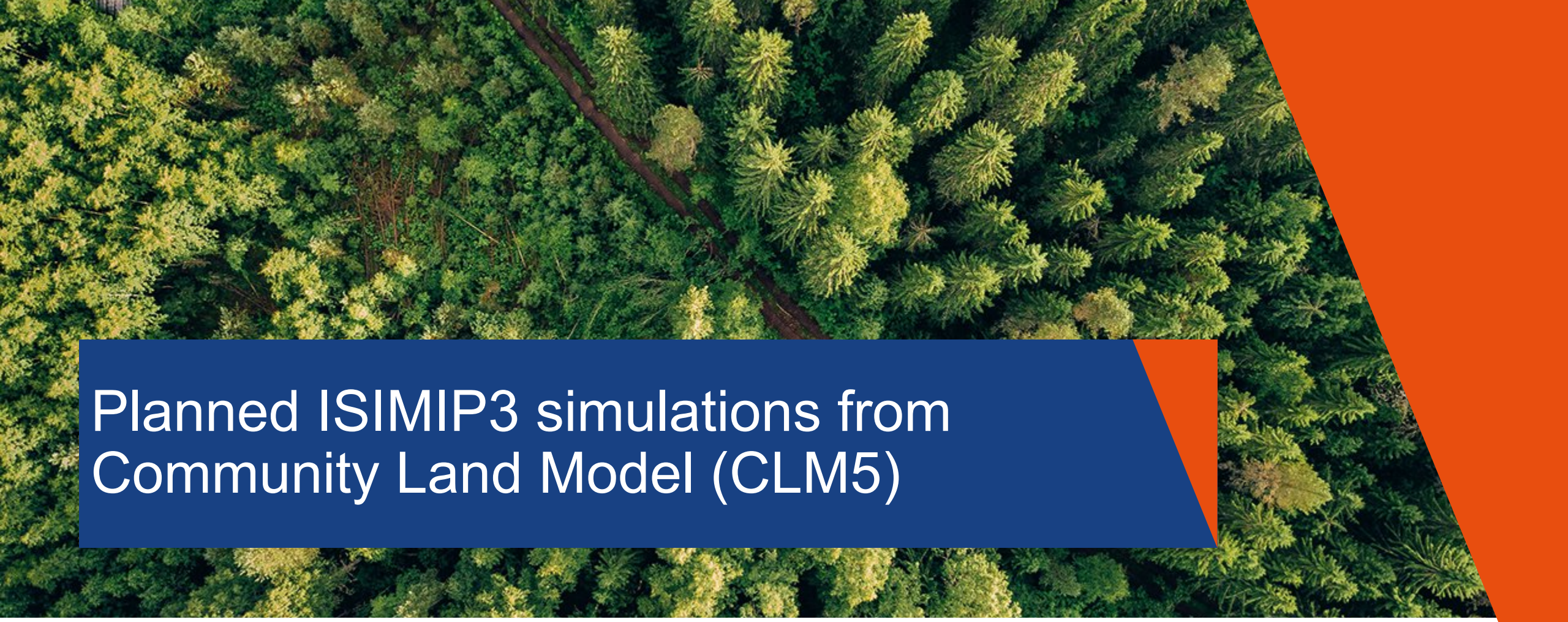


Planned ISIMIP3 simulations from Community Land Model (CLM5)

