

# **SOME METHODOLOGICAL ASPECTS CONCERNING THE USE OF SATELLITE IMAGES AND MAPS IN THE PHYSICO-GEOGRAPHICAL REGIONAL DETERMINATION OF THE ROMANIA TERRITORY**

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**ABSTRACT** - This paper presents some methodological aspects concerning the use of satellite images and maps in the physico-geographical region determination of Romania's territory, as well as some results that can be obtained using this method. In order to determine the physico-geographical units and sub-units using satellite maps (Bucharest page, 1:1.500.000) and satellite images (Landsat, IRS) we have analyzed, from the geographical point of view, some samples of such documents. The resulting maps were compared with the already existing physico-geographical region determination maps. Our results show that the method under consideration has both advantages and disadvantages. One conclusion is sure: satellite images and maps can be used for this purpose together with traditional maps.

**Key words:** satellite map, geographical interpretation, and physical-geographical region, Romania

## **INTRODUCTION**

Determination of territorial units is the basic expression of physico-geographical studies. It is based on the integrated minute analysis of the elements making up the natural components of the geographical environment in their spatial variation.

When determining the physico-geographical regions one uses the notions of homogeneity and variability, continuity and discontinuity in the natural environment, the subordination and the hierarchy of the determined units. Consequently, the essence of this operation consists in the determination of homogeneous territorial units (entities) of different dimensional scales and structural and functional complexities (i.e. orders) with a view to ordering them in an adequate taxonomic system and drawing the limits between them.

According to the present-day knowledge of Romania's territory, its regions are adequately represented from the physico-geographical point of view in several fundamental works such as *Geografia României (1983-1992)*, and *Atlasul Național (1972-1979) – The National Atlas*. This representation of Romania's regions is based on regional maps of each natural element (the map of geo-morphological regions, the map of climatic regions, the map of bio-geographical regions, etc.). Today new documents can be used in the representation of regions – airophotograms, satellite images, and maps.

The present paper has a methodological character. Its purpose is to demonstrate, by means of several examples, how satellite images and maps can be integrated into the physico-geographical determination and representation of Romania's regions. The possible results are compared with the already existing maps of this type.

The physico-geographical determination of regions (and the geographical regional determination in general) relies on a precise methodology and it is the scientific basis for regional development studies.

## METHODS AND PROCEDURES

The comparative analysis of satellite images and of regional maps produced by traditional methods (physico-geographical elements and complexes) highlighted the importance of satellite documents in such a scientific approach. One cannot use just satellite images; these images can only be used in correlation with physico-geographical maps, as some significant hesitations and errors can appear in the drawing of the limits.

In order to bring to light the advantages and difficulties in using satellite maps and images when we represent physico-geographical regions, we have mapped units of different orders starting from the respective document and superimposed the resulting cartographic products on the physico-geographical regions maps from *Tratatul de Geografia României, I, Geografia Fizică, 1983 (Romanian Geography Treatise, I, Physical Geography)*, as well as the relief map of Romania (the geo-morphological representation of regions) (Posea Gr., Badea L., 1984).

Following the areas' chromatic variations and configurations on satellite maps and images in natural colors allowed us to detect and establish the features of the natural and the man-made elements that can help us determine the homogeneous territorial units and draw the limits between them. These features are: natural vegetation, land use, the geometry of agricultural areas; the structure of the hydrographical network (convergences, divergences, etc.); the distribution of settlements (for instance, alignments of settlements formed in the areas of contact between entities). Most often it is necessary to use several indicators.

The quality of the interpretation and of the resulting cartographic materials depends on the scale and the geometrical resolution of the satellite documents. Therefore, in the case of problematic sectors, it is necessary to analyse large-scale maps and high fidelity images using the computer. Zooming and maximizing details makes it possible to determine the physical-geographical entities and the limits between them more precisely.

The satellite documents used in this operation were: the satellite map – Bucharest page (1:1 500 000); IRS satellite map (1:50 000); Landsat images.

## RESULTS

Applying the above methods and procedures we have obtained significant positive results. However, uncertainty and errors are not excluded. We present our results below according to the methodology we have used.

A. Determining and delimiting precisely enough the physical-geographical entities of different orders on small-scale satellite maps

A.1. Physical-geographical entities of identical taxonomic level (especially of higher order)

The Făgăraş Sub-group – the Argeş and the Vâlcea Hills – the plateaus at the feet of the mountains from Argeş County (the Cotmeana Plateau, the Argeş Hills, the Căndeşti Plateau) – Western and Central Plain of Muntenia (the Boian Plain, the Găvanu-Burdea Plain, the Piteşti Plain, the Târgovişte-Ploieşti Plain).

