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

Imperial College London

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University of Reading

# *Benefits and limits of Integrated Fire Management for climate change adaptation: A global quantitative assessment*

Ol Perkins, Olivia Haas, Matt Kasoar, Apostolos Voulgarakis, Doug Kelley, Joao Teixeira & **James Millington**

EGU26-13135

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# Integrated Fire Management

**United Nations Environment Assembly**
**Seventh session**
Nairobi, 8–12 December 2025

**Draft resolution on strengthening the global management of wildfires**

*"Encourages members states… to consider promoting and enhancing international and regional cooperation for* ***integrated fire management****"*


Oliveras Menor *et al.* (2025)

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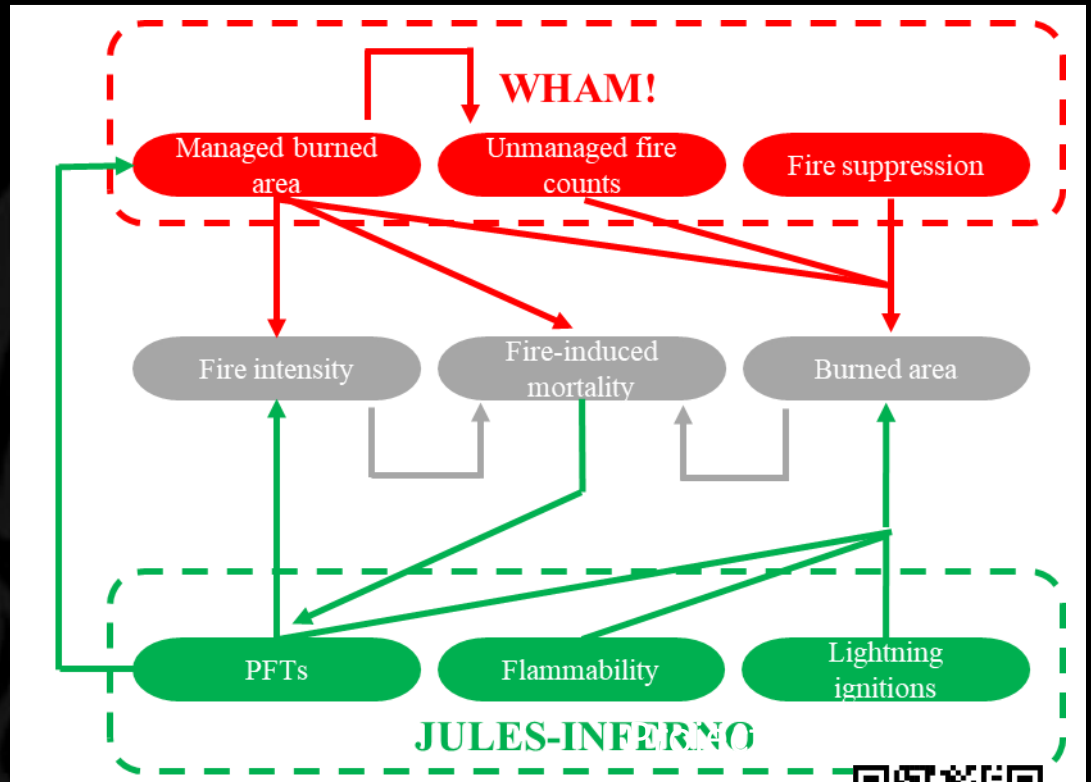
# WHAM-JULES-INFERNO

- WHAM is a global agent-based model of human fire use & management
  - ➢ Empirical basis: DAFI

➢ Represents Agent Functional Types
  - ➢ e.g. ‘Pastoralist’, ‘State forester’
  - ➢ Classification trees driven by environmental and socioeconomic variables
  - ➢ Spatially 0.25-1.85 degrees for decades
  - ➢ Prob. fires escape management (wildfires)
  - ➢ Suppression and Firefighting

➢ Now coupled with JULES-INFERNO




Perkins *et al.* (in review)

