

RADICAL SOIL MANAGEMENT FOR RADICAL SOIL PRODUCTIVITY LIFT



2015
International
Year of Soils

Alex. McBratney

Session Three –
Digital Soil Productivity



Faculty of Agriculture & Environment, University of Sydney, Australia



**SOIL, BIG DATA AND THE
FUTURE OF AGRICULTURE**

CANBERRA, 25 JUNE 2015

- Old soil
- New data

- Old soil
- New information

Simple proposition

Gather (soil) data/information at high spatial or temporal resolution optimise system with reduced risks and improved outcomes.

Issue

Getting the data/information everywhere

- › **GlobalSoilMap**
- › **Detailed specifications**
- › **3 arcsec spatial resolution**
- › **Set of properties appropriate to biophysical modelling**
- › **3D (6 fixed depth ranges)**
- › **Uncertainty**



Soil and Landscape Grid of Australia

- A Facility of Terrestrial Ecology Research Network
- Collaborative partnership facilitated by CSIRO between CSIRO, Geoscience Australia, State soil agencies, the University of Sydney
- Brought most of Australia's disparate legacy soil data and maps together into a harmonised quantitative framework
- Generated maps of GlobalSoilMap properties (+ total N, total P) to Tier 1 GlobalSoilMap specifications (6 depth intervals)

Funders

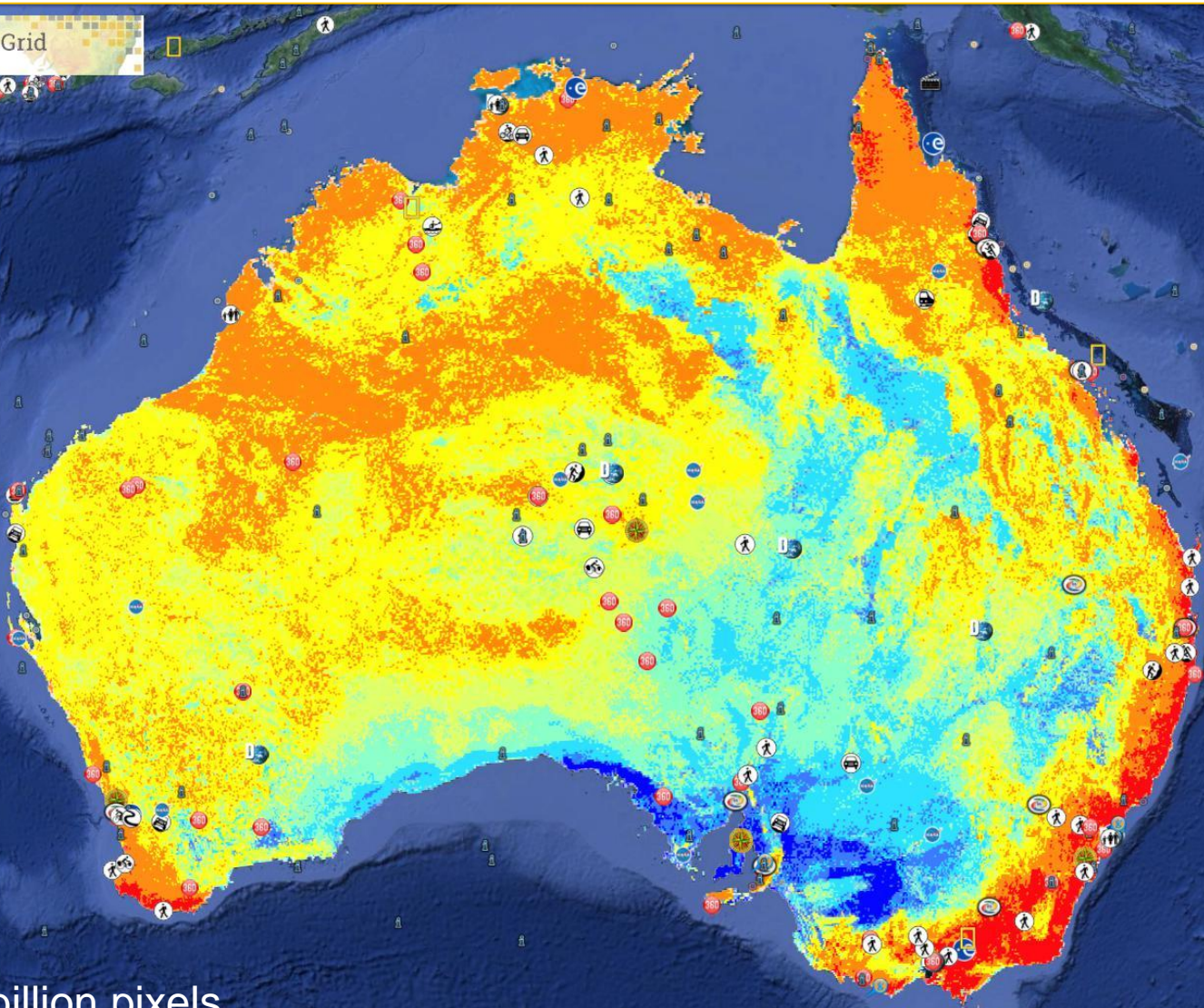


NCRIS
National Research
Infrastructure for Australia
An Australian Government Initiative

