Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Spatial variability and sampling

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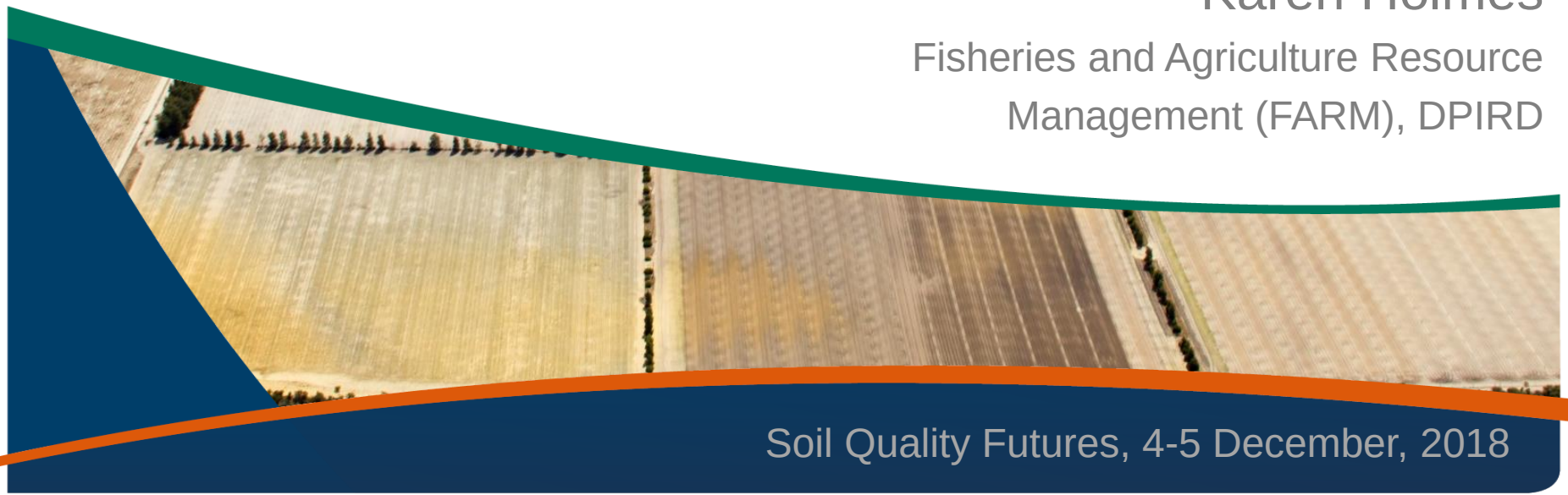


Soil Quality Futures, 4-5 December, 2018

Soils vary spatially and through time

- In paddocks, properties vary with
  - topography
  - parent material
  - Management history

