



## iWaGSS: Integrated Water Governance Support System

# Integrated solutions for water resources management and governance

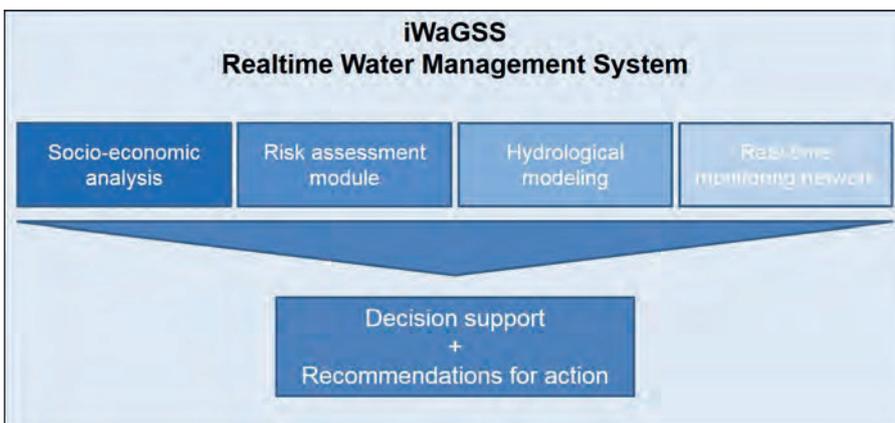
*Jens Hilbig, Karl-Ulrich Rudolph, Dariusz Musiol on behalf of the iWaGSS project*

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### ABSTRACT

The objective of the research project iWaGSS is the development and practical pilot implementation of an innovative water governance system based on new technologies and tools for mitigating water stress and for sustainable management of the water resources in the South African pilot region as well as in other regions with overstressed water resources in Africa and worldwide. Based on four main components – real-time online monitoring, hydrological modelling, risk assessment and socio-economic analysis – the sustainable water governance system (Figure 1) will support decision makers and improve governance processes in the water sector. By increasing the efficiency of water utilisation and protecting natural resources and ecosystems, the iWaGSS project shall contribute to solve the urgent challenges of the global resource water and to achieve the sustainable development goals (SDGs). The iWaGSS consortium consists of eight German partners from research and practice: Institute of Environmental Engineering and Management at Witten/Herdecke University, Environmental Engineering and Ecology – Ruhr-University Bochum, Institute for Water and River Basin Management – Karlsruhe Institute of Technology, Center for Development Research – University of Bonn, Disy Informationssysteme, LAR Process Analysers AG, Global Water Franchise Agency and Die Gewässer-Experten! The German partners are working in close cooperation with South African partners and stakeholders from public administration, academia, development cooperation, industry and civil society. Up to now, several field campaigns have been conducted to collect data and to assess the situation in the pilot region. The installation of the monitoring stations is in a final stage. The current project status and the main components have been presented and discussed with local cooperation partners

and stakeholders in several workshops and meetings. The iWaGSS project has been considered by South African National Parks as essential for the Kruger National Park. SANParks supports the project with own resources and logistical assistance.



*Figure 1: iWaGSS Realtime Water Management System.*

## INTRODUCTION

The Lower Olifants sub-catchment in South Africa has been chosen as the primary iWaGSS demonstration area including the Phalaborwa pilot zone (Figure 2). This pilot region has been selected in close cooperation with South African partners and stakeholders because the development of the region in terms of its ecological diversity and sustainability as well as economic progress and social stability is particularly vulnerable to water-related problems, including transboundary water issues. Thus, the chosen area can be seen as representative for other basins and should be appropriate to proof scalability and transfer of research and innovation results to other regions.



Figure 2: iWaGSS pilot zone.

Water uses and economic activity in the Olifants basin are diverse and range from mining, power generation, metallurgical industries, irrigation, subsistence agriculture and ecotourism. The Lower Olifants sub-catchment is part of the UNESCO Kruger to Canyons Biosphere Reserve. This region – which includes the world renowned Kruger National Park (KNP), rural and peri-urban areas, copper and phosphate mining, subsistence and commercial farming – receives all the consequent pressures from upstream parts of the basin. The water quality of the lower Olifants River is influenced, inter alia, by return flows from mining and agriculture, for example in the Ga-Selati River. Deteriorating water quality at catchment scale (Ashton & Dabrowski, 2011) is not only threatening human health and KNP's animals and ecosystems but also the wide variety of ecosystem goods and services (EGS) that the catchment provides to society. To improve the status of the river and to strengthen the institutional governance framework in the region, a real-time water management system is to be developed. The practical demonstration area with the

world-famous Kruger National Park serves as a flagship project for the global dissemination of the modular iWaGSS water management system.

