Groundwater-Surface Water Interaction in a papyrus wetland

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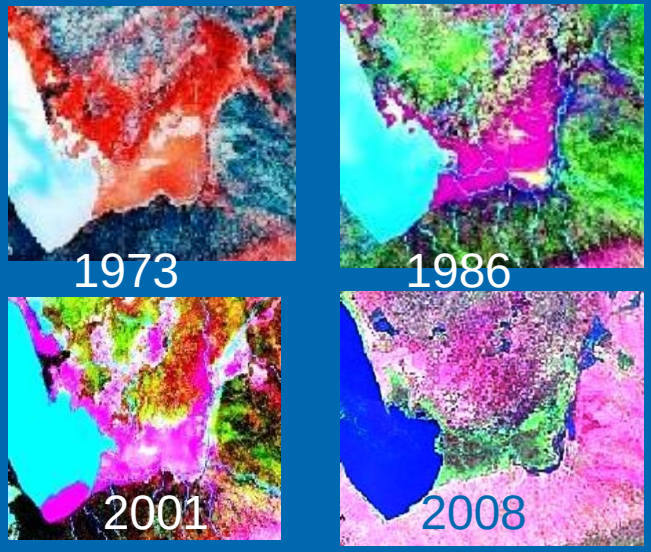
Introduction

- Interest in groundwater-surface water interaction in wetlands has increased in the past 20 years as these ecosystems are lost to development *(Winter 1995).*

- Understanding water flux exchanges is an important issue in Lake Victoria Basin

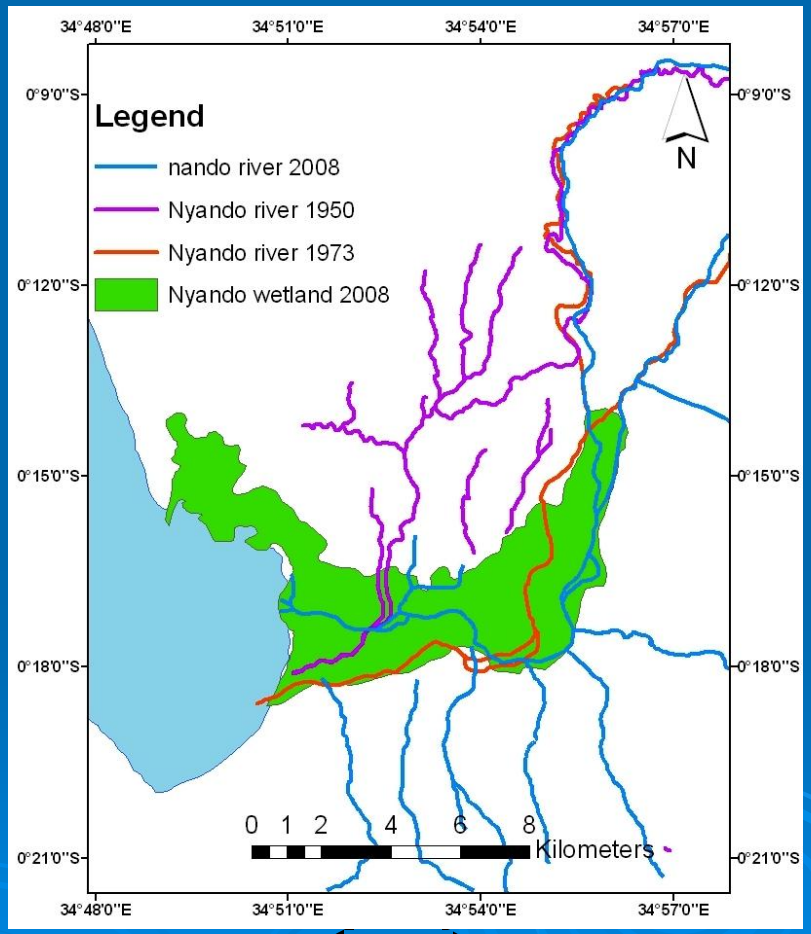
Issues and challenges

Wetland evolution



- Irrigation
- Livestock grazing
- GW abstraction
- Floods and drought

River migration



Wetland functioning and products

Flood attenuation

Biodiversity

Fisheries

Products

Main Objective

To understand groundwater-surface water interactions at Nyando wetland

Specific Objectives

- Determine factors influencing soil moisture content at the root zone
- Develop conceptual models for groundwater-surface water interactions

Main Research Question

What is the relationship between the lake, river, alluvial aquifer and wetland at spatial and temporal scales?

Methods

- Study area and sampling design

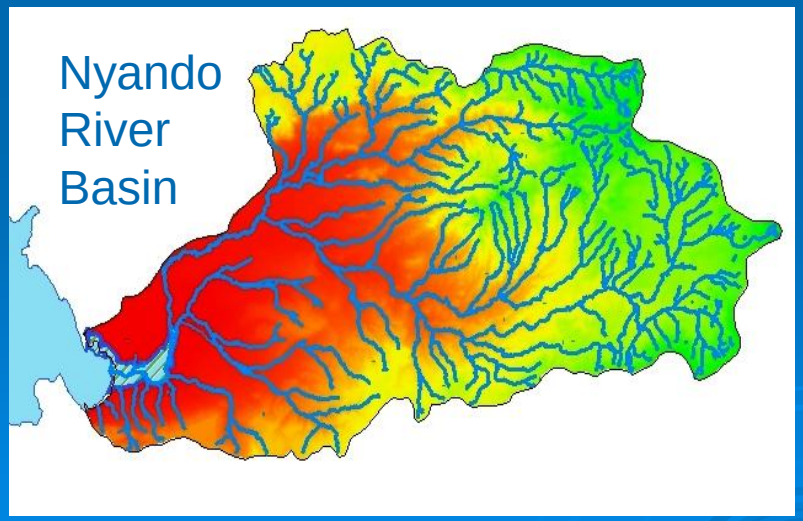
Experimental investigations

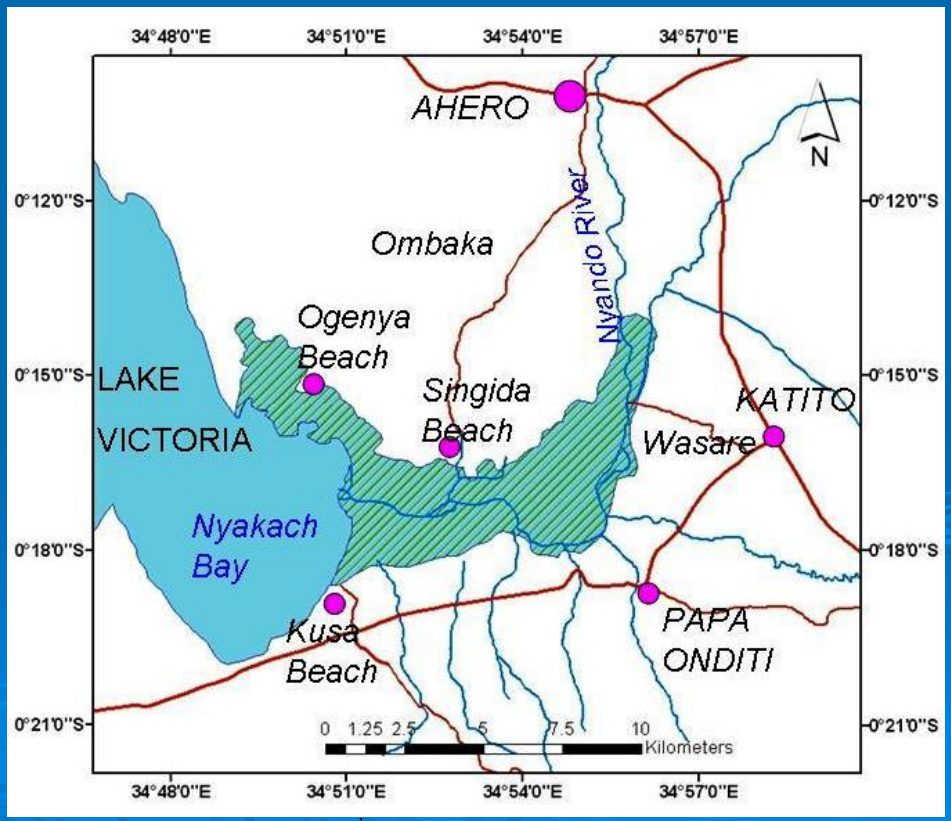
- *Hydrometry*
- *Hydrogeological mapping*
- *Soil moisture content*

