Impact of Extreme Weather Conditions on Healthcare Provision in Urban Ghana

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Extreme climate events and health

- Global surface temperatures expected to rise another 0.3°C to 1.7°C during the 21st Century (IPCC, 2013).

- Greatest in Africa (Collins, 2011), including the largest change in days when extreme temperatures are likely to impact population health (Garland et al., 2015).

- Planet also likely to experience higher risk of flooding - Asia and Africa (Hirabayashi et al., 2013).

- Last 3 decades - Rise in the number of reported severe floods, their cost, and mortality (Kundzewicz et al., 2013).

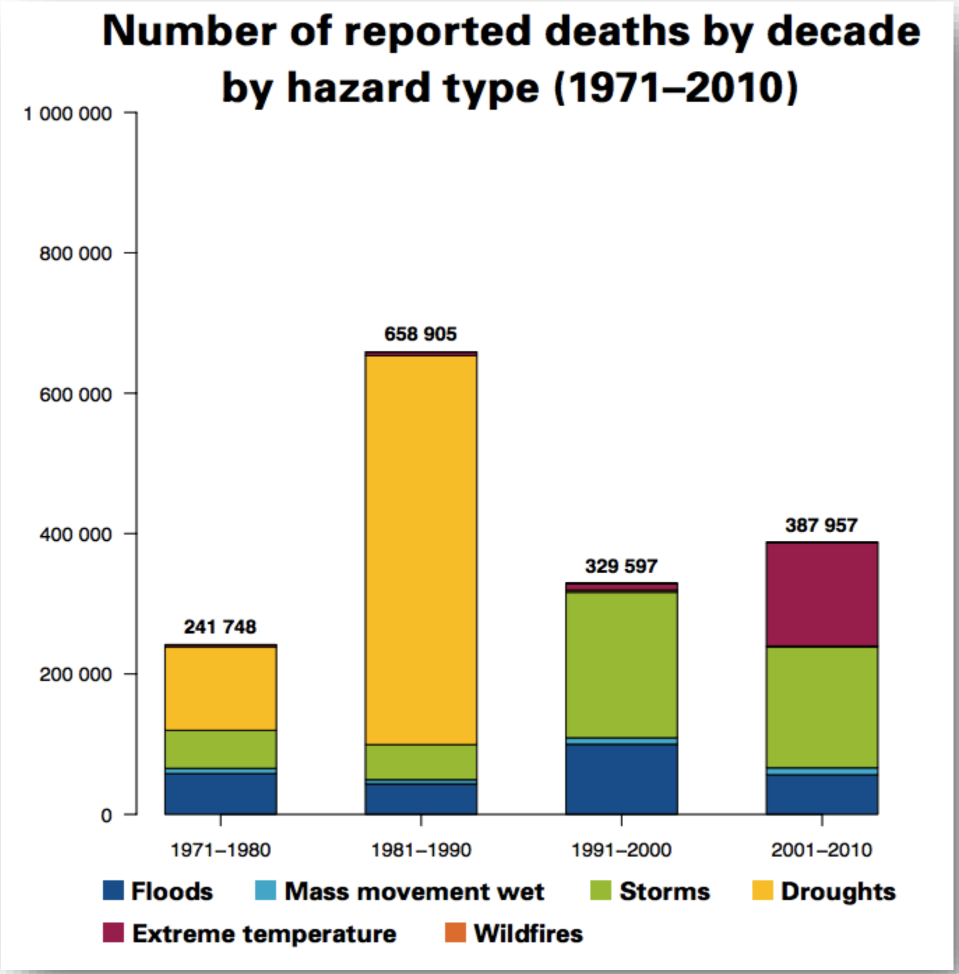
Extreme climate events and health

- Flooding is most frequently occurring natural hazard below storms and earthquakes as most damaging (Wilby et al., 2012).