Partners



Soil and Landscape Grid
of Australia



~ 1 billion pixels

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

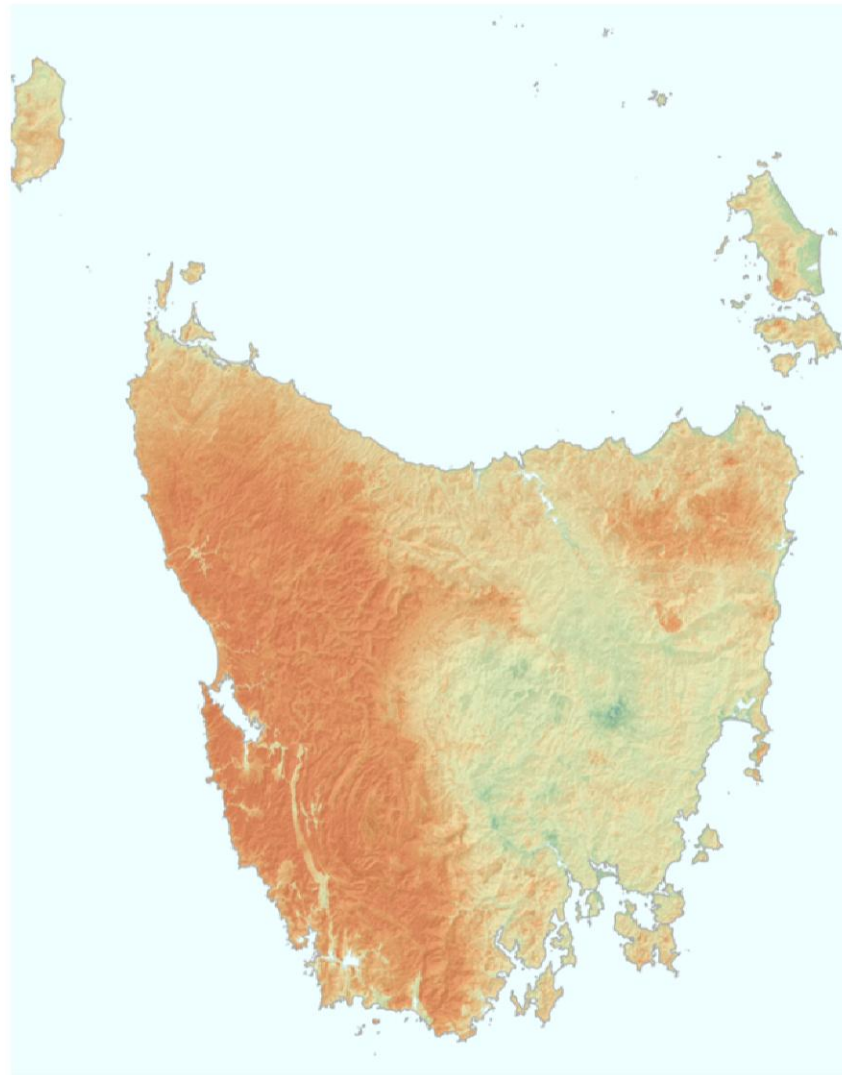
Image Landsat



Google earth

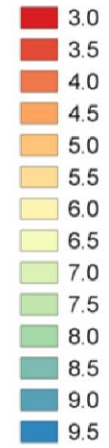
Imagery Date: 4/10/2013 27°18'44.94" S 134°31'41.13" E elev 189 m eye alt 4707.04 km

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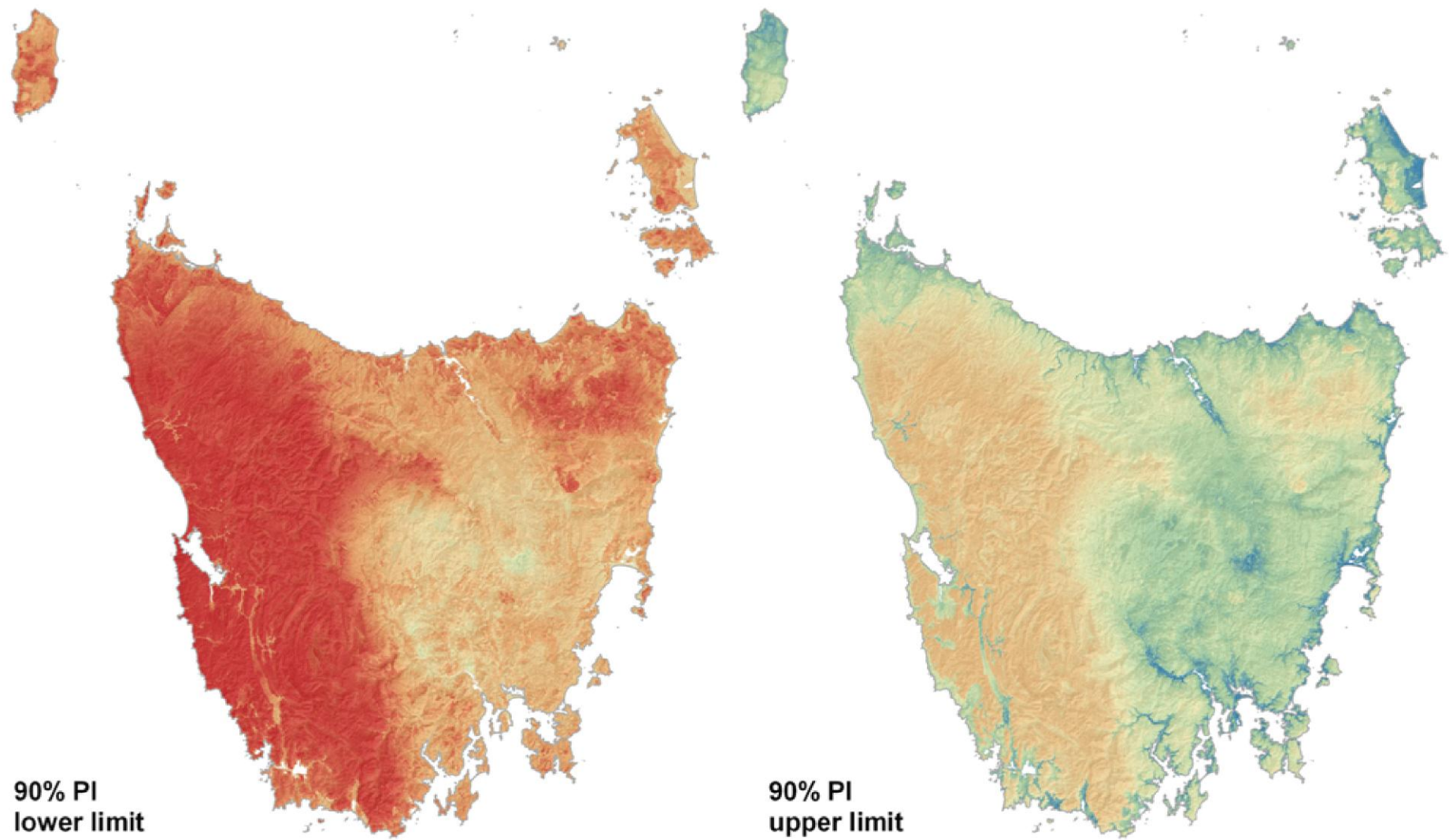
30–60 cm pH (1:5 water)

