



Martina Anna Maggioni

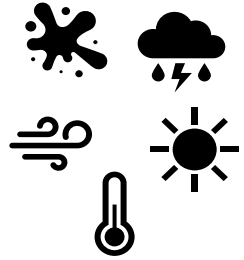
Charité-Universitätsmedizin Berlin, Berlin Germany

Research-grade wearables to assess the impact of extreme heat on residual labour capacity in subsistence farmers in Burkina Faso



Institute of Physiology | Charité Center for Global Health

Background



23°C-28°C => strong heat stress
28°C-30°C => extreme heat stress

WBG
Wet Bulb Globe Temperature

WBG heat exposure				
28.2	29.3	30.4	31.6	(°C)
60 min/hr	45 min/hr	30 min/hr	15 min/hr	0 min/hr
83	85	87	89	(°F)
Hourly work capacity for an acclimatised worker, carrying out moderate activity (300W)				



Environmental
Stress

Heat Stress



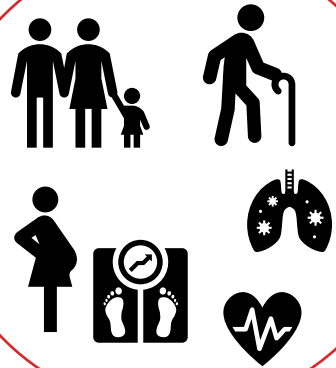
Heat Strain



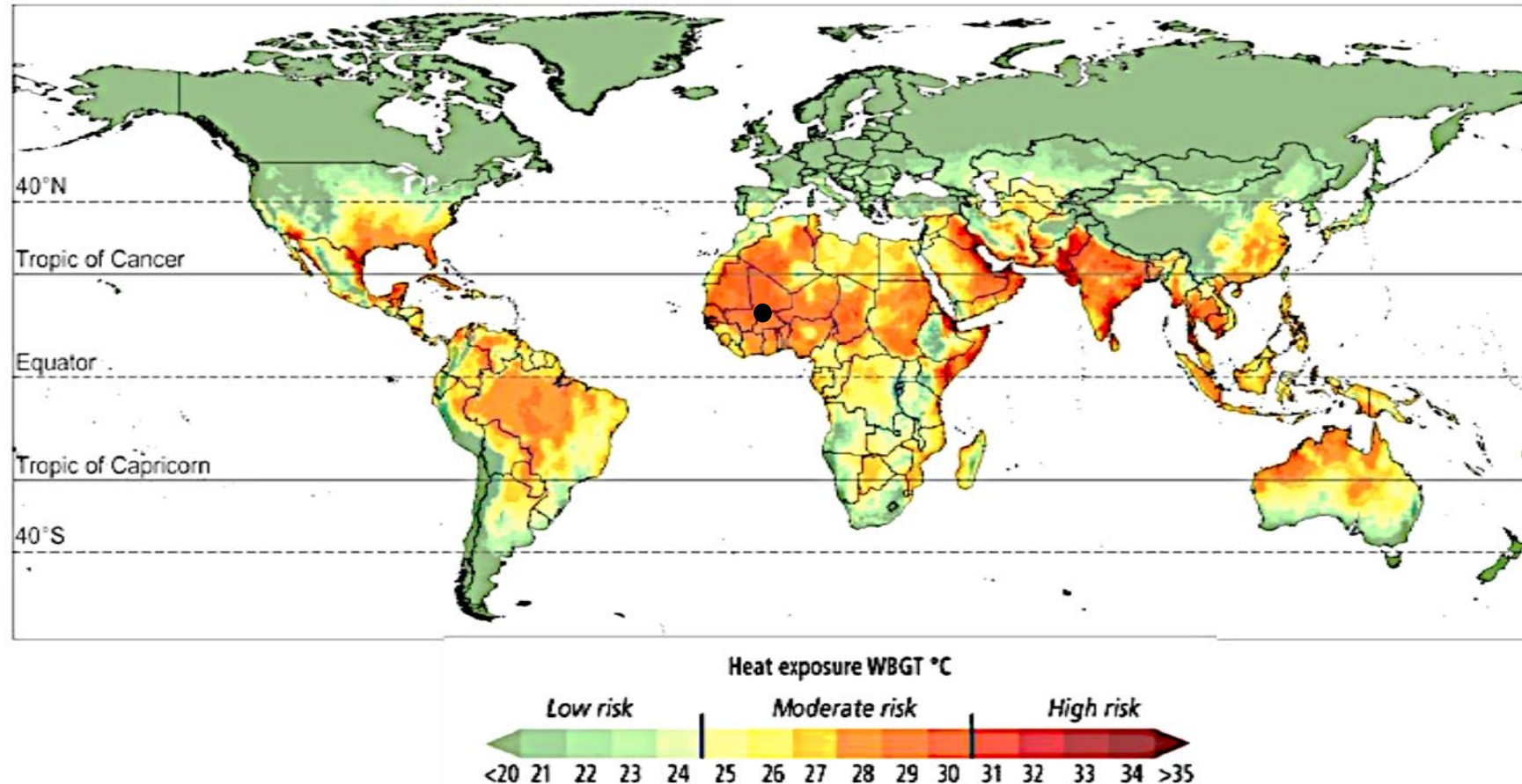
PSI
Physiological Strain Index

Individual
Response

Labor Capacity



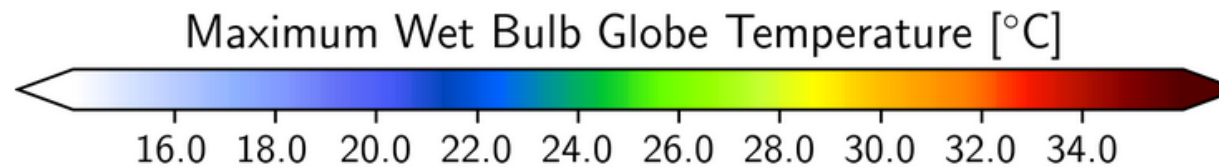
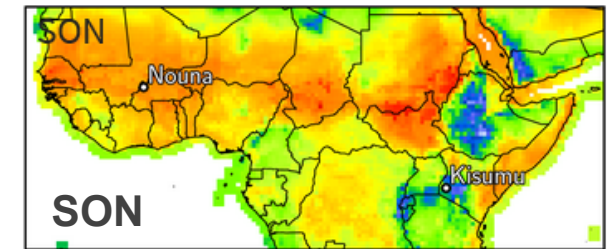
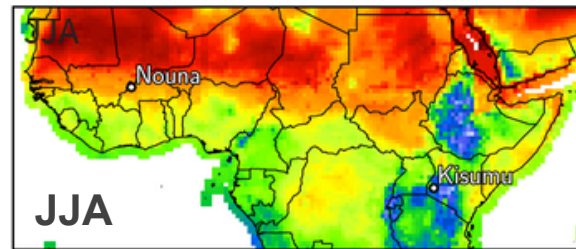
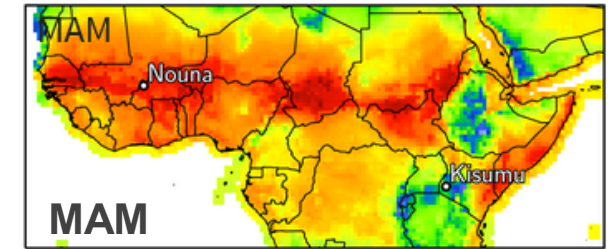
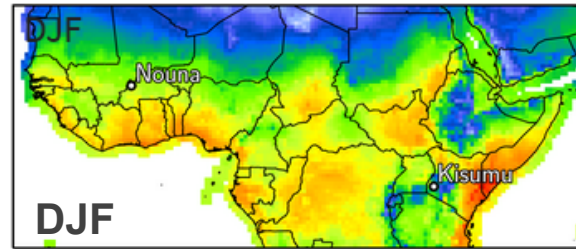
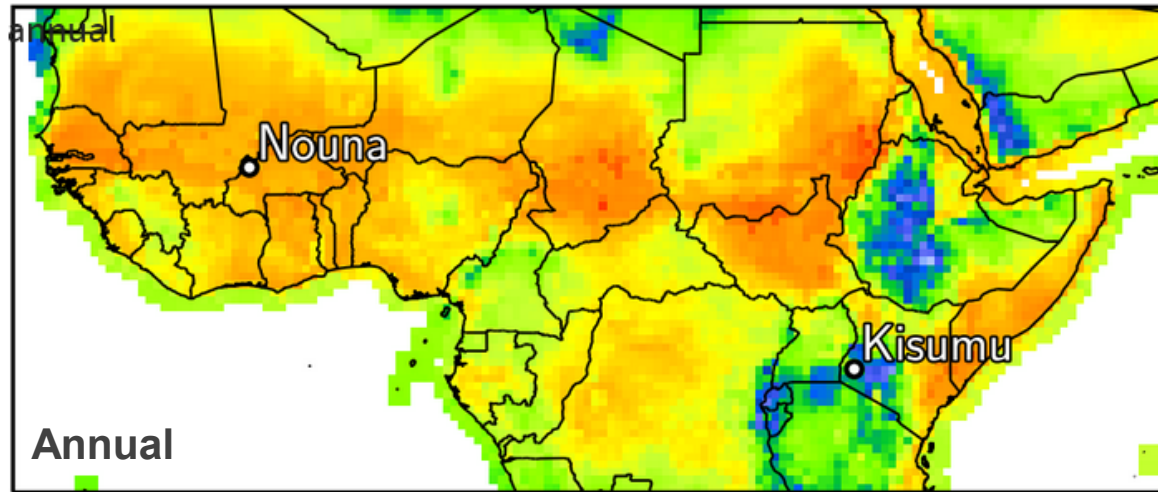
Background II - Climate change and heat stress 1980-2009



