FINAL REPORT

Texas High School Coastal Monitoring Program: Ball, Port Aransas, and Port Isabel High Schools, 2005–2006

Tiffany L. Hepner and James C. Gibeaut





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INTRODUCTION

The Texas Coastal Monitoring Program engages people who live along the Texas coast in the study of their natural environment. High school students, teachers, and scientists work together to gain a better understanding of dune and beach dynamics there. Scientists from The University of Texas at Austin (UT) provide the tools and training needed for scientific investigation. Students and teachers learn how to measure the topography, map the vegetation line and shoreline, and observe weather and wave conditions. By participating in an actual research project, the students obtain an enhanced science education. Public awareness of coastal processes and the Texas Coastal Management Program is heightened through this program. The students' efforts also provide coastal communities with valuable data on their changing shoreline.

This report describes the program and our experiences during the 2005–2006 academic year. During this time, Ball High School on Galveston Island completed its ninth year in the program, and Port Aransas and Port Isabel High Schools completed their seventh year (Fig. 1). All three high schools are continuing the program during the 2006–2007 academic year. The program has expanded to an additional three schools in the Bay City, Texas, region. Discussions of the data collected by the students and recommendations for future high school projects are also included in this report. A manual with detailed field procedures, field forms, classroom exercises, and teaching materials was prepared during the first year of the project at Ball High School in 1997–1998. The program is also enhanced by a continuously updated Web site (http://txcoast.beg.utexas.edu/thscmp/).

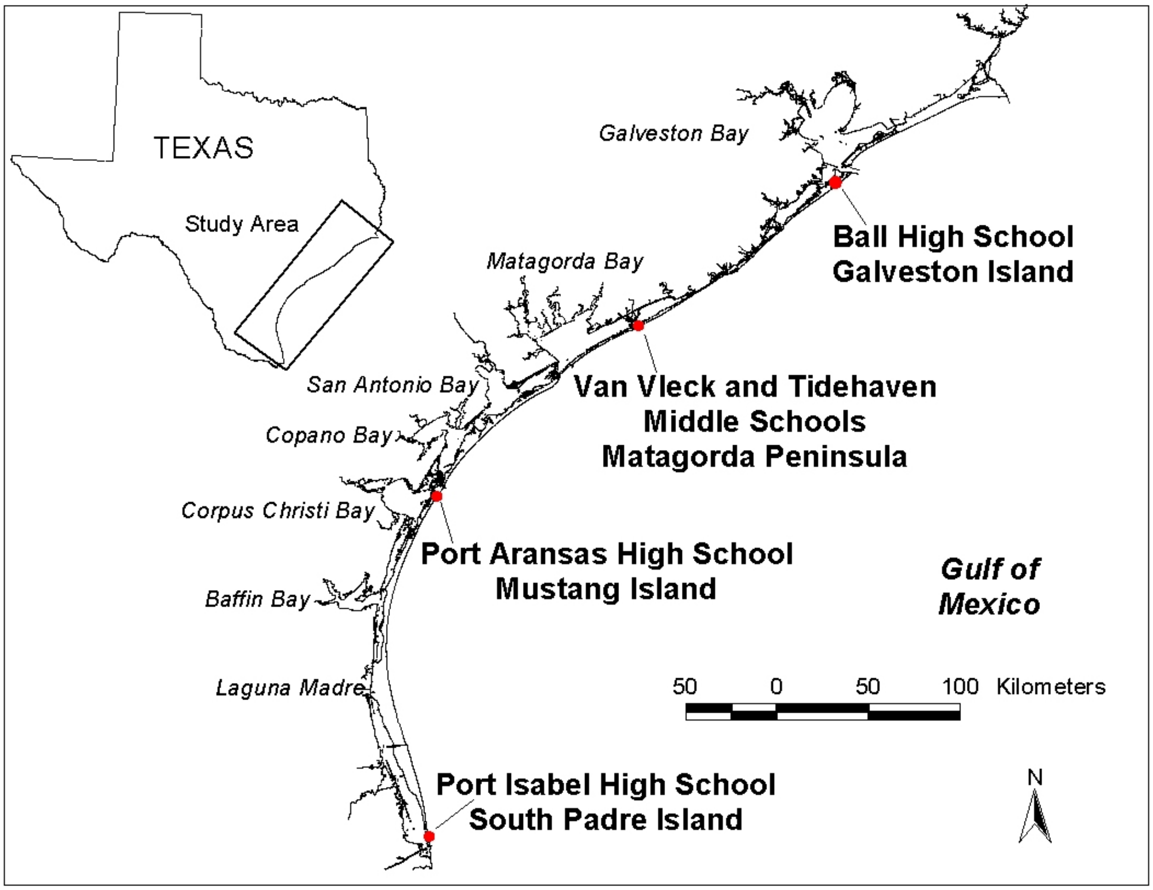

Figure 1. Participating schools.

PROGRAM DESCRIPTION

Goals

The coastal monitoring program has three major goals:

(1) Provide high school students with an inquiry-based learning experience. Students make several field trips to their study sites during the school year. Working in teams, they conduct topographic surveys (beach profiles) of the foredune and beach, map the vegetation line and shoreline, collect sediment samples, and observe weather and wave conditions. Back in the classroom, students analyze their data and look for relationships among the observed phenomena. UT scientists provide background information and guide inquiries about the data, but students are encouraged to form their own hypotheses and test them. Through their collaboration with working scientists on an actual research project, the students gain an enhanced science education.

(2) Increase public awareness and understanding of coastal processes and hazards. We expect that participating students will discuss the program with

their parents, classmates, and neighbors, further expanding the reach of the program. We also expect the program to attract media attention, as it has in the past. Port Isabel High School and the Texas High School Coastal Monitoring Program were featured in a March 4, 2004, article in the *Valley Morning Star* newspaper. A paper featuring the program and data collected by the high school students was published in the fall 2004 issue of *Shore & Beach* (Vol. 72, No. 4), the journal of the American Shore & Beach Preservation Association. A Website (http://txcoast.beg.utexas.edu/thscmp/) containing the latest information is central to the community outreach part of the project. Coastal residents may wish to view the effects of a storm that strikes the upper coast. They are able to do so by accessing the Texas High School Coastal Monitoring Program Website to view maps, graphs, and photographs collected by Ball High School. Curiosity may drive this inquiry at first, but eventually there is increased awareness and appreciation of coastal processes and how future storms could affect a community.

(3) Obtain a better understanding of the relationship between coastal processes, beach morphology, and shoreline change and make data and findings available for solving coastal management problems. The Bureau of Economic Geology (Bureau) at UT has conducted a 30-year research program to monitor shorelines and investigate coastal processes. An important part of this program is the repeated mapping of the shoreline and measurement of beach profiles. Over time, these data are used to determine the rate of shoreline change. A problem we face is the limited temporal resolution in our shoreline data. The beach is a dynamic environment where significant changes in shape and sand volume can occur over periods of days or even hours. Tides, storms, and seasonal wind patterns cause large, periodic or quasi-periodic changes in the shape of the beach. If coastal data are not collected often enough, periodic variations in beach morphology could be misinterpreted as secular changes. The Texas High School Coastal Monitoring Program helps address this problem by providing scientific data at key locations along the Texas coast. These data are integrated into the ongoing coastal research program at the Bureau and are made available to other researchers and coastal managers.

Methods

The central element in the high school monitoring program is at least three class field trips during the academic year, weather permitting. During each trip, students visit several locations and apply scientific procedures to measuring beach morphology and making observations on beach, weather, and wave conditions. These procedures were developed during the program's pilot year (1997–1998) and are presented in detail in a manual and on the Website that also includes field forms. Following is a general discussion of the field measurements.

(1) Beach profile. Students use a pair of Emery rods, a metric tape, and a hand level to accurately survey a shore-normal beach profile from behind the foredunes to the waterline. The students begin the profile at a presurveyed datum stake so that they can compare each new profile with earlier profiles. Consistently oriented photographs are taken with a digital camera. The beach profiles provide detailed data on the volume of sand and the shape of the beach.

(2) Shoreline and vegetation line mapping. Using a differential Global Positioning System (GPS) receiver, students walk along the vegetation line and shoreline mapping these features for display on Geographic Information System software. The GPS mapping provides measurements of the rate of change.

(3) Sediment sampling. Students occasionally take sediment samples along the beach profile at the foredune crest, berm top, and beach face. They then sieve the samples, weigh the grain-size fractions, and inspect the grains using a microscope. These samples show the dependence of sand characteristics on the various processes acting on the beach.

(4) Beach processes. Students measure wind speed and direction, estimate the width of the surf zone, and observe the breaker type. They note wave direction, height, and period and estimate longshore current speed and direction using a float, stop watch, and tape measure. From these measurements, students can infer relationships between physical processes and beach changes in time and space. Students also learn to obtain weather and oceanographic data from resources on the Internet.

Training

UT scientists provide teachers with all the training, information, field forms, and equipment needed to conduct field and lab measurements. During the school year, UT scientists accompany students on at least one field trip and make at least two classroom visits, which may be included with the field trips. The classroom visits provide students with even more insight into conducting scientific research. The scientists discuss with the students general and theoretical issues regarding scientific research, as well as specific techniques and issues related to coastal research. The visits also provide scientists with an opportunity to ensure quality of the data.

Data Management, Data Analysis, and Dissemination of Information

The Web is central to the dissemination of data collected for this program. A Website (http://txcoast.beg.utexas.edu/thscmp/), which resides on a UT server, was implemented toward the end of the 1998–1999 academic year. The Website provides all the information needed to begin a beach monitoring program, as well as curriculum materials for high school teachers. Each school in the program has an area on the Website for posting its data and observations, including photos taken by an electronic camera. UT scientists manage the data in an electronic database and make it available to the public. UT scientists also evaluate the data in light of coastal management problems. Students and the public can now interactively plot beach profiles and retrieve data through the Website.

STUDENT, TEACHER, AND SCIENTIST INTERACTIONS DURING THE 2005–2006 ACADEMIC YEAR

UT scientists, Dr. Gibeaut and Ms. Hepner, worked with teachers Mr. Ron Wooten of Ball High School, Mr. William Slingerland of Port Aransas High School, and Dr. Michelle Zacher of Port Isabel High School. Mr. Wooten chose his Advanced Placement Environmental Science classes to participate in the program. Mr. Slingerland chose his Aquatic Sciences class to participate in the program. Port Isabel High School biology teacher, Dr. Zacher, employed her Advanced Placement Biology and General Biology classes. Approximately 70 students in the 9^{th}, 10^{th}, 11^{th}, and 12^{th} grades actively participated during the year.

The Bureau applied for and successfully acquired additional funding from the Meadows Foundation to expand the program to three schools in the Bay City region. Teacher training for staff from Van Vleck and Tidehaven Middle Schools was held in early March 2005. The first field trips for both of these schools were held in late April 2005. This grant expands the Texas High School Coastal Monitoring Program not only to additional schools but to younger students, who are making the same field measurements as the high school students, but who are visiting only one profile site per field trip. Bay City High School students began monitoring beaches in early 2006. Bay City area schools are monitoring the Matagorda Peninsula beach northeast of the mouth of the Colorado River.

UT scientists visited each school at least once. The visits coincided with field trips. During and after field trips and during lectures, UT scientists discussed careers in science and university life with students. These visits by UT scientists served not only to enhance scientific instruction, but they also gave students insight into science as a career.

During the field trips, students were divided into two or three teams, depending on the size of the class. One team measured the profile while the other team collected data on weather and waves and conducted a GPS survey of the shoreline and vegetation line. Team members had specific tasks, and students took turns performing them. After each team completed its tasks at the first location, the teams switched roles so that everyone had an opportunity to conduct all measurements.

Dividing students into two five- to seven-member teams works well. One team conducts the beach profile and the other measures the processes and the shoreline. Each team finishes at about the same time, although for short profiles, the profiling team may finish early. In this case, an extra task can be assigned to the profiling team. It is important to assign each student a job to keep him or her focused and interested. Time for a little fun should also be allowed. People normally think of the beach as a place of recreation, and participation in this project should not change that. In fact, it is hoped that program participants will enjoy going to the beach even more because of their newly acquired knowledge and observation skills.

The method of breaking students into teams and collecting data works well for Advanced Placement students at Ball, Port Aransas, and Port Isabel High Schools. Adding middle school students to the Program has slightly changed our approach to working with students. For example, the Bay City region schools, which collect data on Matagorda Peninsula, collect data only from one monitoring site. Because of the distance from the schools to the beach (~45 minutes to 1 hour each way), time will not allow data collection from multiple sites. Also, Van Vleck Middle School is involved in another scientific study along Matagorda Peninsula. About 10 students from this school actively collect data for the Coastal Monitoring Program. At Tidehaven Middle School, the Spanish Science Club usually conducts its field trips on Saturday mornings because the group from Tidehaven is a club, and it is harder for the members to receive permission to leave the school during regular hours. Finally, the Bay City High School class, which was added in early 2006, is a special program working with high-risk students. Instead of breaking into groups to collect the data, we attempt to keep the students active by constantly rotating them through the different positions. The last student to conduct a measurement teaches the next student.

The day of the field trip, students meet in the teacher’s classroom to organize equipment and gather additional materials that they may need for the day (coolers with ice and water, lunches, etc.). Throughout the day, data and samples are collected from one to three locations, with sufficient time allotted for lunch and breaks. On some trips there is time for additional scientific inquiry, such as visiting the Laguna Madre Nature Trail on South Padre Island or observing the wetlands at Galveston Island State Park. All trips allow ample time for careful data collection and having the students back at school about 1 hour before the end of the day. During this hour, equipment and samples are stored, and data are filed or transferred to the computer. Following are details on the activities at each school.

Ball High School

Mr. Ron Wooten’s AP Environmental Science classes at Ball High School participated in field trips on September 19, 2005; January 20, 2006; and April 27, 2006. They conducted surveys at the same two locations as previous Ball High classes—one at the Galveston Island State Park, BEG02, and one on Follets Island southwest of San Luis Pass, BEG08 (Fig. 2). The Bureau has also been measuring these profiles since the 1980's. Ms. Hepner accompanied the class and provided further training and background information to the students.

The field trip on September 19 was very exciting. Hurricane Rita formed on Sunday, September 18, and started heading toward the Gulf of Mexico. Initial tracks forecast the storm to make landfall somewhere on the Texas coast by the following weekend. Because this storm was on the heels of devastating Hurricane Katrina, the Ball High School students were aware of the impact of a major hurricane and also because Galveston was hosting many displaced families. Teacher and students alike recognized that the data they were collecting were an important link in the beach-profile database. Data collected on that day would serve as pre-storm baseline data. The students, teacher, and scientist also discussed the potential impact of a major hurricane on Galveston Island. The discussion that day focused on how students and families should prepare.

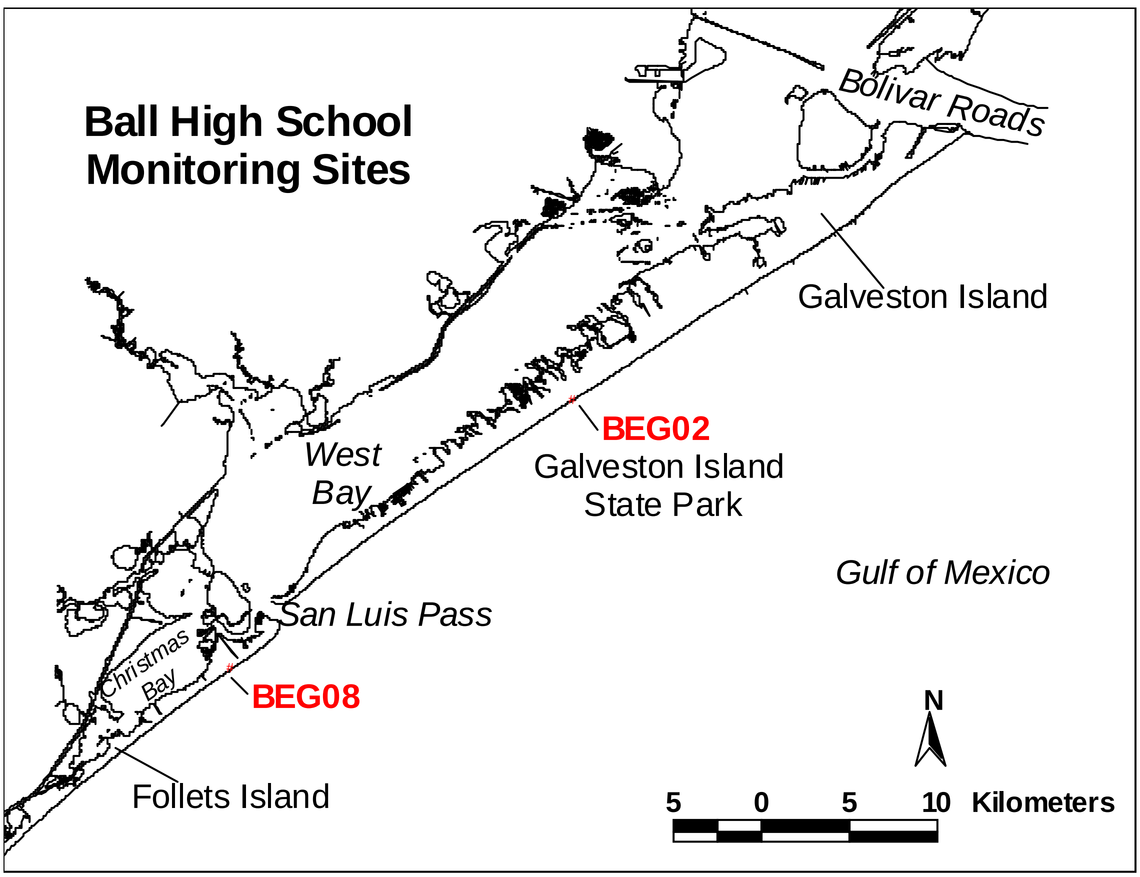

Figure 2. Location map of Ball High School monitoring sites.

