 | 0.0416 |

**Table 89. Regression model H for Dargaville (February)**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9199 | 0.2141 | 4.2971 | 0.0004 |
| H | 0.0048 | 0.0019 | 2.4822 | 0.0226 |

**Table 90. Regression model SOI for Dargaville (April)**

Explained variance (predictability) is 22%
Pearson correlation is 0.47

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.5303 | 0.0871 | 6.0912 | 0 |
| SOI | 0.0119 | 0.005 | 2.3891 | 0.0269 |

## Dunedin

Dunedin region has the following key characteristics:

### Seasonal

- SSR is weakly positive correlated with Z2 (0.28) and HSE (0.29) (Table 4).
- Linear regression of SSR with Z2 and HSE is only significant at 10%level (Table 5).
- Dunedin is strongly positively correlated with Queenstown (0.54) (Table 50).

### Monthly

- Strong correlation between MSR and predictors occur from October to December (>0.5) and there after weaken for the remaining months. (Table 51 to Table 64 and Figure 7).
- All MSR for months except April (Figure 7) have linear regressions that are significant at 5% level. No significance is shown for month April at the 10%level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.450 + 0.008 T (Table 91)
  November: MSR = 2.660 +0.048 MZ2 (Table 92)
  December: MSR = 2.10 + 0.056 SOI (Table 93)
  January: MSR = 2.180 + 0.015 Z2(Table 94)
  February: MSR = 2.324 – 0.026 Z4 (Table 95)
  March: MSR = 1.988 + 0.026 Z2 (Table 96)
  April: none

**Table 91. Regression model T for Dunedin (October)**

Explained variance (predictability) is 45%
Pearson correlation is 0.67

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4499 | 0.3056 | 1.4723 | 0.1501 |
| T | 0.0079 | 0.0015 | 5.3131 | 0 |

**Table 92. Regression model MZ2 for Dunedin (November)**

Explained variance (predictability) is 22%
Pearson correlation is 0.47

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.6595 | 0.3435 | 7.7425 | 0 |
| MZ2 | 0.0474 | 0.0151 | 3.134 | 0.0035 |

**Table 93. Regression model SOI for Dunedin (December)**

Explained variance (predictability) is 15%
Pearson correlation is 0.38

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.1 | 0.2504 | 8.3869 | 0 |
| SOI | 0.0564 | 0.0233 | 2.4153 | 0.0212 |

**Table 94. Regression model Z2 for Dunedin (January)**

Explained variance (predictability) is 11%
Pearson correlation is 0.32

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.1799 | 0.2294 | 9.5029 | 0 |
| Z2 | 0.0152 | 0.0074 | 2.0399 | 0.049 |

**Table 95. Regression model Z4 for Dunedin (February)**

Explained variance (predictability) is 20%
Pearson correlation is -0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.324 | 0.3 | 7.7475 | 0 |
| Z4 | -0.0261 | 0.0089 | -2.9277 | 0.006 |

**Table 96. Regression model Z2 for Dunedin (March)**

Explained variance (predictability) is 16%
Pearson correlation is 0.40

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.9875 | 0.3386 | 5.8704 | 0 |
| Z2 | 0.0261 | 0.01 | 2.6109 | 0.0132 |

## Gisborne

Gisborne region has the following key characteristics:

**Seasonal**

- High SSR is strongly positively correlated (>0.5) with a number of predictors(more than 8) but especially Z1 and Z2 (>0.75). (Table 4).
- Linear regression of SSR with the above predictors are significant at 5% level. (Table 5).
- Gisborne is strongly positively correlated with regions (Table 50);
  Christchurch (0.58)
  Coromandel (0.66)
  Kaikoura (0.70)
  Wellington (0.52).

**Monthly**

- High MSR is strongly (>0.6) correlated with predictors from October to March and only weakly positive (0.39) for April (Table 51 to Table 64 and Figure 8).
- All months have a linear regression that is significant at 5% level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 2.306 + 0.067 Z3 (Table 97)
  November: MSR = 5.441 + 0.099 MZ2 (Table 98)
  December: MSR = 3.059 + 0.074 HNW (Table 99)
  January: MSR = 5.671 + 0.154 MZ2 (Table 100)
  February: MSR = 5.908 + 0.167 Z1 (Table 101)
  March: MSR = 3.221 + 0.104 Z1 (Table 102)
  April: MSR = 1.983 + 0.034 MZ3 (Table 103)

**Table 97. Regression model Z3 for Gisborne (October)**

Explained variance (predictability) is 70%
Pearson correlation is 0.84

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.3062 | 0.2437 | 9.462 | 0 |
| Z3 | 0.067 | 0.0074 | 9.0041 | 0 |

**Table 98. Regression model MZ2 for Gisborne (November)**

Explained variance (predictability) is 42%
Pearson correlation is 0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.4408 | 0.4377 | 12.4295 | 0 |
| MZ2 | 0.099 | 0.0195 | 5.0697 | 0 |

**Table 99. Regression model HNW for Gisborne (December)**

Explained variance (predictability) is 39%
Pearson correlation is 0.62

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.0591 | 0.8342 | 3.6673 | 0.0008 |
| HNW | 0.0739 | 0.0157 | 4.6954 | 0 |

**Table 100. Regression model MZ2 for Gisborne (January)**

Explained variance (predictability) is 38%
Pearson correlation is 0.62

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.6705 | 0.7405 | 7.658 | 0 |
| MZ2 | 0.1543 | 0.0326 | 4.7248 | 0 |

**Table 101. Regression model Z1 for Gisborne (February)**

Explained variance (predictability) is 41%
Pearson correlation is 0.64

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.9083 | 0.6167 | 9.581 | 0 |
| Z1 | 0.1673 | 0.0333 | 5.0181 | 0 |

**Table 102. Regression model Z1 for Gisborne (March)**

Explained variance (predictability) is 36%
Pearson correlation is 0.60

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.2213 | 0.561 | 5.7418 | 0 |
| Z1 | 0.104 | 0.023 | 4.5277 | 0.0001 |

**Table 103. Regression model MZ3 for Gisborne (April)**

Explained variance (predictability) is 15%
Pearson correlation is 0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.9827 | 0.3934 | 5.0399 | 0 |
| MZ3 | 0.0337 | 0.0133 | 2.5276 | 0.016 |

## Hokitika

Hokitika region has the following key characteristics:

### Seasonal

- High SSR is strongly correlated with a number of predictors especially SOI and zonal winds, and low SSR is associated with SW and HNW (Table 4).
- Linear regression of SSR with all the above predictors is significant at 5% level (Table 5).
- Hokitika is strongly positively correlated with regions (Table 50);
  New Plymouth (0.51)
  Paraparaumu (0.55)
  Westport (0.60)

