The importance of more weather data – A practical, local example!

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Each month, the WA Department of Primary Industries & Regional Development (DPIRD) & Bureau of Meteorology (BoM) typically produces a state or national rainfall map utilising more than 180 government weather stations across Western Australia. Whilst these maps are great to show general trends across the state's 25+ million-hectare grain growing area; unfortunately they do not show the actual rainfall variation across the state, with each station representing 142,000 hectares of agricultural land on average.

As we start to collect more rainfall data from more and more data points across the region over time, it opens the opportunity to map rainfall variation at a greater level and accuracy. These higher accuracy maps can later be utilised to measure the accuracy of rainfall predictions, soil moisture modelling, developing crop potential yield maps, or used in water use efficiency mapping when combined with yield data from a harvester.

STEP 1: MAKING A RAINFALL MAP

To make a rainfall map, we need to download the coordinates of the weather-stations involved, and the rainfall value for each station, over a selected time period.

In this case, we utilised the WA DPIRD Weatherstation network and the August 2020 rainfall values. We imported this into a mapping program and used an interpolation method to 'infill' the missing data between the DPIRD stations (the black stars) to create an effective rainfall map shown in figure 1. This map is most accurate right next to the black stars, with the values in-between estimated by statistical methods. Note: the way this data is generated to infill the missing places between the stars is based on the same principles as how to make a yield map!

Independent of this map, we can also show the location of all the SCF monitoring sites on the same map with red-stars, even though they weren't used in this map this time around, and look at a specific subset of our membership region for the next steps (the red square).

STEP 2: RAINFALL VARIATION - THE MORE DATA, THE BETTER!

Figure 2 on the right, is a zoomed-in section of the map we've just produced in step 1.... *But how exactly do we exactly know if this map is accurate?* The best way to statistically find out is to add in more data points into the analysis and test the accuracy.

To do this, we utilise the DPIRD August data, add in our SCF weather monitoring points, and create an in-filled map once more. By having more data included in the analysis, we increase the statistical accuracy of the map and have the ability to see the rainfall variation more effectively. A comparison of this is shown to the right where figure 2 is utilising the DPIRD only stations, and figure 3 is using both DPIRD and the SCF weather stations. *Note the drastic differences between the two images along Woogenellup, Chillinup, Pfeiffer & Kojaneerup-West Roads!*

As we have a known amount of rainfall at each of the SCF weather monitoring sites, we can use this to test the accuracy of the map we had produced utilising DPIRD only weather-station data.

For each of the red stars (SCF monitoring points), we can then measure the predicted rainfall amount directly from the map and compare it against what was physically recorded at the automatic rain gauge or weather station. On average across the ten SCF monitoring sites sampled, the rain gauges recorded 15.7mm less rain than what was predicted from the map, with a range of +12.4 mm to -44.7mm observed from predicted values at the 10 SCF sites.

Table 1 below displays some of the variation seen from recorded (actual) and the predicted (estimated) values. Generally speaking, we saw substantial shifts from the predicted values around the Pfeiffer Road, Chillinup Road, & the Woogenellup road areas, as lower-rainfall values against the predicted headed in a south-easterly direction. Interestingly, both the Mobrup station and our SCF/GRDC/FAR Hyper-Yielding Demonstration monitoring site in Kojaneerup South recorded above the predicted rainfall values, obtaining approximately 8-13mm above the expected values.

Table 1: Rainfall Variation levels (in mm) between predicted and actual readings at SCF WeatherNet monitored locations.

	August 2020 Total Rainfall (mm)		
	Estimated Rainfall	Actual Rainfall	Difference
Woogenellup - SCF Soil Probe Station 1	113.5	86.2	-27.3
Woogenellup - SCF Soil Probe Station 2	113.5	83.8	-29.7
Woogenellup - Woogenellup Rd (North)	114.0	101.6	-12.4
Kendenup DTN Station	90.7	72.0	-18.7
Cranbrook - Yeriminup Rd	92.8	67.6	-25.2
Mobrup Station	60.6	73.0	12.4
Kojaneerup South - Kojaneerup West Rd	136.6	145.0	8.4
Takalarup - Chillinup Rd	128.3	83.6	-44.7
South Stirlings - Pfeiffer Rd	145.0	126.5	-18.5
Perilup - Kwornicup Rd	112.2	111.0	-1.2

