MetService

POWERFUL WEATHER INTELLIGENCE

Road Weather System - User Manual

V1.4 – 1 July 2018

MetService FORECA NZ TRANSPORT AGENCY WAKA KOTAHI

Sunday, 1 July 2018

Dear MetConnect User

Re: Road weather system

This document serves as a user manual for MetService's Road Weather System, as delivered as a module within the MetConnect weather dashboard.

Now that high-resolution modelling is available, high-resolution forecasts can provide a level of detail not previously seen in road weather forecasting; capturing modelled input that has been statistically tuned using MetService road weather stations and mobile weather sensors, it also captures nearby forecast conditions that impact on the road weather conditions and the environment the road passes through (e.g. snow/rain on a mountain side between road weather stations). This service is future-proof. As forecasts improve further, the Road Weather System will automatically benefit.

The Road Weather System utilises NZTA RAMM data to ensure it has the latest in road location, orientation, exposure to the sun details, construction and composition information. A unique system is used to determine the 'sky view' of the road to determine the incoming and outgoing radiation balance, while high-resolution satellite imagery serves to improve short term cloud cover forecasts. In addition, traffic volume, bridge location and the local horizon as seen by the road, including trees and man-made structures are all taken into consideration in the forecasting process.

The incorporation of mobile road weather observations into the modelling system provides valuable data where we currently have limited information. This goes a long way to capture small scale variances in the road condition due cold pockets and inversions in warmer enclosed valleys when these variances are smaller than current model resolution.

Typically, the spatial resolution of the Road Weather System ranges from ~200m to ~5000m over the entire State Highway network. We employ a dynamic spatial resolution system that allows us to stretch the resolution out to 5000m (i.e. a discrete forecast every 5000m) in areas where there are uniform environmental conditions and compress the resolution down to 200m when the environment is changing more rapidly with distance. We are also able to employ a much higher resolution road weather forecast service over key alpine passes, inner cities and areas of strategic importance. In these cases, we are utilising previously unheard-of model resolution of 30 metres – a discrete forecast every 30 metres.

We are excited to deliver this Road Weather System to you and we trust you will find it an innovative, intuitive and accurate operational road weather tool.

Yours sincerely

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OVERVIEW

MetService's Road Weather System is an intuitive system that allows the user to access quality road weather information (observations and forecasts) for the State Highway network from a network-wide perspective, right down to a small section of road within a region.

Road weather information is provided through three main sections (MAP, TABLE and ALERTS); all delivered through one User Interface, contained with your existing MetConnect weather dashboard.

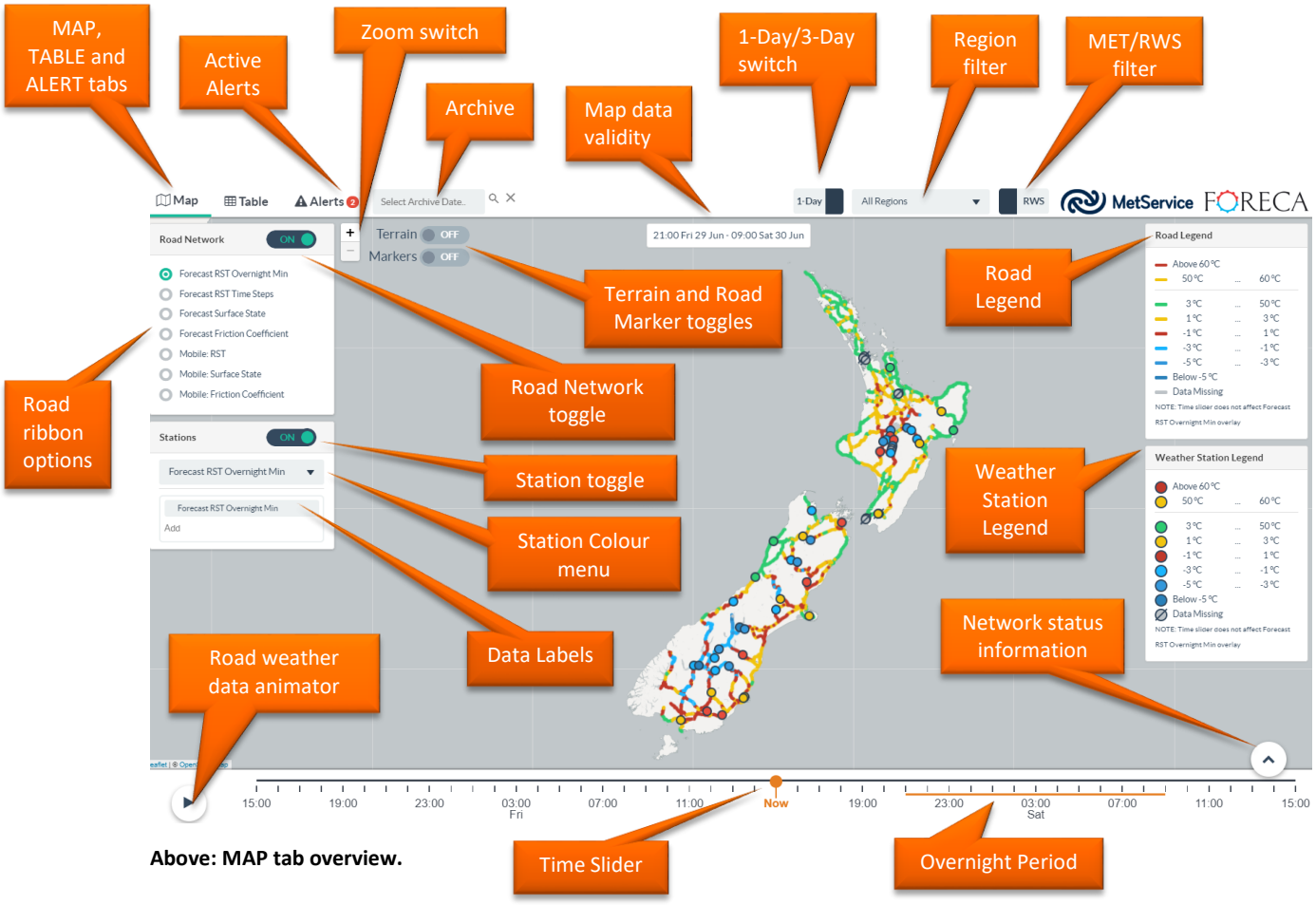
The Road Weather System will provide guidance on which roads are going to freeze, become slippery (or melt); when/where these conditions are likely to occur, and ensure you are kept aware with automatically generated alerts. An archive is provided to allow you to view past data and real-time road weather observations are provided alongside forecasts to ensure you are always kept up to date with the road weather conditions and associated risks.

Remember, this is a modelled forecast service and official manually written MetService forecasts take precedence.

MAP

Overview

The screen shot of the Road Weather System below outlines the main features of the MAP tab. These features are described in more detail below.

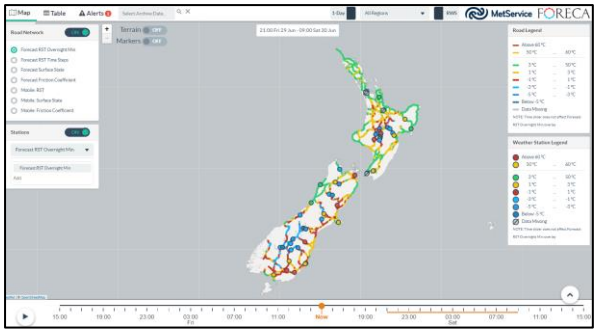


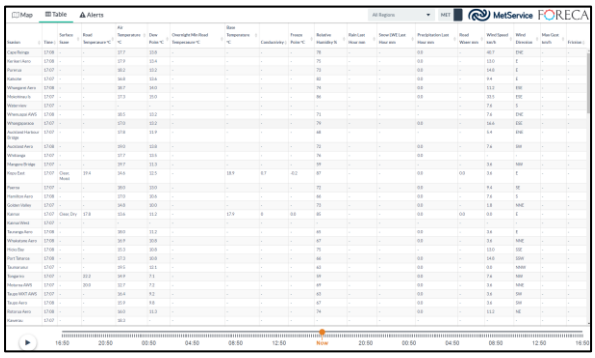
Above: MAP tab overview.

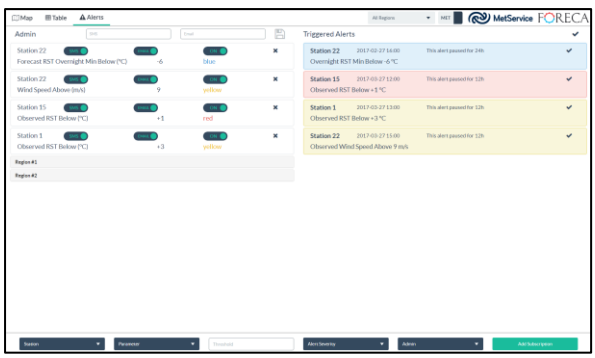
MAP, TABLE, ALERTS tabs

The MAP section is the default page within the Road Weather System interface. A line under the selected tab indicates the active selection. From this page, the user has an option to click on the:

- **MAP** page. This is the main section of the User Interface and is where users are expected to spend most of their time. The MAP page allows users to overlay and toggle various road network layers and weather station data over a map of New Zealand that users can zoom in and out of. Station meteograms and virtual stations are also available for this page.
- **TABLE** page. View columns of road weather forecasts and observations, laid out in a table. Detailed road weather station meteograms are also available from this page.
- **ALERTS** page to allow users to set up their own road weather alerts.







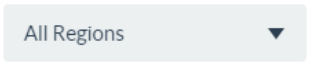
Top to bottom: MAP page, TABLE page, ALERT page

Network Status Information

This is a useful summary tool that can be used as a first stop to get a feel for the past, current and future status of the network. This will ensure users don't miss anything important in terms of road weather. Once users have a good understanding of the network status, they can drill down to access more detailed aspects of the Road Weather System to assist with their decision-making.

These buttons,  on the lower right of the Map page are used to display (and hide) the Network Status Information. This is where users can determine the number of kilometres (and percentage) of the State Highway Network that is Dry, has Dew, Wet, Frost/Ice/Snow conditions.

Users can either choose to view the Network Status of the entire State Highway network or just the region they are associated with. To view the status of a specific region, simply select that region from the Region Filter at the top of the page.



The colours on the Road Status Graph are similar to those used in the Surface State Road Legend.

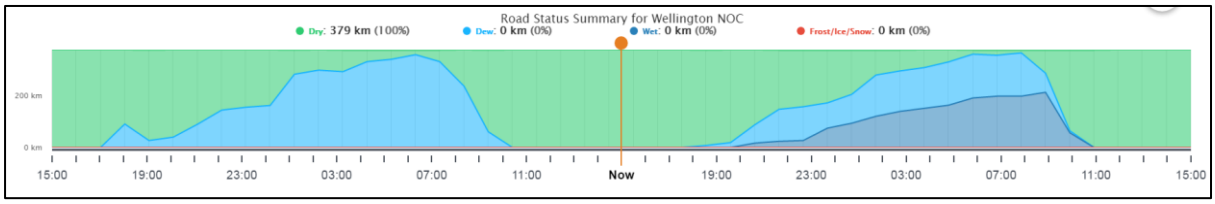
- Green = Dry roads
- Blue = Dew
- Purple = Wet roads
- Red = Frost/Ice/Snow on roads

Network Status Information is provided 24 hours before and after 'Now' (1-Day option). Users can access the Time Slider to view hindcasts (to the left of 'Now') on the Time Slider or forecasts of the future Network Status to the right of 'Now'.

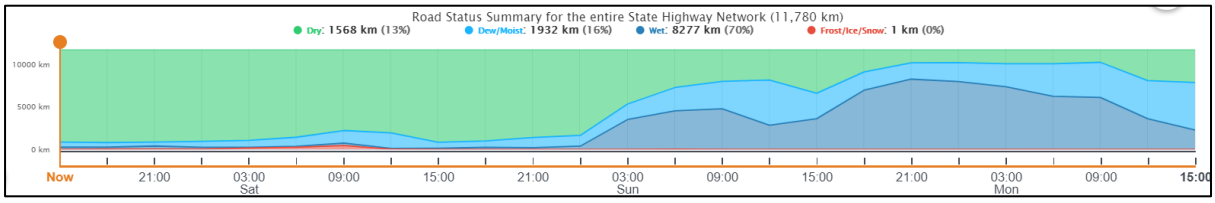
If the user clicks the 1-Day/3-Day switch at the top of the page, the 3-day option displays the status of the network or region for the following three days.

The summary information (number of km/percentages) listed above the graph will change as you select different times with the Time Slider, or simply mouse over the Road Status Graph.

Note, "Now" is in the middle of the 1-day time sider and at the left of the 3-day time slider.

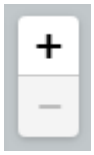


Above: 1-day Network Status Information graph for Wellington region



Above: 3-day Network Status Information graph for the entire New Zealand state highway network.

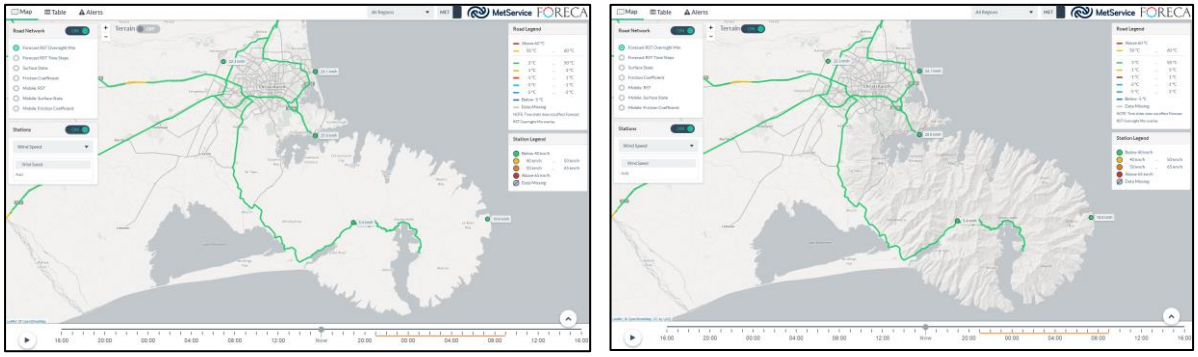
Zoom tool



This tool allows the user to zoom in and out of the MAP page. Users can also zoom in by double-clicking on the map (away from the road ribbon or weather observation point) and zoom out by shift-double clicking on the map (away from the road ribbon and weather observation points). A third option is to zoom in and out of the map by using the mouse wheel.

Terrain toggle

This toggle switch allows users to turn the map terrain off and on. Sometimes it is useful to view the terrain to give the user an indication of the degree of mountainous topography versus flat terrain in the area of interest.



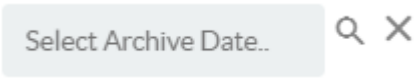
Left: Terrain map turned off. Right: Terrain map turned on.

Road Marker toggle

This toggle switch allows users to turn Road Marker information off and on. This will help users determine where they are on a section of the road network, if there are no other reference points nearby.

Left: Road ribbon with Road Markers toggled 'on'

Archive



The Achive section allows users to access past observations and forecasts. This tool can be useful for post-event analysis.

Access the Archive by clicking in the SELECT ARCHIVE DATE window at the top of the page. A date pad appears to allow you to enter a day of interest. The user can cycle backwards and forwards, month by month, by clicking the 'forward' or 'backwards' arrows at the top left (and right) of the date pad.

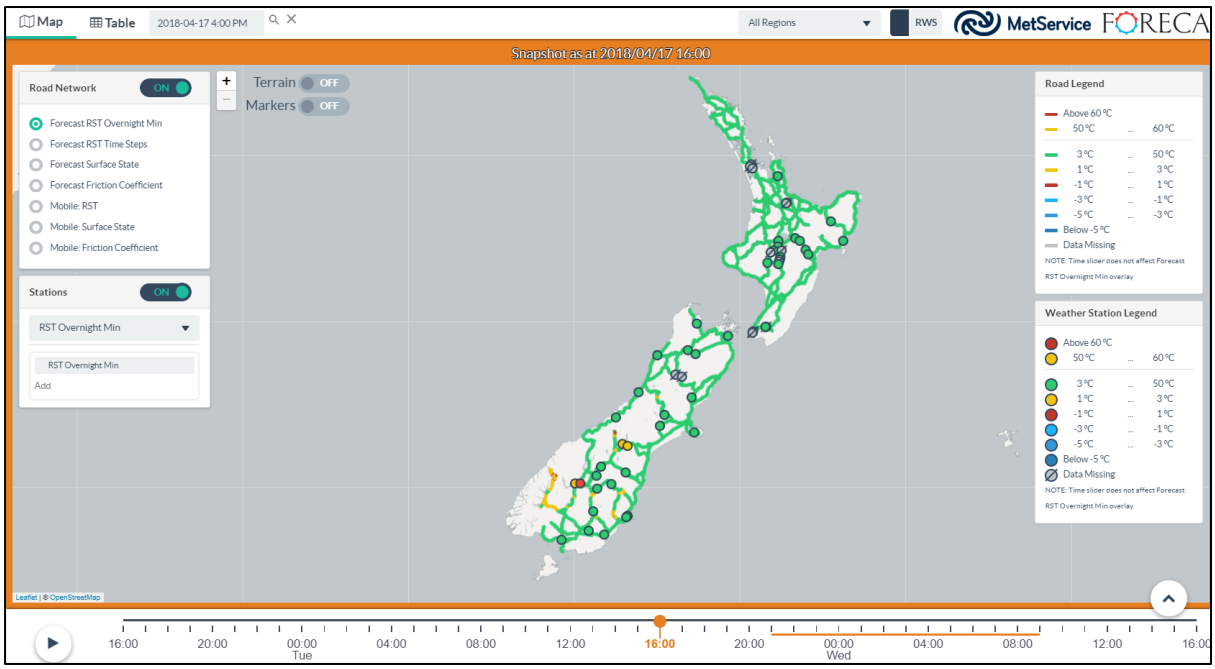
Once a date has been selected, a time window will appear to allow the user to enter an hour of the day to extract data for. Hours can be entered using the 'up' and 'down' arrows that appear when the user clicks in the time box. Click on the AM/PM toggle to switch between morning and evening.

Once the day and time have been selected, click on the 'find' icon to the right of the SELECT ARCHIVE DATE window. The system will extract data for this date and time; allowing the user to interact with the Road Weather System UI as if it were the date and time in question.

The button beside the magnifying glass will clear any date/time entries to enable the user to re-enter alternative dates and times.

To differentiate the archive screen from the real time information screens, a thick red border is placed around the screen. Also, the date and time of the archived information is located at the top of the page, within the thick red border.

To revert back to the real time information screens, click on the and then the button.



Above. Archive screen.

