ENHANCED FIRE BEHAVIOUR PREDICTION IN SPINIFEX GRASSLANDS OF ARID AUSTRALIA USING UAS AND LANDSAT IMAGERY

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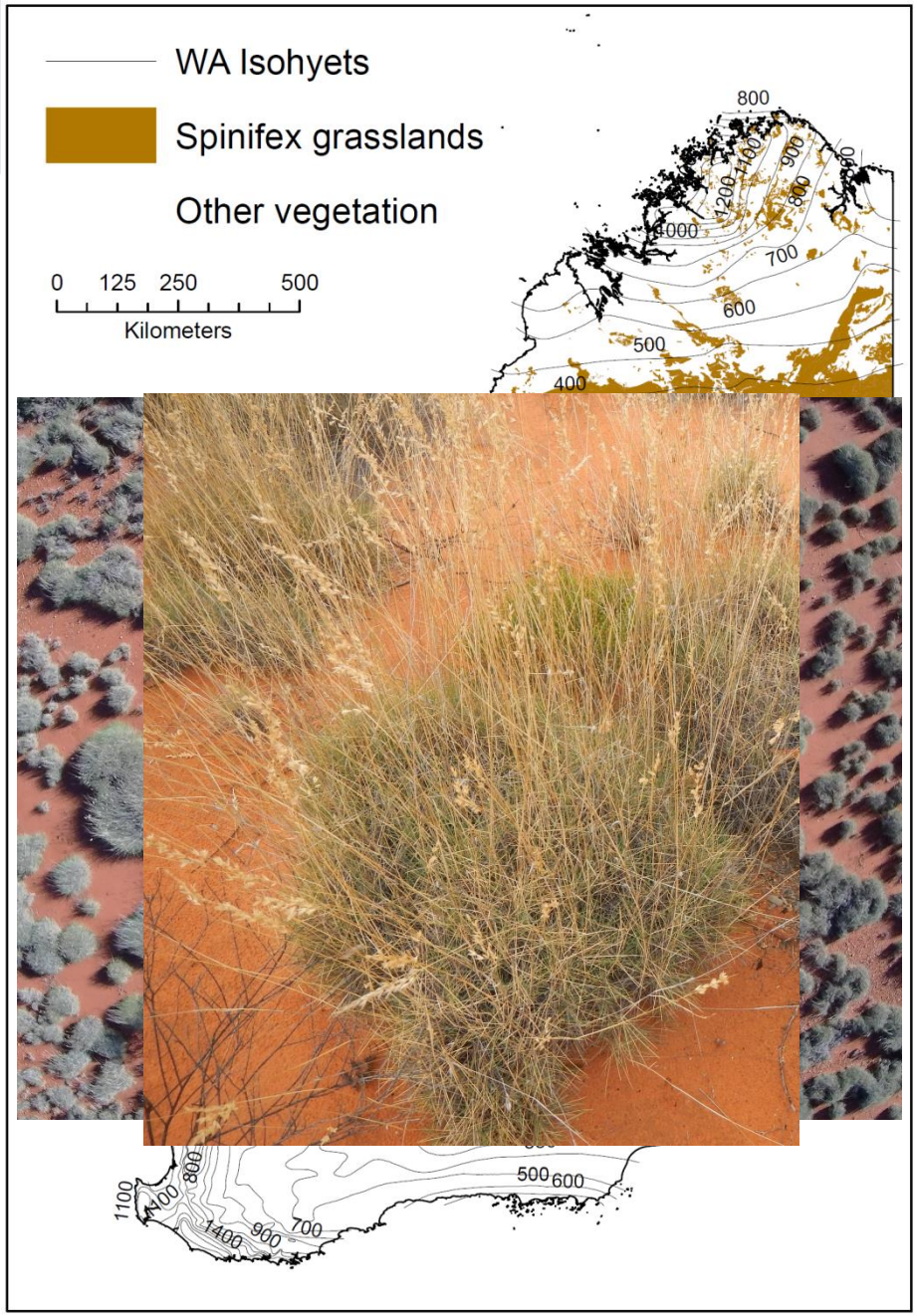
Scope

- **Examine the utility of UAS to:**
  - Enhance spinifex fire behaviour models
  - Relate UAS field measures to satellite imagery

- **Focus**
  - UAS to assess spinifex cover
  - Landsat 8 OLI imagery to provide a desktop assessment of spinifex cover

