



WEFE NEXUS SCIENTIFIC COMPONENT

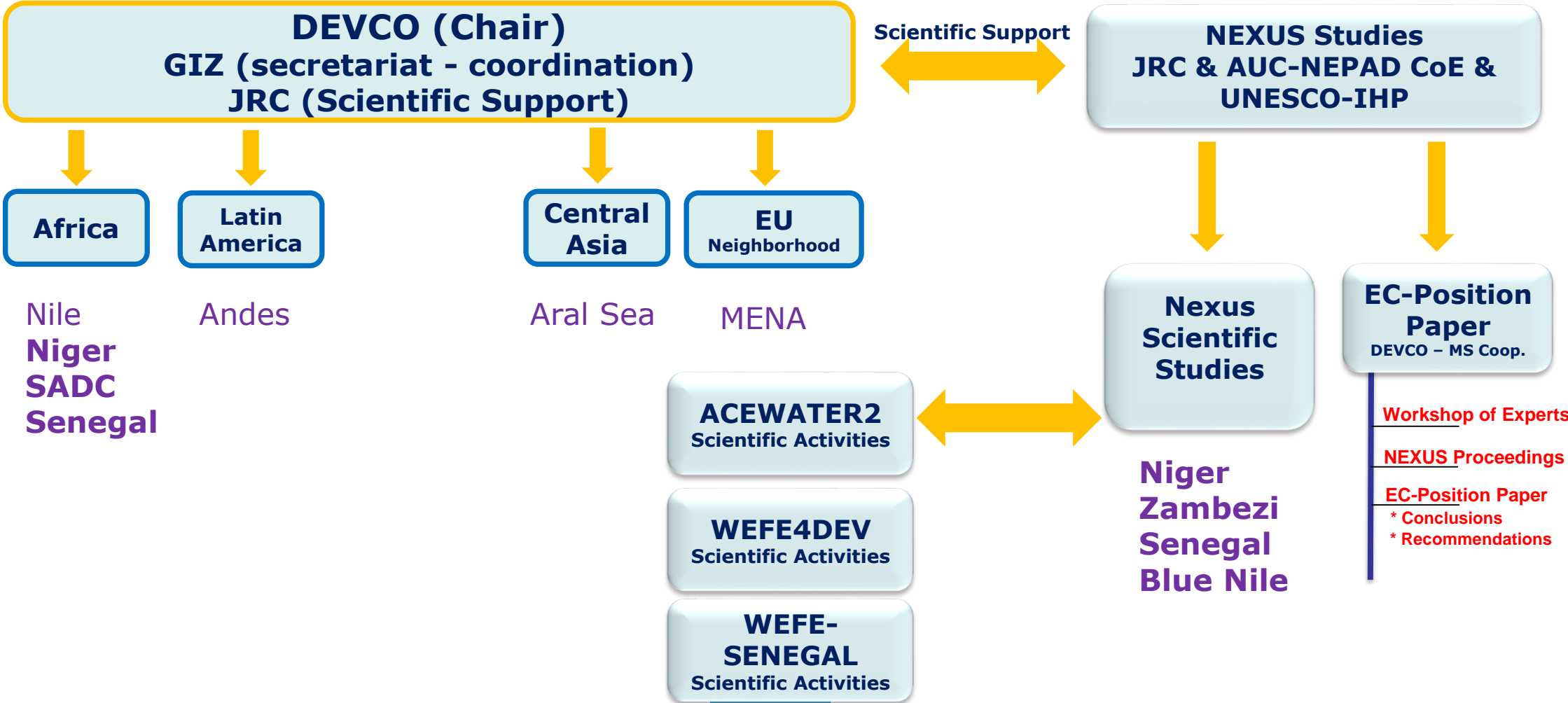
Joint Research Center of the European Commission (JRC), Directorate D-Sustainable resources

Serving society
Stimulating innovation
Supporting legislation
www.jrc.ec.europa.eu





Project Organization



EC – Position Paper on NEXUS & SDGs

- **Proceedings of the Workshop on WEFE Nexus and SDGs:**
 - Contributions from more than **60 WEFE NEXUS Experts**
 - Compilation of WEFE NEXUS Experiences and Knowledge
 - Case Studies from Regions and Lessons learned
 - Conclusions and Recommendations
- **Position Paper on WEFE NEXUS & SDGs:**
 - Brief introduction to the WEFE NEXUS: principles, advantages.
 - WEFE NEXUS in the context of the new EU Consensus on Development
 - Feedback from the NEXUS Regional Dialogues
 - Conclusions and Recommendations



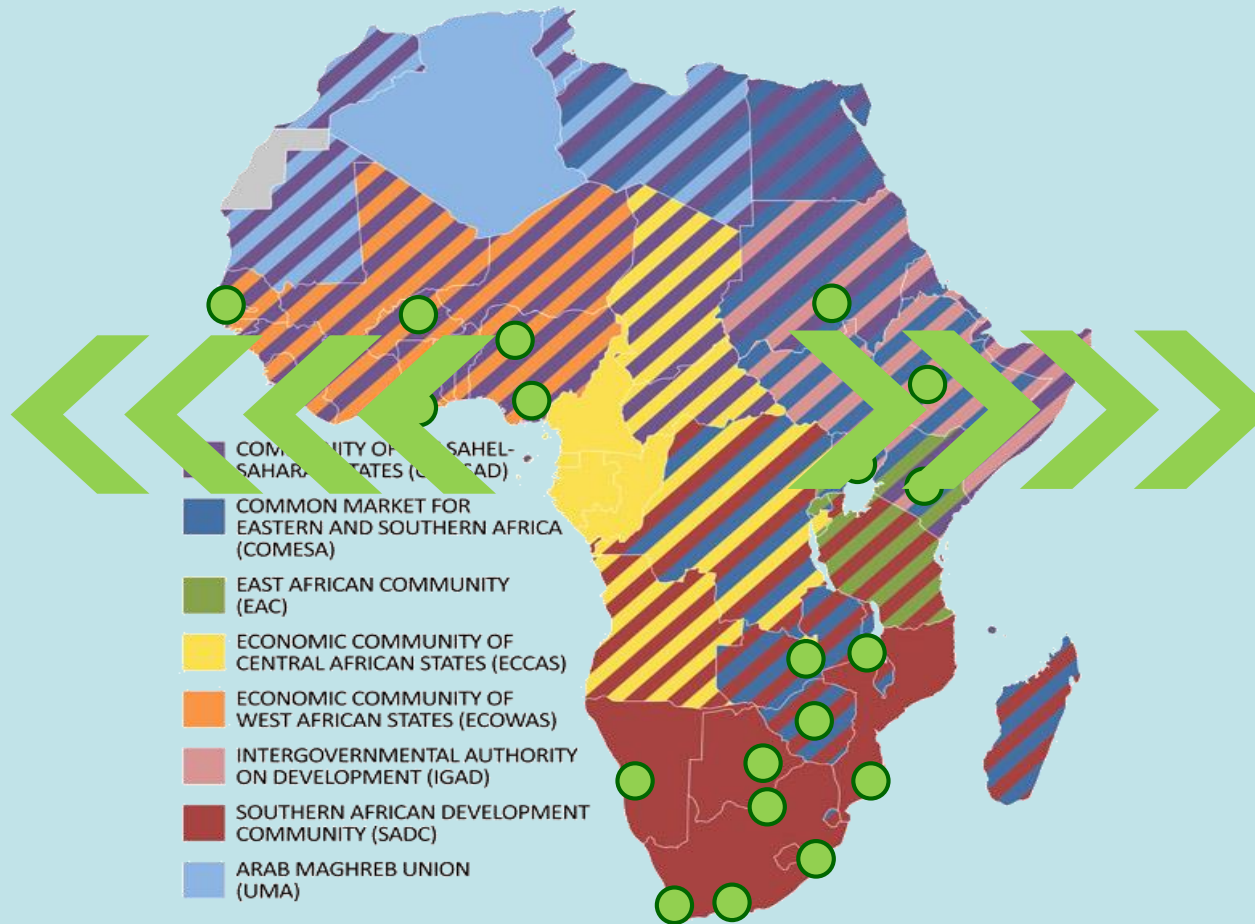


AU-NEPAD Centers of Excellence on Water Science

Scientific level



1. Development of Scientific knowledge, expertise and (demand-driven) tools
2. Support to capacity building and skills development in the water sector



Policy level



1. Identification of needs and priorities
2. Development of (sustainable) strategies and policies
3. Regional Exchange

Centers of Excellence Network is a platform for regional dialogue and collaboration with policy representatives



AU-NEPAD Centers of Excellence on Water Science

SCIENCE COMPONENT

addressing WEFE nexus assessment in large river basins

Western African CoE

1. University of Cheikh Anta Diop (Senegal)- Coordinator
2. International Institute for Water and Environmental Engineering (Burkina Faso)
3. University of Benin (Nigeria)
4. National Water Resources Institute (Nigeria)
5. Kwame Nkrumah University for Sciences and Technology (Ghana)

