Response to Parliamentary Science and Technology Committee enquiry on "The Impact of Spending Cuts on Science and Scientific Research"

British Geophysical Association, 27 January 2010

1. The British Geophysical Association (BGA) is a joint association of the Royal Astronomical Society and the Geological Society of London and represents members of either Society whose specialisation is geophysics, i.e. the application of physics to the study of the Earth and its planetary environment. UK geophysicists are employed in university research and teaching, petroleum exploration and exploitation, civil engineering, environmental consultancy, and government service. The UK is a world leader in both pure and applied geophysical research, and many UK geophysicists take part in, or lead, international research consortia.

2. Geophysics is a broad area of study and includes topics vital to the well-being of society, for instance the diverse causes of sea level change; earthquake and volcano monitoring and prediction; the geomagnetic field and near-Earth space environment used by satellites; detecting and extracting subsurface oil and gas accumulations; and predicting and monitoring subsurface engineering for oil and mineral extraction, waste disposal and carbon dioxide (CO2) capture and storage.

3. Data for geophysical research are often expensive to obtain, e.g. seismic exploration data collected by dedicated ships using specialist equipment refined by many years of research. Their value is seldom restricted to the immediate purpose for which they were obtained, for instance, marine seismic data obtained for oil exploration are now being used to map ocean currents, and decades-long records of the Earth's magnetic field are used in the prediction of geomagnetic disturbances and "space weather" that affect satellites. Some of these uses could not have been predicted when the original data were obtained. The BGA's concern is that funding cuts might cause:

4. (a) Cessation or interruption of UK involvement in international projects to collect and maintain long timespans of geophysical data, e.g. the Ocean Drilling Program's unique collection of seafloor rock and sediment cores, which contain a record of past climate change, but must be stored in a controlled environment to avoid degradation. UK scientists would then be denied access to the resources and would have no input into the future of these programmes.

5. (b) Lack of support for archiving and curating geophysical data, including borehole cores, continuous seismometer records, meteorological and geomagnetic readings, and oceanographic data, causing the resources put into their collection and curation so far to be wasted;

6. (c) Loss of UK expertise in instrument design, geophysical data collection, processing, interpretation and preservation. UK students and professionals in these areas will seek to pursue them abroad, or lose their expertise, and aspiring geophysicists be deterred from entering the profession. This would be particularly deleterious to the UK economy, which is already experiencing a shortage of geophysicists in the oil industry and can anticipate needs for geophysical skills in nuclear waste disposal, carbon capture and storage, and geothermal energy exploitation. Geophysics is a "hard science" requiring an early choice of specialisation in maths and physics by secondary-school pupils. Deterring pupils now is

likely to cause a worsening skill shortage in 5-10 years' time.

7. The geophysical data described above have to be collected continuously and routinely, and often respond to slowly-varying phenomena with periods longer than the five-year parliamentary cycle, for instance the 11-year sunspot cycle, and (ill-defined) cycles of up to thousands of years between mega-earthquakes at plate boundaries such as the Sumatra-Andaman arc, the Caribbean, and Japan. Planetary data, for instance from Mars, which are valuable in predicting environmental change on Earth, have additionally both long spaceship design and flight times and, for outer planets, longer orbital periods and hence longer data collection times before useful seasonal cycles can be observed. The BGA criticised on these grounds the Higher Education Funding Council for England (HEFCE) proposed use of inevitably short-term "impact" to measure eligibility for funding in the proposed Research Excellence Framework (REF), by which the "research" element of HEFCE funding will be decided.

8. We are also concerned that "impact" and "significance" of geophysical research might be assessed by (a) non-specialists, and (b) biased panels of specialists. Non-specialists' judgements are both subjective and unverifiable, and should not contribute to assessment of research excellence. Specialists need to be drawn from an international pool, because of the global nature of geophysics. Bias will arise because the oil and resource extraction industries are highly motivated to send their specialist employees to be panel members, while geoscience research has impacts on the poorest people in the most environmentally vulnerable areas of the Earth, whose interests risk not being represented, or even assessed.

9. The BGA also submitted a response to the Committee's consultation on the regulation of geo-engineering to mitigate climate change. The gist of our response was that geo-engineering project proposals should be assessed by means of reality-based geophysical modelling of their likely effects. To achieve this, geophysical data sets are needed as input to the modelling, and skilled geophysical modellers are required. Cuts to the UK geophysics base endanger both these, the data as described above, but particularly the skills, which have to be developed through a specialist research degree and years of experience in a research environment. The probable disastrous effects of runaway climate change and the desperate measures, such as deep cuts in CO2 emission, being proposed to prevent it, will lead to future geo-engineering project proposals. Without geophysical research, these expensive projects might either lead to disaster or be ruled out as too risky and their possible benefits lost.

10. The study of the Earth is an interdisciplinary science, so geophysical research cannot be considered completely in isolation from research in other areas. Cuts in those areas might have unintended deleterious effects. For instance, geophysical modelling often requires large computing power and storage, so the recent threat by the Japanese government to their scientific supercomputer project is thus indirectly a threat to geophysical research. Interaction of the Earth with the biosphere has been increasingly recognised as an important driver of Earth systems, so for instance sampling, genetically analysing and cultivating organisms from seafloor hot chemical springs, carried out as part of the Ocean Drilling Program, might have a bearing on proposed geothermal-energy systems. Fundamental physics, for instance the interaction of neutrinos with the Earth's interior, could open the way for novel geophysical imaging based on particle accelerator science and engineering. Finally, the Haiti earthquake is a disaster for reasons couched in global-scale economics, sociology and politics, which led to so many poor people in ill-constructed dwellings being

vulnerable, as much as in the geophysics of plate tectonics in the Caribbean. It is difficult to predict the effect on geophysics of cuts in other branches of knowledge, but such prediction should be attempted by appropriately qualified scientists when cuts are proposed.

11. In summary, the consequences of cuts driven by the short-term addressing of the economic crisis would be profound and damaging in the long term to geophysical research, which in turn underpins the political decisions required to maintain Earth systems in a condition to support comfortable human existence. UK geophysicists are so deeply involved in the global scientific effort to understand and, possibly, control the environment and resources that cuts made by the UK alone cannot be regarded as insignificant to global geophysical science.