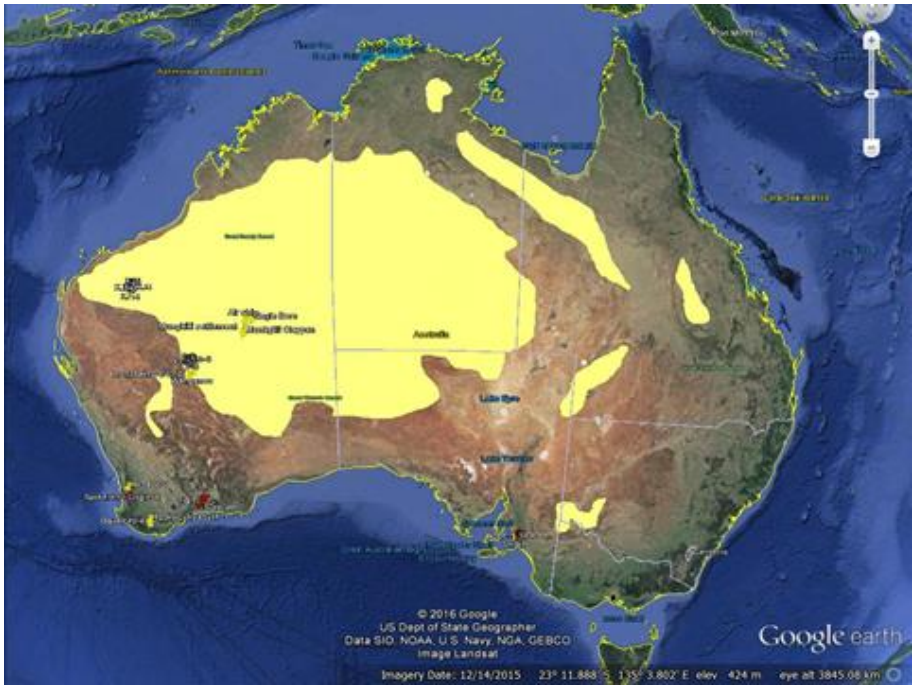
Spinifex Grasslands

- Perennial hummock grass of genus Triodia
- Physical structure of grass and extreme weather influence flammability
- Previous fire regime of Aboriginal management and lightning
- Effect on biodiversity of unmanaged fire



Fire Management

- **Objectives**
  - Mitigate wildfire threat to assets
  - Habitat management
  - Pasture/forage management
- **Strategies**
  - Prescribed burning
  - Limited suppression capability



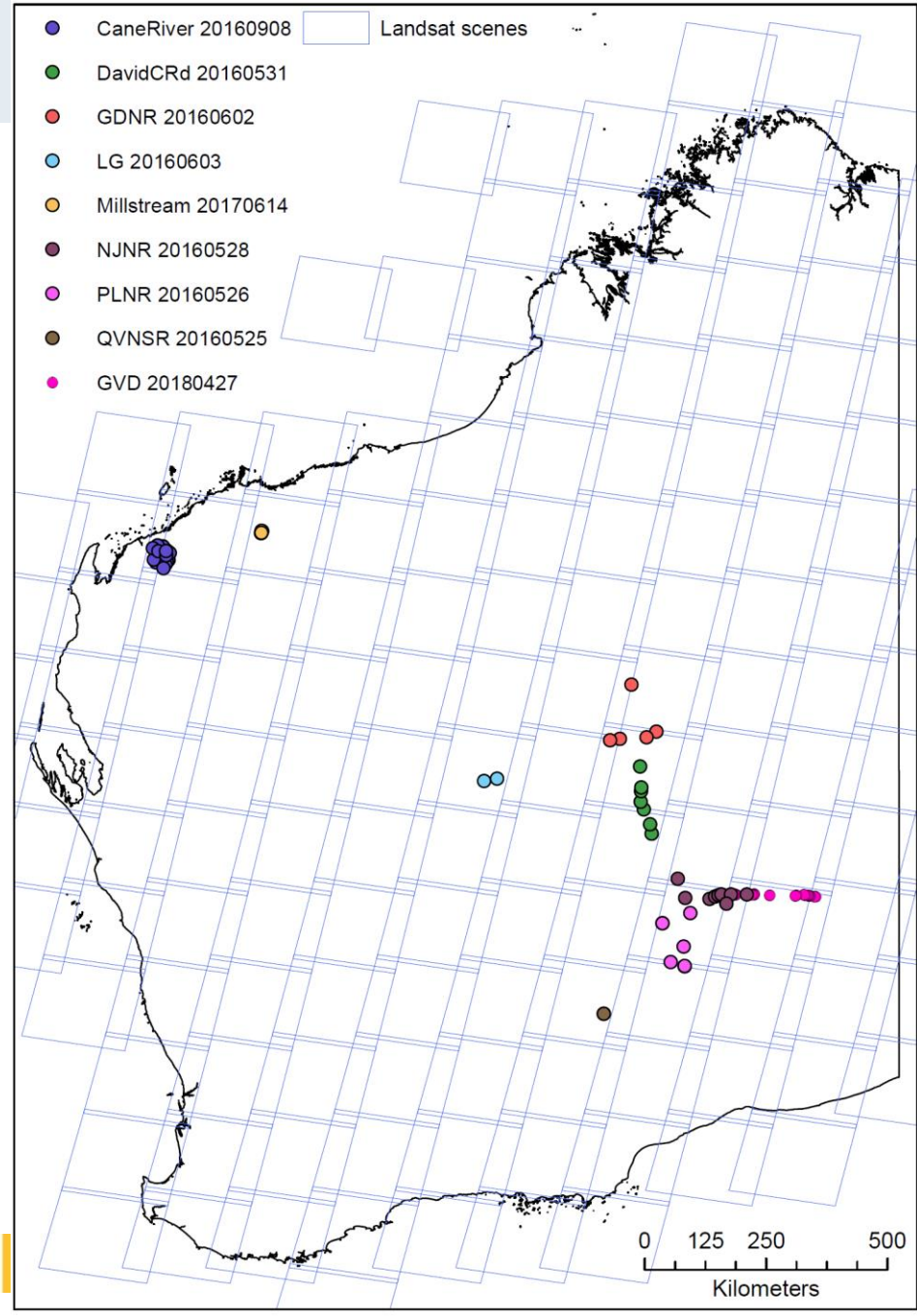
Spinifex grasslands are the dominant vegetation / fuel type in Australia, occupying about 27% of the continent

