

**United Nations International Conference on Space-based Technologies for Disaster Management  
“Risk Assessment in the Context of Global Climate Change”,  
Beijing, China, 7-9 November 2012**

**The role of remote sensing technologies  
and GIS for the disaster management and  
climate change adaptation related to  
forests resources in the Congo Basin  
countries: An overview**

**Maximilien TIOGANG DJOMO**

# Acknowledgements

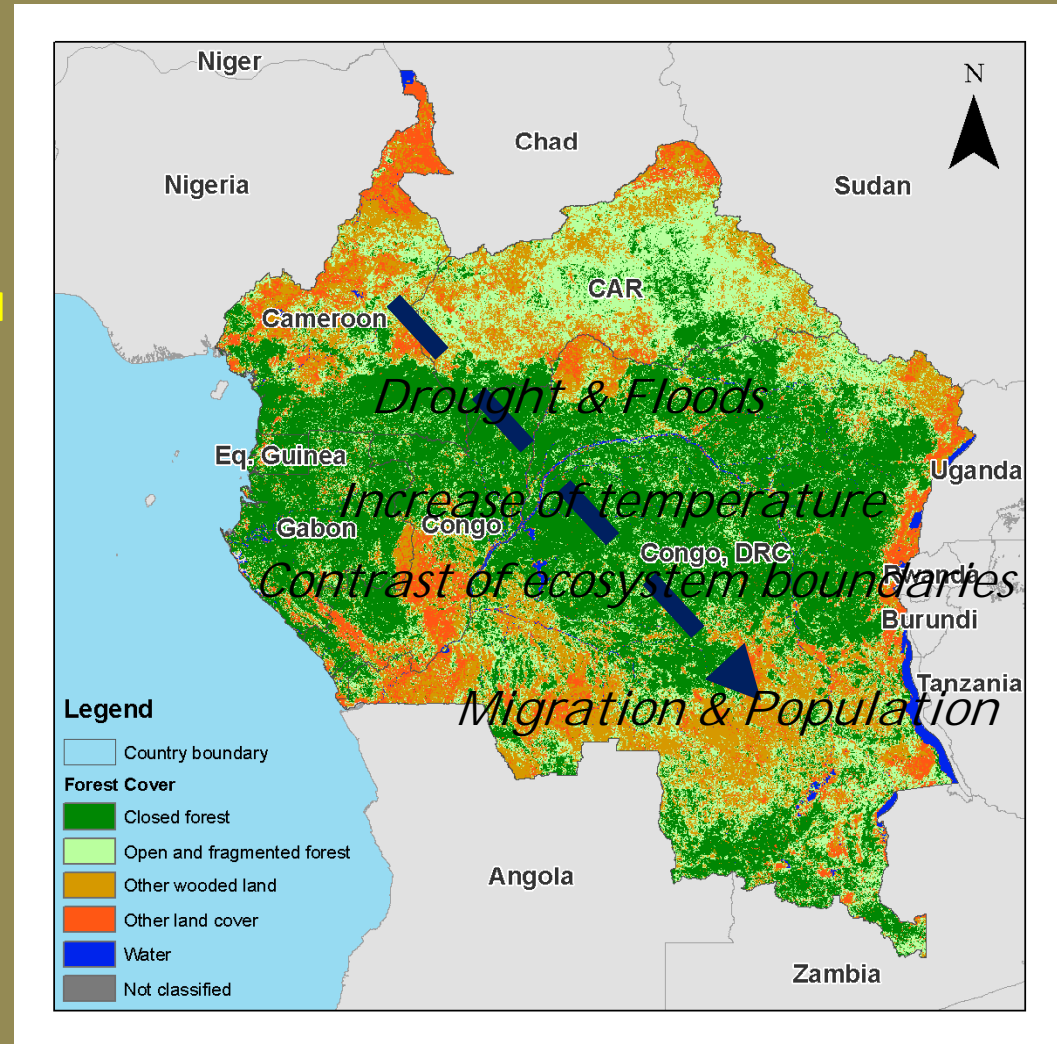
- **UNOOSA (United Nations Office for Outer Space Affairs) gives me the opportunity, with its funding support, to participate to this United Nations International Conference on Space-based Technologies for Disaster Management at Beijing, China**
- **START (Global Change SysTem for Analysis Research and Training) gives me an award within the ACCFP (African Climate Change Fellowship Program) to do a Climate Change Policy Research in the Congo Basin forests**
- **CIFOR (Center for International Forestry Research) Central Africa Regional Office as my duty station and my host institution**
- **MINEP (Cameroon's Ministry of the Environment and Nature Protection) as my home institution**
- **IDRC (Canada's International Development Research Center) & DFID (United Kingdom's Department For International Development), the funding donors of the ACCFP**

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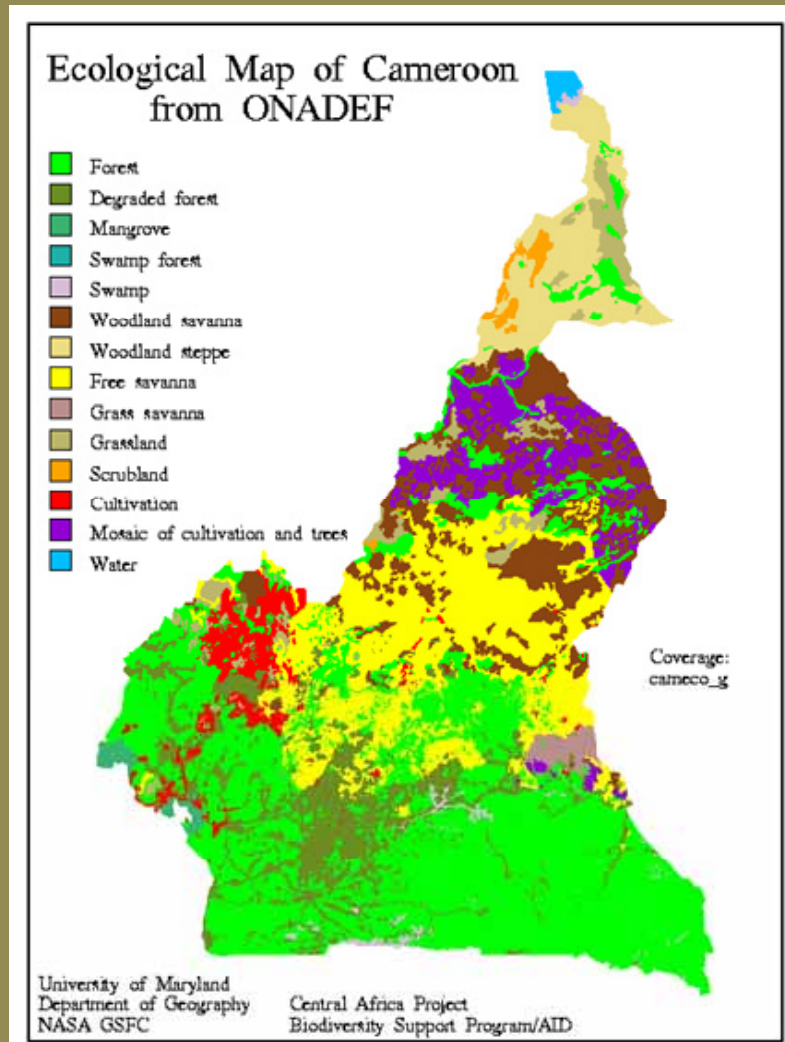
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# Introduction: Recognize the facts of climate change and natural disaster management in the Congo Basin forests

- The natural events and disasters in the sub-region such as floods, droughts, forests fires, landslides challenge agricultural production
- The forests of the Congo Basin contains about 25 to 30 billion tons of carbon in their only vegetation, equivalent to about 4 years of total global emissions of anthropogenic CO<sub>2</sub> (WWF, 2007)
- The consequences include :
  - Global warming & Loss of biodiversity and extinction of plants and animals
  - Loss of the absorption capacity through sequestration
  - Loss of carbon stock for adaptation and development
  - Change in the microclimate of the area with unhealthy living conditions
- Additional protection of 1% of existing forests in the Congo Basin would preserve approximately 230 million tons of carbon (WWF, 2007)



# Example of potentialities of forestry sector of Cameroon in the Congo Basin



- **Total forest area: 23 million hectares representing 51.9% of the total area (47.5 million ha).**
- **Its rainforest covers more than 40% of the national territory**
- **The forest of Cameroon is the third largest in Africa behind the forests of Democratic Republic of Congo and of Gabon**

# Why the necessity of risk assessment and mapping ?

Existence of a low level of experiences exchange in climate change adaptation and disaster management between stakeholders, including with regard to good practice (knowledge, endogenous practices, perceptions, decisions, etc.)



