Educational Activities within IUGG

One of the primary objectives of the IUGG is "to promote the study of all problems relating to the figure of the Earth, and the physics and chemistry of the Earth's interior, surface, fresh waters, oceans and atmosphere, along with relevant studies of other planets." Such an objective necessarily includes educational activities, although the form of those activities varies widely. One of the more subtle yet important activities that of meetings. Within the components of IUGG, dozens of scientific workshops and assemblies are held annually in countries distributed over the globe. These meetings have a strong educational aspect because young and otherwise financially-disadvantaged scientists, who cannot usually travel to international meetings, have the opportunity to gain exposure and present papers in professional forum. In addition, all of the Union's seven Associations maintain Internet web sites that enable public access to general and specific information about their activities.

Because each of the IUGG disciplines requires careful observations made in standardized ways, a common educational strategy is that of training. Three of the Associations plan and fund "schools" in which students, young professionals, and technicians learn the tools and techniques needed to acquire accurate data. The venues for these schools change and are typically held in developing countries where opportunities for training are scarce. Examples include the "Geoid Schools" offered by the International Association of Geodesy (IAG), and the "Workshops on Geomagnetic Observatory Instruments, Data Acquisition and Processing" offered every other year by the International Association of Geomagnetism and Aeronomy (IAGA). The last IAGA Workshop was held in Vassouras, Brazil, in 1998 and in Bratislava, Slovakia, in 2000. The Geoid School was held at the University of Technology, Malaysia, in February 2000. The International Association of Seismology and Physics of the Earth's Interior (IASPEI) also holds workshops; recent ones on seismic methods were held in Israel in 1998 and Greece in 1999.

The educational strategies of each of the Associations are highlighted below. Some Associations publish "handbooks" specializing in specific topics. Others use alternate methods to inform our constituency and the public of important scientific results.

ACTIVITIES OF THE ASSOCIATIONS

International Association of Geodesy (IAG)

IAG has recently (November, 1999) established a Working Group on Education. This Working Group plans to centralize information regarding technical courses on topics of geodesy offered world-wide by universities and private organizations; collect information about educational material (texts, exercises, solutions to exercises, and software used for educational purposes) and have important material translated; propose/initiate courses where necessary, especially in developing countries, investigate the possibility of "distance-learning" internet courses, and foster cooperation between Universities that offer Ph.D. degrees or that would like to offer advanced degrees. They also wish to investigate a strategy to support Ph.D. students in Geodesy.

International Association of Geomagnetism and Aeronomy (IAGA)

IAGA has recently published two handbooks, described below. These were distributed free of charge to the world's network of geomagnetic observatories that report data to World Data Centers. Copies are now sold through the office of the IAGA Secretariat.

Guide for Magnetic Measurements and Observatory Practice (J. Jankowski and C. Sucksdorff, 1996). This Guide provides comprehensive information how to organize and run a magnetic observatory and make magnetic measurements. The main topics include a brief description of Earth's magnetic field, the selection of a site and layout of the observatory, magnetometer instruments (including testing and calibration), absolute magnetic measurements, recording of magnetic variations, and data processing.

Guide for Magnetic Repeat Station Surveys (L. R. Newitt, C.E. Barton, and J. Bitterly, 1996). This Guide presents specifications and procedures recommended to determine magnetic secular variation by carrying out magnetic repeat station measurements. These procedures are much more stringent than those for vector ground-surveys. Permanent magnetic observatories provide the most accurate source of secular variation information, but the present network of magnetic observatories does not give adequate spatial coverage of the globe. Repeat stations provide an important and cost-effective means of supplementing observatory data. Repeat data have long been used for producing regional field models and charts. Appendices to the Guide include an equipment checklist, reporting forms and record sheets, and computer programs.

International Association of Hydrological Sciences (IAHS)

Unique to IUGG, IAHS maintains a permanent office of publications, and prints a number of reports, journals and special volumes. Their most recent book illustrates the nature of these publications. *The Hydrology of the Nile* (J. V. Sutcliffe and Y. P. Parks, 1999). This book presents a regional hydrological study of a very important river. Illustrated by over 100 diagrams and photographs, it is essential reading for hydrologists and water resource engineers working in the Nile basin and those interested in the background to the problems of the region. The hydrology of the whole Nile basin is treated, dealing with each tributary in turn but drawing attention to links between reaches. The Nile is shown to be a set of very different tributaries that came together by geological accident. Nevertheless, evidence from one part of the basin often throws light on a different area. Recent changes are discussed, in particular the dramatic change of regime of Lake Victoria and other lakes which occurred after1961. The relationship between hydrology and vegetation affects the important wetlands of the White Nile basin, and discussion of this relationship includes the effect of increased lake outflows. The authors draw on the extensive records collected throughout the basin to paint a detailed hydrological picture of the regime of the Nile.