Fire behaviour model in spinifex grasslands

- **Prescribed burning utilises fire behaviour model developed for spinifex grasslands (Burrows et al 2006)**
  - Model inputs are
    - Fuel quantity (dry weight) / fuel cover and height
    - Fuel moisture
    - Wind
  - Models predict whether a fire will spread and subsequently the rate of spread
  - In planning locations to prescribe burn information on fuel states is lacking
  - Resource waste when a planned location can not be burnt (too much or too little fuel, too wet or dry)

Field Data

- Range of field trips
- Field dates 2016 captured with XIRO
- 2017, 2018 with Phantom 4
- Field transects also captured
- In total 62 field sites + GVD 20 validation field sites



Transect field data collection

- Spinifex fuel sampling is collected along 2 x 50m lines
- Intercepts of along the continuous measure of the tape
  - Spinifex measures: top height of spinifex clumps; clump shape; clump density; live spinifex; dead spinifex
  - Other cover categories: bare ground; surface litter; annual herbs; soft grasses; woody shrubs and herbs <=1.5m; other vegetation >1.5m
  - Vegetation height

Transect field data collection

- At 10m intervals 1mx1m fuel load sample of all fuel up to 4-6mm diameter
  - Green field weight
  - Oven dry weight estimated by sub-sampling moisture content

- Measures are summarised to:
  - bare ground; live spinifex; and others

UAS field data collection

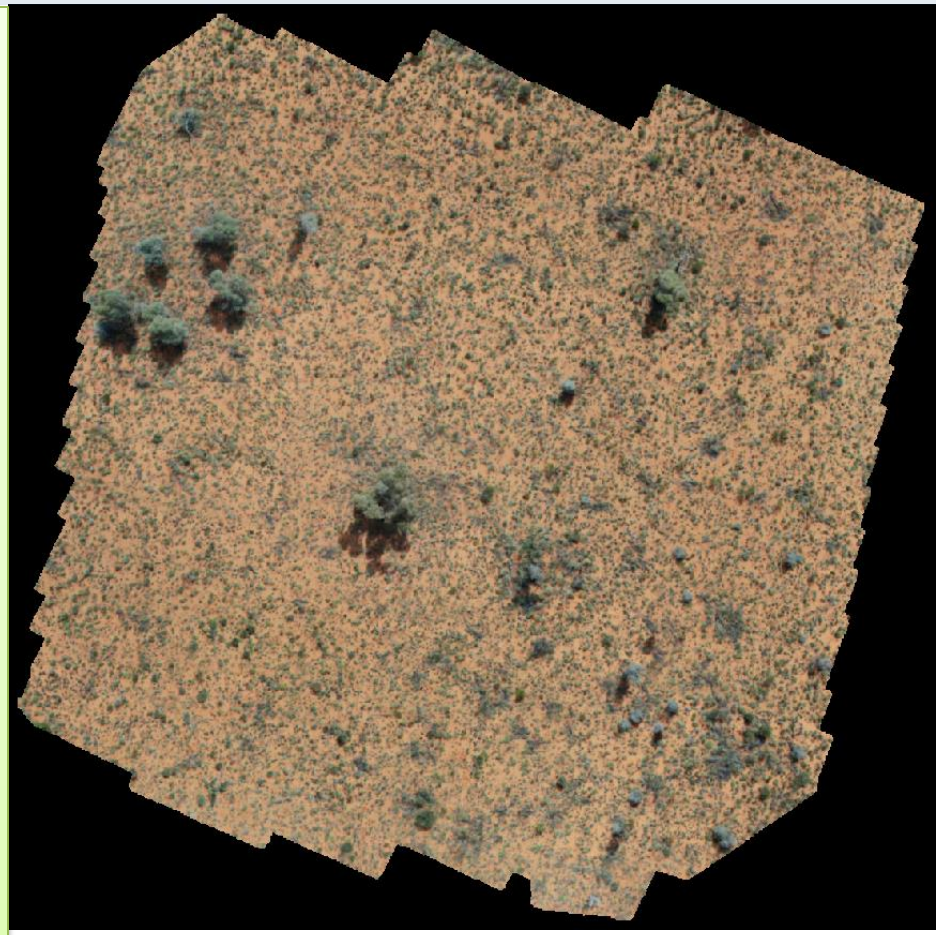
Previous UAS model: XIRO - XPLORER V UG3300

- RGB images, can be cropped & classified to extract cover %
- No GPS and distortion at image edges significant
- Proved the utility of UAS with this device

