

These slides with links:
https://cutt.ly/ABMwebinar_2026-05

WHAM!

The Wildfire Human Agency Model

James Millington and Ol Perkins



Project Homepage

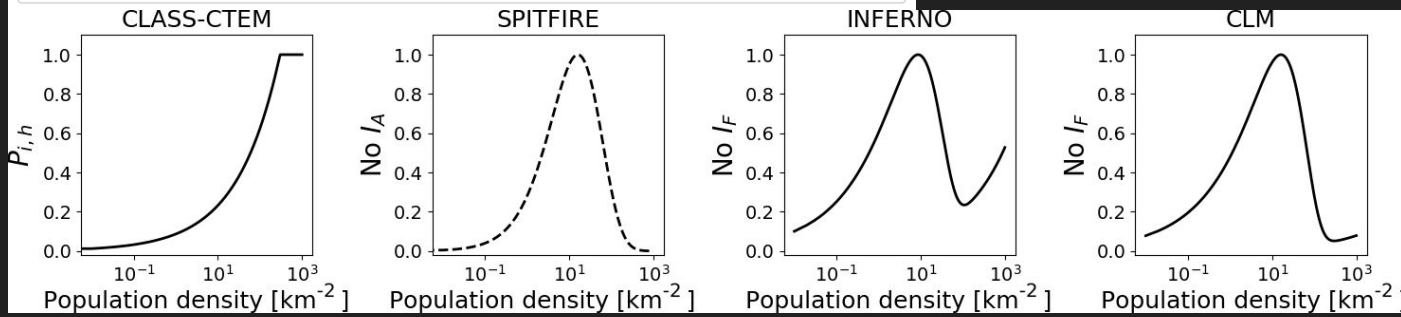
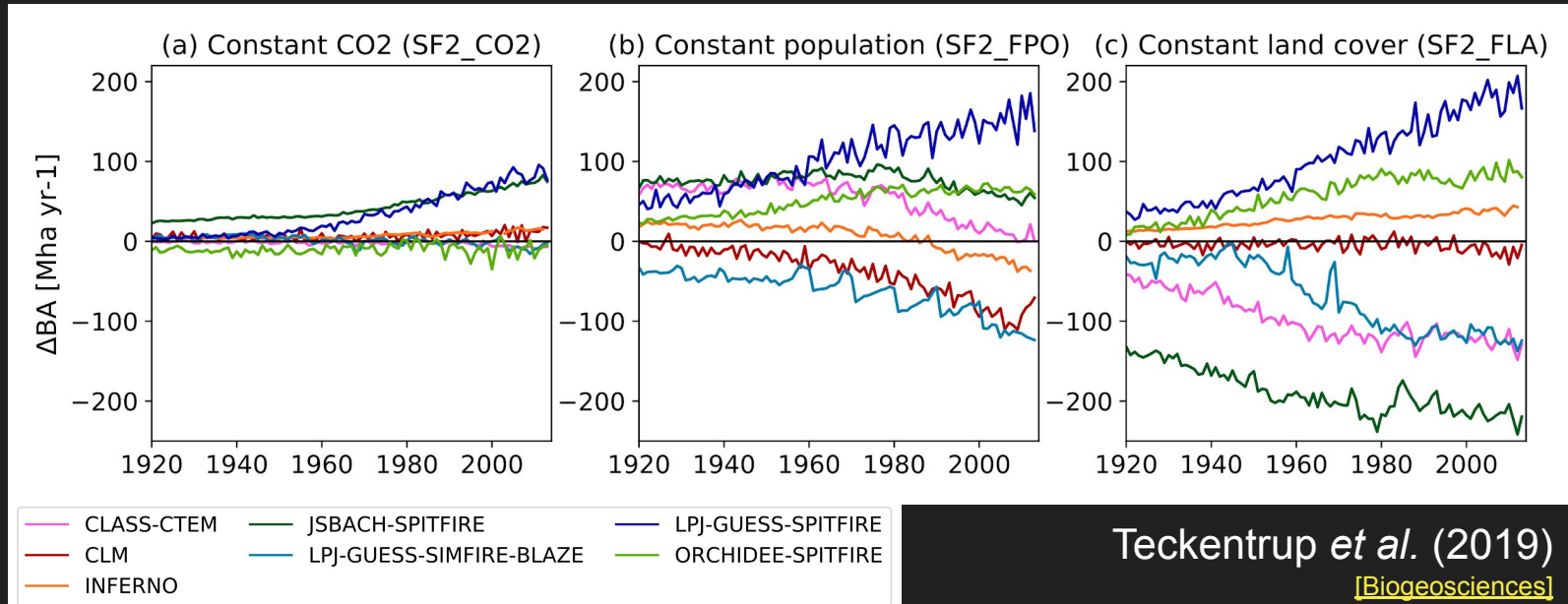