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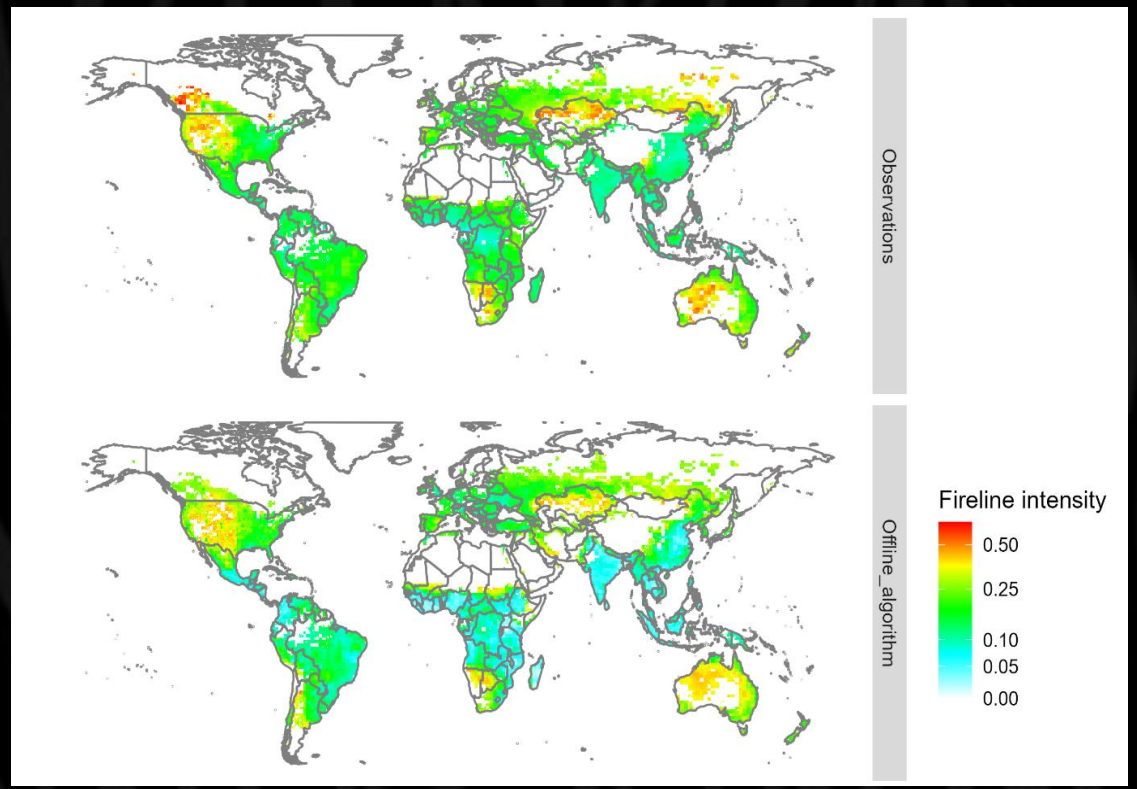
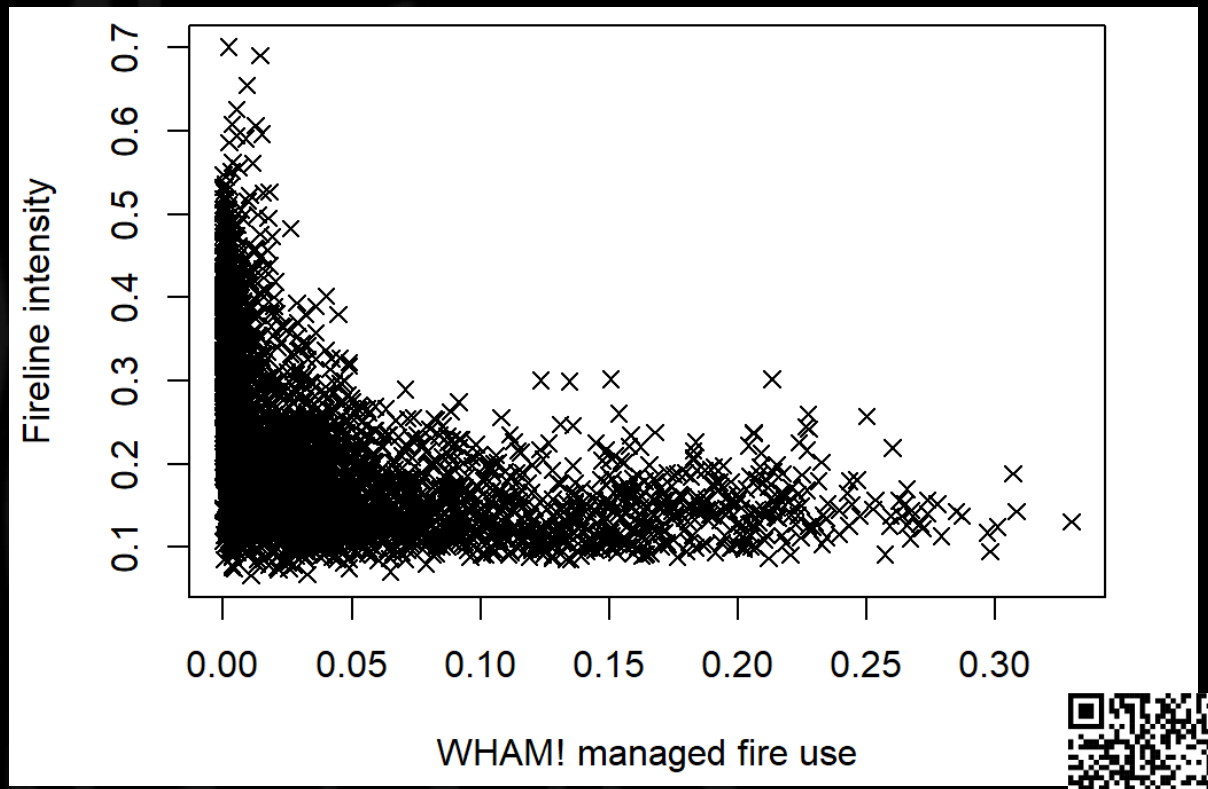
# Modelling fireline intensity

