Feeling the Pull of the Earth

By Neill S. Rosenfeld

Technology has put smartphones in our pockets, GPS in our cars and worldwide video conferencing in our computers. Most of us never think how these modern miracles work - or how fragile is the satellite infrastructure that they rely upon. A blast of solar wind - a stream of charged particles routinely ejected by the sun - could wreak havoc with Earth's magnetosphere and fry the satellites that orbit within it.

That's a real-world implication of the basic research that Theresa Lynn Carranza-Fulmer '11, who earned her BS in physics and geology, is undertaking with the support of a National Science Foundation Graduate Research Fellowship. These fellowships are the most prestigious awards a graduate student in the STEM disciplines (science, technology, engineering and mathematics) can receive. Providing $126,000 over three years, they recognize and support exceptional students who have proposed graduate-level research projects in their fields.

A pre-doctoral candidate at the University of Michigan-Ann Arbor, Carranza-Fulmer studies the magnetosphere, a bubble of space shaped by Earth's magnetic field, the solar wind and the interplanetary magnetic field.

"I want to create a spatial and temporal map of geomagnetic field lines for North America's mid-latitudes and then apply new science by interpolating all of the data to get a better understanding of different types of wave fluctuations," she says. "These fluctuations can be correlated to geomagnetic storms and will build our understanding of the sun-Earth connection," she says.

A fuller understanding could lead to an early-warning system for solar activity "that might help save some of our communications satellites," not to mention electrical power grids, which can be disrupted by solar flares or coronal mass ejections.

The sun shoots out these huge "ejects" of superhot plasma at nearly the speed of light; a shock front may race ahead of them and create a magnetic storm on Earth. These gouts of solar plasma "can be very destructive if we have a high stream of solar wind - that is, a large density of particles - coming toward us," she says. "With the right measurements, we can understand the plasmaspheric density along geomagnetic field lines, which can give us a better understanding of the interaction of the sun-magnetosphere-ionosphere connection."

To gather her data, she uses magnetism-measuring devices called magnetometers, which are available worldwide, along with statistical techniques to interpolate missing data. Statistical estimation is needed because magnetometers tend to be concentrated in the high latitudes, and there are fewer in the middle latitudes.

"The problem we've been facing is having a unified way of presenting the data so we can get the bigger picture of what's going on," she says.

Carranza-Fulmer says that as a City College undergraduate, "I had the dilemma of going into physics or geology, because I loved both, so I decided to major in both."

She spent a summer studying solar physics at Montana State University-Bozeman through a National Science Foundation-funded Research Experience for Undergraduates internship. "I learned so much about the sun's magnetic field and was exposed to the sun-Earth connection," she says. She later worked for a year as a research assistant with the U.S. Geological Survey's geomagnetism program, after having interned there for a summer through a Research Experience in Solid Earth Science for Students also funded by the National Science Foundation. "I knew this is where I needed to be," she says.

Another undergraduate summer internship, at the University of Michigan under her current advisor, Mark Moldwin, resulted in a poster about plasma composition changes during the latest solar cycle (1996-2008). The approximately 11-year-long solar cycles, most notably noted for sunspot activity, also can affect Earth and its satellite communications.

Carranza-Fulmer was born in Texas and moved to New Orleans in time for Hurricane Katrina. She took off three years after high school in 2003 to play drums in jazz and rock bands.

"I wasn't too motivated to go to school," she says. Then an uncle living in New York City suggested that she check out the schools here. "I visited NYU and Columbia but fell in love with City College and said, 'This is my school.'" Now 26, she no longer has the time to play music, but she does squeeze in acrobatic aerial performances on the trapeze and the silks (strands of suspended fabric); it gives her an opportunity to try to defy the magnetic pull of Earth.

National Research Council Ranks CCNY PhD Program Among Best in US

By Ellis Simon, Director of Public Relations

In 1999, The City University of New York began training PhD candidates in biomedical engineering, three years before its engineering school, the Grove School at City College, even had a biomedical engineering department. Fast-forward 12 years to 2011 and the program is now one of the nation's best, according to National Research Council (NRC) rankings.

Continued on page 22