LEVERHULME
Centre for Wildfires,
Environment and Society

KING'S
College
LONDON
Geography



Human Activity in Models of Global Fire



Fire Agents: Structuring a rational conception

1. Pyne's Fire 'Stages' [\[TED 15 min summary\]](#)

- ~~First Fire~~ — ~~pre-human~~
- Second Fire pre-industrial
- 2.5th Fire transition
- Third Fire industrial
- Pyrocene post-industrial(?)

Stages are attitudes towards fire that imply differing use and management



Fire Agents: Structuring a rational conception

2. Land use drives fire use

Non-Extractive



Forest

Pasture



Cropland



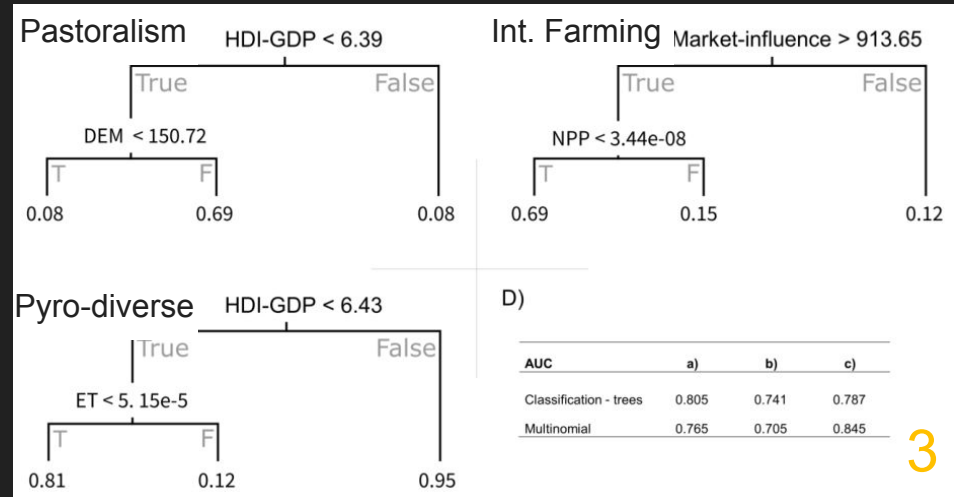
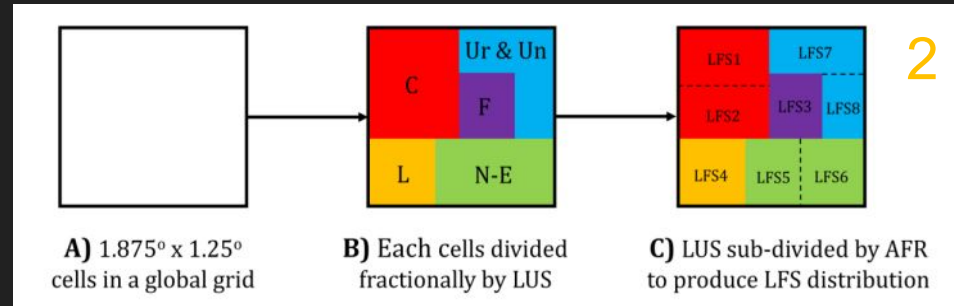
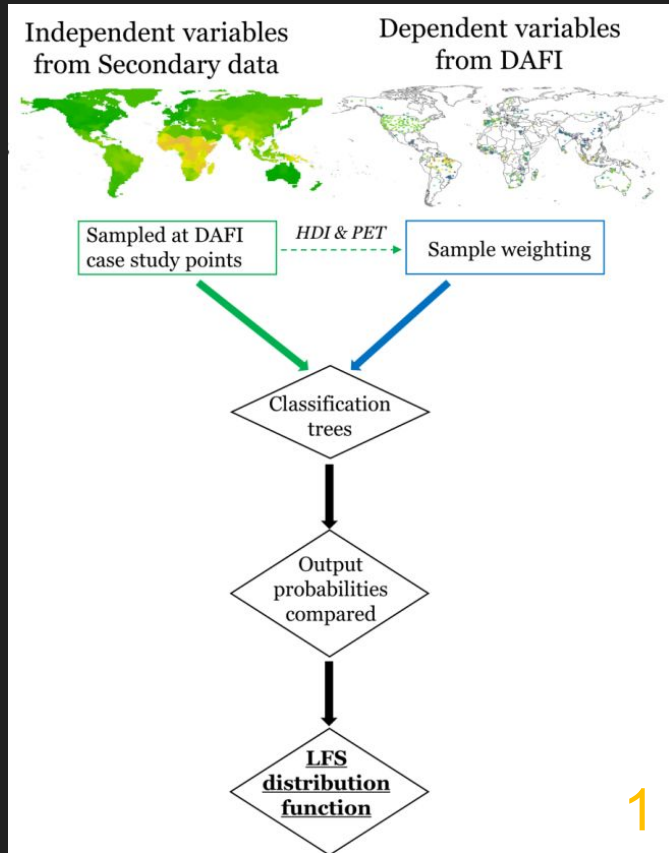
Land-Fire Systems [‘AGENT FUNCTIONAL TYPES’]

