

Why bother about vineyard variability ?

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ECOSYSTEM SCIENCES/SUSTAINABLE AGRICULTURE FLAGSHIP

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A sound philosophy to underpin viticultural decision-making

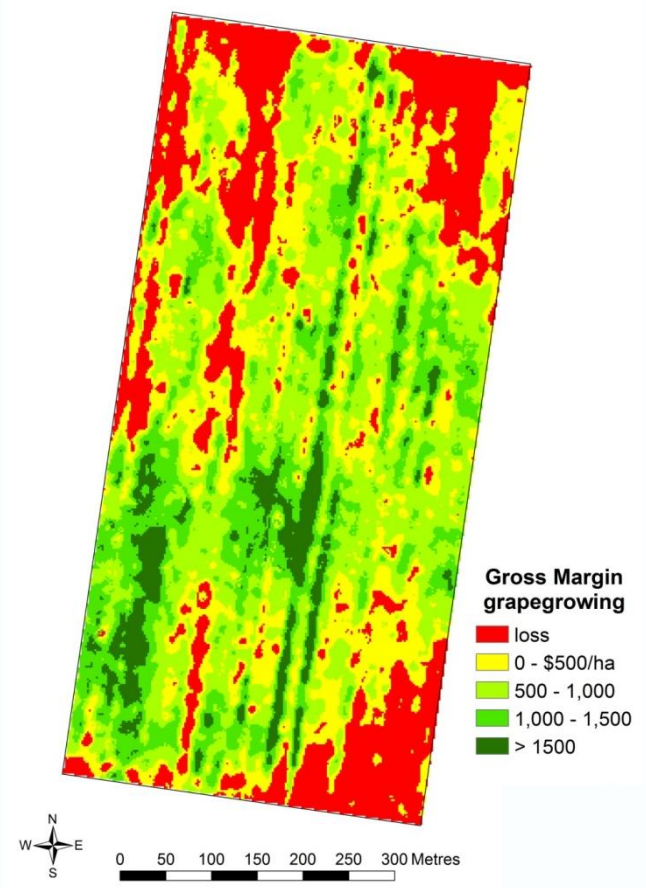
"The overall philosophy is to get it right in the vineyard with a healthy and sustainable vine and soil balance to produce sound, flavoursome grapes."

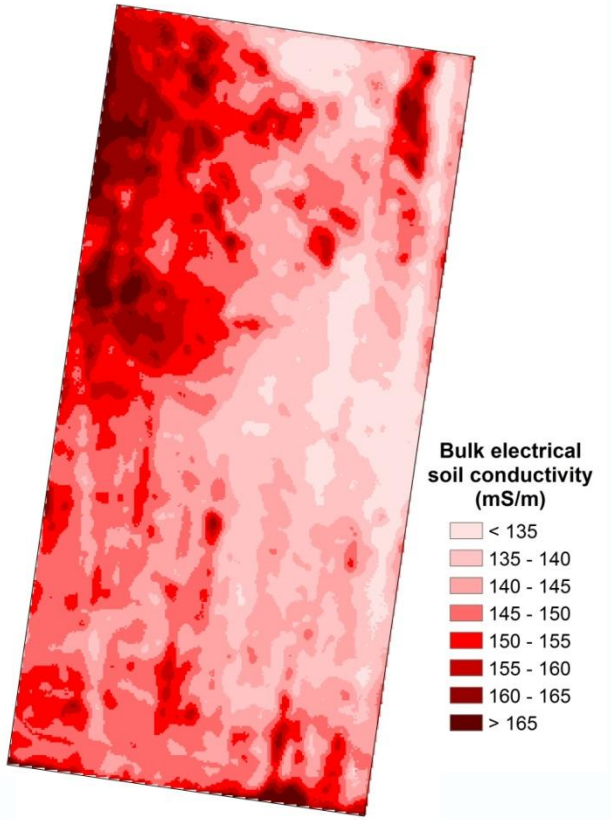
Troy Kalleske – Kalleske Wines 2005 'Greenock' Shiraz

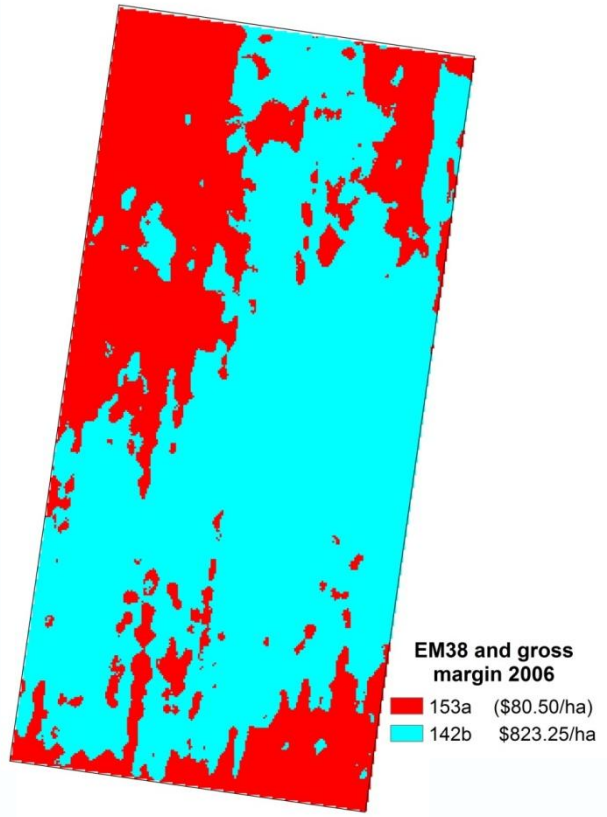
(*Aust. NZ Wine Ind. J.* 22(3) 76-77 – Shiraz Varietal Report)

- **Philosophy and implementation are not the same thing**
  - **So how should this philosophy be implemented ?**
  - **How should viticulturists go about "getting it right" ?**
  - **How will they know when it is ?**
  - **What are the effects (desirable or undesirable) of perturbations to "vine and soil balance" ?**
  - **Is there a $ in it ?**

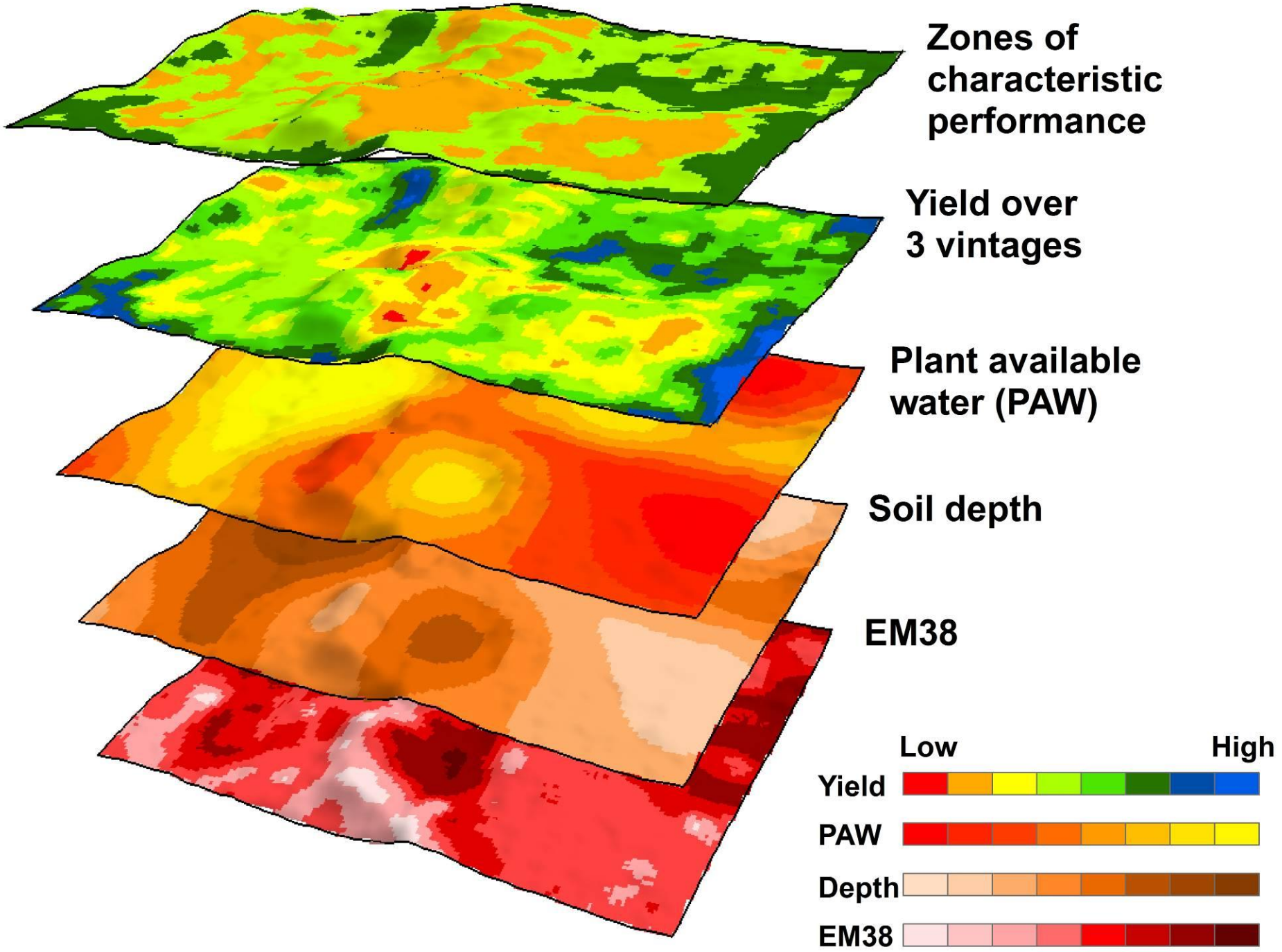
Understanding limitations to production (and that they are variable) is valuable



