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THE CARTOGRAPHIC APPLICATION OF REMOTE SENSING DATA IN SUDAN

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Bernd Meissner and Ursula Ripke 1/

1. Introduction

Geoscientists at the Technische Universit ae (U), the Freie Universit ae (FU) and the Technische Fachhochschule (TFH) Berlin have been carrying out research into the problems of arid and semi-arid regions of Northeast Africa since 1981. The research has been undertaken within the scope of the Special Research Project (SFB) 69 of the German Research Foundation (DFG) and in 1987 the emphasis was shifted from Egypt to the Republic of Sudan. The sub-project Cartography at the TFH Berlin is concerned, via the use of remote sensing data, with the development of maps which, on the one hand, serve to aid orientation and the recording of research data in the field and, on the other hand, act as a cartographic representation of the very same research.

2. The development of satellite maps

The map coverage of Sudan leaves much to be desired. A complete coverage at a scale of 1:250,000 exists, though this is antiquated. Larger scale, modern maps (1:100,000) are only available for the Central and Northeasterly areas of the country. Up to date maps, however, are vitally important in geoscientific field work for orientation and for the recording of results. In this case the immediate availability has a greater priority than the geometrical accuracy. These special demands can be satisfied by the use of processed satellite image maps. The method involved allows the inclusion of intermediate results during the map making process, thus providing more information for field work. The merging of topographic information with a Landsat image base leads to a Work Sheet, which can in turn be used in topographic surveys and updating. Fig. 1 shows an index of these "Work Sheets" completed up or in preparation till the end of 1992. Of these 50 sheets, 42 had been printed by February 1993. The work Sheets made it possible to provide planning and orientational information for large areas at very short notice.

The satellite image maps have been developed step by step using the "Building Block Principle" (Modulsystem). In this way image-supported Work Sheets lead to image-supported topographic maps and image-supported thematic maps, whereby the derivative maps both boast a geometrically and radiometrically corrected base (MEISSNER et al. 1990). Fig. 2 to 4 show the development of such a map using an extract of the 1:250,000 Map of Sudan, El Fasher Sheet (ND 35 1) as an example. The Kutum (ND 35 E) and Port Sudan (NE 37 A) Sheets are at

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present being processed as topographic maps. The inclusion of additional contour lines is in planning.

The next step towards an image-supported thematic map is shown in the Map of Sudan (1:250 000), Khartoum Sheet (D 36 B). The enclosed thematic map is a prototype of the "General Soil Map of Sudan".

For the Jebel-Marra region, an area which is the subject of intense interdisciplinary research (geology, geography, soil science and historical development of settlements) a map series at a scale of 1:100 000 has been developed. The geometrically corrected, image-supported topographic map base makes it possible to map various themes accurately and in great detail. The base maps developed in this way have been used in the production of thematic maps dealing with a variety of subjects (geology, vegetation/ land use, soil science, archaeology, geomorphology and hydrology) and in collaboration with other research groups. These groups include other SFB 69 subprojects, associated research groups and sudanese partner institutions (Geological Research Authority of Sudan/Khartoum, Sudan Survey Department/Khartoum and the Soil Survey Administration/Wad Medani).

In addition to the 1:100 000 and 1:250 000 series the interdisciplinary research carried out by the SFB 69 require small scale maps for the representation of results and for overview purposes. This requirement has been fulfilled with the 1:1 Million map of Sudan and the Index Maps of Sudan 1:10 Million (Fig.1).

A training program for sudanese scientists and technicians is also carried out. In this cooperation City maps were developed by using remote sensing data.

3. Methodical and interdisciplinary research with in the subproject

The practical applications of remote sensing data in thematic maps and the continuing development of such applications is the main concern of the research. The classification of soil groups has been completed for the El Fasher Sheet (1:100 000) and for the monitoring of desertification for Kormā Sheet (DOMNICK 1992). A subsequent step in the process will include the linking of the topographic information gained through remote sensing data with thematic data to form the base of Geographic Information System (GIS). The combination of image processing and computer aided cartography will lead to a gradual reduction in the amount of conventional cartographic work and an increase in the digital methods.

The use of digital relief models as a method of cartographic representation and their combination with satellite image data will be investigated together with an assessment of the feasibility of using Metric Camera images for the stereoscopic interpretation (Kebkaiya 1:100 000).

The production of small scale thematic maps is regarded as a necessary supplement to the written presentation of a project. Therefore, a concept for such maps employing computer cartography has been developed. The 1:8 Million map of NE-Africa (included with this report) displays a result of the concept.

As a result of many years of research, a vast amount of information of various types has been collected in Sudan and this data would prove invaluable to a GIS of the area.

Some of the data will be used in a pilot study which will investigate the methods involved in incorporating information from various interdisciplinary projects into a GIS in the Darfur Region. The 1:100 000 map of the Jebel Marra region is the first step along the road towards the creation this GIS.