From combination of Anthro. Fire Regimes and Land Use Systems

Perkins <i>et al.</i> (2022; 2024)		Land Use System			
		<i>Non-Extractive</i>	<i>Livestock</i>	<i>Crops</i>	<i>Forestry</i>
Anthro. Fire Regime	<i>Pre-Industrial</i>	Unoccupied	Pastoralism (S)	Swidden (S)	Hunt & Gather (S)
	<i>Transition</i>	Unmanaged	Ranching (Extensive, S M)	Small- holding (S M)	Logging (M) (Primary Forest)
	<i>Industrial</i>	Pyro-exclusion (State Manager)	Ranching (Intensive, M)	Farming (Intensive, M)	Managed (M) (Plantation or Second Forest)
	<i>Post-Industrial</i>	Pyro-diverse (Fuel Load Management)	Grazing (Subsidised, Fuel Mgmnt)	Abandoned	Abandoned

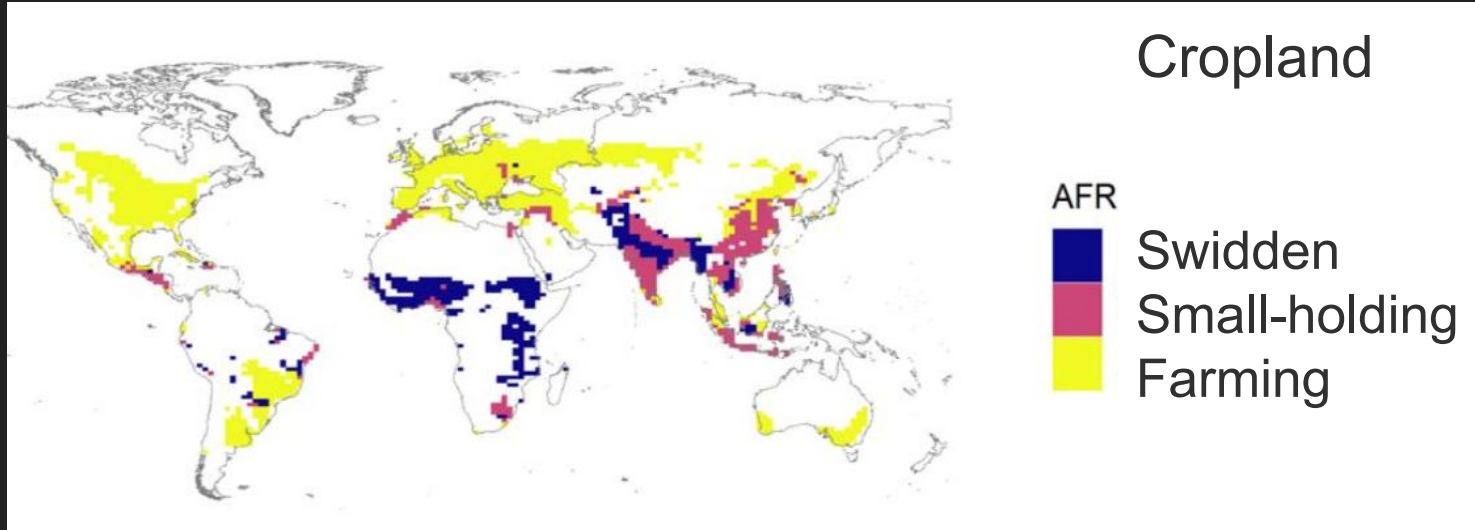
Non-Extractive = e.g. parks S = subsistence M = market

