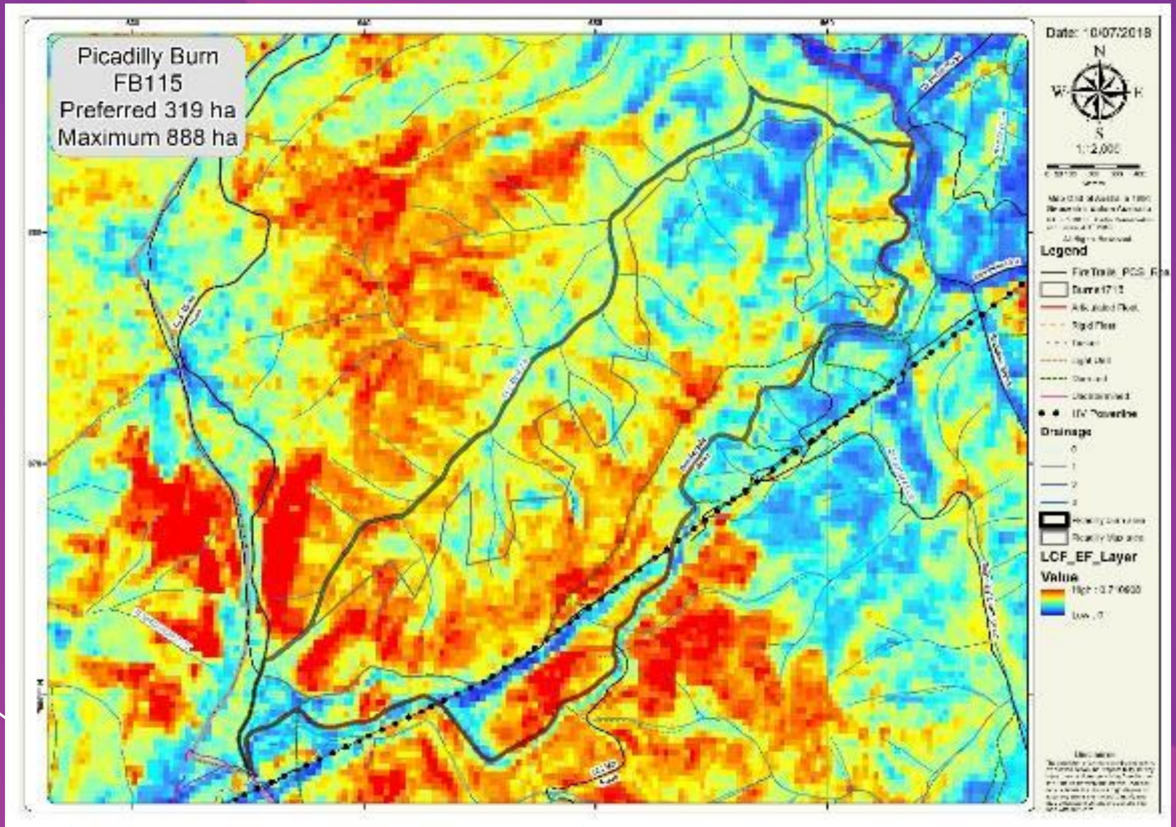
ACT GOVERNMENT

Operational Applications of Remote-sensing for Bushfire Management



Adam Leavesley, Marta Yebra, Albert Van Dijk, Petter Nyman, Brian Levine, Tony Scherl, Neil Cooper

ACT Government

Australian National University

bushfire&natural HAZARDS CRC

I'M GOING TO TALK ABOUT:

1. Fire severity (dNBR)
2. Ways to use LiDAR products
   - Fire suppression
   - Prescribed burning
   - Flammability modelling

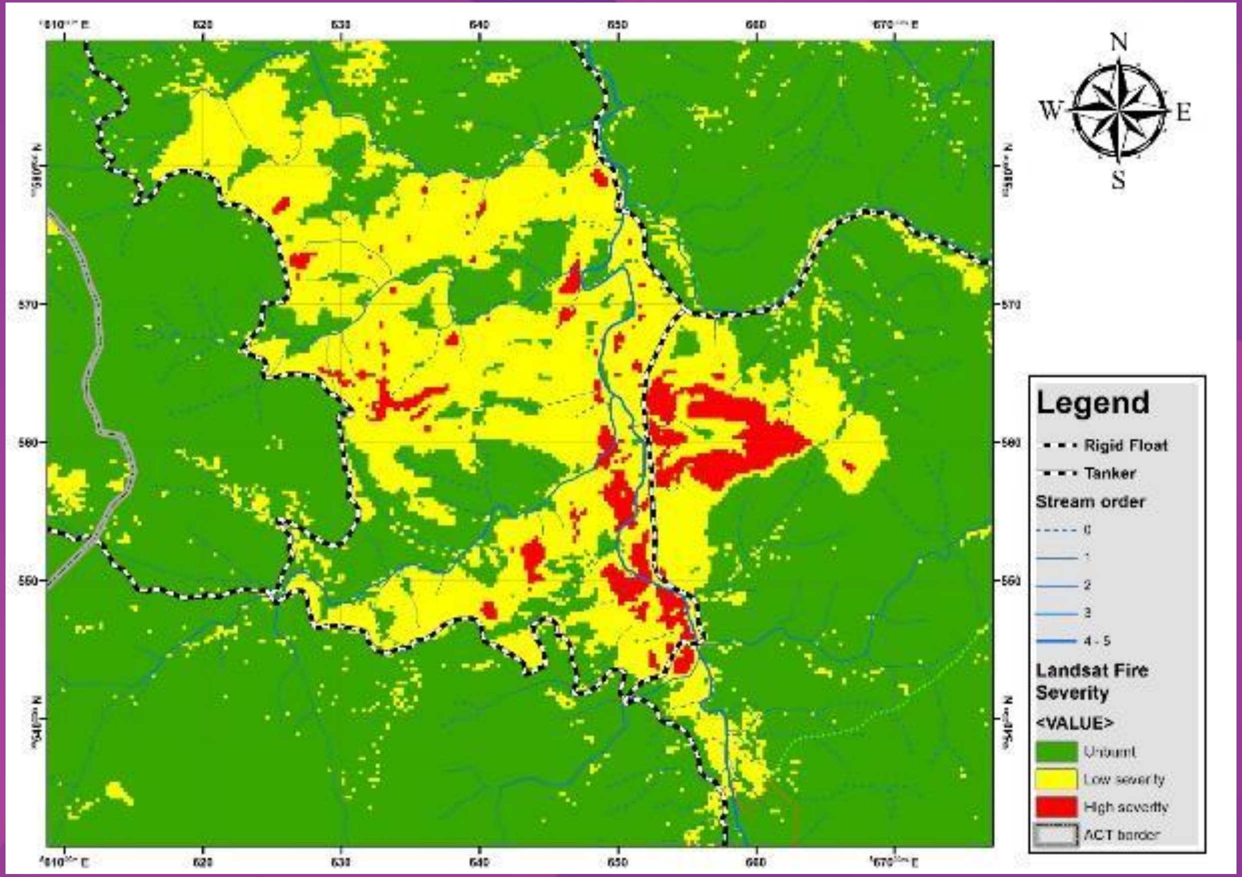
   Australian Flammability Monitoring System (Marta Yebra)

Thanks to GWIS for my invitation

DIFFERENTIAL NORMALISED BURN RATIO

- Developed by US Forest Service - FIREMON

- ACT Parks 3 season pilot
- Autumn 2015-2017
- Ten (10) rural burns
- Size range 115ha – 3838ha



TRUTHING

Ground fuels burnt (%)
Shrub cover (%)
Shrub scorch (%)
Canopy scorch (%)
Canopy burnt (%)

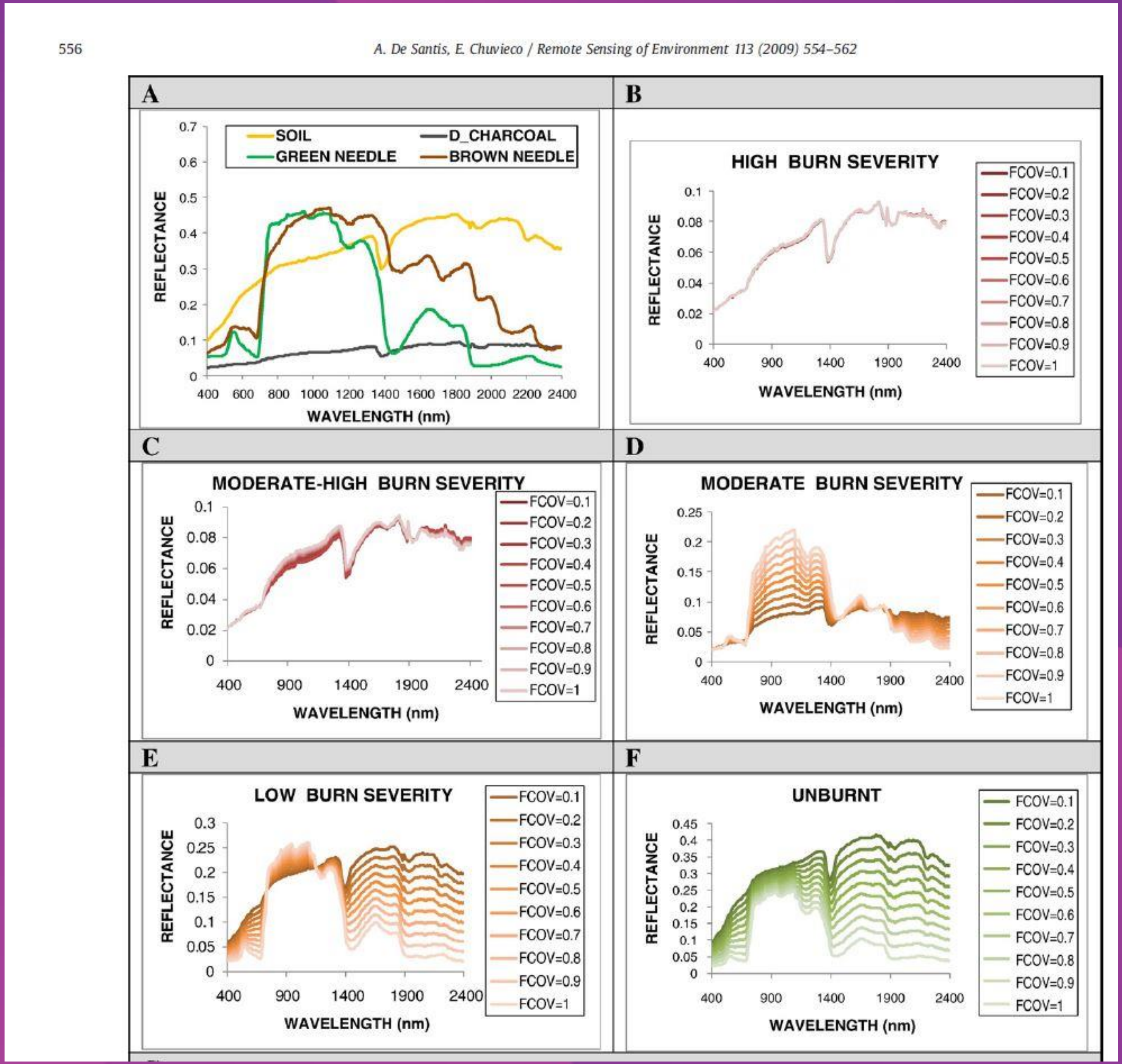
(∆NBR)

Accuracy

Aiming for >85%
(Anderson et al. 1976)

But…
There are some inherent issues with dNBR.