In this example (fig. 1, fig. 2.) we have correlated the following indicators after interpreting satellite images and maps from the geographical point of view: vegetation variations, changes in land use, modifications in the distribution of settlements, and the structure of the hydrographical network and its variations. The homogeneous physical-geographic entities and the discontinuities, i.e. the limits between them, were mostly determined by superimposing and correlating the indicators we have mentioned above.

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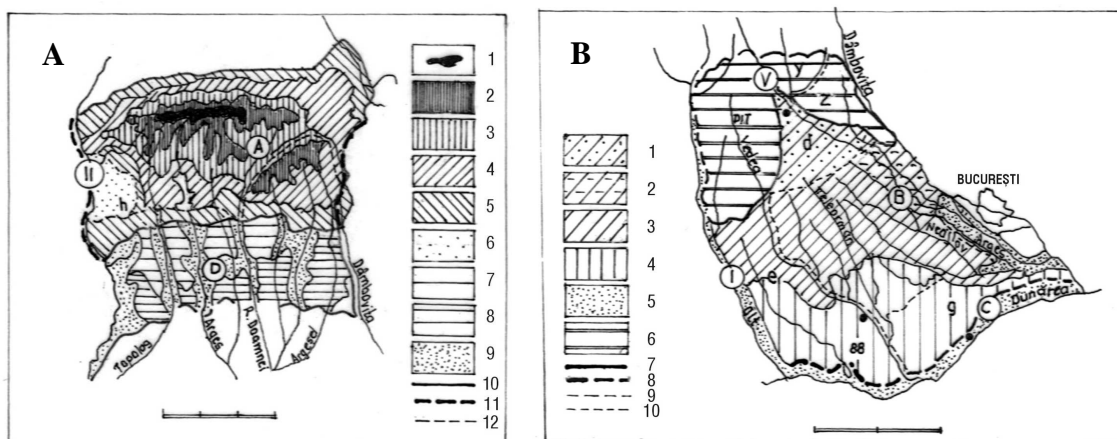


Fig.1. Physico-geographical subunits determined according to traditional methodology  
Source: Geografia României, 1983

A. Central group of the Southern Carpathians (Făgăraș Mts.); Argeș Hills and Vâlcea Hills (1. High mountains with crests, glacial relief and levelled areas covered by alpine lawns; 2. High mountains with crests, glacial relief, and levelled surfaces with bushes and subalpine lawns; 3. High, average, and low mountains with spruce fir forests; 4. High, average, and low mountains with spruce fir, beech, and fir-tree forests; 5. High, average, and low mountains with beech forests and with beech, and common oak forests; 6. Intra-Carpathian depressions where lawns are predominant; 7. High hills with beech and common oak forests; 8. High hills, with common oak forests alternating with beech forests, lawns, orchards, and agricultural land; 9. Sub-Carpathian depressions and valley corridors, with beech forests, beech, and common oak forests, lawns, orchards, and agricultural land; 10. Limits of second order units; 11. Limits of third order units; 12. Limits of fourth order units)

B. Argeș Piedmont Plateau; western and central Muntenia Plain (1. High piedmontan plains with arable terrains, steppe-like lawns, and clusters of oak forests; 2. Subsidence plains, with agricultural land, clusters of oak forests, and lawns; 3. Plains with loess-like, fragmented and terrace deposits, orchards, arable terrains, and clusters of cerris forests, steppe-like lawns with southern elements; 4. Plains with loess-like and terrace deposits, with orchards, arable terrains, clusters of Turkey oak forests and steppe-like lawns; 5. Large river meadows with sands, riverside willow and poplar coppices, and lawns alternating with orchards and arable terrains; 6. Hills and piedmontan plateaus with common oak forests, beech, common oak, Turkey oak forests, lawns, orchards and agricultural land; 7. Limits of second order units; 8. Limits of third order units; 9. Limits of some groups of fourth order units; 10. Limits of fourth order units)