- 2005 – 2014:
  - Flooding - 2.3 billion
  - Extreme heat - 94 million

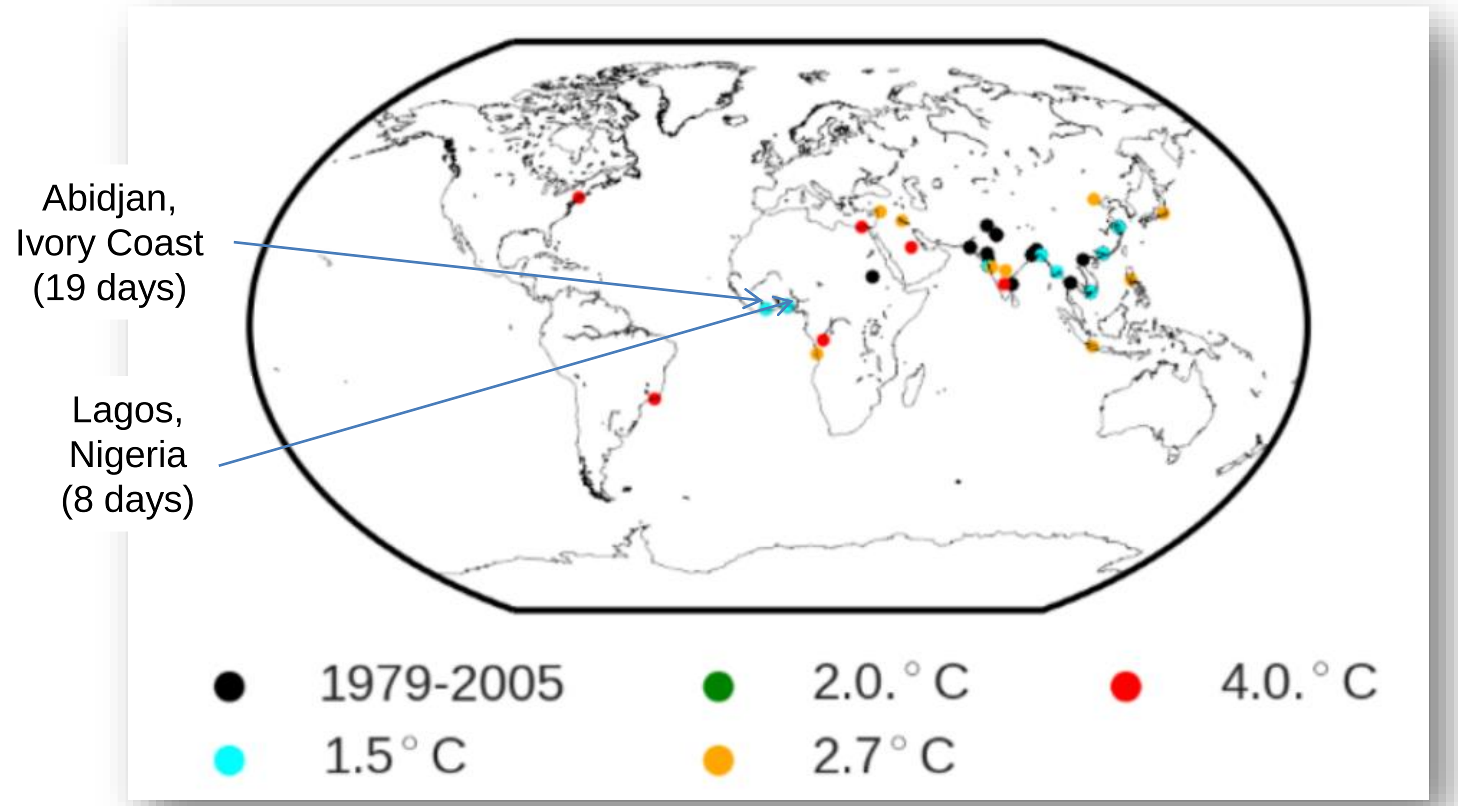
- These extreme weather events, linked to climate change, disproportionately affect the urban poor and their settlements (Gough et al., 2019).

Changing deadliness of hazards



Vulnerability to climate hazards is socially and geographically differentiated. The bar chart shows global mortality by weather-related hazard. Source: WMO (2014).

Projected deadly heat in cities



City regions projected to experience deadly heat stress (>37.6°C) for the first time under different amounts of global warming. Black circles mark locations already experiencing deadly heat stress during the 1979-2005 reference period. Source: Matthews et al. (2017).

Links with urbanisation

- Urban populations - ‘hot spots’ of vulnerability to climate change (Wilby, 2007).

- In many African cities, flood and extreme heat vulnerability linked to urban poverty, informality and populations occupying flood and/or extreme heat hotspots (Few, 2003)

- These issues usually researched discretely, with limited integration.

- Few studies restricted to flooding (Amoako and Inkoom, 2018).

- Do not include extreme heat events or examine the impacts of these events on urban infrastructure, including health service provision.

Knowledge gap

- Extreme weather - direct influence on health outcomes and service provision (Kovats et al. 2008)

- However, evidence in Africa is weak (Amegah et al. 2016)

- WHO (2018) COP 24 Special Report – 5 intervention areas
  - Investing in adaptation
  - Growing capacity and engaging stakeholders
  - Multisectoral approach
  - Good Measures for M & E
  - Ensuring Plans adapt to new knowledge

- No study on West Africa (Garland et al. 2015)

Knowledge gap

- The UK Research Council's "Living with Environmental Changes" covered UK literature from 2010-2017 (Curtis et al. 2017)

- Highlighted 2 areas climate directly affects health
  - Direct infrastructural impacts on service provision
  - Changes to the demand for services during extreme climate events

- Although evidence from high-income settings provides a basis

- Lacks relevant understanding of the confounding effects of the urban infrastructural challenges faced in low- and middle-income countries, including the lack of consistent connectivity to essential services
  - robust transport infrastructures,
  - electricity, water, refuse collection and
  - sanitation

Knowledge gap

- These factors are important (McMichael et al., 2006).
- Thus, evidence needed within West Africa to understand the challenges faced by health services operating with frequent exposure to extreme climate events.
- Such information is vital to strengthen health systems in vulnerable areas and make them more resilient to climate change.

