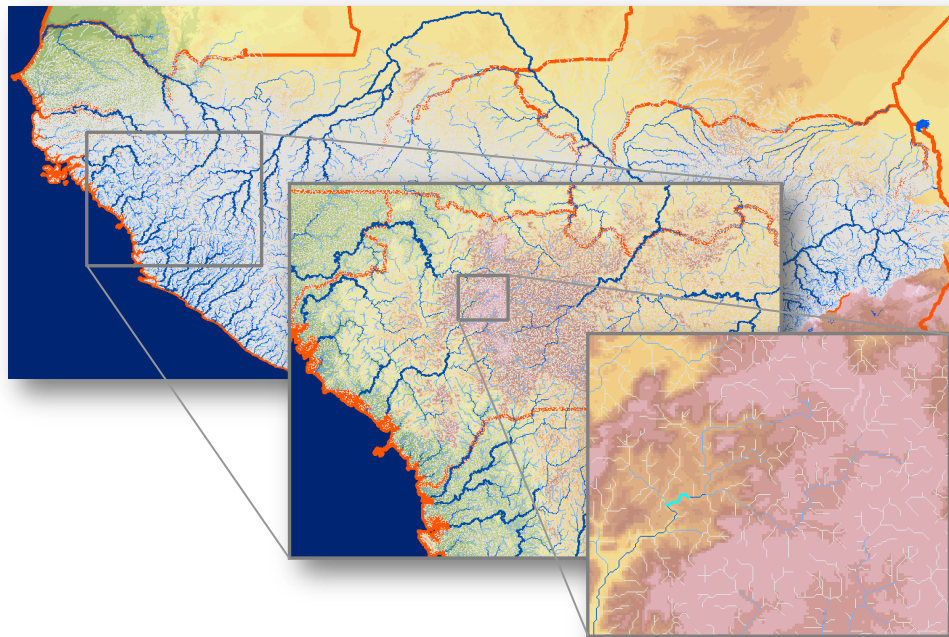


# Cartographie des ressources hydroélectriques via le GIS pour la région de CEDEAO

## Session 8 : Analyse du changement climatique



**Formation, Dakar, Sénégal , juillet 2016**

**Formateur : Harald Kling**

**Pöyry, Hydro Consulting, Hydroélectricité, Autriche**

Financé par



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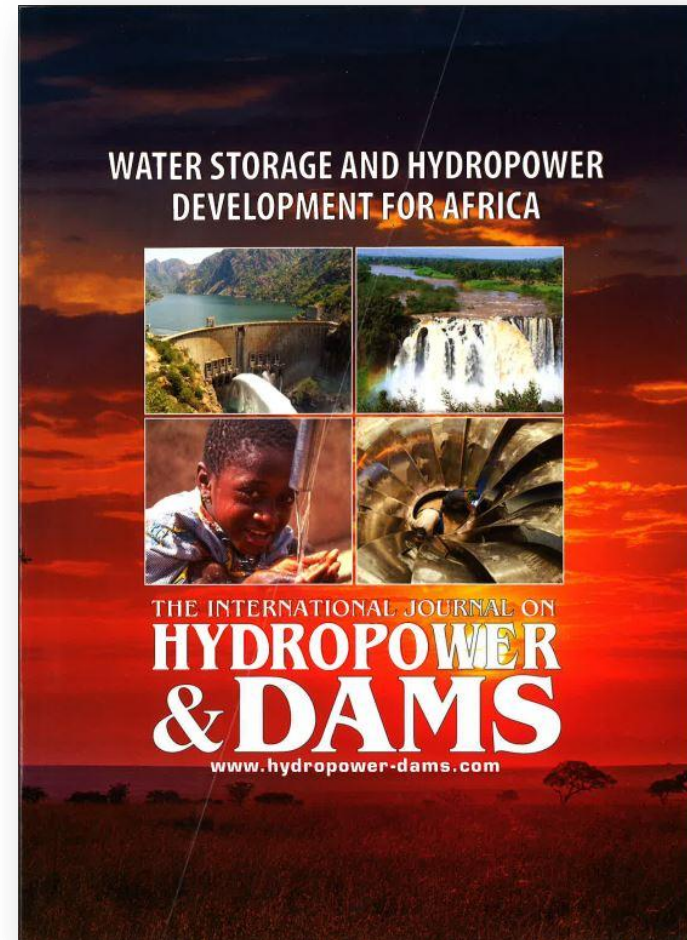
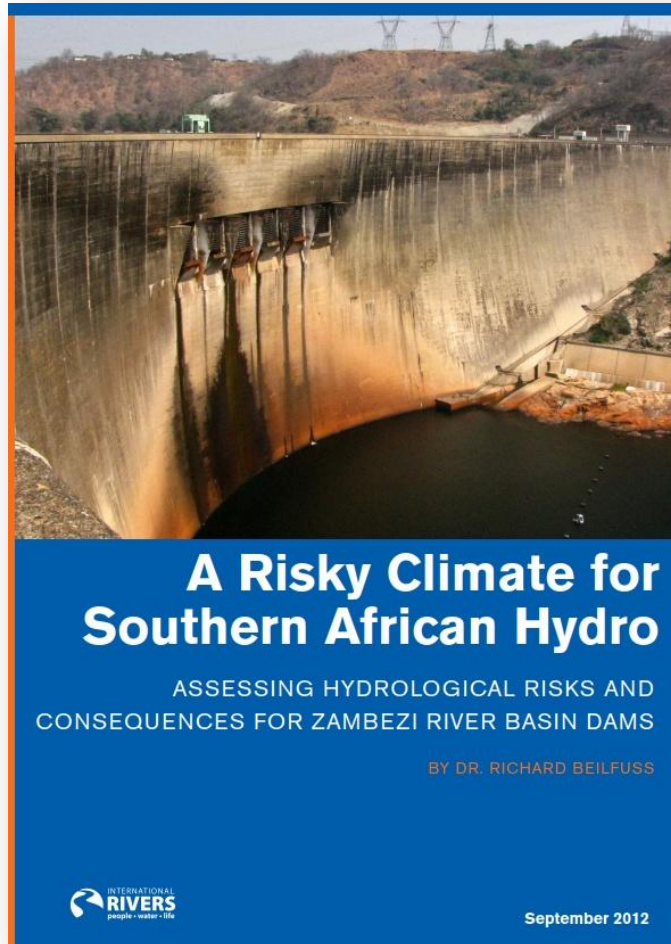