- Experimental analysis
- *Develop conceptual models for GW-SW interaction*

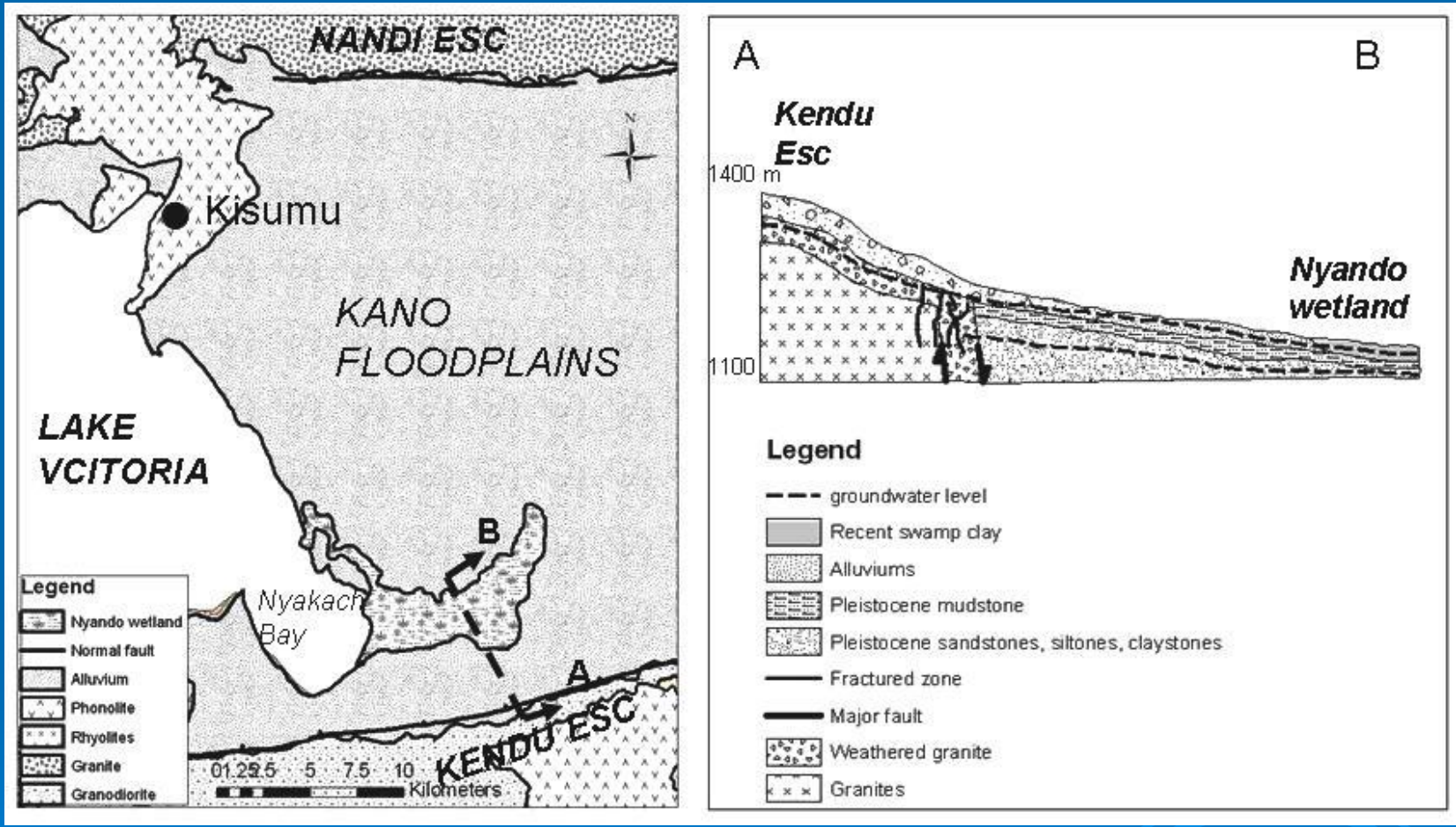
Study Area

Catchment size: 3,900 km^2
Wetland size 4,000 ha
Vegetation: *Cyperus papyrus L*





Geological setting

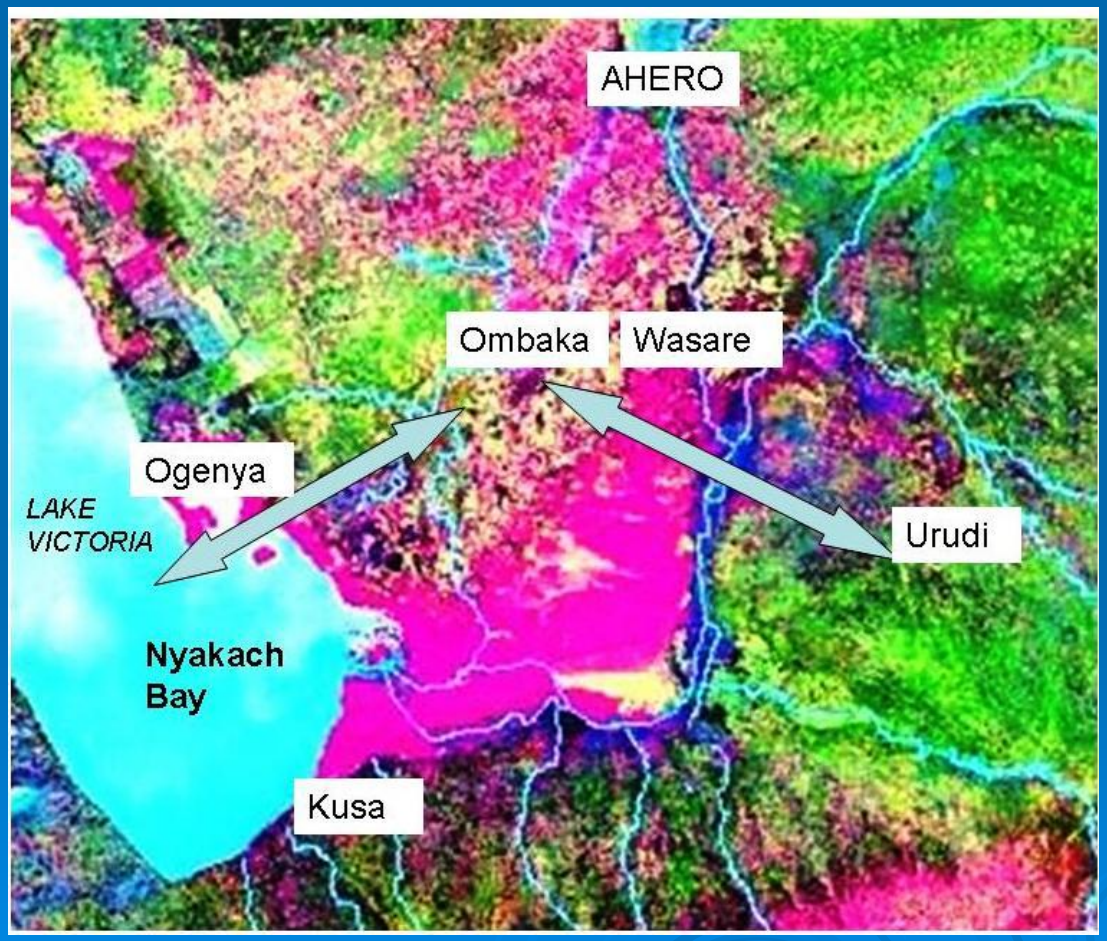


Wetland geological map [Left panel]

Hydrogeological setting {Right panel]

Sampling design

Transects selected based on:
hydrological, ecological and socio-economic gradients