### Monthly

- High MSR is strongly negative correlated (>|0.60|) with predictor Z1 for the months November, December, January and April and slightly weaker in October, Febuary and March (Table 51 to Table 64 and Figure 9).
- All months have a linear regression's that are significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.075 – 0.001 Z3 (Table 104)
  November: MSR = 0.129 – 0.004 Z1 (Table 105)
  December: MSR = 0.177 – 0.004 Z1 (Table 106)
  January: MSR = 0.252 – 0.006 Z1 (Table 107)
  February: MSR = 0.242 – 0.006 Z1 (Table 108)
  March: MSR = 0.184 – 0.002 Z4 (Table 109)
  April: MSR = 0.082 – 0.003 Z1 (Table 110)

**Table 104. Regression model Z3 for Hokitika (October)**

Explained variance (predictability) is 27%
Pearson correlation is –0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.0746 | 0.0095 | 7.8215 | 0 |
| Z3 | -0.001 | 0.0003 | -3.5078 | 0.0013 |

**Table 105. Regression model Z1 for Hokitika (November)**

Explained variance (predictability) is 58%
Pearson correlation is -0.76

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1286 | 0.021 | 6.1296 | 0 |
| Z1 | -0.0044 | 0.0007 | -6.7083 | 0 |

**Table 106. Regression model Z1 for Hokitika (December)**

Explained variance (predictability) is 42%
Pearson correlation is-0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1773 | 0.0202 | 8.7824 | 0 |
| Z1 | -0.0043 | 0.0009 | -4.9002 | 0 |

**Table 107. Regression model Z1 for Hokitika (January)**

Explained variance (predictability) is 51%
Pearson correlation is 0.72

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2521 | 0.0253 | 9.9636 | 0 |
| Z1 | -0.0056 | 0.0009 | -5.9736 | 0 |

**Table 108. Regression model Z1 for Hokitika (February)**

Explained variance (predictability) is 26%
Pearson correlation is 0.51

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2423 | 0.0332 | 7.3075 | 0 |
| Z1 | -0.0062 | 0.0018 | -3.4386 | 0.0016 |

**Table 109. Regression model Z4 for Hokitika (March)**

Explained variance (predictability) is 17%
Pearson correlation is 0.41

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1839 | 0.0244 | 7.5430 | 0 |
| Z4 | -0.0018 | 0.0018 | 2.640 | 0.0012 |

**Table 110. Regression model Z1 for Hokitika (April)**

Explained variance (predictability) is 50%
Pearson correlation is -0.71

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.0819 | 0.0114 | 7.1668 | 0 |
| Z1 | -0.0028 | 0.0005 | -5.8156 | 0 |

## Invercargill

Invercargill region has the following key characteristics:

**Seasonal**

- High SSR is weakly correlated (|0.35-0.42|) with zonal, cross-zonal and meridional flow (Table 4).
- Linear regression of high SSR associations are significant at 5% level (Table 5).
- Invercargill is strongly positively correlated with regions (Table 50);
  Ohakea (0.54)
  Queenstown (0.53)

**Monthly**

- Correlation between MSR and climate predictors are generally weak |0.30 - 0.55| and variable (zonal easterlies and meridional northerlies) for the months October to April. (Table 51 to Table 64 and Figure 10).
- All months except February have linear regressions that are significant at 5% level. The month February is significant at the 10%level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.403 – 0.004 HW (Table 111)
  November: MSR = 0.853 – 0.008 M1 (Table 112)
  December: MSR = 0.762 + 0.008 Z2 (Table 113)
  January: MSR = 0.987 – 0.010 MZ2 (Table 114)
  February: MSR = 0.557 + 0.002 HSE (Table 115)
  March: MSR = 0.564 + 0.004 Z2 (Table 116)
  April: MSR = 0.110 + 0.002 NE (Table 117)

**Table 111. Regression model HW for Invercargill (October)**

Explained variance (predictability) is 12%
Pearson correlation is 0.34

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4027 | 0.0831 | 4.8444 | 0 |
| HW | 0.0041 | 0.0019 | 2.2106 | 0.0333 |

**Table 112. Regression model M1 for Invercargill (November)**

Explained variance (predictability) is 30%
Pearson correlation is -0.55

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8534 | 0.08 | 10.6731 | 0 |
| M1 | -0.008 | 0.002 | -3.9993 | 0.0003 |

**Table 113. Regression model Z2 for Invercargill (December)**

Explained variance (predictability) is 16%
Pearson correlation is 0.40

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.7617 | 0.0804 | 9.4698 | 0 |
| Z2 | 0.0076 | 0.0029 | 2.6317 | 0.0123 |

**Table 114. Regression model MZ2 for Invercargill (January)**

Explained variance (predictability) is 16%
Pearson correlation is -0.40

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9874 | 0.084 | 11.7535 | 0 |
| MZ2 | -0.0097 | 0.0036 | -2.6592 | 0.0114 |

**Table 115. Regression model HSE for Invercargill (February)**

Explained variance (predictability) is 10%
Pearson correlation is 0.31

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.5574 | 0.3204 | 1.7399 | 0.0902 |
| HSE | 0.0024 | 0.0012 | 1.9724 | 0.0561 |

**Table 116. Regression model Z2 for Invercargill (March)**

Explained variance (predictability) is 13%
Pearson correlation is 0.35

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.564 | 0.062 | 9.122 | 0.0 |
| Z2 | 0.004 | 0.002 | 2.333 | 0.025 |

**Table 117. Regression model NE for Invercargill (April)**

Explained variance (predictability) is 28%
Pearson correlation is 0.53

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1104 | 0.0275 | 4.0129 | 0.0003 |
| NE | 0.0019 | 0.0005 | 3.7857 | 0.0005 |

## Kaikoura

Kaikoura region has the following key characteristics:

**Seasonal**

- High SSR is strongly positive (>0.7) correlated with predictors Z1 and Z3 and low SSR is associated with NE (Table 4).
- Linear regression of SSR associations with predictors are significant at 5% level (Table 5).
- Kaikoura is strongly positively correlated with regions (Table 50);
  Christchurch (0.59)
  Coromandel (0.59)
  Gisborne (0.70)
  Wellington (0.58).