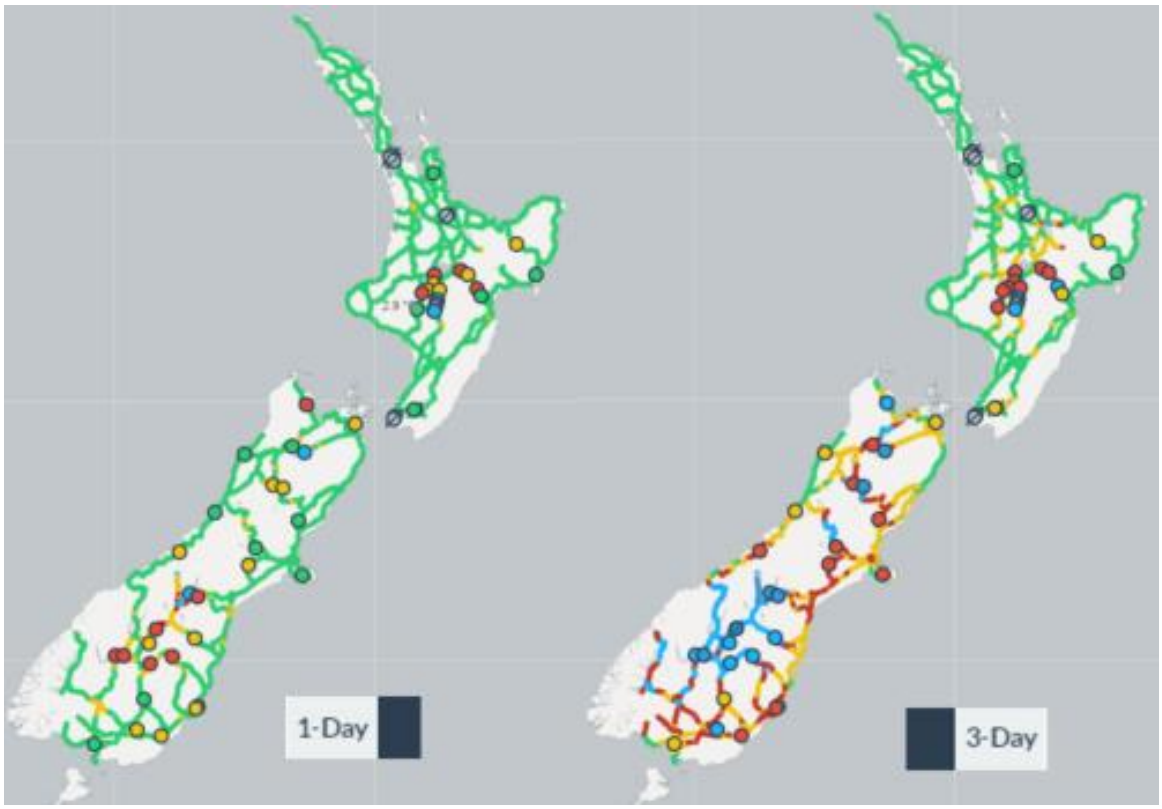
1-Day 3- Day switch

This switch allows users to view data for the 24 hours before and after 'now' (1-day) or the next three days.

If 1-Day is selected and the user selects the Forecast RST Overnight Min layer from the Road Network road ribbon options, the overnight period is either or 9pm 'last night' to 9am this morning , if the site is accessed before 9am or 9pm 'tonight' to 9am 'tomorrow', if the site is accessed after 9am.

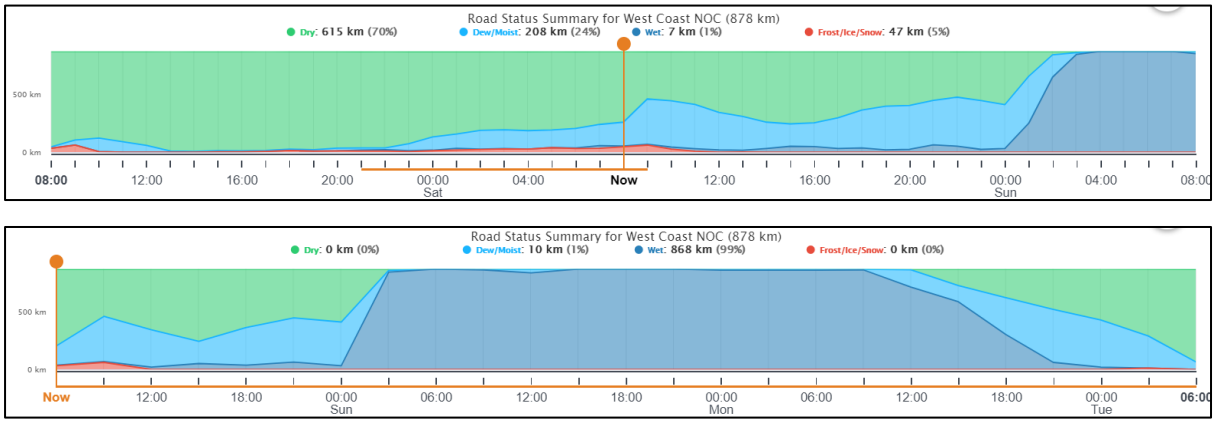
If 3-Day is selected, the 'overnight' period is anytime over the entire three day forecast period; ie the coldest the roads are expected to be over the coming three days.

Note: the orange line on the time slider scale covers the 'overnight' period. 9pm to 9am for the 1-Day forecasts and the entire three-day forecast period for the 3-Day forecasts.



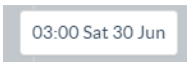
Above: Difference between 1-Day and 3-Day Forecast RST Overnight Min. When Forecast RST Overnight Min is chosen, the 1-Day forecast is for the 9pm to 9am period, ie we are showing the coldest road surface temperatures during this period only. If the Forecast RST Overnight Min is selected while viewing the 3-Day forecast, the coldest road surface temperature over the entire three-day period is displayed.

This 3-Day functionality carries through to other sections of the interface, with the only difference being the temporal resolution of the time scale. The 1-Day option uses hourly time steps on the meteograms, while the 3-Day option uses three-hourly time steps. (Note the meteograms accessed from the Table tab have higher temporal resoltion. The 1-Day option provides meteograms with 10-minute resolution and the 3-Day option provides meteograms with hourly resolution).

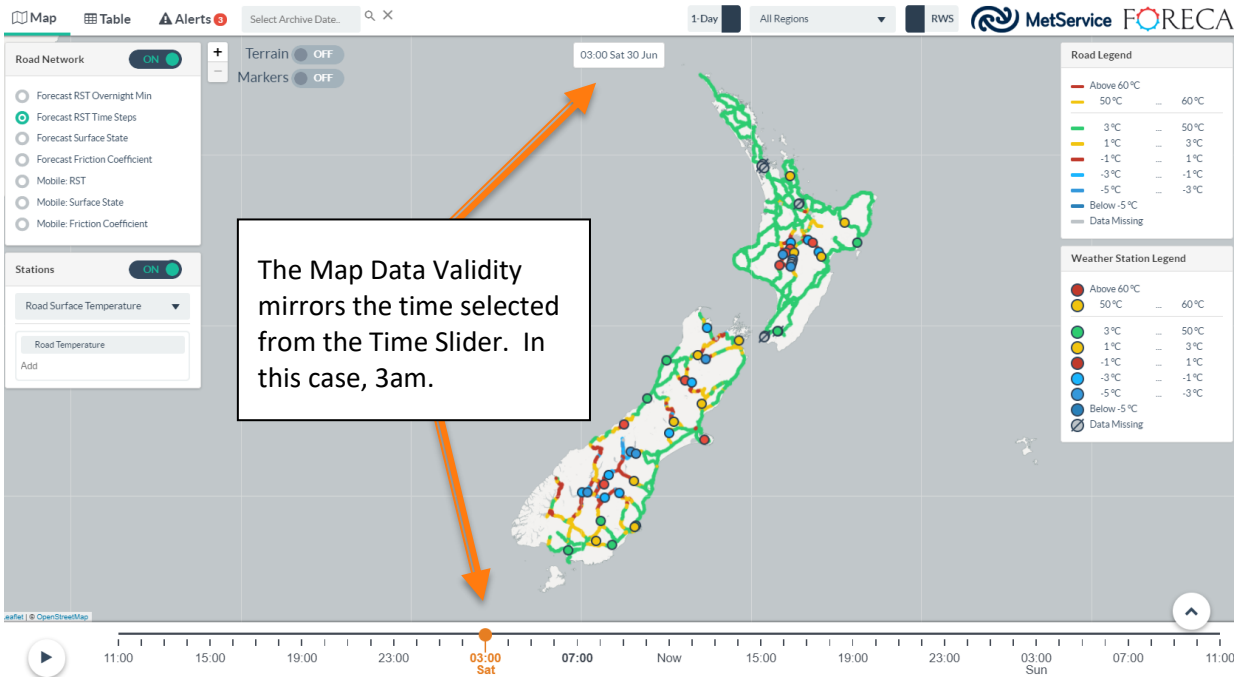


Above: 1-Day (above) and 3-Day (below) Road Status graphs for the same region. Note where 'Now' is located on both graphs (in the middle of the 1-Day and at the left of the 3-Day graph). Also, note the location of the orange 'overnight' period. 9pm to 9am on the 1-Day and for the entire forecast period on the 3-Day graph. Finally, note the wet spell starting midnight on Sunday on the 1-Day graph. The 3-Day graph has the same wet spell commencing at midnight but we can see how long it extends; in this case through until late Monday evening.

Map Data Validity

The time stamp at the top of the map page 

provides the validity of the map information.

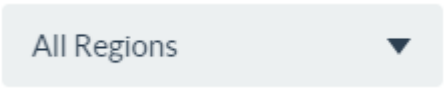


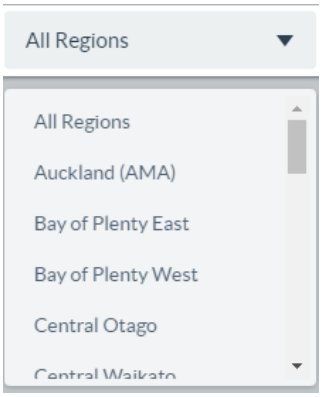
The Forecast RST Overnight Minimum displays the Map Data Validity as a range between 9pm and 9am (1-Day option) or the entire forecast period (3-Day option). Otherwise, the individual time step, as selected from the Time Slider is displayed.

Left to Right Above: Normal time step forecasts (1-Day and 3-Day), Overnight period, 1-Day, Overnight period, 3-Day

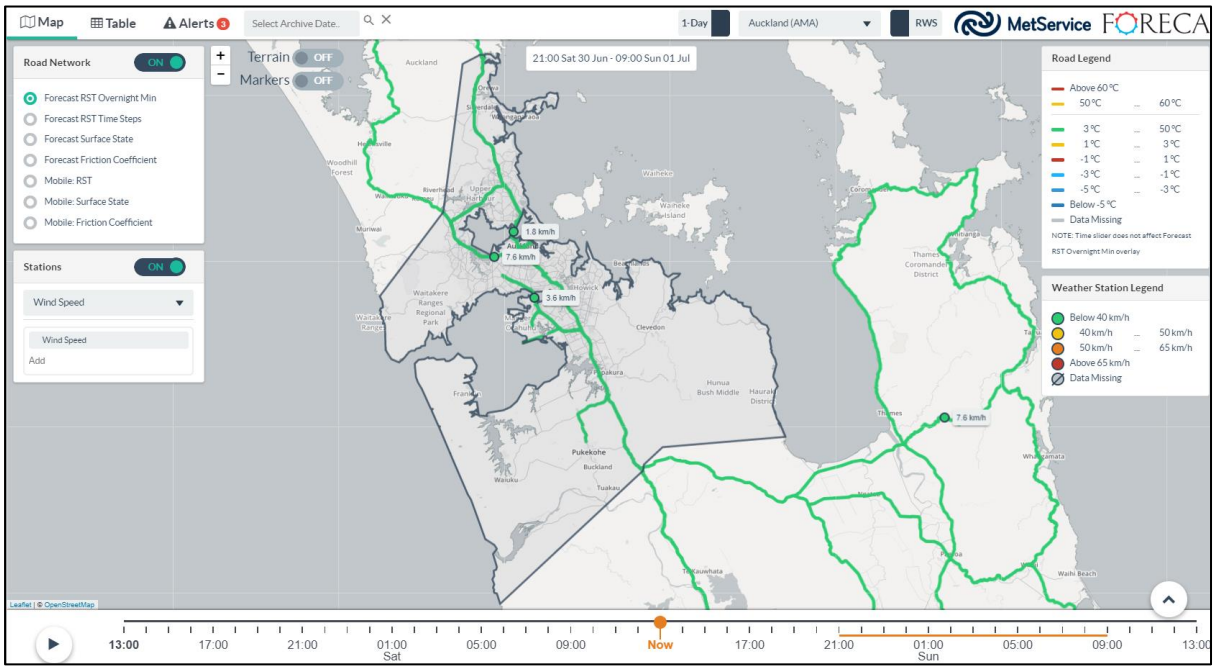
Region filter

This filter allows users to select an area of interest. The default region is all New Zealand; however, the user may click on this filter to display a list of all regions. These relate to NZTA NOC (Network Outcome Contract) regions, listed alphabetically.





Once a user has selected the region of interest, the region will be displayed on the map as a slightly darkened translucent region. In addition, if the Network Status Information (see page 6) is selected after the user has activated a Region Filter, the network status will change from displaying national information to display the status of the filtered region.



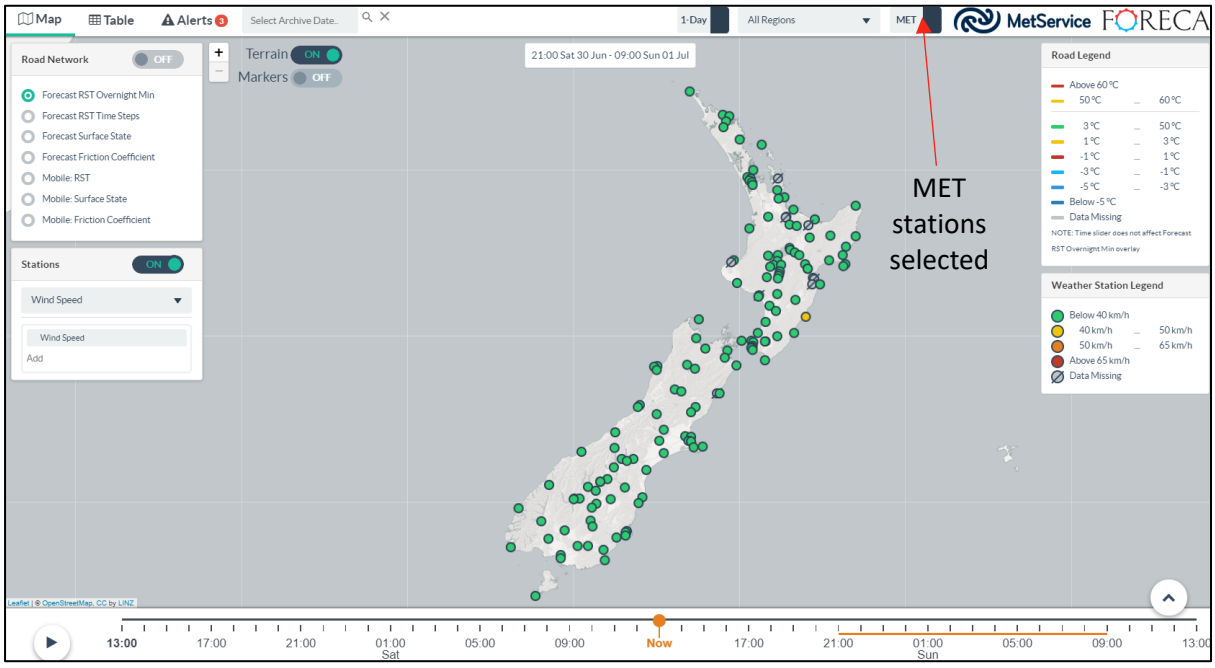
Above: Map with Auckland region activated.

MET/RWS filter

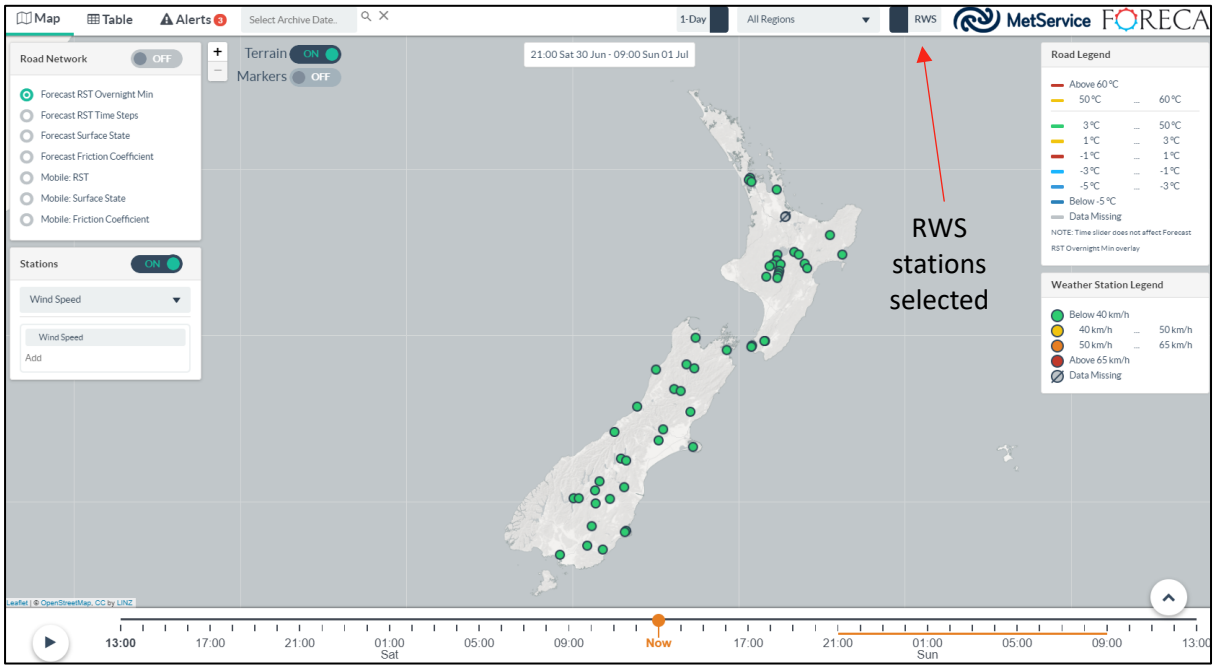
This switch allows user to display either all MET (MetService's) ~200 automatic weather stations on the map or the ~50 RWS (road weather stations) MetService has installed throughout the State Highway network.

Note, not all weather stations output a full complement of weather parameters. MET stations observe atmospheric weather conditions, whereas RWS sites generally observe both atmospheric and road weather conditions. The exception here is that some RWS stations have been installed at specific locations on the State Highway network known to have a specific weather hazard, for example, strong wind. Therefore, some RWS sites may record a subset of road weather conditions.

For more on weather stations, see the Stations section, page 31.



