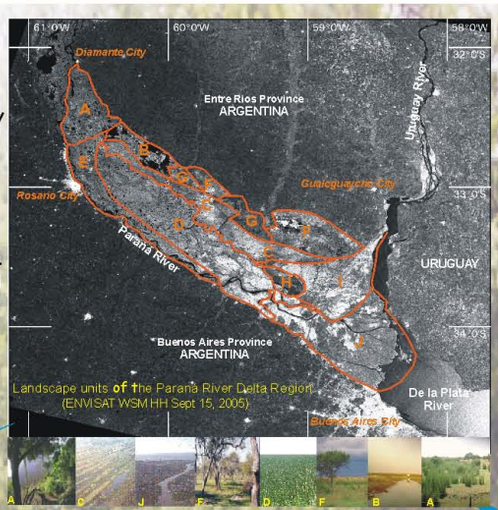
Multiscale-multisensor approach in studying wetlands of the Paraná River Delta Region in Argentina.

P. Kandus[(1)], H. Karszenbaum[(2)], M. Salvia[(2)], G. Gonzalez Trilla[(1)], P. Pratolongo[(1)], F. M. Grings[(2)], L. Zoffoli[(1)], P. Ferrazzoli[(3)]

(1) Universidad de Buenos Aires Facultad de Ciencias Exactas y Naturales (FCEyN), Dpto. de Ecología, Genética y Evolución , Laboratorio de Ecología Regional, Grupo de Investigaciones sobre Ecología de Humedales, Ciudad Universitaria, Pab. II, (1428) Buenos Aires, República Argentina
(2) Instituto de Astronomía y Física del Espacio (IAFE), Ciudad Universitaria, (1428) Buenos Aires, República Argentina.
(3) Università di Roma "Tor Vergata", Facoltà di Ingegneria, Dipartimento di Informatica, Sistemi e Produzione (DISP), Via del Politecnico 1, 00133 Roma, Italia
pato@ege.fcen.uba.ar *http://www.ege.fcen.uba.ar/gieh; http://www.teledeteccion.com.ar*

General Features of Paraná River Delta Region

The Paraná River Delta Region PRDR stretches through the final 300 km of the Paraná basin, close to Buenos Aires city in Argentina. It covers 17,500 km2 . The Paraná river drains an approximate area of 2,310,000 km^2 and is the second most important in South America. Among the great rivers throughout the world, it is the only one that flows from tropical latitudes to temperate zones, where it converges with the Uruguay river into the Del Plata estuary. The PRDR is a complex flood plain having biogeographic and ecological unique characteristics. Species of subtropical lineage (Chaco and rain forest regions) penetrate, and coexist in this region with other species from the neighbouring temperate plains. The region has a subhumid temperate-subtropical climate with rainfalls throughout the whole year (1000 mm/year). The mean annual temperature is approx. 18 °C – 16.7 °C.



Landscape units of the Paraná River Delta Region (ENVISAT WSM HH Sept 15, 2005)

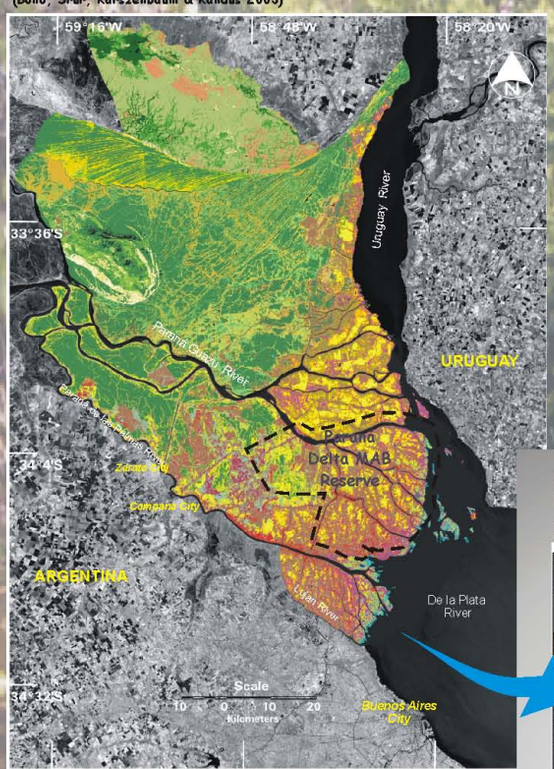
The Region as a complex mosaic of wetlands

