PROJECT SUMMARY

Intellectual Merit: The major goals of this project are:

1. To investigate the role of “scaling” (the transfer of understanding across spatial, temporal, and complexity scales) in better understanding the dynamics of coupled natural and human systems, at scales from individual sites through regional and national systems to global.

2. To investigate the role of ecosystem services (those functions of ecosystems that directly or indirectly support human welfare) in linking ecological and human systems in a dynamic, multi-scale context.

3. To investigate the roles of uncertainty (in parameters, model formulation, and data quality), resilience, and sustainability (the continuity or longevity of specific system characteristics) in understanding the dynamics of coupled natural and human systems at multiple scales.

To carry out this research agenda, a suite of multiscale, dynamic, non-linear, spatially explicit simulation models of coupled natural and human systems will be further developed, tested, and integrated across scales from individual forest plots, agricultural fields, and urban neighborhoods through whole, mixed-use watersheds, up to the entire earth system. The project will explore and evaluate various methods for testing these models against extensive databases (but with variable quality and coverage), and use the models to explore a range of questions about the dynamic behavior and scaling of complex, adaptive, coupled natural and human systems.

Because of biocomplexity, the behavior of the whole system is significantly different from the simple sum of the behavior of its parts. This makes scaling a core problem in biocomplexity research. Questions about scaling to be addressed by the project include: (1) How does the “predictability” (a la Colwell) of model output vary with the modeled resolution (in space, time and complexity) of ecological and socioeconomic processes?; (2) What factors control the divergence between models or measurements at one scale and another?; (3) Can aggregation of models and measurements in one dimension (spatial, temporal or complexity) be compensated with disaggregation in another? Questions about system dynamics include: (1) How is the provision of ecosystem services of value to humans affected by the resilience and sustainability of ecological life-support systems?; (2) How is the sustainability of a complex coupled natural human system related to its productivity, organization, and resilience?; (3) How can we better understand and display the full range of uncertainty about models of coupled natural and human systems?

Broader Impacts: The project will maintain a global perspective through its global scale modeling component, which will be linked to the IGBP/GAIM (Global Analysis, Integration, and Modeling - http://gaim.unh.edu/) program and the new ESSP (Earth System Science Partnership - http://www.ess-p.org/), which links IGBP, IHDP, WCRP, and DIVERSITAS. These programs represent global networks of scientists involved in various aspects of understanding the global earth system. They are only now beginning to attempt to integrate this understanding across the natural and human system components and the proposed project will directly contribute to that integration.

Besides training graduate students, the project will enhance education in two additional distinct ways: (1) through it’s direct connection with the Baltimore Ecosystem Study (an NSF funded LTER site), the project will significantly expand on the education and outreach programs already in place as part of that project; (2) the project will include workshop/short courses that involve a broad range of scientists and stakeholders at both the watershed and global scales.

Results of the project will have broad impact on both the science of integrated, multiscale modeling and on decision-making at regional and global scales. These will occur by: (1) answering the scientific questions about the scaling and dynamics of complex coupled natural human systems outlined above; (2) involvement of a broad range of students and stakeholders in the full spectrum of project activities from model conceptualization to construction, testing, and scenario analysis; and (3) involvement of the broader regional and global scientific community in the project via GAIM, ESSP, and the Baltimore LTER.