**Monthly**

- High MSR is strongly positively correlated (>0.50) for the months October, November, December and March with Z and MZ climate predictors. January and April have a weaker positive correlation (Table 51 to Table 64 and Figure 11).
- All months have a linear regression that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.680 + 0.026 Z3 (Table 118)
  November: MSR = 1.415 + 0.023 Z3 (Table 119)
  December: MSR = 1.269 + 0.045 Z3 (Table 120)
  January: MSR = 1.507 + 0.025 W (Table 121)
  February: MSR = 2.033 + 0.061 MZ2 (Table 122)
  March: MSR = 1.20 + 0.0322 Z1 (Table 123)
  April: MSR = 0.979 + 0.014 Z3 (Table 124)

**Table 118. Regression model Z3 for Kaikoura (October)**

Explained variance (predictability) is 69%
Pearson correlation is 0.83

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6799 | 0.1027 | 6.6169 | 0 |
| Z3 | 0.026 | 0.0031 | 8.5012 | 0 |

**Table 119. Regression model Z3 for Kaikoura (November)**

Explained variance (predictability) is 43%
Pearson correlation is 0.66

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.4148 | 0.1627 | 8.694 | 0 |
| Z3 | 0.0232 | 0.0046 | 5.024 | 0 |

**Table 120. Regression model Z3 for Kaikoura (December)**

Explained variance (predictability) is 28%
Pearson correlation is 0.53

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.2694 | 0.3194 | 3.9739 | 0.0004 |
| Z3 | 0.0448 | 0.0126 | 3.55 | 0.0012 |

**Table 121. Regression model W for Kaikoura (January)**

Explained variance (predictability) is 21%
Pearson correlation is 0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.5068 | 0.3999 | 3.7674 | 0.0006 |
| W | 0.0245 | 0.0083 | 2.9706 | 0.0055 |

**Table 122. Regression model MZ2 for Kaikoura (February)**

Explained variance (predictability) is 25%
Pearson correlation is 0.50

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.0333 | 0.2861 | 7.106 | 0 |
| MZ2 | 0.0614 | 0.0181 | 3.386 | 0.0018 |

**Table 123. Regression model Z1 for Kaikoura (March)**

Explained variance (predictability) is 46%
Pearson correlation is 0.68

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.2 | 0.1392 | 8.6234 | 0 |
| Z1 | 0.0322 | 0.006 | 5.3852 | 0 |

**Table 124. Regression model Z3 for Kaikoura (April)**

Explained variance (predictability) is 13%
Pearson correlation is0.36

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9791 | 0.175 | 5.5951 | 0 |
| Z3 | 0.0139 | 0.0062 | 2.2386 | 0.0318 |

## Kaitaia

Kaitaia region has the following key characteristics:

### Seasonal

- High SSR is negatively correlated with MZ1 (-0.42) (Table 4).
- Linear regression of SSR with MZ1 is significant at 5% level (Table 5).
- Kaitaia is strongly positively correlated with regions (Table 50);
  Auckland (0.61)
  Coromandel (0.61)
  Rotorua (0.70)
  Taupo (0.63)

### Monthly

- High MSR tend to have stronger correlations in spring and weaken through summer and autumn. (Table 51 to Table 64 Table 125 to Table 131 and Figure 12).
- All months have a linear regression that is significant at 5% level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.163 + 0.002 H (Table 125)
  November: MSR = 0.561 + 0.006 HNW (Table 126)
  December: MSR = 2.207 – 0.057 MZ1 (Table 127)
  January: MSR = 1.864 + 0.012 HW (Table 128)
  February: MSR = 4.144 – 0.035 M3 (Table 129)
  March: MSR = 0.824 + 0.006 HSE (Table 130)
  April: MSR = 1.061 + 0.008 Z2 (Table 131)

**Table 125. Regression model H for Kaitaia (October)**

Explained variance (predictability) is 51%
Pearson correlation is 0.71

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1628 | 0.0726 | 2.2429 | 0.0322 |
| H | 0.0019 | 0.0003 | 5.6731 | 0 |

**Table 126. Regression model HNW for Kaitaia (November)**

Explained variance (predictability) is 25%
Pearson correlation is 0.50

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.561 | 0.158 | 3.554 | 0.001 |
| HNW | 0.006 | 0.002 | 3.245 | 0.003 |

**Table 127. Regression model MZ1 for Kaitaia (December)**

Explained variance (predictability) is 21%
Pearson correlation is 0.45

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.207 | 0.2603 | 8.48 | 0 |
| MZ1 | -0.057 | 0.0201 | -2.8391 | 0.0079 |

**Table 128. Regression model HW for Kaitaia (January)**

Explained variance (predictability) is 13%
Pearson correlation is 0.35

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.864 | 0.635 | 2.936 | 0.006 |
| HW | 0.012 | 0.006 | 2.116 | 0.043 |

**Table 129. Regression model M3 for Kaitaia (February)**

Explained variance (predictability) is 12%
Pearson correlation is -0.35

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 4.144 | 0.474 | 8.746 | 0.0 |
| M3 | -0.035 | 0.017 | -2.072 | 0.047 |

**Table 130. Regression model HSE for Kaitaia (March)**

Explained variance (predictability) is 21%
Pearson correlation is 0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8236 | 0.5688 | 1.448 | 0.1577 |
| HSE | 0.0061 | 0.0021 | 2.8553 | 0.0076 |

**Table 131. Regression model Z2 for Kaitaia (April)**

Explained variance (predictability) is 15%
Pearson correlation is 0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.0613 | 0.1157 | 9.1758 | 0 |
| Z2 | 0.0075 | 0.0032 | 2.3299 | 0.0265 |

## Nelson

Nelson region has the following key characteristics:

### Seasonal

- High SSR is weakly correlated (0.4) with Z2 and M2 and low SSR is associated with TNW (Table 4).
- Linear regression of SSR associations with predictors is significant at 5% level (Table 5).
- Nelson is strongly positively correlated with regions (Table 50);
  Christchurch (0.52)
  Ohakea (0.53)
  Paraparaumu (0.62)
  Rotorua (0.54)
  Wellington (0.59).

