DIALOGUE

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Enthusiasm for Earth System Science Continues at GSA

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Many of my younger colleagues will not be familiar with the Whole Earth Catalogue, a wonderful '60s-'70s compilation of ideas and tools for alternative lifestyles. It was an attempt to bring many disparate areas of interest, knowledge, and technology together in a single integrated resource. The growing field of earth systems science reminds me of the catalog. In a world where science so often tends toward ever-greater fragmentation and specialization, earth systems science recognizes the complex connections that act within different realms of the geoscience and across disciplines. Much as the shift in biology to an ecology-based science in the late 1960s revolutionized our understanding of evolution and biological function, viewing Earth as a single complex system has the potential to allow us to develop a truly global view of our planet and its history.

My first exposure to earth systems science occurred shortly after I joined the Department of Environmental Sciences at Penn State Abington. Lee Kump, Jim Kasting, Rob Crane, Kate Freeman, and Eric Barron at University Park were developing an introductory course that used systems and graphical analysis to study Earth's physical environment. Asked to teach the course at the Abington Campus, I simply fell in love

with its ideas, especially the intellectual power that can be obtained from systems analysis supported by simple models. The key is a recognition of the importance of feedback in controlling change within natural systems.

For example, I model the Amazon rainforest ecosystem and the effect of deforestation on system stability for my students. In the forest, there is positive feedback between levels of precipitation and the amount of area covered by healthy forest. Significant decreases in precipitation would be expected to cause losses within the forest. Loss of trees will reduce evapotranspiration in the area and so reduce overall humidity and precipitation. What I find interesting about the system is that this feedback has the potential to stabilize a healthy rainforest and to create a point of no return within the system after significant deforestation. If the point of no return were reached, runaway behavior would lead to collapse of the ecosystem. A simple analysis recognizing interconnections between forest, climate, and human behavior leads to a depressing but important prediction.

It is the ability of systems analysis to cut through the complexity of an earth system to identify its most important functions and components that makes it such a powerful tool. Obviously, a simple analysis, such as the one I describe above, may be wrong. However, even if proven incorrect, I would argue the analysis is important because it identifies questions that need to be answered and so is a valuable tool in directing research.

This past summer, GSA and the Geological Society of London sponsored a joint meeting, Earth Systems Processes. The meeting was full of ideas and intellectual energy based on a systems approach to the earth sciences. As Sharon Mosher said in an earlier "Dialogue" reporting on the event, "... it has been years since I have attended a meeting that had such scientific enthusiasm." Topics ranged from snowball Earth (both the why it could and why it couldn't happen), to changes in atmospheric carbon over time, to the effects of temperature of Venutian plate tectonics, among many others. This fall in Denver, Lee Kump and I hope to recapture a little of that meeting's magic in a technical session that explores the role of feedback in controlling earth systems. We encourage you to use this opportunity to learn more about earth systems science if you are not familiar with it or to share your ideas and research on earth systems if you are.