

# Attribution of historical changes in labour outcomes to climate change

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OF ECONOMICS AND  
POLITICAL SCIENCE ■



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# Introduction

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- Heat stress is already having adverse effects on labour supply and productivity
- Impacts are heterogeneous across sectors and regions (Dasgupta et al., 2021)
- Disentangling the effects of historical climate change on labour in the historic period has not been attempted in the existing literature
- We combine robust estimates of the impact of climatic stressors on effective labour from (Dasgupta et al., 2021) with ISIMIP3a
- Quantify the extent to which changes in labour can be attributed to climate change at the global level but with a **regional focus**
  - Labour supply (number of hours worked)
  - Labour productivity (performance of workers during these hours)
  - Effective labour, a combined metric of these two dimensions
- Heterogeneity across working conditions
  - Low-exposure (labour outside in the shade, or indoors - e.g., manufacturing)
  - High-exposure (outside with no shade - e.g., agriculture and construction)



# Exposure response functions for labour supply

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- Micro surveys from 116 countries for 1971 – 2018
- Responses were aggregated to region-year level using weights from the surveys □ representative at the sub-national level
- A pseudo-panel dataset of nearly 10,000 sub-national regions
- High-exposure: agricultural, hunting, forestry and fishing; construction; and mining
- Low-exposure: manufacturing and utilities
- Panel regressions controlling for both location (sub-national region) and time (survey-year) fixed-effects;



# Exposure response functions for labour productivity

- Five ERFs to assess the impact on labour productivity

Study	Response variable	Spatial scale
M1: Pilcher et al (2002)	Psychological performance e.g., reaction time, tracking or memory tasks	Global
M2: Dunne et al (2013)	Individual capacity to safely perform heavy labour under heat stress	Global
M3: Kjellstrom et al (2014)	Reduction of hourly work capacity for heavy work following the ISO standard	Global
M4: Sahu et al (2013)	Work output per hour of rice farmers calculated by number of rice bundles laid down	India
M5: Li et al (2016)	Time efficiency measures; direct, indirect, and idle time of rebar construction workers	China

- Different nature of the ERFs □ we deploy an augmented mean
- We assume zero impacts for WBGT < 25°C, while for > 25°C, we assume a linear fit with equal weighting of all five ERFs

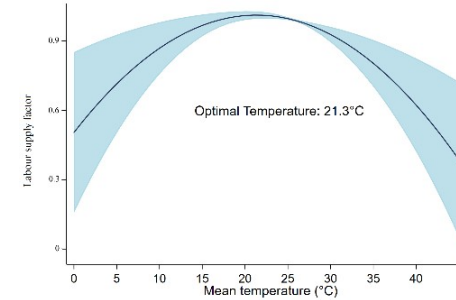
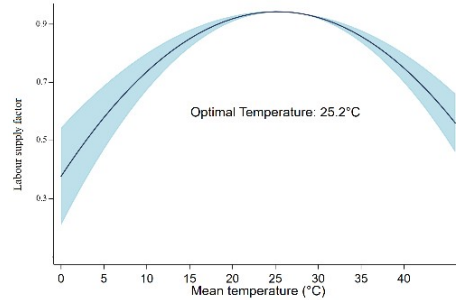


# Temperature - labour supply response functions

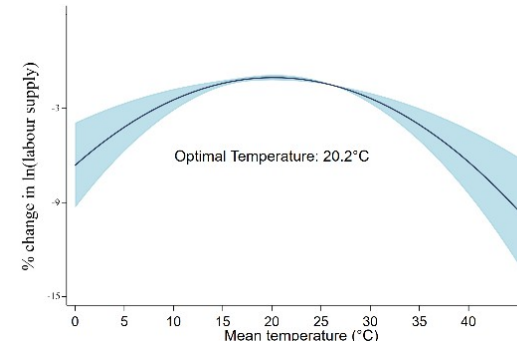
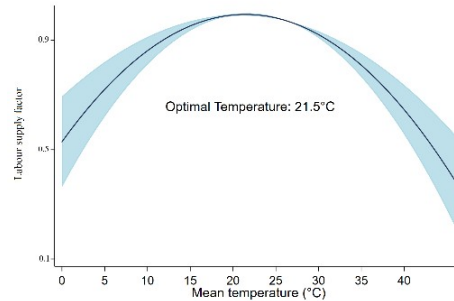
Indoor/outdoor in the shade

