



# Working with Stakeholders to Assess and Mitigate Climate Risks in African Cities

## The CLUVA project

EC Workshop on "Fostering innovative dialogue between researchers  
and stakeholders to meet future challenge

Brussels June 2013

# CLUVA agenda



- Part A project data and context
- Part B multi-disciplinary research activities
  - Step 1 Climate change assessment
  - Step 2 Climate related hazard assessment
  - Step 3 Multi-dimensional vulnerability
  - Step 4 combining and mapping multiple vulnerabilities
  - Step 5 adaptation to climate change
- Part C strengthening links between research, practice and policy making
- Conclusion

# Part A Project data and context



- FP7 project EU contribution : 3 500 000 €
- 13 research partners : Africa



Gaston Berger University Sénégal



University of Ouagadougou Burkina Fasso



University of Yaoundé 1 Cameroon



Ardhi University Tanzania



Addis Ababa University(EIABC) Ethiopia



Centre for Scientific and Industrial Research South Africa

# Project Data and Context

## EU partners



AMRA Italy coordinator



University of Copenhagen Denmark



University of Manchester UK



Technical University of Munich Germany



Helmoltz Centre for Environmental Research Germany



Euro-Mediterranean Centre for Climate Change Research



Norwegian Institute for Urban and Regional Research

# Project data and Context

## EU policy context



- Contribution to the EU strategy for supporting Disaster Risk Reduction(DRR) in developing countries (2009)
  - Support developing countries in integrating DRR considerations into their development policies and planning effectively
  - Support developing countries in reducing disaster risk more effectively through targeted actions on disaster prevention mitigation and preparedness
  - Integrate DRR into EU development and humanitarian aid policies and crisis response

**This research shall conduct prospective studies to assess risks and vulnerabilities of different major urban areas (including the urban-rural interface) and their respective populations, infrastructures, assets, goods and services, with the overall aim to develop innovative approaches to enhance the resilience of cities against climate-change-induced risks**

# Project context

## CLUVA a research project in support of Policies



- CLUVA was designed at producing foresight knowledge in support of climate adaptation policies

In the field of environment and more specifically climate change, science is key to identify and assessing issues, exploring potential solutions and possibly legitimate policy interventions

- Research must be conducted when appropriate in close cooperation with the policy makers at the city level

To allow for an increase in transparency and accountability and the promotion of evidence based policy making

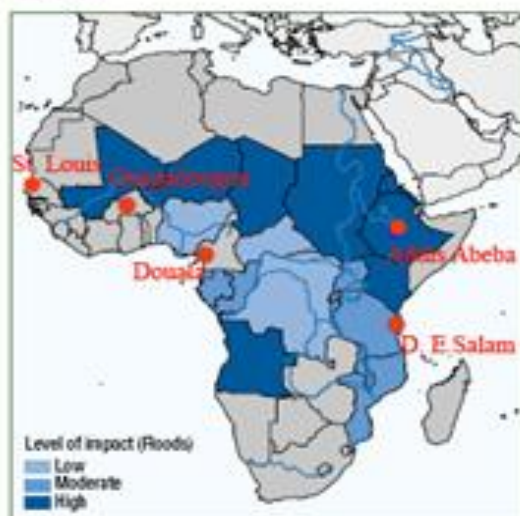
# Project data and context

## African cities selected

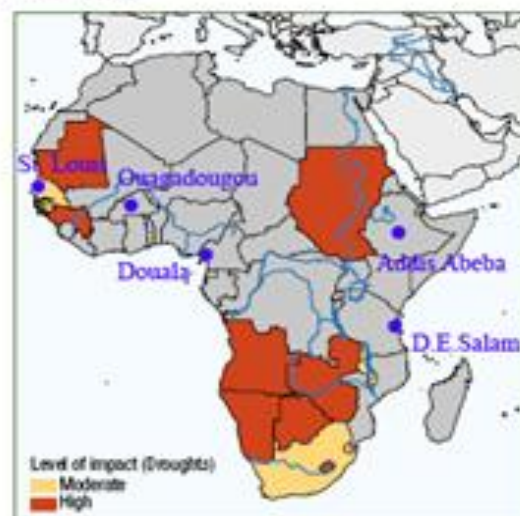


- Criteria
  - Type of climate, type of hazards, political stability, local academic support
- Selected cities and research centre
  - Saint Louis, Senegal (Gaston Berger university)
    - tropical dry coastal, estuary, sea level rise
  - Ouagadougou, Burkina (Ouagadougou university )
    - tropical dry inland west, flood , drought
  - Doula, Cameroun (Yaoundé 1 university)
    - tropical wet, west coast, critical infrastructure, sea level rise
  - Dar es Salam Tanzania (ARDHI university) –
    - tropical wet, east coast, cyclones, sea level rise, flood
  - Addis Ababa Ethiopia, (Addis Abbaba University)
    - Flipping climate inland, flood, drought

## Floods



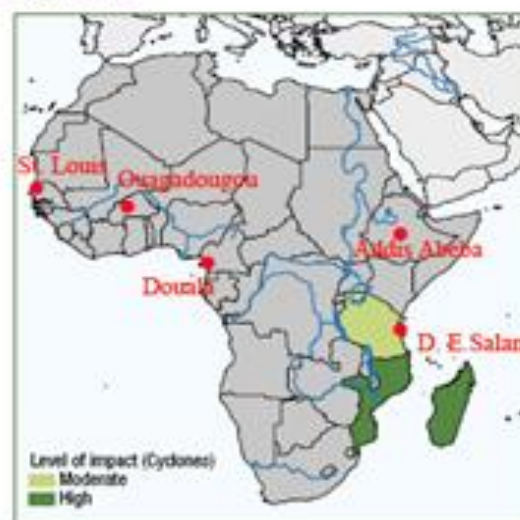
## Droughts



## Sea level rise



## Cyclones



Source: Climate Change Strategy Background reports: World Bank (2008e) and Washington (2008).



