UNDERSTANDING MAPS

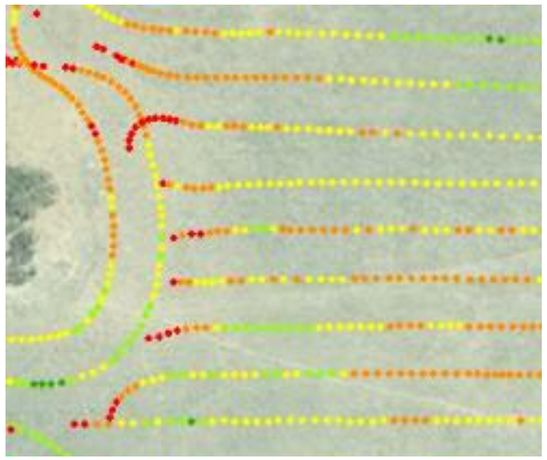
Precision agriculture maps offer farmers a spatial representation of their land to help in diagnosing and treating issues and improving productivity. It is often easier to grasp data when presented visually as a map rather than as a set of figures.

Visual reference points that show areas of high and low performance can assist farmers to make management decisions and allow for variable rate applications of inputs.

Types of Maps

In agriculture, maps are broadly assigned to two overlapping categories·

In Season maps provide a quick feedback loop so that farmers can make decisions to improve a current crop. For example, a nitrogen sensor will record crop vigour and automatically adjust fertiliser levels to optimise yield in the current season. These maps can also be valuable for post season or future reference. Post Season maps provide farmers with information that enables them to make changes in the following season. For example yield maps provide direction for input applications in the following crops. EM38, gamma radiometrics, light and pH mapping all collect valuable information on soils to influence future decisions.



Raw Data (Yield Data)

Using maps to identify problems

Problems potentially identified by maps include·

- Nutrient deficiencies
- In crop weeds
- Root disease

At a basic level, simply overlaying in season aerial photography with yield data can provide some insight into potential problems·

- If yield deficiencies correlate with high growth areas, then weeds could be the issue
- Root diseases can show patterns of growth that are particular to that problem
- With aerial photography or a NDVI, it may be possible to see colour differences that may indicate areas of nutrient deficiency and ground truth work is crucial to confirm suspicions

Carrying either paper or digital versions of maps in farm vehicles (utes and tractors, etc.) allows staff to both ground truth information and mark property features. This provides a useful source of information and reference points for future paddock activities.

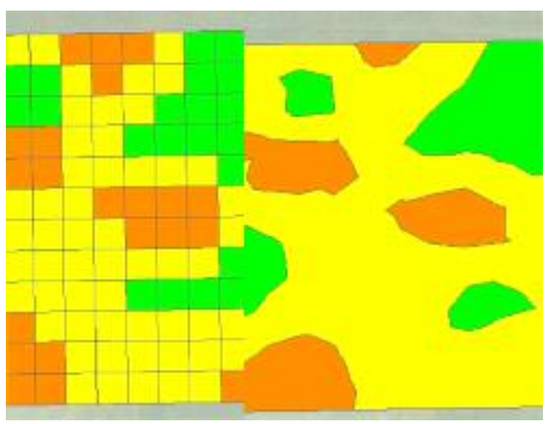
How detailed should I make my zone or grid?

When creating prescriptions for seed, fertiliser or spray operations, you should consider the capabilities of your equipment when choosing the level of detail. You can usually adjust the level of detail in the software.

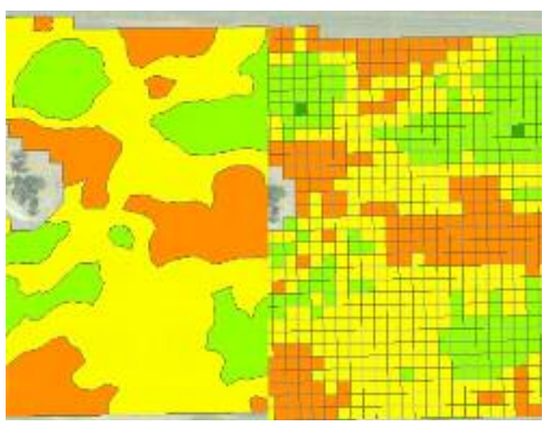
Most precision farming equipment can only change the rate for the whole implement. In these cases, there is less value in creating highly detailed zones, as these may make application less appropriate as the machinery struggles to keep up with frequent small changes.

Machinery with section control can be used to apply different rates across smaller areas.

Most farming software will allow you to adjust this level of detail in the process of creating the zones, from raw data to less detailed grid or zone, or a more detailed grid or zone. The three maps show the same paddock in the three different formats·



Less detailed grid or zone (equivalent to 35m x 35m grid), suitable for most implements.



More detailed zone or grid (equivalent to grids 15m x 15m), suitable for implements with section control.

