LEVERHULME

Centre for **Wildfires**, **Environment** and **Society**

Imperial College London

King's College London

Royal Holloway University of London

University of Reading

Empirical modelling of fire regimes and vegetation responses to fire

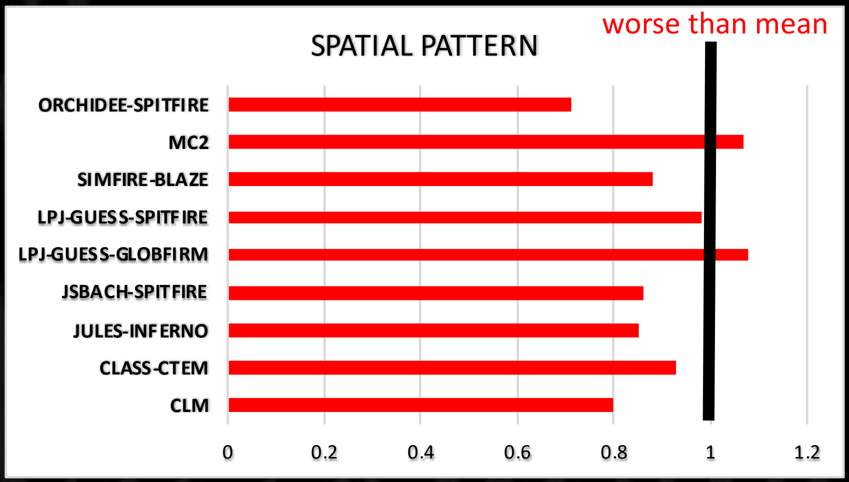
Sandy P. Harrison, Olivia Haas, Yicheng Shen, I. Colin Prentice

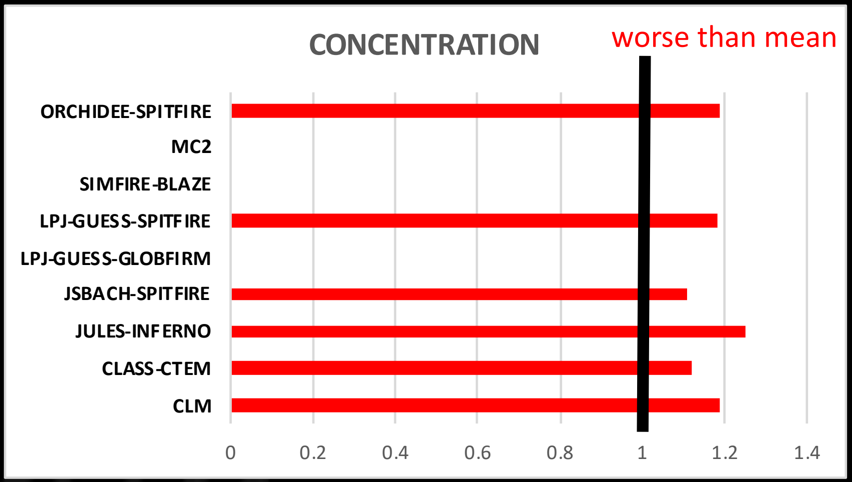
www.centreforwildfires.org

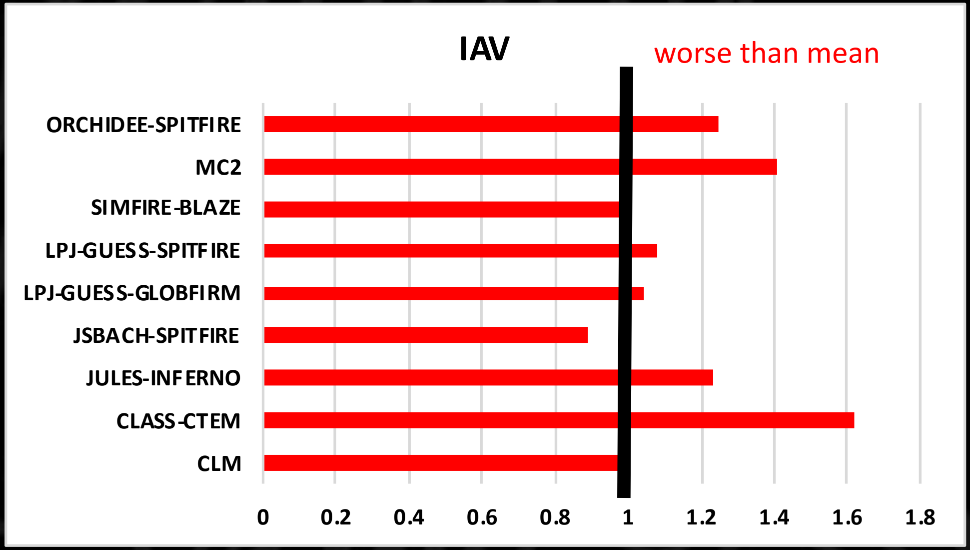
Twitter @centrewildfires

LEVERHULME TRUST

WHY DO WE NEED EMPIRICAL MODELLING?



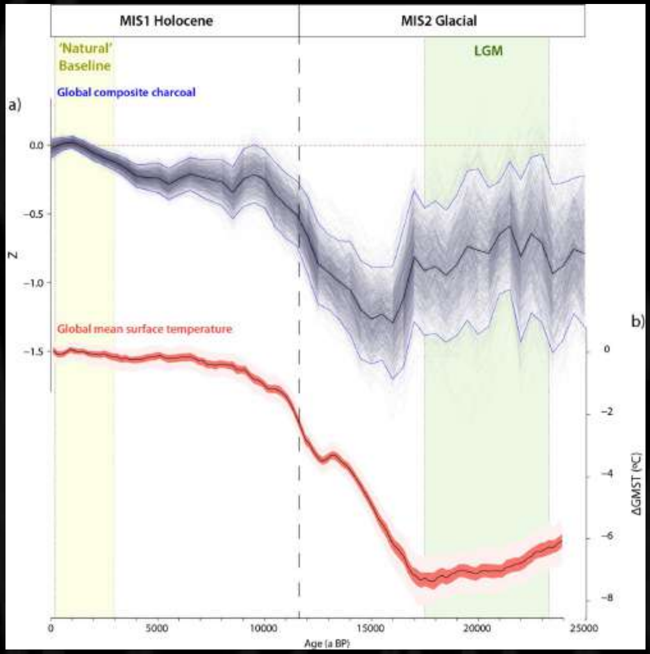




LEVERHULME
Centre for Wildfires, Environment and Society

data from Hantson et al., 2020, GMD

WHY DO WE NEED EMPIRICAL MODELLING?