VRIJE UNIVERSITEIT BRUSSEL

WATER AND CLIMATE DEPARTMENT

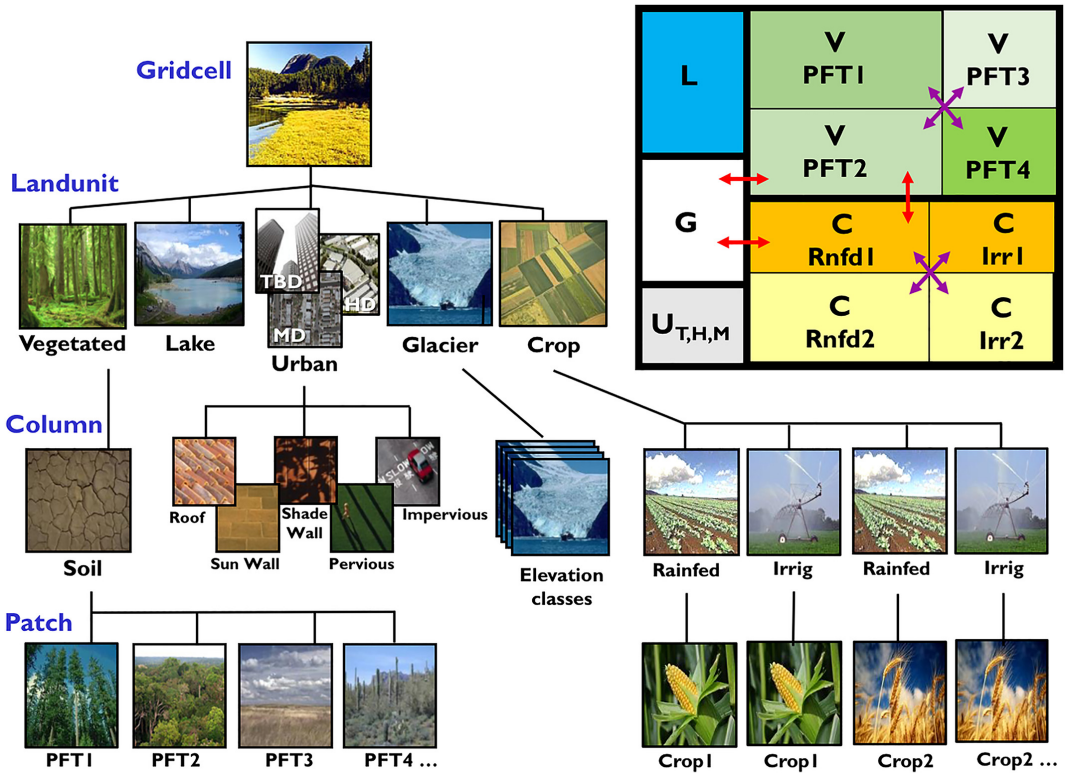
Greta Shum

ISIMIP/ OptimESM Workshop 2025, PIK

07 May 2025

Climate | Resilience | Europe
SPARCCLE

CLM5 as a land surface model



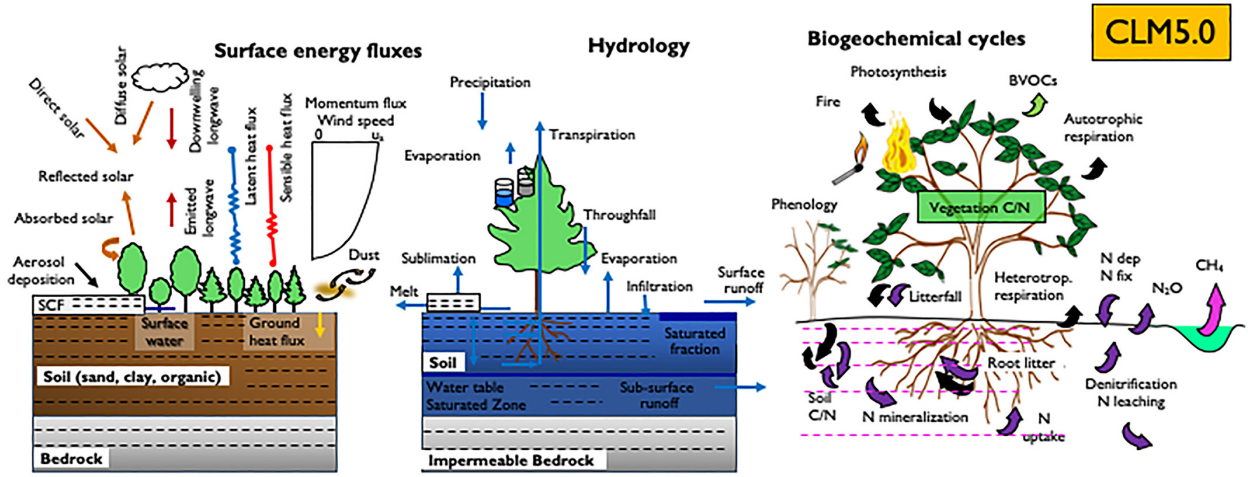
- Global land surface model, land component part of CESM
- Land cover: forests, crops, wetlands, lakes, urban areas; Land cover adapted to CLM Plant Functional Types (PFTs)

