New Report Charts Course for Future of Geosciences

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Over the past century, the geosciences have developed an impressive capability to understand and anticipate events occurring within the Earth system. The past decade has seen an explosion in quantitative geoscience. Progress is continuing to accelerate as advances in observational systems and computational tools are allowing simulations and predictions of geophysical processes with a temporal and spatial resolution unprecedented in human history. With these advances comes the necessity to reflect on the current state of geoscientific research, to reassess the direction in which research should be progressing, and to redefine the goals that can be realistically achieved.

The International Union of Geodesy and Geophysics (IUGG) formed a working group of young scientists charged with developing a vision for the future of the geosciences. The working group combined its expertise and enthusiasm to produce a report, "Geosciences: The Future" (www.iugg.org/geosciences.html), and symposium outlining its view of what is to come. Included in this vision are long-term goals for the major fields of geophysics; that is, plans for 50 years in the future; and short-term priorities, such as plans to address over the next decade. In addition, opportunities for interdisciplinary studies, proposals for the advancement of developing countries, and organizational recommendations for the geosciences are highlighted. The justification for this view of the future is based on the fundamental motivations and societal benefits underpinning geoscientific research. The overriding aim of the geosciences is to reduce uncertainties as much as possible in predicting geoscientific events and, in so doing, to increase the value of the predictions to society. To this end, many specific short-term projects are discussed, ranging from seismic exploration of Mars, to measuring the water ice content of clouds. The majority of the projects are ultimately concerned with elucidating and understanding key processes, thus contributing to the primary scientific knowledge required to produce high-quality predictions. For example, modeling of volcanic magma-wall rock interactions and ionospheric sounding are both process-oriented strategies designed to lead to high-quality predictions of eruptions and weather, respectively.

Modeling and Observations

Impressive models already exist within each individual Earth science discipline and the models incorporate many major relevant components. Modeling often aims at computing the consequences of understood or proposed physics and is therefore complementary to activities that are focused on uncovering previously unknown physics. To improve our modeling ability, two basic strands of model development are required: improvements in model resolution (both spatial and temporal) and improvements in model parameterizations, including boundary and initial conditions. The first strand allows finescale phenomena to be dealt with more realistically and models to be regionalized; the second allows modeling of elements and processes that cannot be included explicitly. The linkage between individual models as components of a single planetary system becomes critical as the resolution and fidelity of individual models becomes increasingly comprehensive.

Geoscientific studies over the next decade must be shaped by the recognition that contemporary approaches seek to understand, predict, and control the response of the Earth system to global change. To this end, many specific short-term projects are discussed, ranging from seismic exploration of Mars, to measuring the water ice content of clouds. The majority of the projects are ultimately concerned with elucidating and understanding key processes, thus contributing to the primary scientific knowledge required to produce high-quality predictions. For example, modeling of volcanic magma-wall-rock interactions and ionospheric sounding are both process-oriented strategies designed to lead to high-quality predictions of eruptions and weather, respectively.

References


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The value of scientific research and the reasons geosciences, the entire population that experience its value to the end-user. In the case of the goal of an Earth system model. The reasons for undertaking it are often best measured by building on the considerable progress already made in computing power and observational resolution. Continued improvements in basic geoscience nor communication of results to policy has been even more developed. The inequality is detrimental to developing countries. The geosciences must play a positive role in both the sustainable economic and scientific development of these countries. Specific vehicles for helping developing countries include opening access to data as discussed above.

The final recommendation to the geosciences is in communication and the transfer of knowledge to policy-makers, the public, and young people. Politicians have many factors to consider in their decisions, and changes in policy cannot be expected until they are justified by quantifiable and easily understandable predictions. The channels of communication to policy-makers must be enhanced. The general public is currently subjected to much misinformation. Geoscientific information must be accurately quantified and properly represented. The use of popular media, including television, will be essential in achieving this goal.

The geosciences must also improve communication with young people who are the future of the planet and need to be made aware of the issues facing them. In addition, through education and outreach, the geosciences must seek to interest the best young minds in a future in the geosciences. Many exciting opportunities will present themselves, and we must ensure that we motivate the next generation of scientists so that the survival of our planet is in the best possible hands.

We hope that both the general and subject-specific recommendations of the report provide a useful framework for exciting geoscience. Many important and challenging opportunities are facing the geosciences. As the resolution and fidelity of models and observations improve and processes are better understood, the accuracy and resolution of predictions will be enhanced. As a consequence, society will enjoy greater confidence in geoscientific information, and will be able to act more decisively and effectively. The geosciences must also look to the future: We must make brave decisions to both improve our quality of life through predictions, and ultimately control our chances of survival.

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Fig. 1. This schematic shows the possible evolution of the major disciplines currently represented by the International Union of Geodesy and Geophysics. "Geosciences: The Future" recommends organizational changes to accommodate the decreased relevance of disciplinary boundaries.