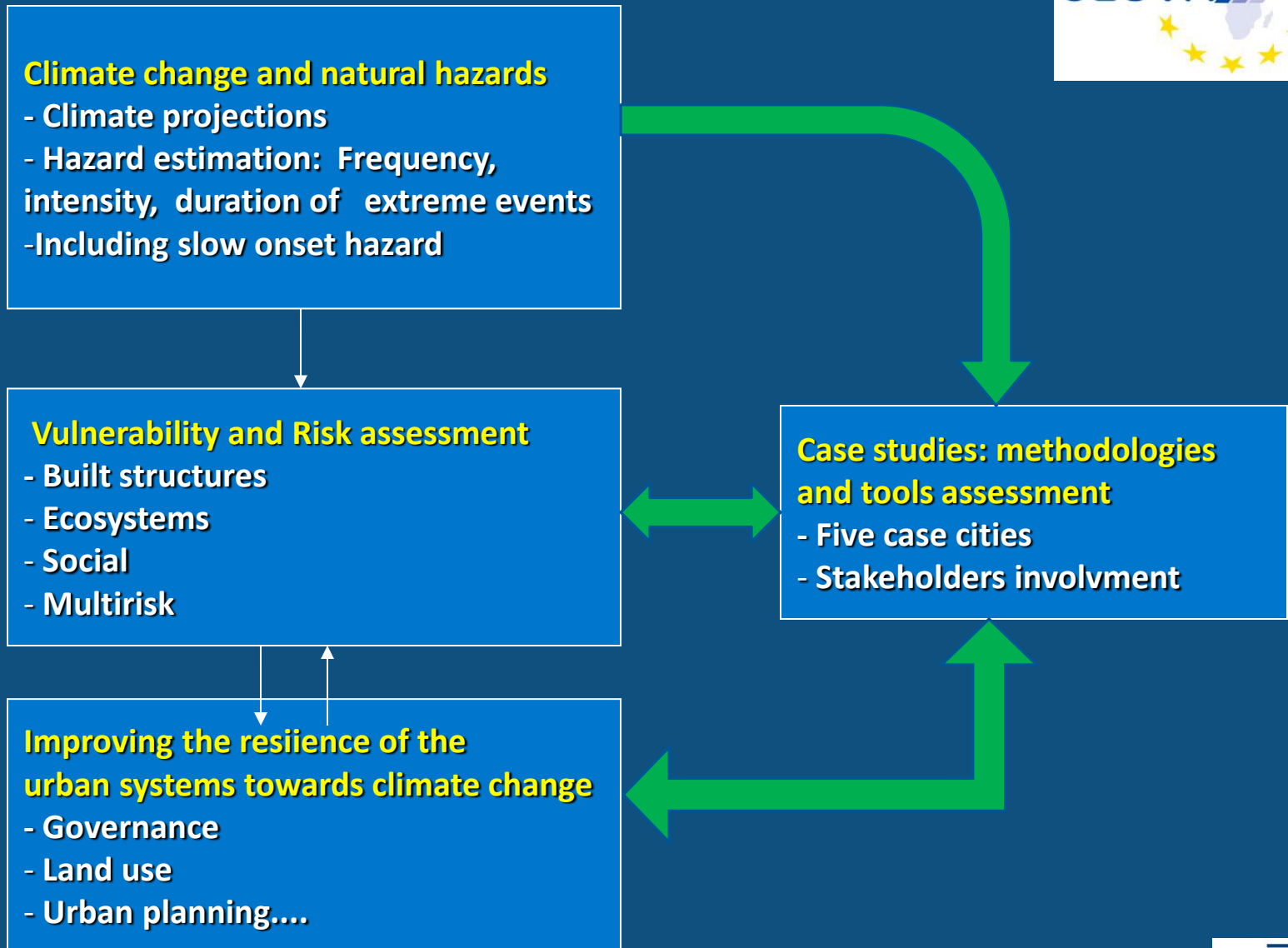
# Project data and context

## Expected major Project's results



- Up-to-date sub-regional climate models
  - Observing system will be proposed to further validate the local models
- Methodology and tools for multiple vulnerabilities assessment of African cities
- Models validated with 5 urban systems
  - Risk/vulnerability assessment and mapping
- Innovative holistic approaches to climate risks mitigation in Africa urban areas
- Improved African R&D capacity in the related field
- **Improved quality of policy decision making and foresight knowledge production**

# Part B CLUVA research activities



# Stakeholders workshop 1 :Presentation of the CLUVA objectives by the local team



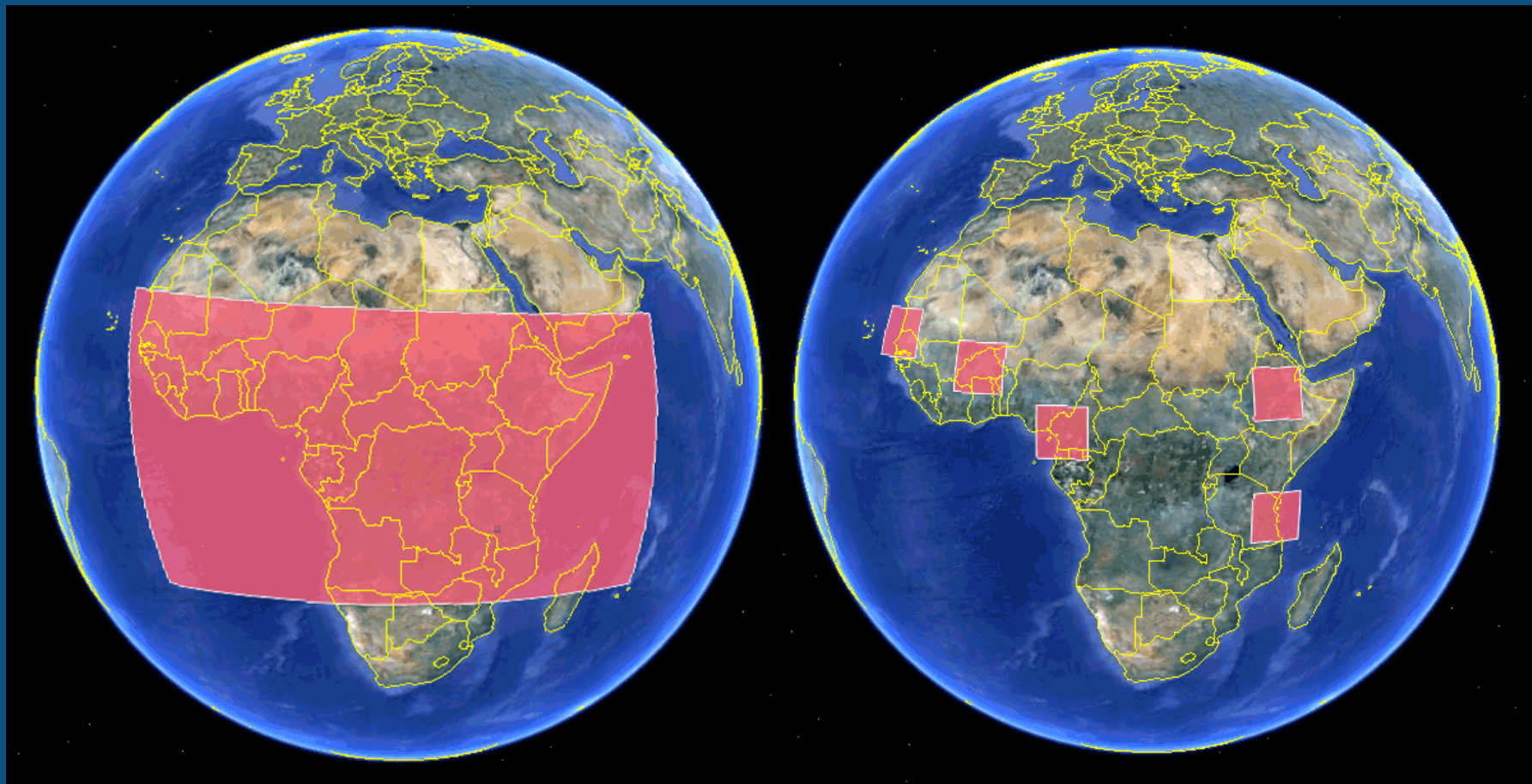
- To understand , adapt and adopt the CLUVA conceptual Framework
  - Commitment to contribute to the three workshops initially planned
  - Commitment to give free access to data own by the municipality
  - Prioritize the risks to be studied by the CLUVA local team
    - In close cooperation with EU researchers
    - With some EU researchers support
    - As a stand alone activity
- Presentation by the local team of the stakeholders model of science promoted by CLUVA
  - The CLUVA science team as an honest broker of policy alternatives
  - To foster longer term cooperation between the local university and the local policy makers



- Part A project data and context
- **Part B multi-disciplinary research activities**
  - Step 1 Climate change assessment
  - Step 2 Climate related hazard assessment
  - Step 3 Multi-dimensional vulnerability
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# step 1 Climate Change assessment