De Santis and Chuvieco 2009

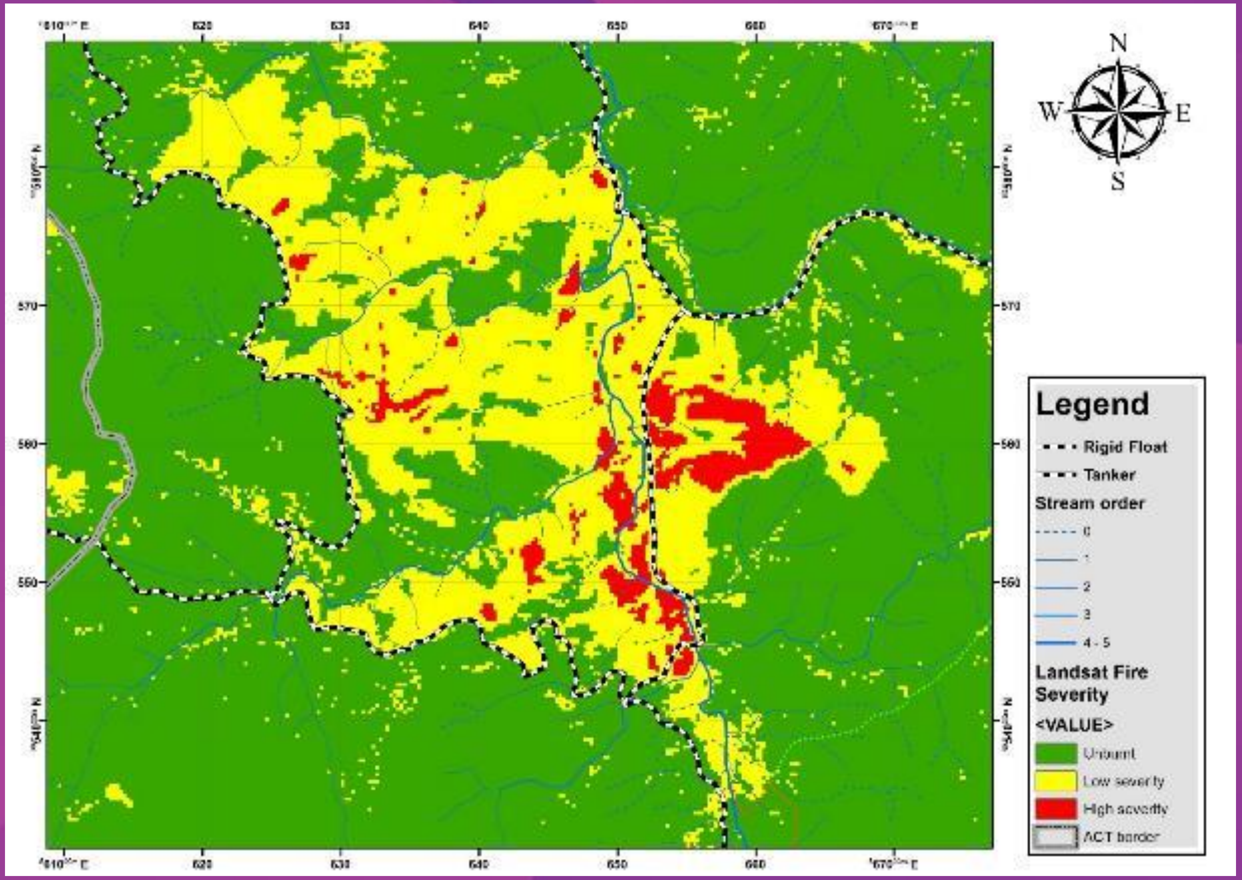


DIFFERENTIAL NORMALISED BURN RATIO

Our solution – 3 classes

Unburnt	<50% ground burnt	ΔNBR <0.1
Low	>50% ground burnt <50% canopy scorch and burnt	0.1< ΔNBR <0.4
High	>50% canopy scorch and burnt	ΔNBR <0.4

ΔNBR Range = -0.09 – 0.99



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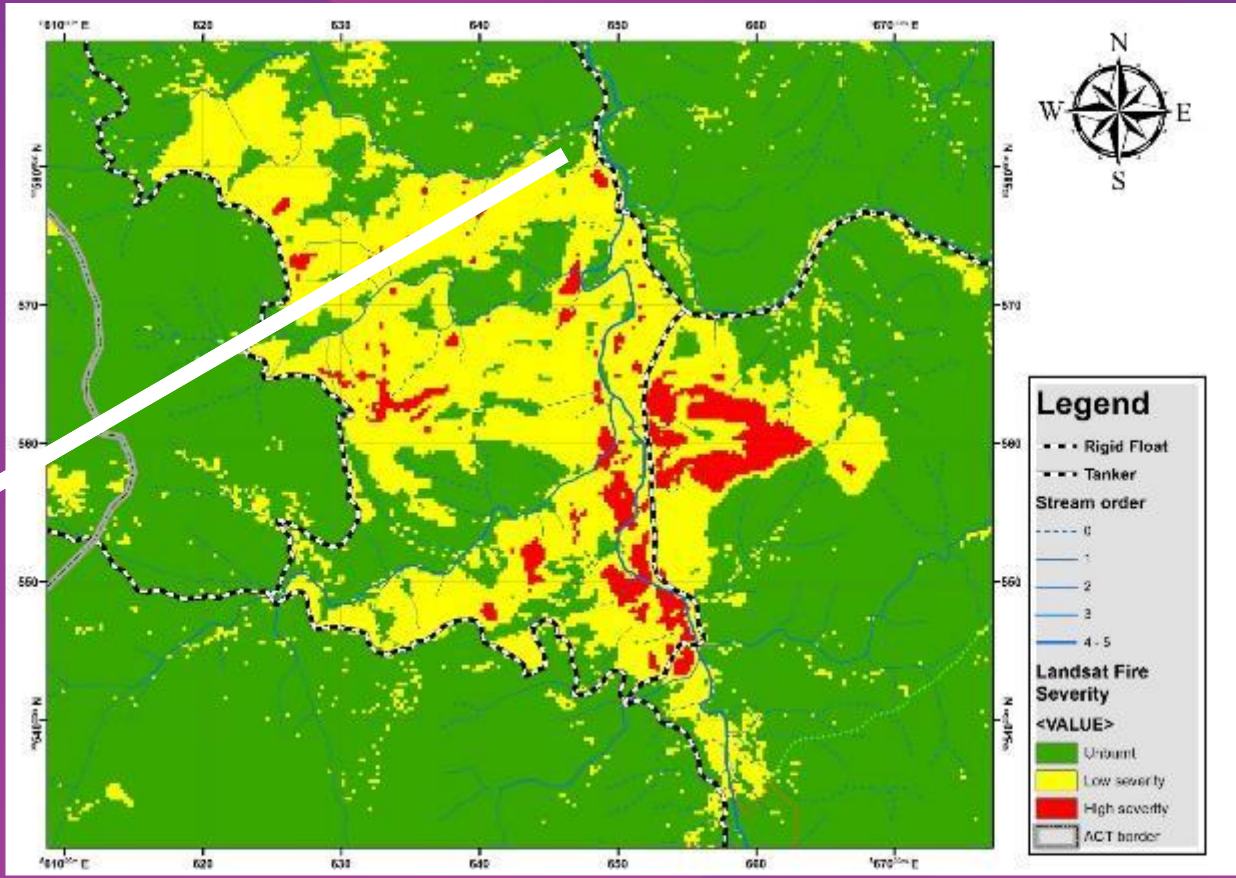

Fire severity analysis of the Cotter River Burn, April 2015

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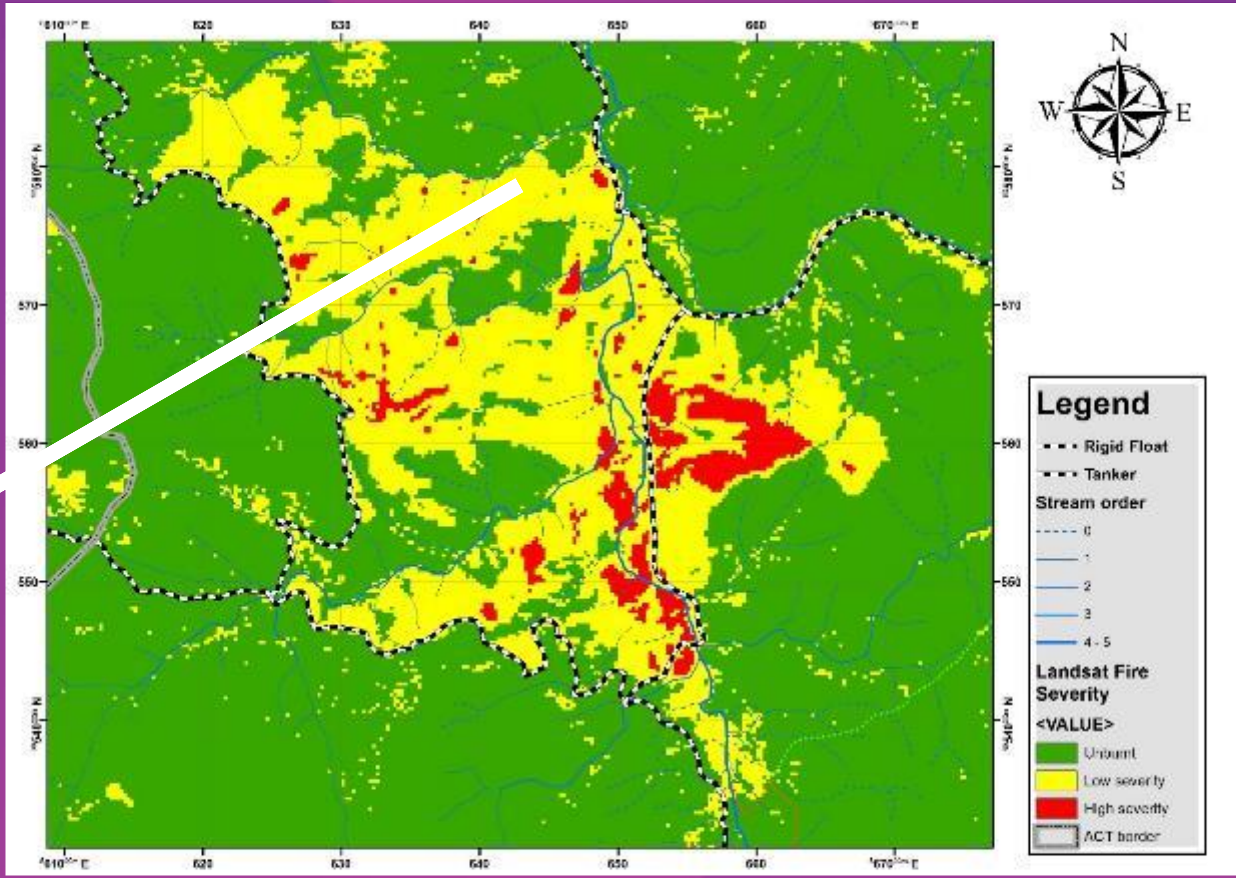

