

# Chair of Hydrology and River Basin Management

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<http://www.hydrologie.bgu.tum.de/>



## Bachelor's program

### Basis module hydrology

- Essential fundamentals of hydrology

### Supplement module hydrology

- Statistical analysis of hydrological data
- Soil hydrology
- Hydrological modeling

### Hydrological field exercise

- A week-long course in which students will get to know manifold measurement instruments and techniques

## Master's program

### Field of Study 1

Urban Environment and Transportation

### Field of Study 2

Environmental Hazards and Resources Management

### Field of Study 3

Environmental Quality and Renewable Energy

### Field of Study 4

Energy efficiency and sustainability of the buildings

- Hydrological and Environmental River Basin Modelling
- Groundwater Hydraulics, Modelling and Management
- Flood Risk and Flood Management
- Integrated Water Resources Management

- Hydrological and Environmental River Basin Modelling
- Groundwater Hydraulics, Modelling and Management



## 1. Hydrology I and II

- Water Circle
- Water Balance (Budget) Models

## 2. Environmental monitoring and risk management

- Introduction to Environmental Monitoring
- Analysis of environmental data
- Introduction to Geostatistics

## 3. Hydrological and Environmental River Basin Modeling

- Overview on eco-hydrological modeling.
- Assessment of mathematical descriptions for plant growth and associated water and nutrient transport
- Water quality, and the influence of different land-uses and management forms.
- Eco-hydrological model (SWAT)

## 4. Flood risk and management

- Concept
- Application
- Case Study (MATLAB)



## 5. Groundwater - hydraulics, modeling and management

- Groundwater hydraulics (basic equations)
- Conceptualization of groundwater modelling
- Finite difference numerical solution for solving steady and transient flow
- The Farm Process Version 2 (FMP2)
- Calibration for parameter estimation of observed field data (PMWIN, Modflow, PEST)
- Contamination and heat transport
- 3D groundwater flow and transport modelling (PMWIN, Modflow )

## 6. Integrated Water Resources Management

- How to Implement IWRM
- Management and planning tools
- IWRM Performance and Evaluation
- River Basin Management Overview

## 7. Geostatistics and environmental monitoring



# Supervised PhD Thesis (finished this year)

## The Effect of Climate Change on Water Resources Potential and Flood Regimes of Omo-Gibe River Basin

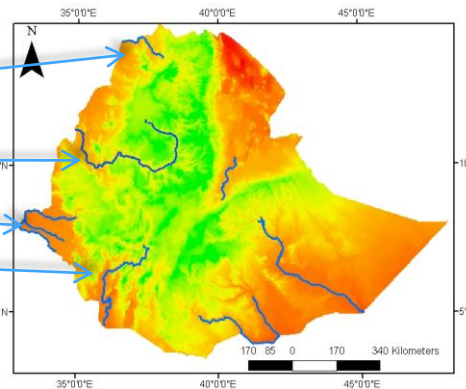
PhD thesis of Abdella Kemal

- Core of the PhD project is to investigate the effects of climate change on water resources potential
- Aims to enhance the ability of designers and decision makers to manage available water resources
- Methodical cores of the thesis are
  - Downscaling techniques for climate model outputs
  - Modeling inflows using the SWIM model

The

- Tekeze
- Blue Nile
- Baro-Akobo
- Omo Gibe

account for 83% of total surface runoff of Ethiopia



Planned dam: Gibe III

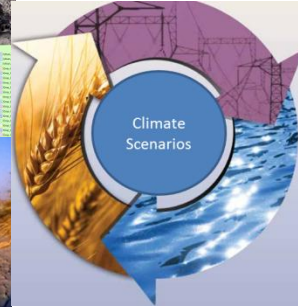
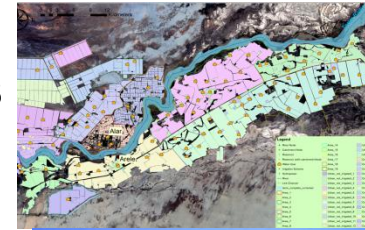
Height	243 m
Volume	14 km <sup>3</sup>
Length	610 m
Area	210 km <sup>2</sup>
Installed capacity	1870 MW
Annual electricity	6500 GWh (estimated)



