## AGU JOURNAL HIGHLIGHTS

**Models used in Intergovernmental Panel on Climate Change assessments underestimate global dimming and brightening** Although observations show that average temperatures across the Earth's surface substantially increased over the twentieth century, this increase has not been linear on decadal timescales. For example, from the 1950s to the 1980s, the Earth experienced "global dimming"—greenhouse warming trends were likely countered by aerosol pollutants, which scattered incoming solar radiation. Decreases in atmospheric aerosol concentrations from 1980 to 2000 due to successful environmental regulations led to widespread "brightening," which offset prior damping and revealed the full magnitude of greenhouse warming. *Wild* analyzed the decadal evolution of temperatures, focusing in particular on diurnal temperature ranges, which are highly correlated with surface solar radiation. He found that the switch from global dimming to brightening was captured in observations by a marked reversal in diurnal temperature range trends. The author then compared observations with outputs from the latest generation of global climate models used in the fourth assessment report of the Intergovernmental Panel on Climate Change. These models tend to underestimate decadal variations in surface warming and diurnal temperature ranges, which suggests that they do not properly consider global dimming and brightening effects. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2008JD011372, 2009)

**Moondust stickiness depends on angle of Sun** Lunar dust, which is thought to be the prime environmental hazard on the Moon, can damage scientific instruments and harm the health of astronauts who inhale it, but its adhesive properties have not been well understood. Analyzing data from the matchbox-sized dust detector experiments deployed by astronauts on the Apollo 11 and 12 missions in 1969, *O'Brien* found that the electrostatic forces that make lunar dust stick to surfaces vary with solar elevation angle. This is because dust particles become positively charged through photoelectric effects excited by solar ultraviolet radiation and X rays, so more intense direct sunlight increases the electrostatic forces that make the dust adhesive. His analysis showed that after dust had collected on the detector and as the solar incidence angle decreased over the course of the lunar day, the electrostatic forces holding the dust to the detector's vertical silicon surface weakened, and the dust began to fall off due to gravity. The author suggests that a sunproof shed could provide a dust-free working environment for astronauts on future Moon missions. (*Geophysical Research Letters*, doi:10.1029/2008GL037116, 2009)

**Tropical cyclones affect humidity of the stratosphere** Tropical cyclones could be a significant source of the deep convection that carries moist air upward to the stratosphere, where it can influence climate, according to *Romps and Kuang*. Using 23 years of infrared satellite imagery, global tropical cyclone best-track data, and reanalysis of tropopause temperature, the authors found that tropical cyclones contribute a disproportionate amount of the tropical deep convection that overshoots the troposphere and reaches the stratosphere. Tropical cyclones account for only 7% of the deep convection in the troposphere, but they account for 15% of the convection that reaches the stratosphere, the authors found. They conclude that tropical cyclones could play a key role in adding water vapor to the stratosphere, which has been shown to increase surface temperatures. Because global warming is expected to lead to changes in the frequency and intensity of tropical cyclones, the authors believe their results suggest the possibility of a feedback mechanism between tropical cyclones and global climate. (*Geophysical Research Letters*, doi:10.1029/2009GL037396, 2009)

**Unlocking the mystery of lightning in thunderclouds** Understanding thundercloud electrification and lightning initiation is challenging because the ranges of electric potential and spatial extents of electric fields inside thunderclouds are not known. Directly measuring electric fields in thunderclouds is challenging: Active regions of storms can cover many cubic kilometers with violent weather conditions, making it difficult to operate balloons and aircraft. *Dwyer et al.* hypothesize that remote sensing of thundercloud electrostatic fields can be obtained through monitoring runaway electrons, which are produced when the rate of energy gain by electrons moving through an electric field exceeds the rate of energy loss from ionizing the air. Such runaway electrons trigger other runaway electrons, resulting in an exponentially growing avalanche of runaway electrons moving through the storm system. The authors propose that radio frequency emissions produced by these avalanches can be monitored to map the magnitudes and directions of the electrostatic field within specific sections of a thundercloud. These radio frequencies are present only when the storm is bombarded by cosmic ray extensive air showers, allowing scientists to identify quickly particular storms that are favorable to the proposed remote sensing techniques. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2008JD011386, 2009)

