National mapping of biodiversity habitat condition for comparative assessments across regions

Kristen J Williams – for the team

Ecological Surprises and Rapid Collapse of Ecosystems in a Changing World
8 - 9 May 2018, The Shine Dome, Canberra, Australia, www.boden2018.com

LAND AND WATER
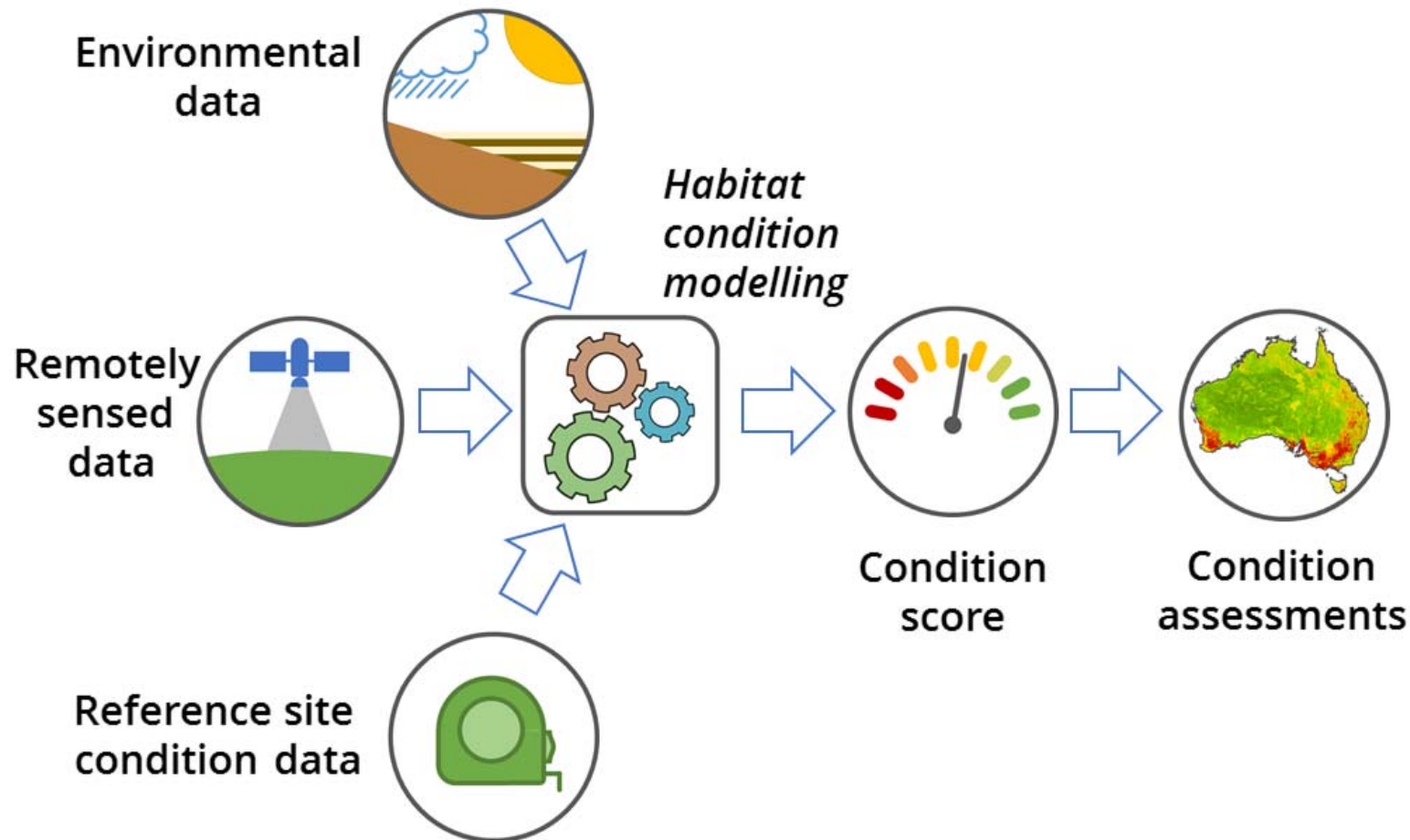www.csiro.au

Australian Government
Department of the Environment and Energy

CENTRAL AUSTRALIAN LANDSCAPE: A rainbow forms and storm clouds gather over an outback scene, north of Alice Springs, Northern Territory, November 1989, photo by **Robert Kerton**

CSIRO

HCAS: Habitat Condition Assessment System

Linking environmental patterns with remote sensing responses for broad-scale assessment of habitat condition

*A CSIRO-DoEE **Biodiversity Knowledge Project***

https://research.csiro.au/biodiversity-knowledge/projects/hcas/

Why do we need a HCAS?

"Essentially we're looking for this project to build a capacity to predict current habitat condition and report on likely trends across the continent to inform our interventions and reporting"

Fiona Dickson and Peter Lyon, 2015
Department of Environment and Energy

What is habitat condition?