# Research Areas

## Sustainable Water and Land Management in Arid Areas

- Interaction surface water – ground water
- Ecosystem functions and services



## Flood Risk Management

- Decision support systems
- Flood forecast



## Catchment Hydrology

- Hydrological and meteorological measurements
- Snow hydrology
- Hydraulic properties of soils

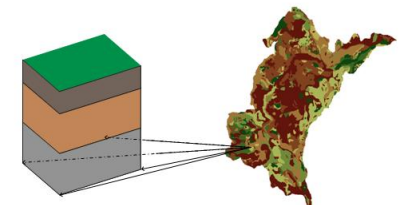


## Process Based Hydrological Modelling

- Climate and Land Use Changes
- Nutrient and Pesticide Transport, Erosion
- Decentralized Flood Protection Measures



$$\psi(\Theta) = \frac{1}{\alpha} \left[ \left( \frac{\Theta - \Theta_r}{\Theta_s - \Theta_r} \right)^{-1/m} - 1 \right]^{1/n}$$

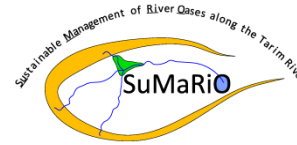




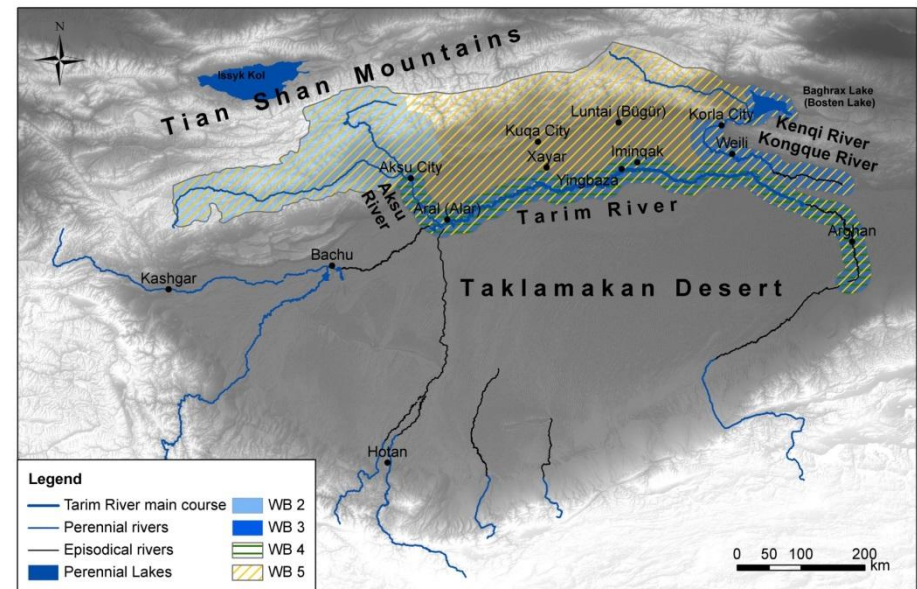
# Projects (ongoing) - SuMaRiO

## SuMaRiO – Sustainable Management of River Oases along the Tarim River / China

- Extremely arid region
- Tarim River is major source of fresh water for
  - Agriculture
  - All commercial sectors
  - Urban life
- Irrigation farming already leads to significant transformation of riverine ecosystems
- „Ecosystem Services“ are affected
- Current water resources management is not sustainable
- Consequences of which are
  - environmental problems and as a further result
  - social problems