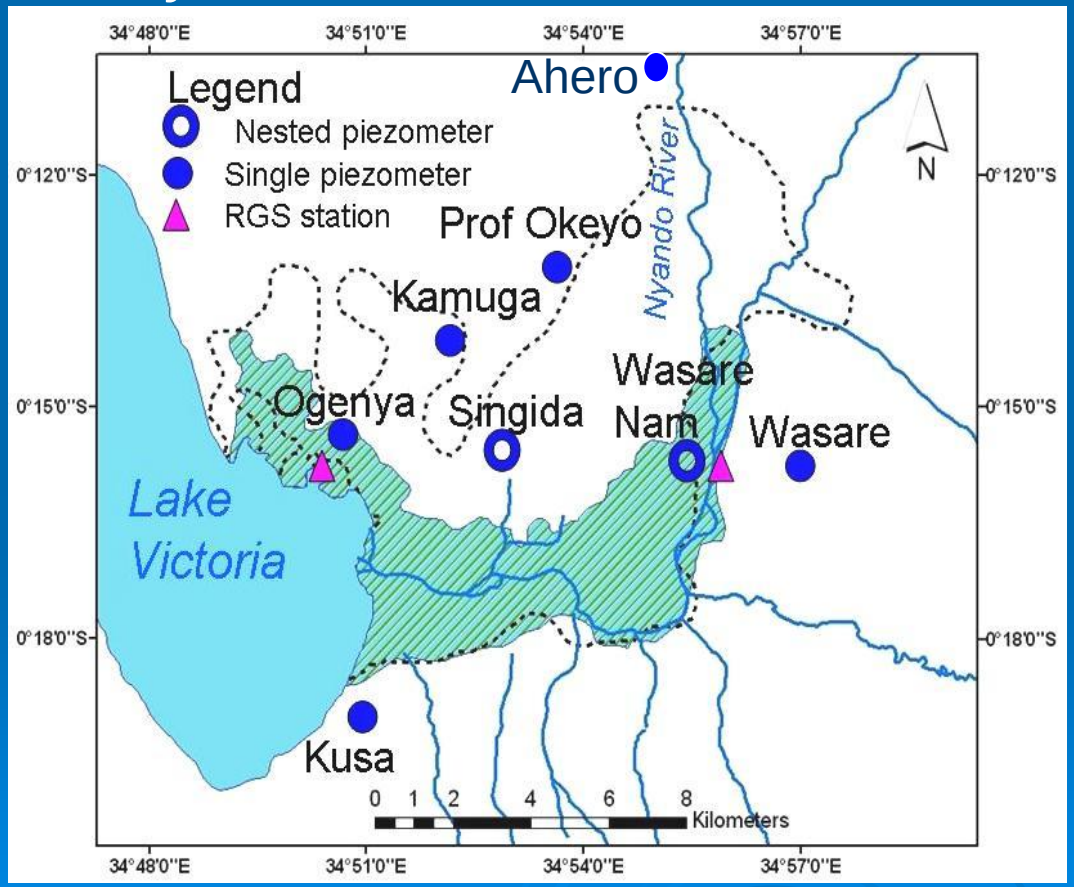


Participatory approach

Experimental investigations

Hydrometry

Nyando wetland Hydrometric Network



- Based on Darcy's Law
- Field installations
- Data collection: automatic and manual
- Experimental analysis

Installations and monitoring

Construction of piezometers

Soil moisture sensor

River gauging station

Weather station

Hydrogeological mapping

- Interpretation of geological maps
- Field reconnaissance studies
- Soil profiling during drilling of piezometers

Measurement of soil moisture content

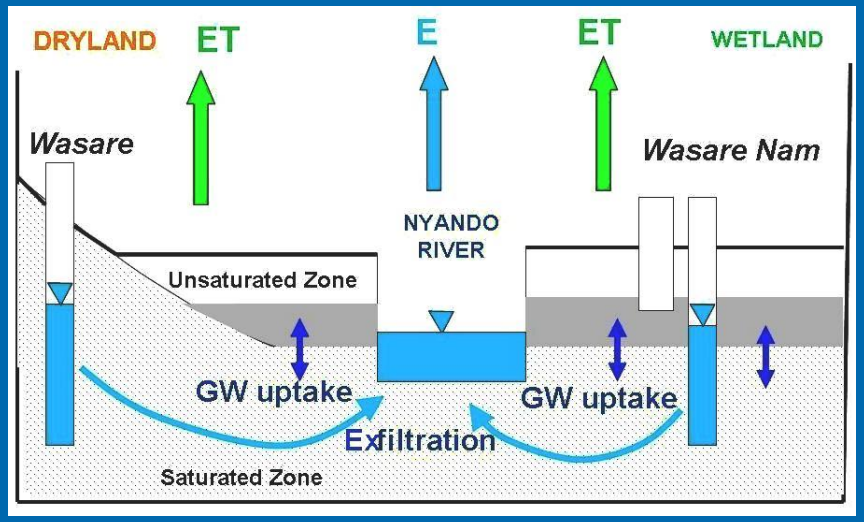
- Holes were augered for placement of sensors
- Sensors were installed at 90 cm, 60 cm and 30 cm depths

Results and Discussion

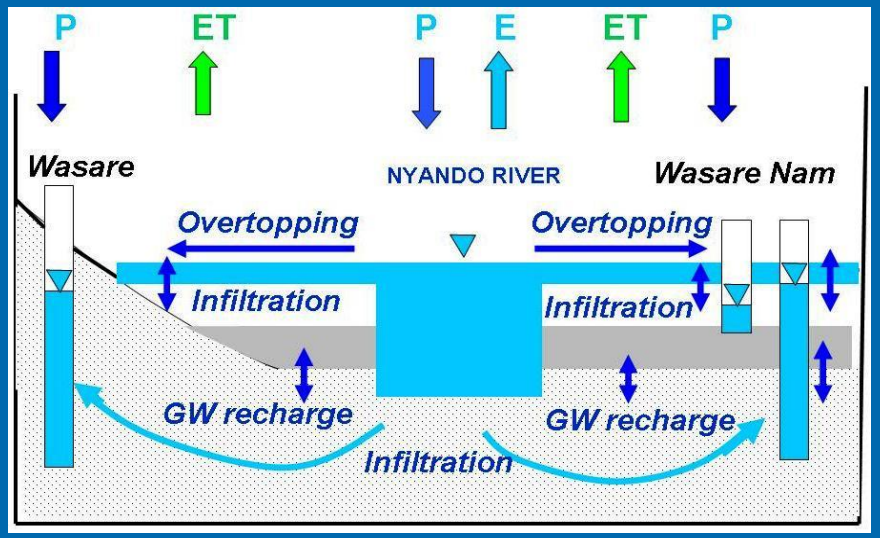
- Conceptual models
- Factors influencing soil moisture, river stage, lake stage and groundwater level
- Lake-aquifer exchanges
- River-aquifer exchanges
- Wetland-aquifer exchanges