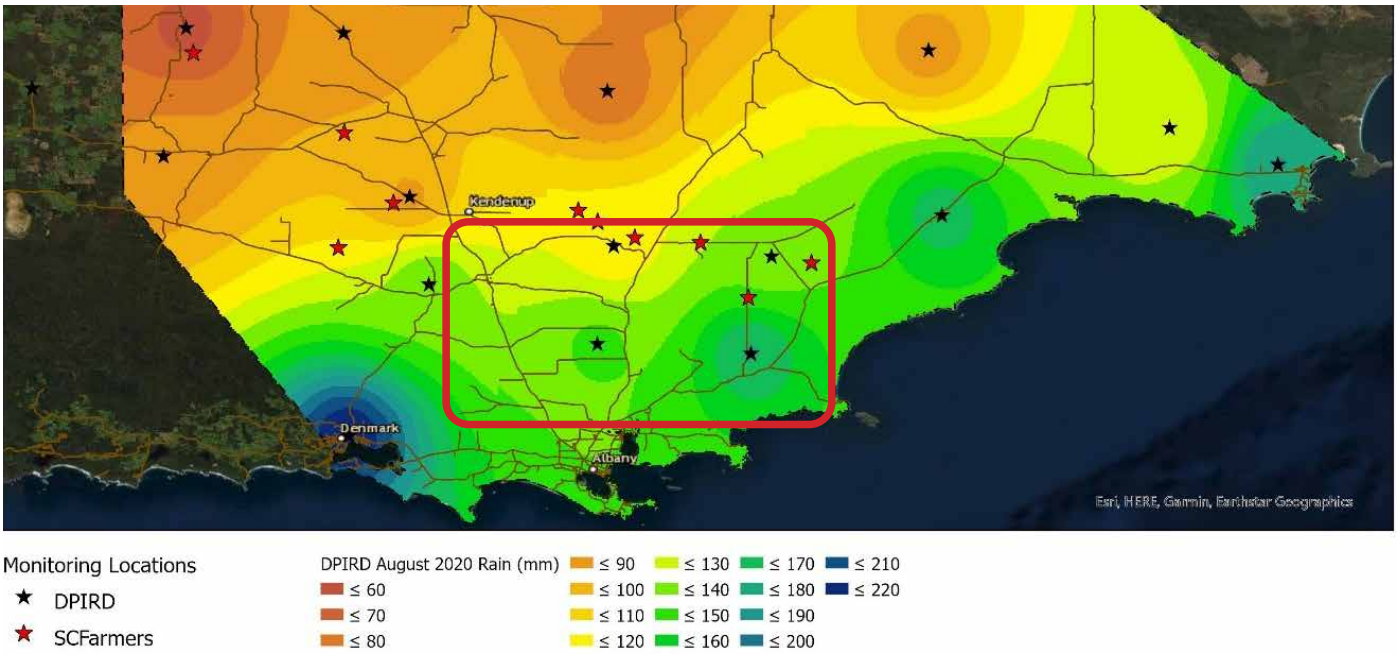

Figure 1: Total August Rainfall interpolated across the SCF membership zone utilising DPIRD weather station data, with an example region of interest which is later discussed.