# Why the necessity of risk assessment and mapping ? Gradual recognition of the climate change effects in Cameroon



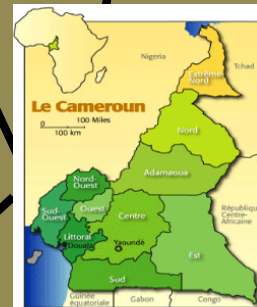
Livestock consumes the plastic



Drought and Floods



Cutted roads by falling trees



Crops lacking water



Crops devastated by fire



# Why the necessity of risk assessment and mapping ?

## Several areas are usually affected



**Habitat/Accomodation**



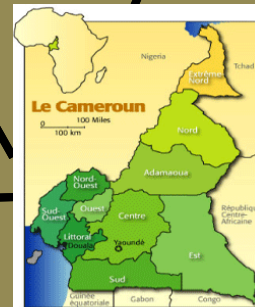
**Water**



**Feeding & Energy**



**Agriculture**



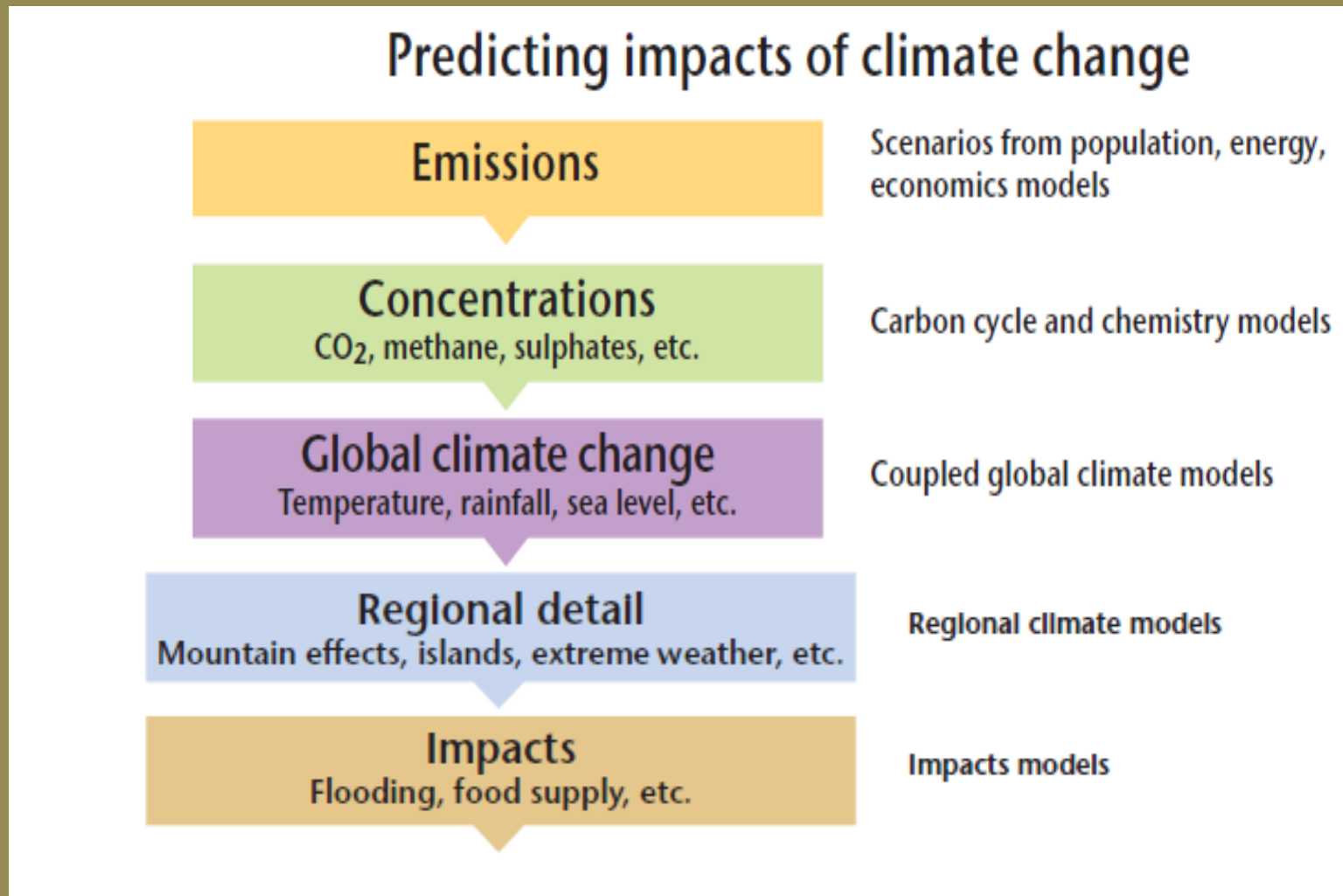
**Health**



**Livestock**

## Regional modeling

- Predicting the impact of climate change and natural disaster on the scale of the region or country



# Mapping the vulnerability of forest communities to climate change and natural hazards in the Congo Basin

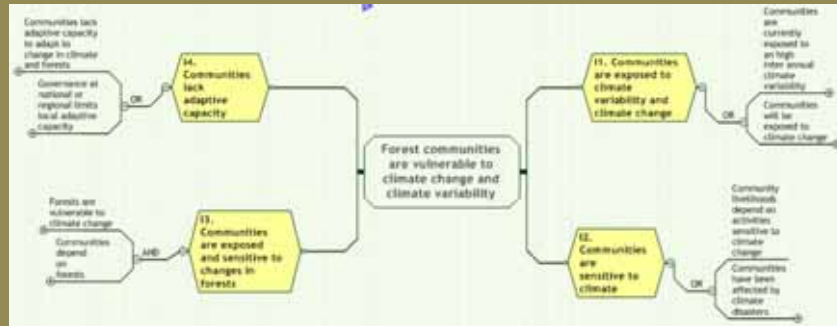
- The importance of mapping vulnerability
  - For informing decision makers and donors about priorities and sources of vulnerability
  - For targeting interventions and disaster management
  - For prioritizing places for in-depth studies
- Problem of uncertainties
  - Vulnerability is a vague concept
- Different views on the factors of vulnerability
  - Data are lacking
  - Future is uncertain
- Uncertainties in climate scenarios
- Challenge:
  - To integrate uncertainties in a rigorous way

# Overview of the method

**Expert**



**Mental model / Concept map**



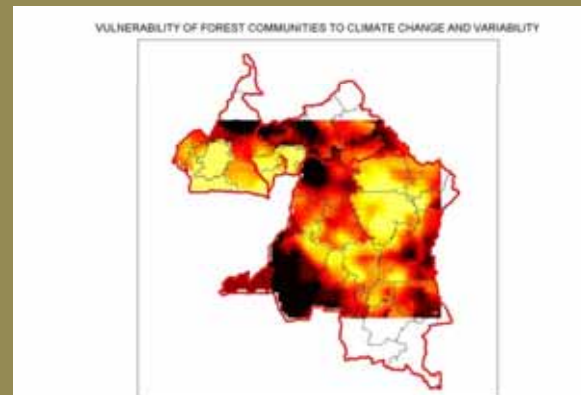
**Fuzzy inference**



**Data**



**Spatial map**



## Methods and tools used

- Expert judgment
- Conceptual mapping
- Fuzzy logic
- Indicators

### **Methods and Tools for Assessing the Vulnerability of Forests and People to Climate Change**

An introduction

Bruno Locatelli  
Hety Herawati  
Maria Brockhaus  
Monica Idinoba  
Markku Kanninen

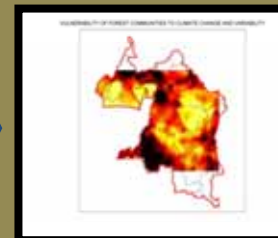
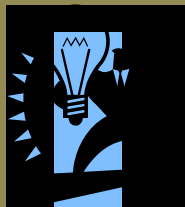
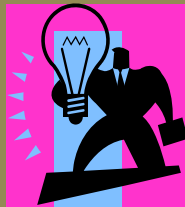
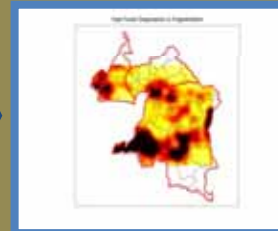