Spatial Distribution of Land-Fire Systems



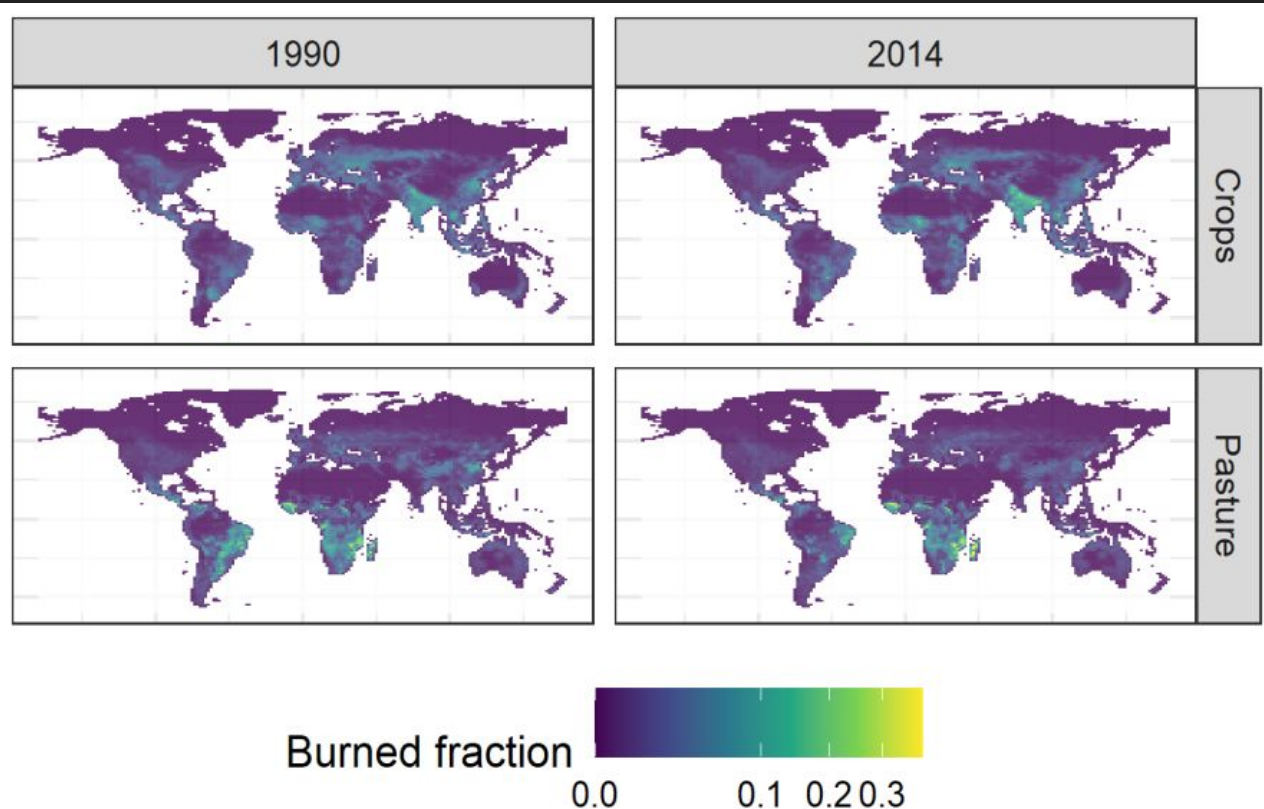
Figs from Perkins *et al.* (2022)

Modelled Spatial Distribution of LFS



Combine density of *LFS* with *data from DAFI* to estimate *human Burned Area*

Modelled Agriculture Burned Area



Paper:
Perkins *et al.* (2024)

Structure of WHAM!

- Represents Agent Functional Types (e.g. 'Pastoralist', 'State forester')
- AFTs have characteristic effects on fire:
 - Burned Area, Frequency
 - Prob. fires escape management (wildfires)
 - Suppression and Firefighting
- Projects AFTs spatially 0.25-1.85° over decades
- Uses classification trees driven by environmental and socioeconomic variables

Paper:
[Perkins *et al.* \(2024\)](#)

Model: WHAM!