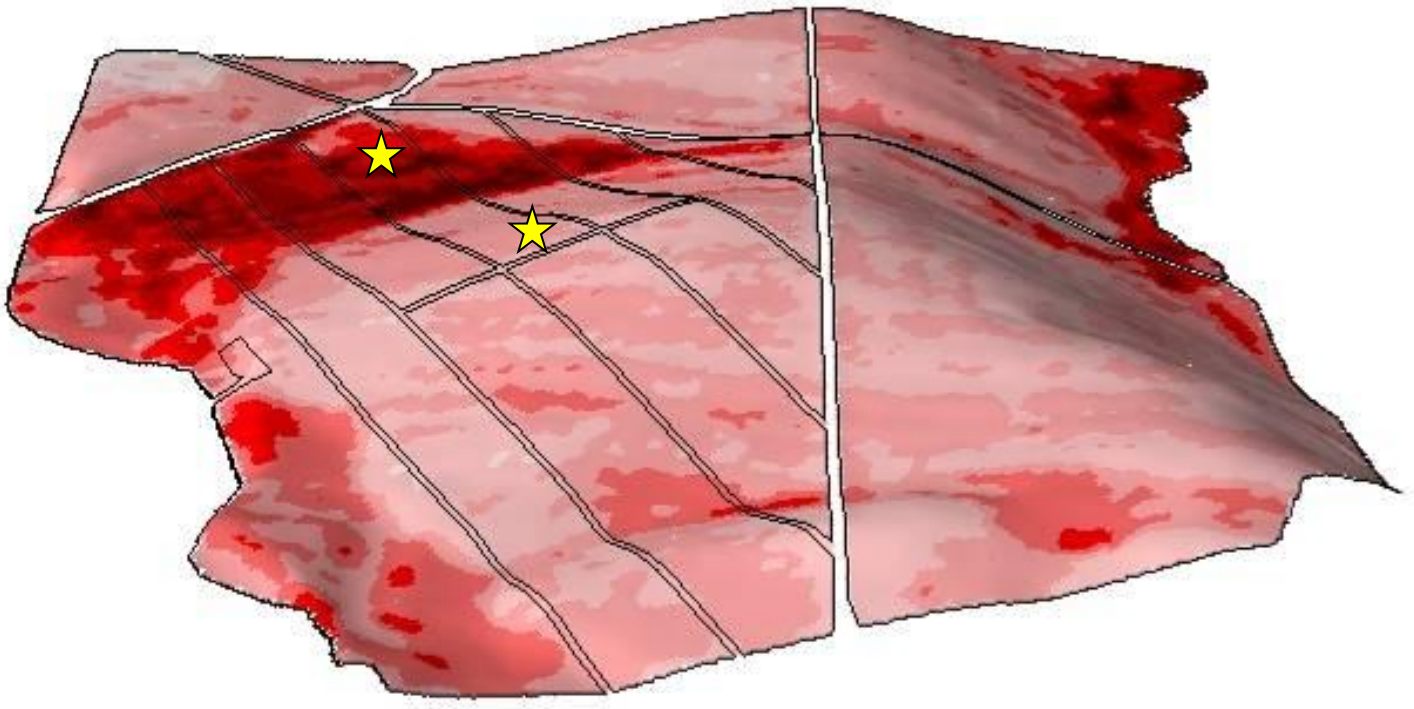





Coonawarra 5-15 cm


Zones of characteristic performance
Yield over 3 vintages
Plant available water (PAW)
Soil depth
EM38
Low
High
Yield
PAW
Depth
EM38

EM38, elevation and a changing soil profile

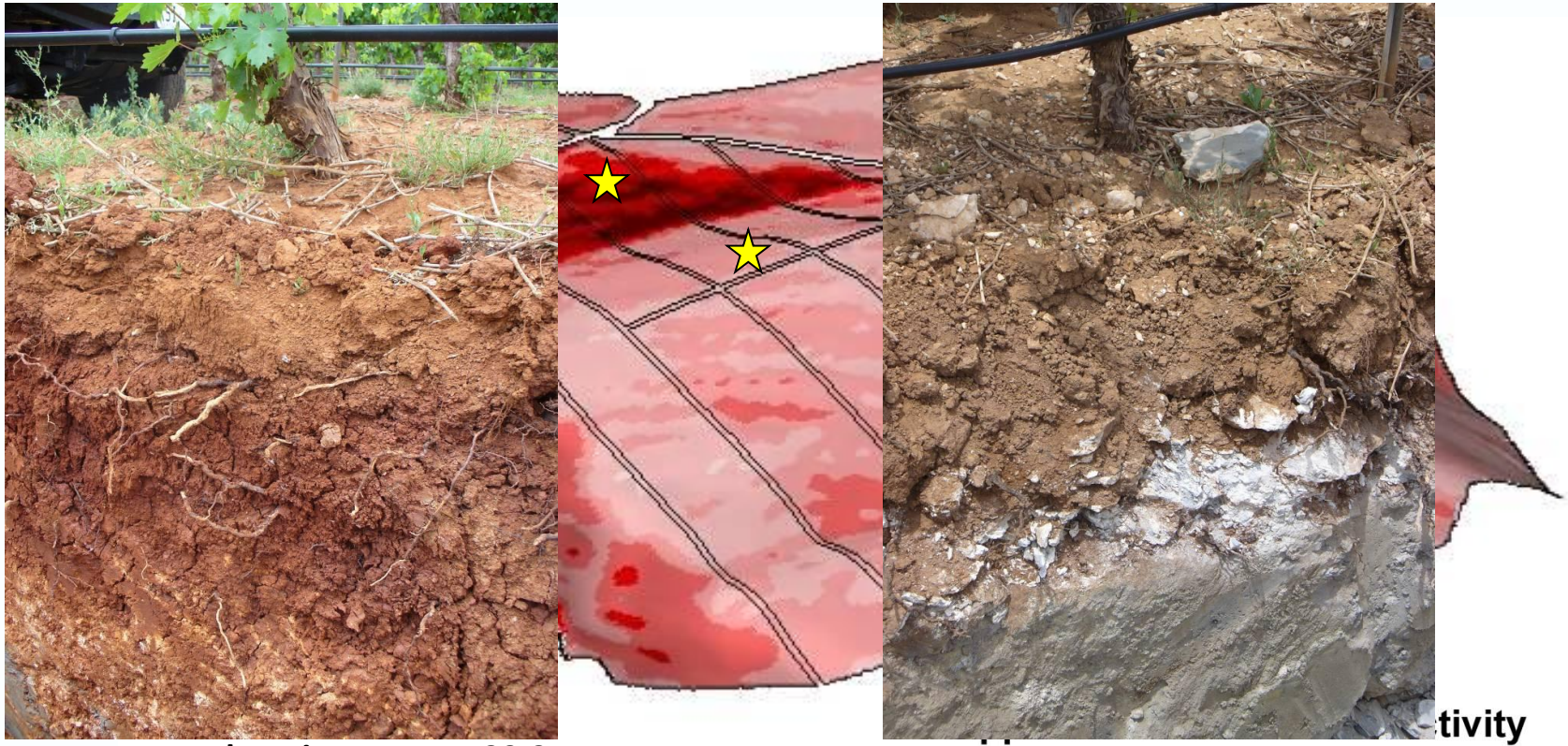


Elevation range = 29.2m

Apparent electrical conductivity EM38 horizontal (dS/m)

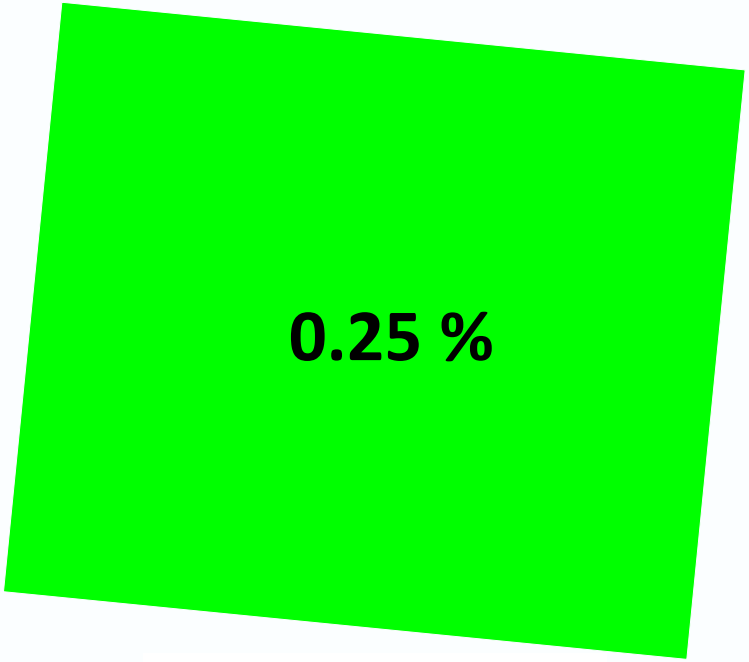
< 0.2	0.65 - 0.8
0.2 - 0.35	0.8 - 0.95
0.35 - 0.5	0.95 - 1.1
0.5 - 0.65	> 1.1