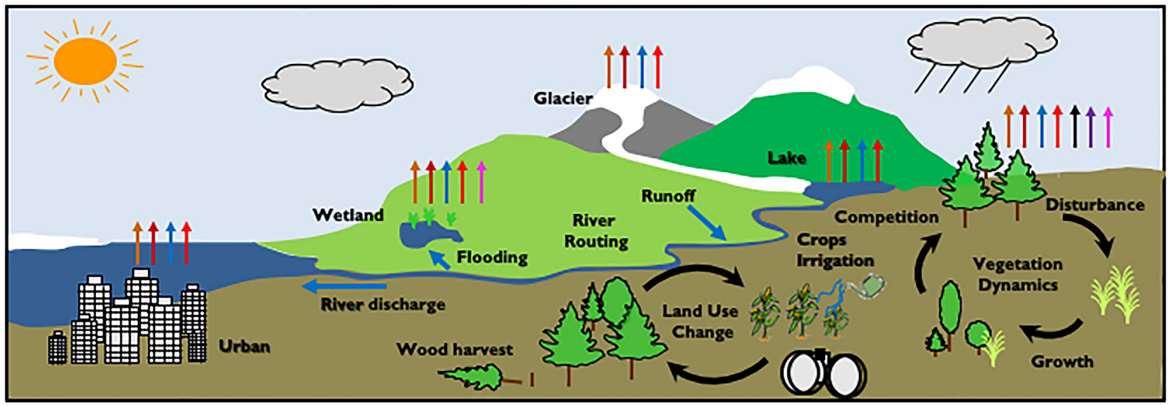
greta.shum@vub.be

Lawrence et al. 2019

CLM5 as ~~a land surface~~ an impact model

- Global land surface model (part of CESM)
- Land cover: forests, crops, wetlands, lakes, urban areas; Land cover adapted to CLM Plant Functional Types (PFTs)
- Simulates energy, water, carbon, and nitrogen cycles
- Produces self-consistent outputs across sectors (water, carbon, energy, nutrients)





greta.shum@vub.be

CLM5 as an cross-sectoral impact model

- Agriculture ☾ crop growth and phenology, irrigation demand, fertilizer application, nitrogen cycling, limitation; management practices (e.g. planting/harvest dates)
- Biomes ☾ ecosystem carbon, nitrogen, phosphorus cycling, GPP, respiration, litterfall, plant-soil nutrient fluxes, canopy interception, stomatal closure, water use efficiency
- Groundwater ☾ soil column (up to 8.5 m, 25 layers), infiltration, surface and sub-surface runoff, gradient diffusion, gravity, and canopy transpiration through root extraction
- Global Water ☾ terrestrial water storage, snow accumulation and melt, canopy interception, infiltration, surface and subsurface runoff, river routing, evapotranspiration (from canopy to ground ice)
- Fire (+ Peat) ☾ non-peat fires outside cropland and tropical closed forests, agricultural fires in cropland, deforestation fires in the tropical closed forests, and peat fires; BA is affected by climate and weather conditions, vegetation composition and structure, and human activities
- Permafrost ☾ freeze/thaw cycles and active layer depth, explicitly simulates thermal and hydrological effects of soil freezing and thawing, as well as the effects of organic matter on soil insulation
- Global Lakes ☾ lake energy balance, water temperature, ice cover, lake hydrology (inflow/outflow), and coupling with river networks

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- **Labour/Health ☾ (sub-daily) calculation of Wet Bulb Globe Temperature and other operational workplace heat stress metrics from temperature, humidity, and radiation in all land grid cells (urban + rural)**

greta.shum@vub.be

Emerging recognition of need to include metrics of humidity and solar radiation in projections of heat stress (for health and labour impacts)

J Appl Physiol 137: 312–328, 2024.
First published June 13, 2024; doi:10.1152/japplphysiol.00613.2023

american physiological society | JOURNAL OF APPLIED PHYSIOLOGY

RESEARCH ARTICLE

Comparing the efficacy of different climate indices for prediction of labor loss, body temperatures, and thermal perception in a wide variety of warm and hot climates