# Diversity and uncertainty

**Experts**

**Mental models**

**Spatial maps**

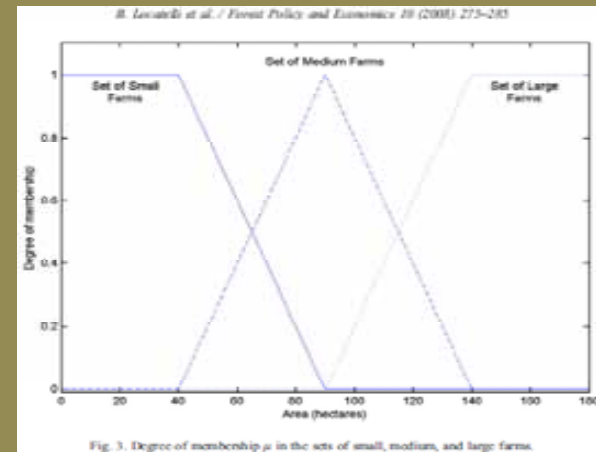


•Analysis of  
diversity of  
mental models

•Analysis of  
uncertainties on  
vulnerability  
hotspots

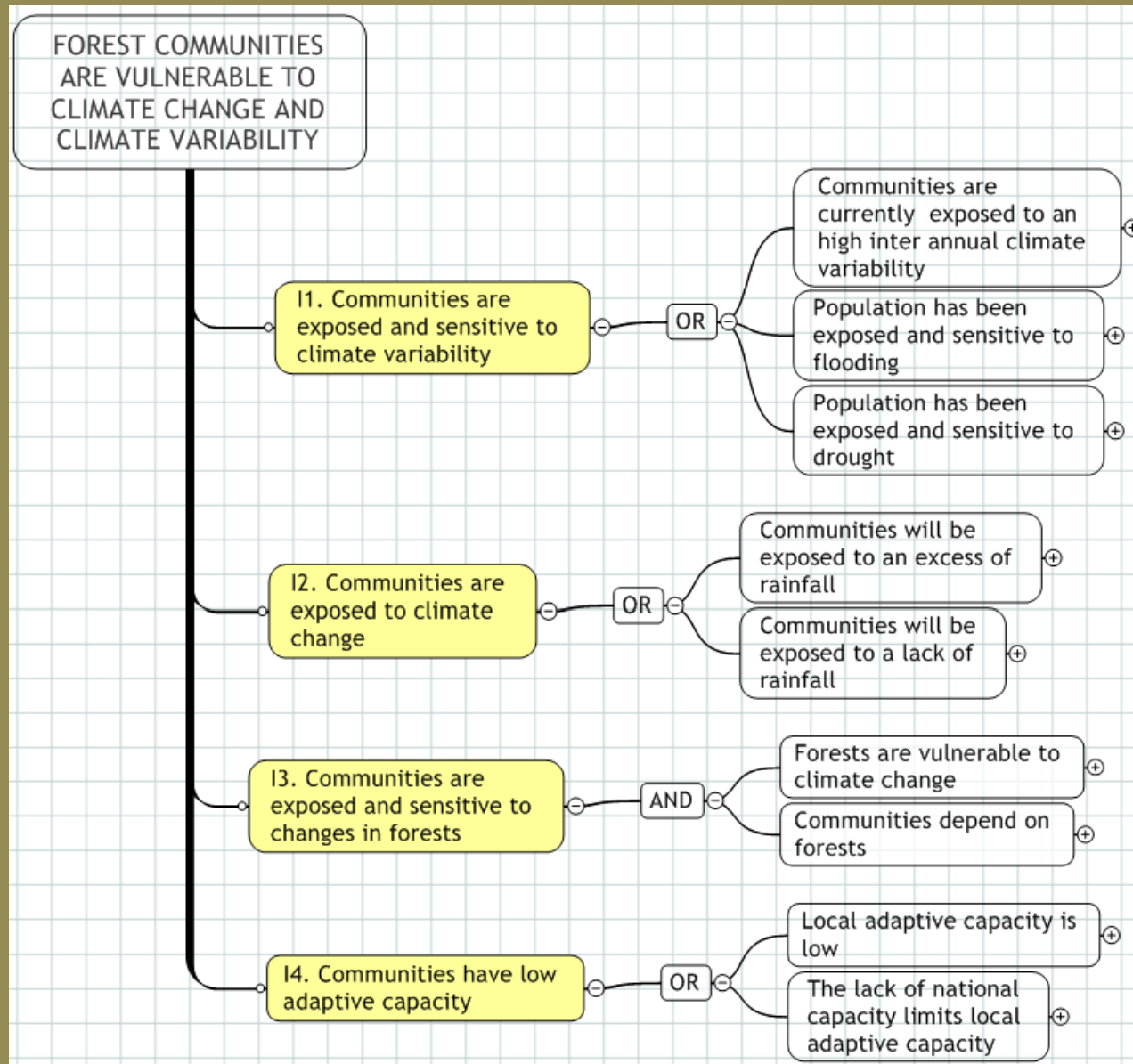
# Fuzzy inference

- Fuzzy logic allows to work with vague concepts
  - Eg. high vulnerability, low incomes... no clear definitions
- Fuzzy logic allows to handle mathematically these concepts
  - Membership functions

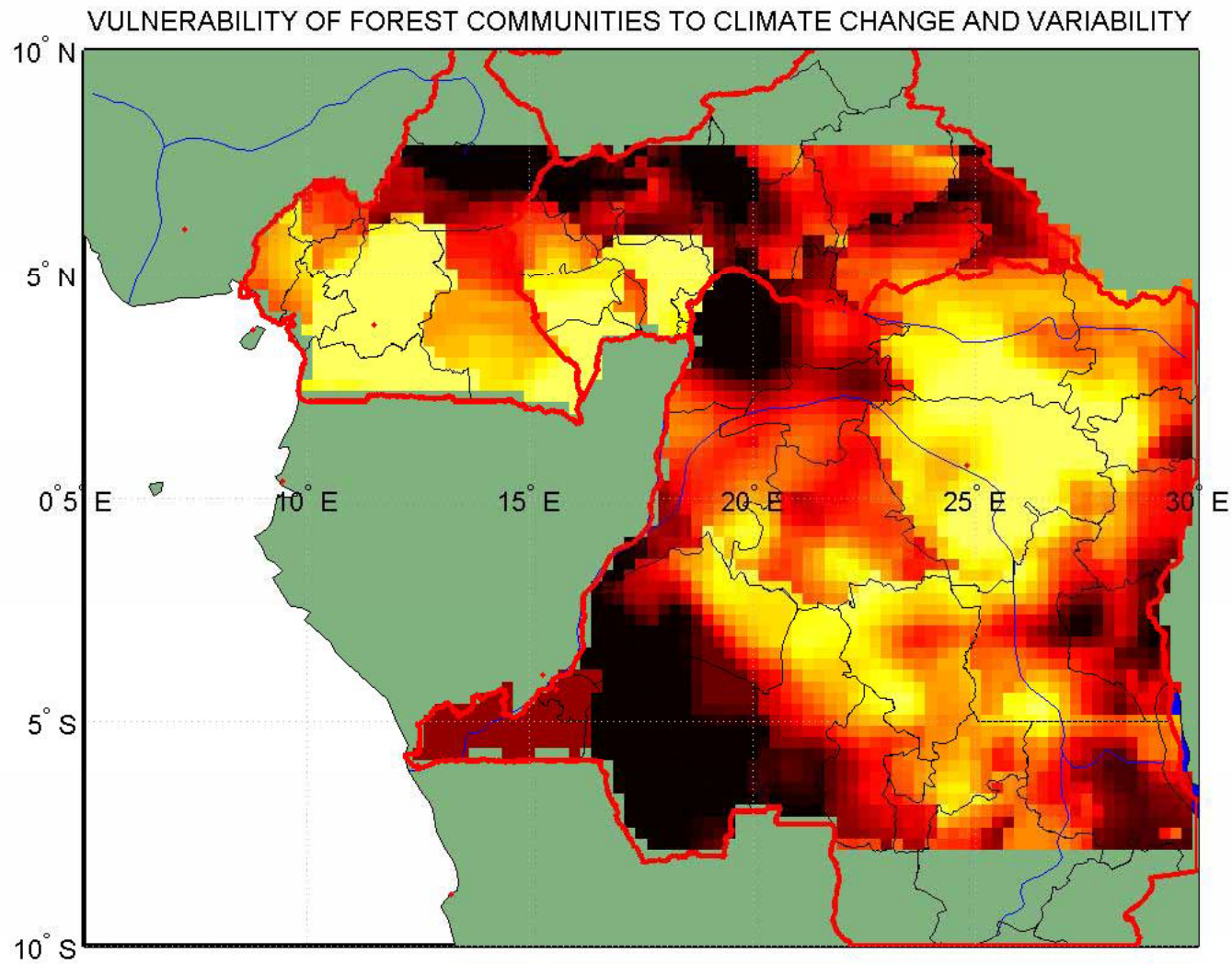


- Mental model = set of fuzzy rules
  - IF (A is low) AND (B is high) THEN (C is high)
  - IF (A is medium) AND (B is medium) THEN (C is medium)

