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General aspects for purchase of data necessary to draw topographic plans and maps

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Abstract:

Recent advances in the field and availability of high precision instruments made the topography receive higher spatial resolution data and a precision better than decades ago. In this paper we want to present general aspects of data acquisition module required to draw plans and maps. We refer to topographic maps, digital elevation models, satellite images and aerial photos.

Keywords: topographical plans and maps, D.E.M., satellite images and aerial photos

1. INTRODUCTION

Topography is an important feature of the terrain that alters hydrological and hydraulic processes involving water resources.

There are situations when a certain area must be studied, but data are not available. In this situations, data can be achieved by several methods considering a lot of parameters including the working scale, the necessary details, the reference system.

Terrain features can be identified by the use of topographic maps, digital elevation Patterns, aerial photographs and satellite image.

2. DATA NECESSARY TO DRAW TOPOGRAPHICAL PLANS AND MAPS

2.1 Topographic maps

Terrain map (electronic or paper) is a graphical representation (plan view) of the earth's surface using contours at scales ranging (1:100 - 1:25000), without taking into account the ellipsoidal shape of the surface land. [5] Zero reference level is the sea, the Black Sea to Romania.

In fig. 1 are the steps taken in making topographic maps, starting from the situation in the field.

Scale and legend are fundamental to topographic maps. Correct interpretation of a map is impossible without understanding these parameters that determines the resolution and detail.

Topographic map are developed for different applications being used in urban planning, emergency management, establishing legal limits land ownership, etc.

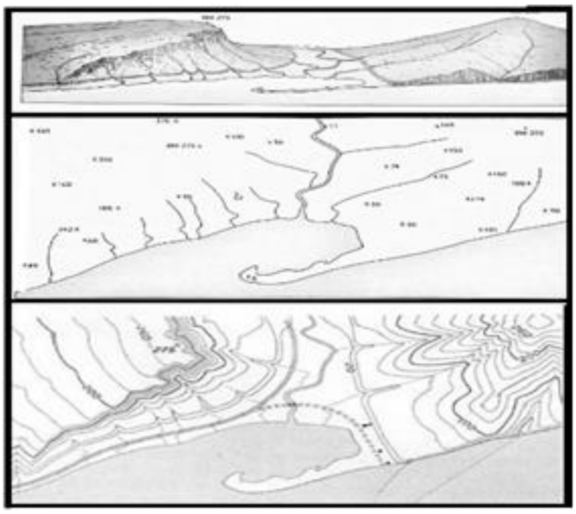

Fig. 1 The steps in making maps [6]

Recent advances in remote sensing lead us to replace topographic maps with digital elevation models (DEM) that provides the same information as topographic maps, but do not require interpolation between contour lines.

2.2 Digital elevation models (D.E.M.)

Digital elevation models are a raster dataset that represents digital form topography. Each cell indicates the elevation value in a certain area. DEM is the

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simplest and most common form of digital representation of land being used to determine issues of land (slope, elevation, terrain features, and watershed delineation) and hydrological and hydraulic modelling processes.

Fig. 2 includes data visualization in a D.E.M. and fig. 3 represents ways of storing data in the form of a matrix.

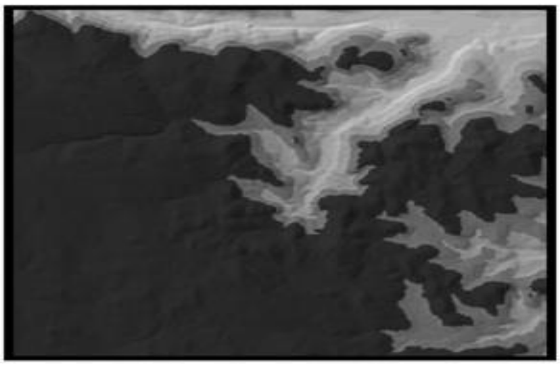

Fig.2 Data visualization in D.E.M.

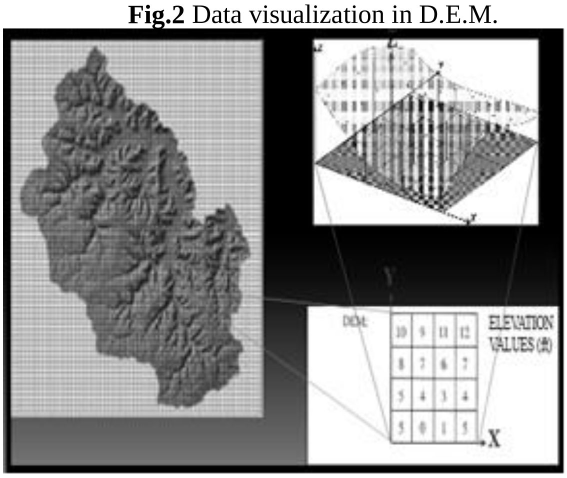

Fig. 3 Data storage in D.E.M [7]

The resolution is a critical parameter for D.E.M, best resolution available is 30 m horizontal coverage with 1 m vertical resolution.