Fire severity analysis of the Cotter River Burn, April 2015

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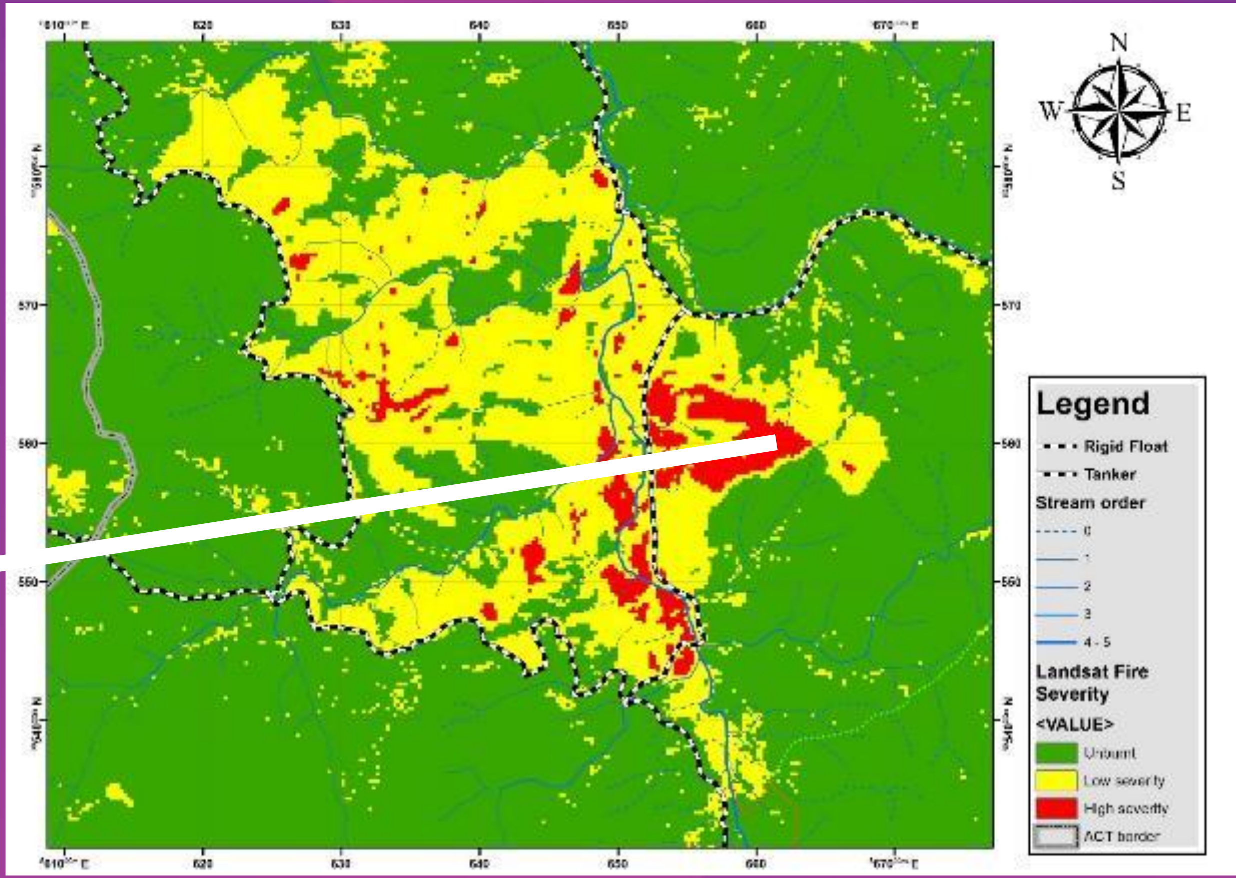

Fire severity analysis of the Cotter River Burn, April 2015

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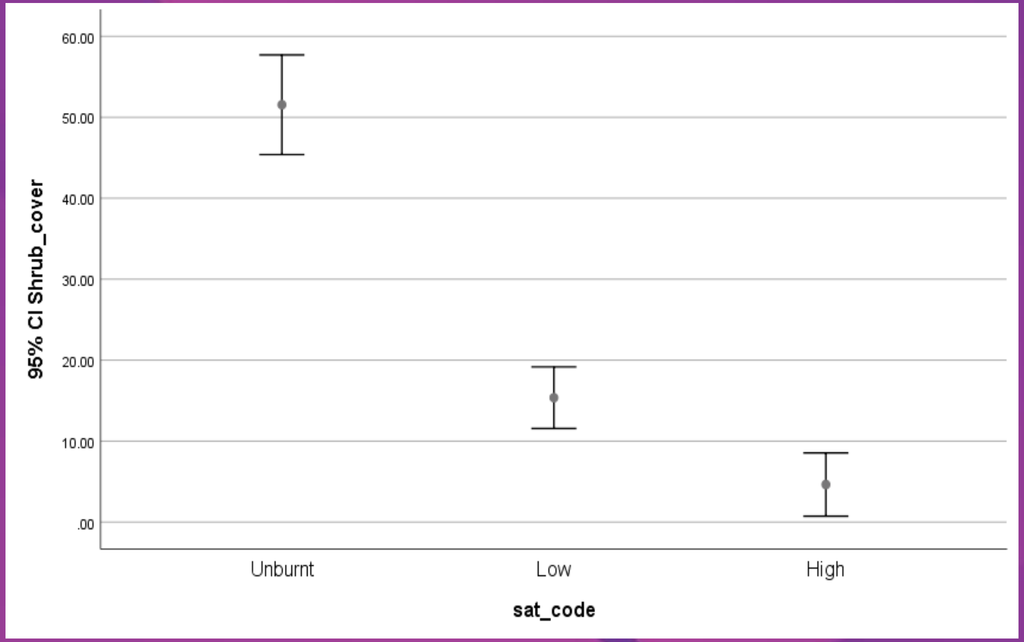
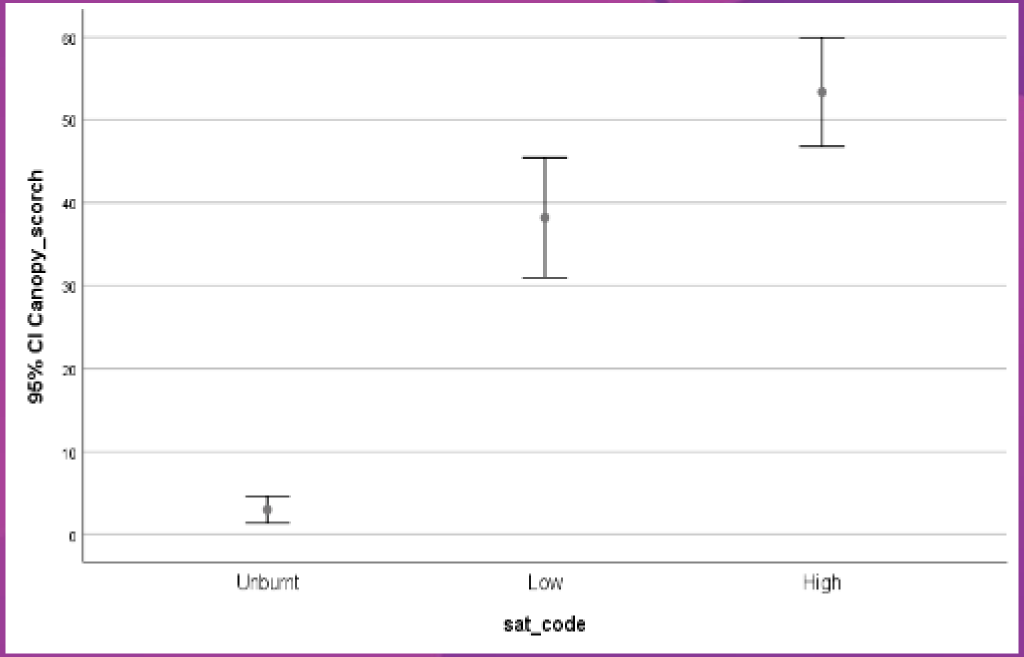
FIRE EFFECTS

Static classes are sub-optimal for the range of land management functions:

Fuel mapping
Post-fire hydrological risk
Emissions reporting
Biodiversity assessment

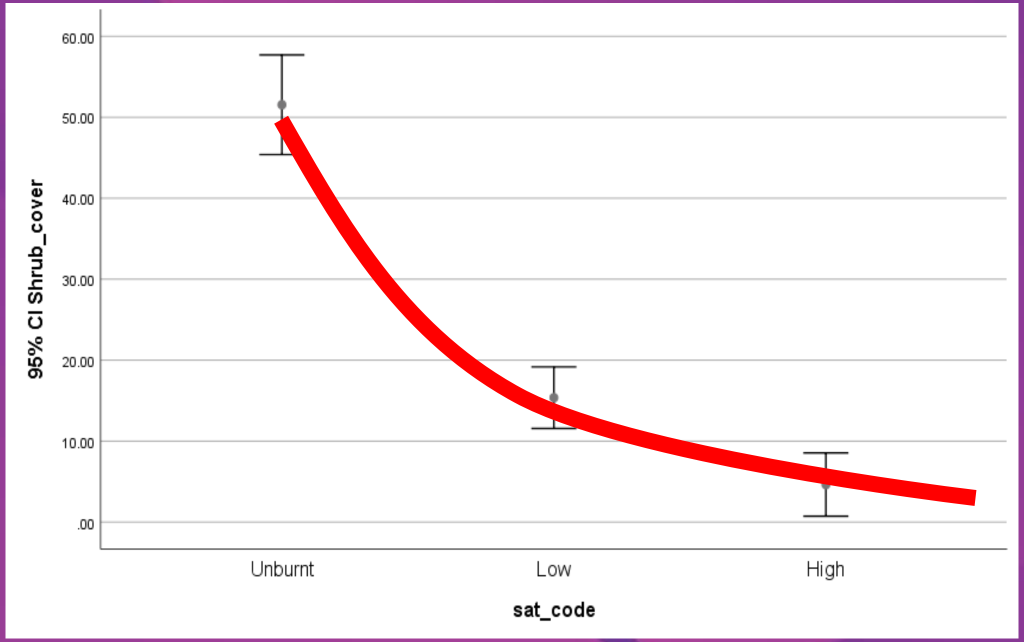


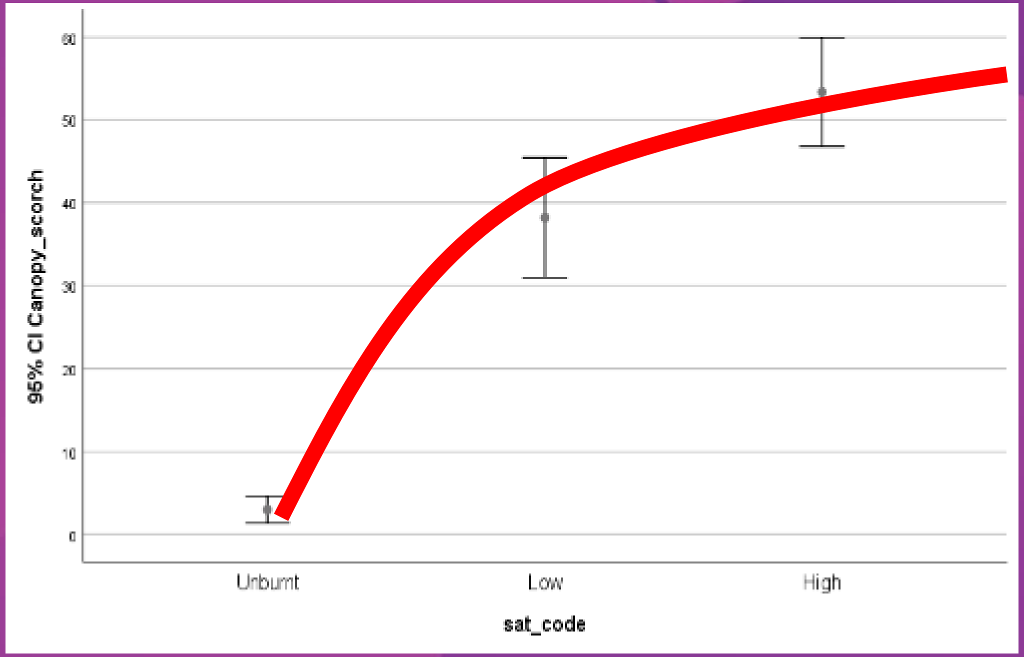


MULTIPLE USES

Static classes are sub-optimal for the range land management functions

Fuel mapping
Post-fire hydrological risk
Emissions reporting
Biodiversity assessment