Outdoor in the sun

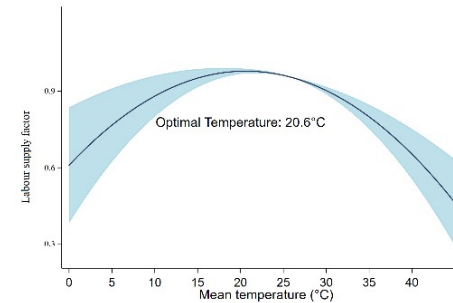
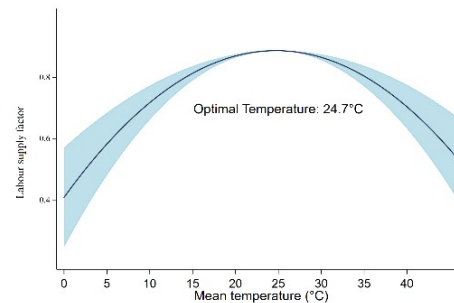
Africa



Asia



Americas

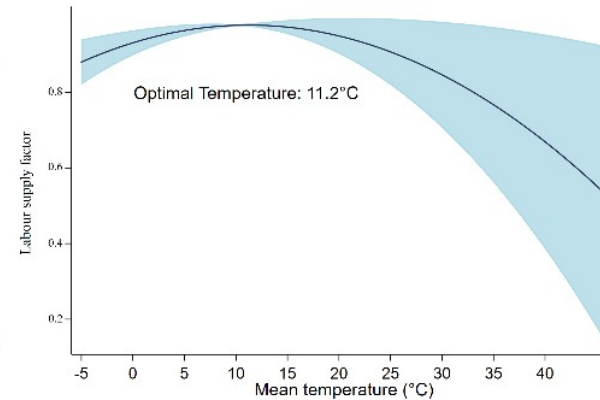
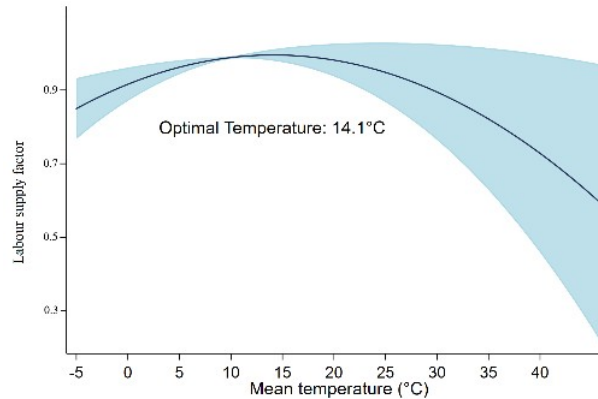


# Temperature - labour supply response functions

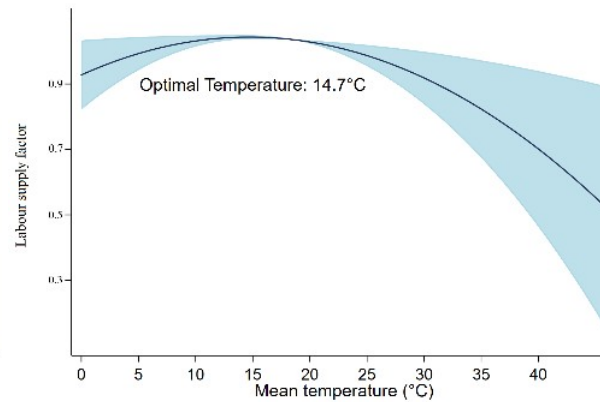
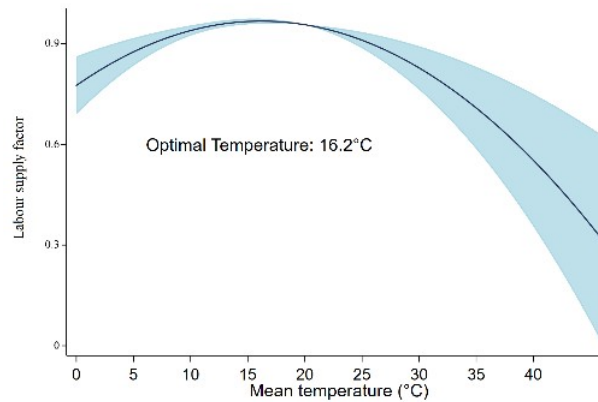
Indoor/outdoor in the shade