- Essentially a human construct which leads to subjective variation in the way condition is defined, assessed and interpreted

- At the site level of observation: An inexhaustive suite of weighted ecosystem variables and a set of archetypes defined in terms of these weighted variables

- Each state has its own method, broadly based on the same concept of condition
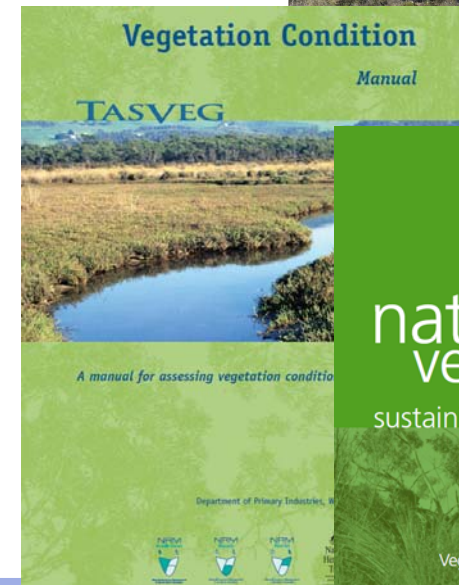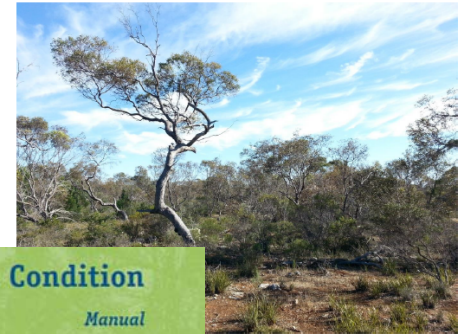
Condition for HCAS

- HCAS measures an ecosystem's current condition relative to reference states

- For HCAS, we define habitat condition to be:

the capacity of an area to provide the structures and functions necessary for the persistence of all species naturally expected to occur there in an intact state

