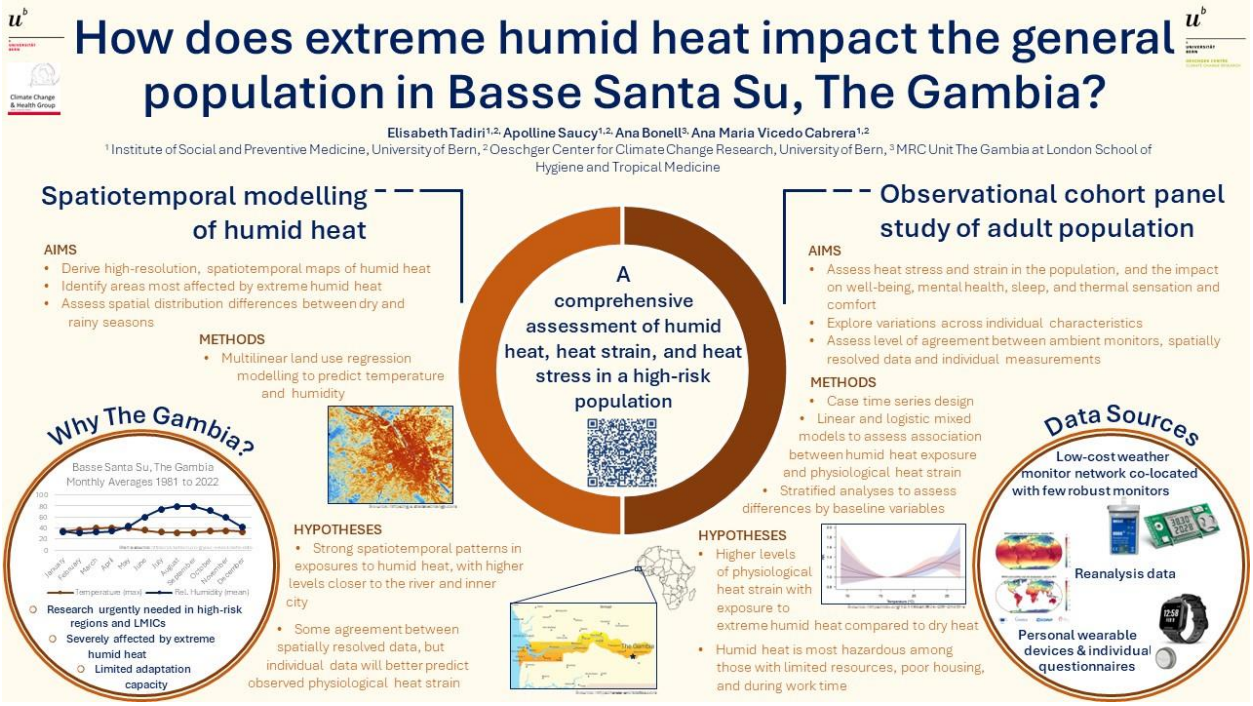

Understanding the distribution and health impacts of extreme humid heat: a panel study in the city of Basse Santa Su, The Gambia

*A study under The ACTUAL project **(Advancing researCh on exTreme hUmid heAt and health)***

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This study will focus on extreme humid heat and heat stress exposure in the general population of a high-risk area in The Gambia (Basse Santa Su) and characterise how that heat stress affects health and well-being. This population was chosen due to the occurrence of very high levels of heat in this area, limited adaptation capacity, and a lack of research on the impact of that heat on the health of the general adult population.

Sub-project 1: Spatiotemporal modelling of humid heat

Aims:

- Assess the exposure level and spatiotemporal distribution of heat and heat stress in Basse Santa Su
- Derive high-resolution, spatiotemporal maps of humid heat
- Identify areas most affected by extreme humid heat
- Assess spatial distribution differences between dry and rainy seasons

Hypothesis: There are strong spatial and temporal patterns in exposures to humid heat with higher levels closer to the river and inner city. There is some agreement between spatially resolved data, but individual data will better predict observed physiological heat strain.

Methods: Exposure measurements will be collected from Basse Santa Su weather station data (including parameters such as temperature, humidity, solar radiation, atmospheric pressure, wind speed and direction), reanalysis data (including weather variables from ERA 5 land reanalysis, land cover data, topography, vegetation, and urban surface geometry), and low-cost weather parameter monitors placed around the study area (recording hourly measurements over the period of 1 year).

Analysis: Multilinear land use regression modelling will be done to predict the single weather variables and a set of heat stress indices. Spatial and temporal variation of each weather variable across the study region will be assessed through maps, and high-risk neighbourhoods and contextual variables associated with different levels of exposure and thermal comfort will be identified. The agreement between exposure measurements will be assessed, and the prediction power of each exposure measurement on measured heat strain will be evaluated.

Sub-project 2: Panel study on heat stress and heat strain

Aims:

- Examine the heat stress experienced by the general population in Basse Santa Su through an observational cohort panel study of a representative sample of the adult population living and working in this area
- Assess heat stress and heat strain in the population, and their impact on well-being, mental health, sleep, and thermal sensation and comfort
- Explore variations across individual characteristics
- Assess level of agreement between ambient monitors, spatially resolved data and individual measurements

Hypothesis: There are higher levels of physiological heat strain with exposure to extreme humid heat compared to dry heat, and that humid heat is particularly hazardous among those with limited resources, poor housing, and during work time.

Methods: Participants will wear a wristwatch-style tracker device for 10 consecutive days, during four timepoints throughout one year. Four non-invasive thermistors will also be placed on participants for the first day of each 10-day observation period to measure weighted mean skin temperature. Information from these wearable devices will determine the level of physiological heat strain through the estimation of the physiological strain index (PSI). During the data collection, a subset of households will be selected for indoor air temperature and humidity monitoring using a portable data logger to estimate indoor overnight temperatures. Demographic and socio-economic information, living conditions, characteristics of the house and general health and well-being data will be collected from questionnaires administered by the study team at recruitment. Daily activity, symptoms of physiological heat strain and

subjective sleep quality data will be collected through questionnaires at regular visits throughout the 10-day data collection periods.

Analysis: Case time series design will be applied, and linear, non-linear, and logistic mixed models will be used to assess the association between exposure to humid heat and physiological heat strain. Stratified analyses with interaction terms will also be done to assess if the association differs according to baseline characteristics such as sex and age.