NIGER
SENEGAL

Southern African CoE

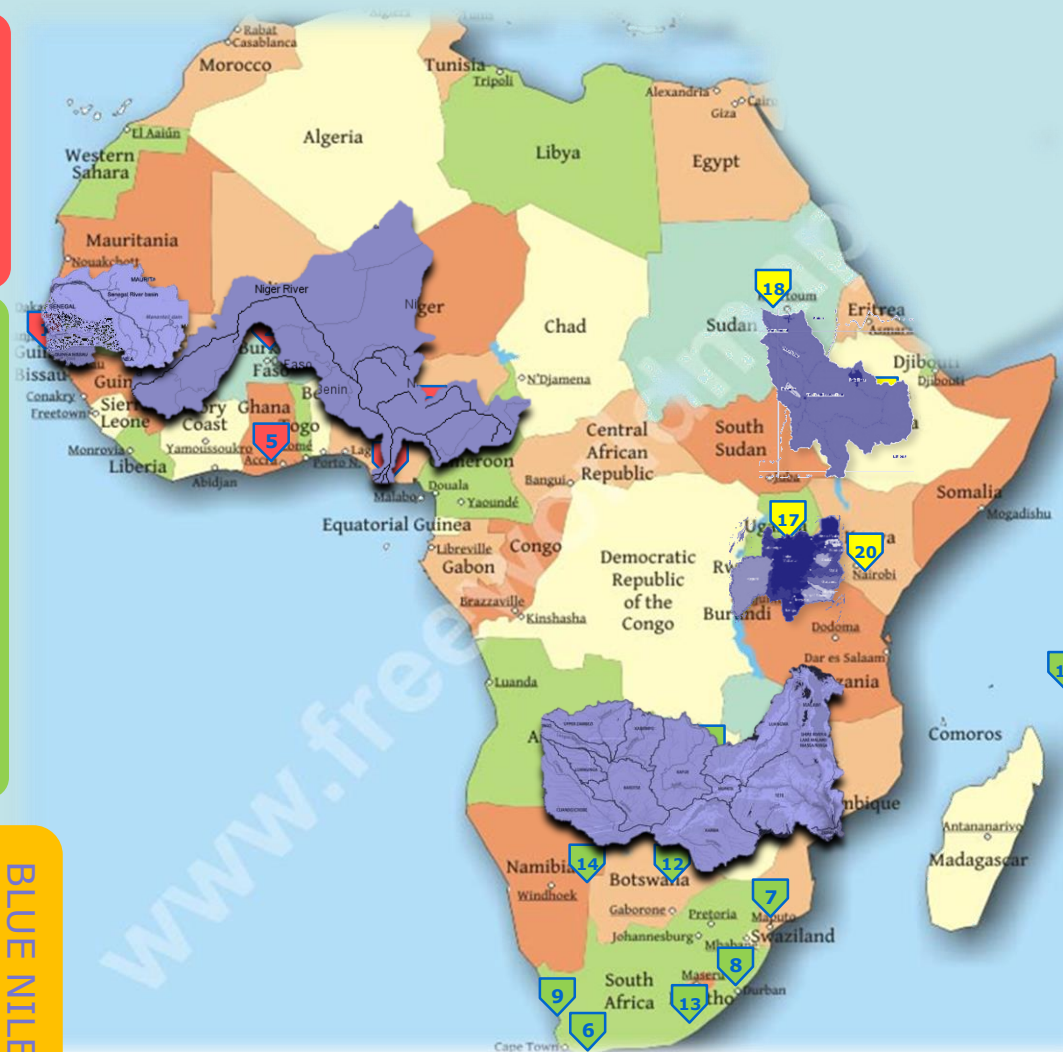
6. Stellenbosch University (South Africa) – Coordinator
7. International Centre for Water Economics and Governance in Africa (Mozambique)
8. University of KwaZulu-Natal (South Africa)
9. University of Western Cape (South Africa)
10. University of Malawi
11. University of Zambia
12. University of Botswana
13. The Council for Scientific and Industrial Research, CSIR (South Africa)
14. Namibia University of S&T
15. National University of S&T (Zimbabwe)
16. University of Mauritius

ZAMBEZI

Eastern and Central Africa CoE (since aug.2017)

17. Makerere University (Uganda)
18. Water Research Center, University of Khartoum (Sudan)
19. Ethiopian Institute of Water Resources, Addis Ababa University (Ethiopia)
20. IGAD Climate Prediction and Applications Centre (Kenya)

BLUE NILE
LAKE
VICTORIA





Water and Cooperation within the Senegal, Niger, Zambezi and Nile River Basins

the **PROJECTs**

OBJECTIVE: assess WEFE nexus interdependences and evaluates sustainable bridging-gap solutions, based on state-of-the-art reviews and scientific analysis

SPECIFIC OBJECTIVES:

1. To evaluate the impacts of changing availability of water due to climate variability, land use, demography and other pressures by using an integrated approach including socio-economic dimension;
2. To develop state-of-the-art scientific analysis on Water-Energy-Food-Ecosystem nexus;
3. To support decision makers with science- and knowledge-based tools and methods for the assessment of patterns of cooperation on water issues;
4. To enhance scientific and technical cooperation, including effective data management, among relevant stakeholders at national and regional level;
5. To provide scientific and technical assistance on monitoring-assessment of ongoing undertakings

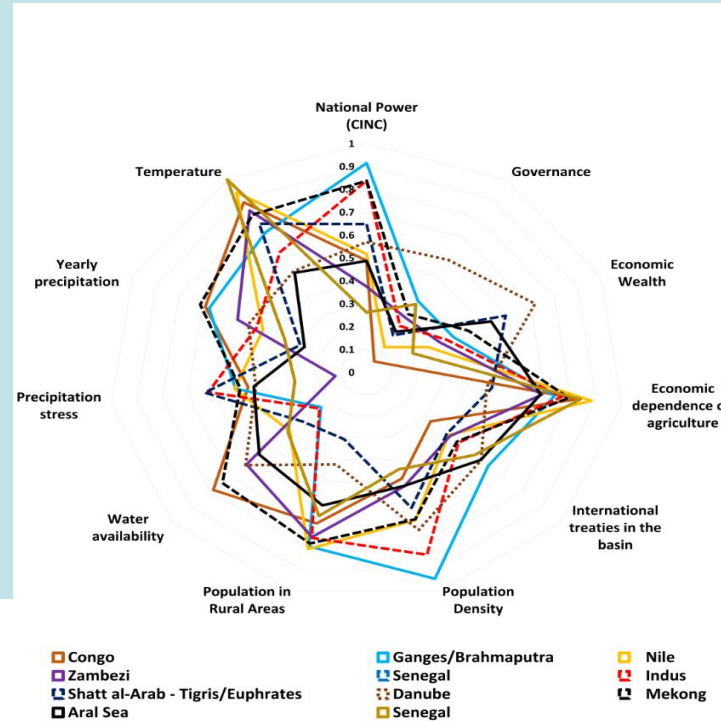
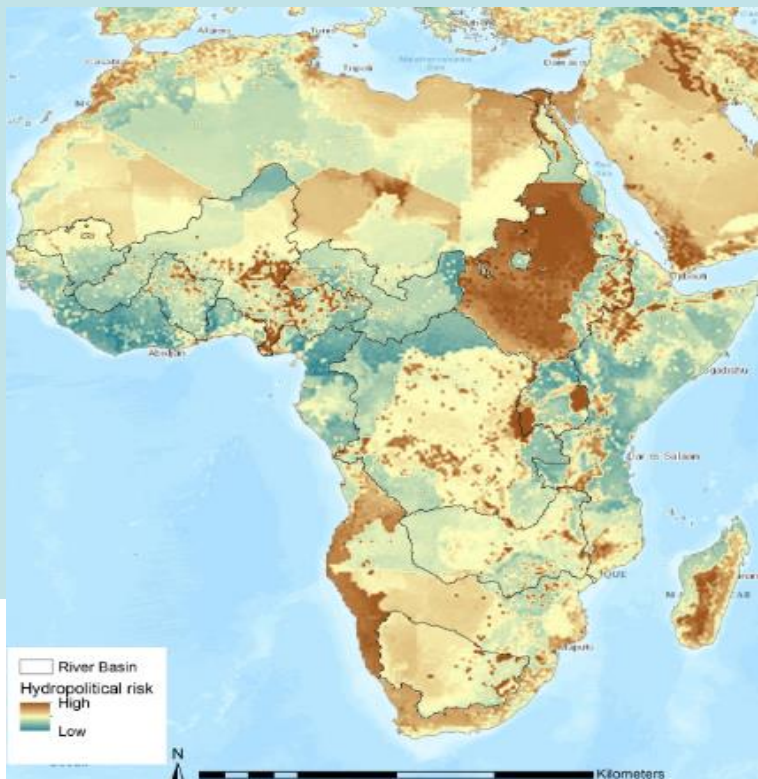
Water Cooperation and Security



**WATER
GOVERNANCE /
COOPERATION /
INFO SYSTEMS**

OUTCOMES

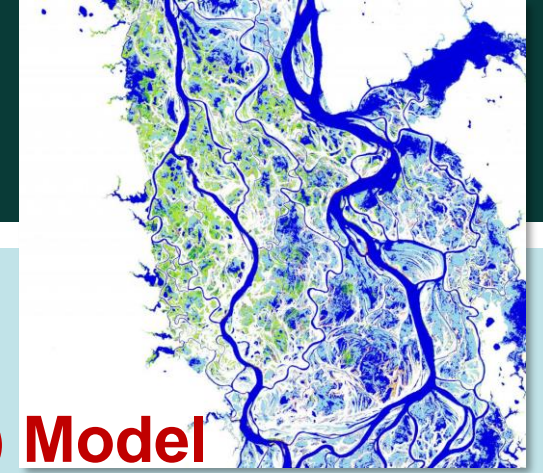
1. Manual on best practices in water governance at river basin level, focusing on water permits and accountability: **30% COMPLETED**
2. African Atlas on Water Cooperation addressing WHAT-IF scenarios simulations in a dynamic web framework: methodological development, data recovery, dynamic web application: **80% COMPLETED**



**JOINT RESEARCH CENTRE
(EU COMMISSION)**

**COUNCIL FOR SCIENTIFIC
AND INDUSTRIAL
RESEARCH (SOUTH AFRICA)**

High-resolution mapping of global surface water



- Based on Landsat images, 1984-2018 coverage, 30m resolution
- Thematic applications:
 - Identify the location and persistence of surface water
 - Long-term change analysis (35 years data)
 - Assessment of climate and human impact on water
 - Improve model forcing and modelling scenarios
 - Support for decision-making process (identification of irrigated areas or new potential areas, rice paddies identification)
 - Analysis of lakes, reservoirs expansion, volume quantification (combined with other data), sea-level rise, river network characterization, etc.