## Downscaling from 200km to 80-8-1 km grid



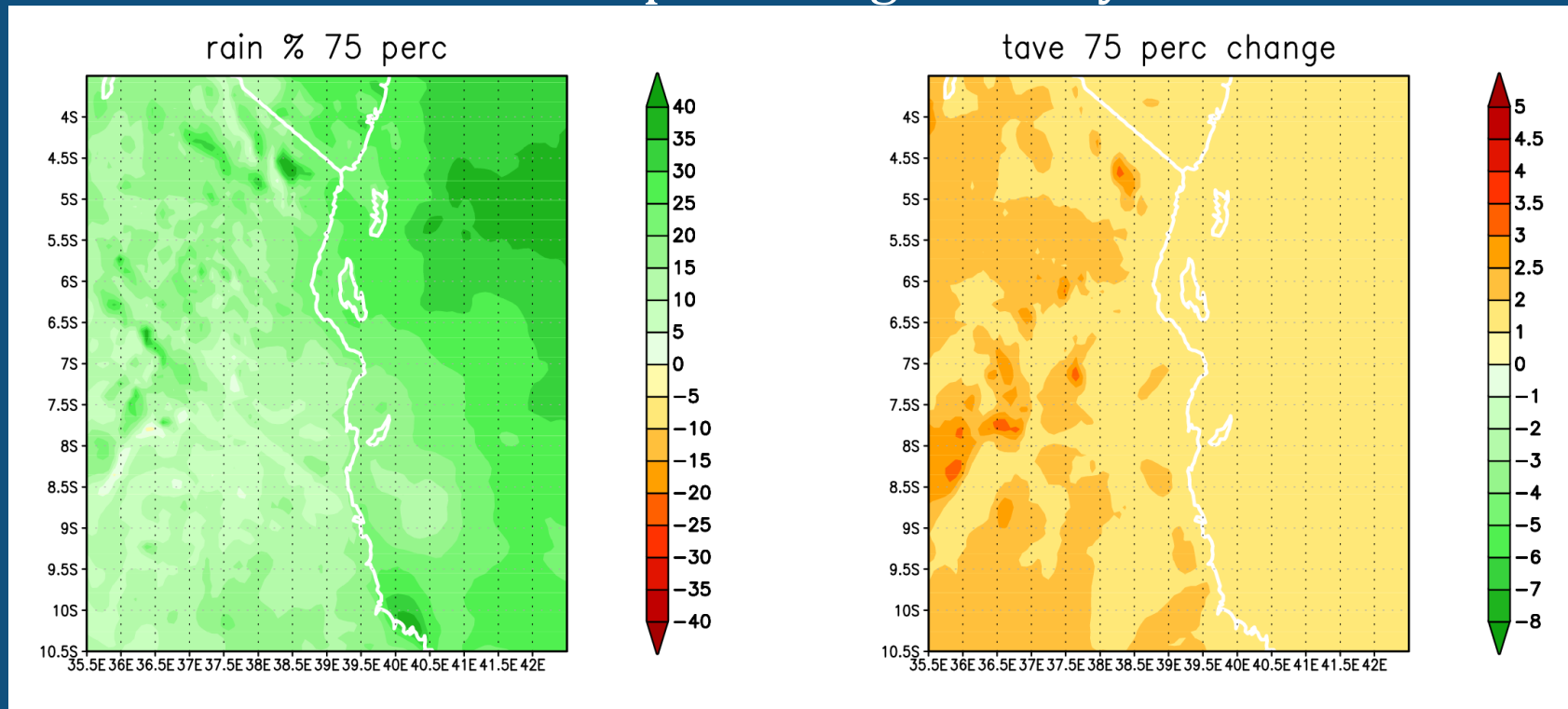
# Step 1 Example Dar es Salaam



Projected change in annual rainfall and temperature  
2040s vs 1960s

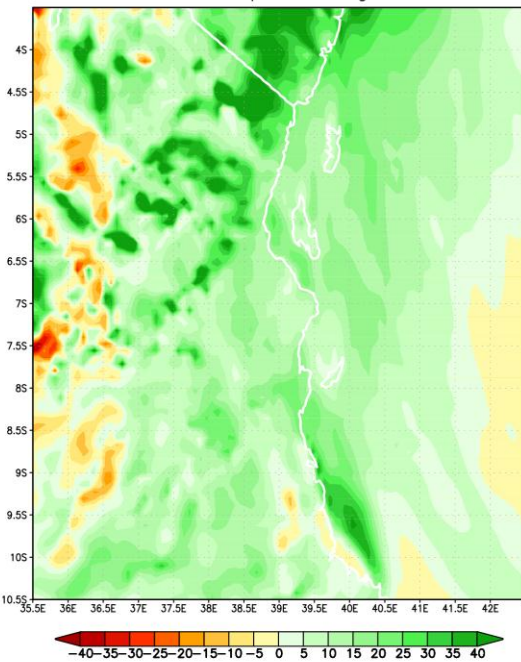
Robust message across ensemble of an increases in rainfall in the  
north

Moderate increase in temp:  $\sim 2$  degrees C by the 2040s

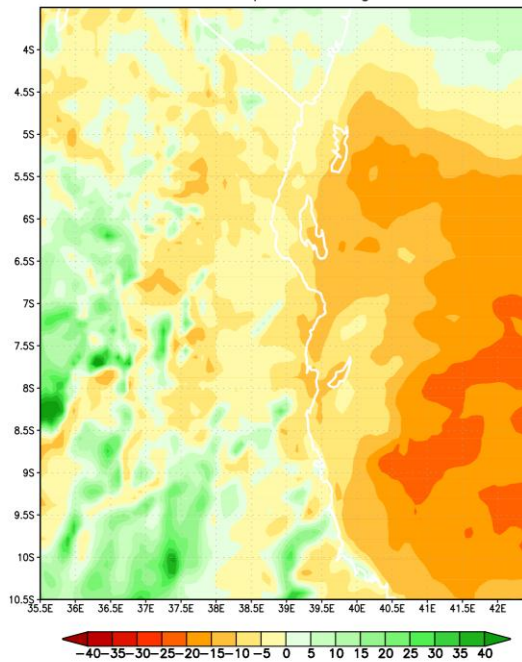




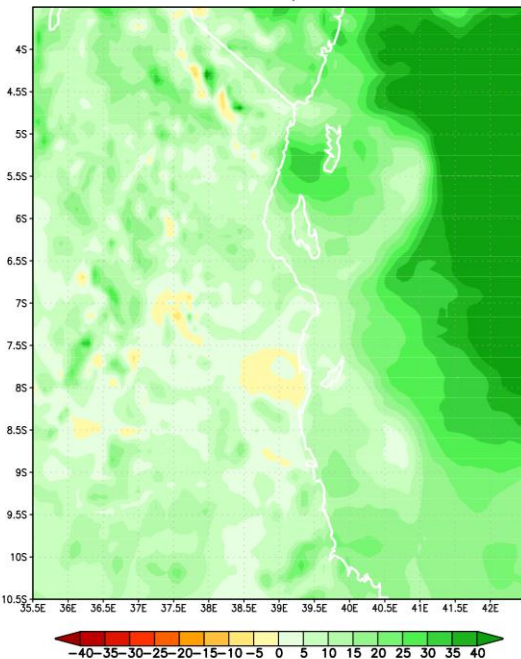
rain % 50 perc change JJA



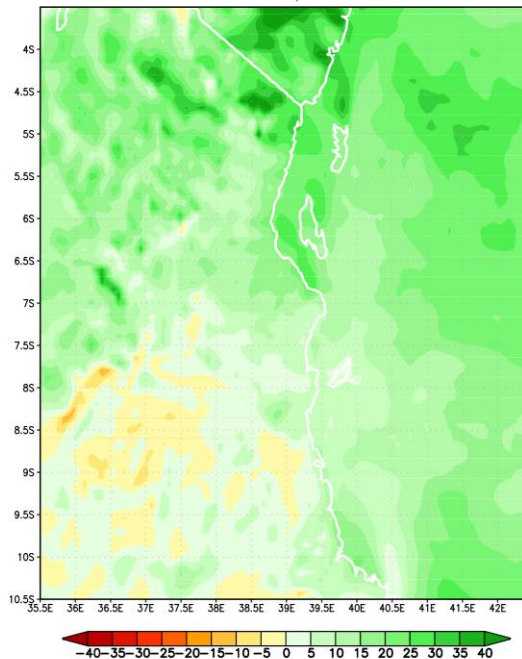
rain % 50 perc change SON



rain % 50 perc DJF



rain % 50 perc MAM



# Step 1

## Dar es Salaam



Projected change in  
rainfall across seasons  
- 2040s vs 1960s

Median of ensemble  
projects relatively large  
increases in rainfall – all  
seasons except (spring)