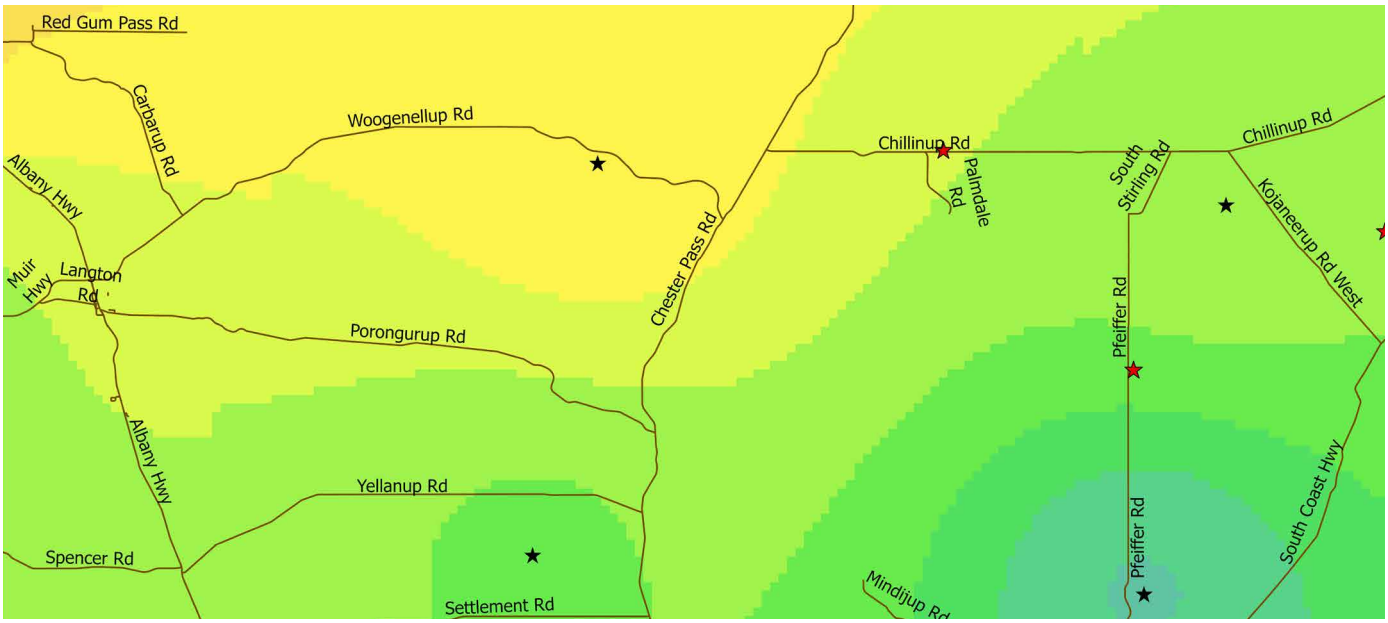

Figure 2: Red Square Inset – A rainfall variation map utilising DPIRD weather stations only.

