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VEGETATION MAPPING FOR TROPICAL MARINE/COASTAL ZONE APPLICATIONS

CARTOGRAPHIE DE LA VEGETATION, APPLICATIONS AUX ZONES COTIERES ET MARINES TROPICALES

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ABSTRACT

Multispectral satellite imagery for tropical zones has been analysed to enable accurate thematic maps depicting vegetative cover at up to 1:100 000 scale to be derived from within a single thematic satellite scene. The key to success is a combination of care in the initial scene selection and the adoption of a rigourous botanical ground truthing methodology using an adequate number of "characterisation plots' within a mapping area.

RESUME

L'image multispectrale satellitaire appliquée aux zones tropicales, a été analysée afin de permettre une représentation pointue de la végétation par carte thématique jusqu'au 1/100 000 provenant d'une seule scène satellitaire.

La clé du succès est dans le soin apporté au choix de la scène initiale et l'adoption d'une méthodologie basée sur une vérité terrain-botanique rigoureuse et fiable. Cette méthodologie utilisera un nombre adéquate de "caractérisations de parcelles" selon une surface cartographiée.

INTRODUCTION

Defining the spatial relationships of plant communities by the process of vegetation mapping is often hampered by difficulties in defining the extent of those communities, since each is a product of the working map scale. The rational behind plant community mapping is discussed elsewhere (Gillison et al., 1981) ; however, it is important to recognise that plants are distributed spatially in response to particular sets of environmental circumstances. Another important concept for terrain analysis is that of vegetation as a "double-edged sword", meaning that it is both an essential component of the terrain, manifest as tree-trunks, a canopy, etc..., which contributes to the satellite image, and an indicator of environmental factors to which its existance in that terrain element is a response. Application of these concepts is integral to the process of inferring thematic implications from satellite imagery.

METHODOLOGY

Sensor

Readily available Landsat mapper (TM) and SPOT imagery has provided most satisfactory results at 1:100 000 scale and larger. LANDSAT Multispectral Scanner (MSS) is also satisfactory to 1:250 000 scale. No attempt is made herein to evaluate all of the assumptions upon which the acquisition and analysis of passive remote sensing imagery is based ; a comprehensive discussion of these assumptions is given by Duggin and Robinove, (1990).

Image Acquisition

A narrow temporal image acquisition window exists for tropical locations because of inundation and cloud cover during the wet season ; and large firescars, both natural and man-made, in the dry season which corrupts ground vegetation cover reflectance. By acquiring imagery at the end of the wet season the contribution of vegetative cover to the spectral reflectance data is maximised. A single cloud-free scene is desirable but mosaicking of multi-temporal scenes can be used providing other scene-change factors ; eg. firescar, are absent.

Ground Truthing

A basis for the ground truthing phase is provided by a false colour composite image, linear contrast stretched in each of the spectral reflectance bands and hard copied by ink-

jet of electrostatic plotting. This is then manually interpreted to identify consistent and repeatable terrain image patterns into which a number of characterisation-plots are located. In practice, the location of these plots is chosen subjectively, without preconceived bias, but ususally with some regard to accessibility and relocateability. At least 50 such plots are generally required in one map scene. Characterisation plots are accessed by helicopter, vehicle and occasionnaly on foot with emphasis on precise location. Each plot is marked out 20 metres square and field data logged including site location details, terrain data attributes, vegetative structure, life form and floristics in accordance with established classification systems, (eg. Specht, 1970). The site is also photographed for later reference.

Image Analysis

Imagery is processed using the supervised maximum-likelihood classification. Polygonal masking can be incorporated in the resultant thematic map to cater for infrastructure, urban areas and rural cropping and grazing areas, for example. The vegetation classification dataset comprising approximately 12 vegetation cover classes is usually smoothed by 3x3 median filtering, warped to UTM coordinates and ink-jet overlayed directly on to a basin planimetric mapsheet.

Map Production

Vegetation map products have been produced on various turn-key image processing systems ; principally the Macdonald Deetwiler Associates (MDA) Meridian at the South Australian Centre for Remote-Sensing (SACRS) which produces a high standard of final map product through a modified Applicon ink-jet plotter. This process produces a master copy from which others can be cheaply reproduced photographically. We also use an AMIGA destop microcomputer system using A-Image software from Image Tech International with good results for "quick-look" products.

Validation

Vegetation/terrain verification is carried out using road and river transects and desirably by airborne overflights. From one such flight of 1 hr duration supplemented by 6 km of road transects in a tropical test area, overall accuracy of vegetation prediction from the classified spectral data was calculated at 78,5 % although accuracy varied among vegetation classes. The accuracy of prediction of vegetation structure was 92 %. These figures are considered entirely satisfactory and give confidence in the methodology for efficient vegetation mapping within a single satellite scene in tropical regions.

CONCLUSION

In hitherto unmapped areas the production of vegetation maps from satellite imagery at scales of 1:100 000 and 1:250 000 is an efficient process highly applicable to coastal-zone natural resource monitoring in tropical regions. The main ingredients for success include :

- Careful selection of cloud-free imagery immediately post-wet season and before extensive firescar has masked vegetative ground cover.

- Adequate botanical ground truthing including consistent structural classification.

- Adherance to established image classification techniques with image processing ideally being conducted by the participating field botanist.