George Havenith,[1] James W. Smallcombe,[1,2] Simon Hodder,[1] Ollie Jay,[2] and Josh Foster[1,3]
[1]Environmental Ergonomics Research Centre, School of Design and Creative Arts, Loughborough University, Loughborough, United Kingdom; [2]Heat and Health Research Incubator, University of Sydney, Sydney, New South Wales, Australia; and [3]Faculty of Life Sciences & Medicine, Centre for Human and Applied Physiological Sciences, King's College London, London,

ENVIRONMENTAL RESEARCH LETTERS

LETTER • OPEN ACCESS

Global labor loss due to humid heat exposure underestimated for outdoor workers

Luke A Parsons, Yuta J Masuda, Timm Kroeger, Drew Shindell, Nicholas H Wolff and June T Spector

Published 13 January 2022 • © 2022 The Author(s). Published by IOP Publishing Ltd
Environmental Research Letters

PNAS RESEARCH ARTICLE | ENVIRONMENTAL SCIENCES OPEN ACCESS

Greatly enhanced risk to humans as a consequence of empirically determined lower moist heat stress tolerance

Daniel J. Vecellio[a,1,2], Qinqin Kong[b,1], W. Larry Kenney[a,c,d], and Matthew Huber[b]

Edited by Kerry Emanuel, Massachusetts Institute of Technology, New Harbor, ME; received April 3, 2023; accepted August 15, 2023

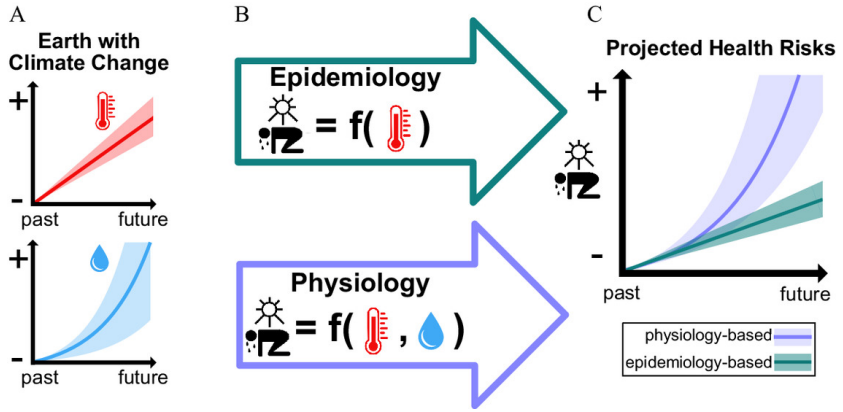
Commentary

A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP11807.

Humidity's Role in Heat-Related Health Outcomes: A Heated Debate

Jane W. Baldwin,[1,2] Tarik Benmarhnia,[3] Kristie L. Ebi,[4] Ollie Jay,[5] Nicholas J. Lutsko,[3] and Jennifer K. Vanos[6]

[1]Department of Earth System Science, University of California, Irvine, Irvine, California, USA
[2]Lamont-Doherty Earth Observatory, Palisades, New York, USA
[3]Scripps Institution of Oceanography, University of California, San Diego, San Diego, California, USA
[4]Center for Health and the Global Environment, University of Washington, Seattle, Washington, USA
[5]Thermal Ergonomics Laboratory, Heat and Health Research Incubator, Faculty of Medicine and Health, University of Sydney, Camperdown, New South Wales, Australia
[6]School of Sustainability, Arizona State University, Tempe, Arizona, USA



Implemented “online” sub-daily calculation of heat stress metrics that include humidity and radiation

Variable long name
Wet Bulb Globe Temperature
Wet Bulb Globe Temperature Above Canopy
Wet Bulb Globe Temperature Below Canopy
Humidex
NWS Heat Index
Apparent Temperature
Wet Bulb Temperature
Discomfort Index
Temperature Humdity Index Comfort
Swamp Cooler Temperature 65% Eff
Swamp Cooler Temperature 80% Eff

