LEVERHULME

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

Imperial College London

KING'S College LONDON

ROYAL HOLLOWAY UNIVERSITY OF LONDON

University of Reading

# Representing northern high latitude peat fires in JULES-INFERNO


Katie Blackford

Apostolos Voulgarakis, Colin Prentice, Chantelle Burton and Matt Kasoar

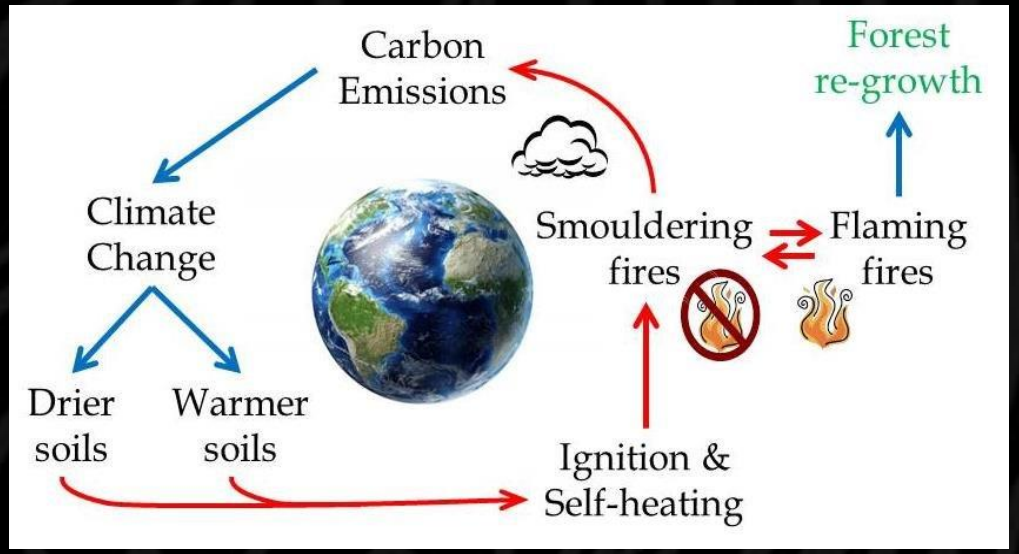

www.centreforwildfires.org

@centrewildfires

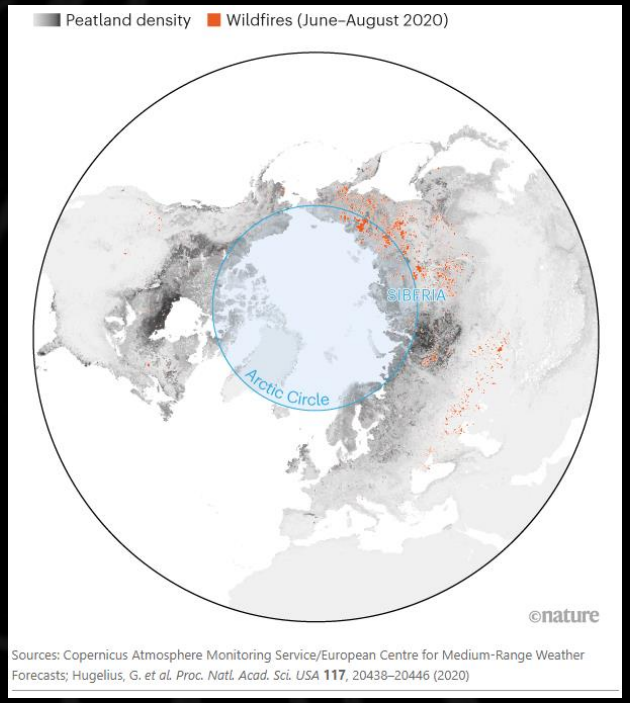
LEVERHULME TRUST

# Peat fires in the Northern high latitudes

- Northern high latitude peatlands store ~415Pg Carbon (Hugelius et al., 2020)
- Largest and most persistent fires, that release large amounts of carbon
- Emit aerosols and particulates that can lead to haze events
- Dominated by smouldering combustion