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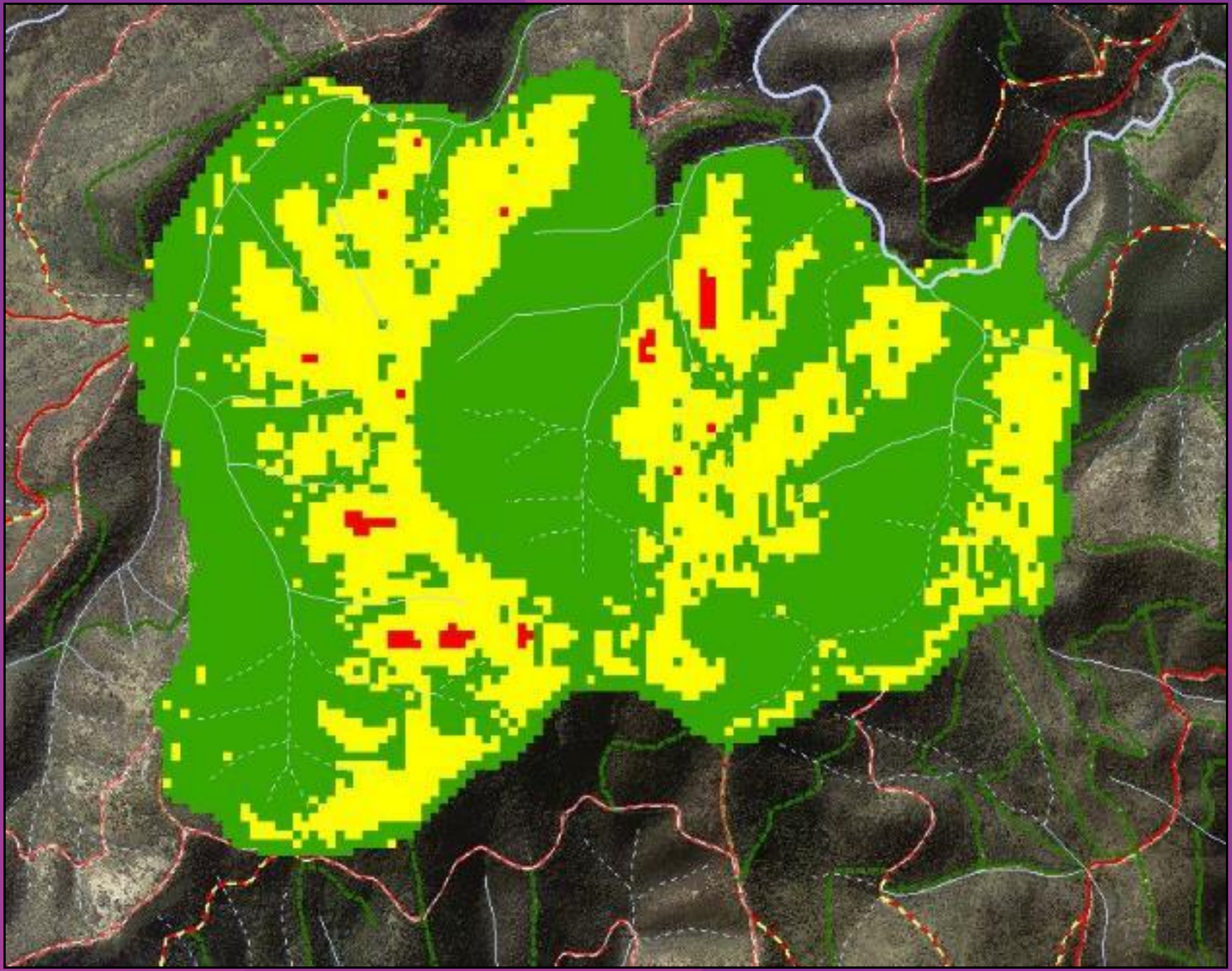
Results of burning program 2015-2017

Unburnt = 59 %
Low severity = 38 %
High severity = 3 %



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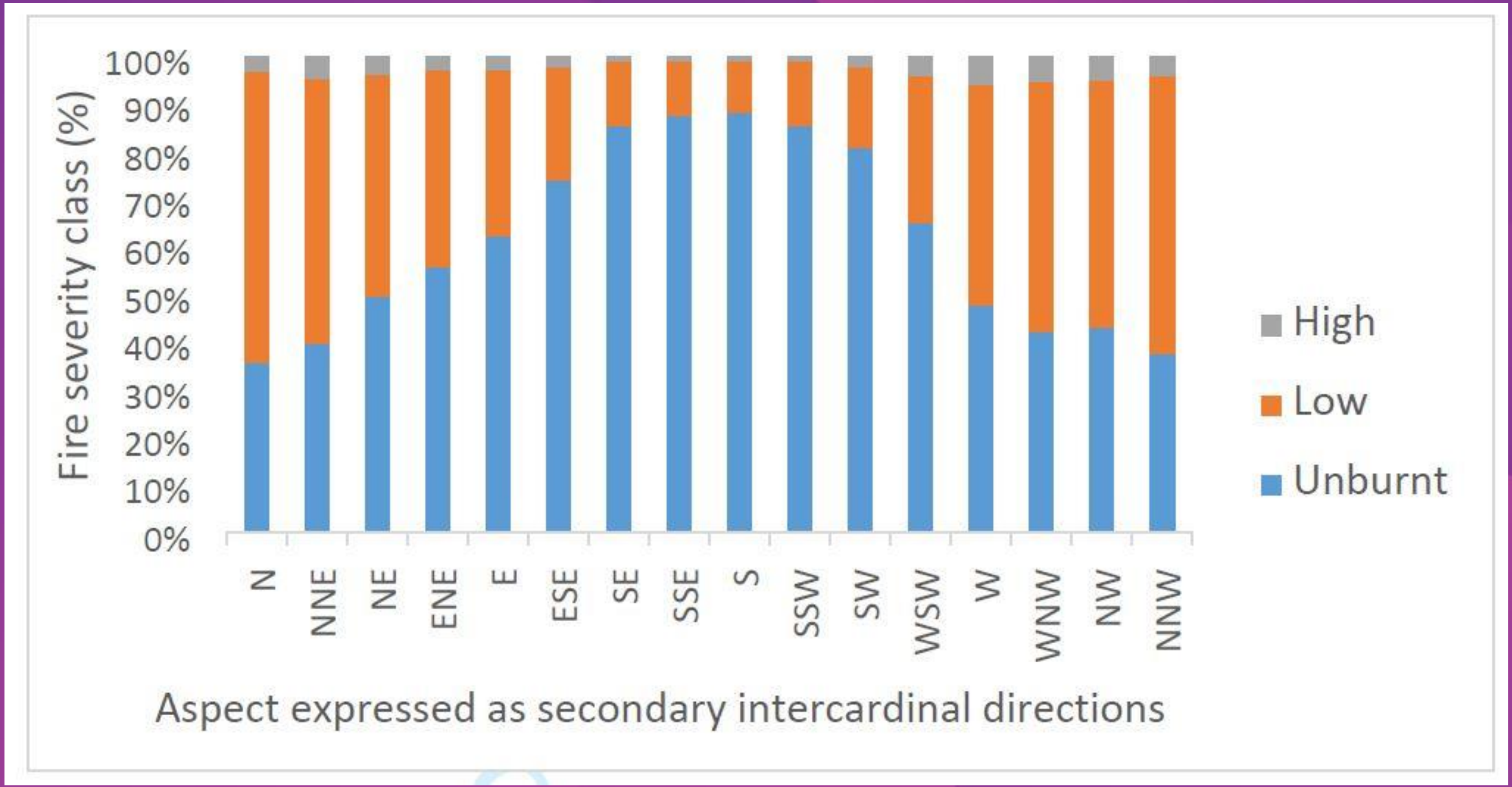
Northern slopes burnt more readily than southern slopes



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ADAPTIVE MANAGEMENT

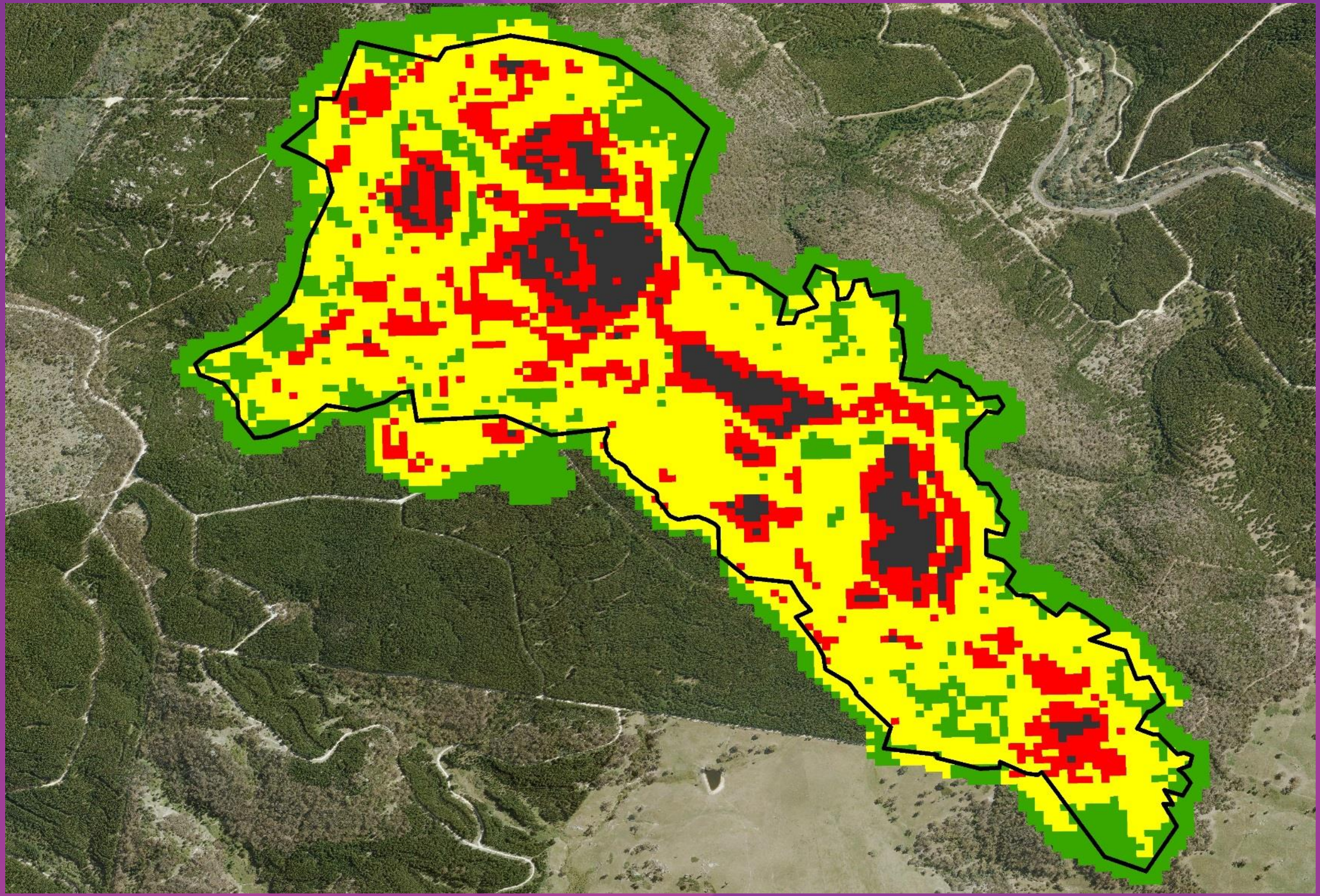
Prescribed burn flammability map derived from analysis of 10 burns 2015-2017.