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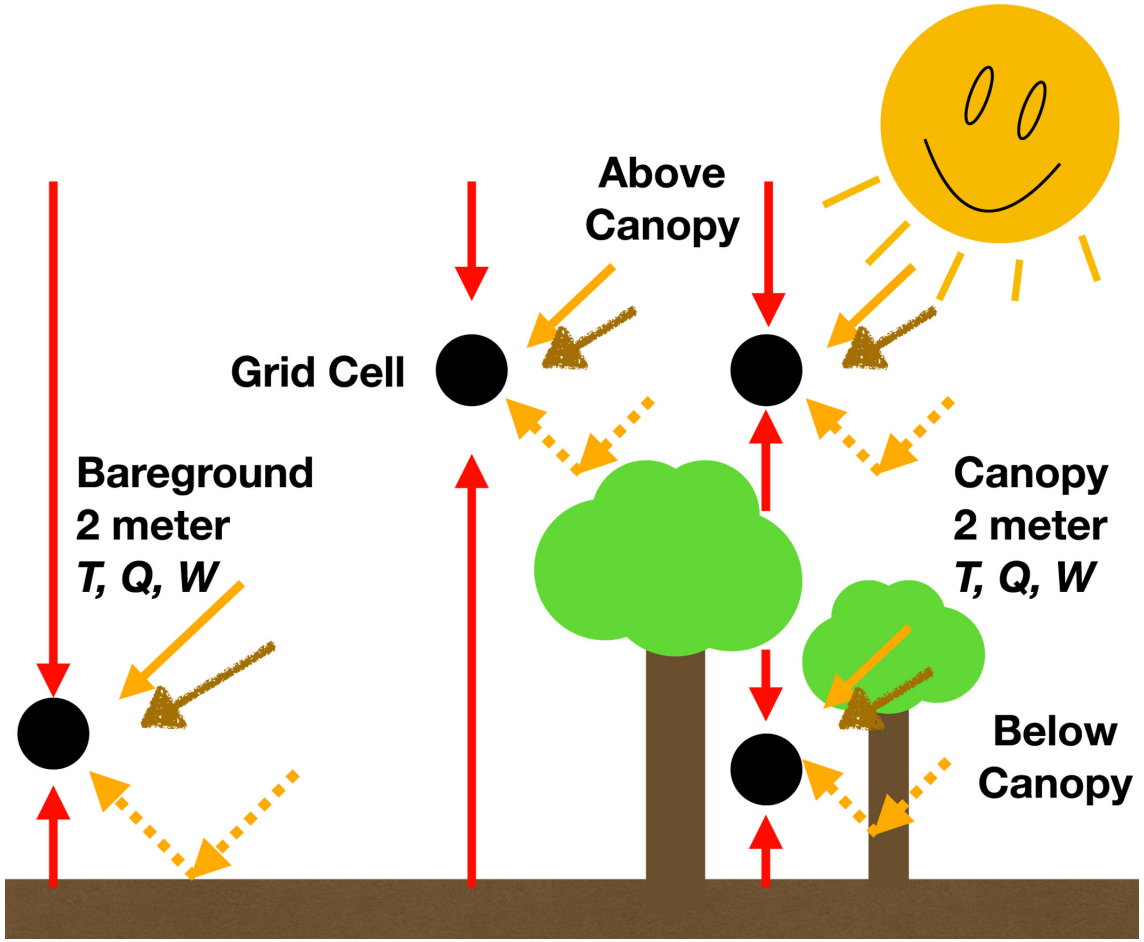

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Simplified WBGT assumes direct sun exposure and overestimates heat stress.