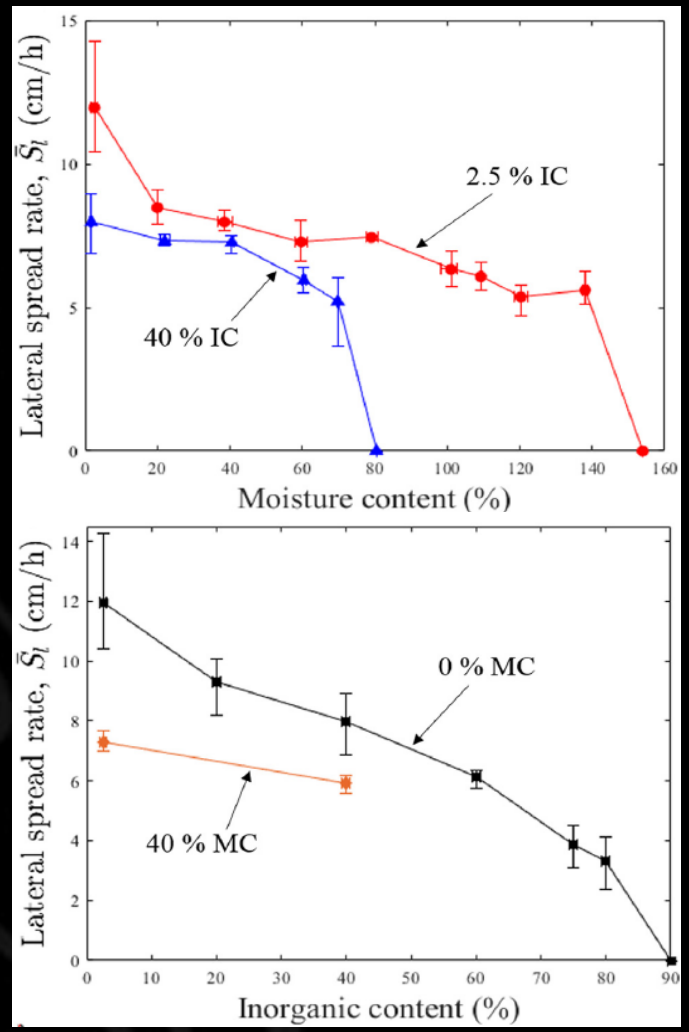

Rein, 2013




Witze, 2020

# Smouldering combustion

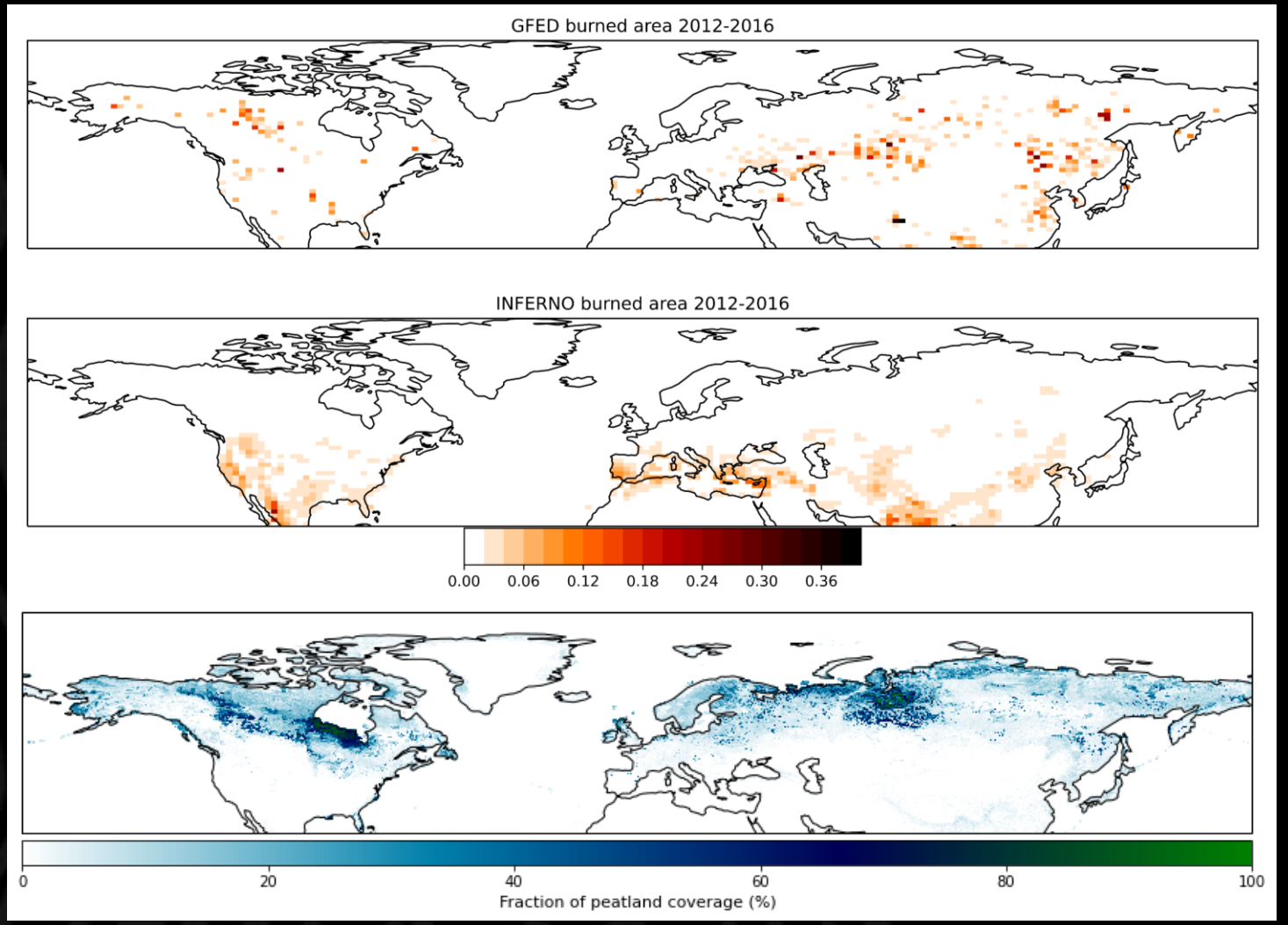
- Slow, low temperature and flameless
- Spread horizontally and in depth
- Ignition and spread influenced by soil properties:
  - Moisture content
  - Inorganic content
  - Bulk density
  - Soil temperature




