

# Furthering Ethical Requirements for Applied Earth Science

MARTIN BOHLE\*

Directorate General Research and Innovation European Commission  
Martin.bohle@ec.europa.eu

ELLIS C. ERLE

University of Maryland, Baltimore County, Baltimore, USA  
ece@umbc.edu

## Abstract

*To face the challenges that anthropogenic global change poses to societal development, the ethical framework for Earth science needs to be robust and both accepted and personally adopted by geoscience professionals. Geoscience and engineering are increasingly called upon to inform societies about anticipated social and environmental outcomes based on scientific understanding. Some professions are regulated to maintain the quality of work, professional integrity, and the trust of the stakeholders. In less applied professions, the role of training in research integrity is important. An oath or promise would strengthen the ethical framework for applied Earth sciences going beyond the existing professional codes relating to research integrity, public regulations or professional charters that refer especially to engineering works.*

## 1. INTRODUCTION

The ongoing processes of anthropogenic global change pose challenges to societal development, nature conservation, and how people value these [Monastersky, 2015]. A framework beyond sound professional practice for handling ethical issues in Earth science is needed [Lynn, 2000; Potthast, 2015]. Earth scientists are intimately involved in discussions about climate change between researchers, diplomats, lawmakers, and industrialists that can result in action to modify humankind's engineered systems for production and consumption of goods. Therefore, modern Earth science and engineering disciplines and related social sciences and humanities need to continue developing their (geo)ethical frameworks in support of professionals [Ellis and Haff, 2009].

This essay is not about improved professional codes, codified practices or geoethics as a discipline nor about geoethics within the combined context of philosophy, politics and sciences [Jamieson, 1996; Proctor, 1998; Cutchin, 2002; Martinez-Frias et al., 2011; Peppoloni and

Di Capua, 2015; Riede et al., 2016; Bobrowsky et al., 2017]. However, these issues provide context for us to discuss and understand geoethical concerns. "What is geoethics, and what does it add to our moral understanding...? [Geoscience] has much to contribute to ethical theory, discourse, and action. The contribution emphasized by geoethics is the importance of context... which generates situated understandings of moral problems" [Lynn, 1998 - p. 282]. Existence of a vibrant geoethical identity throughout our professional community can only serve to strengthen public support for our work and professional recommendations. In this essay, we discuss the idea described in Ellis and Haff [2009] or in Matteucci et al. [2014] of an 'oath' or 'promise', respectively.

## 2. CONTEXT

A core responsibility of Earth science and engineering disciplines is to guide societies towards improved social and environmental outcomes based on robust scientific understanding and technological know-how [Ellis et al., 2016]. Ex-

amples include how to engineer human-geosphere intersections, how to use Earth science to effectively address regional problems, or how production systems can be made more efficient at lower environmental costs [Ellis, 2011; Bohle, 2016].

While Earth science and engineering disciplines have specific professional frameworks relating to scientific methods and technological challenges, their general professional frameworks for the social or political consequences of their work are less developed. Tackling these difficulties involves scientific, technical, economic and other social concerns that all require professional handling of ethical issues beyond the integrity of research, deontological codes or sound engineering practice.

Many applied geoscience studies are especially value-laden; for example, the exploration, discovery, and extraction costs of natural resources compared with expected profits. Therefore, professional organizations of engineering and chartered or licensed geoscientists have developed ethical frameworks [e.g., IAPG, 2017a]. Likewise, some other professions are self-regulated to maintain the quality of work, professional integrity, and the trust of stakeholders through adherence to aspirational statements, codes and standards published by their respective professional societies [e.g., IAPG, 2017b; AAG, 2017]. Earth science as a whole needs a well-developed framework of meta-professional ethics of generic content and simple form (A meta-profession is a profession that is built upon the foundation of another profession, as geoscience teaching is built on the base of geoscience [Arreola et al., 2001]).

Such professional and meta-professional ethical frameworks to handle value-loaded issues in societal context seem less familiar with scientists working in Earth science [Almeida and Vasconcelos, 2015; Peppoloni and Di Capua, 2016]. However, such frameworks are needed, either because of the complexity of handling anthropogenic global change [Waters et al., 2016] or because of the number of different scientific professions and individuals involved [Tumbman and Escobar-Wolff, 2016]. Likewise, the role of training in research integrity and in other aspects of applied ethics is important [Mayer, 2015].

Professionals, researchers, and scholars in Earth science have acquired particular understanding and talents that enable them to investigate, manage, and intervene on various physical, biological and social components of Earth systems for human dwelling and acquisition of resources. These capabilities entail responsibilities with respect to serving the private and public good in the most just manner possible. Also, it sets perspectives for the interaction with colleagues, laypersons, decision takers, and when aggregated, with society, nature and the planet. To outline these responsibilities and perspectives, a geoscientist's promise (as the following) or, alternatively, an oath could be instrumental:

*I promise...*

*... I will practice geosciences being fully aware of the societal implications, and I will do my best for the protection of the Earth system for the benefit of humankind.*

*... I understand my responsibilities towards society, future generations, and the Earth for a sustainable development.*

*... I will put the interest of society foremost in my work.*

*... I will never misuse my geoscience knowledge, resisting constraint or coercion.*

*... I will always be ready to provide my professional assistance when needed, and will always make my expertise available to decision makers.*

*... I will continue lifelong development of my geoscientific knowledge.*

*... I will always maintain intellectual honesty in my work, being aware of the limits of my competencies and skills.*

*... I will act to foster progress in the geosciences, the sharing of geoscientific knowledge, and the dissemination of the geoethical approach.*

*... I will always be fully respectful of Earth processes in my work as geoscientist*

*I promise!*

(Geoethical Promise, from the Cape Town Statement on Geoethics, [Di Capua et al., 2016]).

