# Seasonal Variations of Flow Velocities and Suspended Sediment Concentrations in Lake Okeechobee

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## Introduction

The Lake Okeechobee Hydrodynamic Model (LOHM) has been developed to predict water circulation patterns. These circulation patterns are used as input to the Lake Okeechobee Water Quality Model (LOWQM), which predicts in-lake phosphorus concentrations. The accuracy of predicted circulation patterns directly affects the accuracy of predicted phosphorus concentrations. The LOHM has been calibrated for Lake Okeechobee using mild wind conditions and the model can reasonably simulates water surface elevations, velocities, and temperatures. However, the model may not be applicable to high wind events (winter or strong storm events), due to a lack of storm event data for model validation. To continue the effort of validating the LOHM, data collection of three-dimensional velocity field and temperature during the winter season or strong storm events is needed. Further validation will improve the model's ability to simulate circulation patterns and temperature distribution, will reduce the uncertainty in hydrodynamic modeling in Lake Okeechobee and will accordingly, provide more accurate hydrodynamic information to the LOWQM. It also will enhance the ability of the LOHM to predict the impacts of different management scenarios on lake circulation patterns.

In addition to water movement, the LOHM has a sediment transport module to simulate suspended sediment concentration (SSC) in the lake. Measuring suspended sediment concentrations will validate the model's ability of predicting sediment movement. This appears to be especially important in the south part of Lake Okeechobee, where transport of mud sediments from the central part of the lake may be threatening the viability of submerged aquatic vegetation because of reduced light levels.

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## Study Site

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Lake Okeechobee is a large, shallow subtropical lake located in south central Florida. The lake has a surface area of approximately 1750 $km^2$ and is very shallow, with mean and maximum depths of 2.7 and 5.5 m, respectively. The lake is connected to an extensive canal network by a variety of flow control structures. In addition to providing regional flood control, primary uses of the lake include agricultural water supply, drinking water supply for local municipalities, regional aquifer recharge, and alternative water supply for coastal urban areas with over 3.5 million people. Other uses are commercial and recreational fishing, navigation, and wildlife habitat.

## Data Collection

In this study, three-dimensional flow velocities, SSC, and temperature at four locations in Lake Okeechobee were measured in the period of six weeks from January 18 to March 5, 2000. The data collecting stations labeled as L001, L005, L006 and LZ40. The average water depths during the recording period at L001, L005, L006 and LZ40 are about 4 m , 3.2 m, 3.66 m , and 4.88 m, respectively.

As required to collect continuous data at a period of six weeks, instrumentation with data logger and automated data collecting capability was selected. We used Workhorse velocity profiler for three-dimensional velocity measurement, StowAway temperature logger with sensor for temperature measurement and OBS-3 sensor for SSC measurement. For the calibration of OBS-3 sensors and the verification of SSC data, water bottle samplers were also installed to collect water-sediment mixtures.

## Results

Based on the collected data, physical mechanisms affecting sediment suspension, current velocity and temperature in Lake Okeechobee are analyzed and discussed. The uniqueness of the data collection effort is that the current hydrodynamic and sediment data were recorded under strong wind events. Wind speeds are found to have strong correlation with SSC and surface velocities. Wind is demonstrated to be the dominant mechanism in transporting the suspended sediments and driving the current velocities. An example plot showing the time variations of recorded wind speed, wind stress and SSC at station L006 is presented in Fig. 1. Wind direction is also found to play an important role in affecting the SSC, typically at sites around the northeast and northwest of the lake. Frequently, the surface and bottom velocity components (along either south-north or west-east direction) flow in reversed direction, and result in the stratification and inversion of the SSC. Under strong wind events, in general, the SSC and water temperatures are well mixed. This study has provided valuable data under storm events and mechanism analyses, which will assist in better understanding of the transport of mud sediments, thermal exchanges, and flow patterns of the Lake Okeechobee.

## Acknowledgment

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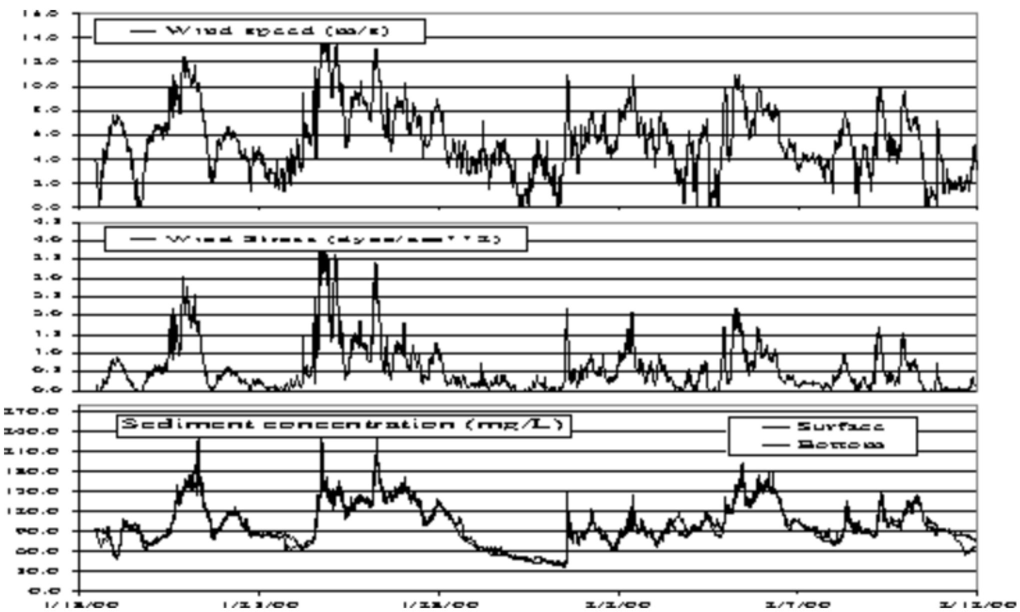

Fig. 1 Time variations of wind speed, wind stress, and SSC at station L006.

If you have any questions, please contact **Dr. C.Vipulanandan**