Applying habitat-based biodiversity accounting across the Australian continent: why is monitoring habitat condition through EO so difficult? Three challenges.
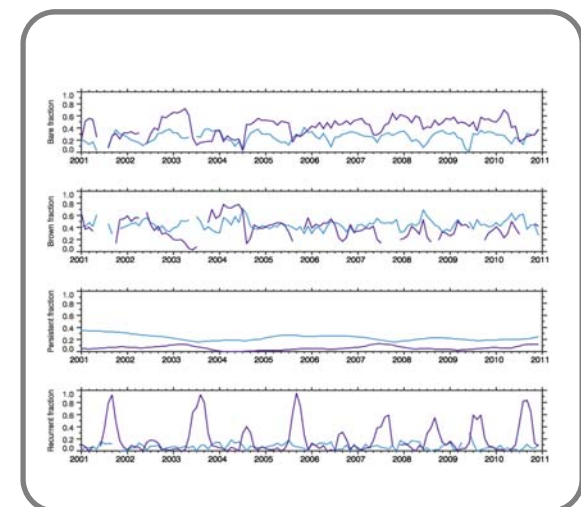
Similarity in land cover attributes between intact state of one ecosystem type and degraded state of another
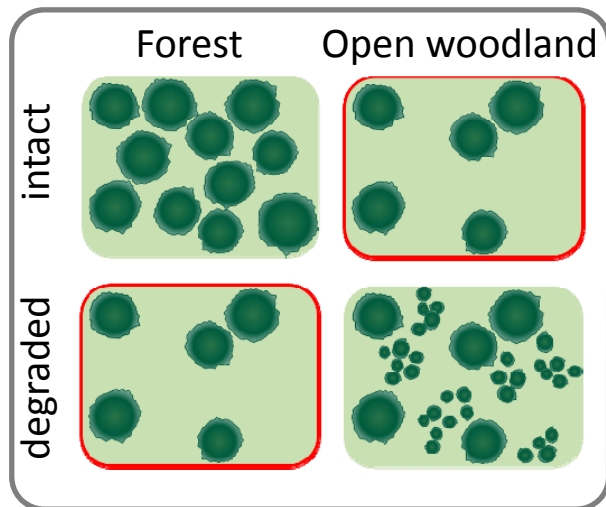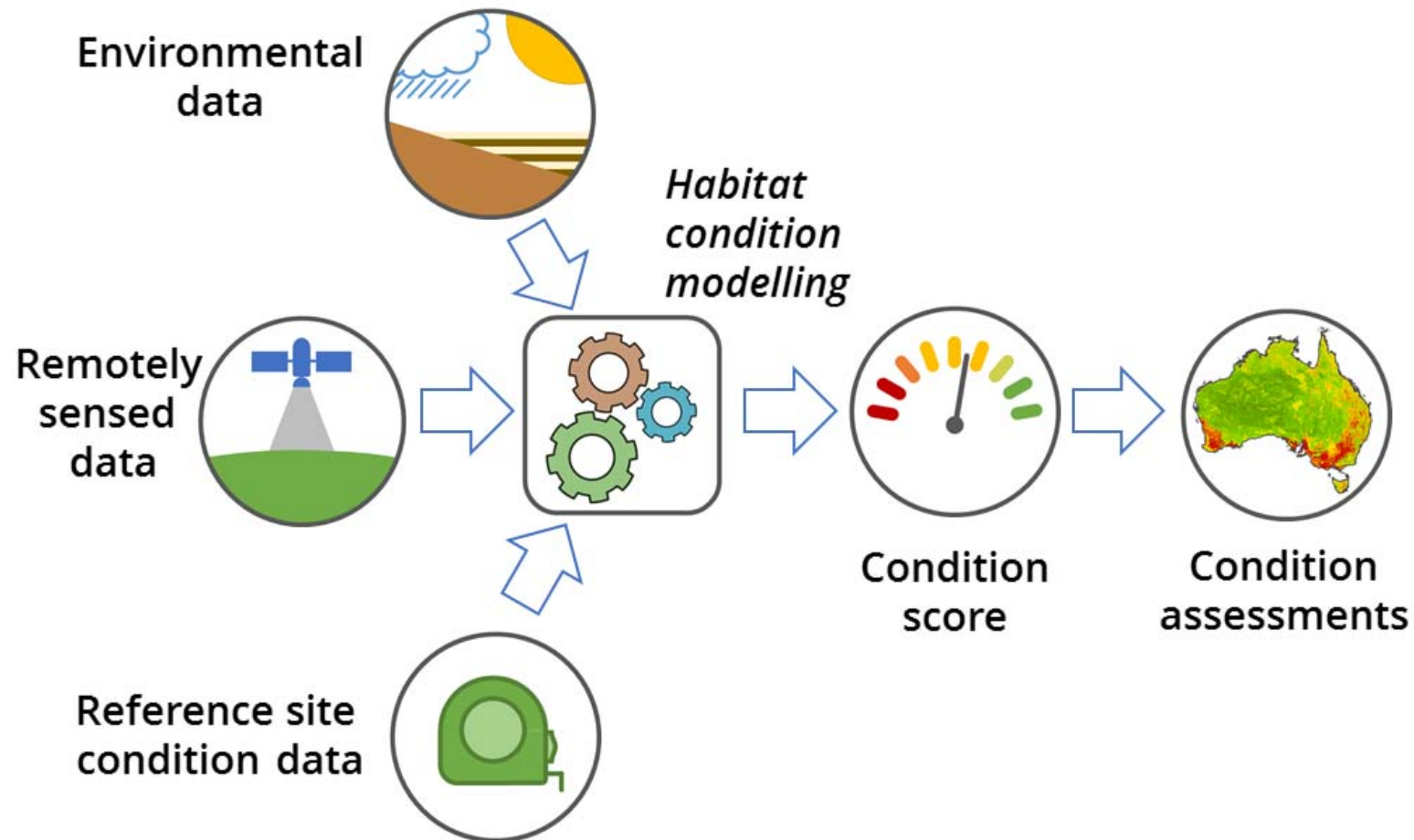
More than one possible 'natural' state for any given location or environment
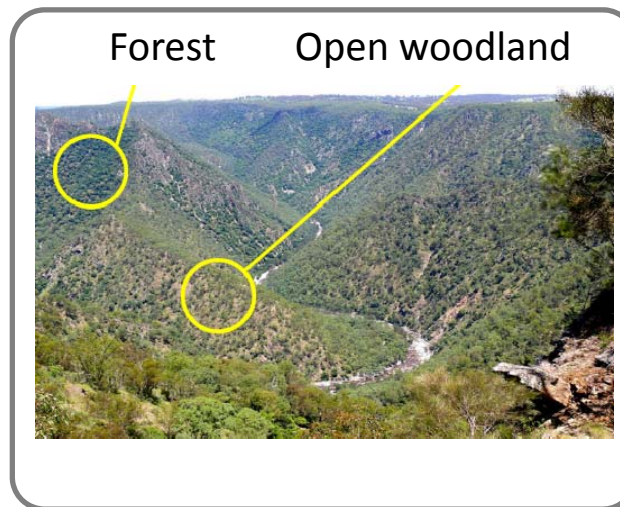
'Natural' systems exhibit short to medium term temporal dynamics in land-cover attributes

What are the key components of HCAS?

Environmental data

Remotely sensed data

Reference site condition data

Habitat condition modelling

Condition score

Condition assessments

Environmental data

- *What is the geoclimate that is driving vegetation characteristics?*

- Vegetation is dynamic in space and time, and naturally varies from place to place

- Soils, land forms and climatic conditions set the over-arching conditions that determine broad vegetation characteristics

Remotely-sensed data

- *What are the vegetation characteristics as observed from satellite?*

- Consistently observing vegetation characteristics across the vast area of Australia requires the use of satellite imagery (or remote sensing)

Reference sites of known condition

- *Where do we already know what condition the vegetation is in?*

- HCAS uses information about the most intact places in Australia to model naturalness – like benchmarking – to train the model

- This is the hardest part: we need to represent all intact landscapes and know if those places are still in 'best attainable condition'