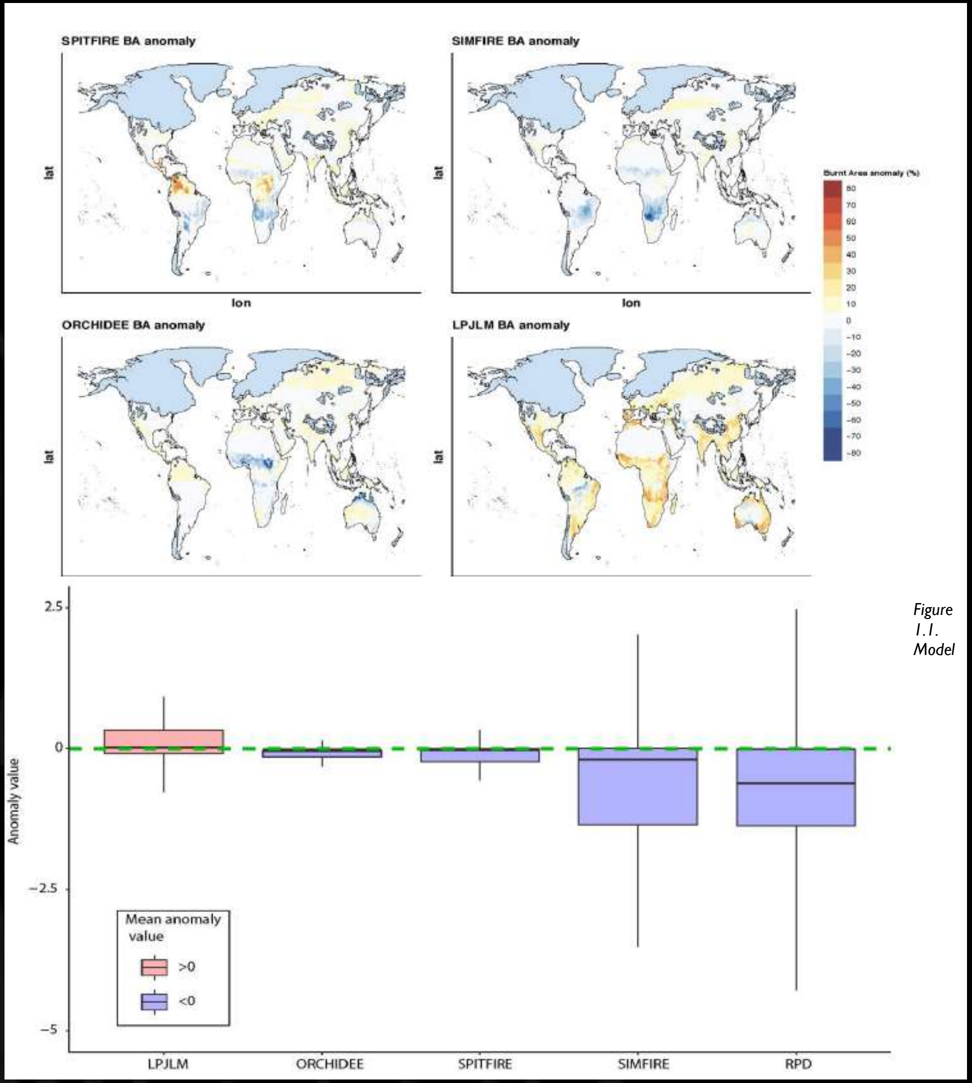


Figure 1.1. Model

Harrison et al., 2022, in prep.