**Distribution of chorus waves observed by satellites** Chorus waves, a type of electromagnetic emission generated by electrons in Earth's radiation belt, play an important role in accelerating and removing the energetic radiation belt electrons that can disrupt satellite electronics and disturb communications with ground-based operators. To improve understanding of the origin and location of chorus waves, *Li et al.* used data from NASA's five Time History of Events and Macroscale Interactions during Substorms (THEMIS) satellites to create a new map of their distribution. In agreement with previous studies, the authors found that nightside chorus occurs only near the equator, whereas dayside chorus extends to higher latitudes. In addition, they observed that amplitudes of chorus waves depend strongly on geomagnetic activity. The most important new finding, the authors noted, is that at a distance of more than 7 Earth radii on Earth's dayside, moderate chorus is present more than 10% of the time (a much higher occurrence rate than on the nightside) and persists even during periods of low geomagnetic activity. The authors believe that the new information could provide additional clues about the origin of dayside and nightside chorus waves. (*Geophysical Research Letters*, doi:10.1029/2009GL037595, 2009)

**Gravity-measuring satellites used to observe Amazon surface water storage and its dynamics** Scientists would like to better understand the physical processes in Amazon hydrological systems. To explore the water storage and dynamics in the Amazon basin, *Han et al.* used 4 years of data from the two Gravity Recovery and Climate Experiment (GRACE) satellites, which measure mass distribution on Earth's surface through instantaneous measurements of the changes in the distance between the satellites. Water stored in the Amazon basin affects mass distribution and thus can be monitored by the GRACE satellites. The authors found that soil water explained about half of the observed changes in intersatellite distance; surface and subsurface runoff explained the rest. By comparing river runoff routing simulations with GRACE data for the Amazon region, the authors found that the overall effective runoff velocity for the entire Amazon basin was about 30 centimeters per second, with significant seasonal variation. They conclude that incorporating GRACE data can help improve routing schemes in large-scale land surface models. (*Geophysical Research Letters*, doi:10.1029/2009GL037910, 2009)

—MOHI KUMAR and ERNIE TRETKOFF, Staff Writers



# BOOK REVIEW

## Geodesy? What's That? My Personal Involvement in the Age-Old Quest for the Size and Shape of the Earth

*Irene K. Fischer*
*iUniverse; 2005; xx + 376 pp.; ISBN 978-0-595-36399-5; $25.95; available as an E-book for $6.*

Imagine a story about a stay-at-home mother who, anticipating the departure of her children for college, takes a job at a government agency and by dint of hard work and persistence becomes a world-renowned scientist. This might sound improbable, but it happens to be the true story of Irene K. Fischer, a geodesist and AGU Fellow. How it happened and the way it did is a fascinating and complex story.

In 1952, Fischer started working at the U.S. Army Map Service (AMS) in Brookmont, Md. (now part of Bethesda), at a time when computers were large, expensive, and feeble compared with the cheapest desktop personal computers available today. Much computing was still done on slow and noisy mechanical calculators. Artificial satellites, space probes, global positioning systems, and the like were science fiction fantasies.

When Fischer began her career, a number of notable scientists, such as John A. O'Keefe and William M. Kaula, were at the agency, and she was fortunate to have them as mentors. By 1961, when I began my short stint at AMS, most had left for the then new NASA Goddard Space Flight Center or to work for contractors. They were replaced by young people with no experience or graduate education, and I was one of them. I became aware of Fischer and her already impressive reputation established by creating maps of the geoid—the equipotential surface that best approximates mean sea level—from sparse astronomical and gravity data, but I did not interact with her until 1979, after she had retired. I then turned over to her the job of editing the AGU journal *Geodesy, Mapping and Photogrammetry*.

I recall many of the people at AMS mentioned in the book. Most were hard working and dedicated, and more than a few were somewhat eccentric and idiosyncratic, an aspect Fischer touches on briefly on page 119. The book notes many people who were helpful and supportive, and a very few—not mentioned by name—who created obstructions. However, Fischer observed that things got worse with time. She even added an epilogue critiquing the 1978 Civil Service Reform Act as creating more potential obstacles for researchers.

Fischer's story is one of being the right person at the right place at the right time. The departure of most of the research staff left vast opportunities. She already had a good mathematical background and teaching experience, and she applied herself with great vigor to learning geodesy. She also had a natural aptitude for the scientific method and a keen sense of knowing what needed to be done to complete a successful research project. A good example was her pulling together the effort to construct a geodetic datum (a coordinate system based on an oblate spheroid model for mapping and surveying) for South America.

Exceptional opportunities were available for Fischer because the United States, unlike European countries, had no university departments of geodesy until Ohio State University founded one in 1951. Agencies such as AMS and the U.S. Coast and Geodetic Survey hired astronomers, mathematicians, and other scientists, often at the undergraduate level, and trained them as geodesists through in-house mentoring and night-school courses. Computer programmers learned their trade much the same way in those days, since departments of computer science had not yet emerged.