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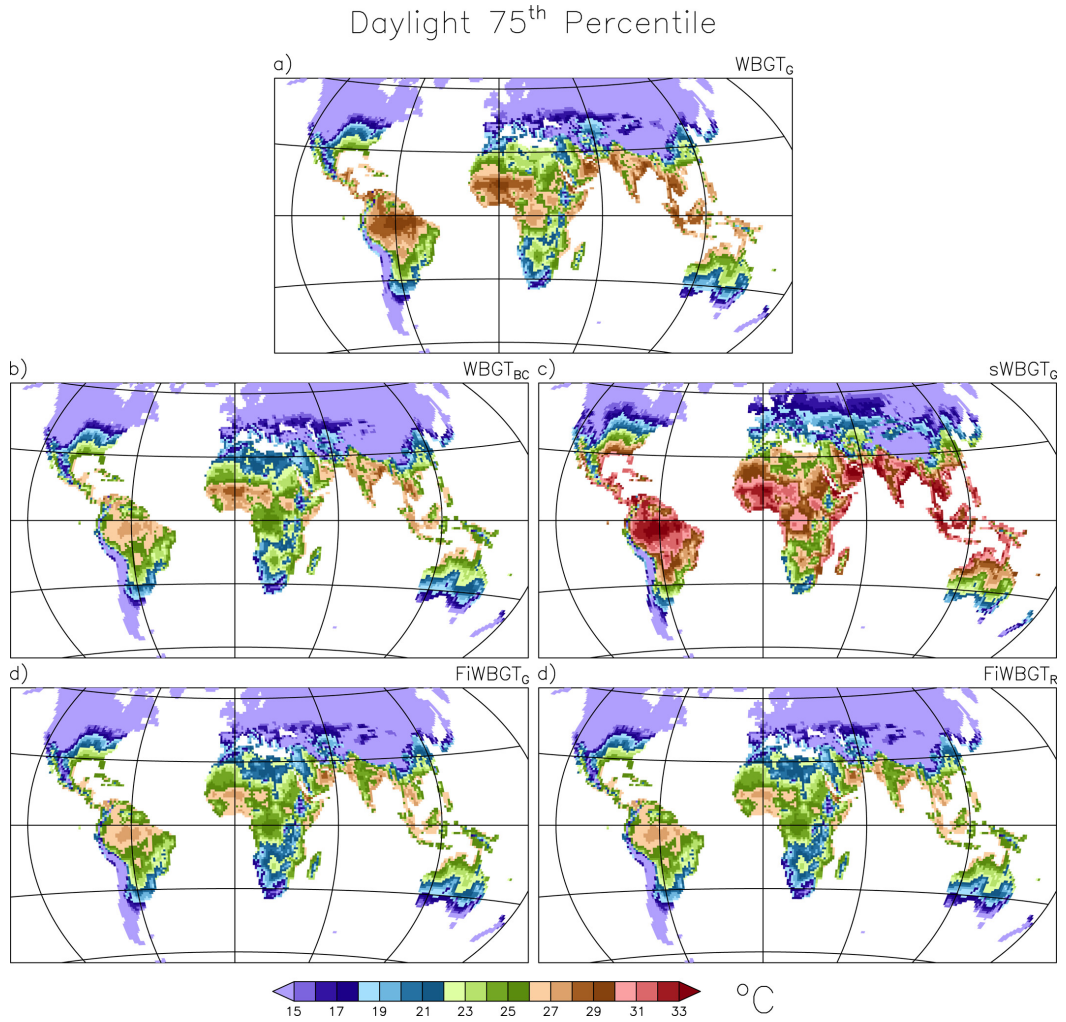

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Added metrics illuminate climate impact on labour and health economies

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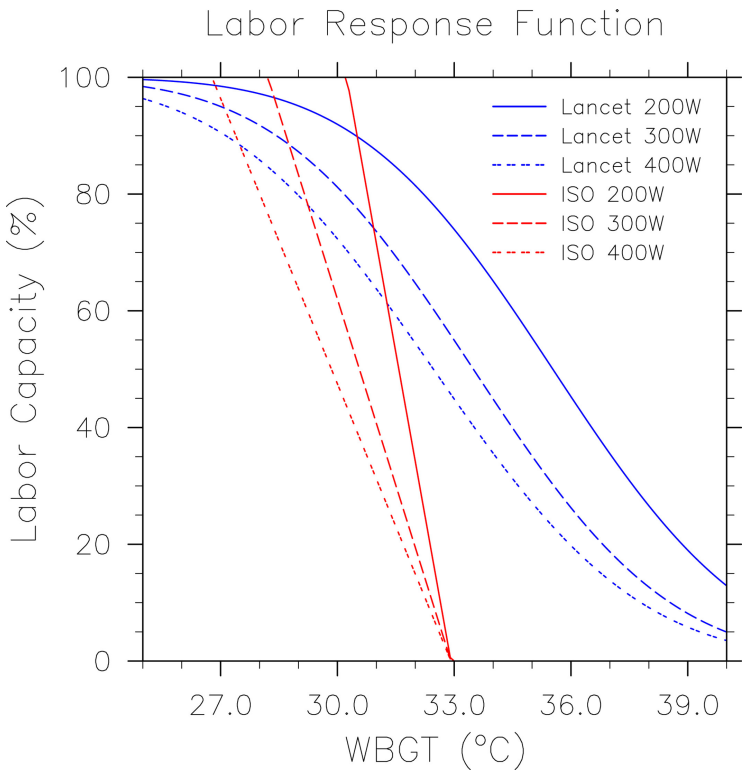