pH



0 25 50 75 100 km



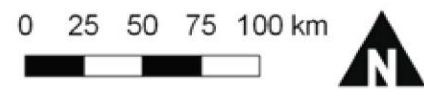


90% PI
lower limit

90% PI
upper limit

30–60 cm pH (1:5 water)

pH	5.0	7.5
3.0	5.5	8.0
3.5	6.0	8.5
4.0	6.5	9.0
4.5	7.0	9.5



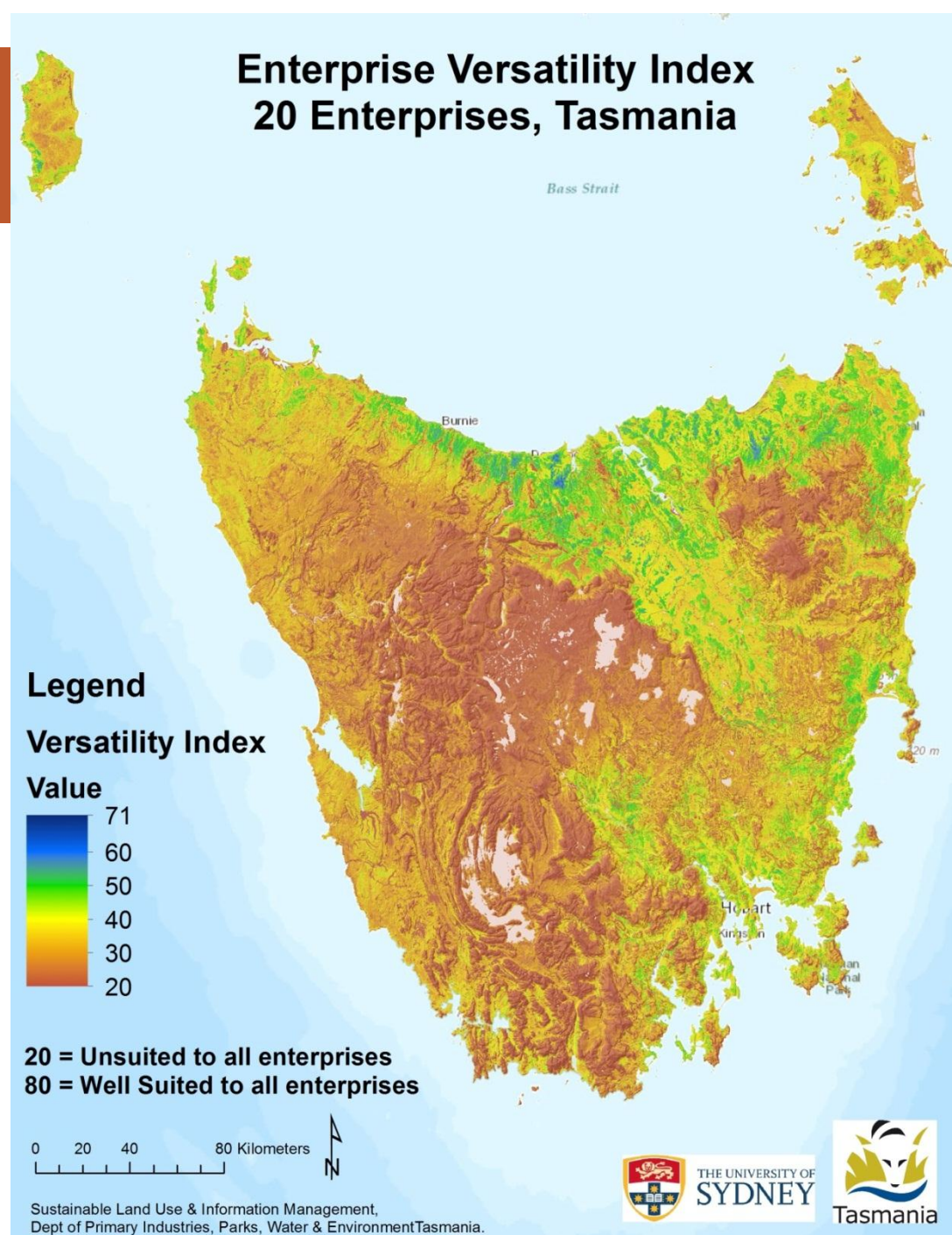
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Application

Suitability for a range of
20 crops (enterprises)