Chair of Hydrology and River Basin Management



Bundesministerium für Bildung und Forschung



# Projects (ongoing) - SuMaRiO

SuMaRiO – Sustainable Management of River Oases along the Tarim River / China



# Projects (ongoing)

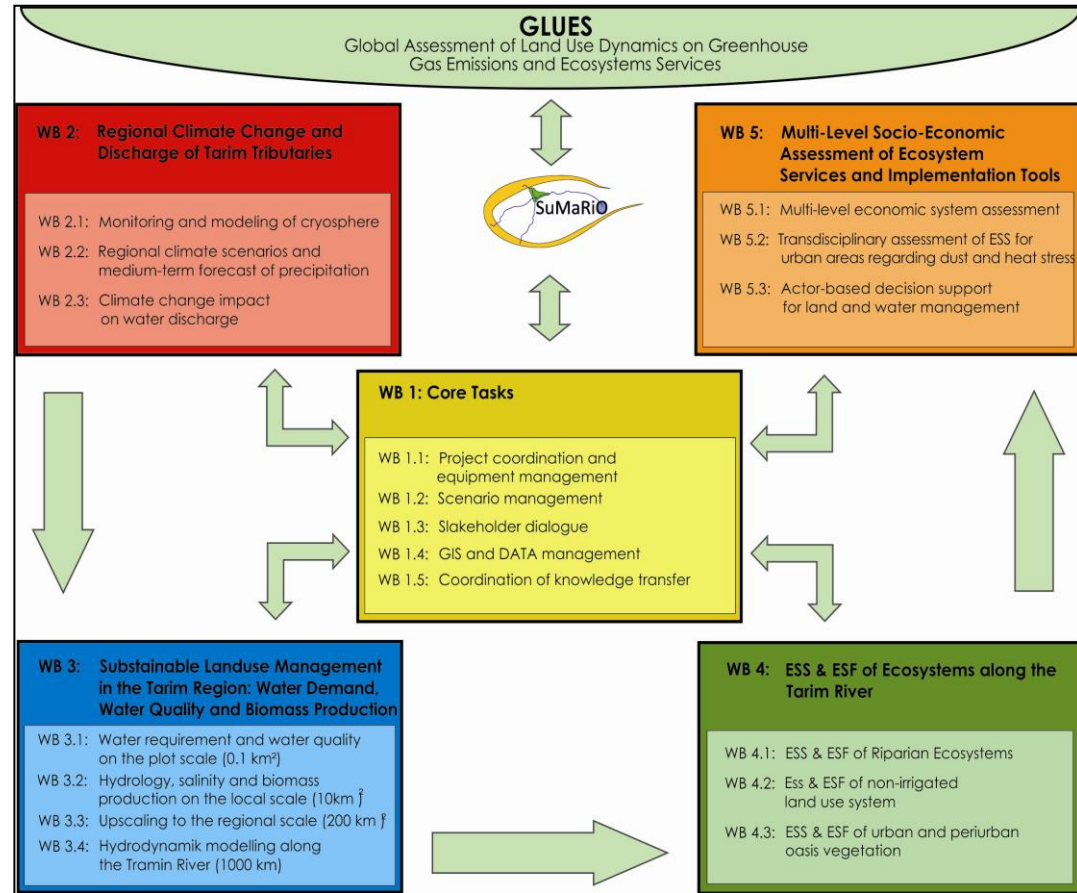
## SuMaRiO – Sustainable Management of River Oases along the Tarim River / China

### Basic project aims

- To optimize water use (ground- and fluvial water) in a sustainable way
- This aims to allow for a reaction on the effects of climate change in sufficient time

### Basic methodology

- Analysis of ecosystem services (right scheme)
- Integration of stakeholders, local decision makers and residents in the research process
- Introduction of participatory approaches in the development of sustainable land management structures



# Projects (ongoing) – Adapt Risk

Adaptive risk-informed decision making for flood management and water resource planning under climate change uncertainty