The **1980–2009** average wet bulb globe temperatures (**WBGT**) of the hottest months globally

(Adapted from Smith et al. 2014)

Background II - Climate change and heat stress- now in the century 2001-2030

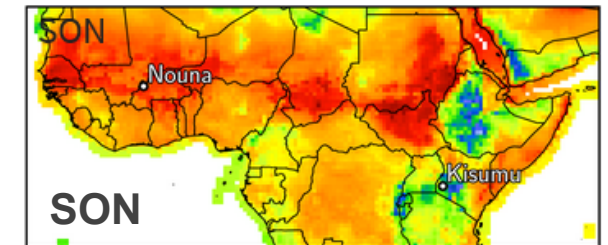
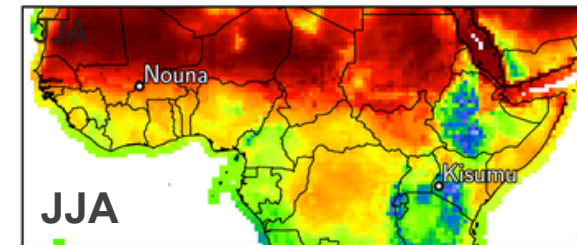
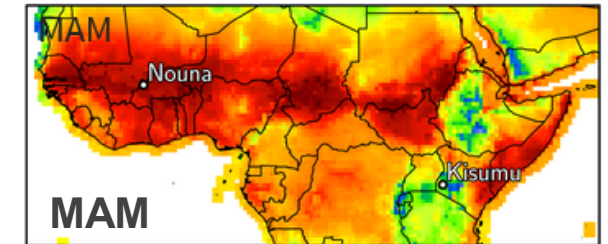
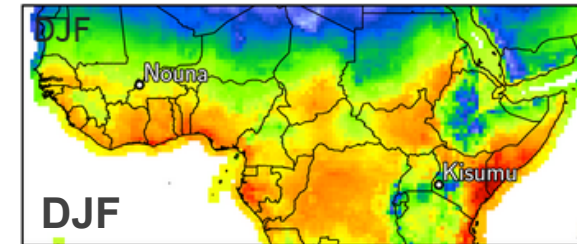
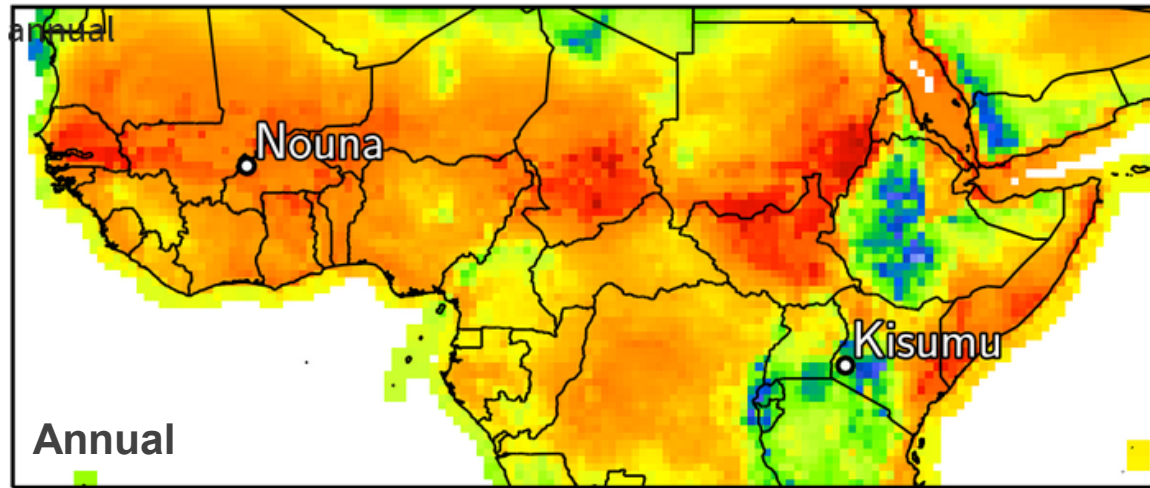