Port Aransas High School

Port Aransas students participated in field trips on September 20, 2005; January 19, 2006; and March 21, 2006. Mr. Slingerland's class collects data at three profile locations on Mustang Island: MUI01 near Horace Caldwell Pier, MUI02 in Mustang Island State Park, and MUI03 (Fig. 3). Port Aransas High School has also been measuring these profiles since 1999. Ms. Hepner accompanied the class and provided further training and background information to the students.

The September 20, 2005, field trip was a few days before Texas/Louisiana border landfall of Hurricane Rita. At the time of the field trip, the landfall location of Rita was still unknown but was predicted for somewhere on the Texas coast. The students at Port Aransas understood that the data they were collecting were going to be an important link in the beach-profile database and would serve as a pre-storm baseline. Because Rita turned north later in the week, the Port Aransas area was not affected.

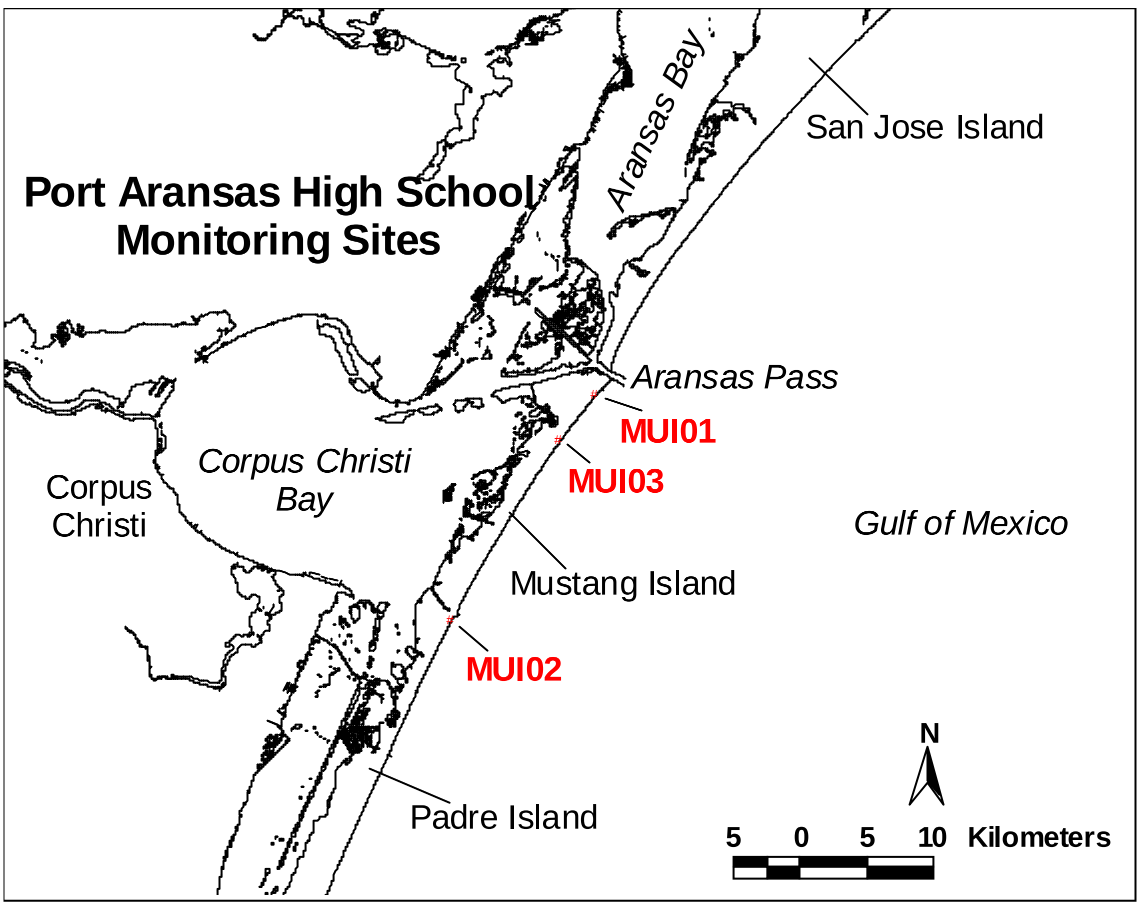

Figure 3. Location map of Port Aransas High School monitoring sites.

Port Isabel High School

Port Isabel students participated in field trips on September 27, 2005; January 31, 2006; and May 1, 2006. Dr. Zacher's Advanced Biology class collects data at two profile locations on South Padre Island: SPI01 in Isla Blanca Park and SPI02 at Beach Access #13 (Fig. 4). Port Isabel High School has also been measuring these profiles since 1999. Ms. Hepner was able to accompany the class only on the final field trip to provide further training and background information to the students. She was unable to participate in the September field trip because it took place immediately following Hurricane Rita's landfall, and she was needed on the Upper Texas Coast for post-storm surveying. Unfortunately, because Ms. Hepner was unable to participate in the first two field trips, the topographic data were not collected properly and will not be included in the results of this report. The students nevertheless learned about the beach environment and making observations.

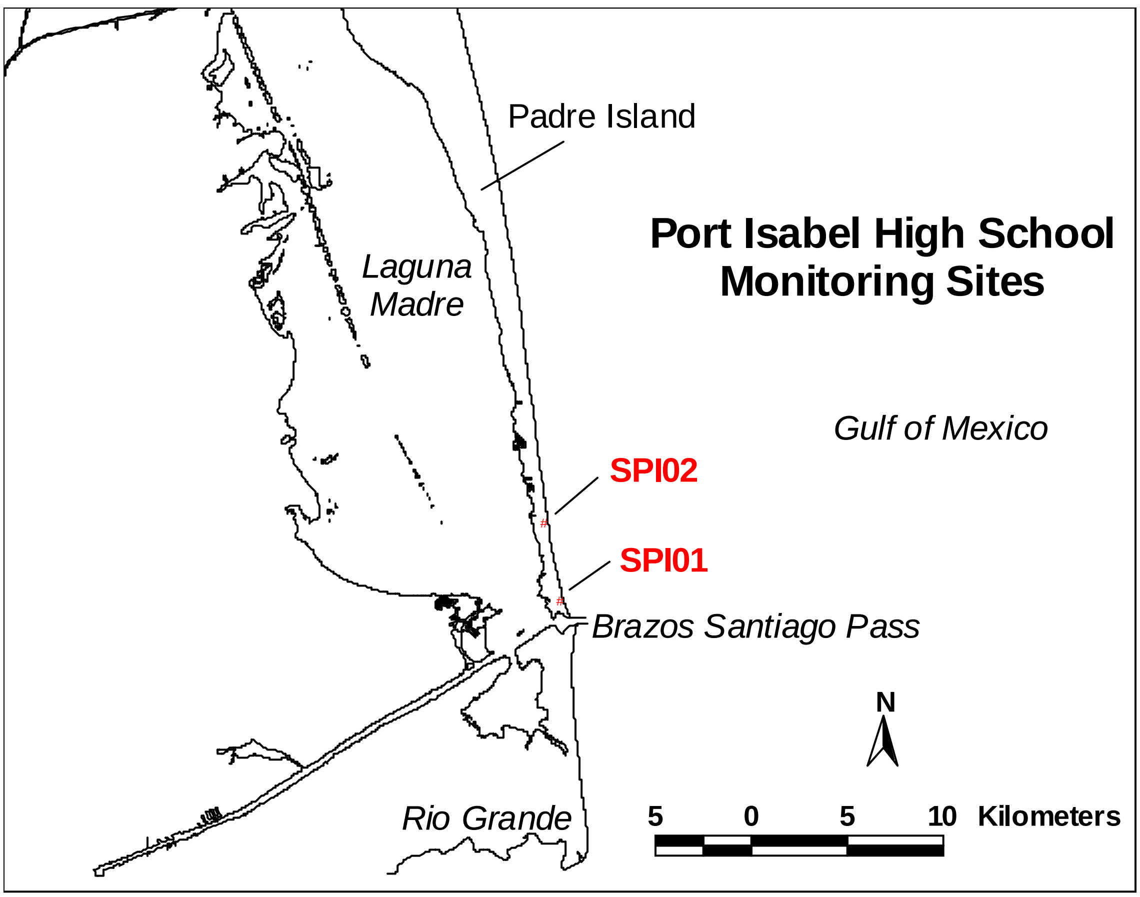

Figure 4. Location map of Port Isabel High School monitoring sites.

Bay City Area Schools

Van Vleck Middle School students participated in field trips on November 18, 2005, and May 5, 2006. Ms. Keelen's 7th grade science class collects data at

MAT01 (Fig. 5). The Spanish Science Club at Tidehaven Middle School participated in field trips on November 17, 2005, and May 6, 2006. The students from Tidehaven collect data at MAT03 (Fig. 5). The 9th grade science class at Bay City High School was the final group to join the Texas High School Coastal Monitoring Program. Those students participated in their first field trip on January 12, 2006, although we did not allow enough time during this field trip to conduct all of the measurements. More time was allotted for the second field trip on May 4, 2006, when all of the data collection tasks were completed. Bay City students collect data at MAT02 (Fig. 5).

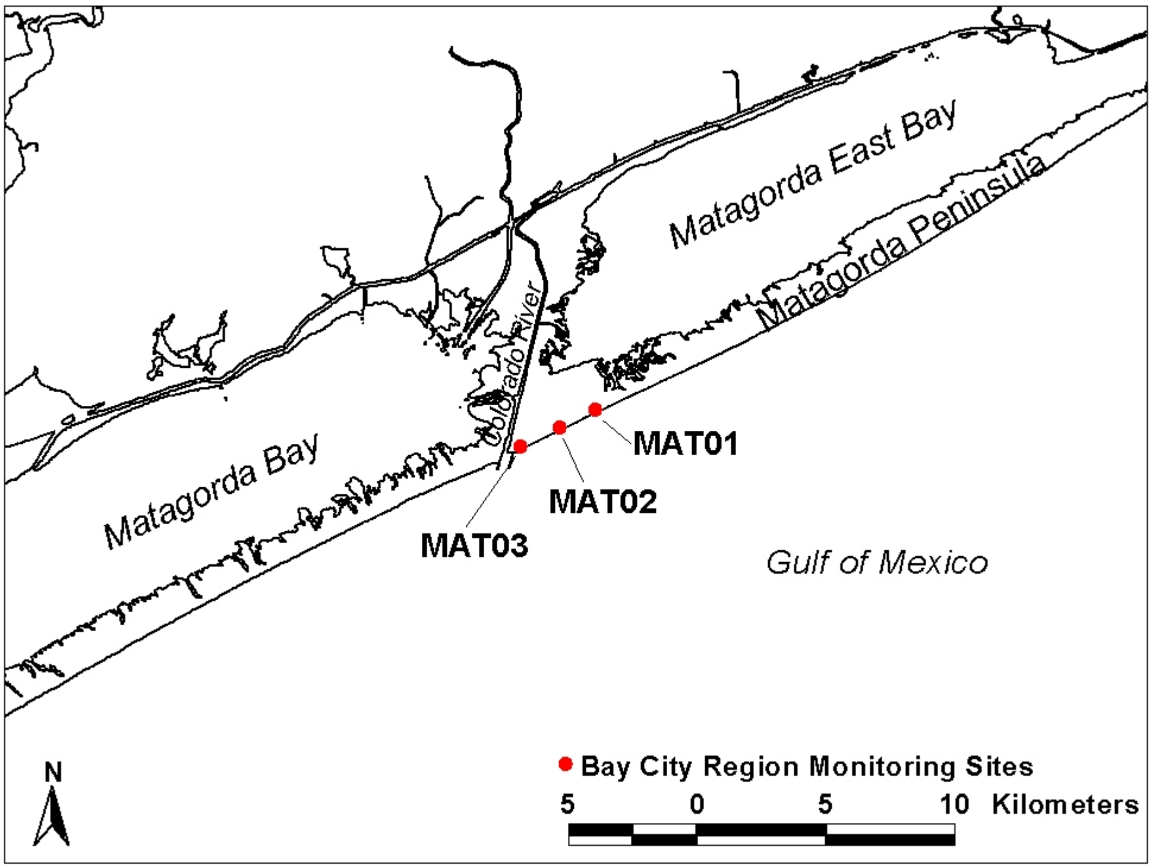

Figure 5. Location map of Bay City region schools monitoring sites.

All three schools were scheduled to conduct three field trips throughout the academic year. Bay City was to have its first field trip September 22, 2005; Van Vleck on September 23, 2005; and Tidehaven on September 24, 2005. Because of Hurricane Rita, field trips were cancelled, and we were unable to reschedule these trips.

EFFECTS ON SCIENCE CURRICULUM

The Texas High School Coastal Monitoring Program addresses several requirements of Texas Essential Knowledge and Skills (TEKS) for science, and the program was relevant in these 2003–2005 Texas high school courses:

(1) Environmental Systems, (2) Aquatic Sciences, and (3) Geology, Meteorology, and Oceanography. The Texas High School Coastal Monitoring Program also addresses several National Science Education Standards: (1) unifying concepts and processes in science, (2) science as inquiry, (3) physical science, (4) Earth and space science, (5) science and technology, and (6) science in personal and social perspectives.

TEKS and Standards related to applying scientific methods in field and laboratory investigations in these courses are well covered in the Coastal Monitoring Program. Specific requirements, such as (1) collecting data and making measurements with precision, (2) analyzing data using mathematical methods, (3) evaluating data and identifying trends, and (4) planning and implementing investigative procedures, are an excellent fit with the program. TEKS and Standards, which require students to use critical thinking and scientific problem solving to make informed decisions, are also well served. Teachers and scientists can use the program to illustrate to students the role science could, should, or does play in developing public policy. A case study of a local erosion problem could be used to illustrate.

The ability to enter data through the Website and to make immediate comparisons with earlier data is expected to increase the interest of students in their measurements and observations. Keeping the Access database online has proven to be a difficult task, however. We have recently had to change a server that houses the Website material, and several page links and coding for the interactive part of the Website have not been updated properly. The code must be searched line by line to determine where links have failed—a daunting task. Therefore, students have not been able to upload data through the Website this academic year. The Website is an important component of the program and will hopefully be running again before the start of the 2005–2006 academic year.

Additional upgrades are planned for the Website that will enhance students' experience. Several exercises have been developed as part of a National Science Foundation grant that utilize the data collected by participants in the program. These have not been added to the site yet because of plans to reorganize the Website design. We recently received funding to create an interactive virtual field trip that will be a main feature of the Website. We also intend to expand the site to make it more of a national resource that will be useful to teachers and students not directly involved in the program.