# Analyse du changement climatique

## Aperçu

- Prévission en matière de changement climatique pour l'Afrique
  - Exemple: bassin du fleuve Zambèze
- Groupe de travail
  - Prévission en matière de changement climatique pour les fleuves en Afrique de l'Ouest
  - Résultats pour le Zambèze utilisés à des fins de comparaison

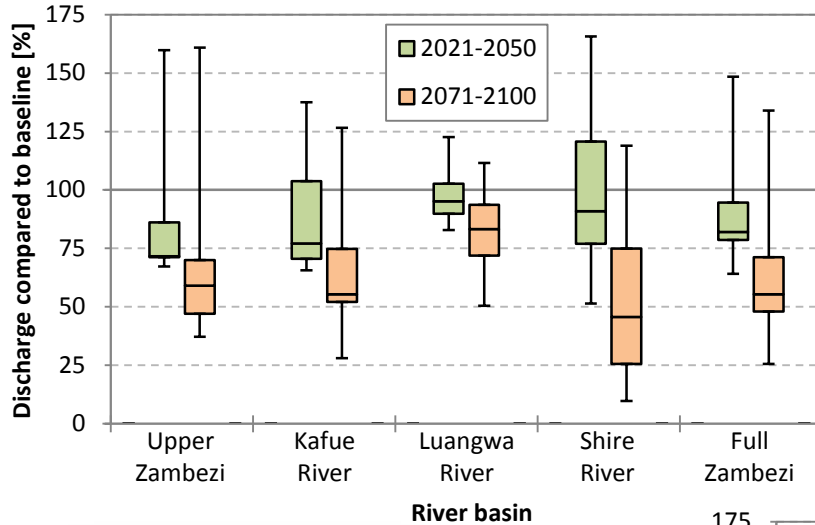
# Impacts du changement climatique sur l'hydroélectricité