Outdoor in the sun

Europe



Global

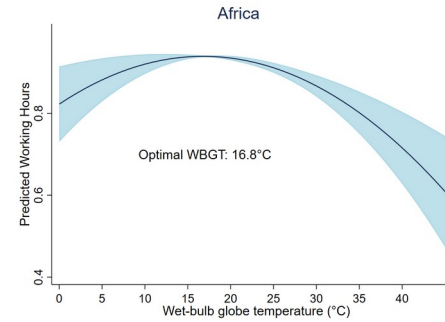
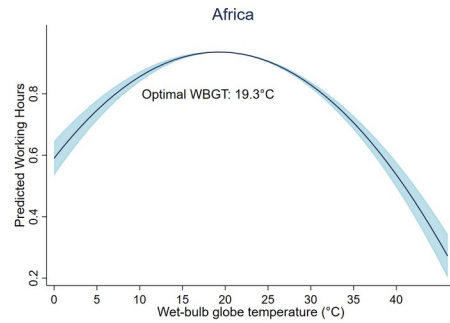


# WBGT - labour supply response functions

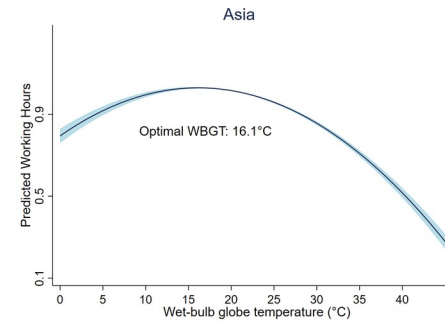
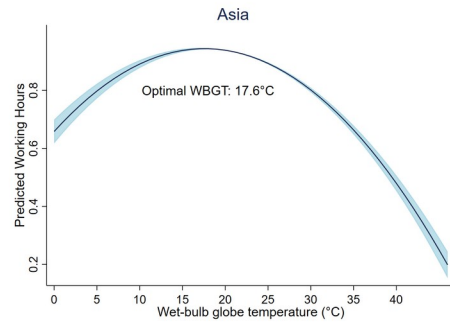
Indoor/outdoor in the shade

Outdoor in the sun

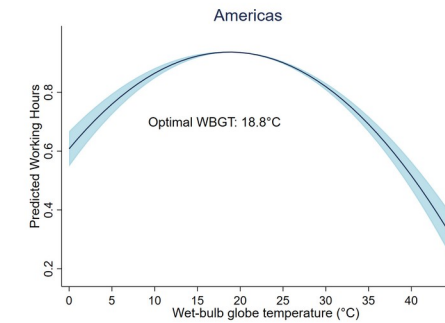
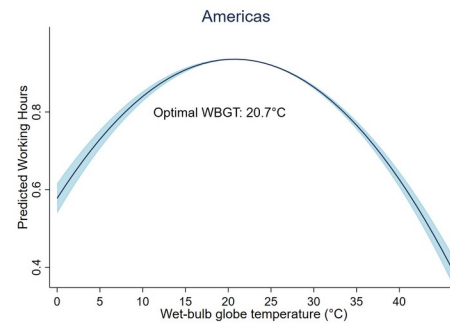
Africa



Asia



Americas



- Stull (2011) method to quantify WBGT
- Hobbs (1977) and Salby (1996) to compute RH

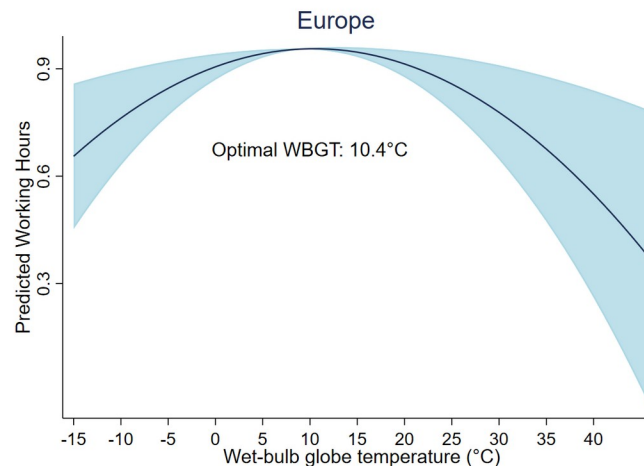
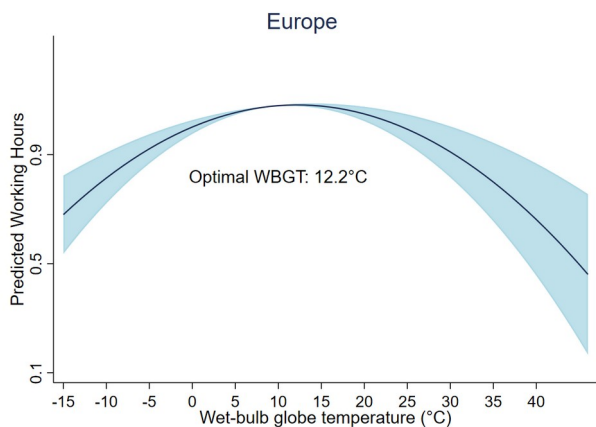