- We are exploring different ways to gather reference data: from site assessments to expert elicitation, in partnership with the ALA
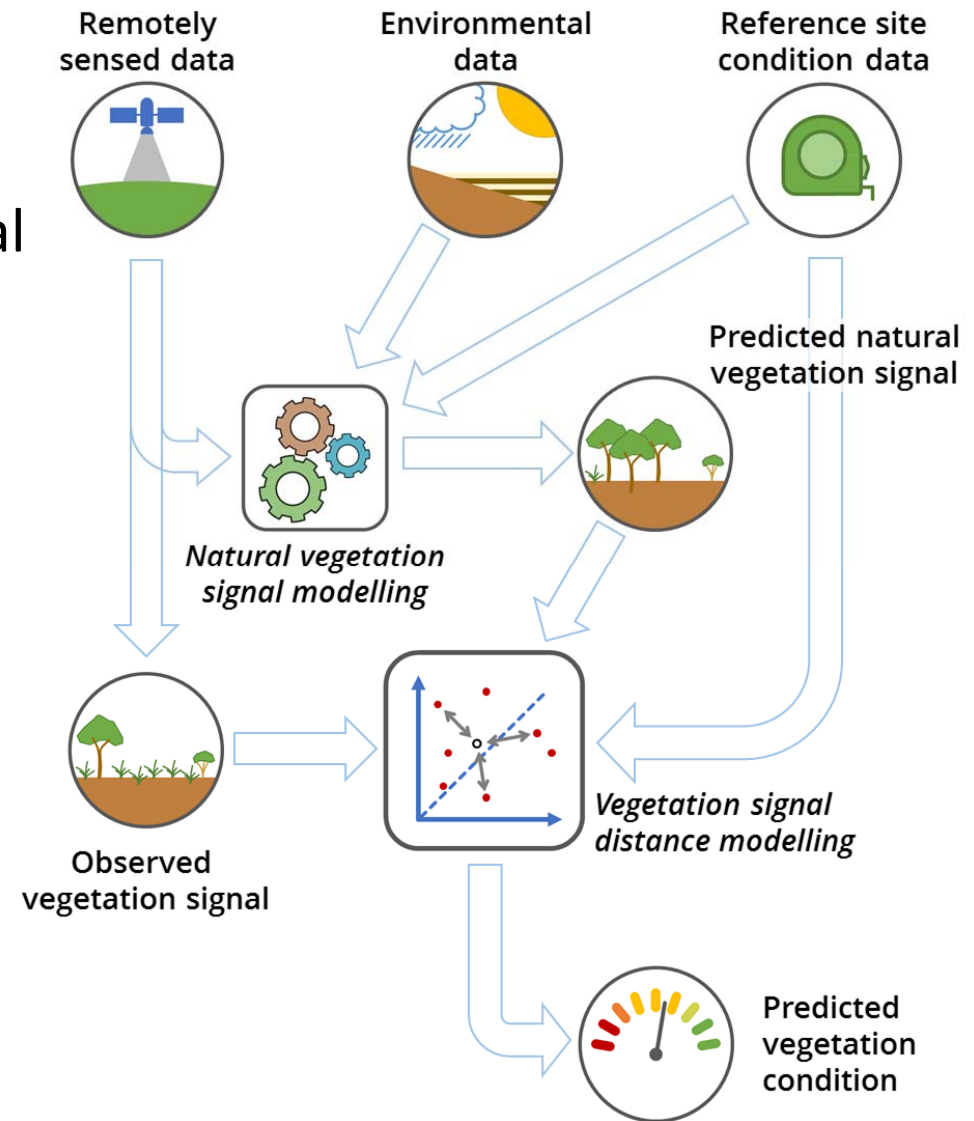
- expertconditionassessments@csiro.au