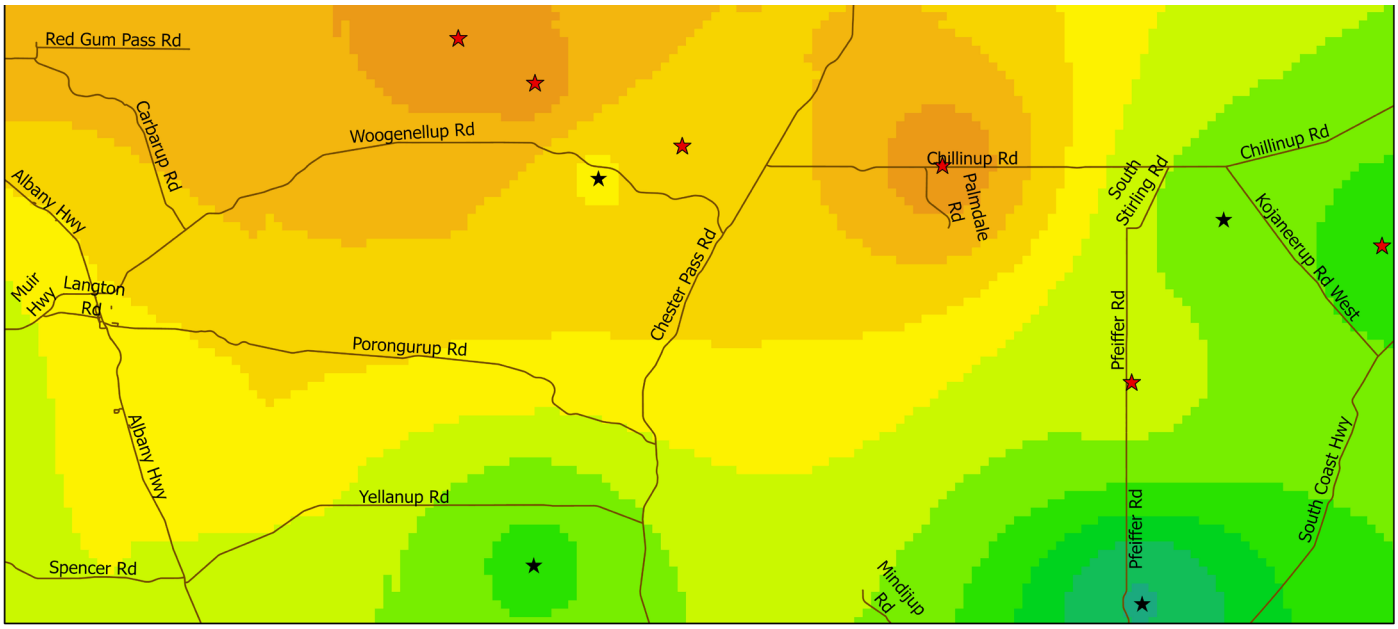

Figure 3: Red Square Inset - An updated rainfall variation map utilising both the DPIRD & SCF WeatherNet stations.

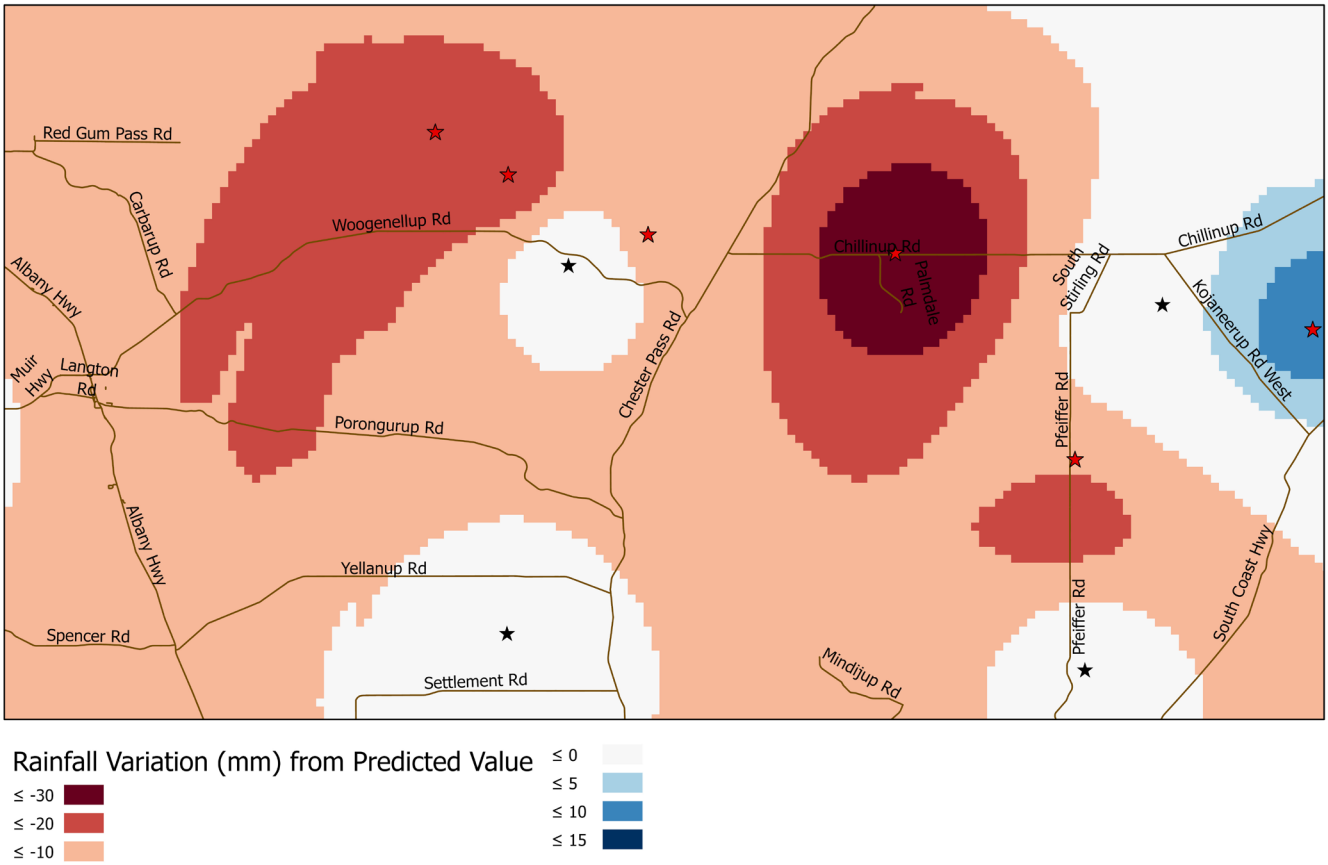

Figure 4: Actual recorded rainfall variation against the predicted rainfall model in mm for August 2020. Note: Areas coloured blue recorded above DPIRD predicted values, whilst red-coloured regions had less than DPIRD predicted rainfall.