1. Model Type: **single purpose** (could be repurposed for others)
2. Code publicly available: **yes** (https://github.com/OliPerkins1987/Wildfire_Human_Agency_Model)
3. Documentation: **readme on GitHub**
4. Years of 'model in use': **2** (since Perkins *et al.* [2024](#))
5. Model keeper: **Yes** (see <https://doi.org/10.17605/OSF.IO/DG8FR>)
6. Funding source: **third-party, now in-house**
7. Model characteristics:

Modularity	Exchangeability 2	Extendability 3
Context-specificity	Transferability 3	Scalability 4

Model: WHAM!

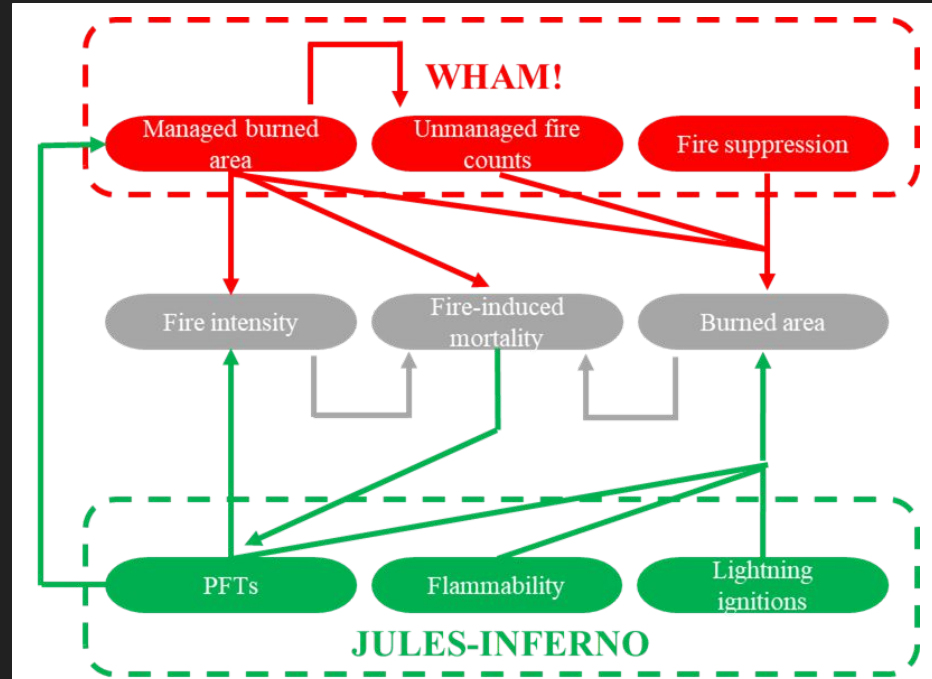
1. What did you find most challenging in your modelling?
 - Data gathering (i.e. DAFI)
 - Convincing non-modeller social scientists that our agent types are appropriate (naming is an issue?)
 - Ongoing integration with climate modelling requires buy-in (expertise)
2. Which community effort would help you most?
 - Harmonising data inputs (e.g., for SSP scenarios)
 - Model intercomparison, integrating with ISIMIP

WHAM-JULES-INFERNO

JULES-INFERNO is a fire-enabled dynamic global vegetation model

[[UKESM](#), [JULES](#)]

Coupling with WHAM!
enables representation of socio-economic drivers of fire alongside biophysical (and their interaction)



Perkins *et al.* (in review)



Integrated Fire Management (IFM)

The integration of economic, sociocultural and environmental factors for ecologically and socially appropriate fire management

➤ Recognises

- benefits of indigenous and local community fire practices
- limitations of suppression-oriented management approaches
- why and how a fire is burning matters, not only where and when

➤ Emphasises

- living with fire rather than excluding it
- human-fire interactions and systemic, holistic understanding
- pro-active fuel management rather than reactive fire-fighting

Experiments - future scenarios

Management

Management scenario	Social attitude to human fire use (all purposes)	Controlled burning for fire regime management	Fire suppression
Baseline	Default	Medium	Medium
Suppression-max	Opposed	Low	High
IFM-max	Supportive	High	Medium

Socio-economics

SSPs	SSP1.26	SSP3.70
Carbon Emissions	Low	High
Economic Dev. in Global South	Strong	Weak
Barriers to Adaptation	Low	High