U. RIPKE leads a team involved in mapping the geology of the area employing the interpretation of aerial photographs and satellite images, taking into account the geological investigations carried out by other projects.

SCHNEIDERBAUER (1993) is preparing a thesis concerning the evaluation of satellite images and aerial photographs as an aid to mapping of geomorphological units and hydrology.

DOMNICK (1992) carried out a methodological investigations employing various satellite systems at different times in order to interpret the dynamics of desertification.

HASER (1993) is investigating the development of settlements of the Jebel Marra region during pre-and early history as a thesis.

Finally the GIS will be an instrument to handel the planning of the development of this region by a better knowledge about the geopotential fram.

4. References

HASER, J. (1993): Siedlungsarchaologie in der Jebel marra-Region - Ph. D., Freie Universitat Berlin (in prep.).

DOMNICK, I. (1992): Regionale Anwendung von Fernerkundungsdaten Fur Desertifikations monitoring - am Beispieldes ostlichen jebel Marra Vorlandes (Darfur/Republik Sudan). - (Unpublished Master Thesis, Freie Universitat Berlin).

MEISSNER, B., RIPKE, U. & CHRIST, F. (1990): Topographic and Thematic Map Approach Sudan 1:250 000 - in KLITZSCH, E. & SCHRANK, E. (Eds.), Berliner Geowiss. Abh. A, 120.1, 351-374.

SCHNEIDERBAUER, S. (1993): Untersuchungen zur Geomorphologie und Hydrogeologie im Bereich des Jebel Marra (Darfur). - (Master Thesis, in prep.; Universität zu Köln).

Index of prepared maps with the scope of SFB 69 (1987 - 1993)

Work Sheets

Sudan 1:250 000 (Sheets Undur, Kereinik, Zalingei, North Wadi Howar, Wadi Howar, Musbat, Kutum, El-Fasher, Nyala, Zalat el Hammad, El-Laqaya, Meidob, Tagabo Hills, Abyad, Taweisha, Jebel Rahib, Jebel Tageru, Umm Sunta, Umm Badr, Kkaja Serug, En nahud, Abu Tabari, Jebel El Ein, Umm Suneita, Sodiri, El Quleit, Abu Zabad, Soteir, Eilai, Es Safya, Kagmar, El Obeid, J. Ed Dair, Baiyuda, Sabaloka, Khartoum, Athara, Shendi, Wadi Amur, Musmar, Adarama, Gedaref
Sudan 1:100 000, Sheet Fughma

Topographic maps

- Sudan 1:1 Million Sheet El Fasher ND 35
- Sudan 1:1 Million Sheets Khartoum ND 36, Athara NE 36 and Wadi Halfa NF 36 (in preparation)
- Sudan 1:250 000 sheets Khartoum and El Fasher
- Sudan 1:250 000 Sheets Kutum und Port Sudan (in preparation)
- Sudan 1:100 000 Sheets Jebel Marra, Dabanga and Korma
- Sudan 1:100 000 Sheets Dor, Gangara, Jebel Gurgei, Kebkabiya, Guldo, Tawila, Umm marahik, El Fasher and Shingil Tobaya (in preparation)
- Sudan 1:50 000 Nyertete.

Geographic maps

- North-East Africa 1
- Sudan 1:10 000 000, Sudan 1:8 000 000, Sudan 1:5 000 000

Geology

- Sudan 1:1 Mio Sheet Uweinat, El Atrun
- SW-Agypten 1:1 Million
- Jebel Rahib Fold Belt 1:250 000, 1:100 000 and 1:50 000
- Sudan 1:250:000 Sheet Tagabo Hills, Sheet Khartoum (in preparation)
- Sudan 1:100 000 Sheet Jebel marra
- Sudan 1:100 000 Sheets Korma, Guldo, Dabanga, Jebel Gurgei and Kebkabiya, Tawila (in preparation)

Vegetation/Landuse

- Sudan 1:100 000 Jebel marra

Desertification

- Sudan 1:100 000 Sheet Korma

Soil

- Sudan 1:250 000 Sheet Khartoum
- Sudan 1:100 000 sheets Korma and El Fasher (in preparation)

Geomorphology

- Sudan 1:100 000 sheets Guldo and Dabanga (in preparation)

Hydrogeology

- Sudan 1:100 000 Sheets Guldo and Dabanga (in preparation)

Archaeology

- Sudan Uri 1:50 000 and 1:12 500
- Sudan 1:100 000 Sheets Dor, Gangara, jebel Gurgei, Kebkabiya, Guldo, Korma, Tawila and Dabanga (in preparation)

City maps

- 1:25 000 Sheets Khartoum-Omdurman, Was Medani, and El Fasher, Nyala
- 1:10 000 Sheets Kutum, Mellit and Zalingei
- 1:7 500 Kebkabiya