STEP 3: RAINFALL ACCURACY MAPPING – THE DIFFERENCE IN HAVING MORE DATA!

Previously in figures 2 & 3 where we had a combination of DPIRD only & SCF/DPIRD only rainfall maps, we can take these layers another step further, and create a rainfall accuracy map (Fig 4.).

This map represents the difference between the two layers, to show regions which had more/less rain than previously estimated in the DPIRD rainfall only map. Simply put, the areas coloured white was accurate in this modelling, red coloured regions received less than predicted rain, and those coloured blue received more rainfall than previously predicted.

To do this calculation, we utilise a mapping calculator in our software to perform the basic analysis as follows:

Rainfall Variation (figure 4)=(DPIRD & SCF Rainfall Map)-(DPIRD Rainfall Map).

STEP 4: MAKING PRODUCTION SENSE FROM RECORDED RAINFALL... WHY IS THIS SO IMPORTANT?

With so few weather monitoring points effectively being extrapolated to assume weather conditions in-between stations generally, it is no wonder why some members don't have faith in current weather forecasting services. Accurate, localised weather maps help growers understand true rainfall variation, which can then be utilised for nutrient management decisions to improve on-farm yields and quality.

Example - Improving the accuracy of predicted yield maps

The more data points that we have, the higher accuracy we can have when it comes time to producing predicted yield maps for a region. Performing basic map calculations utilising average water use efficiency levels, we could easily create potential yield maps for varying crop-types across the membership zone. However, to do this accurately & effectively, SCF and our members must have access to high-quality rainfall data that is relevant to our membership base. Without this extra data across the membership, we cannot utilise the current weather-station networks to predict yields accurately.

One example of the variation we could see is in the map created on the next page (figure 5). This map is generated from the predicted rainfall accuracy map that we had made in figure 4 and assuming a potential yield generated per mm of rainfall, to outline the effect on potential yield from inaccurate forecasting maps.

In assuming a very simplistic water use efficiency for a Barley crop at 20kg of production per mm of rainfall for August and utilising the DPIRD estimated rainfall only data map, we could potentially