At AMS, Fischer did not just tread water or even merely fill a vacuum. She took bold initiatives, such as producing geoid maps and regional datums, as soon as she became comfortable with the science and its extensive computational demands. Later, she expanded the scope of her work to global datums, as artificial satellites provided the need for them and the data to construct them. In Fischer's last few years at what had then become the Defense Mapping Agency, she began to explore matters such as the true nature of oceanographic leveling and why it differed from geodetic leveling.

Many of Fischer's difficulties with the entrenched bureaucracy involved having papers cleared and preprints made in time for distribution at meetings. These problems were not related to classified information but rather were matters of deliberate obstruction, according to Fischer. Also, sometimes her travel was cancelled, which deprived the geodetic community of a spirited participant and the agency of well-deserved recognition. When feasible, Fischer sometimes paid for her own travel and was at least provided with administrative leave.

Toward the end of her career, Fischer received considerable recognition beyond her many government awards. An honorary degree from the University of Karlsruhe, Germany, made her "Dr. Fischer," AGU elected her as a Fellow, and she was inducted as a member of the U.S. National Academy of Engineering.

Because *Geodesy? What's That?* is a personal memoir rather than a dry, academic history, the book is easy and enjoyable to read. All scientists, not just those in geodesy and other Earth sciences, should read this book to get in touch with that period of great and rapid technical progress. In addition, even those who have not had the good fortune to enjoy a scientific career may appreciate this wonderful human interest story.

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## NEW BOOKS

*This column lists recently published books that have been received by* Eos.

*Atmospheric Science for Environmental Scientists,* C. N. Hewitt and A. V. Jackson (Eds.), Wiley-Blackwell, 2009, ISBN 978-1-4051-5690-5, $85.

*Charles Darwin's Shorter Publications: 1829–1883,* John van Wyhe, Cambridge University Press, 2009, ISBN 978-0-521-88809-7, $160.

*Climate Change: Picturing the Science,* Gavin Schmidt and Joshua Wolfe, W. W. Norton, 2009, ISBN 978-0-393-33125-7, $25.95

*Climate Change: The Science of Global Warming and Our Energy Future,* Edmond A. Mathez, Columbia University Press, 2009, ISBN 978-0-231-14642-5, $55.

*Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications,* Seon K. Park and Liang Xu (Eds.), Springer, 2009, ISBN 978-3-540-71055-4, $159.

*Deep Space Flight and Communications: Exploiting the Sun as a Gravitational Lens,* Claudio Maccone, Springer, 2009, ISBN 978-3-540-72942-6, $139.

*Digital Photogrammetry: A Practical Course, Third Edition,* Wilfried Linder, Springer, 2009, ISBN 978-3-540-92724-2, $129.

*Global Tectonics, Third Edition,* Philip Kearey et al., Wiley-Blackwell, 2009, ISBN 978-1-4051-0777-8, $90.

*Impacts of Megaconferences on the Water Sector,* Asit K. Biswas and Cecilia Tortajada, Springer, 2009, ISBN 978-3-540-37223-3, $149.

*Interfacing Geostatistics and GIS,* Jürgen Pilz, Springer, 2009, ISBN 978-3-540-33235-0, $129.

*Land Use Policy and Practice on Karst Terrains: Living on Limestone,* Spencer Fleury, Springer, 2009, ISBN 978-1-4020-9669-3, $99.

*Lecture Notes on the General Theory of Relativity: From Newton's Attractive Gravity to the Repulsive Gravity of Vacuum Energy,* Øyvind Grøn, Springer, 2009, ISBN 978-0-387-88133-1, $89.95

*Mysteries and Discoveries of Archaeoastronomy: From Giza to Easter Island,* Giulio Magli, Springer, 2009, ISBN 978-0-387-76564-8, $27.50

*New Horizons: Reconnaissance of the Pluto-Charon System and the Kuiper Belt,* C. T. Russell (Ed.), Springer, 2009, ISBN 978-0-387-89517-8, $169.

*Percolation Theory for Flow in Porous Media, Second Edition,* A. Hunt and R. Ewing, Springer, 2009, ISBN 978-3-540-89789-7, $99.

*Regional Aspects of Climate-Terrestrial-Hydrologic Interactions in Non-boreal Eastern Europe,* Pavel Y. Groisman and Sergiy Ivanov, Springer, 2009, ISBN 978-90-481-2240-0, $189.

*Satellite Radar Interferometry: Subsidence Monitoring Techniques,* V. B. H. (Gini) Ketelaar, Springer, 2009, ISBN 978-1-4020-9427-9, $129.

*The Themis Mission,* J. L. Burch and V. Angelopoulos (Eds.), Springer, 2009, ISBN 978-0-387-89819-3, $179.