## Études précédentes pour l'Afrique



# Future baisse prévue pour l'Afrique Australe

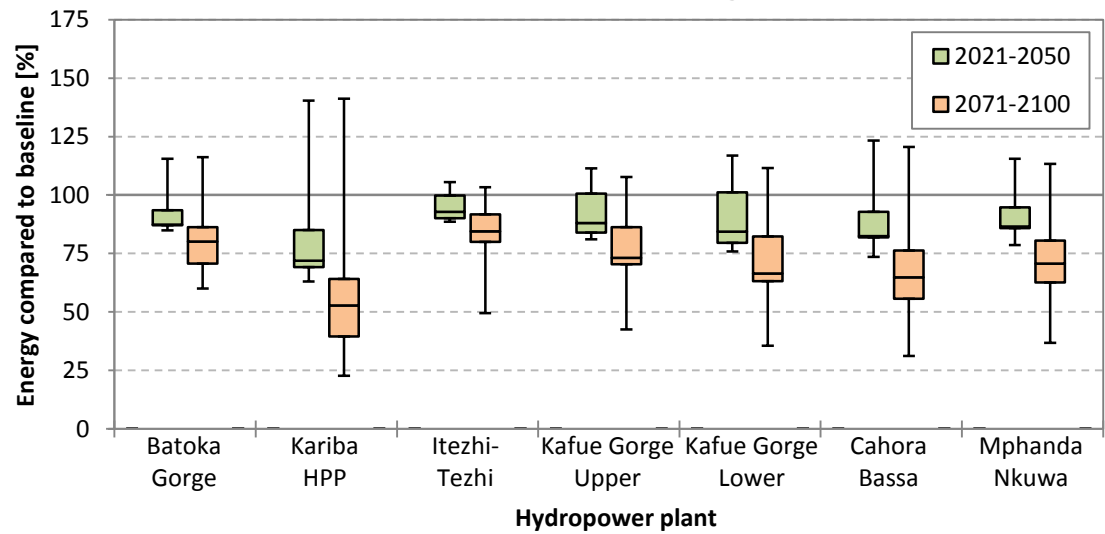
## Futur débit



Les prévisions en matière climatique donnent lieu à des préoccupations pour les investisseurs intervenant dans l'hydroélectricité.

➡ Futur débit en Afrique ?

## Future production en énergie



**Future hydro generation in the Zambezi basin under the latest IPCC climate change projections**

H. Kling, M. Fuchs and P. Stanzel, Pöyry, Austria

Several large hydro plants are already in operation on the Zambezi river in southern Africa, and there are plans for several more. However, climate change is expected to have a significant impact on the water availability of these projects. The study describes the impact of projected climate change on the hydroelectric potential of existing and future major hydro plants in the Zambezi basin.

The Zambezi river basin (1.4 x 10<sup>6</sup> km<sup>2</sup>) is located in southern Africa and is shared by eight countries (see Fig. 1). Among the most important hydroelectric plants in operation in the basin are Kariba (1470 MW), Cahora Bassa (2070 MW) and Kafue. Climate change is expected to have a significant impact on the extension of existing reservoirs, as well as on the construction of new hydroelectric plants and several projects are currently at the planning stage (Stanzel 2010; Kling and Fuchs 2012).

Climate change may have considerable impacts on future hydroelectric generation. Warmer temperatures will lead to increased evaporation losses, but water availability may provide changes in precipitation and runoff. The net result of these changes will depend on the extension of existing reservoirs, as well as on the construction of new hydroelectric plants and several projects are currently at the planning stage (Stanzel 2010; Kling and Fuchs 2012).

Hydroelectric resources for the Zambezi (Stanzel 2012). They have been a key working under the plans in the Zambezi basin (for example Kariba and Cahora Bassa, 2012). Spelling Fuchs, et al., 2012; Stanzel and Kling, 2012). As the availability of climate models for the African continent remains limited, large uncertainty still remains in the projections.

