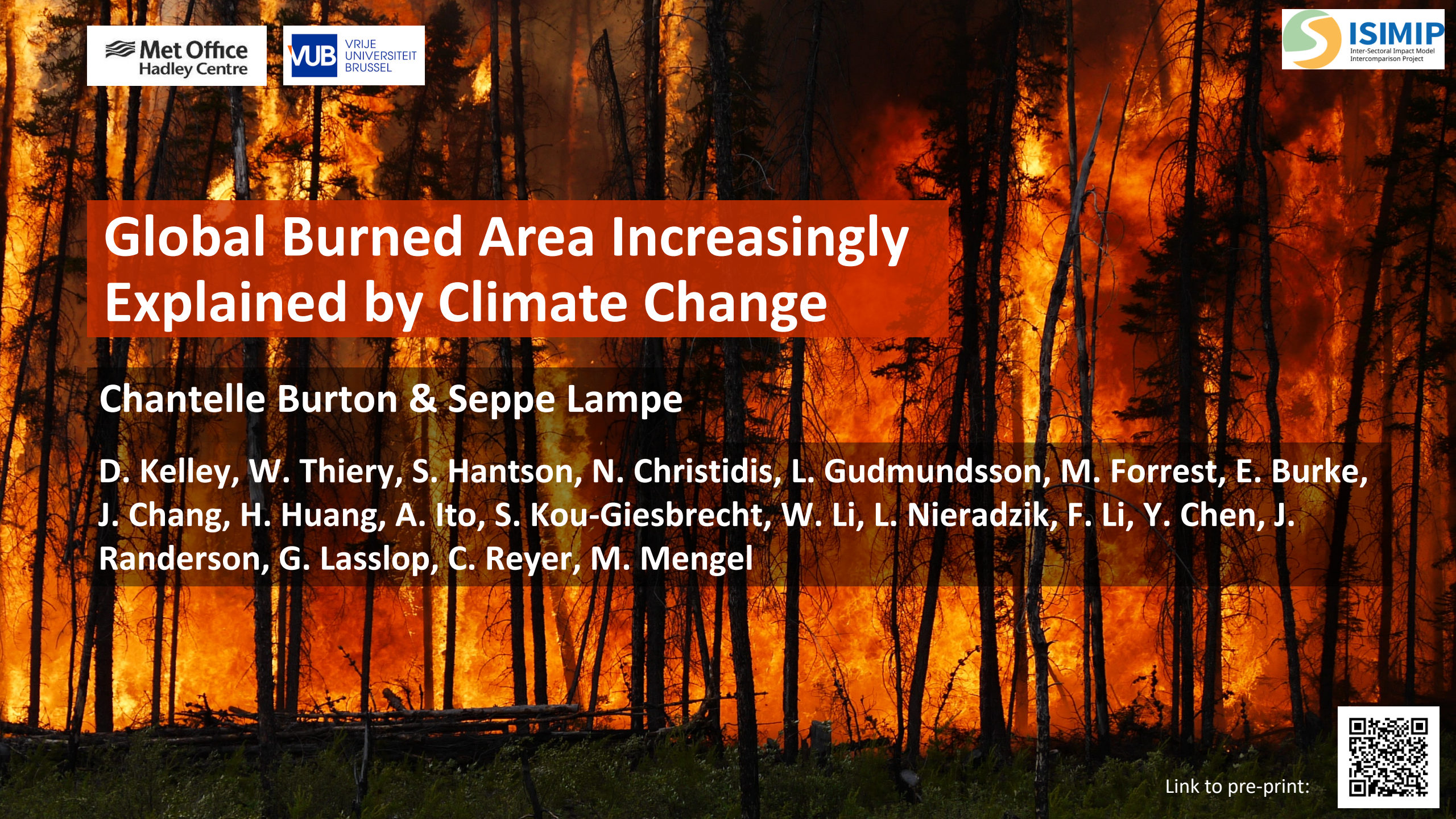


Global Burned Area Increasingly Explained by Climate Change

Chantelle Burton & Seppe Lampe

D. Kelley, W. Thiery, S. Hantson, N. Christidis, L. Gudmundsson, M. Forrest, E. Burke, J. Chang, H. Huang, A. Ito, S. Kou-Giesbrecht, W. Li, L. Nieradzik, F. Li, Y. Chen, J. Randerson, G. Lasslop, C. Reyer, M. Mengel

Link to pre-print:

How can we tackle the challenges science?