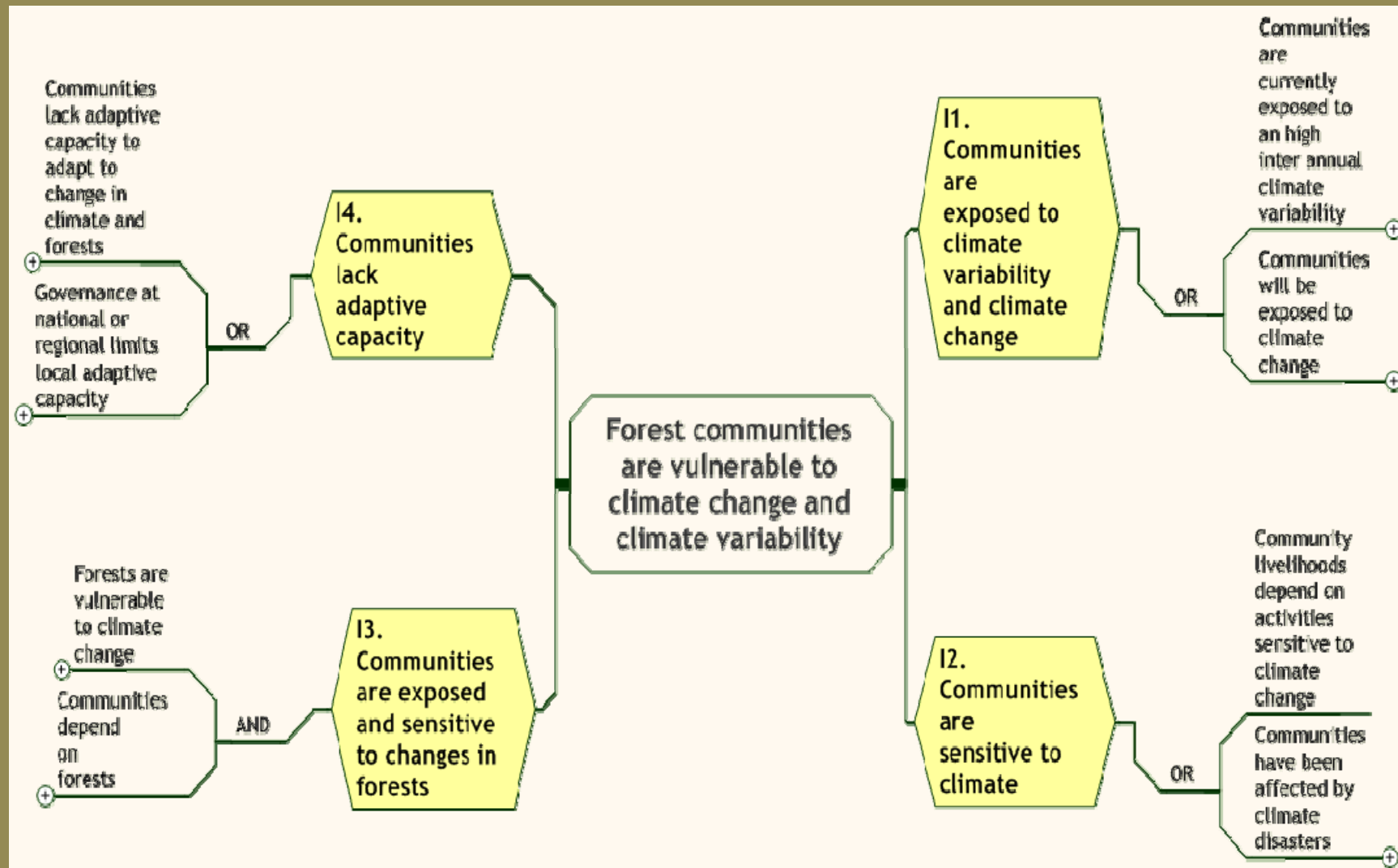
# Example of conceptual map



## Example of resulting spatial map



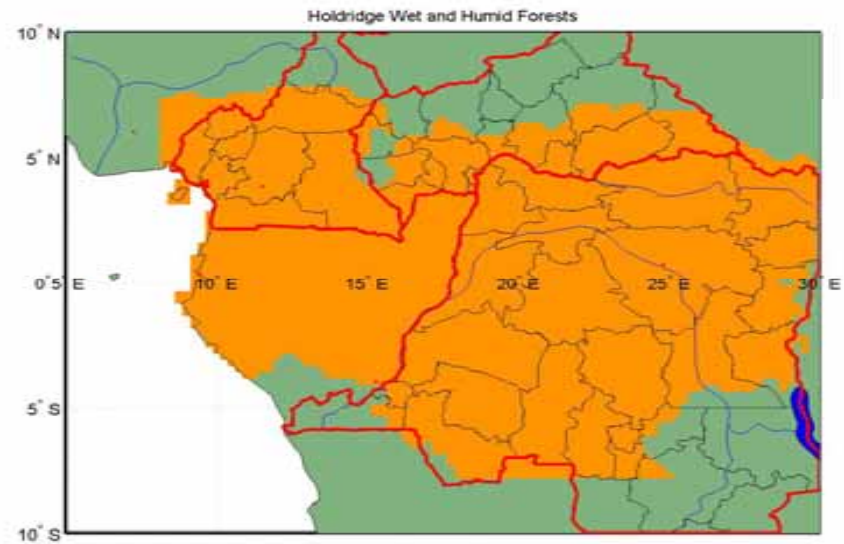
# Methods and Data



# Spatial scope

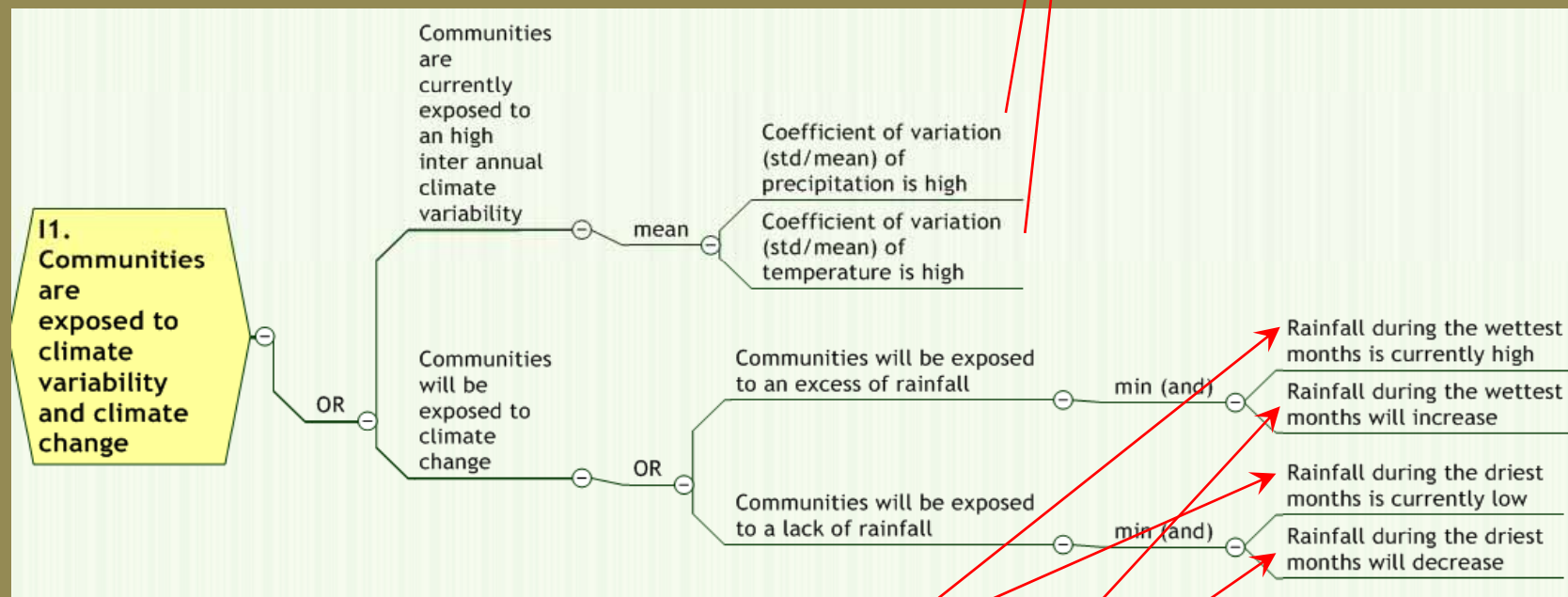


- **Area between  $-8^{\circ}$  and  $+8^{\circ}$  latitude**
- **Area with climate corresponding to wet and humid forest (Holdridge life zones)**
- **Resolution= $0.25^{\circ}$  (around 25 km)**