Quantified by Versatility

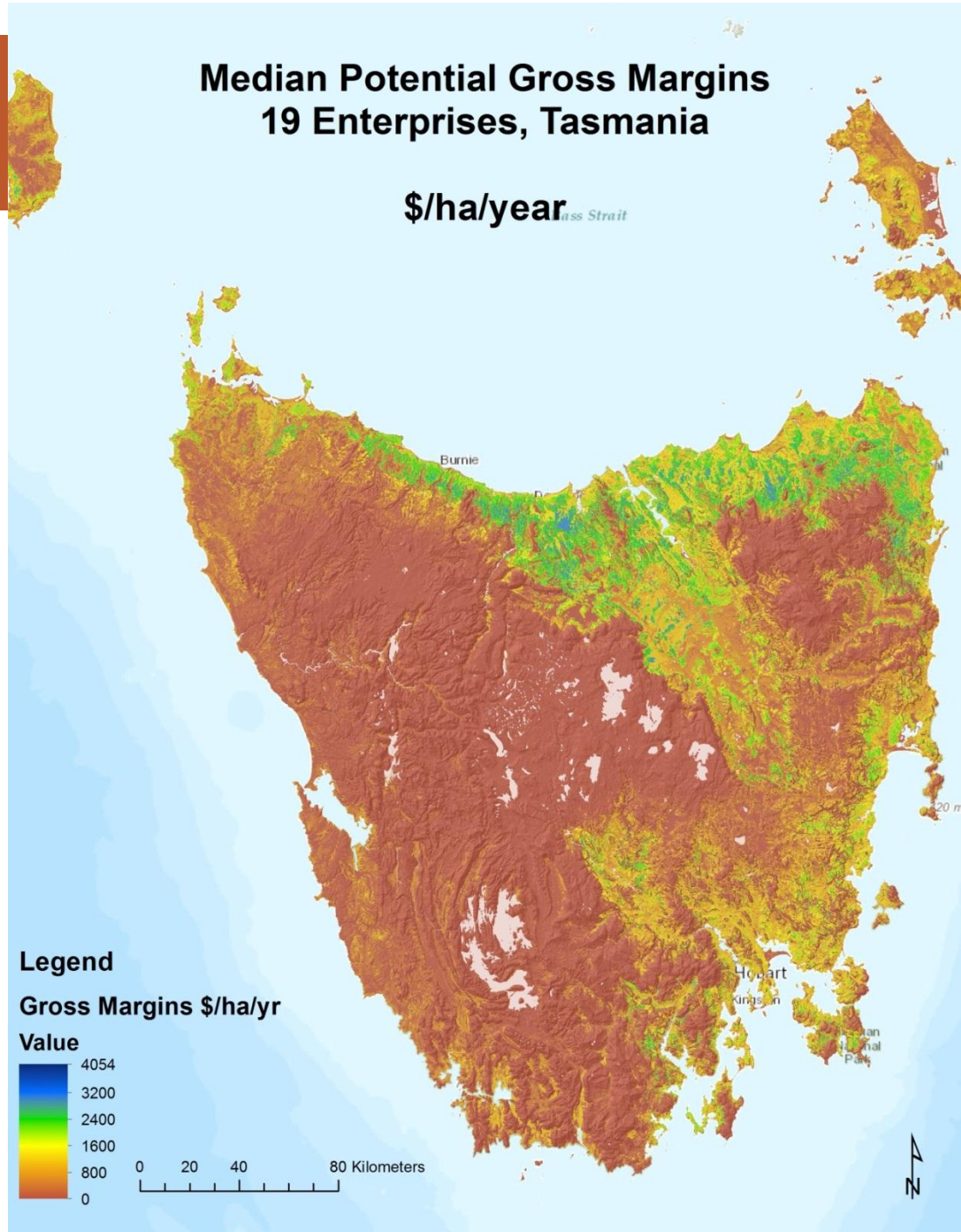
Risk-based



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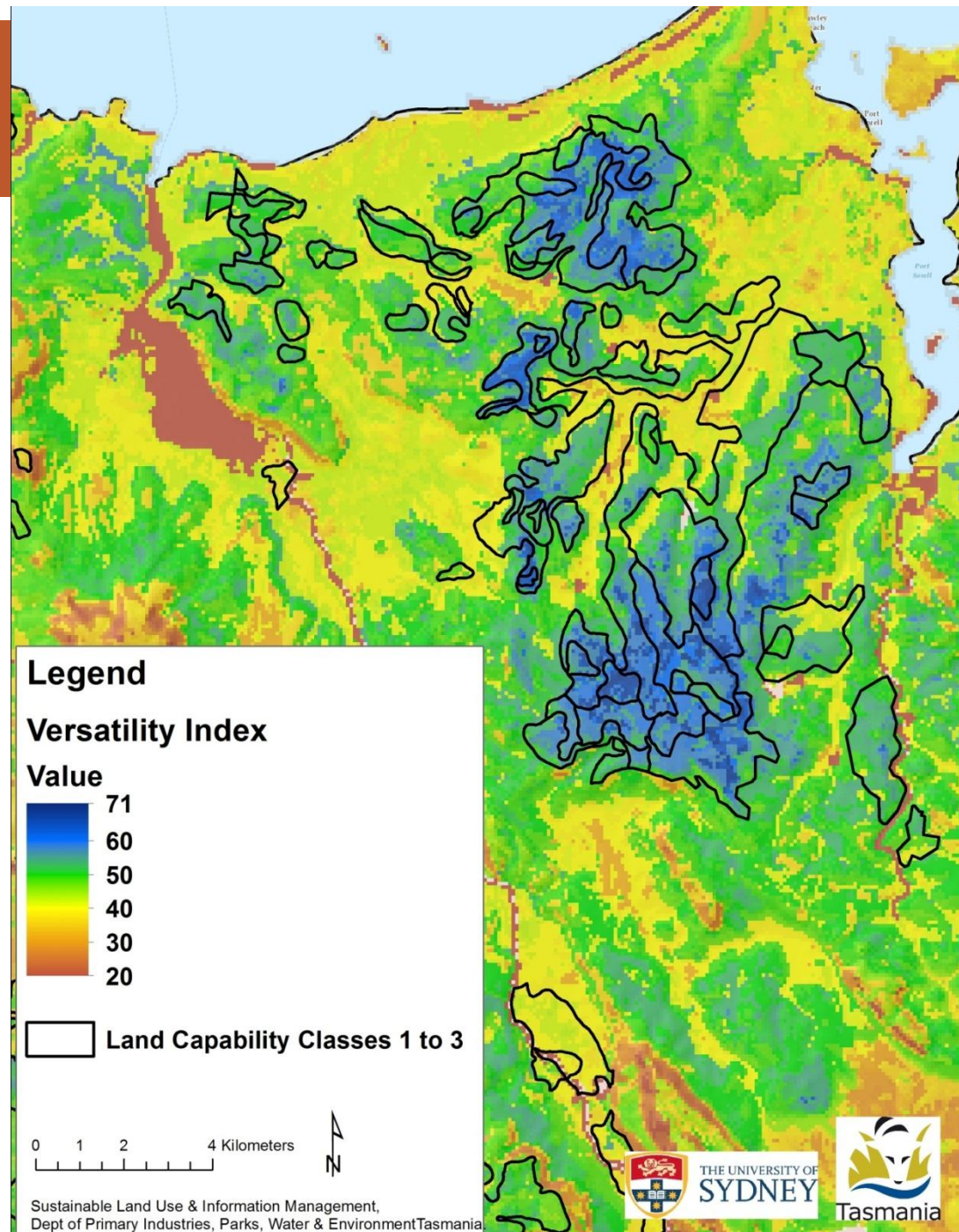
Median Potential Gross Margins 19 Enterprises, Tasmania