Climate Change and Health in
sub-Saharan Africa

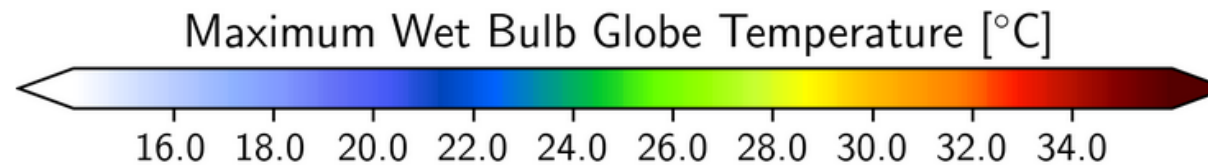


FOR 2936 DFG: Climate Change and Health in Sub Saharan Africa
unpublished data: Frieler K , Hattermann F and Maggioni MA

Background II - Climate change and heat stress- mid of the century 2031-2070



ISMIP3b (SSP 26-Low increase of GHG = below 2°C rise since 1850)

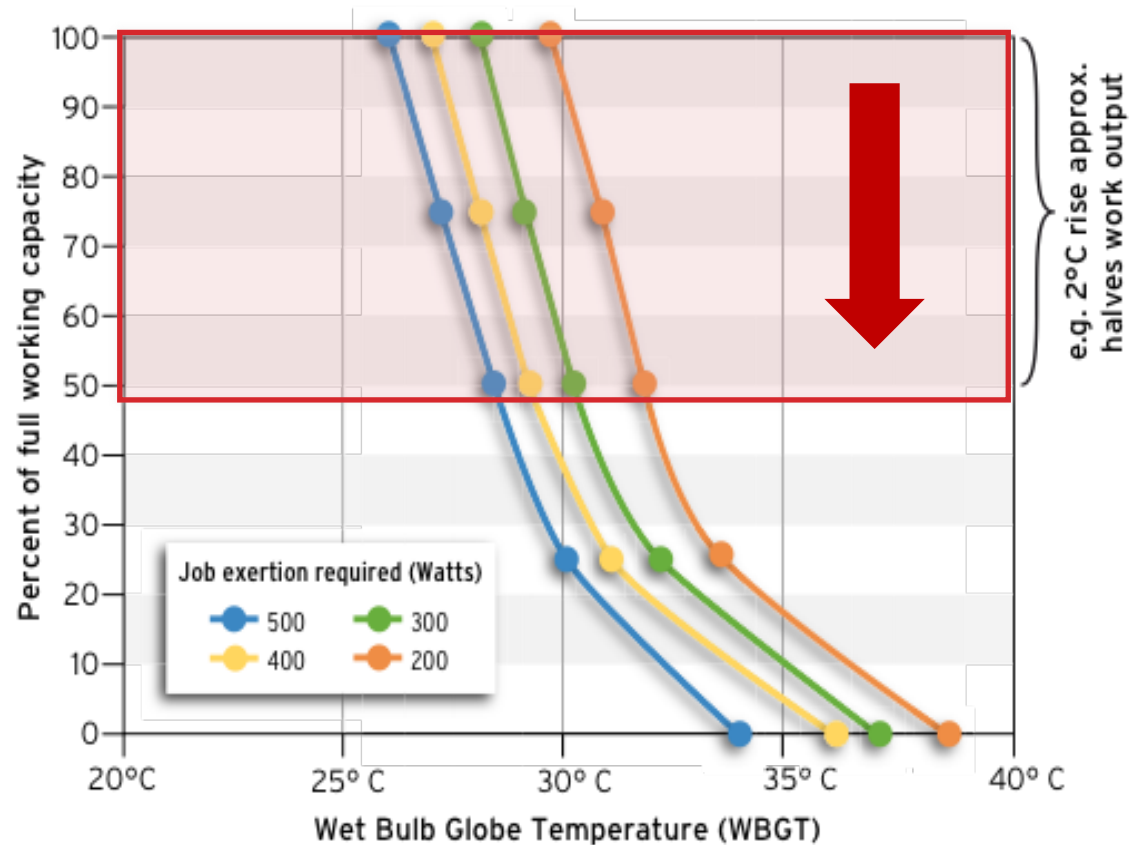