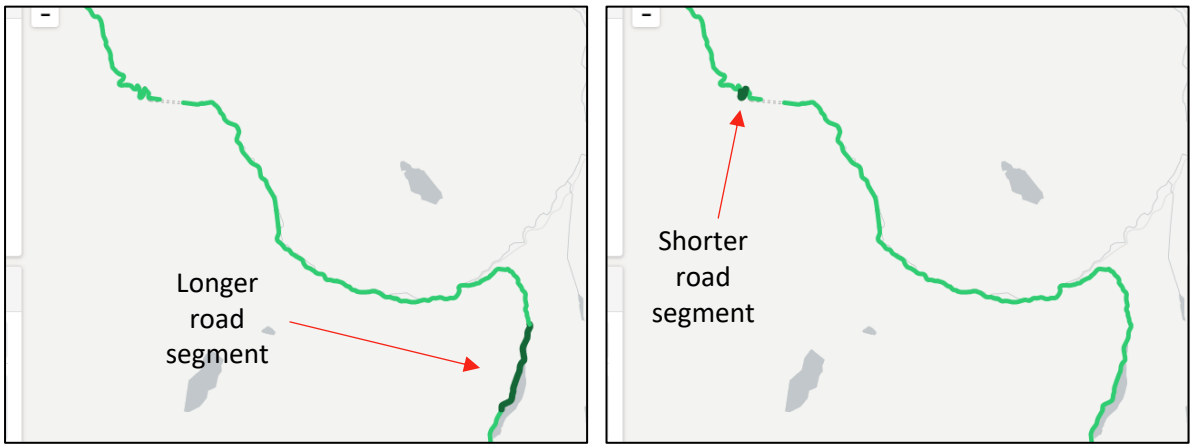
Above: MET filter activated. (Road Network road ribbon layer has been turned off).



Above: RWS filter activated. (Road Network road ribbon layer has been turned off).

A dynamic spatial resolution is utilised by the Road Weather System. This means that where we need to have more information, i.e. the road is passing through complex terrain, we have increased the number of forecast sections on the road. Where the road is running through a homogenous environment, e.g. flat plains, we have reduced the number of forecast sections. Forecast resolution varies from 5000m to 200m over the entire State Highway network and down to 30m in some key places.

The following two maps demonstrate the dynamic spatial resolution of the road ribbons.

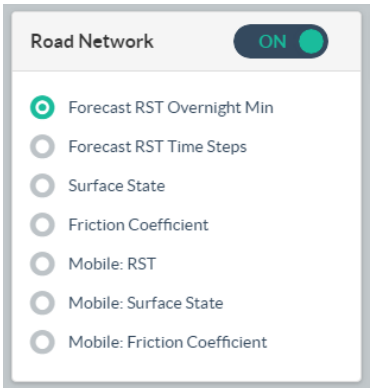


Above Left: Longer forecast segment in a homogenous environment.

Above Right: Shorter forecast segment in an area of twisting mountain road with a variable surrounding environment.

Road Network data

This is one of the main functions of the User Interface. It allows users to select from a range of road weather information layers, as coloured road ribbons as per the radio button selection list below:



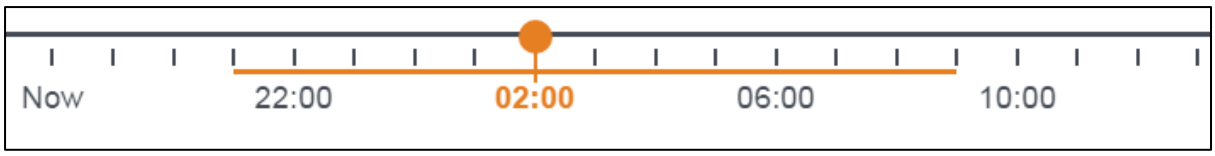
Users can decide if they wish to view the Road Network road ribbons at all. If they do not wish to view this data, they simply switch the toggle from ON to OFF. Users may wish to do this if they wish to only view the Station data, (see page 31) without the Road Network road ribbon layer being displayed on the map

Users may minimise the Road Network box itself by clicking on the Road Network box header. This applies for all text boxes on the main Map page and will allow for more screen real-estate to display road weather information.

There are currently seven different Road Network options for users to select from, as per the image to the left. The first four selections are available as standard road weather forecasts. The remaining three are mobile options and display data from the network of mobile weather sensors, installed on host vehicles.

Forecast RST Overnight Min.

If the 1-Day forecast option is selected, the map layer displays a forecast of the minimum overnight Road Surface Temperature (RST) as a coloured road ribbon**.** Note: The overnight forecast period is ***9pm to 9am*** and is shown by the orange line on the Time Slider scale at the base of the page:



Above: Time Slider for 1-Day Forecast RST Overnight Min forecasts, showing overnight period

If the user is looking at the Forecast RST Overnight Min before 9am, the forecast overnight period will be from 9pm the previous night to 9am that morning. If they are looking at the Forecast RST Overnight Min after 9am, the forecast period will be from 9pm tonight to 9am tomorrow.

If the 3-Day forecast option is selected, the map layer displays a forecast of the minimum Road Surface Temperature (RST) as a coloured road ribbon, over the ***entire three day forecast period***.

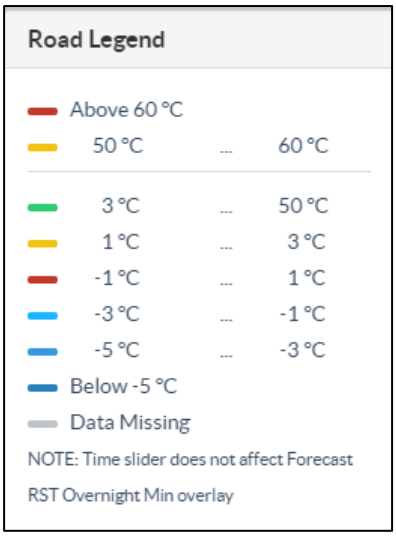
Above: Time Slider for 3-Day Forecast RST Overnight Min forecasts, showing forecast period

This forecast layer is useful for those users wishing to know just how cold it is expected to be overnight and which parts of the network are going to get coldest.

The Forecast RST Overnight Min will not inform the user WHEN the road is going to get cold. In order to ascertain when the coldest temperature is likely to occur, users utilise the Forecast RST Time Steps and station/virtual station meteograms.

As mentioned in the Road Legend, the Time Slider does not affect the Forecast RST Overnight Min road ribbon overlay.

The forecast road ribbon is coloured using the Road Legend colour scale. A green road ribbon means the overnight RST is expected to be above 3^0C (but below 50^0C). An orange road ribbon means the overnight RST is expected to be between 1^0C and 3^0C, while a red road ribbon means the overnight RST is expected to be between -1^0C and 1^0C. Any road ribbon that is blue means the overnight RST is expected to be colder than -1^0C.



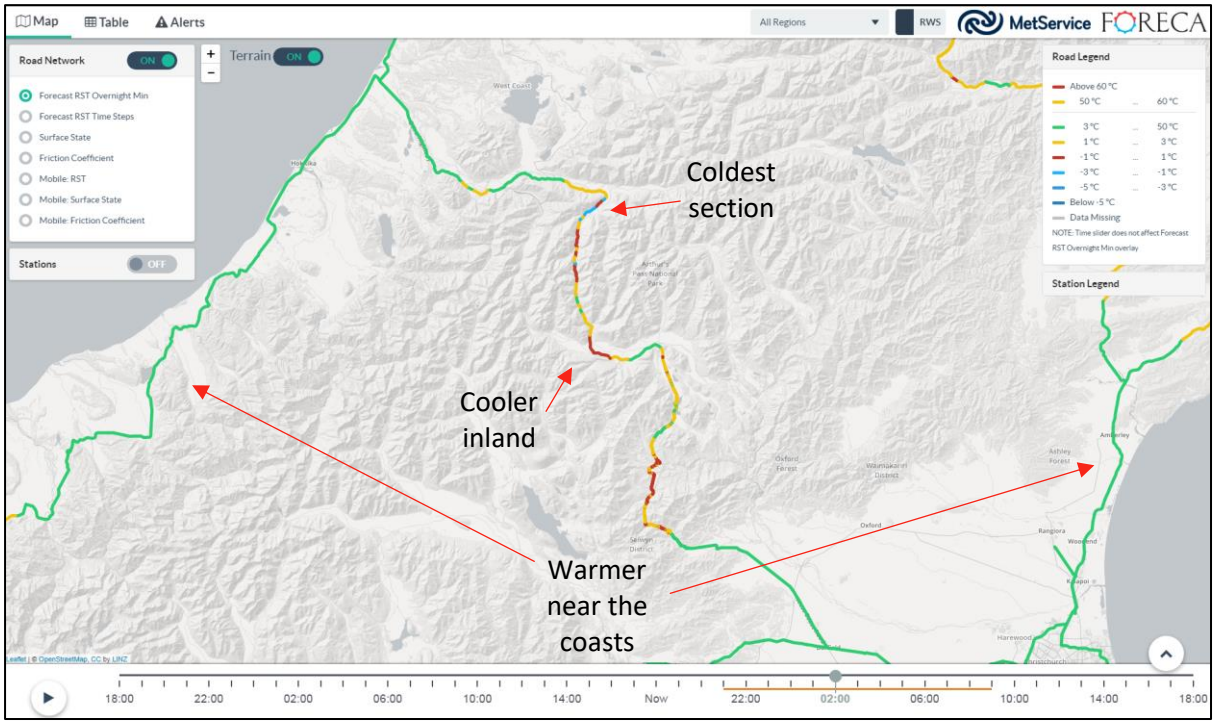
Above: Road Legend: Road Surface Temperatures

We have added second orange and red temperature scales for Road Surface Temperatures above 50^0C to assist with summer-time road bleed and potential tyre delamination issues.

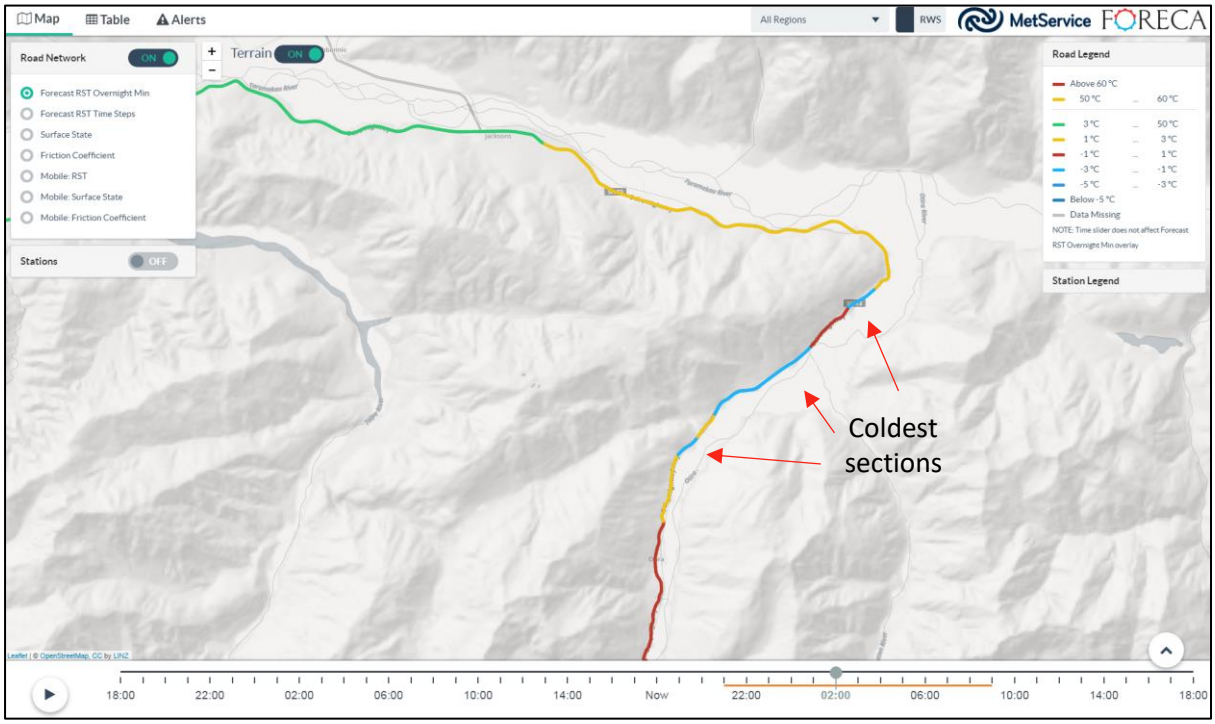
Note: different colour palettes may be used for different weather parameters.

In the screenshot below of SH73 from Christchurch to the West Coast, there are a few points of note.

1. The coastal roads on the West Coast and on the East Coast, extending into the Canterbury Plains are remaining warm (above 3^0C). However, once the road passes into the inland foothills, the RSTs cool down.
2. The coldest section of the SH73 is that part of the road ribbon that is coloured blue (to the east of Jacksons).
3. The resolution of the forecasts on SH73 over Porters Pass is particularly high. Porters Pass is one of the passes we are utilising 30 metre high resolution forecast sections. This means there is a discrete forecast section every 30 metres on the road. This level of forecast resolution means we can pick up smaller scale changes in the road environment. We are utilising 30 metre resolution forecasts at other parts of the network, such as Lewis Pass, Desert Road, the Crown Range Road and parts of the Central and Coastal Otago network. All other parts of the network have a forecast resolution of between 200-5000m.



Above: Forecast RST Overnight Min. SH73.



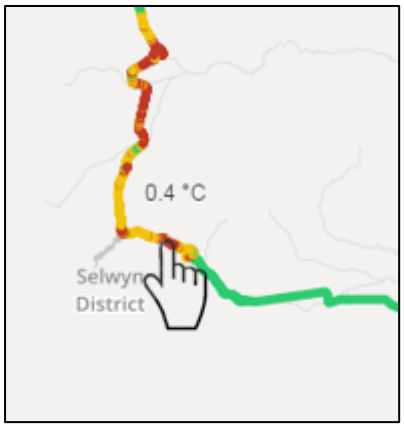
Above: Forecast RST Overnight Min. Zooming in on the coldest section of the road, just east of Jacksons on SH73.

Forecast RST Time Steps.

Users utilise Forecast RST Time Steps to ascertain the current, past and future road surface temperature of any part of the State Highway network in hourly time steps.

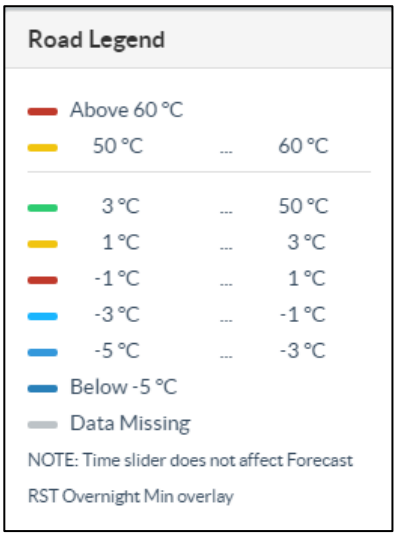
The Forecast RST Time Step map defaults to 'now'. Forecasts or hindcasts of the road surface temperature are available hourly going ahead and backward 24 hours (1-Day option) or going ahead three days in three-hourly steps (3-Day option).

If the user drags the orange dot on the Time Slider at the base of the page to the left of 'Now', or clicks on a time to the left of 'Now' (1-Day option) they will see a hindcast (a past forecast) for that time. Similarly, if they drag the orange dot to the right of 'Now' or click on a time to the right of 'Now', they will see a forecast of the road surface temperature for that time.



The colour of the road ribbon represents the road surface temperature, as per the Road Legend.

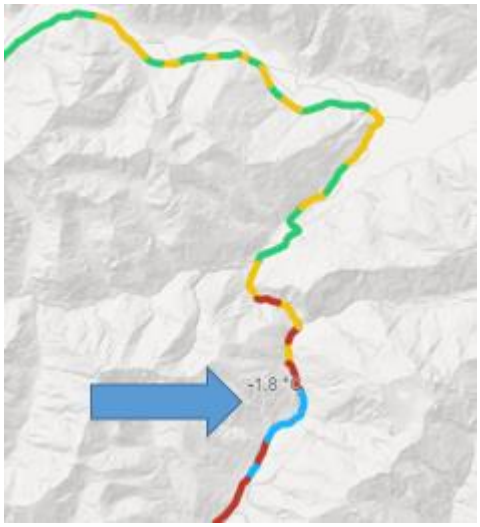
To ascertain the road surface temperature at a specific point on the map, the user can mouse over the road ribbon at the point of interest. A pop up text box displays the forecast RST value.



Above: Mouse-over RST values.

Above: RST Legend

Looking at a section of SH6, near Haast Pass, the Forecast RST Overnight Min map informs us a section of the road just to the south of the Gates of Haast is expected to get down to -1.8 °C. But at what time does this occur?

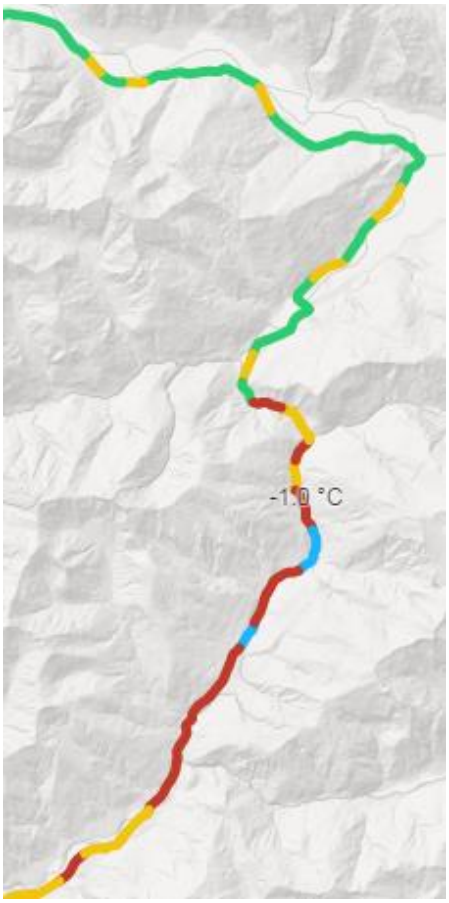


There are several ways to ascertain this. One way is to use the Forecast RST Time Steps.

'Now' (4pm), the RSTs are all ≥3°C

By 6pm, RSTs are starting to cool. RST 2.1°C

By midnight RST cools to 0.7 °C



By 3am RSTs have cooled to -1.0 °C. First sub-zero RST of the night on this section of road.

By 5am RSTs have cooled to -1.8°C. This is the coolest RST of the night.

By 9am RSTs are warming due the influence of sun. But there is still a cool spot at 1.4 °C.

By 11am RSTs are all ≥ 3 °C and our problem location is now 7.5 °C.

The sun is now impacting on all parts of the road.

There is another way to tell when the road is expected to freeze.