\$/ha/year ass Strait



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- › Much finer detail information



The impact of realising the
GlobalSoilmap concept here in
Australia

1. transformational
2. thirty years advance in three
3. a real paradigm shift

- Australian soil is more developed (old) compared with other economically developed countries
- Old “clapped out” soils
- Management challenges

We shouldn't abandon them

We should give some radical bypass surgery

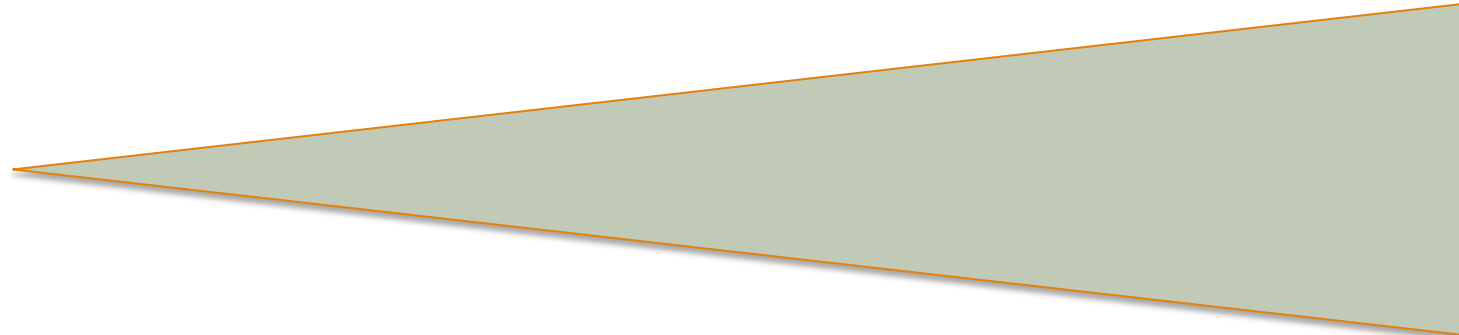
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Increasing time