Few existing studies

- Limited evidence in Africa
  - flooding and access to health services, and
  - flooding and mental health.
- Access to health services reduced (Makanga et al., 2017; Wilunda et al., 2017).
- Mozambique - number of people living more than one hour’s walking distance from health facilities increased by 40% during flood events due to excessive water on roads (Makanga et al., 2017).
- Impaired access can be especially detrimental for people with chronic conditions requiring frequent treatment, such as those with mental health issues.
- Flooding has psychosocial consequences - distress and potentially poor mental health (Harris et al., 2018).

Few existing studies

- Hospitals house some of the most vulnerable at risk of extreme heat - elderly, pregnant mothers and children.

- These groups present with symptoms of extreme heat - fever, or conditions that are vulnerable to the effects of heat, such as cardiovascular events (Crandall and Wilson 2015).

- Hospital buildings - uncomfortable thermal environment for patients and staff during extreme heat events, with the potential to exacerbate health problems.

- Although temperatures are rising across the African continent, little is known about the temperatures that African patients and staff are exposed to.

Few existing studies

- Only one study recorded such data for outpatient waiting rooms in the northern region of Limpopo Province, South Africa.

- Indoor temperatures in the waiting areas were typically 2 to 4°C higher than outside air temperatures and some clinics exceeded maximum temperatures of 38°C (Wright et al., 2017).

- Health services need to be able to respond to extreme climate events in order to be resilient and provide quality services

Aim

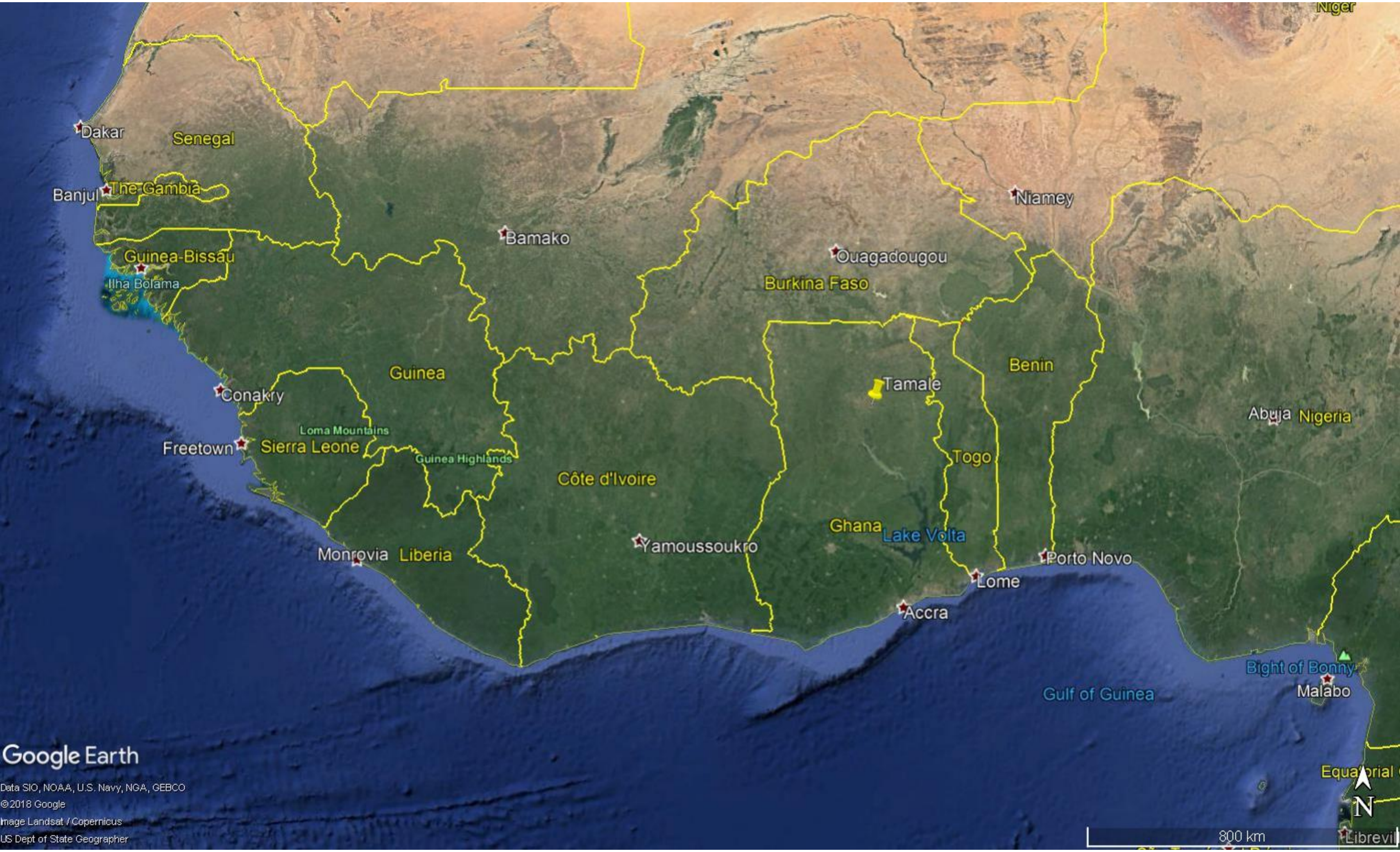
- Explore the vulnerabilities of health services during flooding and extreme heat in two urban areas of Ghana.