# WBGT - labour supply response functions

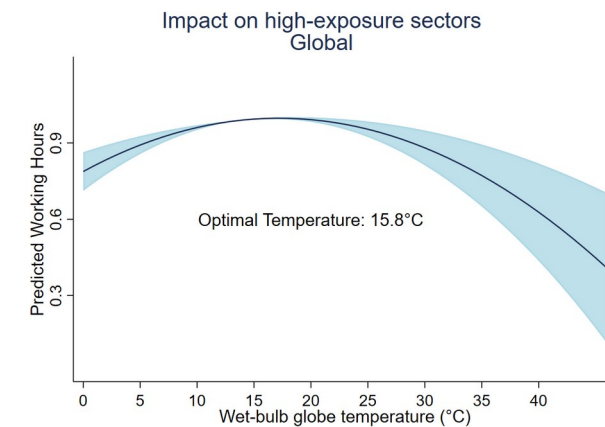
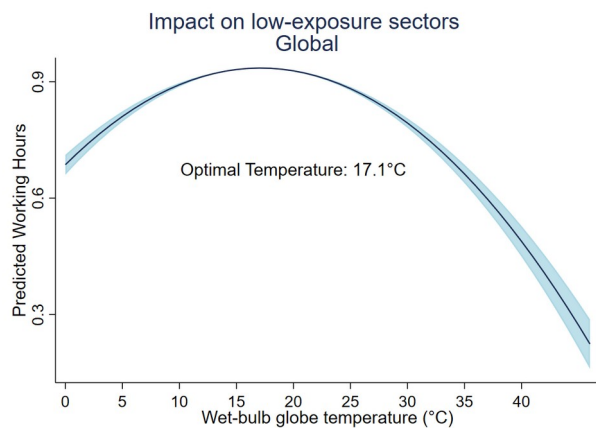
Indoor/outdoor in the shade