The high landscape heterogeneity is derived from combination of the geomorphologic setting and the hydrologic regime which entails a complex of different plant and animal communities that result in a high ecological diversity. Malvarez (1997) defined 9 landscape units (WLU) that are clearly identified and limited in the ENVISAT WSM image (left). To a great extent, landscape patterns are determined by littoral deposits derived from marine ingression and regresión processes that occurred in the Mid-Holocene (around 5,000 years BP) plus past and present fluvial and deltaic phases. On the other hand, local rainfall, the seasonal regime of the Paraná and Uruguay rivers, and moon and wind tides of Del Plata estuary differentially affect individual areas.

Landscape Unit	Geomorphic features	Hydrologic Regime	Vegetation
A	past and actual fluvial	Paraná River	forest/grasslands
B	past and actual fluvial	Paraná River	marshes/open water
C	old marine sandy ridges	Paraná River	riparian forests
D	old tidal plain	Paraná River	mixed herbaceous
E	actual Paraná fluvial plain	Paraná River	forest/marshes
F	old littoral lagoon	Local rain	open forest/grasslands/marshes
G	non active deltas	Paraná River	grasslands/shrublands
H	predeltaic island	Paraná River	grasslands
I	old marine ridges (cheniers)	Paraná and Uruguay River	forest/grasslands/marshes
J	active delta plain	Del Plata estuary	dense forests/marshes

Detailed land cover maps of wetlands produced for the Lower Delta region

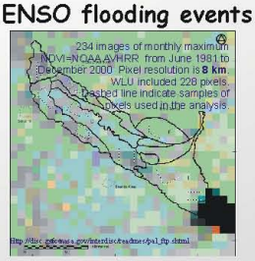
(Bono, Srur, Karszenbaum & Kandus 2003)



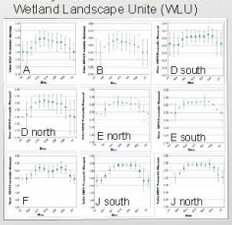
- wet grassland
- grassland
- psamophitic grassland
- sand dune
- Panicum milioides grassland
- baldspot
- grassland
- aquatic plants prairie (1)
- aquatic plant prairie (2)
- Junco marsh mosaic
- prairie of mixed herbaceous plants
- junco marsh
- bars of sediments
- open water
- algerrobo and espinillo forest
- grassland with espinillo trees
- cortadera marsh
- marsh with woofy plants
- ceibo forest
- abandoned afforestation
- willow plantation
- poplar plantation
- man made
- burned areas
- secondary succession forest
- mosaic of grasslands and marshes
- mosaic of grasslands and shrublands
- mosaic of grasslands

The land cover map was performed through a sequential classification of six Landsat Thematic images. Images were selected according their acquisition date and flood condition. 28 land cover classes were obtained (accuracy assessment of around 83%). It was based on recorded field data, assuming that landscape heterogeneity derives from geomorphic setting, hydrologic regime, and human intervention. Vegetation and soil characteristics were the primary variables determining spectral signature of each landcover type.

Temporal pattern of Normalized Vegetation Index (NDVI) NOAA-AVHRR time series from the last two decades. Analysis of WLU functioning and the influence of the ENSO flooding events. (Zoffoli, Kandus, Madanes 2006)

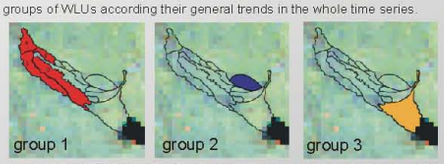


Monthly mean NDVI AVHRR in each Wetland Landscape Unite (WLU)



All WLUs show similar NDVI mean annual maximum, minimum and trends describing annual vegetative cycle. Standard deviations (sd) indicate WLUs inter-annual variablity. Southernmost WLUs (E south, F, J) present less *sd* than the units in the north and central portion of the region.