Increasingly duplex



U

G

D

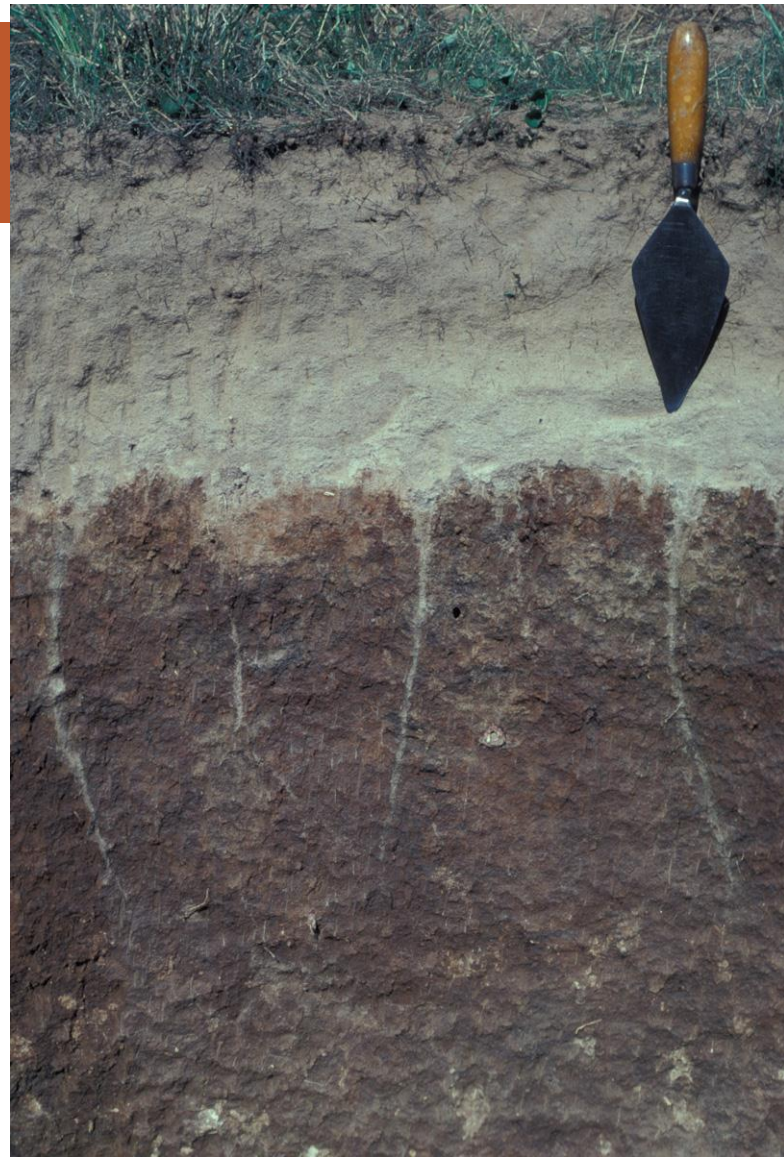
e.g., Walker 1962



Uniform



Time



Duplex

Rejuvenation processes in time

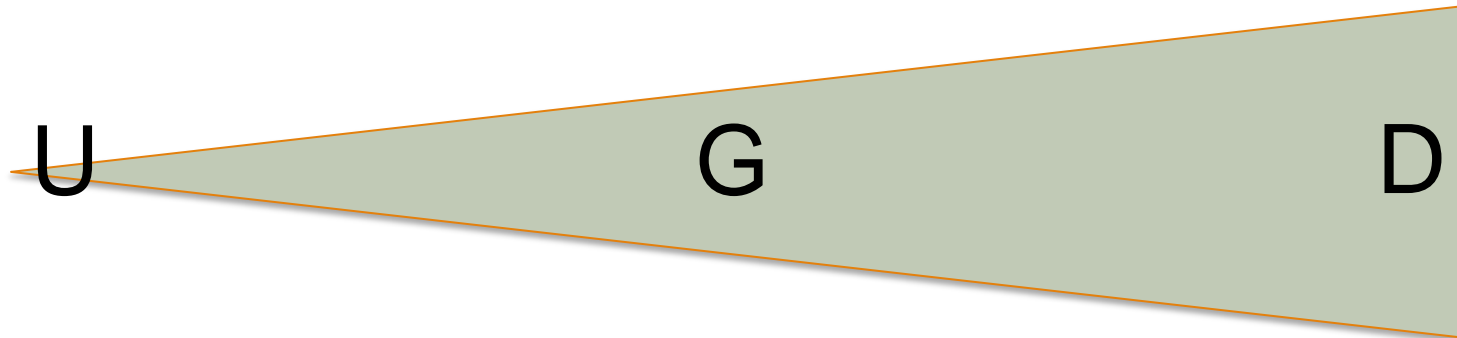


Better performing soils have self-rejuvenation processes:

- Mixing by shrinking, swelling and cracking
- Biological mixing
- Accreting environments