Hydro-Agro(-Clim) Model

- Several indicators calculated for water dynamics analysis
 - Max extent of water
 - Occurrence (1984-2015)
 - Occurrence change between periods
 - Recurrence
 - Seasonality
 - Transitions in water class

J.-F. Pekel, A. Cottam, N. Gorelick, A. S. Belward, **High-resolution mapping of global surface water and its long-term changes**. *Nature* 540, 418-422 (2016). ([doi:10.1038/nature20584](https://doi.org/10.1038/nature20584))

DATA source: EC JRC/Google

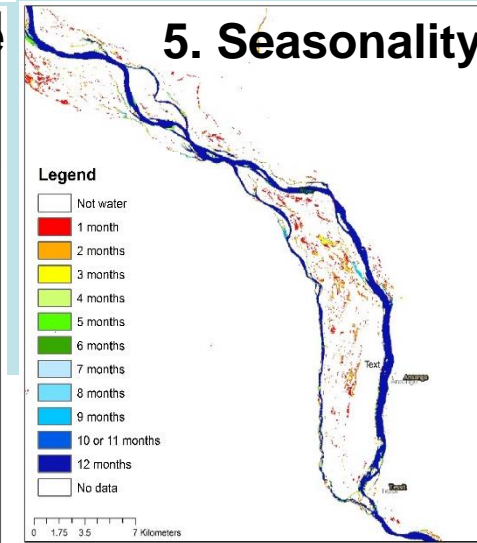
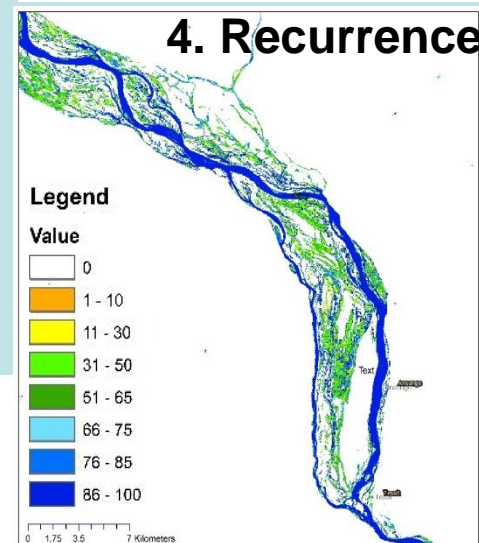
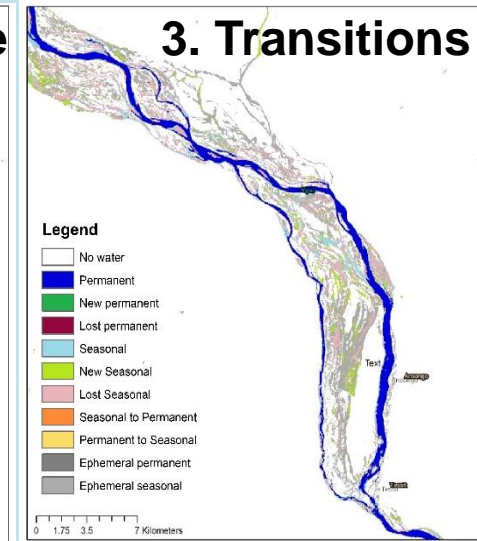
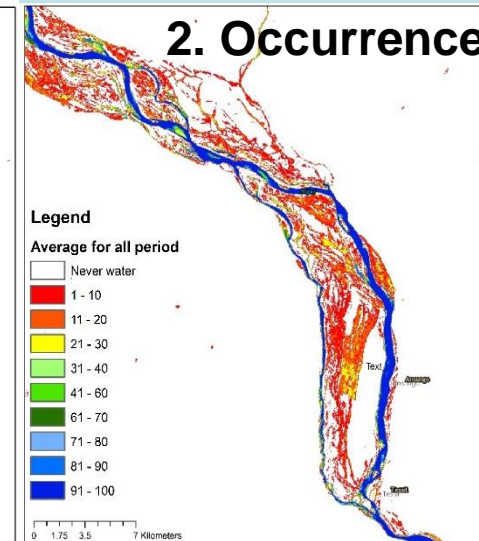
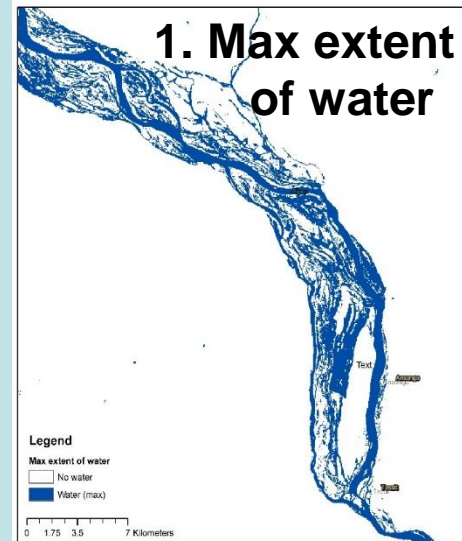
<https://global-surface-water.appspot.com/>

Existing thematic mapping for analysis



NIGER

Example for Gao region (Mali):
important for rice crops



1. shows the max. extent of detected water (1984-2015)
2. captures both the intra and inter-annual (variability expressed as a % of the available observations over time actually identified as water)
3. changes in water state between the first and the last year
4. inter-annual variability of water availability: shows how frequently water returns from one year to another (as %)
5. intra-annual behavior: observed months in which water is present



4. WEFE-SENEGAL Dialogue Platform

3.1 Fouta-Djalou

3.2 Haut Bassin Malien

3.3 Delta du Fleuve

Policy Dialogue

- Identification Acteurs NEXUS
- Analyse Objectifs et Intérêts Acteurs
- Analyse Inter-actuations clefs WEFE
- Identification Projets Intervention**

2. Observatoire Scientifique

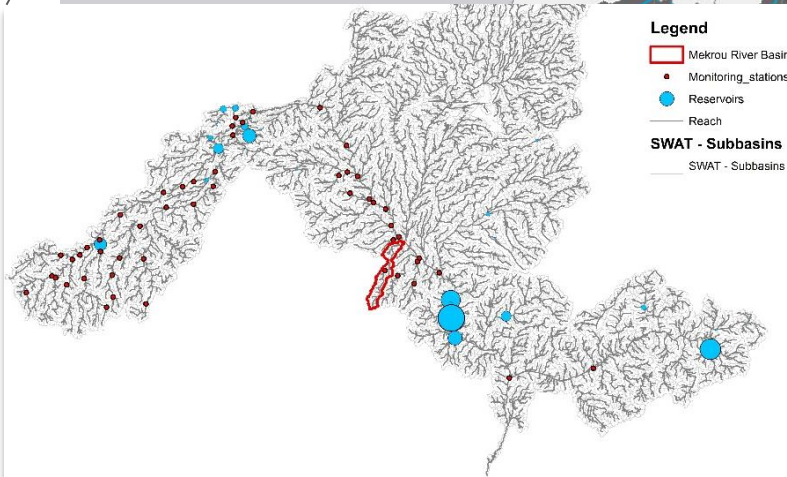
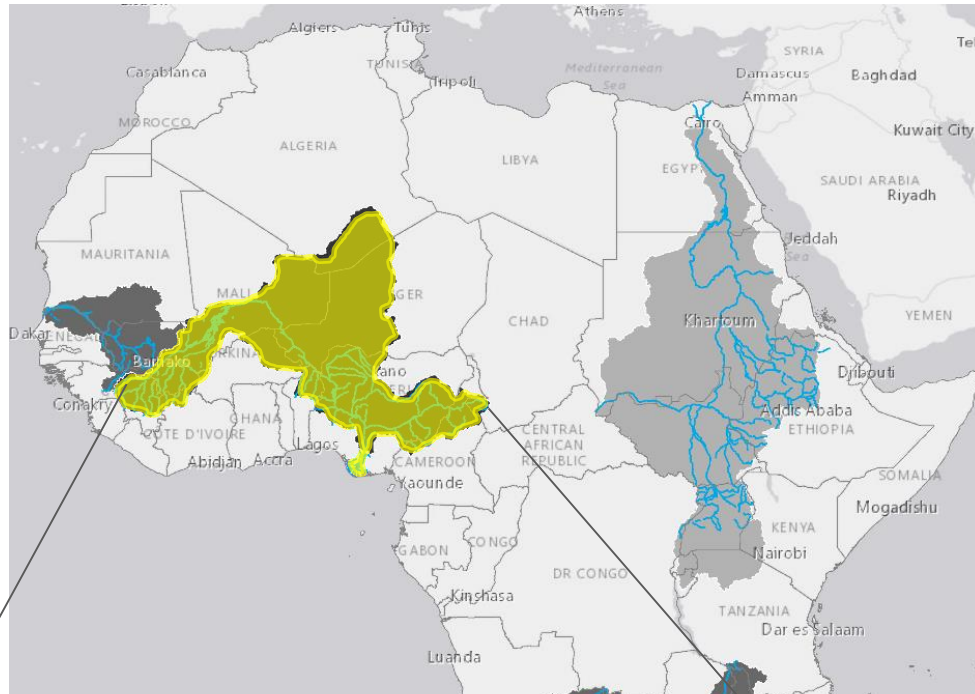
- Support Système d'Aide Décision
- Support Qualités des Eaux
- Suivi Dégradation Environnementale
- Support aux Projets de Recherche
- Etat de Lieux (Fouta Djalou, HBM, Delta)

- Bilan Energétique et NEXUS WE
- Etudes Faisabilité et Planification
- Appui Communautés Locales

- Bilan Energétique et NEXUS WE
- Etudes Faisabilité et Planification
- Appui Communautés Locales

- Plan Gestion Qualité de l'Eau
- Appui Communautés Locales

WEFE CASE STUDIES – NIGER River Basin Scale



NIGER RIVER BASIN (2 170 500 km², largest in West Africa)

The context:

- Rural economy of the basin in transformation (70% of population living in area depending on rainfed agriculture)
- High population growth (3.2%) + Urbanization + increasing energy demand
- Agriculture is dominant for GDP in all 9 countries (40% of basin GDP)
- Environmental degradation challenges (difficult climatic conditions, soil erosion, loss of fertility, water quality and health)
- Water management challenges: water for drinking, agriculture, industry, mining, energy and transport. River flow variability, Multi purposes optimization of energy production vs agricultural need (crop water demands and livestock) and environment; new construction of large dams)
- 30% of pop no access to improved water; 75% no improved sanitation facilities; only 35% access to electricity

W
E
F
E

Main activities:

