COMPARATIVE ANALYSIS OF THE SWAN NUMERICAL MODEL PREDICTIONS AND OF THE PRESSURE SENSOR MEASUREMENTS AT THE ILHA SOLTEIRA LAKE

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1. Introduction

The Ilha Solteira dam reservoir is located in the northwest of São Paulo state, Brazil and it has an extension of 100 km, Figure 1. As most reservoirs in the São Paulo state, it has multiple uses and it is part of the country waterways where important commercial navigation routes are established.

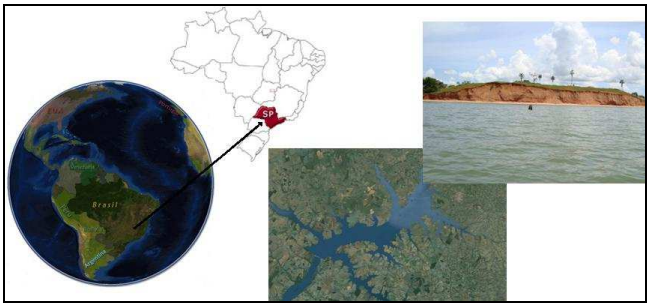
a)  b) 

Figure 1. a) Geographical position of Ilha Solteira lake dam. b) Installation of measuring equipment on the lake

Due the huge dimension of Ilha Solteira dam reservoir, wind generated waves can cause problems to the navigation security, to the stability of the river banks, to the infrastructures around the reservoir or even to public safety. Within this framework, a project code-named ONDISA (Ondas no lago de Ilha Solteira), UNESP (1997, 2008), is under way. This project aims to improve the understanding of hydrodynamics and morphodynamics inside Ilha Solteira dam reservoir. For that, an important aspect is the evaluation of the effects of wind generated waves on the lake margins and/or on the navigation security. So, field-data acquisition, processing and numerical modelling of wind-generated waves have being used to characterize the local wave climate.

An extensive field data campaign has been undertaken since January, 2010. Several instruments were deployed at different locations on the Ilha Solteira reservoir and on its margins to measure waves, currents and winds, Figura 1a. In spite of being very useful to describe local wave and current characteristics, these measurements are of too short duration to characterize the long-term wave climate. Besides, the spatial representation of the wave conditions provided by such measurements is very restricted, in addition to the high cost of equipment deployment, maintenance and monitoring.

So, the use of numerical modeling for wind wave generation, propagation and deformation can be an alternative since it can characterize spatially all the study region and it can be used to long term studies. Particularly, the use of spectral nonlinear model SWAN, Booij et al. 1999, a numerical model that takes into account the wave generation, propagation, attenuation phenomena and non linear interactions between waves and currents, is a good choice Anyway, the application of SWAN involves the establishment of a set of parameters, which must be calibrated for each case study. Therefore, it is interesting to apply the model to situations where data exists and to evaluate the model performance.

So, this paper presents a comparative analysis of the SWAN model numerical predictions with data measured by one of the equipment (sensor pressure) installed in the Ilha Solteira reservoir, in order

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to evaluate the model performance and to calibrate some of its parameters to this region. The analysis was made for the data measured on March 1, 2011.

2. In situ data and numerical model application

Several equipments (pressure sensors, anemometers and others) were installed at the Ilha Solteira reservoir to continuously measure wind and wave characteristics (Sobrinho et al., 2011). One group of those instruments was installed at a tree inside the lake, located at $20^0$20'49.07" latitude, longitude $51^0$18'17.63", Figure 1b. In fact, wind speed and direction are measured by a 2D sonic anemometer positioned at 1.2 m above water level. These data are transmitted, by telemetry, to a data bank in LH2 - Laboratory of Hydrology and Hydrometric UNESP – Campus of Ilha Solteira, Cunha et al. (2009). Wave data (wave heights and periods) are determined from the data measured with the Druck PDCR 1830 pressure sensor (for up to 50 psig, nonlinearity of 0.06% of full scale, equipped with cable feeding 150 m) positioned at 1.5 m below water level (a ventilation tube that provides the reference atmospheric pressure).

The application of the SWAN model to Ilha Solteira reservoir was made for the wind characteristics measured by the 2D sonic anemometer during the period between 0:00 and 24:00 h of March 1, 2010. The SWAN model computational domain was discretized through three rectangular grids, with one covering the whole area of the reservoir, as shown in Figure 2a. The larger mesh (global) has the dimensions 54km x 33km, and is composed of 1 km^2 units. The 2nd grid (nested) was defined with a resolution of 500 m, covering a rectangle of 26.6km x 18.4km. The 3rd grid (nested) was defined with a resolution of 250 m, covering a rectangle of 14.8km x 14.3km, **Error! Reference source not found.**. Numerical results, in terms of wave heights and periods, are obtained for the location of the equipments and are compared with in situ data, Figure 2b. The paper will present and discuss in detail the numerical application of the SWAN model and its comparison to in situ data.

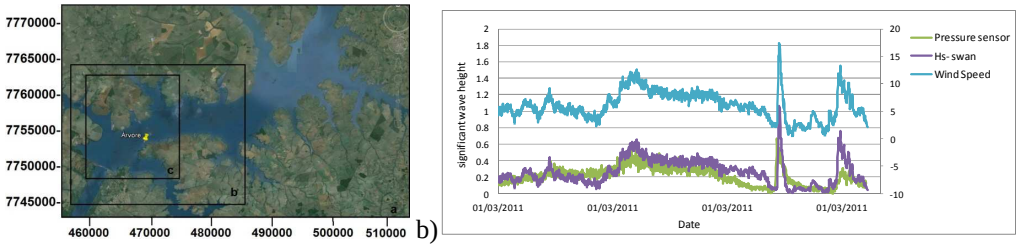

Figure 2: a)SWAN model: Domain and grids; b) Graphical representation of the significant wave heights on March 1, 2011 using the Swan and pressure sensor. The wind data are also shown in figure.

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