# I1. Climatic exposure

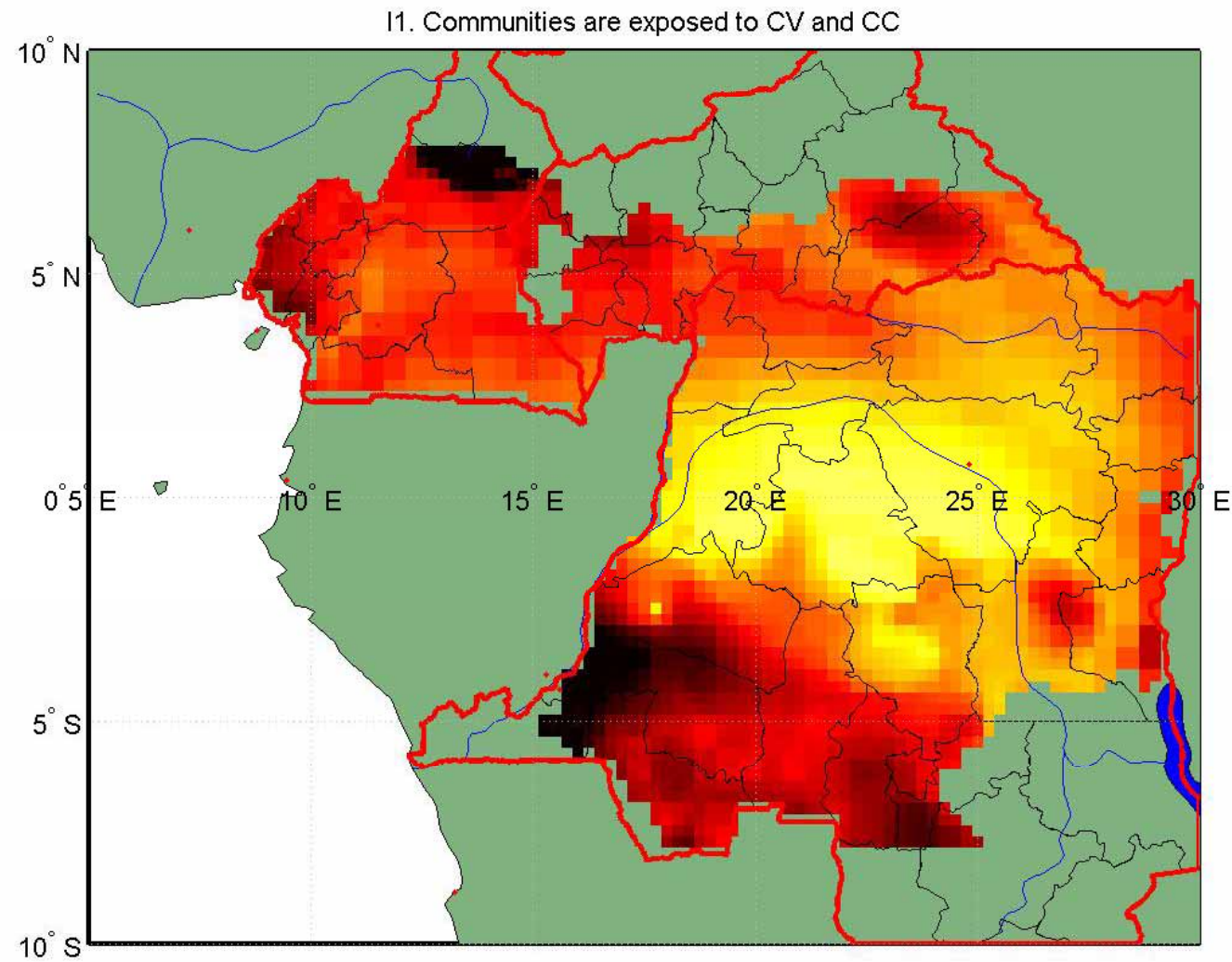
With CRU TS 2.1 (Climate Research Unit, Time Series)



With WorldClim (mean monthly climate 1950-2000)

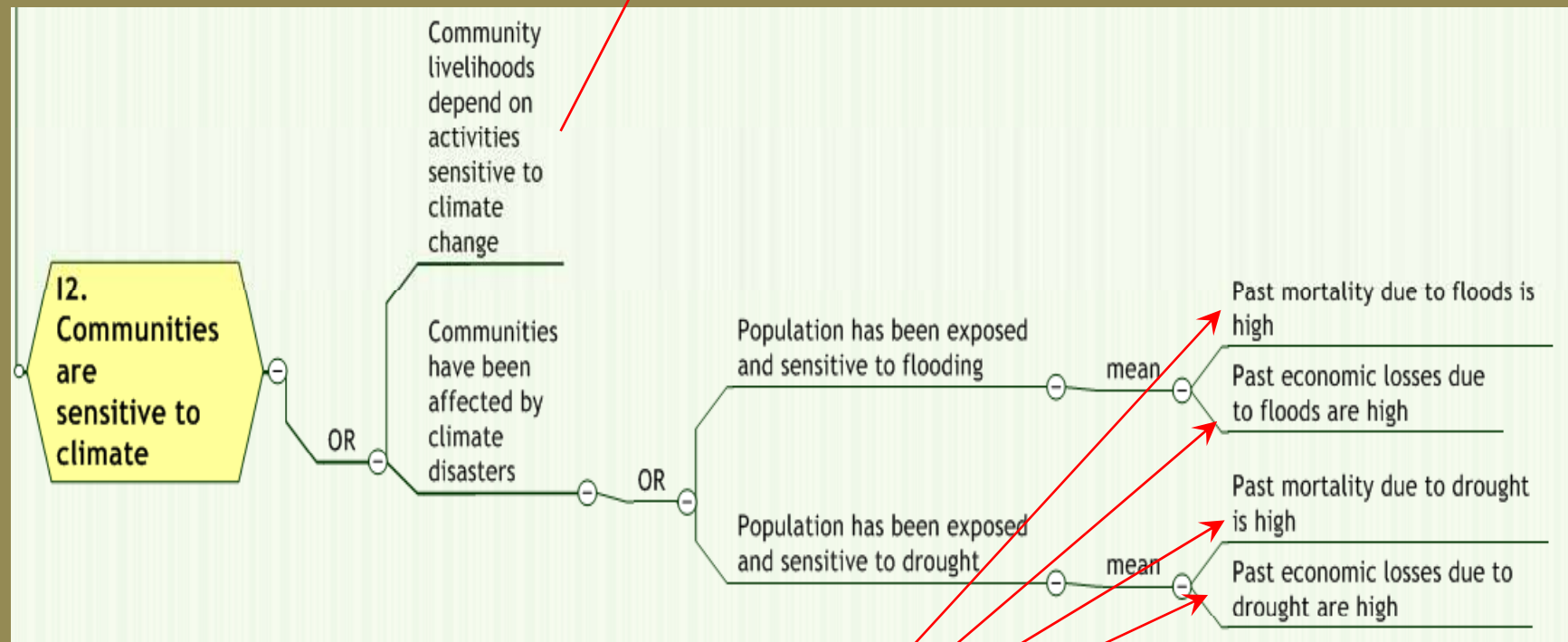
With WorldClim (6 climate scenarios for 2050:  
3 models (HADCM3, CSIRO, CCCMA) and 2 emissions scenarios (A2a, B2a))

