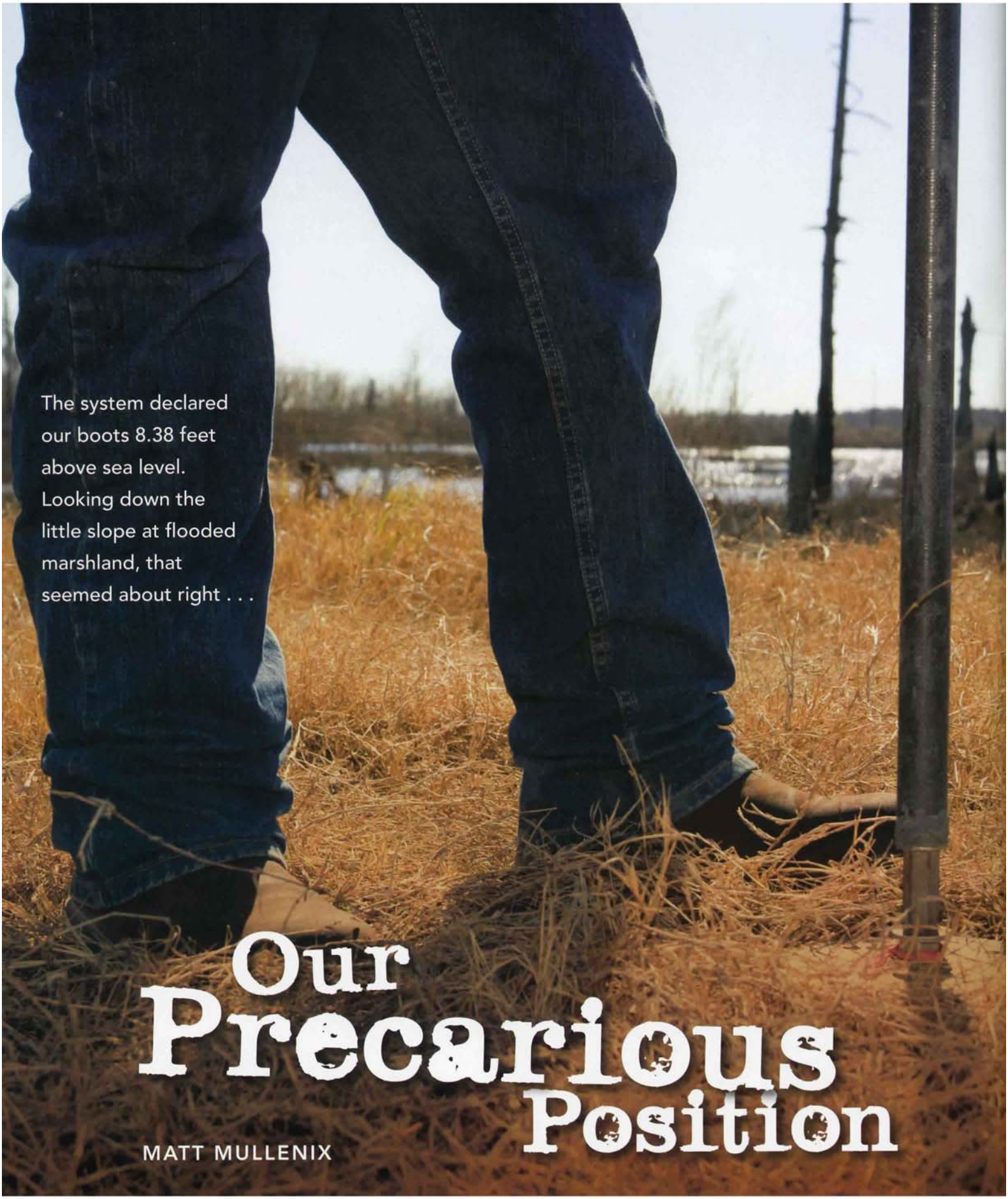

Director of the Center for Geoinformatics and Fruehan Professor of Engineering, Roy Dokka.

HOUMA, LOUISIANA, IS NOT SO REMOTE. Just two hours south of Baton Rouge, the booming port city is served by good roads and connects New Orleans with Lake Charles via the Intercoastal Waterway.

But Jason Kennedy, a professional land surveyor for local engineering firm T. Baker Smith, planned to take us a little farther than corporate headquarters.

Kennedy wanted to show us a levee project near the bayou town of Montegut, southeast of Houma, where the habitable part of the world abruptly ends. For that we'd need a bigger truck, an all-terrain vehicle and boots with good ankle support.

A satellite image of the project area dramatically illustrates several problems facing coastal Louisiana, including saltwater intrusion, wetland erosion and subsidence—literally sinking soil. These effects have left lower Terrebonne Parish (originally called "good earth" by its French settlers) thoroughly saturated. Its remaining fingers of land look like the filaments of a drowned lung.

Although Louisiana's coastal towns have long occupied the narrow strips between bayou and wetland prairie, in recent decades their borders have become sharply defined by the edges of forced drainage levees and concrete canals. Like many settlements, Montegut is now a walled city, fortified by the work of engineers against encroaching open water.