Increasing time



Time →



Increasing water issues

U

G

D

Decreasing yield potential

Increasing radical management

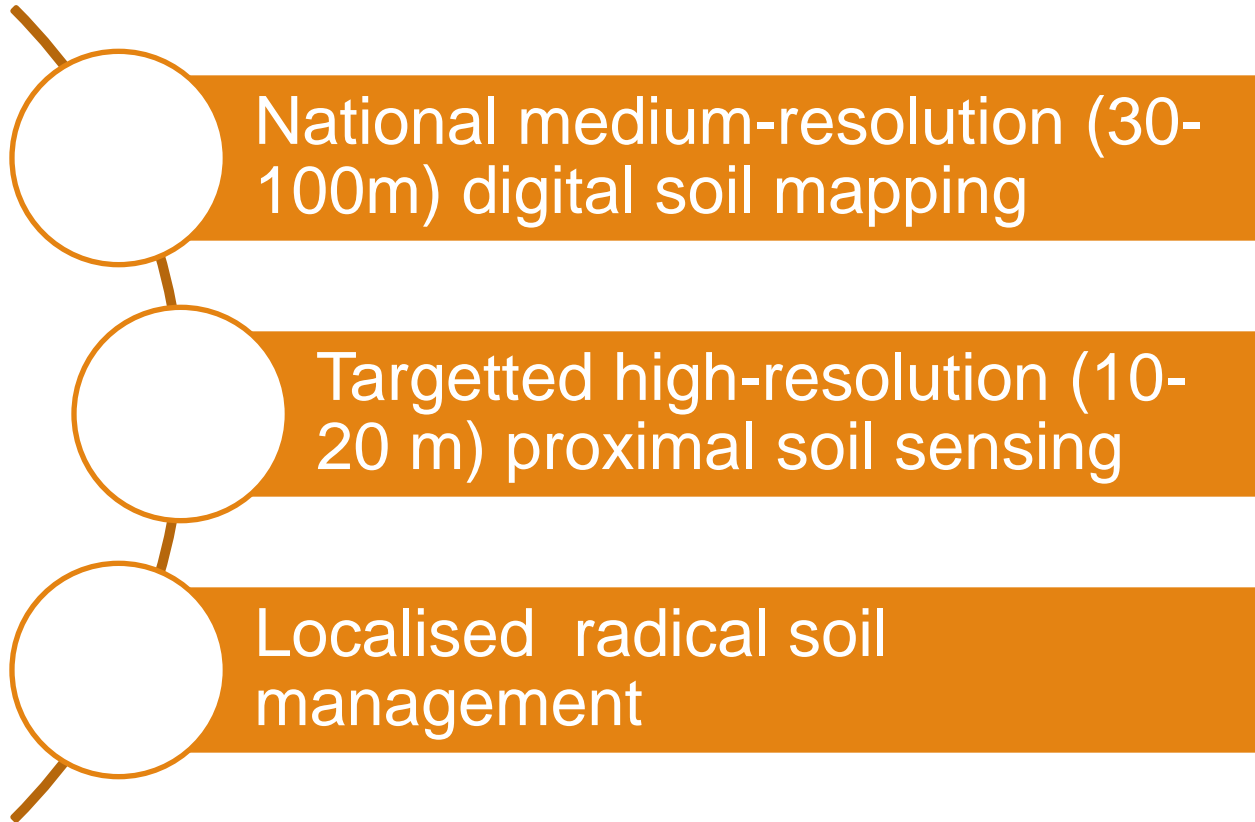
Rejuvenation

Reverse the effects of time
Make the profile more uniform

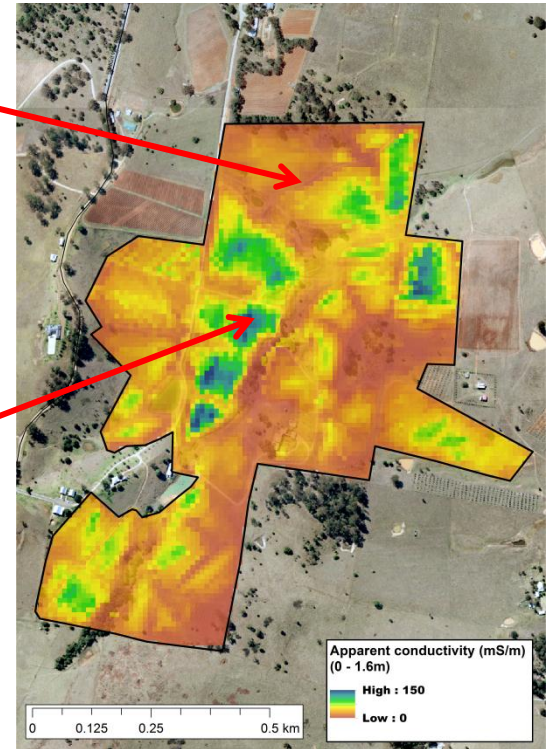
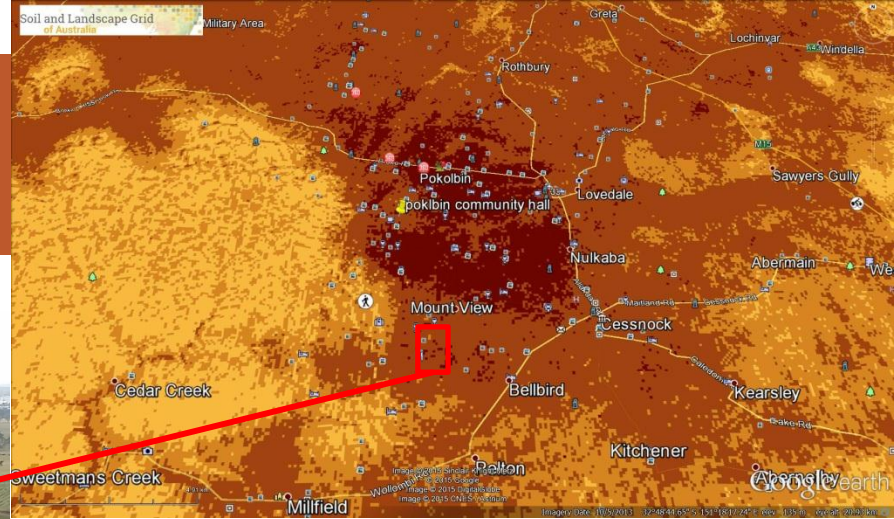
Mix it all up
Add clay to the top and mix it in
Break up the B2 horizon

Delving, Spading, Mixing - Expensive





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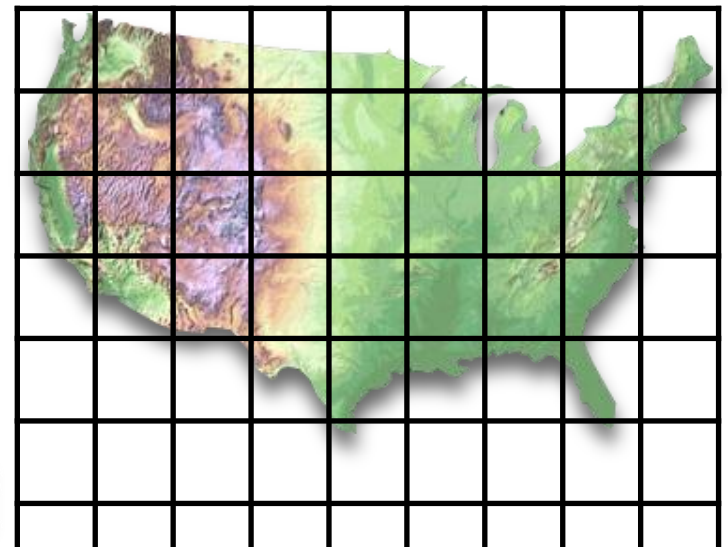


ASIDE - Application of USyd DSMART algorithm over Continental US (CONUS)

CONUS 30 metres → ~9 billion grid cells

Feasible Approach: Moving window

- Split up domain into overlapping blocks
- Run DSMART on each block
- Small region → small sample size → fast random forest
- ~25,000 blocks → **500,000 core hours**



High Performance Computing: Blue Waters

Machine Stats

Comparison

Number of Cores	600,000	>13 quadrillion calculations per second
Memory	1.5 petabytes	300 million images
Short-Term Storage	25 petabytes	All printed documents in all libraries
Long-Term Storage	500 petabytes	10% of all words spoken by humankind

500,000 hours (57 years)



5 hours

National Petascale
Computing Facility



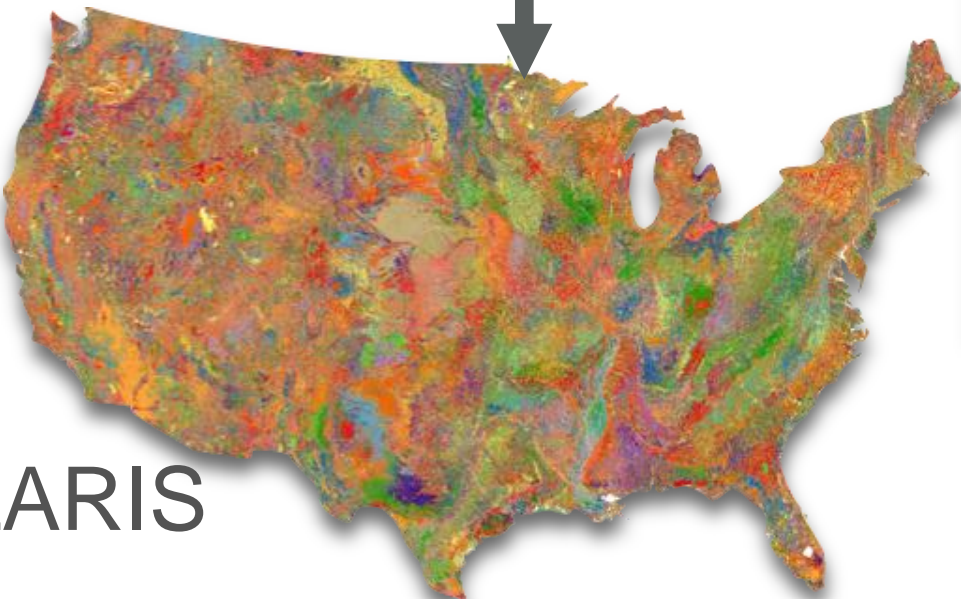
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gSSURGO