# I1. Climatic exposure: Results



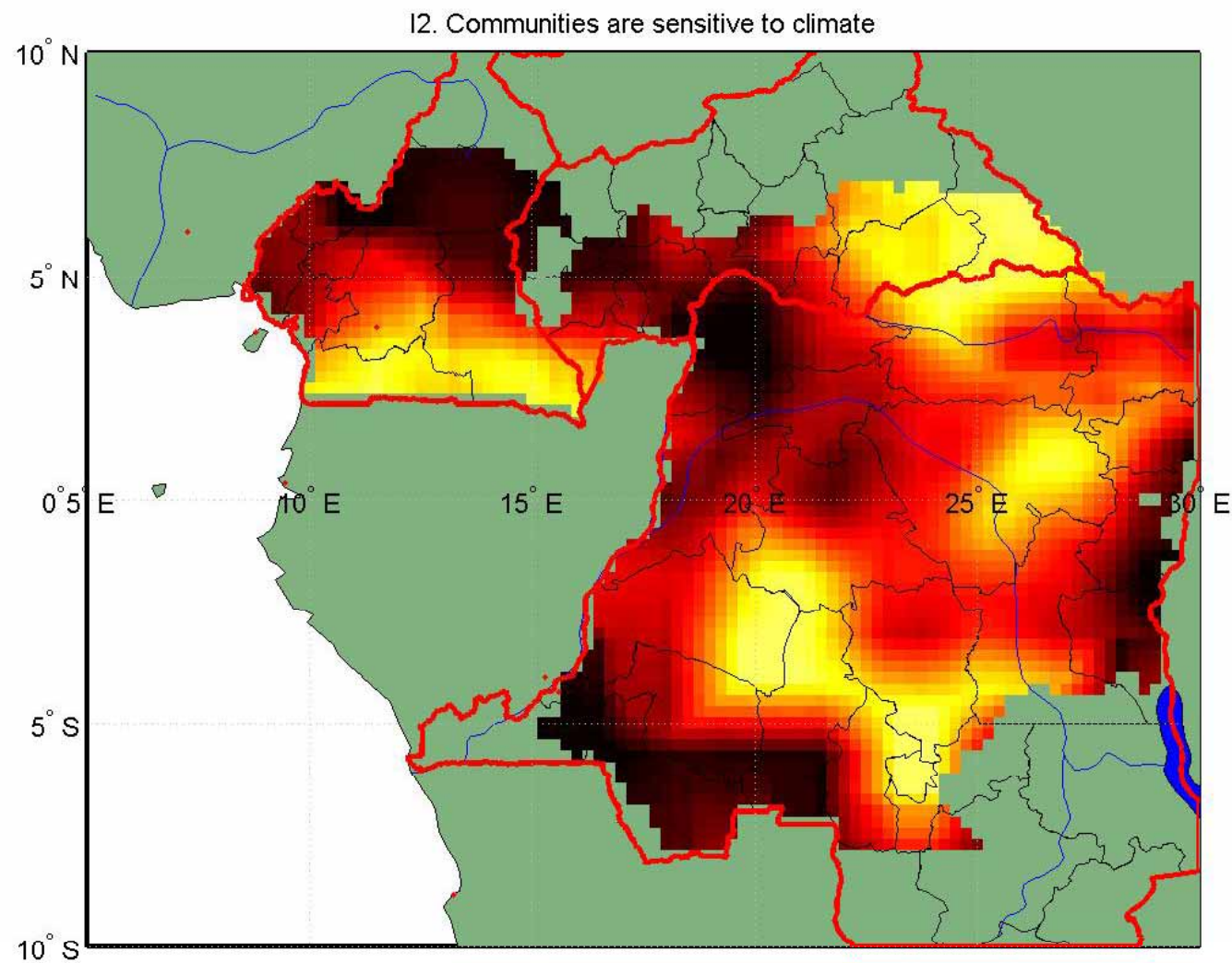
## 12. Sensitivity of communities to climate

?? (no data)



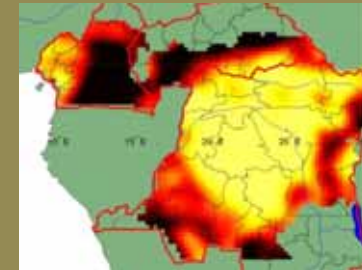
Center For Hazards And Risk Research

## 12. Sensitivity of communities to climate: Results

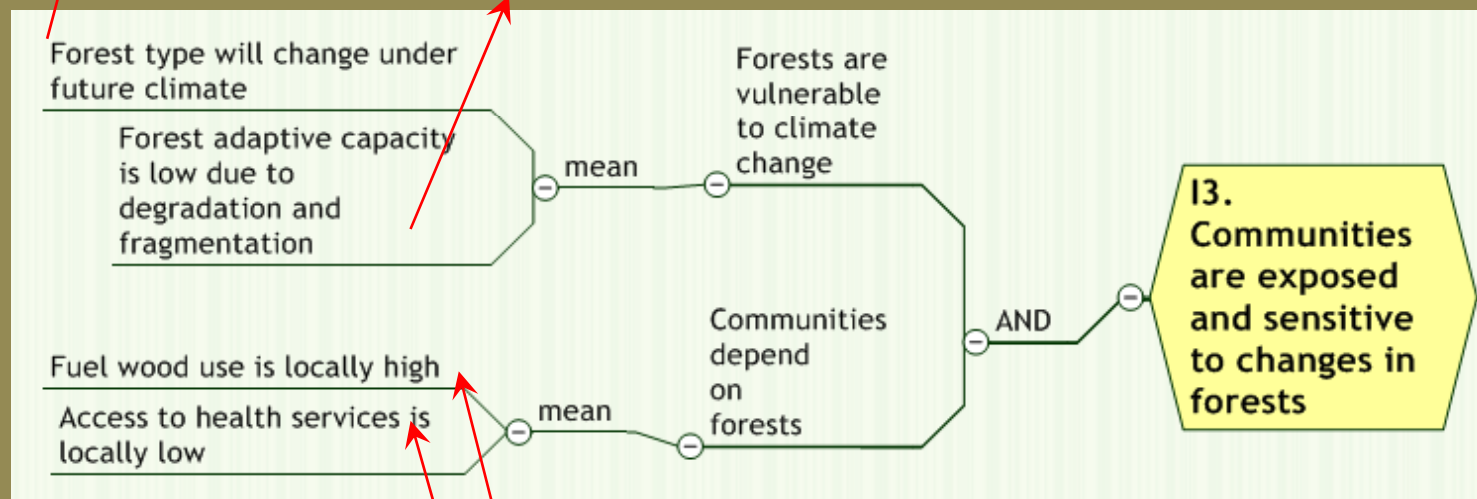


# 13. Exposition and sensitivity to changes in forests

**Change in Holdrige life zones between now and 2020 and 2050.  
WorldClim climate data (now, 2020 and 2050: 12 climate scenarios)**

