Collaboration Research Project

Assessment of dryland salinity dynamics in the Western Cape Province, South Africa (DRYSAL)

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Dryland salinity (DLS) and associated river salinization is widespread throughout areas of dryland agriculture in most semi-arid regions of the world, e.g. Australia and South Africa. It has significant environmental impacts and is causing serious economic threats in agriculture and water supply systems. For example, DLS is reducing the quality of soils and associated crop productivity, affects the water quality of rivers and reservoirs and is furthermore limiting the use of all water resources for water supply to communities, industries and agriculture. River basins in the Western Cape Province, South Africa are also known to be affected by DLS for a long time. Long-term monitoring of water quality in Western Cape Rivers like the Berg River Catchment (BRC) indicated that DLS has been following an increasing trend and caused adaptations in agricultural management. However, despite of valuable research published so far, additional research is required, especially in respect to the origin of the salt as well as salt storages and transport in the unsaturated soil and regolith zone. Also, possible impacts of climate and land use change on water availability in general and DLS dynamics in respect to water quality and food production are of interest to stakeholders.

In 2005, the ***Soil Science Department at Stellenbosch University*** (South Africa) and the ***Department of Geoinformatics at Friedrich Schiller University Jena*** (Germany) initiated the collaborative research project **DRYSAL** to improve our understanding of regional DLS dynamics, salt sources and salt storages, as well as corresponding groundwater salinity dynamics and regional hydrology in intensively used agricultural areas of the Western Cape Province. This study region is characterized by a semi-arid winter rainfall climate with a mean annual rainfall of about 350 mm. The geology is dominated by table mountain sandstone forming the mountain ridge of the Langeberge, and deeply weathered Precambrian Malmesbury shale and other deep sea sediments in the foothill zone west of the mountain ridge.

The central aim of the first phase of **DRYSAL** (2005-2008, SUA 05/001) was to develop a thorough understanding of salinization dynamics based on the quantitative and qualitative measurement, modelling, and assessment of salt and water fluxes in small to medium-sized catchments representing the semi-arid conditions in the Berg River basin (Sandspruit basin: 151 km², Goedertrou experimental site: 0,3 km². Combining data from field studies in 1985 and 1986 complemented by data from chemical analysis of current boreholes and water quality measurements, it was found that the amount of salt transported from the catchment is significantly higher than the salt input by atmospheric deposition which is assumed to be the primary source of salts stored in the landscape. Borehole results indicated that enormous salt masses are still stored in the catchments which might be mobilised by altered land use practises or climate conditions. First model exercises showed that land management features like contour banks strongly affect hydrological fluxes and need to be considered in advanced process-oriented modelling. Also, the web-based data and information system ***DrysalRBIS*** was implemented during the first phase allowing all project partners and stakeholders the access, upload and processing of existing and actual geospatial data, hydrometeorological data and information about water quality and salinity.

Addressing the increasing demand for water for irrigation, domestic and industrial water supply and the expected mobilisation of salt stored in the soils as well as their transport to the rivers resulting from land use and climate change processes, **DRYSAL II** (SUA 08/035) started in 2009 and is aiming i) to identify and simulate major processes controlling hydrological and salinity related system dynamics based on knowledge obtained from previous and ongoing research and ii) prognostic assessments of possible impacts of land use and

climate changes by developing and applying an innovative toolset incorporating field observation, geospatial analyses and integrated modelling.

Based on scientific and technical aims identified during the first phase, the following methodological approach will be applied for **DRYSAL II**: ***1)*** enhancement of ***DrysalRBIS*** integrating new data obtained from field work, GIS-RS analysis and process-oriented modelling; ***2)*** modelling return flow from cultivation method experiments done on Goedertrou and Langgewens test sites and retarding effects of Renosterveld on salinity movement (Voëlvlei test site); ***3)*** hydrological and salinity related system analysis based on knowledge and data obtained from previous and ongoing research to identify processes controlling runoff generation and salt transport to define criteria to delineate Salinity Response Units (SRU); ***4)*** adaptation of JAMS/J2000 model by implementing a salt transport component; ***5)*** regional runoff and salt transport modelling in the Sandspruit basin using SRUs and the adapted JAMS/J2000; and ***6)*** prognostic evaluation of land use and climate change impacts to support a sustainable land and water resources management and to give recommendations to local and regional stakeholders to preserve land and water resources from further degradation.

In addition to its scientific approach, the project aims on building capacity in research, education, and technology by means of continuous staff exchange, joint courses and supervision of student projects at all levels, but also joint publications, complementary projects and follow up initiatives and will thereby contribute to foster both countries' research infrastructure.

Figure. The semiarid landscape of the Western Cape region. The right photograph was taken during the dry season showing salt-affected soils and contour banks, while the left photograph illustrates intensive wheat farming and extensive stock-framing during rain season.

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