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Heat stress, environmental monitoring and labor



Percent of full working capacity with changing WBGT and different workloads- 200 to 500 Watts
(adapted from Smith et al. 2014)

Continuous indoor and outdoor monitoring of **WBGT**
(12 months)



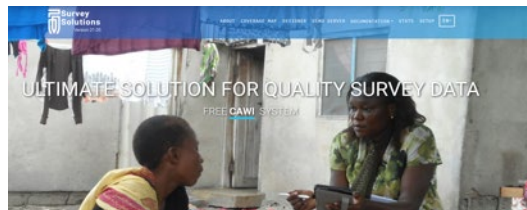
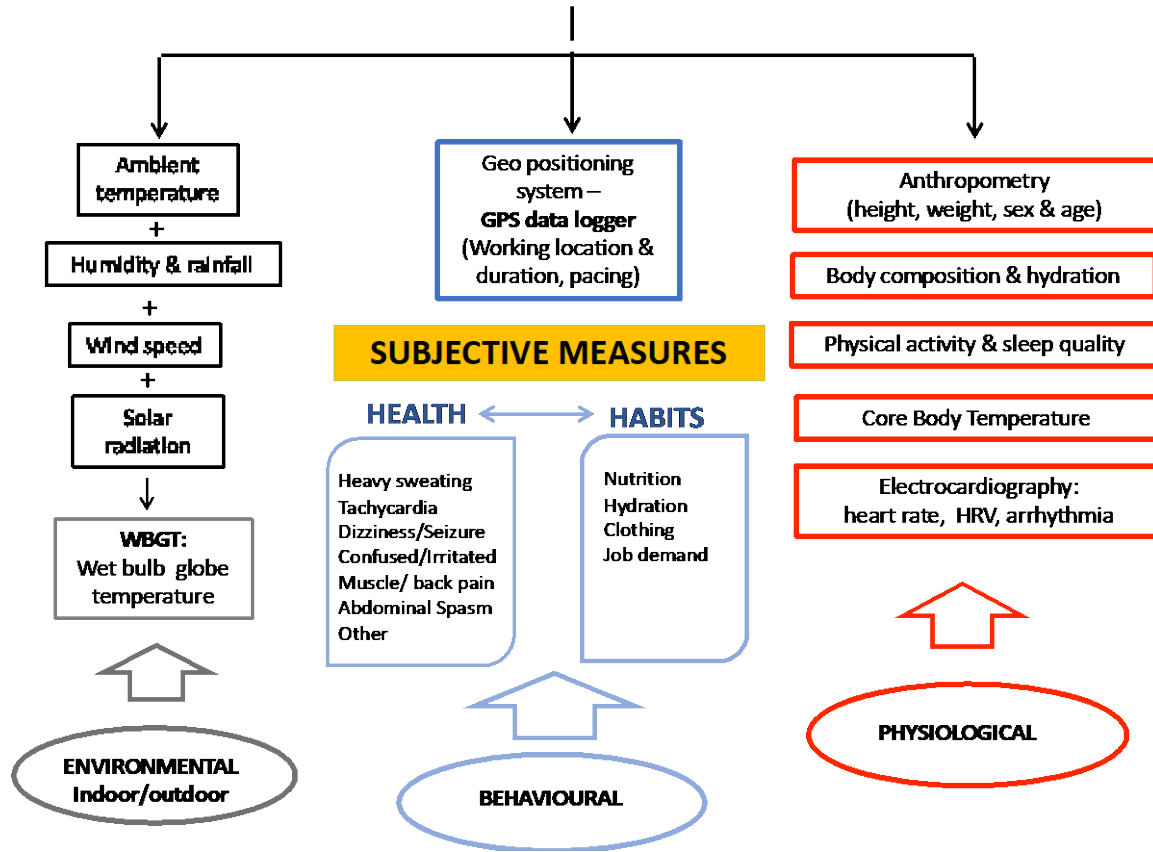
Weather stations (<10 km radius) Indoor WBGT