- Identify the coping strategies that are being used to build resilience by both health service providers and community members.

- The local perspectives provided will enrich our understanding of the vulnerabilities, resilience and potential adaptations needed to enhance health service provision not only in Ghana but other low-income countries.

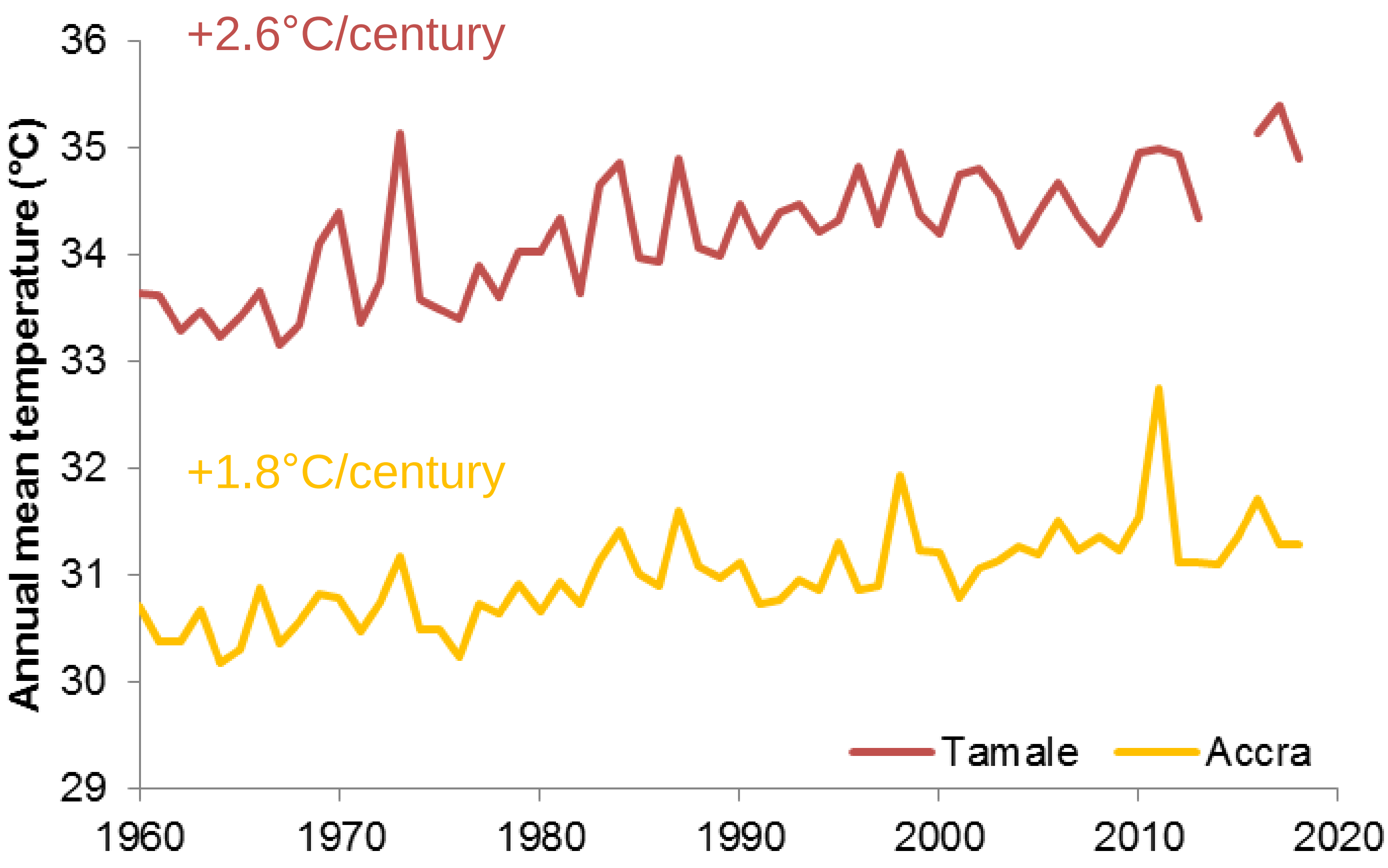



Accra and Tamale, Ghana



Accra 2.3 million Tamale 0.4 million

Temperatures are rising



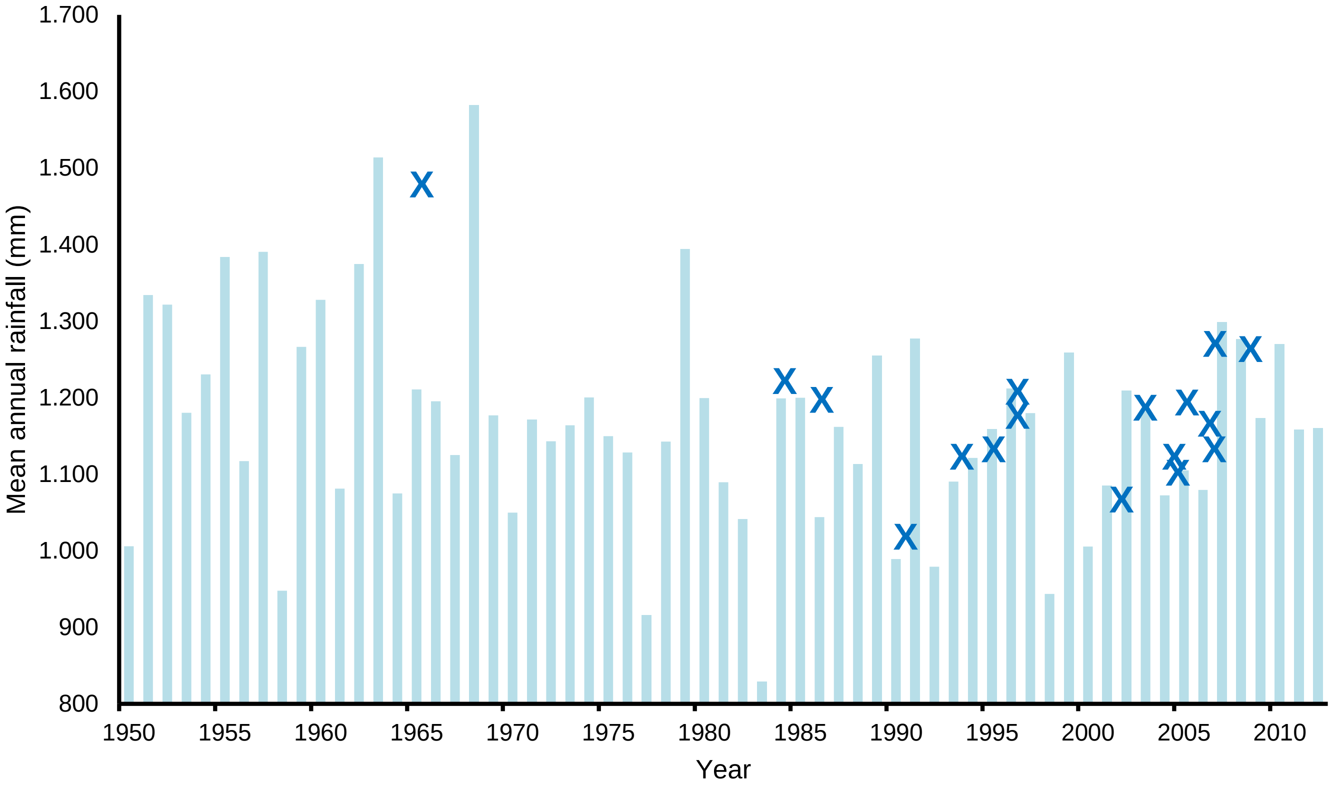
2018 (so far):

Tamale
9th warmest

Accra
11th warmest

Annual mean temperatures measured at the airports of Tamale and Accra since 1960.

Extreme flood events increasing 1950-2012



Over the past five decades, Ghana has been affected by at least 17 major floods, which have cumulatively impacted more than 16 million people and resulted in at least 444 deaths, with Accra recording the most damage

Source: United Nations Office for Disaster Risk Reduction, 2009.

Interviews

- 8 community in depth interviews –1 in each community

- 14 in-depth interviews at health facilities

- – Pharmacy
- – Government health facilities (primary care and in-patient facilities)
- – Private clinics with in-patient facilities

- Tiny tags installed in 10 health facilities in May 2018

Deployment of Tiny Tags

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Vulnerability to Extreme Weather Events in Cities (VEWEC)

