

# MONITORING OF CHRONOLOGICAL STAGES OF DEFORESTATION – AFFORESTATION: THE CASE OF SOUTHERN CHILE

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## ABSTRACT

Industrial forest plantation expansion is dramatically impacting the environment (biodiversity, soil, water, etc.) and social sphere. Since the enactment of Decree Law 701 (DL 701) in 1974 under the military government of Augusto Pinochet, forestry practices in Chile have become more intensive (genetic manipulation, high yield clearcutting and short rotation). The law (and its successive updates) covers up to 75% of plantation costs and is the keystone of pine and eucalyptus forest expansion. This paper presents a pluriannual detection model for monitoring and characterizing the high cutting frequency of these timber plantations. Thirteen Landsat and SPOT images taken between 1976 and 2008 are used and combined with ground data (oblique aerial photography, GPS field surveys and field sheets). A trichromatic composition is built from spectral information taken from a Red and Mid-Infrared (MIR) wavelength along a temporal gradient of 32 years. This multi-temporal on-screen visual interpretation has led to a dynamic interpretation grid which reflects forest management stages in direct relation with pine and eucalyptus crop cycles. The method was tested on various time-steps covering the entire time period on two spatial scales – local and regional. All the spatio-temporal results are conclusive and the model established by remote sensing is of operational value.

## KEYWORDS

Spatio-temporal modeling, change detection, forest management, environment, southern Chile, Landsat, SPOT

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## 1. INTRODUCTION

### 1.1. Industrial plantations and forest rotation

Use of satellite images appears to be particularly well suited to southern Chile, given the forest metamorphosis that has reigned there since 1974. Beginning with the “Decree Law 701” (D.L.701), enacted by General Pinochet shortly after his coup d'état (1973), southern Chile experienced a considerable extension in exotic forest plantation of pine and eucalyptus to the detriment of the native Valdivian forest. This widespread phenomenon developed unequally in both time and space. Begun south of the capital, Santiago de Chile, in the country's *del Bio-Bio* Region, also known as the 8<sup>th</sup> Region, surrounding the town of Concepcion, it spread inexorably southwards, reaching the 9<sup>th</sup> Region of *Araucania* near the town of Temuco, the 10<sup>th</sup> Region of *Los Lagos* surrounding Osorno, and the 14<sup>th</sup> Region of *Los Rios* surrounding Valdivia. Between 1975 and 2007 the average annual planted forest area (both planting and re-planting) on the national level was 95,141 hectares, to attain a total area of 2.2 million hectares in 2007 (INFOR, 2008).

The Chilean forest industry is, in fact, highly competitive on the international market. Exports of wood chips of *Eucalyptus globulus* went from 990,000 tons in 1998 to 1.5 million in 2003, to then surpass the level of 2.5 million tons in 2006 (INFOR, 2007). Exports of forest products were worth 4.9 billion dollars in 2007, 7.3% of Chile's exports. The impressive growth in forest product exports has shown the strength of the forestry sector and its economic potential for the future. In 1964 exports reached a level of around \$27 million, \$127 million in 1974, \$577 million in 1987 and \$2.3 billion in 2000. Forest exports grew by 27.3% during the period 2006-2007 and by 41.7% for the period 2005-2007 (INFOR, 2008). Increased production thus becomes a major objective as it allows businesses to be more competitive and to offer products at a lower cost through an economy of scale. Genetic manipulation