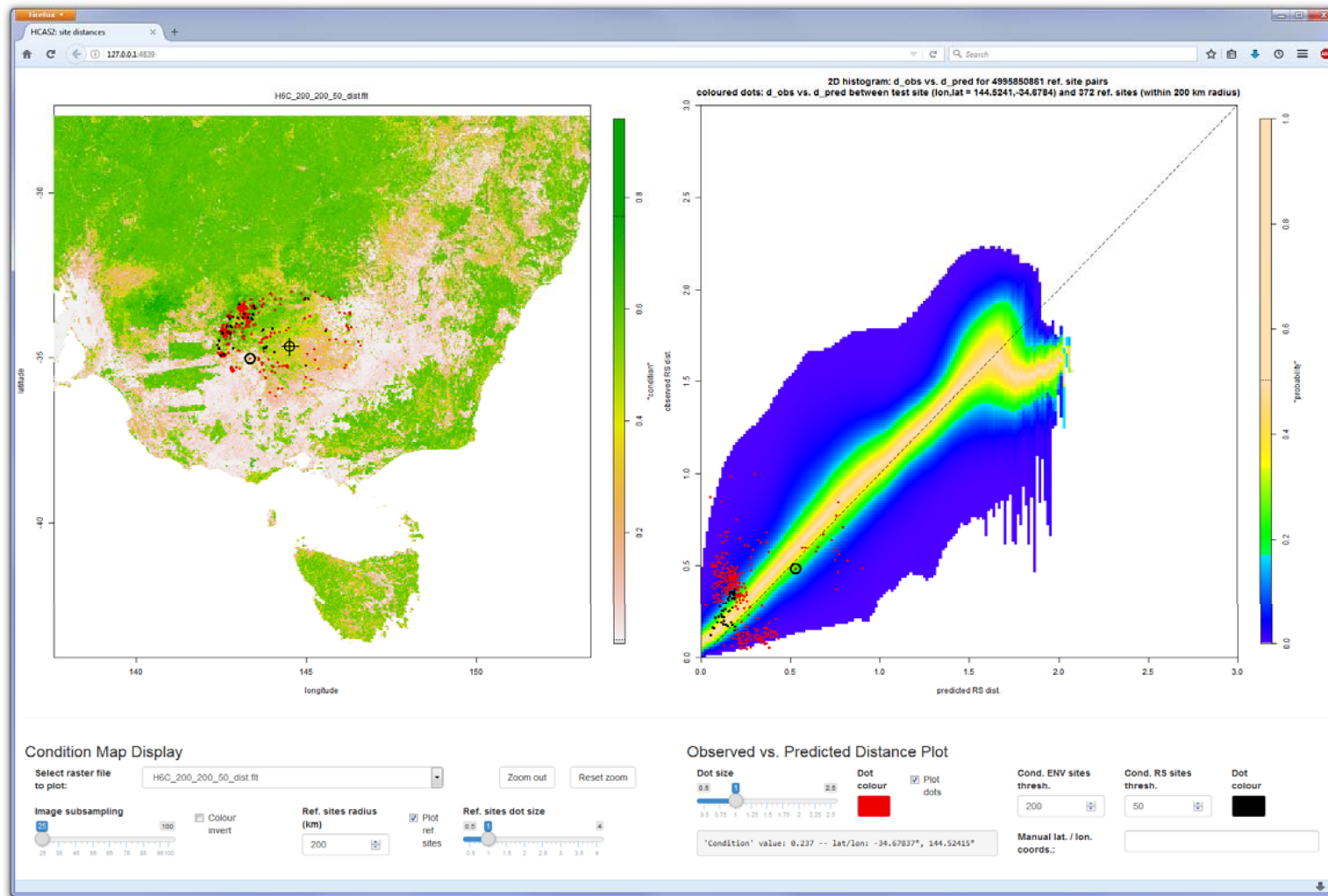*Another CSIRO-DoEE **Biodiversity Knowledge Project***
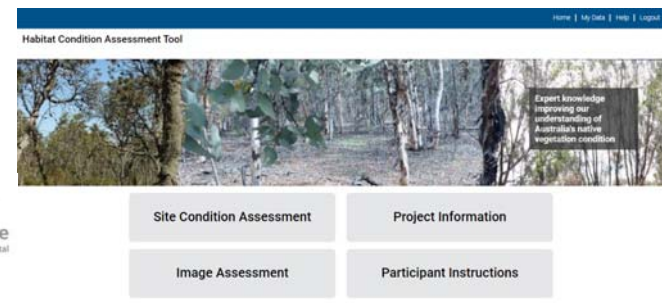
Unpacking HCAS

- Using reference data for intact sites, HCAS predicts the natural vegetation signal

- Then compares with the observed vegetation signal

- Calculates the differences, bounded by similar environmental characteristics

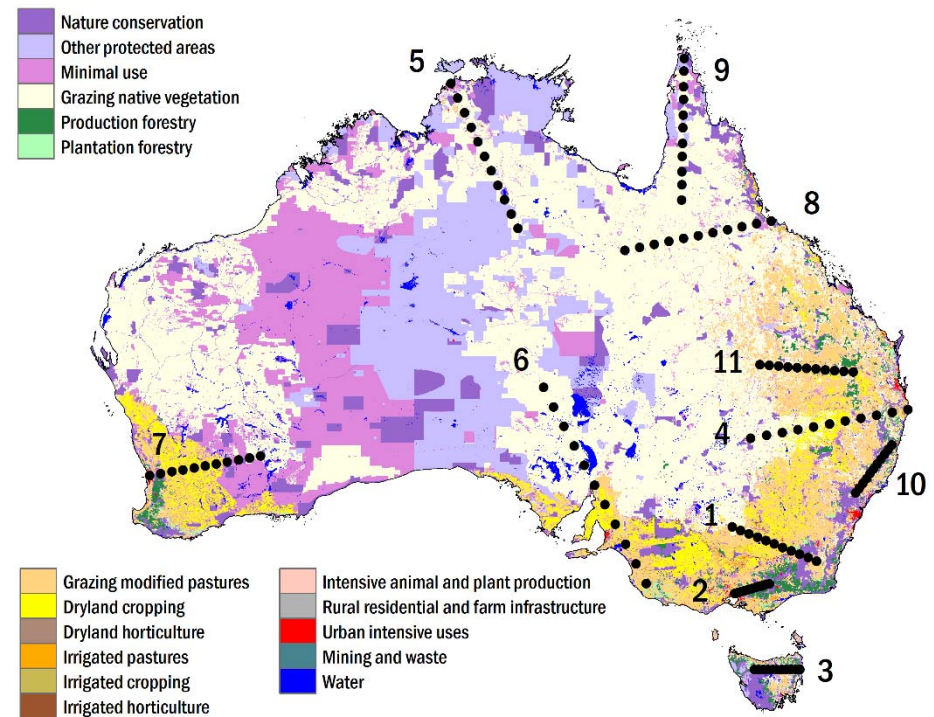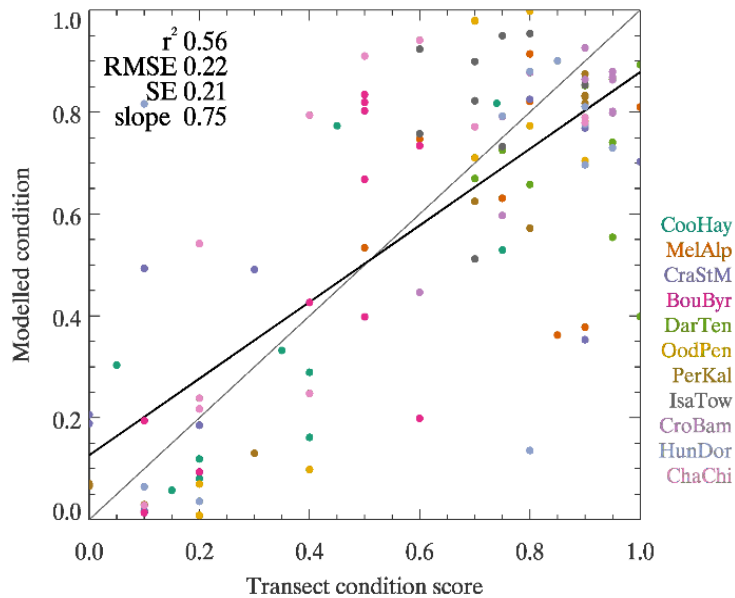- Then calibrates the results using site observation data