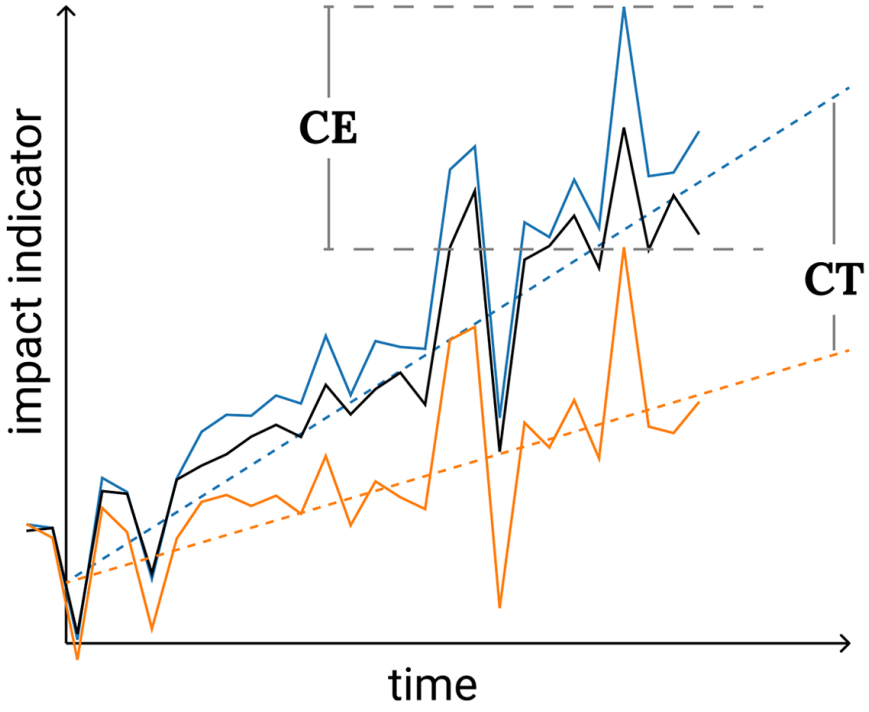
- Observations are uncertain
- Models are uncertain
- Communicating declining global burned area but regional increases
- **How is fire behaviour changing, and what is the role of climate change?**

Attributing burned area to climate change

- 7 fire-DGVMs
- Questions:
  - **What has already changed because of climate change?**
  - **How fast are things changing?**

Burned area (1901-2019)