Fig. 1 Map of the Zambezi basin showing the location of the major hydroelectric plants in operation in the basin (Kariba, Cahora Bassa, Kafue) and the location of the major hydroelectric plants in the planning stage (Batoka Gorge, Itezhi-Tezhi, Kafue Gorge Upper, Kafue Gorge Lower, Cahora Bassa, Mphanda Nkuwa). The map also shows the location of the major hydroelectric plants in the planning stage (Batoka Gorge, Itezhi-Tezhi, Kafue Gorge Upper, Kafue Gorge Lower, Cahora Bassa, Mphanda Nkuwa).

Fig. 2 Change of precipitation (mm) in the Zambezi basin (1980-2100) under the RCP4.5 scenario. The graph shows the change in precipitation (mm) in the Zambezi basin (1980-2100) under the RCP4.5 scenario. The graph shows the change in precipitation (mm) in the Zambezi basin (1980-2100) under the RCP4.5 scenario.

# Prévision en matière de changement climatique pour la centrale hydroélectrique (CHE) de Kainji sur le fleuve Niger

## Publication scientifique utilisant les données de CORDEX



Article

### Quantifying Uncertainties in Modeling Climate Change Impacts on Hydropower Production

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Academic Editors: Daniele Bocchiola, Guglielmina Diolaiuti and Claudio Cassardo  
Received: 3 May 2016; Accepted: 13 June 2016; Published: 24 June 2016

**Abstract** Climate change will have large impacts on water resources and its predictions are fraught with uncertainties in West Africa. With the current global drive for renewable energy due to climate change, there is a need for understanding the effects of hydro-climatic changes on water resources and hydropower generation. A hydrological model was used to model runoff inflow into the largest hydroelectric dam (Kainji) in the Niger Basin (West Africa) under present and future conditions. Inflow to the reservoir was simulated using hydro-climatic data from a set of dynamically downscaled 8 global climate models (GCM) with two emission scenarios from the CORDEX-Africa regional downscaling experiment, driven with CMIP5 data. Observed records of the Kainji Lake were used to develop a hydroelectricity production model to simulate future energy production for the reservoir. Results indicate an increase in inflow into the reservoir and concurrent increases in hydropower production for the majority of the GCM data under the two scenarios. This analysis helps planning hydropower schemes for sustainable hydropower production.

**Keywords:** climate change; hydropower; Kainji Lake; uncertainties

#### 1. Introduction

Continuation of the use of fossil fuels is set to face multiple challenges that include depletion of fossil fuel reserves, environmental concerns, geopolitical and military conflicts as well as instability in fuel prices. The aim of harnessing hydropower and other renewable energy is to focus on the provision of sustainable energy for the economically subjugated fraction of the society, combat energy shortages and provide clean energy from the perspective of the Kyoto directive towards global decarbonization [1]. Hydroelectricity comes from the conversion of potential energy of water through turbines and an electric generator system [2]. Electricity generation from hydropower makes a substantial contribution to meeting today's increasing world electricity demands. However, only about 4 per cent of Africa's technically feasible hydro-potential has been developed, and enormous efforts are