EFFECTS ON SCIENTIFIC RESEARCH, COASTAL MANAGEMENT, AND PUBLIC AWARENESS

During the 2003–2004 and 2004–2005 academic years, Ball High School students measured profile locations in Galveston Island State Park (BEG02, Fig. 2) and on Follets Island to the southwest of Galveston Island. Ball High School students had measured these same locations in previous years, and the

Bureau had conducted quarterly surveys at these locations from 1983 through 1985 after Hurricane Alicia. Since 1985, however, the beaches had been surveyed on an irregular schedule, about once a year, and only when specific projects were funded to do so or when Bureau personnel were in the area conducting other work. The high school beach-monitoring program helps ensure that time series at these key locations are continued. The Galveston Island State Park profile has increased in importance because it served as a control site for comparing profiles measured in front of geotextile tube projects along Pirates Beach to the northeast. Results of a study utilizing data collected by Ball High School students have been published in *Shore & Beach*, the journal of the American Shore & Beach Preservation Association. The data have increased our understanding of recovery of beaches and dunes following storms (Hurricane Alicia, Tropical Storm Frances, Hurricane Claudette, Hurricane Rita) that have impacted the area.

Port Aransas and Port Isabel High Schools continued the beach-profile time series at their established locations. Bay City High School and Van Vleck and Tidehaven Middle Schools began collecting data at their established locations. The profile and processes data that the students collected have been incorporated into the beach-profile database at the Bureau, and scientists are using these data to investigate beach erosion patterns. These data can be viewed at the Texas High School Coastal Monitoring Program Website at http://txcoast.beg.utexas.edu/thscmp/.

Although it will take time to incorporate data into products that support coastal management, it is clear that the data will be useful in explaining beach cycles and defining short-term versus long-term trends. Defining these trends is important for making decisions regarding coastal development and beach nourishment. The program has also increased public awareness through the students. On the basis of inquiries from people wishing to enter their school or group in THSCMP, we think that the program is reaching the public. Television reports, presentations at conferences, and newspaper articles have helped. The Website will continue to be instrumental in extending the reach of the program and increasing public awareness of coastal processes.

SCIENTIFIC RESULTS OF 1997–2006 STUDIES

The first goal of the Texas High School Coastal Monitoring Program is to provide high school students with an inquiry-based learning experience, which is achieved by involving students in a real-world research project. The student-collected beach data can and have been used by researchers at the Bureau to help respond to several beach-related issues. The data are also available to coastal managers and the public online at http://txcoast.beg.utexas.edu/thscmp/.

Profile data are entered into the public-domain software package called "Beach Morphology and Analysis Package" (BMAP). BMAP Version 2, developed by the U.S. Army Corp of Engineers, is commonly used by coastal engineers and scientists for beach-profile analysis. Beach-volume calculations were made using BMAP, and shoreline and vegetation-line positions are determined from notes made by students and scientists while in the field collecting data. The shoreline is designated by the wet/dry line or a berm crest. Volume, shoreline, and vegetation-line plots for sites collected by Ball, Port Aransas, and Port Isabel High Schools are found in Appendix B, profile plots are in Appendix C, and profile plots from Matagorda Peninsula are also included in Appendix C.

Students from Ball High School have been collecting data for the Coastal Monitoring Program since 1997. During this time, Tropical Storm Frances (September 1998) played a major role in reshaping the beaches in Galveston County. Several other severe storms have impacted the study area since the inception of the program. Allison (2001), Fay (2002), and Hurricane Claudette (2003) have each caused varying amounts of damage to beaches and dunes along the Texas coast (Fig. 6). Data collected by Ball High School students on Galveston Island have been used by scientists at the Bureau to track beach and dune recovery stages following Tropical Storm Frances. The storm caused significant damage to beaches along the southeast coast of Texas that was comparable to damage caused by category-3 Hurricane Alicia in 1983 (Hepner and Gibeaut, 2004).

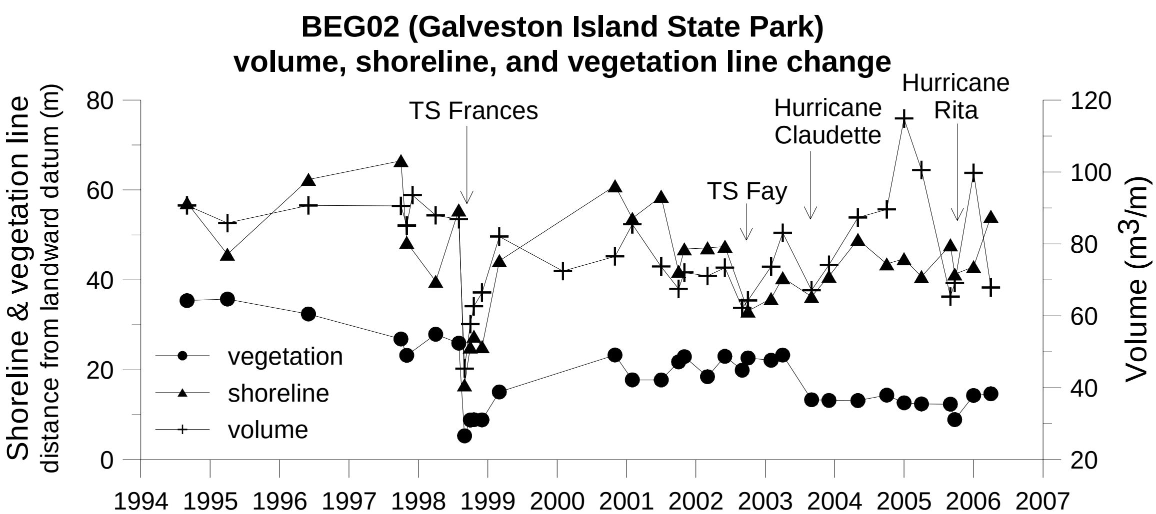

Figure 6. Profile volume, shoreline, and vegetation-line changes at Galveston Island State Park.

Ball High School students provided important pre-storm beach topography data from their two key locations during the 2005–2006 academic year. Hurricane Rita made landfall at Sabine Pass on the Texas/Louisiana border at 7:30 UTC on September 24, 2005. Rita was a category 3 hurricane with maximum sustained winds of about 105 knots. Overall, Rita did not cause episodic beach or dune erosion on Galveston or Follets Islands, as Frances did in 1998. Figure 7 is a plot of pre- and post-storm beach profiles measured at Galveston Island State Park. The pre-storm profile was measured by Ball High

School science students, and the post-storm profile was measured by the Coastal Studies Group from the Bureau of Economic Geology. Rita flattened the profile and caused a small amount of overwash deposition, but the position of the vegetation line and shoreline was not greatly affected (Fig. 6) (Gibeaut, 2005).

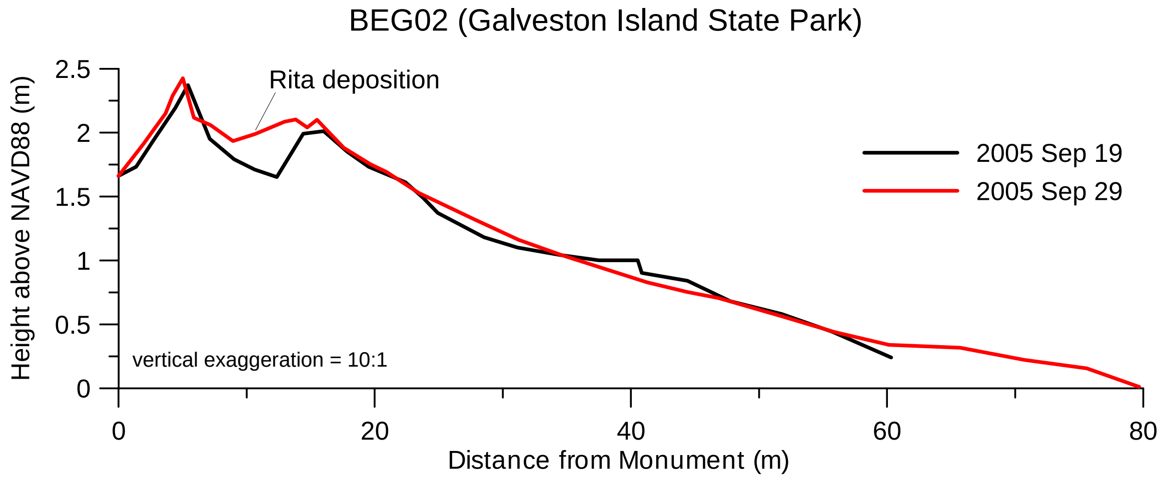

Figure 7. Plot of pre- and post-storm beach profiles measured at Galveston Island State Park.

The BEG02 beach profile at Galveston Island State Park is being incorporated into another study by Bureau scientists. The Bureau is responsible for monitoring impacts of geotextile tubes that have been installed along Galveston Island, Follets Island, and Bolivar Peninsula. Tropical Storm Frances (1998) put many homes on this stretch of coast in danger of being damaged or destroyed during subsequent storms and gradual shoreline retreat. In an effort to prevent such damage from occurring, geotextile-tube storm protection projects were constructed as temporary erosion-control measures. BEG02, located in Galveston Island State Park, is adjacent to a subdivision where the erosion control devices have been installed. One of the observations made during this study involved beach widths measured from the base of the geotextile tube or dune to the waterline. The BEG02 profile site in Galveston Island State Park is south of a geotextile-tube project in the Pirates Beach community. The beach in the relatively natural area of the State Park was wider than it was in front of the subdivision owing to the lack of restriction caused by placement of the geotextile tubes (Gibeaut et al., 2003) (Fig. 8).

Figure 8. Lidar topographic relief image of Galveston Island State Park and Pirates Beach subdivision. Note difference in beach width between the natural beach and in front of the subdivision.

Port Aransas and Port Isabel High Schools have been collecting beach-profile data and coastal-process observations since 1999. Although neither location has experienced the type of dramatic shoreline change that Galveston and Follets Islands have, the information gained from the students' work has been beneficial to Bureau researchers' understanding of the dynamics of the Texas coast. Biannually Brazos Santiago Pass, the southern border of South Padre Island, is dredged. The Pass serves as the southern Gulf of Mexico access to the Gulf Intracoastal Waterway and the Port of Brownsville. Dredged material is placed on beaches of South Padre Island, and the two sites monitored by Port Isabel High School students are within the nourishment areas. The SPI02 monitoring site has also been used by students and scientists to monitor the growth of dunes. When SPI02 was established in August 2000, there were no dunes between the seawall and the waterline at this location. Since that time, sand fences have been installed, and vegetation has been planted. Profile data have been quantifying the effects of these actions (Fig. 9).

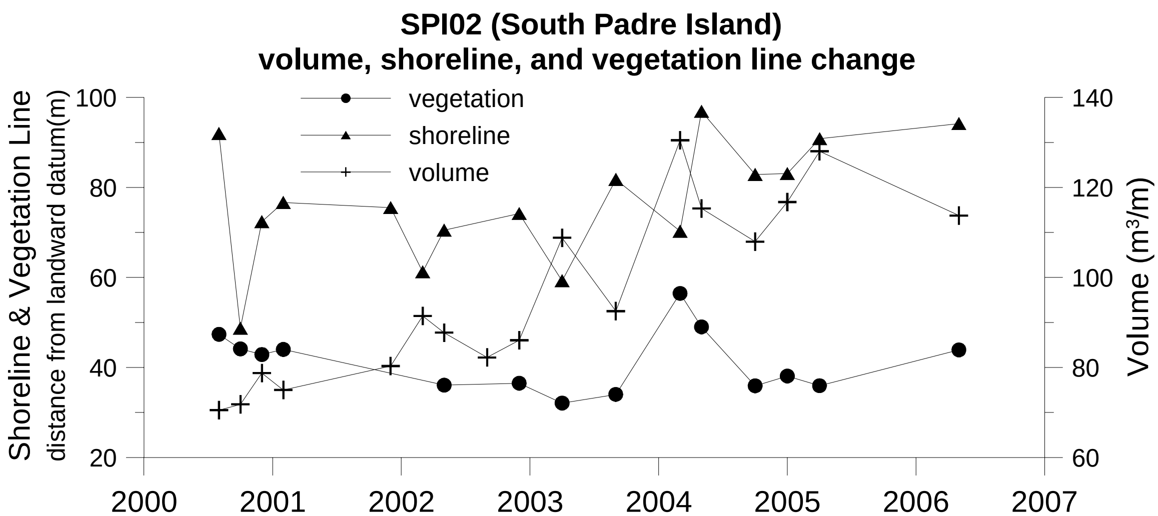

Figure 9. Changes at SPI02 on South Padre Island due to installation of sand fence and beach nourishment.

Van Vleck, Tidehaven, and Bay City students have just completed their first set of beach measurements at Matagorda Bay Nature Park. The park has two special circumstances that make this monitoring especially informative and important. Monitoring sites have been established on the up-drift side of the jetty at the mouth of the Colorado River and at sites that allow us to compare a beach/dune system where vehicular traffic on the beach will be strictly prohibited, along with an adjacent area where vehicular traffic will continue to be permitted. The impacts of coastal structures (jetties) are critical to coastal management, and the impacts of vehicles on Texas' beaches are not well documented. Vehicular traffic is still permitted on what will become the pedestrian beach at Nature Park. Data collected during the 2005–2006 academic year will serve as baseline data for this study on vehicular impact on beaches. Future measurements will show not only change through time at each location but also spatial variation along the Texas coast. Through time, data collected from Matagorda Peninsula will help scientists better understand the relationship between coastal processes, beach morphology, and shoreline change at these locations. Future measurements by all six schools will show not only change through time at each location, but also spatial variation along the Texas coast.

CONCLUSIONS

The Texas High School Coastal Monitoring Program provides high school students with a real-world learning experience outside the everyday classroom. The coastal monitoring program not only provides hands-on education, but it also complies with many TEKS requirements. The 2005–2006 academic year was productive, with Ball, Port Aransas, and Port Isabel High Schools collecting data on several field trips. Van Vleck and Tidehaven Middle Schools and Bay City High School joined the Monitoring Program and began collecting data on Matagorda Peninsula.

In the 9 years since the inception of The Texas High School Coastal Monitoring Program, work of the students at Ball, Port Aransas, Port Isabel, and Bay City High Schools and Van Vleck and Tidehaven Middle Schools has been beneficial to Bureau researchers and coastal managers. Efforts of the students have been useful to several Bureau research projects. Availability of data through the Program's Website allows access to coastal managers and the public. Scientists, students, and the public will continue to gain a better understanding of coastal processes and shoreline change along the Texas coast through this successful student research program.

RECOMMENDATIONS

We consider the ninth year of the Texas High School Coastal Monitoring Program a success and offer the following recommendations for continuance and expansion of the program.

1. Emphasize to students that they are working on a real research project and are collecting scientifically valid data that will eventually appear in a scientific publication. This is a major point that makes this program different from most other field trips or laboratory exercises. Asking students to conduct experiments that have real consequences seems to make a difference to them, and it probably improves the quality of the data.

2. Clearly tell students about the specific scientific problems being addressed, but also emphasize that what they are gaining in experience is not just how to measure beaches but how to conduct scientific field research in general. Students are also learning a different way of viewing their surroundings.

3. Survey a reasonable number of beaches, which, in most cases, means two or three. The program goals of scientific research and science education could be at odds with one another. From a purely scientific point of view, it would be desirable to acquire as many data as possible. That approach, however, would not allow time for discussions on the beach that are not directly related to the measurements. It would also hinder development of observation skills and keep students from enjoying their work.

4. The number of official field trips depends on the class, but a maximum of four trips is reasonable. Some trips may have to be cancelled because of bad weather or other unusual circumstances, and cancelled trips can be difficult to reschedule. Therefore, some freedom must be allowed in the program regarding number of trips and sites measured. Even if just one good data set is collected during the year, it will be useful scientifically. Some students might be encouraged to make additional trips on weekends or after school. Interested students should be encouraged to use the program in a science fair project.

5. When adding schools or a new teacher to the program, a 1- to 2-day seminar before the school year begins and including as many teachers as possible is desirable. If such a seminar could be held, instruction would be more efficient, and teachers and scientists would benefit in the exchange of ideas.

6. A Website adds an important dimension to the project, especially when multiple schools are participating. A Website at which students can exchange observations with those of other schools in Texas increases the educational value of the program by allowing students to observe differences in processes acting along the coast. A Website also illustrates to students how the Internet can be used to conduct research. Furthermore, the Internet is crucial in increasing public awareness of coastal processes, so providing immediate feedback to students through the Internet is important. Students want to see their data and photographs on the Web, and feedback increases their interest in the project.

7. Encourage teachers to incorporate the data into the curriculum for their other classes. One of the goals of the program is to increase public awareness and understanding of coastal processes and hazards. Disseminating data gathered by their peers may increase the interest of students not directly involved in the Coastal Monitoring Program. Data collected and knowledge gained from analysis of the data are applicable to all Environmental Science, Geology, Aquatic Sciences, and Oceanography curricula.