While we do not have observation points at every point of interest on the State Highway network, we have many forecast sections, spread throughout the State Highway network. These sections range in size from 5000m down to 30m. This means we can activate a '**Virtual Station**' for any section of the road to ascertain hindcasts and forecasts for this point of interest.

Simply click on the road ribbon at a point away from a road weather station to display the Virtual Station for that point.

Below is the Virtual Station for the same section of the Haast Pass, near the Gates of Haast on SH6.

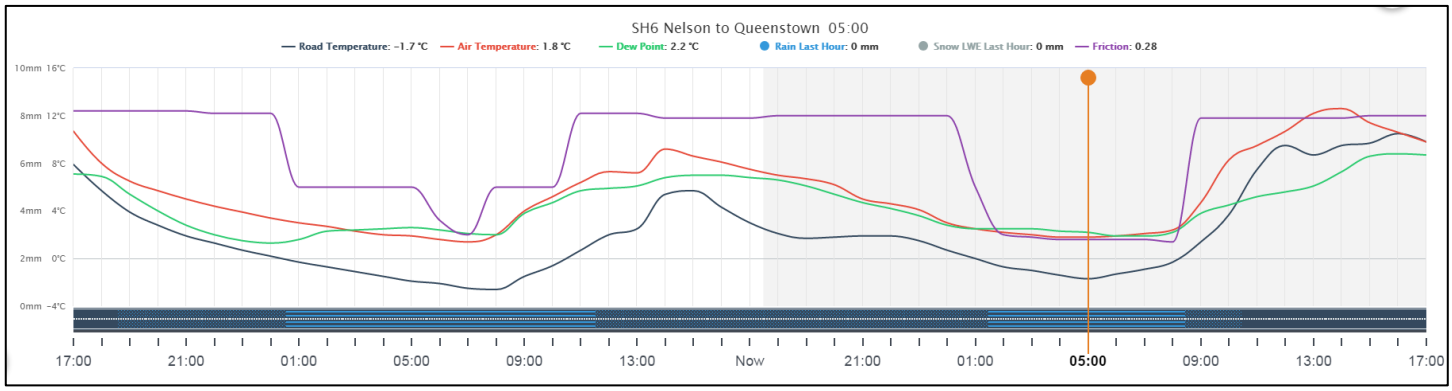
The shaded portion of the graph (right hand side) indicates these are the future (forecast) conditions. The left-hand side of the graph (unshaded) indicates the hindcast for the same location, i.e. forecast conditions before now.

The forecast values are provided for the each of the Virtual Station parameters at the top of the graph.

On the graph, the purple line is Friction (note how it drops when Ice Development is forecast on the road); the red line is the air temperature; the green line is the dew point and the **black line** is the Road Surface Temperature.

From this graph, we can see the RST falls below 0 °C at 1am tomorrow morning and remains sub-zero until about 8:15am.

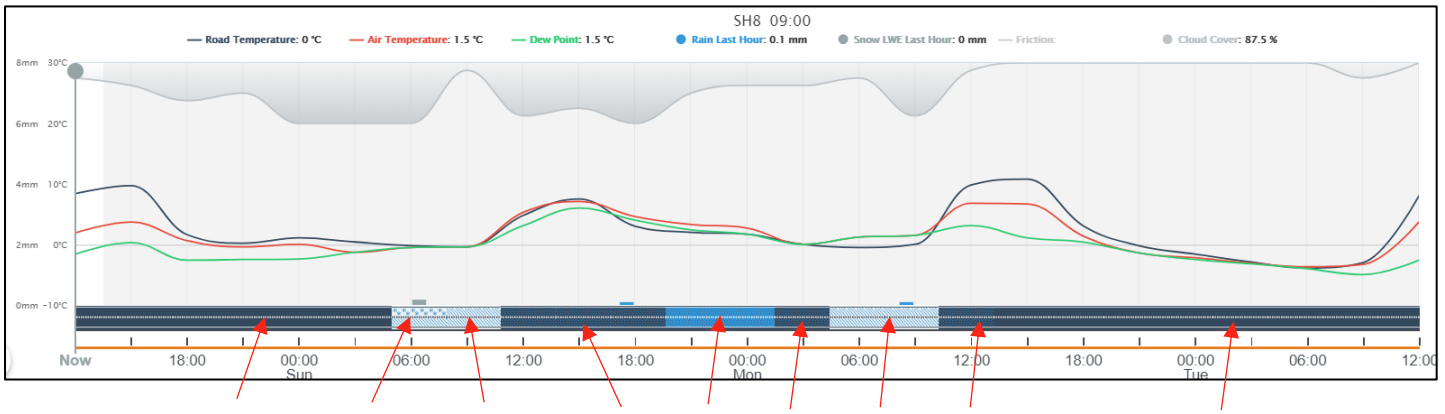
Also note, for most of the period on the graph, the air temperature has cooled to the dew point, resulting on dew forming on the road. See road strip below the graph. Dew first forms on the road from 6:30pm the previous day. Dew continues to deposit on the road during that evening, until the RST passes through 0 °C. At this point we see Ice Development on the road. This remains on the road until the sun heats the road the following morning. At this time, the RST rises through 0 °C and any ice on the road melts to dew. The road remains dewy for the remainder of the day (because the air temperature and dew point are similar) and when the RST drops below 0 °C again, this time at 1am, Ice Development is displayed on the road strip. The road warms again the next morning, passing through 0 °C at 8:15am and the ice becomes dew at 8:30am. The air temperature and dew point drift apart at this point and the road starts to dry. It becomes dry at 1030am and remains dry for the rest of the day.



DRY DEW ICE DEVELOPMENT DEW ICE DEV. DEW DRY

Above: Virtual Station (1-Day option) for a section of SH6 near the Gates of Haast.

In the example below (3-Day option), we show a mixture of road states. Dry, snow fall, snow on pavement, moist, wet and ice/frost throughout the three-day forecast window.



DRY SNOW FALLING SNOW ON PAVEMENT MOIST WET MOIST ICE/ FROST MOIST DRY

Above: Virtual Station (3-Day option) for a section of SH8 near the Tekapo.

Users can click on the 'Now' button on the Time Slider to refresh station measurements and show the latest data. This mode is activated for approximately 15 minutes. This functionality also works in the Table view.

If you notice the 'Now' button has changed from the normal orange colour to grey, simply click on the 'Now' button to refresh the data.

Above: 'Now' button on Time Slider.

Surface State.

The forecast Surface State road ribbon works in the same way as the forecast RST road ribbon but instead of road surface temperatures, the road ribbon displays a range of forecast road states, from dry road to dew/moist, wet road, snow, ice and freezing rain as per the Road Legend to the right.

The definitions of each of these Surface Road States follow:

Dry (excluding seepage)

No significant conditions. No or insignificant amount of all forms of water. No dew formation, frost formation, snowfall or icing rain. Seepage is not modelled.

Dew/Moist

Water condensation has formed on the road from the saturated air above the road. Road surface temperature is above the freezing point.

Wet

Significant amount of water on the road but no or insignificant amount of snow and ice.

Snow Melting

Snow falling, but melting on the road surface as the road surface temperature is above the freezing point.

Snow Falling

Snow falling and accumulating on the road surface with road surface temperature below the freezing point (not melting). No ice, or only insignificant amount.

Snow on Pavement

Significant amount of snow on the road but no or insignificant amount of ice. No solid precipitation at the moment.

Ice Development

Frost deposition from air is forming on the road or liquid water on the road is freezing into ice.

Ice and Water

Significant amount of both ice and water on the road.

Ice/Frost

Significant amount of ice on the road but no water. Frost on icy or dry surface is considered ice.

Freezing Rain

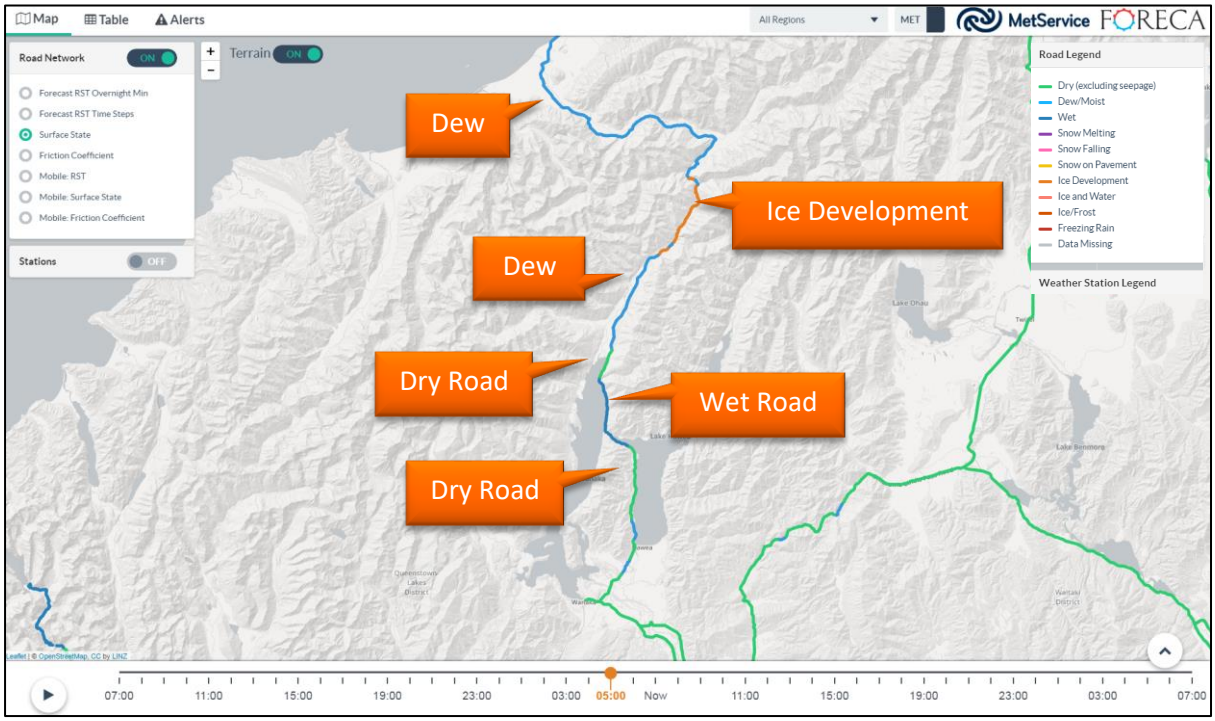
Liquid precipitation on a road surface with a road surface temperature below the freezing point.

The Time Slider at the base of the page can be used to view forecasts of the road state with respect to time. Move the orange dot, or click on a time to the right of 'Now' to view future road states, or to the left of 'Now' for a hindcast of the likely conditions before now (1-Day option).

As per the RST forecast road ribbons, users can zoom in and out of the map for more detail and a mouse-over function provides a text description of the road state if the user hovers the mouse over the road ribbon.

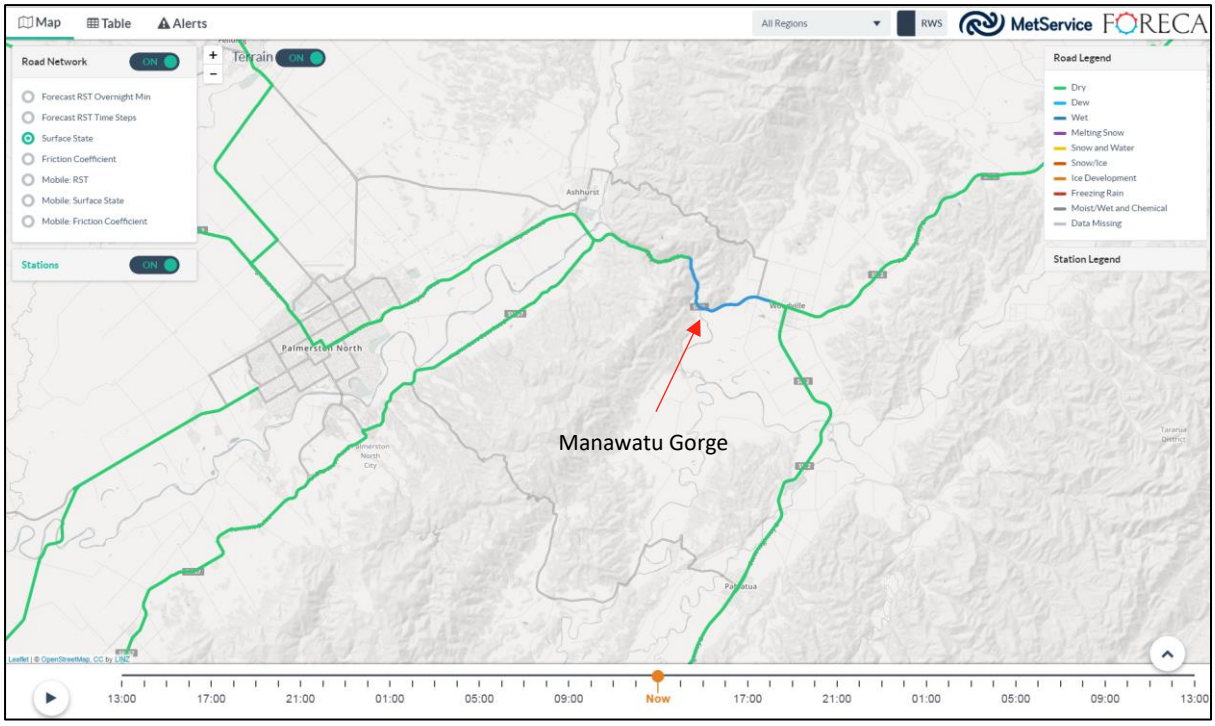
Road state forecasts are provided in hourly temporal resolution (1-Day) and three-hourly temporal resolution (3-Day) thus enabling the user to ascertain how the state of the road changes on an hour by hour or three-hourly basis.

The following section of road (SH6) has several different surface states.



Above: Surface State forecast road ribbon showing several different surface states.

Like the RST road ribbons, high levels of detail can be seen on the forecast road state map. In this case, below, dew is forecast for the Manawatu Gorge, SH3 east of Palmerston North due to the lack of available sun (heating) on the road through the Gorge.



Above: Surface State forecast road ribbon showing dew on the road, Manawatu Gorge.

See the Network Status Section (page 6) for an alternative method of ascertaining the network status in terms of Road State.

The Road Weather System is aware of the location of bridges in the State Highway network and the impact the proximity of water and bridge construction plays in the forecast of road weather conditions. This is particularly evident where we are running the very high resolution (30 metre) road weather forecasting service.

In the following example, let's look at a bridge over the Porter River, on SH73.

Right: Single land bridge over the Porter River, SH73.

The first screenshot highlights a small section of road leading to the southern side of the bridge over the Porter River.

The RST at this point is 0.6 ºC and the corresponding road condition is 'Dew'.

However, if we select a road segment from the road ribbon that represents the bridge itself, the model is of sufficient resolution to recognise the difference from the adjacent road.

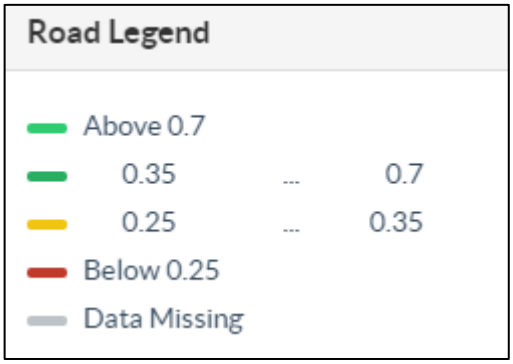
The RST on the bridge is -1.6 ºC and the Surface State is Ice Development, showing us the dew is forming into ice at this location.

Above: Road adjacent to Porter River bridge has an RST of 0.6 ºC and has a Surface State of 'Dew'.

Above: Bridge over the Porter River has an RST of -1.2 °C and has a Surface State of 'Ice Development'.

Friction Coefficient.

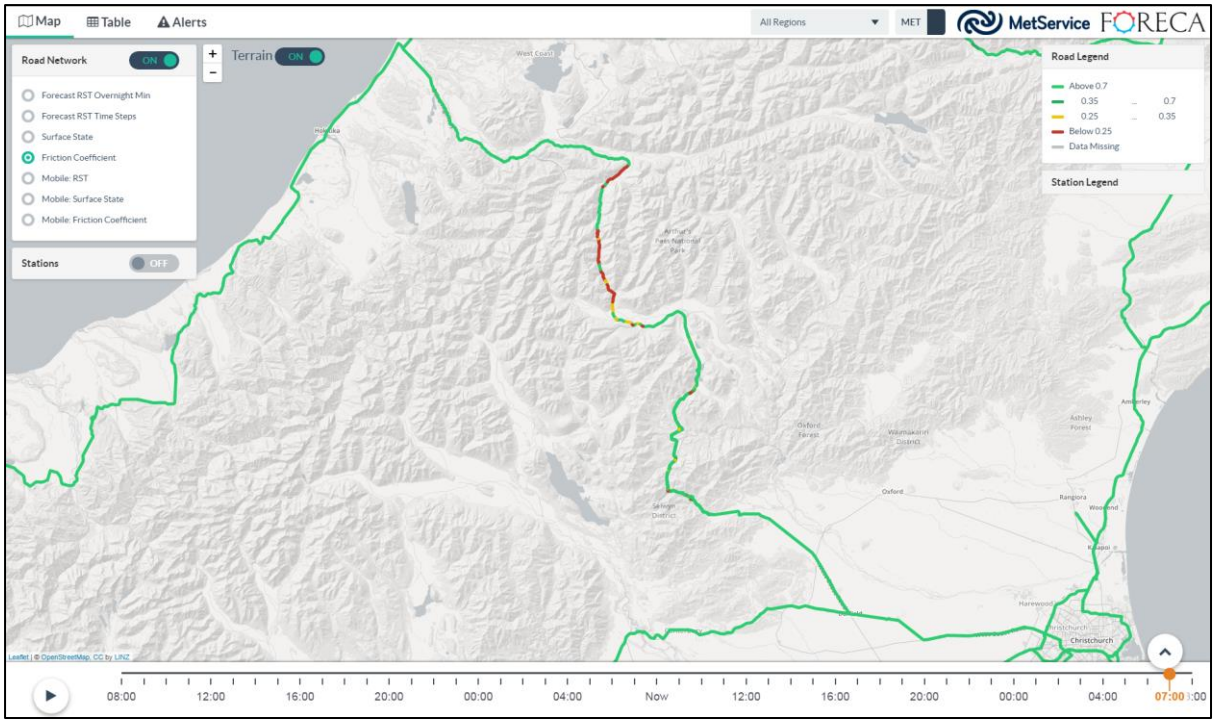
This is another forecast road ribbon, that is presented in the same way as the Road Surface Temperatures and Surface State. Friction Coefficient is a measure of the 'stickiness' or 'slipperiness' of the road and is measured as a coefficient ranging from 0 to 1, where 1 is the stickiest and 0 is the slipperiest.