- $Fire\ line\ intensity = FRP\ /\sqrt{Firesize}$
- $\widehat{Fire\ line\ intensity} \sim f(climate, vegetation, humans)$

Complete algorithm: $\rho = 0.74$




Managed fire vs intensity residuals: $\rho = 0.44$

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# Experiments: Management vs Socio-Economics

## 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 |

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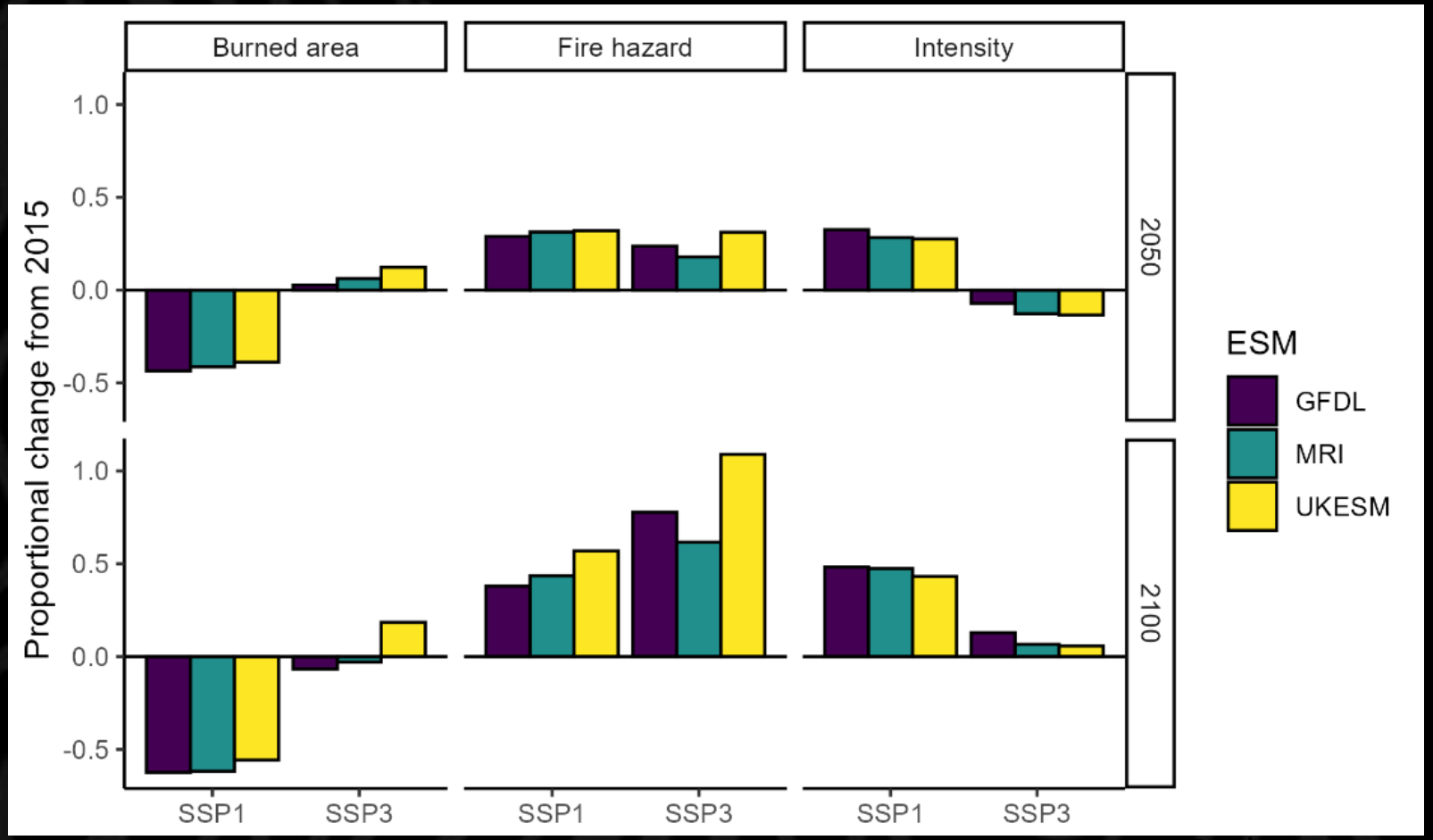
# Results: Socio-Economic Impact

