# HICO Data User's Proposal

**Title:** Use of HICO Imagery for Monitoring Water's Biogeochemical Constituents of an Aquaculture area in a Tropical Reservoir

**Study Area:** Furnas Reservoir, Guapé, MG, Brazil

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**Abstract**

Inland water quality assessment using remote sensing techniques has become one of the main challenges among remote sensing scientists. Several studies have developed bio-optical algorithms for satellite hyperspectral and multispectral sensors such as Hyperion, MEdium Resolution Imaging Spectrometer (MERIS) and Moderate-Resolution Imaging Spectroradiometer (MODIS). These algorithms use specific spectral ranges that correspond to a determined biogeochemical component. This project will investigate the higher spectral resolution of HICO imagery for biogeochemical components assessment of inland waters in Furnas Reservoir, Brazil. Routine ground-based sampling efforts by "Furnas Project" will provide calibration data for the biogeochemical components. Best-fit relationships will be developed between these in situ data, proximal remote sensing data and HICO's L2 data. Finally, this project will investigate the use of HICO's level 2 products for more comprehensive water quality assessment on aquaculture sites in a tropical reservoir.

**Background, Objective and Approach**

According to the Global Aquaculture Production Statistics for the year 2011 from the FAO Fisheries and Aquaculture Department [1] world aquaculture production of food fish reached 62.7 million tons in 2011, up by 6.2% from 59 million tons in 2010. Brazilian aquaculture production was 149,910 ton in the same period and reached the top 12 aquaculture producers. One of the main contributors for this increasing in the Brazilian aquaculture production was the establishment of a new policy for the use of Federal inland waters for aquaculture purposes. To guarantee a minimum environmental impact of these activities, the Brazilian Ministry of Fishery and Aquaculture was commissioned for setting up the necessary protocols for environmental monitoring of the aquaculture parks on reservoirs.

Furnas Reservoir (Figure 1), located in the state of Minas Gerais in the Brazilian Southeast Region, is the study site of a project which aims to monitor and evaluate the impacts of aquaculture on the reservoir. One of the main tool for this monitoring is the use of an autonomous system to collect in-lake meteorological and limnological data. This autonomous system is called 'SIMA'

(Integrated System for Environmental Monitoring) and consists of a set of hardware and software designed for meteorological and limnological data acquisition at near real-time [2]. It is composed of an independent system, consisting of a buoy moored within the Furnas Reservoir containing a fixed payload. The meteorological sensors are fixed 3 m above the water surface while the limnological sensors are fixed 0.5 m below the water surface. The SIMA moored in Furnas Reservoir has also a coupled thermistor chain, that collects water temperature data. All the data are acquired at preprogrammed time intervals (hourly for the Furnas Reservoir) and are transmitted by satellites in quasi-real-time[3]. Additionally, we also have in Furnas Reservoir five auxiliary autonomous systems collecting and storing limnological data. Field campaigns for calibration of these systems and water quality and fish analysis are also conducted in the areas around the stations [4].

Figure 1 - Location of the Furnas Reservoir and SIMA and other auxiliary stations.
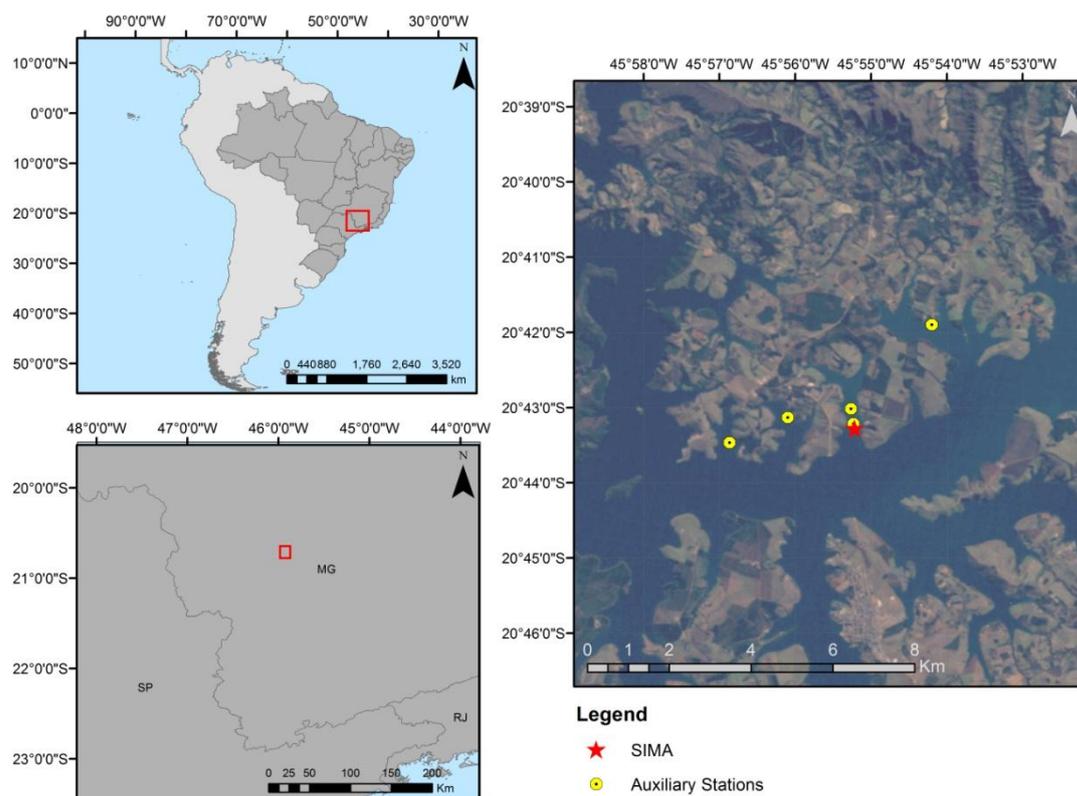