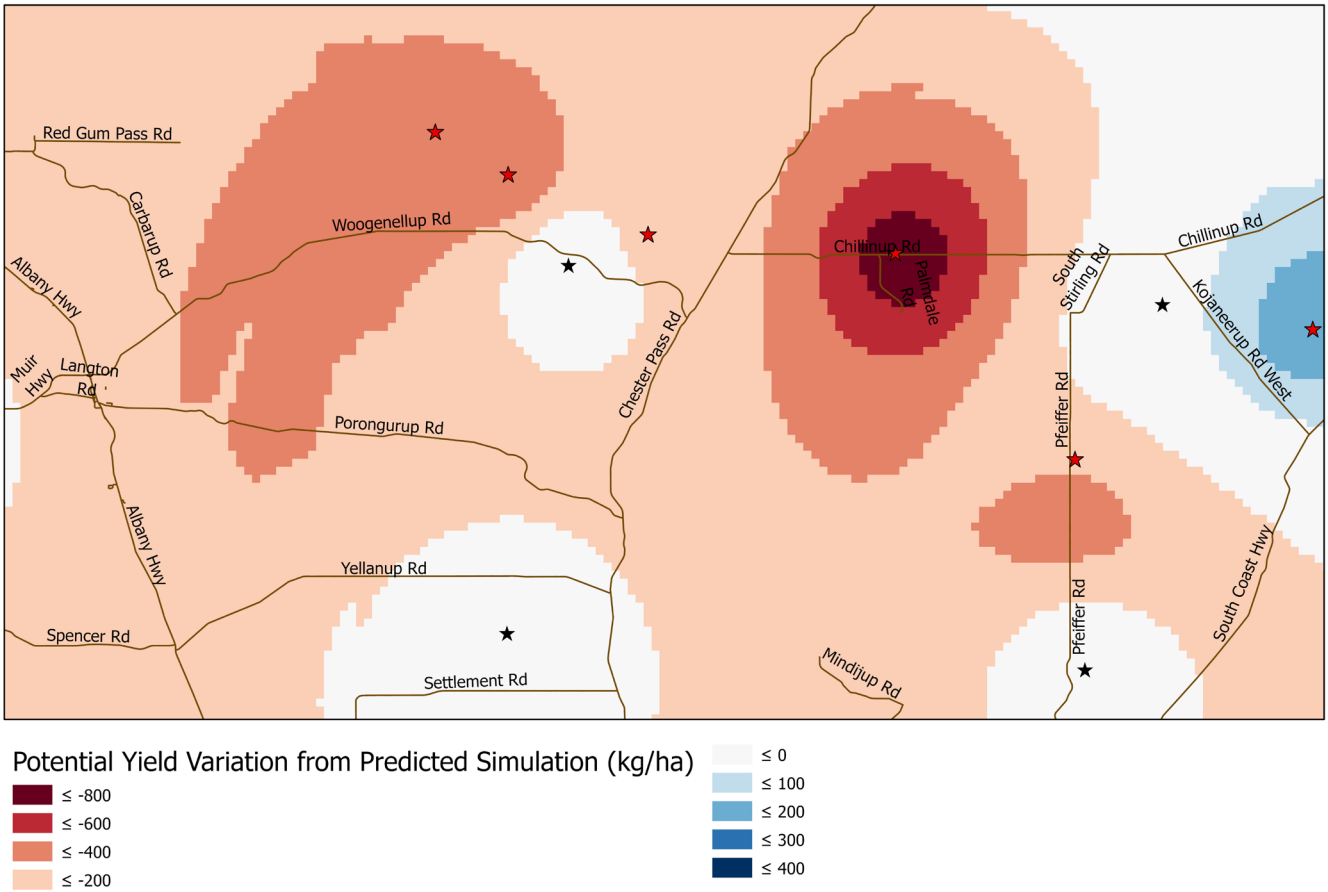

Figure 5 is a practical example of what the yield variation could potentially be seen from estimated crop production maps if we hadn't accounted for the additional monitoring points in the August DPIRD rainfall variation map. Assuming a water use efficiency of 20kg/mm of rainfall in August and all other rainfall/evaporation is previously accounted for.

see a change in the potential yields from -903kg/ha to 265kg/ha on a sub-regional predicted yield map based purely of DPIRD data only. This ultimately helps highlight the requirement of more data points being fed into these models, to help increase the accuracy of predicted yield maps, and ensure farmers can maximise production & quality.

Conclusion:

As previously mentioned, having additional weather monitoring points helps add an extra level of information to our maps, and could be utilised to help improve the accuracy of measuring rainfall events. Whilst there is still quite a few "black-spots" to infill, SCF is committed to helping our members make the most from their data and welcomes discussions about collaborating to improve the accuracy of these maps generated. Installing weather monitoring equipment on your farm effectively means that members can achieve the highest levels of accuracy for rainfall mapping, water-use mapping or even potential-yield maps, helping lead to better production and quality outcomes for our members relevant to their specific location.

ARE YOU INTERESTED IN ON-FARM WEATHER MONITORING?

Stirlings to Coast Farmers can assist members with the procurement and installation of on-farm AgTech from a wide range of vendors, as well as advanced data processing services.

To find out more about the wide range of equipment available to members, station/sensor pricing, software trials or advanced mapping, please contact Philip on 0428 768 589 or philip.honey@scfarmers.org.au

WANT TO VIEW THE LATEST RAINFALL & WEATHER READINGS?

SCF members can access weather station & rain-gauge data from within the "members area" on the SCF Website. Visit www.scfarmers.org.au and click on the "Members Only" button on the top menu.

To find your closest rain-gauge or weather-station, please visit http://bit.ly/SCFweathernet

Australian Government | National Landcare Program

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