Available at

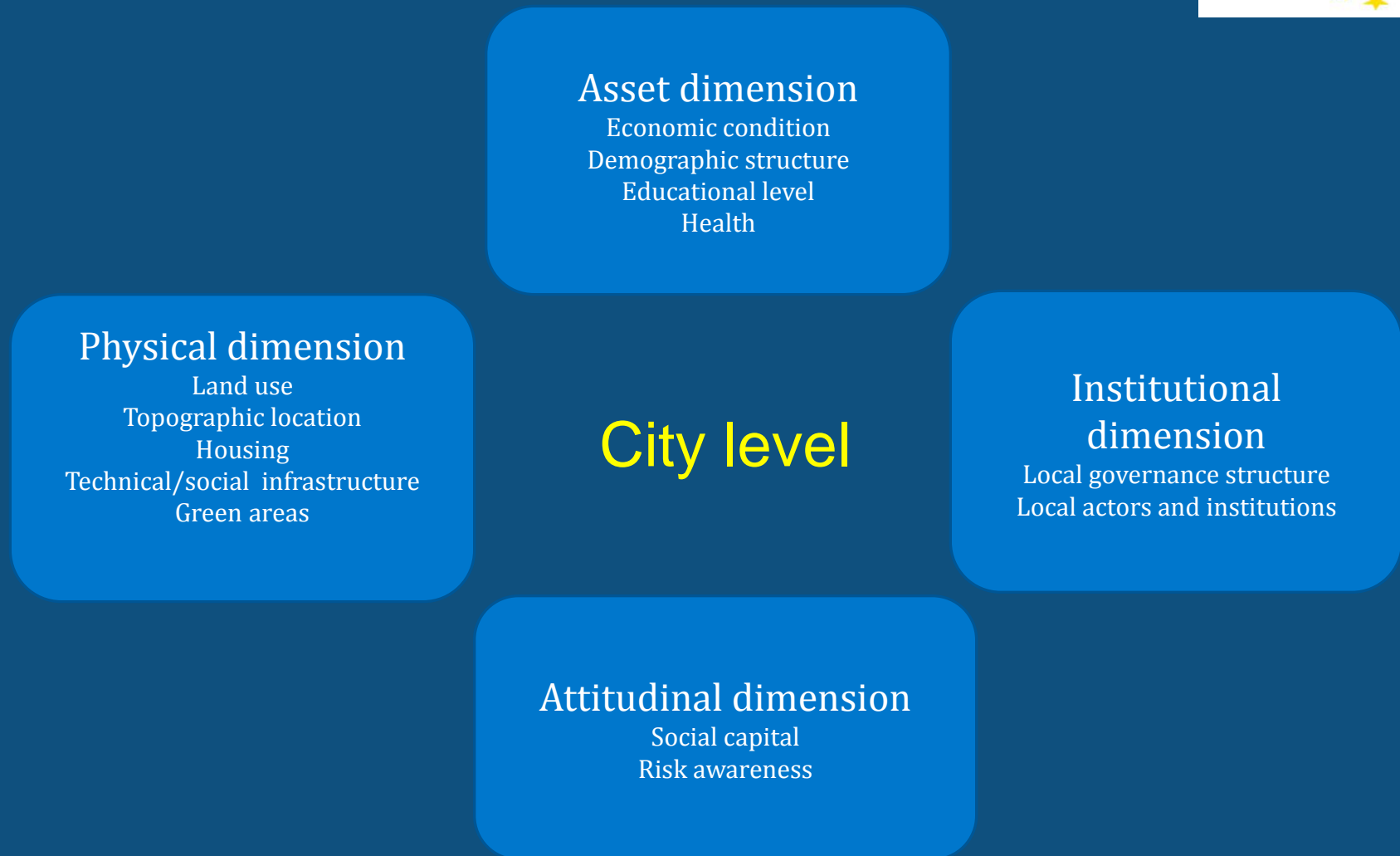
<http://ict4eo.meraka.csir.co.za/cluva>

## Step 2 Climate-related hazard assessment

1. Extreme meteorological events (Temperature, rain, wind)
2. Flooding
3. Droughts
4. Desertication
5. Sea level rise (impact on flood risk and coastal erosion)
6. Cyclones

