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# CLIMATE CHANGE RESILIENCE IN URBAN MOBILITY IN ACCRA

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Project grant is awarded by the Ministry of Foreign Affairs, Denmark (DANIDA)

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## Presentation Format

### Part 1.

1. Background
2. Introduction
3. Study Area
4. The Problem
5. Relevance of the Project
6. Objectives
7. Work Packages
8. Expected outcomes and Outputs

### Part 2 – Methodology





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# BACKGROUND

- ▶ The concept of Climate Change
- ▶ Topical issue of Climate Change
- ▶ Consequences of extreme weather events
- ▶ Calls for the need to undertake research into mechanisms that would help individual regions, and societal and environmental systems to mitigate or adapt to changes.
- ▶ CLIMACCESS as a response.
- ▶ Institutional Collaboration
- ▶ Study Area
- ▶ Duration (2018-2022)
- ▶ Capacity building focus –hydrological modeling, application of UAVs (drones), LIDAR, GIS and Remote Sensing techniques, and 3 double Ph.D sponsorship.

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# Introduction



- ▶ Physical mobility and accessibility to urban locations are important parameters for securing livelihoods and reducing vulnerability of local communities in Sub-Saharan African cities that are challenged by unsustainable spatial development practices and increased frequency of extreme weather events.
- ▶ This proposal describes a comprehensive research effort towards a better understanding of the links between climate change scenarios, urban accessibility and the mobility of urban residents.
- ▶ Extreme rainfall events will become more frequent as a consequence of climate change (USAID 2013)
- ▶ Studies show that rainfall intensities, soil infiltration capacities, landforms, current land use and impervious surface characteristics are very important factors when assessing the risks and damages of urban flooding.

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## Study Area

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- ▶ The study focuses on the Accra metropolitan area.
- ▶ Accra metropolis suffers urban flooding due to a combined effect of rainfall intensities, low soil infiltration capacities, landforms, current land use and impervious surface, characteristic of most urban places.
- ▶ In many African cities, including Accra, long-term under-investments have resulted in insufficient and over-stretched transport systems lagging far behind the demographic as well as the fast spatial growth of the cities
- ▶ Accra has experienced very rapid spatial growth within the last 20 years, and this expansion in the fringe areas is occurring in a largely unplanned and uncontrolled manner, creating sprawling low-density development with low accessibility.



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## The problem

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- ▶ The problem **focuses on accessibility in Accra** in the event of extreme weather occurrences, especially floods.
- ▶ New residential areas at the urban fringe are often serviced by an 'ad-hoc' network of smaller 'dirt' roads that are highly susceptible to flooding.
- ▶ Accra's transport system is therefore highly vulnerable to the effects of extreme weather events.
- ▶ Overall accessibility in Accra is challenged by **severe congestion in many areas, insufficient road capacity and poor road conditions.**
- ▶ Flooding severely affects and hampers mobility by effectively disabling parts of the transport network thereby contributing to the pervasive and exacerbating accessibility problems.
- ▶ This situation is worsened by the fact that there is very little redundancy in the high-level transport network of Accra (Møller-Jensen et al. 2012).

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# Relevance

**CLIMACCESS answers to critical contemporary international and national development issues.**

- ▶ The need to ensure equal access to mobility is addressed by the **UN-SDG for Sustainable Cities and Communities (Goal 11)**.
- ▶ The “New Urban Agenda” of the 2016 Quito Declaration on Sustainable Cities for all (Habitat III).
- ▶ The potential impacts of climate change and the resilience to these impacts are central themes in the **UN agenda as well as in Danida’s strategy for development collaboration with Ghana**.
- ▶ At the country level, Ghana has recently adopted a **National Climate Change Policy that recognizes “rainfall variability leading to extreme events” as a major concern**.  
(The concern lists climate resilient infrastructure as a Policy Focus Area).
- ▶ **UN-HABITAT, 2010, states that urban mobility is a key element of sustainable urbanization in African cities** in response to social and economic challenges as well as climate change, and that there is a need for combining “research, policy advocacy, capacity building and expert assistance within the area of sustainable mobility”.

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# Objectives

1. To establish a comprehensive understanding of the **physical and human factors that determine resilience to climate change impacts on mobility and accessibility** in the Accra region.
2. To enhance research capacity in the field,
3. To introduce new methods for mobility analysis, new methods for predicting urban floods, and
4. To devise policy and planning measures to advance the sustainable urban development agenda.

