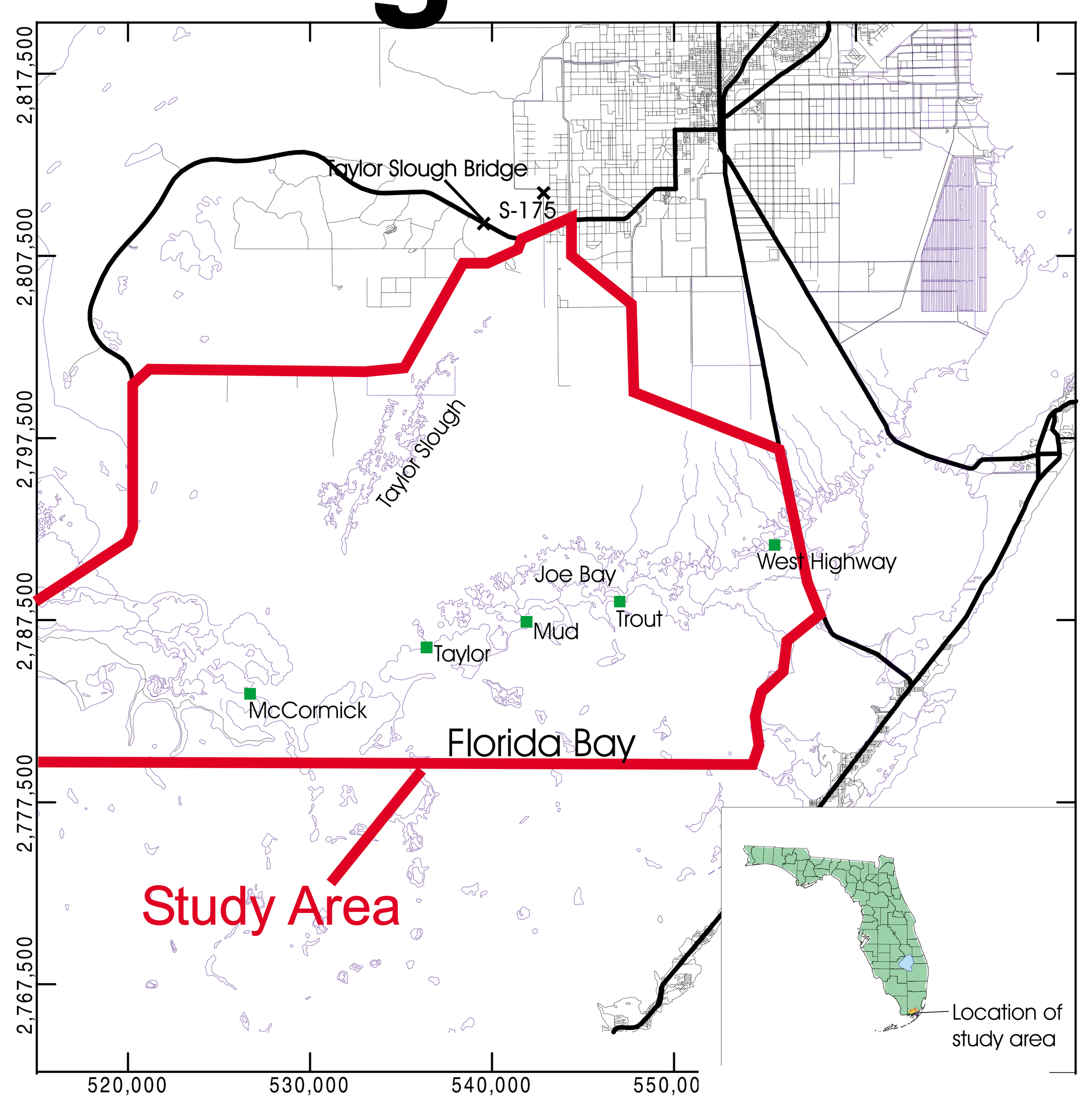
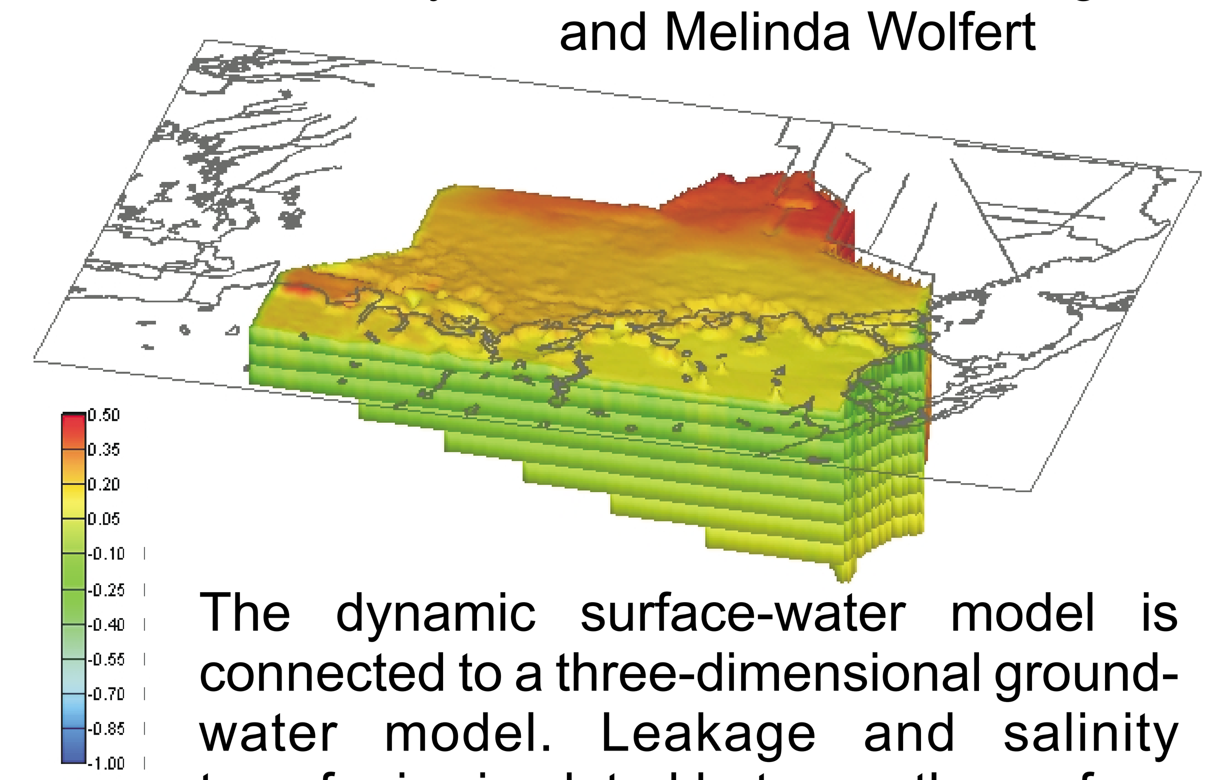
Developing Insight into Coastal Wetland Hydrology Through Numerical Modeling