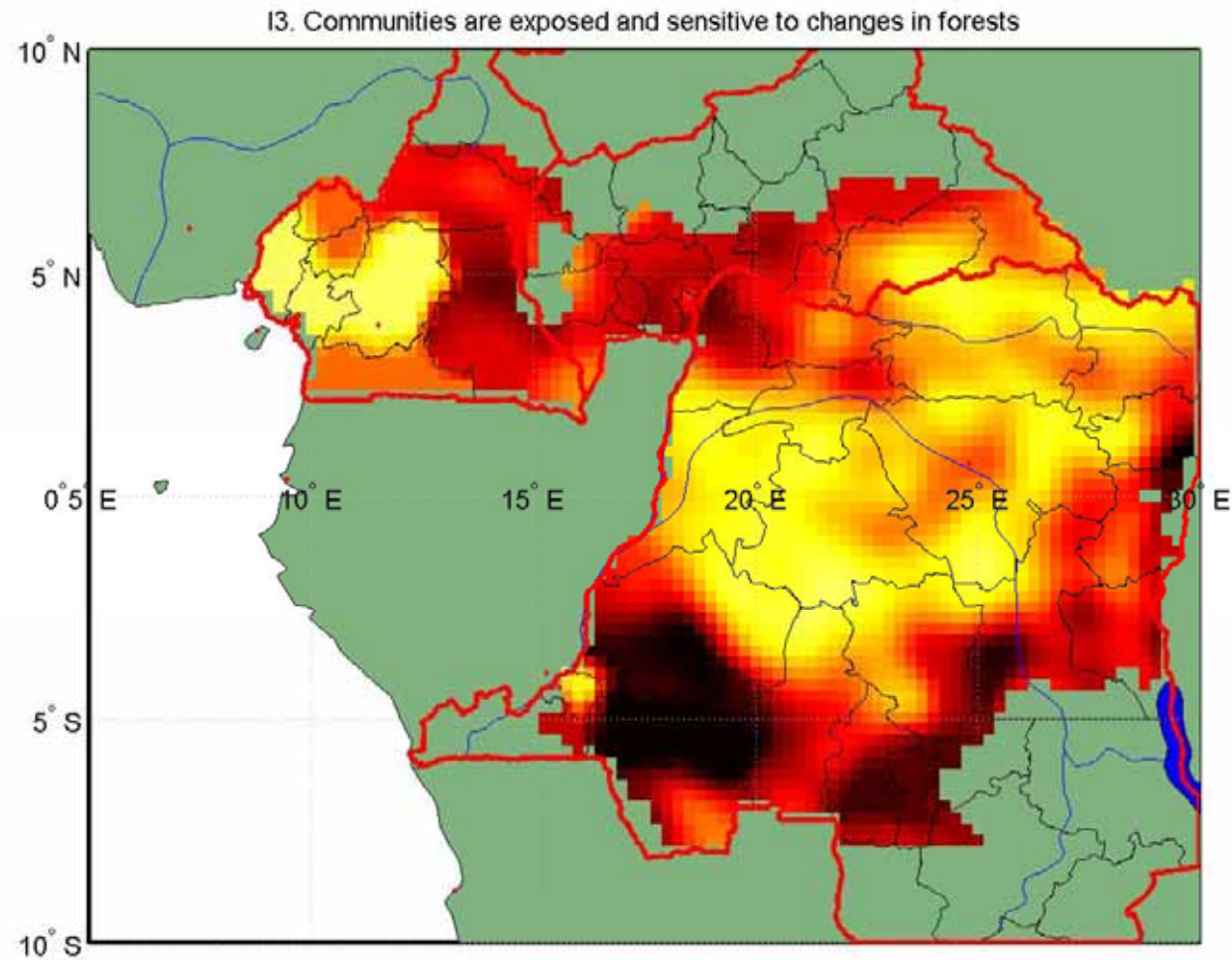


**Forest Cover of the Congo Basin, CARPE, University of Maryland**



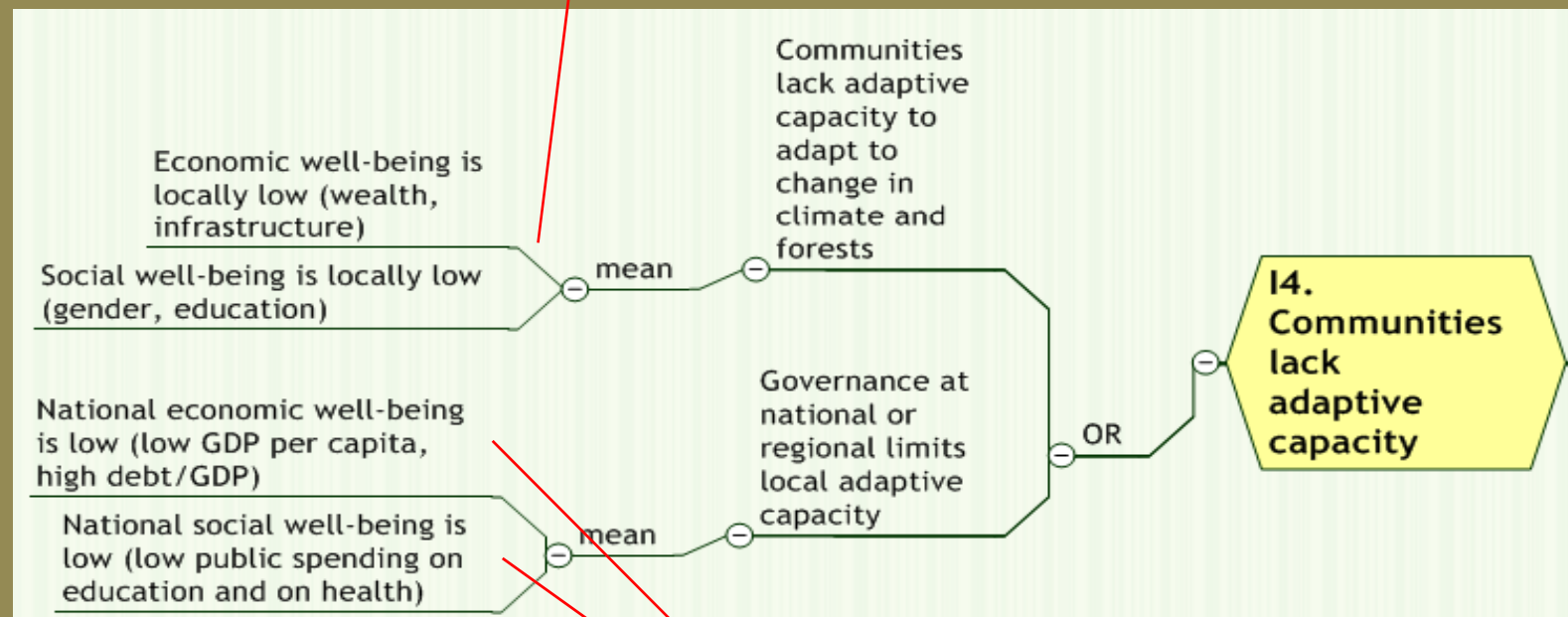
- **For Cameroon: health expenses & use of fuel wood by household in each province.**
- **Strong correlation between dependence on forest and development index ( $R^2=0.83$ )**
- **For CAR and DRC, using the correlation for converting provincial development indices into dependence on forest**

## 13. Exposition and sensitivity to changes in forests: Results



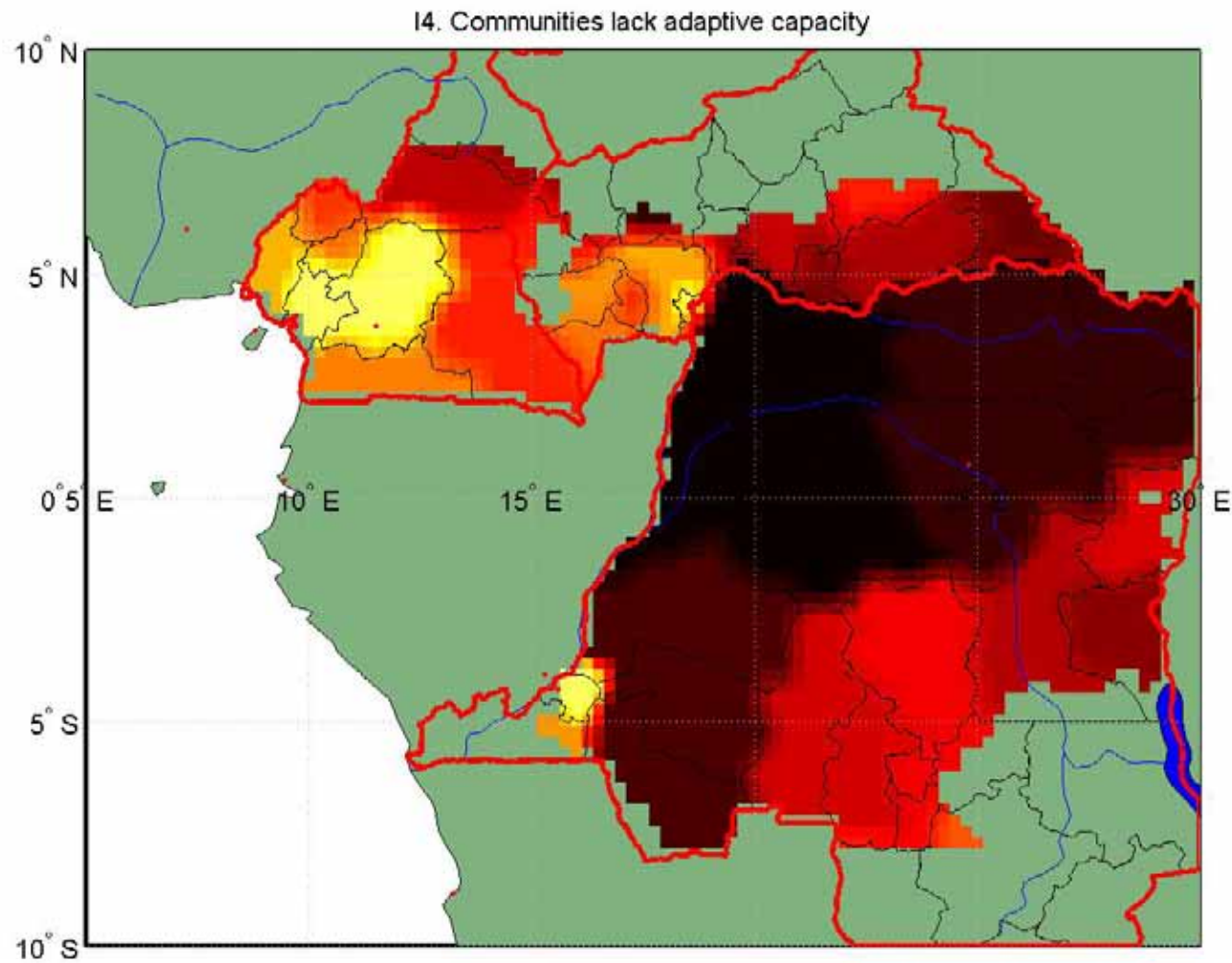
## I4. Lack of adaptive capacity

**Human development indices per provinces (HDI report) or Poverty Indices.**  
**Problem: different indicators for the 3 countries.**