River-aquifer Conceptual models

Effluent situation



Inffluent situation

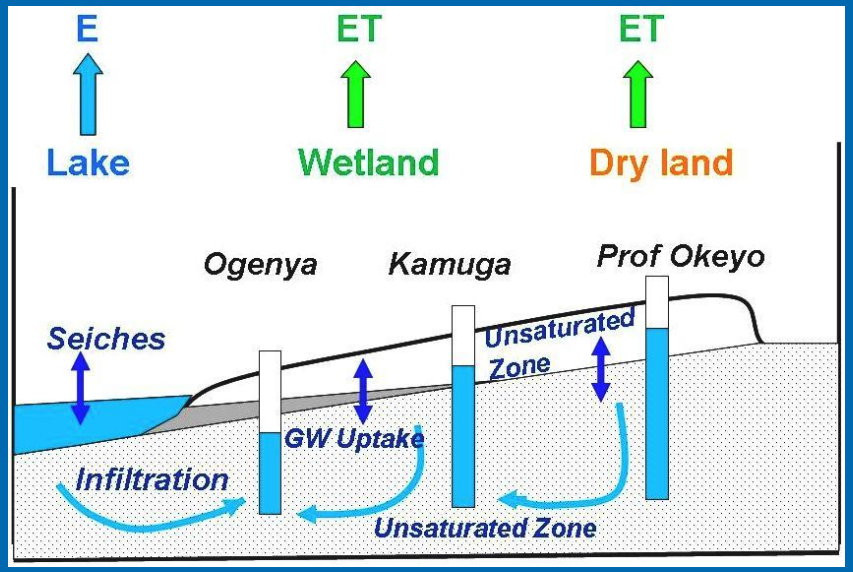


Dry season

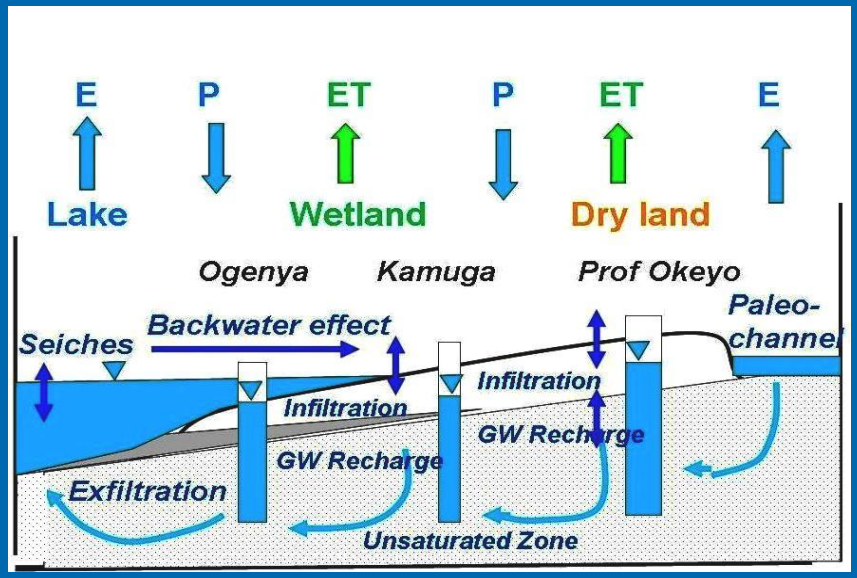
Wet season

Lake-aquifer Conceptual models

Lake recession



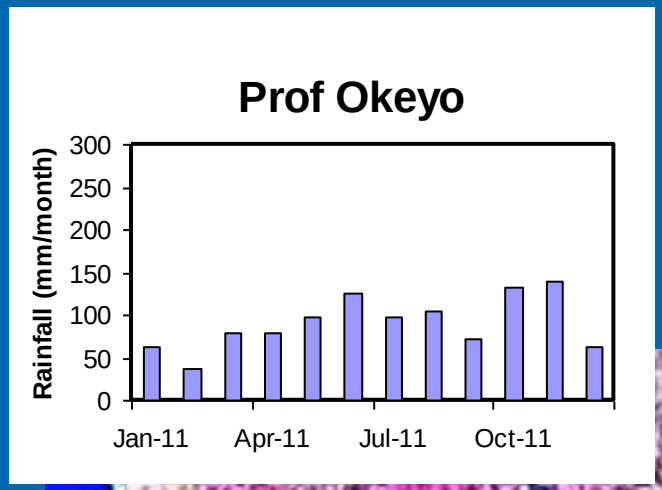
Backwater effect

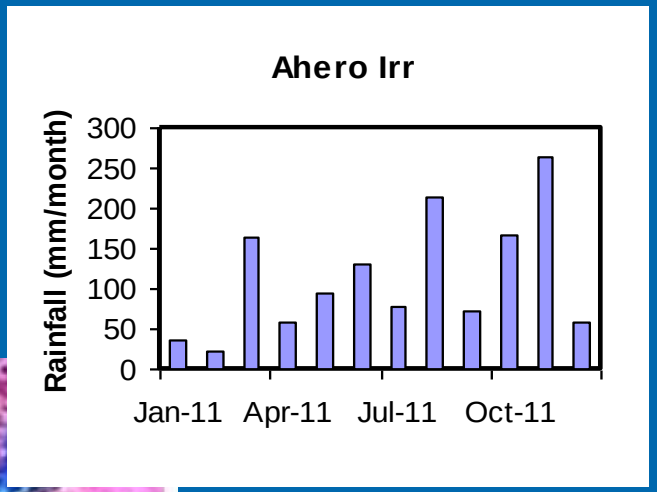


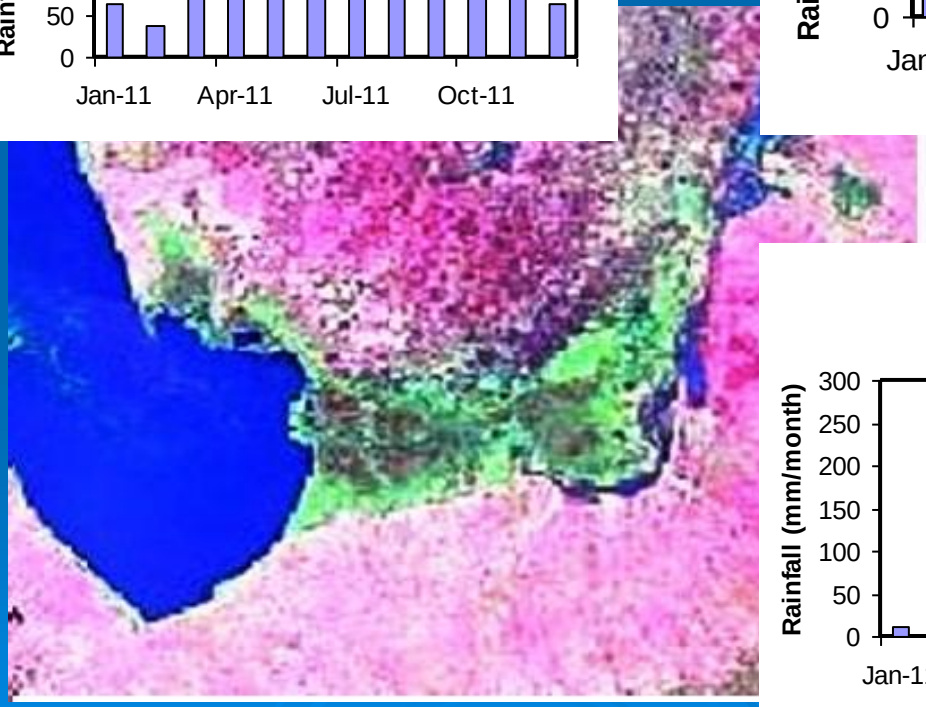
Drought

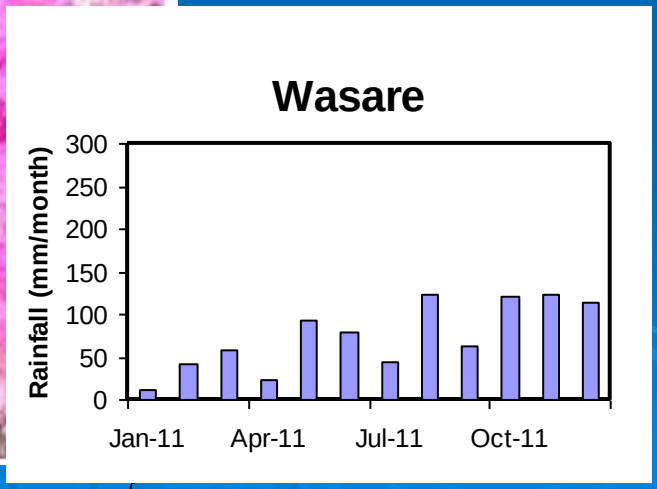
Floods

Rainfall variability







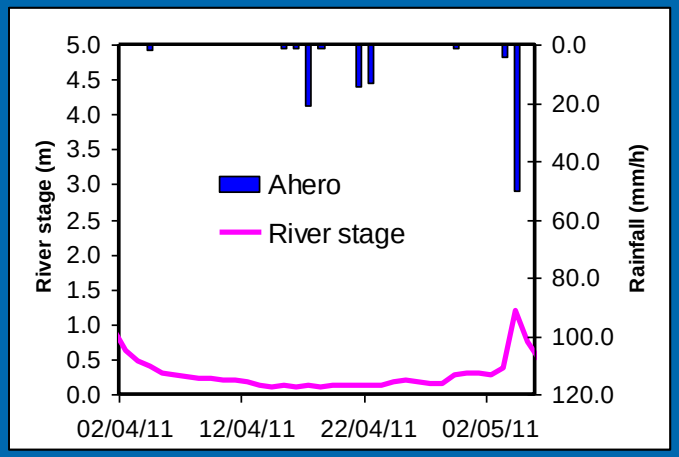


