The Indonesian Journal of Geography, Vol. 15—16, Nos: 49—51,
June 1985—June 1986, pp. 69—74

SPOT SIMULATION FOR URBAN STUDY

By
Dulbahri*

ABSTRACT

This paper discusses the SPOT simulation performances with Toulouse area as an example. An overflight of the Toulouse area was made; resampling of 10 m and 20 m resolution combining with XS1 and XS2 in the creation of the simulation image was used in an effort to study Toulouse urban area. Manual interpretation without fieldchecks is used in this study. Toulouse urban land use can be distringuished and is easily delineated. Based on spectral characteristics, roof reflectance, road pattern, texture, and shape analysis the relative urbanization can be known. The relative network density can be measured so that the building and population density can be estimated using the SPOT simulation image.

INTRODUCTION

Over the last few years urban planners and managers have paid close attention to the progress achieved in satellite-based remote sensing in their attempt to evaluate the extent to which space imagery can replace or complement their conventional means of investigation based on aerial and ground surveys. Remote sensing imagery is used for a synoptic overview to obtain orientation and familiarization with spatial and environmental context in the urban area.

Studies performed with Landsat MSS imagery have shown several

* Drs. Dulbahri is Senior Lecturer in Remote Sensing at the Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia.

limitations inherent in such a system, in particular a too large instantaneous field of view, and consequently, a relatively coarse spatial resolution. Another kind of satellite was launched by France on February 23, 1986. This satellite is named SPOT with 10 m and 20 m resolutions. SPOT is mainly characterized by (i) a high spatial resolution, 10 m in the panchromatic mode and 20 m in the multispectral mode (bands XS1, XS2, and XS3), (ii) an off-nadir viewing feasibility which facilitate stereoscopic effect, resulting three dimensional view, (iii) a high temporal reflectivity 2.5 days at 45° latitude and 3.7 days at the equator, and (iv) large-sized images, 60 km x 60 km.

To get efficient work with the SPOT imagery in the future, France has designed and made some simulations. The simulations similar to the SPOT characteristics were designed. The simulation of SPOT took place in several areas, e.g.: Dakar (Senegal), Niamy (Niger), Paris (France), Thailand, and several areas in Europe. Studies on the SPOT simulation for several cities were carried out to learn the capability of SPOT data. Using the SPOT simulation, the structural aspect of the road pattern corresponds fairly closely to the map to a sampling in 10 m (Balluth *et al.*, 1982). Road patterns and information of blocks between streets can be seen clearly on the SPOT simulation. As compared to MSS with 80 m x 80 m resolution, the SPOT with spatial resolution of 10 m and 20 m should be much more suitable for land use identification and mapping especially for heterogeneous land use area. The use of 10 m resolution in panchromatic mode and 20 m in the multispectral bands (XS2 and XS3) will enable many applications and researches in several fields. (Gastellu-Etchegorry, 1985).

AIM OF THE STUDY

The aim of the study on land use of Toulouse area is to show the ability and the usefulness of 10 m and 20 m spatial resolutions of the SPOT satellite imagery in the urban study. The study has been made by visual interpretation of SPOT simulation without any direct field check. Checking was done by chance in 1982 when the author was in Toulouse for two months.

The data for, this study were taken from SPOT simulation image of Toulouse, France with a scale of 1:20,000, which was produced by radiometric simulation. The data were made in 1981 by combining 10 m panchromatic channel resolution with XS1 and XS2 of 20 m resolution, and resample at 10 m interval. The image scale is 1:20,000.

INTERPRETATION AND ANALYSIS

Based on the SPOT simulation image characteristics, the urban land use of Toulouse can be clearly detected. The SPOT can be used for general study of urban area, while the main characteristics of the major roads, thoroughfares, and natural water ways can be shown. The locations and type of newly developed areas as well as town and country relationship can be clearly detected. The roof material can be distinguished in bried. A general description of some landscape units is given here. Cement or asphalt is bluish white; tiles are yellow or greenish. Based on the characteristics, the old town centre with its buildings of high density can be readily distinguished by greenish colour and overall rounded shape. The greenish colour of the old town centre is due to the old roof tiles.

The new residential suburbs can be easily detected by their yellow colour. The texture of newly developed areas is different from that of the old town. Indeed, the residential suburbs consist essentially of detached houses and small apartment blocks, particularly in the southern part of the built-up area, i.e. groups of small, mostly rectangular, geometrical shapes. The vegetation cover can be easily identified, e.g. the Grand Boulevard with old ring roads circling the Grand Boulevard. The Grand Boulevard is red. Almost all waterways can be detected and the main river and small canal can be traced on the SPOT simulation. The Canal du Midi with an average width of 10 m is clearly visible.

Airport runways are also clearly visible. The small runways with the threshold marking are visible and give good indication of the image resolution. The main airport of Toulouse (Blagnac) can be easily detected.

By using spectral analysis on the SPOT simulation, the small object and landscape with just nearly half an hectare can be distinguished. Based on the spectral analysis the differentiation of the land use of Toulouse area can be easily accomplished.

The land use of such an area, which is also the case for many areas, is the basis of its economic and cultural structure. Land use phenomena in the city, such as the inventory of the available central district and the vacancy rate of buildings are related to the activities which go on in the city.

The function of any area of Toulouse is not so easy to detect on the SPOT simulation image, but some of the land use functions of Toulouse can be interpreted easily. Some of the land use functions in Toulouse can be classified as follows: (1) railway station, (2) woodland, (3) airport, (4) water bodies, (5) recreation area (stadium) (6) residential, (7) central business district, (8) industrial area, and (9) roads (Figure 1).