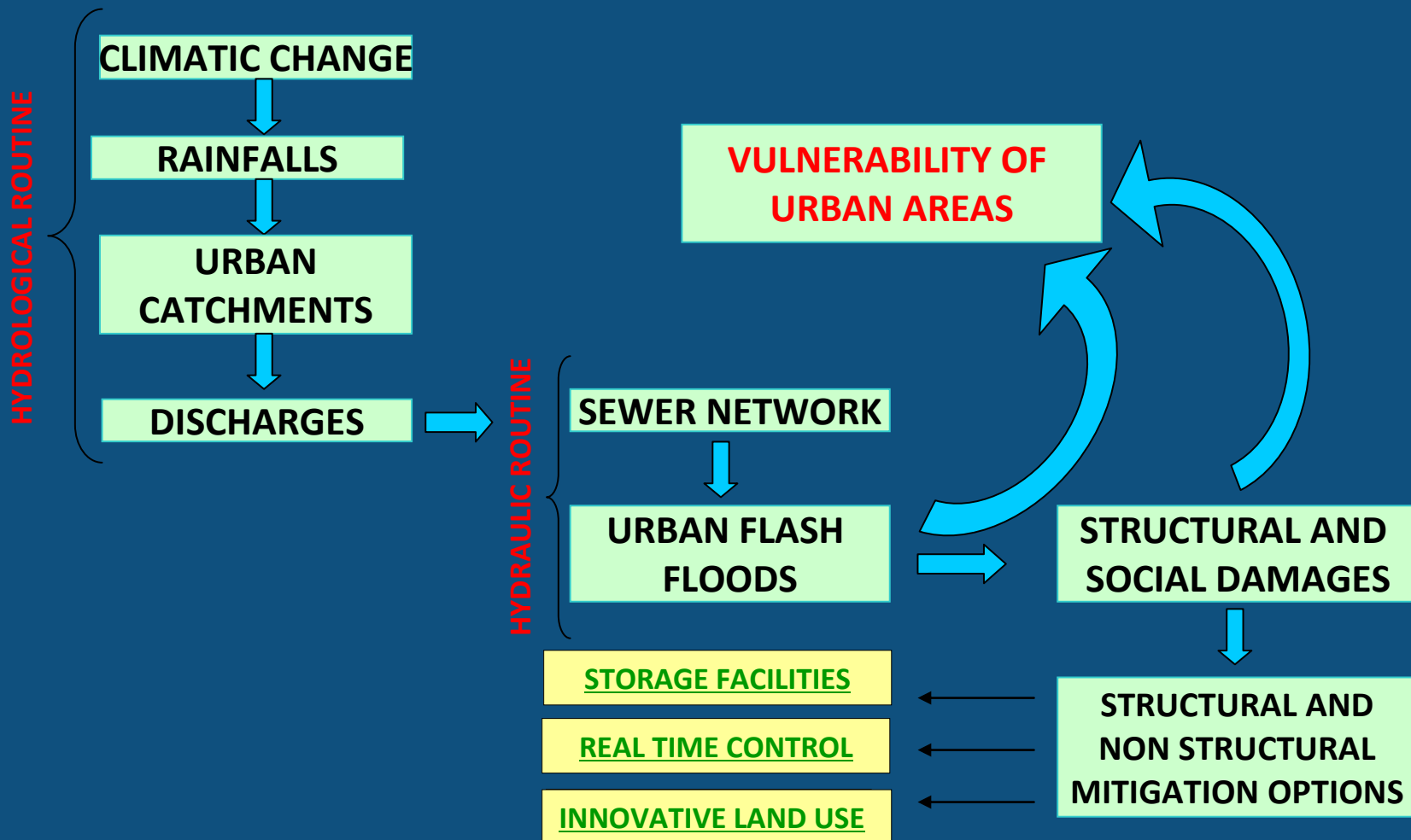


# Step 3 Multi-dimensional vulnerability

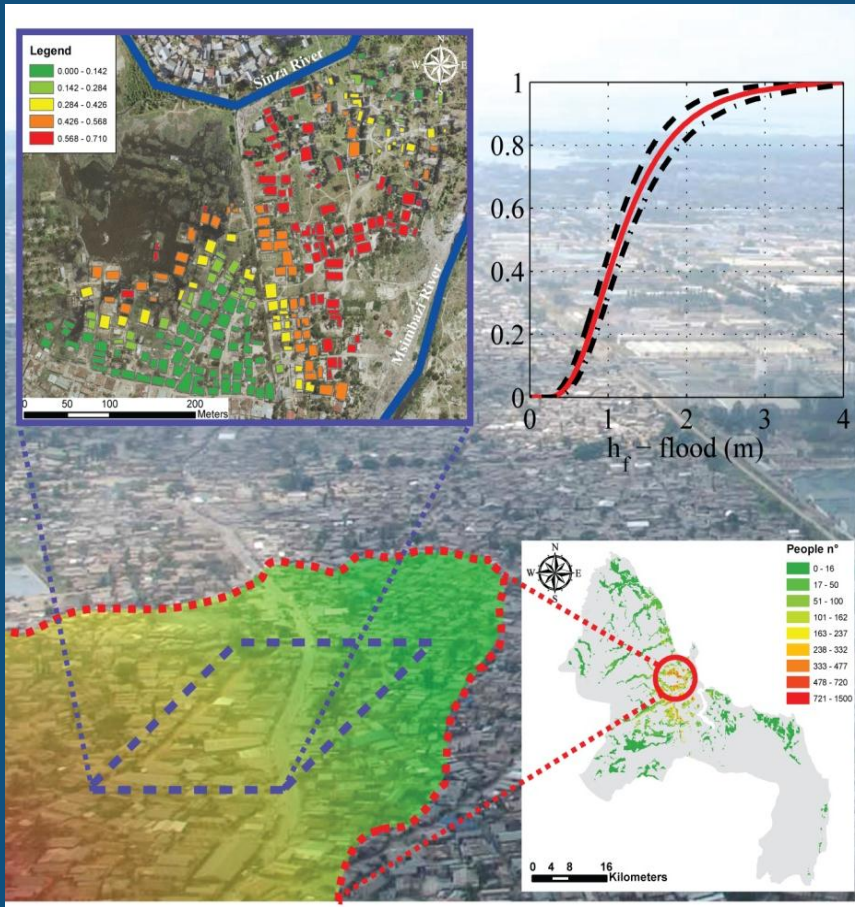


# Step 3 Physical Dimension

ex. physical vulnerability ( to flood)



# Step 3 Physical dimension Vulnerability of buildings and lifelines





# Step 3 Physical Dimension the green infrastructure



Well defined green structures are part of this definition but assessing city-wide functions requires an idea of the green structures within all urban land types not just those which are wholly or mainly 'green'



# Step 3 Assets and Attitudinal dimension

## Local expert surveys



Dar July 2012



Municipality officials and University staff



Community representatives and households



# Step 3 attitudinal / asset dimensions social vulnerability field surveys



With the support of local stakeholders





# Tools for mapping vulnerabilities : UMTs

UMT's integrate ecological and social features and functions within homogeneous spatial units



2.3 Riverine



2.4 Mangrove



5.1 Major road corridor



7.1 Condominium



7.2. Villa & single-storey



7.3 Mud/wood/sand brick



# Mapping vulnerabilities

## UMT map for Dar es Salaam



### Urban Morphology Types

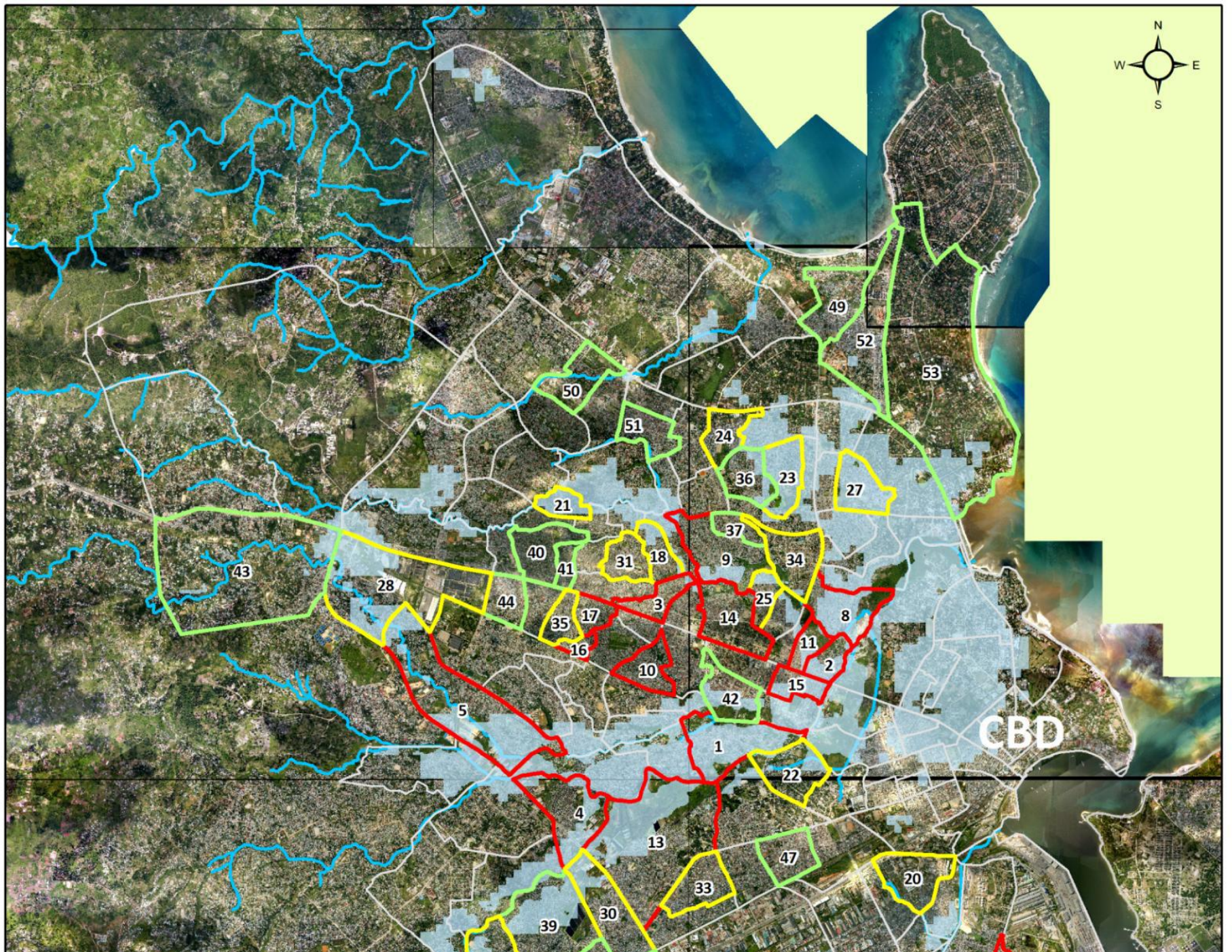
- |                                            |                               |
|--------------------------------------------|-------------------------------|
| 1.1 Horticulture                           | 8.3 Religion                  |
| 1.2 Field Crops                            | 8.4 Institutional             |
| 1.3 Mixed farming                          | 9.1 Malls                     |
| 2.2 Mixed forest                           | 9.3 Open markets              |
| 2.3 Riverine, valleys                      | 10.1 Manufacturing            |
| 2.4 Mangrove                               | 10.2 Offices                  |
| 2.5 Bushland                               | 10.3 Storage and distribution |
| 3.1 Mineral workings/quarries              | 10.4 Garages                  |
| 4.1 Parks                                  | 13.1 Marsh/swamp              |
| 4.2 Stadium & festival sites               | 14.1 Hotels                   |
| 4.3 Beach                                  | 15.1 Military                 |
| 4.4 Other open space                       |                               |
| 4.5 Sports ground                          |                               |
| 5.1 Major road corridor                    |                               |
| 5.2 Airports                               |                               |
| 5.3 Rail                                   |                               |
| 5.4 Port                                   |                               |
| 5.5 Bus stations                           |                               |
| 6.2 Water tanks & treatment                |                               |
| 6.3 Refuse disposal                        |                               |
| 6.4 Cemeteries                             |                               |
| 7.1 Condominium & multi-storey             |                               |
| 7.2 Villa and single storey stone/concrete |                               |
| 7.3 Mud/wood/sand brick construction       |                               |
| 7.4 Mixed                                  |                               |
| 7.5 Scattered settlement                   |                               |
| 8.1 Education and culture                  |                               |
| 8.2 Medical                                |                               |