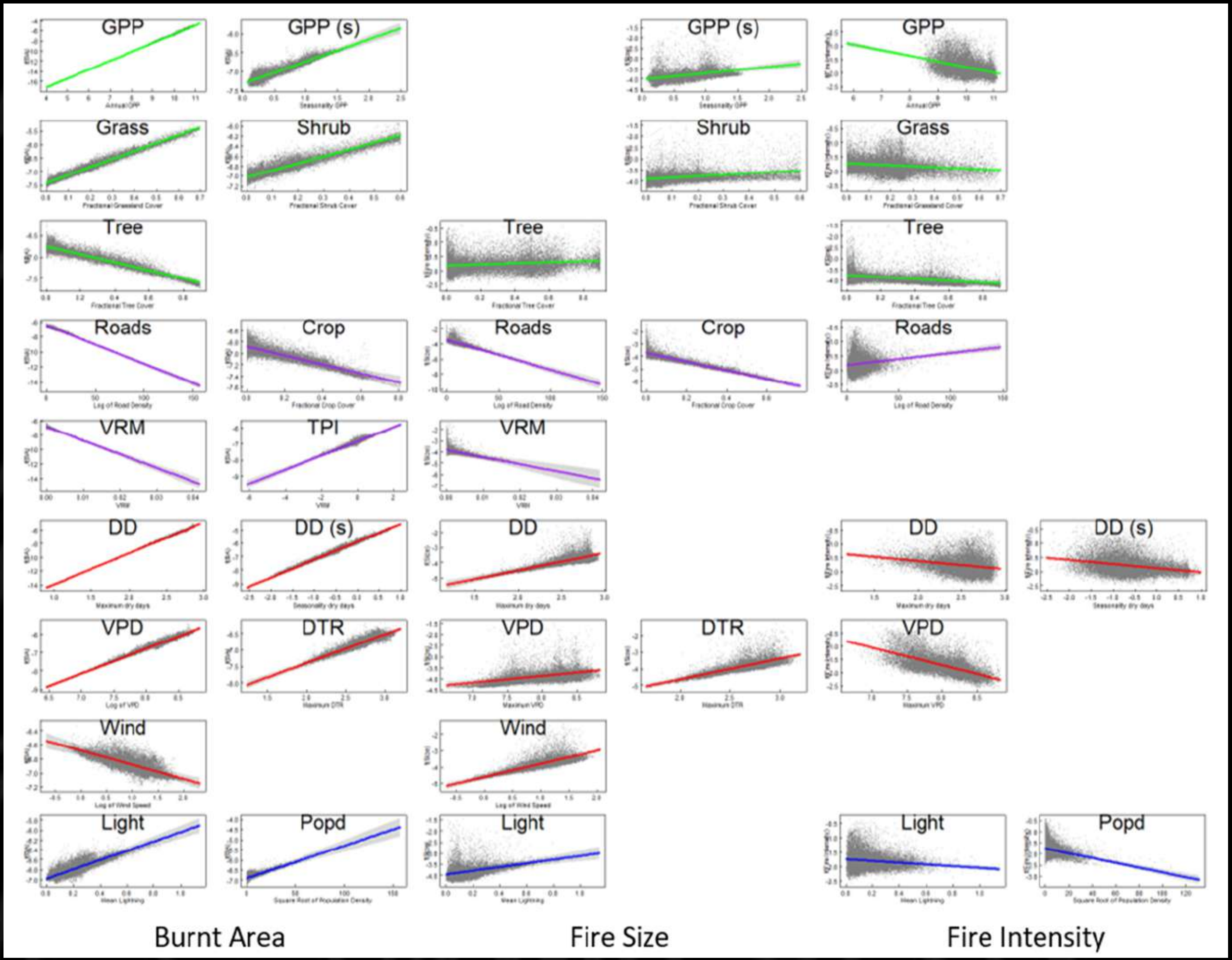
A NEW EMPIRICAL MODEL FOR BA, SIZE and INTENSITY

Predictors	BURNT AREA	FIRE SIZE	FIRE INTENSITY
Maximum monthly number of dry days	70.23	11.16	-14.27
Seasonality of monthly number of dry days	59.26		-16.18
Maximum mean monthly vapour pressure deficit (Pa)	39.11	5.12	-47.55
Maximum mean monthly diurnal temperature range (K)	19.82	14.46	
Mean wind speed of the hottest month ($m\ s^{-1}$)	-6.8	14.41	
Gross primary production ($g\ C\ m^{-2}\ a^{-1}$)	63		-18.47
Seasonality of gross primary production	14.78	5.18	
Fractional tree cover	-18.74	-5.25	9.08