Christensen et al., 2020

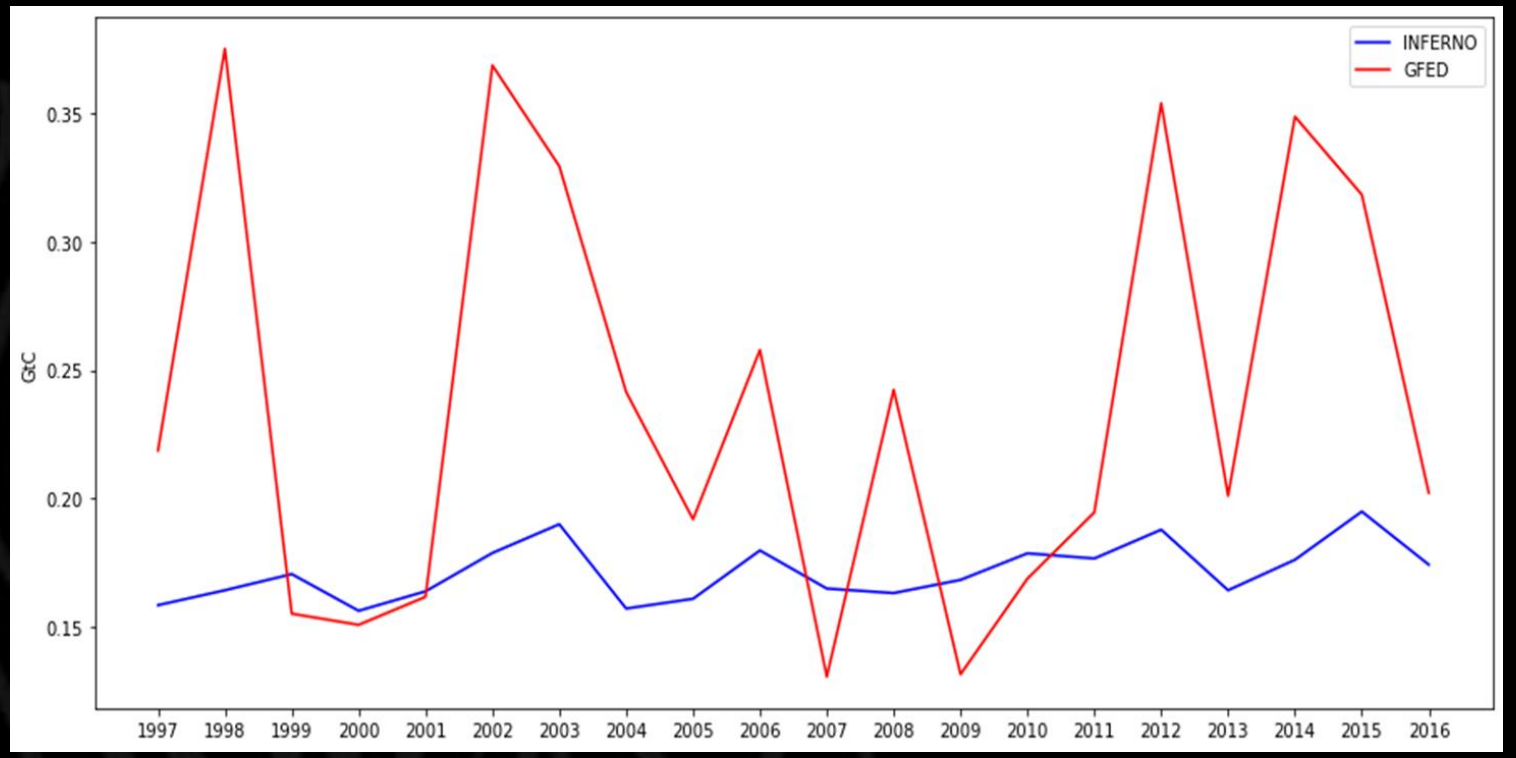
# Present INFERNO

- No representation of peat fires in INFERNO
- Underestimates fires in the northern high latitudes when compared to GFED
  - Especially in areas containing large amounts of peat
- INFERNO also doesn't capture the interannual variability in carbon emissions



