International Cooperation in Geophysics for the Benefit of Society

Research cooperation in geophysics is, by its very nature, international and brings together scientists from and to various parts of the world to investigate and hence to understand our Earth and its environment. Well-organized international geophysical cooperation was established ninety years ago. The International Union of Geodesy and Geophysics, several national (e.g. American Geophysical Union), and most recently regional (e.g. European Geosciences Union, Asia Oceania Geosciences Society) geophysical unions and societies have grown since that time. Today these organizations play a significant role in fostering worldwide scientific cooperation in geophysics. Earth sciences are becoming exceedingly complex with a lot of interactions between the disciplines. What mechanism can be used to encourage relationships between the international, national and regional geoscientific bodies? We present the history of international cooperation in geophysics and discuss some possible modes of strengthening cooperation between geo-societies.

Our Earth both benefits and destroys life on this planet. Our very existence depends on the bounties of the Earth, oceans, and atmosphere, yet often these elements turn against us. Each year earthquakes, drought, storms, volcanoes, disturbances in the Earth’s magnetic field, and other natural hazards affect our communities in ways that range from inconvenience through to mass destruction. Studies of the Earth and its environment in space help scientists to anticipate and warn of such natural disasters and help keep people out of harm’s way. Studies that reveal the secrets of the Earth’s natural resources can improve the quality of life for our growing populations. And scientific understanding of the Earth’s processes can help us reduce our own destructive impact on the environment and help promote sustainable management of its resources. These natural processes know no political boundaries and therefore require organized international cooperation.

International cooperation in geophysics began more than two centuries ago. The need for such cooperation was felt in different parts of the wide domain of geosciences. Perhaps the first was Alexander von Humboldt (1769-1859), who inspired the earliest extensive international geophysical cooperation. In the first decade of the nineteenth century, after his return from South America, Humboldt organized widespread simultaneous magnetic observations. Later Carl Friedrich Gauss (1777-1855) founded the Magnetic Union, which fostered the institution of magnetic observatories during 1836-1841. This union promoted a cooperative scheme of simultaneous observation in which
fifty observatories, distributed over five continents, took part. In oceanography and maritime meteorology, international cooperation also began early, in 1853, under the influence of Matthew Fontaine Maury (1806-1873). Later, in 1900, Prince Albert I of Monaco, who devoted his time and resources to oceanography, granted his patronage to the establishment of the International Marine Association. International cooperation in geodesy can trace its roots back to the nineteenth century, when Friedrich Wilhelm Bessel (1784-1846) and Gauss made important contributions to the science. In 1861 General Baeyer (a student of Bessel) wrote a report suggesting that the States of Europe should work together on the measurement of the size and shape of the Earth and proposing methods to achieve this aim. The King of Prussia accepted the report and invited the countries concerned to subscribe to the plan. The first international geodetic community assembled in Berlin and established Europäische Grandmessung in 1864, which became the Association Géodésique Internationale in 1886. An international organization in meteorology began in 1872 and in seismology in 1903.

At the outbreak of WWI in 1914, there were international organizations for geodesy, for seismology, for meteorology (which took geomagnetism and geoelectricity under its wing), and oceanography. The war interrupted the operation of these bodies, though some were kept active by the then neutral nations. Already in 1917, in the midst of that war, some scientific leaders from the allied nations (that later won victory) gave thought to the post-war renewal of international scientific cooperation. In 1918 they met in London and Paris and decided to withdraw from the pre-existing international organizations and to found a new body, the International Research Council, the predecessor of the International Council for Science (ICSU). This Council was set up at Brussels, Belgium, in 1919 with the purposes to coordinate international activity in the different branches of science, to stimulate the creation of international scientific associations or unions, and to guide international scientific activity in the scientific branches where no such organizations existed. At once, after its own formation, it instituted several international scientific unions. First among these was the International Union of Geodesy and Geophysics (IUGG, http://www.iugg.org).

IUGG was established on 28 July 1919 as an international, non-governmental, non-profit organization, in place of several pre-existing organizations, independent and separate from one another. Only nine countries adhered to the Union: Australia, Belgium, Canada, France, Great Britain, Italy, Japan, Portugal, and USA. Today the IUGG membership includes 67 countries of Africa, America, Asia, Europe, and Oceania. Thus, the foundation of IUGG gave us the advantage
of close cooperation, the opportunity to share data, and recurrent easy opportunities for discussion among geophysicists.