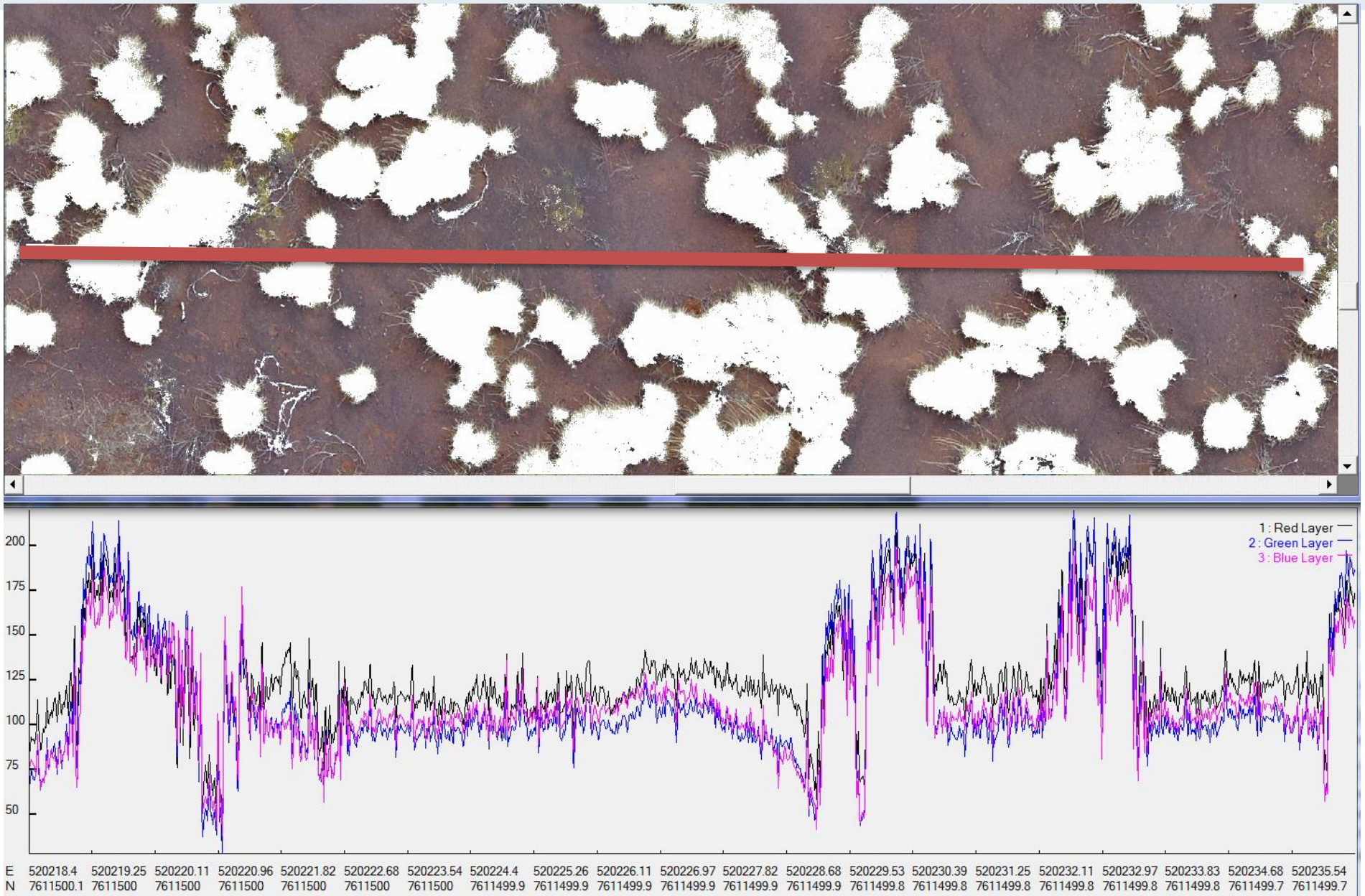
UAS field data collection

Current UAS model: DJI Phantom 4 Pro

- RGB image capture, can be classified to extract cover %
- GPS capture, possible to create image mosaics with Agisoft Photoscan software
- Higher quality images and more reliable outputs
- Now able to create point clouds to assess volume using LAStools software



