Application of OLI images to improve the water supply management in large cities: the case of São Paulo Metropolitan Region

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Backgroud

* Along the last year the São Paulo Metropolitan Region (SPMR), Brazil, experienced one of the worst drinking water supply crises in its history;

* Among the causes of this crisis we can cite rainfall indices far below the climatological mean, low investments in the modernization of water supply systems during the last decade and the lack of and an efficient monitoring and forecasting system to predict the water storage;

* Our goal is to provide remote sensing-based tools and products to assist decision makers in Brazil to improve the water resources planning and management in large cities.

Study area - Cantareira System (CS)

* Responsible for supplying drinking water to about 9.4 million people;

* Formed by 5 reservoirs;

* Storage capacity = 978 million m³.

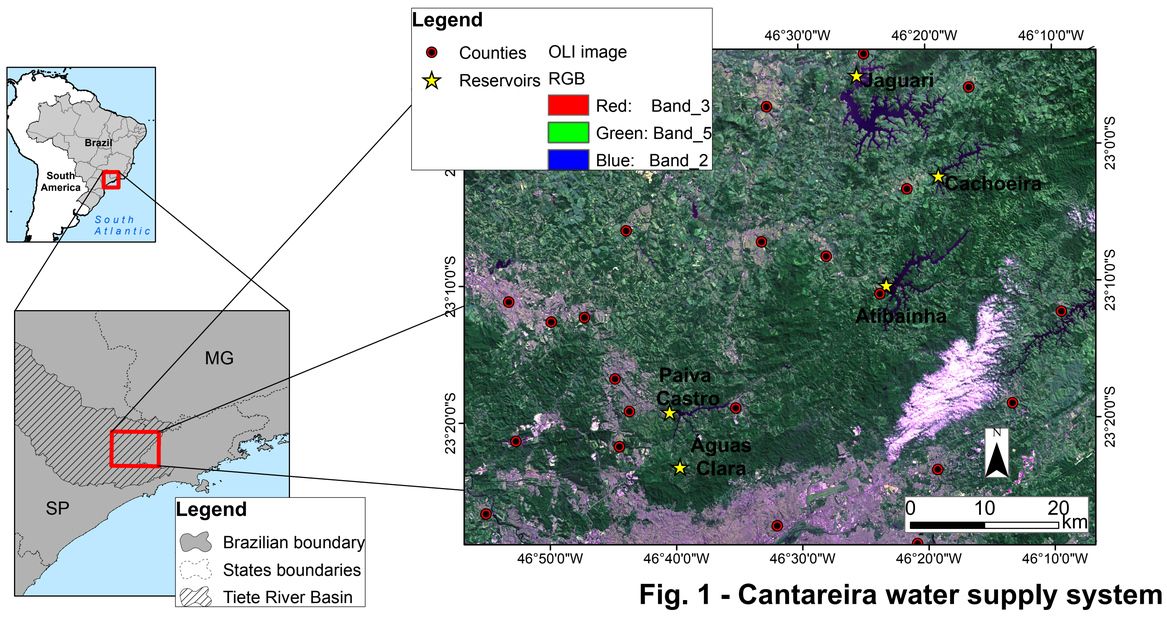

Fig. 1 - Cantareira water supply system

Material and Methods

Remote Sensing data:

* Landsat-8 - Operational Land Imager (OLI) data;

* 13 images acquired between 12 May 2013 and 3 Aug 2014;

* Path/row: 219/76

Operational data:

* CS water volume (%) provided daily by São Paulo State Sanitation Company (SABESP).

Methodological framework:

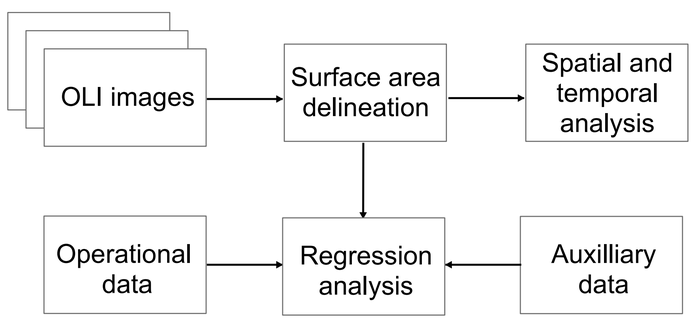

Fig. 2 - Data processing workflow

Preliminary results

* MNDWI provided the best results to delineate the reservoirs surface (RMSE < 5% of total area);

* CS reservoirs superficial area decreases ~36% (27 km²);

* Jaguari reservoir showed the highest decrease in the superficial area (~58%, 23 km²);

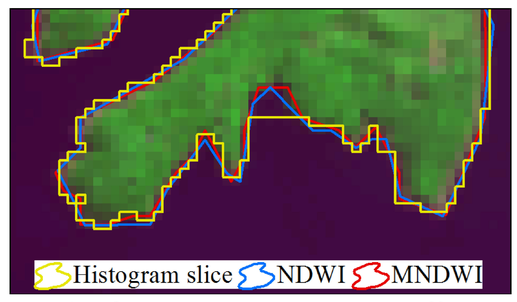

Fig.3 - Comparison between different methods tested to delineate the reservoirs surface.