We use light green to depict what is regarded as a safe road in terms of slipperiness, i.e. anywhere with a Friction Coefficient of more than 0.7. A darker green is

used when the Friction Coefficient is expected to be between 0.35 and 0.7 (typically due to rain) and orange when we expect the Friction Coefficient to be between 0.25 and 0.35 (typically some solid form of water, i.e. ice is required). Red is used when we expect the Friction Coefficient to be less than 0.25 (i.e. poor friction with ice).

The following screen shot displays a range of different Friction Coefficients on SH73 from Christchurch to the West Coast.



Above: Friction Coefficient forecast road ribbon showing a range of values on SH73.

As per the RST forecast and Surface State road ribbons, users can zoom in and out of the map for more detail and a mouse-over function provides a text description of the Friction Coefficient if the user hovers the mouse over the road ribbon.

Friction Coefficient forecasts are provided in hourly (1-Day option) and three-hourly (3-Day option) temporal resolution thus enabling the user to ascertain how the friction of the road is expected to change on an hour by hour or three hour by three hour basis.

The Friction Coefficient is a highly non-linear but continuous function of water layer depth, ice layer depth and road surface temperature. The Friction Coefficient uses a statistical formula that takes water, ice/snow layer thickness and road surface temperature into consideration and outputs a statistical connection. We would be happy to modify this statistical connection to reflect information gained from recent New Zealand scrim testing although initial testing has resulted in a close correlation.

Note: The friction formula is not necessarily 100% in sync with the discrete road Surface State road ribbons as it is continuous function based on water/solid on road and temperature at the time. The Surface State condition road ribbons result from the median of the forecast between the time steps. Thus, it is possible to see apparently mismatched Surface State and Friction Coefficient road ribbons.

Mobile: RST, Mobile Surface State, Mobile Friction Coefficient

One of the benefits of the Road Weather System is we can display weather data from mobile weather sensors of our choice within the User Interface.

Mobile weather sensors are devices that are fitted to a vehicle, normally by way of a strong magnetic clamp in such a way that the unit is directed towards the road surface. Power is provided via a standard 12V cigarette lighter socket. Once fitted, the unit detects a range of weather parameters and sends this information via blue tooth to a mobile telephone that is supplied with the mobile unit. As the vehicle is driven along the road, weather parameters are recorded and displayed in near real time or historically via the Road Weather System interface. Cellular communications are used to deliver the data for processing in real time and display. If cellular communications are not available at a particular location, the data is stored until such a time as communications are available.

We will be looking for host vehicles to install these mobile sensors on. If your business is interested in hosting a mobile weather sensor, please let us know.

We are aware there are a wide range of mobile weather units available to the market. We therefore carried out a test of a number of these units in order to ascertain which are most suitable for use in the New Zealand environment and on New Zealand roads. Our testing against other mobile units and also against our own in-situ road weather stations confirmed the Teconer range of mobile road weather units are not only best performing but also the easiest to install and most efficient to run operationally.

We have selected a basic and advanced unit to deploy in New Zealand. As well as unit direction and location, the basic unit can record:

- Air temperature
- Road surface temperature

Above: Basic mobile road weather sensor

As well as unit direction and location, the advanced unit can measure:

- Air temperature
- Road surface temperature
- Friction
- Water/ice thickness on road
- Surface state
    - dry
    - moist
    - humid
    - wet
    - ice
    - snow
    - slush

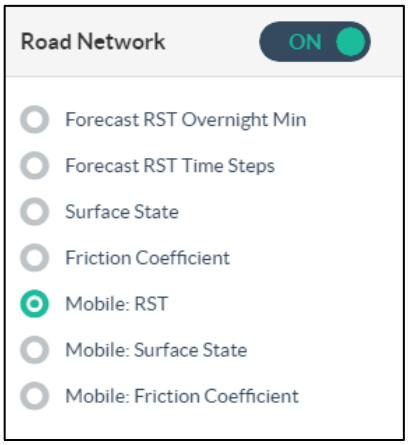
Above: Advanced mobile road weather sensor

Both units can also record (through the mobile phone) photographs of the road surface at preselected intervals or preselected locations, however this capability is not yet built into the Road Weather System.

In the same way users can select other road ribbon layers, they can also select a range of mobile weather sensor information from the Road Network selection panel, as follows:

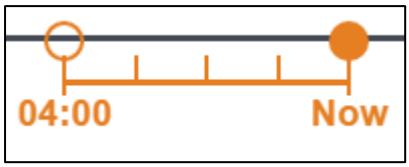
- Mobile RST
- Mobile Surface State
- Mobile Friction Coefficient

The Mobile RST, Surface State and Friction Coefficient road layers each have a slightly different mechanism on the User Interface to display data. The Time Slider has a *Journey Start Point* indicator, depicted by an open orange circle and a *Journey End Point* indicator, depicted by a solid orange circle. In order to view the mobile weather data over a certain period, simply click the mobile weather parameter you are interested in on the Road Network selection panel (RST, Surface State or Friction Coefficient) and then move the Journey Start Point Indicator to the left the number of hours you are interested in. You can define the Journey End Point in the same way.



Above: Road Network selection panel, showing the three Mobile Road Network layers.

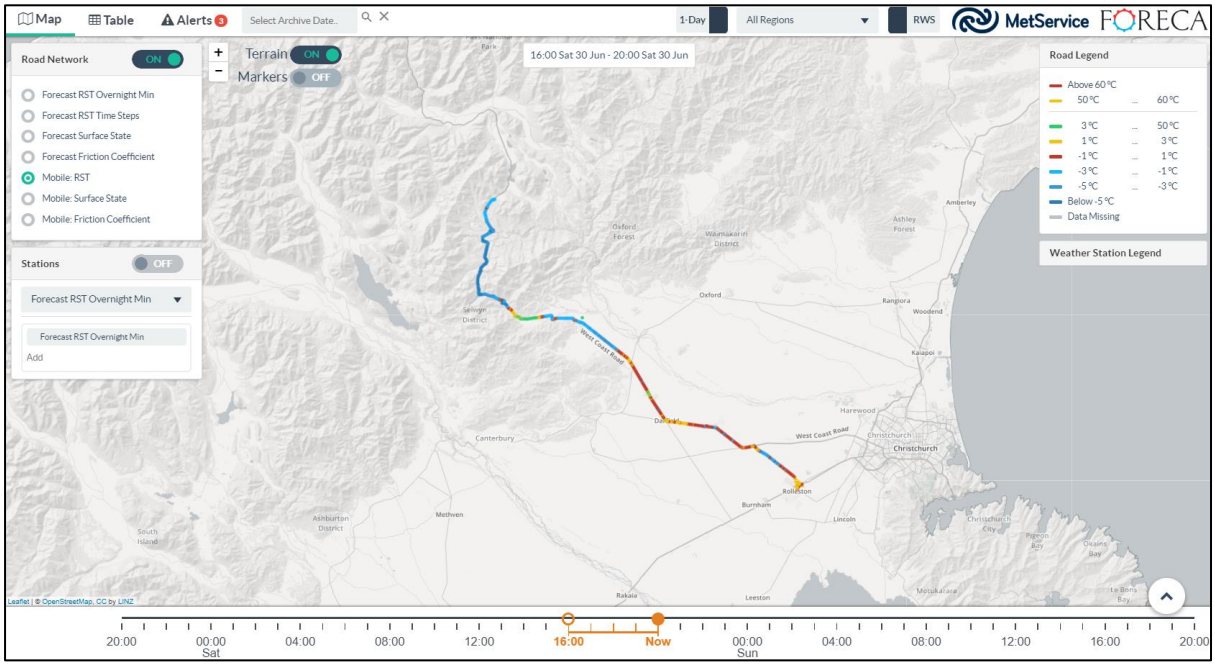
In the example below, the user has selected to view mobile data from 'now' back four hours to 4am.



Above: Mobile data Time Slider

In the following example, a vehicle fitted with a mobile weather sensor has travelled on SH73 from Rolleston to the Craigieburn Forest area.

The screen shot below shows Mobile RST data from the period 'now' back 4 hours; i.e. a journey that took place between 4pm and 8pm. This is confirmed by the time stamp at the top of the map. The road ribbon is coloured, as per the standard RST Road Legend colouring. Mouse-over data is available, just as it is for the other road ribbon data.



Above: Mobile RST data

The mobile data provides a high level of detail, as can be seen by the image below; a zoomed in screen shot of the same journey.

Above: Mobile RST data - zoom

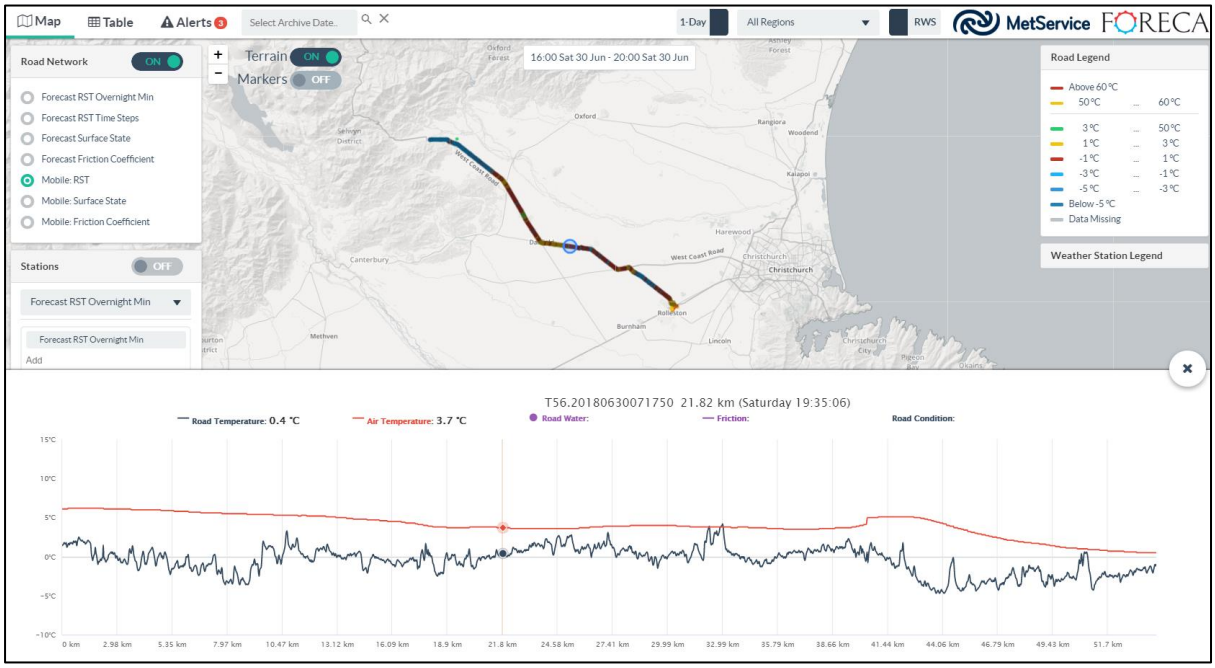
If a vehicle is fitted with an advanced mobile weather sensor, the mobile surface state and mobile friction coefficient road ribbons are displayed in the same manner.

If a user clicks on any part of the Mobile road ribbon, the selected route will be highlighted on the map and a meteogram showing the observed mobile weather parameters over this section of the journey will be displayed under the map.

The start of the journey is at the left-hand side of the graph and the end of the journey is at the right-hand side of the graph. Distance markers are placed at along the lower x-axis.

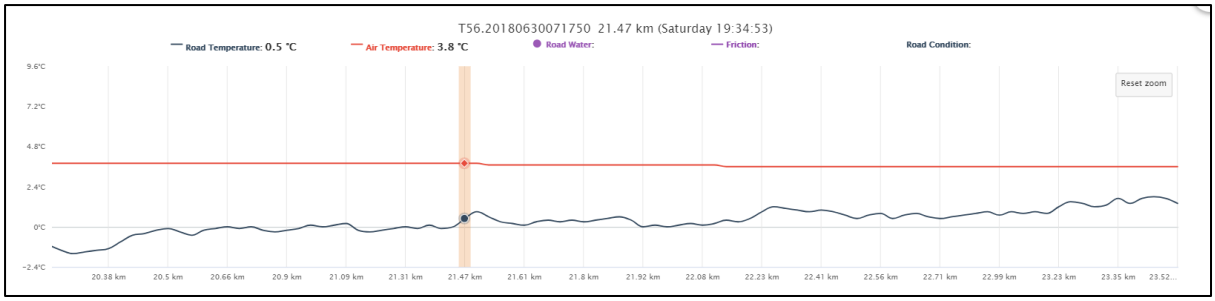
All received mobile weather parameters are plotted. In this case just road temperature and air temperature are plotted. However, if an advanced mobile weather sensor was in use, other parameters, such as friction, road water depth and dew point would be visible.

As the user moves their mouse over the meteogram, the observed mobile weather parameters change at the top of the graph in accordance with the location the user is hovering over. In addition, a small blue circle is placed over the route on the main map to depict where the data was recorded.



Above: Mobile weather data

In order to view the meteogram data in higher detail, users can left-click and drag over a section of the graph they are interested in – then release. The graph will zoom in to the selected area on the meteogram. Click the Reset zoom button to return to the original meteogram.

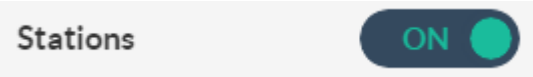


Above: Mobile weather data – zoom.

Stations

This section is used to view observed and forecast data from the MetService network of in-situ Automatic Weather Stations (AWS).

To view the AWS data, click the Station on/off toggle to 'on'.



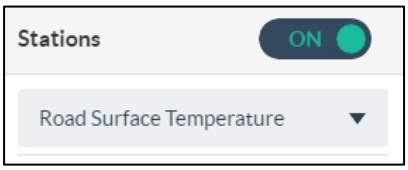
Users can choose to view the Station data with or without the Road Network data layer. For the purposes of clarity, we will turn the Road Network data layer off.

Next, users can choose to view Station data from the entire MetService network of ~200 AWS units (MET) or to view the smaller network of ~50 Road Weather Stations (RWS). Users make this selection by clicking the MET/RWS toggle at the top of the page.

Users can identify the Stations by hovering their mouse over the Station Dot on the map.

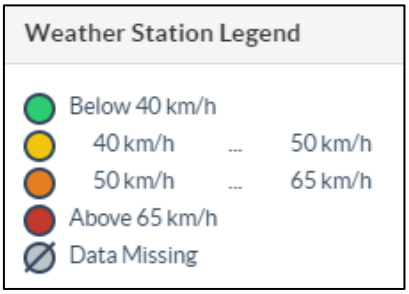
The Station Dots are coloured per the parameter selected from the Station Colour menu. The choices in the Station Colour menu are currently:

- Forecast RST Overnight Min
- Road Surface Temperature
- Road Surface State
- Friction
- Air Temperature
- Wind Speed
- Max Gust Last 10min
- Precipitation Last Hour

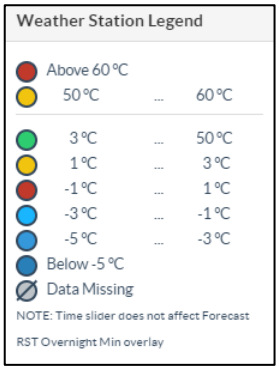


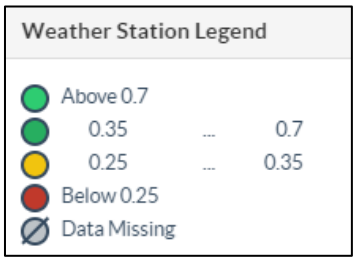
Above: Station Colour menu, showing Road Surface Temperature as the selected parameter.

In the following screen shot, the user has selected Wind Speed from the Station Colour menu. You will note all stations have a green dot other than Cape Reinga (Far North of the North Island) and Brothers Island (Cook Strait). When wind speed is selected from the Station Colour menu, the Station Legend changes to display a range of wind speeds. Cape Reinga and Brothers Island are coloured orange because the wind speed at these two locations is higher than the other sites.

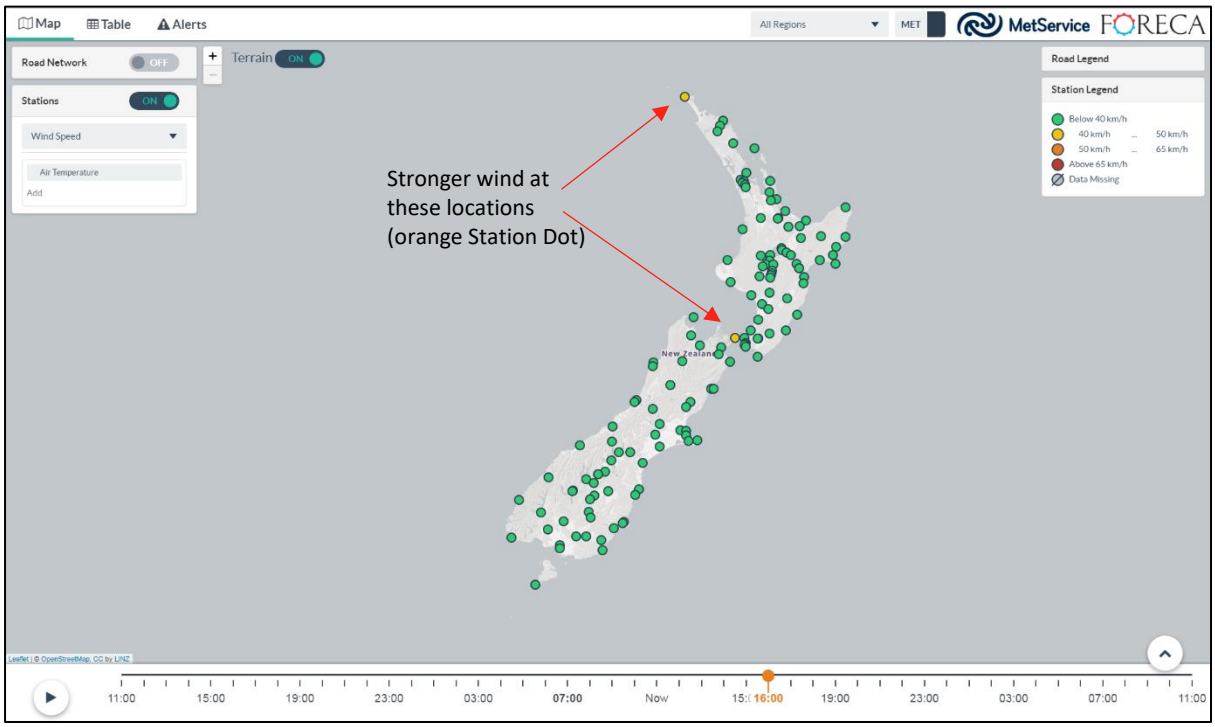


Above: Weather Station Legend for Wind Speed and Max Gust



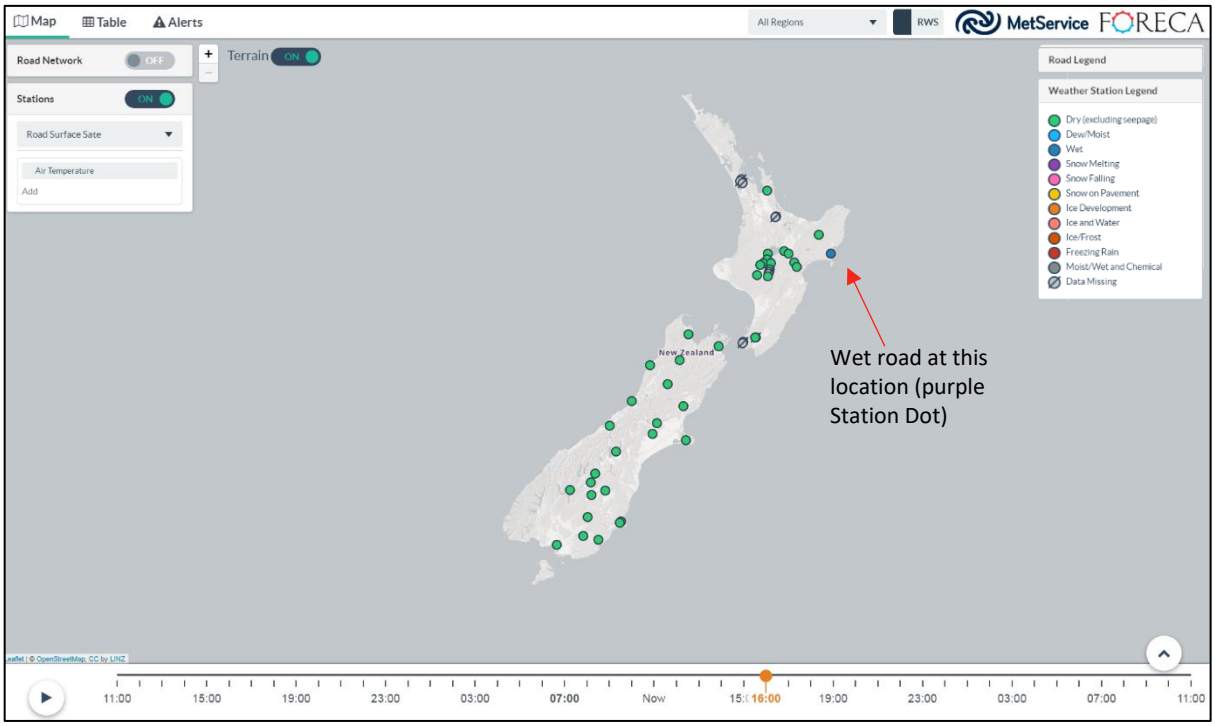


Above: Left to Right: Weather Station Legends for RST, Surface State and Friction



Above: Map showing all MET Station sites. Wind Speed has been selected from the Station Colour menu. Note Cape Reinga and Brother Island have stronger winds than all other stations. (They have an orange Station Marker).