### Monthly

- High MSR and predictors are strongly correlated (>0.65) for October, November and January and slightly weaker for the remaining months, especially February. (Table 51 to Table 64 and Figure 13).
- All months have a linear regression that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.803 + 0.021 M2 (Table 132)
  November: MSR = 0.558+ 0.017 HNW (Table 133)
  December: MSR = 1.102 + 0.025 HW (Table 134)
  January: MSR = 3.688 + 0.053 Z2 (Table 135)
  February: MSR = 3.782 – 0.01.82 MZ1 (Table 136)
  March: MSR = 2.219 + Z2 0.032 Z2 (Table 137)
  April: MSR = 0.710 + 0.005 HNW (Table 138)

**Table 132. Regression model M2 for Nelson (October)**

Explained variance (predictability) is 44%
Pearson correlation is 0.66

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8033 | 0.0859 | 9.353 | 0 |
| M2 | 0.0214 | 0.0041 | 5.2051 | 0 |

**Table 133. Regression model HNW for Nelson (November)**

Explained variance (predictability) is 44%
Pearson correlation is 0.66

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.5584 | 0.264 | 2.1153 | 0.0416 |
| HNW | 0.0168 | 0.0032 | 5.2583 | 0 |

**Table 134. Regression model HW for Nelson (December)**

Explained variance (predictability) is 31%
Pearson correlation is 0.56

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.1015 | 0.4253 | 2.5903 | 0.0139 |
| HW | 0.0251 | 0.0063 | 3.9771 | 0.0003 |

**Table 135. Regression model Z2 for Nelson (January)**

Explained variance (predictability) is 43%
Pearson correlation is 0.66

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.6881 | 0.3068 | 12.0205 | 0 |
| Z2 | 0.0526 | 0.0101 | 5.2285 | 0 |

**Table 136. Regression model MZ1 for Nelson (February)**

Explained variance (predictability) is 19%
Pearson correlation is -0.43

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.7822 | 0.541 | 6.9918 | 0 |
| MZ1 | -0.1822 | 0.0629 | -2.8951 | 0.0064 |

**Table 137. Regression model Z2 for Nelson (March)**

Explained variance (predictability) is 32%
Pearson correlation is 0.57

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.2193 | 0.2545 | 8.719 | 0 |
| Z2 | 0.0315 | 0.0076 | 4.1587 | 0.0002 |

**Table 138. Regression model HNW for Nelson (April)**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.7101 | 0.1615 | 4.3979 | 0.0001 |
| HNW | 0.0049 | 0.0015 | 3.2986 | 0.0022 |

## New Plymouth

New Plymouth region has the following key characteristics:

**Seasonal**

- High SSR is strongly correlated (>0.52) with SOI and HSE, while low SSR is associated with SW and HW (Table 4).
- Linear regression of SSR associated with key predictors are significant at 5% level (Table 5).
- Dunedin is strongly positively correlated with regions (Table 50);
  Hokitika (0.51)
  Taupo (0.66)
  Wanganui (0.76)

**Monthly**

- High MSR is strongly correlated (> 0.6) to predictors in January and moderately correlated for the remaining months (Table 51 to Table 64 and Figure 14).
- All months have a linear regression that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.161 – 0.001 Z4 (Table 139)
  November: MSR = 0.238 + 0.001 HSE (Table 140)
  December: MSR = 0.446 – 0.007 MZ1 (Table 141)
  January: MSR = 0.748 – 0.027 MZ1 (Table 142)
  February: MSR = 0.228 + 0.002 HSE (Table 143)
  March: MSR = 0.633 – 0.025 MZ1 (Table 144)
  April: MSR = 0.123 + 0.001 HSE (Table 145)

**Table 139. Regression model Z4 for New Plymouth (October)**

Explained variance (predictability) is 19%
Pearson correlation is –0.43

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.161 | 0.017 | 9.559 | 0.0 |
| Z4 | -0.001 | 0.001 | -2.250 | 0.035 |

**Table 140. Regression model HSE for New Plymouth (November)**

Explained variance (predictability) is 19%
Pearson correlation is 0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2382 | 0.0551 | 4.3257 | 0.0003 |
| HSE | 0.001 | 0.0004 | 2.3049 | 0.031 |

**Table 141. Regression model MZ1 for New Plymouth (December)**

Explained variance (predictability) is 17%
Pearson correlation is -0.41

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4457 | 0.0487 | 9.1467 | 0 |
| MZ1 | -0.0073 | 0.0035 | -2.0871 | 0.0487 |

**Table 142. Regression model MZ1 for New Plymouth (January)**

Explained variance (predictability) is 36%
Pearson correlation is -0.60

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.7481 | 0.0824 | 9.0747 | 0 |
| MZ1 | -0.0266 | 0.0074 | -3.5795 | 0.0016 |

**Table 143. Regression model HSE for New Plymouth (February)**

Explained variance (predictability) is 19%
Pearson correlation is 0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2283 | 0.2379 | 0.9596 | 0.3477 |
| HSE | 0.0022 | 0.0009 | 2.3033 | 0.0311 |

**Table 144. Regression model MZ1 for New Plymouth (March)**

Explained variance (predictability) is 17%
Pearson correlation is -0.41

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6334 | 0.1296 | 4.886 | 0.0001 |
| MZ1 | -0.0245 | 0.0113 | -2.1734 | 0.0403 |

**Table 145. Regression model HSE for New Plymouth (April)**

Explained variance (predictability) is 30%
Pearson correlation is 0.55

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.123 | 0.06 | 2.0501 | 0.0525 |
| HSE | 0.0007 | 0.0002 | 3.0979 | 0.0053 |

## Ohakea

Ohakea region has the following key characteristics:

### Seasonal

- High SSR is strongly correlated with SST (0.57) (Table 4).
- Linear regression of SSR with SST is significant at 5% level (Table 5).
- Ohakea is strongly positively correlated with regions (Table 50);
  Invercargill (0.54)
  Nelson (0.53)
  Paraparaumu (0.75)
  Westport (0.63)

### Monthly

- High MSR is strongly correlated to predictors in October and April and generally weaker for the other months (Table 51 to Table 64 and Figure 15).
- All months' linear regressions are significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.853 + 0.009 Z2 (Table 146)
  November: MSR = 1.446 + 0.009 HNW (Table 147)
  December: MSR = 2.323 + 0.021 Z2 (Table 148)
  January: MSR = 3.686 – 0.026 M3 (Table 149)
  February: MSR = 4.374 + 0.040 Z4 (Table 150)
  March: MSR = 3.495 – 0.039 M3 (Table 151)
  April: MSR = 2.135 + 0.063 SOI (Table 152)

**Table 146. Regression model Z2 for Ohakea (October)**

Explained variance (predictability) is 25%
Pearson correlation is 0.50

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8525 | 0.0923 | 9.2352 | 0 |
| Z2 | 0.009 | 0.0027 | 3.365 | 0.0019 |

**Table 147. Regression model HNW for Ohakea (November)**

Explained variance (predictability) is 13%
Pearson correlation is 0.36

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.4461 | 0.3401 | 4.2519 | 0.0002 |
| HNW | 0.009 | 0.004 | 2.2803 | 0.029 |

