

Six Ramsar remote sensing case studies were developed in 2002 as part of the NASA Socioeconomic Data and Application Center's (SEDAC) Ramsar Wetlands Data Gateway, developed in support of the Ramsar Convention on Wetlands of International Importance. That web service has been discontinued but the case studies are available from the documentation page for SEDAC's Sea Level Rise Impacts on Ramsar Wetlands of International Importance, v1 (2000–2010) data set at <https://doi.org/10.7927/H4CC0XMD>

Argentina: Esteros del Ibera

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1. Introduction

The Lagunas y Esteros del Iberá is a Ramsar site that was designated on 18 January 2002. The site itself is 24,550 hectares in size, but the associated wetland complex covers more than 12,000 square kilometers, or one-seventh of the Argentine province of Corrientes. The Esteros is one of the last large wetland ecosystems in South America that has remained significantly unmodified by human activities. This inland rain- and groundwater-fed wetland is located between three large rivers, the Rio Paraná alto, the Rio Paraná medio and the Rio Uruguay. There is no surface connection to the rivers, with the exception of the outlet to the Rio Corrientes that feeds into the Parana Medio.

The wetland consists of a vast mosaic of marshes, swamps and lagoons, of which nearly 60 percent are permanently inundated. The interrelation between permanently and seasonally flooded wetland ecosystems supports a diversified community of wildlife typical of subtropical seasonal savannahs.

This remote sensing study was conducted for habitat mapping, wetland delineation, and to determine water optical quality and water quality. Funding for the study was provided by the European Commission's International Cooperation Fourth Framework Programme.

2. Methods and results

The study utilized a total of 40 images from Landsat TM and ETM, and SAC-C MMRS (an Argentine sensor), acquired between the dates of February 1998 and February 2002. A series of satellite image was used to determine a distribution of particular habitats and to analyze the changes in land use and characteristics over a 15 year period. These images were made available by the Argentine Commission on Space Activities (CONAE) as part of the SAC-C mission. Habitat definition was carried out using field data and a simulated SAC-C image (175 m. spatial resolution). The definition of habitats was based on homogeneous polygons which were defined in the field through the use of GPS data, field observations and location of vegetation censuses on a topographic map. Seven habitat types were defined, including permanent lagoons, open marsh areas (esteros), temporary marsh areas (malezales or bañados) and four types of consolidated floating mats of vegetation (embalsados). The examination of a temporal series of images demonstrated that significant changes have occurred inland use in the last two decades.

The SAC-C time series images were of great importance in the study of the distribution of vegetation and water characteristics of the wetland. Satellite data was also used to study the change in land use and the possible hydrological changes that have occurred in the wetland after the construction of the nearby hydroelectric facility (see Figure 1). Field measurements and satellite measured radiances were compared to examine the spatial and seasonal variation of the available habitat and the optical characteristics of the shallow lake water bodies. Furthermore, a land use classification of the border areas was made to determine the changes in land use and the wetland overall extension using satellite data. A long term monitoring plan was created through the continued collaboration with CONAE to continue to monitor the vegetation and water quality.