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Gibeaut, J. C., Hepner, T. L., Waldinger, R. L., Andrews, J. R., Smyth, R. C., and Gutierrez, R., 2003. Geotextile tubes along the upper Texas Gulf coast: May 2000 to March 2003. The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Coastal Coordination Council pursuant to National Oceanic and Atmospheric Administration Award No. NA07OZ0134, under GLO contract number 02-493 R, 37 p. + apps.

Hepner, T. L., and J. C. Gibeaut, 2004. Tracking post-storm beach recovery using data collected by Texas high school students. *Shore and Beach*. Volume 72, Number 4. Pages 5 to 9.

APPENDIX A: PROFILE INFORMATION

All profile coordinates are in NAD83. Heights above the GRS80 Ellipsoid were converted to North American Vertical Datum 88 (NAVD88) using the Geiod99 Ellipsoid Model.

Profile	Latitude (deg min)	Longitude (deg min)	Easting (m)	Northing (m)	HAE (m)	NAVD88 (m)	Azimuth (M)
BEG02	29 11.64	94 57.09	310255.20	3231059.16	-24.75	2.54	139
BEG08	29 3.22	95 8.90	290838.52	3215830.51	-25.21	2.09	145

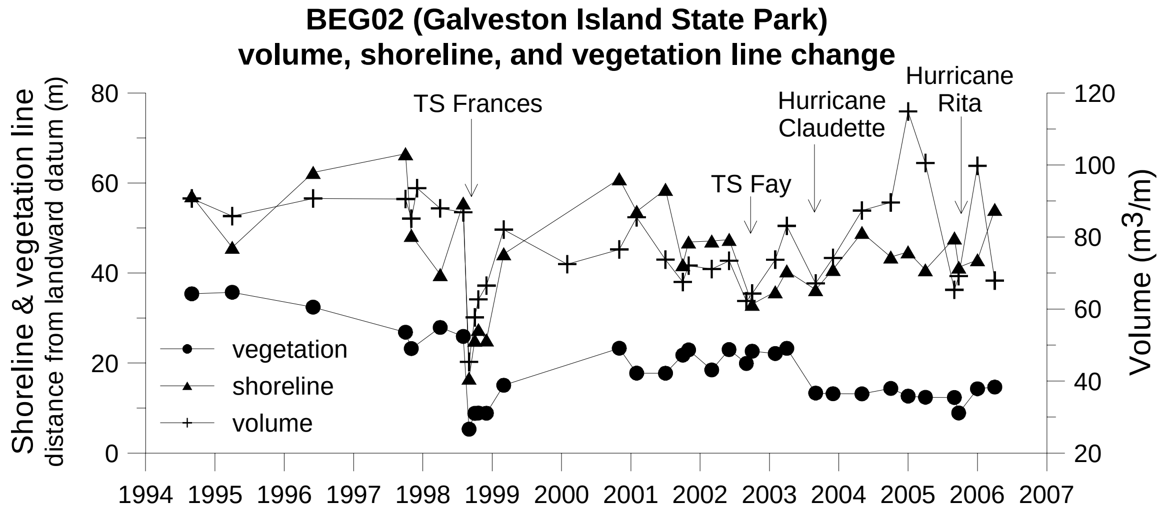
Profile	Latitude (deg min)	Longitude (deg min)	Easting (m)	Northing (m)	HAE (m)	NAVD88 (m)	Azimuth (M)
MUI01	27 49.53	97 03.40	691396.24	3079393.46	-22.29	3.79	123
MUI02	27 40.42	97 10.19	680502.58	3062388.03	-24.14	1.69	120
MUI03	27 47.66	97 05.08	688697.42	3075882.34	-22.08	3.95	125

Profile	Latitude (deg min)	Longitude (deg min)	Easting (m)	Northing (m)	HAE (m)	NAVD88 (m)	Azimuth (M)
SPI01	26 4.57	97 9.46	684274.71	2885422.83	-18.48	2.75	70
SPI02	26 6.79	97 9.93	683438.99	2889509.24	-18.11	3.19	78

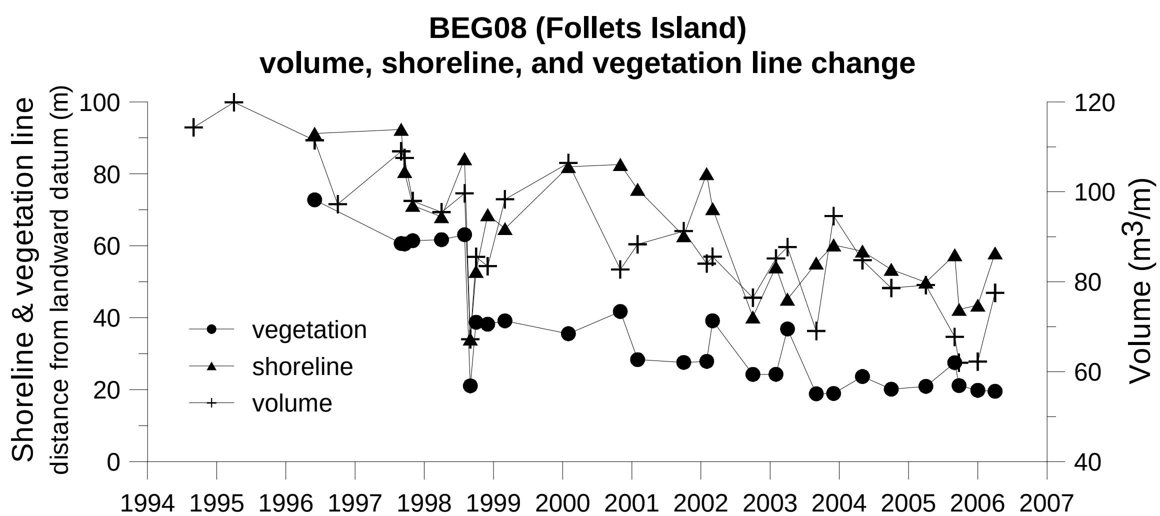
Profile	Latitude (deg min)	Longitude (deg min)	Easting (m)	Northing (m)	HAE (m)	NAVD88 (m)	Azimuth (M)
MAT01	28 36.67	95 56.55	212269.73	3168453.74	-22.77	3.69	148
MAT02	28 36.31	95 57.47	210751.39	3167825.80	-23.25	3.22	148
MAT03	28 35.91	95 58.48	309090.26	3167112.23	-21.81	4.68	148

APPENDIX B: GRAPHS OF VOLUME, SHORELINE, AND VEGETATION-LINE CHANGE

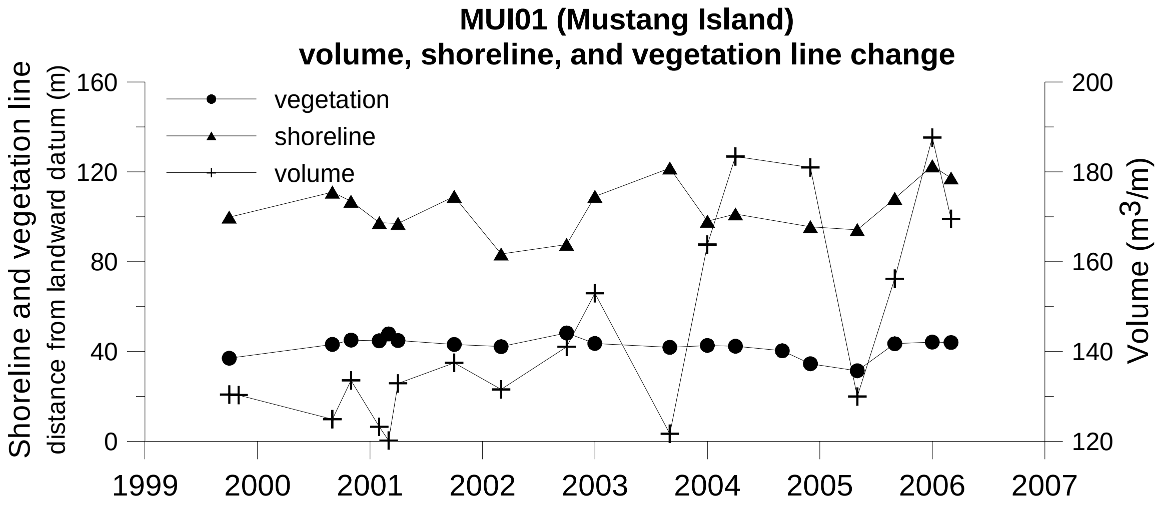
BEG02 volumes are calculated from datum to 1.5 m below datum. Profiles that did not extend to –1.5 m were extrapolated.



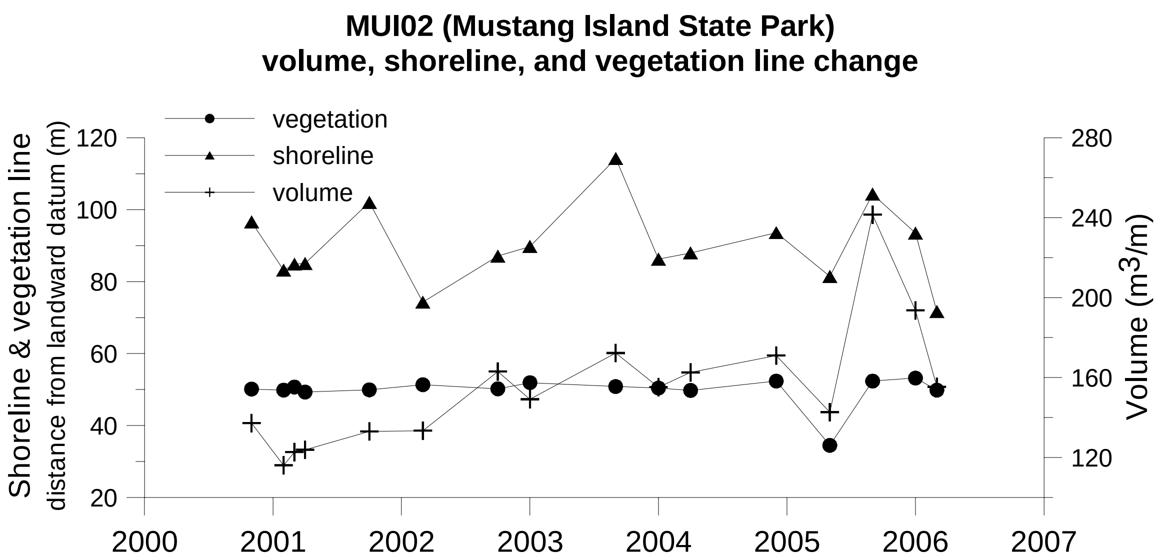
BEG08 volumes are calculated from datum to 1.5 m below datum. Profiles that did not extend to –1.5 m were extrapolated.



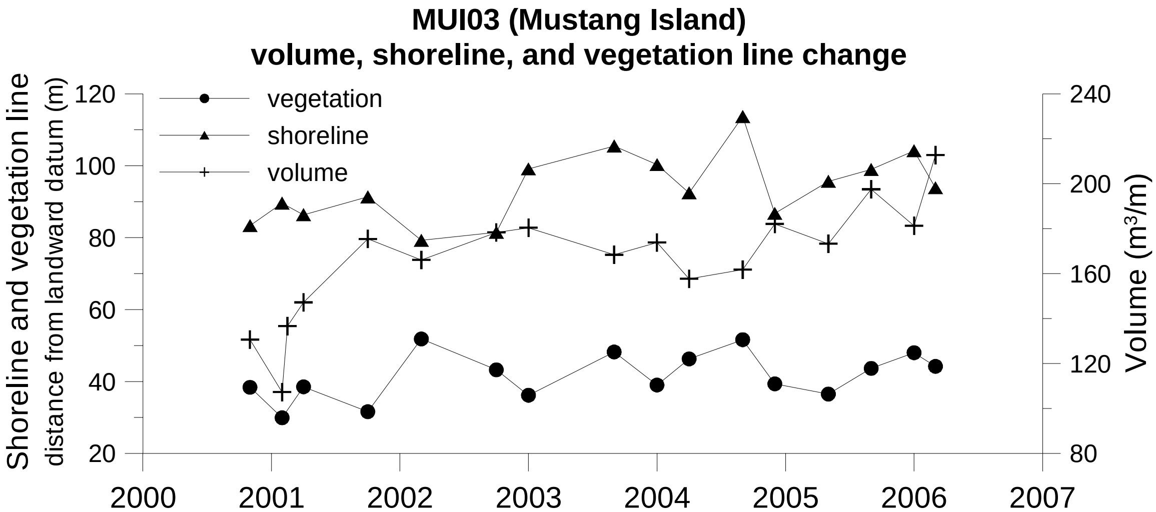
MUI01 volumes are calculated from datum to 3 m below datum. Profiles that did not extend to –3 m were extrapolated.



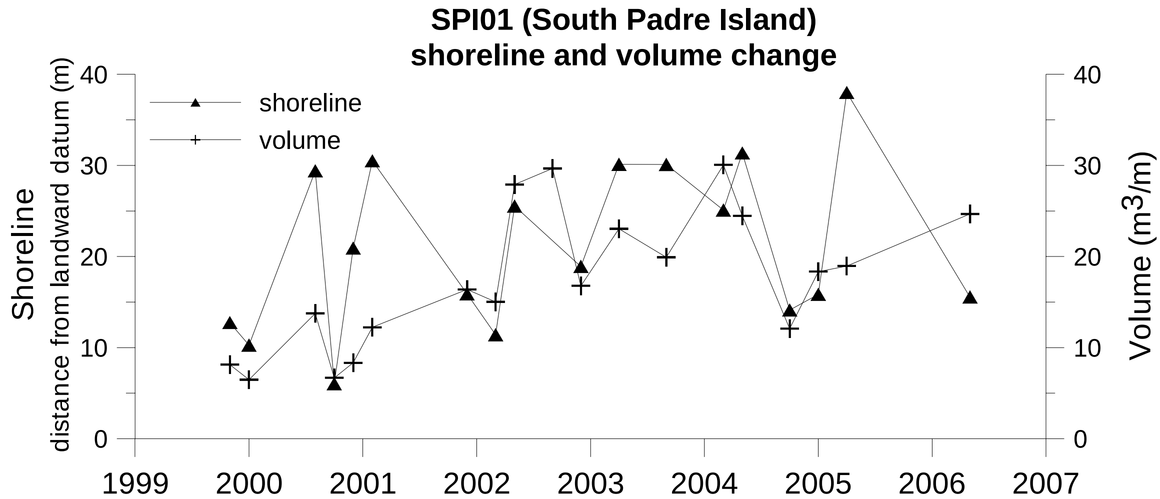
MUI02 volumes were calculated from datum to 1 m below datum. Profiles that did not extend to –1 m were extrapolated.



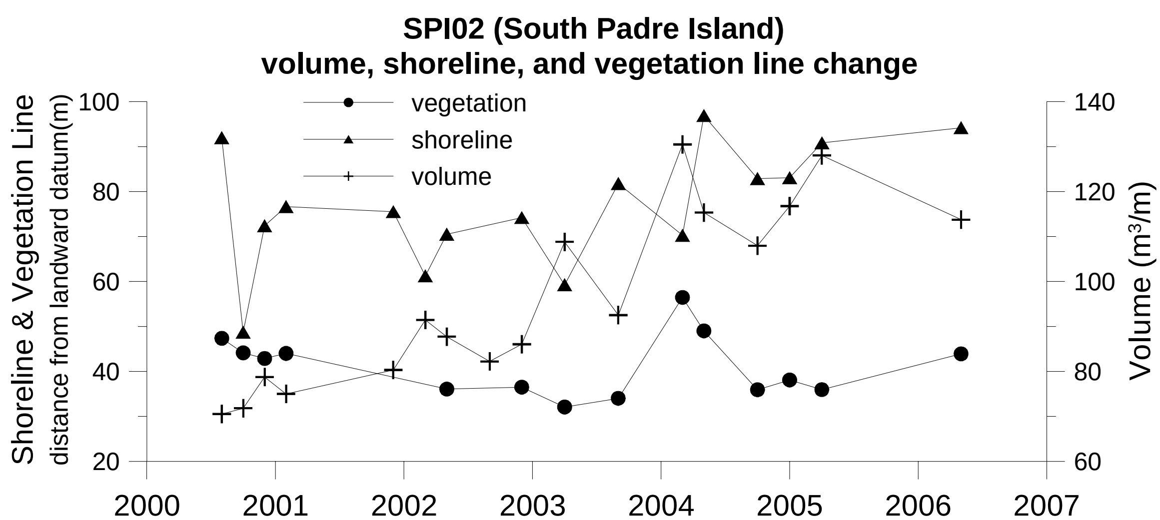
MUI03 volumes were calculated from datum to 3.25 m below datum. Profiles that did not extend to –3.25 m were extrapolated.



