Building on previous analysis and modeling of the hydrology of the Great Ruaha Basin

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CLIVET Workpackage 2

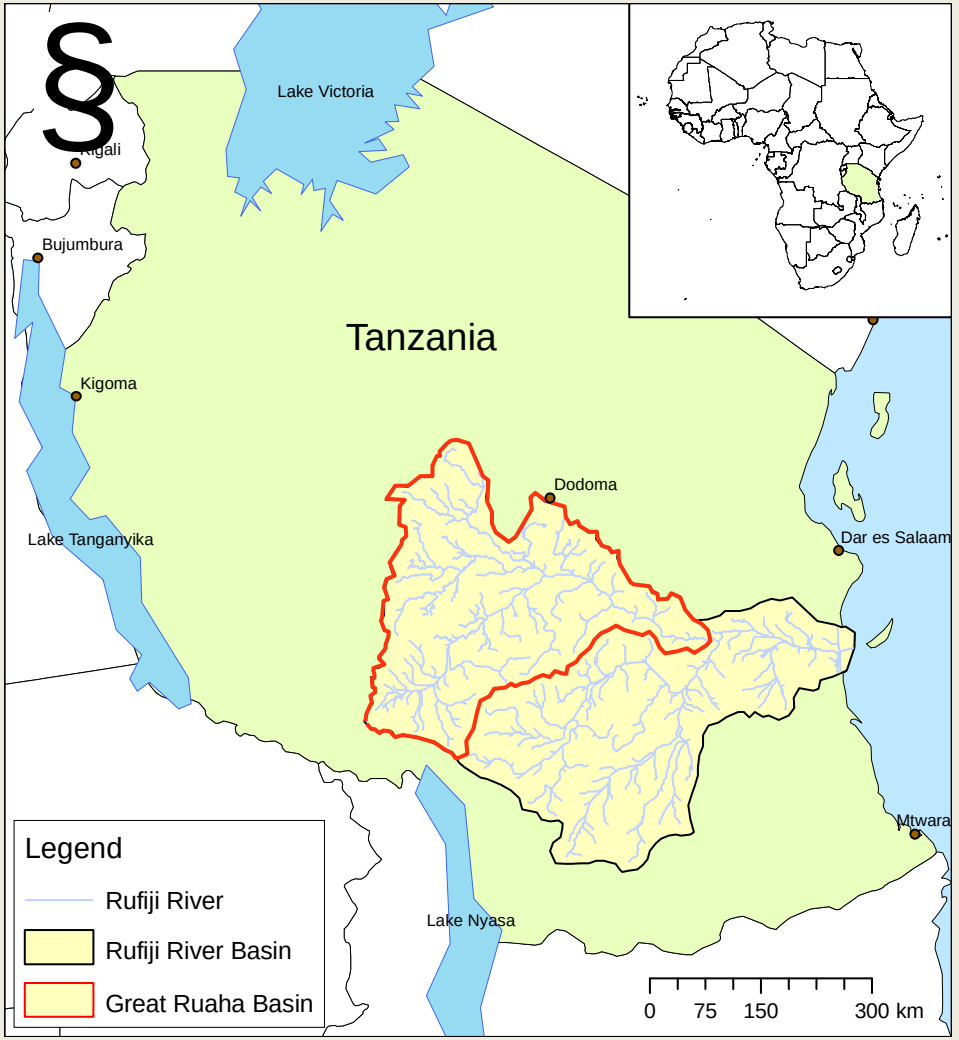
- Predicting and analyzing impacts of climate change and adaptation measures on hydrology and water resources for agriculture in selected river basins in Tanzania

WP tasks

- Collect and analyze hydrological data
- Characterize and model hydrological processes
- Utilize the model for land use change impact assessment
- Utilize the model for CC impact assessment
- Utilize the model for Water management assessment

Basin selection

- Within the Rufiji basin
- Coordinated with WP3
- Possibly the Great Ruaha River subbasin



Basin selection

- The upper part of the Great Ruaha River subbasin (Usangu plains) is well documented
- Data are available
- Has a long history of land use change
- Competing water users
- Declining base flow
- Data collected and analyzed during the RIPARWIN project