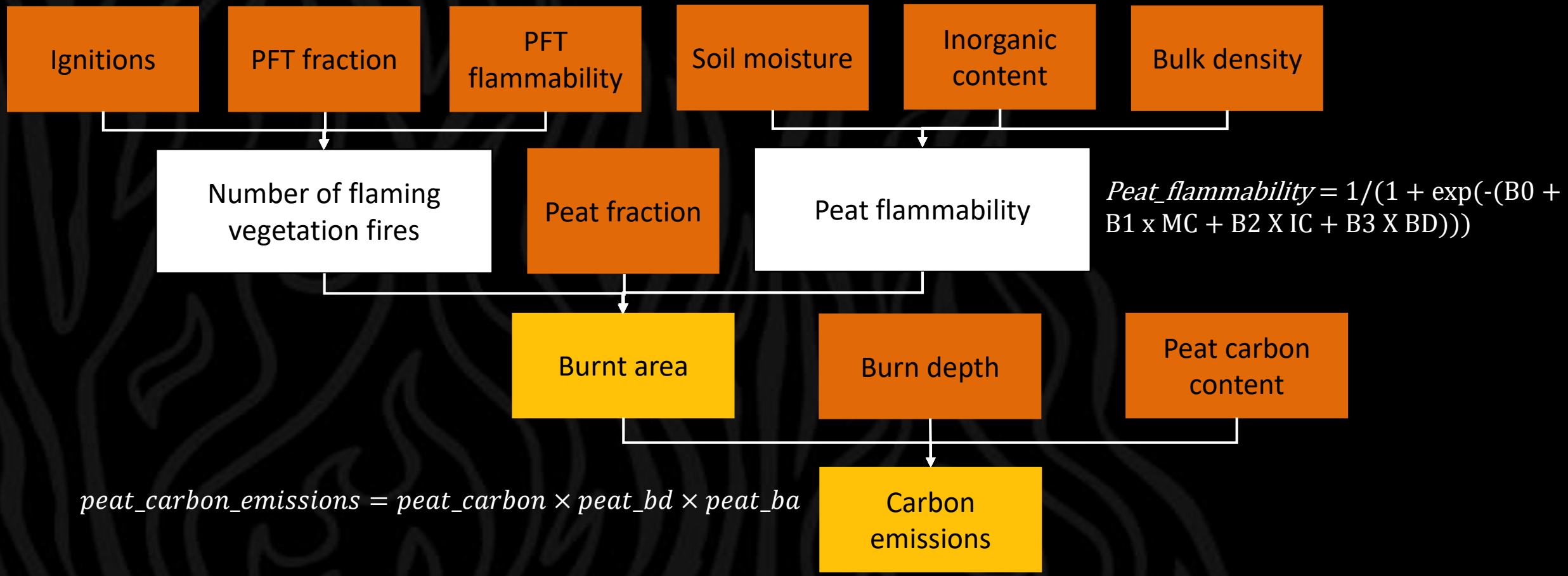
# Present INFERNO

- No representation of peat fires in INFERNO
- Underestimates fires in the northern high latitudes when compared to GFED
  - Especially in areas containing large amounts of peat
- INFERNO also doesn't capture the interannual variability in carbon emissions