Results point to a fundamental trade-off between burned area and fire intensity

➢ Consequently, fire intensity increases *more* in SSP1 than SSP3

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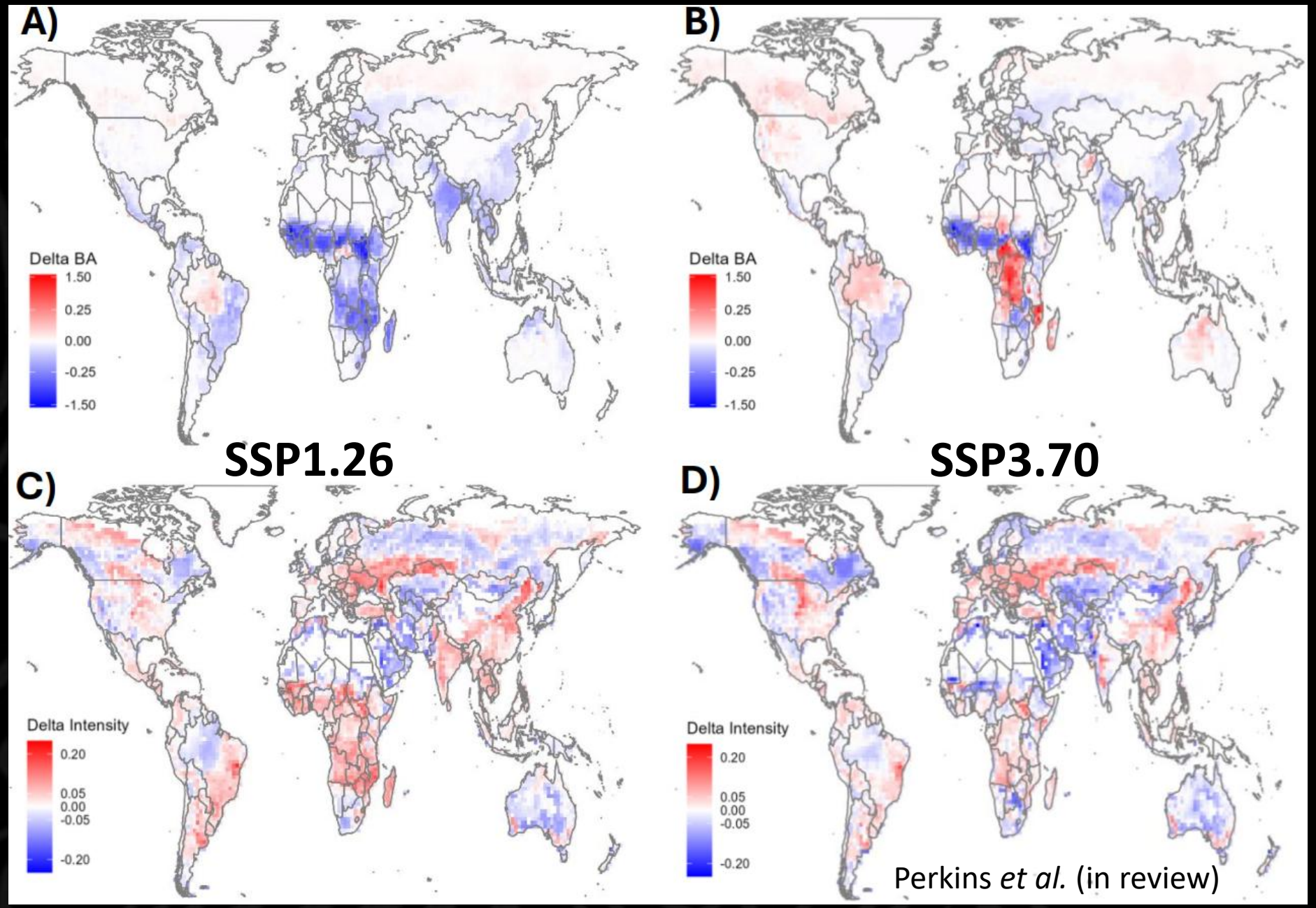
# Results: Fire regime change 2015-2100

