OpenGIS Application in Geoscientific Projects - Exemplification Yemen

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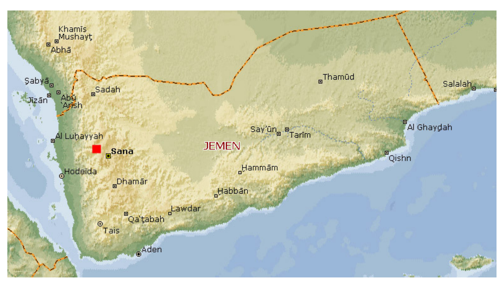
Objectives

- ✓ identify and characterise areas with georisks, e. g. rock slides
- ✓ identify and assess the types and the impact of watererosion
- ✓ create scenarios for erosion by water
- ✓ give recommendations for sustainable land use
- ✓ examine OpenSource software regarding its benefits for official development assistance (ODA) projects
- ✓ provide developable software architecture and projects to the counterparts with the use of GRASS and PostgreSQL

PostgreSQL GRASS

Project Area

- ✓ north-western of Yemen's capital Sanaa
- ✓ arid to semiarid climate
- ✓ two short rainy seasons per year with torrential rains
- ✓ elevation between 2500 and 3000 m a.s.l.
- ✓ landscape composed of Cuestas and Wadis
- ✓ ancient cultivated land with deficiencies of water
- ✓ arable farming is practiced on terraces using intensive groundwater irrigation

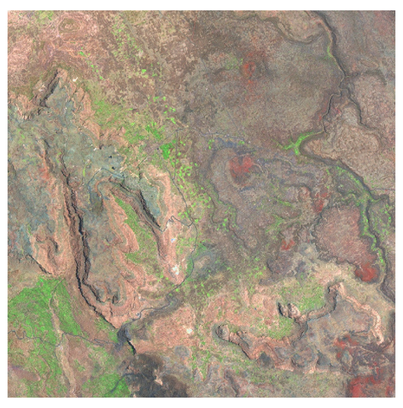


location of the project area

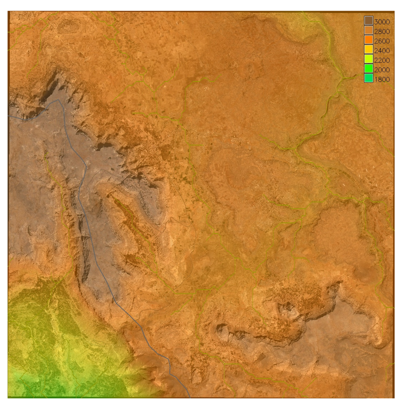
Al-Dhafir – disastrous rock fall in Cretaceous sandstones (Tawilah series)

Work in Progress

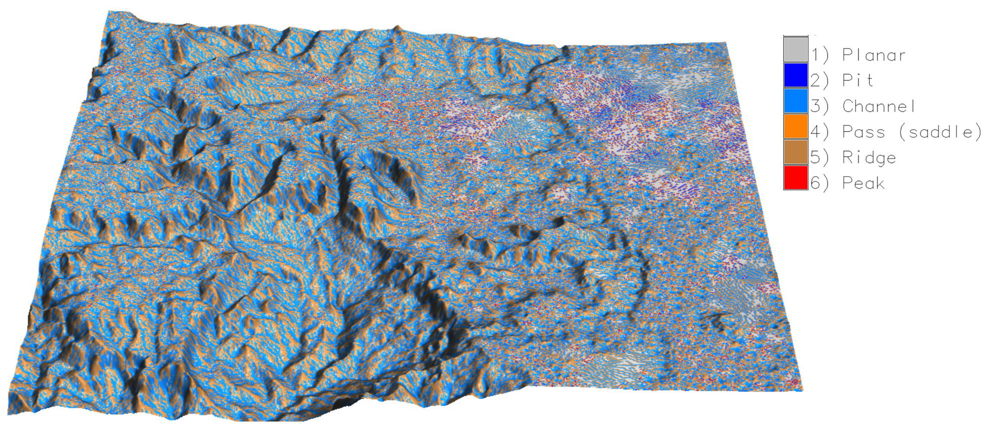
- ✓ embedding of various useful data sources (climatic time series, Landsat, SRTM, Corona, MOMS, topographic and thematic maps)
- ✓ create the necessary information layers (geology, lithology, soils, land cover/use)
- ✓ derive terrain parameters from the elevation model
- ✓ evaluate the landscape and changes by landscape analysis
- ✓ prepare the necessary input layers to compute erosion and deposition rates
- ✓ assess the georisk due to mass movement