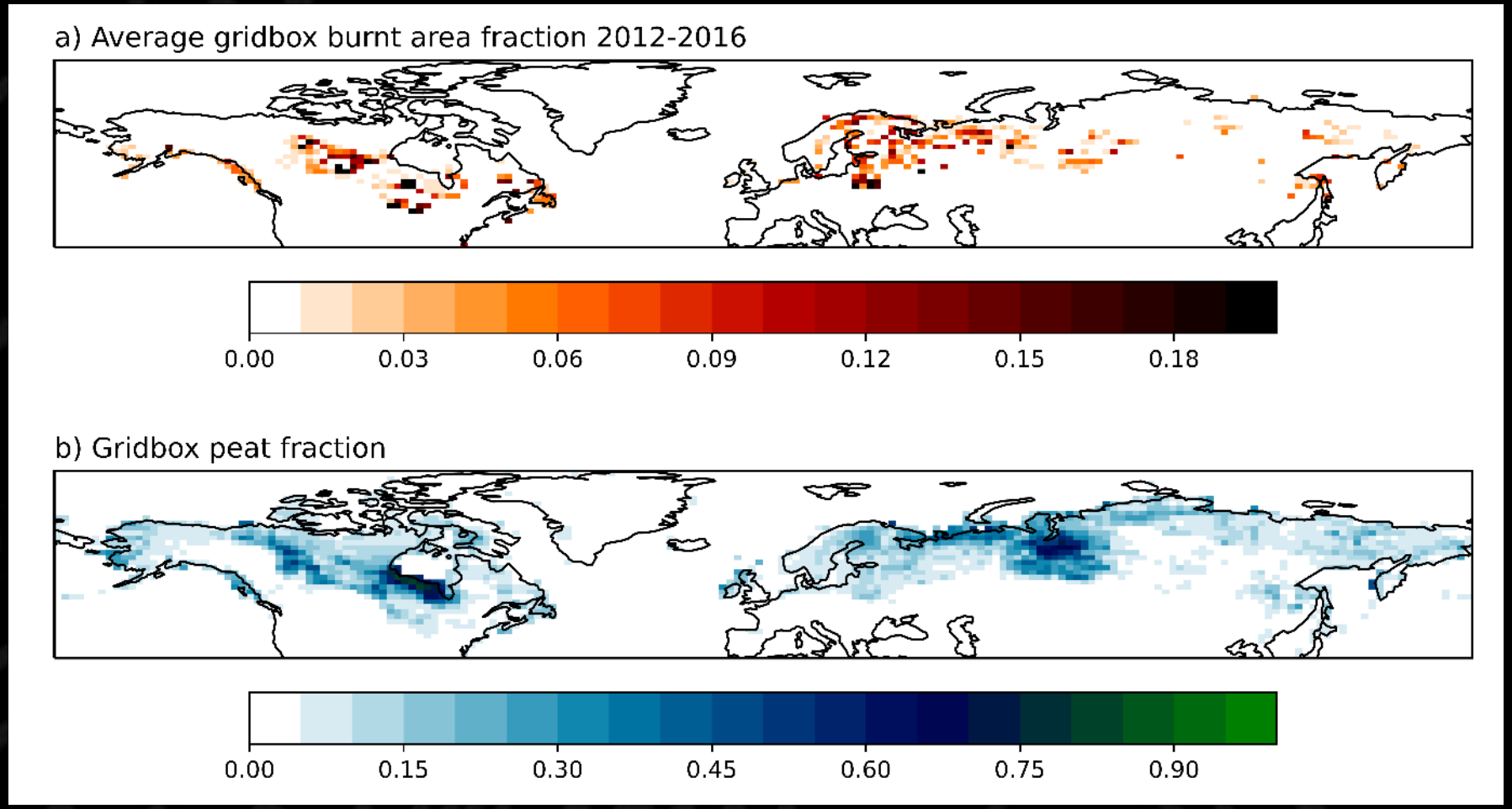
# Representing peat fires in INFERNO

$$peat\_ba = \left[\sum_{PFTs} (ignitions \times PFT\_flammability \times PFT\_fraction)\right] \times peat\_flammability \times peat\_fraction \times peat\_avg\_ba$$