UAS cover classification

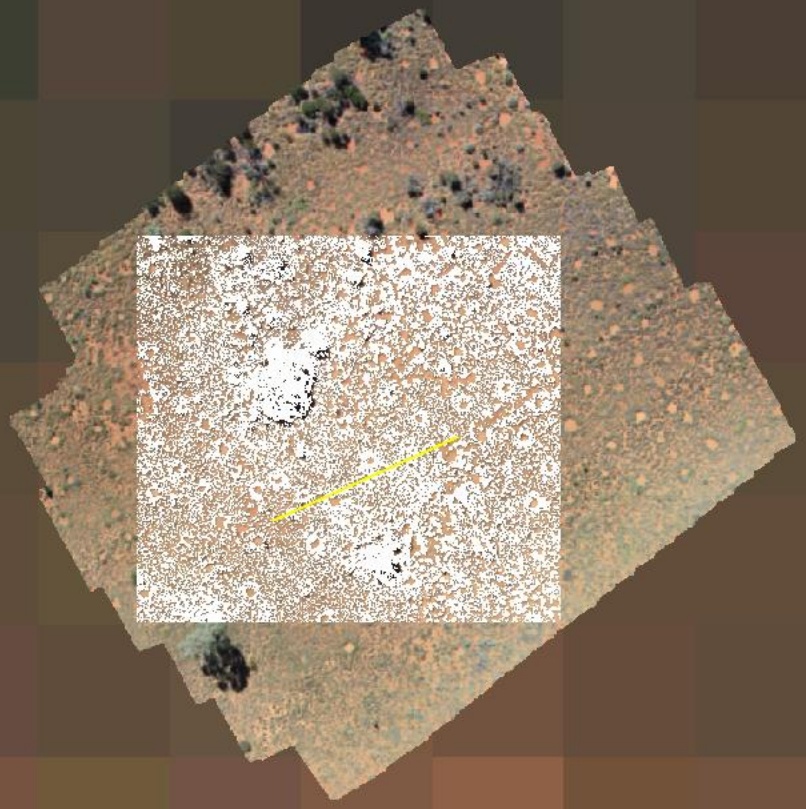


Landsat Satellite Imagery

- To enable desktop assessments of spinifex cover investigated relationship with satellite imagery
- Landsat 8 Operational Land Imager chosen due to cost, coverage and radiometric correction
- Landsat 8 OLI characteristics
  - 30m pixel
  - 8 spectral bands available at 30m, 6 utilised
  - 16 day revisit

Band 1 - Ultra Blue (coastal/aerosol)
Band 2 - Blue
Band 3 - Green
Band 4 - Red
Band 5 - Near Infrared (NIR)
Band 6 - Shortwave Infrared (SWIR) 1
Band 7 - Shortwave Infrared (SWIR) 2
Band 9 - Cirrus