Burned Area

Intensity



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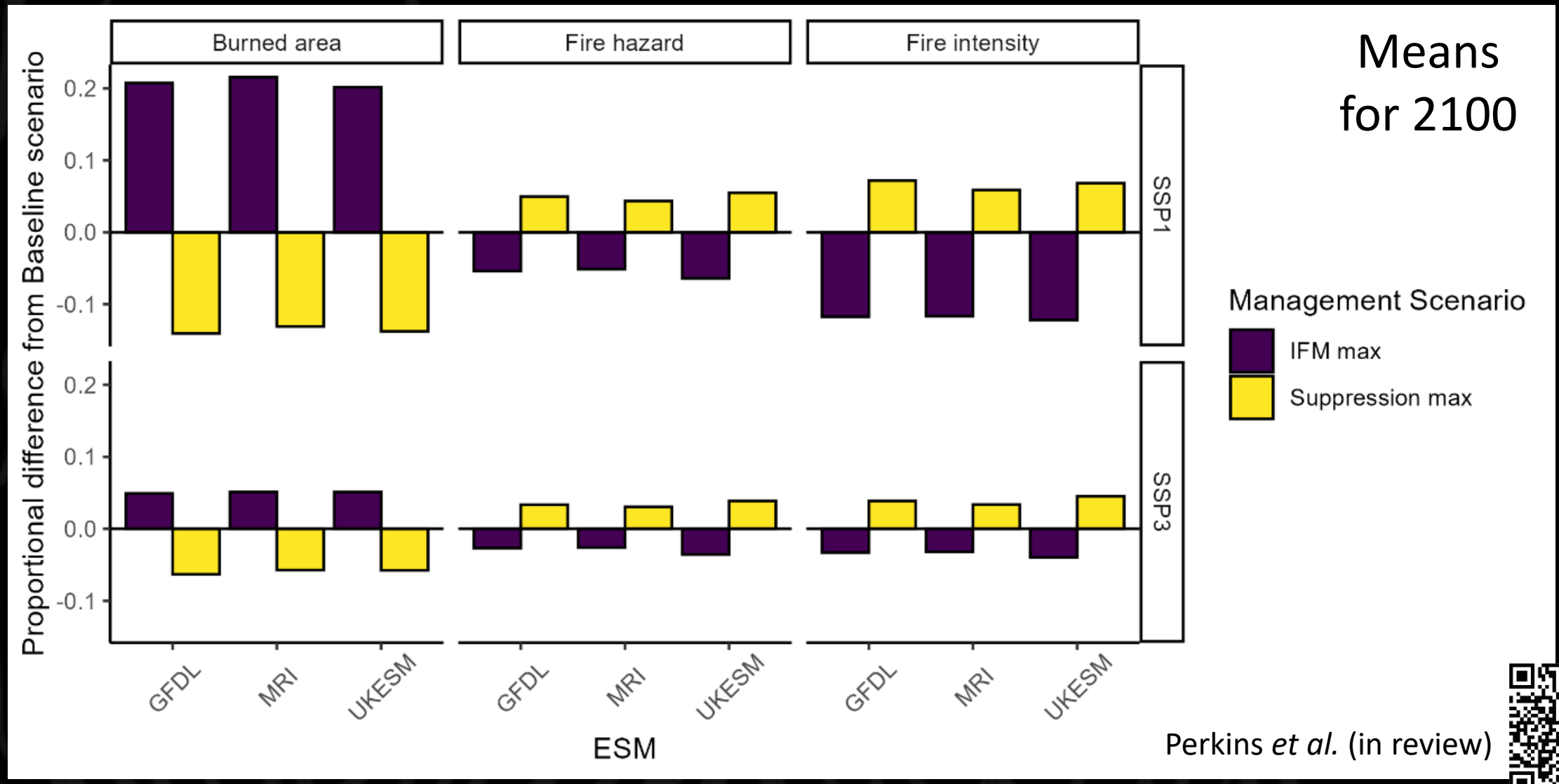
# Results: Management vs Socio-Economics