We are still working on it

Abiotic ENV surfaces (44D)

Variable screening

"Preliminary" ENV space (25D)

PPR

$$\mathbb{E}(y|x) = \bar{y} + \sum_{k=1}^{K} \alpha_k \cdot g_k(\boldsymbol{\beta}_k^{\mathsf{T}} \cdot \boldsymbol{x})$$

Model selection

ENV variable selection

PPR model fitting

RS surfaces (21D)

Variable screening

"Preliminary" RS space (6D)

PCA

Condition Inference

PPR-predicted RS space (6D)

Scaled RS space (6D)

Reference "pristine" sites (coordinates)
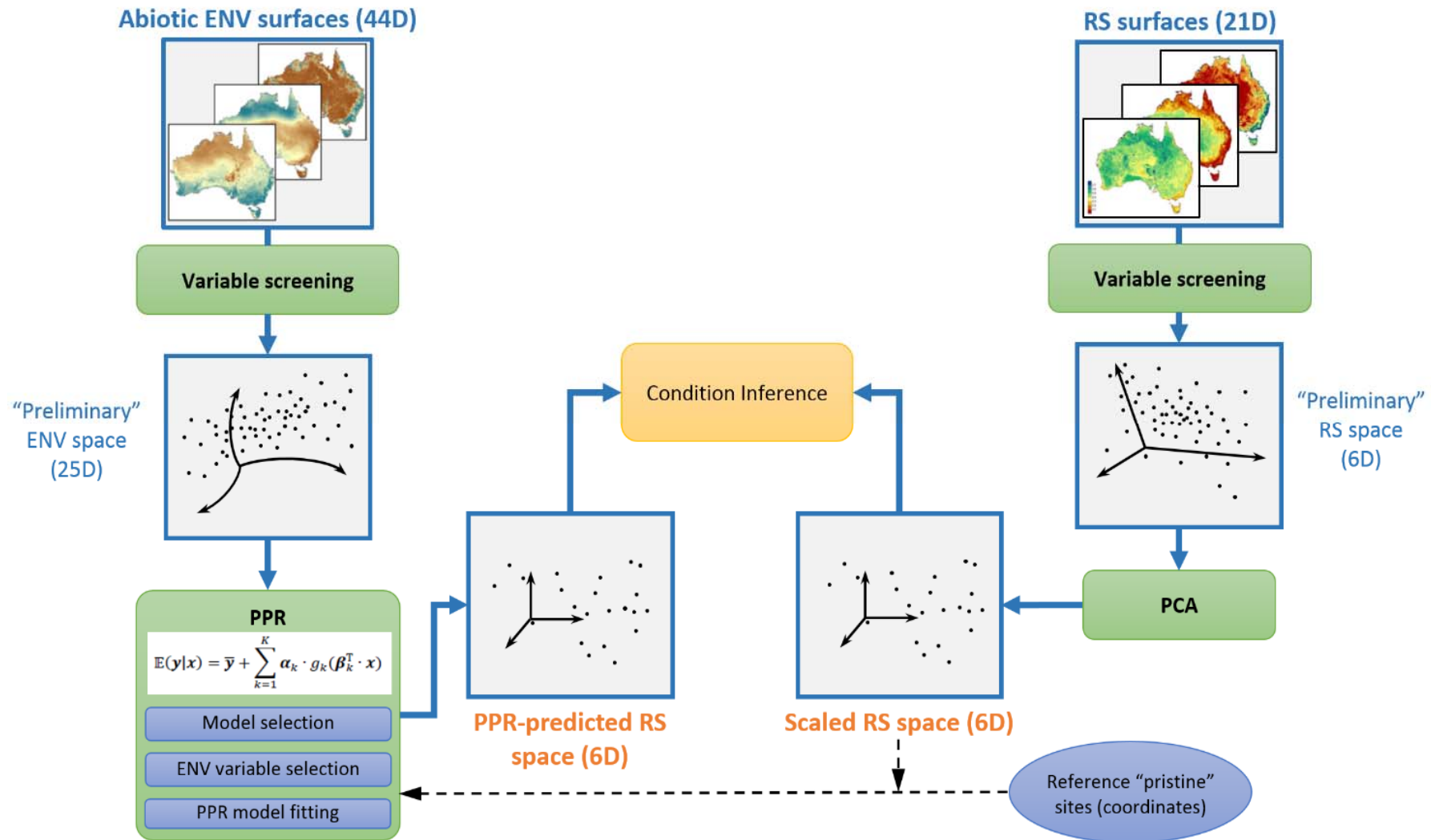
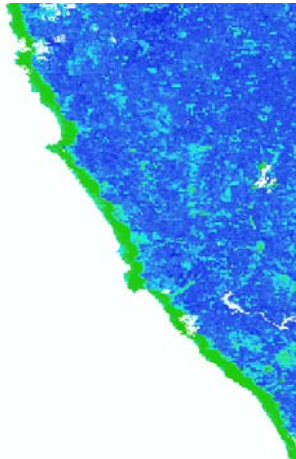# Developed some tools and diagnostic tests