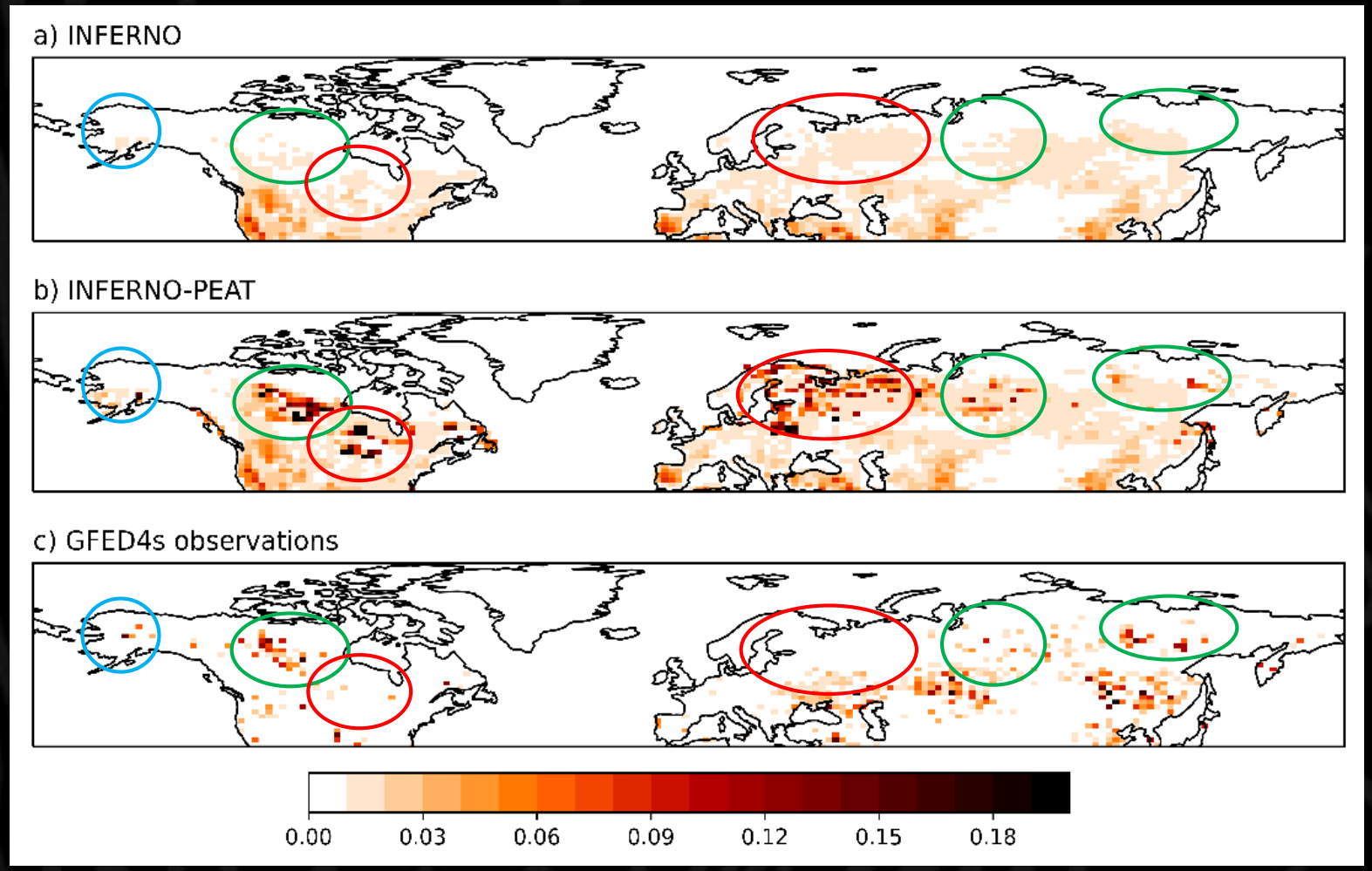



$$peat\_carbon\_emissions = peat\_carbon \times peat\_bd \times peat\_ba$$

# Burnt area

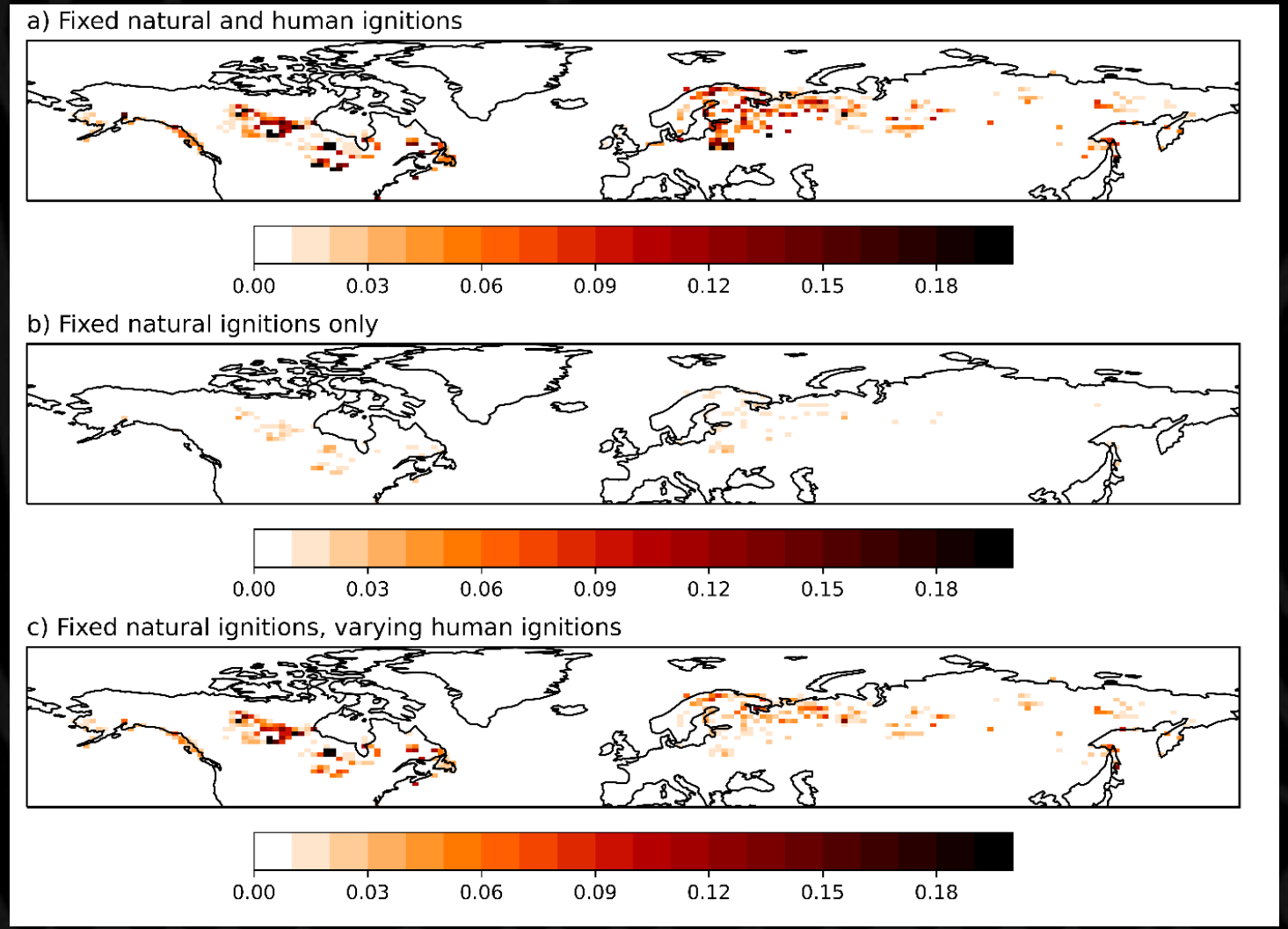

a) Average gridbox burnt area fraction 2012-2016
0.00
0.03
0.06
0.09
0.12
0.15
0.18
b) Gridbox peat fraction
0.00
0.15
0.30
0.45
0.60
0.75
0.90