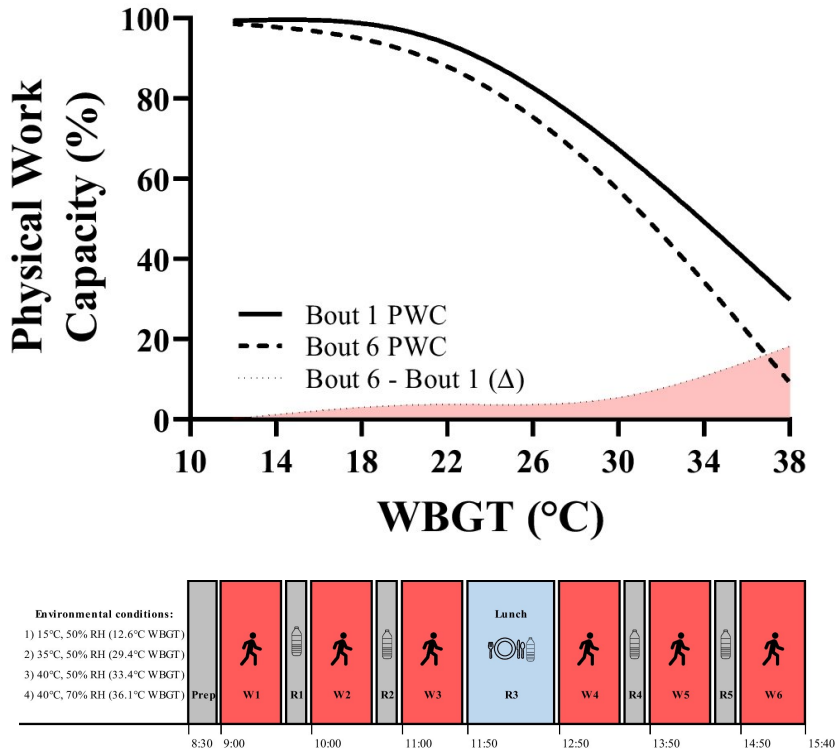

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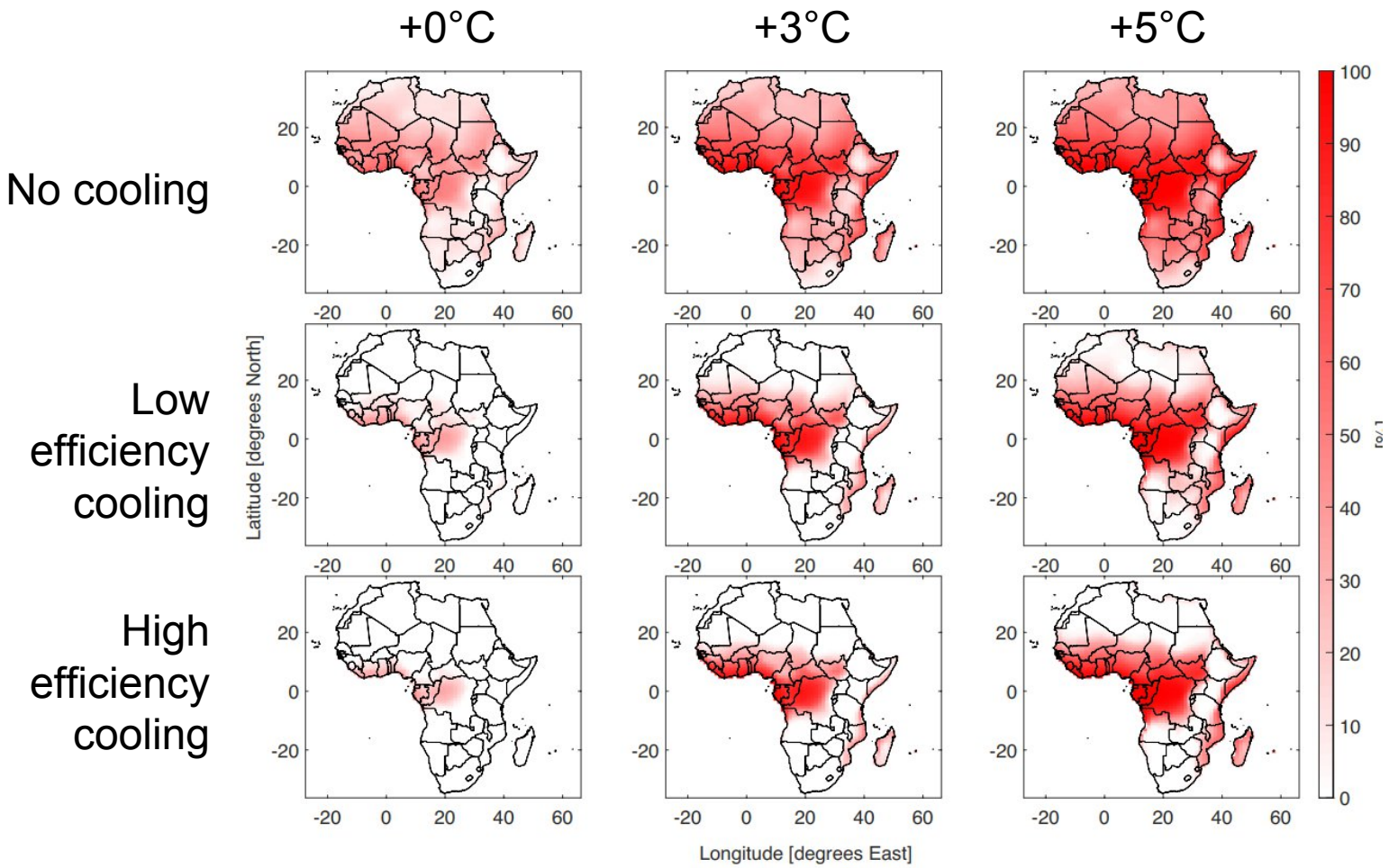
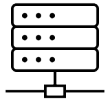