CT = contribution of climate change to trend in impact



Factual simulation

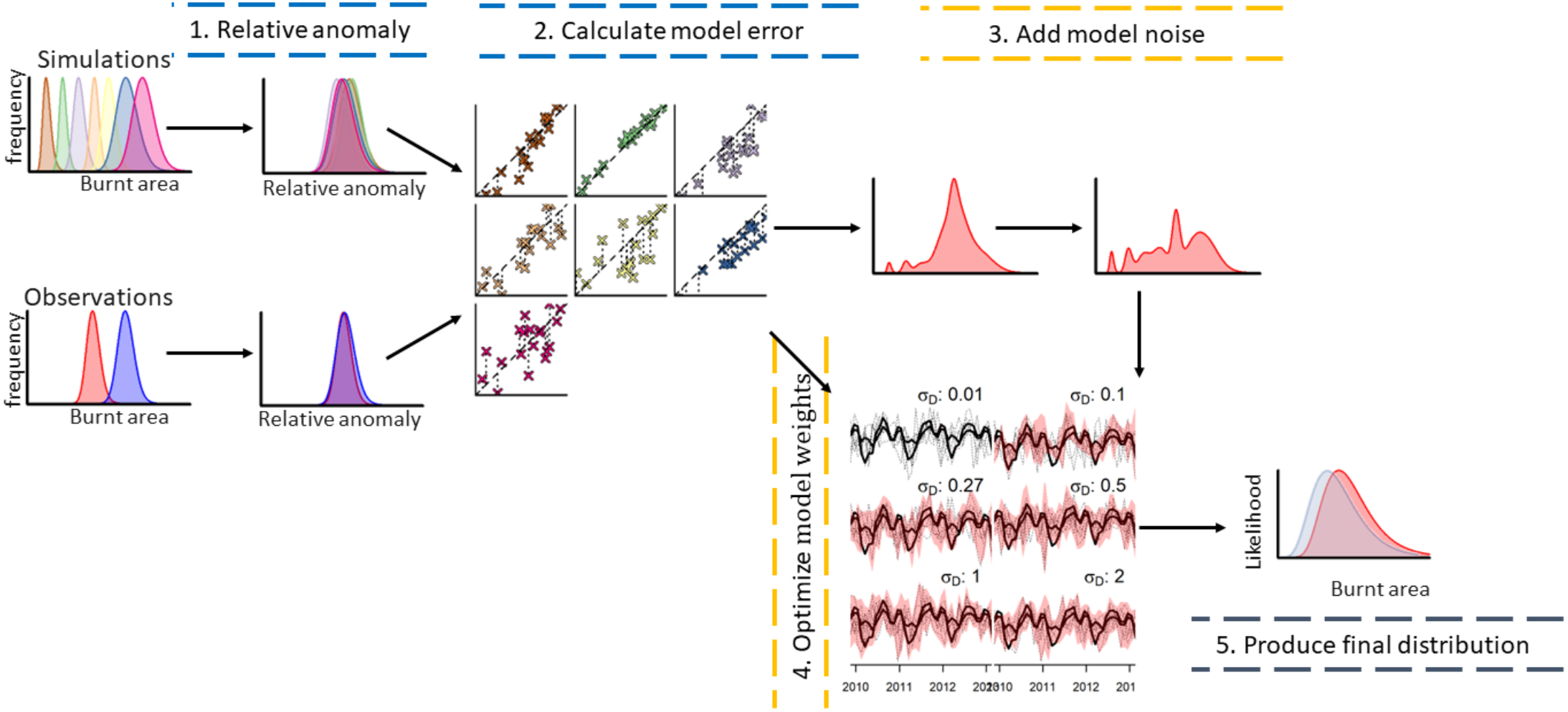
observations

Counterfactual simulation

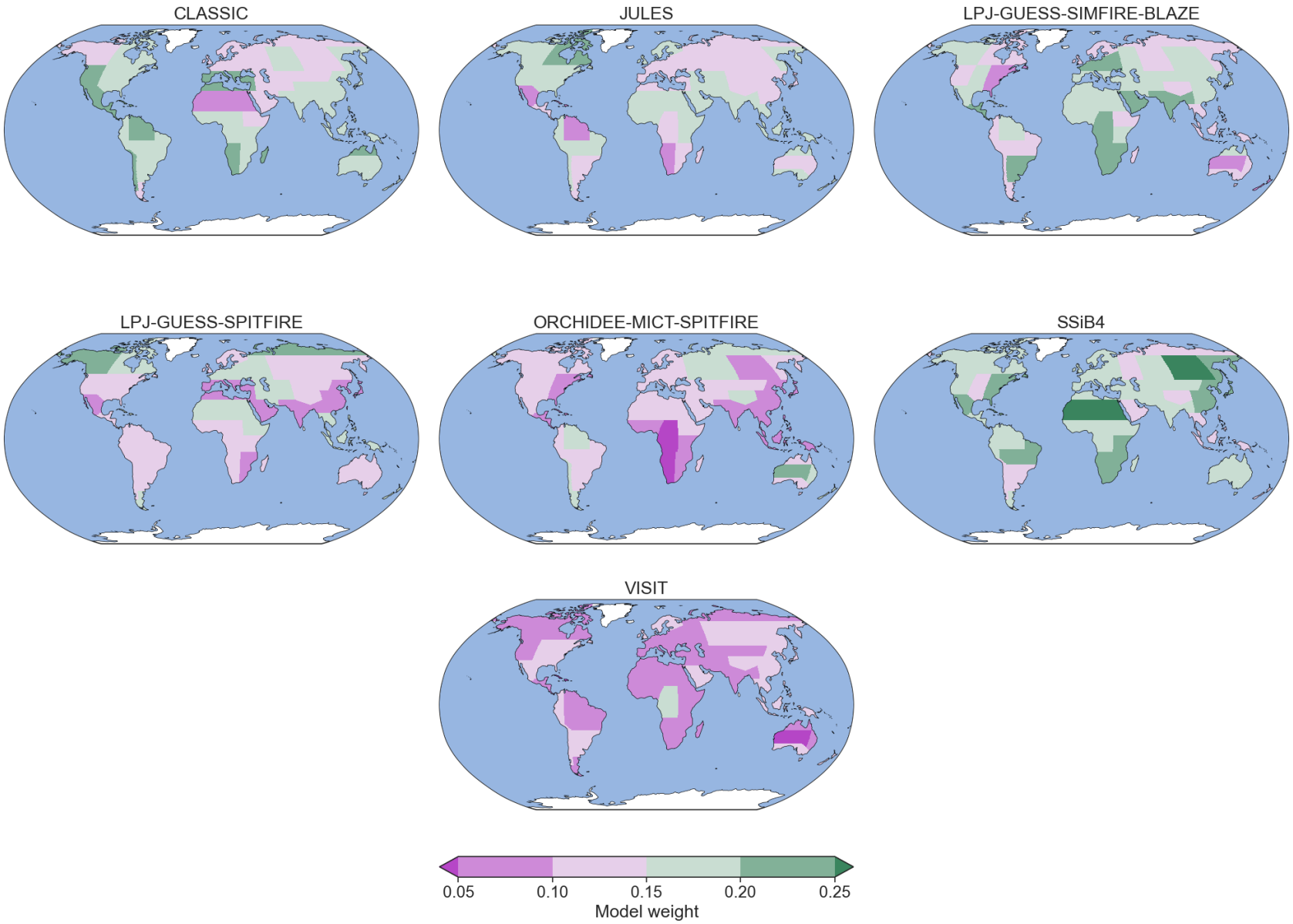
Fixed 1901 atmospheric CO_2 & detrended climate

Mengel et al., 2021

How?

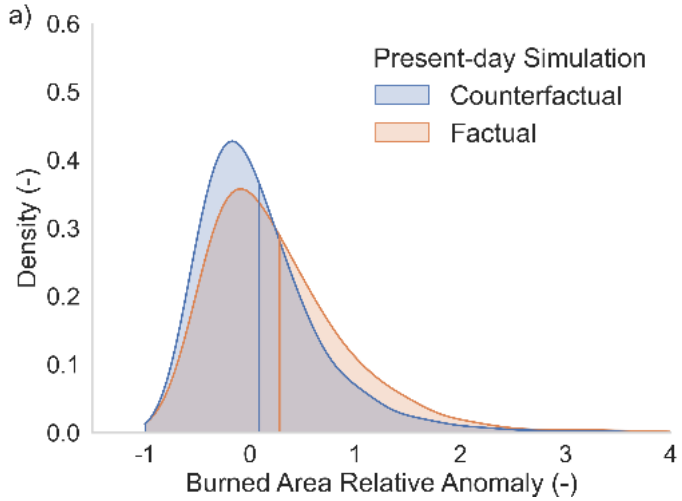

1. Relative anomaly
2. Calculate model error
3. Add model noise
Simulations
frequency
Burnt area
Relative anomaly
Observations
frequency
Burnt area
Relative anomaly
4. Optimize model weights
σD: 0.01
σD: 0.1
σD: 0.27
σD: 0.5
σD: 1
σD: 2
2010
2011
2012
2010
2011
2012
Likelihood
Burnt area
5. Produce final distribution

