IT-Infrastructure, Scientific Computing, Model Data Management Workflows

Project WASCAL

Aims and goals

WASCAL’s 3 components:

- Competence Center
- Core Research Program
- Graduate Studies Program

Chronology of WASCAL’s development

DKRZ and WASCAL

DKRZ mission and competences

- Scientific computing
- Data management

IT-Infrastructure

Ongoing activities
WASCAL Partner Countries

- Benin
- Burkina Faso
- Côte d’Ivoire
- The Gambia
- Ghana
- Mali
- Niger
- Nigeria
- Sénégal
- Togo
High Climate Variability in West Africa

e.g. annual areal precipitation amount [mm], Volta basin, GPCC
The heaviest loads of dust (highest aerosol concentrations) emanating from the Bodele Depression in Chad. 40 million tons of dust are swept across the Atlantic from the Sahara to the Amazon each year, half of which are coming from the Bodele Depression.

Severe Land Cover Changes in West Africa


http://www.grida.no/graphicslib/detail/deforestation-in-west-africa-case-cote-divoire_8cb5#
Tremendous Population Increase in West Africa

> 80 % of the West African population are living from the income produced in agriculture; *often subsistence agriculture*

Severe land use changes are expected for the future due to increasing agricultural activity
WASCAL – Primary Objectives

Establishment of a West African Science Service Center on Climate Change and Adapted Land Use (WASCAL):

- to investigate the impacts of climate change and land use change on ecosystems and society in West Africa
- to develop adaptation strategies to reduce the negative consequences of climate change, climate extremes and land use change
- to strengthen capacities and competences in research, education and policy making of West-African countries

In partnership with West African and German universities, research centers and services
General aim of WASCAL:
Identification of robust and adaptable land use systems and the development of measures for maintenance or re-establishment of functional ecosystems that support the sustainable development of society and preserving natural resources for future generations.

The Competence Center (CC) shall bring together the West African research community, enable information exchange with German partners and thus make available expert knowledge existing in Germany with respect to climate change and adapted land use, strengthening the capacity of the region to judge the consequences of land management practices.
The **project's goals are to**

- strengthen the conditions and capacities in West Africa,
- study science-based scenarios and options for enhancing the resilience of natural and societal systems in the face of impending climate change
- support politicians and decision-makers designing and implementing land management structures that ensure the availability of vital ecosystem services and that form the livelihood of the local population
- collaborate in the education of future generations of scientists and politicians having profound knowledge of climate change related subjects and who will be able to develop applicable adaptation strategies and contribute evidence-based contributions to the international climate change discussion.
Observation networks are maintained and data managed in Competence Center in Ouagadougou, Burkina Faso

1. Climate Network (Kunstmann)
2. Hydrology Network (Diekkrüger)
3. Socio-economy and Household Network (Wünscher)
4. Biodiversity Network (Linsenmayr)
5. Remote Sensing Group (Müller)
6. Data Management (Kunkel/Rogmann)
7. Scientific Computing (DKRZ)
Climate Group Activities

Establishment of meteorological networks within the core research sites

- additional observations needed e.g. for validation of RCMs, land surface models and as input for hydrological and agricultural models …
- highly needed for further sub disciplines e.g. agricultural field experiments
- Installations of eddy covariance stations, climate stations and further hydrological measurement devices within the core research sites

Installation started in September 2012

Establishment of a transnational climate observation network for the WASCAL countries

- to improve the existing networks of meteorological services
- to gain observations for a refined regional climate analysis and evaluation of climate simulations

activity is going to start soon (hopefully)
A. Local-scale observation network within the WASCAL core research sites:

- 3 micro-meteorological towers, 25 climate stations (partially installed by hydro group)
- 30 discharge- and 60 groundwater gauges (installed by hydro group)
- Installation of climate stations will be finalized this year (2013)

B. Large-scale, transnational network covering WASCAL countries

- 36 climate stations with an automatic data transfer (GCOS compatible)
- 80 discharge- and 120 groundwater gauges (to be done by hydro group)
- + program for collecting past observations
- + program for training of met staff

In close cooperation with national met and hydro services, ACMAD, AGRHYMET, WMO-GCOS, University Bonn
Initially the core research sites are located in the Sudanian savannah belt, which is considered to be the potential breadbasket of West Africa.
Core Research Sites

- Already existing river gauge
- Already existing met station
- WASCAL EC-Station

... + 25 WASCAL climate stations distributed over all core research sites

CRP

Dano
Sissili & Nazienga
Tono, Anayere, Atankwidi, Vea
Pendjari
GRP on the West African Climate System (GRP-WACS) has been initiated by the FUTA: 19 doctoral students, 10 students are already in their second year, 3 are currently in Germany.
Summary of selected climate research activities within WASCAL

- Installation of eddy covariance stations, climate stations and further hydrological measurement devices within the core research sites has been almost finished
- Initiation of first simulation experiments using regional climate models, land surface models and further models
- WASCAL competence center became an international institution this year + it has already recruited first senior scientists and further staff
WASCAL Partner Organisations

- West African universities (11+):
  - Université d'Abomey-Calavi (Benin), Université de Ouagadougou (Burkina Faso), University of the Gambia (The Gambia)
  - Kwame Nkrumah University of Science and Technology (Ghana), Université de Cocody-Abidjan (Côte d'Ivoire)
  - Université de Bamako (Mali), Université Abdou Moumouni de Niamey (Niger)
  - Federal University of Technology Akure (Nigeria), Federal University of Technology Minna (Nigeria)
  - Université Cheikh Anta Diop de Dakar (Senegal), Université de Lomé (Togo)