0 5 10 20 Kilometers







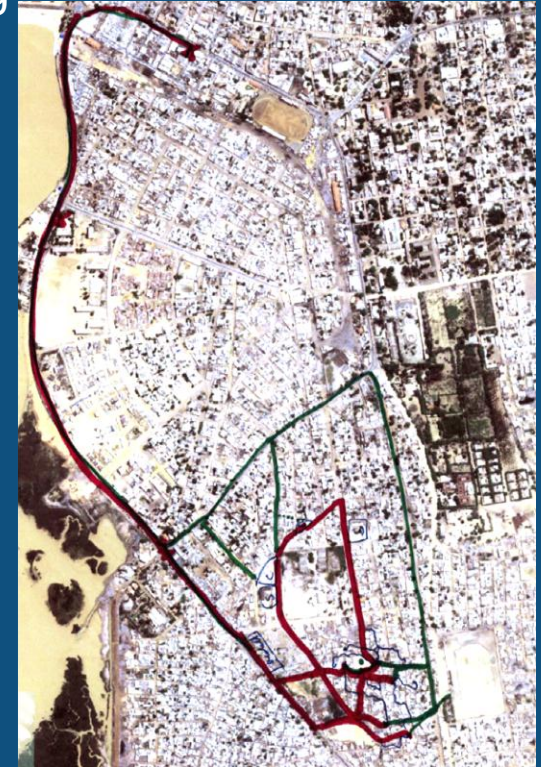


# Mapping vulnerabilities: hotspot areas selection of vulnerability indicators St Louis



Stakeholders meeting on multirisks modeling and mapping

- What makes people vulnerable – some results?
  - Low accessibility to main raised tarmac roads
  - Low accessibility to open raised areas for refuge during floods
  - Inefficient local district councils to organise relief during floods and to push the city council to invest in local technical infrastructure



**All meeting with stakeholders  
Are multi-disciplinary**

## Step 3 Institutional Dimension of vulnerability

### Governance challenges (Dar es Salaam)



- Unclear organisation at national level (overlapping authorities)
- Lack of vertical cooperation and decentralisation of decisions
- No mechanisms in place for co-ordination vertically and horizontally
- Lack of operational capacity in disaster risk management,
- lack of DRM knowledge among urban planners
- Public Participation not working properly
- Lack of capacity to establish Public Private Partnerships
- Strategic Plan never approved – master planning prevails

## Step 4 Combining vulnerabilities

### Geographical indicators



- ‘Indicator, of which the origin of the proxy variable can be identified by means of x and y coordinates, set in a geographic reference system’. Map based on indicators
- Good for spatially differentiated decisions
- Easy to grasp for non-experts – effective communication
- Easy data capture potential
- Spatial presentation of multiple -dimensional vulnerability
- Availability of geocoded data
- How to include qualitative data collected in smaller areas?

# Step 4 Combining vulnerabilities

## Geographical indicators



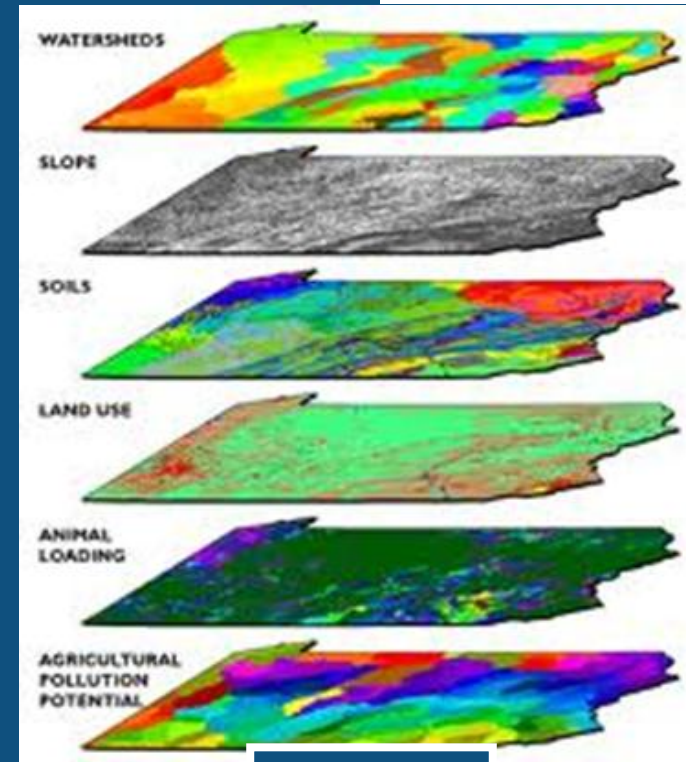
- Multi-dimensional vulnerability indicators, Physical, assets, institutional, attitudinal
- Reduction: Which are related to the vulnerability of CLUVA cities? Do they fulfill criteria?
- Integrate in a GIS system towards geographical delineation of multiple indicators - statistical analysis - combined vulnerability maps – identification of hot spots.