DSMART

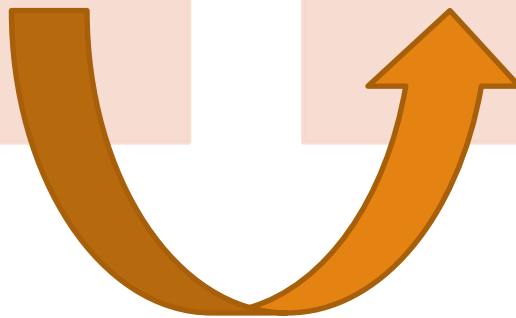
Environmental
Covariates

POLARIS



Lots of new national
medium spatial resolution
soil data and information
coming on-stream

One major application in
Australia is to utilise to
target optimising local
radical soil management



Joined-up Thinking

Aspiration



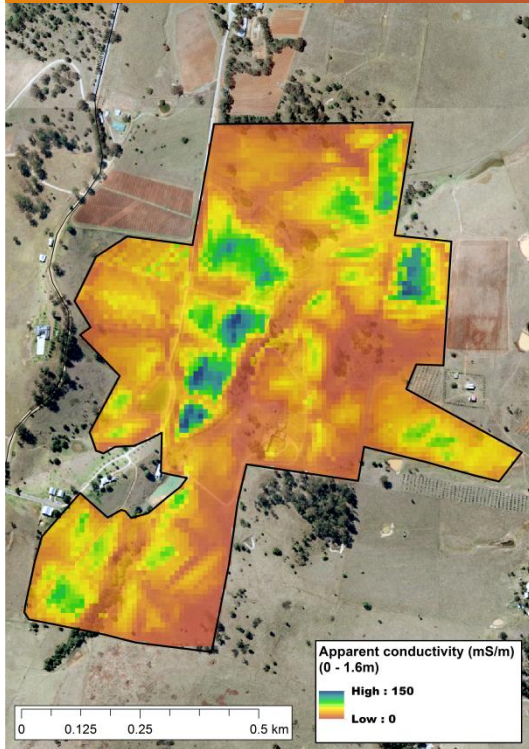
Old soil rejuvenated
cost-effectively by
big new data and
information will
deliver a radical
productivity lift

THANKS
FOR
LISTENING

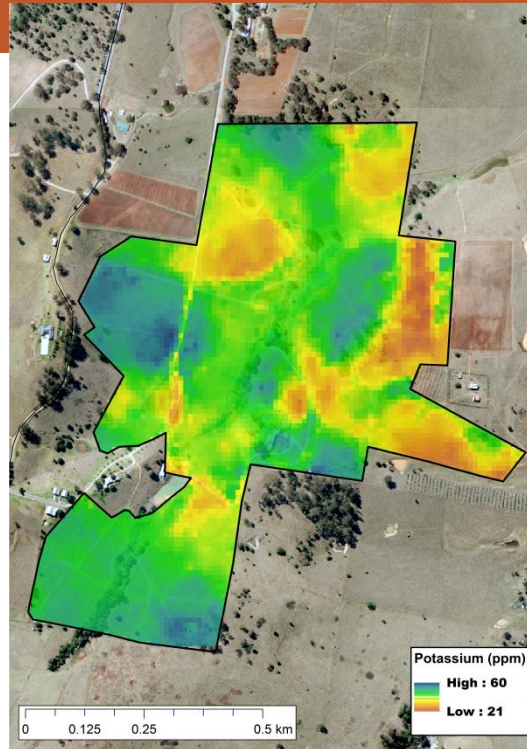
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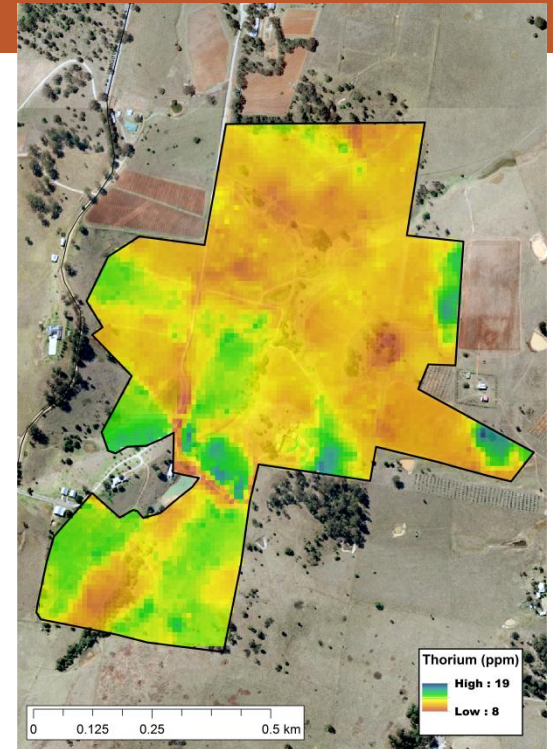
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Conductivity



Potassium



Thorium