## Project Aim:

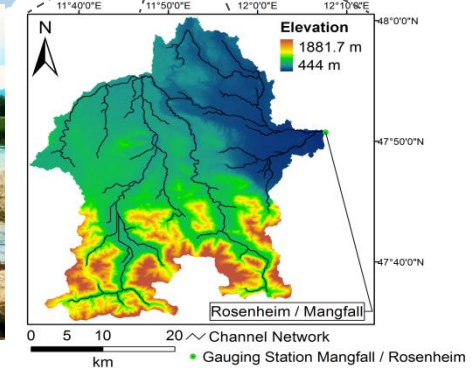
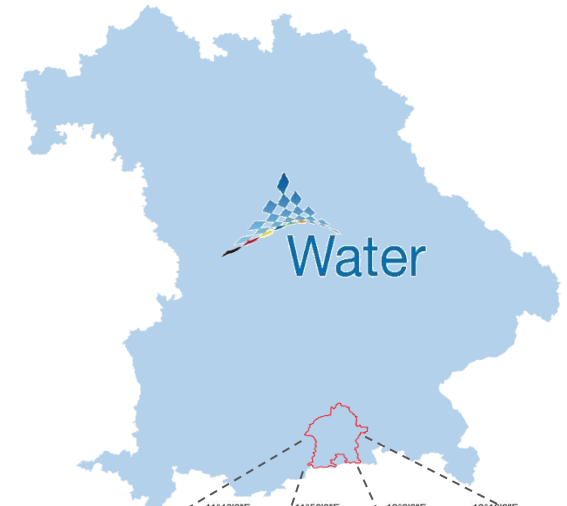
To develop a methodological framework of decision making under uncertainty that allows taking into account the adaptability of the infrastructure

## Key points:

- Rigorous mathematical modelling of uncertainties
- Bayesian decision analysis for assessing the optimality of risk mitigation strategies.
- Application of hydrological and hydraulic models
- Assessment of model uncertainty
- Impact of natural hazards for the safety of critical infrastructure
- Collaboration with policy makers and industry

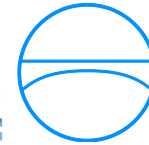
## Focus hydrological modelling and evaluation of flood protection measures conducted