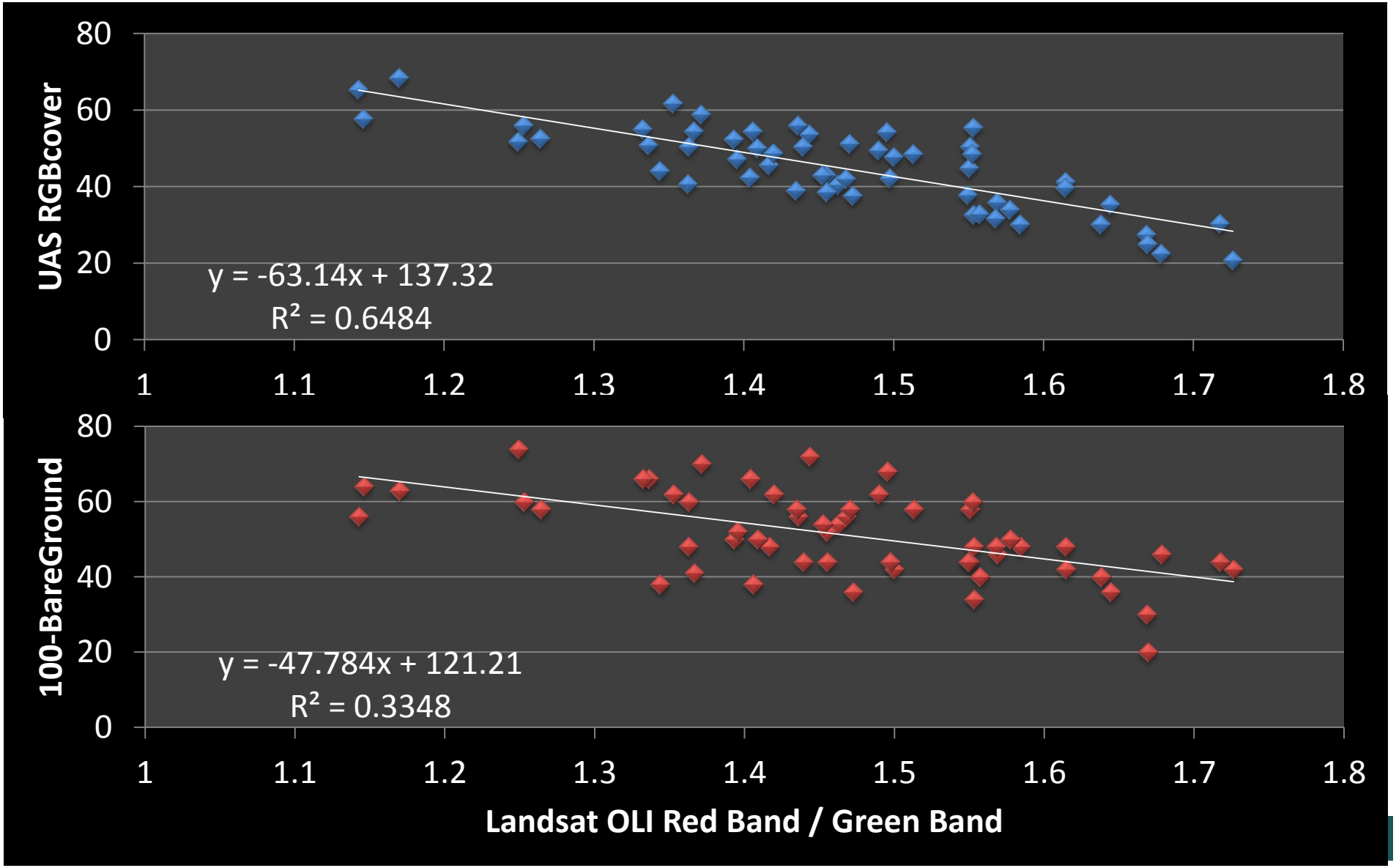
Landsat | UAS | Transect



Landsat cover index

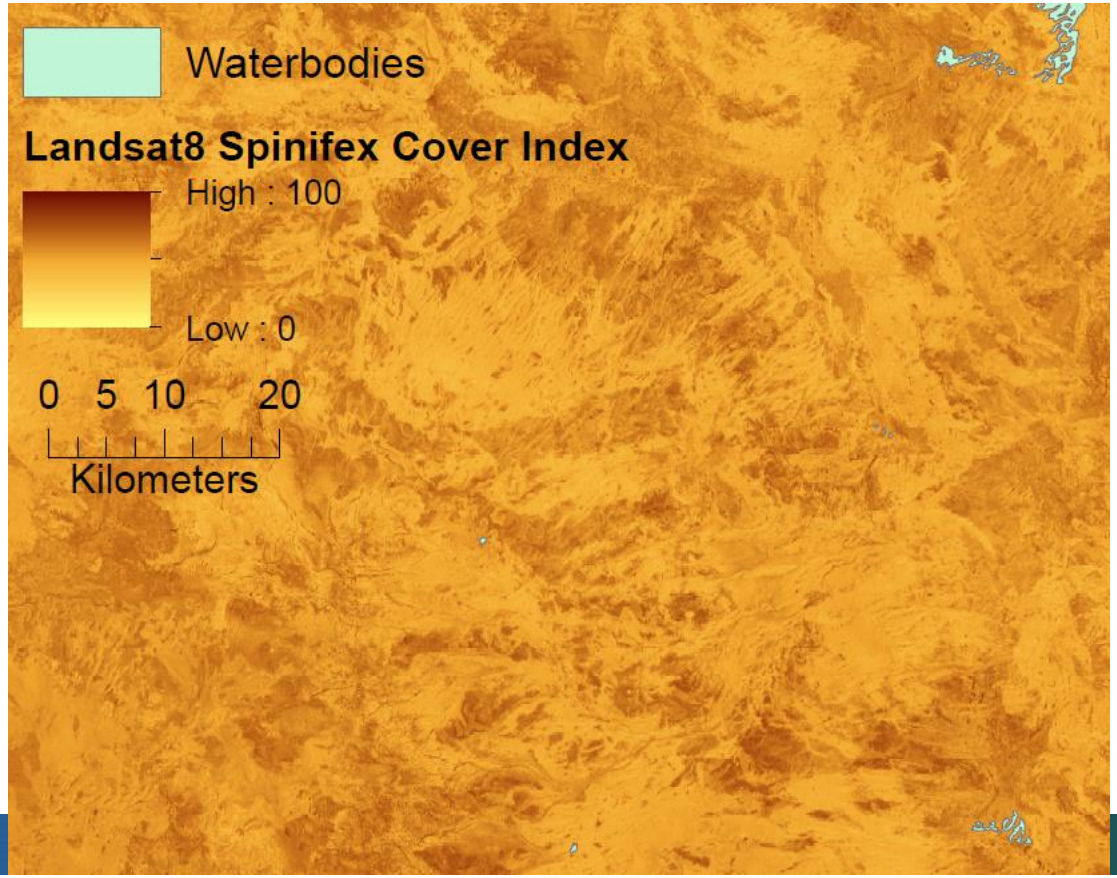
- An index is a combination of spectral bands that show the relative abundance of a landscape attribute of interest e.g. NDVI
- Field data of spinifex cover was used to derive spinifex indices using discriminant analysis
- Also tested established vegetation indices
- Red band / Green band index derived during UAS classification had the strongest relationship