Proportion of pixels which burnt by aspect
Yellow = 64%
Red = 12%

Wildfire severity

dNBR from Sentinel 2

Green = Unburnt
Yellow = Low/Moderate
Red = High
Black = Very high



Pierce’s Creek Fire, ignited 1 November 2018

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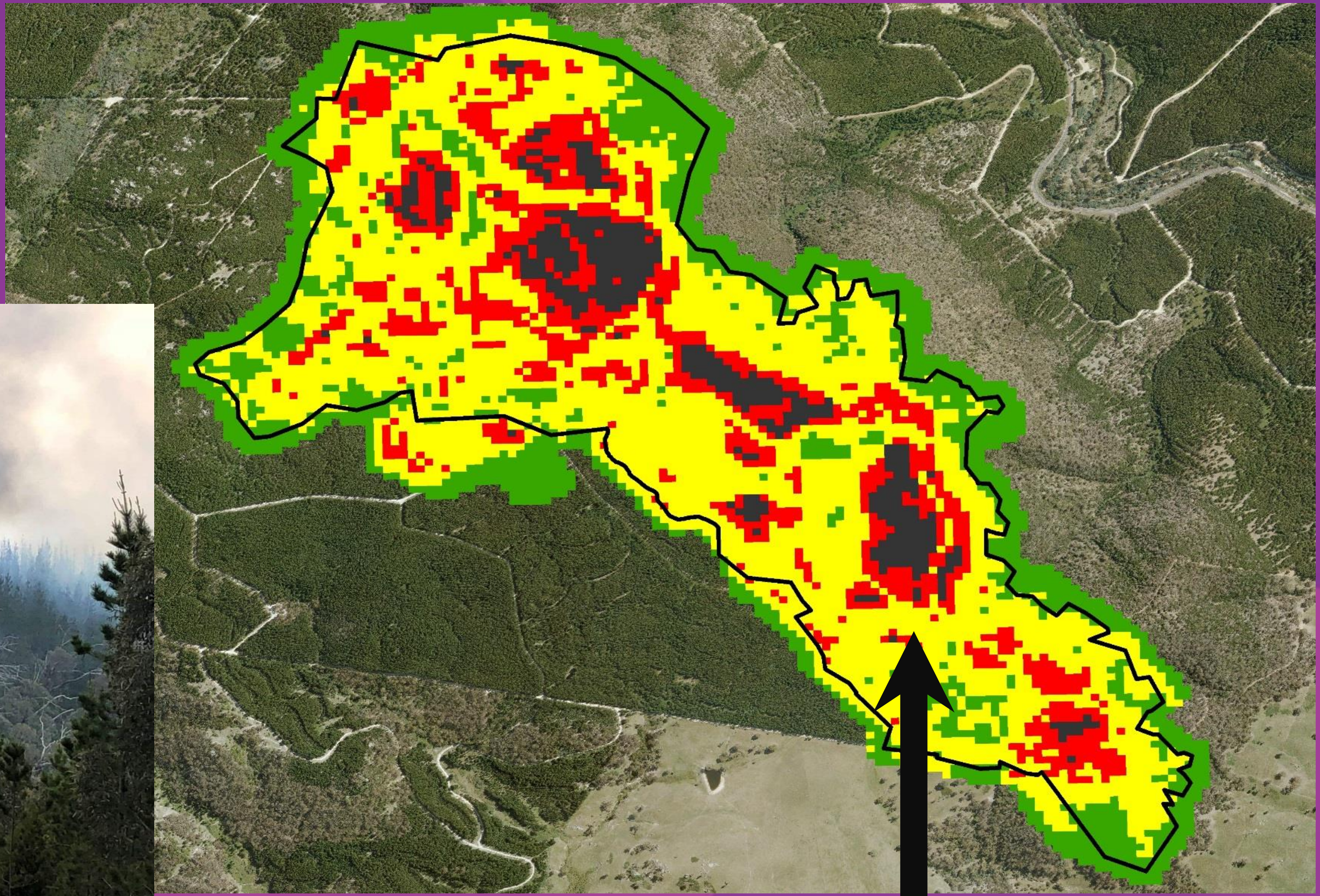
Wildfire severity



Pierce’s Creek Fire, ignited 1 November 2018

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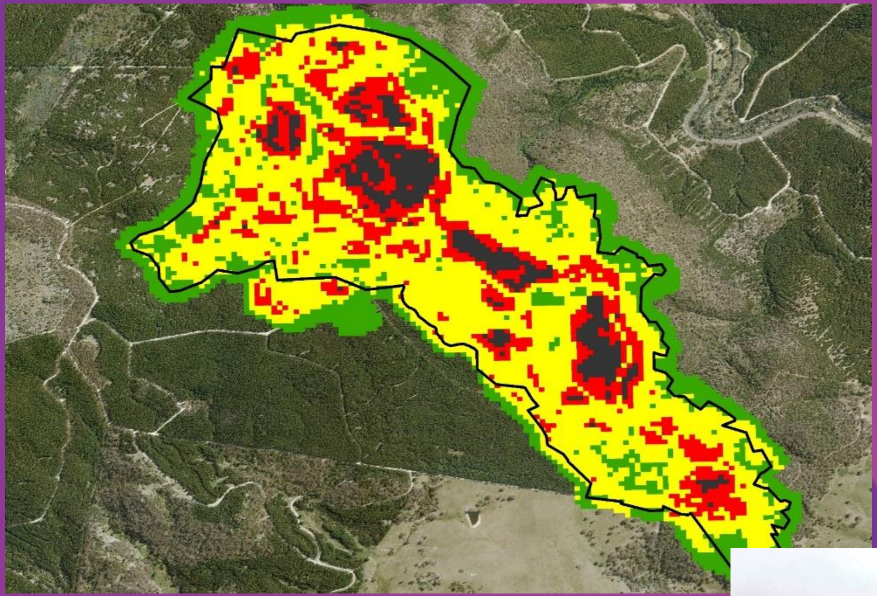


Evaluating:

ΔNBR (Sentinel 2)
ΔNBR (Landsat 8)
Radiative Transfer Model
Vegetation Structure Perpendicular Index
Random Forests

Pierce’s Creek Fire, ignited 1 November 2018

Why invest in LiDAR for fire/fuel mapping?

Inadequate knowledge of fuels and fuel condition was implicated in the Margaret River (Keelty, 2012) and Lancefield escapes (Carter *et al*. 2015).

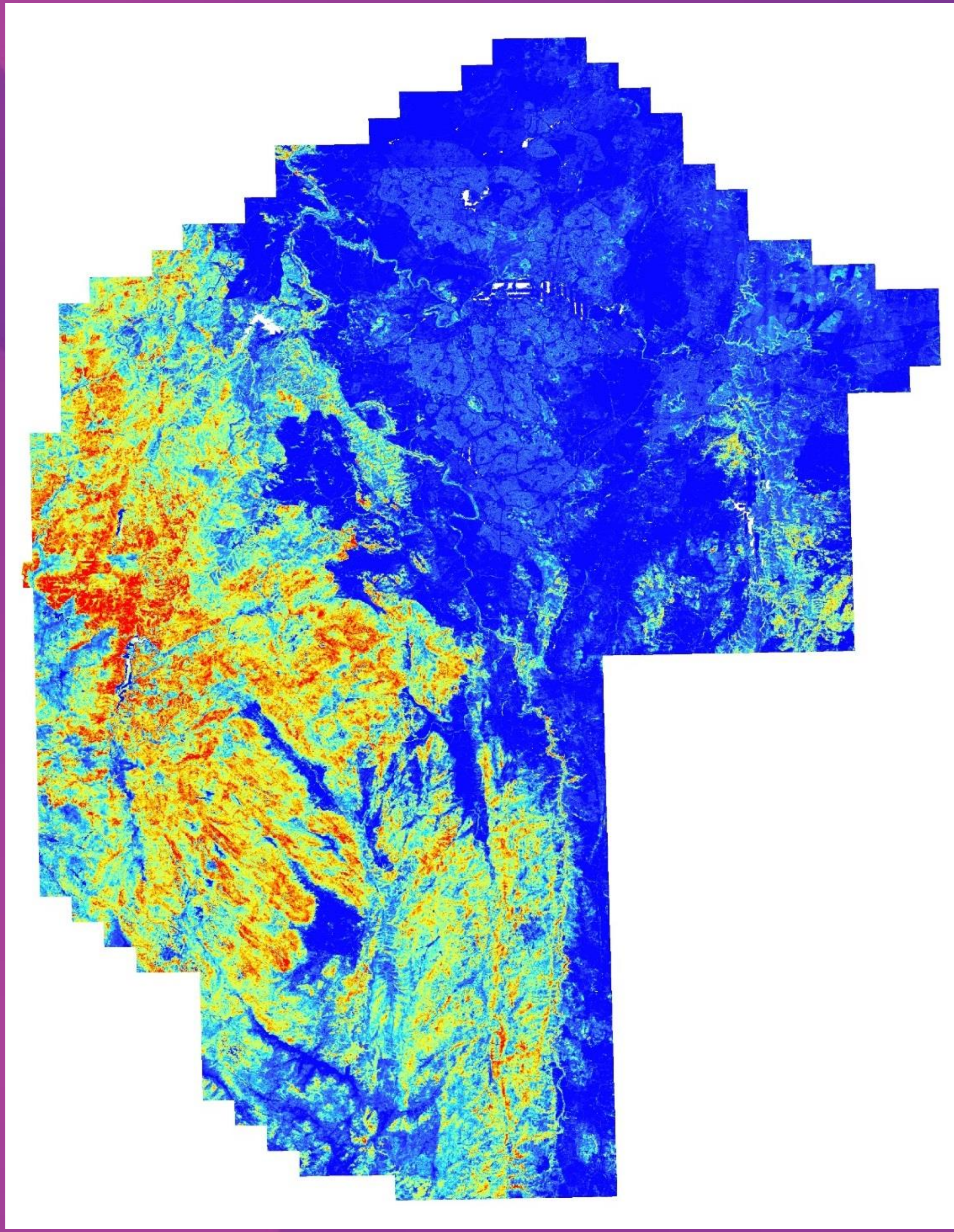
LiDAR-derived Fuel Mapping

AIMS:

1. Develop easily-derived experimental products for land managers.
2. Develop prototype processes and specifications.

OFHA and Project Vesta inputs

(Van Dijk, 2017; Hines et al. 2010; Gould et al. 2007)