Fractional shrubland cover	26.35	7.61	[redacted]
Fractional grassland cover	52.91		-11.91
Vector Ruggedness Measure	-21.39	-5.78	
Topographic Position Index	18.86		
Road density (km^{-2})	-37.32	-16.47	8.58
Fractional cropland cover	-10.05	-22.42	
Population density (km^{-2})	10.64		-13.49
Mean monthly lightning ground-strikes (km^{-2})	12.35	5.5	-7.15
R^2 (McFadden, 1974)	**O.69**	**0.29**	**0.27**

LEVERHULME
Centre for **Wildfires, Environment** and **Society**

Haas et al., 2022, ERL

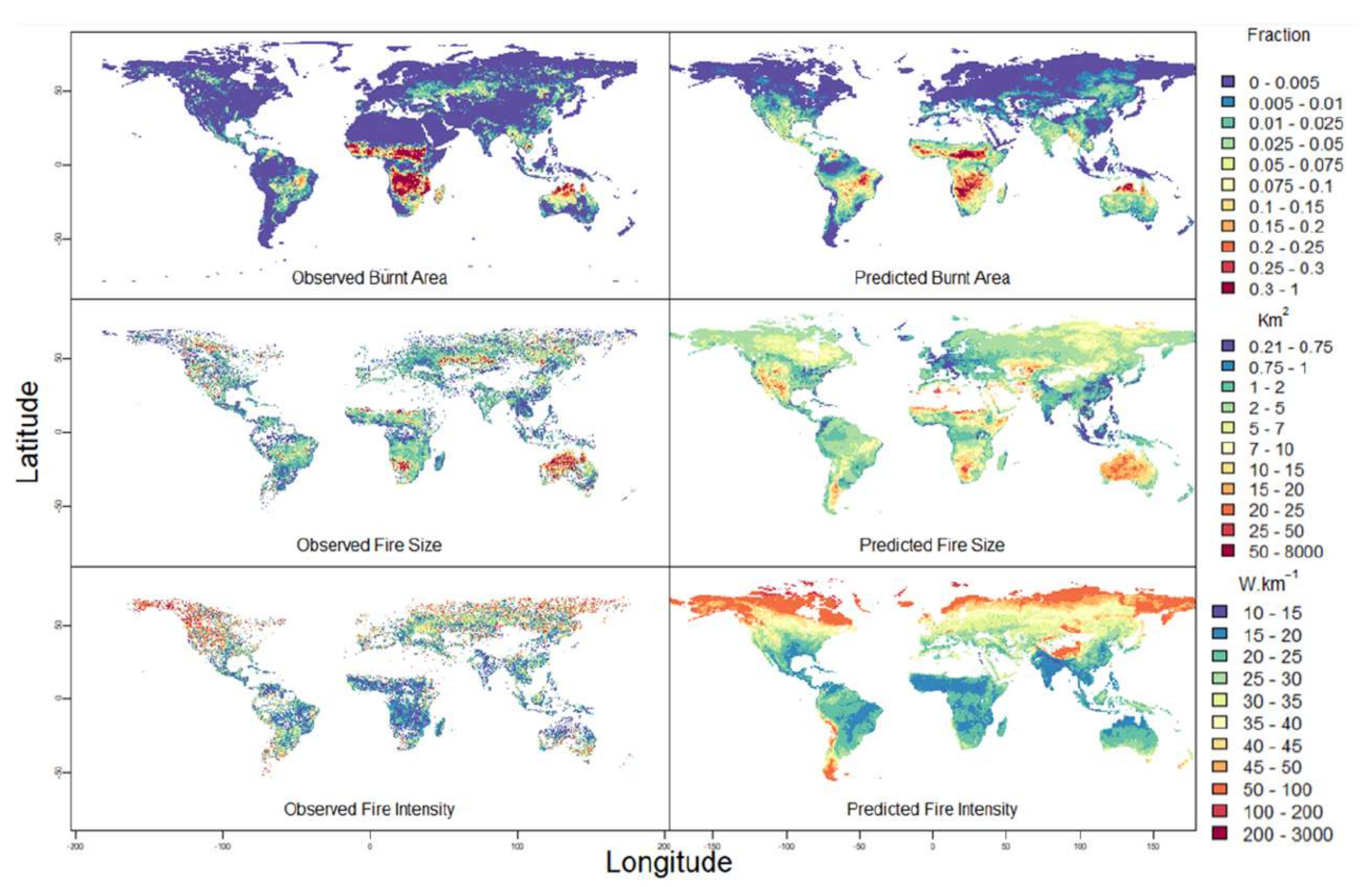
A NEW EMPIRICAL MODEL FOR BA, SIZE and INTENSITY