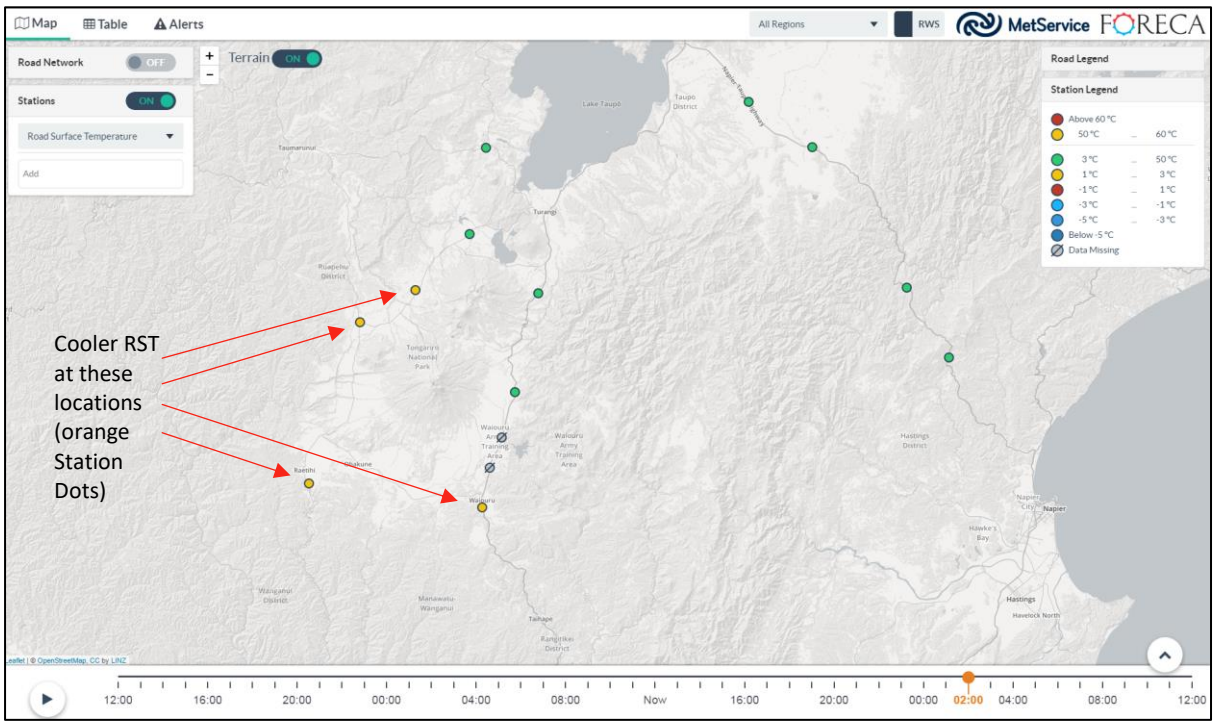
In the following screen shot, the user has selected Road Surface State from the Station Colour menu. You will note all stations have a green dot (or a grey missing icon, as this station doesn't report the selected parameter) other than Wharerata near Gisborne. This is because all stations are reporting a dry road (green Station ID) and Wharerata is showing a purple Station ID (wet road).



Above: Map showing RWS stations only. Road Surface State has been selected from the Station Colour menu. Note Wharerata is the only station showing a Road Surface State that is other than dry.

In the following screen shot, the user has selected Road Surface Temperature from the Station Colour menu. You will note all stations have a green dot (or a grey missing icon, as this station doesn't report the required parameter) other than Waiouru, Raetihi, National Park and Mangatepopo Road. This is because all stations are reporting RSTs of 3°C and above (green Station Dot) other than Waiouru, Raetihi, National Park and Mangatepopo Road. These are showing an orange Station Dot (RST between 1°C and 3 °C).

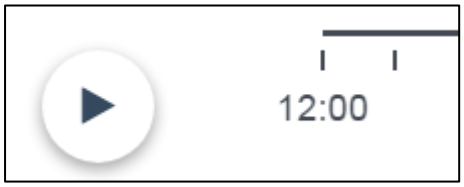
Two stations are displaying missing data; Waiouru North and Aqueduct Hill. This is because these are smaller stations and do not have a road surface temperature probe. They were installed primarily to observe wind speeds and locations known to be particularly windy.



Above: Map showing RWS stations only. Road Surface Temperature has been selected from the Station Colour menu. Note four stations are reporting cooler RSTs.

The Time Slider at the base of the map is used to display either observed Station parameters (from 'Now' and to the left of 'now' (1-Day option) or forecast Station parameters (to the right of 'Now'). Users can either drag the orange Time Slider button to the time of interest, or they can click on the time of interest to view data for that particular time.

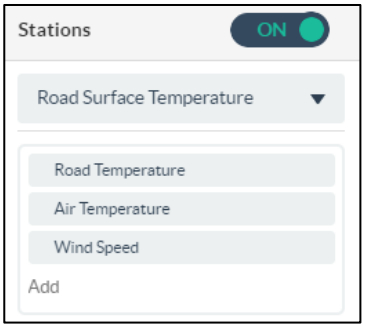
Users may also click the 'play' button to the left of the Time Slider to automatically advance the Time Slider.



Above: Time Slider Animator

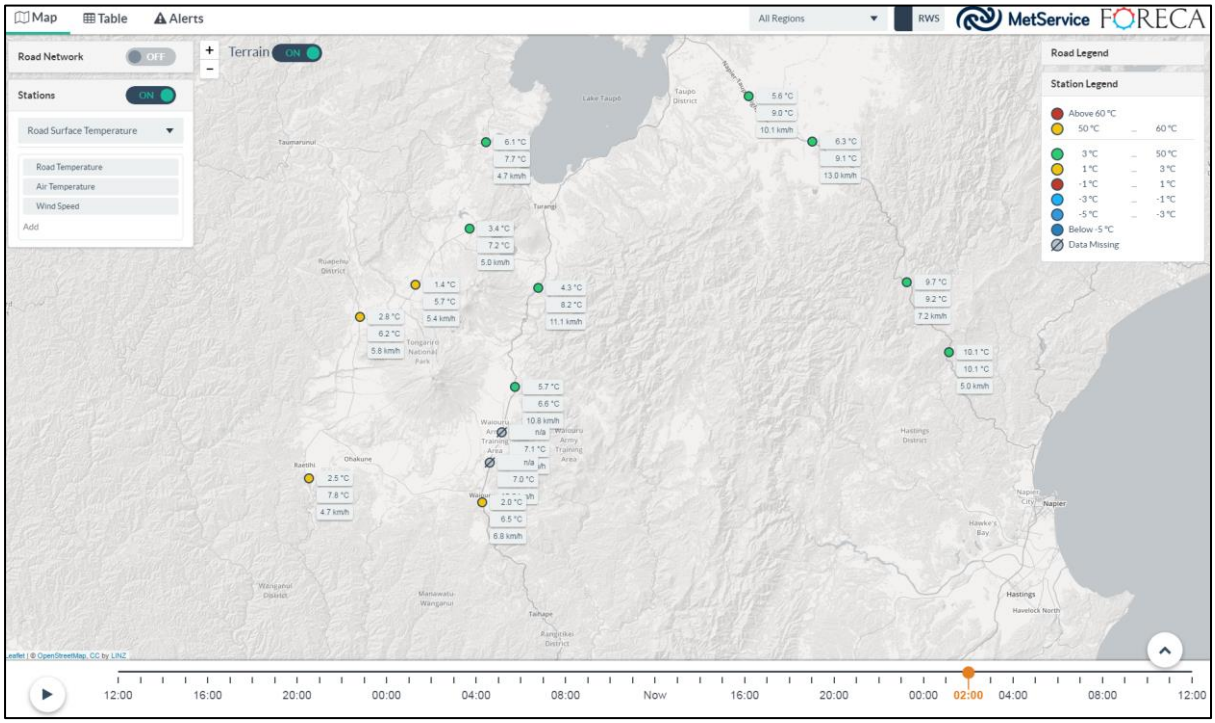
Users can add up to three weather parameters (observed or forecast, depending on the location of the Time Slider) to the Station Dots on the Map screen. On the screen shot below, the user has selected road temperature, air temperature and wind speed to be displayed alongside the Station Dot, which is displaying Road Surface Temperature (selected from the Station Colour menu).

Users can select up to three items from the following list of weather parameters to display alongside the Station Dot from the Data Labels section:



Above: Data Labels selection.

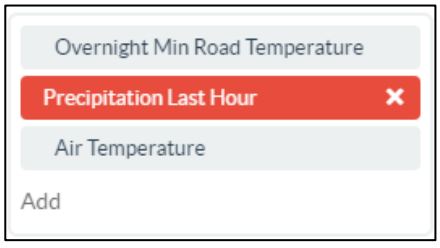
- Forecast RST Overnight Min
- Road Temperature
- Air Temperature
- Dew Point
- Base Temperature
- Conductivity
- Freeze Point
- Relative Humidity
- Rain Last Hour
- Snow LWE (Liquid Water Equivalent) Last Hour
- Road Water
- Wind Speed
- Max Gust
- Wind Direction



Above: Map showing RWS stations only. Road Surface Temperature has been selected from the Station Colour menu and three weather parameters have been selected to be displayed.

Users can remove displayed weather parameters from alongside the Station Dot by hovering the mouse over the unwanted parameter on the Data Labels section. The parameter will turn red and an 'x' will appear. Click on the 'x' to remove the parameter.

To add a new parameter to display alongside the Station Dot, simply select a new parameter from the Data Labels section.



Above: To remove a parameter from alongside the Station Dot. Click the 'x'

Users can click on a Station Dot to view a detailed Station Meteogram for that Road Weather station. The Station Meteogram shows real time data ('Now'), past observations (to the left of 'Now' [1-Day option only]) and forecasts for this location (to the right of 'Now').

Up to fourteen different parameters can be displayed on the Station Meteogram, as follows:

- Road Temperature
- Air Temperature
- Dew Point
- Freeze Point
- Base Temperature
- Relative Humidity
- Precipitation Last Hour
- Rain Last Hour
- Snow LWE (Liquid Water Equivalent) Last Hour
- Road Water
- Wind Speed
- Max Gust
- Friction
- Cloud Cover

Note; not all parameters may be displayed. The Station Meteogram will only display observed parameters if that station has sensors to record that weather parameter.

Also note in relation to precipitation vs rain/snow. The forecast differentiates between rain and snow, but since the weather stations do not detect precipitation type, the past measurements will only display 'precipitation' instead of the breakdown to rain/snow.

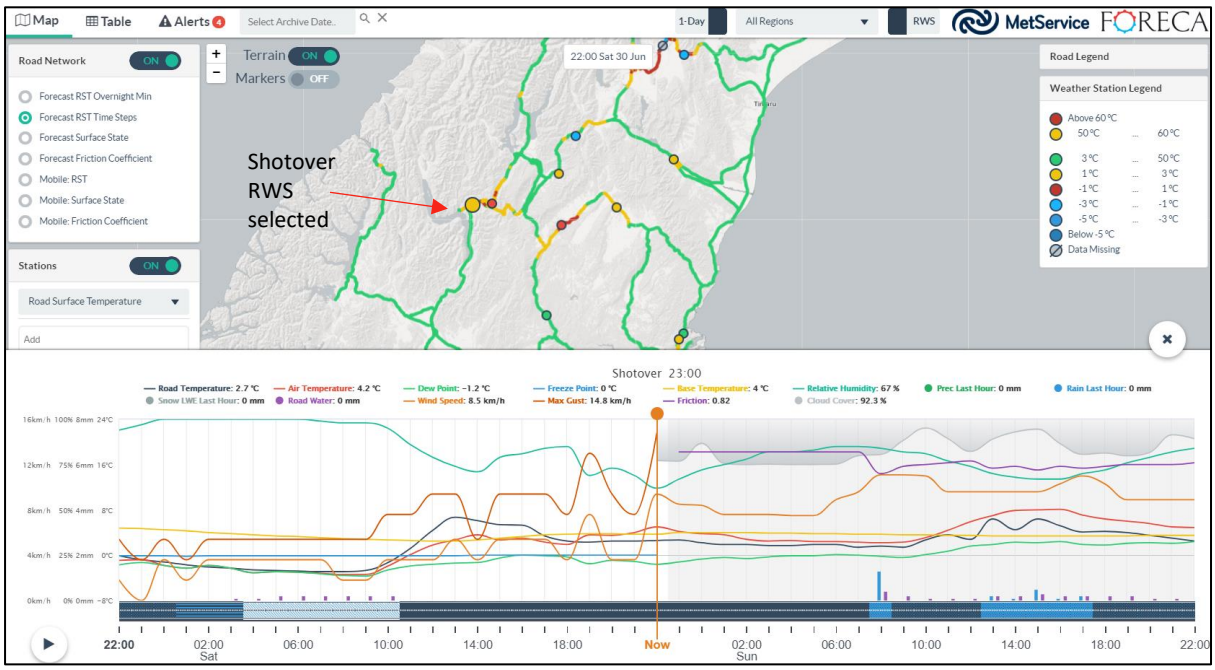
When a user clicks on a Station Dot to view the Station Meteogram, the Station Dot will enlarge to remind the user this station has been selected and the Station Meteogram will appear under the Map.

As the user drags the orange Time Slider point backwards (1-Day option only) or forwards in time from 'Now', each of the constituent weather parameters, as displayed above the Station Meteogram will change to reflect the observed (1-Day option only) or forecast values at that particular time. The same effect can be achieved by simply running the mouse over the Meteogram itself.

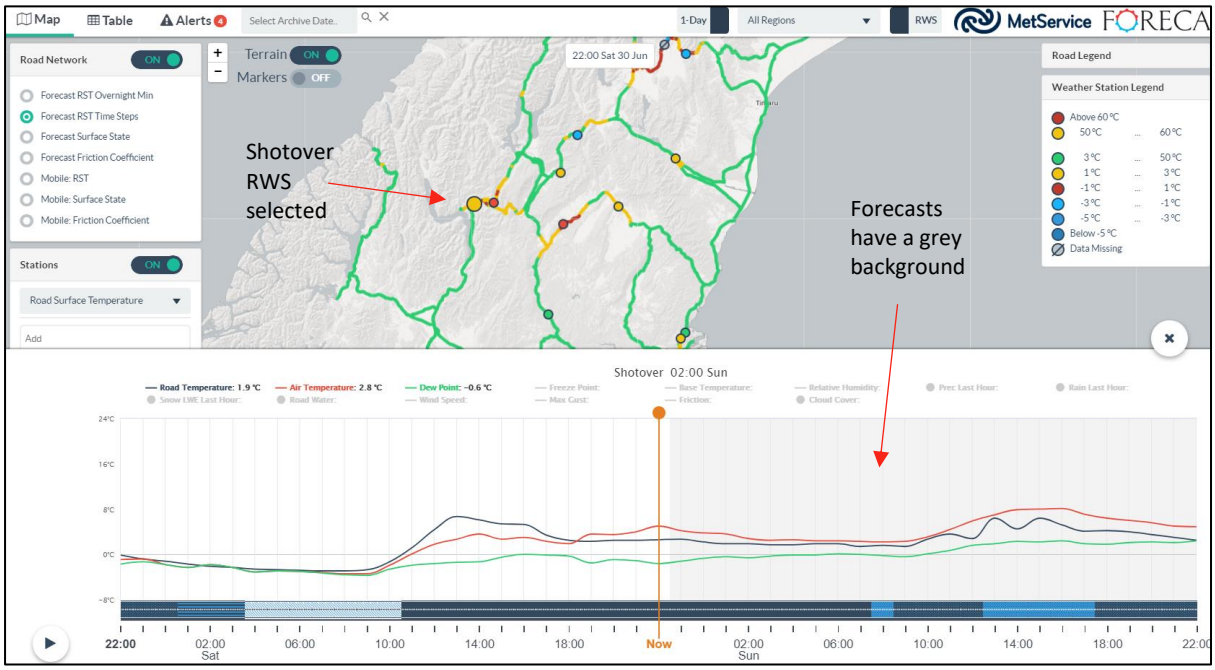
The Station Meteogram can be a complex graph, showing all available road weather parameters (as per the example on the following page) or it can be simplified if the user chooses to select just a few of the important road weather parameters they happen to be interested in.