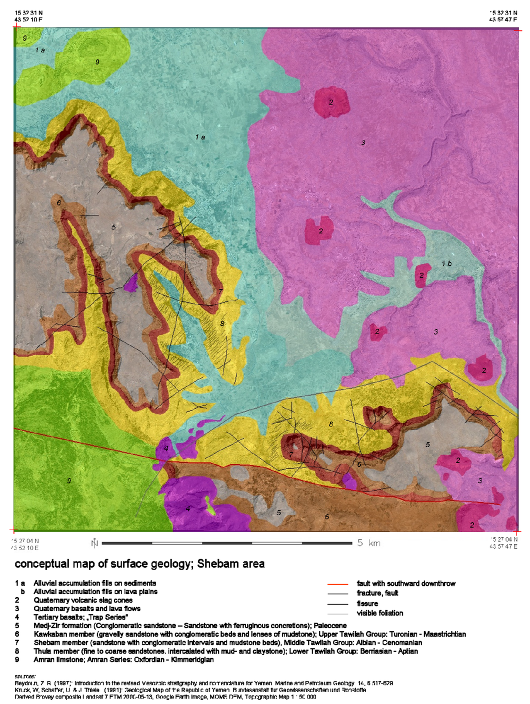
Brovey transformated composite (Landsat ETM)



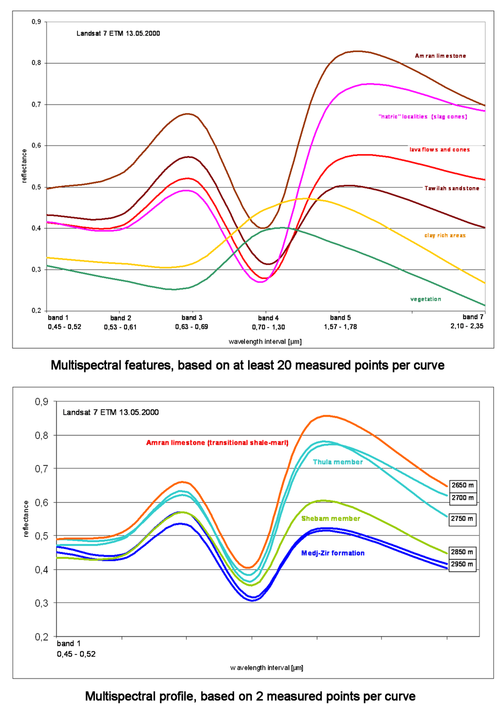
Elevation and watershed



Morphometric features



Conceptual surface geology



Spectral signatures

Future Tasks

- ✓ use of high resolution images (Google Earth Images, SPOT, IKONOS, QuickBird, ALOS)
- ✓ estimate infiltration rates, complete the necessary input layers and drive the GRASS (WEPP) sediment erosion, transport, deposition model
- ✓ evaluate the results with estimation of errors
- ✓ compute the erosion and deposition rates depending on various changes in land management and intensity of precipitation

Summary

Complex software systems are always a significant part in environmental and geo-relevant projects. Up to now technically mature commercial systems are preferably used, since they are widely spread, and possess a user-friendly user interface and very good operator instructions. Furthermore, the software producers conduct professional training courses in which they teach a wide range of users these programmes. The producers offer a worldwide service. However, the high costs both for acquisition as well as for upgrading of commercial GIS programmes have to be taken into account. Besides, the software so far on the market does not have all the tools to solve geo-relevant tasks. That is why in these cases very costly special programmes have to be purchased.

For more than a decade the number of users of open source software has been increasing. Three packages that satisfy by their capacity are preferably used in geosciences: the database management system PostgreSQL, the statistic software package R and the geographic information system GRASS.

Geoscientists of the Federal Institute for Geosciences and Natural Resources (BGR, Hanover, Germany) are testing possible application of open source software programmes in complex geoscientific projects, particularly in Official Development Assistance (ODA) projects.

BGR has been supporting public counterpart organisations in developing countries in solving geo-relevant questions and institution building. For some 35 years BGR has been cooperating with the Republic of Yemen conducting ODA-projects. At the beginning the projects focussed on advisory service towards the establishing of a geological survey, and on the prospection of mineral resources and groundwater. At present stress is put on the implementation of integrated water management.

The open source software GRASS is applied together with ERDAS IMAGINE and ArcGIS in a new research project in which the georisk is assessed in a pilot area northwest of the capital Sana'a by using satellite imagery. In this mountain area the geo-hazard due to rock falls plays a decisive role resulting in casualties and damage of infrastructure.

In this semi-arid region arable farming is practiced on terraces up to altitudes of more than 3000 m a.s.l., since terracing is the management method to utilize soil and water in the best way. As a consequence of labour migration to the golf states, terraces were abandoned. Torrential rains of up to 30 mm in half an hour eroded the soil, leaving behind gullies and interrill erosion. By means of open source software the areas most vulnerable towards erosion can be identified in satellite images and both the removal and the deposition can be quantified.

This can be done by using the processing and interpretation of the information of satellite imagery in combination with GIS work. GRASS GIS could well be an appropriate tool since it has additional tools for image processing. Besides, it has a mature system of keeping data in a DBMS by now. For example, physical properties are computed which further soil mapping, such as the Tasseled Cap Index and the Brovey-Transformation can be used for the interpretation of the lithology.

The sophisticated tools of raster and image processing in GRASS support the generation of necessary information on land cover, land use, change of land use, geology, and distribution of soil types.

GRASS has tools that are based upon the digital elevation model. They can be used for common derivations as well as for sophisticated methods. The determination of surface run-off and erosion/deposition rates are the most promising methods. The modules implemented in GRASS facilitate the calculation of various scenarios with varying factors for precipitation, land use and land management.

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

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