by Jochen Scholtes at the chair of Hydrology and River Basin Management



# Projects (ongoing) - NIMA-NEX

Nile Management - Nexus Expert Tool



**CLI-NEX**



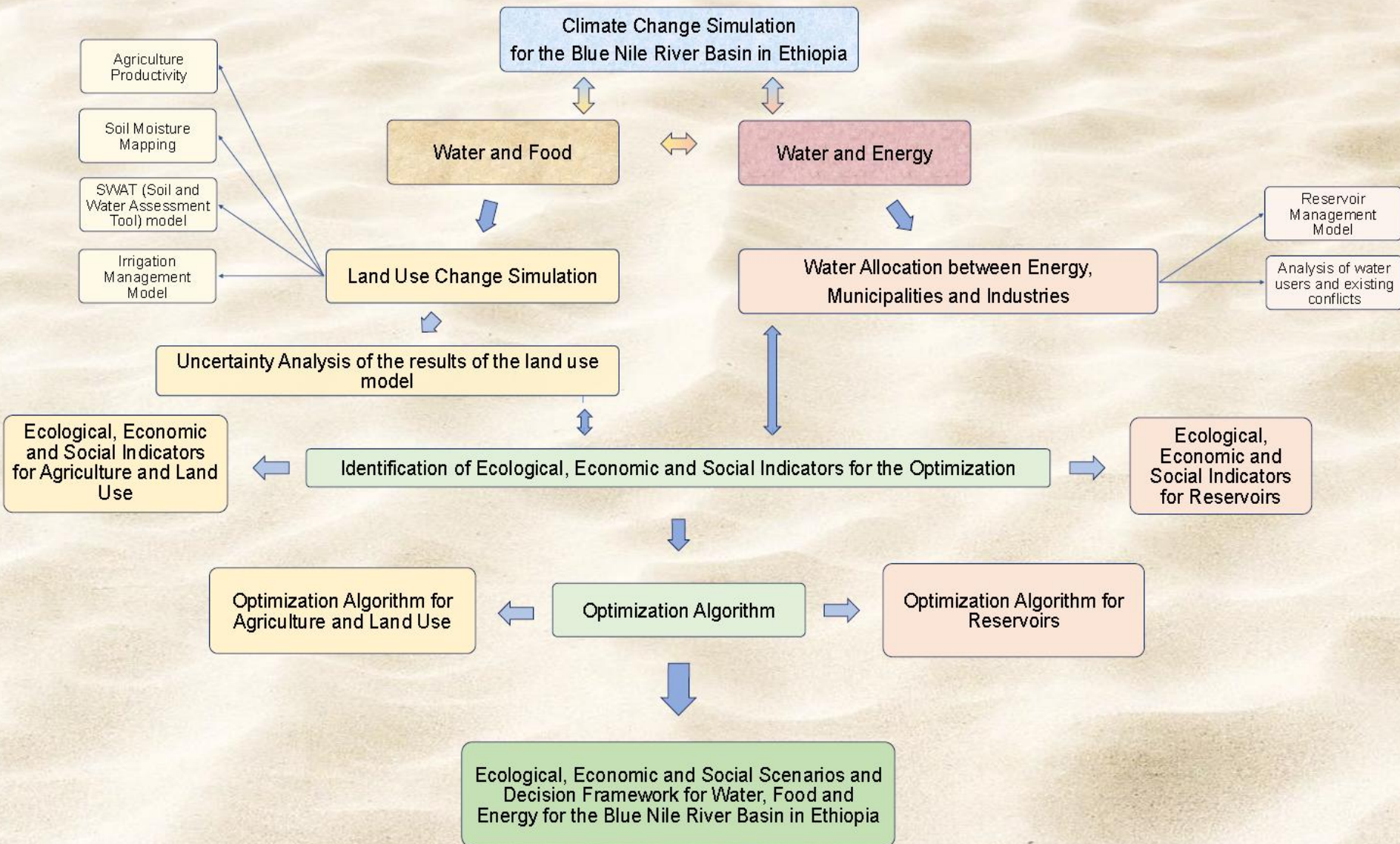
**HY-NEX**



**MA-NEX**

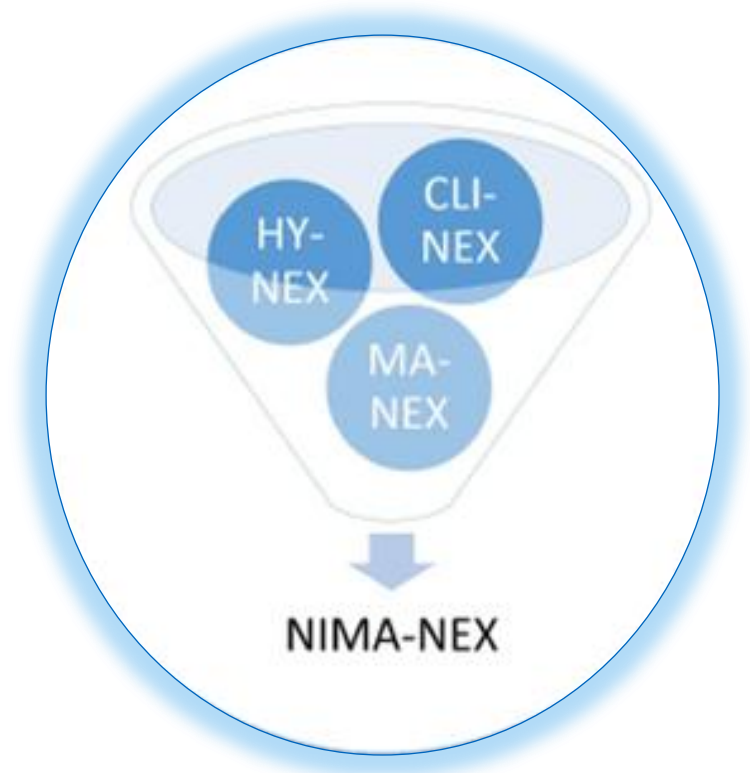


# Projects (ongoing) - NIMA-NEX



## Aims and expecting outcomes

- Developing an integrated management tool for the Blue Nile River Basin in Ethiopia, the NIMA-NEX-project will optimize the overall use of the Nile waters.
- A sustainable use of the water resources, all relevant factors (climate, natural resources, economy and society) will be taken into account, so as to maximize the overall benefits.
- The political stability and peaceful coexistence of the countries that share the Nile waters will stay in the first line for the whole project.



# THANK YOU!