Outdoor in the sun

Europe

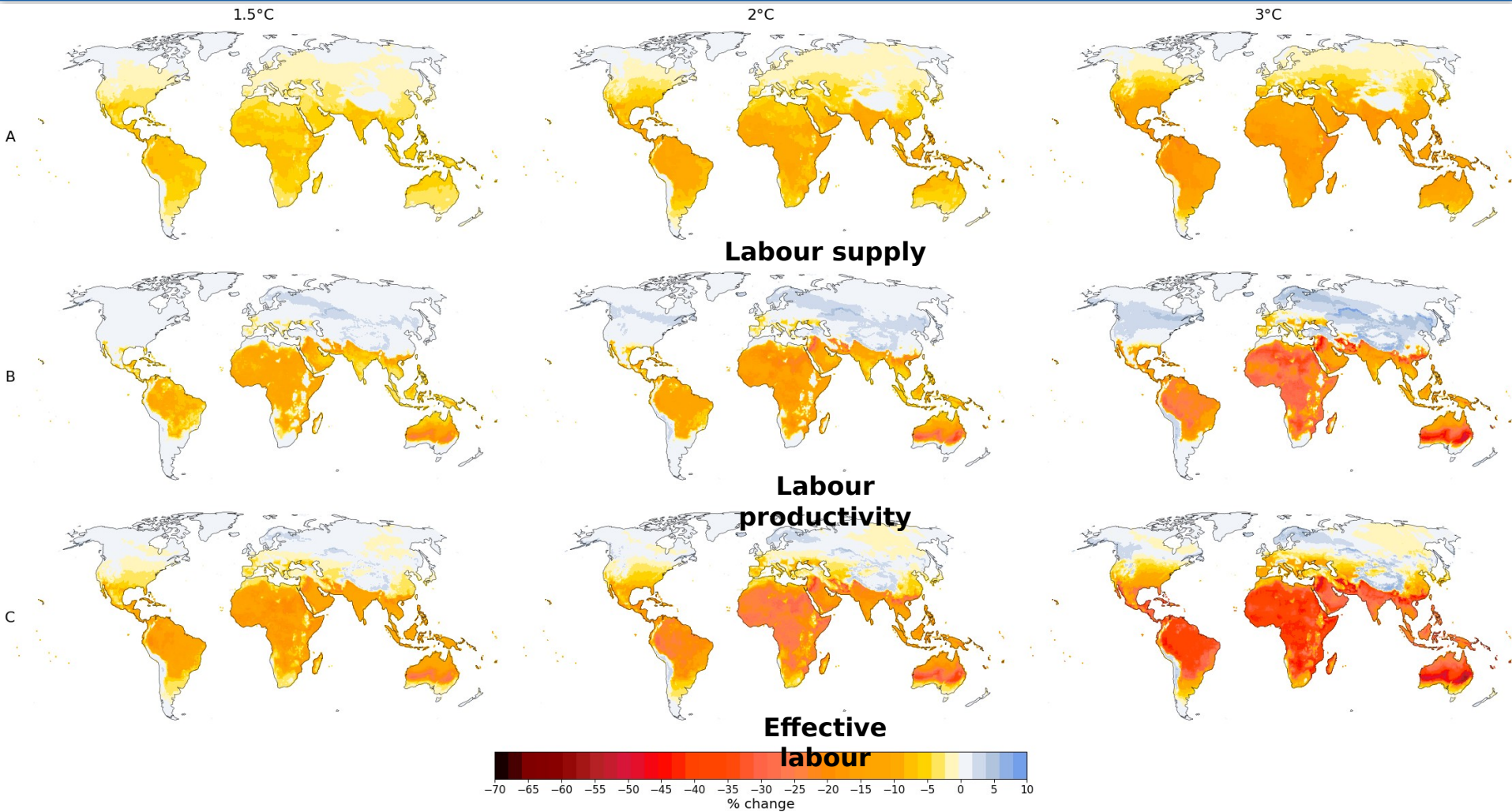


Global

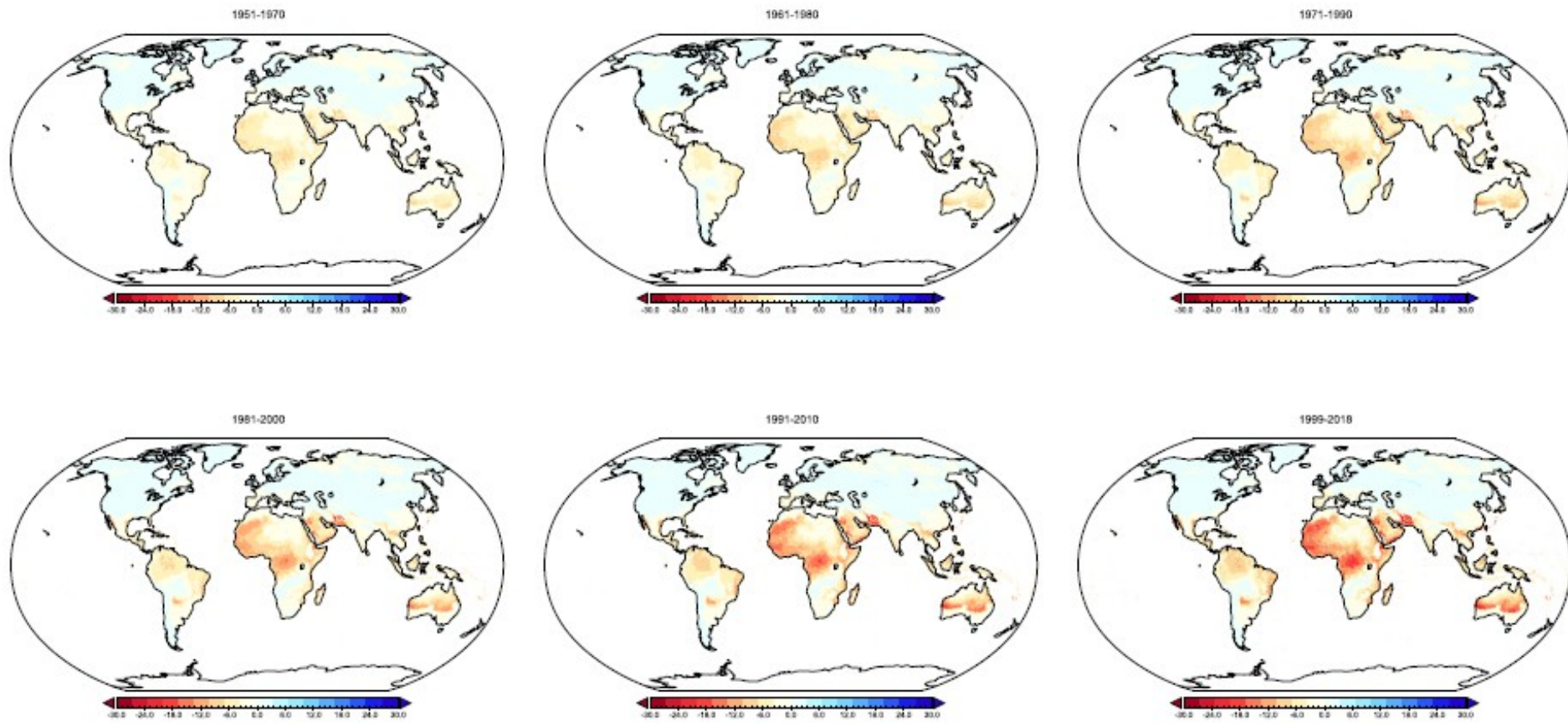




