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Scientists Outline Planetary Boundaries: A Safe Operating Space for Humanity

New approaches are needed to help humanity deal with climate change and other global environmental threats that lie ahead in the 21st century, according to a group of 28 internationally renowned scientists.

The scientists propose that global biophysical boundaries, identified on the basis of the scientific understanding of the earth system, can define a "safe planetary operating space" that will allow humanity to continue to develop and thrive for generations to come. This new approach to sustainable development is conveyed in the current issue of the scientific journal Nature. The authors have made a first attempt to identify and quantify a set of nine planetary boundaries, including climate change, freshwater use, biological diversity, and aerosol loading.

The research was performed by a working group at UC Santa Barbara's National Center for Ecological Analysis and Synthesis (NCEAS), in cooperation with the Stockholm Resilience Centre at Stockholm University.

One important strand of the research behind this article is based in the global project known as IHOPE. The goal of the Integrated History and future Of People on Earth (IHOPE) project is to understand the interactions of the environmental and human process over the ten to hundred millennia to determine how human and

biophysical changes have contributed to Earth system dynamics. The IHOPE working group is assembled at NCEAS today.

The scientists emphasize that the rapid expansion of human activities since the industrial revolution has now generated a global geophysical force equivalent to some of the great forces of nature.

"We are entering the Anthropocene, a new geological era in which our activities are threatening the earth's capacity to regulate itself," said co-author Will Steffen, professor at the Australian National University (ANU) and director of the ANU Climate Change Institute. "We are beginning to push the planet out of its current stable Holocene state, the warm period that began about 10,000 years ago and during which agriculture and complex societies, including our own, have developed and flourished. The expanding human enterprise could undermine the resilience of the Holocene state, which would otherwise continue for thousands of years into the future."

Robert Costanza, director of the Gund Institute at the University of Vermont and one of the IHOPE project leaders at NCEAS, said: "Human history has traditionally been cast in terms of the rise and fall of great civilizations, wars, and specific human achievements. This history leaves out the important ecological and climate contexts that shaped and mediated these events. Human history and earth system history have traditionally been developed independently, with little interaction among the academic communities. The Nature article provides evidence of the necessities to establish a thorough, long-term historical understanding of the exchange between human societies and the earth system, in order to set standards for safe navigation within planetary boundaries and avoid crossing dangerous thresholds."

Planetary boundaries is a way of thinking that will not replace politics, economics, or ethics, explained environmental historian Sverker Sörlin of the Stockholm Resilience Centre and the Royal Institute of Technology, Stockholm. "But it will help tell all of us where the dangerous limits are and therefore when it is ethically unfair to allow more emissions of dangerous substances, further reduction of biodiversity, or to continue the erosion of the resource base. It provides the ultimate guardrails that can help societies to take action politically, economically. Planetary boundaries should be seen both as signals of the need for caution and as an encouragement to innovation and new thinking of how to operate safely within these boundaries while at same time securing human well being for all."

Lead author Johan Rockström, director of the Stockholm Resilience Centre at Stockholm University, said: "The human pressure on the Earth System has reached a scale where abrupt global environmental change can no longer be excluded. To continue to live and operate safely, humanity has to stay away from critical ‘hard-wired' thresholds in Earth's environment, and respect the nature of the planet's climatic, geophysical, atmospheric and ecological processes. Transgressing planetary boundaries may be devastating for humanity, but if we respect them we have a bright future for centuries ahead."

In addition to the authors named above, the group of IHOPE-related scientists who contributed to the Nature article includes systems ecologist Carl Folke, of the Stockholm Resilience Centre, and archaeologist Sander van der Leeuw at Arizona State University. Among other authors are Katherine Richardson, an oceanographic biologist with the University of Copenhagen, and Nobel laureate Paul Crutzen, an atmospheric chemist with the Max Planck Institute, Mainz, Germany.

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