Using the shape, road pattern, roof reflectance, and texture, the relative period of urbanization of Toulouse can be traced. The oldest area can be detected

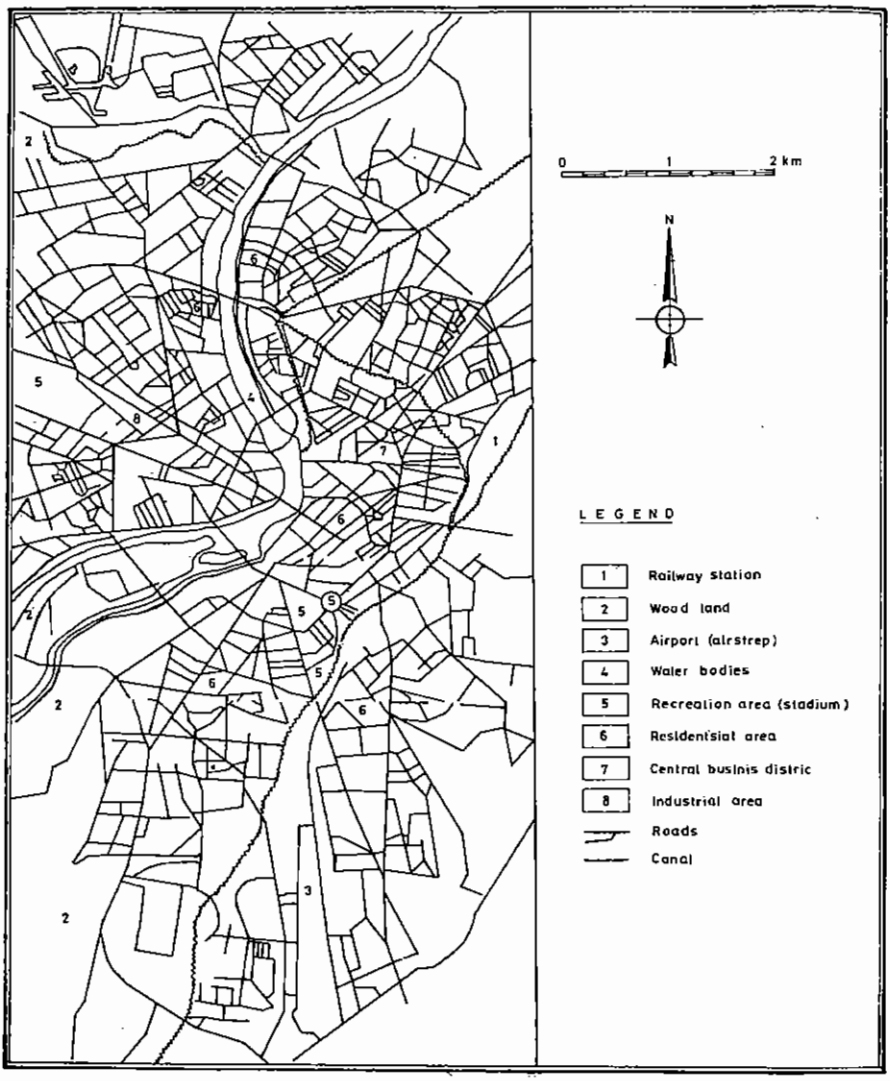

Figure 1. Toulouse Land Use Interpretative Map

and distinguished from the other phenomena. The oldest area is green in colour, very thinly covered by vegetation, and with rounded shape. The younger area looks yellow with relatively more vegetation cover. Based on the reflection of roof material, shape, texture, relative vegetation cover, roads density and pattern of the distinguished area, the urbanization stage of Toulouse can be easily classified.

The bridges, roads, streets, rivers, and canals can also be traced. Based on the spectral analysis, most of the streets and roads in Toulouse area can be detected so that the network densities can be measured and the figures of network densities can be used for urban morphology analysis. Futhermore, the network density can be used to detect the densely populated area. In general, the spatial distributions and environmental context in an urban area can be identified and analysed on the SPOT simulation image.

CONCLUSION

As the SPOT satellite has been launched, the ability of the SPOT satellite can be understood. It is obvious that SPOT imagery will soon be of a higher degree of interest as a conventional tool to monitor the land use changes, farmland decreases for built-up use, the location and extent of new dwellings.

Based on the SPOT image analysis, some conclusions can be drawn:

1. The high resolution of the SPOT is useful for land use identification, especially in the heterogeneous land use area.
2. Roof material can be identified.
3. The periods of urbanization of cities can be traced.
4. The communication network density is observable and can be measured.

ACKNOWLEDGEMENT

The author would like to acknowledge the advice, assistance, and help provided by Dr. J.P. Gastellu-Etchegorry, Dr. J.M. Fox, and Prof. Dr. Sutanto, PUSPICS staff members.

REFERENCES

Balluth and Laine D. 1982. *Urban Planning Land Use in a Large Metropolis Paris*. Toulouse: Toulouse SPOT Imagery Simulation GDTA.

Brachet G. 1984. *SPOT Newsletter*. December 15, 1984. Toulouse: ONES.

CNES. 1984. *SPOT Newsletter.* July 15, 1984. Toulous: CNES.

Gastellu E,J.P. 1985. A new Cartography with the SPOT Satellite. Paper presented at *Seminar on Cartography and Remote Sensing in Indonesia.* Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia.