Seasonal climate and regional weather forecasts within the West African Science Service Centre on Climate Change and Adapted Land Use

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in close cooperation with University Bonn,
Federal University of Technology Akure, German Climate Computing Centre
and further national and international institutions

iGUA Institute of Geography University of Augsburg
UNIA Universität Augsburg University
KIT Karlsruhe Institute of Technology

Outline and Objective

1. **Short overview** about the current status of the West African Science Service Centre on Climate Change and Adapted Land Use (**WASCAL**)

2**. Current and future research activities** performed in the field of **seasonal climate forecasts** within the core research program of WASCAL

Further objective of this presentation:

- **Harmonization** and **iteration** of our activities **with PRESAO community**
- **To receive feedbacks** from the community to incorporate their knowledge and experiences for the development of user-specific forecasting techniques

WASCAL

- **WASCAL is not a classical research project** (which will end in four years)
- **Science Service Centre** will be established/build in Ouagadougou
    - To answer questions in the field of climate change and adapted land use
    - Develop adaptation measures to improve the resilience of the socio-ecological system
- **International and transboundary:** ten West African countries are involved in this project (Burkina Faso, Cote d'Ivoire, Mali, Ghana, Benin, Togo, Nigeria, Gambia, Niger, Senegal)
- **Integrated approach** and **assessment**; a number of disciplines (climatologists, hydrologists, soil scientists, agronomist, biologists, social scientists, …) are involved in this project

Main Tasks in WASCAL / Time Schedule

Observation Network & Competence Centre	Core Research Program	Graduate Research Schools

Preparatory phase: July 2010 - July 2012

1. Development of the research concept & scientific agenda
2. Initiate first activities within the Core Research Program
3. Initiate the Graduate Research Program

Main phase: August 2012 – December 2015 **(hopefully!)**

Task 1: Observation Network

Objective

Extension and update of current observation networks in WASCAL countries for various disciplines e.g.:

- Climate observation network
- Hydrological observation network
- Biodiversity network

Time schedule

- **Observation network will start once WASCAL has gained legal status**
- The current plan is that the main activities will start in August 2012.
- Climate observation network is scheduled for January 2013

Task 1: Climate Observation Network

Proposed activities

as result of the workshop in August 2010, Accra, Ghana and the questionnaire

A. Improvement of the current network: Upgrade and extension
B. Upgrade and extension of technical infrastructure of meteorological services
C. Training program for staff e.g. at international institutions (AGRYHMET, ASECNA/EAMAC)

Details of all activities (A,B,C) will be jointly iterated with the national and international meteorological services → kick off hopefully in the beginning of 2013.

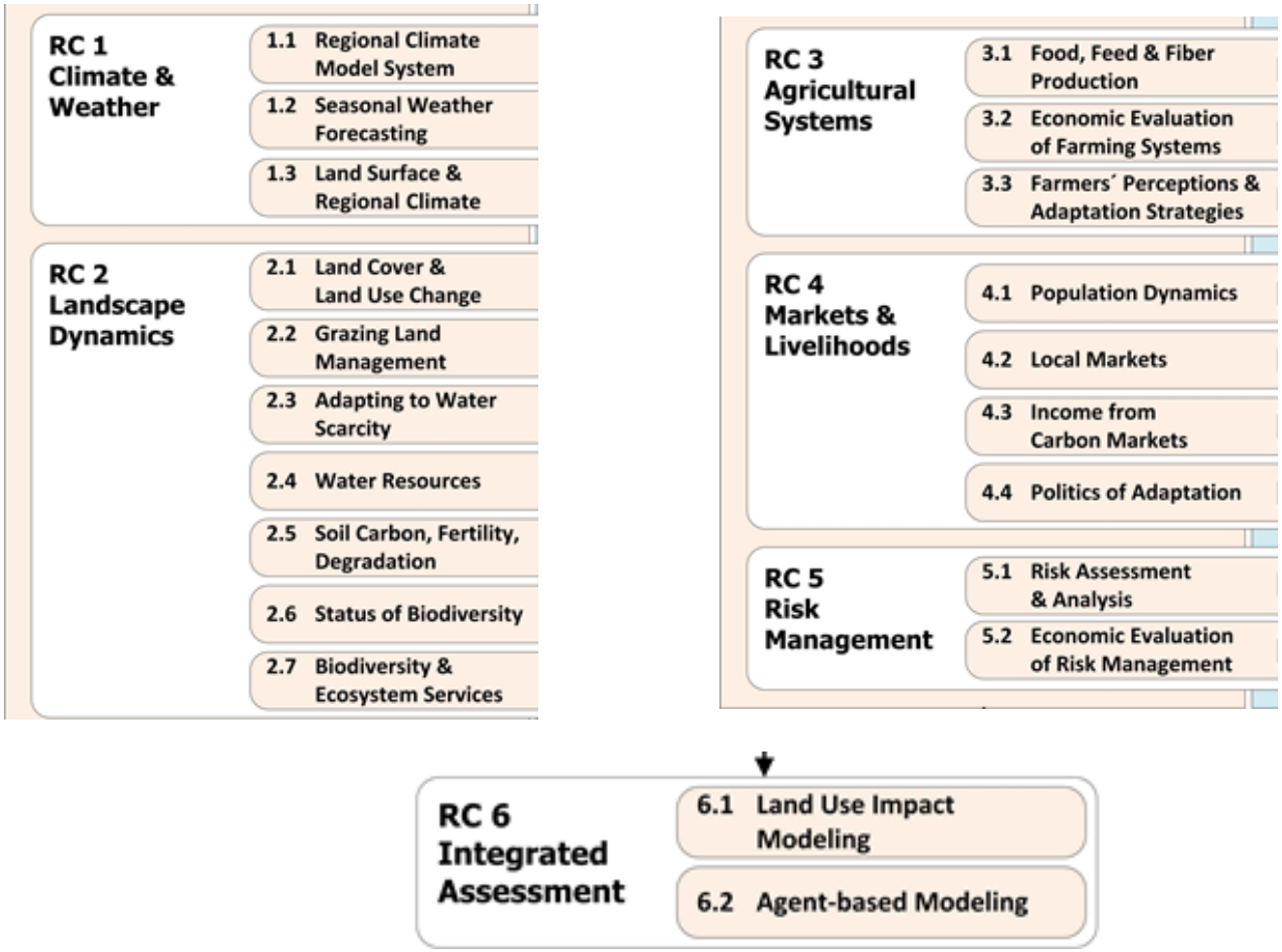
Organisation

- organized by the climate group of the Competence Centre
- KIT/University of Augsburg is co-initiating and co-organising this activity but only for the first 1.5 years.

Task 1: Competence Centre

- Competence Centre = Science Service Centre
- International institute will be established in Ouagadougou, Burkina Faso.
- Interim building
  - close to the international university 2ie
  - on-going renovation.
- Six departments will be hosted at the Competence Centre:
  - Climate, hydrology , land management (remote sensing), agro-economy, biology and data management
  - call for application: researchers can apply for positions in the competence centre

Task 2: Core Research Program



Research Cluster “Climate and Weather”

Regional Climate Modeling System Development

Interactions between Land Surface Change and Regional Climate

Seasonal Climate Forecast and Regional Weather Prediction

mostly techniques in the field of **downscaling** are developed and enhanced

Motivation of Downscaling in Seasonal Forecasting

as formulated by D. S. Wilks (2001):

"… Comparison of past seasonal forecasts with corresponding observed seasonal outcomes has demonstrated real and potentially useful information content [….] but the temporally aggregated nature of the forecast quantities may be difficult for some decision makers to incorporate into their operations. In particular, many models of agricultural, hydrological, and other weather- and climate-sensitive managed systems operate on a daily time step …"

Major problem: low spatiotemporal resolution of seasonal forecasts

Solution: Downscaling = transfer of the coarse global information to a finer spatio-temporal resolution

Downscaling Approaches

Two groups of downscaling techniques (Zorita and von Storch, 1997):

A: Statistical (empirical) downscaling e.g.

- weather generators
- classification techniques
- conditional approaches

B: Dynamical (process-based) downscaling

- limited area models / regional climate models

Combination of both techniques

Seasonal Climate Forecast and Regional Weather Prediction

(1) Advancement and development of forecasting techniques:

- for agricultural and hydrological relevant variables such as the onset of the rainy season or an optimal window for planting

- for variables that are important for the prediction of droughts and floods such as the rainfall amount in the next three months or the areal precipitation for a river basin

(2) **Adaptation of techniques to needs of national and international weather, hydrological and agricultural services**

- to improve the existing forecast system e.g. harmonization of available forecast information

Techniques for agricultural relevant variables

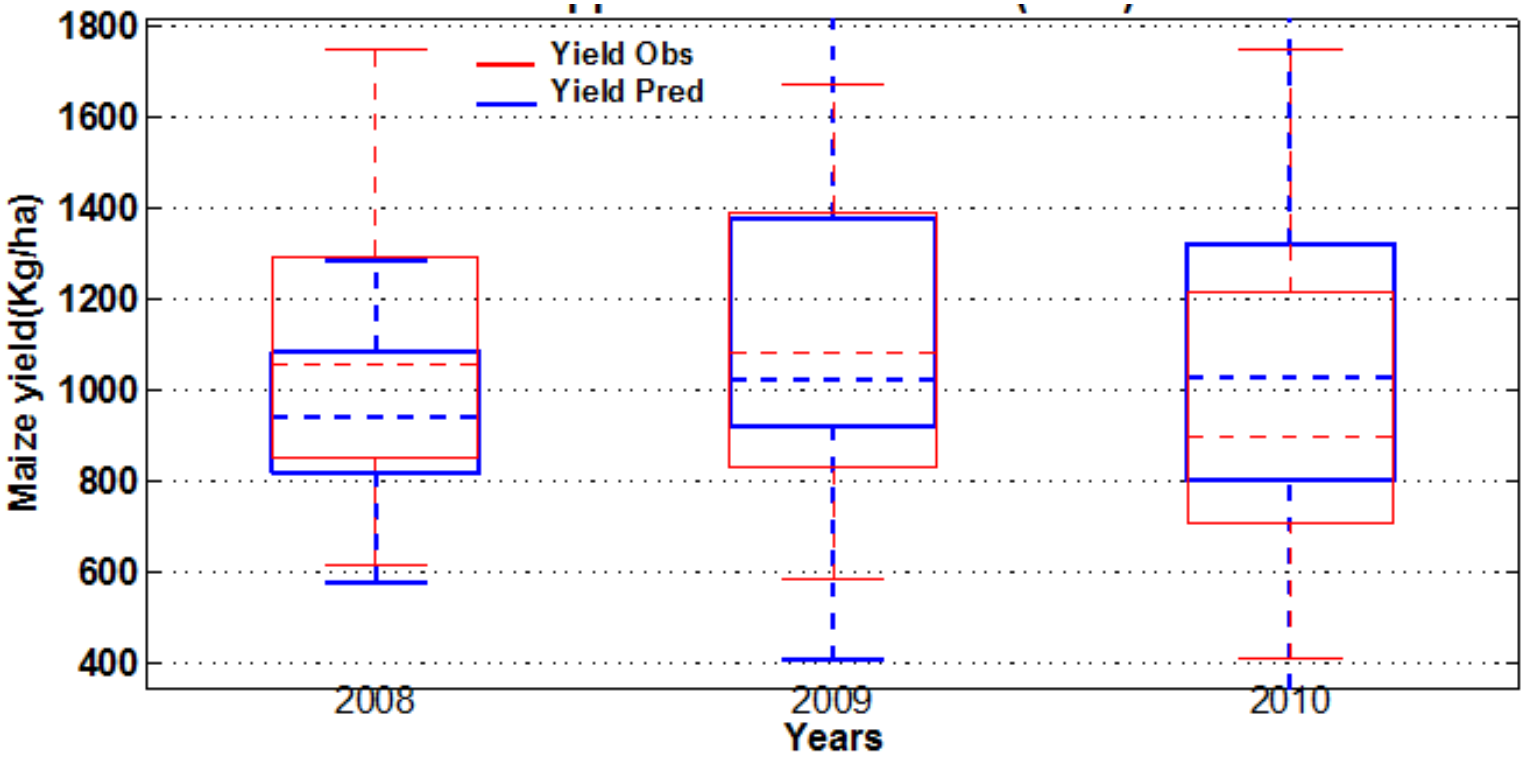
Topic: Simulation of annual yields for a given crop species

- Test case: annual maize yield for Burkina Faso
- Crop model: General Large Area Crop Model (GLAM); process-based approach
- Impact of planting dates on maize yield

Study region and data

- Burkina Faso
- Observed crop yield for maize on province level provided by AGRHYMET
- Test period: 2000 - 2010
- daily observed gridded precipitation from surface stations
- Split-sampling: validation period 2008 - 2010

Techniques for agricultural relevant variables



Seasonal Climate Forecast and Regional Weather Prediction

(3) Seasonal forecasts are also characterized by high uncertainties

- Development of techniques for describing the uncertainty and express the forecasts as probabilities

- develop strategies in decision making situations (no drought/drought) to optimize the benefit for a certain user

Two Examples of Decision Making Situations

… that are sensitive for meteorological information

Case A: Warning for extremes e.g. drought or floods

Decision makers must decide between two actions:

- Give an alarm for protective action to save people and goods – costs
- No alarm: no protective action – no costs

Case B: Fallowing/planting problem
(see Brown et al., 1986)

Farmers must decide between two actions:

- Action A: plant a crop – costs
- Action B: no planting, let the land lie fallow – no costs

Outcomes of a Warning System for Droughts

		observation	
		drought	no drought
forecast	drought	hit	*false alarm*
	no drought	miss	inverse hit

Cost-Benefit Analysis e.g. for a Drought Warning System

Calculation of total expense *E (e.g. Wilks, 2006):*

$$E = (a + b)C + c \cdot L$$

a = number of hits
b = number of false alarms
c = number of misses

C = costs for an alarm due to protective action

L = loss of a miss

➡ Minimise total expense E to maximise benefit (optimum strategy)

Summary

Current status of WASCAL

- WASCAL is still in the preparatory phase: the main phase will start hopefully in August 2012
- Activities within the framework of observation network will start in the main phase, but the exact time schedule is still uncertain

Research activities in field of seasonal climate forecasts focus on

- Forecasting techniques for agricultural and hydrological relevant variables and indices of hydro-meteorological extremes
- Adapted to needs of national and international weather, hydrological and agricultural services
- We need here your suggestions, recommendations to improve existing forecasting systems

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