

## Sheet Flow in Vegetated Wetlands of the Everglades

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Little is known about the behavior of shallow surface-water (sheet) flows in and through the vegetated wetlands of the Everglades, including the nature and extent of the effects of water-management controls. This project focuses on quantifying flow velocities and investigating local and regional forces both internal and external that affect sheet flows in varied vegetative communities of the southern Everglades. The purpose of the project is to determine the magnitude, direction, and nature of flows in the wetlands of Everglades National Park (ENP). Insight into sheet flow behavior in wetlands is essential to the development and use of models to evaluate and compare restoration scenarios for the greater Everglades ecosystem.

Three stations were established in 1999 and 2000 to monitor flows and related hydrologic conditions in differing vegetative communities within Shark River Slough (fig. 1). Monitoring station SH1 was established in medium dense spikerush (*Eleocharis*) on the edge of a dense sawgrass (*Cladium jamaicense*) stand; GS-203 was located in medium dense sawgrass at the edge of dense sawgrass; and GS-33 was established in an area of patchy, medium dense spikerush with significant concentrations of submerged aquatic vegetation and periphyton. All three stations were co-located with hydrologic stations to provide water level and rainfall data for flow analyses. Additionally, GS-33 was located near a gage that provided meteorological data for use in flow analyses.

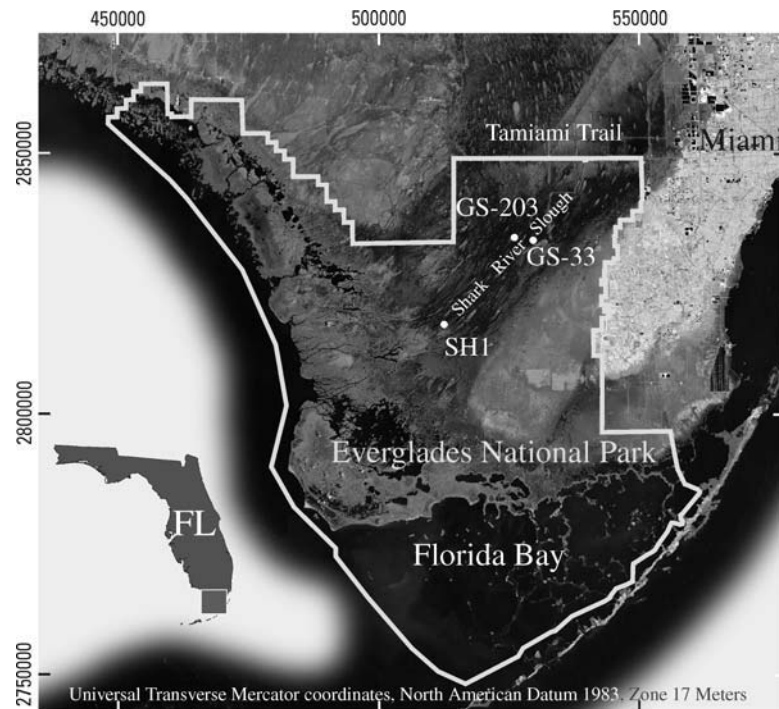


Figure 1. South Florida image showing stations GS-203, GS-33, and SH1.

Flow velocities, water and air temperatures, and specific conductances were monitored continuously, typically bi-hourly, at all sites. Flow velocities were measured at a fixed point in the water column using autonomous-recording, acoustic Doppler velocity (ADV) meters. The

ADV meter yields 3-D velocity components to a resolution of 0.1 mm/s with an accuracy of 1 % of measured velocity (Sontek, 2001). Water and air temperatures were monitored using thermistors spaced at 5-cm or 10-cm depth intervals above the plant litter layer. Specific conductances were sampled at a fixed point in the water column near the plant litter layer. All data were collected, edited, and filtered according to methods established and documented in Riscassi and Schaffranek (2002).