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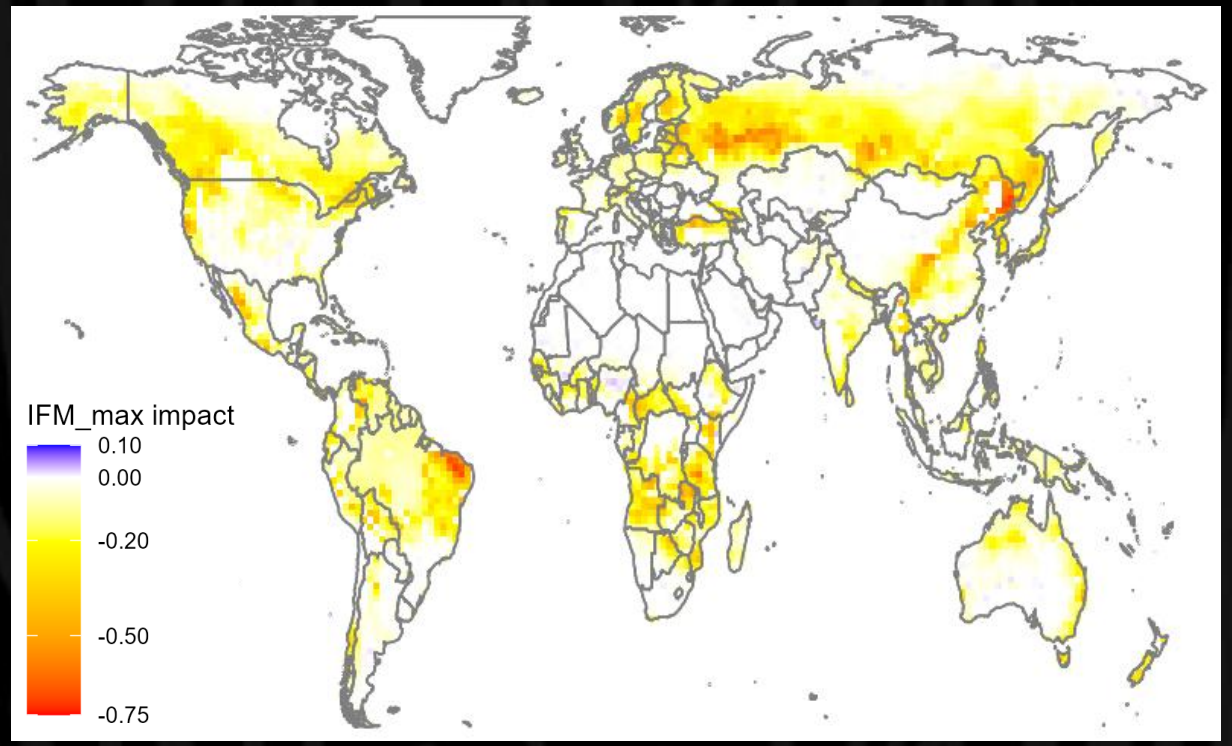
# Results: Management

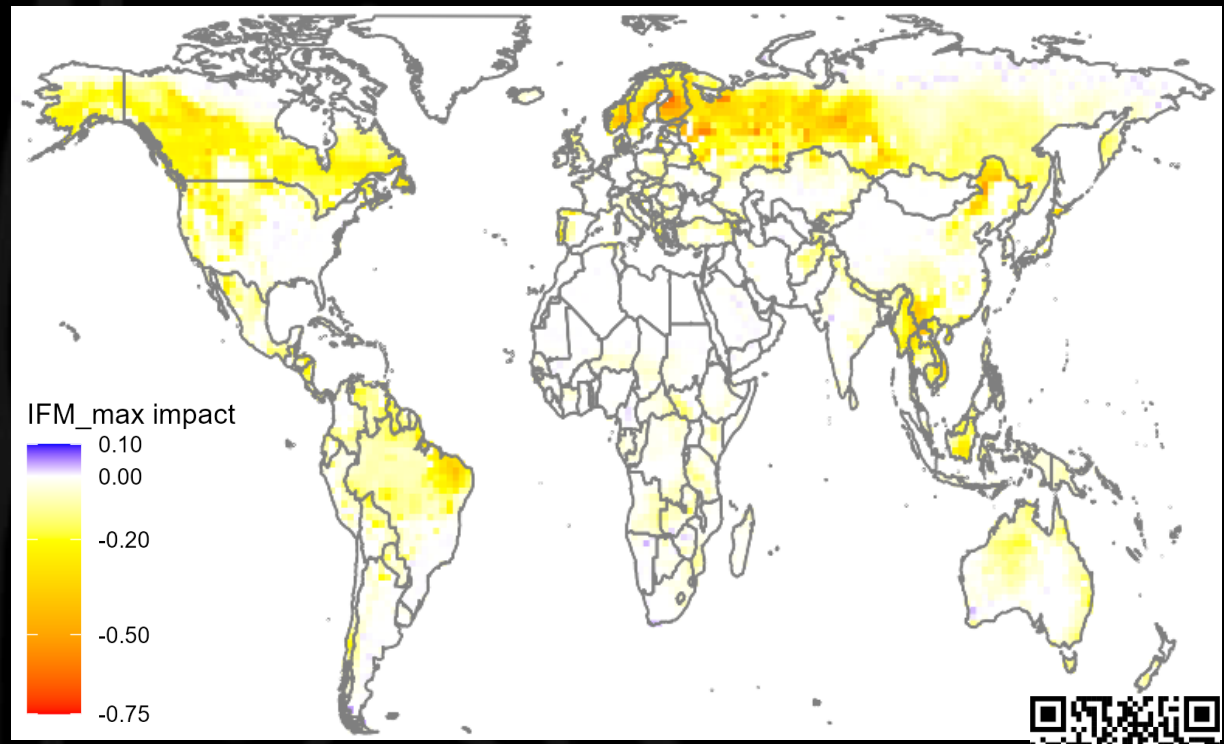
## Integrated Fire Management *does* reduce intensity