Community details

Community	Kukuo	**City**	TA
Champion	MICHAEL		

Site/building/room details

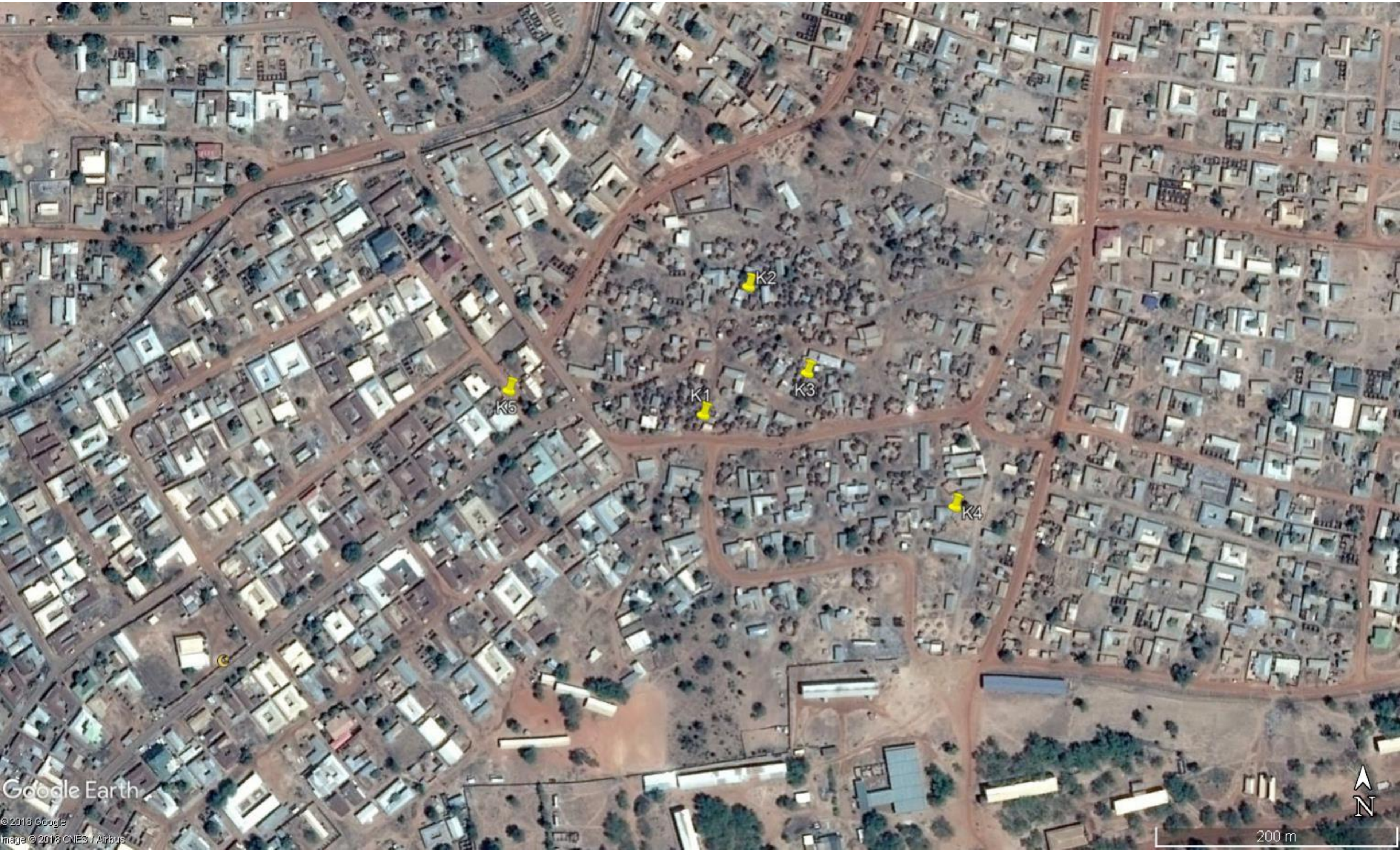
Site code/address			
Coordinates	9° 24' 2" N 0° 49' 3" W		9.40059 0.81749
Site elevation (m)	~~153~~ (151)	**Building height (m)**	4
Building/room ~~type~~ use	Chiefs living room	**Number of occupants**	1
Building age, condition, wall and roof materials type	+ 100yrs	Metal roof	
Artificial heat sources	TV, fridge		
Ventilation	Roof fan, window, door.		

Tiny tag details

Tiny-tag serial code	S/N 819692 (3223)		
Time of deployment	08:45	**Date of deployment**	14/1/18
Installer	RW		
Fixing site	Chiefs main living room		
Fixing height (m)	~ 2m.	**Fixing aspect (°N)**	
Other	Capacity 10 Mar 2018 (10 mins)		

Surveying experiences and temperatures

Location of houses with tiny tags, Tamale



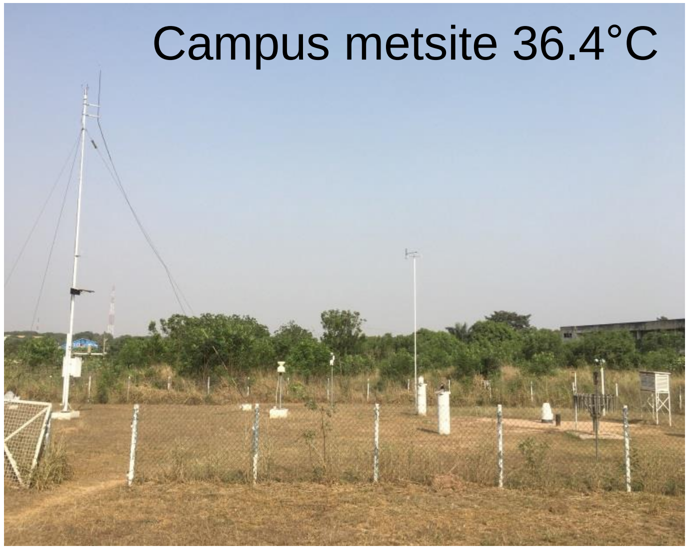
Reference sites

Tamale airport meteorological station [left] and inside the Stevenson screen [right]

Example high temperatures (Accra)


Cooking area 48.1°C


Living room 45.5°C


Campus metsite 36.4°C


Cinema 38.7°C


Ward 33.8°C


Thatch store 30.9°C

Example high temperatures (Tamale)

