Availability of Geodetic Surveys by the U.S. Geological Survey in South Florida.

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INTRODUCTION

A new collaborative study, involving Florida International University (FIU), South Florida Water Management (SFWMD), U.S. Geological Survey (USGS), and the National Park Service (NPS), began in April 2014 in the mangrove lakes region of Everglades National Park (ENP). The purpose of the study is to gain an understanding of surface and ground water interactions as well as the water quality implications in a lake system lacking freshwater deliveries. The USGS was tasked to install a network of benchmarks in order to relate changes in surface and ground water levels to a common datum. Establishment of a benchmark network tied to a common datum (NAVD 88) improves the development of a water budget and computation of the residence times within the mangrove lakes region.

OBJECTIVES

1. Install a network of elevation benchmarks (BMs) and reference marks (RMs) at station locations throughout the mangrove lakes region.
2. Obtain NAVD 88 elevation for all BMs and RMs in the region.

STUDY AREA

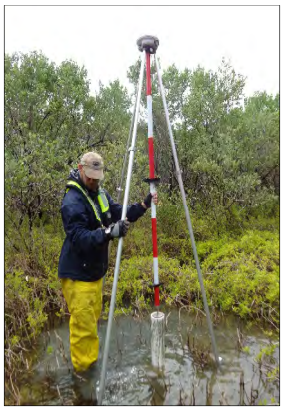
FIU = Florida International University, CLO = Cuthbert Lake Outlet.

METHODS

Level 1 Static GNSS Procedure

- Two static GNSS deployments conducted on different days at different times for a minimum of 4 hours each provides a geometric change in the satellite constellation and atmospheric variability, thereby eliminating bias and improving accuracy.
- GNSS units deployed on newly created benchmarks at the objective locations or at a temporary static observation point installed in the open water where the satellite signal would not be affected by interference form the mangrove canopy.

METHODS (Cont.)



Newly established benchmarks.

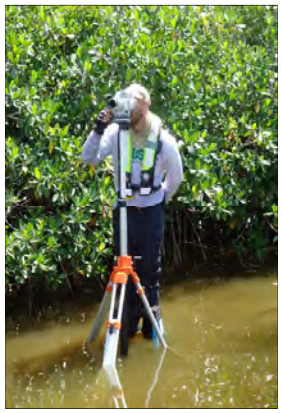
- GNSS deployment on a first order NGS monument located close the objective. Sites will be compared to the published NGS elevation as a quality assurance on the overall deployment.
- All GNSS session files submitted to the NGS Online Positioning User Service (OPUS) program for processing.

Temporary static open water observation points.

Differential Leveling Procedure

- Establish arbitrary station levels circuit to newly established benchmarks, temporary static observation points (located in open water), associated station reference marks, and measuring points for ground and surface water monitoring stations to obtain difference between all points (Kenney, 2010)
- Apply the difference found between the arbitrary elevation and the true elevations of the static observation point (obtained through the GNSS survey) to all levels circuit points as an offset to get the true NAVD 88 elevations to all points.

METHODS (Cont.)



Run arbitrary station levels circuit and obtain difference between all points.

Processing Sheets

- A processing sheet (Excel) was created to document the various aspects of the survey for each location. Each processing sheet includes the following tabs: Documentation, GNSS Results and Survey Level, Level Summary and GNSS Adjustment, Circuit Level notes, Site Sketch, Opus Sheet 1 and 2, NGS Data Sheet, Known BM run 1 and 2. The GNSS Results and Level tab provides the summary of the GNSS quality.

RESULTS

All study locations were graded as Level I surveys. See table 11 in Rydlund and others (2012) for more information on the quality assurance results document in the GNSS Results and Level tab. As such reported accuracy was considered to be within +/- 6cm of the true elevation.

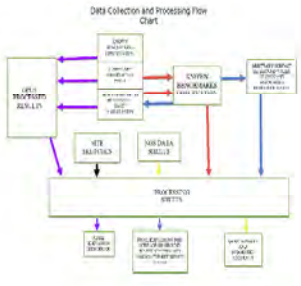
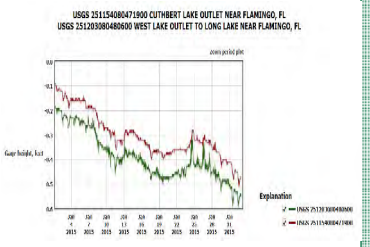


Chart showing the work flow of necessary elements.

RESULTS (Cont.)



Comparison of surface water data collected at West Lake Outlet and Cuthbert Lake Outlet.

CONCLUSIONS

- Established a network of benchmarks in the remote coastal lakes region of the Everglades.
- The establishment of a common datum (NAVD88) at monitoring stations in remote areas of Everglades National Park allows for an accurate description of water elevation gradients and consequently improve results of hydrologic modeling efforts.

Future Directions

- Use of this technology to:
  (1) verify existing BMs and expand the BM network into other remote areas of ENP and;

  (2) relate coastal water level monitoring stations and known elevations to changes in sea level rise, storm surge, bank erosion, and retreating shorelines.

REFERENCES

Kenney, T.A., 2010, Levels at gaging stations: U.S. Geological Survey Techniques and Methods 3-A19, 60 p.

Rydlund, P.H., Jr., and Densmore, B.K., 2012, Methods of practice and guidelines for using survey-grade global navigation satellite systems (GNSS) to establish vertical datum in the United States Geological Survey: U.S. Geological Survey Techniques and Methods, book 11, chap. D1, 102 p. with appendixes.

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