Landsat cover index and field data



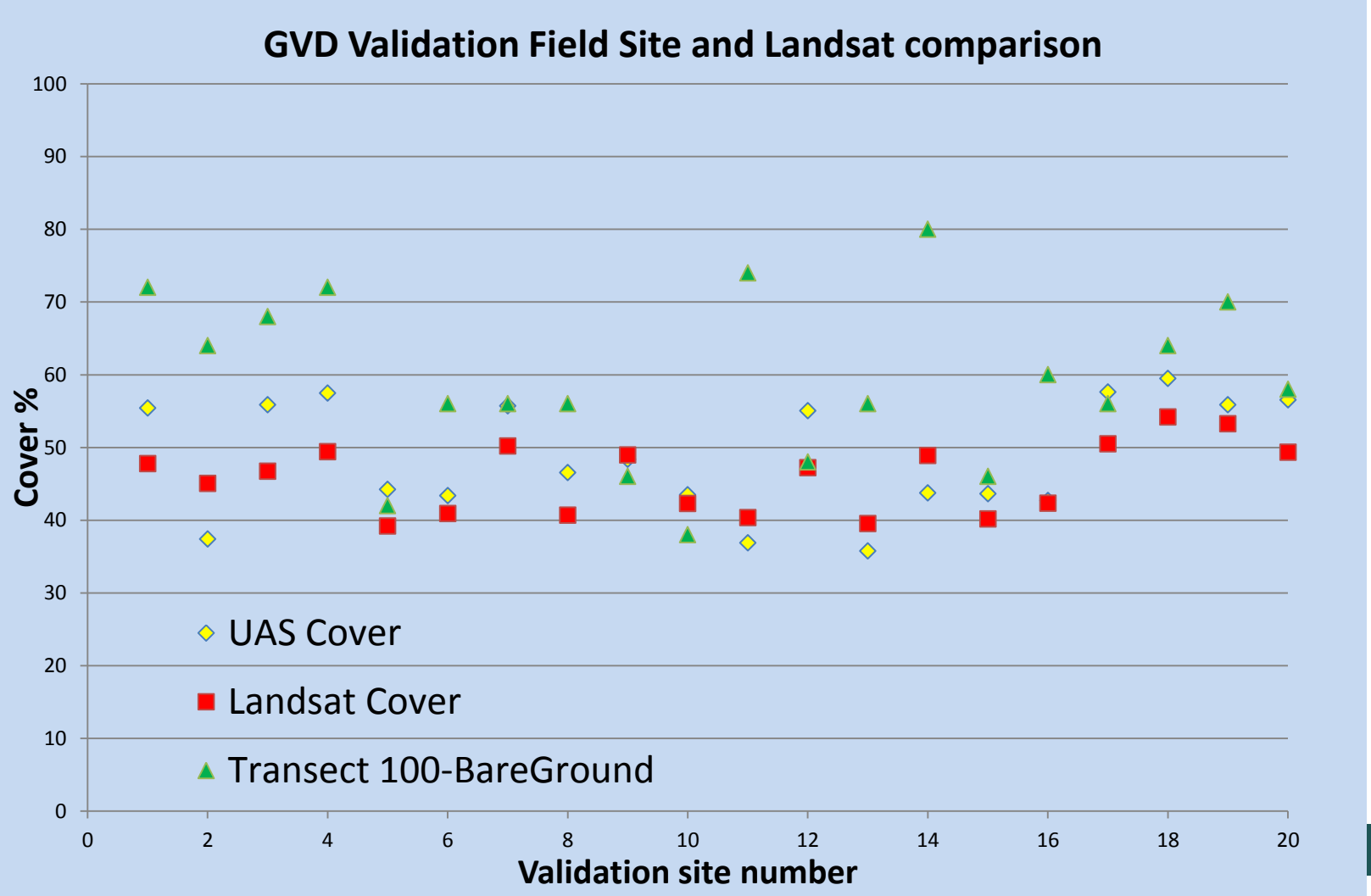
Landsat cover index application

- Derived regression can be applied to corrected Landsat 8 OLI imagery
- Only applicable in spinifex dominated grasslands



Validation

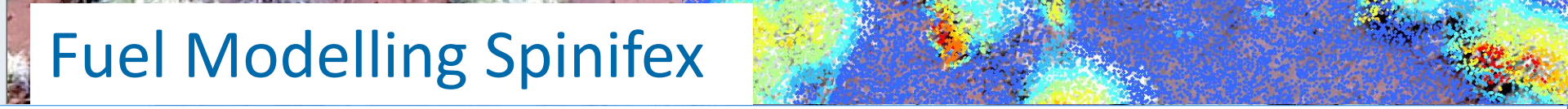
- 20 field sites in the Great Victoria Desert captured 27-30 April 2018
- Differences between UAS Cover and Landsat Cover less than 10%