Blacksmith 61.0°C

Living room 39.0°C

Airport metsite 41.5°C

Living room 44.7°C

Workshop 50.3°C

With shade 38.2°C

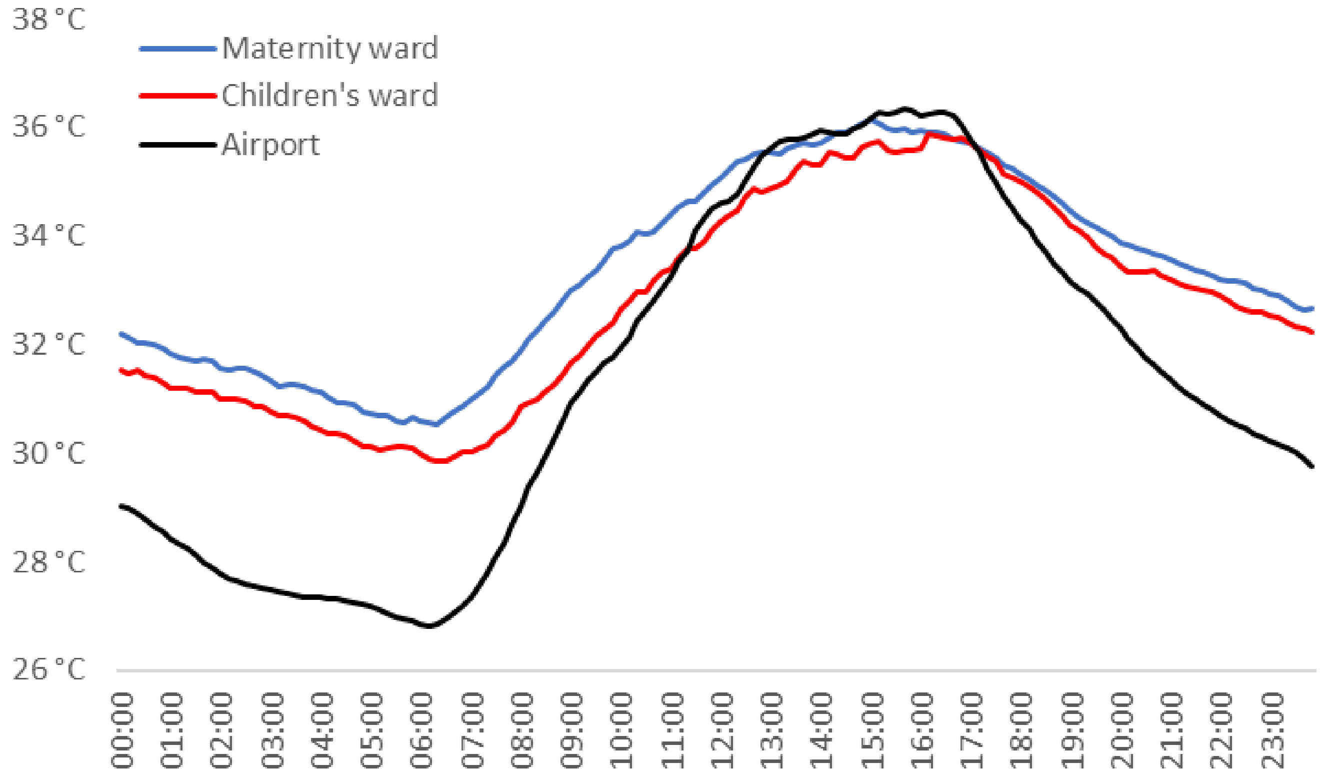
Nocturnal heat island (Agblogbloshie)

Differences in mean minimum outdoor air temperature relative to the campus metsite

Typical indoor temperatures at healthcare facilities in Tamale

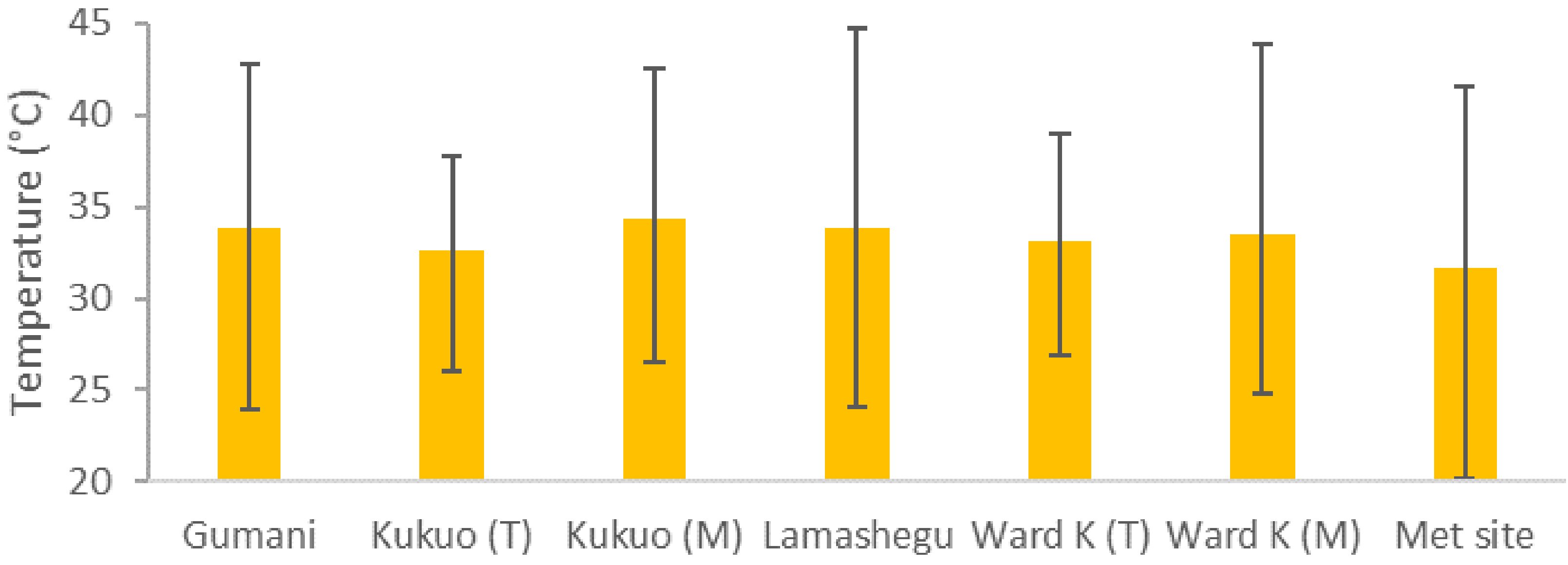
Mean indoor temperatures recorded at health facilities in Tamale, Ghana during the period 22 May 2018 to 3 July 2018. T-bars show the range experienced at each site.