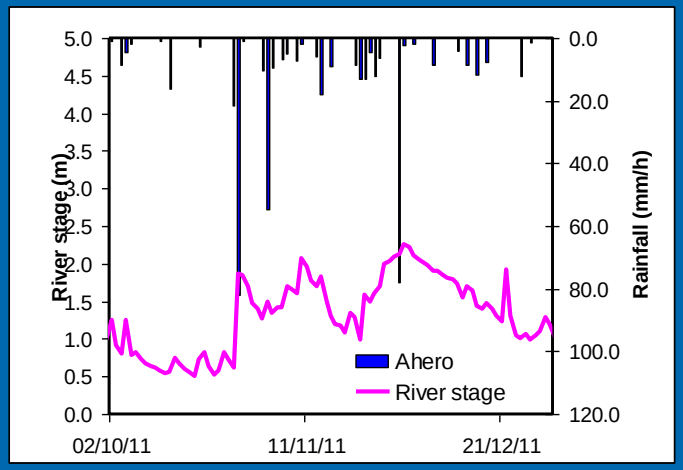
Influence of rainfall on river stage

Dry period

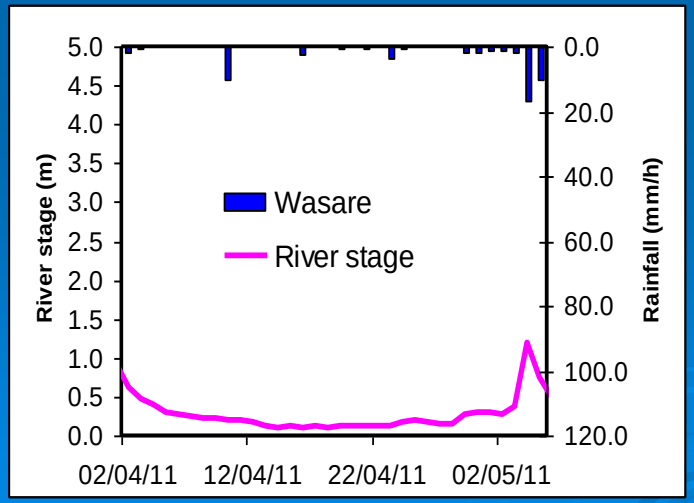
Wet period

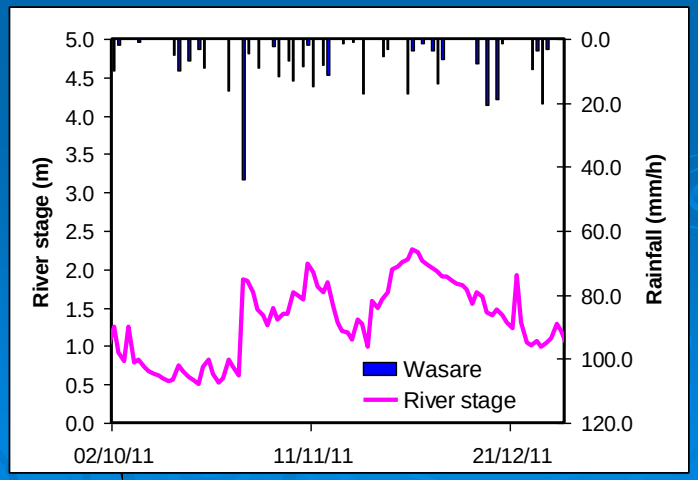
Upper Catchment



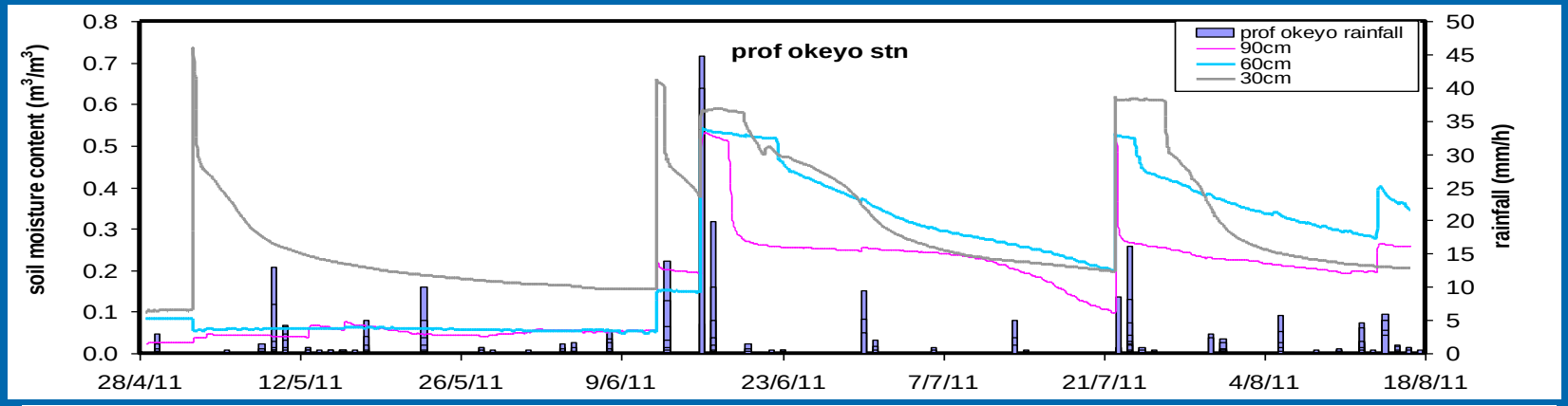


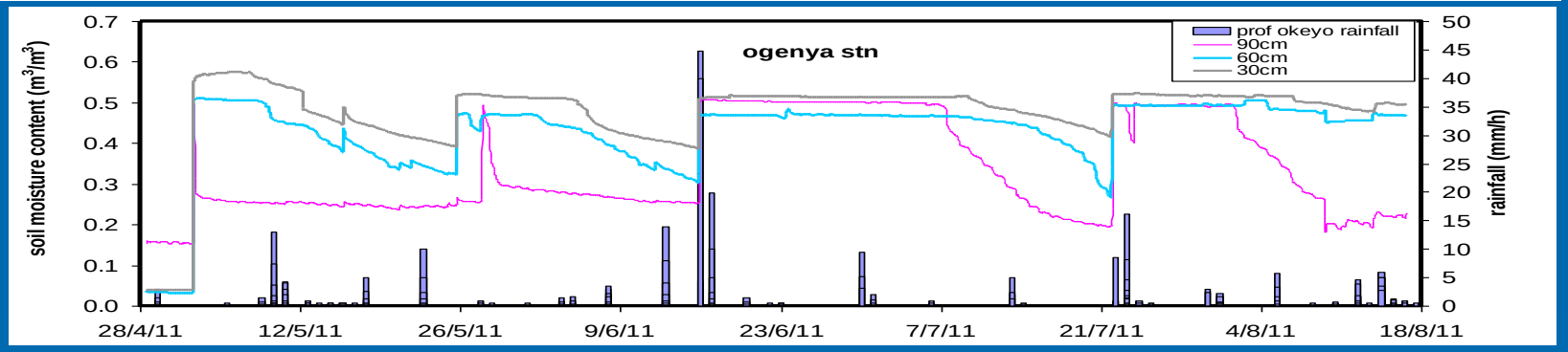
Wetland

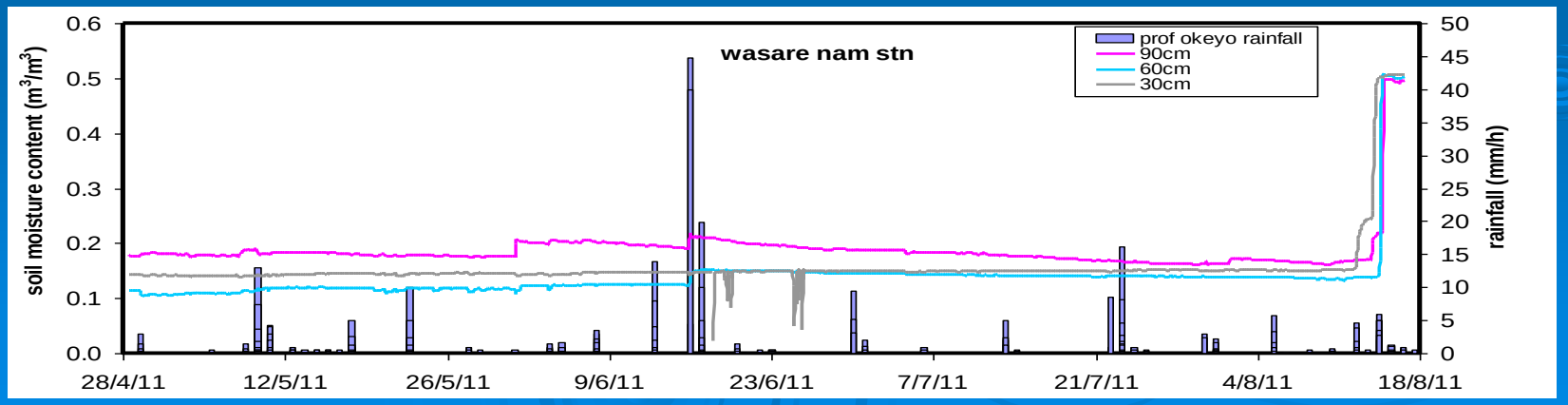




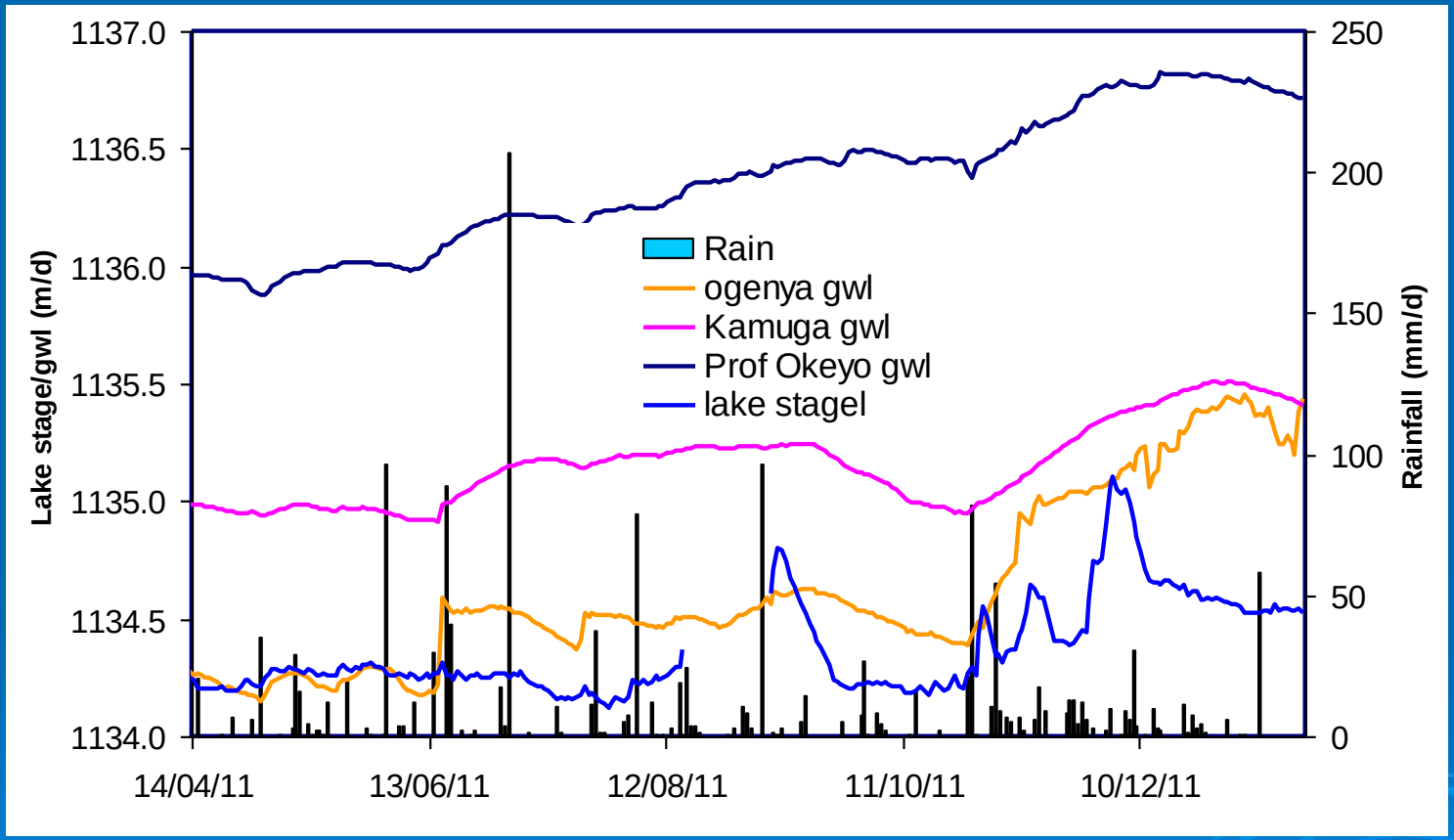
Influence of rainfall on SMC





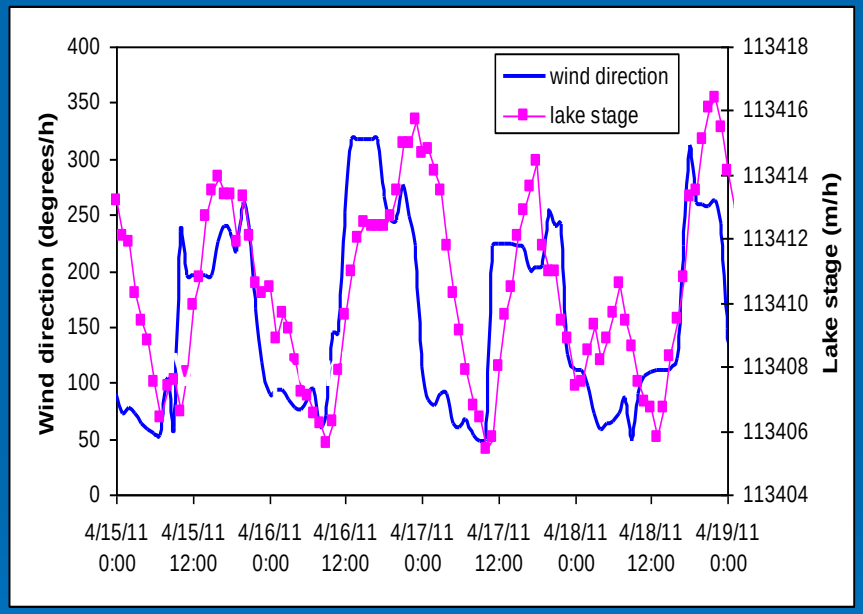