**Table 148. Regression model Z2 for Ohakea (December)**

Explained variance (predictability) is 13%
Pearson correlation is 0.36

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.323 | 0.260 | 8.937 | 0.0 |
| Z2 | 0.021 | 0.009 | 2.268 | 0.029 |

**Table 149. Regression model M3 for Ohakea (January)**

Explained variance (predictability) is 11%
Pearson correlation is 0.33

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.686 | 0.301 | 12.228 | 0.0 |
| M3 | -0.026 | 0.012 | -2.079 | 0.045 |

**Table 150. Regression model Z4 for Ohakea (February)**

Explained variance (predictability) is 19%
Pearson correlation is 0.43

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 4.3742 | 0.4653 | 9.4006 | 0 |
| Z4 | -0.0403 | 0.0143 | -2.8242 | 0.0078 |

**Table 151. Regression model M3 for Ohakea (March)**

Explained variance (predictability) is 23%
Pearson correlation is -0.48

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.4947 | 0.3498 | 9.9909 | 0 |
| M3 | -0.0389 | 0.0119 | -3.2569 | 0.0025 |

**Table 152. Regression model SOI for Ohakea (April)**

Explained variance (predictability) is 32%
Pearson correlation is 0.57

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.1352 | 0.2342 | 9.1179 | 0 |
| SOI | 0.0631 | 0.0154 | 4.0973 | 0.0002 |

## Paraparaumu

Paraparaumu region has the following key characteristics:

### Seasonal

- High SSR has moderate correlations with predictors SST, M3 and HSE and low SSR is associated with the T predictor(Table 4).
- Linear regression of SSR with SST, HSE, M3 and T are significant at 5% level (Table 5).
- Paraparaumu is strongly positively correlated with regions (Table 50);
  Hokitika (0.55)
  Nelson (0.62)
  Ohakea (0.75)

### Monthly

- High MSR are moderately correlated (|0.40– 0.49|) for all months except April which has a weak correlation (Table 51 to Table 64 Table 153 to Table 159 and Figure 16).
- All months have a linear regressions that are significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.912 – 0.027 MZ1 (Table 153)
  November: MSR = 0.810 _ 0.0127 MZ1 (Table 154)
  December: MSR = 0.694 + 0.010 HW (Table 155)
  January: MSR = 1.18 + 0.011 R (Table 156)
  February: MSR = 2.175 – 0.020 Z4 (Table 157)
  March: MSR = 0.941 + 0.006 H (Table 158)
  April: MSR = 0.935 + 0.012 SOI (Table 159)

**Table 153. Regression model MZ1 for Paraparaumu (October)**

Explained variance (predictability) is 18%
Pearson correlation is -0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9118 | 0.0983 | 9.2753 | 0 |
| MZ1 | -0.0202 | 0.0075 | -2.6886 | 0.011 |

**Table 154. Regression model MZ1 for Paraparaumu (November)**

Explained variance (predictability) is 17%
Pearson correlation is -0.41

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8096 | 0.0912 | 8.8805 | 0 |
| MZ1 | -0.0268 | 0.01 | -2.6824 | 0.0111 |

**Table 155. Regression model HW for Paraparaumu (December)**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6943 | 0.1951 | 3.5579 | 0.0011 |
| HW | 0.0096 | 0.0029 | 3.3072 | 0.0022 |

**Table 156. Regression model R for Paraparaumu (January)**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.183 | 0.2943 | 4.0196 | 0.0003 |
| R | 0.0109 | 0.0033 | 3.3068 | 0.0022 |

**Table 157. Regression model Z4 for Paraparaumu (February)**

Explained variance (predictability) is 19%
Pearson correlation is -0.43

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.1748 | 0.2265 | 9.6 | 0 |
| Z4 | -0.0197 | 0.0068 | -2.891 | 0.0065 |

**Table 158. Regression model H for Paraparaumu (March)**

Explained variance (predictability) is 18%
Pearson correlation is 0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9411 | 0.3693 | 2.5483 | 0.0154 |
| H | 0.0063 | 0.0023 | 2.7912 | 0.0084 |

**Table 159. Regression model SOI for Paraparaumu (April)**

Explained variance (predictability) is 11%
Pearson correlation is 0.34

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9347 | 0.0846 | 11.0549 | 0 |
| SOI | 0.0121 | 0.0056 | 2.1526 | 0.0381 |

## Queenstown

Queenstown region has the following key characteristics:

### Seasonal

- High SSR is moderately correlated with SST (0.45) and low SSR is associated with TNW (Table 4).
- Linear regression of SSR with SST is significant at 5% level and TNW is only significant at 10%level (Table 5).
- Dunedin is strongly positively correlated with regions (Table 50);
  Dunedin (0.54)
  Invercargill (0.53)

### Monthly

- High MSR is strongly correlated (>0.55) to predictors for months November, December, January and March and the other months have a weaker correlations (Table 51 to Table 64 Table 160 to Table 166 and Figure 17).
- All months except April have a linear regression that is significant at 5% level. The month April is significant at the 10%level (Table 52 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.683 – 0.013 MZ1 (Table 160)
  November: MSR = 1.046 + 0.008 R (Table 161)
  December: MSR = 0.698 + 0.011 SW (Table 162)
  January: MSR = 2.980 – 0.109 MZ1 (Table 163)
  February: MSR = 0.944 + 0.007 HSE (Table 164)
  March: SSR = 1.237 + 0.012 Z2 (Table 165)
  April: SSR = 0.388 + 0.006 TSW (Table 166)

**Table 160. Regression model MZ1 for Queenstown (October)**

Explained variance (predictability) is 19%
Pearson correlation is -0.44

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6828 | 0.0867 | 7.8795 | 0 |
| MZ1 | -0.0132 | 0.0062 | -2.1198 | 0.0474 |

**Table 161. Regression model R for Queenstown (November)**

Explained variance (predictability) is 32%
Pearson correlation is 0.57

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.0456 | 0.1693 | 6.1769 | 0 |
| R | 0.0077 | 0.0026 | 2.9915 | 0.0075 |

**Table 162. Regression model SW for Queenstown (December)**

Explained variance (predictability) is 41%
Pearson correlation is 0.64

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6977 | 0.3561 | 1.9594 | 0.0649 |
| SW | 0.0113 | 0.0031 | 3.6011 | 0.0019 |

**Table 163. Regression model MZ1 for Queenstown (January)**

Explained variance (predictability) is 32%
Pearson correlation is -0.56

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.979 | 0.4089 | 7.2861 | 0 |
| MZ1 | -0.1087 | 0.0357 | -3.0423 | 0.0064 |