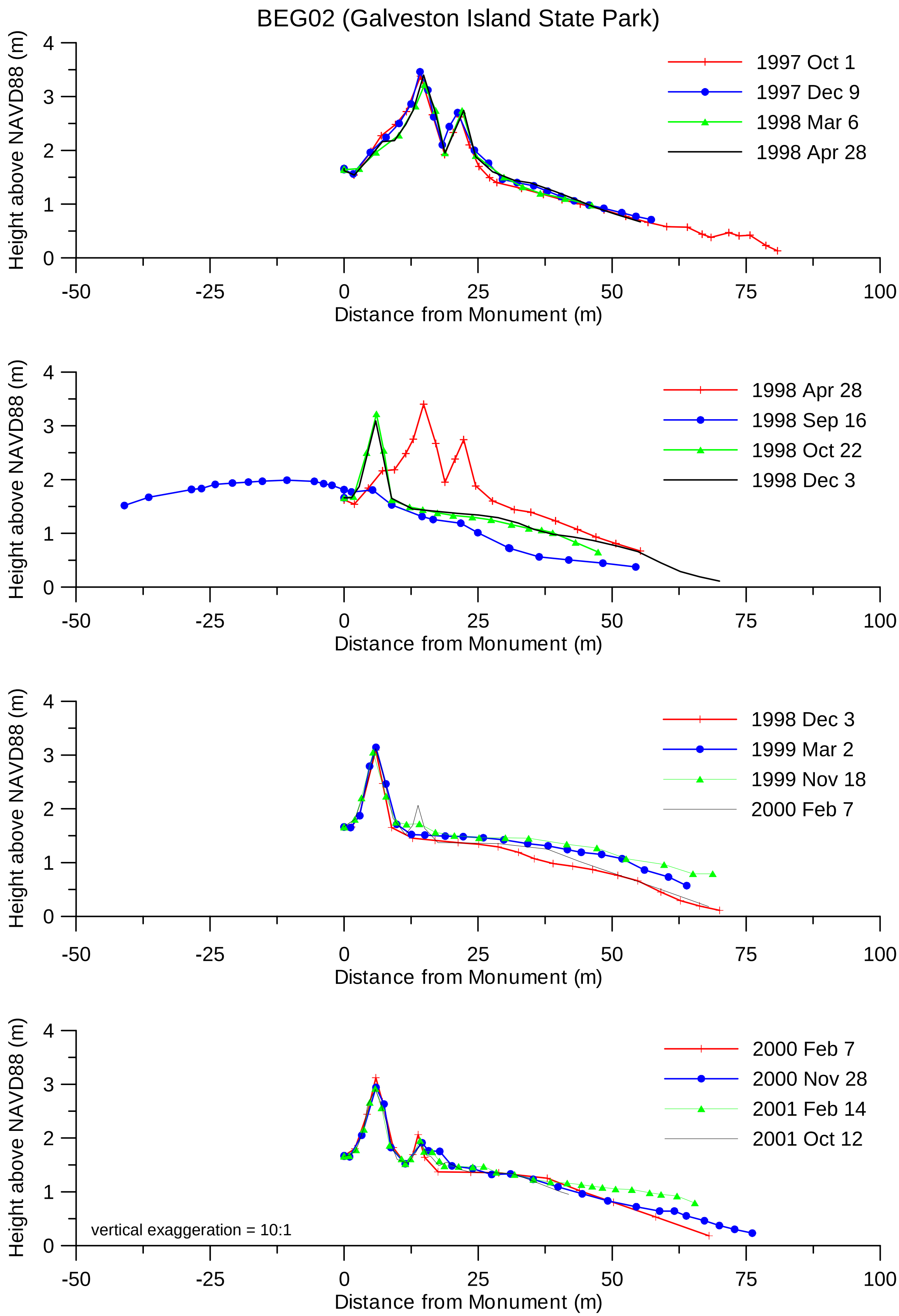
SPI01 volumes were calculated from datum to 2.25 m below datum. Profiles that did not extend to –2.25 m were extrapolated.

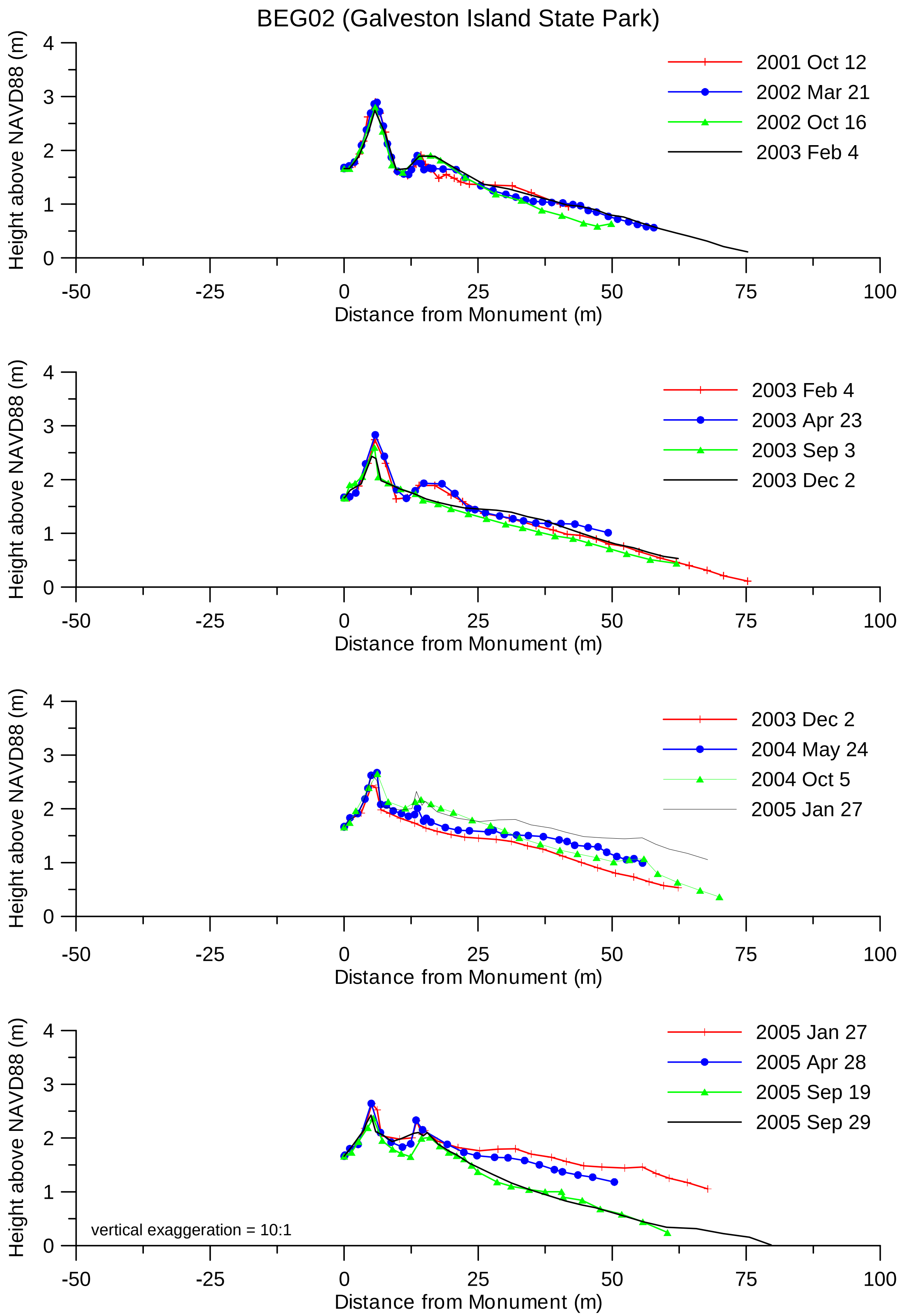


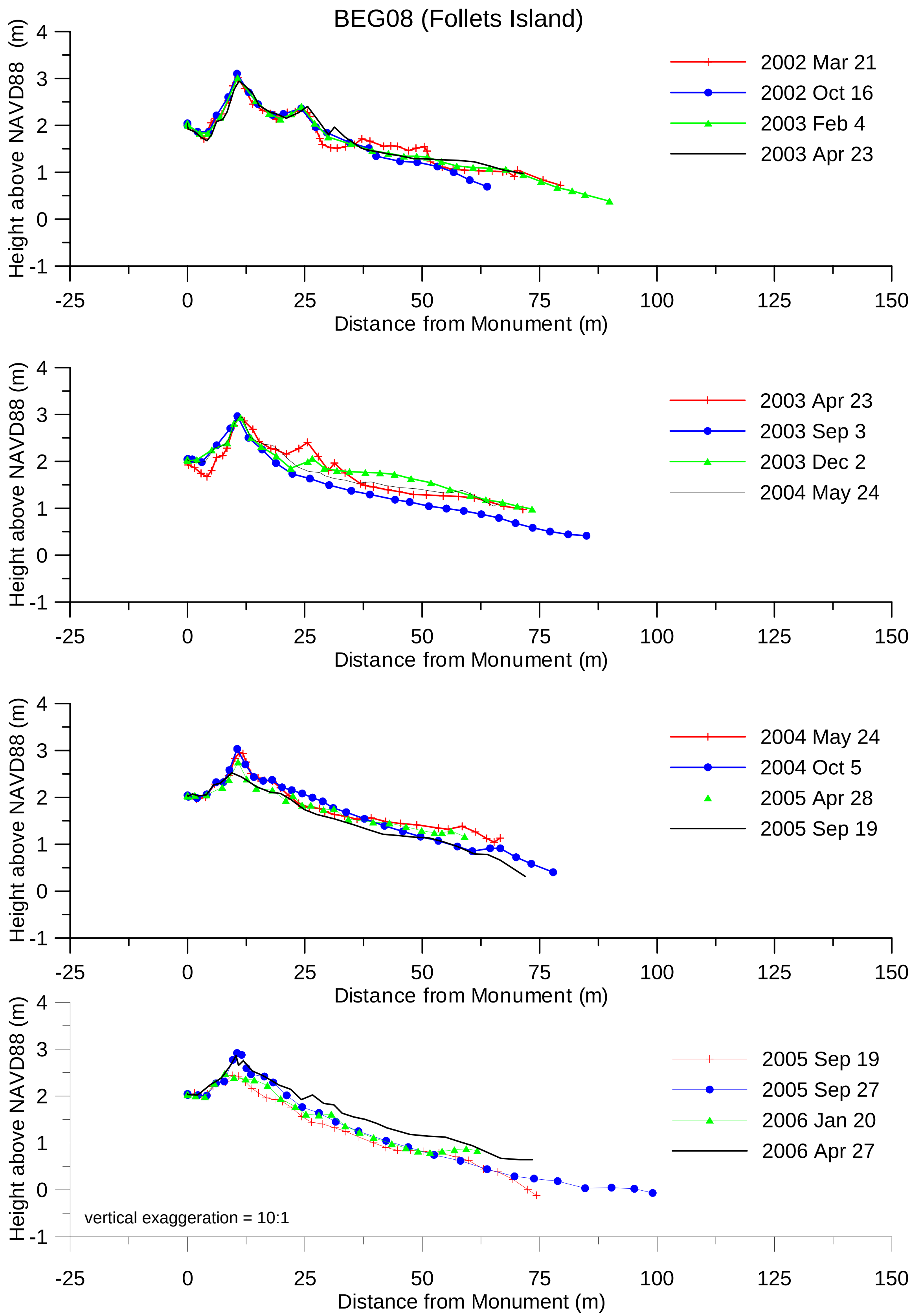
SPI02 volumes were calculated from datum to 2.5 m below datum. Profiles that did not extend to –2.5 m depth were extrapolated.