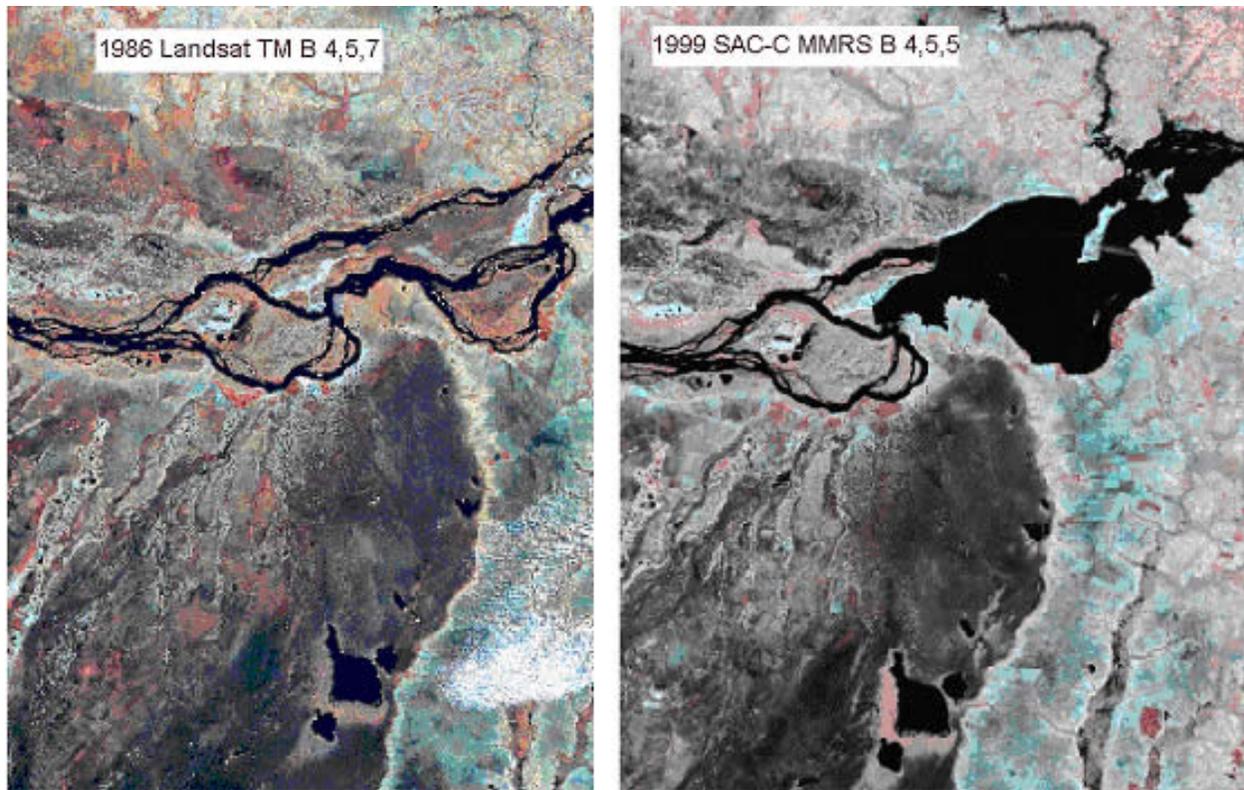


Figure 1 - The northern part of the Esteros del Ibera wetland, with the Parana river to the north. The two dates (1986 at left, and 1999 at right) show the impact of the construction of the Yacyreta Hydroelectric facility on the Parana river and the creation of the large artificial reservoir, directly above the wetland.

For the water quality monitoring, standard correction techniques (including dark pixel) were used to obtain reflectances, these were correlated to onsite measurements of water optical properties. This information was then tested and extended to other parts of the wetland. The time series data showed seasonal variations in water quality, which demonstrated hydrological impacts of small rivers on the wetland (Figure 2). This analysis helped to establish general observations on the possible influences of agricultural activities on the water quality.

The remotely sensed data were also combined in a GIS with land use maps, ecological data related to key species, and limnological data on water quality. The imagery helped to show the extent and characteristics of an extensive wetland area to local and regional audiences. Finally, the data were used for various modeling purposes.

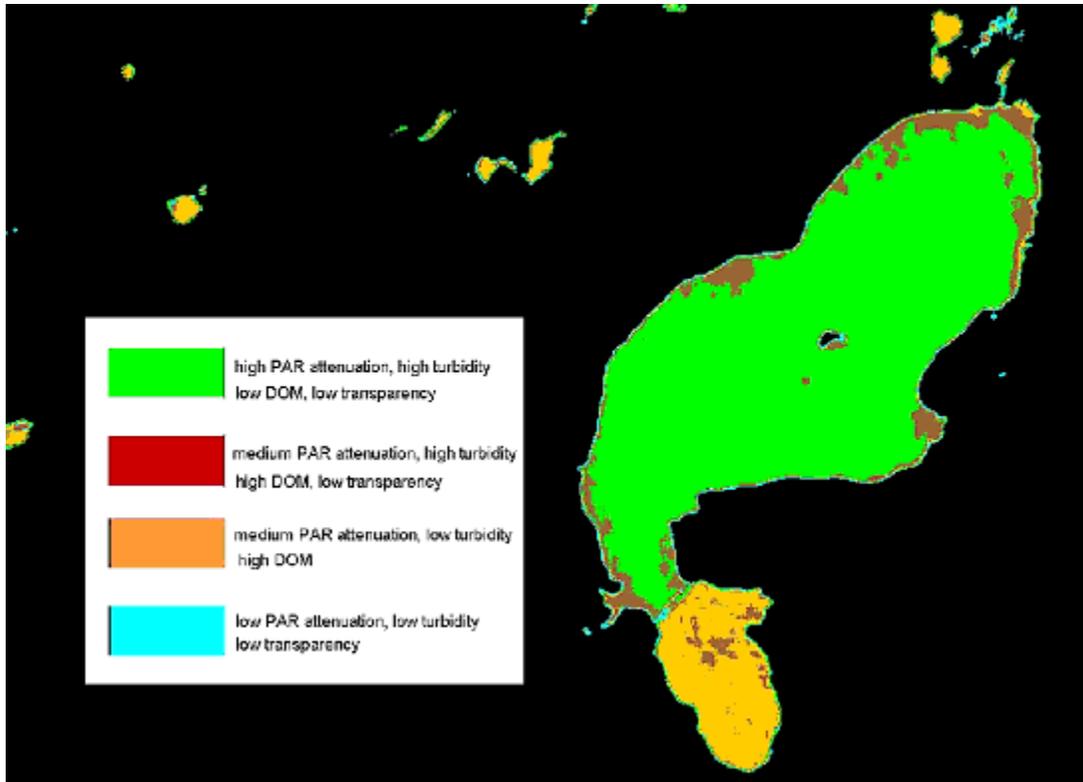


Figure 2 - Spatial variation of optical water quality parameters based on reflectance based algorithms (ETM) for a single date in November 2001. The study lake is the Laguna Ibera, in the Esteros del Ibera wetland, Corrientes Argentina. Four classes of water are characterized based on a knowledge-based classification using transparency, turbidity, attenuation coefficient for photosynthetic available radiation (PAR) and dissolved organic matter concentrations. Vegetated wetland areas and agricultural areas have been masked out.

3. Conclusions

Due to the extensive nature and remoteness of the Esteros del Ibera wetland, remote sensing techniques were found to be fundamental in the study of the wetland, in particular the vegetation and water characteristics and their spatial distribution. By the same token, however, ground truthing over a significant part of the wetland area was nearly impossible, due to its remoteness and lack of infrastructure.

The Esteros del Ibera are continuing to be monitored as part of a long term monitoring project, in collaboration with the Argentine Space Agency. More information is available through the above-referenced web site.