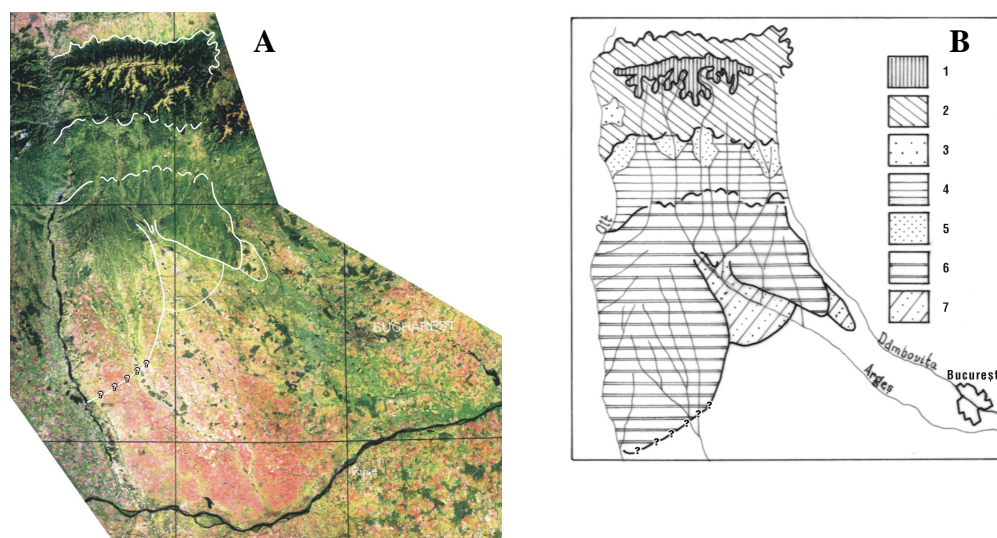


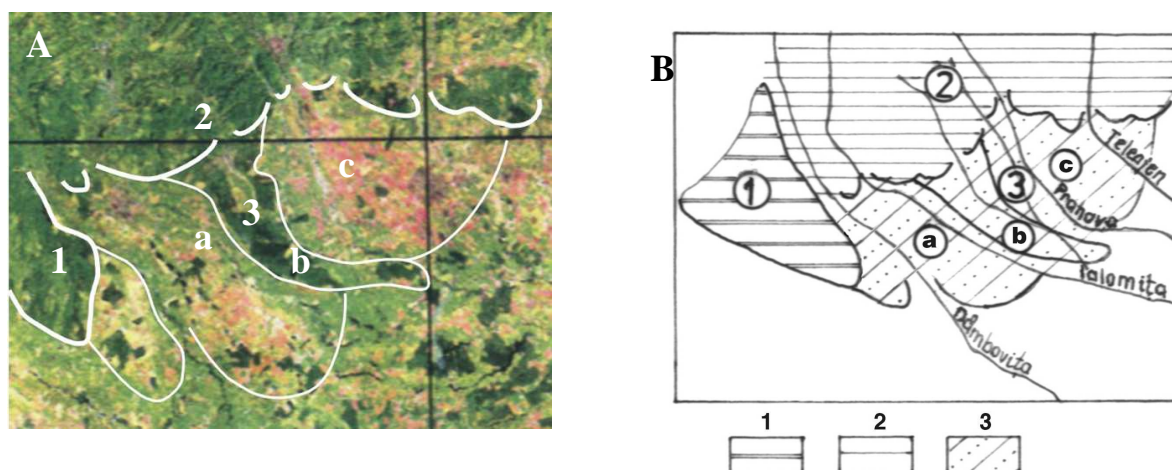
Fig. 2. Physico-geographical subunits determined according to satellite images (Bucharest page, 1:1.500.000): A. Satellite map; B. Derivate map (1. High mountains with crests, glacial relief, levelled surfaces with alpine lawns, clusters of bushes, and subalpine lawns; 2. High, average and low altitude mountains with coniferous, mixed, and deciduous forests; 3. Intra-Carpathian depressions (Loviștei Depression) where lawns are predominant; 4. Sub-Carpathian hills with deciduous forests; 5. Sub-Carpathian depressions and valley corridors with deciduous forests, lawns, orchards, and arable terrains; 6. Piedmontan hills, with deciduous forests, lawns, orchards, and arable terrains; 7. Piedmontan plains where orchards and arable terrains are predominant; 8. Limits of high order units; 9. Limits of low order units)

A.2. Subunits within the same taxonomic entity the Târgoviște Plain – the Cricovul Dulce Plain – the Ploiești Plain.

The differentiation between the Târgoviște Plain and the Ploiești Plain, on the one hand, and the Cricovul Dulce Plain, on the other hand, was possible by means of observing the pronounced contrasts in the structure of the land and the configuration of the hydrographic network: a massive deciduous forest (*Quercus*), and the reduced number of settlements in Cricovul Dulce Plain; the predominance of arable terrains, the large number of settlements (including two big towns), the divergent character of the hydrographic network in Târgoviște Plain and Ploiești Plain (fig.3.).

