Evaluation of Flows in Wetlands Adjacent to Canal C-111 in the Southern Florida Everglades

By

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Introduction

Wetlands between canal C-111 and the eastern panhandle of Everglades National Park (ENP) are a major pathway for freshwater flow to nearshore embayments of Florida Bay. Overbank flows from C-111 are controlled by hydraulic structures S-18C and S-197. In 1996-7, spoil mounds along the southwest bank of C-111 were removed to increase overbank flow and enhance sheet flow in the wetlands. Flow data were collected in 1997 and 1999 to analyze canal/wetland flow exchanges and to develop a flow model of this connected canal/wetland ecosystem (Schaffranek, 1996).

Data Collection

Flow velocities were measured using portable SonTek 10-MHz acoustic Doppler velocity (ADV) meters suspended from telem. The ADV meter measures flow velocity in a 0.25 cm remote sampling volume with an accuracy better than 1 mm/s (SonTek, 1997). At sites with sufficient flow depth, velocities were measured at 0.3, 0.5, and 0.8 depths. Two-minute burst samples were taken at a frequency of 10 Hz resulting in 1200 geoidally-referenced velocity components. Measured velocity data were processed through a series of filters (Ball and Schaffranek, 2000) to remove spurious values. A sample plot of East North, and up (ENU) velocity components with 2-second running averages is shown for a mid-depth measurement at one site. Average and standard deviation of velocity, correlation (Cor), and signal strength (SNR) values are shown for each velocity component. ENU velocity components are used to resolve the mean flow speed and direction, which are 0.72 cm/s and 212 degrees, respectively, at this site.

Flow Analyses

Flows in the C-111 wetlands were fairly consistently in the south-southwest direction during both measurement periods, averaging 205 and 191 cm/s clockwise from magnetic north in 1997 and 1999, respectively. Flow velocities were variable within measurement periods but consistent between years, averaging 0.8 and 0.5 cm/s in 1997 and 1999, respectively. In the wetlands adjacent to the canal overbank, the greatest flow velocities were measured very close to the canal, but velocities decreased rapidly and variability in the wetlands. Spatial variability in the wetland flow velocities is likely due to a combination of the variable influences of overbank discharges along the canal, local effects of the irregular topographic relief, and the heterogeneous vegetation of the wetlands. In the 1999 data set, flow velocities were greatest near the end of the L-31W canal due to S-175 control structure releases during and following a major hydraulic pump test and increased flows related to tropical storm Harvey on September 21, 1999. Between the two white lines drawn on the site image, measured flow directions along the east-west ENP boundary are in close agreement with the pattern of drainage channels and alignment of tree islands in the C-111 wetlands. This indicates that a significant amount of fresh water from the northern segment of C-111 and eastern part of Taylor Slough potentially flows into Joe Bay which supports findings that discharges from Joe Bay are a major source of fresh water for northeastern Florida Bay (Patino, 1999).

Canal/Wetland Flow Exchanges

Discharges computed through five transects approximately parallel to the 8-km east-southwest segment of the C-111 canal reveal a significant rapid loss of sheet flow in the adjacent wetlands. The diminished sheet flow discharges are directly attributed to both a reduction in flow depths and velocities. Diversion of sheet flow to several mangrove-lined drainage channels that extend southward from the canal through the wetlands to Florida Bay and loss of surface flow to the highly permeable surficial aquifer are factors suspected of contributing to this flow attenuation.

Summary

Precise measurements of extremely low flow velocities have been made in the shallow wetlands adjacent to canal C-111. The results and findings of these efforts are intended to provide guidance for restoration actions needed to improve the timing, distribution, and quantity of sheet flows through the C-111 wetlands and into Florida Bay. These data are undergoing further analyses and are being used to develop a numerical flow model of the C-111 drainage system. The flow data collected during September 1997 and 1999 are available at the South Florida Information Access (SOFIA) website (http://sofia.usgs.gov). Plots of flow vectors from the September 1999 data collection effort can be found at the Tides and Inflows in the Mangroves of the Everglades (TIME) website (http://time.er.usgs.gov/).

References