VUB WATER AND CLIMATE DEPARTMENT
greta.shum@vub.be

Parkes et al. 2022

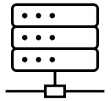
Experimental Setup and Workflow



Flemish Supercomputing System (VSC)

greta.shum@vub.be

Experimental Setup and Workflow



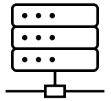
Flemish Supercomputing System (VSC)

Preprocessing →

- Disaggregate daily forcing to 3-hourly
- Convert land surface type to CLM: 19 plant functional types, 8 actively managed crop types (rainfed and irrigated)
- Add custom output variables for sector-specific needs

greta.shum@vub.be

Experimental Setup and Workflow



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- 81 confirmed variables across 10 sectors (49 at pft-level)
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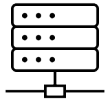

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  - Raw output ~ 23 Tb
  - ☾ 2.74 Pb + sens. expts.

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Experimental Setup and Workflow

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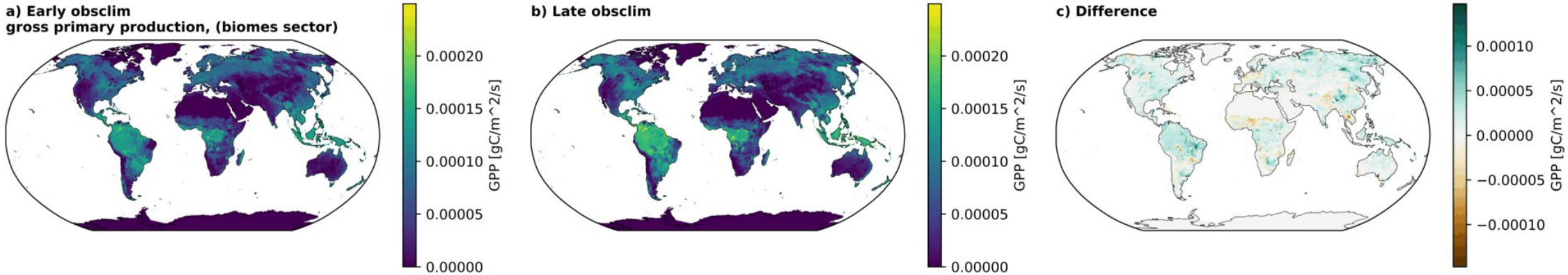

greta.shum@vub.be

Please reach out if you have variable requests!

greta.shum@vub.be

Thank you!