LiDAR-derived estimate of Elevated Fuel

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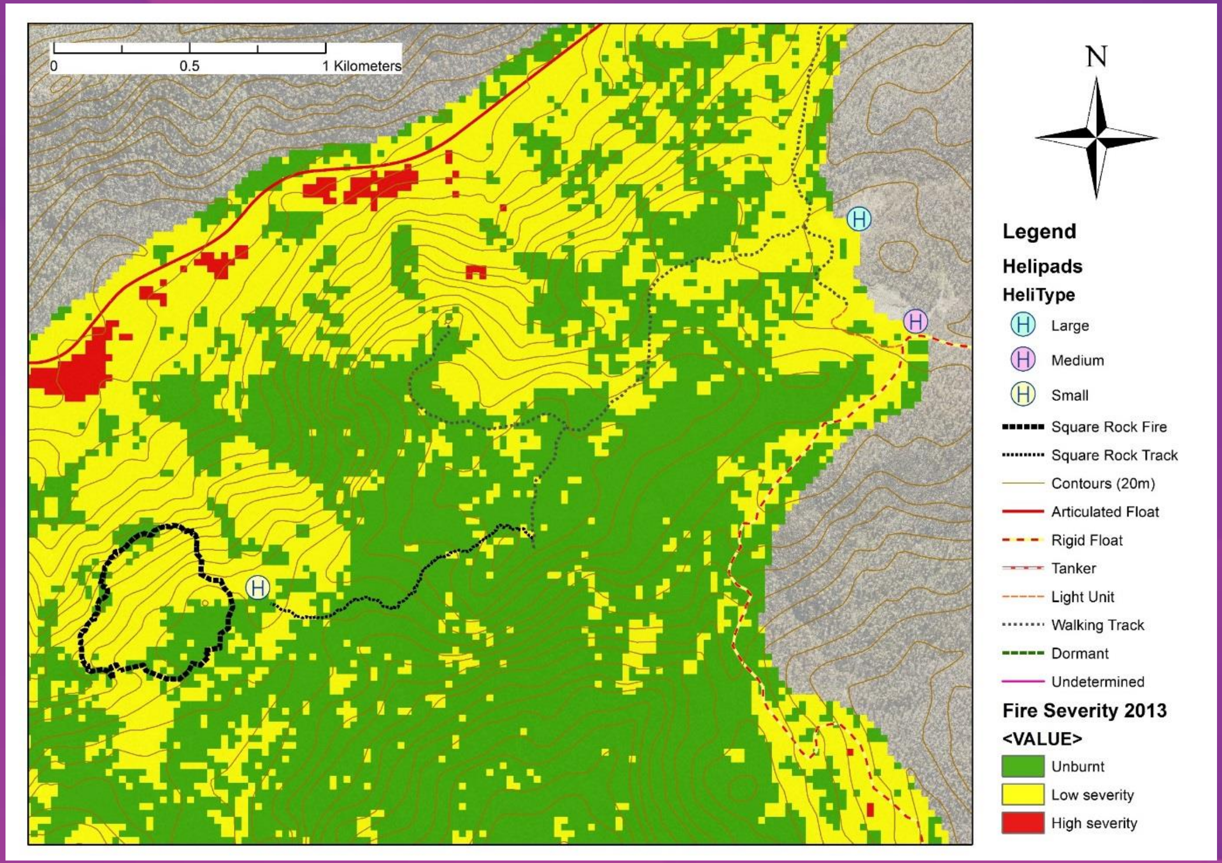
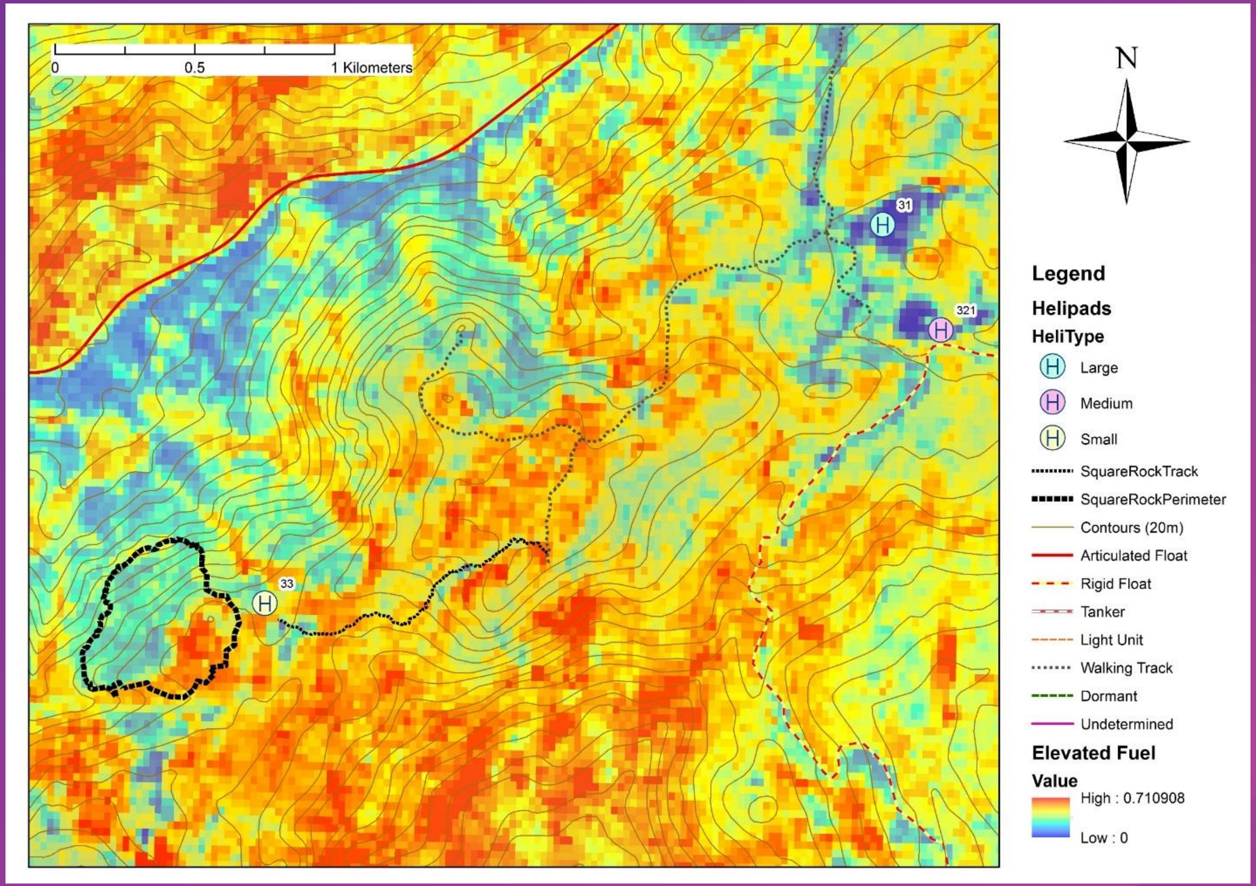
LiDAR for Suppression



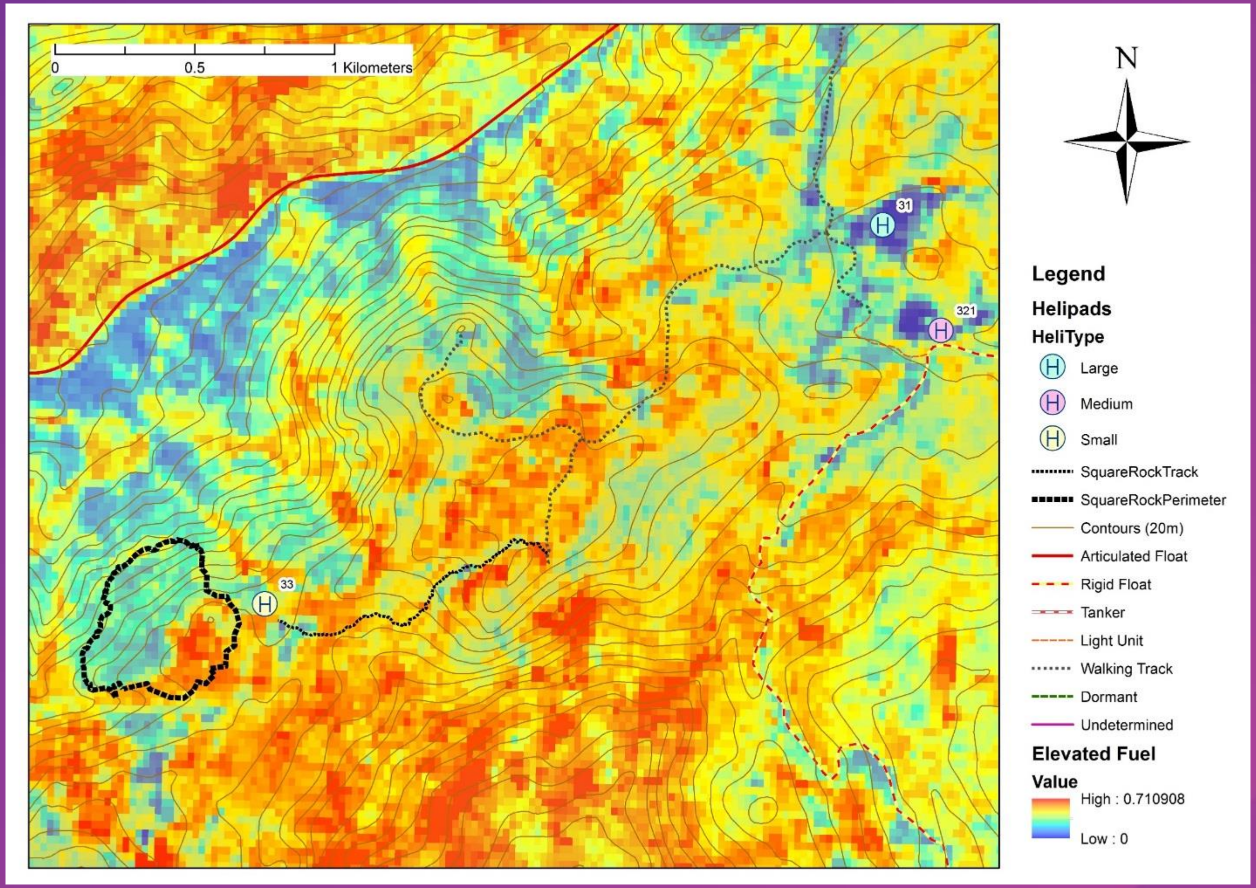
Fire severity analysis, April 2013
Severity: Red = High, Yellow = Low, Green = Unburnt

Square Rock Fire 28 January 2019



LiDAR-derived Elevated Fuel, May-June 2015
Blue = Low, Yellow = Moderate, Red = High

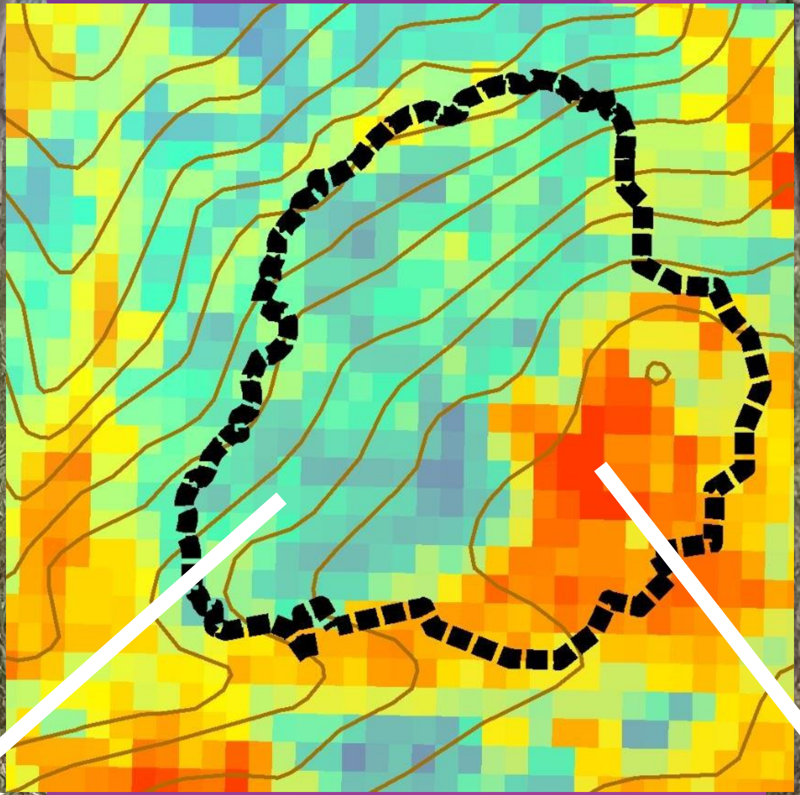
LiDAR for Suppression



LiDAR-derived Elevated Fuel, May-June 2015
Blue = Low, Yellow = Moderate, Red = High