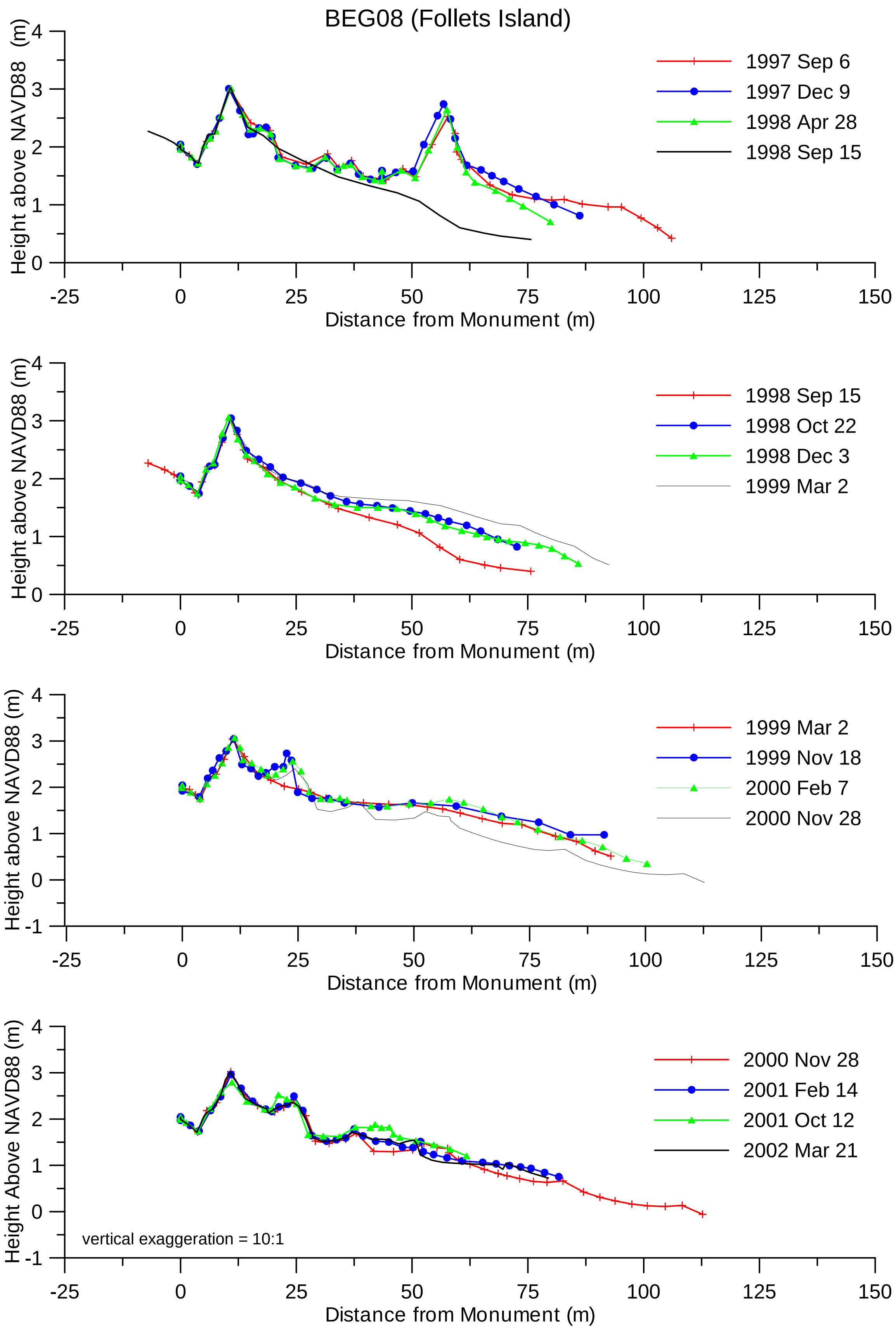


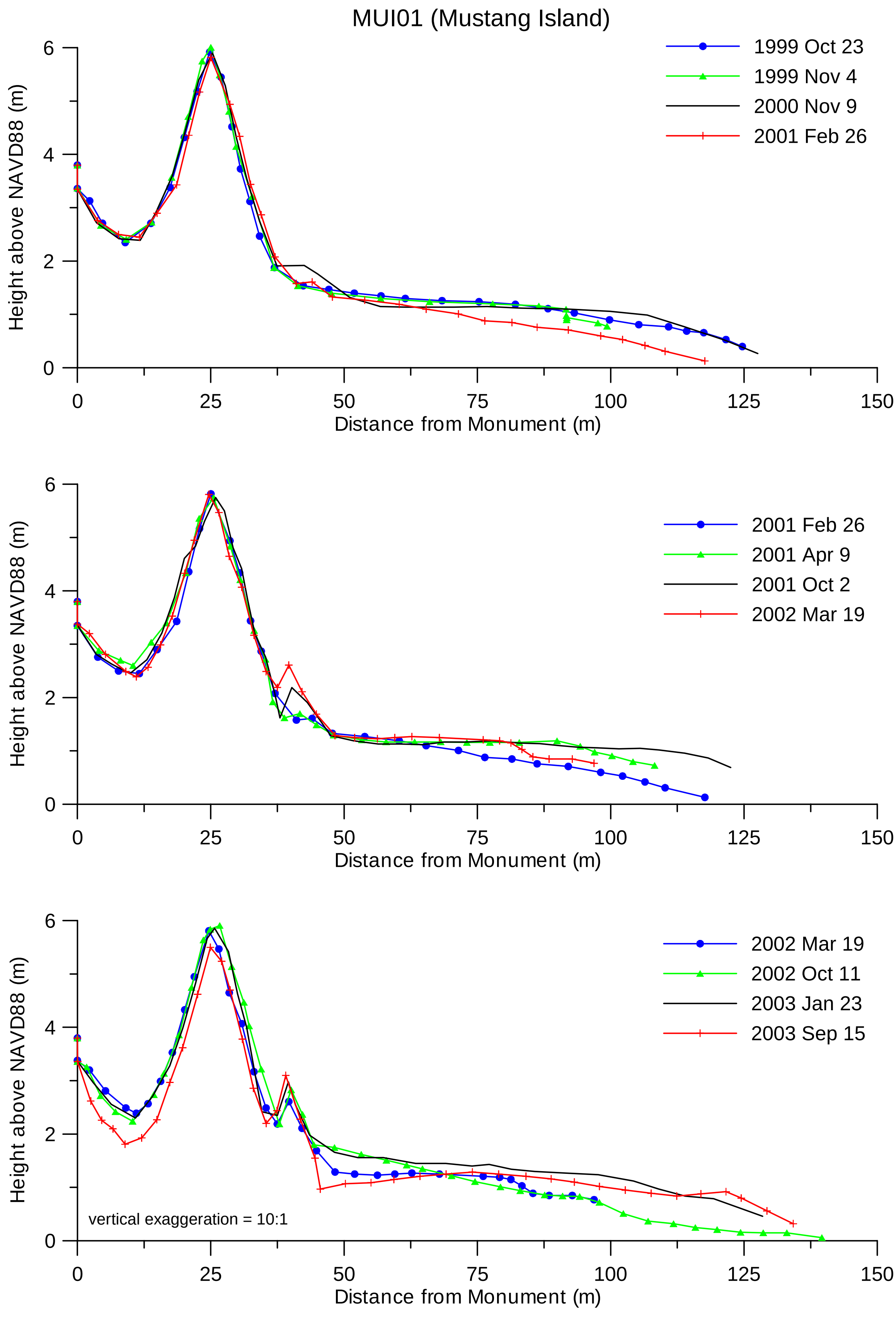
APPENDIX C: GRAPHS OF BEACH PROFILES

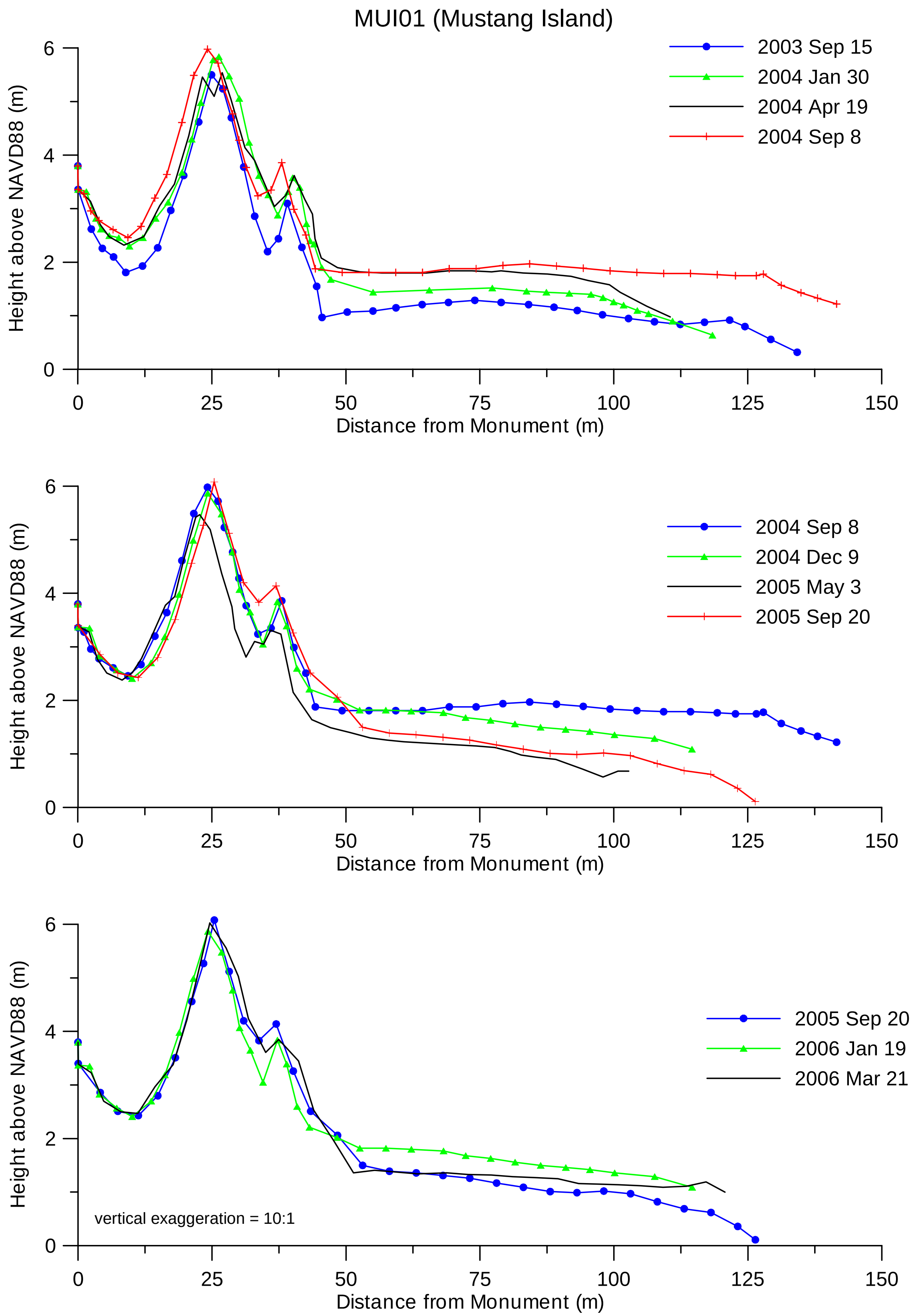

BEG02 (Galveston Island State Park)
Height above NAVD88 (m)
Distance from Monument (m)
1997 Oct 1
1997 Dec 9
1998 Mar 6
1998 Apr 28
1998 Apr 28
1998 Sep 16
1998 Oct 22
1998 Dec 3
1998 Dec 3
1999 Mar 2
1999 Nov 18
2000 Feb 7
2000 Feb 7
2000 Nov 28
2001 Feb 14
2001 Oct 12
vertical exaggeration = 10:1

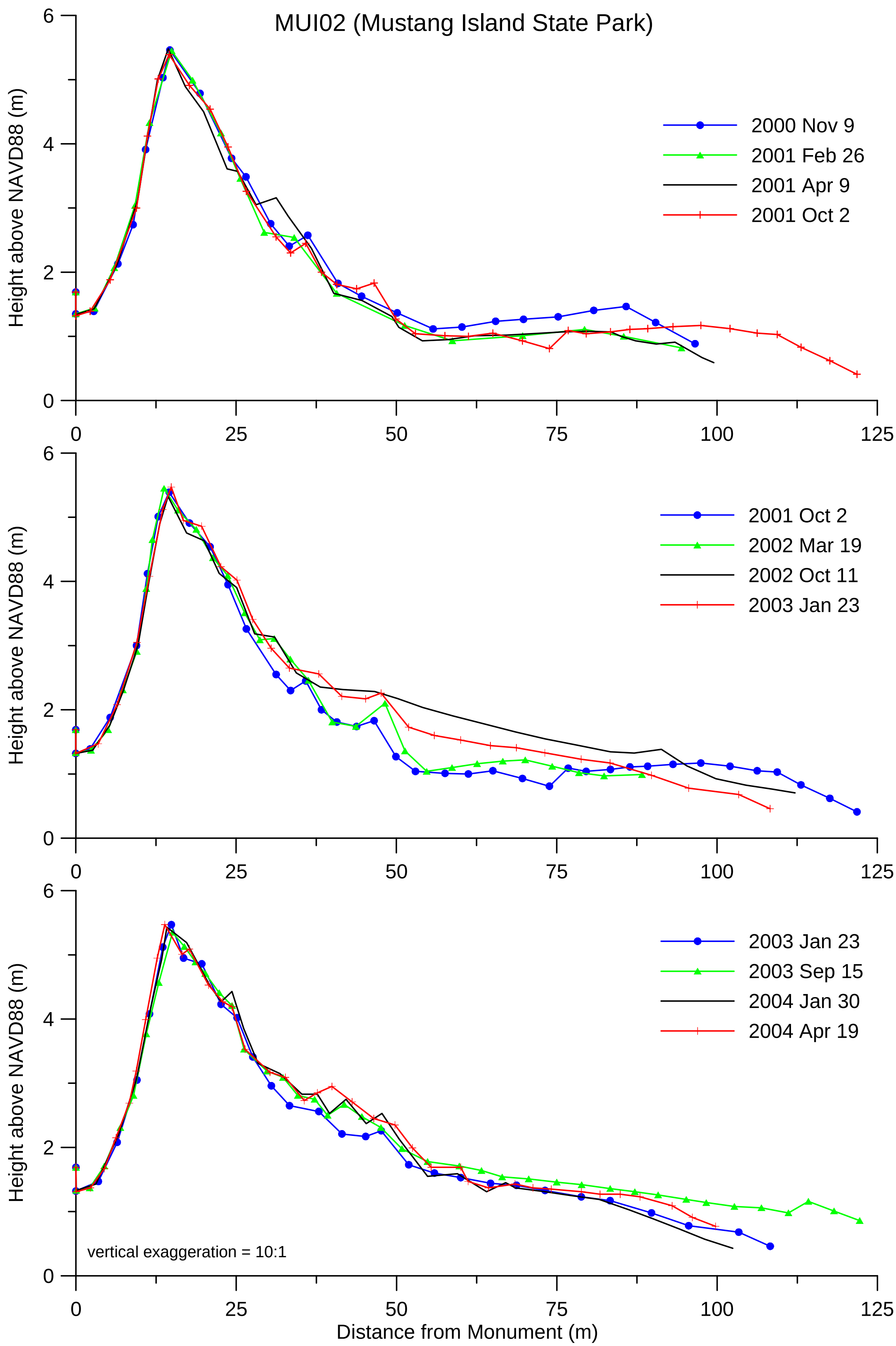

BEG02 (Galveston Island State Park)
Height above NAVD88 (m)
Distance from Monument (m)
2001 Oct 12
2002 Mar 21
2002 Oct 16
2003 Feb 4
2003 Feb 4
2003 Apr 23
2003 Sep 3
2003 Dec 2
2003 Dec 2
2004 May 24
2004 Oct 5
2005 Jan 27
2005 Jan 27
2005 Apr 28
2005 Sep 19
2005 Sep 29
vertical exaggeration = 10:1

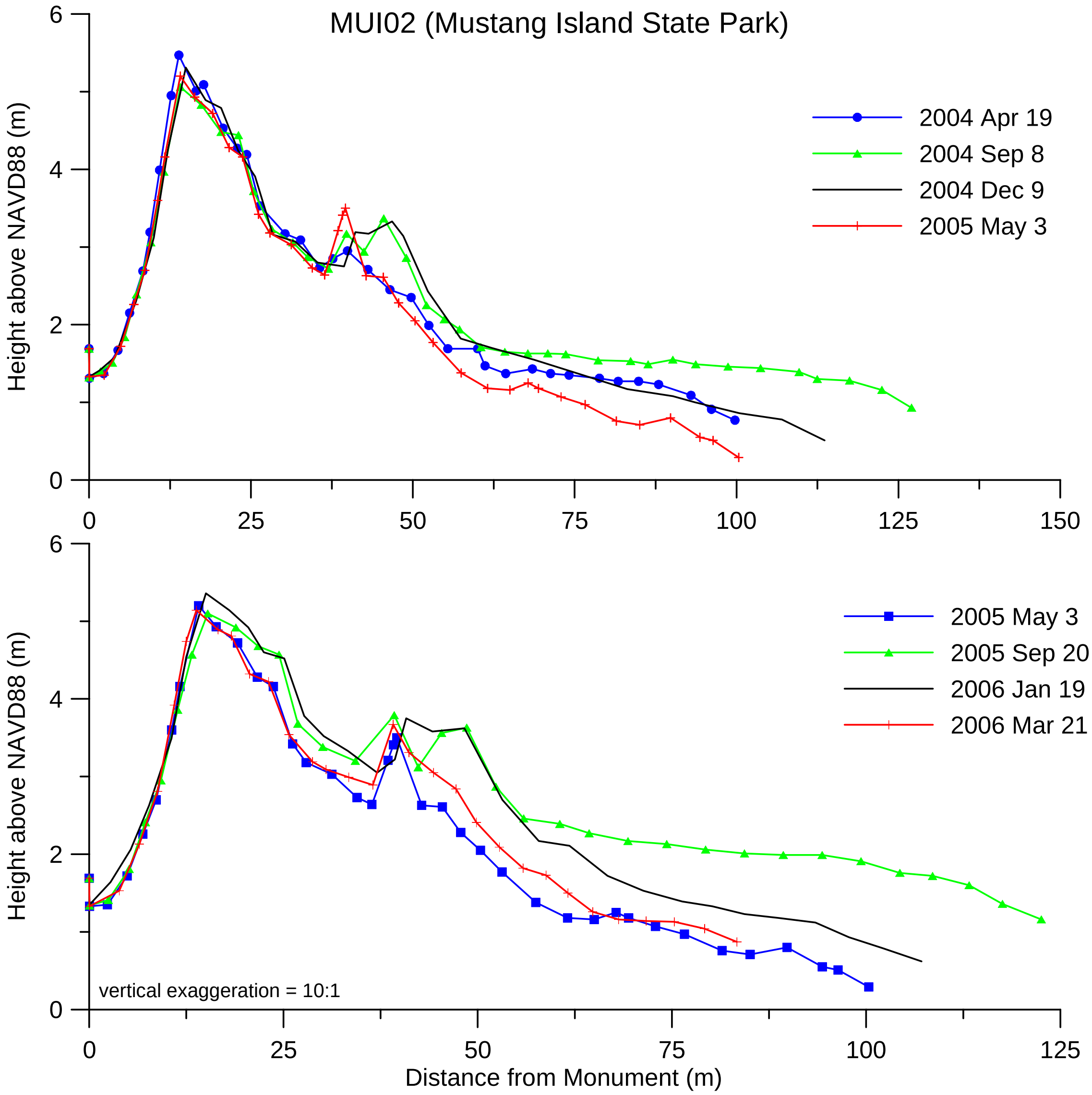

BEG08 (Follets Island)
Height above NAVD88 (m)
Distance from Monument (m)
2002 Mar 21
2002 Oct 16
2003 Feb 4
2003 Apr 23
2003 Apr 23
2003 Sep 3
2003 Dec 2
2004 May 24
2004 May 24
2004 Oct 5
2005 Apr 28
2005 Sep 19
2005 Sep 19
2005 Sep 27
2006 Jan 20
2006 Apr 27
vertical exaggeration = 10:1
-25
0
25
50
75
100
125
150
4
3
2
1
0
-1

