MAPPING DESERT AREAS AT THE SCALE OF 1:200 000 WITH THE USE OF TM DATA

Wojciech Bychawski, Ryszard Gronet, Romuald Kaczyński

Centre for Remote Sensing of the Institute of Geodesy and Cartography, Jasna 2/4, 00-950 Warsaw

Poland

Commission IV

Abstract

The method using Thematic Mapper Landsat CCT data as an aid for mapping the desert regions is presented. The method was applied on desert region for elaboration of thematic together with planimetric maps and the photomap all at the scale of 1:200 000. Ground Control Points coordinates were measured using Doppler techniques. Correction, classification and visualization of CCT's TM Landsat were carried out by means of the image analysis system 2 PAAC of OVAAC 8 at the Centre for Remote Sensing in Warsaw. E-4 Wild rectifier and A-8 Wild stereoplotter were used for analog elaboration of visualized and corrected TM images. The final planimetric map including seven categories of the desert area fits to the accuracy standards of the map at the scale 1:200 000.

As has been repoprted in many papers, Landsat Thematic Mapper data can help to generate accurate planimetric and thematic maps much quicker and cheaper than it has ever been possible. This is particularly important for the developing countries. The TM data is best suited to producing photomaps at the scales up to 1:100 000. This data also gives the possibility to identify different kinds of terrain features and patterns, which make up the map content. A standard planimetric error 11 - 13 m /0.4 pixel/ has been reported by several investigators /1/, /2/. Different kinds of terrain can be analyzed with the use of different spectral channels of the TM.

Since the position of Landsat 5 cannot be established with needed accuracy, the determination of the elements of absolute orientation is an essential element in using TM data for topographic mapping. Only a few Ground Control Points /GCP/ are needed for the creation of controlled masaic and map compilation.

One quarter of Landsat scene recorded on CCT has been used for investigation. This data covers the territory of 8100 km^2 of desert land, which is equivalent to an area which would be covered by approx. 130 aerial photographs taken in the scale of 1:60 000. For elaboration of these photographs one would have to position a minimum of 12 GCP and calculate a few hundred photocontrol points in the aerotriangulation process.

Only 6 GCP'S have been used for the elaboration of the above TM data. CCT data has been enhanced and corrected in the Remote Sensing Centre of the Institute of Geodesy and Cartography in Warsaw using OVAAC-8 system.

Corrected and visualized photographs /7 bands/ in the scale 1:600 000 have been enlarged to the scale 1:200 000. These photo-

graphs have been used during field work. 6 good quality GCP'S well distributed over the surveyed territory have been identified in the terrain and on photographs. The X,Y coordinates have been obtained with the accuracy of RMSx,y better then ± 20 m with the use of satellite Doppler System.

The most important and characteristic terrain features appearing on Landsat images have been identified in the field during a few day's long reconnaissance trip.

All the subsequent stages of the elaboration have been carried out at the Polish Remote Sensing Centre in Warsaw:

- marking control points with the use of Transmark /Zeiss, Jena/,
- rectification of photographs using E-4 Wild rectifier,
- map compilation on A-8 Wild stereoplotter,
- unsupervised and supervised classification of CCT Thematic Mapper data on OVAAC-8 image processing system.

Planimetric map and photomap of the investigated area have been produced in the scale of 1:200 000.
The standard planimetric error of the construction of photomap has been established at ± 0.3 mm on basis of calculations carried out for over 50 control points.

The planimetric map has been produced with the use of two 16 x 16 cm copies of visualized image of the test area in the scale of 1:600 000, which were analyzed as a pair on A-8 Wild stereoplotter.

Certain terrain features such as escarpments, abrupt denivelations, ueds and desert roads have been enhanced by the application of this procedure and allowed for the creation of a kind of quasi-stereoscopic "terrain model". This model has been done in the scale of 1:300 000 and adjusted to the scale of 1:200 000 using GPS'S with the error of ± 0.3 mm.

The final planimetric map has been prepared in the scale 1:200 000. The comparison of this map with existing topographic maps in the same scale /based on aerial photographs/ shows 85% of terrain features have been recognized and plotted correctly on our map. While wandering through the test area with Landsat TM photographs we have noticed that the information on the differences between various terrain features and cover types provided by these images is very helpful in finding ones way in the desert. Unsupervised and supervised /based on our field notes/ classification of multispectral TM data has allowed for the recognized of 7 distincts categories of terrain type/cover:

1. Rocky /stony/ surface on a dusty clay bedding /hamada, black/
2. Rocky /stony/ surface with streaks of drifting sands on a dusty clay bedding /hamada, grey - brown/
3. Sandy - rocky surface with zones of gravel /srir - hamada, brown - yellow/
4. Sandy surface with zones of gravel /srir - reg, brown - yellow/
5. Sand dunes /erg - dunes, yellow - brown/
6. Ueds
7. Escarpments.

The content of our planimetric map has been enriched by introducing this information.

In conclusion: Photogrammetric evaluation of TM image has shown that planimetric position accuracy of less than 0.3 mm in the scale of 1:200 000 can be achieved,i.e.the TM images are suitable for mapping at this scale. The information on terrain type/cover categories which can be extracted from multispectral data can be used for enriching the thematic content of such maps. Simple photogrammetric instrumentation can be used for mapping on the basis of well corrected and enhanced TM data at the scale of 1:200 000. The cost of producing such a map is 20 times lower than that of producing a map of similar territory with the use of aerial photographs.

References:

1. Borgeson W.T., Batson R.M., Kieffer M.H.
Geometric accuracy of Landsat-4 and Landsat-5 TM images.
Ph.Eng. No 12, 1985 p.1893-1898.
2. Welch R., Jordan T.R. Ehlers M.
Comparative evaluations of geodetic accuracy and cartographic potential of Landsat4 and Landsat-5 TM image data.
Ph.Eng. No 9, 1985 p.1249-1262.