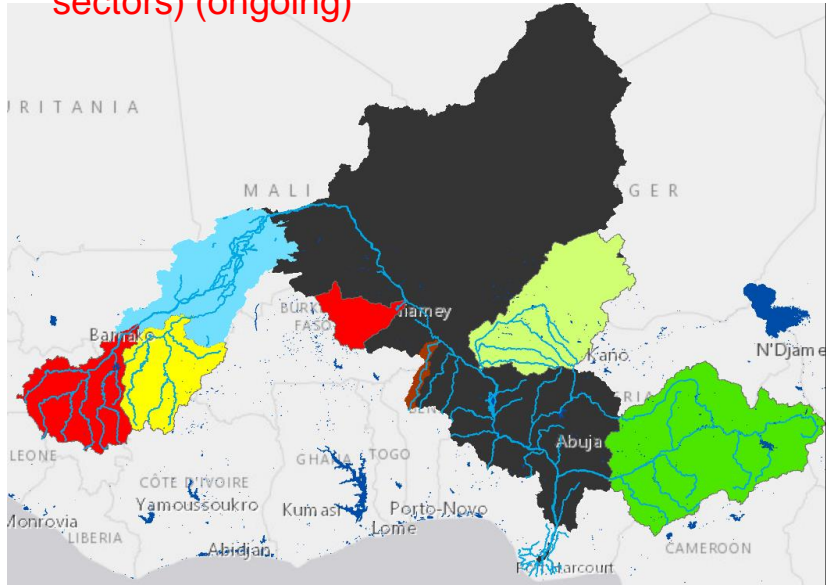
- Development of e-Nexus system in support to multi sectorial analysis
- Development and implementation of a Multi Objective Optimization analysis in the Nexus context (MEKROU subbasin)
- Setting up of a modelling system (SWAT model) with AGRHYMET partnership at river basin scale (focusing on calibration in specific subbasins)
- Identification of 2 pilot areas on interest for the Basin in the Nexus context (agriculture diffused, water demands high, reservoirs management, 'data for scenarios' available).

WEFE CASE STUDIES - Niger RB

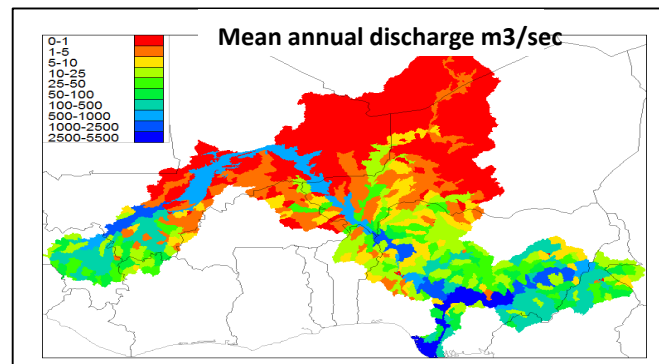
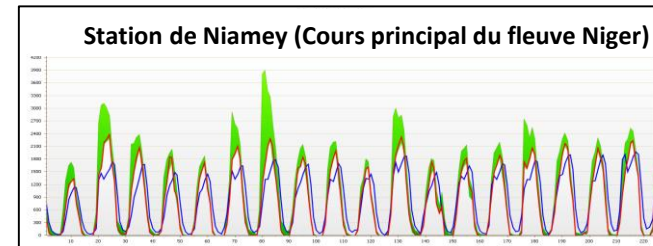
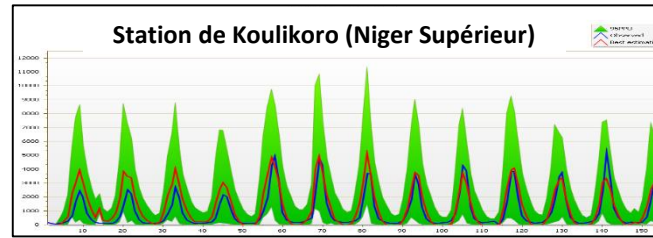
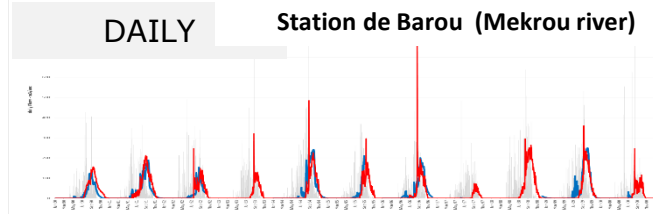
Data and modelling - SWAT

Results of the calibration of SWAT (Niger):

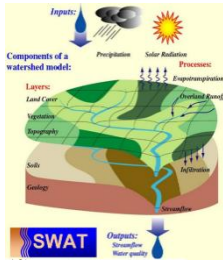
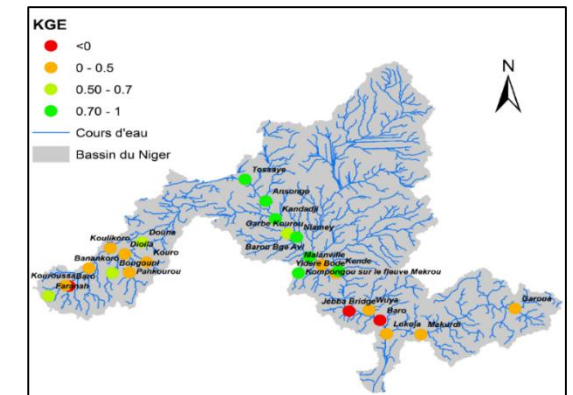
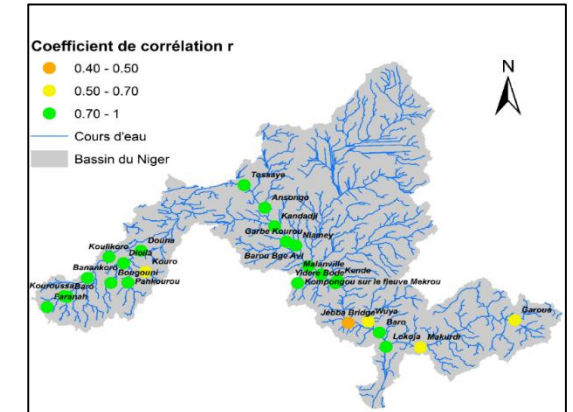
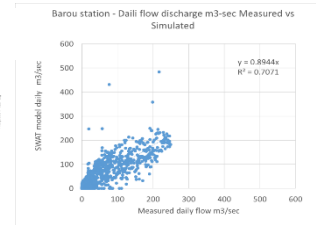
- Model Setup at River basin scale (DEM, soil, meteo, landuse, management, reservoirs, etc.)
- Regional Calibration at Subbasin level (6 main subbasins + other regions extrapolating parameters)
- Improving of the setup and specifically of the management component (dams, crop, irrigation areas and volumes,....) – with Agrymet
- water resource management scenarios (ongoing)
- Improving the management component (dams, crop, irrigation areas and volumes, water abstractions per sectors) (ongoing)



SWAT calibration (NIGER)



Discharge - flows



<http://swat.tamu.edu/>

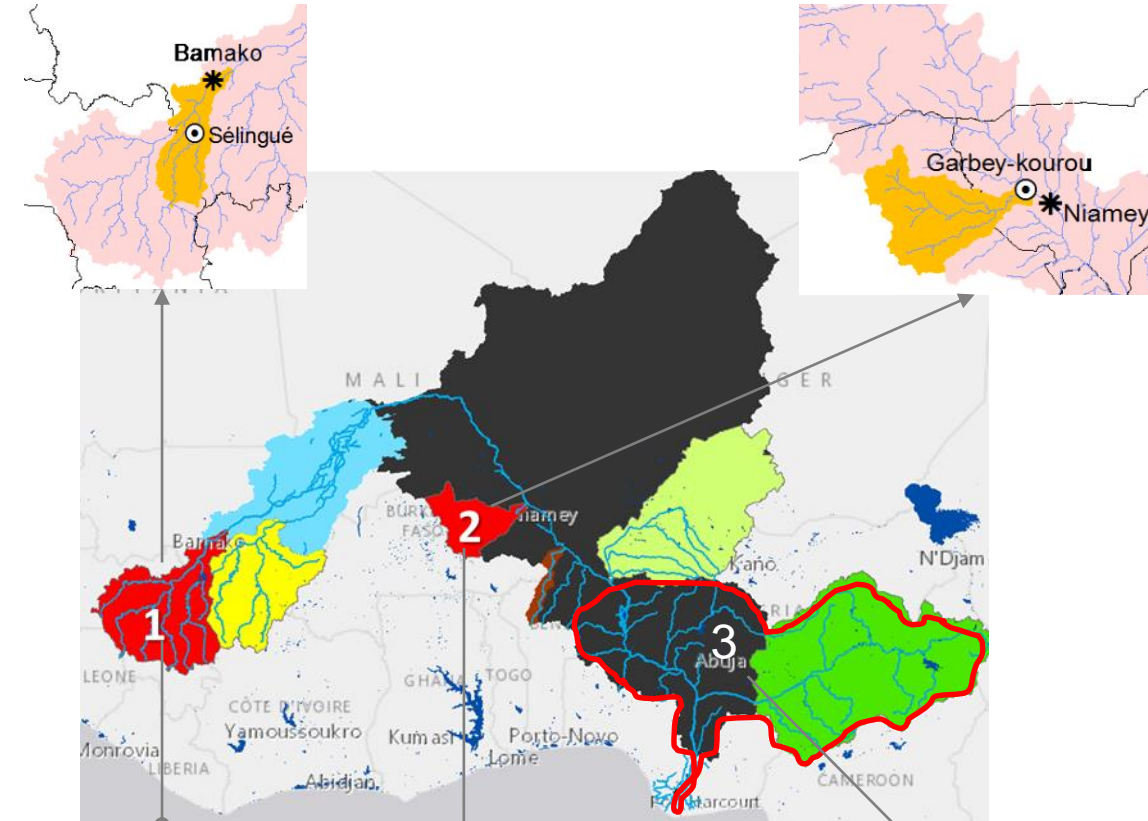


Development of water resource management scenarios in the Niger basin

Identification of **focus sites** (Agrhyment): *area with important water demands for different sectors, important for the contribution to GDP, several components involved (ex: multi purpose reservoir management, crop production, irrigation demand, navigation, food security..) monitoring data availability.*