(but is not as important as socio-economic conditions)

**SSP1**




**SSP3**




Red is greater reduction in intensity 2015-2100

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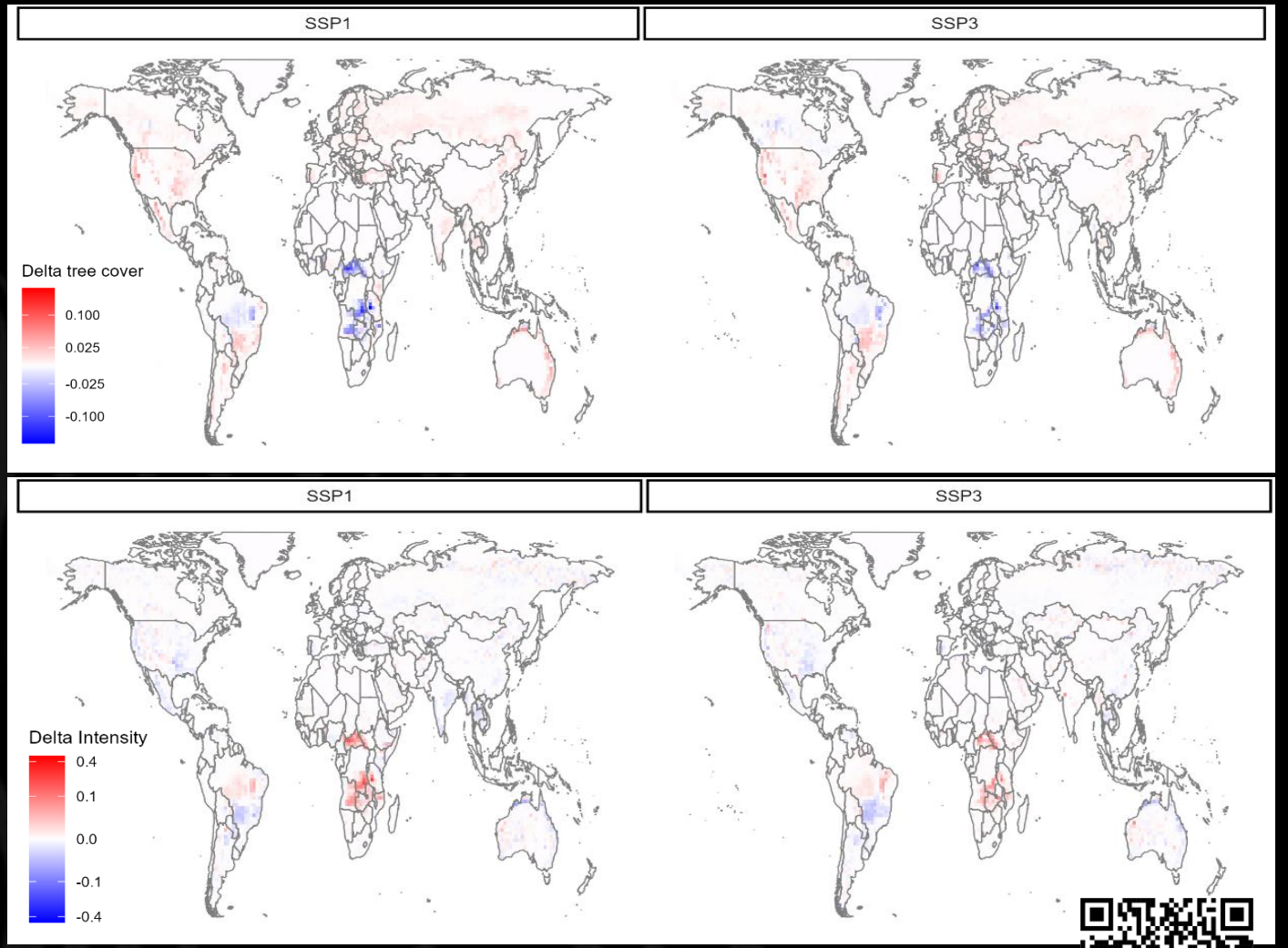
# Fuel feedbacks from controlled burning

- Dynamic coupling with JULES shows IFM leads to increased tree cover in the tropics, but decreased tree cover in the extra-tropics
- There is a (beneficial) negative fuel feedback from IFM on fire intensity in the tropics, but a (bad) positive fuel feedback on fire intensity in the extra tropics




Blue shades indicate impact of fuels on tree cover (top) and fireline intensity (bottom) under IFM, and red shades *vice versa*.

