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Quantitative assessment of gully erosion dynamics using a GIS implementation of Sidorchuks' DYNGUL model in Southern KwaZulu-Natal, South Africa

adel omran[1,6], Dietrich Schroeder[2], Christian Sommer[1,5], Volker Hochschild[1], Aleksey Sidorchuk[3], and Michael Maerker[4]

[1]Tuebingen University, Faculty of Mathematics and Natural Science, Geography, Germany (adel.omran@ggi.uni-tuebingen.de)

[2]Department of Photogrammetry and Geoinformatics, Faculty Geomatics, Computer Science and Mathematics, Hochschule für Technik Stuttgart, Germany.

[3]Lomonossow Moscow State University, Moscow, Russia.

[4]Department of Earth and Environmental Sciences, University of Pavia, Via A. Ferrata, 1 - 27100 - Pavia, Italy.

[5]ROCEEH, a joint research project of the Heidelberg Academy of Sciences and Humanities, Heidelberg, Germany.

[6]Department of Science and Mathematical Engineering, Faculty of Petroleum and Mining Engineering- Suez University, Suez, Egypt.

Soil erosion is considered as one of the main threats affecting both rural and urban areas in many different parts all over the world. Therefore, increasing attention has been attributed to soil erosion in the last decades. This can also be documented by an increasing number of studies targeting soil erosion assessment using qualitative and quantitative models. However, gully erosion phenomena have been widely neglected in erosion modelling due to the nature and complexity of the related processes and hence, it is also more difficult to simulate, predict and to visualize its effects. Sidorchuk (1999) established a Fortran based dynamic erosion model called DYNGUL to describe the first quick stage of gully development, coinciding with the main changes in gully morphology; like changes in volume, area and elevation of the longitudinal profile. The DYNGUL model is based on the solution of the equations of mass conservation and gully bed deformation. The model of straight slope stability was used to predict gully side wall inclination and of the finite morphology of the gully. The objective of this contribution is to establish a GIS tool for a quantitative gully erosion assessment and to predict gully evolution over time. The tool will help: i) to cope with or mitigate gully erosion processes and ii) to plan measures to stabilize the landscape affected by gully erosion. Therefore, we developed a Python-based tool that can be applied in a GIS environment. The model was tested its performance and the sensitivity of physical parameters with data from a gully in the Drakensberg Mountains, KwaZulu-Natal, South Africa. The results of the gully erosion model showed that their sensitivity to lithological and hydrological factors is rather high.