Influence of rainfall on GW level and lake stage

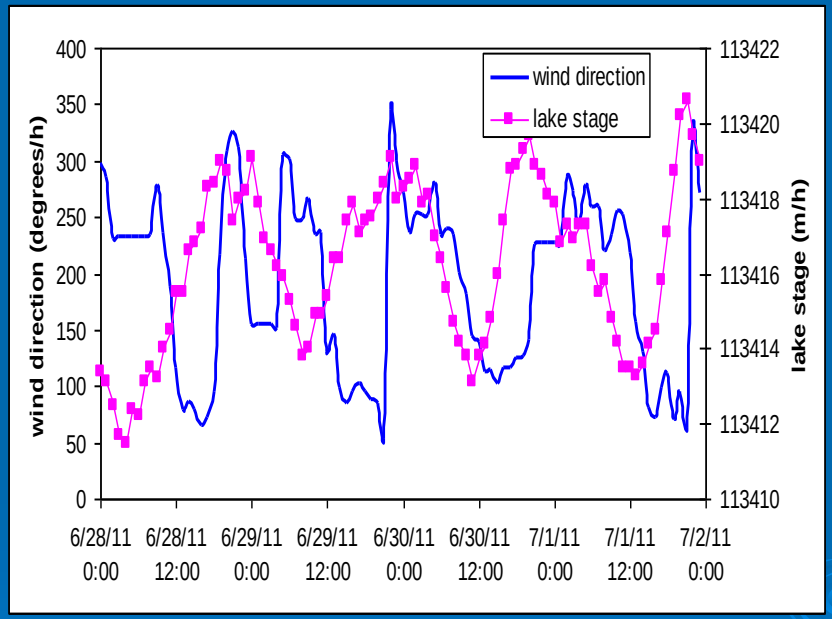


Diurnal influence of wind direction on lake stage

Dry period

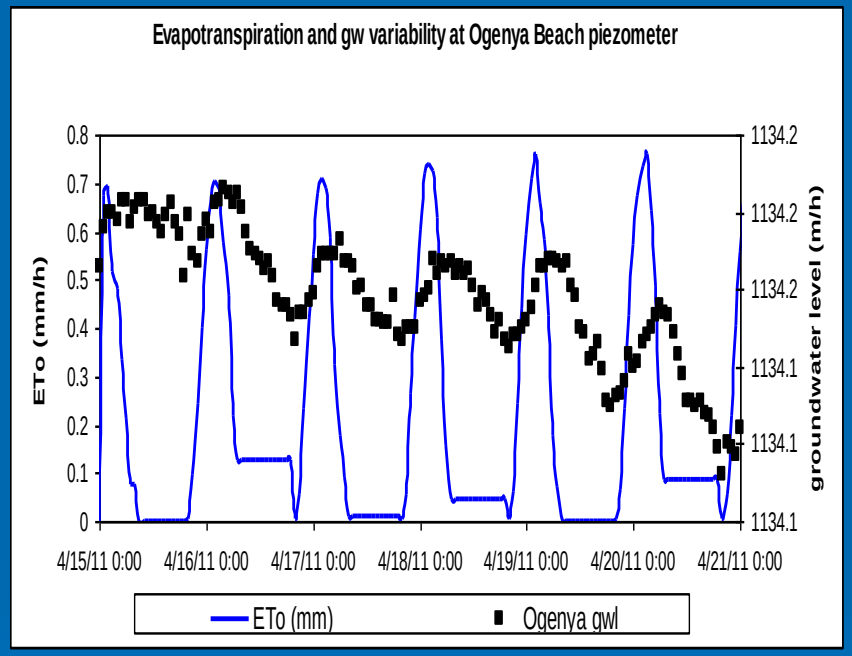


wet period

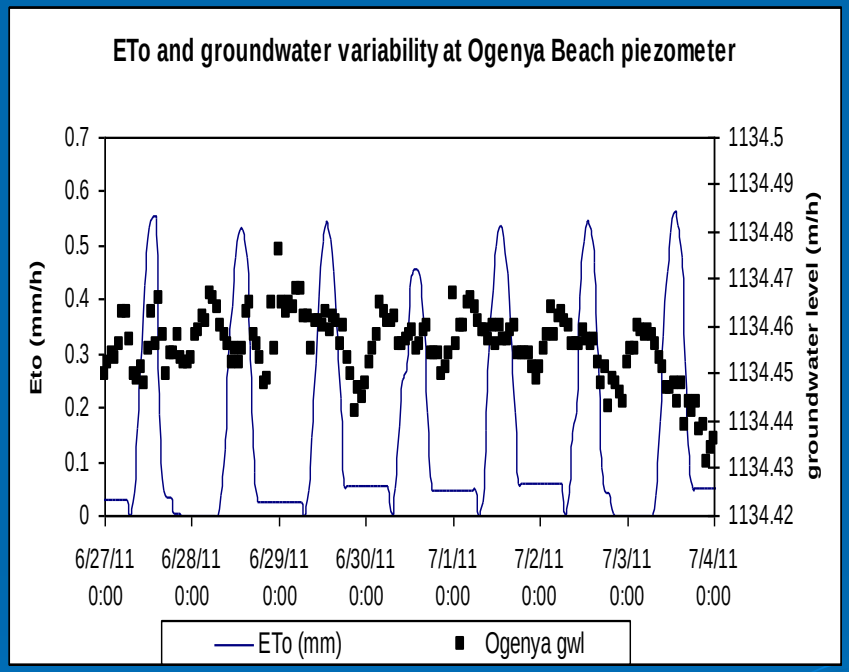


Influence of ETo to gwl in the wetland

Dry period



Wet period

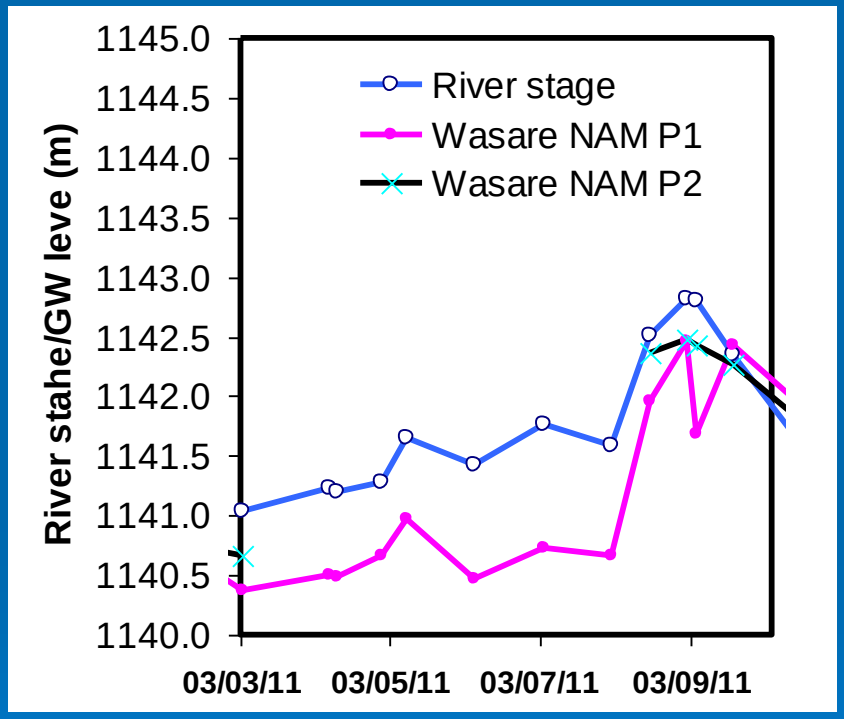


ETo peaks before GW level at Ogenya Beach piezometer

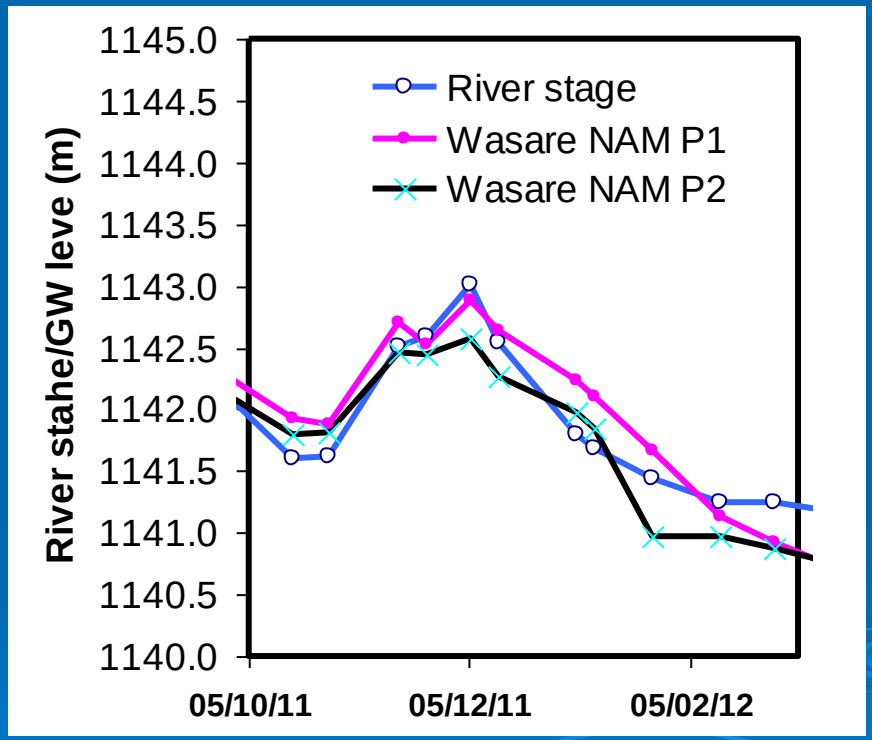
River-aquifer interaction