## METHODS

The project consists of 10 work packages:

- 1. Water Governance**  
With a focus on economic aspects of governance and micro-level governance
- 2. Risk Assessment and Hydrological Modelling**  
A combination of risk assessment tools and a 1-D hydrological model of the river system
- 3. Reservoir Modelling**  
Numeric hydraulic modelling and morphodynamic simulation of the Phalaborwa Barrage
- 4. Realtime Water Quality Monitoring**  
Installation and operation of a network of water quality monitoring stations
- 5. Data Management and Data Integration**  
Development of a GIS-based realtime decision support and management system
- 6. Adapted Operation and Management Concepts**  
Including wastewater management, water quality and emissions as well as water reuse
- 7. Transboundary Governance**  
Focusing on impacts of transboundary water governance on people and nature protection
- 8. Remote Sensing**  
Use of drones for river monitoring
- 9. Capacity Development**  
Workshops and trainings
- 10. Dissemination and transfer of results**  
Transfer of iWaGSS tools and results to other river basins

## INTERIM RESULTS AND DISCUSSION

### Water Governance

Analysing water governance institutions and transboundary water governance in the Lower Olifants catchment, the project focuses on economic aspects of governance. With regard to the South African institutions, an implementation

gap can be identified: South Africa has established a world-wide acknowledged body of water legislation (National Water Act 1998), but is struggling with its implementation. The implementation gap between the macro level (legislation, institutional framework) and the micro level (local institutions and water management practice) leads to water crisis, deterioration of resources, collapsing infrastructure and substandard services. Informal institutions and stakeholder groups are taking over some of the administrative and management functions (cf. Pollard et al 2011). iWaGSS is now focusing on utility governance on a micro-level scale taking (financial) incentives and economic aspects into account. With regard to transboundary water governance, the main issues are the impacts of current transboundary water governance on the provisioning and non-provisioning ecosystem services in the Kruger and Limpopo national parks as well as alternative transboundary water governance approaches and their transaction costs and economic benefits.

## Water Quality Monitoring

Currently, iWaGSS water quality monitoring equipment has been installed permanently at three monitoring sites (Oxford, Sawong and Cleveland) at the Olifants River upstream the KNP border. Monitoring data of these stations will give a good overview of water quality from a) upstream parts of the Olifants catchment entering Phalaborwa barrage, b) Selati and Olifants water quality at the confluence and c) Olifants water quality before reaching the KNP border and flowing into the park. The water quality monitoring stations provide a real-time online toxicity analysis as well as monitoring of pH,

conductivity, redox potential and weather/climate data. A large volume sampler has been installed at the Oxford station to determine the mass of transported sediments. Additional turbidity probes have been installed at Oxford and Sawong.