EM38, elevation and a changing soil profile

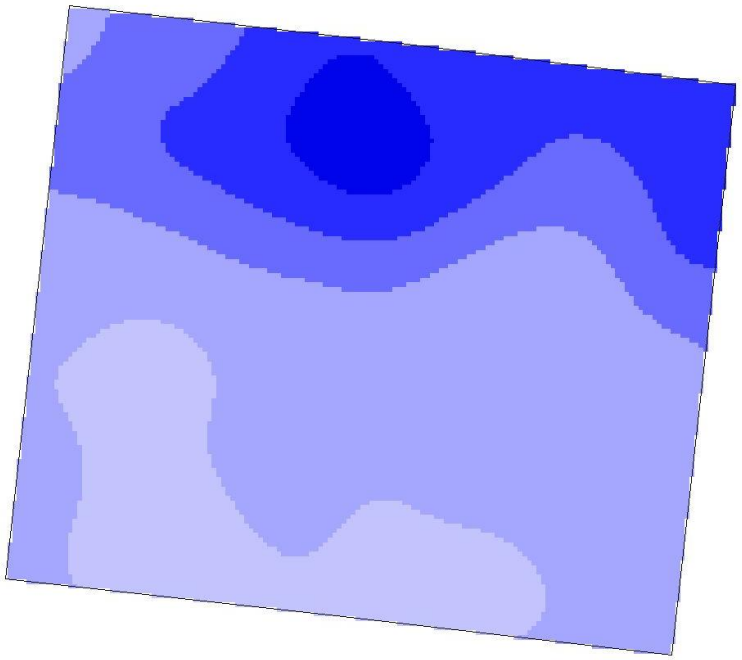


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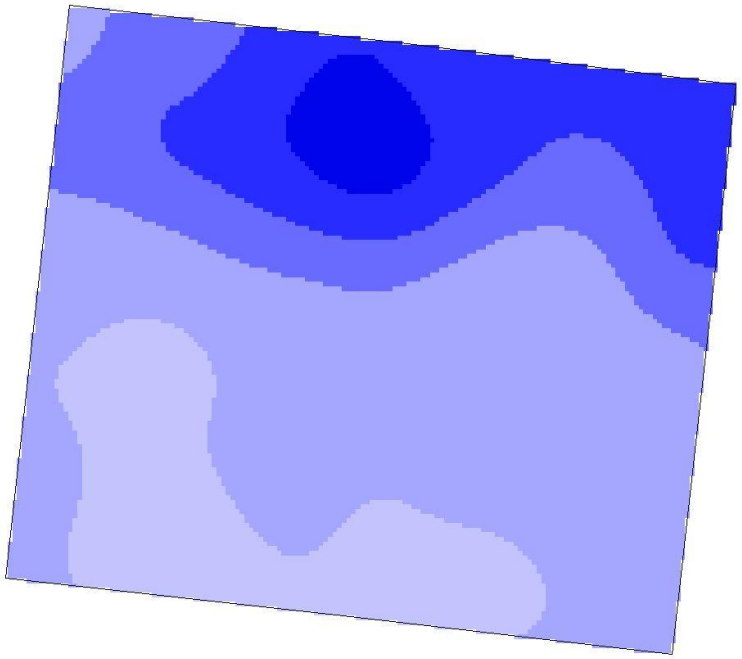
Using knowledge of spatial variation to make better decisions – the example of petiole P



Using knowledge of spatial variation to make better decisions – the example of petiole P



Using knowledge of spatial variation to make better decisions – the example of petiole P



Petiole P (%)

- <0.15
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- >0.4

Mean = 0.25 % (n=190)

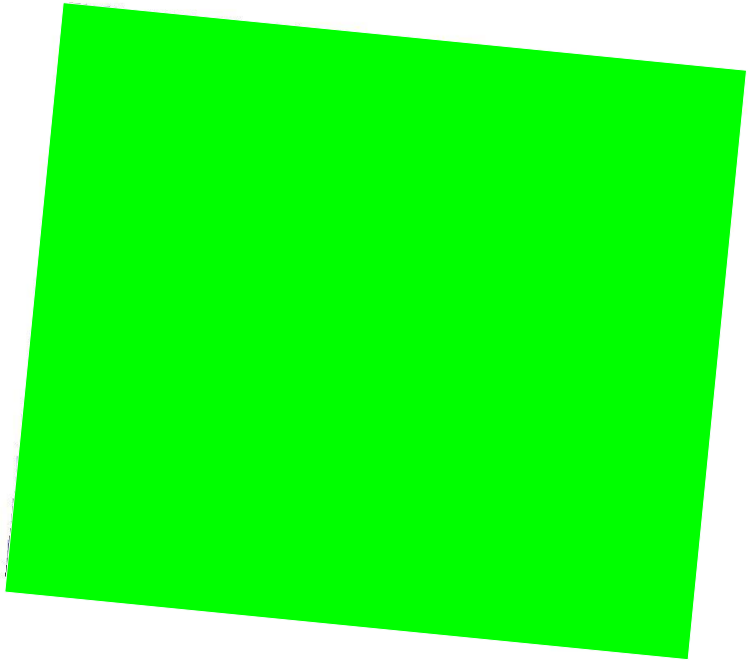


Interpretation

- Deficient (<0.2)
- Marginal (0.2-0.24)
- Adequate (0.25-0.5)
- High (>0.5)

Reuter & Robinson (1997)

Which one of these maps would help you make the best decision ?



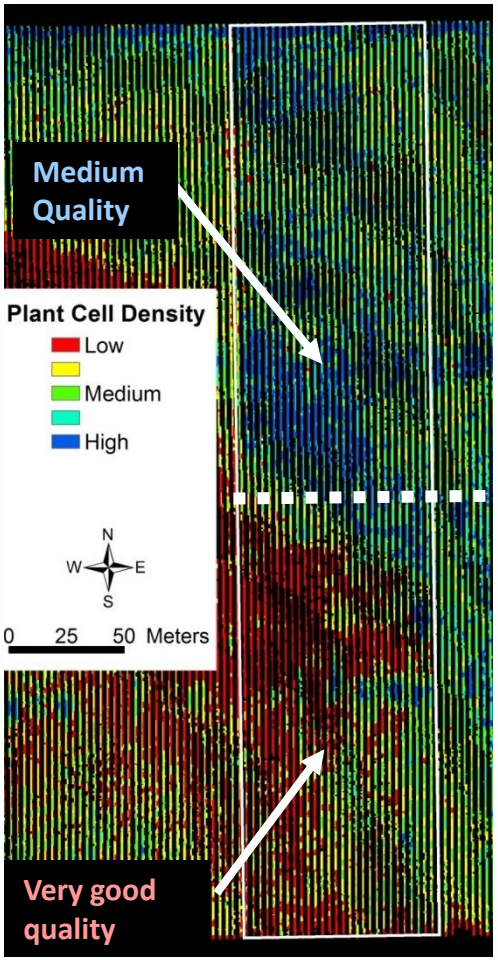


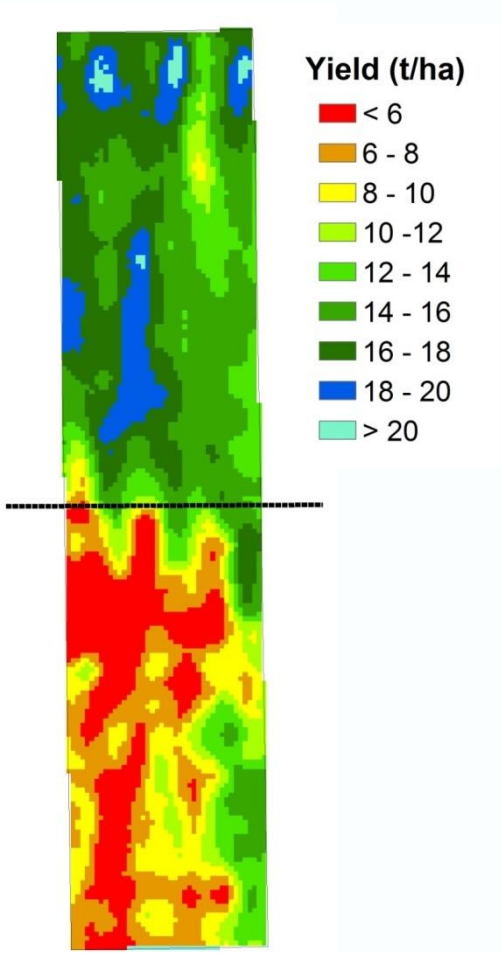
Interpretation

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Reuter & Robinson (1997)

Understanding variability is profitable





N section

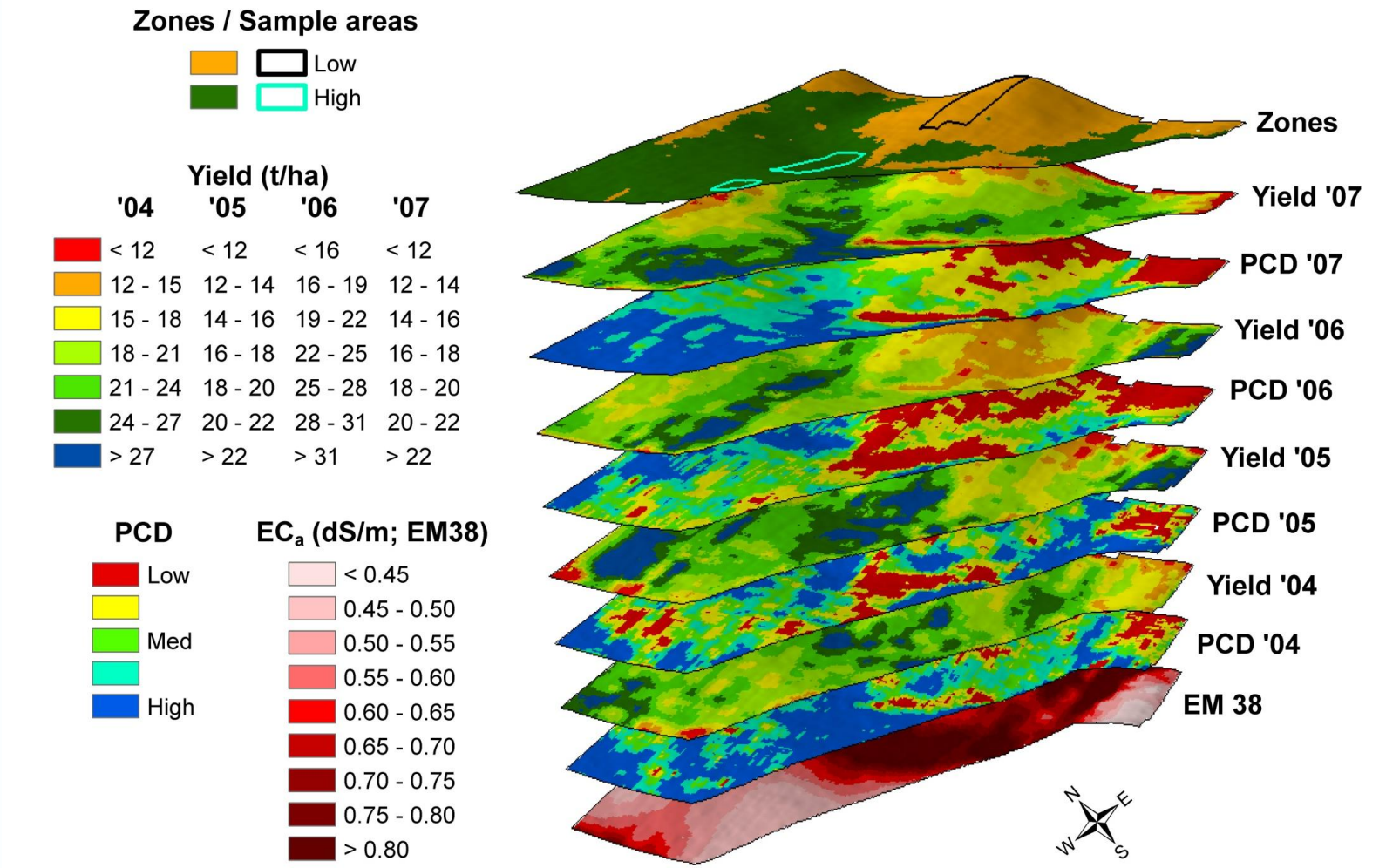
High Yield
(mean 16 t/ha)
'Classic Dry Red'
(≈ $19/bottle)