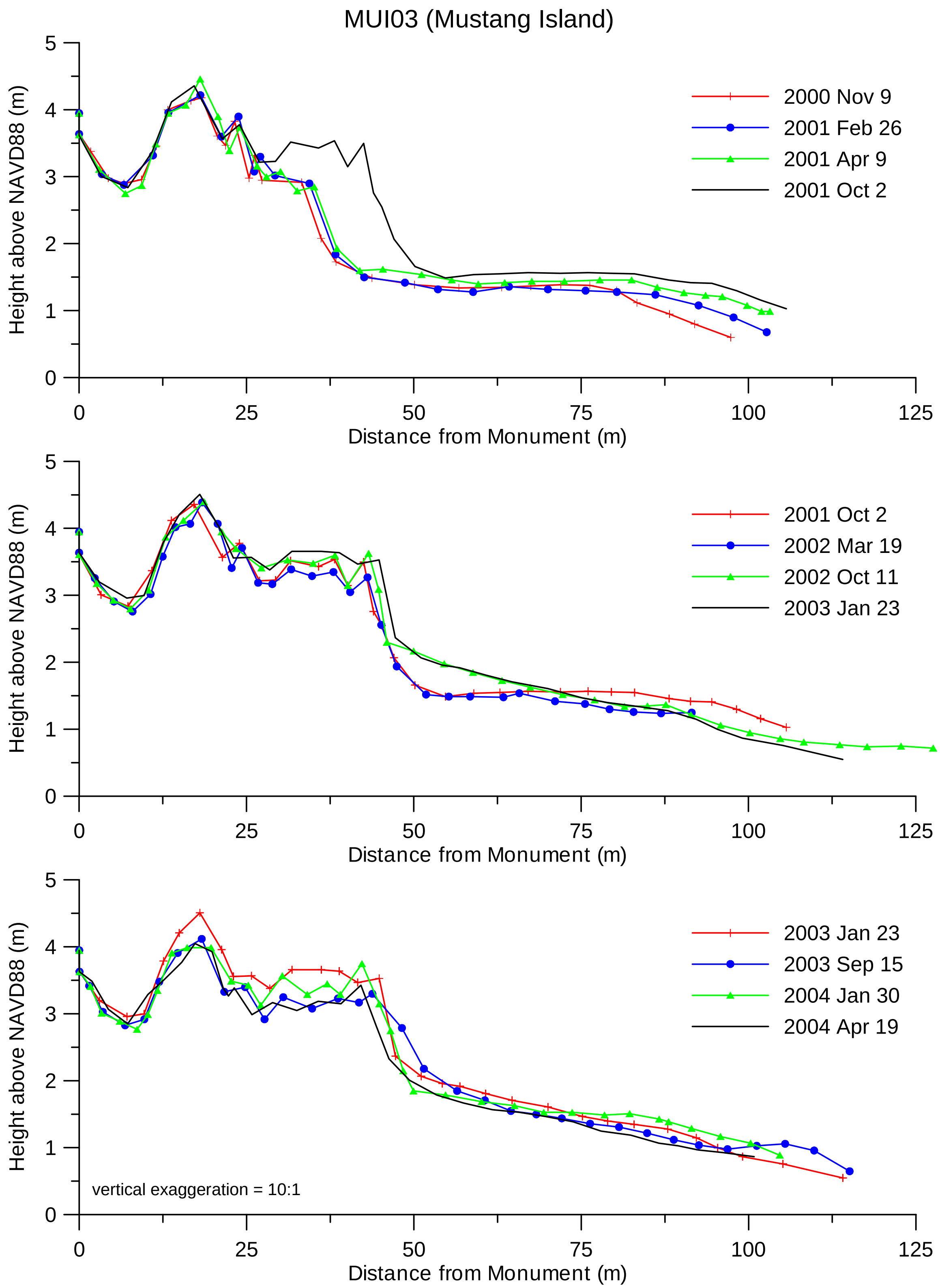

BEG08 (Follets Island)
Height above NAVD88 (m)
Distance from Monument (m)
1997 Sep 6
1997 Dec 9
1998 Apr 28
1998 Sep 15
1998 Sep 15
1998 Oct 22
1998 Dec 3
1999 Mar 2
1999 Mar 2
1999 Nov 18
2000 Feb 7
2000 Nov 28
2000 Nov 28
2001 Feb 14
2001 Oct 12
2002 Mar 21
Height Above NAVD88 (m)
vertical exaggeration = 10:1


MUI01 (Mustang Island)
1999 Oct 23
1999 Nov 4
2000 Nov 9
2001 Feb 26
Height above NAVD88 (m)
Distance from Monument (m)
2001 Feb 26
2001 Apr 9
2001 Oct 2
2002 Mar 19
Height above NAVD88 (m)
Distance from Monument (m)
2002 Mar 19
2002 Oct 11
2003 Jan 23
2003 Sep 15
vertical exaggeration = 10:1
Height above NAVD88 (m)
Distance from Monument (m)

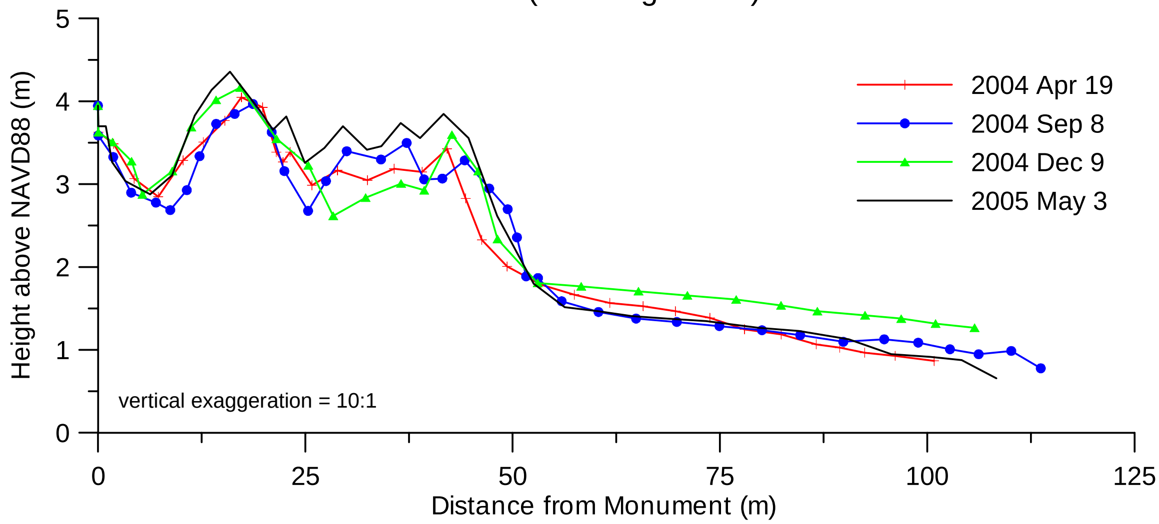

MUI01 (Mustang Island)
Height above NAVD88 (m)
Distance from Monument (m)
2003 Sep 15
2004 Jan 30
2004 Apr 19
2004 Sep 8
2004 Sep 8
2004 Dec 9
2005 May 3
2005 Sep 20
2005 Sep 20
2006 Jan 19
2006 Mar 21
vertical exaggeration = 10:1

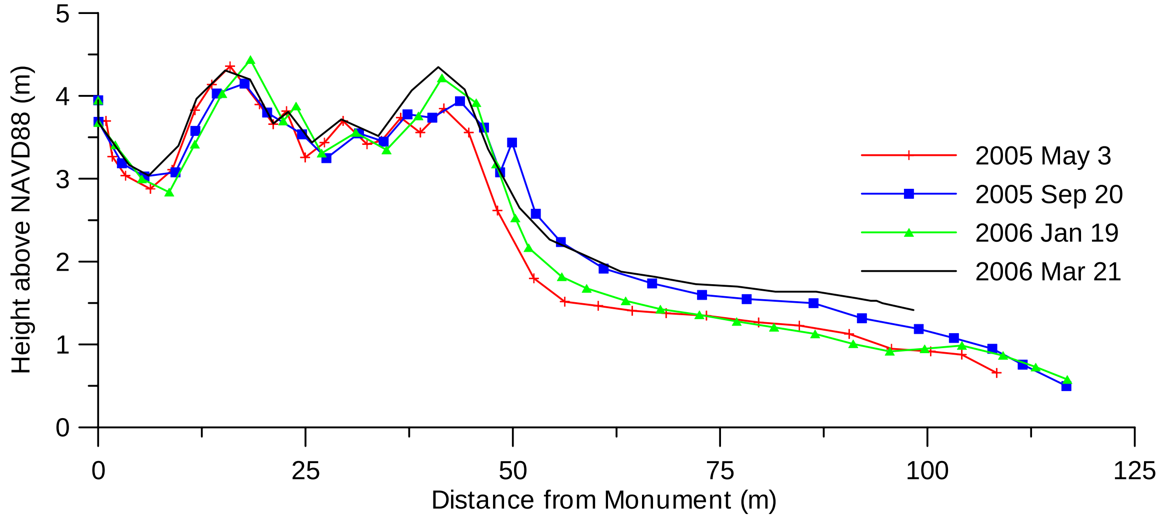

MUI02 (Mustang Island State Park)
Height above NAVD88 (m)
2000 Nov 9
2001 Feb 26
2001 Apr 9
2001 Oct 2
2002 Mar 19
2002 Oct 11
2003 Jan 23
2003 Sep 15
2004 Jan 30
2004 Apr 19
vertical exaggeration = 10:1
Distance from Monument (m)
0
25
50
75
100
125
2
4
6


MUI02 (Mustang Island State Park)
Height above NAVD88 (m)
2004 Apr 19
2004 Sep 8
2004 Dec 9
2005 May 3
0
2
4
6
0
25
50
75
100
125
150
2005 May 3
2005 Sep 20
2006 Jan 19
2006 Mar 21
vertical exaggeration = 10:1
Distance from Monument (m)

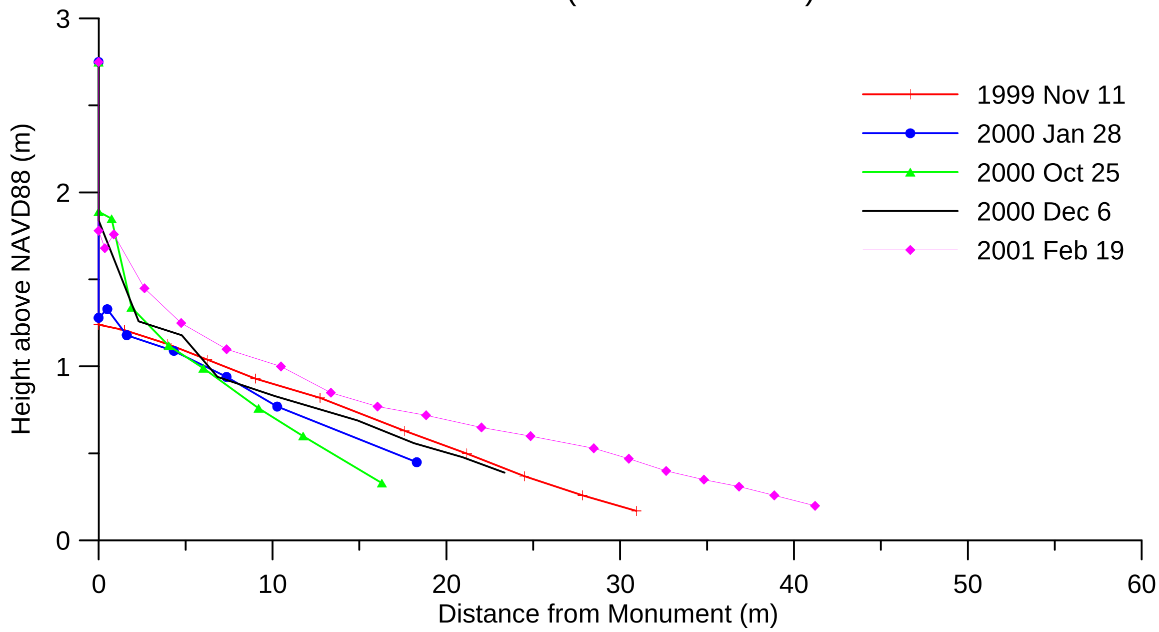

MUI03 (Mustang Island)
Height above NAVD88 (m)
Distance from Monument (m)
0
1
2
3
4
5
0
25
50
75
100
125
2000 Nov 9
2001 Feb 26
2001 Apr 9
2001 Oct 2
2001 Oct 2
2002 Mar 19
2002 Oct 11
2003 Jan 23
2003 Jan 23
2003 Sep 15
2004 Jan 30
2004 Apr 19
vertical exaggeration = 10:1

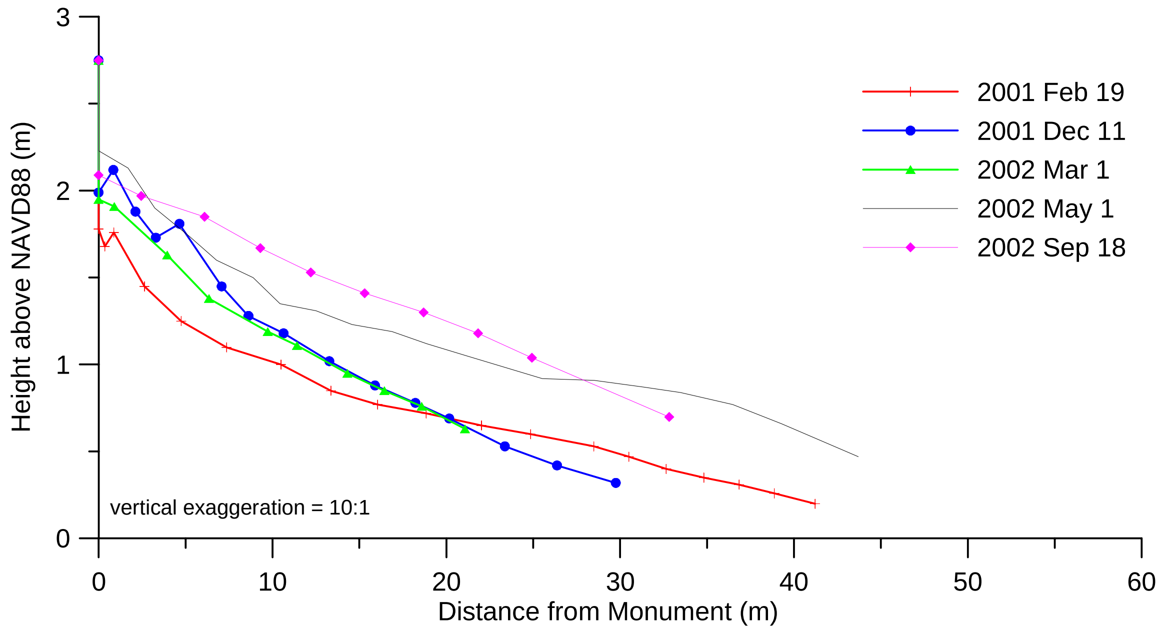
MUI03 (Mustang Island)