Infrared image of a Remote Area Fire Team winch operation
White = Hot, Black = Cold
(photo: ACT ESA)

Burnt April 2013



Burnt January 2003

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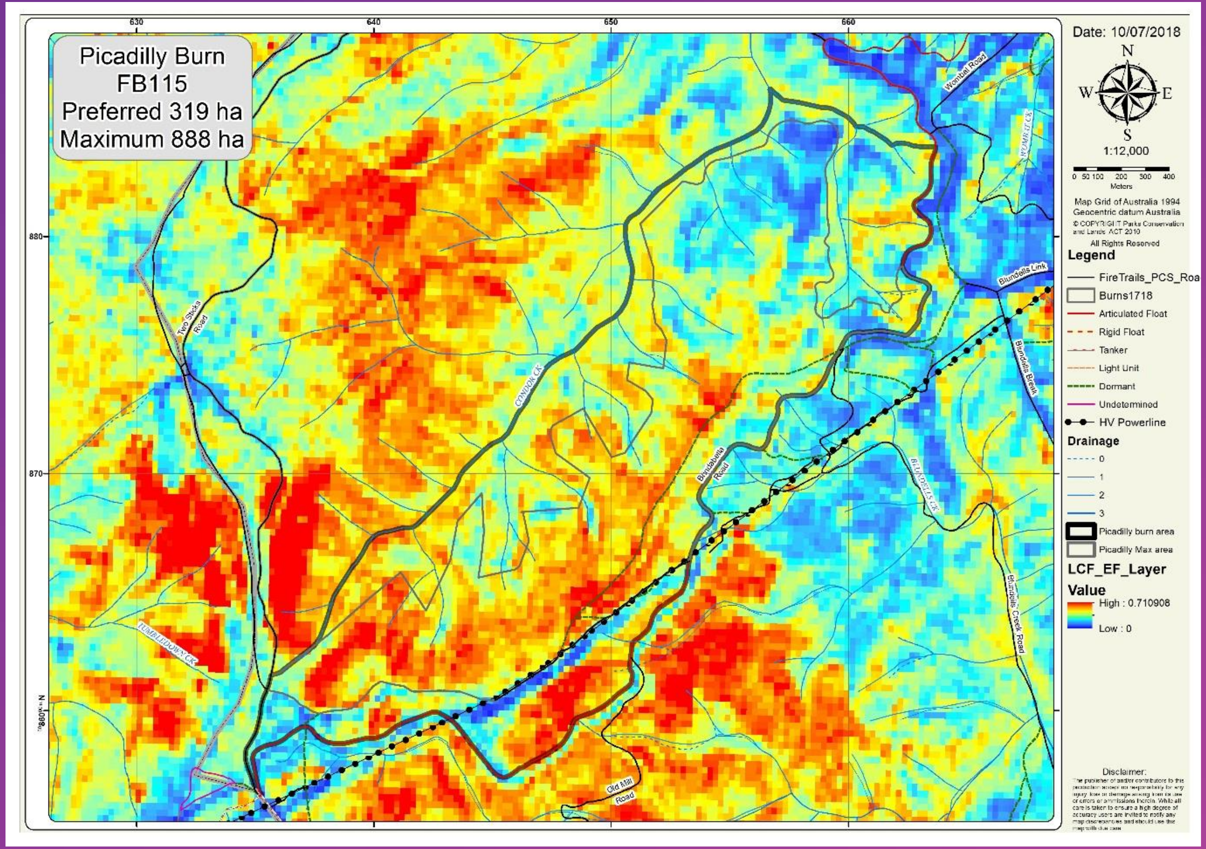
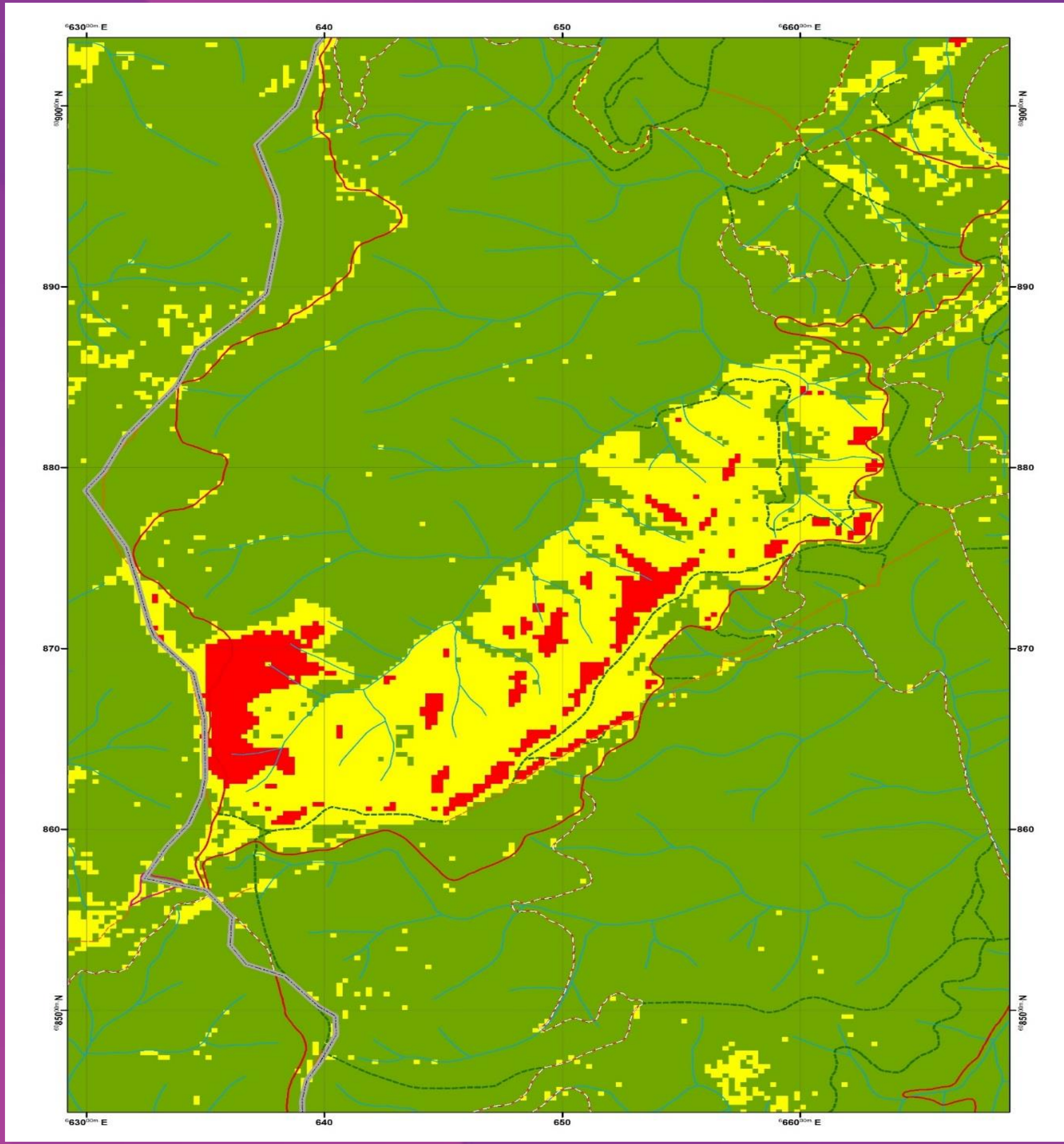
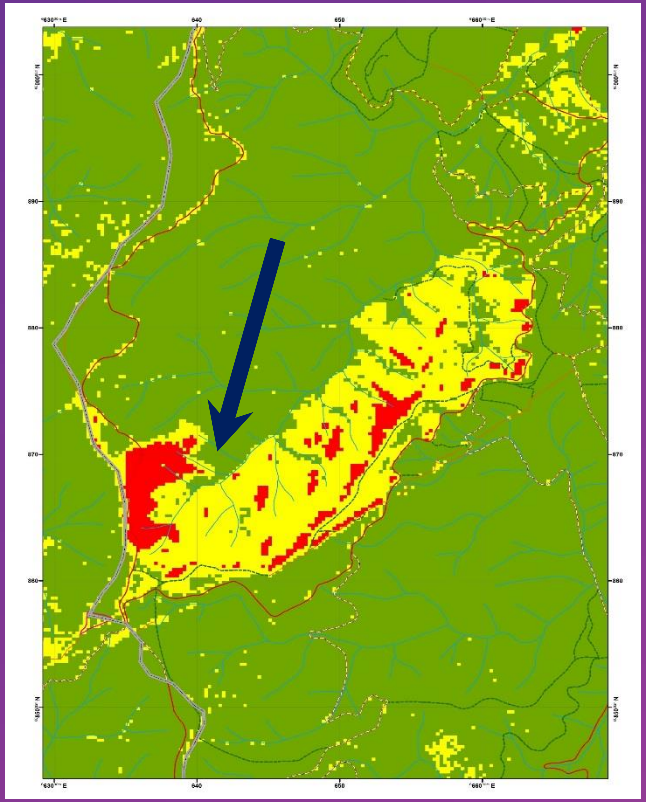
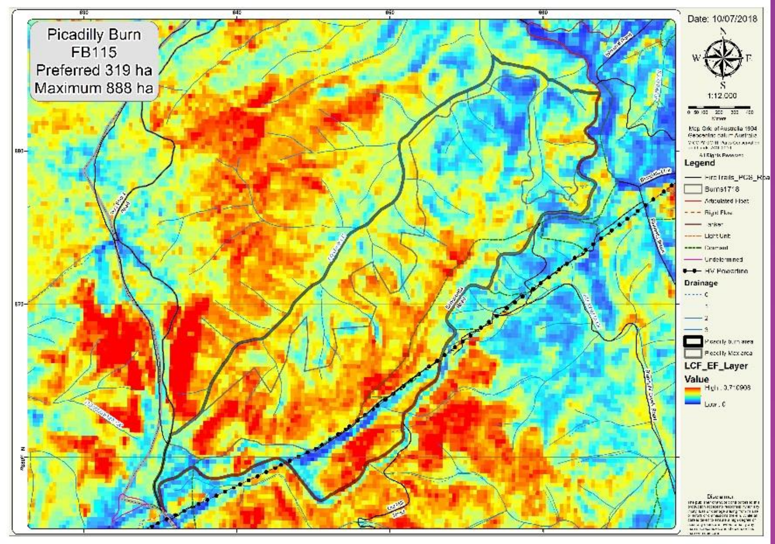


Piccadilly burn, LiDAR-derived Elevated Fuel



dNBR Fire Severity Assessment, Piccadilly




Picadilly Burn
FB115
Preferred 319 ha
Maximum 888 ha
Date: 10/07/2018
Legend
Drainage
LCF_EF_Layer
Value


DIRECTION
190 deg(T)
55H FA
63870 87290
ACCURACY 5 m
DATUM WGS84
Fire severity…
2018-06-19
11:54:14+10:00

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LiDAR summary

1. Generally suitable for fuel mapping, but…

… issues with bark and litter.