S section

Low Yield
(mean 8 t/ha)
Cabernet Sauvignon
(≈ $30/bottle)

Increase in retail value of production > $42,000/ha

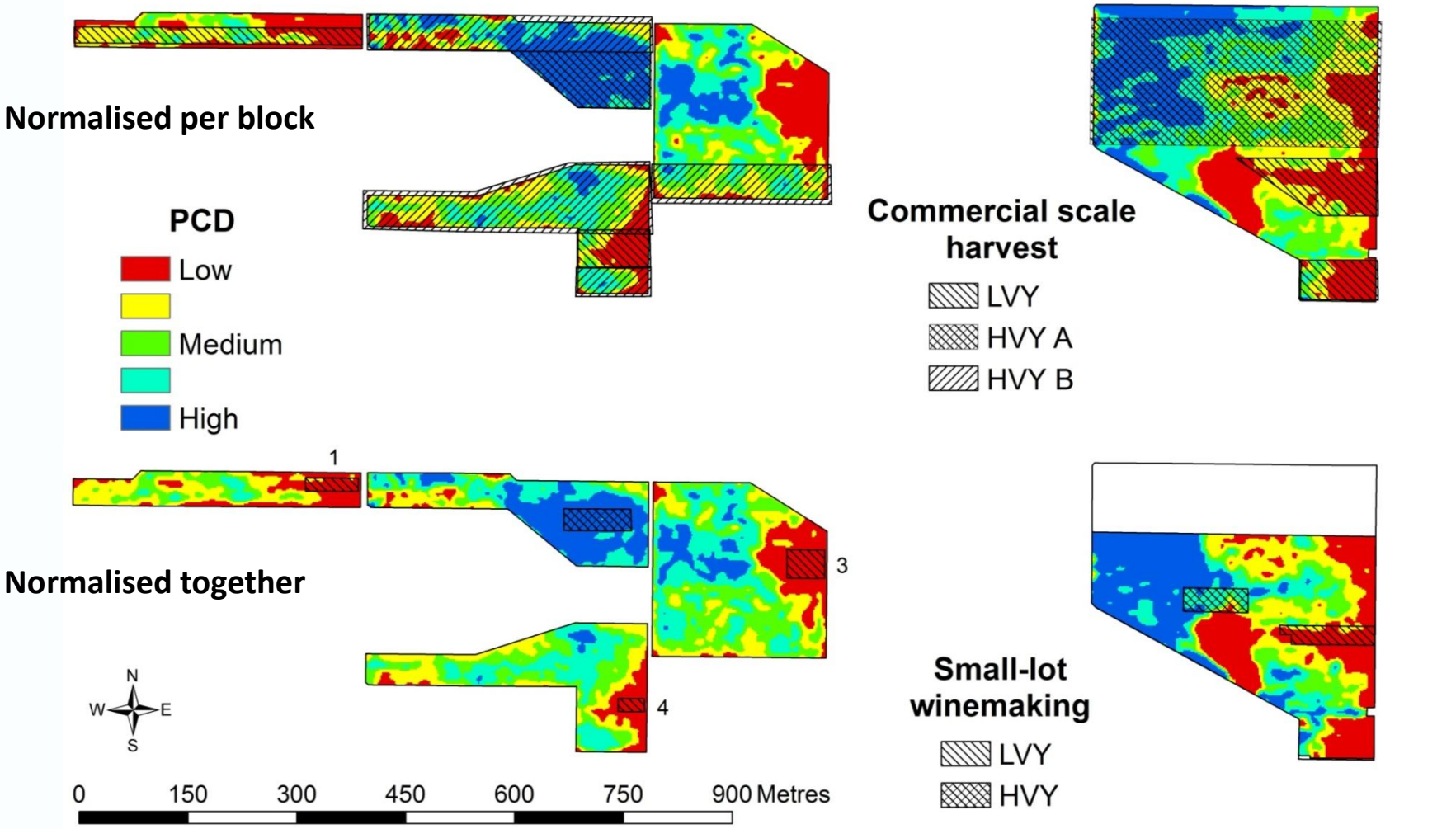
Understanding vineyard variation – Deakin Estate



Deakin Estate



Matching like parcels of fruit – vintage 2009



Bramley et al. (2011) Aust. J. Grape and Wine Res. **17**, 298-305

Benefits of multi-block selective harvesting

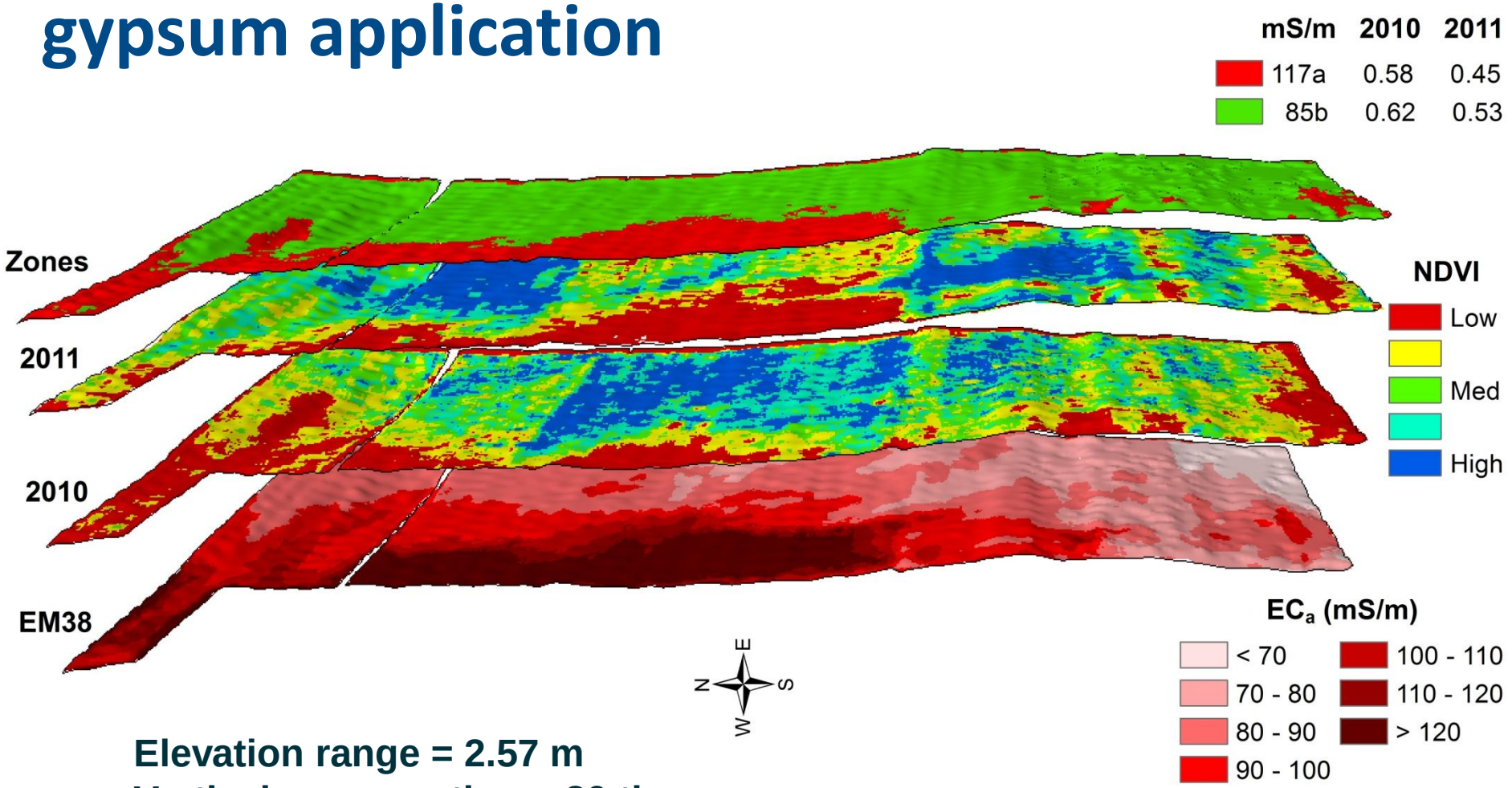
- **So long as the price differential between the HVY and LVY fruit is greater than $39/t, then selective harvesting delivers a benefit.**
  - **In 2009, prices received for grapes were $423 (HVY) and $520 (LVY)**

- **Benefits to the winemaker are potentially quite large:**
  - **For a $5/bottle differential (wholesale) between 'premium' and 'super-premium', the net benefit of the selective harvesting = $249,492 ($9,980/ha or $1,211/t)**
  - **When this differential is only $1/bottle, the net benefit = $45,492 (1,820/ha or $221/t)**

    (net of harvest costs)

Further information: Aust. J. Grape and Wine Res. 17, 298-305.

A sugar industry example – variable rate gypsum application



Elevation range = 2.57 m
Vertical exaggeration = 30 times

Uniform management is a sub-optimal strategy – a Burdekin example

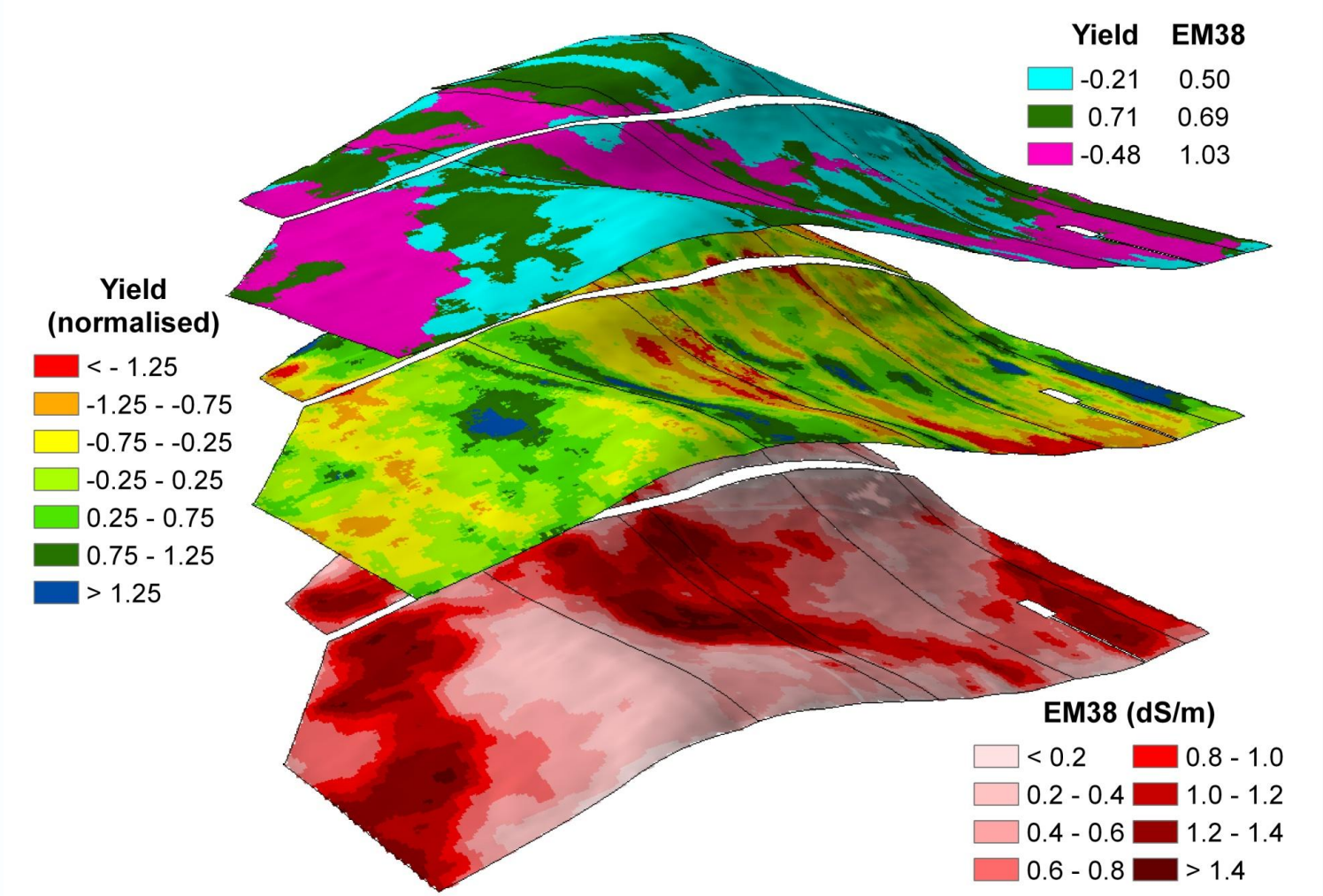
- Instead of applying gypsum at 3.5 t/ha uniformly, a better strategy might be to apply 6 t/ha in the sodic areas and a maintenance application (1 t/ha) over the rest of the block
  - Invest in resources where they are likely to deliver greatest benefit
- Gypsum costs $150/tonne spread

- Uniform application to 26.7 ha @ 3.5 t/ha = $14,018 or $525/ha
- Variable rate application: 6.4 ha @ 6t/ha = $ 5,760
- 20.3 ha @ 1t/ha = $ 3,045
- $ 8,805 or $195/ha
- Variable rate saving vs uniform application = $ 330/ha

Understanding variability for improved management of the land resource

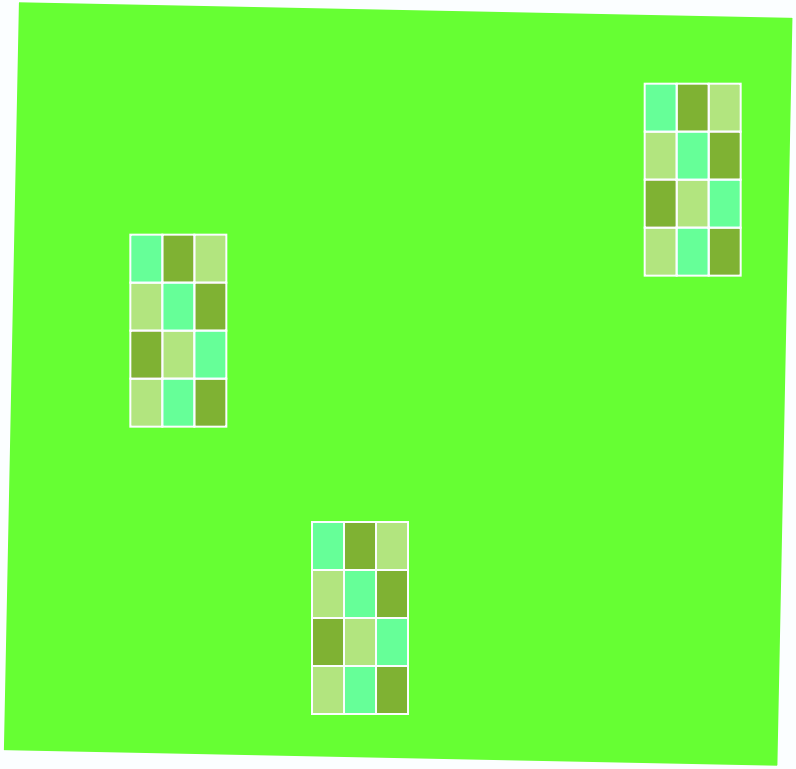


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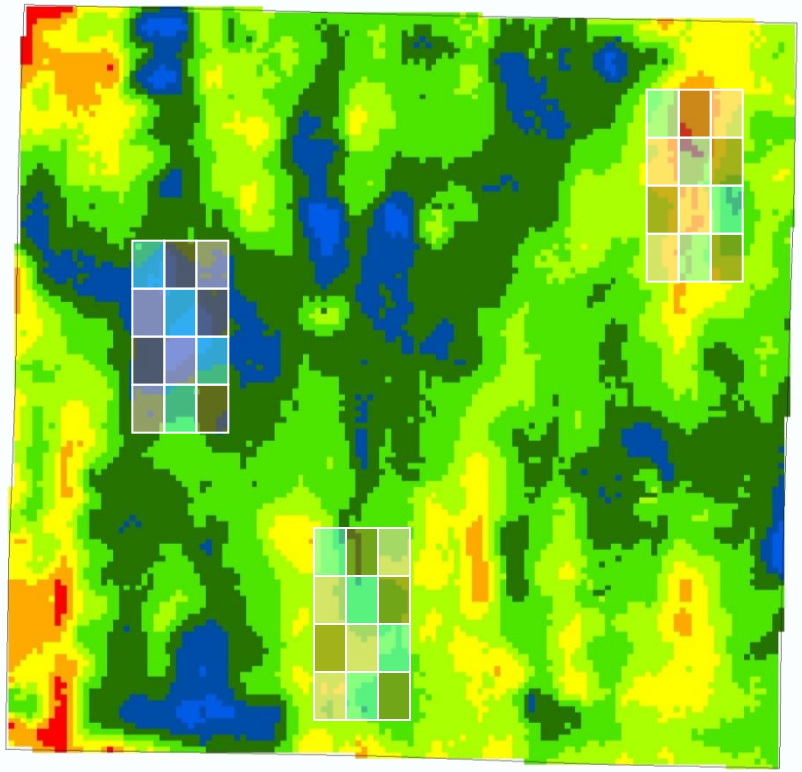
Vineyard variability and experimentation

- Randomised plots
- Imposed treatments
- ANOVA
- Many assumptions
  - All the variation in the response is composed additively of a treatment effect and a random component – treatment effect is assumed constant across the experimental area.
- But fine for questions like: "Do grapevines need P to grow ?"