Two areas identified for the focus:

1. **“haut bassin du fleuve Niger”** - zone of Sélingué: multipurpose dam, important for economy, agriculture and Niger flow regulation
2. **“Niger moyen”** - Sirba basin (Niamey region): *the largest tributary of the right bank of the Middle Niger, contributes significantly to flooding in Niamey, important area for cropping and livestock (completion for land and water res.), deforestation for cropland expansion), water quality issue*
3. **“Nigeria country area”** (NWR1) Climate variability and characterization of extreme events, hydrology and reservoir management, agriculture and water in northern Nigeria



hydro electric power and irrigation purposes
2.17 Mm3

Rice planting: Selingue region



Total surface: 40 000 km²
Landuse: shrub bush, fallow savannah, and rain-fed millet
Irrigated crops: rice, vegetables



- HYDROLOGY AND FLOODING RISKS IN NIGERIA
- Climate variability
- Reservoir management
- water allocation (WEAP)

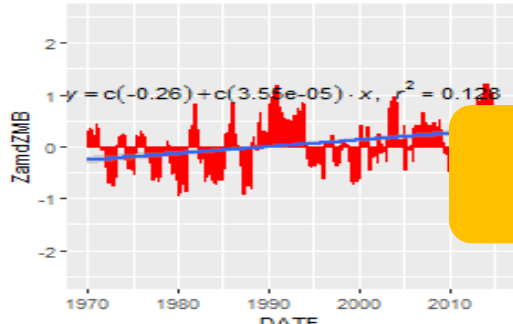
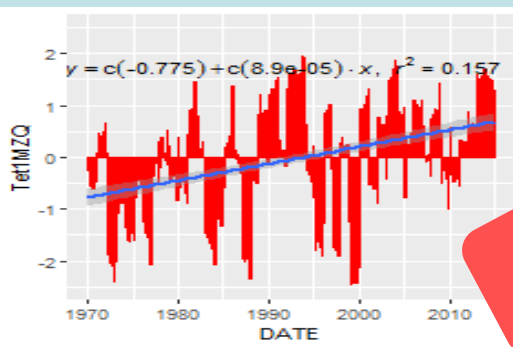
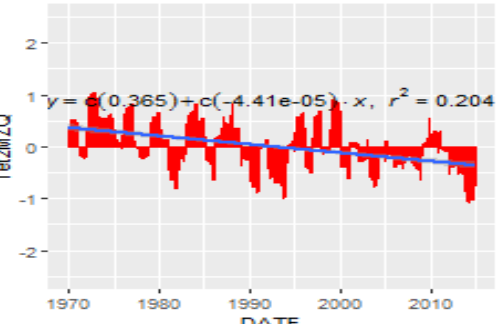
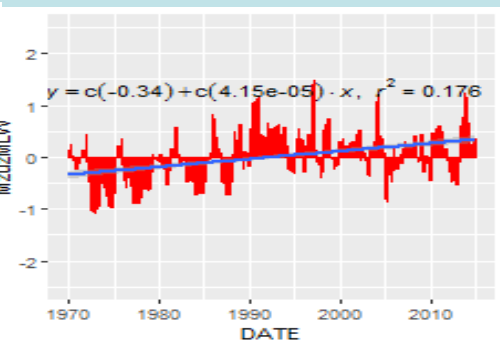
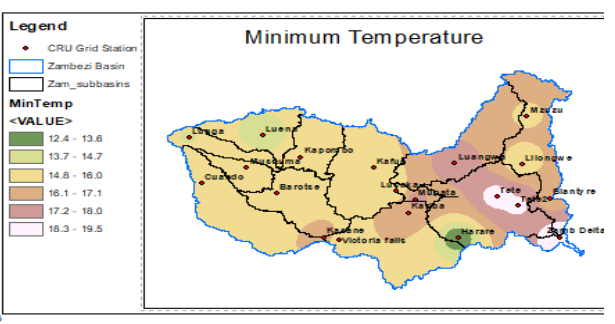
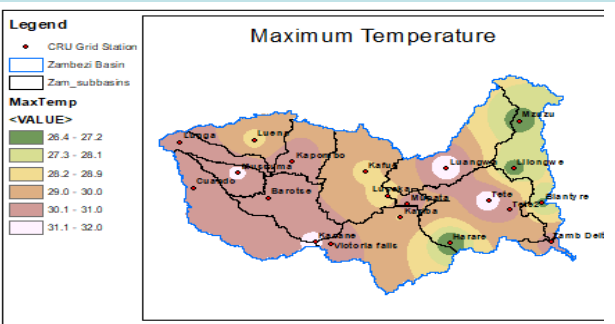
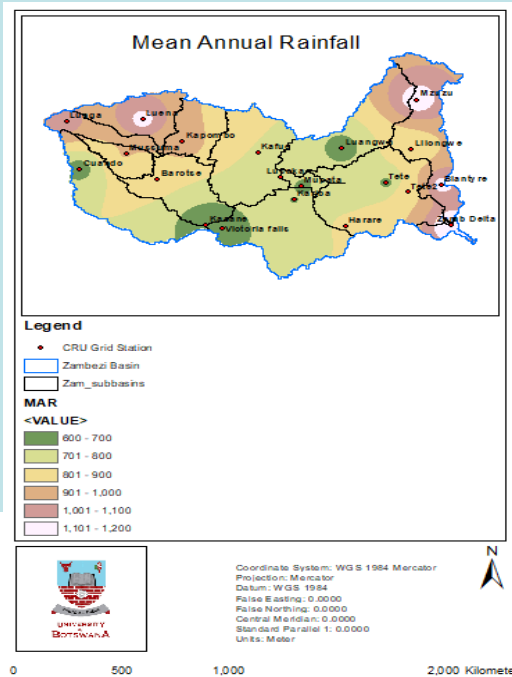


Water and Cooperation within the Zambezi River Basin

CLIMATE VARIABILITY / EXTREMES

OUTCOMES

1. Climate Database (i.e. rainfall, temperature, including remote sensed datasets, ground stations and related time series);
2. Climate Variability (CV) analysis, based on remote sensed data sources and ground stations, to assess extremes and seasonal anomalies and frequencies;
3. Climate risk assessments on extreme events (droughts, floods) at ZRB scale, based on analysis of relevant indicators (i.e. SPI, SPEI, SFI) and state of the art methodologies (Regional Frequency Analysis).



COMPLETE

UNIVERSITY OF BOTSWANA

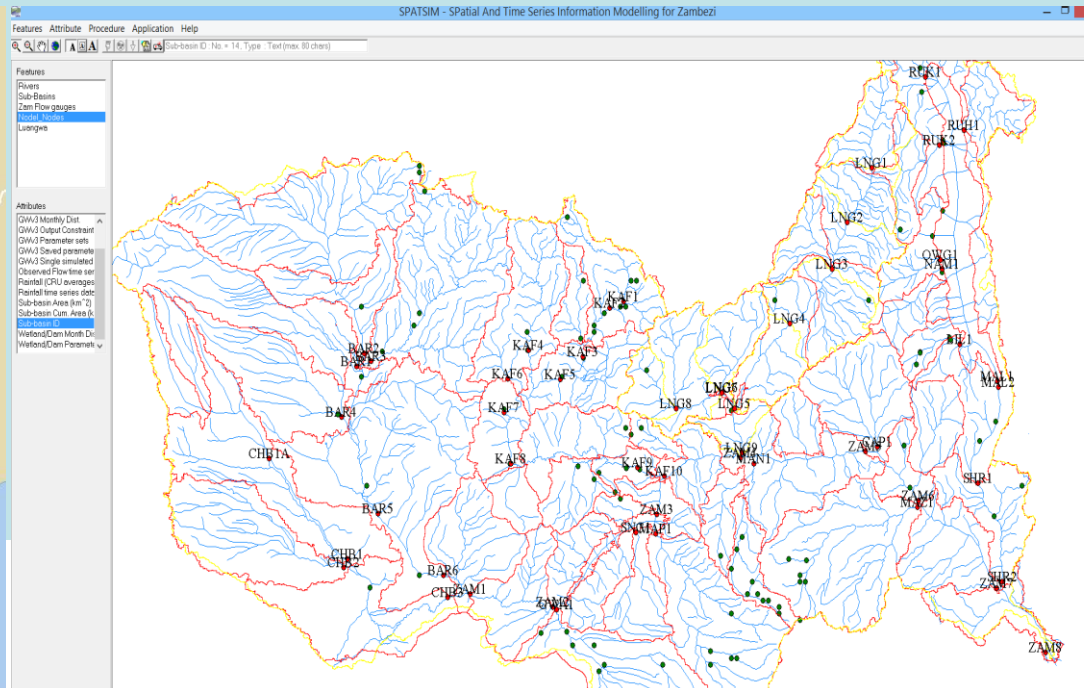
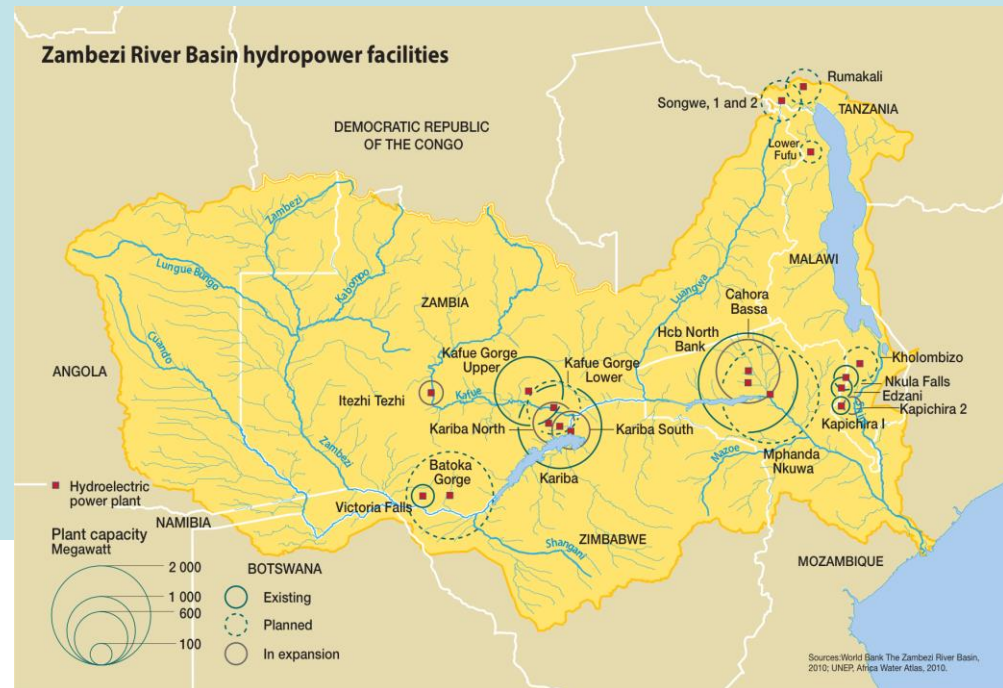