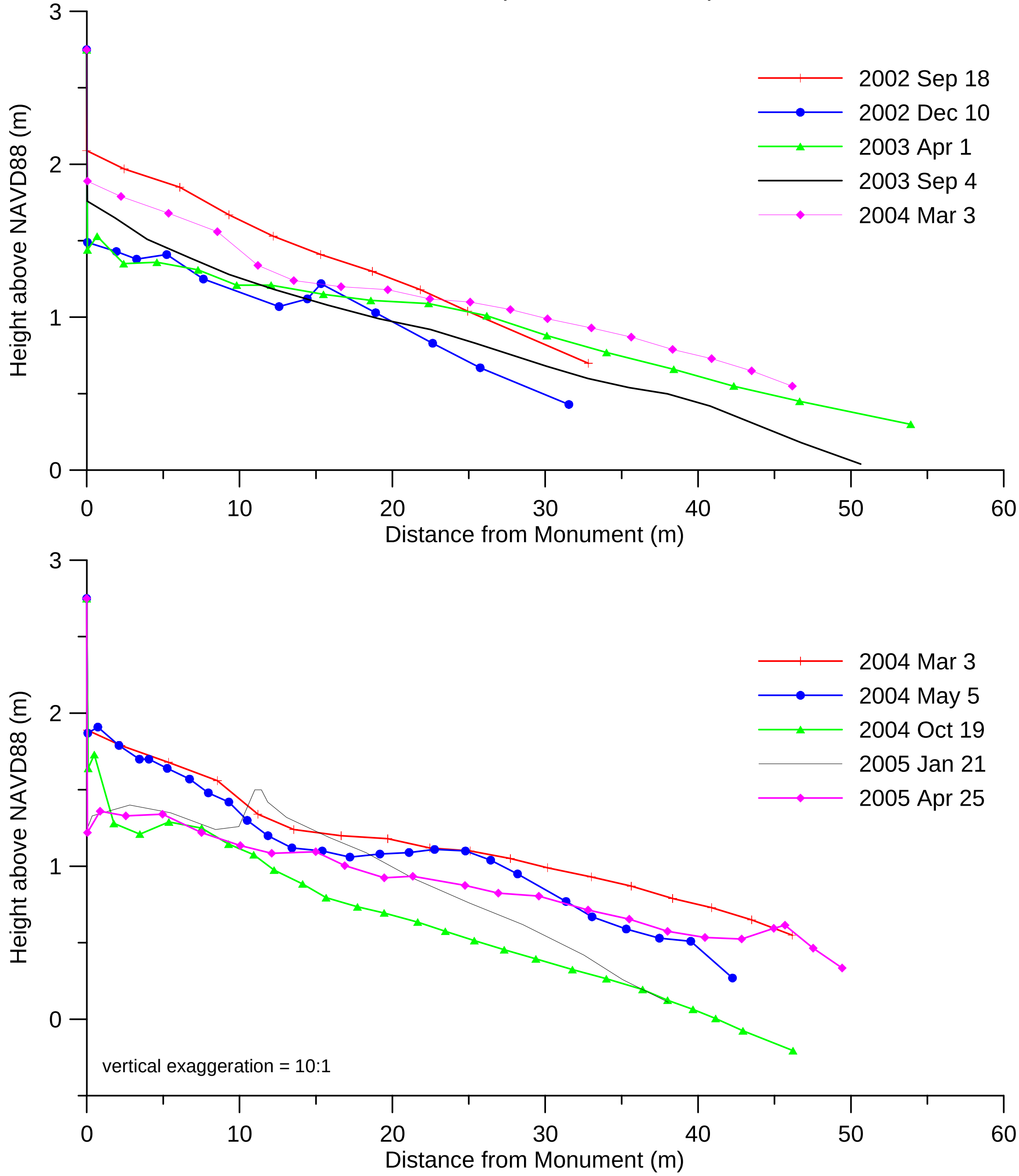


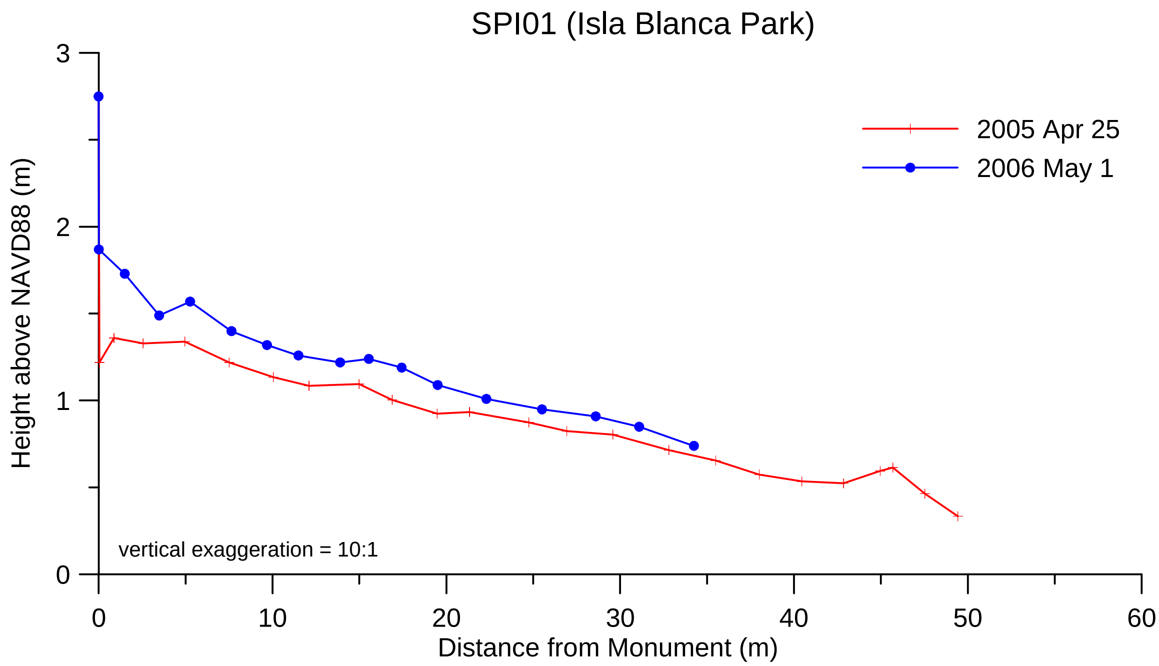
SPI01 (Isla Blanca Park)

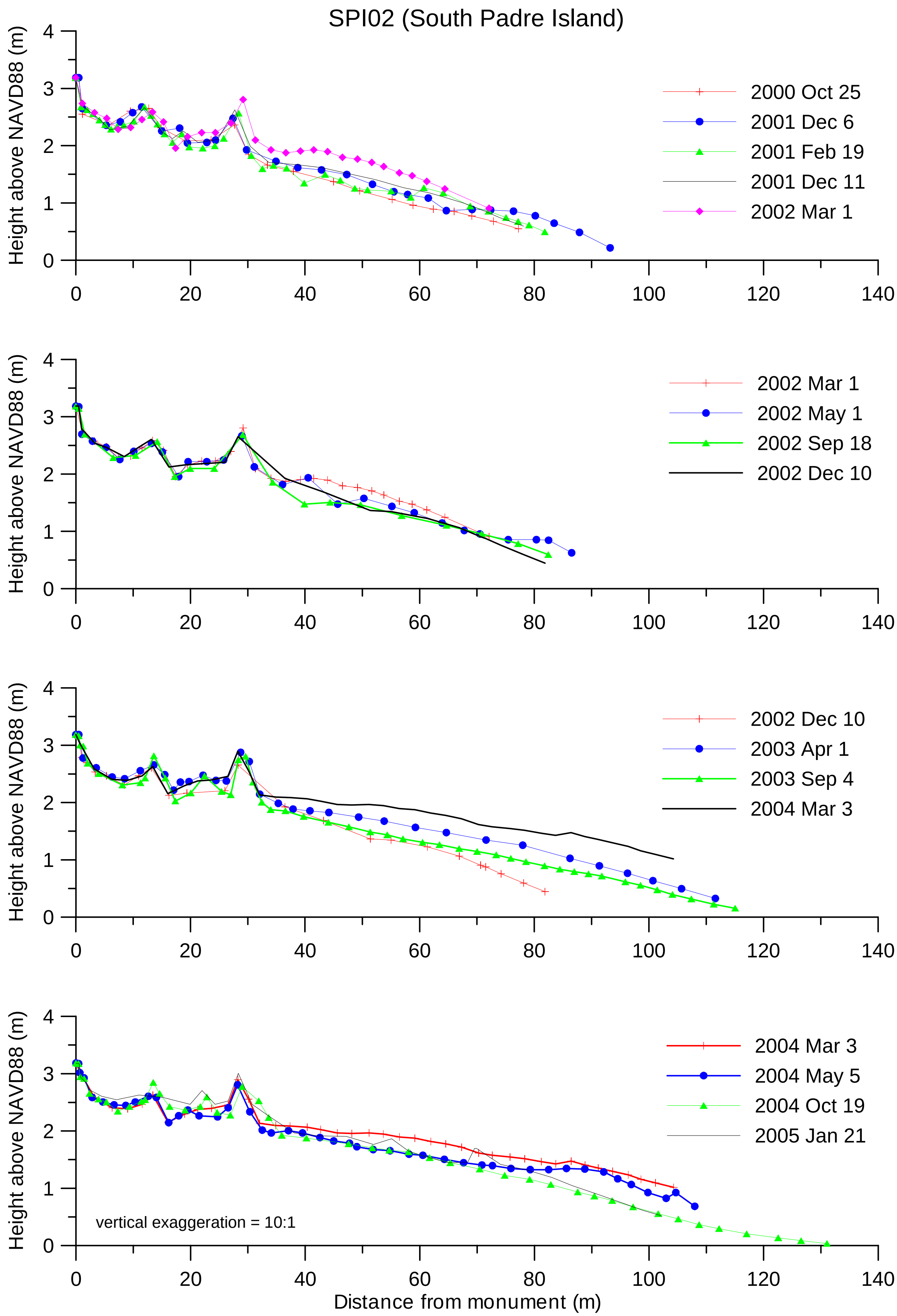




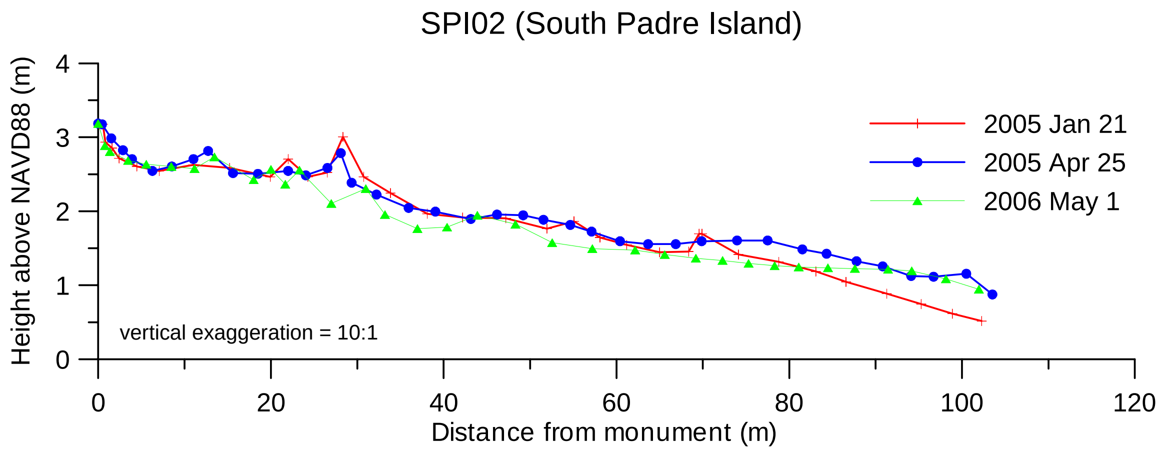
SPI01 (Isla Blanca Park)

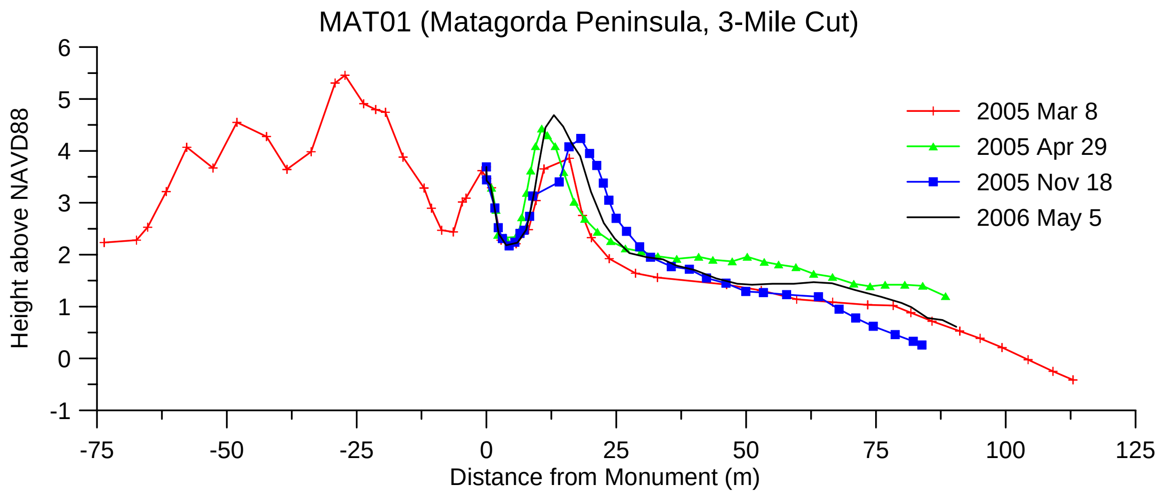


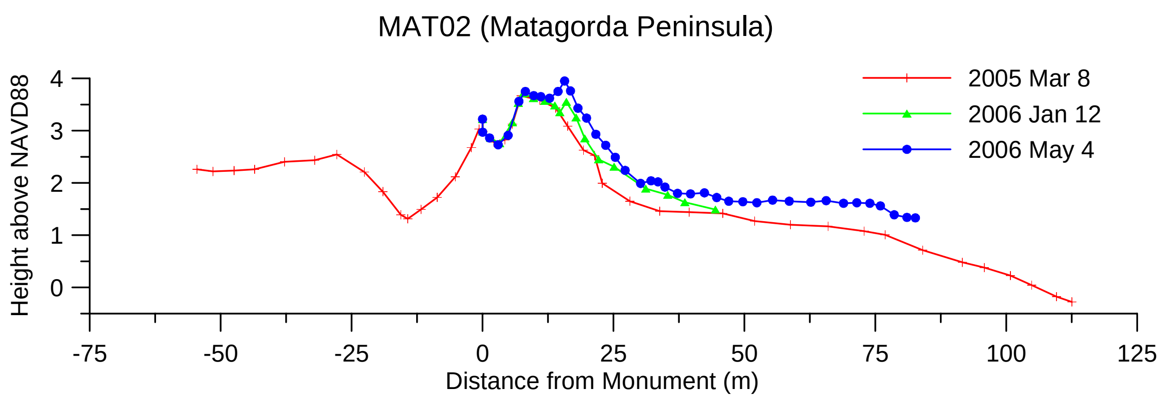

SPI01 (Isla Blanca Park)
2005 Apr 25
2006 May 1
Height above NAVD88 (m)
3
2
1
0
vertical exaggeration = 10:1
0
10
20
30
40
50
60
Distance from Monument (m)

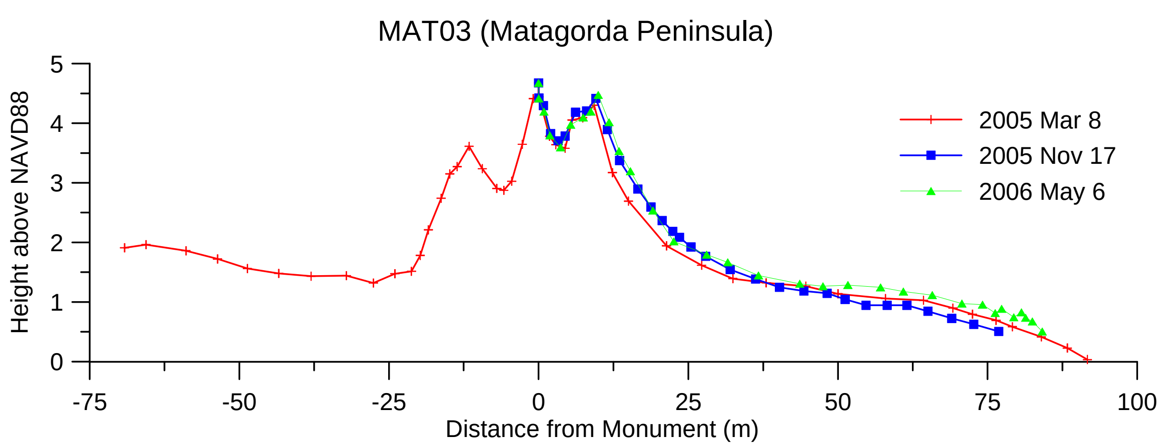


SPI02 (South Padre Island)
Height above NAVD88 (m)
2000 Oct 25
2001 Dec 6
2001 Feb 19
2001 Dec 11
2002 Mar 1
2002 Mar 1
2002 May 1
2002 Sep 18
2002 Dec 10
2002 Dec 10
2003 Apr 1
2003 Sep 4
2004 Mar 3
2004 Mar 3
2004 May 5
2004 Oct 19
2005 Jan 21
vertical exaggeration = 10:1
Distance from monument (m)


SPI02 (South Padre Island)
Height above NAVD88 (m)
0
1
2
3
4
2005 Jan 21
2005 Apr 25
2006 May 1
vertical exaggeration = 10:1
0
20
40
60
80
100
120
Distance from monument (m)


MAT01 (Matagorda Peninsula, 3-Mile Cut)
Height above NAVD88
Distance from Monument (m)
2005 Mar 8
2005 Apr 29
2005 Nov 18
2006 May 5
-75
-50
-25
0
25
50
75
100
125
-1
0
1
2
3
4
5
6


MAT02 (Matagorda Peninsula)
Height above NAVD88
Distance from Monument (m)
2005 Mar 8
2006 Jan 12
2006 May 4
-75
-50
-25
0
25
50
75
100
125
0
1
2
3
4


MAT03 (Matagorda Peninsula)
Height above NAVD88
Distance from Monument (m)
2005 Mar 8
2005 Nov 17
2006 May 6
-75
-50
-25
0
25
50
75
100
0
1
2
3
4
5