In figure 4 is an example, taken from the literature specialty that highlights the importance of a DEM in implementing flood risk maps.

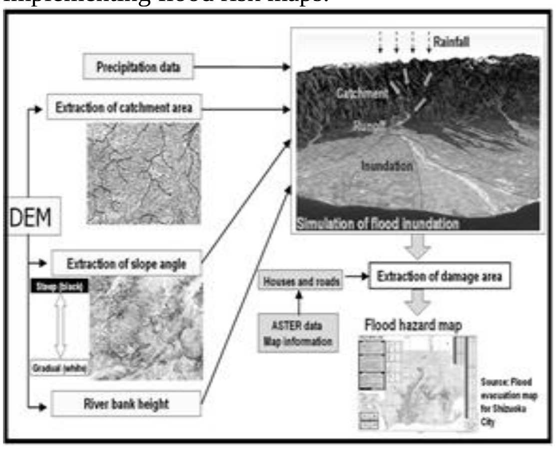

Fig.4 The importance of a DEM in implementing flood risk maps [8]

Using DEM as a platform for data entry, the simulation of precipitation, infiltration, drainage and flooding can estimate flood risk areas.

Digital Elevation Models allow a better representation of the terrain and the direct extraction of hydrological features, bringing benefits in terms of cost-effective processing time compared to traditional methods based on topographic maps.

2.3 Aerial photographs

Aerial photography is the production of photographic images using helicopters or aircraft primarily scope for the mapping. Aerial photography was practiced for the first time in over 160 years ago in France.

Vertical aerial photographs (fig.5) are low distortion and have been used for data retrieval.

One of the advantages of vertical aerial photographs is that they are in a variety of sizes.

The main disadvantage is that they are not very recent.

Most photos are taken at an angle less than 90^0 from the ground (fig.5) . Photograph skew depends on the height of the aircraft above the ground and the distance to the object. Oblique aerial photographs are good illustrations, but are affected by distortion.

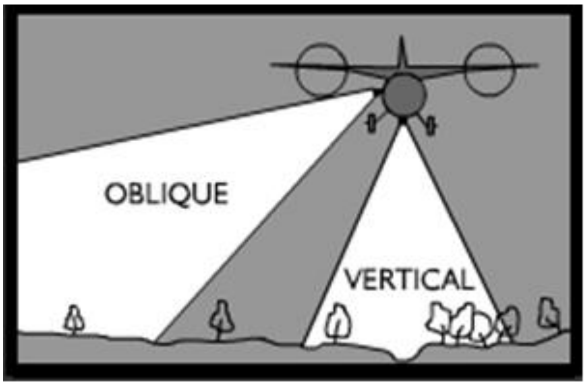

Fig.5 Vertical and oblique aerial photographs [8]

Unlike a topographic map features on an aerial photograph are not generalized or symbolized. Although aerial photographs record all visible features on the Earth's surface, they are not easily identifiable. With careful interpretation, aerial photographs are an excellent source of spatial data for the study (fig.6), providing information about the shape of objects, spatial arrangement, size, colour (hue) than surrounding objects, shadows (indicate size, shape, orientation), texture land (river, lake, mountains, forest), the relationships between objects (building located near a lake).

In addition to spatial features, aerial photographs provide temporal information and series of photos can indicate changes over time in an area. [4]

The method aerial photographs of is largely replaced by satellite images.

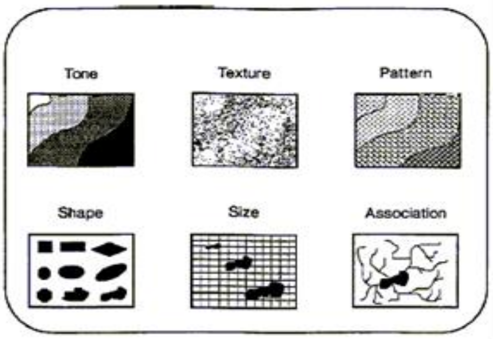

Fig.6 The images of spatial features offered by airlines [10]

Satellite images

Satellite images refer to a series of images transmitted by artificial satellites orbiting the Earth. These images are used for mapping, environmental monitoring, archaeological, or weather predictions for military purposes.

Remote sensing is the science of obtaining, processing and interpreting images that record the interaction of electromagnetic energy and matter. [11]

Using remote sensing can study climate change and its effects, agricultural productivity, the impact of human activities on land coverage, landforms that cannot be studied from the ground, air quality, the phenomena of floods, droughts and volcanoes erupts, changing borders ecosystems (deserts, forests), ocean currents, temperature, wind, air-sea interactions, etc.

Aerial photograph of the basis of remote sensing (using the visible spectrum) for the first time in 1909, is widely used in WWI (World War I).

With the advent of the first artificial satellite in 1957, moves to outer space remote sensing.

The fig.7 is the operation of the remote sensing process from solar energy (passive remote sensing system) to the practical.