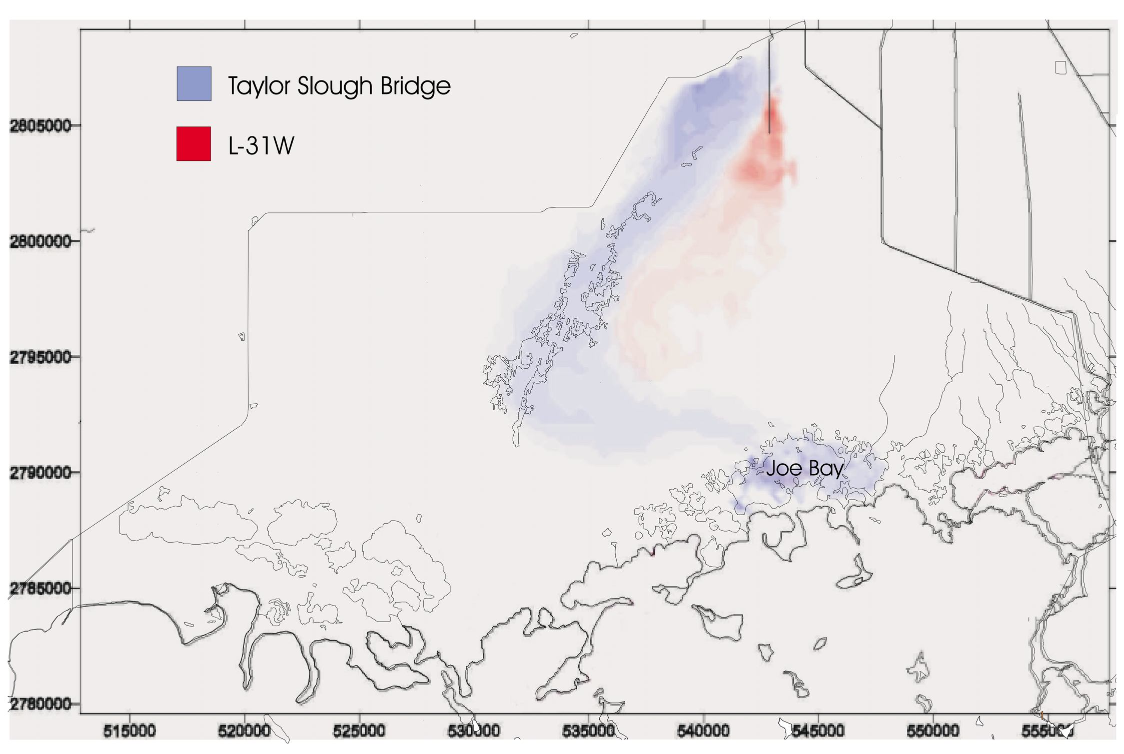
by Eric Swain, Christian Langevin and Melinda Wolfert