Climate 2016, 4, 34; doi:10.3390/cl4030034

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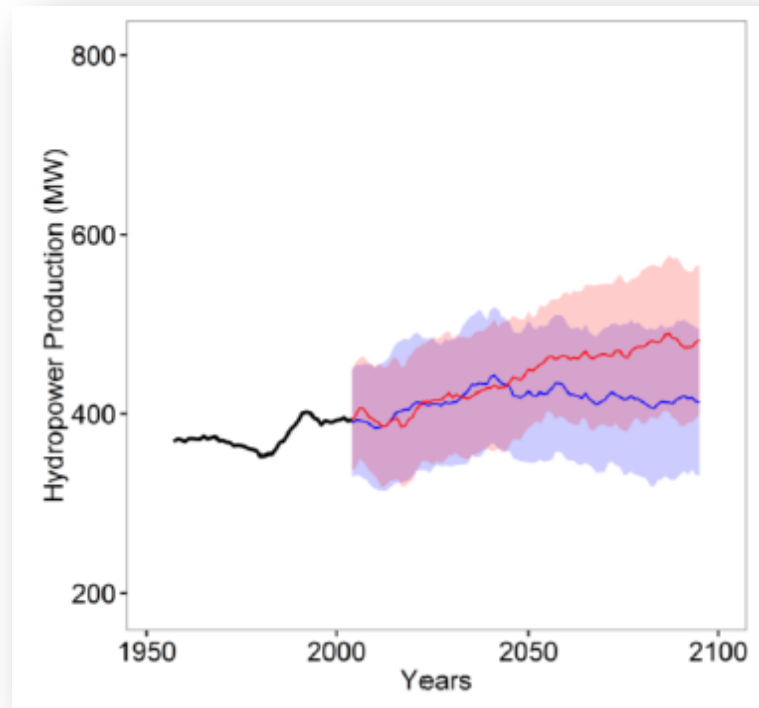
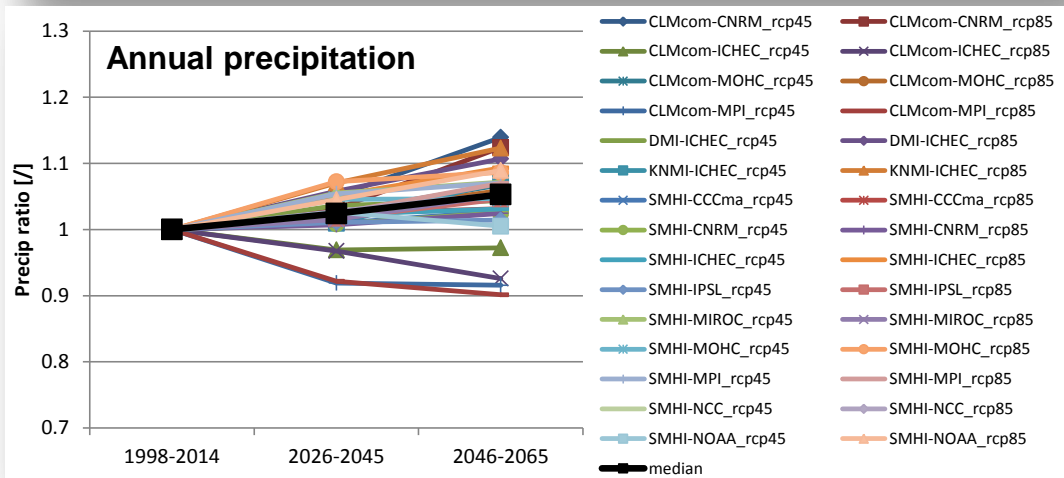
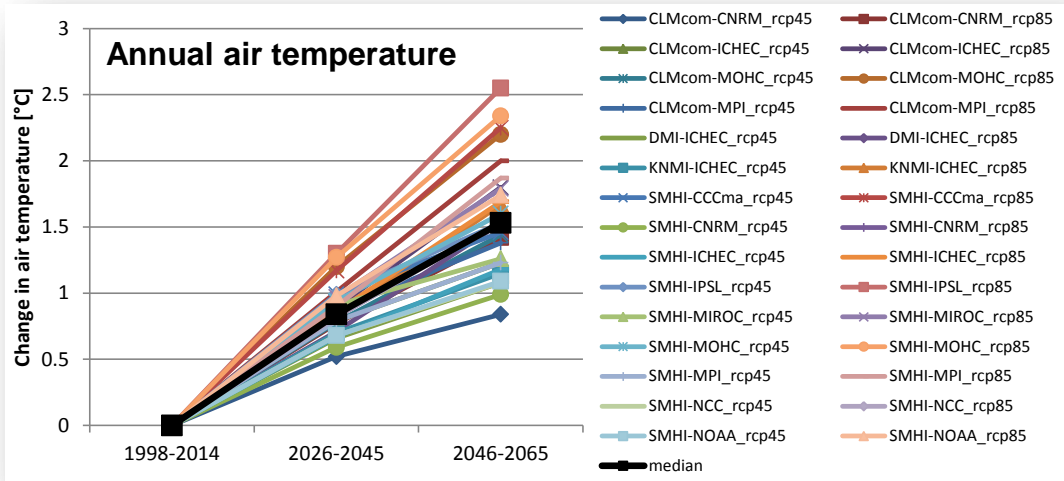
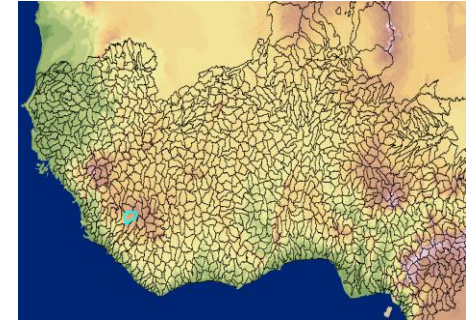