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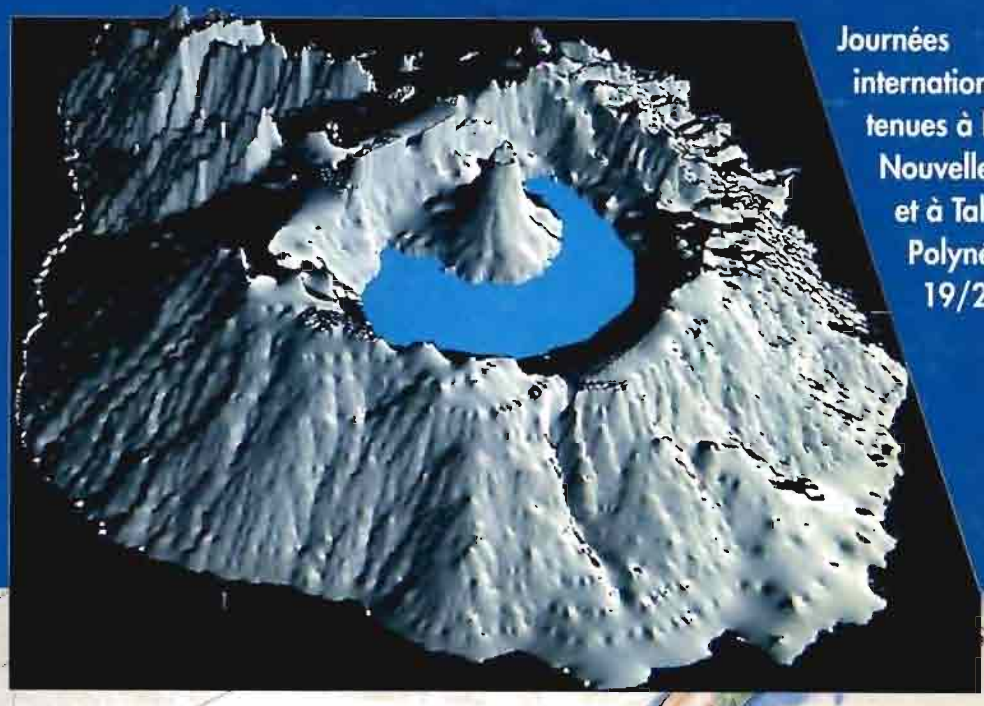

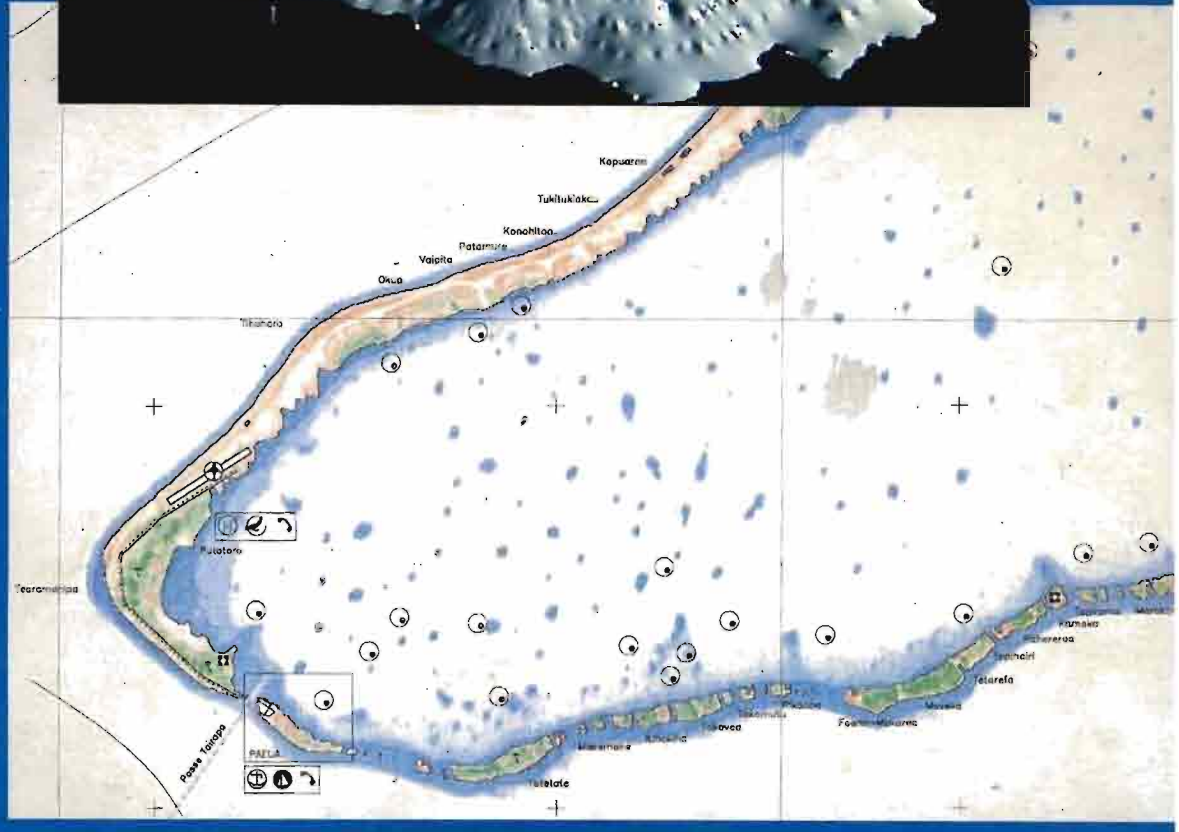

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