**Table 164. Regression model HSE for Queenstown (February)**

Explained variance (predictability) is 21%
Pearson correlation is 0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9441 | 0.7335 | 1.2871 | 0.2135 |
| HSE | 0.0065 | 0.0029 | 2.2447 | 0.0369 |

**Table 165. Regression model Z2 for Queenstown (March)**

Explained variance (predictability) is 30%
Pearson correlation is 0.55

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.2366 | 0.1565 | 7.9027 | 0 |
| Z2 | 0.0118 | 0.004 | 2.923 | 0.0084 |

**Table 166. Regression model TSW for Queenstown (April)**

Explained variance (predictability) is 15%
Pearson correlation is 0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.3875 | 0.1215 | 3.1885 | 0.0048 |
| TSW | 0.0061 | 0.0033 | 1.8264 | 0.0835 |

## Rotorua

Rotorua region has the following key characteristics:

### Seasonal

- High SSR is strongly correlated with MZ1 (-0.56) (Table 4).
- Linear regression of SSR with MZ1 is significant at 5% level (Table 5).
- Rotorua is strongly positively correlated with regions (Table 50);
  Auckland (0.57)
  Coromandel (0.65)
  Dargaville (0.55)
  Kaitaia (0.70)
  Nelson (0.54)
  Taupo (0.61)
  Tauranga (0.67)

### Monthly

- High MSR is strongly correlated (>0.55) to predictors during October, December and January and has a weaker correlations in the remaining months. (Table 51 to Table 64 Table 167 to Table 173 and Figure 18).
- All months have linear regressions that are significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.299 + 0.005 M2 (Table 167)
  November: MSR = 0.681 + 0.008 M2 (Table 168)
  December: MSR = 1.008 + 0.020 M2 (Table 169)
  January: MSR = 2.199 + 0.036 M2 (Table 170)
  February: MSR = 1.610 – 0.053 MZ1 (Table 171)
  March: MSR = 0.930 + 0.009 Z2 (Table 172)
  April: MSR = 0.684 + 0.0132 SOI (Table 173)

**Table 167. Regression model M2 for Rotorua (October)**

Explained variance (predictability) is 34%
Pearson correlation is 0.58

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2993 | 0.026 | 11.4948 | 0 |
| M2 | 0.0052 | 0.0013 | 4.1225 | 0.0002 |

**Table 168. Regression model M2 for Rotorua (November)**

Explained variance (predictability) is 20%
Pearson correlation is 0.45

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.681 | 0.0623 | 10.938 | 0 |
| M2 | 0.0079 | 0.0027 | 2.8587 | 0.0073 |

**Table 169. Regression model M2 for Rotorua (December)**

Explained variance (predictability) is 48%
Pearson correlation is 0.70

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.0077 | 0.0839 | 12.017 | 0 |
| M2 | 0.02 | 0.0036 | 5.5648 | 0 |

**Table 170. Regression model M2 for Rotorua (January)**

Explained variance (predictability) is 35%
Pearson correlation is 0.59

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.9867 | 0.2296 | 8.6515 | 0 |
| M2 | 0.0357 | 0.0083 | 4.2816 | 0.0001 |

**Table 171. Regression model MZ1 for Rotorua (February)**

Explained variance (predictability) is 15%
Pearson correlation is -0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.610 | 0.180 | 8.933 | 0.0 |
| MZ1 | -0.053 | 0.021 | -2.494 | 0.018 |

**Table 172. Regression model Z2 for Rotorua (March)**

Explained variance (predictability) is 22%
Pearson correlation is 0.47

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9296 | 0.1015 | 9.161 | 0 |
| Z2 | 0.0092 | 0.003 | 3.0963 | 0.0039 |

**Table 173. Regression model SOI for Rotorua (April)**

Explained variance (predictability) is 15%
Pearson correlation is 0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6843 | 0.0817 | 8.3754 | 0 |
| SOI | 0.0132 | 0.0053 | 2.4954 | 0.0176 |

## Taupo

Taupo region has the following key characteristics:

### Seasonal

- High SSR is weakly correlated with HSE (0.38) and low SSR is associated with TNW (Table 4).
- Linear regression of SSR with TNW is significant at 5% level and HSE is only significant at 10% level (Table 5).
- Taupo is strongly positively correlated with regions (Table 50);
  Coromandel (0.59) Dargaville (0.54)
  Kaitaia (0.63) New Plymouth (0.66)
  Rotorua (0.61) Tauranga (0.62)
  Wanganui (0.65)

### Monthly

- High MSR is strongly correlated (0.59) to predictors in October and generally the association weakens through the season. (Table 51 to Table 64 Table 175 to Table 180 and Figure 19).
- All months have a linear regression that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.132 + 0.001 H (Table 174)
  November: MSR = 0.544 + 0.002 NE (Table 175)
  December: MSR = 0.929 + 0.014 Z2 (Table 176)
  January: MSR = 2.144 – 0.068 MZ1 (Table 177)
  February: MSR = 1.684 – 0.015 Z4 (Table 178)
  March: MSR = 0.756 + 0.005 HNW (Table 179)
  April: MSR = 0.861 + 0.023 SOI (Table 180)

**Table 174. Regression model H for Taupo (October)**

Explained variance (predictability) is 35%
Pearson correlation is 0.59

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1319 | 0.0785 | 1.6807 | 0.1076 |
| H | 0.0014 | 0.0004 | 3.367 | 0.0029 |

**Table 175. Regression model NE for Taupo (November)**

Explained variance (predictability) is 22%
Pearson correlation is 0.47

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.5438 | 0.0808 | 6.7318 | 0 |
| NE | 0.0017 | 0.0007 | 2.4252 | 0.0244 |

**Table 176. Regression model Z2 for Taupo (December)**

Explained variance (predictability) is 21%
Pearson correlation is 0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.929 | 0.1698 | 5.4705 | 0 |
| Z2 | 0.0144 | 0.0061 | 2.3511 | 0.0286 |

**Table 177. Regression model MZ1 for Taupo (January)**

Explained variance (predictability) is 26%
Pearson correlation is -0.51

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.144 | 0.281 | 7.625 | 0.0 |
| MZ1 | -0.068 | 0.025 | -2.776 | 0.011 |

**Table 178. Regression model Z4 for Taupo (February)**

Explained variance (predictability) is 19%
Pearson correlation is -0.43

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.684 | 0.223 | 7.558 | 0.0 |
| Z4 | -0.015 | 0.007 | -2.246 | 0.035 |

**Table 179. Regression model HNW for Taupo (March)**

Explained variance (predictability) is 14%
Pearson correlation is 0.37

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.756 | 0.193 | 3.915 | 0.001 |
| HNW | 0.005 | 0.003 | 1.832 | 0.081 |

