

## **HICO Data User's Proposal**

### **Hyperspectral remote sensing of water quality in Paranaguá Bay, southern Brazil.**

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#### **Abstract/project summary**

The spatial distribution of the water quality properties in the Paranaguá Estuarine Complex (PEC), south-eastern Brazil, is still little known in different time scales of the forcing. In this study our objective is to take advantage of the higher spatial and spectral resolution of HICO data and the ability to obtain images at different times of day. Our approach is to evaluate the distribution and variability of water quality properties during different conditions of tide and freshwater discharge (summer-winter). The water quality parameters (temperature, salinity, oxygen concentration, turbidity (scattering), Chlorophyll-a fluorescence, pH, coloured dissolved organic matter (CDOM) and other algal pigments (phycoerythrin, phycocyanin)) will be measured, along the PEC, biweekly during six months using a continuous flow-through shipboard instrument suite (pocketFerryBox). This study will describe the spatial distributions of the bio-optical and physical water quality parameters and their interaction in this unique estuary-shelf

regime. Additionally it will be used for calibration and validation of hydrodynamic, sediment transport and water quality models.

### **Statement of work**

The main objective of this study is the determination of the relative concentrations and variability of different water quality parameters (pigments, total suspended matter, depth light attenuation coefficient, colored dissolved organic matter (CDOM)) at the Paranaguá estuarine/coastal systems at different temporal scales (seasonal and tidal). Of particular interest is monitoring and estimating the source and fate of these parameters and the estuarine/coastal interactions (export to the coast).

### **Project description**

The continent-ocean interface is composed of a mosaic of environments with specific processes of transport and deposition associated with the hydrodynamic conditions that reflect directly on the different biotic and abiotic compartments.

The Paranaguá Estuarine Complex (PEC), located in south-eastern Brazil, is a large interconnected subtropical estuarine system, comprising two main water bodies, with a watershed area 3870 km<sup>2</sup>, water body area (without wetlands) 551.8 km<sup>2</sup>, vegetated flooded area 295.5 km<sup>2</sup>, drainage density 1.12 rivers/km<sup>2</sup> and tidal flat area 136 km<sup>2</sup>, this tidal flat area represents 24.6% of the water body area (Noernberg et al. 2006). The study area includes the largest continuous tract of Atlantic Rainforest in Brazil and several protected areas, which are part of the Core areas of the Mata Atlântica Biosphere Reserve, established in 1992. The system is connected to the open sea by three tidal channels. Mangrove swamps and marshes mainly fringe the interior of the system, while ocean exposed areas adjacent to the mouth are composed of extensive sand beaches and some rocky shores. The mean tidal range is 2.2 m, with a tidal prism of 1.34 km<sup>3</sup> and a tidal intrusion of 12.6 km. It is a partially mixed estuary with a residence time of 3.49 days and a mean fresh water runoff up to 200m<sup>3</sup>s<sup>-1</sup> (Lana, 2000).

The spatial distribution of the water quality properties in the PEC is still little known in different time scales of the forcing (tides, meteorological events, winter / summer). Time series of MODIS images have been used in the analysis of the estuarine plume on the inner shelf (Noernberg and Freitas, 2007; Angelotti, 2008). However, the coarse spatial resolution of MODIS and the morphological complexity of the PEC hinder this analysis in the estuarine area. In this study our objective is to take advantage of the higher spatial and spectral resolution of HICO data and the ability to obtain images at different times of day. Our approach is to evaluate the variability of water quality properties distribution in different conditions of tide and freshwater discharge (summer-winter).

Besides the ecological importance of determining the spatial distribution of the water quality parameters for analysis of the sources, sinks and estuary-shelf interaction, the surveys will also be important in the calibration and validation of hydrodynamic, sediment transport and water quality models that are being implemented in PEC (Mayerle et al., 2011 a,b).

## Schedule and Plans

Biweekly water quality field survey in Paranaguá Estuarine Complex (center coordinates 25° 30'S; 48° 25'W) (Figure 1) will start in August 2011 and will extend until February of 2012. Additional sampling will take place during combinations of clear sky and HICO overpass.

The water quality will be made using a pocketFerryBox (4H Jena) and the measured parameters are: temperature, salinity, oxygen concentration, turbidity (scattering), Chlorophyll-a fluorescence, pH, coloured dissolved organic matter (CDOM) and other algal pigments (phycoerythrin, phycocyanin). The pocketFerryBox is an automated monitoring systems that provides continuous measurements with a sampling frequency less than 2 minutes with easy adaptation to small boats (GPS, water intake, own pump).

MODIS algorithms will be applied to the HICO imagery to obtain the geophysical parameters (pigments, total suspended matter, light attenuation coefficient depth and colored dissolved organic matter (CDOM)). This also will permit the comparison of MODIS and HICO data especially in the estuarine plume influence area.



Figure 1 – Paranaguá Estuarine Complex (PEC) and planned pocketFerryBox transect.

## **Personnel**

Mauricio A. Noernberg will lead this work. The weekly water quality sampling is in collaboration with Byanka Mizerkowski from UFPR Byanka and Friedhelm Schroeder and Wilhelm Petersen from the Institute of Coastal Research / Helmholtz Center Geesthacht (HZG). The HICO images processing is in collaboration with Richard W. Gould from United State Naval Research Laboratory and Bruno Moreira from UFPR.

## **Facilities**

The Coastal Oceanography and Remote Sensing Laboratory at the Center for Marine Studies in Pontal do Paraná, southeast Brazil, has 4 computer workstation for image processing using IDL/ENVI, Geomatica and SeaDAS software, 4TB raid storage, and a wide variety of field and laboratory equipment for oceanographic measurements, meteorological station and pocketFerryBox. The laboratory has dedicated use of a 21.5' open boat for access to the field.

## **Deliverables**

- 1) Validation of HICO standard data products for the Paranaguá Estuarine Complex and coastal adjacent area.
- 2) Yearly participation in HICO Data Team Meetings.

## **References**

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