* CS reservoirs superficial area showed a high correlation with the water volume in the CS ($R^2 > 0.95$);

* The preliminary adjusted model showed to be suitable to predict the stored water volume based on the CS superficial area (RMSE < 3%).

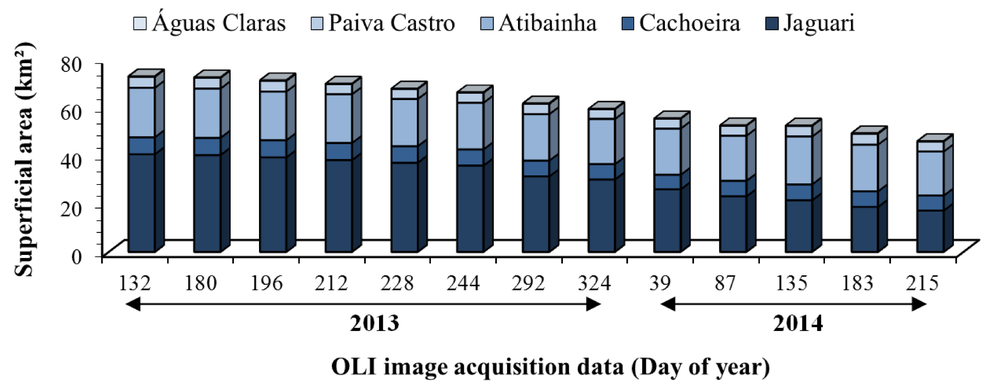

Fig.4 - Temporal dynamics of surface area of CS reservoirs

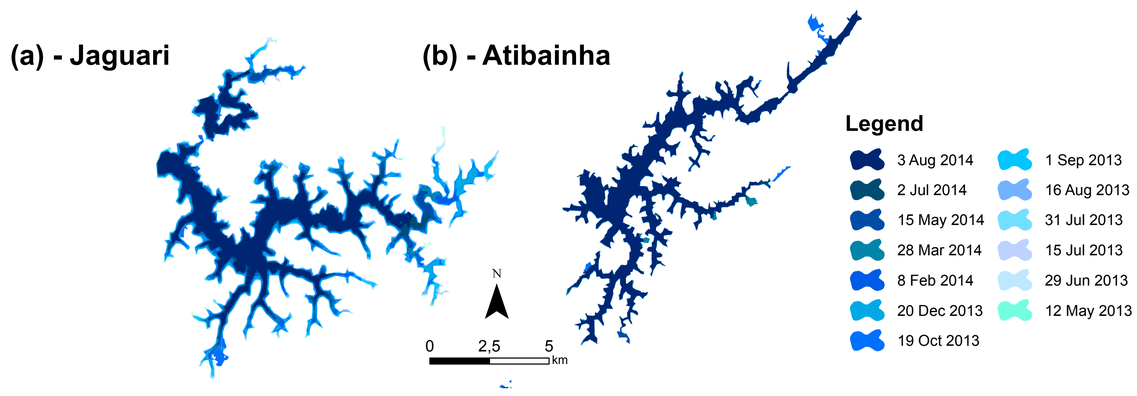

Fig.5 - Spatio-temporal dynamics of surface area (a) Jaguari reservoir and (b) Atibainha reservoir.

$$CS\_volume = 0.0147(CS\_area)^2 - 0.3473(CS\_area)$$

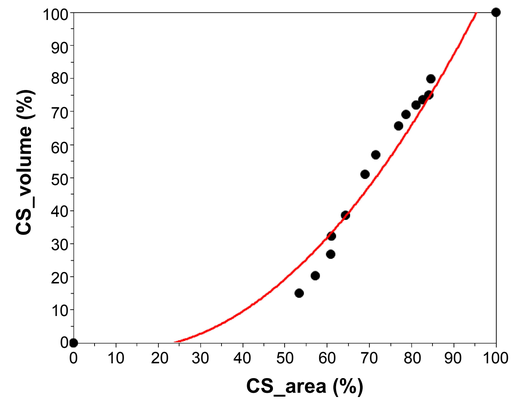

Fig.6 - Best fit model. Reservoir area X volume.

Conclusions and Future steps

* OLI images showed to be suitable to delineate the superficial area of CS reservoirs, allowing to understand the spatio-temporal dynamics of these water bodies and to identify the drought prone areas;

* In the future step, the time series of water superficial area and the auxiliary data will be used to generate a model to forecast the CS volume. We are also planning to develop a web based monitoring and forecast platform to provide the products for the public.