**Specifically, the research and capacity building should lead to reduced inequality in access to mobility and, thereby, reduced vulnerability of local communities challenged by unsustainable spatial development practices and increased frequency of extreme weather events.**

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## Work Packages for achieving Objectives -1

The project will pursue the objectives outlined through novel research and methods-development in an interdisciplinary setup with four sub-objectives:

**Work package A: Urban mobility patterns, livelihood strategies and vulnerability**

- ▶ The objective of this package is to explore local mobility patterns and practices imbedded in the livelihood strategies of urban residents in four selected urban settlements, and to analyze these practices within the context of climate change resilience. (Ref. to study sites).
- ▶ The research will explore household- and community-level responses, as well as more long-term strategies to reduce vulnerability and build resilience.

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## Work Packages for achieving Objectives -2

**Work package B. Scenarios of climate change and urban flooding**

- ▶ The objective of this package is to analyze how climate change will affect future urban flooding patterns.
- ▶ The research will focus on the influence of climate change on the future precipitation pattern in the region and the expected future urban flooding levels as a consequence of extreme weather events.
- ▶ The research will apply a newly developed method for forecasting how storm-water will flow in urban areas during extreme rain events.
- ▶ The method is able to map local depressions which will be flooded under given precipitation events and the amount of spillover to lower lying areas, thereby predicting where larger water bodies will accumulate.
- ▶ At the detailed scale selected test areas will be mapped using a **small UAV** ("drone"), LIDAR and other remote sensing techniques.



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## Work Packages for achieving Objectives -3

### **Work package C.** Transport network analysis: Impact of flooding on urban accessibility and mobility

- ▶ The objective of this package is to **analyze the vulnerability of the transport system within the context of current urban spatial development practices** using novel applications of spatial network analysis tools.
- ▶ The aim is to analyze spatially how flooding events directly affect the transport network by reducing network connectivity, accessibility and general speed levels, and how this further affects levels of mobility and accessibility in different urban areas.
- ▶ Linking accessibility analysis with flood maps resulting from work package B. the research is expected to result in a new 'vulnerability map' of the transport network in different parts of the city area and spatial projections of accessibility and mobility levels under future climate change-scenarios.
- ▶ Furthermore, the research is expected to result in the **identification of vulnerable 'gateway' locations in the Accra area that are characterized by a high risk of flooding as well as a position in the transport system that controls the accessibility to large urban areas.**

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## Work Packages for achieving Objectives - 4

### **Work package D.** Towards a comprehensive understanding of the interplay between climate change, urban accessibility and the mobility of urban residents.

- ▶ This work package will run in parallel with the other work packages and has multiple objectives:
  - 1) to coordinate the research in work package A-C and facilitate the start-up phase, including stakeholder identification and case site selection,
  - 2) to facilitate the production of joint scientific papers and policy briefs based on the research results obtained in work package A-C, and
  - 3) to specifically address capacity building within the field both in the participating research institutes and among stakeholders, based on training, supervision and workshops.
- ▶ The aim is to develop and disseminate a comprehensive holistic and multi-scale perspective on climate change resilience in relation to urban mobility and accessibility and the research will provide strategies for decreasing vulnerability to extreme weather events.

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## Expected outcomes and outputs -1

The main outcomes of the project are expected to be research capacity building and access for planners, decision-makers, stakeholders and academia to research-based knowledge, methods and data within:

- ▶ 1. Mobility practices and livelihood strategies of urban residents and their perception of challenges and vulnerabilities related to mobility, accessibility and extreme weather events.
- ▶ 2. Region-specific properties of climate change, and methods for modeling urban flooding based on UAV, LIDAR and other remote sensing techniques.
- ▶ 3. Impact of climate change on urban mobility and accessibility levels.
- ▶ 4. Multi-scale strategies to secure sustainable urban development in terms of accessibility and mobility, given increased frequency of extreme weather events.
- ▶ Methods for producing local and regional maps of high-risk locations for urban flooding that integrate UAV, LIDAR and other remote sensing techniques (development, validation, training).
- ▶ Flood maps for selected settlements (detailed) and city-wide (coarse).

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## Expected outcomes and outputs -2

- ▶ Methods for spatial network analysis of accessibility to produce vulnerability maps of transport net and identifying key locations that impact mobility (development, validation, training).
- ▶ Three PhD degrees at University of Ghana and University of Copenhagen (double-degree model).
- ▶ 8-9 co-authored scientific papers.
- ▶ Final conference on methods, results and implications.
- ▶ Publication of two Policy Briefs.
- ▶ Website with results and documentation.