Vectors showing flow speeds and directions, in the horizontal plane relative to magnetic north, during the 2000-2001 wet season at GS-203 are shown in figure 2. Flow velocities were measured 10 cm above the plant litter layer throughout the wet season. Water depths at the ADV probe (fig. 2) were fairly constant at approximately 40 cm in late October through early November, but fell steadily in late November through mid-January (31 to 16 cm) except for one 4-cm increase on December 9<sup>th</sup> due to a rain event. Early in the wet season when water levels were relatively high, flow speed and direction averaged 0.62 cm/s and 235 degrees, respectively, with standard deviations of 0.06 cm/s and 7 degrees. As water levels declined in the later part of the wet season, the average flow velocity was slightly lower at 0.53 cm/s with an identical average direction. However, there was more than a threefold increase in the range of measured flow speeds and directions with standard deviations increasing to 0.19 cm/s and 22 degrees, respectively. Perturbations on the flow are considerably damped with increased flow depth as is clearly evidenced by both the quality and range of measured flow velocities. Implications are that during times of higher water levels more stable regional factors appear to drive flows more uniformly, however, as water levels fall, flow velocities at the sample depth decrease and become more susceptible to dynamic forces imposed by wind and rainfall at the water surface. Changes in the relationship between the water depth and vegetation composition as water levels fall also appear to alter the influences that vegetation has on vertical flow structure and, therefore, local sheet flow behavior.

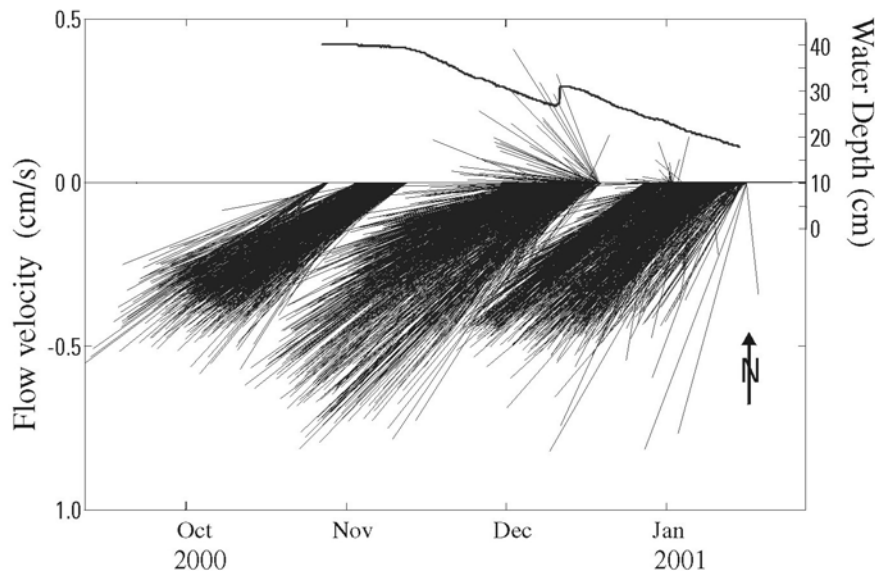


Figure 2. Water depths and flow velocities at station GS-203.

Data sets similar to that for GS-203 illustrated in figure 2, collected at the other sites, have yielded additional insight into the typical range of flow velocities found in particular vegetative communities and the dynamics of velocities and sheet flow conditions within and between sites. Findings from all data collected and analyzed to date at all sites indicate that dynamics in the magnitude, direction, and nature of sheet flows are attributed in varying degrees to both internal

and external effects, both locally- and regionally-driven. Local conditions include the type, density, and physical attributes of vegetation in the area, as well as the presence and composition of submerged aquatic vegetation and (or) periphyton. Upstream vegetation, water levels, water-surface slopes, landscape gradients, proximity of airboat trails, presence of tree islands, and vegetative heterogeneity are regional factors that affect sheet flow conditions. Dynamic forces such as storm and rainfall events also have variable effects on sheet flow behavior.

**References:**

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