Extreme indoor heat on wards (Tamale)



10-minute indoor temperatures for the maternity ward and children's ward of a hospital in Tamale, Ghana on 13 June 2018.

Health worker exposure to extreme heat (home life)



Indoor temperatures of living rooms in low-income communities during January to March 2018 (i.e. the hottest period). T and M denote thatch and metal roofed homes respectively.

Impact of extreme heat on health facilities

- All health facilities on average (5°C) warmer than met site
  - Greater thermal inertia of buildings and influence of urban heat island

- Mean indoor temp for health facilities about 1.7°C warmer in Tamale than Accra
- Mean night temp slightly cooler (0.5°C) in Tamale than Accra

– More respiratory problems, dehydration, hypertension, strokes, cerebral meningitis, asthma, boils and heat rashes

Impact of extreme heat on health facilities

- Poor ventilation exacerbates heat
- Fans not effective over 34°C
- Limits ability of health workers to discharge duties
- Sweat into open wounds during surgery and possibility of infection
- Set up intravenous fluids and surgery with mobile phone lights
- Disruption to infrastructure during extreme heat
- Lack of water and power outages – implications for hygiene
- Pharmacy loses refrigeration
- Drugs damaged
- Vaccination cold chain storage affected

Impact of extreme heat on health facilities

- Overcrowding during extreme heat

- Mixed admissions – Children to Adult Wards, Females to Male Wards, Malaria cases to Surgical Ward

- Challenge of sleeping at night increases fatigue of health workers whilst at work, elevating the risk of errors

Building resilience to extreme heat

- Installation of large windows and doors with nets to increase ventilation
- Potential for solar powered A/C being explored
- Lobbying power company to give more info on power outages
- Seeking fuel supply to run donated generator
- Hoping for early warnings for extreme heat or related power or water outages

Impact of flooding on health facilities

- More cases of malaria, respiratory infections, typhoid, cholera, gastrointestinal problems and diabetes
- More patients results in not enough beds or staff to cope – "No bed syndrome"
- Up to waist high flood waters
  - Moving equipment to higher levels
  - Damaged generator
  - Loss of medicines, supplies and equipment
  - Challenge to walk between buildings – accidents on muddy surfaces

Impact of flooding on health facilities

- Electricity supplies disrupted – Power companies disconnect to avoid electrocution

- Communities isolated from services – Problem for those on regular medications – mental health, diabetes and hypertension

- Limited support for stress effects of floods

- Emergency response to floods largely focussed on physical health – need to consider mental health

- Lack of safe and dry places to sleep results in lack of sleep and increases stress

Building resilience to floods

- Mobilising community members near health facility to clear rubbish so drains do not become blocked
- Building raised areas for equipment and supplies
- Building walls to stop floods from entering wards
- Requesting more staff in rainy season
- Hoping for early warnings of floods
  - Need to link with existing health systems and communication platforms
  - Staff need to be trained what to do with the information
  - Need to be reliable

Concluding remarks

VEWEC given a rare opportunity to investigate the impacts of extreme weather on healthcare provision in a low-income country setting

Communities are *already* enduring extraordinary temperatures in homes, public spaces and workplaces

Communities are facing multiple health threats from heat, flash floods, water- and vector-borne diseases

City regions of the global South are in the front-line of global change impacts but some adaptations could buy time

Acknowledgement

Partners: Loughborough University, University of Ghana & University for Development Studies, Tamale

Climate:

Dr Raymond Kasei

Prof Rob Wilby

Livelihoods:

Prof Paul Yankson

Prof Katherine Gough

Health:

Prof Sam Codjoe

Prof Paula Griffiths

Water & electricity:

Dr Eben Amankwaa

Dr Sam Kayaga