B. Possibilities to determine the physico-geographical units and sub-units and trace the limits increase thanks to the use of high fidelity images and large-scale satellite maps (1:25 000; 1:50 000)

For instance, the delimitation of most of the perimeter of the Cotmeana Plateau (Cotmeana Piedmont) is possible on a high fidelity satellite image (Landsat TM) by considering the following indicators: the general form of a fan specific to a relief unit situated at the foot of the mountain, the divergence of valleys and interflaves in such a relief unit, specific land use, all these elements in contrast with Boian Plain, Găvanu-Burdea Plain and Pitești Plain. The northern limit is very clear, it is possible to notice the slopes created by the erosion oriented towards the Sub-Carpathian Hills (or towards the hill surrounded by depressions), the slopes sculptured in the monoclin of the Getic Plateau. The whole of the southern limit is hard or impossible to draw because the contact between the plain at the foot of the mountain and the plains



**Fig.3. A: Delimitation of the physico-geographical subunits of the High Piedmont Plain on satellite map (Bucharest page 1:1.500.000); B: Delimitation of physico-geographical subunits of the High Piedmont Plain in traditional maps (Geografia României, 1983) (1. Cândești Piedmont with deciduous forests; 2. Prahova Sub-Carpathians, with deciduous forests, lawns, orchards, and arable terrains; 3. Piedmontan plains: a) the Târgoviște Plain with lots of agricultural terrains; b) the Cricovului Dulce Plain with lots of deciduous forests (*Quercineae*); c) the Ploiești Plain with lots of agricultural terrains)**

produced by the loess-like deposits and terraces does not appear on the satellite image as a very clearly differentiated land fund (fig.4.). On the IRS satellite map (1:50 000), the border between the Argeș Hills situated at the foot of the mountain, and the Pitești Plain is very clear. It is marked by a change in the structure of the hydrographical network, in the main morphological lines and in land use (fig.5.).

Large-scale satellite maps can be successfully used for micro-region delimitation needs.

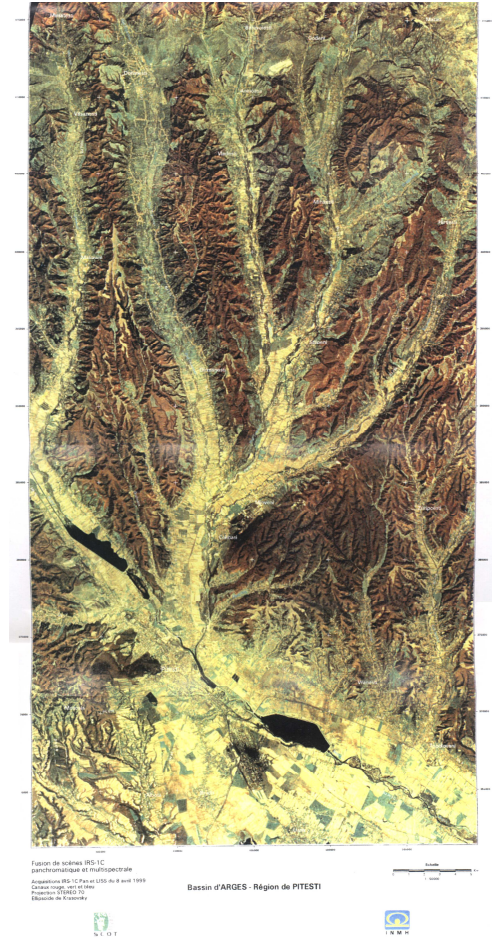
C. Possible errors caused by the exclusive use of satellite maps and images in the physico-geographical delimitation of regions

Errors may appear in the determination of units, sub-units and physico-geographical limits on satellite maps, and images because on these documents (especially on small-scale ones) the similarities and the disparities between physico-geographical elements (geographical elements, in general) cannot always be noticed. For instance, the same vegetation covers the contact between two relief units (the hill-the plain; the mountain-the hill) or several geo-morphological elements (slope-glacis; plain at the foot of the mountains-bottom of a depression or valley). Land use does not always change abruptly at the contact between two geo-morphological units/elements. These aspects are specific to the areas of physico-geographical (or geographical, in general) interference.

This is why it is necessary to use satellite images and maps cautiously. Hesitations and errors can be eliminated by consulting the physico-geographical maps and by means of direct outdoors observations in the areas with such problems.



*Fig. 4. On LANDSAT TM the Cotmeana Piedmont is visible. Its limits with Boianu and the Găvanu-Burdea Plains are difficult to draw.*



*Fig. 5. The contact between the Getic Piedmont and the Pitesti Plain is clear on this IRS image.*

## CONCLUSIONS

Using satellite maps and images in order to delimit the physico-geographical units of Romania's territory is possible and necessary, but the results depend on map scale and image fidelity, and the accurate application of the selected methods and procedures.

One cannot use only satellite maps and images, these should be used in correlation with physico-geographical maps and outdoors observations, because not all situations are sufficiently clear.

When only satellite documents are used, one has to be very careful because significant errors can occur.

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