IUGG is dedicated to the promotion and coordination of scientific studies of the Earth (physical, chemical, and mathematical) and its environment in space. These studies include the shape of the Earth, its gravitational and magnetic fields, the dynamics of the Earth as a whole and of its component parts, the Earth's shape, surface, internal structure, composition and tectonics, the generation of magmas, volcanism and rock formation, the hydrological cycle including snow and ice, all aspects of the oceans, the atmosphere, cryosphere, ionosphere, magnetosphere and solar-terrestrial relations, and analogous problems associated with the Moon and other planets. The Union encourages the application of this knowledge to societal needs, such as the development of mineral resources, mitigation of natural hazards and environmental preservation.

From the outset IUGG had six sections (re-named associations in 1930), those of geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography and volcanology; the hydrology section was created three years later in 1922 at the first General Assembly of IUGG. Today IUGG is comprised of eight semi-autonomous International Associations, each responsible for a specific range of topics or themes within the overall scope of Union activities: cryospheric sciences (IACS), geodesy (IAG), geomagnetism and aeronomy (IAGA), hydrological sciences (IAHS), meteorology and atmospheric sciences (IAMAS), physical sciences of the oceans (IAPSO), seismology and physics of the Earth's interior (IASPEI), and volcanology and chemistry of the Earth's interior (IAVCEI).

IUGG and its Associations reach out to scientists across the boundaries of country and discipline to increase scientific understanding of the Earth and to apply that knowledge for the benefit of society. In addition to serving science, as all professional societies do, IUGG and the Associations also work to enable science. Participants enable science under IUGG in a number of ways. They form a consensus on the best investigations to promote our understanding, given natural and political constraints. The international associations of IUGG work to set standards for research and agree on definitions and algorithms. Participants pass resolutions on important issues where all agree, such as the vote to support the Nuclear Test Ban Treaty. IUGG makes research visible to the international scientific community, to government agencies, to industry, and to the public in general through their education and outreach activities. These activities include classes, workshops, handbooks, manuals, guides for accepted practice, maps, videos, and published surveys. In addition, several associations
work to have important printed materials translated into several languages to increase their applicability. In these ways, IUGG and the associations enable science by justifying public support for research in Earth systems and also play a special role in bringing state-of-the-art science to all the countries of the world. This is done primarily through meetings, workshops, and assemblies that are often held in countries that do not normally attract such scientific meetings, for example, Vietnam and Ecuador. IUGG encourage young scientists, particularly those from developing countries, and nurture their participation as scientists and as leaders by subsidizing their participation in symposia and general assemblies.

IUGG has initiated and/or vigorously supported collaborative efforts that have led to highly productive world-wide interdisciplinary research programs, such as the International Geophysical Year (IGY, 1957-58), the Upper Mantle Project (1964-70), the International Hydrological Decade (1965-74), the Geodynamics Project (1972-79), the Global Atmospheric Research Programme (1967-80), World Climate Research Programme (1980-present), International Lithosphere Program (1981-present), Global Geodetic Observing System (2003-present) and others. These programs have set a model for international, interdisciplinary cooperation. The scientific accomplishments of these international programs are too numerous to list, but include the discovery of the Van Allen radiation belts encircling the Earth, the first estimates of the size of Antarctica’s ice mass, confirmation of the Alfred Wegener’s theory of continental drift (“Verschieung der Kontinente”), understanding of seafloor spreading, and the development of the new theory of plate tectonic as a result of international cooperation (D. McKenzie, W. Morgan, X. Le Pichon, T. Wilson, to name just a few). Even in tense political and economic times (most of the programs were initiated and conducted during the Cold War), scientists from around the world worked together for the betterment of humankind. Representing all geophysical disciplines, IUGG has been, and continues to be, involved in projects and programs related to climate change, global warming, and related environmental impacts. IUGG scientists working under the umbrella of the Inter-governmental Panel on Climate Change (IPCC) made us all proud, when IPCC shared the 2007 Nobel Peace Prize.

IUGG has initiated and supported ICSU initiatives, especially those in which Earth sciences have a role to play. One major contribution was the creation, some 50 years ago, through ICSU, of the World Data Centers and the Federation of Astronomical and Geophysical Data Analysis Services. These are being transformed to the ICSU World Data System, from which the data gathered during major research programs and data products will be available to researchers everywhere. IUGG
cooperates with the ICSU GeoUnions, which include IUGG and seven other international scientific unions dealing with astronomy (IAU), geography (IGU), Quaternary research (INQUA), photogrammetry and remote sensing (ISPRS), geological sciences (IUGS), soil sciences (IUSS), and radio science (URSI). Joint research topics of the GeoUnions include geoscience data and information, health, natural hazards, and water. IUGG cooperates with UNESCO in the study of natural catastrophes, hydrological and oceanographic research. IUGG also places particular emphasis on the scientific problems of economically less-developed countries by sponsoring activities relevant to their scientific needs (e.g. Geosciences in Africa, Water Resources, Health and Well-Being etc.)