# Future impacts: outdoor in the sun



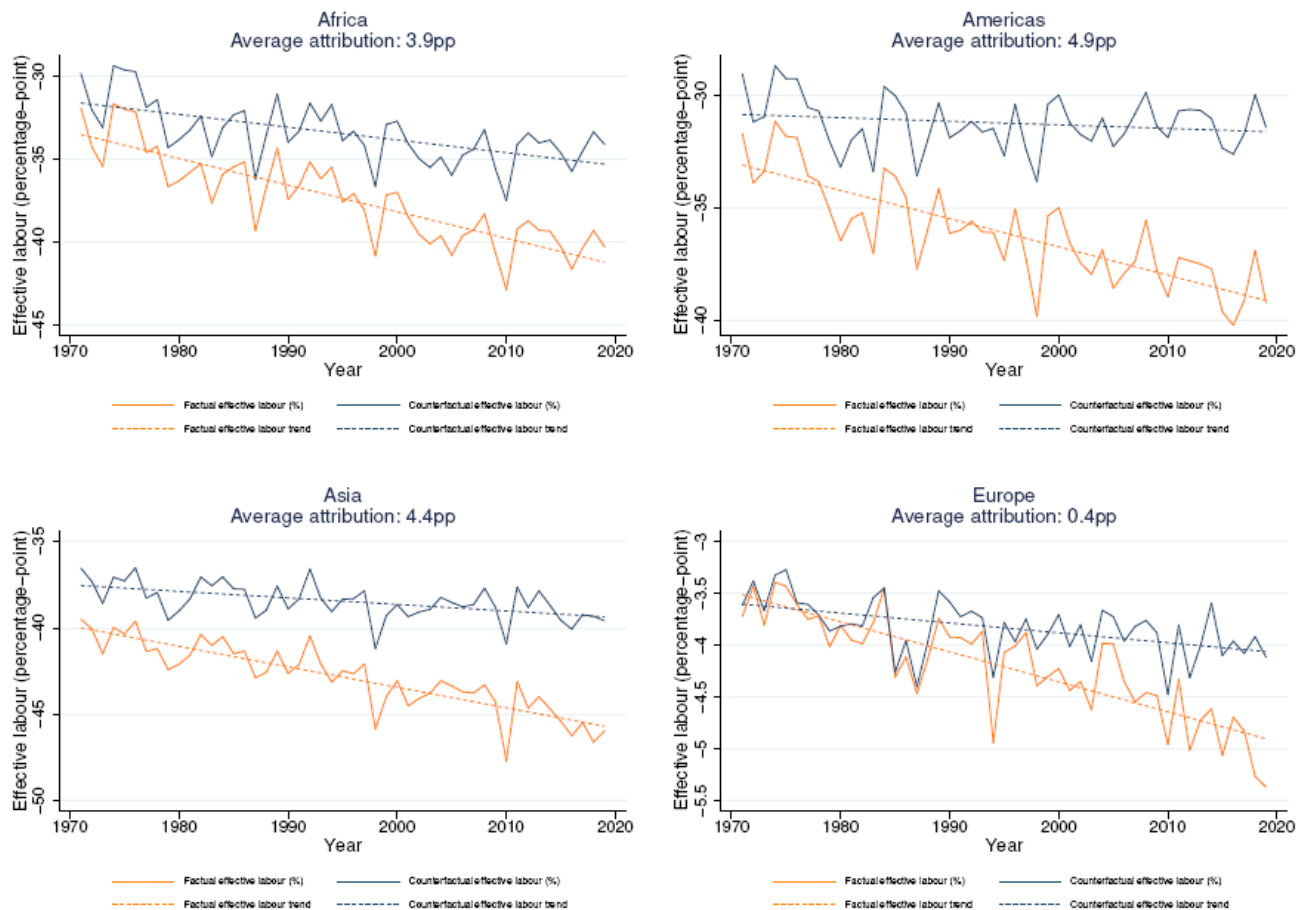
# Attribution: effective labour outdoor in the sun (temperature)