To evaluate:

- ✓ Physical activity/labor in **subsistence farmers**
- ✓ During different **seasons**
- ✓ **Men and Women** (Nouna HDSS)

Integrated mixed methods, research established wearables

OBJECTIVE MEASURES



1. Quantitative data:



Physical Activity (PA), Energy Expenditure (TEE), sleep quality/quantity, intensity of light & exposure, continuously, over 12 months



Bioimpedance analysis, 1/month



Blood pressure, 1/month



1-lead ECG, 24h continuously, 1/month



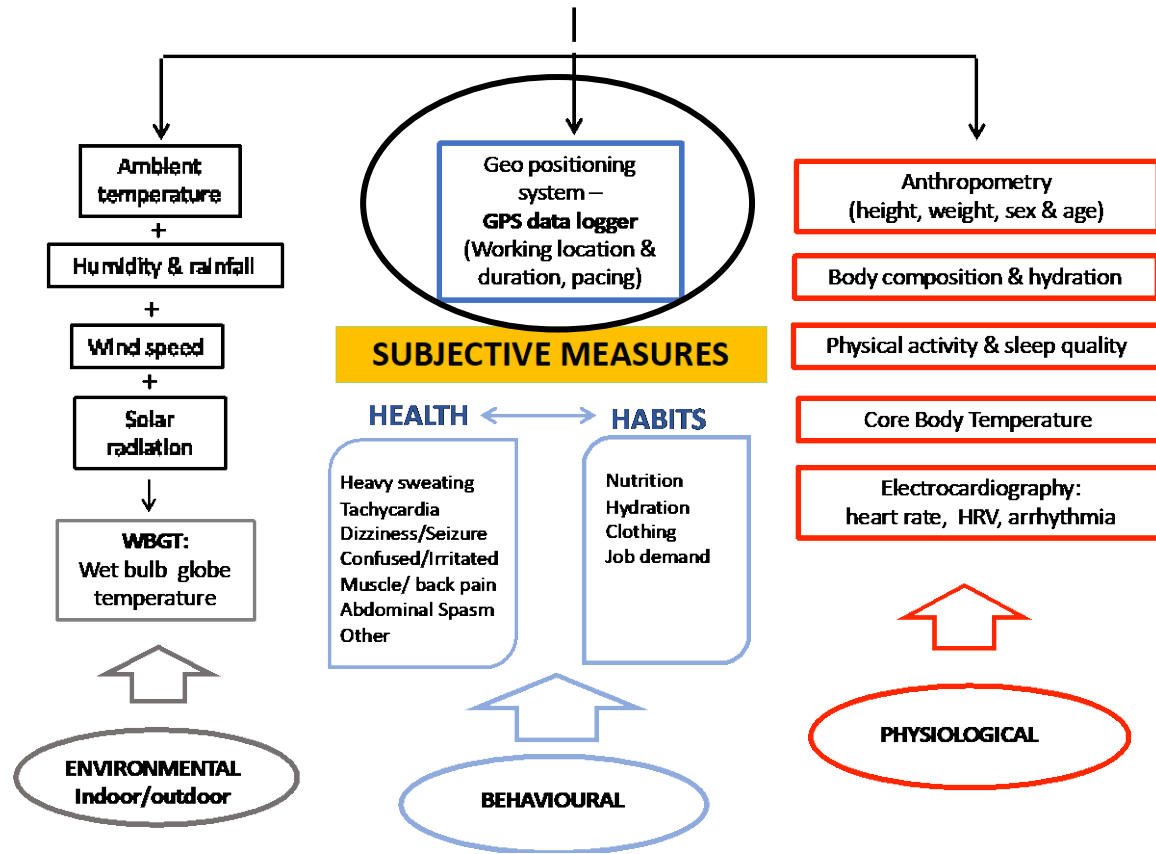
Core Body Temperature, heat-flux, 24h continuously, 1/month



