

Geologic Hazard Assessments Subactivity

Program	1999 Estimate	Uncontrol. & Related Chgs	Program Redirect	Program Changes	FY 2000 Budget Request	Change from 1999
Earthquake Hazards	48,560	1,075	-7,120	1,600	44,115	-4,445
Volcano Hazards	19,759	354	-2,845	-250	17,018	-2,741
Landslide Hazards	2,370	60	-237	0	2,193	-177
Global Seismographic Network	3,831	42	-392	0	3,481	-350
Geomagnetism	1,849	50	-296	400	2,003	154
Total Requirements \$000	76,369	1,581	-10,890	1,750	68,810	-7,559

Note: The Program Redirect column reflects the redirection of funds to the Integrated Science, Science Support, and Facilities activities.

Geomagnetism

Current Program Highlights

Magnetic Observatories — The USGS operates a network of 13 magnetic observatories in the conterminous United States, Alaska, Guam, Puerto Rico, and Hawaii. These observatories provide nationwide coverage, continuously measure the Earth's magnetic field, and carry out periodic observations for precise determination of the geomagnetic field to calibrate the continuous measurements. The data gathered by these observatories form the backbone of the program. Magnetic field variations are tracked continuously, and the data are made available to clients in a variety of time frames ranging from near real-time to five-year summary information, depending on clients' needs and requirements. Most of these observatories are fully instrumented (no onsite personnel) and the last few staffed observatories are in the process of being converted to unmanned operations. A program objective is to have all observatories in full, automatic operation during the next maximum of solar activity expected during 2000-2001.

Data Management and Satellite Operations — USGS geomagnetic observatories use satellite transmission links to send data at 12-minute intervals to the USGS Geomagnetic Data Management Center in Golden, Colorado. This Center also operates as an international geomagnetic information node, which is connected with similar installations worldwide for the distribution of geomagnetic data via satellite.

National Geomagnetic Information Center — This center serves as the U.S. clearinghouse and information hub for products and services related to the Earth's magnetic field. The center produces CD-ROM's that contain definitive data from the USGS magnetic observatories, operates an online dial-up and WWW service (<http://geomag.usgs.gov/>) that allows users to obtain values of the Earth's magnetic field for any date, location, and elevation, and provides educational materials for teachers and the general public.

Modeling and Charting — Due to gradual but significant changes in the Earth's magnetic field, the USGS produces new magnetic field charts every five years and disseminates these charts to the user community worldwide. This user community includes all branches of the Armed Forces and other DOD agencies, the navigation and transportation infrastructure, and mineral and petrocarbon exploration industries. The charts graphically show the values of the magnetic field and its projected changes over time. The sophisticated mathematical models used to create the charts take into consideration all of the components of the Earth's magnetic field and their actual and forecast variations. The final models are used to calculate the Earth's complete magnetic field at any time and location.

Applications Research — The USGS conducts geomagnetic research to achieve a better understanding of basic geomagnetic processes and their effects on our physical and social environments. For example, developing new models of the behavior of the ionosphere and magnetosphere enables us to make better predictions of the duration and end times of geomagnetic storms.

Recent Accomplishments

New Models for the Earth's Magnetic Field — The Earth's magnetic field varies on very short time scales due to "space weather" caused by solar activity, and on very long time scales caused by changes in the Earth's internal magnetic field. This "Main" field varies slowly but erratically with time due to processes in the Earth's core. One of the primary products of this program is to combine measurement of the Earth's Main magnetic field from worldwide and domestic sources to produce mathematical models predicting the strength, direction, and variation of the main magnetic field over five year periods. The models are based on a continuous flow of new data involving millions of measurements, which must be reduced, corrected, and analyzed. The last comprehensive epoch model was produced in 1995. In FY 1999 the main field model for 2000 will be produced. Various maps and charts can be generated from the mathematical description of the main field model. These products are used in a wide range of public, commercial, and military navigation applications and attitude/heading reference systems. One interesting result of these analyses is that the Main field is currently decaying at the rate of about 7 percent per century and that this decay rate is increasing. If the Earth's Main field strength continues to decline at this present rate, a reversal of the field (i.e. a swapping of the Earth's north and south poles) could occur in less than 1400 years.

Geomagnetic Observatory Operations — The USGS currently operates 13 geomagnetic observatories worldwide. During FY 1998 –1999 these observatories were converted to automated operations with only caretaker functions required. What used to be labor intensive observations are now carried out automatically and the results transmitted to the National

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Geomagnetic Information Center in Golden, Colorado, in real-time. Upgrade of the Guam and Barrow observatories was completed in FY 1998. Under an agreement with the National Imagery and Mapping Agency (NIMA) additional observatories are being established in the Pacific Ocean where a lack of data results in unreliable or incomplete information of the short-term variation of the field in this region. NIMA need geomagnetic data from the broad expanses of the Pacific Ocean for military navigation purposes. During FY 1999, automated observatories will be established at Majuro in the Marshall Islands and at a site in the Galapagos Islands.

Real-time Geomagnetic Data — The short-term variations in the magnetic field (changes within minutes) can have severe impacts on satellite communications, power grids, military navigation and guidance systems, spacecraft operations, and commercial geophysical exploration. Current and reliable data from USGS geomagnetic observatories are essential to recognizing the onset and strength of these space weather episodes. USGS data are transmitted to various military and other government agencies continuously on a 24-hour basis. Information on short-term variations also is available through dial-up modem and a Web site. Telephone requests for data average about 500 inquires per month. A typical request would come from an oil exploration firm about to conduct a geomagnetic survey. A magnetic storm in progress could increase the background “noise” and make it impossible to detect the small variations caused by underground geologic structures. During FY 1999, data services have been made more efficient and reliable through improvements in data collection platforms at the observatories and through modernization of data processing software and hardware at the data center in Colorado.

Justification for Program Change

Real Time Hazards (+\$0.4 million) —The demand for current, reliable information on short-term changes in the magnetic field to avoid disruptions in navigation, communication, operation of the nation’s power grids and satellite networks has outpaced USGS

communication and data processing and dissemination capability. The beginning of a major magnetic storm can be detected within 20 minutes of its onset. However, the peak in the storm may come many minutes to hours later, and the entire storm may last over several days. As more customers become dependent on USGS storm information, a need exists to replace outdated communication and data processing equipment. With this increase, faster computers at the data management center and more rapid data transmission capability from the observatories will be added to improve the reliability and speed of processing and delivery of geomagnetic data.

	FY 2000 Request	Program Change
\$(000)	2,003	+400