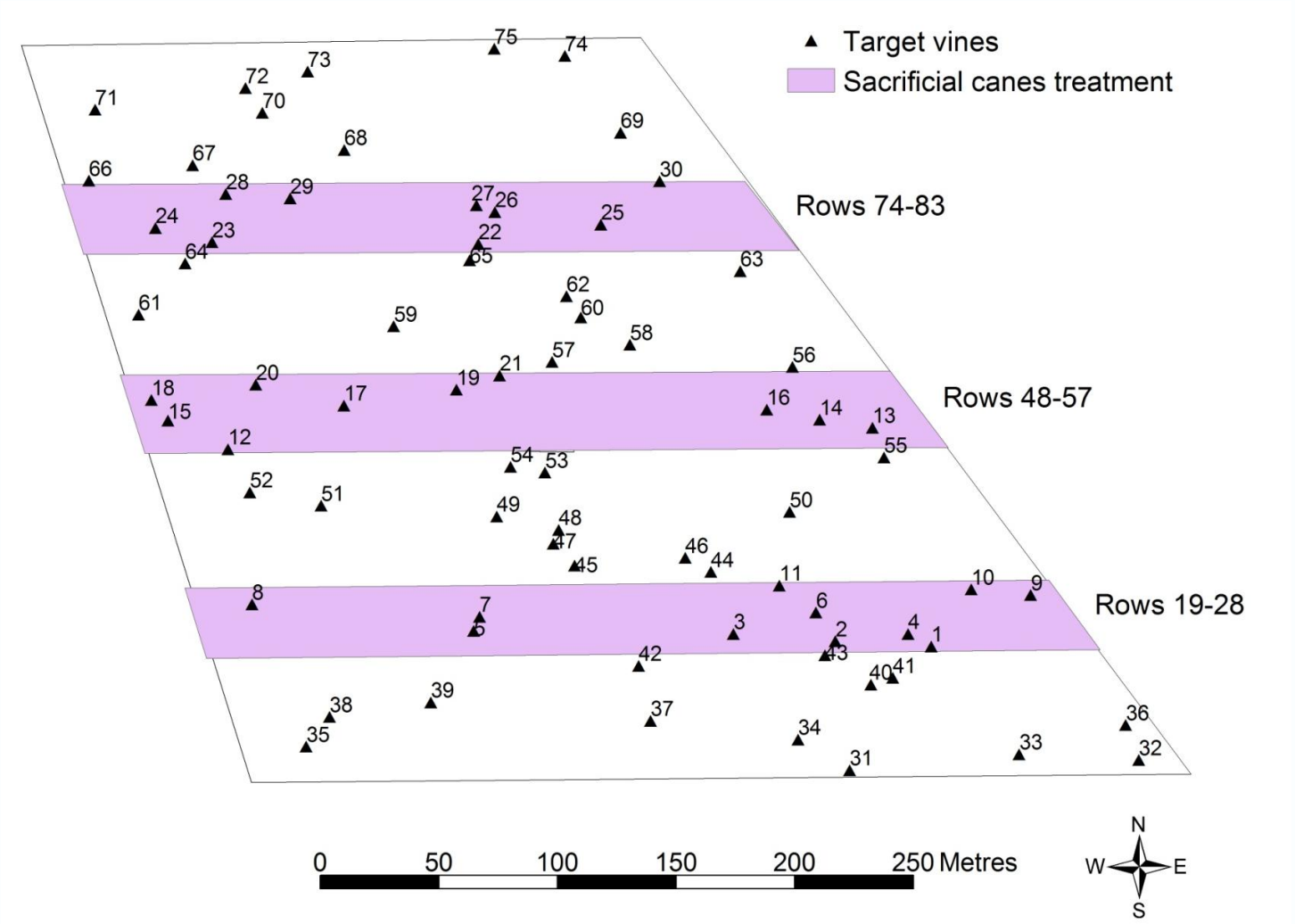


How researchers can get it wrong

- Randomised plots
- Imposed treatments
- ANOVA
- Many assumptions
- But fine for questions like: "Do grapevines need P to grow ?"
- Not fine for questions like: "How much P do I need for my vines to meet my fruit yield and quality targets ?"
- NB. Potential importance of covariates – "Krige's relation"



How growers can also get it wrong
Sacrificial canes experiment - Padthaway



Control – normally pruned



Sacrificial canes retained

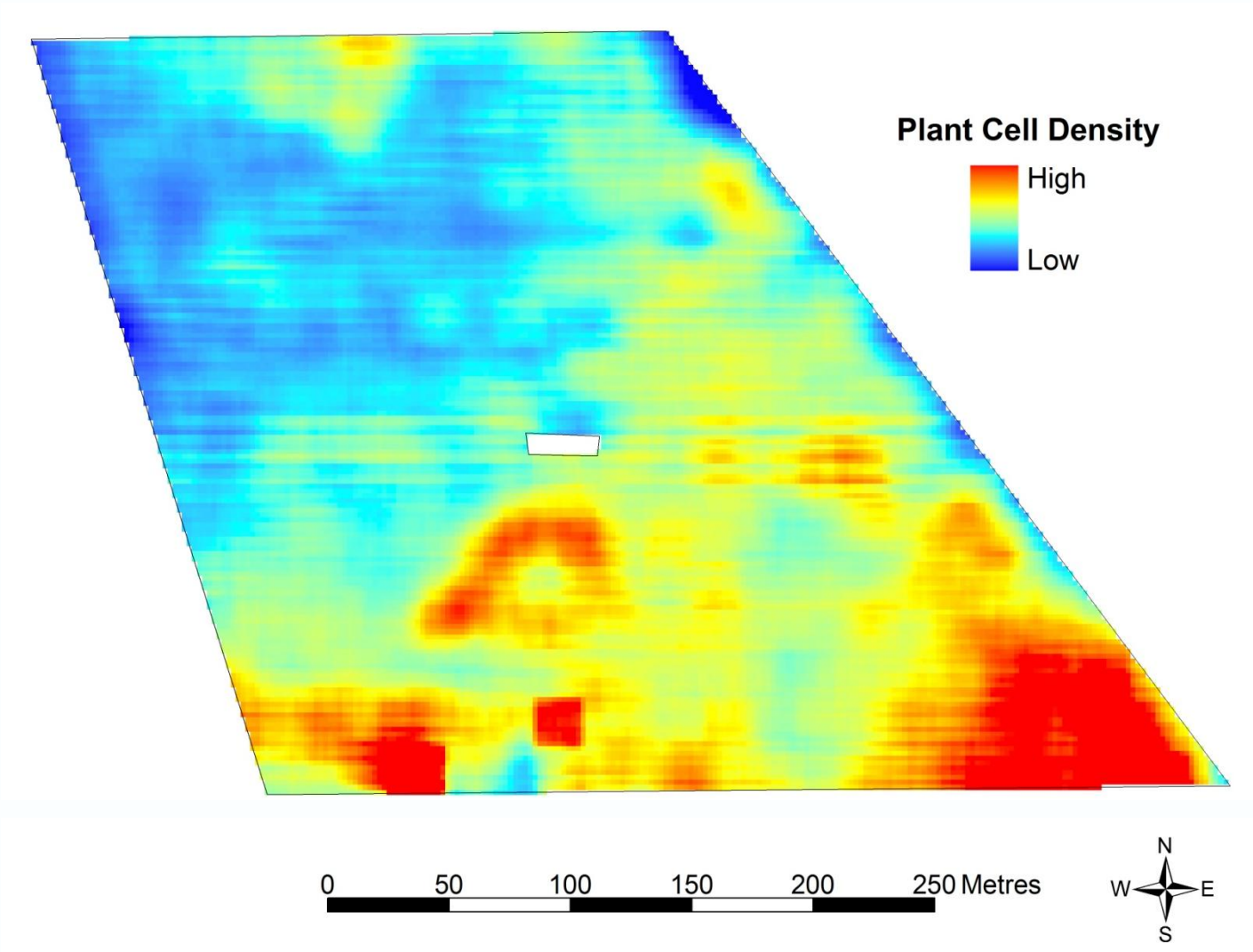


Sacrificial canes experiment - Padthaway

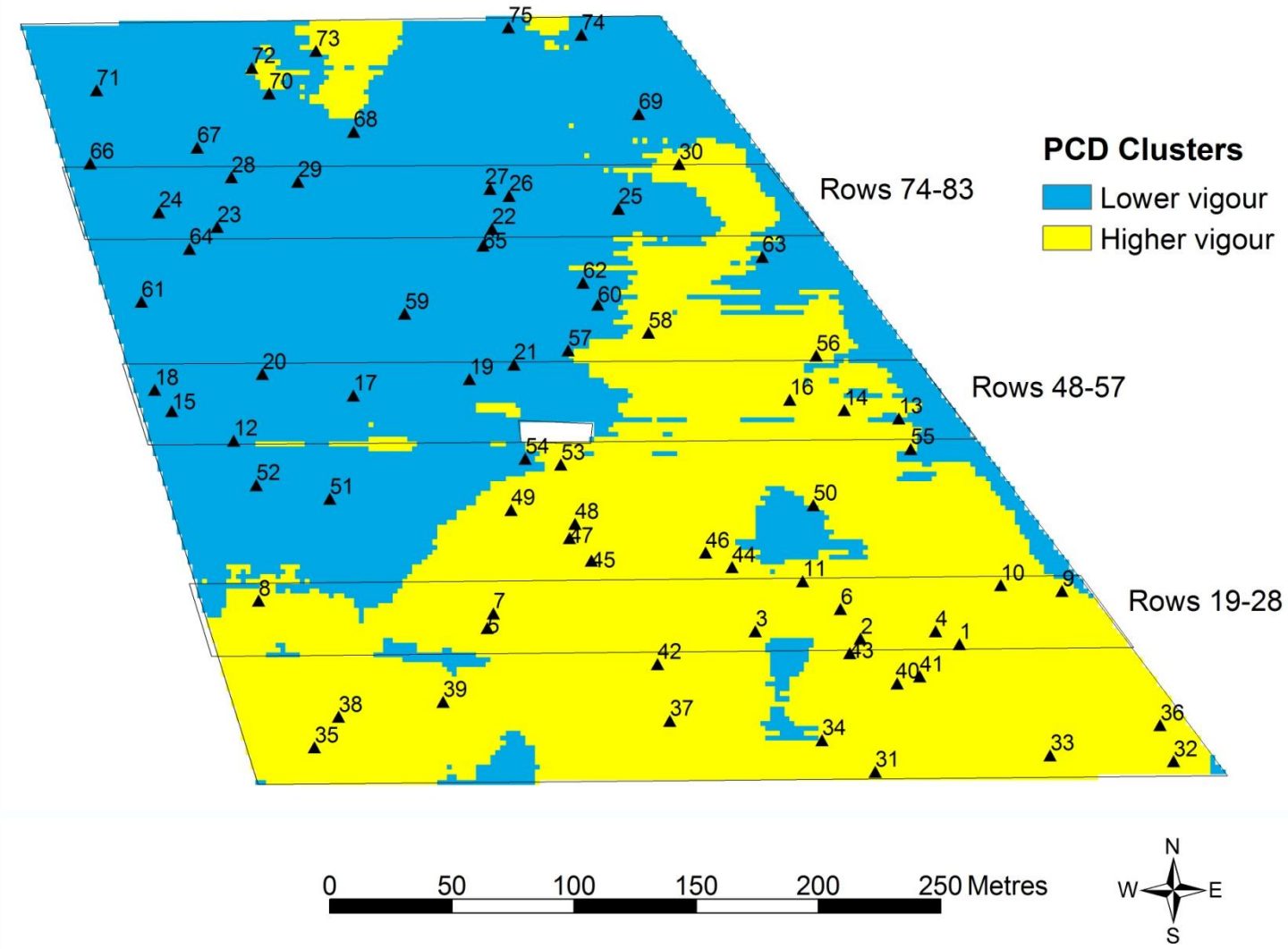
A. Comparison between control and sacrificial canes – the viticulturists experiment.