LEVERHULME
Centre for **Wildfires**, **Environment** and **Society**

Haas et al., 2022, ERL

A NEW EMPIRICAL MODEL FOR BA, SIZE and INTENSITY

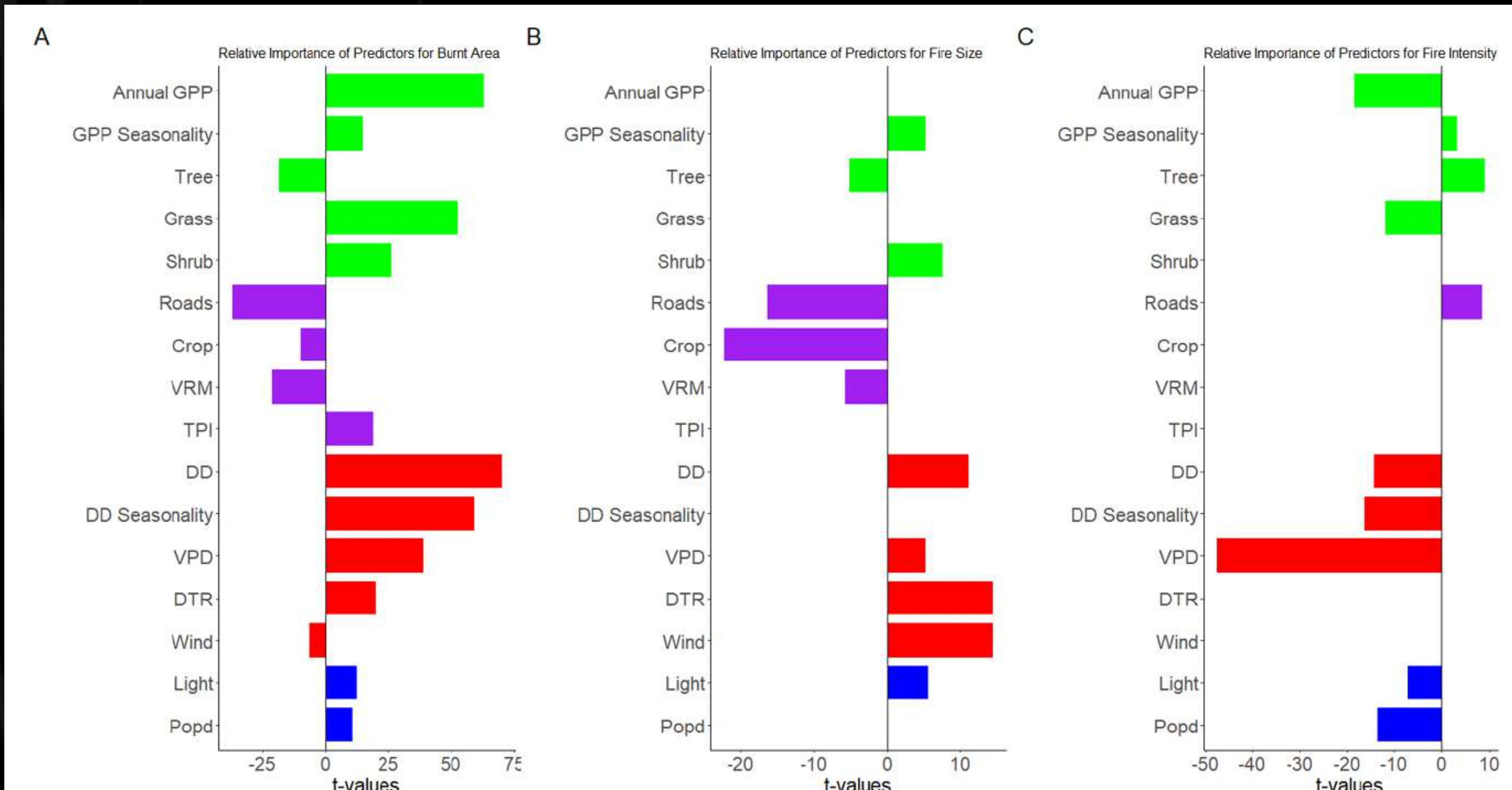


LEVERHULME
Centre for **Wildfires, Environment** and **Society**

Haas et al., 2022, ERL

A NEW EMPIRICAL MODEL FOR BA, SIZE and INTENSITY

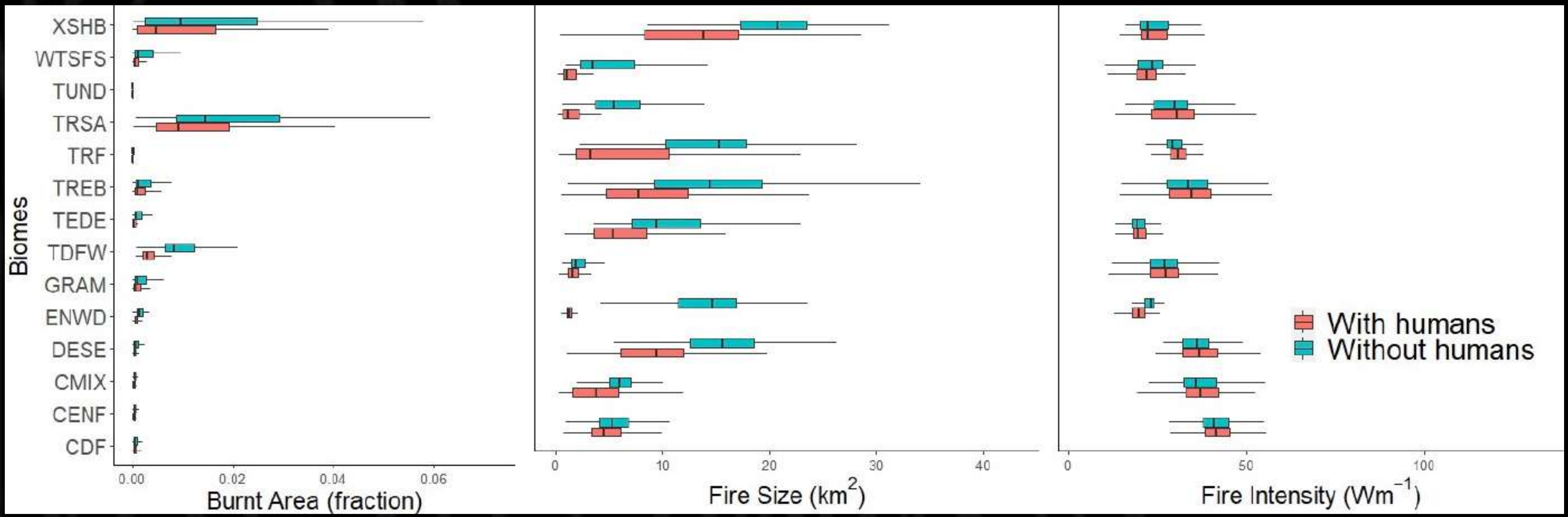