Field measurements of pertinent hydrologic parameters can yield relevant and crucial information for water managers, but in order to integrate all this information into a coherent picture, a numerical model is a useful tool. This is what has been done in the Southern Inland and Coastal Systems (SICS) study area. The extensive set of field studies yield information on all the important hydrologic parameters; elevation, frictional resistance, evapotranspiration, and flow measurements. This allowed a numerical model to be constructed almost entirely from field data. The behavior of the model lends insight into the direction, timing, and volumes of flow, the patterns of inundation, and the effects of modifications in the system.

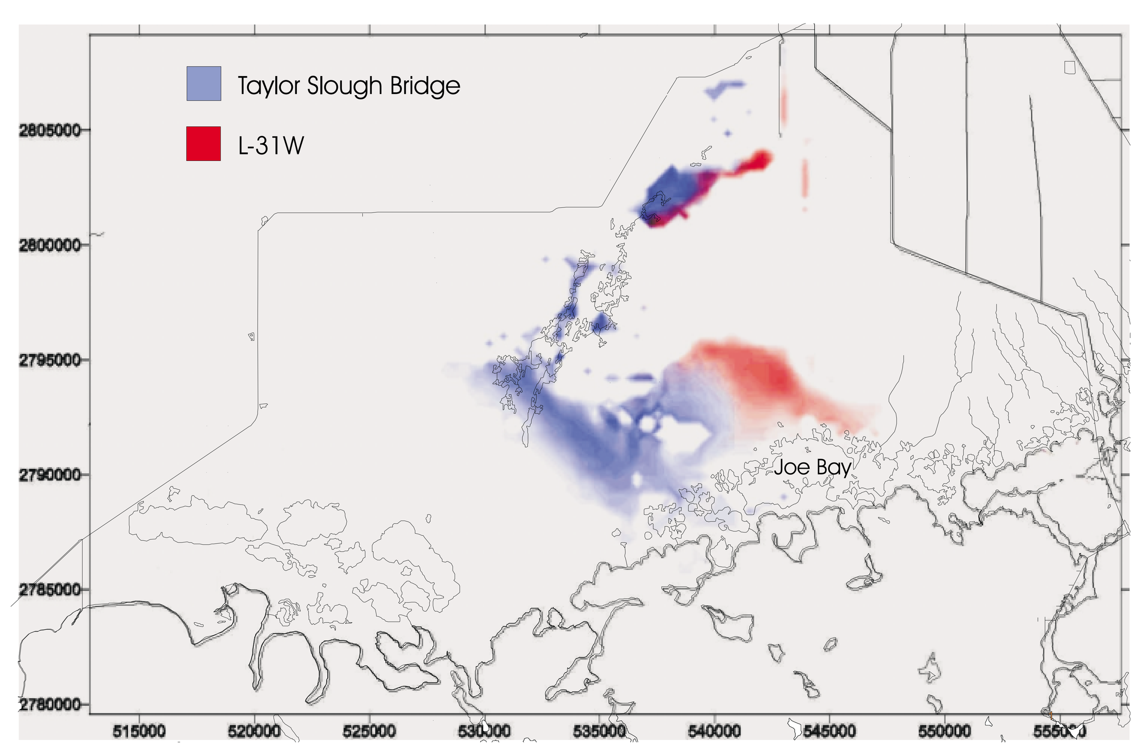




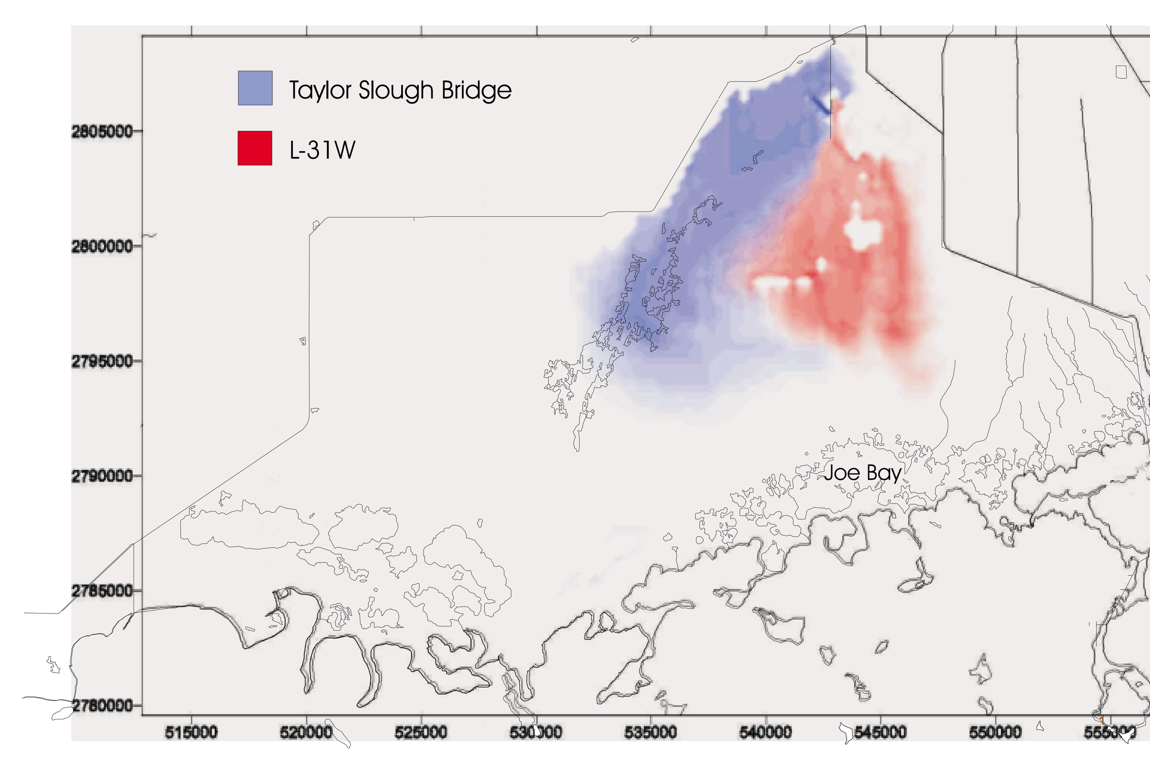
The dynamic surface-water model is connected to a three-dimensional ground-water model. Leakage and salinity transfer is simulated between the surface and ground-water. This is necessary due to the high connectivity of the system