Finding ways to validate via expert transects
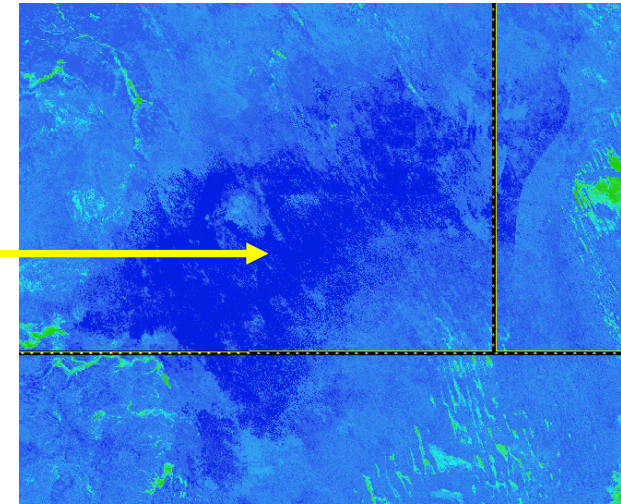
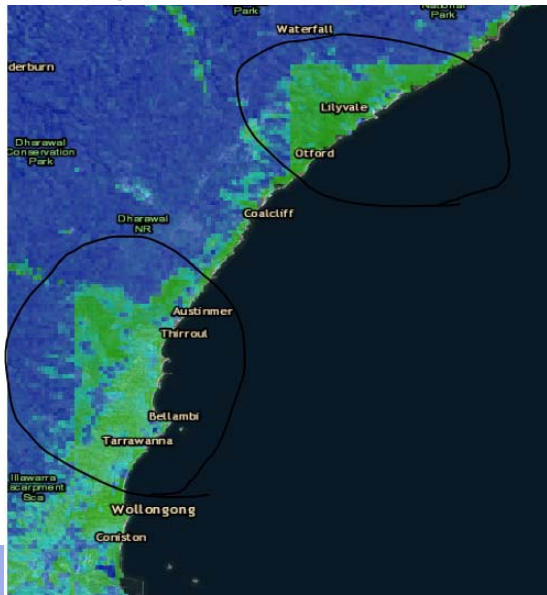# And variously delving into the limitations