## Field campaigns

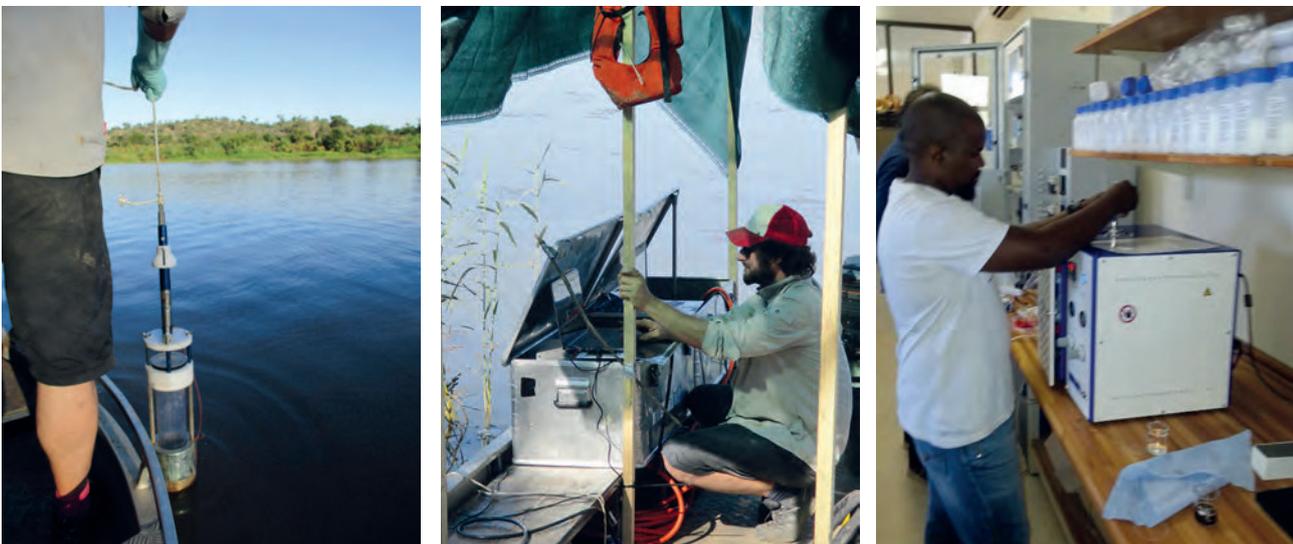
Additional data (including aerial pictures, river-cross sections of the Olifants and Selati River as well as some minor tributaries upstream KNP, bathymetric and sediment remobilisation studies of the Phalaborwa barrage) has been collected during several field campaigns (Figure 3) using portable equipment like drones, acoustic doppler current profiler, echosounder and several samplers.

This data will be further processed and analysed to generate for example digital surface models of the river system and to calibrate hydrological models of the Lower Olifants catchment. Grab samples of water and sediment provide additional information on several locations in the project region.

## Modelling

Combining aerial pictures of a drone with ADCP data seems to be a promising approach to generate river cross sections of high quality for the hydrological modelling. This approach will be further developed by eE+E, Die Gewässer-Experten! and the South African Council for Scientific and Industrial Research (CSIR). First models of both the river system and the Phalaborwa Barrage (Figure 4) have been created which will be evaluated and further refined.

*Figure 3: Field campaigns a) Sediment sampling (KIT), b) Bathymetric survey (KIT) and c) Analysing grab samples (LAR/SAEON)*



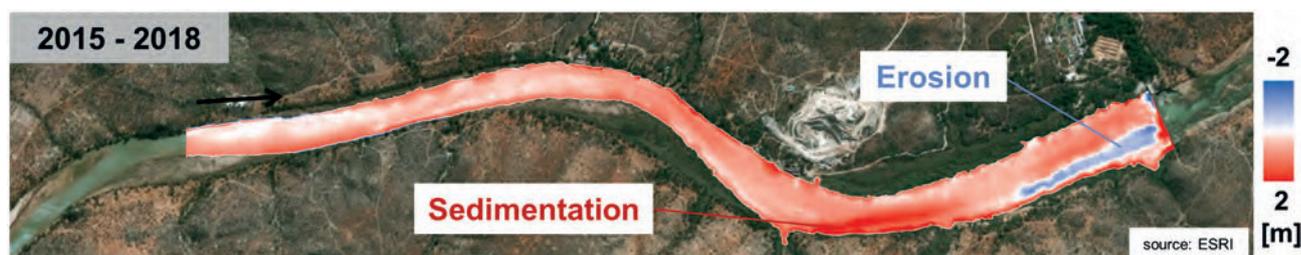


Figure 4: Phalaborwa Barrage – topography change over time (KIT)

## CONCLUSIONS & OUTLOOK

The current status and first interim results have been presented and discussed with South African partners and stakeholders in October 2018. The project meets the needs of both water management institutions and water users in the region. Especially the modelling outcomes and the water quality data are expected to provide benefit for authorities and water management institutions as well as for water users and researchers. In addition, the assessment of the wastewater treatment plants and operational concepts for the water supply system including the management of the barrage are met

with great interest. This is reflected by the strong support and various in-kind contributions of South African partners and stakeholders. Based on the interim modelling results of the sedimentation processes, alternative gate operations at the Phalaborwa barrage will be tested and analysed in 2019. A first transfer of the iWaGSS drone concept for river monitoring is now discussed with SANParks to generate a digital surface model of a remote river gorge at the Mozambican border. The unclear lines of responsibility and informal governance mechanisms in the water sector will be further investigated based on a case study of the provision of municipal water services including the financing mechanisms.

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