- National meteo- and hydro- services in West Africa (12+)

- National agricultural research centers in West Africa (6+):
  - INRAB - Benin, INERA - Burkina Faso, CSIR - Ghana, CNRA - Côte d'Ivoire, IER - Mali, ITRA - Togo

- Regional and international institutions (9+):
  - VBA, AGRHYMET/CILSS, Institut 2iE, FARA, AGRA, UNU-EHS, IWMI, IFPRI, WMO

- German universities and research centers (8):
  - University of Bonn, Karlsruhe Institute of Technology, University of Augsburg, German Aerospace Centre,
  - German Climate Computing Centre, University Würzburg, University Rostock, Research Centre Jülich
Chronology of WASCAL‘s development

Previous projects in West Africa funded by the BMBF:
GLOWA - VOLTA
BIOTA West Africa
IMPETUS

2009 - 2012 WASCAL Preliminary phase

WASCAL (BMBF 2012 - 2016): Main Phase

SASSCAL – South Africa, Namibia, Angola, Zambia, Botswana
Since 2012 (Center in Windhuk, Namibia)
Preparatory phase: July 2010 - September 2012

• Development of the research concept & scientific agenda
• Initiate first activities within the Core Research Program
• Initiate selected Graduate Research Programs

Main phase: October 2012 – February 2016

• Establishment of the International Competence Centre
• Establishment of 6 PhD Graduate Research Programs and 4 Master Programs
• Realization of the activities within the Core Research Program
Mission of DKRZ:

to provide high performance computing platforms, sophisticated and high capacity data management, and superior service for premium climate science.

DKRZ competences:

- High performance compute, storage, and visualization systems optimized for climate research
- Parallelization and optimization of climate models and workflows
- Efficient management of highest data volumes
- 3D visualization to communicate research results
- Support of current projects on climate research
CMIP5 calculations with the MPI Earth system model, the MPI-ESM.

CORDEX Climate Simulations for Africa using COSMO-CLM (CCLM) and REMO
DKRZ contributes to WASCAL goal of supporting the efforts of scientists, decision takers and stakeholders to adapt to and mitigate climate change in rural West Africa.

The Data Management Department of DKRZ is supporting the WASCAL Competence Center in establishing and operating a high performance computing infrastructure.

Such computing facilities are a prerequisite for developing new tools for national and regional organizations.

WASCAL Core Research Program: developing models of climate change and weather, landscape dynamics, agricultural systems, markets and livelihoods, risk management and interdisciplinary systems analysis.

The computing facilities of the WASCAL CC will be used to simulate scenarios, among them alternative land use options under climate change, and analyze the results and discuss these with people locally.
Ongoing activities

Provide consultation on the IT-Infrastructure in the WASCAL CC, e.g. specifications for a Linux cluster at the CC, plus workstations and PCs

Managing DKRZ computing project 726 “WASCAL – Regional climate simulations West Africa” (542,250 CPUh, 50,000 GB). 13 users, 5 of whom are from West Africa, the others from the team of climate scientist Prof. Dr. Harald Kunstmann

Simulations are performed on DKRZ super computer “blizzard”, an IBM Power6 machine, with RCMs WRF and RegCM, with CCLM completing the multi-model ensemble to be added soon.

Internet connection test between the local server at WASCAL Competence Center (www.wascal.org) in Ouagadougou and the anonymous ftp server at DKRZ / ZMAW in Hamburg.
General objective:
Development of a scientific computing concept for regional climate modelling including a data management concept for data and metadata.

Tasks:
1) Planning of a HPC concept for WA regional climate models
2) Adjustment of this concept to DKRZ climate computing environment
3) Tailoring of application adapted model data products
4) Data transfer planning according to existing network capacities
5) Layout of the data repository and concept of the data access
6) Cooperation and coordination with database of observational data
Climate Group at Uni Augsburg and KIT

A) Regional climate change simulation experiments using state-of-the-art regional climate models such as RegCM4, WRF and CCLM
to investigate the impacts of climate change
can start now

B) Development and evaluation of a regional climate model using a land surface model with additional hydrological process descriptions and an enhanced representation of land surface properties
to investigate the impacts of land surface changes under changing climate conditions

started in March 2013
Network Connections in Europe

Géant2 – TransEurasia Information Network

... to other continents
Internet connection test

Result:
Files sizes: between 2.4 GB and 9.6 GB
Transfer rate: between 183 KB/S and 340 KB/s
Transfer time series: between 7:10 AM – 2:30 AM local time
Duration: Two (2) weeks in August 2013
Internet connection: 3 MB/s in upload and 3 MB/s in download
Ping or round-trip time means time to receive an answer after a request on wascal server: www.wascal.org
Via ADSL (old connection): TTL 150 -300 ms (milli seconds)
Via wimax VSAT (new connection): TTL 600- 995 ms

Test performed by: Symphorien MEDA / IT / Geoportal Administrator, observed by Dr. M. Bamba SYLLA, Senior Scientist, Climate Modeling, Climate Change and Meteorology
WASCAL RCM Data Workshop at DKRZ, Hamburg  
1-2 Oct. 2013

Day 1:
• WASCAL RCM Simulations at DKRZ
• Selected regional climate model studies for (West) Africa
• Future WASCAL simulation experiments in 2014

Day 2:
• Climate Model Data Management:
  ➢ Management of climate model data at WDCC/DKRZ
  ➢ Global climate data from ESGF
  ➢ Data processing, analysis and visualization
• Preparation of proposal for computing resources 2014 (at DKRZ and elsewhere)  until 31 Oct. 2013
Thank you!