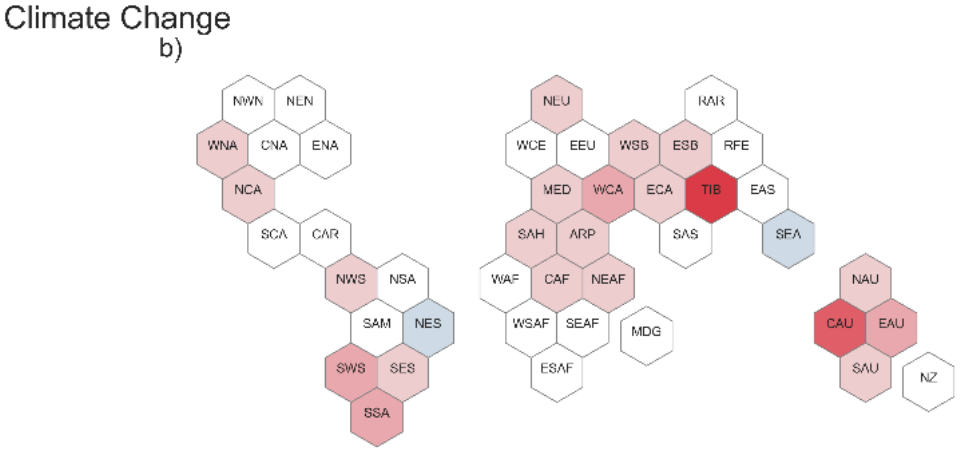
Weights


CLASSIC
JULES
LPJ-GUESS-SIMFIRE-BLAZE
LPJ-GUESS-SPITFIRE
ORCHIDEE-MICT-SPITFIRE
SSiB4
VISIT
0.05
0.10
0.15
0.20
0.25
Model weight

Results: Change in Mean

- Shift in mean
- Relative Anomaly
- Factual vs Counterfactual
- 2003-2019





- ➢ **16% more burned area globally** due to climate change
- ➢ 62% more in Central Australia, 18% in West Siberia and 17% in the Mediterranean