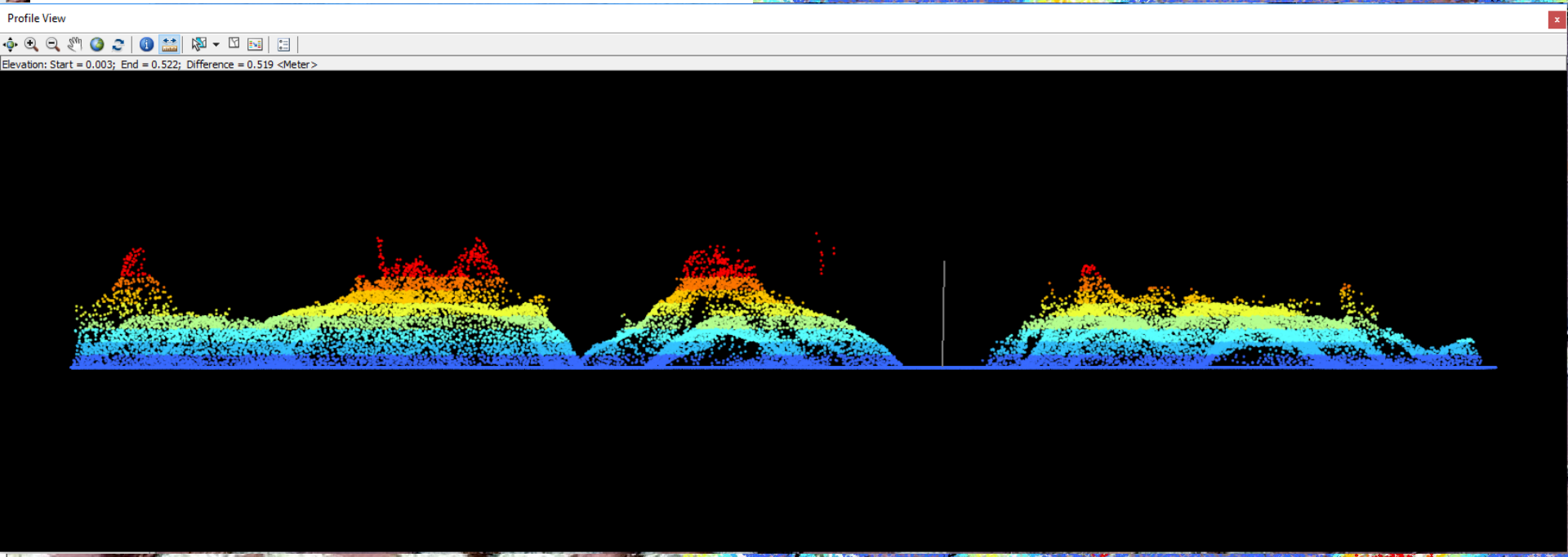


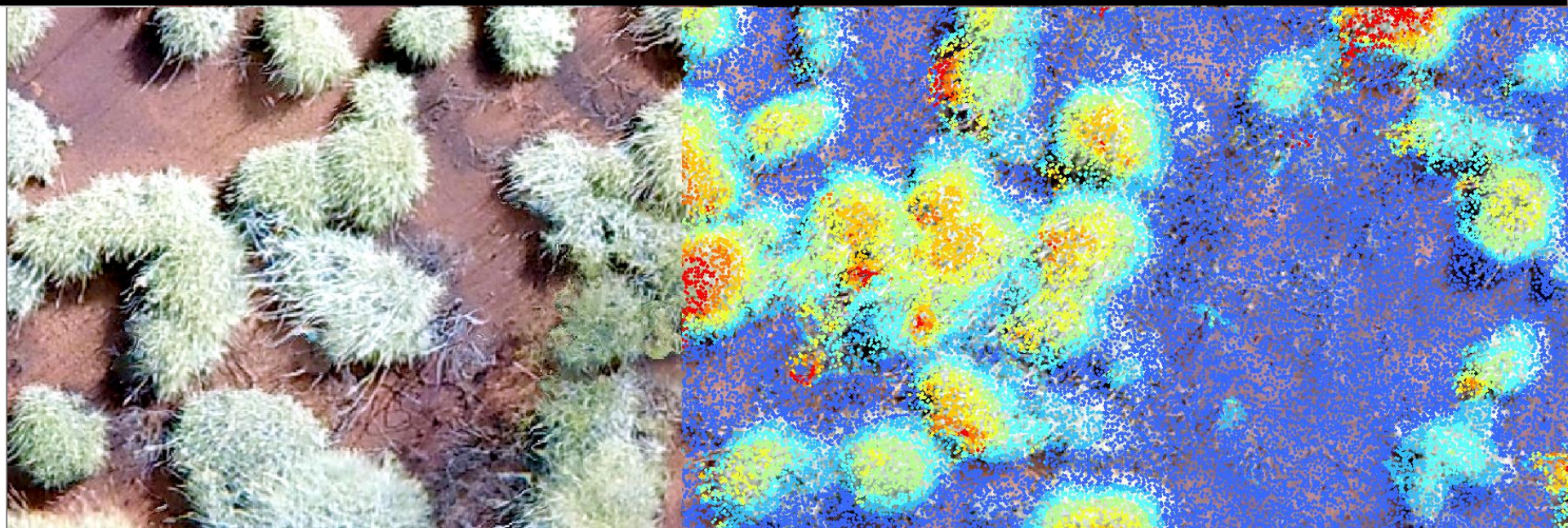
Development of other spinifex characteristics

- Spinifex clump shape, height and distribution in the landscape are other important aspects that influence fire behaviour
- Point cloud analysis of UAS field data reveals clump shape, height and volumes can be determined
- The continuity of the spinifex cover can also be quantified

Fuel Modelling Spinifex







Future work

- More field trips to fill in gaps in geographic location and rainfall variation
- Examine the utility of point cloud information
- Moisture index development
- Use of time lapse capture of burn activities
- Scale to whole of state and operationalise
  - Use of other satellite imagery such as Sentinel-2

Summary

- UAS provide more comprehensive evaluation in the field of spinifex cover and volume and distribution
- UAS derived cover can be scaled to satellite imagery
- Field capture times using UAS are much quicker than transect methods, however moisture samples are still required
- Fire behaviour models can be improved by the use of field data captured by UAS – including imagery and video capture
- Impact on operations will be in saved time and resources in being able to better plan prescribed burning field trips

Thanks

- Errol Thoomes
- Jane Chapman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