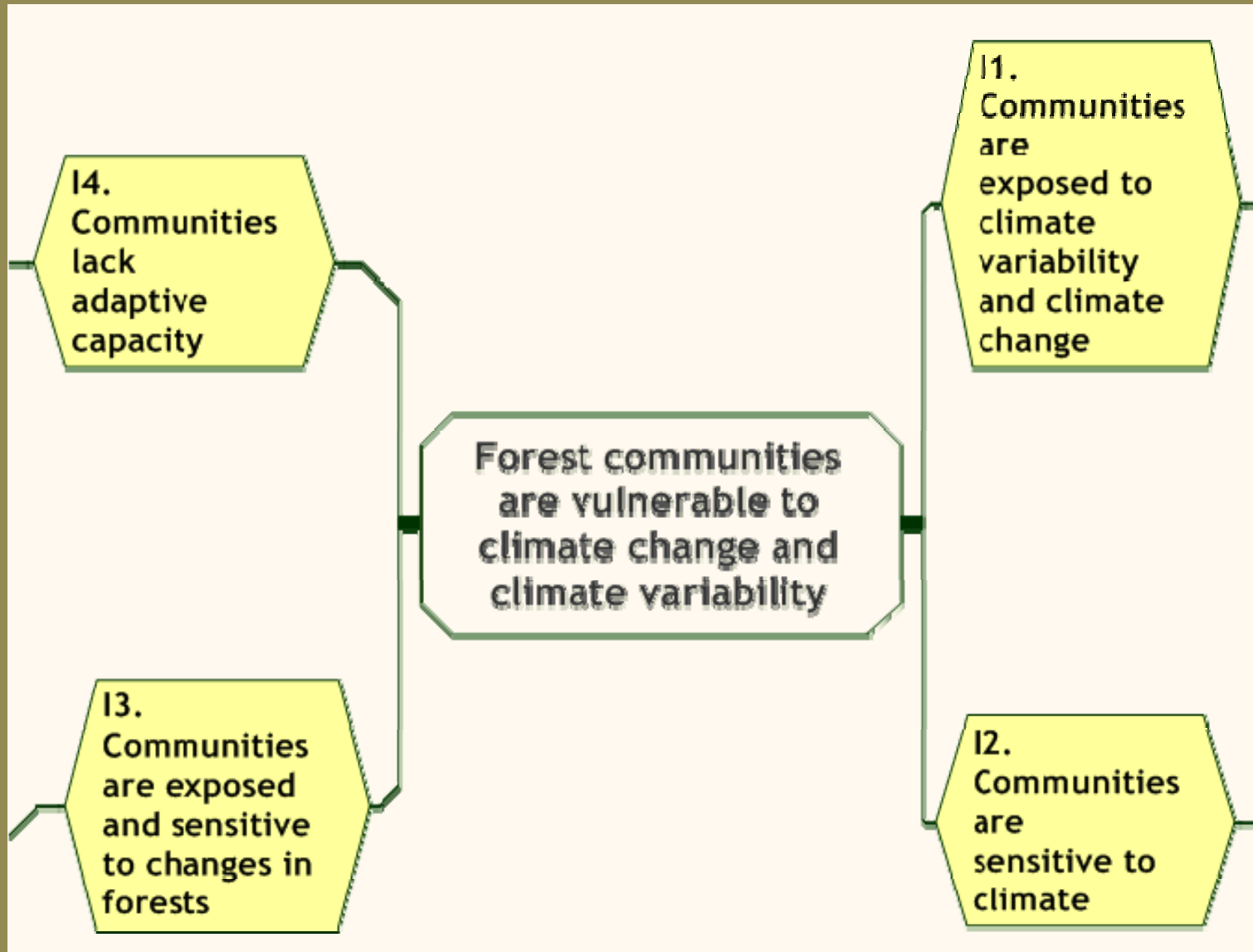


**National statistics (UNDP)**

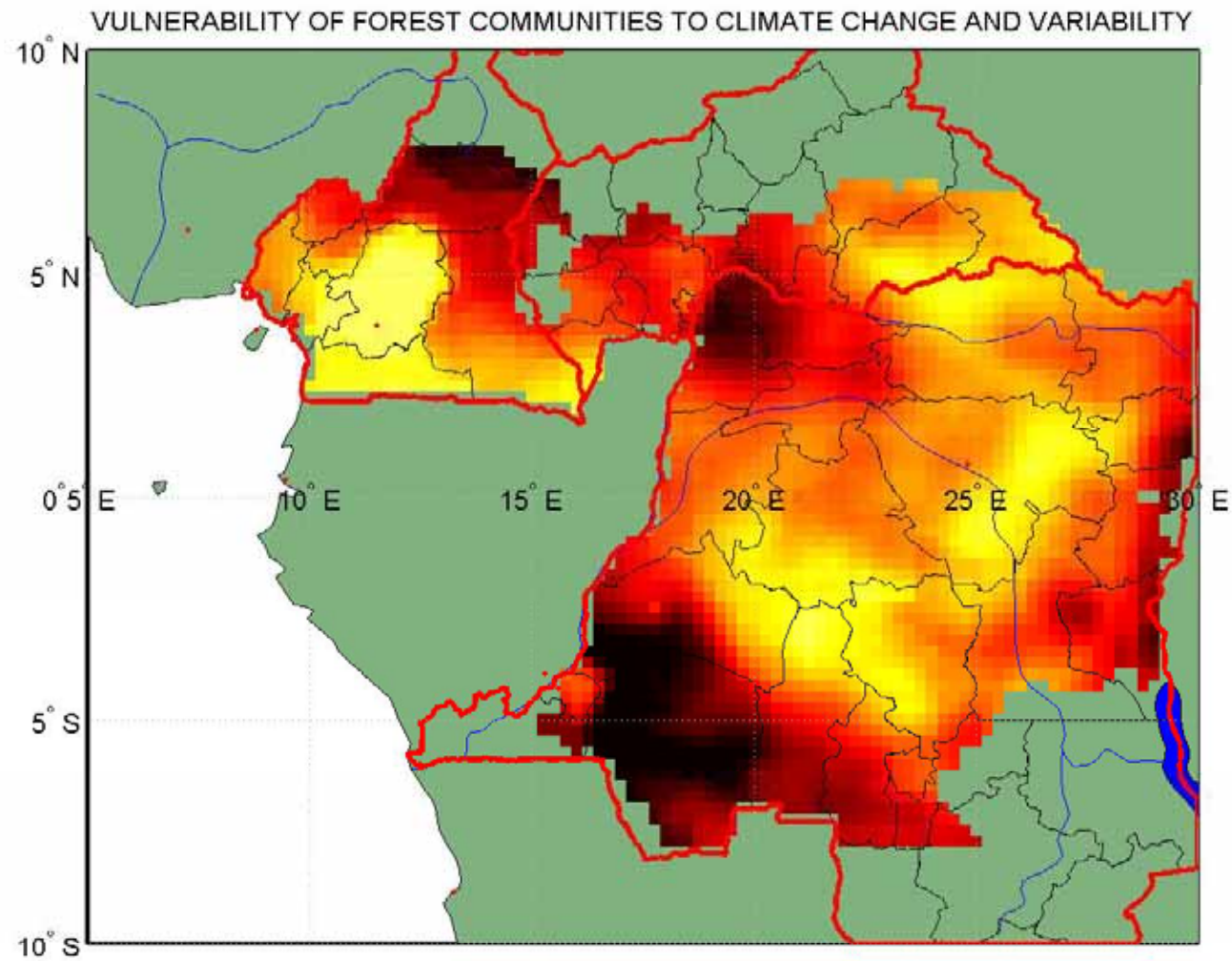
## I4. Lack of adaptive capacity: Results



## Combining the 4 indicators



## Combining the 4 indices: Results



## The way forward

- Building new conceptual maps
  - With real experts (not me!)
  - How to incorporate: diversity of livelihoods, gender issues, minority...?
- Working on functions
  - E.g. thresholds of annual rainfall for considering communities exposed and not exposed to drought and floods
- Looking for data at sub national scales
  - Broadening the scope (include other countries of Congo Basin).
- Analyzing the diversity of conceptual maps and spatial maps
  - Where are the “certain” vulnerability hotspots
- Communicating the results
  - Including Local stakeholders

# Thank You For Your Kind Attention !