- Effective labour in high-exposure and outdoor working conditions was 1.3 percentage-point lower in 1951-1970 compared to a no climate change scenario
- **3.1 percentage points lower in 1998-2018**



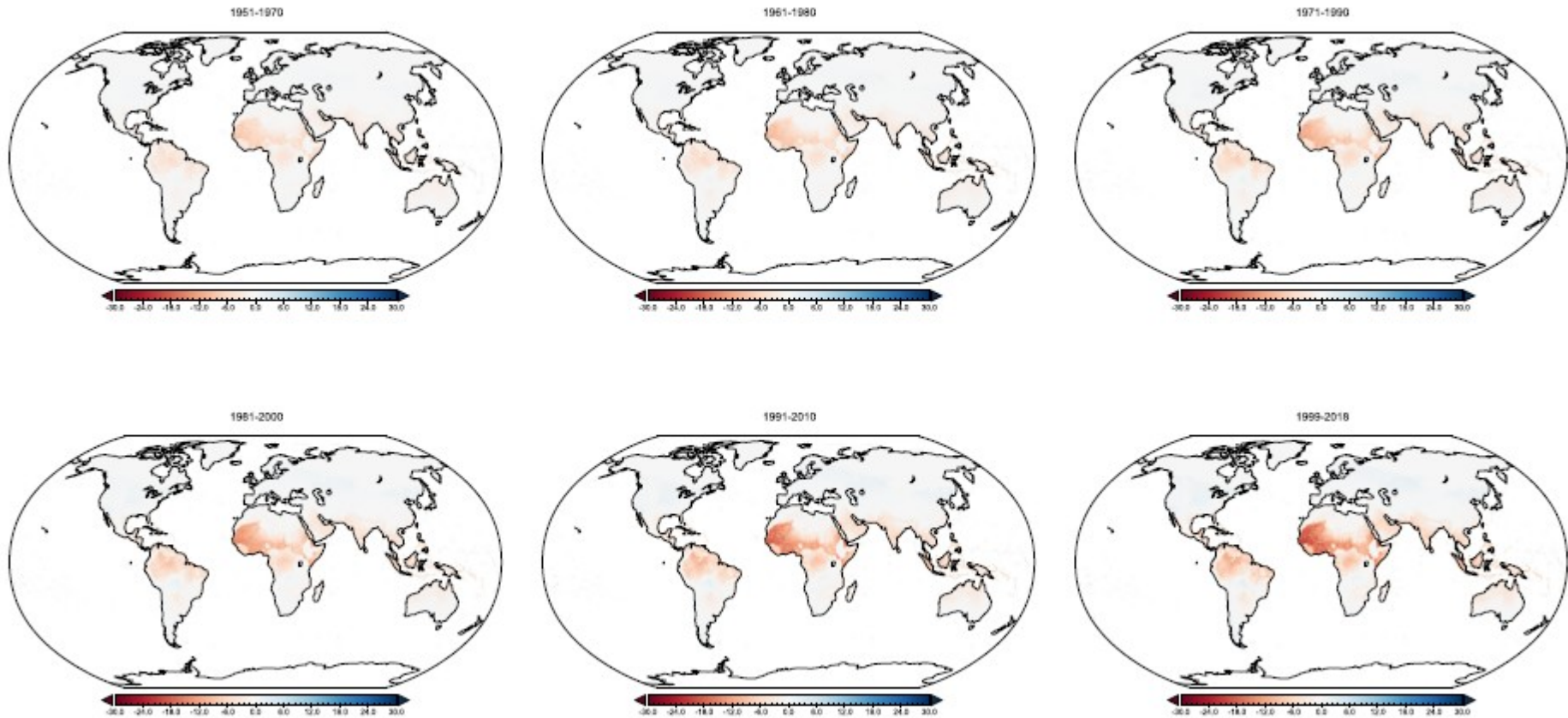
# Attribution: effective labour outdoor in the sun (temperature)



- Highest impacts in South Asia (4.9 percentage points) and sub-Saharan Africa (4.6 percentage points)



