OBJECT-BASED IMAGE ANALYSIS FOR MESO-SCALE APPROACH: THE EXPERIENCE OF LANDCOVER MAPPING OF THE BRAZILIAN COASTAL RAINFOREST BIOME

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The Brazilian Coastal Rainforest is presently considered as one of the richest set of ecosystems of the planet in terms of biological diversity. Distributed over more than 23º of latitude (figure 1), this biome comprises a series of phytophysiognomies, that favored a significant environmental diversity and, in consequence, the evolution of a complex and highly rich biota (MMA - Ministry of the Environment - 1998).
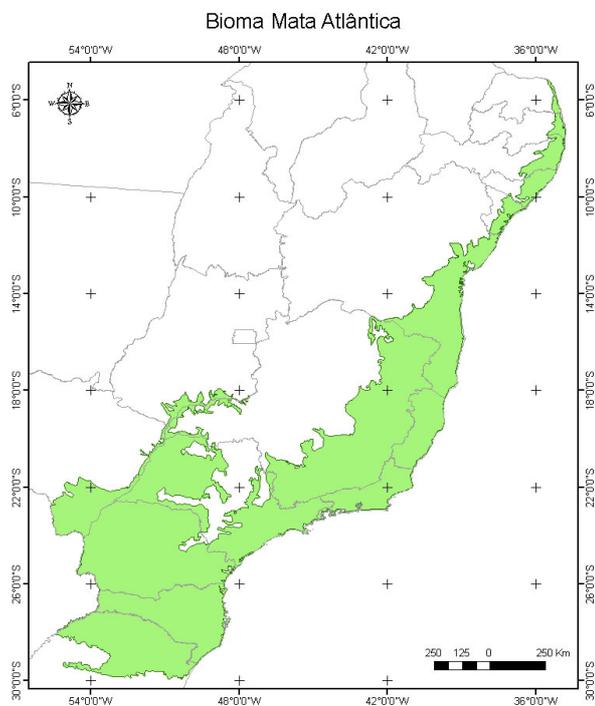

Figure 1 - Spatial Distribution of the Brazilian Coastal Rainforest Biome

This study is the result of an initiative by the PROBIO Project, for Preservation and Sustainable Use of the Brazilian Biological Diversity, sponsored by the Ministry of the Environment - MMA with the main objective to map, in meso-scale detail (1:250,000), of the remnants of the vegetation land cover of the biome "Mata Atlântica" (Coastal Rainforest).

Despite that the majority of the experiences in object-based analysis have been made with high-resolution images in urban applications (Antunes & Lingnau, 2005; De Pinho et. al., 2005; Frauman & Wolf, 2005); in the present work it was aimed at adapting that methodology to landcover mapping through the application of Landsat images. The eCognition® system allows handling of multiple resolution images, in addition to thematic data, such as, hypsometry, geomorphology, soils and vegetation; favoring the characterization and identification of different classes of vegetation covers.

The present work proposes to present the experiences obtained in the mapping of an area of vast spatial distribution that required processing of 96 ETM/Landsat scenes. To optimize digital processing, the scenes were grouped and equalized in mosaics following the framing system used by the International Millionth Map (figure 2), reducing this way the efforts directed to the editing process of the pages. The main difficulties were encountered in the generation of image sub-sets, distributed over a five-year timeframe (2000 to 2005), making the equalizing process more difficult.
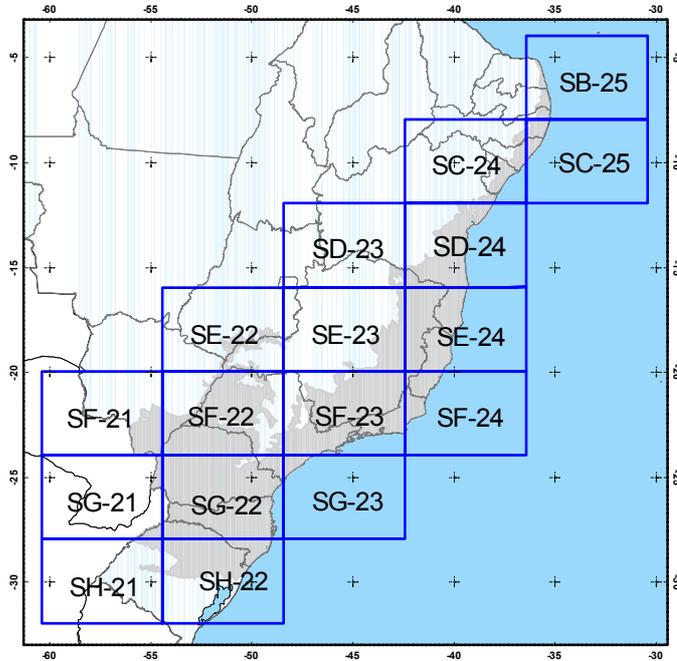

Figure 2. Sub-sets of ETM mosaics following the framing system used by International Millionth Map

A hierarchical vegetation classification system used by the Brazilian Geographical and Statistical Institute - IBGE was adopted, after being adjusted to the hierarchical structure of the image segmentation and definition of the characteristic features of the objects for each system subdivision. Thus, object-images were generated for different spatial units:

• first order, differentiating the main vegetation classes of the Coastal Rainforest and associated ecosystems (forest, mangroves, high-mountain grassland, etc.) and the anthropic covers (agriculture, anthropic field, urban and reforestation areas).
• second order corresponding to forest sub-classes (ombrophilous, seasonal).
• third order containing the physiognomies (deciduous and semi-deciduous) and formations (alluvial, lowland, sub-mountainous, mountainous and high-mountainous).

The supervised classification was performed using a fuzzy model based on the spectral analysis of the target behavior, (training areas obtained on the ground) allowing grouping of similar objects. A top-down approach was used. The classes at the same hierarchical level were analyzed and characterized by different object features (descriptors), part of which were personalized through a construction mode available by eCognition.

Considering the results obtained, the descriptors that presented the best performance in class separation were included in the work. The hierarchy and grouping of classes were designed for three spatial approximations according to the structure of super-objects and sub-objects of the segmentation. In the first approximation, water bodies and shadows were discriminated. This decision allowed the later adoption of water as a class as one additional element for definition of other items of caption, as was the case of mangroves and marshes areas. Following, major groups were separated according to the density of the vegetation cover and intensity of the spectral response. That approximation practically responded for the first division between natural covers and their different uses, with exception of some types of cultures and pastures. In these two stages mainly spectral values (layer values), were used, such as mean and standard deviation of the bands (red, green, blue, near, medium and distant-medium infra-red), brightness, as well as some ratios between bands. Finally, position descriptors, as well as generic shape features and thematic features were used in the identification of all physiognomies of vegetation cover.

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