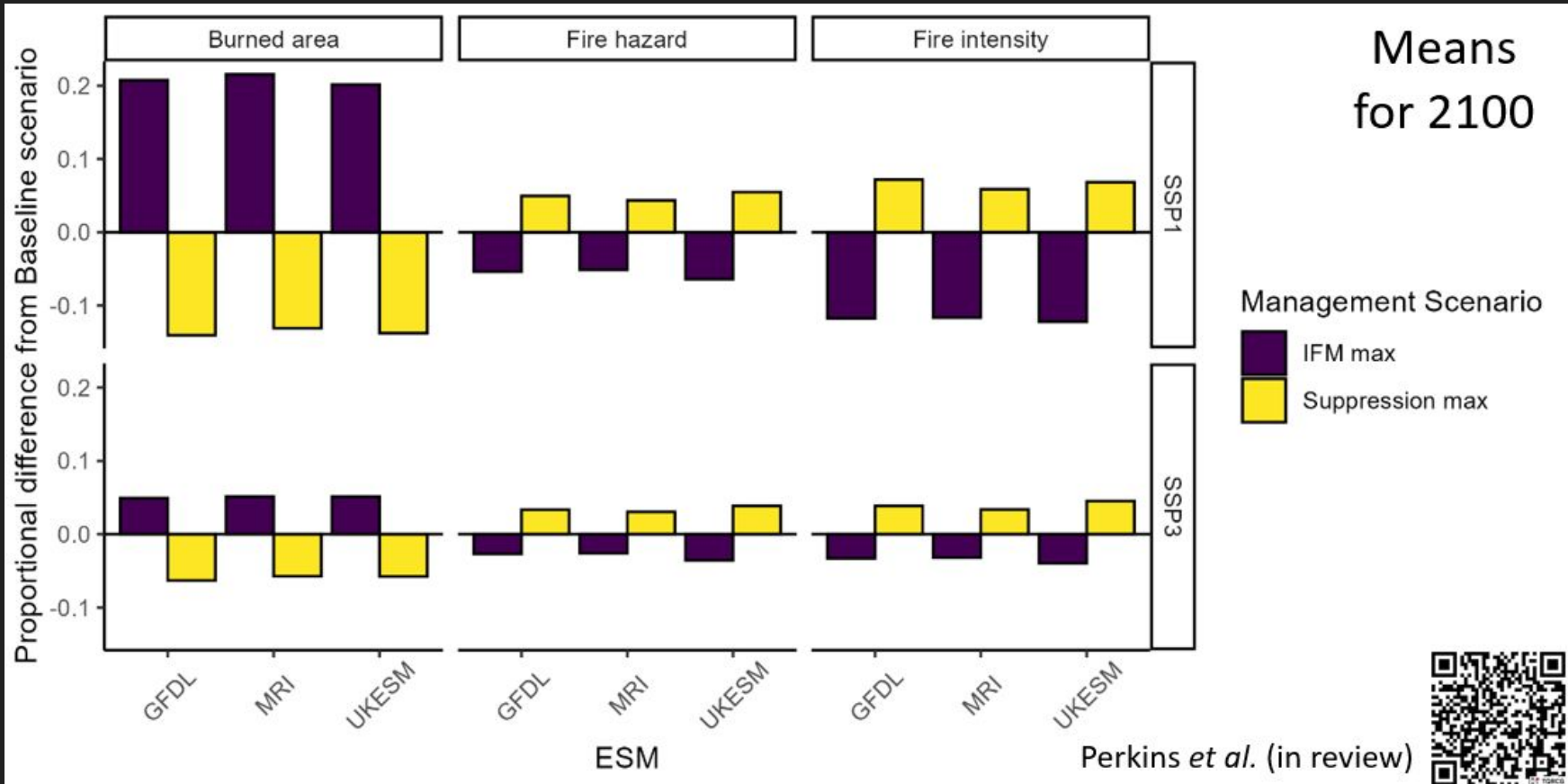
Gridded socio-economic capitals for SSPs

Global projections decadal to 2100 with spatial resolution of 0.25°

<i>Capital</i>	<i>Input Data (Baseline)</i>	<i>Input Data (Projection)</i>	<i>Rescaling Method</i>	<i>Output units</i>
<i>Health</i>	HDI health index - (Kummu et al., 2018).	Life Expectancy - (UNDESA, 2022); Country-level Gini - (Rao et al., 2019).	Rasterisation of sub-national polygons	0-1 index
<i>Education</i>	HDI education index - (Kummu et al., 2018).	Participation proportion - (KC & Lutz 2017); Participation years - ((Potančoková et al., 2014); Country-level Gini - (Rao et al., 2019).	Rasterisation of sub-national polygons	0-1 index
<i>Working age population</i>	Working Age Population - (KC & Lutz 2017); Total Population - (CIESIN NASA, 2018).	Working Age Population - (KC & Lutz 2017); Total Population - (Jones & O'Neill 2016).	Rasterisation of national data using population	Count (persons) per pixel
<i>Gini</i>	Country-level Gini - (Rao et al., 2019); 'Light Gini' index - (Mirza et al., 2021).	Country-level Gini - (Rao et al., 2019).	Rasterisation of national data using 'light Gini'	0-1 index
<i>Total energy consumption</i>	Energy use per capita - (EIA 2024, EI 2024).	Energy supply - (Riahi et al., 2017, Bauer et al., 2017); Total Population (Jones & O'Neill 2016).	Rasterisation of national data using population	kWh
<i>Market access</i>	Urban Fraction - (Hurtt et al., 2020); Population Density - (CIESIN, 2017); Road Density - (Meijer et al., 2018); GDP per capita - (Kummu et al., 2018).	Urban Fraction - (Hurtt et al., 2020); Total Population - (Jones & O'Neill, 2016); Road Density - (Meijer et al., 2018); GDP per capita - (Murakami et al., 2021).	None	0-1 index

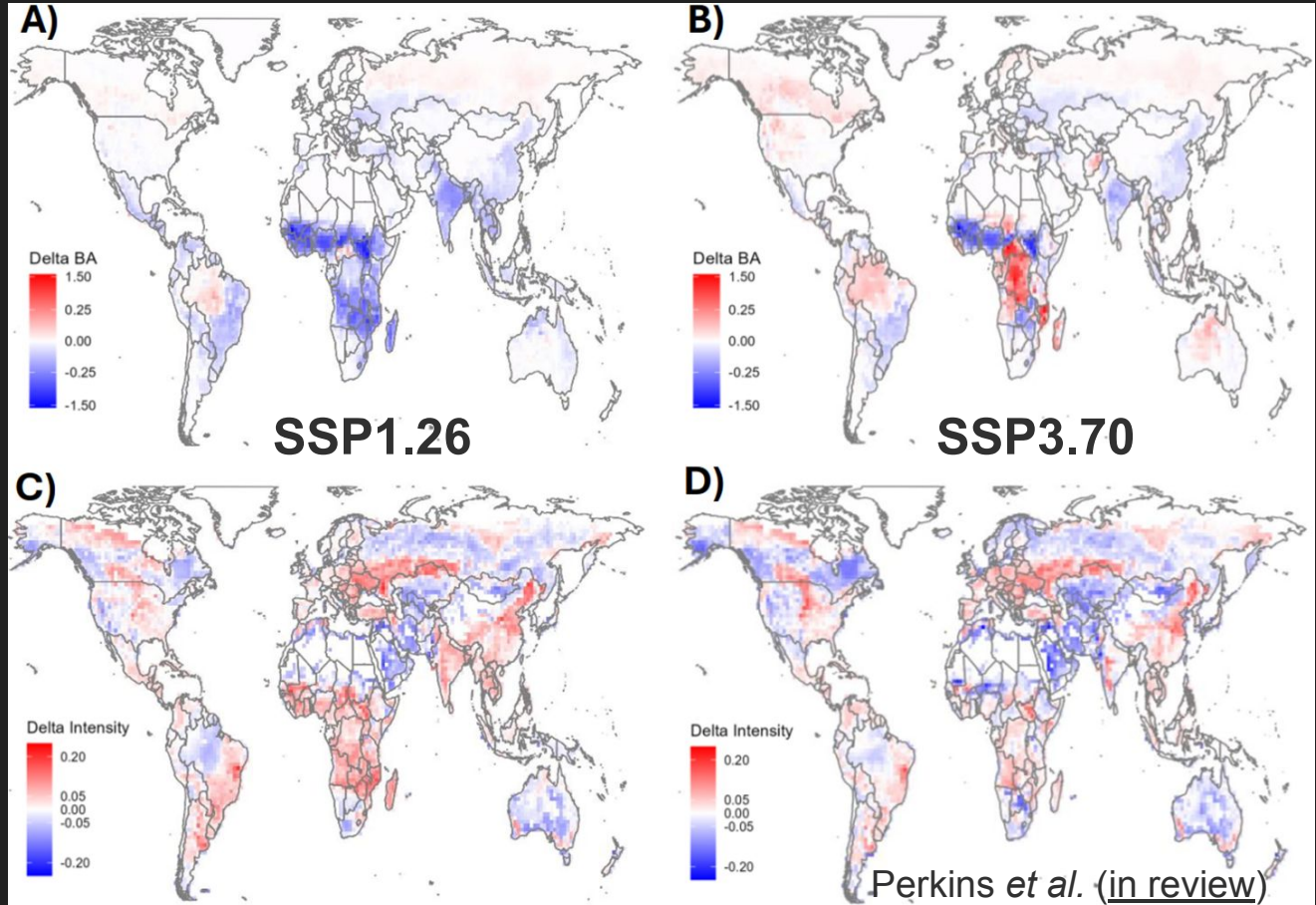
Data available at
[Perkins et al. \(2025\)](#)