Location of waters on October 14. 1996



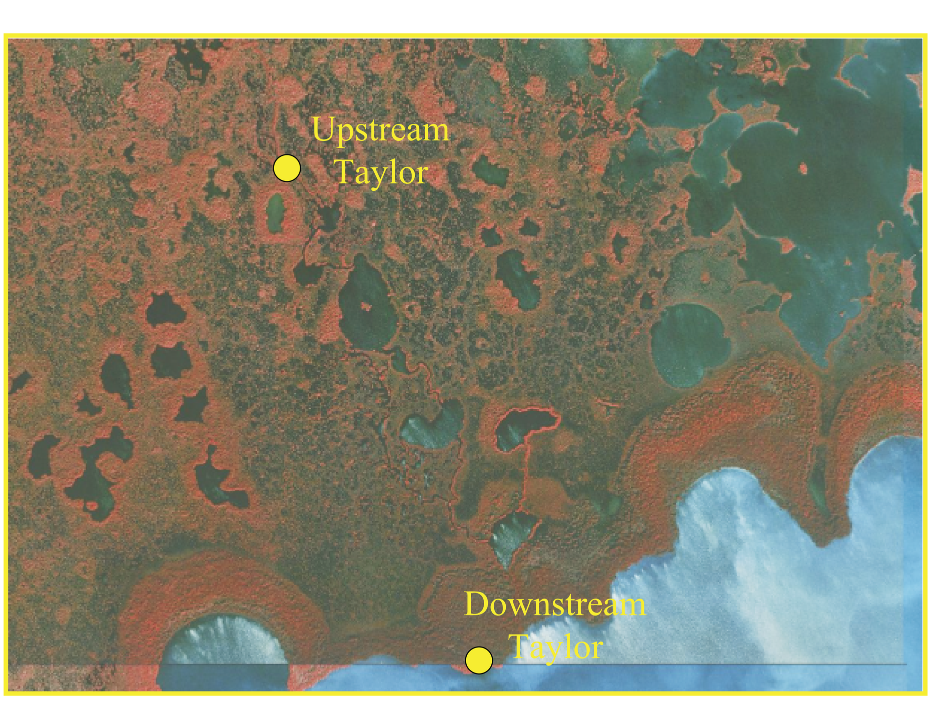
Location of waters on February 2. 1997



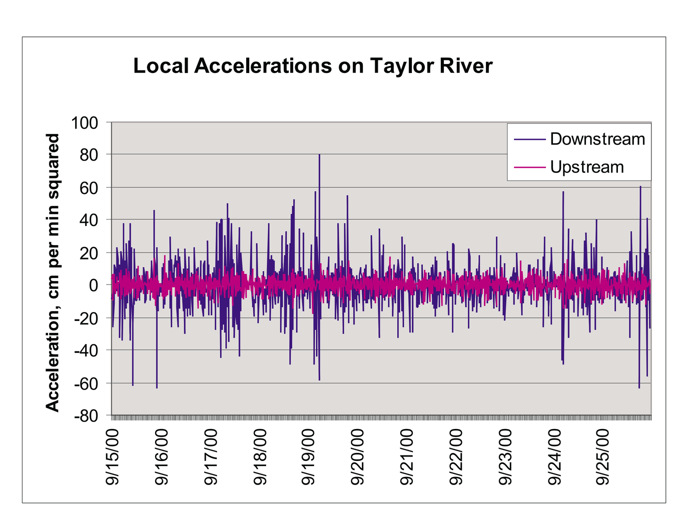
Location of waters on July 1. 1997

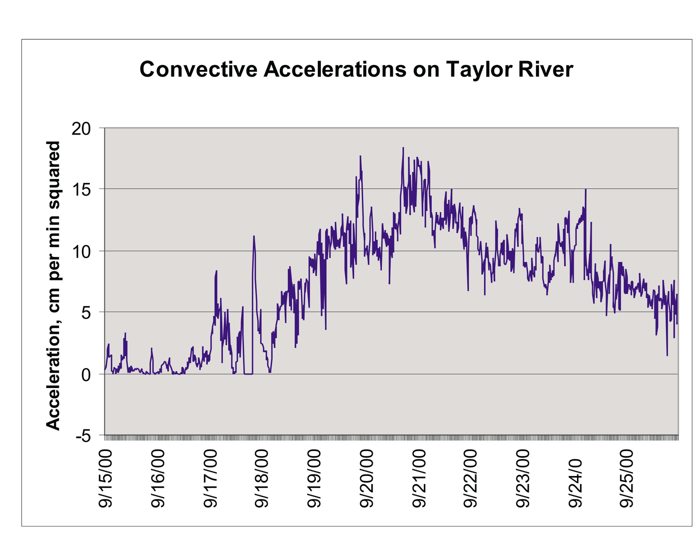
The numerical model can be used to track the path of waters entering the study area from different boundary locations. These figures represent the relative concentrations of imaginary constituents with fixed concentrations at two northern boundaries; Taylor Slough Bridge and L-31W Canal. These figures show the location of these waters at three times during a period of a year. A disctinct southeastern turn towards Joe Bay is seen as the waters proceed down Taylor Slough.