### 3. DISCUSSION

Human communities face significant challenges that will only expand in the future. Applying a wider knowledge base than natural sciences or embracing a multidisciplinary approach to environmental problems this sets challenging ethical and social perspectives [Bonneuil and Frescoz, 2013; Hamilton et al., 2015]. To cope with these challenges of anthropogenic global change, the role and responsibility of Earth scientists, engineers, and scholars should include concern for the societies and environments in which the individuals reside, the individual scientist's particular conscience, and relationships with colleagues [Bobrowsky et al., 2017].

Only by guaranteeing the intellectual freedom of researchers, scholars, professionals, and practitioners to apply robust professional standards can geoscientists follow appropriate ethical approaches and strive for excellence (Peppoloni and Di Capua, this volume). By increasing awareness of the ethical implications of applied work Earth science will be a force for public good, such as addressing the exploitation of geo-resources, land and sea management, mitigation of natural and human-made geo-hazards, and climate change adaptation and mitigation. In these works, ethical and social issues are central: for scientific or professional debates and public opinion, trustworthy handling of data, risk communication, education, integrity, anti-harassment/discrimination, gender or inclusion.

Geoethics is not a specialist domain, and a mere promise or oath would help to understand the multi-dimensionality of Earth science professionalism. It includes the dimensions of individual behaviour, social responsibility, and viewing Earth from various angles as a home for many, and it offers different points of equilibria. These multiple equilibria would reflect different philosophical, geoscience, and economic or social concerns, so that sound individual and professional behaviour can prosper in different societal settings. The single response could dwell on shared professional responsibility, know-how, mutual understanding of diversity, and intellectual honesty. As 'bedrock' to an oath or promise the regulat-

ed geoscience professions provide a robust setting of professional codes and regulations to support professionals [Bobrowsky, 2013]. Given a geoscientist's promise or oath, such codes find their extension in softer means, such as through recognized shared best practices. Such means would further professional frameworks and geoethical thinking, and they would provide reference and the space for the habitual diversity of individual, professional, social, economic, and environmental situations within Earth science.

A geoscientist's promise or oath offers an intermediate level of codification. It should enable Earth scientists and scholars to cope better with the economic, social, cultural, and geologic differences between countries that affect their work [Stewart and Gill, 2017]. It should also hope them deal more effectively with the vast diversity in geoscience concerns ranging from (geo)heritage sites through all of the forms of applied geoscience, whether relevant to a particular country, region, or to the entire planet.

It appears further that a geoscientist's promise or oath also helps to address communication, outreach, and advocacy on issues of geoethical concerns in a case-dependent manner that is balanced yet has a standard foundation. The well-founded-ness of these activities is critical to handle the breadth of Earth-system complexities such as non-linear behaviour, uncertainties, incomplete sets of observations, counter-intuitiveness of many natural processes [Pievani, 2015], and human habits of perceiving these [Levin et al., 2015]. Finally, a geoscientist's promise or oath will make Earth scientists aware of issues such as the need to earn public trust, to respect the limits of our knowledge, and to confront the denial of scientific evidence.

A 'geoscientists promise' or 'oath for Earth scientist' should further responsible application of science and engineering. The personal commitment enshrined in them anchors in the professional sphere of geosciences and their application contexts. Specialist's work and practitioners activities will further these commitments when addressing matters such as the ethics of the professional at work, an inclusive composition of the workforce, and

integrity of the individual. Thus, the general ethical framework for applied Earth sciences can be strengthened by an "Oath for Earth scientists" or a "Geoscientist's promise" that aggregates a wider context. In this manner, the concern of Riede et al. [2016] is addressed, namely: *"While we shy away from drafting an 'Environmental Archaeology Promise'... a discussion on the pros and cons of such a document might be a vital step along the path towards structured action rather than individual activism."*

#### 4. CONCLUSION

Summarizing an 'ethical requirement' of a promise or oath offers a flexible framework for aggregate professional ethics for a broad range of application cases. It includes the constraints of Earth sciences, engineering and scholarship, such as limited understanding of human-geospheric processes and cultural biases in their valuation, and it relates to education, training and professional practices.

The ethical requirements of an oath or promise could offer an additional level of scientific respectivity cultural standards above existing professional codes relating to research integrity and public regulations and professional charters. It remains the issue how to integrate the promise or oath into vocational education.

Finally, it is to consider whether the notions like 'oath' or 'promise' convene the appropriate level of individual commitment. Within the (western) cultures and languages of the authors' preference is for the notion 'promise'. However, we are curious what term other cultures and languages may offer.

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