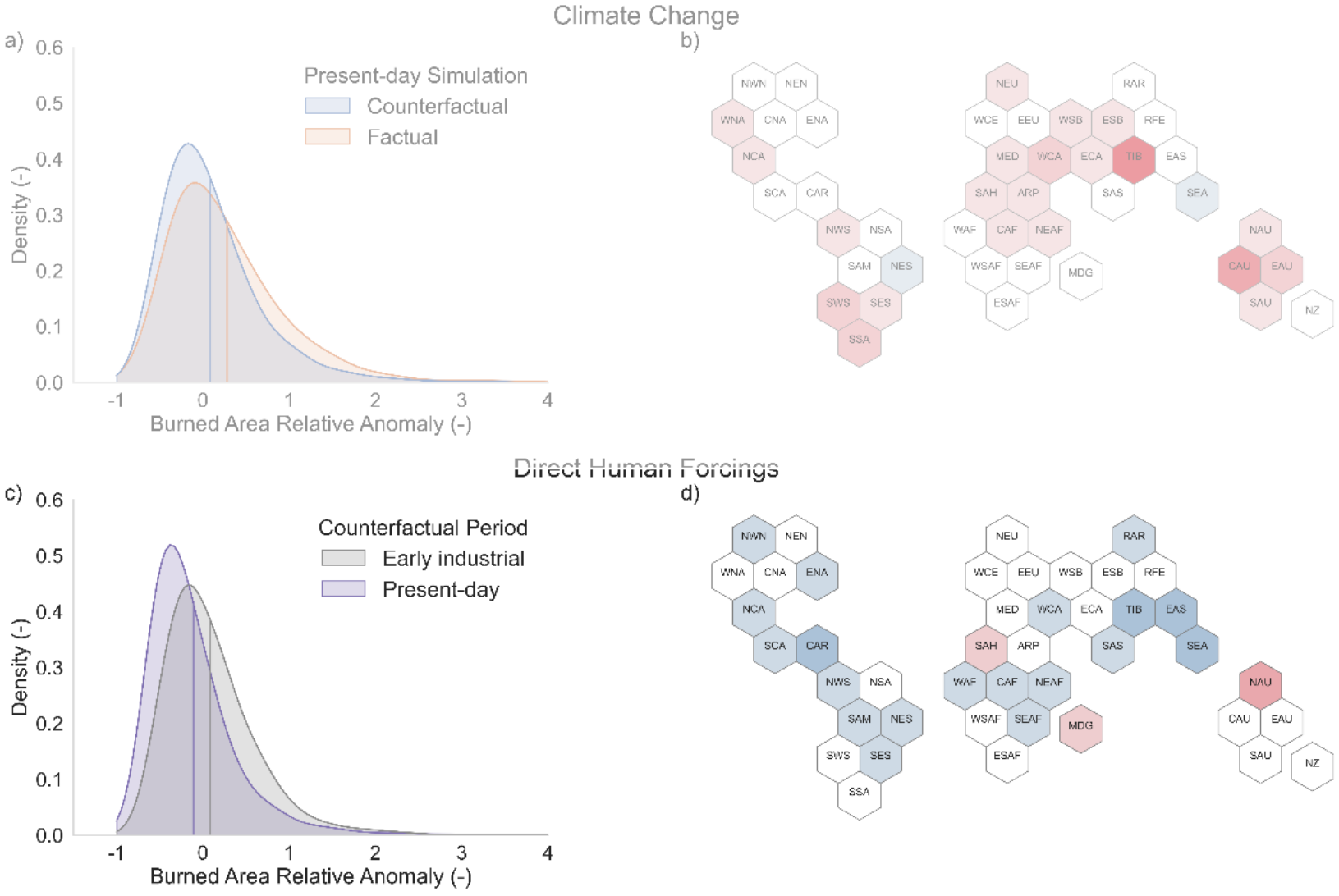
Results: Change in Mean

- Socio-economic factors (DHF)
- Counterfactual 1901-1920 vs 2003-2019

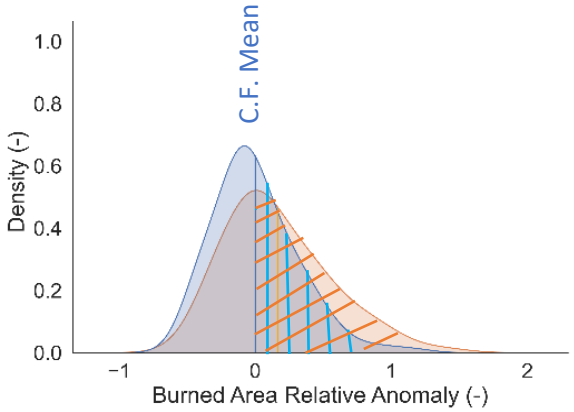
➢ **19% less burned area globally** due to DHF