BURNT AREA FIRE SIZE INTENSITY



LEVERHULME
Centre for **Wildfires, Environment** and **Society**

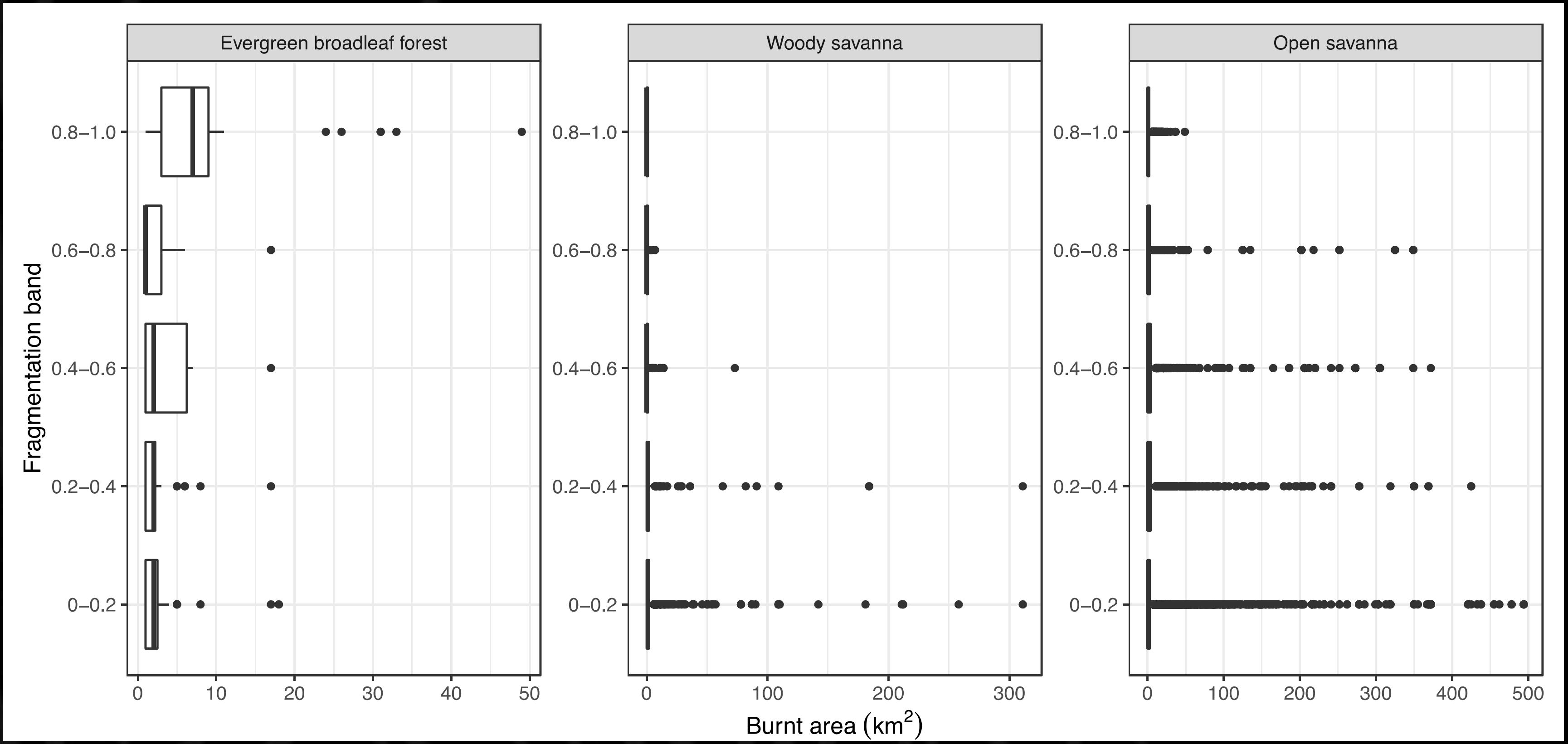
Haas et al., 2022, ERL

MODELLING THE IMPACT OF HUMANS ON FIRE



Harrison et al., 2022, ICAANE

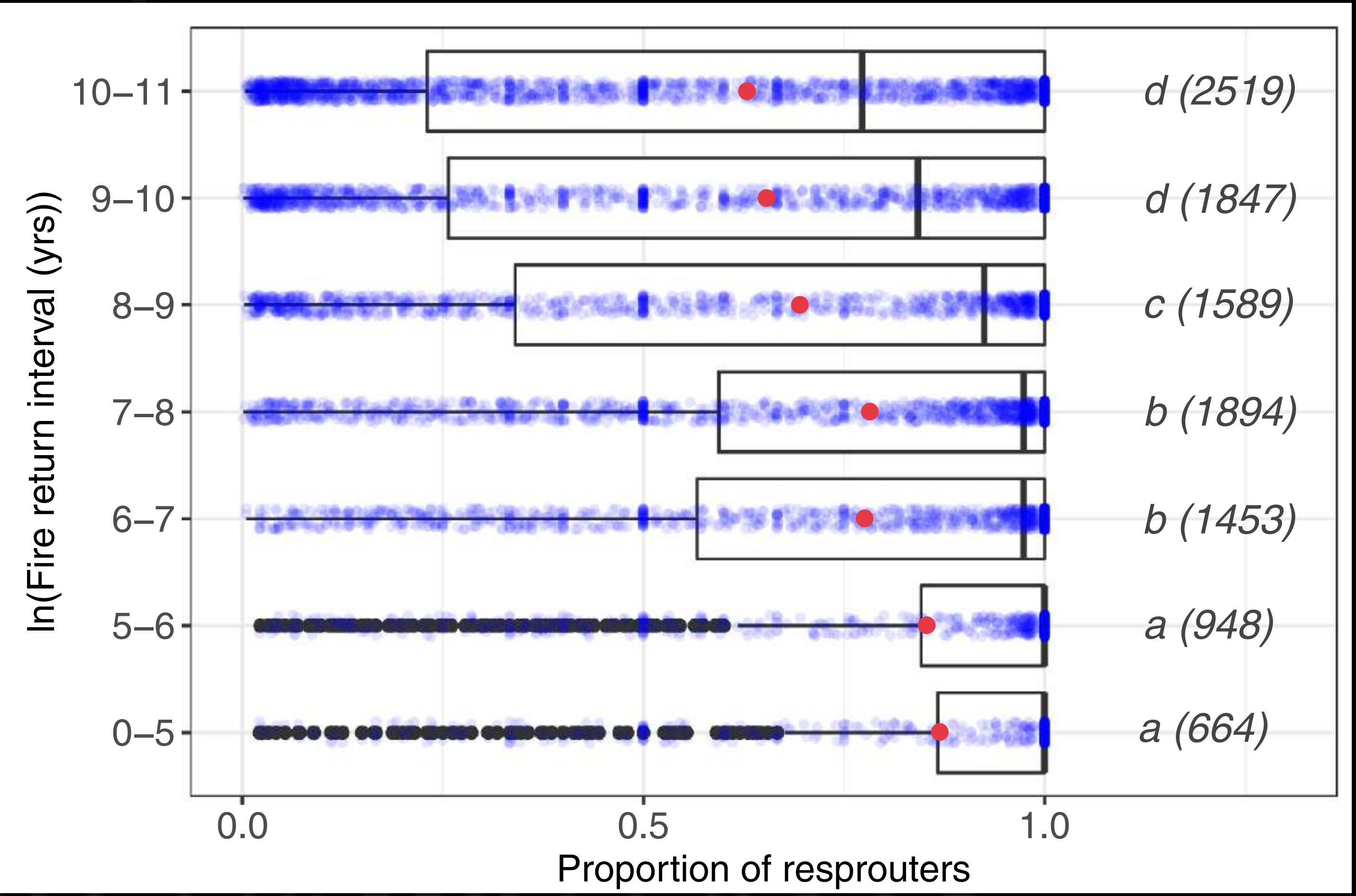
THE IMPACT OF FRAGMENTATION ON FIRE is influenced by VEGETATION



LEVERHULME
Centre for **Wildfires**, **Environment** and **Society**

Harrison et al., 2021, ERL

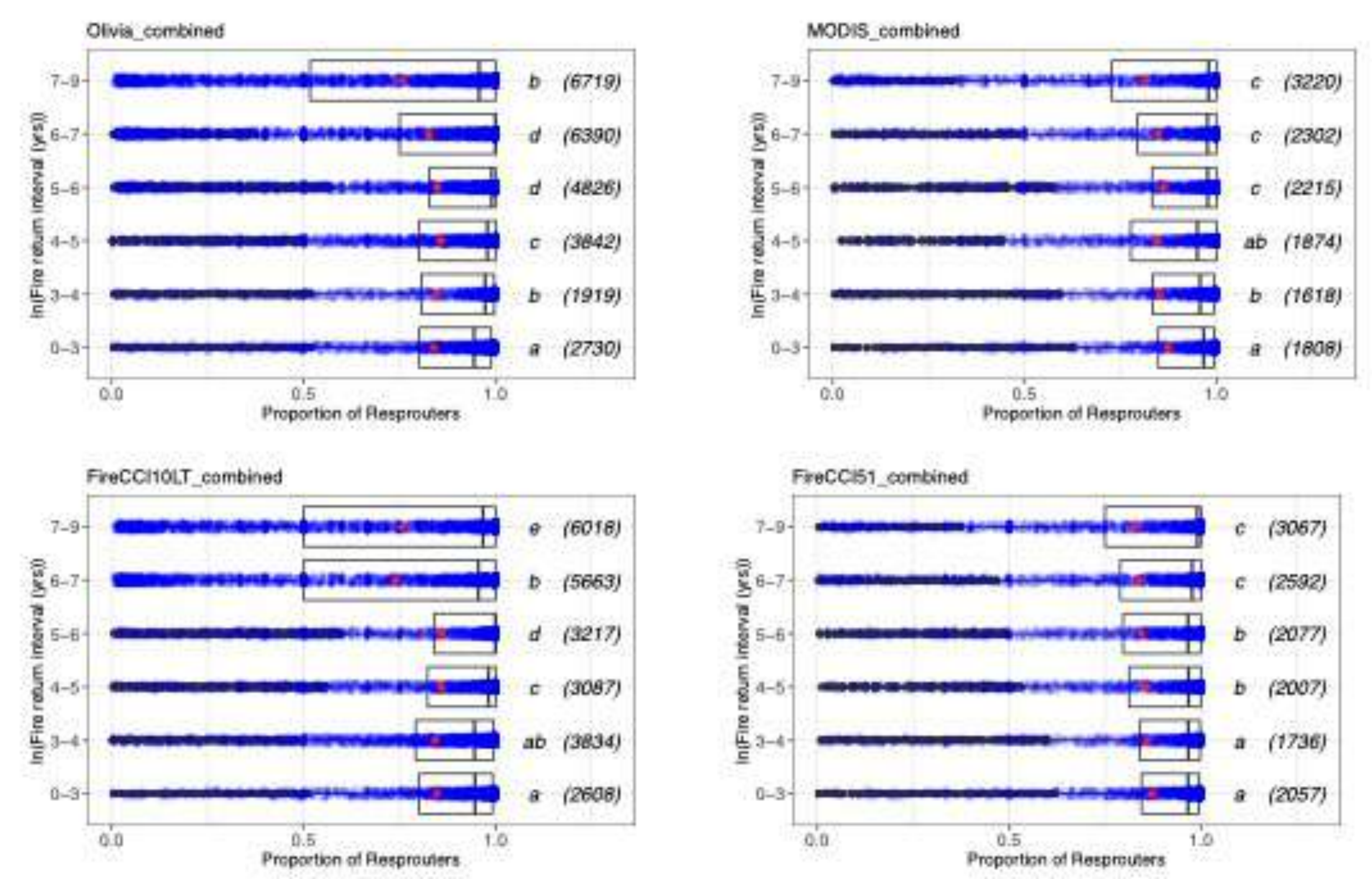
THE ROLE of RESPROUTING



LEVERHULME
Centre for **Wildfires**, **Environment** and **Society**

Harrison et al., 2021, ERL

RESPROUTING



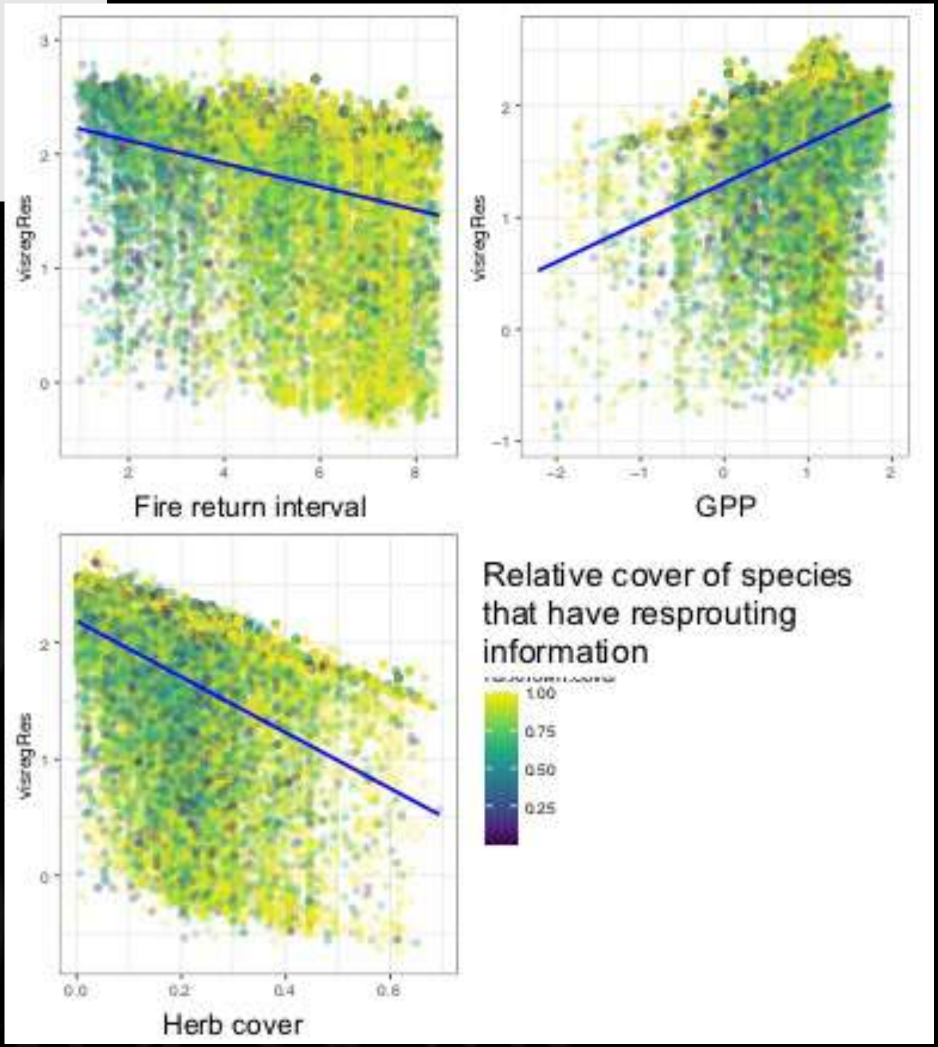
LEVERHULME
Centre for **Wildfires**, **Environment** and **Society**