**Table 180. Regression model SOI for Taupo (April)**

Explained variance (predictability) is 24%
Pearson correlation is 0.49

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8607 | 0.1501 | 5.7338 | 0 |
| SOI | 0.0232 | 0.0088 | 2.6259 | 0.0154 |

## Tauranga

Tauranga region has the following key characteristics:

### Seasonal

- High SSR is strongly correlated (0.52) to predictor Z2 and low SSR is associated with NE and TNW (Table 4).
- Linear regression of SSR with significant predictors is significant at the 5 %level (Table 5).
- Tauranga is strongly positively correlated with regions (Table 50);
  Coromandel (0.62)
  Dargaville (0.55)
  Rotorua (0.67)
  Taupo (0.62)
  Wanganui (0.54)

### Monthly

- High MSR is strongly correlated (>|0.5|)to predictors from October to February and the correlation weakens in March and April (Table 51 to Table 64 Table 51 to Table 64 and Figure 20).
- All months have a linear regression that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for the highest correlation of each month is:
  October: MSR = 0.609 + 0.012 MZ3 (Table 181)
  November: MSR = 1.349 + 0.025 MZ1 (Table 182)
  December: MSR = 2.359 – 0.077 MZ1 (Table 183)
  January: MSR = 3.030 + 0.050 M2 (Table 184)
  February: MSR = 3.068 – 0.036 M3 (Table 185)
  March: MSR = 1.521 + 0.013 Z2 (Table 186)
  April: MSR = 0.964 – 0.022 MZ1 (Table 187)

**Table 181. Regression model MZ3 for Tauranga (October)**

Explained variance (predictability) is 31%
Pearson correlation is 0.56

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6095 | 0.0853 | 7.1479 | 0 |
| | 0.0125 | 0.0036 | 3.4722 | 0.0018 |

**Table 182. Regression model MZ3 for Tauranga (November)**

Explained variance (predictability) is 42%
Pearson correlation is 0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.3486 | 0.1693 | 7.9666 | 0 |
| MZ3 | 0.0246 | 0.0056 | 4.3977 | 0.0002 |

**Table 183. Regression model MZ1 for Tauranga (December)**

Explained variance (predictability) is 30%
Pearson correlation is -0.54

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.3592 | 0.3062 | 7.7057 | 0 |
| MZ1 | -0.0774 | 0.023 | -3.3666 | 0.0023 |

**Table 184. Regression model M2 for Tauranga (January)**

Explained variance (predictability) is 25%
Pearson correlation is 0.50

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.030 | 0.423 | 7.165 | 0.0 |
| M2 | 0.050 | 0.017 | 3.016 | 0.005 |

**Table 185. Regression model M3 for Tauranga (February)**

Explained variance (predictability) is 29%
Pearson correlation is 0.53

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.0676 | 0.3231 | 9.4938 | 0 |
| M3 | -0.0355 | 0.0107 | -3.324 | 0.0025 |

**Table 186. Regression model Z2 for Tauranga (March)**

Explained variance (predictability) is 21%
Pearson correlation is 0.46

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.521 | 0.161 | 9.457 | 0.0 |
| Z2 | 0.013 | 0.005 | 2.735 | 0.011 |

**Table 187. Regression model MZ1 for Tauranga (April)**

Explained variance (predictability) is 16%
Pearson correlation is -0.39

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.9644 | 0.1105 | 8.7309 | 0 |
| MZ1 | -0.0222 | 0.0098 | -2.2696 | 0.0311 |

## Wanganui

Wanganui region has the following key characteristics:

### Seasonal

- High SSR is moderately correlated (|0.45-0.50|) with SST, Z2 and W and low SSR is associated with TNW and HW (Table 4).
- Linear regression of SSR with associated predictors are significant at 5% level (Table 5).
- Wanganui is strongly positively correlated with regions (Table 50);
  Coromandel (0.50)
  New Plymouth (0.76)
  Taupo (0.65)
  Tauranga (0.54)

### Monthly

- High MSR is strongly correlated (>0.50) to predictors for all months except February (Table 51 to Table 64 and Figure 21).
- All months except February have linear regressions that are significant at 5% level. The month of February is significant at the 10% level (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.195 + 0.002 W (Table 188)
  November: MSR = 0.806 + 0.013 M2 (Table 189)
  December: MSR = 0.711 + 0.011 Z2 (Table 190)
  January: MSR = 0.527 + 0.018 HNW (Table 191)
  February: MSR = 1.156 +0.028 SOI (Table 192)
  March: MSR = 0.110 + 0.005 H (Table 193)
  April: MSR = 0.619 + 0.726 SST (Table 194)

**Table 188. Regression model W for Wanganui (October)**

Explained variance (predictability) is 29%
Pearson correlation is 0.54

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1948 | 0.075 | 2.5967 | 0.0177 |
| W | 0.0019 | 0.0007 | 2.7872 | 0.0117 |

**Table 189. Regression model M2 for Wanganui (November)**

Explained variance (predictability) is 37%
Pearson correlation is 0.61

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.8056 | 0.1043 | 7.7248 | 0 |
| M2 | 0.013 | 0.0039 | 3.3583 | 0.0033 |

**Table 190. Regression model Z2 for Wanganui (December)**

Explained variance (predictability) is 35%
Pearson correlation is 0.59

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.7108 | 0.0958 | 7.423 | 0 |
| Z2 | 0.0105 | 0.0033 | 3.1657 | 0.0051 |

**Table 191. Regression model HNW for Wanganui (January)**

Explained variance (predictability) is 42%
Pearson correlation is 0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.5269 | 0.2694 | 1.9555 | 0.0654 |
| HNW | 0.018 | 0.0049 | 3.691 | 0.0016 |

**Table 192. Regression model SOI for Wanganui (February)**

Explained variance (predictability) is 14%
Pearson correlation is 0.37

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.156 | 0.203 | 5.694 | 0.0 |
| SOI | 0.028 | 0.016 | 1.777 | 0.091 |

**Table 193. Regression model H for Wanganui (March)**

Explained variance (predictability) is 34%
Pearson correlation is 0.58

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1103 | 0.3062 | 0.3603 | 0.7226 |
| H | 0.0054 | 0.0017 | 3.1036 | 0.0058 |

**Table 194. Regression model SST for Wanganui (April)**

Explained variance (predictability) is 34%
Pearson correlation is 0.58

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.6193 | 0.1278 | 4.844 | 0.0001 |
| SST | 0.7263 | 0.2258 | 3.2162 | 0.0043 |

## Wellington

Wellington region has the following key characteristics:

