Changing Responses of Land Dynamics and Vulnerability to Flooding Under Policy and Environmental Change near Poyang Lake, China

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We aim to understand the inter-relationships between flooding, land-cover and land-use change (LCLUC), human welfare, and ecological quality. The context of the project is the broader fields of land-change science and sustainability science that seek to evaluate the complex interactions between environmental variability and human activity at multiple space and time scales.

The project is structured around four primary research questions: (1) How have LCLUC patterns and dynamics in the Poyang Lake Region (PLR), China changed over the last 20 years as a consequence of changes in the frequency and intensity of flooding and liberalization of land and economic policies? (2) How have changes in LCLUC patterns and dynamics, or lack of changes, affected the vulnerability of the people and economy of the region to flooding hazards? (3) What are the implications of these changes, or lack of changes, for the amount and quality of wetland wildlife habitats? and (4) How might future changes in lake levels affect vulnerability of human livelihoods and wetland wildlife habitats?

We propose to develop, validate, and analyze spatial and temporal models of Poyang Lake levels, land-use patterns, and wetland habitat quality. Lake levels will be modeled by relating observed lake levels with image-based inundated areas, using a version of the SRTM digital elevation model (DEM), which we will enhance with additional image and map data, to establish quantitative relationships. Land-cover patterns will be modeled both empirically, to evaluate linkages of observed patterns (from Landsat imagery) with socio-economic and environmental variation, and simulations of agent-based models (ABMs), which can simulate aggregate land-use patterns on the basis of farmer and land-holder decision making, as constrained by economic, policy and environmental factors. Wetland wildlife habitats will be modeled either inductively, using genetic algorithms or a similar empirical model fitting approach, or deductively, through a rules based on expert knowledge, depending on the sufficiency of available field data for the inductive approach. Each of the individual models will be validated to the best available data and analyzed on its own.

We will then evaluate the interactions between the models experimentally, to improve our understanding of the coupled human and ecological consequences of hydrological variability and, ultimately, to support decisions associated with risk from flood dynamics. Experimentation with the models will be structured around a series of scenarios that will be designed from plausible current and future conditions within both the socioeconomic and physical-hydological systems. The scenarios will allow us to evaluate influences on human and ecological systems of policies aimed at reducing flood vulnerability, of those aimed at economic development, and of engineering works that have floodwater management as primary or secondary goals, like the Three Gorges Dam and levees around Poyang Lake. While the regional focus of the project is the PLR, we will collaborate with LCLUC researchers to evaluate the context and comparability of this specific case within the entire Yangtze Basin.