Satellite Remote Sensing has been used as a potential tool for environmental management. These techniques have been largely explored due to several advantages such as: (1) the synoptic view of the satellite images which allows

the user to retrieve information from the entire study site; (2) the acquisition of data from remotely access places; (3) the temporal resolution which can provide a historical dataset allowing the users to retrieve information from the past [5]. Therefore, remote sensing techniques have been used to facilitated the decision-making of environmental managers and policy makers.

Nevertheless, the use of remote sensing techniques to monitor inland waters is still a challenge. Under our FAPESP (Foundation for Research Support of the State of São Paulo) project (grant 2011/19523-8) we developed bio-optical algorithms for the estimation of biogeochemical parameters from tropical hydroelectric reservoirs in Brazil. However our studies were only based on proximal to hyperspectral remote sensing because of the lack of satellite sensors with an adequate spectral resolution for remote sensing of water quality studies.

Recent research have used HICO imagery to inland waters, Moses et al. [6] presented results that demonstrate the potential of HICO's near-infrared (NIR)–red models to estimate chlorophyll-*a* (chl-*a*) concentration. Their results demonstrate the utility of HICO imagery as a tool for determining water quality. Cho et al. [7] used HICO imagery to the differentiation between benthic habitats, particularly seagrass and macroalgae. They developed a slope algorithm using HICO and in situ data over the Indian River Lagoon, Florida, USA. The algorithm was able to distinguish between seagrass and macroalgae substrates more accurately compared to the results obtained using Iterative Self-Organizing Data Analysis Technique and Spectral Angle Mapping classification methods.

Thus the main goal of this project is to use Level 2 (L2) HICO's images to develop bio-optical algorithms to the aquaculture areas at Furnas Reservoir - Brazil.

**Facilities**

"Project Furnas" has a large network of collaborating groups which includes: Brazilian Agricultural Research Corporation, (EMBRAPA Environment), National Institute for Space Research (INPE), São Paulo's Agency for Agribusiness Technology (APTA), Minas Gerais Agriculture and Livestock Research

Company (EPAMIG), Minas Gerais State Technical Assistance and Rural Extension Enterprise (EMATER-MG), University of Campinas (UNICAMP), Federal University of Lavras (UFLA), University Center of Education Foundation Octávio Bastos (UNIFEOB), Faculty of Jaguariúna (FAJ), Pontifical Catholic University of Campinas (PUCCAMP), Federal University of São Carlos (UFSCar), Federal University of Alfenas (UNIFAL) and Brazilian Institute of Veterinary [4].

**Schedule and Plans**

To investigate the real potential of hyperspectral images to retrieve of water quality variables in an aquaculture area in the Furnas Reservoir, we propose the use of L2 HICO imagery. The L2 HICO imagery will be used to derive estimates of selected biogeochemical parameters for inland lakes. Initially, these parameters will include chlorophyll-a concentration, total suspended solids concentration and others optically active components. A forthcoming research project will be conducted to develop quasi-analytical algorithms utilizing the improved spectral characteristics of HICO to estimate inherent optical properties. Therefore we request the data acquisition for at least two dates during the year (one during the austral summer/autumn and one during austral winter/spring) representing dry an wet seasons for the study site.

Additionally to HICO imagery, field campaigns using RAMSES spectroradiometers and absorption coefficients analysis from water samples will be conducted to the development and validation of the models. It will also be used in this process with field data collected by a network of collaborating groups and agencies from the "Furnas Project " [4].

**References:**

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