Strengthening cooperation between international, regional and national geophysical and geoscientific unions and societies is one of the principal goals of IUGG activities. The American Geophysical Union (AGU), established by the National Academy of Sciences as the U.S. National Committee for IUGG in 1919, today has become a distinguished union of individual geoscientists around the world. Several regional geoscience societies also evolved during the last several decades, most prominent being the European Geosciences Union (EGU) and the Asia Oceania Geosciences Society (AOGS). These, and some other national and regional geophysical societies, together with IUGG play a strong part in the international cooperation and promotion of geophysical sciences. At the same time there are a lot of overlaps in scientific and science-policy activities of these unions and societies. It is evident that international linkages between IUGG, AGU, EGU, AOGS, and other geophysical societies as well as their linkage with the International Scientific Unions, that comprise the GeoUnions, are going to become more and more important in the XXI century, and cooperation among unions and societies should be strengthened.

Several international programs have been associated with the IGY fiftieth anniversary. These are shining examples of international scientific cooperation between international, regional, and national societies and unions: the International Polar Year (IPY, 2007-2008), International Year of Planet Earth (IYPE, 2007-2009), the International Heliophysical Year (IHY, 2007-2008), and the Electronic Geophysical Year (eGY, 2007-2008). IPY, co-sponsored by ICSU and the World Meteorological Organization, brought together many nations to investigate Arctic and Antarctic regions and covered two full annual cycles at both poles. IPY sponsored 170 projects involving 60 countries resulting in an overall project budget of about one billion EUR. IYPE which was proposed by IUGS and UNESCO, endorsed by the UN General Assembly, and enthusiastically supported by
IUGG, ILP (the joint IUGG-IUGS international program on lithosphere), AGU, EGU and some other international, regional and national societies, produced an excellent international outreach program ensuring greater and more effective use by society of the knowledge accumulated by the world’s Earth scientists. One element of this program was an international meeting of Young Earth Scientists. The IUGG programs, eGY and IHY, were more specific: IHY focused on studies of fundamental heliophysical processes, whereas eGY fostered international cooperation in data stewardship. As an example of fruitful cooperation, eGY provoked the creation of scientific bodies dealing with data and information and developed links between them: the ICSU Scientific Steering Committee for Information and Data, IUGG Commission on Geophysical Data and Information, AGU Focus Group on Earth and Space Sciences Informatics, and EGU Division on Earth and Space Science Informatics.

Another way to strengthen international cooperation is to develop joint research meetings. AGU was the first geophysical union to develop joint meetings, initially with other national unions (e.g. AGU-Canadian Geophysical Union meetings) and later with regional unions (e.g. AGU-EGS joint meeting, Meeting of Americas including IUGG Associations as co-sponsors). IUGG seeks to implement the policy of joint Scientific Assemblies organized with relevant national and regional groupings. Joint outreach activity is an important tool of international cooperation. For example, open forums can bring together geoscience unions, policy makers, and representatives of industry and media to discuss how modern science of the Earth system can assist in solving urgent problems of society. In relation to the joint meetings, the unions could develop programs to assist young scientists from the economically less developed countries to attend the joint meetings (the AGU Berkner program and the host programs of IUGG scientific assemblies are examples of existing international travel grant programs).

Joint policy statements can also foster fruitful cooperation among societies. After the 2004 Indian Ocean great earthquake and tsunami, the IUGG issued a statement and resolution. Based on this resolution and AGU statement on natural hazards, ICSU issued the statement on Science and Natural Hazards. The subsequent implementation of the Indian Ocean Monitoring System is, in part, attributable to the credibility that these resolutions and statements imparted to the process. A new step in international cooperation in natural hazards research will be the joint activities as part of the framework of the new ICSU Program on Integrated Research on Disaster Risk, and the research
and outreach programs of the IUGG Commission on Geophysical Risk and Sustainability, the AGU Focus Group on Natural Hazards, and the EGU Division on Natural Hazards.

Knowledge and data on the earth system gained during international research cooperation provide the information necessary for the discovery and responsible use of natural resources, sustainable management of the environment, reducing the impact of natural hazards, and to satisfy our curiosity about the Earth's natural environment and the consequences of human activities.

Acknowledgments. The authors thank JoAnn Joselyn and Karl Fuchs for thorough review of the manuscript and constructive comments.

ALIK ISMAIL-ZADEH, Karlsruhe Institute of Technology, Karlsruhe, Germany

TOM BEER, Commonwealth Scientific and Industrial Research Organization, Aspendale, Australia

References