Water and Cooperation within the Zambezi River Basin

**HYDROLOGY /
HYDROPOWER /
DAMS
OPTIMIZATION**

OUTCOMES

1. Manual on guidelines in modelling hydrology and hydropower, including spatial database with dataset, tools, assessments: **100% COMPLETED**
2. Hydrological balance assessment: **50% COMPLETED**
3. Multi-purpose optimization model focused on major dams within ZRB: **30% COMPLETED**
4. Economic assessment of hydropower at ZRB scale: **30% COMPLETED**



**UNIVERSITY OF
STELLENBOSCH (SOUTH
AFRICA)**

**INTERNATIONAL CENTER FOR
WATER ECONOMICS AND
GOVERNANCE IN AFRICA
(MOZAMBIQUE)**

**NAMIBIA UNIVERSITY OF
SCIENCE AND TECHNOLOGY**



Water and Cooperation within the Zambezi River Basin (WACOZA)

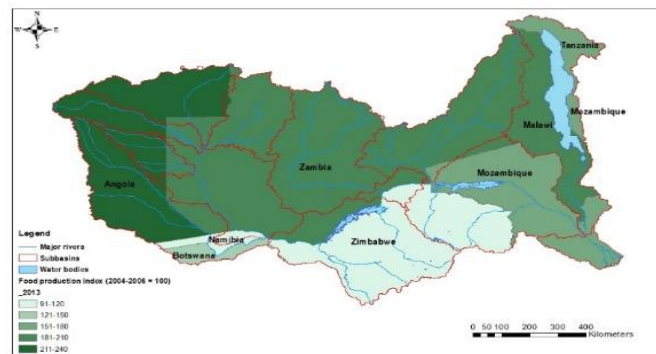
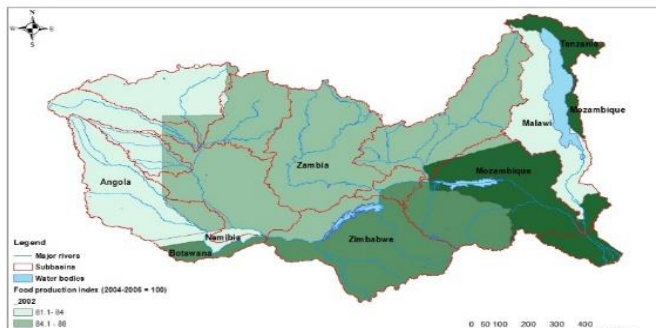
AGRICULTURE

OUTCOMES

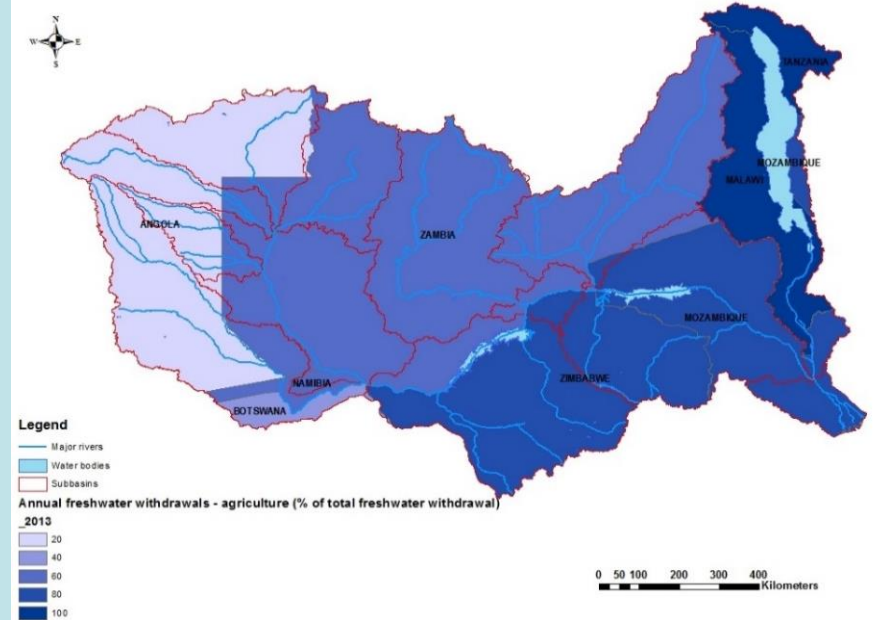
1. Agriculture assessment (crops water demand, productivity and potential impact of irrigation expansion) and scenarios-based management practices: **50% COMPLETED**

UNIVERSITY OF MALAWI

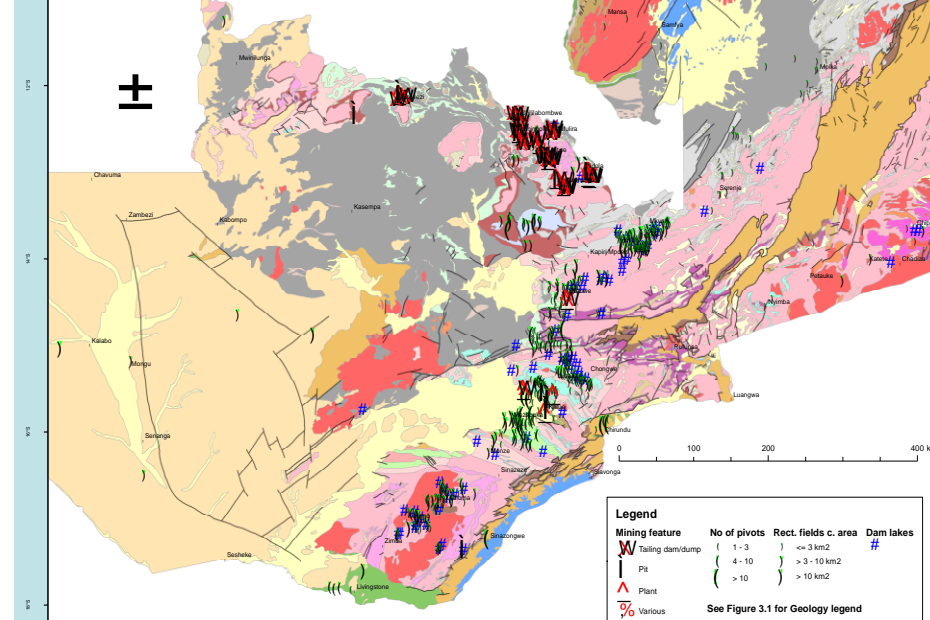
UNIVERSITY OF KWA-ZULU NATAL (SOUTH AFRICA)



Food Production Index in the ZRB (2006 and 2010=100): (a) in 2002; and (b) in 2013



Annual Agricultural water withdrawals as % of total freshwater withdrawals



Irrigation (and mining features) in Zambia



Water and Cooperation within the Zambezi River Basin

OUTCOMES

1. Groundwater hydrology baseline database at ZRB and selected countries level, literature review, available data sources and existing country/regional scale studies of major relevance to WEF nexus;
2. Complete groundwater assessment, production of several maps: availability, productivity, vulnerability, for few shared regional case studies

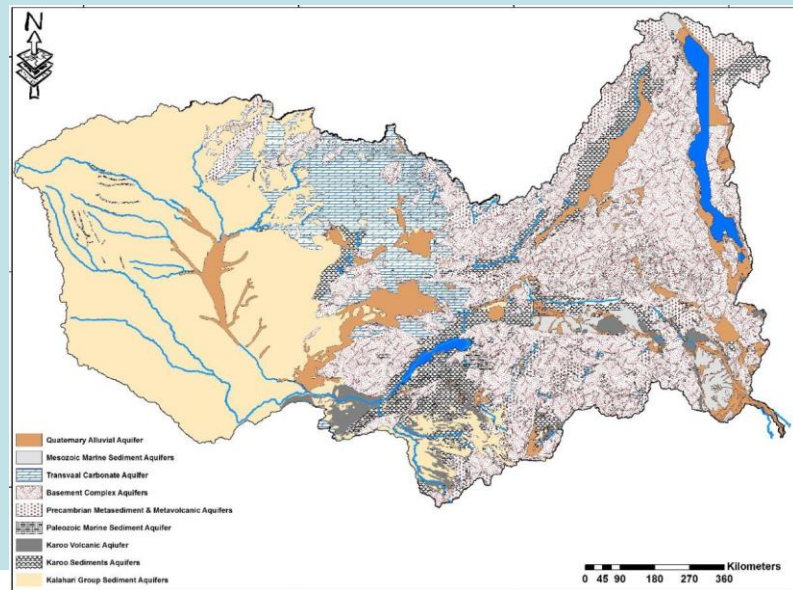
**GROUNDWATER
HYDROLOGY /
QUALITY**

WESTERN CAPE
UNIVERSITY (SOUTH
AFRICA)