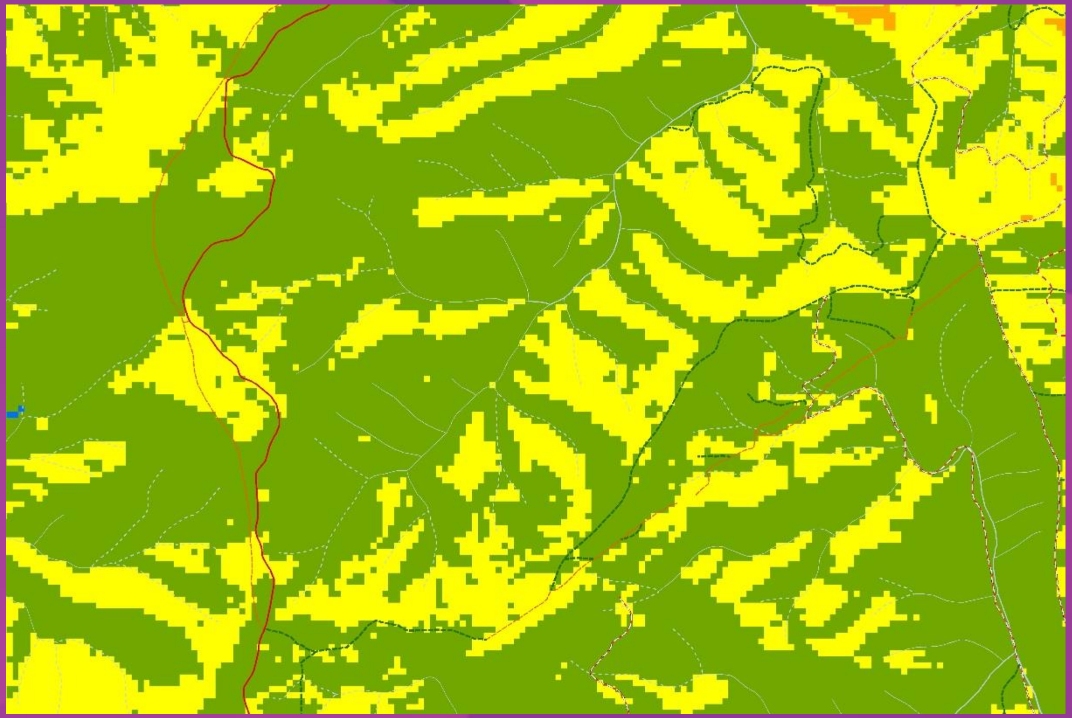
1. Suitable for carbon, post-burn hydrology and biodiversity assessments
2. Low frequency still delivers value for suppression and prescribed burning
3. Towards “remote-sensing enabled systems”

SUB-CANOPY MICROCLIMATE MODEL

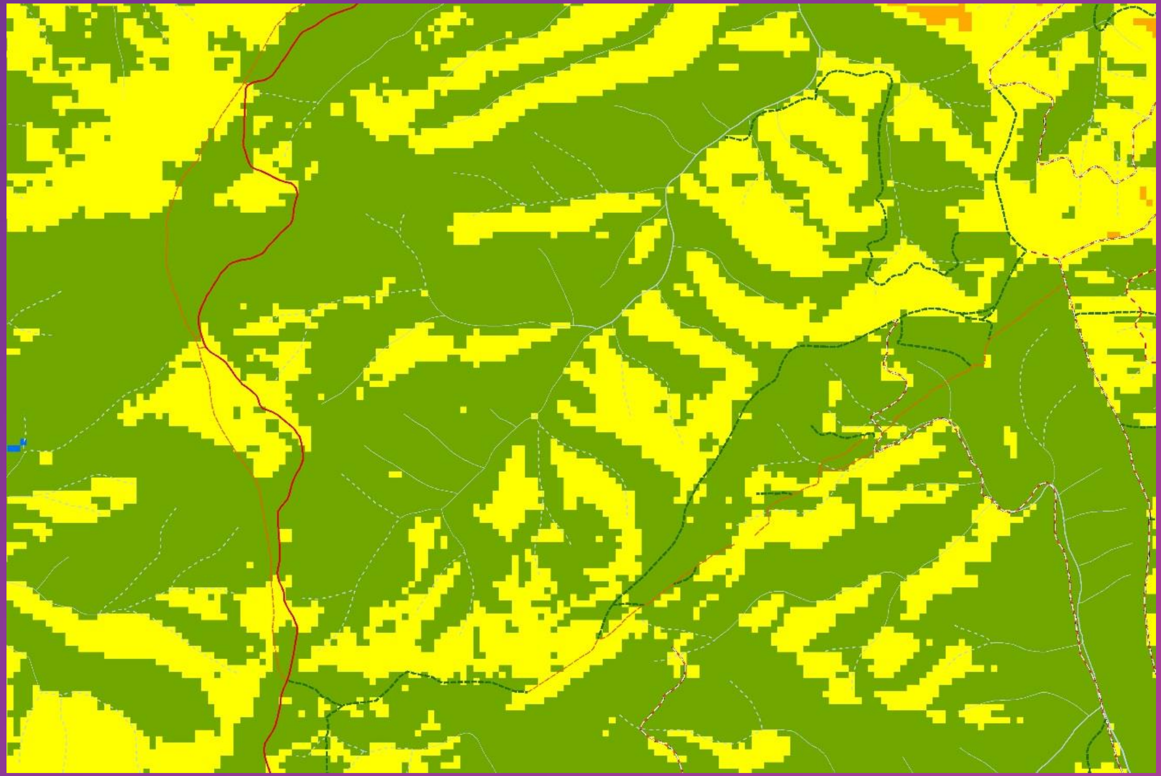
Combines:

- Slope
- Aspect
- Vegetation shading

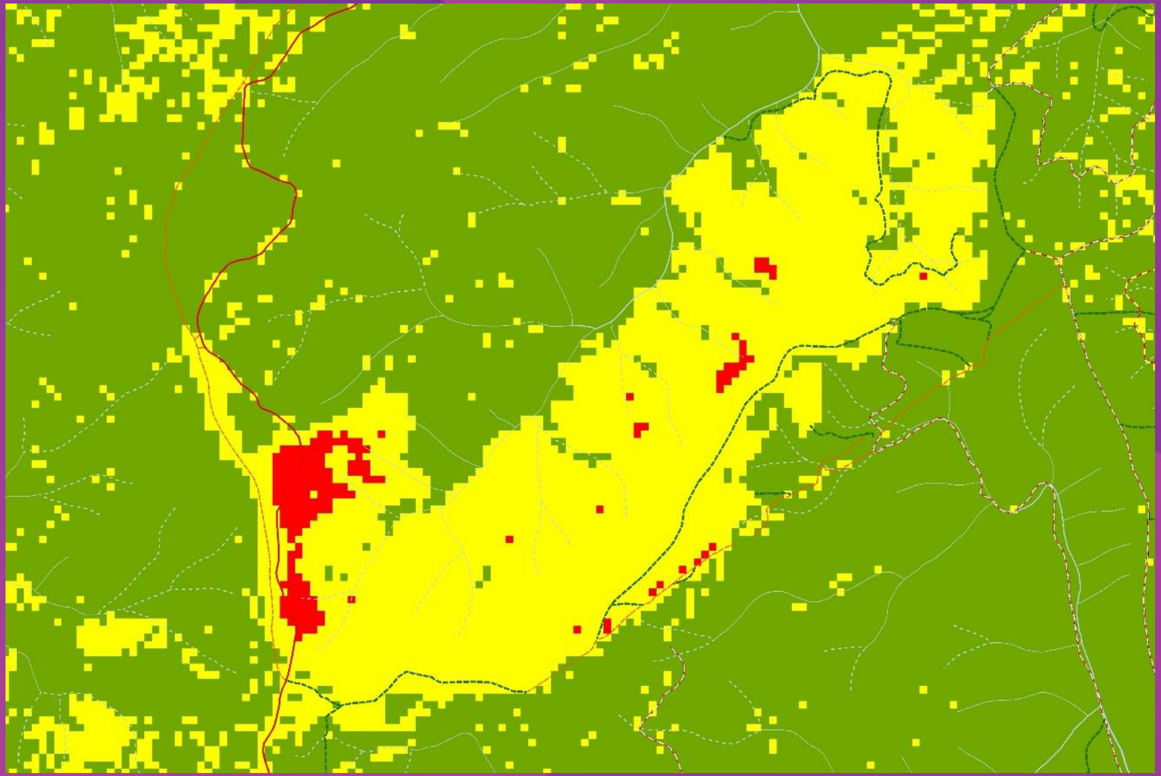
To estimate the effects of shortwave raditiation at the forest floor (Nyman *et al*. 2018).



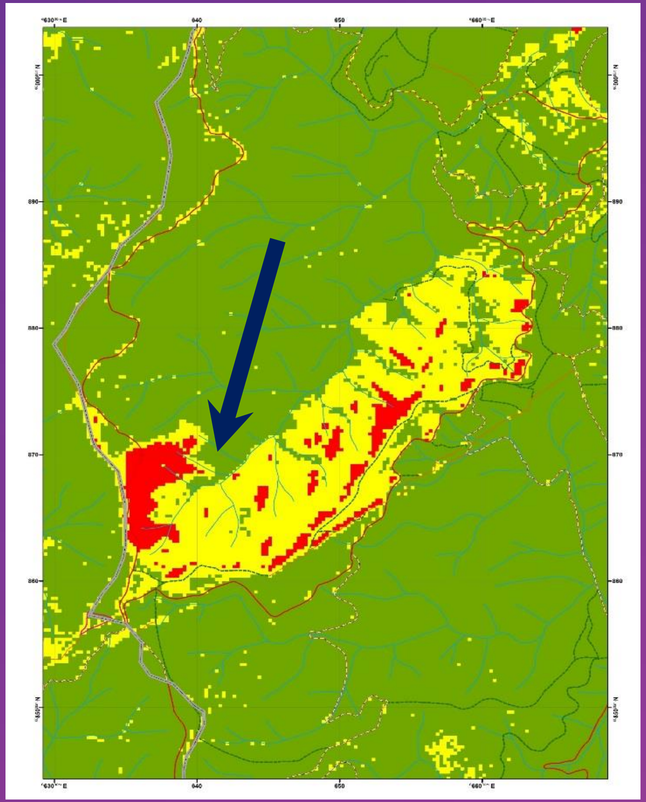
Net solar radiation in April

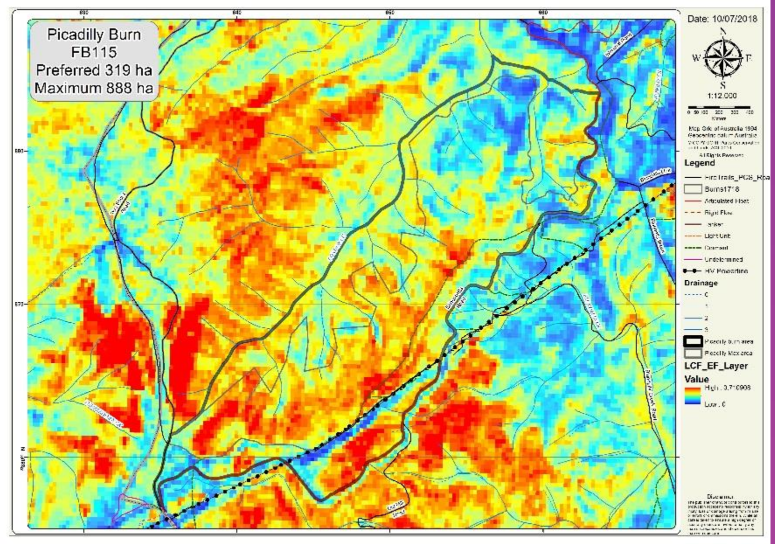


Net solar radiation in April



dNBR of prescribed burn April 2018

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Fire severity…
2018-06-19
11:54:14+10:00

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Other Work in Australia

- Australian Flammability Monitoring System (Marta Yebra, ANU)

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Thanks to:
Colleagues in ACT Parks, ACT RFS and ACT F&R for skilfully implementing the fire suppression and burning programs.