	Yield (kg m^{-1})	Bunch No.	Bunch wt. (g)	Berry wt. (g)	Berries Bunch^{-1}	Baumé (°Bé)	pH	TA (g L^{-1})	Colour (mg g^{-1})	Phenolics (a.u g^{-1})
Control	6.52^{a}	28.0^{a}	136.1^{a}	1.16^{a}	117^{a}	13.3^{a}	3.47^{a}	6.76^{a}	1.75^{a}	1.31^{a}
Sacrificial	4.88^{b}	28.5^{a}	103.6^{b}	1.10^{a}	93^{b}	13.3^{a}	3.39^{b}	6.95^{b}	1.76^{a}	1.32^{a}

Sacrificial canes experiment - Padthaway



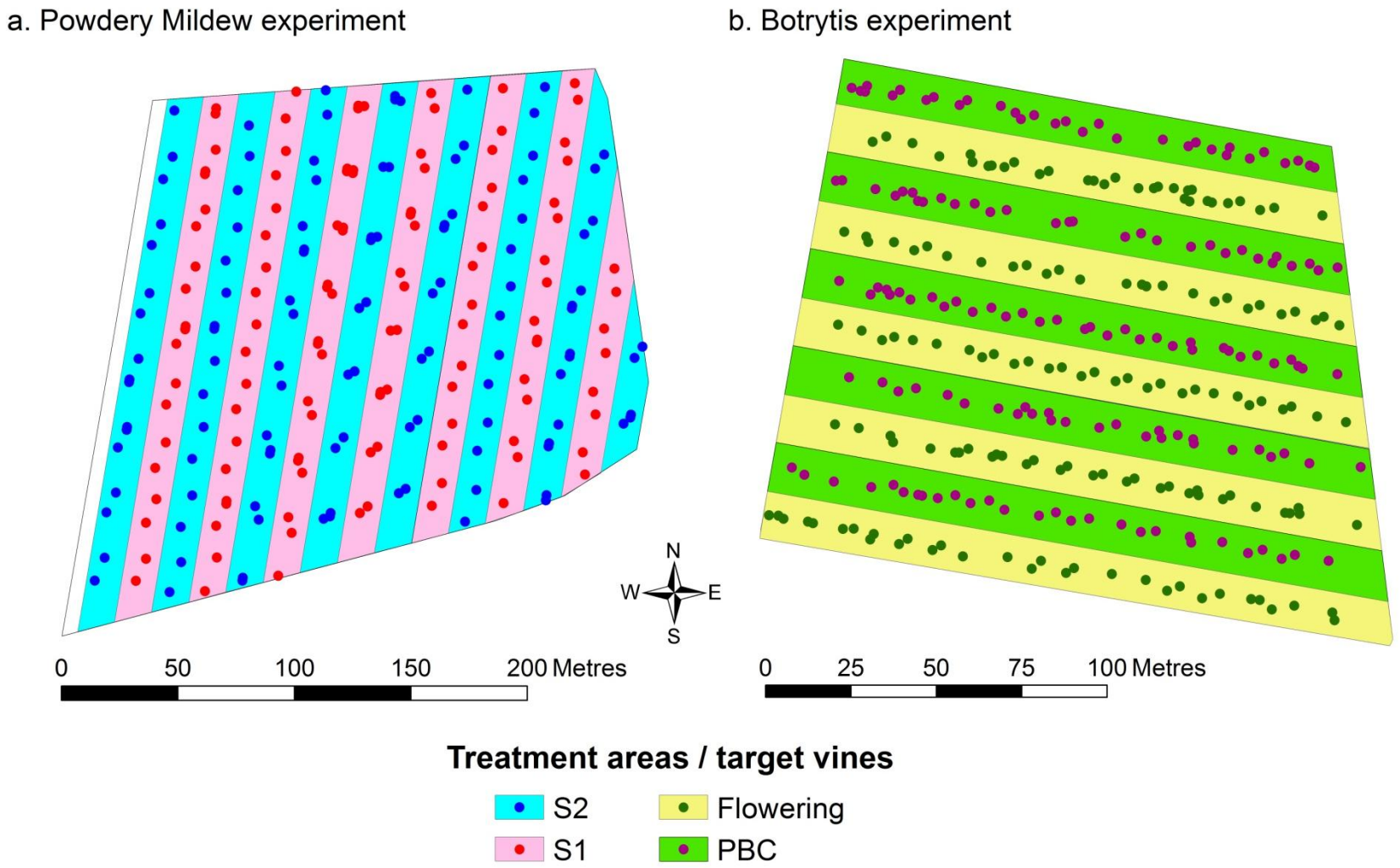
Sacrificial canes experiment - Padthaway



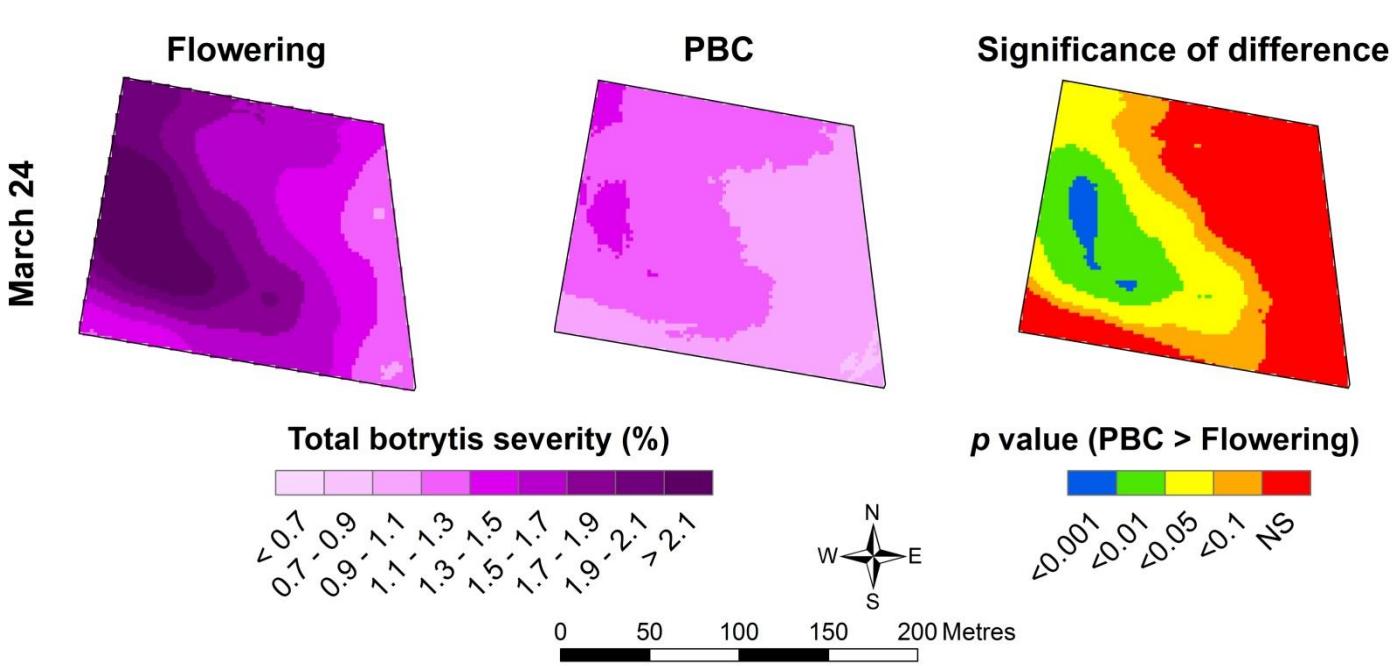
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B. Comparison between PCD/vigour classes, independent of treatment.										
Low PCD	4.46^{a}	25.4^{a}	107.9^{a}	1.03^{a}	104^{a}	13.7^{a}	3.45^{a}	6.71^{a}	1.92^{a}	1.41^{a}
High PCD	7.22^{b}	31.0^{b}	137.9^{b}	1.24^{b}	111^{b}	12.9^{b}	3.43^{a}	6.96^{b}	1.59^{b}	1.22^{b}

