

Independent surveys prove both time and cost effective

Multibeam surveys give a more reliable and comprehensive picture of the underwater environment

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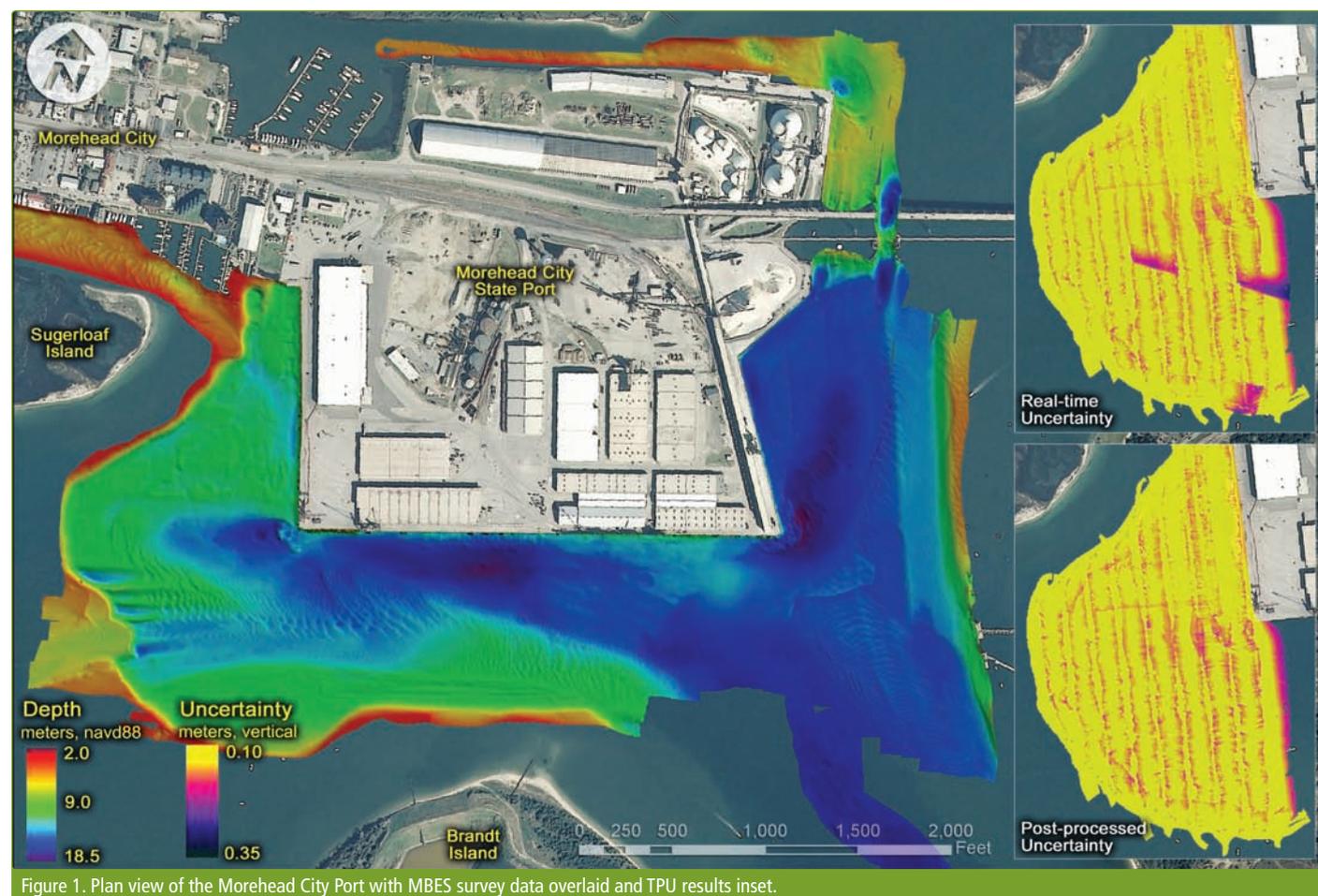
Highly accurate and repeatable hydrographic surveys provide Port and Harbor Authorities with essential information to facilitate and address management, safety, environmental impacts, security and expansion. While singlebeam surveys have traditionally provided a 2D cross-section of the seabed, this limited perspective does not compare to a 3D assessment of morphology, habitat potential, object detection, scour and sub-surface structure mapping, as well as supporting extremely accurate pre- and post-dredge volume change analysis. This can only be achieved by using a survey-grade multibeam echo-sounder (MBES), acquiring 100 percent bottom coverage and full ensonification.

More reliable surveys

Recently, the North Carolina Port of Morehead City and Weeks Marine Inc. required the spatial coverage, accuracy and repeatability

of an IHO Special Order MBES survey for an extensive dredging project (Figure 1).