## Step 4 Combined vulnerability indicators

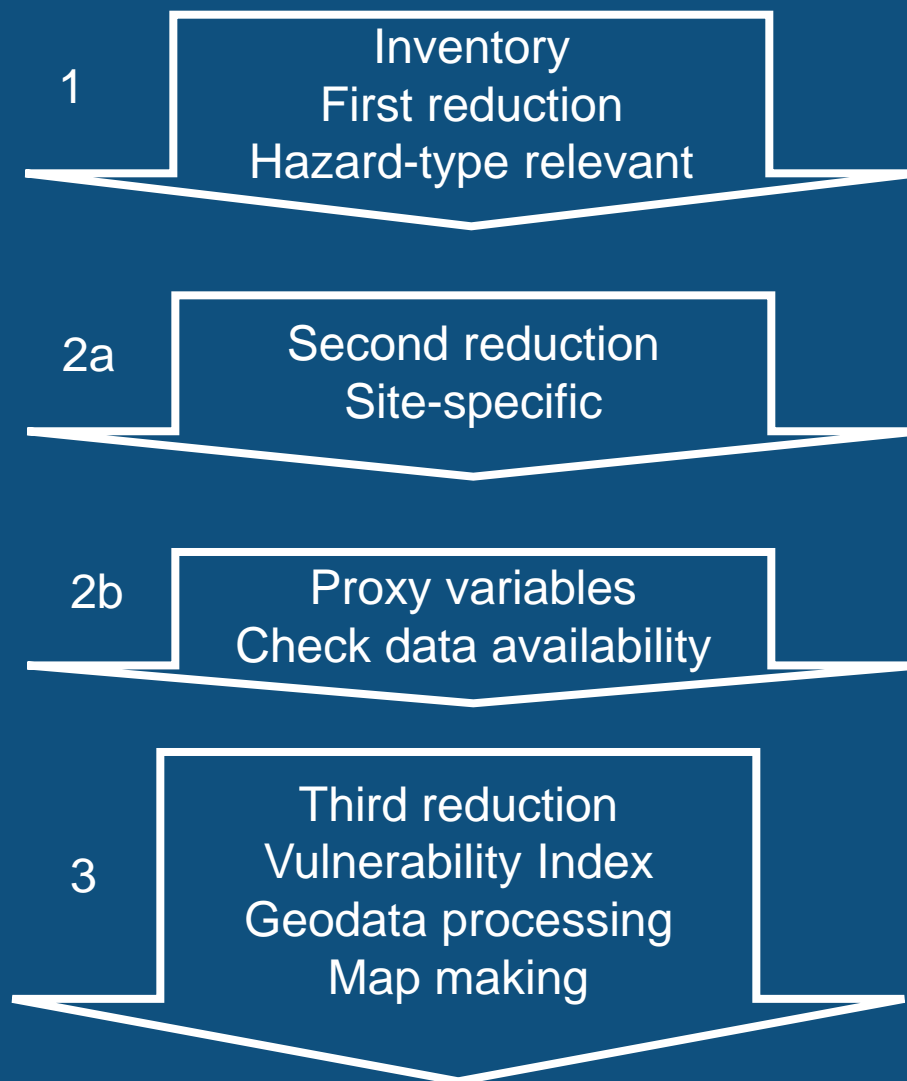


- Ranking of indicators
- Further data collection, generation and processing
- Statistical analysis, creation of index
- Maps part of the basis for urban strategies





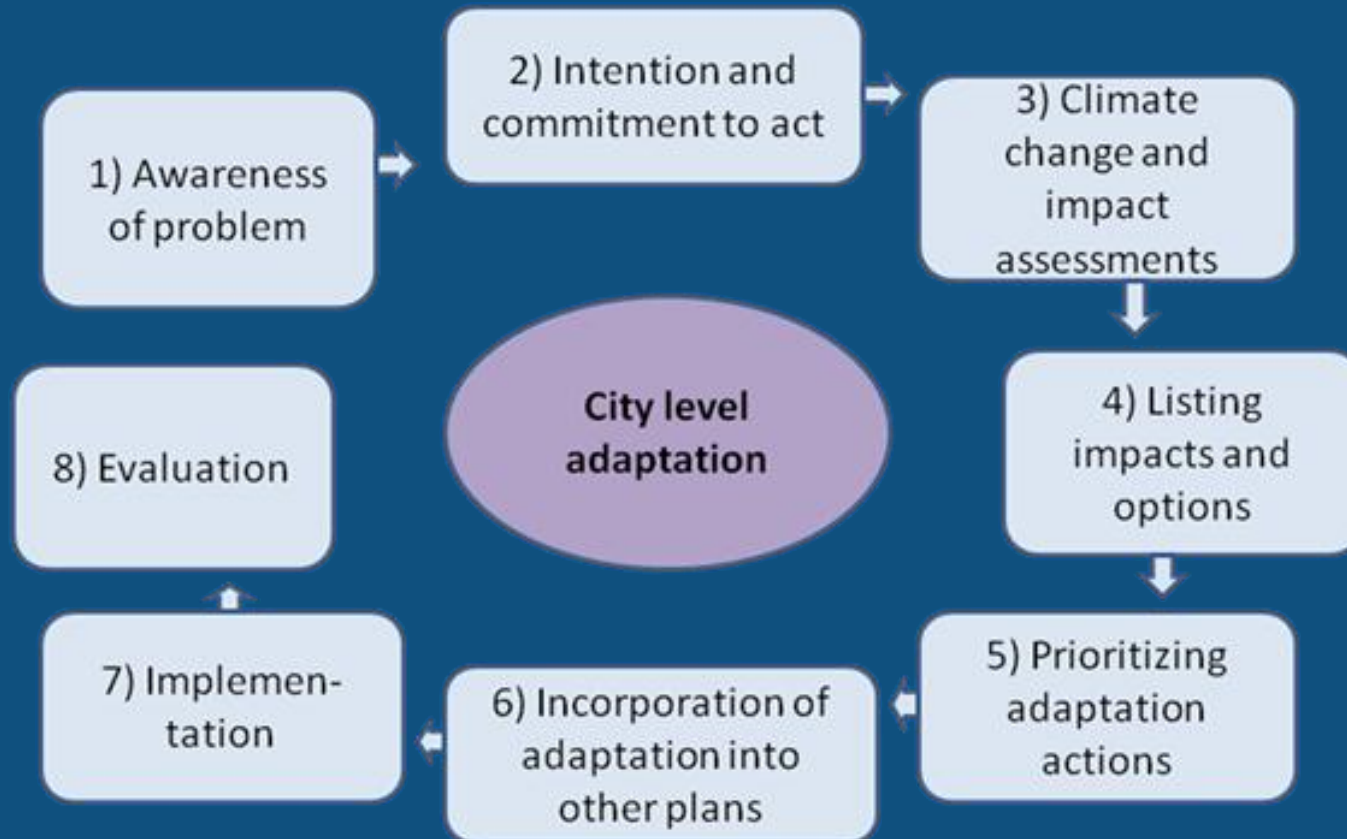
# Step 4 A stakeholders-based approach



- Literature study  
Expert survey  
St. Louis, Dar,  
Addis 2011
- Local expert survey  
St Louis nov 2011  
Ranking/Weighting  
Dar July 2012
- Data collection  
Some data collected  
Field surveys  
St. Louis mobility measurements
- Validation  
Statistical Analysis