International Association of Meteorology and Atmospheric Sciences (IAMAS)

IAMAS promotes educational activities through the Alliance for Capacity Transfer (ACT), a joint activity of IUGG, the World Meteorological Organization (WMO, representing all national meteorological and hydrological services), the University Corporation for Atmospheric Research, and the scientific community at large. The purpose of ACT is to stimulate intensive collaboration among its entities by providing close links between operations and research, developing and developed countries, and within regions or scale-related groups. ACT facilitates application of newly developed scientific insights and technologies, providing and exchanging software for data processing and synthesis,

developing new approaches to education and training, and by creating international "Help" bulletins and "Mentoring" Boards and other means for discussion and collaboration through the Internet. ACT makes full use of already available Internet Web sites relating to meteorology, hydrology and oceanography (through the IUGG Associations), and the availability of a large pool of dedicated scientists willing to volunteer as resource persons and advisors. In 1999, ICSU awarded IUGG and the Scientific Committee on Oceanic Research (SCOR) a grant of $30,000 to develop ACT. These funds are managed by the Secretary-General of IAMAS.

International Association of the Physical Sciences of the Ocean (IAPSO)

IAPSO has the primary goal of "promoting the study of scientific problems relating to the oceans and the interactions taking place at the sea floor, coastal, and atmospheric boundaries insofar as such research is conducted by the use of mathematics, physics, and chemistry." As such, IAPSO's outreach is directed toward the professional community of ocean sciences and related disciplines. They organize meetings that permit interactions amongst ocean scientists throughout the world; establish commissions, sub-committees to encourage and coordinate international research activities; provide basic services significant to the conduct of physical oceanography; and publish proceedings of symposia, meetings, and workshops, and fundamental references on the current state-of-the art and knowledge of physical oceanography.

International Association of Seismology and Physics of the Earth's Interior (IASPEI)

IASPEI has a Committee on Education, established in 1996. Their primary activities have been focused on completing two 'handbooks' as described below.

International Handbook of Earthquake and Seismology (in preparation, edited by W. Lee, H. Kanamon and P.C. Jennings). The Handbook aims to review relevant theories, survey useful methods and techniques, and to document and archive basic seismic data. It will consist of about 84 chapters grouped into 10 parts, with 4 CD-ROMs containing material to augment the printed chapters. The Handbook will be published in 2001 on the occasion of the 100th anniversary of the International Association of Seismology, the predecessor of IASPEI.

New Manual of Seismological Observatory Practice (in preparation; an update of the Manual of Seismological Observatory Practice [1979] now available via the Internet at http://www.seismo.com). The New Manual will be developed and maintained on the web as a continuously upgraded, up-dated and complemented reference source with integrated training modules (although a hard copy version is planned that will include an easy-to-update loose-leaf collection of worksheets). The tutorial material will aim to create a broad interdisciplinary problem awareness and understanding of the scientific, technical and theoretical fundamentals of seismological observations and their routine analysis and at the motivation of observatory personnel.

IASPEI was a major contributor to the Global Seismic Hazard Assessment Program (GSHAP) which was launched in 1992 by the International Lithosphere Program (ILP) with the support of the International Council of Scientific Unions (ICSU). GSHAP was a demonstration program within the framework of the United Nations International Decade for Natural Disaster Reduction (UN/IDNDR). GSHAP has now come to an end with the completion of the Global Seismic Hazard Map. The global map combines the effort of more than 500

scientists, with 95 principal authors. All the results of the program, the regional reports and maps, and the global map can be found on the GSHAP site at http://seismo.ethz.ch/GSHAP/. A special volume of *Annali di Geofisica* is also in press, containing all reports and a folded copy of the map. The volume and the map are available free of charge, and will be globally distributed.

International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)

The primary educational activities of this Association are more visual. They have recently produced 2 videotapes: "Understanding Volcanic Hazards," available in both PAL and NTSC (VHS) formats and in English, Spanish, French, and Italian, and "Reducing Volcanic Hazards," available in both PAL and NTSC (VHS) formats and in English and Spanish. They produce and sell an attractive wall calendar featuring well-known and scenic volcanoes. The calendar not only informs the public but also raises money for their purposes. In 1994 they issued a document "Safety Recommendations For Volcanologists And The Public" including a poster "Safety at Volcanoes" intended for schools.

Summary

IUGG understands the importance of reaching out to the public, and sharing our knowledge for the benefit of all. Our educational strategies include:

- the beneficial aspects of scientific gatherings world-wide
- "short-course" schools and workshops devoted to specific methodologies
- inter-linked internet sites that inform, provide access to expertise, and allow a means to exchange data and computer software
- printed material, including scientific papers, handbooks, and manuals that teach and standardize observational techniques and data processing methods
- maps, posters, calendars, and videotapes that promote public safety
- consolidated information about degree programs at universities worldwide, course content, and financial aid for advanced study.

We look forward to new possibilities to educate the public and our young and mid-career professionals as we seek to achieve our primary objective of scientific understanding of our planet Earth and its place in the Universe.

Report to ICSU, January 2000