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# END OF PART 1

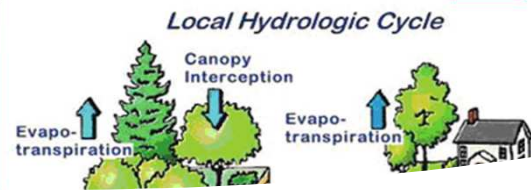
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## Impacts on transportation/mobility





# Urban Flooding



## Impacts on Health

- ▶ Warmer average temperatures can increase breeding of mosquitoes and consequently increase the incidence of mosquito borne diseases such as malaria, dengue fever and filariasis.
- ▶ Warmer temperatures can also increase rat populations which may lead to an increase in the incidence of *leptospirosis* carried in rat urine. This will be a threat for areas of paddy cultivation



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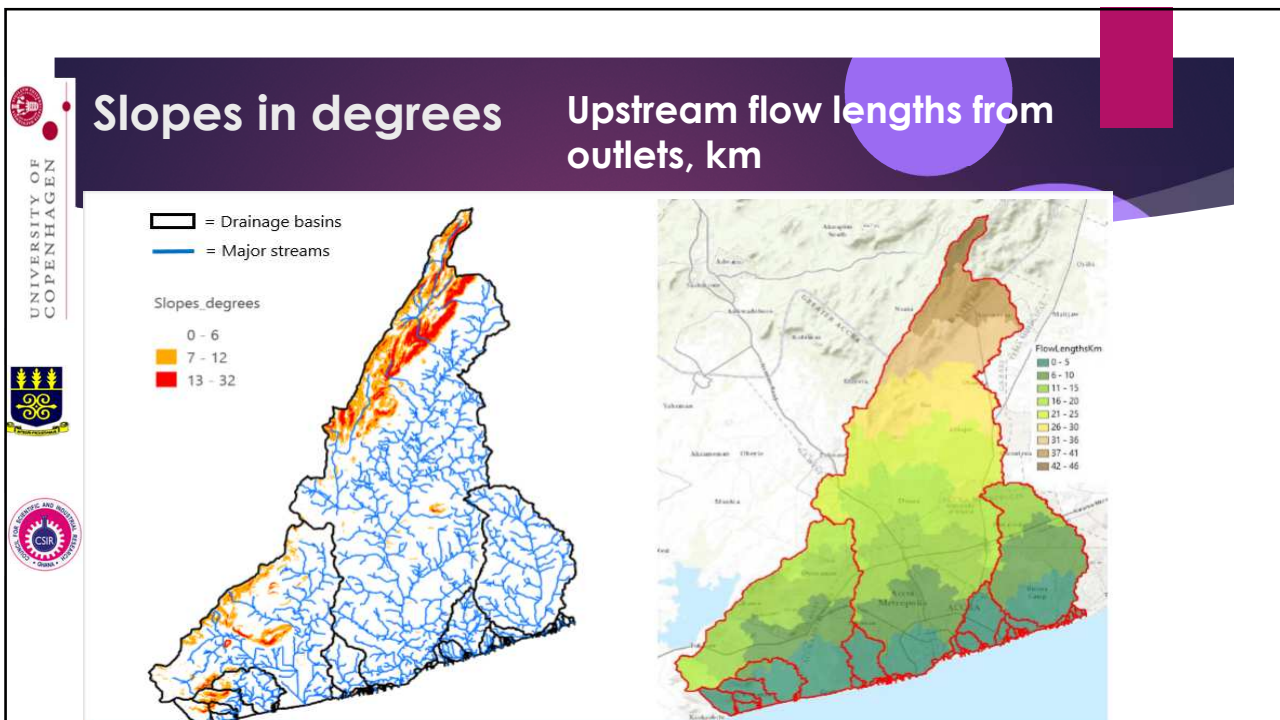
Institute for Scientific & Technological Information



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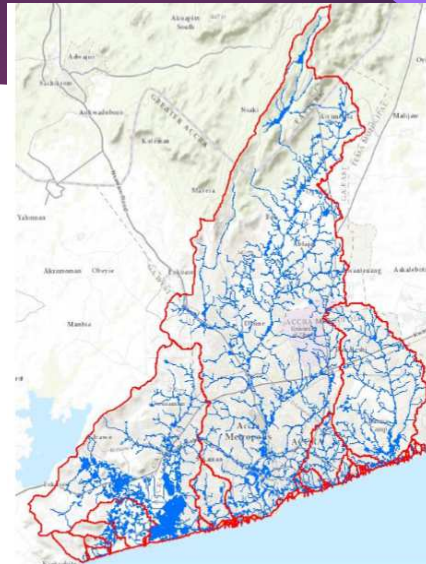
## Study Area