Speaking at the January 2009 conference "Grand Challenges in Coastal Resiliency," LSU geologist and Fruehan Professor of Engineering Roy Dokka addressed the region's plight, reiterating what is for him not just an inescapable interpretation of data, but a rallying cry: As he put it to the assembled group of about eighty research scientists and engineers, "I'm watching Louisiana ooze into the Gulf of Mexico."

Dokka's lab, the Center for Geoinformatics (or C4G), has been instrumental in providing evidence for this surprising conclusion. Made fully operational in September of 2007, C4G uses a unique satellite-based system called the GULFNet Realtime Network to establish accurate elevation data everywhere in the state and its territorial waters. The Network's fifty Continually Operating GPS Reference Stations (CORS) reveal a two-tiered process of subsidence threatening the entire Louisiana coastal plain.

Dokka explained that surface and substrate layers are sinking at different rates and for different reasons. Subsidence is fastest near the surface, where levees prevent seasonal flooding and the layers of silt they once left behind. Meanwhile, municipal pumps desiccate and compact the soil beneath Louisiana homes and highways. Far below, a geological process Dokka likens to a "slow earthquake" is in progress along regional fault lines and is slowly pulling everything down with it.

Combined, these forces explain southern Louisiana's annual eighth-to-one inch drop in elevation relative to sea level. The situation complicates coastal restoration and flood protection efforts. For example, freshwater di-

Rolling along the top of the 4-1 Levee, southeast of Montegut, Louisiana.

version projects that can rebuild silt-starved deltas must now factor in the long term effects of subsidence. But of more immediate concern to Louisiana residents, scientists and policy makers are the levees. Everyone wants to know: Has subsidence lowered their level of protection?

On the drive to Montegut, Jason Kennedy explained how his firm is answering that question with help from the Center for Geoinformatics.

In response to catastrophic levee failures in 2005, the Louisiana state legislature mandated new surveys and periodic monitoring of elevation along the tops of hundreds of miles of publicly maintained levees. Before the establishment of the GULFNet Realtime Network, land surveyors relied on techniques for marking elevation that hail from the earliest days of the field. Kennedy described the traditional method as arduous and costly, involving line-of-sight measurements from known points of elevation called Vertical Control Marks (or "benchmarks") established by the National Geodetic Survey (NGS).

Frequent monitoring of levee heights with this method is prohibitively expensive. A compounding problem is that many government benchmarks have fallen out of calibration or have simply disappeared. Of the original ten thousand elevation reference points, only 330 are still supported by NGS. These few are slowly sinking along with the rest of the state; in Dokka's words, relying on them for modeling current and future threats to coastal populations is akin to "washing surgical instruments in a lake." The "best available data" standard is not good enough.

The GULFNet system replaces antiquated NGS benchmarks with satellite-monitored transponders located across Louisiana, western Mississippi and southeastern Texas. Private contractors like T. Baker Smith access these "smart benchmarks" through Internet-capable cellular communications, and they use the data to cheaply and accurately determine land elevations in the field.

"It's a huge advantage for us," said Jason Kennedy, whose company compensates the Center for Geoinformatics' research consortium while passing the savings on to its customers, including the State of Louisiana.

At a pump station south of Montegut, Kennedy backed the ATV off its trailer and cranked up its tiny diesel engine. We were soon bumping along the top of a dirt levee toward a rendezvous with the survey crew.

Reinforced and rebuilt in places breeched as recently as winter of 2008, the narrow 4-1 Levee is not a mighty earthwork. Only twenty paces wide, it angles from the southeast side of Montegut to the east end of Bayou Pointe Aux Chenes. This modest levee is all that separates the homes, schools and workplaces of two busy communities from the Gulf of Mexico.

Kennedy yelled over engine noise and a strong marsh wind. "We don't have a hurricane protection levee in Terrebonne Parish," he says. "People think we do. We've got these forced drainage levees, which just keep out the rainwater." A local extension of the federal levee system called Morganza-to-the-Gulf is planned, but until that's complete, the little 4-1 is all they have.

About two miles into the marsh we found crew members Bryan Little and Brody Davis taking cross section elevations of the levee with a GPS receiver tied into the GULFNet system. Equipped with Bluetooth technology, the pole-mounted device chatted wirelessly to its various components and relayed data back to Houma, Baton Rouge, and other points to determine its position in space.

Accurate within the height and width of a golf ball, the system declared our boots to be 8.38 feet above sea level. Looking down the little slope at flooded marshland, that seemed about right. The device then calculated our position in latitude and longitude and recorded the location for later downloading. With the morning's other transect points included, a detailed model of the 4-1 Levee will be made and compared with previous years' measurements. The data will show which sections of the 4-1 are sinking faster than others and by how much.

Those sections will be repaired. The slowly sinking landscape won't be as easy to fix.

The Center for Geoinformatics hopes to expand GULFNet across the entire southern coast of the U.S., increasing the reach and resolution—and therefore the predictive power—of the data it provides. Grants from the National Geodetic Survey, part of the U.S. Department of Commerce, and revenues from the Center's unique commercial partnerships help ensure that "smart benchmarks" will continue to support smart decisions for our coastal communities.

ON THE WEB: www.c4g.lsu.edu

T. Baker Smith field technician Brody Davis takes elevation data with the LSU GULFNet system.