- Different patterns
- Different rates

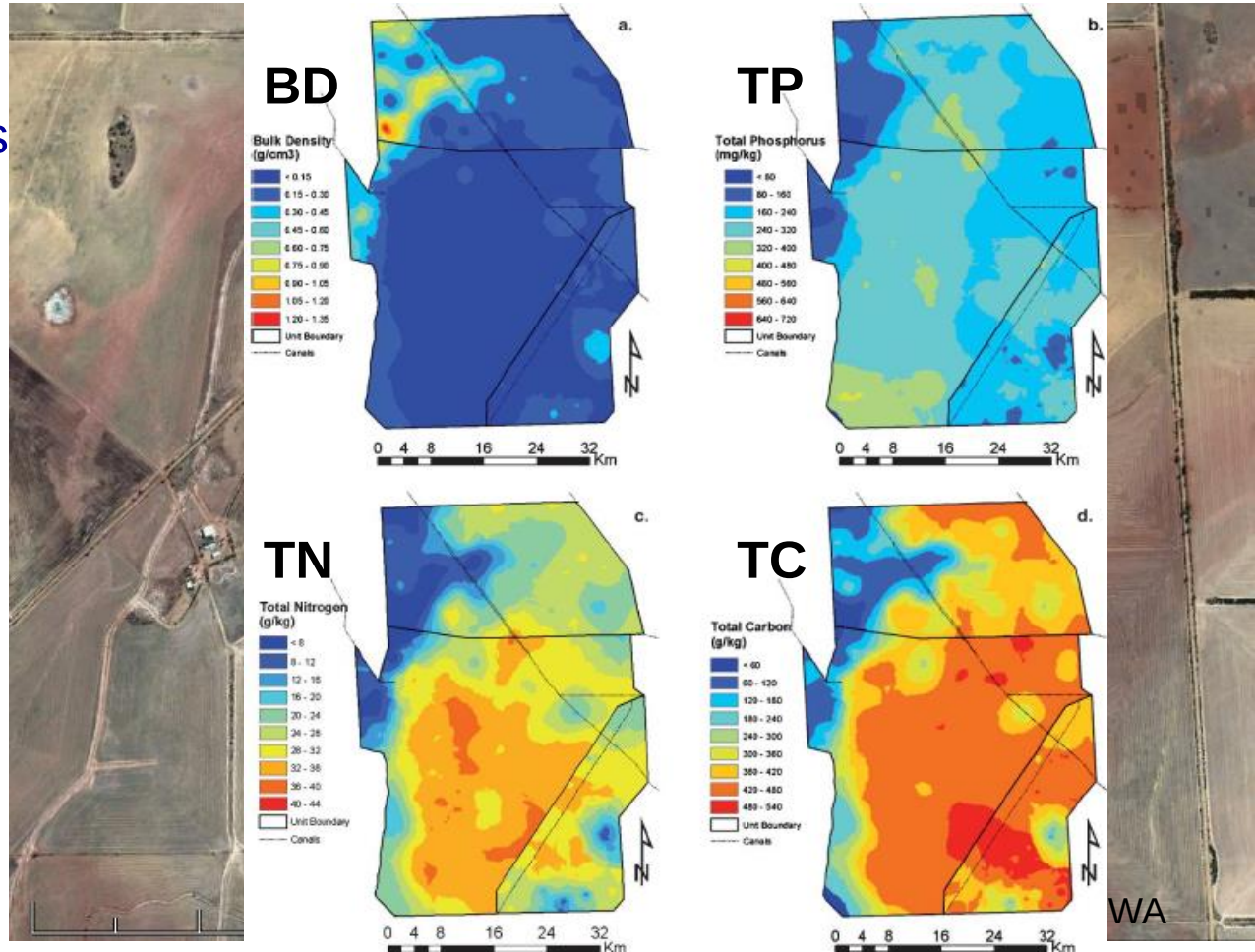
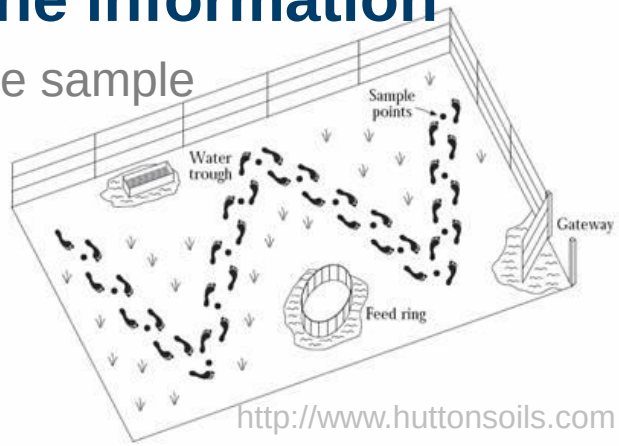


