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Assessing Ability to Forecast Geomorphic System Responses to Climate and Land-Use Changes

Jon D. Pelletier
University of Arizona

A. Brad Murray
Duke University

Jennifer L. Pierce
Boise State University

MEETINGS

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Meeting of Working Group on the Forecasting of Landscape Responses to Climate and Land-Use Changes; Tucson, Arizona; 24–28 September 2013

PAGE 3

As the global community faces the effects of ongoing and future climate and land-use changes (C&LUC), geoscientists are called to action to assess the risks associated with such changes, assist with forecasts of future Earth states, quantify hazards to life, and suggest reasonable adaptation strategies. Earth surface scientists have developed conceptual and mathematical models for how geomorphic systems, including those associated with natural hazards that put trillions of dollars in infrastructure and tens of millions of lives at risk, will respond to and give feedback on C&LUC.

In addition to field observations, recent revolutions in remote sensing and Quaternary geochronology provide essential data for model testing and improvement. To date, however, many available models have not been implemented into forecasting tools such as Earth System Models. Successful forecasting of the cascade of changes from climate and human actions to landscapes and life will require better coordination among the research communities working on C&LUC,

spanning a range of geomorphic and coupled human-geomorphic systems and across a range of scales and land-surface processes.

To facilitate better coordination among Earth surface scientists and the broader geoscientific community, a group of 24 Earth surface scientists met at a National Science Foundation–funded workshop at Biosphere 2 near Tucson, Ariz., to assess scientists' ability to forecast changes in Earth surface under scenarios of C&LUC and to identify where key knowledge gaps remain and how we might best bridge those gaps. Workshop participants highlighted the ability of existing models to honor the nonlinear interactions, thresholds, alternate stable states, and extreme, rare events characteristic of Earth as a system. Experts in each process zone emphasized the importance of feedbacks (e.g., among vegetation cover, topography, near-surface fluid flow, and erosion/deposition) and antecedent conditions to forecast how landscapes, writ large, will respond to C&LUC. Successfully addressing this will require more collaboration among hydrologists, ecologists, Quaternary scientists, and geomorphologists.

Workshop participants also underscored the need for risk assessments to include a quantification of the ranges of possible responses and their associated uncertainties, including the uncertainties associated with the stochastic nature of triggering events, the heterogeneity of land-surface properties, and our incomplete knowledge of the underlying processes.

Participants prepared a report that discusses themes that crosscut specific process zones and forecast methodologies. Appendices to the main body of that report are now being written to synthesize existing knowledge on how geomorphic systems are likely to respond to changes in C&LUC variables and to identify exemplar models and data that demonstrate our ability to forecast responses to C&LUC within specific process zones, i.e., hillslope, fluvial, coastal, aeolian, glacial, and periglacial. An additional appendix will identify specific strategies and proofs-of-concept for how collaboration between Earth surface scientists and Earth system modelers can be enhanced.

The geoscientific community and stakeholders are invited to register as members of our working group and provide feedback on the draft of the main body of the report by 31 January at <http://geomorphicprediction.geo.arizona.edu>. Please allow some time for new-user registration.

—JON D. PELLETIER, Department of Geosciences, University of Arizona, Tucson; jdpellet@email.arizona.edu; A. BRAD MURRAY, Department of Geosciences, Duke University, Durham, N. C.; and JENNIFER L. PIERCE, Department of Geosciences, Boise State University, Boise, Idaho.