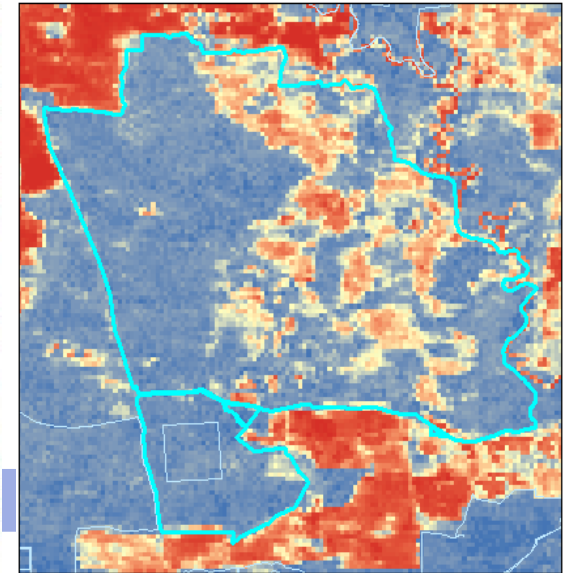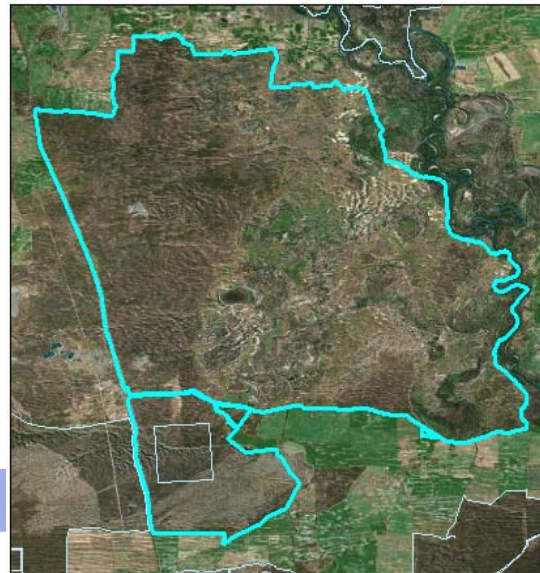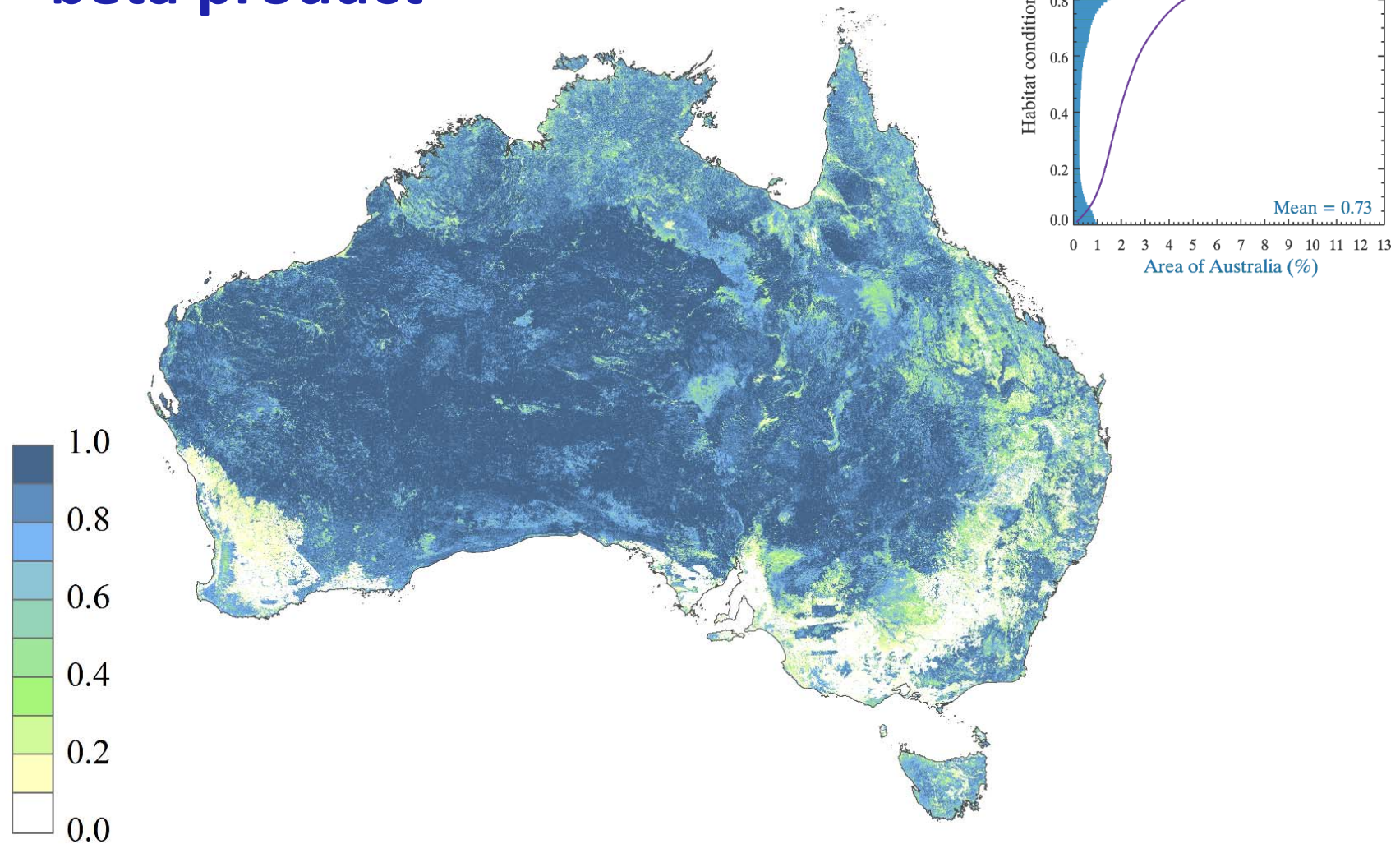**Registration issue of MODIS coastline**

Inland dunes

Sharp data edges: environmental variables

Hattah - Kulkyne National Park Vic

Here's what it looks like: HCAS v2.0 – beta product

HCAS/HCAT: Team

Concept, Design and Analysis

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Steven Sinclair

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Jenet Austin

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Amy Warnick

Peter Brenton

Thank You

Policy Applications and Use

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Australian Government
Department of the Environment and Energy

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ATLAS OF LIVING AUSTRALIA

CSIRO