Figure: Bruland et al., 2006

Need a clear plan for how you will use the information

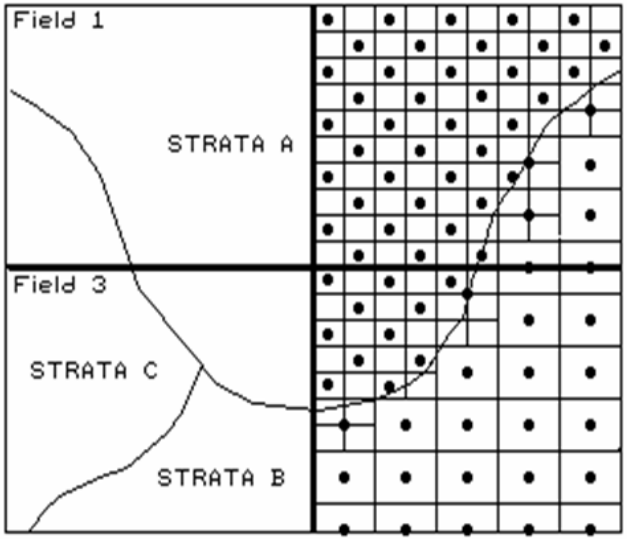
- Map? Monitor? What unit of interest?
  - (e.g. soil type x management, texture x rainfall gradient)
- Having a look. No further analysis
  - Haphazard/convenience sampling
- Test conceptual model
  - Purposive or judgement sampling (e.g. Catena)
- Measure a property and uncertainty (statistics)
  - Probabilistic sampling
  - Benchmarking (revisit same sites)

Composite sample



http://www.huttonsoils.com

Grid



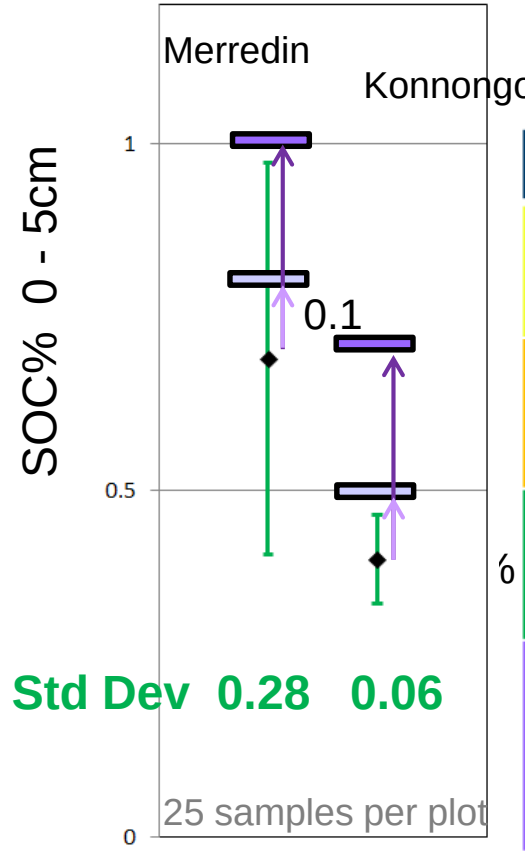
http://www.innovativegis.com

Sampling to detect change in mean value

Variability affects how large a change can be detected

$$n > \frac{2 z_{\alpha}^{2} s^{2}}{y^{2}}$$

Saby et al 2008: Eq 5



	Left	Right	Left	Right
Samples (n)	**7**	**1**	**61**	**3**
Confidence in change (**z** statistic)	95% High	95% High	95% High	95% High
Standard Deviation (**s**)	0.28 **HIGH**	0.06 **LOW**	0.28 **HIGH**	0.06 **LOW**
Minimum detectable change (**y**)	0.3 %SOC **LARGE**	0.3 %SOC **LARGE**	0.1 %SOC **SMALL**	0.1 %SOC **SMALL**

- Decide how you'll use the information
  - Different problems need different sampling designs
  - Spatial and temporal scale is critical
  - Measure a property or map?
- Need variability information
  - Measure it, if possible.
  - From literature, or even expert opinion
  - Also rates of change
- Don't start an expensive sampling exercise without knowing your sample plan will be adequate to answer the question

Happy World Soils Day!

Visit dpird.wa.gov.au

Helpful references

Saby et al., 2008. Will European soil-monitoring networks be able to detect changes in topsoil organic carbon content? Global Change Biology 14: 2432-2442.

Conyers et al., 2018. Spatial variation in soil organic carbon and nitrogen at two field sites under crop and pasture rotations in southern New South Wales, Australia. Soil Research 56:780-792.

Bruland et al 2006. Spatial distribution of soil properties in water conservation area 3 of the Everglades. Soil Sci Am J 70: 1662 – 1676

Z is the value of the standardized normal distribution at probability alpha
S is standard deviation (s^2 is variance)
Y is minimum detectable change in your property
N is number of samples at a ‘site’