Road weather parameters can be made visible/invisible within the Station Meteogram by clicking on the parameter of interest, from the list above the Station Meteogram. If the user mouses over a road weather parameter of interest on the list above the Station Meteogram, this road weather parameter will be highlighted on the Station Meteogram and all other road weather parameters on the graph will be dimmed.

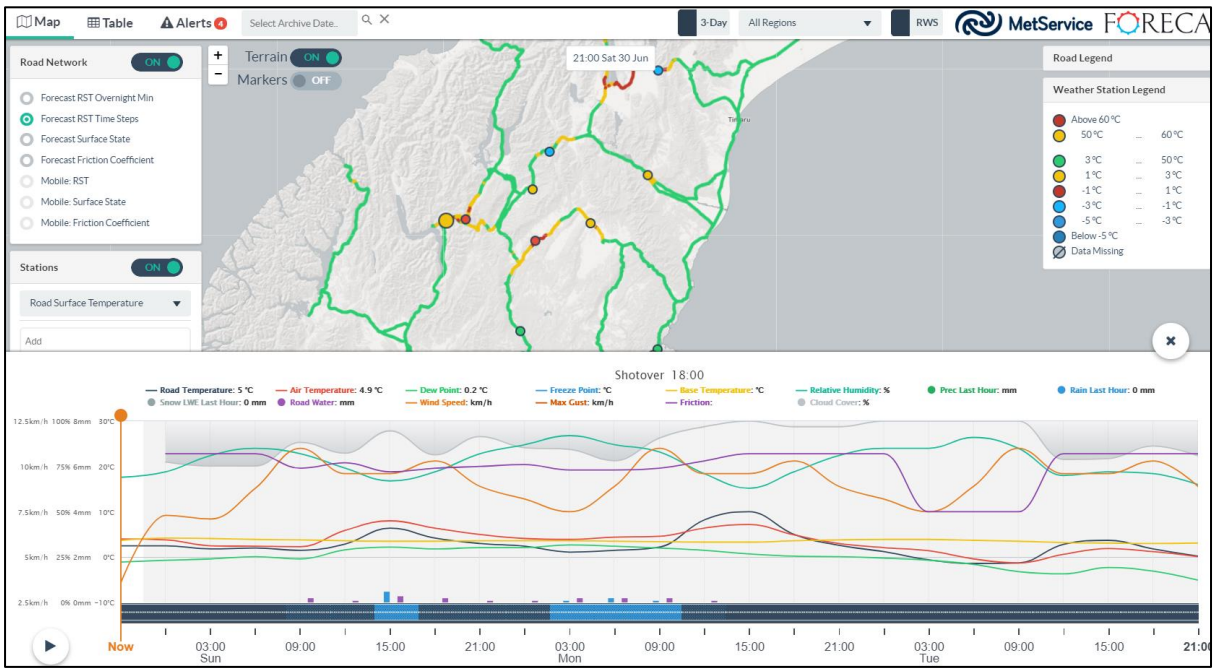
The forecast section of the meteogram has a light grey wash to differentiate it from the observation section.



Above: 1-Day Road Weather Station Meteogram, displaying many road weather parameters.



Above: The same 1-Day Road Weather Station Meteogram, displaying only RST, air temperature and dew point road weather parameters.



Above: 3-Day Road Weather Station Meteogram, displaying many road weather parameters.

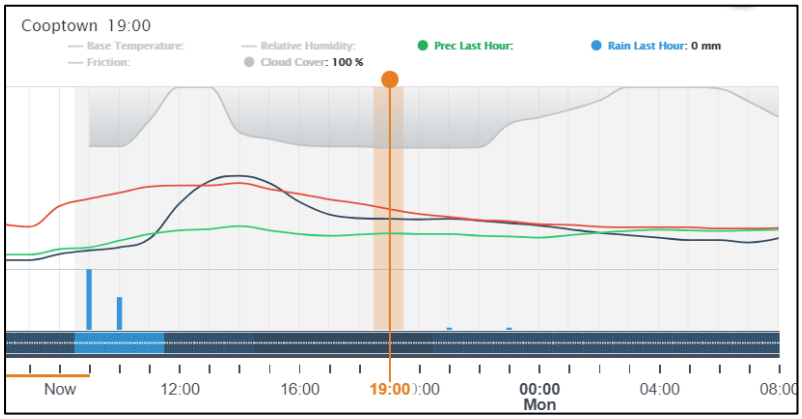
Above: The same 3-Day Road Weather Station Meteogram, displaying only RST, air temperature and dew point road weather parameters.

A word on cloud forecasts within the meteograms. Cloud is an important aspect of the Road Weather System. Think cloud layers will impact on the amount of incoming radiation (heat) from the sun and therefore the amount of heating available to the road during the day. Conversely, thick (low) cloud layers at night will reduce the outgoing radiation to space from the road and keep the road warmer over the night hours. A little like pulling a duvet over you to keep you warm in bed.

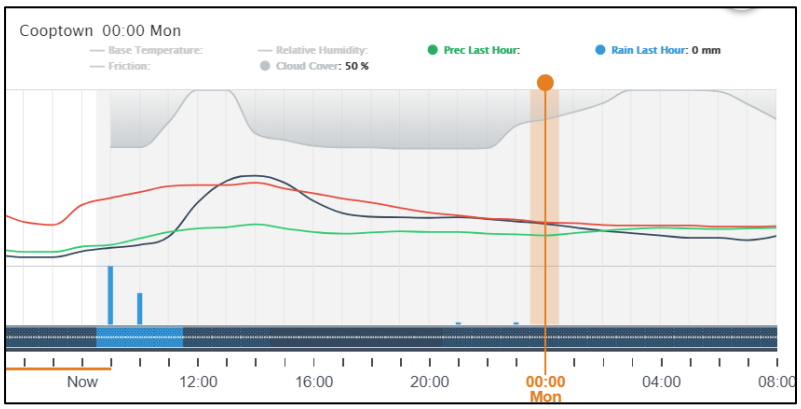
We display cloud cover in the station meteograms as a layer that extends down from the top of the meteogram. The more it hangs down, from the top of the meteogram, the more cloud there is.

The three meteograms below show three different levels of cloud at Cooptown on Banks Peninsula. The first meteogram has 100% cloud cover at 1900hrs; 50% cloud cover at midnight and 0% cloud cover at 0400hrs.

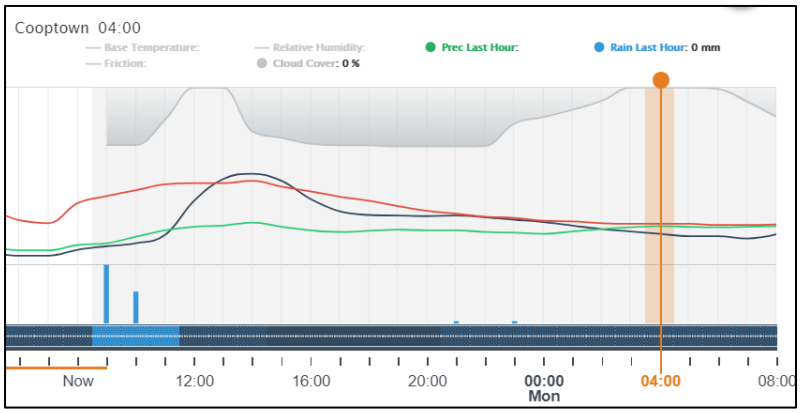
The percentage of cloud cover is provided in the text descriptions at the top of the meteogram.



Left: 100% cloud cover at 1900hrs.



Left: 50% cloud cover at midnight.



Left: 0% cloud cover at 0400hrs.

TABLE

The table section provides users an alternative way of view road weather data. Station locations can be sorted alphabetically from A-Z and Z-A. Road weather data can be sorted from low to high and high to low in order to ascertain the locations most likely to be impacted by extreme road weather.

Data can also be categorised by selecting the MET/RWS filter, to allow the user to view all MetService Station data or just the Road Weather Stations.

In addition, users can decide if they wish to view all regions of New Zealand from the Region Filter or just the region or NOC of interest.

Finally, the Time Slider at the base of the page can be used to view current conditions ('Now' on the Time Slider) as well as earlier observations (to the left of 'Now' on the Time Slider; 1-Day option) and future forecasts (to the right of 'Now' on the Time Slider; 1-Day and 3-Day options).

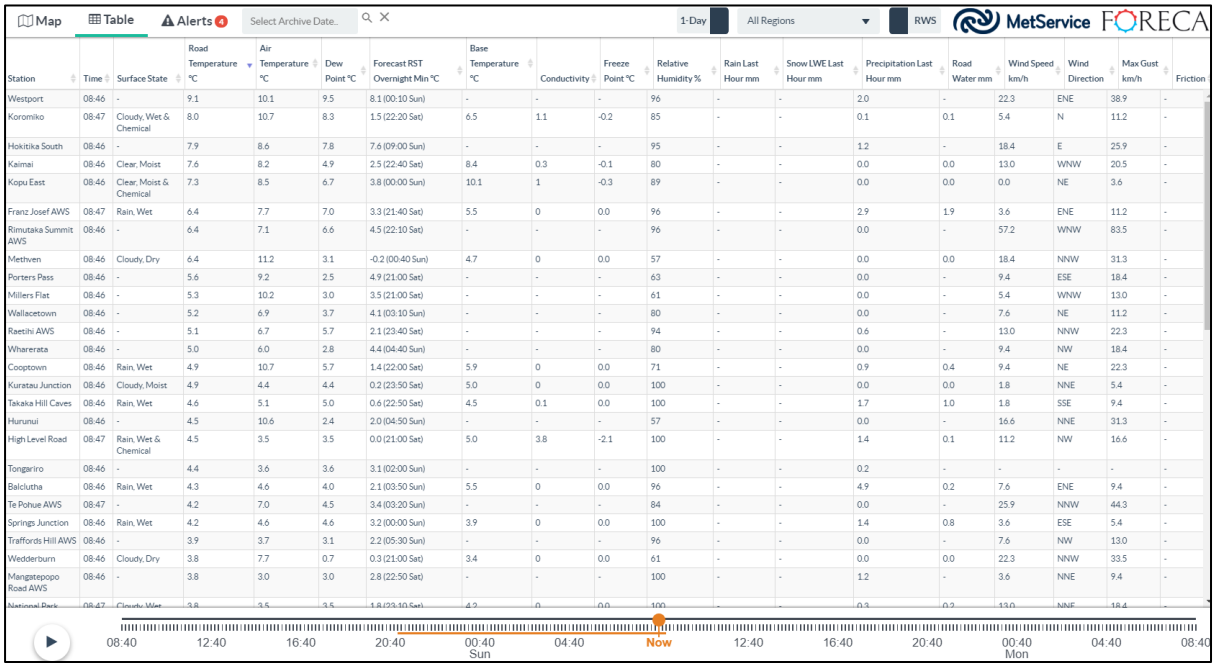
Note: some Stations do not have the full complement of road weather sensors, therefore some data parameters will be missing from these stations.

The following parameters are displayed within the Table:

- Station Name
- Time (of data)
- Surface State
- Road Temperature
- Air Temperature
- Dew Point
- Overnight Min Road Temperature (overnight time period defined by the orange overnight time zone on the Map page)
- Base Temperature
- Conductivity
- Freeze Point
- Relative Humidity
- Rain Last Hour
- Snow LWE (Liquid Water Equivalent) Last Hour
- Precipitation Last Hour
- Road Water
- Wind Speed
- Wind Direction
- Max Gust Friction

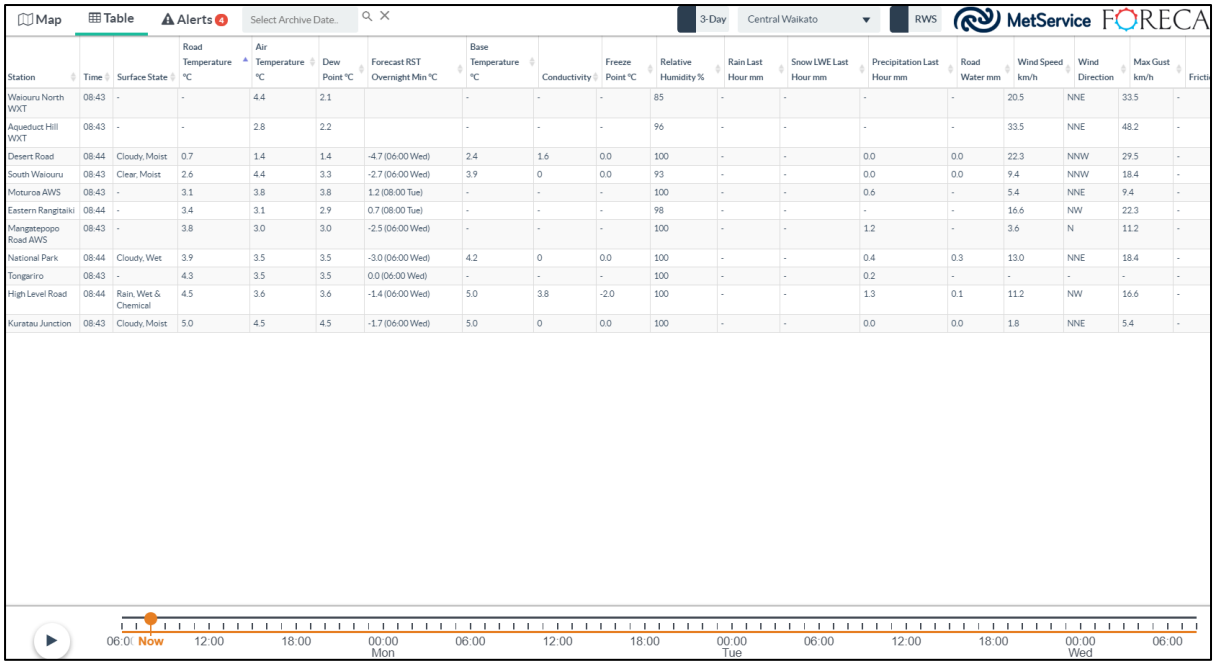
Observation and forecast road weather data are provided in ten minute increments via the Time Slider if the user selects the 1-Day option and in hourly increments if the user selects the 3-Day option. Users may also use the Animator at the lower left of the screen to automatically scroll through the time period covered by the Time Slider.

The following are two examples of a Table view of RWS data.



Station	Time	Surface State	Road Temperature °C	Air Temperature °C	Dew Point °C	Forecast RST Overnight Min °C	Base Temperature °C	Conductivity	Freeze Point °C	Relative Humidity %	Rain Last Hour mm	Snow LWE Last Hour mm	Precipitation Last Hour mm	Road Water mm	Wind Speed km/h	Wind Direction	Max Gust km/h	Friction
Westport	08:46	-	9.1	10.1	9.5	8.1 (00:10 Sun)	-	-	-	96	-	-	2.0	-	22.3	ENE	38.9	-
Koromiko	08:47	Cloudy, Wet & Chemical	8.0	10.7	8.3	1.5 (22:20 Sat)	6.5	1.1	-0.2	85	-	-	0.1	0.1	5.4	N	11.2	-
Hokitika South	08:46	-	7.9	8.6	7.8	7.6 (09:00 Sun)	-	-	-	95	-	-	1.2	-	18.4	E	25.9	-
Kaimai	08:46	Clear, Moist	7.6	8.2	4.9	2.5 (22:40 Sat)	8.4	0.3	-0.1	80	-	-	0.0	0.0	13.0	WNW	20.5	-
Kopu East	08:46	Clear, Moist & Chemical	7.3	8.5	6.7	3.8 (00:00 Sun)	10.1	1	-0.3	89	-	-	0.0	0.0	0.0	NE	3.6	-
Franz Josef AWS	08:47	Rain, Wet	6.4	7.7	7.0	3.3 (21:40 Sat)	5.5	0	0.0	96	-	-	2.9	1.9	3.6	ENE	11.2	-
Rimutaka Summit AWS	08:46	-	6.4	7.1	6.6	4.5 (22:10 Sat)	-	-	-	96	-	-	0.0	-	57.2	WNW	83.5	-
Methven	08:46	Cloudy, Dry	6.4	11.2	3.1	-0.2 (00:40 Sun)	4.7	0	0.0	57	-	-	0.0	0.0	18.4	NNW	31.3	-
Porters Pass	08:46	-	5.6	9.2	2.5	4.9 (21:00 Sat)	-	-	-	63	-	-	0.0	-	9.4	ESE	18.4	-
Millers Flat	08:46	-	5.3	10.2	3.0	3.5 (21:00 Sat)	-	-	-	61	-	-	0.0	-	5.4	WNW	13.0	-
Wallacetown	08:46	-	5.2	6.9	3.7	4.1 (03:10 Sun)	-	-	-	80	-	-	0.0	-	7.6	NE	11.2	-
Raetihi AWS	08:46	-	5.1	6.7	5.7	2.1 (23:40 Sat)	-	-	-	94	-	-	0.6	-	13.0	NNW	22.3	-
Wharerata	08:46	-	5.0	6.0	2.8	4.4 (04:40 Sun)	-	-	-	80	-	-	0.0	-	9.4	NW	18.4	-
Cooptown	08:46	Rain, Wet	4.9	10.7	5.7	1.4 (22:00 Sat)	5.9	0	0.0	71	-	-	0.9	0.4	9.4	NE	22.3	-
Kuratau Junction	08:46	Cloudy, Moist	4.9	4.4	4.4	0.2 (23:50 Sat)	5.0	0	0.0	100	-	-	0.0	0.0	1.8	NNE	5.4	-
Takaka Hill Caves	08:46	Rain, Wet	4.6	5.1	5.0	0.6 (22:50 Sat)	4.5	0.1	0.0	100	-	-	1.7	1.0	1.8	SSE	9.4	-
Hurunui	08:46	-	4.5	10.6	2.4	2.0 (04:50 Sun)	-	-	-	57	-	-	0.0	-	16.6	NNE	31.3	-
High Level Road	08:47	Rain, Wet & Chemical	4.5	3.5	3.5	0.0 (21:00 Sat)	5.0	3.8	-2.1	100	-	-	1.4	0.1	11.2	NW	16.6	-
Tongariro	08:46	-	4.4	3.6	3.6	3.1 (02:00 Sun)	-	-	-	100	-	-	0.2	-	-	-	-	-
Balclutha	08:46	Rain, Wet	4.3	4.6	4.0	2.1 (03:50 Sun)	5.5	0	0.0	96	-	-	4.9	0.2	7.6	ENE	9.4	-
Te Pohue AWS	08:47	-	4.2	7.0	4.5	3.4 (03:20 Sun)	-	-	-	84	-	-	0.0	-	25.9	NNW	44.3	-
Springs Junction	08:46	Rain, Wet	4.2	4.6	4.6	3.2 (00:00 Sun)	3.9	0	0.0	100	-	-	1.4	0.8	3.6	ESE	5.4	-
Traffords Hill AWS	08:46	-	3.9	3.7	3.1	2.2 (05:30 Sun)	-	-	-	96	-	-	0.0	-	7.6	NW	13.0	-
Wedderburn	08:46	Cloudy, Dry	3.8	7.7	0.7	0.3 (21:00 Sat)	3.4	0	0.0	61	-	-	0.0	0.0	22.3	NNW	33.5	-
Mangatepopo Road AWS	08:46	-	3.8	3.0	3.0	2.8 (22:50 Sat)	-	-	-	100	-	-	1.2	-	3.6	NNE	9.4	-
National Park	08:47	Cloudy, Wet	3.8	3.5	3.5	1.8 (23:10 Sat)	4.2	0	0.0	100	-	-	0.3	0.2	13.0	NNE	18.4	-

Above: Table of NZ-wide RWS data, listed Z-A. (1-Day option). Note ten-minute data increments and location of 'Now'; in the middle of the Time Slider.