The most important thing is that the zones are well targeted to address potential issues in the paddock and always retain raw data so it can be used in the future!

Case Study

Paul Rudiger owns 2,500ha near Loxton in the South Australian Mallee, running a legume and cereal enterprise, breeding Murray Grey x Charolais cattle and running a cattle feedlot.

Paul focuses on efficiency gains as he operates the farm on his own with some help from his son Brycen. Keen to make fertiliser applications more precise, Paul had long considered VRT as the next logical step for his farming system, but lacked the know-how to bring the system together. Although he had bought a VRTcapable seeder 12 years ago, the tractor GPS was not connecting to the seeder box GPS even though the systems were compatible.

With the help of a local agronomist and a PA mapping consultant, yield maps were downloaded from Paul's New Holland header and used in conjunction with EM38 data to identify three distinct production zones on the farm.

Combined with soil test results, the consultants formulated a map with variable rate fertiliser rates for each zone, fine-tuned with Paul's knowledge on paddock performance.

A new cable fixed the communication issue between the seeder and the tractor. In 2015 – for the first time – Paul applied VR fertiliser during seeding to boost more productive zones and reduce expenditure on poorer performing areas.

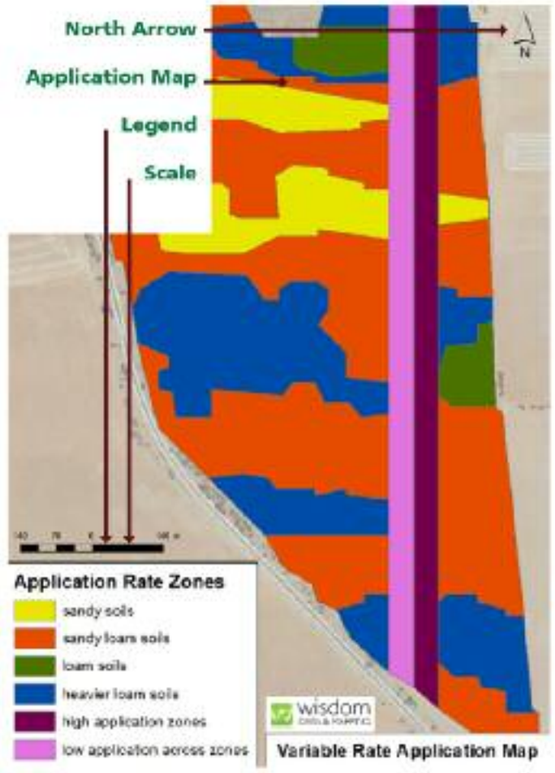
"It's exciting to see the rates changing and knowing that the system works. I can see the benefits of putting fertiliser where it's needed most" said Paul, during seeding 2016. Compared to blanket fertiliser rates, the most significant gains from VRT were $40-$50 per hectare.

Paul also recognises the value that the yield and EM38 maps bring in producing the prescription map. "Once you blend all the information together to produce the prescription map, you get better, more precise information to make correct decisions. Certainly the individual maps show you interesting data, but it's the combination of information that is particularly beneficial".

Paul's advice to other farmers is to consider technology systems and compatibility when buying new machinery.

"Usually the decision to buy a machine is based on other features and the technology is secondary. If you want to be VRT farming, the technology needs to be a primary consideration".

Although Paul has made the decision to stick with one machinery brand, he does admit that the compatibility between different brands is improving all the time.



Using PA maps without zones

Whilst precision farming operations aim to optimise inputs, variable rate applications don't fit well for all farms. For those unable to use variable rate inputs, there is still a range of benefits to developing precision agriculture maps·

- Yield data can be collected so that trends can be identified
- Herbicides can be applied using variable rate control, even if seeding is confined to blanket rates.
- Underperforming areas and longer term trends can be identified and remedied using a targeted approach

A final word

The maps you decide to use within your operation and how you choose to implement them will depend on your specific needs. When choosing a service provider, you should always clearly define your aims to ensure that the correct format is selected.

Farmers looking to survey their own land (i.e. with aerial photography) should be mindful that the expense of buying the required components can render the exercise cost prohibitive, and it is often more effective to use a specialist contractor. However, as the cost of relative technologies decreases, more opportunities for self assessment will exist.

Where to from here?

There are a number of excellent publications containing information on mapping at spaa.com.au/pa-publications.php.

For more information, please contact SPAA on 0437 422 000 or email info@spaa.com.au. You can also connect with us via social media· facebook.com/spaa.inc @SPAA_EO This factsheet was supported by SPAA Society of Precision Agriculture Australia Inc through funding from the South Australian Grain Industry Trust Fund as part of project SPAA115 – Communicating Innovations in Precision Agriculture· Factsheet series.

The case study was funded jointly by Natural Resources South Australian Murray-Darling Basin and the Australian Government's National Landcare Programme. All images supplied by Wisdom Data and Mapping.