Sharing with stakeholders 4<sup>th</sup> Stakeholders meeting

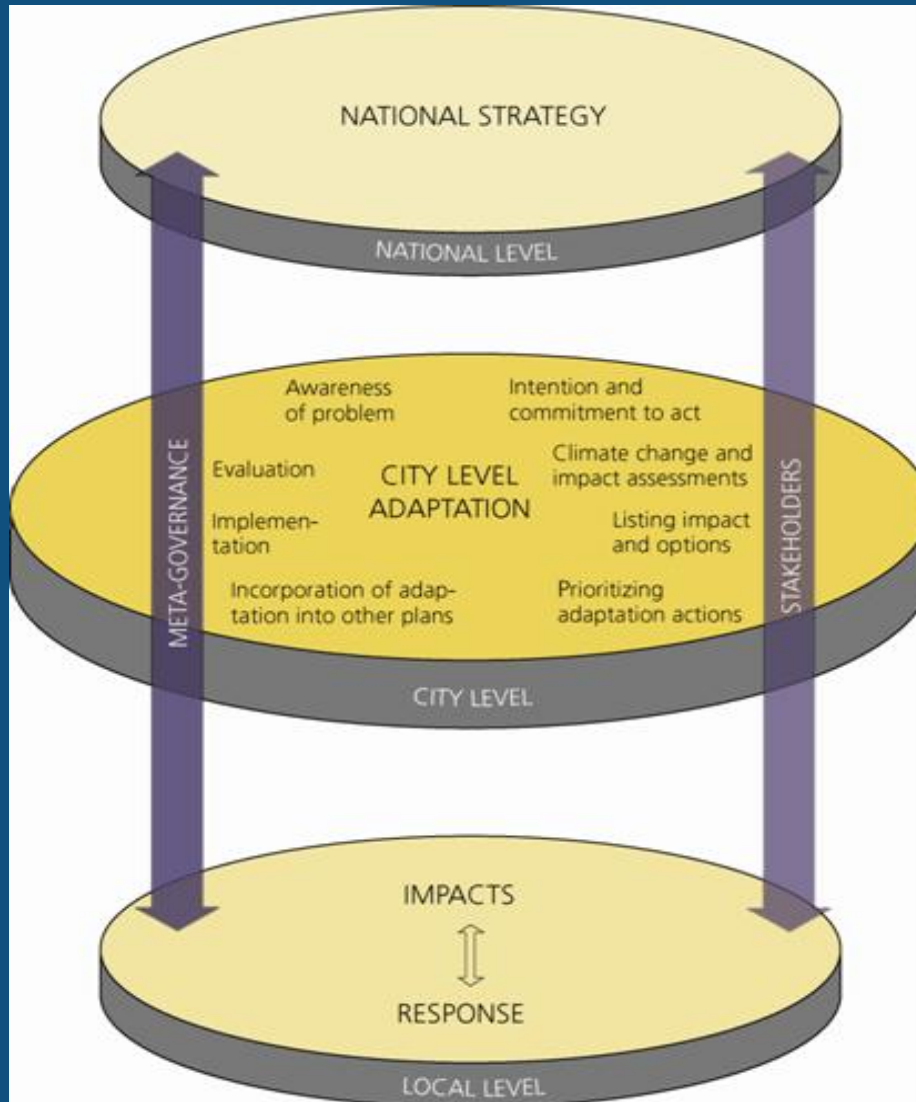
## Step 5 : adaptation to climate Change



Inspired by UN Habitat 2011, Bicknell et al. and city adaptation plans



# Step 5 Recommendation for Adaptation Governance



- new area within urban planning
- What works in one city may be infeasible or even irrelevant in another city
- Dependent on coordination between different governance levels and sectors
- Dependent on involvement of various stakeholders

# CLUVA agenda



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- **Part C strengthening links between research, practice and policy making**
- Conclusion

## Part C : Strengthening links between Research, Practice and Policy making



- CLUVA is aimed at producing foresight knowledge in support of climate adaptation policies
- In the field of environment and more specifically climate change, science is key to identify and assessing issues, exploring potential solutions and ultimately legitimate policy interventions
- Research in CLUVA is conducted in close cooperation with the policy makers at the city or the region level
- It will allow for an increase in transparency and accountability and the promotion of evidence based policy making
- Case study reports aims at translating research finding in policy support documents

# How to produce exploitable foresight knowledge?



- How to device a real scientist/policy maker interface
  - failure of African scientists to influence development agendas and development practices (so far)
  - authorities are over-protective when it comes to sharing data
  - Most past research projects did not address issues of policy relevance and were not geared to work out problems within a policy timescale.
- Critical success factors.
  - A strong political will on both side university- local authorities
  - Using and improving existing interfaces
  - Operate at all stage of the policy making process
    - Early warning, Issue identification ( done by CLUVA)
    - Policy design, implementation, assessment and review ( very first draft)

# How to deal with complexity

## Climate change specific issues 1



- Complex far-from equilibrium socio-ecological-economic system
  - Non linear interconnected causal relationship
  - Irreducible uncertainties, indeterminacy, ignorance
  - Irreversibility
- Large temporal and spatial scale
- Cross-sector
  - Wide range of actors not used to work together
- Related to a broad set of (local) values
  - Ethical, political, economic, social cultural
- Need for a local definition of precautionary principle

# How to deal with complexity

## Climate change specific issues 2



- Interconnectedness
  - A complex landscape of interconnected environmental and societal challenges:
    - Climate, poverty, food security, population growth, health, governance
    - Systemic risks both of sudden change and slow(hidden) failure)
    - Spreading of uncertainties
- **Implication for foresight knowledge production:** the team
  - be highly interdisciplinary integration of natural, social and technical science
  - should acknowledge diverse understanding and values
  - integrate local socio-political and institutional knowledge
  - recognise the uncertainties and then the limit of scientific knowledge
  - accept to operate on an evolving knowledge basis
  - needs flexibility, cooperation, sharing of best practices

# Policy report

## African Cities case studies



- Common conceptual framework:
  - Spatial analysis of the climate induced natural hazards and the exposed elements at risk ( population, economic assets including eco-systems)
    - Collection of all existing information: geological, climate, nature intensity, frequency of hazards, environment indicators, land use etc.
    - Hotspot identification and characterization per type of hazard
    - Assessment of the local institutional capacities
    - Assessment of the various vulnerabilities
    - Assessment of the current action plans
    - (The study will include the peri-urban expansion area)
  - Foresight studies of climate change impact at the 2050 horizon
    - For the selected hazards and the 6 IPCC scenarios
  - Innovative land use and governance strategies to reduce vulnerability and coping capacity

# African Cities case studies managed by the African local teams



- Final reports: 5 independent Case Study reports
- Part1: Current situation
  - Spatial analysis, risk zoning
  - Vulnerability and Institutional capacity assessment
    - Governance structure related to risk management
    - Urban planning and land use regulation
    - Exposure of economic assets
    - Exposure of the ecosystem
    - Social vulnerability
    - Current preparedness to climate change



# African Cities case studies managed by the African local teams



- Part2 : local instantiation of IPCC climate change scenarios
  - climate scenarios ( temperature wind, precipitation, humidity etc.)
  - Probabilistic natural hazard scenarios ( impact)
    - Hydro-geological, storms, heat waves, drought, sea level etc.
  - Exposure analysis ( spatial analysis per selected risk)
  - Vulnerability of urban structures and life lines
  - Ecosystem vulnerability
  - Social vulnerability
  - Understanding multi-risks
- Part 3 Adaptation and mitigation
  - Development of innovative land use
  - Governance strategies
  - Any other action to increase resilience to climate change

# Conclusion



- CLUVA has already produced valuable knowledge and methods applicable in an African context:
- Thanks to a mix of conventional research and foresight knowledge But....
- The involvement of policymakers in the research early in the process is crucial but not enough
- Tension between social-science research is prevalent in most African countries and failed so far to influence the development agenda
- Data policy has to be revisited etc....

Thank you for your attention

For more information please visit

[www.cluva.eu](http://www.cluva.eu)

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