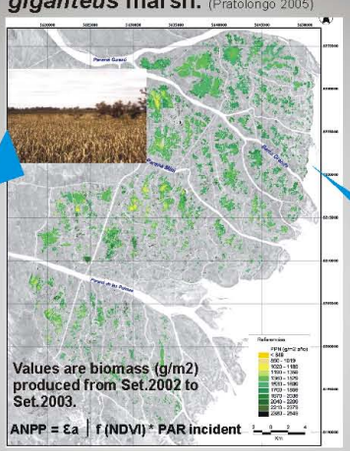
Pearson Correlation Coefficient indicates differences between three main groups of WLUs according their general trends in the whole time series.



Autocorrelation Coefficient (AC) also shows differences between three main groups of WLUs. In addition AC suggests that
1) the 1983 ENSO event was the only one with significant impact, particularly on WLUs group 1. Other ENSO events did not differ from common hidrologic pulses.
2) the ENSO '83 had less impact in portions of WLUs more connected with the main streams (E, D south), than in WLUs unnconected (B, D north)
3) WLUs more affected by ENSO '83 recover their annual trend several years after.

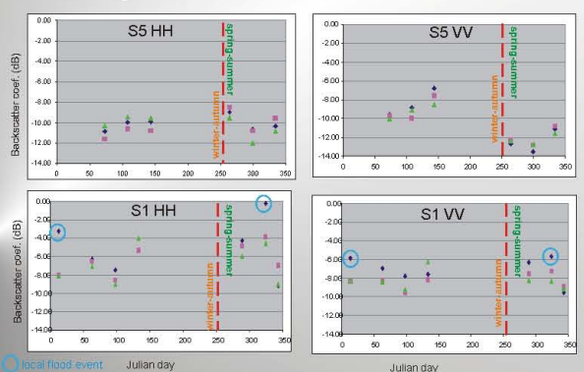
In spite of the coarse spatial resolution, long term NDVI-NOAA AVHRR seems to be a powerful tool that gives information on temporal behaviour of wetland ecosystem functioning at regional scale. Some WLUs are coincident with a particular long term NDVI functional pattern, though others may show several ones.

Aboveground Net Primary Production (ANPP) of *Scirpus giganteus* marsh. (Pratolongo 2005)



S. giganteus marsh covers more than 40% of the Lower Delta surface showing a net aboveground primary production (ANPP) of 1514.12 ± 305.11g m^{-2} year^{-1} (C.V.=20%). ANPP field measurements were calibrated with NDVI derived from Landsat ETM+ surface reflectance time series data resulting in the first map of ANPP for the delta marshes.
S giganteus ANPP seems to be sensitive to environment when changes in hydrologic condition occurs (Pratolongo, Kandus and Brinson, submitted).

Monitoring *S. giganteus* marshes using ENVISAT ASAR data



Standard 5 VV images show differences in backscatter coefficient in *S giganteus* marshes between winter-autumn and spring-summer dates.Canopy attenuation can be responsible for them.
Standard 1 HH signal has less interaction with leaves thus images are able to detect under-canopy flood events. Standard 1 (HH AND VV) mode does not recall differences between season conditions as well as Standard 5 does not tell apart presence of water above the substrate

The results presented in this poster were produced during the last six years under a multisensor and field work integrative approach, in order to understand the multiscale structure and functioning of wetland ecosystems on the Paraná River Delta Region. The high heterogeneity in terms of wetlands structure and functioning is an advantage of this region when the interests are focussed on the comparisson of ecosystem features and the contribution of different sensors to this goal. Forthcoming efforts will focuss in the direction of intensifying fielwork and continuing the development of multiscale-multisensor remote sensing procedures for wetland classification and monitoring ecosystem health and process.