➢ Reduction in burned area in many regions

➢ DHF has damped the effect of climate change on burned area

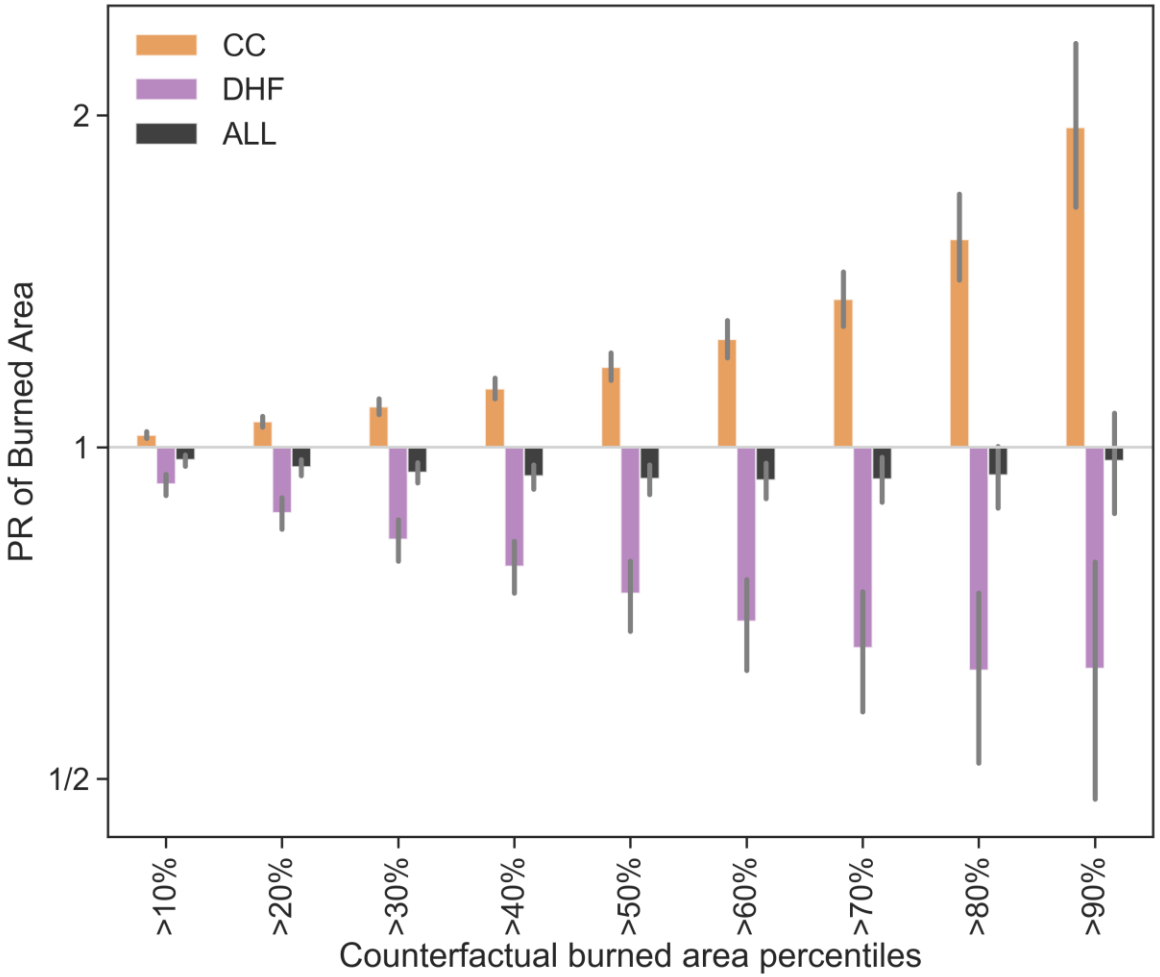


Results: Highest burned area increases the most



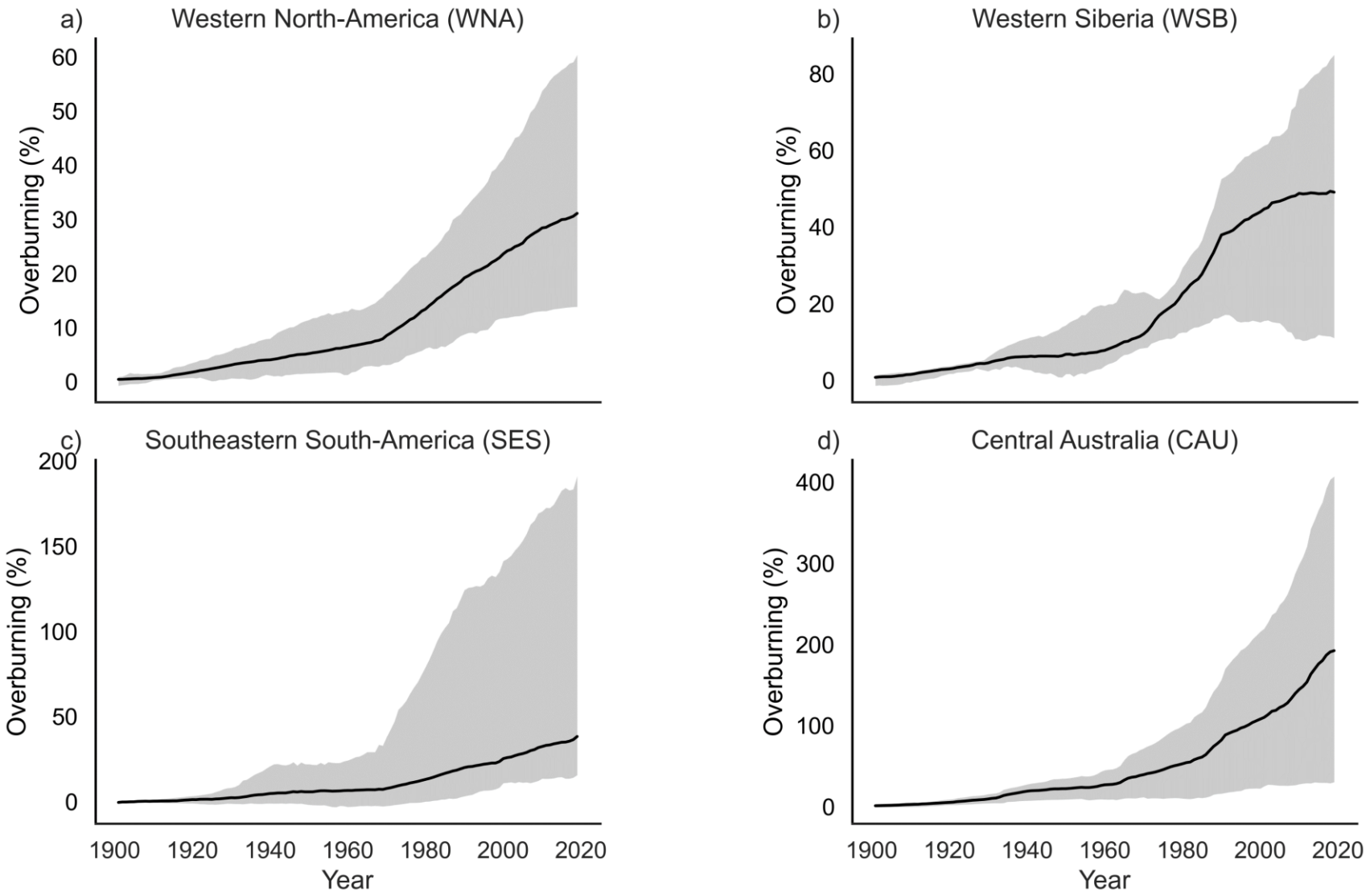
$$\textbf{\textit{Probability Ratio}}\ (\mathrm{PR}) = \frac{\sum \boldsymbol{BA} > \overline{\boldsymbol{BA_{CF}}})}{\sum (\boldsymbol{BA_{CF}} > \overline{\boldsymbol{BA_{CF}}})}$$

- **25% increase** in probability of **above-average burned area** due to climate change
- Direct Human Forcing reduces PR
- net effect: **DHF counteracts climate-driven increase**