The Geodynamics survey team employed a Kongsberg Simrad EM3002 dual-head MBES system, coupled with an Applanix POS MV 320 v4 inertial navigation system using Inertially-Aided Real-Time Kinematic GPS Technology (IARTK-GPS). The vessel used to acquire these data is a custom-built survey launch, specifically designed around the EM3002 system. The vessel has had both a complete sensor offset and alignment survey ($\leq 1\text{mm RMS}$), along with the standard pre-survey QA/QC MBES routines (patch test) to greatly increase the accuracy of the final soundings, while dramatically reducing motion and overlap artifacts common to non-survey-grade swath bathymetry systems.



Although IARTK-GPS has greatly enhanced the accuracy of both singlebeam and multibeam surveys, there are still inherent problems associated with geodetic GPS data, such as cycle slips, periods of high DOPs, and data gaps that can increase the overall error budget of a hydrographic survey. Because accuracy was the paramount concern in this dredge ‘payment’ survey, Geodynamics used a navigation/attitude post-processing tool from Applanix called POSPac MMS. POSPac allows for the forward, backward and combined processing of raw GPS navigation files, using GPS observables from a network of nearby base stations to minimize atmospheric delays and other interferences, ultimately providing superior vessel attitude and tidal data correctors for the entire survey.

Altogether, the comprehensive vessel survey, published system accuracies, and the real-time and post-processed systems’ performance measures provide accurate estimates of the Total Propagated Uncertainty (TPU) for each sounding. An accurate measurement of error per sounding is essential for establishing the reliability of any hydrographic survey.

In the Morehead City Port survey, Geodynamics was able to reduce the average TPU by half: from 0.21m to 0.10m by implementing modern hydrographic survey techniques and post-processing capabilities (Figure 1, inset). This low degree of uncertainty puts the survey well within the IHO Special Order classification. Additionally, repetitive surveys (n = 4) on individual sub-aqueous rock and concrete structures at the Port show a ≤ 0.03 m variability between three surveys and the reference surface (Figure 2). Results of this statistical analysis illustrate very accurate repeatability and an accuracy potential greater than the calculated TPU for this survey. Simply stated, highly accurate soundings mean Port Authorities know exactly how much scour, fill, or dredge occurred, and can pinpoint areas not in compliance and calculate dredge payments based on exact volumes.

Additional benefits of MBES survey data

While the primary goal of the project was an accurate pre- and post-dredge survey, a number of additional ‘value added’ benefits arose from the MBES data, including identification of future maintenance dredging zones, and the inspection of sub-aqueous armor stone and piling integrity around several of the berths. This was accomplished through integration of the final 0.25m Digital Elevation Model and MBES backscatter mosaic into a multidimensional Geographic Information Systems (GIS) database

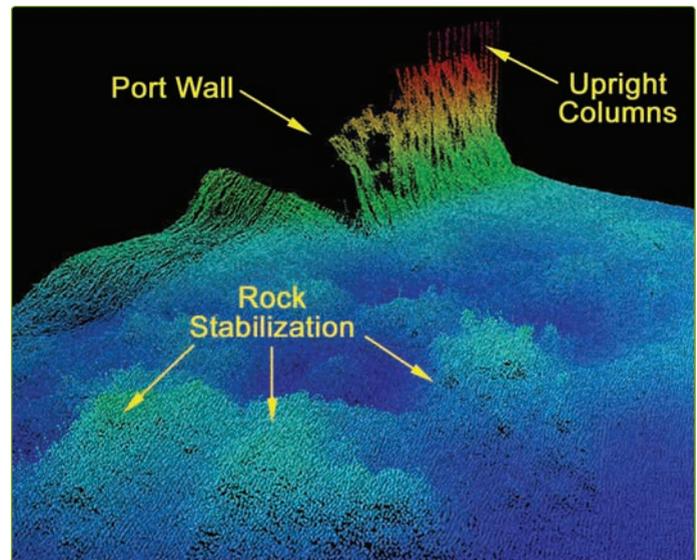


Figure 2. 3D oblique view of subaqueous port stabilization at Berth 6.

maintained for the Port of Morehead City. The database contains various environmental layers of both terrestrial and marine information that can help port planners, engineers and managers quickly and efficiently disseminate these data. As a decision support tool, the GIS database can aid the Port in mitigation and risk assessment for expansion, sediment classification for materials management, and habitat assessment or potential, physical processes modeling and simulations, and can provide a means of cataloging underwater objects with pinpoint accuracy and their relationship to infrastructure and assets (Figure 2).

In the long-term, repetitive hydrographic survey grids, even those with varying spatial and temporal resolution, can be compared in the GIS to assess sediment transport trends and provide the information necessary to make dredging and construction more efficient, environmentally-friendly and cost-effective.

Ultimately, the MBES survey significantly increased confidence in the data across the entire dredge area, and the GIS database created will support future decisions at the Port. While independent surveys may at first seem like an additional expense, their accuracy and repeatability very likely will save a great deal of money for clients in the short- and long-term.