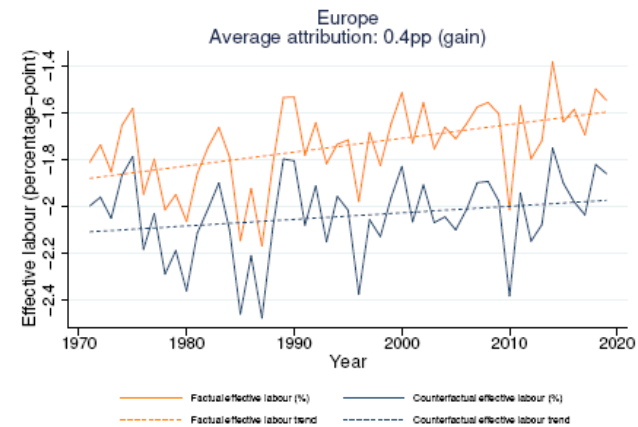
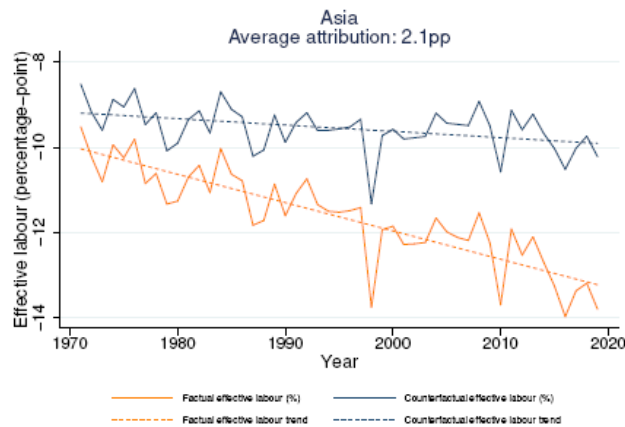
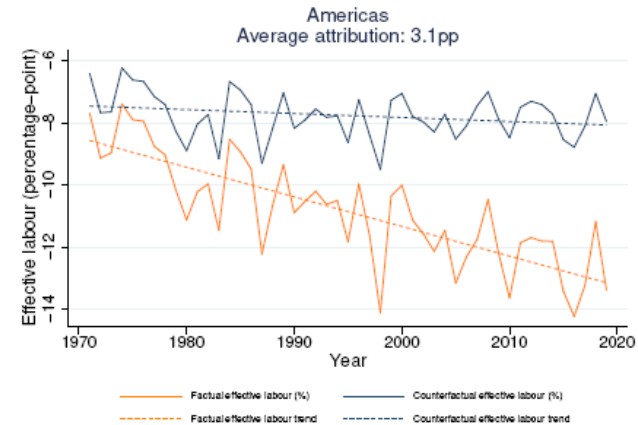
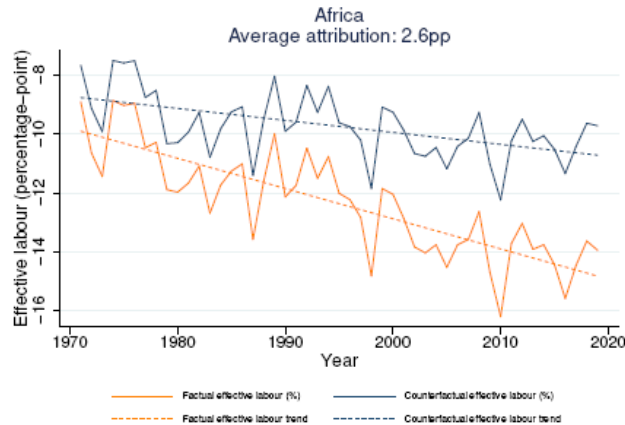
# Attribution: effective labour indoor (temperature)



- Lower impacts in the low-exposure sectors



# Attribution: effective labour outdoor in the sun (temperature)



# Discussion and next steps

- Clear and robust evidence that reductions in labour outcomes due to heat stress can be attributed to historical climate change
- To do: weight by population □ results will change slightly
- Attributing climate impacts on labour has implications for policymakers and employers in the context of labour protection regulations and workers' health
- Especially for those working in high-exposure sectors
- **Starting point for the estimation of loss and damage**
- Implications for policymakers and the labour force adjustments
  - Mechanisation and transition pathways (agricultural and construction) might help with labour shortages exacerbated by heat stress
  - Work-time shifting – unintended consequences, exposure to vector-borne diseases, and lack of sleep □ maladaptation
  - More data on health implications – kidney and cardiovascular diseases
  - How do companies adapt?
  - How about regulations?
- **It is complicated – priorities and incentives may not align**



# Thank you!

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