Time	Type	Collection method	What is collected	Target Use	Extra Tips
Post season	Yield Map	A sensor measures grain volume moving along the header elevator and records it at close intervals together with precise GPS reference point.	Crop yield, usually in tonnes per ha or some other volumetric measurement, along with exact location of measurement.	Yield maps allow growers to identify paddock areas based on performance and prescribe applications within a paddock in order to maximise profitability.	
In season or post season	Infra Red	An aerial platform such as light plane or drone is flown over paddocks with a specialised sensor. The sensor measures heat radiated, which can show growth rates along with animal or insect activity.	A near infrared image shows crop performance. Some sensors also record estimated temperature.	Data from infra red sensors provides information about crop health that cannot be seen by the human eye. This gives growers an opportunity to determine what factors may be affecting crop performance (stress, disease, pests etc.) earlier, allowing more proactive decision making. They also offer the potential to identify areas of animal activity in dense vegetation or insect activity in horticultural crops. Near infra red generally works over shorter distances.	There is a range of closely related infra red sensor types known as hyperspectral sensors. Most are too expensive for agricultural applications but research and development in this area is advancing all the time.
In season or post season	Aerial Photography	An aerial platform such as light plane or drone is flown over paddocks, collecting images with a camera.	Large scale, aerial view of crops.	Aerial photography is useful in baseline mapping, identifying underlying issues and verifying other data types.	
Post season	EM 38	A sensor is pulled along behind the vehicle on a sled for close ground contact. Electromagnetic pulses are directed into the ground, and the returning pulse is measured.	EM38 data is used to identify and measure soil types, especially at depth.	Soil maps assist growers in better understanding their soil types and applying variable rate applications to maximise profitability. It should always be used in combination with deep soil testing so the EM38 results can be matched with actual soils. Provides another layer of information which can be paired with other sensors to give a fuller picture of the target soils.	EM38 works best in landscape types where there is a large variation in soil texture such as dune swales. EM38 sensors do not return consistent results in soils with high levels of rock. It can be used in conjunction with other techniques such as gamma radiometrics to provide an accurate soil picture where EM38 is unsuitable alone.
Post season	Gamma radio metrics	Ground platform such as ute or tractor.	Measures levels of background radiation emitted by soil and rocks.	Light mapping can be used with data from other sensors (i.e. EM38) to provide a more complete picture of soil condition.	
Post season	Light mapping	A specialised instrument - towed behind a ute - that uses an optical sensor behind a sapphire plate to measure reflectance from the soil.	Soil organic matter content.	Input decisions can be adjusted for areas of high/low crop performance.	Still in trial stages in Australia.
In Season or post season	NDVI (Normalised differential vegetation index)	Collected aerially, via a plane or drone. Four band aerial photography with the bands tuned to show high growth areas of vegetation.	Crop biomass	As well as understanding crop nitrogen needs, connecting nitrogen sensors to a rate controller allows real time, variable rate fertiliser applications.	
In season	Nitrogen Sensing	A unit mounted to a tractor senses light reflectance from the crop during one or more in crop pass.	Crop nitrogen status	pH maps provide farmers with a guide to managing unfavourable pH conditions, i.e. by adding lime to acid soils.	Nitrogen sensing brands include CropSpec (Topcon) and Greenseeker (Trimble)
Post Season	pH mapping	Soil samples are collected for pH testing, generally in a laboratory. Advanced machines can collect and test soil samples in real time, on location.	Soil pH status.	During harvest, grains can be blended based on protein status to ensure each truckload makes the highest possible grade at the silo.	
In season and post season	Protein mapping	Header based instrument measures grain protein levels.	Protein value of harvested grain	Protein maps can also be used during the following season, i.e. adding higher levels of nitrogen to increase crop protein.	

NSW Department of Primary Industries is a state government organisation that aims to assist the community with the production of quality food and fibre for domestic and export use. The functions of NSW Department of Primary Industries are research, advisory and regulatory for both agricultural plants and animals. The Department has several research stations and centres located around the state specialising in various agricultural production areas.

The Condobolin Agricultural Research & Advisory Station (CARAS)
The research station has been part of the local agricultural community since 1912 when it was established as a demonstration farm. There have been many varied projects run at the station over the years.

Current Agronomy Research Projects
Southern Barley Agronomy, Frost Project, Optimising Canola Profitability (canola agronomy), pulse agronomy, VSAP (Variety Specific Agronomy Packages). Barley, wheat, canola, field pea and chickpea research trials are conducted across the central west of NSW under the above projects based out of Condobolin Research Station.

NVT (National Variety Testing) trials are conducted at CARAS - testing wheat, barley, oats, canola, field pea and lupin.

Collaborative work is conducted at CARAS in conjunction with SARDI (barley), Intergrain (wheat, barley), CSU – Wagga Wagga (weed suppression) & CWFS (stubble management). Approximately 6000-8000 plots are sown on an annual basis at CARAS.