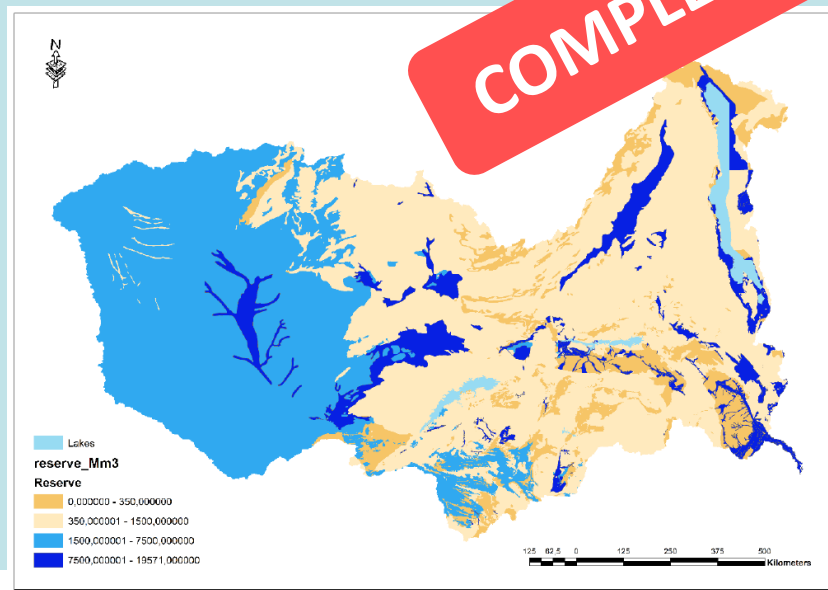
UNIVERSITY OF
ZAMBIA

NATIONAL UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(ZIMBABWE)

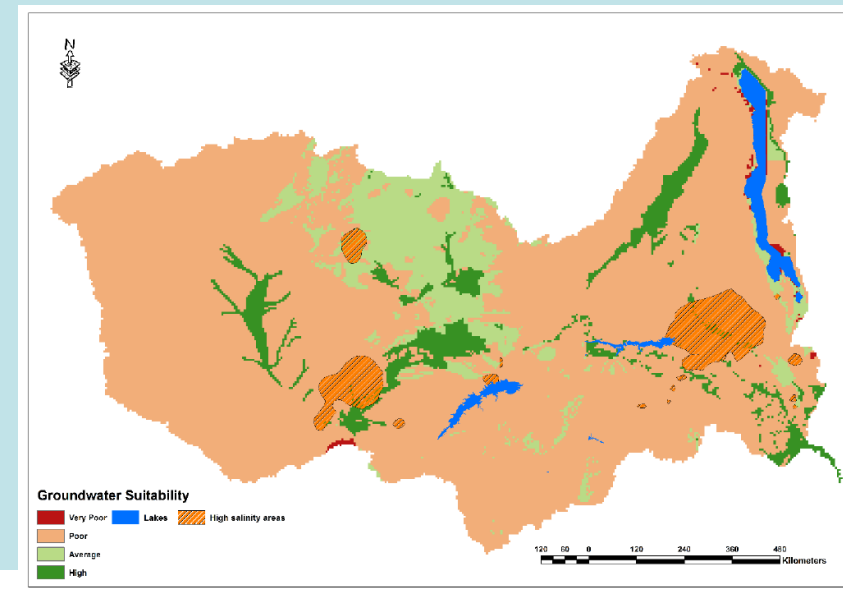
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Lithology based aquifer map



Aquifer reserve potential

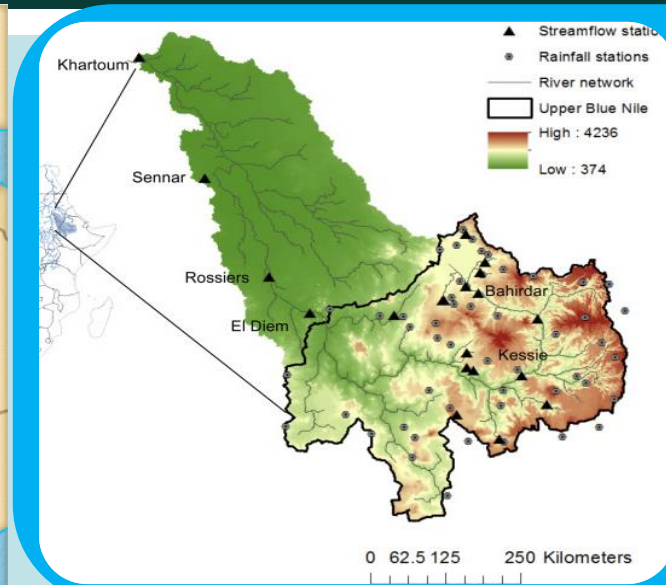


Suitability (potential and quality)

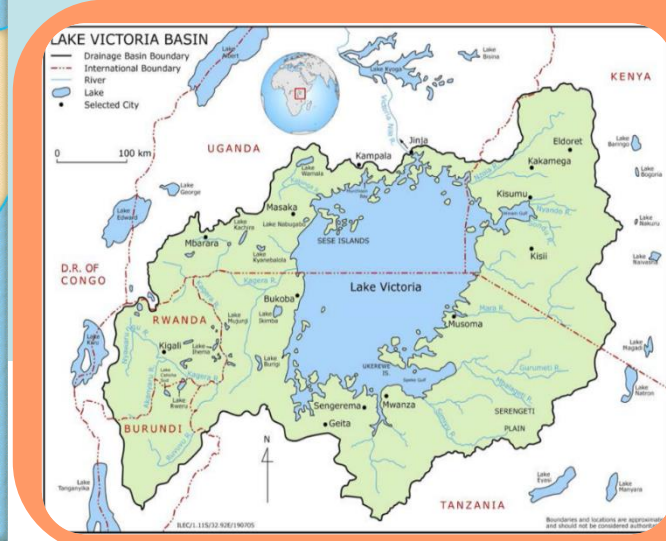


Water and Cooperation within the Nile River Basin

GEOGRAPHICAL SCOPE



- BLUE NILE BASIN**
- WATER RESEARCH CENTRE, KHARTOUM UNIVERSITY**
- ETHIOPIAN INSTITUTE OF WATER RESOURCES, ADDIS ABABA UNIVERSITY**
- ICPAC**



- LAKE VICTORIA BASIN**
- MAKERERE UNIVERSITY**
- ICPAC**

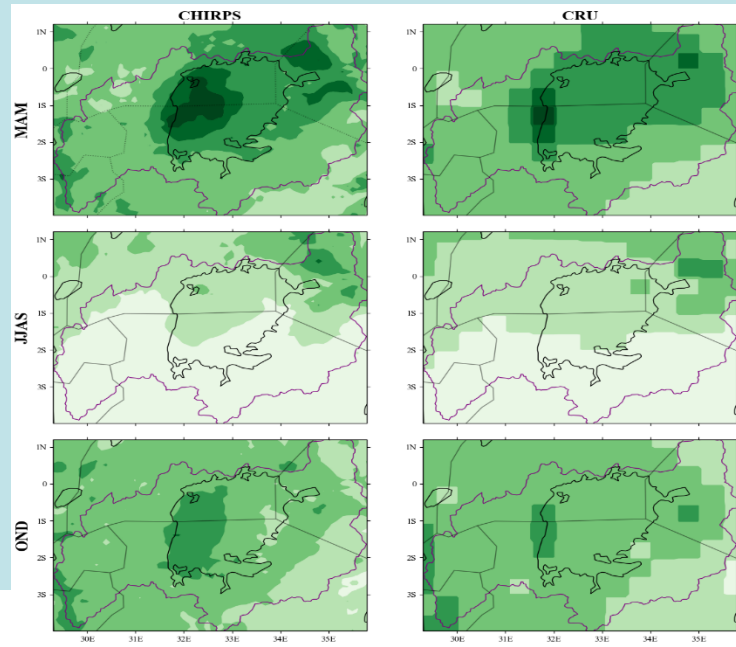
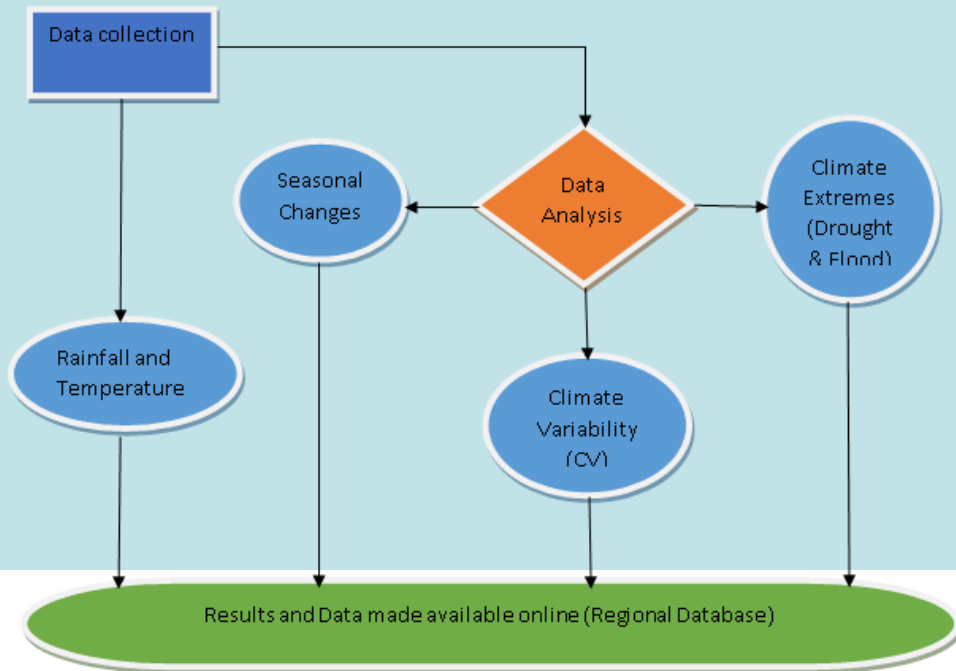


Water and Cooperation within the Nile River Basin (WACONI)

CLIMATE VARIABILITY / EXTREMES

OUTCOMES:

1. Regional (IGAD region) meteo-climate datasets (remote sensed datasets, ground based stations and related time series) and indices maps, relevant to CV analysis and extreme events risks assessment: **100% COMPLETED**
2. Report on CV analysis and extreme events risks assessment based on state-of-the-art indices (i.e. SPEI, SFI), at IGAD regional scale and with specific focus on BNB and LVB: **30% COMPLETED**



The observed seasonal rainfall patterns for the period 1981-2017

ICPAC

LAKE VICTORIA BASIN

BLUE NILE BASIN



Water and Cooperation within the Nile River Basin (WACONI)

