that depicted demographics of all types, overlaid on maps of the major metropolitan areas. Each of those books must have required many years of effort to produce. Each was obsolete by the time it was published.

Multidimensional data plots are essential for illustrating concepts as diverse as jet streams, weather maps, and voter preference polls. Noesys is an important advance in analysis and visualization of such complex data with a Windows-based PC or a Macintosh computer. It enables the rapid input, analysis, and output of massive multidimensional data sets by taking advantage of the hierarchical data format (HDF), a common format for data interchange, and HDF-EOS, a convention used by NASA for earth science data. The program allows quick and easy analysis, display, manipulation, and organization of large amounts of multidimensional data. It has translators to import the essential file formats in common use such as ASCII text, binary, DTED, netCDF, CDF, SDTS, TIFF, GeoTIFF, PICT, and BMP.

Noesys allows editing of data, data tables, grids, color palettes, map projections, and all other attributes of the HDF format. Matrix data can be manipulated and visualized in the form of raster images, contour plots, vector plots, polar plots, and surface plots. Three-dimensional surface plots can be created, rotated, and labeled. Volumetric data can be visualized as slices, isosurfaces, volumes, and cutouts. Standard color palettes are available, or custom palettes can be created.

Different versions of Noesys vary in their implementation of IDL (Interactive Data Language). In the entry-level program, one can enter simple IDL commands with a command-line interface. In Noesys Plus, IDL macros can be created, saved, and executed. At the highest level, Noesys+IDL, multiline commands can be compiled to manipulate data and display the results graphically, which is particularly useful when a standard analysis and display protocol is used repeatedly.

The design of this program is excellent and appears to be bug-free. Most menu commands are intuitive. The manual includes several real-world examples, which exercise all the important features of the program, including mapping. The examples are well-chosen; they are understandable to anyone working with quantitative data but not so esoteric as to apply to only one specialty.

This program will be a welcome addition to anyone who needs to interpret and create visual images of large data sets.

Noesys 2.0 for Windows 95, 98, or NT 4.0 requires at least 125 MB disk space. For Macintosh OS 8.1 or higher, the program requires 154 of MB disk space.

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TECHSIGHTING
SEISMOLOGY

Where the Ground Shakes

Seismologists can determine the location and magnitude of an earthquake within minutes. But before local authorities can initiate an effective emergency response to reduce fatalities and injuries, they need to know where the most intense ground shaking has occurred. Such information is valuable in identifying and evacuating hazardous structures, repairing vital infrastructure (such as water supplies and telephone lines), and shutting down or rerouting utilities (such as gas, electric, or nuclear power) that pose a secondary hazard. A dense array of seismometers and strong ground-motion instruments near the event can be used to determine the intensity of ground shaking, but, unfortunately, many areas do not have these monitoring networks, and intense ground shaking does not always occur near the epicenter.

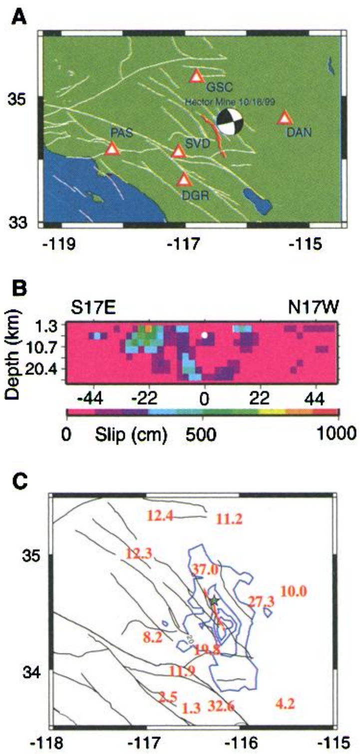

Fig. 1. (**A**) Map showing the locations of TriNet broadband and strong motion stations (triangles) used to determine the source characteristics of the 16 October 1999 earthquake shown by the focal mechanism. The bold red line shows the surface rupture of the 1992 Landers earthquake (magnitude 7.3). (**B**) Slip map showing fault slip distribution on a planar fault. White circle, hypocenter. (**C**) Predicted peak horizontal ground velocity (PGV) shown as blue contours in intervals of 20 cm/s. Red numbers, observed PGV values at TriNet stations. Red line, surface rupture of the 16 October 1999 event; black lines, nearby faults.

Douglas Dreger and Asya Kaverina of the University of California at Berkeley have developed a technique to rapidly determine the strong ground motion in sparsely monitored areas. They applied the method to the Hector Mine earthquake (magnitude 7.1) that occurred in the Mojave Desert on 16 October 1999 (*1*). Dreger and Kaverina used the southern California TriNet and the Berkeley Digital Seismic networks to determine the earthquake's location, magnitude, and mechanism, including a clear fault plane. They calculated the amount and direction of the rupture away from the hypocenter and derived a "shakemap" (*2*), which predicts the location and intensity of strong ground motions, with only five three-component seismometers rather than the usual 10 or more. These instruments were within an 80- to 200-km radius from the epicenter, and Dreger and Kaverina identified a region of peak ground motions 10- to 50-km southeast of the epicenter. Their shakemap was complete within hours of the event, but the entire process could be automated in the future to provide a shakemap within 30 min.

Thus, their technique pinpoints the locations of strong ground motions with a minimum number of instruments to quickly provide information that is crucial for local emergency response. The technique can be combined with existing seismic networks and automated to increase the accuracy and speed of shakemap production in areas of sparse instrument coverage. Although the technique is most useful for regions without many instruments, it can also be effective in those that are well-instrumented because earthquakes can damage the instruments or sever the lines of communication, creating delays in accessing or processing seismic data.

—LINDA ROWAN

References and Notes

1. D. S. Dreger and A. Kaverina, in preparation. May also be downloaded from http://seismo.berkeley.edu/~dreger/hectorweb/hectweb.htm
2. A shakemap is a data-driven map of strong shaking parameters. D. J. Wald *et al.*, *Earthquake Spectra* **15**, 537 (1999).

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