### Seasonal

- High SSR is strongly positive correlated (>0.50) with predictors HNW (0.69) and Z2, Z3 and (Table 4).
- Linear regression of SSR with associated predictors are significant at 5% level (Table 5).
- Wellington is strongly positively correlated with regions (Table 50);
  Christchurch (0.52)
  Coromandel (0.59)
  Gisborne (0.52)
  Kaikoura (0.58)
  Nelson (0.50)

### Monthly

- High MSR are strongly correlated (>0.5) for October, November, December and March while for the months February and April the correlation are much weaker (Table 51 to Table 64 and ).
- All months have a linear regressions that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 1.607 + 0.018 Z2 (Table 195)
  November: MSR = 3.058 + 0.035 Z2 (Table 196)
  December: MSR = 3.960 + 0.056 Z2 (Table 197)
  January: MSR = 5.177 + 0.049 MZ2 (Table 198)
  February: MSR = 3.816 + 0.007 HSE (Table 199)
  March: MSR = 1.853 + 0.034 HNW (Table 200)
  April: MSR = 2.256 +0.020 Z1 (Table 201)

**Table 195. Regression model Z2 for Wellington (October)**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.6073 | 0.1716 | 9.3651 | 0 |
| Z2 | 0.0183 | 0.005 | 3.6682 | 0.0008 |

**Table 196. Regression model Z2 for Wellington (November)**

Explained variance (predictability) is 27%
Pearson correlation is 0.52

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.0582 | 0.2846 | 10.7448 | 0 |
| Z2 | 0.0349 | 0.0094 | 3.7183 | 0.0007 |

**Table 197. Regression model Z2 for Wellington (December)**

Explained variance (predictability) is 26%
Pearson correlation is 0.51

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.9603 | 0.4358 | 9.0875 | 0 |
| Z2 | 0.0561 | 0.0156 | 3.5906 | 0.001 |

**Table 198. Regression model MZ2 for Wellington (January)**

Explained variance (predictability) is 14%
Pearson correlation is 0.38

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 5.1774 | 0.4432 | 11.6809 | 0 |
| MZ2 | 0.0486 | 0.0192 | 2.5234 | 0.0159 |

**Table 199. Regression model HSE for Wellington (February)**

Explained variance (predictability) is 11%
Pearson correlation is 0.33

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 3.8162 | 0.8734 | 4.3694 | 0.0001 |
| HSE | 0.0071 | 0.0033 | 2.1386 | 0.0391 |

**Table 200. Regression model HNW for Wellington (March)**

Explained variance (predictability) is 41%
Pearson correlation is 0.65

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 1.8528 | 0.5791 | 3.1993 | 0.0028 |
| HNW | 0.0339 | 0.0066 | 5.1569 | 0 |

**Table 201. Regression model HE for Wellington (April)**

Explained variance (predictability) is 17%
Pearson correlation is -0.42

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 2.9415 | 0.3347 | 8.7878 | 0 |
| HE | -0.0082 | 0.0029 | -2.7788 | 0.0085 |

## Westport

Westport region has the following key characteristics:

### Seasonal

- High SSR is strongly correlated (>0.50) with predictors SOI, SST, Z4 and HSE and low SSR is associated with predictor W (Table 4).
- Linear regressions of SSR with associated predictors are significant at 5% level (Table 5).
- Westport is strongly positively correlated with regions (Table 50);
  Hokitika (0.60)
  Ohakea (0.63)

### Monthly

- High MSR is strongly correlated (>0.50) to predictors fro the months November to January, especially in November (0.72) and gradually weakens towards autumn. (Table 51 to Table 64 and Figure 23).
- All months have a linear regression that is significant at 5% level. (Table 51 to Table 64).
- The predicted equations for each month is:
  October: MSR = 0.082 – 0.001 MZ2 (Table 202)
  November: MSR = 0.176 – 0.003 Z4 (Table 203)
  December: MSR = 0.215 – 0.003 M3 (Table 204)
  January: MSR = 0.128 + 0.003 HW (Table 205)
  January: MSR = 0.402 – 0.007 Z1 (Table 206)
  February: MSR = 0.390 – 0.009 Z3 (Table 207)
  March: MSR = 0.297 – 0.003 Z4 (Table 208)
  April: MSR = 0.135 – 0.001 Z4 (Table 209)

**Table 202. Regression model MZ2 for Westport (October)**

Explained variance (predictability) is 22%
Pearson correlation is –0.47

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.0818 | 0.0129 | 6.3589 | 0 |
| MZ2 | -0.0014 | 0.0005 | -2.7521 | 0.0105 |

**Table 203. Regression model Z4 for Westport (November)**

Explained variance (predictability) is 52%
Pearson correlation is -0.72

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1755 | 0.0265 | 6.6314 | 0 |
| Z4 | -0.0031 | 0.0006 | -5.3878 | 0 |

**Table 204. Regression model M3 for Westport (December)**

Explained variance (predictability) is 31%
Pearson correlation is -0.56

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2153 | 0.0293 | 7.3511 | 0 |
| M3 | -0.0032 | 0.0009 | -3.4988 | 0.0016 |

**Table 205. Regression model HW for Westport (January)**

Explained variance (predictability) is 30%
Pearson correlation is 0.55

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1275 | 0.0992 | 1.2859 | 0.2094 |
| HW | 0.0031 | 0.0009 | 3.4062 | 0.0021 |

**Table 206. Regression model Z1 for Westport (January)**

Explained variance (predictability) is 28%
Pearson correlation is 0.53

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.4016 | 0.0637 | 6.3070 | 0.0000 |
| Z1 | -0.0072 | 0.0022 | -3.3081 | 0.0026 |

**Table 207. Regression model Z3 for Westport (February)**

Explained variance (predictability) is 23%

Pearson correlation is -0.48

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.3896 | 0.055 | 7.0871 | 0 |
| Z3 | -0.0089 | 0.0031 | -2.9074 | 0.0071 |

**Table 208. Regression model Z4 for Westport (March)**

Explained variance (predictability) is 17%
Pearson correlation is -0.41

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.2974 | 0.04 | 7.4288 | 0 |
| Z4 | -0.0026 | 0.0011 | -2.3518 | 0.0259 |

**Table 209. Regression model Z4 for Westport (April)**

Explained variance (predictability) is 14%
Pearson correlation is -0.38

| | Coefficient | Std Error | T value | P(2 tail) |
|---|---|---|---|---|
| | | | | |
| Constant | 0.1346 | 0.0241 | 5.5914 | 0 |
| Z4 | -0.0012 | 0.0005 | -2.1736 | 0.0383 |