Dry season

Dry season

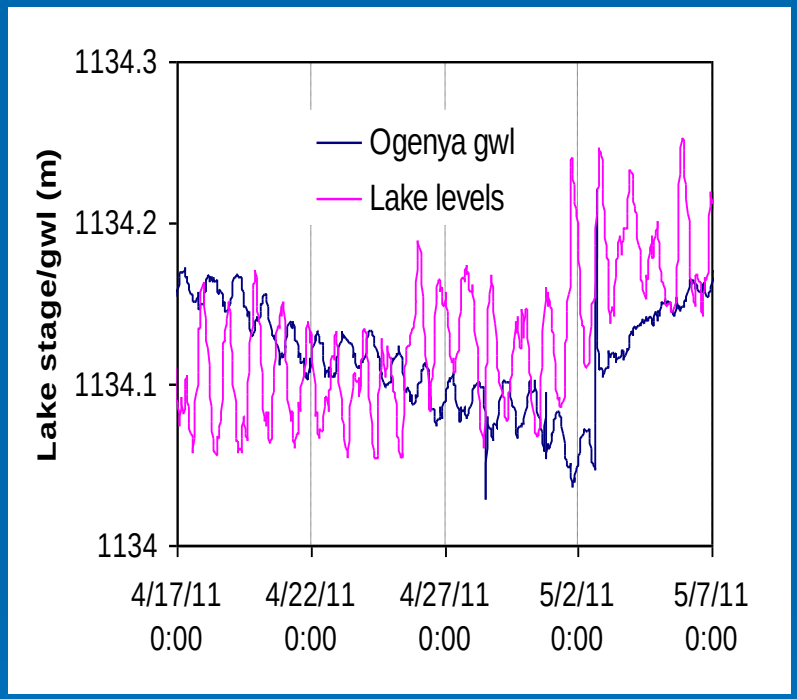


Wet season



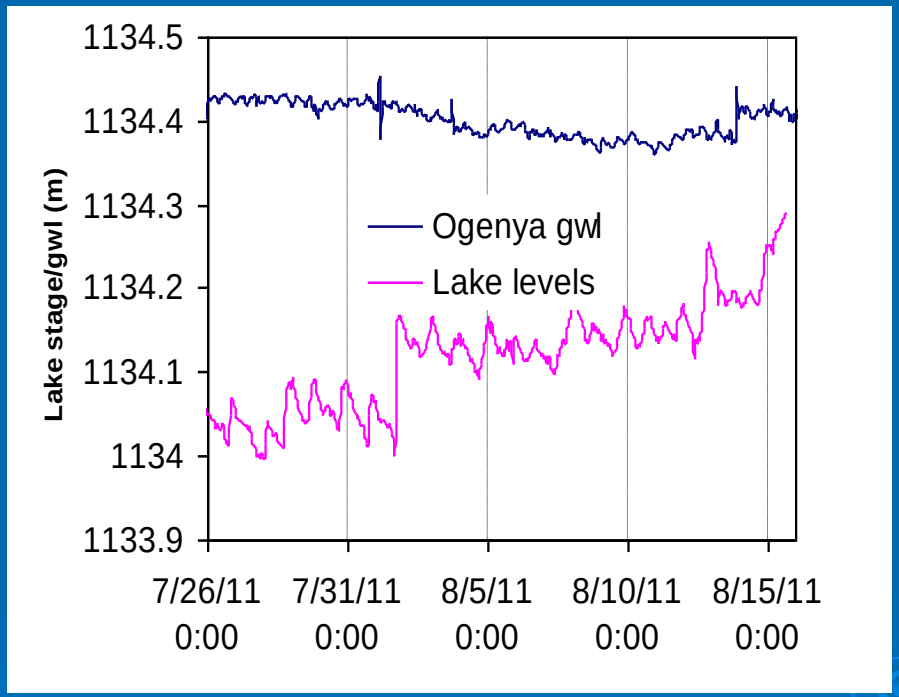
Lake-aquifer interaction

Dry season



Lake-aquifer interaction

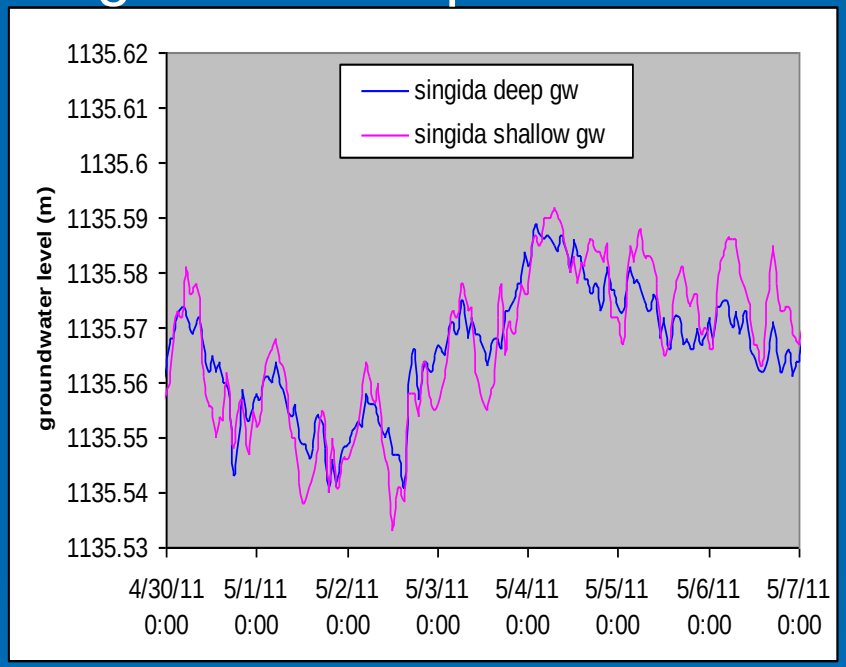
Wet season



GW exfiltrates in lake

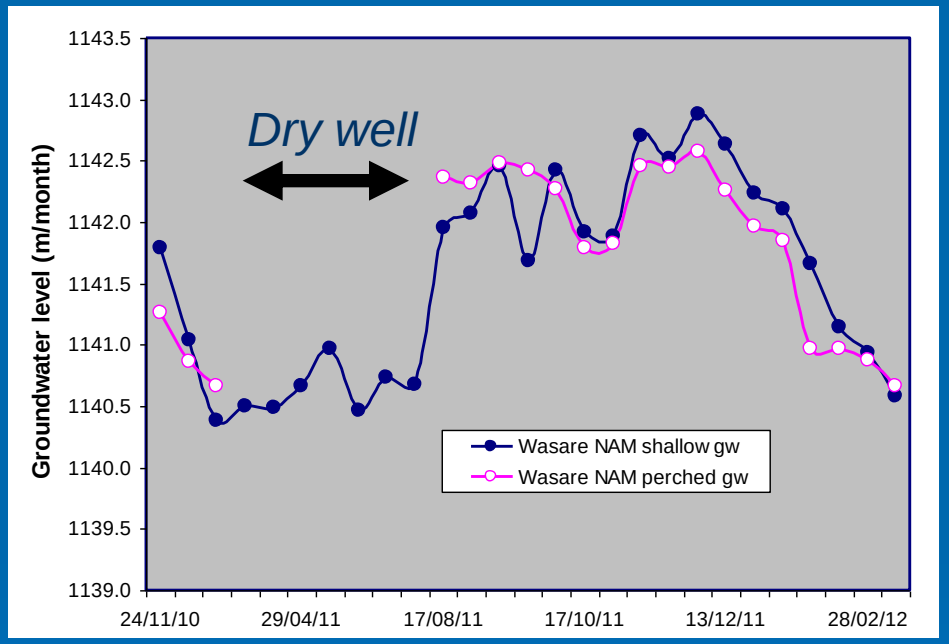
Wetland-aquifer interaction

Singida nested piezometer



Intermediate GW has similar hydraulic head with local groundwater

Wasare Nam nested piezometer



Intermediate GW has higher hydraulic head than local GW most of the time

Conclusions

- The river, lake, alluvial aquifer and wetland are hydraulically connected
- Wind direction is the main forcing function of lake level fluctuations
- The main factors influencing soil moisture content are: rainfall, river overtopping, backwater effects and groundwater exfiltration

Acknowledgements

- ECOLIVE Project
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- Wetland community
- Research Assistants

Thank you