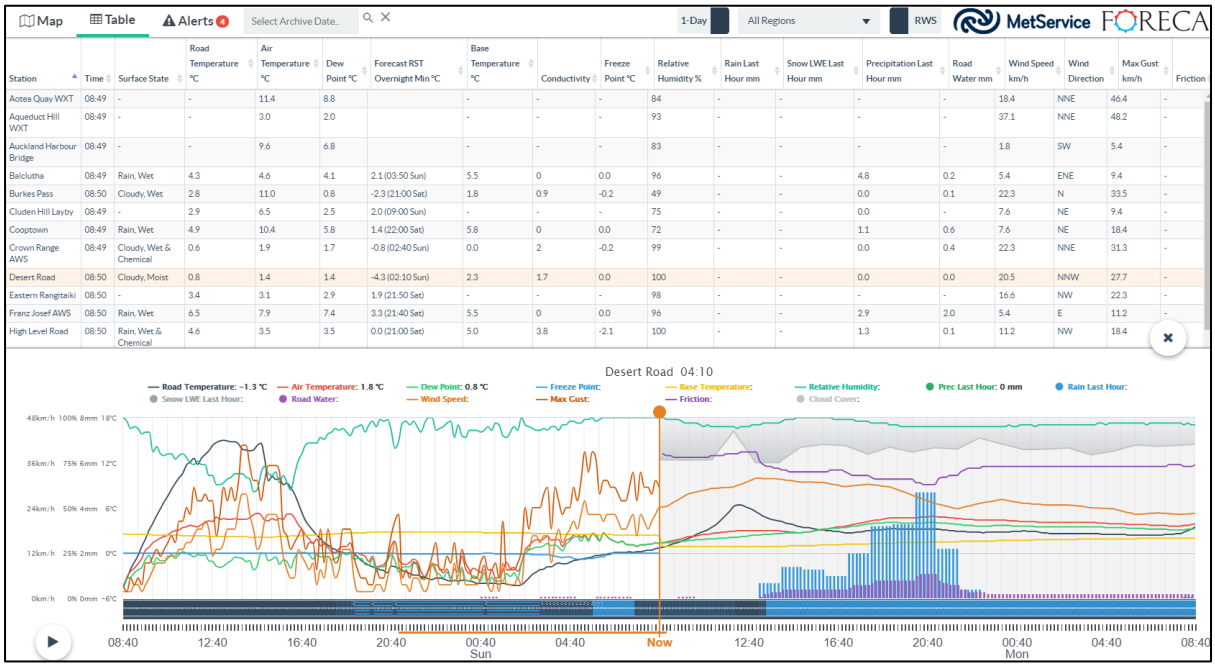
Station	Time	Surface State	Road Temperature °C	Air Temperature °C	Dew Point °C	Forecast RST Overnight Min °C	Base Temperature °C	Conductivity	Freeze Point °C	Relative Humidity %	Rain Last Hour mm	Snow LWE Last Hour mm	Precipitation Last Hour mm	Road Water mm	Wind Speed km/h	Wind Direction	Max Gust km/h	Friction
Waiouru North WXT	08:43	-	-	4.4	2.1		-	-	-	85	-	-	-	-	20.5	NNE	33.5	-
Aqueduct Hill WXT	08:43	-	-	2.8	2.2		-	-	-	96	-	-	-	-	33.5	NNE	48.2	-
Desert Road	08:44	Cloudy, Moist	0.7	1.4	1.4	-4.7 (06:00 Wed)	2.4	1.6	0.0	100	-	-	0.0	0.0	22.3	NNW	29.5	-
South Waiouru	08:43	Clear, Moist	2.6	4.4	3.3	-2.7 (06:00 Wed)	3.9	0	0.0	93	-	-	0.0	0.0	9.4	NNW	18.4	-
Moturoa AWS	08:43	-	3.1	3.8	3.8	1.2 (08:00 Tue)	-	-	-	100	-	-	0.6	-	5.4	NNE	9.4	-
Eastern Rangitaiki	08:44	-	3.4	3.1	2.9	0.7 (08:00 Tue)	-	-	-	98	-	-	-	-	16.6	NW	22.3	-
Mangatepopo Road AWS	08:43	-	3.8	3.0	3.0	-2.5 (06:00 Wed)	-	-	-	100	-	-	1.2	-	3.6	N	11.2	-
National Park	08:44	Cloudy, Wet	3.9	3.5	3.5	-3.0 (06:00 Wed)	4.2	0	0.0	100	-	-	0.4	0.3	13.0	NNE	18.4	-
Tongariro	08:43	-	4.3	3.5	3.5	0.0 (06:00 Wed)	-	-	-	100	-	-	0.2	-	-	-	-	-
High Level Road	08:44	Rain, Wet & Chemical	4.5	3.6	3.6	-1.4 (06:00 Wed)	5.0	3.8	-2.0	100	-	-	1.3	0.1	11.2	NW	16.6	-
Kuratau Junction	08:43	Cloudy, Moist	5.0	4.5	4.5	-1.7 (06:00 Wed)	5.0	0	0.0	100	-	-	0.0	0.0	1.8	NNE	5.4	-

Above: Table of RWS data for the Central Waikato region, listed from coldest RST to warmest. (3-Day option). Note hourly time increments and location of 'Now'; at the left-hand side of the time slider.

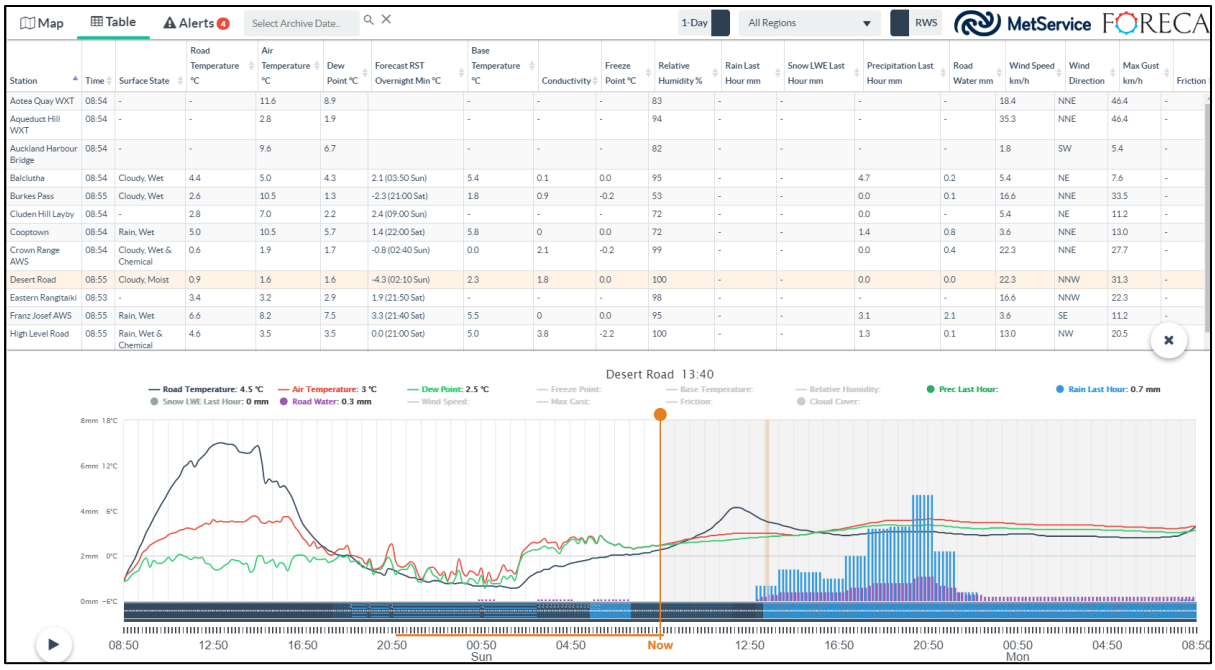
Users can click on any of the Road Weather stations within the Table to view a Road Weather Meteogram of that station. The Station Meteogram can be a complex graph, showing all available road weather parameters or it can be simplified if the user chooses to select just a few of the important road weather parameters they happen to be interested in.

Road weather parameters can be made visible/invisible within the Station Meteogram by clicking on the parameter of interest, from the list above the Station Meteogram. If the user mouses over a road weather parameter of interest on the list above the Station Meteogram, this road weather parameter will be highlighted on the Station Meteogram and all other road weather parameters on the graph will be dimmed.

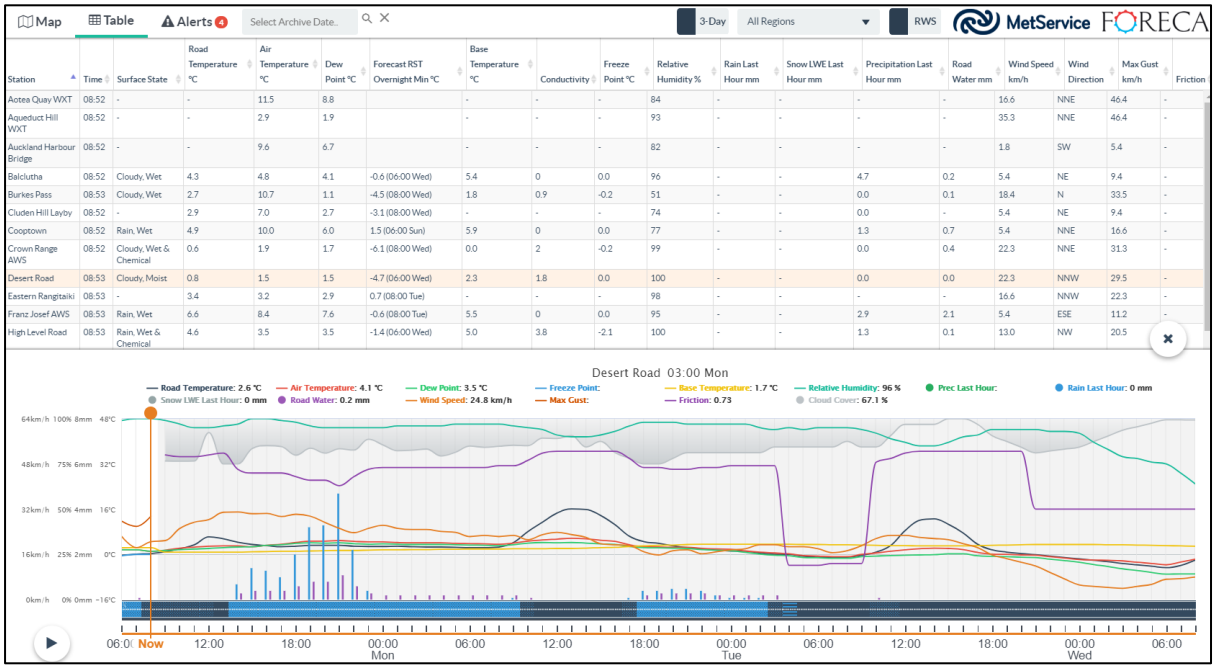
Users can click on the 'Now' button on the Time Slider to refresh station measurements and show the latest data. This mode is activated for approx. 15 minutes and also works in the Map view.



Above: Detailed Road Weather Station meteogram, for Desert Road. 1-Day option.



Above: Less detailed Road Weather Station meteogram, for Desert Road. 1-Day option. Showing road temperature, air temperature, dew point, rain last hour and road water.



Station	Time	Surface State	Road Temperature °C	Air Temperature °C	Dew Point °C	Forecast RST Overnight Min °C	Base Temperature °C	Conductivity	Freeze Point °C	Relative Humidity %	Rain Last Hour mm	Snow LWE Last Hour mm	Precipitation Last Hour mm	Road Water mm	Wind Speed km/h	Wind Direction	Max Gust km/h	Friction
Aotea Quay WXT	08:52	-	-	11.5	8.8		-	-	-	84	-	-	-	-	16.6	NNE	46.4	-
Aqueduct Hill WXT	08:52	-	-	2.9	1.9		-	-	-	93	-	-	-	-	35.3	NNE	46.4	-
Auckland Harbour Bridge	08:52	-	-	9.6	6.7		-	-	-	82	-	-	-	-	1.8	SW	5.4	-
Balclutha	08:52	Cloudy, Wet	4.3	4.8	4.1	-0.6 (06:00 Wed)	5.4	0	0.0	96	-	-	4.7	0.2	5.4	NE	9.4	-
Burkes Pass	08:53	Cloudy, Wet	2.7	10.7	1.1	-4.5 (08:00 Wed)	1.8	0.9	-0.2	51	-	-	0.0	0.1	18.4	N	33.5	-
Cluden Hill Layby	08:52	-	2.9	7.0	2.7	-3.1 (08:00 Wed)	-	-	-	74	-	-	0.0	-	5.4	NE	9.4	-
Cooptown	08:52	Rain, Wet	4.9	10.0	6.0	1.5 (06:00 Sun)	5.9	0	0.0	77	-	-	1.3	0.7	5.4	NNE	16.6	-
Crown Range AWS	08:52	Cloudy, Wet & Chemical	0.6	1.9	1.7	-6.1 (08:00 Wed)	0.0	2	-0.2	99	-	-	0.0	0.4	22.3	NNE	31.3	-
Desert Road	08:53	Cloudy, Moist	0.8	1.5	1.5	-4.7 (06:00 Wed)	2.3	1.8	0.0	100	-	-	0.0	0.0	22.3	NNW	29.5	-
Eastern Rangitaiki	08:53	-	3.4	3.2	2.9	0.7 (08:00 Tue)	-	-	-	98	-	-	-	-	16.6	NNW	22.3	-
Franz Josef AWS	08:53	Rain, Wet	6.6	8.4	7.6	-0.6 (08:00 Tue)	5.5	0	0.0	95	-	-	2.9	2.1	5.4	ESE	11.2	-
High Level Road	08:53	Rain, Wet & Chemical	4.6	3.5	3.5	-1.4 (06:00 Wed)	5.0	3.8	-2.1	100	-	-	1.3	0.1	13.0	NW	20.5	-

Above: Detailed Road Weather Station meteogram, for Desert Road. 3-Day option.

ALERTS

Users have the ability to set up and define alerts for forecast and observed road weather parameters. Alerts are issued whenever user-threshold criteria are met. Users are notified at the trigger time and then every 12 hours for observations and every 24 hours for forecasts, while the thresholds are triggered.

Alert checks are performed every 10 minutes (when new observations are received AND new station forecasts are run) so users could potentially receive a new alert every 10 minutes.

The process of generating an alert is as follows:

STEP 1. Click on the ALERTS tabs

STEP 2. Enter your mobile number and email. You only need to do this once. Your mobile number must be in this format: **+64275638626**

STEP 3. Select a station of interest from the STATION pull-down menu.

STEP 4. Select a weather parameter from the PARAMETER pulldown menu. Current options are:

- Forecast RST Overnight Min Below…
- Observed RST Below…
- Observed RST Above…
- Observed Wind Speed Above…
- Observed 1h Precipitation Above mm…
- Observed 10min Precipitation Above mm…
- Observed Wind Gust Above km/h

STEP 5. Enter a Threshold. Thresholds are the values beyond which you wish to be alerted.

If a user selected 'Observed RST Below', the threshold might be '2.0'. If the user selected 'Observed Wind Speed Above', the threshold might be '50'.

STEP 6. Click the ADD SUBSCRIPTION button to activate the alert

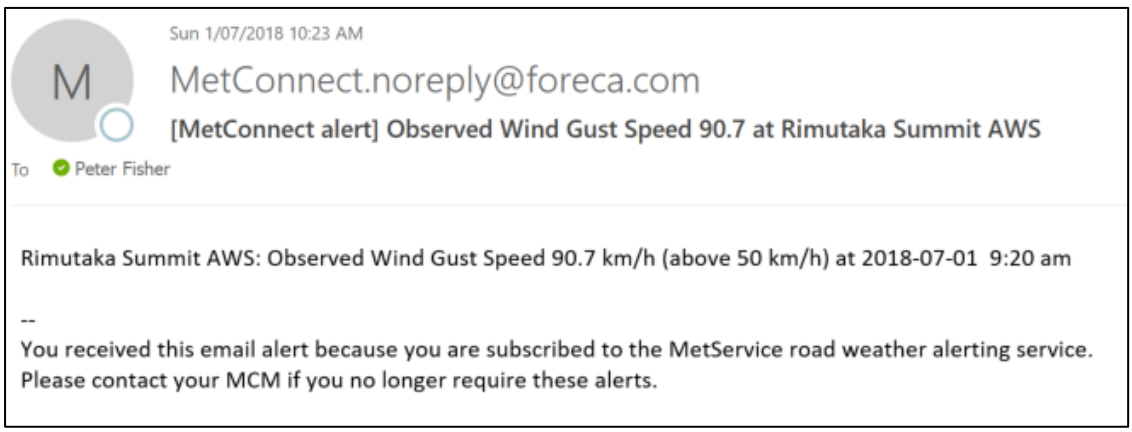
STEP 7. Click on the SMS or EMAIL switch to activate the type of alert you wish to receive.

STEP 8. (Optional). Assign a colour to your alert. By default, all new alerts are block. If a user wishes to group alerts, they can do so by colour. The user may wish to assign blue to wind alerts, green for rain alerts, or use yellow for moderately interesting alerts and red for critical alerts.

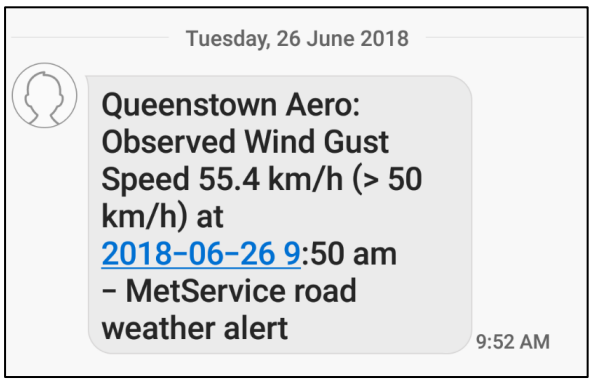
STEP 9. Turn alert on.

All current alerts for the user will be displayed on the right side of the screen. They will be coloured based on the alert colour the user selects.

Above: Alert screen.



Above: example of an email alert for observed wind gusts



Above: Example of an SMS txt alert for observed wind gusts