Mutual Dependency of Field Measurements and Numerical Model Simulations

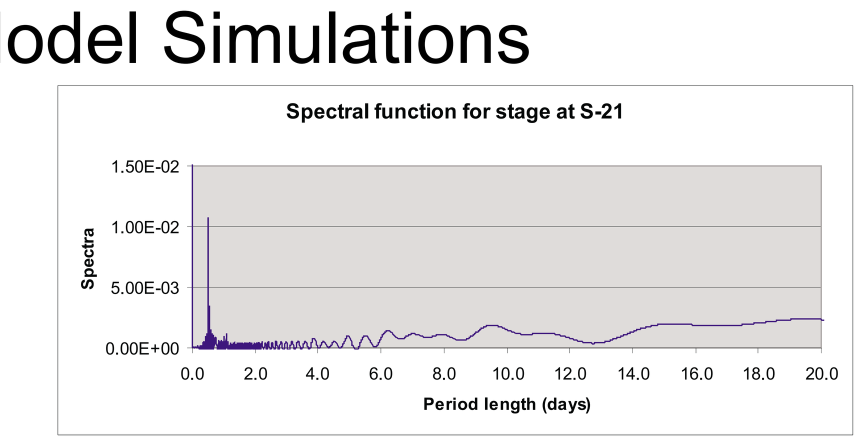


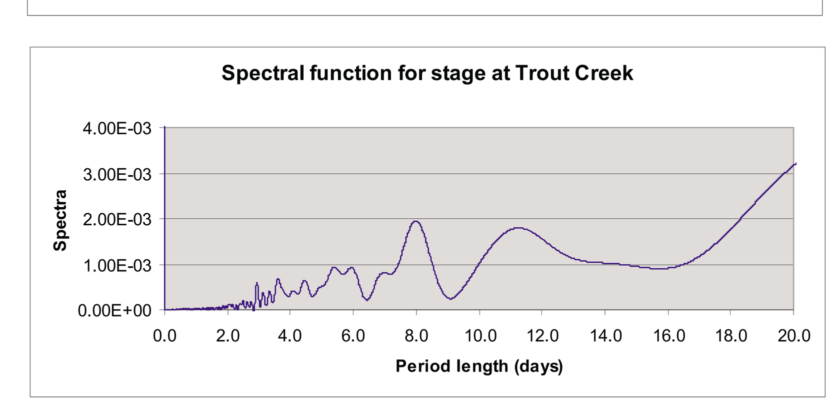
At Taylor River, the installation of a flow and stage site upstream of the existing site allowed the field determination of coastal creek frictional resistance. Previously, the coastal creek friction values were determined through calibration of the computer model. With the new station, the friction coefficient can be determined by the water level differences between the stations and the measured flowrates. Daily mean stages and water levels were used from the period July 31, 1999 to August 1, 2000. The mean value of Manning's n was computed to be 0.121. The computer model calibrated value is 0.152. The values are close considering the effective length of the river in the model is somewhat shorter than the distance between the field stations.

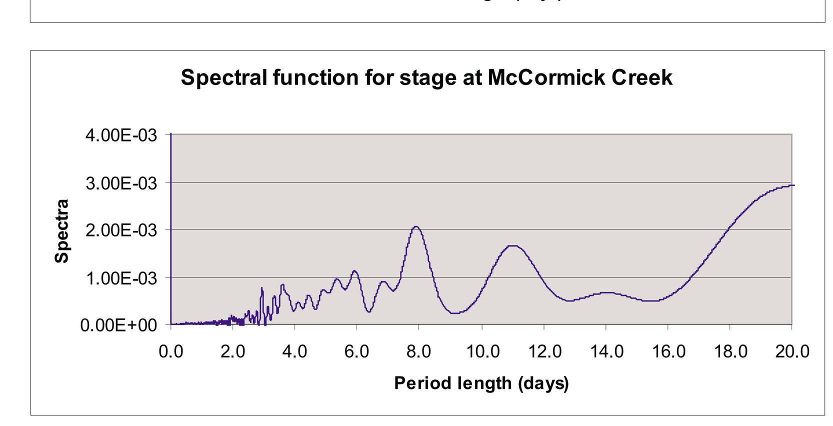




The data collected at these sites also serves to analyze the temporal and spatial properties of the velocity variations in the study area. This is useful in delineating the numerical scheme for the model. The plots show the local (dv/dt) and convective v(dv/dx) accelerations determined from these two stations. The magnitude of these terms indicates if a dynamic wave solution is needed in the numerical model.







In order to determine if the study area's coastal boundary creeks are subject to a lunar tide, a spectral analysis was done on water levels at a site known to be subject to a lunar tide, S-21, and two sites in the SICS study area. The analysis shows dominate frequencies in the stage fluctuations, which indicates a distinct lunar tide (½ day) signature at S-21 but no such signature at the two SICS sites, Trout and McCormick.

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