Surprisingly, the LANL rate went up dramatically in the first three months of the shutdown, from 2.0 for January–June 2004 to 2.5 for January–September 2004, although the rates for the four nuclear-weapons labs ended up closely comparable, nevertheless.[1,2] One likely contribution to the remarkable rise in the LANL rate was the intense stress from the rush to meet artificial deadlines during the early chaos of the shutdown. The director's threat to close the lab for any future safety or security infraction put a punishing psychological burden on the staff. His decision was a classic top-down fiat. As any safety expert knows, you improve safety by getting buy-in from the workers—by valuing them and the work they do—and by listening to them.

References

1. See the Department of Energy's injury and illness statistics at http://www.eh.doe .gov/cairs/cairs/summary/oipds034/t3.html.
2. See http://www.eh.doe.gov/cairs/cairs/summary/ oipds043/t3.html.

Brad Lee Holian
(brad.lee.holian@comcast.net)
Los Alamos National Laboratory
Los Alamos, New Mexico

Coastline Changes from Melting Ice Sheets

In their article "Satellite-Observed Changes in the Arctic" in the August 2004 issue of PHYSICS TODAY (page 38), Josefino Comiso and Claire Parkinson state, "The [Greenland] ice sheet is 1.7 km thick on average, with a total volume of ice that, if entirely melted, would increase Earth's sea level by about 7.2 m" (p. 40). That statement is incorrect. It would be correct to say that as a result of that imaginary melting of Greenland's ice sheet, all ocean waters would get 7.2 m deeper.

However, when the ocean waters get 7.2 m deeper, every square meter on all ocean floors covering 71% of Earth's surface would be subject to an additional downward pressure from 7.2 metric tons. To preserve Earth's volume, some land areas would have to rise correspondingly according to Archimedes' principle, so that the isostatic equilibrium between continents and oceans would remain within reasonable limits.

For example, during the last ice age, Scandinavia's ice sheet, which was up to 3 km thick, pressed Earth's crust down by as much as 700 m into the underlying mantle. The pressure of the ice sheet thus forced some of the mantle material to flow outward under the crust in the surrounding areas and raise those areas, both ground and seafloor, by smaller amounts. At the ice age maximum, the ground under the ice sheet was pressed down by an extra pressure of up to 300 metric tons per square meter.

The Scandinavian ice sheets melted some 10 000 to 8 000 years ago, and the mantle material started to flow back and raise Earth's crust in the depressed areas toward its pre–ice age elevations. That backflow and the resulting land rise were rather rapid originally, but the land uplift has slowed to just under 1 cm per year, now that most of the mantle material's backflow has stopped.

As a second example of seafloor movements under variable loads, consider that even 1-m-high ocean tides at some shores tilt the seafloor and the neighboring shores twice a day by easily measurable amounts.

If the Greenland ice sheet melts, it will do so over centuries, and Earth will have plenty of time to adjust toward its isostatic equilibrium. There certainly will not be anywhere near a 7.2-m rise in the mean (average) sea level.

Lasse A. Kivioja
(lakivio@yahoo.com)
Purdue University
Lafayette, Indiana

I read with great interest the article by Josefino Comiso and Claire Parkinson about melting in the Arctic. However, as often occurs in papers dealing with climate change, I found the information not very practical. I'm particularly worried about changes in the sea level at middle latitudes. I own a house a couple of meters above the highest tide line, on the seashore in northwestern Spain. In the area there are several granite docks and piers that date from the mid-18th century. It seems that in 250 years, sea level has not changed appreciably. However, recent climate-change research has raised a lot of doubts and fears in people who own oceanfront property. I would appreciate it if Comiso, Parkinson, and other people working in the field could be more specific in their models and predictions. It would be very helpful in protecting our investments.

Jose M. Ortiz de Zarate
(jmortizz@fis.ucm.es)
Universidad Complutense
Madrid, Spain

Comiso and Parkinson reply: Lasse Kivioja is correct that deglaciation leads to isostatic adjustments that would affect sea level, that these adjustments would vary regionally, and that full melting of the Greenland ice sheet would take considerable time. However, the 7.2-m estimated sea-level rise for a full deglaciation of Greenland is the same value tabulated by the Intergovernmental Panel on Climate Change, with the specific indication that "sea level rise equivalent is calculated with allowance for isostatic rebound."[1] Any such estimates involve approximations and sizable error bars, but the 7.2-m value should be correct at least to first order.

We agree with Jose Ortiz de Zarate that for people with oceanfront property, practical information in the form of quantitative predictions would be very desirable. The point of our article, however, was to summarize recent satellite-observed changes in the Arctic. Accurate predictions require sophisticated coupled models of the ocean, atmosphere, and cryosphere system. Ortiz de Zarate might be interested in page 672 of reference 1, which presents maps of projected 21st-century sea-level changes resulting from thermal expansion and ocean circulation changes, with those projections based on coupled climate-model simulations. Also, imposing an anticipated temperature rise of 8 °C on an ice-sheet model, Anne Letréguilly and coworkers[2] calculate a projected ice volume decrease of 68 500 km^3 in Greenland and a sea level rise of 17 cm worldwide by 2100.

References

1. J. A. Church, J. M. Gregory, P. Huybrechts, M. Kuhn, K. Lambeck, M. T. Nhuan, D. Qin, P. L. Woodworth, in *Climate Change 2001: The Scientific Basis*, J. T. Houghton et al., eds., Cambridge U. Press, New York (2001), p. 639.
2. A. Letréguilly, P. Huybrechts, N. Reeh, *J. Glaciology* **37**, 149 (1991).

Josefino Comiso
(josefino.c.comiso@nasa.gov)
Claire Parkinson
(claire.l.parkinson@nasa.gov)
NASA's Goddard Space Flight Center
Greenbelt, Maryland

Publish-or-Perish Postscripts

Let me offer an alternative engineering perspective to Mohamed Gad-el-Hak's well-crafted Opinion piece (PHYSICS TODAY, March 2004, page 61). Some journal articles