ABOUT THE AUTHORS

David Bernstein is the Chief Certified Hydrographer and Lead GISP at Geodynamics, with over 15 years experience in the field. He holds a B.S. degree in Environmental Geo-Science and M.S. in Marine Geology from West Virginia University and North Carolina State University respectively.

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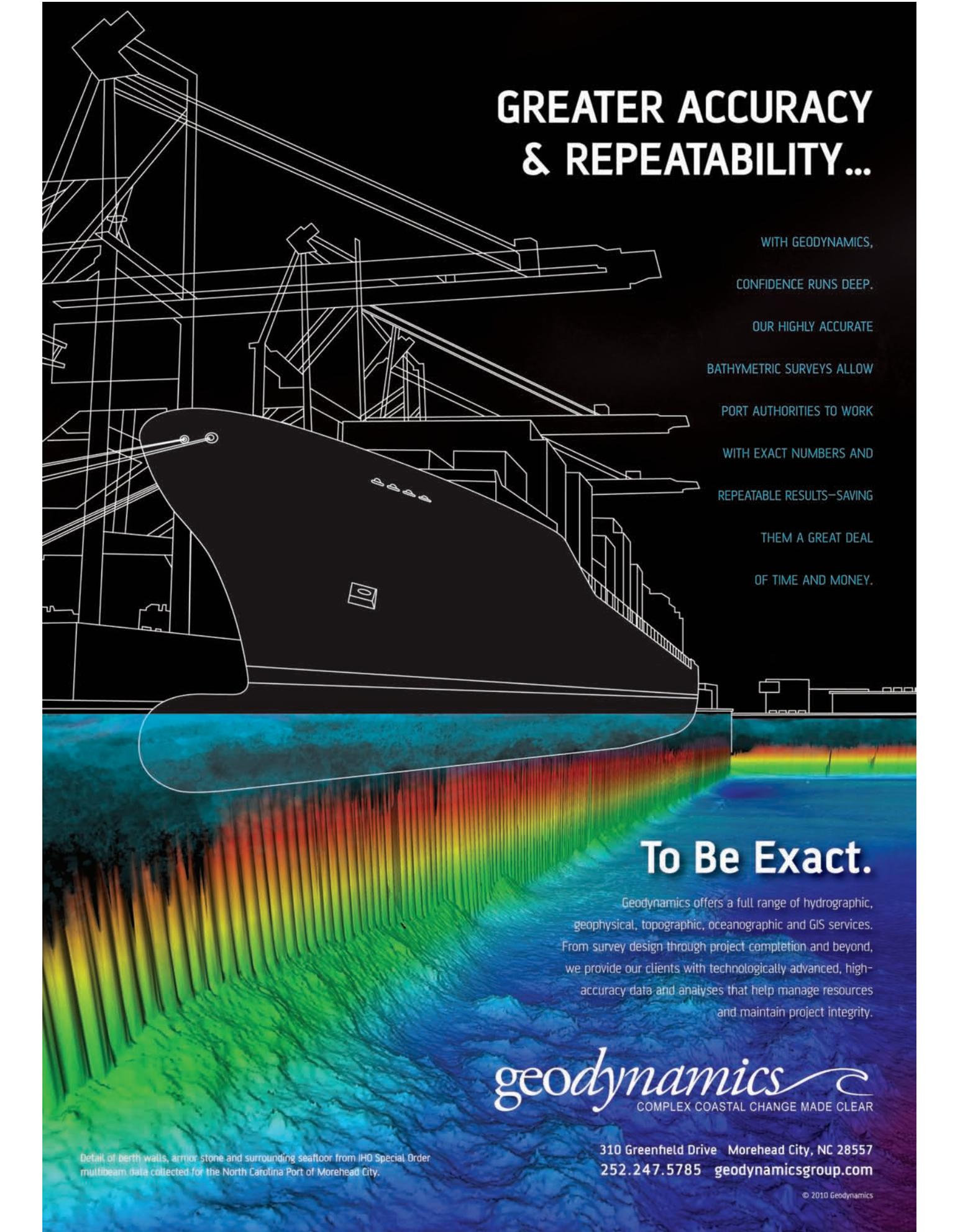
ABOUT THE COMPANY

Geodynamics offers a full range of hydrographic, geophysical, topographic, oceanographic and GIS services to support a variety of maritime projects. The company is committed to the highest quality data acquisition and analysis through continued investment in highly trained staff and the latest hardware and software technologies. From survey design to project completion and beyond, Geodynamics provides clients with technologically advanced, highly accurate data products and analyses that help manage resources and maintain project integrity.

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COMPLEX COASTAL CHANGE MADE CLEAR

Detail of berth walls, armor stone and surrounding seafloor from IHO Special Order multibeam data collected for the North Carolina Port of Morehead City.

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