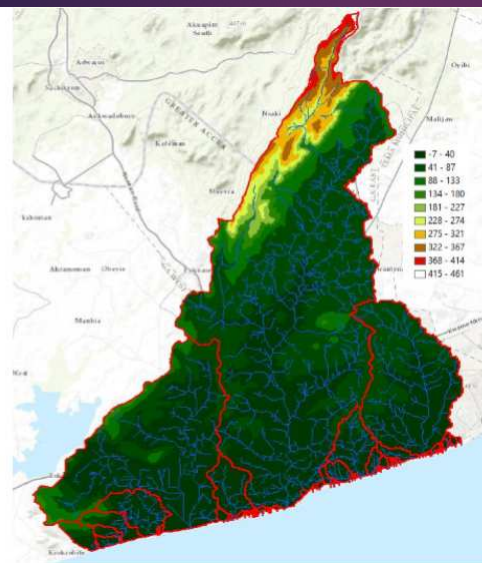
## Identify major drainage basins, streams and bluespots deeper than .5 meters



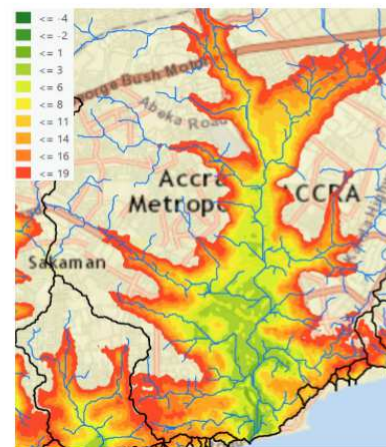
Investigation of a digital terrain model in 10 m resolution purchased from Airbus, Germany

- = Drainage basins
- = Major streams
- = Bluespots

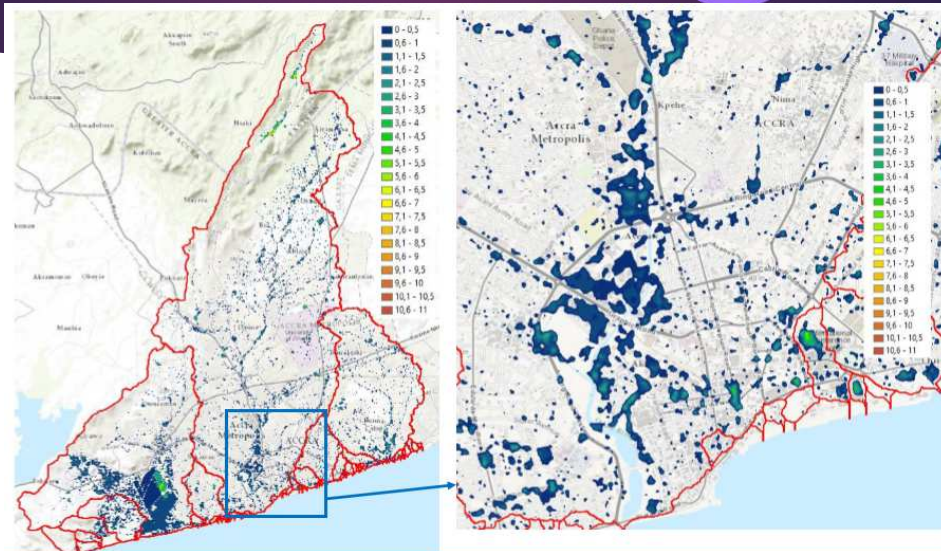
## Topographic Overview. Sliced elevations, m asl



- = Drainage basins
- = Major streams

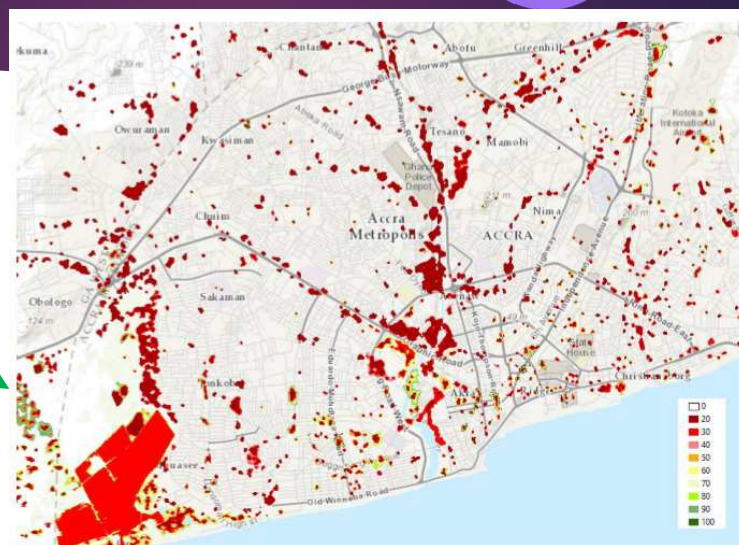


## Bluespot depths at pour point levels



## Precipitation in mm to fill up the sinks

Salt Ponds





## Water corridor volumes in m3 at a 30 mm event