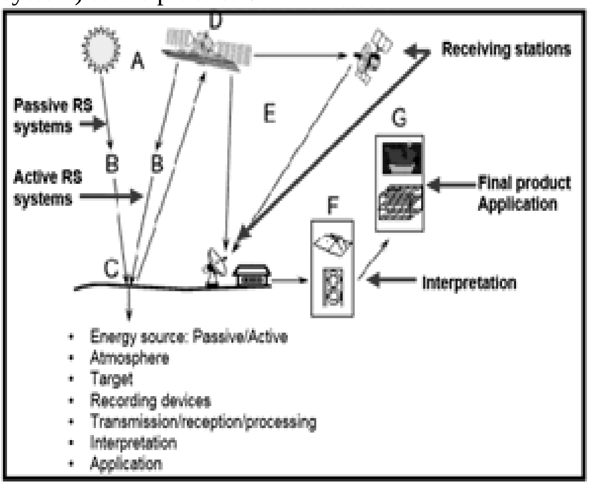

Fig. 7 The stages of remote sensing [12]

A remote sensing tool collects information about an object or phenomenon, without coming into direct contact with it, the sensor is located on the satellite platform. Remote sensing is similar to math, the sensors measure the amount of electromagnetic radiation emitted by the object or geographical area, the information is processed on the basis of algorithm.

The sensors used can be passive (solar energy reflected or absorbed and re-emitted as infrared, wavelength, ASTER, Landsat, AVHRR) and active sensors (emitting radiation, LIDAR, RADAR, and SONAR)

The table 1 below presents a statistical summary of the main sensors, the cost/ km^2 taking into account resolution.

Table 1[13]

Sensors	Cost/ km^2	Type (spatial res.)	Sales contact
Landsat 5&7 1982 to –	£0.01	Multispectral (Medium) 30 meters (£235/ ~170x180 km^2)	http://edc.usgs.gov/products/satellite/tm.html
Aster 2000 to –	£0.01	Multispectral (Medium-High) 15 to 90 meters (£50/~60x60 km^2)	http://edc.usgs.gov/products/satellite/aster.html
Spot 1986 to –	£0.5	Multispectral (Medium) 10-20 metres (£1800/ 60x60 km^2)	http://www.npagroup.co.uk/imagery/satimagery/pdf/price_list.pdf http://www.infoterra-global.com/
Ikonos 1999 to –	£9	Multispectral (High) 1-4 metres (£1089 / 11x 11 km^2)	http://www.npagroup.co.uk/imagery/satimagery/ikonos.htm
Aerial photography	~ £25	Variable (High)	http://www.ordnancesurvey.co.uk/oswebsite/
Lidar	~ £250	(cost dependent on sampling density and service providers)	http://www.infoterra-global.com http://www.environment-agency.gov.uk/science/monitoring/131047/?version=1&lang=_e

Next we make a brief presentation of the main sensors view in fig.8.

Fig. 8 Main senzors

Landsat represents the world's longest continuously acquired collection of space-based moderate-resolution land remote sensing data. Nearly four decades of imagery provides a unique resource for those who work in agriculture, geology, forestry, regional planning, education, mapping, and global change research. Landsat images are also invaluable for emergency response and disaster relief. [15]

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is an imaging instrument onboard Terra, the flagship satellite of NASA's Earth Observing System (EOS) launched in December 1999. ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI), and Japan Space Systems (J-spacesystems). ASTER data is used to create detailed maps of land surface temperature, reflectance, and elevation. [14]

The SPOT (Satellites Pour l'Observation de la Terre or Earth-observing Satellites) remote-sensing programme was set up in 1978 by France in partnership with Belgium and Sweden. The SPOT satellites constellation offers acquisition and revisit capacity allowing to acquire imagery from anywhere in the world, every day. [16]

The IKONOS Satellite sensor is a high-resolution satellite operated by DigitalGlobe. Its capabilities include capturing a 3.2m multispectral, Near-Infrared (NIR)/0.82m panchromatic resolution at nadir. Its applications include both urban and rural mapping of natural resources and of natural disasters, tax mapping, agriculture and forestry analysis, mining, engineering, construction, and change detection. It can yield relevant data for nearly all aspects of environmental study. IKONOS images have also been procured by Satellite Imaging Corporation for use in the media and motion picture industries, providing aerial views and satellite photos for many areas around the world. Its high resolution data makes an integral contribution to homeland security, coastal monitoring and facilitates 3D Digital Terrain Models and Digital Elevation Models. [17]

Lidar (also written LIDAR or LiDAR) is a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light. Lidar is popularly used as a technology to make high-resolution maps, with applications in geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, remote sensing, atmospheric physics, airborne laser swath mapping (ALSM), laser altimetry, and contour mapping. [18]

3. CONCLUSIONS

Topographic maps can be used to provide useful information in a range of areas - from town and country planning to the finding of a tourist route.

Satellite images have the advantage that they can be repeated easily with permanent activity satellites coverage areas are much higher than imagery and data are available in digital format are easy to process.

Compared to satellite images, aerial images can be a better choice when you take into account the costs are cheaper than those obtained by satellite. May better reflect changes in an area (satellite images may be available in a short period of time and may not reflect changes and developments in an area). The resolution and clarity are best.

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