Shen et al., in prep.

RESPROUTING

	Est.	S.E.	z val.	p	VIF
(Intercept)	2.3	0.07	34.82	0	
Fire return interval	-0.11	0.01	-10.75	0	1.05
GPP	0.33	0.03	11.05	0	1.03
Herb cover	-2.27	0.12	-18.28	0	1.02

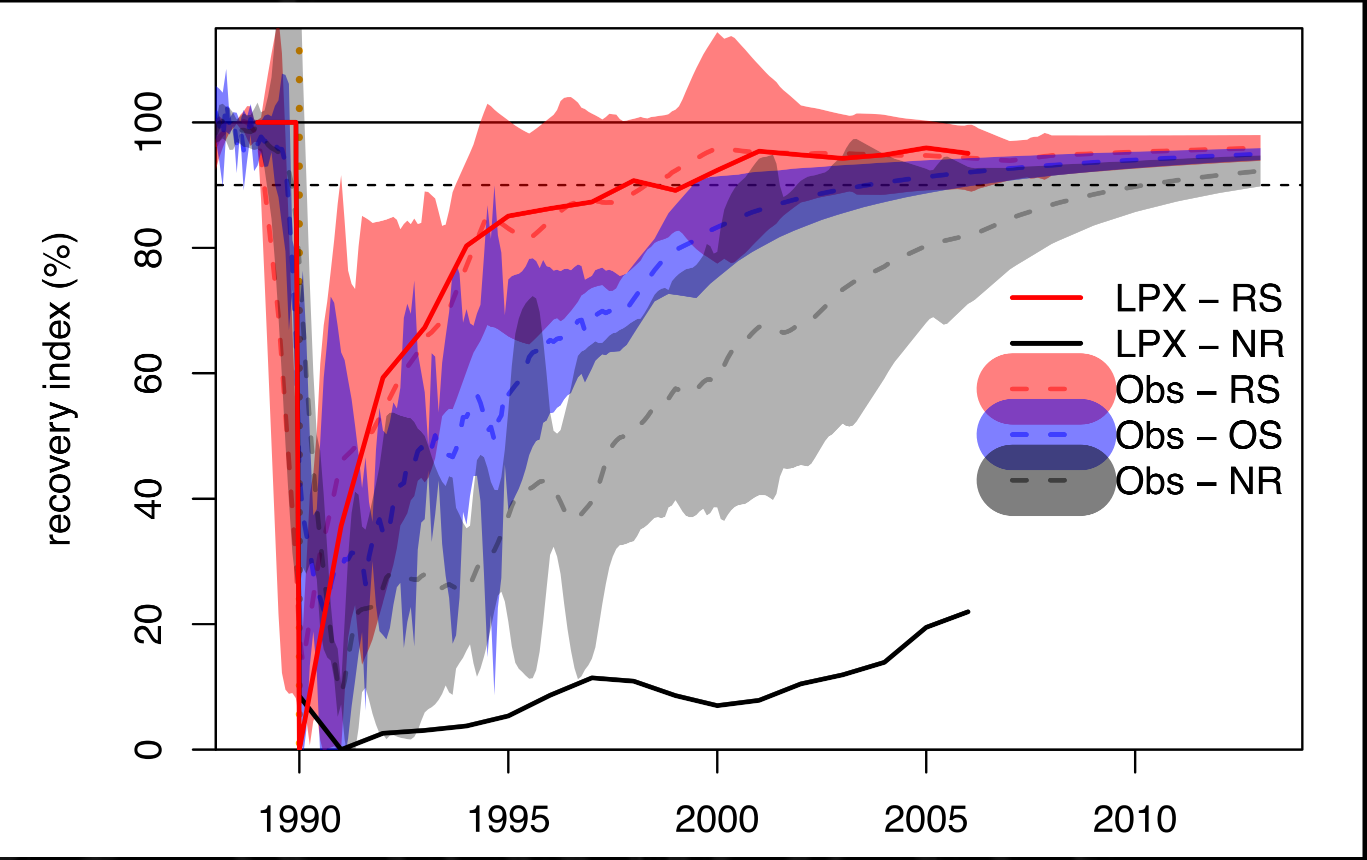
MODEL FIT:
Pseudo-R^2 (Cragg-Uhler) = 0.05
Pseudo-R^2 (McFadden) = 0.04
Observations: 26426



Shen et al., in prep.

LEVERHULME
Centre for **Wildfires**, **Environment** and **Society**

IMPACT OF RESPROUTING on RECOVERY



Kelley et al., 2024, GMD

TAKE-HOME MESSAGES

- SOTA fire models DON'T perform well
- empirical analyses provide insights on how to model fire better
- the controls on burnt area, fire size and fire intensity are different
- human impacts affect different components of fire regime
- vegetation properties are important for modelling fire
- impact of fragmentation differs with veg type
- vegetation traits vary with fire regimes
- modelling e.g. resprouting will have impact on recovery

LEVERHULME
Centre for **Wildfires**,
Environment and **Society**