Perkins *et al.* (in review)

# What's missing here?

- Extreme events [though Olivia Haas has a plan]
- Narrowing of burning windows for prescribed fire (due to climate change)
- Grazing [implemented offline, see Perkins *et al.* 2025]

james.millington@kcl.ac.uk
o.perkins@uea.ac.uk

*Thanks!*

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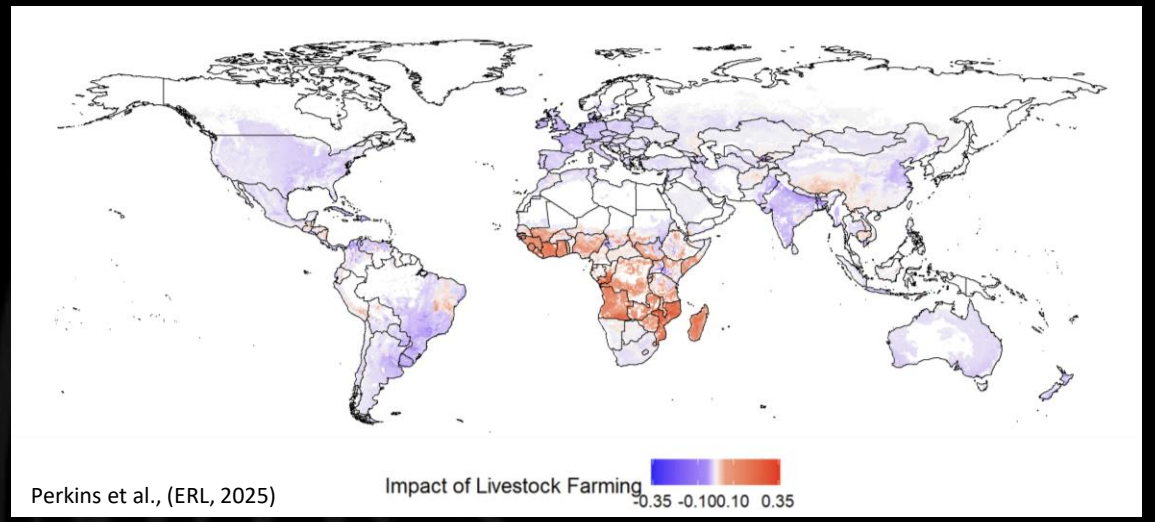
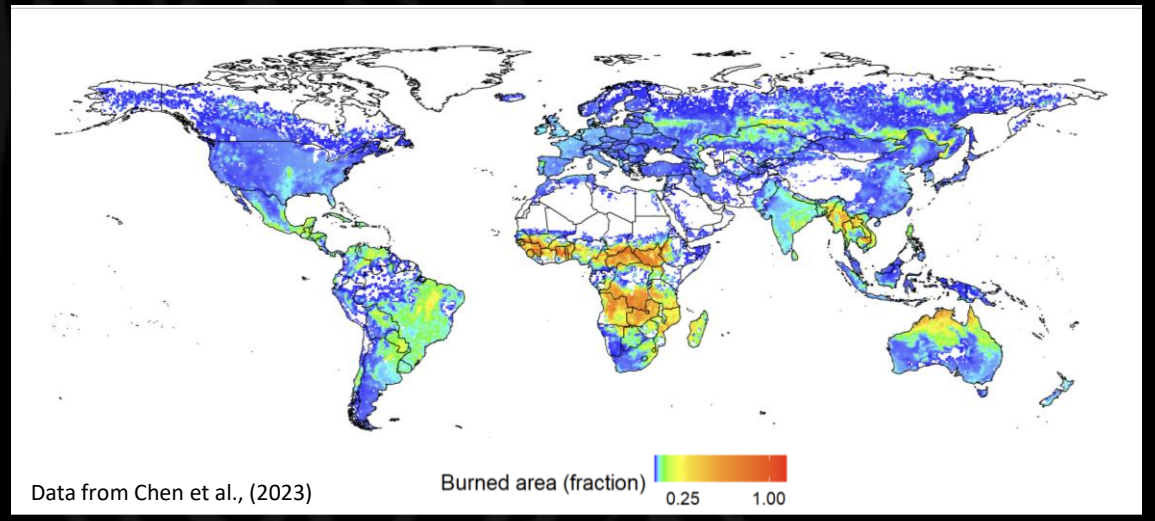
# Another missing process… Grazing

- We built a representation of grazing pressure in WHAM!
  - ➢ Differentiates between grain & grass-fed livestock
  - ➢ And livestock size (up to 200% difference in feed requirement…)
- Combined with pastoral burning, this helps explain the strong spatial anomaly in burned area in SSA

Top: Impact on burned area of grazing & pastoral burning
Bottom: Burned area in a world without livestock farming




Perkins *et al.* (2025, ERL)