Do the experiment over the whole block

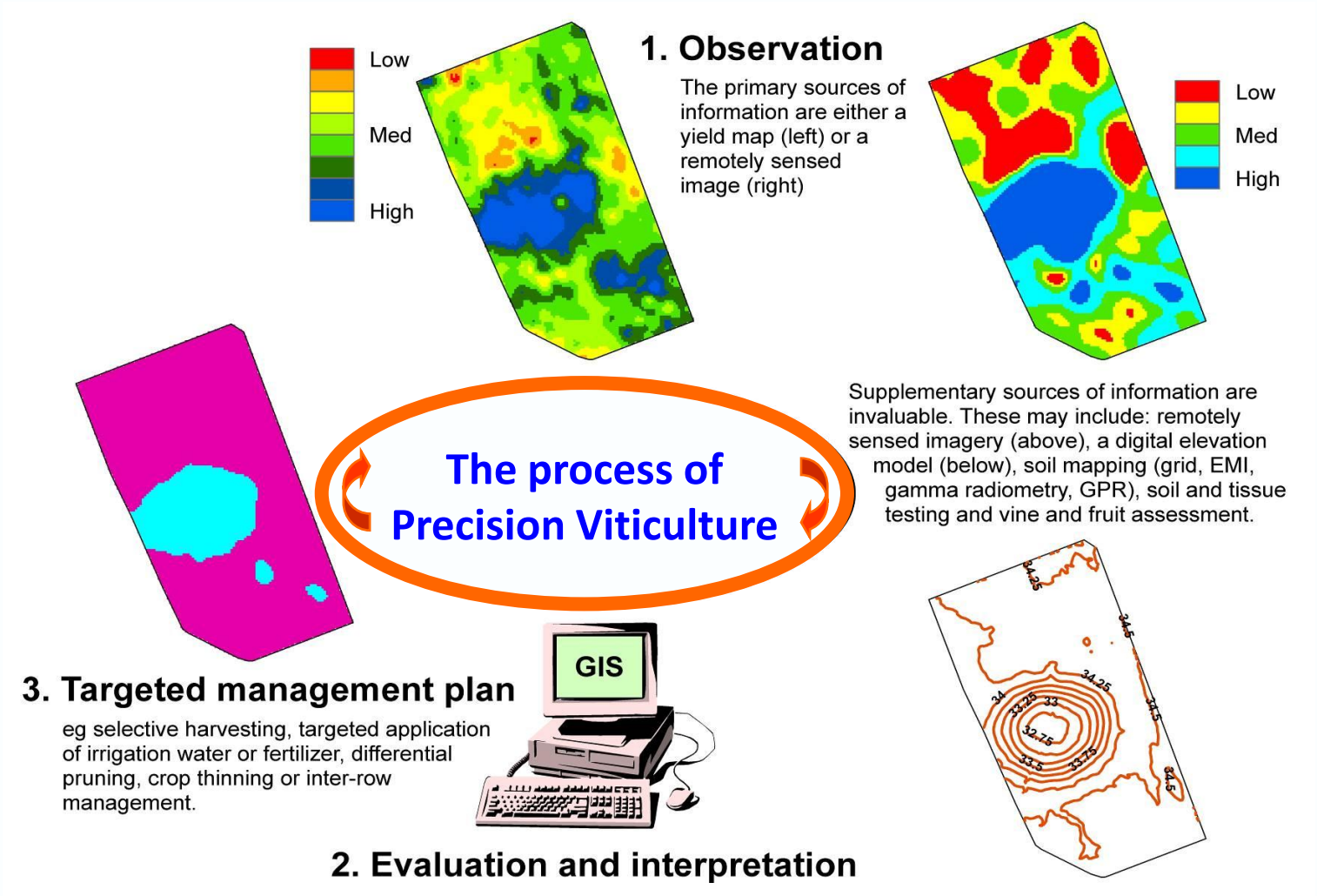


Botrytis experiment – timing of sprays

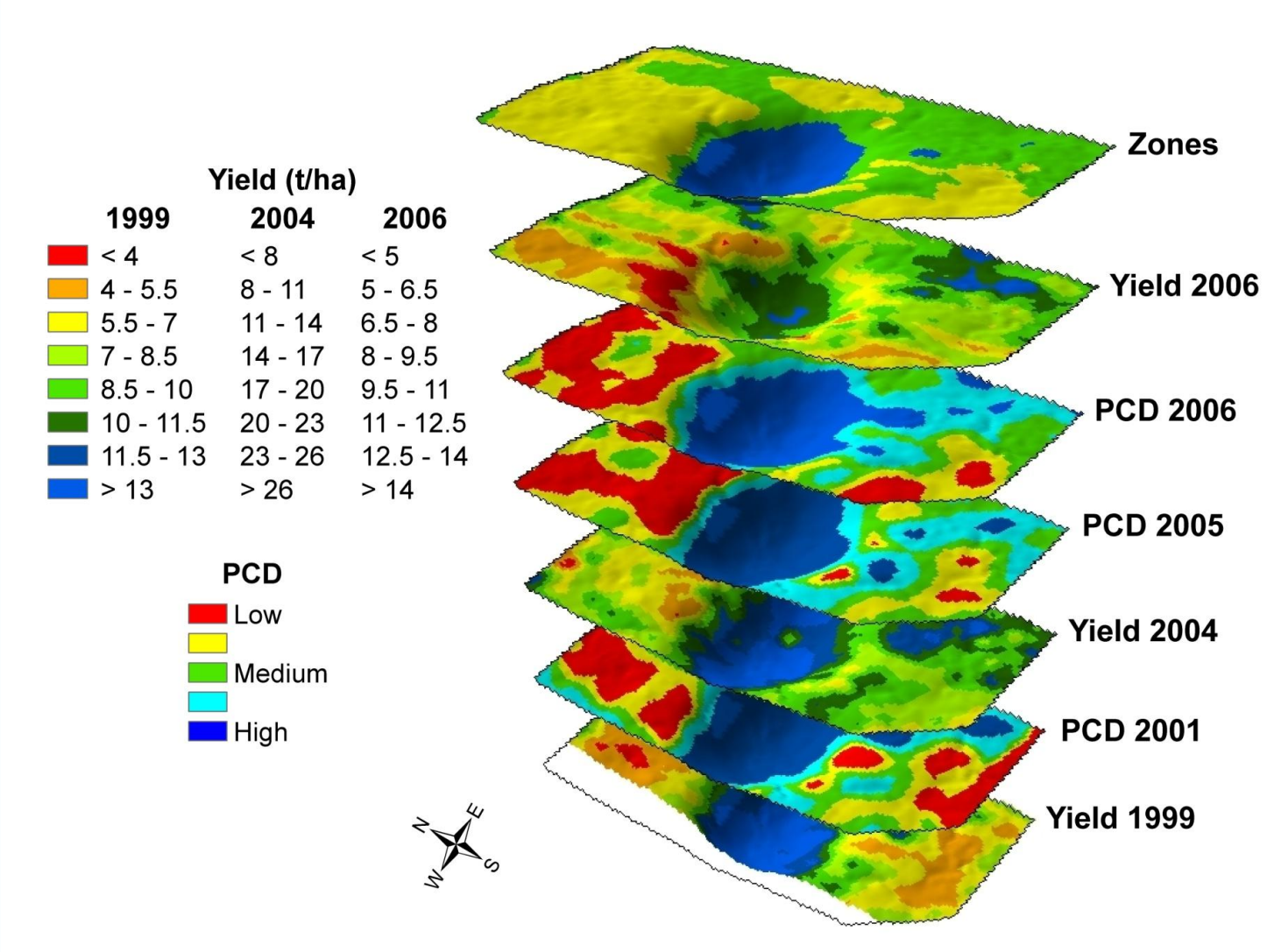


- **For experiments involving sprays, there is an important additional benefit in using the whole-of-block approach from an extension / farmer realism perspective...**
  - **The treatments can be implemented using the farmers' own spray rig – v. different to a back-pack !**

Precision Viticulture is about understanding vineyard variability and so making better management decisions



A sound basis for "*getting it right*"



So, why bother about vineyard variability ?

- **Because you should !**
  - Vineyards are variable; the uniform vineyard does not exist
- **Because you can !**
  - Whereas in the past, inability to (sometimes) see and manage variability has meant that uniform management has been the default, the tools of PV are now readily and cost-effectively available to assist in recognising and taking advantage of variability.
- **Because doing so will help improve your decision-making...**
  - *"...get it right in the vineyard..."*
  - Improved resource-use efficiency
  - Opportunities for product differentiation (and telling a better story)
- **...and improve your profitability**

Industry attitudes to adoption of PV

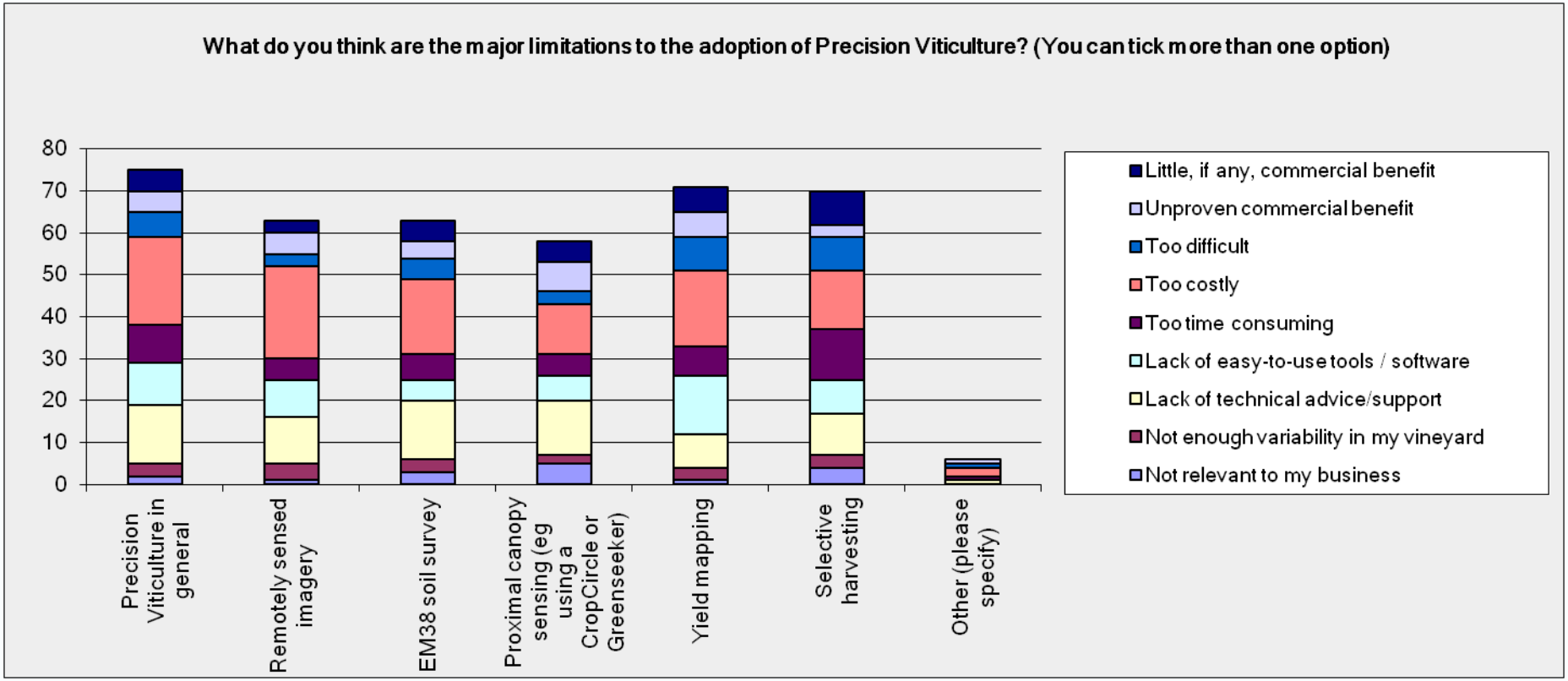
- **66% survey respondents believed that PV is already delivering or will most likely deliver a benefit to their business.**
- **74% expected to be using at least some aspect of PV within the next 3 years.**

	Remote sensing		EM38 soil survey		Yield mapping		Proximal sensing		Selective harvesting	
	Users	Non-users	Users	Non-users	Users	Non-users	Users	Non-users	Users	Non-users
No. Respondents	32	28	31	29	15	44	11	47	29	29
No. Advanced users[B]	23	2	23	2	15	10	11	14	22	3
Commercial benefit now	17		9		7		4		16	
Commercial benefit likely	7	11	14	12	5	21	5	15	7	18
Total beneficial (%)	75	39	74	41	80	48	82	32	79	62
Total beneficial overall (%)	58		58		56		41		71	

[B]Advanced users are defined as those using 3 or more PV technologies

Wine and Viticulture Journal, Sept/Oct 2013, 69-73.

Limitations to adoption



Wine and Viticulture Journal, Sept/Oct 2013, 69-73.

Thank you

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