Results: Increasing effect of climate change

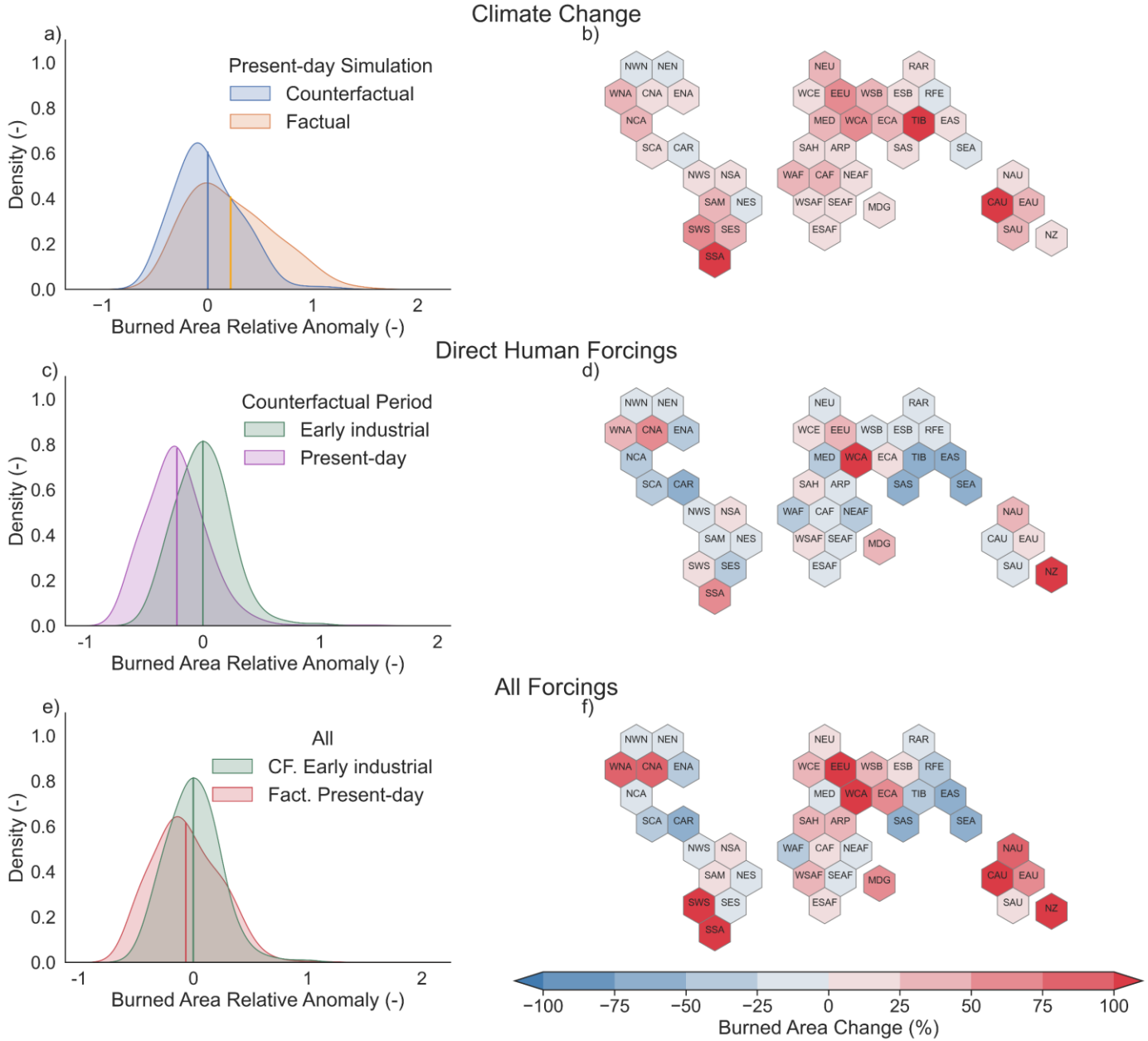
- Increase in 38/43 regions
- Contribution of climate change to burned area is increasing by 0.22% yr^{-1} globally
- 2.5% yr^{-1} increase in CAU