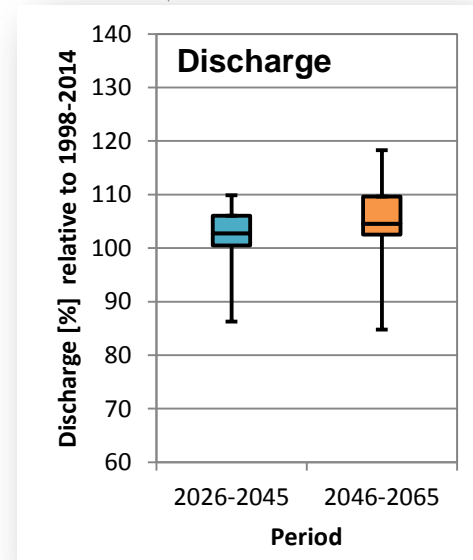
Figure 7. Ensemble median projected annual hydropower production in Kainji lake; black lines represent the historical data, red lines are RCP8.5, blue lines are RCP4.5 and standard deviations across 8 GCMs are showcased in the surrounding bounds.

# Changement climatique

Exemple concernant le cours supérieur de la rivière Makona (en Guinée)



Modèle du bilan hydrique



# Changement climatique

Montrer le réseau fluvial  
Faire un zoom avant sur la centrale hydroélectrique de Kainji  
Cliquer sur les simulations et montrer les attributs  
Expliquer Q\_2035\_P50 et al.

**Passer à la présentation du GIS...**

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## Groupe de travail

### Prévisions en matière de changement climatique pour quelques fleuves

- Groupes de 3 à 4 personnes (même chose que précédemment)
- Chaque groupe sélectionner un fleuve(ou deux)
- Nous poserons des questions sur les prévisions en matière de changement climatique pour le débit futur dans le GIS
- Nous résumerons les résultats dans un tableau



## Groupe de travail

### Prévisions en matière de changement climatique pour quelques fleuves

Prévision de changement du débit futur (2026-2045 par rapport à 1998-2014)

Fleuve	Quartile inférieur	Médiane	Quartile supérieur
Zambèze	-21 %	-18 %	-6 %
<i>Le fleuve sélectionné par vous...</i>			
Mano	+ 1,3 %	+ 4,5 %	+ 7,2 %
Gambie	- 9,1 %	- 2,7 %	+ 11,1 %
Cavalla	- 1,3 %	+ 3,5 %	+ 14,4 %
Séwa	- 0,4 %	+ 2,8 %	+ 6,4 %
Sénégal	- 9,2 %	- 2,6 %	+ 4,7 %
Corubal	- 7,6 %	- 1,3 %	+ 4,8 %
Volta	- 11,5 %	- 2,3 %	+ 4,5 %
Geba	- 20,2 %	- 7 %	+ 7,2 %

# Synthèse globale de la formation

- Première journée : aperçu général au sujet des nouvelles couches du GIS
  - Couches existantes pour les centrales hydroélectriques
  - Couches des zones climatiques
  - Couches des réseaux fluviaux
  - Couches des sous-zones
  - Rapports pays
  - Changement climatique (incorporé dans d'autres couches)
- Deuxième journée : Groupe de travail et exemples pratiques
  - Classification des centrales hydroélectriques
  - Taille et production d'électricité des centrales hydroélectriques
  - Analyse du bilan hydrique
  - Analyse du changement climatique
- Les nouvelles couches du GIS seront mises en ligne dans ECOWREX au cours des prochains mois
- Une formation additionnelle en utilisant le système ECOWREX est prévue

Fin

**Merci pour votre aimable participation !**



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