# Burnt area comparisons




- Improved representation in Canada and Siberia
- Not capturing burnt area in Alaska
- Large over estimations in Northern US/Southern Ontario, Canada
- Also large overestimations in Fennoscandia, Eastern Europe and North West Russia

# Effect of humans on peat fires

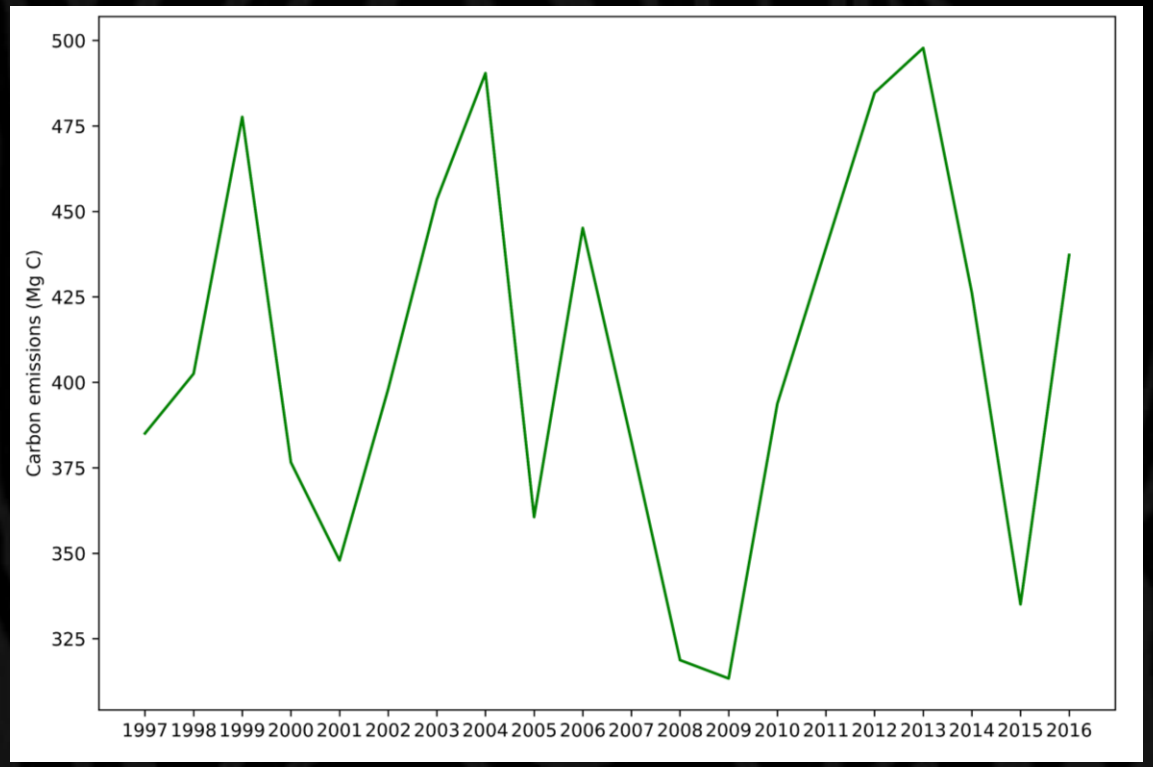



- 3 factorial runs
  - INFERNO ignition mode 1 (fixed natural and human ignitions)
  - Fixed natural ignitions only
  - Fixed natural ignitions and varying human ignitions with population density
- Allowing population density to alter human ignitions and suppressions, results in a reduction in burnt area in more populated regions

# Peat fire carbon emissions

Average annual carbon emissions in the northern high latitudes (>45º)

Peat model only




INFERNO-PEAT vs GFED

# Conclusions and future work

- INFERNO-PEAT improves the representation of fires in the northern high latitudes
  - Using varying human ignitions helps to reduce the positive bias in burnt area in more populated regions.
  - Carbon emissions show negligible improvements – possibly due to not modelling burn depth
- Incorporation into JULES – branch vn6.3_peat_fires
- Investigating alternative datasets for model evaluation
  - Possible use of NO2/CO ratios

LEVERHULME

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

Imperial College London

KING'S College LONDON

ROYAL HOLLOWAY UNIVERSITY OF LONDON

University of Reading

# Thank you

www.centreforwildfires.org

@centrewildfires

LEVERHULME TRUST