Results: Management



Results: SSPs

Burned Area

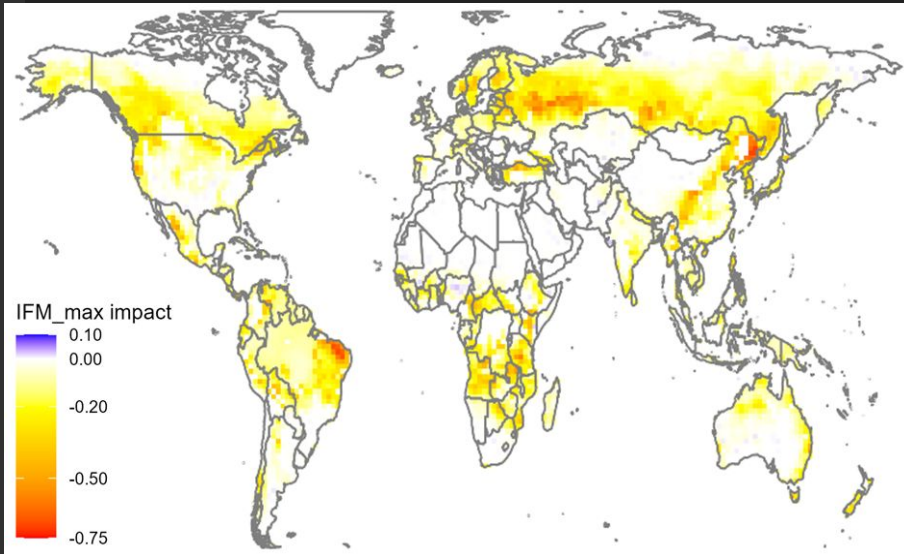


Intensity

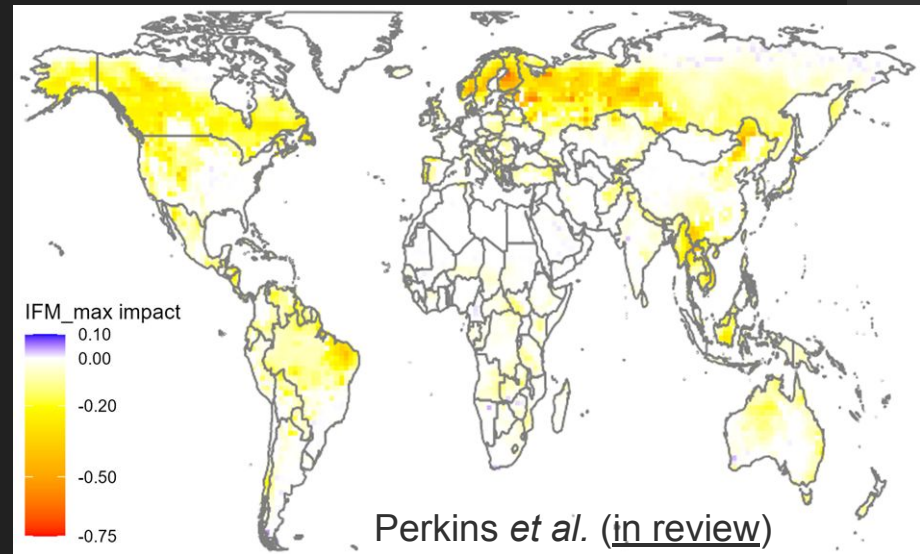
Results: Management vs SSPs

Integrated Fire Management *does* reduce intensity
(but is not as important as socio-economic conditions)

SSP1



SSP3



Perkins *et al.* (in review)

Red is greater reduction in intensity 2015-2100

WHAM!

The Wildfire Human Agency Model

James Millington and Ol Perkins



Project Homepage



LEVERHULME
Centre for Wildfires,
Environment and Society