Source: Kashaigili et al. 2006

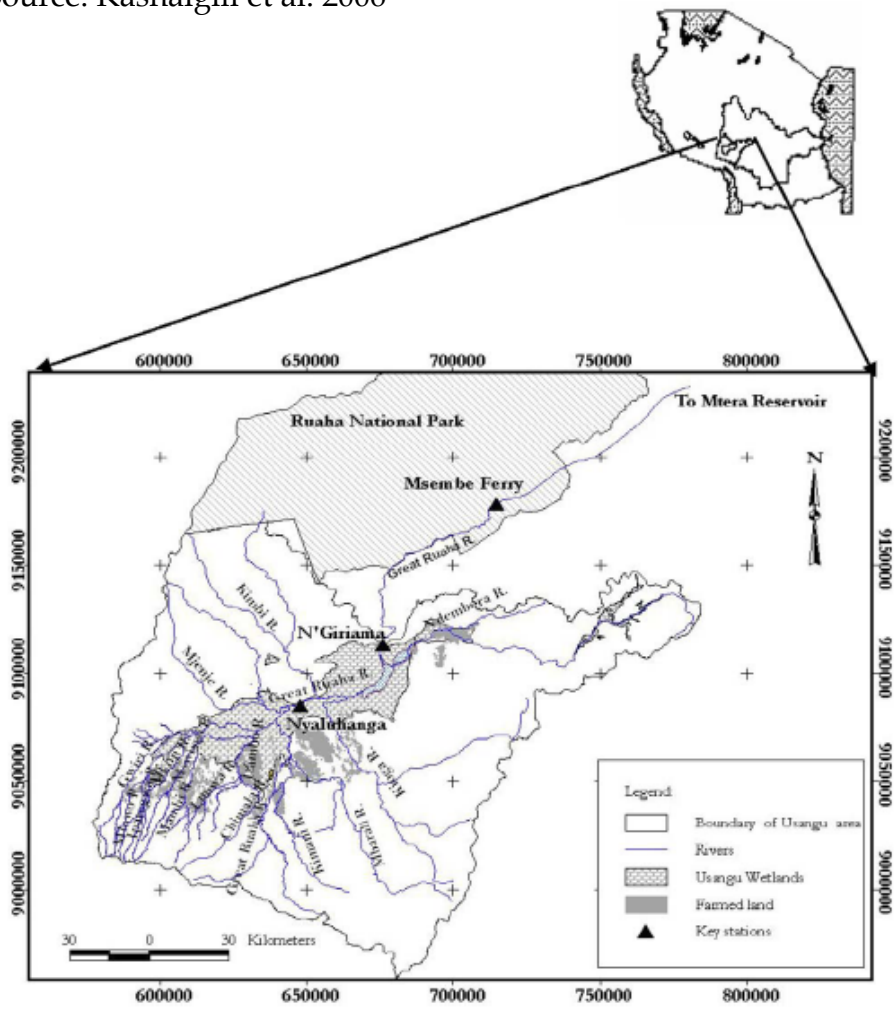


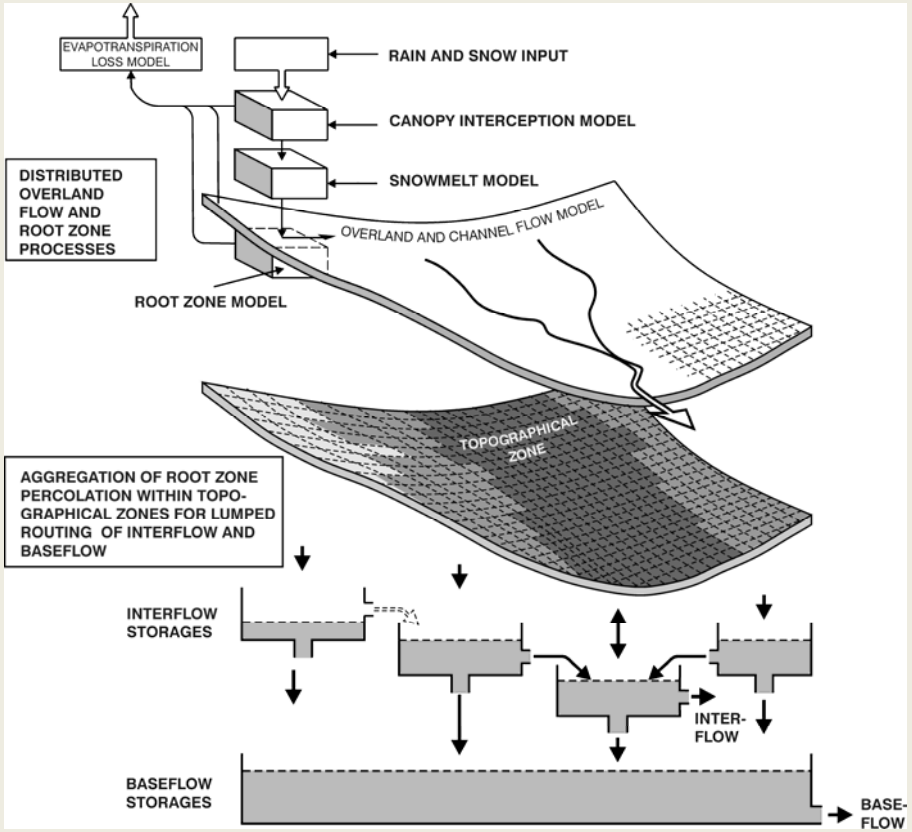
Fig. 1. Map of Tanzania showing location of the Usangu wetlands.