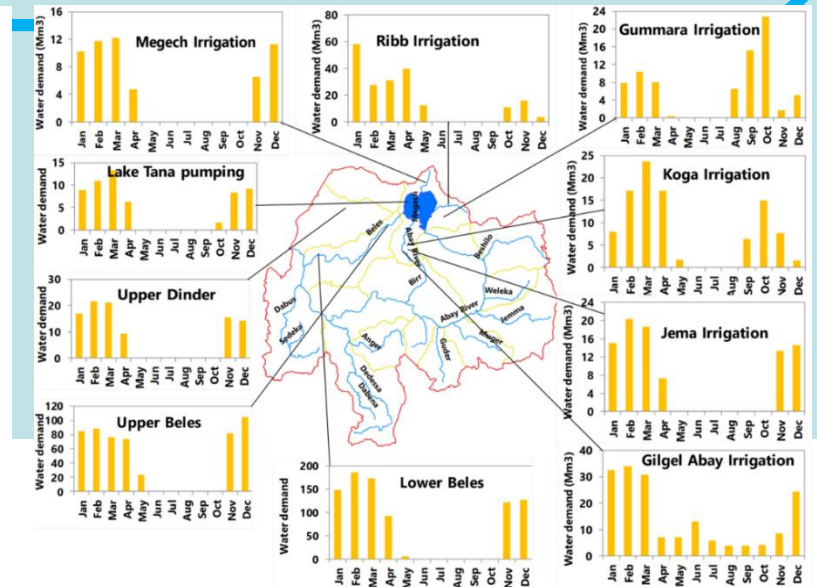
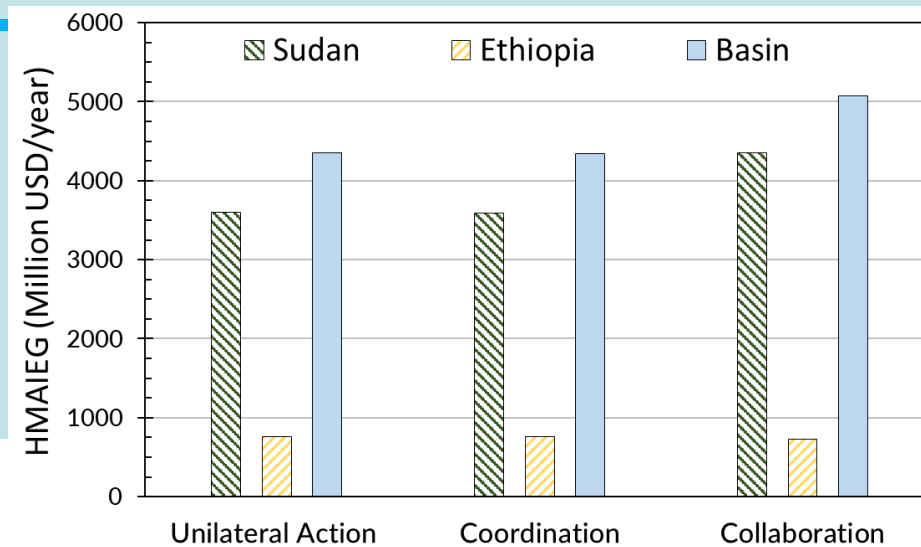
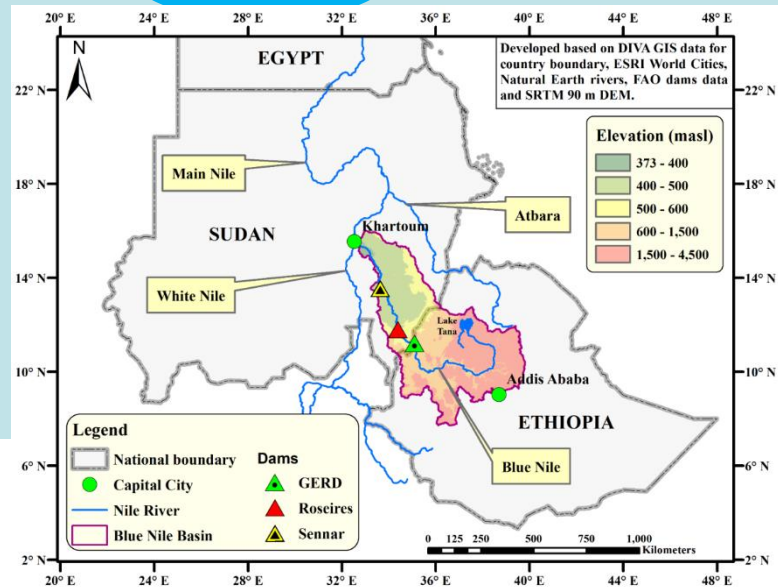
ETHIOPIAN
INSTITUTE WATER
RESOURCES

KHARTOUM
UNIVERSITY

BLUE NILE UP/DOWN STREAM GERD

OUTCOMES:

1. Comprehensive Assessment Report on WEFE nexus (current and future scenarios), including the design and implementation of a hydrological and hydropower optimization modeling framework and agricultural water management: **50% COMPLETED**
2. Manual on the methodological approach for assessing the impact of access to water and water quality on human health in rural and urban areas of the BNB: **100% COMPLETED**
3. Report and baseline spatial database on hydrology and water uses by source and sector (i.e. hydropower, irrigation, water supply) based on local and public domain data sources.: **50% COMPLETED**





Water and Cooperation within the Nile River Basin (WACONI)

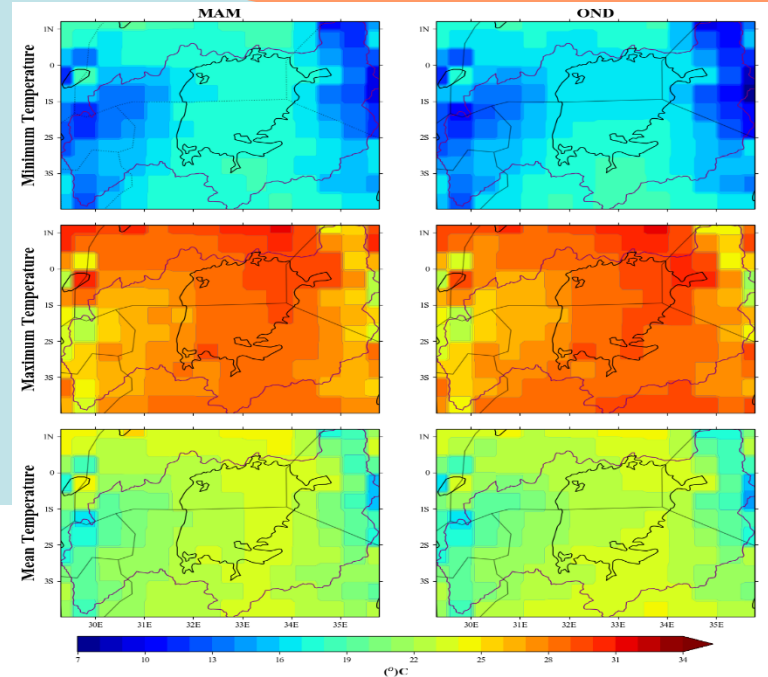
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MAKERERE UNIVERSITY

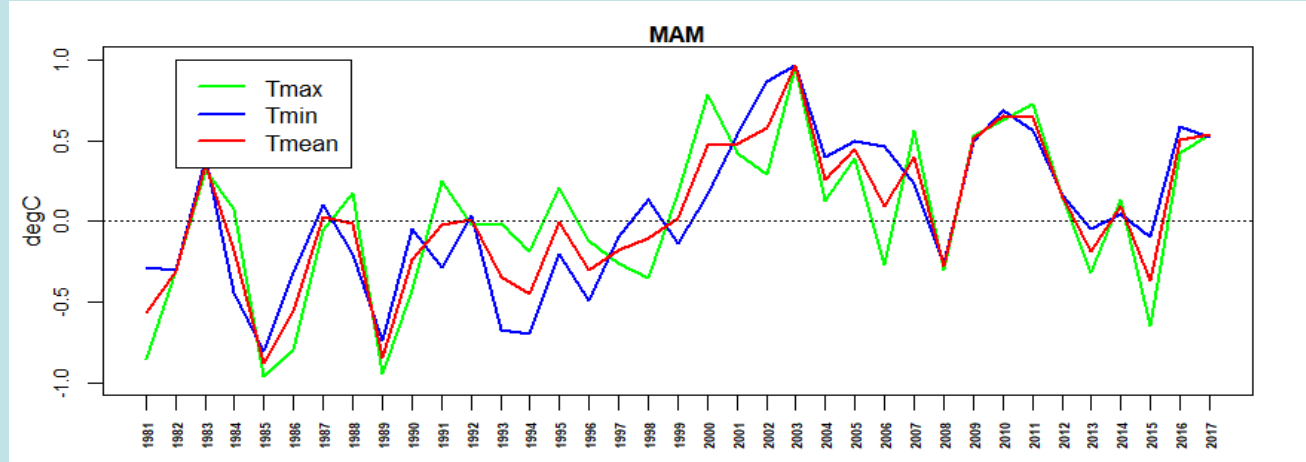
LAKE VICTORIA

OUTCOMES:

1. Report and baseline spatial database on hydrology and water uses by source and sector (i.e. agriculture, water supply) coupled with land use and cover, based on local and public domain data sources and aimed at supporting analysis and modelling activities at LVB scale: **30% COMPLETED**
2. Comprehensive Assessment Report on WEF nexus (current and future scenario), including the design and implementation of a water quality and crop modeling framework, at LVB scale: **30% COMPLETED**
3. Assessment Report on hydrological and water balance modeling framework over the LVB, under current and future scenario: **30% COMPLETED**



The observed seasonal (MAM & OND) surface temperature patterns for the period 1981-2017



Time series of seasonal maximum, minimum and mean temperature anomalies (units: °C) from 1981 to 2017 relative to reference period (1981–2010)

European Development Days – 2019

18-19 June, Brussels, Belgium



Session

Water Sciences and Capacity Development

Empowering people to leave no-one behind.

18th June 2019 – 10H00



Any questions?

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