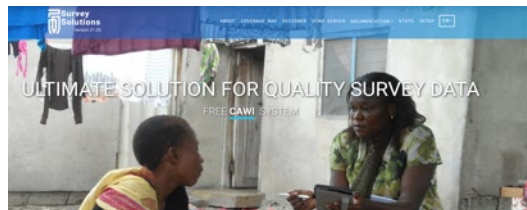
2. Qualitative data: Computer assisted Interview (CAI) for feasibility & acceptability - coping strategies- heat impact on health (1/month)

Integrated mixed methods, research established wearables

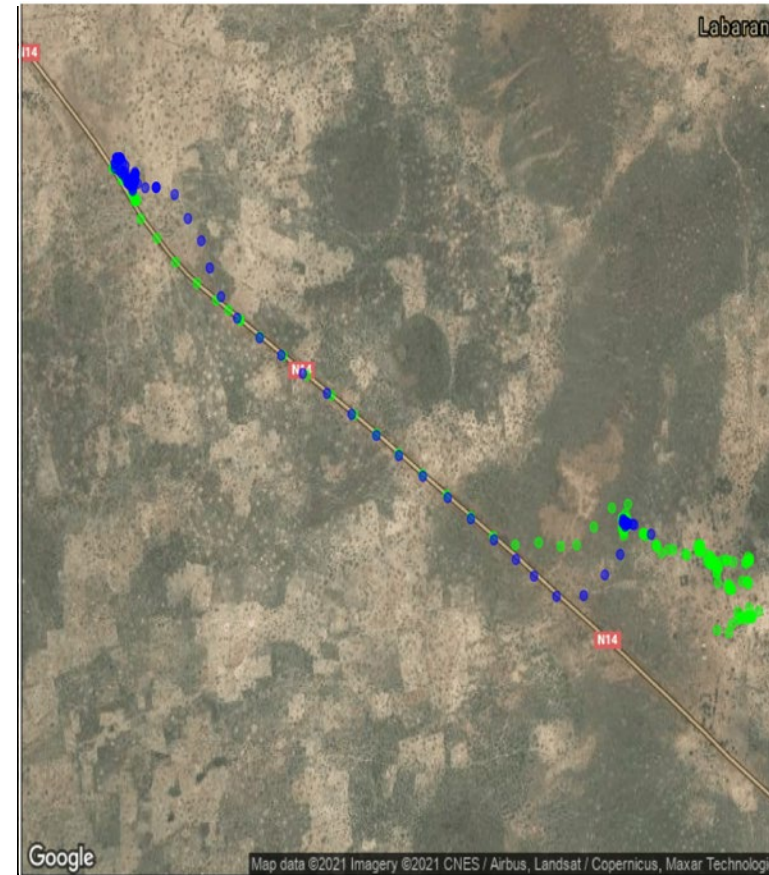
OBJECTIVE MEASURES



Weather stations & indoor WBGT, 12 months



1. Quantitative data => individual tracking GPS



Woman 1

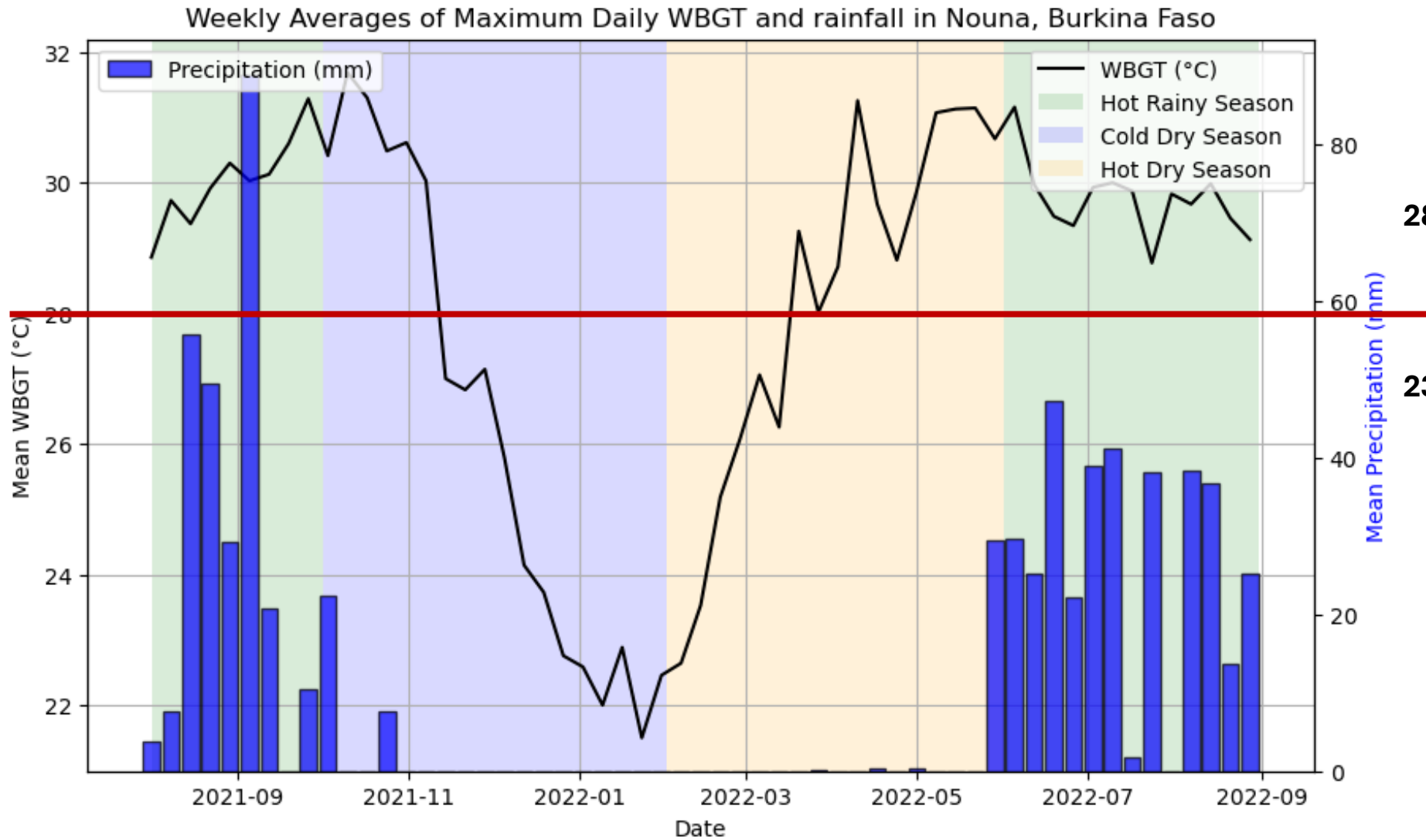
Time: 4:10 pm to 8:32 pm
Distance: 12.07 km

Man 1

Time: 12:00 pm to 5:33 pm
Distance: 8.26 km

2. Qualitative data: Computer assisted Interview (CAI) for feasibility & acceptability - coping strategies- heat impact on health (1/month)

Results – outdoor environment (WBGT) in Nouna



Results – Sleep duration (WBGT indoor environment)



Farmers exposed to environmental
WBGT > 28 for 10 months per year



Farmers use self-adaptation strategies: reducing
intensity/ duration / shifting tasks to cooler times



**Women not able to implement such strategies as men
are** (house chores + farming)



This flexibility is **not possible for wage workers** in the same
setting / urban areas



Due to the **fixed daylight duration in SSA** and **future climate change** scenarios,
spontaneous adaptations will **no longer protect farmers (women) from heat-related
health risks and food insecurity => urgent additional sustainable adaptations.**



Climate Change and Health in
sub-Saharan Africa

<https://cch-africa.de>

DFG

Deutsche
Forschungsgemeinschaft



CHAC2024

Climate and Health
Africa Conference

Thank you!

Special thanks to all our participants and the great team at CRSN Nouna!

Questions?