Model code selection

- The Usangu wetland in The Great Ruaha River subbasin requires integrated surface water-groundwater modelling
- Model capable of describing the land use change history and scenarios
- Irrigation module
- Possibly compare different models

The MIKE SHE model

- Distributed surface-groundwater water modelling
- Integrated modelling of ET, unsaturated zone and saturated zone
- Flexible land use description
- Irrigation included
- Data demanding
- Computationally slow
- Expertise at GEUS



The SWAT model

- SWAT is a river basin scale model developed to quantify the impact of land management practices in large, complex watersheds (USGS)

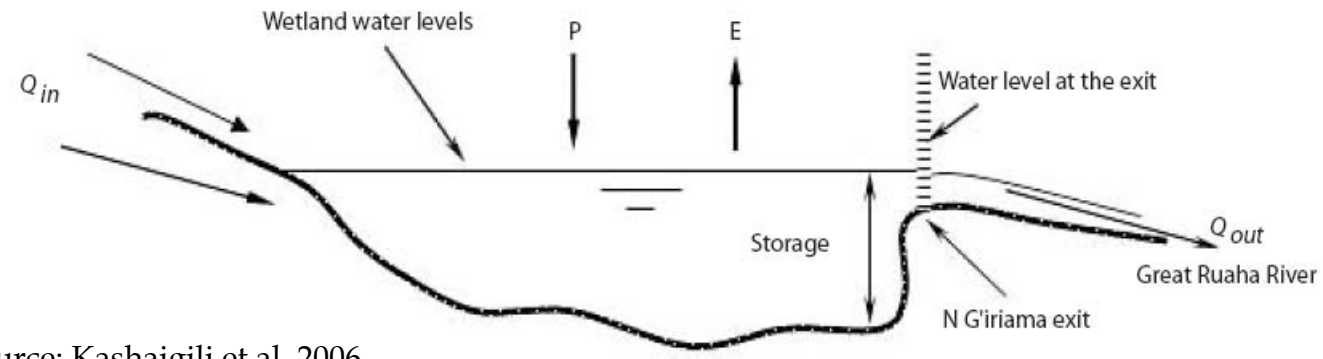
- Distributed hydrological modelling tool (HRU)
- Describes primarily surface water
  - Discharge
  - Recharge
  - AET
- Integrated in GIS
- Free software
- Expertise at WRED

- Has been widely applied for large catchments all around the world.
- Has previously been applied for Climate change studies
- Lacks a detailed description of groundwater

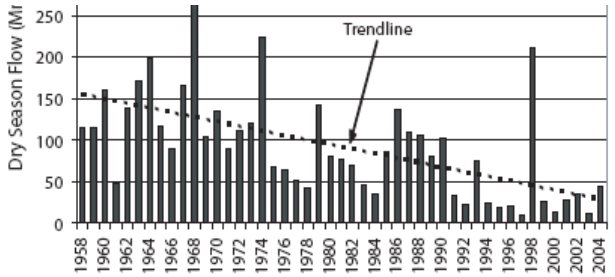
Examples of historic data and trends – from RIPARWIN

- Long
  series
  Ferry
- Rainf
  Mbar
  prese
- Docu
  in irrigated area, wetland area and dry season flow
- Conceptual wetland model

FIGURE 11.
Conceptualization of the Eastern Wetland as a simple reservoir.



Source: Kashaigili et al. 2006



Source: Kashaigili et al. 2006

Source: Daily river flow data for the Msembe Gauging Station from Rufiji Basin Water Office (RBWO)

Documented decrease in dry season flows

- Documented change in irrigated area, wetland area and dry season flow
- Historical dispute over causes of the decrease (Lankford, 2004)
- Hopefully our modeling analysis can contribute to the documentation of the causes

Data analysis and conceptual model

- Build on the RIPARWIN and extent the analysis to the Great Ruaha Basin
- The findings from RIPARWIN gives us a detailed history of the Usangu plains
- We need to recreate similar stories for other parts of the Great Ruaha Basin
- Gather and analyze the available data
- In collaboration with WP3: Create a coarse land use change history of the Great Ruaha Basin
- Build a conceptual model for the entire Great Ruaha Basin
- Take the modeling of the Basin a step further by utilizing a comprehensive distributed modeling tool
- This physically based model can be used for running climate and management scenarios

Modelling timeline

History

- 1958-1974: Undisturbed (natural) system
- 1974-present: Major land use change and decline in dry season flow

Model simulations

- 1958-1974: Model calibration of constant geological parameters
- 1974-present: Model calibration of dynamic land use change and associated river flow

Remote sensing data options for the Rufiji-Ruaha catchments

- The advantage is uniform data coverage in a large catchment
- Cheap and easy data access
- Data format suited for distributed hydrological modelling
- Limited time window
- All RS estimates should be calibrated or validated with “real” observations

- Precipitation
  - CPC-FEWS 0.1 deg, daily 1995-present
- Vegetation/landuse
  - MODIS or Landsat
- Actual evapotranspiration
  - MODIS
- Groundwater Storage change
  - GRACE

Scenario Modeling

From WP1

- A hydrological model has been established that can simulate the historic period (1958-2009)
- Recalibrate the model using Hindcast simulations from the climate model
- Run the future climate scenario using the model
- Input needed: Rainfall, temperature, PET/Rn/Rs

From WP3

- Test the impact of various historic and future land use change scenarios
- Test the impact of management actions

- Input needed: Concrete and simplified Land use change and management history and scenarios