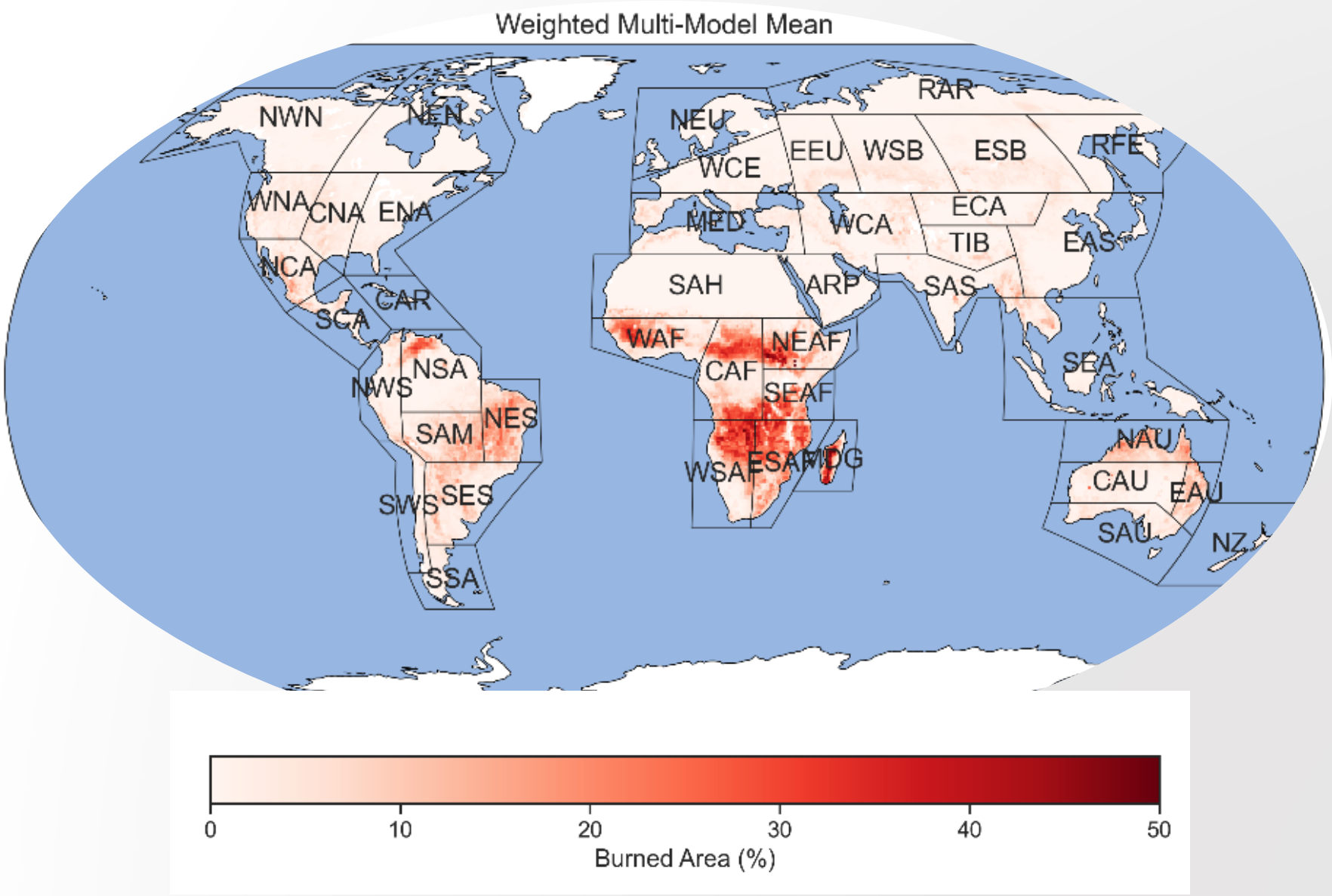
Out soon in Nat. Climate Change

- Climate change has already driven an increase in burned area
- Mitigated by socio-economics
- Effect of climate change is increasing
- ***DHF may have been mitigating the effects of climate change until now, but fire regimes may be increasingly affected as the climate continues to change***

Spare slides

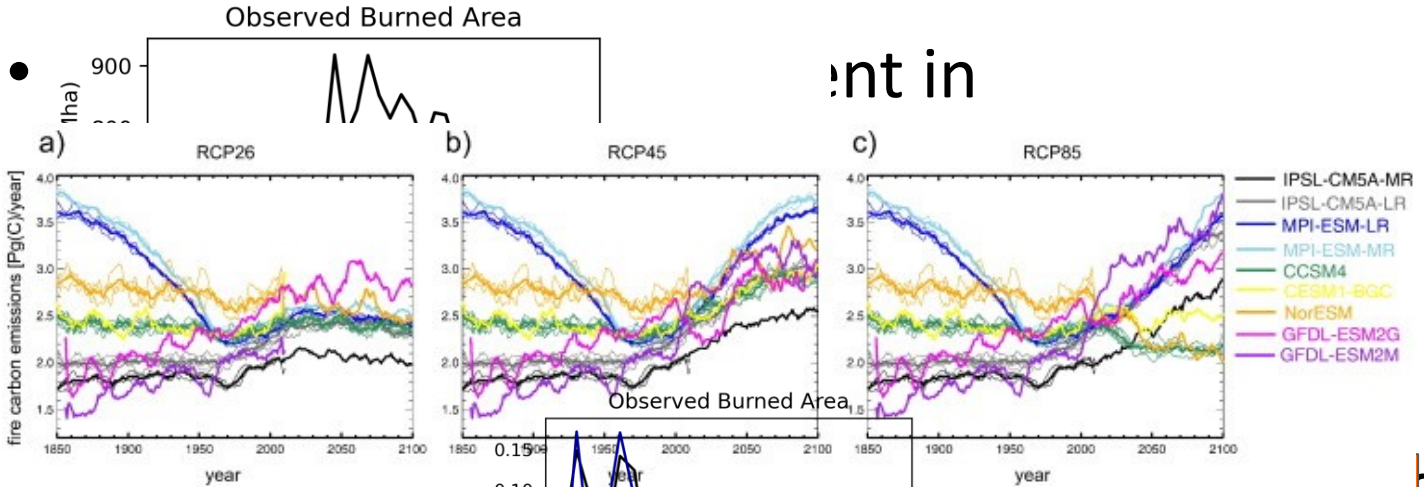

Climate Change
a)
Present-day Simulation
Counterfactual
Factual
Density (-)
Burned Area Relative Anomaly (-)
b)
Direct Human Forcings
c)
Counterfactual Period
Early industrial
Present-day
d)
All Forcings
e)
All
CF. Early industrial
Fact. Present-day
f)
NWN NEN WNA CNA ENA NCA SCA CAR NWS NSA SAM NES SWS SES SSA
NEU RAR WCE EEU WSB ESB RFE MED WCA ECA TIB EAS SAH ARP SAS SEA WAF CAF NEAF WSAF SEAF MDG ESAF
NAU CAU EAU SAU NZ
−100 −75 −50 −25 0 25 50 75 100
Burned Area Change (%)

Regions


Weighted Multi-Model Mean
NWN
NEN
NEU
RAR
WCE
EEU
WSB
ESB
RFE
WNA
CNA
ENA
MED
WCA
ECA
TIB
EAS
NCA
SAH
ARP
SAS
CAR
SCA
WAF
NEAF
CAF
SEA
NSA
NWS
SEAF
NES
SAM
NAU
WSAF
ESAF
MDG
CAU
EAU
SES
SWS
SAU
NZ
SSA
0
10
20
30
40
50
Burned Area (%)

How can we tackle the challenges nce??

- Large differences in observations, short satellite records
- Disagreement across models
- nt in



Kloster & Lasslop, 2017

and carbon cycles

- How is fire behaviour changing, and what is the role of climate